SIM8971x Hardware Design

LTE Module

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Version History

Date	Version	Description of change	Author
2023-05-10	1.01	Original	Junfeng Zhang
2023-08-16	1.02	Add other series modules Modify WiFi RF parameters	Daofu Yang Junfeng Zhang

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1 Introduction

SIM8971 module is a smart module newly released by SIMCom Wireless Solutions Co., Ltd. This module has the Android operating system, and the customers could use it for the development of their hardware devices.

This document introduces the hardware interfaces of the SIM8971 module. The users could quickly understand the definition of the interfaces, the electrical performance, and the die size of the module. Notice that SIM8971x series modules support different radio frequency (RF) bands, different memory capacity, and different software version, etc. Please consult the local sales for more detailed information if needed.

1.1 Product Outline

SIM8971x series module is a 4G Android smart module developing by the platform of Qualcomm QCM6125. QCM6125 is an 8-Core customized 64-Bit ARM V-8 compatible application processor (Qualcomm® Kryo™ 260 CPU) adopting 11nm FinFET production process. It's high performance 4-Core basic frequency is up to 2.0GHz, and low power consumption 4-Core is up to 1.8GHz. SIM8971x series module has abundant multi-media functions, including the 4K@30 fps video codec, the 2520*1080 single displaying screen, four MIPI cameras, and the multi-channel analog- and digital-audio input and output. SIM8971x series module supports multiple communication modes, including the GSM/GPRS/EDGE, the WCDMA/HSPA+, the LTE-FDD, and the LTE-TDD. It also supports the WiFi 802.11 a/b/g/n/ac, and the BT5.X short range communication. For the satellite positioning system, SIM8971x series module supports the GPS, the GLONASS, the BEIDOU, and the Galileo. In conclusion, SIM8971x series module is a highly integrated product, which is widely applying to intelligent terminal devices in the field of the Internet of Things(IOT).

SIM8971x series module is available in six variants: SIM8971EA, SIM8971CE, SIM8971NA, SIM8971JP, SIM8971JP-E, SIM8971W. The following tables show the supported frequency bands and network standards of SIM8971 series module.

Table 1: SIM8971EA Frequency Bands

Mode	Frequency bands
LTE-FDD	B1/B2/B3/B4/B5/B7/B8/B20/B28
LTE-TDD	B38/B39/B40/B41
WCDMA	B1/B2/B4/B5/B8
2G	GSM850/EGSM900/DCS1800/PCS1900

Wi-Fi 802.11 a/b/g/n/ac	2412–2484 MHz
	5180–5825 MHz
BT2.1+EDR /3.0 /4.2 LE/5.x	2402-2480 MHz
GNSS[2]	GPS L1: 1575.42 ±1.023 MHz GLONASS: 1597.5–1605.8 MHz BDS: 1561.098 ±2.046 MHz Galileo: 1575.42 ±1.023 MHz

Table 2: SIM8971CE Frequency Bands

Mode	Frequency bands
LTE-FDD	B1/B3/B5/B8
LTE-TDD	B34/B38/B39/B40/B41
WCDMA	B1/B8
2G	EGSM900/DCS1800
Wi-Fi 802.11 a/b/g/n/ac	2412–2484 MHz
	5180–5825 MHz
BT2.1+EDR /3.0 /4.2 LE/5.x	2402–2480 MHz
GNSS[2]	GPS L1: 1575.42 ±1.023 MHz GLONASS: 1597.5–1605.8 MHz BDS: 1561.098 ±2.046 MHz Galileo: 1575.42 ±1.023 MHz

Table 3: SIM8971NA Frequency Bands

Mode	Frequency bands
LTE-FDD	B2/B4/B5/B7/B12/B13/B17/B25/B26
LTE-TDD	B41
WCDMA	B2/B4/B5
2G	N/A
Wi-Fi 802.11 a/b/g/n/ac	2412–2484 MHz
	5180–5825 MHz
BT2.1+EDR /3.0 /4.2 LE/5.x	2402–2480 MHz
GNSS[2]	GPS L1: 1575.42 ±1.023 MHz GLONASS: 1597.5–1605.8 MHz BDS: 1561.098 ±2.046 MHz Galileo: 1575.42 ±1.023 MHz

Table 4: SIM8971JP Frequency Bands

Mode	Frequency bands
LTE-FDD	B1/B3/B8/B18/B19/B26
LTE-TDD	B41

WCDMA	N/A
2G	N/A
Wi-Fi 802.11 a/b/g/n/ac	2412–2484 MHz
	5180–5825 MHz
BT2.1+EDR /3.0 /4.2 LE/5.x	2402–2480 MHz
GNSS[2]	GPS L1: 1575.42 ±1.023 MHz GLONASS: 1597.5–1605.8 MHz BDS: 1561.098 ±2.046 MHz Galileo: 1575.42 ±1.023 MHz

Table 5: SIM8971JP-E Frequency Bands

Mode	Frequency bands
LTE-FDD	B1/B2/B3/B4/B5/B7/B8/B18/B19/B20/B26/B28
LTE-TDD	B38/B39/B40/B41
WCDMA	B1/B2/B4/B5/B8
2G	GSM850/EGSM900/DCS1800/PCS1900
Wi-Fi 802.11 a/b/g/n/ac	2412–2484 MHz
	5180–5825 MHz
BT2.1+EDR /3.0 /4.2 LE/5.x	2402-2480 MHz
GNSS[2]	GPS L1: 1575.42 ±1.023 MHz GLONASS: 1597.5–1605.8 MHz BDS: 1561.098 ±2.046 MHz Galileo: 1575.42 ±1.023 MHz

Table 6: SIM8971W Frequency Bands

Mode	Frequency bands
LTE-FDD	N/A
LTE-TDD	N/A
WCDMA	N/A
2G	N/A
Wi-Fi 802.11 a/b/g/n/ac	2412–2484 MHz
	5180–5825 MHz
BT2.1+EDR /3.0 /4.2 LE/5.x	2402–2480 MHz
GNSS[2]	N/A

NOTE

GNSS[2]:Supports GPS/BDS/GLO combination by default; Can support GPS/BDS/GAL combination; Can support GPS/GLO combination.

This document is only for the SIM8971x series module without PMI charging IC. It doesn't support the Charging function, the Fuel Gauge, the Flash Driver, the Detection of the Battery ID and the Battery Therm.
SIM8971x series module supports a wide range of the functional configuration. Please contact the SIMCom support team for details.

1.2 Functional Overview

Table 7: General features

Feature	Description
Processor	Customized 64-bit ARM V-8 compatible application processor (Qualcomm® Kryo™ 260 CPU) High Performance 4-Core frequency up to 2.0GHz,1MB L2 Low power consumption 4-Core frequency up to 1.8GHz,512KB L2
Memory	LPDDR4X RAM, (2 × 16 Bit)BUS, Highest working frequency 1804MHz Built-in eMMC 5.1 Flash, Refer to the Table 1 for memory capacity, Default configuration: 64GB UFS + 6GB LPDDR4, Optional configuration: 128GB UFS + 8GB LPDDR4
SD	SD external interface supports SD3.0 TF card (Maximum 256G), support hot plug detection
Operation System	Support Android 10.1
System Upgrade	Upgrade via USB interface, support forced download
Power Supply	Power Domain: 3.4V~4.4V, support single-cell lithium battery power supply.
Display	One 4-Lane MIPI_DSI interface, the highest resolution is 2520*1080, 60fps.
Camera	MIPI combination DPHY 1.2 / CPHY 1.0 can be configured as 4/4/4 or 4/4/2/1 D-PHY: 2.5Gbps/Channel, C-PHY: ~10Gbps(3.42Gbps/Channel) Dual 14-bit ISP, 16 MP + 16MP Single ISP: 16 MP 30 ZSL, Dual ISP: 25 MP 30 ZSL
Video Codec	Encoding: 4k30 10-Bit HEVC, 4K30: H264/VP8 Decoding: 4K30 8-Bit H.264/VP8, 4K30 10-Bit HEVC/VP9, 1080p60 MPEG-2 Wireless display(Encoding & Decoding): 4K30 decode & 1080p30 encode
Audio	2-Channel Digital Audio Interface I2S: Support Master- and Salve-Mode 3-Channel Analog Audio Input Master Microphone: Differential Input, Built-in Bias Headphone Microphone: Single-ended Input, Built-in Bias Denoise Microphone: Differential Input, Built-in Bias 4-Channel Digital Microphone Input

	3-Channel Analog Audio Output Headphone: Class AB Amplifier Stereo Output Handset: Class AB Amplifier Differential Output Speaker: Class D Amplifier Differential Output
Audio Codec	MP3, AAC, He-AAC v1, v2, WMA 9/Pro, Dolby AC-3, eAC-3, DTS-HD, FLAC, APE, ALAC, AIFF, and EVS
Speech Codec	EVRC, EVRC-B, EVRC-WB, G.711, G.729A/AB, GSM-FR, GSM-EFR, GSM-HR, AMR-NB, AMR-WB, AMR-eAMR, AMR-BeAMR
USB	Support USB 3.1 with DP interface, support USB2.0 Support USB Type-C Interface, Support MICRO-USB Interface Support OTG.
UART	Support up to 5 Serial Ports A 2-Wire Serial Port for Debug Three 4-Wrie Serial Ports support hardware flow control, High-speed up to 4Mbps.
I2C	Support up to nine I2C for touch screen, camera, sensor and other peripherals
SPI	Support up to four SPI interfaces, support master mode, the highest rate 50MHz
USIM Card	Support Dual Card Dual Standby: 1.8V/2.95V Dual Voltage Adaptive
Power Level	Class 4 (33dBm±2dB) for EGSM850 Class 4 (33dBm±2dB) for EGSM900 Class 1 (30dBm±2dB) for DCS1800 Class 1 (30dBm±2dB) for PCS1900 Class E2 (27dBm±3dB) for EGSM850 8-PSK Class E2 (27dBm±3dB) for EGSM900 8-PSK Class E2 (26dBm±3dB) for DCS1800 8-PSK Class E2 (26dBm±3dB) for PCS1900 8-PSK Class 3 (24dBm+1/-3dB) for WCDMA bands Class 3 (23dBm±2dB) for LTE-FDD bands Class 3 (23dBm±2dB) for LTE-TDD bands
LTE Features	Support 3GPP R10 CAT4 FDD and TDD Support 1.4 to 20 MHz RF Bandwidth Support Downstream 2x2 MIMO FDD: the maximum 150Mbps(DL) / the maximum 50Mbps(UL) TDD: the maximum 150Mbps(DL) / the maximum 35Mbps(UL)
UMTS Features	Support 3GPP R8 DC-HSDPA/HSPA+/HSDPA/HSUPA/WCDMA Support 16-QAM, 64-QAM and QPSK modulation DC-HSDPA: maximum 42Mbps(DL) HSUPA: maximum 5.76Mbps(UL) WCDMA: maximum 384Kbps(DL) / maximum 384bps(UL)
GSM Features	R99: CSD: 9.6Kbps, 14.4Kbps

	GPRS: Support GPRS Multi-Slot Level 33(Default 33) Coding format: CS-1, CS-2, CS-3, and CS-4 Maximum 85.6Kbps(UL) / Maximum 107Kbps(DL) EDGE: Support EDGE Multi-Slot Level 33(Default 33) Support GMSK and 8-PSK modulation and coding Methods Downlink Coding Format: CS 1-4 and MCS 1-9 Uplink Coding Format: CS 1-4 and MCS 1-9 The maximum 236.8Kbps(UL) / The maximum 296Kbps(DL)
WLAN Features	2.4G/5G Dual Frequency Range, Support 802.11a/b/g/n/ac, Maximum 433Mbps Support Wake-on-WLAN(WoWLAN) Support ad-hoc Mode WAPI supports SMS4 Hardware Encryption Support AP Mode Support Wi-Fi Direct
BT Features	BT2.1+EDR /3.0 /4.2 LE/5.x
Satellite Positioning	GPS /GLONASS /BDS/Galileo
Temperature	Operature Temperature: -35℃~ +75℃［1］ Extend Operation Temperature: -40℃ ~ +85℃［2］ Storage Temperature: -40℃~ +90℃
Physical Size	Size: 43.0(±0.2)×44.0(±0.2) ×3.0(±0.2)mm Weight: 13.6g

NOTE

SIM8971x series module works normally within the extend operation temperature range, but if the testing procedures fully accord with 3GPP standard could not be guaranteed.

1.3 Product Outline

SIMCom offers a whole set of the evaluation boards for customer debugging, including the EVB board, SIM8971-TE board, the USB cable, the RF cables, the adapter, and other peripherals.

2 Package Information

2.1 Hardware Block Diagram

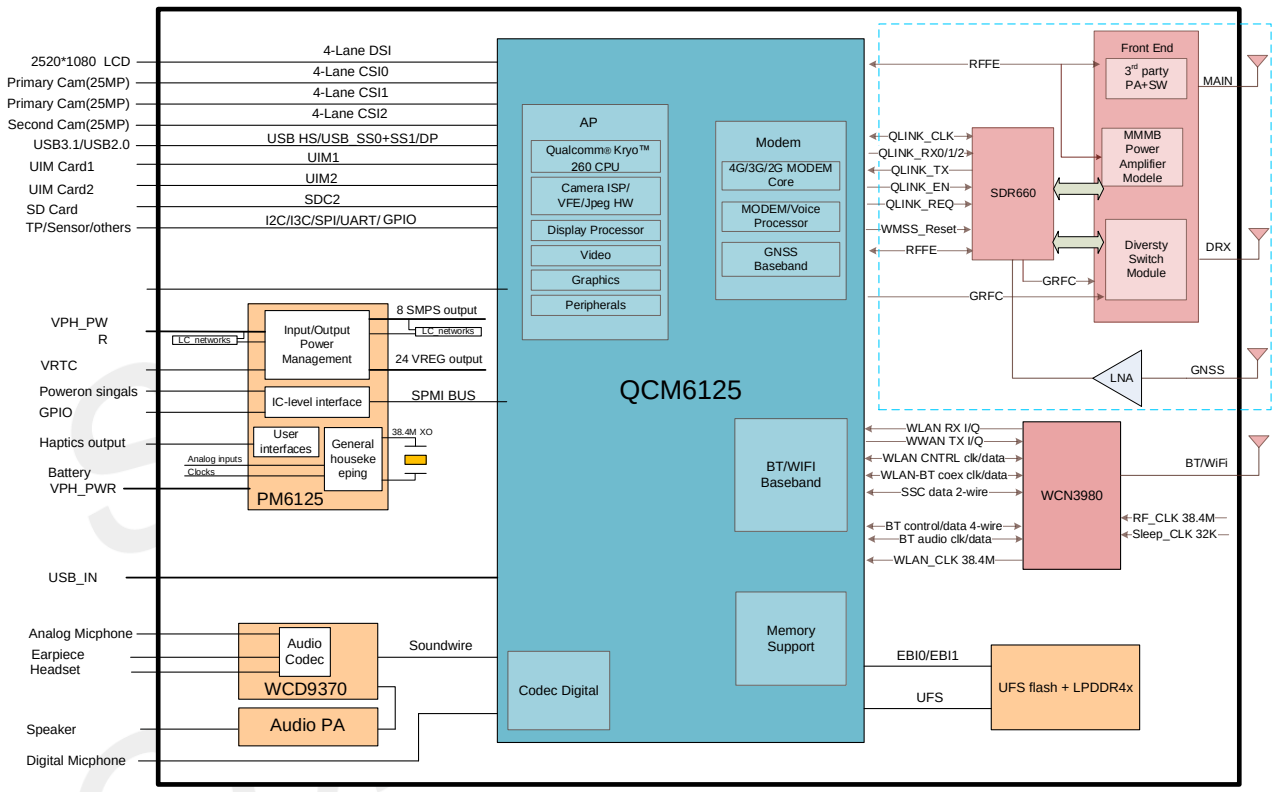

Figure 1: Module Block Diagram

2.2 Pin Assignment Overview

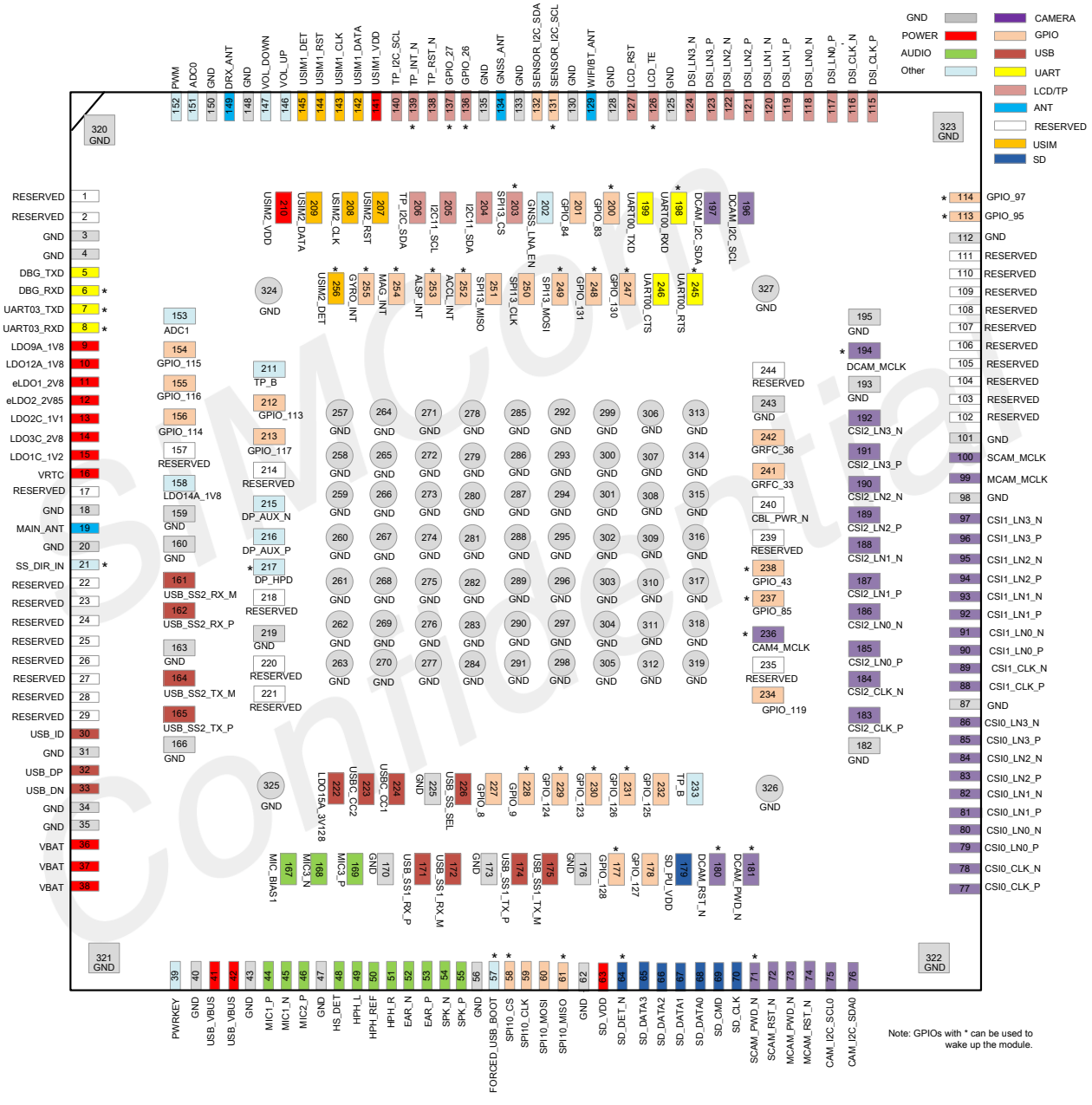

Figure 2: Pin Assignment Overview

2.3 PIN Description

Table 8: Defination of the I/O Parameters

Symble	Description
PIN Properties	
PI	Power Input
PO	Power Output
AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
Digital Interface Pull Up and Pull Down	
NP	No Pull Up or No Pull Down
PU	Pull Up
PD	Pull Down

Table 9: Pin Properties

PIN Num	PIN Name	Power Domain	QCM6125 PIN	Reset Status	Wakeup Interrupt	Note
1	RESERVED					
2	RESERVED					
3	GND					
4	GND					
5	DBG_TXD	1.8V	GPIO_16	DO		
6	DBG_RXD	1.8V	GPIO_17	DI	√	
7	UART03_TXD	1.8V	GPIO_14	B-PD	√	
8	UART03_RXD	1.8V	GPIO_15	B-PD	√	
9	LDO9A_1V8	1.8V				
10	LDO12A_1V8	1.8V				
11	ELDO1_2V8	2.8V				
12	ELDO2_2V85	2.85V				
13	LDO2C_1V1	1.1V				
14	LDO3C_2V8	2.8V				
15	LDO1C_1V2	1.2V				
16	VRTC	3.0-3.25V				Typical:

						3.0V
17	RESERVED					
18	GND					
19	MAIN_ANT					
20	GND					
21	SS_DIR_IN	1.8V	GPIO_102	B-PD	√	
22	RESERVED					
23	RESERVED					
24	RESERVED					
25	RESERVED					
26	RESERVED					
27	RESERVED					
28	RESERVED					
29	RESERVED					
30	USB_ID	0-4.75V				
31	GND					
32	USB_DP					
33	USB_DN					
34	GND					
35	GND					
36	VBAT	3.4-4.4V				Typical: 4.0V
37	VBAT	3.4-4.4V				
38	VBAT	3.4-4.4V				
39	PWRKEY	1.8V				
40	GND					
41	USB_VBUS	3.6-10V				
42	USB_VBUS	3.6-10V				
43	GND					
44	MIC1_P					
45	MIC1_N					
46	MIC2_P					
47	GND					
48	HS_DET					
49	HPH_L					
50	HPH_REF					
51	HPH_R					
52	EAR_N					
53	EAR_P					
54	SPK_N					
55	SPK_P					
56	GND					

57	USB_BOOT	1.8V	GPIO_99	B-PD	√	No external pull-ups
58	SPI10_CS	1.8V	GPIO_25	B-PD	√	
59	SPI10_CLK	1.8V	GPIO_24	B-PD		
60	SPI10_MOSI	1.8V	GPIO_23	B-PD		
61	SPI10_MISO	1.8V	GPIO_22	B-PD		
62	GND					
63	SD_VDD	2.95V				
64	SD_DET_N	1.8V	GPIO_98	B-PD	√	
65	SD_DATA3	1.8/2.95V		B		
66	SD_DATA2	1.8/2.95V		B		
67	SD_DATA1	1.8/2.95V		B		
68	SD_DATA0	1.8/2.95V		B		
69	SD_CMD	1.8/2.95V		B		
70	SD_CLK	1.8/2.95V		DO		
71	SCAM_PWD_N	1.8V	GPIO_47	B-PD	√	
72	SCAM_RST_N	1.8V	GPIO_48	B-PD		
73	MCAM_PWD_N	1.8V	GPIO_41	B-PD		
74	MCAM_RST_N	1.8V	GPIO_46	B-PD		
75	CAM_I2C_SCL0	1.8V	GPIO_38	B-PD		
76	CAM_I2C_SDA0	1.8V	GPIO_37	B-PD		
77	CSI0_CLK_P					
78	CSI0_CLK_N					
79	CSI0_LN0_P					
80	CSI0_LN0_N					
81	CSI0_LN1_P					
82	CSI0_LN1_N					
83	CSI0_LN2_P					
84	CSI0_LN2_N					
85	CSI0_LN3_P					
86	CSI0_LN3_N					
87	GND					
88	CSI1_CLK_P					
89	CSI1_CLK_N					
90	CSI1_LN0_P					
91	CSI1_LN0_N					
92	CSI1_LN1_P					
93	CSI1_LN1_N					
94	CSI1_LN2_P					
95	CSI1_LN2_N					
96	CSI1_LN3_P					

97	CSI1_LN3_N					
98	GND					
99	MCAM_MCLK	1.8V	GPIO_35	B-PD		
100	SCAM_MCLK	1.8V	GPIO_34	B-PD		
101	GND					
102	RESERVED					
103	RESERVED					
104	RESERVED					
105	RESERVED					
106	RESERVED					
107	RESERVED					
108	RESERVED					
109	RESERVED					
110	RESERVED					
111	RESERVED					
112	GND					
113	GPIO_95	1.8V	GPIO_95	B-PD	√	
114	GPIO_97	1.8V	GPIO_97	B-PD	√	
115	DSI_CLK_P					
116	DSI_CLK_N					
117	DSI_LN0_P					
118	DSI_LN0_N					
119	DSI_LN1_P					
120	DSI_LN1_N					
121	DSI_LN2_P					
122	DSI_LN2_N					
123	DSI_LN3_P					
124	DSI_LN3_N					
125	GND					
126	LCD_TE	1.8V	GPIO_89	B-PD	√	
127	LCD_RST	1.8V	GPIO_90	B-PD		
128	GND					
129	WIFI/BT_ANT					
130	GND					
131	SENSOR_I2C_SCL	1.8V	GPIO_29	B-PD	√	
132	SENSOR_I2C_SDA	1.8V	GPIO_28	B-PD		
133	GND					
134	GNSS_ANT					
135	GND					
136	GPIO_26	1.8V	GPIO_26	B-PD	√	
137	GPIO_27	1.8V	GPIO_27	B-PD	√	

138	TP_RST_N	1.8V	GPIO_87	B-PD		No external pull-ups
139	TP_INT_N	1.8V	GPIO_88	B-PD	√	
140	TP_I2C_SCL	1.8V	GPIO_7	B-PD		
141	USIM1_VDD	1.8 /2.95V				
142	USIM1_DATA	1.8 /2.95V	GPIO_76	B-PD		
143	USIM1_CLK	1.8 /2.95V	GPIO_77	B-PD		
144	USIM1_RST	1.8 /2.95V	GPIO_78	B-PD		
145	USIM1_DET	1.8 V	GPIO_79	B-PD	√	
146	VOL_UP	1.8V		I-PU		
147	VOL_DOWN	1.8V		I-PU		
148	GND					
149	DRX_ANT					
150	GND					
151	ADC0	0-1.875V	PMU GPIO_03B			
152	PWM		PMU GPIO_08B			
153	ADC1	0-1.875V	PMU GPIO_07B			
154	GPIO_115	1.8V	GPIO_115	B-PD		
155	GPIO_116	1.8V	GPIO_116	B-PD		
156	GPIO_114	1.8V	GPIO_114	B-PD		
157	RESERVED					
158	LDO14A_1V8	1.8V				
159	GND					
160	GND					
161	USB_SS2_RX_M					
162	USB_SS2_RX_P					
163	GND					
164	USB_SS2_TX_M					
165	USB_SS2_TX_P					
166	GND					
167	MIC_BIAS1					
168	MIC3_N					
169	MIC3_P					
170	GND					
171	USB_SS1_RX_P					
172	USB_SS1_RX_M					
173	GND					
174	USB_SS1_TX_P					
175	USB_SS1_TX_M					
176	GND					
177	GPIO_128	1.8V	GPIO_128	B-PD	√	

178	GPIO_127	1.8V	GPIO_127	B-PD		
179	SD_PU_VDD	1.8/2.95 V				
180	DCAM_RST_N	1.8V	GPIO_42	B-PD	√	
181	DCAM_PWD_N	1.8V	GPIO_92	B-PD	√	
182	GND					
183	CSI2_CLK_P					
184	CSI2_CLK_N					
185	CSI2_LN0_P					
186	CSI2_LN0_N					
187	CSI2_LN1_P					
188	CSI2_LN1_N					
189	CSI2_LN2_P					
190	CSI2_LN2_N					
191	CSI2_LN3_P					
192	CSI2_LN3_N					
193	GND					
194	DCAM_MCLK	1.8V	GPIO_36	B-PD	√	
195	GND					
196	DCAM_I2C_SCL	1.8V	GPIO_40	B-PD		
197	DCAM_I2C_SDA	1.8V	GPIO_39	B-PD		
198	UART00_RXD	1.8V	GPIO_3		√	
199	UART00_TXD	1.8V	GPIO_2			
200	GPIO_83	1.8V	GPIO_83	B-PD	√	
201	GPIO_84	1.8V	GPIO_84	B-PD		
202	GNSS_LNA_EN	1.8V				
203	SPI13_CS	1.8V	GPIO_21	B-PD	√	
204	I2C11_SDA	1.8V	GPIO_30	B-PD		
205	I2C11_SCL	1.8V	GPIO_31	B-PD		
206	TP_I2C_SDA	1.8V	GPIO_6	B-PD		
207	USIM2_RST	1.8/2.95 V	GPIO_74	B-PD		
208	USIM2_CLK	1.8/2.95 V	GPIO_73	B-PD		
209	USIM2_DATA	1.8/2.95 V	GPIO_72	B-PD	√	
210	USIM2_VDD	1.8/2.95 V				
211	TP_B					
212	GPIO_113	1.8V	GPIO_113	B-PD		
213	GPIO_117	1.8V	GPIO_117	B-PD		
214	RESERVED					
215	DP_AUX_N					
216	DP_AUX_P					
217	DP_HPD	1.8V	GPIO_100	B-PD	√	No external pull-ups

218	RESERVED					
219	GND					
220	RESERVED					
221	RESERVED					
222	LDO15A_3V128	3.128V				
223	USBC_CC2					
224	USBC_CC1					
225	GND					
226	USB_SS_SEL					
227	GPIO_8	1.8V	GPIO_8	B-PD		
228	GPIO_9	1.8V	GPIO_9	B-PD	√	
229	GPIO_124	1.8V	GPIO_124	B-PD	√	
230	GPIO_123	1.8V	GPIO_123	B-PD	√	
231	GPIO_126	1.8V	GPIO_126	B-PD	√	
232	GPIO_125	1.8V	GPIO_125	B-PD		
233	TP_B					
234	GPIO_119	1.8V	GPIO_119	B-PD		
235	RESERVED					
236	CAM4_MCLK	1.8V	GPIO_44	B-PD	√	
237	GPIO_85	1.8V	GPIO_85	B-PD	√	
238	GPIO_43	1.8V	GPIO_43	B-PD	√	
239	RESERVED					
240	CBL_PWR_N					
241	GRFC_33	1.8V	GPIO_67	B-PD		
242	GRFC_36	1.8V	GPIO_66	B-PD		
243	GND					
244	RESERVED					
245	UART00_RTS	1.8V	GPIO_1	B-PD	√	
246	UART00_CTS	1.8V	GPIO_0	B-PD		
247	GPIO_130	1.8V	GPIO_130	B-PD	√	
248	GPIO_131	1.8V	GPIO_131	B-PD	√	
249	SPI13_MOSI	1.8V	GPIO_19	B-PD	√	
250	SPI13_CLK	1.8V	GPIO_20	B-PD		
251	SPI13_MISO	1.8V	GPIO_18	B-PD		
252	ACCL_INT	1.8V	GPIO_81	B-PD	√	
253	ALPS_INT	1.8V	GPIO_91	B-PD	√	
254	MAG_INT	1.8V	GPIO_82	B-PD	√	
255	GYRO_INT	1.8V	GPIO_80	B-PD	√	
256	USIM2_DET	1.8V	GPIO_75	B-PD	√	
257	GND					
258	GND					

259	GND					
260	GND					
261	GND					
262	GND					
263	GND					
264	GND					
265	GND					
266	GND					
267	GND					
268	GND					
269	GND					
270	GND					
271	GND					
272	GND					
273	GND					
274	GND					
275	GND					
276	GND					
277	GND					
278	GND					
279	GND					
280	GND					
281	GND					
282	GND					
283	GND					
284	GND					
285	GND					
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300	GND					
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305	GND					
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311	GND					
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313	GND					
314	GND					
315	GND					
316	GND					
317	GND					
318	GND					
319	GND					
320	GND					
321	GND					
322	GND					
323	GND					
324	GND					
325	GND					
326	GND					
327	GND					

NOTE

In the column of the QCM6125 PIN, all the GPIO_XX are configurable GPIOs except the UIM Cards signals. But pulling up the following GPIOs would affect the module's boot-up. These GPIOs are including GPIO_87, GPIO_99, and GPIO_100.

Table 10: Pin Description

PIN Name	PIN Num	I/O	Description	Note
Power Supply				

LDO9A_1V8	9	PO	Mainly for external GPIO pull up and the 1.8V power level conversion	1. No sleep when booting up. 2. Not for the peripherals power supply.
LDO12A_1V8	10	PO	1.8 V Output Power Supply (Mainly for the external I/O)	Power supply for external cir cuit. A parallel 2.2uF~4.7uf c apacitance is required. If unused, keep it open..
eLDO1_2V8	11	PO	2.8 V Output Power Supply (Mainly for the Sensor)	Power supply for external cir cuit. A parallel 2.2uF~4.7uf c apacitance is required. If unused, keep it open..
eLDO2_2V85	12	PO	2.85 V Output Power Supply (Mainly for the LCD AVDD and the TP AVDD)	Power supply for external cir cuit. A parallel 2.2uF~4.7uf c apacitance is required. If unused, keep it open..
LDO2C_1V1	13	PO	1.1 V Output Power Supply (Mainly for the rear camera's DVDD)	Power supply for external cir cuit. A parallel 2.2uF~4.7uf c apacitance is required. If unused, keep it open..
LDO3C_2V8	14	PO	2.8 V Output Power Supply (Mainly for the camera's AVDD)	Power supply for external cir cuit. A parallel 2.2uF~4.7uf c apacitance is required. If unused, keep it open..
LDO1C_1V2	15	PO	1.2 V Output Power Supply (Mainly for the front camera's DVDD)	Power supply for external cir cuit. A parallel 2.2uF~4.7uf c apacitance is required. If unused, keep it open..
VRTC	16	PI/PO	3V Secondary Power Supply Input and Charging Output	If unused, keep it open.
VBAT	36, 37, 38	PI/PO	Primary Power Supply	Maximum Current 3A, Highly recommend increasing the TVS diode to prevent the surge and electrostatic discharge （ESD）.
LDO14A_1V8	158	PO	1.8 V Output Power Supply	Power supply for external cir cuit. A parallel 2.2uF~4.7uf c apacitance is required. If unused, keep it open..
LDO15A_3V128	222	PO	3.128 V Output Power Supply	Power supply for external cir cuit. A parallel 2.2uF~4.7uf c apacitance is required. If unused, keep it open..
Ground				

GND	3, 4, 18, 20, 31, 34, 35, 40, 43, 47, 56, 62, 87, 98, 101, 112, 125, 128, 130, 133, 135, 148, 150, 159, 160, 163, 166, 170, 173, 176, 182, 193, 195, 219, 225, 243, 257-327			
Micro-USB/Type-C/DP Interface				
USB_VBUS	41, 42	PI/PO	USB VBUS Power Input	
SS_DIR_IN	21	DI	CC Detection Pin	1. Only for the USB function. 2. Connecting this PIN to the SS_DIR_OUT PIN when debugging with the Type-C. 3. Connecting the this PIN to the ground via a 4.7kΩ resistor when debugging with the Micro USB.
USB_ID	30	DO	USB_ID Control Signal	Connecting the USB_ID PIN to the GPIO43 when debugging with the Type-C.
USBC_CC2	223	AI/AO	Type-C CC2 Signal	
USBC_CC1	224	AI/AO	Type-C CC1 Signal	
USB_DP	32	AI/AO	USB 2.0 Differential P (+)	1. For Download, Debug, and Data Transmission. 2. A part of Type-C Interface.
USB_DN	33	AI/AO	USB 2.0 Differential N (-)	
USB_SS2_RX_M	161	AI	USB 3.1 Lane2 Receiver M (-)	USB_SS1 and USB_SS2 could not work at the same time. The USB data line traces should have a 90Ω±10% differential impedance.
USB_SS2_RX_P	162	AI	USB 3.1 Lane2 Receiver P (+)	
USB_SS2_TX_M	164	AO	USB 3.1 Lane2 Transmitter M (-)	
USB_SS2_TX_P	165	AO	USB 3.1 Lane2 Transmitter P (+)	
USB_SS1_RX_P	171	AI	USB 3.1 Lane1 Receiver P (+)	
USB_SS1_RX_M	172	AI	USB 3.1 Lane1 Receiver M (-)	
USB_SS1_TX_P	174	AO	USB 3.1 Lane1 Transmitter P (+)	
USB_SS1_TX_M	175	AO	USB 3.1 Lane1 Transmitter M (-)	
USIM Card Interface				
USIM1_VDD	141	PO	(U)SIM1 Card Power	
USIM1_DATA	142	DI/DO	(U)SIM1 Card Data	Only for USIM1.
USIM1_CLK	143	DO	(U)SIM1 Card Clock	
USIM1_RST	144	DO	(U)SIM1 Card Reset	

USIM1_DET	145	DI	(U)SIM1 Card Detection	1. Only for the USIM. 2. Default Low Active Detection. 3. Pull up to the LDO9A_1V8. 4. Highly recommend connecting to the ground if the SIM Card does not support the hot plug detection.
USIM2_DET	256	DI	(U)SIM2 Card Detection	
USIM2_RST	207	DO	(U)SIM2 Card Reset	Only for USIM2.
USIM2_CLK	208	DO	(U)SIM2 Card Clock	
USIM2_DATA	209	DI/DO	(U)SIM2 Card Date	
USIM2_VDD	210	PO	(U)SIM2 Card Power	
SDIO/SD Card Interface				
SD_VDD	63	PO	SD Card Power Supply	
SD_DET_N	64	DI	SD Card Detection	1. Default Low Active Detection. 2. Pull up to the LDO9A_1V8.
SD_DATA3	65	DI/DO	SDIO Data3	Reserved the pull-ups to the SD_PU_VDD.
SD_DATA2	66	DI/DO	SDIO Data2	
SD_DATA1	67	DI/DO	SDIO Data1	
SD_DATA0	68	DI/DO	SDIO Data0	
SD_CMD	69	DI/DO	SD Card Command	
SD_CLK	70	DI/DO	SD Card Clock	
SD_PU_VDD	179	PO	SD Card Pull up Power, 1.8V/2.95V Dual Voltage	
Touching Screen Interface				
TP_I2C_SDA	206	OD	TP I2C Data Signal	Highly recommend an external 2.2KR resistor pulling up to the LDO9A_1V8.
TP_I2C_SCL	140	OD	TP I2C Clock Signal	
TP_INT_N	139	DI	TP Interruption Signal	
TP_RST_N	138	DO	TP Reset Signal	With Boot function, avoid an external pull up.
Displaying Screen Interface				
DSI_CLK_P	115	AO	LCD MIPI Clock P (+)	The MIPI data line traces should have a 85Ω ±15% differential impedance.
DSI_CLK_N	116	AO	LCD MIPI Clock N (-)	
DSI_LN0_P	117	AO	LCD MIPI Lane0 P (+)	
DSI_LN0_N	118	AO	LCD MIPI Lane0 N (-)	
DSI_LN1_P	119	AO	LCD MIPI Lane1 P (+)	
DSI_LN1_N	120	AO	LCD MIPI Lane1 N (-)	
DSI_LN2_P	121	AO	LCD MIPI Lane2 P (+)	
DSI_LN2_N	122	AO	LCD MIPI Lane2 N (-)	
DSI_LN3_P	123	AO	LCD MIPI Lane3 P (+)	

DSI_LN3_N	124	AO	LCD MIPI Lane3 N (-)	
LCD_TE	126	DI	LCD tearing effect	1.8 V
LCD_RST	127	DO	LCD Reset	1.8 V
PWM	152	DO	PWM Output	
Camera Interface				
CSI0_CLK_P	77	AI	MIPI CSI0 Clock P (+)	Default Rear Camera, The MIPI data line traces should have a 85Ω ±15% differential impedance.
CSI0_CLK_N	78	AI	MIPI CSI0 Clock N (-)	
CSI0_LN0_P	79	AI	MIPI CSI0 Data0 P (+)	
CSI0_LN0_N	80	AI	MIPI CSI0 Data0 N (-)	
CSI0_LN1_P	81	AI	MIPI CSI0 Data1 P (+)	
CSI0_LN1_N	82	AI	MIPI CSI0 Data1 N (-)	
CSI0_LN2_P	83	AI	MIPI CSI0 Data2 P (+)	
CSI0_LN2_N	84	AI	MIPI CSI0 Data2 N (-)	
CSI0_LN3_P	85	AI	MIPI CSI0 Data3 P (+)	
CSI0_LN3_N	86	AI	MIPI CSI0 Data3 N (-)	
MCAM_MCLK	99	DO	CSI0 Clock Signal	
MCAM_PWD_N	73	DO	CSI0 Power Down Signal	
MCAM_RST_N	74	DO	CSI0 Reset Signal	
CSI2_CLK_P	183	AI	MIPI CSI2 Clock P (+)	Default Front Camera, The MIPI data line traces should have a 85Ω ±15% differential impedance. Divide into two cameras with a 2-Lane and an 1-Lane.
CSI2_CLK_N	184	AI	MIPI CSI2 Clock N (-)	
CSI2_LN0_P	185	AI	MIPI CSI2 Data0 P (+)	
CSI2_LN0_N	186	AI	MIPI CSI2 Data0 N (-)	
CSI2_LN1_P	187	AI	MIPI CSI2 Data1 P (+)	
CSI2_LN1_N	188	AI	MIPI CSI2 Data1 N (-)	
CSI2_LN2_P	189	AI	MIPI CSI2 Data2 P (+)	
CSI2_LN2_N	190	AI	MIPI CSI2 Data2 N (-)	
CSI2_LN3_P	191	AI	MIPI CSI2 Data3 P (+)	
CSI2_LN3_N	192	AI	MIPI CSI2 Data3 N (-)	
SCAM_MCLK	100	DO	CSI2 Clock Signal	
SCAM_PWD_N	71	DO	CSI2 Power Down Signal	
SCAM_RST_N	72	DO	CSI2 Reset Signal	
CAM_I2C_SCL0	75	OD	CSI2 I2C Clock	Only for the Camera. Highly recommend an external 2.2KR resistor pulling up to the LDO12A_1V8.
CAM_I2C_SDA0	76	OD	CSI2 I2C Data	
CSI1_CLK_P	88	AI	MIPI CSI1 Clock P (+)	Default 2nd Rear Camera, The MIPI data line traces should have a 85Ω ±15% differential impedance.
CSI1_CLK_N	89	AI	MIPI CSI1 Clock N (-)	
CSI1_LN0_P	90	AI	MIPI CSI1 Data0 P (+)	
CSI1_LN0_N	91	AI	MIPI CSI1 Data0 N (-)	
CSI1_LN1_P	92	AI	MIPI CSI1 Data1 P (+)	
CSI1_LN1_N	93	AI	MIPI CSI1 Data1 N (-)	

CSI1_LN2_P	94	AI	MIPI CSI1 Data2 P (+)	
CSI1_LN2_N	95	AI	MIPI CSI1 Data2 N (-)	
CSI1_LN3_P	96	AI	MIPI CSI1 Data3 P (+)	
CSI1_LN3_N	97	AI	MIPI CSI1 Data3 N (-)	
DCAM_MCLK	194	DO	CSI1 Clock Signal	
DCAM_RST_N	180	DO	CSI1 Reset Signal	
DCAM_PWD_N	181	DO	CSI1 Power Down Signal	
DCAM_I2C_SCL	196	OD	CSI1 I2C Clock	Only for the Camera. Highly recommend an external 2.2KR resistor pulling up to the LDO12A_1V8.
DCAM_I2C_SDA	197	OD	CSI1 I2C Data	
CAM4_MCLK	236	DO	Fourth Camera Clock Signal	
Key Interface				
VOL_UP	146	DI	Volume Up Key	1.8 V
VOL_DOWN	147	DI	Volume Down Key	1.8 V
PWRKEY	39	DI	Power Key	1.8 V
CBL_PWR_N	240	DI	Pull down for power on	1.8 V, Grounding this pin to boot up the system
Sensor Interface				
SENSOR_I2C_SCL	131	OD	External Sensor I2C Clock	1. Only for SENSOR. 2. Need external pull-ups.
SENSOR_I2C_SDA	132	OD	External Sensor I2C Data	
ACCL_INT	252	DI	Accelerate Sensor Interruption Pin	
GYRO_INT	255	DI	Gyroscope Sensor Interruption Pin	
MAG_INT	254	DI	Magnetic Sensor Interruption Pin	
ALPS_INT	253	DI	Light Sensor Interruption Pin	
Audio Interface				
MIC1_P	44	AI	Primary Microphone Input Positive	
MIC1_N	45	AI	Primary Microphone Input Negative	
MIC2_P	46	AI	Headphone Microphone Input Positive	
HS_DET	48	AI	Headphone Detection	
HPH_L	49	AO	Headphone Left-Channel	
HPH_REF	50	AI	Headphone Main Reference Ground	
HPH_R	51	AO	Headphone Right-Channel	
EAR_N	52	AO	Headphone Output Negative	

EAR_P	53	AO	Headphone Output Positive	
SPK_N	54	AO	Speaker Output Negative	
SPK_P	55	AO	Speaker Output Positive	
MIC_BIAS1	167	PO	Microphone Bias Voltage	
MIC3_N	168	AI	Denoise Microphone Input Negative	
MIC3_P	169	AI	Denoise Microphone Input Positive	
Radio Frequency Antenna Interface				
MAIN_ANT	19	AI/AO	Main Antenna Interface	
WIFI/BT_ANT	129	AI/AO	Wi-Fi/BT Antenna Interface	
GNSS_ANT	134	AI	GNSS Antenna Interface	
DRX_ANT	149	AI	DRX Antenna Interface	
UART Interface				
DBG_TXD	5	DO	Debug UART Transmitter	Only for Debug
DBG_RXD	6	DI	Debug UART Receiver	
UART03_TXD	7	DO	UART03 Transmitter	
UART03_RXD	8	DI	UART03 Receiver	
UART00_TXD	199	DO	UART00 Transmitter	
UART00_RXD	198	DI	UART00 Receiver	
UART00_RTS	245	DO	UART00 Request Receiver	
UART00_CTS	246	DI	UART00 Erase Transmitter	
ADC interface				
ADC0	151	AI	Common ADC Interface	Maximum ADC Voltage: 1.875 V
ADC1	153	AI		
Antenna Tuner Interface				
GRFC_36	242	DI/DO	Common RF Tuner	1. Only for RF Tuner. 2. Avoid pulling up the GRFC_36 when booting up.
GRFC_33	241	DI/DO	Common RF Tuner	
SPI Interface				
SPI10_CS	58	DO	SPI10 Select	1. Only Support Master Mode.
SPI10_CLK	59	DO	SPI10 Clock	
SPI10_MOSI	60	DO	SPI10 MOSI	
SPI10_MISO	61	DI	SPI10 MISO	
SPI13_CS	203	DO	SPI13 Select	1. Only Support Master Mode.
SPI13_CLK	250	DO	SPI13 Clock	
SPI13_MOSI	249	DO	SPI13 MOSI	
SPI13_MISO	251	DI	SPI13 主输入从输出	
Forced Download interface				
USB_BOOT	57	DI	USB Forced Boot Signal, Forced	Avoid an external pull up,

			connect to the LDO9A_1V8 Pin when booting up the device	Reserved Testing Points
GPIOs				
GPIO_95	113	DI/DO	Configurable GPIO	
GPIO_97	114	DI/DO	Configurable GPIO	
GPIO_26	136	DI/DO	Configurable GPIO	
GPIO_27	137	DI/DO	Configurable GPIO	
GPIO_115	154	DI/DO	Configurable GPIO	
GPIO_116	155	DI/DO	Configurable GPIO	
GPIO_114	156	DI/DO	Configurable GPIO	
GPIO_128	177	DI/DO	Configurable GPIO	
GPIO_127	178	DI/DO	Configurable GPIO	
GPIO_83	200	DI/DO	Configurable GPIO	
GPIO_84	201	DI/DO	Configurable GPIO	
GPIO_113	212	DI/DO	Configurable GPIO	
GPIO_117	213	DI/DO	Configurable GPIO	
GPIO_8	227	DI/DO	Configurable GPIO	
GPIO_9	228	DI/DO	Configurable GPIO	
GPIO_124	229	DI/DO	Configurable GPIO	
GPIO_123	230	DI/DO	Configurable GPIO	
GPIO_126	231	DI/DO	Configurable GPIO	
GPIO_125	232	DI/DO	Configurable GPIO	
GPIO_119	234	DI/DO	Configurable GPIO	
GPIO_85	237	DI/DO	Configurable GPIO	
GPIO_43	238	DI/DO	Configurable GPIO	
GPIO_130	247	DI/DO	Configurable GPIO	
GPIO_131	248	DI/DO	Configurable GPIO	
Other Interface				
DP_AUX_N	215	AIO	DP Auxiliary Channel N (-)	
DP_AUX_P	216	AIO	DP Auxiliary Channel P (+)	
DP_HPD	217	DI	DP Detection	Avoid pulling up when booting up the system.
USB_SS_SEL	226	DO	USB Super-Speed Channel Selection	
TP_B	211, 233	-	Disassembly Detection Pair	Connecting TP_B internally.
GNSS_LNA_EN	202	DO	External LNA Control Signal	If unused, keep it open.
Reserved PINs				
RESERVED	1,2,17,22~29, 102~111, 157, 214, 218, 220, 221, 235, 239,244			

NOTE

1、Highly recommend all the GND pins are connecting to the ground.
2、Highly recommend all the RESERVED and the unused pins disconnected.

3 Interface Applications

3.1 Power Supply

The VBAT Input power range of the SIM8971 module is 3.5V to 4.4V, and the typical voltage is 3.9V. The instantaneous peak current of the SIM8971 module could reach 3A. So, to enable the module is running smoothly, the power supply should be able to provide the peak current up to 3A. If the power supply is designed improperly, there would be a large voltage drop on the VBAT. The shutdown voltage of the SIM8971 module is 2.61V. If the voltage drop on the VBAT is lower than 2.61V, the module would power off.

3.1.1 Pin Overview

SIM8971x series module supports a single lithium battery power supply (4.2V or 4.35V battery cell). It also supports the other types of batteries. But the maximum voltage could not exceed the maximum allowance voltage of the module. Otherwise, the module would be burned.In terms of the non-battery power supply applications, the module would power by an LDO when the DC input is up to 5V. The reference design is showing in Figure 3.

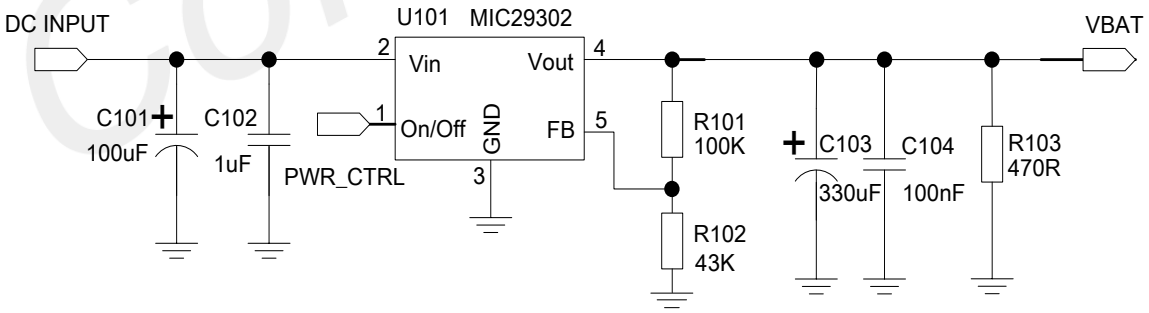


Figure 3: LDO Power Supply Reference Design

NOTE

Since the current consumption of the module is very small when powering off or sleeping. Highly recommend adding R103 as the minimum load to ensure the MIC29302 is working smoothly with the light load. Please refer to the MIC29302's specification for detailed information.

Highly recommend selecting a relative high efficiency switching power supply for hardware design when the difference between the input (DC Input) and the output (VBAT) is too large. The reference design is showing in Figure 4.

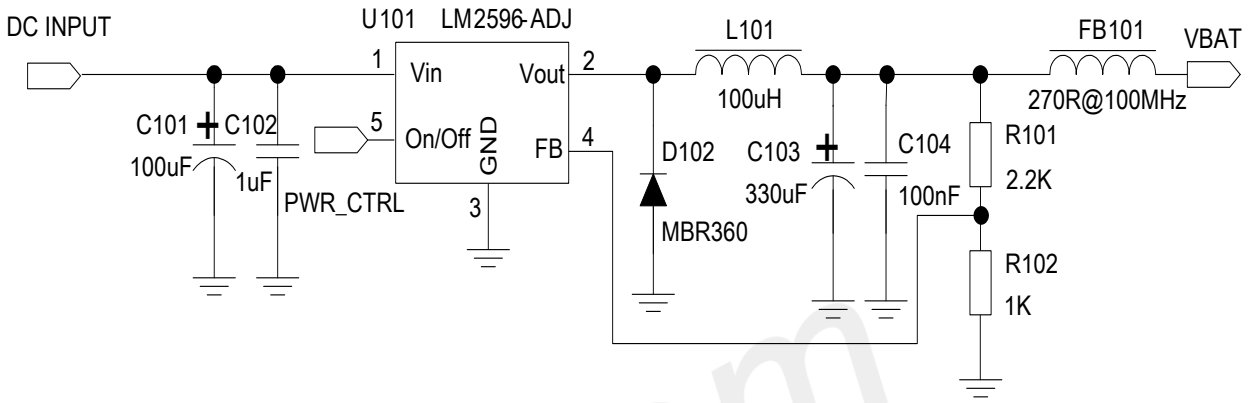


Figure 4: DC-DC Power Supply Reference Design

NOTE

1. Highly recommend disconnect the VBAT power supply to power off the module when the module is running abnormally. After that, restart the module by powering.

3.1.2 Power Supply Stability Design

Highly recommend place bypass capacitors and voltage stabilizing components near the VBAT Pin to enhance the stability of the power supply. The reference design is showing in the Figure 5.

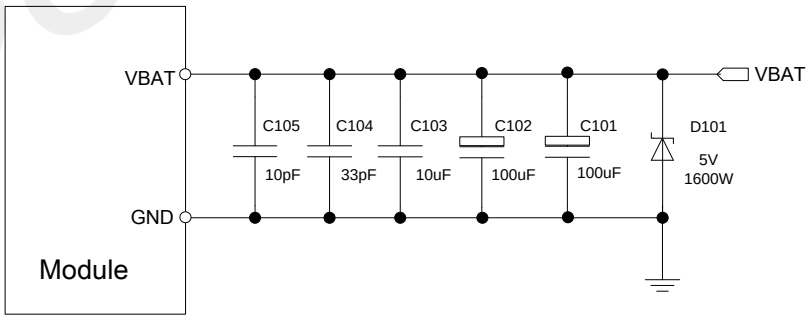


Figure 5: VBAT Input Reference Design

In Figure 5, C101 and C102 are two Low-ESR 100Uf tantalum capacitors. C103 is a 1uF to 10uF ceramic capacitor. The function of C104 and C105 is to decrease the high frequency interference. D101 is a 5V/1600W transient voltage suppression diode, preventing the chip from being damaged by surge. For PCB wiring, the capacitors and the diodes should be close to the VBAT Pin as far as possible, and the VBAT wiring should be as short as possible with the width at least 3mm.

Table 11: Recommended TVS Diode

	Vendor	Manufacture Number	Power(Watts)	Package
1	Prisemi	PTVSHC3N4V8U	3200W	DFN2×2-3L
2	Prisemi	PTVSHC2EN5VU	1600W	DFN1610-2L

3.2 Power On & Power Off

The on-off of the SIM8971x series module has two status, including the normal on-off and the abnormal on-off. In terms of the high- and low-pressure, and the high- and low-temperature, it should be working within the maximum power domain when running the module. Otherwise, exceeding the absolute maximum power domain would cause permanent damage to the module.

3.2.1 Power On

PWRKEY Pin defines as the boot-up key when the VBAT is powering on, and triggering PWRKEY with at least 2s low-level pulse starts the module. PWRKEY Pin has internal pull-up, and the typical high-level voltage is 1.8V. The reference design is showing as below.

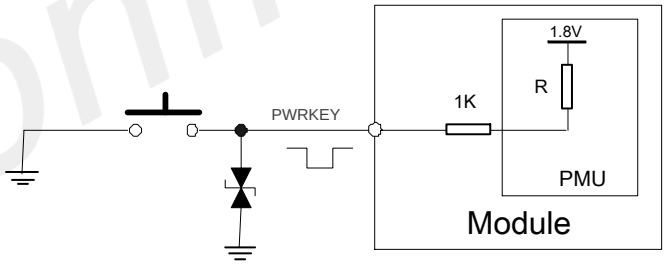


Figure 6: Power On/Off Design with a Key

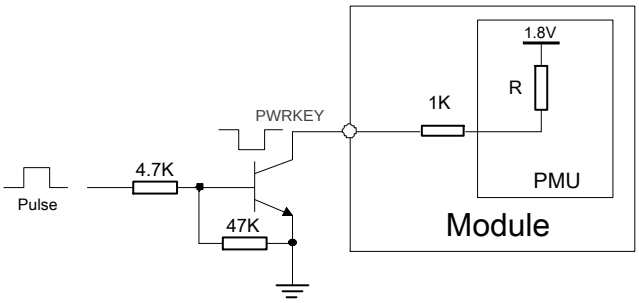


Figure 7: Power On/Off Design with an OC Gate

Highly recommend the customers consider the PWRKEY Pin's electrical characteristics when designing. The electrical characteristics are showing in Table 7.

Table 12: PWRKEY Features

Parameters	Description	Minimum	Typical	Maximum	Unit
V_{IH}	High-Level Input Voltage	1.4	-	-	V
V_{IL}	Low-Level Input Voltage	-	-	0.6	V

3.2.2 Power On Sequence

Figure 8 shows the power on sequence of the module.

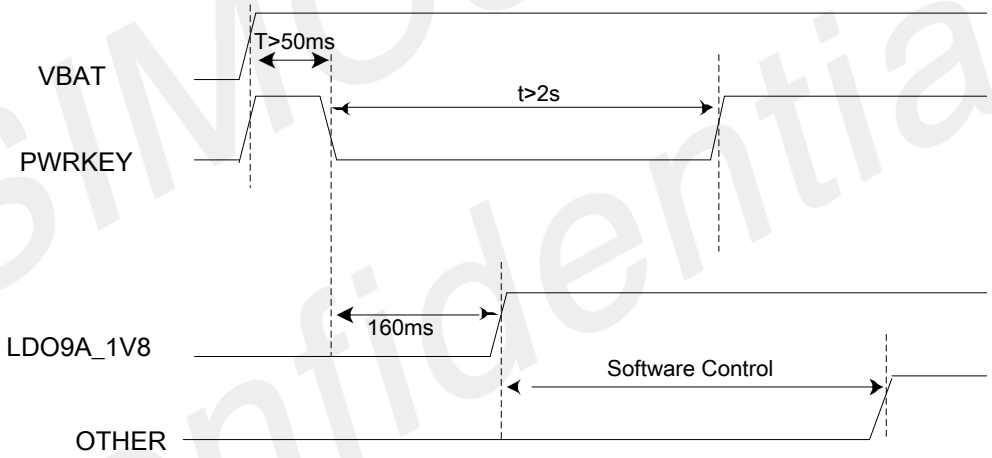


Figure 8: Power On Sequence

NOTE

Highly recommend pulling down the PWRKEY Pin when booting up the VBAT voltage at 3.8V stabilizing for at least 50ms. Do not pull down the PWRKEY Pin all the time.
Avoid pulling down the PWRKEY Pin.
Avoid pulling down the VOL_DOWN Pin.
Pulling down the VOL_DOWN Pin for 12-15s would trigger the hardware power off mode, then the system is restarting instantly.

3.2.3 Power Off

Pull down the PWRKEY Pin with at least 1s to power off the module. There is a pop up prompt window confirming the action of shutting down the device when the module detects the control instructions. Apart from that, pulling down the PWRKEY Pin with over 8s would be forced restart the module. Figure 9 shows the power off sequence.

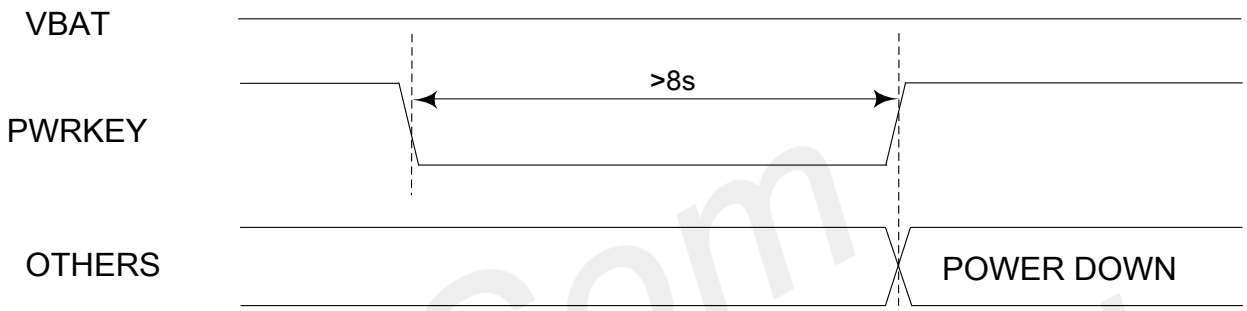


Figure 9: Power Off Sequence

Powering on and powering off are using the same pin, and they have the same reference design.

NOTE

1. The hardware design should cove the function of powering off the module. It is forbidden to run the module when powering off or restarting. Forced powering off the module adopts only when the module is running abnormally.
2. Highly recommend adding a low-cost microcontroller to control the PWRKEY. Not only for the normal powering on and powering off but also for the watchdog function to protect the operation system.
3. Do not cut off the VBAT power supply directly when the module is running smoothly. It is to protect the internal flash memory.
4. Highly recommend to power off the module by the PWRKEY Pin or the AT command before disconnecting the VBAT power supply.

3.3 Power On & Power Off

The VRTC is a standby power supply, connecting with a button battery or a large capacitor. VRTC would help to maintain the RTC timing when the VBAT is powering off. VRTC would also work as charging the button battery or a large capacitor when the VBAT is powering on.

- If the RTC fails, the RTC clock could be synchronized by connecting the data when the module is

powering on.

- Please refer to the Table 8 for VRTC characteristics.
- The input power domain for the VRTC voltage supply is 2.0V to 2.35V. The typical voltage is 3.0V. The average current consumption is 20uA when disconnecting the VBAT and connecting the RTC only.
- When powering on via the VBAT, the RTC working error is 50ppm. Switching the power supply mode of the VRTC Pin cause the RTC working error is 200ppm.
- Highly recommend the ESR of the button battery is less than 2K when connecting an external rechargeable button battery. Highly recommend to pick SEIKO's MS621FE FL11E.
- Highly recommend the ESR of the capacitor is 100uF when connecting an external large capacitor.

The reference designs for VRTC are showing below.

- **External Capacitor Power Supply for RTC**

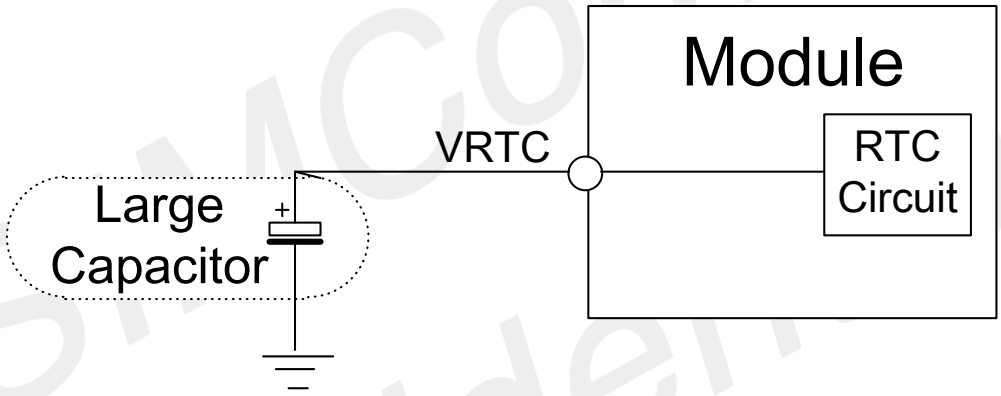


Figure 10: External Capacitor Power Supply for RTC

- **Non Rechargeable Battery Power Supply for RTC**

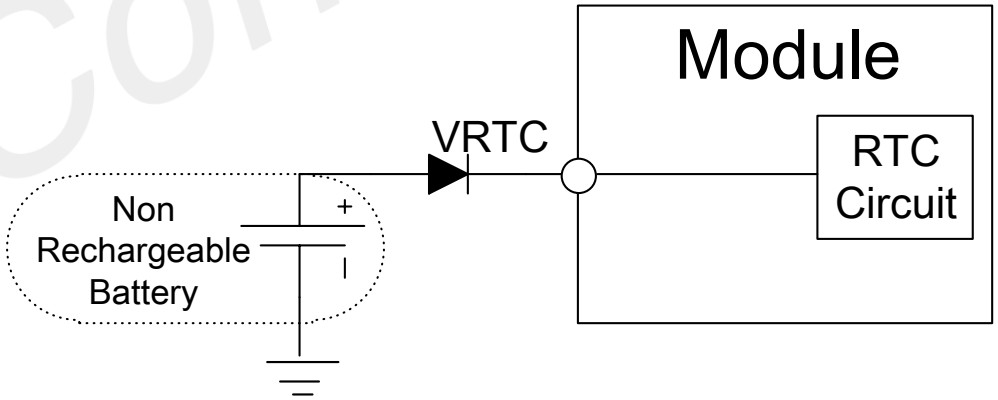


Figure 11: Non Rechargeable Battery Power Supply for RTC

- **Rechargeable Battery Power Supply for RTC**

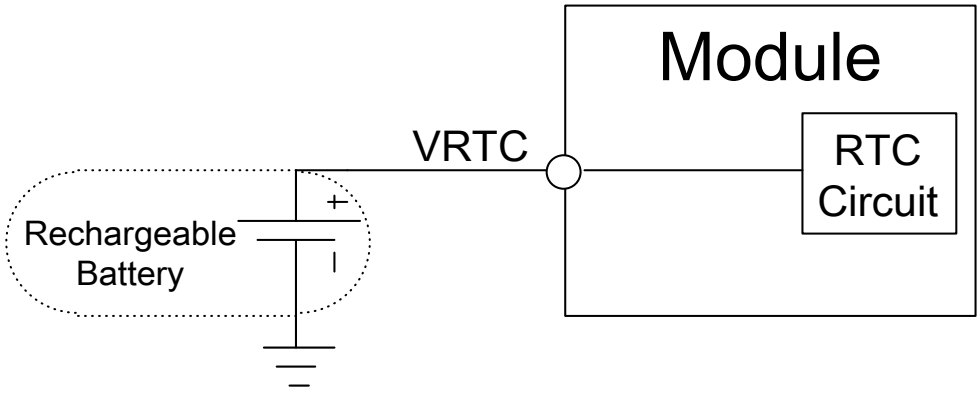


Figure 12: Rechargeable Battery Power Supply for RTC

The typical voltage of the VRTC is 3.0V. And the average current consumption is 20uA when disconnecting the VBAT and connecting the RTC only. The VRTC characteristics are showing in Table 8.

Table 13: VRTC Features

Parameters	Description	Minimum	Typical	Maximum	Unit
$VRTC_{-IN}$	VRTC Input Voltage	2.0	3.0	3.25	V
$T_{\text{- series resistance}}$	Standby Battery connecting in series resistor	800		2100	Ω
I_{RTC-IN}	VRTC Current Consumption （VBAT=0V）	-	20.0	-	uA
$VRTC_{-OUT}$	VRTC Output Voltage	2.5	3.1	3.2	V
$I_{RTC-OUT}$	VRTC Output Current	-		2	mA

NOTE

If the VBAT is connecting an external non-removable rechargeable battery, float the VRTC Pin. Also, the software should be modified to turn off the VRTC charging instructions.

3.4 Power Output

SIM8971x series module has 11 power outputs in total, which are suitable for a wide range of external interfaces and peripherals. Highly recommend a capacitor of 33pF and a capacitor of 10pF parallel connection to the ground, which could prevent high-frequency interference effectively.

Table 14: Power Definition

Power Name	PIN Num	Output Voltage (V)	Rated Current (mA)	Default on	Description
LDO9A_1V8	9	1.8V	20	ON	External Power and External GPIO pull up and the 1.8V power level conversion
LDO12A_1V8	10	1.8V	300	Off	Cameras and MIPI IOVDD(1.8V) Power
eLDO1_2V8	11	2.8	300	Off	2.8 V Power for sensors
eLDO2_2V85	12	2.85	300	Off	TP AVDD and LCD AVDD2.85V Power
LDO2C_1V1	13	1.1	800	Off	1.1 V Rear Camera DVDD
LDO3C_2V8	14	2.8	300	Off	2.8 V Camera AVDD
LDO1C_1V2	15	1.2	800	Off	1.2 V Front Camera DVDD
VRTC	16	2.0-3.25	-	ON	VRTC Power
VBAT	36, 37, 38	3.4-4.4	-	ON	Main Power
LDO14A_1V8	158	1.8	600	Off	1.8 V Power Output
LDO15A_3V128	222	3.128	150	Off	3.128 V Power Output

3.5 USB Interface

3.5.1 Micro-USB Interface and Type-C Interface

SIM8971x series module supports a USB interface, complying with USB 3.1/2.0 protocol and supporting USB OTG. The speed for the USB3.1 is up to 10Gbps, and for the USB 2.0 is up to 480Mbps. It is downward compatible with full speed (12Mbps) mode. USB_HS interface supports the function of the AT command transmission, of the data transmission, of the software debugging, and of the software upgrading.

Table 15: USB Interface

PIN Name	PIN Num	I/O	Description	Note
USB_VBUS	41, 42	PI/PO	USB Power Input	Vmin=4.35V Vnorm=5.0V Vmax=10V
USB_DP	32	AI/AO	USB HS Data P	The USB data line traces should have a 90Ω±10%
USB_DN	33	AI/AO	USB HS Data N	

				differential impedance.
SS_DIR_IN	21	DI	CC Detection Pin	1. Only for the USB function. 2. Connecting this PIN to the SS_DIR_OUT PIN when debugging with the Type-C. 3. Connecting the this PIN to the ground via a 4.7kΩ resistor when debugging with the Micro USB.
USB_CC2	223	AI/AO	USB Type-C CC2	
USB_CC1	224	AI/AO	USB Type-C CC1	
USB_SS1_RX_P	171	AI	USB 3.1 Lane1 Receiver P (+)	The USB data line traces should have a 90Ω±10% differential impedance.
USB_SS1_RX_M	172	AI	USB 3.1 Lane1 Receiver M (-)	
USB_SS1_TX_P	174	AO	USB 3.1 Lane1 Transmitter P (+)	The USB data line traces should have a 90Ω±10% differential impedance.
USB_SS1_TX_M	175	AO	USB 3.1 Lane1 Transmitter M (-)	
USB_SS2_RX_M	161	AI	USB 3.1 Lane2 Receiver M (-)	The USB data line traces should have a 90Ω±10% differential impedance.
USB_SS2_RX_P	162	AI	USB 3.1 Lane2 Receiver P (+)	
USB_SS2_TX_M	164	AO	USB 3.1 Lane2 Transmitter M (-)	The USB data line traces should have a 90Ω±10% differential impedance.
USB_SS2_TX_P	165	AO	USB 3.1 Lane2 Transmitter P (+)	

SIM8971x series module only supports Micro-USB or Type-C at one time due to different protocols. If the hardware configuration is connecting with Type-C, but the physical channel is running through the Micro-USB interface, the USB identification would run timeout.

Table 16: The Interface Configuration of the Micro-USB or the Type-C

PIN Name	PIN Num	Micro-USB	Type-C
SS_DIR_IN	21	4.7K Pull down to the Ground	Float

- **The Type-C Interface Reference Design**

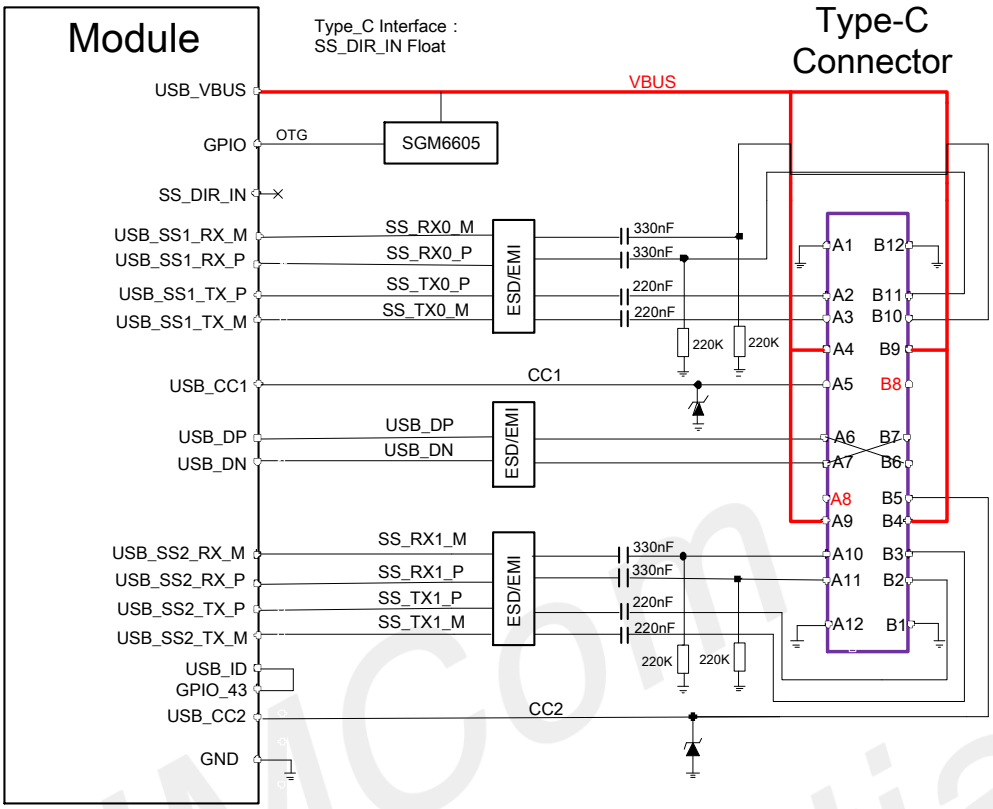


Figure 13: USB Type-C Connection Reference Design

- **The Micro-USB Interface Reference Design**

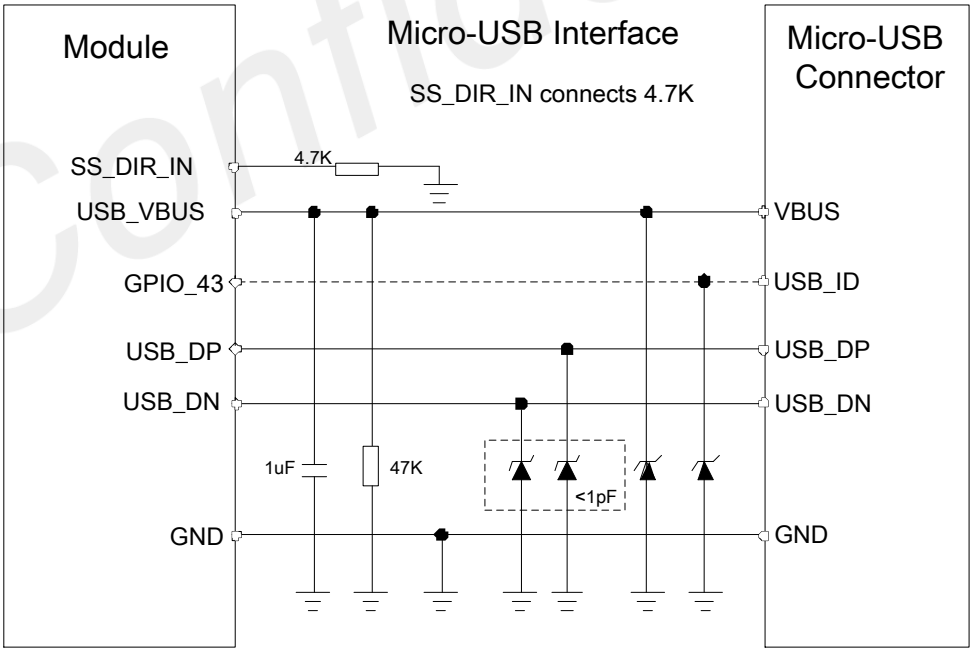


Figure 14: USB Micro-USB Connection Reference Design

3.5.2 Micro-USB Interface and Type-C Interface Feature

Table 17: DP and USB3.1 Type-C Compatible Pin Definition

PIN Name	PIN Num	USB Mode	Display Port Mode
USB_SS1_RX_P/M	171/172	USB_SS1_RX_P/M	DP_LANE3_P/M
USB_SS1_TX_P/M	174/175	USB_SS1_TX_P/M	DP_LANE2_P/M
USB_SS2_RX_P/M	162/161	USB_SS2_RX_P/M	DP_LANE0_P/M
USB_SS2_TX_P/M	165/164	USB_SS2_TX_P/M	DP_LANE1_P/M
DP_AUX_P/N	221/220	SBU1/2	DP_AUX_P/N
USB _DP/M	32/33	USB _DP/M	USB_HS_DP/M
USB_VBUS	41/42	VBUS	VBUS

- **The Type-C Interface with DP Function Reference Design**

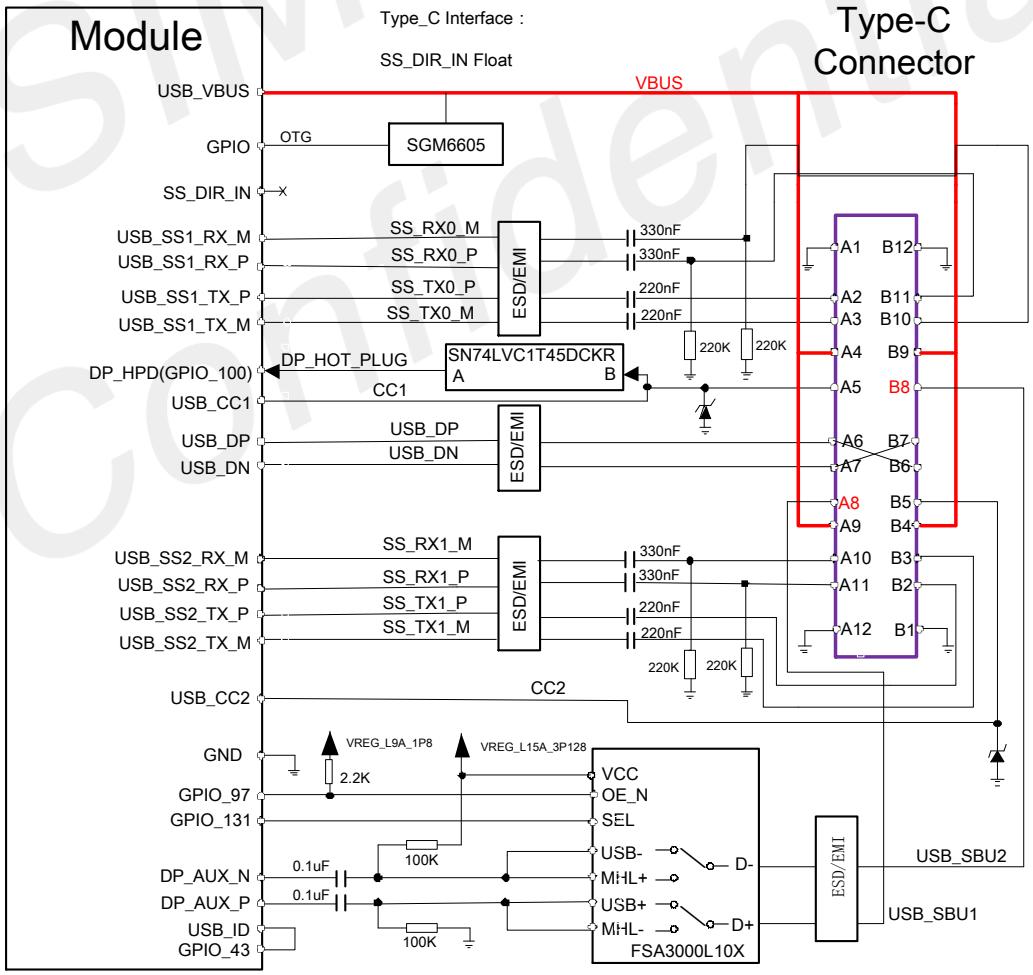


Figure 15: USB Type-C with DP Function Connection Reference Design

SIM8971x series module supports the 4-Lane DP interface, and it supports 1920X1200 displaying screen. Apart from that, it shares functional pins with the USB3.1 Type-C interface.

USB Mode: USB mode and DP mode could not work at the same time.

DP Mode: DP and USB2.0 could work properly at the same time. But not for the USB3.1. For the DP interface, the USB0_DP_AUX_P pin and the USB0_DP_AUX_M pin are needed in addition to the USB3.1 compatible pins.

Highly recommend disconnect the Type-C interface and the DP_AUX_P/N signals when running with the USB function. A switch is needed in this case. The switch is closing by default. The DP_EN_N output is active low when switching into the DP interface. The USBC_ORTENTAION output is active high when switching into the MHL channel.

PCB wiring protocols and hardware design notices for USB signals are listing below.

- Differential pair routing, 90+-10% differential impedance, and stereo ground plane are needed.
- Reserved ESD protection components close to the USB interface:
  Highly recommend the TVS junction capacitance value on the USB2.0 signal lines less than 2pF.
  Highly recommend the TVS junction capacitance value on the USB3.1 signal lines less than 0.5pF.
- Do not wiring the USB signals under the crystal oscillator, the oscillator, the magnetic devices, and the RF signals. Highly recommend routing in the inner layer and stereo ground plane.
- Highly recommend the USB2.0 signals, the USB3.1 TX signals, and the USB 3.1 RX signals are wiring as differential pairs separately. For DP displaying function, highly recommend the USB3.1 TX signals, the USB 3.1 RX signals, and the DP_AUX signals are wiring as differential pairs separately.

3.6 UART/SPI/I2C/I2S Interface

SIM8971x series module supports multiple sets of the UART, the I2C, the SPI, and the I2S. The combination of multiple interfaces is flexible and achievable by the configuration of GPIOs. The interface voltage is 1.8V.

3.6.1 UART/SPI/I2C Interface Multiplexing

Table 18: UART/SPI/I2C Interface Multiplexing Feature

Set	PIN Name	PIN Num	GPIO	Multiplex1 SPI	Multiplex2 UART	Multiplex3 I2C/I3C
1	UART00_CTS	246	GPIO_0	SPI00_MISO	UART00_CTS	I2C00_SDA
	UART00_RTS	245	GPIO_1	SPI00_MOSI	UART00_RTS	I2C00_SCL

	UART00_TXD	199	GPIO_2	SPI00_CLK	UART00_TXD	
	UART00_RXD	198	GPIO_3	SPI00_CS	UART00_RXD	
2	TP_I2C_SDA	206	GPIO_6	SPI02_MISO	UART02_CTS	TP_I2C_SDA
	TP_I2C_SCL	140	GPIO_7	SPI02_MOSI	UART02_RTS	TP_I2C_SCL
	GPIO_8	227	GPIO_8	SPI02_CLK	UART02_TXD	
	GPIO_9	228	GPIO_9	SPI02_CS	UART02_RXD	
3	UART03_TXD	7	GPIO_14		UART03_TXD	I2C03_SDA
	UART03_RXD	8	GPIO_15		UART03_RXD	I2C03_SCL
4	DBG_TXD	5	GPIO_16		DBG_TXD	I2C04_SDA
	DBG_RXD	6	GPIO_17		DBG_RXD	I2C04_SCL
5	SPI13_MISO	251	GPIO_18	SPI13_MISO		
	SPI13_MOSI	249	GPIO_19	SPI13_MOSI		
	SPI13_CLK	250	GPIO_20	SPI13_CLK		
	SPI13_CS	203	GPIO_21	SPI13_CS		
6	SPI10_MISO	61	GPIO_22	SPI10_MISO	UART10_CTS	I2C10_SDA
	SPI10_MOSI	60	GPIO_23	SPI10_MOSI	UART10_RTS	I2C10_SCL
	SPI10_CLK	59	GPIO_24	SPI10_CLK	UART10_TXD	
	SPI10_CS0	58	GPIO_25	SPI10_CS0	UART10_RXD	
7	SENSOR_I2C_SDA	132	GPIO_28			SENSOR_I2C_SDA
	SENSOR_I2C_SCL	131	GPIO_29			SENSOR_I2C_SCL
8	I2C11_SDA	204	GPIO_30			I2C11_SDA
	I2C11_SCL	205	GPIO_31			I2C11_SCL
9	CAM_I2C_SDA0	76	GPIO_37			CAM_I2C_SDA0
	CAM_I2C_SCL0	75	GPIO_38			CAM_I2C_SCL0
	DCAM_I2C_SDA	197	GPIO_39			DCAM_I2C_SDA
	DCAM_I2C_SCL	196	GPIO_40			DCAM_I2C_SCL

- SIM8971x series module defines the default configuration for these pins highlighting in green. Please consult SIMCom staff to review the reference design and functions for these pins.
- SIM8971x series module supports 4 sets of SPI, 5 sets of UART, and 7 sets of I2C (excluding camera's I2C). Choosing only one function among the SPI, the UART, and the I2C in the same bus set. For example, the I2C10 and the UART10 (TX/RX) could not function well at the same time.
- Highly recommend an external 2.2KR resister pulling up to the 1.8V power supply for I2C.
- Do not reuse the Debug GPIO16 and GPIO17.
- SPI interface could support the working frequency up to 50MHz.

3.6.2 UART Voltage Level Shift Circuit

SIM8971x series module supports up to 5 sets of the UART interfaces, including the 2 sets of the 2-Lane

interface, and the Debug UART for debugging. The other 4 sets of the 4-Lane interface support the hardware flow control with the speed up to 4Mbps. The interface voltage for UART on the SIM8971x series module is 1.8V. Taking a voltage level shift chip for voltage switching if needed. Highly recommend pick TI's TXS0104EPWR, and the reference design is showing in the following Figures.

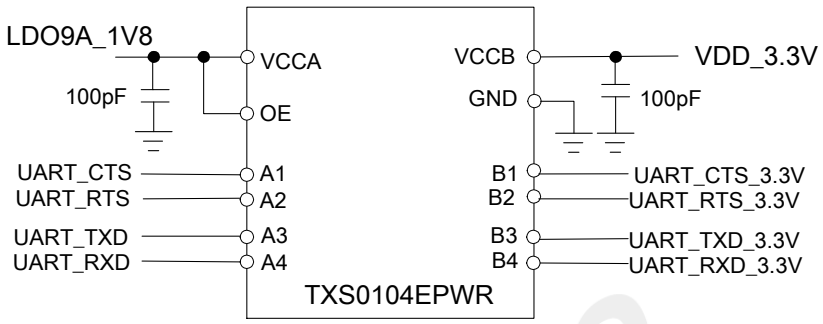


Figure 16: UART Voltage Level Shift Reference Design

The compatible reference design is showing below.

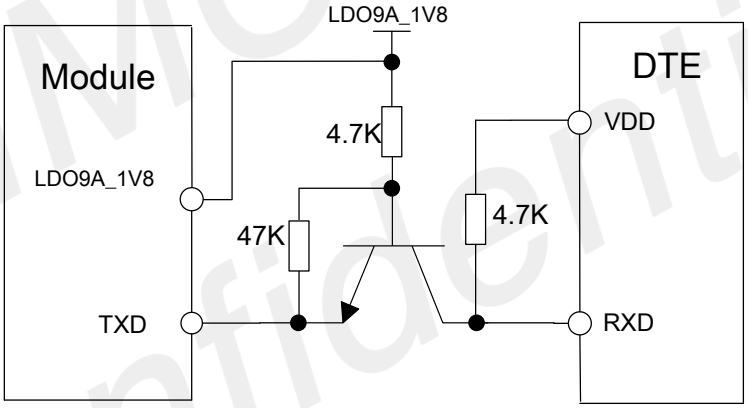


Figure 17: TX Voltage Level Shift Reference Design

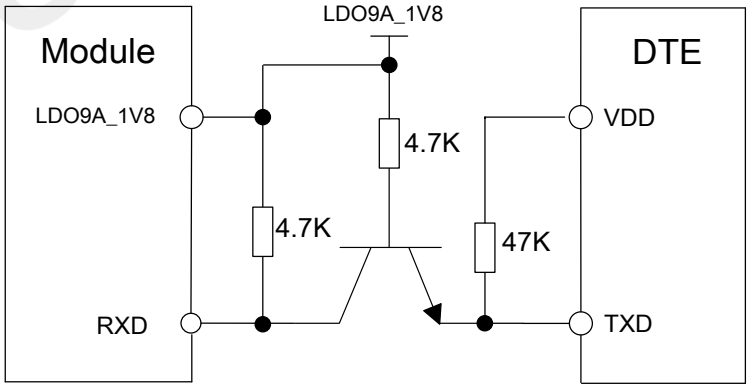


Figure 18: RX Voltage Level Shift Reference Design

3.6.3 SPI Interface

SIM8971x series module supports up to 4 sets of the SPI interfaces. They only support the host mode, and the highest working frequency is 50MHz.

Table 19: Recommend SPI Interface

PIN Name	PIN Num	Multiplex	I/O	Description	Notes
UART00_RXD	198	SPI00_CS	DO	SPI Chip Select Signal	
UART00_TXD	199	SPI00_CLK	DO	SPI Clock Signal	
UART00_RTS	245	SPI00_MOSI	DO	SPI Data Output Signal	
UART00_CTS	246	SPI00_MISO	DI	SPI Data Input Signal	
SPI10_CS	58		DO	SPI Chip Select Signal	
SPI10_CLK	59		DO	SPI Clock Signal	
SPI10_MOSI	60		DO	SPI Data Output Signal	
SPI10_MISO	61		DI	SPI Data Input Signal	
SPI13_CS	203		DO	SPI Chip Select Signal	
SPI13_CLK	250		DO	SPI Clock Signal	
SPI13_MOSI	249		DO	SPI Data Output Signal	
SPI13_MISO	251		DI	SPI Data Input Signal	

3.6.4 I2C Interface

SIM8971x series module supports up to 9 sets of the I2C interfaces, but only open the following 5 sets of the I2C interfaces by default. They only support the host mode, and the highest speed is 400Kbps. Highly recommend an external 2.2KR resister pulling up to the 1.8V power supply for I2C.

Table 20: Recommend I2C Interface

PIN Name	PIN Num	I/O	Pull Up Voltage	Description	Notes
TP_I2C_SDA	206	OD	LDO9A_1V8	TP I2C Data Signal	For TP
TP_I2C_SCL	140	OD	LDO9A_1V8	TP I2C Clock Signal	
CAM_I2C_SDA0	76	OD	LDO12A_1V8	Camera I2C Data	For Cameras
CAM_I2C_SCL0	75	OD	LDO12A_1V8	Camera I2C Clock	
DCAM_I2C_SDA	197	OD	LDO12A_1V8	Camera I2C Data	For Cameras
DCAM_I2C_SCL	196	OD	LDO12A_1V8	Camera I2C Clock	
SENSOR_I2C_SDA	132	OD	LDO9A_1V8	External Sensor I2C Data	For Sensors
SENSOR_I2C_SCL	131	OD	LDO9A_1V8	External Sensor I2C Clock	

3.6.5 I2S Interface

SIM8971x series module supports 2 sets of the I2S interfaces. It supports the input- mode, the output-mode, and the host-/device-mode. The definition is showing in Table 16.

Table 21: Recommend I2S Interface

PIN Name	PIN Num	Multiplex I2S	I/O	Description	Notes
I2S1_SCK	232		DO	I2S1 Clock	
I2S1_WS	231		DO	I2S1 Word Select	
I2S1_DATA0	178		DI/DO	I2S1 Data0	
I2S1_DATA1	177		DI/DO	I2S1 Data1	
I2S2_SCK	251		DO	I2S2 Clock	
I2S2_WS	249		DO	I2S2 Word Select	
I2S2_DATA0	250		DI/DO	I2S2 Data0	
I2S2_DATA1	203		DI/DO	I2S2 Data1	

3.7 SD Card Interface

SIM8971x series module supports SD 3.0/MMC cards with 4-Bit data interface or SDIO 3.0 devices. The SD cards comply with the following protocols.

- SD Specifications Part 1 Physical Layer Specification Version 3.00
- Part A2 SD Host Controller Standard Specification Version 3.00
- Part E1 SDIO Specification Version 3.00

Table 22: Recommend I2S Interface

PIN Name	PIN Num	I/O	Description	Notes
SD_VDD	63	PO	SD Card Power Supply	Vnorm=2.95V Maximum Current Output at 600mA
SD_PU_VDD	179	PO	SD Card Pull up Power, 1.8V/2.95V Dual Voltage	Maximum Current Output at 50mA
SD_CLK	70	DO	SDIO Clock	The SDIO data line traces should have a 50Ω±10% differential
SD_CMD	69	DI/DO	SDIO Command	
SD_DATA0	68	DID/O	SDIO Data0	

SD_DATA1	67	DI/DO	SDIO Data1	impedance.
SD_DATA2	66	DI/DO	SDIO Data2	
SD_DATA3	65	DI/DO	SDIO Data3	
SD_DET_N	64	DI	SD Card Detection	1. Default Low Active Detection. 2. Pull up to the LDO9A_1V8.

The reference design for SD card is showing in the Figure 19.

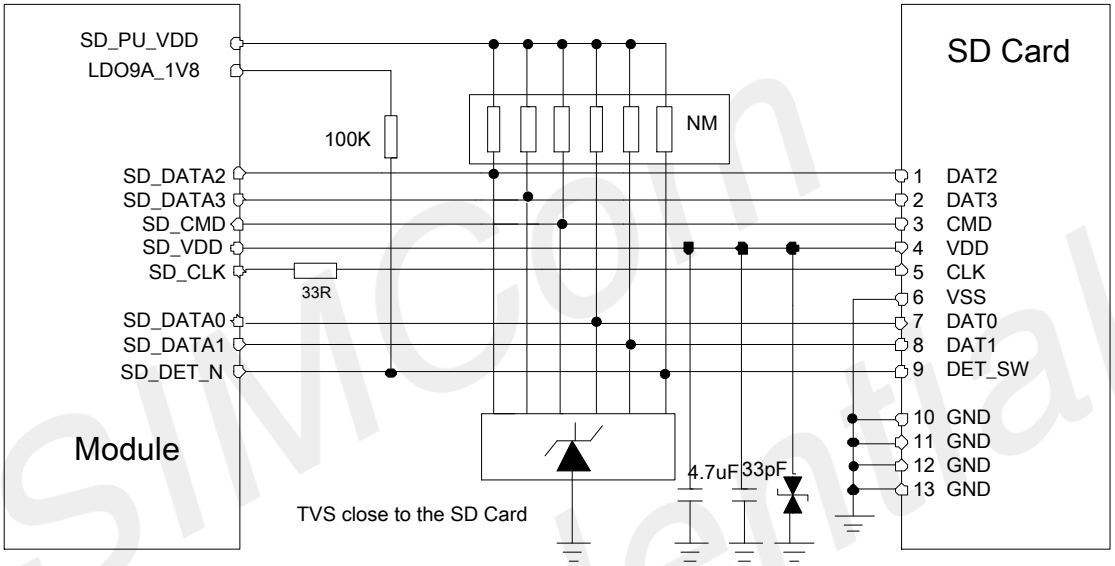


Figure 19: SD Card Reference Design

NOTE

SD_VDD is a fixed 2.96V power output.
Highly recommend avoiding pull up the SDC2 signal lines to the SD_VDD.
Refer to chapter 4 for PCB design rules.

3.8 TP Interface

SIM8971x series module provides an I2C interface, an interruption function pin, and a reset pin, connecting the touching panel to operate.

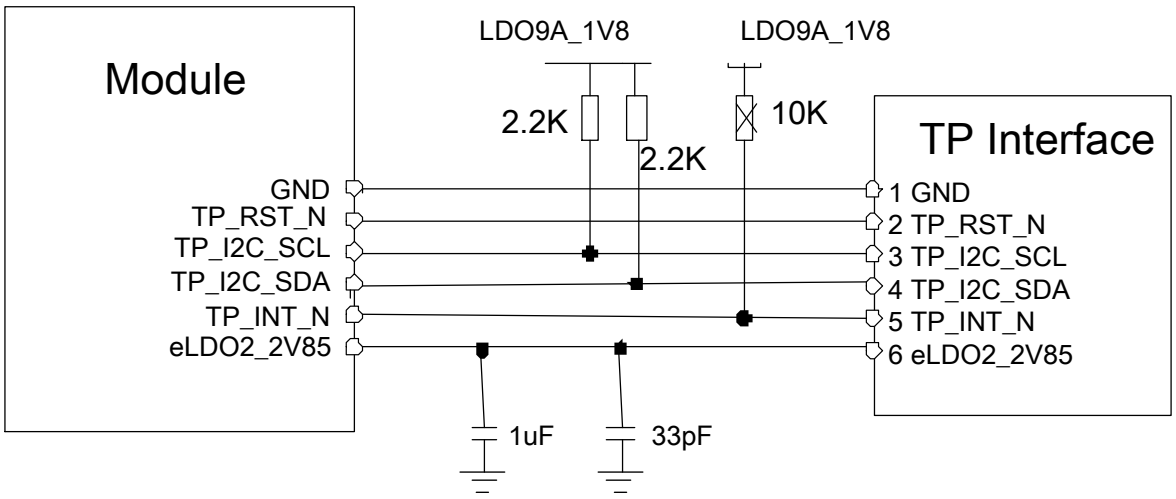


Figure 20: TP Interface Reference Design

NOTE

Highly recommend an external 2.2KR resister pulling up to the 1.8V power supply for TP I2C.

3.9 LCD Interface

SIM8971x series module's video output interface meets the requirements of MIPI_DSI standard. It has a 4-Lane DSI DPHY 1.2 interface with the speed up to 1.5Gbps. It also supports dual screen display with the maximum resolution of 2520*1080 (FHD+). Apart from that, the SIM8971x series module supports displaying screen with display port protocol via the USB Type-C interface.

The PWM pin of the module could control the backlight brightness by software configuration.

Table 23: Recommend I2S Interface

PIN Name	PIN Num	I/O	Description
DSI_CLK_P	115	AO	LCD MIPI Signal
DSI_CLK_N	116	AO	
DSI_LN0_P	117	AI/AO	
DSI_LN0_N	118	AI/AO	
DSI_LN1_P	119	AI/AO	
DSI_LN1_N	120	AI/AO	
DSI_LN2_P	121	AI/AO	
DSI_LN2_N	122	AI/AO	

DSI_LN3_P	123	AI/AO	
DSI_LN3_N	124	AI/AO	
LDO9A_1V8	9	PO	LCM IO 1.8V Power Supply
eLDO2_2V85	12	PO	LCM VCC 2.85V Power Supply
PWM	152	DO	Backlight PWM Control Signal
LCD_RST	127	DO	LCD Reset Signal
LCD_TE	126	DI	LCD Tearing Effect Signal

The MIPI signal lines are high-speed signal lines. Highly recommend place a common mode inductor close to the LCM to avoiding EMI interference. Float the MIPI_Lane2 and the MIPI_Lane3 when the LCM only has 2-Lane differential pair data signals. Highly recommend adopting the module's integrated reference circuits if the LCD interface has no bias voltage hardware design. Notice that the positive bias voltage and the negative bias voltage of the LCD are between the LCD_VSN and the LCD_VSP of the module. The reference design is showing in the Figure 21.

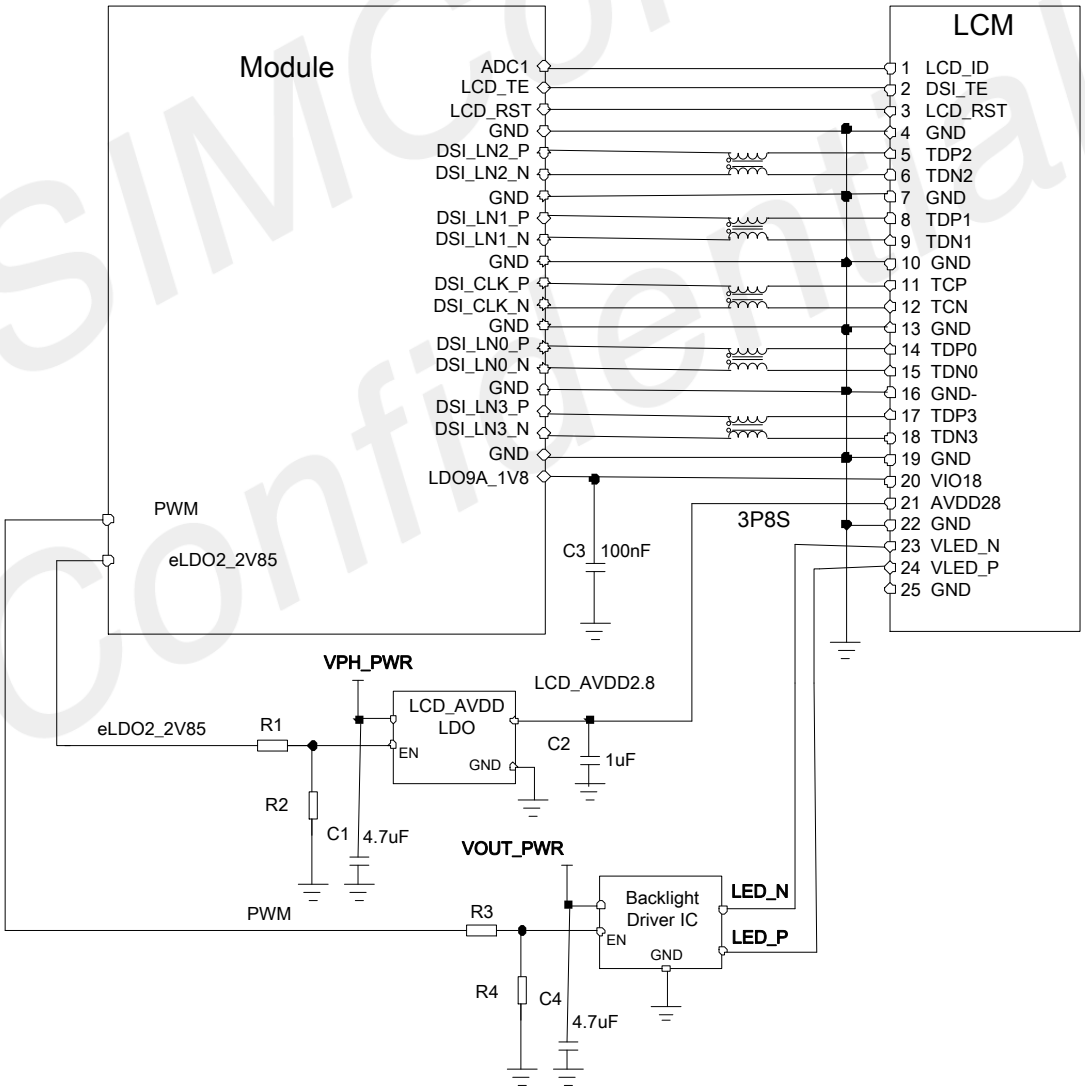


Figure 21: LCD Interface & the Backlight Reference Design

3.10 Camera Interface

SIM8971x series module's video input interface meets the requirements of MIPI_CSI standard.

- 3 sets of 4-Lane CSI interfaces.
  Support 3 (4-Lane + 4-Lane + 4-Lane) cameras or
  Support 4 (4-Lane + 4-Lane + 2-Lane + 1-Lane) cameras.
- Selectable on in the following two settings.
  Support DPHY 1.2 with the speed up to 1.5Gbps/Lane or
  Support CPHY 1.0 with the speed up to 10.26Gbps(total).
- Support dual image signal processing (ISP) with the resolution up to 25M pixels (dual ISP). The maximum capacity of each ISP is 16M pixels. Only support one when the ISP is over 16M pixels.
- Support 4-Lane MCLKs, 2-Lane CCI I2C interfaces, and the GPIOs with different functions.

3.10.1 CPHY & DPHY Interface of the Cameras

SIM8971x series module supports CPHY 1.0. The difference between the CPHY and the DPHY are the different effective transmission mode. CPHY enables the data transmission speed faster through the following technical improvements. Firstly, CPHY converts the original 2-Lane group transmission of DPHY into 3-Lane group transmission. Then, CPHY does not need the Clock lane. The two are compatible in pin definitions.

Table 24: Camera Interface Definition

PIN Name	PIN Num	I/O	Description	Notes
LDO2C_1V1	13	PO	Rear Camera DVDD 1.1V	Maximum Current 800mA
LDO12A_1V8	10	PO	Camera VDDIO 1.8V	I2C Pull-up Power Maximum Current 300mA
eLDO2_2V85	12	PO	Camera VCM 2.85V Power	Maximum Current 300mA
LDO3C_2V8	14	PO	Camera AVDD 2.8V Power	Maximum Current 300mA
LDO1C_1V2	15	PO	Front Camera DVDD 1.2V	Maximum Current 800mA
CSI1_CLK_P	88	AI	CAMERA1 MIPI Signal 2nd Rear Camera	
CSI1_CLK_N	89	AI		
CSI1_LN0_P	90	AI/AO		
CSI1_LN0_N	91	AI/AO		
CSI1_LN1_P	92	AI/AO		
CSI1_LN1_N	93	AI/AO		
CSI1_LN2_P	94	AI/AO		
CSI1_LN2_N	95	AI/AO		
CSI1_LN3_P	96	AI/AO		

CSI1_LN3_N	97	AI/AO		
CSI2_CLK_P	183	AI	CAMERA2 MIPI Signal Front Camera	Multiplex Configurable Differential Data Lanes for the fourth Camera
CSI2_CLK_N	184	AI		
CSI2_LN0_P	185	AI/AO		
CSI2_LN0_N	186	AI/AO		
CSI2_LN1_P	187	AI/AO		
CSI2_LN1_N	188	AI/AO		
CSI2_LN2_P	189	AI/AO		
CSI2_LN2_N	190	AI/AO		
CSI2_LN3_P	191	AI/AO		
CSI2_LN3_N	192	AI/AO		
CSI0_CLK_P	77	AI	CAMERA0 MIPI Signal Rear Camera	
CSI0_CLK_N	78	AI		
CSI0_LN0_P	79	AI/AO		
CSI0_LN0_N	80	AI/AO		
CSI0_LN1_P	81	AI/AO		
CSI0_LN1_N	82	AI/AO		
CSI0_LN2_P	83	AI/AO		
CSI0_LN2_N	84	AI/AO		
CSI0_LN3_P	85	AI/AO		
CSI0_LN3_N	86	AI/AO		
MCAM_RST_N	74	DO	Rear Camera Reset	1.8V Power Domain
MCAM_PWD_N	73	DO	Rear Camera Power Down	1.8V Power Domain
SCAM_RST_N	72	DO	Front Camera Reset	1.8V Power Domain
SCAM_PWD_N	71	DO	Front Camera Power Down	1.8V Power Domain
CAM_I2C_SDA0	76	OD	Camera I2C Data	1.8V Power Domain
CAM_I2C_SCL0	75	OD	Camera I2C Clock	1.8V Power Domain
SCAM_MCLK	100	DO	Front Camera Clock	1.8V Power Domain
MCAM_MCLK	99	DO	Rear Camera Clock	1.8V Power Domain
DCAM_MCLK	194	DO	2nd Rear Camera Clock	1.8V Power Domain
CAM4_MCLK	236	DO	Fourth Camera Clock	1.8V Power Domain
DCAM_RST_N	180	DO	2nd Rear Camera Reset	1.8V Power Domain
DCAM_PWD_N	181	DO	2nd Rear Camera Power Down	1.8V Power Domain
DCAM_I2C_SDA	197	OD	Camera I2C Data	1.8V Power Domain
DCAM_I2C_SCL	196	OD	Camera I2C Clock	1.8V Power Domain

Table 25: DPHY & CPHY PIN Definition

CSIx PHY（1 of 3）	DPHY	CPHY
Lane0	MIPI_CSIx_DCLK_P	/
	MIPI_CSIx_DCLK_N	MIPI_CSIx_TLN0_A

Lane1	MIPI_CSIx_DLN0_P	MIPI_CSIx_TLN0_B
	MIPI_CSIx_DLN0_N	MIPI_CSIx_TLN0_C
Lane2	MIPI_CSIx_DLN1_P	MIPI_CSIx_TLN1_A
	MIPI_CSIx_DLN1_N	MIPI_CSIx_TLN1_B
Lane3	MIPI_CSIx_DLN2_P	MIPI_CSIx_TLN1_C
	MIPI_CSIx_DLN2_N	MIPI_CSIx_TLN2_A
Lane4	MIPI_CSIx_DLN3_P	MIPI_CSIx_TLN2_B
	MIPI_CSIx_DLN3_N	MIPI_CSIx_TLN2_C

Figure 22 shows the application diagram of the CSI interface. It is a combination configuration, including 4 DPHY sensors, 3 CPHY sensors, a DPHY sensor, and a CPHY sensor. Note that CSI2 could be split into two cameras (2-Lane + 1-Lane or 1-Lane + 1-Lane). The following applications are flexible.

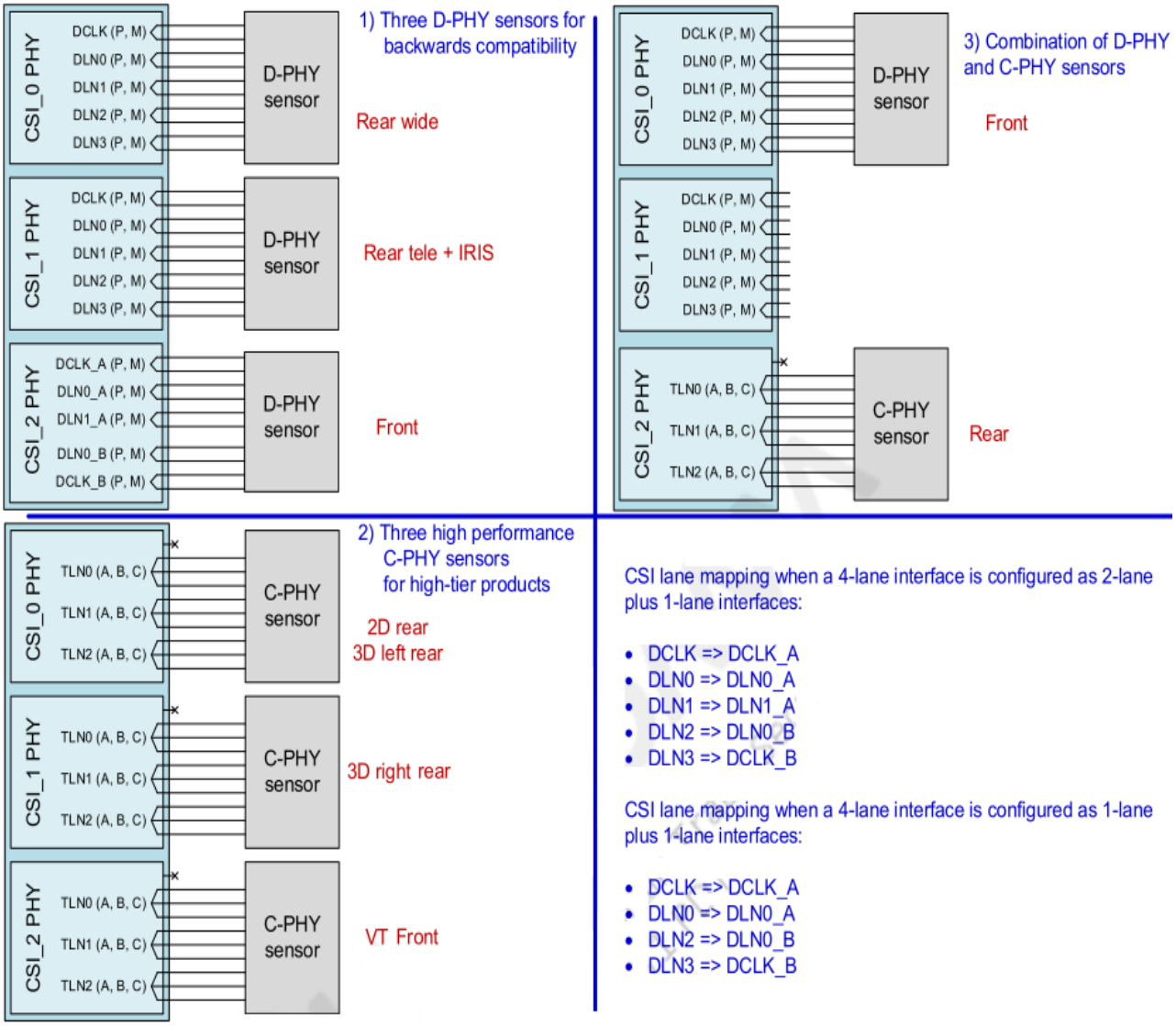


Figure 22: CPHY & DPHY Interface Applications

3.10.2 DPHY Applications

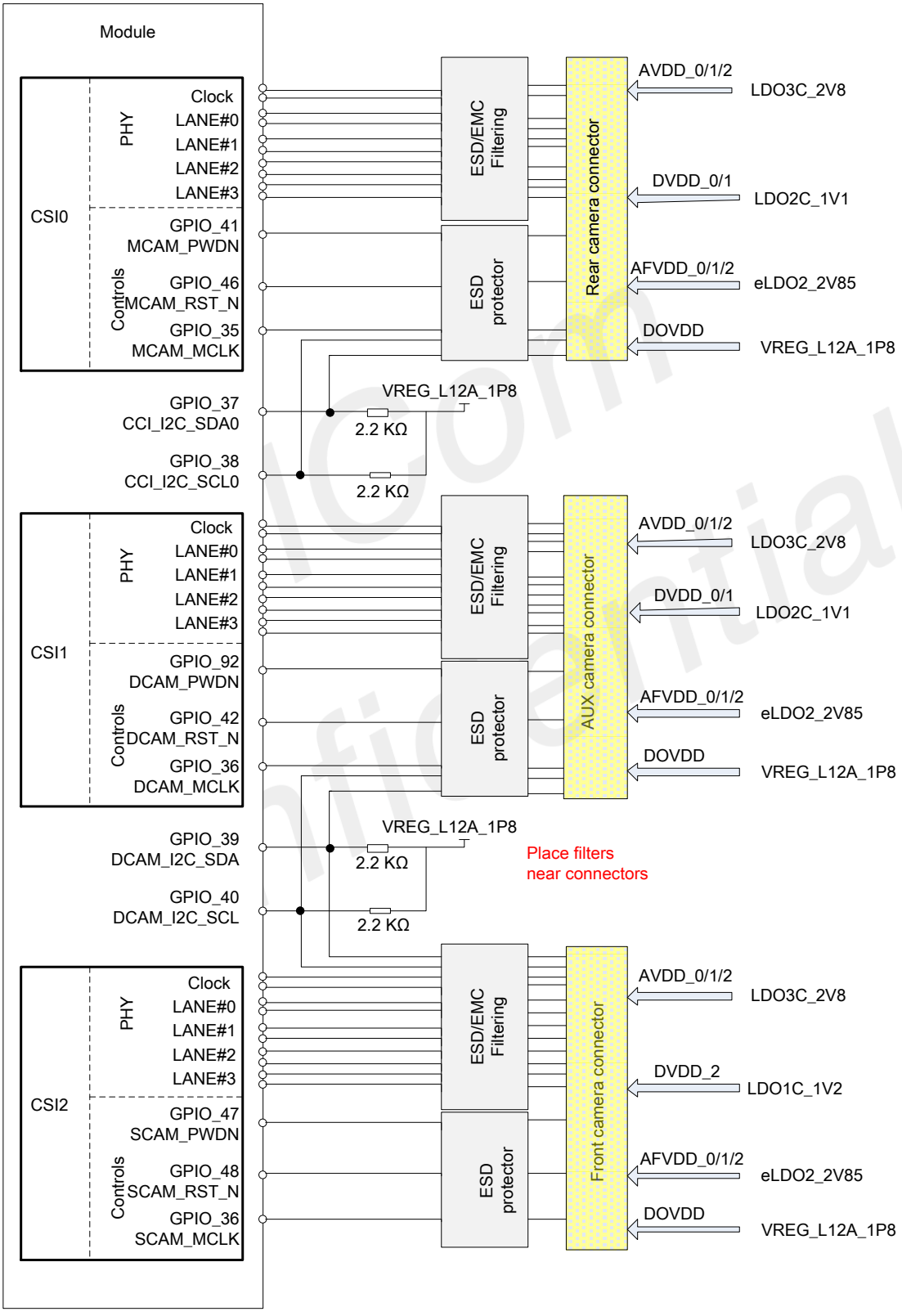


Figure 23: Three sets of MIPI-CSI Interface Applications

3.11 Audio Interface

SIM8971x series module supports three analog audio inputs, including the MIC1 differential pair interface for the master microphone, the MIC3 differential pair interface for the denoising microphone, and the MIC2 single ended interface for the audio jack.

- Three-Channel analog audio output interface.
  Handset.
  Headphone.
  Speaker.
- Two-Channel digital microphone interface.
  Support 4 digital microphones.

Table 26: DPHY & CPHY PIN Definition

PIN Name	PIN Num	I/O	Description
SPK_P	55	AO	Speaker Output Positive
SPK_N	54	AO	Speaker Output Negative
EAR_P	53	AO	Handset Output Positive
EAR_N	52	AO	Handset Output Negative
HPH_L	49	AO	Headphone Left Channel
HPH_REF	50	AI	Headphone Reference Ground
HPH_R	51	AO	Headphone Right Channel
HS_DET	48	AI	Headphone Detection
MIC2_P	46	AI	MIC2 Positive
MIC1_N	45	AI	MIC1 Negative
MIC1_P	44	AI	MIC1 Positive
MIC3_N	168		MIC3 Negative
MIC3_P	169	AI	MIC3 Positive
MIC_BIAS1	167	PO	MIC Bias

3.11.1 Microphone Interface

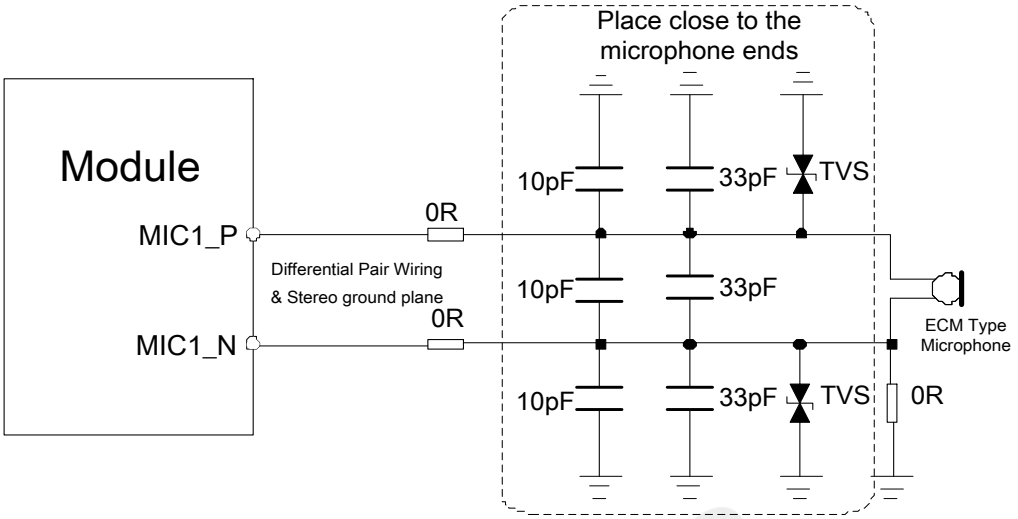


Figure 24: ECM Type Microphone Reference Design

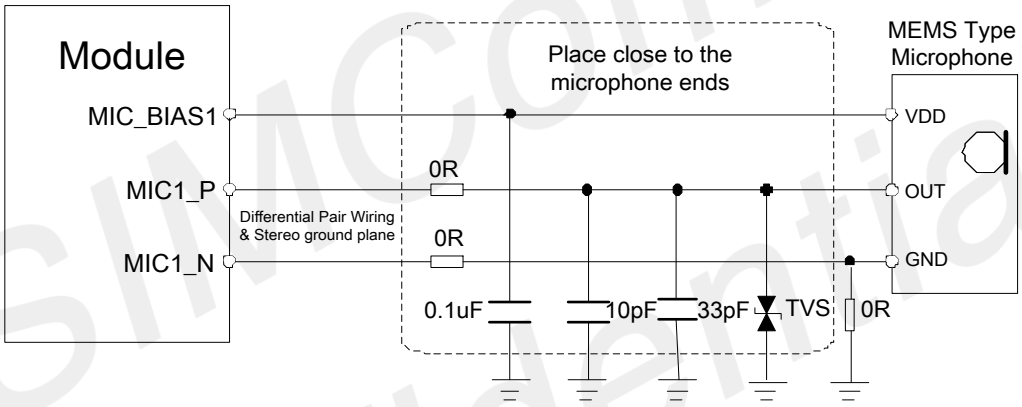


Figure 25: MEMS Type Microphone Reference Design

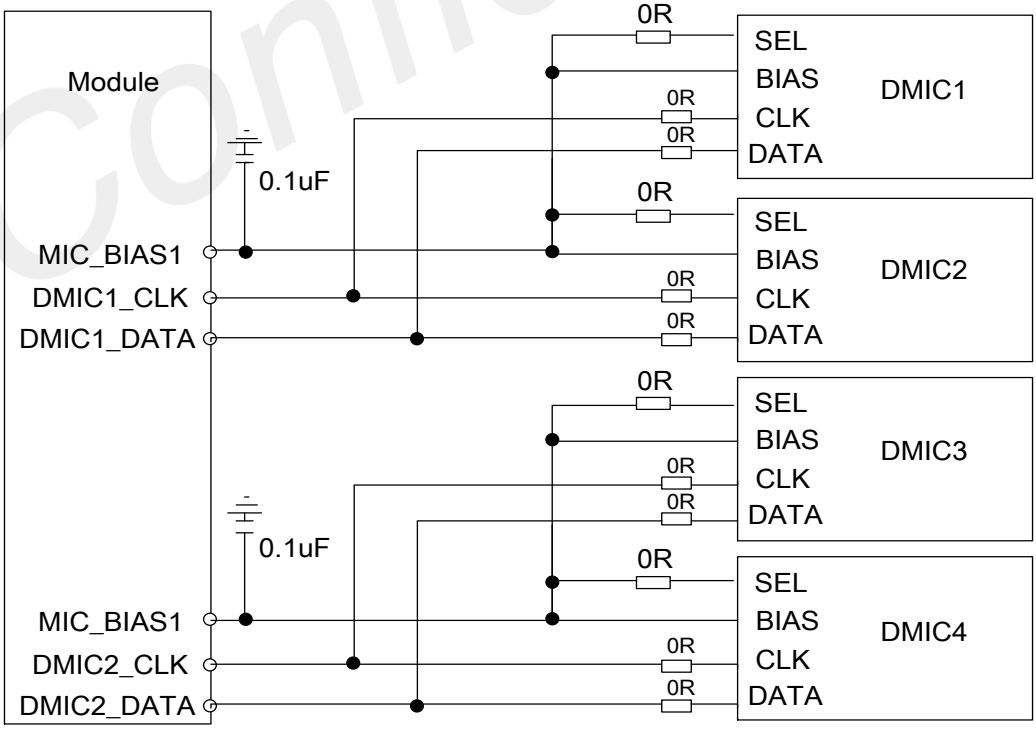


Figure 26: Digital Microphone Reference Design

3.11.2 Headphone Interface

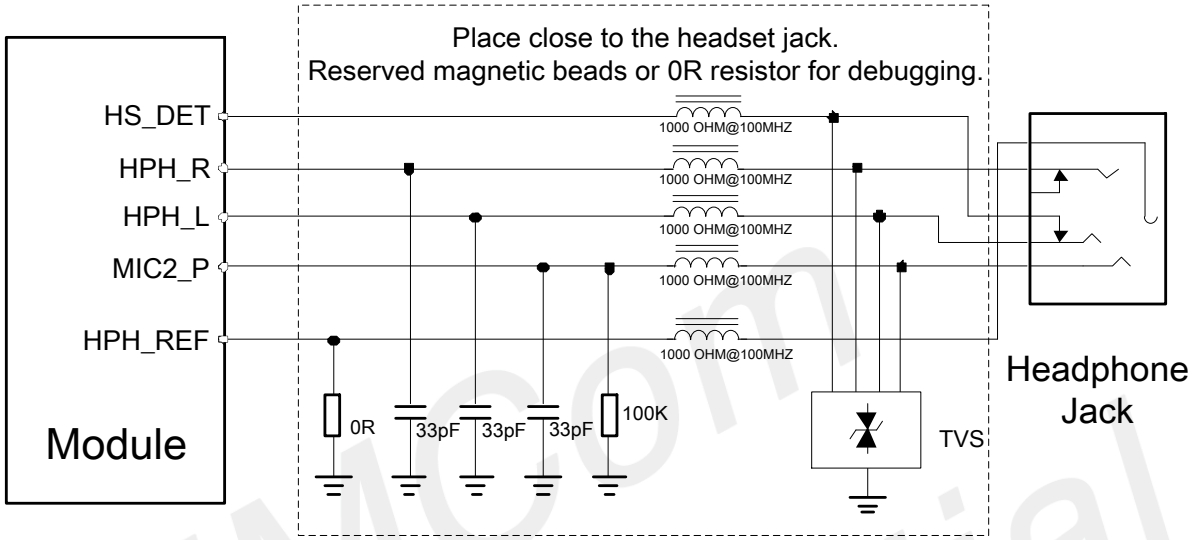


Figure 27: Headphone Reference Design

NOTE

1. The reference design for headphone in the Figure 27 is working actively high. The software detection mode configuration changes if the customers are picking an audio working actively low.
2. Highly recommend the HS_DET and the HPH_L form a detection loop, and the HPH_L has an internal 100KR resistor pulling down to the ground. The HS_DET is connecting to the HPH_L presenting actively low when disconnecting the headphone. The HS_DET and the HPH_L are disconnecting presenting actively high when inserting the headphone.
3. Picking a bidirectional TVS on the network due to the negative voltage on the HPH signal.

Table 27: Headphone Output Feature

Parameter	Testing Condition	Minimum	Typical	Maximum	Unit
Output Power	Input = 0 dBFS	27	30	-	mW
Output Voltage	Input = 0 dBFS	0.94	0.99	-	Vrms
Loads		4	32	-	Ω
Off Impedance		-	20	-	Ω

3.11.3 Handset Interface

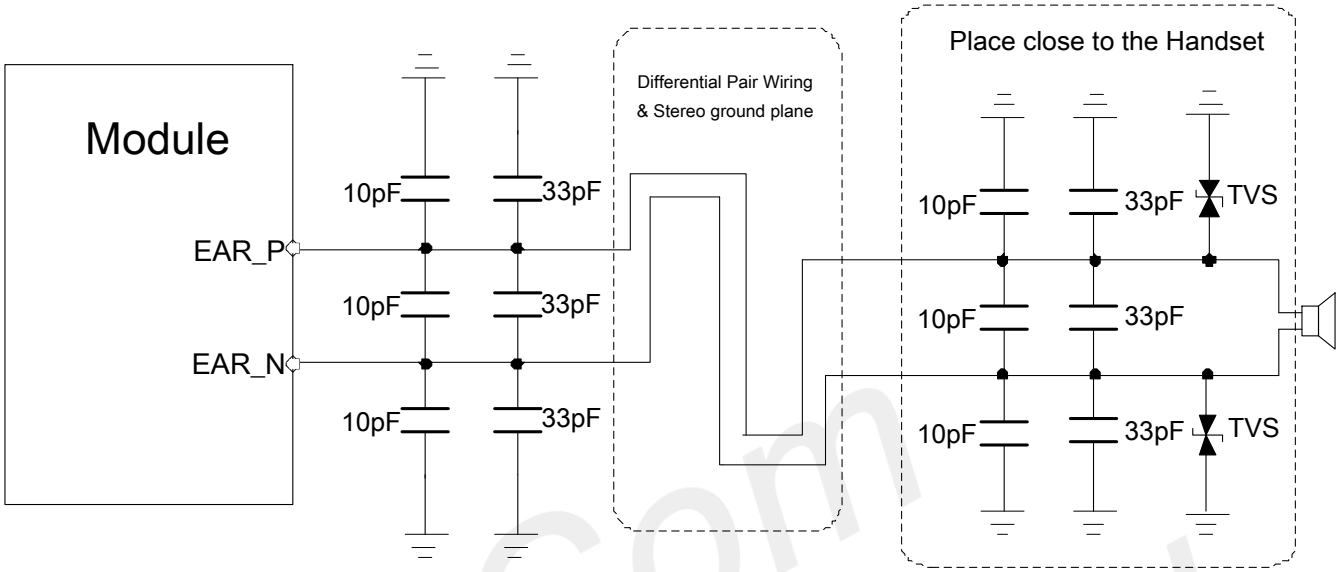


Figure 28: Handset Reference Design

Table 28: Handset Output Feature

Parameter	Testing Condition	Minimum	Typical	Maximum	Unit
Output Power	PA gain = 6 dB, 32 Ω, THD+N ≤ 1%	115	123	-	mW
	PA gain = 6 dB, 10.67 Ω, THD+N ≤ 1%	150	-	-	mW
Output Voltage	Input = 0 dBFS, PA gain = 6 dB	1.93	1.97	-	Vrms
Loads		10.67	32	-	Ω

3.11.4 Speaker Interface

SIM8971x series module offers a speaker interface for external audio power amplifier (PA) connection.

Table 29: Speaker Output Feature

Parameter	Testing Condition	Minimum	Typical	Maximum	Unit
Max Power	THD+N=1%,RL=8 Ω，VBAT=3.6V		1.2	-	W
Fosc	Modulation Frequency	600	800	1000	KHz
Efficiency	Po=1W,RL=8 Ω，VBAT=3.6V		83	-	%
TON	Start-up Time		40	-	ms

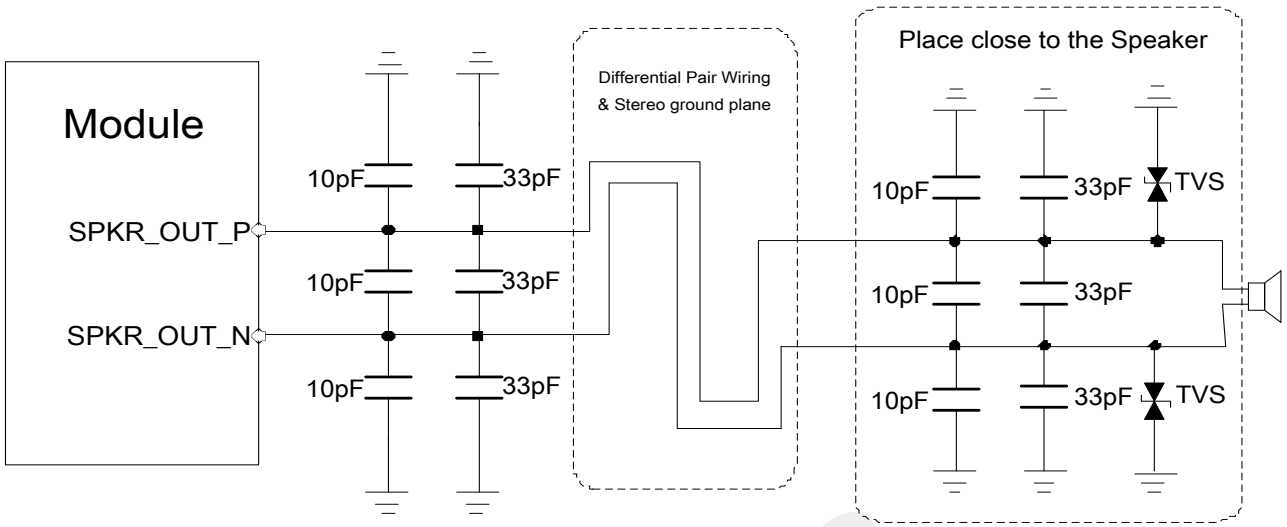


Figure 29: Speaker Reference Design

3.11.5 Speaker Interface

SIM8971x series module offers a MIC_BIAS1. There are the Microphone Reference Design in the chapter 3.11.1. As shown in the pictures, ECM type Microphone and MEMS type Microphone do not need the MIC BIAS voltage.

MIC_BIAS1 is for the external MEMS type microphone, the feature is showing below.

Table 30: MIC BIAS Voltage Feature

Parameter	Testing Condition	Minimum	Typical	Maximum	Unit
Output Voltage	No Load	1.0	1.8	2.85	V
Output Voltage Error	No Load	-3.5	0.00	3.5	%
Output Current	2 Mics,1~1.5mA/Mic	0.005	3.0	6.0	mA
Output switch to ground	On resistance	-	-	20	Ω
	Sink current	2.0	-	-	mA
Output Noise	0.1 μF bypass	0.0	2.7	5.0	μVrms
PSRR- Power supply rejection ratio	at 20 Hz	93	-	-	dB
	at 200 Hz to 1 kHz	113	-	-	dB
	at 2 kHz	100	-	-	dB
	at 10 kHz	90	-	-	dB
	at 20 kHz	78	-	-	dB
Output capacitor value	External bypass mode	0.025	0.1	0.5	μF

3.12 UIM Card Interface

SIM8971x series module offers two UIM Cards interface, supporting dual card dual standby. The UIM Cards interface also supports the 1.8V/2.95V dual voltage and the hot plug detection.

Table 31: USIM Card Interface

PIN Name	PIN Num	I/O	Description	Notes
USIM2_VDD	210	PO	SIM Card2 Power, 1.8V/2.95V Dual Voltage	
USIM2_DATA	209	DI/DO	SIM Card2 Data	
USIM2_CLK	208	DO	SIM Card2 Clock	
USIM2_RST	207	DO	SIM Card2 Reset	
USIM2_DET	256	DI	SIM Card2 Detection	1. Default Low Active Detection. 2. Need external pull-ups when using. 3. Do not float it.
USIM1_DET	145	DI	SIM Card1 Detection	
USIM1_RST	144	DO	SIM Card1 Reset	
USIM1_CLK	143	DO	SIM Card1 Clock	
USIM1_DATA	142	DI/DO	SIM Card1 Data	
USIM1_VDD	141	PO	SIM Card1 Power, 1.8V/2.95V Dual Voltage	

NOTE

The standard software version supports dual cards, and the single card function needs to be supported by the special software version.

The reference design for the UIM Card is showing in the Figure 30.

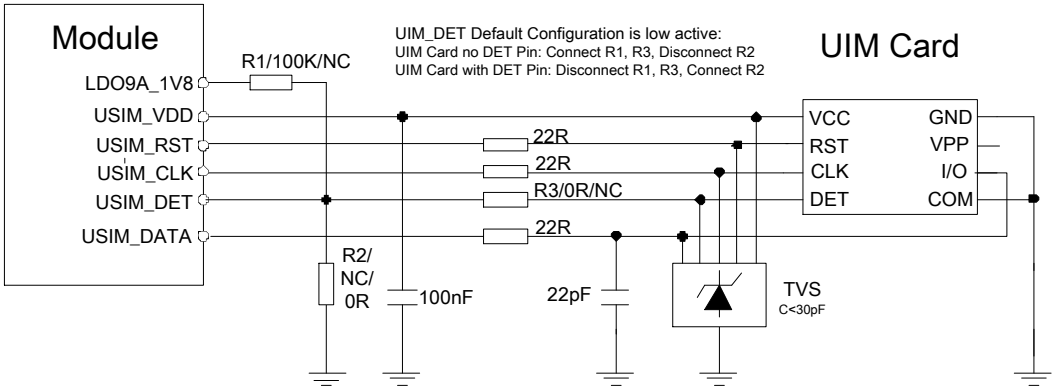


Figure 30: UIM Card Interface Reference Design

NOTE

1. The USIM_DATA Pin of the module pulls up to the USIM_VDD internally. Avoid external pull-ups.
2. Place the TVS close to the UIM Card receptacle interface.
3. Highly recommend the parasitic capacitance of the TVS on the USIM_CLK should be less than 30pF.
4. Highly recommend the 22R resistor in series on the signal lines to enhance the ESD protection.
5. Highly recommend reserved 22pF capacitor pulling down to the ground on the USIM_DATA line preventing the radio frequency interference.

3.13 ADC

SIM8971x series module offers two 16-Bit resolution ADC providing by the power management IC. The feature is showing in Table 27.

Table 32: ADC Interface Feature

Parameter	Description	Minimum	Typical	Maixmum	Unit
Input voltage range	Programmable	0	-	1.875	V
Resolution		-	16	-	bits
Analog input bandwidth		-	500	-	kHz
Sample rate		-	4.8	-	MHz
ADC resolution (LSB)		-	64.879	-	uV
1/1 channel end-to-end accuracy	Calibrated data result	-11	6	11	mV
1/1 channel end-to-end accuracy with internal pull-up	Calibrated data result	-12.5	7	12.5	mV
1/3 channel end-to-end accuracy	Calibrated data result	-20	10	20	mV
100 K pull-up	Trimmed value	99.5	100	100.5	kΩ
400 K pull-up	Trimmed value	398	100	402	kΩ
30 K pull-up	Trimmed value	29.7	30	30.3	kΩ
1/1 channel AMUX input resistance		10	-	-	MΩ
1/3 channel AMUX input resistance		1	-	-	MΩ

NOTE

Highly recommend connecting the ADC with a resistance voltage division circuit preventing the module from burning due to the high power supply voltage ADC detection.

3.14 Sensor Interface

SIM8971x series module communicates with sensors via I2C or I3C. It supports various sensors, including the hall sensor, the acceleration sensor, the geomagnetism sensor, the gyroscope sensor, the temperature sensor, the light sensor, and the pressure sensor.

The sensors interface's pins in the module are showing in Table 28.

Table 33: Sensor Interface Feature

PIN Name	PIN Num	I/O	Description	Notes
SENSOR_I2C_SCL	131	OD	External Sensor I2C Clock	Need an external 2.2KR pull up resistor
SENSOR_I2C_SDA	132	OD	External Sensor I2C Data	
ACCL_INT	252	DI	Acceleration Interruption	
GYRO_INT	255	DI	Gyroscope Interruption	
MAG_INT	254	DI	Geomagnetism Interruption	
ALPS_INT	253	DI	Light Sensor Interruption	
LDO9A_1V8	9	PO	Sensor I2C Pull Up VDD or VDDIO Power Supply	
eLDO1_2V8	11	PO	AVDD3.0V Power Supply	

3.15 Forced Emergency Download Interface

SIM8971x series module offers a USB_BOOT Pin, which is an emergency download interface. Pulling up the USB_BOOT to the LDO9A_1V8 before powering on enables the module to run into the emergency download mode, which is also applying for the treatment when the product starts abnormally. Highly recommend reserved the testing points for software upgrading and debugging.

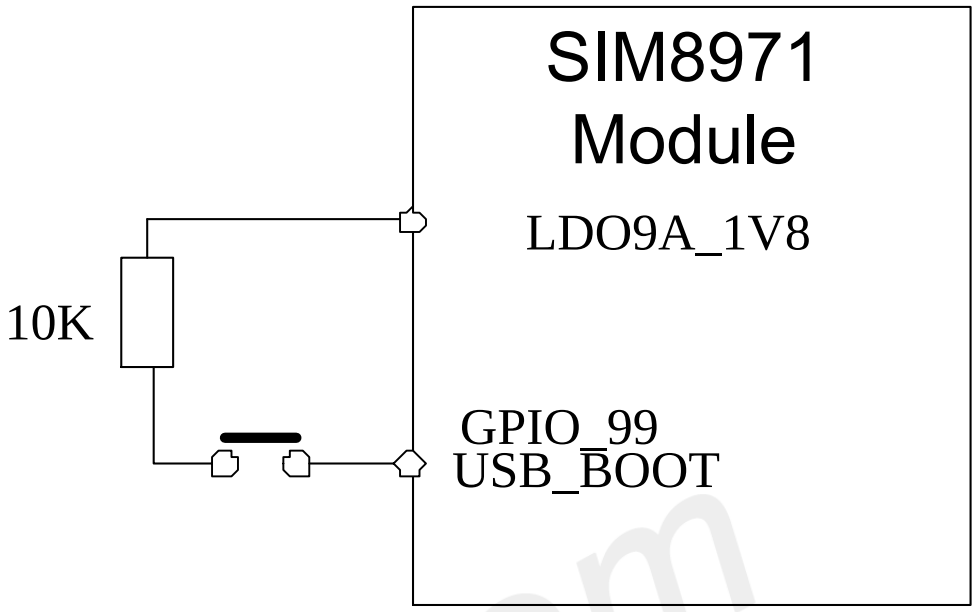


Figure 31: Emergency Download Interface Reference Design

4 WIFI & BT

SIM8971x series module offers a common antenna interface combining the WIFI and the BT function. The customers could connect the external WIFI and BT two in one antenna via this interface. In the TDD mode, the WIFI and the BT coexist.

4.1 WIFI Outline

SIM8971x series module supports the 2.4GHz and the 5GHz dual bands WLAN wireless communication. It supports multiple modes, including the 802.11a, the 802.11b, the 802.11g, the 802.11n, and the 802.11ac. The highest rate is 433Mbps. The characteristics are as follows.

- Support the 2.4GHz and the 5GHz dual frequency bands, with the frequencies of 2402MHz~2482MHz and 5180MHz~5825MHz respectively.
- Support the Wake-on-WLAN.
- Support the WAPI SMS4 hardware encryption.
- Support the AP mode and the STATION mode.
- Support the WIFI Direct.
- Support the 2.4G MCS 0~7 for HT20 and HT40.
- Support the 2.4G MCS 0~8 for VHT20.
- Support the 2.4G MCS 0~9 for VHT40.
- Support the 5G MCS 0~7 for HT20 and HT40.
- Support the 5G MCS 0~8 for VHT20.
- Support the 5G MCS 0~9 for VHT40 and VHT80.

4.1.1 WIFI Feature

Table 34: WIFI Emitter Feature

	制式	速率	带宽	输出功率【1】
2.4GHz	802.11b	CCK 1Mbps	--	18dBm±2.5dB
	802.11b	CCK 11Mbps	--	18dBm±2.5dB
	802.11g	6Mbps	20M	16dBm±2.5dB
	802.11g	54Mbps	20M	14dBm±2.5dB

	802.11n HT20	MCS0	20M	16dBm±2.5dB
	802.11n HT20	MCS7	20M	14dBm±2.5dB
	802.11n HT40	MCS0	40M	16dBm±2.5dB
	802.11n HT40	MCS7	40M	14dBm±2.5dB
	802.11ac VHT20	MCS0	20M	16dBm±2.5dB
	802.11ac VHT20	MCS8	20M	13dBm±2.5dB
	802.11ac VHT40	MCS0	40M	15dBm±2.5dB
	802.11ac VHT40	MCS9	40M	11dBm±2.5dB
5GHz	802.11a	OFDM 6Mbps	20M	17dBm±2.5dB
	802.11a	OFDM 54Mbps	20M	15dBm±2.5dB
	802.11n HT20	MCS0	20M	17dBm±2.5dB
	802.11n HT20	MCS7	20M	14dBm±2.5dB
	802.11n HT40	MCS0	40M	13dBm±2.5dB
	802.11n HT40	MCS7	40M	11dBm±2.5dB
	802.11ac VHT20	MCS0	20M	16dBm±2.5dB
	802.11ac VHT20	MCS8	20M	14dBm±2.5dB
	802.11ac VHT40	MCS0	40M	15dBm±2.5dB
	802.11ac VHT40	MCS9	40M	13dBm±2.5dB
	802.11ac VHT80	MCS0	80M	15dBm±2.5dB
	802.11ac VHT80	MCS9	80M	12dBm±2.5dB

NOTE

The output power value is testing based on the standards of Mask and EVM.

Table 35: WIFI Receiver Feature

	Standard	Speed	Bandwidth	Receiving Sensitivity
2.4GHz	802.11b	CCK 1Mbps	--	-95dBm
	802.11b	CCK 11Mbps	--	-84dBm
	802.11g	6Mbps	20M	-90dBm
	802.11g	54Mbps	20M	-73dBm
	802.11n HT20	MCS0	20M	-88dBm
	802.11n HT20	MCS7	20M	-67dBm
	802.11n HT40	MCS0	40M	-85dBm
	802.11n HT40	MCS7	40M	-64dBm
	802.11ac VHT20	MCS0	20M	-88dBm
	802.11ac VHT20	MCS8	20M	-67dBm
	802.11ac VHT40	MCS0	40M	-85dBm
	802.11ac VHT40	MCS9	40M	-59dBm
5GHz	802.11a	OFDM 6Mbps	20M	-92dBm

	802.11a	OFDM 54Mbps	20M	-76dBm
	802.11n HT20	MCS0	20M	-91dBm
	802.11n HT20	MCS7	20M	-72dBm
	802.11n HT40	MCS0	40M	-89dBm
	802.11n HT40	MCS7	40M	-69dBm
	802.11ac VHT20	MCS0	20M	-90dBm
	802.11ac VHT20	MCS8	20M	-69dBm
	802.11ac VHT40	MCS0	40M	-88dBm
	802.11ac VHT40	MCS9	40M	-65dBm
	802.11ac VHT80	MCS0	80M	-86dBm
	802.11ac VHT80	MCS9	80M	-61dBm

4.2 BT Outline

SIM8971x series module supports the BT5.0. It supports multiple modes, including the GFSK, the 8-DPSK, and the π/4-DQPSK. The performance indexes are showing as follows.

Table 36: BT RF Feature

Emission Feature			
Mode	DH5	2DH5	3DH5
Emission Power	10dBm±2dB	9dBm±2dB	9dBm±2dB
Receiving Feature			
Mode	DH5	2DH5	3DH5
Receiving Sensitivity	-93dBm	-93dBm	-82dBm

5 GNSS

SIM8971x series module supports multiple positioning systems, including the GPS, the GLONSS, and the BeiDou. LNA is a built-in component in the module to effectively enhance the receiving sensitivity of GNSS.

5.1 GNSS Outline

Table 37: GNSS Feature

Paramater	Status	Typical	Unit
CN0	CN Value	40@-130dBm	dB/Hz
Static Drift	CEP-50	5	m
Sensitivity	Tracking	-159	dBm
	Recapturing	-156.5	dBm
	Cold start	-147	dBm
TTFF	Cold start	35	s
	Warm start	15	s
	Hot start	5	s

5.2 GNSS RF & Antenna Design Guideline

The GNSS signal is a weak signal. If the antennas and the routings are not designed properly, it is easy to interfere with the GNSS signal, resulting in the decline of the GNSS receiving sensitivity, and even the GNSS positioning time. To avoid the negative effects, the following principles shall be observed in GNSS RF Design.

- The isolation between the GNSS antenna and other antennas shall be at least 15dB.
- The GNSS RF signal lines and RF related components must be away from the high-speed signals, the power switch signals, and other clock signals.
- The GNSS antenna must be away from the LCD screen, the camera, and other peripherals.
- The GNSS antenna shall be placed close to the top of the equipment as far as possible.
- Refer to chapter 6.4 for the GNSS antenna reference design.

6 Antenna Interface

SIM8971x series module has four antenna interfaces, including the MAIN antenna, the DRX antenna, the GNSS antenna, and the WIFI/BT antenna. To ensure the well RF performance of the products, the RF lines wiring through the antenna pin to the antenna interfaces must meet the following requirements.

- Ensure the RF lines are wiring with the 50Ω differential impedance.
- The RF lines must have a complete stereo ground plane.
- The RF lines must away from the other interference sources, including the high-speed signals, the clock signals, the sound sensing devices, and the motor, etc.
- The RF lines shall be as short as possible to avoid loss and interference.

6.1 MAIN Antenna & DRX Antenna

The MAIN antenna interface and the DRX antenna interface feature are showing as follows.

Table 38: MAIN Antenna & DRX Antenna Feature

PIN Name	PIN Num	I/O	Description	Feature
MAIN_ANT	19	AI/AO	2G/3G/4G Main Antenna Interface	50Ω Impedance
DRX_ANT	149	AI	4G DRX Antenna Interface	50Ω Impedance

6.1.1 Operating Frequency Band

SIM8971x series module's operating frequency bands are showing as follows.

Table 39: Operating Frequency Band

Frequency Band	Receiver	Emitter	Channel
GSM850	869-894MHz	824-849MHz	128-251
EGSM900	925-960MHz	880-915MHz	0-124, 975-1023
DCS1800	1805-1880MHz	1710-1785MHz	512-885
PCS1900	1930-1990MHz	1850-1910MHz	512-810
WCDMA B1	2110-2170 MHz	1920-1980 MHz	TX: 9612-9888

			RX: 10562-10838
WCDMA B2	1930-1990MHz	1850-1910MHz	TX: 9262-9538；RX: 9662-9938
WCDMA B4	2110-2155MHz	1710-1755MHz	TX: 1312-1862；RX: 1537-2087
WCDMA B5	869-894MHz	824-849MHz	TX: 4132-4233 RX: 4357-4458
WCDMA B8	925-960MHz	880-915 MHz	TX: 2712-2863 RX: 2937-3088
LTE B1	2110-2170 MHz	1920-1980 MHz	TX: 18000-18599 RX: 0-599
LTE B2	1930-1990MHz	1850-1910MHz	TX: 18600-19199 RX: 600-1199
LTE B3	1805-1880 MHz	1710-1785 MHz	TX: 19200-19949 RX: 1200-1949
LTE B4	2110-2155MHz	1710-1755MHz	TX: 19950-20399 RX: 1950-2399
LTE B5	869-894 MHz	824-849MHz	TX: 20400-20649 RX: 2400-2649
LTE B7	2620-2690MHz	2500-2570MHz	TX: 20750-21449 RX: 2750-3449
LTE B8	925-960 MHz	880-915 MHz	TX: 21450-21799 RX: 3450-3799
LTE B12	729-746MHz	699-716MHz	TX: 23010-23179 RX: 5010-5179
LTE B13	746-756MHz	777-787MHz	TX: 23180-23279 RX: 5180-5279
LTE B17	734-746MHz	704-716MHz	TX: 23730-23849 RX: 5730-5849
LTE B20	791-821MHz	832-862MHz	TX: 24150-24449 RX: 6150-6449
LTE B25	1850-1915MHz	1930-1995MHz	TX: 26040-26689 RX:8040-8689
LTE B26	859-894MHz	814-849MHz	TX: 26690-27039 RX: 8690-9039
LTEB28	758-803MHz	703-748MHz	TX: 27210-27259 RX: 9210-9659
LTE B66	2110-2200MHz	1710-1780MHz	TX: 131972-132671 RX: 66436-67335
LTE B71	617-652MHz	663-698MHz	TX: 133122-133471 RX: 68586-68935
LTE B34	2010-2025 MHz	2010-2025 MHz	36200-36349
LTE B38	2570-2620 MHz	2570-2620 MHz	37750-38249
LTE B39	1880-1920 MHz	1880-1920 MHz	38250-38649
LTE B40	2300-2400 MHz	2300-2400 MHz	38650-39649
LTE B41	2496-2690MHz	2496-2690MHz	39650-41589

6.1.2 RF Reference Design

SIM8971x series module's MAIN antenna reference design is showing as follows.

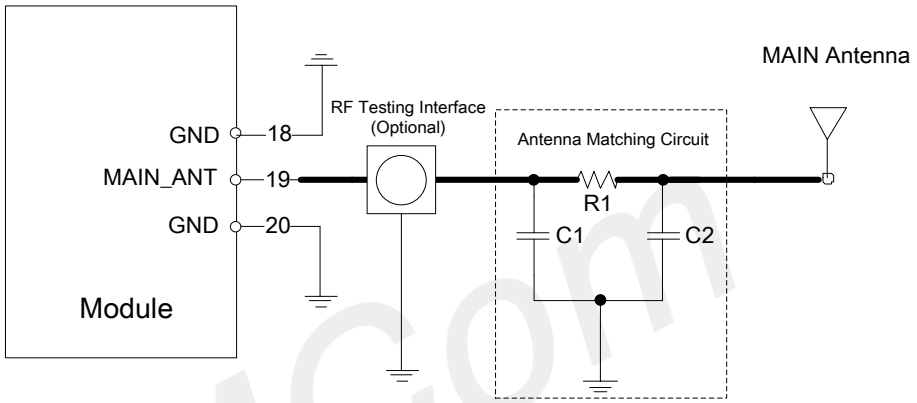


Figure 32: MAIN Antenna Reference Design

In Figure 32, R1, C1, and C2 are the antenna matching components. All these three components are adjustable to match the efficient and effective communication quality based on the interface debugging result. Selecting R1 with 0R resistor by default, and reserved C1 and C2 with disconnection by default. Highly recommend reserved an RF testing interface to modify accurately and conveniently. Considering the low cost, recommend ensure 50Ω impedance for the RF lines and cancel the RF testing interface.

SIM8971x series module's DRX antenna reference design is showing as follows.

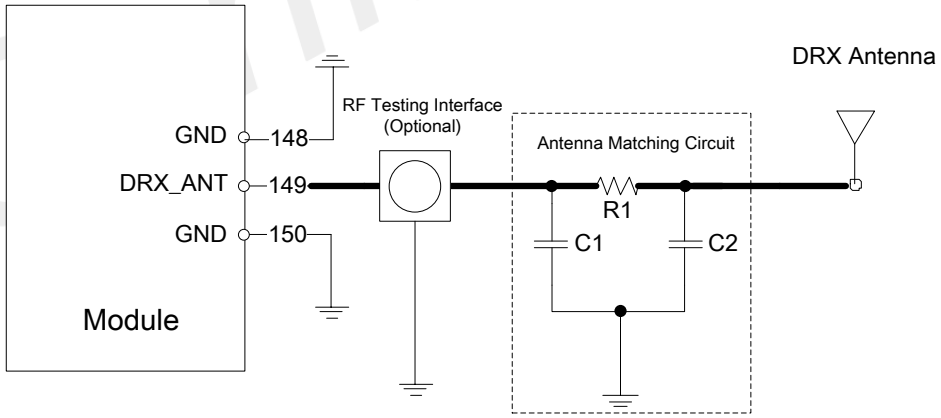


Figure 33: DRX Antenna Reference Design

In Figure 33, R1, C1 and C2 are the antenna matching components. All these three components are adjustable to match the efficient and effective communication quality based on the interface debugging result. Selecting R1 with 0R resistor by default, and reserved C1 and C2 with disconnection by default. Highly recommend reserved an RF testing interface to modify accurately and conveniently. Considering the low cost, recommend ensure 50Ω impedance for the RF lines and cancel the RF testing interface.

6.2 WIFI/BT Antenna Interface

SIM8971x series module's WIFI/BT antenna interface feature is showing as follows.

Table 40: WIFI/BT Antenna Feature

PIN Name	PIN Num	I/O	Description	Feature
WIFI/BT_ANT	129	AI/AO	WIFI/BT Antenna Interface	50Ω Impedance

SIM8971x series module's WIFI/BT operating frequency bands are showing as follows.

Table 41: WIFI/BT Operating Frequency Band

Type	Frequency Band	Unit
802.11a/b/g/n/ac	2402~2482 5180~5825	MHz
BT 5.0	2402~2482	MHz

SIM8971x series module's WIFI/BT antenna reference design is showing as follows.

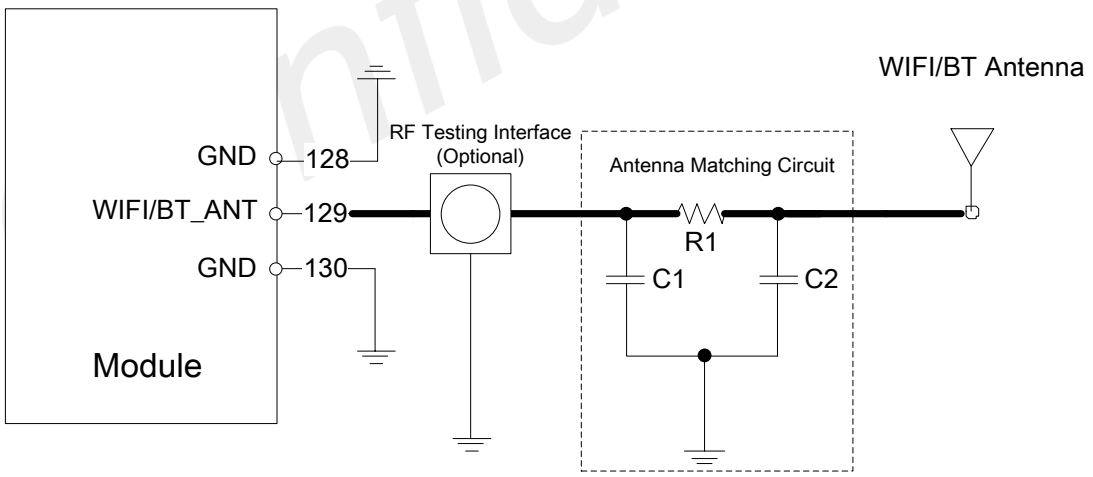


Figure 34: WIFI/BT Antenna Reference Design

In Figure 34, R1, C1 and C2 are the antenna matching components. All these three components are adjustable to match the efficient and effective communication quality based on the interface debugging result. Selecting R1 with 0R resistor by default, and reserved C1 and C2 with disconnection by default. Highly recommend reserved an RF testing interface to modify accurately and conveniently. Considering the low cost, recommend ensure 50Ω impedance for the RF lines and cancel the RF testing interface.

6.3 GNSS Antenna Interface

SIM8971x series module's GNSS antenna interface feature is showing as follows.

Table 42: GNSS Antenna Feature

PIN Name	PIN Num	I/O	Description	Feature
GNSS_ANT	134	AI	GNSS Antenna Interface	50Ω Impedance

SIM8971x series module's GNSS operating frequency bands are showing as follows.

Table 43: GNSS Operating Frequency Band

Type	Frequency Band	Unit
GPS	1575.42±1.023	MHz
GLONASS	1597.5~1605.8	MHz
BDS	1559.05 – 1563.14	MHz

6.3.1 GNSS Passive Antenna Reference Design

SIM8971x series module's GNSS passive antenna reference design is showing as follows.

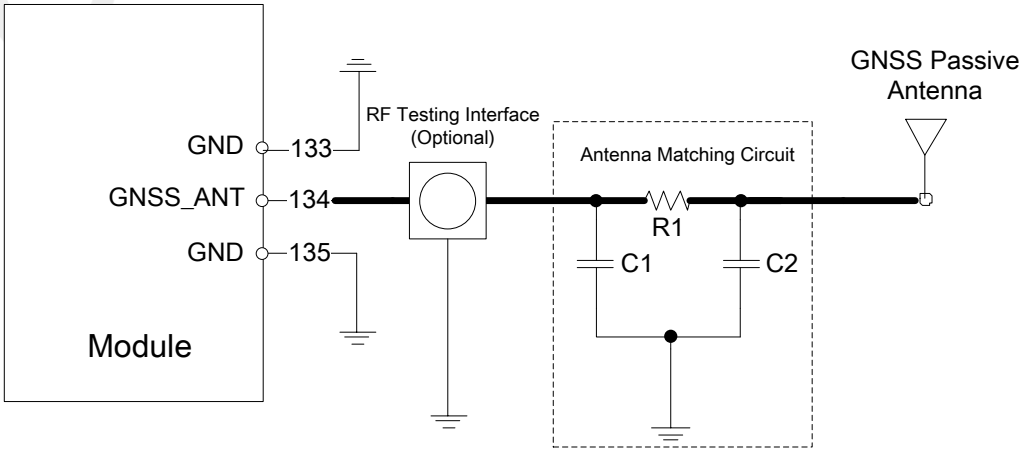


Figure 35: GNSS Passive Antenna Reference Design

In Figure 35, R1, C1 and C2 are the antenna matching components. All these three components are adjustable to match the efficient and effective communication quality based on the interface debugging result. Selecting R1 with 0R resistor by default, and reserved C1 and C2 with disconnection by default. Highly recommend reserved an RF testing interface to modify accurately and conveniently. Considering the low cost, recommend ensure 50Ω impedance for the RF lines and cancel the RF testing interface.

6.3.2 GNSS Active Antenna Reference Design

SIM8971x series module's GNSS active antenna reference design is showing as follows.

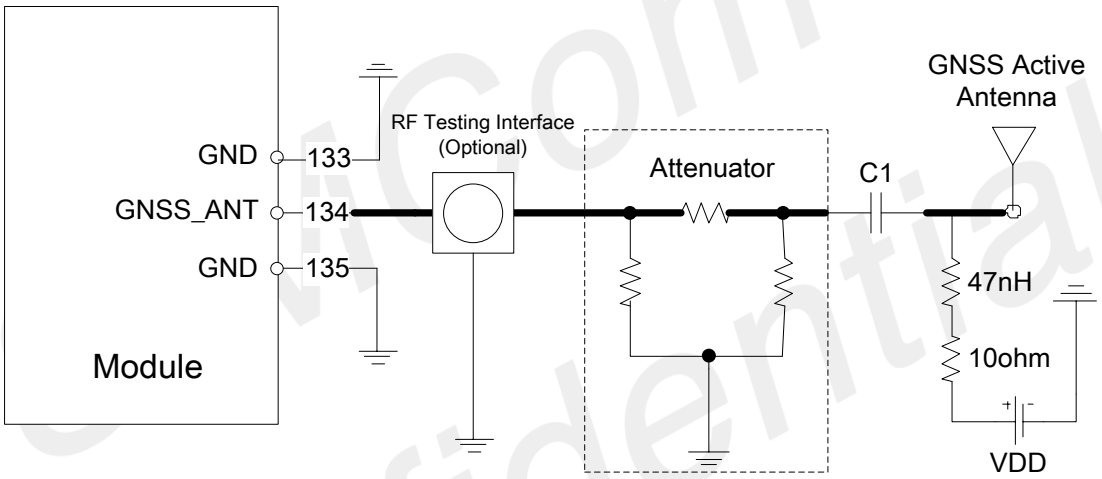


Figure 36: GNSS Active Antenna Reference Design

In Figure 36, highly recommend reserved the attenuator, and the attenuation value is determined by the gain of the external active antenna. Generally speaking, the attenuation value and antenna gain of the attenuator meet the following formula.

Antenna Gain = Attenuation value + Cable Losses

VDD is using to for the active antenna's power supply. The voltage value is determined by the antenna's feature. C1 is using to isolate straight, and the default value is 33pF. Highly recommend reserved an RF testing interface to modify accurately and conveniently. Considering the low cost, recommend ensure 50Ω impedance for the RF lines and cancel the RF testing interface.

6.4 RF Signals PCB Wiring Guideline

Highly recommend the characteristic impedance of all RF signal lines shall be controlled at 50Ω when the

customers route their PCB. Generally, the impedance of RF signal lines is determined by the dielectric constant (ER), the wiring width (W), the ground clearance (S), the height of the reference ground plane (H), and other factors.

RF routing characteristic impedance control usually adopts the microstrip-slot line and the coplanar waveguide-slot line. The reference designs of 50Ω impedance are showing as follows.

- **Microstrip-slot Line Structure**

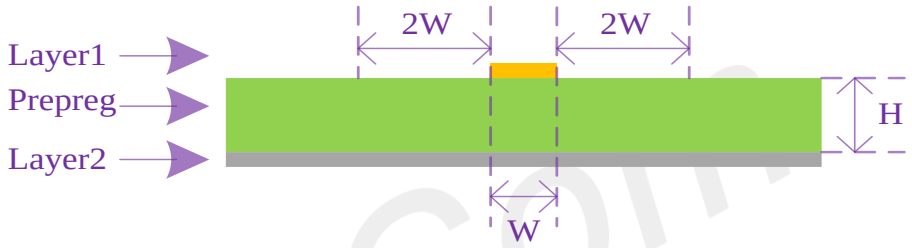


Figure 37: Two Layers PCB Microstrip-slot Line Structure

Table 44: Two Layers PCB Microstrip-slot Line Structure Impedance Control Feature

Thickness	Er	Signal Thickness	Signal Layer	Reference Layer	Impedance	Width
1mm	4.2	0.035mm	Layer1	Layer2	50 ohm	1.7mm (67 mil)
1.6mm	4.2	0.035mm	Layer1	Layer2	50 ohm	3mm (118 mil)

- **Coplanar Waveguide-slot Line**

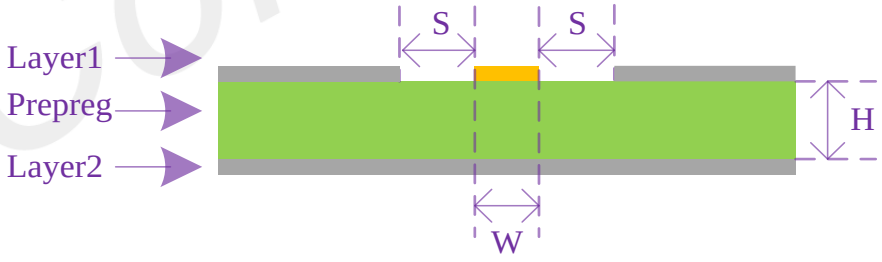


Figure 38: Two Layers PCB Coplanar Waveguide-slot Line Structure

Table 45: Two Layers PCB Coplanar Waveguide-slot Line Structure Impedance Control Feature

Thickness	Er	Signal Thickness	Signal	Reference	Impedance	W	S
1mm	4.2	0.035mm	Layer1	Layer2	50 ohm	0.65mm(25.6 mil)	0.2mm (7.8 mil)
1.6mm	4.2	0.035mm	Layer1	Layer2	50 ohm	0.65mm(25.6 mil)	0.15mm (5.9 mil)

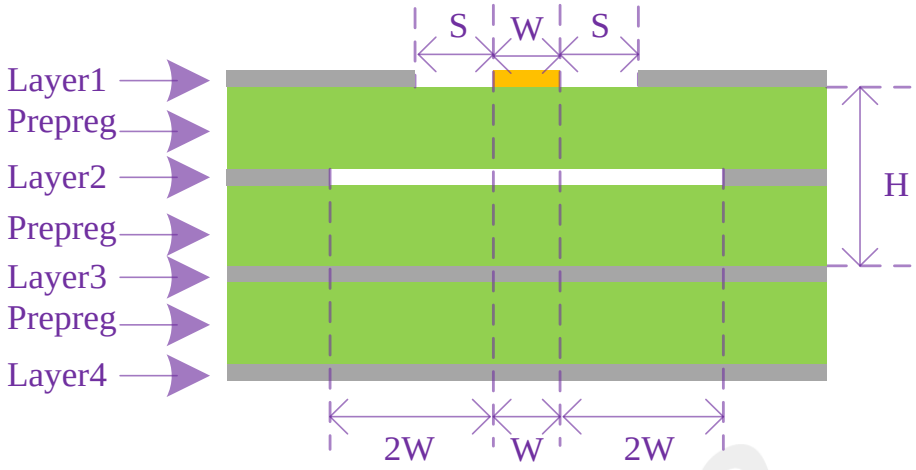


Figure 39: Four Layers PCB Coplanar Waveguide-slot Line Structure (Reference Layer Three)

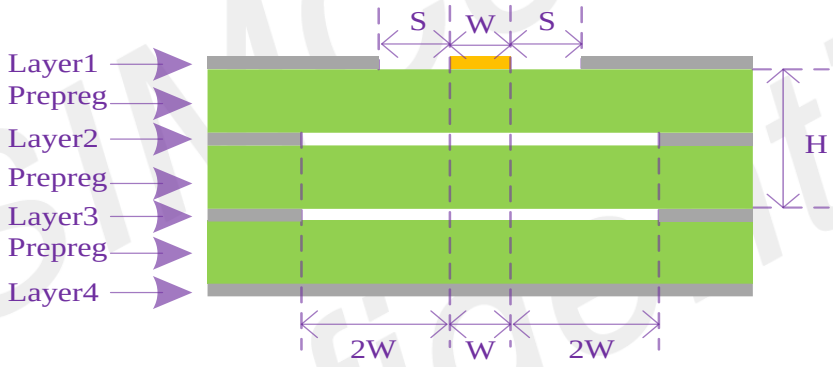


Figure 40: Four Layers PCB Coplanar Waveguide-slot Line Structure (Reference Layer Four)

To ensure the well RF performance of the products, the RF lines wiring through the antenna pin to the antenna interfaces must meet the following requirements.

- Ensure the RF lines are wiring with the 50Ω impedance.
- The RF lines must have a complete stereo ground plane.
- Add more ground holes around the RF signal lines and the reference ground to enhance the RF performance.
- The RF lines must away from the other interference sources, including the high-speed signals, the clock signals, the sound sensing devices, and the motor, etc.
- The RF lines shall be as short as possible to avoid loss and interference.
- The GND pin adjacent to the RF interface pin of the module is not subject to thermal pad treatment and is in full contact with the ground.
- Avoid wiring crossing the whole PCB. Avoid the right-angle routing. Highly recommend wiring with a circular arc or a 135-degree routing.
- Be aware of the distance between the components and the lower PCB ground, especially for the RF connecting device package.
- Digging out the GND copper foil on the surface of the PCB below the connector if necessary.
- The distance between the ground hole and the signal line shall be at least 2 times the line width(2*W).

6.5 Antenna Installation

6.5.1 GNSS Passive Antenna Reference Design

SIM8971x series module's antenna interface installation requirements are showing as follows.

Table 46: Antenna Installation Requirements

Antenna	Parameters' Requirements
GSM/WCDMA/LTE	Standing wave ratio: ≤ 2 Gain (dBi): >1 Maximum Input Power (W): 50 Input Impedance (Ω): 50 Polarization Type: Vertical Insertion Loss: < 1dB (GSM850/EGSM900, WCDMA B5/B8, LTE B5/B8/B12/B17/ B20) Insertion Loss: < 1.5dB (DCS1800/PCS1900, WCDMA B1/B2/B3/B4, LTE B1/B2/B3/B4/B39) Insertion Loss: < 2dB (B7/B38/B40/B41)
Wi-Fi/BT	Standing wave ratio: ≤ 2 Gain (dBi): > 1 Maximum Input Power (W): 50 Input Impedance (Ω): 50 Polarization Type: Vertical Insertion Loss: < 1dB
GNSS	Frequency Bands: 1559 - 1607MHz Polarization Type: Right-Handed Circular or Linear Polarization Standing wave ratio: < 2 (Typical) Passive Antenna Gain: > 0dBi Active Antenna Noise Coefficient: < 1.5dB (Typical) Active Antenna Gain: > -2dBi Active Antenna Integrated LNA Gain: <17dB (Typical) Active Antenna Total Gain: <17dBi (Typical)

6.5.2 RF Connector

Highly recommend pick the Hirose U.FL-R-SMT's RF connector.

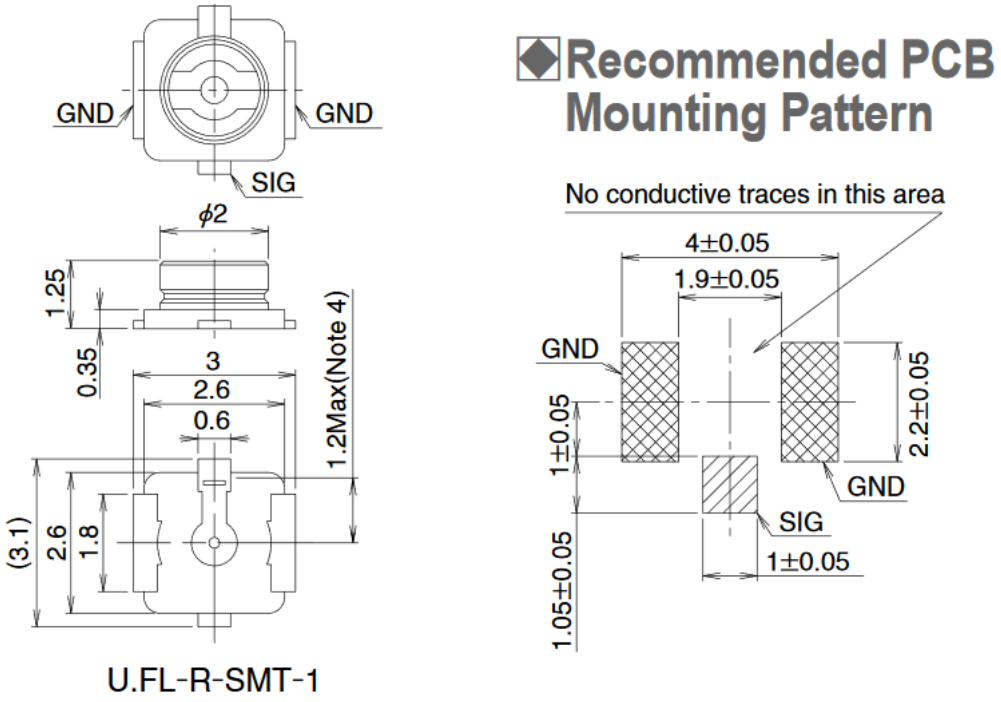


Figure 41: Hirose U.FL-R-SMT Connector's Size and Package

7 PCB Wiring

This chapter mainly introduces the requirements in PCB layout wiring. The purpose is to minimize the interference issue, to optimize the product performance, and to shorten the Research and Development (R&D) cycle.

7.1 Stack Selection

Highly recommend at least a four-layer through holes PCB layout design to facilitate impedance control and signal line shielding.

7.2 PCB Routing Guidelines

Highly recommend considering the following aspects in PCB layout design.

7.2.1 Antenna

SIM8971x series modules has four antenna interfaces in total, including the MAIN_ANT, the DRX_ANT, the GNSS_ANT, and the WIFI/BT_ANT. The requirements for the RF components are showing as follows.

- Ensure the RF lines are wiring with the 50Ω impedance.
- The RF lines must have a complete stereo ground plane.
- Add more ground holes around the RF signal lines and the reference ground to enhance the RF performance.
- The RF lines must away from the other interference sources, including the high-speed signals, the clock signals, the sound sensing devices, and the motor, etc.
- The RF lines shall be as short as possible to avoid loss and interference.
- Avoid wiring crossing the whole PCB. Avoid the right-angle routing. Highly recommend wiring with a circular arc or a 135-degree routing.
- Be aware of the distance between the components and the lower PCB ground, especially for the RF connecting device package.

7.2.2 Power Supply & Ground

Highly recommend wiring the VBAT positive electrode as short and thick as possible. Highly recommend wiring through large capacitors and zener diodes before connecting to the power supply pin of the module. Considering the backflow ground of the power supply is necessary when routing. Wiring the VBAT to the ground path as shore as possible to ensure the lower impedance.

7.2.3 USIM Card

The requirements for the USIM card are showing as follows.

- Highly recommend the USIM card receptacle interface is away from the RF antennas.
- Highly recommend wiring the USIM card signals away from the RF signal lines, the VBAT, and the high-speed signal lines as far as possible.
- Highly recommend the ground of the USIM card is well connecting to the main ground of the module.
- Notice that well protect the USIM_CLK signal to prevent the interference from other signals.
- Highly recommend wiring the UIM card signals away from the return path of the VBAT because there is a large current passing through the return path on VBAT.

7.2.4 MIPI

The requirements for the MIPI signal are showing as follows.

- Two-phase differential pair routings with 85Ω differential impedance and the error at ±15Ω.
- Three-phase differential pair routings with 44Ω single ended and the error at ±15Ω.
- Highly recommend a complete stereo ground plane and the full reference ground.
- Highly recommend minimizing the number of vias.
- Highly recommend the total length of wiring is less than 305mm.
- Highly recommend the length difference in the group is less than 0.7mm.
- Highly recommend the length difference between groups is less than 1.4mm.

Table 47: SIM8971 MIPI Lane Wiring Difference

PIN Num	PIN Name	Length (mm)	Difference (mm)
115	DSI_CLK_P	40.48	0.03
116	DSI_CLK_N	40.45	
117	DSI_LN0_P	37.32	-0.01

118	DSI_LN0_N	37.33	
119	DSI_LN1_P	35.17	0.03
120	DSI_LN1_N	35.14	
121	DSI_LN2_P	37.79	-0.04
122	DSI_LN2_N	37.83	
123	DSI_LN3_P	34.66	0.03
124	DSI_LN3_N	34.63	
77	CSI0_CLK_P	36.23	-0.26
78	CSI0_CLK_N	36.49	
79	CSI0_LN0_P	38.58	0.44
80	CSI0_LN0_N	39.14	
81	CSI0_LN1_P	39.75	-0.13
82	CSI0_LN1_N	39.88	
83	CSI0_LN2_P	41.50	-0.39
84	CSI0_LN2_N	41.89	
85	CSI0_LN3_P	43.83	0
86	CSI0_LN3_N	43.83	
88	CSI1_CLK_P	36.80	0.15
89	CSI1_CLK_N	36.65	
90	CSI1_LN0_P	35.88	0.17
91	CSI1_LN0_N	35.69	
92	CSI1_LN1_P	37.73	0.53
93	CSI1_LN1_N	37.20	
94	CSI1_LN2_P	39.89	0.32
95	CSI1_LN2_N	39.57	
96	CSI1_LN3_P	40.67	0.31
97	CSI1_LN3_N	40.46	
183	CSI2_CLK_P	66.23	0.2
184	CSI2_CLK_N	66.03	
185	CSI2_LN0_P	67.12	-0.15
186	CSI2_LN0_N	67.27	
187	CSI2_LN1_P	72.47	-0.3
188	CSI2_LN1_N	72.77	
189	CSI2_LN2_P	76.66	0.49
190	CSI2_LN2_N	76.17	
191	CSI2_LN3_P	80.65	0.64
192	CSI2_LN3_N	80.01	

7.2.5 USB

The requirements for the USB signal are showing as follows.

- Highly recommend place the common mode inductance close to the USB connector.
- Differential pair routings with 90Ω differential impedance and the error at ±10%.
- Highly recommend the length difference of HS differential pair is less than 2.0mm.
- Highly recommend the length difference of SS differential pair is less than 0.7mm.
- If SS lanes need to be compatible with DP function, the spacing between the groups of the USB_SS1_RX_M/P, the USB_SS1_TX_M/P, the DP_AUX_M/P, the USB_SS2_RX_M/P, and the USB_SS2_TX_M/P is less than 9mm.
- If no DP function, it is unnecessary to consider the equal length of the USB_SS_TX and the USB_SS_RX.
- Highly recommend wiring the VBUS as wide as possible if the USB integrates the charging function.
- Highly recommend placing the testing points on the routing path to minimize the branch length.
- Place the data line of the USB signal away from sensitive circuits or signals because they are high-frequency signals. The sensitive signals include the RF signals, the audio signals, and the 38.4MHZ XO signals.
- Highly recommend reserved the RX and the TX at least 3 times the linewidth, and other signals 4 times the linewidth.

Table 48: SIM8971 USB Wiring Length

PIN Num	PIN Name	Length (mm)	Difference (mm)
32	USB_DP	49.98	-0.08
33	USB_DN	50.06	
171	USB_SS1_RX_P	41.61	0
172	USB_SS1_RX_M	41.61	
174	USB_SS1_TX_P	29.92	0.03
175	USB_SS1_TX_M	29.95	
161	USB_SS2_RX_M	29.12	0.01
162	USB_SS2_RX_P	29.13	
164	USB_SS2_TX_M	33.34	0
165	USB_SS2_TX_P	33.34	
215	DP_AUX_N	23.73	-0.05
216	DP_AUX_P	23.68	

7.2.6 SD Card

The requirements for the SD card signal are showing as follows.

- Highly recommend a complete stereo ground plane and the full reference ground.

- Differential pair routings with 50Ω differential impedance and the error at ±10%.
- Highly recommend the length difference between the CLK and the DATA/CMD is less than 1mm.
- Highly recommend the line spacing at least 2 times the linewidth.
- Highly recommend the total capacitance on the 50MHz signal line shall be less than 22pF, and the wiring length is less than 40mm.
- Highly recommend the total capacitance on the 208MHz signal line shall be less than 5pF, and the wiring length is less than 20mm.

Table 49: SIM8971 SD Card Wiring Length

PIN Num	PIN Name	Length (mm)
65	SD_DATA3	36.04
66	SD_DATA2	36.05
67	SD_DATA1	36.08
68	SD_DATA0	36.30
69	SD_CMD	36.00
70	SD_CLK	36.07

7.2.7 Audio

The requirements for the audio signal are showing as follows.

- Highly recommend wiring the audio signal lines away from the antennas, the RF signal lines, and other high-speed signal lines.
- Highly recommend all the audio signal lines are wiring with a complete stereo ground plane and the full reference ground, and away from the return VBAT.
- Highly recommend wiring the MIC1_P/N, the EAR_P/ N, and the SPK_P/N as differential pairs.
- Highly recommend isolating the HPH_L and the HPH_R with the HPH_REF in the middle to decrease the crosstalk interference.

8 Electrical & Reliability

8.1 Absolute Maximum Value

Table 50: Absolute Maximum Value

Parameter	Description	Minimum	Maximum	Unit
VBAT	DC Supply Voltage	-0.3	5	V
VBUS	USB 5V Supply Voltage	-0.3	7	V
VRTC	Backup Battery Supply Voltage	-	3.5	V

8.2 Temperature Range

Table 51: Temperature Range

Parameter	Minimum	Typical	Maximum	Unit
Operating Temperature	-35	25	+75	℃
Storage Temperature	-40		+90	℃

8.3 Operating Voltage

Table 52: Operating Voltage

Parameter	Minimum	Typical	Maximum	Unit
VBAT	3.5	4.0	4.4	V
VBUS	3.6	-	10	V
VRTC	2.0	3.0	3.25	V

8.4 Digital Interface Feature

Table 53: SD Interface Electrical Feature (1.8V)

Parameter	Description	Minimum	Typical	Maximum	Unit
V_{IH}	High Level Input Voltage	1.27	-	2	V
V_{IL}	Low Level Input Voltage	-0.3	-	0.58	V
V_{OH}	High Level Output Voltage	1.4	-	-	V
V_{OL}	Low Level Output Voltage	0	-	0.45	V

Table 54: SD Interface Electrical Feature (2.95V)

Parameter	Description	Minimum	Typical	Maximum	Unit
V_{IH}	High Level Input Voltage	1.85	-	3.25	V
V_{IL}	Low Level Input Voltage	-0.3	-	0.74	V
V_{OH}	High Level Output Voltage	2.21	-	2.96	V
V_{OL}	Low Level Output Voltage	0	-	0.37	V

Table 55: USIM Card Interface Electrical Feature (USIM_VDD = 1.8V or 2.95V)

Parameter	Description	Minimum	Typical	Maximum	Unit
V_{IH}	High Level Input Voltage	0.7* USIM_VDD	-	USIM_VDD+0.3	V
V_{IL}	Low Level Input Voltage	-0.3	-	0.2* USIM_VDD	V
V_{OH}	High Level Output Voltage	0.8*USIM_VDD	-	USIM_VDD	V
V_{OL}	Low Level Output Voltage	0	-	0.4	V

Table 56: GPIO Electrical Feature

Parameter	Description	Minimum	Typical	Maximum	Unit
V_{IH}	High Level Input Voltage	1.17	-	-	V
V_{IL}	Low Level Input Voltage	-	-	0.6	V
V_{OH}	High Level Output Voltage	1.3	-	-	V
V_{OL}	Low Level Output Voltage	-	-	0.45	V

8.5 Current Consumption (VBAT = 3.9V)

Table 57: Current Consumption

Parameter	Condition	Minimum	Typical	Maximum	Unit
Shutdown Leakage Current	Shutdown Leakage Current	-	130	T50	uA
Flight Mode	Flight Mode	-	3.1	4	mA
Standby Current	GSM/GPRS BS-PA-MFRMS=2 BS-PA-MFRMS=5 BS-PA-MFRMS=9	 - - -	 4.3 3.6 3.3	 5 5 5	
	WCDMA, 2.56sec,DRX=8	-	3.4	5	
	LTE-FDD, standby 2.56s, DRX=8	-	4.8	5	
	LTETDD, standby 2.56s, DRX=8	-	3.6	5	
Call Current	**GSM Talk** EGSM850 PCL=5@32.2dB Channel=189 EGSM900 PCL=5@32.2dB Channel=62 EGSM1800 PCL=0@29.7dB Channel=698 EGSM1900 PCL=0@29.7dB Channel=661 **WCDMA Talk** WCDMA TX=0dBm WCDMA TX=10dBm **VoL LTE** FDD 20MHz TX=0 dBm TDD 20MHz TX=0 dBm	 - - - - - - - -	 230 261 189 159 175 225 210 180	 300 300 250 250 200 250 270 220	
Data Transmission Maximum Current	**WCDMA Max power** WCDMA B1 Max power@23.7dBm WCDMA B5 Max power@23.0dBm WCDMA B8 Max power@23.1dBm **LTE FDD Max power** B1 power@23dBm BW=20MHZ Channel=18300 B2 power@23dBm BW=20MHZ Channel=18900 B3 power@23dBm BW=20MHZ Channel=19575 B4 power@23dBm BW=20MHZ Channel=20175 B5 power@23dBm BW=10MHZ	 - - - - - - - - -	 466 444 444 537 520 508 503 583 629 522 461 470	 570 570 570 700 700 700 700 600 800 600 600 600	mA

	Channel=20525	-	531	600	
	B7 power@23dBm BW=20MHZ	-	472	600	
	Channel=21100	-	506	700	
	B8 power@23dBm BW=10MHZ	-	521	600	
	Channel=21625	-	492	600	
	B12 power@23dBm BW=10MHZ				
	Channel=23095	-	474	600	
	B13 power@23dBm BW=10MHZ	-	579	700	
	Channel=23230	-	455	700	
	B17 power@23dBm BW=10MHZ	-	644	700	
	Channel=23790	-	572	700	
	B20 power@23dBm BW=20MHZ				
	Channel=24300				
	B25 power@23dBm BW=20MHZ				
	Channel=26365				
	B26 power@23dBm BW=15MHZ				
	Channel=26865				
	B28 power@23dBm BW=20MHZ				
	Channel=27460				
	LTE TDD Max power				
	B34 power@23dBm BW=20MHZ				
	Channel=36275				
	B38 power@23dBm BW=20MHZ				
	Channel=37800				
	B39 power@23dBm BW=10MHZ				
	Channel=38300				
	B40 power@23dBm BW=10MHZ				
	Channel=39150				
	B41 power@23dBm BW=10MHZ				
	Channel=40740				
Peak Current	RF Burst			3.0	A

8.6 Electrostatic Protection

Notice that the electrostatic protection is very important when producing, assembling and operating modules. The performance parameters of the module test results are as follows:

Table 58: ESD Feature (Temperature: 25℃, Humidity: 45%)

PIN Name	Contact Discharge	Air Discharge
VBAT	±5KV	±10KV

GND	±5KV	±10KV
Antenna Interface	±5KV	±10KV
Other Interface	±0.5KV	±1KV

8.7 RF Transmission Power

Table 59: Conducted Output Power

Frequency Band	Power	Minimum
GSM850	33dBm ±2dB	5dBm ± 5dB
E-GSM900	33dBm ±2dB	5dBm ± 5dB
DCS1800	30dBm ±2dB	0dBm ± 5dB
PCS1900	30dBm ±2dB	0dBm ± 5dB
GSM850(8-PSK)	27dBm ±3dB	5dBm ± 5dB
E-GSM900 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
DCS1800 (8-PSK)	26dBm +3/-4dB	0dBm ±5dB
PCS1900(8-PSK)	26dBm +3/-4dB	0dBm ±5dB
WCDMA B1	24dBm +1/-3dB	<-50dBm
WCDMA B2	24dBm +1/-3dB	<-50dBm
WCDMA B4	24dBm +1/-3dB	<-50dBm
WCDMA B5	24dBm +1/-3dB	<-50dBm
WCDMA B8	24dBm +1/-3dB	<-50dBm
LTE-FDD B1	23dBm +/-2.7dB	<-40dBm
LTE-FDD B2	23dBm +/-2.7dB	<-40dBm
LTE-FDD B3	23dBm +/-2.7dB	<-40dBm
LTE-FDD B4	23dBm +/-2.7dB	<-40dBm
LTE-FDD B5	23dBm +/-2.7dB	<-40dBm
LTE-FDD B7	23dBm +/-2.7dB	<-40dBm
LTE-FDD B8	23dBm +/-2.7dB	<-40dBm
LTE-FDD B12	23dBm +/-2.7dB	<-40dBm
LTE-FDD B13	23dBm +/-2.7dB	<-40dBm
LTE-FDD B17	23dBm +/-2.7dB	<-40dBm
LTE-FDD B20	23dBm +/-2.7dB	<-40dBm
LTE-FDD B25	23dBm +/-2.7dB	<-40dBm
LTE-FDD B26	23dBm +/-2.7dB	<-40dBm
LTE-FDD B28	23dBm +/-2.7dB	<-40dBm
LTE-FDD B66	23dBm +/-2.7dB	<-40dBm
LTE-FDD B71	23dBm +/-2.7dB	<-40dBm
LTE-TDD B34	23dBm +/-2.7dB	<-40dBm
LTE-TDD B38	23dBm +/-2.7dB	<-40dBm

LTE-TDD B39	23dBm +/-2.7dB	<-40dBm
LTE-TDD B40	23dBm +/-2.7dB	<-40dBm
LTE-TDD B41	23dBm +/-2.7dB	<-40dBm

8.8 Conducted Receiving Sensitivity

Table 60: Conducted Receiving Sensitivity

Frequency Band	Receiving Sensitivity (Typical)	Receiving Sensitivity (Maximum)
GSM850	-109dBm	-108dBm
EGSM900	-109.5dBm	-108dBm
DCS1800	-109dBm	-108dBm
PCS1900	-109.5dBm	-108dBm
WCDMA B1	-111dBm	-110dBm
WCDMA B2	-111.5dBm	-110dBm
WCDMA B4	-110dBm	-110dBm
WCDMA B5	-110.5dBm	-110dBm
WCDMA B8	-110.5dBm	-110dBm
LTE FDD/TDD	参考表 48	3GPP standard

Table 61: LTE Reference Sensitivity 3GPP Standard (QPSK)

E-UTRA Frequency Band Code	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz	Actual Value @10MHz	Duplex Mode
1	-	-	-100	-97	-95.2	-94	-99	FDD
2	-102.7	-99.7	-98	-95	-93.2	-92	-99.5	FDD
3	-101.7	-98.7	-97	-94	-92.2	-91	-99.5	FDD
4	-104.7	-101.7	-100	-97	-95.2	-94	-99	FDD
5	-103.2	-100.2	-98	-95	-	-	-98.5	FDD
6	-	-	-100	-97	-	-	-	FDD
7	-	-	-98	-95	-93.2	-92	-98	FDD
8	-102.2	-99.2	-97	-94	-	-	-98.5	FDD
9	-	-	-99	-96	-94.2	-93	-	FDD
10	-	-	-100	-97	-95.2	-94	-	FDD
11	-	-	-100	-97	-	-	-	FDD
12	-101.7	-98.7	-97	-94	-	-		FDD

13	-	-	-97	-94	-	-		FDD
14	-	-	-97	-94	-	-		FDD
17	-	-	-97	-94	-	-		FDD
18	-	-	-100	-97	-95.2	-		FDD
19	-	-	-100	-97	-95.2	-		FDD
20	-	-	-97	-94	-91.2	-90	-100	FDD
21	-	-	-100	-97	-95.2		-	FDD
22	-	-	-97	-94	-92.2	-91	-	FDD
23	-104.7	-101.7	-100	-97	-95.2	-94	-	FDD
24	-	-	-100	-97	-	-	-	FDD
25	-101.2	-98.2	-96.5	-93.5	-91.7	-90.5		FDD
26	-102.7	-99.7	-97.5	-94.5	-92.7			FDD
28		-100.2	-98.5	-95.5	-93.7	-91	-100	FDD
66	-104.2	-101.2	-99.5	-96.5	-94.7	-93.5		FDD
71	-	-	-97.2	-93.5	-92.4	-91.2		FDD
33	-	-	-100	-97	-95.2	-94	-	TDD
34	-	-	-100	-97	-95.2	-	-99.5	TDD
35	-106.2	-102.2	-100	-97	-95.2	-94	-	TDD
36	-106.2	-102.2	-100	-97	-95.2	-94	-	TDD
37	-	-	-100	-97	-95.2	-94	-	TDD
38	-	-	-100	-97	-95.2	-94	-99.5	TDD
39	-	-	-100	-97	-95.2	-94	-100	TDD
40	-	-	-100	-97	-95.2	-94	-100	TDD
41	-	-	-99	-96	-94.2	-93	-99	TDD
42	-	-	-99	-96	-94.2	-93	-	TDD
43	-	-	-99	-96	-94.2	-93	-	TDD

9 Manufacture & Production

9.1 Top- and Bottom-View of the Module

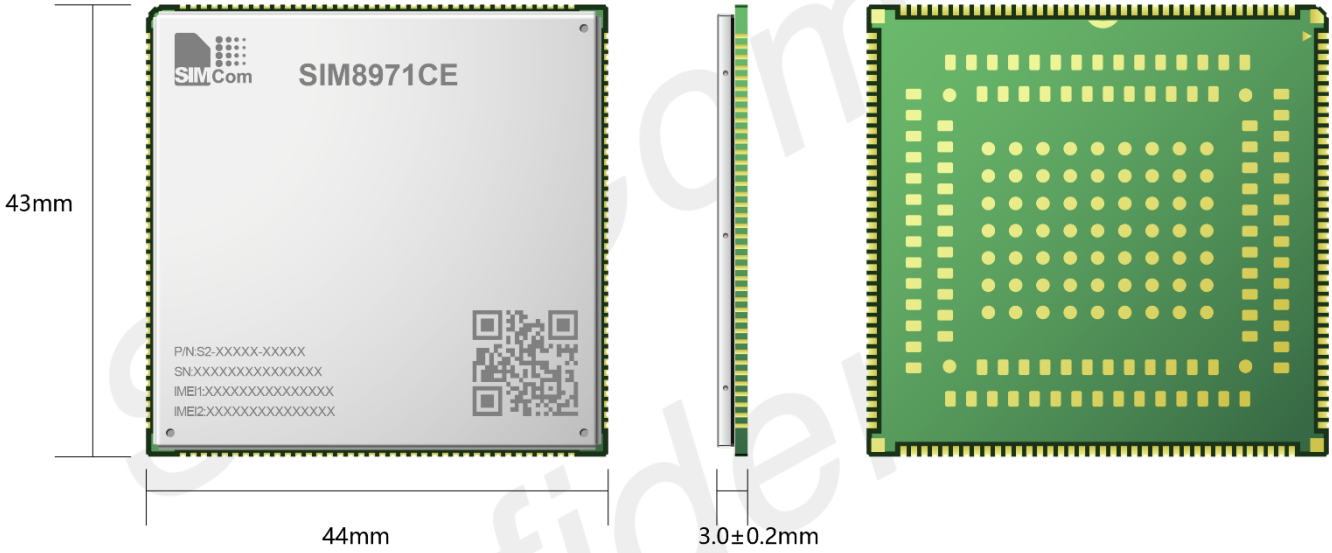


Figure 42: Top- and Bottom-View of the Module

NOTE

This picture is the effect drawing of the module design.

9.2 Mechanical Dimensional Size

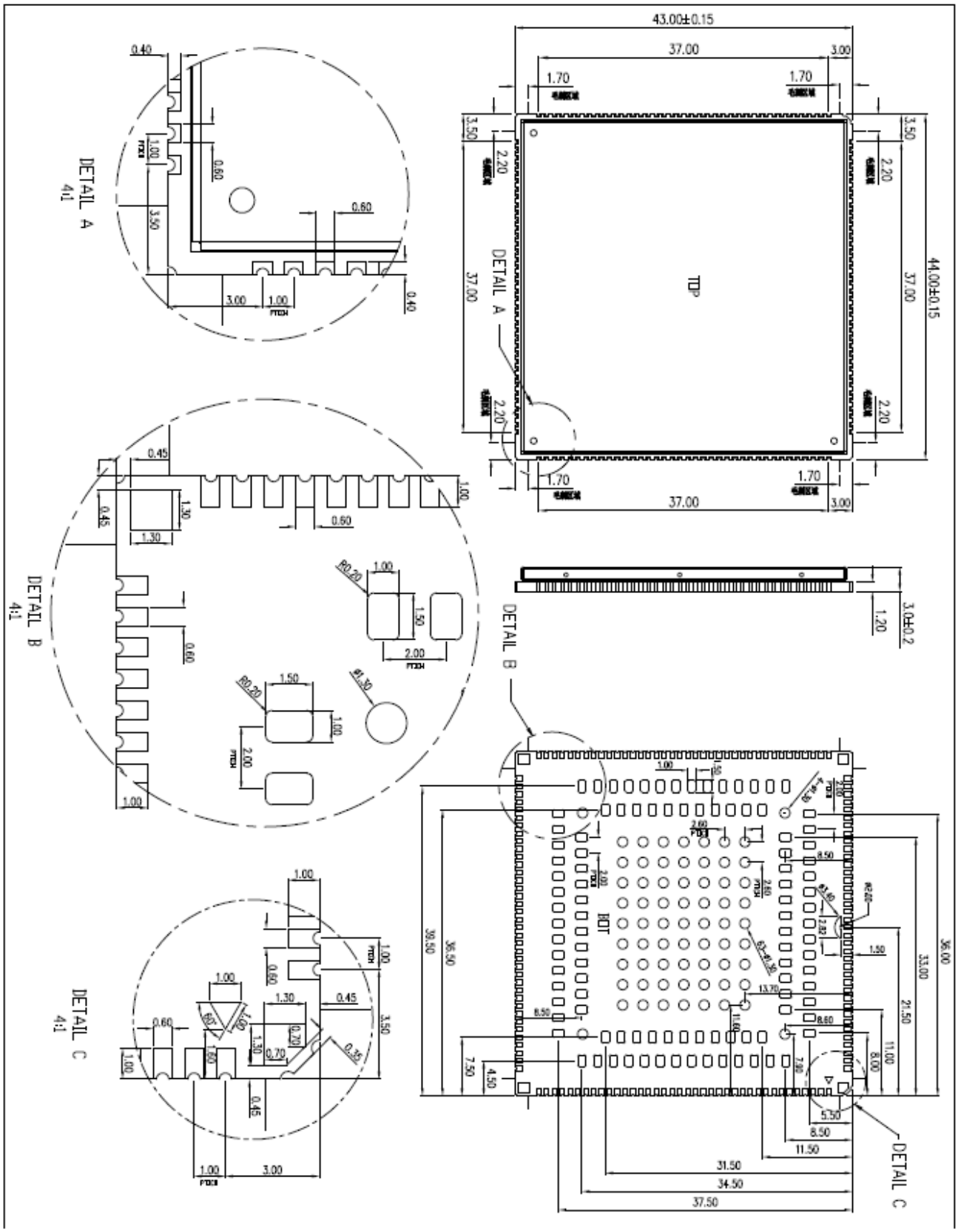


Figure 43: Three-Dimensional Size (Unit: mm)

9.3 Recommend Physical Outline Drawing

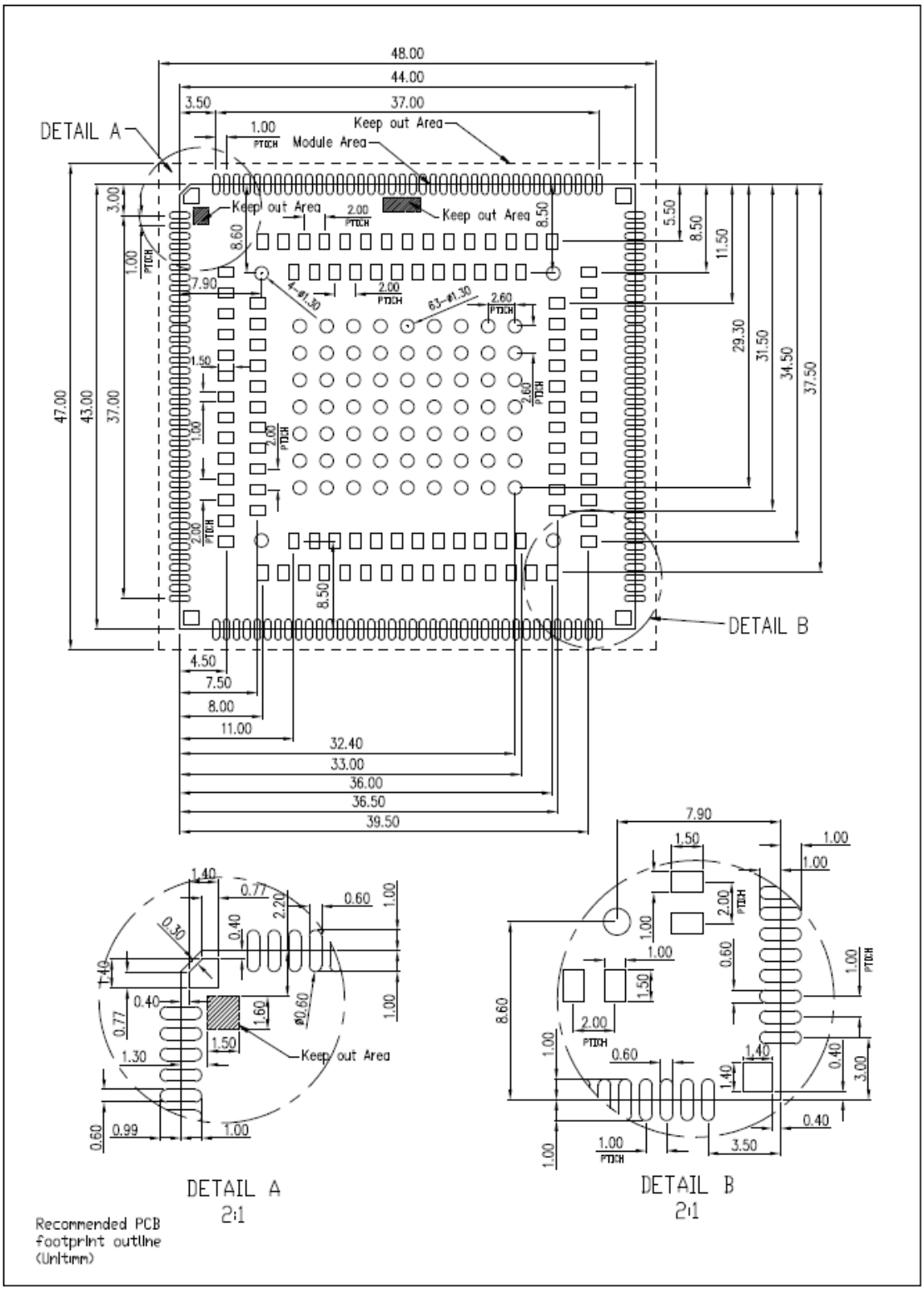


Figure 44: Recommend Physical Outline Drawing (Unit: mm)

9.4 Recommend Physical SMT Stencil Drawing

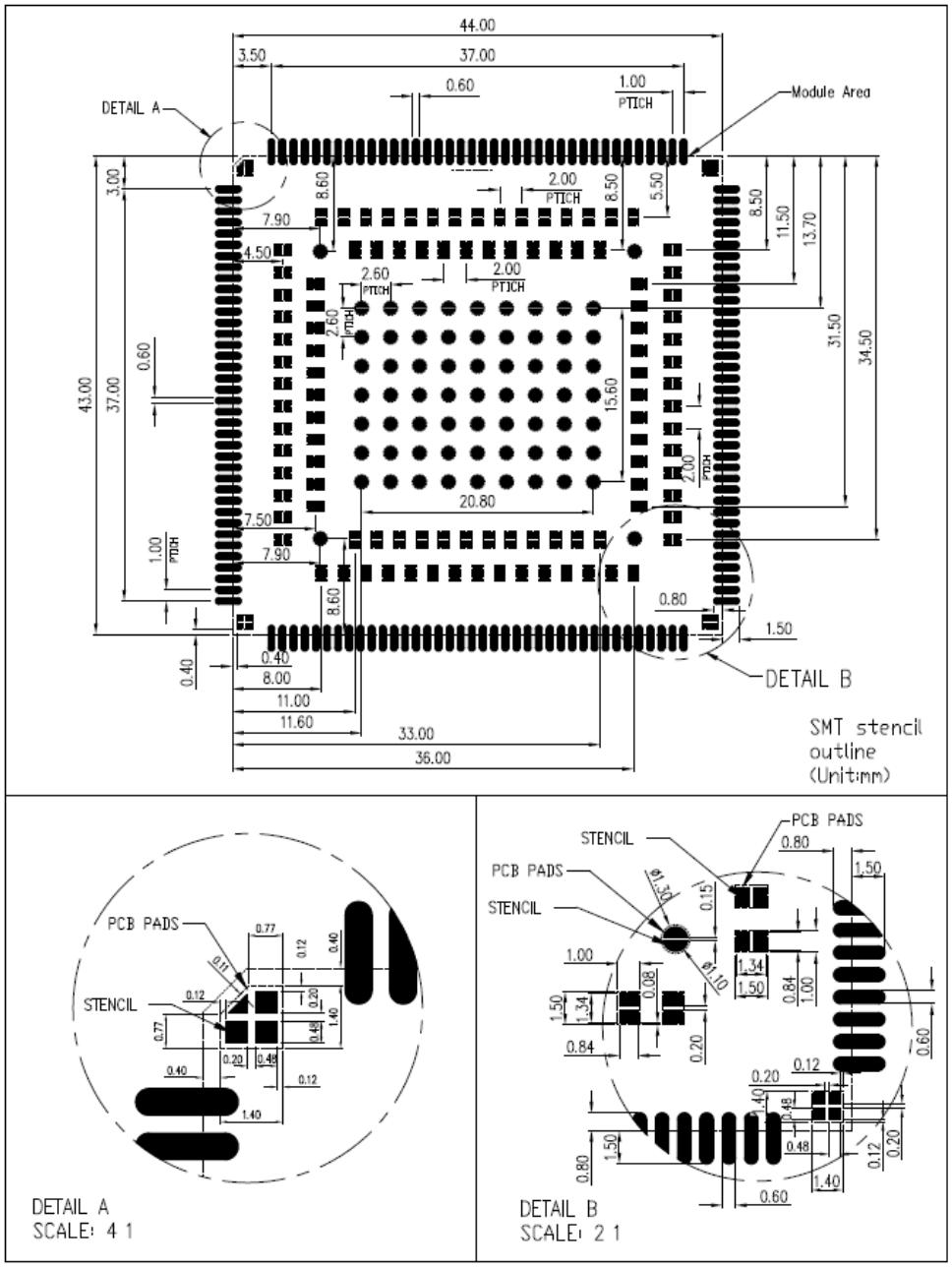
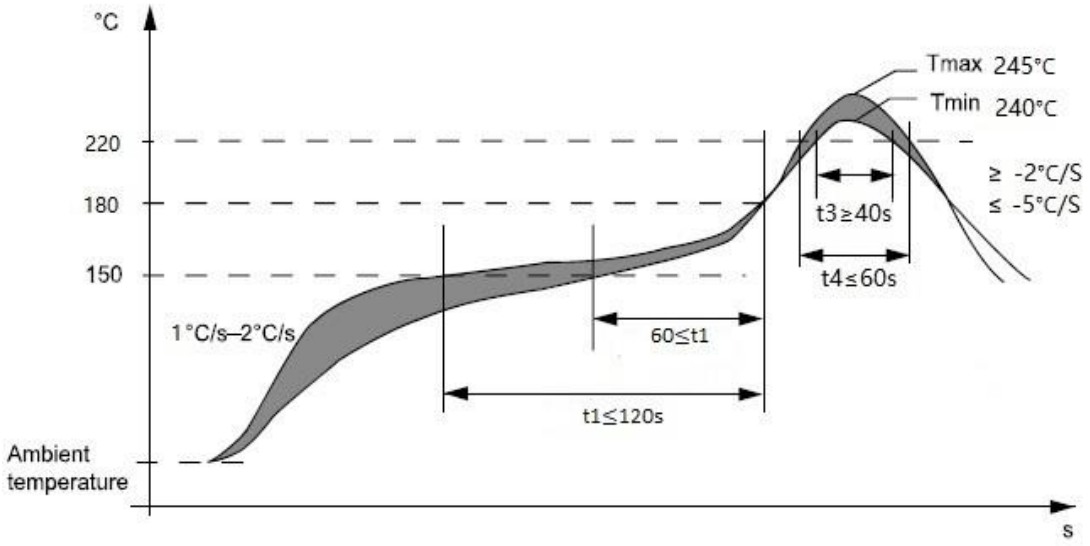


Figure 45: Recommend Physical SMT Stencil Drawing (Unit: mm)

9.5 Recommend Temperature Curve of Reflow Furnace



Reflow profile		
Temperature	**Time**	**Key Parameters**
Preheat zone (room temperature~150°C)	NA	Temperature rise slope:1~2°C
Constant temperature 1 (150~180°C)	60-120s	/
Constant temperature 2 (180~220°C)	15-20s	/
Reflow (≥220℃)	50-70s	Maximum Temperature:240~245°C
Cooling Zone	Cooling Slope:-2~-5°C/s	
Note:Test position contains welding spots of MCU,LGA and LCC.		

Figure 46: Recommend Temperature Curve of Reflow Furnace

NOTE

Please review the “Module Secondary-SMT-UGD” for detailed information on the module transmission, manufacture, and production.

9.6 Moisture Sensitivity Level (MSL)

Modules are shipped in vacuum-sealed aluminum foil bag bags, vacuum-packed according to IPC/JEDEC

specification J-STD-020C

- Recommended storage Range: temperature of 23±5 ° C, and the relative humidity is 35% ~ 60%
- Storage period (vacuum-sealed packed) : The recommended storage period is 12 months

The SIM8971x module meets the Moisture sensitivity level 3. The following table lists the shelf life of the module after unpacking.

The workshop life of the product with MSL 3 is 168 hours. When the temperature of the workshop is 23± 5 ° C and the relative humidity is lower than 60%, the module shall start the reflow soldering or high-temperature operations after unpanking in 168 hours. Otherwise, the module shall be stored in an environ ment with relative humidity less than 10% (such as a moisture-proof cabinet) to keep dry.

Table 62: Moisture Sensitivity Level Classification

Classification	Factory Environment ≦ +30℃/60%RH
1	Indefinite Shelf Life Environment ≦+30℃/85% RH
2	1 Year
2a	4 Weeks
3	168 Hours
4	72 Hours
5	48 Hours
5a	24 Hours
6	Attaching after forced baking After baking, the module must be pasted within the time limit specified on the label

The following situations also require baking treatment:

- The storage temperature and humidity do not meet the recommended storage conditions
- Vacuum sealed packaging bags leak and materials are loose
- Before module repair
- It fails to complete production or storage according to the humidity sensor level 3 control after the module is unpacked

9.7 Baking Requirements

SIM8971 series module should be full baked before reflow welding due to the moisture sensitivity level. Otherwise, the module may be permanently damaged during reflow welding. The module shall be baked for 8 hours in a high-temperature container with a temperature of 120°C±5°C. Note that the tray could not resistant to high temperature. The user should take the module out of the tray for baking, otherwise the tray may be damaged by high temperature.

Table 63: Baking Requirements

Optional Baking Condition	Baking Period
120°C±5°C, <5% RH	8 Hours

NOTE

1. It is not recommended to expose the module to the air for a long time after disassembling the vacuum packaging.
2. Before baking, it is necessary to take the module out of its packaging and place the bare module on a high-temperature resistant appliance to avoid high-temperature damage to the plastic tray or reel; The module for secondary baking must be welded within 24 hours after baking, otherwise it needs to be vacuum packaged again for storage or stored in a drying box.
3. Please pay attention to ESD protection when unpacking and placing modules, such as wearing anti-static gloves.

9.8 Packaging

The SIM8971x module offers the following packaging size.

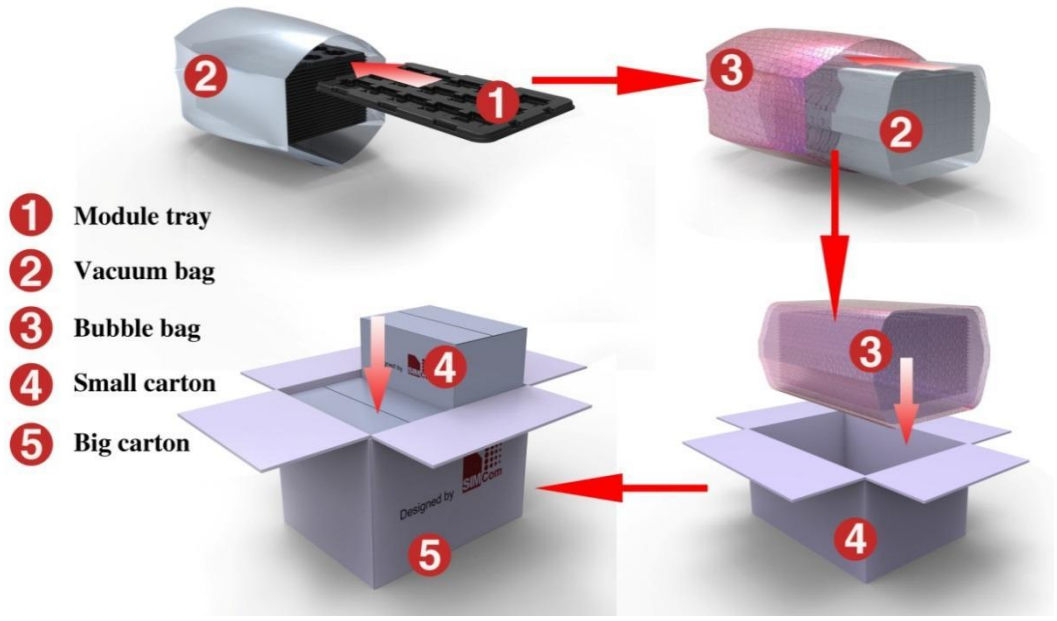


Figure 47: Packaging Diagram

The module tray of the SIM8971x series module is showing as follows.

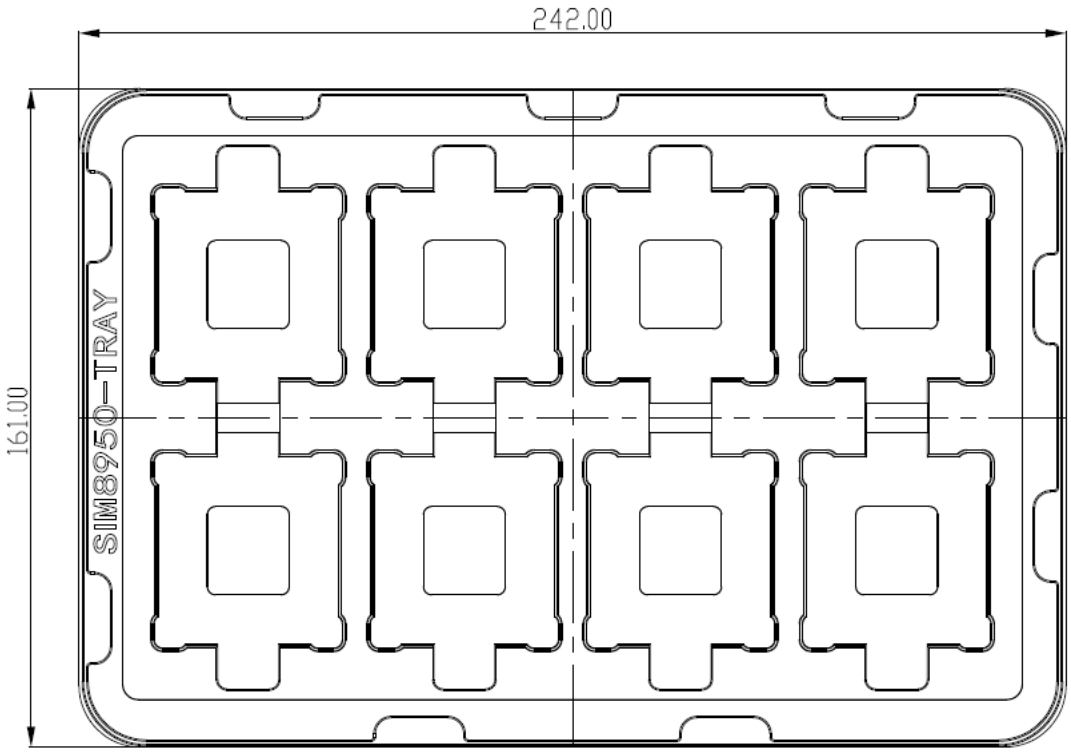


Figure 48: Module Tray Size

Table 64: Module Tray Size

Length（±3mm）	Width（±3mm）	Standard Packaging Num
242.0	161.0	8

The small carton size of the SIM8971x series module is showing as follows.

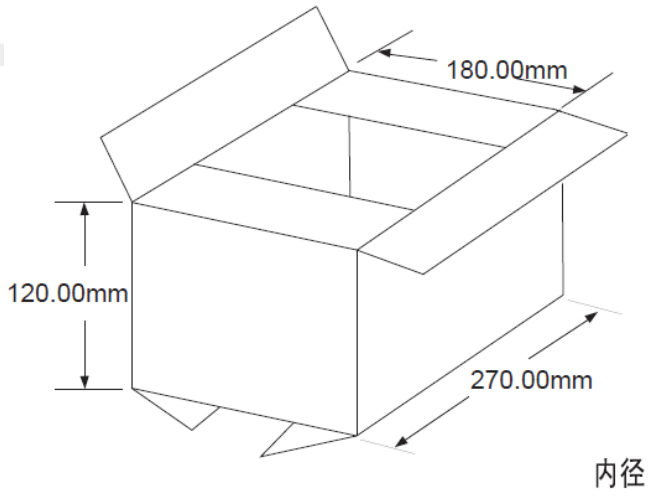


Figure 49: Small Carton Size

Table 65: Small Carton Size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Standard Packaging
270	180	120	8*19-2=150

The big carton size of the SIM8971x series module is showing as follows.

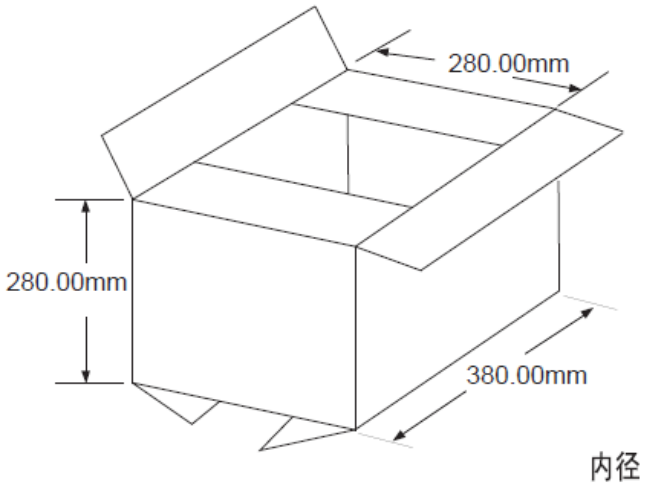


Figure 50: Big Carton Size

Table 66: Big Carton Size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Standard Packaging
380	280	280	150*4=600

10 Recommend Devices

Table 67: Recommend Cameras Lists

Direction	Resolution	Model	Vendor
Front/Back	2M	GC2145	GALAXYCORE
Front	5M	OV5675	OmniVision
		OV5695	OmniVision
		S5K5E9	SAMSUNG
	8M	OV8856	OmniVision
Back	12M	OV12A	OmniVision
		S5K2L7SA03	SAMSUNG
		IMX362	SONY
		MX486	SONY
	13M	AR1337	ON Semiconductor
		OV13855	OmniVision
		OV13880	OmniVision
		S5K3L6	SAMSUNG
		S5K3M3SM24	SAMSUNG
		IMX258(PDAF)	SONY
	16M	HR1630	Huai'an imaging equipment manufacturing Co., Ltd
		OV16B10	OmniVision
		OV16885	OmniVision
Front		OV16885-4C	OmniVision
		S5K3P8SP	SAMSUNG
Back		S5K3P8SX	SAMSUNG
		IMX351	SONY
		IMX499	SONY
Front	20M	OV20880-4C	OmniVision
		S5K2T7SP	SAMSUNG
Back		IMX350	SONY
		IMX376	SONY
	23M	IMX318	SONY

Table 68: Recommend Screen

Model	Vendor	Resolution	Glass	Size
ST7703 -TDO-0545F71958	Truly	FHD	TFT	5.45”

Table 69: Recommend Gyroscope Sensors Lists

No.	Part Number	Vendor	Accelerometer	Gyroscope
1	BMA222E	Bosch	√	√
2	BMA250E	Bosch	√	√
3	BMA253	Bosch	√	√
4	BMA255	Bosch	√	√
5	BMG160	Bosch		√
6	BMI120	Bosch	√	√
7	BMI160	Bosch	√	√
8	BMI260	Bosch	√	√
9	BMI27	Bosch	√	√
10	BMX160	Bosch	√	√
11	ICM-20600	InvenSense	√	√
12	ICM-20602	InvenSense	√	√
13	ICM-20607	InvenSense	√	√
14	ICM-20608-D	InvenSense	√	√
15	ICM-20609	InvenSense	√	√
16	ICM-20621	InvenSense	√	√
17	ICM-20622	InvenSense	√	√
18	ICM-20626	InvenSense	√	√
19	ICM-20690	InvenSense	√	√
20	ICM-40602	InvenSense	√	√
21	ICM-40604	InvenSense	√	√
22	ICM-40605	InvenSense	√	√
23	ICM-42602	InvenSense	√	√
24	ICM-42605	InvenSense	√	√
25	ICM-42605-M	InvenSense	√	√
26	ICM-42608	InvenSense	√	√
27	LSM6DS3TR	ST	√	√
28	LSM6DS3TR-C	ST	√	√
29	LSM6DSLTR	ST	√	√
30	LSM6DSM	ST	√	√
31	LSM6DSMTR	ST	√	√

Table 70: Recommend Geomagnetism Sensors Lists

No.	Part Number	Vendor
1	AK09911C	AKM
2	AK09915C	AKM

3	AK09915D	AKM
4	AK09916C	AKM
5	AK09918C	AKM
6	HSCDTD008A	Alps
7	BMM150	Bosch
8	BMM160	Bosch
9	GMC306	Globalmems
10	IST8305	iSentek
11	IST8306	iSentek
12	IST8307	iSentek
13	IST8310	iSentek
14	MXG4300	MagnaChip
15	MMC3530	MEMSIC
16	MMC3630	MEMSIC
17	MMC3630KJ	MEMSIC
18	MMC5603NJ	MEMSIC
19	STM350MC	Senodia
20	STM480MW	Senodia
21	LIS2MDL	ST
22	AF6133	Voltafield
23	AF6133E	Voltafield
24	AF8133J	Voltafield
25	AF9133	Voltafield
26	YAS539	Yamaha

Table 71: Recommend Light Sensors Lists

No.	Part Number	Vendor	Proximity	Ambient Light
1	TMD26203	ams	√	
2	TMG49033	ams	√	√
2	CM36686	Capella	√	√
3	AP3426	Dyna Image	√	√
4	EPL2590KTWJP	Elan	√	√
5	MN66213	Elan	√	√
6	LTR-578ALS	Lite-On	√	√
7	RPR-0521RS	ROHM	√	√
8	RPR-0531	ROHM	√	√
9	RPR-0531RS	ROHM	√	√
10	STK2232	Sensortek	√	√
11	STK3311	Sensortek	√	√
12	STK3321	Sensortek	√	√

13	STK3327	Sensortek	√	√
14	STK3328	Sensortek	√	√
15	STK3332	Sensortek	√	√
16	STK3335	Sensortek	√	√
17	STK3338	Sensortek	√	√
18	V2000	Sensortek	√	√
19	PA22401001	TXC	√	
20	PA22A00001	TXC	√	√

Table 72: Recommend Pressure Sensors Lists

No.	Part Number	Vendor
1	BME680	Bosch
2	BMP280	Bosch
3	BMP285	Bosch
4	BMP380	Bosch
5	ICP-10100	InvenSense
6	ICP-10101	InvenSense
7	ICP-10110	InvenSense
8	ICP-10111	InvenSense
9	2SMPB-02B	omron
10	2SMPB-02E	omron
11	BM1383AGLV	ROHM
12	LPS22HB	ROHM
13	LPS22HBTR	ROHM
14	LPS22HH	ROHM

11 Appendix

11.1 Relative Documents

Table 73: Relative Documents

No.	Document Name	Description
[1]	GSM 07.07：	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[2]	GSM 07.10：	Support GSM 07.10 multiplexing protocol
[3]	GSM 07.05：	Digital cellular telecommunications (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
[4]	GSM 11.14：	Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[5]	GSM 11.11：	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[6]	GSM 03.38：	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[7]	GSM 11.10	Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification; Part 1: Conformance specification
[8]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[9]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[10]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[11]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[12]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.

[13]	EN 301 908-02 V2.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000. Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive
[14]	EN 301 489-24 V1.2.1	Electromagnetic compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
[15]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[16]	GCF-CC V3.23.1	Global Certification Forum - Certification Criteria
[17]	2002/95/EC	Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

11.2 Terms & Abbreviations

Table 74: Terms & Abbreviations

Terms	Description
ADC	Analog-to-Digital Converter
AMR	Adaptive Multi-Rate
BOM	Bill of materials
bps	Bits per second
BT	Bluetooth
CDMA	Code division multiple access
CS	Coding Scheme
CSD	Circuit Switched Data
CSI	Camera serial interface
CTS	Clear to Send
DAC	Digital-to-analog converter
DDR	Double data rate
DSDA	Dual SIM dual active
DSDS	Dual SIM dual standby
DSP	Digital signal processor
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready

DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
ESD	Electrostatic Discharge
ESR	Effective series resistance
ETS	European Telecommunication Standard
EVDO	Evolution data optimized
FDD	Frequency division duplex
FR	Full Rate
GNSS	Global navigation satellite system
GPIO	General-purpose input/output
GPRS	General Packet Radio Service
GPU	Graphics processing unit
GSM	Global Standard for Mobile Communications
HR	Half Rate
HSPA	High-speed packet access
I2C	Inter-integrated circuit
IMEI	International Mobile Equipment Identity
ISP	Image signal processing
Kbps	kilobits per second
LCD	Liquid crystal display
LDO	Low dropout (linear regulator)
LPDDR	Low-power DDR
MIC	Microphone
MIPI	Mobile industry processor interface
PA	Power amplifier
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PCL	Power Control Level
PCS	Personal Communication System, also referred to as GSM 1900
PDU	Protocol Data Unit
RF	Radio Frequency
PM	Power management
RoHS	Restriction of hazardous substances
PPP	Point-to-point protocol
PWM1	Pulse-width modulator
RMS	Root Mean Square (value)
RTC	Real-time clock
RX	Receive Direction
SD	Secure digital
SDC	Secure digital controller

SIM	Subscriber Identification Module
SMS	Short Message Service
SMT	Surface mount technology
SPI	Serial peripheral interface
TDD	Time Division Distortion
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
UIM	User identity module
URC	Unsolicited Result Code
USB	Universal serial bus
USSD	Unstructured Supplementary Service Data
WCDMA	Wideband code division multiple access
WCN	Wireless connectivity network
WLAN	Wireless local area network

11.3 Safety Caution

Table 75: Safety Caution

Marks	Requirements
	When in a hospital or other health care facility, observe the restrictions about the use of mobiles. Switch the cellular terminal or mobile off, medical equipment may be sensitive and not operate normally due to RF energy interference.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Forgetting to think much of these instructions may impact the flight safety, or offend local legal action, or both.
	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.
	Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.

GSM cellular terminals or mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, especially with a mobile fee or an invalid SIM card. While you are in this condition and need emergent help, please remember to use emergency calls. In order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength.

Some networks do not allow for emergency call if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call.

Also, some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.

Declaration of conformity

Herby, SIMCom Wireless Solutions Limited declares that this MODULE,SIM8971NA is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

CE

EU Declaration of Conformity (DoC)

Hereby we,

Name of manufacturer:	SIMCom Wireless Solutions Limited
Address:	Building 3,No. 289, Linhong Road, Changning District, Shanghai, P.R.China

declare that this DoC is issued under our sole responsibility and that this product:

Product description:	LTE Wireless Data Module
Type designation(s):	SIM8971EA
Trademark:	SIMCom

Object of the declaration: [Model: SIM8971EA The device is LTE Wireless Data Module, it supports 2.4G/5G WIFI, BT, BLE, GPS, 2G/3G/ 4G functions. For more details, pls refer to the user manual.]
is in conformity with the relevant Union harmonization legislation:
Radio Equipment Directive 2014/53/EU:
with reference to the following standards applied:

Safety	IEC 62368-1: 2018; EN IEC 62368-1: 2020+A11: 2020;
Electromagnetic compatibility	ETSI EN 301 489-1 V2.2.3(2019-11) ETSI EN 301 489-3 V2.3.2(2023-01) Draft ETSI EN 301 489-17 V3.2.5 (2022-08) ETSI EN 301 489-19 V2.2.1(2022-09) ETSI EN 301 489-52 V1.2.1 (2021-11) EN IEC 61000-3-2: 2019+A1:2021 EN 61000-3-3: 2013+A2:2021
Radio frequency spectrum usage	ETSI EN 301 511 V12.5.1(2017-03); ETSI EN 301 908-1 V15.1.1(2021-09); ETSI EN 301 908-2 V13.1.1(2020-06); ETSI EN 301 908-13 V13.2.1(2022-02); ETSI EN 300 328 V2.2.2(2019-07); ETSI EN 303 413 V1.2.1(2021-04); ETSI EN 301 893 V2.1.1 (2017-05); ETSI EN 300 440 V2.2.1 (2018-07);
Health	EN IEC 62311: 2020
Article 3.3.g emergency services access	N/A

Notified Body Name: TIMCO Engineering, Inc., with Notified Body number Notified Body Number: 1177
Applicable Modules: B+C
Where applicable:
The issued EU-type examination certificate: XXXXXXXXX
Accessories: N/A

Software version: SIM8971B01V08 *(Note: Some software updates will be released by the manufacturer to fix some bug or enhance some function after placing on the market. All versions released by the manufacturer have been verified and still compliance with the related rules. All RF parameters (e.g.: frequency range, output power) are not accessible to the user, and can't be changed by the user.)*

Signed for and on behalf of:
August 25, 2023 China
Place and date of issue

Mr Yongsheng Li, Manager
Name, Function, signature

Is in conformity with the Radio Equipment Regulation 2017 with reference to the following Standards applied:

Health and Safety	IEC 62368-1: 2018 EN IEC 62368-1: 2020+A11: 2020 EN IEC 62311: 2020
Electromagnetic compatibility	ETSI EN 301 489-1 V2.2.3(2019-11) ETSI EN 301 489-19 V2.2.1(2022-08) ETSI EN 301 489-52 V1.2.1 (2021-11) EN IEC 61000-3-2: 2019 EN 61000-3-3: 2013+A1:2019
Radio frequency spectrum usage	ETSI EN 301 908-1 V15.1.1(2021-09); ETSI EN 301 908-2 V13.1.1(2020-06); ETSI EN 301 908-13 V13.2.1(2022-02); Draft ETSI EN 301 908-25 V15.1.1_0.0.9(2021-06); 3GPP TS 38.521-1 V17.4.0(2022-03); 3GPP TS 38.521-3 V17.4.0(2022-03); ETSI EN 303 413 V1.2.1(2021-04);

The UK Approved Body Kiwa Ltd., with Approved Body number 0058 performed:
[choose applicable Modules: B+C]

Where applicable:
The issued UK type examination certificate: [XXXXXXXXXX]

Accessories:

Hareware version: V1.03
Software Version: 2212B03V02X62M44A-M2
Signed for and on behalf of:

June 7, 2023 China
Place and date of issue

Mr Yongsheng Li Manager
Name, Function, signature

FCC MODULAR APPROVAL INFORMATION EXAMPLES for Manual

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1 This device may not cause harmful interference.
2 This device must accept any interference received, including interference that may cause undesiredoperation.

CAUTION: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

1 Reorient or relocate the receiving antenna.

2 Increase the separation between the equipment and receiver.

3 Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

4 Consult the dealer or an experienced radio/TV technician for help.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

OEM INTEGRATION INSTRUCTIONS:

This device is intended only for OEM integrators under the following conditions:

The module must be installed in the host equipment such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the internal on-board antenna that has been originally tested and certified with this module. External antennas are not supported. As long as these 3 conditions above are met, further transmitter test will not be required.

However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.). The end-product may need Verification testing, Declaration of Conformity testing, a Permissive Class II Change or new Certification. Please involve a FCC certification specialist in order to determine what will be exactly applicable for the end-product.

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product(including the transmitter) and obtaining a separate FCC authorization. In such cases, please involve a FCC certification specialist in order to determine if a Permissive Class II Change or new Certification is required.

Upgrade Firmware:

The software provided for firmware upgrade will not be capable to affect any RF parameters as certified forthe FCC for this module, in order to prevent compliance issues.

End product labeling:

This transmitter module is authorized only for use in device where the antenna may be installed such that20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains FCC ID: 2AJYU-8XK0001”.

Information that must be placed in the end user manual:

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

“CAUTION: Exposure to Radio Frequency Radiation.

Antenna shall be mounted in such a manner to minimize the potential for human contact during normal operation. The antenna should not be contacted during operation to avoid the possibility of exceeding theFCC radio frequency exposure limit.

Requirement per KDB996369 D03

3.14 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of amodule grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need tonotify host manufacturers that further testing is required.3

Explanation: This module meets the requirements of FCC part 22, part 24, part 27, part90.

3.15 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits onantennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer’s instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The EUT has a Rubber Duck Antenna, and the antenna use a permanently attached antennawhich is not replaceable

3.16 Limited module procedures

If a modular transmitter is approved as a “limited module,” then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the productinto which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is not a limited module.

3.17 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects:

layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

1 Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width,shape(s),

dielectric constant, and impedance as applicable for each type of antenna);

2 Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency,

the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);

3 The parameters shall be provided in a manner permitting host manufacturers to design the printedcircuit (PC) board layout;

4 Appropriate parts by manufacturer and specifications;

5 Test procedures for design verification; and

6 Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: Yes, The module with trace antenna designs, and This manual has been shown the layout of trace design, antenna, connectors, and isolation requirements.

3.18 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: 2AJYU-8XK0001.

3.19 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type")).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The EUT has a Rubber Duck Antenna, and the antenna use a permanently attached antenna which is not replaceable.

3.20 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes

advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCCID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the following texts: “Contains FCC ID: 2AJYU-8XK0001”

3.21 Information on test modes and additional testing requirements5

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer’s determination that a module as installed in a host complies with FCC requirements.

Explanation: Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

3.22 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specificrule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuity, so the module does not require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B.