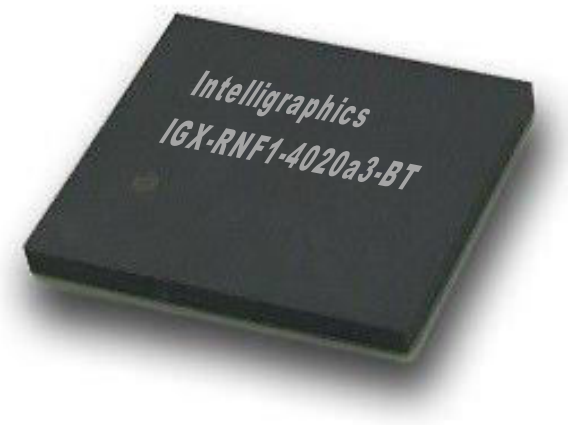
Datasheet
IGX QCA4020
Hardware Module - IGX-RNF1-4020a3-BT

Intelligraphics
Intelligent Connected Secure

IGX-RNF1-4020a3-BT



»» Ultra Small 802.11n Dual-Band 1Tx1R Wireless + Bluetooth v5.0 + Zigbee (15.4) IoT Module

This module is an intelligent platform for the Internet of Things (IoT) that contains a low-power Wi-Fi (802.11 a/b/g/n 1x1), Bluetooth Low Energy (BLE) 5.0 and Zigbee (802.15.4) connectivity protocols along with SSL, enabling a low-cost, low-complexity system to obtain full-featured internet connectivity and reliable information exchange.

QCA4020 device contains three processors:

- The first processor, an ARM Cortex-M4F@ up to 128MHz is used as the application processor. It runs the Qualcomm network stack as well as OEM application code. Customer software runs under an RTOS such as ThreadX or FreeRTOS and so on.
- Second processor, an ARM Cortex-M0@64MHz, which is utilized as the connectivity processor for BLE and 802.15.4 subsystem.
- Third processor, CPU which is a dedicated processor to run the Wi-Fi dual-band function.

The IGX-RNF1-4020a3-BT module provides a highly-integrated and flexible platform for developing and evaluating products and applications based on QCA4020 SoC. IGX-RNF1-4020a3-BT module can be either used with a development kit for software development or incorporated into OEM products to enable rapid deployment of Wi-Fi connected system.

KEY FEATURES

- IEEE Standards Support, 802.11a, 802.11b, 802.11g, 802.11n, and single-stream 1x1.
- Supports 20MHz channel width in 2.4 and 5GHz.
- Operate at ISM frequency Band (2.4/5GHz).
- Bluetooth Low Energy (BLE) compliant to the SIG v5.0 specification.

- Green TX power-saving mode and Low-power listen mode.
- Rich set of GPIOs and interface: I2C, HSUART, UART, SPI, QSPI, SDIO2.0, I2S, JTAG, Sensor ADC (up to 8 channels, 12bit, 1Mbps), up to 8 PWM optimized for LED lighting applications.
- Advanced power management scheme to minimize power dissipation for each use case.
- Supports 32Mb NOR flash memory.
- Supports on board printed Antenna.
- Supporting OS: **ThreadX RTOS and FreeRTOS**

SPECIFICATIONS

1. Software Specifications

Standards	• 802.11a;802.11b; 802.11g; 802.11n, 802.11d, 802.11h , 802.11v • STA, SoftAP Mode, WiFi-Direct, IBSS • 11n Features: STBC, LDPC, MLD, MRC, Short GI, AMPDU Rx and Tx aggregation, AMSDU Rx
Driver Support	**ThreadX RTOS and FreeRTOS**
Security	• WEP, WPA-PSK, WPA2-PSK, WPS • Enterprise IEEE 802.1x EAP-TLS
Network Services Support	• TCP, UDP, DHCP client/server, BSD Socket, SSL • DNS client/server, SNTP, CoAP Client/server, websocket • HTTP Client/Server, MQTT Client, SSDP, mDNS, IGMP v1/v2
Supported IoT Frameworks	• Amazon Web Services (AWS) IoT • Microsoft Azure IoT
SDK Features	• Concurrent demo SCC/MCC (SoftAP + STA) • Concurrent mode: Wi-Fi direct client + Legacy Station • Sniffer mode with optional filters • Low power listen, Preferred Network Offload (PNO) • Network solicitation offload • ARP Offload

	• Wake on Wireless (WoW) • OTA firmware upgrade • Secure Storage and Secure Boot • Support for Green Tx, Store-Recall (Suspend/Resume)

2. Zigbee Function

Standard	802.15.4
Modulation Scheme	O-QPSK
Transmit Output Power	Typical: 0dBm
Receiver Sensitivity	-101dBm

3. Bluetooth Function

Main Chipset	Qualcomm QCA4020
Standard	BT v5.0
Bus Interface	UART
Data Rate	1Mbps, 2Mbps
Modulation Scheme	GFSK
Frequency Range	2.400 ~ 2.4835GHz
Operating Channel	0 ~ 39

Transmit Output Power	+4 ≤ Output Power ≤ +2dBm; Class 2 Device
Receiver Sensitivity	< 0.1% BLE 1M at -93dBm

4. Wi-Fi Function

Main Chipset	Qualcomm QCA4020
Standards	IEEE 802.11a; 802.11b; 802.11g; 802.11n
BUS Interface	UART
Data Rate	**802.11a:** 54, 48, 36, 24, 18, 12, 9, 6Mbps **802.11b:** 11, 5.5, 2, 1Mbps **802.11g:** 54, 48, 36, 24, 18, 12, 9, 6Mbps **802.11n:** MCS 0 ~ 7 for HT20
Media Access Control	CSMA/CA with ACK
Modulation Technique	**802.11a:** 64QAM, 16QAM, QPSK, BPSK **802.11b:** CCK, DQPSK, DBPSK **802.11g:** 64QAM, 16QAM, QPSK, BPSK **802.11n:** 64QAM, 16QAM, QPSK, BPSK
Network Architecture	Infrastructure mode
Operation Channel	**2.4GHz:-** 11: (Ch. 1-11) – United States 13: (Ch. 1-13) – Europe 14: (Ch. 1-14) – Japan **5GHz:-** 21: USA 19: EU 8: Japan
Frequency Range	**802.11bg:** 2.400 ~ 2.4835GHz **802.11a:** 5.15 ~ 5.85GHz
Transmit Output Power - single chain @ant;Tolerance:	**± 2dBm @ 2.4GHz; ±2.5dBm @ 5GHz** **2.4GHz:**

802.11b	**1Mbps**	**2Mbps**	**5.5Mbps**	**11Mbps**
Tgtpwr (dBm)	17	17	17	17

802.11g	6~24Mbps	36Mbps	48Mbps	54Mbps
Tgtpwr (dBm)	16	16	16	16

802.11n HT20	MCS0	MCS1	MCS2	MCS3	MCS4
Tgtpwr (dBm)	16	16	16	16	16
	MCS5	MCS6	MCS7		
	16	16	16		

5GHz:

802.11a	6~24Mbps	36Mbps	48Mbps	54Mbps
Tgtpwr (dBm)	13	13	12	11

802.11n HT20	MCS0	MCS1	MCS2	MCS3	MCS4
Tgtpwr (dBm)	13	13	13	13	12
	MCS5	MCS6	MCS7		
	11	10	9		

Receiver Sensitivity

Frequency Band	Rate	Condition	1x1(1SS) (dBm)
2.4G	11b-1M	PER < 8%	-94
	11b-11M	PER < 8%	-87
	11g-6M	PER < 10%	-91
	11g-54M	PER < 10%	-75
	11n-HT20MCS0	PER < 10%	-92
	11n-HT20MCS7	PER < 10%	-71
5G	11a-6M	PER < 10%	-89
	11a-54M	PER < 10%	-72
	11n-HT20MCS0	PER < 10%	-89
	11n-HT20MCS7	PER < 10%	-69

Security	WPA, WPA2, WEP 64bit & 128bit, IEEE 802.1X, IEEE 802.11i

5. Common Function

<table>
<tr><td>Operating Voltage</td><td colspan="5">3.3 V ± 5% I/O supply voltage</td></tr>
<tr><td>Power Consumption</td><td colspan="5">
<table>
<tr><td rowspan="2">Mode</td><td colspan="2">Average</td><td colspan="2">Peak</td></tr>
<tr><td>2.4G</td><td>5G</td><td>2.4G</td><td>5G</td></tr>
<tr><td>TX</td><td>315mA</td><td>360mA</td><td rowspan="3">472mA</td><td rowspan="3">540mA</td></tr>
<tr><td>RX</td><td>302mA</td><td>360mA</td></tr>
<tr><td>Standby</td><td colspan="2">70mA</td></tr>
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<tr><td>Antenna Type</td><td colspan="5">Printed Antenna for WiFi/BT/15.4</td></tr>
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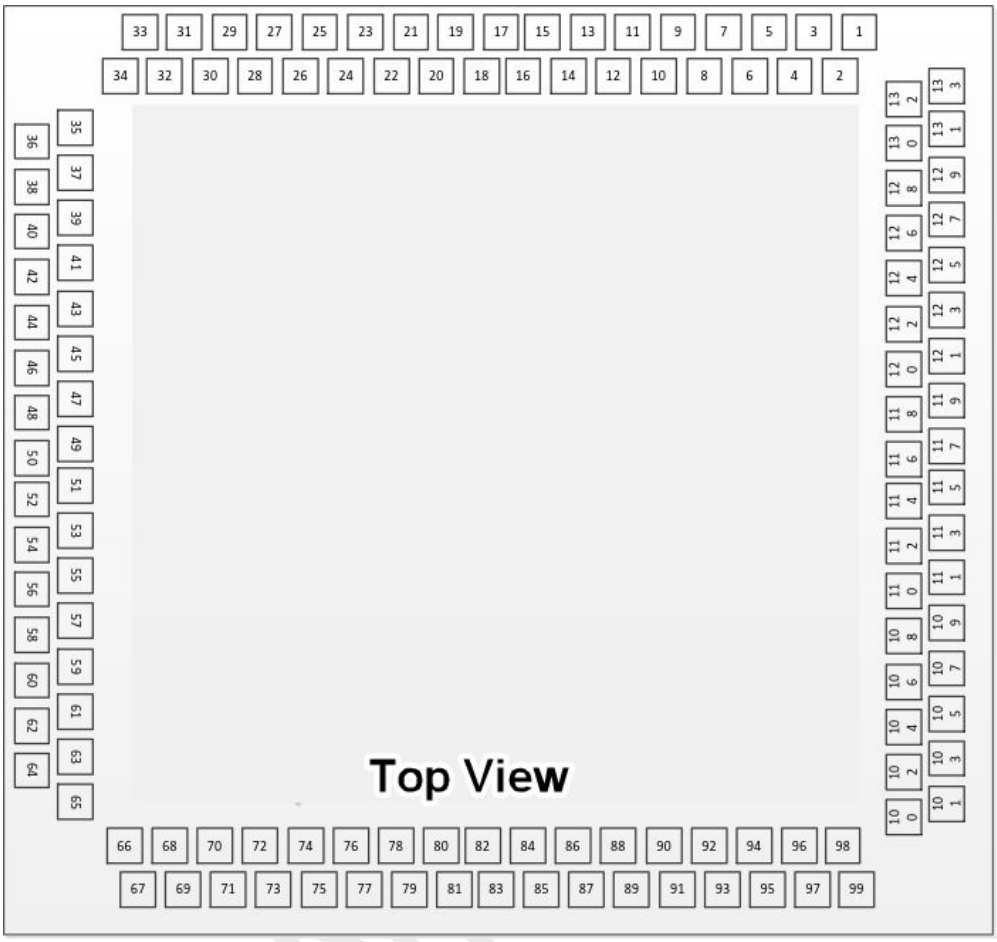
RECOMMENDED OPERATION CONDITIONS

Symbol	Parameter	Min.	Type	Max.	Units
SWREG_IN_WL VDD33_WL	WL Internal SWREG supply	3.14	3.3	3.46	V
VDD33_ANT_WL VDD33_RF_WL VDD33_XTAL_WL VDD33_PLL_WL VDD33_SYNTH_WL VDD33_USB_WL	WL Analog High Voltage supply	3.14	3.3	3.46	V
DVDD12_WL	WL Core Digital supply	1.2	1.26	1.32	V
VDD12_BB_PLL_WL VDD12_RF_WL VDD12_SYNTH_WL	WL Core Analog supply	1.2	1.26	1.32	V
DVDDIO_AO_WL DVDDIO_WL VDDIO_BE AVDDIO_BE	VIO = 3.3V	3.14	3.3	3.46	V

MODULE PINOUT



PIN ASSIGNMENT

Pin.	Pin Define	I/O	Description	Status
1	GND	G	Ground	YES
2-4	VBATT_BE	P	3.3V supply input	YES
5	GND	G	Ground	YES
6	NC	-	Not Used	NC
7	WAKEUP_N_WL	I	This signal requires 10K ohm pull-up	NC
8	GPIO59_BE / HS_UART2_DM_CTS / SENSEADC7	I/IO	Can be used either ADC or GPIO. When used as ADC, VIO must be 1.8V only When used as GPIO, VIO can be either 1.8V or 3.3V, but ADC must be disabled by SW	YES
9	GPIO58_BE / SENSEADC6	I/IO	Can be used either ADC or GPIO. When used as ADC, VIO must be 1.8V only When used as GPIO, VIO can be either 1.8V or 3.3V, but ADC must be disabled by SW	YES
10	CHIP_PWD_L_WL	I	WiFi reset signal(active low)	YES
11	GPIO19_BE	I/O	Can be configured as SPI_Slave_CS / SDIO_Slave_CMD / SD_Master_CMD / HS_UART1_DM_TXD / PWM_out1	YES

Pin.	Pin Define	I/O	Description	Status
12	GPIO57_BE / SENSEADC5	I/IO	Can be used either ADC or GPIO. When used as ADC, VIO must be 1.8V only When used as GPIO, VIO can be either 1.8V or 3.3V, but ADC must be disabled by SW	YES
13	USB_D+_WL	I/O	USB differential positive, No Used, NC	NC
14	USB_D-_WL	I/O	USB differential negative, No Used, NC	NC
15	GPIO20_BE	I/O	Can be configured as SPI_Slave_MISO /SDIO_Slave_Data0 / SD_Master Data0 / HS_UART1 DM_RXD / PWM_Out2	YES
16	GPIO18_BE	I/O	Can be configured as SPI_Slave_CLK / SDIO_Slave_CLK / SD_Master_CLK(O) / HS UART1_DM_CTS / PWM_Out_6	YES
17	Bypass_INT_PMU_MSK	I	No Connect	NC
18	GPIO56_BE / SENSEADC4	I/IO	Can be used either ADC or GPIO. When used as ADC, VIO must be 1.8V only When used as GPIO, VIO can be either 1.8V or 3.3V, but ADC must be disabled by SW	YES
19	GPIO21_BE	I/O	Can be configured as SDIO_Slave_Data1 / SD_Master Data1(B) / PWM Out_4	YES
20	GPIO55_BE / SENSEADC3	I/IO	Can be used either ADC or GPIO. When used as ADC, VIO must be 1.8V only When used as GPIO, VIO can be either 1.8V or 3.3V, but ADC must be disabled by SW	YES
21	GPIO23_BE	I/O	Can be configured as SPI_Slave_MOSI / SDIO_Slave_Data3 / SD_Master_Data3(B) / HS_UART1_DM_RFR / PWM Out_5	YES
22	USB20_DM_BE	I/O	USB differential negative	YES
23	USB20_DP_BE	I/O	USB differential positive	YES
24	SENSEADC1_BE	I	ADC input. If used, VIO must be 1.8V; can be floating if not used	YES
25	GPIO54_BE / SENSEADC2	I/IO	Can be used either ADC or GPIO. When used as ADC, VIO must be 1.8V only When used as GPIO, VIO can be either 1.8V or 3.3V, but ADC must be disabled by SW	YES
26	GPIO22_BE	I/O	Can be configured as SDIO_Slave_Data2 / SD_Master_Data2(B) / PWM Out_3	YES
27	SENSEADC0_BE	I	ADC input. If used, VIO must be 1.8V; can be floating if not used	YES
28	GPIO26_BE	I/O	Can be configured as SPI0_Master_MOSI / JTAG2_BE_TMS	YES
29	GPIO24_BE	I/O	Can be configured as SPI0_Master_CS_N / M0&M4_UART2_RX / JTAG2_BE_TCK	YES
30	GPIO27_BE	I/O	Can be configured as SPI0_Master_MISO / JTAG2_BE_TDI	YES
31	GPIO25_BE	I/O	Can be configured as SPI0_Master_CLK / M0&M4_UART2_TX / JTAG2_BE_TDO	YES
32	GPIO12_BE	I/O	Can be configured as PWM Out_0	YES
33	GND	G	Ground	YES
34	NC	-	Not used	NC
35	RTC32K_XTALI	I	Optional external 32.768KHz crystal input, no connect(or floating)	NC
36	RTC32K_XTALO	O	Optional external 32.768KHz crystal output, no connect(or floating)	NC
37	CHIP_PWD_L_BE	I	M4 processor and BLE/15.4 Reset signal(active low)	YES
38	GND	G	Ground	YES
39-41	VDD11	P	1.1V input supply, host no need to provide	NC
42	GND	G	Ground	YES

Pin.	Pin Define	I/O	Description	Status
43-44	VDDIO18_BE	P	Module internal connect to VDD33 for 3.3V VIO. No need externally to provide VIO	YES
45	GND	G	Ground	YES
46	GPIO28_BE	I/O	Can be configured as I2S_BCLK	YES
47	GPIO29_BE	I/O	Can be configured as I2S_RXD	YES
48	GPIO30_BE	I/O	Can be configured as I2S_TXD	YES
49	GPIO32_BE	I/O	Can be configured as I2S_MCLK	YES
50	GPIO31_BE	I/O	Can be configured as I2S_FSYNC	YES
51	GPIO17_BE	I/O	Can be configured as SPI0_CS1_N / I2C1_Master_SDA / HS_UART0_DM_RXD	YES
52	GPIO14_BE	I/O	Can be configured as HS_UART0_DM_CTS	YES
53	GPIO16_BE	I/O	Can be configured as SPI0_CS2_N / I2C1_Master_SCL / HS_UART0_DM_RFR / BT Active	YES
54	GPIO13_BE	I/O	Can be configured as PWM Out_7	YES
55	GPIO15_BE	I/O	Can be configured as HS_UART0_DM_TXD	YES
56	GPIO11_BE	I/O	Can be configured as I2C0_Master_SDA / JTAG1_BE_TDI	YES
57	GPIO48_BE	I/O	Ext_32K_IN	YES
58	GPIO9_BE	I/O	Can be configured as M0&M4_UART0_TX / JTAG1_BE_TDO	YES
59	GPIO10_BE	I/O	Can be configured as I2C0_Master_SCL / JTAG1_BE_TMS	YES
60	GPIO53_BE	I/O	Can be configured as JTAG3_BE_TDI	YES
61	GPIO8_BE	I/O	Can be configured as M0&M4_UART0_RX / JTAG1_BE_TCK	YES
62	GPIO52_BE	I/O	Can be configured as JTAG3_BE_TMS	YES
63	GPIO51_BE	I/O	Can be configured as JTAG3_BE_TDO	YES
64	GPIO49_BE	I/O	General-purpose input/output	YES
65-66	NC	-	No Connect	NC
67-69	GND	G	Ground	YES
70	NC	-	No Connect	NC
71	GND	G	Ground	YES
72-75	NC	-	No Connect	NC
76	GND	G	Ground	YES
77	NC	-	No Connect	NC
78	GPIO50_BE	I/O	Can be configured as JTAG3_BE_TCK	YES
79	GPIO7_BE	I/O	Can be configured as BT PRIORITY	YES
80	GPIO41_BE	I/O	General-purpose input/output	YES
81	GPIO6_BE	I/O	Can be configured as WLAN ACTIVE	YES
82	GPIO60_BE	I/O	Can be configured as HS_UART2_DM_TXD (O) / BT PRIORITY	YES
83	GPIO5_BE	I/O	Can be configured as BT ACTIVE	YES
84	GPIO4_BE / WL_WKUP_BE	I	Wake up on WLAN. WLAN to wake up M4 processor system. Connect from GPIO_18_WL	YES
85	GND	G	Ground	YES
86-97	NC	-	No Connect	NC
98-101	GND	G	Ground	YES
102-103	NC	-	No Connect	NC

Pin.	Pin Define	I/O	Description	Status
104	GND	G	Ground	YES
105-108	NC	-	No Connect	NC
109	GND	G	Ground	YES
110	EXT_CLKOUT_BE	G	1.1Vpp clock output same as crystal frequency	NC
111	GND	G	Ground	YES
112-114	NC	-	No Connect	NC
115	GND	G	Ground	YES
116	NC	-	No Connect	NC
117	PWRDWN_OUT_N	-	Not used	NC
118	NC	-	No Connected	NC
119	GND	G	Ground	YES
120-123	NC	-	No Connect	NC
124	GND	G	Ground	YES
125	NC	-	No Connect	NC
126	IOT_MODE_EN_WL	I	This signal requires 10Kohm pull-down. Not used, NC	NC
127	GND	G	Ground	YES
128-129	VDDIO18_WL	P	Module internal connect to VDD33 for 3.3V VIO. No need externally to provide VIO	NC
130	GND	G	Ground	YES
131-133	NC	-	No Connect	NC

***The following signal type is defined:**

I: Input; O: Output; I/O: Input/Output; G: Ground; P: Voltage Supply

BOOTSTRAP SIGNALS

Table 2: JTAG mode

GPIO9_BE	GPIO25_BE	GPIO18_BE	Description
0	0	0	No JTAG enabled
0	0	1	JTAG Pins on GPIO[53:50]_BE
0	1	0	JTAG Pins on GPIO[11:8]_BE
0	1	1	JTAG Pins on GPIO[27:24]_BE
1	X	X	Not Allowed

Table 3: 32.768 KHz Sleep Clock Mode

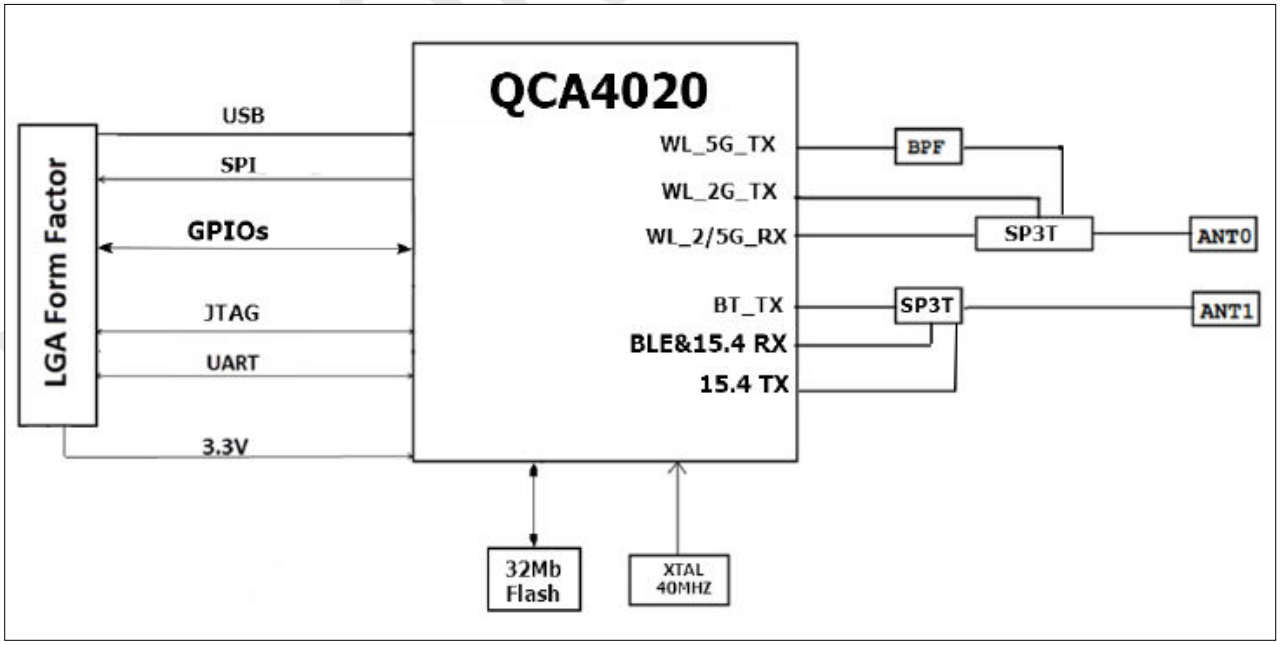
GPIO21_BE	GPIO20_BE	Description
0	0	Chip internal LPO
0	1	External Crystal 32.768KHz

1	0	External 32.768KHz TCXO Clock connected to GPIO48_BE
1	1	Not Allowed

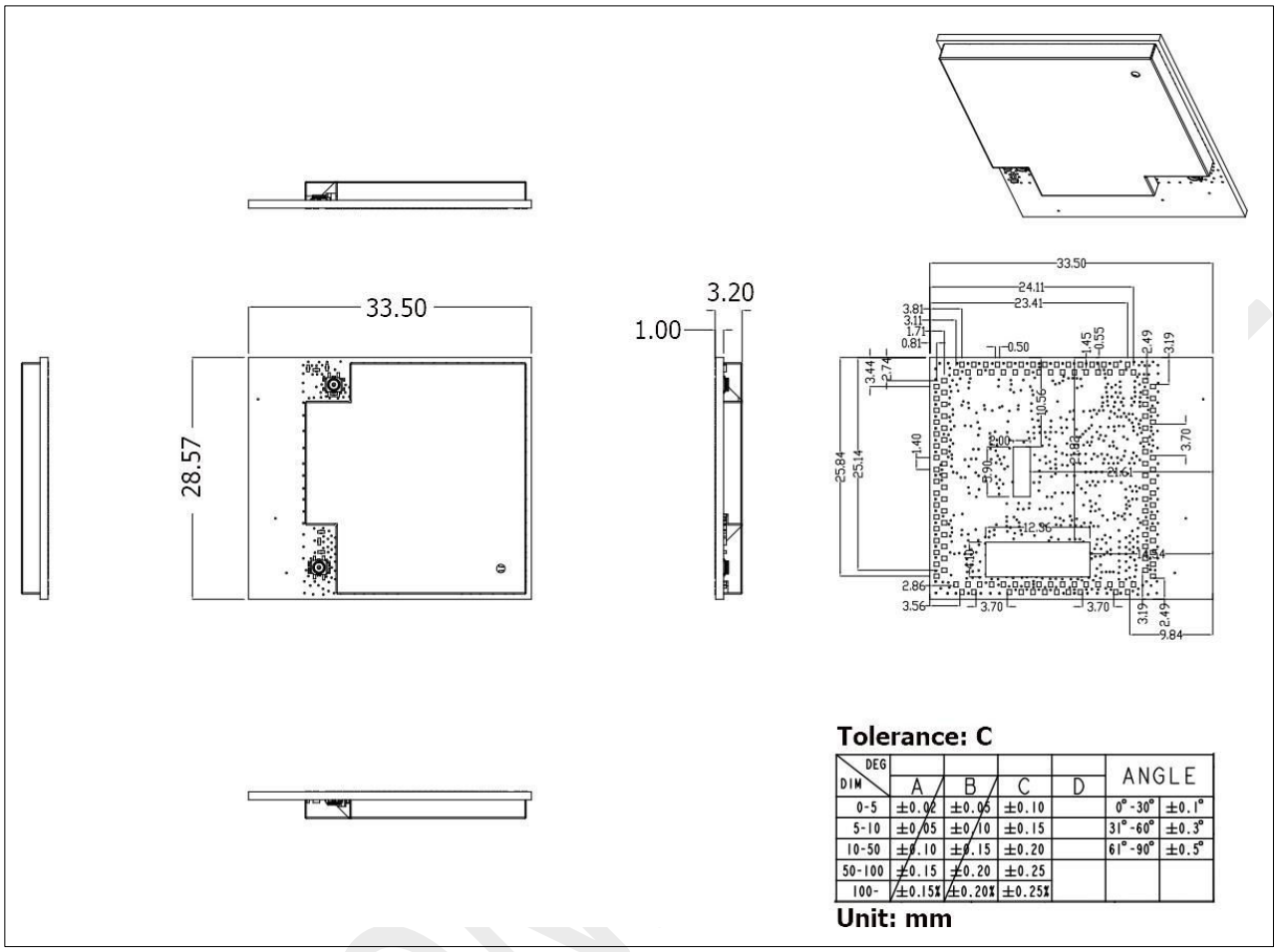
ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Min.	Type	Max.	Units
VIH	High Level Input voltage	2.4	-	3.6	V
VIL	Low Level Input voltage	-0.3	-	0.3	V
VOH	High Level Output voltage	3.0	-	3.3	V
VOL	Low Level Output voltage	-0.3	-	0.4	V

BLOCK DIAGRAM



MECHANICAL

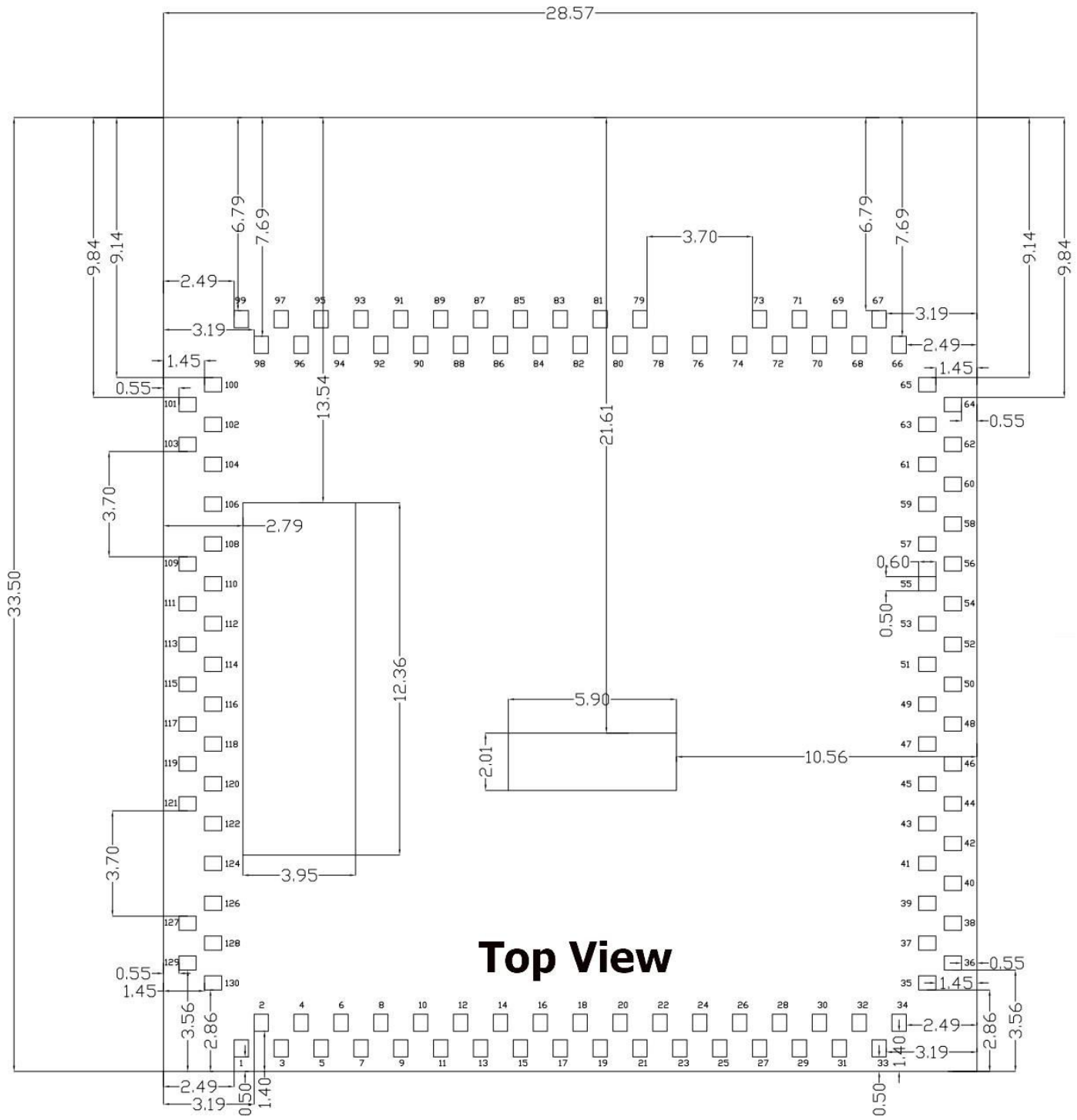


Tolerance: C

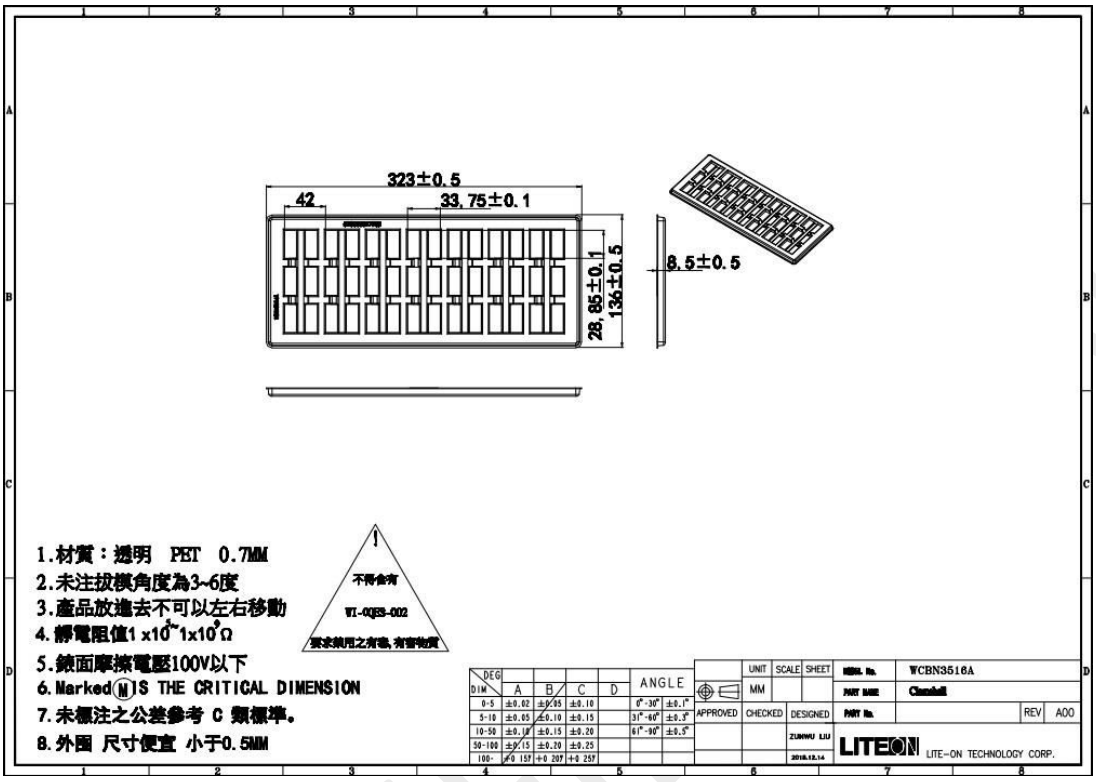
DEG / DIM	A	B	C	D	ANGLE	
0-5	±0.02	±0.05	±0.10		0°-30°	±0.1°
5-10	±0.05	±0.10	±0.15		31°-60°	±0.3°
10-50	±0.10	±0.15	±0.20		61°-90°	±0.5°
50-100	±0.15	±0.20	±0.25			
100-	±0.15%	±0.20%	±0.25%			

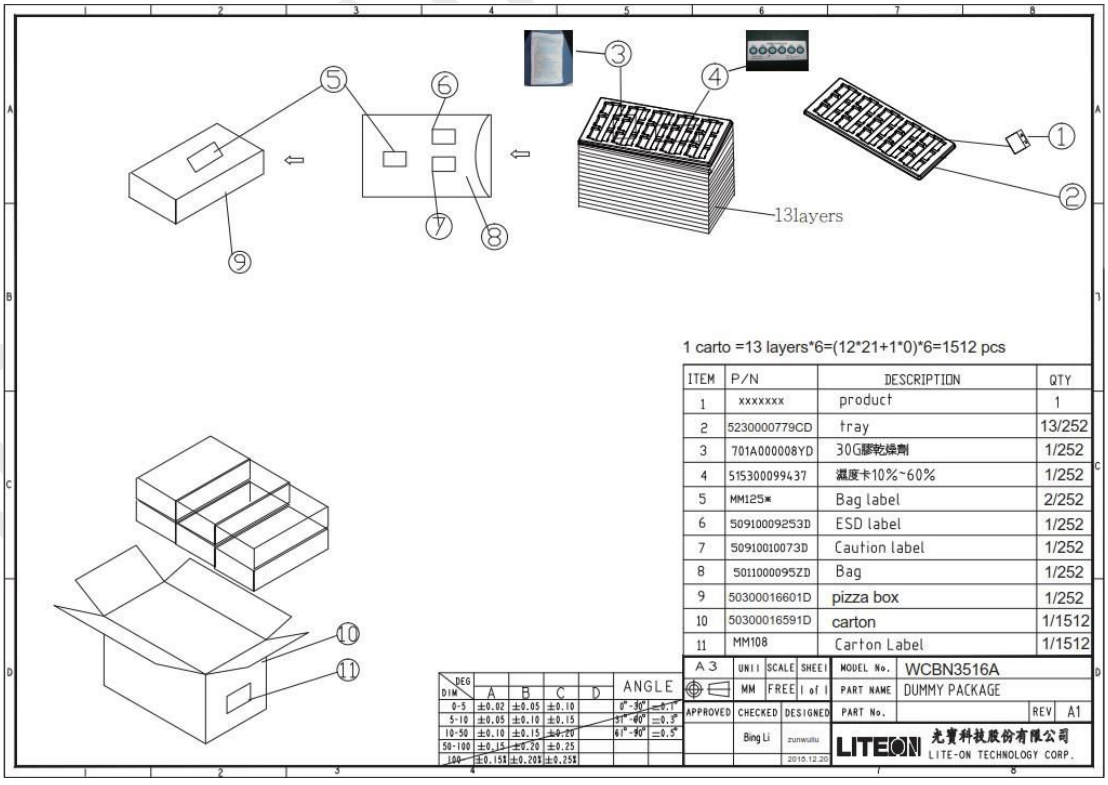
Unit: mm

FOOTPRINT (Unit: mm)



PACKING DRAWING





ENVIRONMENTAL

OPERATING

Ambient Operating Temperature: -20 to 80°C

Relative Humidity: 5-90% (non-condensing)

STORAGE

Temperature: -40 to 80°C (-40 to 176°F)

Relative Humidity: 5-95% (non-condensing)