UM12311

Introduction to the FRDM-STBI-NPM8 shield board

Rev. 1.0 — 9 June 2025 User manual

Document information

Information	Content
Keywords	Industrial pressure sensor, FRDM-STBI-NPM8, shield board, evaluation, board, evaluation hardware, NPM8
Abstract	This document introduces the FRMD-STBI-NPM8 shield board and how to configure. It also explains where to find resources, configuration, and development tools associated with the board.

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1 Introduction

The FRDM-STBI-NPM8 is an evaluation board composed of all necessary headers, jumpers, and signal test points to quickly evaluate the NPM8 pressure sensor.

This document is intended to help a user quickly set up, configure, and operate the FRDM-STBI-NPM8 evaluation board.

2 Finding kit resources and information on the NXP website

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

The information page for the industrial pressure monitoring sensor, NPM8, and the FRDM-STBI-NPM8 evaluation shield board can be found at: https://www.nxp.com/FRDM-STBI-NPM8.

The information page provides overview information, documentation, software and tools, ordering information and a Getting Started tab. The Getting Started tab provides quick-reference information applicable to using the FRDM-STBI-NPM8, including the downloadable assets referenced in this document.

2.1 Collaborate in the NXP community

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

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

3 Getting ready

The FRDM-STBI-NPM8 evaluation shield board has two use profiles:

1. As an expansion card mounted atop the FRDM-MCXW71, where the NPM8 is a SPI client to the MCXW71 controller, which provides a 2.4 GHz wireless connectivity channel. This profile also requires a PC and SW package (demo) available at nxp.com.
2. As a standalone, the NPM8 serves as a UART controller, hosting an IN100 NanoBeacon Bluetooth Low Energy (BLE) Development expansion card (from InPlay).

3.1 Kit contents

The FRDM-STBI-NPM8 box includes:

- FRDM-STBI-NPM8 shield board compatible with Arduino Uno headers.
- 10x jumpers for hardware configuration

3.2 Additional hardware

The FRDM-STBI-NPM8 can be paired with a variety of NXP MCU boards, however there is a demo project provided for the FRDM-MCXW71 MCU board for evaluation. Detailed information is provided in Section 4.

3.3 Static handling requirements

CAUTION

This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling. You must use a ground strap or touch the PC case or other grounded source before unpacking or handling the hardware.

3.4 Minimum system requirements

The FRDM-STBI-NPM8 evaluation board requires a Windows 10 PC workstation and a Freedom FRDM-MCXW71 MCU board.

3.5 Software

To use this evaluation board, installing the required software is essential. All necessary software can be found on the board's information page. Search for FRDM-STBI-NPM8 on NXP's website or access it directly at: FRDM-STBI-NPM8.

4 Getting to know the hardware

4.1 Kit overview

The FRDM-STBI-NPM8 shield board incorporates an NPM8 sensor. The NPM8 is a fully integrated industrial pressure monitoring sensor (IPMS) that includes a programmable 8-bit CPU (S08 family) and enables wired and wireless communication.[1]

The FRDM-STBI-NPM8 shield board can be easily connected to a NXP Freedom MCU board via the Arduino headers for evaluation (see Section 5). The following board is recommended:

- FRDM-MCXW71

⚠ These evaluation boards provide a way to change between profiles and help users in their software development. The FRDM-STBI-NPM8 shield board also contains footprints for low-frequency (LF) reception (125 KHz) and sub-GHz radio frequency (RF) transmission. However, the passive elements related with these sub-Ghz wireless modules:

- Are not populated in this board revision as they are not targeted as main profiles
- Must not be populated in this board revision in order for this board to maintain EMC compliance with FCC requirements and the EU Radio Equipment Directive

See Section 4.7 for bill of material (BOM) details and refer the NPM8 data sheet for more information.

4.2 NPM8 sensor board features

The NPM8 family comprises fully integrated industrial pressure monitoring sensors (IPMS) with an absolute pressure range of 90 kPa to 1500 kPa. These sensors incorporate a dual-axis accelerometer architecture within a 4 mm × 4 mm × 1.98 mm package, optimized for ultra-low power consumption, featuring a typical standby current of 180 nA.

The NPM8Kx4S IPMS integrates an 8-bit microcontroller (MCU) and offers seven GPIOs, a client SPI, and a two-channel timer/pulse width modulation (PWM) module, ensuring system control and communication.

Features include:

- Absolute pressure ranges: 90 kPa to 1500 kPa
- Transducer measurement interfaces with low-power AFE:
  - 10-bit compensated pressure sense element
  - 8-bit compensated internal device temperature measurement
  - 8-bit compensated internal device voltage measurement
- 8-bit S08 compact instruction set controller:
  - 64 bytes low-power always-on non-volatile memory (NVM) parameter registers
  - 512 bytes SRAM
  - 16 kB flash memory (512 bytes reserved for NXP coefficients)
- Native wireless two-way communication:
  - Radio frequency transmission at 315 MHz or 434 MHz
  - Data reception at 125 kHz
- Wired communication:
  - Client SPI supporting host access to internal peripherals, registers and memory.
  - Host SPI and controller I2C enabled via software drivers
- Small package: 4 mm x 4 mm x 1.98 mm. QFN, 24 pins, 0.5 mm pitch

1 The NPM8 sensor on the shield board is preprogrammed with an example application firmware. Refer to the NPM8_MCXW71_Starting_Package.zip on the NPM8 product webpage.

- Target applications: Air compressors, air tools, rachet wrench, paint sprayers
- Low power consumption, allowing to supply the sensor from a coincell battery
- Temperature range: –40 ℃ to 125 ℃
- Qualified in compliance with NXP Standard Industrial Mission Profile

4.3 Example system NPM8 sensor hosted by MCXW71 MCU

Figure 1 shows an example system with the FRDM-MCXW71 serving as the host for the NPM8 sensor via the SPI. The DATA_RDYb signal is utilized by the NPM8 sensor to notify the host when data is available. Table 1 provides jumper settings (J3) necessary to configure the FRDM-MCXW71 as a host.

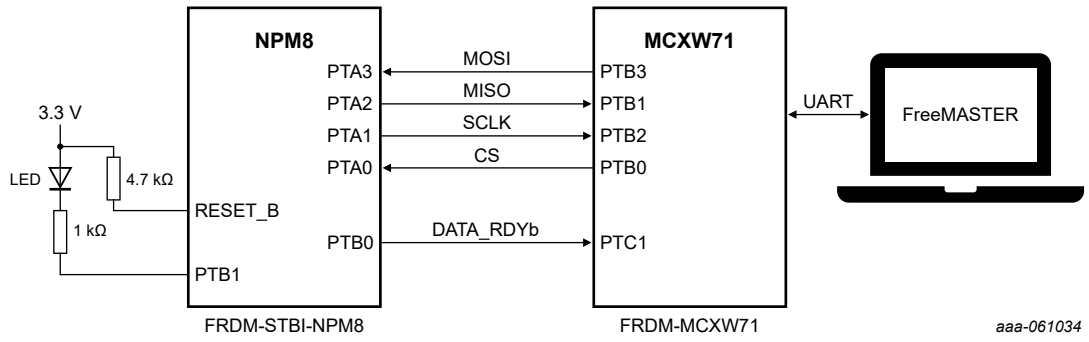

Figure 1. FRDM-MCXW71 hosting the NPM8 sensor

4.4 Example system NPM8 sensor hosting the IN100 development kit

Figure 2 shows an example system with the NPM8 sensor acting as the host for the IN100 BLE Beacon via UART communication. This setup highlights a low-power application, with both devices primarily operating in Sleep mode. Two additional pins are designated for WAKE-UP and TRIGGER signals to facilitate this functionality. Table 2 outlines the required jumper (J3) configurations to enable the NPM8 sensor as the host for the IN100 BLE Beacon.

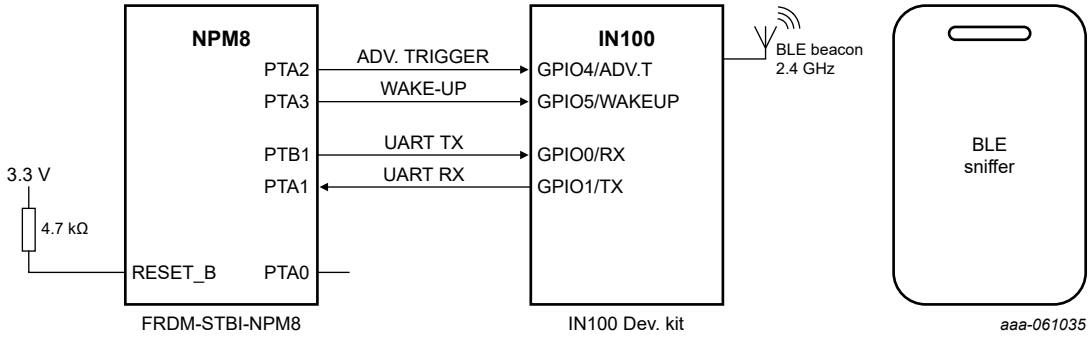

Figure 2. NPM8 sensor hosting the IN100 BLE Beacon

4.5 NPM8 shield board featured components

Figure 3 identifies important components on the board.

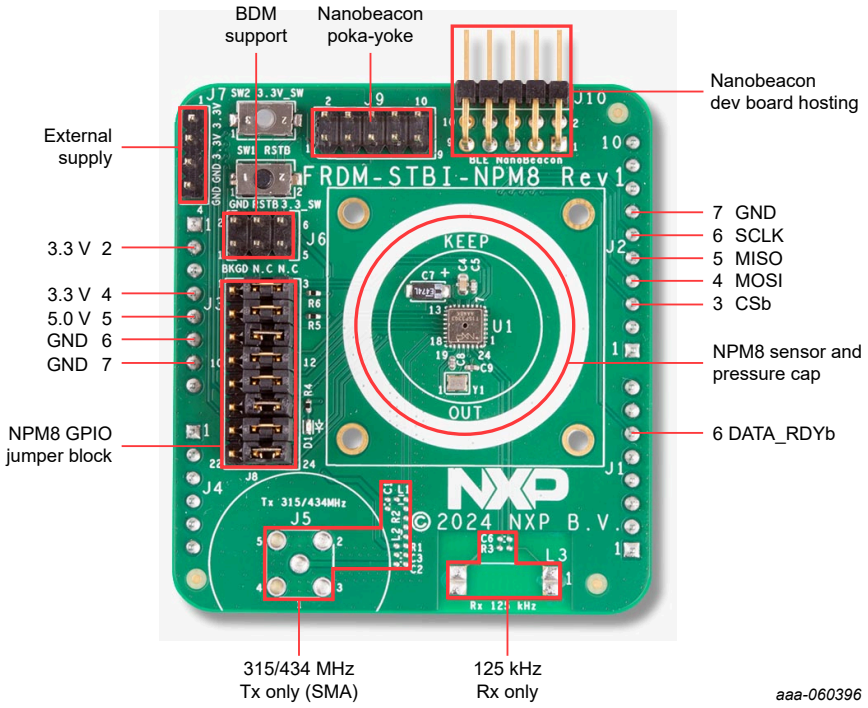

Figure 3. NPM8 shield board – primary features

The FRDM-STBI-NPM8 shield board comes with standard Arduino Uno headers and can be paired with NXP Freedom MCU boards for user evaluation and software development. For evaluation and prototyping, NXP provides a demo project targeted to the FRDM-MCXW71 board and the hardware design files.

4.5.1 BDM support

The standard 2x3 header pin arrangement, see Figure 3, is provided for typical background Debug mode (BDM) interface cables. A normally open momentary pushbutton switch is provided to assert RSTb low. A normally closed momentary pushbutton switch is provided to interrupt power to the NPM8 (part of BDM access).

4.5.2 Pressure cap

- A pressure cap and a backing plate might be required for high-pressure tests. A keep-out zone was designed in the NPM8 shield board to accommodate for those elements.
  Note: *These elements are not provided as part of the FRDM-STBI-NPM8 kit.*

The following are recommendations:

- A pressure cap of 30.5 mm square, with 2 mm bolt holes patterned on a ±12.4 mm grid.
- A threaded backing plate for the PCB backside, allowing for even distribution of significant clamping force – sandwiching the PCB between the pressure cap and the backing plate.
- Four 2 mm x 12 mm bolts (with flat washers) are required to complete the assembly.

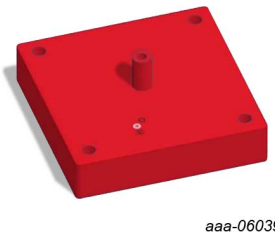

Figure 4. Pressure cap top view

Figure 5. Pressure cap bottom view

Figure 6. Threaded backing plate

4.5.3 NPM8 GPIO jumper block

A 3x8 jumper block is provided to route the NPM8's GPIO signals to other resources of the PCB. See Section 4.7 for specific details. This jumper block supports two use profiles for this PCB:

In the following configuration (Table 1), the PCB is affixed atop a FRDM-MCXW71 development board. The NPM8 is a conventional SPI client to the MCU. The FRDM-MCXW71 offers the ability to evaluate of the MCXW71's multiprotocol wireless support for Bluetooth LE, Zigbee, ThreadX, and Matter.

Table 1. Typical jumper settings for NPM8 connected to MCXW71

J3			Connection notes
1	2	3	Installs a 4.7 KΩ pull up on BKGD (PTA4.PKGD)
4	5	6	Installs a 4.7 KΩ pull up on RSTb (RSTb.VPP)
7	8	9	NTM8 drives DATA_RDYb to MCXW71
10	11	12	NTM8 receives MOSI from MCXW71
13	14	15	NTM8 drives MISO to MCXW71
16	17	18	NTM8 receives SCLK from MCXW71
19	20	21	NTM8 drives USER LED cathode (optional, a convenience feature)
22	23	24	NTM8 receives CSb from MCXW71

In the following configuration (Table 2), the NPM8 emulates a UART peripheral, conversing with an IN100 NanoBeacon BLE development board, provided by our partner InPlay. In this configuration the PCB is standalone, and external power (3.3 V) must be applied, typically at the x4 male pin header blocks installed at J7.

Table 2. Typical jumper settings for NPM8 hosting the NanoBeacon

J3			Connection notes
1	2	3	Installs a 4.7 KΩ pull up on BKGD (PTA4.PKGD)
4	5	6	Installs a 4.7 KΩ pull up on RSTb (RSTb.VPP)
7	8	9	—
10	11	12	NTM8 drives IN100's MGPIO5_WAKEUP input
13	14	15	NTM8 drives IN100's MPGIO4_TRIGGER input
16	17	18	NTM8 receives IN100's UART Tx data
19	20	21	NTM8 drives IN100's UART Rx data
22	23	24	—

4.5.4 NanoBeacon Poka-Yoke

A 2x5 pin(s) jumper block is installed at J9 to route the required signals from the IN100 development board (Beacon) to other resources of the PCB. To use the NanoBeacon profile, jumpers must be installed on J9 headers.

Note: *J9-9 and J9-10 are required to be connected only for eFusing the NanoBeacon.*

Table 3. Typical jumper settings for NPM8 connected to MCXW71

J9		Connection notes
1	**2**	VDDQ supply for eFusing the IN100 Beacon
3	**4**	Provides PWR (+3.3 V) connection for IN100 development board
5	**6**	Provides GND connection for IN100 development board
7	**8**	IN100 RXD/TXD Poka-Yoke
9	**10**	IN100 RXD/TXD Poka-Yoke

4.6 FRDM-STBI-NPM8 hardware design files

The FRDM-STBI-NPM8 shield board design files can be found and downloaded from the NPM8 product page under the Tools and Software tab. See Section 6 for applicable documents and links.

4.7 Schematic, board layout and bill of materials

The Design Resources tab on the FRDM-STBI-NPM8 webpage provides essential technical documentation, including the schematic, board layout, and bill of materials (BOM) for the evaluation board. For more information, go to https://www.nxp.com/FRDM-STBI-NPM8.

5 Configuring the hardware

Figure 7 shows the typical hardware configuration incorporating the FRDM-STBI-NPM8 evaluation board with standard Arduino headers combined with the FRDM-MCXW71 MCU board. See Table 1 for a description of the hardware configuration.

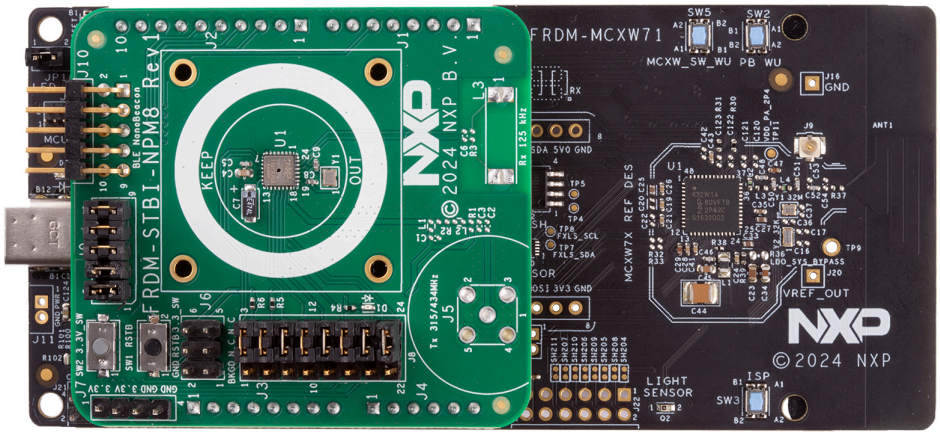

Figure 7. NPM8 shield mounted atop FRDM-MCXW71 development board

Figure 8 the FRDM-STBI-NPM8 in its standalone configuration, functioning as a host for the IN100 BLE Nano Beacon. The IN100 operates in Codeless mode, eliminating the need for firmware development and allowing users to quickly configure and deploy BLE applications. See Table 2 for a description of the hardware configuration.

Figure 8. NPM8 shield standalone mode hosting the NanoBeacon

NXP provides software (SW) packages to support the evaluation of both configurations: demo projects designed for the FRDM-MCXW71 and the NanoBeacon IN100 (Standalone mode). These SW package demos can be accessed on the NPM8 webpage.

6 References

[1] NPM8 — Industrial Pressure Monitoring Sensor product page. https://www.nxp.com/NPM8

[2] FRDM-STBI-NPM8 webpage — https://www.nxp.com/FRDM-STBI-NPM8resources/sensor-sw-component-library/sensor-drivers-for-nxp-sensors:SENSOR-DRIVERS

[3] NanoBeacon Config Tool Application Notes: https://inplay-tech.com/s/NanoBeacon-Config-Tool-User-Guide-EN_08242022.pdf

[4] IN100 development Kit: https://media.digikey.com/pdf/Data%20Sheets/InPlay%20PDFs/IN100_Dev_Kit.pdf

7 Revision history

Table 4. Revision history

Document ID	Release date	Description
UM12311 v.1.0	09 June 2025	Initial version

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