ACT88422EVK1-101 User's Guide

Description

This document describes the characteristic and operation of the Qorvo ACT88422EVK1-101 evaluation kit (EVK). It provides setup and operation instructions, schematic, layout, BOM, and test data. This EVK demonstrates the ACT88422-101 Qorvo PMU power management IC. Other ACT88422-xxx 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 Qorvo'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 ACT88422EVK1-101 is specifically configured for the ACT88422-101. This CMI does not use the Push-Button.

Figure 1 – EVK Picture

Setup

Required Equipment

ACT88422 EVK

USB-TO-I2C Dongle

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

Oscilloscope – >100MHz, >2 channels

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

Digital Multi-meters (DMM)

Windows compatible computer with spare USB port.

EVK Setup

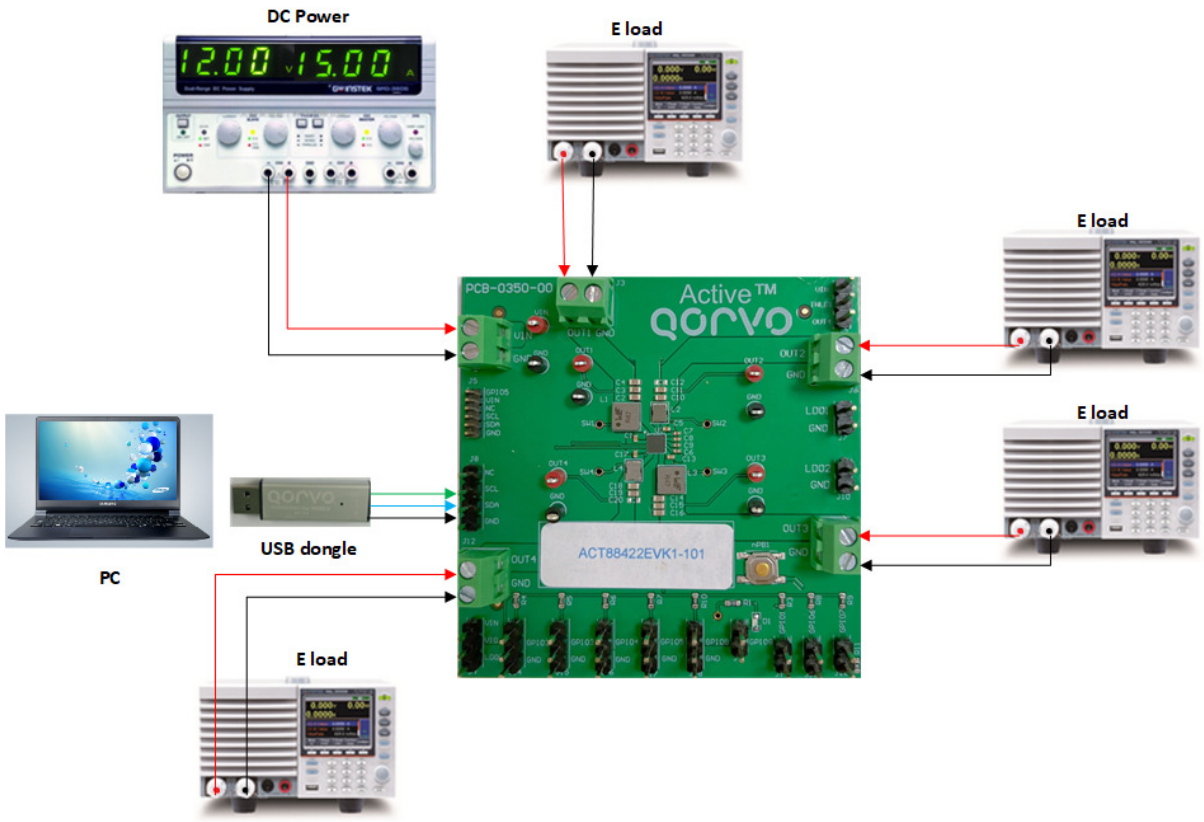


Figure 2 – EVK Setup

Hardware Setup

1. Decide which voltage will power VIO_IN. Qorvo recommends powering VIO_IN from the VIN input. Connect a shorting jumper between J4-1 and J4-2 header to power VIO_IN from the VIN input voltage.
2. Connect a jumper between J2-1 and J2-2 header to power VIN_LDO1 from VIN input voltage.
3. No jumpers are needed for GPIO2/3/4. These are three state GPIOs and can accept a floating input. Leaving these open sets the following:
    a. Buck1=VSET0=2.5V
    b. Buck2=VSET0=0.91V
    c. Buck3=VSET1=0.78V
    d. Buck4=Buck mode set to VSET1=1.2V
    e. LDO1=1.8V
4. No jumper is needed for GPIO6. GPIO6 has a pullup resistor to VIO which sets LDO2 in LDO mode to1.8V.
5. No jumper is needed for GPIO7. GPIO7 is configured to EXT_PG (active low) mode for POR default.
6. No jumper is needed for GPIO8. GPIO8 is configured to EXT_PG (active low) mode for POR default.
7. Connect an appropriate load to each power supply output.
8. 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.

Figure 3 – Shorting Jumper Settings

GUI Setup (optional)

1. Refer to the end of this document for detailed instructions to install the ACT88422 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 J8 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 toward the lower left corner of the Dongle.

Dongle Cable Connctor (black wire connected to GND of the J8 I2C jumper on the ACT88420 EVK board)

Figure 4 – USB-TO-I2C Dongle Connection

EVK Design Parameters

The ACT88422EVK1-101 is designed for a 3.3V input voltage. Table1 shows the Regulators’ output voltage and the current supply capability.

Table 1. EVK Design Parameters

Parameter	Description	Min	Typ	Max	Unit
VIN	Operation Input range of Power Supply	2.7	3.3	3.7	V
OUT1	Buck1 output voltage (floating GPIO2)		2.5		V
OUT2	Buck2 output voltage (floating GPIO2)		0.91		V
OUT3	Buck3 output voltage (floating GPIO3)		0.78		V
OUT4	Buck4 output voltage (floating GPIO4)		1.2		
LDO1	LDO1 output voltage		1.8		
LDO2	LDO2 output voltage (GPIO6=H)		1.8		
Io_OUT1	Buck1 load current		2		A
Io_OUT2	Buck2 load current		1.5		A
Io_OUT3	Buck3 load current		2.5		A
Io_OUT4	Buck4 load current		1.5		A
Io_LDO1	LDO1 load current		0.2		A
Io_LDO2	LDO2 load current		0.02		A

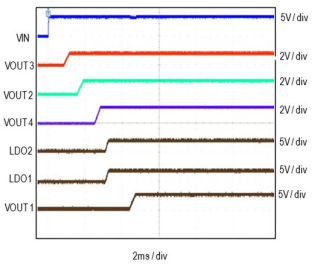
EVK Operation

Turn-on

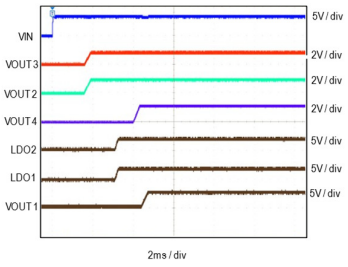
Apply the 3.3V input voltage. All outputs automatically turn on with the *programmed startup sequence*.

Test Results

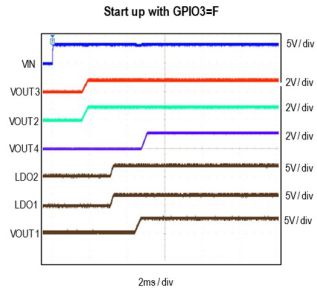
Start up with hot plug



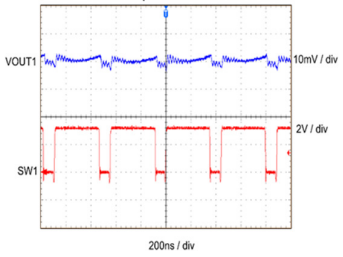
Start up with GPIO3=H



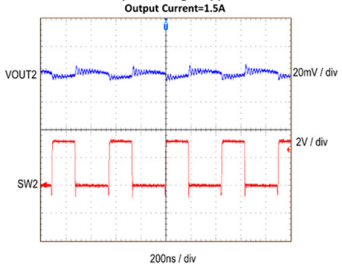
Start up with GPIO3=F



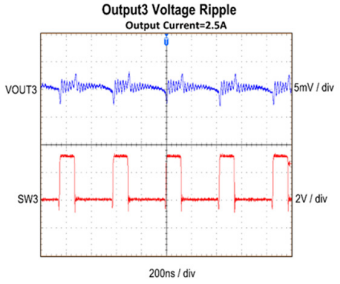
Output1 Voltage Ripple
Output Current=2A



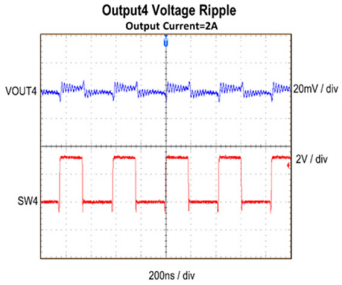
Output2 Voltage Ripple
Output Current=1.5A



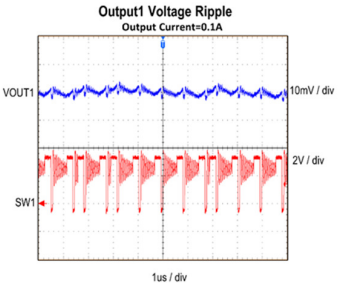
Output3 Voltage Ripple
Output Current=2.5A

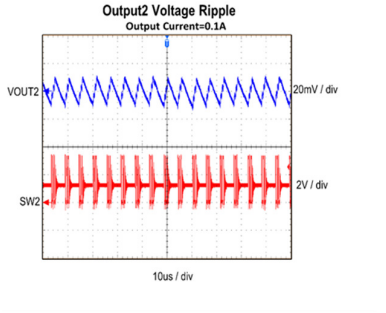


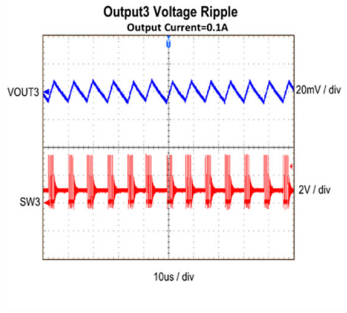
Output4 Voltage Ripple
Output Current=2A

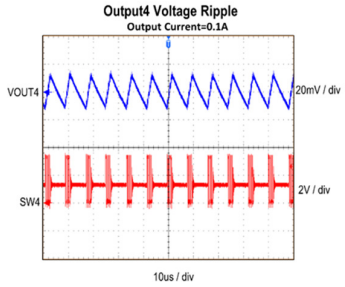


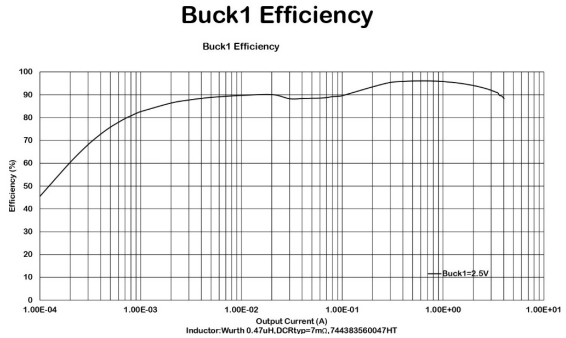
Output1 Voltage Ripple
Output Current=0.1A

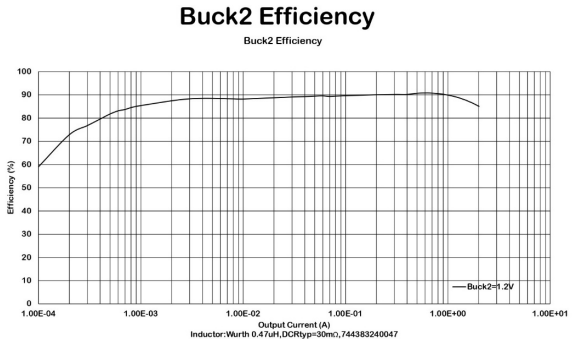


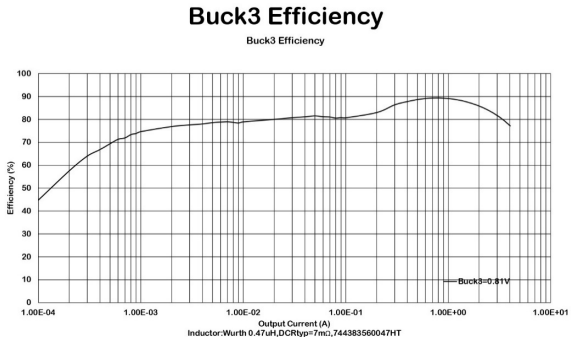

Output2 Voltage Ripple
Output Current=0.1A
VOUT2
20mV / div
SW2
2V / div
10us / div

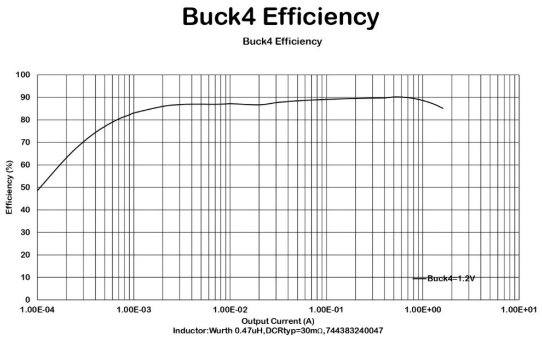

Output3 Voltage Ripple
Output Current=0.1A
VOUT3
20mV / div
SW3
2V / div
10us / div

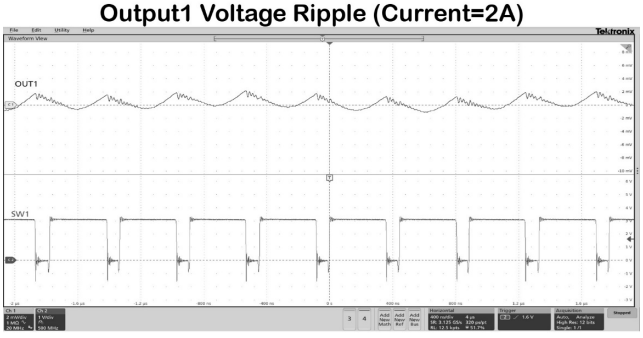

Output4 Voltage Ripple
Output Current=0.1A
VOUT4
20mV / div
SW4
2V / div
10us / div


Buck1 Efficiency
Buck1 Efficiency
Efficiency (%)
Buck1=2.5V
Output Current (A)
Inductor:Wurth 0.47uH,DCRtyp=7mΩ,744383560047HT

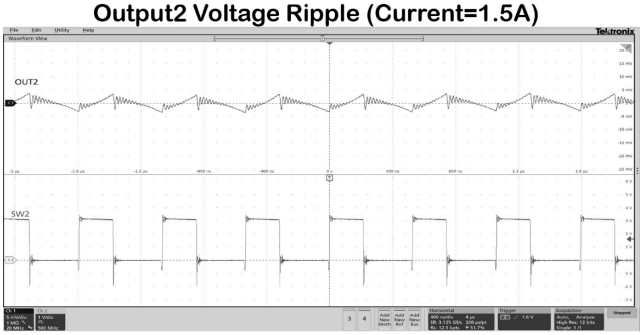

Buck2 Efficiency
Buck2 Efficiency
Efficiency (%)
Buck2=1.2V
Output Current (A)
Inductor:Wurth 0.47uH,DCRtyp=30mΩ,744383240047


Buck3 Efficiency
Buck3 Efficiency
Efficiency (%)
Buck3=0.81V
Output Current (A)
Inductor:Wurth 0.47uH,DCRtyp=7mΩ,744383560047HT

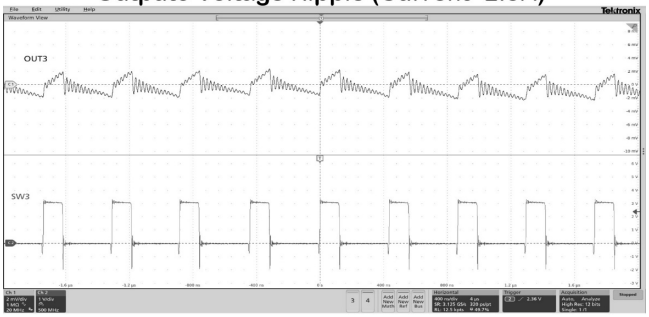

Buck4 Efficiency
Buck4 Efficiency
Efficiency (%)
Buck4=1.2V
Output Current (A)
Inductor:Wurth 0.47uH,DCRtyp=30mΩ,744383240047


Output1 Voltage Ripple (Current=2A)
Tektronix
OUT1
SW1

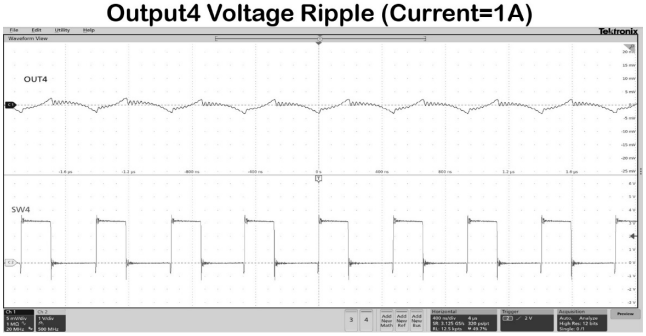
Output2 Voltage Ripple (Current=1.5A)



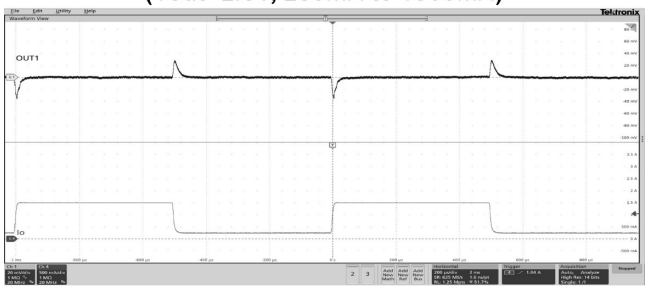
Output3 Voltage Ripple (Current=2.5A)



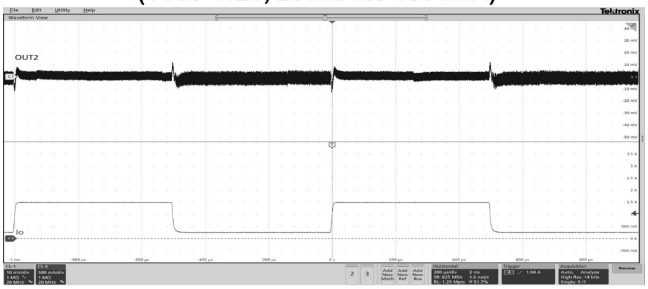
Output4 Voltage Ripple (Current=1A)



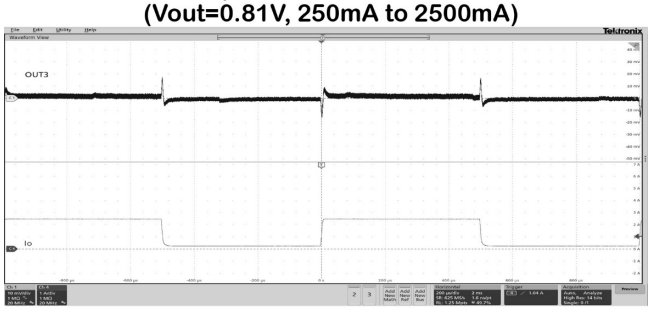
Output1 Load Transient
(Vout=2.5V, 250mA to 1500mA)



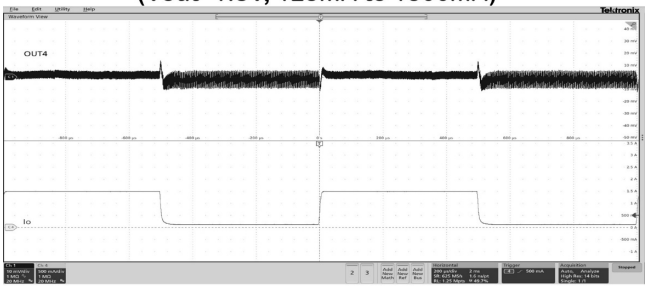
Output2 Load Transient
(Vout=1.2V, 250mA to 1500mA)



Output3 Load Transient
(Vout=0.81V, 250mA to 2500mA)



Output4 Load Transient
(Vout=1.8V, 125mA to 1500mA)



Schematic

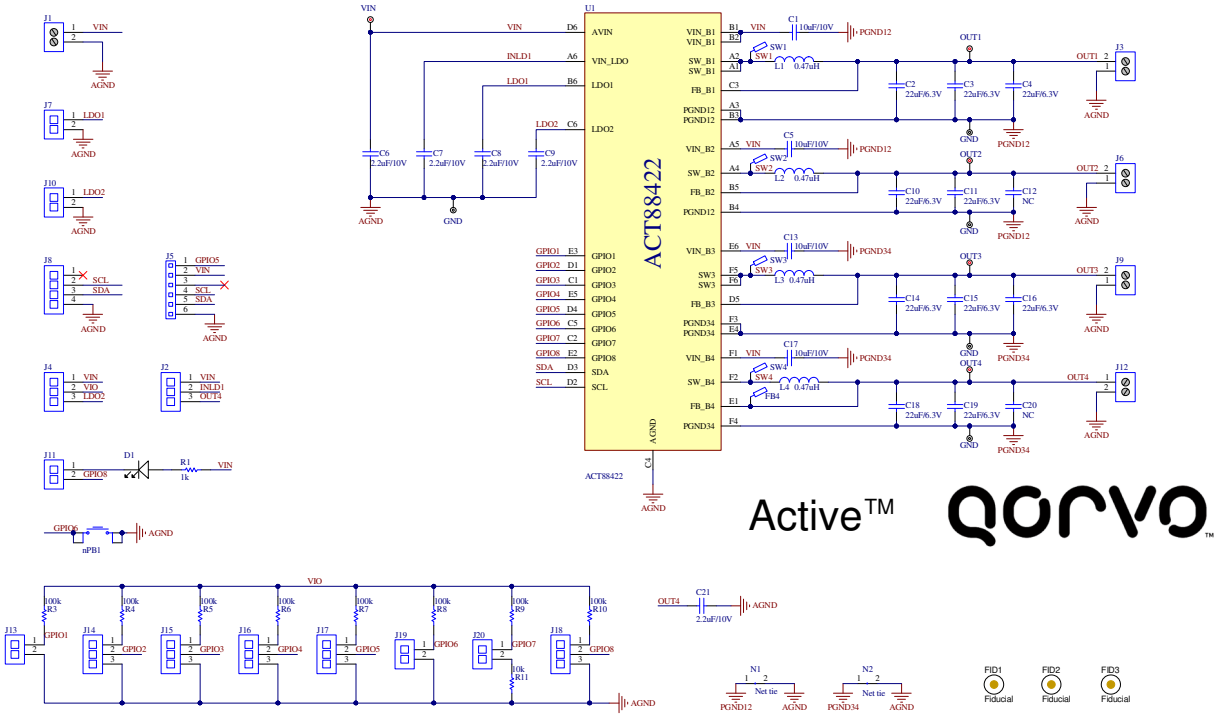


Figure 5 – ACT88422EVK1-101 Schematic

Bill of Materials

Table 2 - BOM

Item	Designator	Quantity	Description	Package	Manufacturer	Part Number
1	C2, C3, C4, C10, C11, C14, C15, C16, C18, C19	12	Capacitor, Ceramic, 22uF/6.3V,20%, X5R	'0603	Standard	Standard
2	C12, C20	0	Capacitor, Ceramic, 22uF/6.3V,20%, X5R	'0603	Standard	Standard
3	C1, C5, C13, C17	4	Capacitor, Ceramic, 10uF/10V,20%, X5R	'0402	Standard	Standard
4	C6, C7, C8, C9	4	Capacitor, Ceramic, 2.2uF/10V,20%, X5R	'0402	Standard	Standard
5	C21	0	Capacitor, Ceramic, 2.2uF/10V,20%, X5R	'0402	Standard	Standard
6	J1, J3, J6, J9, J12	5	CON, Screw Terminal, 3.50, 2P	con, tbk,350-2p, kf350	Wurth	691214110002S
7	J7, J10, J11, J13, J19, J20	6	CON, Header, 2.54, Male, 2P, TH	con, hdr,254-2p	Wurth	61300211121
8	J2, J4, J14, J15, J16, J17, J18	7	CON, Header, 2.54, Male, 3P, TH	con, hdr,254-3p	Wurth	61300311121
9	J8	1	CON, Header, 2.54, Male, 4P, TH	con, hdr,254-4p	Wurth	61300411121
10	J5	1	CON, Header, 1.27, Male, 6P, TH	con, hdr,1.27-6P	Digikey	GRPB061VWVN-RC
11	D1	1	Diode, Led, Blue	WL-SMCW_0603	std	std
12	L1, L3	2	Inductor, 0.47uH	L4020_MAPI_R - cover-pk-L2520	Wurth	744383560047HT
13	L2, L4	2	Inductor, 0.47uH	L25xx_MAPI_R - cover L2010	Wurth	744383240047
14	R3, R4, R5, R6, R7, R8, R9, R10	8	Resistor, SMD,100k, 5%	R0603_M	Standard	Standard
15	R11	1	Resistor, SMD,10k, 5%	R0603_M	Standard	Standard
16	R1	1	Resistor, SMD,1k, 5%	R0603_M	Standard	Standard
17	nPB1	1	Switch, TSW, TE-1437565-0	SW, TSW, TE-1437565-0	std	std
18	GND, GND, GND, GND, GND	5	TEST POINT PC MINI .040"D BLK	tpt, key-stone-5001	KeyStone	5001
19	VIN, OUT1, OUT2, OUT3, OUT4	5	TEST POINT PC MINI .040"D RED	tpt, key-stone-5000	KeyStone	5000
20	U1	1	IC, ACT88422_WLCSP	WLCSP36(6x6)	Qorvo	ACT88422-101T
21	PCB-0350-02	1	PCB	N/A	N/A	PCB-0350-02
22	Label	1	ACT88422EVK1-101, Arail, 6	N/A	N/A	N/A
23	Jumper	3	J2(VIN to INLD1), J4(VIN to VIO), J20(GPIO7 to GND)	N/A	N/A	N/A

Layout

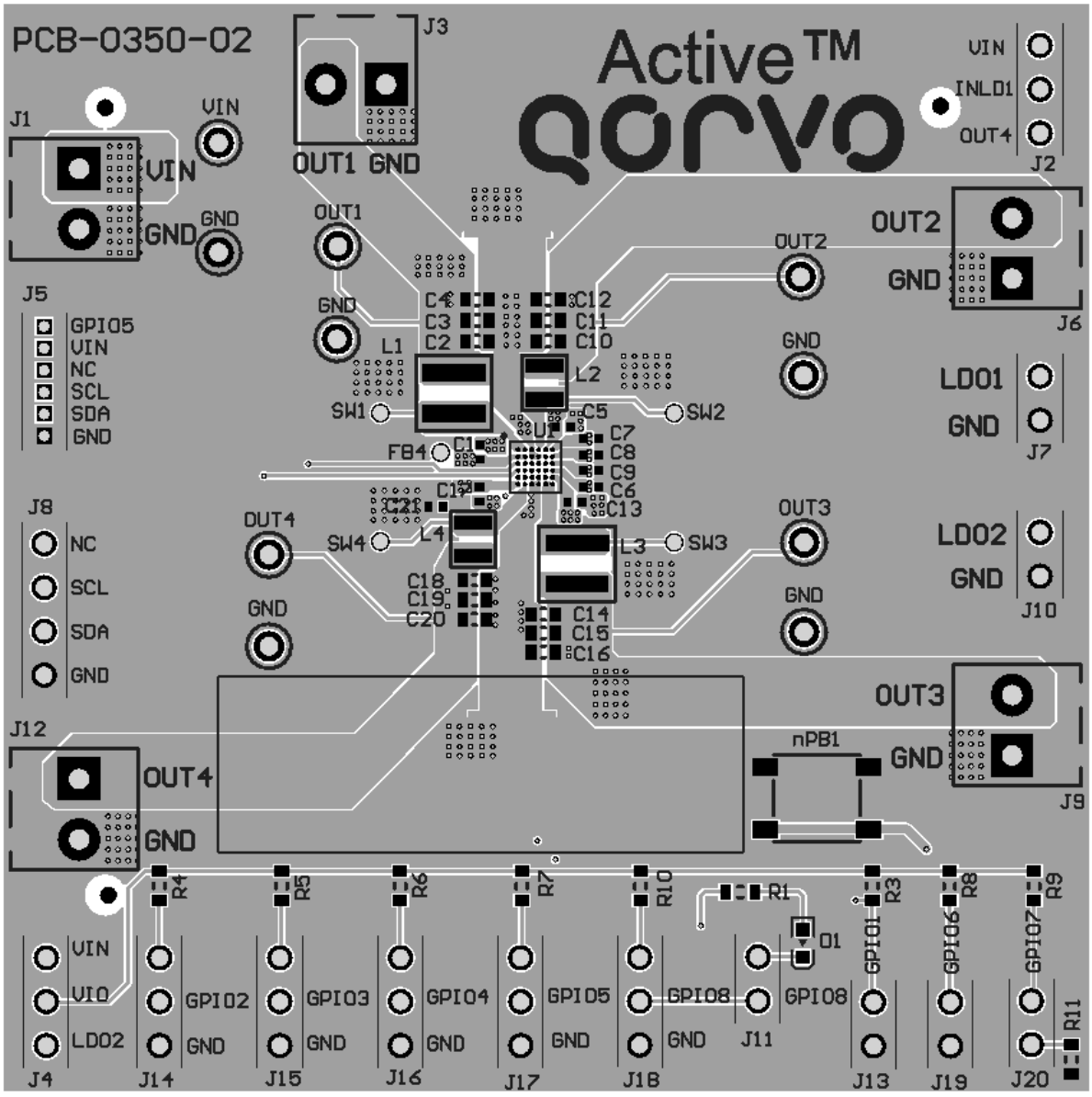


Figure 6 – Layout Top Assembly

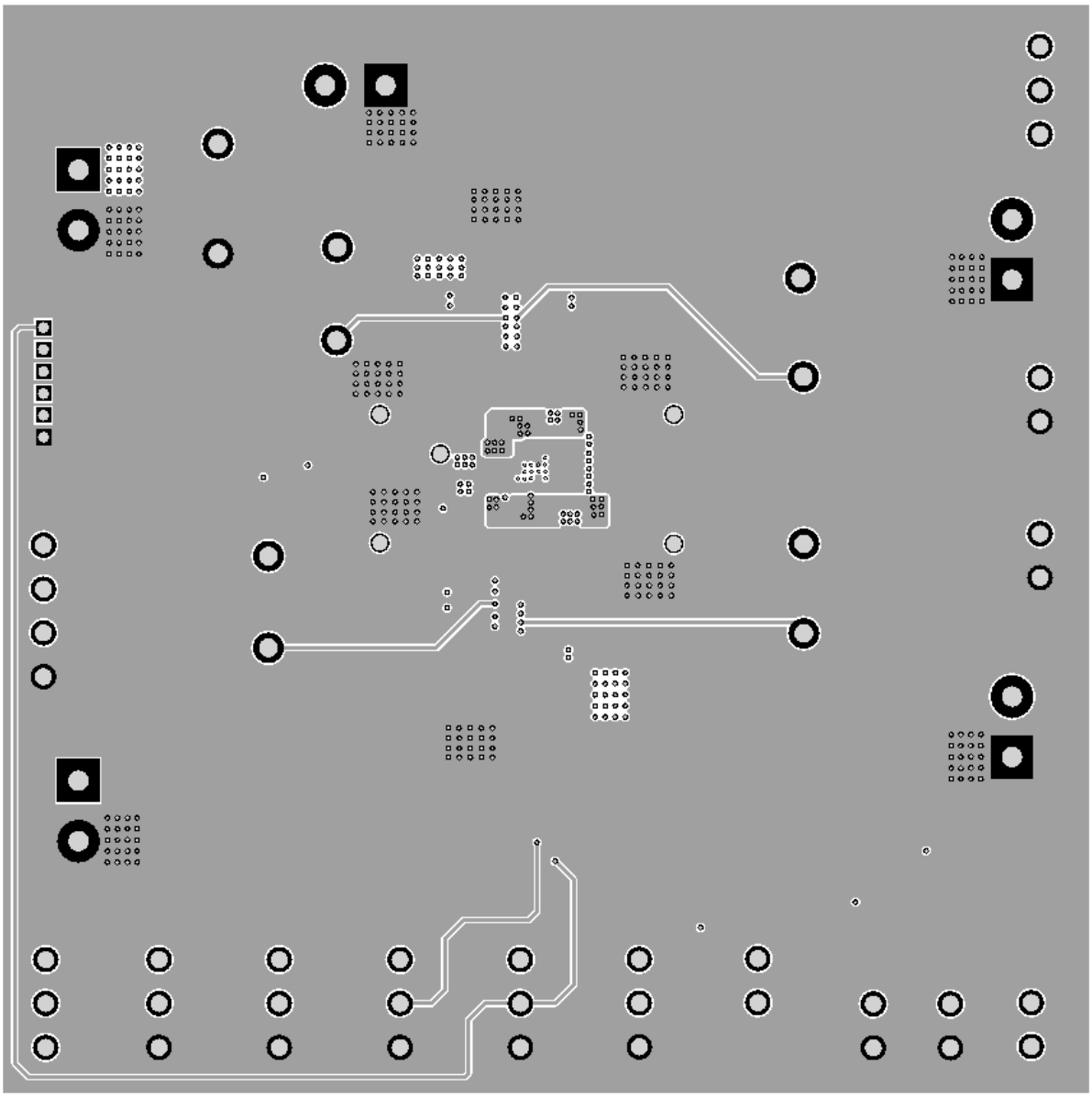


Figure 7 – Layout GND Layer

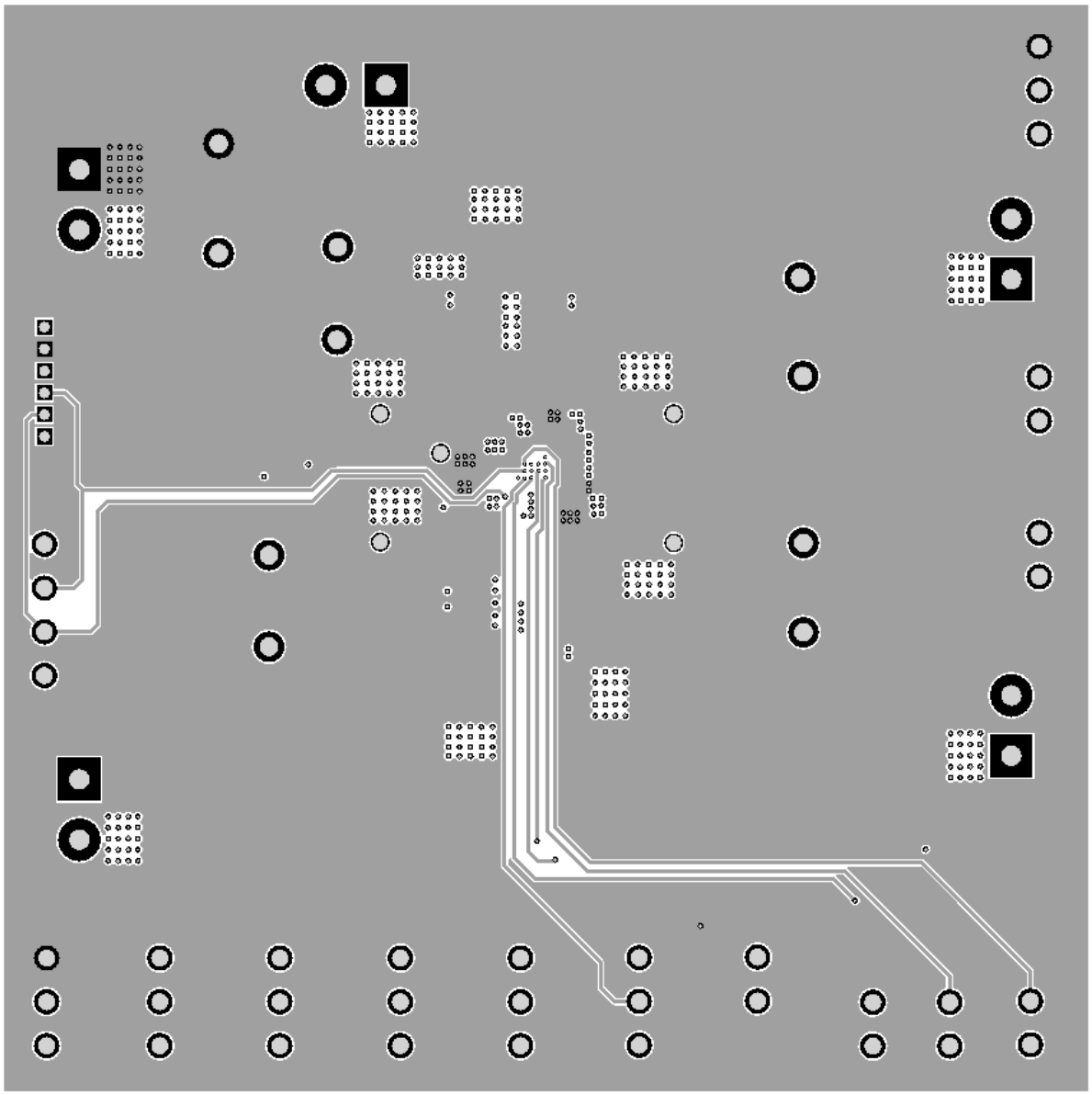


Figure 8 – Layout VIN Layer

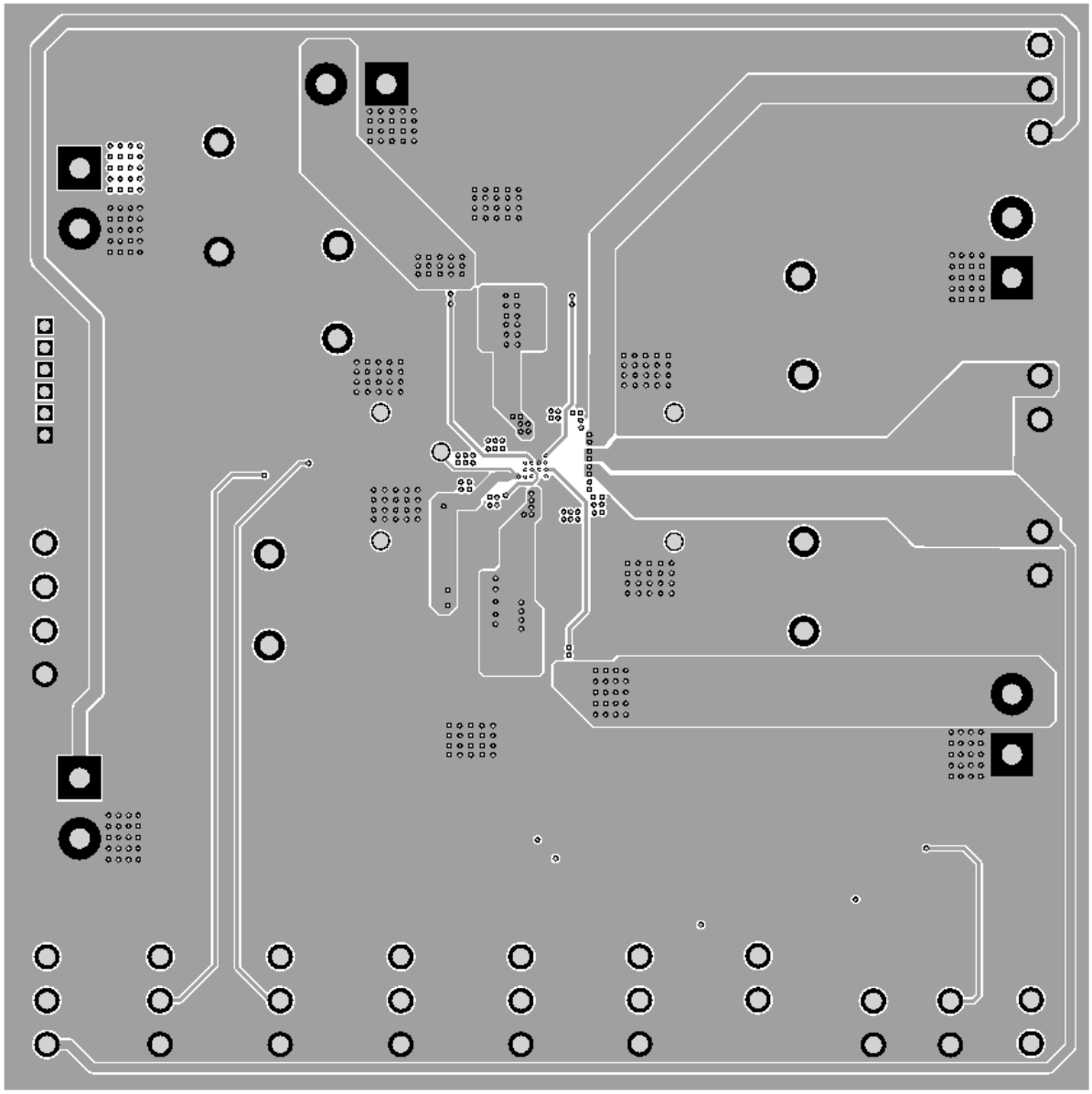


Figure 9 – Layout Bottom Layer

GUI Installation

1. Download the GUI files from Qorvo's website and save them on your computer.
2. Plug the USB-TO-I2C dongle into a free USB port.
3. Double click on the ACT88422 GUI.exe to start the ACT88422 GUI.

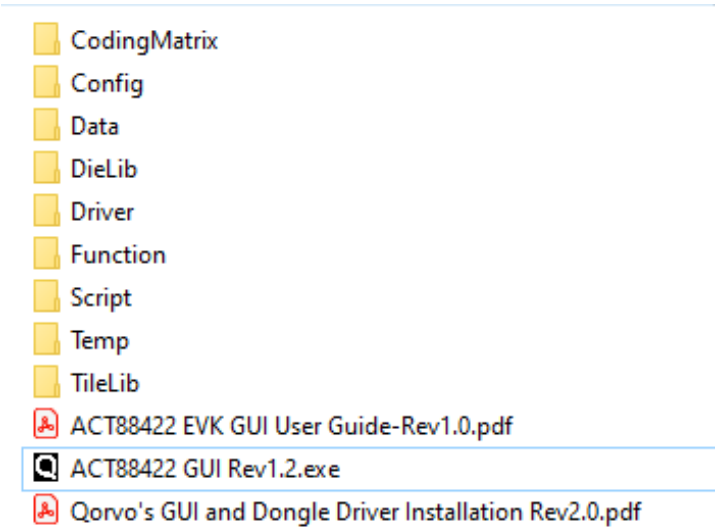


Figure 10 – Dongle Driver

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: Configuration Mode and Regulator Mode. In Configuration Mode screen it displays each regulator's basic information on a single page, all the information is user configurable via the drop-down boxes. Regulator Mode allows the user to view and change the IC's advanced internal registers of each regulator.

Configuration Mode

Click the "Configuration" button in the left of the GUI screen to see the basic user programmable options. This display mode allows user to change some basic settings of each regulator (voltages, current…). User can use either the mouse scroll or the right-side scroll bar to navigate to other regulators. Using drop-boxes, left-click the small arrow next to the value, then a selection pop-up displays all possible options to choose from. Scroll up/down to find the target value and left-click to select it. After the required parameters are changed, click the "Write" button to transfer the changes from the GUI to the IC.

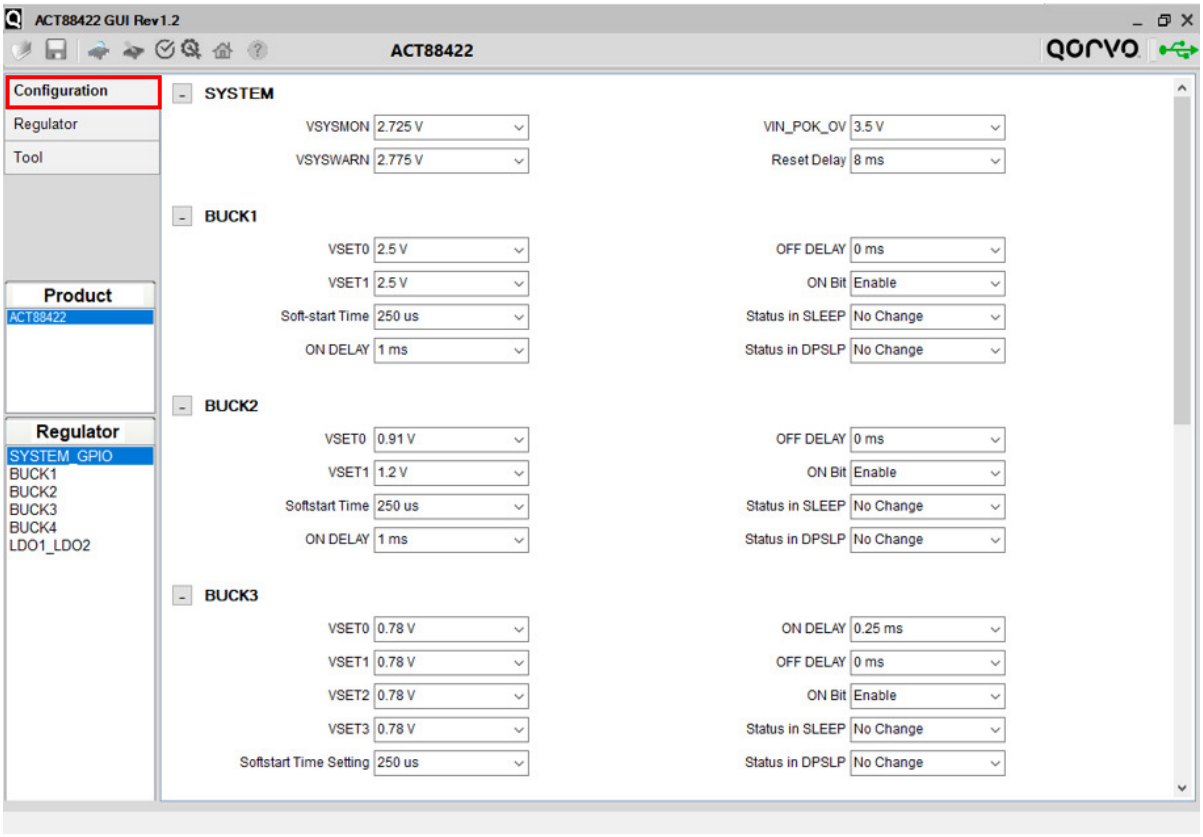


Figure 11 – GUI Configuration Mode

Regulator Mode

Click the “Regulator” button in the left of the GUI screen to see all available user programmable options. In the left side of the screen, click on the Tiles Selector to choose which regulator or LDO’s to show. There are two tabs for each tile, “Setting “and “Register”.

The “Settings” tab is easy to read and has drop down menus that show the available choices. The “Registers” tab shows the actual register values required to achieve a desired setting.

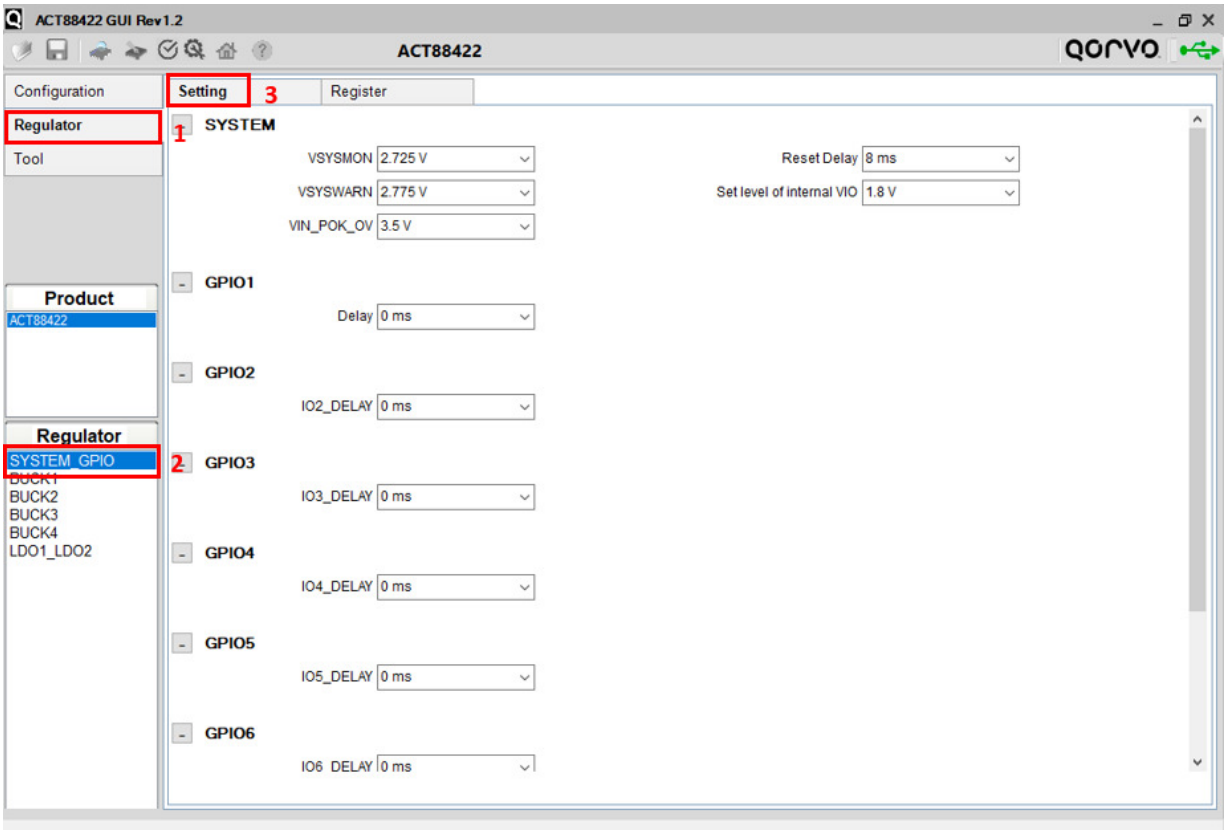


Figure 12 – GUI Setting Tab of Regulator Mode

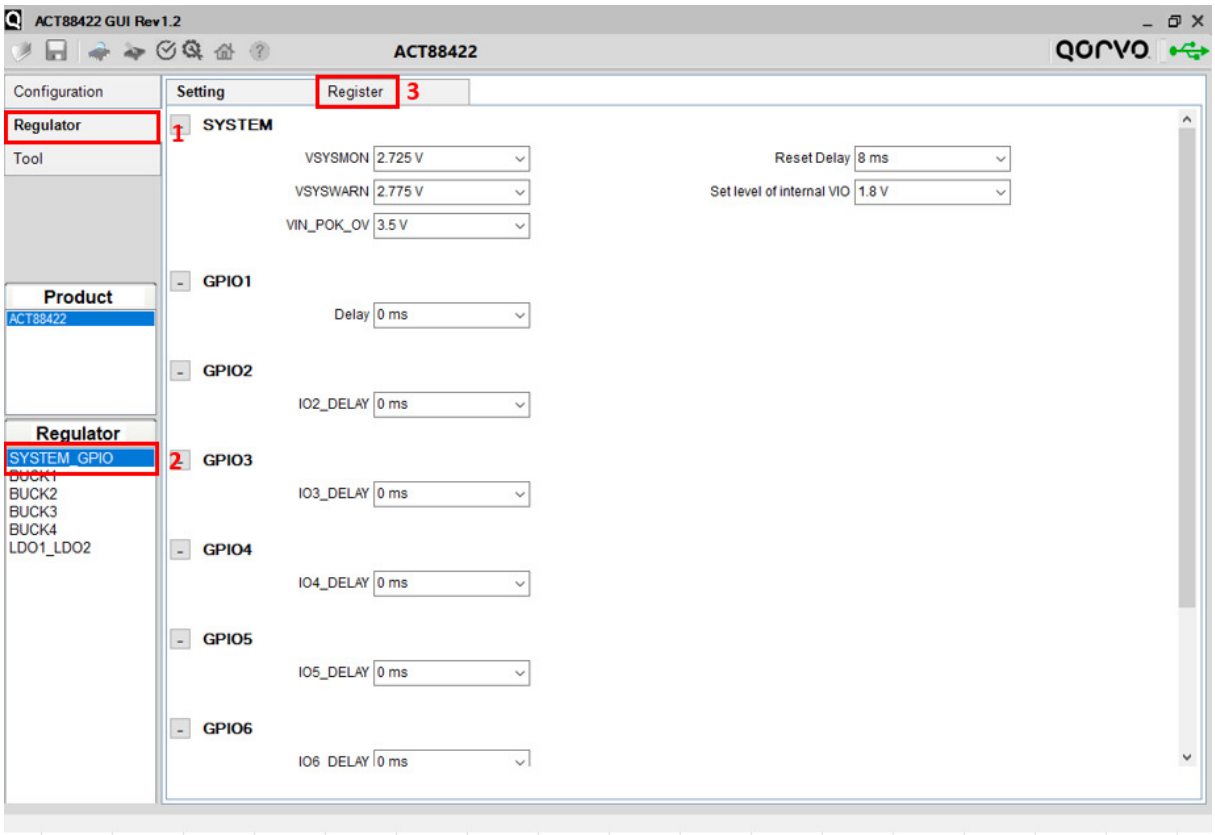


Figure 13 – GUI Register Tab of Regulator Mode

Button Descriptions

Read: Clicking on this button reads the ACT88422 registers and displays them in the GUI. Note that this reads all registers. Active-Semi recommends reading registers each time the ACT88422 powers-up to acquire the initial register settings. Qorvo 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.

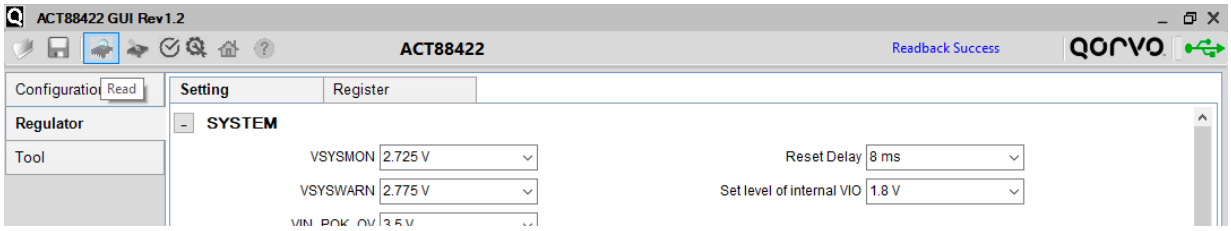


Figure 14 – Read Button

Write: Clicking on this button writes the GUI settings to the ACT88422's registers. All registers are written, regardless of whether or not they were changed.

Note: Remember that changes to the GUI settings are not transferred into the IC until the GUI's "Write" button is pressed.

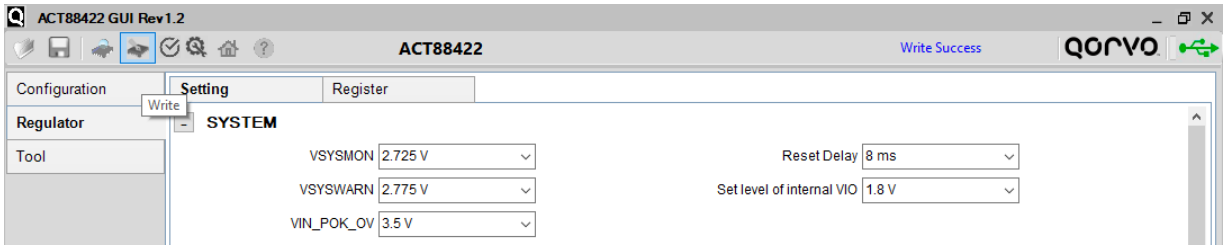


Figure 15 – Write Button

Confirm: Confirm function allows user to compare the ACT88422's registers information on GUI with the values read from IC.

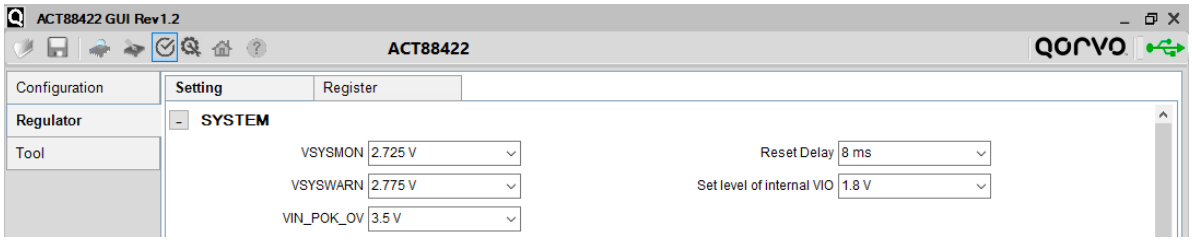


Figure 16 – Confirm Button

I2C Configuration: I2C configuration function allows user to select one of the ACT88422's I2C addresses for Read/Write function.

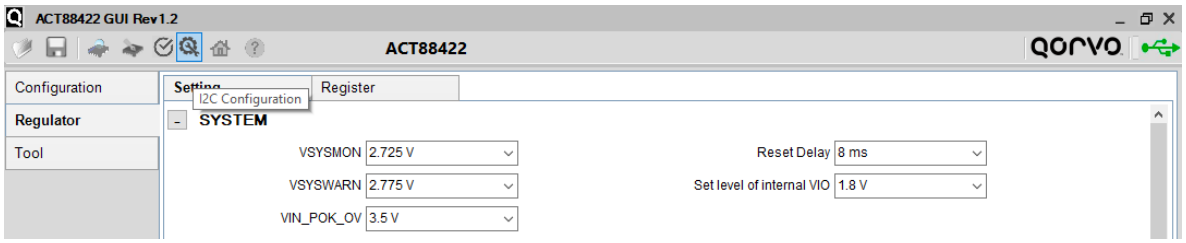


Figure 17 – I2C Configuration Button

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 18 – Dongle Connection Status