BC68&M66

Compatible Design

NB-IoT/GSM/GPRS Module Series

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About the Document

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1 Introduction

Quectel BC68 is a high-performance NB-IoT module compatible with Quectel GSM/GPRS M66 module. This document briefly describes the compatible design between BC68 and M66 modules.

2 General Descriptions

2.1. Product Description

M66 is a Quad-band GSM/GPRS engine that works at frequencies of GSM850MHz, EGSM900MHz, DCS1800MHz and PCS1900MHz. The M66 features GPRS multi-slot class 12 and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. BC68 is a high-performance NB-IoT module with low power consumption. BC68 and M66 are designed as compatible products. Customers can choose a proper module according to specific application demands. The compatible design guideline ensures a smooth migration from M66 to BC68 for customers' products.

Table 1: Module General Information

Module	Appearance	Packaging	Dimensions	Description
BC68		44-pin LCC 14-pin LGA	17.7mm × 15.8mm × 2.0mm	NB-IoT module
M66		44-pin LCC	17.7mm × 15.8mm × 2.3mm	GSM/GPRS module

2.2. Features Overview

The following table compares general properties and features of BC68 and M66 modules.

Table 2: Features Overview

Feature	BC68	M66
Power Supply	3.1V~4.2V Typ. 3.6V	3.3V~4.6V Typ. 4.0V
Peak Current	VBAT: Max 0.8A	VBAT: Max 0.8A
Sleep Current	Max 5uA @Power Saving Mode (PSM)	1.3mA @DRX=5 1.2mA @DRX=9
Frequency Bands	H-FDD: B1/B3/B5/B8/B20/B28*	Quad-band: GSM850MHz/EGSM900MHz/ DCS1800MHz/PCS1900MHz
GSM	Not supported	Supported
NB-IoT	Supported	Not supported
GPRS	Not supported	Multi-slot class 12
BT	Not supported	Supported BT3.0
Temperature Range	Operation temperature range: -35°C ~ +75°C [1)] Extended temperature range: -40°C ~ +85°C [2)] Storage temperature range: -40°C ~ +90°C	Operation temperature range: -35°C ~ +75°C [1)] Extended temperature range: -40°C ~ +85°C [2)] Storage temperature range: -40°C ~ +90°C
UART Interface	**Main port:** When used for AT command communication and data transmission, the baud rate is 4800bps, 9600bps (default) and 115200bps When used for firmware upgrading, the baud rate is 921600bps Debug port: Used for firmware debugging Only supports 921600bps baud rate Signal level: 3.0V	Baudrate: 300bps to 115200bps Autobauding: 4800bps to 115200bps Flow control: RTS/CTS Signal level: 2.8V
Analog Audio	Not supported	One analog input channel

		Two analog output channels
ADC	ADC*	Supported
RTC Backup	Not supported	Vnorm=2.8V VI=1.5V~3.3V
PCM Interface	Not supported	Supported
Firmware Upgrade	UART, DFOTA	UART

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 a voice, SMS, data transmission, emergency call, 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 normal operating temperature levels, the module will meet 3GPP specifications again.
3. "*" means under development.

2.3. Pin Assignment

The following figure shows the pin assignment of BC68 and M66.

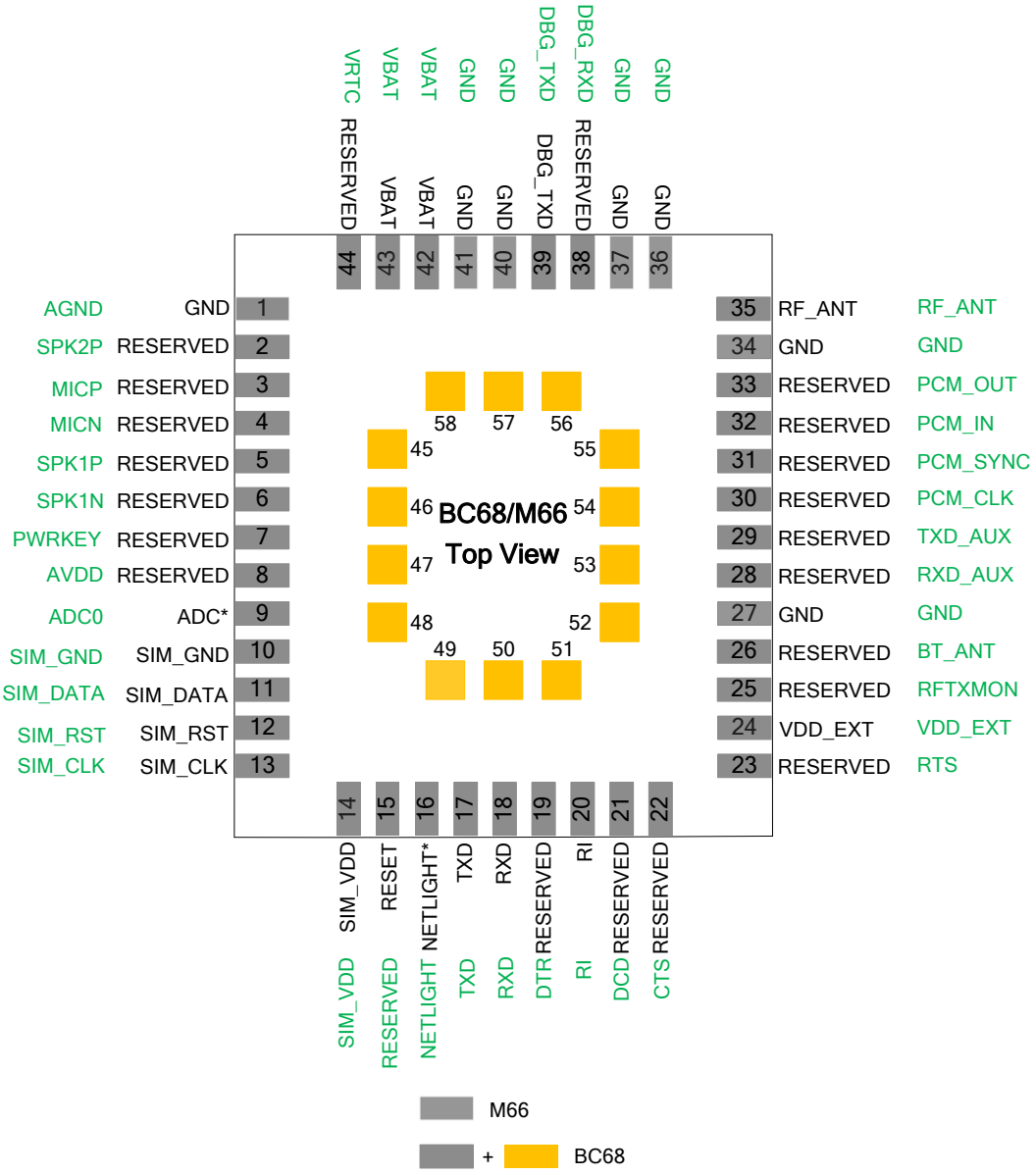


Figure 1: BC68&M66 Pin Assignment

NOTES

1. The black colored pin names are defined for BC68 module.
2. The green colored pin names are defined for M66 module.
3. The orange colored pins of BC68 are additional pins compared with M66.

3 Pin Description

This chapter describes the pin definition of BC68 and M66, as well as the pin comparison between them.

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
OD	Open Drain

The following table shows the comparison of pins between BC68 and M66.

Table 4: Pin Comparison between BC68 and M66

Pin No.	BC68			M66		
	Pin Name	IO	Description	Pin Name	IO	Description
1	GND			AGND		Analog ground. Separate ground connection for external audio circuits
2	RESERVED	/	/	SPK2P	AO	Channel 2 voice output
3	RESERVED	/	/	MICP	AI	Positive voice input
4	RESERVED	/	/	MICN	AI	Negative voice input signal

5	RESERVED	/	/	SPK1P	AO	Channel 1 Positive voice output
6	RESERVED	/	/	SPK1N	AO	Channel 1 Negative voice output
7	RESERVED	/		PWRKEY	DI	Used to power on/off the module
8	RESERVED	/	/	AVDD	PO	Reference voltage of ADC circuit
9	ADC*	AI	General purpose analog to digital converter	ADC0	AI	General purpose analog to digital converter
10	SIM_GND		USIM ground	SIM_GND		Specified ground for USIM card
11	SIM_DATA	IO	USIM data	SIM_DATA	IO	(U)SIM card data signal
12	SIM_RST	DO	USIM reset	SIM_RST	DO	(U)SIM card reset signal
13	SIM_CLK	DO	USIM clock	SIM_CLK	DO	(U)SIM card clock signal
14	SIM_VDD	PO	Power supply for USIM card	SIM_VDD	PO	Power supply for (U)SIM card
15	RESET	DI	Reset the module	RESERVED	/	/
16	NETLIGHT*	DO	Network status indication	NETLIGHT	DO	Network status indication
17	TXD	DO	Transmit data	TXD	DO	Transmit data
18	RXD	DI	Receive data	RXD	DI	Receive data
19	DTR	DI	Data terminal ready	DTR	DI	Data terminal ready
20	RI	DO	Ring indication	RI	DO	Ring indication
21	RESERVED	/	/	DCD	DO	Data carrier detection
22	RESERVED	/	/	CTS	DO	Clear to send
23	RESERVED	/	/	RTS	DI	Request to send
24	VDD_EXT	PO	3.0V output power supply for external circuits. It cannot be used to supply power for external circuits when in PSM.	VDD_EXT	PO	Supply 2.8V voltage for an external circuit.

25	RESERVED	/	/	RFTXMON	DO	Transmission signal indication
26	RESERVED	/	/	BT_ANT	IO	BT antenna pad
28	RESERVED	/	/	RXD_AUX	DI	Receive data
29	RESERVED	/	/	TXD_AUX	DO	Transmit data
30	RESERVED	/	/	PCM_CLK	DO	PCM clock
31	RESERVED	/	/	PCM_SYNC	DO	PCM frame synchronization
32	RESERVED	/	/	PCM_IN	DI	PCM data input
33	RESERVED	/	/	PCM_OUT	DO	PCM data output
35	RF_ANT	IO	RF antenna pad	RF_ANT	IO	RF antenna pad
38	RESERVED	/	/	DBG_RXD	DI	Receive data
39	DBG_TXD	DO	Transmit data	DBG_TXD	DO	Transmit data
42	VBAT	PI	Main power supply of the module: VBAT=3.1V~4.2V	VBAT	PI	Main power supply of module: VBAT=3.3V~4.6V
43	VBAT	PI	Main power supply of the module: VBAT=3.1V~4.2V	VBAT	PI	Main power supply of module: VBAT=3.3V~4.6V
44	RESERVED	/	/	VRTC	IO	Power supply for RTC when VBAT is not supplied for the module.
27, 34, 36, 37, 40, 41,	GND	/	Ground	GND	/	Ground
45~58	RESERVED	/	/	/	/	/

NOTES

1. The red colored pins are compatible pins with different functionalities.
2. The black colored pins are compatible pins with the same functionality.
3. The orange colored pins of BC68 are additional pins compared with M66.
4. Keep all reserved and unused pins unconnected.
5. All GND pins should be connected to ground.
6. "*" means under development.

4 Hardware Reference Design

The following chapters describe the compatible design between BC68 and M66 on main functionalities.

4.1. Power Supply

4.1.1. Reference Design for Power Supply

The power design for the module is very important, as the performance of a module largely depends on the power source. The power supply for BC68 and M66 should be able to provide sufficient current up to 2A.

A TVS diode needs to be added on the VBAT trace to increase surge voltage withstand capability. The following figure shows a reference design for battery power supply and the designed output of the power supply is about 3.6V.

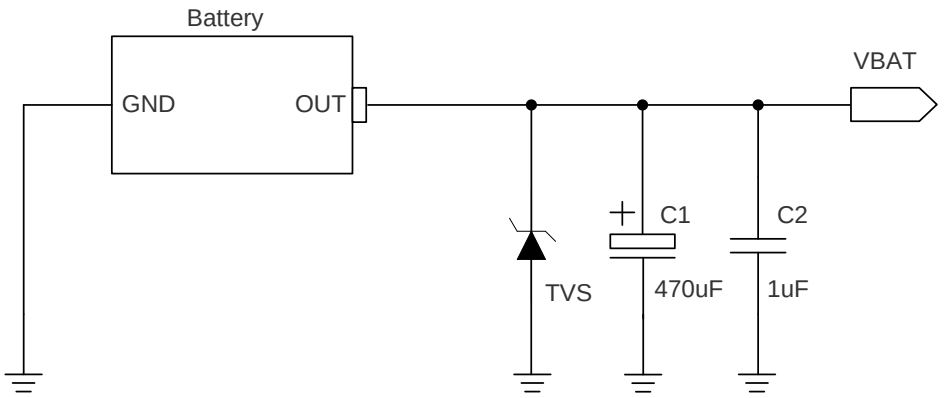


Figure 2: Reference Circuit of Power Supply

4.1.2. Reduce Voltage Drop

The power supply range of BC68 is from 3.1V to 4.2V. The power supply range of M66 is 3.3V to 4.6V 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. In addition, in order to get a stable output voltage, a TVS diode also needs to be added on the VBAT trace to increase surge voltage withstand capability.

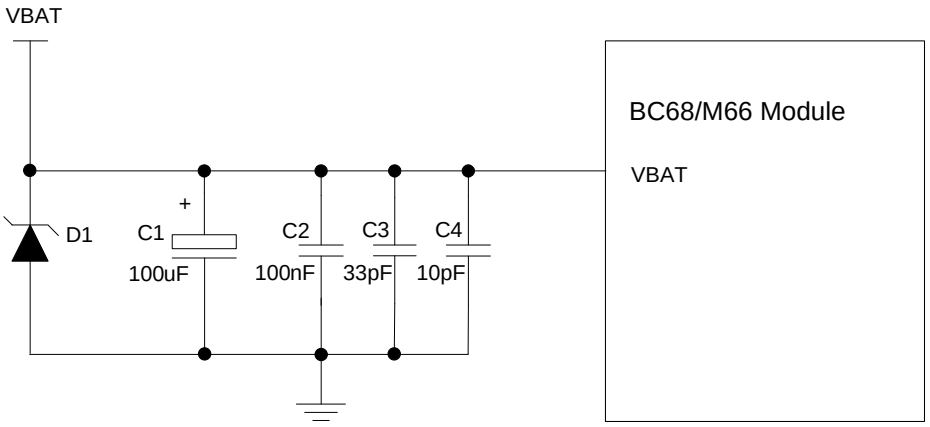


Figure 3: Reference Circuit of VBAT

4.2. Power-on Circuit

The turn-on method of BC68 is different from M66. BC68 can be powered on automatically when VBAT pins are powered. M66 will be powered on by driving the pin PWRKEY to a low level voltage for more than 100ms, and an open collector driver circuit is suggested to control the PWRKEY. The following is a reference design for power-on circuit of M66.

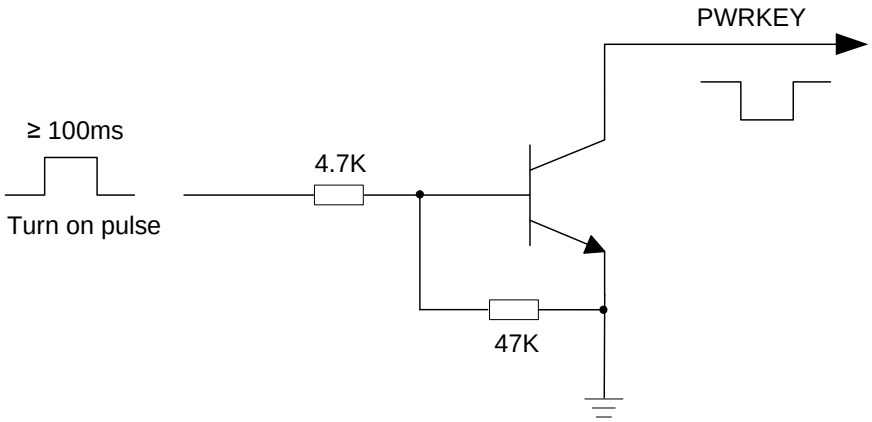


Figure 4: Driving Circuit of the PWRKEY

The power-on scenario of BC68 and M66 are illustrated in the figure below.

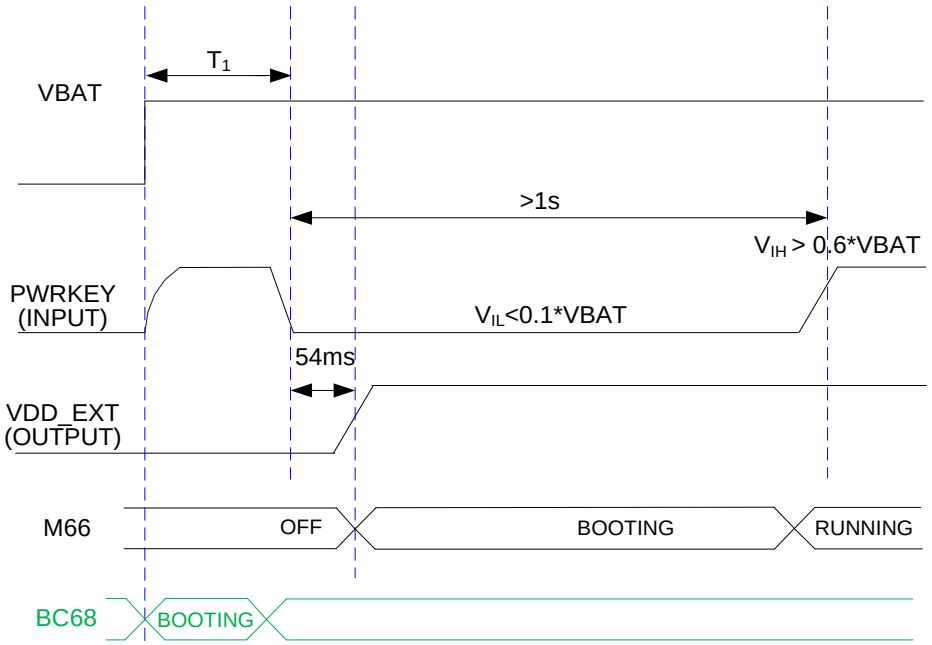


Figure 5: Timing of Power-on Scenario

NOTES

1. Please make sure VBAT is stable before pulling down PWRKEY pin. The time of T_1 is recommended to be 100ms. It is not recommended to always pull down PWRKEY pin.
2. The parts marked in green in the above figure are for BC68.
3. The parts marked in black in the above figure are for M66.

4.3. Power-off Circuit

4.3.1. Power down Module via AT Command

M66 can be turned off through **AT+QPOWD** command. It is a safe way to turn off the module. This command will let the module log out from the network and allow the firmware to save important data before completely disconnecting the power supply. For more details about the command, please refer to ***document [1]***.

BC68 can be turned off by shutting down the VBAT power supply.

The power-down scenario is illustrated in the figure below.

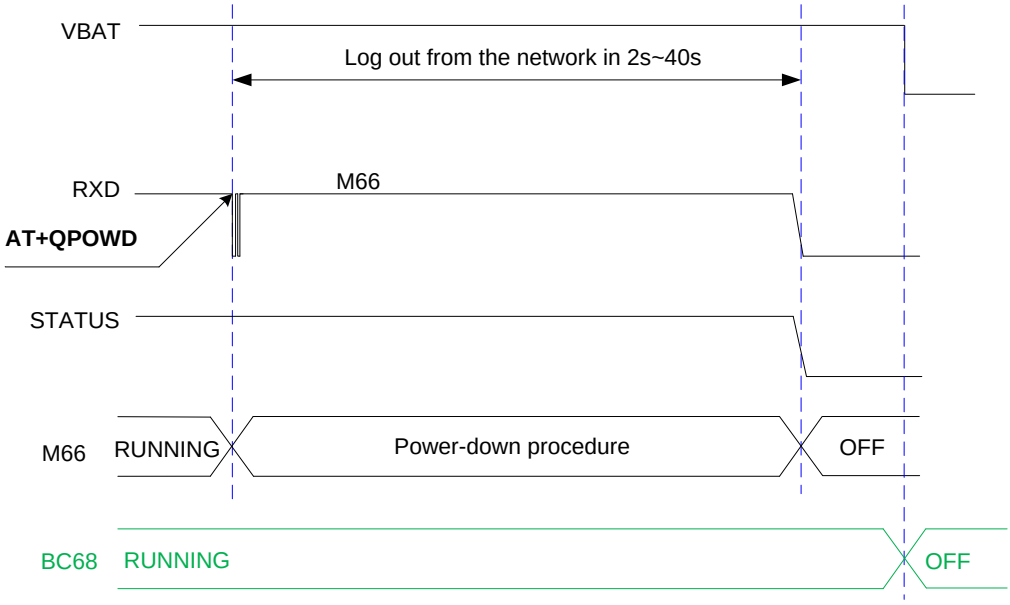


Figure 6: Timing of Power-down through AT Command

NOTES

1. The parts marked in green in the above figure are for BC68.
2. The parts marked in black in the above figure are for M66.
3. The time for the module to log out from network depends on local network quality.

4.3.2. Power down M66 Using PWRKEY Pin

It is a safe way to turn off M66 module by driving PWRKEY to a low level voltage for 0.7s~1s, while BC68 could not be turned off by this pin.

The power-down scenario for M66 by PWRKEY is illustrated in the figure below.

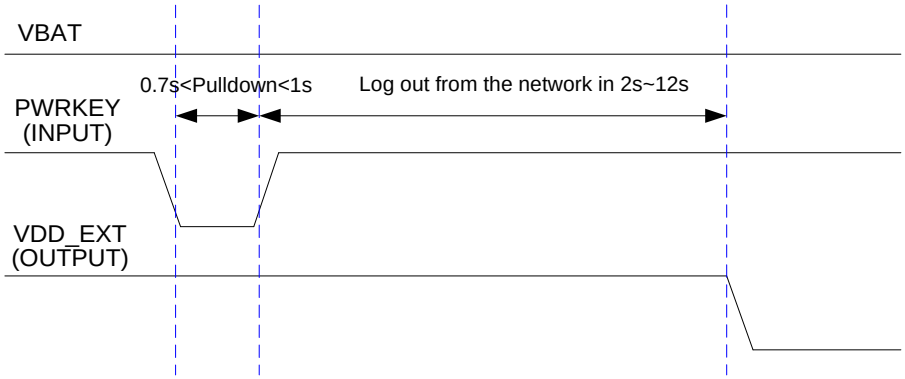


Figure 7: Timing of Power-down for M66 by PWRKEY

4.4. Reset BC68

The BC68 can be reset by the following two ways:

- **Hardware**

The module can be reset by driving RESET to a low level voltage for more than 100ms. The reset scenario for BC68 by RESET is illustrated in the figure below.

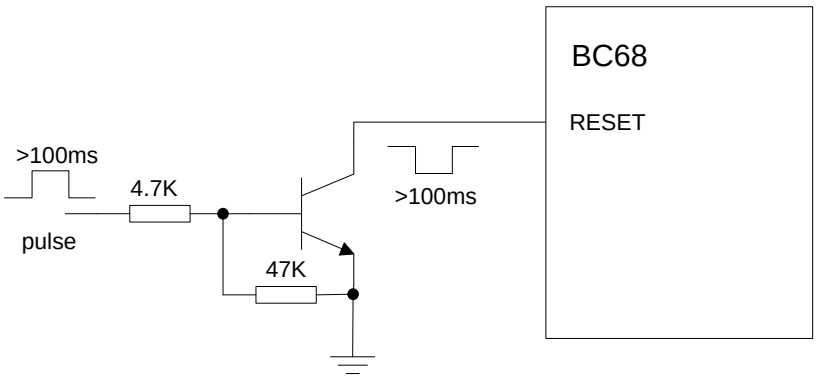


Figure 8: Reference Circuit of RESET by Using Driving Circuit

The reset scenario is illustrated in the figure below.

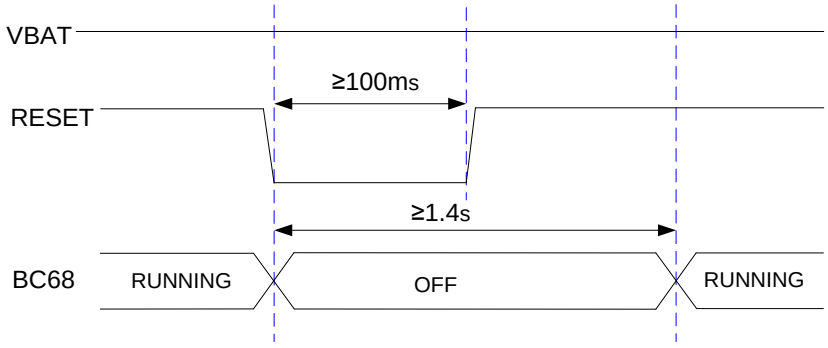


Figure 9: Timing of Resetting Module

- **Software**

Reset the module using command **AT+NRB**. For more details about the command, please refer to ***document [2]***.

4.5. Network Status Indication

The NETLIGHT pin can be used to drive a network status indicator LED. A reference design is shown below.

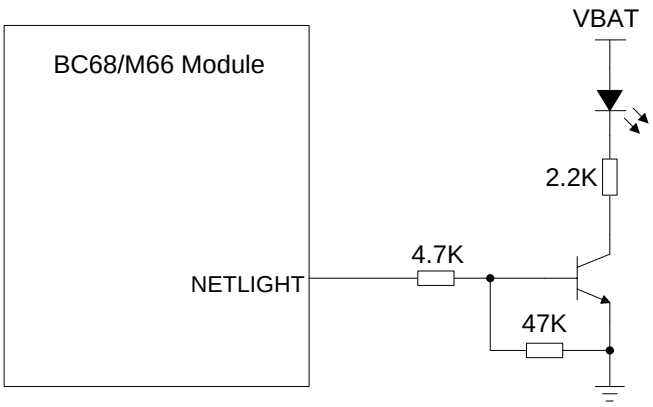


Figure 10: Reference Circuit of NETLIGHT

4.6. (U)SIM Interface

M66 supports 1.8V or 3.0V SIM/USIM cards, while BC68 supports 1.8V or 3.0V USIM cards. The pin assignment of BC68's USIM interface and M66's (U)SIM interface is compatible.

The following figure shows a reference design for (U)SIM interface with a 6-pin (U)SIM card connector.

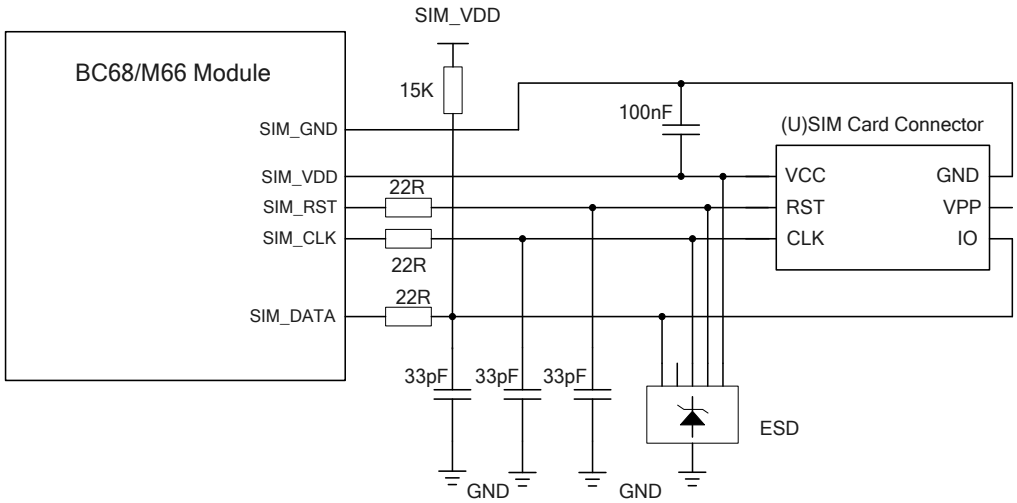


Figure 11: Reference Circuit of (U)SIM Card Interface with a 6-Pin (U)SIM Card Connector

4.7. UART Interfaces

The voltage domain of UART interface for BC68 is different from that of M66. The following is the voltage domain of the modules.

Table 5: UART Interface Voltage Domain

Module	UART Interface	Voltage Domain	Description
M66	Main UART& Debug UART	2.8V	Support RTS/CTS
BC68		3.0V	/

The following is a reference design of the UART interface when the application processor communicates with M66 via UART interface. It is recommended to add a level match circuit between the module and the DTE, because of the different power domain of their UART interface. For details, please refer to ***document [4]***.

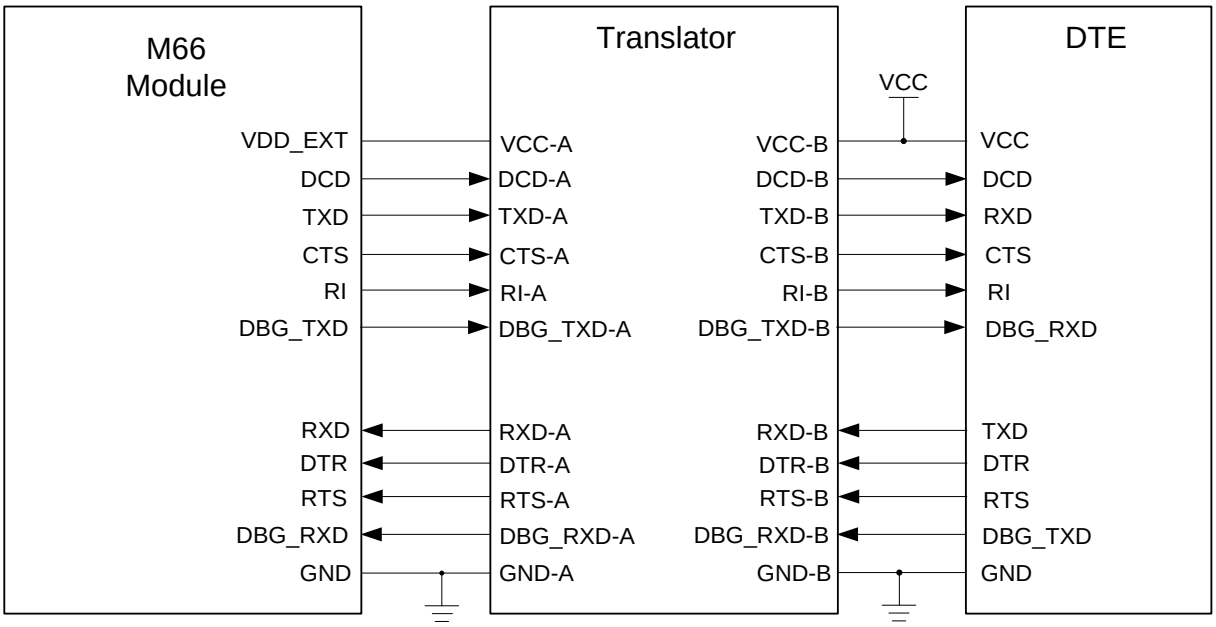


Figure 12: Reference Design of M66 UART Interface

If the DTE is 3.0V or 3.3V power domain, a reference design of 3.3V level match for BC68 is shown as below.

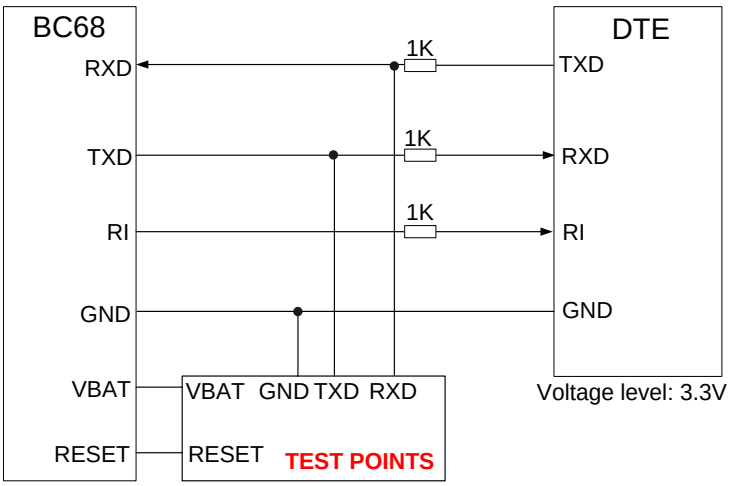


Figure 13: Reference Design of BC68 UART Interface for 3.3V System

NOTES

1. In order to reduce the power consumption of the system, it is highly recommended to add resistors with resistance greater than 1KΩ on the UART port signal traces when the host's voltage level is 3.0V or 3.3V.
2. It is recommended to reserve the test points (RXD, TXD, RESET and VBAT) for firmware upgrading.

4.8. ADC Interface

The pin ADC* of BC68 module and the pin ADC0 of M66 provide a 10-bit ADC input channel to read the voltage value. In addition, M66 offers an AVDD pin to provide a reference voltage for ADC0 and the max voltage of AVDD is 2.8V. In order to improve the accuracy of ADC, the layout of ADC should be surrounded by ground.

NOTE

"*" means under development.

4.9. RF Antenna Interface

RF_ANT and BT_ANT of M66 are compatible to RF_ANT of BC68. The RF antenna interface has an impedance of 50Ω. A reference circuit for the interface is shown below. In order to achieve better RF performance, a π-type matching circuit should be reserved, and the π-type matching components (R1/C1/C2) should be placed as close the antenna as possible. By default, the resistance of R1 is 0Ω and capacitors C1 and C2 are not mounted.

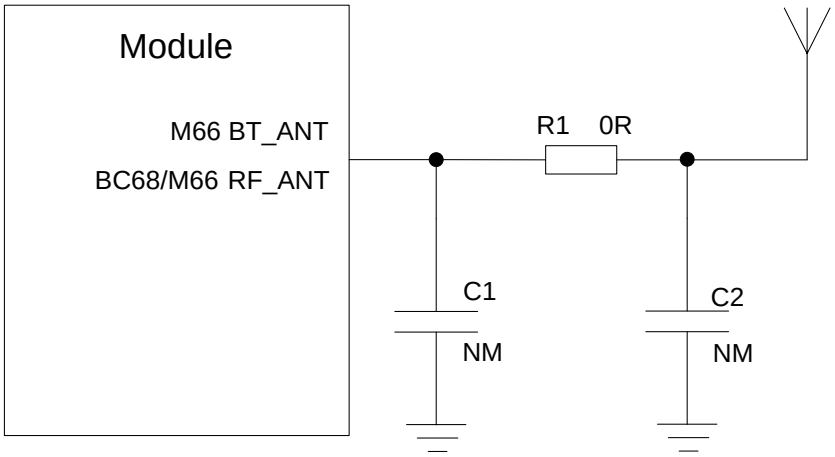


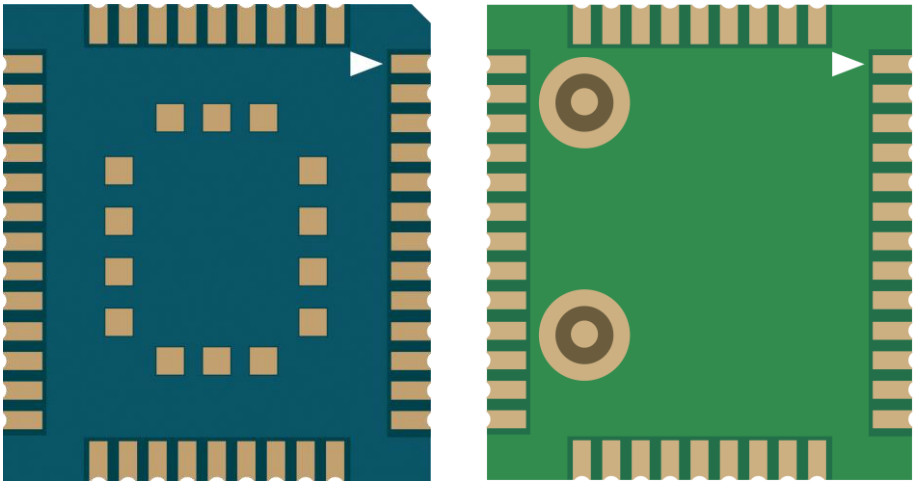
Figure 14: Reference Circuit of RF Interface

5 Recommended Footprint and Stencil Design

This chapter mainly introduces the recommended footprint and stencil design for BC68 and M66 modules.

5.1. Recommended Compatible Footprint

The following figure shows the bottom view of BC68 and M66.



BC68 M66

Figure 15: Bottom View of BC68/M66

The following figure shows the recommended compatible footprint of BC68 and M66.

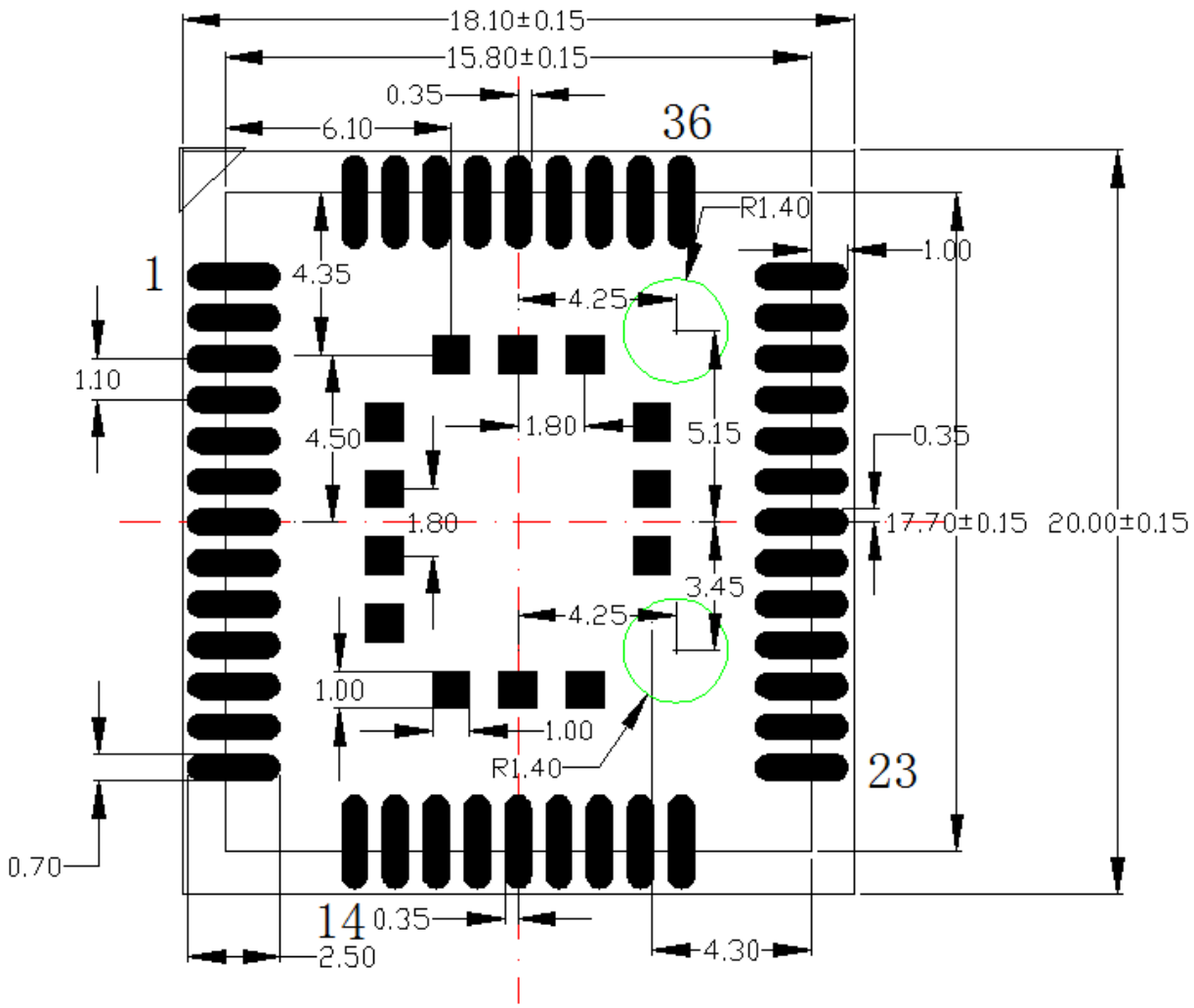


Figure 16: Recommended Footprint of BC68/M66 (Unit: mm)

NOTES

1. The modules should be kept about 3mm away from other components in the host PCB.
2. The circular test points with a radius of 1.4mm in the above recommended footprint should not be designed in schematic and PCB decal, and these test points should be served as a keepout area.
3. The pin 52 of BC68 should not be designed in the recommended footprint for compatibility with M66 module.

5.2. Recommended Stencil Design

The thickness of PCB is different. In order to ensure the module soldering quality, the thickness of stencil is recommended to be 0.2mm for M66 and 0.18mm for BC68. For more details, please refer to ***document [5]***.

The recommended stencil design for BC68 is shown as below.

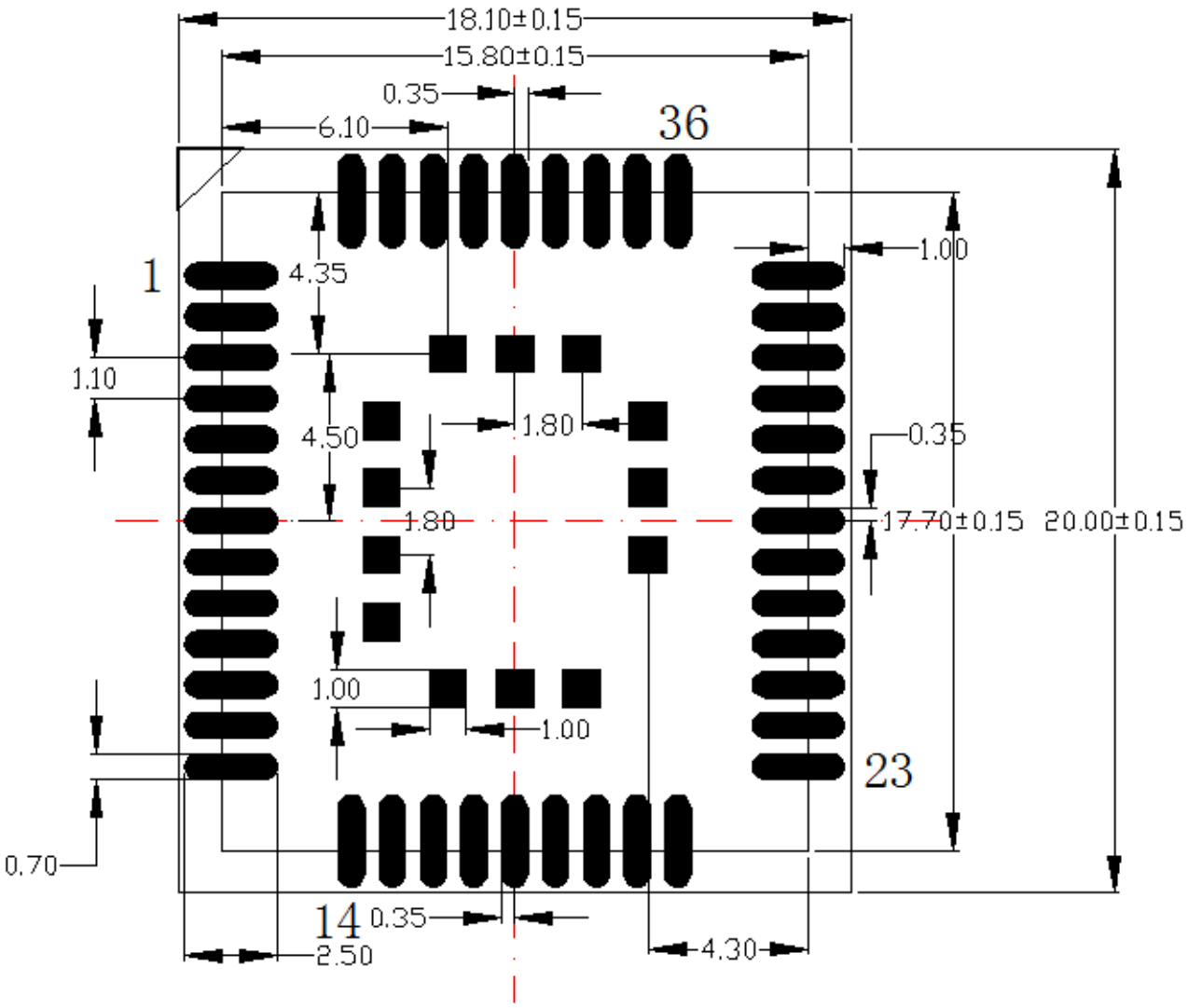


Figure 17: Recommended Stencil Design for BC68 (Unit: mm)

The recommended stencil design for M66 is shown as below.

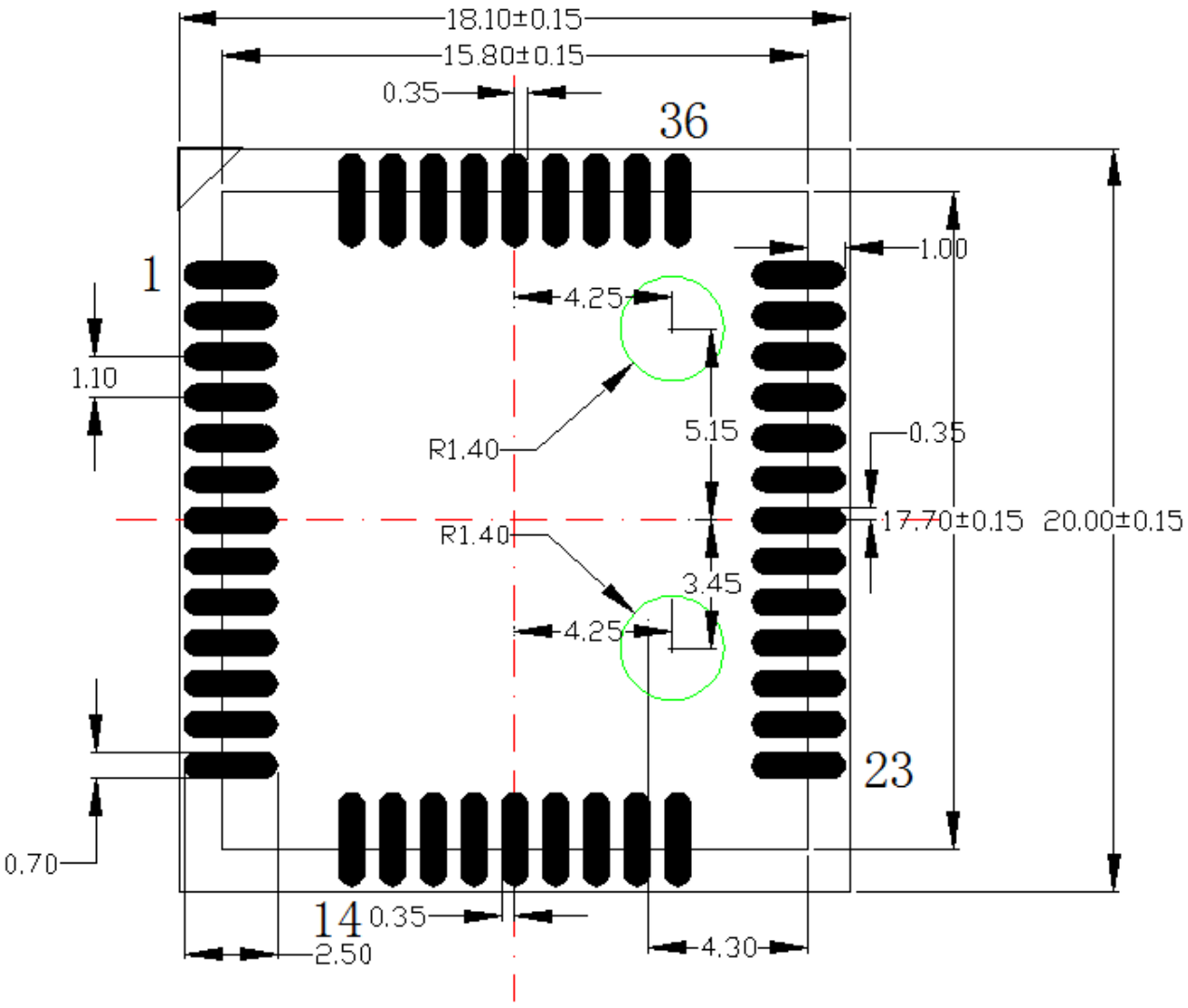


Figure 18: Recommended Stencil Design for M66 (Unit: mm)

5.3. Installation Sketch Map

The following figure shows the sketch map of installation for BC68 and M66.

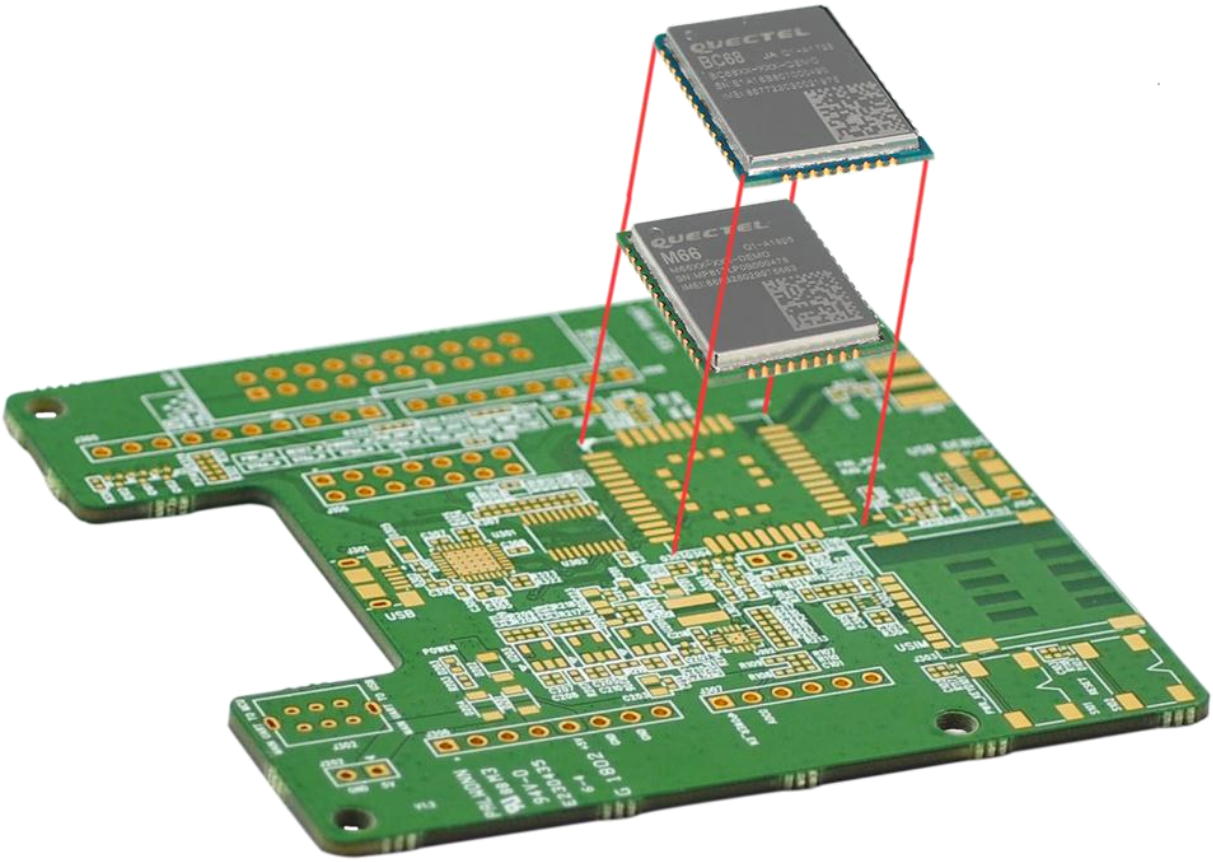


Figure 19: Installation Sketch Map for BC68/M66

6 Manufacturing and Packaging

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 235ºC~245ºC (for SnAg3.0Cu0.5 alloy). The absolute max reflow temperature is 260ºC. To avoid damage to the module caused by repeated heating, 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.

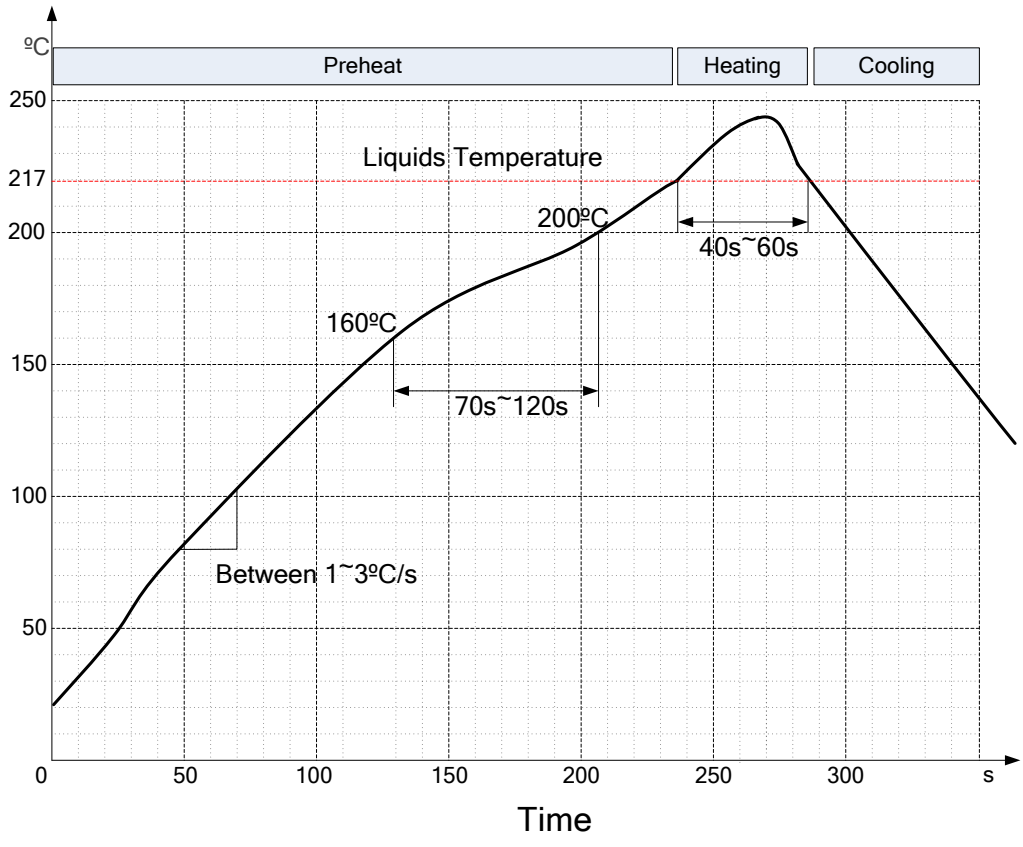


Figure 20: Reflow Soldering Thermal Profile

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.

6.2.1. BC68 and M66 Packaging

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

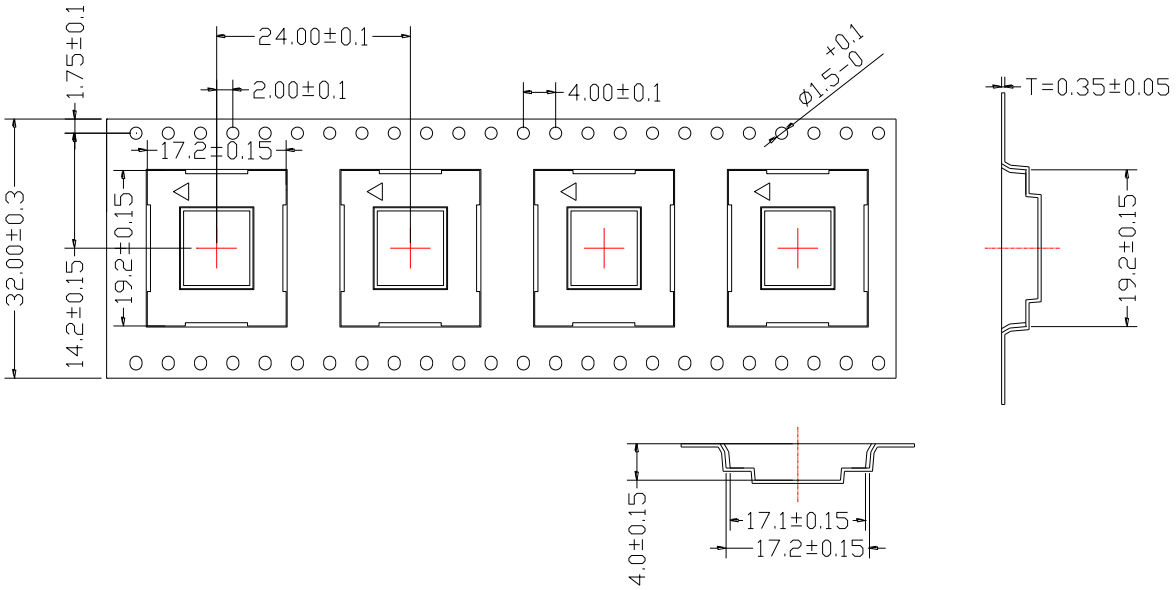


Figure 21: Tape Dimensions

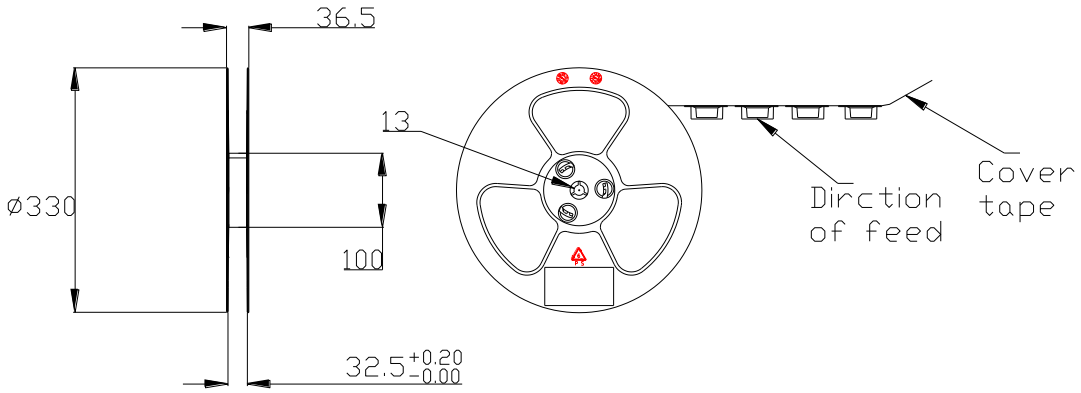


Figure 22: Reel Dimensions

7 Appendix A References

Table 6: Related Documents

SN	Document Name	Remark
[1]	Quectel_M66_AT_Commands_Manual	AT commands manual
[2]	Quectel_BC95-G&BC68_AT_Commands_Manual	AT Commands Manual for BC68 and BC95-G
[3]	Quectel_BC68_Hardware_Design	BC68 Hardware Design
[4]	Quectel_M66_Hardware_Design	M66 Hardware Design
[5]	Module_Secondary_SMT_User_Guide	Module Secondary SMT User Guide

Table 7: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
BT	Bluetooth
CTS	Clear To Send
DCD	Data Carrier Detect
DCS	Digital Communication System
DFOTA	Delta Firmware Upgrade Over the Air
DRX	Discontinuous Reception
DTR	Date Terminal Ready
EGSM	Extended Global System for Mobile
ESD	Electrostatic Discharge

GSM	Global System for Mobile Communications
GPRS	General Packet Radio Service
LCC	Leadless Chip Carriers
LDO	Low Dropout Regulator
LED	Light Emitting Diode
LGA	Land Grid Array
LTE	Long Term Evolution
NB-IoT	Narrow Band Internet of Things
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PCS	Personal Communication System
PSM	Power Saving Mode
RF	Radio Frequency
RI	Ring Indicator
RTC	Real Time Clock
RTS	Require To Send
RXD	Receive Direction
SMT	Surface Mount Technology
SWD	Serial Wire Debug
TXD	Transmitting Direction
UART	Universal Asynchronous Receiver & Transmitter
(U)SIM	(Universal) Subscriber Identity Module