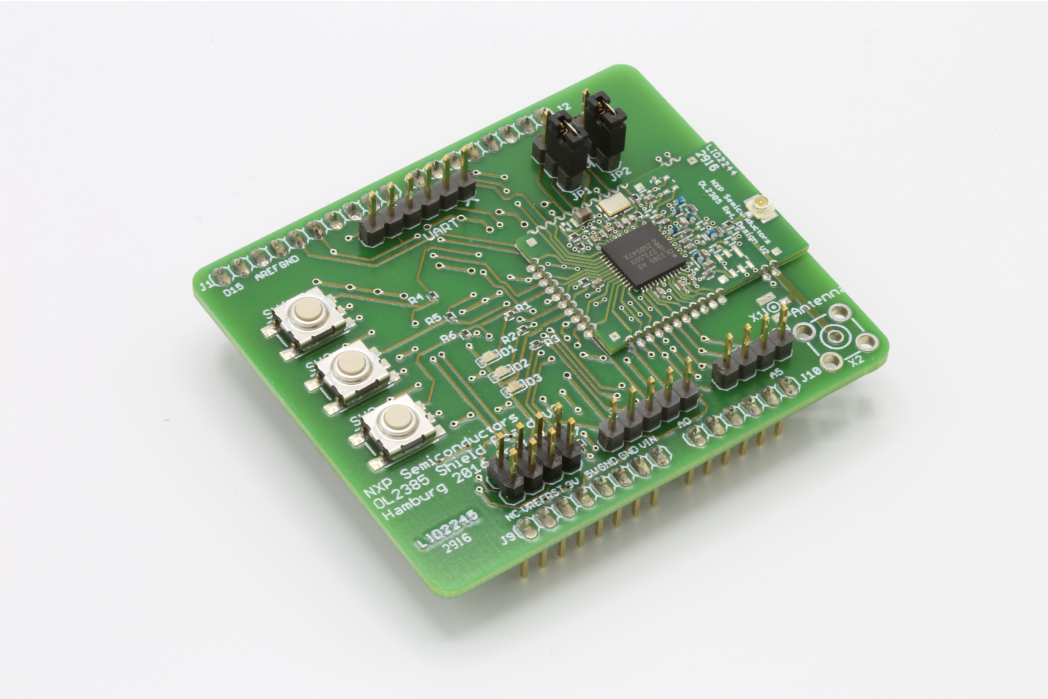
KTOM2385SF001UG

OM2385/FS001 development kit

Rev. 1.0 — 28 October 2016 User guide

1 OM2385/SF001



2 Important notice

NXP provides the enclosed product(s) under the following conditions:

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.

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

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3 Overview of the OM2385/FS001 development kit

The OM2385/FS001 development kit provides an evaluation platform for designing SIGFOX network applications that use NXP's OL2385 single-chip RF transceiver.

The kit consists of three boards: the OL2385 Shield Board, the OL2385 Reference Design Board and a FRDM-KL43Z board. The OL2385 Reference Design board is permanently affixed to the surface of the OL2385 Shield Board. The Reference Design Board contains an embedded OL2385 transceiver and serves as a wireless modem. When connected to an antenna (included in the kit), it provides all the functionality required to communicate with the SIGFOX network. The OL2385 Shield Board contains connectors for external communication. The Shield Board is mounted by means of four Arduino™ connectors to the FRDM-KL43Z. The FRDM-KL43Z acts as the communication link between the development kit and a PC. It comes pre-loaded with microcode that manages the interface between the PC and the OL2385 reference board.

Users must initially register their device with SIGFOX using a unique ID and access code provided with the kit. Once the device has been registered, the kit can be used to connect to the SIGFOX network and test the functionality of the OL2385-based application under development.

To interact with the development kit, users must connect the kit to a PC through the OpenSDA port on the FRDM-KL25Z. A terminal emulator (such as HyperTerminal) provides the interface, allowing users to login to the network and send and receive messages. Designers can also use the Kinetis Design Studio (KDS) to develop and download microcode to the KL43Z.

4 Getting started

4.1 Kit contents/packing list

The OM2385/SF001 development kit contents includes:

- Assembled and tested OM2385/SF001 FRDM board mounted to a firmware loaded FRDM-KL43Z board
- Antenna with attached uFL connector
- Standard A (male) to Mini B (male) USB cable
- Quick start guide

4.2 Jump start

NXP's analog product development boards provide an easy-to-use platform for evaluating NXP products. The boards support a range of analog, mixed-signal and power solutions. They incorporate monolithic ICs and system-in-package devices that use proven high-volume technology. NXP products offer longer battery life, a smaller form factor, reduced component counts, lower cost and improved performance in powering state of the art systems.

1. Go to http://www.nxp.com/OM2385.
2. Review your Tools Summary Page.
3. Locate and click:

4. Download the documents, software and other information.

Once the files are downloaded, review the user guide in the bundle. The user guide includes setup instructions, BOM and schematics. Jump start bundles are available on each tool summary page with the most relevant and current information. The information includes everything needed for design.

4.3 System requirements

The kit requires the following to function properly with the software:

- USB enabled computer running Windows XP, Vista, 7, 8, or 10 (32-bit or 64-bit)
- Terminal emulation software (such as HyperTerminal)

5 Getting to know the hardware

5.1 Board overview

The OM2385/SF001 consists of a base board (the OL2385 shield board) with a permanently attached daughter board (the OL2385 reference design board). The combination—along with the attached FRDM-KL43Z board—serves as a development platform that provides wireless modem access to the SIGFOX network. Once properly registered, the board allows users to send and receive messages across the network.

5.2 Board features

The board features:

- Arduino connector compatibility with other Freedom boards
- Support for UART, SPI, MDI and GPIO communication
- SIGFOX Communication Library

5.3 Block diagram

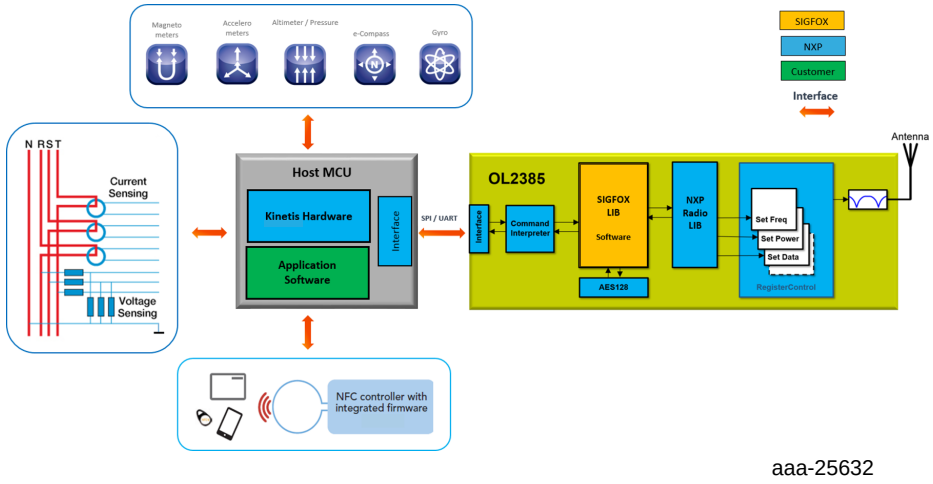

Figure 1. Block diagram

5.4 Device features

This OM2385/SF001 reference board features the following NXP product:

Table 1. Device features

Device	Description	Features
OL2385	Low-Power Multi-Channel UHF RF Wireless Platform	• Single IC for bands (160 to 960 MHz) • Ulltra-low RX power below 11 mA • Up to +14 dBm output power at 29 mA • Sensitivity –128 dBm at 4 kHz • 400 kbps 4(G)FSK, 200 kbps 2(G)FSK, ASK, OOK • Excellent Phase Noise • Supported Software Standards: – Supports SIGFOX in FCC and ETSI modes (RCZ1-4) – WMBus2013, KNX, 802.15.4, T108, sub-GHz ZigBee • SIGFOX P1 certified • VQFN48 package (7 X 7 mm^2) • Operating temperature range: –40 °C

5.5 Board description

Figure 2 describes the main elements on the OM2385/SF001 board.

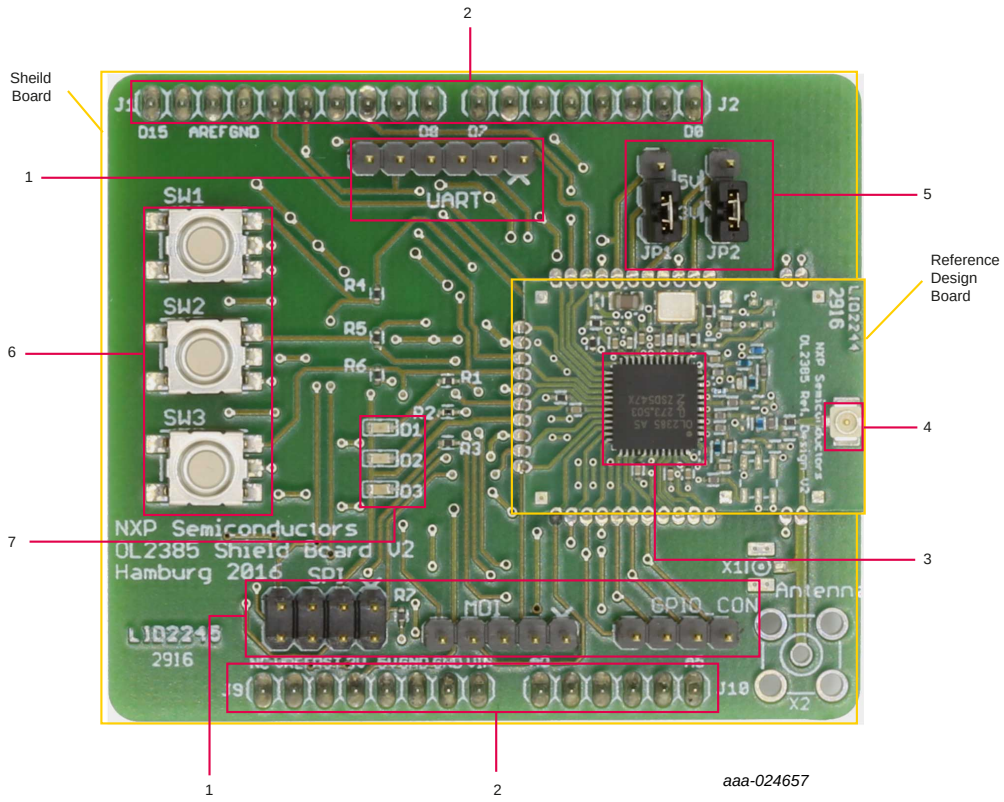

Figure 2. Board description

Table 2. Board description

Number	Name	Description
1	Communication connectors	Provide connectivity for SPI, MDI, GPIO and UART support
2	Arduino™ connectors	Provide connectivity to FRDM-KL43Z and other Freedom boards
3	OL2385	Low-Power Multi-Channel UHF RF Wireless Platform
4	SMA connector	Provides connectivity to UHF antenna
5	Jumpers	Select board voltage levels
6	Button switches	Control digital inputs to Arduino™ connectors
7	LEDs	Indicate status

5.6 LED display

The board contains the following LED:

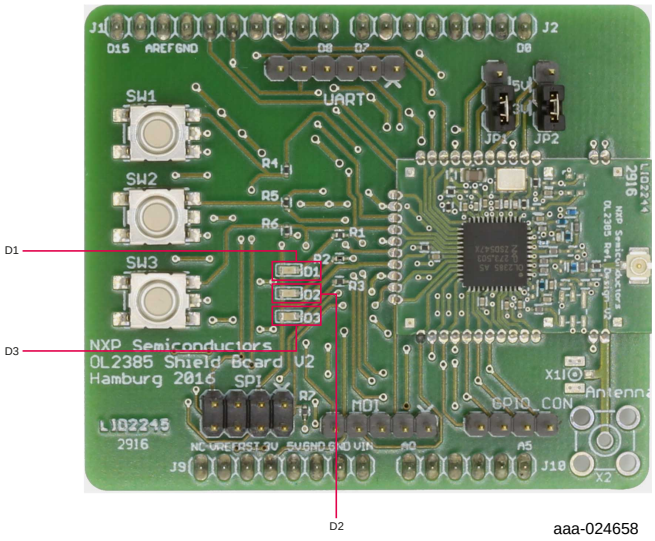

Figure 3. LED locations

Table 3. LED locations

LED ID	Description
D1	LED Green. Not used
D2	LED Yellow. On by default. Blinks to indicate the transmission of a single frame.
D3	LED Red. On by default. Blinks six times to indicate an error in initialization. Blinks 20 times to indicate a Watchdog timeout

5.7 Jumper definitions

Figure 4 shows the location of jumpers and switches on the OM2385/SF001 evaluation board.

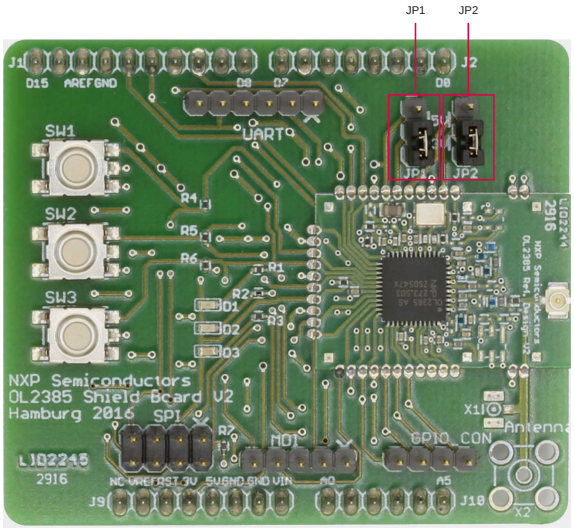

Figure 4. Jumper locations

By default both board jumpers are set to the 1-2 position. Because the board only functions at 3.3 V, the jumpers must remain set to the 1-2 position. Do no move the jumpers to the 2-3 position.

Table 4. Jumper definitions

Jumper/Switch	Description	Setting	Connection/Result
JP1	Supply voltage setting	**[1–2]**	3.0 V selected
		[2–3]	5.0 V selected. DO NOT USE
JP2	Supply voltage setting	**[1–2]**	3.0 V selected
		[2–3]	5.0 V selected. DO NOT USE

5.8 Switch definitions

Figure 5 shows the location of switches on the OM2385/SF001 Shield Board.

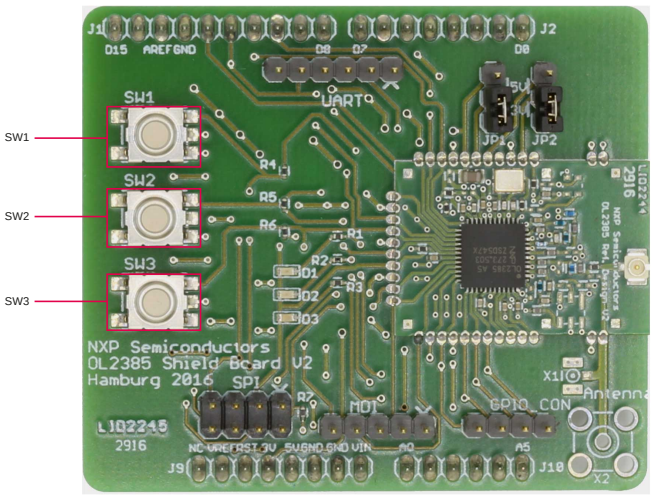

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Figure 5. Switch locations

Table 5 describes the function of the three switches.

Table 5. Switch definitions

Switch	Description	Function
SW1	Can be used to drive host pins	Open to customer use
SW2	Can be used to drive host pins	Open to customer use
SW3	Can be used to drive host pins	Open to customer use

5.9 Connectors

The board has the following connectors:

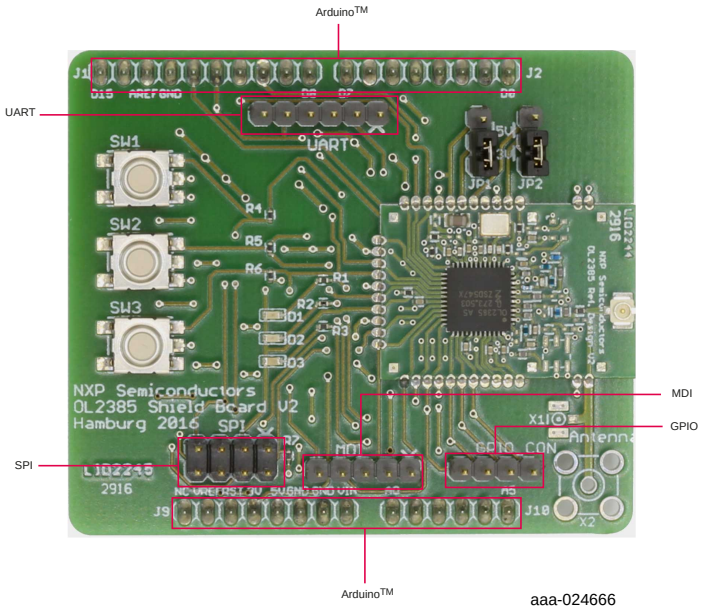


Figure 6. Connector locations

Table 6. Connectors

Banana connector name	Description
Arduino™	Arduino connections to FRDM-KL43Z board
UART	Universal Asynchronous Receiver/Transmiter (UART) port
SPI	Serial-Parallel Interface (SPI) port
MDI	Monitor and Debug Interface (MDI) port
GPIO	General Purpose Input/Output (GPIO) port

6 FRDM-KL43Z

The NXP Freedom development platform is a set of software and hardware tools supporting evaluation and development. It is ideal for rapid prototyping of microcontroller-based applications. The NXP Freedom KL43Z hardware is a simple, yet sophisticated design featuring a Kinetis L series microcontroller, the industry's first microcontroller built on the ARM® Cortex™-M0+ core.

Figure 7 shows a top view of the FRDM-KL43Z and highlights its main components.

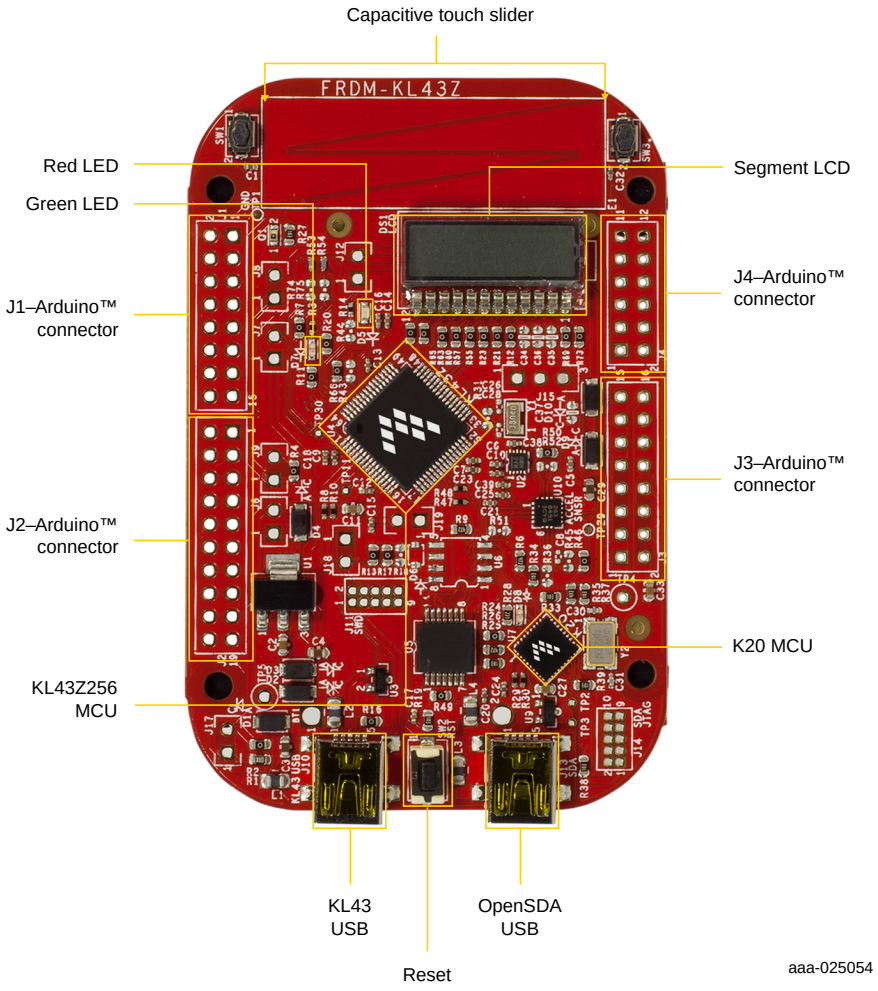


Figure 7. FRDM-KL43Z

A single row of Arduino™ connectors on the OM2385/SF001 connects to the outer row (even numbers) of the Arduino™ connectors on the FRDM-KL43Z. Table 7 describes the connections between the two boards.

Table 7. OM2385/SF001 to FRDM-KL43Z connections

OM2385/SF001		FRDM-KL43Z		Pin hardware name		Description
Header	Pin	Header	Pin	OM2385/SF001	FRDM-KL43Z	OM2385/SF001
J2	Not used	J1	1	Not used	PTB18	Not used
J2	1	J1	2	D00	PTA1	GPIO (UART0_RX)
J2	Not used	J1	3	Not used	PTB19	Not used

OM2385/SF001		FRDM-KL43Z		Pin hardware name		Description OM2385/SF001
Header	Pin	Header	Pin	OM2385/SF001	FRDM-KL43Z	
J2	2	J1	4	D01	PTA2	GPIO (UART1_TX)
J2	Not used	J1	5	Not used	PTC0	Not used
J2	3	J1	6	D02	PTD3	GPIO
J2	Not used	J1	7	Not used	PTC4	Not used
J2	4	J1	8	D03	PTA12	Digital input (SW1), connects Switch 1
J2	Not used	J1	9	Not used	PTC6	Not used
J2	5	J1	10	D04	PTA4	Digital input (SW2), connects Switch 2
J2	Not used	J1	11	Not used	PTC7	Not used
J2	6	J1	12	D05	PTA5	Digital input (SW3), connect Switch 3
J2	Not used	J1	13	Not used	N/C	Not used
J2	7	J1	14	D06	PTE29	GPIO (I2C0_SCL)
J2	Not used	J1	15	Not used	PTC5	Not used
J2	8	J1	16	D07	PTE30	GPIO (2C0_SDA)
J1	Not used	J2	1	Not used	N/C	Not used
J1	1	J2	2	D08	PTA13	GPIO
J1	Not used	J2	3	Not used	N/C	Not used
J1	2	J2	4	D09	PTD2	Digital input (SPI_ACK)
J1	Not used	J2	5	Not used	N/C	Not used
J1	3	J2	6	D10	PTD4	Digital output (SPI_CS), required for SPI communication
J1	Not used	J2	7	Not used	N/C	Not used
J1	4	J2	8	D11	PTD6	SPI0_MOSI, required for SPI communication (MISO expected on FRDM-KL43Z side)
J1	Not used	J2	9	Not used	N/C	Not used
J1	5	J2	10	D12	PTD7	SPI0_MISO, required for SPI communication (MISO expected on FRDM-KL43Z side
J1	Not used	J2	11	Not used	N/C	Not used
J1	6	J2	12	D13	PTD5	SPI0_SCK, required for SPI communication
J1	Not used	J2	13	Not used	N/C	Not used
J1	7	J2	14	GND	GND	Ground
J1	Not used	J2	15	Not used	N/C	Not used
J1	8	J2	16	AREF	VREFH	Voltage reference
J1	Not used	J2	17	Not used	PTB17	Not used
J1	9	J2	18	D14	PTE0	GPIO (UART1_TX)
J1	Not used	J2	19	Not used	PTB16	Not used
J1	10	J2	20	D15	PTE1	GPIO (UART1_RX)
J10	Not used	J4	1	Not used	PTE20	Not used

OM2385/SF001		FRDM-KL43Z		Pin hardware name		Description OM2385/SF001
Header	Pin	Header	Pin	OM2385/SF001	FRDM-KL43Z	
J10	1	J4	2	A0	PTB0	GPIO (ADC0 / I2C0_SCL)
J10	Not used	J4	3	Not used	PTE21	Not used
J10	2	J4	4	P11 (A1)	PTB1	GPIO (P11)
J10	Not used	J4	5	Not used	PTE22	Not used
J10	3	J4	6	MSCL (A2)	PTB2	GPIO (MSCL)
J10	Not used	J4	7	Not used	PTE23	Not used
J10	4	J4	8	MSDA (A3)	PTB3	GPIO (MSDA)
J10	Not used	J4	9	Not used	PTE0	Not used
J10	5	J4	10	A4	PTC2	GPIO (ADC4 / I2C1_SDA)
J10	Not used	J4	11	Not used	PTE30	Not used
J10	6	J4	12	A5	PTC1	GPIO (ADC5 / I2C1_SCL)
J9	Not used	J3	1	Not used	N/C	Not used
J9	1	J3	2	N/C	SDA_PTD5	No Connection
J9	Not used	J3	3	Not used	N/C	Not used
J9	2	J3	4	IOREF	P3V3	IO reference voltage
J9	Not used	J3	5	Not used	N/C	Not used
J9	3	J3	6	RESET	RST	Reset
J9	Not used	J3	7	Not used	N/C	Not used
J9	4	J3	8	V+	P3V3	Voltage reference
J9	Not used	J3	9	Not used	N/C	Not used
J9	5	J3	10	5V_USB	P5V_USB	USB voltage
J9	Not used	J3	11	Not used	N/C	Not used
J9	6	J3	12	GND	GND	Ground
J9	Not used	J3	13	Not used	N/C	Not used
J9	7	J3	14	GND	GND	Ground
J9	Not used	J3	15	Not used	N/C	Not used
J9	8	J3	16	VIN	P5-9V	VIN

7 Configuring the hardware

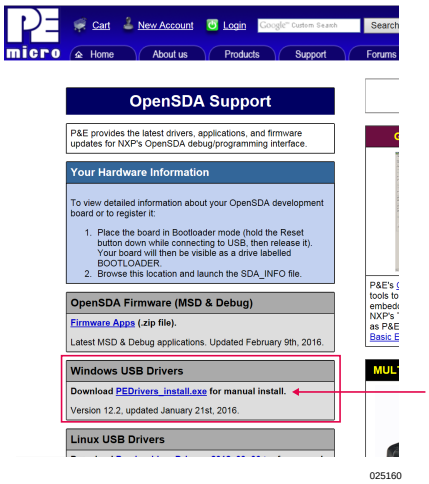
To configure the OM2385/FS001, the user must:

1. Download drivers for the FRDM-KL43Z (first time only).
2. Connect the hardware for use with the SIGFOX network.

7.1 Downloading and installing the driver for the FRDM-KL43Z

This procedure involves downloading the FRDM-KL43Z driver from the P & E Microcomputer Systems website and installing it on the host PC.

1. Go to the P & E Microcomputer Systems OpenSDA page at http://www.pemicro.com/opensda and, in the **Windows USB Drivers** box, click to download the **PEDrivers_install.exe** file to a location on the host PC.



2. When the download completes, click on the **PEDrivers_install.exe** file and follow the instructions to install the driver.
3. Connect a USB cable between the host PC and the FRDM-KL43Z USB port labeled **SDA** (J13).
4. Open Windows Explorer on the host PC. An icon labeled **FRDM-KL43Z** appears as a removable drive on the PC.

The FRDM-KL43Z is now ready for use with the OM2385/SF001 development kit.

7.2 Connecting the hardware for use with the SIGFOX network

To connect the hardware to send messages across the SIGFOX network, do the following:

1. Check to assure that the OM2385 board is firmly attached to the FRDM-KL43Z. When connecting the boards, the three switches on the shield board should be on the same side as the USB ports on the FRDM-KL43Z board.
2. Attach the PCB antenna (included with the kit) by snapping the uFL connector on the antenna to the uFL connector on the shield board.
3. Connect the Standard A end of the supplied USB cable to a Windows host PC. Connect the Mini B to the FRDM-KL43Z USB port labeled **SDA** (J13).

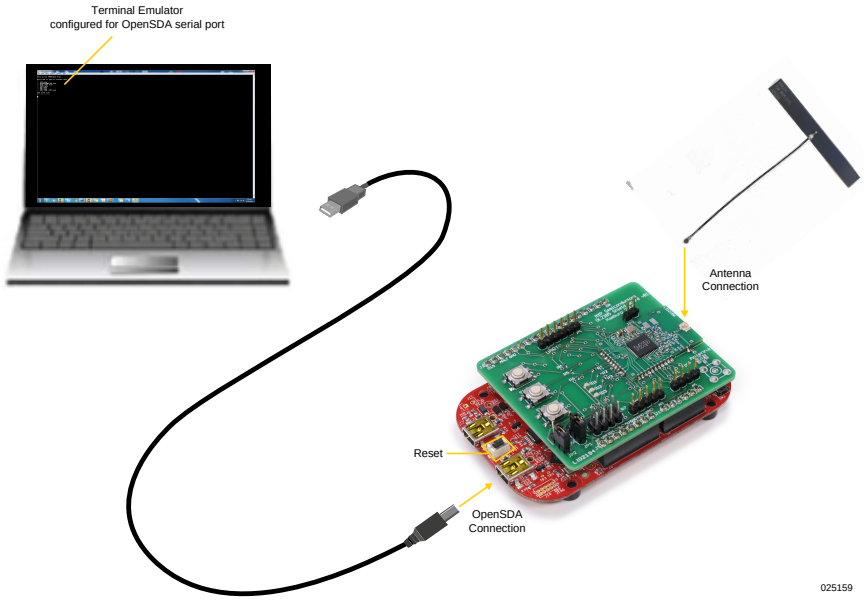


Figure 8. OM2385SF001 development kit hardware configuration

The OM2385/SF001 is now ready to be configured for use with the SIGFOX network.

8 Setting up the software

Prior to using the OM2385/FS001, the designer must:

- Configure the terminal emulator.
- Get the Device ID and the Portable Access Code (PAC) for the modem.
- Activate a SIGFOX account and register the device
- Verify that the board is successfully sending and receiving messages on the SIGFOX network

The following sections describe the process for each of the above steps.

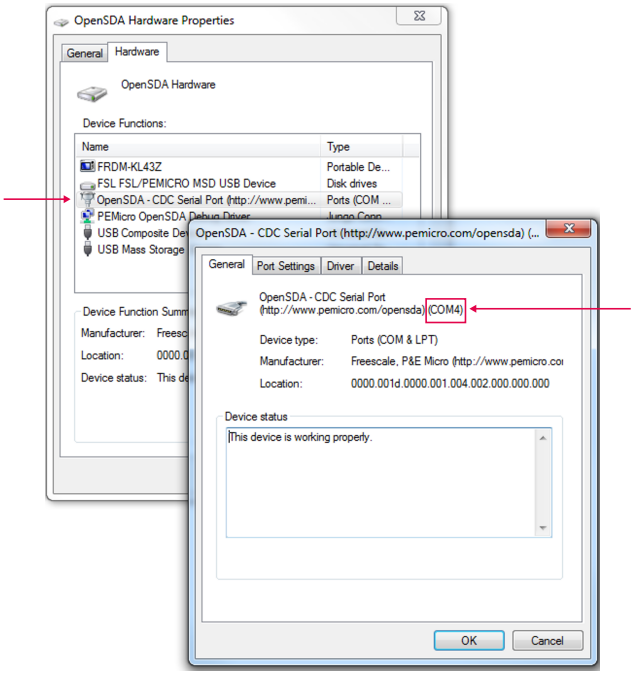
8.1 Configuring the terminal emulator

Prior to communicating with the SIGFOX network, the terminal emulator must be properly configured for serial communication. The process is as follows:

8.1.1 Getting the COM port number for the FRDM-KL43Z

Windows automatically assigns a COM port number to the FRDM-KL43Z OpenSDA port (**SDA**). This COM port number is required when connecting a terminal to the demo. To retrieve this number, do the following:

1. Assure that the USB cable is connected to the host PC through the **SDA** port on the FRDM-KL43Z.
2. From the Windows Control Panel under **Hardware and Sound** -> **Devices and Printers**, open the **Device Manager**.
3. In the Device Manager, click on **Ports (COM & LPT)**. Under **OpenSDA – CDC Serial Port**, note the COM port number.



8.1.2 Setting up the serial port

The terminal emulator must be configured to support serial port communication. The procedure differs depending on the type of terminal emulator in use. However, all terminal emulators must be configured with the following settings.

- The terminal must be set up to use the COM port assigned to the OpenSDA port on the FRDM-KL43Z. (See Section 8.1.1 "Getting the COM port number for the FRDM-KL43Z".)
- The COM port must be configured with the following parameters:
  - 9600 baud rate
  - 8-bit word length
  - No parity bit
  - One stop bit

Figure 9 "Serial port configuration screen" shows the setup when the Tera Term emulator is used.

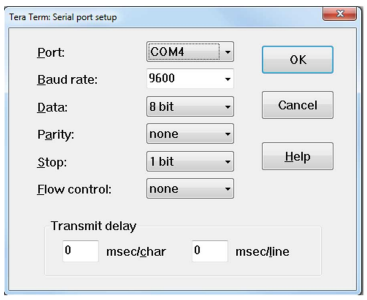
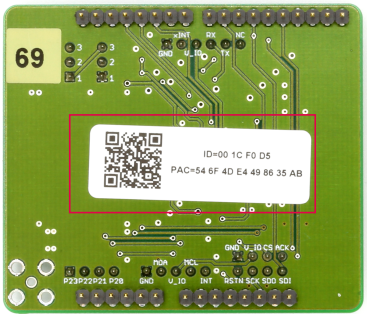


Figure 9. Serial port configuration screen

8.2 Getting the Device ID and PAC

To get the 8-digit hexadecimal Device ID and 16-digit hexadecimal Portable Access Code (PAC), proceed as follows :

1. Detach the OM2385 shield board from the FRDM-KL43Z board. Locate the sticker on the back surface of the shield board and make a note of the 8-digit hexadecimal Device ID and the 16-digit hexadecimal Portable Access Code (PAC) (shown below).



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2. Assuming that the board is configured as described in Section 7 "Configuring the hardware", connect the USB cable from the **SDA** port on the FRDM-KL43Z to the PC.
3. Activate the terminal emulator and press the reset button (**RST**) on the FRDM-KL43Z to display a numbered menu of commands. If the list of commands does not appear, the FRDM-KL43Z microcode may need to be reloaded (see Section 10 "Appendix A—Downloading microcode to the FRDM-KL43Z")
4. From the command list, select command **0** and press **Enter**.
5. The Device ID and PAC displays as shown above. The the Device ID number should be identical to the number on the board label.

8.3 Activating a SIGFOX account

To activate a SIGFOX account, do the following:

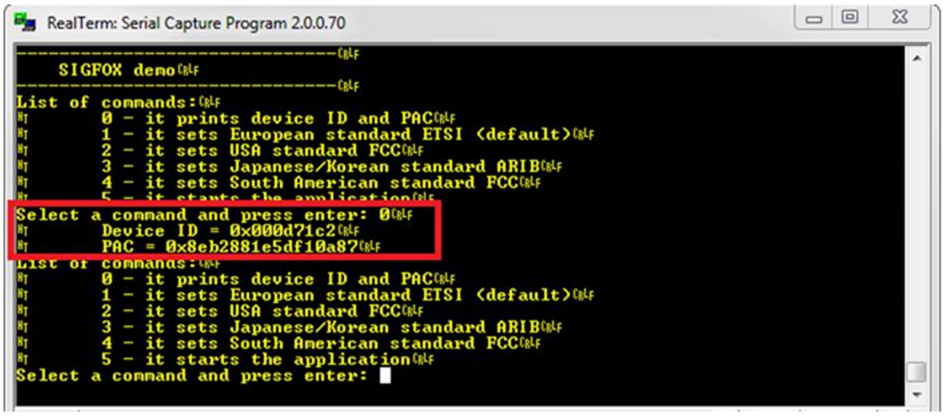
1. Go to backend.sigfox.com/activate. On the **Choose your kit provider** page, select **NXP** as the kit provider.
2. On the upper right side of the page, select **Account details**. When the **Device Kit Activation** page displays, enter the appropriate account information. Then click **SUBSCRIBE**.

3. When the **Pick Your Country** page displays, select the appropriate country and Secondary Network Operator (SNO).
4. In the page that displays, enter the Device ID and the PAC. Then click **NEXT**.

8.4 Verifying that the board is sending and receiving messages

To verify that the board is sending and receiving messages on the SIGFOX network, do the following:

1. Connect the **SDA** port on the FRDM-KL43Z to a USB port on the PC.
2. Activate the terminal emulator and press the reset button (**RST**) on the FRDM-KL43Z to see the following menu:



3. In the **List of commands**, select the appropriate region (**1**, **2**, **3** or **4**), then press **Enter**. This configures the device according to the selected regional standards. (This selection will have to be made every time the board is re-connected through the **SDA** port.)
4. To start the application, select the command **5** and press **Enter**.
5. Login to the SIGFOX account created in Section 8.3 "Activating a SIGFOX account".
6. Pick up the OM2385/SF001 board and do one of the following:
   - Using a twisting motion, vigorously shake the board back and forth a few times.
   - Press either the SW1 or the SW2 button on the board

   Both methods generate a message to the SIGFOX network.
7. Return to the SIGFOX page and click on Device's ID. Then click **Messages**. A screen displays showing each message transmitted. The first byte of the message determines data type as follows:

Table 8. SIGFOX message - first byte format

Value (HEX)	Description	Unit of measurement
01	Temperature	Degrees Centigrade
02	Illuminance	Lumens (lx)
03	Acceleration	Thousandths of a gravitational field strength units (mg)

Figure 10 shows a typical SIGFOX message screen.

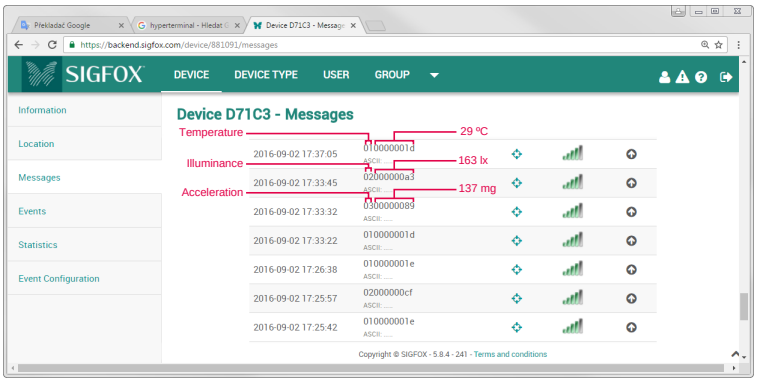


Figure 10. SIGFOX message screen

9 Schematics, board layout and bill of materials

OM2385/SF001 board schematics, board layout and bill of materials are available in the Jump Start section of the Tool summary page at the following URL: http://www.nxp.com/OM2385

10 Appendix A—Downloading microcode to the FRDM-KL43Z

The OM2385/SF001 development kit comes with microcode already loaded on the FRDM-KL43Z. This appendix is intended for use only if the factory installed microcode is no longer functional and a fresh copy needs to be flashed to the board.

The procedure involves downloading the appropriate driver from the P & E Microcomputer Systems website and installing it on the FRDM-KL43Z board.

1. Go to the P & E Microcomputer Systems OpenSDA page at http://www.pemicro.com/opensda and in the **OpenSDA Firmware (MSD & Debug)** box, click to download the **Firmware Apps** zip file.
2. When the download completes, unzip the file contents to a folder on the host PC.
3. Connect the Standard A plug of the USB cable to the host PC.
4. On the FRDM-KL43Z, press and hold down the **Reset** button. With the button held down, attach the mini-B plug of the USB cable to the FRDM_KL43Z USB port labeled **SDA** (J13). Then release the **Reset** button. A blinking LED indicates the board is in Bootloader mode.
5. Open Windows Explorer on the host PC. An icon labeled **BOOTLOADER** appears as a removable drive on the PC.
6. From the files extracted from the PEMicro zip file, locate the driver file named **MSD-DEBUG-FRDM-KL43Z48M_Pemicro_v118.SDA**. Drag and drop this file onto the **BOOTLOADER** icon.
7. Unplug the USB mini-B plug then re-insert the plug back into the SDA port. A blinking LED on the board indicates that the FRDM-KL43Z is in bootload mode.
8. Go to the OM2385/SF001 Tool Summary page at http://www.nxp.com/OM2385 and open the Jump Start page. From the list of items, select and download the microcode file **FRDM_KL43_OL2385_DemoConsole.srec**.

9. Drag and drop the microcode file **FRDM_KL43_OL2385_DemoConsole.srec** onto the **FRDM-KL43Z** icon on the host PC.
10. Unplug the USB mini-B plug from the SDA port. The microcode is now installed and launches automatically each time the board is turned on.

11 Revision history

Revision	Date	Description of changes
1.0	10/2016	Initial release

12 References

The following URLs reference related NXP products and application solutions:

NXP.com support pages	Description	URL
OM2385/SF001	Tool summary page	http://www.nxp.com/OM2385

13 Contact information

Visit http://www.nxp.com/support for a list of phone numbers within your region.
Visit http://www.nxp.com/warranty to submit a request for tool warranty.

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For more information, please visit: http://www.nxp.com
For sales office addresses, please send an email to: salesaddresses@nxp.com
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