UM11907

PCA9452A-EVK evaluation board

Rev. 1.0 — 9 February 2024 **User manual**

Document information

Information	Content
Keywords	PCA9452A, PMIC, i.MX 93x auto
Abstract	This document describes the operation of the PCA9452A-EVK evaluation board

Important notice

IMPORTANT NOTICE

For engineering development or evaluation purposes only

NXP provides the product under the following conditions:

This evaluation kit is for use of ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY.

It is provided as a sample IC pre-soldered to a printed-circuit board to make it easier to access inputs, outputs and supply terminals. This evaluation board may be used with any development system or other source of I/O signals by connecting it to the host MCU computer board via off-the-shelf cables. This evaluation board is not a Reference Design and is not intended to represent a final design recommendation for any particular application. Final device in an application heavily depends on proper printed-circuit board layout and heat sinking design as well as attention to supply filtering, transient suppression, and I/O signal quality.

The product provided may not be complete in terms of required design, marketing, and or manufacturing related protective considerations, including product safety measures typically found in the end device incorporating the product. Due to the open construction of the product, it is the responsibility of the user to take all appropriate precautions for electric discharge. In order to minimize risks associated with the customers' applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards. For any safety concerns, contact NXP sales and technical support services.

1 Introduction

The PCA9452A is a single chip Power Management IC (PMIC) designed to support the i.MX 93x processors family in both 1 cell Li-ion and Li-polymer battery portable application and 5 V adapter non-portable applications.

This document is the user manual for the PCA9452A evaluation kit. It is intended for the engineers involved in the evaluation, design, implementation, and validation of this single power management-integrated circuit PCA9452A.

The PCA9452A-EVK user manual covers information regarding connecting the hardware, installing the software and tools, configuring the environment and using the kit.

This customer evaluation board provides full access to all the features in the PCA9452A device.

2 PCA9452A key features

- Six high-efficiency step-down regulators
  - One 6 A dual phase buck regulator with DVS feature and remote sense
  - One 3 A buck regulator with DVS feature and remote sense
  - One 3 A buck regulator
  - Two 2 A buck regulators
- Five linear regulators
  - Two 10 mA LDOs
  - One 150 mA LDO
  - One 200 mA LDO
  - One 300 mA LDO
- 400 mA load switch with built-in active discharge resistor
- 32.768 kHz crystal oscillator driver and buffer output
- Two channel logic level translator
- Power control I/O
  - Power ON/OFF control
  - Standby/run mode control
- Fm+ 1 MHz I^2C-bus interface
- ESD protection
  - Human Body Model (HBM): +/- 2000 V
  - Charged Device Model (CDM): +/-500 V
- 8 mm × 8 mm, 56 pin HVQFN with 0.5 mm pitch

3 Applications

- Automotive Infotainment
- Heads up display (HUD)
- GPS
- Monitoring System
- IoT Devices
- High-end consumer and industrial

4 Finding kit resources and information on the NXP website

NXP Semiconductors provides online resources for evaluation boards and its supported device(s) on http://www.nxp.com.

The information page for evaluation boards is http://www.nxp.com/PCA9452A-EVK.

The information page provides overview information, documentation, software and tools, parametric, ordering information and a Getting Started tab. The Getting Started tab provides quick-reference information applicable to these evaluation boards, including the downloadable assets referenced in this document.

4.1 Collaborate in the NXP community

The NXP community is for sharing ideas and tips, asking and answering technical questions, and receiving input on just about any embedded design topic. The NXP community is at http://community.nxp.com.

5 Getting ready

Working with this evaluation board requires the evaluation kit components, additional hardware, and a Windows PC workstation with installed software.

5.1 Evaluation kit components

- 1x PCA9452A evaluation board, which allows easy evaluation on function and features
- 1x Interface (FTDI C232HM-DDHSL-0) cable, which serves as a USB to I^2C interface between the computer and the PCA9452A evaluation board.

5.2 Additional hardware

In addition to the kit components, the following hardware is necessary or beneficial when working with this kit.

- Power supply with a range of 3.0 V to 5.0 V and a current limit set initially to 1.0 A (maximum current consumption can be up to 7.0 A)
- Oscilloscope/multimeter
- Electronic load (optional) - each power rail output can be connected to e-load for testing

5.3 Windows PC workstation

This evaluation board requires a Windows PC workstation. Meeting these minimum specifications should produce great results when working with this evaluation board.

- USB-enabled computer with Windows 7, Windows 8, or Windows 10

5.4 PCA9452A-EVK GUI software

Installing software is necessary to work with this evaluation board.

- Go to http://www.nxp.com/PCA9452A-EVK.
- Extract the zip file PCA9452_EVB_GUI.zip into selected folder. No need to install. (if password is asked during unzip, then type “NXP”)
- Install the FTDI cable driver from website https://www.ftdichip.com/Drivers/D2XX.htm
- Run the file PCA9452.exe. The interface window is shown in Figure 1.

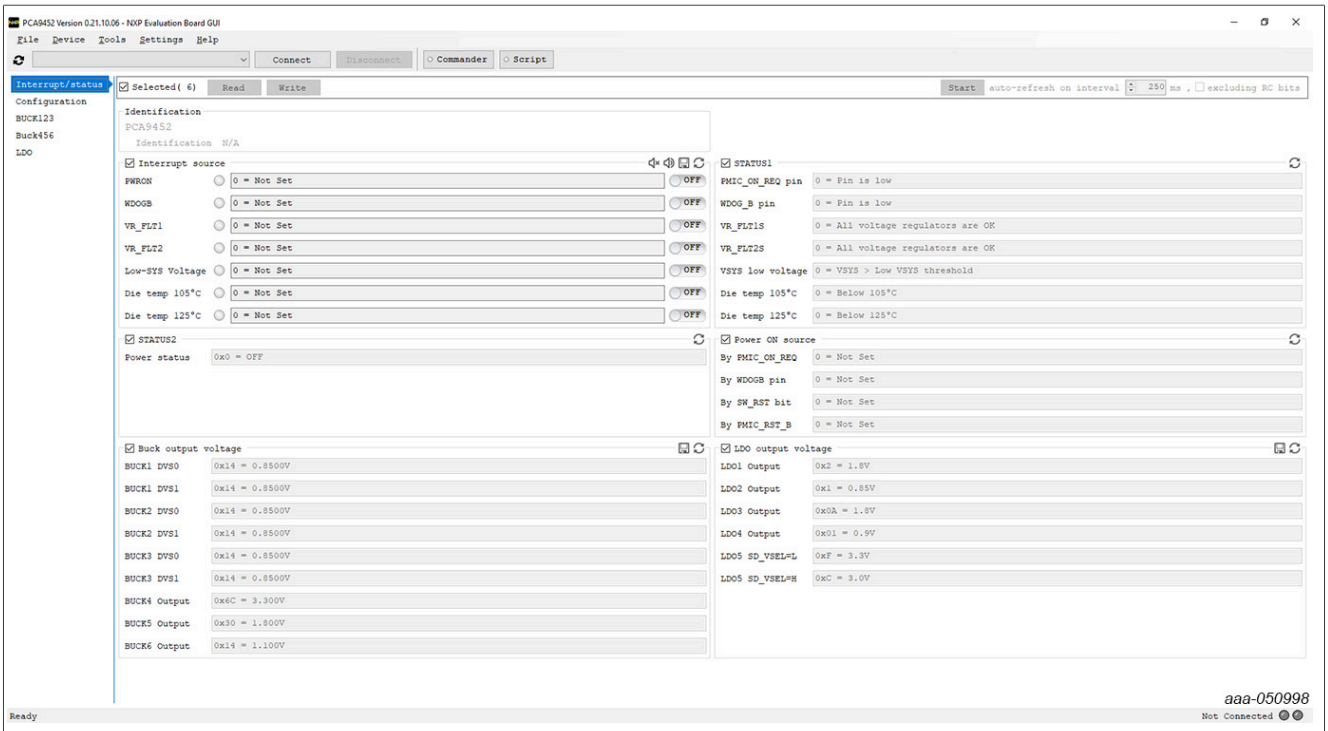

Figure 1. Interface window

6 Get to know the hardware

6.1 Kit overview

This evaluation board features the PCA9452A power management IC. The kit integrates all hardware needed to fully evaluate the PMIC. It integrates a communication bridge based on FTDI to interface with the PCA9452A GUI software interface to fully configure and control the PMIC.

6.1.1 Evaluation board features

- Six buck regulators
  - One 6 A buck regulator with DVS
  - One 3 A buck regulator with DVS
  - One 3 A buck regulator
  - Two 2 A buck regulators
- Four linear regulators
  - One 10 mA LDO
  - One 150 mA LDO
  - One 200 mA LDO
  - One 300 mA LDO
- 400 mA load switch with a built-in active discharge resistor
- 32.768 kHz crystal oscillator driver and buffer output
- Two-channel logic level translator
- System features
  - 2.85 V to 5.5 V operating input voltage range
  - Power ON/OFF control

- Standby/run mode control
- Smart DVS control
- Interrupt configuration
- Fm+ 1 MHz I^2C Interface (via FTDI USB to I^2C cable)

6.2 Kit featured components

Figure 2 helps to identify the different main components on the board.

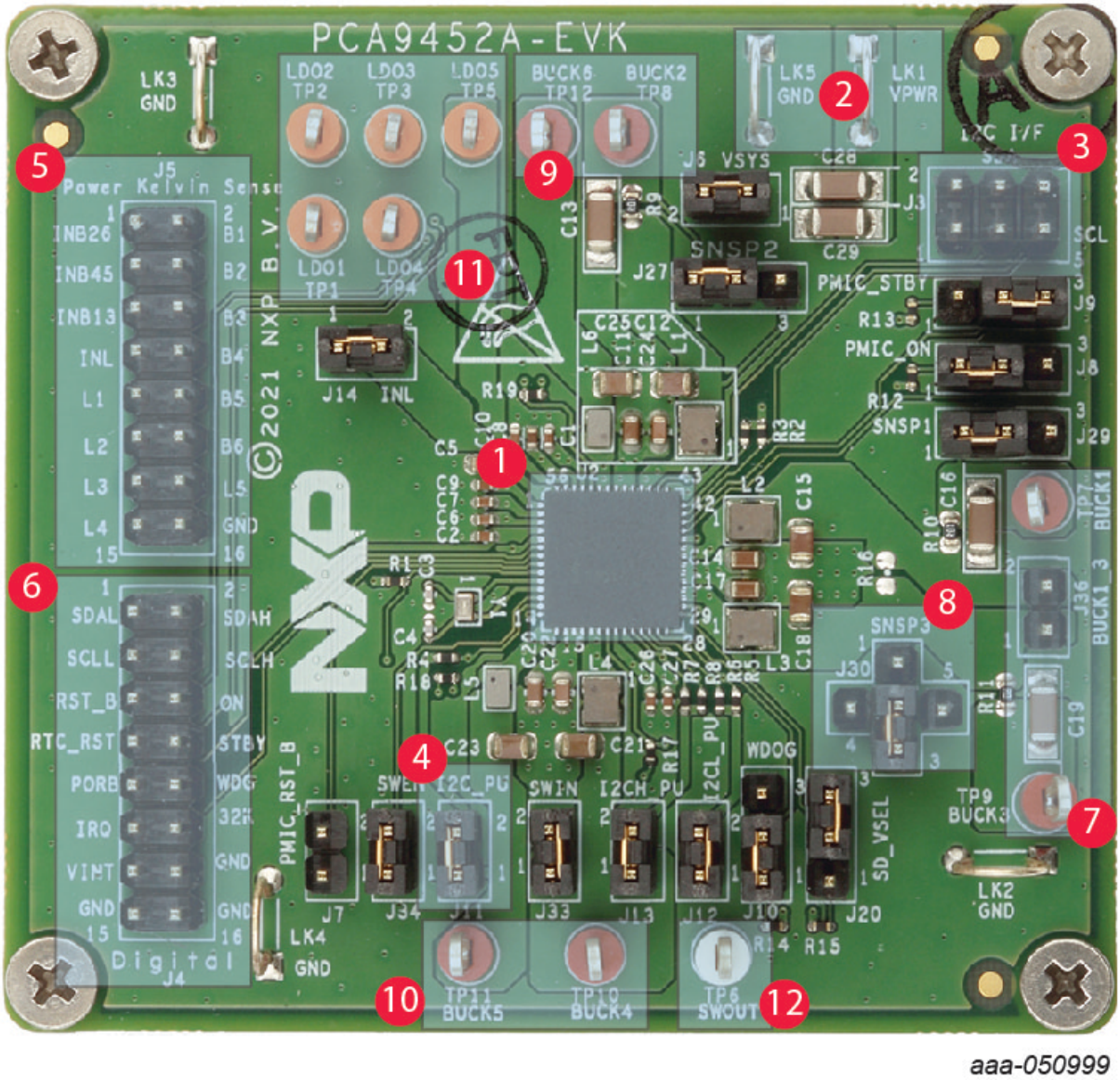

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Figure 2. Evaluation board featured component locations

1. PCA9452A PMIC
2. VPWR and GND input power connectors
3. I^2C connector
4. I^2C pullup voltage jumper (I2C_PU)

5. Kelvin sense connector
6. Digital IO connector
7. BUCK1 and BUCK3 output test points
8. BUCK3 Feedback connection
9. BUCK2 and BUCK6 output test points
10. BUCK4 and BUCK5 output test points
11. LDO outputs test points
12. Load switch output test point

6.3 Default jumper configuration

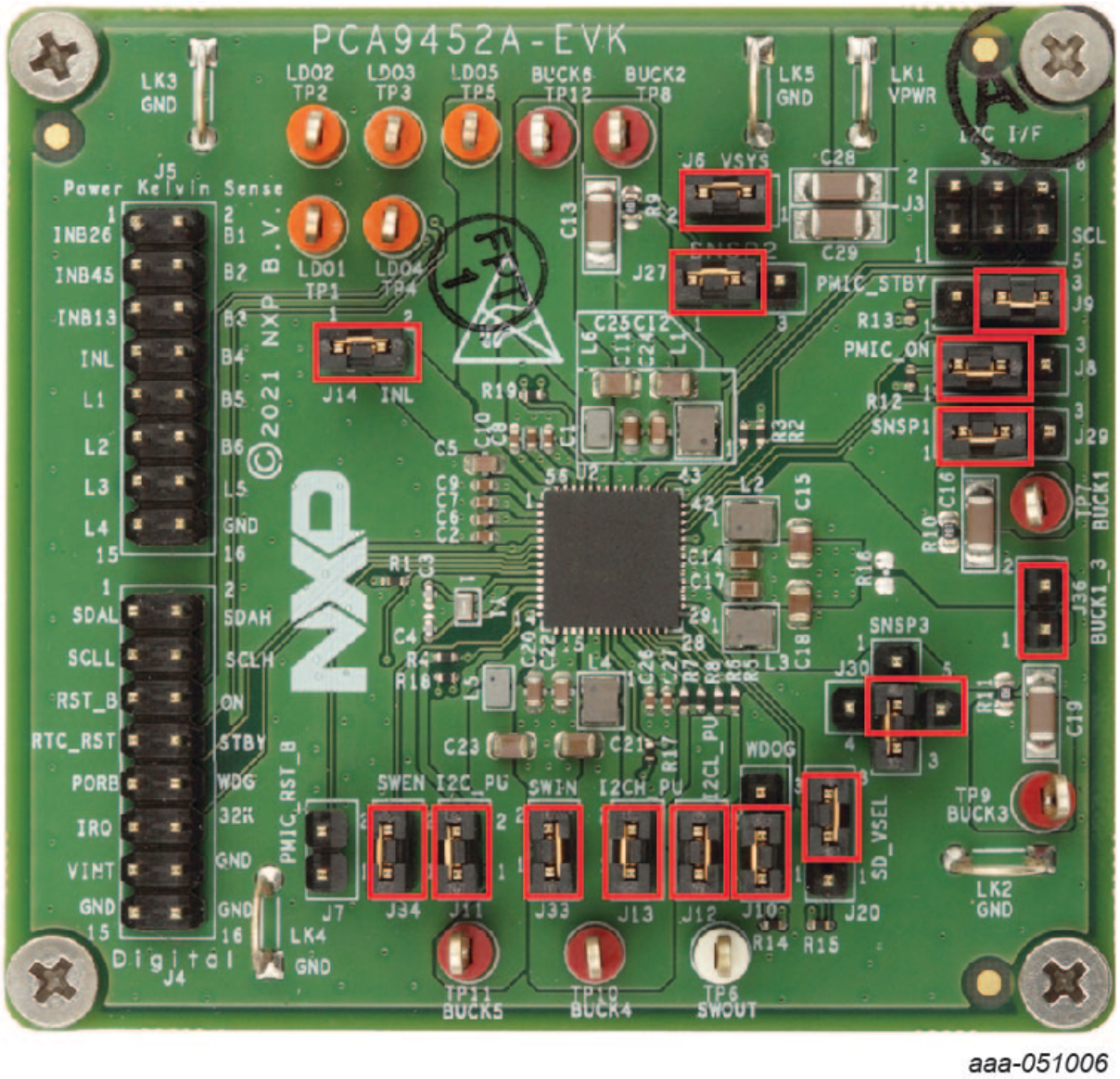


Figure 3. Default jumper configuration

Table 1. Evaluation board jumper description

Name	Default	Description
J6	1-2	Connects PMIC VSYS pin to main board VSYS
J7	No connection	Controls PMIC_RST_B (PMIC Reset) signal • Once it is asserted low (J7 = 1-2), PMIC performs reset.
J10	1-2	Controls WDOG_B (Watchdog reset input) signal • 1-2 -> Pull-up to VPWR (normal operation) • 2-3 -> Pull-down to GND
J11	1-2	Pull up of SDA,SCL, IRQ_B pins to BUCK5
J12	1-2	Pull up of SCLL,SDAL pins to BUCK5
J13	1-2	Pull up of SCLH,SDAH pins to BUCK4
J14	1-2	INL1 Enablement. Connects the INL input for LDOs to VPWR
J20	2-3	Selects SD_VSEL level • 1-2 -> SD_VSEL = High (LDO5 = 1.8 V default output) • 2-3 -> SD_VSEL = Low (LDO5 = 3.3 V default output)
J27	1-2	BUCK2 Feedback connection: • 1-2 -> Remote sense • 2-3 -> Local sense
J29	1-2	BUCK1 Feedback connection: • 1-2 -> Remote sense • 2-3 -> Local sense
J30	2-5	BUCK3 Feedback connection and BUCK1/BUCK3 Dual Phase control: • 1-2 -> Local sense for BUCK3 • 2-3 -> Remote sense for BUCK3 • 2-4 -> Pull-up to INB13 (VPWR rail), BUCK 3 is disabled. • 2-5 -> Pull-down to GND, BUCK1 and BUCK3 are configured as dual phase buck
J33	1-2	SWIN Connect to BUCK4
J34	1-2	SW_EN connect to BUCK4
J36	1-2	BUCK1 and BUCK3 Single/Dual Phase • 1-2 -> Dual Phase configuration • No connection -> Single Phase configuration

6.4 Test points

Use the test points to measure the output voltage signal of the PMIC regulators and load switch by oscilloscope/ multimeter.

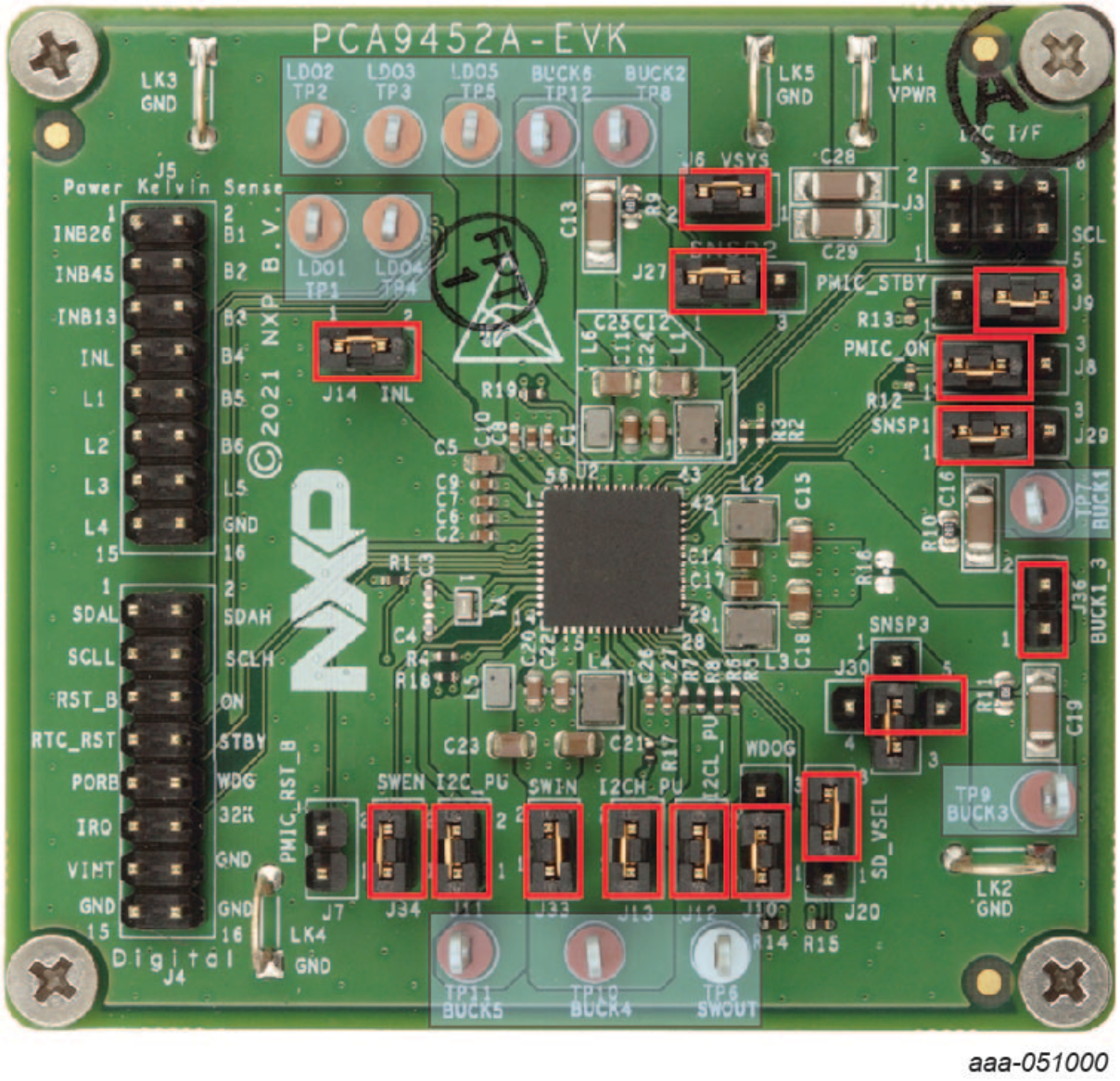


Figure 4. Evaluation board test points

Table 2. Evaluation board test point descriptions

Name	Signal	Description
TP1	LDO1	Power path for the LDO1 output.
TP2	LDO2	Power path for the LDO2 output.
TP3	LDO3	Power path for the LDO3 output.
TP4	LDO4	Power path for the LDO4 output.
TP5	LDO5	Power path for the LDO5 output.
TP6	SWOUT	Output of the Load Switch
TP7	BUCK1	Power path for the BUCK1 output.

Table 2. Evaluation board test point descriptions*...continued*

Name	Signal	Description
TP8	BUCK2	Power path for the BUCK2 output.
TP9	BUCK3	Power path for the BUCK3 output.
TP10	BUCK4	Power path for the BUCK4 output.
TP11	BUCK5	Power path for the BUCK5 output.
TP12	BUCK6	Power path for the BUCK6 output.

6.5 Connectors

6.5.1 Main input power connectors

Main input power VPWR is supplied using LK1 and LK5 connectors.

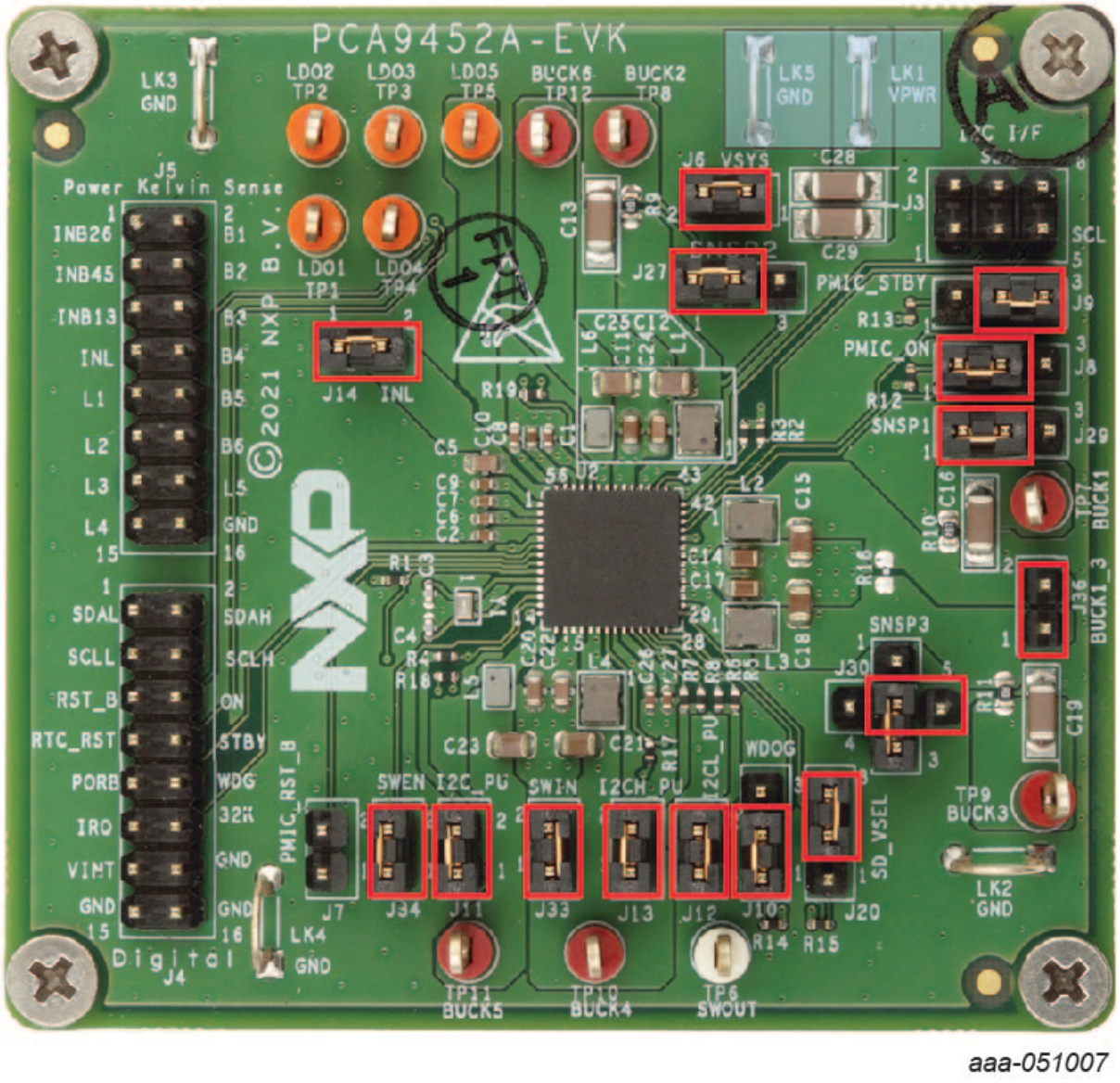


Figure 5. Main input power connectors

Table 3. Main input power connectors

Name	Signal	Description
LK1	VPWR	Main system input power supply System operating range from 2.85 V to 5.5 V (5.0 V Typ)
LK5	GND	Main system ground

6.5.2 Interface connectors

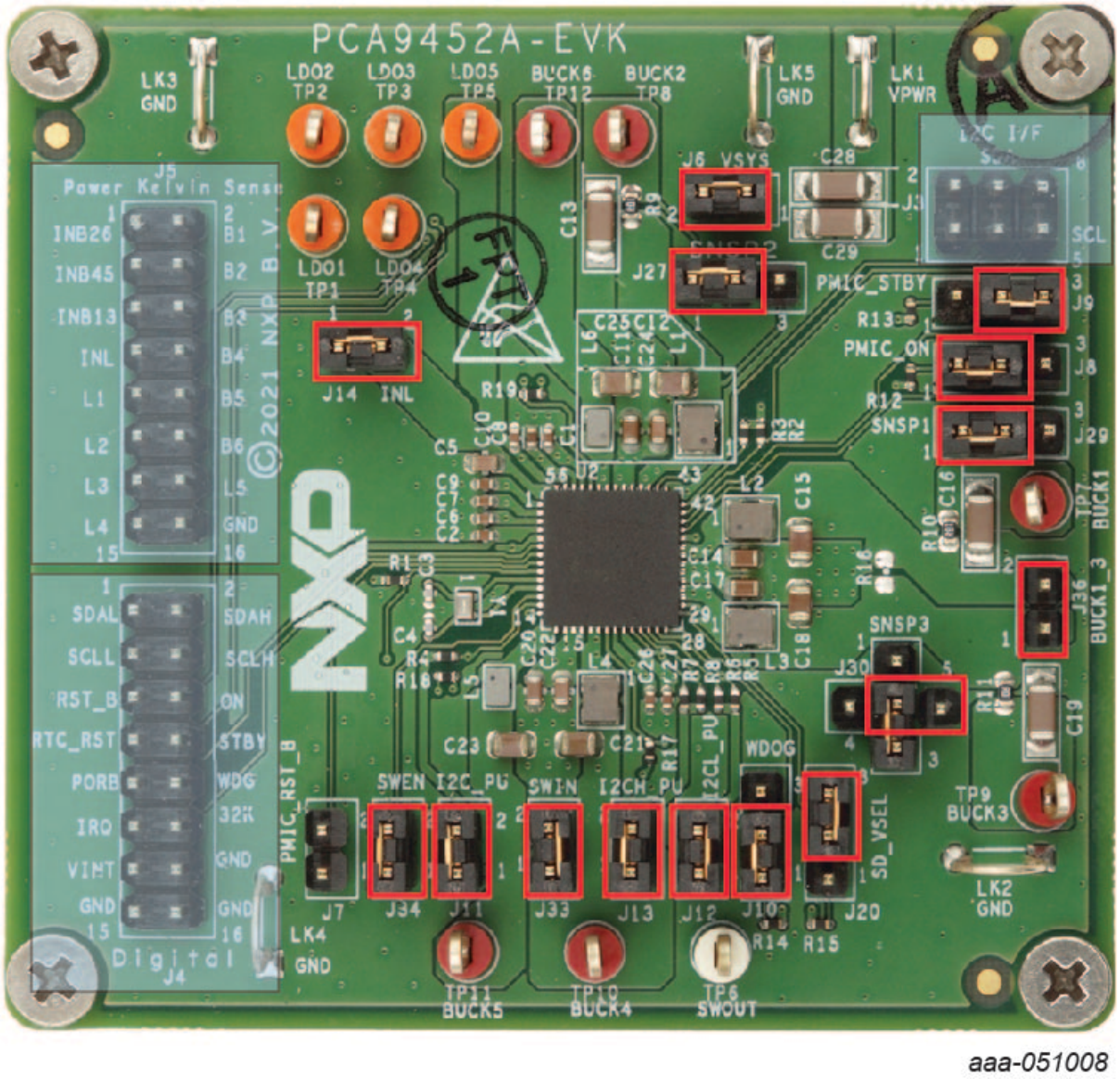


Figure 6. Interface connectors

Table 4. Digital IO connector (J4)

Name	Signal	Type	Description
J4-1	SDAL	Input/Output	Level translator low voltage IO pin, SDA referenced to VINT, 1.8 V
J4-2	SDAH	Input/Output	Level translator high voltage IO pin, SDA referenced to SWIN, 3.3 V
J4-3	SCLL	Output	Level translator low voltage IO pin, SCL referenced to VINT, 1.8 V
J4-4	SCLH	Output	Level translator high voltage IO pin, SCL referenced to SWIN, 3.3 V
J4-5	RST_B	Input	PMIC reset input pin.
J4-6	ON	Input	PMIC ON input from Application processor.

Table 4. Digital IO connector (J4)*...continued*

Name	Signal	Type	Description
J4-7	RTC-RST	Output	Reset output pin.
J4-8	STBY	Input	Standby mode input from Application processor.
J4-9	PORB	Output	Power On reset output pin.
J4-10	WDG	Input	Active low watchdog reset input pin from application processor.
J4-11	IRQ	Output	Direct connection to IRQ_B pin for interrupt signal
J4-12	32K	Output	32.768kHz clock CMOS output with LDO1 power rail.
J4-13	VINT	Power	Internal Power supply output pin.
J4-14	GND	GND	Analog ground.
J4-15			
J4-16			

Table 5. I^2C connector (J3)

Name	Signal	Type	Description
J3-1	-	-	Not Connected
J3-2	GND	Power	Direct connection to system ground
J3-3	SDA	Input/Output	Connection to I^2C serial data signal
J3-4	SDA	Input/Output	Connection to I^2C serial data signal
J3-5	SCL	Input	Connection to I^2C serial clock signal
J3-6	GND	Power	Direct connection to system ground

Table 6. Kelvin sense connector (J5)

Name	Signal	Description
J5-1	VPWR	Sense from INB26
J5-2	R_SNSP1	Remote sense for BUCK1 regulator output
J5-3	VPWR	Sense from INB45
J5-4	R_SNSP2	Remote sense for BUCK2 regulator output
J5-5	VPWR	Sense from INB13
J5-6	R_SNSP2	Remote sense for BUCK3 regulator output
J5-7	INL1	Sense from LDO inputs
J5-8	BUCK4FB	Remote sense for BUCK4 regulator output
J5-9	LDO1	LDO1 sense from LDO load caps
J5-10	BUCK5FB	Remote sense for BUCK5 regulator output
J5-12	BUCK6FB	Remote sense for BUCK6 regulator output
J5-13	LDO3	LDO3 sense from LDO load caps
J5-14	LDO5	LDO5 sense from LDO load caps

Table 6. Kelvin sense connector (J5)*...continued*

Name	Signal	Description
J5-15	LDO4	LDO4 sense from LDO load caps
J5-16	GND	Direct connection to system ground

7 Evaluation kit connections and configuration

7.1 Test setup

Figure 7 shows test setup block diagram.

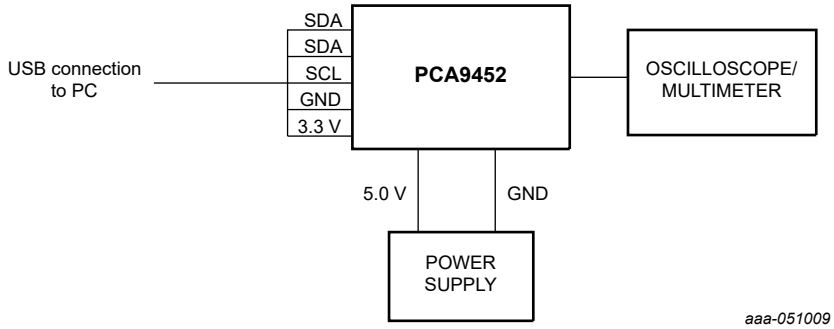


Figure 7. PCA9452A-EVK test setup

7.2 Evaluation board connection

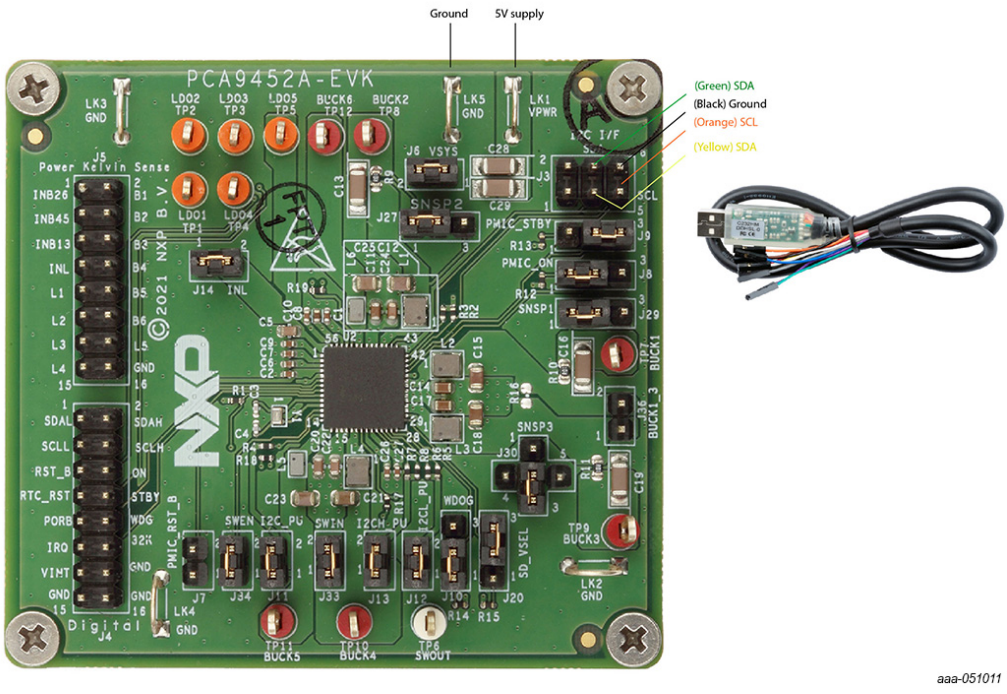


Figure 8. PCA9452A-EVK connections

7.2.1 Configure and power the board

Connect the wires of the FTDI cable on the following pins as shown in Figure 8, and make sure the power supply is turned off and the USB connector is disconnected during the wiring stage:

1. Connect both SDAs, SCL, GND, and the 3.3 V wires from the FTDI cable as mentioned in Figure 8 above.
   a. SCL serial clock signal (orange cable) should be connected to pin 5 of the 'Digital IO' connector (J3).
   b. Both SDA serial data wires (yellow and green cables) should be connected to create bidirectional data. Connect yellow cable to pin 3, and green cable to pin 4 of the 'Digital IO' connector (J3).
   c. GND ground signal (black cable) should be connected to pin 6 or pin 2 of the 'Digital IO' connector (J3).
   d. Remove jumper from J11. 3.3 V supply wire (red cable) from FTDI cable should be connected to pin 2 of the 'I2C_PU' connector (J11).
2. With the power supply turned off, connect 5 V power supply to LK1 connector and corresponding ground to LK5.
3. Turn ON power supply.
4. Connect USB connector of the FDTI cable to PC.

7.2.2 Default power configuration

The default power configuration can be checked without doing any HW or SW modifications. Check the default voltage configuration using a multimeter on BUCK1, BUCK2, BUCK3, BUCK4, BUCK5, BUCK6, LDO1, LDO3, LDO4, and LDO5 test points:

Table 7. Default voltage configuration

Regulator	PCA9452A
BUCK1/BUCK3	0.85 V
BUCK2	0.6 V
BUCK4	3.3 V
BUCK5	1.8 V
BUCK6	1.1 V
LDO1	1.8 V
LDO3	1.8 V
LDO4	0.8 V
LDO5	1.8 V/3.3 V

8 PCA9452A GUI software

As shown in Figure 9, the PCA9452A software GUI is an user friendly tool to access the on-chip registers to perform write/read commands manually or automatically (depending on different setting chosen from the GUI). Below is a quick guide of the key blocks that the PCA9452A software GUI provides.

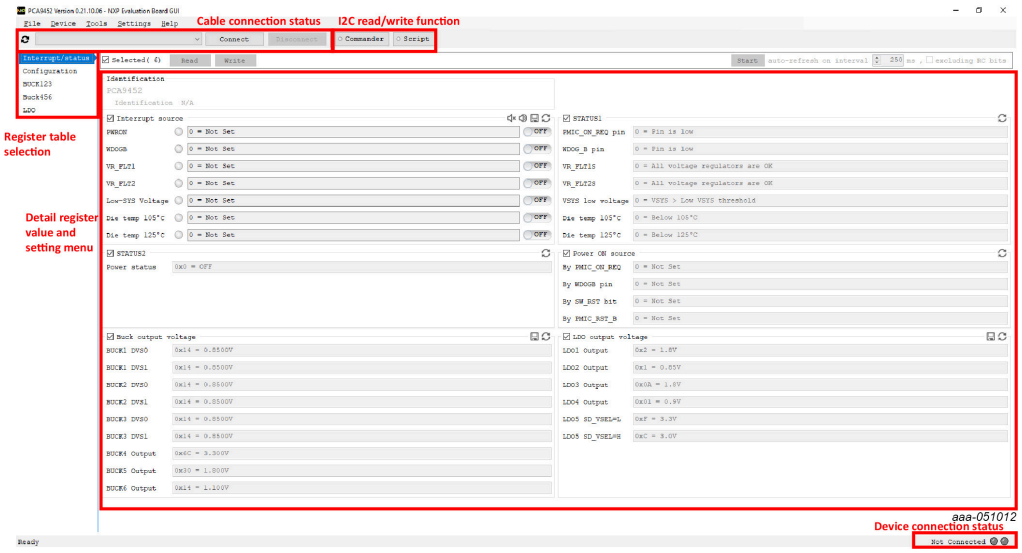


Figure 9. PCA9452A GUI

8.1 GUI setup

After turning on the power supply and plugging in the USB part of the FTDI cable, the GUI detects the cable automatically. Select the cable type (FT2TRWH9) from the drop-down menu, and then click “Connect” button.

On the “Device connection status” section (right bottom part of the screen), the GUI shows “Connected” with green light.

8.2 Register table section

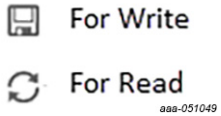
The registers are categorized as shown below:

- Interrupt/status – Includes status registers like Interrupts source, power status, power on source, and output regulator levels.
- Configuration - system configuration, power-up/power-down sequence control, reset behaviors, UVLO threshold, fault information, and level translator control.
- Buck123 – Includes all of the configuration registers for all Buck regulators 1, 2, and 3, including DVS controls.
- Buck456 – Includes all of the configuration registers for all Buck regulators 4, 5, and 6.
- LDO – Includes all of the configuration registers for all LDO regulators.

8.3 I²C read and write

PCA9452A software GUI provides three ways to read and write.

- On register table, click the “read”/“write” button for the whole table, or click:



- Command. Read or write the Hex value to specific register.
- Script. Run the script to read or write a series of registers. Using guideline can be found in help menu.

9 PCA9452A evaluation steps

The following sections show how to perform evaluation of the PCA9452A using the evaluation board and the software GUI.

9.1 I^2C pullup configuration for proper GUI interface

This step must be done with the power supply turned off and USB cable disconnected. For I^2C interface communication using the PCA9452A software GUI, remove J11 jumper (I2C_PU), and connect the red cable (3.3 V) from the FTDI cable to pin 2 of J11 jumper (I2C_PU).

9.2 Jumper configuration

This step also needs to be done with the power supply turned off and USB cable disconnected. With exception of J11 jumper, please connect the jumpers in default configuration as shown in Section 6.3.

9.3 Connect and power the board

As shown in Figure 8, connect the wires of the FTDI cable and power supply according to the information in Section 7.2.1.

9.4 Working on the PCA9452A software GUI

Open, setup, and connect the GUI as directed in Section 8.1, then start configuring the PMIC using the different tabs.

9.4.1 BUCK configuration

Select ‘BUCKxxx’ tab from the register table selection.

From here you can change all the configuration registers for all the buck regulators of the PCA9452A, configure the low power modes, enable the active discharge resistor, use forced PWM, change enable modes, configure the DVS speed (for BUCK1, BUCK2 and BUCK3), and change output voltages by either by writing the value or using the horizontal slide bar.

Use the multimeter to check the voltage on the buck test points to confirm the voltage changes when configured.

9.4.2 LDO configuration

Select ‘LDO’ tab from the register table selection.

From here you can change all the configuration registers for all the LDO regulators of the PCA9452A, configure the low power modes, enable the active discharge resistor, change enable modes, and change output voltages by either by writing the value or using the horizontal slide bar.

Use the multimeter to check the voltage on the LDO test points to confirm the voltage changes when configured.

9.4.3 Load switch configuration

Select ‘LDO’ tab from the register table selection.

From here you can change all the configuration registers for the Load Switch of the PCA9452A, enable the active discharge resistor, change enable modes, and configure the different protection mechanisms.

9.4.4 GUI close

Click ‘Disconnect’ button, disconnect USB cable from the PC and turn OFF the Power Supply and close the PCA9452A GUI.

10 Schematic diagram

The schematic diagram of PCA9452A-EVK is available at URL: http://www.nxp.com/PCA9452A-EVK.

11 Placement

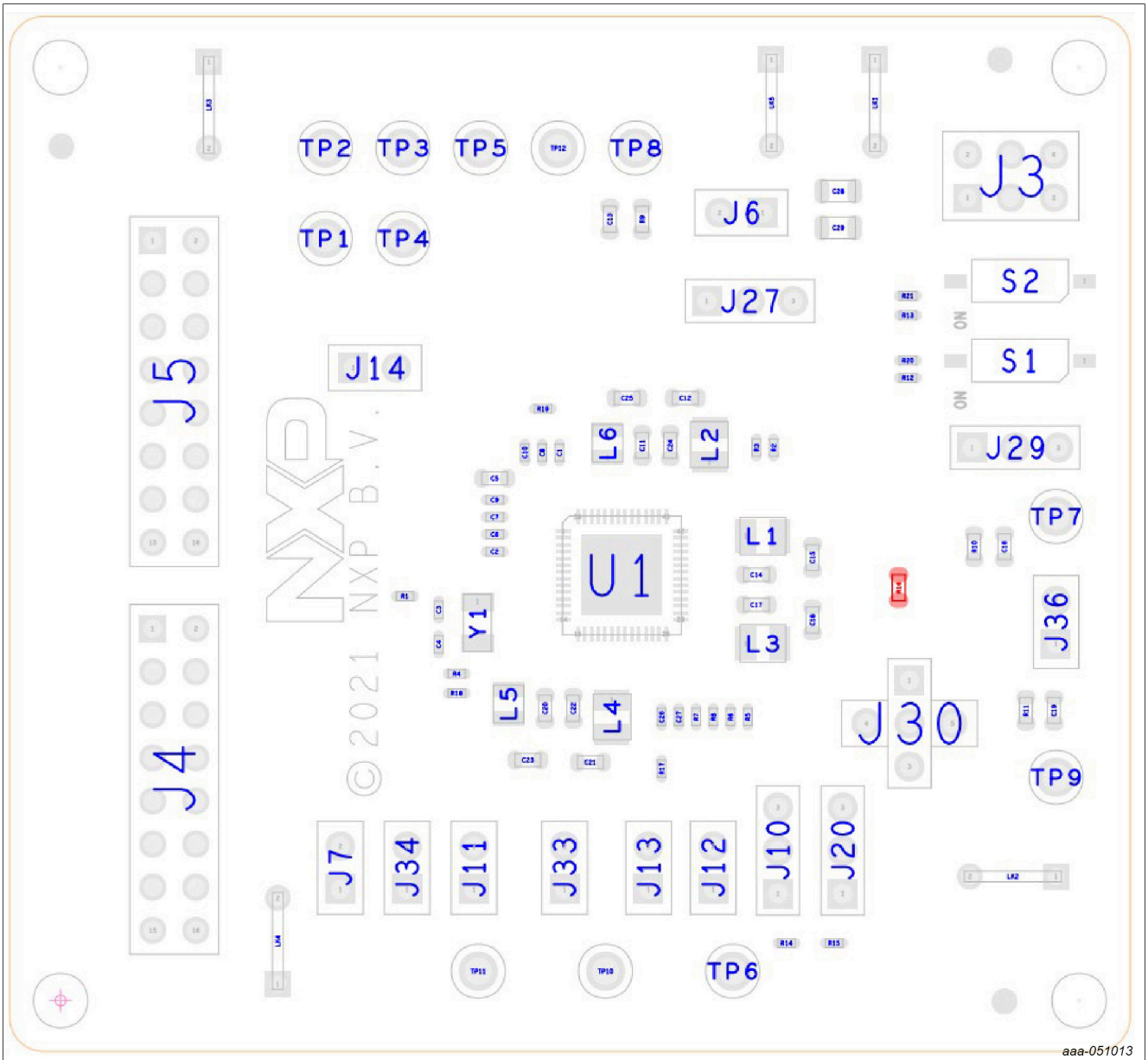


Figure 10. PCA9452A-EVK parts placement

12 Bill of materials

The BOM of PCA9452A-EVK board is based on **SCH-50787 REV x.**

Table 8. PCA9452A- EVB BOM

Description	Quantity	Reference	MFG_NAME	MFG_PN
CAP CER 1uF 10V 10% X7S 0402	8	C1, C2, C6, C7, C9, C10, C26, C27	MURATA	GRM155C71A105KE11D
CAP CER 3.9pF 200V 0.1pF C0G HIGH Q 0402	2	C3, C4	MURATA	GQM1555C2D3R9BB01
CAP CER 4.7uF 10V 10% X7S 0603	3	C5, C22, C24	murata	GRM188C71A475KE11D
CAP CER 2.2uF 10V 10% X7S AEC-Q200 0402	1	C8	MURATA	GRT155C71A225KE13
CAP CER 10uF 10V 10% X7R 0603	4	C11, C14, C17, C20	MURATA	GRM188Z71A106KA73D
CAP CER 22uF 10V 20% X6S AEC-Q200 0805	6	C12, C15, C18, C21, C23, C25	MURATA	GRT21BC81A226ME13
CAP CER 47uF 10V 20% X6S 1206	5	C13, C16, C19, C28, C29	TDK	C3216X6S1A476M160AC
DIODE SCH RECT 3A 40V AEC-Q101 SOD123W	12	D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12	NEXPERIA	PMEG4030ER, 115
HDR 2X3 TH 100MIL CTR 344H AU 118L	1	J3	WURTH ELEKTRONIK EISOS GMBH & CO. KG (ELECTRONIC & ELECTROMEHANICAL COMP)	61300621121
HDR 2X8 TH 100MIL CTR 344H AU 118L	2	J4, J5	WURTH ELEKTRONIK EISOS GMBH & CO. KG (ELECTRONIC & ELECTROMEHANICAL COMP)	61301621121
HDR 1X2 TH 100MIL SP 342H AU 118L	9	J6, J7, J11, J12, J13, J14, J33, J34, J36	WURTH ELEKTRONIK EISOS GMBH & CO. KG (ELECTRONIC & ELECTROMEHANICAL COMP)	61300211121
HDR 1X3 TH 2.54MM SP 344H AU 118L	6	J8, J9, J10, J20, J27, J29	WURTH ELEKTRONIK EISOS GMBH & CO. KG (ELECTRONIC & ELECTROMEHANICAL COMP)	61300311121
SUBASSEMBLY HDR 1X3 TH 2.54MM SP 344H AU 118L + HDR 1X1 TH -- 344H AU 118L	1	J30	SUBASSEMBLY	210-80732, 210-81266
CON 2 JUMPER PLUG SHORTING TH 200MIL SP 305H --	5	LK1, LK2, LK3, LK4, LK5	KEYSTONE ELECTRONICS	5026
IND PWR 0.47uH@1MHz 4.5A 0.021OHM 20% SMT	4	L1, L2, L3, L4	Cyntec	HMLB25201B-R47MSR
Ind, Power, 0.47uH, 25mohms, 3.9A rms, 4.8A sat, Shielded, SMT	2	L5, L6	Cyntec	HTEP20120H-R47MSR
RES MF 100K 1/10W 5% AEC-Q200 0402	6	R1, R4, R12, R13, R14, R15	KOA SPEER	RK73B1ETTP104J
RES MF 4.7K 1/10W 5% AEC-Q200 0402	6	R2, R3, R5, R6, R7, R8	KOA SPEER	RK73B1ETTP472J

Table 8. PCA9452A- EVB BOM*...continued*

Description	Quantity	Reference	MFG_NAME	MFG_PN
RES MF 0.01 OHM 1/10W 1% AEC-Q200 0603	3	R9, R10, R11	YAGEO	RL0603FR-070R01L
RES MF ZERO OHM -- AEC-Q200 0603	1	R16	KOA SPEER	RK73Z1JTTD
RES MF ZERO OHM 1/16W 5% 0402	3	R17, R18, R19	YAGEO AMERICA	RC0402JR-070RL
TEST POINT ORANGE 70X220 MIL TH	5	TP1, TP2, TP3, TP4, TP5	KEYSTONE ELECTRONICS	5008
TEST POINT WHITE 70X220 MIL TH	1	TP6	KEYSTONE ELECTRONICS	5007
TEST POINT PC MULTI PURPOSE RED TH	6	TP7, TP8, TP9, TP10, TP11, TP12	KEYSTONE ELECTRONICS	5010
IC POWER MANAGE MENT 2.7-5.5V AEC-Q100 HVQFN56	1	U2	NXP	PCA9452AHN
XTAL 32.768KHZ 4PF 20PPM SMT	1	Y1	Abracon LLC	ABS05W-32.768KHZ-K-2-T

13 Revision history

Table 9. Revision history

Document ID	Release date	Description
UM11907 v.1.0	20240209	• Initial version

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