GTI Cellular-IoT Universal Modules Specification

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Contents

1 Scope

This present document proposes mechanical, electrical, software and performance requirements for Cellular-IoT universal module implementations. The assigned allocations are intended to enable the module supplier and host device integrator to design compatible circuits with aligned pad assignments as specified.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

The following referenced documents are necessary for the application of the present document.

[1] ETSI GS SMT 001 Surface Mount Technology (SMT); Requirements for Embedded Communication Modules for Machine To Machine Communications.

[2] ETSI TS 102 671 Smart Cards; Machine to Machine UICC; Physical and logical characteristics.

3 Definitions, symbols and abbreviations

For the purposes of the present document, the following terms and definitions apply:

Abbreviation	Definitions
ADC	Analog-to-digital converter
APN	Access Point Name
EDGE	Enhanced Data rate for GSM Evolution
eMTC	enhanced MTC
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
I2C	Inter-Integrated Circuit bus
I2S	Integrated Inter Chip Sound
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identification Number
LCC	Leadless Chip Carriers
LGA	Land Grid Array
MCU	Microcontroller Unit
NB-IoT	Narrow Band-Internet of Things

PCM	Pulse Code Modulation
RTC	Real-Time Clock
SIM	Subscriber Identification Module
SPI	Serial Peripheral Interface
TD-LTE	Time Division-Long Term Evolution
TD-SCDMA	Time Division-Synchronous Code Division Multiple Access
UART	Universal Asynchronous Receiver/Transmitter
URL	Uniform Resource Locator
USB	Universal Serial Bus

4 Module classification and communication modes

4.1 Overview

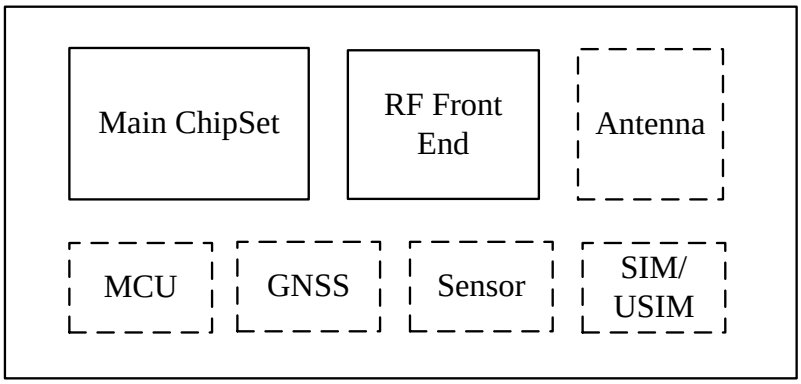

Figure 4-1 Module device structure diagram

A module device must include main chipset unit and RF front end unit, as shown in Fig. 4-1. A module device may also include MCU unit, position unit, sensor unit, SIM/USIM unit and antenna unit.

4.2 Communication modes and frequency bands

Communication modes supported by C-IoT universal modules may include the following communication modes such as GSM/GPRS/EDGE, TD-SCDMA, TD-LTE, NB-IoT, eMTC and Cat 1.

1) Communication modes supported by C-IoT universal modules include GSM/GPRS/EDGE should comply with the communication function, frequency bands and performance requirements defined in *3GPP 04 series.*
2) Communication modes supported by C-IoT universal modules include TD-SCDMA should comply with the communication function, frequency bands and performance requirements defined in *3GPP 25 series.*
3) Communication modes supported by C-IoT universal modules include TD-LTE should comply with the communication function, frequency bands and performance requirements defined in *3GPP 36 series.*

4) Communication modes supported by C-IoT universal modules include NB-IoT should comply with the communication function, frequency bands and performance requirements defined in *3GPP 36 series.*
5) Communication modes supported by C-IoT universal modules include eMTC should comply with the communication function, frequency bands and performance requirements defined in *3GPP 36 series.*
6) Communication modes supported by C-IoT universal modules include Cat 1 should comply with the communication function, frequency bands and performance requirements defined in *3GPP 36 series.*

4.3 Module classification

Except communication modes and frequency bands, this specification defines the following 8 dimensions, including package, function, model, size, power supply-voltage type, I/O supply-voltage type, applicable scenario (consumer, industrial and vehicle), and positioning, as shown in Fig. 4-2. In addition, the thickness of the module should be less than or equal to 2.8mm.

Package	Function	Model	Size	power supply-voltage type	I/O supply-voltage type	applicable scenario	position

Figure 4-2 Universal module classification structure

1） Package
Two categories: LCC and LGA, coded as C (LCC), and G (LGA).
2） Function
Two categories: Basic and Smart, coded as B and S respectively,
a) Basic module means this module can only be used as a modem,
b) Smart module means this module can be used as an AP besides as a modem.
3） Model & Size
Modules can be divided into three categories in model: Big, Middle and Small, coded as B, M and S respectively. Following rules are applied,
a) Small means both the length and the width of the module are less than 20mm,
b) Middle means both the length and the width of the module are less than 25mm, while the length of any side of the module is greater than or equal to 20mm,
c) Big means the length of any side of the module is greater than or equal to 25mm.
Size can be coded as (length, width) (mm*mm),
4） power supply-voltage type
Two categories: A (3.1V-4.2V), B (1.8V-3.6V).
5） I/O supply-voltage type
Two categories: A (2.8-3V), B (1.8V).
6） applicable scenario
Three categories: A (consumer), B (industrial), C (vehicle).
7） Position
If the module supports GNSS, then it should be coded as P.

For example, CBS1618BBBP means the universal module is a LCC package basic module whose power supply voltage type is B, I/O supply voltage type is B and applicable scenario is industrial, and positioning is supported.

5 Basic Functions Requirements

5.1 Management

5.1.1 Module Identification Management

Cellular-IoT universal modules should have module identifications in order to allow IoT management platforms to manage modules and IoT terminals. Use IMEI as the module identification to ensure that IoT management platforms can map the module identification to IMSI of its SIM/USIM.

5.1.2 Module Status Management

Cellular-IoT universal modules should support module status management, and have the capability to detect and report its communication capability, hardware status, and software status.

5.1.3 Software Downloading and Upgrading Management

Cellular-IoT universal modules should provide a communication channel to let terminals containing the modules download or upgrade their software. Cellular-IoT universal modules also should support local and remote upgrade for their own software.

5.1.4 Module Parameters Profile Management

Cellular-IoT universal modules should have predefined cellular network configuration parameters, such as APN, SMS center number, IoT platform SMS service accessing number, IP address (or URL) and port number, etc.

5.2 SIM Card Functions

Cellular-IoT universal modules should support SIM/USIM interface, and they may support embedded-SIM soldering to the circuit board. Embedded-SIM should follow the requirements defined in *ETSI TS 102 671 Smart Cards; Machine to Machine UICC; Physical and logical characteristics*.

5.3 Debugging Function Requirements

Cellular-IoT universal modules need to have development logging function which can be enabled or disabled, and debugging logs can be configured to output through UART, USB or SPI.

6 Physical Form Factor Specifications

This clause defines the multiple physical form factors in terms of dimensions and pad assignments. Every design is complimentary to each other.

6.1 Module Layouts

6.1.1 CBS1618

For CBS1618 universal modules, the length is 18mm, while the width is 16mm, within the range of error ±0.5%. LCC package, 40 pins. The physical form factor, dimensions, pad numbering and placement are shown in Fig.6-1.

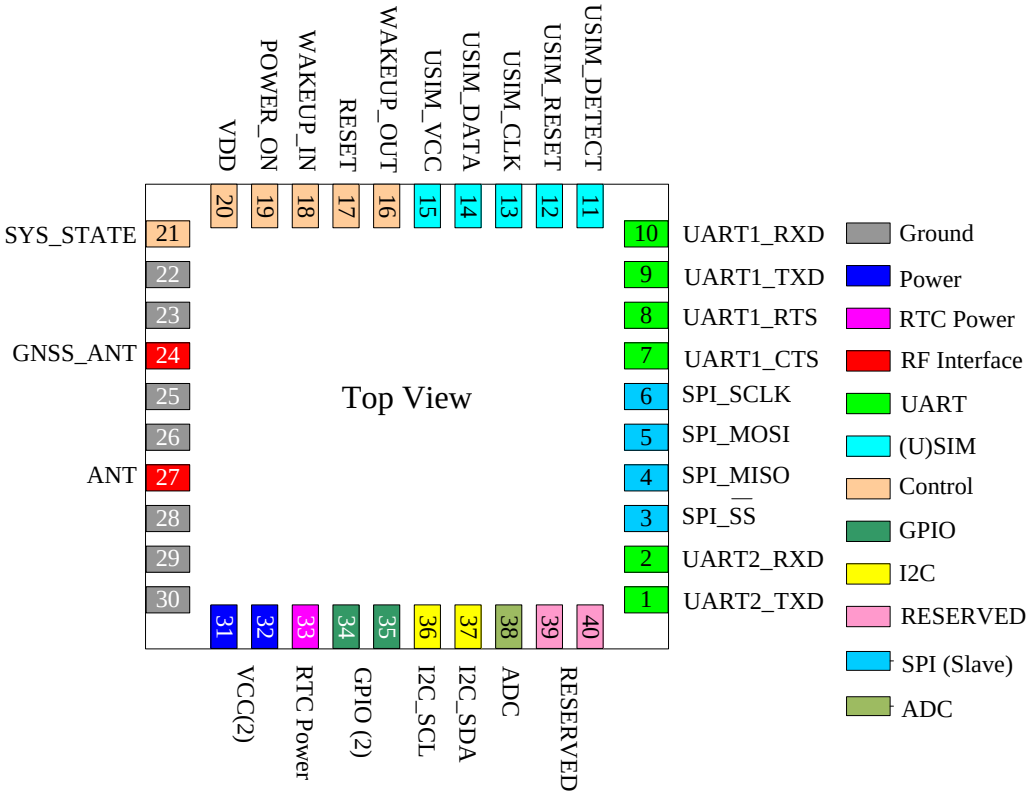

Figure 6-1 CBS1618 physical form factor, dimensions, pad numbering and placement

6.1.2 CBM1620

For CBM1620 universal modules, the length is 20mm, while the width is 16mm, within the range of error ±0.5%. LCC package, 40 pins. The physical form factor, dimensions, pad numbering and placement are shown in Fig.6-2.

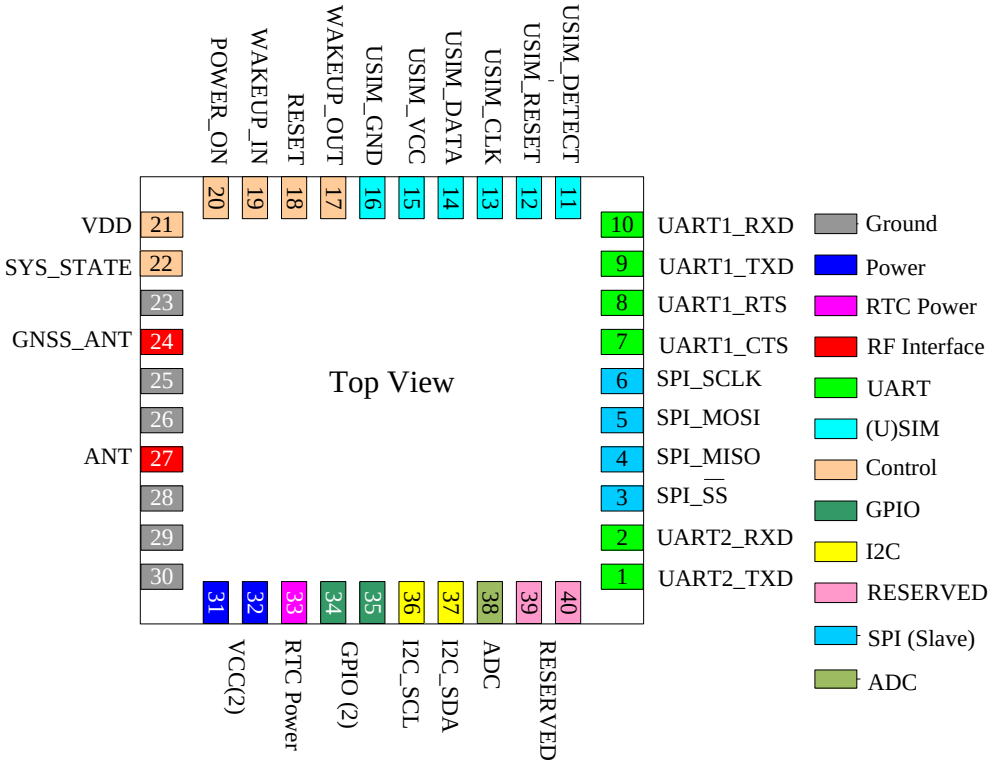

Figure 6-2 CBM1620 physical form factor, dimensions, pad numbering and placement

6.1.3 CBM2024

For CBM2024 universal modules, the length is 24mm, while the width is 20mm, within the range of error ±0.5%. LCC package, 52 pins. The physical form factor, dimensions, pad numbering and placement are shown in Fig.6-3.

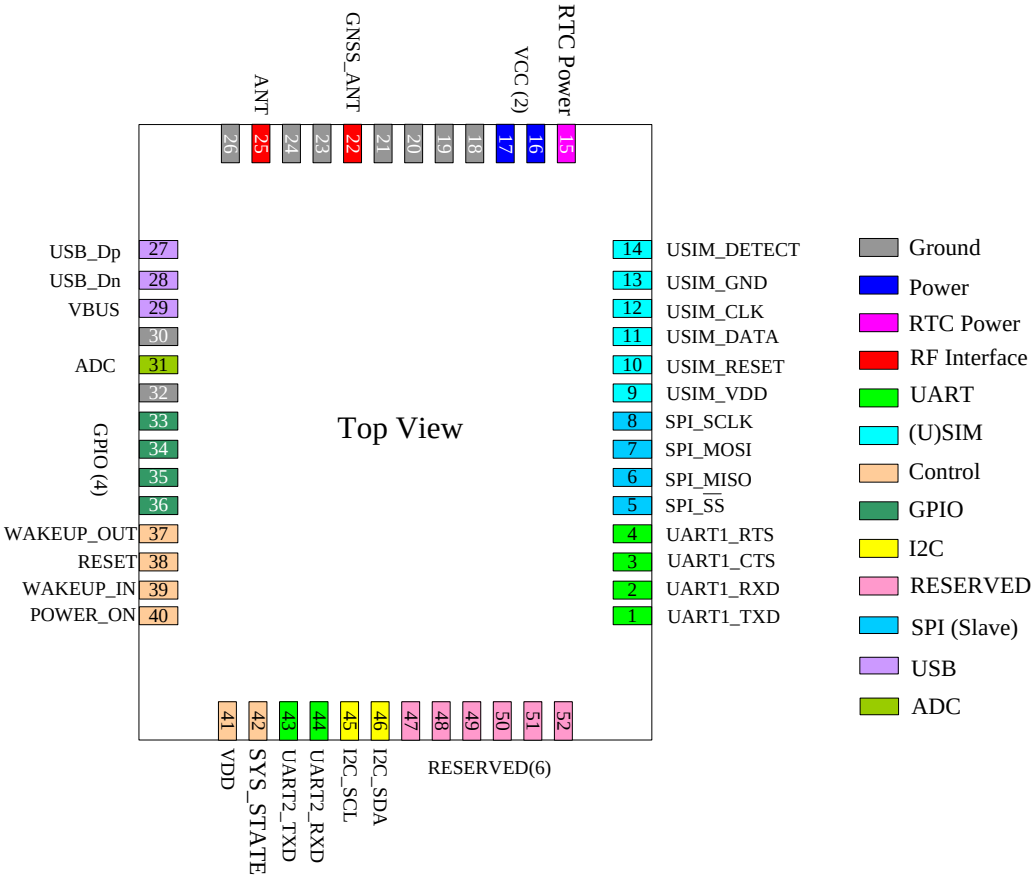

Figure 6-3 CBM2024 physical form factor, dimensions, pad numbering and placement

6.1.4 CBB2426

For CBB2426 universal modules, the length is 26mm, while the width is 24mm, within the range of error ±0.5%. LCC package, 68 pins. The physical form factor, dimensions, pad numbering and placement are shown in Fig.6-4.

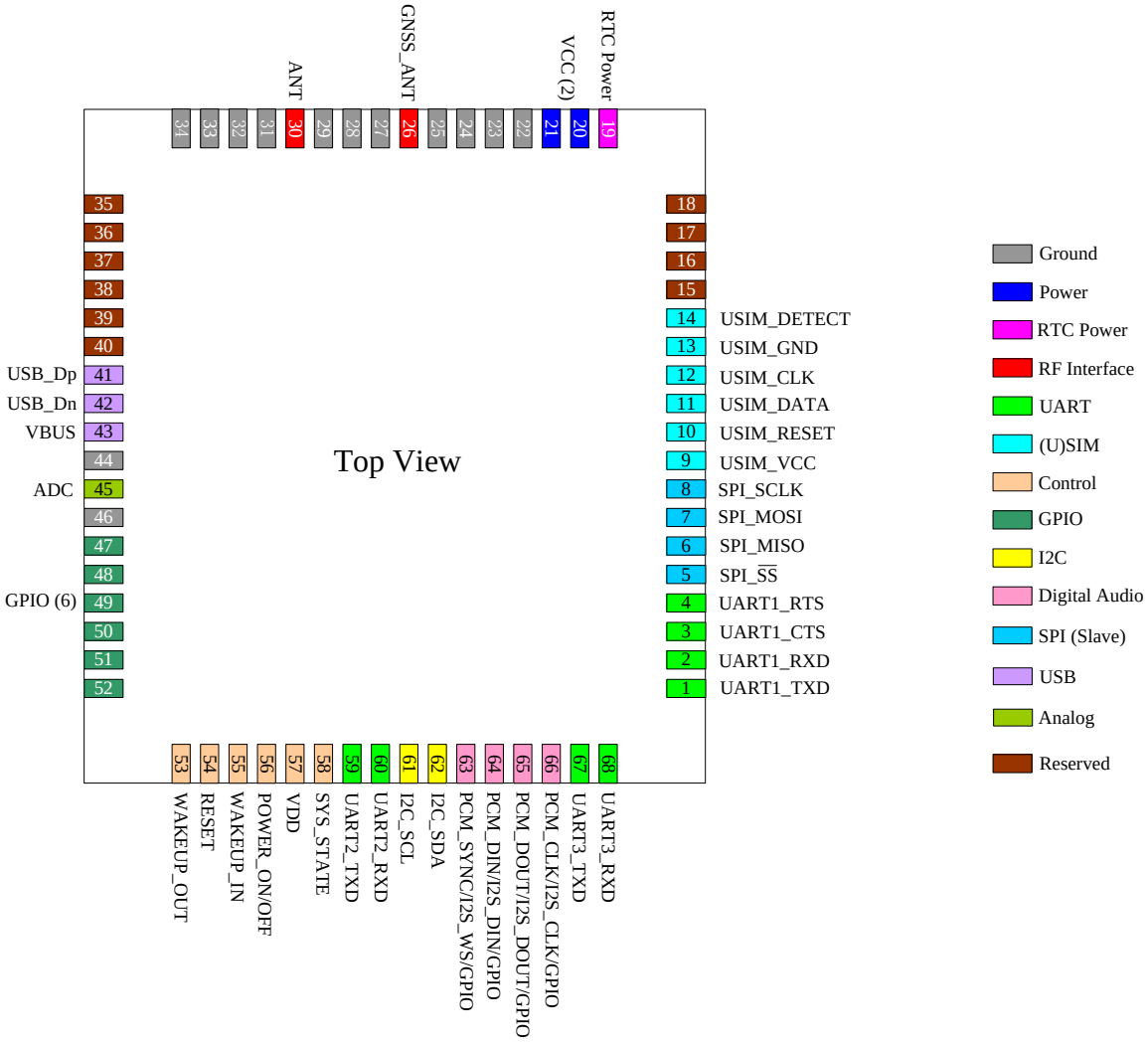

Figure 6-4 CBB2426 physical form factor, dimensions, pad numbering and placement

6.2 Pad Size and Spacing

6.2.1 CBS1618

For CBS1618 universal modules, Fig.6-5 shows the dimensions of the pads, the distance between pads and the distance between the pads and the edge of the module. The module is symmetric with respect to the placement of the pads on each side. All measurements are in mm, within the range of error ±0.5%.

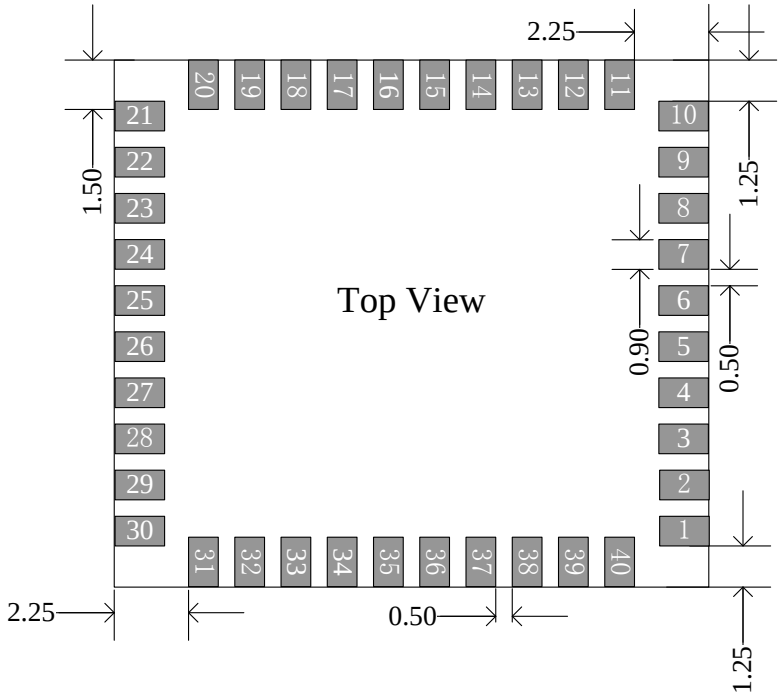

Figure 6-5 CBS1618 Pad Size and Spacing (unit: mm)

6.2.2 CBM1620

For CBM1620 universal modules, Fig.6-6 shows the dimensions of the pads, the distance between pads and the distance between the pads and the edge of the module. The module is symmetric with respect to the placement of the pads on each side. All measurements are in mm, within the range of error ±0.5%.

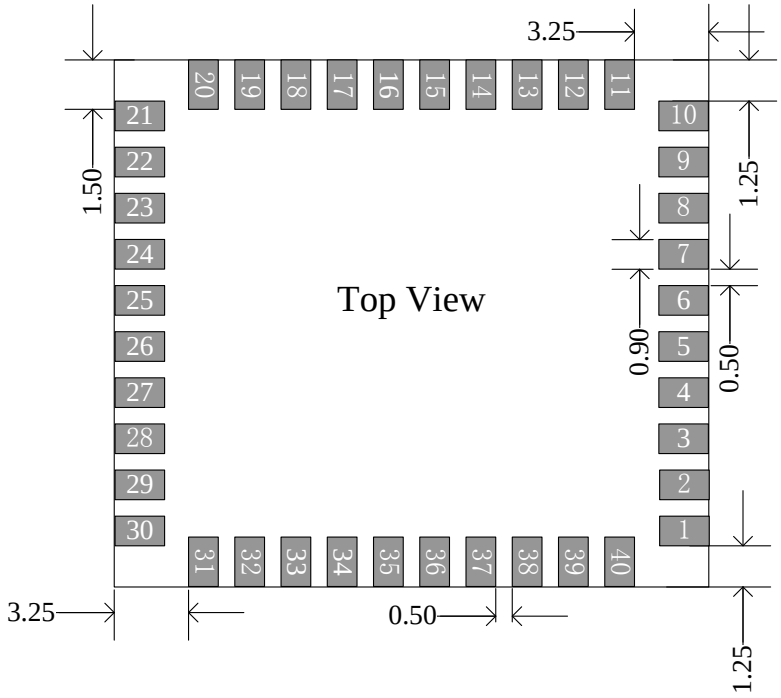

Figure 6-6 CBM1620 Pad Size and Spacing (unit: mm)

6.2.3 CBM2024

For CBM2024 universal modules, Fig.6-7 shows the dimensions of the pads, the distance between pads and the distance between the pads and the edge of the module. The module is symmetric with respect to the placement of the pads on each side. All measurements are in mm, within the range of error ±0.5%.

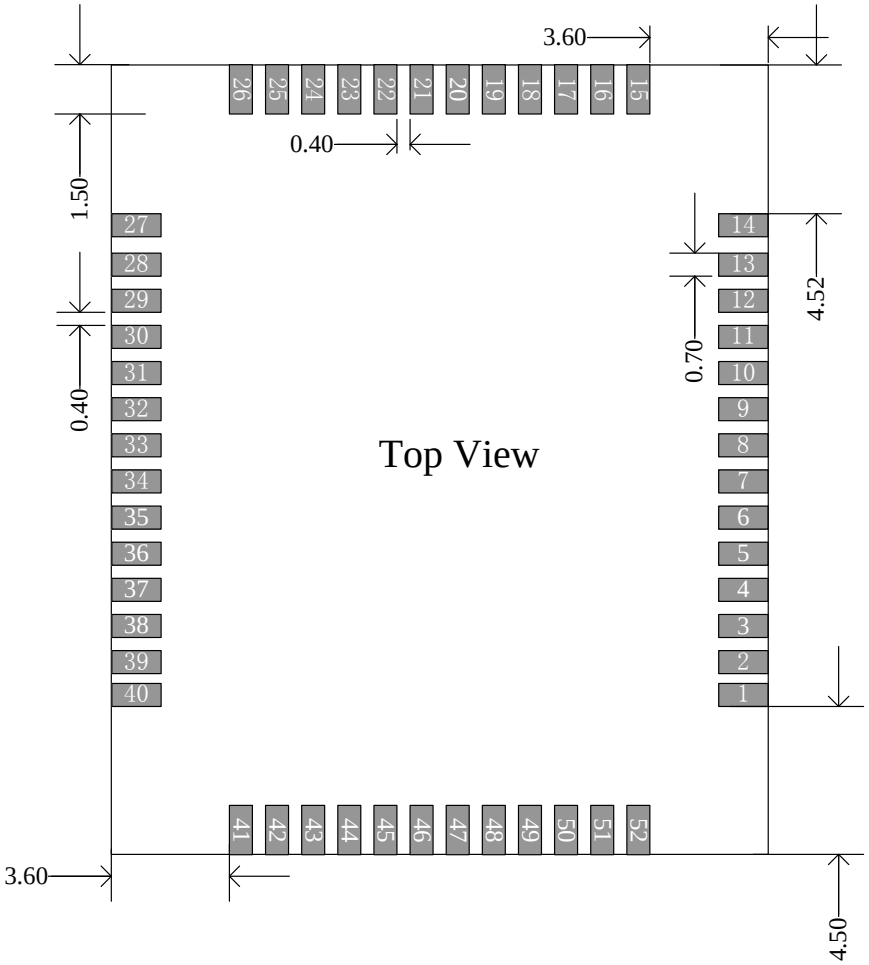

Figure 6-7 CBM2024 Pad Size and Spacing (unit: mm)

6.2.4 CBB2426

For CBB2426 universal modules, Fig.6-8 shows the dimensions of the pads, the distance between pads and the distance between the pads and the edge of the module. The module is symmetric with respect to the placement of the pads on each side. All measurements are in mm, within the range of error ±0.5%.

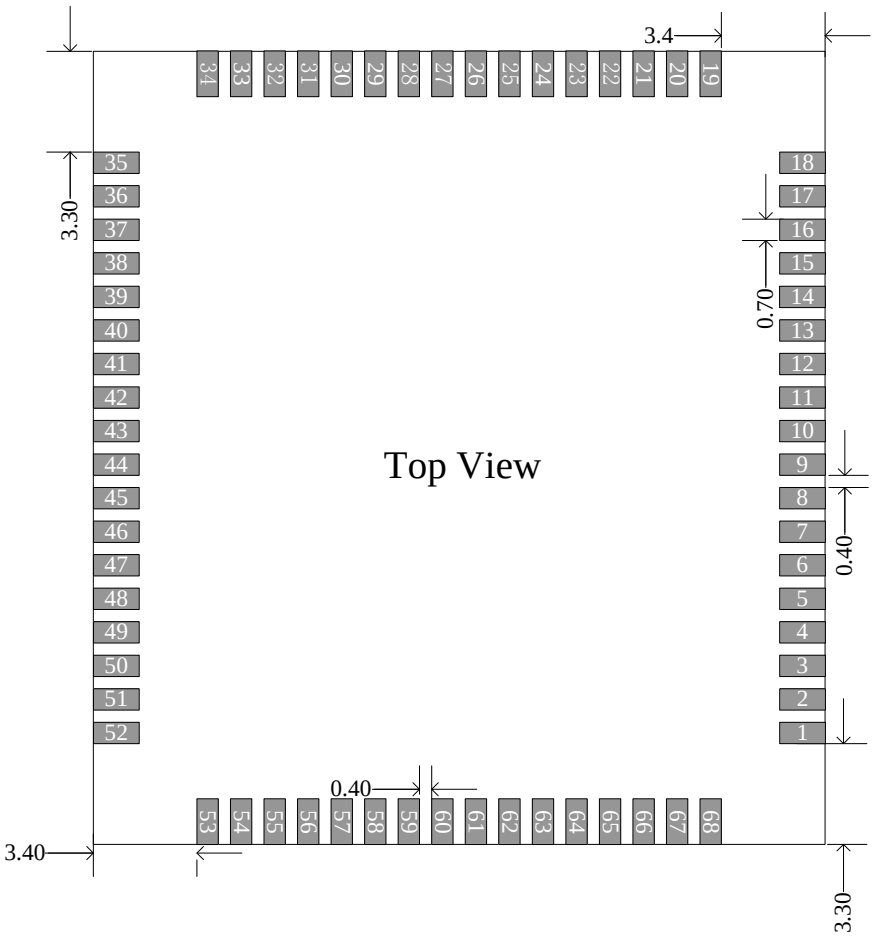

Figure 6-8 CBB2426 Pad Size and Spacing (unit: mm)

6.3 Pad Assignments

6.3.1 CBS1618

Pad assignments of module CBS1618 are listed in Table 6-1.

Table 6-1 CBS1618 Pad Assignments

No.	Name	Description
1	UART2_TXD	TXD for the 2nd UART
2	UART2_RXD	RXD for the 2nd UART
3	SPI_$\overline{SS}$	$\overline{SS}$ for SPI
4	SPI_MISO	MISO for SPI
5	SPI_MOSI	MOSI for SPI
6	SPI_SCLK	SCLK for SPI
7	UART1_CTS	CTS for the 1st UART
8	UART1_RTS	RTS for the 1st UART
9	UART1_TXD	TXD for the 1st UART

10	UART1_RXD	RXD for the 1st UART
11	USIM_DETECT	DETECT for USIM
12	USIM_RESET	RESET for USIM
13	USIM_CLK	CLK for USIM
14	USIM_DATA	DATA for USIM
15	USIM_VCC	Power supply for USIM
16	WAKEUP_OUT	Module wakes up host
17	RESET	Reset
18	WAKEUP_IN	Host wakes up module
19	POWER_ON/OFF	Power on/off
20	VDD	Reference logic level from module
21	SYS_STATE	Module status indication
22	GND	Ground
23	GND	Ground
24	GNSS_ANT	GNSS antenna
25	GND	Ground
26	GND	Ground
27	ANT0	Antenna
28	GND	Ground
29	GND	Ground
30	GND	Ground
31	VCC1	Power supply
32	VCC2	Power supply
33	RTC Power	Power supply for RTC
34	GPIO	General purpose I/O
35	GPIO	General purpose I/O
36	I2C_SCL	SCL for I^2C
37	I2C_SDA	SDA for I^2C
38	ADC	Analog-to-Digital Converter
39	RESERVED	TBD
40	RESERVED	TBD

6.3.2 CBM1620

Pad assignments of module CBM1620 are listed in Table 6-1.

Table 6-2 CBM1620 Pad Assignments

No.	Name	Description
1	UART2_TXD	TXD for the 2nd UART
2	UART2_RXD	RXD for the 2nd UART
3	SPI_$\overline{SS}$	$\overline{SS}$ for SPI
4	SPI_MISO	MISO for SPI

5	SPI_MOSI	MOSI for SPI
6	SPI_SCLK	SCLK for SPI
7	UART1_CTS	CTS for the 1st UART
8	UART1_RTS	RTS for the 1st UART
9	UART1_TXD	TXD for the 1st UART
10	UART1_RXD	RXD for the 1st UART
11	USIM_DETECT	DETECT for USIM
12	USIM_RESET	RESET for USIM
13	USIM_CLK	CLK for USIM
14	USIM_DATA	DATA for USIM
15	USIM_VCC	Power supply for USIM
16	USIM_GND	Ground for USIM
17	WAKEUP_OUT	Module wakes up host
18	RESET	Reset
19	WAKEUP_IN	Host wakes up module
20	POWER_ON/OFF	Power on/off
21	VDD	Reference logic level from module
22	SYS_STATE	Module status indication
23	GND	Ground
24	GNSS_ANT	GNSS antenna
25	GND	Ground
26	GND	Ground
27	ANT0	Antenna
28	GND	Ground
29	GND	Ground
30	GND	Ground
31	VCC1	Power supply
32	VCC2	Power supply
33	RTC Power	Power supply for RTC
34	GPIO	General purpose I/O
35	GPIO	General purpose I/O
36	I2C_SCL	SCL for I^2C
37	I2C_SDA	SDA for I^2C
38	ADC	Analog-to-Digital Converter
39	RESERVED	TBD
40	RESERVED	TBD

6.3.3 CBM2024

Pad assignments of module CBM2024 are listed in Table 6-3.

Table 6-3 CBM2024 Pad Assignments

No.	Name	Description

1	UART1_TXD	TXD for the 1st UART
2	UART1_RXD	RXD for the 1st UART
3	UART1_CTS	CTS for the 1st UART
4	UART1_RTS	RTS for the 1st UART
5	SPI_$\overline{SS}$	$\overline{SS}$ for SPI
6	SPI_MISO	MISO for SPI
7	SPI_MOSI	MOSI for SPI
8	SPI_SCLK	SCLK for SPI
9	USIM_VCC	Power supply for USIM
10	USIM_RESET	RESET for USIM
11	USIM_DATA	DATA for USIM
12	USIM_CLK	CLK for USIM
13	USIM_GND	Ground for USIM
14	USIM_DETECT	DETECT for USIM
15	RTC Power	Power supply for RTC
16	VCC1	Power supply
17	VCC2	Power supply
18	GND	Ground
19	GND	Ground
20	GND	Ground
21	GND	Ground
22	GNSS_ANT	GNSS antenna
23	GND	Ground
24	GND	Ground
25	ANT0	Antenna
26	GND	Ground
27	USB_Dp	USB data (positive)
28	USB_Dn	USB data (negative)
29	VBUS	USB detect
30	GND	Ground
31	ADC	Analog-to-Digital Converter
32	GND	Ground
33	GPIO	General purpose I/O
34	GPIO	General purpose I/O
35	GPIO	General purpose I/O
36	GPIO	General purpose I/O
37	WAKEUP_OUT	Module wakes up host
38	RESET	Reset
39	WAKEUP_IN	Host wakes up module
40	POWER_ON/OFF	Power on/off
41	VDD	Reference logic level from module
42	SYS_STATE	Module status indication

43	UART2_TXD	TXD for the 2nd UART
44	UART2_RXD	RXD for the 2nd UART
45	I2C_SCL	SCL for I^2C
46	I2C_SDA	SDA for I^2C
47	RESERVED	TBD
48	RESERVED	TBD
49	RESERVED	TBD
50	RESERVED	TBD
51	RESERVED	TBD
52	RESERVED	TBD

6.3.4 CBB2426

Pad assignments of module CBB2426 are listed in Table 6-4.

Table 6-4 CBB2426 Pad Assignments

No.	Name	Description
1	UART1_TXD	TXD for the 1st UART
2	UART1_RXD	RXD for the 1st UART
3	UART1_CTS	CTS for the 1st UART
4	UART1_RTS	RTS for the 1st UART
5	SPI_$\overline{SS}$	$\overline{SS}$ for SPI
6	SPI_MISO	MISO for SPI
7	SPI_MOSI	MOSI for SPI
8	SPI_SCLK	SCLK for SPI
9	USIM_VCC	Power supply for USIM
10	USIM_RESET	RESET for USIM
11	USIM_DATA	DATA for USIM
12	USIM_CLK	CLK for USIM
13	USIM_GND	Ground for USIM
14	USIM_DETECT	DETECT for USIM
15	RESERVED	TBD
16	RESERVED	TBD
17	RESERVED	TBD
18	RESERVED	TBD
19	RTC Power	Power supply for RTC
20	VCC1	Power supply
21	VCC2	Power supply
22	GND	Ground
23	GND	Ground
24	GND	Ground

25	GND	Ground
26	GNSS_ANT	GNSS antenna
27	GND	Ground
28	GND	Ground
29	GND	Ground
30	ANT0	Antenna
31	GND	Ground
32	GND	Ground
33	GND	Ground
34	GND	Ground
35	RESERVED	TBD
36	RESERVED	TBD
37	RESERVED	TBD
38	RESERVED	TBD
39	RESERVED	TBD
40	RESERVED	TBD
41	USB_Dp	USB data (positive)
42	USB_Dn	USB data (negative)
43	VBUS	USB detect
44	GND	Ground
45	ADC	Analog-to-Digital Converter
46	GND	Ground
47	GPIO	General purpose I/O
48	GPIO	General purpose I/O
49	GPIO	General purpose I/O
50	GPIO	General purpose I/O
51	GPIO	General purpose I/O
52	GPIO	General purpose I/O
53	WAKEUP_OUT	Module wakes up host
54	RESET	Reset
55	WAKEUP_IN	Host wakes up module
56	POWER_ON/OFF	Power on/off
57	VDD	Reference logic level from module
58	SYS_STATE	Module status indication
59	UART2_TXD	TXD for the 2nd UART
60	UART2_RXD	RXD for the 2nd UART
61	I2C_SCL	SCL for I^2C
62	I2C_SDA	SDA for I^2C
63	PCM_SYNC/I2S_WS/GPIO	Digital Audio signal
64	PCM_DIN/I2S_DIN/GPIO	Digital Audio signal
65	PCM_DOUT/I2S_DOUT/GPIO	Digital Audio signal
66	PCM_CLK/I2S_CLK/GPIO	Digital Audio signal

67	UART3_TXD	TXD for the 3rd UART
68	UART3_RXD	RXD for the 3rd UART

7 Technical requirements of electrical interface

7.1 Power supply interface

7.1.1 DC power supply interface

Interface type	Interface name	Description	Type
Power interface	VCC	External DC power supply	I

There are two classes of power supply voltage:

1) Class A power supply voltage: cutoff voltage 3.1V, maximum voltage 4.2V, typical voltage 3.6V,

2) Class B power supply voltage: cutoff voltage 1.8V, maximum voltage 3.6V, typical voltage 2.5V.

7.1.2 Data I/O interfaces voltage

There are two classes of voltage:

1) Class A voltage 2.8V ~ 3.0V,

2) Class B voltage 1.8V.

7.1.3 RTC power supply interface

Interface type	Interface name	Description	Type
Power interface	RTC Power	Module clock power input	I

For internal clock power supply. To ensure that the internal clock power is still exist even VCC does not supply power.

Cutoff voltage 1.1V, maximum voltage 1.8V, typical voltage 1.3V.

7.2 Module control and status interface

7.2.1 Power switch and status indication interface

Interface type	Interface name	Description	Type
Control and		Power switch to power on/off the	I

status interface	POWER_ON/OFF	module	
	SYS_STATE	Indication of module current status. There are four states represented by different waveforms. 1. Shutdown (same as when there is no external power supply) 2. Offline (frequency 1Hz, duty cycle 50%) 3. Online (frequency 0.3Hz, duty cycle 10%) 4. Data transmission (frequency 10Hz, duty cycle 50%)	O

When there is external DC power supply, POWEN_ON/OFF pin is used for switching module between enable and disable states. Low level triggered.

7.2.2 Module reset interface

Interface type	Interface name	Description	Type
Control and status interface	RESET	Used for module reset	I

Low level triggered.

7.2.3 Module wakeup interface

Interface type	Interface name	Description	Type
Control and status interface	WAKEUP_IN	For external device to wake up the module	I
	WAKEUP_OUT	For module to wake up other devices	O

Low level triggered.

7.2.4 The reference voltage of VDD output interface

Interface type	Interface name	Description	Type
Control and status interface	VDD	Reference voltage output interface	O

7.3 RF interface

Interface type	Interface name	Description	Type
Radio interface	ANT0	Main antenna (for single antenna and more antenna systems)	I/O
	GNSS_ANT	GNSS antenna	I

NOTE: The impedance characteristics of RF traces between RF pad and antenna connector shall be controlled at about 50 ohms, and the RF traces shall be as short as possible.

7.4 SIM interface

Interface type	Interface name	Description	Type
SIM interface	USIM_GND	USIM ground	
	USIM_DETECT	USIM DETECT signal	I
	USIM_RESET	USIM RESET signal	O
	USIM_CLK	USIM CLK signal	O
	USIM_DATA	USIM DATA signal	I/O
	USIM_VCC	USIM power output	O

7.5 Data I/O interfaces

7.5.1 UART interface

UART interface: 2-wire, 4-wire and 8-wire configurations.

2 wire UART interface: only contains UART_RXD, UART_TXD pins.

4 wire UART interface: contains UART_RTS, UART_CTS, UART_RXD and UART_TXD pins.

8 wire UART interface: including all the pins in the following table.

Interface type	Interface name	Description	Type
SIM Interface	UART_RXD	Receive data	I
	UART_TXD	Transmit data	O
	UART_RTS	Request to send data	I
	UART_CTS	Clear to send data	O
	UART_DSR	The sending data is ready	O
	UART_DCD	Carrier detection	O
	UART_RING	Ring signal for call	O

	UART_DTR	The peer data is ready	I

The module UART interface shall support 5/6/7/8 bit data transmission.

The modules UART interface shall support adaptive baud rate, and shall support common baud rate between 9600 and 115200.

7.5.2 GPIO interface

GPIO interface is mainly used to control and expend the modules pin definition for development purpose, and shall provide interrupt function.

Interface type	Interface name	Description	Type
Data communication interface	GPIO	input /output interface	I/O

7.5.3 I2C interface

Interface type	Interface name	Description	Type
Data communication interface	I2C_SCL	Bidirectional clock line	I/O
	I2C_SDA	Bidirectional data line	I/O

7.5.4 SPI interface

Interface type	Interface name	Description	Type
SPI	SPI_$\overline{SS}$	$\overline{SS}$ signal of SPI interface	I
	SPI_MISO	MISO signal of SPI interface	O
	SPI_MOSI	MOSI signal of SPI interface	I
	SPI_SCLK	signal of SPI interface	I

7.5.5 USB interface

Interface type	Interface name	Description	Type
USB	USB_Dp	USB data signal lines (positive differential)	I/O

	USB_Dn	USB data signal lines (negative differential)	I/O
	VBUS	Power supply	I

7.6 Analog interface

7.6.1 ADC interface

Interface type	Interface name	Description	Type
Analog interface	ADC	AD conversion interface	I/O

7.7 Audio interface

7.7.1 PCM interface

PCM digital audio interface.

Interface type	Interface name	Description	Type
PCM	PCM_SYNC	PCM synchronization signal	O
	PCM_DIN	PCM input data	I
	PCM_DOUT	PCM output data	O
	PCM_CLK	PCM clock	I

7.7.2 I2S interface

I2S digital audio interface.

Interface type	Interface name	Description	Type
I2S	I2S_WS	I2S word select signal	I/O
	I2S _DIN	I2S input data	I
	I2S _DOUT	I2S output data	O
	I2S _CLK	I2S clock	I

8 Software technical requirements

In order to ensure the software development compatibility for different universal

communication modules, it is recommended to define minimum AT commands, including AT minimum commands for SMS, AT minimum General commands, AT minimum commands for Network services, AT minimum commands for Mobile termination control and status, AT minimum commands for Mobile termination errors and AT minimum commands for packet domain.

8.1 AT minimum commands for SMS

The following are the recommended AT minimum commands for SMS derived from [3GPP TS 27.005], including the basic functionality of SMS service.

Table 8-1. AT minimum commands for SMS

AT commands	Description
CSMS	Select Message Service
CMGF	Set command to choose input and output format of messages (Protocol Data Unit (PDU) or text mode)
CSCA	Set command to update the SMS Service Centre address, through which mobile originated SMS are transmitted.
CMGS	Execution command to send message to the network
CNMI	Set command to select the procedure about how to receive new messages from the network
CNMA	Execution command to confirm correct reception of a new message

8.2 AT minimum General commands

The following are the recommended AT minimum General commands derived from [3GPP TS 27.007], which are for the identification of universal communication modules.

Table 8-2. AT minimum General commands

AT commands	Description
CGMI	Request manufacturer identification
CGMM	Request model identification
CGMR	Request revision identification
CGSN	Request product serial number identification
CIMI	Request international mobile subscriber identity

8.3 AT minimum commands for Network services

The following are the recommended AT minimum commands for Network services, derived from [3GPP TS 27.007]. These commands are for NB-IoT/eMTC Network service related commands.

Table 8-3. AT minimum commands for Network services

AT commands	Description
CREG	Network registration
COPS	Public Land Mobile Network (PLMN) selection
CPSMS	Power saving mode setting
CEDRXS	Extended idle mode DRX (eDRX) setting
CEDRXRDP	eDRX read dynamic parameters
CCIOTOPT	Cellular IoT (CIoT) optimization configuration

8.4 AT minimum commands for Mobile termination control and status

The following are the recommended AT minimum commands for Mobile termination control and status, derived from [3GPP TS 27.007]. These commands are for power, display, indicator handling and setting real time clock facilities.

Table 8-4. AT minimum commands for Mobile termination control and status

AT commands	Description
CFUN	Set phone functionality
CSQ	Signal quality
CCLK	Clock
CLAC	List all available AT commands
CRCES	Reading Coverage Enhancement Status

8.5 AT minimum commands for Mobile termination errors

The following are the recommended AT minimum commands for Mobile termination errors, derived from [3GPP TS 27.007], which are for error report.

Table 8-5. AT minimum commands for Mobile termination errors

AT commands	Description
CMEE	Report mobile termination error
CME	Mobile termination error result code

8.6 AT minimum commands for packet domain

The following are the recommended AT minimum commands for packet domain, derived from [3GPP TS 27.007]. These commands are used by universal communication modules to support packet switched services.

Table 8-6. AT minimum commands for packet domain

AT commands	Description
CGDCONT	Define PDP context
CGATT	PS attach or detach

CGPADDR	Show PDP address
CEREG	EPS network registration status
CSCON	Signalling connection status
CNMPSD	No more PS data
CSODCP	Sending of originating data via the control plane
CRTDCP	Reporting of terminating data via the control plane

9 Performance requirements

9.1 Application processor capability

To satisfy the basic application needs of the cellular-IoT universal module, the processor clock should be 32MHz or higher.

9.2 Storage

To satisfy the needs for cellular-IoT universal modules to connect to OneNET IoT platform, the module shall reserve at least 5kB RAM free space, and at least 50kB FLASH free space.

9.3 Temperature characteristics

The cellular-IoT universal module shall adapt to the following working ambient temperature ranges and storage requirements.

The storage environment shall be between -45 to 95 °C.

A module for consumer applications shall work properly in the temperature range between -20 and 60 ℃;

A module for industrial applications shall work properly in the temperature range between -40 and 85 ℃;

A module for vehicle applications shall work properly in the temperature range between -40 and 125 °C.

9.4 Reliability

The cellular-IoT universal module shall be able to withstand random vibration, mechanical shock, salt spray and dust, to work and store in low temperature and high temperature environments, and to comply with the industrial reliability requirements for the terminal device where the module is integrated.