# NCV887801 Start-Stop Demo

# Demonstration Note for NCV887801 Automotive Grade High-Frequency Start-Stop Boost Controller

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## Description

This NCV887801 demonstration board provides a convenient way to evaluate a high frequency boost controller designed to supply a minimum output voltage during Start-Stop vehicle battery voltage sags. The unit is in low $I_q$ sleep-mode under normal battery operating condition and wakes-up when the monitored voltage drops below 7.3 V and begin regulating once 6.8 V is reached. Switching frequency is 450 kHz. The demo board is rated 6.8 V/3.6 A at a 2.6 V input voltage. Operation below 2.6 V is possible if output current is reduced.

## Key Features

- Automatic enable below 7.3V
- Disable Override Function
- Status Indicator
- Boost Operation at 6.8V
- 450kHz Switching Frequency
- Input Undervoltage Lockout
- Wide Input Voltage of 2.6V to 45V
- Low Quiescent Current in Sleep Mode (<12µA Typical)
- Cycle-by-Cycle Current Limit Protection
- Automotive Grade


**Figure 1**. NCV887801 Start-Stop Demo Board

## Demonstration Board Terminals

| Terminal | Function |
|---|---|
| VIN (connector jack) | Positive DC input voltage (power) |
| GND (connector jack) | Common DC return (power) |
| VOUT (connector jack) | Regulated DC output voltage (power) |
| GND (small post) | Common DC return, monitoring point |
| VC (small post) | Voltage compensation, monitoring point |
| VOUT (small post) | Regulated DC output voltage, monitoring point |
| VDRV (small post) | Driving voltage, monitoring point |
| DISB (small post) | Disable override input, monitoring point |
| STAT (small post) | Status indicator, monitoring point |
| ISNS (small post) | Current sense resistor voltage, monitoring point |
| VG (small post) | MOSFET gate voltage, monitoring point |
| SW (small post) | MOSFET drain voltage, monitoring point |

## Absolute Maximum Ratings

(Voltages are with respect to GND)

| Rating | Value | Unit |
|---|---|---|
| DC supply voltage (VIN) | -0.3 to 45 | V |
| DC voltage (VC, ISNS) | -0.3 to 3.6 | V |
| DC Voltage (DISB, STAT) | -0.3 to 6 | V |
| Junction Temperature | -40 to 150 | °C |
| Ambient temperature (Demo Board) | -40 to 105 | °C |

## Electrical Characteristics

($T_A$ = 25°C, 2.6V ≤ $V_{IN}$ ≤ Vout, $V_{DISB}$ = 5V, unless otherwise specified)

| Characteristics | Conditions | Typical Value | Unit |
|---|---|---|---|
| **Switching** | | | |
| Switching Frequency | ROSC = 10.7kΩ | 450 | kHz |
| **Current Limit** | | | |
| Cycle-by-cycle Current Limit (FET) | - | 18 | A |
| **Protections** | | | |
| Maximum Duty Cycle | - | 0.83 | - |
| VOUT Undervoltage Lockout (UVLO) | VOUT falling | 3.59 | V |
| Thermal Shutdown | $T_A$ increasing | 170 | °C |

## Operational Guidelines

The demo board is rated to operate under full load for input voltage as low as 2.6V at the input terminal under full power (less if output current is reduced). Start-Stop applications use reverse battery protection diodes in front of the boost converter (Fig. 2), so the input source can operate down to 2.6V plus a diode drop (i.e ~3V).

**Notes**:

a. The IC UVLO (undervoltage lockout) is 4.05V for VOUT rising, 3.59V for VOUT falling (0.54V hysteresis).
b. Limit time spent with the power supply operating at minimum input voltage (equivalent to VIN = 2.6V) to avoid overheating the power semiconductors.

**First Time Power-Up:**

1. Connect a DC source voltage (15A capable) set to a voltage of 12-13V as shown in Fig. 1.
2. Connect the DISB TTL control signal as shown in Fig. 1. The initial DISB state should be set to logic-'0'.
3. Connect a 3.6A constant current load on the output.
4. Decrease the DC input voltage until the PCB VIN voltage is 5.5V $\pm$ 0.5V.
5. Set the DISB control signal to a TTL high state (i.e. 5V).
6. Verify that the unit is regulating at VOUT = 6.8V.
7. Reduce the DC input voltage until the PCB VIN = 2.6V. Verify that the unit is regulating at VOUT = 6.8V.

**Start-Stop Voltage Transient Test:**

1. Connect both DC1 and DC2 input power supplies as illustrated in Fig. 2. Adjust DC2 so that PCB VIN = 2.6V for a 3.6A load.
2. Connect a 3.6A load on the output. If a load resistor is used, it is recommended to start from a DC1 input voltage of 8.5-9.0V to avoid overstressing the PCB boost diode (D1, rated 4A).
3. Monitor VOUT. Disconnect supply DC1. VOUT should have a response similar to that of Fig 3.

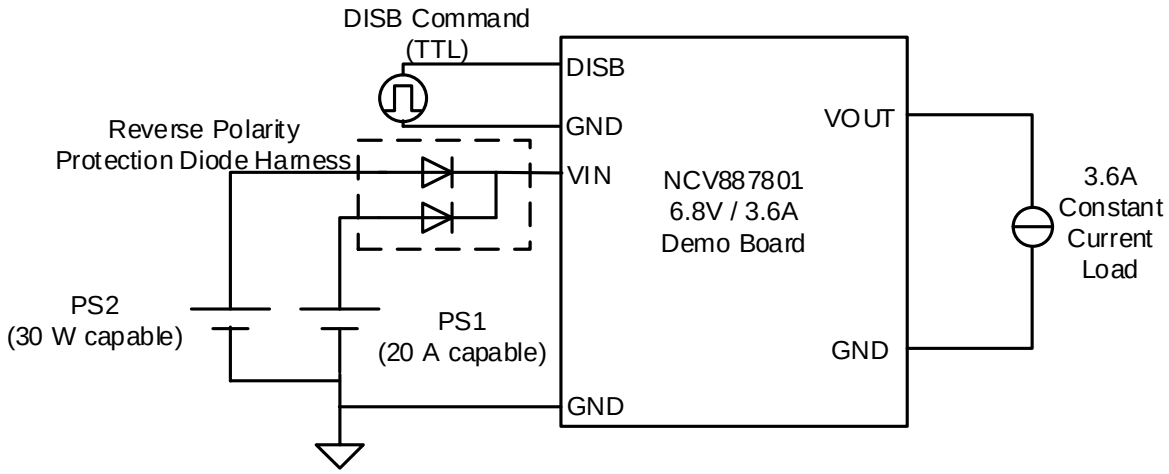


**Figure 2.** Demo Board Connections

## Typical Performance

### ***DC1 is disabled, then re-enabled***

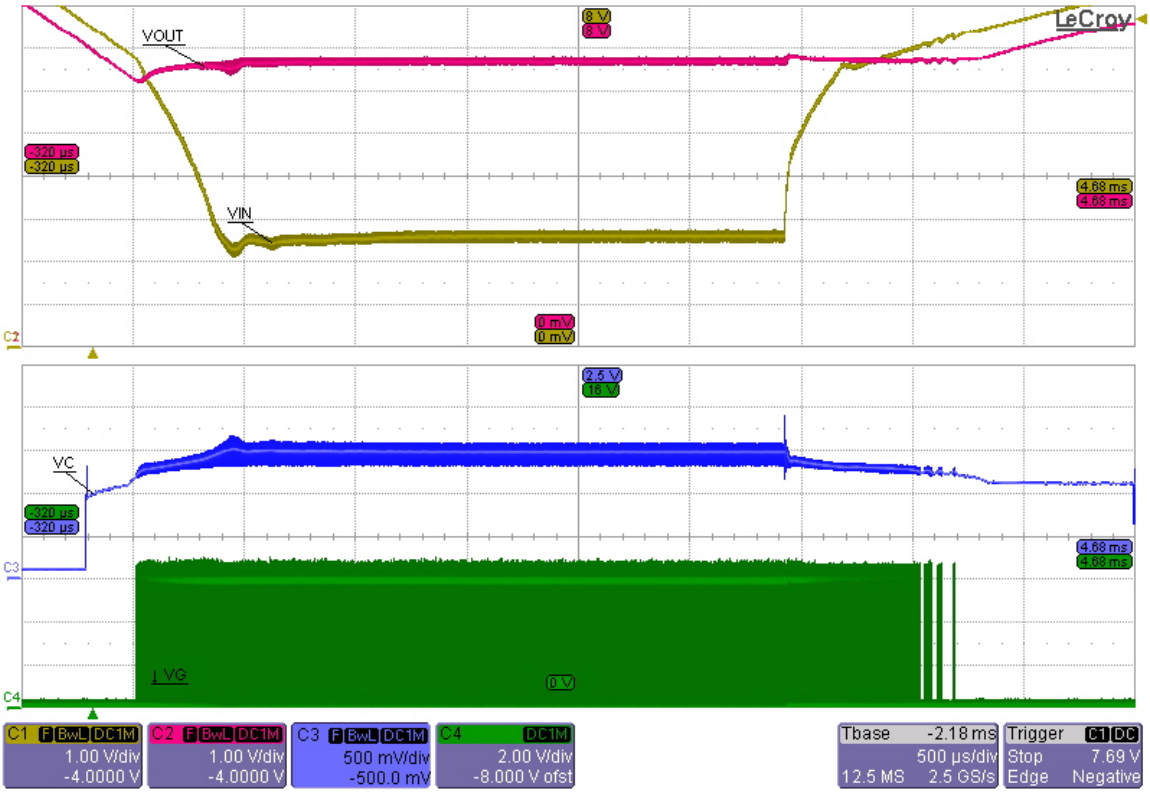


**Figure 3 NCV887801 Demo Board Waveforms**

- DC2 at VIN adjusted to 2.6V (after reverse polarity protection diode)
- VOUT = 6.8V, $I_{OUT}$ = 3.6A

## Schematic

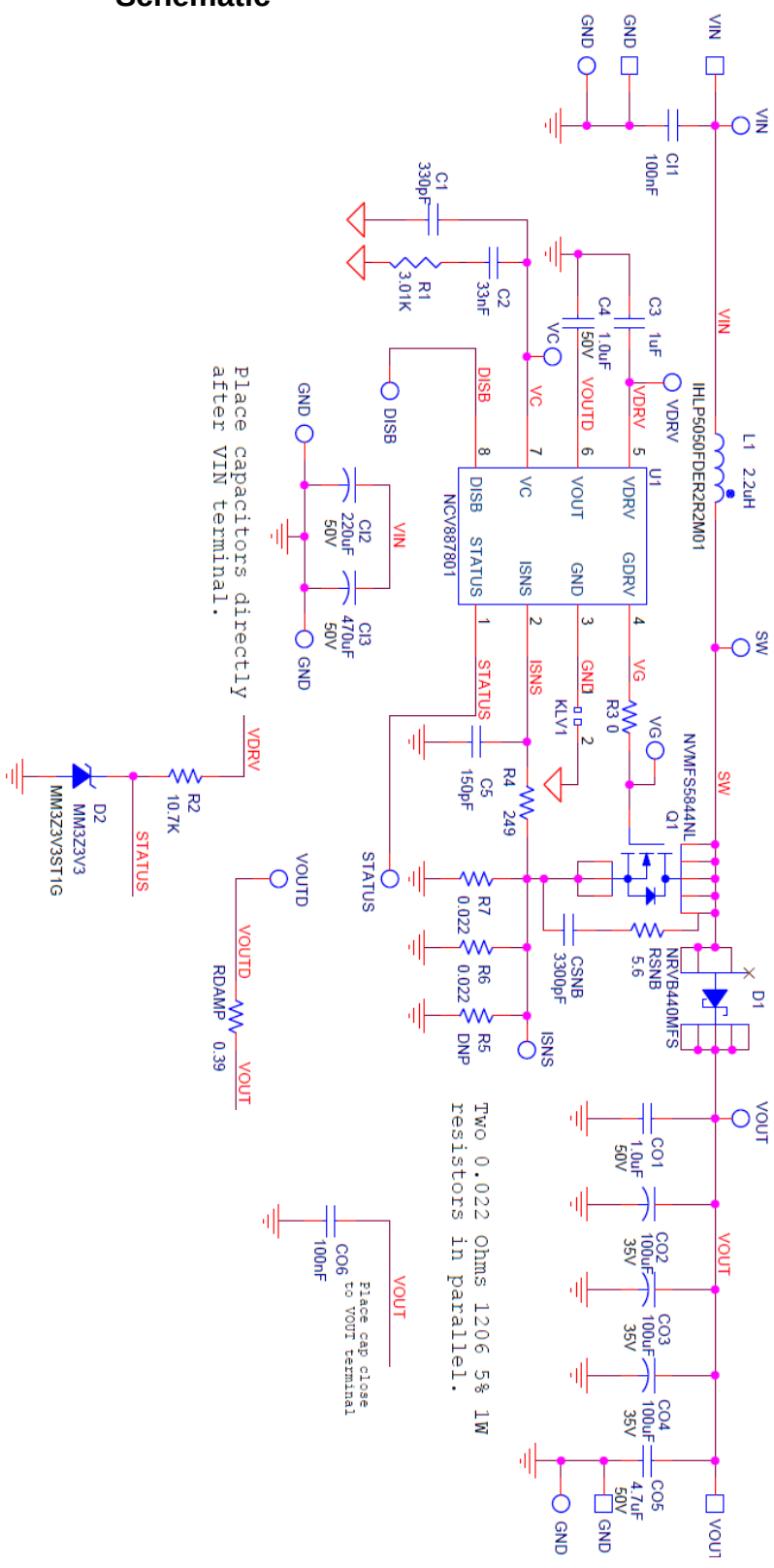


**Figure 4.** NCV887801 boost 6.8V/3.6A demonstration board schematic

## Bill of Materials

| Reference Designator(s) | Quantity | Description | Value | Tolerance | Manufacturer | Manufacturer's Part Number | Substitution Allowed | RoHS Compliant |
|---|---|---|---|---|---|---|---|---|
| C1 | 1 | CAP CER 330PF 50V 5% NP0 0603 | 330pF | 5% | Murata Electronics North America | GCM1885C1H331JA16D | Yes | Yes |
| C2 | 1 | CAP CER 0.033UF 50V 10% X7R 0603 | 0.033uF | 10% | TDK Corporation | CGA3E2X7R1H333K080AA | Yes | Yes |
| C3 | 1 | CAP CER 1UF 16V 10% X7R 0603 | 1uF | 10% | Murata Electronics North America | GCM188R71C105KA64D | Yes | Yes |
| C4, CO1 | 2 | CAP CER 1UF 50V 10% X7R 0805 | 1.0uF | 10% | TDK Corporation | CGA4J3X7R1H105K125AB | Yes | Yes |
| C5 | 1 | CAP CER 150PF 50V 5% NP0 0603 | 150pF | 5% | Murata Electronics North America | GCM1885C1H151JA16D | Yes | Yes |
| CI1, CO6 | 2 | CAP CER 0.1UF 50V 10% X7R 0805 | 100nF | 10% | Murata Electronics North America | GCM21BR71H104KA37L | Yes | Yes |
| CI2 | 1 | CAP ALUM 220UF 50V 20% SMD | 220uF | 20% | Chemi-Con | EMZA500ADA221MJA0G | Yes | Yes |
| CI3 | 1 | CAP ALUM 470UF 50V 20% RADIAL | 470uF | 20% | Panasonic Electronic Components | EEU-FC1H471 | Yes | Yes |
| CO2, CO3, CO4 | 3 | CAP ALUM 100UF 35V 20% SMD | 100uF | 20% | Nichicon | RHS1V101MCN1GS | No | Yes |
| CO5 | 1 | CAP CER 4.7UF 50V 10% X7R 1210 | 4.7uF | 10% | Murata Electronics North America | GCM32ER71H475KA55L | Yes | Yes |
| CSNB | 1 | CAP CER 3300PF 50V 5% NP0 0603 | 3300pF | 5% | TDK Corporation | CGA3E2C0G1H332J080AA | Yes | Yes |
| D1 | 1 | 40 V, 4.0 A Schottky Rectifier SO8-FL | 40V / 4A | N/A | ON Semiconductor | NRVB440MFST1G | No | Yes |
| D2 | 1 | DIODE ZENER 3.3V 200MW SOD323 | 3.3V | 5% | ON Semiconductor | MM3Z3V3T1G | Yes | Yes |
| L1 | 1 | INDUCTOR POWER 2.2UH 22A SMD | 2.2uH | 20% | Vishay Dale | IHLP5050FDER2R2M01 | No | Yes |
| Q1 | 1 | N-Channel Power MOSFET 60V 61A SO- | 60V / 61A | N/A | ON Semiconductor | NVMFS5844NL | No | Yes |
| R1 | 1 | RES 3.01K OHM 1/10W 1% 0603 SMD | 3.01K | 1% | Vishay Dale | CRCW06033K01FKEA | Yes | Yes |
| R2 | 1 | RES 10.7K OHM 1/10W 1% 0603 SMD | 10.7k | 1% | Vishay Dale | CRCW060310K7FKEA | Yes | Yes |
| R3 | 1 | RES 0.0 OHM 1/10W JUMP 0603 SMD | 0 | Jumper | Vishay Dale | CRCW06030000Z0EA | Yes | Yes |
| R4 | 1 | RES 249 OHM 1/10W 1% 0603 SMD | 249 | 1% | Vishay Dale | CRCW0603249RFKEA | Yes | Yes |
| R5 | DNP | | | | | | | |
| R6, R7 | 2 | RES 0.022 OHM 1W 5% 1206 SMD | 0.022 | 5% | Panasonic Electronic Components | ERJ-8BWJR022V | No | Yes |
| RDAMP | 1 | RES 0.39 OHM 1/10W 1% 0603 SMD | 0.39 | 1% | Panasonic Electronic Components | ERJ-3RQFR39V | Yes | Yes |
| RSNB | 1 | RES 5.60 OHM 1/10W 1% 0603 SMD | 5.6 | 1% | Vishay Dale | CRCW06035R60FKEA | Yes | Yes |
| GND1, GND2, VIN1, VOUT | 4 | TERM SOLDER TURRET .219" .109"L | N/A | N/A | Mill-Max Manufacturing Corp. | 2501-2-00-44-00-00-07-0 | Yes | Yes |
| DISB, GND2, GND4, GND5, GND6, ISNS, SW, VC, VDRV, VG, VIN2, VOUT1, VOUT2 | 13 | PIN INBOARD .042" HOLE 1000/PKG | N/A | N/A | Vector Electronics | K24C/M | Yes | Yes |
| U1 | 1 | Automotive Non-Sync Boost Controller | N/A | N/A | ON Semiconductor | NCV887801 | No | Yes |

## PCB Layout

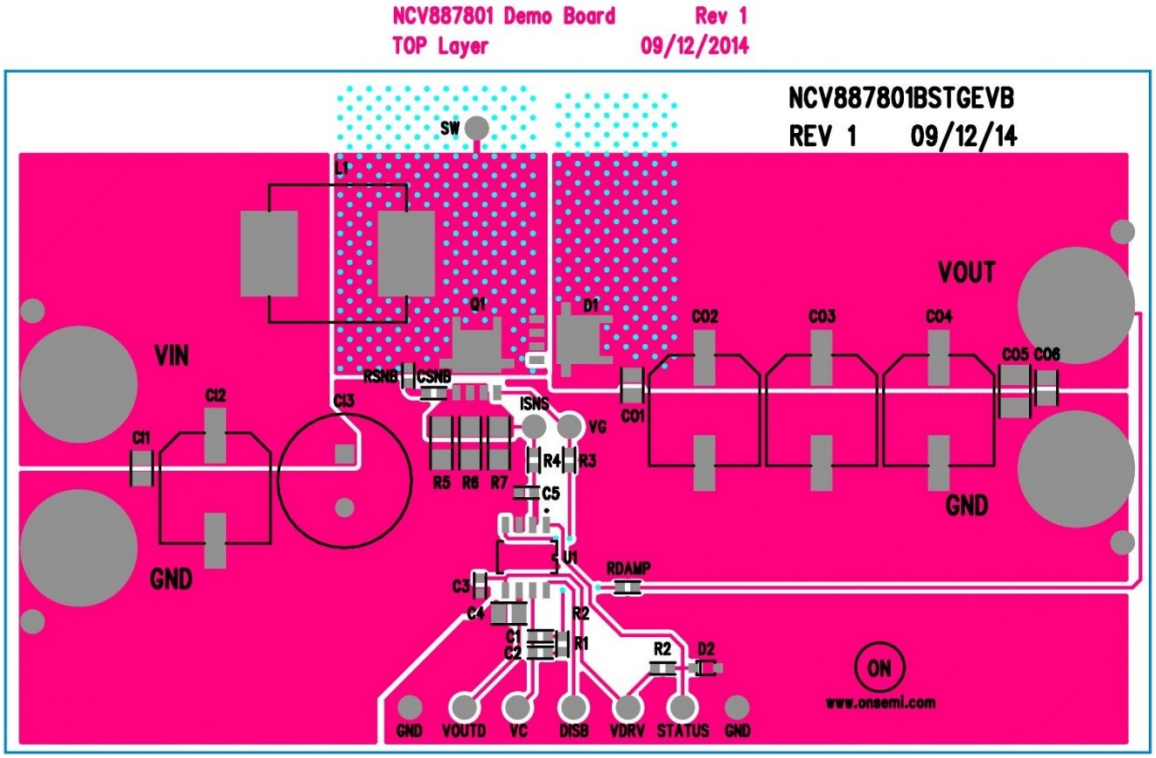


**Figure 5.** Top View

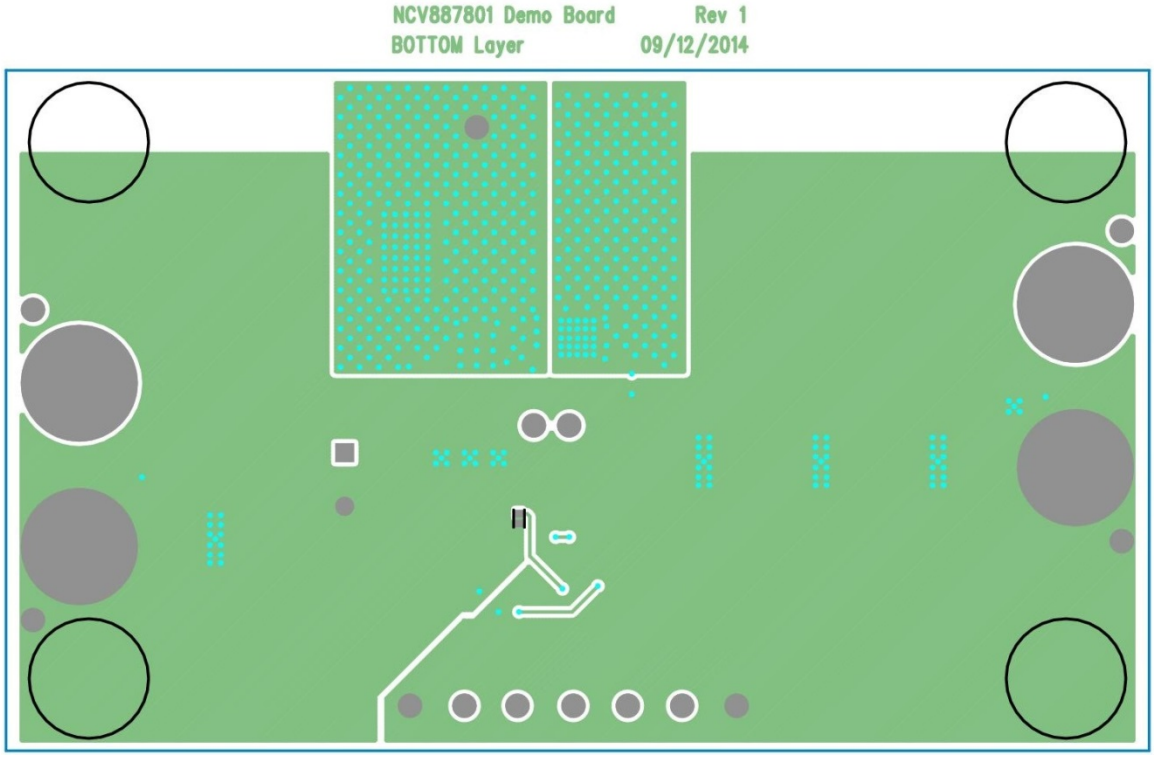


**Figure 6.** Bottom View

## Typical performance

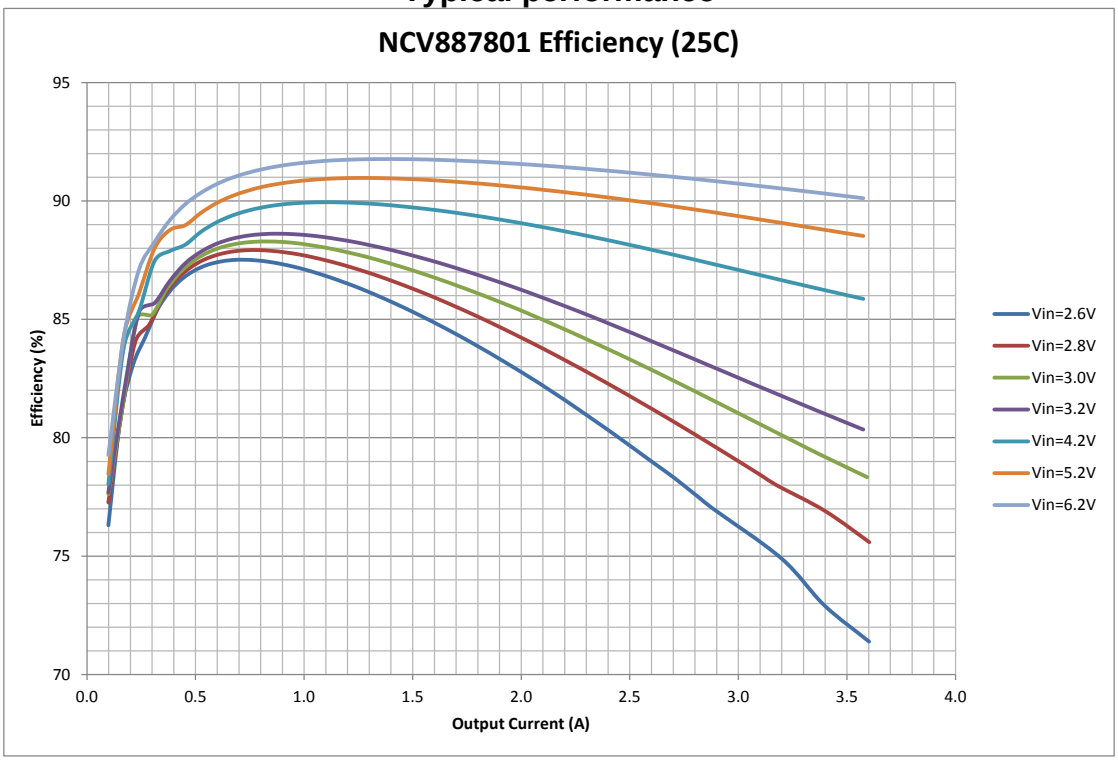


**Figure 7 NCV887801 Efficiency**

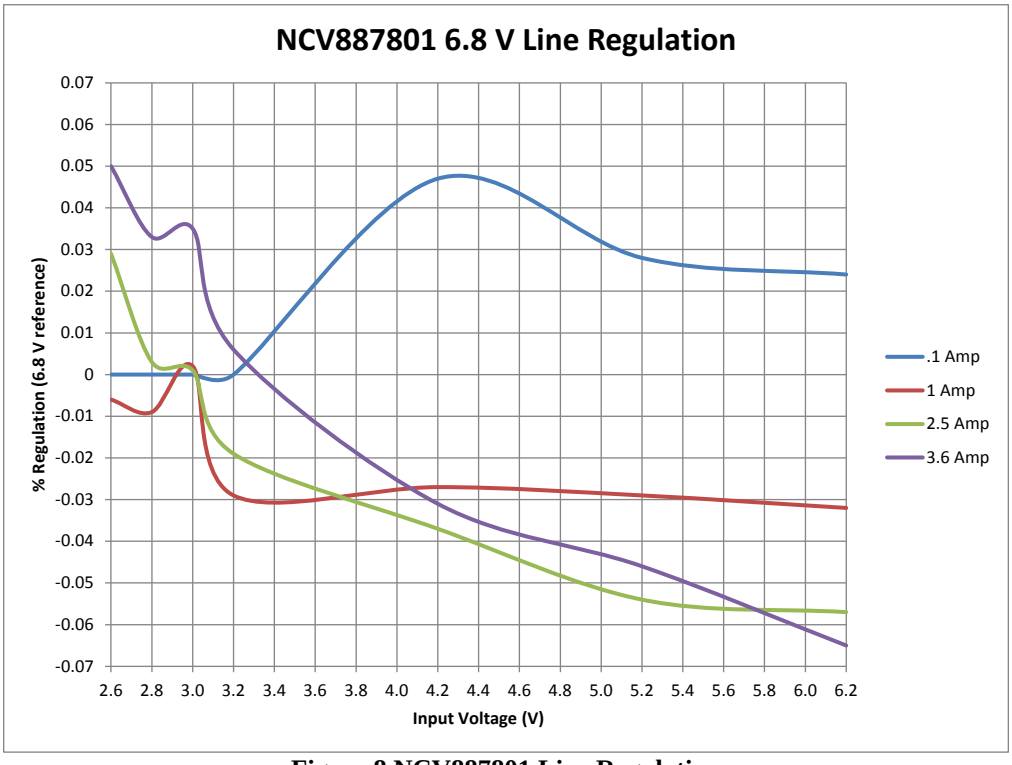


**Figure 8 NCV887801 Line Regulation**

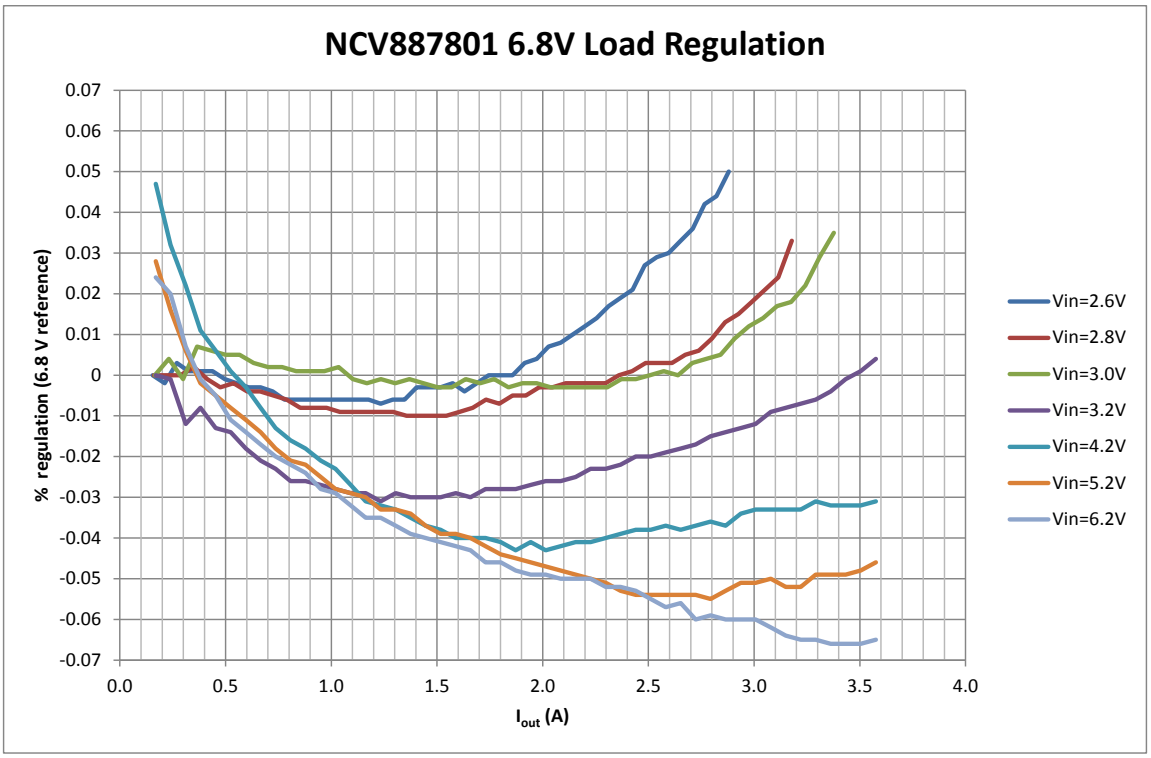


**Figure 9 NCV887801 Load Regulation**