

Project No: VC5SL16

Date: 2019.08.16

Rev: V1.1

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Customer name: _____

Model: VC5SL16

B&T P/N: _____

Spec.: Single-Chip low power dual bands Wireless LAN(WLAN)
and Bluetooth Low Energy(v5.0)

Sealed by corporation:

Compilation	Verify	Approval
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Sealed by customer:

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SPECIFICATION

**Single-Chip low power dual bands
Wireless LAN(WLAN) and Bluetooth Low Energy(v5.0)
SoC Module**

VC5SL16

Version: V1.1

Change History of Revision

1. Overview

The VC5SL16 is a highly integrated Wi-Fi and Bluetooth SOC module. Main chip RTL8720DN is a highly integrated Single-Chip low power dual bands(2.4GHz and 5GHz) Wireless LAN(WLAN) and Bluetooth Low Energy(v5.0). It consists of a high-performance MCU(ARM V8M,Cortex-M4F instruction compatible) named KM4, a low power MCU(ARM V8M,Cortex-M0 instruction compatible) named KM0, WLAN (802.11 a/b/g/n) MAC, an 1T1R capable WLAN baseband, RF, Bluetooth and peripherals.

BW16 integrates internal memories for complete WIFI and BLE5.0 protocol functions. The embedded memory configuration also provides simple application developments.

2. Features

Wireless

Items	Description
WIFI	<ul style="list-style-type: none">802.11 a/b/g/n 1x1, 2.4GHz & 5GHzSupport 20MHz/40MHz up to MCS7Low power architectureSupport low power Tx/Rx for short range applicationLow power beacon listen modeLow power Rx modeVery low power suspends mode (DLPS)External PA is supported
BT BLE	<ul style="list-style-type: none">Support BLESupport both central and peripheral modesHigh power mode (10dbm, share the same PA with WIFI)Internal co-existence mechanism between WIFI and BT to share the same antenna.
BT BLE5.0	<ul style="list-style-type: none">Support BLE5.0

Secure

Items	Description
Hardware engine	<ul style="list-style-type: none">AES/DES/SHA hardware engine
TrustZone	<ul style="list-style-type: none">TrustZone-M supported
Secure boot	<ul style="list-style-type: none">Secure boot supported
SWD protection	<ul style="list-style-type: none">Debug port access protection and prohibition modes
eFuse protection	<ul style="list-style-type: none">Security eFuse
RSIP	<ul style="list-style-type: none">Flash Decryption on-the-fly

Peripheral Interfaces

- 3 ADC interface are shared with the uart interfaces
- 2 UART with standard baud rate support
- 1 I2C interfaces are shared with the PWM interfaces
- 1 SPI interfaces are shared with the PWM interfaces
- 4 PWM interfaces
- All of the above interfaces can be used as GPIO

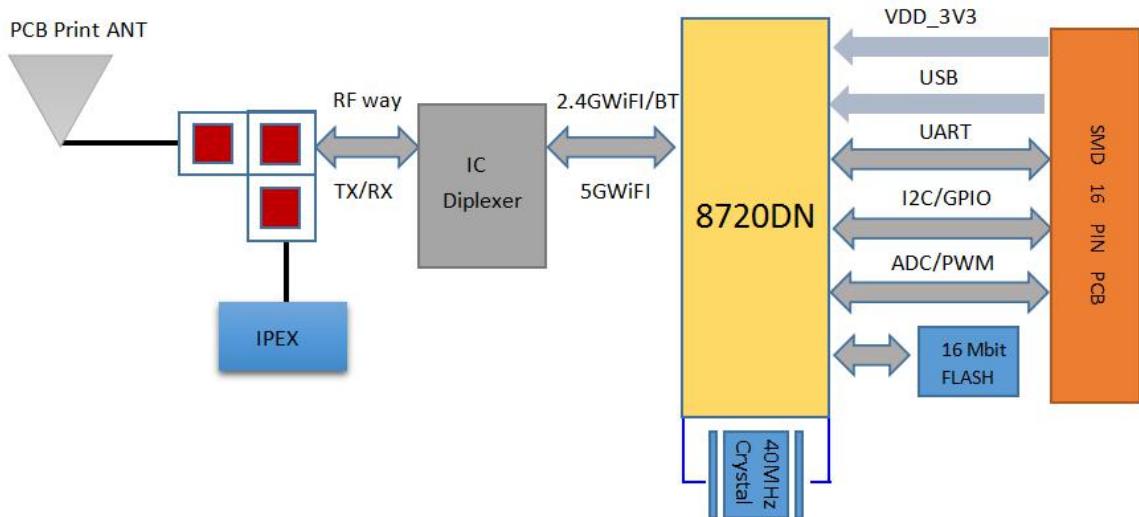
3. Applications

- BLE beacon
- Industrial wireless control
- Bluetooth gateway
- Wearable electronical devices
- Security ID tags
- Smart home

4. General Specification

Hardware Features	
Model	VC5SL16
Antenna Type	IPEX connect or PCB Antenna
Major Chipset	RTL8720DN
Power Supply	3.3±5% V
Dimension	24.0*16.0* 3.1mm (LxWxH) ±0.2mm
WIFI Wireless Features	
Wireless Standards	IEEE 802.11 a/b/g/n
Frequency Range	2.412-2.484GHz & 5.180-5.825GHz
Data Rates	802.11a : 6,9,12,18,24,36,48,54Mbps
	802.11b : 1,2,5.5,11Mbps
	802.11g : 6,9,12,18,24,36,48,54Mbps
	802.11n : MCS0-MCS7 @ HT20 /2.4GHz and 5GHz band
Modulation Technique	MCS0--MCS7 @ HT40 /2.4GHz and 5GHz band
	DSSS (DBPSK, DQPSK, CCK)
	OFDM (BPSK, QPSK, 16-QAM, 64-QAM)
Work Mode	AP, Station, AP/Client
Others	
Environment	Operating Temperature: -20°C~85°C
	Storage Temperature: -40°C~125°C
	Operating Humidity: 10%~90% (non-condensing)
	Storage Humidity: 5%~90% (non-condensing)
Certification	RoHS compliance、FCC、CE、SRRC
Bluetooth Wireless Features	
Wireless Standards	Bluetooth5.0 BLE
Frequency Range	2.402GHz -2.480GHz
Receive Sensitivity	-92dBm
Transmit Power	7±2dBm

5. Block Diagram



6. Electrical Specifications

1) DC Characteristics

Current Consumption	Min.	Typ.	Max.	Unit
DC 3.3V (with internal regulator and integrated CMOS PA)	-	-	450	mA
DC_IO (including VDD_IO)	-	-	200	mA
DC_IO_33 (3.3V I/O Rating Current)	-	-	50	mA
ESD Protection (vESD)	-	-	2000	V

BW16 series modules are Electrostatic Sensitive Devices and require special precautions while handling.



ESD precautions:

The BW16 module are electrostatic sensitive devices (ESD) and require special ESD precautions typically applied to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling, transportation and operation of any application that incorporates the BW16 module. Don't touch the module by hand or solder with non-anti-static soldering iron to avoid damage to the module.

2) RF Characteristics for IEEE802.11a

Items	Contents			
Specification	IEEE802.11a			
Mode	OFDM 54Mbps			
Channel frequency	5.180-5.825GHz			
Freq.Error(±15ppm)	±10 ppm			
RX (PER≤-65dBm@10%)	-76 dBm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±2dBm)		14		dBm
EVM (≤-25 dB)		-30		dB

3) RF Characteristics for IEEE802.11b

Items	Contents			
Specification	IEEE802.11b			
Mode	CCK 11 Mbps			
Channel frequency	2412 ~ 2484 MHz			
Freq.Error(±15ppm)	±10 ppm			
RX (PER≤-76dBm@8%)	-88 dBm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±2 dBm)		16		dBm
EVM (≤-9 dB)		-21		dB

4) RF Characteristics for IEEE802.11g

Items	Contents			
Specification	IEEE802.11g			
Mode	OFDM 54Mbps			
Channel frequency	2412 ~ 2484 MHz			

Freq.Error(± 15 ppm)	± 10 ppm			
RX (PER ≤ -65 dBm@10%)	-78 dBm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (± 2 dBm)		16		dBm
EVM (≤ -25)		-34		dB

5) RF Characteristics for IEEE802.11n (BW20_MCS7)

Items	Contents			
Specification	IEEE802.11n BW20_MCS7			
Mode	BW20_MCS7 65 Mbps			
Channel frequency	2412 ~ 2484 MHz			
Freq.Error(± 15 ppm)	± 10 ppm			
RX (PER ≤ -64 dBm@10%)	-76 dBm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (± 2 dBm)		15		dBm
EVM (≤ -28)		-31		dB

6) RF Characteristics for IEEE802.11n (BW40_MCS7)

Items	Contents			
Specification	IEEE802.11n BW40_MCS7			
Mode	BW40_MCS7 65 Mbps			
Channel frequency	2412 ~ 2484 MHz			
Freq.Error(± 15 ppm)	± 10 ppm			
RX (PER ≤ -61 dBm@10%)	-74 dBm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (± 2 dBm)		15		dBm
EVM (≤ -28)		-31		dB

7) RF Characteristics for IEEE802.11n (BW20_MCS7)

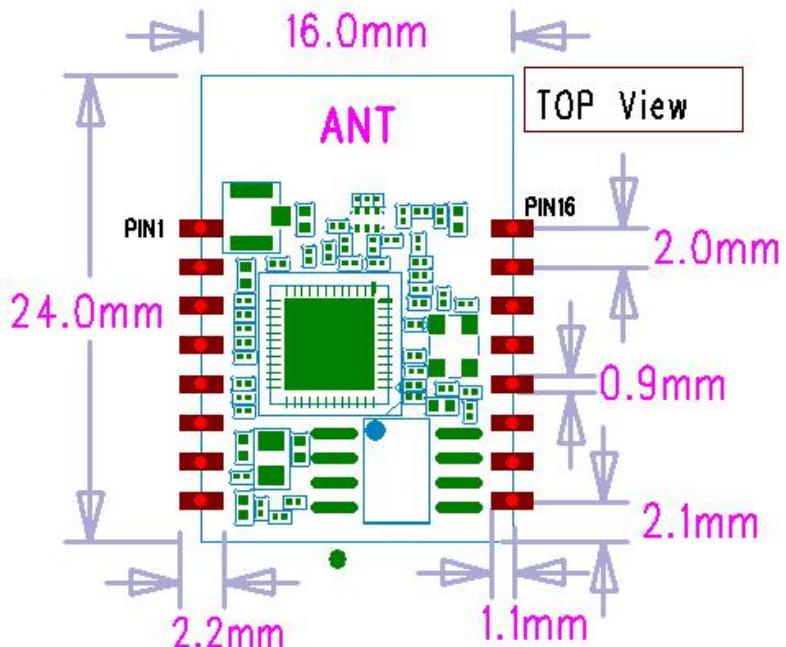
Items	Contents			
Specification	IEEE802.11n BW20_MCS7			

Mode	BW20_MCS7 65Mbps			
Channel frequency	5.180-5.825GHz			
Freq.Error(± 15 ppm)	± 10 ppm			
RX(PER \leq 61dBm@10%)	-75dBm			
TX Characteristics	Min.	Typ.	Max.	Unit.
Power Level(± 2 dBm)		13		dBm
EVM(≤ 28)		-31		dB

8) RF Characteristics for IEEE802.11n (BW40_MCS7)

Items	Contents			
Specification	IEEE802.11n BW40_MCS7			
Mode	BW40_MCS7 65 Mbps			
Channel frequency	5.180-5.825GHz			
Freq.Error(± 15 ppm)	± 10 ppm			
RX (PER \leq -61dBm@10%)	-74 dBm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (± 2 dBm)		13		dBm
EVM (≤ 28)		-30		dB

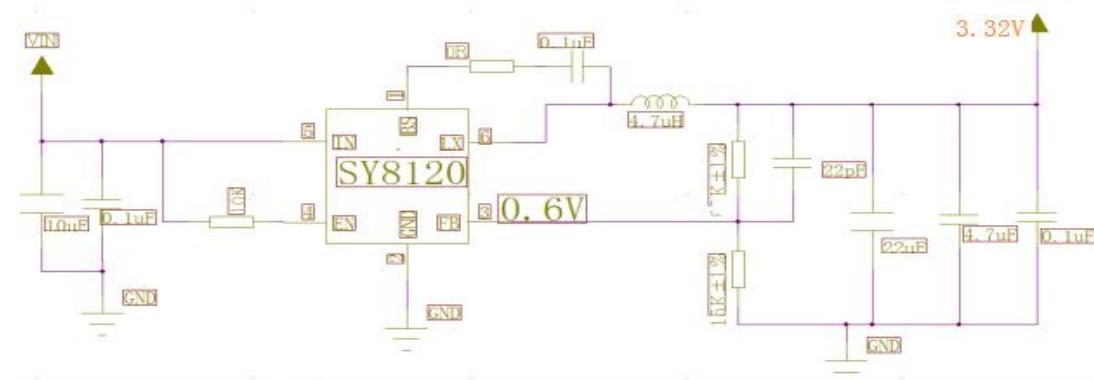
7.Package Dimensions & Pin Definition



Pin No.	Definition	I/O	Description
1	PA[13]	IO	LP_PWM1、SPI1_MISO
2	PB[3]	IO	ADC、SWD_CLK
3	CHIP_EN	I	Enable chip. 1: Enable chip; 0: Shutdown chip
4	PA[15]	IO	SPI1_CS
5	PA[8]	IO	UART_LOG_RXD
6	PA[27]	IO	SWD_DATA
7	PA[26]	IO	LP_I2C_SDA、LP_PWM5
8	VDD_3V3	Power	3.3V INPUT、450mA MAX
9	GND	GND	GND
10	PA[25]	IO	LP_I2C_SCL、LP_PWM4
11	PA[7]	IO	UART_LOG_TXD
12	PA[14]	IO	SPI1_CLK
13	PA[30]	IO	LP_PWM1
14	PA[12]	IO	SPI1_MOSI、LP_PWM0
15	PB[2]	IO	LP_UART_RXD
16	PB[1]	IO	LP_UART_TXD

8. Reference Schematic of Evaluation Board

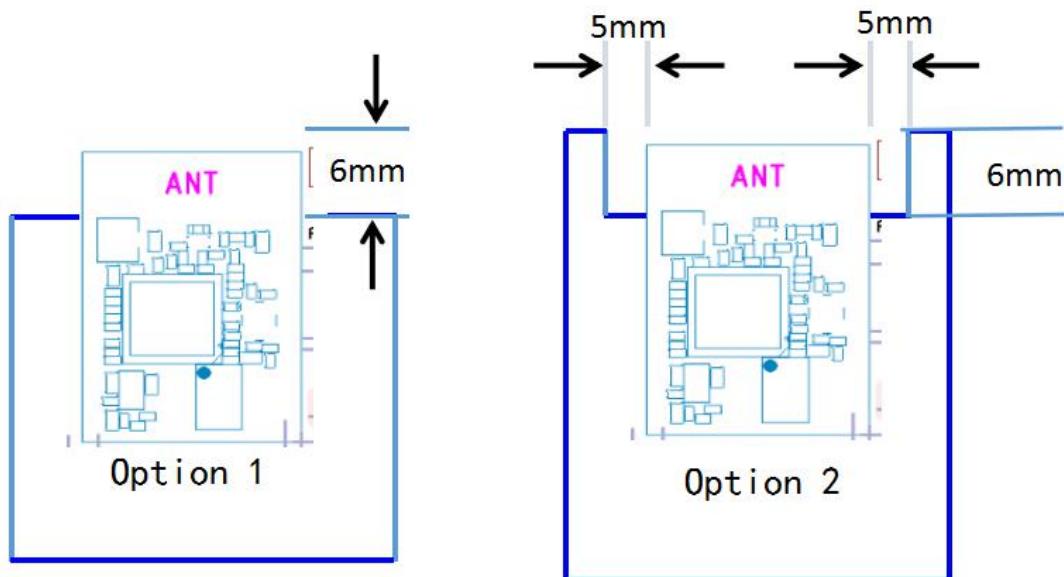
- 1) Power Supply Reference Design 350mA@3.3V and Ripple is less than 40mV



- 2) This module have a print Antenna . In order to get the best RF performance of the end product, please pay attention to the rational design of the module and the placement of the antenna on the bottom plate according to this guide.

Option 1 (recommend): Place the module along the edge of the main board, and keep the antenna out of main board pcb;

Option 2(recommend): Place the module along the main board side, and keep enough space for antena;



9. Manufacturing Process Recommendations

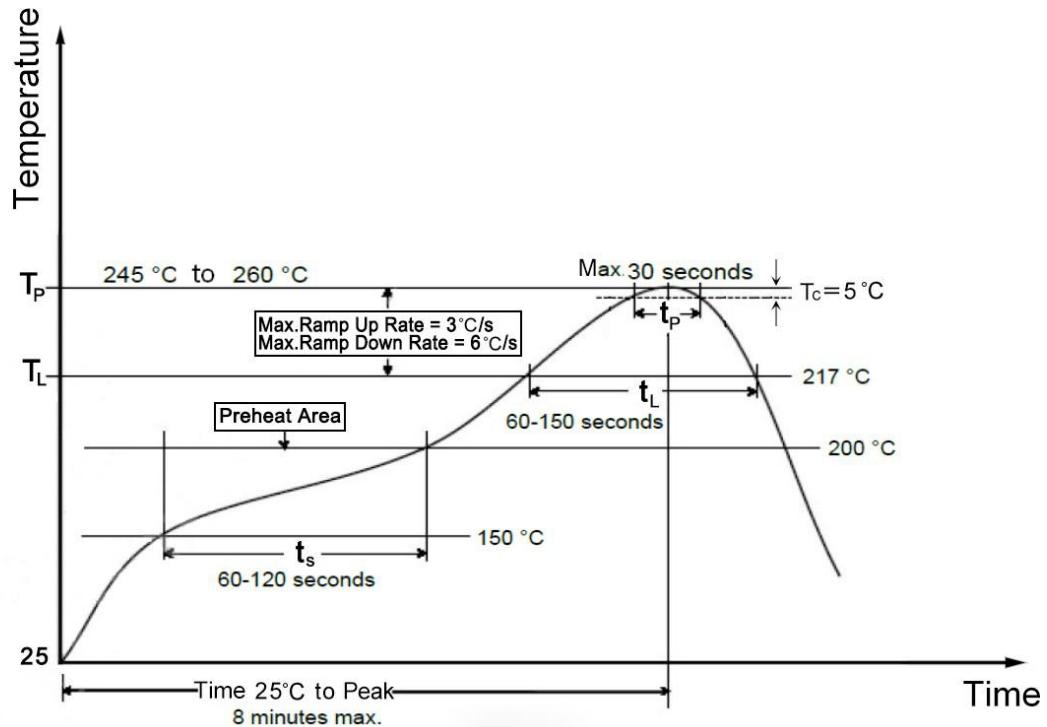


Figure 5: BW16 Typical Lead-free Soldering Profile

Note: The final soldering temperature chosen at the factory depends on additional external factors like choice of soldering paste, size, thickness and properties of the baseboard etc. Exceeding the maximum soldering temperature in the recommended soldering profile may permanently damage the module.

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 20

cm 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 “2A7KK-VC5SL16”

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 1dBi

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 :2A7KK-VC5SL16

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 1dBi

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: 2A7KK-VC5SL16

2.9 Information on test modes and additional testing requirements⁵

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: Ningde lingyang Electronic 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.