

# UM11526

KITFS5600FRDMEVM evaluation board

Rev. 1 — 25 May 2021

User manual

## Document information

Information	Content
Keywords	FS5600, controller, FET
Abstract	The KITFS5600FRDMEVM is a hardware evaluation tool that allows performance test of the FS5600.



## 1 Revision history

---

### Revision history

Rev	Date	Description
v.1	20210525	<ul style="list-style-type: none"><li>Initial version</li></ul>

## 2 Introduction

---

The FS5600 integrates a 36 V DC-DC controller with external FETs and a 36 V DC-DC converter with internal FETs. In addition, it offers functional safety features such as independent voltage monitors, windowed watchdog timer, I/O monitoring via ERRMON and FCCU and built-in self-test. This document covers connecting the hardware, installing the software and tools, configuring the environment and using the kit.

This document is the user guide for the KITFS5600FRDMEVM evaluation board. This document is intended for the engineers involved in the evaluation, design, implementation, and validation of FS5600.

## 3 Finding kit resources and information on the NXP web site

---

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

The information page for KITFS5600FRDMEVM evaluation board is at <http://www.nxp.com/KITFS5600FRDMEVM>. The information page provides overview information, documentation, software and tools, parametrics, ordering information and a **Getting Started** tab. The **Getting Started** tab provides quick-reference information applicable to using the KITFS5600FRDMEVM evaluation board, including the downloadable assets referenced in this document.

### 3.1 Collaborate in the NXP community

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

The NXP community is at <http://community.nxp.com>.

## 4 Getting ready

---

Working with the KITFS5600FRDMEVM requires the kit contents, additional hardware and a Windows PC workstation with installed software.

### 4.1 Kit contents

- Assembled and tested evaluation board in an anti-static bag
- FRDM-K82F Freedom Development Platform
- Quick Start Guide

### 4.2 Additional hardware

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

- Power supply with a range upto 40 V
- Oscilloscope
- Voltmeter

### 4.3 Windows PC workstation

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

- USB-enabled computer with Windows 7 or Windows 10

### 4.4 Software

Installing software is necessary to work with this evaluation board. All listed software is available on the evaluation board's information page at <http://www.nxp.com/KITFS5600FRDMEVM>.

## 5 Getting to know the hardware

### 5.1 Kit overview

The KITFS5600FRDMEVM is a hardware evaluation tool that allows performance test of the FS5600.

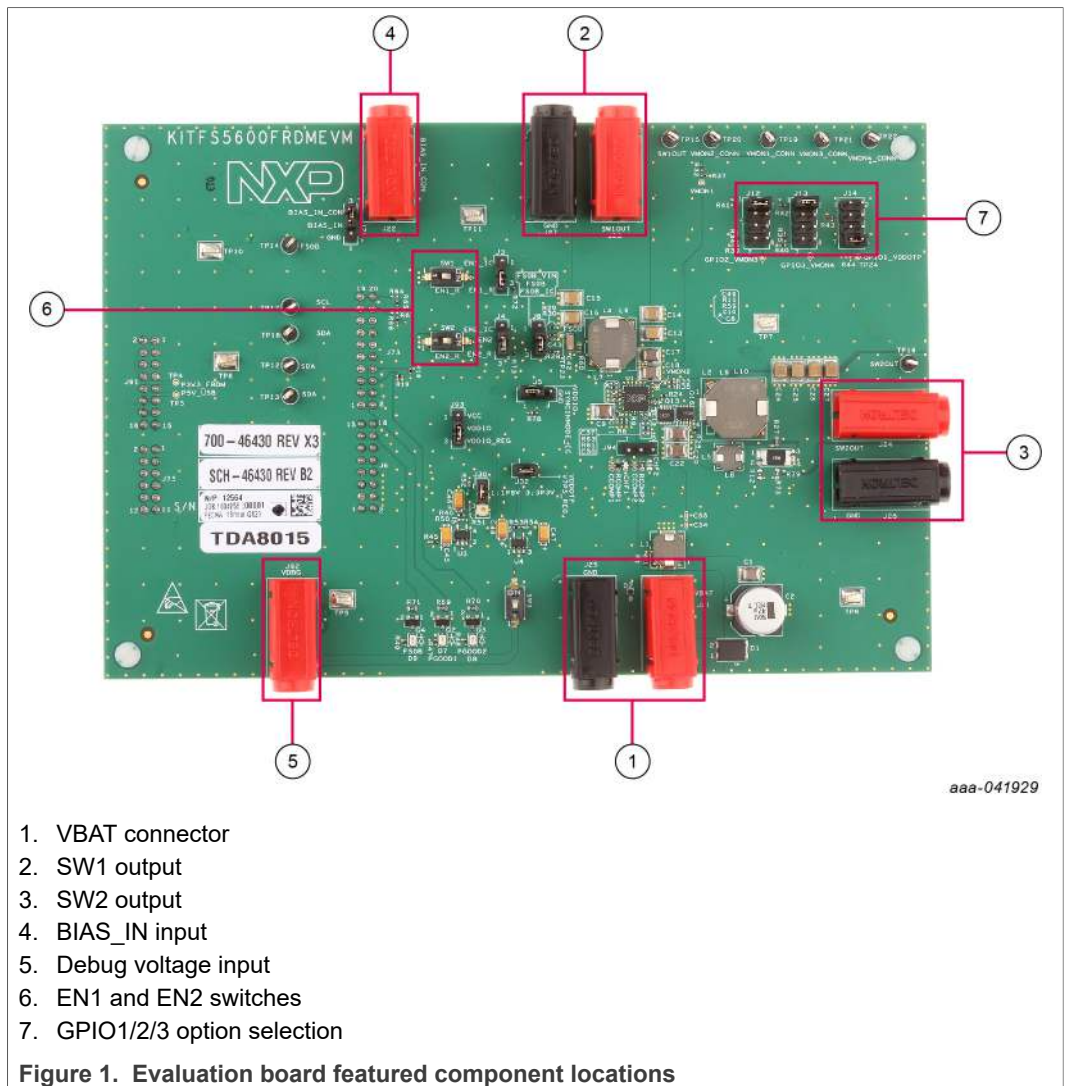
An Emulation mode is possible to test different OTP configurations as needed. Different inductors and MOSFETs are included in the kit to allow the user to try different switching frequencies.

#### 5.1.1 KITFS5600FRDMEVM features

- VBAT power supply connectors
- SW1 output capability up to 3.5 A (internal MOSFET)
- SW2 output capability up to 15 A (external MOSFET)
- EN1/2 switches
- PGOOD1/2 status indicators
- FS0B external safety pin
- LEDs that indicate signal or regulator status
- Emulation mode capabilities
- USB connection and GUI for register access, OTP emulation and programming

### 5.2 Kit featured components

[Figure 1](#) identifies important components on the board.



5.2.1 Jumpers

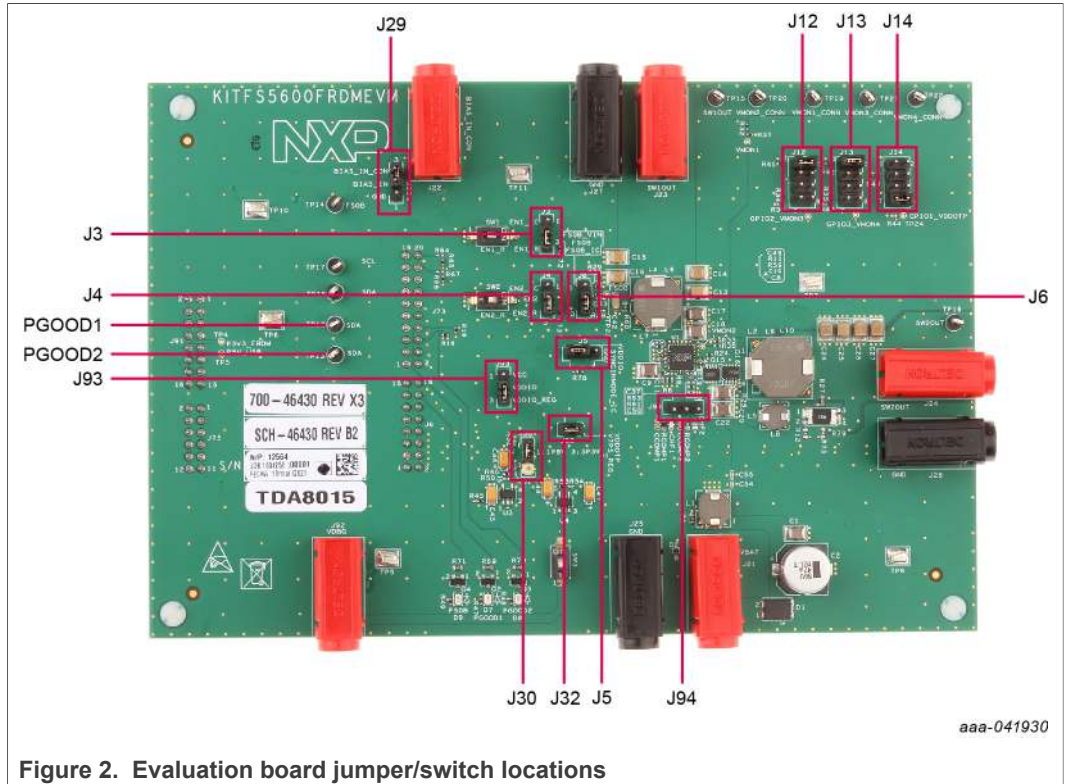


Figure 2. Evaluation board jumper/switch locations

Table 1. Evaluation board jumper/switch descriptions

Name	Default	Description
J3	2-3 shorted	Controls EN1 source <ul style="list-style-type: none"> <li>• 1-2 shorted → From Freedom board</li> <li>• 2-3 shorted → From onboard switch</li> </ul>
J4	2-3 shorted	Controls EN2 source <ul style="list-style-type: none"> <li>• 1-2 shorted → From Freedom board</li> <li>• 2-3 shorted → From onboard switch</li> </ul>
J5	1-2 shorted	MODE logic level control <ul style="list-style-type: none"> <li>• 1-2 → Ground</li> <li>• 2-3 → VDDIO</li> </ul>
J8	2-3 shorted	FS0B pull up source <ul style="list-style-type: none"> <li>• 1-2 → VIN</li> <li>• 2-3 → VDDIO</li> </ul>
J12	1-2 shorted	GPIO2/VMON3 selection <ul style="list-style-type: none"> <li>• 1-2 → GPO2</li> <li>• 3-4 → FCCU1</li> <li>• 5-6 → Ground</li> <li>• 7-8 → VMON3</li> </ul>
J13	1-2 shorted	GPIO3/VMON4 selection <ul style="list-style-type: none"> <li>• 1-2 → GPO3</li> <li>• 3-4 → FCCU2</li> <li>• 5-6 → ERRMON2</li> <li>• 7-8 → VMON4</li> </ul>

Table 1. Evaluation board jumper/switch descriptions...continued

Name	Default	Description
J14	7-8 shorted	GPIO1 selection <ul style="list-style-type: none"> <li>• 1-2 → Floating</li> <li>• 3-4 → GPO1</li> <li>• 5-6 → ERRMON1</li> <li>• 7-8 → VDDOTP (for debug and development)</li> </ul>
J29	1-2 shorted	BIAS_IN selection <ul style="list-style-type: none"> <li>• 1-2 → Connect to ground</li> <li>• 2-3 → BIAS_IN connected to J22. Apply 5.0 V on J22.</li> </ul>
J30	1-2 shorted	VDDIO voltage selection <ul style="list-style-type: none"> <li>• 1-2 → 1.8 V</li> <li>• 2-3 → 3.3 V</li> </ul>
J32	1-2 shorted	VDDOTP Debug Selection <ul style="list-style-type: none"> <li>• Closed → Apply debug voltage to VDDOTP</li> <li>• Open → Do not apply VDDOTP</li> </ul>
J93	2-3 shorted	Select the source for VDDIO <ul style="list-style-type: none"> <li>• 1-2 shorted → VCC</li> <li>• 2-3 shorted → LDO on board (see J30 for voltage selection)</li> </ul>
J94	1-2 shorted	SW2 compensation selection <ul style="list-style-type: none"> <li>• 1-2 → 450 kHz operation</li> <li>• 2-3 → 2.2 MHz operation</li> </ul>

### 5.3 Schematic, board layout and bill of materials

The schematic, board layout and bill of materials for the KITFS5600FRDMEVM evaluation board are available at <http://www.nxp.com/KITFS5600FRDMEVM>.

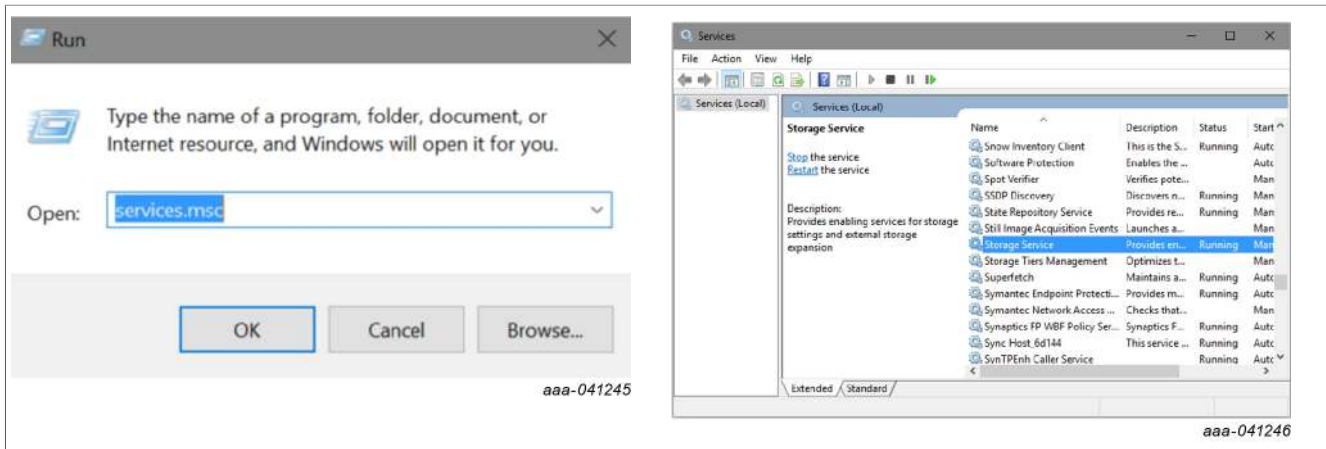
## 6 Installing and configuring software and tools

### 6.1 GUI installation

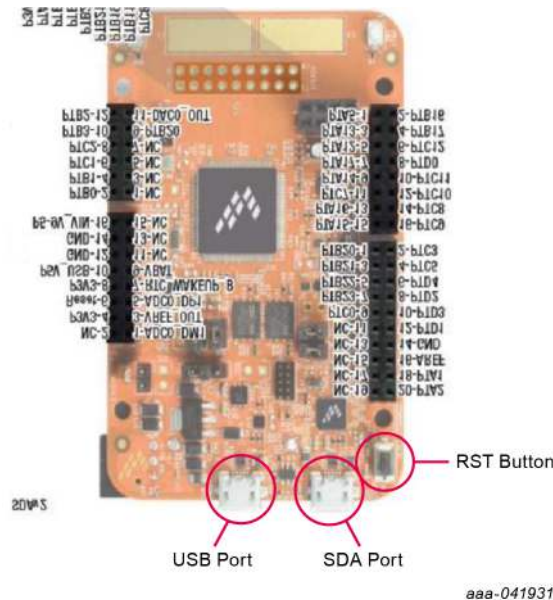
Unzip the **NXPGUI\_PR\_x** into any desired location. Find the **NXP\_GUI\_x.x-Setup** from the GUI folder inside the package and run it to install the GUI in any desired location.

### 6.2 Freedom board firmware update

For Windows 10, disable the storage services: run services.msc; double-click on the storage service from the list and press the Stop button.



1. Press the RST push button on the Freedom board and connect the USB cable into the SDA port (J5) on the Freedom board.



2. If a new "BOOTLOADER" device appears on the left pane of the File explorer:
  - a. Drag and drop the downloaded file "0244\_k20dx\_bootloader\_update\_0x8000.bin" into the BOOTLOADER drive. Make sure to allow enough time for the firmware to be saved in the Bootloader.
  - b. Disconnect and reconnect the USB cable into the SDA port (this time WITHOUT pressing the RST push button).
  - c. Drag and drop the file "k20dx\_frdmk82f\_if\_crc\_legacy\_0x8000.bin" from the package (MCU folder) into the MAINTENANCE drive.

**Note:**

*Make sure to allow enough time for the firmware to be saved in the Bootloader. The device should change to **FRDM\_K82FD**.*

3. Skip 2a if MAINTENANCE appears in the File Explorer instead of BOOTLOADER. Follow 2b and 2c instead.
4. Locate the file "**nxp-gui-fw-frdmk82f-usb\_hid-fs5600\_xxx.bin**" from the package (MCU folder) and drag and drop the file into the FRDM\_K82FD device.



5. Freedom board Firmware is successfully loaded. Disconnect and reconnect the USB cable into the USB port. Open the previously installed NXPGUI. The “Start” button on the top-left corner must be activated.
6. If only the NXPGUI firmware needs to be updated, then start from step 4 above. The PC detects **FRDM\_K82FD**.

## 7 Configuring the hardware for startup

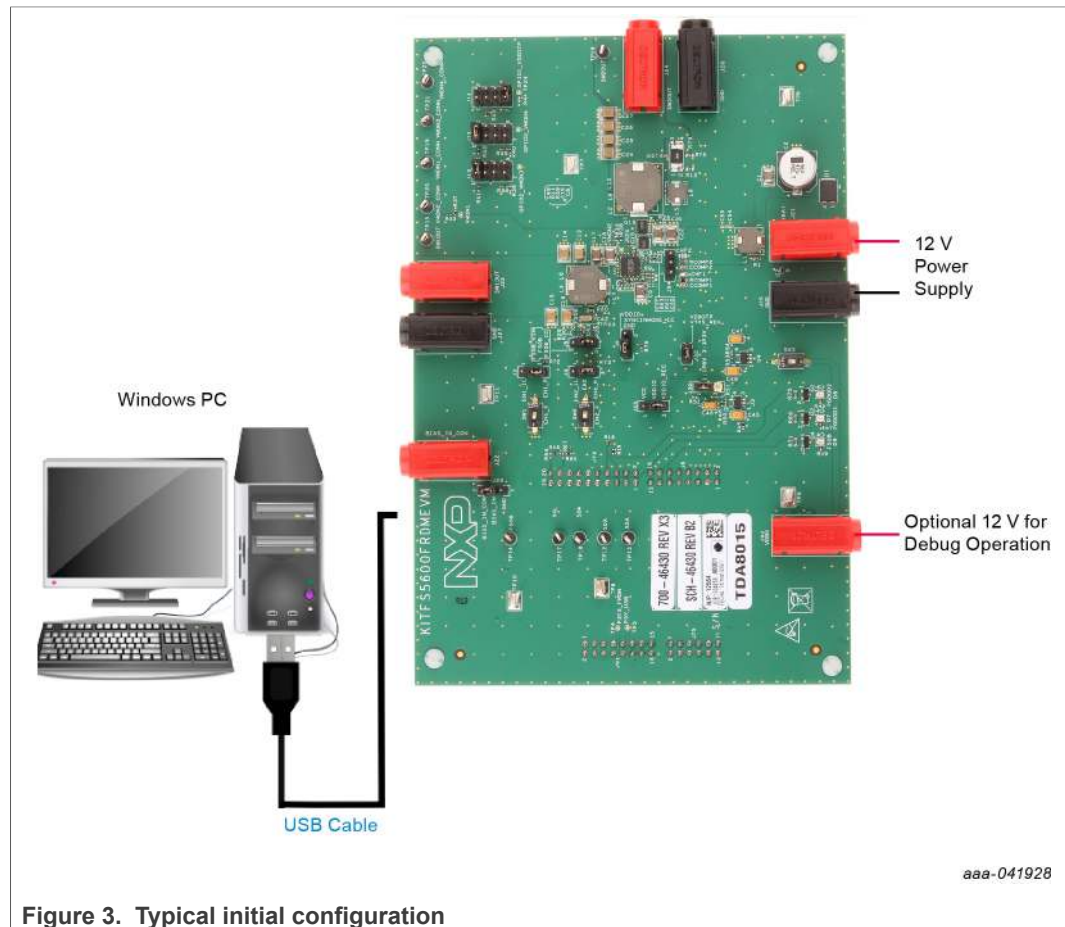


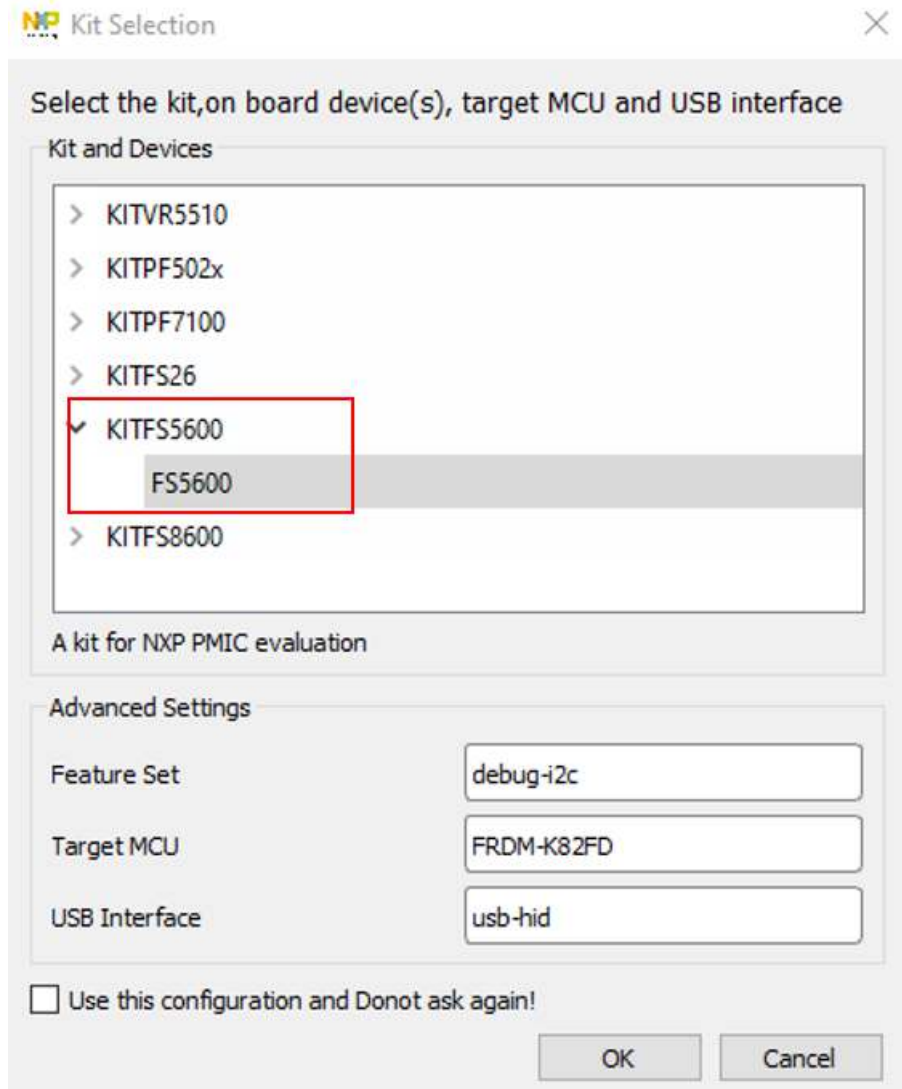
Figure 3. Typical initial configuration

Figure 3 presents a typical hardware configuration incorporating the development board, power supply and Windows PC workstation.

To configure the hardware and workstation as illustrated in Figure 3, complete the following procedure:

1. Ensure that jumpers are in the default positions as shown in [Section 5.2.1 "Jumpers"](#).
2. With the USB cable connected to the PC and the USB port in the freedom board K82F, apply power to the evaluation board by applying 12 V between J21 and J25.
3. Press **Reset** on the Freedom board to make sure that the board is recognized.
4. Run the installed **NXPGUI** application from the Start menu or the installation folder.

5. A configuration window is displayed. Select the kit type and the device silicon version, and then click **OK**.



6. Click **Start** to enable the connection to the device. Once the device is connected properly, the “Start” button is activated and the system is ready for operation.



7. If the NXPGUI does not recognize the FRDM-K82F board or if the **Start** button does not get activated, then it is possible that the interface is broken. In this case, reprogramming of the FRDM board can be attempted.

## 8 Using the KITFS5600FRDMEVM evaluation board

This section summarizes the overall setup. Detailed description is provided in the following sections.

### 8.1 Modifying the mirror registers on the fly

1. Make sure that the part is turned On with EN1 or EN2 high.
2. Move jumper J14 to 7-8 position.
3. Move switch SW3 to ON position.
4. Apply 12 V to J92.
5. Enter **Test Mode** in the GUI using the drop-down list, and then click **Apply**.



6. The mirror registers can be modified using the appropriate tab in the GUI anytime the part is On.
7. The user can create a script using the OTP tab by using the Export menu to automate some actions.

### 8.2 Starting up with a known configuration

With EN1 = EN2 = 0, apply VBAT.

1. Move jumper J14 to 7-8 position.
2. Move switch SW3 to On position.
3. Apply 12 V at J92.
4. Apply EN1 or EN2 = High.
5. The state machine of FS5600 stops in a debug state to allow the user to configure the mirror registers. The mirror registers can be configured in this state using the GUI either by running a script, or individually modifying them.
6. After configuring the mirror registers as needed, move SW3 to Off position. The FS5600 powers up with the configured register settings.

## 9 References

- [1] **KITFS5600FRDMEVM** — detailed information on this board, including documentation, downloads, and software and tools  
<http://www.nxp.com/KITFS5600FRDMEVM>
- [2] **FS5600** — product information on FS5600, Automotive Dual Buck Regulator and Controller with Voltage Monitors and Watchdog Timer  
<http://www.nxp.com/FS5600>

## 10 Legal information

### 10.1 Definitions

**Draft** — A draft status on a document indicates that the content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included in a draft version of a document and shall have no liability for the consequences of use of such information.

### 10.2 Disclaimers

**Limited warranty and liability** — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors. In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory. Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of NXP Semiconductors.

**Right to make changes** — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

**Suitability for use** — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

**Applications** — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification. Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products. NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by

customer's third party customer(s). NXP does not accept any liability in this respect.

**Terms and conditions of commercial sale** — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nxp.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

**Export control** — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

**Evaluation products** — This product is provided on an "as is" and "with all faults" basis for evaluation purposes only. NXP Semiconductors, its affiliates and their suppliers expressly disclaim all warranties, whether express, implied or statutory, including but not limited to the implied warranties of non-infringement, merchantability and fitness for a particular purpose. The entire risk as to the quality, or arising out of the use or performance, of this product remains with customer. In no event shall NXP Semiconductors, its affiliates or their suppliers be liable to customer for any special, indirect, consequential, punitive or incidental damages (including without limitation damages for loss of business, business interruption, loss of use, loss of data or information, and the like) arising out of the use of or inability to use the product, whether or not based on tort (including negligence), strict liability, breach of contract, breach of warranty or any other theory, even if advised of the possibility of such damages. Notwithstanding any damages that customer might incur for any reason whatsoever (including without limitation, all damages referenced above and all direct or general damages), the entire liability of NXP Semiconductors, its affiliates and their suppliers and customer's exclusive remedy for all of the foregoing shall be limited to actual damages incurred by customer based on reasonable reliance up to the greater of the amount actually paid by customer for the product or five dollars (US\$5.00). The foregoing limitations, exclusions and disclaimers shall apply to the maximum extent permitted by applicable law, even if any remedy fails of its essential purpose.

**Translations** — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

**Security** — Customer understands that all NXP products may be subject to unidentified or documented vulnerabilities. Customer is responsible for the design and operation of its applications and products throughout their lifecycles to reduce the effect of these vulnerabilities on customer's applications and products. Customer's responsibility also extends to other open and/or proprietary technologies supported by NXP products for use in customer's applications. NXP accepts no liability for any vulnerability. Customer should regularly check security updates from NXP and follow up appropriately. Customer shall select products with security features that best meet rules, regulations, and standards of the intended application and make the ultimate design decisions regarding its products and is solely responsible for compliance with all legal, regulatory, and security related requirements concerning its products, regardless of any information or support that may be provided by NXP. NXP has a Product Security Incident Response Team (PSIRT) (reachable at [PSIRT@nxp.com](mailto:PSIRT@nxp.com)) that manages the investigation, reporting, and solution release to security vulnerabilities of NXP products.

### 10.3 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

**NXP** — wordmark and logo are trademarks of NXP B.V.

---

## Tables

---

Tab. 1. Evaluation board jumper/switch descriptions ..... 6

## Figures

---

Fig. 1. Evaluation board featured component locations ..... 5

Fig. 2. Evaluation board jumper/switch locations ..... 6

Fig. 3. Typical initial configuration ..... 9

---

## Contents

---

<b>1</b>	<b>Revision history</b> .....	<b>2</b>
<b>2</b>	<b>Introduction</b> .....	<b>3</b>
<b>3</b>	<b>Finding kit resources and information on the NXP web site</b> .....	<b>3</b>
3.1	Collaborate in the NXP community .....	3
<b>4</b>	<b>Getting ready</b> .....	<b>3</b>
4.1	Kit contents .....	3
4.2	Additional hardware .....	3
4.3	Windows PC workstation .....	4
4.4	Software .....	4
<b>5</b>	<b>Getting to know the hardware</b> .....	<b>4</b>
5.1	Kit overview .....	4
5.1.1	KITFS5600FRDMEVM features .....	4
5.2	Kit featured components .....	4
5.2.1	Jumpers .....	6
5.3	Schematic, board layout and bill of materials .....	7
<b>6</b>	<b>Installing and configuring software and tools</b> .....	<b>7</b>
6.1	GUI installation .....	7
6.2	Freedom board firmware update .....	7
<b>7</b>	<b>Configuring the hardware for startup</b> .....	<b>9</b>
<b>8</b>	<b>Using the KITFS5600FRDMEVM evaluation board</b> .....	<b>11</b>
8.1	Modifying the mirror registers on the fly .....	11
8.2	Starting up with a known configuration .....	11
<b>9</b>	<b>References</b> .....	<b>11</b>
<b>10</b>	<b>Legal information</b> .....	<b>12</b>

---

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

---

© NXP B.V. 2021.

All rights reserved.

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

Date of release: 25 May 2021  
Document identifier: UM11526