

Notion LTE CAT-1 Module

M12



The M12 module is a CAT-1 wireless data communication module that supports TDD-LTE and FDD-LTE network modes. M12 adopts LCC package, the overall size is 23*23*2.3mm, 65 external LCC pads, 49 bottom LGA pads, small size, rich peripheral interface, simple peripheral circuit, at the same time, the product built-in compatible Bluetooth function, bring more options for customers differentiated design.

Band support

China

- LTE(FDD): 1/3/5/8
- LTE(TDD):34/38/39/40/41n

Europe/Africa/Middle East/Southeast

Asia/South Asia/Korea

- LTE(FDD): 1/2/3/4/5/7/8/20/28
- LTE(TDD):34/38/39/40/41n

Latin America

- LTE(FDD):1/2/3/4/5/7/8/12/13/17/66
- LTE(TDD):38/40/41n

general characteristic

- Working Temperature:-30°C~75°C
- Humidity: 5%~95%
- Power supply: 3.3-4.3V, typical:3.8V
- Power dissipation: 3-15mA @3.8V
- Size: 23*23*2.3mm
- AT command: 3GPP TS 27.007 and 27.005
- Operating system:
Windows/Linux/Android

RF characteristics

- Transmitted power

LTE: +21dBm (3GPP TS 36.101 R9 Class 3)

Rate

- LTE Cat 1: DL 10Mbps / UL 5Mbps

Functional block diagram

Interface

- PWM*3
- USB 2.0*1
- Uart *2
- SDIO *1
- ADC *2
- I2C *1
- SPI *1
- KEY MATRIX:6*6
- USIM*2
- AUDIO*1
- Antenna: LTE, BT
- Sensitivity
 - FDD B1 -99dBm(10M)
 - FDD B2 -97.5dBm(10M)
 - FDD B3 -99dBm(10M)
 - FDD B4 -100dBm(10M)
 - FDD B5 -99dBm(10M)
 - FDD B7 -99dBm(10M)
 - FDD B8 -99dBm(10M)
 - TDD B12 -100dBm(10M)
 - TDD B13 -99.5dBm(10M)
 - TDD B17 -100.5dBm(10M)
 - FDD B20 -98.5dBm(10M)
 - FDD B28 -99.5dBm(10M)
 - TDD B34 -100.5dBm(10M)
 - TDD B38 -100dBm(10M)
 - TDD B39 -100.5dBm(10M)
 - TDD B40 -100.5dBm(10M)
 - TDD B41 -100.5dBm(10M)
 - TDD B66 -100dBm(10M)

M12 Pin Definition

PIN NO.	PIN Name	PIN GPIO	I/O	Description	Remark column
1	LED1_CTRL	GPIO_21	O	The LED_CTRL controls the LED light through an external triode	MMC1_DAT2
2	KP_LED_PWM4	GPIO_11	O	KP_LED_PWM4 controls the key backlight through an external triode	I2C2_SDA/PWM4
3	LCD_BL_PWM3	GPIO_10	O	The LCD_BL_PWM3 controls the LCD backlight through an external triode	I2C2_SCL/PWM3
4	GND	/	/	/	/
5	GND	/	/	/	/
6	GND	/	/	/	/
7	VBAT	/	PI	Power Supply:3.3to4.3V(typical:3.8V)	The layout width must be no less than 1.5mm
8					
9					
10	USB_VBUS	/	PI	USB status detection pin	/
11	CHG_STAT	GPIO_32	I	Charging status detection pin of external charging chip	PWM2
12	CHG_EN	GPIO_22	O	Enable pin for external charging chip	MMC1_DAT1
13	GPS_VBACKUP	/	PO	GPS RTC standby power supply pin	/
14	VLDO7_GPS_3_V3	/	PO	Power supply for the external GPS module	Max current 100mA
15	GPS_UART3_T_XD	GPIO_15	I/O	External GPS module serial communication RX pin	If the external GPS module is 3.3V, TX/RX requires level conversion to 3.3V
16	GPS_UART3_R_XD	GPIO_14	I/O	External GPS module serial communication TX pin	
17	VLDO2_1V8	/	PO	1.8V LDO Output, can be used to pull up the GPIO or the LCD screen I/O power supply or the built-in Bluetooth power supply	Max current 200mA
18	VLDO6_LCD_2_V8	/	PO	LCD screen power supply and RF switch power supply	Max current 100mA
19	LCD_RST	GPIO_124	O	The reset pin for LCD serial peripheral interface	/
20	LCD_LDO_EN	GPIO_121	O	Enable control pin for LCD External Power supply (LDO)	/
21	LCD_CS0	GPIO_34	O	Slave selection pin for LCD serial peripheral interface	/
22	LCD_SPI_DATA	GPIO_36	O	Data pin for LCD serial peripheral interface	UART3_TXD
23	LCD_SPI_RS	GPIO_35	O	Command pin for LCD serial peripheral interface	UART3_RXD
24	LCD_SPI_CLK	GPIO_33	O	Clock signal pin for LCD serial peripheral interface	/
25	GND	/	/	/	/
26	VLDO8_3V0_USIM2	/	PO	SIM card 2 Power supply	The module automatically recognizes the 1.8V or 3.0V SIM card
27	USIM2_CLK	GPIO_45	O	SIM card 2 clock pin	I2C4_SCL/GPIO45
28	USIM2_RST_N	GPIO_47	O	SIM card 2 Reset pin	
29	USIM2_DATA	GPIO_46	O	SIM card 2 data pin	I2C4_SDA/GPIO46
30	VLDO3_3V0_USIM	/	PO	SIM card 1 Power supply	The module automatically recognizes the 1.8V or 3.0V SIM card

31	USIM_CLK	/	O	SIM card 1 clock pin	/
32	USIM_RST_N	/	O	SIM card 1 Reset pin	/
33	USIM_DATA	/	O	SIM card 1 data pin	/
34	GND	/	/	/	/
35	USB_DP	/	I/O	USB differential data signal	The wiring requires 90Ω differential impedance
36	USB_DN	/	I/O		
37	EAR_N	/	AO	Audio differential data signal	/
38	EAR_P	/	AO		
39	SPKPA_EN	GPIO_80	O	Audio PA enable control pin	/
40	MIC_P	/	AI	Audio MIC input	/
41	MICBIAS	/	O	Audio MICBIAS	/
42	MICBIAS_CTL	GPIO_37	O	Audio MICBIAS is controlled by triode to switch the on-board MIC/ headset MIC pins	/
43	HP_DET	GPIO_79	I	Earphone insert detection pin	/
44	HEAD_PTT	GPIO_78	I	Headset PTT enable pin. Active low	/
45	CI2C_SCL	GPIO_49	I/O	I2C clock pin	/
46	CI2C_SDA	GPIO_50	I/O	I2C data pin	/
47	GND	/	/	/	/
48	GND	/	/	/	/
49	RF_ANT	/	AI/O	Rf antenna pin	/
50	GND	/	/	/	/
51	GND	/	/	/	/
52	MK_OUT_0	GPIO_01	I/O	input detection pin for matrix keys/individual keys	/
53	MK_IN_0	GPIO_00	I/O	input detection pin for matrix keys/individual keys	/
54	MK_IN_1	GPIO_02	I/O	input detection pin for matrix keys/individual keys	UART4_RXD
55	MK_OUT_1	GPIO_03	I/O	input detection pin for matrix keys/individual keys	UART4_TXD
56	MK_IN_4	GPIO_08	I/O	input detection pin for matrix keys/individual keys	PWM1/PWM3
57	MK_OUT_4	GPIO_09	I/O	input detection pin for matrix keys/individual keys	PWM2/PWM4/MKOUT[4]: Low level is detected during power on ,enter USB download mode
58	MK_IN_2	GPIO_04	I/O	input detection pin for matrix keys/individual keys	UART4_RXD/SSP1_SCLK
59	MK_OUT_2	GPIO_05	I/O	input detection pin for matrix keys/individual keys	UART4_TXD/SSP1_FRM
60	MK_IN_3	GPIO_06	I/O	input detection pin for matrix keys/individual keys	PWM3/SSP1_RXD
61	GND	/	/	/	/
62	ONKEYN	/	I	In the off state, the pin continues to pull down for 3S to power on, and in the on state, the pin continues to pull down for 5S to power off	Do not pull down directly; otherwise, the system will restart continuously
63	EXTON1N	/	I	Directly pull down the EXTON1N pin and power on automatically.Keep this pin NC if not used.	/
64	LED2_CTRL	GPIO_24	O	The LED2_CTRL controls the LED light through an external triode	MMC1_DAT0
A1	GND	/	/	/	/

A2	GND	/	/	/	/
A3	GND	/	/	/	/
A4	GND	/	/	/	/
A5	GND	/	/	/	/
A6	CP_UART_DTR	GPIO_27	I/O	CP Data Terminal Ready	MMC1_CLK
A7	GND	/	/	/	/
A8	GND	/	/	/	/
A9	GND	/	/	/	/
B1	GND	/	/	/	/
B2	GND	/	/	/	/
B3	GND	/	/	/	/
B4	GND	/	/	/	/
B5	GND	/	/	/	/
B6	GND	/	/	/	/
B7	GND	/	/	/	/
B8	GND	/	/	/	/
B9	MK_OUT_3	GPIO_07	I/O	input detection pin for matrix keys/individual keys	PWM4/SSP1_TXD
C1	GND	/	/	/	/
C2	GND	/	/	/	/
C3	GND	/	/	/	/
C4	MK_OUT_6	GPIO_13	I/O	input detection pin for matrix keys/individual keys	I2C3_SDA
D1	GND	/	/	/	/
D2	GND	/	/	/	/
D3	GPIO_23	GPIO_23	I/O	1.8V power domain,GPIO,Keep this pin NC if not used.	
D4	MK_IN_6	GPIO_12	I	input detection pin for matrix keys/individual keys	I2C3_SCL
E1	GND	/	/	/	/
E2	GND	/	/	/	/
E3	LCD_TE	GPIO_26	O	frame synchronization signal for LCD SPI serial peripheral interface	I2C4_SDA/MMC1_CLK
E4	AP_UART1_RXD	GPIO_29	I	AP serial data receiving pin	
F1	GND	/	/	/	/
F2	GND	/	/	/	/
F3	USIM_CD	GPIO_25	I/O	SIM Card Insertion Detection Pin (reserved)	I2C4_SCL/MMC1_CMD
F4	AP_UART1_TXD	GPIO_30	O	AP serial data sending pin	default: Print log
G1	GND	/	/	/	/
G2	GND	/	/	/	/
G3	CP_UART_CTS	GPIO_53	I/O	CP serial interface clears the transmit signal pin	UART3_RXD/MMC1_DA_T1
G4	CP_UART_RXD	GPIO_51	I	CP serial input pin	MMC1_DAT3
H1	GND	/	/	/	/
H2	GND	/	/	/	/
H3	GND	/	/	/	/
H4	GND	/	/	/	/
H5	GND	/	/	/	/
H6	GND	/	/	/	/
H7	GND	/	/	/	/
H8	GND	/	/	/	/

H9	CP_UART_RTS	GPIO_54	I/O	CP serial interface request send pin	UART3_TXD/MMC1_DA T0
J1	GND	/	/	/	/
J2	GND	/	/	/	/
J3	GND	/	/	/	/
J4	AUXADC_IN3	/	AI	ADC Extended interface, can support high voltage battery capacity detection	1V8 or 1V2 power domain,default:1V2 power domain
J5	AUXADC_IN	/	AI	The ADC_IN2 interface is used to collect the signal of the potentiometer volume	1V8 or 1V2 power domain,default:1V2 power domain
J6	CP_UART_RI	GPIO_31	I/O	CP serial ring indicating pin	MMC1_CMD
J7	TORCH_PWM1	GPIO_126	O	default:Flashlight brightness control pin	PMW1/PWM4
J8	CP_UART_TXD	GPIO_52	I/O	CP serial output pin	MMC1_DAT2
Z1	GND	/	/	/	/
Z2	GND	/	/	/	/
Z3	GND	/	/	/	/
Z4	GND	/	/	/	/
65	ANT	/	AI/O		/

/ Note: All the above I/O interfaces belong to the 1.8V voltage domain unless specified



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: 2AR45-M12"

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 22, 24, 27.it

Specifically identified Conducted output power, Effective Radiated Power of Transmitter(EIRP), peak-to-average ratio, 99% & 26dB Occupied Bandwidth, Band Edge at antenna terminals, Spurious emissions at antenna terminals, Field strength of spurious radiation, Frequency stability.

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 0dBi
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: 2AR45-M12

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 0dBi

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: 2AR45-M12

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: Shanghai Notion Information 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.