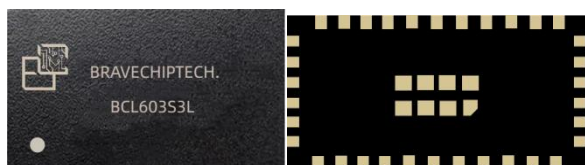




# BCL603S3L Smart Ring Chiplet Datasheet



## Features

- Integrates more than 20 devices such as Apollo3 blue, LDO, crystal oscillator, resistance and capacitance
- Working voltage: 1.755V~3.63V
- can provide up to 20 GPIO ports, including 2 I<sup>2</sup>C, 3 SPI, 14bit ADC, PPG, NTC, IMU, ECG, NFC, LED and other peripherals and sensors
- supports BLE 5.2, embedded Bluetooth Low Energy stack, and GATT services
- ARM Cortex-M4 32bit with floating point computing core, the main frequency up to 96MHz
- SPOT technology, the CPU power consumption is 6uA/MHz
- 384KB SRAM, 1M ROM, of which the Bluetooth protocol stack occupies 20KB, supports various algorithms such as heart rate, blood oxygen, blood pressure, sleep, step counting, and 3DoF
- 1MB Flash. Historical data can be retained for more than 7 days. Dual-backup OTA upgrade is supported

- Transmit power: -20 dBm ~ +4dBm
- High receiving sensitivity: -94dBm
- TX RX Peak current < 3mA(0dBm)
- Ring resting current < 0.6μA
- Ring broadcast status current <50uA at 1s interval
- Ring heart rate oximetry current <1.6mA
- Ring battery life can be more than 7 days
- Operating temperature range: -40 °C ~85 °C

## Application

- Smart Health ring
- XR space interactive controller
- Wearable devices
- Anti-loss device
- Data transparent module
- Miniaturized Bluetooth device

Number	Package Type	Type
BCL603S3L	LGA34 (4×6.8mm)	Tape/Reel

## Description

BCL603S3L is a high-performance, ultra-low power dedicated chip for smart ring Chiplet. It adopts 4mm width LGA package form. Smart ring can adopt two-layer FPC design, reduce BOM quantity by 30%, ensure the yield of PCBA can reach 95% or more when bending, and provide special communication protocol and calculation

library for smart ring. Support secondary development and custom protocol development.

### Revision record:

Version	Name	Date	Description
V1.0	Wenxuan Liu	2023.05.22	Original Version
V1.1	Wenxuan Liu	2023.12.28	Pin Description
V1.2	Lizhen Zou	2024.1.22	Update Pinout Diagram
V1.3	Danlei Wang	2025.04.24	Update the chip diagram, Pinout Diagram, pin definition, and typical circuit diagram
V1.4	Danlei Wang	2026.05.11	Update Packaging Dimensions

## Catalogue

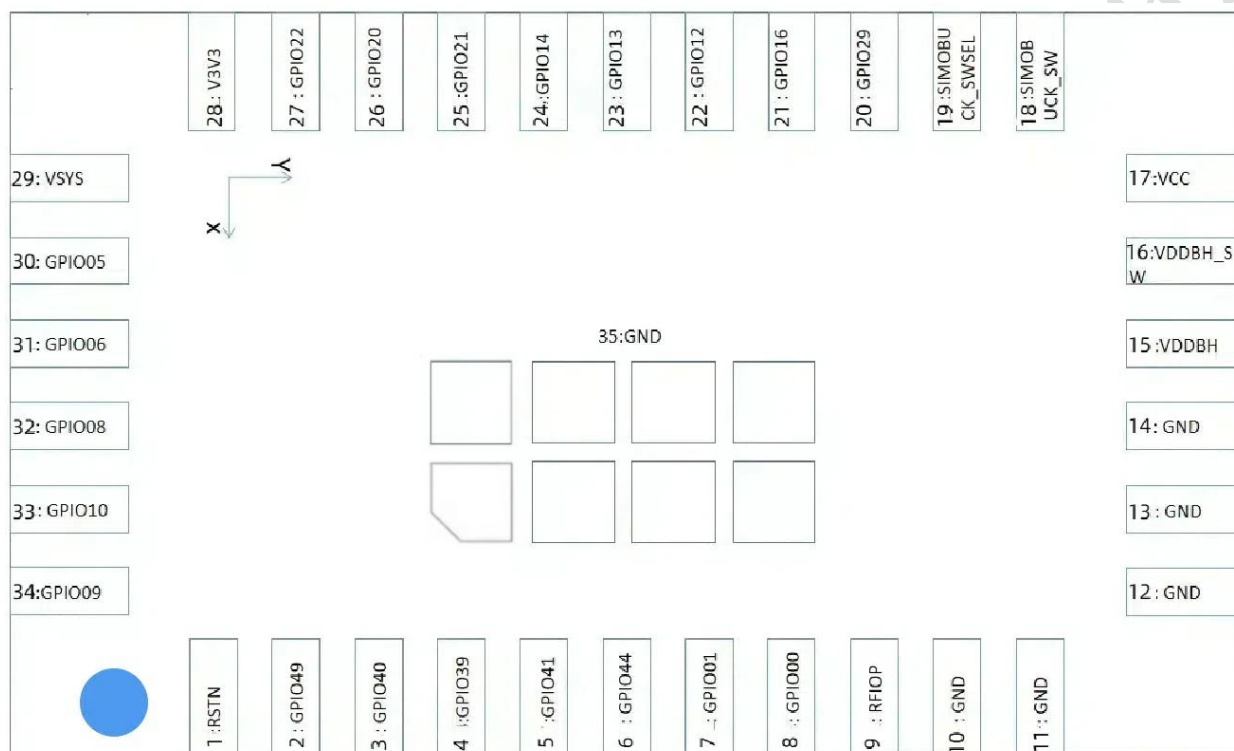
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## 1、 Introduction

BCL603S3L uses Chiplet technology to integrate Apollo3 blue, LDO, crystal oscillator and critical resistance and capacitance, designed for smart ring applications, greatly reducing product size, improving production yield, and simplifying power, clock and RF design. The specific parameters of the main chip can be found in the official ambiq specification.

## 2、 Pin description



Pin Number	Pin Name	Type	Description
1	RSTN	I/O	External Reset Input
2	GPIO49/UART0RX/NCE49/CT30/M5SSDAWIR3/M5MISO	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. UART0 Receive</li> <li>3. IO Master N Chip Select 49</li> <li>4. Timer/Counter Interface Signal 30</li> <li>5. I2C Master 5 I/O Data SPI Master 5 3 Wire Data</li> <li>6. SPI Master 5 Input Data</li> </ol>
3	GPIO40/UART0RX/UART1RX/TRIG0/M4SDAWIR3/M4	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. UART0 Receive</li> <li>3. UART1 Receive</li> <li>4. ADC Trigger Input 0</li> </ol>

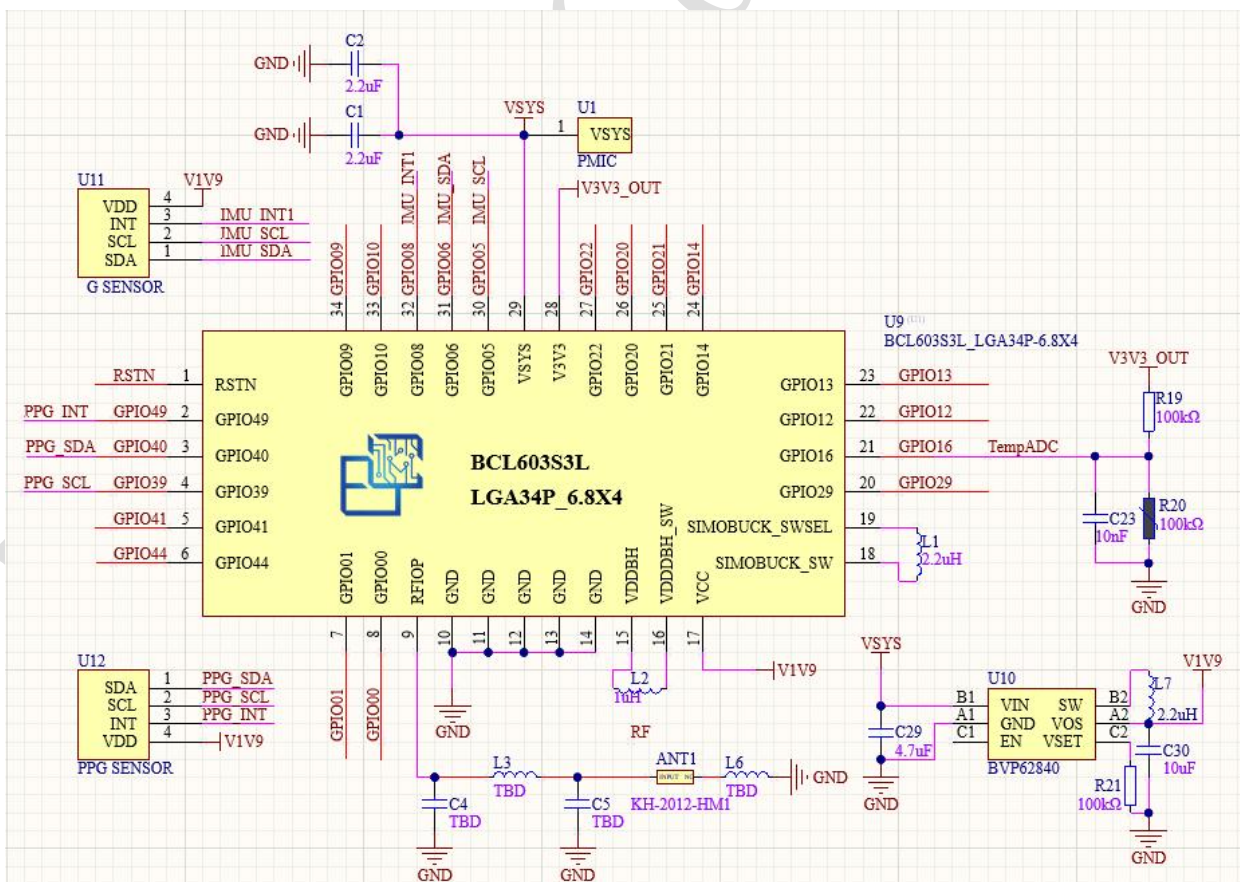
	MISO		<ul style="list-style-type: none"> <li>5. I2C Master 4 I/O Data</li> <li>SPI Master 4 3 Wire Data</li> <li>6. SPI Master 4 Data Input</li> </ul>
4	GPIO39/UART0TX/UART1TX/CT25/M4SCKL/M4SCK	I/O	<ul style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. UART0 Transmit</li> <li>3. UART1 Transmit</li> <li>4. Timer/Counter Interface Signal 25</li> <li>5. I2C Master 4 Clock</li> <li>6. SPI Master 4 Clock</li> </ul>
5	GPIO41/NCE41/BLEIF_IRQ/SWO/I2SWCLK/UA1RTS/UART0TX/UA0RTS	I/O	<ul style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. IO Master N Chip Select 41</li> <li>3. BLE Interface IRQ Observation</li> <li>4. Serial Wire Debug Output</li> <li>5. I2S Word Clock</li> <li>6. UART1 Request To Send (RTS)</li> <li>7. UART0 Transmit</li> <li>8. UART0 Request To Send (RTS)</li> </ul>
6	GPIO44/UA1RTS/NCE44/CT20/M4MOSI/UART0TX	I/O	<ul style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. UART1 Request To Send (RTS)</li> <li>3. IO Master N Chip Select 44</li> <li>4. Timer/Counter Interface Signal 20</li> <li>5. SPI Master 4 Output Data</li> <li>6. UART0 Transmit</li> </ul>
7	GPIO01/SLSDAWIR3/SLMOSI/UART0TX/MSPI5/NCE1	I/O	<ul style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. I2C Slave I/O Data</li> <li>SPI Master 3 3 Wire Data</li> <li>3. SPI Slave Input Data</li> <li>4. UART0 Transmit</li> <li>5. MSPI Master Interface Signal 5</li> <li>6. IO Master N Chip Select 1</li> </ul>
8	GPIO00/SLSCL/SLSCK/CLKOUT/MSPI4/NCE0	I/O	<ul style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. I2C Slave Clock</li> <li>3. SPI Slave Clock</li> <li>4. Programmable Output Clock</li> <li>5. MSPI Master Interface Signal 4</li> <li>6. IO Master N Chip Select 0</li> </ul>
9	RFIOP	RF	Single Ended Antenna connection end
10	GND	Ground	Ground
11	GND	Ground	Ground
12	GND	Ground	Ground
13	GND	Ground	Ground

14	GND	Ground	Ground
15	VDDBH	Power	BLE/Burst Buck Converter Voltage Output Supply
16	VDDBH_SW	Power	BLE/Burst Buck Converter Inductor Switch
17	VCC	Power	Digital Voltage Supply
18	SIMOBUCK_S W	Power	SIMO Buck Converter Inductor Switch Output
19	SIMOBUCK_S WSEL	Power	SIMO Buck Converter Inductor Switch Input
20	GPIO29/ADCS E1/NCE29/CT 9/UA0CTS/UA 1CTS/UART0 RX/PDMDAT A	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. Analog to Digital Converter Single-Ended Input 1</li> <li>3. IO Master N Chip Select 29</li> <li>4. Timer/Counter Interface Signal 9</li> <li>5. UART0 Clear To Send (CTS)</li> <li>6. UART1 Clear To Send (CTS)</li> <li>7. UART0 Receive</li> <li>8. PDM Data</li> </ol>
21	GPIO16/ADCS E0/NCE16/TRI G0/SCCRST/C MPIN0/UART 0TX/UA1RTS	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. Analog to Digital Converter Single-Ended Input 0</li> <li>3. IO Master N Chip Select 16</li> <li>4. ADC Trigger Input 0</li> <li>5. Secure Card Controller Reset</li> <li>6. Voltage Comparator Input 0</li> <li>7. UART0 Transmit</li> <li>8. UART1 Request To Send (RTS)</li> </ol>
22	GPIO12/ADC D0NSE9/NCE 12/CT0/PDMC LK/UA0CTS/ UART1TX	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. Analog to Digital Converter Differential N Input 0 / Single-Ended Input 9</li> <li>3. IO Master N Chip Select 12</li> <li>4. Timer/Counter Interface Signal 0</li> <li>5. PDM Clock Output</li> <li>6. UART0 Clear To Send (CTS)</li> <li>7. UART1 Transmit</li> </ol>
23	GPIO13/ADC D0PSE8/NCE1 3/CT2/I2SBCL K/UA0RTS/U ART1RX	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. Analog to Digital Converter Differential P Input 0 / Single-Ended Input 9</li> <li>3. IO Master N Chip Select 13</li> <li>4. Timer/Counter Interface Signal 2</li> <li>5. I2S Bit Clock</li> <li>6. UART0 Request To Send (RTS)</li> <li>7. UART1 Receive</li> </ol>

24	GPIO14/ADC D1P/NCE14/U ART1TX/PDM CLK/SWDCK/ 32kHzXT	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. Analog to Digital Converter Differential P Input 1</li> <li>3. IO Master N Chip Select 14</li> <li>4. UART1 Transmit</li> <li>5. PDM Output Clock</li> <li>6. Serial Wire Debug Clock</li> <li>7. 32kHz Clock</li> </ol>
25	GPIO21/SWDI O/NCE21/UA RT0RX/UART 1RX/SCCRST/ UA1CTS	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. Software Data I/O</li> <li>3. IO Master N Chip Select 21</li> <li>4. UART0 Receive</li> <li>5. UART1 Receive</li> <li>6. Secure Card Controller Reset</li> <li>7. UART1 Clear To Send (CTS)</li> </ol>
26	GPIO20/SWD CK/NCE20/U ART0TX/UAR T1TX/I2SBCL K/UA1RTS	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. Software Debug Clock</li> <li>3. IO Master N Chip Select 20</li> <li>4. UART0 Transmit</li> <li>5. UART1 Transmit</li> <li>6. I2S Bit Clock</li> <li>7. UART1 Request To Send (RTS)</li> </ol>
27	GPIO22/UART 0TX/NCE22/C T12/PDMCLK/ MSPI0/SWO	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. UART0 Transmit</li> <li>3. IO Master N Chip Select 22</li> <li>4. Timer/Counter Interface Signal 12</li> <li>5. PDM Output Clock</li> <li>6. MSPI Master Interface Signal 0</li> <li>7. Serial Wire Debug Output</li> </ol>
28	V3V3	Power	3.3V output of internal LDO
29	VSYS	Power	Power input of internal LDO
30	GPIO05/M0SC L/M0SCK/UA 0RTS/CT8	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. I2C Master 0 Clock</li> <li>3. SPI Master 0 Clock</li> <li>4. UART0 Request To Send (RTS)</li> <li>5. Timer/Counter Interface Signal 8</li> </ol>
31	GPIO06/M0SD AWIR3/M0MI SO/UA0CTS/C T10/I2SDAT	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. I2C Master 0 Data SPI Master 0 3 Wire Data</li> <li>3. SPI Master 0 Input Data</li> <li>4. UART0 Clear To Send (CTS)</li> <li>5. Timer/Counter Interface Signal 10</li> <li>6. I2S Data</li> </ol>
32	GPIO08/M1SC L/M1SCK/NC	I/O	<ol style="list-style-type: none"> <li>1. General Purpose I/O</li> <li>2. I2C Master 1 Clock</li> </ol>

	E8/SCCCLK/U ART1TX		<ol style="list-style-type: none"> <li>SPI Master 1 Clock</li> <li>IO Master N Chip Select 8</li> <li>Secure Card Controller Clock</li> <li>UART1 Transmit</li> </ol>
33	GPIO10/UART 1TX/M1MOSI/ NCE10/PDMC LK/UA1RTS	I/O	<ol style="list-style-type: none"> <li>General Purpose I/O</li> <li>UART1 Transmit</li> <li>SPI Master 1 Output Data</li> <li>IO Master N Chip Select 10</li> <li>PDM Clock Output</li> <li>UART1 Request To Send</li> </ol>
34	GPIO09/M1SD AWIR3/M1MI SO/NCE9/SCC IO/UART1RX	I/O	<ol style="list-style-type: none"> <li>General Purpose I/O</li> <li>I2C Master 1 Data SPI Master 1 3 Wire Data</li> <li>SPI Master 1 Input Data</li> <li>IO Master N Chip Select 9</li> <li>Secure Card Controller I/O</li> <li>UART1 Receive</li> </ol>
35	GND	Ground	Ground

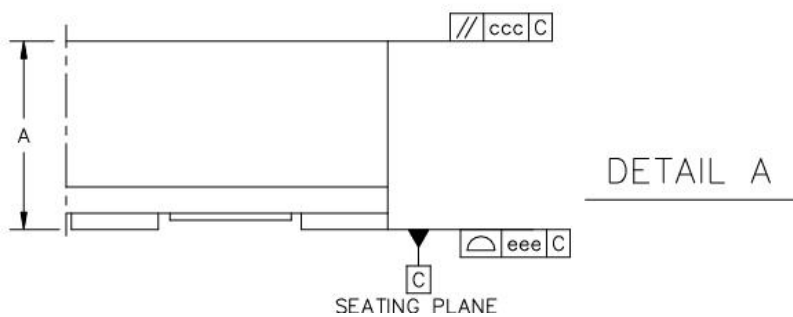
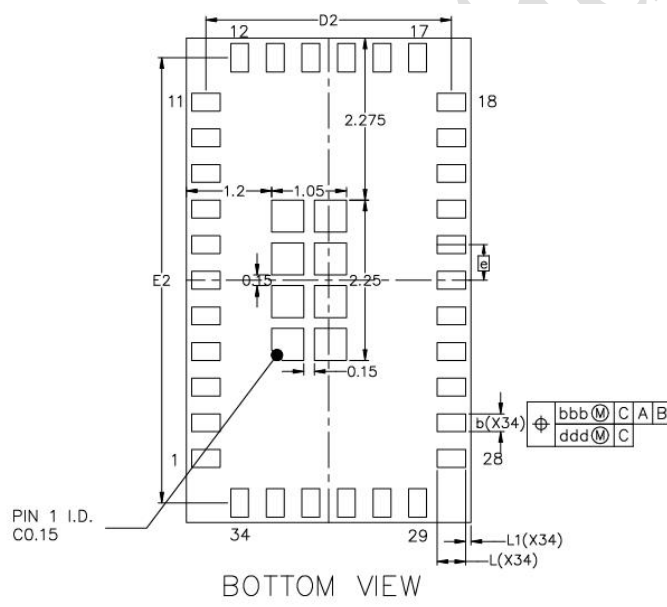
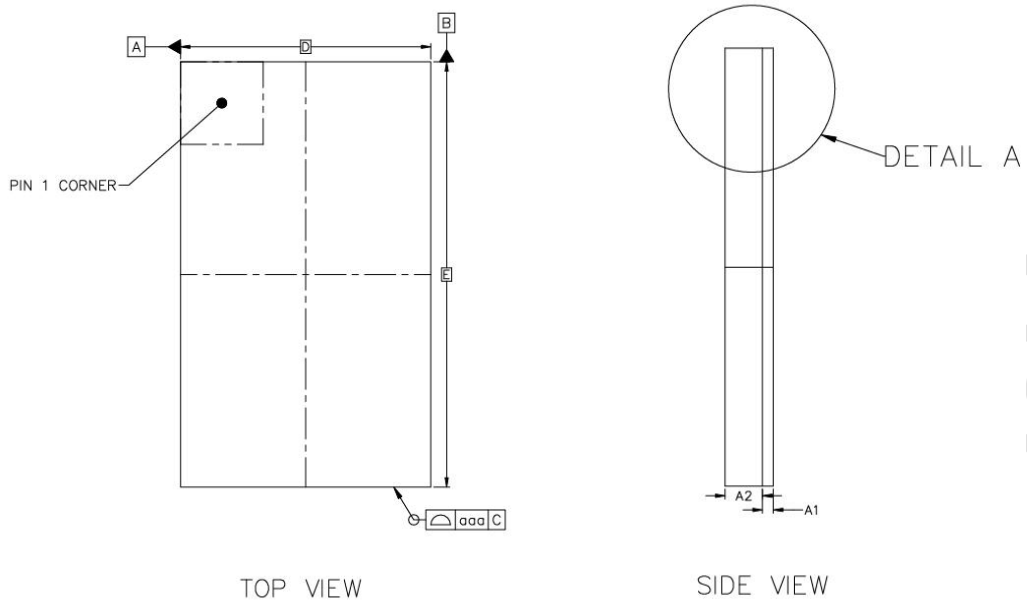
### 3、Typical circuit



## 4、Electrical Characteristics

Symbol	Conditions	Min	Value	Max	Unit
Power Supply Voltage VCC	/	1.755	1.8	5.5	V
IO Voltage	/	0	1.8	3.63	V
Operating temperature	/	-40	25	80	°C
Storage temperature	/	-55	/	120	°C
Wireless modulation mode	GFSK				
Frequency range	/	2.402	/	2.480	Ghz
Number of channels	/	/	40	/	/
Air speed	/	1	/	2	Mbps
Rf port impedance	/	/	50	/	Ohm
Transmitting power	/	-20	0	+4	Dbm
Emission current	/	/	3	/	mA
Receiving current	/	/	3	/	mA
Receiving sensitivity	/	/	-94	/	dbm
Ring resting current	3.7V	/	0.6	/	uA
Ring standby current	3.7V	/	50	/	uA
Ring operating current	3.7V	/	1.6	/	mA
Ring using time	/	5	7	9	Day
Ring standby time	/	/	30	/	Day
Operating humidity	/	10%	30%	90%	/
Storage humidity	/	5%	30%	90%	/

## 5、Package Dimensions



	SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS	A	0.700	0.750	0.800
MOLD CAP	A2	---	0.580	---
SUBSTRATE THICKNESS	A1	0.140	0.170	0.200
LEAD WIDTH	b	0.200	0.250	0.300
BODY SIZE	X	D	3.900	4.000
	Y	E	6.700	6.800
LEAD PITCH	e	0.500		
EDGE PAD CENTER TO CENTER	D2	3.450 BSC		
	E2	6.250 BSC		
LEAD LENGTH	L	0.350	0.400	0.450
LEAD TIP TO PKG EDGE	L1	0.000	0.075	0.150
PACKAGE EDGE TOLERANCE	aaa	0.100		
MOLD FLATNESS	ccc	0.100		
COPLANARITY	eee	0.080		
LEAD OFFSET	bbb	0.100		
	ddd	0.080		

Notes.

1. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
2. DIMENSIONS AND TOLERANCE CONFORM TO ASME Y14.5-2009.