# UM11854 KITPF5030SKTEVM programming board Rev. 1 — 9 March 2023

**User manual** 

#### **Document information**

| Information | Content   |
|-------------|---|
| Keywords    | PF5030, KITPF5030SKTEVM, KL25Z, I <sup>2</sup> C, spf-53091   |
| Abstract    | The KITPF5030SKTEVM provides flexibility to explore all the features of the device and make measurements on the main part of the application. |



### Revision history

| Rev | Date     | Description     |
|-----|----------|-----------------|
| v.1 | 20230309 | Initial release |

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This evaluation kit is intended 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 simply connecting it to the host MCU or 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 will be heavily dependent on proper printed circuit board layout and heat sinking design as well as attention to supply filtering, transient suppression, and I/O signal quality.

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# 1 Introduction

The KITPF5030SKTEVM board user manual is intended for the engineers involved in the evaluation, design, implementation, and validation of PF5030 Configurable Power Management IC.

The KITPF5030SKTEVM enables development on PF5030 family of devices. The kit can be connected to the NXP GUI software, which allows the user to explore registers, try OTP configurations, and burn the part.

The devices can be placed and removed easily from the board using the socket. This board supports the PF5030 family of devices. The delivered board consists of a soldered device with empty OTP content in order to leave the opportunity to the user to burn the OTP configuration. The board contains a superset device PPF5030BMDA0ES, allowing tests on all the PF5030 derivatives. Each device OTP can be burned twice, which provides flexibility.

### KITPF5030SKTEVM programming board

# 2 Finding resources and information on the NXP website

NXP Semiconductors provides online resources for this evaluation board and its supported devices on <u>http://www.nxp.com</u>.

The information page for KITPF5030SKTEVM board is available at <u>http://www.nxp.com/KITPF5030SKTEVM</u>. The information page provides overview information, documentation, software and tools, parametric data, ordering information and a Getting Started tab. The Getting Started tab provides quick-reference information applicable to using the KITPF5030SKTEVM board, including the downloadable assets referenced in this document.

The information page for "NXP GUI for Automotive PMIC Families" is at <u>http://www.nxp.com/NXP GUI for</u> <u>Automotive PMIC Families</u>. The information page provides overview information, documentation, downloads, and development tools.

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# 3 Getting ready

Working with the KITPF5030SKTEVM requires the kit contents, additional hardware, and a Windows PC workstation with installed software.

# 3.1 Kit contents

- · Assembled and tested KITPF5030SKTEVM connected to a FRDM-KL25Z in an anti-static bag
- 2 ft or 3 ft USB-STD A to USB-B-mini cable
- 1x Pluggable terminal block, two positions, straight, 3.81 mm pitch
- 3x Pluggable terminal block, three positions, straight, 3.81 mm pitch
- · Jumpers mounted on board
- Quick Start Guide

# 3.2 Additional hardware

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

• One or two power supplies with a range from 3.3 V to 5.0 V, and a current limit set initially to 1.0 A

# 3.3 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 or Windows 10

## 3.4 Software

Installing software is necessary to work with this evaluation board. All listed software is available on the evaluation boards information page.

- http://www.nxp.com/KITPF5030SKTEVM
- NXP GUI for automotive PMIC families latest version

# 4 Getting to know the hardware

The KITPF5030SKTEVM provides flexibility to explore all the features of the device and make measurements on the main part of the application. In combination with the FRDM-KL25Z MCU board, the NXP GUI software allows access to the registers in read and write mode. All regulators are accessible through connectors. DC-DC switching nodes and other nonuser signals are mapped on test points. Digital signals (I<sup>2</sup>C, RSTB) are accessible through connectors. Pin PWRON has a switch to control them. A supply switch is available to power on or off the device.

The main purpose of this kit is to burn the OTP configuration. The main purpose of this kit is to evaluate PF5030 in automotive applications. The device always starts loading the fused configuration (OTP) (that may be blank) to the mirror registers, then the user can override the mirrors using Emulation mode. The device can be programmed/fused two times. This board is able to fuse the OTP without any extra tools or board. In Emulation mode, as long as the power is supplied, the board configuration stays valid. However, the main and fail-safe configurations are lost when the device restarts or goes into deep fail-safe (DEEP-FS) state, because OTP is reloaded and overwrite the mirrors content.

Note: Due to the socket, this kit is not optimized for performance measurement or current higher than 1.0 A.

### 4.1 Kit overview

The KITPF5030SKTEVM is a hardware evaluation tool that allows OTP burning. Due to the socket, PF5030 part can be configured without the need to solder it. Devices can be programmed two times. The KITPF5030SKTEVM is a hardware evaluation tool that allows performance test. PF5030 can be evaluated with this board because it is populated with a superset part. The PPF5030BMDA0ES part soldered on the board can be fused twice.

An Emulation mode is possible to test as many configurations as needed. From USB voltage, an external DC-DC provides VDDIO\_SEL voltage with a choice of 1.8 V, 3.3 V (default), or 5.0 V. Furthermore, another external DC-DC generates the OTP programming voltage (7.95 V) without any need for an external power supply.

# 4.2 KITPF5030SKTEVM features

- VIN power supply connector (1x or 2x 3.3 V to 5.0 V)
- BUCK1 and BUCK2: 0.7 V to 1.5 V up to 1.0 A (socket limit)
- BUCK3: 1.0 V to 3.3 V up to 1.0 A (socket limit)
- LDO1 and LDO2: 1.5 V to 5.0 V
- PWRON switch
- FS0B external safety pin
- Embedded USB connection for easy connection to software NXP GUI (access to I<sup>2</sup>C bus, IOs, RSTB, FS0B, INTB, debug, AMUX\_OUT, regulators, register access, OTP emulation, and OTP programming)
- · LEDs that indicate signals and regulator status
- · Support OTP fuse capabilities
- Voltage monitoring jumper setting

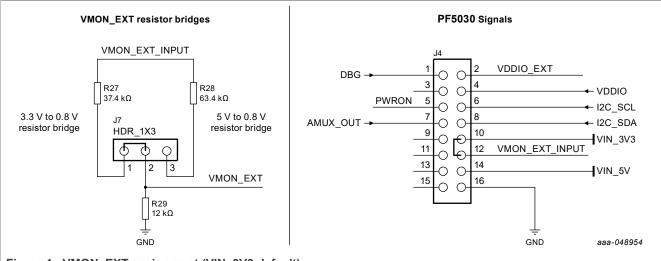
# 4.3 Schematic, board layout, and bill of materials

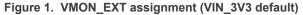
The schematic, board layout, and bill of materials for the KITPF5030SKTEVM board are available at <u>http://www.nxp.com/KITPF5030SKTEVM</u>.

### 4.3.1 VMON board configuration

The VMON configuration is highly dependent on the use case. This kit is delivered with a default configuration.

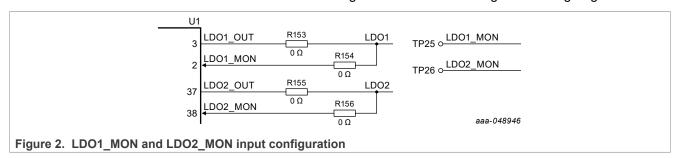
The user can assign VMON\_EXT differently to address the use case using J4 and J7 connectors shown in <u>Figure 1</u>. J7 is used to select the VMON\_EXT (VMON0) external resistor divider to monitor 3.3 V or 5.0 V. J4 is used to connect the VMON\_EXT external resistor divider input VMON\_EXT\_INPUT to an external voltage, VIN\_3V3, or VIN\_5V. By default, VMON\_EXT is monitoring VIN\_3V3.





By default, BUCK2\_FB (VMON2) is connected to BUCK2 though R162. However, When BUCK2 is disabled or used in multiphase with BUCK1, BUCK2\_FB can be connected to an external voltage. R162 must be removed in this case and the internal DAC must be configured to the voltage monitoring target.

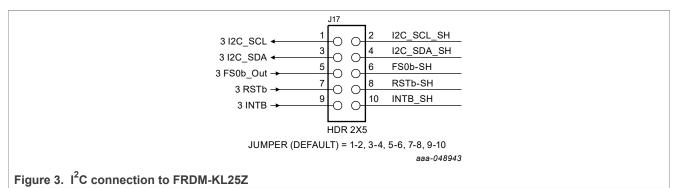
By default, LDO1\_MON (VMON4) and LDO2\_MON (VMON5) pins are tied to LDO1 and LDO2, respectively. LDO1\_MON and LDO2\_MON can be used to monitor an external voltage using test points TP25 (LDO1\_MON) and TP26 (LDO2\_MON), then R154 and/or R156 must be removed. Figure 2 shows the corresponding part of the schematic. The internal resistors dividers can be configured to select the voltage monitoring target.



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# 4.3.2 I<sup>2</sup>C

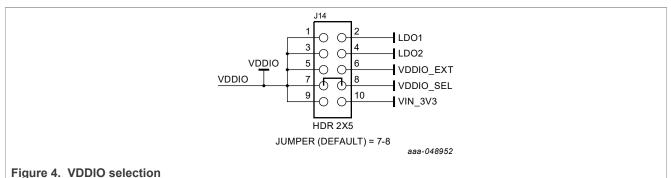
The I<sup>2</sup>C bus is connected to KL25Z MCU to communicate with NXP GUI. Another MCU can be connected to the I<sup>2</sup>C bus on J4 connector, but J17 1-2 and 3-4 must be removed to disconnect the FRDM-KL25Z MCU (see Figure 3). In addition to this change, make sure that the VDDIO voltage domain and ground are the same on MCU side and KITPF5030SKTEVM side.



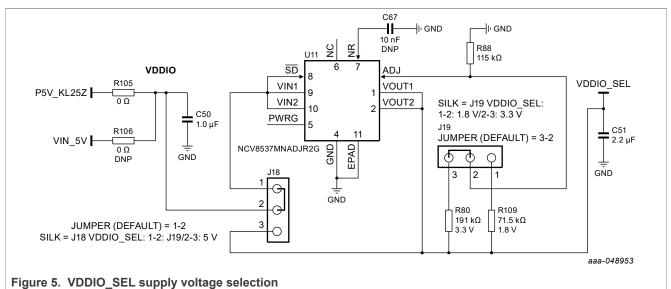
### 4.3.3 VDDIO

The VDDIO pin is powered through VDDIO net and is used to supply internal buffers and I<sup>2</sup>C communication.

The selection of VDDIO is made using J14 connector as shown in <u>Figure 4</u>. By default, an external LDO is provided to feed VDDIO through the VDDIO\_SEL net.



The I<sup>2</sup>C is compatible with 1.8 V, 3.3 V, and 5.0 V, therefore VDDIO\_SEL voltage is configurable between 1.8 V, 3.3 V, or 5.0 V using J18 and J19 connectors (3.3 V by default) shown in <u>Figure 5</u>.



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# 4.4 Kit featured components

Figure 6 identifies important components and Table 1 provides details.

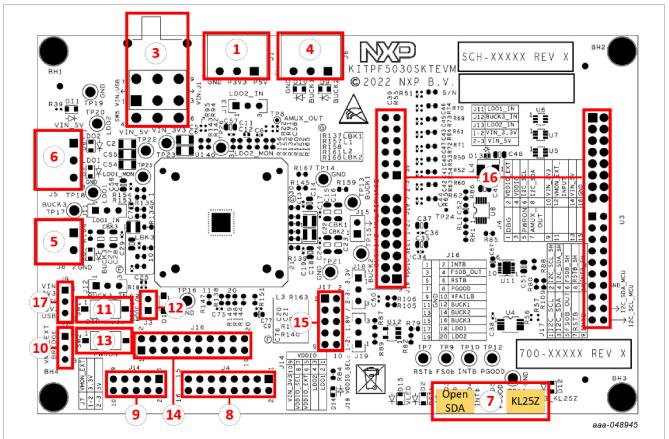


Figure 6. Evaluation board featured components location

| Table 1 | <b>Evaluation</b> | board | featured  | components | location |
|---------|-------------------|-------|-----------|------------|----------|
|         | Lvalaation        | bourd | icutui cu | components | location |

| Number | Description   |  |  |
|--------|---|--|--|
| 1      | VIN_5V and VIN_3V3 power supply input   |  |  |
| 3      | VIN three position switch   |  |  |
|        | Left position: VIN from USB   |  |  |
|        | Middle position: board not supplied   |  |  |
|        | Right position: VIN from J1   |  |  |
| 4      | BUCK1/2 regulators output   |  |  |
| 5      | BUCK3 regulator output  |  |  |
| 6      | LDO1/2 regulators output  |  |  |
| 7      | USB connectors (OpenSDA for MCU flash; KL25Z for NXP GUI control)                 |  |  |
| 8      | Debug connectivity. Access to PF5030 signals                                      |  |  |
| 9      | VDDIO selection   |  |  |
| 10     | VMON_EXT resistor bridge configuration (choice between monitoring 3.3 V or 5.0 V) |  |  |
| 11     | OTP mode switch   |  |  |
| 12     | DBG pin to ground if unplugged  |  |  |

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| Number | Description                         |  |
|--------|-------------------------------------|--|
| 13     | PWRON pin switch                    |  |
| 14     | Signal debug connector              |  |
| 15     | FRDM-KL25Z board signals connection |  |
| 16     | FRDM-KL25Z board connectors         |  |
| 17     | VLED supply configuration           |  |

#### Table 1. Evaluation board featured components location...continued

### 4.4.1 Connectors

Figure 7 shows the location of connectors on the board.

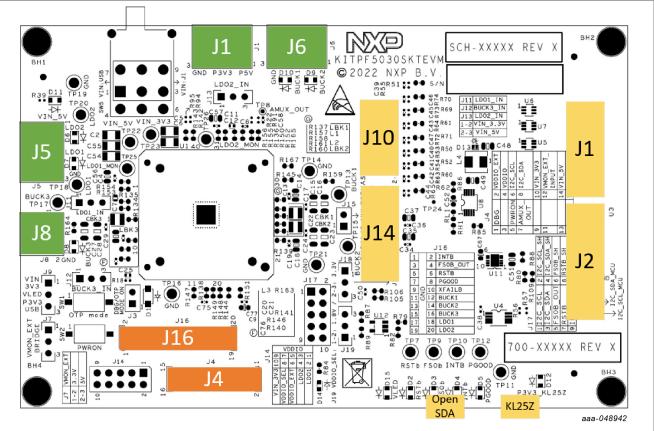


Figure 7. Evaluation board connectors location

# 4.4.1.1 VIN connector (J1)

#### Table 2. VIN\_5V and VIN\_3V3 connector (J1)

| Schematic label | Signal name | Description                |
|-----------------|-------------|----------------------------|
| J1-1            | VIN_5V      | 5 V voltage supply input   |
| J1-2            | VIN_3V3     | 3.3 V voltage supply input |
| J1-3            | GND         | Ground                     |

# 4.4.1.2 Output power supply connectors

#### Table 3. LDO1/2 connector (J5)

| Schematic label | Signal name | Description           |
|-----------------|-------------|-----------------------|
| J5-1            | LDO2        | LDO2 regulator output |
| J5-2            | LDO1        | LDO1 regulator output |
| J5-3            | GND         | Ground                |

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#### Table 4. BUCK1/2 connector (J6)

| Schematic label | Signal name | Description            |
|-----------------|-------------|------------------------|
| J6-1            | BUCK2       | BUCK2 regulator output |
| J6-2            | BUCK1       | BUCK1 regulator output |
| J6-3            | GND         | Ground                 |

#### Table 5. BUCK3 connector (J8)

| Schematic label | Signal name | Description            |
|-----------------|-------------|------------------------|
| J8-1            | BUCK3       | BUCK3 regulator output |
| J8-2            | GND         | Ground                 |

# 4.4.1.3 Debug connector (J4)

| Fable 6. Debug connector (J4) |                |                                   |  |
|-------------------------------|----------------|-----------------------------------|--|
| Schematic label               | Signal name    | Description                       |  |
| J4-1                          | n.c.           | Not connected                     |  |
| J4-2                          | VDDIO_EXT      | External VDDIO voltage supply     |  |
| J4-3                          | INTB           | Interrupt output pin (active low) |  |
| J4-4                          | n.c.           | Not connected                     |  |
| J4-5                          | PWRON          | PWRON input pin                   |  |
| J4-6                          | I2C_SCL        | I <sup>2</sup> C serial clock     |  |
| J4-7                          | AMUX_OUT       | Analog multiplexer output         |  |
| J4-8                          | I2C_SDA        | I <sup>2</sup> C serial data      |  |
| J4-9                          | n.c.           | Not connected                     |  |
| J4-10                         | VIN_3V3        | VIN_3V3 voltage supply            |  |
| J4-11                         | n.c.           | Not connected                     |  |
| J4-12                         | VMON_EXT_INPUT | VMON_EXT voltage divider input    |  |
| J4-13                         | n.c.           | Not connected                     |  |
| J4-14                         | VIN_5V         | VIN_5V voltage supply             |  |
| J4-15                         | n.c.           | Not connected                     |  |
| J4-16                         | GND            | Ground                            |  |

# 4.4.1.4 Voltage monitoring connector (J16)

### Table 7. Voltage monitoring connector (J16)

| Schematic label | Signal name | Description                                   |
|-----------------|-------------|---|
| J16-1           | GND         | Ground  |
| J16-2           | INTB        | Interrupt output pin (active low-logic level) |
| J16-3           | GND         | Ground  |
| J16-4           | FS0B_out    | Fail-safe pin (active low-logic level)        |

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| Schematic label | Signal name | Description  |
|-----------------|-------------|--|
| J16-5           | GND         | Ground   |
| J16-6           | RSTB        | Reset input / output pin (active low-logic level)            |
| J16-7           | GND         | Ground   |
| J16-8           | PGOOD       | Power good output pin  |
| J16-9           | GND         | Ground   |
| J16-10          | XFAILB      | Power synchronization input/output with NXP low voltage PMIC |
| J16-11          | GND         | Ground   |
| J16-12          | BUCK1       | BUCK1 regulator output                                       |
| J16-13          | GND         | Ground   |
| J16-14          | BUCK2       | BUCK2 regulator output                                       |
| J16-15          | GND         | Ground   |
| J16-16          | BUCK3       | BUCK3 regulator output                                       |
| J16-17          | GND         | Ground   |
| J16-18          | LDO1        | LDO1 regulator output  |
| J16-19          | GND         | Ground   |
| J16-20          | LDO2        | LDO2 regulator output  |

## Table 7. Voltage monitoring connector (J16)...continued

# 4.4.1.5 FRDM-KL25Z board connectors

#### Table 8. FRDM-KL25Z safety output connector (J1)

| Schematic label | Signal name | Description                           |
|-----------------|-------------|---------------------------------------|
| J1-1 to J1-9    | n.c.        | Not connected                         |
| J1-6            | INTB_MCU    | Interruption (active low-logic level) |
| J1-7            | n.c.        | Not connected                         |
| J1-8            | RSTB_MCU    | Reset (active low-logic level)        |
| J1-9 to J1-11   | n.c.        | Not connected                         |
| J1-12           | FS0b_MCU    | Fail-safe (active low-logic level)    |
| J1-13 to J1-16  | n.c.        | Not connected                         |

# Table 9. FRDM-KL25Z I<sup>2</sup>C connector (J2)

| Schematic label | Signal name | Description                        |
|-----------------|-------------|------------------------------------|
| J2-1 to J2-13   | n.c.        | Not connected                      |
| J2-14           | GND         | Ground                             |
| J2-15 to J2-17  | n.c.        | Not connected                      |
| J2-18           | I2C_SDA_MCU | I <sup>2</sup> C serial data line  |
| J2-19           | n.c.        | Not connected                      |
| J2-20           | I2C_SCL_MCU | I <sup>2</sup> C serial clock line |

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| Schematic label | Signal name | Description                         |
|-----------------|-------------|-------------------------------------|
| J10-1           | BUCK2_ADC   | BUCK2 regulator output to KL25Z ADC |
| J10-2           | DBG_ADC     | DBG pin voltage to KL25Z ADC        |
| J10-3           | BUCK1_ADC   | BUCK1 regulator output to KL25Z ADC |
| J10-4           | AMUX_ADC    | AMUX pin to KL25Z ADC               |
| J10-5           | BUCK3_ADC   | BUCK3 regulator output to KL25Z ADC |
| J10-6           | LDO1_ADC    | LDO1 regulator output to KL25Z ADC  |
| J10-7           | n.c.        | Not connected                       |
| J10-8           | LDO2_ADC    | LDO2 regulator output to KL25Z ADC  |
| J10-9           | n.c.        | Not connected                       |
| J10-10          | VIN_ADC     | VIN pin voltage to KL25Z ADC        |
| J10-11          | n.c.        | Not connected                       |
| J10-12          | VDDIO_ADC   | VDDIO pin voltage to KL25Z ADC      |

# Table 10. FRDM-KL25Z ADC connector (J10)

#### Table 11. FRDM-KL25Z supply connector (J14)

| Schematic label | Signal name | Description                |
|-----------------|-------------|----------------------------|
| J14-1 to J14-3  | n.c.        | Not connected              |
| J14-4           | P3V3_KL25Z  | 3.3 V generated from KL25Z |
| J14-5 to J14-7  | n.c.        | Not connected              |
| J14-8           | P3V3_KL25Z  | 3.3 V generated from KL25Z |
| J14-9           | n.c.        | Not connected              |
| J14-10          | P5V_KL25Z   | 5.0 V generated from USB   |
| J14-11          | n.c.        | Not connected              |
| J14-12          | GND         | Ground                     |
| J14-13          | n.c.        | Not connected              |
| J14-14          | GND         | Ground                     |
| J14-15          | n.c.        | Not connected              |
| J14-16          | n.c.        | Not connected              |

# Table 12. FRDM-KL25Z USB connectors

| Schematic label | Signal name | Description  |
|-----------------|-------------|--|
| KL25Z           | NA          | USB connector used to communicate with the PF5030 part |
| OpenSDA         | NA          | USB connector used to flash the KL25Z MCU              |

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### 4.4.2 Test points

Figure 8 shows test points that provide access to various signals to and from the boards.

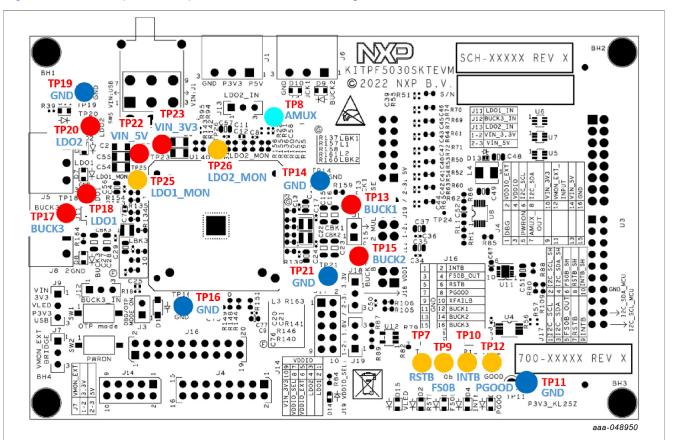


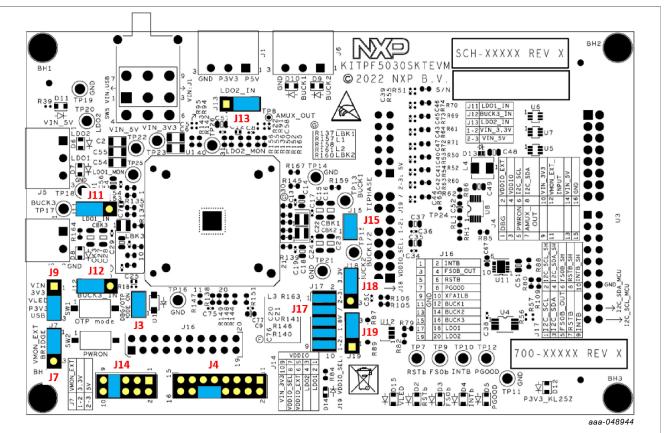
Figure 8. Evaluation board test points

| Table 13. | Evaluation | board | test | points | description |
|-----------|------------|-------|------|--------|-------------|
|-----------|------------|-------|------|--------|-------------|

| Signal name | Description  |
|-------------|--|
| RSTB        | Reset pin (active low)   |
| AMUX        | Analog multiplexer output  |
| FS0B        | Fail-safe pin (active low)   |
| INTB        | Interruption pin (active low)  |
| PGOOD       | Power good pin (active high)   |
| BUCK1       | BUCK1 regulator output   |
| BUCK2       | BUCK2 regulator output   |
| BUCK3       | BUCK3 regulator output   |
| LDO1        | LDO1 regulator output  |
| LDO2        | LDO2 regulator output  |
| VIN_5V      | VIN pin voltage  |
| VIN_3V3     | BUCK1/2_IN pin voltage   |
| LDO1_MON    | LDO1_MON pin voltage   |
| LDO2_MON    | LDO2_MON IN pin voltage  |
| GND         | Ground   |
|             | RSTB           AMUX           FS0B           INTB           PGOOD           BUCK1           BUCK2           BUCK3           LD01           LD02           VIN_5V           VIN_3V3           LD01_MON           LD02_MON |

## 4.4.3 Jumpers

Figure 9 shows jumper locations for board configuration.



| Figure 9   | Evaluation board  | iumners loca  | ation (with de | fault nosition) |
|------------|-------------------|---------------|----------------|-----------------|
| i iguio o. | Effault off board | janiporo iooc |                | radic poortion) |

| Name       | Function                 | Pin number | Description  |
|------------|--------------------------|------------|--|
| J3         | Apply voltage to DBG pin | 1–2        | Either 4.5 V (DBG mode) or 7.95 V (OTP mode). See SW1 position |
| J4         | VMON_EXT input           | 10-12      | VIN_3V3  |
|            | selection                | 12-14      | VIN_5V   |
| J7         | VLED selection           | 1-2        | VIN_3V3  |
|            |                          | 2-3        | P3V3_KL25Z   |
| <b>J</b> 9 | VMON_EXT resistor        | 1–2        | Monitors 3.3 V   |
|            | bridge selection         | 2-3        | Monitors 5.0 V   |
| J11        | LDO1 input               | 1-2        | LDO1_IN tied to VIN_3V3  |
|            |                          | 2-3        | LDO1_IN tied to VIN_5V   |
| J12        | BUCK3 input              | 1-2        | BUCK3_IN tied to VIN_3V3                                       |
|            |                          | 2-3        | BUCK3_IN tied to VIN_5V  |
| J13        | LDO2 input               | 1-2        | LDO2_IN tied to VIN_3V3  |
|            |                          | 2-3        | LDO2_IN tied to VIN_5V   |

| Table 14. E | Evaluation | board | jumpers | description |
|-------------|------------|-------|---------|-------------|
|-------------|------------|-------|---------|-------------|

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| Name | Function                        | Pin number | Description               |
|------|---------------------------------|------------|---------------------------|
| J14  | VDDIO input                     | 1-2        | VDDIO tied to LDO1        |
|      |                                 | 3-4        | VDDIO tied to LDO2        |
|      |                                 | 5-6        | VDDIO tied to VDDIO_EXT   |
|      |                                 | 7-8        | VDDIO tied to VDDIO_SEL   |
|      |                                 | 9-10       | VDDIO tied to VIN_3V3     |
| J15  | BUCK1/2 multiphase              | 1-2        | BUCK2 tied to BUCK1       |
| J17  | I <sup>2</sup> C and safety IOs | 1-2        | I <sup>2</sup> C SCL      |
|      | connection to FRDM-<br>KL25Z    | 3-4        | I <sup>2</sup> C SDA      |
|      |                                 | 5-6        | FS0B_out                  |
|      |                                 | 7-8        | RSTB                      |
|      |                                 | 9-10       | INTB                      |
| J18  | VDDIO_SEL selection A           | 1-2        | See J19                   |
|      |                                 | 2-3        | VDDIO_SEL voltage @ 5.0 V |
| J19  | VDDIO_SEL selection B           | 1-2        | VDDIO_SEL voltage @ 1.8 V |
|      |                                 | 2-3        | VDDIO_SEL voltage @ 3.3 V |

#### Table 14. Evaluation board jumpers description...continued

## 4.4.4 LED signaling

Figure 10 shows the LEDs provided as visual output devices for the evaluation board:

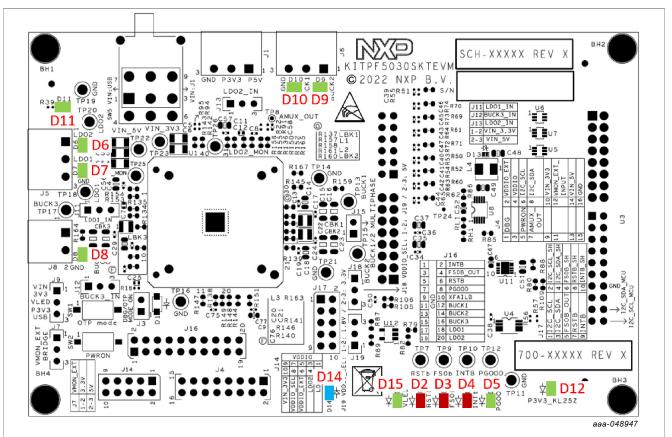


Figure 10. Evaluation board LED signaling location

| Label | Name         | Color | Description                                |
|-------|--------------|-------|--|
| D2    | RSTB         | Red   | RSTB asserted (low-logic level)            |
| D3    | FS0B         | Red   | FS0B asserted (low-logic level)            |
| D4    | INTB         | Red   | INTB asserted (low-logic level)            |
| D5    | PGOOD        | Green | PGOOD released                             |
| D6    | LDO2         | Green | LDO2 ON                                    |
| D7    | LDO1         | Green | LDO1 ON                                    |
| D8    | BUCK3        | Green | BUCK3 ON                                   |
| D9    | BUCK2        | Green | BUCK2 ON                                   |
| D10   | BUCK1        | Green | BUCK1 ON                                   |
| D11   | VIN_5V       | Green | VIN_5V ON                                  |
| D12   | P3V3_KL25Z   | Green | P3V3_KL25Z ON                              |
| D14   | DBG ≥ 7.85 V | Blue  | DBG pin voltage ≥ 7.85 V (OTP programming) |
| D15   | VLED         | Green | VLED ON                                    |

| Table 15  | Evoluction | board I ED | aignaling | description |
|-----------|------------|------------|-----------|-------------|
| Table 15. | Evaluation | board LED  | signaling | description |

## 4.4.5 Switches

Figure 11 and Figure 12 show switches locations for board operation.

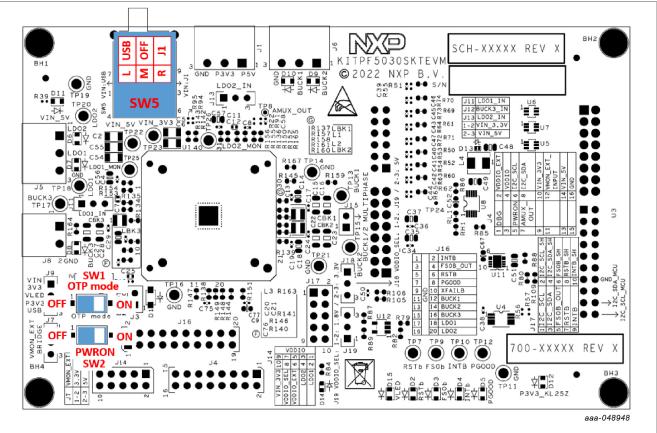
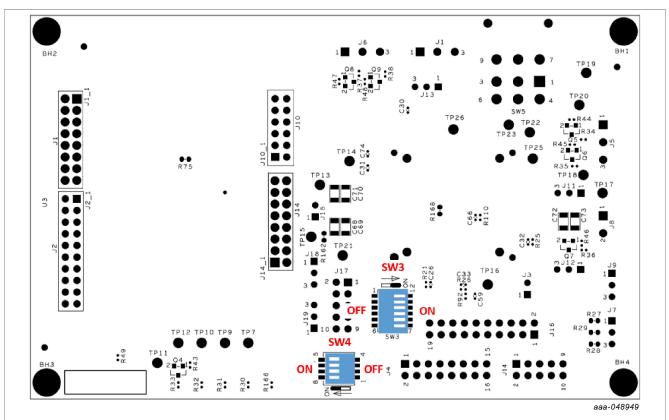


Figure 11. Switches location top

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# KITPF5030SKTEVM programming board



#### Figure 12. Switches location bottom

#### Table 16. SW1 description

| Position | Function     | Description   |
|----------|--------------|---|
| RIGHT    | OTP mode ON  | PF5030 OTP can be emulated and programmed when J3 populated |
| LEFT     | OTP mode OFF | PF5030 OTP cannot be emulated and programmed                |

### Table 17. SW2 description

| Position | Function       | Description            |
|----------|----------------|------------------------|
| RIGHT    | PWRON pin high | PF5030 can power up    |
| LEFT     | PWRON pin low  | PF5030 cannot power up |

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### Table 18. SW3 description

| Switch number | Line   | LED | Description   |
|---------------|--------|-----|---|
| 1             | VIN_5V | D11 |   |
| 2             | BUCK1  | D10 |   |
| 3             | BUCK2  | D9  | Each LED is connected through an independent switch.<br>Disconnecting them allows more accurate efficiency measurement. |
| 4             | BUCK3  | D8  | The switches also disconnect the FRDM-KL25Z ADC inputs.   |
| 5             | LDO1   | D7  |   |
| 6             | LDO2   | D6  |   |

#### Table 19. SW4 description

| Switch number | Line  | LED | Description   |
|---------------|-------|-----|---|
| 1             | PGOOD | D5  | Each LED is connected through an independent switch.              |
| 2             | INTB  | D4  | Disconnecting them allows more accurate efficiency measurement.   |
| 3             | FS0B  | D3  | The switches also disconnect the level shifters to the FRDM-KL25Z |
| 4             | RSTB  | D2  | inputs.   |

#### Table 20. SW5 description

| Position | Function | Description              |
|----------|----------|--------------------------|
| RIGHT    | VIN ON   | PF5030 supplied from USB |
| MIDDLE   | VIN OFF  | PF5030 not supplied      |
| LEFT     | VIN ON   | PF5030 supplied from J1  |

# 5 Installing and configuring software and tools

The programming/evaluation boards are always delivered with the GUI firmware already flashed. If MCU firmware is already flashed, ignore this section. If it is specified that firmware must be updated or it is malfunctioning, follow these instructions.

# 5.1 Flashing or updating the FRDM-KL25Z GUI firmware

If bootloader is already loaded in the FRDM-KL25Z board, steps 1-3 are not required. Start from step 4.

1. Disable the Storage Service and Windows Search: Run Services, double click, and stop them as shown in <u>Figure 13</u>.

| ction View  | Help  |                                |               |         |              |          | File Action View | Help   |                                |              |         |              |       |
|-------------|---|--------------------------------|---------------|---------|--------------|----------|------------------|--|--------------------------------|--------------|---------|--------------|-------|
| <b>T </b>   |   |                                |               |         |              | -        | -                | 🗟 🖬 🕨 🖬 🖬 🕨  |                                |              |         |              |       |
| ces (Local) | Services (Local)  |                                |               |         |              |          | Services (Local) | Services (Local)   |                                |              |         |              |       |
|             | Storage Service   | Name                           | Description   | Status  | Startup Type | Log ^    |                  | Windows Search   | Name                           | Description  | Status  | Startup Type | Log   |
|             |   | Sensor Service                 | A service fo  |         | Manual (Trig | Loc      |                  |  | Windows Perception Service     | Enables spa  |         | Manual (Trig | Loc   |
| •           | Stop the service  | Server                         | Supports fil  | Running | Automatic    | Loc      | •                | Stop the service   | Windows Presentation Fou       | Optimizes p  | Running | Manual       | Loc   |
|             | the second se | Shared PC Account Manager      | Manages pr    |         | Disabled     | Loc      |                  | The service  | Windows Push Notification      | This service | Running | Automatic    | Loc   |
|             |   | Shell Hardware Detection       | Provides no   | Running | Automatic    | Loc      |                  |  | Windows Push Notification      | This service | Running | Automatic    | Loc   |
|             | Description:  | Smart Card                     | Manages ac    | Running | Automatic (T | Loc      |                  | Description:   | 🖓 Windows Remote Manage        | Windows R    |         | Manual       | Net   |
|             | Provides enabling services for storage settings and external storage  | Smart Card Device Enumera      | Creates soft  |         | Manual (Trig | Loc      |                  | Provides content indexing, property<br>caching, and search results for files, e- | Windows Search                 | Provides co  | Running | Automatic (D | . Loc |
|             | expansion   | Smart Card Removal Policy      | Allows the s  |         | Manual       | Loc      |                  | mail, and other content.   | S Windows Time                 | Maintains d  | Running | Manual (Trig | Loc   |
|             |   | SMS Agent Host                 | Provides ch   | Running | Automatic (D | Loc      |                  |  | Windows Update                 | Enables the  | Running | Manual (Trig | Los   |
|             |   | SNMP Trap                      | Receives tra  |         | Manual       | Loc      |                  |  | WinHTTP Web Proxy Auto         | WinHTTP i    | Running | Automatic    | Lo    |
|             |   | Snow Inventory Client          | This is the S | Running | Automatic    | Loc      |                  |  | Wired AutoConfig               | The Wired    | Running | Automatic    | Loc   |
|             |   | Software Protection            | Enables the   | Running | Automatic (D | Net      |                  |  | WLAN AutoConfig                | The WLANS    | Running | Automatic    | Loc   |
|             |   | Spot Verifier                  | Verifies pote |         | Manual (Trig | Loc      |                  |  | Sector WMI Performance Adapter | Provides pe  |         | Manual       | Loc   |
|             |   | SSDP Discovery                 | Discovers n   |         | Disabled     | Loc      |                  |  | Sector Contens                 | This service |         | Manual       | Lo    |
|             |   | State Repository Service       | Provides re   | Running | Manual       | Loc      |                  |  | Q Workstation                  | Creates and  | Running | Automatic    | Ne    |
|             |   | Still Image Acquisition Events |               |         | Manual       | Loc      |                  |  | WWAN AutoConfig                | This service |         | Manual       | Lo    |
|             |   |                                | Provides en   | Running | Manual (Trig | Loc      |                  |  |                                | This service |         | Manual       | Loc   |
|             |   |                                | Optimizes t   |         | Manual       | Loc      |                  |  | Abox Game Monitoring           | This service |         | Manual (Trig | Loc   |
|             |   |                                | Maintains a   | Running | Automatic    | Loc      |                  |  | A Xbox Live Auth Manager       | Provides au  |         | Manual       | Loc   |
|             |   | Symantec Endpoint Protecti     |               | Running | Automatic    | Loc      |                  |  | Abox Live Game Save            | This service |         | Manual (Trig |       |
|             |   |                                | Checks that   |         | Manual       | Loc      |                  |  | Xbox Live Networking Service   | This service |         | Manual       | Loc   |
|             |   | Sync Host_15c8b4               | This service  | Running | Automatic (D | Loc Y    |                  |  | <                              |              |         | _            | >     |
|             | Extended Standard   | •                              |               |         |              | <u> </u> |                  | Extended Standard  |                                |              |         |              |       |
|             |   |                                |               |         |              |          |                  |  |                                |              |         |              |       |
| -           |   |                                |               |         |              |          |                  |  |                                |              |         |              | _     |

Figure 13. Services configuration

- 2. Press the RST push button and connect the USB cable to the SDA port on the FRDM-KL25Z board.
  A new "bootloader" device appears on the left pane of the file explorer
- 3. Drag and drop the file "MSD-DEBUG-FRDM-KL25Z\_Pemicro\_v118.SDA" to the bootloader drive Ensure that there is enough time for the firmware to be saved in the bootloader
- 4. Disconnect the USB cable, then reconnect it to the SDA port **WITHOUT** pressing the RST push button
  - This time, FRDM\_KL25Z device appears on the left pane of the file explorer as in Figure 14.

|                                    | <ul> <li>▲ Computer</li> <li>▷ ▲ Local Disk (C:)</li> <li>▷ □ Local Disk (D:)</li> <li>▷ □ Local Disk (E:)</li> </ul> | <br> |
|------------------------------------|---|------|
| Figure 14. FRDM-KL25Z in left pane | FRDM-KL25Z (G:)<br>aaa-044227   |      |

5. Locate the file "nxp-gui-fw-frdmkl25z-usb\_hid-device\_<version>.bin" from the package. Drag and drop this file into the FRDM\_KL25Z device.

Ensure that there is enough time for the firmware to be saved.

6. Freedom board firmware is successfully loaded. Disconnect the USB-cable and reconnect it to the KL25Z USB port.

# 5.2 Installing NXP GUI software package

To install the "NXP GUI for Automotive PMIC Families" or obtain the NXP GUI package, unzip an open "1 - NXP\_GUI\_Setup" folder as shown in Figure 15.

| Name              | e               | Status  | Date modified     | Туре          | Size       |
|-------------------|-----------------|---------|-------------------|---------------|------------|
| 0                 | - Documentation | $\odot$ | 6/8/2020 10:57 AM | File folder   |            |
| <mark></mark> 1   | - NXP_GUI_Setup | g       | 6/8/2020 5:26 PM  | File folder   |            |
| 2                 | - KL25Z_FW      | $\odot$ | 6/4/2020 1:42 PM  | File folder   |            |
| L L               | ICENSE.txt      | $\odot$ | 6/4/2020 11:14 AM | Text Document | 3 KB       |
|                   |                 |         |                   |               | aaa-044228 |
| Figure 15. NXP_GU | JI_Setup folder |         |                   |               |            |

Then double click on the "NXP\_GUI-version-Setup.exe" shown in Figure 16 and follow the instructions.

| Name                                 | Status | Date modified    | Туре        | Size       |
|--------------------------------------|--------|------------------|-------------|------------|
| 궁 NXP_GUI-3.1.45-Setup.exe           | S      | 6/6/2020 6:55 PM | Application | 64,336 KB  |
|                                      |        |                  |             | aaa-044229 |
| Figure 16. NXP_GUI_version_Setup.exe |        |                  |             |            |

To install the application on Windows PC, proceed with the pop-up windows shown in Figure 17 and Figure 18.

| Welcome                                     | e to NXP_GUI 3.1.45 Setup   | License Agreement Please review the license terms before installing NXP_GUI 3.1.45.   |
|---|---|---|
| 3.1.45.<br>It is recommer<br>before startin | e you through the installation of NXP_GUI<br>nded that you close all other applications<br>g Setup. This will make it possible to update<br>m files without having to reboot your | Press Page Down to see the rest of the agreement.  /*  Copyright 2019 TESSOLVE  * All rights reserved.  |
| Click Next to c                             | ontinue.  | <ul> <li>Redistribution and use in source and binary forms, with or without modification,</li> <li>are permitted provided that the following conditions are met:</li> <li>Redistributions of source code must retain the above copyright notice, this list</li> <li>of conditions and the following disclaimer.</li> <li>If you accept the terms of the agreement, click I Agree to continue. You must accept the agreement to install NXP_GUI 3.1.45.</li> </ul> |
|   | Next > Cancel   | Nullsoft Install System v3.05   |

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| Choose Components<br>Choose which features of NXP_               | GUI 3.1.45 you want to install.   |   |       | Choose Install Location<br>Choose the folder in which to instal NXP_GUI 3, 1, 45.  | (                   |
|--|-----------------------------------|---|-------|--|---------------------|
| Check the components you war<br>install. Click Next to continue. | nt to install and uncheck the com | oonents you don't want  | : to  | Setup will install NXP_GUI 3.1.45 in the following folder. To install in a dif<br>Browse and select another folder. Click Install to start the installation. | ferent folder, dick |
| Select components to install:                                    | MainSection<br>Optional           | Description<br>Position your mouse<br>over a component to<br>see its description. |       | Destination Folder   | Browse              |
| Space required: 164.4 MB   |                                   |   |       | Space required: 164.4 MB<br>Space available: 26.9 GB   |                     |
| ullsoft Install System v3.05                                     |                                   |   |       | Nullsoft Install System v3.05  |                     |
|  | < Back                            | Next > Ca   | ancel | < Back Insta   | all Cancel          |

## Figure 18. NXP GUI setup 2/2

Select the options shown in <u>Figure 19</u> before completing the installation of the setup:

- Run NXP\_GUI
- Show Readme

| WXP_GUI 3.1.45 Setup        | Completing NXP_GUI 3.1.45 Setup   |  |
|-----------------------------|---|--|
|                             | NXP_GUI 3.1.45 has been installed on your computer.<br>Click Finish to close Setup. |  |
|                             | Run NXP_GUI 3.1.45         Show Readme  |  |
|                             |   |  |
|                             | < Back Finish Cancel  |  |
|                             | aaa-044232  |  |
| 9. NXP GUI setup completion |   |  |

Select Finish to complete the installation.

When installation is finished, you can search the application on the Windows search bar as "NXPGUI". Click to launch.

Figure

# 6 Using PF5030 NXP GUI

To follow the steps in this section, ensure that the board is connected using the appropriate hardware configuration.

Always use the latest version of the NXP GUI.

# 6.1 Starting the PF5030 NXP GUI

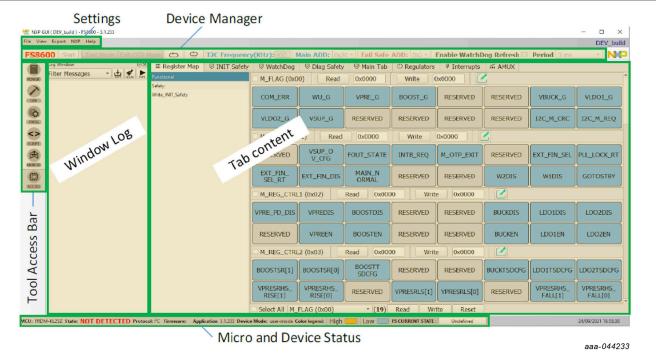
When your kit is ready and the NXP GUI is installed, click to launch the GUI from your Windows search bar. When the kit selection window appears, as shown in Figure 20, select PF5030.

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Figure 20. Kit selection window

To avoid the kit selection window on every launch, you can check the box "Use this configuration and do not ask again". The window shown in <u>Figure 21</u> opens.

### KITPF5030SKTEVM programming board



#### Figure 21. NXP GUI framework

You are now using the PF5030 GUI interface. It can be divided in several parts:

- Settings: Import or export files, configure framework.
- Device Manager: Start communication with device. Enter or exit test mode. I<sup>2</sup>C communication settings.
- Tool Access Bar: Quick access to the PF5030 evaluation tools and features.
- Window Log: Microcontroller and device communication events.
- Tab Content: Content of each tool or tab. There can be more tabs, boxes, or windows.
- **Micro and Device Status:** Indicates if the computer USB is connected to the kit. Displays firmware and GUI version. Displays the current state of the fail-safe state machine. Click Display button to refresh.

**Note:** The tool access bar shows the GUI tools in the sequence that they must be used. The first step is to verify device POWER dissipation and then configure the OTP. When the power is verified and OTP is done, the device can be programmed or emulated with a SCRIPT. MIRROR registers can be read/modified to a configuration validation. To verify states and configure safety reactions, the Access tab allows registers handling.

### 6.2 Power tab

The POWER tool allows the calculation of power management power dissipation.

User must start by setting or importing an OTP configuration to preset all regulators, then entering the current consumption of each rail.

As PF5030 can be supplied by more than one voltage rail, two input supply rails can be set on "INPUT PARAMETERS" group. Once the voltages are set, each regulator must be associated to one of those rails. The voltages set are used to calculate the power dissipation. The calculated absorbed input currents are assigned to the associated rail.

### KITPF5030SKTEVM programming board

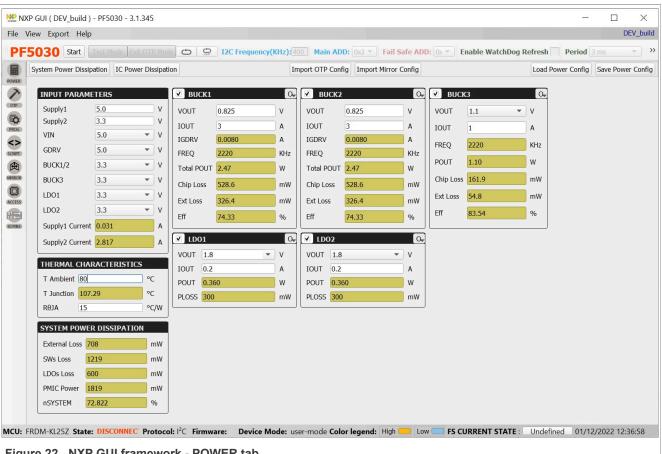


Figure 22. NXP GUI framework - POWER tab

Each regulator can be enabled / disabled by clicking on the upper left corner check box.

Additional options are available on the menu on the upper right corner of each regulation, such as:

- Operation mode: Single or multiphase, regulator or load switch
- **Component selection**: input / output capacitors, inductor and DCR. DCR is automatically changed based on inductor value and can be reedited
- · Advanced parameters: detailed losses summary
- Efficiency chart: regulator losses / output current plot at current junction temperature
- · Power chart: regulator losses partition

### 6.3 OTP tab

The OTP tool allows the configuration of OTP registers and generates scripts for OTP emulation or OTP programming. These scripts program parameters that the main state machine and the fail-safe state machine control.

At the right side, fill **Customer Details** and **Program Details** sub-windows. Set **Device Core ID** and **Device Type** for device pre-configuration.

The OTP tool includes the following tabs:

- System Configuration
- Switching and LDO Regulators
- Functional Safety

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These tabs are used to define the entire PF5030 OTP configuration.

When the OTP configuration is defined, TBB/OTP scripts can be generated using the Export menu. Generate a TBB file for emulation and an OTP file for OTP programming.

It is possible to save a configuration to use or modify it later. To export the OTP configuration, click "Save Config". To import a configuration initially saved from the OTP tool or the Mirrors tab, click the Import button.

#### 6.3.1 System configuration tab

The system configuration tab has several sections, divided into two groups. The first group is related to OTP configuration itself:

- System Configuration: I<sup>2</sup>C addresses, VIN threshold, program ID, fault retry management, regulator assignment
- Clock and Synchronization: Clock modulation, XFAILB synchronization
- VMON OV Deep Fail-safe Reaction: configures device reaction when OV event is detected.
- **Power Sequence Configuration**: This box is used to define the power sequence of the device and device reaction when TSD happens. If the configuration is modified, the power-up sequence graph is updated automatically.

Figure 23 shows an OTP configuration example.

|                    | System Configuration                       |            |                | Clock and Synchronisation      |      | 1         |               |        | Power Sequence Con        |              |                                 | 1         |          |     |
|--------------------|--|------------|----------------|--------------------------------|------|-----------|---------------|--------|---------------------------|--------------|---------------------------------|-----------|----------|-----|
| IZCDEVADDR         | 0.20                                       | • 0000     | CLK_DIV1       | 2.22 MHz                       | 10   | Regulator | Sequence      | EN     | Phase Delay               | Cloc         | k Soft start                    | TSE       | Behavior | r , |
| 12CDEVID           | 0/21                                       | ▼ 0000     | CLK_DTV2       | 455 KHz                        | 100  | VPRE      | OFF dy 250 µs | *      | Not delayed               | ♥ CLK2       | ▼ 2 mV/µs                       | •         |          |     |
| BAT_SC_EN          | Enabled                                    | ▼ 1        | MOD_EN         | Disable clock modulation       | 0    | Boost     | Slot 0        | - V    | Delayed by 1 Clock Cycle  | ▼ CLK1       | -                               | Shutdow   | + DFS    | *   |
| TBAT_SC_CFG        | 1 ms                                       | <b>v</b> 0 | MOD_CONF       | Triangular modulation -        | 0    | Buck      | Slot 1        | - V    | Delayed by 2 Clock Cycles | ▼ CLK1       | <ul> <li>10.41 mV/μs</li> </ul> | * Shutdow | + DFS    |     |
| NoMCU              | Application with MCU                       | <b>v</b> 0 | PLL_SEL        | Disabled                       | 0    | LDO1      | Slot 2        | *      |                           |              |                                 | Shutdow   | + DFS    | *   |
| VSUPCEG            | Automotive application(3.3V < VPRE < 4.5V) | <b>v</b> 0 | FOUT_SLOT_EN   | FOUT slot assignment disabled  | 0    | LDO2      | Slot 3        | *      |                           |              |                                 | Shutdow   | + DFS    |     |
| PWRDWN_DFS         | Transition to DFS with power down sequence | ▼ 1        | FOUTS          | Do not drive FOUT low          | 1111 |           |               | t Time | Power-Up Last Slot        |              | down First Slot                 |           |          | -   |
| AUTORETRY_EN       | Enabled                                    | ▼ 1        | XFAIL8_CFG     | No synchronization             | 00   | Slo       | t Config 1 ms |        |                           | ower down st |                                 | -         |          |     |
| AUTORETRY_INFINITE | Endless                                    | ▼ 1        | XFAILBS        | Do not wait for XFAILB release | 1111 |           |               |        |                           |              |                                 |           |          |     |
| VMON0_REG_ASSIGN   | External regulator (No action if OV)       | • 000      | XFAILB_PWD_CFG | No Power down                  | 0    |           |               |        |                           |              |                                 |           |          |     |
|                    | External regulator (No action if OV)       | ▼ 000      |                |                                |      |           |               |        |                           |              |                                 |           |          |     |
| VMON1_REG_ASSIGN   |  |            |                |                                |      |           |               |        |                           |              |                                 |           |          |     |
|                    | External regulator (No action if OV)       | ▼ 000      |                |                                |      |           |               |        |                           |              |                                 |           |          |     |

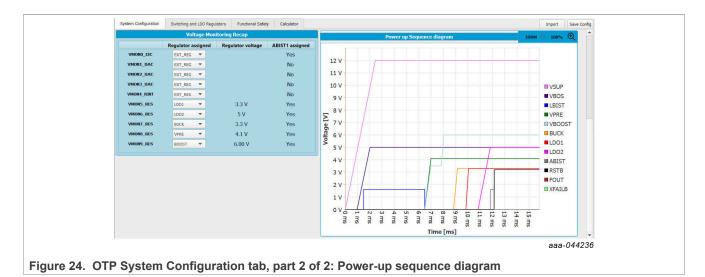
Figure 23. OTP System Configuration Tab, part 1 of 2: OTP configuration

The second group is related to VMON board connection and startup sequence diagram:

- Voltage monitoring recap for power-up sequence diagram drawing: This box is NOT related to the OTP configuration. It allows the definition of an assignment between the VMONx and the regulators to plot the power-up sequence graph. It does not configure any registers. It is only used as information. It is saved as comment on the configuration script.
- Power-up sequence diagram: This diagram reflects the power-up sequence of the PF5030 depending on the OTP configuration. To plot the associated configuration, it uses the "Voltage Monitoring Recap". The powerup sequence timing may not be 100 % accurate. If shown, the RSTB, the FOUT, and the XFAILB voltages are different from 3.3 V to differentiate between the different curves.

Figure 24 shows a voltage monitoring recap connection and the resulting power-up sequence diagram.

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# 6.3.2 Switching and LDO regulators tab

The switching and LDO Regulators tab shown in Figure 25 has several sections:

- Block diagram: Summarizes the output voltage and startup slot of each regulator
- SMPSs configuration: Switching Mode Power Supplies configuration.
- LDOs configuration: Linear dropout regulators configuration

| Block Diagram      | VPRE Configuration  | BOOST Configuration                                    | BUCK Configuration                                     | LDO1 Configuration                            | LDO2 Configuration               |
|--------------------|---|--|--|---|----------------------------------|
| FSSG3 ASL-0<br>VRE | VPRETON         60 ns         01           VPREV         4.1 V         • 01111           VPRESC         52 mV/µs         • 000101           VPRELIN         100 mV         11           VPRESC         80 ns         00           VPRESRIS         PU/PD/900 mA         11           VPRESRIS         PU/PD/130 mA         00 | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | LDOIV 3.3 V • 1011<br>LDO1_SW_EN Disabled • 0 | LDO2V 5V 11<br>LDO2ILIM 150 mA 1 |

Figure 25. OTP SMPS and LDO regulators Configuration tab

#### 6.3.3 Functional safety tab

The functional safety tab shown in Figure 26 has several sections:

- System Safety Configuration: Watchdog, RSTB, PGOOD, safety path, SVS clamp
- **Voltage Monitoring**: Define the voltage monitoring configuration. Some protections have been implemented to avoid OTP configuration issue.

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|                  | System Safety Configuration      |             |            |    |         |   |         | Voltage Mo | n <b>itoring</b> |             |                                  |                                |        |
|------------------|----------------------------------|-------------|------------|----|---------|---|---------|------------|------------------|-------------|----------------------------------|--------------------------------|--------|
| RRMON_EN         | Disabled                         | <b>~</b> 0  |            | EN | Voltage |   | UV TH   | OV TH      | UV Debound       | e OV Debour | ce PGOOD Ctrl                    | ABIST1 Assi                    | gnment |
| CCU_EN           | Disabled                         | - 0         | VMON0_I2C  | V  | 3.3 V   | * | 90.0% * | 110.0% *   | 25 µs 🔹          | 25 µs       | <ul> <li>Assigned</li> </ul>     | <ul> <li>Assigned</li> </ul>   | *      |
| WD_DIS           | Watchdog monitoring enabled      | <b>~</b> 0  | VMON1_DAC  |    | 1.4 V   | * | 90.0% - | 110.0% -   | 25 µs 🔹          | 25 µs       | <ul> <li>Not assigned</li> </ul> | <ul> <li>Not assign</li> </ul> | ned 🔹  |
| WD_SELECTION     | Challenger watchdog              | * 1         | VMON2_DAC  |    | 0.7 V   | * | 90.0% * | 110.0% *   | 25 µs 🔹          | 25 µs       | <ul> <li>Not assigned</li> </ul> | <ul> <li>Not assign</li> </ul> | ned *  |
| LT_RECOVERY_EN   | Disabled                         | - 0         | VMON3_DAC  |    | 0.7 V   | - | 90.0% * | 110.0% -   | 25 µs 🔹          | 25 µs       | <ul> <li>Not assigned</li> </ul> | <ul> <li>Not assign</li> </ul> | ned 🔹  |
| RSTB_8s_DIS      | Counter enabled                  | - 0         | VMON4_RINT |    | 1.8 V   | * | 90.0% * | 110.0% *   | 25 µs 🔹          | 25 µs       | <ul> <li>Not assigned</li> </ul> | <ul> <li>Not assign</li> </ul> | ned 🔹  |
| RSTB DLY         | No delay                         | - 0         | VMON5_RES  | V  | 0.8 V   |   | 90.0% - | 110.0% -   | 25 µs 🔹          | 25 µs       | <ul> <li>Assigned</li> </ul>     | <ul> <li>Assigned</li> </ul>   | *      |
| STB2PGOOD        | Fault asserting RSTb won't asser | t PGOOD - 0 | VMON6_RES  | V  | 0.8 V   |   | 90.0% - | 110.0% -   | 25 µs 🔹          | 25 µs       | <ul> <li>Assigned</li> </ul>     | <ul> <li>Assigned</li> </ul>   | -      |
| MON123 SVS CLAMP | 9                                | • 00000     | VMON7_RES  | ~  | 0.8 V   |   | 90.0% - | 110.0% -   | 25 µs 🔹          | 25 µs       | <ul> <li>Assigned</li> </ul>     | <ul> <li>Assigned</li> </ul>   | -      |
| 1101125_5V5_CEAH | 10 303                           | 00000       | VMON8_RES  | ~  | 0.8 V   |   | 90.0% * | 110.0% -   | 25 µs 🔹          | 25 µs       | <ul> <li>Assigned</li> </ul>     | <ul> <li>Assigned</li> </ul>   | *      |
|                  |                                  |             | VMON9_RES  | V  | 0.8 V   |   | 90.0% * | 110.0% -   | 25 µs 🔹          | 25 µs       | <ul> <li>Assigned</li> </ul>     | <ul> <li>Assigned</li> </ul>   | *      |

Figure 26. OTP Functional Safety tab

## 6.4 Establishing the connection between the NXP GUI and the hardware

The device manager allows the connection of the PF5030 development board with the NXP GUI.

Before plugging the KL25Z USB port to the computer, the MCU is in a "NOT DETECTED" state.

| MCU: FRDM-KL25Z State: NOT DETECTED | Protocol: I <sup>2</sup> C Firmware: | Application 3.1.140 Device Mode: user-mode |
|-------------------------------------|--------------------------------------|--|
|                                     |                                      | aaa-0442:                                  |

After plugging in the USB, the MCU state changes to "DISCONNECTED." If the state does not change, press the RST button on the freedom board.

At this state, the communication with the MCU can be started.

MCU: FRDM-KL25Z State: CONNECTED Protocol: I<sup>2</sup>C Firmware: 0.3 Application 3.1.140 Device Mode: user-mode aaa-044255

The MCU state changes to "CONNECTED" and the firmware version is displayed.

To start the communication with the PF5030, click the "Start" button. The GUI is able to identify the device address to establish the communication.



When the communication has started successfully, the PF5030 (device name) switches to green.

| FS8600 | Stop | Test Mode | Exit OTP Mode | G | <b>C</b> | I2C Frequency(KHz): 400 | Main ADD: | 0x20 - | Fail Safe ADD: | 0x2 *   |
|--------|------|-----------|---------------|---|----------|-------------------------|-----------|--------|----------------|---------|
|        |      |           |               |   |          |                         |           |        | aaa            | -044258 |

When the device starts with the DBG pin voltage at 7.95 V (EVB OTP mode LED on), the state machine stops at the Main/FS OTP MODE state.

The current mode can be read using the refresh button and loop refresh button highlighted in red. Clicking refresh reads the state one time. Clicking the loop refresh latches and reads the state periodically until a new click deactivates it.

When the "Exit OTP mode" button is green, the device is in OTP mode. When in OTP mode, device I<sup>2</sup>C register addresses are the default values 0x20 for main and 0x21 for fail-safe. An "Exit OTP mode" button click sends

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commands to the main state and the fail-safe state machine to exit OTP mode and initiate device start-up. The addresses are automatically updated to keep device communication.



Test mode can be enabled and disabled by clicking the Test Mode button when DBG pin voltage is 7.95 V (EVB OTP mode LED on). When the button is green, Test mode is activated. The button state can also be refreshed by clicking the arrow loop buttons.

| ▼ Fail Safe ADD: 0x2 ▼ | Main ADD: 0x20 - | I2C Frequency(KHz): 400 | Ð | Exit OTP Mode | Test Mode | Stop | FS8600 |
|------------------------|------------------|-------------------------|---|---------------|-----------|------|--------|
| aaa-044260             |                  |                         |   | _             |           |      |        |

Figure 27. GUI and device in test mode

The current device mode (user / test) is shown on the device status bar.

Test mode can be entered when device is not in OTP mode.

When in OTP mode, the device is necessarily in Debug mode.

### 6.5 OTP mode and device programming

Device enters OTP mode when the DBG pin voltage is set to 7.95 V before start-up. The OTP mode consists of a device state machine stop at Main/FS OTP MODE states. When in Main/FS OTP mode states, the I<sup>2</sup>C addresses are 0x20 for main and 0x21 for fail-safe. The Main/FS OTP mode states are left when one of these conditions is met:

- Imposing DBG pin voltage inferior to 5.5 V
- Sending Main/FS OTP mode exit command through I<sup>2</sup>C
- Clicking NXP GUI button "Exit OTP Mode"

The NXP GUI is able to identify these addresses automatically from the device.

Then, the device addresses are set based on the mirror registers values. User can only change these addresses in the mirror register in Test mode.

#### 6.5.1 Device programming

The Device Programming tab shown in <u>Figure 28</u> allows OTP device programming using a file initially generated by the OTP tool. This tab is only available when **Test mode** is active.

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| Device Programming Conf           Select TBB/OTP File         Bro           File Name         Not Select           Status         Not Ready           Program         Reset                                  | wse<br>ed   |   | OTP Mode<br>FS OTP Mode Exit<br>FS OTP Mode RT<br>Main OTP Mode Exit<br>Main OTP Mode RT<br>Read Write   |
|--|---|---|--|
|  | Fuse E  | lox Status  |  |
| Main Programming Status         BUSY         ERROR         ONE_ERR         TWO_ERR         MAX_PGM_EXCEED         VRR_CHECK_TRIES         PGM_FAIL_WP         BOOT_ERROR         VRR_ERROR         BOOT_DONE | Main Sector Flags         Sector 1 Flags         CRC       Image: CRC         BOOT Enable(BE)       Image: CRC         Sector 1 bis Flags         CRC       Image: CRC         BOOT Enable(BE)       Image: CRC         Write Protected(WP)       Image: CRC         Write Protected(WP)       Image: CRC         MTP       Image: CRC         Image: CRC       Image: CRC         BOOT Enable(BE)       Image: CRC         Write Protected(WP)       Image: CRC         MTP       Image: CRC | FailSafe Programming S         BUSY         ERROR         ONE_ERR         TWO_ERR         MAX_PGM_EXCEED         VRR_CHECK_TRIES         PGM_FAIL_WP         BOOT_ERROR         VRR_ERROR         BOOT_DONE | FailSafe Sector Flags         Sector 1 Flags         CRC       Image: CRC         BOOT Enable(BE)       Image: CRC         Write Protected(WP)       Image: CRC         Sector 1bis Flags       CRC         CRC       Image: CRC         BOOT Enable(BE)       Image: CRC         Write Protected(WP)       Image: CRC         Write Protected(WP)       Image: CRC         MTP       Image: CRC         BOOT Enable(BE)       Image: CRC         Write Protected(WP)       Image: CRC         MTP       Image: CRC         MTP       Image: CRC         MTP       Image: CRC         MTP       Image: CRC |
|  |   | Read  |  |
|  |   |   | aaa-044261   |

To set up the hardware before OTP burning, see <u>Section 7.3</u> configure put device in OTP mode, then follow the steps:

- Start the device in **OTP mode**.
- Enter Test mode.
- Browse and load the script file you want to burn (OTP or TBB type).
- The program button is available.
- Click Program.

Before programming, the GUI verifies if the DBG pin voltage is 7.95 V.

If the DBG pin voltage is less than 7.95 V, a pop-up window is shown requiring to turn on the 7.95 V. The blue LED on the board indicates that an 7.95 V voltage is available on the DBG pin. At the end of the first OTP programming, the MTP index = 1, WP, BE, and CRC flags are orange.

The Main/Fail-safe sector flags provide the OTP fuse status, as shown in <u>Table 21</u>. It helps to determine how many times the part was burned.

 Table 21. OTP burning flag status

| OTP burning step               | Sector | BE     | WP     | CRC    | MTP index |
|--------------------------------|--------|--------|--------|--------|-----------|
| mirrors empty, OTP not burned  | 1      | blue   | blue   | blue   | orange    |
|                                | 1bis   | blue   | blue   | blue   | blue      |
| mirrors filled, OTP not burned | 1      | blue   | blue   | orange | orange    |
|                                | 1bis   | blue   | blue   | orange | blue      |
| OTP burned once                | 1      | orange | orange | orange | orange    |
| OTP burned twice               | 1bis   | orange | orange | orange | orange    |

The example shown in Figure 28 corresponds to the OTP not burned, mirrors empty line in Table 21.

To check if a valid OTP configuration is already burned, switch off the supply and then on again. Start the device by clicking the "Exit OTP Mode" button. The device starts with the OTP configuration.

### 6.6 User mode controls

The device operation is called **User mode** when the Main/FS state machines are not in OTP MODE state and not in Test Mode. In this mode, the main/fail-safe addresses come from mirror registers / fused OTP.

When using the EVB, the voltages on device pins can be verified in ACCESS > AMUX > ADC Measurements (see <u>Section 6.6.3.9</u>).

#### 6.6.1 Working with the script editor

The register and OTP emulation can be configured with the script editor shown in <u>Figure 29</u>. The script editor is useful for trying various OTP configurations in OTP mode.

| Filter Messages  | Device FS8600  |   | Script Commands Window   |                    | Script Resu | Its Window     |
|--|--|---|--------------------------|--------------------|-------------|----------------|
| <ul> <li>Sent and</li> <li>Received</li> <li>Commands</li> </ul> |  | Command<br>Script Editor                | Script                   | Text Editor        |             | Script Results |
|  |  |   |                          |                    |             |                |
|  |  |   | Managen                  | nent Commands      |             |                |
|  |  |   |                          | La ?               |             |                |
|  | and the first of the second se | 1 222 Denies Mader Lat. made Cales Inco | et High 🛑 Low 🛑 FS CURRE | NT STATE: OTP_MODE |             | 24/09/2021 16: |

Figure 29. Script editor

The main subareas of this panel are:

- Command Script Editor: Builds commands to be sent to the device.
- Script Text Editor: Sends a sequence of register configurations from a text file or from a command edited directly in this area.
- Script Results: Displays result status of each command sent to the device.
- Sent and Received Commands: Displays a summary of commands sent and received from the device.
- Management Commands: Used for scripts.

#### 6.6.1.1 Command script editor

Using the script editor, you can execute any command either directly or from a file. It is also possible to save and modify a script. Using the brush symbol, it is possible to clean windows if necessary.

All commands must follow a specific syntax. The Help menu describes the commands available in the script editor and the syntax to be used.

Figure <u>30</u> shows an example of building a command from the panel.

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| Instrumentation       Ist parameters       2nd parameters       3rd parameters       4th parameters       Sth parameters         SET_REG       Device       Reg. set       Reg. name /<br>Reg. address       Reg. value       -       -         GET_REG       Device       Reg. set       Reg. name /<br>Reg. address       -       -       -         SET_DPIN_PinName       Device       Dig. pin value       -       -       -       -         GET_DPIN_PinName       Device       -       -       -       -       -       -         GET_APIN_PinName       Device       -   | This help page describes commands<br>List of commands<br>SET_REG : sets value of a selected  | d register.  | or and their format.  |                                  |               |               |
|--|--|--|---|----------------------------------|---------------|---------------|
| Interview       Ist parameters       Interview       Interview<  | READ_REG : reads value of a select<br>SET_DPIN_PinName : sets value<br>GET_DPIN_PinName : gets value<br>GET_APIN_PinName : gets value  | cted register.<br>of a selected digital pin.<br>of a selected digital pin.<br>of a selected analog pin.  | Returned value is in mV.<br>Jevice.   |                                  |               |               |
| Commands         1st parameter         2nd parameter         3rd parameter         4th parameter         5th parameter           SET_REG         Device         Reg. set         Reg. name /<br>Reg. address         Reg. value         -           GET_REG         Device         Reg. set         Reg. name /<br>Reg. address         -         -           SET_DPIN_PinName         Device         Dig. pin value         -         -         -           GET_APIN_PinName         Device         .         -         -         -           GET_APIN_PinName         Device         -         -         -         -           GET_APIN_PinName         Device         -         -         -         -           Device         -         -         -         -         -           CetT_APIN_PinName         Device         -         -         -         -           Device device mode address in device address in device address registers which have similar function.         Reg. address: register address in device device mode address registers which have similar function.           Reg. address: register address in device dotabatelet.         Op. pin value: wold on device dotabatelet.         Op. pin value: wold on device mode.         -           Reg. address: register address in device dotadatelet.         O  | Command format   |  |   |                                  |               |               |
| SET_REG       Device       Reg. set       Reg. name /<br>Reg. address       Reg. value       -         GET_REG       Device       Reg. set       Reg. name /<br>Reg. address       -       -       -         GET_REG       Device       Reg. set       Reg. name /<br>Reg. address       -       -       -         SET_DPIN_PinName       Device       Dig. pin value       -       -       -       -         GET_APIN_PinName       Device       -       -       -       -       -       -         GET_APIN_PinName       Device       - <t< th=""><th>The following table describes comm</th><th>and parameters. All param</th><th>aters are mandatory.</th><th></th><th></th><th></th></t<>   | The following table describes comm   | and parameters. All param  | aters are mandatory.  |                                  |               |               |
| GET_REG       Device       Reg. set       Reg. name /<br>Reg. address       -       -         SET_DPIN_PinName       Device       Dig. pin value       -       -       -         GET_DPIN_PinName       Device       Dig. pin value       -       -       -         GET_APIN_PinName       Device       -       -       -       -         GET_APIN_PinName       Device       -       -       -       -         GET_APIN_PinName       Device       -       -       -       -         Description of command parameters mentioned in the table above:       Device:       -       -       -         Device: device name (alias used in application).       Reg. set: register set name. Register adeaeanse. Textpoint to x prefx) format.       Reg. address: You y  | Commands   | 1st parameter  | 2nd parameter   | 3rd parameter                    | 4th parameter | 5th parameter |
| SET_DPIN_PinName       Device       Dig. pin value       -       -       -         GET_DPIN_PinName       Device       -       -       -       -       -         GET_DPIN_PinName       Device       -       -       -       -       -         GET_APIN_PinName       Device       -       -       -       -       -         GET_APIN_PinName       Device       -       -       -       -       -         Description of command parameters mentioned in the table above:       Device device name (also used in application).       -       -       -       -         Description of command parameters mentioned in the table above:       Device device name (also used in application).       -       Device device databatet. <th>SET_REG</th> <th>Device</th> <th>Reg. set</th> <th>Reg. name /<br/>Reg. address</th> <th>Reg. value</th> <td>~</td>  | SET_REG  | Device   | Reg. set  | Reg. name /<br>Reg. address      | Reg. value    | ~             |
| GET_DPJIH_PinName       Device       -       -       -       -         GET_APIN_PinName       Device       -       -       -       -       -         GET_APIN_PinName       Device       -       -       -       -       -       -         Description of command parameters mentioned in the table above:       -       -       -       -       -       -       -         Descreptor of command parameters mentioned in the table above:       - <th>GET_REG</th> <th>Device</th> <th>Reg. set</th> <th></th> <th>÷</th> <td>E.</td>  | GET_REG  | Device   | Reg. set  |                                  | ÷             | E.            |
| GET_APJIH_PinName       Device       -       -       -       -         GET_APJIH_PinName       Device       -       -       -       -       -         Description of command parameters mentioned in the table above:       Device: device name (alias used in application).       Reg. set: register sets allows to associate registers which have similar function.         Reg. address:register address in dectand or hexadecmal (with 0x prefix) format.       Reg. address:register address in dectand or hexadecmal (with 0x prefix) format.         Reg. address:register address in dectand or hexadecmal (with 0x prefix) format.       Reg. address:register address in dectand or hexadecmal (with 0x prefix) format.         Win name: name of digital or noted of address at address in dectand or hexadecmal (with 0x prefix) format.       Reg. address:register address in dectand or hexadecmal (with 0x prefix) format.         Win name: name of digital or noted of address are bow and high .       Hexague: negister address are bow and high .         Message: an exage to be digital prix Allowed strings are low and high .       Hexague: negister address are bow and high .         Wessage: an exage to be digital prix Allowed strings are low and high .       Hexague: negister address ad   | SET_DPIN_PinName   | Device   | Dig. pin value  | -                                | ÷             | H.            |
| Description of command parameters mentioned in the table above:<br>Devices device name (alias used in application),<br>Reg. set: register sets and in application),<br>Reg. anter: register name. Register sets allows to associate registers which have similar function.<br>Reg. address: register address in decimal or hexadecimal (with 0x prefix) format.<br>Reg. address: register address in decimal or hexadecimal (with 0x prefix) format.<br>Reg. address: register address in decimal or hexadecimal (with 0x prefix) format.<br>Reg. address: register value in decimal or hexadecimal (with 0x prefix) format.<br>Reg. address: register value of digital or analog pin as defined in device datasheet.<br>Dip, pin value: value of digital pin, Allowed strings are low and high'.<br>Meessage: a message to be displayed in a dialog. It cannot contain ': character, which is used as delimiter of parameters.<br>Mode: name of a device mode.<br>Script example<br>Note that name of registers, register sets, devices and pins depends on particular device.<br>// Sets the 'M_FLAG' register in the 'functional' register set.<br>SET_REGISPS8001:functional:M_FLAG:W000<br>// Sets value of the 'FS08_MCU' (digital pin (low/high).<br>GET_DFINFS8001:functional:M_FLAG<br>// Cets value of her 'FS08_MCU' (digital pin (low/high).<br>GET_DFINFS8001:Finctional:M_FLAG:WCU'<br>// Cets value of her 'M_MLAG' caladop pin.  | GET_DPIN_PinName   | Device   | ÷   | -                                | ь.            |               |
| Device: device name (alias used in application).<br>Reg. set: register set name. Register sets allows to associate registers which have similar function.<br>Reg. anate: register anae. additional or hexadecimal (with 0x prefix) format.<br>Reg. value: register value in decimal or hexadecimal (with 0x prefix) format.<br>Reg. value: register value of digital or analog pin as defined in device datasheet.<br>Dig, pin value: value: of digital or analog pin as defined in device datasheet.<br>Dig, pin value: value: of digital or analog pin as defined in device datasheet.<br>Dig, pin value: value: of digital or analog pin as defined on device datasheet.<br>Dig, pin value: value: of digital or analog pin as defined on device datasheet.<br>Dig, pin value: value: of digital or analog pin as defined on device datasheet.<br>Dig, pin value: value: of digital or analog pin as defined on device datasheet.<br>Script example<br>Note that name of registers, register sets, devices and pins depends on particular device.<br>// Sets the 'M_FLAG' register in the 'functional' register set to value 0x00.<br>SET_ESGF3S8001:functional:M_FLAG: Value:<br>// Sets value of Hew T_FLAG register in the 'functional' register set.<br>GET_ESGF3S8001:functional:M_FLAG<br>(digital pin (digital pin (low/high).<br>GET_DFINF3S8001:Finctional:M_FLAG<br>(digital pin (low/high) | GET_APIN_PinName   | Device   |   | ~                                | -             | a.            |
|  | Device: device name (alias used in<br>Reg. set: register set name. Regis<br>Reg. name: register name and defi<br>Reg. address: register address in<br>Big. pin value: value of digital pri<br>Message: a message to be display<br>Mode: name of a device mode.<br>Script example:<br>Note that name of registers, register<br>// Sets the 'M.F.AG' register in the<br>SET_REG-FSBO01fnrotfonal M.F.IAG' register<br>// Gets value of the 'M.F.IAG' Register in the<br>GET_REG-FSBO01fnrotfonal M.F.IAG' Register<br>// Gets value of the 'M.F.IAG' Register in the | application).<br>ter sets allows to association<br>idential attasheet.<br>.decimal or hexadecimal (with 0)<br>g pin as defined in device<br>a defined in device<br>a dialog. It cannot co<br>er sets, devices and pins d<br>.functional' register set to<br>.ge:0x00<br>ter in the 'functional' regist<br>46<br>bit functional' regist<br>46<br>bi | e registers which have similar<br>ith 0x prefix) format.<br>(prefix) format.<br>datasheet.<br>and 'high'.<br>ontain ': character, which is<br>epends on particular device.<br>value 0x00. | used as delimiter of parameters. |               |               |

### 6.6.1.2 Management commands

Some commands are used for formatting the scripts. Figure 31 shows the description of each button.

|                                   | NN     LOOP     Loop     Image: State of the state o |
|-----------------------------------|--|
|                                   | aaa-044265   |
| Figure 31. Script editor commands |  |
| • Run: Runs the script once.      |  |

- Loop: Runs the script continuously in a loop.
- Save: Save the script that is present in the script command window in text file.
- **Open**: Open a saved script from the desired location.
- ATE: Saves the script in ATE format.
- Clear: Clears the script command window.
- Script Editor Help Window: Describes the commands available in script editor and their formats.

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### 6.6.1.3 Script generator

The script editor allows the user to save script sequence files, as shown in <u>Figure 32</u>. However, a script sequence file is already saved as an example in the script generator. This script is used to release FS0B when the PF5030 is using simple watchdog.

| Device FS8600  | Script Commands Window  | Script Results Window   |
|--|---|---|
| Device PS8600<br>Allas PS8600<br>Digital Pins<br>Analog Pins<br>Registers<br>Mode<br>Control<br>Generator<br>Generator<br>Generator: FS08_RELEASE_SIMPLE_WATCHDO<br>Script Generator | Script Commands Window<br>SET_REG:FS8600:SAFETY:FS_WD_WINDOW_DUR:0x0208<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_WD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_RD_ANSWER:0x5A82<br>SET_REG:FS8600:SAFETY:FS_RELEASE_FS08:0x8245 | Script Results Window<br>OK : Write Register : FS_WD_WINDOW_DUR : 0xd04<br>OK : Write Register : FS_WD_NNUR : 0x5ab2<br>OK : Write Register : FS_WD_ANSWER : 0x5ab2<br>OK : Write Register : FS_STATES : 0x4000<br>OK : Write Register : FS_RELEASE_FS0B : 0xb2a5 |
|  |   |   |
|  |   | ± ±   |
| mare: 0.13 Application 3.1.233 Device Mode: test-mode Calor  |   | 호<br>· · · · · · · · · · · · · · · · · · ·  |

Figure 32. Script generator

### 6.6.2 Mirrors tab

Test mode must be applied to enable the Mirrors tab. This tab is divided in main and fail-safe mirrors registers, shown in <u>Figure 33</u> and <u>Figure 34</u>, respectively.

The "Read All" / "Write All" buttons can be used to read/write all the mirror registers. The mirrors configuration content can be exported and imported in the OTP tool as OTP configuration to generate TBB/OTP script files.

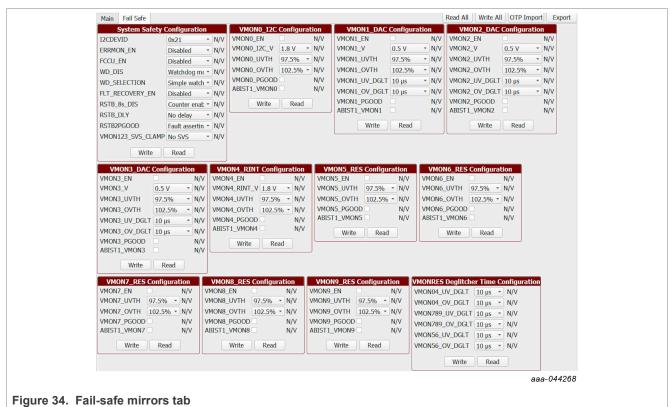
## **NXP Semiconductors**

# UM11854

### KITPF5030SKTEVM programming board

|  | nfiguration   |   | Synchronisation   |                                   | nce Configuration    |                           | Configuration     |       |
|--|---|---|---|-----------------------------------|----------------------|---------------------------|-------------------|-------|
| I2CDEVADDR   | 0x20 • N/V  | _   | 2.85 MHz • N/V  |                                   | 0.5 ms • N/V         | VPRETON                   | 25 ns             | N/\   |
| BAT_SW_EN  | Disabled • N/V  | CLK_DIV2  | 2.5 MHz • N/V   | BOOSTS                            | Slot 0 • N/V         | VPREV                     | 3.3 V -           | N/\   |
| TBAT_SW_CFG  | 1 ms * N/V  | MOD_EN  | Disable clock * N/V   | BUCKS                             | Slot 0 • N/V         | VPRESSRAMP                | 1 mV/µs 👻         | N/\   |
| VSUPCFG  | Automotive a * N/V  | MOD_CONF  | Triangular m 👻 N/V  | LDO1S                             | Slot 0 • N/V         | VPRESC                    | 21 mV/µs 🔹        | N/\   |
| PWRDWN_DFS   | Transition to • N/V   | PLL_SEL   | Disabled - N/V  | LDO2S                             | Slot 0 - N/V         | VPREILIM                  | 50 mV -           | N/\   |
| AUTORETRY_EN   | Disabled • N/V  | FOUT_SLOT_EN  | FOUT slot as: • N/V   | PWRUP_LASTS                       | Power up enc * N/V   | VPRETOFF                  | 80 ns             | N/\   |
| AUTORETRY_INFINITE   | E 15 times • N/V  | FOUTS   | Drive FOUT I - N/V  | PWRDWN_FIRSTS                     | Power down * N/V     | VPRESRLS                  | PU/PD/130 n *     | N/\   |
| VMON0_REG_ASSIGN   |   |   | No synchroni * N/V  | Write                             | Read                 | VPRESRHS                  | PU/PD/130 n *     | Ξ.    |
| VMON1_REG_ASSIGN   |   |   | Do not wait f * N/V   |                                   |                      | VPRE_CLK_SEL              |                   | N/\   |
| VMON4_REG_ASSIGN   |   |   | FG No Power do * N/V  |                                   |                      | VPRE_PH                   | Not delayed -     |       |
| DEVICE_ID  | 0x00 • N/V  | Write   | e Read  |                                   |                      | VPRE_OFF_DLY              | OFF dly 250   *   | N/\   |
| Write  | Read  |   |   | J                                 |                      | Write                     | Read              |       |
|  |   | J   |   |                                   |                      |                           |                   | _     |
| BOOST Confi<br>BOOSTEN Di  |   | BUCK Con  |   | LDO1 Config                       |                      | LDO2 Conf                 | -                 | 1.0.4 |
|  | isabled - N/V B   | UCKEN   | Disabled 🔹 N/V 🛛 LI   | DO1V 1.5                          |                      | JZV 1                     | 1.1 V - I         | V/V   |
|  |   |   | N/N/ 11   | DOL CHU EN DI                     | LL L NAV LD          |                           |                   | 101   |
| BOOSTV 5.  |   |   |   |                                   |                      |                           | 400 mA - 1        |       |
| BOOSTV 5.<br>BOOSTTONTIME 50   | Dins N/V B  | UCKV 1  | I V - N/V C   | DO1_SW_EN Dis<br>ONF_TSD_LDO1 Reg |                      | D2ILIM 4<br>NF_TSD_LDO2 R |                   |       |
| BOOSTV 5.<br>BOOSTTONTIME 50<br>BOOSTSC 35   | D ns N/V B<br>58 mV/µs ▼ N/V B  | UCKV 1<br>UCK_CLK_SEL   | L V - N/V C<br>CLK1 - N/V   |                                   |                      |                           |                   |       |
| BOOSTV 5.<br>BOOSTTONTIME 50<br>BOOSTSC 35<br>BOOSTRCOMP 75  | 0 ns N/V B<br>58 mV/μs • N/V B<br>50 kΩ • N/V B   | UCKV 1<br>UCK_CLK_SEL C<br>UCK_PH N   | L V - N/V C<br>CLK1 - N/V<br>Not delayed - N/V  | ONF_TSD_LDO1 Reg                  | gulator sht • N/V CC | NF_TSD_LDO2               | Regulator sht - 1 |       |
| BOOSTV5.BOOSTTONTIME50BOOSTSC35BOOSTRCOMP75BOOSTCCMP12   | D ns         N/V         Bi           58 mV/μs         N/V         Bi           50 kΩ         N/V         Bi           25 pF         N/V         Bi   | UCKV 1<br>UCK_CLK_SEL C<br>UCK_PH N<br>UCK_CTRL_RC 6  | I         V         ~         N/V         C           LK1         ~         N/V         C           Not delayed         ~         N/V         C           55KΩ         ~         N/V         C  | ONF_TSD_LDO1 Reg                  | gulator sht • N/V CC | NF_TSD_LDO2               | Regulator sht - 1 |       |
| BOOSTV5.BOOSTTONTIME50BOOSTSC35BOOSTRCOMP75BOOSTCCOMP12BOOSTLLIM2  | D ns         N/V         B           58 mV/μs         N/V         B           50 kΩ         N/V         B           25 pF         N/V         B           A         N/V         B   | UCKV 1<br>UCK_CLK_SEL 0<br>UCK_PH 1<br>UCK_CTRL_RC 6<br>UCK_CTRL_GM 4                           | L V - N/V<br>LK1 - N/V<br>Not delayed - N/V<br>55KΩ - N/V<br>18 μS - N/V  | ONF_TSD_LDO1 Reg                  | gulator sht • N/V CC | NF_TSD_LDO2               | Regulator sht - 1 |       |
| BOOSTV 5.<br>BOOSTTONTIME 50<br>BOOSTSC 33<br>BOOSTSCOMP 72<br>BOOSTCCOMP 12<br>BOOSTILIM 2<br>BOOSTSR 50  | D ns         N/V         B           58 mV/μs         N/V         B           50 kΩ         N/V         B           25 pF         N/V         B           A         N/V         B           0 V/μs         N/V         B  | UCKV 1<br>UCK_CLK_SEL 0<br>UCK_PH 1<br>UCK_CTRL_RC 0<br>UCK_CTRL_GM 4<br>UCKILIM 2              | L         V         • N/V         C           LK1         • N/V         N/V         C           Vot delayed         • N/V         N/V         K           55KΩ         • N/V         N/V         K           18 μS         • N/V         N/V         N/V  | ONF_TSD_LDO1 Reg                  | gulator sht • N/V CC | NF_TSD_LDO2               | Regulator sht - 1 |       |
| BOOSTV 5.<br>BOOSTTONTIME 50<br>BOOSTSC 35<br>BOOSTCOMP 75<br>BOOSTCOMP 12<br>BOOSTLM 2<br>BOOSTSR 50<br>BOOST_CLK_SEL C                                       | D ns         N/V         B           58 mV/μs         N/V         B           50 kΩ         N/V         B           25 pF         N/V         B           0 V/μs         N/V         B           0 V/μs         N/V         B           LK1         N/V         D | UCKV 1<br>UCK_CLK_SEL C<br>UCK_PH M<br>UCK_CTRL_RC C<br>UCK_CTRL_GM 4<br>UCKILIM 2<br>WS_BUCK 1 | L         V         N/V         C           LK1         N/V         N/V         C           Not delayed         N/V         N/V         N/V           3555Ω         N/V         N/V         N/V           18 µS         N/V         N/V         N/V           0.1 A         N/V         N/V         N/V | ONF_TSD_LDO1 Reg                  | gulator sht • N/V CC | NF_TSD_LDO2               | Regulator sht - 1 |       |
| BOOSTV 5.<br>BOOSTCONTIME 50<br>BOOSTSC 35<br>BOOSTRCOMP 75<br>BOOSTRCMP 12<br>BOOSTRUM 2<br>BOOSTR 50<br>BOOSTSC 10<br>BOOSTSC 10<br>BOOSTSC 10<br>BOOSTSC 10 | D ns         N/V         B           58 mV/μs         N/V         B           50 kΩ         N/V         B           25 pF         N/V         B           0 V/μs         N/V         B           0 V/μs         N/V         B           LK1         N/V         C | UCKV 1<br>UCK_CLK_SEL C<br>UCK_PH M<br>UCK_CTRL_RC C<br>UCK_CTRL_GM 4<br>UCKILIM 2<br>WS_BUCK 1 | L         V         • N/V         C           LK1         • N/V         N/V         C           Vot delayed         • N/V         N/V         K           55KΩ         • N/V         N/V         K           18 μS         • N/V         N/V         N/V  | ONF_TSD_LDO1 Reg                  | gulator sht • N/V CC | NF_TSD_LDO2               | Regulator sht - 1 |       |
| BOOSTV 5.<br>BOOSTSC 35<br>BOOSTSC 35<br>BOOSTCOMP 75<br>BOOSTCOMP 12<br>BOOSTLIM 2<br>BOOSTSR 55<br>BOOST_CLK_SEL C   | D ns         N/V         B           58 mV/μs         N/V         B           50 kΩ         N/V         B           25 pF         N/V         B           0 V/μs         N/V         B           0 V/μs         N/V         B           LK1         N/V         C | UCKV 1<br>UCK_CLK_SEL C<br>UCK_PH M<br>UCK_CTRL_RC C<br>UCK_CTRL_GM 4<br>UCKILIM 2<br>WS_BUCK 1 | L         V         N/V         C           LK1         N/V         N/V         C           Not delayed         N/V         N/V         N/V           3555Ω         N/V         N/V         N/V           18 µS         N/V         N/V         N/V           0.1 A         N/V         N/V         N/V | ONF_TSD_LDO1 Reg                  | gulator sht • N/V CC | NF_TSD_LDO2               | Regulator sht - 1 |       |

#### Figure 33. Main mirrors tab



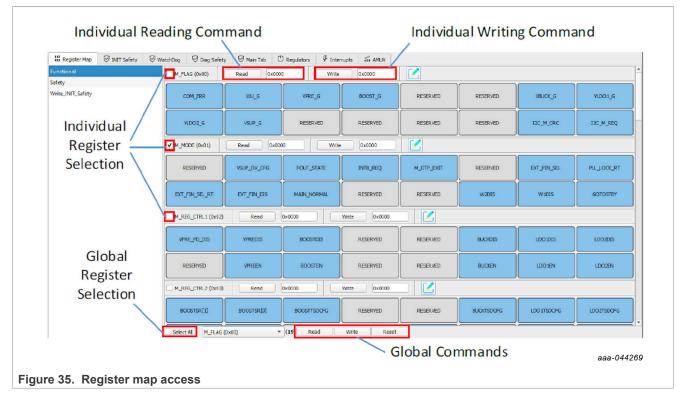
•

### 6.6.3 Access tab

### 6.6.3.1 Register map

All PF5030 I<sup>2</sup>C registers can be accessed in write and read mode using this tab shown in <u>Figure 35</u>. These registers are divided into three sections:

- **Functional**: Main functional I<sup>2</sup>C registers (diagnostics, configuration, and controls)
- **Safety**: Safety I<sup>2</sup>C registers (diagnostics and configuration)
- Write INIT safety: Safety registers that can be written only during initialization phase (INIT\_FS state).



To read the values of a register, click the **READ** button. The value is read from the device and is displayed on a label near the **READ** button. It is also displayed in the log window.

To write the bit values individually, click the desired bit. The corresponding bit button color changes. The value is updated in the log window. Click the WRITE button to write the register. To write the values through a text box near the **WRITE** button, enter the appropriate write value. Then click the **WRITE** button to write the register.

When registers have been selected, global commands can also be used:

- WRITE: Writes data to all the selected register at once.
- READ: Reads data back from the selected register at once.
- **RESET**: Resets all the input text boxes to 0x00. Write bits are set to 0. Change register bit buttons are set to the default setting.

The value can also be written by selecting the Edit option near the **WRITE** button. Bits and corresponding values are displayed in a pop window as shown in <u>Figure 36</u>. Select the options of all write bits, close the input dialog box, and click the **WRITE** button. Selected input combinations are written to the register.

### KITPF5030SKTEVM programming board

| RESERVED   | VSUP_OV_CF  | G FOUT_STATE   | INTB_REQ                                    | M_OTP_E    | т                   | RESERVED                                      | EXT_FIN_SEL                                      | PLL_LOCK_RT |
|--|---|--|---|------------|---------------------|---|--|-------------|
| EXT_FIN_<br>SEL_RT                                 | EXT_FIN_DIS   | MAIN_N<br>ORMAL  | RESERVED                                    | RESERV     |                     | W2DI5   | W1DI5  | GOTOSTBY    |
| NP M   | I_MODE (0x01) Bit-M   | 1ap Dialog   |   |            | 7                   |   |  | ×           |
| Set  | Value (Edital   | ble)   |   | Register C | Conte               | nt  |  |             |
| FOUT<br>INTB<br>M_O'<br>EXT_<br>EXT_<br>W2D<br>W1D | T_STATE: [<br>B_REQ: ]<br>DTP_EXIT: ]<br>_FIN_sel: ]<br>_FIN_DIS: ]<br>DIS: ]<br>DIS: ] | 0V min - 32V type<br>Drive FOUT pin low :<br>to Assertion<br>to action<br>to action<br>to affect<br>vake up enabled<br>vake up enabled<br>bevice remains in cu | state • • • • • • • • • • • • • • • • • • • | FOUT_STA   | TE:<br>RT:<br>EL_R1 | Drive FOUT<br>PLL not lock<br>F: Internal doc | k oscillator is selec<br>e NOT in Normal<br>bled | tted        |



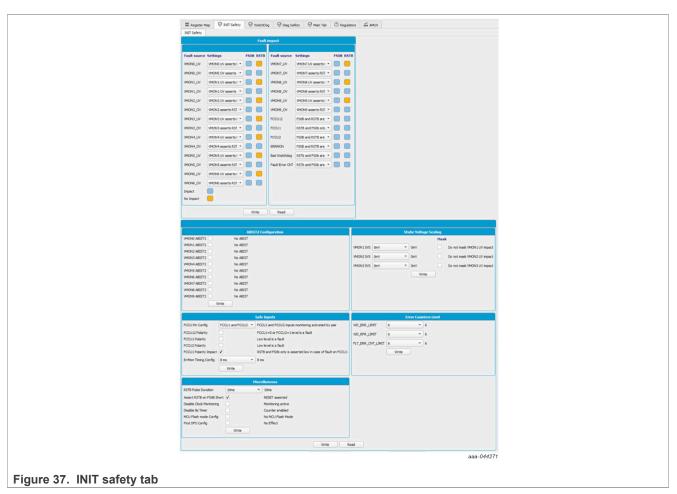
Writing an INIT\_FS register automatically updates the corresponding NOT register.

### 6.6.3.2 INIT Safety tab

This tab allows the initialization phase (INIT\_FS state) configuration, that must be done before the first good watchdog refresh until the 2 seconds timeout limit.

In this tab, safety features can be configured, such as the safety output reaction when voltage monitoring fault is detected, watchdog refresh counter, fault error counter, as shown in <u>Figure 37</u>. The Analog Built-In Self-Test 2 ABIST2 (used for voltage monitoring assigned to external regulator), the VMON1 Static Voltage Scaling, counters limit, and other INIT\_FS registers are also configurable from this tab. See the PF5030 data sheet for a complete description of these registers.

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To ease the configuration, Read and Write All buttons are implemented.

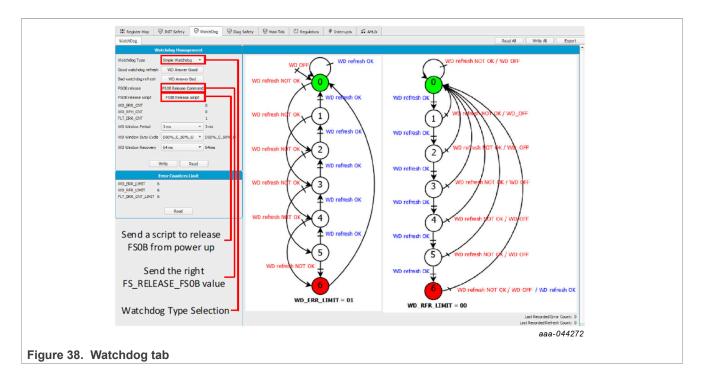
### 6.6.3.3 Watchdog tab

The watchdog tab gathers all the registers and configurations having an impact on the watchdog, except "Watchdog Type". The watchdog error and refresh counters are displayed depending on the limit configuration. Watchdog answers can be generated and sent to the device depending on the watchdog type. The watchdog type configured in the OTP must be manually selected in the drop-down list to explore the watchdog features. If the user is not aware of the type of watchdog configured in the OTP, it can be found in Mirrors tab.

The "FS0B Release Command" calculates and sends the right secure 16-bit word to release FS0B.

A simplified way to release FS0B after power-up is to select the right type of watchdog configured in the OTP and then click the "FS0B Release script" button. This action sends the right sequence to close the initialization sequence, sets the error counter back to 0, and then releases FS0B, shown in Figure 38.

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### 6.6.3.4 Diagnostic Safety tab

The diagnostic safety tab shown in Figure 39 makes it possible to know the safety status of the device. The safety function events, like voltage monitoring flags, analog and logical BIST status, and safety pins are automatically reported in this tab. The PF5030 can also get out of OTP or Debug mode using this tab.

| Safe IO  | Diag. Safety   | OV/UV Status  | Status and States  | General Flags  |
|--|--|---|--|--|
| Report PCOOD Change     No failure       Report PCOD Devent     No Power GOOD       Report PCOD Devent     No external RESET       STB drag     No external RESET       STB drag     No reset       STB drag     No failure       STB revect     Bor failure       STB revect     No reset       STB revect     Bor failure       STB revect     No failure       STB revect     Bor failure       STB revect     Bor failure       STB revect     Bor failure       STB revect     Bor failure       STO enne     High       FSOB drag     No failure       StOB request     Bor failure       Stob INIT fail-sofe     Read | PCCU12 Error     No Error       PCCU12 Error RT     No Error       PCCU1 Error RT     No Error       PCCU1 Error RT     No Error       PCCU2 Error RT     No Error       PFMOn Advowledge     ErrMon Status       ErrMon Status     Good WD Refresh       WD Tming     Good WD Refresh       PS 12C CRC Status     No Error       F3 12C Access Status     No Error       Write     Read | WICH0_JIV         No Indervoltage           WICH1_UV         No Indervoltage           WICH1_UV         No Unervoltage           WICH1_UV         No Unervoltage           WICH1_UV         No Unervoltage           WICH1_UV         No Unervoltage           WICH1_UV         No Undervoltage           WICH2_UV         No Undervoltage           WICH2_UV         No Undervoltage           WICH3_UV         No Undervoltage           WICH4_UV         No Undervoltage           WICH4_UV         No Undervoltage           WICH5_UV         No Undervoltage <t< th=""><th>ABISTI Status Pess<br/>ADISTI Status Pess<br/>UBIST Status Pess<br/>FS Test Mode Activation Status Active<br/>FS Debug Mode Ext<br/>FS Debug Mode RT No debug<br/>FS OTP Mode Ext<br/>FS OTP Mode Ext<br/>FS OTP Mode RT No debug<br/>Fail Safe Machine State FS 13<br/>Write Read</th><th>PS 12C Communication Error Active<br/>Watchdog Reflexit Error No debug<br/>Voltage Monitoring Error Dx00<br/>OTP 81C compution No corruption<br/>No corruption No corruption<br/>Write Read</th></t<> | ABISTI Status Pess<br>ADISTI Status Pess<br>UBIST Status Pess<br>FS Test Mode Activation Status Active<br>FS Debug Mode Ext<br>FS Debug Mode RT No debug<br>FS OTP Mode Ext<br>FS OTP Mode Ext<br>FS OTP Mode RT No debug<br>Fail Safe Machine State FS 13<br>Write Read | PS 12C Communication Error Active<br>Watchdog Reflexit Error No debug<br>Voltage Monitoring Error Dx00<br>OTP 81C compution No corruption<br>No corruption No corruption<br>Write Read |

### 6.6.3.5 Main tab

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Main configuration is possible from the main tab shown in Figure 40. The clock management box allows the configuration of the clock modulation. A regulator can be assigned to a voltage monitoring using the VMON assignment box, leading to a shutdown if OV occurs on the associated regulator.

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|--|--------------------------------------|
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### KITPF5030SKTEVM programming board

The PF5030 can enter STANDBY/LPOFF state using the "Go to Standby" command, setting the bit GOTO STBY = 1.

|   | lock Management  |   |  | Miscellaneous  | VMO  | N Assignment  |  |
|---|--|---|--|--|--|---|--|
| Clock Frequency Tuning         0           External FIN Deable            External FIN Select RT         External FIN Select RT           FIN Divides Select         Divides           OUT MUS Select         High m           FOUT Olock Select         CK 14           FOUT Phase Delay         No deli | Internal clock or<br>by 1      v Divider by 1<br>PLL not locked<br>pedance (HI      High impedance<br>elected     C K 1 selected | lation<br>scillator is selected   | BAT Fail<br>VSLP OV Weet: Deable<br>Wake: Deable<br>Wake2 RT<br>Wake2 Deable<br>Wake2 RT<br>XFALLB RT<br>Main 12C RCS Status<br>Main 12C Access Status<br>INTB Assertion Request | Battery Disconceton (POR cocurs)     Bottery Disconceton (POR cocurs)     S0V min - 32V type - 34V max     wake up enabled     WARE: Is high     wake up enabled     WARE: Is low level     XFALE: Is low level     No error     No error     Write Reed | VMON1 External Regulator<br>VMON2 External Regulator<br>VMON2 External Regulator<br>VMON3 External Regulator<br>VMON4 External Regulator<br>VMON6 External Regulator<br>VMON6 External Regulator<br>VMON7 External Regulator | External Regulator (No action if OV)     External Regulator (No action if OV)     External Regulator (No action if OV)  |  |
| Battery   |  |   | eral Flags   | Device State   |  | Power Sequence  |  |
|   | / driver command sensed high<br>/ pad sensed high<br>AT_SC_CFG<br>Read   | Wake Up Event<br>VSJP Event<br>VPRE Event<br>VBOOST Event<br>Buck Event<br>LDO1 Event<br>LDO2 Event | Ition Error No Failure<br>Wake event<br>Event occurred<br>Event occurred<br>No Event<br>No Event<br>No Event<br>No Event<br>No Event   | Resume from DFS due to TSD Event Does not resume fro<br>Resume from DFS Does not resume fro  | te FOI<br>im STRY<br>im STRY due to XFAILB<br>im deep fail-sofe due to TSD   | ILD Glot <u>Do not assert durin</u> <u>O</u> o not ass<br>JIF Glot <u>Do not drive during</u> <u>O</u> o not dri<br>JIF State <u>Drive FOU</u><br><u>Write</u> Read |  |

### 6.6.3.6 Regulators tab

The regulator tab shown in Figure 41 is used to configure the PF5030 SMPS or LDO. Regulators can be enabled or disabled on registers using I<sup>2</sup>C commands, and the state / status of each regulators is also shown.

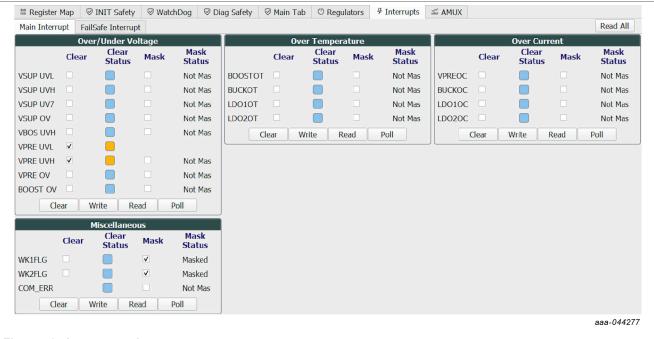
Each regulator has its own thermal shutdown (TSD) protection. After a TSD, the regulator is automatically reenabled when the temperature returns to the normal operation range. Nevertheless, an additional configuration, by regulator, is available to make device transition to deep fail-safe (DEEP-FS) state in case of TSD and consequently shut down all regulators. In a practical perspective, it means that TSD on regulators supplying MCU rails can be configured to make a transition to DEEP-FS while regulators supplying external loads wont.

| Voltage R   | legulators  | Regulators Control  |
|---|---|---|
| VPRE           PRE HS Raing SR         PU/PC/120mA         *         PU/PC/130mA           PRE HS Paling SR         PU/PC/120mA         *         PU/PC/130mA           PRE LS SR         PU/PC/900mA         *         PU/PC/900mA           PRE Pull Down Disable         no effect         write | VBODST           Behavior in case of TSD         Regulator shutdown + Regulator shutdown + State machine it ansitton to Standby mode           VBODST LS SR         500 V/Ls           Write         500 V/Ls | VPRE Finable in Normal Mode  VPRE Disable in Normal Mode  Boost Einable in Normal Mode  Boost Stable in Normal Mode  Boost Stable in Normal Mode  Buck Einable in Normal Mode  Buck State  Buck State |
| BUCK<br>ehavior in case of TSD Regulator shutdowr V Regulator shutdown + State machine transition to Standby mode<br>Write  | LDO1<br>Behavor in case of TSD Regulator shutdown V Regulator shutdown + State machine transition to Standby mode<br>Write  | LD01Enable in Normal Mode LD01Disable in Normal Mode LD01State LD02Chable in Normal Mode LD02DStable in Normal Mode LD02DState  |
| ehavior in case of TSD Regulator shutdown * Regulator shutdown + State machine transition to Standby mode Write Write Write   | Read  | Write Read  |

#### Figure 41. Regulators tab

### 6.6.3.7 Main interrupts tab

The main interrupts tab shown in <u>Figure 42</u> allows the monitoring of the regulators, the wake inputs, and the communication events or status. It allows the reading, writing, and polling of overvoltage/undervoltage, overtemperature, and overcurrent flags.



#### Figure 42. Interrupts tab

Different commands can be used to manage the interrupts:

- Clear: Interrupt flags latched and selected are cleared
- Write: Masks an interruption when the mask is selected
- · Read: Gives the status of all interrupts
- Poll: Reads interrupts values in a loop

Additionally, Clear All / Read All buttons are available to control all interrupts on one click.

### 6.6.3.8 Fail-safe interrupts tab

The fail-safe interrupts tab shown in <u>Figure 43</u> allows the monitoring of the overvoltage/undervoltage fail-safe monitoring status and the watchdog. It allows the reading, writing, and polling of overvoltage/undervoltage flags.

| Main Interrupt |       | afe Interrupt   |       |                | -        |        |                 |      |                |                   |       |                 |      | Read All      |
|----------------|-------|-----------------|-------|----------------|----------|--------|-----------------|------|----------------|-------------------|-------|-----------------|------|---------------|
|                | U     | nder Voltag     | e     |                |          | 0\     | ver Voltag      | e    |                | Safety Interrupts |       |                 |      |               |
| (              | Clear | Clear<br>Status | Mask  | Mask<br>Status |          | Clear  | Clear<br>Status | Mask | Mask<br>Status |                   | Clear | Clear<br>Status | Mask | Mask<br>Statu |
| VMON0 UV       |       |                 |       | Not Mas        | VMON0 OV |        |                 |      | Not Mas        | FCCU1             |       |                 |      | Not Ma        |
| VMON1 UV       |       |                 |       | Not Mas        | VMON1 OV |        |                 |      | Not Mas        | FCCU2             |       |                 |      | Not Ma        |
| VMON2 UV       |       |                 |       | Not Mas        | VMON2 OV |        |                 |      | Not Mas        | FCCU12            |       |                 |      |               |
| VMON3 UV       |       |                 |       | Not Mas        | VMON3 OV |        |                 |      | Not Mas        | ERRMON            |       |                 |      | Not Ma        |
| VMON4 UV       |       |                 |       | Not Mas        | VMON4 OV |        |                 |      | Not Mas        | BAD_WD_DATA       |       |                 |      |               |
| VMON5 UV       |       |                 |       | Not Mas        | VMON5 OV |        |                 |      | Not Mas        | BAD_WD_TIMING     |       |                 |      |               |
| VMON6 UV       |       |                 |       | Not Mas        | VMON6 OV |        |                 |      | Not Mas        | Clear             | Write | Read            | Poll |               |
| VMON7 UV       |       |                 |       | Not Mas        | VMON7 OV |        |                 |      | Not Mas        |                   |       |                 |      |               |
| VMON8 UV       |       |                 |       | Not Mas        | VMON8 OV |        |                 |      | Not Mas        |                   |       |                 |      |               |
| VMON9 UV       |       |                 |       | Not Mas        | VMON9 OV |        |                 |      | Not Mas        |                   |       |                 |      |               |
| Clear          | W     | rite Rea        | d 🔤 I | Poll           | Cle      | ar Wri | te Re           | ad   | Poll           |                   |       |                 |      |               |
| -              |       |                 |       |                |          |        |                 |      |                |                   |       |                 | aa   | a-0442        |

The same set of commands is used as the set to manage the interrupts as main interrupts.

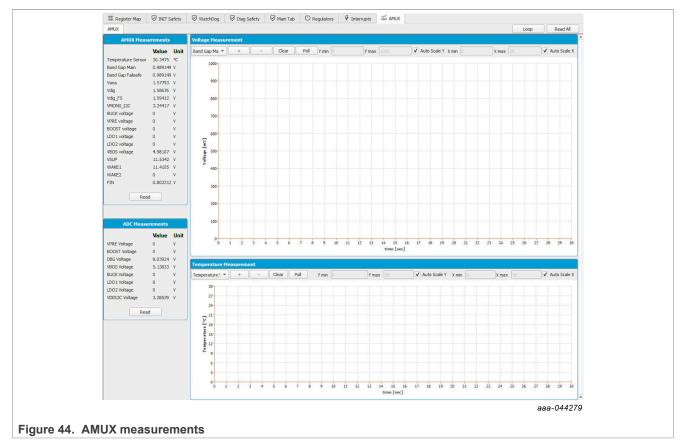
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### 6.6.3.9 AMUX

The AMUX tab shown in <u>Figure 44</u> allows the selection of an AMUX pin channel and gets its current value by using the exclusive KL25Z AMUX ADC channel. You can do a single read or display various channels dynamically on the voltage or temperature graph. The displayed values already apply the divider and temperature formulas.

The input / output voltage rails are also monitored independently using additional the KL25Z ADC channels.

To use the dynamic graph, select the channel then click the "+" button to add to the graph. To start polling, click the "Poll" button. Click the "Poll" button again to stop measurements.



# 7 Using an evaluation board

Before starting the process, consult the development board scheme and user manual to configure the required use case.

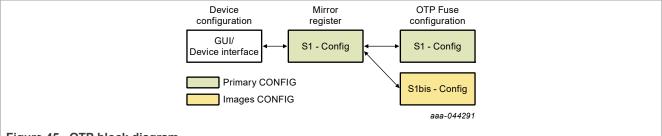
Learn about OTP before operating with the device. The device has a high level of flexibility due to the parameter configuration available in the OTP. It impacts the functionality of the device. It is key to understand how OTP parameters can be programmed, the interaction with mirror registers, and the PF5030 device.

The OTP-related operations can only be performed in test mode (emulation) and OTP mode (programming, test mode is enabled automatically). When using emulation, the device loses the configuration when the power supply is switched off, when the device enters deep fail-safe (DEEP-FS) state, or when it goes standby.

## 7.1 OTP and mirrors registers

The device incorporates two OTP blocks. One is for the main section, the other for the fail-safe section. During configuration, each of them uses dedicated sectors.

Each block is divided in two sectors, S1 and S1bis respectively, so the device can be fused two times. The OTP configuration scheme is shown in <u>Figure 45</u> (same implementation for main and fail-safe).



### Figure 45. OTP block diagram

At device starts-up, the content of the valid (last programmed) sector is loaded into mirror registers. The mirror register content is accessible from the NXP GUI, using specific I<sup>2</sup>C commands. The NXP GUI manages the mirror configuration, which facilitates access. The mirror register content handling is called "OTP emulation".

To burn the OTP configuration, the mirror register content must be loaded with the desired content. Then a command must be sent to burn the mirror content to the next available OTP sector. The first sector to be burned is S1, the second S1bis. The NXP GUI automatically manages the next sector to be burned. It is not possible to revert to the previous sector. When the user reaches the sector S1bis, there is no other possibility for burn. However, the emulation is still available.

## 7.2 Device modes

There are several modes that describe device operation.

There are three modes to run the device:

- User mode: Only user-related registers can be accessed and handled.
- **OTP mode**: OTP fuse content loaded to mirror registers. OTP programming / emulation (mirror registers handling) possible.
- Test mode: OTP programming and mirror registers handling (emulation) granted.

There are two modes to run the device related to the fail-safe state machine:

- Normal mode: Watchdog windowing and initialization (INIT\_FS state) timeout depend on OTP configuration.
- Debug mode: Watchdog windowing disabled, no initialization timeout, fail-safe safety reactions disabled.

Debug and OTP modes are enabled by applying voltage on DBG pin during startup and/or restart.

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OTP mode activation implies in Debug mode activation.

Debug and OTP modes can be disabled with an  $I^2C$  command.

Test mode can be enabled at any moment with an I<sup>2</sup>C command when the voltage is applied on DBG pin.

## 7.3 Configuring the hardware for start-up

<u>Figure 46</u> presents a typical hardware configuration incorporating the development board, power supply and, Windows PC workstation.

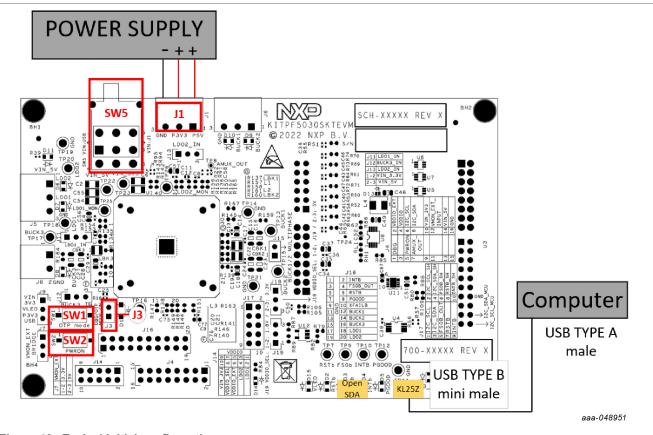


Figure 46. Typical initial configuration

To configure the hardware and workstation as illustrated in Figure 46, complete the following procedure:

1. Install jumpers and switches for the configuration shown in <u>Table 22</u>.

| Board                     | Configuration  |  |                              |  |  |  |  |  |  |
|---------------------------|--|--|------------------------------|--|--|--|--|--|--|
| configuration             | Normal mode  | OTP / test mode entry  |                              |  |  |  |  |  |  |
| Watchdog<br>configuration | Watchdog windowing enabled, 2 seconds<br>INIT_FS timeout (OTP WDW_INF = 0) | Watchdog windowing disabled,                                     | OTP programming / emulation, |  |  |  |  |  |  |
|                           | Watchdog windowing disabled, no<br>INIT_FS timeout (OTP WDW_INF = 1)       | no INIT_FS timeout   | Debug mode enabled           |  |  |  |  |  |  |
| J3 (DBG)                  | Open   | Connect 1 to 2<br>DBG pin voltage pulled to 4.5 V or 7.95 V (SW1 |                              |  |  |  |  |  |  |
| SW2 (PWRON)               | Close (I   | Close (PWRON pin high-logic level)                               |                              |  |  |  |  |  |  |
| SW5 (VIN)                 | Midd   | le position (supplies OFF)                                       |                              |  |  |  |  |  |  |
| SW1 (OTP mode)            | Open (DBG = VIN  | _5V)   | Close (OTP mode ON)          |  |  |  |  |  |  |

#### Table 22. Hardware configuration

- 2. Connect the Windows PC USB port to the KITPF5030SKTEVM board using the provided USB 2.0 cable.
- 3. If external power supplies are used, set the power supplies to 3.3 V and 5.0 V, and current limit to 1.0 A. With power turned off, attach the power supplies positive and negative outputs to J1, then turn on.
- 4. Put SW5 in LEFT position if USB power is used or RIGHT position if external power supply is used.

At this step, if the product is in OTP mode entry configuration, all regulators are OFF. The user can power up with an OTP configuration or configure the mirror registers before powering up. Power-up sequence starts as soon as one of these four actions occurs:

- J3 jumper is removed
- SW1 is switched OFF
- OTP mode exit command is sent using I<sup>2</sup>C
- NXP GUI button "Exit OTP Mode" is clicked

## 7.4 Working in OTP emulation mode

At start-up, the device always uses the content of the mirror register. This content can come from OTP fuse or from a configuration written directly in the mirror register. OTP emulation means that the user can emulate the fuse content by writing in the mirror register, which allows trials before burning the OTP.

- 1. Configure the hardware for OTP mode entry.
- 2. Launch the NXP GUI for Automotive PMIC Families software.
- 3. Create an OTP configuration and export/generate the TBB/OTP script file.
- 4. Establishing the connection between the NXP GUI and the hardware.

| MCU: FRDM-KL25Z State: CONNECTED | Protocol: I <sup>2</sup> C Firmware: 0.3 Application 3.1.144 Device Mode: user-mode Color legend: High Low | FS CURRENT STATE : | OTP_MODE |
|----------------------------------|--|--------------------|----------|
|                                  |  |                    | 000 04   |

Check that the fail-safe state machine is in OTP MODE state and "Exit OTP mode" must be green. If not, check 1 and redo this step. While in OTP mode, all regulators are off.

- 5. On the script editor, load the TBB/OTP script file and send content to the mirror registers.
- 6. Click "Exit OTP mode" button, if all goes right, regulators start-up and fail-safe state machine must be in INIT FS state.

| MCU: FRDM-KL25Z State: CONNECTED | Protocol: I <sup>2</sup> C Firmware: 0.3 Application 3.1.144 Device Mode: test-mode Color legend: High Low FS CURRENT STATE : | INIT_FS    |
|----------------------------------|---|------------|
|                                  |   | aaa-044295 |

- a. If the mirror registers are filled (with a configuration using the Script editor), that configuration is used in the emulation session.
- b. If the mirror registers are not filled (with a configuration using the Script editor), the currently programmed OTP fuse configuration is used, if it exists.

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c. Otherwise, the mirror registers are not filled and the OTP fuse is not burned. The device does not start up properly.

Device is in Debug mode. As long as Debug mode is not exited by writing FS\_STATES: [FS\_DBG\_MODE\_EXIT] bit to 1, the FS0B pin cannot be released.

## 7.5 Releasing FS0B script

The following script can be used to release FS0B:

- Disable the watchdog windowing (simple watchdog configuration is used here).
- Close the initialization phase with (a first) good watchdog refresh.

Table 23 Release FS0B sequence example for simple watchdog (ASIL B)

- Exit the Debug mode.
- Send six (default) additional consecutive good watchdog refreshes to revert the fault error counter to 0.
- Release FS0B pin, which is only valid if watchdog windowing is activated in OTP.

| Table 20. Release i oub sequence example for simple wateraog (Aoie D) |      |               |       |             |  |  |  |  |  |
|---|------|---------------|-------|-------------|--|--|--|--|--|
|   | Step | Register name | Value | Description |  |  |  |  |  |

| Step | Register name        | Value  | Description   |
|------|----------------------|--------|---|
| 1    | FS_WD_WINDOW_DUR     | 0x020B | WDW_PERIOD[4:0] = 0x00000 (watchdog disabled)             |
| 2    | FS_NOT_WD_WINDOW_DUR | 0xFD04 | NOT of FS_WD_WINDOW_DUR                                   |
| 3    | FS_WD_ANSWER         | 0x5AB2 | 1st good watchdog answer (close the initialization phase) |
| 4    | FS_STATES            | 0x4000 | FS_DBG_MODE_EXIT = 1<br>(exit debug mode)                 |
| 5    | FS_WD_ANSWER         | 0x5AB2 | 2nd good watchdog answer                                  |
| 6    | FS_WD_ANSWER         | 0x5AB2 | 3rd good watchdog answer                                  |
| 7    | FS_WD_ANSWER         | 0x5AB2 | 4th good watchdog answer                                  |
| 8    | FS_WD_ANSWER         | 0x5AB2 | 5th good watchdog answer                                  |
| 9    | FS_WD_ANSWER         | 0x5AB2 | 6th good watchdog answer                                  |
| 10   | FS_WD_ANSWER         | 0x5AB2 | 7th good watchdog answer                                  |
| 11   | FS_RELEASE_FS0B      | 0xB2A5 | FS0B pin released (pulled to high level)                  |

This sequence can be sent using a script built with NXP GUI. There are two options:

- Clicking ACCESS > WatchDog > "Watchdog Management" > "FS0B Release script". Remember to chose appropriated "Watchdog Type" before.
- Clicking SCRIPT (editor) > Generator > "FS0B\_RELEASE\_XX\_WATCHDOG", then click "RUN".

KITPF5030SKTEVM programming board

## 8 References

[1] **KITPF5030SKTEVM** — detailed information on this board, including documentation, downloads, and software and tools

http://www.nxp.com/KITPF5030SKTEVM

- [2] **PF5030** detailed information on PF5030 <u>http://www.nxp.com/PF5030</u>
- [3] NXP GUI for Automotive PMIC Families Software GUI for NXP Automotive PMIC products https://www.nxp.com/PMIC-GUI-SW

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