

# NCS35011 Evaluation Board User's Manual

## NCS35011EVK

### Introduction

This user's manual provides information regarding the configuration and method to test the NCS35011 IC. The evaluation board serves as a demonstration of NCS35011 general functionality. NCS35011 manages lithium-ion batteries from 3 to 5 cells in series with accurate battery indication through 3 to 5 LED outputs. Each cell in the battery pack is monitored for an over-voltage (OV) and

under-voltage (UV) condition. Upon detecting an over-voltage, the ODI pin will assert indicating a fault condition and stay asserted until the fault is cleared. During an under voltage condition, the UDI pin will also assert indicating the fault but will have a pulse width that is pre-set in the protector. Both OV and UV detections have a hard coded pre-set delay time before fault indication.

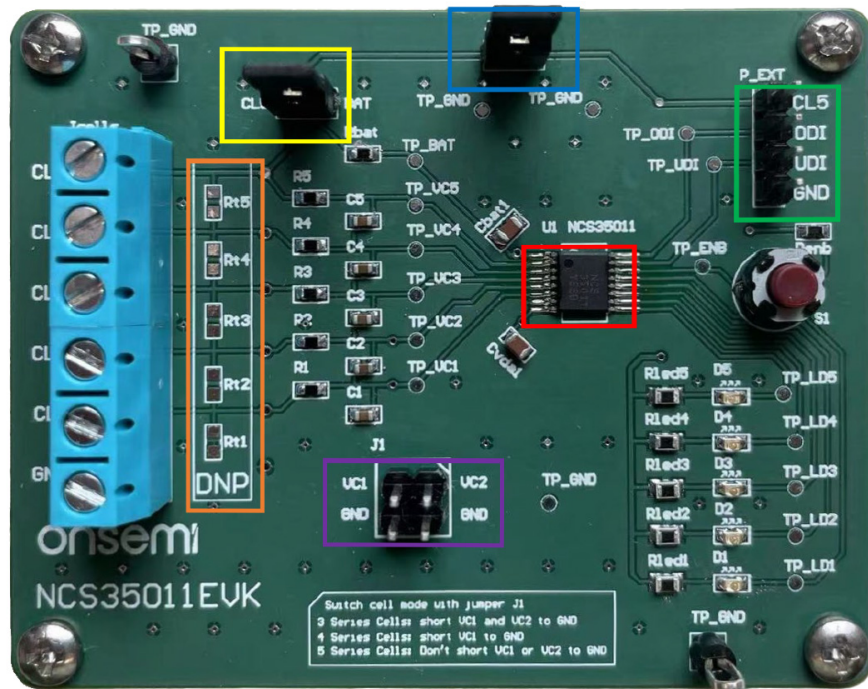


Figure 1. NCS35011 Evaluation Board

### Features

- Over-Voltage (OV) and Under-Voltage (UV) Detection
- Protection for 3, 4 and 5 Series Cells
- State of Charge (SoC) Indication with High Voltage Tolerant LEDs for 3, 4, and 5 LED Options
- Configurable Fault Outputs (Push-Pull or Open Drain Active High or Low)
- High-Accuracy Voltage Measurement  $\pm 5$  mV
- Low Power Consumption  $I_{CC} = 4 \mu A$
- Input BAT Voltage Range 4 V to 25 V, Tolerant to 65 V for Increased Immunity to Surge
- Extended Junction Temperature Range to 125°C

### Quick Start

#### Recommended Setup

Before beginning, the following setup is needed:

- DC power supplies to generate the battery cell voltages.
- A single DC power supply and five SMD (Rt1–Rt5) or external test resistors to generate the voltage divided cell voltages.
- Two external Pull-up resistors for UDI and ODI pin open-drain configuration test.
- Function generator to generate the cell level over voltage or under voltage.
- Oscilloscope.
- Digital Multi-meter.

# NCS35011EVK

## Board Setup

### Step 1:

Identify the NCS35011 configurations. Depending on the IC trim, a different **J1** (see **Purple** boxed area in Figure 1) configuration may be required to short the corresponding VC pins to GND to create the 3, 4, or 5 series cells test mode.

### Step 2:

Identify the NCS35011 ODI and UDI pin configurations. If IC is configured as Open-drain, external pull-up resistors are needed to connect between CL5 and ODI/UDI (see **Green** boxed area in Figure 1). It is recommended to limit the UDI and ODI current less than 5 mA.

### Step 3:

**Jcells** jumper is the connector for external power or battery connection. Battery cell voltages can be generated through

multiplier DC power supplies or SMD 0603 resistors Rt1 – Rt5 (see **Orange** boxed area in Figure 1) to create the voltage divided cell voltages.

### Step 4:

**JBAT** jumper (see **Yellow** boxed area in Figure 1) allow user to measure the quiescent current into the IC BAT pin; **J0** jumper (**Blue** boxed area) allow user to measurement current through all the LEDs.

### Step 5:

SMD test points (TP\_BAT, TP\_VC5, TP\_VC4, TP\_VC3, TP\_VC2, TP\_VC1, TP\_GND, TP\_LD1, TP\_LD2, TP\_LD3, TP\_LD4, TP\_LD5, TP\_ENB, TP\_UDI, and TP\_ODI) allow user to probe and measure each IC pins voltage. Refer to the schematic and layout diagrams found in Figure 2 and Figure 3 respectively as needed.

**Figure 2. NCS35011 Evaluation Board Schematic**

# NCS35011EVK

## Layout Diagram

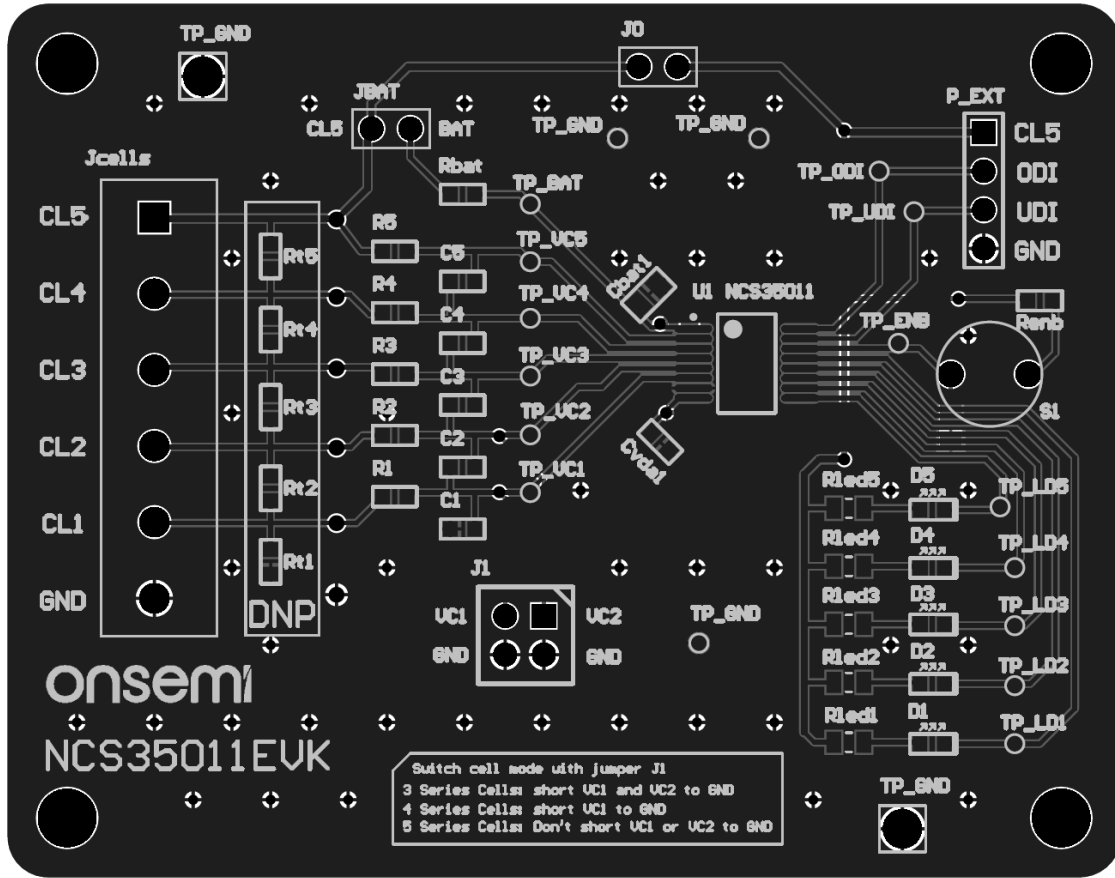


Figure 3. NCS35011 Evaluation Board Layout

Table 1. BILL OF MATERIALS

| Quantity | Designator | Part Number      | Value            | Footprint    |
|----------|------------|------------------|------------------|--------------|
| 1        | U1         | NCS35011         |                  | TSSOP16      |
| 1        | S1         | MCR08MT1G        | Switch           | SW-PB        |
| 5        | D1-5       | APTD1608LZGCK    | Green LED        | 0603         |
| 5        | C1-5       | Capacitor        | 0.1 $\mu$ F 35 V | 0603         |
| 1        | Cbat1      | Capacitor        | 0805 70/100 V    | 0805 /1206   |
| 1        | Cvda1      | Capacitor        | 1 $\mu$ F 6 V    | 0603         |
| 6        | R1-5, Rbat | Resistor         | 1 k              | 0603         |
| 1        | Renb       | Resistor         | 10 k             | 0603         |
| 5        | Rled1-5    | Resistor         | 12 k             | 0805         |
| 1        | Jcells     | TB002-500-06BE   | Terminal block   |              |
| 1        | JBAT, J0   | Header Connector | 1 x 2            |              |
| 1        | J1         | Header Connector | 2 x 2            |              |
| 1        | P_EXT      | Header Connector | 1 x 4            |              |
| 2        | TP_GND     | Test Loop        |                  | Through Hole |

**onsemi**, **onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

The evaluation board/kit (research and development board/kit) (hereinafter the "board") is not a finished product and is not available for sale to consumers. The board is only intended for research, development, demonstration and evaluation purposes and will only be used in laboratory/development areas by persons with an engineering/technical training and familiar with the risks associated with handling electrical/mechanical components, systems and subsystems. This person assumes full responsibility/liability for proper and safe handling. Any other use, resale or redistribution for any other purpose is strictly prohibited.

**THE BOARD IS PROVIDED BY ONSEMI TO YOU "AS IS" AND WITHOUT ANY REPRESENTATIONS OR WARRANTIES WHATSOEVER. WITHOUT LIMITING THE FOREGOING, ONSEMI (AND ITS LICENSORS/SUPPLIERS) HEREBY DISCLAIMS ANY AND ALL REPRESENTATIONS AND WARRANTIES IN RELATION TO THE BOARD, ANY MODIFICATIONS, OR THIS AGREEMENT, WHETHER EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY AND ALL REPRESENTATIONS AND WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, AND THOSE ARISING FROM A COURSE OF DEALING, TRADE USAGE, TRADE CUSTOM OR TRADE PRACTICE.**

**onsemi** reserves the right to make changes without further notice to any board.

You are responsible for determining whether the board will be suitable for your intended use or application or will achieve your intended results. Prior to using or distributing any systems that have been evaluated, designed or tested using the board, you agree to test and validate your design to confirm the functionality for your application. Any technical, applications or design information or advice, quality characterization, reliability data or other services provided by **onsemi** shall not constitute any representation or warranty by **onsemi**, and no additional obligations or liabilities shall arise from **onsemi** having provided such information or services.

**onsemi** products including the boards are not designed, intended, or authorized for use in life support systems, or any FDA Class 3 medical devices or medical devices with a similar or equivalent classification in a foreign jurisdiction, or any devices intended for implantation in the human body. You agree to indemnify, defend and hold harmless **onsemi**, its directors, officers, employees, representatives, agents, subsidiaries, affiliates, distributors, and assigns, against any and all liabilities, losses, costs, damages, judgments, and expenses, arising out of any claim, demand, investigation, lawsuit, regulatory action or cause of action arising out of or associated with any unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of any products and/or the board.

This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and may not meet the technical requirements of these or other related directives.

**FCC WARNING** – This evaluation board/kit is intended for use for engineering development, demonstration, or evaluation purposes only and is not considered by **onsemi** to be a finished end product fit for general consumer use. It may generate, use, or radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment may cause interference with radio communications, in which case the user shall be responsible, at its expense, to take whatever measures may be required to correct this interference.

**onsemi** does not convey any license under its patent rights nor the rights of others.

**LIMITATIONS OF LIABILITY:** **onsemi** shall not be liable for any special, consequential, incidental, indirect or punitive damages, including, but not limited to the costs of requalification, delay, loss of profits or goodwill, arising out of or in connection with the board, even if **onsemi** is advised of the possibility of such damages. In no event shall **onsemi**'s aggregate liability from any obligation arising out of or in connection with the board, under any theory of liability, exceed the purchase price paid for the board, if any.

The board is provided to you subject to the license and other terms per **onsemi**'s standard terms and conditions of sale. For more information and documentation, please visit [www.onsemi.com](http://www.onsemi.com).

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at [www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)