# NCV890103GEVB

# NCV890103 Evaluation Board User's Manual

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## EVAL BOARD USER'S MANUAL

### Description

The NCV890103 is a fixed-frequency, monolithic, Buck switching regulator intended for Automotive, battery-connected applications that must operate with up to a 36 V input supply. The regulator is suitable for systems with low noise and small form factor requirements often encountered in automotive driver information systems. The NCV890103 is capable of converting the typical 4.5 V to 18 V automotive input voltage range to outputs as low as 3.3 V at a constant switching frequency above the sensitive AM band, eliminating the need for costly filters and EMI countermeasures. A Reset pin signals when the output is in regulation, and a pin is provided to adjust the delay before the RSTB signal goes high. The NCV890103 also provides several protection features expected in Automotive power supply systems such as current limit, short circuit protection, and thermal shutdown. In addition, the high switching frequency produces low output voltage ripple even when using small inductor values and an all-ceramic output filter capacitor – forming a space-efficient switching regulator solution.

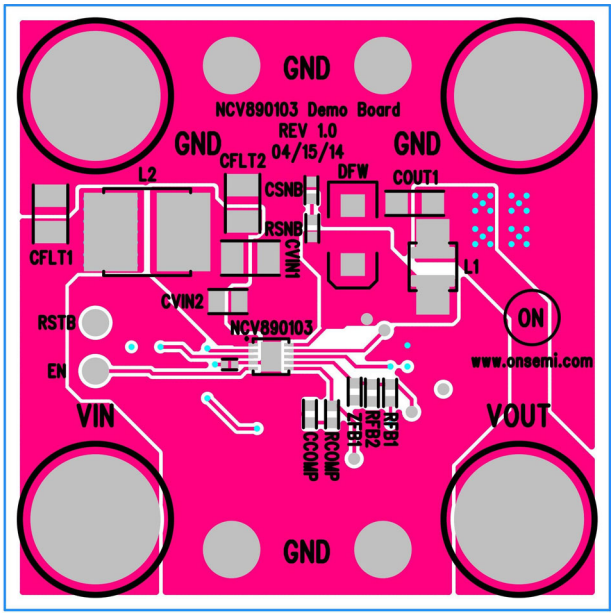



**Figure 1. NCV890103 Evaluation Board**

### Key Features

- Internal N-channel Power Switch
- Low $V_{IN}$ Operation Down to 4.5 V
- High $V_{IN}$ Operation to 36 V
- Withstands Load Dump to 40 V
- 2 MHz Free-running Switching Frequency
- Reset with Adjustable Delay
- Logic level Enable Input Can be Directly Tied to Battery
- 1.4 A (min) Cycle-by-Cycle Peak Current Limit
- Short Circuit Protection enhanced by Frequency Foldback
- ±1.75% Output Voltage Tolerance
- Output Voltage Adjustable Down to 0.8 V
- 1.4 Millisecond Internal Soft-Start
- Thermal Shutdown (TSD)
- Low Shutdown Current
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC–Q100 Qualified and PPAP Capable
- Wettable Flanks DFN (Pin Edge Plating)
- These Devices are Pb-Free and are RoHS Compliant

### Typical Applications

- Audio, Infotainment, Safety – Vision Systems, Instrumentation

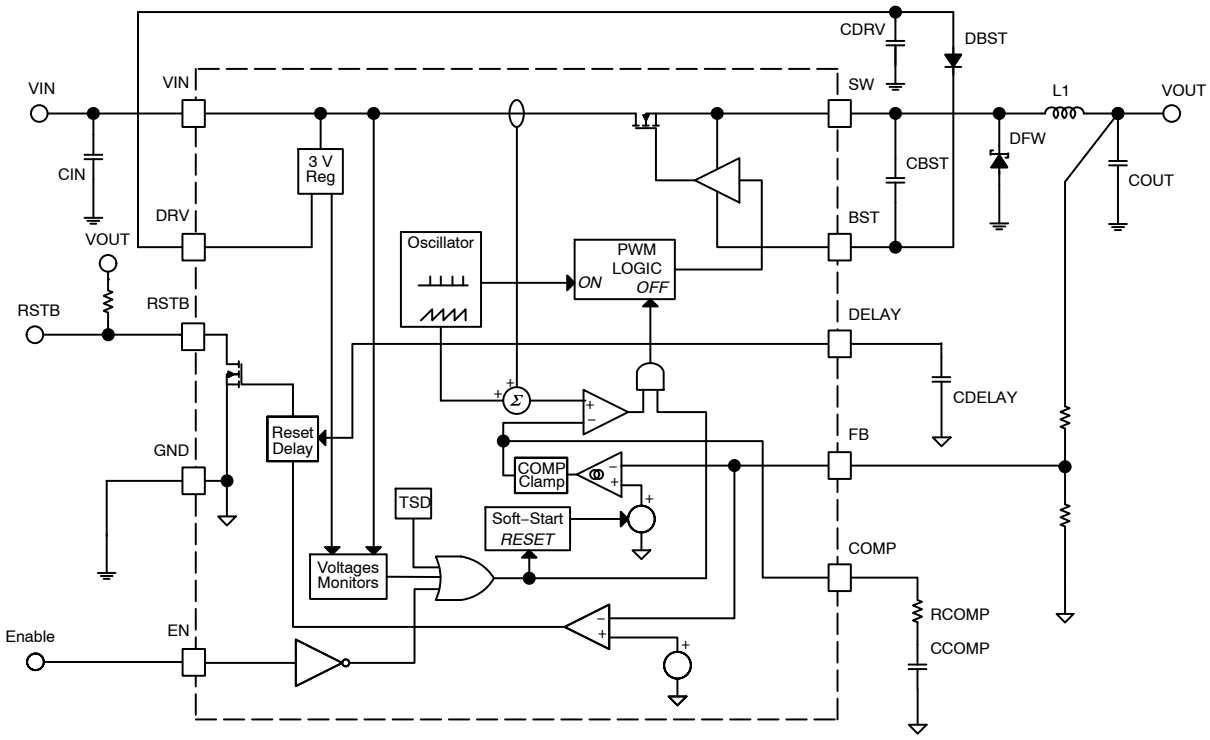



**Figure 2. NCV890103 Block Diagram**

## TYPICAL APPLICATION

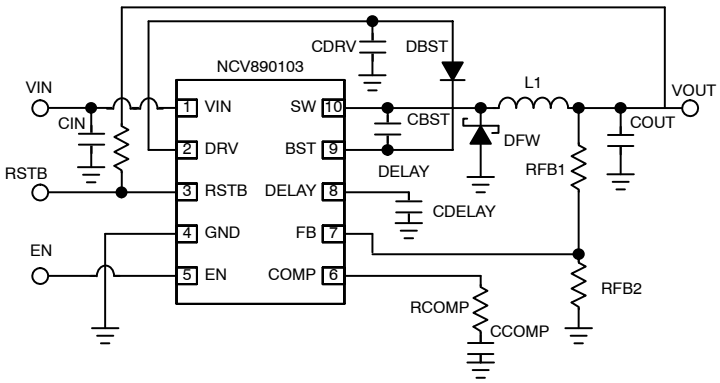



**Figure 3. NCV890103 Typical Application**

**Table 1. EVALUATION BOARD TERMINALS**

| Pin Name | Function |
|---|---|
| VIN | Positive dc Input Voltage |
| GND | Common dc Return |
| VOUT | Positive dc Output Voltage |
| EN | Master Enable Input |
| RSTB | Reset with Adjustable Delay |

**Table 2. ABSOLUTE MAXIMUM RATINGS** (Voltages are with respect to GND)

| Rating | Value | Unit |
|---|---|---|
| Dc Supply Voltage (VIN, EN) | −0.3 to 40 | V |
| Dc Supply Voltage (RSTB) | −0.3 to 6 | V |
| Storage Temperature Range | −55 to +150 | °C |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

**Table 3. ELECTRICAL CHARACTERSITICS**

| Characteristic | Conditions | Typical Value | Unit |
|---|---|---|---|
| **REGULATION** | | | |
| Output Voltage (VOUT) | | 5.0 | V |
| Line Regulation (VOUT) | $I_{OUT}$ = 1.0 A | 0.1 | % |
| Load Regulation (VOUT) | $V_{IN}$ = 13.2 V | 0.1 | % |
| **SWITCHING** | | | |
| Switching Frequency | | 2.0 | MHz |
| Soft-start Time | | 1.4 | ms |
| **CURRENT LIMIT** | | | |
| Peak Current Limit (VOUT) | EN = 5 V | 2.35 | A |
| **PROTECTIONS** | | | |
| Input Undervoltage Lockout (UVLO) | $V_{IN}$ Decreasing | 3.4 | V |
| Thermal Shutdown | $T_J$ Rising | 170 | °C |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

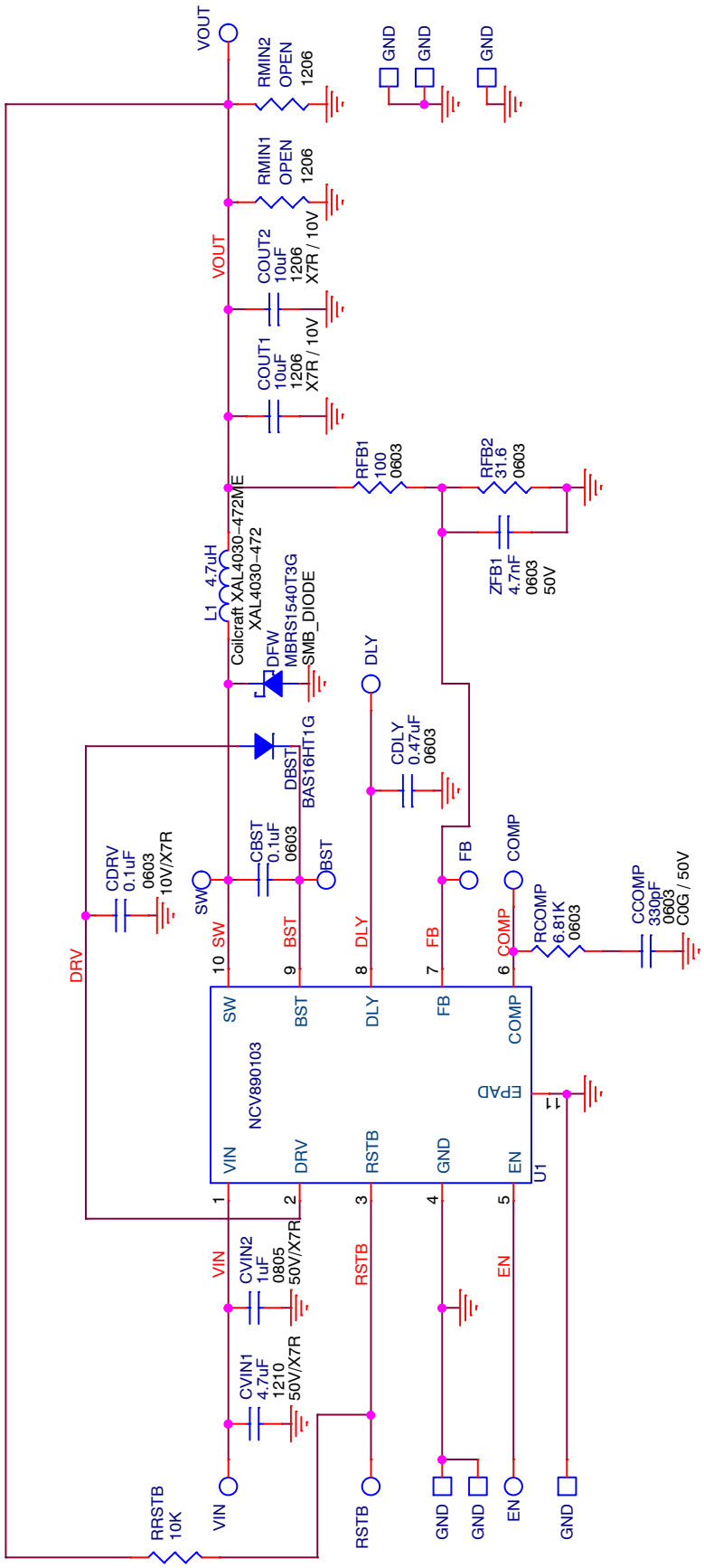



**Figure 4. NCV890103GEVB Evaluation Board Schematic**

## OPERATIONAL GUIDELINES

1. Connect a dc input voltage, within the 6.0 V to 36 V range, between VIN and GND.
2. Connect a dc enable voltage, within the 2.0 V to 36 V range, between EN and GND. This will power up the switcher. The VOUT signal should be 3.3 V.
3. Add a load to VOUT – up to 1.0 A.

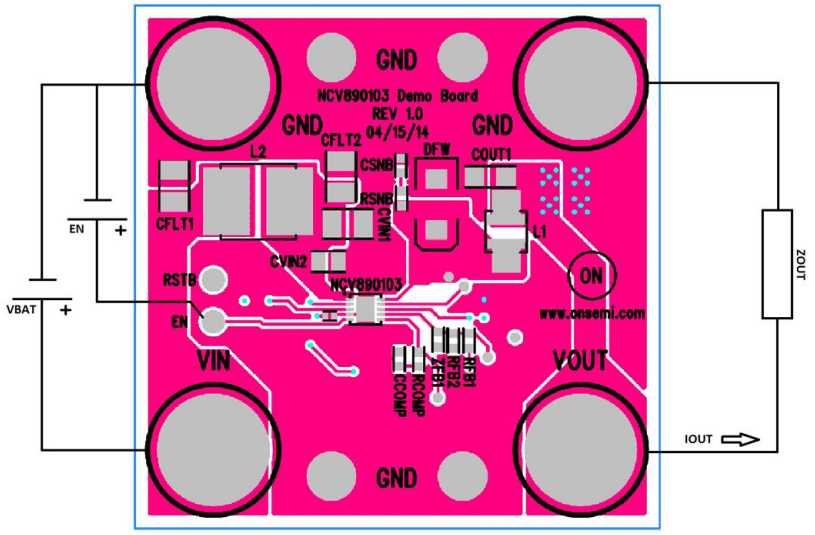
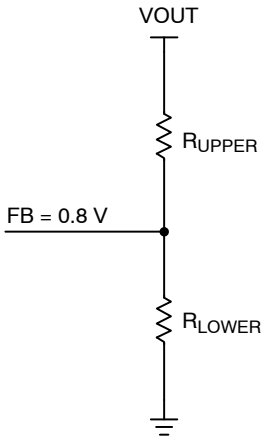



**Figure 5. NCV890103 Board Connections**

## ADDITIONAL GUIDELINES

### Output Voltage Selection

The voltage output for the switcher is adjustable and can be set with a resistor divider. The FB reference for the switcher is 0.8 V.




Use the following equation:

$$R_{UPPER} = R_{LOWER} \frac{V_{OUT} - V_{FB}}{V_{FB}}$$

Some common setups are listed below:

| Desired Output (V) | VREF (V) | $R_{UPPER}$ (kΩ, 1%) | $R_{LOWER}$ (kΩ, 1%) |
|---|---|---|---|
| 1.2 | 0.8 | 5.11 | 10.0 |
| 1.5 | 0.8 | 8.87 | 10.0 |
| 1.8 | 0.8 | 12.7 | 10.0 |
| 2.5 | 0.8 | 21.5 | 10.0 |
| 3.3 | 0.8 | 31.6 | 10.0 |
| 5.0 | 0.8 | 52.3 | 10.0 |

### Reset with Adjustable Delay

The RSTB pin is pulled low as long as the voltage on the FB pin is lower than 92% (typical) of the reference voltage (which corresponds to the output voltage being lower than 92% of its regulation level). It is high impedance when the voltage goes above 94% (typical) of the regulation level, after a delay adjusted by the capacitor on the DELAY pin.

The capacitor is held at ground until the output enters regulation: $C_{DELAY}$ is then quickly charged to the internal rail voltage ($V_{RESU}$), then discharged by the $I_{delay}$ current until its voltage reaches the lower threshold $V_{DELTH}$. Only at this moment the RSTB pin voltage goes high, indicating the end of the Reset condition.

A small filtering delay (of duration $t_{PG}$) ensures that the RSTB signal doesn't toggle from high to low in case of high frequency noise when the output is in regulation.

A pull-up resistor is needed on the RSTB pin, as it features an open collector output, capable of sinking 1 mA minimum at 400 mV.

The RSTB pin is also pulled low in case of UVLO ($V_{IN}$ below the UVLO threshold), TSD (temperature shutdown) or Disable ($V_{EN}$ below the enable threshold) events.

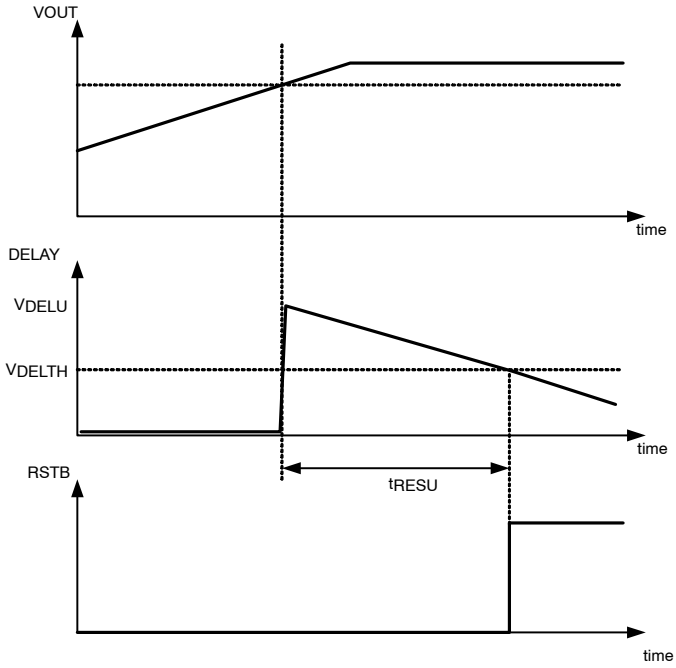



**Figure 6. Typical Operation of the Reset with Delay Function**

## TYPICAL PERFORMANCE

### Efficiency

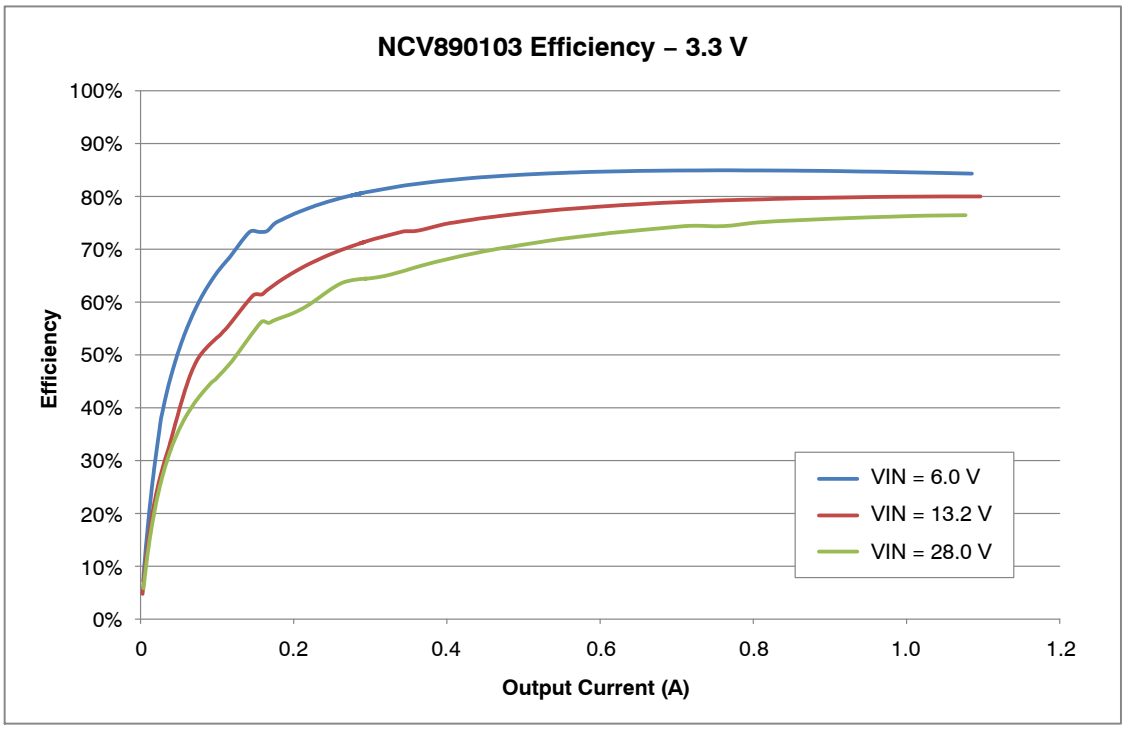



**Figure 7. Efficiency with a 3.3 V Output**

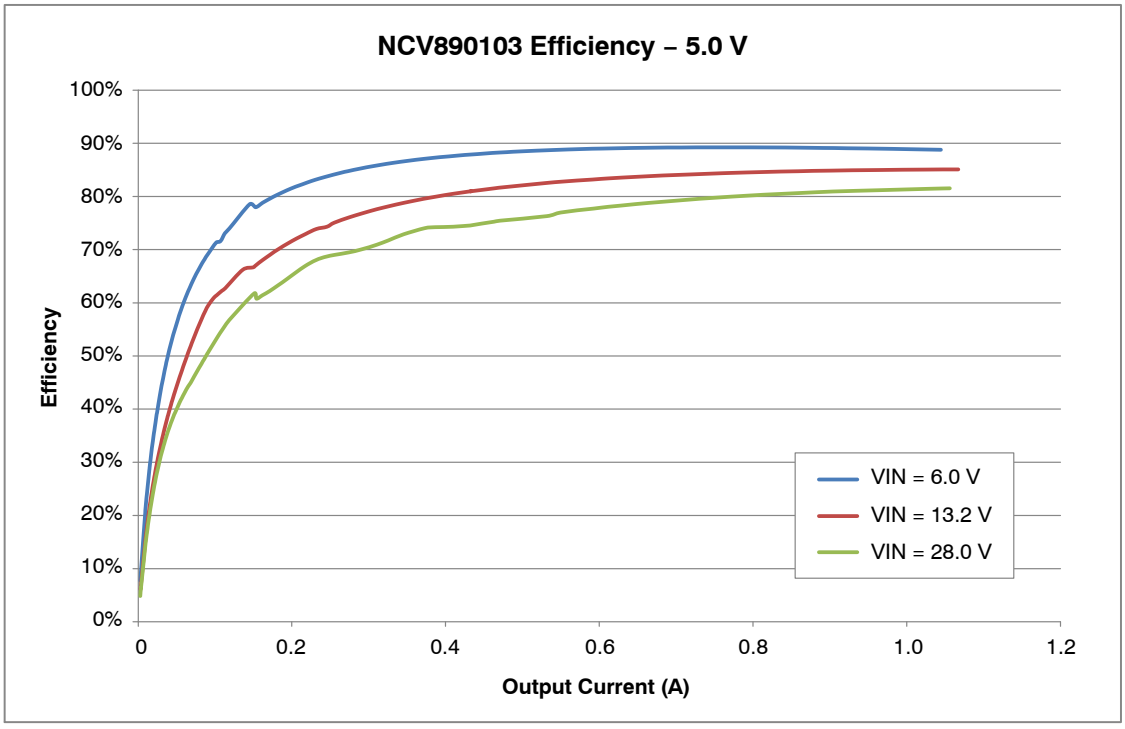



**Figure 8. Efficiency with a 5.0 V Output**

**Line Regulation**

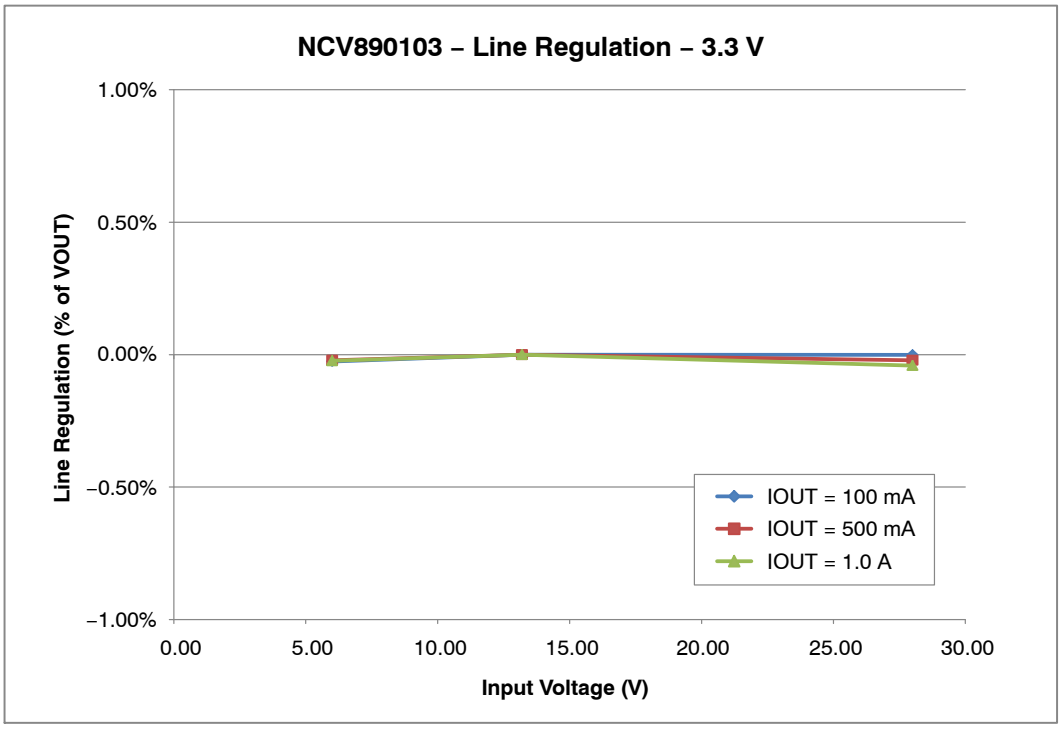



**Figure 9. Line Regulation for a 3.3 V Output**

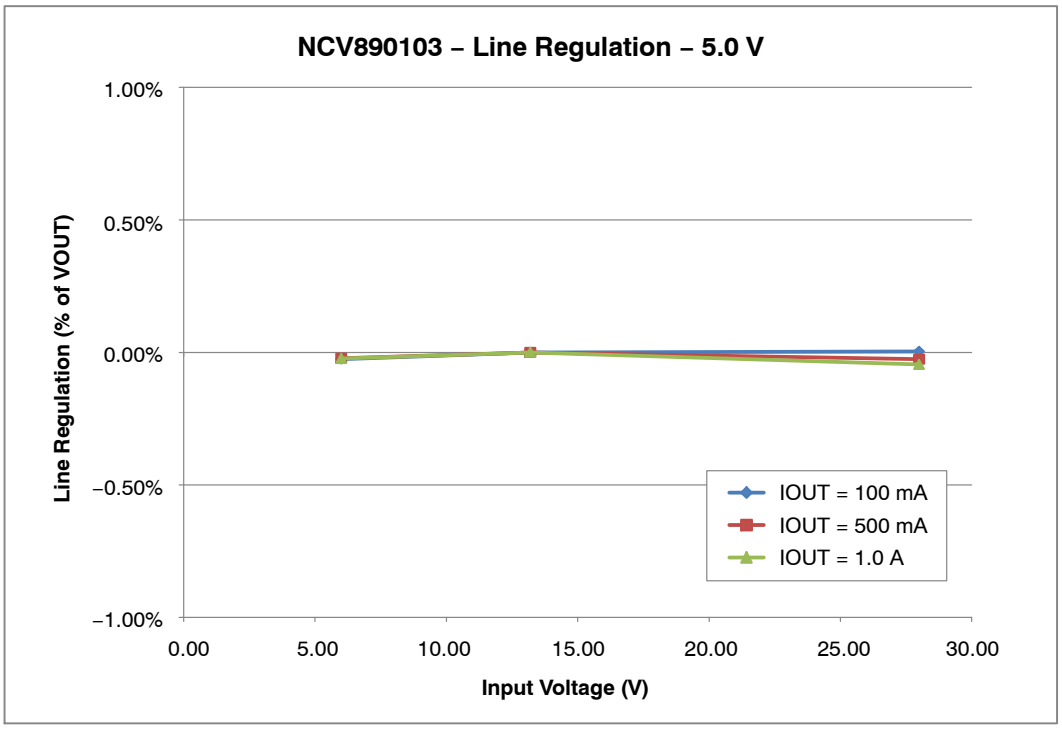



**Figure 10. Line Regulation for a 5.0 V Output**

**Load Regulation**

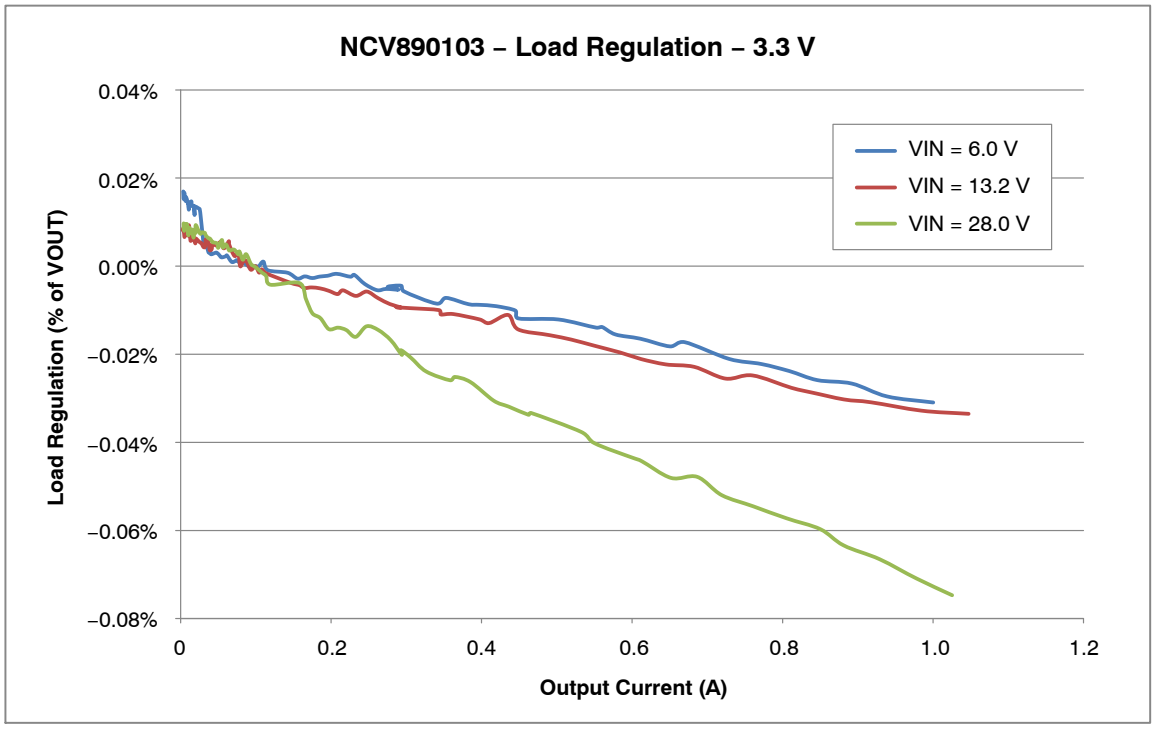



**Figure 11. Load Regulation with a 3.3 V Output**

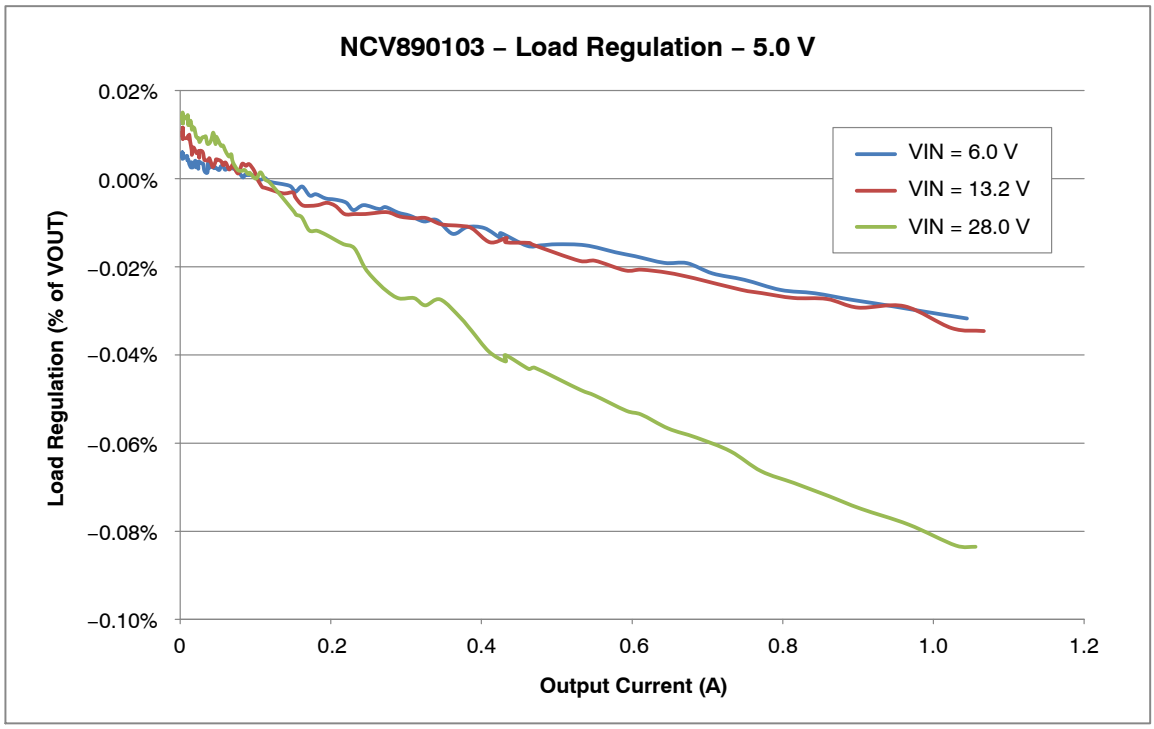



**Figure 12. Load Regulation with a 5.0 V Output**

## SCHEMATIC

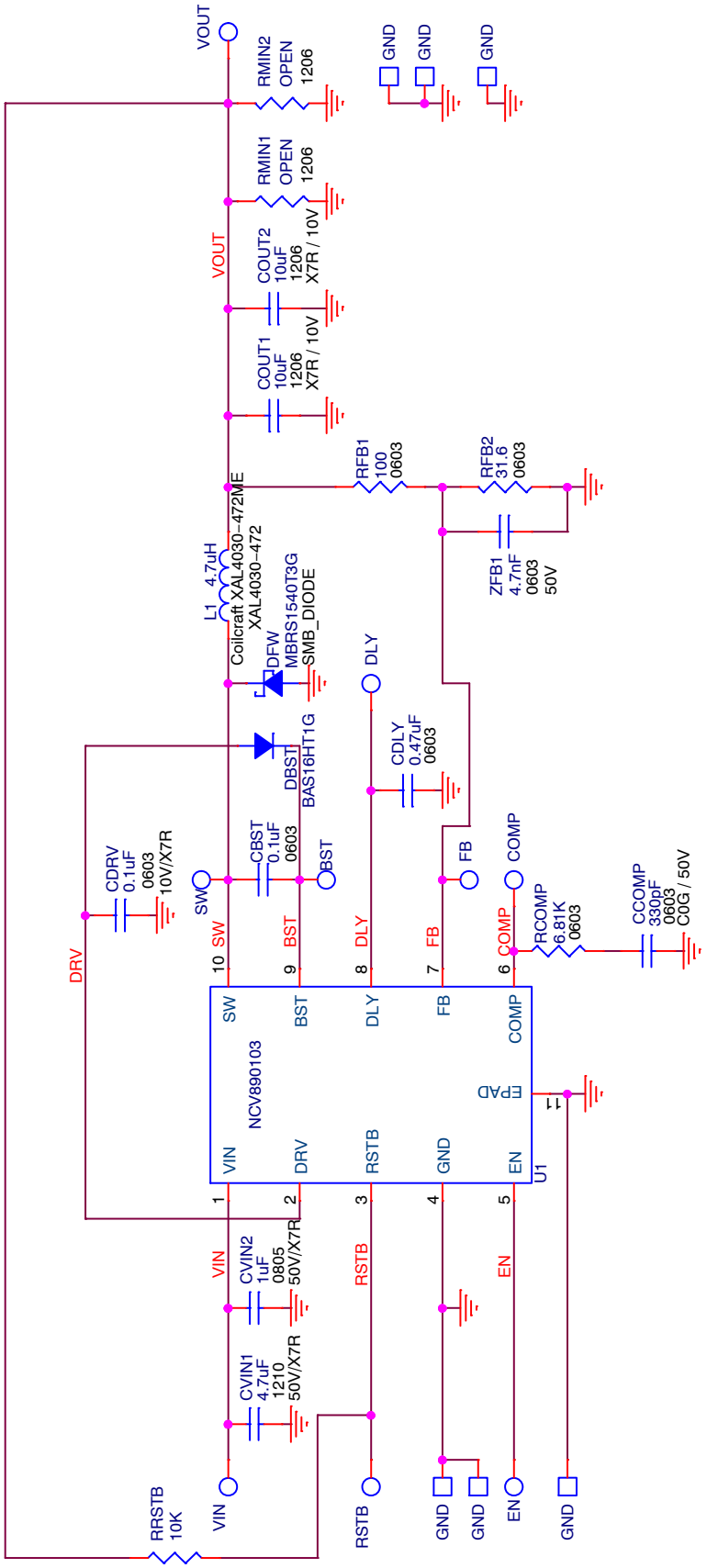



**Figure 13. Schematic**

## PCB LAYOUT

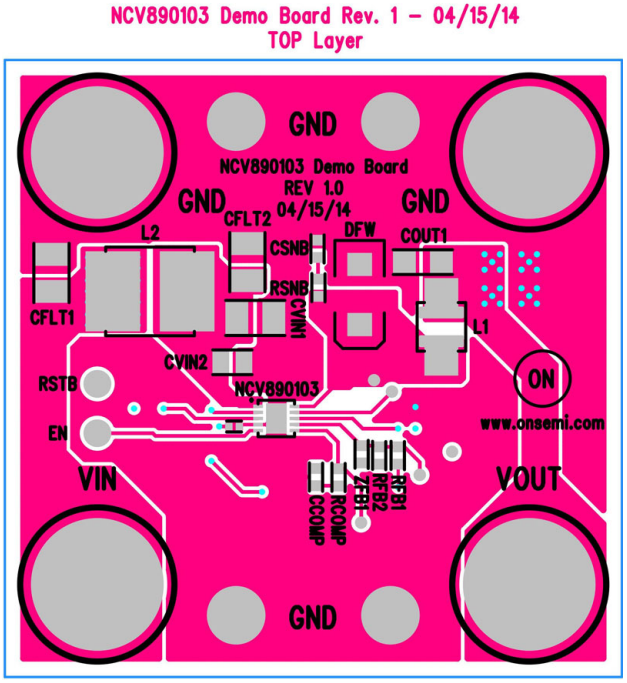



Figure 14. Top View

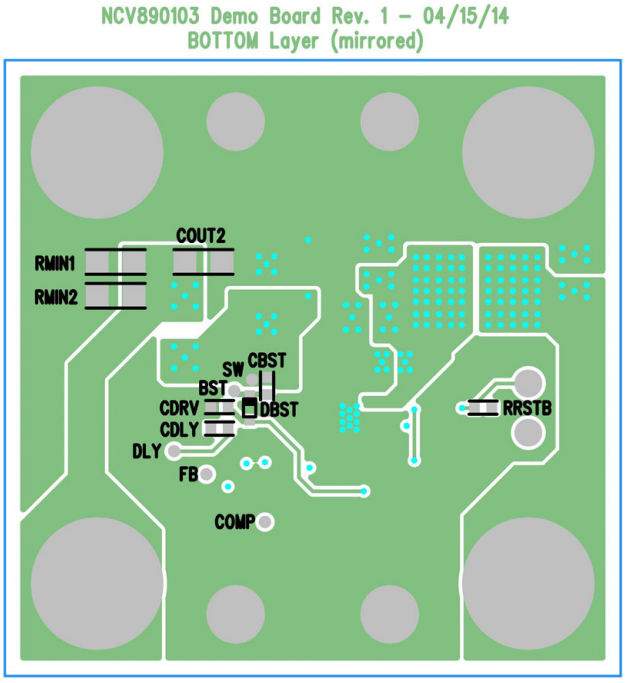



Figure 15. Bottom View

## BILL OF MATERIALS

**Table 4. BILL OF MATERIALS**

| Reference Designator(s) | Qty. | Description | Value | Tolerance | Footprint | Manufacturer | Manufacturer's Part Number | Substitution Allowed |
|---|---|---|---|---|---|---|---|---|
| CBST, CDRV | 2 | CAP .10 μF 10 V CERAMIC X7R 0603 | 0.1 μF | 10% | 603 | Kemet | C0603C104K8RACTU | Yes |
| CCOMP | 1 | CAP CER 330 pF 50 V C0G 0603 | 330 pF | 10% | 603 | Murata Electronics North America | GCM1885C1H331JA16D | Yes |
| CDLY | 1 | CAP CER 0.47 μF 25 V 10% X7R 0603 | 0.47 μF | 10% | 603 | Murata Electronics North America | GCM188R71E474KA64D | Yes |
| CFLT1, CFLT2, CVIN1 | 3 | CAP CER 4.7 μF 50 V 10% X7R 1210 | 4.7 μF | 10% | 1210 | Murata Electronics North America | GRM32ER71H475KA88L | Yes |
| COUT1, COUT2 | 2 | CAP CER 10 μF 10 V 10% X7R 1206 | 10 μF | 10% | 1206 | Taiyo Yuden | LMK316AB7106KLHT | Yes |
| CVIN2 | 1 | CAP CER 1.0 μF 50 V X5R 0805 | 1.0 μF | 10% | 805 | Murata Electronics North America | UMK212BJ105KG-T | Yes |
| DBST | 1 | DIODE SWITCH 200 mA 75 V SOD323 | 75 V/0.2 A | N/A | SOD_323 | ON Semiconductor | BAS16HT1G | No |
| DFW | 1 | DIODE SCHOTTKY 4.0 A 40 V SMB | 40 V/4.0 A | N/A | SMB_DIODE | ON Semiconductor | NRVB440MFST1G | No |
| L1 | 1 | INDUCTOR POWER 4.7 μH 4.5 A 20% SMD | 4.7 μH | 4.5A | XAL4030-472 | Coilcraft | XAL4030-472ME | No |
| *L2 | 1 | RES 0.0 Ω 1/4 W JUMP 1206 SMD | 0 Ω | 5% | 1206 | Yageo | RC1206JR-070RL | Yes |
| RCOMP | 1 | RES 6.98 kΩ 1/10 W 1% 0603 SMD | 6.98 kΩ | 1% | 603 | Vishay/Dale | CRCW06036K98FKEA | Yes |
| RFB1 | 1 | RES 100 Ω 1/10 W 1% 0603 SMD | 100 Ω | 1% | 603 | Vishay/Dale | CRCW0603100RFKEA | Yes |
| RFB2 | 1 | RES 31.6 Ω 1/10 W 1% 0603 SMD | 31.6 Ω | 1% | 603 | Vishay/Dale | CRCW060331R6FKEA | Yes |
| RRSTB | 1 | RES 10.0 kΩ 1/10 W 1% 0603 SMD | 10.0 kΩ | 1% | 603 | Vishay/Dale | CRCW060310K0FKEA | Yes |
| ZFB1 | 1 | CAP CER 4700 pF 50 V 10% X7R 0603 | 4700 pF | 10% | 603 | Murata Electronics North America | GRM188R71H472KA01D | Yes |
| CSNB | 1 | | Do Not Populate | | 603 | | | Yes |
| RMIN1, RMIN2 | 2 | | Do Not Populate | | 1206 | | | Yes |
| RSNB | 1 | | Do Not Populate | | 603 | | | Yes |
| BST, COMP, DLY, FB, RDEP, RMOD, SW | 7 | CIRCUIT PIN PRNTD .020″D .425″L | Do Not Populate | N/A | TPA | Mill-Max Manufacturing Corp. | 3128-2-00-15-00-00-08-0 | Yes |
| GND1, GND2, VIN, VOUT | 4 | CONN JACK BANANA UNINS PANEL MOU | N/A | N/A | BANANA | Emerson Network Power Connectivity Soultions | 108-0740-001 | Yes |

**Table 4. BILL OF MATERIALS** (continued)

| Reference Designator(s) | Qty. | Description | Value | Tolerance | Footprint | Manufacturer | Manufacturer's Part Number | Substi-tution Allowed |
|---|---|---|---|---|---|---|---|---|
| GND3−GND6 | 4 | TERM SOLDER TURRET .219″ .109″L | N/A | N/A | TURRET | Mill-Max Manufacturing Corp. | 2501-2-00-44-00-00-07-0 | Yes |
| EN, RSTB | 2 | PIN INBOARD .042″ HOLE 1000/PKG | N/A | N/A | TP | Vector Electronics | K24C/M | Yes |
| NCV890103 | 1 | 1.2 A 2 MHz Automotive Buck Switching Regulator | NCV890103 | N/A | 10PINDFNP5 | ON Semiconductor | NCV890103MWTXG | No |

*L2 is a placeholder footprint for an optional input inductor filter component. Boards are shipped with a shorting jumper installed to complete the input path.

NOTE: All devices are RoHS Compliant.

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