

 **CP6012**

BT5.0 + 2.4GHz-Proprietary

Datasheet

General Description

The CP6012 is a very low power, high performance and highly integrated BT5.0 + 2.4G Proprietary dual-mode solution, designed for operation over the 2400MHz to 2483.5Mhz ISM frequency band.

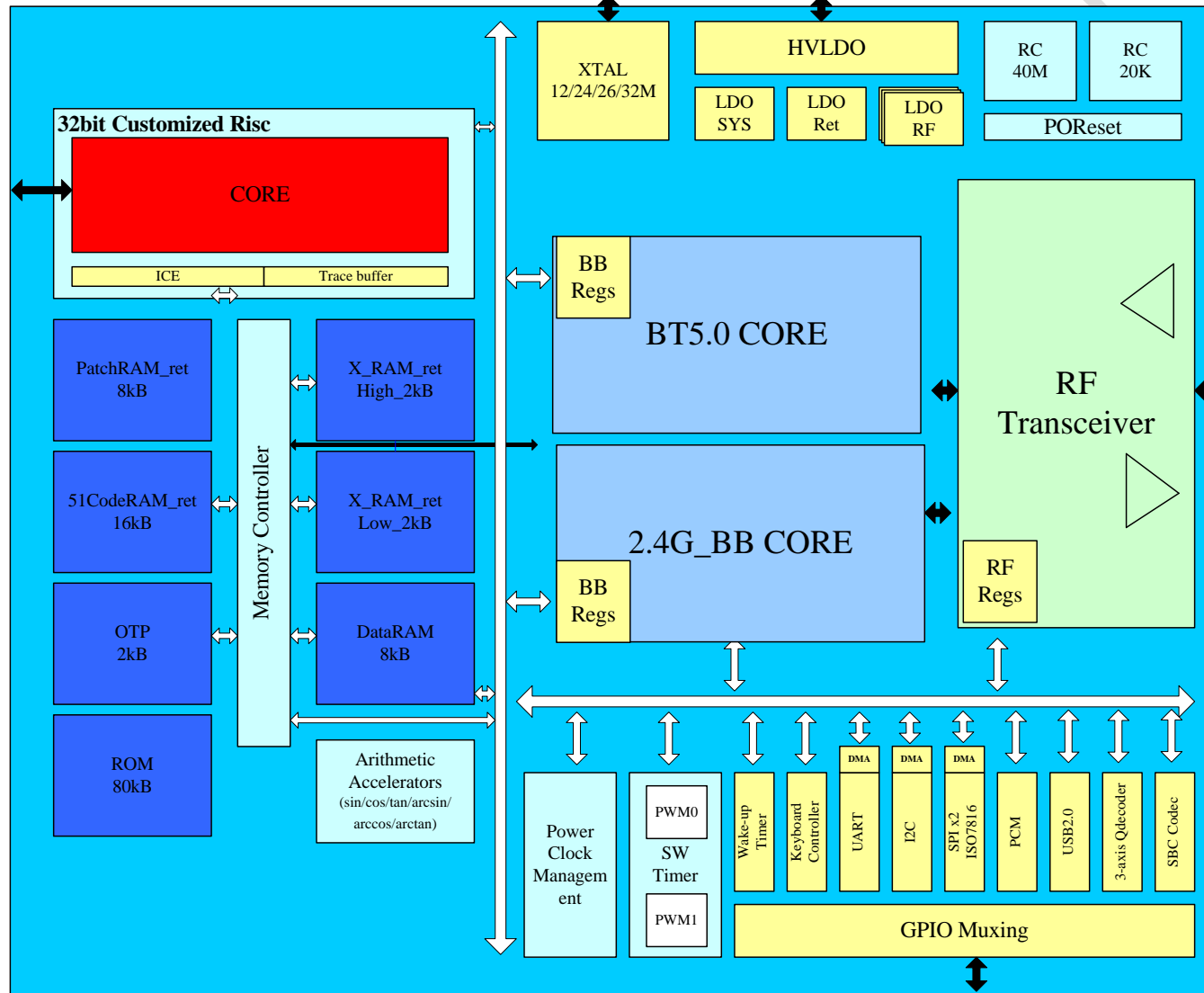
CP6012 is manufactured using advanced 55nm CMOS low leakage process, which offers highest integration, lowest power consumption, lowest leakage current and reduced BOM cost while simplifying the overall system design.

CP6012 operates with a power supply range from 1.8 to 5.5V and has very low power consumption in both Tx and Rx modes, enabling long lifetimes in battery-operated systems while maintaining excellent RF performance. The device can enter an ultra low power sleep mode in which the registers and retention memory content are retained while low power Oscillator and sleep timer is ON.

Key Features

- BLE+2.4GHz-Proprietary triple-mode RF SOC
- Very Low Power Consumption
 - 10nA shut down mode (external interrupts)
 - 620nA sleep mode (32kHz RC OSC, sleep timer and register ON)
 - 2uA retention mode (32kHz RC OSC, sleep timer, 2k retention memory and register ON)
 - Rx peak current @3V (ideal DCDC)
 - 6.75mA in BLE/2.4G mode
 - Tx peak current @3V (-2dBm, ideal DCDC)
 - 12mA in BLE/2.4G mode
 - <25uA avg, 500ms sniff hold connection
- 2.4GHz Transceiver
 - Single-end RFIO
 - -93dBm in BLE mode
 - support 250kbps, 1Mbps data rates
 - Tx Power upto +6dBm
- Oscillators
 - 16M/24M/32M XTAL supported (default 24M)
 - 50M RC oscillator
 - Low Jitter 32K RC oscillator
- Dual Core Digital Architecture
 - 8051 Core for application
 - 16kB code RAM
 - 32bit-Risc Core for link management
 - 80kB code ROM
 - 8kB code RAM
 - All RAMs can be set to retention mode
- Arithmetic Accelerators [*Accuracy : (sign, 15b.16b)*]
 - sin/cos/tan/sin⁻¹/cos⁻¹/tan⁻¹/ multi/div/sqrt
- Analog Peripherals
 - 8 channel ADC with 10 bit accuracy/3Msps
- Digital Peripherals
 - Two-wire Master (I2C compatible), upto 400kbps; UART(RTS/CTS) with HCI-H5 protocol, upto 3.25Mbps; SPI Master, upto 24Mbps
 - ISO7816
 - AES128 HW encryption
 - LED drive capability
 - PWM
 - 20x8 keyscan
 - 3 axis Q-decoder

Block Diagram



Electrical Specifications

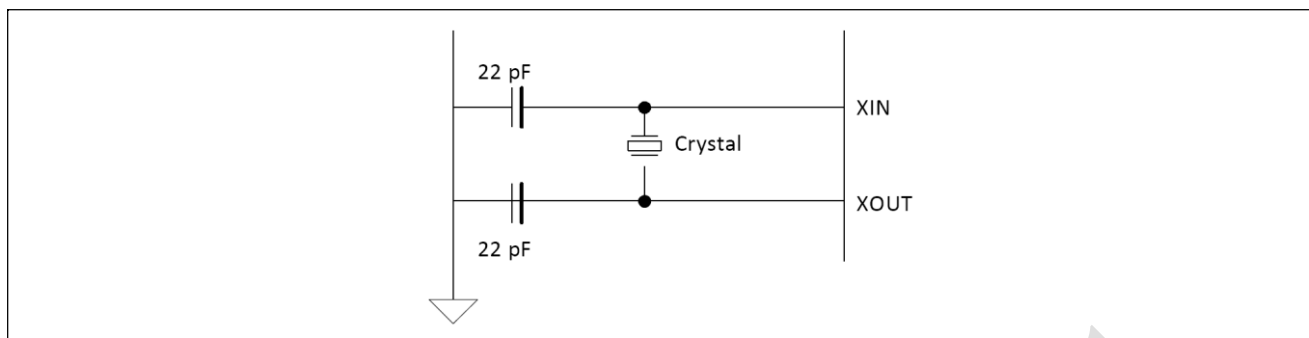
Name	Parameter (Condition)	Min	Typ	Max	Unit	Com ment
Power Supplies						
HVIN	Voltage Input, typically 1uF decouple cap	3.1	4.2	5.5	V	(1)
HVOUT	Voltage Output, typically 1uF decouple cap, maximum 50mA load capability	2.75	2.85	2.95	V	
IQ_HV	Quiescent Current of high voltage LDO		750		nA	
VIN	Voltage Input, typically 1uF decouple cap	1.5		3.6	V	
VINPA	Voltage Input, typically 5pF decouple cap	1.5		3.6	V	(2)
VINLPM	Voltage Input	1.8		3.6	V	(3)
VIO	Voltage Input	1.7		3.6	V	(4)
DVDD	Voltage Output, typically 1uF decouple cap	1.1	1.2	1.3	V	
VDDLPM	Voltage Output, typically 100nF decouple cap	1.1	1.2	1.3	V	
Temperature						
TEMP	Temperature	-20		+85	°C	
Digital Input Pin						
VIH	High Level	VIO-0.3		VIO+0.3	V	
VIL	Low Level	VSS		VSS+0.3	V	
Digital Onput Pin						
VOH	High Level	VIO-0.3		VIO+0.3	V	(5)
VOL	Low Level	VSS		VSS+0.3	V	
Current Consumption						
IVDD	Shut down mode, can only be waked up by wake-up pin.		10		nA	
IVDD	Retention mode (LPO, no retention RAM, POR, sleep timer, I/O interrupts ON), can be waked up by sleep timer & any GPIO		0.70		uA	(6)
IVDD	Retention mode (LPO, 2kB retention RAM, POR, sleep timer, I/O interrupts ON), can be waked up by sleep timer & any GPIO		1.25		uA	
IVDD	RX mode, BLE & 2.4G mode, 100% ON (with ideal DCDC @3V)		6.75		mA	(7)
IVDD	TX mode, BLE & 2.4G mode, 100% ON (with ideal DCDC @3V)		16		mA	(8)
IVDD	Average Current, 500ms sniff, hold connection			25	uA	
Normal RF Condition						
FOP	Operating Frequency	2400		2480	MHz	
FXTAL	Crystal Frequency	12	24	32		(9)
Transmitter Characteristics						
PRF	RF output power	-20	0	6	dBm	
CD	Carrier Drift Rate		5		kHz/50us	

PRF1	Out of band emission 2 MHz (GFSK)		-40		dBm	
PRF2	Out of band emission 3 MHz (GFSK)		-48		dBm	
BW	20dB bandwidth		0.9		MHz	
PRF1	Out of band emission 2 MHz ($\pi/4$ DQPSK & 8PSK)		-30	-20		
PRF2	Out of band emission 3 MHz ($\pi/4$ DQPSK & 8PSK)		-42	-40		
Receiver Characteristics						
BT4.0 (BLE)						
SEN	High Gain mode, Sensitivity @30.8%PER		-93		dBm	
SEN	Standard Gain mode, Sensitivity @30.8%PER		-87		dBm	
MaxIn	Maximum Input Power		0		dBm	
C/ICO	Co-channel C/I, GFSK		7		dB	
C/I1ST	ACS C/I 1MHz, GFSK		5.5	7	dB	
C/I2ND	ACS C/I 2MHz, GFSK		-36	-34	dB	
C/I3RD	ACS C/I 3MHz, GFSK		-43		dB	
C/I1STI	ACS C/I Image channel, GFSK		-34		dB	
C/I2NDI	C/I 1 MHz adjacent to image channel, GFSK		-28		dB	

- (1) HVIN & HVOUT are input & output of a high voltage LDO which is integrated in CP6012, input voltage range from 3.1~5.5V, and maximum load capability upto 50mA. Typically used in Li_BAT (3.2~4.2V) or USB_Power(4.5~5.5V) applications. If input voltage is lower than 3.6V, HVIN & HVOUT should be left unconnected and CP6012 should be powered by VIN/VINLPM/VINPA directly.
- (2) If RF output power should be larger than -4dBm, VINPA should be larger than 2.5V.
- (3) VINLPM should always be powered ON in all working cycles.
- (4) VIO should always be powered ON in all working cycles.
- (5) Drive capability of GPIO[6:7] & GPIO[18:22] is up to 30mA, other GPIO's drive capability is 10mA
- (6) By default, 2kB retention memory is ON in retention mode. Up to 4kB retentionable X_memory available at the cost of extra 600nA retention mode current. Besides, 16kB 51-code memory is also retentionable at the cost of extra 1.6uA retention mode current.
- (7) Result based on standard gain mode
- (8) Result based on -2dBm Pout
- (9) 12M, 16M, 24M, 26M, 32M crystal supported, 24M by default

Crystal Oscillator

The crystal oscillator requires a crystal with an accuracy of ± 30 ppm as defined by the Bluetooth specification. Two external load capacitors in the range of 5 pF to 30 pF are required to work with the crystal oscillator. The selection of the load capacitors is crystal dependent. The recommended crystal specification shows below.



Recommended Oscillator Configuration — 20 pF Load Crystal

Reference Crystal Electrical Specifications

Name	Parameter (Condition)	Min	Typ	Max	Unit	Comment
Frequency			24		MHz	
Oscillation mode			Fundamental			
Frequency tolerance	@25°C		±10	±30	ppm	
Tolerance stability over temp	@0°C to +70°C		±10	±30	ppm	
Load capacitance			20		pF	
Operating temperature range		-20		+70	degree	
Drive Level			100		uW	

Power consumption

W/O DC-DC	Parameter	Average Current	Unit
Sleep	/	700	nA
Sniff	500ms interval	21.99	uA
Discoverable	ADV interval: 640ms Scan interval: 1280ms Scan window: 11.25ms	138.66	uA

With DC-DC	Parameter	Average Current	Unit
Sleep	/	700	nA
Sniff	Sniff Interval:500ms	17.92	uA
Discoverable	ADV interval: 640ms Scan interval: 1280ms Scan window: 11.25ms	89.5	uA

Bluetooth Security

1. Pairing
 - Pin Code
2. Security Simple Pairing
 - Just Work(No input)
 - Keyboard
 - DisplayYesNo

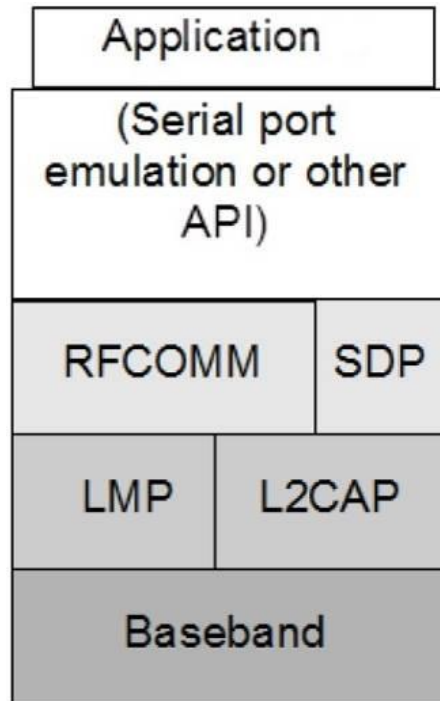
MFi

Support Apple's MFi authentication and iAP1/iAP2 protocols.

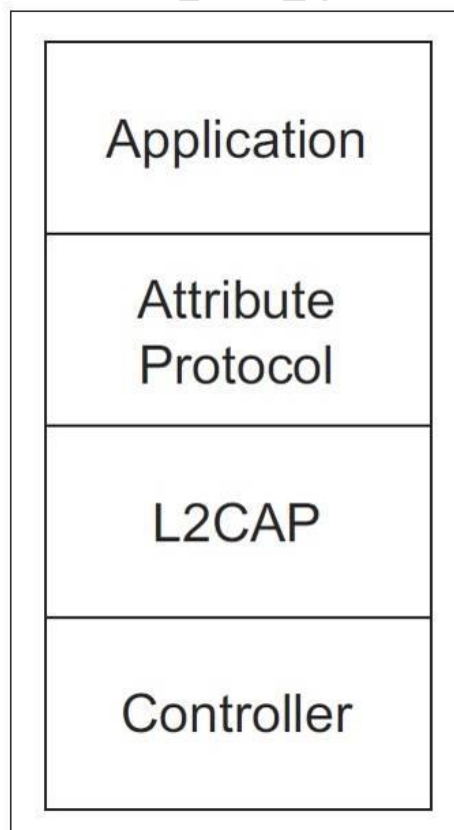
Confidential

Bluetooth Stack

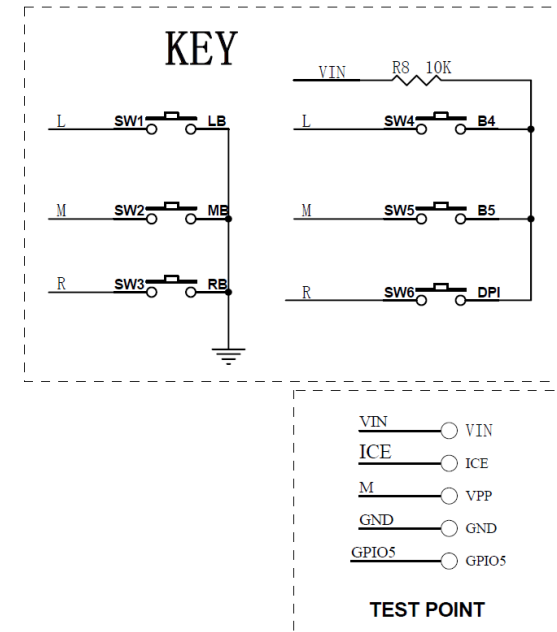
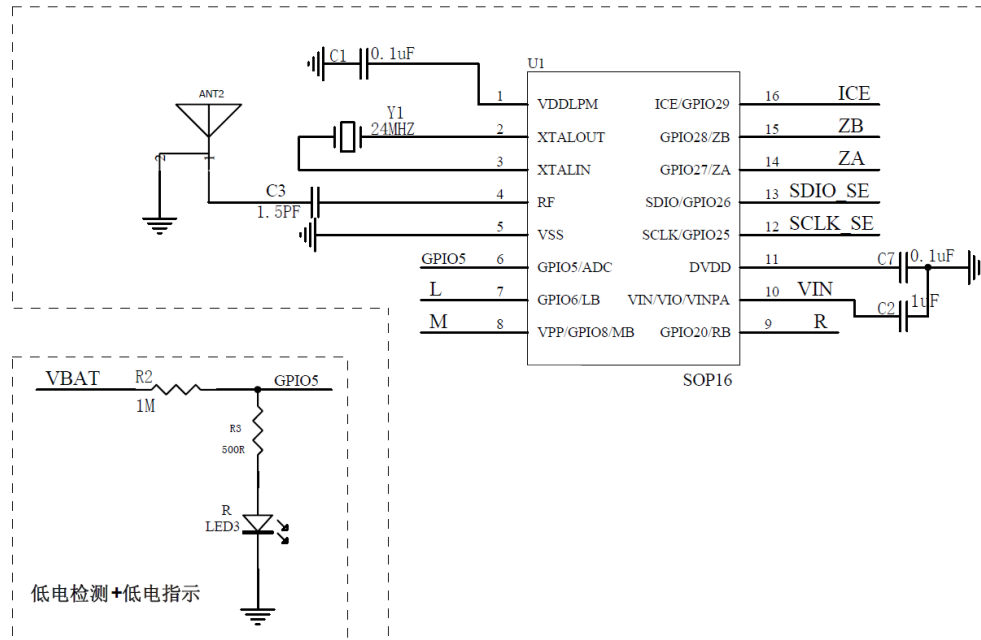
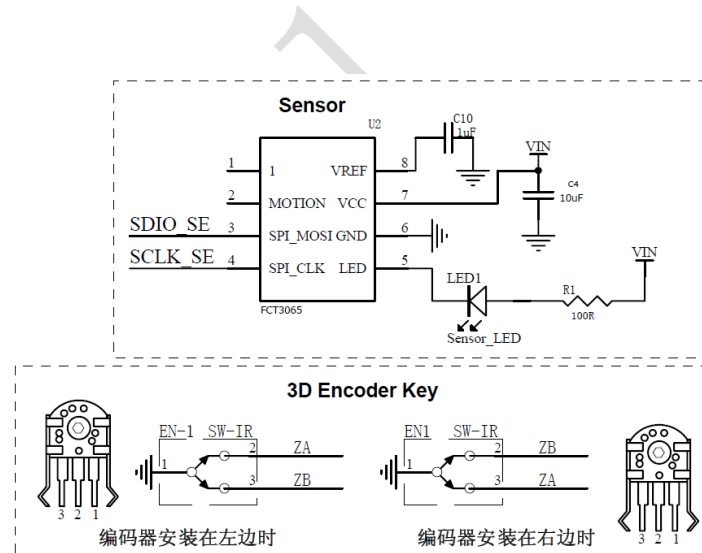
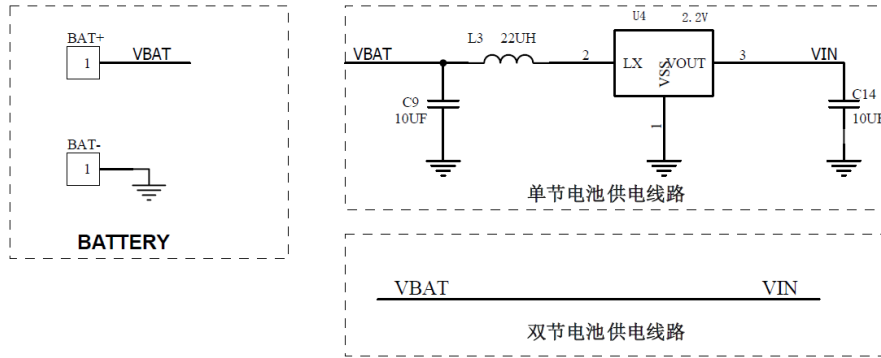
1. Serial Port Profile



2. Generic Attribute Profile



Application Schematic



Package Information

VDDLPM	1	16	GPIO29/ICE
XTALOUT	2	15	GPIO28
XTALIN	3	14	GPIO27
RF	4	13	GPIO26
VSS	5	12	GPIO25
GPIO5	6	11	DVDD
GPIO6	7	10	VIN
GPIO8	8	9	GPIO20

**CP6012
SOP16L**

SOP 16	Pin Name	Type	Function Description
1	VDDLPM	Power_O	internal LDO output, 1.2V. Need an external bypass cap here 100nF
2	XTALOUT	Ana_O	XTAL port
3	XTALIN	Ana_I	XTAL port, or external CLK in
4	RF	RF Port	
5	VSS	Power_O	GND
6	GPIO[5]	Dig_IO	pls check "sheet: GPIO_Muxing"
7	GPIO[6]	Dig_IO	pls check "sheet: GPIO_Muxing"
8	GPIO[8]	Dig_IO	pls check "sheet: GPIO_Muxing"
9	GPIO[20]	Power_O	pls check "sheet: GPIO_Muxing"
10	VIN	Power_O	Voltage Input,3.3V typically 0.1uF decouple cap
11	DVDD	Power_O	internal LDO output, 1.2V. Need an external bypass cap here 0.1uF
12	GPIO[25]	Power_O	pls check "sheet: GPIO_Muxing"
13	GPIO[26]	Dig_IO	pls check "sheet: GPIO_Muxing"
14	GPIO[27]	Dig_IO	pls check "sheet: GPIO_Muxing"
15	GPIO[28]	Dig_IO	pls check "sheet: GPIO_Muxing"
16	GPIO[29]ICE	Dig_IO	pls check "sheet: GPIO_Muxing"

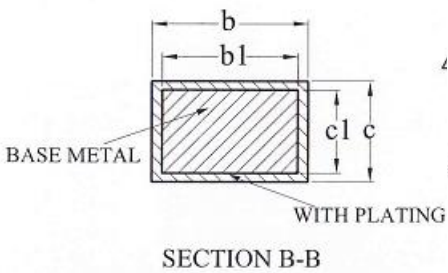
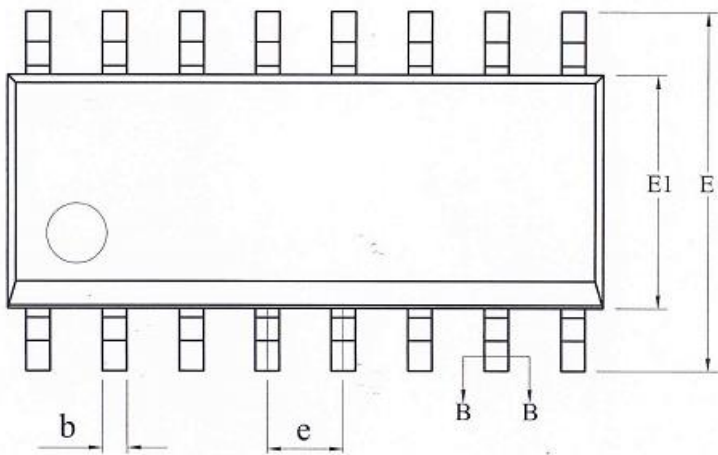
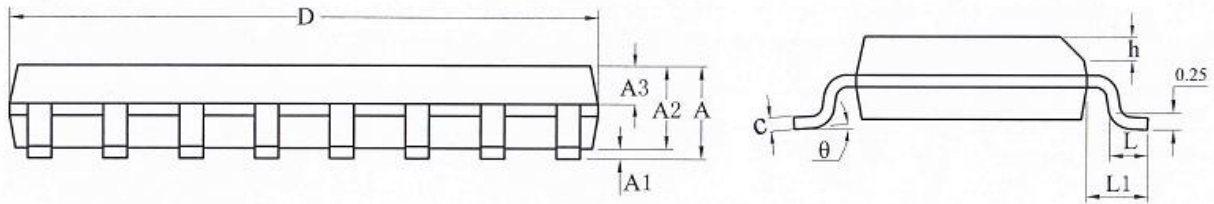
Note: Most GPIOs are by default configured to input status after power-on reset, except for GPIO25 & GPIO26 which are in output status. If a GPIO is not used as well as it is not configured to output, it can be connected to GND. But GPIO2 & GPIO/25/26 MUST NOT be connect to GND at any time.

GPIO Muxing Table

GPIOs	Function1	Function2	Function-Analog	Keyscan
GPIO[5]	PWM OUT1		adc_channel1	row 6
GPIO[6]	UARTTX	PWM OUT0	adc_channel2	row 7
GPIO[8]			wakeup	col 1
GPIO[20]	PWM OUT0		adc_channel6	col 11
GPIO[21]	PWM OUT0		adc_channel7	col 12
GPIO[22]	PWM OUT0		adc_channel8	col 13
GPIO[23]	SPIMISO	PCM DOUT		col 14
GPIO[24]	SPICS	PCM DIN		col 15
GPIO[25]	SPICLK	PCM CLK		col 16
GPIO[26]	SPIMOSI	PCM SYNC		col 17
GPIO[27]	YA	CLKREQ_IN		col 18
GPIO[28]	YB	CLKREQ_OUT		col 19
GPIO[29]	ZA			col 20

Note: Drive capability of GPIO[6:7] & GPIO[18:22] is up to 30mA, other GPIO's drive capability is 10mA

Package Physical Dimension (SOP_16 16L)



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	—	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	—	0.47
b1	0.38	0.41	0.44
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	9.80	9.90	10.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	—	0.50
L	0.50	—	0.80
L1	1.05REF		
θ	0	—	8°