UM12405

PF9453 WLCSP - Evaluation kit user manual

Rev. 1.0 — 26 November 2025 User manual

Document information

Information	Content
Keywords	PF9453, PMIC, i.MX91X
Abstract	This document describes the operation of the PF9453UK-EVK.

1 Introduction

The PF9453 is a single-chip power management integrated circuit (PMIC) designed for the i.MX 91 processor. It provides power supply solutions for IoT, smart appliance, and portable applications when size and efficiency are critical.

This document is the user manual for the PF9453 WLCSP evaluation kit. It is intended for the engineers involved in the evaluation, design, implementation, and validation of this single PMIC PF9453.

The PF9453UK-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 PF9453 device.

Section 8 shows a more detailed guidance on how to use the PF9453UK-EVK.

2 Applications

- IoT Devices
- White goods appliances
- Industrial application
- Portable devices

3 Finding kit resources and information on the NXP web site

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

The information page for evaluation boards is is https://www.nxp.com/design/design-center/development-boards-and-designs/PF9453UK-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.

3.1 Collaborate in the NXP community

The NXP community is for sharing ideas and tips, ask and answer technical questions, and receive input on just about any embedded design topic. The NXP community is at https://community.nxp.com.

4 Getting ready

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

4.1 Evaluation kit components

- One PF9453UK-EVK evaluation board, which allows evaluation of functions and features.
- One USB type C cable

4.2 Additional hardware

In addition to the kit components, the following hardware is recommended when working with this kit.

- Power supply with a range of 2.7 V to 5.0 V (current limit set initially to 1.0 A; maximum power consumption at default voltages can be up to 18 W)
- Oscilloscope/multimeter
- Electronic load (optional) - each power rail output can be connected to e-load for testing.

4.3 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

4.4 PF9453 EVB GUI software

Installing software is necessary to work with this evaluation board.

- Go to PF9453 EVB graphical user interface.
- Extract the evaluation kit GUI zip file, PF9453_EVB_GUI_1.25.2.21-x64, into the selected folder. No need to install. (If the password is requested to unzip, type “NXP”.)
- Install the FTDI D2XX direct drivers from https://www.ftdichip.com/Drivers/D2XX.html
- Run the file PF9453.exe. The interface window is shown in Figure 1.

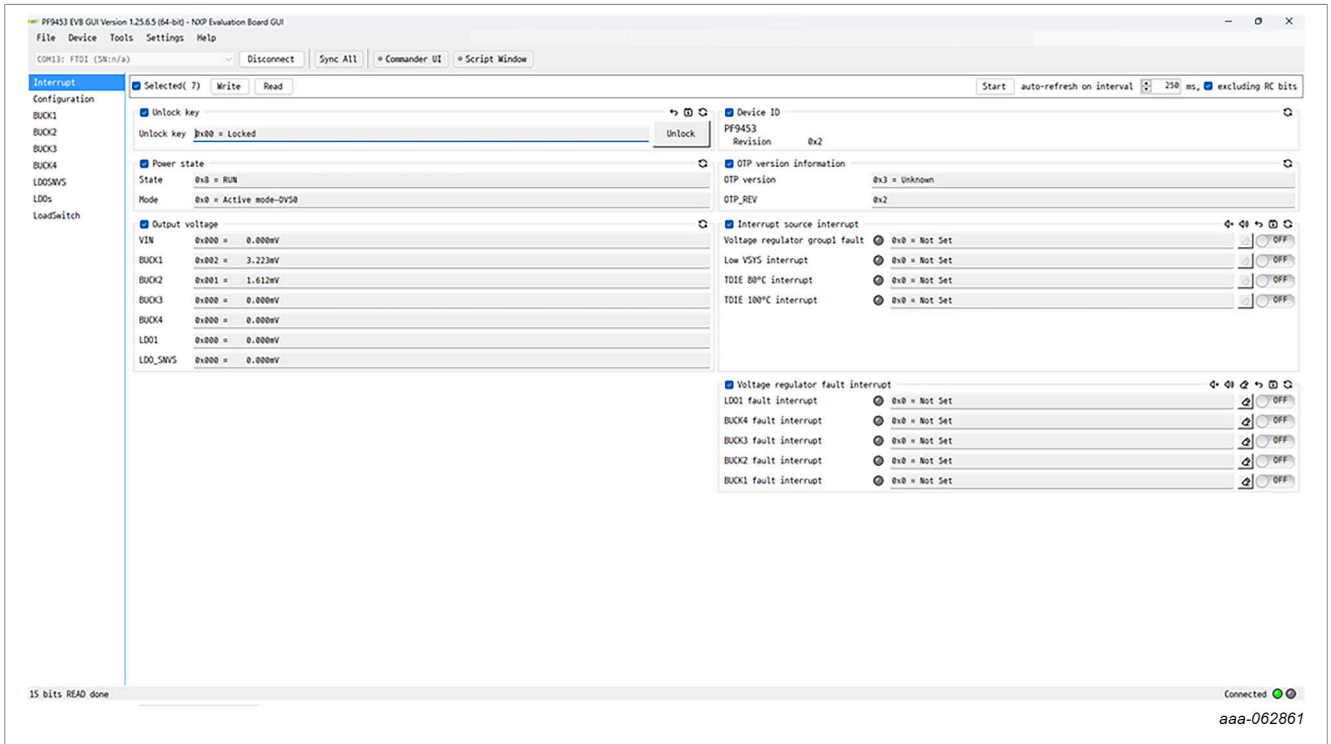

Figure 1. Interface window

5 Getting to know the hardware

The NXP analog product development boards provide a platform for evaluating NXP products. The boards support a range of analog, mixed-signal and power solutions. They incorporate monolithic integrated circuits and system-in-package devices that use proven high-volume technology.

5.1 Kit overview

This evaluation board features the PF9453 PMIC. The kit integrates all hardware needed to fully evaluate the PMIC and a communication bridge based on future technology devices international ltd (FTDI) to interface with the PF9453 GUI software interface to configure and control the PMIC.

5.1.1 Evaluation board features

- Four Buck regulators:
  - One 2.5 A BUCK regulator
  - One 1.5 A BUCK regulator with DVS
  - Two 1 A BUCK regulators
- Two linear regulators:
  - One 10 mA LDO
  - One 250 mA LDO
- One 400 mA load switch with a built-in active discharge resistor
  - 32.768 kHz Crystal oscillator driver and buffer output
- System features:
  - 2.7 V to 5.5 V operating input voltage range
  - Power ON/OFF control
  - Standby/run mode control
  - DVS control
  - Interrupt configuration
  - Fm+ 1 MHz I^2C Interface (via FTDI USB to I^2C cable)

5.2 Kit featured components

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

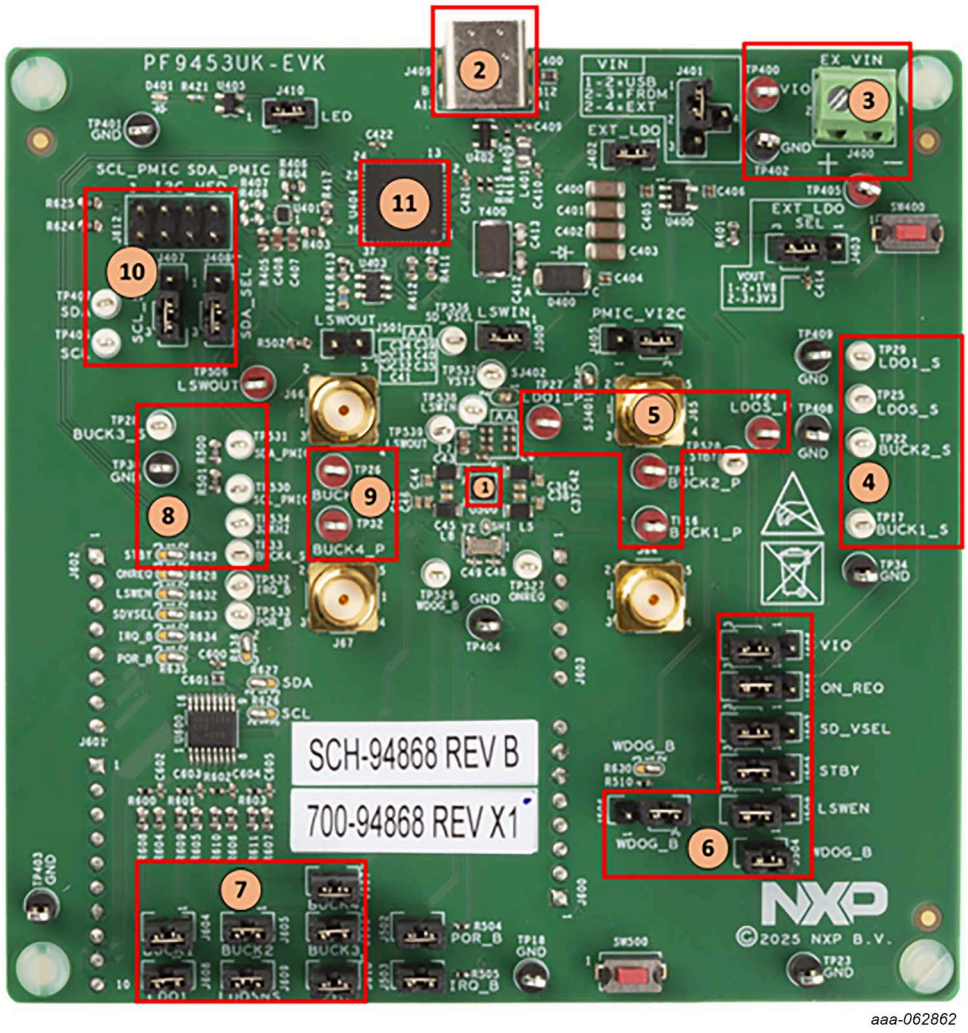

Figure 2. Evaluation board featured component locations

1. PF9453 PMIC (WLCSP package)
2. USB type C connector
3. VPWR and GND input power connectors
4. LDO1, LDO_SNVS, BUCK1 and BUCK2 sensing test points
5. LDO1, LDO_SNVS, BUCK1 and BUCK2 power test points
6. Digital signals jumper selectors
7. ADC Jumpers
8. BUCK3 and BUCK4 sensing test points, SDA, SCL and 32 kHz tests points
9. BUCK3 and BUCK4 power test points
10. I2C headers and tests points
11. FTDI (I2C to USB IC)

5.3 Default jumper configuration

Figure 3 shows the default jumper configuration of the board.

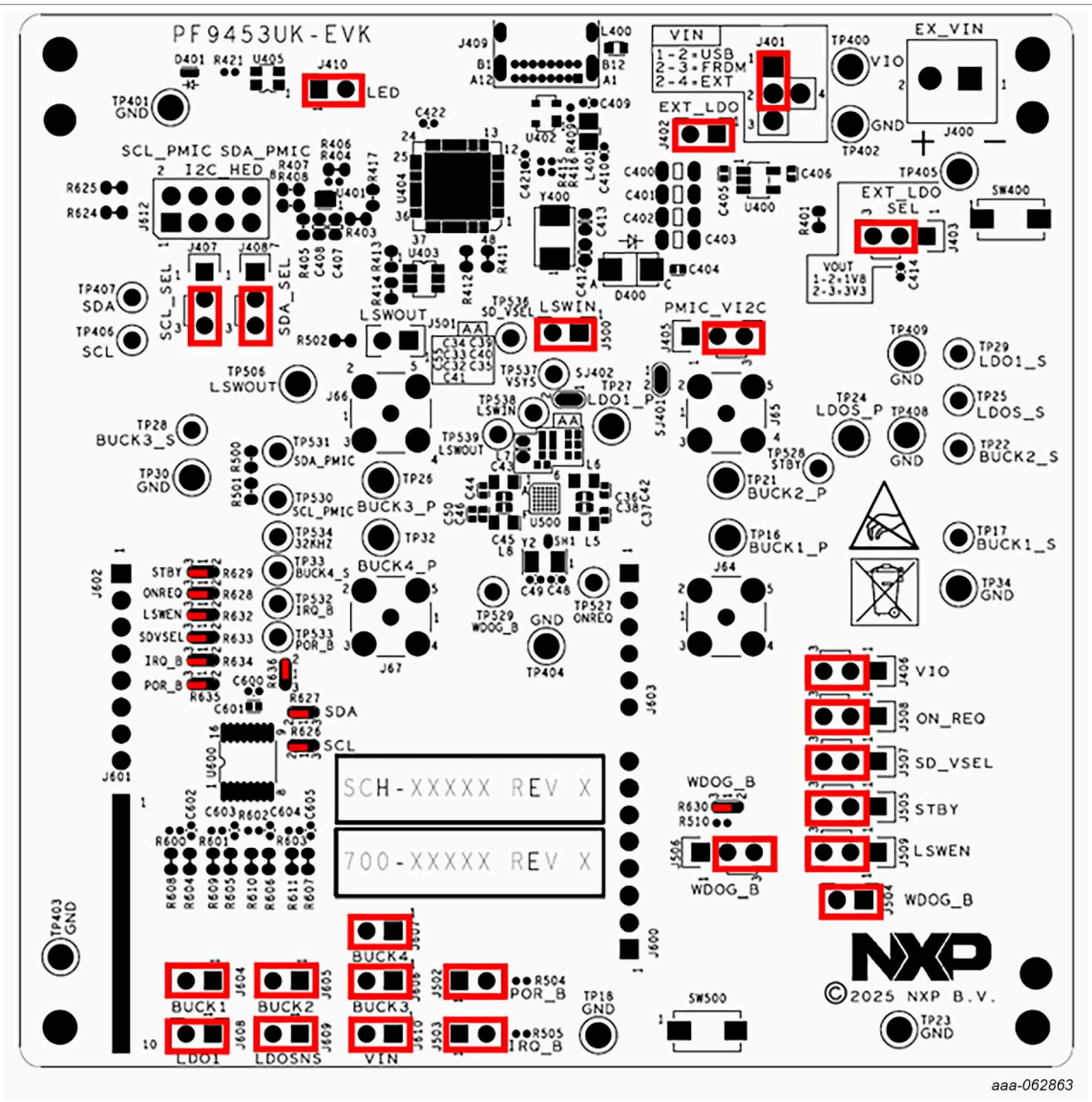

Figure 3. Evaluation board default jumper configuration

Table 1. Evaluation board jumper descriptions

Name	Default	Description
J401	1 to 2	Selects source voltage for VSYS and PSYS (PMIC input voltage): • 1 to 2 → PMIC input voltage comes from the USB type C connector • 2 to 4 → PMIC input voltage comes from external connector (J400) or test points (TP400 and TP402) • 2 to 3 → PMIC input voltage comes from FRDM_VIN Connector (J600-06)
J402	Closed	Connects the external LDO (U400) to VIN voltage

Table 1. Evaluation board jumper descriptions*...continued*

Name	Default	Description
J403	1 to 3	Selects output voltage of the external LDO (U400): • 1 to 2 → External LDO output voltage = 1.8 V • 2 to 3 → External LDO output voltage = 3.3 V
J405	2 to 3	Selects PMIC I^2C pullup voltage: • 1 to 2 → I2C Voltage comes from BUCK4 Out • 2 to 3 → I2C Voltage comes from External LDO (U400)
J406	2 to 3	Selects PMIC pullup voltage for digital signals: • 1 to 2 → VIO Voltage comes from LDO_SNVS • 2 to 3 → VIO Voltage comes from External LDO (U400)
J407	2 to 3	Selects if SCL_PMIC signal (PMIC I^2C signal) passes through the level shifter (U401) or not: • 1 to 2 → SCL_PMIC signal passes through level shifter (U401) • 2 to 3 → SCL_PMIC signal does not passes through level shifter (U401)
J408	2 to 3	Selects if SDA_PMIC signal (PMIC I^2C signal) passes through the level shifter (U401) or not: • 1 to 2 → SDA_PMIC signal passes through level shifter (U401) • 2 to 3 → SDA_PMIC signal does not passes through level shifter (U401)
J410	Closed	Connects the green LED driver (U405) to VIN voltage.
J500	Closed	Connects load switch Input to BUCK4 out
J501	Open	Jumper for internal validation only
J502	Closed	Connects POR_B signal to VIO pullup voltage
J503	Closed	Connects IRQ_B signal to VIO pullup voltage
J504	Closed	Connects WDOG_B signal to SW500
J505	2 to 3	Selects PMIC_STBY_REQ signal voltage level: • 1 to 2 → PMIC_STBY_REQ connected to VIO • 2 to 3 → PMIC_STBY_REQ connected to GND
J506	2 to 3	Selects WDOG_B signal voltage level: • 1 to 2 → WDOG_B connected to VIO • 2 to 3 → WDOG_B connected to GND
J507	2 to 3	Selects SD_VSEL signal voltage level: • 1 to 2 → SD_VSEL connected to VIO • 2 to 3 → SD_VSEL connected to GND
J508	2 to 3	Selects PMIC_ON_REQ signal voltage level: • 1 to 2 → PMIC_ON_REQ connected to VIO • 2 to 3 → PMIC_ON_REQ connected to GND
J509	2 to 3	Selects LSW_EN signal voltage level: • 1 to 2 → LSW_EN connected to VIO • 2 to 3 → LSW_EN connected to GND
J604	Closed	Connects BUCK1_OUT voltage to ADC0 channel

Table 1. Evaluation board jumper descriptions*...continued*

Name	Default	Description
J605	Closed	Connects BUCK2_OUT voltage to ADC1 channel
J606	Closed	Connects BUCK3_OUT voltage to ADC2 channel
J607	Closed	Connects BUCK4_OUT voltage to ADC3 channel
J608	Closed	Connects LDO1_OUT voltage to ADC4 channel
J609	Closed	Connects LDO_SNVS voltage to ADC5 channel
J610	Closed	Connects VIN voltage to ADC6 channel

Table 2. Evaluation board solder joint descriptions

Name	Signal	Description
SJ401	Closed	Connects VIN to PSYS
SJ402	Closed	Connects VIN to VSYS
R626	1 to 2	Selects SCL signal source: • 1 to 2 → SCL signal comes from FTDI IC • 2 to 3 → SCL signal comes from FRDM connector (J601–10)
R627	1 to 2	Selects SDA signal source: • 1 to 2 → SDA signal comes from FTDI IC • 2 to 3 → SDA signal comes from FRDM connector (J601–09)
R628	1 to 3	Selects PMIC_ON_REQ signal source: • 1 to 2 → PMIC_ON_REQ signal comes from FTDI IC • 1 to 3 → PMIC_ON_REQ signal comes from FRDM connector (J602–01)
R629	1 to 3	Selects PMIC_STBY_REQ signal source: • 1 to 2 → PMIC_STBY_REQ signal comes from FTDI IC • 1 to 3 → PMIC_STBY_REQ signal comes from FRDM connector (J602–02)
R630	1 to 3	Selects WDOG_B signal source: • 1 to 2 → WDOG_B signal comes from FTDI IC • 1 to 3 → WDOG_B signal comes from FRDM connector (J602–03)
R632	1 to 3	Selects LSW_EN signal source: • 1 to 2 → LSW_EN signal comes from FTDI IC • 1 to 3 → LSW_EN signal comes from FRDM connector (J602–05)
R633	1 to 3	Selects SD_VSEL signal source: • 1 to 2 → SD_VSEL signal comes from FTDI IC • 1 to 3 → SD_VSEL signal comes from FRDM connector (J606–06)
R634	1 to 3	Selects IRQ_B signal source: • 1 to 2 → IRQ_B signal comes from FTDI IC • 1 to 3 → IRQ_B signal comes from FRDM connector (J606–07)

Table 2. Evaluation board solder joint descriptions...*continued*

Name	Signal	Description
R635	1 to 3	Selects POR_B signal source: • 1 to 2 → POR_B signal comes from FTDI IC • 1 to 3 → POR_B signal comes from FRDM connector (J606–08)
R636	1 to 3	Selects ADC supply voltage source: • 1 to 2 → ADC voltage comes from FTDI_3.3 V • 1 to 3 → ADC voltage comes from FRDM_3.3 V connector (J600–05)

5.4 Test points

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

Table 3. Evaluation board test point descriptions

Name	Signal	Description
TP16	BUCK1_OUT	Power test point for the BUCK1 output voltage
TP17	BUCK1_OUT	Sensing test point for the BUCK1 output voltage
TP18	GND	GND test point
TP21	BUCK2_OUT	Power test point for the BUCK2 output voltage
TP22	BUCK2_OUT	Sensing test point for the BUCK2 output voltage
TP23	GND	GND test point
TP24	LDO_SNVS	Power test point for LDO_SNVS output voltage
TP25	LDO_SNVS	Sensing test point for LDO_SNVS output voltage
TP26	BUCK3_OUT	Power test point for the BUCK3 output voltage
TP27	LDO1_OUT	Power test point for LDO1_OUT output voltage
TP28	BUCK3_OUT	Sensing test point for the BUCK3 output voltage
TP29	LDO1_OUT	Sensing test point for LDO1_OUT output voltage
TP30	GND	GND test point
TP32	BUCK4_OUT	Power test point for the BUCK4 output voltage
TP33	BUCK4_OUT	Sensing test point for the BUCK4 output voltage
TP34	GND	GND test point
TP400	EXT_VIN	Sensing test point for external voltage input
TP401	GND	GND test point
TP402	GND	GND test point
TP403	GND	GND test point
TP404	GND	GND test point
TP405	LDO_EXT_VOUT	Sensing test point for output voltage for the external LDO (U400)
TP406	SCL	Sensing test point for SDA signal (this I^2C signal comes from lever shifter U401 or jumper J407)

Table 3. Evaluation board test point descriptions*...continued*

Name	Signal	Description
TP407	SDA	Sensing test point for SCL signal (this I^2C signal comes from lever shifter U401 or jumper J408)
TP408	GND	GND test point
TP409	GND	GND test point
TP506	LSWOUT	Power test point for LSWOUT voltage
TP527	PMIC_ON_REQ	Sensing test point for PMIC_ON_REQ signal
TP528	PMIC_STBY_REQ	Sensing test point for PMIC_STBY_REQ signal
TP529	WDOG_B	Sensing test point for WDOG_B signal
TP530	SCL_PMIC	Sensing test point for SCL_PMIC signal (this I^2C signal comes from the PMIC)
TP531	SDA_PMIC	Sensing test point for SDA_PMIC signal (this I^2C signal comes from the PMIC)
TP532	IRQ_B	Sensing test point for IRQ_B signal
TP533	POR_B	Sensing test point for POR_B signal
TP534	CLK_32_OUT	Sensing test point for CLK_32_OUT signal
TP536	SD_VSEL	Sensing test point for SD_VSEL signal
TP537	VSYS	Sensing test point for VSYS signal
TP538	LSWIN	Power test point for LSWIN voltage
TP539	LSWOUT	Sensing test point for LSWOUT voltage

5.5 Connectors

5.5.1 Main input power connectors

Main input power VPWR is supplied using TP400 and TP402 test points or J400 connector.

Table 4. Main input power connectors

Name	Signal	Description
J400-1	GND	GND screw terminal for external input voltage for the PMIC
J400-2	EX_VIN	Power screw terminal for external input voltage for the PMIC
TP400	EX_VIN	Power test point for VPWR voltage (external input voltage for the PMIC)
TP402	GND	GND test point

5.5.2 FRDM/Arduino connectors

FRDM/Arduino connectors J600, J601 and J602, are used to have access to the digital pins of the PF9453 by using a FRDM or Arduino board to monitor and set. Table 5 explains each of the pins included in these connectors.

Table 5. FRDM/Arduino connectors J600, J601, J602

Name	Signal	Type	Description
J600-05	FRDM_3V3	Input/output	3.3 V voltage FRDM pin header
J600-06	FRDM_VIN	Input	Voltage in for system when J401 is in position 2 to 4

Table 5. FRDM/Arduino connectors J600, J601, J602*...continued*

Name	Signal	Type	Description
J600-07	GND	GND	GND
J600-08	GND	GND	GND
J601-10	SCL_FRDM	Input/output	Connection to SCL signal
J601-09	SDA_FRDM	Input/output	Connection to SDA signal
J601-06	GND	GND	GND
J602-08	POR_B_FRDM	Output	Power-on reset output pin. Open drain output requiring external pullup resistor
J602-07	IRQ_B_FRDM	Output	PMIC interrupt pin, open drain output requiring external pullup resistor
J602-06	SD_VSEL_FRDM	Input	LDO1 voltage selection input pin. LDO1 output is 3.3 V when it is driven low and 1.8 V when it is driven high
J602-05	LSW_EN_FRDM	Input	Load Switch enable input pin. It has internal 1.5 Ω pulldown resistor or output pin for DBUS debounce filter function
J602-03	WDOG_B_FRDM	Input	Watchdog reset input from application processor
J602-02	PMIC_STBY_REQ_FRDM	Input	Standby mode input from application processor
J602-01	PMIC_ON_REQ_FRDM	Input	PMIC On signal input from an application processor

Note: *The pins that are not mentioned in the J600, J601 and J602 connectors tables are also not connected to any signal. J612 is a reserved connector for internal validations.*

6 Evaluation kit connections and configuration

6.1 Test setup

Figure 4 shows test setup block diagram.

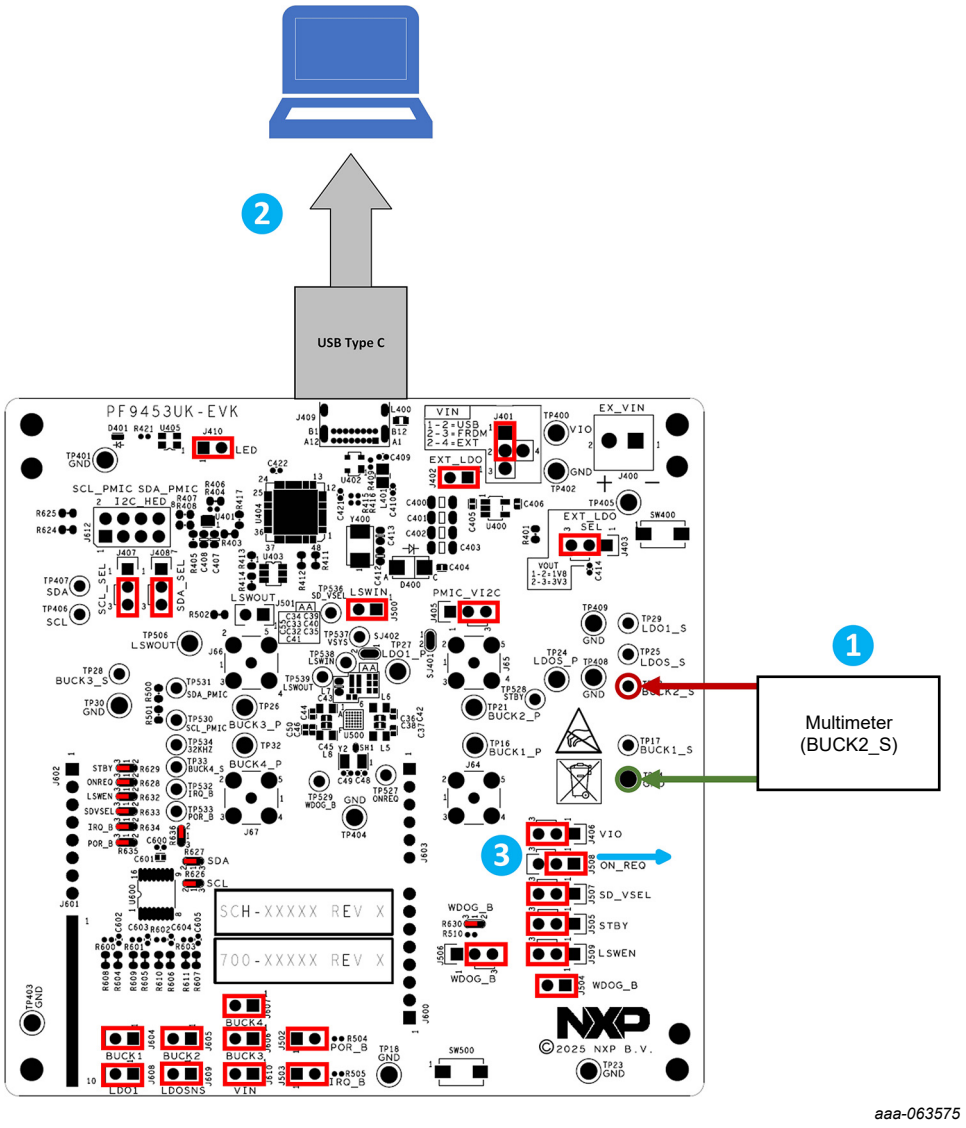

Figure 4. PF9453 EVB test set up

6.2 Configure and power the board

See Figure 4 and follow the steps to test the PF9453UK-EVK. Ensure that all jumpers are in their default positions before starting. (See Section 5.3):

1. Connect the positive terminal of the multimeter to TP22 (BUCK2_S) test point and the negative terminal of the multimeter to TP34 GND test point, see Figure 4 where step 1 is represented with the circle with number 1.
2. Connect the USB -Type C to the PF9453UK-EVK. See that the green LED D401 is ON, see Figure 4 circle with number 2. Use the USB Type-C connector as the power supply with this configuration. Avoid connecting loads that may exceed its power capacity. For tests requiring higher current—such as efficiency measurements—use an external power supply. See Section 6.4 for setup instructions. If the USB Type-C supply is sufficient, proceed to the next step.
3. Move the J508 to position J508 (1 to 2), refer to Figure 4, circle with number 3 (this turns on the PMIC by setting the high state the PMIC_ON_REQ pin).

4. Measure the default voltage of BUCK2 with the multimeter, it must be 0.85 V (default voltage).

6.3 Default power configuration

The default power configuration can be checked without doing any hardware (HW) or software (SW) modifications. Check the default voltage configuration using a multimeter on BUCK1, BUCK2, BUCK3, BUCK4, LDO1, and LDO SNVS test points.

Table 6. Default voltage values

Regulator	PF9453
BUCK1	1.1 V
BUCK2	0.85 V
BUCK3	1.8 V
BUCK4	3.3 V
LDO1	0.8 V
LDO SNVS	1.8 V

6.4 Using an external power supply

Figure 5 shows how to connect an external power supply in the PF9453UK-EVK.

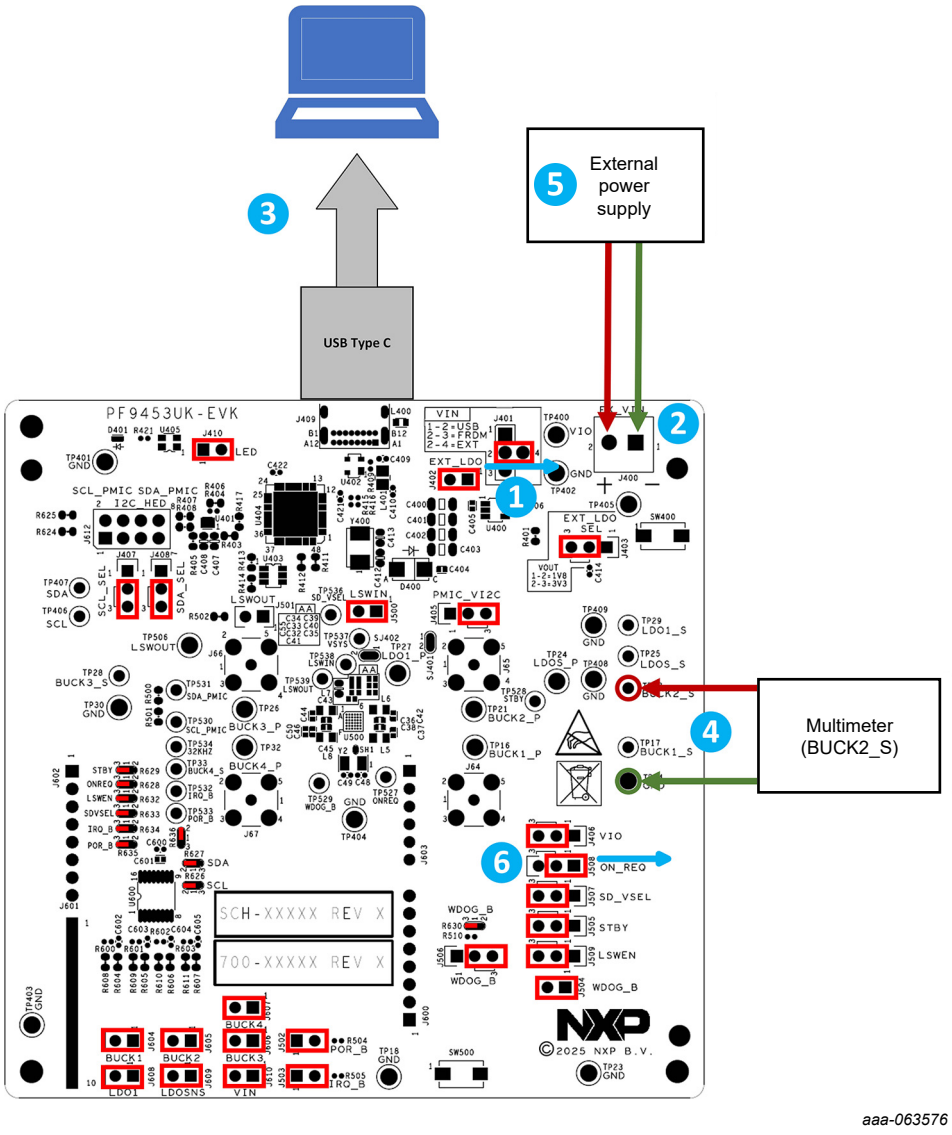

Figure 5. Using an external power supply

Follow next steps to start testing the PF9453UK-EVK with an external power supply. Before starting, ensure that all jumpers are in their default positions. (See Section 5.3) and no other cables are connected to the PF9453UK-EVK:

1. Move the J401 jumper to position J401 (2 to 4). Input the PMIC voltage from an external power supply, see Figure 5. Step 1 is represented by the number 1.
2. Connect the external power supply to the J400 connector: positive terminal to J400 (pin 2), negative terminal J400 (pin 1) see Figure 5, circle with number 2. The external power supply can also be connected to the following tests points: positive terminal to TP400 (VPWR) and negative terminal to TP402 (GND).
3. Connect the USB-Type C to the PF9453UK-EVK, see Figure 5, circle with number 3.
4. Connect the positive terminal of the multimeter to TP22 (BUCK2_S) test point and the negative terminal of the multimeter to TP34 (GND) test point. See Figure 5, circle with number 4.
5. Configure the power supply to 5.0 V, 1 A, and turn it on. See that the green LED D401 is ON, see the Figure 5, circle with number 5.
6. Move the J508 Jumper to position J508 (1 to 2), see Figure 5, circle with number 6. (This turns on the PMIC by setting the high state the PMIC_ON_REQ pin.)

7. Measure the default voltage of BUCK2 with the multimeter, must be 0.85 V (default voltage).

7 PF9453 WLCSP GUI

7.1 GUI overview

As shown in Figure 6, the PF9453 software GUI is a tool to access the on-chip registers to perform write/read commands manually or automatically (depending on different settings chosen from the GUI). The following is a guide of the key blocks that the PF9453 software GUI provides.

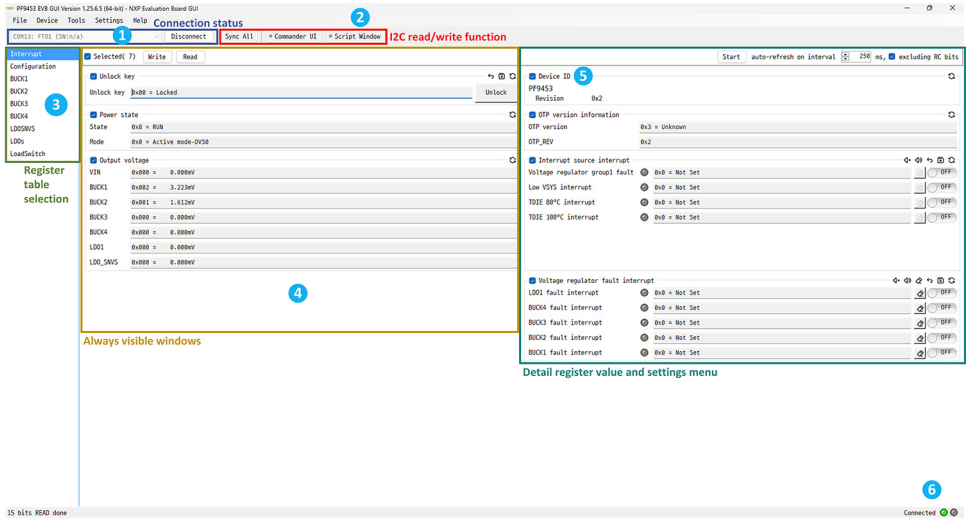

Figure 6. PF9453 GUI when WLCSP is connected

Note: *The GUI supports WCLSP and QFN packages. Depending on the evaluation board, the GUI automatically detects which it is, and it displays the registers available for this package*

7.2 GUI setup

After plugging in the USB-Type C cable is mentioned in Section 6, the GUI should detect the EVK.

Select the driver type (FTDI Sn: n/a) from the drop-down menu on Connection status (see , number 1), and then, click **Connect**.

If the connection was successfully done, see in the interrupt sheet: the device ID information (see Figure 6, number 5), The name of the devices will be shown as "PF9453" and the green circle will turn on with the legend “connected” (see Figure 6, number 6).

Note: *If there is an issue connecting with the PF9453 GUI, ensure the FTDI drivers are installed, see Section 8 for more details.*

7.3 Register table section

The registers are categorized as shown below:

- **INTERRUPT** – Includes status registers of interrupts source, voltage regulator fault, OTP version information and Device ID information
- **CONFIGURATION** – System configuration, reset behaviors, UVLO threshold and clock driver enable register
- **BUCK1** – Includes all the configuration registers for BUCK1

- **BUCK2** – Includes all the configuration registers for BUCK2 including DVS
- **BUCK3** – Includes all the configuration registers for BUCK3
- **BUCK4** – Includes all the configuration registers for BUCK4
- **LDOSNVS** – Includes all the configuration registers for LDO SNVS
- **LDO1** – Includes all the configuration registers for LDO1.
- **Load switch** – Includes all the configuration registers for the load switch

7.4 Always–visible window

PF9453 GUI has an always-visible window (see Figure 6, number 4.) This window allows the user to see the unlocked key and power state registers plus the measurement of each voltage of the PMIC regulators. The following are descriptions of each of these sections:

- Unlock key register: These registers lock and unlock the registers related to the voltage level of each regulator. For more details, refer to the PF9453 Datasheet.
- Power state register: These registers allow to see the state of the PMIC, for example RUN, STBY, OFF. For more details, refer to PF9453 Datasheet.
- Voltage: PF9453UK-EVK has an ADC IC connected to different voltages in the board. Those voltages are shown in the current section. Voltage measurements can be refreshed by the **Read** button on this section or with the **Auto refresh** button at the top right of the GUI.

For more details about the ADC connection, refer to the SCH file of the PF9453UK-EVK.

7.5 I²C read and write

PF9453 software GUI provides three ways to read and write.

1. In the always-visible window at the top-right, there are two symbols that allow you to write to and read from all selected registers in that sheet, see Figure 7. Alternatively, there are also two buttons at the top labeled 'Write' and 'Read' that provide the same functionality.

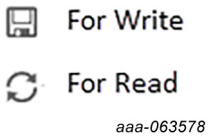

Figure 7. Write/Read button

2. For each register, the same two symbols mentioned earlier appear at the top-right of the window containing that register, allowing you to write to or read from that specific register.
3. Script. Run the script to read or write a series of registers. User guidelines can be found in the help menu.

8 PF9453UK-EVK getting started summary

The following sections show how to perform an evaluation of the PF9453 using the evaluation board and the software GUI.

8.1 Jumper configuration

This step must be done with the USB-Type C cable disconnected. Connect the jumpers in the default configuration as shown in Section 5.3.

8.2 Connect and power the board

As shown in Figure 4, connect the USB-Type C cable and follow the steps in Section 6.2. If an external power supply is needed for testing, i.e., efficiency tests, see Section 6.4.

8.3 Working on the PF9453 software GUI

Open, set up, and connect the GUI as directed in Section 7.2. Then,configure the PMIC using the different tabs. In the always–visible window, press the **Read** button on the voltage section to see the voltage level of each regulator and see the default value of each.

8.3.1 Buck configuration

Select the BUCKx tab from the register table selection.

Click the **unlock** in the always-visible window (see Figure 6, number 4) to unlock the regulator registers.

From here: change all the configuration registers for all the buck regulators of the PF9453, then configure the low power modes. Enable the active discharge resistor, use forced PWM, and change enable modes. Finally, configure the DVS speed (for BUCK2), and change output voltages by either 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 finished.

8.3.2 LDO configuration

Select the ‘LDOx’ tab from the register table selection.

Be sure the **unlock** button in the always-visible window (see Figure 6, number 4) is enabled.

From here: change all the configuration registers for all the LDO regulators of the PF9453, configure the low power modes, and enable the active discharge resistor. Change enable modes, and change output voltages by either 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 finished.

8.3.3 Load-switch configuration

Select the load switch tab from the register table selection.

From here: it is possible to change all the configuration registers for the load switch of the PF9453, enable the active discharge resistor, change enable modes, and configure the different protection mechanisms.

8.3.4 GUI close

Click **Disconnect** and disconnect the USB cable from the PC and close the PF9453 GUI.

9 Revision history

Table 7. Revision history

Document ID	Release date	Description
UM12405 v.1.0	26 November 2025	Initial version

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