General Description

BDE-SG1311P3U/BDE-SG1311P3N is a multiprotocol Sub-1 GHz wireless module supporting IEEE 802.15.4g, IPv6-enabled smart objects (6LoWPAN), mioty, Wi-SUN®, proprietary systems, including the TI 15.4-Stack (Sub-1 GHz). The module is based on an Arm® Cortex® M4 main processor and optimized for low-power wireless communication and advanced sensing in grid infrastructure, building automation, retail automation, personal electronics and medical applications.

BDE-SG1311P3U/BDE-SG1311P3N has a software defined radio powered by an Arm® Cortex® M0, which allows support for multiple physical layers and RF standards. The module supports 915/868-MHz bands by default. If you want other bands in Sub-1 GHz to be supported, you can contact us for the customization. The module has an efficient built-in PA that supports +14 dBm TX at 24.9 mA and +20 dBm TX at 64 mA. In RX it has -121 dBm sensitivity and 88 dB blocking ±10 MHz in TI's SimpleLink™ long-range mode with 2.5-kbps data rate.

The module has a low sleep current of 0.7 µA with RTC and 32KB RAM retention.

The module has two options for antenna connection, on board U.FL connector (Part number: BDE-SG1311P3U) and RF pad output (Part number: BDE-SG1311P3N). The overall dimension of the module is 24.9 mm x 19 mm x 2.15 mm.

Key Features

- **Wireless microcontroller**
  - Powerful 48-MHz Arm® Cortex®-M4 processor
  - 352KB flash program memory
  - 32KB of ultra-low leakage SRAM
  - 8KB of Cache SRAM (Alternatively available as general-purpose RAM)
  - Programmable radio includes support for 2-(G)FSK, 4-(G)FSK, MSK, OOK, IEEE 802.15.4 PHY and MAC
  - Supports over-the-air upgrade (OTA)
- **Low power consumption**
  - MUC consumption
    - 2.63 mA active mode, CoreMark
    - 55 µA/MHz running CoreMark
    - 0.8 µA standby mode, RTC, 32KB RAM
    - 0.1 µA shutdown mode, wake-up on pin
  - Radio Consumption:
    - 5.4 mA RX at 868 MHz
    - 24.9 mA TX at +14 dBm at 868 MHz
    - 64 mA TX at +20 dBm at 915 MHz
- **Wireless protocols support**
  - mioty
  - Wireless M-Bus

- SimpleLink™ TI 15.4-stack
- 6LoWPAN
- Proprietary systems
- **High performance radio**
  - -121 dBm for 2.5-kbps long-range mode
  - -118 dBm at 9.6 kbps narrowband mode, 868 MHz
  - -110 dBm at 50 kbps, 802.15.4, 868 MHz
  - Output power up to +20 dBm with temperature compensation
  - Down to 4 kHz receiver filter bandwidth
- **Peripherals**
  - 23 GPIOs
  - Digital peripherals can be routed to any GPIO
  - Four 32-bit or eight 16-bit general-purpose timers
  - 12-bit ADC, 200 kSamples/s, 8 channels
  - 8-bit DAC
  - Two comparators
  - Programmable current source
  - UART, SSI, I2C, I2S
  - Real-time clock (RTC)
  - Integrated temperature and battery monitor

- Security enablers
  - AES 128-bit cryptographic accelerator
  - True random number generator (TRNG)
  - Additional cryptography drivers available in Software Development Kit (SDK)
- Operating range
  - On-chip buck DC/DC converter
  - 1.8-V to 3.8-V single supply voltage
  - -40 to +85°C (By default)
  - -40 to +105°C (Contact for customization)
- Antenna
  - On board U.FL connector (Part Number: BDE-SG1311P3U)
  - RF pad output (Part Number: BDE-SG1311P3N)
- Dimension
  - 24.9 mm x 19 mm x 2.15 mm
- Standards Conformance
  - CE-RED (Europe)
  - FCC (US)
  - ISED (Canada)

Applications

- Grid infrastructure
  - Smart Meters – electricity meter, water meter, gas meter, and heat cost allocator
  - Grid communications – wireless communications
  - EV charging infrastructure – AC charging (pile) station
  - Other alternative energy – energy harvesting
- Building automation
  - Building security systems – motion detector,
  - Door and window sensor, glass break detector, panic button, electronic smart lock and IP network camera

- HVAC systems – thermostat, environmental sensor and HVAC controller
  - Fire safety – smoke and head detector, gas detector and fire alarm control panel
- Retail automation
  - Retail automation & payment application – electronic shelf labels andportable POS terminal
- Personal electronics
  - RF remote controls
  - Smart speakers and smart displays
  - Gaming and electronic and robotic toys
  - Wearables (non-medical) and smart trackers

Contents

1. Reference

TBD

2. Block Diagram

BDE-SG1311P3U/BDE-SG1311P3N is a power-optimized true system-on-chip (SoC) module. With a 48-MHz and a 32.768-KHz slow clock XTAL and all the passives components, it allows faster time to market at reduced development cost. The module has two options for the antenna connections. One is on board U.FL connector, user can attached a 915/868-MHz external antenna through the connector, but to remember to use the antenna with RP-SMA (Reverse Polarity SMA) connector because this is restricted by the antenna requirement by FCC and ISED. The other option is to connect the antenna through the RF pad to the module on the application board.
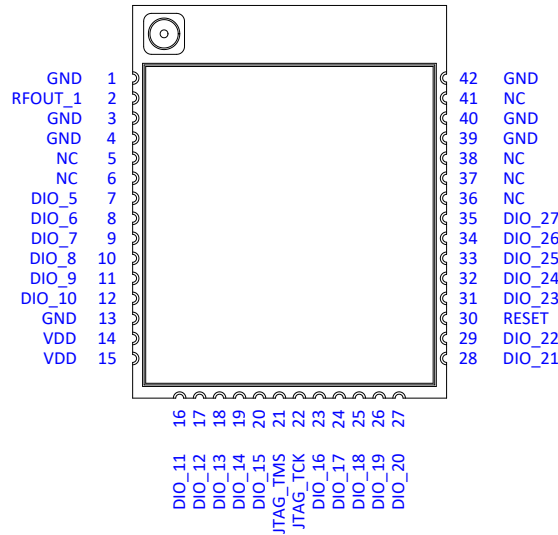
3. Pinout

Figure 2-1. Pinout Diagram Top View

Table 2-1 describes the definitions of the pins.

Table 2-1. Pin Description

Pin #	Pin Name	Type	Description
1	GND	GND	Ground
2	RFOUT_1	AIO	RF pad out, connect with a 50 ohm antenna if used
3	GND	GND	Ground
4	GND	GND	Ground
5	NC (Note 1)	-	NC
6	NC	-	NC
7	DIO_5	DIO	Digital GPIO, high-drive capability
8	DIO_6	DIO	Digital GPIO, high-drive capability
9	DIO_7	DIO	Digital GPIO, high-drive capability
10	DIO_8	DIO	Digital GPIO
11	DIO_9	DIO	Digital GPIO
12	DIO_10	DIO	Digital GPIO
13	GND	GND	Ground
14	VDD	Power	Power supply(Note 2)
15	VDD	Power	Power supply
16	DIO_11	DIO	Digital GPIO
17	DIO_12	DIO	Digital GPIO
18	DIO_13	DIO	Digital GPIO
19	DIO_14	DIO	Digital GPIO
20	DIO_15	DIO	Digital GPIO
21	JTAG_TMS	DIO	JTAG TMSC, high-drive capability
22	JTAG_TCK	DI	JTAG TCKC

Pin #	Pin Name	Type	Description
23	DIO_16	DIO	GPIO, JTAG_TDO, high-drive capability
24	DIO_17	DIO	GPIO, JTAG_TDI, high-drive capability
25	DIO_18	DIO	Digital GPIO
26	DIO_19	DIO	Digital GPIO
27	DIO_20	DIO	Digital GPIO
28	DIO_21	DIO	Digital GPIO
29	DIO_22	DIO	Digital GPIO
30	RESET	DI	Reset, active low. Internal 100K ohm pull-up resistor and 0.1uF decoupling capacitor
31	DIO_23	DIO, AI	Digital GPIO, Analog Input
32	DIO_24	DIO, AI	Digital GPIO, Analog Input
33	DIO_25	DIO, AI	Digital GPIO, Analog Input
34	DIO_26	DIO, AI	Digital GPIO, Analog Input
35	DIO_27	DIO, AI	Digital GPIO, Analog Input
36	NC	-	NC
37	NC	-	NC
38	NC	-	NC
39	GND	GND	Ground
40	GND	GND	Ground
41	NC	-	NC
42	GND	GND	Ground

Note 1: NC stands for No Connect; DI stands for Digital Input; DIO stands for Digital Input-Output; AI stands for Analog Input; AIO stands for Analog Input-Output.

Note 2: Refer to 4.2 for recommended operating voltage.

4. Characteristics

All MIN/MAX specification limits are guaranteed by design, production testing and/or statistical characterization. Typical values are based on characterization results at default measurement conditions and are informative only.

Default measurement conditions (unless otherwise specified): V_{DDS} = 3.3 V, T_A = 25 ℃. All radio measurements are performed with standard RF measurement equipment.

4.1. Absolute Maximum Ratings

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, so functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification are not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Table 4-1. Absolute Maximum Ratings

Parameter	Description	Conditions		Min	Max	Unit
V_{DDS}	Supply voltage	-		-0.3	4.1	V
V_{DIO}	Voltage on any digital pins	-		-0.3	VDDS+0.3, max 4.1	V
V_{AI}	Voltage on ADC input pins	Voltage scaling enabled	-	-0.3	VDDS	V
		Voltage scaling disabled, internal reference	-	-0.3	1.49	
		Voltage scaling disabled, VDDS as reference	-	-0.3	VDDS/2.9	
T_{STG}	Storage temperature		-	-40	150	°C

4.2. Recommended Operating Conditions

Table 4-2. Recommended Operating Conditions

Parameter	Description	Conditions	Min	Typ	Max	Unit
V_{DDS}	Regular	-	1.8	3.3	3.8	V
	Boost mode, VDDR=1.95V, +14 dBm RF output sub-1 GHz power amplifier	-	2.1	3.3	3.8	
	Boost mode, VDDR=1.95V, +20 dBm RF output high power amplifier	-	3.3	3.3	3.8	
T_A	Operating temperature	-	-40	25	85[Note 1]	°C

Note 1: The module can operate at 105°C, please contact for customization.

5. Mechanical Specifications

5.1. Dimensions

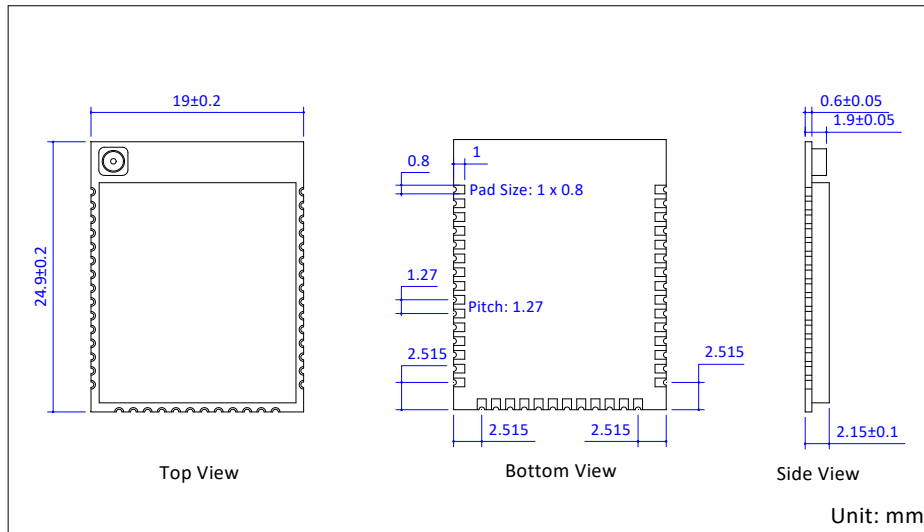The module dimensions are presented in the following figure:

Figure 5-1. Mechanical Drawing

5.2. PCB Footprint

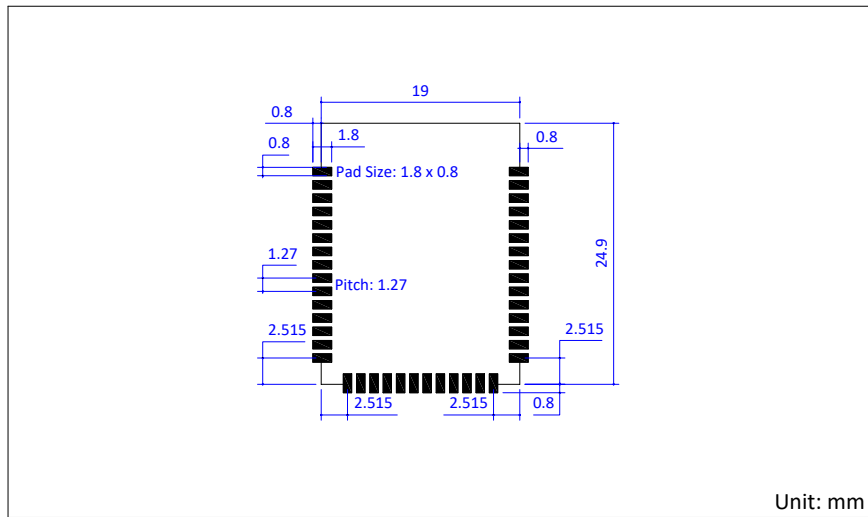The footprint for the PCB is presented in the following figure:

Figure 5-2. Module Footprint Top View

6. Ordering Information

Part Number	Description	Size (mm)	Package	MOQ
BDE-SG1311P3U	Sub-1 GHz wireless module with PA, operating at 915/868-MHz, with U.FL connector on module	24.9 × 19 × 2.15	Tape & Reel	1000
BDE-SG1311P3N	Sub-1 GHz Wireless Module with PA, operating at 915/868-MHz, with RF pad out	24.9 × 19 × 2.15	Tape & Reel	1000

7. Revision History

Revision	Date	Description
V0.1	18-Jan-2022	Preliminary
V1.0	01-Dec-2022	Further

FCC Warning

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules
FCC Part 15.247

2.3 Specific operational use conditions
This transmitter/module and its antenna(s) must not be co-located or operating in conjunction with any transmitter.
This information also extends to the host manufacturer's instruction manual.

2.4 Limited module procedures
Not applicable

2.5 Trace antenna designs
It is "not applicable" as trace antenna which is not used on the module.

2.6 RF exposure considerations
This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This compliance to FCC radiation exposure limits for an uncontrolled environment, and minimum of 20cm separation between antenna and body.
The host product manufacturer would provide the above information to end users in their end-product manuals.

2.7 Antennas

Frequency Band	902-928MHz
Antenna Designation	Whip Antenna
Antenna Gain	3.5dBi

2.8 Label and compliance information

The end product must carry a physical label or shall use e-labeling followed KDB784748D01 and KDB 784748 stating "Contains Transmitter Module FCC ID: 2ABRU-SG1311P3".

2.9 Information on test modes and additional testing requirements

For more information on testing, please contact the manufacturer.

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for the specific rule parts (FCC Part 15.247) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed when contains digital circuity.

FCC Statements

(OEM) Integrator has to assure compliance of the entire end-product incl. the integrated RF Module. For 15 B (§15.107 and if applicable §15.109) compliance, the host manufacturer is required to show compliance with 15 while the module is installed and operating.

Furthermore the module should be transmitting and the evaluation should confirm that the module's intentional emissions (15C) are compliant (fundamental / out-of-band). Finally the integrator has to apply the appropriate equipment authorization (e.g. Verification) for the new host device per definition in §15.101.

Integrator is reminded to assure that these installation instructions will not be made available to the end-user of the final host device.

The final host device, into which this RF Module is integrated" has to be labeled with an auxiliary label stating the FCC ID of the RF Module, such as "Contains FCC ID: 2ABRU-SG1311P3

"This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:
(1)this device may not cause harmful interference, and
(2)this device must accept any interference received, including interference that may cause undesired operation."

"Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment."

The Integrator will be responsible to satisfy SAR/ RF Exposure requirements, when the module integrated into the host device.

Module statement

The single-modular transmitter is a self-contained, physically delineated, component for which compliance can be demonstrated independent of the host operating conditions, and which complies with all eight requirements of § 15.212(a)(1) as summarized below.

1) The radio elements have the radio frequency circuitry shielded.
2) The module has buffered modulation/data inputs to ensure that the device will complywith Part 15 requirements with any type of input signal.
3) The module contains power supply regulation on the module.
4) The module contains a permanently attached antenna.
5) The module demonstrates compliance in a stand-alone configuration.
6) The module is labeled with its permanently affixed FCC ID label.
7) The module complies with all specific rules applicable to the transmitter, including all the conditions provided in the integration instructions by the grantee.
8) The module complies with RF exposure requirements.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help

IC Statements

The final host device, into which this RF Module is integrated" has to be labeled with an auxiliary label stating the IC of the RF Module, such as" Contains transmitter module IC: 25657-SG1311P3
Le périphériquehôte final, danslequelce module RF estintégré "doitêtreétiqueté avec uneétiquetteauxiliaireindiquant le CI du module RF, tel que" Contient le module émetteur IC: 25657-SG1311P3

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:
(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licencecontenudans le présentappareilestconforme aux CNR d'Innovation, Sciences et Développementéconomique Canada applicables aux appareils radio exempts de licence. L'exploitationestautorisée aux deux conditions suivantes :

(1) L' appareil ne doit pas produire de brouillage;
(2) L' appareildoit accepter tout brouillageradioélectriquesubi, mêmesi le brouillageest susceptible d' encompromettre le fonctionnement.

RF Exposure Warning Statements:
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.
This equipment shall be installed and operated with minimum distance 20cm between the radiator & body.

Radio Frequency Exposure Statement for IC:The device has been evaluated to meet general RF exposure requirements. The device can be used in mobile exposure conditions. The min separation distance is 20cm.

Déclaration d'exposition aux radiofréquences pour IC:
L'appareil a été évalué pour répondre aux exigences générales en matière d'exposition aux RF. L'appareil peut être utilisé dans des conditions d'exposition mobiles. La distance de séparation minimale est de 20 cm.

This radio transmitter [IC: 25657-SG1311P3] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Cet émetteur radio [IC: 25657-SG1311P3] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne répertoriés, avec le gain maximal autorisé indiqué. Les types d'antenne non inclus dans cette liste qui ont un gain supérieur au gain maximum indiqué pour tout type répertorié sont strictement interdits pour une utilisation avec cet appareil.

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