

# NCV890430

## NCV890430 Evaluation Board User's Manual

### Description

The NCV890430 is a fixed-frequency Synchronous Buck regulator intended for Automotive, battery-connected applications that operate with up to a 45 V input supply. It is suitable for automotive systems requiring low noise and low shutdown currents that also need to operate at low input voltage close to the output voltage. A reset pin (with adjustable delay) simplifies interfacing with a microcontroller. This part also features an enable input that can either be connected to a low voltage (such as a micro-controller output) or high voltage (such as the battery input), and a synchronization input. The NCV890430 also provides several protection features expected in automotive



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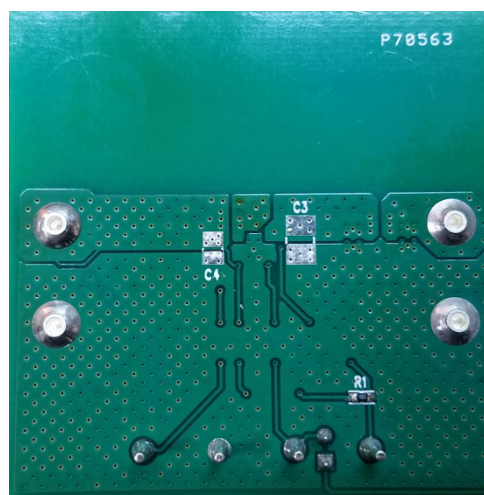
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### EVAL BOARD USER'S MANUAL

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 all-ceramic input and output filter capacitors – forming a space-efficient switching regulator solution.



Top Side



Bottom Side

**Figure 1. Evaluation Board Photo**

### Features and Benefits

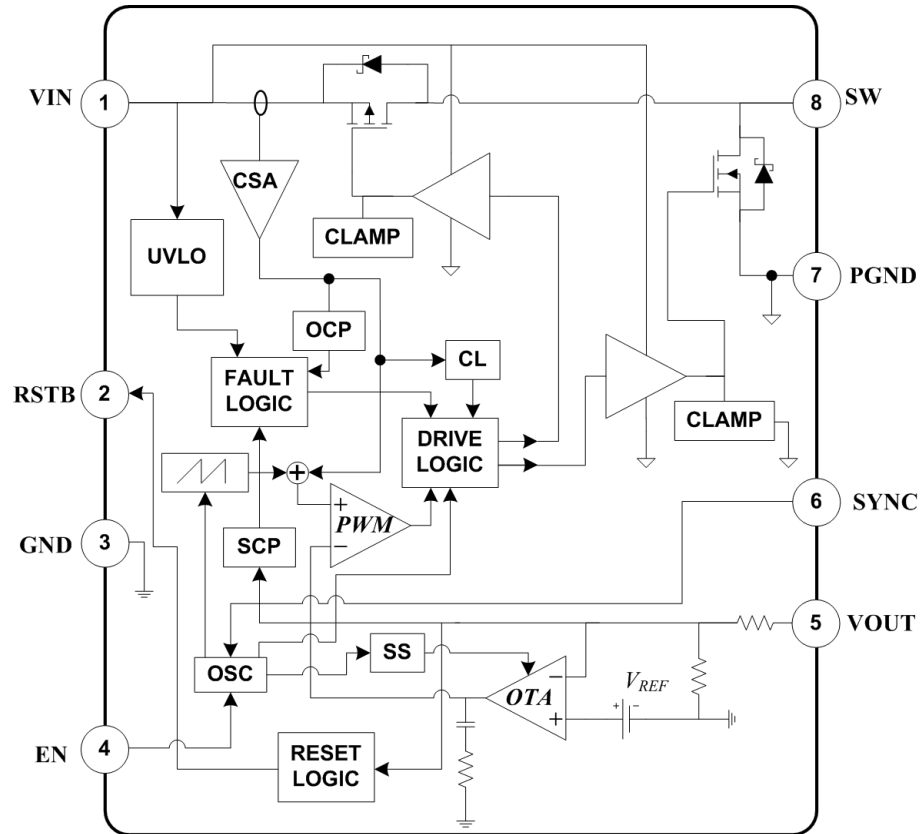
- Internal 550 mΩ P Channel and 300 mΩ N-Channel Power Switches
- Capable of 100% Duty Cycle Operation
- $V_{IN}$  Operating Range 3.5 V to 37 V, Withstands Load Dump to 45 V
- 2 MHz Free-running Switching Frequency
- Shutdown Current Less than 10  $\mu$ A
- High Voltage Enable Pin
- Synchronization Input Pin

- Maximum DC Output Current of at Least 0.6 A
- Fixed Output Voltages of 2.5 V, 3.3 V or 5.0 V with  $\pm 2\%$  Accuracy

### Typical Applications

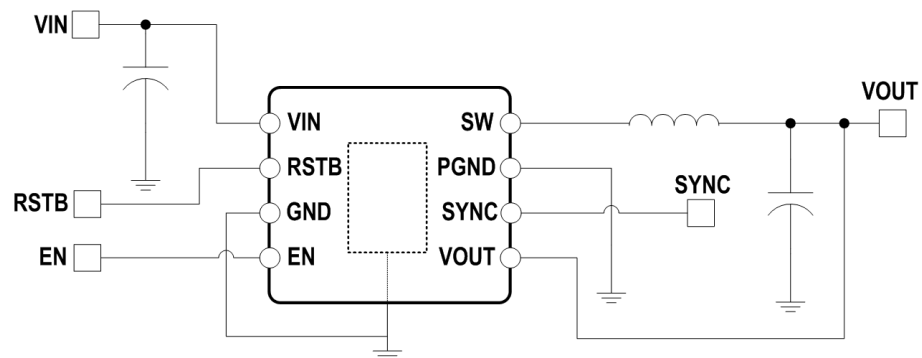
- Automotive Infotainment and Instrumentation
- Automotive Body Applications
- Linear Regulator Replacement
- Rear View Camera

### BLOCK DIAGRAM



### Figure 2. NCV890430 Simplified Block Diagram

## TYPICAL APPLICATION



### Figure 3. NCV890430 Typical Application Diagram

**Table 1. EVALUATION BOARD TERMINALS**

| Pin Number | Pin Name | Function                                                                                                                                                                                                       |
|------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1          | VIN      | Input voltage from battery. Place an input filter capacitor in close proximity to this pin.                                                                                                                    |
| 2          | RSTB     | Reset reporting flag. Open drain output, pulling down to ground when the output voltage is out of regulation. The value of the external pull-up resistor determines the delay time that the Reset is held low. |
| 3          | GND      | Analog ground reference – should be connected directly to the output capacitor ground and the exposed pad.                                                                                                     |
| 4          | EN       | Enable input. Connecting a “high” voltage (TTL compatible, battery voltage tolerant) to this pin turns on the regulator. A low voltage forces the part into a very low Iq shutdown mode.                       |
| 5          | VOOUT    | Output voltage sensing for regulation.                                                                                                                                                                         |
| 6          | SYNC     | Synchronization input. Connecting an external clock to this pin synchronizes switching to the rising edge of the SYNC signal.                                                                                  |

**Table 2. ABSOLUTE MAXIMUM RATINGS**

(Voltages are with respect to GND)

| Rating                            | Value       | Units |
|-----------------------------------|-------------|-------|
| DC supply voltage (VIN)           | –0.3 to 45  | V     |
| DC supply voltage (EN)            | –0.3 to 40  | V     |
| DC supply voltage (VOOUT)         | –0.3 to 18  | V     |
| DC supply voltage (SYNC and 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 CHARACTERISTICS**

| Characteristics                    | Conditions                               | Typical Value            | Units |
|------------------------------------|------------------------------------------|--------------------------|-------|
| <b>Regulation</b>                  |                                          |                          |       |
| Output Voltage (NCV890430MW25GEVB) |                                          | 2.5                      | V     |
| Output Voltage (NCV890430MW33GEVB) |                                          | 3.3                      | V     |
| Output Voltage (NCV890430MW50GEVB) |                                          | 5.0                      | V     |
| <b>Switching</b>                   |                                          |                          |       |
| Switching Frequency                |                                          | 2.0                      | MHz   |
| Soft-start Time                    |                                          | 1.4                      | ms    |
| Synchronization Frequency Range    | 2.5 V version<br>3.3 V and 5.0 V version | 1.8 to 2.2<br>1.8 to 2.5 | MHz   |
| <b>Current Limit</b>               |                                          |                          |       |
| Peak Current Limit                 |                                          | 1.9                      | A     |
| <b>Protections</b>                 |                                          |                          |       |
| Input Undervoltage Lockout (UVLO)  | V <sub>IN</sub> decreasing               | 3.2                      | V     |
| Input Overvoltage Protection       | V <sub>IN</sub> increasing               | 37                       | V     |
| Thermal Shutdown                   | T <sub>J</sub> 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.

### Quick-Start Guide

The following steps will get you familiar with the setup of inputs and outputs of the NCV890430.

#### Required Equipment

|                                               |             |
|-----------------------------------------------|-------------|
| 1 DC Source – $\geq 40$ V, $\geq 2$ A capable | VIN         |
| 1 Oscilloscope – 2 Channel minimum            | VOUT and SW |
| 1 Multi-meter                                 | VOUT        |
| 1 DC Electronic Load – 1 A capable            | ILOAD       |

1. Disconnect the EN jumper.
2. Connect DC source set to 13.2 V DC between the VIN and GND terminals in the center left of the evaluation board.
3. Connect a multi-meter or oscilloscope probe between the VOUT and GND terminals located in the center right of the evaluation board.
4. Connect the EN jumper between VIN to the EN input.

Verify that VOUT is:

- a.) 2.5 V  $\pm 2\%$  for NCV890430MW25GEVB
  - b.) 3.3 V  $\pm 2\%$  for NCV890430MW33GEVB
  - c.) 5.0 V  $\pm 2\%$  for NCV890430MW50GEVB
5. Apply a 600 mA load to VOUT.
    - a.) Verify that VOUT is at the necessary regulated voltage.
    - b.) Place a scope probe tip on the SW side of L1. It should show a stable 2 MHz pulsed waveform with amplitude approximately between VIN and GND.

waveform with amplitude approximately between VIN and GND.

6. While at load, increase VIN to 21 V.  
Verify that the SW signal now shows a stable 1 MHz pulsed waveform with amplitude approximately between VIN and GND.
7. Increase VIN to 39 V.  
Verify the switching regulator turns off and there is 0 V at VOUT.
8. Reduce VIN to 13.2 V.  
Verify that VOUT is restored to the necessary regulated voltage and that the SW signal returns to a 2 MHz pulsed waveform with amplitude approximately between VIN and GND.
9. Remove the jumper between VIN the EN input.  
Verify the switching regulator turns off and there is 0 V at VOUT.
10. Disconnect all external connections from the board and restore the EN jumper.

#### Soft Start

The NCV890430 contains a battery-connectable EN pin for the regulator. A common setup includes the following connections:

EN  $\rightarrow$  VIN

When the EN connection on the board is as shown above, the following startup profile can be seen on an oscilloscope:

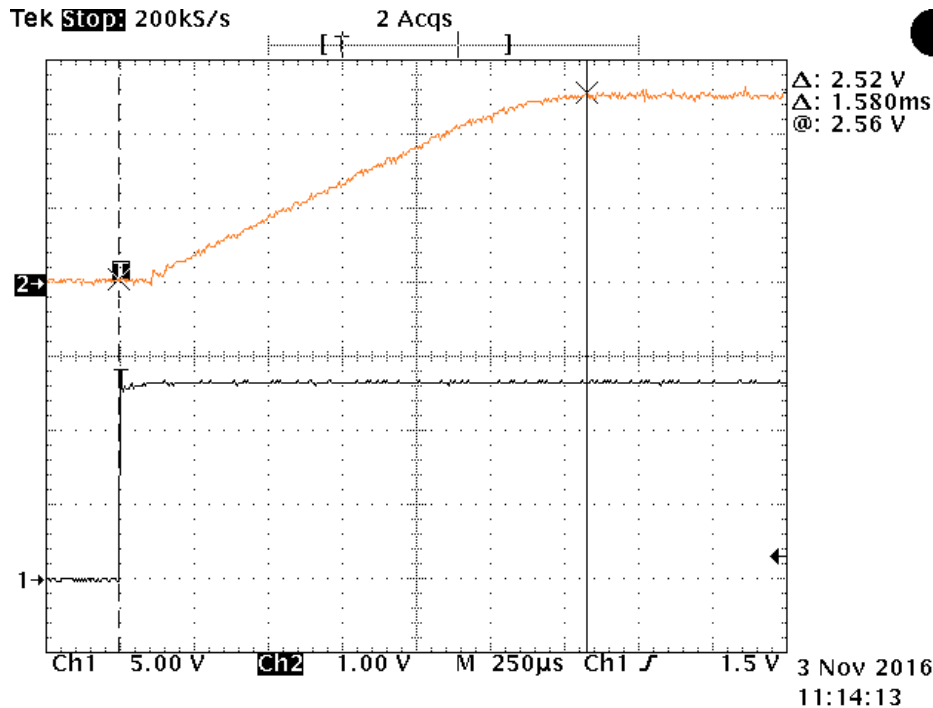


Figure 4. Typical NCV890430 Startup Profile

## EMI Filter

In a typical application, an LC filter is used on the input line of a buck regulator to filter EMI from the device. On this demo board, an LC filter is pre-populated to allow you to perform EMI testing directly with this demo board.

LF1: 1.0  $\mu$ H  
CF1: 0.1  $\mu$ F

An input filter can drastically reduce the emissions from a switching regulator.



Figure 5. LC Filter on VIN Line

Efficiency

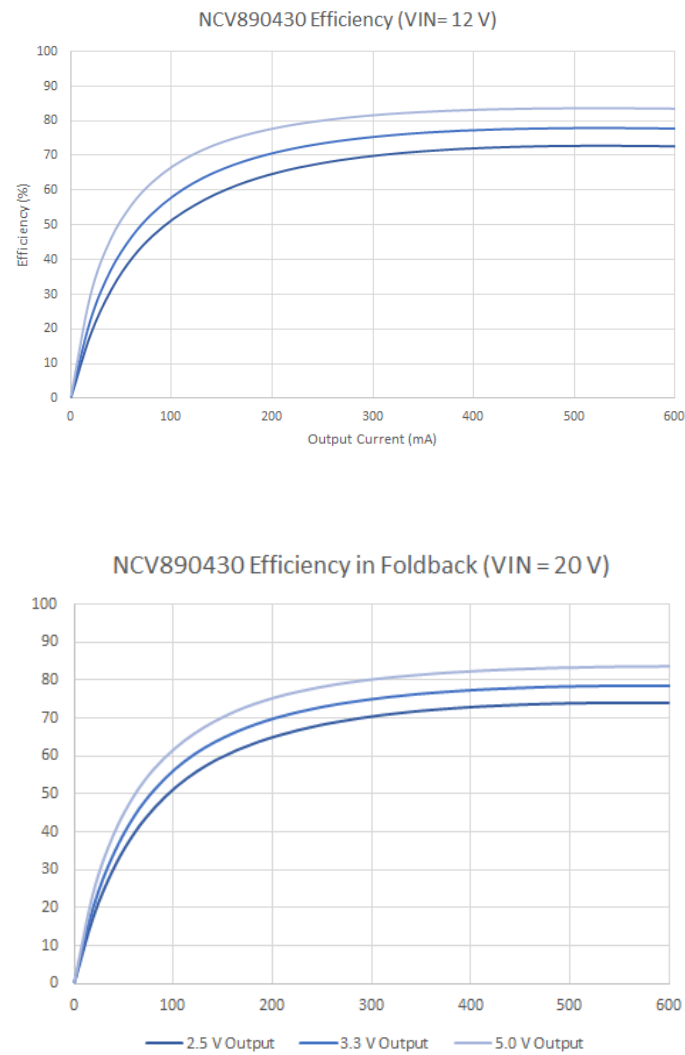


Figure 6. NCV890430 Efficiency Curves

SCHEMATIC

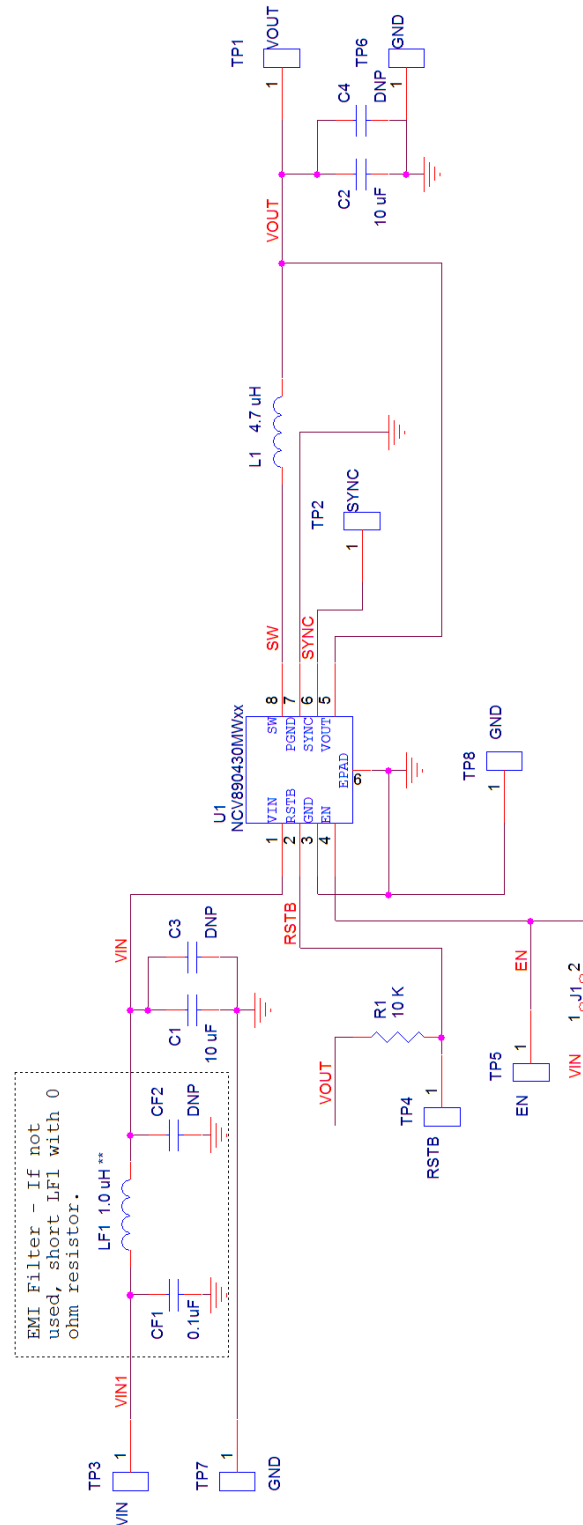


Figure 7. NCV890430MWxxGEVB Evaluation Board Schematic – Rev.1

# NCV890430

## PCB LAYOUT

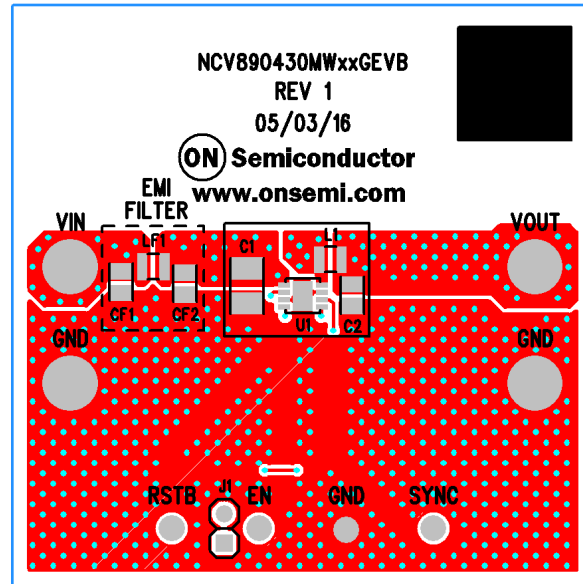


Figure 8. NCV890430MWxxGEVB PCB Layout – Top

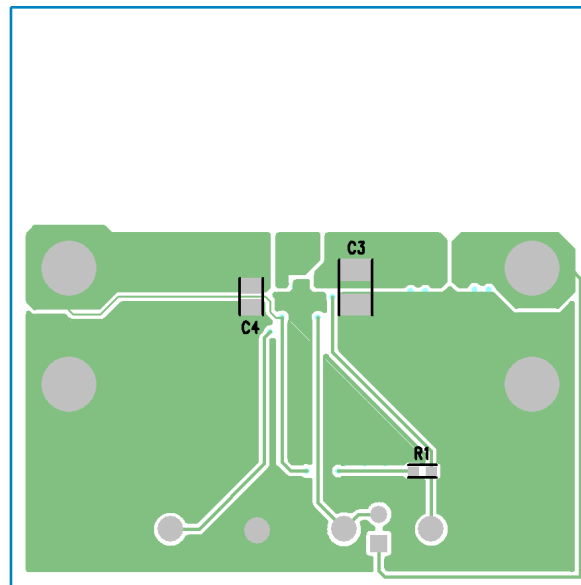


Figure 9. NCV890430MWxxGEVB PCB Layout – Bottom (mirrored)

All evaluation board PCB layouts are identical with the exception of TOP Silkscreen and device mounted upon them.



## BILL OF MATERIALS

Table 4. BILL OF MATERIALS

| Reference Designator(s) | Qty | Description                                    | Value       | Tolerance | Footprint        | Manufacturer                     | Manufacturer's Part Number |
|-------------------------|-----|------------------------------------------------|-------------|-----------|------------------|----------------------------------|----------------------------|
| C1                      | 1   | CAP CER 10UF 50V 10% X7R 1210                  | 10 $\mu$ F  | 10%       | 1210             | Taiyo Yuden                      | UMK325AB7106KM-T           |
| C3                      | 1   | CAP CER 10UF 50V 10% X7R 1210                  | 10 $\mu$ F  | 10%       | DNP              | Taiyo Yuden                      | UMK325AB7106KM-T           |
| C2                      | 1   | CAP CER 10UF 10V 10% X7R 0805                  | 10 $\mu$ F  | 10%       | 805              | Murata Electronics North America | GRM21BR71A106KE51L         |
| C4                      | 1   | CAP CER 10UF 10V 10% X7R 0805                  | 10 $\mu$ F  | 10%       | DNP              | Murata Electronics North America | GRM21BR71A106KE51L         |
| CF1                     | 1   | CAP CER 0.1UF 50V 10% X7R 0805                 | 0.1 $\mu$ F | 10%       | 805              | Murata Electronics North America | GCM21BR71H104KA37K         |
| CF2                     | 1   | CAP CER 0.1UF 50V 10% X7R 0805                 | 0.1 $\mu$ F | 10%       | DNP              | Murata Electronics North America | GCM21BR71H104KA37K         |
| L0                      | 1   | FIXED IND 1UH 2.5A 75 MOHM SMD                 | 1.0 $\mu$ H | 30%       | WURTHSMA LL SMDL | Wurth Electronics Inc            | 78438323010                |
| L1                      | 1   | FIXED IND 4.7UH 940MA 388 MOHM                 | 4.7 $\mu$ H | 30%       | WURTHSMA LL SMDL | Wurth Electronics Inc            | 78438323047                |
| R1                      | 1   | RES 10.0K OHM 1/10W 1% 0603 SMD                | 10.0 K      | 1%        | 603              | Vishay/Dale                      | CRCW060310K0FKEA           |
| GND1, GND2, VIN1, VOUT  | 4   | TERM SOLDER TURRET .219" .109"L                | N/A         | N/A       | TURRET           | Mill-Max Manufacturing Corp.     | 2501-2-00-44-00-00-07-0    |
| J1                      | 1   | DIODE SCHOTTKY 4.0A 40V SMB                    | N/A         | N/A       | JMP              | Molex Connector Corporation      | 22-28-4023                 |
|                         | 1   | DIODE SWITCH 200MA 100V SOD323                 | N/A         | N/A       |                  | Sullins Connector Solutions      | SSC02SYAN                  |
| EN, GND3, RSTB, SYNC    | 4   | High Current Shielded Inductor 1.0uH, 8.7A SAT | N/A         | N/A       | TP               | Vector Electronics               | K24C/M                     |
| U1                      | 1   | High Current Shielded Inductor 2.2uH, 5.6A SAT | N/A         | N/A       | 8PINDFNP 65      | ON Semiconductor                 | NCV890430MWxxTXG           |

\*The Bills of Materials for all three evaluation boards covered in this user's manual are identical with the exception of the mounted device. This can be either NCV890430MW25TXG, NCV890430MW33TXG, or NCV890430MW50TXG.

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