

Preliminary Data Sheet

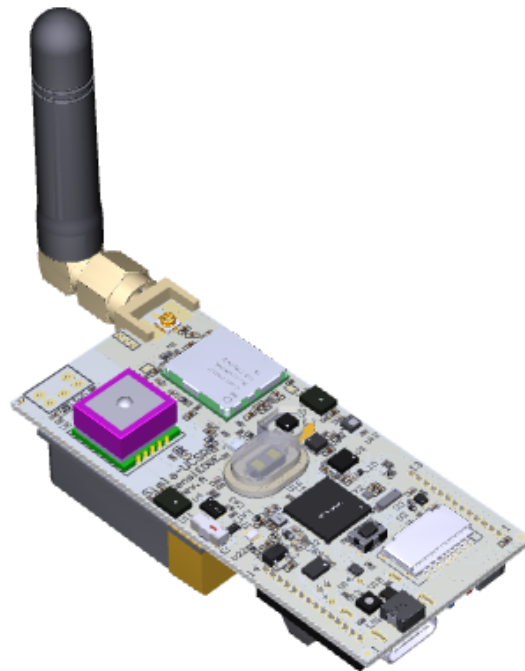
SensiLPWAN 1.0 SIMLA-xx

Version 1.0.0

June, 2020

SensiLPWAN => Sigfox | LoRa | GPS

PreCertified Product combining all in one



Communication option: MCU + BLE + GPS + Sensors + LoRa or Sigfox.

Antenna option: u.FL or SMA Connector.

Battery options: Rechargeable or Non-Rechargeable Battery.

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1 Overview

1.1 General Information

The SensiLPWAN 1.0 is a low cost System on Module with low power consumption. SensiLPWAN 1.0 integrates Micro Controller, variety of Sensors, rechargeable Li-Ion or non-rechargeable CR123A battery, BLE, LoRa and GPS. It provides an ideal building block that easily integrates with a wide range of target markets requiring rich functionality. SensiLPWAN 1.0 is compact, cost effective and with low power consumption.

The SensiLPWAN 1.0 enables wireless connectivity, not requiring any RF experience or expertise. It provides a complete RF platform in a tiny form factor and being a pre-certified solution optimizes the time to market of the final applications.

SensiLPWAN 1.0 IoT Module is a Bridging-the-Gap solution to any embedded design. Fit to the vast array of battery-powered applications requiring the integration of Multiple Sensors with LoRa, GPS and BLE connectivity without compromising on cost and power consumption.

1. Base Part numbers

SIMLA-xx

2. SensiLoRa 1.1 Full Configuration Versions

Include all connectivities : USB, BLE, LoRa, Sigfox, GPS

SIMLA-SC : **S**MA, **C**R123A battery

SIMLA-UC : **u**.FL, **C**R123A battery

SIMLA-SR : **S**MA, **R**echargeable battery

SIMLA-UR : **u**.FL, **R**echargeable battery

3. Eval Kit part Number - SensiLPWAN 1.0 Dev. Kit

SIMLA-SC-DKL

SIMLA-UC-DKL

SIMLA-SR-DKL

SIMLA-UR-DKL

4. Schematics:

SIMLA-xx : SensiLPWAN 1.0 Module with Sensors

5. Software:

SensiLPWAN 1.0_SW

Contact SensiEDGE support services for further information:
<mailto:support@SensiEDGE.com>.

1.2 Feature's Summary

Table 1 – SensiLPWAN 1.0, Features Summary

Product Type	Module
Dimension	30 x 65 x 11 mm
LoRa	
LoRa Certified Module	CMWX1ZZABZ-078
Transmitting Power	18.5dBm±1.5dB
Sensitivity	-117.5dBm
Supported Frequencies	868 MHz, 915 MHz
Antenna	External SMA or U.FL(UMCC) (depends on SensiLoRa 1.1 module version)
Antenna Interface	50Ω impedance control
Host Interface LoRa	LPUART
RoHS	All hardware components are fully compliant with EU RoHS directive
Microcontroller	STM32WB55RG
Processor	ARM® 32-bit Cortex®-M4 CPU with FPU, Bluetooth® 5 and 802.15.4 radio solution
GPS	ORG1410
Sensors	
Accelerometer, Gyroscope	LSM6DSRX
Magnetic sensor	LIS2MDL
Relative Humidity & Temperature sensor	HTS221
Pressure sensor	LPS22HH
Proximity sensor	VL53L1X
Digital MEMS Microphones	MP34DT05-A
Ambient Light and Ultraviolet Light sensor	SI1133-AA00
Air Quality Gas sensor	SGP-30
User Interface	
RG LED	LTST-C195KGJRKT
User Button	KMR221NG
Buzzer	TE044003-1
Data Logger	
SD-Card	Up to 32GB
Serial Flash Memory	8Mbit SPI Flash W25Q80DV
Mounting Type	14pins/1.27 and 13pins/1.27 pitch female
Pin-Header Connector 14 pins	M52-5001445
Pin-Header Connector 13 pins	M52-5001345
Extension Interface	
GPIO	20
I2C	2

SPI	2
USART	1
LPUART	1
ADC (12 bit)	8 ch
USB	FS
PWM	10
SAI	1
Power Interface	
Rechargeable Battery	Yes
CR123A	Yes
USB-C	Yes
Mini USB	Yes (on Carrier Board)

* Under Development/Planning

1.3 Block Diagram

The system is based on 6 main blocks:

- Connectivity
- Micro Controller
- Extensions & Power
- Sensors
- Data Logger
- User Interface

Figure 1 – SensiLPWAN 1.0 , Block Diagram

Connectivity

	LORA
	SIGFOX
	GPS
	BLE 5.0
	USB C



Multiprotocol wireless 32-bit MCU
Arm®-based Cortex®-M4 with FPU,
Bluetooth® 5.0 and
802.15.4 radio solution

Sensors

	3D Accelerometer & 3D Gyroscope LSM6DSRX
	Magnetic Sensor LIS2MDL
	Relative Humidity & Temperature Sensor HTS221
	Pressure Sensor LPS22HH
	Proximity Sensor VL53L1X
	2 Digital MEMS Microphones MP34DT05-A
	Ambient Light & UV Light Sensor Si1133-AA00
	Air Quality Gas Sensor SGP-30

Extensions

Connect external components by using
GPIO, I2C, SPI, ADC, PWM,
UART, SAI interfaces

User Interface

	Red-Green LED
	User Button
	Buzzer

Power

Various Power Supply:
Rechargeable Battery,
CR123A, USB-C

Storage

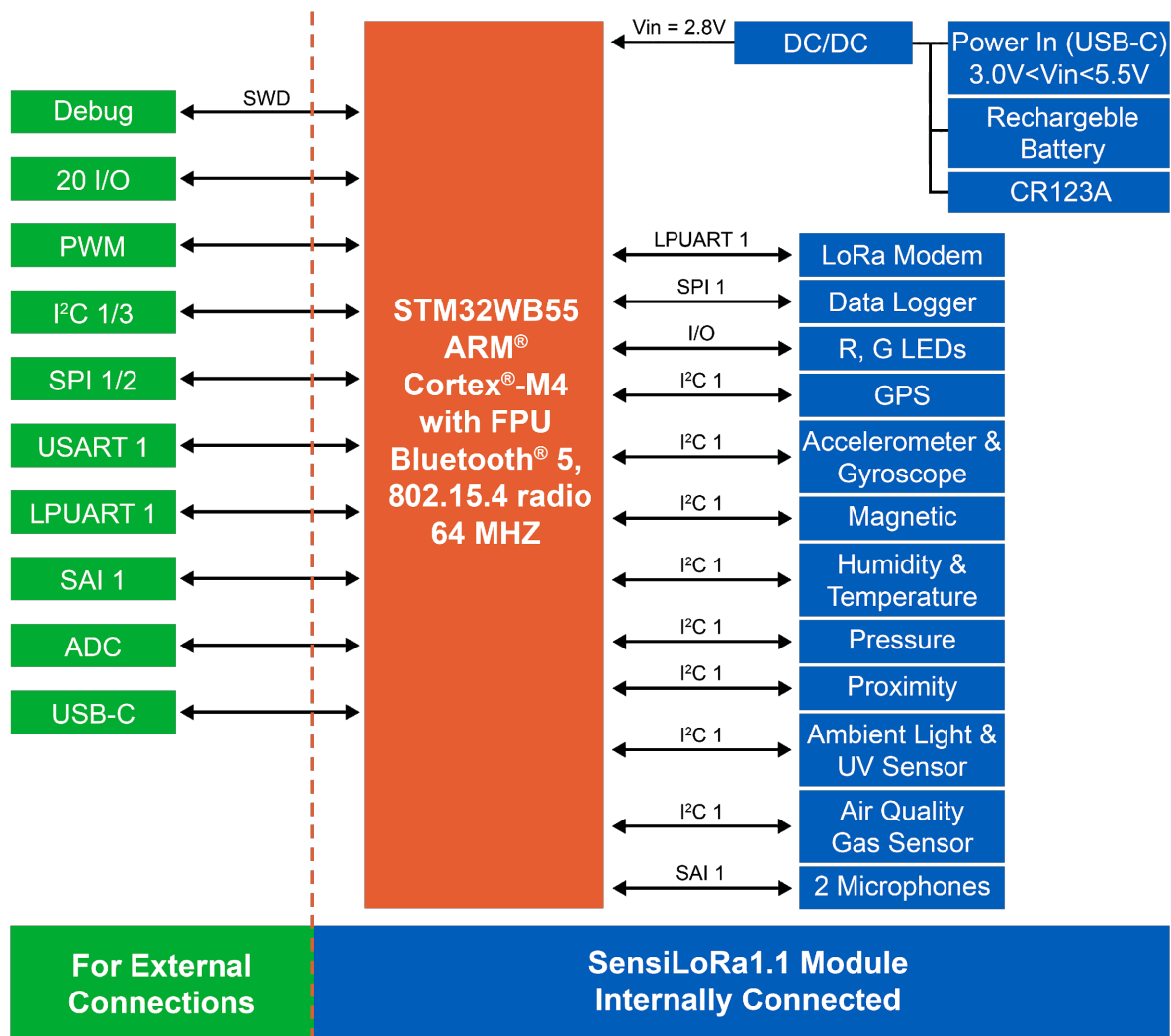
 **Data Logger**
(Internal SPI Flash + SD-Card)

2 Main Hardware Components

This section summarizes the main hardware building blocks of the SensiLPWAN 1.0 Module. Part of the Connectivity used by the SensiLPWAN 1.0 module for internal connection between MCU and Sensors.

Microphones use SAI1 interface, Sensors and GPS are connected to MCU using I2C1, Data Logger is connected via SPI1, LoRa Modem is connected via LPUART1.

Figure 2 – SensiLPWAN 1.0, Connections Diagram



2.1 Microcontroller

2.1.1 STM32WB55

The SensiLPWAN 1.0 module contains ST's STM32WB55RG MCU. The STM32WB55xx multiprotocol wireless and ultra-low-power devices embed a powerful and ultra-low-power radio compliant with the Bluetooth® Low Energy SIG specification v5.0 and with IEEE 802.15.4-2011. They contain a dedicated Arm® Cortex® -M0+ for performing all the real-time low layer operation.

The STM32WB55xx devices are designed to be extremely low-power and are based on the high-performance Arm[®] Cortex[®]-M4 32-bit RISC core operating at a frequency of up to 64 MHz. The Cortex[®]-M4 core features a Floating point unit (FPU) single precision that supports all Arm[®] single-precision data-processing instructions and data types. It also implements a full set of DSP instructions and a memory protection unit (MPU) that enhances application security.

2.2 LoRa

2.2.1 CMWX1ZZABZ

The SensiLPWAN 1.0 module contains Murata's Sub-G Module CMWX1ZZABZ-078. The CMWX1ZZABZ-078 Low Power Wide Area Network (LPWAN) wireless module from Murata is a stand-alone, compact and low power solution that supports the LoRaWAN[™] and Sigfox wireless protocols - one of the first to support both on a single hardware platform. All frequency bands specified for LoRa and Sigfox applications globally are supported with this module, removing the requirement for separate solutions for different regions. The dual-mode approach allows customers to decide which network technology serves the application best depending on location, service requirements and cost.

2.3 GPS

2.3.1 ORG1410

The SensiLPWAN 1.0 module contains OriginGPS's GPS antenna module ORG1410. Micro Hornet ORG1410 module is a miniature multi-channel GPS with SBAS, QZSS and other regional overlay systems receiver that continuously tracks all satellites in view, providing real-time positioning data in industry's standard NMEA format.

Micro Hornet ORG1410 module offers superior sensitivity and outstanding performance, achieving rapid TTFF in less than one second, accuracy of approximately two meters, and tracking sensitivity of -163dBm.

2.4 Sensors

The SensiLPWAN 1.0 module contains the variety of sensors:

- ST's 3D accelerometer and 3D gyroscope
- ST's 3-Axis Magnetometer
- ST's humidity and temperature sensor
- ST's pressure sensor
- ST's proximity sensor
- ST's 2 digital microphones
- Silicon Lab's ambient light (ALS) and ultraviolet light sensor (UVS)
- Sensirion's air quality gas sensor

2.4.1 LSM6DSRX: 3D accelerometer and 3D gyroscope

The LSM6DSRX is a system-in-package featuring a 3D digital accelerometer and a 3D digital gyroscope with an extended full-scale range for gyroscope, up to 4000 dps, and high stability over temperature and time.

The LSM6DSRX supports main OS requirements, offering real, virtual and batch sensors with 9 kbytes with FIFO compression up to three times for dynamic data batching.

2.4.2 LIS2MDL: 3-Axis Magnetometer

The LIS2MDL is an ultra-low-power high-performance 3-Axis Magnetometer. This device offers the unique flexibility for designers to implement movement and position detection in space-constrained products such as personal navigation devices.

2.4.3 HTS221: humidity and temperature sensor

The HTS221 is an ultra-compact sensor for relative humidity and temperature. It includes a sensing element consists of a polymer dielectric planar capacitor structure and a mixed signal ASIC to provide the measurement information through digital serial interfaces.

2.4.4 LPS22HH: pressure sensor

The LPS22HH is an ultra-compact piezo resistive absolute pressure sensor which functions as a digital output barometer. The sensing element, which detects absolute pressure, consists of a suspended membrane manufactured using a dedicated process developed by ST.

2.4.5 VL53L1X: proximity sensor

The VL53L1X is a state-of-the-art, Time-of-Flight (ToF), laser-ranging sensor, enhancing the ST FlightSense™ product family. It is the fastest miniature ToF sensor on the market with accurate ranging up to 4 m and fast ranging frequency up to 50 Hz.

Unlike conventional IR sensors, the VL53L1X uses ST's latest generation ToF technology which allows absolute distance measurement whatever the target color and reflectance.

2.4.6 MP34DT05-A: digital microphone

The MP34DT05-A is an ultra-compact, low power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated to producing audio sensors.

2.4.7 Si1133-AA00: ambient light (ALS) and ultraviolet light sensor (UVS)

The Si1133 is a UV Index Sensor and Ambient Light Sensor with I2C digital interface and programmable-event interrupt output. This sensor IC includes dual 23-bit analog-to-digital converters, integrated high-sensitivity array of UV, visible and infrared photodiodes, and digital signal processor.

2.4.8 SGP30: air quality gas sensor

The SGP30 is an air quality sensor from the sensor experts at Sensirion, with I2C interfacing and fully calibrated output signals with a typical accuracy of 15% within measured values. The SGP30 combines multiple metal-oxide sensing elements on one chip to provide more detailed air quality signals. This is a gas sensor that can detect a wide range of Volatile Organic Compounds (VOCs) and H₂ and is intended for indoor air quality monitoring.

2.5 Data Logger

2.5.1 SD-Card

The SensiLPWAN 1.0 module supports working with external SD-Cards via SPI interface.

2.5.2 W25Q80DV: Serial Flash Memory

The SensiLPWAN 1.0 module contains Winbond W25Q80DV.

The W25Q80DV (8M-bit) Serial Flash memory provides a storage solution for systems with limited space, pins and power. The 25Q series offers flexibility and performance well beyond ordinary Serial Flash devices. They are ideal for code shadowing to RAM, executing code directly from Dual/Quad SPI (XIP) and storing voice, text and data. The W25Q80DV operates on a single 2.7V to 3.6V power supply with current consumption as low as 1µA for power-down.

The W25Q80DV array is organized into 4,096 programmable pages of 256-bytes each. Up to 256bytes can be programmed at a time. Pages can be erased in groups of 16 (4KB sector erase), groups of 128 (32KB block erase), groups of 256 (64KB block erase) or the entire chip (chip erase). The W25Q80DV has 256 erasable sectors and 16 erasable blocks respectively. The small 4KB sectors allow for greater flexibility in applications that require data and parameter storage.

2.6 User Interface

The SensiLPWAN 1.0 module contains the variety of user interfaces:

- C&K's Button (PC13)
- DB Unlimited's Buzzer (PA9)
- Lite-On's RG-LED (Led R @ PB0, Led G @ PB1)
- Analog Device's Battery Monitor (I2C1)

2.6.1 KMR221NG: Button

C&K's button is a SMT Top Actuated operating direction button.

2.6.2 TE044003-1: Buzzer

The TE044003-1 Buzzer is based on Electro-Magnetic Acoustic Transducer for non-contact sound generation and reception using electromagnetic mechanisms.

2.6.3 LTST-C195KGJRKT: Dual color chip LED

Lite-On's SMD Red/Green LED based 2 separate LED's in a package, allows two colors (red and green), while only having 4 pins (Dual set cathode and anode) miniature sizes and special configurations for space-sensitive applications. The color of the LED depends on the polarity of the connection, allowing separate and both colors at the same time. 2.6.4 LTC2942-1: Battery Monitor

The LTC[®]2942-1 measures battery charge state, battery voltage and chip temperature in handheld PC and portable product applications. Its operating range is perfectly suited for single cell Li-Ion batteries. A precision coulomb counter integrates current through an internal sense resistor between the battery's positive terminal and the load or charger. The three measured quantities (charge, voltage and temperature) are stored in internal registers accessible via the onboard SMBus/I2C interface.

The LTC2942-1 features programmable high and low thresholds for all three measured quantities. If a programmed threshold is exceeded, the device communicates an alert using either the SMBus alert protocol or by setting a flag in the internal status registers.

3 External Connectors

The SensiLPWAN 1.0 exposes two low profile connectors. First J1 is 14 pin while second J2 is 13 pin Board to Board connectors. The recommended mating connectors for Custom board interfacing are:

Pin Name: J1, J2

J1 - 14 pins 1row 1.27 Female

J2 - 13 pins 1row 1.27 Female

Pin #:	Pin Number
Schematic Name:	MCU name description
Type:	Pin type & description
	S – Power Pin and/or Ground Pin
	I/O – GPIO
Func (#):	Function Number 1 to 4
Description:	Description of the Pin

3.1 Pin Mux

Table 2 and Table 3 explain function of connectivity pins in SensiLPWAN 1.0 module as well Pin MUX and alternate function available.

Table 2 – SensiLPWAN 1.0 J1, Alternate Function

Pin #	Schematic Name	Type	Func 1	Func 2	Func 3	Func 4	Description
1	+5V	S	–	–	–	–	Input voltage from USB +5V
2	VDD_MCU	S	–	–	–	–	+2.8V from voltage regulator
3	PC2	I/O	ADC1_IN3	–	SPI2_MISO	–	–
4	PC4	I/O	ADC1_IN13	–	–	–	–
5	PB10	I/O	LPUART1_RX	TIM2_CH3	SPI2_SCK	I2C3_SCL	LoRa module TX
6	PA5	I/O	SPI1_SCK	TIM2_CH1	ADC1_IN10	–	–
7	PA6	I/O	SPI1_MISO	TIM16_CH1	ADC1_IN11	–	–
8	PA7	I/O	SPI1_MOSI	TIM17_CH1	ADC1_IN12	I2C3_SCL	–
9	PB7	I/O	USART1_RX	TSC_G2_IO4	–	I2C1_SDA	–
10	PB6	I/O	USART1_TX	TSC_G2_IO3	–	I2C1_SCL	–
11	SWCLK	I/O	–	–	–	–	Serial clk pin SWD
12	SWDIO	I/O	–	–	–	–	Serial data pin SWD
13	nRESET	I/O	–	–	–	–	Reset pin
14	GND	S	–	–	–	–	Ground pin

Table 3 – SensiLoRa J2, Alternate Function

Pin #	Schematic Name	Type	Func 1	Func 2	Func 3	Func 4	Description
1	PC1	I/O	ADC1_IN2	SPI2_MOSI	LPUART1_TX	I2C3_SDA	–
2	GND	S	–	–	–	–	Ground pin
3	PC12	I/O	TSC_G3_IO4	SYS_WKUP3	–	–	–
4	PB11	I/O	LPUART1_TX	TIM2_CH4	–	I2C3_SDA	LoRa module RX
5	PC0	I/O	ADC1_IN1	–	LPUART1_RX	I2C3_SCL	–
6	PA15	I/O	TIM2_CH1	TSC_G3_IO1	–	–	–
7	PA0	I/O	TIM2_CH1	SYS_WKUP1	ADC1_IN15	–	–
8	PB14	I/O	TSC_G1_IO3	SPI2_MISO	–	I2C3_SDA	–
9	PB13	I/O	TSC_G1_IO2	SPI2_SCK	–	I2C3_SCL	–
10	PC6	I/O	GPIO_EXTI6	–	–	–	–
11	PA10	I/O	TIM1_CH3	–	USART1_RX	I2C1_SDA	–
12	PB8	I/O	I2C1_SCL	TIM16_CH1	SAI1_CK1	–	–
13	PB9	I/O	I2C1_SDA	TIM17_CH1	SAI1_D2	–	–

4 Microcontroller

4.1 STM32WB55RG

4.1.1 General Description

The STM32WB55RG multiprotocol wireless and ultra-low-power devices embed a powerful and ultra-low-power radio compliant with the Bluetooth® Low Energy SIG specification v5.0 and with IEEE 802.15.4-2011. They contain a dedicated Arm® Cortex®-M0+ for performing all the real-time low layer operation.

The STM32WB55RG devices are designed to be extremely low-power and are based on the high-performance Arm® Cortex®-M4 32-bit RISC core operating at a frequency of up to 64 MHz. The Cortex®-M4 core features a Floating point unit (FPU) single precision that supports all Arm® single-precision data-processing instructions and data types. It also implements a full set of DSP instructions and a memory protection unit (MPU) that enhances application security.

Enhanced inter-processor communication is provided by the IPCC with six bidirectional channels. The HSEM provides hardware semaphores used to share common resources between the two processors.

The STM32WB55RG devices embed high-speed memories (1 Mbyte of Flash memory, 256 Kbyte of SRAM), a Quad-SPI Flash memory interface (available on all packages) and an extensive range of enhanced I/Os and peripherals.

Direct data transfer between memory and peripherals and from memory to memory is supported by fourteen DMA channels with a full flexible channel mapping by the DMAMUX peripheral.

The STM32WB55RG devices feature several mechanisms for embedded Flash memory and SRAM: readout protection, write protection and proprietary code readout protection. Portions of the memory can be secured for Cortex®-M0+ exclusive access.

The two AES encryption engines, PKA and RNG enable lower layer MAC and upper layer cryptography. A customer key storage feature may be used to keep the keys hidden.

4.1.2 Features

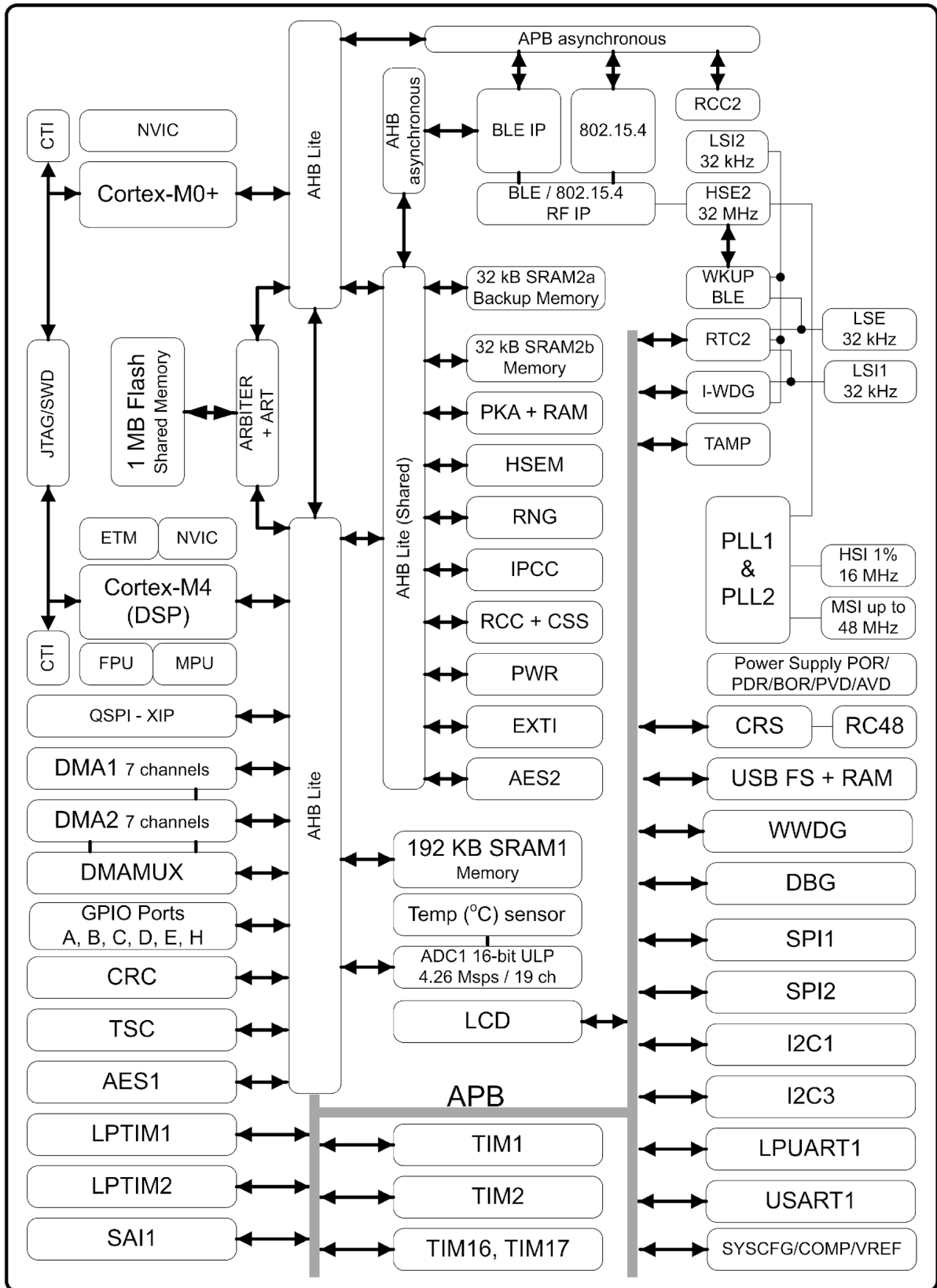
- Includes ST state-of-the-art patented technology
- Radio
 - 2.4 GHz
 - RF transceiver supporting Bluetooth® 5 specification, IEEE 802.15.4-2011 PHY and MAC, supporting Thread and ZigBee® 3.0
 - RX sensitivity: -96 dBm (Bluetooth® Low Energy at 1 Mbps), -100 dBm (802.15.4)
 - Programmable output power up to +6 dBm with 1 dB steps – Integrated balun to reduce BOM Support for 2 Mbps
 - Dedicated Arm® 32-bit Cortex® M0 + CPU for real-time Radio layer – Accurate RSSI to enable power control

- Suitable for systems requiring compliance with radio frequency regulations ETSI EN 300 328, EN 300 440, FCC CFR47 Part 15 and ARIB STD-T66
- Support for external PA
- Available integrated passive device (IPD) companion chip for optimized matching solution (MLPF-WB55-01E3 or MLPF-WB55-02E3)
- Ultra-low-power platform
 - 1.71 to 3.6 V power supply
 - -40 °C to 85 / 105 °C temperature ranges
 - 13 nA shutdown mode
 - 600 nA Standby mode + RTC + 32 KB RAM
 - 2.1 µA Stop mode + RTC + 256 KB RAM
 - Active-mode MCU: < 53 µA / MHz when RF and SMPS on
 - Radio: Rx 4.5 mA / Tx at 0 dBm 5.2 mA
- Core: Arm® 32-bit Cortex®-M4 CPU with FPU, adaptive real-time accelerator (ART Accelerator) allowing 0-wait-state execution from Flash memory, frequency up to 64 MHz, MPU, 80 DMIPS and DSP instructions
- Performance benchmark
 - 1.25 DMIPS/MHz (Drystone 2.1)
 - 219.48 CoreMark® (3.43 CoreMark/MHz at 64 MHz)
- Energy benchmark
 - 303 ULPMark™ CP score
- Supply and reset management
 - High efficiency embedded SMPS step-down converter with intelligent bypass mode
 - Ultra-safe, low-power BOR (brownout reset) with five selectable thresholds
 - Ultra-low-power POR/PDR
 - Programmable voltage detector (PVD)
 - VBAT mode with RTC and backup registers
- Clock sources
 - 32 MHz crystal oscillator with integrated trimming capacitors (Radio and CPU clock)
 - 32 kHz crystal oscillator for RTC (LSE)
 - Internal low-power 32 kHz (±5%) RC (LSI1)
 - Internal low-power 32 kHz (stability ±500 ppm) RC (LSI2)
 - Internal multispeed 100 kHz to 48 MHz oscillator, auto-trimmed by LSE (better than ±0.25% accuracy)
 - High speed internal 16 MHz factory trimmed RC (±1%)
 - 2x PLL for system clock, USB, SAI and ADC
- Memories
 - Up to 1 MB Flash memory with sector protection (PCROP) against R/W operations, enabling authentic Bluetooth® Low Energy and 802.15.4 SW stack
 - Up to 256 KB SRAM, including 64 KB with hardware parity check
 - 20x32-bit backup register
 - Boot loader supporting USART, SPI, I2C and USB interfaces
 - OTA (over the air) Bluetooth® Low Energy and 802.15.4 update
 - Quad SPI memory interface with XIP
- Rich analog peripherals (down to 1.62 V)
 - 12-bit ADC 4.26 Msps, up to 16-bit with hardware oversampling, 200 µA/Msps
 - 2x ultra-low-power comparator

- Accurate 2.5 V or 2.048 V reference voltage buffered output
- System peripherals
 - Inter processor communication controller (IPCC) for communication with Bluetooth® Low Energy and 802.15.4
 - HW semaphores for resources sharing between CPUs
 - 2x DMA controllers (7x channels each) supporting ADC, SPI, I2C, USART, QSPI, SAI, AES, timers
 - 1x USART (ISO 7816, IrDA, SPI Master, Modbus and Smartcard mode)
 - 1x LPUART (low power)
 - 2x SPI 32 Mbit/s
 - 2x I2C (SMBus/PMBus)
 - 1x SAI (dual channel high quality audio)
 - 1x USB 2.0 FS device, crystal-less, BCD and LPM
 - Touch sensing controller, up to 18 sensors
 - LCD 8x40 with step-up converter
 - 1x 16-bit, four channels advanced timer
 - 2x 16-bits, two channels timer
 - 1x 32-bits, four channels timer
 - 2x 16-bits ultra-low-power timer
 - 1x independent SysTick
 - 1x independent watchdog
 - 1x window watchdog
- Security and ID
 - Secure firmware installation (SFI) for Bluetooth® Low Energy and 802.15.4 SW stack
 - 3x hardware encryption AES maximum 256-bit for the application, the Bluetooth® Low Energy and IEEE802.15.4
 - Customer key storage / key manager services
 - HW public key authority (PKA)
 - Cryptographic algorithms: RSA, Diffie-Helman, ECC over GF(p)
 - True random number generator (RNG)
 - Sector protection against R/W operation (PCROP)
 - CRC calculation unit
 - Die information: 96-bit unique ID
 - IEEE 64-bit unique ID. Possibility to derive 802.15.4 64-bit and Bluetooth® Low Energy 48-bit EUI
- Development support
 - Serial wire debug (SWD), JTAG for the Application processor
 - Application cross trigger with input / output
 - Embedded Trace Macrocell™ for application

4.1.3 Block Diagram

Figure 3 - STM32WB55RG, Block Diagram



4.1.4 Connections

Figure 4 - STM32WB55RG Schematic Connections

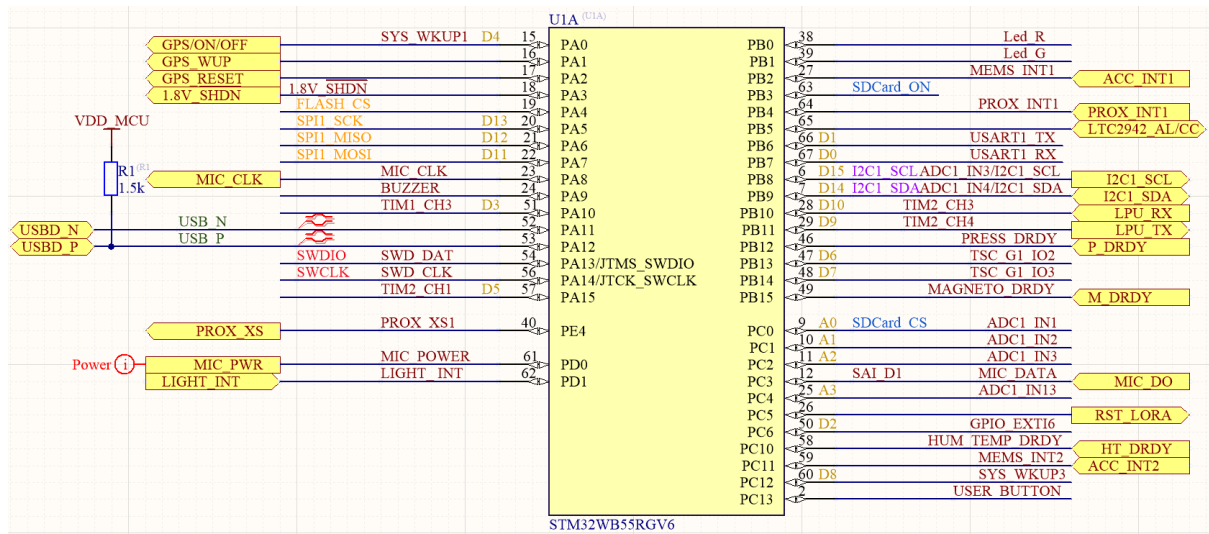


Figure 5 - STM32WB55RG Schematic Connections, RF part

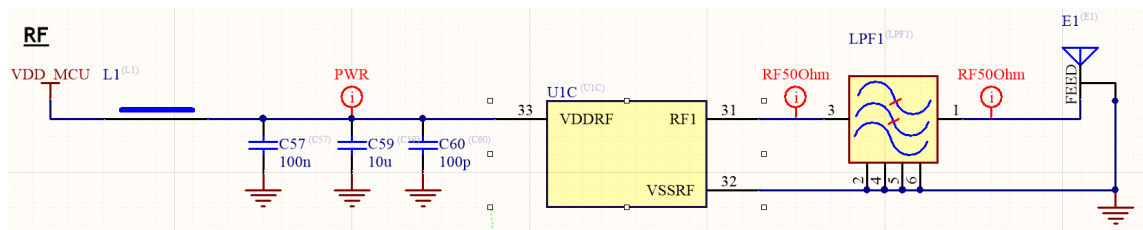


Figure 6 - STM32WB55RG Schematic Connections, Power part

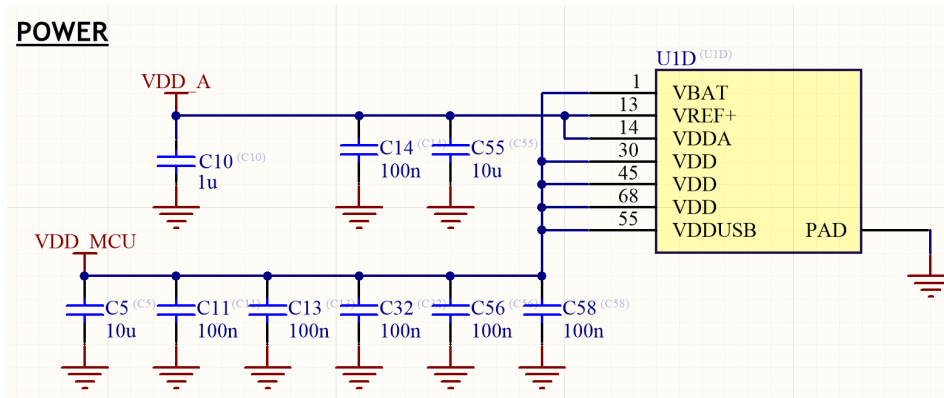


Figure 7 - STM32WB55RG Schematic Connections, SMPS part

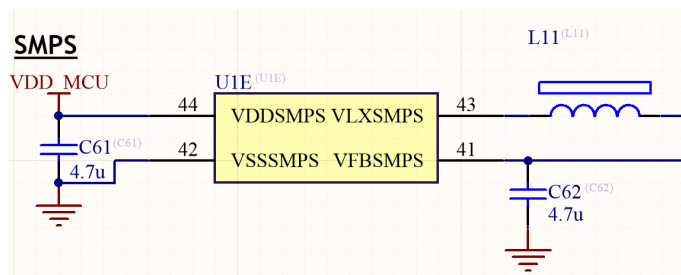
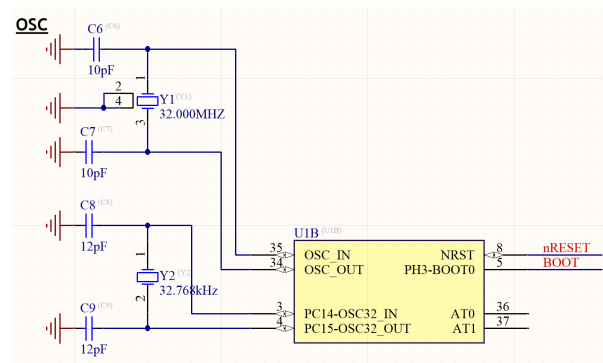


Figure 8 - STM32WB55RG Schematic Connections, OSC part



5 LoRa

5.1 CMWX1ZZABZ

5.1.1 General Description

The CMWX1ZZABZ-078 Low Power Wide Area Network (LPWAN) wireless module from Murata is a stand-alone, compact and low power solution that supports the LoRaWAN[™] and Sigfox wireless protocols - one of the first to support both on a single hardware platform. Measuring 12.5 x 11.6 x 1.76 mm, in a metal shielded LGA package, the Murata LPWAN module is one of the world's smallest solutions for adding LoRa and Sigfox connectivity to applications. The module is designed to be a fully standalone solution incorporating an SX1276 RF transceiver from Semtech and a STM32L Cortex M0+ microcontroller from ST Microelectronics, with 192Kbytes available flash memory. All frequency bands specified for LoRa and Sigfox applications globally are supported with this module, removing the requirement for separate solutions for different regions. The dual-mode approach allows customers to decide which network technology serves the application best depending on location, service requirements and cost.

Key applications for the Murata LPWAN module include smart metering (gas and water flow meters), Internet of Things sensor nodes, wearables, and Machine to Machine (M2M) communications. The variety of LoRaWAN[™] and Sigfox applications currently in development includes placing sensor nodes in remote and unpredictable environments and by using an internal TCXO crystal oscillator the CMWX1ZZABZ-078 module has an operating temperature range of -40 to +85 °C.

LoRa and Sigfox are low-power wide area network protocols (LPWANs) for applications requiring long range communications with relatively low data rates – up to 15km range is possible in non-urban environments. Normal output power for the protocols is + 14dBm and + 13dBm respectively, while LoRa range can be further boosted by a power amplifier boost function to increase RF output to + 20dBm for long range applications or those where the end-device is sited in a poor signal location indoors.

Being a very low-power protocols, both are ideal for battery powered applications and those using energy harvesting and EDLC / supercapacitor / lithium-ion capacitor solutions. The Murata LPWAN module can be powered with a 2.2 to 3.6 V DC supply and battery powered applications can be designed for lifetimes in excess of 10 years before replacements are needed.

5.1.2 Features

Table 4 – CMWX1ZZABZ-078 Key Features

Feature	Details
Interfaces	I2C, UART, USB, SPI
Main ICs	STM32L, SX1276
Reference Clocks	Integrated 32MHz clock (TCXO with frequency error = ± 2 ppm) and 32.768KHz clock (frequency error = ± 20 ppm)
Supported Frequencies	868 MHz, 915 MHz
Module Size	12.5 mm x 11.6 mm x 1.76 mm (Max)
Weight	0.48g (Typ)
Package	Metal Shield can
RoHS	This module is compliant with the RoHS directive

5.1.3 Functional Diagram

Figure 9 – CMWX1ZZABZ-078, Functional Diagram

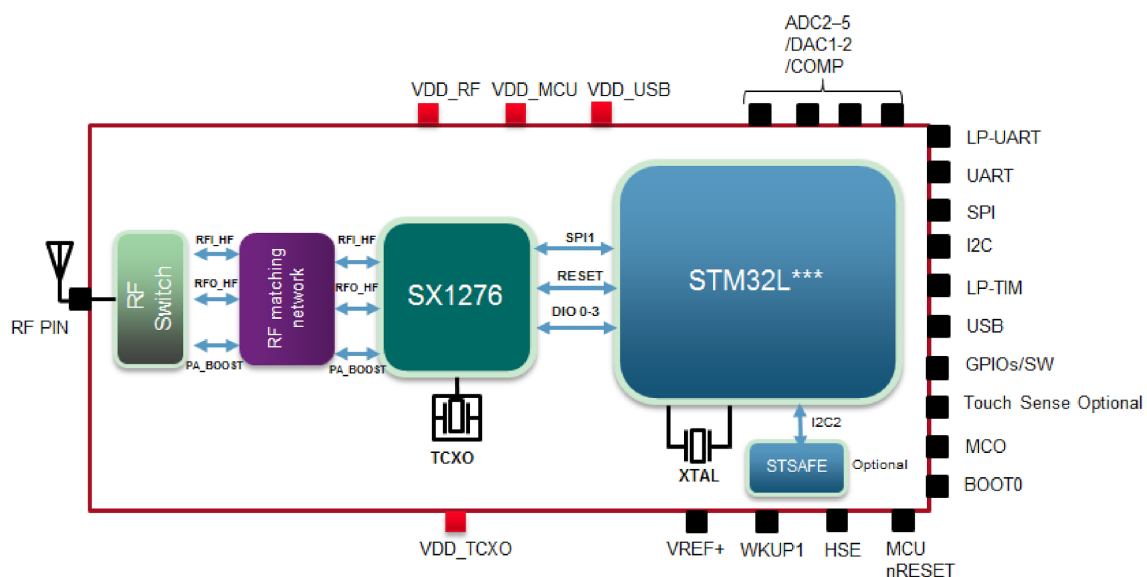
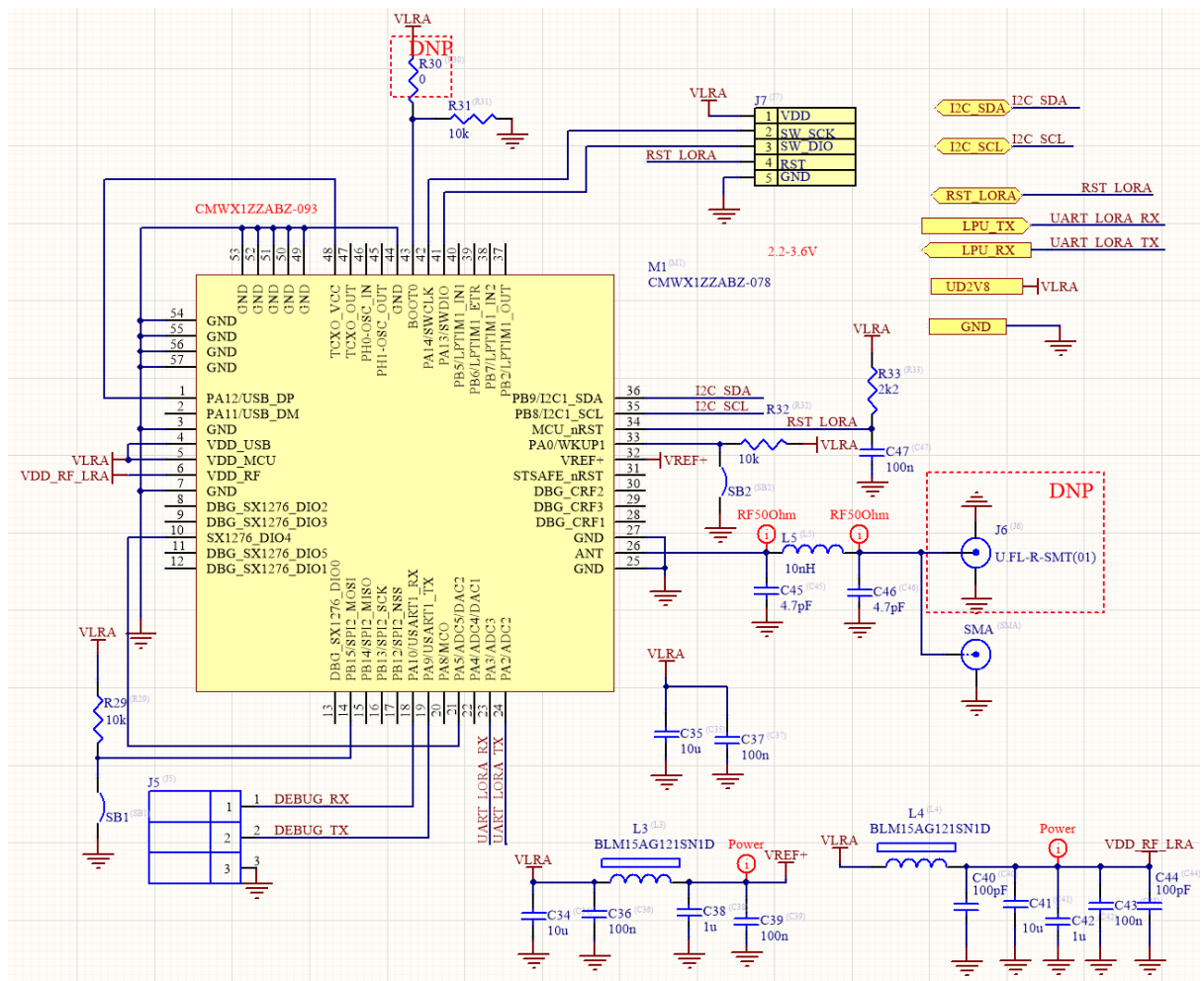


Figure 10 – CMWX1ZZABZ-078 Schematic Connections



6 GPS

6.1 ORG1410

6.1.1 General Description

Designed to support compact and traditional applications such as smart watches, wearable devices, asset trackers, Micro Hornet ORG1410 module is a miniature multi-channel GPS with SBAS, QZSS and other regional overlay systems receiver that continuously tracks all satellites in view, providing real-time positioning data in industry's standard NMEA format.

Micro Hornet ORG1410 module offers superior sensitivity and outstanding performance, achieving rapid TTFF in less than one second, accuracy of approximately two meters, and tracking sensitivity of -163dBm.

Micro Hornet module integrates OriginGPS proprietary on-board GPS antenna, dual-stage LNA, RF LDO, SAW filter, TCXO, RTC crystal and RF shield with market-leading SiRFstarIV™ GPS SoC.

Micro Hornet ORG1410 module is introducing industry's lowest energy per fix ratio, unparalleled accuracy and extremely fast fixes even under challenging signal conditions, such as in built-up urban areas, dense foliage or even indoor.

Innovative architecture can detect changes in context, temperature, and satellite signals to achieve a state of near continuous availability by maintaining and opportunistically updating its internal fine time, frequency, and satellite ephemeris data while consuming mere microwatts of battery power.

6.1.2 Features

- Autonomous operation
- Active antenna on-board
- OriginGPS Noise Free Zone System (NFZ™) technology
- Fully integrating:
 - Antenna element, Dual-stage LNA, SAW filter, TCXO, RTC crystal, GPS SoC, LDO regulator, RF shield
- GPS L1 1575.42 frequency, C/A code
- SBAS (WAAS, EGNOS, MSAS) and QZSS support
- 48 channels
- Ultra-high Sensitivity down to -163dBm enabling Indoor Tracking
- TTFF of < 1s in 50% of trials under Hot Start conditions
- Low Power Consumption of $\leq 11\text{mW}$ in ATP™ mode
- High Accuracy of < 2.5m in 50% of trials
- High update rate of 5Hz, 1Hz by default
- Autonomous A-GPS by Client Generated Extended Ephemeris (CGEE™) for non-networked devices
- Predictive A-GPS by Server Generated Extended Ephemeris (SGEE™) for connected devices
- Ephemeris Push™ for storing and loading broadcast ephemeris

- Host controlled power saving mode
- Self-managed low power modes - ATP™, PTF™, APM™ and SiRFAware® MPM™
- Almanac Based Positioning (ABP™)
- Multipath and cross-correlation mitigation
- Active Jammer Detector and Remover
- Fast Time Synchronization for rapid single satellite time solution
- ARM7® microprocessor system
- Selectable UART, SPI or I2C host interface
- NMEA protocol by default, switchable into One Socket Protocol (OSP®)
- Programmable baud rate and messages rate
- PPS output less than 30ns synchronized to GPS epoch
- Single voltage supply 1.8V or 2V to 5.5V
- Ultra-small LGA footprint of 10mm x 10mm
- Ultra-low weight of 2.5g
- Surface Mount Device (SMD)
- Optimized for automatic assembly and reflow processes
- Operating from -40°C to +85°C
- FCC, CE, VCCI certified
- RoHS II/REACH compliant

6.1.3 Functional Diagram

Figure 11 – ORG1410, Architecture

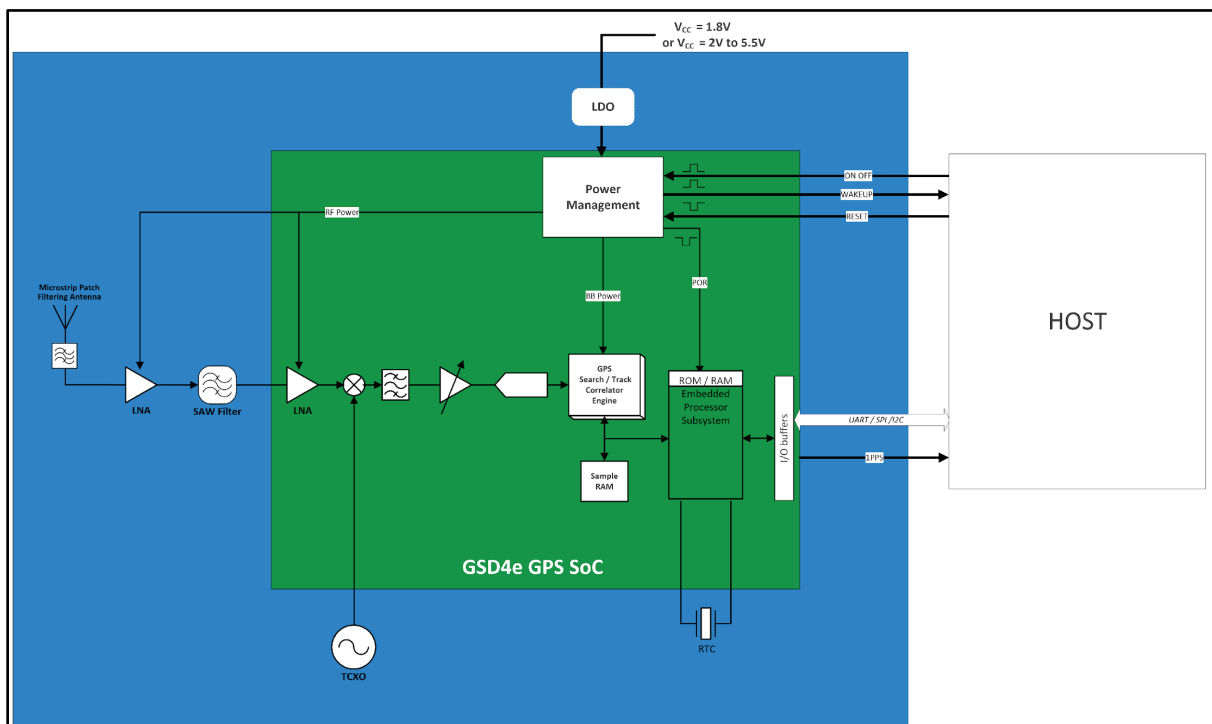
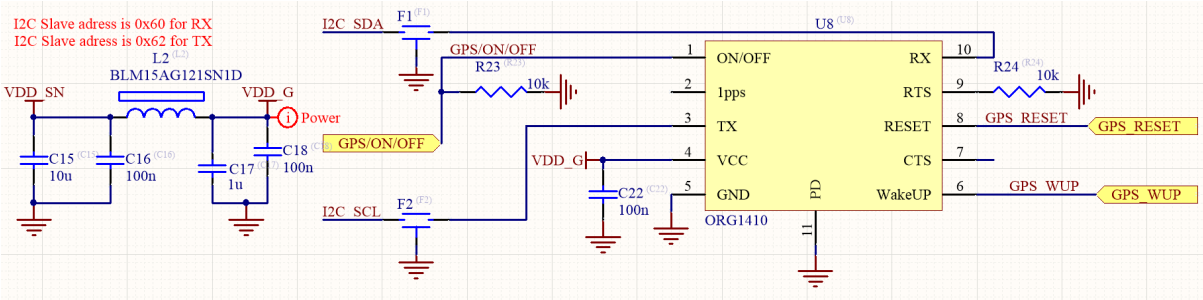


Figure 12 – ORG1410, Block diagram



6.1.4 Connections

Figure 13 – ORG1410 Schematic Connections



7 Sensors

7.1 LSM6DSRX: 3D accelerometer and 3D gyroscope

7.1.1 General Description

The LSM6DSRX is a system-in-package featuring a 3D digital accelerometer and a 3D digital gyroscope with an extended full-scale range for the gyroscope, up to 4000 dps, and high stability over temperature and time.

The LSM6DSRX supports main OS requirements, offering real, virtual and batch sensors with 9 kbytes with FIFO compression up to three times for dynamic data batching.

ST's family of MEMS sensor modules leverages the robust and mature manufacturing processes already used for the production of micromachined accelerometers and gyroscopes.

The LSM6DSRX has a full-scale acceleration range of $\pm 2/\pm 4/\pm 8/\pm 16$ g and an angular rate range of $\pm 125/\pm 250/\pm 500/\pm 1000/\pm 2000/\pm 4000$ dps.

The LSM6DSRX embeds a broad range of advanced functions supporting Android wearable sensors and programmable sensors (suitable for activity recognition).

The LSM6DSRX embeds a Machine Learning Core able to identify if a data pattern matches an activity in a user-defined set of classes, reducing power consumption and increasing performance of the sensor.

The LSM6DSRX is available in a plastic land grid array (LGA) package.

7.1.2 Features

- Extended full-scale range for gyroscope up to 4000 dps
- High stability over temperature and time
- Smart FIFO up to 9 kbytes
- Android compliant
- Auxiliary SPI for OIS data output for gyroscope and accelerometer
- $\pm 2/\pm 4/\pm 8/\pm 16$ g full scale
- $\pm 125/\pm 250/\pm 500/\pm 1000/\pm 2000/\pm 4000$ dps full scale
- Analog supply voltage: 1.71 V to 3.6 V
- SPI / I2C & MIPI I3CSM serial interface with main processor data synchronization
- Supports sensor synchronization S4S for Qualcomm, full spec compliant (I2C, MIPI I3CSM, SPI)
- Advanced pedometer, step detector and step counter
- Significant Motion Detection, tilt detection
- Programmable Finite State Machine: accelerometer, gyroscope, and external sensors
- Machine Learning Core
- Standard interrupts: free-fall, wakeup, 6D/4D orientation, click and double-click
- Embedded temperature sensor

- ECOPACK, RoHS and “Green” compliant

7.1.3 Block Diagram

Figure 14 – LSM6DSRX, Block Diagram of filters

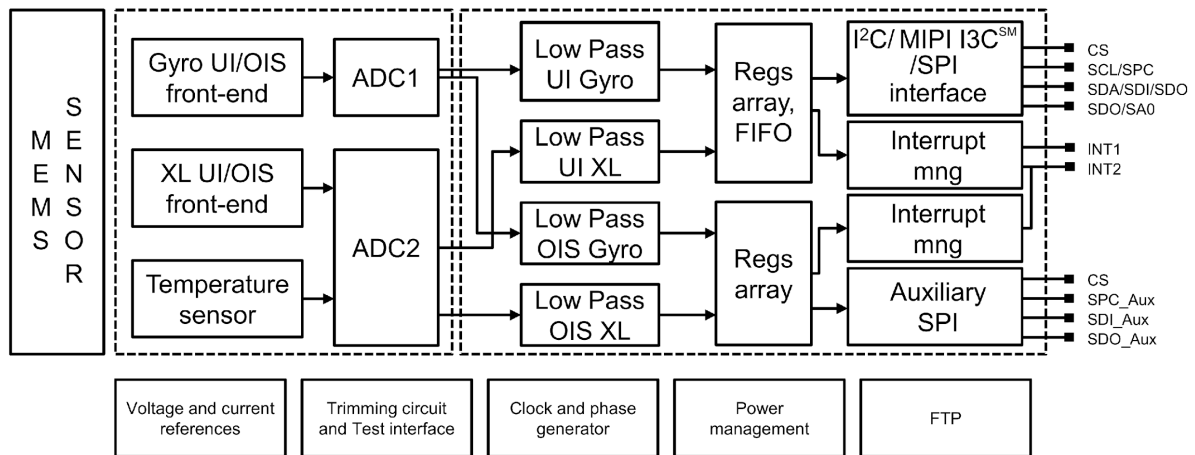
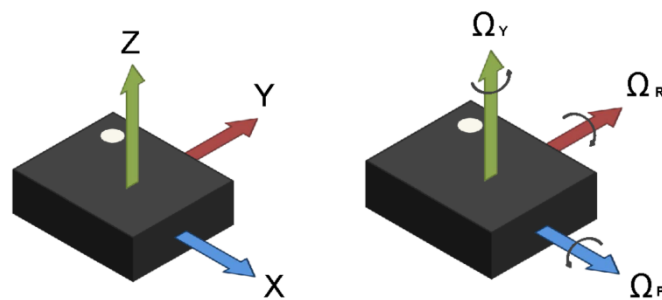


Figure 15 - LSM6DSRX, Direction of the Detectable Accelerations and angular



7.1.4 Connections and Signals

Figure 16 - LSM6DSRX, Schematic Connections

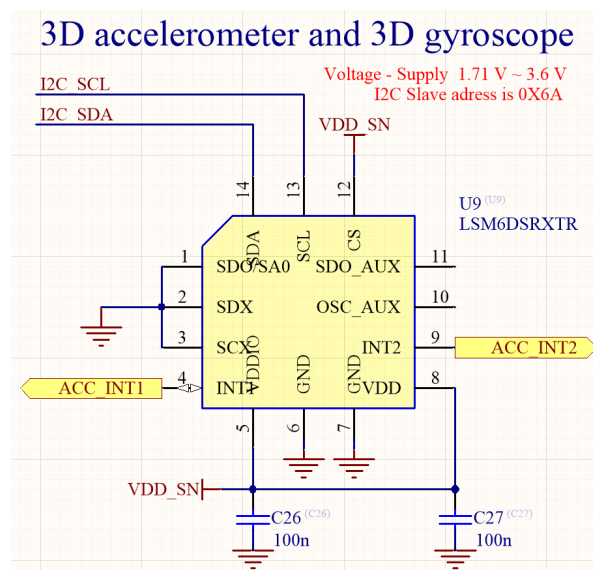


Table 5 - LSM6DSRX, Pin Assignment

Pin#	Name	Mode 1 function	Mode 2 function	Mode 3/ Mode 4 function
1	SDO/SA0	SPI 4-wire interface serial data output (SDO) I2C least significant bit of the device address (SA0)		
2	SDx	Connect to VDDIO or GND	I2C serial data master (MSDA)	Auxiliary SPI 3/4-wire interface serial data input (SDI) and SPI 3-wire serial data output (SDO)
3	SDx	Connect to VDDIO or GND	I2C serial clock master (MSCL)	Auxiliary SPI 3/4-wire interface serial port clock (SPC_Aux)
4	INT1	Programmable interrupt in I2C and SPI		
5	VDDIO	Power supply for I/O pins		
6	GND	0 V supply		
7	GND	0 V supply		
8	VDD	Power supply		
9	INT2	Programmable interrupt 2 (INT2)/ Data enable (DEN)	Programmable interrupt 2 (INT2)/ Data enable (DEN)/ I ² C master external synchronization signal (MDRDY)	Programmable interrupt 2 (INT2)/ Data enable (DEN)
10	OCS_Aux	Leave unconnected		Auxiliary SPI 3/4-wire interface enable
11	SDO_Aux	Connect to VDD_IO or leave unconnected		Auxiliary SPI 3-wire interface: leave unconnected Auxiliary SPI 4-wire interface: serial data output (SDO_Aux)
12	CS	I2C/MIPI I3C SM /SPI mode selection (1: SPI idle mode / I2C/MIPI I3C SM communication enabled; 0: SPI communication mode / I2C/MIPI I3C SM disabled)		
13	SCL	I2C/MIPI I3C SM serial clock (SCL) SPI serial port clock (SPC)		
14	SDA	I2C/MIPI I3C SM serial data (SDA) SPI serial data input (SDI) 3-wire interface serial data output (SDO)		

7.2 LIS2MDL: 3-Axis Magnetometer

7.2.1 General Description

The LIS2MDL is a 3D digital magnetometer system-in-package with a digital I2C and 3-wire SPI serial interface standard output, performing at 200µA in high-resolution mode and no more than 50 µA in low-power mode (at 20 Hz output data rate). Thanks to the ultra-low noise performance of the magnetometer, the device combines always-on low-power features with superior sensing precision for an optimal motion experience for the consumer.

The LIS2MDL has a magnetic field dynamic range of ± 50 gauss.

The LIS2MDL includes an I2C serial bus interface that supports standard, fast mode, fast mode plus, and high-speed (100 kHz, 400 kHz, 1 MHz, and 3.4 MHz) and an SPI serial standard interface.

The LIS2MDL can be configured to generate an interrupt signal for magnetic field detection and to automatically compensate for hard-iron offsets provided from the higher application layer.

7.2.2 Features

- 3 magnetic field channels
- ± 50 gauss magnetic dynamic range
- 16-bit data output
- SPI/I2C serial interfaces
- Analog supply voltage 1.71 V to 3.6 V
- Selectable power mode/resolution
- Single measurement mode
- Programmable interrupt generator
- Embedded self-test
- Embedded temperature sensor
- ECOPACK[®], RoHS and “Green” compliant

7.2.3 Block Diagram

Figure 17 - LIS2MDL, Block Diagram

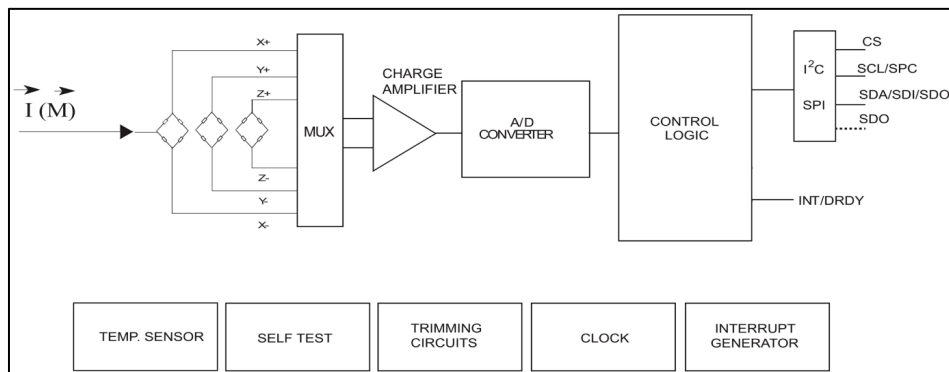
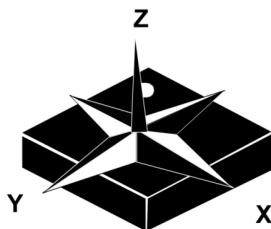


Figure 18 - LIS2MDL, Direction of the Detectable Magnetic Fields

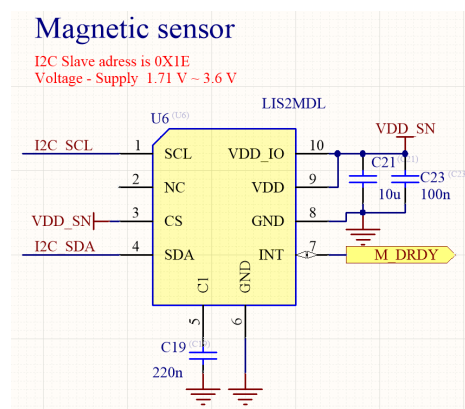


7.2.4 Connections and Signals

Table 6 - LIS2MDL, Pin Assignment

Pin#	Name	Function
1	SCL SPC	I2C serial clock (SCL) SPI serial port clock (SPC)
2	NC	Internally not connected. Can be tied to VDD, VDDIO, or GND.
3	CS	I2C/SPI mode selection (1: SPI idle mode / I2C communication enabled; 0: SPI communication mode / I2C disabled)
4	SDA SDI SDO	I2C serial data (SDA) SPI serial data input (SDI) 3-wire interface serial data output (SDO)
5	C1	Capacitor connection (C1 = 220 nF)
6	GND	Connected to GND
7	INT/DRDY/SDO	Interrupt/data-ready signal or SDO line for 4-wire SPI connection
8	GND	Connected to GND
9	VDD	Power supply
10	VDD IO	Power supply for I/O pins
11	NC	Internally not connected. Can be tied to VDD, VDDIO, or GND.
12	NC	Internally not connected. Can be tied to VDD, VDDIO, or GND.

Figure 19 - LIS2MDL, Schematic Connections



7.3 HTS221: humidity and temperature sensor

7.3.1 General Description

The HTS221 is an ultra-compact sensor for relative humidity and temperature. It includes a sensing element and a mixed signal ASIC to provide the measurement information through digital serial interfaces.

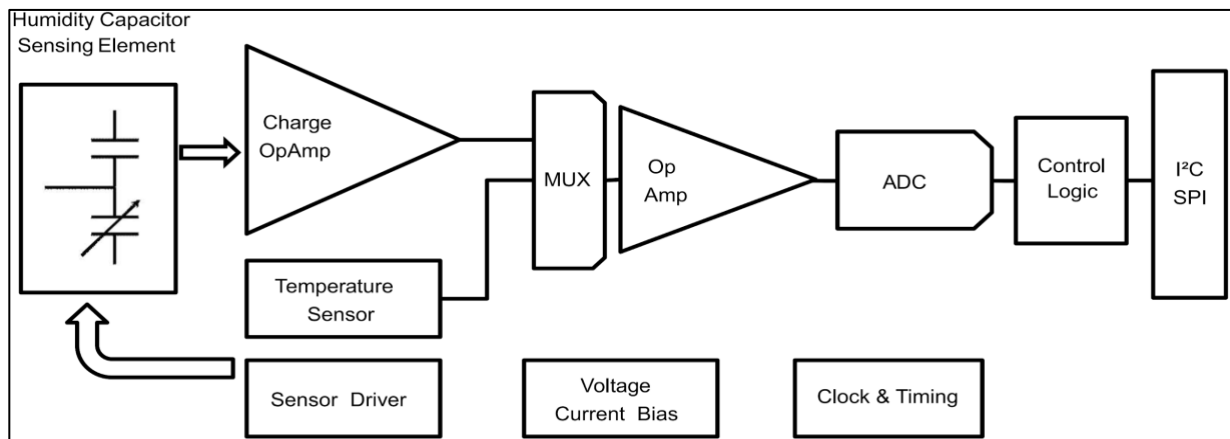
The sensing element consists of a polymer dielectric planar capacitor structure capable of detecting relative humidity variations and is manufactured using a dedicated ST process.

7.3.2 Features

- 0 to 100% relative humidity range
- Supply voltage: 1.7 to 3.6 V
- Low power consumption: 2 μ A @ 1 Hz ODR
- Selectable ODR from 1 Hz to 12.5 Hz
- High rH sensitivity: 0.004% rH/LSB
- Humidity accuracy: $\pm 3.5\%$ rH, 20 to +80% rH
- Temperature accuracy: ± 0.5 °C, 15 to +40 °C
- Embedded 16-bit ADC
- 16-bit humidity and temperature output data
- SPI and I2C interfaces
- Factory calibrated
- Tiny 2 x 2 x 0.9 mm package
- ECOPACK® compliant

7.3.3 Block Diagram

Figure 20 - HTS221, Block Diagram



7.3.4 Connections and Signals

Figure 21 - HTS221, Schematic Connections

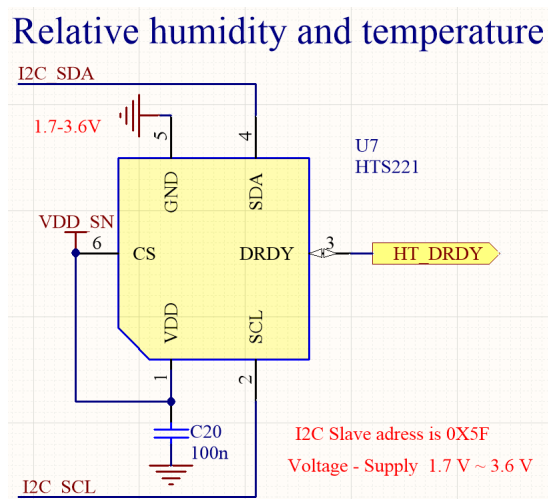


Table 7 - HTS221, Pin Assignment

Pin#	Name	Function
1	VDD	Power supply
2	SCL SPC	I2C serial clock (SCL) SPI serial port clock (SPC)
3	DRDY	Data Ready output signal
4	SDA SDI SDO	I2C serial data (SDA) SPI serial data input (SDI) 3-wire interface serial data output (SDO)
5	GND	Ground
6	SPI enable	I2C/SPI mode selection (1: SPI idle mode / I2C communication enabled; 0: SPI communication mode / I2C disabled)

7.4 LPS22HH: pressure sensor Pressure Sensor

7.4.1 General Description

The LPS22HH is an ultra-compact piezoresistive absolute pressure sensor which functions as a digital output barometer. The device comprises a sensing element and an IC interface which communicates through I2C, MIPI I3CSM or SPI from the sensing element to the application.

The sensing element, which detects absolute pressure, consists of a suspended membrane manufactured using a dedicated process developed by ST.

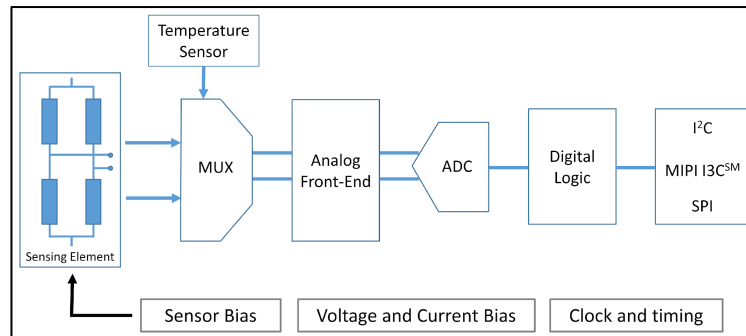
The LPS22HH is available in a full-mold, holed LGA package (HLGA). It is guaranteed to operate over a temperature range extending from -40 °C to +85 °C. The package is holed to allow external pressure to reach the sensing element.

7.4.2 Features

- 260 to 1260 hPa absolute pressure range
- Current consumption down to 4 µA
- Absolute pressure accuracy: 0.5 hPa
- Low pressure sensor noise: 0.65 Pa
- High-performance TCO: 0.65 Pa/°C
- Embedded temperature compensation
- 24-bit pressure data output
- ODR from 1 Hz to 200 Hz
- SPI, I2C or MIPI I3CSM interfaces
- Embedded FIFO
- Interrupt functions: Data-Ready, FIFO flags, pressure thresholds
- Supply voltage: 1.7 to 3.6 V
- High shock survivability: 22,000 g
- Small and thin package
- ECOPACK[®] lead-free compliant

7.4.3 Block Diagram

Figure 22 - LPS22HH, Block Diagram



7.4.4 Connections and Signals

Figure 23 - LPS22HH, Schematic Connections

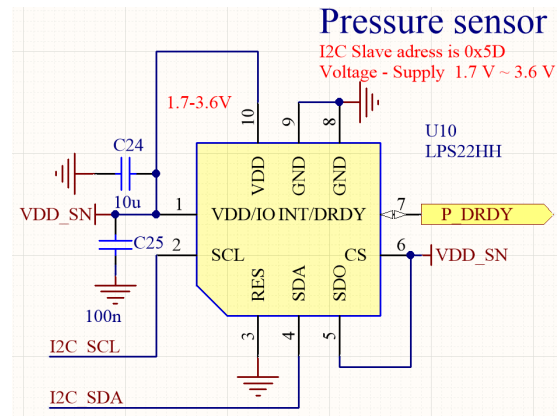


Table 8 - LPS22HH, Pin Assignment

Pin#	Name	Function
1	Vdd_IO	Power supply for I/O pins
2	SCL SPC	I2C / MIPI I3C SM serial clock (SCL) SPI serial port clock (SPC)
3	Reserved	Connect to GND
4	SDA SDI SDI/SDO	I2C / MIPI I3C SM serial data (SDA) 4-wire SPI serial data input (SDI) 3-wire serial data input / output (SDI/SDO)
5	SDO SA0	4-wire SPI serial data output (SDO) I2C less significant bit of the device address (SA0) MIPI I3C SM least significant bit of the static address (SA0)
6	CS	SPI enable I2C and MIPI I3C SM /SPI mode selection (1: SPI idle mode / I2C mode and MIPI I3C SM communication enabled; 0: SPI communication mode / I2C and MIPI I3C SM disabled)
7	INT DRDY	Interrupt or Data-Ready
8	GND	0 V supply
9	GND	0 V supply
10	VDD	Power supply

7.5 VL53L1X: proximity sensor

7.5.1 General Description

The VL53L1X is a state-of-the-art, Time-of-Flight (ToF), laser-ranging sensor, enhancing the ST FlightSense™ product family. It is the fastest miniature ToF sensor on the market with accurate ranging up to 4 m and fast ranging frequency up to 50 Hz.

Housed in a miniature and reflowable package, it integrates a SPAD receiving array, a 940 nm invisible Class1 laser emitter, physical infrared filters, and optics to achieve the best ranging performance in various ambient lighting conditions with a range of cover window options.

Unlike conventional IR sensors, the VL53L1X uses ST's latest generation ToF technology which allows absolute distance measurement whatever the target color and reflectance.

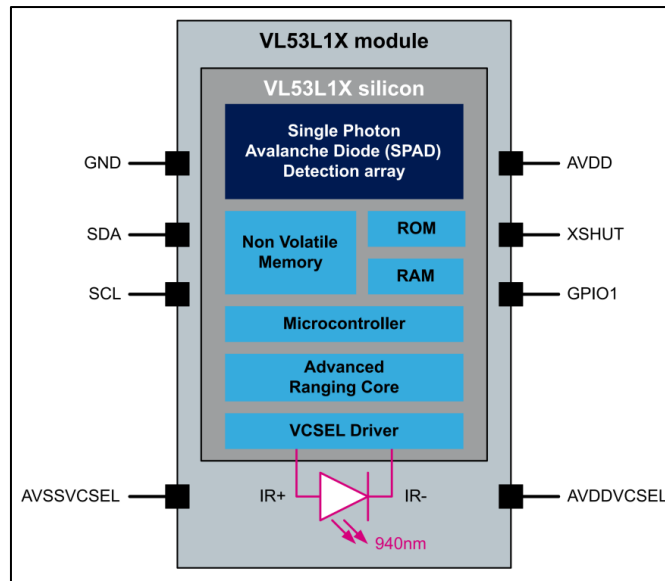
It is also possible to program the size of the ROI on the receiving array, allowing the sensor FoV to be reduced.

7.5.2 Features

- Fully integrated miniature module
 - Size: 4.9x2.5x1.56 mm
 - Emitter: 940 nm invisible laser (Class1)
 - SPAD (single photon avalanche diode) receiving array with integrated lens
 - Low-power microcontroller running advanced digital firmware
- Pin-to-pin compatible with the VL53L0X FlightSense™ ranging sensor
- Fast and accurate long distance ranging
 - Up to 400 cm distance measurement
 - Up to 50 Hz ranging frequency
- Typical full field-of-view (FoV): 27°
- Programmable region-of-interest (ROI) size on the receiving array, allowing the sensor FoV to be reduced
- Programmable ROI position on the receiving array, providing multizone operation control from the host
- Easy integration
 - Single reflowable component
 - Can be hidden behind many cover window materials
 - Software driver and code examples for turnkey ranging
 - Single power supply (2v8)
 - I²C interface (up to 400 kHz)
 - Shutdown and interrupt pins

7.5.3 Block Diagram

Figure 24 - VL53L1X, Block Diagram



7.5.4 Connections and Signals

Figure 25 - VL53L1X, Schematic Connections

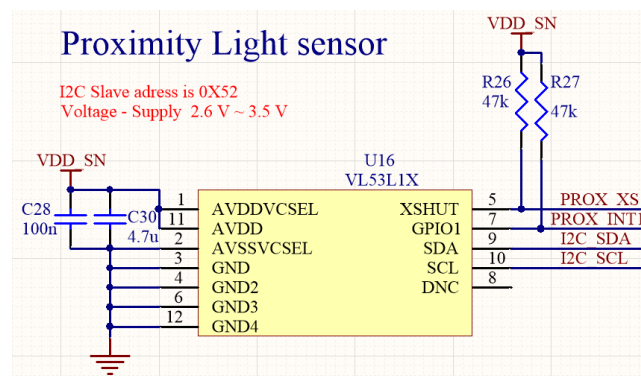


Table 9 - VL53L1X, Pin Assignment

Pin#	Name	Function
1	AVDDVCSEL	VCSEL supply, to be connected to main supply
2	AVSSVCSEL	VCSEL ground, to be connected to main ground
3	GND	To be connected to main ground
4	GND2	To be connected to main ground
5	XSHUT	Xshutdown pin, active low
6	GND3	To be connected to main ground
7	GPIO1	Interrupt output. Open drain output
8	DNC	Do not connect, must be left floating
9	SDA	I ² C serial data
10	SCL	I ² C serial clock input
11	AVDD	Supply, to be connected to main supply
12	GND4	To be connected to main ground

7.6 Digital Microphone

7.6.1 General Description

The MP34DT05-A is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated to producing audio sensors.

The IC interface is manufactured using a CMOS process that allows designing a dedicated circuit able to provide a digital signal externally in PDM format.

The MP34DT05-A is a low-distortion digital microphone with a 64 dB signal-to-noise ratio and $-26 \text{ dBFS} \pm 3 \text{ dB}$ sensitivity.

7.6.2 Features

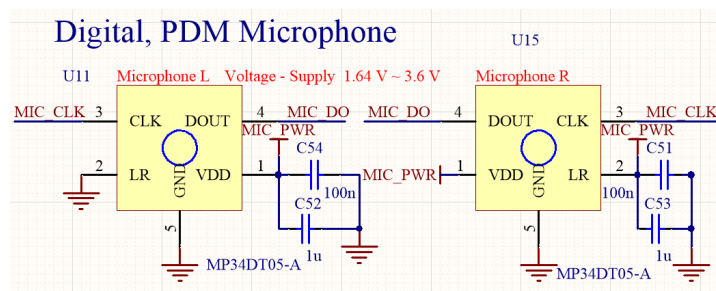
- Single supply voltage
- Low power consumption
- AOP = 122.5 dB SPL
- 64 dB signal-to-noise ratio
- Omnidirectional sensitivity
- $-26 \text{ dBFS} \pm 3 \text{ dB}$ sensitivity
- PDM output
- HCLGA package
 - Top-port design
 - SMD-compliant
 - EMI-shielded
 - ECOPACK®, RoHS, and “Green” compliant

7.6.3 Connections and Signals

Table 10 - MP34DT05-A, Pin Assignment

Pin#	Name	Function
1	VDD	Power supply
2	LR	Left/Right channel selection
3	CLK	Synchronization input clock
4	DOUT	Left/Right PDM data output
5	GND	Ground

Figure 26 - MP34DT05-A, Schematic Connections



7.7 Si1133-AA00: ambient light and ultraviolet light sensor

7.7.1 General Description

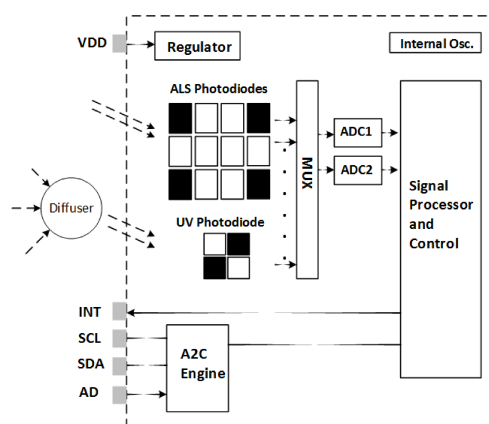
The Si1133 is a UV Index Sensor and Ambient Light Sensor with I2C digital interface and programmable-event interrupt output. This sensor IC includes dual 23-bit analog-to-digital converters, integrated high-sensitivity array of UV, visible and infrared photodiodes, and digital signal processor. The Si1133 is provided in a 10-lead 2x2 mm DFN package and capable of operation from 1.62 to 3.6 V over the -40 to $+85$ °C temperature range.

7.7.2 Features

- High accuracy UV index sensor
 - Matches erythermal curve
- Ambient light sensor
 - <100 mlx resolution possible, allowing operation under dark glass
 - <100 mlx resolution possible, allowing operation under dark glass
 - Up to 128 klx dynamic range possible across two ADC range settings
- Industry's lowest power consumption
 - 1.62 to 3.6 V supply voltage
 - <500 nA standby current
 - Internal and external wake support
 - Built-in voltage supply monitor and power-on reset controller
- Trimmable internal oscillator with typical 1% accuracy
- I2C Serial communications
 - Up to 3.4 Mbps data rate
 - Slave mode hardware address decoding
- Small package options
 - 10-lead 2 x 2 x 0.65 mm QFN
- Temperature Range: -40 to $+85$ °C

7.7.3 Block Diagram

Figure 27 - Si1133-AA00, Block Diagram

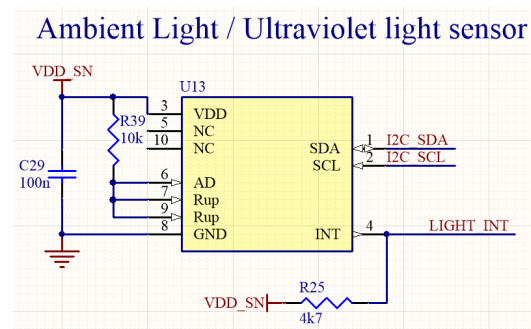


7.7.4 Connections and Signals

Table 11 - Si1133-AA00, Pin Assignment

Pin#	Name	Function
1	SDA	I2C data.
2	SCL	I2C clock.
3	VDD	Power Supply. Voltage source.
4	INT	Interrupt Output. This pin is an open drain output. Must be at logic level high during power-up sequence to enable low power operation.
5	DNC	Do Not Connect. This pin is electrically connected to an internal Si1133 node. It should remain unconnected.
6	AD	I2C Address Select. It is sensed during startup. Pull up to VDD with 47 k Resistor for default I2C address (0x55). Pull down with 47 k Resistor to select alternate I2C address (0x52).
7	RPullup	Resistor Pullup. Always connect to VDD through a pull-up resistor.
8	GND	Ground. Reference voltage.
9	RPullup	Resistor Pullup. Connect to VDD through a pull-up resistor when not in use.
10	DNC	Do Not Connect. This pin is electrically connected to an internal Si1133 node. It should remain unconnected.

Figure 28 - Si1133-AA00, Schematic Connections



7.8 SGP30: air quality gas sensor

7.8.1 General Description

The SGP30 is a digital multi-pixel gas sensor designed for easy integration into air purifier, demand-controlled ventilation, and IoT applications. Sensirion's CMOSens[®] technology offers a complete sensor system on a single chip featuring a digital I2C interface, a temperature controlled micro hotplate, and two preprocessed indoor air quality signals. As the first metal-oxide gas sensor featuring multiple sensing elements on one chip, the SGP30 provides more detailed information about the air quality.

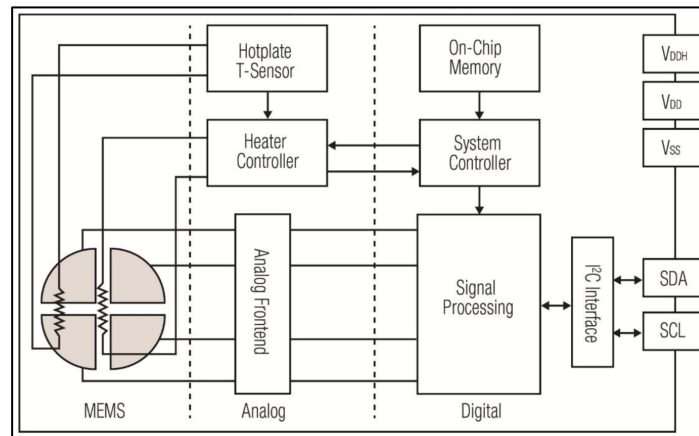
The sensing element features an unmatched robustness against contaminating gases present in real-world applications enabling a unique long-term stability and low drift. The very small 2.45 x 2.45 x 0.9 mm³ DFN package enables applications in limited spaces. Sensirion's state-of-the-art production process guarantees high reproducibility and reliability. Tape and reel packaging, together with suitability for standard SMD assembly processes make the SGP30 predestined for high-volume applications.

7.8.2 Features

- Multi-pixel gas sensor for indoor air quality applications
- Outstanding long-term stability
- I2C interface with TVOC and CO₂eq output signals
- Low power consumption: 48 mA at 1.8V
- Chip module tape and reel packaged, reflow solderable

7.8.3 Block Diagram

Figure 29 – SGP30, Block Diagram



7.8.4 Connections and Signals

Figure 30 – SGP30, Schematic Connections

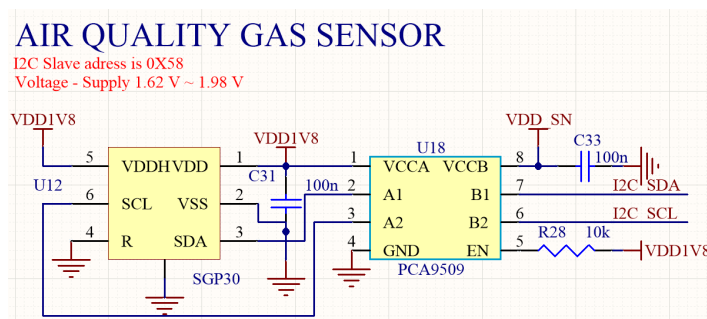


Table 12 – SGP30, Pin Assignment

Pin#	Name	Function
1	VDD	Supply voltage
2	VSS	Ground
3	SDA	Serial data, bidirectional
4	R	Connect to ground (no electrical function)
5	VDDH	Supply voltage, hotplate
6	SCL	Serial clock, bidirectional

8 Data Logger

SensiLPWAN 1.0 uses single SPI1 interface for both SD-Card and W25Q80DV Flash memory. This means the device cannot work with SD-Card and W25Q80DV at the same time.

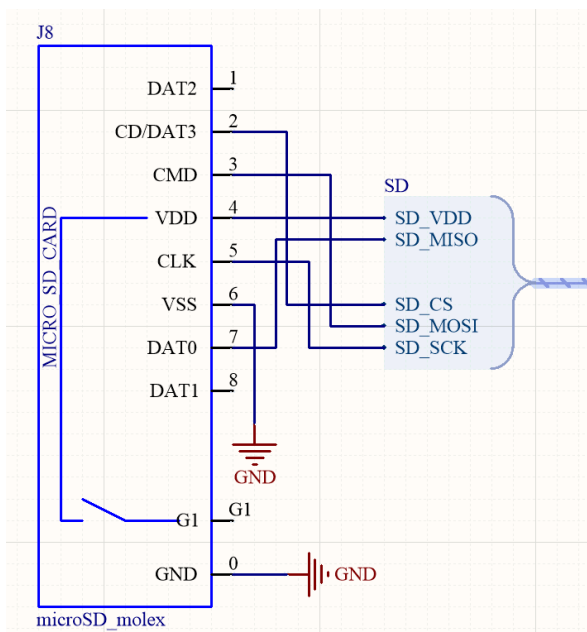
8.1 SD-Card

8.2.1 Description

The SensiLPWAN 1.0 module supports working with external SD-Card via SPI interface.

8.2.2 Connections and signal

Figure 31 – SD-Card, Schematic Connections



8.2 W25Q80DV: Serial FLASH Memory

8.2.1 Description

The W25Q80DV (8M-bit) Serial Flash memory provides a storage solution for systems with limited space, pins and power. The 25Q series offers flexibility and performance well beyond ordinary Serial Flash devices. They are ideal for code shadowing to RAM, executing code directly from Dual/Quad SPI (XIP) and storing voice, text and data. The W25Q80DV operates on a single 2.7V to 3.6V power supply with current consumption as low as 1 μ A for power-down.

The W25Q80DV array is organized into 4,096 programmable pages of 256-bytes each. Up to 256 bytes can be programmed at a time. Pages can be erased in groups of 16 (4KB sector erase), groups of 128 (32KB block erase), groups of 256 (64KB block erase) or the entire chip (chip erase). The W25Q80DV has 256 erasable sectors and 16 erasable blocks

respectively. The small 4KB sectors allow for greater flexibility in applications that require data and parameter storage.

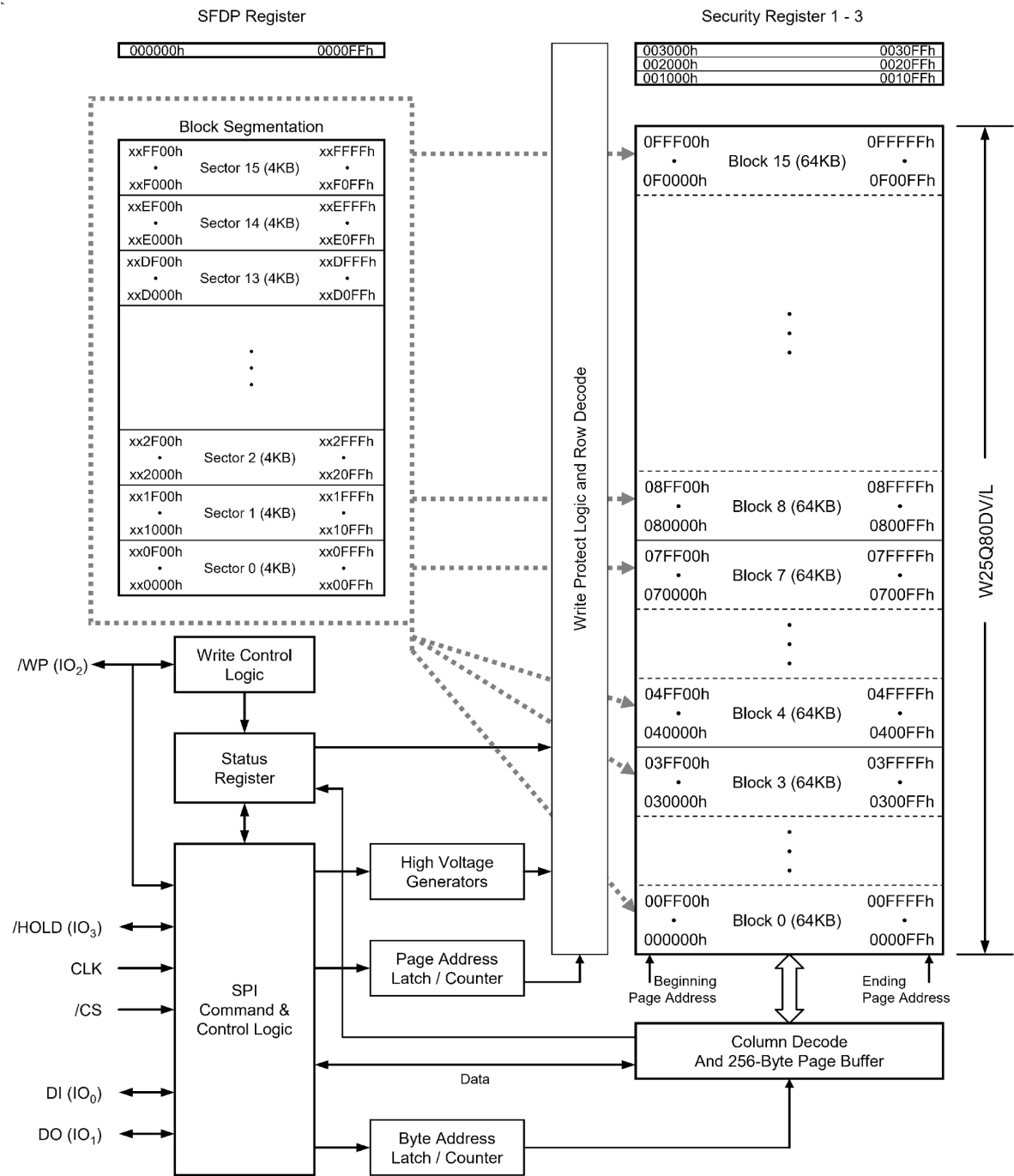
The W25Q80DV supports the standard Serial Peripheral Interface (SPI), and a high performance Dual/Quad output as well as Dual/Quad I/O SPI: Serial Clock, Chip Select, Serial Data I/O0 (DI), I/O1 (DO), I/O2 (/WP), and I/O3 (/HOLD). SPI clock frequencies of up to 104MHz are supported allowing equivalent clock rates of 208MHz (104MHz x 2) for Dual I/O and 416MHz (104MHz x 4) for Quad I/O when using the Fast Read Dual/Quad I/O instructions. These transfer rates can outperform standard Asynchronous 8 and 16-bit Parallel Flash memories. A Hold pin, Write Protect pin and programmable write protection, with top, bottom or complement array control, provide further control flexibility. Additionally, the device supports JEDEC standard manufacturer and device identification with a 64-bit Unique Serial Number.

8.2.2 Features

- Family of SpiFlash Memories
 - W25Q80DV: 8M-bit/1M-byte (1,048,576)
 - 256-byte per programmable page
 - Standard SPI: CLK,/CS,DI,DO,/WP,/Hold
 - Dual SPI: CLK, /CS, IO0, IO1, /WP, /Hold
 - Quad SPI: CLK, /CS, IO0, IO1, IO2, IO3
 - Uniform 4KB Sectors, 32KB & 64KB Blocks
- Highest Performance Serial Flash
 - W25Q80DV
 - 104MHz Dual/Quad SPI clocks
 - 208/416MHz equivalent Dual/Quad SPI
 - 50MB/S continuous data transfer rate
- Software and Hardware Write Protection
 - Write-Protect all or portion of memory
 - Enable/Disable protection with /WP pin
 - Top or bottom array protection
- Flexible Architecture with 4KB sectors
 - Uniform Sector/Block Erase (4/32/64-kbytes)
 - Erase/Program Suspend & Resume
 - More than 100,000 erase/write cycles
 - More than 20-year data retention
- Low Power, Wide Temperature Range
 - W25Q80DV: Single 2.7 to 3.6V supply
 - <1µA Power-down(typ.)
- Advanced Security & Identification Features
 - Software and Hardware Write-Protect
 - Top/Bottom, 4KB complement array protection
 - Power Supply Lock-Down and OTP protection
 - 64-Bit Unique ID for each device
 - Discoverable Parameters (SFDP) Register
 - 3X256-Byte Security Registers with OTP locks
 - Volatile & Non-volatile Status Register Bits

8.2.3 Block Diagram

Figure 32 - W25Q80DV, Block Diagram



8.2.4 Connections and Signals

Figure 33 - W25Q80DV, Schematic Connections

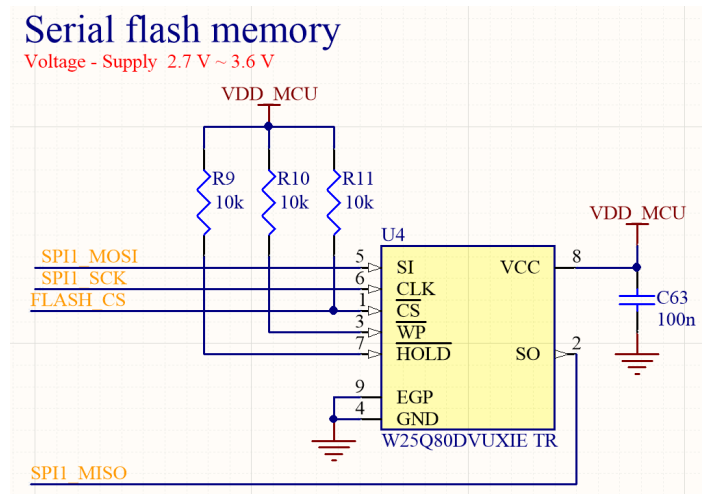


Table 13 - W25Q80DV, Pin Assignment

Pin#	Name	Function
1	/CS	Chip Select Input
2	DO (IO1)	Data Output (Data Input Output 1) ⁽¹⁾
3	/WP (IO2)	Write Protect Input (Data Input Output 2) ⁽²⁾
4	GND	Ground
5	DI (IO0)	Data Input (Data Input Output 0) ⁽¹⁾
6	CLK	Serial Clock Input
7	/HOLD (IO3)	Hold Input (Data Input Output 3) ⁽²⁾
8	VCC	Power Supply

Notes:

1. IO0 and IO1 are used for Standard and Dual SPI instructions
2. IO0 – IO3 are used for Quad SPI instructions, /HOLD (or /RESET) function is only available for Standard/Dual SPI.

9 Absolute Maximum Characteristics

TBD

10 Operational Characteristics

10.1 Power supplies

TBD

10.2 Power Consumption

TBD

11 DC Electrical Characteristics

TBD

12 Environmental Specifications

TBD

13 Mechanical Drawings

13.1 SensiLPWAN 1.0 Module: SIMUB-LG

Dimensions of the SensiLPWAN 1.0 Module are shown on figures 34 - 35.

Figure 34 – SensiLoRa1.1, Top View [mm]

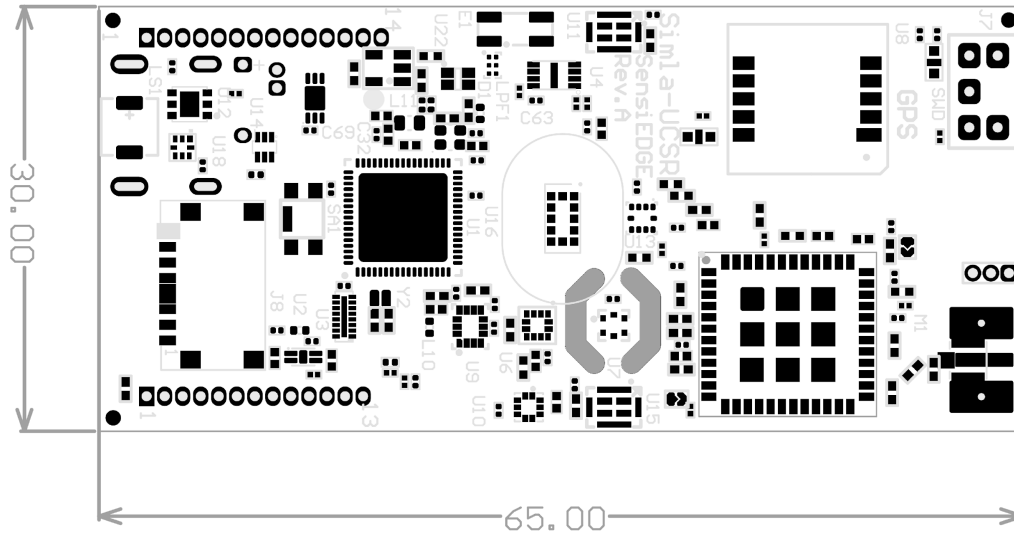


Figure 35 – SensiLoRa1.1, Down View

