BC660K-GL&BC66&BC66-NA

Compatible Reference Design

NB-IoT Module Series

Version: 1.0

Date: 2022-05-25

Status: Released

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About the Document

Revision History

Version	Date	Author	Description
-	2022-05-25	Winks WANG	Creation of the document
1.0	2022-05-25	Winks WANG	First official release

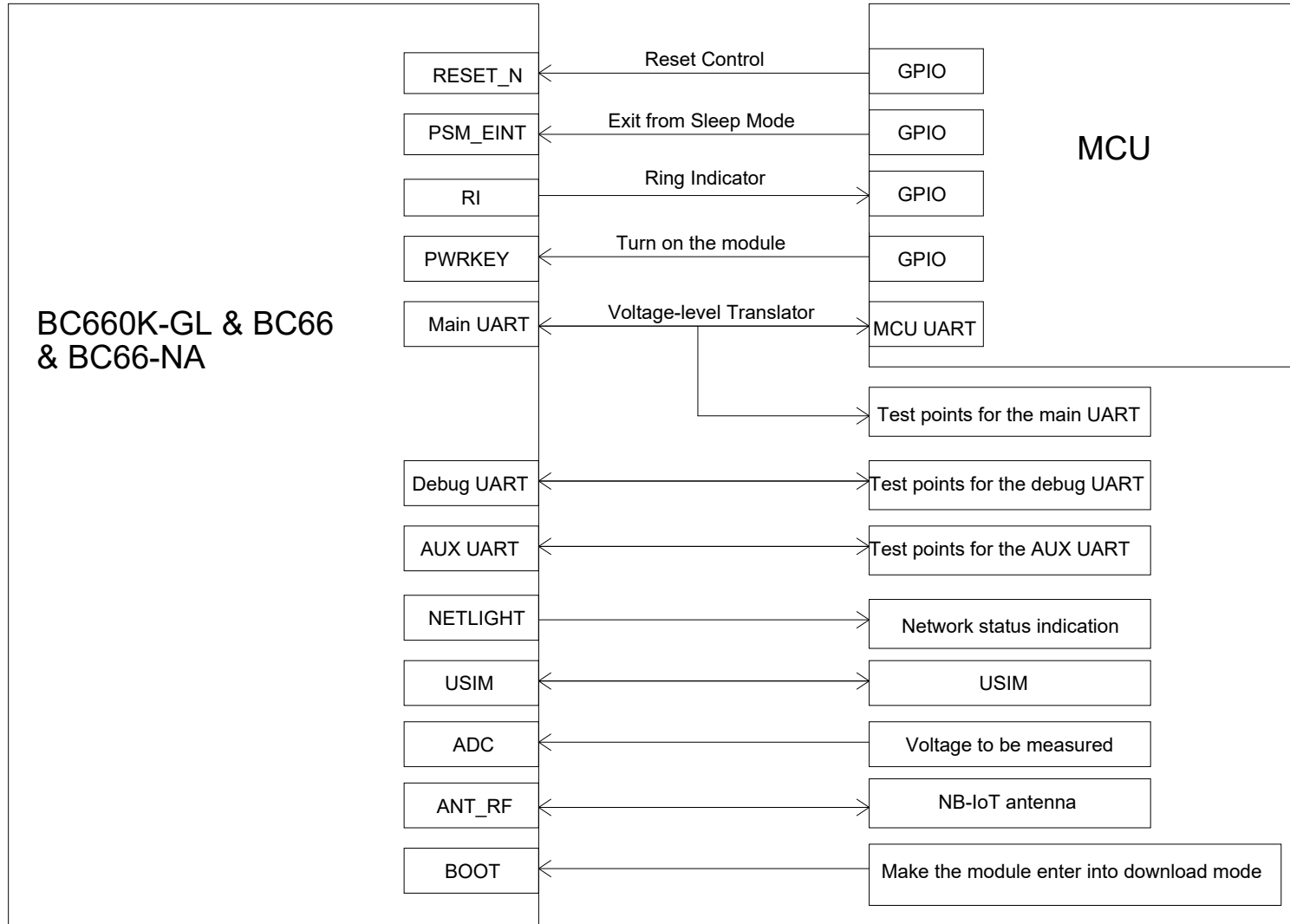# Contents

1 Reference Design

1.1. Introduction

This document provides a compatible reference design for Quectel BC660K-GL, BC66 and BC66-NA modules, including the design for power supply, module interfaces, USIM interface, etc.

1.2. Schematics

The following schematics illustrate the compatible design for the BC660K-GL, BC66 and BC66-NA modules. This design is for your reference only.
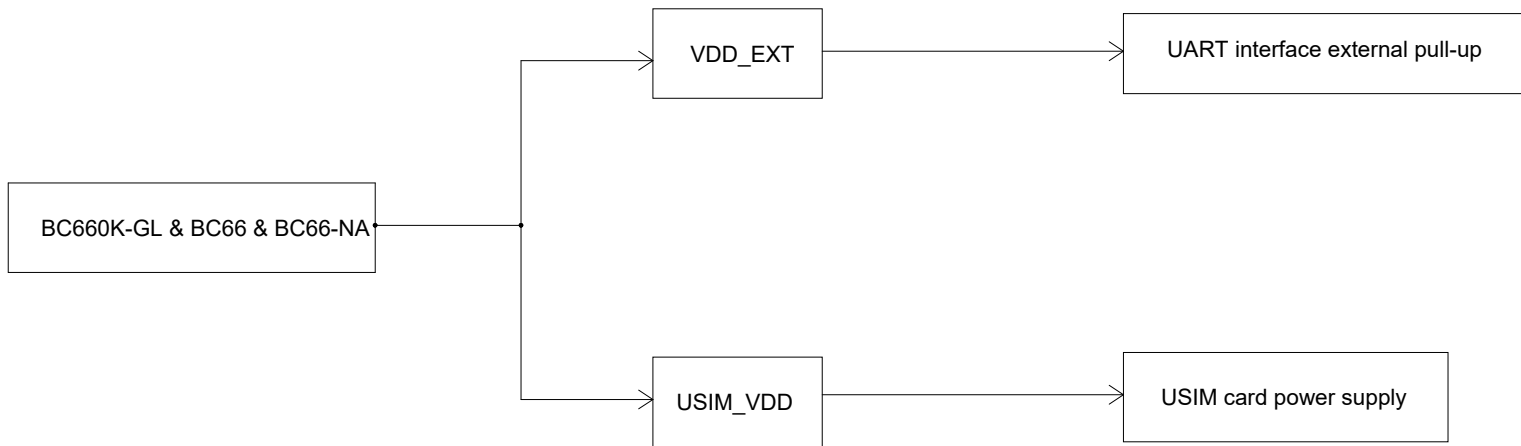
Block Diagram

BC660K-GL & BC66 & BC66-NA			MCU
RESET_N	← Reset Control	GPIO	
PSM_EINT	← Exit from Sleep Mode	GPIO	
RI	→ Ring Indicator	GPIO	
PWRKEY	← Turn on the module	GPIO	
Main UART	↔ Voltage-level Translator	MCU UART	

	→ Test points for the main UART
Debug UART	↔ Test points for the debug UART
AUX UART	↔ Test points for the AUX UART
NETLIGHT	→ Network status indication
USIM	↔ USIM
ADC	← Voltage to be measured
ANT_RF	↔ NB-IoT antenna
BOOT	← Make the module enter into download mode

NOTE:

PWRKEY and AUX UART are only for BC66&BC66-NA; BOOT is only for BC660K-GL.

Power System Block Diagram

Battery → Switch S201

5V_DC → U201 DC-DC → Switch S201

Switch S201 → VBAT → BC660K-GL & BC66 & BC66-NA

Switch S201 → NETLIGHT

BC660K-GL & BC66 & BC66-NA → VDD_EXT → UART interface external pull-up

BC660K-GL & BC66 & BC66-NA → USIM_VDD → USIM card power supply
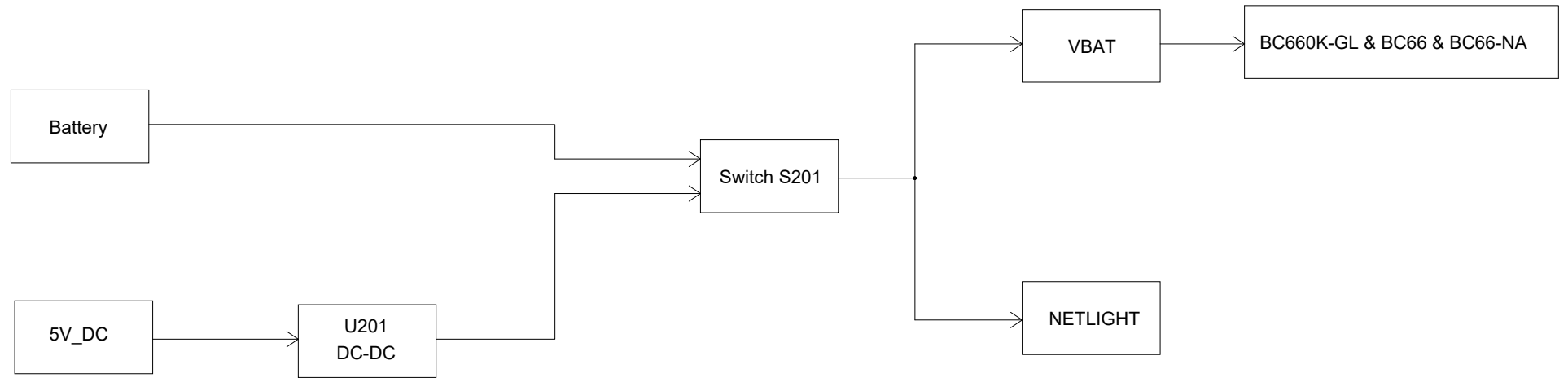
Module Interfaces

Module Interface Circuit

NOTE 3

NOTE 1

ANT_RF

NOTE 3

NOTE 3

NOTE 2

NOTE 3

NOTE 3

NOTE 3

TP0101
TP0102
TP0103
TP0104

[9] PWRKEY/BOOT

[3] ADC
[5] USIM_GND
[5] USIM_DATA
[5] USIM_RST
[5] USIM_CLK

VBAT

DBG_TXD [6]
DBG_RXD [6]

Pin	Name
1	GND1
2	RESERVED1
3	GPIO1
4	GPIO2
5	GPIO3
6	GPIO4
7	PWRKEY/BOOT
8	RESERVED2
9	ADC0
10	USIM_GND
11	USIM_DATA
12	USIM_RST
13	USIM_CLK

U0101A
BC660K-GL & BC66 & BC66-NA

RESERVED12
VBAT2
VBAT1
GND7
GND6
DBG_TXD
DBG_RXD
GND5
GND4

Name	Pin
ANT_RF	35
GND3	34
RESERVED11	33
RESERVED10	32
RESERVED9	31
RESERVED8	30
TXD_AUX	29
RXD_AUX	28
GND2	27
RESERVED7	26
RESERVED6	25
VDD_EXT	24
RESERVED5	23

R0103
0R
C0106 NM
C0107 NM

TXD_AUX [6]
RXD_AUX [6]

VDD_EXT

C0105
2.2 uF

USIM_VDD
RESET_N
NETLIGHT
MAIN_TXD
MAIN_RXD
PSM_EINT
RI
RESERVED3
RESERVED4

14 USIM_VDD
15 [6,9] RESET_N
16 [9] NETLIGHT
17 [6,7] MAIN_TXD
18 [6,7] MAIN_RXD
19 [9] PSM_EINT
20 RI
21
22

[3] GRFC1
[3] GRFC2

TP0105
TP0106 Tuner

RESERVED19
RESERVED18
RESERVED17

Pin	Name
45	RESERVED13
46	RESERVED14
47	USB_MODE
48	RESERVED15

U0101B

Name	Pin
GRFC2	55
GRFC1	54
RESERVED16	53
VIO_SEL	52

[8]USB_MODE

GRFC2 [3]
GRFC1 [3]

R0104 0R/NM

BC660K-GL & BC66 & BC66-NA

VUSB_3V3
USB_DP
USB_DM

49 VUSB_3V3
50 [8] USB_DP
51 [8] USB_DM

NOTE:

1. For future debugging, a π-type matching circuit is recommended to be placed between ANT_RF and the antenna. For more information, see the RF Layout Application Note of the module.
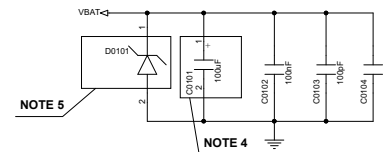
2. BC66 and BC66-NA:

VDD_EXT is a 1.8 V output power supply and has no voltage output in Deep Sleep mode. It is intended to supply power for the module's pull-up circuits,

and is thus not recommended to be used as the power supply for external circuits.

BC660K-GL:

VDD_EXT is a 1.8/3.3 V output power supply and has no voltage output in Deep Sleep/Light Sleep mode.

It is used to supply power for the module's pull-up circuits,

and thus is not recommended to be used as the power supply for external circuits.

3. PWRKEY, AUX UART and USB interface are only for BC66 and BC66-NA; GPIO, BOOT, GRFC and VIO_SEL are only for BC660K-GL;

The VIO_SEL is used to control VDD_EXT voltage selection for BC660K-GL.

when VIO_SEL is grounded (R0104 mounted), and VBAT < 3.3 V, VDD_EXT = VBAT;

when VIO_SEL is grounded (R0104 mounted), and VBAT ≥ 3.3 V, VDD_EXT = 3.3 V;

When VIO_SEL is floating (R0104 not mounted), VDD_EXT = 1.8 V.

VBAT Input

VBAT

D0101

C0101 100nF
C0102 100nF
C0103 100nF
C0104 22uF

NOTE 5

NOTE 4

NOTE:

1. BC66 and BC66-NA: The input voltage of VBAT ranges from 2.1 V to 3.63 V.

BC660K-GL: The input voltage of VBAT ranges from 2.2 V to 4.3 V.

2. The width of VBAT trace is recommended to be wider than 0.5 mm, and the longer the trace is, the wider it should be.

3. The capacitors should be placed in ascending order of the capacitance value, and the one with the minimum capacitance should be

placed nearest the VBAT pins. Additionally, all these capacitors should be placed as close to the VBAT pins as possible.

4. The capacitance of C0101 should be chosen by debugging to ensure that the voltage of VBAT will not fall below the lowest operation

voltage of the module during bursting.

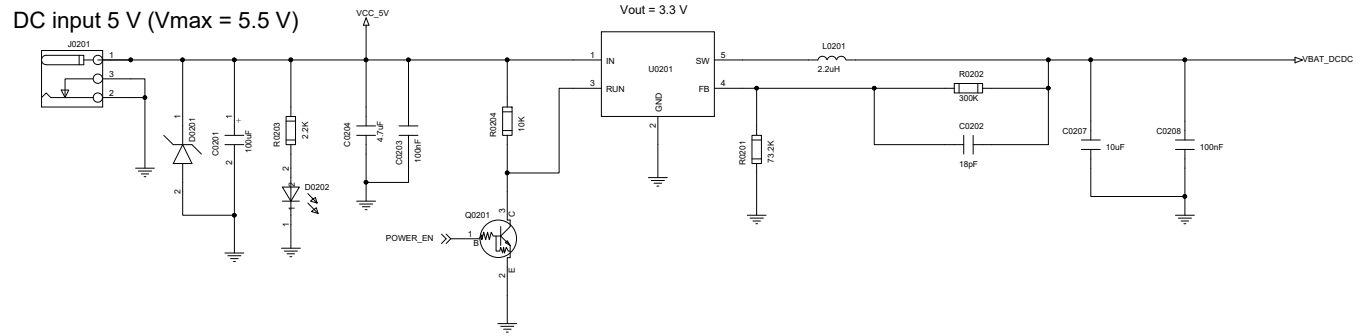5. It is recommended to add a TVS close to the VBAT pin.

ADC

VOLTAGE_INPUT

R0101

R0102

C0108
100nF

ADC [3]
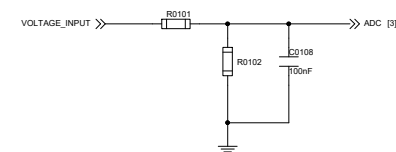
NOTE:

BC66 and BC66-NA:

1. The maximum input voltage of the 10-bit ADC is 1.4 V.

BC660K-GL:

2. The maximum input voltage of the 12-bit ADC is 1.2 V.

3. A 320 kΩ pull-down resistor is integrated inside the ADC pin.

This resistor needs to be considered when you calculate the voltage division relationship.

Power Supply

DC-DC Power Supply

DC input 5 V (Vmax = 5.5 V)

VCC_5V

Vout = 3.3 V

J0201

D0201
C0201 100uF
R0203 2.2K
D0202
C0204 4.7uF
C0203 100nF
R0204 10K

U0201
IN   SW   5
RUN   FB   4
GND

L0201 2.2uH
R0202 300K
C0202 18pF
C0207 10uF
C0208 100nF
VBAT_DCDC

R0201 73.2K

Q0201
POWER_EN

NOTE:

The output current of the power converter should be no less than 0.5 A.

Battery Application

BAT0201

D0203
C0205 47uF
C0206 100nF
VBAT_BATTERY
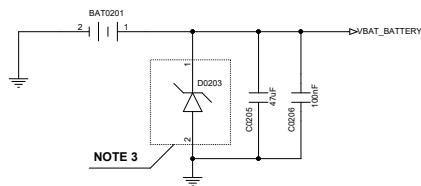
NOTE 3

NOTE:

1. The battery voltage must to meet the module's power supply requirements,and the battery's rated output current should be higher than the module's

   maximum current consumption.Additionally,it is recommended to do reverse battery protection to avoid damages to the module.

2. For different batteries selected, the capacitance of C0205 should be adjusted appropriately according to the debugging results.
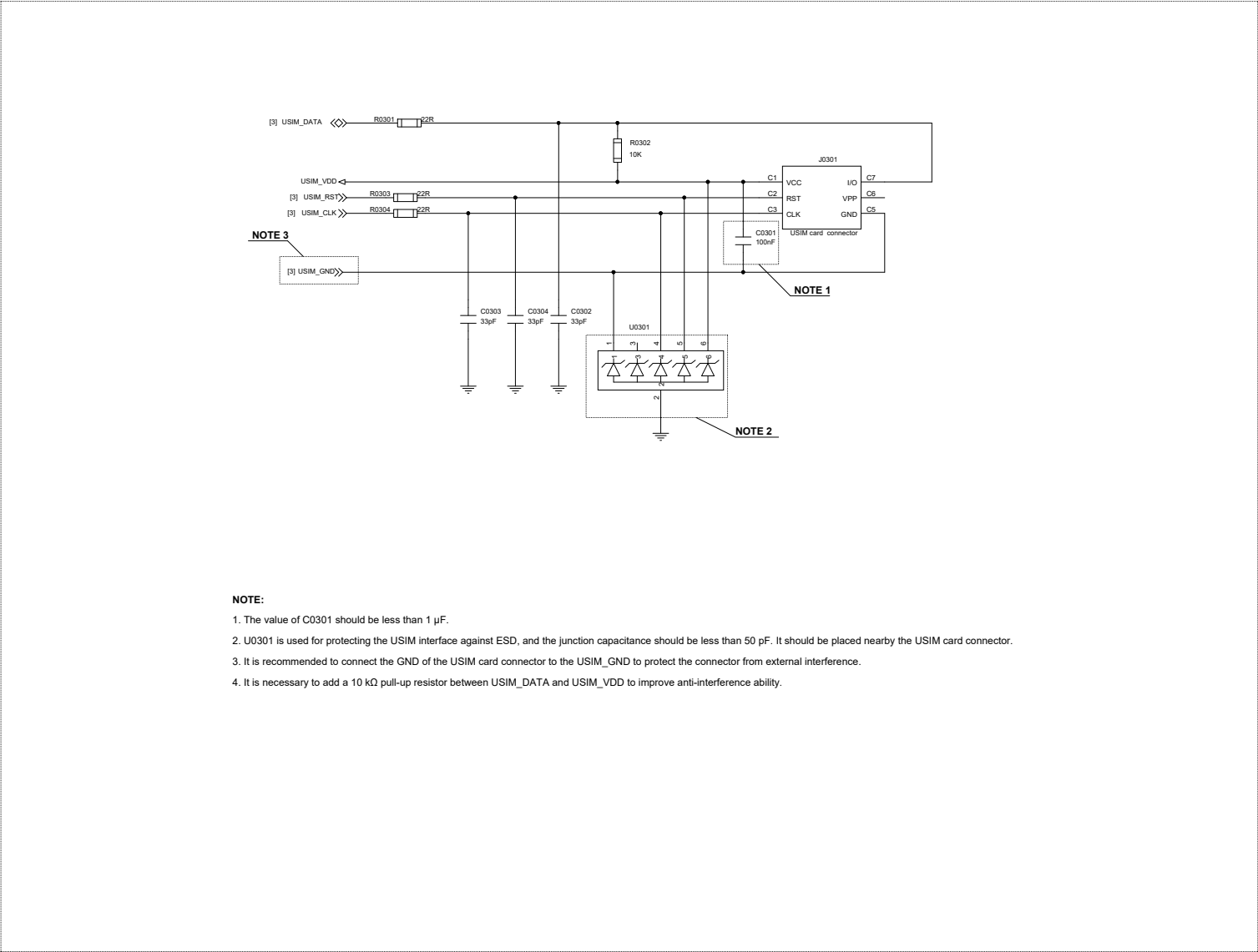
3. It is recommended to add a TVS close to the battery.

Power Supply Selection

S0201
VBAT_BATTERY   1   5
               2   VBAT
VBAT_DCDC   3   4
SS-12D02-VG2
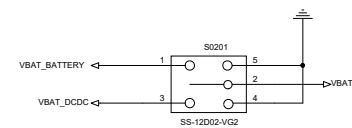
NOTE:

1. S0201 is used to switch between an external DC power supply and a battery power supply.

2. BC66 and BC66-NA: VBAT ranges from 2.1 V to 3.63 V, and the Vnom is 3.3 V.

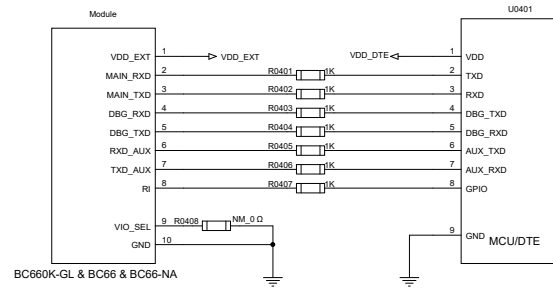   BC660K-GL: VBAT ranges from 2.2 V to 4.3 V, and the Vnom is 3.3 V.

USIM Interface

[3] USIM_DATA   R0301 22R

R0302
10K

J0301

USIM_VDD

[3] USIM_RST   R0303 22R
[3] USIM_CLK   R0304 22R

C1	VCC	I/O	C7
C2	RST	VPP	C6
C3	CLK	GND	C5

USIM card connector

C0301
100nF

NOTE 3

[3] USIM_GND

NOTE 1

C0303   C0304   C0302
33pF   33pF   33pF

U0301

NOTE 2

NOTE:

1. The value of C0301 should be less than 1 µF.

2. U0301 is used for protecting the USIM interface against ESD, and the junction capacitance should be less than 50 pF. It should be placed nearby the USIM card connector.

3. It is recommended to connect the GND of the USIM card connector to the USIM_GND to protect the connector from external interference.

4. It is necessary to add a 10 kΩ pull-up resistor between USIM_DATA and USIM_VDD to improve anti-interference ability.
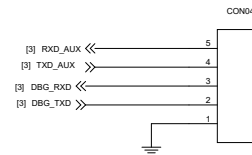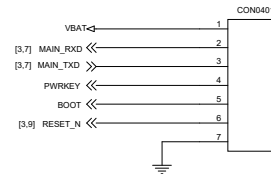
UART Interfaces Circuit (1)

Reference Design for UART

Module

U0401

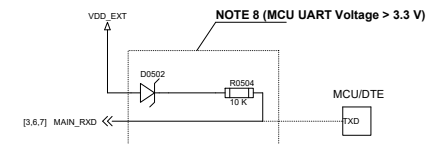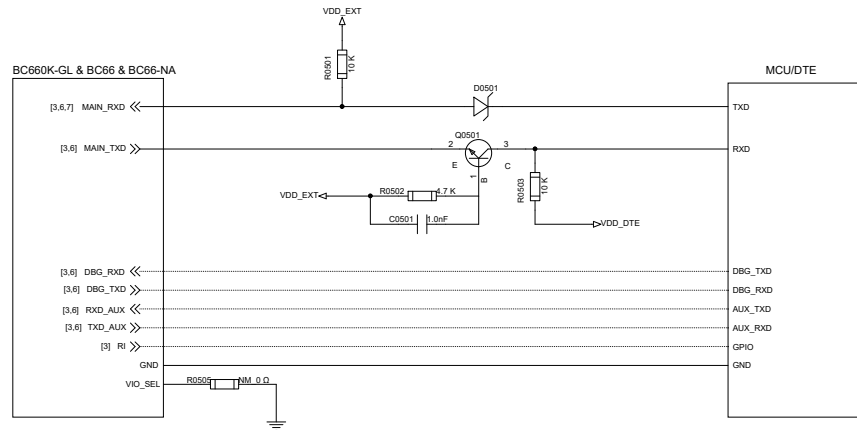| Pin	Signal			Pin	Signal
1	VDD_EXT → VDD_EXT		VDD_DTE →	1	VDD
2	MAIN_RXD	R0401 1K		2	TXD
3	MAIN_TXD	R0402 1K		3	RXD
4	DBG_RXD	R0403 1K		4	DBG_TXD
5	DBG_TXD	R0404 1K		5	DBG_RXD
6	RXD_AUX	R0405 1K		6	AUX_TXD
7	TXD_AUX	R0406 1K		7	AUX_RXD
8	RI	R0407 1K		8	GPIO
9	VIO_SEL	R0408 NM_0 Ω		9	GND
10	GND				MCU/DTE

BC660K-GL & BC66 & BC66-NA

NOTE:

1. When a URC or message is received, the module will inform the DTE through the RI pin.

2. Pay attention to the level matching issue of UART interfaces during application.

3. The VDD_EXT voltage domain of BC66 and BC66-NA is 1.8 V.

4. For BC660K-GL:

    When VIO_SEL is grounded and VBAT < 3.3 V, VDD_EXT = VBAT;

    When VIO_SEL is grounded and VBAT ≥ 3.3 V, VDD_EXT = 3.3 V;

    When VIO_SEL is floating, VDD_EXT = 1.8 V.

    If the voltage domain of your application system is 1.8 V, do not mount R0408;

    If the voltage domain of your application system is 3.3 V, mount R0408;

5. MAIN_RXD of BC660K-GL cannot be pulled up to VDD_EXT directly.

6. BC660K-GL does not support AUX UART.

Test Points

CON0401

Pin	Signal
1	VBAT
2	[3,7] MAIN_RXD
3	[3,7] MAIN_TXD
4	PWRKEY
5	BOOT
6	[3,9] RESET_N
7	

CON0402

Pin	Signal
5	[3] RXD_AUX
4	[3] TXD_AUX
3	[3] DBG_RXD
2	[3] DBG_TXD
1	

UART Interfacces Circuit (2)

BC660K-GL & BC66 & BC66-NA

MCU/DTE

VDD_EXT
R0501 10 K

D0501

[3,6,7] MAIN_RXD — TXD
[3,6] MAIN_TXD — RXD

Q0501
E 2
B 1
C 3

VDD_EXT
R0502 4.7 K
C0501 1.0nF
R0503 10 K
VDD_DTE

[3,6] DBG_RXD — DBG_TXD
[3,6] DBG_TXD — DBG_RXD
[3,6] RXD_AUX — AUX_TXD
[3,6] TXD_AUX — AUX_RXD
[3] RI — GPIO
GND — GND
VIO_SEL — R0505 NM 0 Ω

NOTE 8 (MCU UART Voltage > 3.3 V)

VDD_EXT

D0502
R0504 10 K

MCU/DTE

[3,6,7] MAIN_RXD — TXD

NOTE:

1. When there is a SMS or URC is received, the module will inform DTE with the RI pin.

2. Please pay attention to the level matching issue of UART interfaces during application.

3. The circuit design of dotted line section can refer to the design of solid line transistor section, but please pay attention to the direction of connection.

4. The UART level-shifting circuit does not apply to applications with high baud rates exceeding 460 kbps.

5. VIO_SEL is only for BC660K-GL, while using the level-shifting circuit, choose 1.8 V or 3.3 V according to MCU UART voltage.

6. BC660K-GL does not support AUX UART.

7. While using BC66 and BC66-NA, mount R0501 and do not mount R0505. While using BC660K-GL, do not mount R501 and R505.

8. While using BC660K-GL, in order to avoid leakage and abnormal wake-up, do not pull up MAIN_RXD to VDD_EXT directly:

    MCU UART Voltage ≤ 3.3 V, do not mount R0501, and substitute D0501 with a 1 kΩ resistor.

    MCU UART Voltage > 3.3 V, to pull up MAIN_RXD to VDD_EXT, you need to connect a TVS in series first,

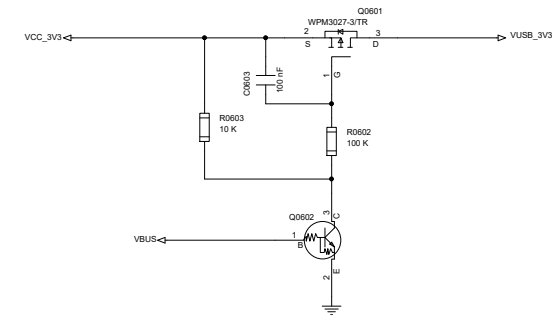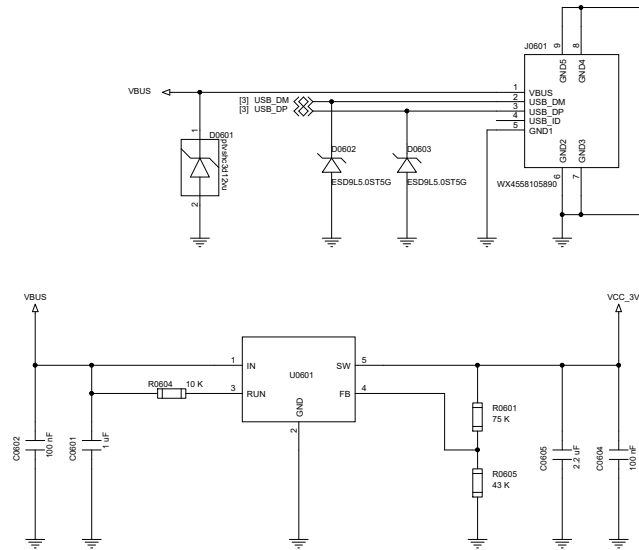   and then pull up MAIN_RXD through a 4.7–20 kΩ resistor.

USB Interface Circuit

USB Download Circuit

R0606 10 K
S0601
USB_MODE[3]
D0604 ESD9L5.0ST5G
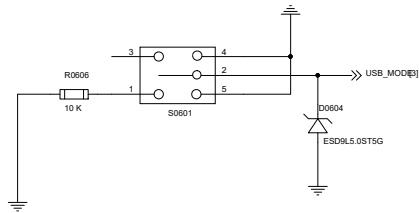
USB_MODE Pin	Pull down through a 10 kΩ resistor	Floating
USB MODE	USB download function	Catch Log via USB

USB Circuit

J0601
WX4558105890
GND5
GND4
VBUS
USB_DM
USB_DP
USB_ID
GND1
GND2
GND3

[3] USB_DM
[3] USB_DP

D0601 PESD3V3L2UY
D0602 ESD9L5.0ST5G
D0603 ESD9L5.0ST5G

VBUS

VCC_3V3

U0601
IN
RUN
SW
GND
FB

R0604 10 K
R0601 75 K
R0605 43 K

C0602 100 nF
C0601 1 uF
C0605 2.2 uF
C0604 100 nF

VCC_3V3
VUSB_3V3
Q0601 WPM3027-3/TR
S G D

C0603 100 nF
R0603 10 K
R0602 100 K

Q0602
VBUS
B C E

NOTE:

1. The USB interface and thereof signal traces should be kept away from power supply, RF interface and other sensitive signal traces.

2. The impedance of USB signal traces should be controlled as 90 Ω.

3. BC660K-GL does not support USB interface.

4. It is recommended to select a TVS with parasitic capacitance less than 3 pF for USB signal lines, and place them close to the USB connector.
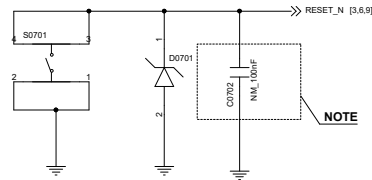
MCU Connection

Reset - MCU Circuit Application
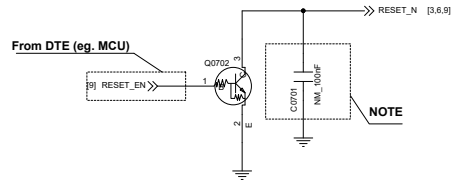
From DTE (eg. MCU)

[9] RESET_EN

Q0702

C0701 NM_100nF

RESET_N [3,6,9]

NOTE

NOTE:

It is recommended to reserve a 100 nF filter capacitor close to the RESET_N pin, which is not mounted by default.

Reset - Button Application

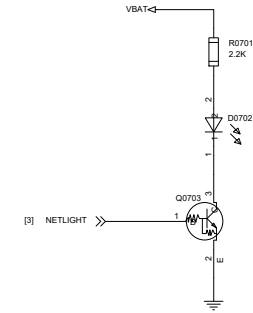S0701

D0701

C0702 NM_100nF

RESET_N [3,6,9]

NOTE

NOTE:

It is recommended to reserve a 100 nF filter capacitor close to the RESET_N pin, which is not mounted by default.
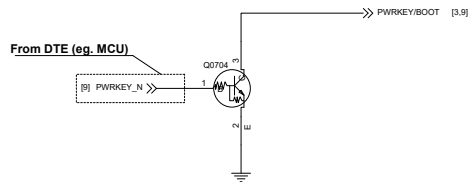
PSM_EINT Circuit Application

From DTE (eg. MCU)

[9] PSM_EINT_EN

Q0701
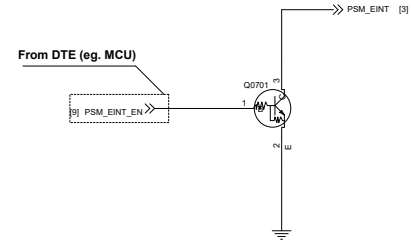
PSM_EINT [3]

NOTE:

PSM_EINT wakes up the module from sleep mode.

Network Status Indication

VBAT

R0701 2.2K

D0702

Q0703

[3] NETLIGHT

NOTE:

NETLIGHT indicates the module's network status.

PWRKEY - MCU Circuit Application

From DTE (eg. MCU)

[9] PWRKEY_N

Q0704

PWRKEY/BOOT [3,9]

PWRKEY/BOOT - Button Application

S0702

D0703

PWRKEY/BOOT [3,9]

MCU GPIOs

MCU

GPIO — RESET_N [9]

GPIO — PSM_EINT_EN [9]

GPIO — PWRKEY_N [9]

GPIO — POWER_EN [4]