

Product Specification

QCA9377-3 Dual-Band 1x1 802.11ac and Bluetooth v4.1 Combo Module

Project Name	QCA9377-3 WiFi+BT Combo LGA Module
Part No.	W9377
Model Name.	-

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0. Revision History

Date	Document revision	Author	Change Description
2015/3/31	0.1	Andy. Tu	Initial release(draft)
2015/4/10	0.2	Andy. Tu	Update LGA pin-out and Mechanical Drawing
2015/07/10	0.3	Rachel.wu	Update RF characteristics
2015/07/27	0.4	Rachel.wu	1. Change LGA Pin#6 signal from NC to Host_wakeup_BT in section2.3 2. Update the reflow profile in section7.6

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1. Introduction

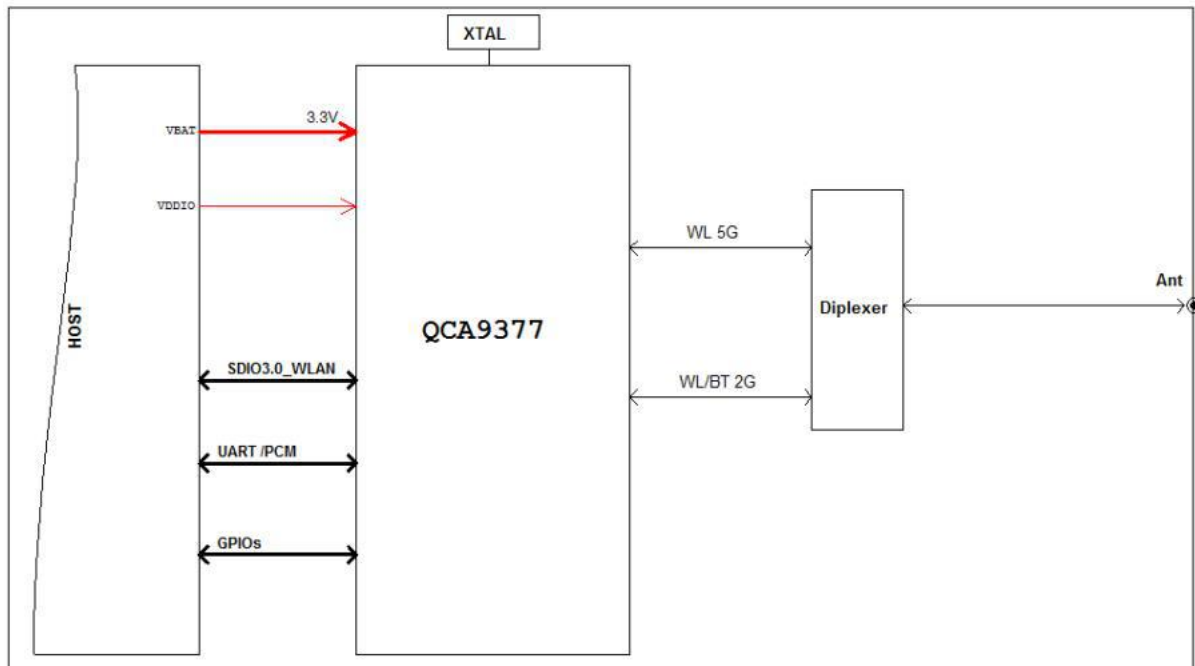
Project Name: QCA9377-3 WLAN+BT Combo LGA Module

Project Number: W9377

This documentation describes the engineering requirements specification of QCA9377-3 LGA module. It is a confidential document .

1.1 Scope

This module design is based on the Qualcomm Atheros QCA9377-3 HW v1.1 chipset. The QCA9377-3 is a single-chip wireless local area network (WLAN) and Bluetooth (BT) combo solution to support 1x1 with IEEE802.11a/b/g/n/ac WLAN standards and BT4.1+HS enabling seamless integration of WLAN/BT and Low Energy technology.



1.2 Function

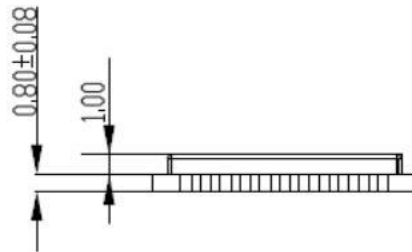
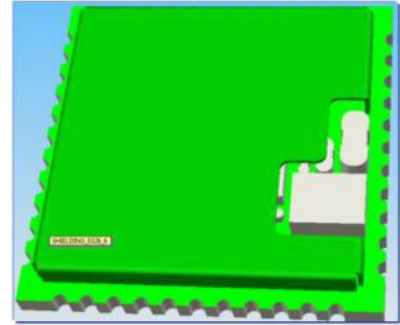
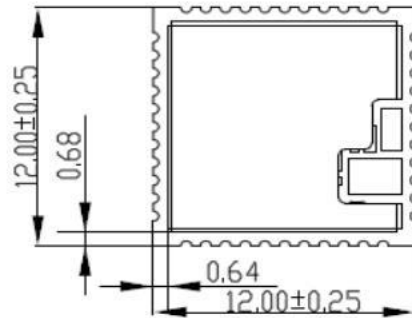
- WLAN dual-band 1x1 IEEE802.11a/b/g/n/ac and Bluetooth V4.1+HS
- Support WLAN 20MHz/40MHz at 2.4GHz and 20/40/80 MHz at 5GHz
- Support BT4.1+HS , BLE and be backwards compatible with BT1.x,2.x+EDR.
- Support BT for class 1 and class 2 power level transmissions without requiring an external PA.
- Support low-power SDIO3.0 interface for WLAN and UART/PCM interface for BT
- Support Multi-user MiMO
- Support WiFi/BT coexistence
- Both WLAN and BT power management utilize advanced power saving techniques:
 - ✓ clock gating on idle or inactive blocks;
 - ✓ voltage scaling on specific blocks in certain states;
 - ✓ fast start and settling circuits to reduce Tx;
 - ✓ active duty cycles, processor frequency scaling,
 - ✓ and other techniques to optimize power consumption across all operating states.Including additional features such as: Low-Density Parity Check(LDPC)
- One-chip one-time programmable(OTP) memory
- GP/HF compliance

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2. Mechanical Specification

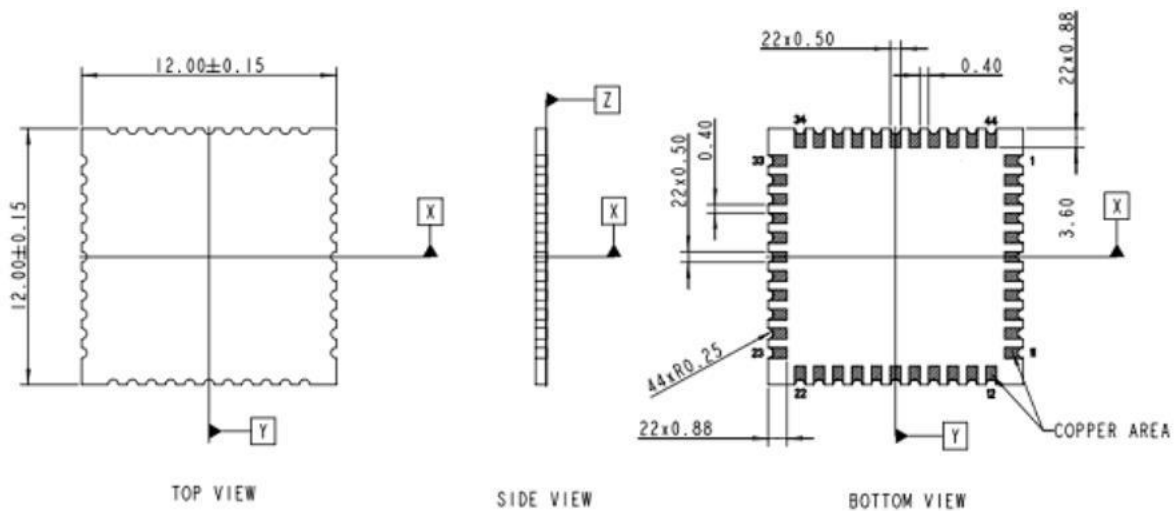
2.1 Mechanical Drawing

Typical module dimension (W x L): 12mm x12mm.
The Z-height is 1.85mm (typical) and 1.98mm (max)



Unit: mm

2.2 Recommended LGA Land Pattern



Unit: mm

Suggest use "solder-mask on pad" design for main-board LGA pad

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2.3 Module LGA Pin-out

[illegible]

Signal Group	Pin No.	Signal	I/O	Description	Voltage	Connecting
Power	9	VDD	I	DC power supply +3.3V input	3.3V	Yes
	22	VDDIO	I	External power source input for VIO domain. Default use 1.8V for SDIO3.0 mode	1.8V or 3.3V	Yes
Ground	1,3,20,31,33,36	GND		Return current path	0V	Yes
ANT	2	WL_BT_ANT	I/O	Wi-Fi/BT RF signal	-	Yes
Control	12	WL_EN	I	GPIO pin to on/off the Wi-Fi function by software. Active high. Reserve pull high 100K resistor and shunt 100pF capacitor to GND on platform.	VDDIO	Yes
	34	BT_EN	I	GPIO pin to on/off the BT function by software. Active high. Reserve pull high 100K resistor and shunt 100pF capacitor to GND on platform.	VDDIO	Yes

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	24	LPO	I	External low-power 32.768KHz clock input.	VDDIO	Yes
	13	WL_wakeup_Host	O	WLAN device wakeup platform	VDDIO	Yes
SDIO	6	Host_wakeup_BT	I	Host/platform wakeup BT device	VDDIO	Yes
	14	SDIO_DATA2	I/O	SDIO data2 exchange,	VDDIO	Yes
	15	SDIO_DATA3	I/O	SDIO data3 exchange	VDDIO	Yes
	16	SDIO_CMD	I/O	SDIO Command Interface	VDDIO	Yes
	17	SDIO_CLK	I	SDIO 3.0 Clock	VDDIO	Yes
	18	SDIO_DATA0	I/O	SDIO data0 exchange	VDDIO	Yes
	19	SDIO_DATA1	I/O	SDIO data1exchange	VDDIO	Yes
UART/ PCM	41	UART RTS	O	UART Ready To Send, connected to CTS on the platform.	VDDIO	Yes
	42	UART_TXD	O	UART Transmit Data, connected to RXD on the platform.	VDDIO	Yes
	43	UART_RXD	I	UART Receive Data, connected to TXD on the platform.	VDDIO	Yes
	44	UART CTS	I	UART Clear To Send, connected to RTS on the platform.	VDDIO	Yes
	25	PCM_OUT	O	PCM synchronous data output, connected to PCM_IN on the platform.	VDDIO	Yes
	26	PCM_CLK	I/O	PCM Clock	VDDIO	Yes
	28	PCM_SYNC	I/O	PCM synchronous data SYNC	VDDIO	Yes
	27	PCM_IN	I	PCM synchronous data input, connected to PCM_OUT on the platform.	VDDIO	Yes
UART_De bug	39	Debug_UART_TXD	O	TXD for Wi-Fi Uart_debug only, connected to RXD of the platform.	VDDIO	Option
	40	Debug_UART_RXD	I	RXD for Wi-Fi Uart_debug only, connected to TXD of the platform.	VDDIO	Option
JTAG_De bug	7	TRSTN &BT_wakeup_Host	I/O	1.BT wakeup platform 2.Reserve for EJTAG	VDDIO	Yes
	8	TMS	I/O	Reserve for EJTAG	VDDIO	Option
	29	TDI	I	Reserve for EJTAG	VDDIO	Option
	30	TDO	O	Reserve for EJTAG	VDDIO	Option
	32	TCK	I/O	Reserve for EJTAG	VDDIO	Option
Others	4,5,10,11, 21,23,35, 37,38	NC		No Connect		No

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3. Electrical Specification

3.1 Absolute Maximum Ratings

These specifications indicate levels where permanent damage to the device can occur. Functional operation is not guaranteed under these conditions. Operation at absolute maximum conditions for extended can adversely affect long-term reliability of the device.

Symbol	Condition	Min.	Typ.	Max	Unit
VDD	Respect to GND	-0.3	3.3	3.63	V
Max Ripple on Supplied Voltage	3.3V			330	mVpp
Storage Temperature	--	-40	25	+85	°C
ESD(HBM)				2000	V

3.2 Recommended Operating Condition

Symbol	Condition	Min.	Typ.	Max	Unit
VDD	Respect to GND	3.135	3.3	3.465	V
VDDIO	Respect to GND	1.71	1.8 or 3.3	3.46	V
Operating Temperature	--	-10	+25	+70	°C

Function operation is not guaranteed outside this limit, and operation outside this limit for extended periods can adversely affect long-term reliability of the device.

3.3 Digital Logic Characteristics

Table 1 General DC Electrical Characteristics (for 1.8V VIO Operation)

Symbol	Parameter	Condition	Min.	Max	Unit	Notes
+3.3V	Power supply		3.3-5%	3.3+5%	V	
VIH	High-level input voltage		0.7-VIO	VIO+0.3	V	
VIL	Low-level input voltage		-0.3	0.3-VIO	V	
IIL	Input low leakage current		-5	5	uA	
VOH	High-level output voltage		VIO-0.4	VIO	V	
VOL	Low-level output voltage		0	0.4	V	
IOH	High-level output voltage		3	-	mA	
IOL	Low-level output current		-	-11	mA	

3.4 RF Characteristics

All typical performance specification are based-on operation at room temperature(+25°C) using default parameter setting and nominal supply voltages at RF connector port.

¹
Note : The target power table maybe updated later based-on final DVT report and official regulatory testing.

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Wi-Fi	Standard	IEEE802.11a/b/g/n/ac																																		
	Data Rate	802.11b: 11, 5.5, 2, 1 Mbps; 802.11 a/g: 54, 48, 36, 24, 18, 12, 9, 6 Mbps 802.11n: HT20 mode: MCS0~MCS15,up to 72.2Mbps HT40 mode: MCS0~MCS15,up to 150Mbps 802.11ac VHT80:MCS0~MCS9,up to 433.3Mbps																																		
	Bandwidth	20MHz,40MHz for 2.4GHz, 20MHz, 40MHz, 80MHz for 5GHz																																		
	Modulation Techniques	802.11b: CCK, DQPSK, DBPSK 802.11a/g: 64QAM,16QAM, QPSK, BPSK 802.11n: 64QAM,16QAM, QPSK, BPSK 802.11ac: 256QAM,64QAM,16QAM, QPSK, BPSK																																		
	Frequency Range	2.4GHz~2.4835GHz, 5.15GHz~5.845GHz																																		
	Media Access Control	CSMA/CA with ACK																																		
	Transmit Output Power (Power tolerance 2G: +/-1.5dB and 5G: +/-2dB) Note:	<table><tr><td>CCK</td><td>1L, 2, 5L</td><td>5S</td><td>11L</td><td>11S</td></tr><tr><td>2G</td><td>19</td><td>19</td><td>19</td><td>19</td></tr></table>										CCK	1L, 2, 5L	5S	11L	11S	2G	19	19	19	19															
		CCK	1L, 2, 5L	5S	11L	11S																														
		2G	19	19	19	19																														
		<table><tr><td>OFDM</td><td>6 ~ 24</td><td>36</td><td>48</td><td>54</td></tr><tr><td>2G</td><td>18</td><td>17</td><td>17</td><td>17</td></tr><tr><td>5G</td><td>15</td><td>14</td><td>13</td><td>12</td></tr></table>										OFDM	6 ~ 24	36	48	54	2G	18	17	17	17	5G	15	14	13	12										
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2G		18	17	17	17																															
5G		15	14	13	12																															
Nss=1 <table><tr><td>HT20</td><td>MCS0</td><td>MCS1_2</td><td>MCS3_4</td><td>MCS5</td><td>MCS6</td><td>MCS7</td></tr><tr><td>2G</td><td>18</td><td>18</td><td>18</td><td>17</td><td>17</td><td>16.5</td></tr><tr><td>5G</td><td>15</td><td>15</td><td>14</td><td>13</td><td>13</td><td>11</td></tr></table>										HT20	MCS0	MCS1_2	MCS3_4	MCS5	MCS6	MCS7	2G	18	18	18	17	17	16.5	5G	15	15	14	13	13	11						
HT20		MCS0	MCS1_2	MCS3_4	MCS5	MCS6	MCS7																													
2G		18	18	18	17	17	16.5																													
5G		15	15	14	13	13	11																													
Nss=1 <table><tr><td>HT40</td><td>MCS0</td><td>MCS1_2</td><td>MCS3_4</td><td>MCS5</td><td>MCS6</td><td>MCS7</td></tr><tr><td>2G</td><td>17</td><td>17</td><td>17</td><td>16</td><td>16</td><td>16</td></tr><tr><td>5G</td><td>14</td><td>14</td><td>14</td><td>13</td><td>13</td><td>11</td></tr></table>										HT40	MCS0	MCS1_2	MCS3_4	MCS5	MCS6	MCS7	2G	17	17	17	16	16	16	5G	14	14	14	13	13	11						
HT40		MCS0	MCS1_2	MCS3_4	MCS5	MCS6	MCS7																													
2G		17	17	17	16	16	16																													
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VHT20	MCS0	MCS1_2	MCS3_4	MCS5	MCS6	MCS7	MCS8																													
2G	-	-	-	-	-	-	-																													
15	15	15	14	13	13	11	11																													
Nss=1 <table><tr><td>VHT40</td><td>MCS0</td><td>MCS1_2</td><td>MCS3_4</td><td>MCS5</td><td>MCS6</td><td>MCS7</td><td>MCS8</td><td>MCS9</td></tr><tr><td>2G</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr><tr><td>5G</td><td>14</td><td>14</td><td>14</td><td>13</td><td>13</td><td>11</td><td>10</td><td>9</td></tr></table>										VHT40	MCS0	MCS1_2	MCS3_4	MCS5	MCS6	MCS7	MCS8	MCS9	2G	-	-	-	-	-	-	-	-	5G	14	14	14	13	13	11	10	9
VHT40	MCS0	MCS1_2	MCS3_4	MCS5	MCS6	MCS7	MCS8	MCS9																												
2G	-	-	-	-	-	-	-	-																												
5G	14	14	14	13	13	11	10	9																												
Nss=1 <table><tr><td>VHT80</td><td>MCS0</td><td>MCS1_2</td><td>MCS3_4</td><td>MCS5</td><td>MCS6</td><td>MCS7</td><td>MCS8</td><td>MCS9</td></tr><tr><td>5G</td><td>13</td><td>13</td><td>13</td><td>12</td><td>12</td><td>10</td><td>9</td><td>8</td></tr></table>										VHT80	MCS0	MCS1_2	MCS3_4	MCS5	MCS6	MCS7	MCS8	MCS9	5G	13	13	13	12	12	10	9	8									
VHT80	MCS0	MCS1_2	MCS3_4	MCS5	MCS6	MCS7	MCS8	MCS9																												
5G	13	13	13	12	12	10	9	8																												

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BT	Minimum Receiver Sensitivity	2.4GHz: 11b 1Mbps: -97dBm(typical)@PER<=8% 11b 11Mbps: -90dBm(typical) @PER<=8% 11g 6Mbps: -92dBm(typical)@PER<=10% 11g 54Mbps: -76dBm(typical)@PER<=10% 11n HT20 MCS0: -92dBm(typical)@PER<=10% 11n HT20 MCS7: -73dBm(typical)@PER<=10% 11n HT40 MCS0: -89dBm(typical)@PER<=10% 11n HT40 MCS7: -71dBm(typical)@PER<=10% 5GHz: 11a 6Mbps: -89dBm(typical) @PER<=10% 11a 54Mbps: -73dBm(typical) @PER<=10% 11n HT20 MCS0: -89dBm (typical)@PER<=10% 11n HT20 MCS7: -69dBm(typical)@PER<=10% 11n HT40 MCS0: -86dBm(typical)@PER<=10% 11n HT40 MCS7: -67dBm(typical)@PER<=10% 11ac VHT20 MCS8 Nss=1: -67dBm (typical)@PER<=10% 11ac VHT40 MCS9 Nss=1: -63dBm(typical)@PER<=10% 11ac VHT80 MCS9 Nss=1: -60dBm(typical)@PER<=10%
	Radio Modulation	FHSS
	Operating Frequency	2.402GHz ~ 2.4835GHz
	Channel Numbers	79 channels with 1MHz BW
	BDR Transmitter Output Power	Typical: +10dBm (class1,it can be changed by BT firmware)
	BDR Power Control	2dB≤Power Control Step≤8dB
	BDR Initial Carrier Freq. Tolerance	≤ ± 75 kHz
	BDR Carrier Frequency Drift	Drift Rate/50us <±20kHz DH1: +/- 25kHz,DH3: +/- 40kHz,DH5: +/- 40kHz
	BDR Modulation Characteristics	140kHz ≤ Δf1avg ≤175kHz Δf2max ≥115kHz Δf2avg/Δf1avg ≥0.8
	BDR Maximum Receiver Signal	-20dBm@ BER <= 0.1% at 1Mbps
	BDR Multi-slot Sensitivity	Typical -90dBm @ BER <= 0.1% at 1Mbps
	BDR Single Sensitivity	Typical -90dBm @BER <= 0.1% at 1Mbps
	EDR Relative Power	P[GFSK]-4dB<P[DPSK]< P[GFSK]+1dB
	EDR Stability and Mod Accuracy	-75 kHz <ωi < 75 kHz -10kHz<ω0 <10kHz RMS DEVM<=0.13 for all 8DPSK @3Mbps Peak DEVM<=0.25 for all 8DPSK @3Mbps 99% DEVM<=0.2 for 99% 8DPSK @3Mbps
	BDR Frequency Range	FL>2.4GHz,FH<2.4835GHz
	EDR Sensitivity	Typical -88dBm@BER <= 0.01% at 2Mbps Typical -85dBm@BER <= 0.01% at 3Mbps
	BDR TX Output Spectrum -20dB Bandwidth	≤1MHz
	LE Output Power	≥ -6dBm(Typical)
	LE Modulation Characteristics	225kHz ≤ Δf1avg ≤275kHz; Δf2max ≥185kHz for at least 99.9% test packets; Δf2avg/Δf1avg ≥0.8
	LE Carrier frequency offset and drift	Carrier frequency offset: ±150kHz Carrier Drift: ≤50kHz Drift rate: ≤20kHz/50us
	LE Receiver Sensitivity	Typical -90dBm@PER <= 30.8%,GFSK,1Mbps

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3.5 Operating System Support

Support the Linux & Android operating system on normal driver.

4. Regulatory Certification

The product delivery is a pre-tested module, without the module level certification. For module approval, the platform's antennas are required for the certification.

5. Quality

This combo module shall pass the standard reliability testing.
The product quality must be followed-up by Foxconn factory quality control system.

6. Environmental Requirements and Specifications

6.1 Temperature

6.1.1 Operating Temperature Conditions

The product shall be capable of continuous reliable operation when operating in ambient temperature of -10°C to +70°C.

6.1.2 Non-Operating Temperature Conditions

Neither subassemblies shall be damaged nor shall the operational performance be degraded when restored to the operating temperature when exposed to storage temperature in the range of -40°C to +85°C.

6.2 PCB Bending

The PCB bending spec shall be keep planeness under 0.1mm for both Foxconn and end assembly customer.

6.3 Handling environment

6.3.1. ESD

The product ESD immunity is HBM(Human Body Model) +2000(V) max . Please handle it under ESD protection environment.

This device is ESD sensitive device, it must be protected at all times from ESD, industry-standard ESD precautions should be used at all times.

6.3.2. Terminals

The product is mounted with motherboard through Land Grid Array. In order to prevent poor soldering, please do not touch LGA portion by hand.

6.3.3. Falling

It will cause damage on the mounted components when the product is falling or receiving drop shock. It may cause the product mal-function.

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7.4 Storage Condition

7.4.1 Moisture barrier bag before opened

Moisture barrier bag must be stored under 30 degree C, humidity under 85% RH. The calculated shelf life for the dry packed product shall be a 12 months from the bag seal date.

7.4.2. Moisture barrier bag open

Humidity indicator cards must be blue, <30%.

7.5 Baking Condition

Products require baking before mounting if

1. Humidity indicator cards reads >30%
2. Temp <30 degree C, humidity < 70% RH, over 96 hours

Baking condition: 125 degree C, 12 hours

Baking times: 1 time

7.6 Soldering and reflow condition

- 1) Heating method
Conventional Convection or IR/convection
- 2) Temperature measurement
Thermocouple d=0.1mm ~ 0.2mm CA (K) or CC (T) at soldering portion or equivalent method.
- 3) Solder paste composition
Sn/3.0Ag/0.5Cu
- 4) Allowable reflow soldering times: 2 times based on the below reflow soldering profile
Recommend only one time reflow soldering for better reliability performance.
- 5) Temperature profile
Reflow profile condition typically used by QCA is given as below

QCA typical SMT reflow profile conditions (for reference only)

Profile stage	Description	Temperature range	Lead-free (high-temperature) condition limits
Preheat	Initial ramp	< 150°C	3°C/sec max
Soak	Dry out and flux activation	150 to 190°C	75 to 120 sec
Ramp	Transition to liquidus (solder-paste melting point)	190 to 220°C	< 30 sec
Reflow	Time above liquidus	220 to 245°C ¹	50 to 70 sec
Cool down	Cool rate - ramp-to-ambient	< 220°C	6°C/sec max

1. During the reflow process, the recommended peak temperature is 245°C (minimum). This temperature should not be confused with the peak temperature reached during MSL testing

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