

# NCV898031 SEPGEVB

## NCV898031 Automotive Grade High-Frequency SEPIC Controller Evaluation Board User's Manual



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### EVAL BOARD USER'S MANUAL

#### Description

This NCV898031 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. The output is rated 7 V/8.5 W with a 2 MHz switching frequency over the typical 6 V to 18 V automotive input voltage range.

#### Key Features

- 7 V/1.22 A Output
- 2 MHz Switching Frequency
- Input Undervoltage Lockout
- Internal Soft-Start
- Wide Input Voltage of 6 V to 40 V
- Regulates through Load Dump Conditions
- Automotive Grade



Figure 1. NCV898031 SEPIC Evaluation Board

**Table 1. EVALUATION BOARD TERMINALS**

| Terminal         | Function                    |
|------------------|-----------------------------|
| V <sub>IN</sub>  | Positive DC Input Voltage   |
| GND              | Common DC Return            |
| V <sub>OUT</sub> | Regulated DC Output Voltage |
| EN               | Enable Input                |

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

| Rating                                 | Value      | Unit |
|----------------------------------------|------------|------|
| DC Supply Voltage (V <sub>IN</sub> )   | -0.3 to 40 | V    |
| DC Supply Voltage (EN)                 | -0.3 to 6  | V    |
| Junction Temperature                   | -40 to 150 | °C   |
| Ambient Temperature (Evaluation Board) | -40 to 105 | °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 CHARACTERISTICS**

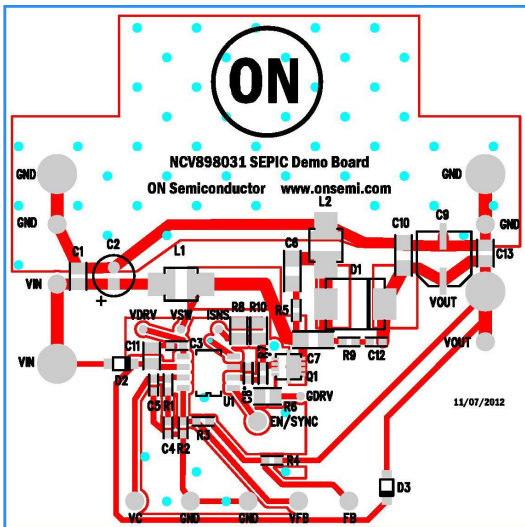
(T<sub>A</sub> = 25°C, 4.5 V ≤ V<sub>IN</sub> ≤ 40 V, V<sub>EN</sub> = 2 V, V<sub>OUT</sub> = 3.3 V, 0 ≤ I<sub>OUT</sub> ≤ 1.2 A, unless otherwise specified)

| Characteristic                     | Condition                  | Typical Value | Unit |
|------------------------------------|----------------------------|---------------|------|
| <b>Switching</b>                   |                            |               |      |
| Switching Frequency                | –                          | 2             | MHz  |
| Soft-Start Time                    | –                          | 650           | μs   |
| <b>Current Limit</b>               |                            |               |      |
| Cycle-by-Cycle Current Limit (FET) | –                          | 4             | A    |
| <b>Protections</b>                 |                            |               |      |
| Input Undervoltage Lockout (UVLO)  | V <sub>IN</sub> Decreasing | < 6 (Note 1)  | V    |
| Input Undervoltage Lockout (UVLO)  | V <sub>IN</sub> Increasing | 6.7           | V    |
| Thermal Shutdown                   | T <sub>A</sub> Increasing  | 170           | °C   |

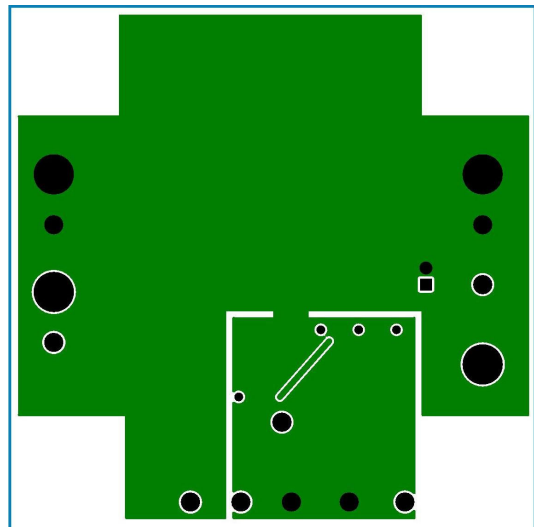
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. NCV898031 IC UVLO is 3.05 V (V<sub>IN</sub> falling). The demo board current limit resistor was selected to limit power when V<sub>IN</sub> is reduced below 6 V. See Point 3 from Test Procedure.

## PCB LAYERS



**Figure 2. Top View**



**Figure 3. Bottom View**

TYPICAL PERFORMANCE

Start-up

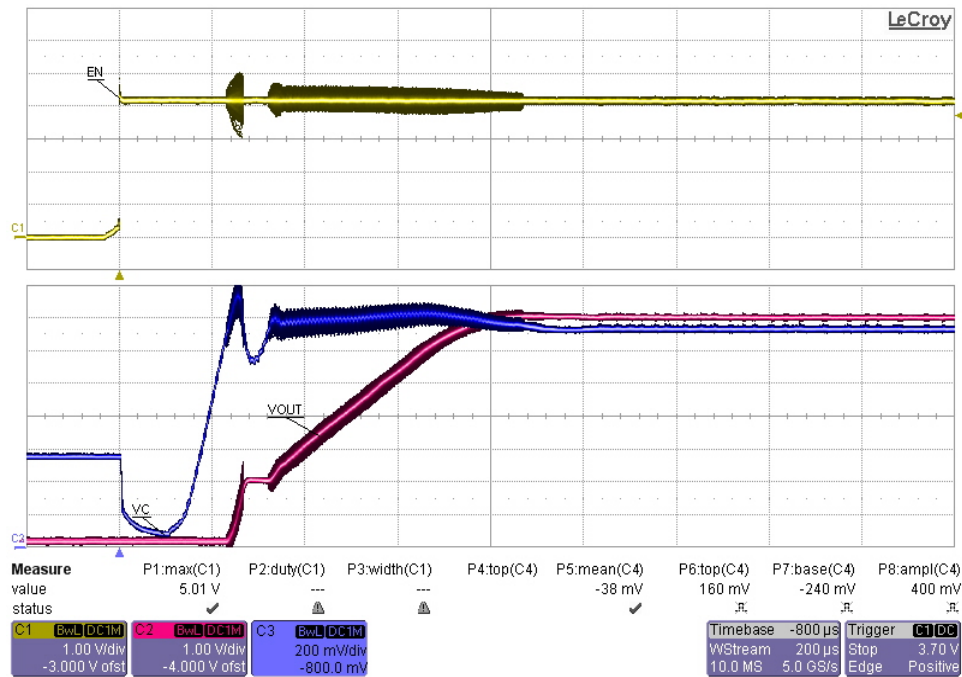


Figure 4. Typical Start-up with  $V_{IN} = 12$  V,  $I_{OUT} = 1.22$  A

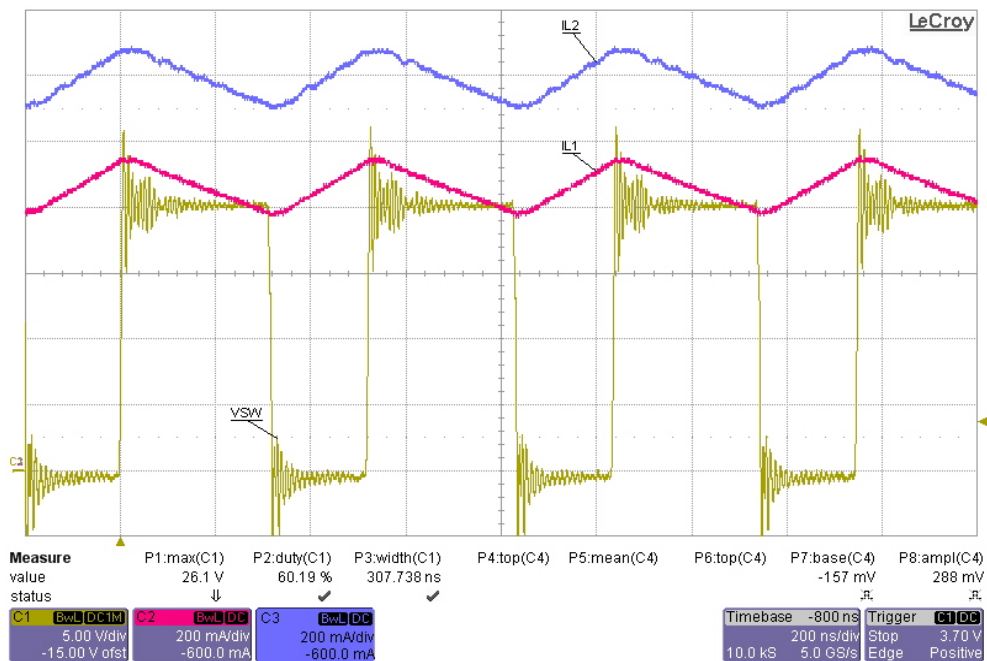


Figure 5. Operational Waveforms,  $V_{IN} = 12$  V,  $R_{IOUT} = 1.22$  A

SCHEMATIC

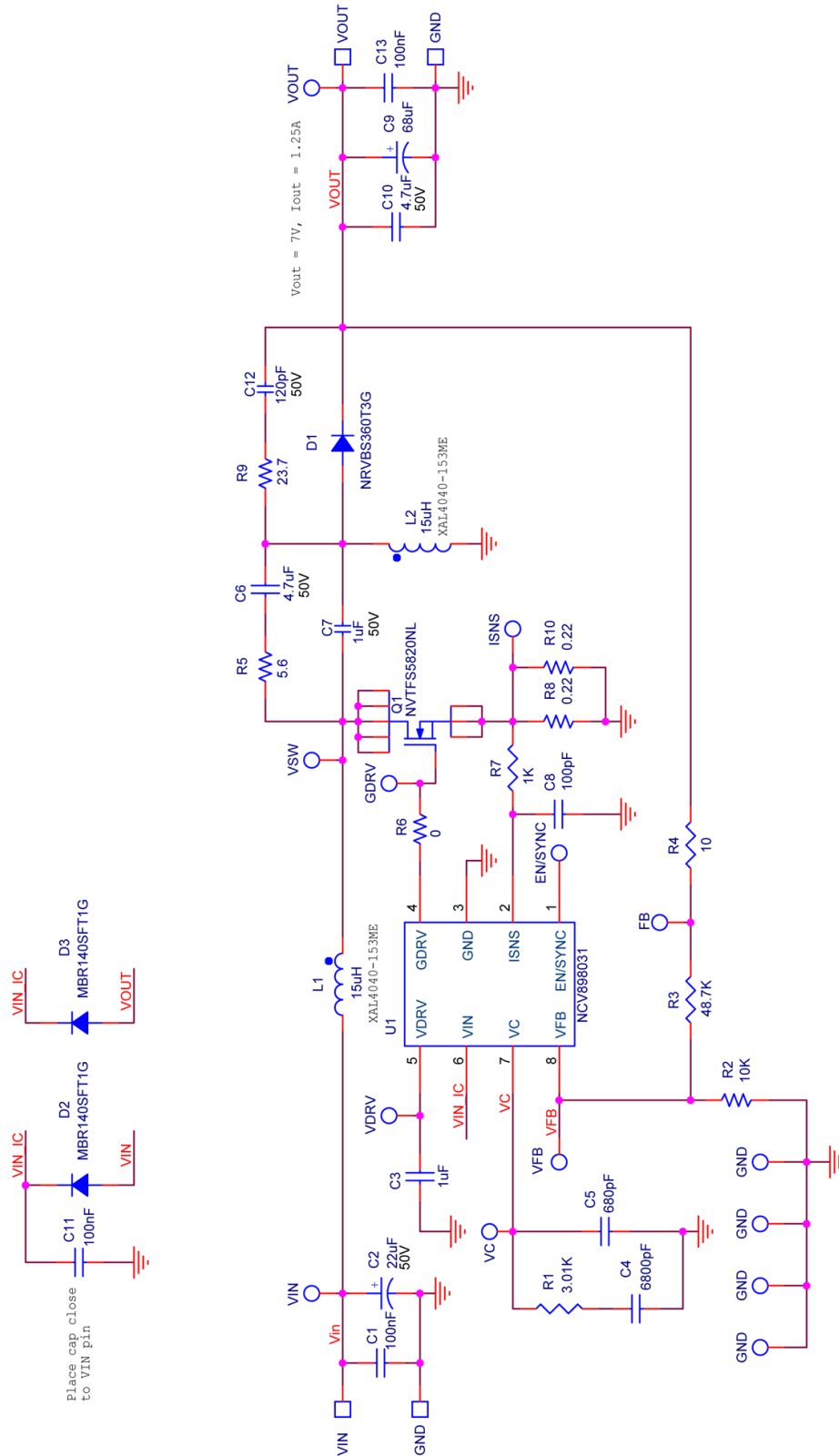


Figure 6. NCV898031 SEPIC Evaluation Board Schematic

# NCV898031SEPGEVB

**Table 4. BILL OF MATERIALS**

| Reference Designator(s)                                  | Quantity | Description                                          | Footprint     | Manufacturer's Part Number | Vendor Part #        |
|----------------------------------------------------------|----------|------------------------------------------------------|---------------|----------------------------|----------------------|
| C1, C11, C13                                             | 3        | CAP CER 0.1 $\mu$ F 50 V 10% X7R 0805                | 805           | GRM21BR71H104KA01L         | 490-1666-1-ND        |
| C2                                                       | 1        | CAP ALUM 10 $\mu$ F 50 V 20% RADIAL                  | CAP_RAD_5X11  | EKZE500ELL100ME07D         | 565-1702-ND          |
| C3                                                       | 1        | CAP CER 1 $\mu$ F 16 V 10% X7R 0603                  | 603           | GCM188R71C105KA64D         | 490-5241-1-ND        |
| C4                                                       | 1        | CAP CER 6800PF 50 V 10% X7R 0603                     | 603           | GRM188R71H682KA01D         | 490-1508-1-ND        |
| C5                                                       | 1        | CAP CER 680PF 50 V 5% NP0 0603                       | 603           | GRM1885C1H681JA01D         | 490-1447-1-ND        |
| C6, C10                                                  | 2        | CAP CER 4.7 $\mu$ F 50 V 10% X7R 1206                | 1206          | C3216X7R1H475K             | 445-8032-1-ND        |
| C7                                                       | 1        | CAP CER 1 $\mu$ F 50 V 10% X7R 1206                  | 1206          | GCM31MR71H105KA55L         | 490-4795-1-ND        |
| C8                                                       | 1        | CAP CER 100 pF 50 V 5% NP0 0603                      | 603           | GCM1885C1H101JA16D         | 490-4767-1-ND        |
| C9                                                       | 1        | CAP HYBRID CONDUCTIVE POLYMER<br>68 $\mu$ F 10 V 20% | SUNCON_6p6CAP | 10HVA68M                   | SUNCON               |
| C12                                                      | 1        | CAP CER 120 pF 50 V 5% NP0 0603                      | 603           | GRM1885C1H121JA01D         | 490-1429-1-ND        |
| D1                                                       | 1        | 60 V, 3.0 A Schottky Rectifier                       | SMC_DIODE     | NRVBS360T3G                | ON Semiconductor     |
| D2, D3                                                   | 2        | DIODE SCHOTTKY 40 V 1 A SOD123FL                     | SOD_123       | MBR140SFT1G                | ON Semiconductor     |
| L1, L2                                                   | 2        | High Temp SMT Power Inductor 15 $\mu$ H 2.8 A        | XAL4040       | XAL4040-153ME              | XAL4040-153ME        |
| Q1                                                       | 1        | N-CHANNEL MOSFET, LL, 60 V 11.5 m $\Omega$           | WDFN8         | NVTF55820NL                | ON Semiconductor     |
| R1                                                       | 1        | RES 3.01 k $\Omega$ 1/10 W 1% 0603 SMD               | 603           | CRCW06033K01FKEA           | 541-3.01KHCT-ND      |
| R2                                                       | 1        | RES 10.0 k $\Omega$ 1/10 W 1% 0603 SMD               | 603           | CRCW060310K0FKEA           | 541-10.0KHCT-ND      |
| R3                                                       | 1        | RES 48.7 k $\Omega$ 1/10 W 1% 0603 SMD               | 603           | CRCW060348K7FKEA           | 541-48.7KHCT-ND      |
| R4                                                       | 1        | RES 10.0 $\Omega$ 1/10 W 1% 0603 SMD                 | 603           | CRCW060310R0FKEA           | 541-10.0HCT-ND       |
| R5                                                       | 1        | RES 5.6 $\Omega$ 1/10 W 5% 0603 SMD                  | 603           | CRCW06035R60JNEA           | 541-5.6GCT-ND        |
| R6                                                       | 1        | RES 0.0 $\Omega$ 1/8 W 0805 SMD                      | 805           | CRCW08050000Z0EA           | 541-0.0ACT-ND        |
| R7                                                       | 1        | RES 1.00 k $\Omega$ 1/10 W 1% 0603 SMD               | 603           | CRCW06031K00FKEA           | 541-1.00KHCT-ND      |
| R8, R10                                                  | 2        | RES .22 $\Omega$ 1/3 W 1% 0805 SMD                   | 805           | RL1220S-R22-F              | CSR1206FK25L0TR-ND   |
| R9                                                       | 1        | RES 23.7 $\Omega$ 1/10 W 1% 0603 SMD                 | 603           | CRCW060323R7FKEA           | 541-23.7HCT-ND       |
| TP1, TP3, TP4,<br>TP7, TP8,<br>TP14, TP15,<br>TP16, TP17 | 9        | PIN INBOARD .042" HOLE 1000/PKG                      | TP            | K24C/M                     | V1055-ND             |
| TP2, TP5, TP6,<br>TP9                                    | 4        | CIRCUIT PIN PRNTD .020"D .425"L                      | SMALLTP       | 3128-2-00-15-00-00-08-0    | ED90324-ND           |
| TP10, TP11,<br>TP12, TP13                                | 4        | TERM SOLDER TURRET .219" .109"L                      | TURRET        | 2501-2-00-44-00-00-07-0    | 2501-200440000070-ND |
| U1                                                       | 1        | 2 MHz Non-Synchronous SEPIC/Boost<br>Controller      | SOIC8_N_ADJ   | NCV898031D1R2G             | ON Semiconductor     |

## TEST PROCEDURE

1. Connect a DC input voltage, within the 6 V to 40 V range, between  $V_{IN}$  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 7 V/1.22 A output power at a minimum input voltage of 6 V. The NCV898031  $V_{IN}$  has its operational voltage diode-oriented between the

converter output and input voltages. The converter turns-on typically at 6.7 V ( $V_{IN}$  rising). Once energized, the output voltage supplies power to the IC when the battery voltage is less than the IC  $V_{IN}$  input voltage. 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.

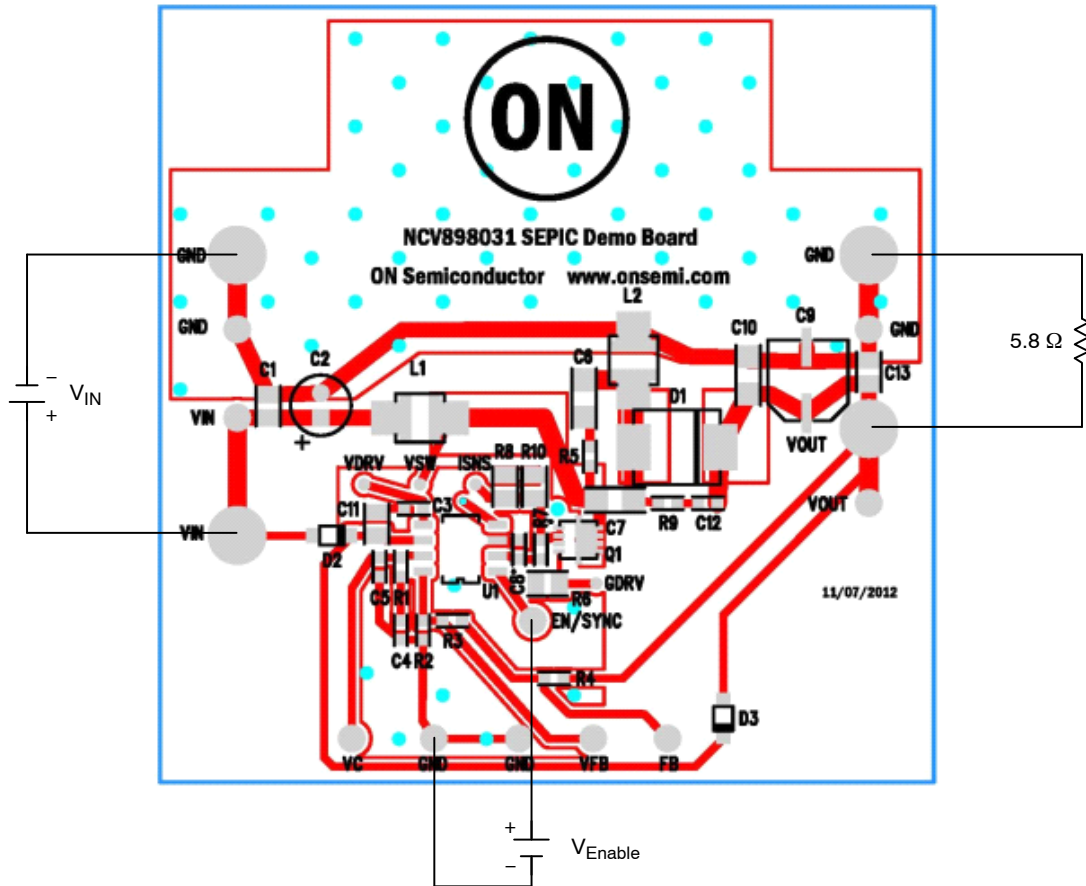


Figure 7. Evaluation Board Connections

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