



G01-SPIPXC User Manual

A. Product Overview

G01-SPIPXC is a 160mW industrial wireless data transceiver with high speed and high stability, operates at ISM band 2.4GHz. The module uses original Si24R1. It comes with high-performance IPEX antenna and accurate impedance matching. The module is equipped with a shielding cover to effectively enhance the anti-interference capability. It features enough power, good spectral properties, small harmonic wave, small cross talk, and super small volume. Some of the devices meet military grade standard.



B. Product Features

- Comes with IPEX antenna, transmission distance up to 2.0km^[1]
- Super low power consumption, the lowest power consumption is about 2uA
- Operation frequency 2.401-2.482GHz, a total of 82 channels
 - Frequency adjustable, 1MHz stepping
 - GFSK modulation
- 3 FIFO levels
 - Transmission length: 1-32 bytes each data packet
 - Receiving length: 1-32 bytes each data packet
 - Automatically resend mechanism
 - Support data transmission of 6 channels
- Communication interface
 - Hardware SPI interface of 4-Pin
 - 4Mbps data speed is recommended, Max speed is up to 10Mbps.
- Multiple levels of wireless data rate
 - 3 levels of wireless data rate are optional: ^[2] 250Kbps, 1Mbps, 2Mbps
- 4 power levels adjustable, the max power is about 16dBm
- The actual launch of EUT shall prevail ^[3]
- 4 operation modes ^[4]
 - Power down
 - Standby
 - Send
 - Receive
- Supply voltage range
 - 2.0V-3.6VDC
- Receiving sensibility
 - -95dBm (data speed 2Mbps)
 - -99dBm (data speed 1Mbps)
 - -108dBm (data speed 250Kbps)
- Ultra-small volume, SMD package
 - 13 * 19mm
 - Module weight is about 0.5g
- Ultra-small volume, in-line package
 - 12 * 19mm
 - Module weight is about 3.5g

Remarks:

1. Open, sunny, no obstacles; The max power, height 2m, data speed 250Kbps
2. The airspeed is higher, the distance is closer. The wireless data rate is lower, the distance is longer.
3. For transmitting power, please see chip manual of Si24R1
4. For four operation modes, please see chip manual Si24R1
5. Voltage higher than 3.6V will damage the module permanently

C. Electrical Parameters

Test condition: $T_c = 25^{\circ}\text{C}$, $V_{CC} = 3.3\text{V}$

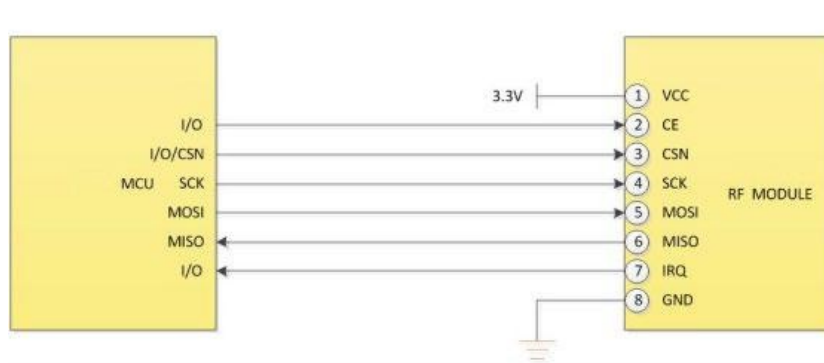
Parameter	Parameter name	Description	Min. value	Typic	Max. value	Unit
Voltage	Supply ^[1]		2.0		3.6	VDC
	Communication level	The communication level is generally smaller than the supply voltage, and VCC in $0.7 \times V_{CC}$ refers to the supply voltage.	$0.3 \times V_{CC}$		$0.7 \times V_{CC}$	V
Current	Transmitting current ^[2]			210		mA
	Receiving current	CE=1		28		mA
	Turn off current	Set Si24R1 as power down mode, CE is low level.		2		uA
RF Parameters	Operating frequency	Adjustable, 1MHz stepping	2.401		2.482	GHz
	Transmitting power	The actual launch of EUT shall prevail		/		dBm
	Receiving sensitivity	-96dBm@250kbps, receive sensitivity is detailed in the chip manual		-108		dBm
	Wireless data rate	3 data rate are available (250Kbps、1Mbps、2Mbps)	250K	250K	2M	bps
Operation Environment	Operating temperature	Industrial grade	-40		+85	$^{\circ}\text{C}$
	Operating humidity	Relative humidity, no condensation	10%		90%	
	Storage temperature		-40		+125	$^{\circ}\text{C}$

Remarks:

1. Voltage higher than 3.6V will damage the module. The lower the voltage, the lower the transmission power.
2. Power supply capability must be greater than 30mA.

D. Module Functions

5.1 Recommended Connection Diagram



5-1 connectivity diagram

1. High level CE is valid. When the module writes the register, it must first be set to power-down mode. It is recommended to connect CE to the IO port of the micro-controller.
2. IRQ is recommended to connect the external interrupt of the micro-controller. Alternatively, the SPI query mode can be used to obtain the interrupt status.
3. The Si24R1 technical manual requires that the high-level time of the CE pin is greater than 10us to start data transmission. However, to make the same code compatible with our G01 series modules with PA and LNA, it is recommended to change CE to high level after setting the SPI operation. After the completion of the transmission, continue to maintain a high level of 1ms, and then lower the CE.

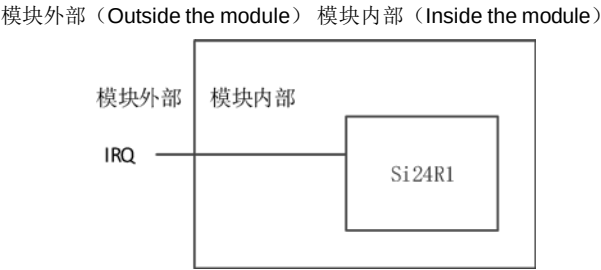
5.2 Pin Definition

Pin No.	Pin Name	Pin Direction	Pin Description
1	VCC		Power supply, range 1.9~3.6V, recommend 3.3V, it is recommended to add ceramic filter capacitors externally.
2	CE	input	Module control pin, please see Si24R1 datasheet for details
3	CSN	input	Module chip select pin, used to start an SPI communication
4	SCK	input	Module SPI bus clock
5	MOSI	input	Module SPI data input pin
6	MISO	output	Module SPI data output pin
7	IRQ	output	Module interrupt signal output, valid in low communication level
8	GND		Ground, connect to power reference ground

* See the Si24R1 data sheet for pin definitions, software drivers, and communication protocols of the module. *

5.3 Pin Function

Function of IRQ Pin



Picture 5-2 IRQ Local Connection Diagram

IRQ is an interrupt mapping pin, which is active at low level. Refer to the Si24R1 chip manual for the specific interrupt signal it represents.

CE pin function

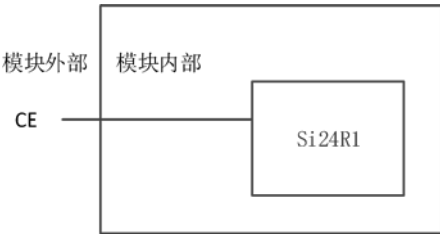
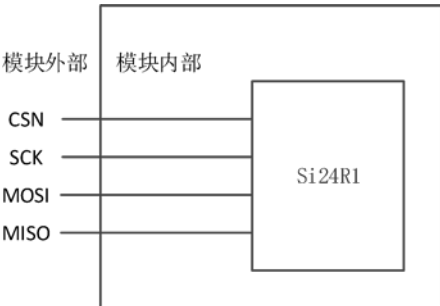


Figure 5-3 CE pin local connection diagram

The module control pin, the module's transmit mode (TXD) and receive mode (RXD) are determined by this pin. See the Si24R1 chip manual for details.

Function of SPI pin

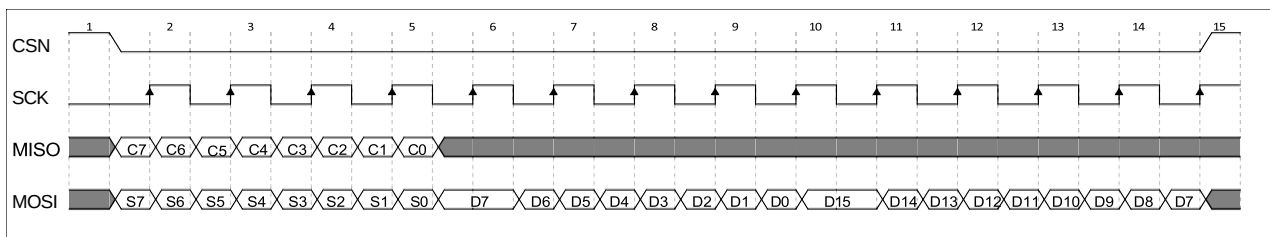


Picture 5-4 SPI local connection diagram

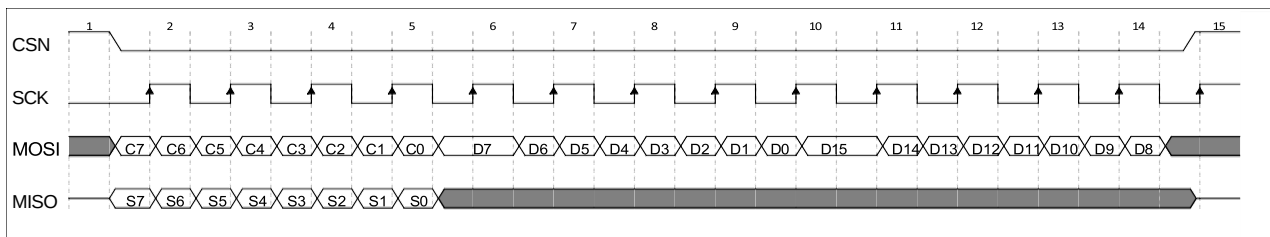
The SPI sequence diagram is as follows:

Abbr	Description
Cn	SPI command bit
Sn	Status register bit

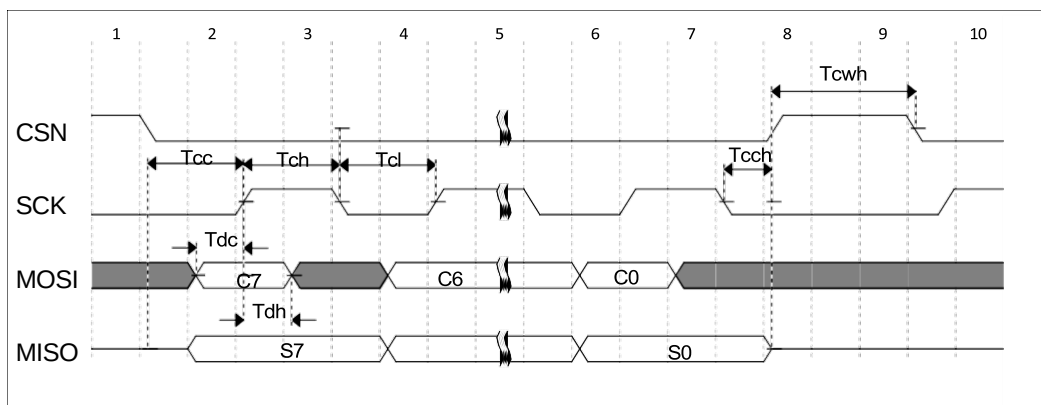
Dn	Data bit
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Picture 5-5 Sequence diagram of SPI read operation



Picture 5-6 Sequence diagram of SPI write operation

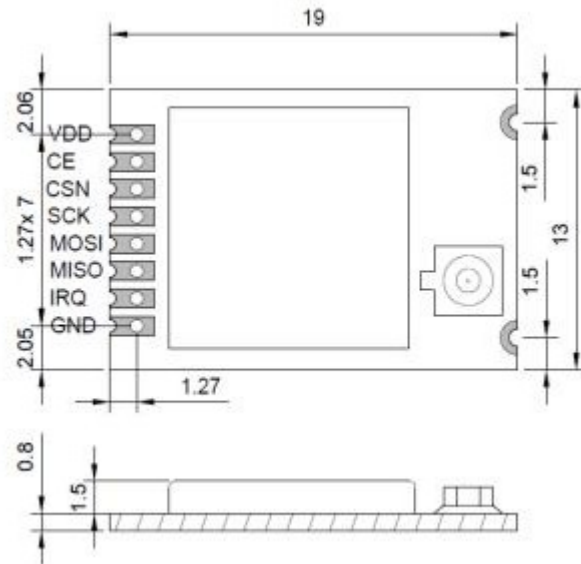


Picture 5-7 SPI sequence diagram of parameters

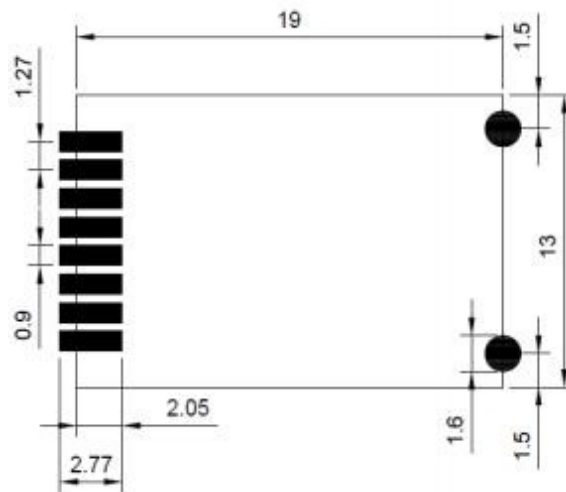
Parameters	Description	Min.	Max.	Unit
Symbols				
Tcc	Chip select clock setting	2		ns
Tch	Clock high level time	40		ns
Tcl	Clock low level time	40		ns
Tcch	The selection time lasts	2		ns
Tcwh	Chip selection idle time	50		ns
Tdc	Data initialization clock	2		ns
Tdh	Data duration	2		ns

E. Package Information

6.1 Overall dimension(unit: mm)

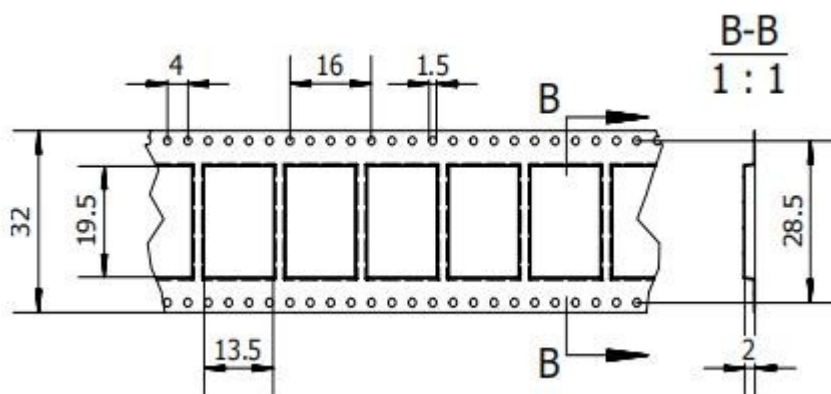
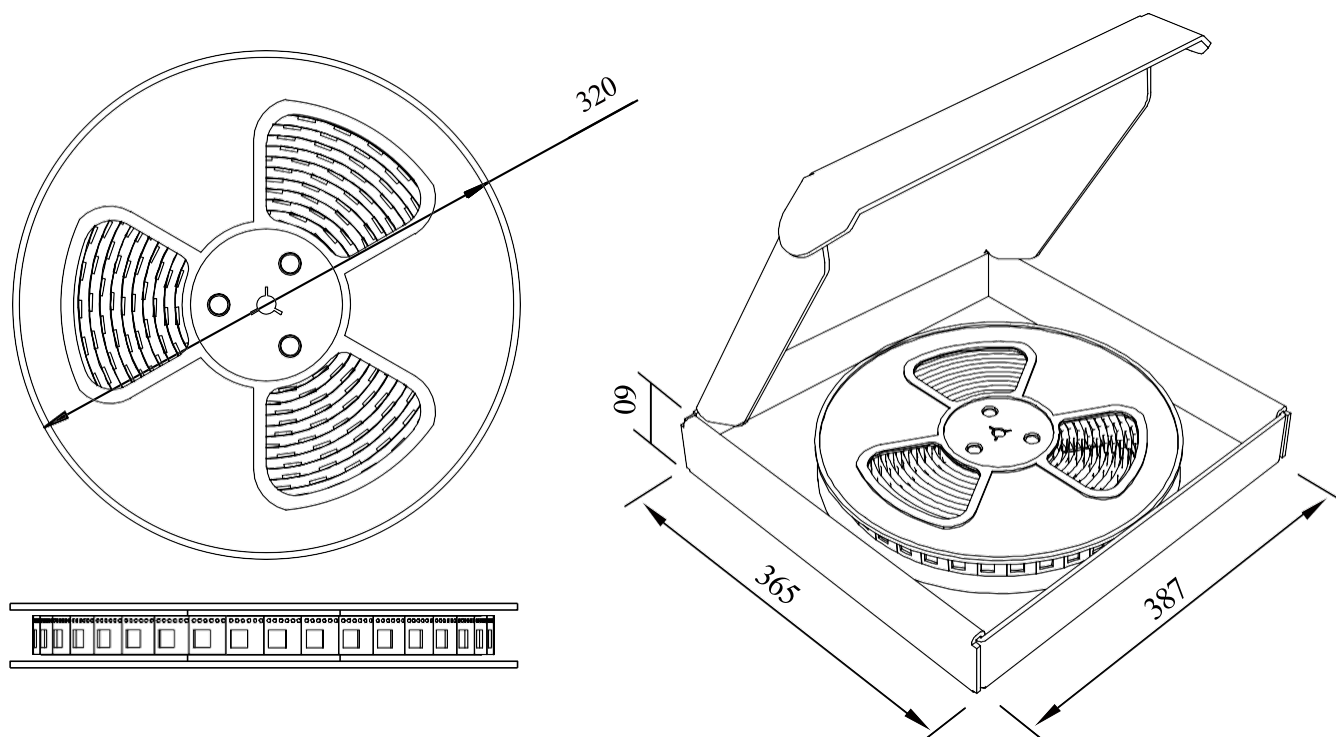


6.2 Reference Pad Design (unit: mm)



F. Package

7.1 Electrostatic Bag Package (unit: mm)



Important Remarks and Disclaimers

As the hardware and software of the product continue to improve, this manual may be subject to change, and the final version of the manual shall prevail.

Users of this product need to pay attention to the product dynamics on the official website, so that users can get the latest information of this product in time.

The pictures and diagrams used in this manual to explain the functions of this product are for reference only. The measured data in this specification are all measured by our company at room temperature for reference only. Please refer to the actual measurement for details.

Chengdu Gisemi Electronics Co., Ltd. reserves the right of final interpretation and modification of all contents in this manual.

FCC WARNING

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. 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.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

15.105 Information to the user.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

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.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

This transmitter must not be co-located or operating in conjunction with any other

antenna or transmitter.

The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination.

The firmware setting is not accessible by the end user.

The final end product must be labelled in a visible area with the following: "Contains Transmitter Module
"FCC ID: 2BH87-G01"

Requirement per KDB996369 D03

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section

2.10 below concerning the need to notify host manufacturers that further testing is required.3

Explanation: This module meets the requirements of FCC part 15C (15.247).it Specifically identified AC

Power Line Conducted Emission, Radiated Spurious emissions, Band edge and RF Conducted Spurious Emissions, Conducted Peak Output Power, Bandwidth, Power Spectral Density, Antenna Requirement.

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The product antenna uses an irreplaceable antenna with a gain of 3.47dBi

2.4 Single Modular

If a modular transmitter is approved as a "Single Modular," then the module manufacturer is responsible for approving the host environment that the Single Modular is used with. The manufacturer of a Single Modular must describe, both in the filing and in the installation instructions, the alternative means that the Single Modular manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A Single Modular manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited

module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This Single Modular procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module. Explanation: The module is a single module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna); b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered); c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout; d) Appropriate parts by manufacturer and specifications; e) Test procedures for design verification; and f) Production test procedures for ensuring compliance

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through

the change in FCC ID (new application) procedure followed by a Class II permissive change application

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: The module complies with FCC radiofrequency radiation exposure limits for uncontrolled environments. The device is installed and operated with a distance of more than 20 cm between the radiator and your body." This module follows FCC statement design, FCC ID : 2BH87-G01

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type").

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product.

The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The product antenna uses an irreplaceable antenna with a gain of

3.47dBi

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2BH87-G01

2.9 Information on test modes and additional testing requirements

5 Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

Explanation: Shenzhen Hertz Innovations Technology Co., Ltd. can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) 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. If the grantee markets their product

as being Part 15

Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.

IC Caution:

- English:

This device complies with Industry Canada licence-exempt RSS standard(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.

To maintain compliance with RSS-102 RF Exposure guidelines, This equipment should be installed and operated with minimum 20cm distance between the radiator and your body: Use only the supplied antenna.

The final end product must be labelled in a visible area with the following: "Contains Transmitter Module "IC: 32872-G01".

- French:

Le présent appareil est conforme aux CNR d'Industrie 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, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Pour être conforme aux lignes directrices d'exposition RF RSS-102, cet équipement doit être installé et exploité à une distance minimale de 20cm entre le radiateur et votre corps: n'utilisez que l'antenne fournie.

Le produit final doit être étiqueté dans une zone visible avec la mention suivante: "contient le Module d'émetteur" IC: 32872-G01".