## 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 designs 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
- Three operating modes: Normal, Deep-Sleep and Power-Down

### I/O Ports – GPIO

- 16 GPIO pins

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

### 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

### 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

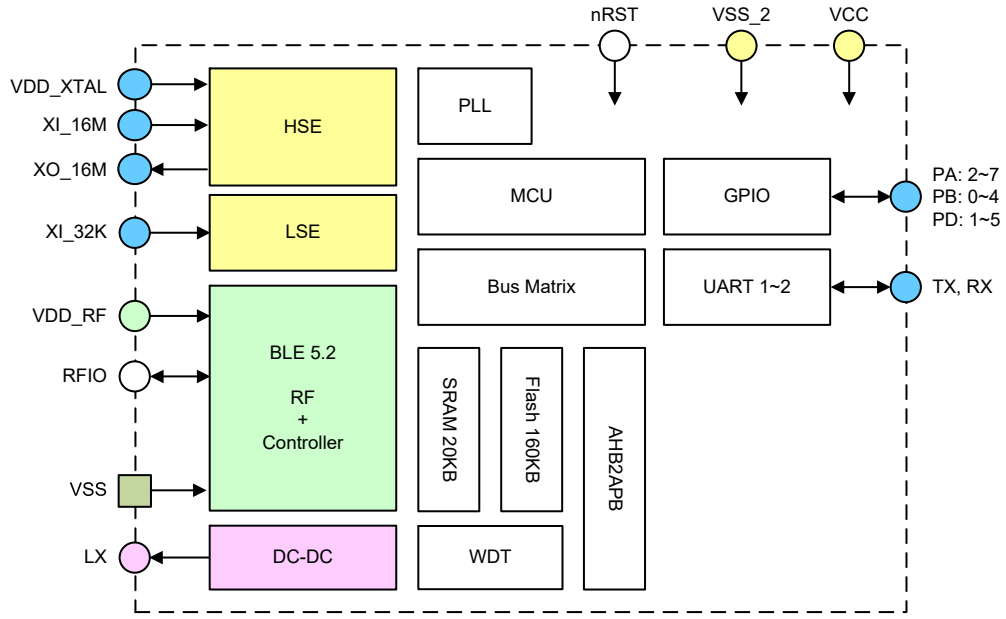
# Overview

## Device Information

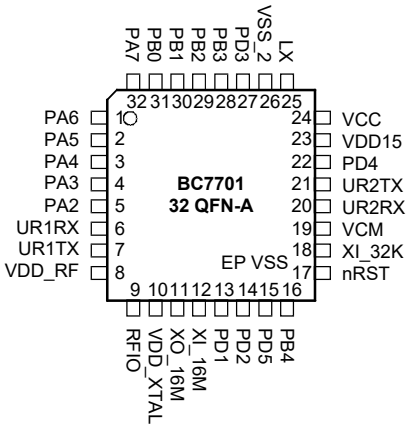
| Peripherals | | BC7701 |
|---|---|---|
| Main Flash (KB) | | 160 |
| SRAM (KB) | | 20 |
| Timers | WDT | 1 |
| | RTC | 1 |
| Communication | UART | 2 |
| GPIO | | 16 |
| CPU frequency | | 16MHz |
| Operating voltage | | 2.0V~3.6V |
| Operating temperature | | -40°C~85°C |
| Package | | 32-pin QFN |

**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 |
| UR1RX | 6 | I/O | UART1 receive pin |
| UR1TX | 7 | I/O | UART1 transmit pin |
| 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<br>$V_{CM}$=Common mode voltage |
| UR2RX | 20 | I/O | UART2 receive pin |
| UR2TX | 21 | I/O | UART2 transmit pin |
| 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.

# 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** | | | | | |

| Symbol | Parameter | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| 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 |

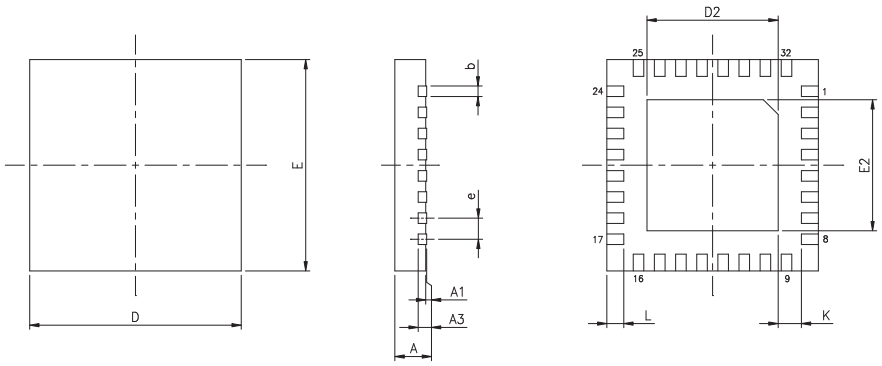
## Package Information

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 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 REF | |
| b | 0.006 | 0.008 | 0.010 |
| D | | 0.157 BSC | |
| E | | 0.157 BSC | |
| e | | 0.016 BSC | |
| D2 | 0.100 | — | 0.108 |
| E2 | 0.100 | — | 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 REF | |
| b | 0.15 | 0.20 | 0.25 |
| D | | 4.00 BSC | |
| E | | 4.00 BSC | |
| e | | 0.40 BSC | |
| D2 | 2.55 | — | 2.75 |
| E2 | 2.55 | — | 2.75 |
| L | 0.25 | 0.30 | 0.35 |
| K | 0.20 | — | — |