ACT4921EVK1-301 User's Guide

Description

This document describes the characteristic and operation of the Active Semi ACT4921EVK1-301 evaluation kit (EVK). It provides setup and operation instructions, schematic, layout, BOM, and test data. This EVK demonstrates the ACT4921QI301 eFuse power management IC. Other ACT4921QIxxx 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 the ICs register settings for things like fault thresholds and responses, storage voltage setting, startup delays, IC status, and more. This gives the user the flexibility to configure the EVK to match their real world system. Note that the ACT4921QI301 is specifically configured for the ACT4921QI301 IC.

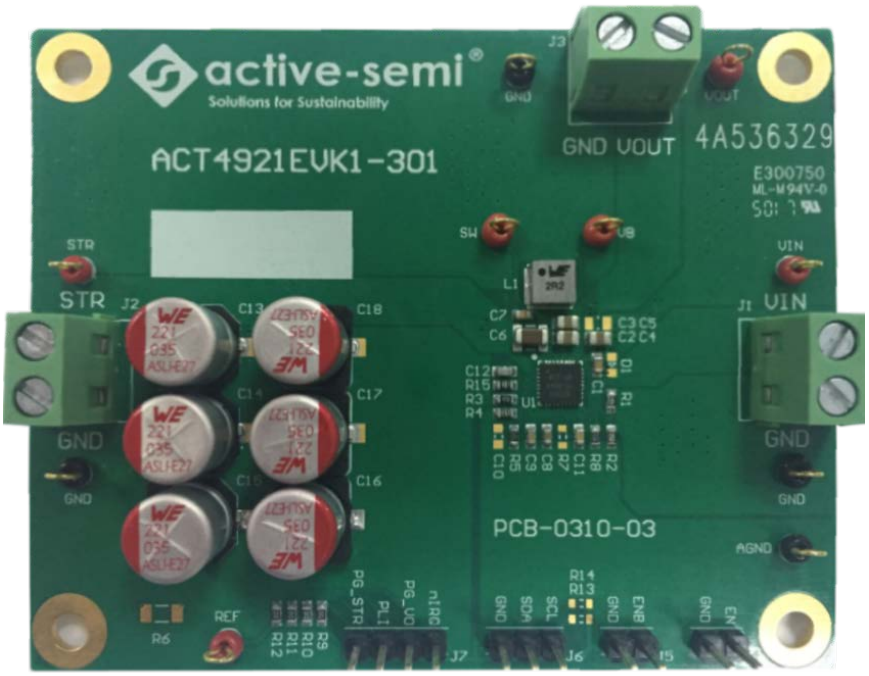


Figure 1 – EVK Picture

Setup

Required Equipment

ACT4921EVK1-301.

USB-TO-I2C Dongle.

Power supply – 2.6V-7V @ 3A for full power operation.

Oscilloscope – >100MHz, >4 channels

Loads – Electronic or resistive. 3A minimum current capability.

Digital Multi-meters (DMM).

Windows compatible computer with spare USB port.

EVK Setup

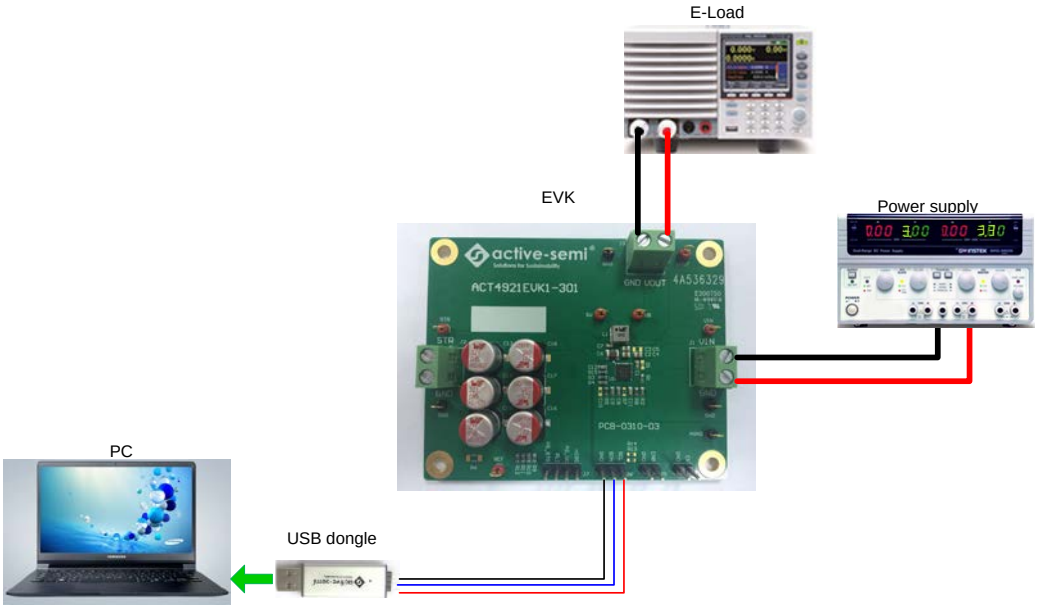


Figure 2 – EVK Setup

Hardware Setup

1. If using I2C, ensure that a shorting jumper is placed across J6 to provide a pullup voltage.
2. Connect a power supply to J1.
3. Connect an appropriate load to J3.

GUI Setup (optional)

1. Refer to the end of this document for detailed instructions to install the ACT4921 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 J6 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.

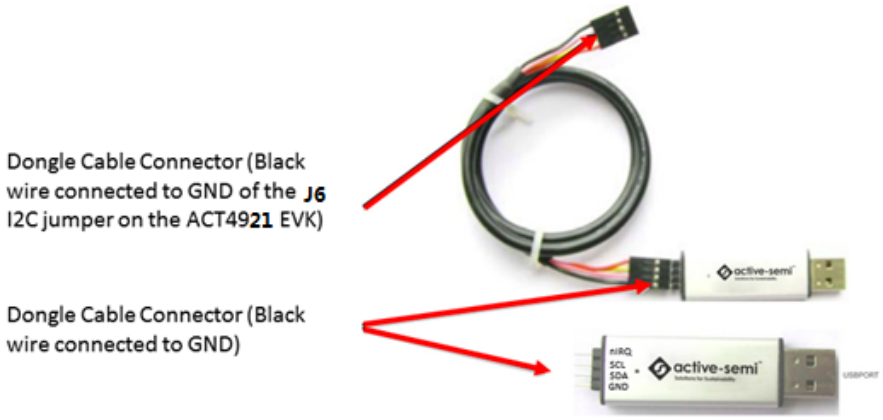


Figure 3 – USB-TO-I2C Dongle Connection

EVK Design Parameters

The ACT4921EVK1-301 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	2.9	3.3	3.7	V
I_{OUT}	Load current		3		A
I_{CL}	eFuse current limit		4		A
V_{STR}	Storage voltage		28		V
V_{Buck}	Buck output voltage in supplement mode		3.3		V
$T_{softstart}$	Softstart time		5		ms
T_{holdup}	Supplement mode holdup time		40		ms

Note: When testing holdup time, IOUT=3A in supplement mode.

Jumpers and Connectors

J1 – Input voltage to the EVK.

J2 – Additional storage capacitor connector .This connector allows additional storage capacitors to be easily added for evaluation.

J3 – Output power from the EVK. This is the system load.

J4 – EN pin is internally pulled high by the ACT4921. The eFuse works normally when this pin is pulled high. Installing a shorting jumper on J4 pulls EN low and disables the eFuse.

J5 – ENB pin is internally pulled high by the ACT4921. The boost circuitry works normally when this pin is pulled high. Installing a shorting jumper on J5 pulls ENB low and disables the boost.

J6 – I2C connector. Connect to the Active Semi USB-TO-GPIO dongle or to any other I2C communication device.

J7 – Status Indicator connector. This connector provides easy access to the nIRQ, PG_VO, PLI, and PG_STR signals.

EVK Operation

Turn on

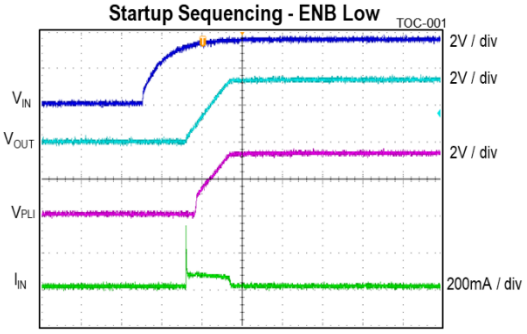
The EVK is preconfigured and ready to use. Apply the 3.3V input voltage and the EVK automatically powers up, charges the storage capacitors, and delivers power to the load. No modifications are needed to start evaluating the ACT4921's many functions such as supplement mode, current limiting, etc.

Modifications

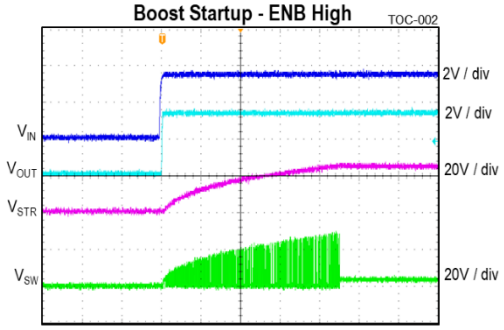
The EVK is designed to allow the user to immediately start evaluating the ACT4921 functionality. After the user becomes familiar with the EVK functionality and has verified that they can reproduce the performance data, they can easily modify the EVK to match their specific system level requirements. Refer to the ACT4921 datasheet for detailed design equations.

Test Results

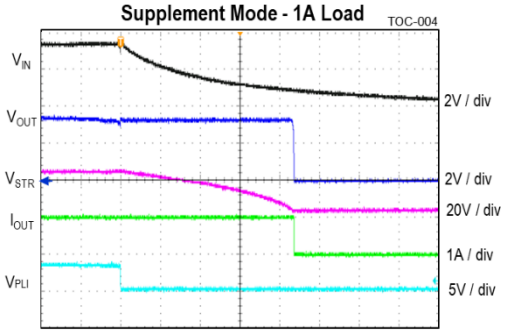
CMI 301
Startup Sequencing - ENB Low
TOC-001



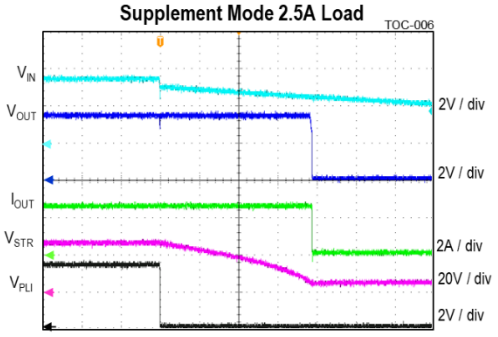
CMI 301
Boost Startup - ENB High
TOC-002



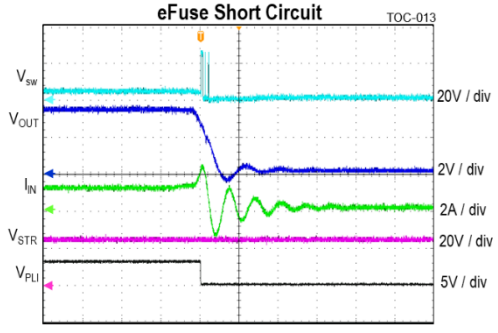
CMI 301
Supplement Mode - 1A Load
TOC-004



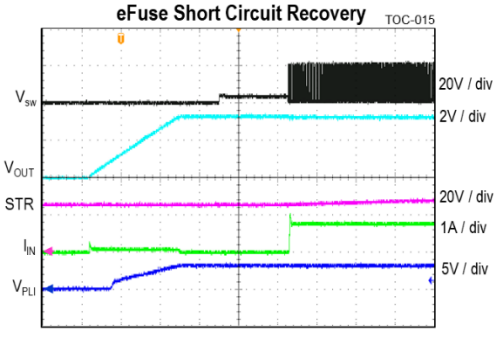
CMI 301
Supplement Mode 2.5A Load
TOC-006

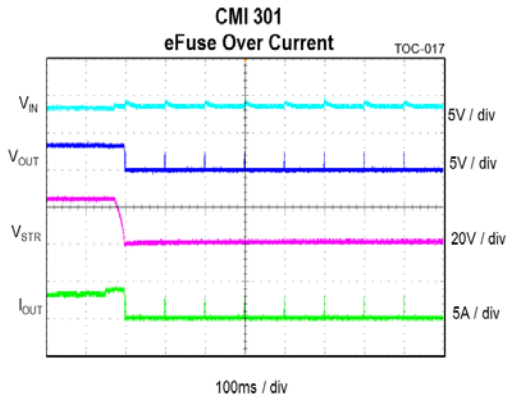


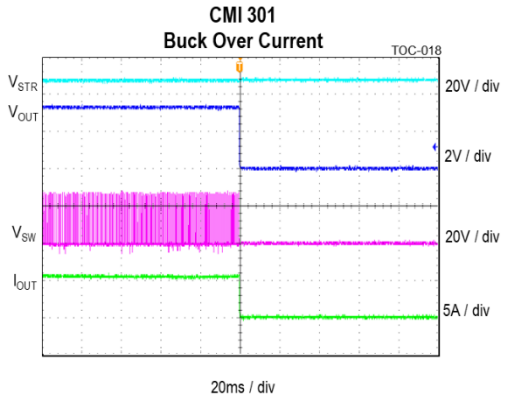
CMI 301
eFuse Short Circuit
TOC-013

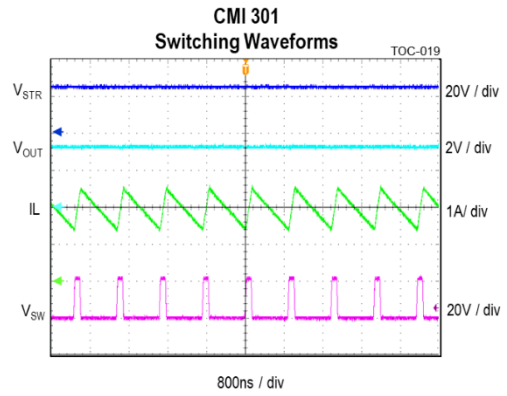


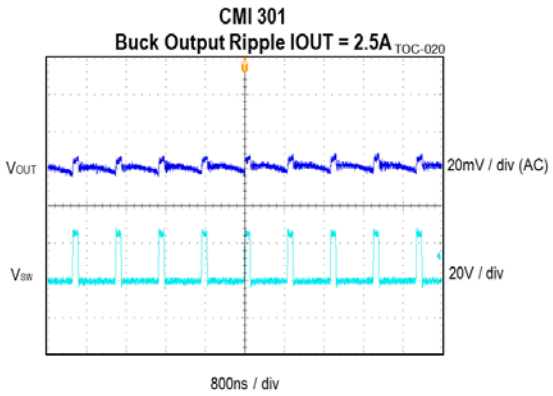
CMI 301
eFuse Short Circuit Recovery
TOC-015

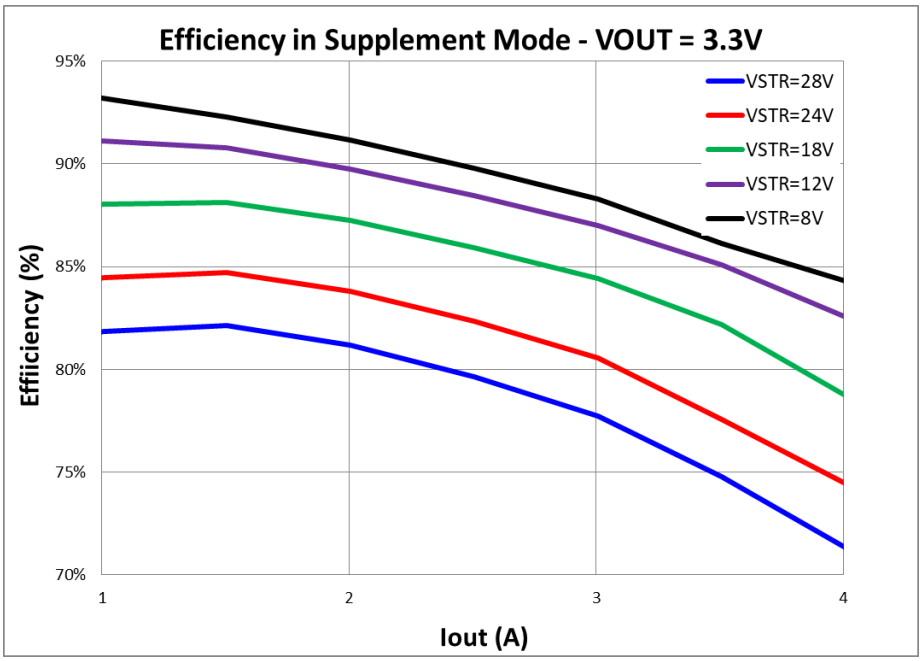


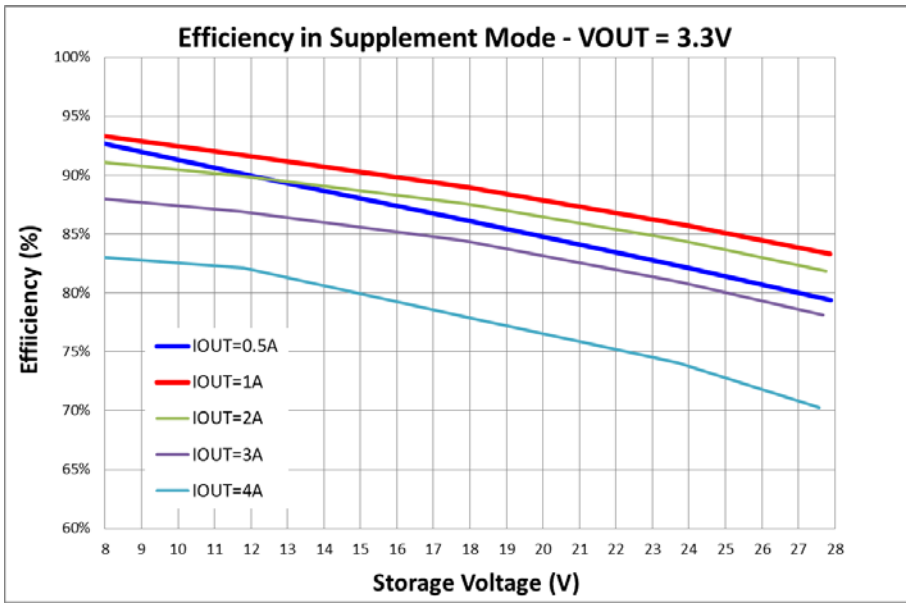

CMI 301
eFuse Over Current
TOC-017
VIN
VOUT
VSTR
IOUT
5V / div
5V / div
20V / div
5A / div
100ms / div


CMI 301
Buck Over Current
TOC-018
VSTR
VOUT
VSW
IOUT
20V / div
2V / div
20V / div
5A / div
20ms / div


CMI 301
Switching Waveforms
TOC-019
VSTR
VOUT
IL
VSW
20V / div
2V / div
1A/ div
20V / div
800ns / div


CMI 301
Buck Output Ripple IOUT = 2.5A
TOC-020
VOUT
VSW
20mV / div (AC)
20V / div
800ns / div


Efficiency in Supplement Mode - VOUT = 3.3V
95%
90%
85%
80%
75%
70%
Effiiciency (%)
1
2
3
4
Iout (A)
VSTR=28V
VSTR=24V
VSTR=18V
VSTR=12V
VSTR=8V


Efficiency in Supplement Mode - VOUT = 3.3V
100%
95%
90%
85%
80%
75%
70%
65%
60%
Effiiciency (%)
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Storage Voltage (V)
IOUT=0.5A
IOUT=1A
IOUT=2A
IOUT=3A
IOUT=4A

Schematic

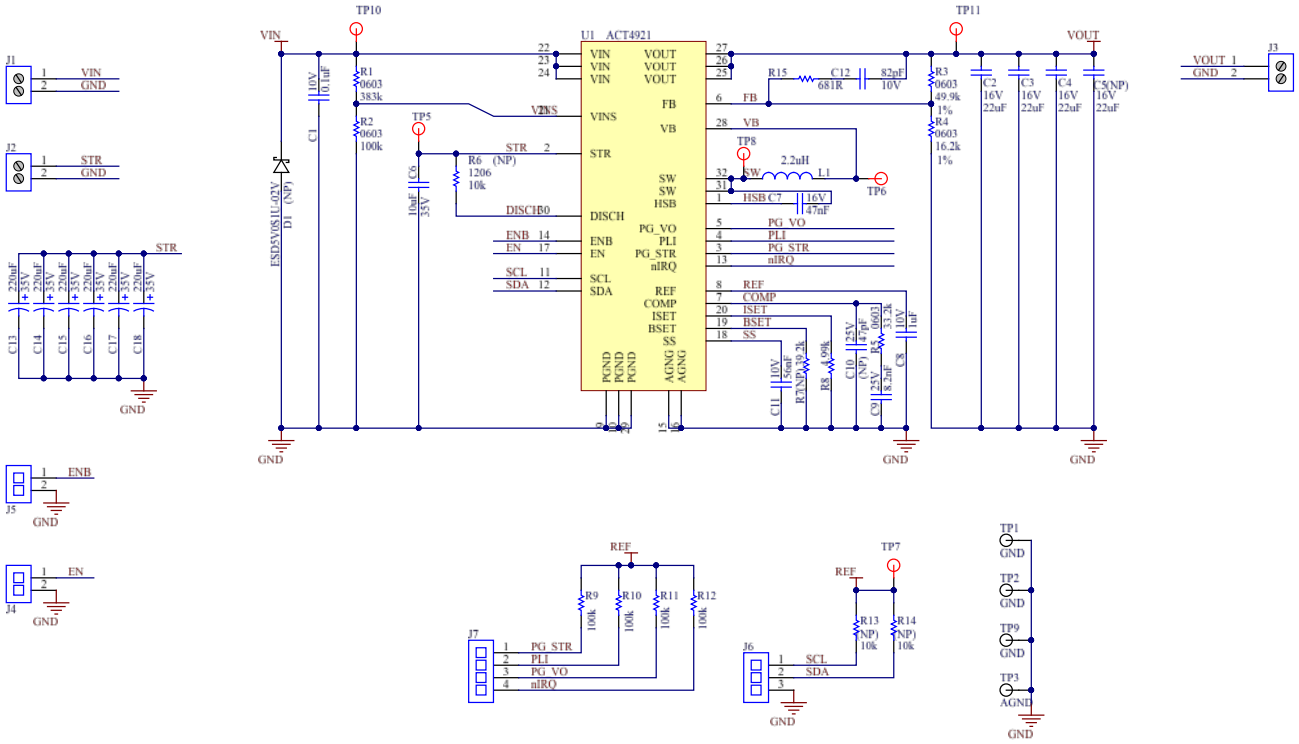


Figure 4 – ACT4921EVK1-301 Schematic

Layout

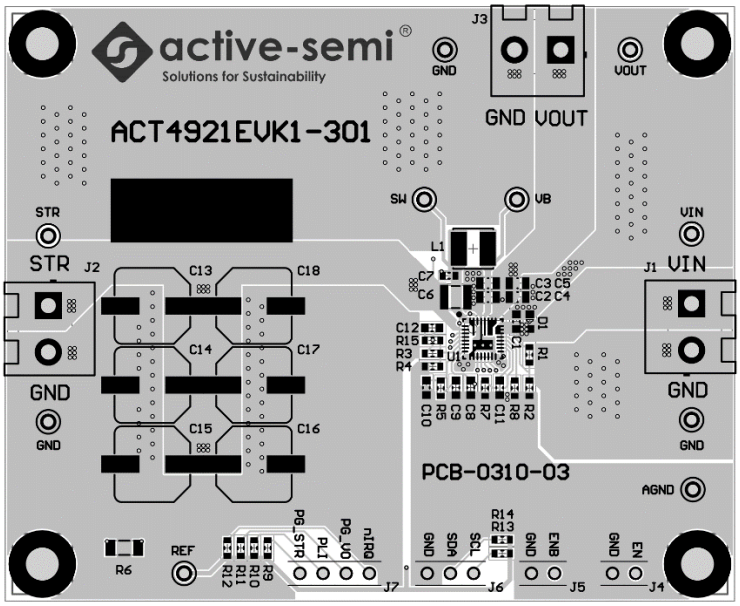


Figure 5 – Layout Top Layer

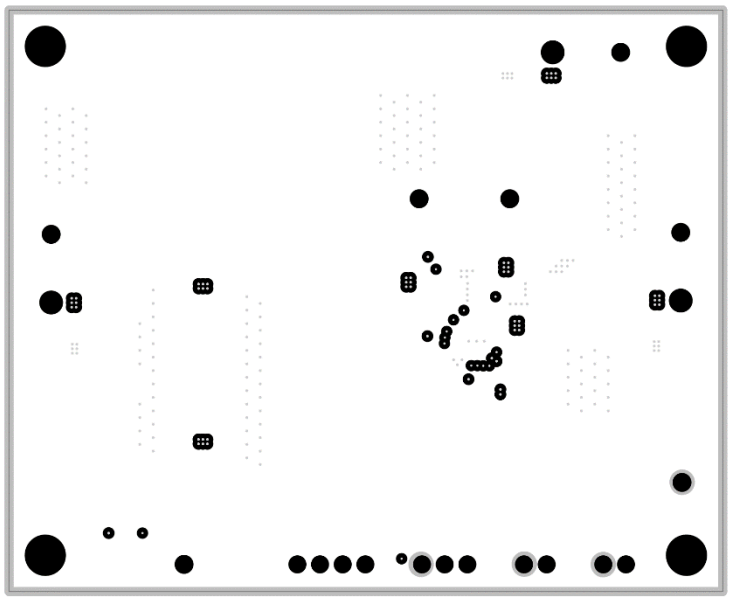


Figure 6 – Layout GND

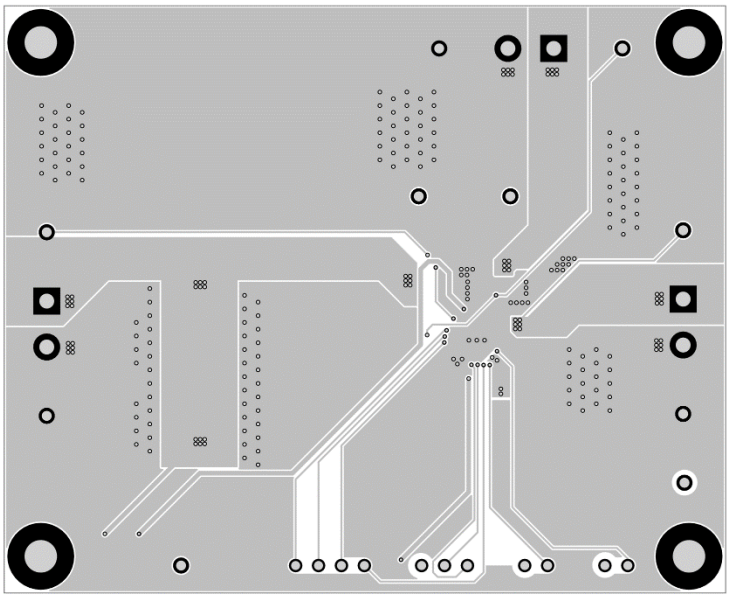


Figure 7 – Layout Power

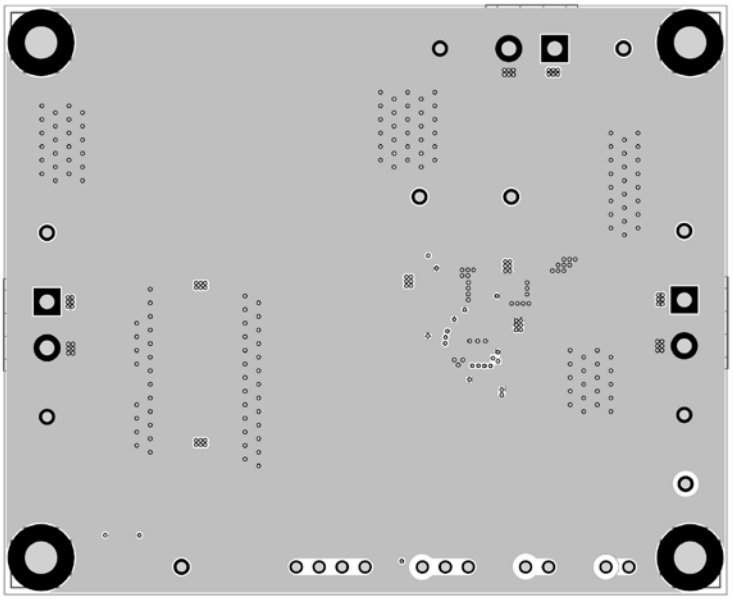


Figure 8 – Layout Bottom Layer

Bill of Materials

Item	Designator	QTY	Description	Package	MFR	Part Number
1	C1	1	Cap, Ceramic, 0.1uF, 10V, X7R, 10%	0603	Std	Std
2	C2,C3,C4,C5(NP)	3	Cap, Ceramic, 22uF, 16V, X5R, 10%	0805	Std	Std
3	C6	1	Cap, Ceramic, 10uF, 35V, X7R, 10%	1206	Std	Std
4	C7	1	Cap, Ceramic, 47nF, 16V, X7R, 10%	0603	Std	Std
5	C8	1	Cap, Ceramic, 1uF, 10V, X7R, 10%	0603	Std	Std
6	C9	1	Cap, Ceramic, 8.2nF, 25V, X7R, 10%	0603	Std	Std
7	C10(NP)	1	Cap, Ceramic, 47pF, 25V, X7R, 10%	0603	Std	Std
8	C11	1	Cap, Ceramic, 56nF, 10V, X7R, 10%	0603	Std	Std
9	C12	1	Cap, Ceramic, 82pF, 10V, X7R, 10%	0603	Std	Std
10	C13,C14,C15,C16, C17,C18	6	Capacitor, Aluminum,220uF,35V	8x10.5	Wurth-WCAP-ASLI	865080553014
11	D1(NP)	0	Diode,TVS 5V	SC79		ESD5V0S1U-02V
12	L1	1	Inductor, 2.2uH, 5.2A	4020	Wurth	74438357022
13	R1	1	Resistor, 383k, 1%	0603	Std	Std
14	R2	1	Resistor, 100k, 1%	0603	Std	Std
15	R3	1	Resistor, 49.9k, 1%	0603	Std	Std
16	R4	1	Resistor, 16.2k 1%	0603	Std	Std
17	R5	1	Resistor, 33.2k, 1%	0603	Std	Std
18	R6 (NP)	0	Resistor, 10k, 1%	1206	Std	Std
19	R7 (NP)	0	Resistor, 39.2k, 1%	0603	Std	Std
20	R8	1	Resistor, 4.99k, 1%	0603	Std	Std
21	R9, R10, R11, R12	4	Resistor, 100k, 1%	0603	Std	Std
22	R13 (NP), R14 (NP)	0	Resistor, 10k, 1%	0603	Std	Std
23	R15	1	Resistor, 681R, 1%	0603	Std	Std
24	J1, J2, J3	3	Header, Series 213 - 5mm horizontal entry	5mm	Wurth Elektronik	691213710002
25	J4, J5	2	Header, 2pin, 100mil	PITCH: 2.54MM	Wurth Elektronik	61300211121
26	J6	1	Header, 3 pin, 100mil	PITCH: 2.54MM	Wurth Elektronik	61300311121
27	J7	1	Header, 4 pin, 100mil	PITCH: 2.54MM	Wurth Elektronik	61300411121
28	TP1, TP2, TP3, TP9	4	TEST POINT PC MINI .040"D BLACK	0.040"	Keystone	5000
29	TP5, TP6, TP7, TP8, TP10, TP11	5	TEST POINT PC MINI .040"D RED	0.040"	Keystone	5001
30	U1	1	ACT4921QI301-T	FCQFN4x4-32	Active-Semi	ACT4921QI301-T
31	PCB	1	ACT4921EVK1-301	n/a	n/a	PCB-0310-03

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.

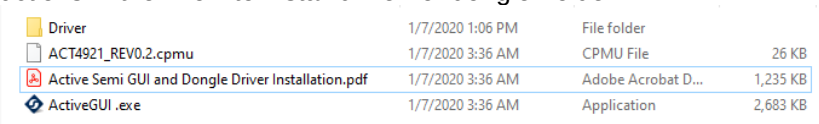


Figure 9 – Dongle Driver installation

4. Double click on the ACT4921 GUI.exe to start the ACT4921 GUI.

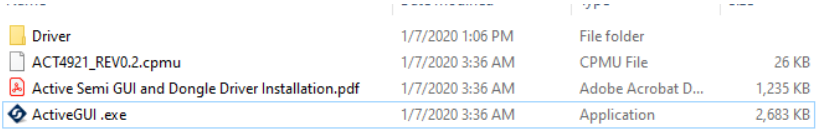


Figure 9 – Run the GUI

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 contains the button text for changing setting for every single bit.

Basic Mode

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

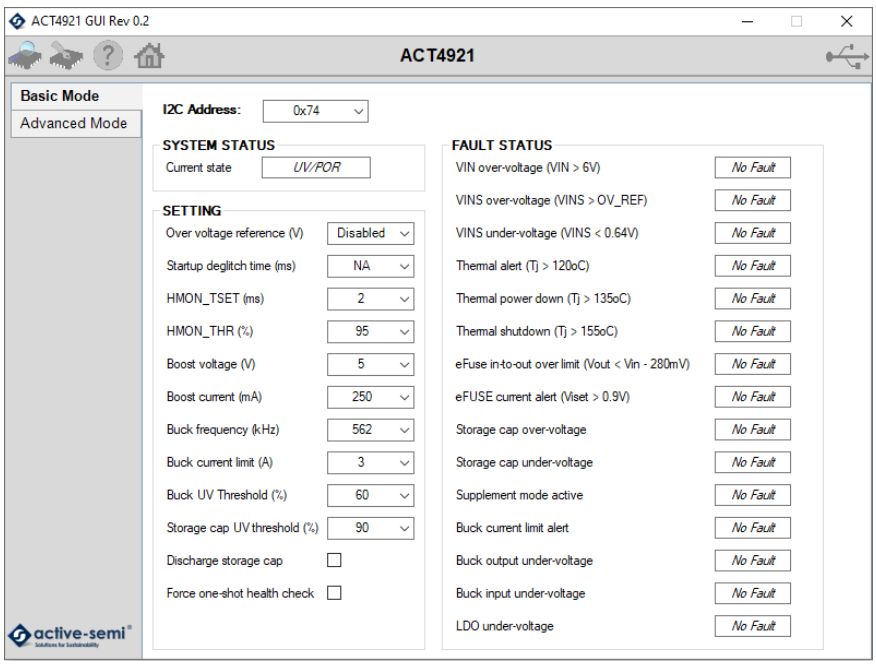


Figure 10 – GUI Basic Mode