# ACT4911EVK1-301User's Guide

## Description

This document describes the characteristic and operation of the Active Semi ACT4911EVK1QW301 evaluation kit (EVK). It provides setup and operation instructions, schematic, layout, BOM, and test data. This EVK demonstrates the ACT4911QW301eFuse power management IC. Other ACT4911QWxxx options can be evaluated on this EVK by replacing the IC and any other necessary components.

## Features

The EVK can be used as a standalone board if desired. However, to access the internal registers and to take full advantage of the IC's capability, the user must connect the EVK kit to a PC with Active Semi's USB-TO-I2C interface dongle and use the GUI software. The EVK provides full access to each converter's input and output voltage, as well as all the digital control signals. This gives the user the flexibility to configure the EVK to match their real-world system. Note that the ACT4911EVK1-301 is specifically configured for the ACT4911QW301 IC.

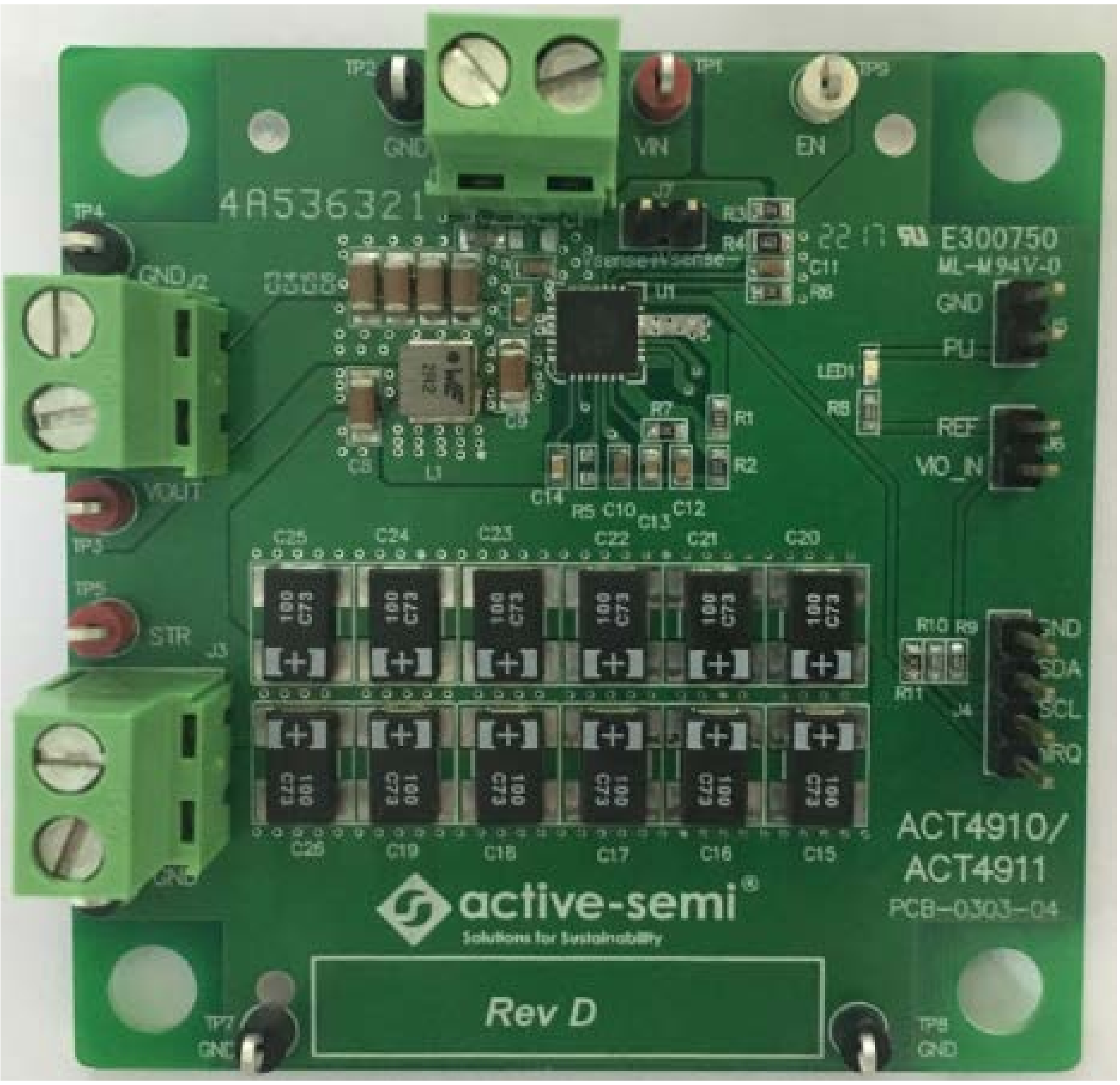


**Figure 1 – EVK Picture**

# Setup

## Required Equipment

ACT4911 EVK

USB-TO-I2C Dongle

Power supply – 3.3V @ 5A for full power operation

Oscilloscope – >100MHz, >2 channels

Loads – Electronic or resistive.  4A minimum current capability.

Digital Multimeters (DMM)

Windows compatible computer with spare USB port.

# EVK Setup

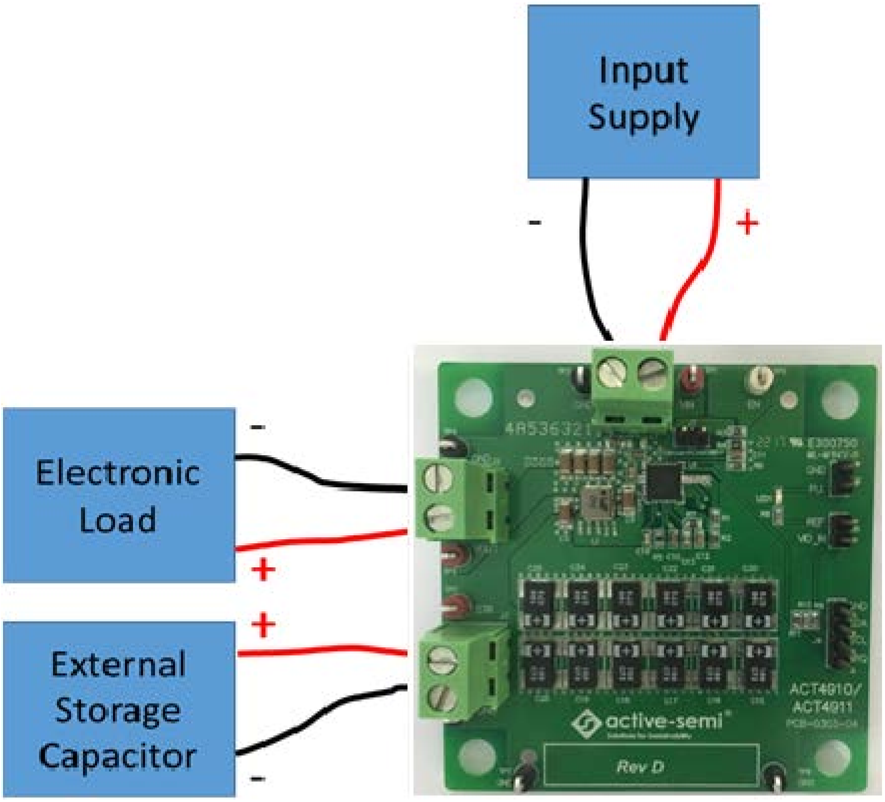



**Figure 2 – EVK Setup**

## Hardware Setup

1. If using I2C, ensure that a shorting jumper is placed across J6 to provide a pullup voltage.
2. Connect a lab supply to J1.
3. Connect an appropriate load to J2.

## GUI Setup (optional)

1. Refer to the end of this document for detailed instructions to install the ACT4911 GUI.
2. Connect the USB-TO-I2C dongle to the computer via a USB cable.
3. Connect the USB-TO-I2C dongle to the EVK J4 connector. Refer to Figure 3 to ensure the correct polarity of the connection. As a guide, use the "Active-Semi" logo on the top of the dongle so the black wire is connected toward the lower left corner of the Dongle.

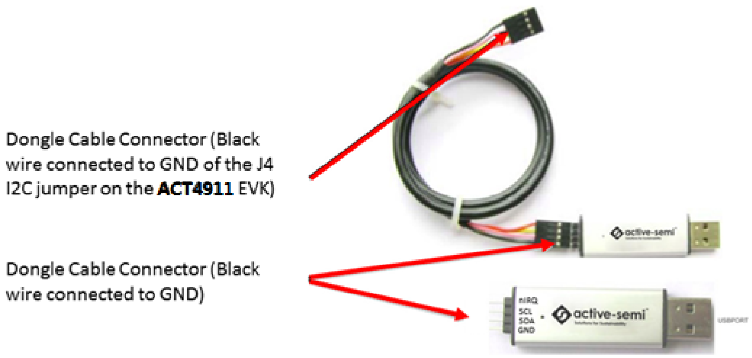



**Figure 3 – USB-TO-I2C Dongle Connection**

## EVK Design Parameters

The ACT4911EVK1-301 is designed for a 3.3V input voltage. The maximum operating voltage is determined by the IC's maximum input voltage rating. The minimum operating voltages are determined by the buck converters' minimum input voltage and by the LDOs' dropout voltages. Maximum currents are determined by the IC's CMI settings, which can be changed via I2C after startup.

**Table 1. EVK Design Parameters**

| Parameter | Description | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| VIN | eFuse input voltage | | 3.3 | | V |
| $I_{OUT}$ | Load current | | 2 | | A |
| $I_{CL}$ | eFuse current limit | | 3.5 | | A |
| $V_{STR}$ | Storage voltage | | 12 | | V |
| EN_UV | Input voltage falling threshold to start supplement mode | | 3.05 | | |
| VBuck | Buck output voltage in supplement mode | | 3.15 | | |
| $T_{softstart}$ | Softstart time | | 20 | | ms |
| $T_{holdup}$ | Supplement mode holdup time | | 3 | | ms |

## Jumpers and Connectors

J1 – Input voltage to the EVK.
J2 – Output power from the EVK. This is the system load.
J3 – Additional storage capacitor connector. This connector allows additional storage capacitors to be easily added for evaluation
J4 – I2C connector. Connect to the Active Semi USB-TO-GPIO dongle or to any other I2C communication device.
J5 – PLI output. This allows easy access the PLI or PG_STR pin.
J6 – I2C pullup voltage source. Place a shorting jumper across J6 to pullup the I2C lines to the IC REF voltage. An external voltage may be applied to J6-2 if desired.
J7 – eFuseRdson measurement. This connector provides easy to access Kelvin connections to measure the eFuseRdson. Do not use J7 to apply power to the EVK or as an output connector for the load.

## EVK Operation

### Turnon

The EVK is preconfigured and ready to use. Apply the 3.3V input voltage and the EVK automatically powers, charges the storage capacitors, and delivers power to the load. No modifications are needed to start evaluating the ACT4911's many functions such as supplement mode, ADC measurements, current limiting, etc.

## Modifications

The EVK is designed to allow the user to immediately start evaluating the ACT4911 functionality. After the user becomes familiar with the EVK functionality and has verified that they can reproduce the performance data, they can easily modify the EVK to match their specific system level requirements. Refer to the ACT4911 datasheet for detailed design equations.

#### PLI vs PG_STR Functionality

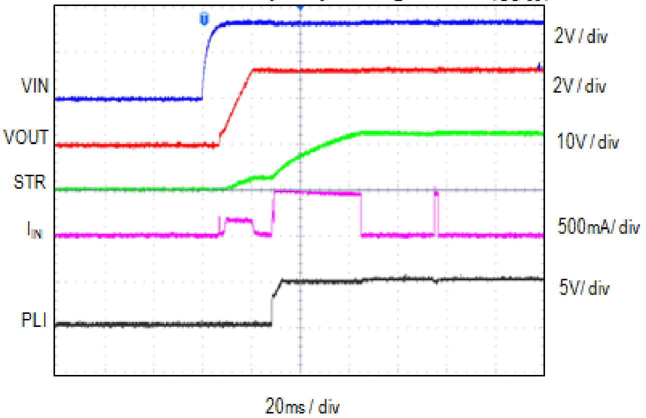
The ACT4911 default setting for pin 2is for the PLI functionality. If the user changes this functionality to the PG_STR function, populate R8 with a 2.2kohm resistor to enable LED1 to turn on when PG_STR goes low.

#### Input Snubber

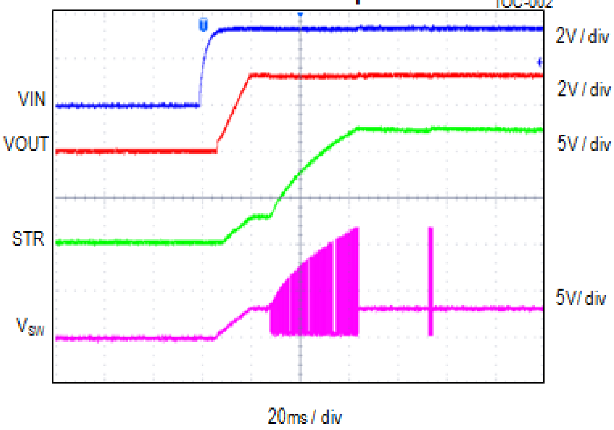
The EVK contains a non-populated input snubber. If testing with long, inductive cables, populating the snubber with the appropriate values will reduce overshoot when the input is hot plugged. 1nF and 10Ω are good starting points.

## Test Results

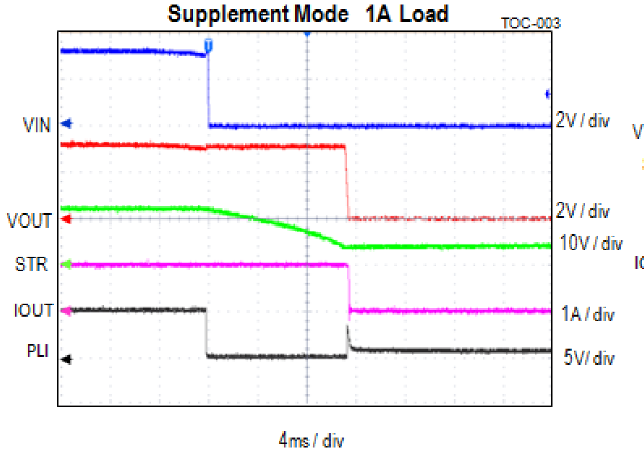
CMI 301
Startup Sequencing



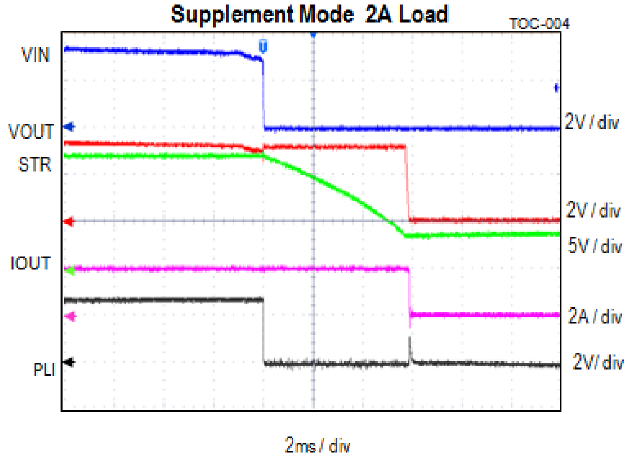

CMI 301
Boost Startup



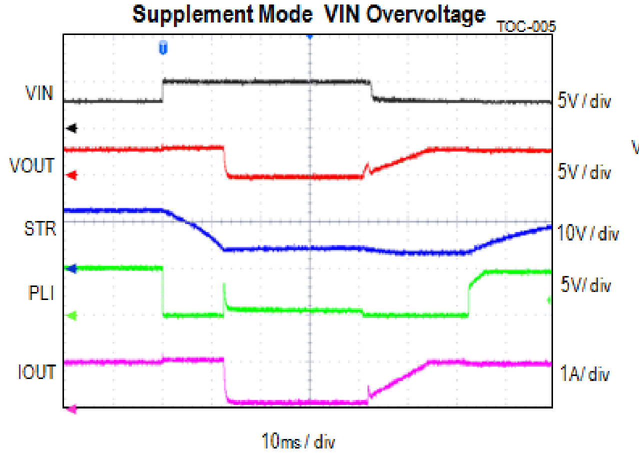

CMI 301
Supplement Mode 1A Load



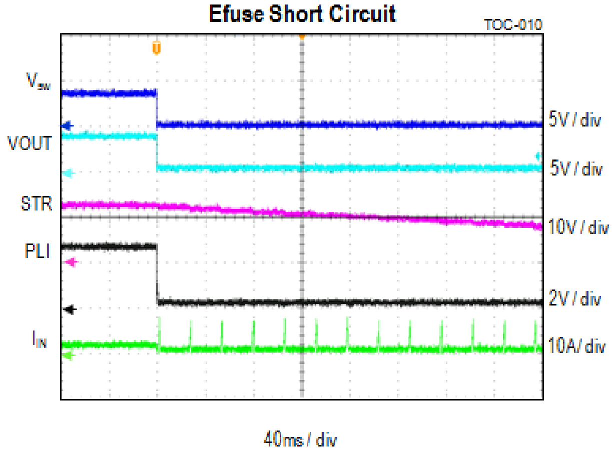

CMI 301
Supplement Mode 2A Load




CMI 301
Supplement Mode VIN Overvoltage

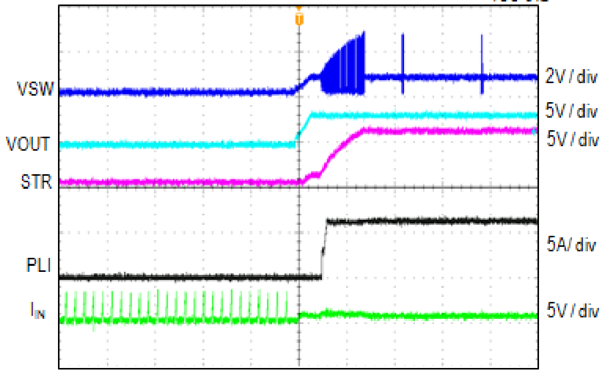



CMI 301
Efuse Short Circuit



**CMI 301**
**eFuse Short Circuit Recovery**

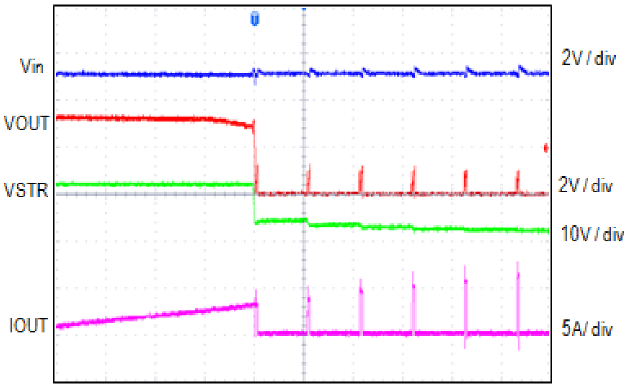
TOC-012




40ms / div

**CMI 301**
**Efuse Over Current**

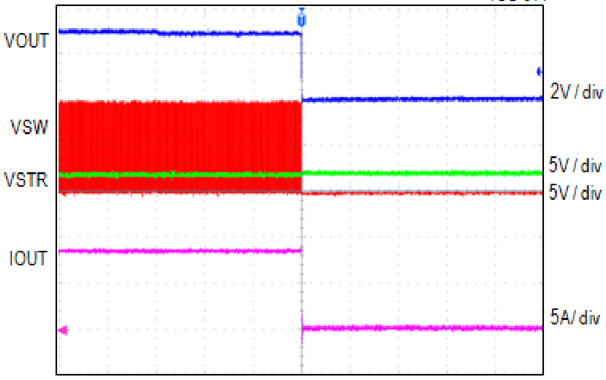
TOC-013




100ms / div

**CMI 301**
**Buck Over Current**

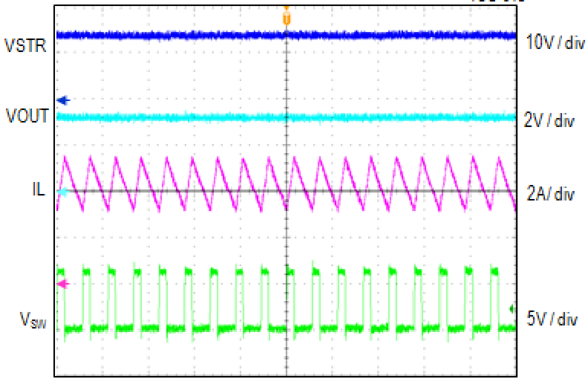
TOC-014




4ms / div

**CMI 301**
**Switching Waveforms**

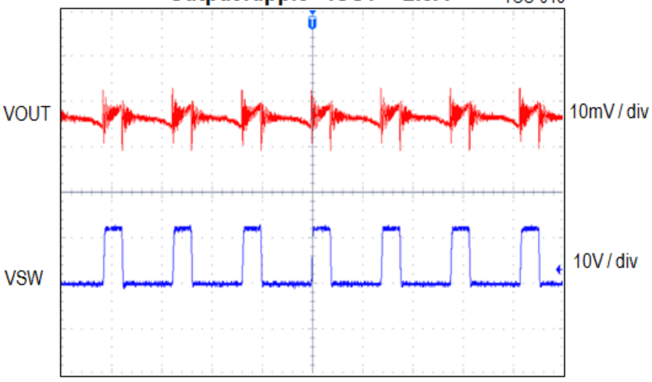
TOC-015




2us / div

**CMI 301**
**Output Ripple IOUT = 2.5A**

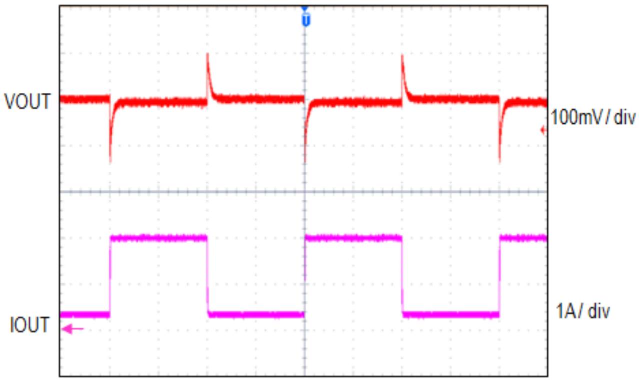
TOC-016



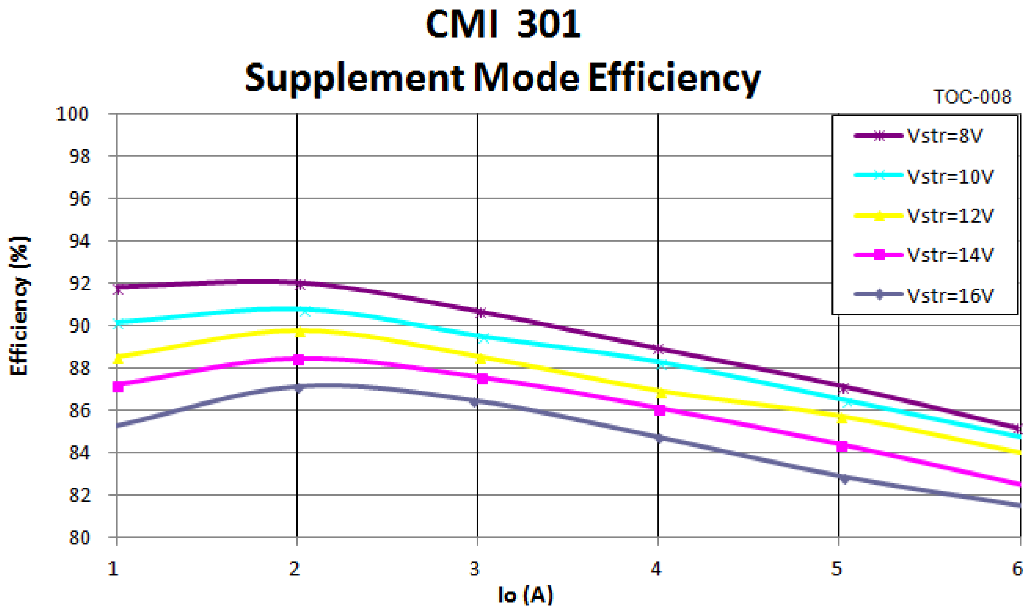

800ns / div

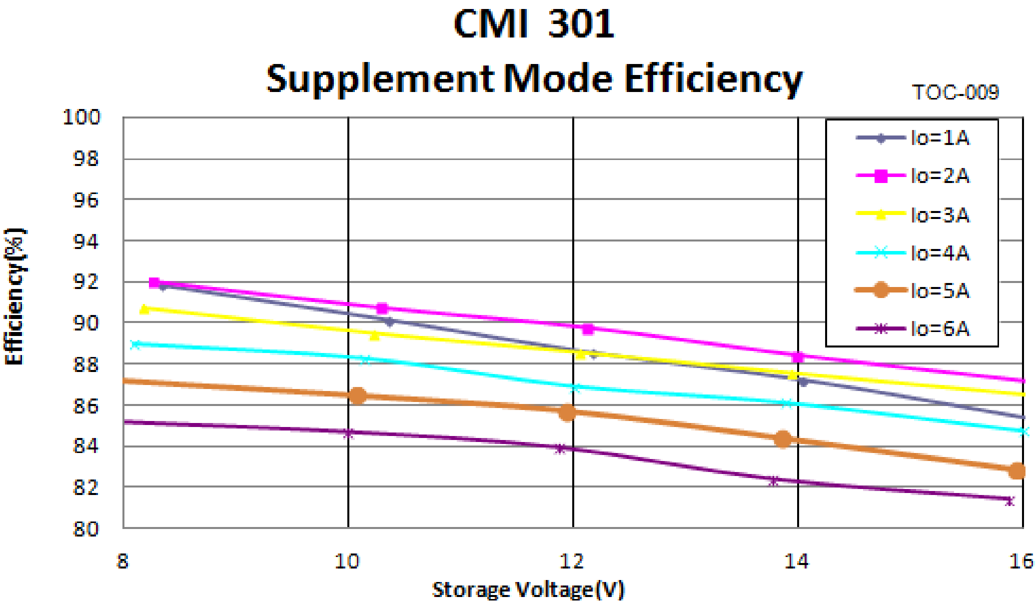
**CMI 301**
**Buck Load Transient**

TOC-017




2ms / div


CMI 301
Supplement Mode Efficiency
TOC-008
Efficiency (%)
100
98
96
94
92
90
88
86
84
82
80
1
2
3
4
5
6
Io (A)
Vstr=8V
Vstr=10V
Vstr=12V
Vstr=14V
Vstr=16V


CMI 301
Supplement Mode Efficiency
TOC-009
Efficiency(%)
100
98
96
94
92
90
88
86
84
82
80
8
10
12
14
16
Storage Voltage(V)
Io=1A
Io=2A
Io=3A
Io=4A
Io=5A
Io=6A

## Schematic

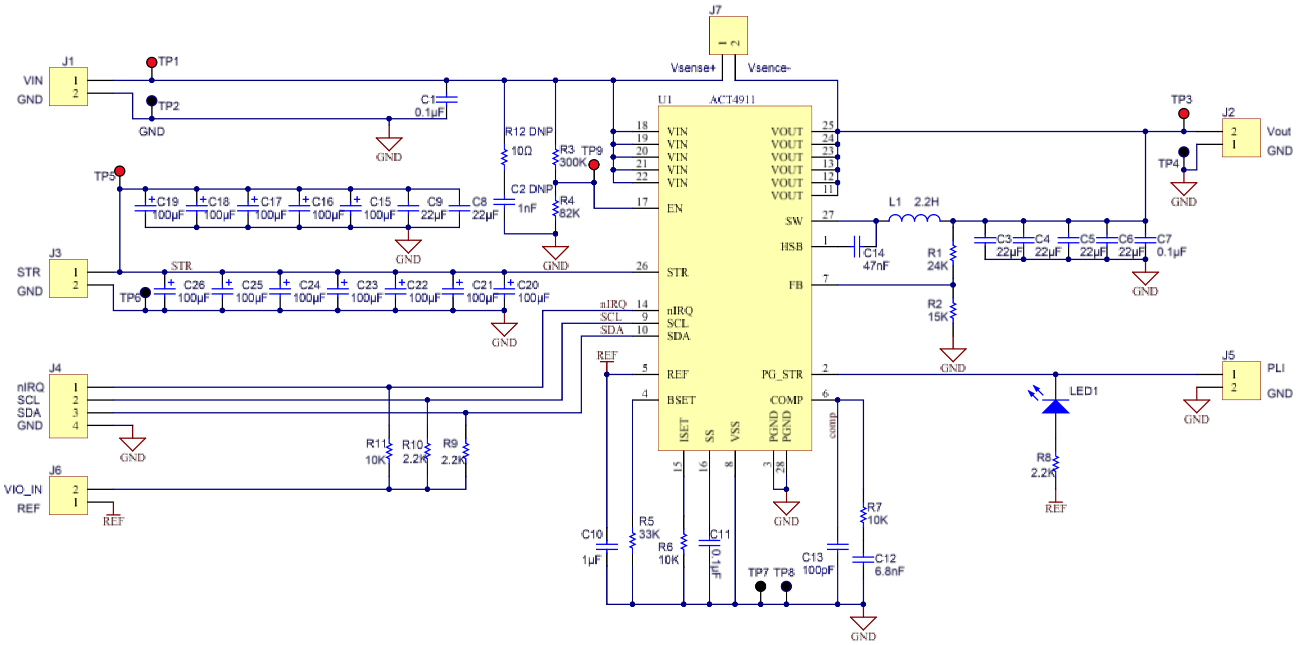



**Figure 4 – ACT4911EVK1-301 Schematic**

## Layout

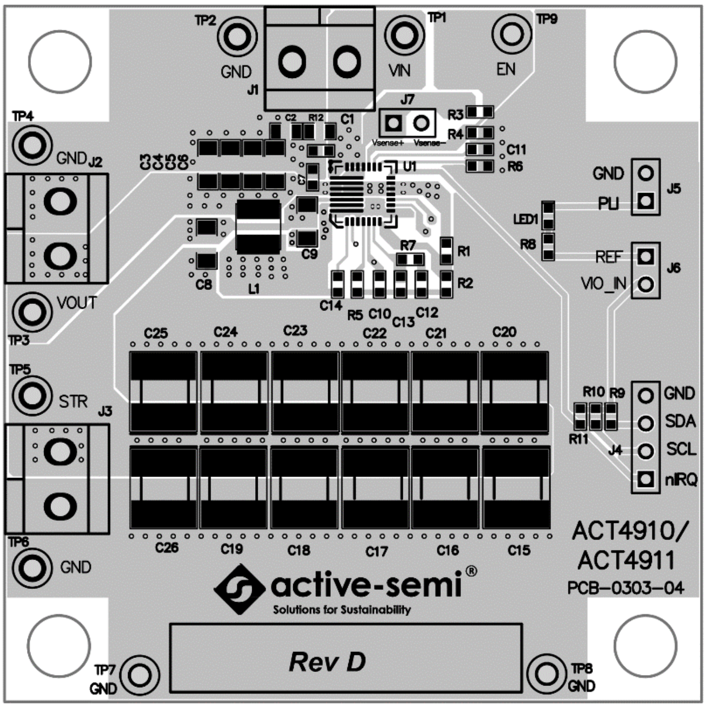



Figure 5 – Layout Top Layer

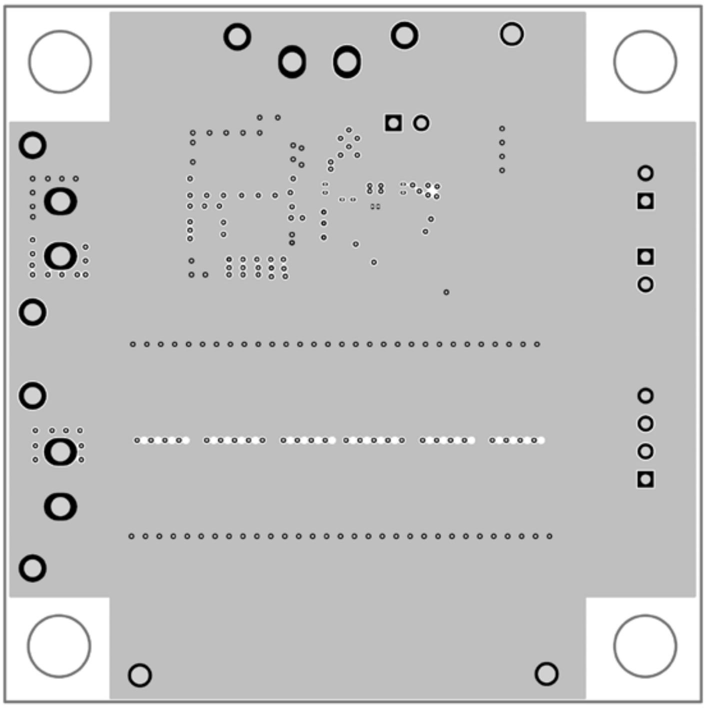


Figure 6 – Layout GND

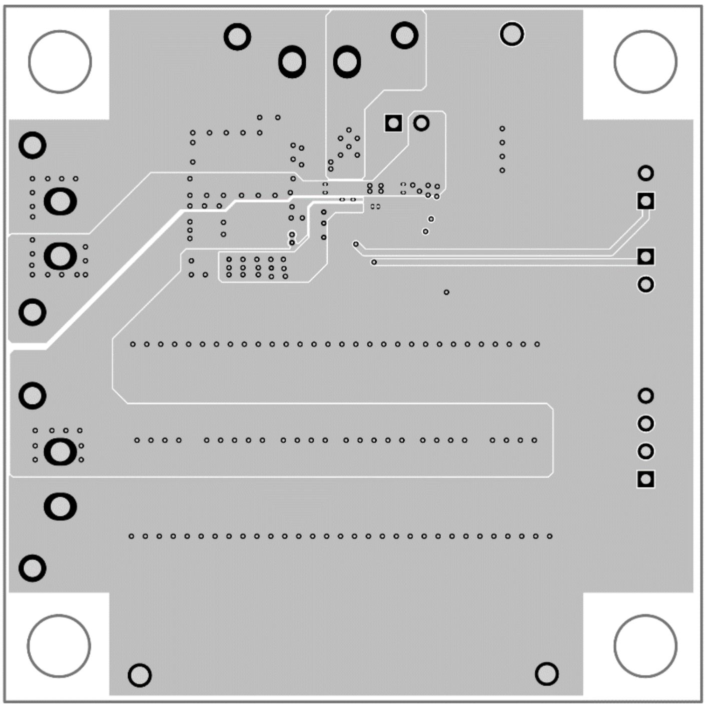


**Figure 7 – Layout Power**

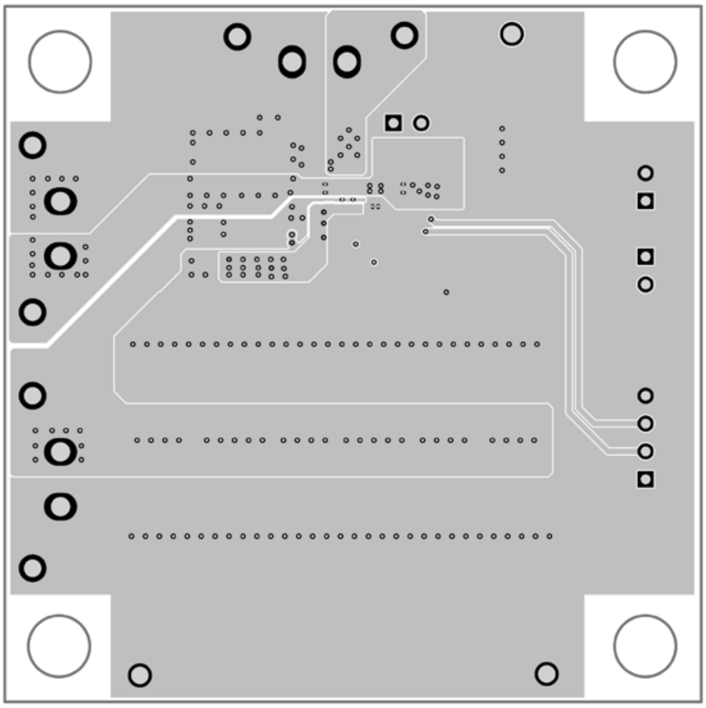


**Figure 8 – Layout Bottom Layer**

## Bill of Materials

| Item | Ref Des | QTY | Description | Package | MFR | Part Number |
|---|---|---|---|---|---|---|
| 1 | C1 | 2 | Cap, Ceramic, 0.1uF, 50V, 10%, X7R | 0603 | Std | Std |
| 2 | C2 | 0 | Cap, Ceramic, 1nF, 50V, 10%, X7R | 0603 | Std | Std |
| 3 | C3, C4,C5,C6 | 4 | Cap, Ceramic, 22uF, 35V, 10%, X7R | 1206 | Std | Std |
| 4 | C7 | 1 | Cap, Ceramic, 0.1uF, 50V, 10%, X7R | 0603 | Std | Std |
| 5 | C8,C9 | 2 | Cap, Ceramic, 22uF, 35V, 10%, X7R | 1206 | Std | Std |
| 6 | C10 | 1 | Cap, Ceramic, 1uF, 16V, 10%, X7R | 0603 | Std | Std |
| 7 | C11 | 1 | Cap, Ceramic, 100nF, 16V, 10%, X7R | 0603 | Std | Std |
| 8 | C12 | 1 | Cap, Ceramic, 6800pF, 16V, 10%, X7R | 0603 | Std | Std |
| 9 | C13 | 1 | Cap, Ceramic,100pF, 16V, 10%, X7R | 0603 | Std | Std |
| 10 | C14 | 1 | Cap, Ceramic, 47nF, 25V, 10%, X7R | 0603 | Std | Std |
| 11 | C15,C16,C17,C18,C19,C20, C21,C22,C23,C24,C25,C26 | 12 | Tantalum Solid Capacitor, 100uF, 16V, 20% | D12 | Panasonic | 16TQC100MYF |
| 12 | L1 | 1 | Inductor, 2.2uH, 6A, 3.15mohm, SMD Flat Wire High Current | 7x7x4.8mm | Wurth Elektronik | 74438357022 |
| 13 | LED1 | 1 | LED, Bright Green | 0603 | Wurth Elektronik | 150060VS75000 |
| 14 | R1 | 1 | Res,24kΩ, 1% | 0603 | Std | Std |
| 15 | R2 | 1 | Res, 15kΩ, 1% | 0603 | Std | Std |
| 16 | R3 | 1 | Res, 300kΩ, 1% | 0603 | Std | Std |
| 17 | R4 | 1 | Res,82kΩ, 1% | 0603 | Std | Std |
| 18 | R5 | 1 | Res, 33kΩ, 1% | 0603 | S td | Std |
| 19 | R6 | 1 | Res, 10kΩ, 1% | 0603 | Std | Std |
| 20 | R7 | 1 | Res,10kΩ, 5% | 0603 | Std | Std |
| 21 | R8,R9,R10 | 3 | Res, 2.2KΩ, 5%, | 0603 | Std | Std |
| 22 | R11 | 1 | Res, 10KΩ, 5% | 0603 | Std | Std |
| 23 | R12 | 0 | Res, 10Ω, 5% | 0603 | Std | Std |
| 24 | J1,J2,J3 | 3 | Header, Series 213 - 5mm horizontal entry | 5mm | Wurth Elektronik | 691213710002 |
| 25 | J4 | 1 | Header, 4 pin, 100mil | PITCH: 2.54MM | Wurth Elektronik | 61300411121 |
| 26 | J5,J6 | 2 | Header, 2 pin, 100mil | PITCH: 2.54MM | Wurth Elektronik | 61300211121 |
| 27 | TP1, TP3,TP5 | 3 | Test Point, Red, Through Hole, 1mm | 0.040" | Keystone | 5000 |
| 28 | TP2,TP4,TP6,TP7,TP8 | 5 | Test Point, Black, Through Hole, 1mm | 0.040" | Keystone | 5001 |
| 29 | U1 | 1 | ACT4911QW301-T | QFN28 | Active-semi | ACT4911QW301-T |
| 30 | PCB | 1 | PCB, ACT4910/ACT4911 | n/a | n/a | PCB-0303-04 |

# GUI Installation

1. Contact Active Semi for the GUI files and save them on your computer.
2. Plug the USB-TO-I2C dongle into a free USB port.
3. Follow the instructions in the “How to install driver for dongle” folder.

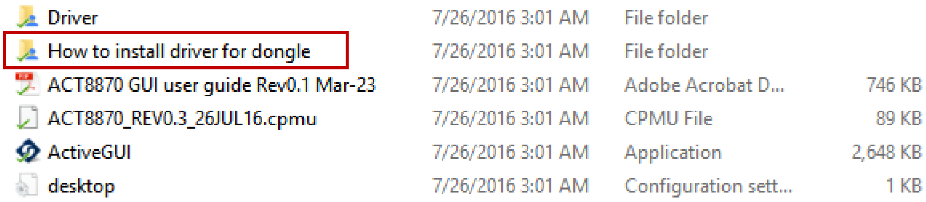



**Figure 9 – Dongle Driver**

4. Double click on the ACT4911 GUI.exe to start the ACT4911 GUI.

## GUI Overview

The GUI has 2 basic function buttons allocated in top-left of the Tool Bar which are Read and Write I2C. The GUI contains 2 setting modes: Basic Mode and Advanced Mode. In Basic Mode screen it displays basic user programmable configuration options are programmed using the drop-down boxes or check boxes. Advanced Mode contain the button text for changing setting for every single bit.

### Basic Mode

The following figure show the GUI in basic mode. This mode allows the user to easily change one or more IC settings.

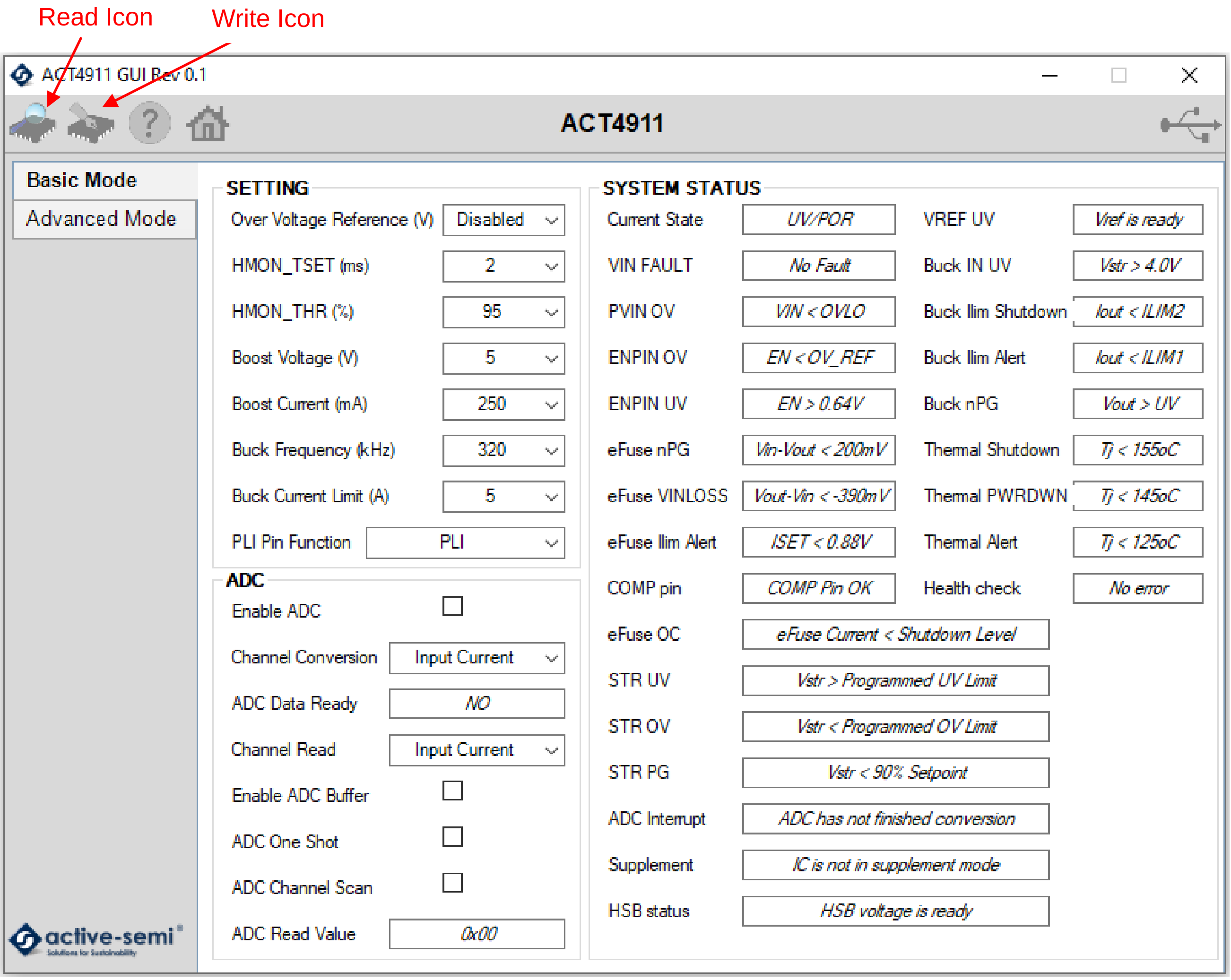



**Figure 10 – GUI Basic Mode**

### Advanced Mode

Click the “Advanced Mode” button in the left of the GUI screen to see all available user programmable options. With Advanced Mode, additional user programmable features can be selected using the button text. In the left side of the Advanced Mode Screen, click on the Tiles Selector to display the register to view or change. Then change a register one bit at a time by clicking on the desired bit. The value of the bit is display right next to the bit-name button.

Note that the far right side of the screen contains a scroll down button to scroll down to additional registers since the Tile Screen can only display up to 8 bytes at once.

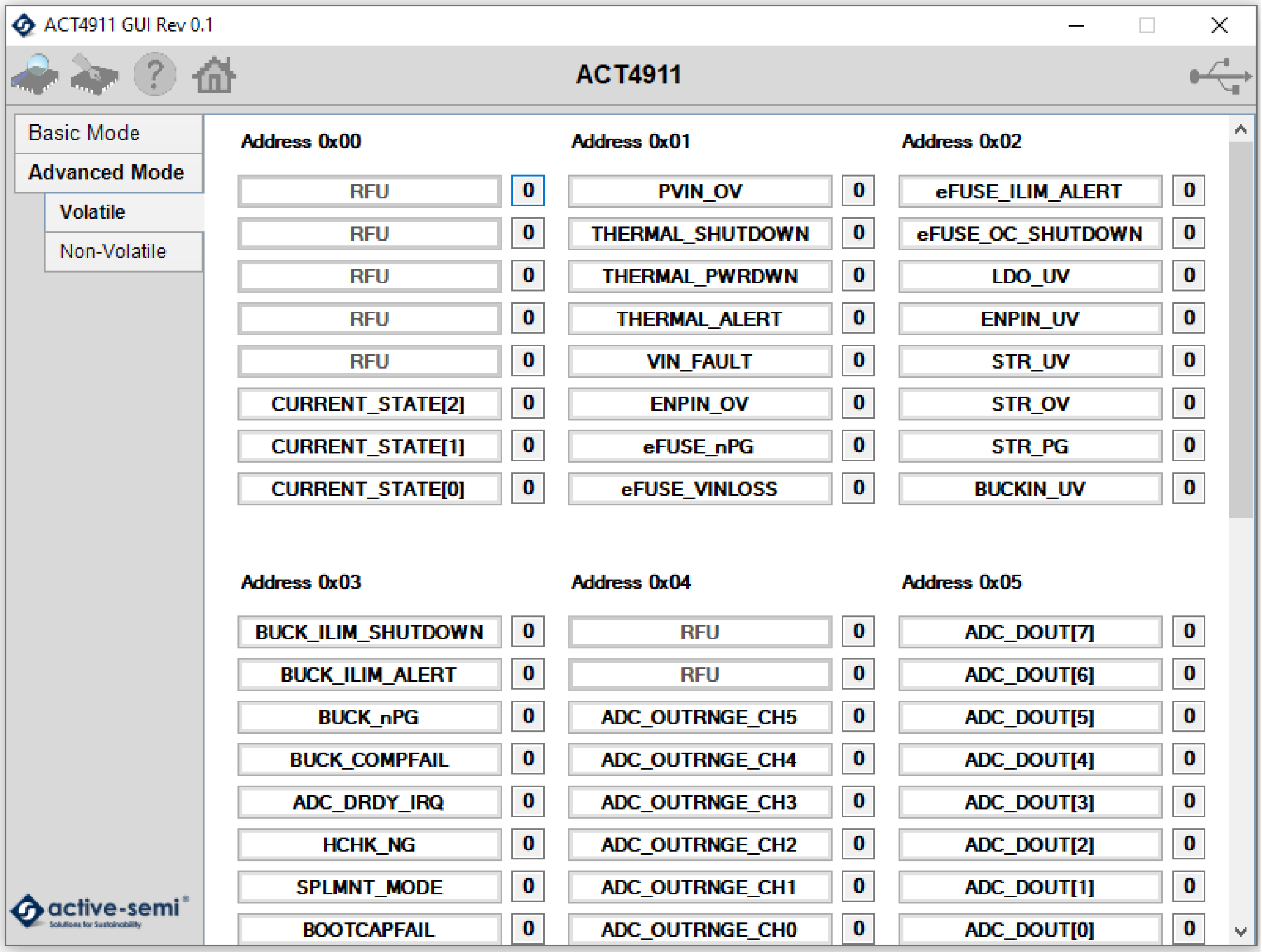



**Figure 11 – GUI Advanced Mode**

### Button Descriptions

**Read:** Clicking on this button reads the ACT4911 registers and displays them in the GUI. Note that this reads all registers. Active-Semi recommends reading registers each time the ACT4911 powers-up to acquire the initial register settings. Active-semi also recommends reading registers after making changes to them. Immediately reading the registers after a write confirms the changes were properly stored. This also updates the SYSTEM STATUS box to ensure that one of the changes did not generate a fault condition.