HOLTEK

BC7701
BT5.2 BLE Controller

General Description

The BC7701 is a fully-integrated, single-chip Bluetooth Low Energy (BLE) controller with 2Mbps data rate supported. The BC7701 integrates a switch DC-DC regulator and designes to act as BLE slave according to the Bluetooth specification 5.2.

Moreover, during the intervals with no active BLE RF connection, the BC7701 works in Deep Sleep mode which can further reduce the power consumption.

The device is suitable for use in a wide range of BLE products such as health care products, home appliances, smart device information beacons, human interface device service products etc.

Features

Core

- MCU integrated
- 16MHz operating frequency
- The BC7701 implements on-chip DC-DC for a wide range of power and only one power supply is needed

On-chip Memory

- 160KB on-chip Flash memory
- 20KB on-chip SRAM

Bluetooth Low Energy Controller

- 2.4GHz RF transceiver compatible with Bluetooth Low Energy (BLE) 5.2 specification
- 16MHz external crystal reference clock
- GFSK modulation, Frequency-Hopping Spread Spectrum (FHSS)
- Support LE 1Mbps and 2Mbps
- Receiver supports programmable gain of over 70dB
- Excellent receiver sensitivity of -94dbm @1Mbps
- Programmable transmitter output power up to +3.5dBm
- Software-based True Random Number Generator (TRNG)
- Three operating modes: Normal, Deep-Sleep and Power-Down

Analog to Digital Converter – ADC

- 10-bit generic ADC
- Five external channels and one internal channel can be selected for ADC transfer
- Supports both single and continuous modes

I/O Ports – GPIO

- Up to 20 GPIO pins

There are up to 20 General Purpose I/O pins for the implementation of logic input/output functions.

Pulse Width Modulator – PWM

- 16-bit PWM timers
- 32kHz clock or 16MHz clock can be selected by PWM timers

The PWM consists of timer mode and PWM mode. The timer mode can generate interrupt to MCU and the PWM mode can generate PWM waveform for driving external device such as LED.

Watchdog Timer – WDT

- Reset event for the system

The system will reset after the watchdog timer is expired.

Real Time Clock – RTC

- 32-bit RTC timer
- Wake-up MCU event

Inter-integrated Circuit – I²C

- Supports both master and slave modes with a frequency of up to 400kHz
- Supports 7-bit and 10-bit addressing modes and general call addressing

Serial Peripheral Interface – SPI

- Supports both master and slave modes
- The SPI clock speed can be up to 4MHz

Universal Asynchronous Receiver Transmitter – UART

- Full duplex communication
- Fully programmable serial communication characteristics including:
  - Word length: 5, 6, 7 or 8-bit character
  - Parity: Even, odd or no-parity bit generation and detection
  - Stop bit: 1 or 2 stop bit generation
- Error detection: Parity, overrun and frame error
- Auto hardware flow control mode – RTS, CTS
- FIFO Depth: 8-level for both receiver and transmitter

The UART baud rate can be up to 3.2MHz.

Package and Operation Temperature

- 32-pin QFN package
- Operation temperature range: -40°C to 85°C

Overview

Device Information

Peripherals		BC7701
Main Flash (KB)		160
SRAM (KB)		20
Timers	PWM	6
	WDT	1
	RTC	1
Communication	SPI	1
	UART	2
	I²C	1
ADC	Resolution	10-bit
	Speed	500K
	Channels	6
GPIO		Up to 20
CPU frequency		16MHz
Operating voltage		2.0V~3.6V
Operating temperature		-40°C~85°C
Package		32-pin QFN

Features and Peripheral List

Block Diagram
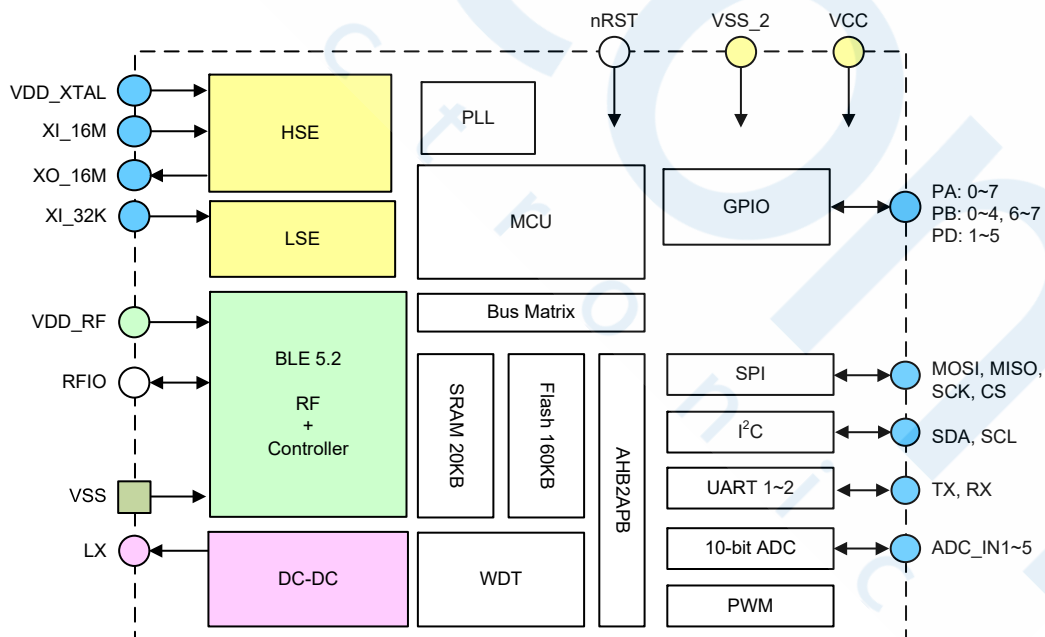
Pin Assignment
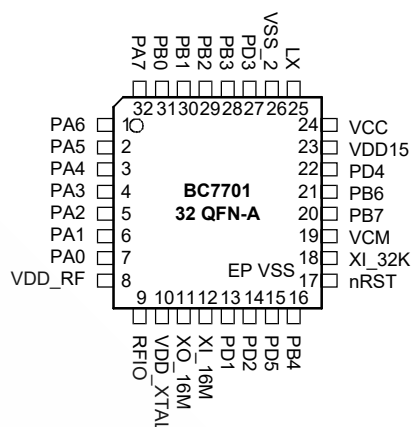
Pin Description

Pin Name	Pin No.	Type(Note)	Description
PA6	1	I/O	General purpose I/O
PA5	2	I/O	General purpose I/O
PA4	3	I/O	General purpose I/O
PA3	4	I/O	General purpose I/O
PA2	5	I/O	General purpose I/O
PA1	6	I/O	General purpose I/O
PA0	7	I/O	General purpose I/O
VDD_RF	8	P	RF power
RFIO	9	AI/O	RF input or output
VDD_XTAL	10	P	Crystal oscillator power
XO_16M	11	AO	16MHz Crystal oscillator output
XI_16M	12	AI	16MHz Crystal oscillator input
PD1	13	I/O	General purpose I/O
PD2	14	I/O	General purpose I/O
PD5	15	I/O	General purpose I/O
PB4	16	I/O	General purpose I/O
nRST	17	I	Hardware reset
XI_32K	18	AI	32.768kHz Crystal oscillator input
VCM	19	AO	Voltage for ADC reference. Use this pin only when ADC is enabled V_{CM}=Common mode voltage
PB7	20	I/O	General purpose I/O
PB6	21	I/O	General purpose I/O
PD4	22	I/O	General purpose I/O
VDD15	23	P	Internal power
VCC	24	P	Digital power supply
LX	25	AO	Switching output. Connect this pin to the switching end of the inductor
VSS_2	26	P	Ground reference for digital I/O
PD3	27	I/O	General purpose I/O
PB3	28	I/O	General purpose I/O
PB2	29	I/O	General purpose I/O
PB1	30	I/O	General purpose I/O

Pin Name	Pin No.	Type(Note)	Description
PB0	31	I/O	General purpose I/O
PA7	32	I/O	General purpose I/O
VSS	EP	P	Exposed Pad on the bottom of the package. Internally connected to RF Grounding. Solder this exposed pad to a PCB pad that uses multiple ground vias to provide heat transfer out of the device into the PCB ground planes. These multiple ground vias are also required to achieve the noted RF performance.

Note: I = Input; O = Output; A = Analog port; P = Power supply; EP = Exposed pad.

GPIO Mapping

Pin Name	Pin No.	Type	Description
PA0	7	I/O	UART1_TX
PA1	6	I/O	UART1_RX
PA2	5	I/O	I²C_SCL
PA3	4	I/O	I²C_SDA
PA4	3	I/O	SPI_SCK
PA5	2	I/O	SPI_MOSI
PA6	1	I/O	SPI_MISO
PA7	32	I/O	SPI_CS
PB0	31	I/O	PWM0
PB1	30	I/O	PWM1
PB2	29	I/O	PWM2
PB3	28	I/O	PWM3
PB4	16	I/O	PWM4
PB6	21	I/O	UART2_TX
PB7	20	I/O	UART2_RX
PD1	13	I/O	ADC Channel 1
PD2	14	I/O	ADC Channel 2
PD3	27	I/O	ADC Channel 3
PD4	22	I/O	ADC Channel 4
PD5	15	I/O	ADC Channel 5

Electrical Characteristics

Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the device. These are stress ratings only. Stresses beyond absolute maximum ratings may cause permanent damage to the device. Note that the device is not guaranteed to operate properly at the maximum ratings. Exposure to the absolute maximum rating conditions for extended periods may affect device reliability.

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	External Main Supply Voltage	2.0	3.6	V
V_{IN}	Input Voltage on I/O	V_{CC}-0.3	V_{CC}+0.3	V
T_A	Ambient Operating Temperature Range	-40	+85	°C
T_{STG}	Storage Temperature Range	-55	+150	°C

Recommended DC Operating Conditions

T_A=25°C

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{CC}	Operating Voltage	—	2.0	3.0	3.6	V

A.C. Characteristics

T_A=25°C

Symbol	Parameter		Min.	Typ.	Max.	Unit
Crystal Oscillator 16MHz						
f_{HSE}	Frequency		—	16	—	MHz
ACC_{HSE}	Frequency Accuracy Requirement		-30	—	30	ppm
ESR	Equivalent Series Resistance		—	—	80	Ω
C0	Crystal Shunt Capacitance		—	—	3	pF
CL	Crystal Load Capacitance		—	7	—	pF
Crystal Oscillator 32.768kHz						
f_{LSE}	Frequency		—	32.768	—	kHz
ACC_{LSE}	Frequency Accuracy Requirement		-20	—	20	ppm
ESR	Equivalent Series Resistance		—	—	70k	Ω
C0	Crystal Shunt Capacitance		—	—	2	pF
CL	Crystal Load Capacitance		—	12.5	—	pF
RX Characteristic						
CI0	In-band Blocking	Co-channel Interference	—	7	—	dB
CI1		Interfere at f_{OFFS}=±1MHz	-9	—	-6	dB
CI2		Interfere at f_{OFFS}=±2MHz	—	-44	—	dB
CI3		Interfere at f_{OFFS}=±3MHz	—	-50	—	dB
CI4		Interfere at f_{IMAGE}	—	-25	—	dB
CI5		Interfere at f_{IMAGE}=±1MHz	—	-35	—	dB
Intermodulation	Pin=-64dBm; Punwant=50dBm; f0=2f1-f2, f2-f1=3/4/5MHz		-25	—	-22	dBm
PSENS	Sensitivity @ 1Mbps		—	-94	—	dBm
	Sensitivity @ 2Mbps		—	-91	—	dBm
PTX	Output Power		—	3.5	—	dBm
TX Characteristic						
P_{TX}	Output Power		—	3.5	—	dBm
P_{BW}	Modulation 20dB Bandwidth		—	—	1	MHz
PRF1	Out of Band Emission 2MHz		—	-20	—	dB
PRF2	Out of Band Emission 3MHz		—	-58	—	dB
Dev	Transmit FM Deviation		115	250	300	kHz
Drift	Transmit Drift in any Position		—	—	400	Hz/µs

BLE Power Consumption Characteristics

V_{CC}=3V, T_A=25°C

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{RX}	Supply Current (RX Mode)	—	—	8	—	mA
I_{TX}	Supply Current (TX Mode, 0dBm Output Power)	—	—	5.83	—	mA
I_{SLEEP}	Supply Current (IDLE Mode when MCU Deep Sleep)	—	—	1.6	—	μA
I_{ACT}	Supply Current (IDLE Mode when MCU Active)	—	—	1.38	—	mA
I_{PDN}	Supply Current (Power Down)	—	—	1	—	μA

I/O Port Characteristics

T_A=25°C

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{IL}	Low Level Input Voltage	3V I/O	0	—	0.3	V
V_{IH}	High Level Input Voltage	3V I/O	2.7	—	3.3	V
V_{OL}	Low Level Output Voltage	3V, I_{OH}=0.25mA	—	—	0.3	V
V_{OH}	High Level Output Voltage	3V, I_{OH}=-0.25mA	V_{CC}-0.3	—	V_{CC}	V

Package Information

Note that the package information provided here is for consultation purposes only. As this information may be updated at regular intervals users are reminded to consult the Holtek website for the latest version of the Package/ Carton Information.

Additional supplementary information with regard to packaging is listed below. Click on the relevant section to be transferred to the relevant website page.

• Package Information (include Outline Dimensions, Product Tape and Reel Specifications)

• Packing Meterials Information

• Carton information

SAW Type 32-pin QFN (4mm×4mm×0.55mm) Outline Dimensions
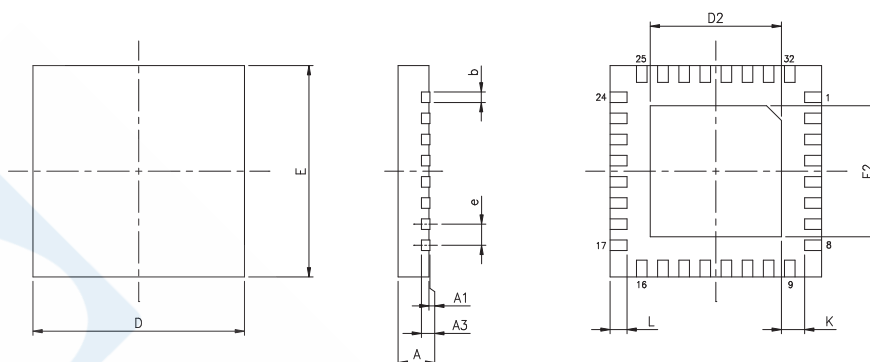
Symbol	Dimensions in inch		
	Min.	Nom.	Max.
A	0.020	0.022	0.024
A1	0.000	0.001	0.002
A3	—	0.006 BSC	—
b	0.006	0.008	0.010
D	—	0.157 BSC	—
E	—	0.157 BSC	—
e	—	0.016 BSC	—
D2	0.104	0.106	0.108
E2	0.104	0.106	0.108
L	0.010	0.012	0.014
K	0.008	—	—

Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	0.50	0.55	0.60
A1	0.00	0.02	0.05
A3	—	0.150 BSC	—
b	0.15	0.20	0.25
D	—	4.00 BSC	—
E	—	4.00 BSC	—
e	—	0.40 BSC	—
D2	2.65	2.70	2.75
E2	2.65	2.70	2.75
L	0.25	0.30	0.35
K	0.20	—	—