BC95&M35 R2.0

Compatible Design

GSM/GPRS/NB-IoT Module Series

Rev. BC95&M35 R2.0_Compatible_Design_V1.2

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About the Document

History

Revision	Date	Author	Description
1.0	2016-10-24	Bryant CHEN/ Mark ZHANG	Initial
1.1	2016-12-14	Bryant CHEN/ Mark ZHANG	Changed the name of BC95 variants from BC95-CM/BC95-SL/BC95-VF to BC95-B8/BC95-B5/BC95-B20.
1.2	2017-03-15	Bryant CHEN	1. Deleted SWD interface information for BC95 module. 2. Added PCM interface information for M35 R2.0 module. 3. Modified the reference design for power supply. 4. Modified the sketch map of installation between BC95 and M35 R2.0.

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1 Introduction

Quectel NB-IoT BC95 module is compatible with Quectel GSM/GPRS M35 R2.0 module. This document briefly describes the compatible design between BC95 and M35 R2.0 modules.

2 General Descriptions

2.1. Product Description

M35 R2.0 is a quad-band GSM/GPRS module which works at frequencies of GSM850, EGSM900, DCS1800 and PCS1900. BC95 is an NB-IoT module that includes three variants: BC95-B5, BC95-B8 and BC95-B20. BC95 and M35 R2.0 are designed as compatible products. Customers can choose a proper module for applications according to their needs. The compatible design guideline ensures a smooth migration from M35 R2.0 to BC95 for customers' products.

Table 1: Module General Information

Module	Appearance	Packaging	Dimensions	Description
BC95		54-pin LCC + 40-pin LGA	19.9 × 23.6 × 2.2mm	NB-IoT module; contains three variants: BC95-B5, BC95-B8 and BC95-B20.
M35 R2.0		42-pin LCC	19.9 × 23.6 × 2.65mm	GSM/GPRS module

2.2. Feature Overview

The following table compares general properties and features of M35 R2.0 and BC95 modules.

Table 2: Feature Overview

Feature	M35 R2.0	BC95
Power supply	3.3V~4.6V	3.1V~4.2V
Peak current	VBAT: Max 2.0A	VBAT: Max 0.3A
Frequency bands	Quad band: GSM850/900/1800/1900	BC95-B5: Band 5 @H-FDD BC95-B8: Band 8 @H-FDD BC95-B20: Band 20 @H-FDD
GPRS	Multislot class 12	Not supported
Temperature range (Board temperature)	Operation temperature range: -35°C ~ +75°C[1)] Extended temperature range: -40°C ~ +85°C[2)]	Operation temperature range: -30°C ~ +75°C[1)] Extended temperature range: -40°C ~ +85°C[2)]
Serial interface	Baudrate: 300 to 115200bps Autobauding: 4800 to 115200bps Flow control: RTS/CTS Power domain: 2.8V	Baudrate: ● Main port: 9600/115200bps[3)] ● Debug port: 921600bps Power domain: 3.0V
USIM&SIM interface	Support USIM/SIM card: 1.8V or 3.0V	Only support USIM card: 3.0V
Analog audio	Two analog input channels and two analog output channels	Not supported
RTC backup	$V_O$max=3.0V V_I=1.5V~3.3V	Not supported

NOTES

1. [1)] Within operation temperature range, the module is 3GPP compliant.
2. [2)] Within extended temperature range, the module remains the ability to establish and maintain SMS, data transmission, etc. There is no unrecoverable malfunction. There are also no effects on radio spectrum and no harm to radio network. Only one or more parameters like P_{out} might reduce in their value and exceed the specified tolerances. When the temperature returns to the normal operating temperature levels, the module will meet 3GPP specifications again.
3. [3)] BC95 supports 9600bps baud rate for AT command communication & data transmission and 115200bps for firmware upgrading on main port.

2.3. Pin Assignment

The following figure shows the pin assignment of BC95 and M35 R2.0.

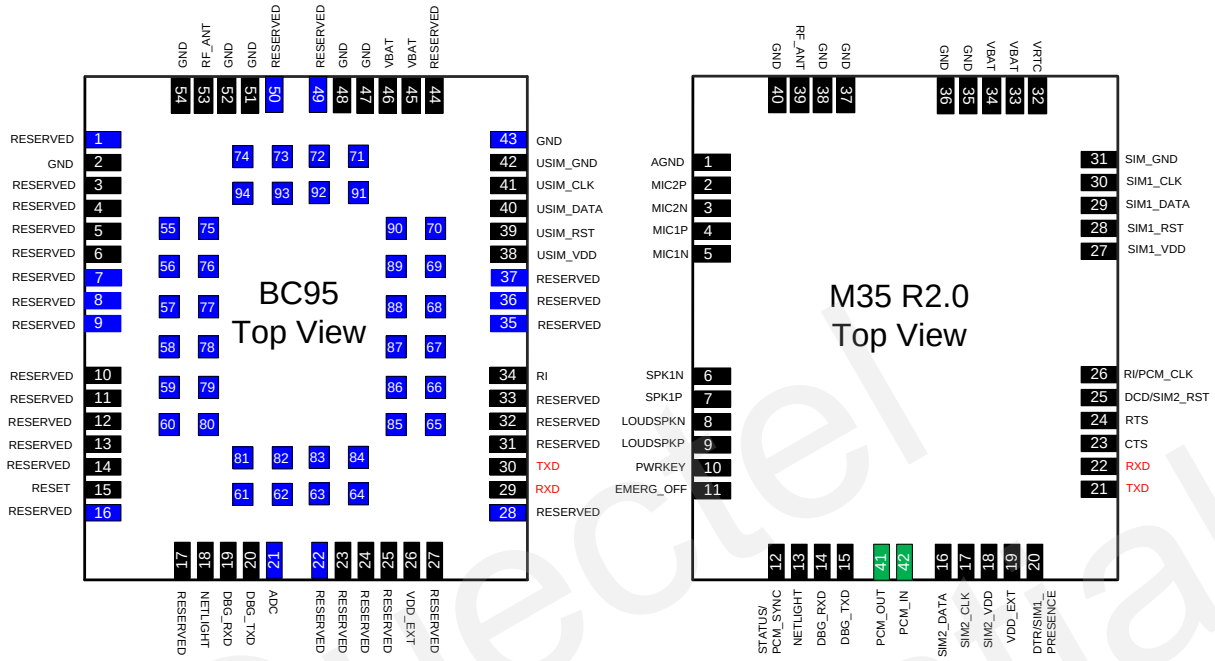


Figure 1: BC95&M35 R2.0 Pin Assignment

NOTES

1. The blue pins of BC95 are the additional pins compared with M35 R2.0.
2. The green pins of M35 R2.0 are the additional pins compared with BC95.
3. Please pay attention to the position of red pins on BC95 and M35 R2.0.

The figure below shows the combination of pin assignment for BC95 and M35 R2.0.

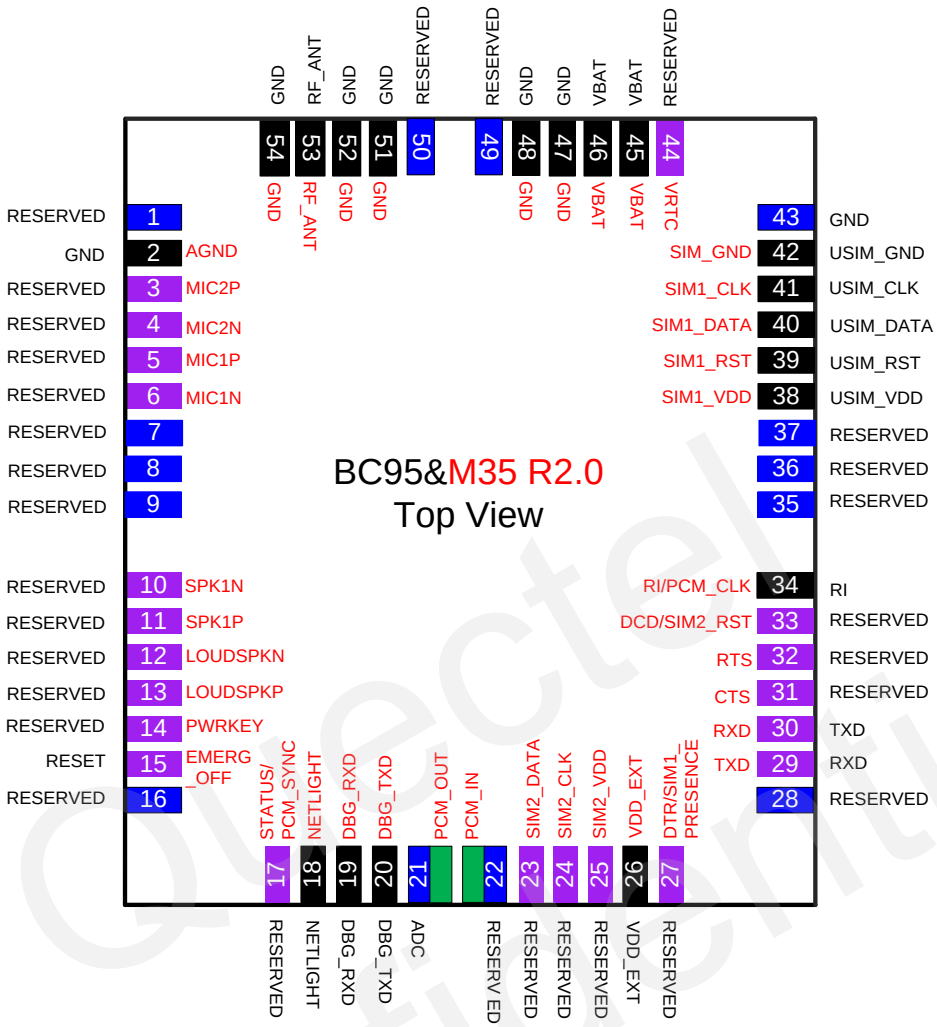


Figure 2: Combined Pin Assignment of BC95&M35 R2.0

NOTES

1. BC95 and M35 R2.0 are identical in size. The black pins of BC95 and M35 R2.0 are compatible pins on main functions.
2. The blue pins of BC95 are the additional pins compared with M35 R2.0.
3. The pin names marked in red in the inside area are M35 R2.0's.
4. The green pins of M35 R2.0 are the additional pins compared with BC95.
5. The purple pins are different pins on main functions.

3 Pin Description

This chapter describes the pin definition and comparison of BC95 and M35 R2.0.

Table 3: I/O Parameters Definition

Symbol	Description
IO	Bidirectional
DI	Digital Input
DO	Digital Output
PI	Power Input
PO	Power Output
AI	Analog Input
AO	Analog Output

The following table shows the comparison of pins between BC95 and M35 R2.0.

Table 4: Comparison of Pins

BC95				M35 R2.0			
Pin No.	Pin Name	IO	Description	Pin No.	Pin Name	IO	Description
1	RESERVED	/	/	/	/	/	/
2	GND	/	Ground	1	AGND	/	Ground
3	RESERVED	/	/	2	MIC2P	AI	Channel 2 Microphone positive input
4	RESERVED	/	/	3	MIC2N	AI	Channel 2 Microphone negative input

5	RESERVED	/	/	4	MIC1P	AI	Channel 1 Microphone positive input
6	RESERVED	/	/	5	MIC1N	AI	Channel 1 Microphone negative input
7	RESERVED	/	/	/	/	/	/
8	RESERVED	/	/	/	/	/	/
9	RESERVED	/	/	/	/	/	/
10	RESERVED	/	/	6	SPK1N	AO	Channel 1 audio negative output
11	RESREVED	/	/	7	SPK1P	AO	Channel 1 audio positive output
12	RESERVED	/	/	8	LOUDSPKN	AO	Channel 2 audio negative output
13	RESERVED	/	/	9	LOUDSPKP	AO	Channel 2 audio positive output
14	RESERVED	/	/	10	PWRKEY	DI	Turn on/off the module. Pulled up to VBAT.
15	RESET	DI	Reset the module	11	EMERG_ OFF	DI	Emergency off. Pulling down for at least 40ms will turn off the module in case of emergency. Use it only when shutting down via PWRKEY or AT command cannot be implemented.
16	RESERVED	/	/	/	/	/	/
17	RESERVED	/	/	12	STATUS/ PCM_SYN[1)]	DO	Indicate the module's operating status/ PCM synchronization signal. These functions can be switched through AT command. 2.8V

18	NETLIGHT*	DO	Network status indication. 2.8V	13	NETLIGHT	DO	Indicate the module's network status. 2.8V
19	DBG_RXD	DI	RXD port for debugging UART. 3.0V	14	DBG_RXD	DI	RXD port for debugging UART. 2.8V
20	DBG_TXD	DO	TXD port for debugging UART. 3.0V	15	DBG_TXD	DO	TXD port for debugging UART. 2.8V
21	ADC*	AI	General purpose analog to digital converter	/	/	/	/
/	/	/	/	41	PCM_OUT	DO	PCM serial data output. 2.8V
/	/	/	/	42	PCM_IN	DI	PCM serial data input. 2.8V
22	RESERVED	/	/	/	/	/	/
23	RESERVED	/	/	16	SIM2_DATA	IO	SIM2 data. 1.8V/3.0V
24	RESERVED	/	/	17	SIM2_CLK	DO	SIM2 clock. 1.8V/3.0V
25	RESERVED	/	/	18	SIM2_VDD	PO	Power supply for SIM2 card. 1.8V/3.0V.
26	VDD_EXT	PO	3.0 V	19	VDD_EXT	PO	2.8V
27	RESERVED	/	/	20	DTR/SIM1_ PRESENCE [2)]	DI	Data terminal ready/ SIM card insertion detection. These functions can be switched through AT command. 2.8V
28	RESERVED	/	/	/	/	/	/
29	RXD	DI	Receive data 3.0V	21	TXD	DO	Transmit data 2.8V
30	TXD	DO	Transmit data 3.0V	22	RXD	DI	Receive data 2.8V

31	RESERVED	/	/	23	CTS	DO	Clear to send 2.8V
32	RESERVED	/	/	24	RTS	DI	Request to send 2.8V
33	RESERVED	/	/	25	DCD/ SIM2_RST[3]	DO	Data carrier detection/reset signal of SIM2 card. 2.8V
34	RI*	DO	Ring indicator 3.0V	26	RI/ PCM_CLK[4]	DO	Ring indicator/PCM clock signal. These functions can be switched through AT command. 2.8V
35	RESERVED	/	/	/	/	/	/
36	RESERVED	/	/	/	/	/	/
37	RESERVED	/	/	/	/	/	/
38	USIM_VDD	PO	Power supply for USIM card. 3.0V	27	SIM1_VDD	PO	Power supply for SIM1 card. 1.8/3.0V
39	USIM_RST	DO	Reset signal of USIM card. 3.0V	28	SIM1_RST	DO	Reset signal of SIM1 card. 1.8/3.0V
40	USIM_ DATA	IO	Data signal of USIM card. 3.0V	29	SIM1_DATA	IO	Data signal of SIM1 card. 1.8/3.0V
41	USIM_ CLK	DO	Clock signal of USIM card. 3.0V	30	SIM1_CLK	DO	Clock signal of SIM1 card. 1.8/3.0V
42	USIM_ GND	/	Ground	31	SIM1_GND	/	Ground
43	GND	/	Ground	/	/	/	/
44	RESERVED	/	/	32	VRTC	PI/ PO	$V_O$max=3.0V $V_O$min=2.0V $V_O$norm=2.8V. V_I=1.5~3.3V Iin≈10uA
45	VBAT	PI	Main power supply of module. 3.1V~4.2V	33	VBAT	PI	Main power supply of module. 3.3V~4.6V

46	VBAT	PI	Main power supply of module. 3.1V~4.2V	34	VBAT	PI	Main power supply of module. 3.3V~4.6V
47	GND	/	Ground	35	GND	/	Ground
48	GND	/	Ground	36	GND	/	Ground
49	RESERVED	/	/	/	/	/	/
50	RESERVED	/	/	/	/	/	/
51	GND	/	Ground	37	GND	/	Ground
52	GND	/	Ground	38	GND	/	Ground
53	RF_ANT	IO	RF antenna	39	RF_ANT	IO	RF antenna
54	GND	/	Ground	40	GND	/	Ground
55~58, 67~70, 75~80, 84~91	RESERVED	/	/	/	/	/	/
59~66, 71~74, 81~83, 92~94	GND	/	Ground	/	/	/	/

NOTES

1. The blue pins of BC95 are the additional pins compared with M35 R2.0.
2. The pins marked in red are compatible pins, but their functions are different.
3. The green pins of M35 R2.0 are the additional pins compared with BC95.
4. The black pins are compatible pins on main functions.
5. Keep all RESERVED and unused pins unconnected.
6. All GND pins should be connected to ground.
7. The AGND pin of M35 R2.0 should be routed as single-ended to main ground when analog audio is used in single-ended application. Otherwise, it can be connected to GND directly.
8. "*" means NETLIGHT, ADC and RI functions of BC95 are under development.
9. [1] When using the PCM interface, STATUS pin can be used as PCM_SYNC pin.
10. [2] DTR pin can be used as SIM1_PRESENCE pin via AT command. For more details, please refer to the ***document [2]***.
11. [3] When using the SIM2 interface, DCD pin can be used as SIM2_RST pin.
12. [4] When using the PCM interface, RI pin can be used as PCM_CLK pin.

4 Hardware Reference Design

The following chapters describe compatible design of BC95 and M35 R2.0 on main functionalities.

4.1. Power Supply

4.1.1. Reference Design for Power Supply

The power supply is one of the key factors in module design, as the performance of the module largely depends on the power source. The battery power supply is capable of providing the sufficient current up to 2A.

The following figure shows a reference design for battery power source. The typical battery output voltage is 3.6V.

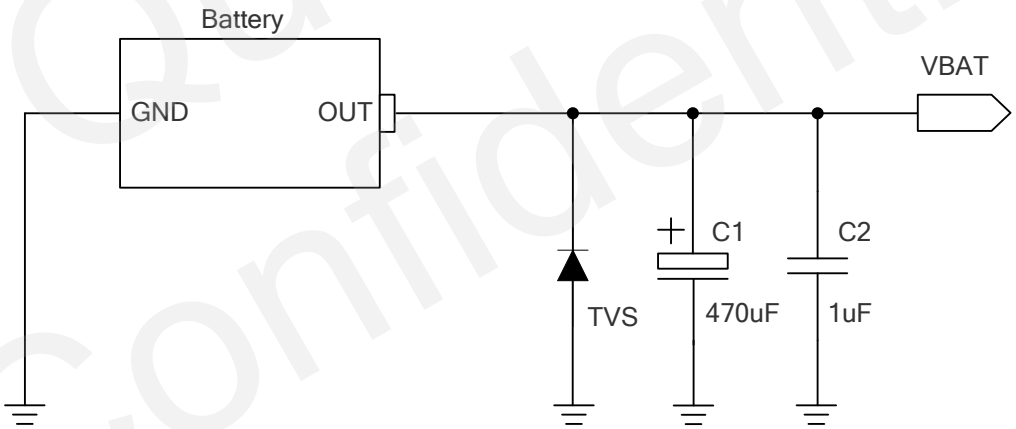


Figure 3: Reference Circuit of Power Supply

4.1.2. Reduce Voltage Drop

The power supply range of M35 R2.0 module is from 3.3V to 4.6V and the power supply range of BC95 is from 3.1V to 4.2V. Attention should be paid to the range of the power source to make sure that the input voltage will never drop below 3.3V and never exceed 4.2V, and the typical power supply is 3.6V. The VBAT pins of BC95 are compatible with that of M35 R2.0, therefore, it is recommended to mount C1~C4.

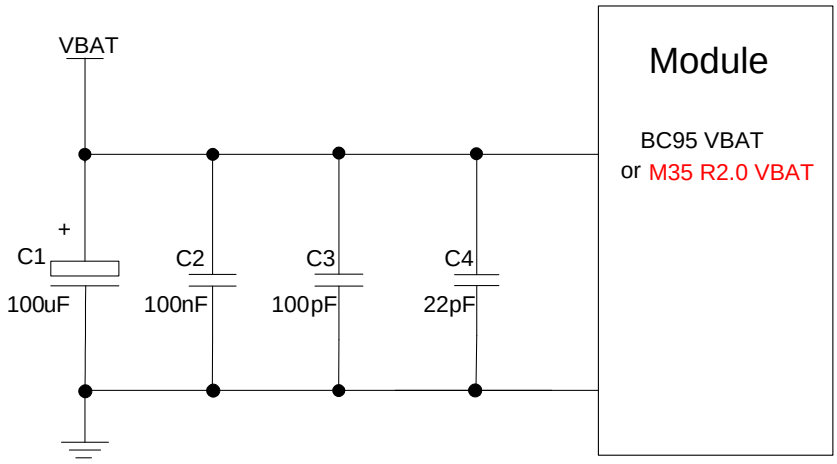


Figure 4: Reference Circuit for VBAT Input

4.2. Power-on Circuit

The turn-on method of BC95 and M35 R2.0 is different. BC95 can be automatically turned on by supplying power source to VBAT pins, while M35 R2.0 will be started after pressing PWRKEY for about 1s. The following circuit is a reference design for M35 R2.0 power-on circuit.

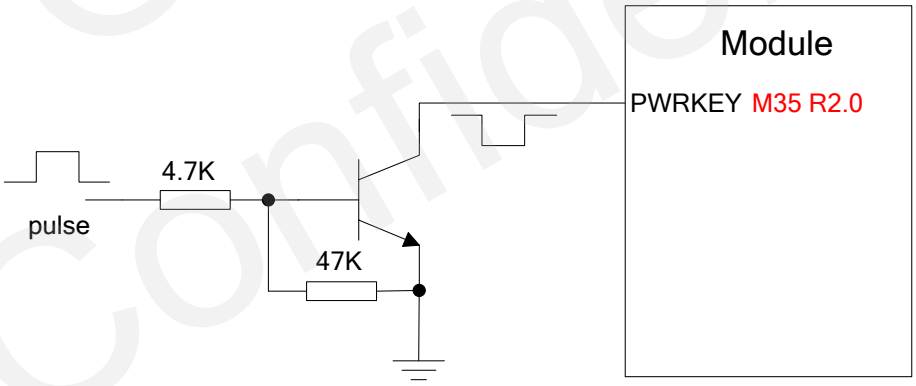


Figure 5: Driving Circuit of the PWRKEY

The turning on scenarios of BC95 and M35 R2.0 is illustrated as the following figure.

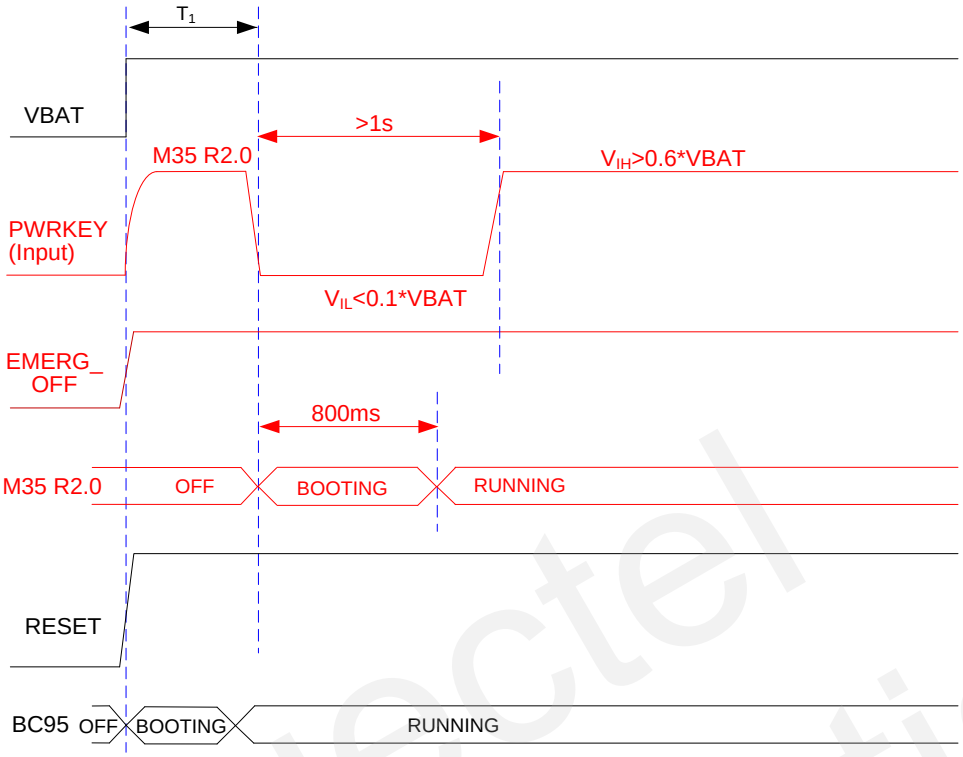


Figure 6: Timing of Turning on Scenarios

NOTES

1. Make sure that VBAT is stable before pulling down PWRKEY pin. The time of T_1 is recommended as 200ms. It is not recommended to always pull down PWRKEY pin.
2. The part in the above figure marked in red is for M35 R2.0.
3. The part in the above figure marked in black is for BC95.

4.3. Power-off Circuit

4.3.1. Power Down Module

M35 R2.0 module can be turned off through **AT+QPOWD** command or driving the PWRKEY to a low level voltage for a certain time, while BC95 can only be turned off by shutting down the VBAT power supply.

The power-down scenario is illustrated as the following figure.

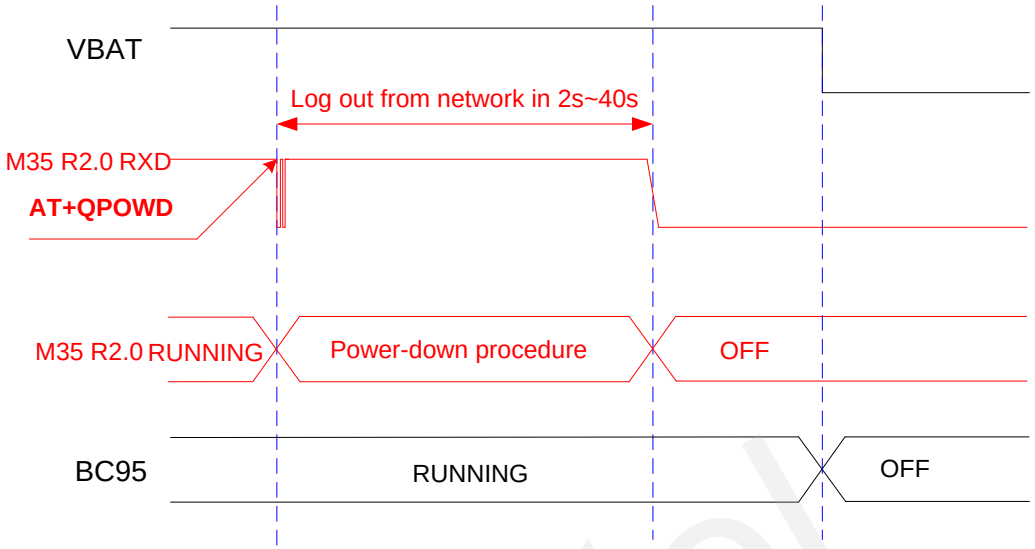


Figure 7: Timing of Turning off Scenarios (Use AT Command for M35 R2.0)

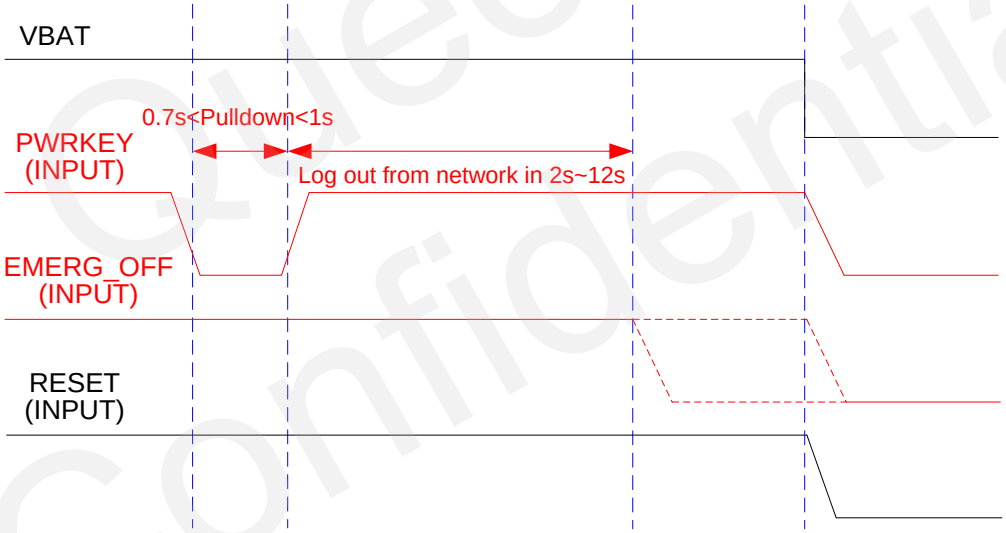


Figure 8: Timing of Turning off Scenarios (Use PWRKEY for M35 R2.0)

NOTES

1. The part in the above figure marked in red is for M35 R2.0.
2. The part in the above figure marked in black is for BC95.
3. The time of logging out from network depends on the local network signal.

4.3.2. EMERG_OFF&RESET Interface

The EMERG_OFF circuit of M35 R2.0 is compatible with the RESET circuit of BC95. The M35 R2.0 can be shut down by EMERG_OFF pin and BC95 can be reset by RESET pin. They can only be used under abnormal situation.

The following circuit is a reference design for M35 R2.0 emergency shutdown and BC95 reset.

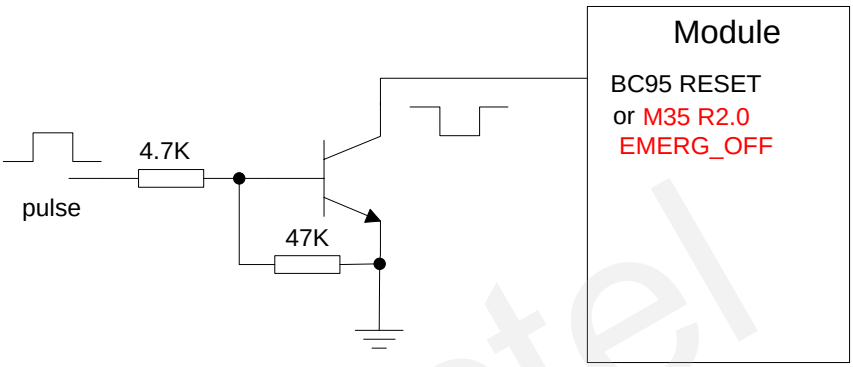


Figure 9: Driving Circuit of Emergency Shutdown and Reset

The emergency shutdown and reset scenario is illustrated as the following figure.

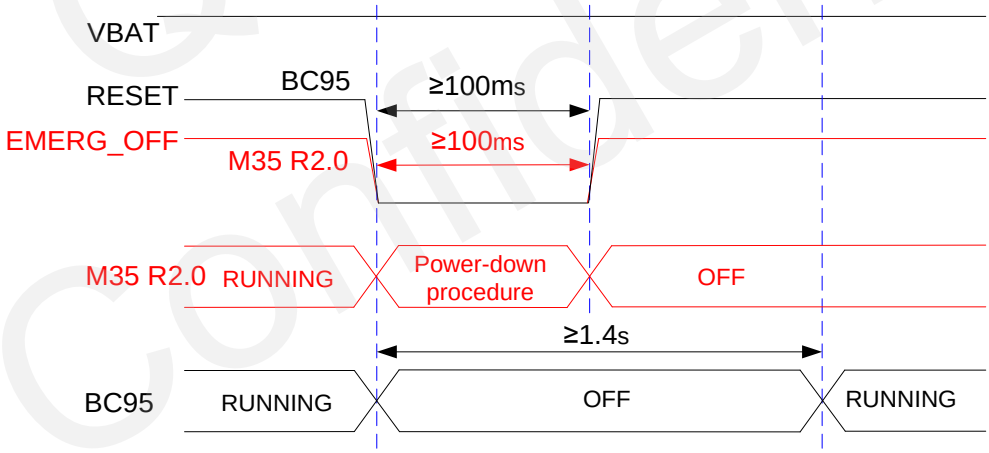


Figure 10: Timing of Emergency Shutdown and Reset

NOTE

The time of logging out from network depends on the local network signal.

4.4. Network Status Indication*

The NETLIGHT pin can be used to drive a network status indicator LED. The following circuit is a reference design of NETLIGHT.

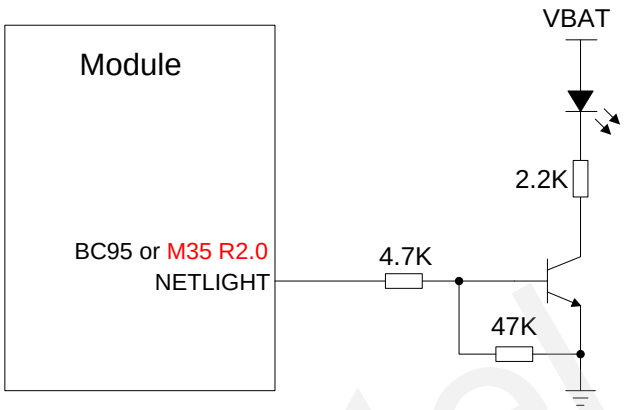


Figure 11: Reference Circuit of the NETLIGHT

NOTE

"*" means this function of BC95 is under development.

4.5. USIM&SIM Interface

SIM interface of M35 R2.0 supports 1.8V or 3.0V USIM/SIM cards by default, while USIM interface of BC95 only supports 3.0V USIM card. The pin assignment of BC95's USIM interface is compatible with M35 R2.0's SIM1 interface.

A reference circuit for a 6-pin USIM&SIM card connector is illustrated as the following figure.

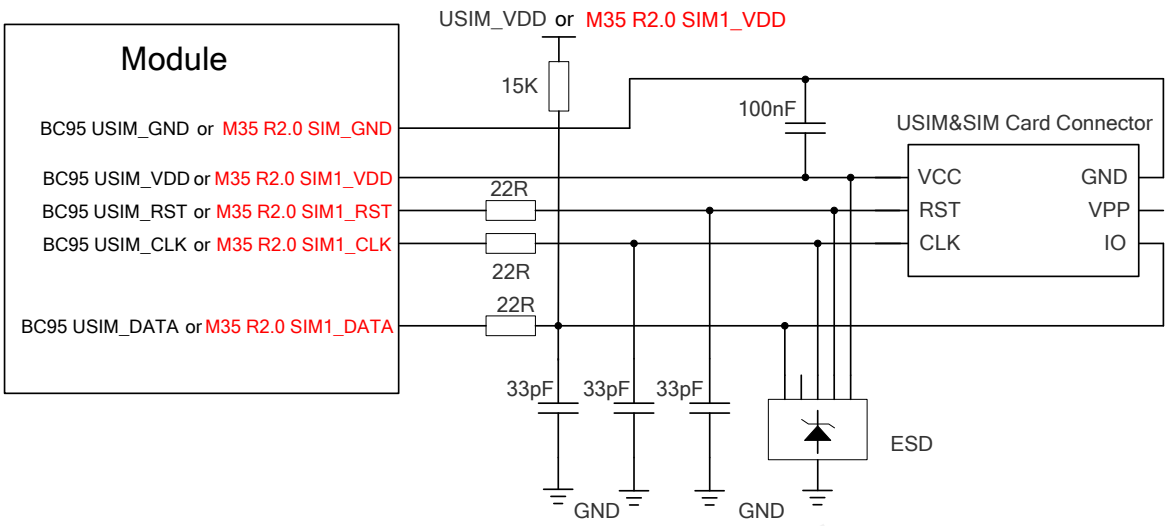


Figure 12: Reference Circuit of 6-Pin USIM&SIM Card Connector

4.6. UART Interface

MAIN_UART and DBG_UART on BC95 and M35 R2.0 have the same function, but with different voltage domain: 3.0V for BC95 UART port and 2.8V for M35 R2.0 UART port. The BC95 UART port does not support hardware flow control.

The following circuit shows a reference design of UART interface level match when application processor communicates with module via UART interface. It is recommended to add a level match circuit between M35 R2.0/BC95 module and DTE because of the difference on power domain. For details, please refer to ***document [1]***.

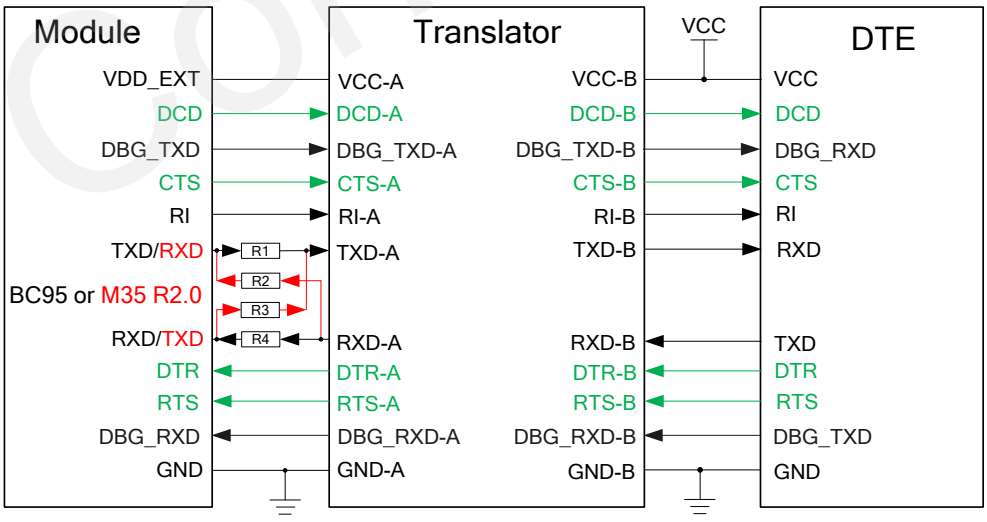


Figure 13: Reference Design of UART Interface

NOTES

1. UART pins of M35 R2.0 module belong to 2.8V power domain and UART pins of BC95 belong to 3.0V power domain.
2. The red pins are MAIN_UART ports of M35 R2.0.
3. The green pins of M35 R2.0 are the additional pins compared with BC95.
4. Mount R1 and R4 when using BC95 module, and mount R2 and R3 when using M35 R2.0 module. The resistance of R1~R4 is 0Ω.

4.7. RF Interface

RF_ANT pins of BC95 and M35 R2.0 are compatible. The RF interface has an impedance of 50Ω. A reference circuit is shown in the following figure. In order to adjust RF performance, it should reserve a π-type matching circuit. The resistance of R1 is 0Ω by default and C1 and C2 capacitors are not mounted.

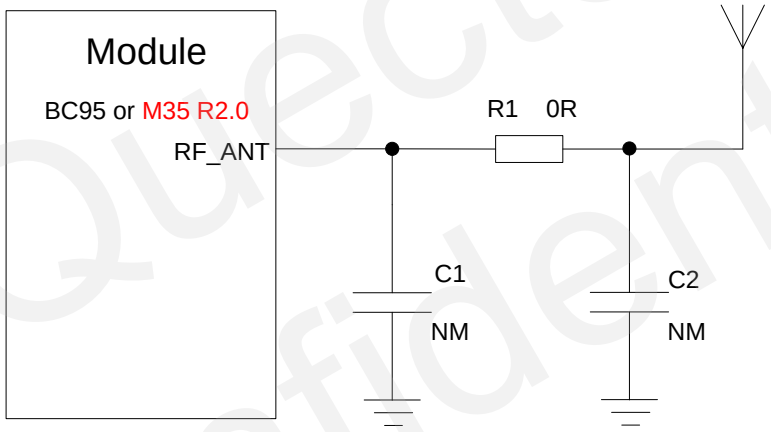
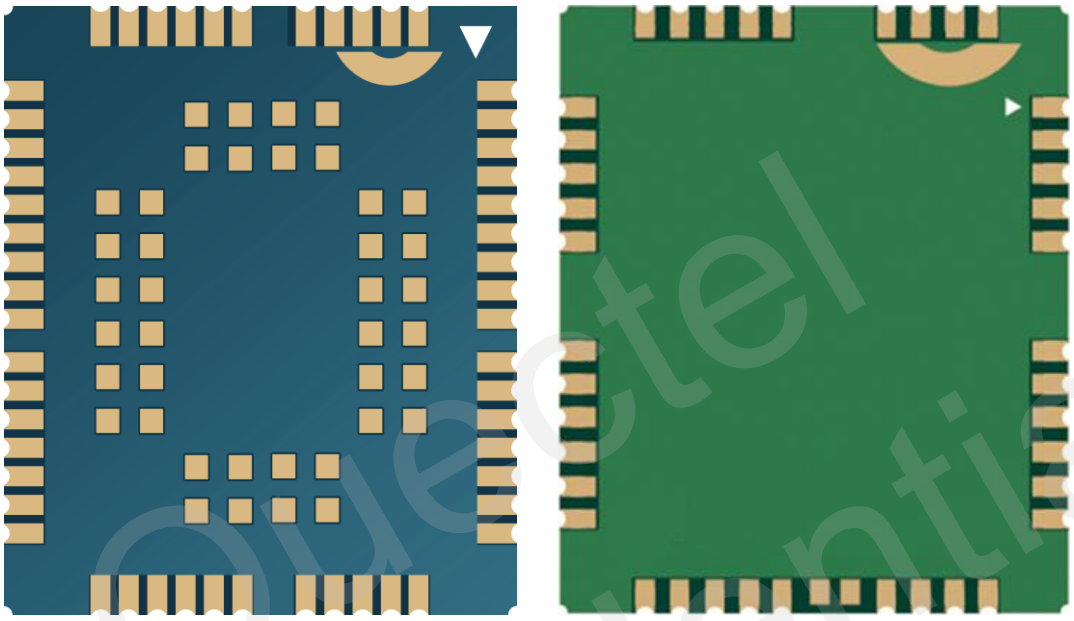


Figure 14: Reference Circuit of RF Interface

5 Recommended Footprint

The following figure shows the bottom view of BC95 and M35 R2.0.



BC95 M35 R2.0

Figure 15: Bottom View of BC95 and M35 R2.0

The following figure shows the recommended compatible footprint of BC95 and M35 R2.0.

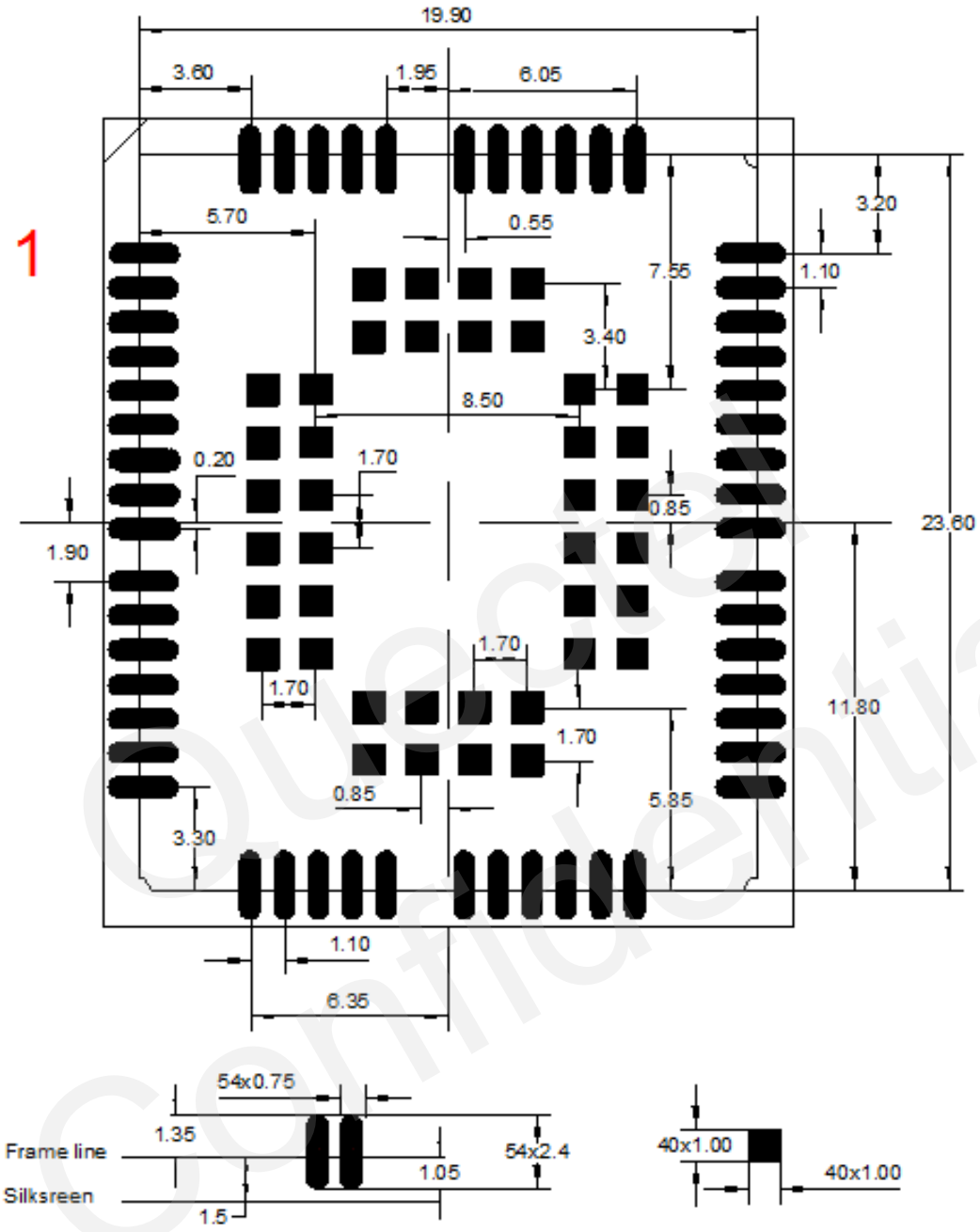


Figure 16: Recommended Compatible Footprint (Unit: mm)

The thickness of PCB is different, to ensure the module soldering quality, the thickness of stencil is recommended to be 0.15mm for BC95 module and 0.2mm for M35 R2.0. For more details, please refer to ***document [3]***.

The recommended stencil of BC95 is shown as below.

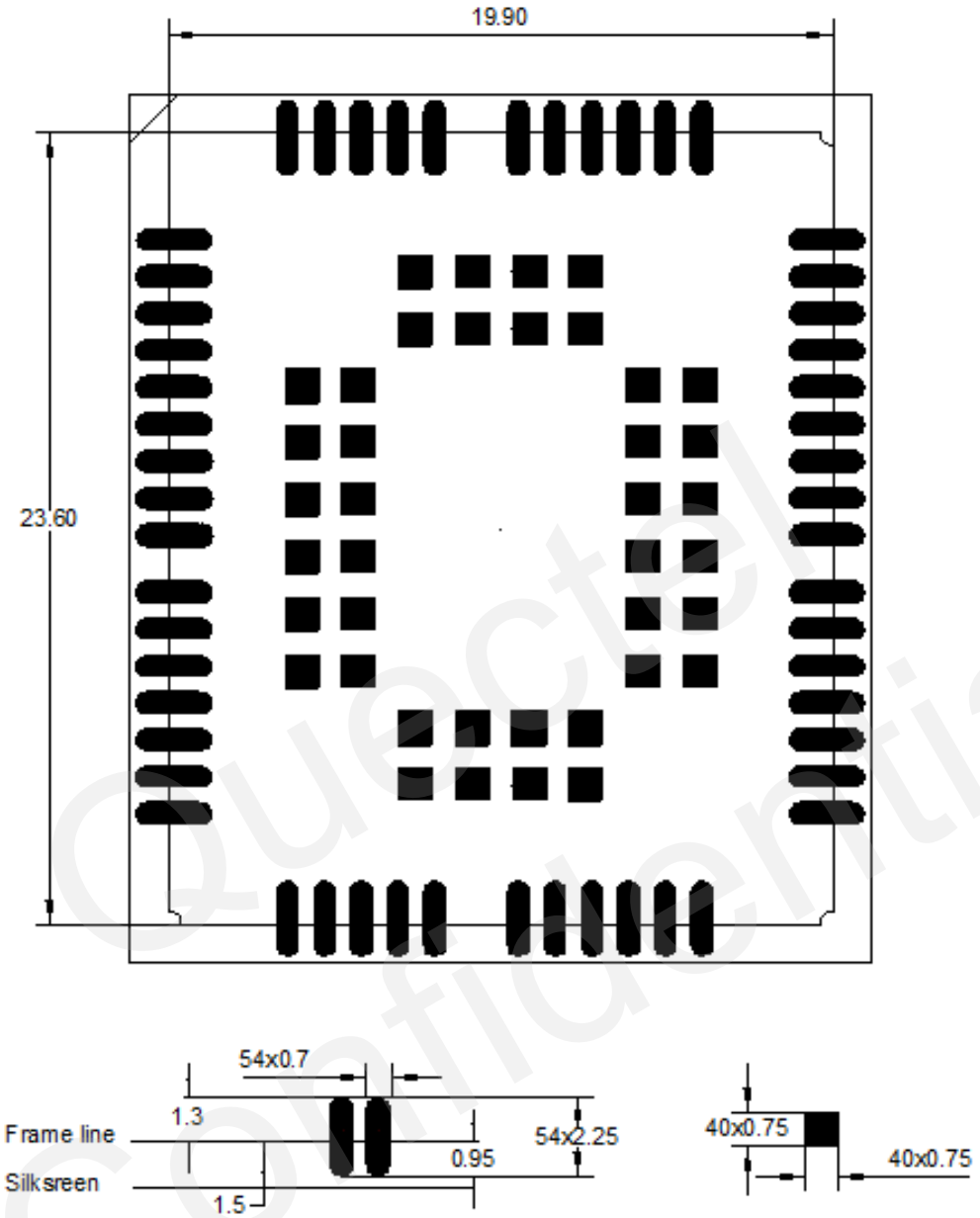


Figure 17: Recommended Stencil of BC95 (Unit: mm)

The recommended stencil of M35 R2.0 is shown as below.

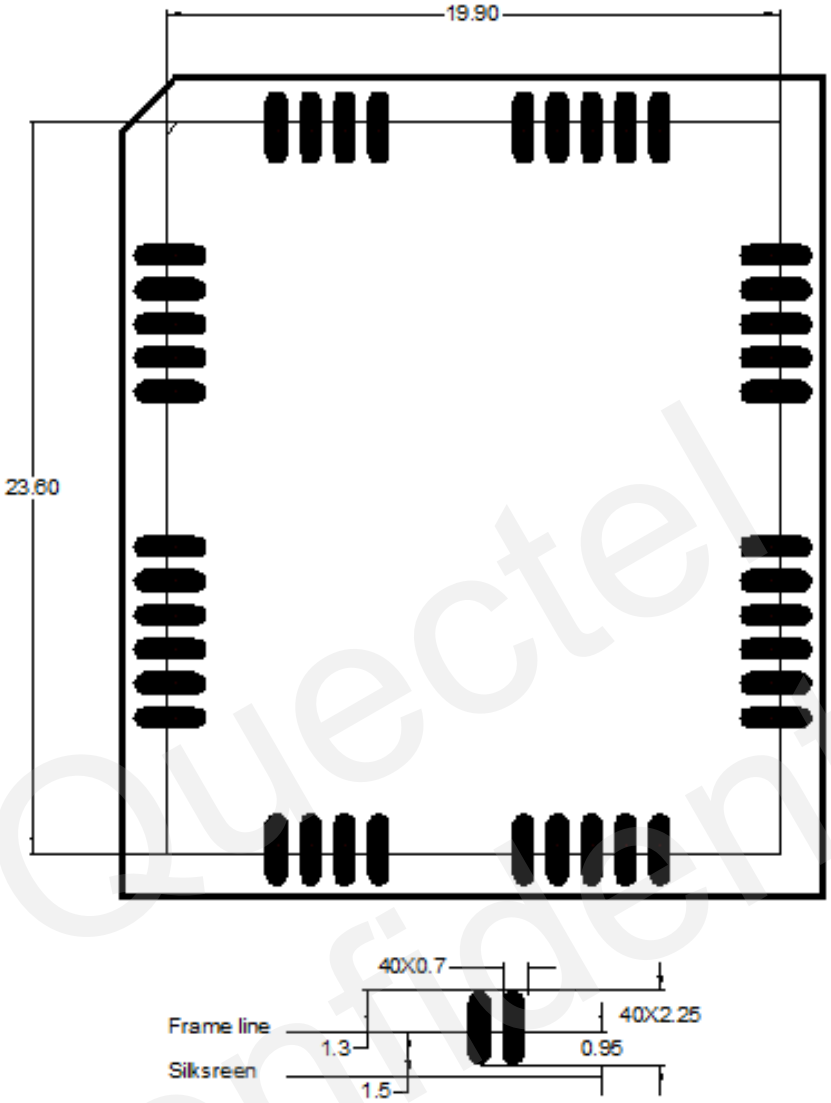


Figure 18: Recommended Stencil of M35 R2.0 (Unit: mm)

The following figure shows the sketch map of installation between BC95 and M35 R2.0.

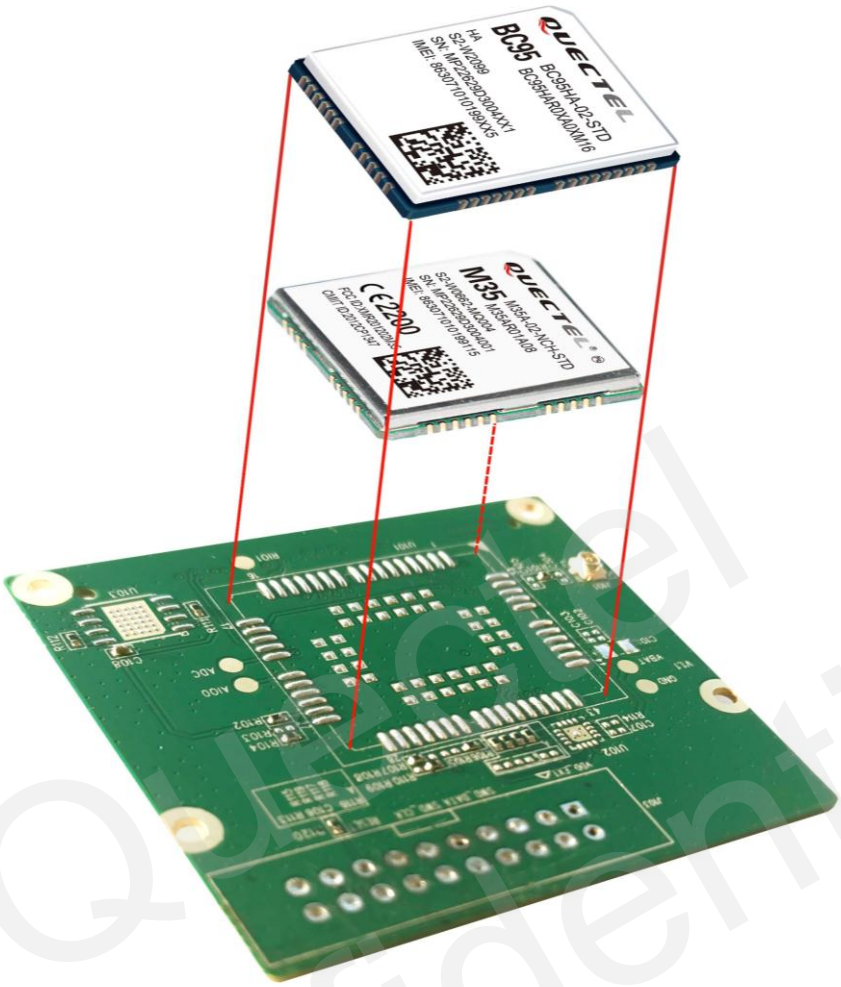


Figure 19: Installation Sketch Map for BC95 and M35 R2.0

6 Manufacturing and Packaging

The following table shows the compatible manufacturing and packaging information between BC95 and M35 R2.0.

Table 5: Manufacturing

Feature	BC95&M35 R2.0
Reflow Profile	Compatible
Reel	Compatible

6.1. Soldering

Push the squeegee to apply the solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate to the PCB. The force on the squeegee should be adjusted properly so as to produce a clean stencil surface on a single pass.

It is suggested that the peak reflow temperature is 235 ~ 245ºC (for SnAg3.0Cu0.5 alloy). The absolute max reflow temperature is 260ºC. To avoid damage to the module when it is repeatedly heated, it is suggested that the module should be mounted after reflow soldering for the other side of PCB has been completed. Recommended reflow soldering thermal profile is shown below.

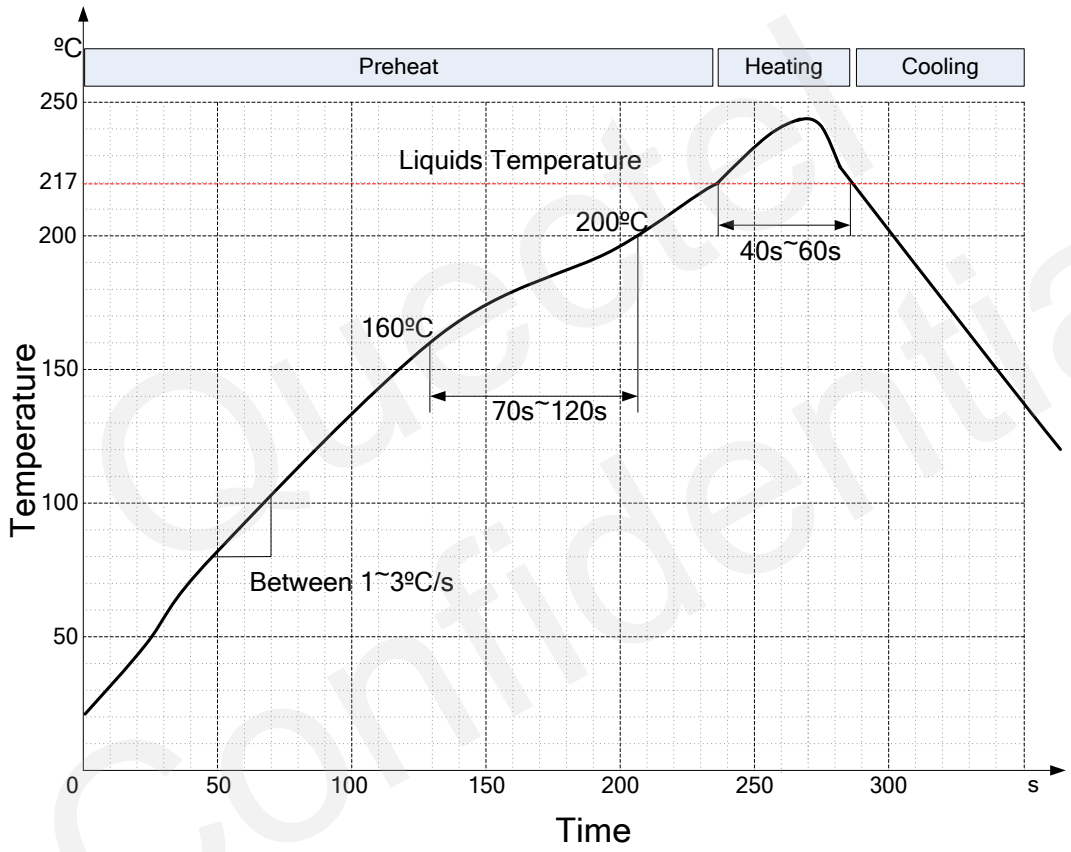


Figure 20: Reflow Soldering Thermal Profile

6.2. Packaging

The modules are stored inside a vacuum-sealed bag which is ESD protected. It should not be opened until the devices are ready to be soldered onto the application.

The reel is 330mm in diameter and each reel contains 250 modules.

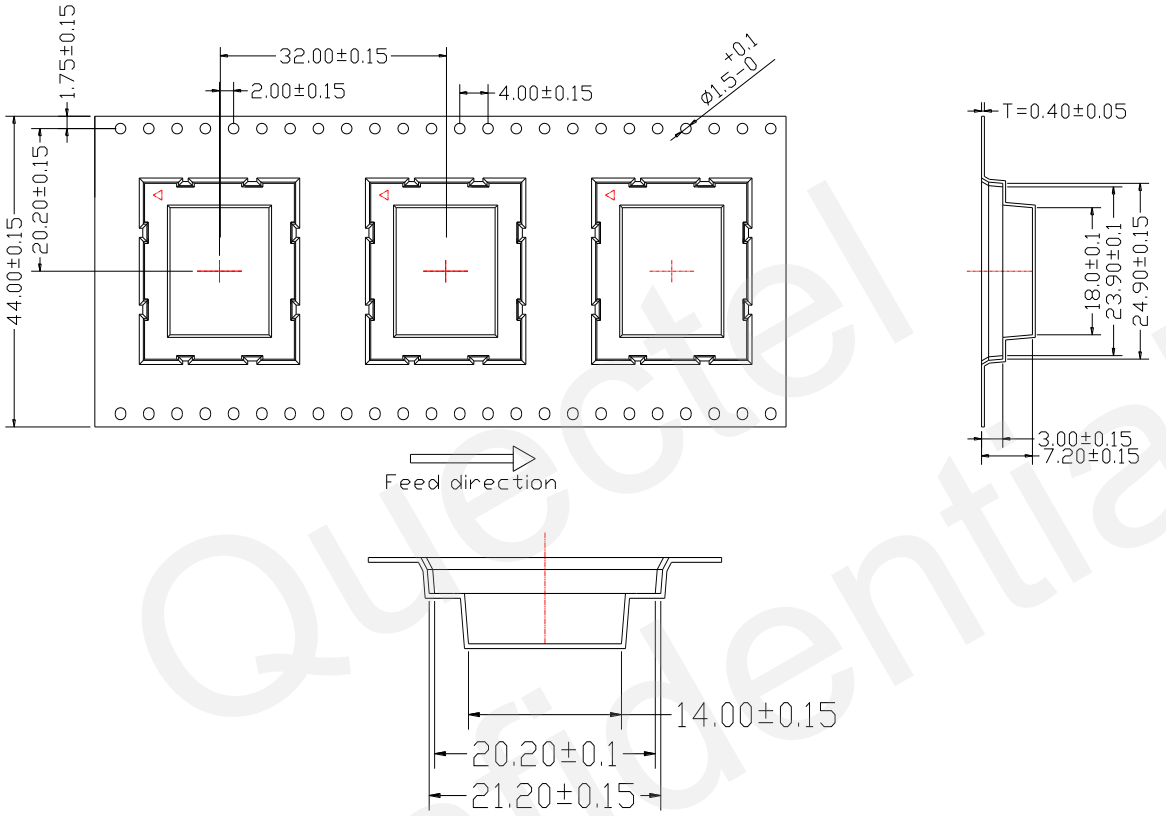


Figure 21: Tape Specification

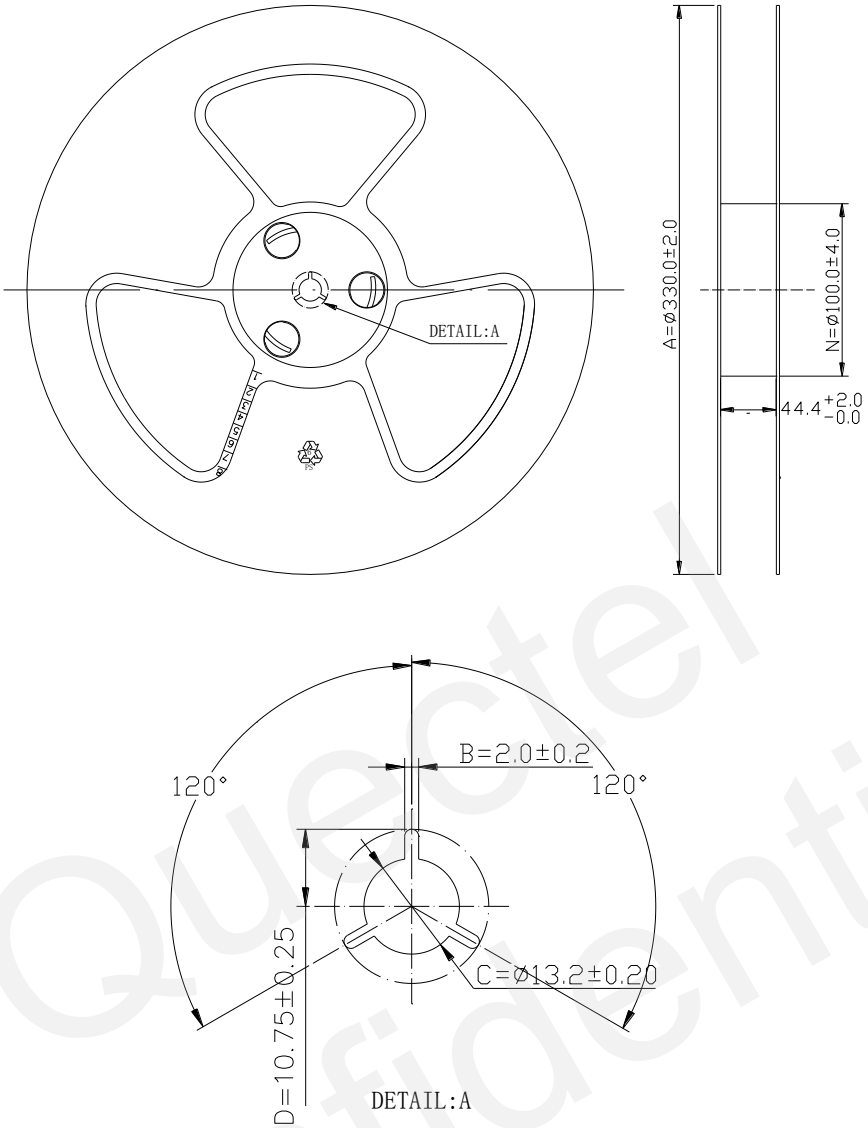


Figure 22: Reel Specification

7 Appendix A

Table 6: Related Documents

SN	Document Name	Remark
[1]	Quectel_BC95_Hardware_Design	BC95 Hardware Design
[2]	Quectel_M35_Hardware_Design	M35 Hardware Design
[3]	Module_Secondary_SMT_User_Guide	Module Secondary SMT User Guide