

EC2x&UC20

Compatible Design

UMTS/HSPA/LTE Module Series

Rev. EC2x&UC20_Compatible_Design_V1.0

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About the Document

History

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1 Introduction

Quectel EC2x module contains EC25, EC21, EC20 and EC20 R2.0 variants which are all compatible with UC20. This document briefly describes the compatible design among EC25, EC21, EC20 R2.0, EC20 and UC20, which can help you easily migrate from one to either of the others in your design and manufacturing.

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2 General Descriptions

2.1. Product Description

EC25, EC21, EC20 R2.0, EC20 and UC20 modules have some serial products. The following tables show the frequency bands and module general information.

Table 1: Module Frequency Bands

Module	LTE	UMTS	GSM	Rx-diversity	GNSS
EC25-A	FDD: B2/B4/B12	WCDMA: B2/B4/B5		Y	
EC25-E	FDD: B1/B3/B5/B7/B8/B20 TDD: B38/B40/B41	WCDMA: B1/B5/B8	900/1800	Y	GPS GLONASS BeiDou Galileo QZSS
EC25-V	FDD: B4/B13			Y	
EC25-AUT	FDD: B1/B3/B5/B7/B28	WCDMA: B1/B5		Y	
EC21-A	FDD: B2/B4/B12	WCDMA: B2/B4/B5		Y	
EC21-E	FDD: B1/B3/B5/B7/B8/B20	WCDMA: B1/B5/B8	900/1800	Y	GPS GLONASS BeiDou Galileo QZSS
EC21-V	FDD: B4/B13			Y	
EC21-AUT	FDD: B1/B3/B5/B7/B28	WCDMA: B1/B5		Y	
EC21-AUTL	FDD: B3/B7/B28			Y	
EC20-C R2.0	FDD: B1/B3/B8 TDD: B38/B39/B40/B41	WCDMA: B1/B8 TD-SCDMA: B34/B39	900/1800	Y	GPS GLONASS BeiDou Galileo QZSS
EC20-CE R2.0	FDD: B1/B3/B8 TDD: B38/B39/B40/B41	WCDMA: B1/B8 TD-SCDMA: B34/B39 CDMA: BC0	900/1800	Y	




EC20-C	FDD: B1/B3/B8 TDD: B38/B39/B40/B41	WCDMA: B1/B8 TD-SCDMA: B34/B39	900/1800	Y	
EC20-CE	FDD: B1/B3 TDD: B38/B39/B40/B41	WCDMA: B1 TD-SCDMA: B34/B39 CDMA: BC0	900/1800	Y	GPS GLONASS
EC20-A	FDD: B2/B4/B5/B12/B17	WCDMA: B2/B4/B5	850/1900	Y	
EC20-E	FDD: B1/B3/B5/B7/B8/B20	WCDMA: B1/B5/B8	850/900/ 1800/1900	Y	
UC20-A		WCDMA: B2/B5		Y	
UC20-E		WCDMA: B1/B8	850/900/ 1800/1900	Y	GPS GLONASS
UC20-G		WCDMA: B1/B2/B5/B6/B8	850/900/ 1800/1900	Y	

NOTE

Y = supported (including LTE and UMTS)

EC25, EC21, EC20 R2.0, EC20 and UC20 are designed as compatible products. You can choose the right module for your applications. Under the help of the compatible design guideline, you can migrate from one to either of the others smoothly during your product design and manufacturing.

Table 2: Module General Information

Module Name	Picture	Packaging	Dimensions	Description
EC25		80 LCC pads + 64 LGA pads	29 × 32 × 2.4mm	LTE module (EC25-A, EC25-E, EC25-V, and EC25-AUT)
EC21		80 LCC pads + 64 LGA pads	29 × 32 × 2.4mm	LTE module (EC21-A, EC21-E, EC21-V, EC21-AUT and EC21-AUTL)
EC20 R2.0		80 LCC pads + 64 LGA pads	29 × 32 × 2.4mm	LTE module (EC20-C R2.0 and EC20-CE R2.0)

EC20		76 LCC pads + 64 LGA pads	29 × 32 × 2.4mm	LTE module (EC20-C, EC20-CE, EC20-A and EC20-E)
UC20		72 LCC pads + 40 LGA pads	29 × 32 × 2.5mm	UMTS/HSPA+ module (UC20-A, UC20-E and UC20-G)

2.2. Feature Overview

The following table compares the general features of EC25, EC21, EC20 R2.0, EC20 and UC20.

Table 3: Feature Overview

Feature	UC20	EC20	EC20 R2.0/EC21/EC25
Power Supply	3.3~4.3V, Typ.=3.8V	3.3~4.3V, Typ.=3.8V	3.3~4.3V, Typ.=3.8V
Peak Current	VBAT_BB&RF: max 2.0A	VBAT_BB&RF: max 2.0A	VBAT_BB&RF: max 2.0A
Sleep Current (USB Suspended)	2G: 3.7mA @DRX=2 3G: 3.0mA @DRX=6	2G: 3.7mA @DRX=2 3G: 3.0mA @DRX=6	TBD
LTE Features		Support 3GPP R9 CAT3 FDD: Max 50Mbps (UL), 100Mbps (DL) TDD: Max 18Mbps (UL), 61Mbps (DL)	EC20 R2.0/EC25: Support up to LTE CAT4. Max 50Mbps (UL), Max 150Mbps (DL) EC21: Support up to LTE CAT1 Max 5Mbps (UL), Max 10Mbps (DL)
Temperature Range	Operating temperature range: -35°C ~ +75°C ¹⁾ Extended temperature range: -40°C ~ +85°C ²⁾	Operating temperature range: -35°C ~ +75°C ¹⁾ Extended temperature range: -40°C ~ +85°C ²⁾	Operating temperature range: -35°C ~ +75°C ¹⁾ Extended temperature range: -40°C ~ +85°C ²⁾
UART Interface	Baud rate: reach up to 921600bps Flow control: RTS/CTS	Baud rate: reach up to 921600bps Flow control: RTS/CTS	Baud rate: reach up to 921600bps Flow control: RTS/CTS
USB Interface	USB 2.0 HS (Slave only)	USB 2.0 HS (Slave only)	USB 2.0 HS (Slave only)

Digital Audio	PCM interface	PCM interface	PCM interface
I2C Interface	Supported	Supported	Supported
USIM Detection	YES	YES	YES
GNSS	GPS+GLONASS	GPS+GLONASS	GPS, GLONASS, BeiDou, Galileo, QZSS
Firmware Upgrade	USB interface and DFOTA	USB interface and DFOTA	USB interface and DFOTA ³⁾

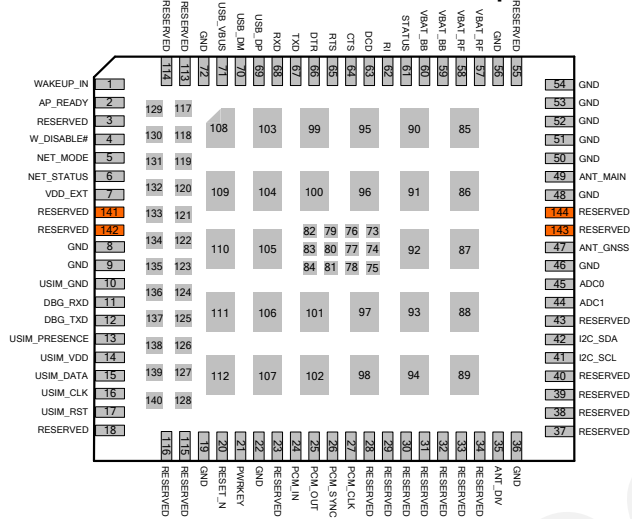
NOTES

- ¹⁾ Within operating temperature range, the module is 3GPP compliant.
- 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 is compliant with 3GPP specification again.
- ³⁾ This function is under development.

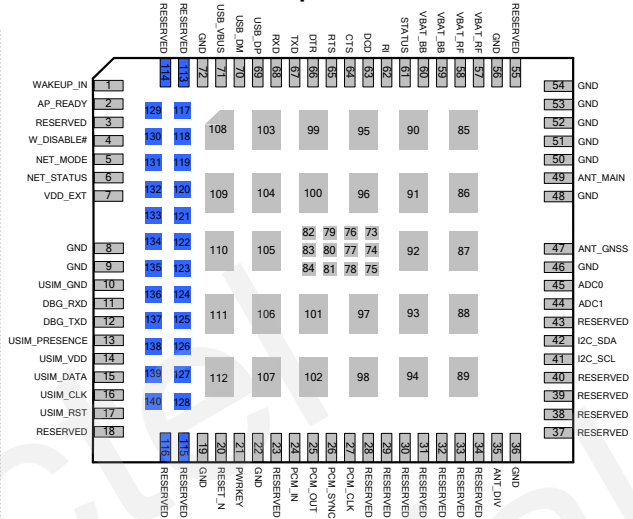
2.3. Pin Assignment

The following figures show the pin assignment of EC25, EC21, EC20 R2.0, EC20 and UC20.

EC25/EC21/EC20 R2.0 Top View



EC20 Top View



UC20 Top View

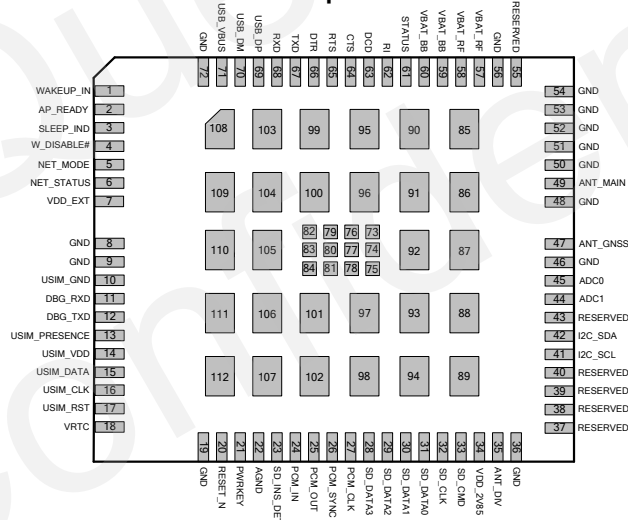


Figure 1: EC2x&UC20 Pin Assignment

NOTES

1. The orange pins are the additional pins of EC25/EC21/ EC20 R2.0 as compared with EC20.
2. The blue pins are the additional pins of EC20 as compared with UC20.

3 Pin Description

This chapter describes the pin definition of EC25, EC21, EC20 R2.0, EC20 and UC20.

Table 4: I/O Parameters Definition

Symbol	Description
AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
IO	Bidirectional Input/Output
OD	Open Drain
PI	Power Input
PO	Power Output

3.1. Common Pins

The following table shows EC25, EC21, EC20 R2.0, EC20 and UC20's common pins with the same function.

Table 5: Common Pins

EC2x				UC20			
Pin No.	Pin Name	I/O	Power Domain	Pin No.	Pin Name	I/O	Power Domain
1	WAKEUP_IN	DI	1.8V	1	WAKEUP_IN	DI	1.8V

2	AP_READY	DI	1.8V	2	AP_READY	DI	1.8V
4	W_DISABLE#	DI	1.8V	4	W_DISABLE#	DI	1.8V
5	NET_MODE	DO	1.8V	5	NET_MODE	DO	1.8V
6	NET_STATUS	DO	1.8V	6	NET_STATUS	DO	1.8V
7	VDD_EXT	PO	1.8V	7	VDD_EXT	PO	1.8V
8	GND	-	Ground	8	GND	-	Ground
9	GND	-	Ground	9	GND	-	Ground
10	USIM_GND	-	Ground	10	USIM_GND	-	Ground
11	DBG_RXD	DI	1.8V	11	DBG_RXD	DI	1.8V
12	DBG_TXD	DO	1.8V	12	DBG_TXD	DO	1.8V
13	USIM_PRESENCE	DI	1.8V	13	USIM_PRESENCE	DI	1.8V
14	USIM_VDD	PO	1.8/3.0V	14	USIM_VDD	PO	1.8/3.0V
15	USIM_DATA	IO	1.8/3.0V	15	USIM_DATA	IO	1.8/3.0V
16	USIM_CLK	DO	1.8/3.0V	16	USIM_CLK	DO	1.8/3.0V
17	USIM_RST	DO	1.8/3.0V	17	USIM_RST	DO	1.8/3.0V
19	GND	-	Ground	19	GND	-	Ground
20	RESET_N	DI	1.8V	20	RESET_N	DI	1.8V
21	PWRKEY	DI	1.8V	21	PWRKEY	DI	1.8V
22	GND	-	Ground	22	AGND	-	Ground
23	RESERVED	-	-	23	RESERVED	-	-
24	PCM_IN	DI	1.8V	24	PCM_IN	DI	1.8V
25	PCM_OUT	DO	1.8V	25	PCM_OUT	DO	1.8V
26	PCM_SYNC	IO	1.8V	26	PCM_SYNC	IO	1.8V
27	PCM_CLK	IO	1.8V	27	PCM_CLK	IO	1.8V
28	RESERVED	-	-	28	RESERVED	-	-
29	RESERVED	-	-	29	RESERVED	-	-

30	RESERVED	-	-	30	RESERVED	-	-
31	RESERVED	-	-	31	RESERVED	-	-
32	RESERVED	-	-	32	RESERVED	-	-
33	RESERVED	-	-	33	RESERVED	-	-
34	RESERVED	-	-	34	RESERVED	-	-
35	ANT_DIV	AI	-	35	ANT_DIV	AI	-
36	GND	-	Ground	36	GND	-	Ground
37	RESERVED	-	-	37	RESERVED	-	-
38	RESERVED	-	-	38	RESERVED	-	-
39	RESERVED	-	-	39	RESERVED	-	-
40	RESERVED	-	-	40	RESERVED	-	-
41	I2C_SCL	OD	1.8V only	41	I2C_SCL	OD	1.8V only
42	I2C_SDA	OD	1.8V only	42	I2C_SDA	OD	1.8V only
43	RESERVED	-	-	43	RESERVED	-	-
44	ADC1	AI	0.3V~ VBAT_BB	44	ADC1	AI	0.2~4.2V
45	ADC0	AI	0.3V~ VBAT_BB	45	ADC0	AI	0.2~2.1V
46	GND	-	Ground	46	GND	-	Ground
47	ANT_GNSS	AI	-	47	ANT_GNSS	AI	-
48	GND	-	Ground	48	GND	-	Ground
49	ANT_MAIN	IO	-	49	ANT_MAIN	IO	-
50	GND	-	Ground	50	GND	-	Ground
51	GND	-	Ground	51	GND	-	Ground
52	GND	-	Ground	52	GND	-	Ground
53	GND	-	Ground	53	GND	-	Ground
54	GND	-	Ground	54	GND	-	Ground
55	RESERVED	-	-	55	RESERVED	-	-

56	GND	-	Ground	56	GND	-	Ground
57	VBAT_RF	PI	3.3~4.3V	57	VBAT_RF	PI	3.3~4.3V
58	VBAT_RF	PI	3.3~4.3V	58	VBAT_RF	PI	3.3~4.3V
59	VBAT_BB	PI	3.3~4.3V	59	VBAT_BB	PI	3.3~4.3V
60	VBAT_BB	PI	3.3~4.3V	60	VBAT_BB	PI	3.3~4.3V
61	STATUS	OD	-	61	STATUS	OD	-
62	RI	DO	1.8V	62	RI	DO	1.8V
63	DCD	DO	1.8V	63	DCD	DO	1.8V
64	CTS	DO	1.8V	64	CTS	DO	1.8V
65	RTS	DI	1.8V	65	RTS	DI	1.8V
66	DTR	DO	1.8V	66	DTR	DI	1.8V
67	TXD	DI	1.8V	67	TXD	DO	1.8V
68	RXD	DI	1.8V	68	RXD	DI	1.8V
69	USB_DP	IO	-	69	USB_DP	IO	-
70	USB_DM	IO	-	70	USB_DM	IO	-
71	USB_VBUS	PI	Typ. 5V	71	USB_VBUS	PI	Typ. 5V
72	GND	-	Ground	72	GND	-	Ground
73~84	RESERVED	-	-	73~84	RESERVED	-	-
85~112	GND	-	Ground	85~112	GND	-	Ground

3.2. Different Pins

The following table shows the different functional pins of EC25, EC21, EC20 R2.0, EC20 and UC20.

Table 6: Different Functional Pins between EC2x and UC20

EC2x				UC20			
Pin No.	Pin Name	I/O	Power Domain	Pin No.	Pin Name	I/O	Power Domain
3	RESERVED	-	-	3	SLEEP_IND	DO	1.8V
18	RESERVED	-	-	18	VRTC	IO	1.5~3.25V
113~140	RESERVED	-	-				

The following table shows the additional pins of EC25/EC21/EC20 R2.0 as compared with EC20.

Table 7: Additional Pins of EC25/EC21/EC20 R2.0 vs EC20

PIN No.	Pin Name	I/O	Pin Description
141~144	RESERVED	-	-

NOTES

1. Keep all reserved and unused pins unconnected.
2. All GND pins should be connected to ground.

4 Hardware Reference Design

4.1. Power Supply

The power supply range of EC25, EC21, EC20 R2.0, EC20 and UC20 is from 3.3V to 4.3V. Attention should be paid to the range of power source to make sure that the input voltage will never drop below 3.3V or exceed 4.3V. The typical power supply is 3.8V. The following figure shows a reference design for a 5V input power source. The designed output for the power supply is 3.88V and the maximum load current is 3A. The VBAT_BB and VBAT_RF pins should be divided into two separated paths in star structure. In addition, in order to get a stable output voltage, it is suggested to use a zener diode whose reverse zener voltage is 5.1V and dissipation power is more than 0.5 watt.

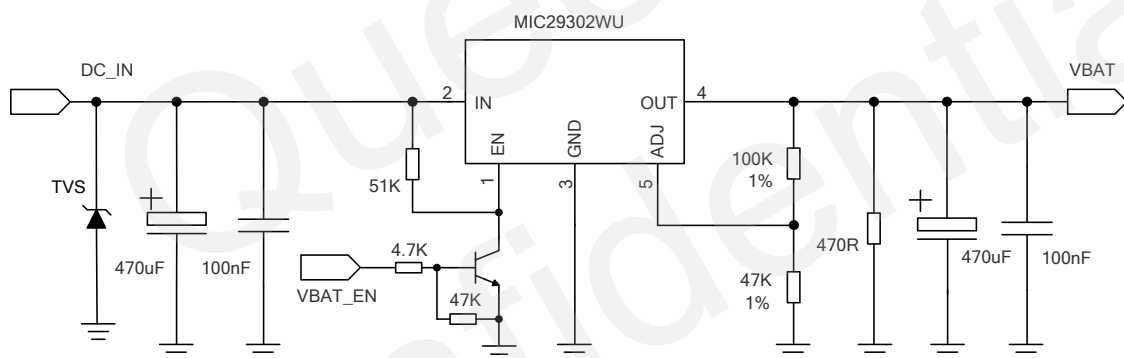


Figure 2: Reference Circuit of Power Supply

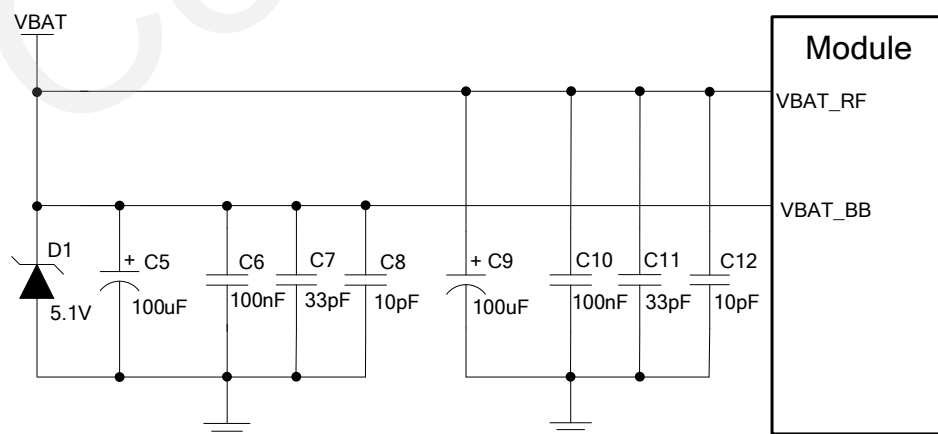


Figure 3: Reference Circuit of Star Structure

4.2. Power on and off Circuit

The following is a reference design for EC25, EC21, EC20 R2.0, EC20 and UC20's power on and off circuit.

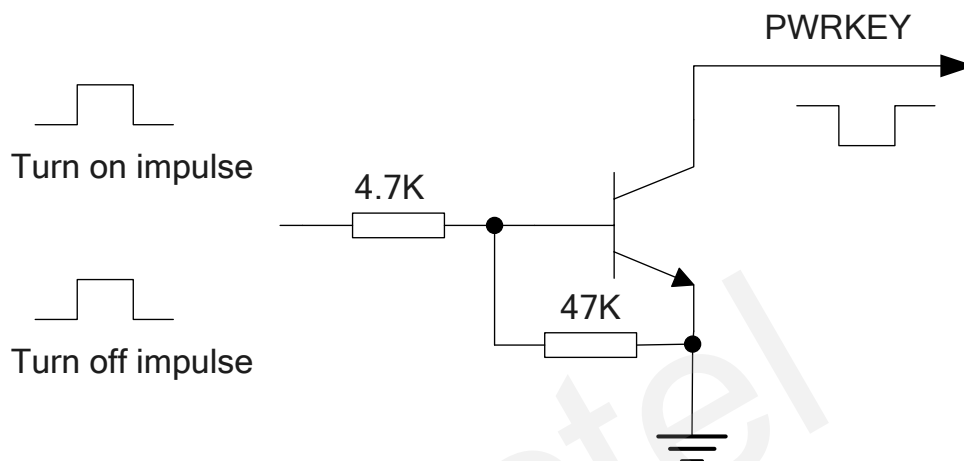


Figure 4: Turn on and off the Module Using Driving Circuit

4.3. Reset Circuit

When it is failed to turn off the module by both command **AT+QPOWD** and PWRKEY pin, the RESET_N can be used to reset the module. The following is a reference design for EC25, EC21, EC20 R2.0, EC20 and UC20's reset circuit.

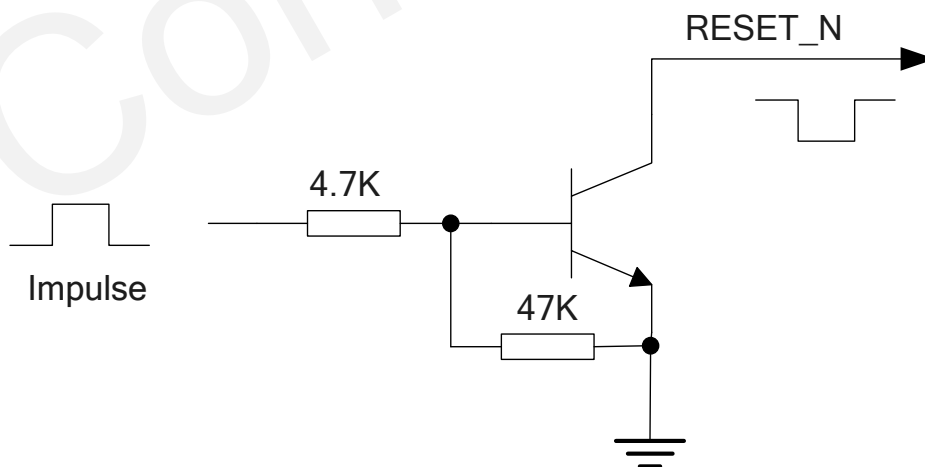


Figure 5: Reset the Module Using Driving Circuit

4.4. USIM Interface

The USIM interface of EC25, EC21, EC20 R2.0, EC20 and UC20 supports 1.8V or 3.0V USIM/SIM cards. A reference circuit for an 8-pin USIM card holder is illustrated below.

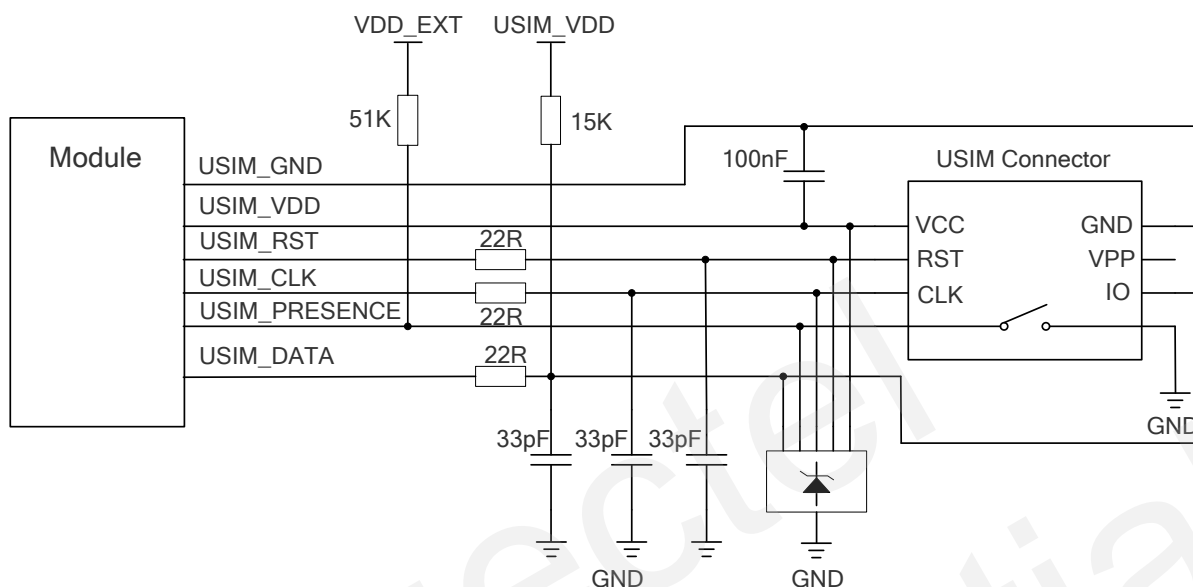


Figure 6: Reference Circuit for an 8-Pin USIM Card Holder

If you do not need the USIM card detection function, keep USIM_PRESENCE unconnected. A reference circuit for a 6-pin USIM card holder is illustrated as the following figure.

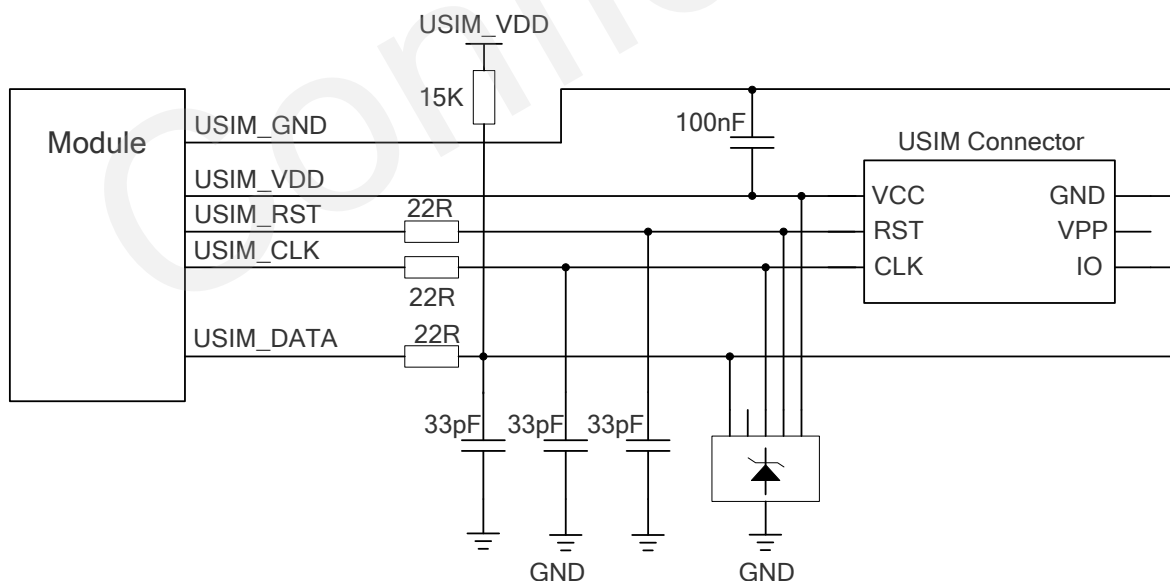


Figure 7: Reference Circuit for a 6-Pin USIM Holder

4.5. USB Application

EC25, EC21, EC20 R2.0, EC20 and UC20 all contain one integrated Universal Serial Bus (USB) transceiver meeting USB 2.0 specification, and support high-speed (480Mbps) and full-speed (12Mbps) modes; UC20 can additionally support low-speed (1.5Mbps) mode. The USB interface can be used for AT command communication, data transmission, GNSS NMEA sentences output, software debugging and firmware upgrade.

The USB interface is recommended to be reserved for firmware upgrade in your design. The following figure shows the reference circuit of USB interface.

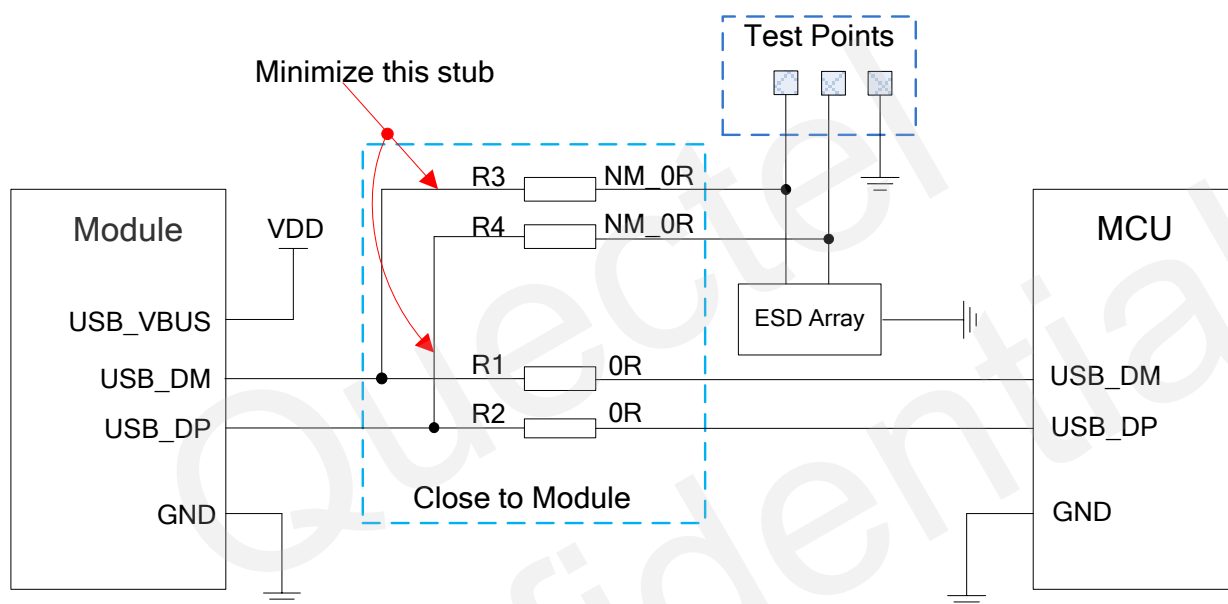


Figure 8: Reference Circuit of USB Application

In order to meet USB data line signal integrity, components R1, R2, R3 and R4 must be placed close to the module, and then these resistors should be placed close to each other as well. The extra stubs of trace must be as short as possible.

NOTE

EC25, EC21, EC20 R2.0, EC20 and UC20 modules can only be used as a slave device.

4.6. PCM Application

EC25, EC21, EC20 R2.0, EC20 and UC20 support one PCM interface used for audio applications with the same feature. The following figure shows a reference design of PCM interface with external codec IC.

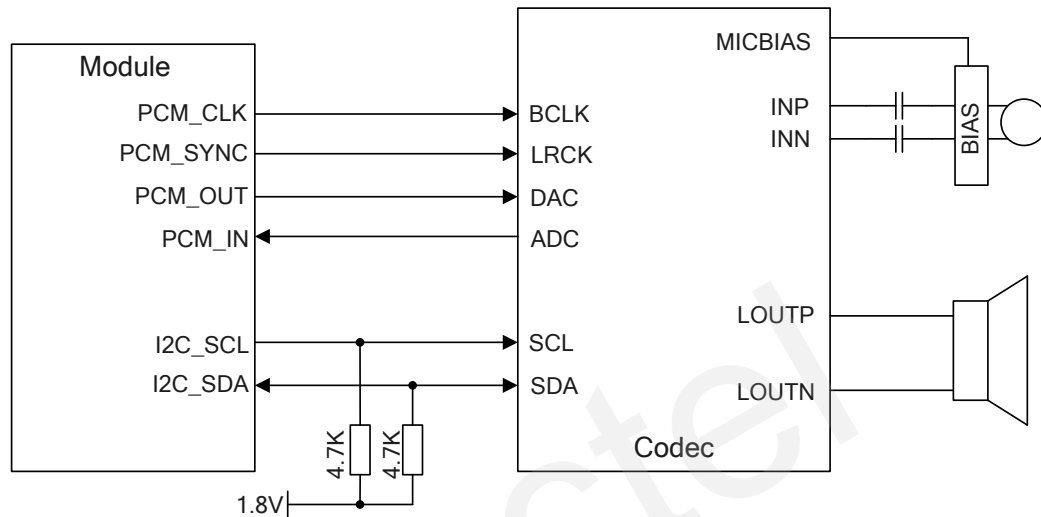


Figure 9: Reference Circuit of PCM Application with Audio Codec

NOTE

It is recommended to reserve the RC (R=22ohm, C=22pF) circuit on the PCM lines, especially for PCM_CLK.

4.7. UART Interface

EC25, EC21, EC20 R2.0, EC20 and UC20 support a main UART and a debug UART interface. The main UART interface can be used for data transmission, AT command communication and firmware upgrade; the debug UART interface can be used for GNSS NMEA sentences output.

EC25, EC21, EC20 R2.0, EC20 and UC20 modules provide 1.8V UART interface. A level translator should be used if your application is equipped with a 3.3V UART interface. Level translator TXS0108EPWR provided by **Texas Instrument** is recommended. The following figure shows a reference design.

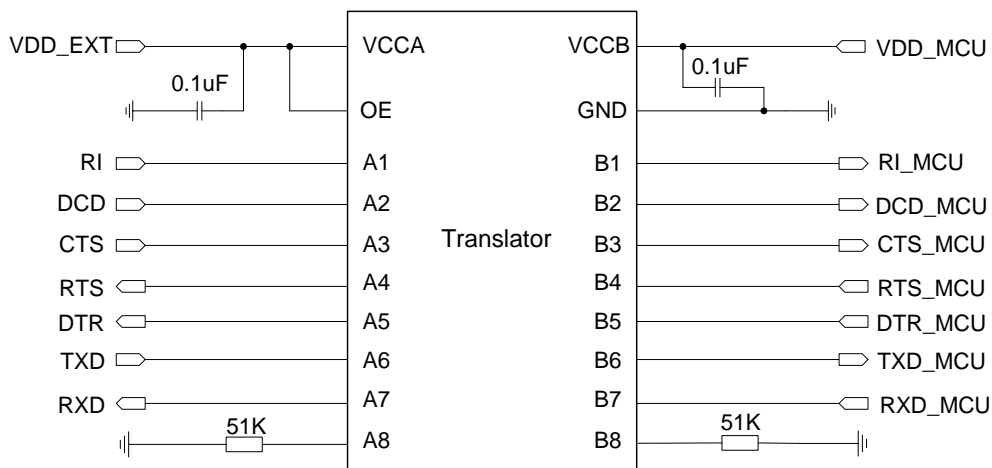


Figure 10: Reference Circuit with Level Translator Chip

Please visit <http://www.ti.com> for more information.

Another example with transistor translation circuit is shown as below. The circuit design of dotted line section can refer to the design of solid line section, in terms of both module input and output circuit designs; but please pay attention to the direction of connection.

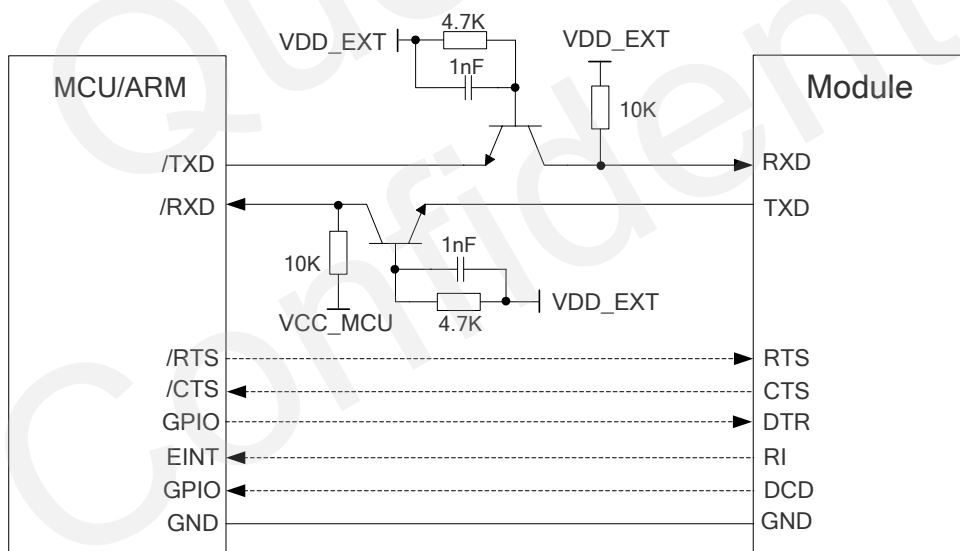


Figure 11: Reference Circuit with Transistor Circuit

NOTE

Transistor circuit solution is not suitable for applications with high baud rate exceeding 460Kbps.

4.8. Antenna Interface

EC25, EC21, EC20 R2.0, EC20 and UC20 have the same antenna interfaces: ANT_MAIN, ANT_GNSS and ANT_DIV. For better RF performance, a π -type matching circuit should be reserved. The following figure shows a reference circuit.

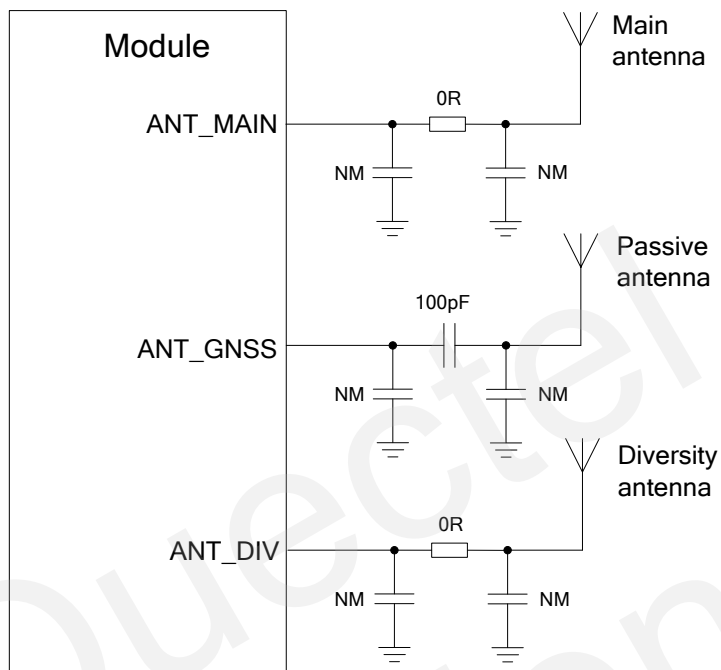


Figure 12: Reference Circuit of Antenna Interface

5 Recommended Footprint

The following figure shows the recommended compatible footprint of EC25, EC21, EC20 R2.0, EC20 and UC20.

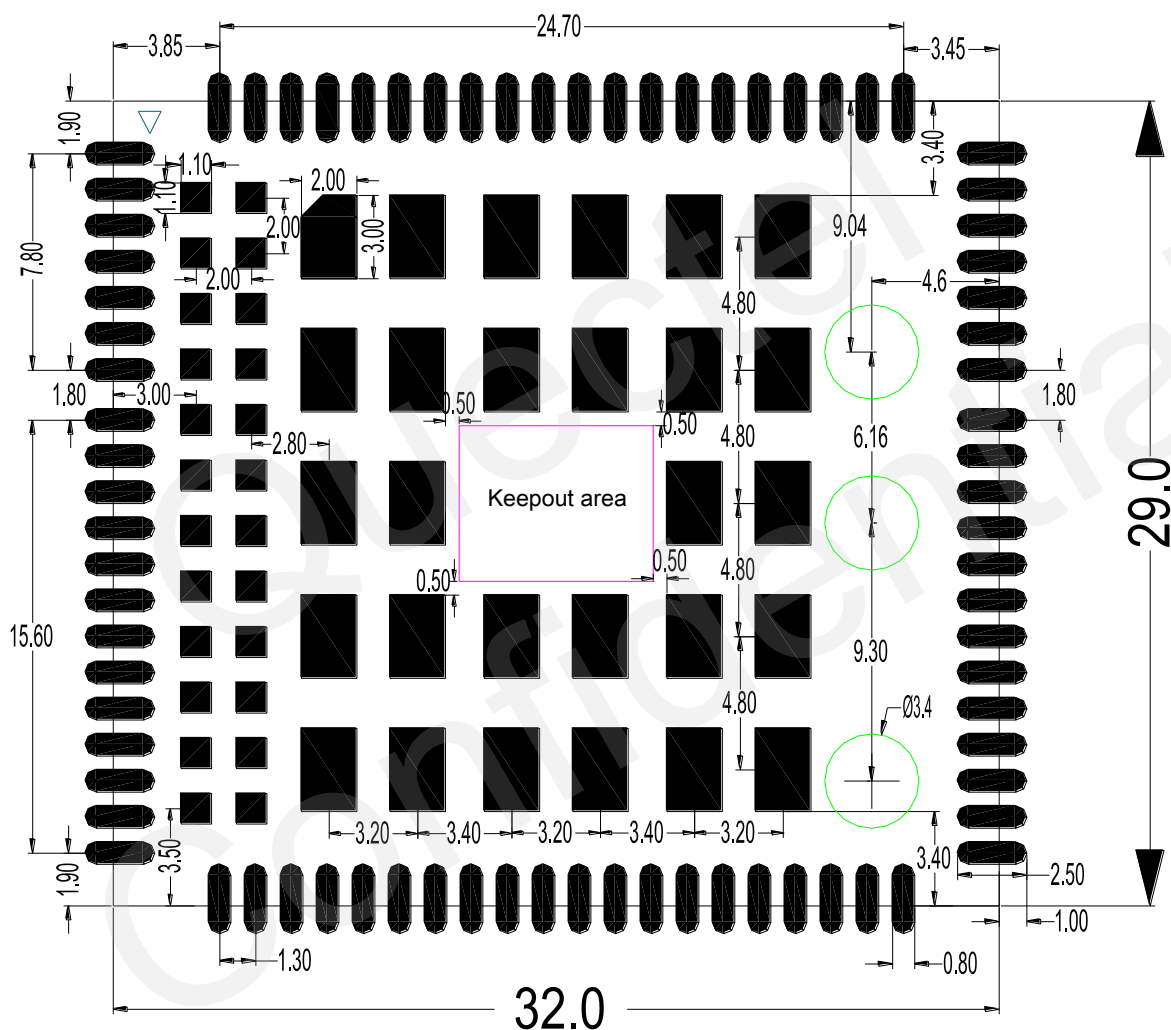


Figure 13: Recommended Compatible Footprint (Unit: mm)

If SGMII or Wi-Fi function is not needed, it is recommended to keep out the area for pins 117~140. The following figure shows the recommended compatible footprint without SGMII or Wi-Fi function.

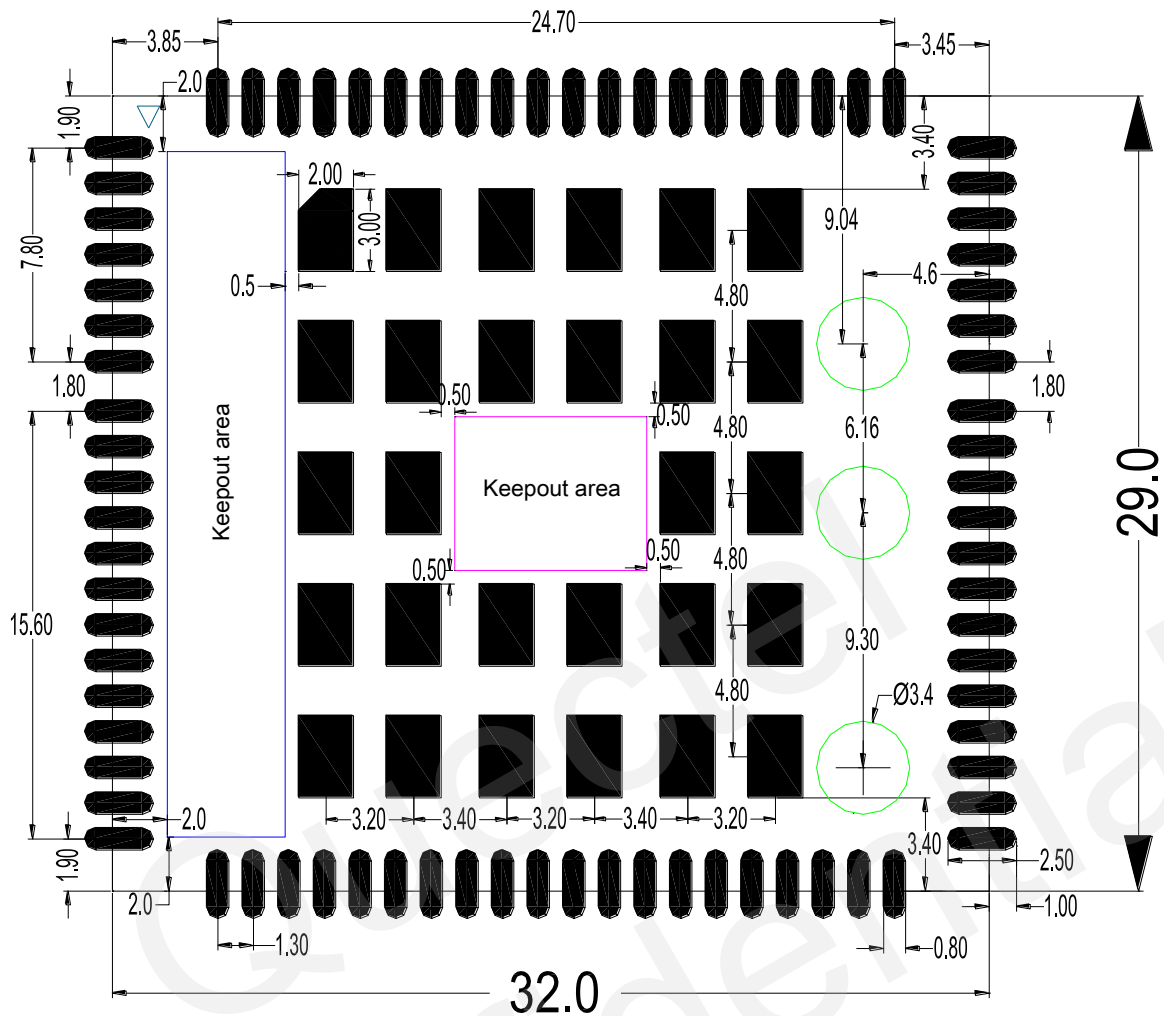


Figure 14: Recommended Compatible Footprint without SGMII or Wi-Fi (Unit: mm)

NOTES

1. The purple area should be kept out.
2. It is recommended to keep out the blue area for pins 117~140, if SGMII or Wi-Fi function is not needed.
3. When it concerns to compatible design with UC20, the three round green areas should be kept out.
4. For convenient maintenance of the module, keep about 3mm between the module and other components in the host PCB.

The following figure shows the sketch map of installation among EC25, EC21, EC20 R2.0, EC20 and UC20.

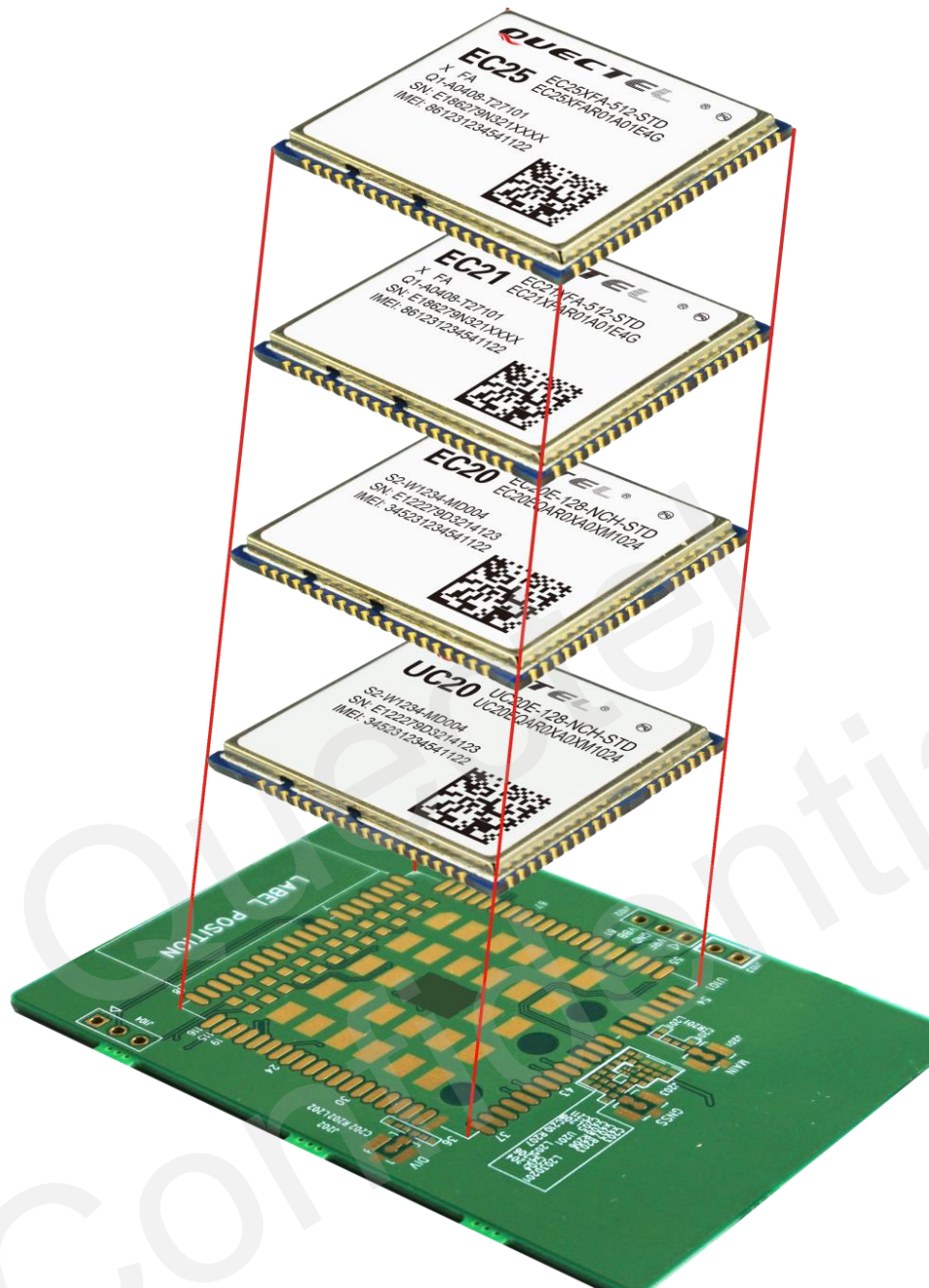


Figure 15: Installation Sketch Map for ECxx and UC20

6 Appendix References

Table 8: Related Documents

SN	Document Name	Remark
[1]	Quectel_UC20_Hardware_Design	UC20 Hardware Design
[2]	Quectel_EC20_Hardware_Design	EC20 Hardware Design
[3]	Quectel_EC25_Hardware_Design	EC25 Hardware Design
[4]	Quectel_EC20 R2.0_Hardware_Design	EC20 R2.0 Hardware Design
[5]	Quectel_UC20_Reference_Design	UC20 Reference Design
[6]	Quectel_EC20_Reference_Design	EC20 Reference Design
[7]	Quectel_EC25_Reference_Design	EC25 Reference Design
[8]	Quectel_EC20 R2.0_Reference_Design	EC20 R2.0 Reference Design