ACT88430EVK1-101User's Guide

Description

This document describes the characteristics and operation of the Active Semi ACT88430EVK1-101 evaluation kit (EVK). It provides setup and operation instructions, schematic, layout, BOM, and test data. This EVK demonstrates the ACT88430QJ101 ActivePMU power management IC. Other ACT88430QJxxx 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 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 ACT88430EVK1-101 is specifically configured for the ACT88430QJ101.

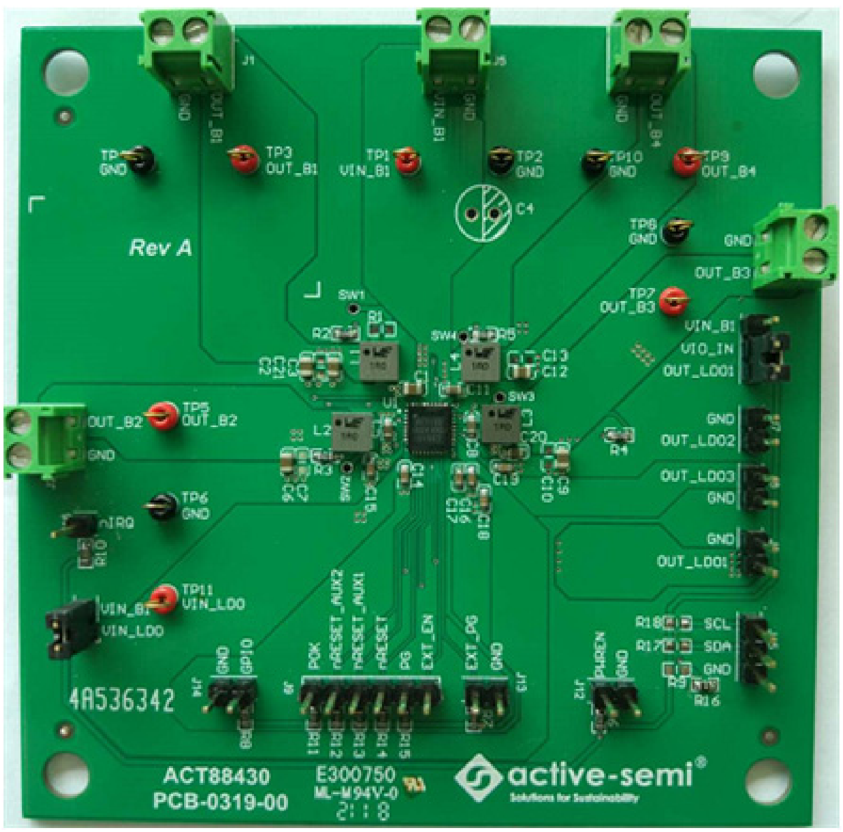


Figure 1 – EVK Picture

EVK Contents

The ACT88430EVK1-101 evaluation kit comes with the following items:

1. EVK assembly
2. USB-TO-I2C dongle
    a. Dongle
    b. Custom 4-pin connector that connects the USB-TO-I2C dongle to the EVK assembly

Required Equipment

ACT88430 EVK

USB-TO-I2C Dongle

Power supply – 5V @ 4A for full power operation

Oscilloscope – >100MHz, >2 channels

Loads – Electronic or resistive. 4.0A minimum current capability.

Digital Multimeters (DMM)

Windows compatible computer with spare USB port.

Hardware Setup

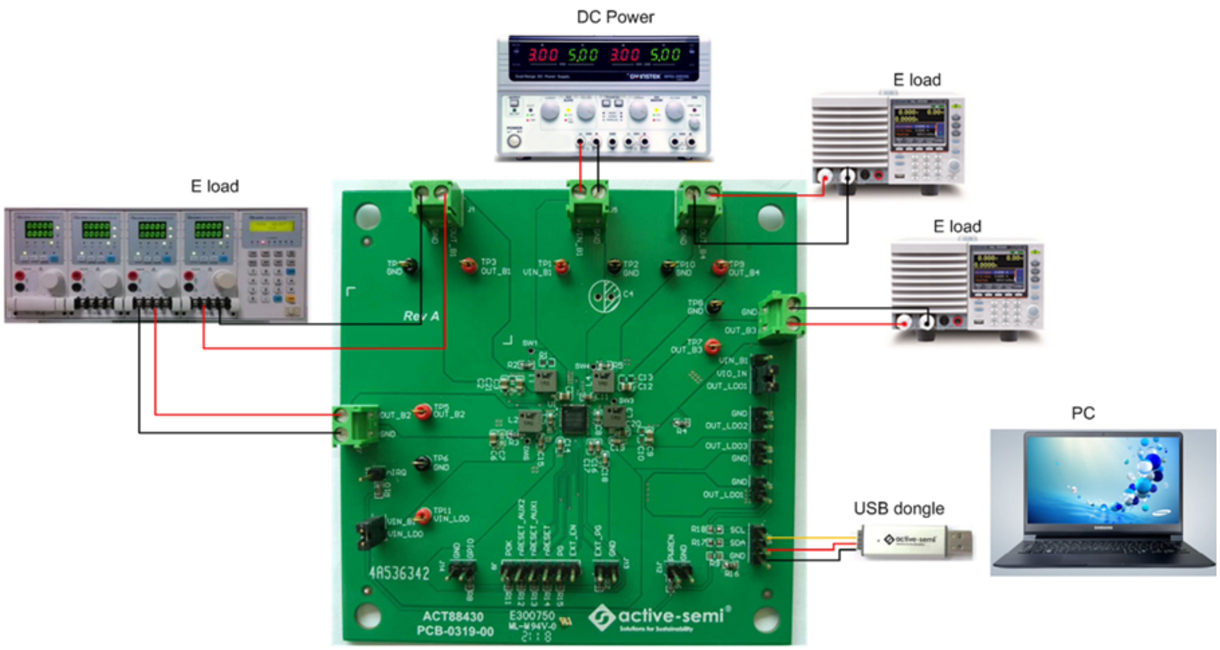


Figure 2 – EVK Setup

Quick Start

Hardware Setup

1. Decide which voltage will power VIO_IN. Active Semi recommends powering VIO_IN from the VIN_B1 input. Install a shorting jumper between J11-1 and J11-2to power VIO_IN from the VIN_B1 input voltage, OR connect a shorting jumper betweenJ11-2 and J11-3 to power VIO_IN from the OUT_LDO1output voltage.
2. Connect a lab supply between J5-2 and J5-1 to power VIN_B1.
3. Connect a shorting jumper to J10 to power the LDO input voltages from the main input supply (VIN_B1). Connect a lab supply between J10-1 and GND to power the LDO input voltages from a different input voltage.
4. Note that the typical setup is to apply the same 3.3V input voltage to all inputs. Using different input voltage sources requires careful consideration of startup sequencing.
5. Connect an appropriate load to each power supply output.
6. Turn on the lab supplies.
7. The outputs turn on automatically when voltage is applied to VIN_B1.
8. If you do not want the outputs to automatically startup, place a shorting jumper on the PWREN connector (J12) and short the nRESET_AUX1 pin (J9) to ground. Then remove the PWREN shorting jumper to enable Buck4, LDO1/2/3. Remove the nRESET_AUX1 short to enable Buck1/2/3.

GUI Setup (optional)

1. Refer to the end of this document for detailed instructions to install the ACT88430 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 J15 connector. Refer to Figure 4 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 to the Dongle GND pin.

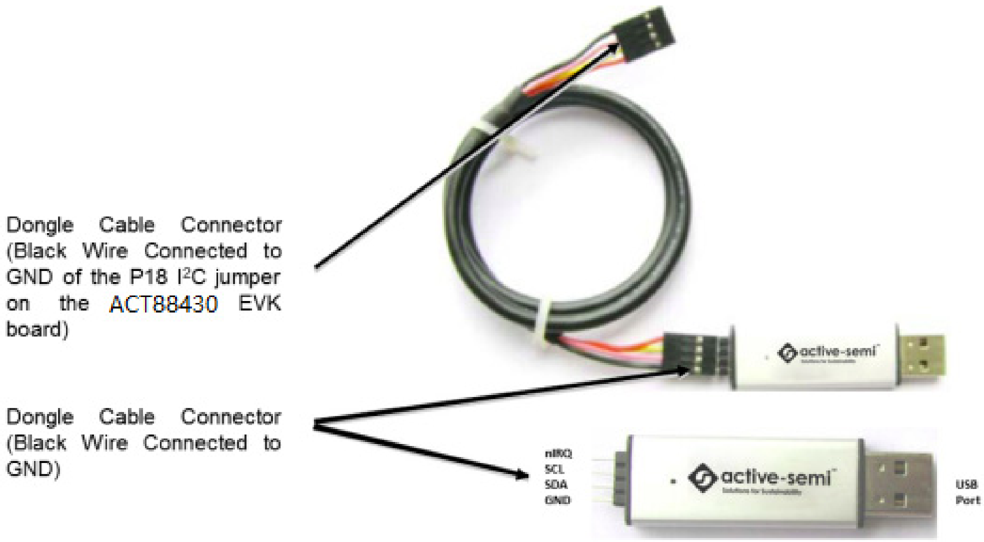


Figure 4 – USB-TO-I2C Dongle Connection

EVK Design Parameters

The ACT88430EVK1-101 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_B1	All buck input voltages	3	3.3	3.6	V
VIN_LDO1	LDO1 input voltage	3	3.3	3.6	V
VIN_LDO23	LDO23 input voltage	3	3.3	3.6	V
I_{B1_max}	Maximum Buck 1 load current		4.0		A
I_{B2_max}	Maximum Buck 2 load current		2.5		A
I_{B3_max}	Maximum Buck 3 load current		2.5		A
I_{LDO1_max}	Maximum LDO 1 load current		0.8		A
I_{LDO2_max}	Maximum LDO 2 load current		0.2		A
I_{LDO3_max}	Maximum LDO 3 load current		0.2		A

EVK Operation

Turn On

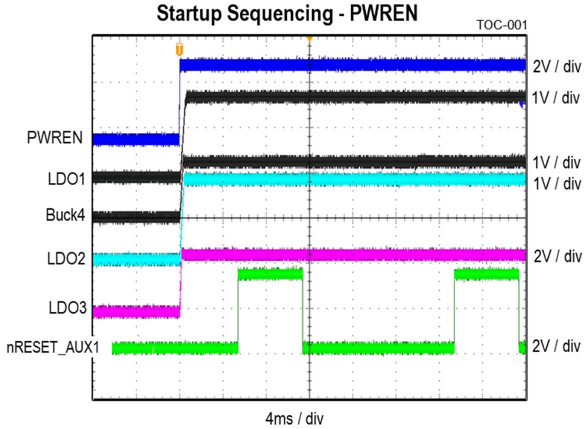
Apply the 3.3V input voltage. Pull PWREN high to enable Buck4, LDO1/2/3. Pull RESET_AUX1 high to enable Buck1/2/3. All outputs automatically turn on with the programmed startup sequence.

Sleep Mode

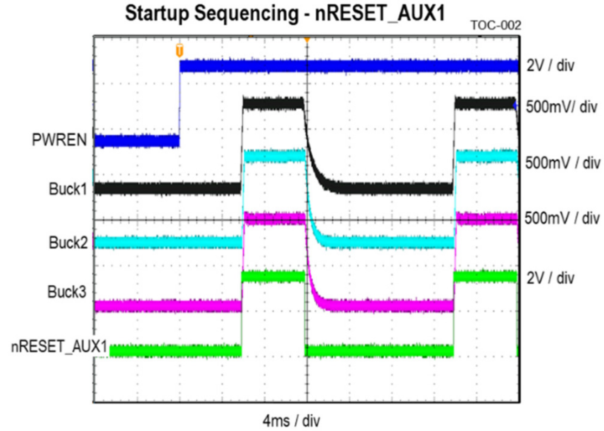
After all outputs are turned on, enter Sleep Mode by pulling nRESET_AUX1 low. In Sleep Mode,Buck1/2/3 outputs turn off and Buck4,LDO1/2/3 stay on.

Test Results

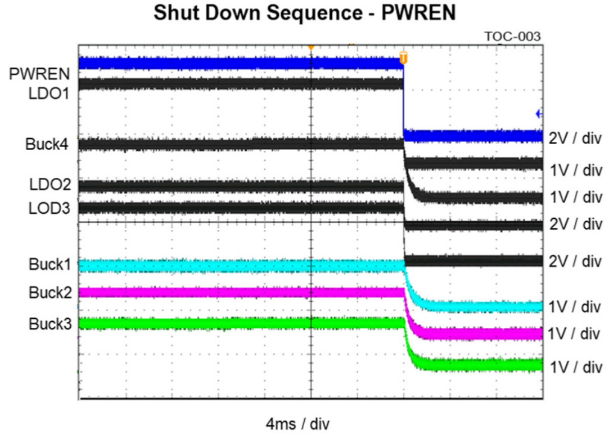
CMI 101
Startup Sequencing - PWREN



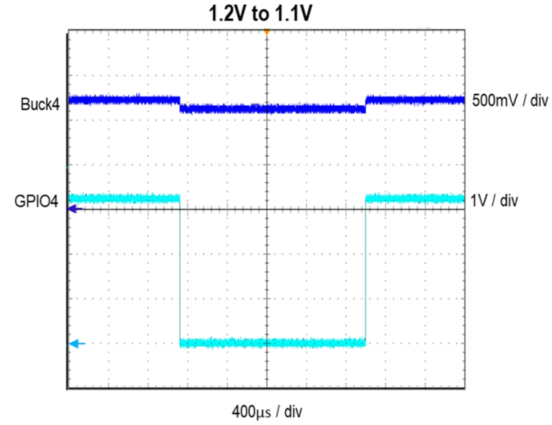
CMI 101
Startup Sequencing - nRESET_AUX1

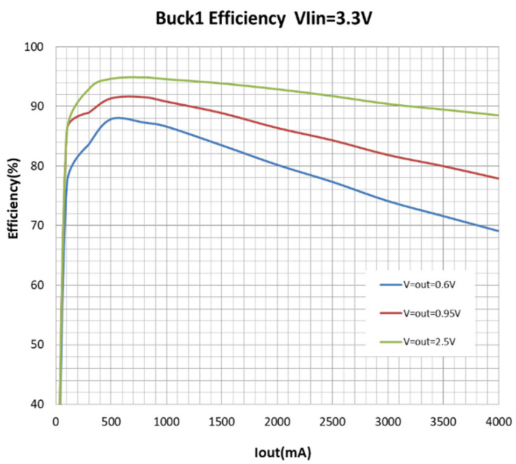


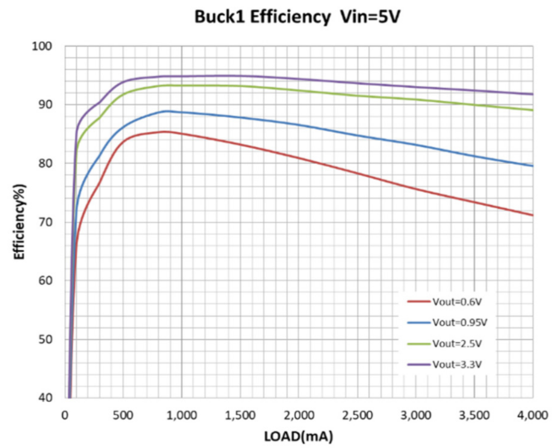
Shut Down Sequence - PWREN

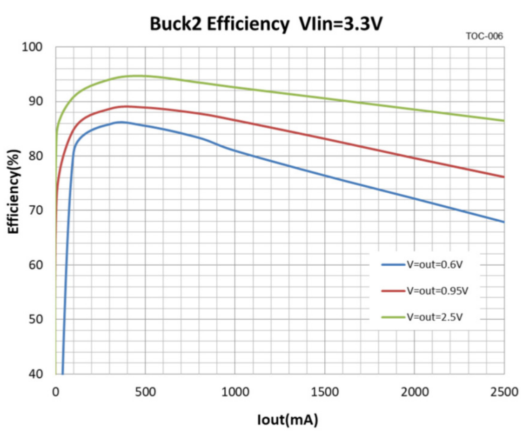


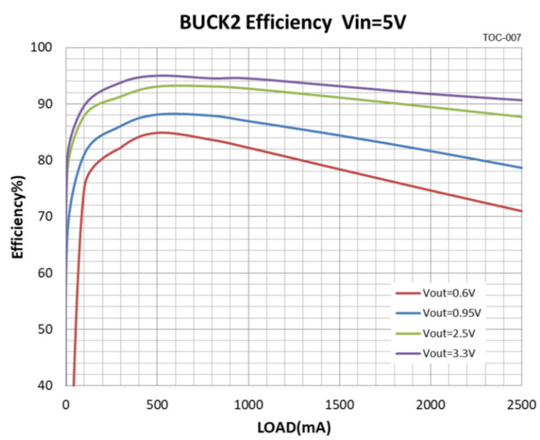
Buck4
1.2V to 1.1V

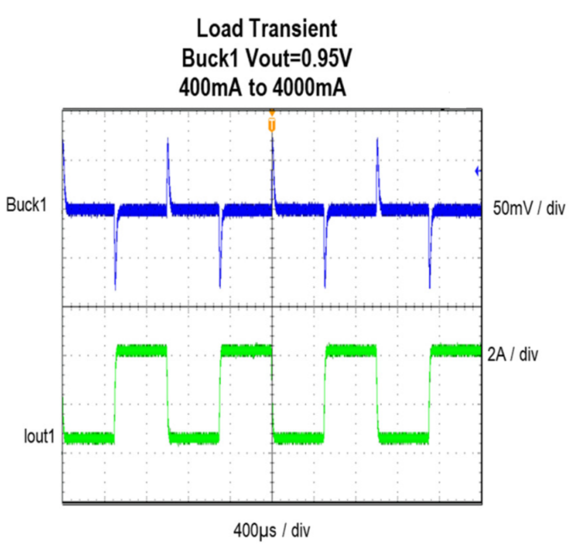


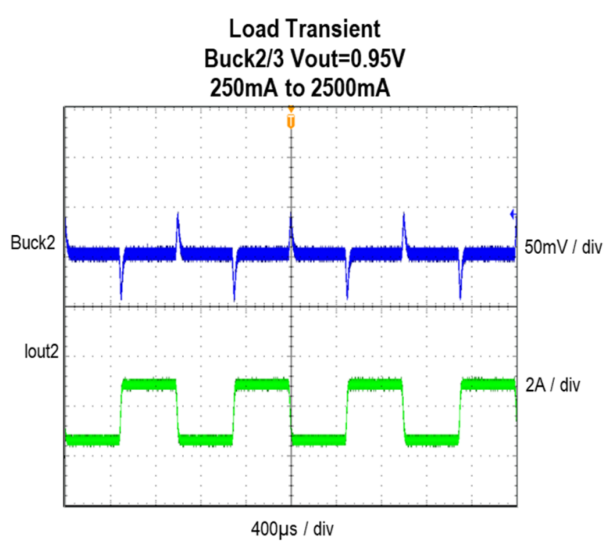

Buck1 Efficiency Vlin=3.3V
Efficiency(%)
Iout(mA)
V=out=0.6V
V=out=0.95V
V=out=2.5V


Buck1 Efficiency Vin=5V
Efficiency%)
LOAD(mA)
Vout=0.6V
Vout=0.95V
Vout=2.5V
Vout=3.3V

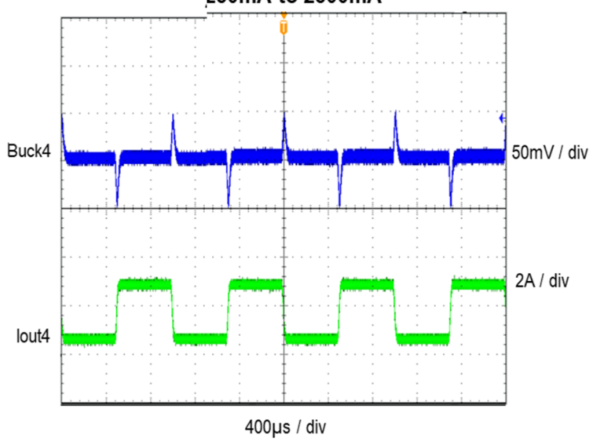

Buck2 Efficiency Vlin=3.3V
TOC-006
Efficiency(%)
Iout(mA)
V=out=0.6V
V=out=0.95V
V=out=2.5V


BUCK2 Efficiency Vin=5V
TOC-007
Efficiency%)
LOAD(mA)
Vout=0.6V
Vout=0.95V
Vout=2.5V
Vout=3.3V

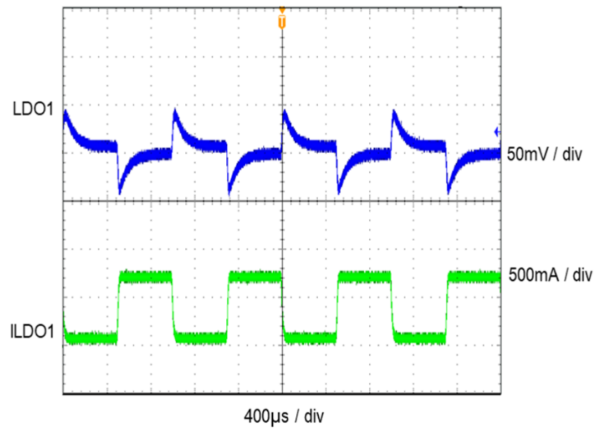

Load Transient
Buck1 Vout=0.95V
400mA to 4000mA
Buck1
50mV / div
2A / div
Iout1
400µs / div


Load Transient
Buck2/3 Vout=0.95V
250mA to 2500mA
Buck2
50mV / div
Iout2
2A / div
400µs / div

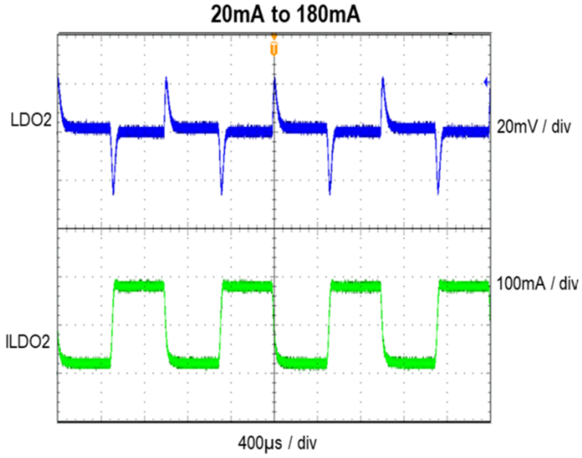
Load Transient
Buck4 Vout=1.2V
250mA to 2500mA



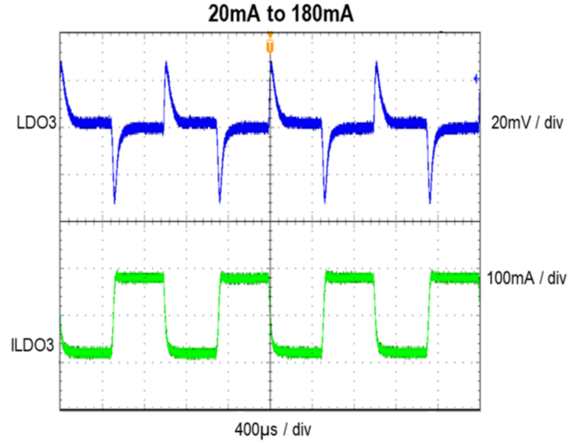
Load Transient
LDO1 Vout=1.8V
80mA to 720mA

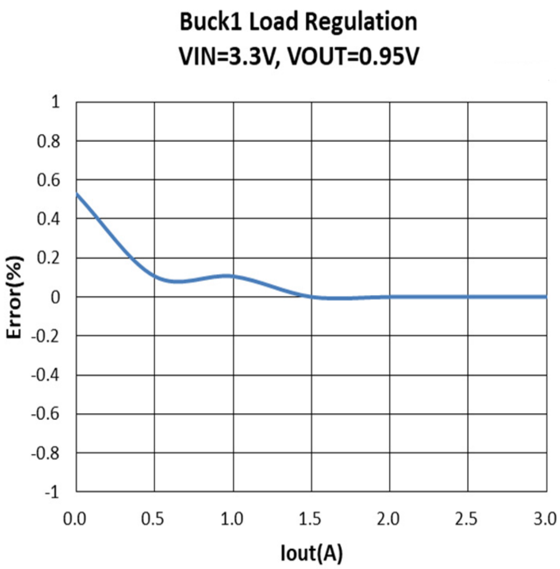


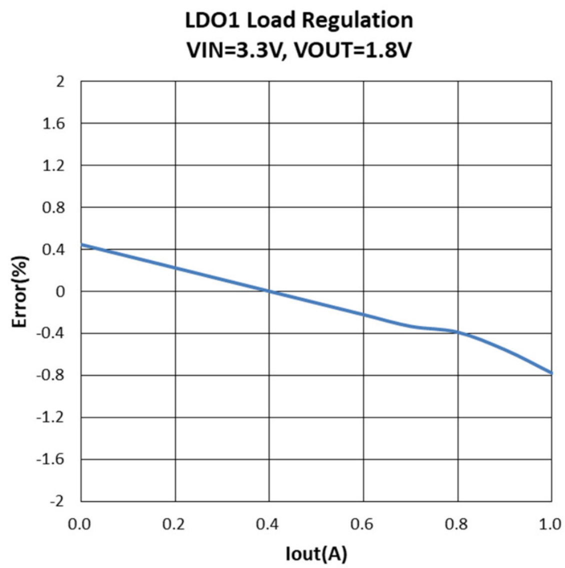
Load Transient
LDO2 Vout=1.8V
20mA to 180mA

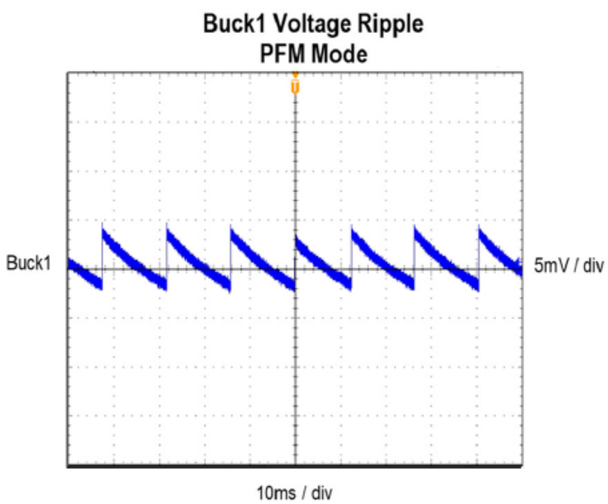


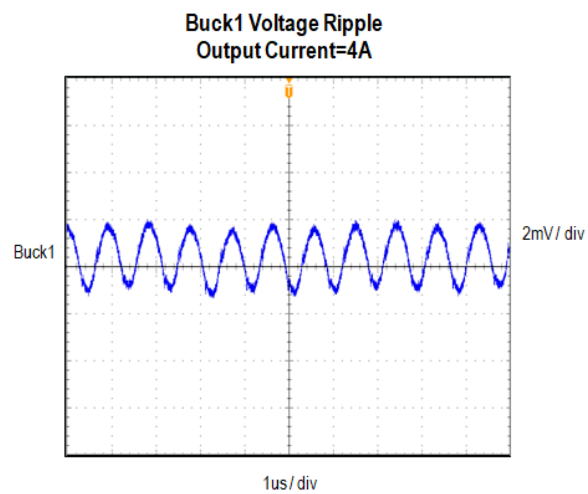
Load Transient
LDO3 Vout=2.5V
20mA to 180mA



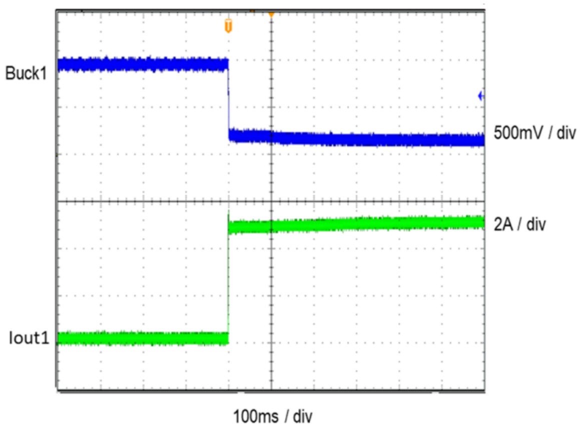

Buck1 Load Regulation
VIN=3.3V, VOUT=0.95V
Error(%)
Iout(A)


LDO1 Load Regulation
VIN=3.3V, VOUT=1.8V
Error(%)
Iout(A)

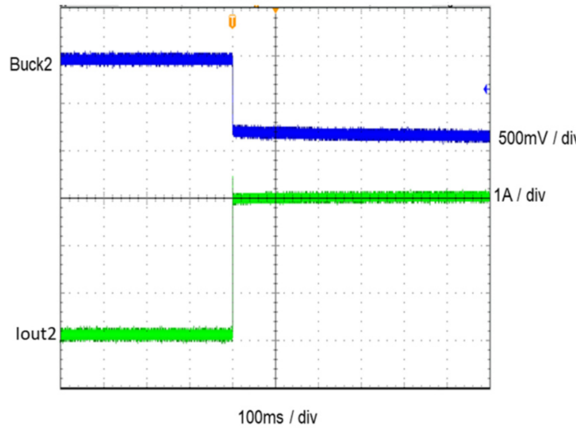

Buck1 Voltage Ripple
PFM Mode
Buck1
5mV / div
10ms / div


Buck1 Voltage Ripple
Output Current=4A
Buck1
2mV / div
1us / div

Short Circuit
Buck1



Short Circuit
Buck2/3/4



Schematic

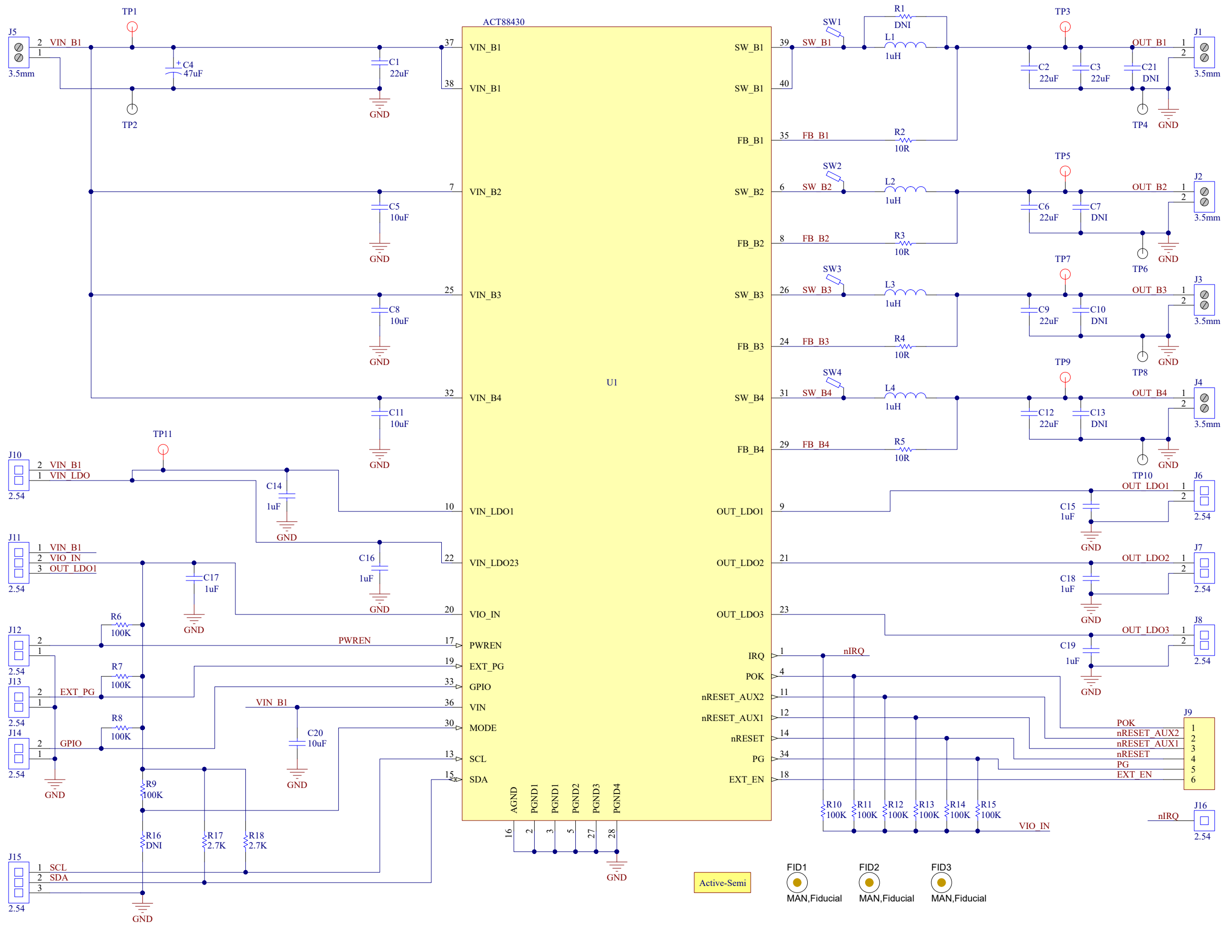


Figure 5 – ACT88430EVK1-101 Schematic

Layout

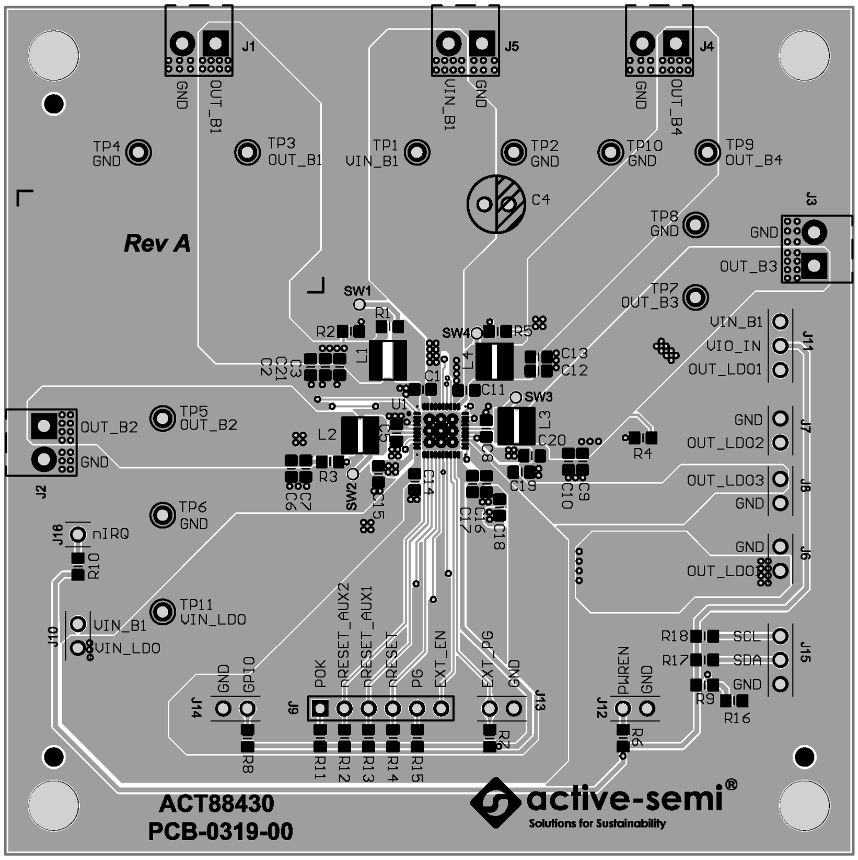


Figure 6 – Layout Top Assembly

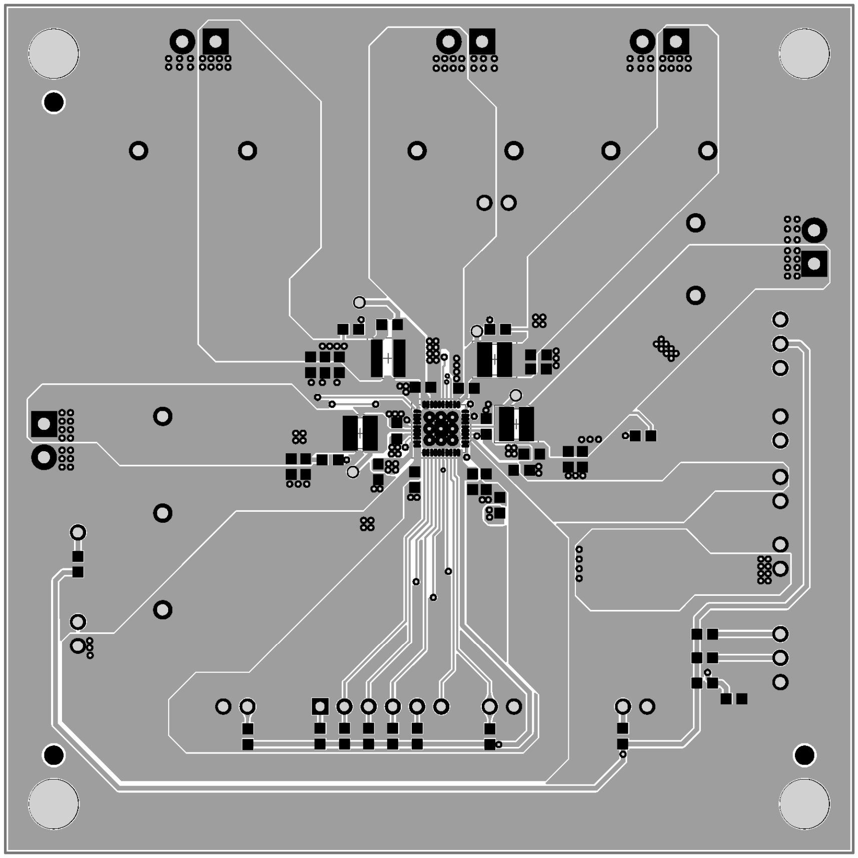


Figure 7 – Layout Top Layer

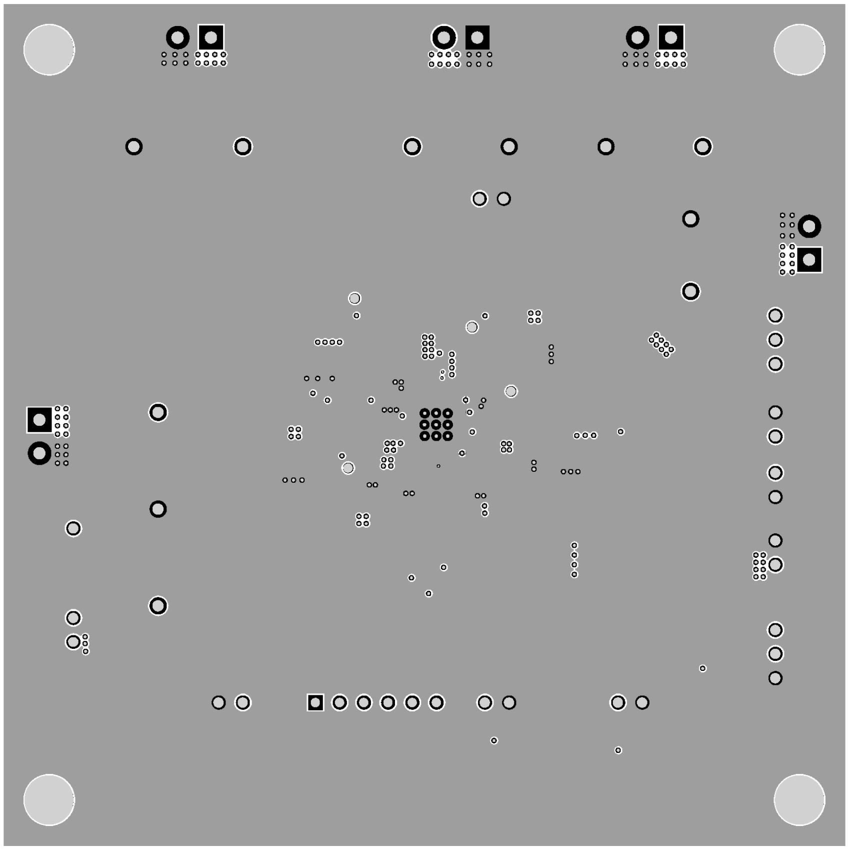


Figure 8 – Layout Layer 2

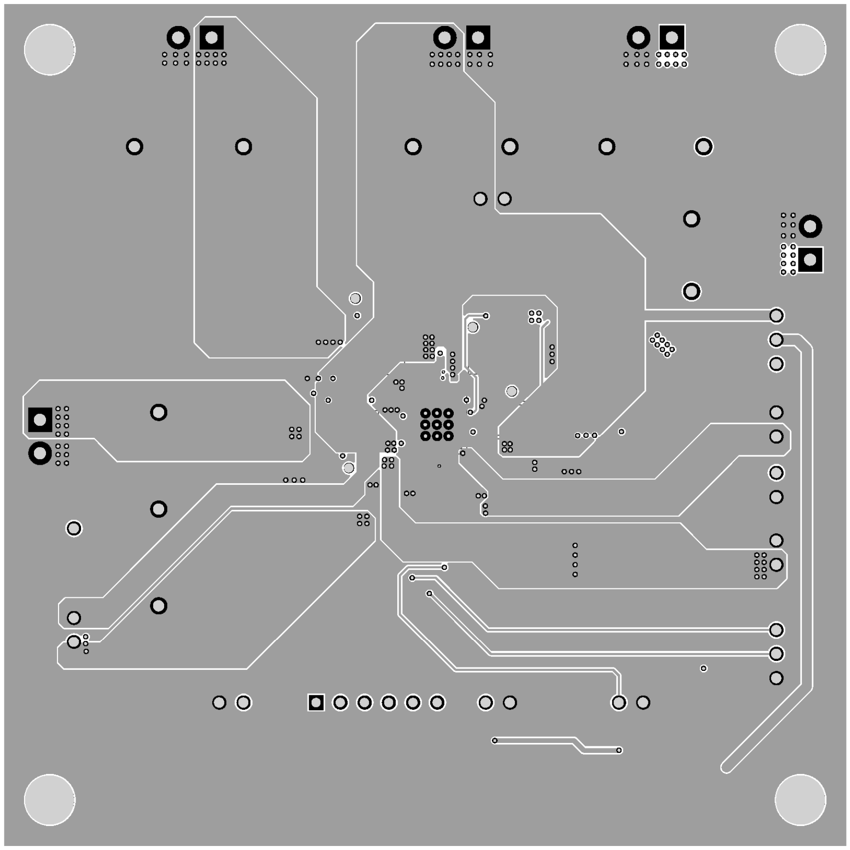


Figure 9 – Layout Layer 3

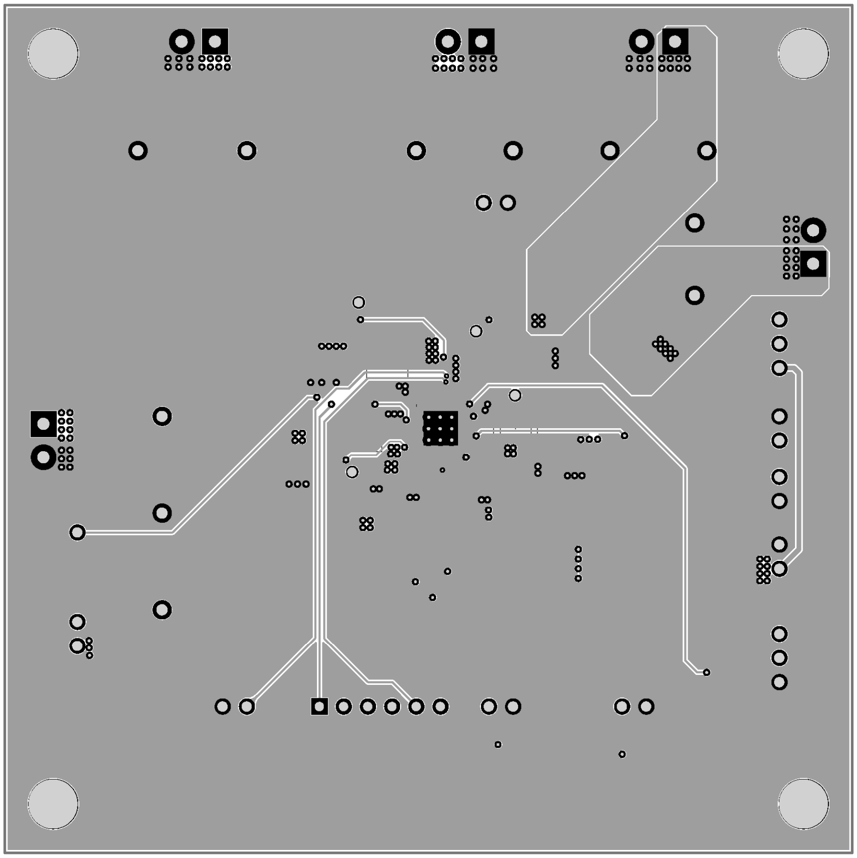


Figure 10 – Layout Bottom Layer

Bill of Materials

Table 2 - BOM

Item	Ref Des	QTY	Description	Package	MFR	Part Number
1	C1,C2,C3,C6,C9,C12	6	Cap, Ceramic, 22uF, 6.3V, 20%, X5R	0603	Samsung	CL10A226MQ8NRNC
5	C4	0	Cap, Aluminium Electro-lytic, 470uF, 10V	6.3x11mm	Capxon	KF471M010E110A
2	C5, C8, C11,C20	4	Cap, Ceramic, 10uF, 10V, 10%, X5R	0603	Samsung	CL10A106KP8NNNC
3	C7, C10, C13, C21	0	Cap, Ceramic, 22uF, 6.3V, 20%, X5R, DIPN	0603	Samsung	CL10A226MQ8NRNC
4	C14, C15, C16, C17, C18, C19	6	Cap, Ceramic, 1uF, 25V, 10%, X7R	0603	Yageo	std
6	L1,L2, L3, L4	4	Inductor, 1uH, 7.2A, 12mohm, SMD	4.1 x 4.1 x 2.1mm	Wurth Elektronik	74438356010
7	R1	0	Res, 0Ω, 5%	0603	Yageo	std
8	R2, R3, R4, R5	4	Res, 10Ω, 1%	0603	Yageo	std
9	R6, R7, R8, R10, R11, R12, R13, R14, R15	9	Res, 100kΩ, 5%	0603	Yageo	std
10	R9	0	Res, 100kΩ, 5%	0603	Yageo	std
11	R16	1	Res, 0Ω, 5%	0603	Yageo	std
12	R17,R18	2	Res, 2.7kΩ, 5%	0603	Yageo	std
13	TP1, TP3, TP5, TP7, TP9, TP11	6	Test Point, Red	0.063"	Keystone	5000
14	TP2, TP4, TP6, TP8, TP10	5	Test Point, BLK	0.063"	Keystone	5001
15	J1, J2, J3, J4, J5	5	CON, Screw Terminal, 3.50, 2P, KF350	3.50, 2P	Wurth Elektronik	691214110002
16	J6, J7, J8, J10, J12, J13, J14	7	Header, 2 pin, 100mil	254-2p	Wurth Elektronik	61300211121
17	J9	1	Header, 6 pin, 100mil	254-6p	Wurth Elektronik	61300611121
18	J11, J15	2	Header, 3 pin, 100mil	254-3p	Wurth Elektronik	61300311121
19	J16	1	Header, 1 pin, 100mil	254-1p	Wurth Elektronik	61300111121
20	U1	1	IC, ACT88430, Integrated PMU	QFN40	Active-semi	ACT88430QJ101
21	--	1	Shorting Jumper	n/a	Wurth Elektronik	60900213421
22	--	1	PCB	n/a	n/a	PCB-0319-00

GUI Installation

1. You can find the ACT88430 GUI files on the Active Semi website. 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.

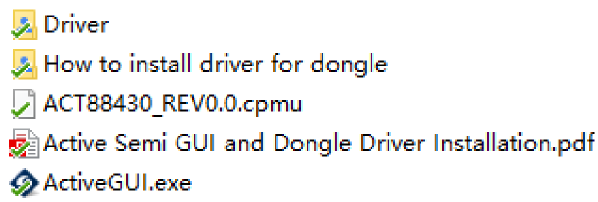


Figure 11 – Dongle Driver

4. Double click on the Active GUI.exe to start the ACT88430 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.

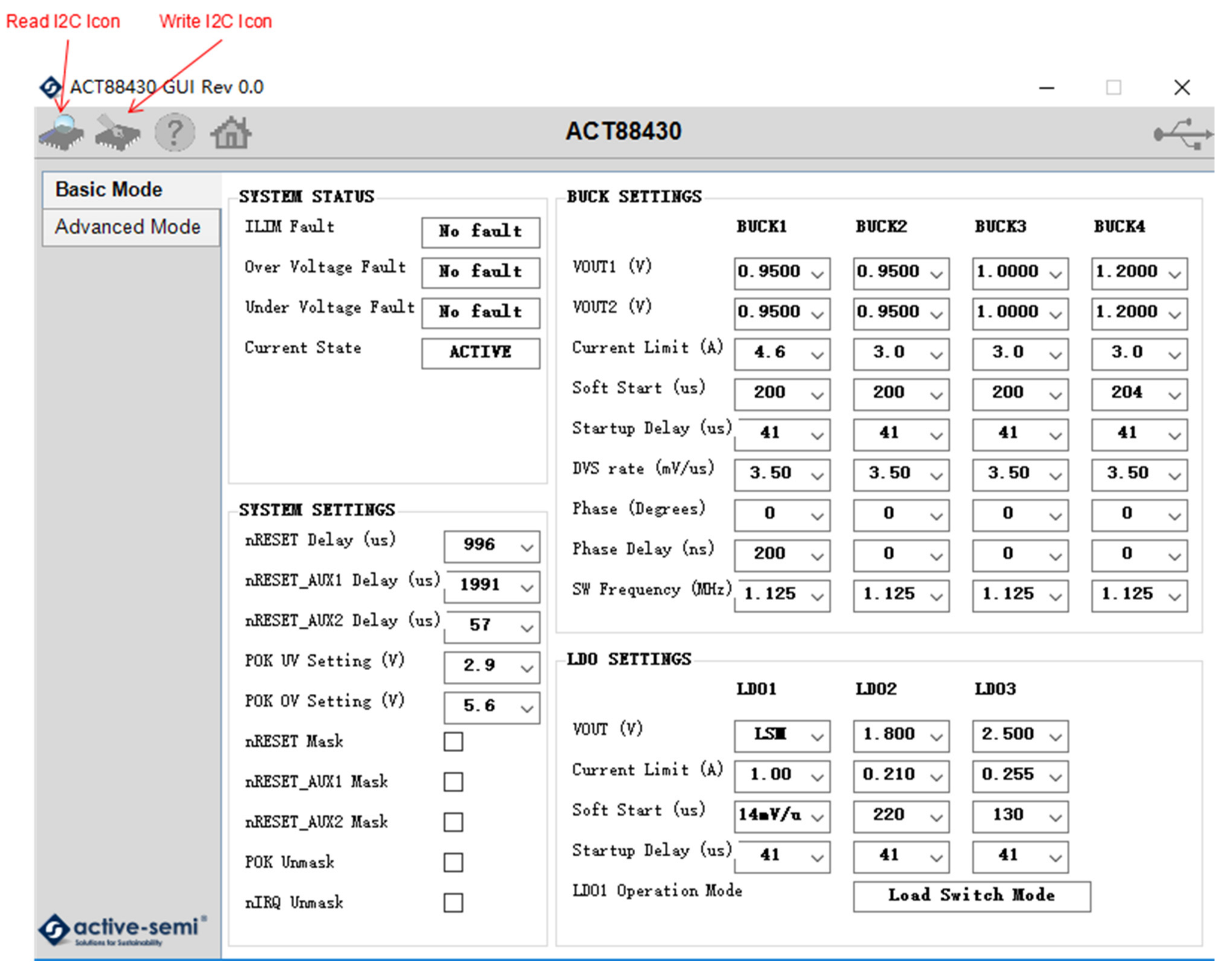


Figure 12 – GUI Basic Mode

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.

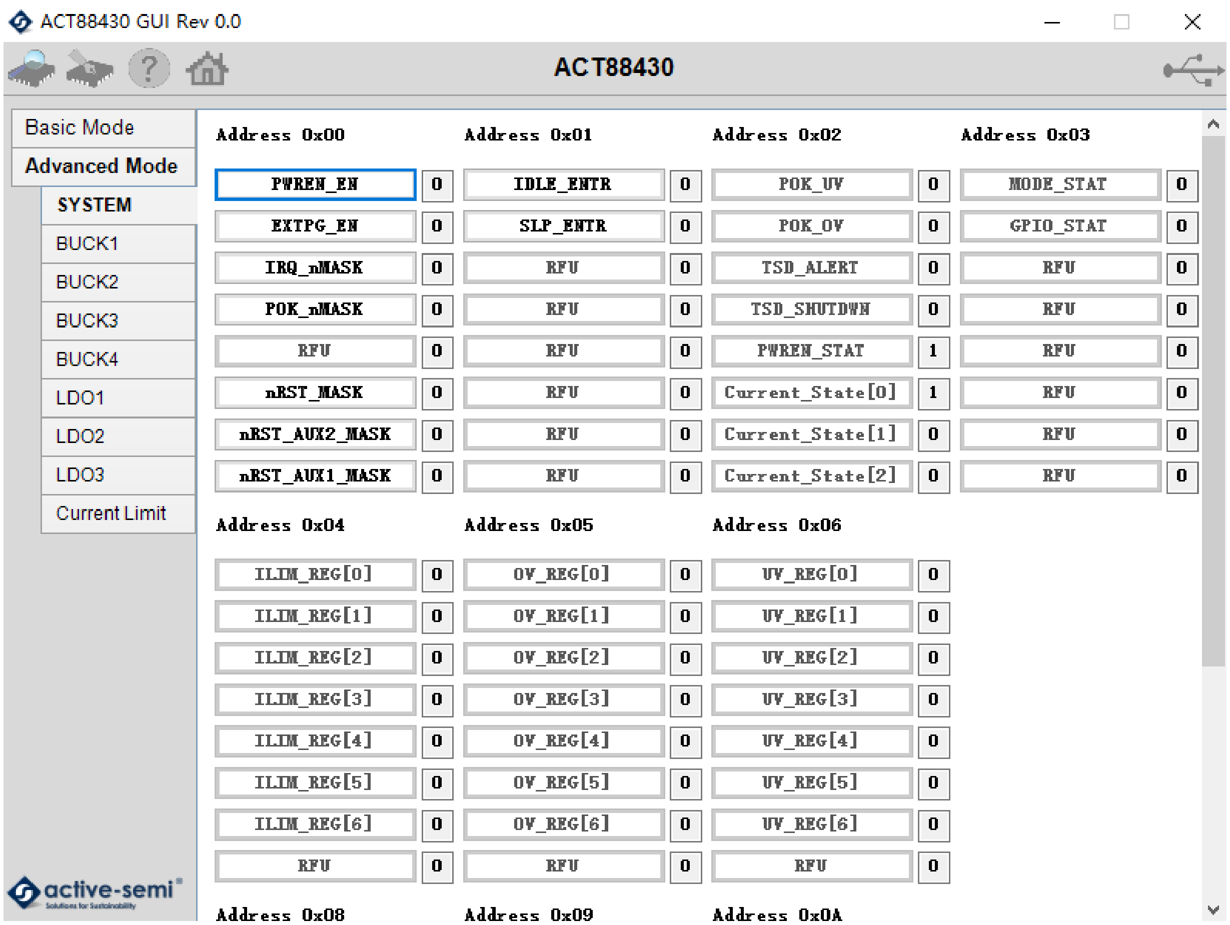


Figure 13 – GUI Advanced Mode

Button Descriptions

Read: Clicking on this button reads the ACT88430 registers and displays them in the GUI. Note that this reads all registers. Active-Semi recommends reading registers each time the ACT88430 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.

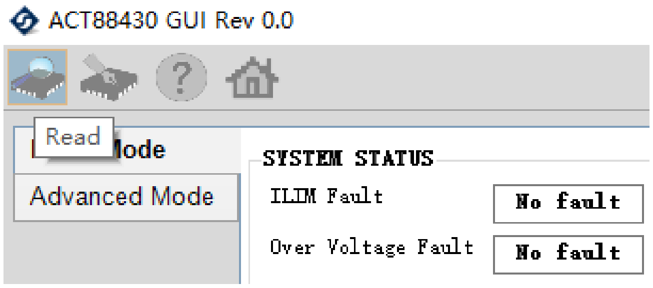


Figure 14 – Read Button

Write: Clicking on this button writes the GUI settings to the ACT88430's registers. All registers are written, regardless of whether or not they were changed.

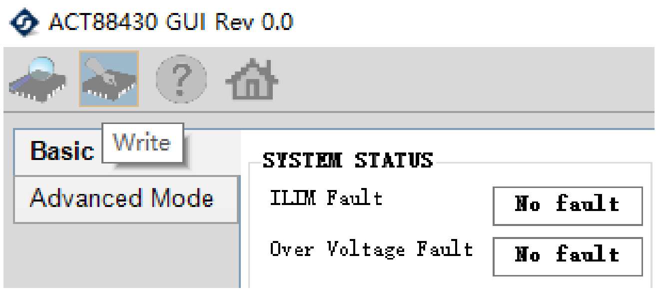


Figure 15 – Write Button

Dongle Connection Status: The GUI also contains a dongle is connected status which indicates that Active-Semi's USB-TO-I2C dongle is connected to the USB port of the driver installed. The figure below shows the two possible indication status graphics.

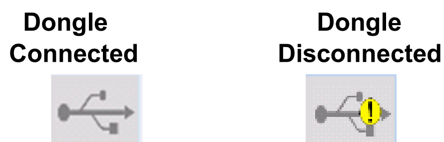


Figure 16 – Dongle Connection Status