

## NCV8871 Automotive Grade High-Frequency SEPIC Controller Evaluation Board User's Manual



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### EVAL BOARD USER'S MANUAL

#### Description

This NCV8871 evaluation board provides a convenient way to evaluate a high-frequency current-mode control SEPIC converter design. The topology uses two inductors. No additional components are required, other than dc supplies for the input and enable voltages. An external clock can be used to synchronize the switching frequency. The output is rated 12 V / 2 A with a 170 KHz switching frequency over the typical 6 V to 18 V automotive input voltage range.

#### Key Features

- 12 V / 2 A Output
- 170 KHz Switching Frequency (NCV887100)
- Input Undervoltage Lockout
- Internal Soft-Start
- Wide Input Voltage of 6 V to 40 V
- Regulates through 45 V Load Dump Conditions
- External Clock Synchronization up to 1.1 MHz
- Automotive Grade

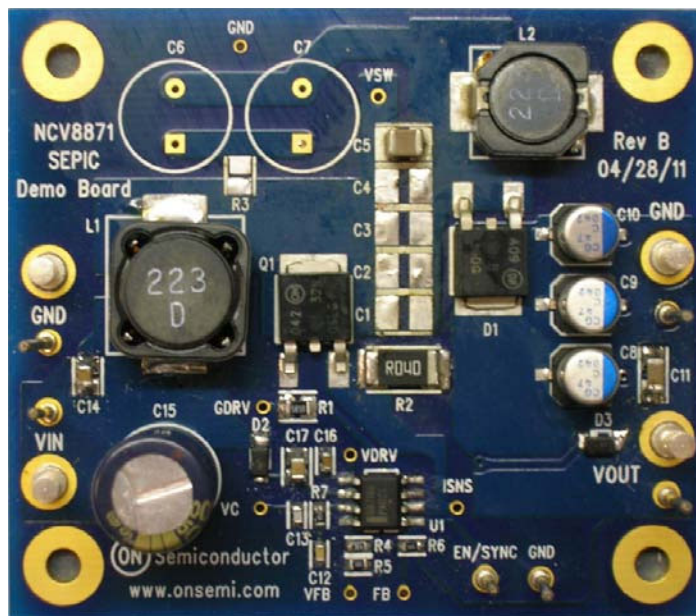


Figure 1. NCV887100 SEPIC Evaluation Board

**Table 1. EVALUATION BOARD TERMINALS**

| Terminal | Function                          |
|----------|-----------------------------------|
| VIN      | Positive DC input voltage.        |
| GND      | Common DC return.                 |
| VOUT     | Regulated DC output voltage.      |
| EN/SYNC  | Enable and synchronization input. |

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

| Rating                                    | Value      | Unit |
|-------------------------------------------|------------|------|
| DC Supply Voltage (VIN)                   | –0.3 to 40 | V    |
| DC Supply Voltage (EN/SYNC)               | –0.3 to 6  | V    |
| Peak Transient Voltage (Load Dump on VIN) | 45         | V    |
| Junction Temperature                      | –40 to 150 | °C   |
| Ambient Temperature (evaluation board)    | –40 to 105 | °C   |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

**Table 3. ELECTRICAL CHARACTERISTICS**

( $T_A = 25^\circ\text{C}$ ,  $4.5\text{ V} \leq V_{IN} \leq 40\text{ V}$ ,  $V_{EN} = 2\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $0 \leq I_{OUT} \leq 1.2\text{ A}$ , unless otherwise specified)

| Characteristic                     | Conditions          | Typical Value | Unit |
|------------------------------------|---------------------|---------------|------|
| <b>Switching</b>                   |                     |               |      |
| Switching Frequency                |                     | 170           | KHz  |
| Soft-start Time                    |                     | 7.4           | ms   |
| SYNC Frequency Range               |                     | 170 – 1025    | KHz  |
| <b>Current Limit</b>               |                     |               |      |
| Cycle-by-cycle Current Limit (FET) |                     | 10            | A    |
| <b>Protections</b>                 |                     |               |      |
| Input Undervoltage Lockout (UVLO)  | $V_{IN}$ decreasing | $< 6^*$       | V    |
| Input Undervoltage Lockout (UVLO)  | $V_{IN}$ increasing | 6.7           | V    |
| Thermal Shutdown                   | $T_A$ increasing    | 170           | °C   |

\*See Note 3 from Operational Guidelines (on next page)

## OPERATIONAL GUIDELINES

1. Connect a DC input voltage, within the 6 V to 40 V range, between VIN and GND.
2. Connect a DC enable voltage, within the 2.0 V to 5.0 V range, between EN/SYNC and GND.
3. The evaluation board feedback components were selected to for continuous operation at rated 12 V / 2 A output power at a minimum input voltage of 6 V. The NCV887100  $V_{IN}$  has its operational voltage diode-ored between the converter output (12 V) and input voltages. The converter turns-on typically at 6.7 V. Once energized, the output voltage supplies power to the IC when the battery voltage is below (approximately) 11.5 V. The decreasing  $V_{IN}$  UVLO voltage depends on load current as well as

$V_{IN}$ , and will be less than 6 V when operating below rated output current.

4. Optionally for external clock synchronization, connect a pulse source between EN/SYNC and GND. The high state level should be within the 2 to 5 V range, and the low state level within the -0.3 V to 0.8 V range, with a minimum pulse width of 40 ns and a frequency within the 170 and 1100 KHz range.

NOTE: The converter was designed for 170 KHz 12 V / 2 A continuous mode operation. Operation beyond 170 KHz and/or at a different output voltage may require modifications of feedback loop component and inductor values.

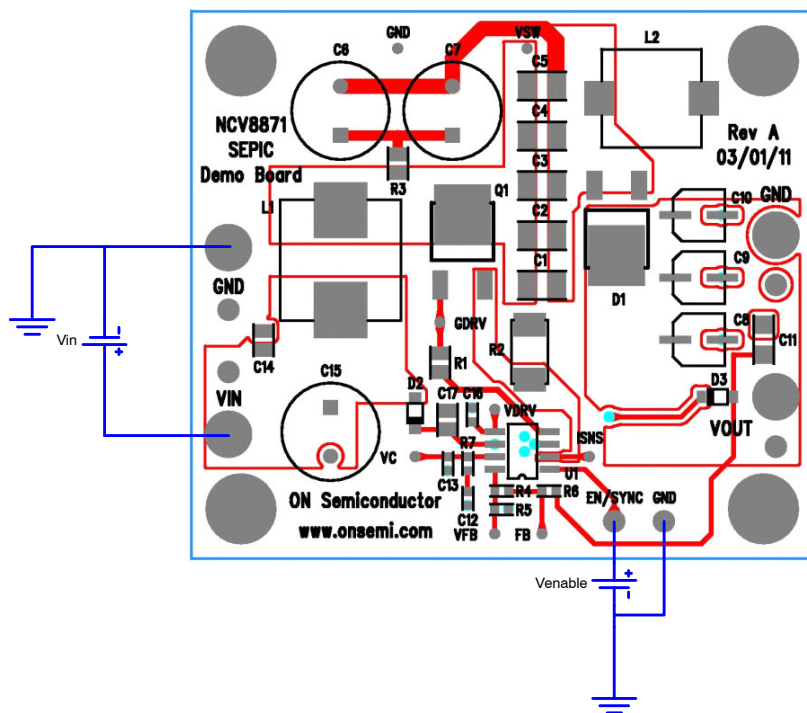


Figure 2. Evaluation Board Connections

# NCV8871SEPGEVB

## TYPICAL PERFORMANCE

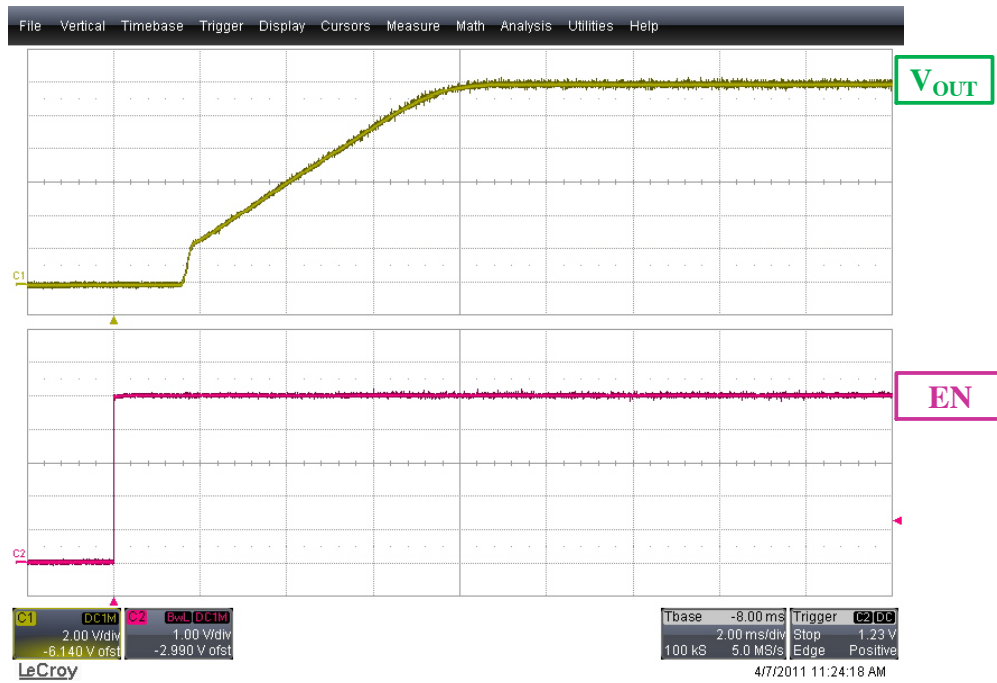


Figure 3. Typical Start-up with  $V_{IN} = 12\text{ V}$ ,  $R_{OUT} = 6\ \Omega$



Figure 4. Operational Waveforms,  $V_{IN} = 12\text{ V}$ ,  $R_{OUT} = 6\ \Omega$

SCHEMATIC

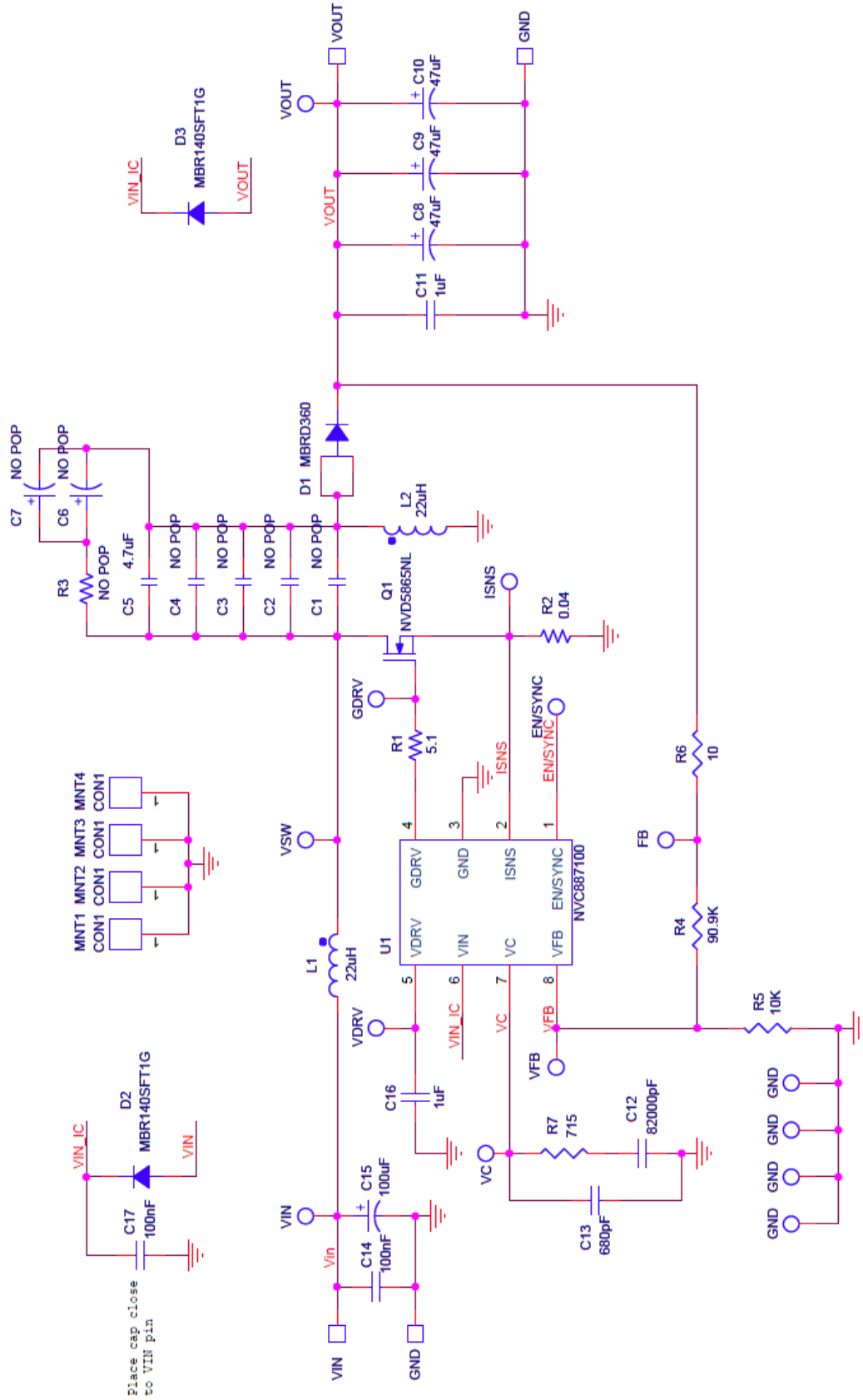


Figure 5. NCV887100 SEPIC Evaluation Board Schematic

# NCV8871SEPGEVB

**Table 4. BILL OF MATERIALS**

| Component | Description                                   | Manufacturer P/N   | Vendor P/N              |
|-----------|-----------------------------------------------|--------------------|-------------------------|
| C1        | DO NOT POPULATE                               |                    |                         |
| C2        | DO NOT POPULATE                               |                    |                         |
| C3        | DO NOT POPULATE                               |                    |                         |
| C4        | DO NOT POPULATE                               |                    |                         |
| C5        | CAP CER 4.7UF 50V 10% X7R 1210                | GRM32ER71H475KA88L | 490-1864-1-ND           |
| C6        | DO NOT POPULATE                               |                    |                         |
| C7        | DO NOT POPULATE                               |                    |                         |
| C8        | CAP POLY ALUM 47UF 16V SMD                    | PCG1C470MCL1GS     | 493-3095-1-ND           |
| C9        | CAP POLY ALUM 47UF 16V SMD                    | PCG1C470MCL1GS     | 493-3095-1-ND           |
| C10       | CAP POLY ALUM 47UF 16V SMD                    | PCG1C470MCL1GS     | 493-3095-1-ND           |
| C11       | CAP CER 1UF 50V X7R 1206                      | GCM31MR71H105KA55L | 490-4795-1-ND           |
| C12       | CAP CER .082UF 10% 16V X7R 0603               | 0603YC823KAT2A     | 478-1238-1-ND           |
| C13       | CAP CER 680PF 50V 5% C0G 0603                 | GRM1885C1H681JA01D | 490-1447-1-ND           |
| C14       | CAP CER .1UF 50V X7R 0603                     | GCM188R71H104KA57D | 490-4779-1-ND           |
| C15       | CAP 100UF 50V ELECT FC RADIAL                 | EEU-FC1H101        | P10323-ND               |
| C16       | CAP CER 1UF 16V X7R 10% 0603                  | GCM188R71C105KA64D | 490-5241-1-ND           |
| C17       | CAP CER .1UF 50V X7R 0603                     | GCM188R71H104KA57D | 490-4779-1-ND           |
| D1        | 60 V, 3.0 A Schottky Rectifier DPAK           | MBRD360G           | MBRD360G                |
| D2        | DIODE SCHOTTKY 40V 1A SOD123FL                | MBR140SFT1G        | MBR140SFT1G             |
| D3        | DIODE SCHOTTKY 40V 1A SOD123FL                | MBR140SFT1G        | MBR140SFT1G             |
| L1        | High Temp SMT Power Inductor 2.3A             | MSS1260T-223ML     | MSS1260T-223ML          |
| L2        | High Temp SMT Power Inductor 1.9A             | MSS1038T-223ML     | MSS1038T-223ML          |
| Q1        | N-CHANNEL MOSFET, LOGIC LEVEL,<br>60V 16mOHMS | NVD5865NL          | NVD5865NL               |
| R1        | RES 5.10 OHM 1/8W 1% 0805 SMD                 | CRCW08055R10FKEA   | 541-5.10CCCT-ND         |
| R2        | RES .04 OHM 3W 1% 2512 SMD                    | CRA2512-FZ-R040ELF | CRA2512-FZ-R040ELFCT-ND |
| R3        | DO NOT POPULATE                               |                    |                         |
| R4        | RES 90.9K OHM 1/10W 1% 0603 SMD               | RC0603FR-0790K9L   | 311-90.9KHRCT-ND        |
| R5        | RES 10.0K OHM 1/10W 1% 0603 SMD               | MCR03EZPFX1002     | RHM10.0KHCT-ND          |
| R6        | RES 10.0 OHM 1/10W 1% 0603 SMD                | RC0603FR-0710RL    | 311-10.0HRCT-ND         |
| R7        | RES 715 OHM 1/10W 1% 0603 SMD                 | CRCW0603715RFKEA   | 541-715HCT-ND           |
| U1        | ON SEMI Non-Sync Boost Controller             | NCV887100          | NCV887100D1R2G          |

# NCV8871SEPGVB

## PCB LAYOUT

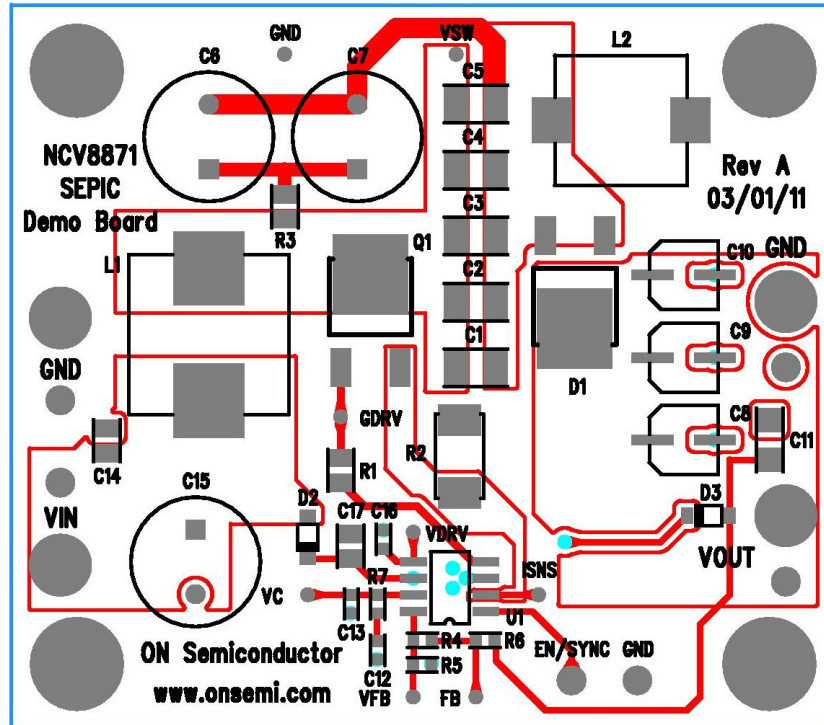


Figure 6. Top View

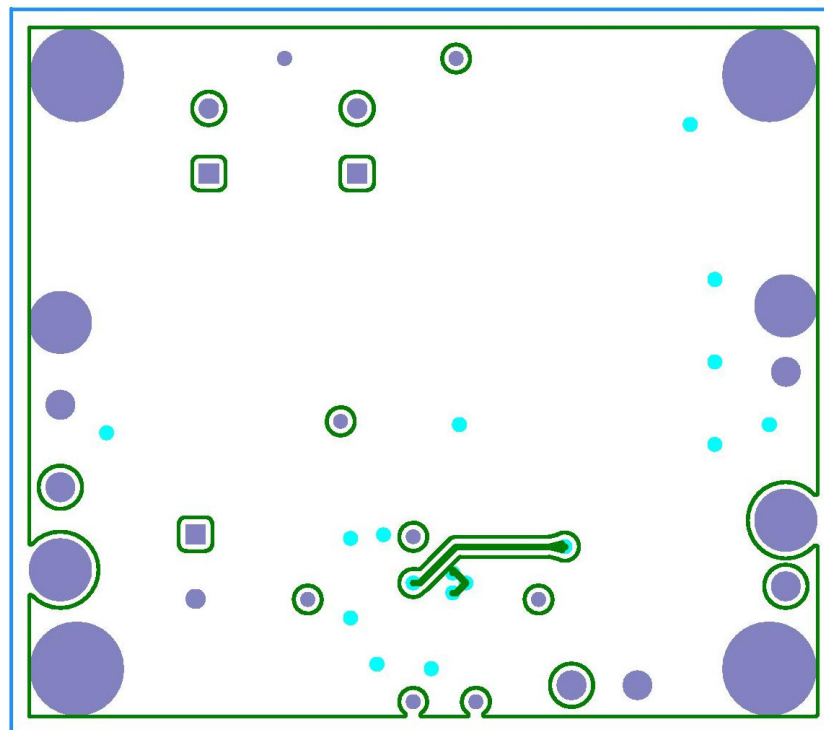


Figure 7. Bottom View

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