# BK3435 Bluetooth Low Energy Single Mode SoC

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# 1      General Description

## 1.1  Overview

The BK3435 chip is a highly integrated Bluetooth 4.2 low energy single mode device, with 2 Mbps data rate option. It integrates a high-performance RF transceiver, baseband, ARM9E core, rich feature peripheral units, programmable protocol and profile to support BLE application. The Flash program memory makes it suitable for customized applications.

The BK3435 is designed with advanced technology process and integrated with switch DCDC regulator, that it has ultra-low power consumption and ultra-low leakage power. The embedded high order interference suppression filter and fast automatic gain control logic make it work well in high interference environment.

## 1.2  Block Diagram
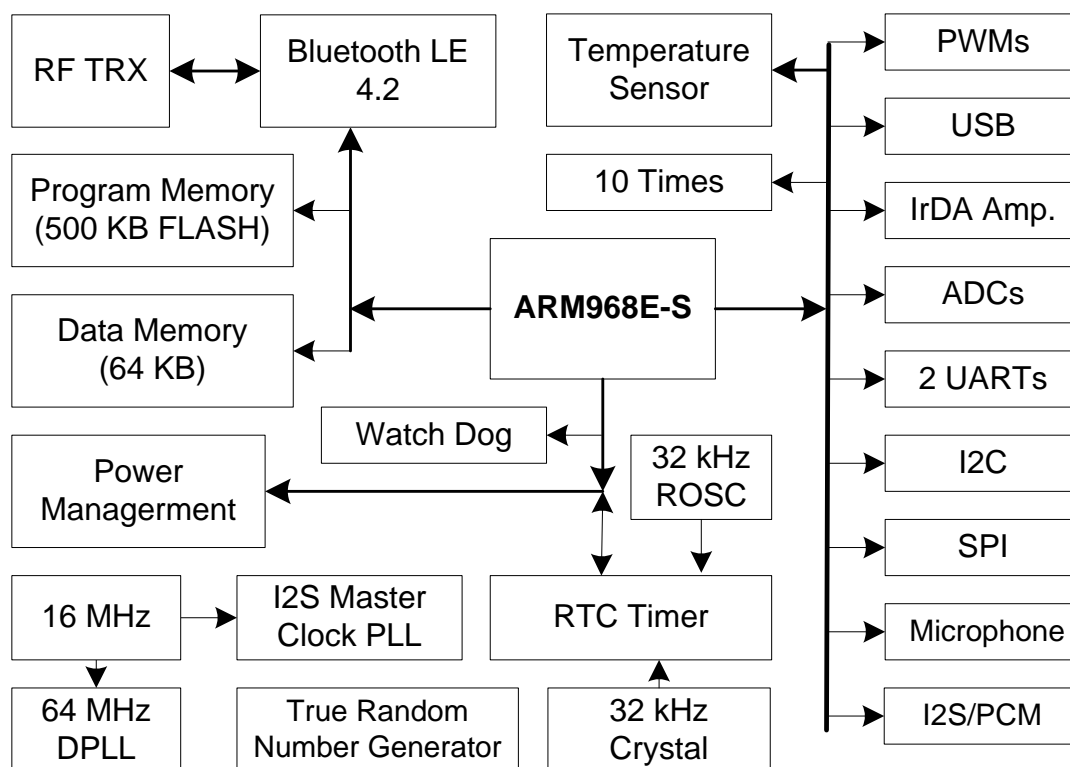


**Figure 1 BK3435 Block Diagram**

## 1.3 Features

- Bluetooth® SIG Bluetooth Low Energy Single-Mode (BLE) compliant
- Low-power 2.4GHz Transceiver
- ARM968E Core Microprocessor integrated
- 500 KB programmable Flash for Program and 64 KB RAM for Data
- Operation voltage from 0.9 V to 3.6 V
- Clock
  - 16 MHz crystal reference clock
  - 64 MHz digital PLL clock
  - 32 kHz ring oscillator
  - External 32KHz crystal oscillator
  - MCU can run with any clock source with internal frequency divider
  - Dedicate audio PLL clock for I2S main clock
- Interface and peripheral units
  - Quad IO FLASH programming
  - JTAG, I2C, SPI interface
  - Two UART interface
  - Multi-channels PWM output
  - USB Host and Device interface
  - IrDA receiver and transmitter amplify
  - On-chip high accurate temperature sensor
  - On-chip 10 bit general ADC
  - On-chip audio gain amplify and 16 bit microphone ADC
  - GPIO with multiplexed interface functions
  - True random number generator
  - I2S/PCM digital audio interface with master and slave mode
- Typical Package Type
  - 32-pin QFN 4x4, 40-pin QFN5x5 and 48-pin QFN6x6

## 2  PIN information

### 2.1  QFN32
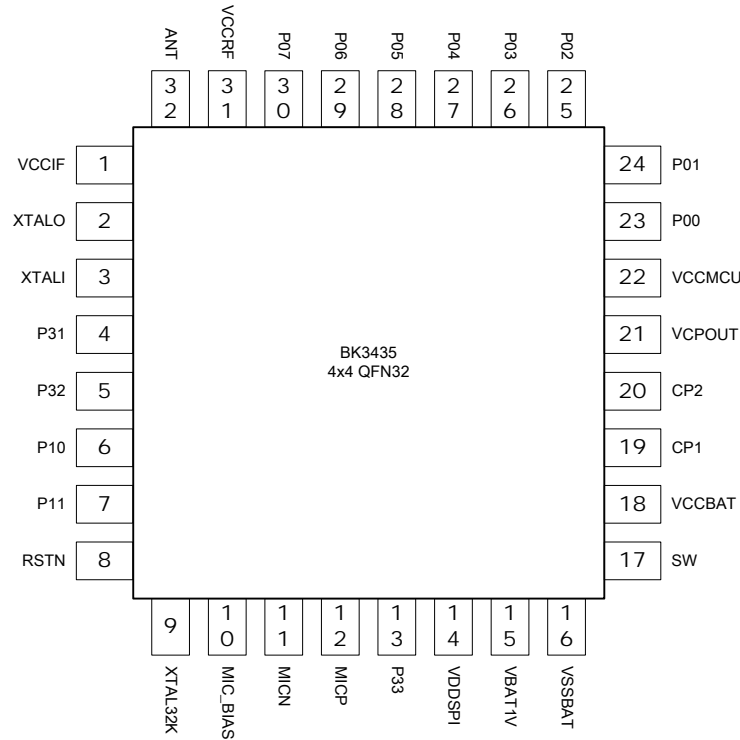


**Figure 2 BK3435 QFN32 pin assignment**

**Table 1 BK3435 QFN32 Pin Description**

| PIN | Name | Pin Function | Description |
|-----|------|--------------|-------------|
| 1 | VCCIF | Power | IF power |
| 2 | XTALO | Analog | 16 MHz crystal output |
| 3 | XTALI | Analog | 16 MHz crystal input |
| 4 | P31 | Digital I/O | General purpose IO |
| 5 | P32 | Digital I/O | General purpose IO |
| 6 | P10 | Digital I/O | General purpose IO |
| 7 | P11 | Digital I/O | General purpose IO |
| 8 | RSTN | Analog | Active low pin reset |
| 9 | XTAL32K | Analog | 32kHz Crystal input |
| 10 | MIC_BIAS | Analog | Microphone bias voltage output |
| 11 | MIC_N | Analog | Microphone input N |
| 12 | MIC_P | Analog | Microphone input P |
| 13 | P33 | Digital I/O | General purpose IO |
| 14 | VDDSPI | Analog | LDO output |

| 15 | VBAT1V | Analog | One battery mode (battery input) or two battery mode (Ground) |
| 16 | VSSBAT | Ground | Ground |
| 17 | SW | Analog | Switch regulator pin for two battery mode |
| 18 | VCCBAT | Power | Power |
| 19 | CP1 | Analog | Charge pump component for FLASH |
| 20 | CP2 | Analog | Charge pump component for FLASH |
| 21 | CPOUT | Power | Charge pump output voltage for FLASH |
| 22 | VCCMCU | Power | Power |
| 23 | P00 | Digital I/O | General purpose IO |
| 24 | P01 | Digital I/O | General purpose IO |
| 25 | P02 | Digital I/O | General purpose IO |
| 26 | P03 | Digital I/O | General purpose IO |
| 27 | P04 | Digital I/O | General purpose IO |
| 28 | P05 | Digital I/O | General purpose IO |
| 29 | P06 | Digital I/O | General purpose IO |
| 30 | P07 | Digital I/O | General purpose IO |
| 31 | VCCRF | Power | RF power |
| 32 | ANT | RF | RF signal port |

## 2.2  QFN40
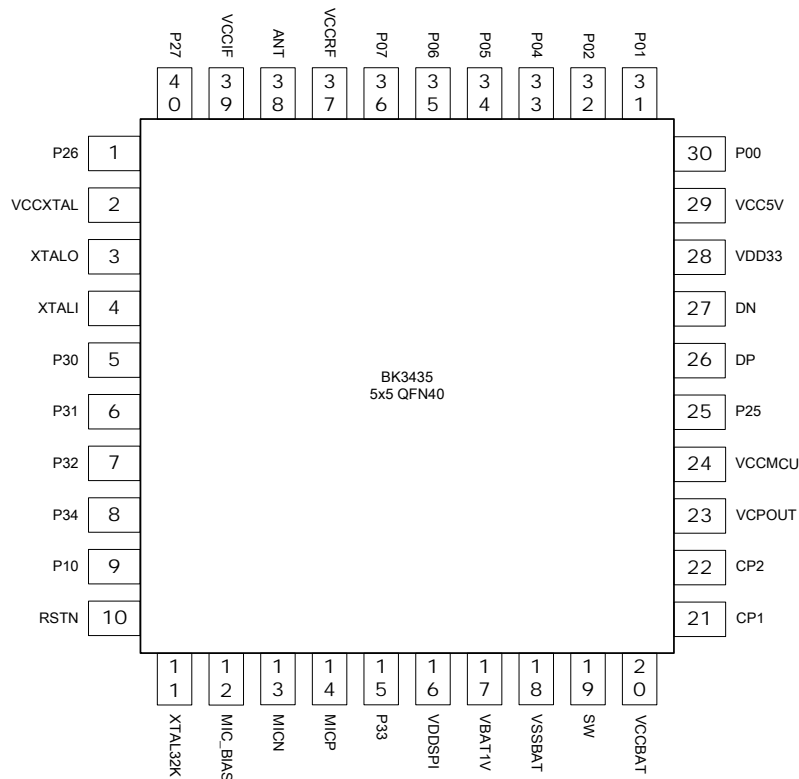


Figure 3 BK3435 QFN40 pin assignment

## Table 2 BK3435 QFN40 Pin Description

| PIN | Name | Pin Function | Description |
|-----|------|--------------|-------------|
| 1 | P26 | Digital I/O | General purpose IO |
| 2 | VCCXTAL | Power | XTAL power |
| 3 | XTALO | Analog | 16 MHz crystal output |
| 4 | XTALI | Analog | 16 MHz crystal input |
| 5 | P30 | Digital I/O | General purpose IO |
| 6 | P31 | Digital I/O | General purpose IO |
| 7 | P32 | Digital I/O | General purpose IO |
| 8 | P34 | Digital I/O | General purpose IO |
| 9 | P10 | Digital I/O | General purpose IO |
| 10 | RSTN | Analog | Active low pin reset |
| 11 | XTAL32K | Analog | 32kHz Crystal input |
| 12 | MIC_BIAS | Analog | Microphone bias voltage output |
| 13 | MIC_N | Analog | Microphone input N |
| 14 | MIC_P | Analog | Microphone input P |
| 15 | P33 | Digital I/O | General purpose IO |
| 16 | VDDSPI | Analog | LDO output |
| 17 | VBAT1V | Analog | One battery mode (battery input) or two battery mode (Ground) |
| 18 | VSSBAT | Ground | Ground |
| 19 | SW | Analog | Switch regulator pin for two battery mode |
| 20 | VCCBAT | Power | Power |
| 21 | CP1 | Analog | Charge pump component for FLASH |
| 22 | CP2 | Analog | Charge pump component for FLASH |
| 23 | CPOUT | Power | Charge pump output voltage for FLASH |
| 24 | VCCMCU | Power | Power |
| 25 | P25 | Digital I/O | General purpose IO |
| 26 | DP | Analog | USB positive |
| 27 | DN | Analog | USB negative |
| 28 | VDD33 | Power | USB LDO output |
| 29 | VCC5V | Power | USB power supply |
| 30 | P00 | Digital I/O | General purpose IO |
| 31 | P01 | Digital I/O | General purpose IO |
| 32 | P02 | Digital I/O | General purpose IO |
| 33 | P04 | Digital I/O | General purpose IO |
| 34 | P05 | Digital I/O | General purpose IO |
| 35 | P06 | Digital I/O | General purpose IO |
| 36 | P07 | Digital I/O | General purpose IO |
| 37 | VCCRF | Power | RF power |
| 38 | ANT | RF | RF signal port |
| 39 | VCCIF | Power | IF power |
| 40 | P27 | Digital I/O | General purpose IO |

## 2.3  QFN48
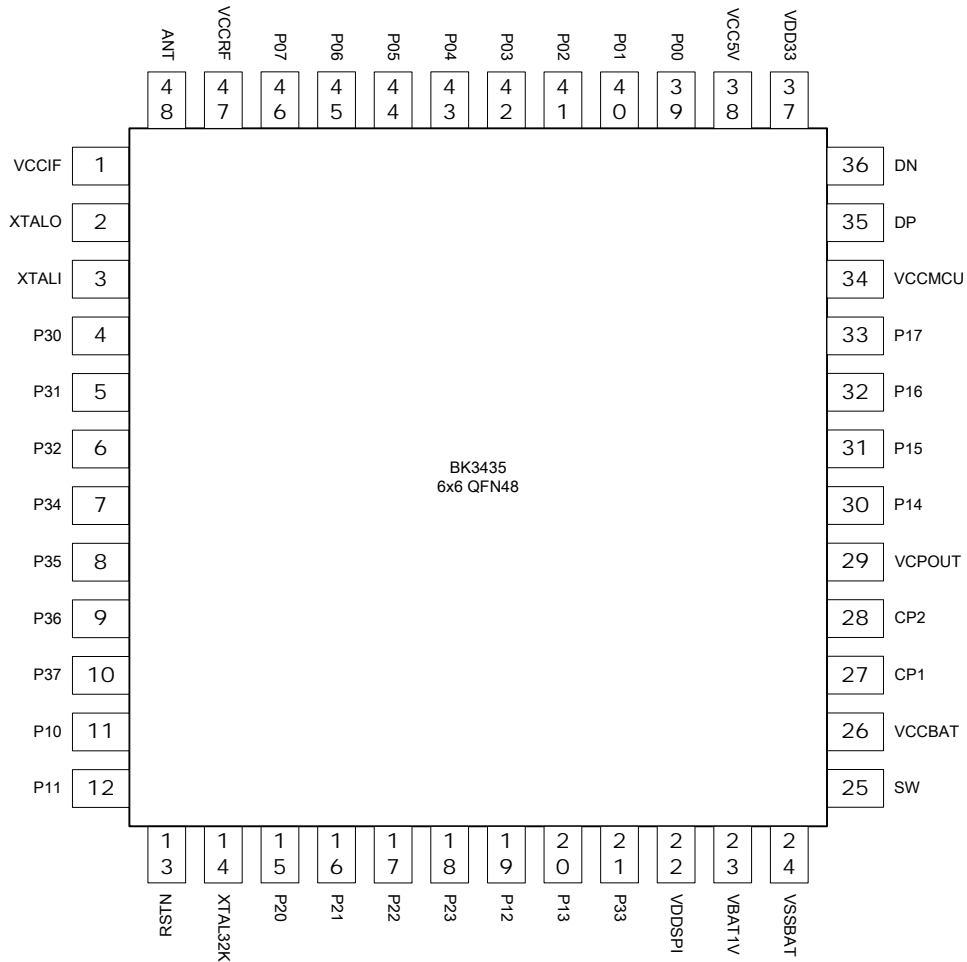


**Figure 4 BK3435 QFN48 pin assignment**

**Table 3 BK3435 QFN48 Pin Description**

| PIN | Name | Pin Function | Description |
|---|---|---|---|
| 1 | VCCIF | Power | IF power |
| 2 | XTALO | Analog | 16 MHz crystal output |
| 3 | XTALI | Analog | 16 MHz crystal input |
| 4 | P30 | Digital I/O | General purpose IO |
| 5 | P31 | Digital I/O | General purpose IO |
| 6 | P32 | Digital I/O | General purpose IO |
| 7 | P34 | Digital I/O | General purpose IO |
| 8 | P35 | Digital I/O | General purpose IO |
| 9 | P36 | Digital I/O | General purpose IO |
| 10 | P37 | Digital I/O | General purpose IO |

| 11 | P10 | Digital I/O | General purpose IO |
|---|---|---|---|
| 12 | P11 | Digital I/O | General purpose IO |
| 13 | RSTN | Analog | Active low pin reset |
| 14 | XTAL32K | Analog | 32kHz Crystal input |
| 15 | P20 | Digital I/O | General purpose IO |
| 16 | P21 | Digital I/O | General purpose IO |
| 17 | P22 | Digital I/O | General purpose IO |
| 18 | P23 | Digital I/O | General purpose IO |
| 19 | P12 | Digital I/O | General purpose IO |
| 20 | P13 | Digital I/O | General purpose IO |
| 21 | P33 | Digital I/O | General purpose IO |
| 22 | VDDSPI | Analog | LDO output |
| 23 | VBAT1V | Analog | One battery mode (battery input) or two battery mode (Ground) |
| 24 | VSSBAT | Ground | Ground |
| 25 | SW | Analog | Switch regulator pin for two battery mode |
| 26 | VCCBAT | Power | Power |
| 27 | CP1 | Analog | Charge pump component for FLASH |
| 28 | CP2 | Analog | Charge pump component for FLASH |
| 29 | CPOUT | Power | Charge pump output voltage for FLASH |
| 30 | P14 | Digital I/O | General purpose IO |
| 31 | P15 | Digital I/O | General purpose IO |
| 32 | P16 | Digital I/O | General purpose IO |
| 33 | P17 | Digital I/O | General purpose IO |
| 34 | VCCMCU | Power | Power |
| 35 | DP | Analog | USB positive |
| 36 | DN | Analog | USB negative |
| 37 | VDD33 | Power | USB LDO output |
| 38 | VCC5V | Power | USB power supply |
| 39 | P00 | Digital I/O | General purpose IO |
| 40 | P01 | Digital I/O | General purpose IO |
| 41 | P02 | Digital I/O | General purpose IO |
| 42 | P03 | Digital I/O | General purpose IO |
| 43 | P04 | Digital I/O | General purpose IO |
| 44 | P05 | Digital I/O | General purpose IO |
| 45 | P06 | Digital I/O | General purpose IO |
| 46 | P07 | Digital I/O | General purpose IO |
| 47 | VCCRF | Power | RF power |
| 48 | ANT | RF | RF signal port |

# 3  Functional Description

## 3.1  GPIO

The BK3435 has totally many GPIO pins, which can be configured as either input or output. There are secondary functions available for GPIO pins and configurable by firmware.

At the beginning of the chip starts up, the chip will enter programming mode, JTAG mode or normal according received command from Mode Selecting Pin.

### Table 4 BK3435 GPIO function mapping

| | | Description | I/O | PROGRAM Mode | Mode Selection Pin | Jtag mode |
|---|---|---|---|---|---|---|
| P00 | UART1 | UART_TX | O | | | |
| P01 | | UART_RX | I | | | |
| P02 | I2C | SCL-IR_TRX | I/O | HOLD_FLA | | |
| P03 | | SDA | I/O | WP_FLA | | JTAG_NTRST |
| P04 | SPI | SPI_SCK | I/O | SI_FLA ( Output To FLASH ) | SPI_MOSI | JTAG_TDI |
| P05 | | SPI_MOSI | I/O | SO_FLA | SPI_MISO | JTAG_TDO |
| P06 | | SPI_MISO | I/O | SCK_FLA | SPI_SCK | JTAG_TCK |
| P07 | | SPI_NSS | I/O | CSN_FLA | SPI_CS | JTAG_TMS |
| P10 | PWM | PWM[0]（20mA） | O | | | |
| P11 | | PWM[1]（20mA） | O | | | |
| P12 | | PWM[2] | O | | | |
| P13 | | PWM[3] | O | | | |
| P14 | | PWM[4] | O | | | |
| P15 | | PWM[5] | O | | | |
| P16 | UART2 | UART2_TX | O | | | |
| P17 | | UART2_RX | O | | | |
| P20 | 3DS | PWM_3DS | O | | | |
| P21 | | PWM_3DS | O | | | |
| P22 | | PWM_3DS | O | | | |
| P23 | | PWM_3DS | O | | | |
| P25 | I2S | PCM_BCLK | O | | | |
| P26 | | PCM_SCLK | O | | | |
| P27 | | PCM_DOUT | O | | | |
| P30 | ADC | Ch0/PCM_DIN | I | | | |
| P31 | | Ch1 | I | | | |
| P32 | | Ch2 | I | | | |
| P33 | | Ch3/CKAUDIO | | | | |
| P34 | | Ch4 | I | | | |
| P35 | | Ch5 | I | | | |
| P36 | | Ch6 | I | | | |

| P37 | | Ch7 | I | | | |
|---|---|---|---|---|---|---|

Each GPIO pin can be the source to wake up MCU from shut down state. In the shutdown state, any voltage level change on the pre-configured GPIO pin will trigger the wake-up procedure.

## 3.2 Timers

### 3.2.1 PWM Timers

There are six 16 bits PWM timers. The clock of PWM timers can be selected as 32 KHz clock or 16 MHz clock by register.

There are two modes of PWM timers. One is timer mode and another is PWM mode. The timer mode can generate interrupt to MCU. The PWM mode can generate PWM waveform and output to GPIO pins to drive external device such as LED. Six GPIO pins can be used to output PWM waveform separately.

### 3.2.2 3DS Timers

There are four 22 bits timers for 3D glasses, who run with 16 MHz clock. The 3DS timers can be used to generate differential PWM waveform, and also can be used as general timer.

### 3.2.3 Watch dog timer and RTC timer

The watch dog timer and RTC timer run on the always on power domain, whose clock source is 32 kHz clock.

The 16 bits watch dog timer runs with 4 kHz frequency that its period can be up to 16 second. After watch dog timer is expired, it will reset the whole chip.

The 32 bits RTC timer in always on power domain run with ROSC frequency that its period can be up to one day. After RTC timer is expired, it will wake up the MCU.

## 3.3 ADC

A 10-bit generic ADC is integrated in BK3435. Total eight external channels and

two internal channels can be selected for ADC transfer. It supports both single and continuous mode. There is a 0~30 dB audio amplifier for the external input, with 3 dB gain step.

| ADC Channel Number | ADC Source |
|---|---|
| Channel 0 | GPIO30 |
| Channel 1 | GPIO31 |
| Channel 2 | GPIO32 |
| Channel 3 | GPIO33 |
| Channel 4 | GPIO34 |
| Channel 5 | GPIO35 |
| Channel 6 | GPIO36 |
| Channel 7 | GPIO37 |
| Internal Channel 0 | Temperature Sensor |
| Internal Channel 1 | VCCBAT-pin |

## 3.4  UART, I2C and SPI

There are two set UARTs, one set I2C and one set SPI interface, which support both master and slave mode.

The UART baud rate can be up to 3.2 MHz, and the SPI clock speed can be up to 4 MHz。

## 3.5  Audio interface

To convert audio signal from microphone input to digital, there is a 0 to 42 dB gain audio PGA with 3 dB gain step and 16 bit 16 kHz sigma-delta ADC.

## 3.6  IrDA Transceiver
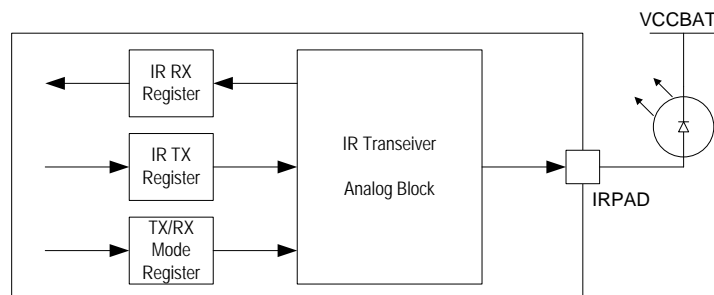
It integrates IR receiver and transmitter amplify that the chip can support IR function without any external amplifier.

## 3.7 USB

It integrates USB host and device transceiver and base band.

## 3.8 True random number generator

By using device noise variation characteristic, it provides one bit true random number generator.

## 3.9 I2S Digital Audio

The I2S audio interface is mapped to GPIO[25,26,27,30], which support arbitrate sample rate from 8 kHz to 96 kHz. When working as master, the main clock can be output from GPIO33.

The I2S interface supports both PCM mono channel mode and I2S stereo channel mode. The data width can be 16, 24 and 32 bit.

# 4 Electrical Specifications

**Table 5 BK3435 RF Characteristics**

| Name | Parameter (Condition) | Min | Typical | Max | Unit | Comment |
|---|---|---|---|---|---|---|
| | **Operating Condition** | | | | | |
| VCC | Voltage | 0.9 | 3.0 | 3.6 | V | |
| TEMP | Temperature | -40 | +27 | +125 | ºC | |
| | **Digital input Pin** | | | | | |
| VIH | High level | VCC-0.3 | | VCC+0.3 | V | |
| VIL | Low level | VSS | | VSS+0.3 | V | |
| | **Digital output Pin** | | | | | |
| VOH | High level (IOH=-0.25mA) | VCC- 0.3 | | VCC | V | |
| VOL | Low level(IOL=0.25mA) | VSS | | VSS+0.3 | V | |
| | **Normal condition** | | | | | |
| IVDD | Deep sleep | | TBD | | uA | |
| IVDD | Sleep current (RF OFF, 32 kHz  clock, DIG Retention) | | 2 | | uA | |
| IVDD | Active RX (3.3 V) | | 5.2 | | mA | With DCDC |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | regulator |
| IVDD | Active TX @ -1 dBm (3.3 V) | | 5 | | mA | With DCDC regulator |
| | **Normal RF condition** | | | | | |
| FOP | Operating frequency | 2400 | | 2480 | MHz | |
| FXTAL | Crystal frequency | | 16 | | MHz | |
| RFSK | Air data rate | | 1 | 2 | Mbps | |
| | **Transmitter (1 Mbps mode)** | | | | | |
| PRF | Output power | -20 | -1 | +4 | dBm | |
| PBW | Modulation 20 dB bandwidth | | | 1 | MHz | |
| PRF1 | Out of band emission 2 MHz | | -20 | | dB | |
| PRF2 | Out of band emission 3 MHz | | -58 | | dB | |
| Dev | Transmit FM deviation | 185 | 250 | 300 | kHz | |
| Drift | Transmit drift in any position | | | 400 | Hz/us | |
| | R**eceiver** | | | | | |
| Max Input | 1 E-3 BER | | -10 | | dBm | |
| RXSENS | 1 E-3 BER sensitivity | | -96 | -97 | dBm | |
| Intermodulation | Pin=-64 dBm; Punwant=-50 dBm; f0=2f1-f2, f2-f1=3 MHz or 4 MHz or 5 MHz | | -25 | -22 | dBm | |
| C/ICO | Co-channel C/I | | 7 | | dB | |
| C/I1ST | ACS C/I 1MHz | -9 | | -6 | dB | |
| C/I2ND | ACS C/I 2MHz | | -44 | | dB | |
| C/I3RD | ACS C/I 3MHz | | -50 | | dB | |
| C/I1STI | ACS C/I Image channel | | -25 | | dB | |
| C/I2NDI | ACS C/I 1 MHz □adjacent to image channel | | -35 | | dB | |
| Block | Block @ 2399,and 2484 | | -15 | | dBm | |
| Block | Block @ 2 GHz and 3 GHz | | -15 | | dBm | |
| Leakage | Leakage @ < 1GHz | | -71 | | dBm | |
| Leakage | Leakage @ >1GHz | | -56 | | dBm | |

## 5  Package Information

### 5.1  QFN 4x4 32-Pin

The BK3435 32-Pin uses the 4mmx4mm QFN package.



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | 0.80 | 0.85 | 0.90 |
| A1 | 0 | 0.02 | 0.05 |
| A2 | 0.60 | 0.65 | 0.70 |
| A3 | | 0.20REF | |
| b | 0.15 | 0.20 | 0.25 |
| D | 3.90 | 4.00 | 4.10 |
| E | 3.90 | 4.00 | 4.10 |
| D2 | 2.80 | 2.90 | 3.00 |
| E2 | 2.80 | 2.90 | 3.00 |
| e | 0.30 | 0.40 | 0.50 |
| H | | 0.30REF | |
| K | | 0.25REF | |
| L | 0.25 | 0.30 | 0.35 |
| R | 0.09 | – | – |
| c1 | – | 0.10 | – |
| c2 | – | 0.10 | – |
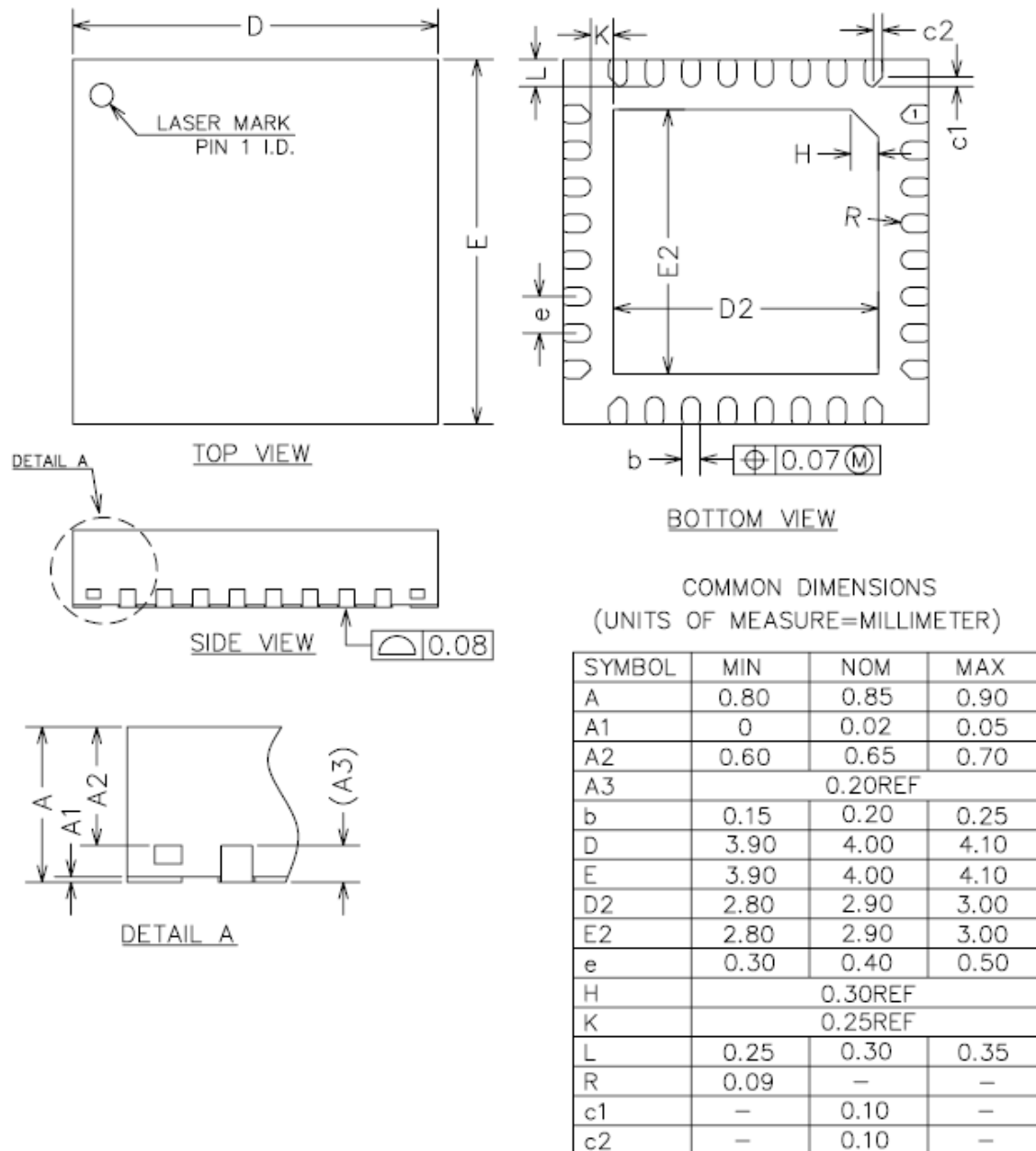
## 5.2  QFN 5x5 40-Pin

The BK3435 40-Pin uses the 5mmx5mm QFN package.
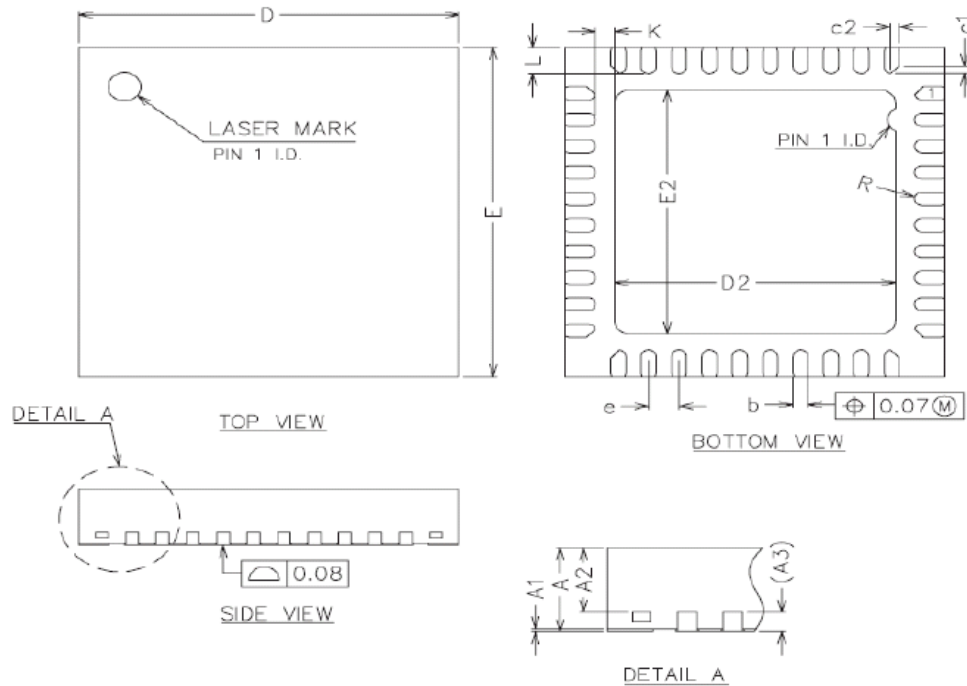


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | 0.80 | 0.85 | 0.90 |
| A1 | 0 | 0.02 | 0.05 |
| A2 | 0.50 | 0.65 | 0.60 |
| A3 | | 0.20REF | |
| b | 0.15 | 0.20 | 0.25 |
| D | 4.90 | 5.00 | 5.10 |
| E | 4.90 | 5.00 | 5.10 |
| D2 | 3.60 | 3.70 | 3.80 |
| E2 | 3.60 | 3.70 | 3.80 |
| e | 0.35 | 0.40 | 0.45 |
| K | 0.20 | – | – |
| L | 0.35 | 0.40 | 0.45 |
| R | 0.075 | – | – |
| C1 | – | 0.12 | – |
| C2 | – | 0.12 | – |

## 5.3 QFN 6x6 48-Pin

The BK3435 48-Pin uses the 6mmx6mm QFN package.
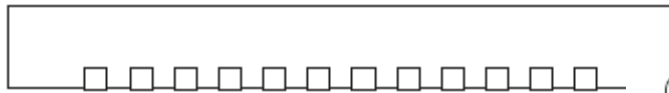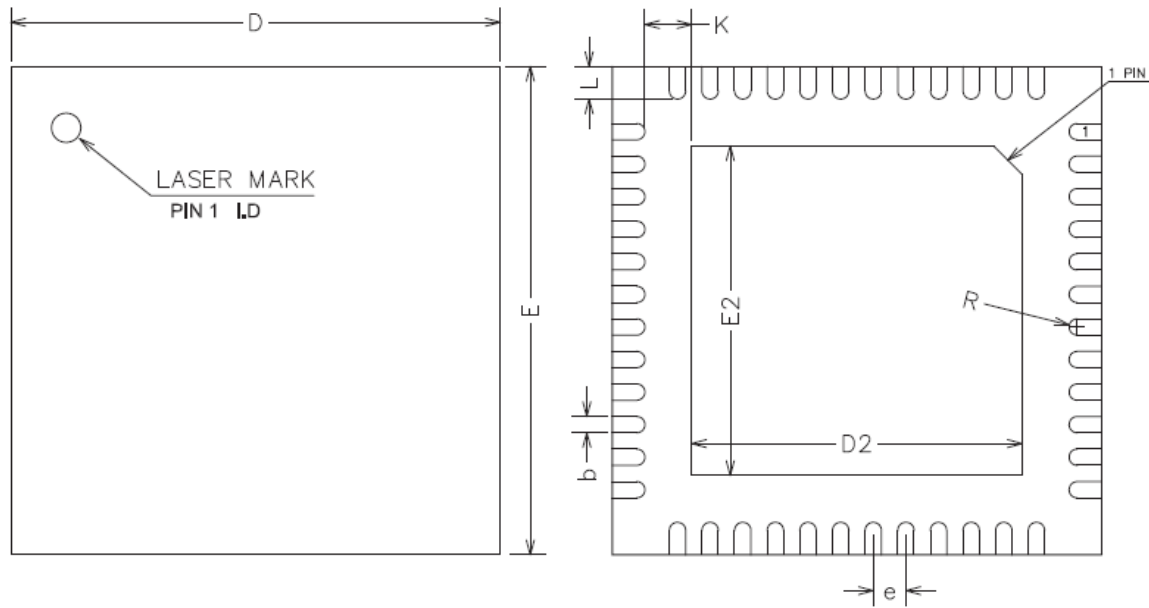


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|--------|------|--------|------|
| A | 0.70 | 0.75 | 0.80 |
| A1 | 0 | 0.02 | 0.05 |
| A3 | | 0.20REF | |
| b | 0.15 | 0.20 | 0.25 |
| D | 5.90 | 6.00 | 6.10 |
| E | 5.90 | 6.00 | 6.10 |
| D2 | 3.95 | 4.05 | 4.15 |
| E2 | 3.95 | 4.05 | 4.15 |
| e | 0.35 | 0.40 | 0.45 |
| K | 0.20 | — | — |
| L | 0.35 | 0.40 | 0.45 |
| R | 0.09 | — | — |
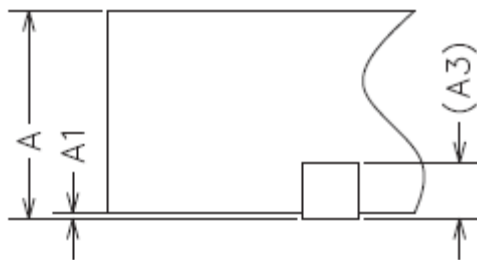
## 6 Order Information

| Part number | Package | Packing | Minimum Order Quantity |
|---|---|---|---|
| BK3435QN32B | QFN 4mmx4mm 32-Pin | Tape Reel | 3K |
| BK3435QN40C | QFN 5mmx5mm 40-Pin | Tape Reel | 3K |
| BK3435QN48B | QFN 6mmx6mm 48-Pin | Tape Reel | 3K |

## *Revision History*

| Version | Date | Author(s) | Description |
|---|---|---|---|
| 1.0 | 14/Feb/2017 | WF | Initial |
| | 14/July/2017 | WF | Update resource and feature |
| 2.0 | 28/July/2017 | WF | Update pin information and ADC channel assignment |
| 2.1 | 29/July/2017 | WF | Add 48-pin package |
| 2.2 | 22/Aug/2017 | WF | Add 40-pin package and update description |
| 2.4 | 7/Sep/2017 | WF | Update 40-pin package with USB added |
| | | | |
| | | | |
| | | | |