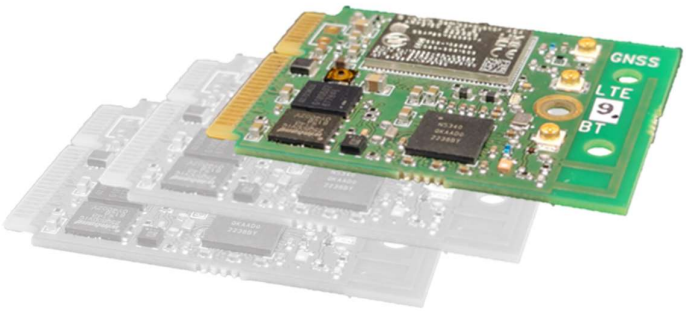
Sensoan SGW Family Technical Specification



1. Overview

Sensoan SGW board is a connectivity and processor module for multipurpose IoT devices.
It's a fast track for your IoT product.

SGW-2 is a low power module which combines the nRF9160's cellular capabilities, nRF5340's local connectivity, and eSIM support for seamless connectivity and secure communication in IoT applications. SGW-2 can be directly connected to battery and just by adding LTE and GPS antennas module is ready for use. 2,4 GHz antenna for local connectivity is on board.

SGW-3 is like SGW2 but uses nRF9161 for LTE connectivity and nRF52840 for local connectivity.
SGW3 can be used e.g. for Wirepas gateway.

SGW-4 is on roadmap and will use nRF7002 for WiFi connectivity and nRF5340 for local connectivity.

All SGW modules have the same Board Edge connector which offers a lot of GPIOs.
By making a simple interface board SGW can e.g. monitor a wide variety of sensor inputs and control connected systems. Module can connect to the Sensoan Data Collection Service, or other custom service, over cellular network or WiFi (SGW-4 only) and the functionalities can be controlled with web interface. Cloud based services require that relevant services are enabled.

Applications:	
• Logistics and asset tracking • Industrial process monitoring • Smart building automation • Retail and monitoring devices • Smart energy solutions • Smart agriculture	• Low power sensor devices • Wireless sensor with edge computing • Wireless IoT gateways • Sensor networks • Beacon scanners • etc.

SGW models	LTE-M & NB-IoT	WiFi (dual band)	BLE or other 2,4 GHz radio	Status	
SGW-2	nRF9160	-	nRF5340	Available	
SGW-3	nRF9161	-	nRF52840	Samples available	
SGW-4	-	nRF7002	nRF5340	On roadmap	

2. Main building blocks

nRF9160 System-in-Package (SiP)

Low power SiP with integrated LTE-M/NB-IoT modem and GNSS

The nRF9160 SiP is making the latest LTE technology accessible for a wide range of applications and developers. With the fully integrated SiP and pre-certification for global operation, it solves the complex wireless design challenges as well as the comprehensive set of qualifications needed to utilize cellular technology.
By integrating an application processor, multimode LTE-M/NB-IoT/GNSS modem, RF front-end (RFFE) and power management in a 10x16x1.04 mm package, it offers the most compact solution for cellular IoT on the market.

Key data

LTE-M/NB-IoT modem	
Frequency range	700-2200 MHz
Throughput (DL/UL)	LTE-M: 300/375 kbps NB-IoT: 30/60 kbps
Output power	Up to 23 dBm
RX sensitivity	LTE-M: -108 dBm NB-IoT: -114 dBm GPS: -155 dBm
Mode	HD-FDD

Application processor	
CPU	64 MHz Arm Cortex-M33 Arm TrustZone
Flash	1 MB
RAM	256 KB
Security	Arm Cryptocell 310
Peripherals	4×SPI/UART/TWI 4 × PWM, PDM, I2S 12 bit/200 ksps ADC 3×TIMER, 2×RTC, WDT

For full specification see Nordic Semiconductor's nRF9160 web pages.

nRF9161 System-in-Package (SiP)

Low power SiP with integrated LTE-M/NB-IoT and DECT NR+ modem, and GNSS

The nRF9161 surpasses its predecessor (nRF9160), with improved features including support for DECT NR+ and 3GPP Release 14 LTE-M/NB-IoT LTE stack.

Key features

- Fully integrated SiP with 64 MHz Arm Cortex-M33 and multimode LTE-M/NB-IoT modem with DECT NR+ support and GNSS
- 700-2200 MHz LTE band support
- 1.9GHz NR+ band support
- Certified for global operation
- Dedicated programmable application processor and memory
- 1 MB flash + 256 KB RAM
- Arm TrustZone + Arm CryptoCell 310

For full specification see Nordic Semiconductor's nRF9161 web pages.

nRF5340 System-on-Chip (SoC)

Dual-core Bluetooth 5.4 SoC supporting Bluetooth LE, Bluetooth mesh, NFC, Thread and Zigbee

The nRF5340 is the world's first wireless System-on-Chip (SoC) with two Arm® Cortex®-M33 processors. The combination of two flexible processors, the advanced feature set, and an operating temperature up to 105 °C, makes it the ideal choice for LE Audio, professional lighting, advanced wearables, and other complex IoT applications.

Key features

- High-performance application processor
  - 128/64 MHz Arm Cortex-M33 with FPU and DSP instructions
  - 1 MB Flash + 512 KB RAM
  - 8 KB 2-way set associative cache
- Fully-programmable network processor
  - 64 MHz Arm Cortex-M33 with 2 KB instruction cache
  - 256 KB Flash + 64 KB RAM
- Next level security
  - Trusted execution with Arm TrustZone
  - Hardware accelerated cryptography with Arm CryptoCell-312
  - Secure Key Storage
  - Secure bootloader with root-of-trust and DFU
- Bluetooth Low Energy
  - Bluetooth 5.3
  - LE Audio
  - Direction Finding
  - 2 Mbps, Advertising Extensions and Long Range
- Bluetooth mesh
- Thread, Zigbee and 802.15.4
- NFC
- Full range of digital interfaces with EasyDMA
  - Full-speed USB
  - 96 MHz encrypted QSPI
  - 32 MHz high-speed SPI
- 105 °C extended operating temperature
- 1.7-5.5 V supply voltage range

For full specification see Nordic Semiconductor's nRF5340 web pages.

nRF52840 System-on-Chip (SoC)

Multiprotocol Bluetooth 5.4 SoC supporting Bluetooth Low Energy, Bluetooth mesh, NFC, Thread and Zigbee.

The nRF52840 SoC is a member of the nRF52 Series. It meets the challenges of sophisticated applications that need protocol concurrency and a rich and varied set of peripherals and features. It offers generous memory availability for both Flash and RAM, which are prerequisites for such demanding applications.

The nRF52840 is fully multiprotocol capable with full protocol concurrency. It has protocol support for Bluetooth LE, Bluetooth mesh, Thread, Zigbee, 802.15.4, ANT and 2.4 GHz proprietary stacks including Wirepas.

Key features

- 64 MHz Cortex-M4 with FPU
- 1 MB Flash, 256 KB RAM
  - GHz Transceiver
- 2 Mbps, 1 Mbps, Long Range
- Bluetooth Low Energy, Bluetooth mesh
- ANT, 802.15.4, Thread, Zigbee
- +8 dBm TX Power
- 128-bit AES CCM, ARM CryptoCell
- UART, SPI, TWI, PDM, I2S, QSPI
- PWM
- 12-bit ADC
- NFC-A
- USB 2.0

For full specification see Nordic Semiconductor's nRF52840 web pages.

nRF7002 Wi-Fi 6 Companion IC

Low-power Wi-Fi 6 companion IC providing seamless connectivity and Wi-Fi-based locationing.

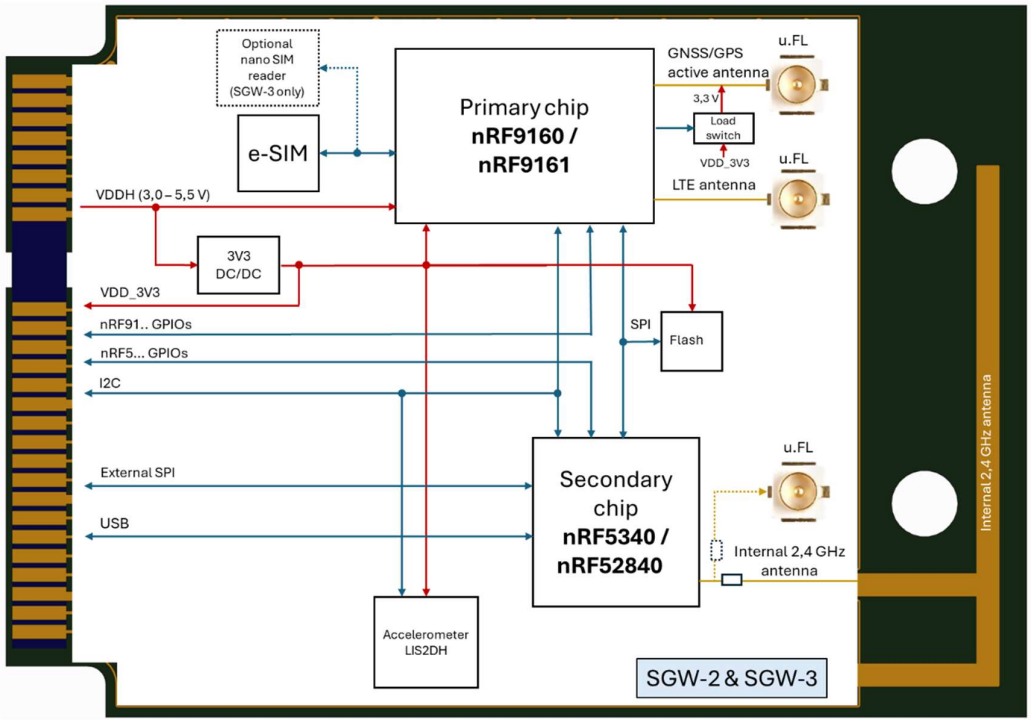
The nRF7002 Wi-Fi 6 companion IC is a highly integrated IC designed to enable the integration of Wi-Fi 6 connectivity into a wide variety of applications. The IC provides a low power and cost-effective solution for adding the latest Wi-Fi 6 technology to products, allowing them to benefit from high speeds, improved range, and greater reliability offered by the latest Wi-Fi standard.

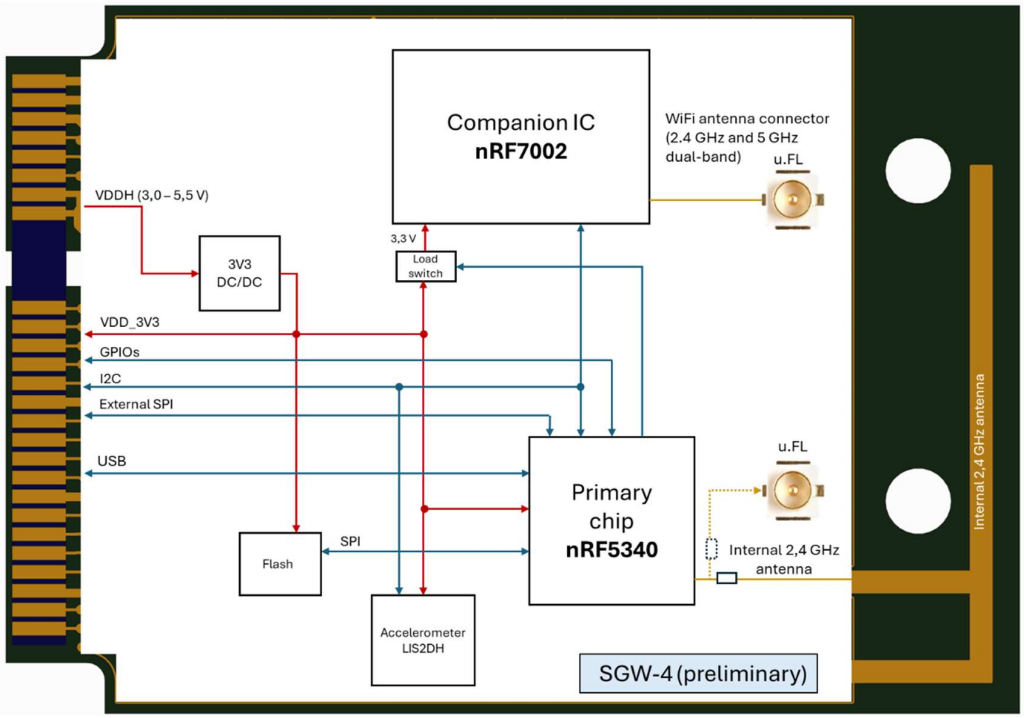
nRF7002 Wi-Fi Companion IC

- 2.4 GHz and 5 GHz dual-band
- Low-power and secure Wi-Fi for the IoT
- Ideal coexistence with Bluetooth LE
- Supported in nRF Connect SDK
- Target Wake Time (TWT)
- WPA3 Personal/Enterprise
- SPI / QSPI
- Wi-Fi 6 Station (STA)
- Complies with 802.11a/b/g/n/ac/ax
- 1 Spatial Stream (SS)
- 20 MHz channel bandwidth
- 64 QAM (MCS7), 86 Mbps PHY throughput
- OFDMA (Downlink and Uplink)
- BSS coloring
- Co-existence interfaces

For full specification see Nordic Semiconductor's nRF7002 web pages.

3. Block diagrams

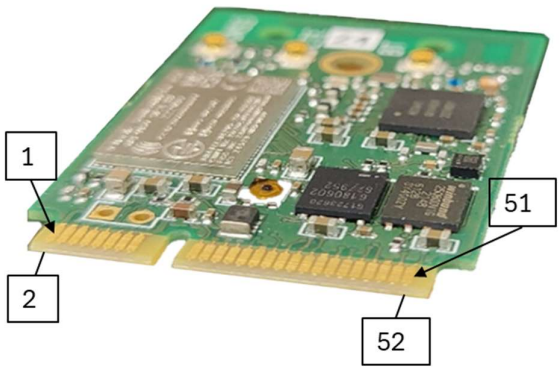


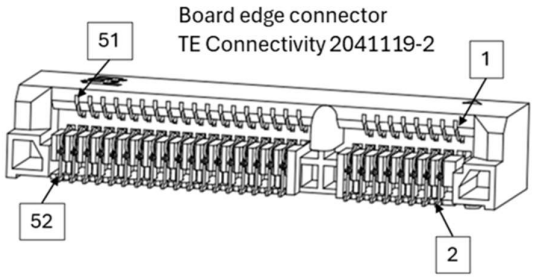


4. Sensoan SGW board edge connector specification

Sensoan SGW family board edge interface specification																				
TOP SIDE				SGW-2		SGW-3		SGW-4		Bottom side				SGW-2		SGW-3		SGW-4		
PIN #	NAME	GROUP	INFO	nRF9160	nRF5340	nRF9161	nRF52840	nRF7002	nRF52840	PIN #	NAME	GROUP	INFO	nRF9160	nRF5340	nRF9161	nRF52840	nRF7002	nRF52840	
1	VDDH	VDDH	3.3V-5.5V input to SGW	✓		✓				2	GND	GND		✓	✓	✓	✓	✓	✓	
3	VDDH	VDDH	3.3V-5.5V input to SGW	✓		✓				4	GND	GND		✓	✓	✓	✓	✓	✓	
5	VDDH	VDDH	3.3V-5.5V input to SGW	✓		✓				6	GND	GND		✓	✓	✓	✓	✓	✓	
7	LED_Red	LED_R/G/B	Parallel to SGW LED	✓		✓			✓	8	LED_Green	LED_R/G/B	Parallel to SGW LED	✓		✓			✓	
9	LED_Blue	LED_R/G/B	Parallel to SGW LED	✓		✓			✓	10	GND	GND		✓	✓	✓	✓	✓	✓	
11	BUTTON	GPIO	Parallel to SGW button	✓		✓	✓		✓	12	GND	GND		✓	✓	✓	✓	✓	✓	
13	VDD_3V3	VDD_3V3	3.3V output from SGW	✓	✓	✓	✓	✓	✓	14	GND	GND		✓	✓	✓	✓	✓	✓	
15	VDD_3V3	VDD_3V3	3.3V output from SGW	✓	✓	✓	✓	✓	✓	16	GND	GND		✓	✓	✓	✓	✓	✓	
17	GPIO_7_AIN			✓		✓			✓	18	GPIO_5_AIN	ADC3	Analog input to SGW	✓		✓	✓		✓	
19	GPIO_6_AIN	ADC3	Analog input to SGW	✓		✓			✓	20	GPIO_3_AIN	ADC2	Analog input to SGW	✓		✓			✓	
21	GPIO_4_AIN	ADC2	Analog input to SGW	✓		✓			✓	22	GPIO_1_AIN	ADC1	Analog input to SGW	✓		✓			✓	
23	GPIO_2_AIN	ADC1	Analog input to SGW	✓		✓			✓	24	GPIO_8_AIN				✓		✓		✓	
25	GPIO_18				✓		✓		✓	26	GPIO_17				✓		✓		✓	
27	GND	GND		✓	✓	✓	✓	✓	✓	28	VBUS	USB	USB 5V		✓		✓		✓	
29	GPIO_16				✓		✓		✓	30	USB_DN	USB	USB_DN		✓		✓		✓	
31	I2C_SDA	I2C	I2C_SDA	✓	✓	✓	✓	✓	✓	32	USB_DP	USB	USB_DP		✓		✓		✓	
33	I2C_SCL	I2C	I2C_SCL	✓	✓	✓	✓	✓	✓	34	A_SWDIO	Debug A	Primary chip	✓		✓			✓	
35	A_SWDCLK	Debug A	Primary chip	✓		✓			✓	36	A_RESET	Debug A	Primary chip	✓		✓			✓	
37	GND	GND		✓		✓			✓	38	GPIO_15			✓		✓			✓	
39	GPIO_14			✓		✓			✓	40	GPIO_13			✓		✓			✓	
41	GPIO_12	Serial	Serial TX	✓		✓			✓	42	GPIO_11	Serial	Serial RX	✓		✓			✓	
43	B_SWDIO	Debug B	Secondary chip		✓		✓			44	B_RESET	Debug B	Secondary chip	✓		✓				
45	B_SWDCLK	Debug B	Secondary chip		✓		✓			46	GND	GND		✓	✓	✓	✓	✓	✓	
47	GND	GND		✓	✓	✓	✓	✓	✓	48	GPIO_10	SPI	GPIO/SPI_CS_2	✓		✓	✓		✓	
49	SPI_MOSI	SPI	GPIO		✓		✓		✓	50	SPI_CLK	SPI	GPIO		✓		✓		✓	
51	SPI_MISO	SPI	GPIO		✓		✓		✓	52	GPIO_9	SPI	GPIO/SPI_CS_1		✓		✓		✓	

I/O should be used for specified purpose
I/O usage recommendation
I/O can be freely configured

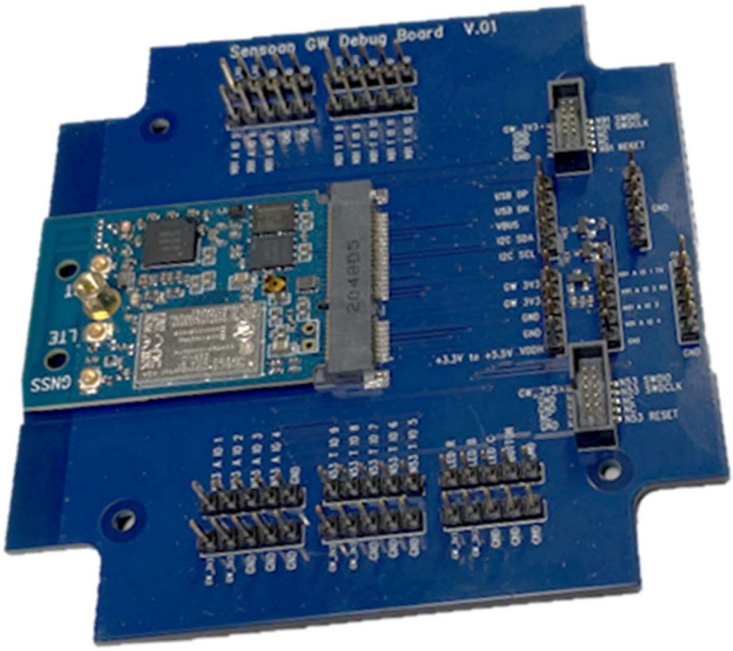




5. Flashing and debugging

The nRF9160/nRF916 and nRF5340/nRF52840 are flashed via edge connector pins 34-36 and 43-45 respectively. These correspond to the SWDIO, SWDCLK and RESET pins of each chip (see the table above).

Sensoan offers a Debug Board for flashing and debugging purposes. Debug Board has two 10-pin connectors for primary and secondary chip flashing. Contact Sensoan for further information.



6. SGW module technical specification

Cellular Connectivity (SGW-2 and SGW-3)	LTE-M / NB IoT radio: Nordic Semiconductor nRF9160/nRF9161, on-board eSIM, MFF2 format Certified bands in Sensoan reference design (Europe): B1 (2100) UL (MHz) 1920…1980 DL (MHz) 2110…2170 B3 (1800+) 1710…1785 1930…1990 B8 (900 GSM) 880…915 925…960 B20 (800 DD) 832…862 791…821 B28 (700 APT) 703…748 758…803 Maximum transmitted power: +23dBm (conducted) All supported bands: ○ Cat-M1: B1, B2, B3, B4, B5, B8, B12, B13, B14, B18, B19, B20, B25, B26, B28, B66 ○ Cat-NB1/NB2: B1, B2, B3, B4, B5, B8, B12, B13, B17, B19, B20, B25, B26, B28, B66
Local connectivity	Listens short range wireless sensors / beacons Frequency range: 2402…2480 MHz Max radiated power less than +10 dBm, conducted <+8 dBm (nRF5340 conducted max. power is + 3dBm) Optional: U.FL connector for external antenna
WiFi connectivity (SGW-4 only)	On roadmap. Specification will be added.
Positioning (SGW-2 and SGW-3)	GPS & optional cell tower-based triangulation
LTE antenna connector	U.FL for LTE antenna
GPS antenna connector (SGW-2 and SGW-3)	U.FL for active GPS antenna (recommendation)
Optional 2,4 GHz antenna connector	U.FL connector is on board but RF signal is wired to internal antenna Use of antenna connector requires 0-ohm resistor placement change
Power in VDDH	3,3 V – 5.5 V (SGW-2 works from 3,0 to 3,3 V but nRF9160 may not fulfill all specifications) Recommended power supply 5 VDC, > 0,5 A
Power out VDD_3V3	Regulated 3,3 V (100mA) If VDDH is 3,3 V or less, VDD_3V3 follows VDDH
On-board flash memory	SGW-2: 1 MB SGW-3: 8 MB
On-board sensor	Accelerometer, STM LIS2DH12
Analog inputs	Max 8 pcs
Digital IOs	Min. 8 pcs Note: analog inputs can be used for digital signals, too
Dimensions	43 mm x 30 mm x 2,4 mm
Weight	4 g
Operating conditions	Sensoan SGW is designed for products which internal temperature stays between - 40° C - + 85 °C and relative humidity is below 90 %

Storage conditions	Storage and transportation temperatures shall be within -40° C - + 85 °C.

7. Disposing of the product

When taking out of service, Sensoan SGW module should be returned to the manufacturer or recycled according to local instructions among other electronics waste.

8. EU regulatory conformance

Sensoan Oy has declared SGW-2 compliance with

- Radio Equipment Directive (RED) 2014/53/EU
- Low Voltage Directive (LVD) 2014/35/EU
- Restriction of the use of certain hazardous substances (RoHS) 2011/65/EU

in its reference design.

SGW-3 Declaration of Conformity is under work

9. Version history

Version	Content	Date
1.0	Approved	3.12.2024