

General Description

The BDE-SG13R is a low power, multiprotocol Sub-1 GHz wireless module series that provides a series of variants for users, including different MCU cores, different memory size, different antenna options and external SPI flash options. Please refer to Table 1-1 for variant details.

The module series supports IEEE 802.15.4, IPv6-enabled smart objects (6LoWPAN), Wireless M-Bus, Wi-SUN, Amazon Sidewalk, mioty, proprietary systems, and TI 15.4-Stack (Sub-1 GHz). The module is based on an Arm® Cortex® M33 main processor and optimized for low-power wireless communication and advanced sensing in building security systems, HVAC, smart meters, medical, wired networking, gateways and grid communications, home theater & entertainment, and connected peripherals markets.

The device supports industry standard frequency bands (868MHz, 915MHz) to meet the industrial needs. The module has an efficient built-in PA that supports +14 dBm TX at 25.8 mA current consumption, In RX it has -121 dBm sensitivity in SimpleLink™ long-range mode.

The module has a low standby current of 0.98 μ A and full RAM retention. Consistent with many customers' 10 to 15 years or longer life cycle requirements. BDE-SG13R integrates all required system-level hardware components including clocks, passives and low-cost PCB design.

Table 1-1. Module Variants

Orderable Part Number	Chipset	Flash (KB)	SRAM (KB)	Antenna on Sub-1G	Operating Temperature (°C)	On-Board SPI Nor Flash Support	
BDE-SG1314R10U32	CC1314R10	1024	288	U.FL Connector	-40°C ~ 85°C	32Mbit	
BDE-SG1314R10N32				ANT Pin		Not Included	
BDE-SG1314R10U0				U.FL Connector			
BDE-SG1314R10N0				ANT Pin			
BDE-SG1314R10U32-IN				U.FL Connector	-40°C ~ 105°C		32Mbit
BDE-SG1314R10N32-IN				ANT Pin			Not Included
BDE-SG1314R10U0-IN				U.FL Connector			
BDE-SG1314R10N0-IN				ANT Pin			
BDE-SG1312R7U32				CC1312R7	704	144	U.FL Connector
BDE-SG1312R7N32	ANT Pin	Not Included					
BDE-SG1312R7U0	U.FL Connector						
BDE-SG1312R7N0	ANT Pin						
BDE-SG1312R7U32-IN	U.FL Connector		-40°C ~ 105°C				32Mbit
BDE-SG1312R7N32-IN	ANT Pin						Not Included
BDE-SG1312R7U0-IN	U.FL Connector						
BDE-SG1312R7N0-IN	ANT Pin						
BDE-SG1311R3U32	CC1311R3	352	32				U.FL Connector
BDE-SG1311R3N32				ANT Pin	Not Included		
BDE-SG1311R3U0				U.FL Connector			
BDE-SG1311R3N0				ANT Pin			
BDE-SG1311R3U32-IN				U.FL Connector		-40°C ~ 105°C	32Mbit
BDE-SG1311R3N32-IN				ANT Pin			Not Included
BDE-SG1311R3U0-IN				U.FL Connector			
BDE-SG1311R3N0-IN				ANT Pin			

Note: This module series supports extended industrial temperature grade which can operates from -40°C to 105°C. The part number should comes with “-IN” suffix. For example, the part number BDE-SG1314R10U32-IN is the extended industrial temperature grade version.

Key Features

- Wireless microcontroller
 - Powerful 48-MHz Arm® Cortex®-M33 (CC1314R10) or Cortex®-M4F (CC1312R7) or Cortex®-M4 (CC1311R3)
 - 1024kB (CC1314R10) or 704kB (CC1312R7) or 352kB (CC1311R3) flash program memory
 - 8kB of Cache SRAM
 - 288kB (CC1314R10) or 144kB (CC1312R7) or 32kB (CC1311R3) of ultra-low leakage SRAM
 - Dynamic multiprotocol manager (DNM) driver
 - Supports over-the-air upgrade (OTA)
- Ultra-Low power sensor controller
 - Autonomous MCU with 4kB of SRAM
 - Sample, store, and process sensor data
 - Fast wake-up for low-power operation
 - Software defined peripherals; capacitive touch, flow meter, LCD
- Low power consumption
 - MCU consumption:
 - ✧ 3.4 mA active mode, CoreMark®
 - ✧ 71 µA/MHz running CoreMark
 - ✧ 0.98 µA standby mode, RTC, 256KB RAM
 - ✧ 0.17 µA shutdown mode, wake-up on pin
 - Ultra Low-power sensor controller consumption:
 - ✧ 30 µA in 2 MHz mode
 - ✧ 809 µA in 24 MHz mode
 - Radio Consumption:
 - ✧ 25.8 mA TX at 14 dBm at 868 MHz
- Wireless protocol support
 - Wi-SUN®
 - mioty®
 - Amazon Sidewalk (CC1314R10, CC1312R7)
 - Wireless M-Bus
 - SimpleLink™ TI 15.4-stack (Sub- 1 GHz)
 - Proprietary systems
- High performance radio
 - Coherent modem, 802.15.4 O-QPSK
 - -121 dBm for 2.5 kbps long-range mode
 - -110 dBm at 50 kbps, 802.15.4, 868 MHz
- Regulatory compliance (On-going)
 - FCC
 - IC
 - CE-RED
- MCU peripherals
 - Most digital peripherals can be routed to any GPIO
 - Four 32-bit or eight 16-bit general-purpose timers
 - 12-bit SAR ADC, 200 ksps, 8 channels
 - 8-bit DAC
 - Two Comparators
 - Programmable current source
 - Four UART, four SPI, two I²C, I²S
 - Real-time clock (RTC)
 - Integrated temperature and battery monitor
- Security enablers
 - Supports secure boot
 - Supports secure key storage and device ID
 - Arm TrustZone for trusted execution environment
 - AES 128- and 256-bit cryptographic accelerator
 - Public key accelerator
 - SHA2 accelerator (full suite up to SHA-512)
 - True random number generator (TRNG)
 - Secure debug lock
 - Software anti-rollback protection
- Operating range
 - On-chip buck DC/DC converter
 - 1.8-V to 3.8-V single supply voltage
 - -40 to +85°C
 - -40 to +105°C (-IN variants)
- Antenna: ANT pin or U.FL connector
- Package
 - Dimension: 22 mm x 15 mm x 2.15 mm
 - LCC-39 (30 GPIOs)
 - RoHS-compliant package

Applications

- 868, and 902 to 928 MHz ISM and SRD systems with down to 4 kHz of receive bandwidth
- Building automation
 - Building security systems – motion detector, electronic smart lock, door and window sensor, garage door system, gateway
 - HVAC – thermostat, wireless environmental sensor, HVAC system controller, gateway
 - Fire safety system – smoke and heat detector, fire alarm control panel (FACP)
 - Video surveillance – IP network camera
 - Elevators and escalators – elevator main control panel for elevators and escalators
- Grid infrastructure
 - Smart meters –water meter, gas meter, electricity meter, and heat cost allocator
 - Grid communications – wireless communications – Long-range sensor applications
- Other alternative energy – energy harvesting, solar inverters
- Industrial transport – asset tracking
- Factory automation and control
- Medical
- Electronic point of sale (EPOS) – Electronic Shelf Label (ESL)
- Personal Electronics
 - Connected peripherals – consumer wireless module
 - Home theater & entertainment – smart speakers, set-top box
 - Gaming
 - Wearables (non-medical)
- Wireless Modules
 - Wireless third party modules
 - Wireless communications modules

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1. References

- [1] CC1314R10 resources: <https://www.ti.com/product/CC1314R10>
- [2] CC1312R7 resources: <https://www.ti.com/product/CC1312R7>
- [3] CC1311R3 resources: <https://www.ti.com/product/CC1311R3>

2. Block Diagram

The module, as seen in Figure 2-1, comprises of:

- 48-MHz XTAL
- 32.768-kHz XTAL
- Power inductors and capacitors
- Pull-up resistor
- Passive balun filter
- Decoupling capacitors
- Matching circuit
- U.FL connector (optional)
- 32Mbit SPI flash memory (optional)

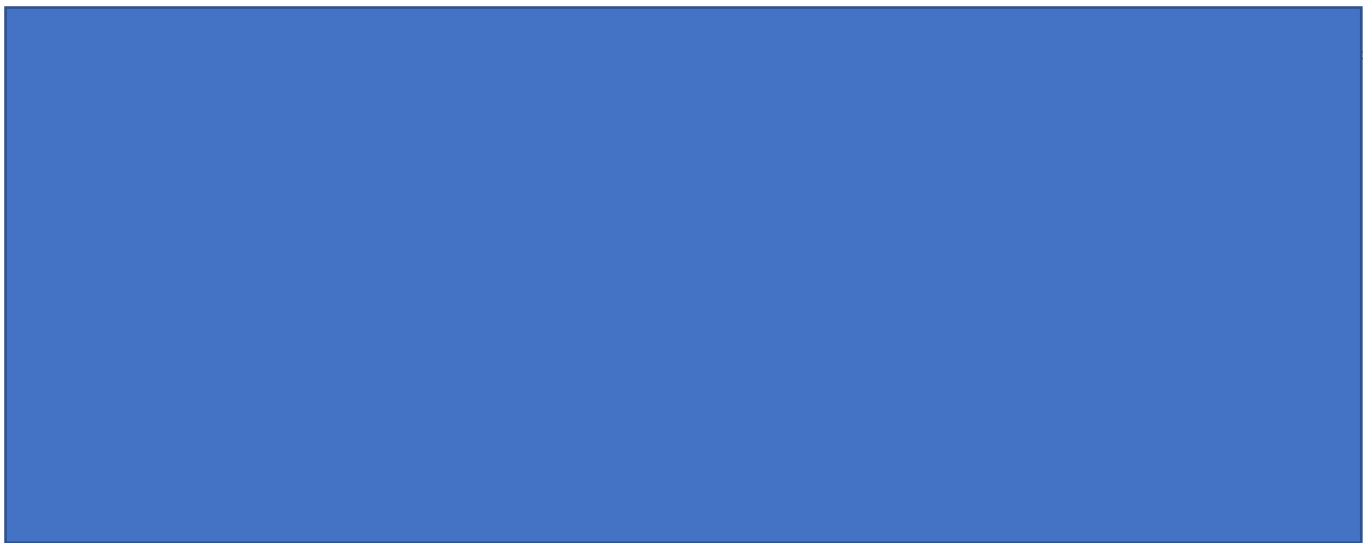


Figure 2-1. BDE-SG13R Module Block Diagram

3. Terminal Configuration and Functions

3.1. Pin Diagram

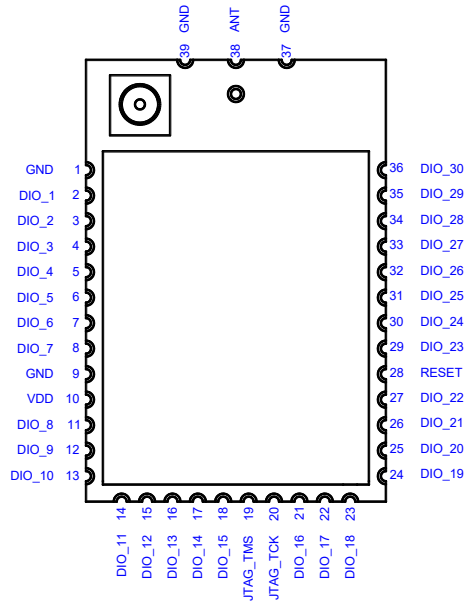


Figure 3-1. Pin Diagram (Top View)

3.2. Pin Attributes and Pin Multiplexing

Table 3-1 describes the definitions of the pins of the module. Pin number of the chip is also stated here, because the VQFN pin is referred to in the software design kit (SDK).

Table 3-1. Pin Description ⁽¹⁾

Module Pin #	Pin Name	Type	Chip Pin #	Description
1	GND	Ground	-	Power ground
2	DIO_1	I/O	6	GPIO, Sensor Controller
3	DIO_2	I/O	7	GPIO, Sensor Controller
4	DIO_3	I/O	8	GPIO, Sensor Controller
5	DIO_4	I/O	9	GPIO, Sensor Controller
6	DIO_5	I/O	10	GPIO, Sensor Controller, high-drive capability
7	DIO_6	I/O	11	GPIO, Sensor Controller, high-drive capability
8	DIO_7	I/O	12	GPIO, Sensor Controller, high-drive capability
9	GND	Ground	-	Power ground
10	VDD	Power	-	Power supply
11	DIO_8	I/O	14	GPIO
12	DIO_9	I/O	15	GPIO
13	DIO_10	I/O	16	GPIO
14	DIO_11	I/O	17	GPIO
15	DIO_12	I/O	18	GPIO
16	DIO_13	I/O	19	GPIO
17	DIO_14	I/O	20	GPIO
18	DIO_15	I/O	21	GPIO
19	JTAG_TMS	I/O	24	JTAG TMS, high-drive capability
20	JTAG_TCK	I	25	JTAG TCK
21	DIO_16	I/O	26	GPIO, JTAG_TDO, high-drive capability

Module Pin #	Pin Name	Type	Chip Pin #	Description
22	DIO_17	I/O	27	GPIO, JTAG_TDI, high-drive capability
23	DIO_18	I/O	28	GPIO
24	DIO_19	I/O	29	GPIO
25	DIO_20	I/O	30	GPIO
26	DIO_21	I/O	31	GPIO
27	DIO_22	I/O	32	GPIO
28	RESET	I	35	Reset, active-low
29	DIO_23	I/O	36	GPIO, Sensor Controller, analog capability
30	DIO_24	I/O	37	GPIO, Sensor Controller, analog capability
31	DIO_25	I/O	38	GPIO, Sensor Controller, analog capability
32	DIO_26	I/O	39	GPIO, Sensor Controller, analog capability
33	DIO_27	I/O	40	GPIO, Sensor Controller, analog capability
34	DIO_28	I/O	41	GPIO, Sensor Controller, analog capability
35	DIO_29	I/O	42	GPIO, Sensor Controller, analog capability
36	DIO_30	I/O	43	GPIO, Sensor Controller, analog capability
37	GND	Ground	-	Power ground
38	ANT	-	-	Antenna port (When disconnected with UFL, this port can be used)
39	GND	Ground	-	Power ground

4. Specifications

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.

PARAMETER	MIN	MAX	UNIT	Notes
VDD	-0.3	4.1	V	
Voltage on any digital pins	-0.3	VDD+0.3≤4.1	V	
Voltage on ADC input	-0.3	VDDS	V	Voltage scaling enabled
	-0.3	1.49	V	Voltage scaling disabled, internal reference
	-0.3	VDD/2.9	V	Voltage scaling disabled, VDD as reference
Storage temperature	-40	125	°C	

4.2. Recommended Operating Conditions

PARAMETER	MIN	TYP	MAX	UNIT	NOTE
VDD	1.8	3.3	3.8	V	
	2.3	3.3	3.8	V	SPI flash variants
Operating temperature	-40	-	85	°C	
	-40	-	105	°C	-IN variants
Rising supply voltage slew rate	0		100	mV/μs	
Falling supply voltage slew rate	0		20	mV/μs	

5. Mechanical Specifications

5.1. Dimensions

The following pages include mechanical, footprint drawings, and marking information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document.

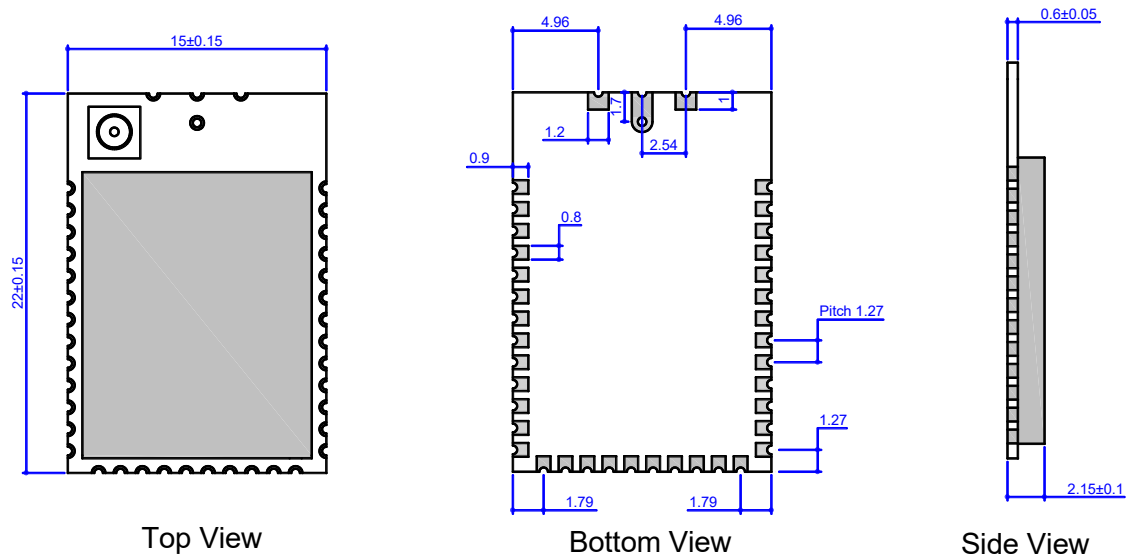
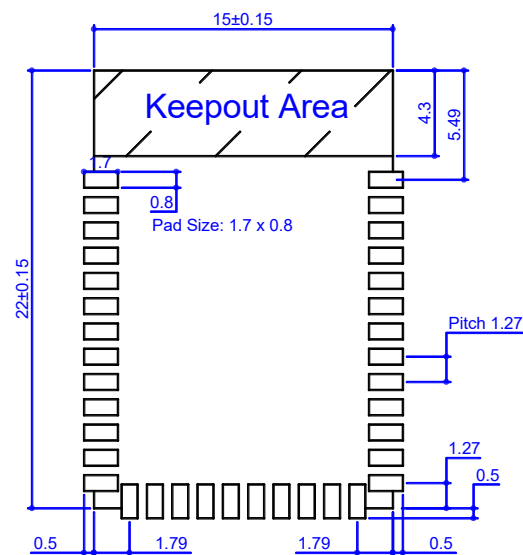


Fig 5-1. Mechanical Drawing

1.1 PCB Footprint



Note:

1. All dimensions are in millimeter
2. Solder mask should be the same or 5% larger than the dimension of the pad
3. Solder paste must be the same as the pin for all peripheral pads. For ground pins, make the solder paste 20% smaller than the pad.

Fig 5-2. Module Footprint Top View

6. Typical Reflow Profile

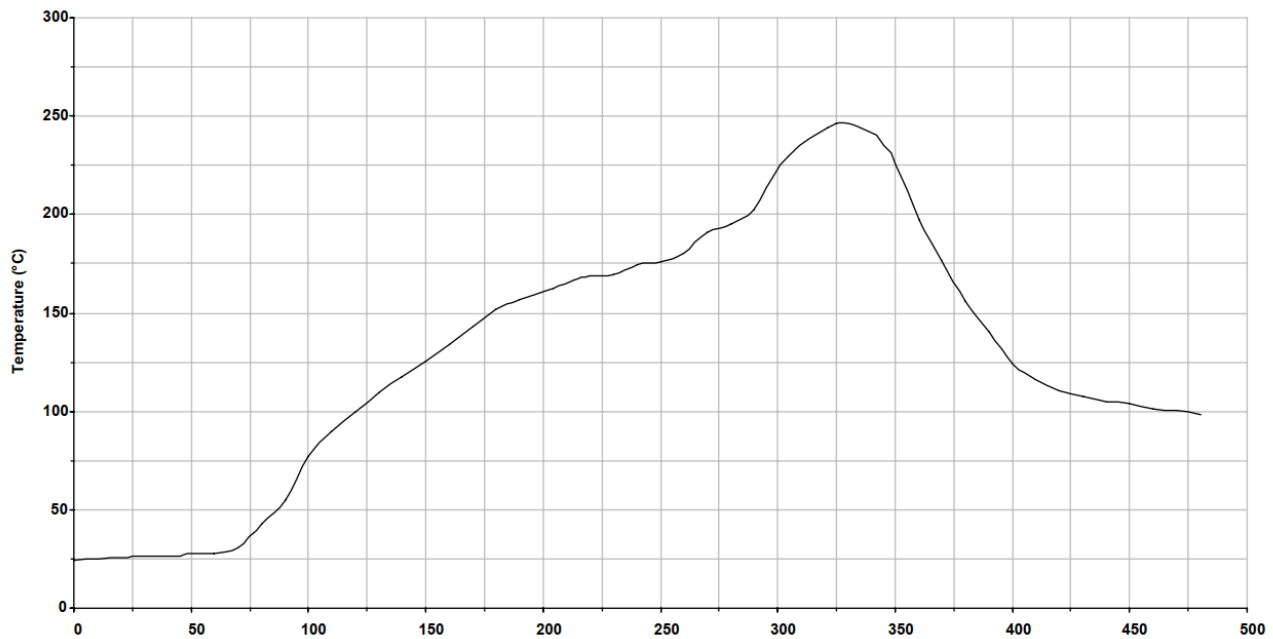


Figure 6-1. Typical Reflow Profile

Key features of the profile:

- Initial ramp = 1-2.5°C/sec to 175°C ±25°C equilibrium
- Equilibrium time = 60 to 180 seconds
- Ramp to maximum temperature (245°C) = 3°C/sec max.
- Time above liquidus temperature (217°C): 45-90 seconds
- Device absolute maximum reflow temperature: 260°C

7. Certification

7.1. Regulatory Compliance

The module is certified for FCC, IC/ISED and ETSI/CE as listed in below table. More regions can be cover by request.

Table 7-1. Certification Information

Regulatory Body / Region	ID	MPN
FCC (USA)	2ABRU-SG13R	BDE-SG1314R10U32
IC/ISED (Canada)	25657-SG13R	BDE-SG1314R10N32
ETSI/CE (Europe)	NA	BDE-SG1314R10U0
		BDE-SG1314R10N0
		BDE-SG1314R10U32-IN
		BDE-SG1314R10N32-IN
		BDE-SG1314R10U0-IN
		BDE-SG1314R10N0-IN
		BDE-SG1312R7U32
		BDE-SG1312R7N32
		BDE-SG1312R7U0
		BDE-SG1312R7N0
		BDE-SG1312R7U32-IN
		BDE-SG1312R7N32-IN
		BDE-SG1312R7U0-IN
		BDE-SG1312R7N0-IN
		BDE-SG1311R3U32
		BDE-SG1311R3N32
		BDE-SG1311R3U0
		BDE-SG1311R3N0
		BDE-SG1311R3U32-IN
		BDE-SG1311R3N32-IN
		BDE-SG1311R3U0-IN
		BDE-SG1311R3N0-IN

7.2. Antenna

Table 7-2. Certified Antenna List

Manufacturer	Manufacturer Part Number	Antenna Type	Frequency Range (MHz)	Gain (dBi)	Note
BDE	BDE-W89-20713-HRP	Whip antenna	863 - 870 902 - 928	3.8	External

7.3. FCC Compliance

7.3.1. FCC Statement

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.

7.3.2. FCC Caution

Any changes or modifications to this unit not expressly approved by BDE 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.

7.3.3. Integration Instructions

List of applicable FCC rules

FCC Part 15.247

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.

Limited module procedures

Not applicable

Trace antenna designs

Not applicable

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.

Antennas

Refer to Table 7-2

Label and compliance information

The end product must carry a physical label or shall use e-labeling followed KDB784748D01 and KDB784748 stating "Contains Transmitter Module FCC ID: 2ABRU-SG13R".

Information on test modes and additional testing requirements

Contact BDE for more information.

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 circuitry.

(OEM) Integrator has to assure compliance of the entire end-product that includes the 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.

7.4. IC/ISED Compliance

7.4.1. IC Statement

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference, and,
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- (1) L'appareil ne doit pas produire de brouillage;
- (2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

7.4.2. IC Caution

Any changes or modifications to this unit not expressly approved by BDE 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.

7.4.3. Integration Instructions

Label and compliance information

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-SG13R".

Informations sur l'étiquette et la conformité

Le périphérique hôte final, dans lequel ce module RF est intégré "doit être étiqueté avec une étiquette auxiliaire indiquant le CI du module RF, tel que "Contient le module émetteur IC: 25657-SG13R".

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. (TBD)

This radio transmitter [IC: 25657-SG13R] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed in Table 6, 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-SG13R] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous, avec le gain maximal admissible 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.

7.5. ETSI/CE Compliance

The module is certified with required EU radio and EMC directives. See Table 7-1 for detailed standards the module complies with, or refer to UK Declaration of Conformity.

8. Ordering Information

Part Number	Core Chip	Size (mm)	Operation Temperature	Shipping Form	MOQ
BDE-SG1314R10N32	CC1314R10	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1314R10U32	CC1314R10	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1314R10N32	CC1314R10	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1314R10U32	CC1314R10	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1314R10N32-IN	CC1314R10	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K
BDE-SG1314R10U32-IN	CC1314R10	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K
BDE-SG1314R10N32-IN	CC1314R10	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K
BDE-SG1314R10U32-IN	CC1314R10	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K
BDE-SG1312R7N32	CC1312R7	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1312R7U32	CC1312R7	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1312R7N32	CC1312R7	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1312R7U32	CC1312R7	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1312R7N32-IN	CC1312R7	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K
BDE-SG1312R7U32-IN	CC1312R7	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K
BDE-SG1312R7N32-IN	CC1312R7	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K
BDE-SG1312R7U32-IN	CC1312R7	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K
BDE-SG1311R3N32	CC1312R7	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1311R3U32	CC1312R7	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1311R3N32	CC1312R7	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1311R3U32	CC1312R7	22 × 15 × 2.15	-40 to +85°C	Tape & Reel	1K
BDE-SG1311R3N32-IN	CC1312R7	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K
BDE-SG1311R3U32-IN	CC1312R7	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K
BDE-SG1311R3N32-IN	CC1312R7	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K
BDE-SG1311R3U32-IN	CC1312R7	22 × 15 × 2.15	-40 to +105°C	Tape & Reel	1K

9. Revision History

Revision	Date	Description
V1.0	8-June-2023	Initial release

You can find the latest documentation from this [Link](#).

Important Notice and Disclaimer

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