



# YC1178



**Bluetooth 5.0 BR/EDR/BLE**

**Datasheet**

Yichip Microelectronics

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## Revision History

| Version     | Date      | Author | Description                   |
|-------------|-----------|--------|-------------------------------|
| preliminary | 2020-1-07 |        | Initial version               |
|             | 2020-4-13 |        | Add sch ,package and pin list |
|             | 2020-4-15 | CG     | Add BUCK diagram and TWS Sch  |
|             |           |        |                               |
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## General Description

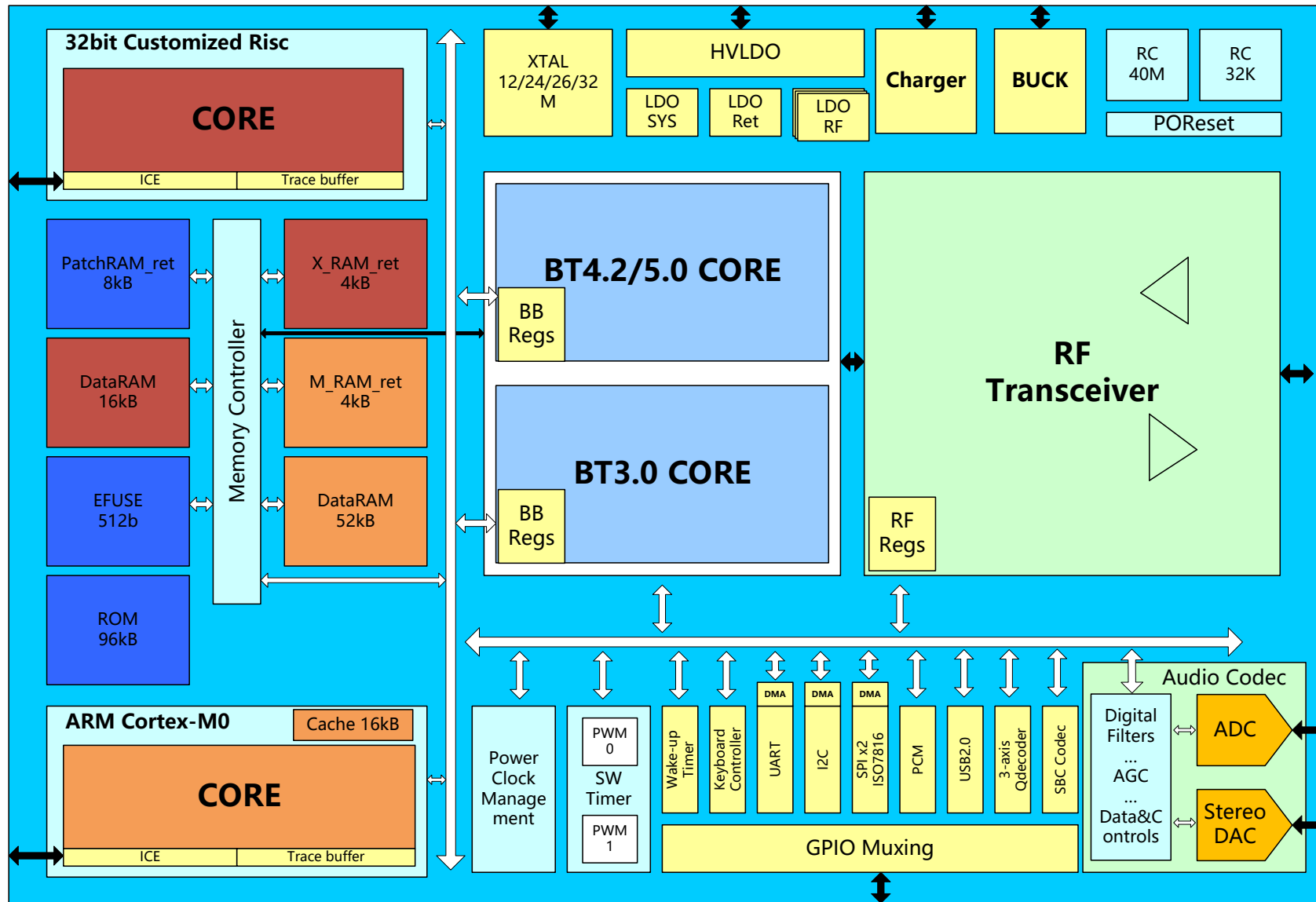
The YC1178 is a very low power, high performance and highly integrated Bluetooth 5.0 BR/EDR/BLE , designed for operation over the 2400MHz to 2483.5Mhz ISM frequency band.

YC1178 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. Rich peripherals including an 8-channel general purpose ADC, power-on-reset (POR), Arithmetic Accelerators, UART/SPI/I2C and up to 38 GPIOs, which further reduce overall system cost and size.

YC1178 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

- Bluetooth 5.0 Classical/BLE Proprietary double-mode RF SOC
- Charger/Buck integrated
- 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 w/o DCDC
    - 10mA in BLE/2.4G mode
  - Tx peak current w/o DCDC @ -2dBm
    - 18mA in BLE/2.4G mode
  - Rx peak current with DCDC
    - 6mA in BLE/2.4G mode
  - Tx peak current with DCDC @ -2dBm
    - 10mA in BLE/2.4G mode
  - <25uA avg, 500ms sniff hold connection
- 2.4GHz Transceiver
  - Single-end RFIO
  - -95dBm in BLE mode
  - support 250kbps, 1/2/3Mbps data rates
  - Tx Power up to +9dBm
- Audio function
  - Mic PGA 0-42dB, 6dB per step
  - 16-bits ADC
  - 2x16Bit DAC, Stereo
  - Audio SNR: ADC 80dB; DAC 100dB
- Oscillators
  - 16M/24M/32M XTAL supported (default 24M)
  - 40M RC oscillator
  - Low Jitter 20K RC oscillator
- Dual Core Digital Architecture
  - ARM Cortex-M0 Core for application
    - Data RAM 56kB+Cache 16kB
    - CPU clock speed up to 192Mhz
  - 32bit-Risc Core for link management
    - 96kB code ROM and 512bit EFUSE
    - 8kB patch RAM and 20kB data RAM
    - 4kB RAMs can be set to retention mode
- Analog Peripherals
  - 8 channel ADC with 10 bit accuracy/3Msps
- Digital Peripherals
  - Two-wire Master (I2C compatible), up to 400kbps; UART(RTS/CTS) with HCI-H5 protocol, up to 3.25Mbps; SPI Master, up to 24Mbps, internal QSPI connect **4MB Flash**
  - Individual QSPI can connect external PSRAM
  - AES256 HW encryption
  - LED drive capability
  - PWM
  - 20x8 key scan
  - USB2.0 fullspeed, 4Eps, support host mode
  - SD Card Host Controller supported



## Electrical Specifications

| Name                | Parameter (Condition)                                                                                                   | Min     | Typ  | Max     | Unit | Comment |
|---------------------|-------------------------------------------------------------------------------------------------------------------------|---------|------|---------|------|---------|
| 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                                                | 3.1     | 3.3  | 3.4     | V    |         |
| CHARGE_VAD          | Voltage Input, typically 4.7uF decouple cap                                                                             | 4.8     | 5    | 5.5     | V    |         |
| CHARGE_VBAT         | Voltage Input, typically 4.7uF decouple cap                                                                             | 4.0     | 4.2  | 4.6     | 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     | ℃    |         |
| Digital Input Pin   |                                                                                                                         |         |      |         |      |         |
| VIH                 | High Level                                                                                                              | VIO-0.3 |      | VIO+0.3 | V    |         |
| VIL                 | Low Level                                                                                                               | VSS     |      | VSS+0.3 | V    |         |
| Digital Output 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                | RX mode, EDR mode, 100% ON (with ideal DCDC @3V)                                                                        |         | 7.25 |         | mA   |         |
| IVDD                | TX mode, BLE & 2.4G mode, 100% ON (with ideal DCDC @3V)                                                                 |         | 16   |         | mA   | (8)     |
| IVDD                | TX mode, EDR mode, 100% ON (with ideal                                                                                  |         | 17   |         | mA   |         |

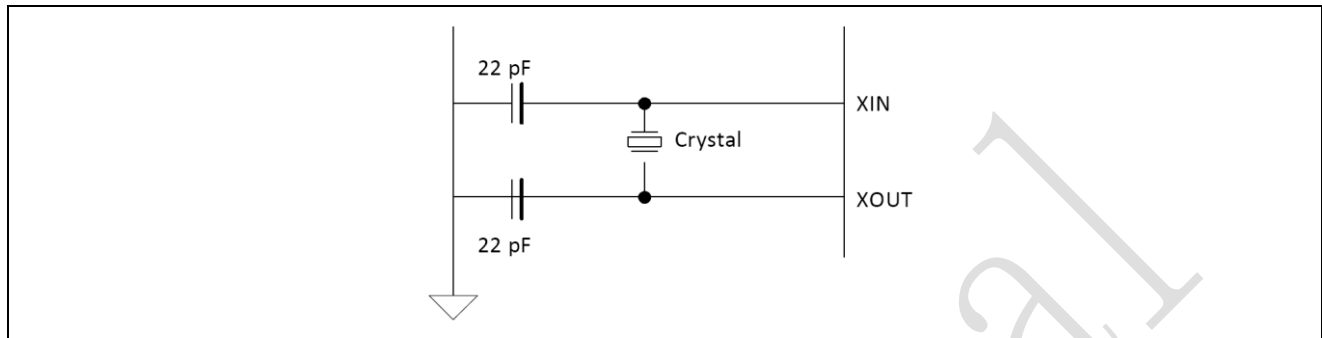
|                                    |                                                        |      |     |      |           |     |
|------------------------------------|--------------------------------------------------------|------|-----|------|-----------|-----|
|                                    | DCDC @3V)                                              |      |     |      |           |     |
| IVDD                               | Average Current, 500ms sniff, hold connection          |      |     | 25   | uA        |     |
| <b>Normal RF Condition</b>         |                                                        |      |     |      |           |     |
| FOP                                | Operating Frequency                                    | 2400 |     | 2480 | MHz       |     |
| FXTAL                              | Crystal Frequency                                      | 12   | 24  | 32   |           | (9) |
| <b>Transmitter Characteristics</b> |                                                        |      |     |      |           |     |
| PRF                                | RF output power                                        | -20  | 0   | 9    | dBm       |     |
| CD                                 | Carrier Drift Rate                                     |      | 5   |      | kHz/50 us |     |
| 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       |     |
| EVM                                | Modulation Accuracy, RMS DEVM ( $\pi/4$ DQPSK)         |      | 7   | 20   | %         |     |
|                                    | Modulation Accuracy, RMS DEVM (8PSK)                   |      | 7   | 13   | %         |     |
|                                    | Modulation Accuracy, 99% DEVM ( $\pi/4$ DQPSK)         |      | 14  | 30   | %         |     |
|                                    | Modulation Accuracy, 99% DEVM (8PSK)                   |      | 14  | 20   | %         |     |
|                                    | Modulation Accuracy, Peak DEVM ( $\pi/4$ DQPSK & 8PSK) |      | 18  | 35   | %         |     |
|                                    | Modulation Accuracy, Peak DEVM (8PSK)                  |      | 18  | 25   | %         |     |
| 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  |           |     |
| <b>Receiver Characteristics</b>    |                                                        |      |     |      |           |     |
|                                    | <b>BT4.0 (BLE)</b>                                     |      |     |      |           |     |
| SEN                                | High Gain mode, Sensitivity @0.1%                      |      | -95 |      | dBm       |     |
| SEN                                | Standard Gain mode, Sensitivity @0.1%                  |      | -92 |      | dBm       |     |
| Max In                             | Maximum Input Power                                    |      | 0   |      | dBm       |     |
| C/ICO                              | Co-channel C/I, Basic Rate, GFSK                       |      | 7   |      | dB        |     |
| C/I1ST                             | ACS C/I 1MHz, Basic Rate, GFSK                         |      | 5.5 | 7    | dB        |     |
| C/I2ND                             | ACS C/I 2MHz, Basic Rate, GFSK                         |      | -36 | -34  | dB        |     |
| C/I3RD                             | ACS C/I 3MHz, Basic Rate, GFSK                         |      | -43 |      | dB        |     |
| C/I1STI                            | ACS C/I Image channel, Basic Rate, GFSK                |      | -34 |      | dB        |     |
| C/I2NDI                            | C/I 1 MHz adjacent to image channel, Basic Rate, GFSK  |      | -28 |      | dB        |     |
|                                    | <b>BT3.0 (BR &amp; EDR)</b>                            |      |     |      |           |     |
| SEN                                | Basic Rate, GFSK, BER<0.1%, Dirty Tx on                |      | -92 |      | dBm       |     |
| SEN                                | EDR, $\pi/4$ DQPSK, BER<0.01%, Dirty Tx on             |      | -93 |      | dBm       |     |
| SEN                                | EDR, 8PSK, BER<0.01%, Dirty Tx on                      |      | -83 |      | dBm       |     |

|         |                                                         |  |      |  |     |  |
|---------|---------------------------------------------------------|--|------|--|-----|--|
| MaxIn   | Maximum Input Power                                     |  | 0    |  | dBm |  |
| C/ICO   | Co-channel C/I, EDR, $\pi/4$ DQPSK                      |  | 10.5 |  | dB  |  |
| C/I1ST  | ACS C/I 1MHz, EDR, $\pi/4$ DQPSK                        |  | -8   |  | dB  |  |
| C/I2ND  | ACS C/I 2MHz, EDR, $\pi/4$ DQPSK                        |  |      |  | dB  |  |
| C/I3RD  | ACS C/I 3MHz, EDR, $\pi/4$ DQPSK                        |  | -54  |  | dB  |  |
| C/I1STI | ACS C/I Image channel, EDR, $\pi/4$ DQPSK               |  | -27  |  | dB  |  |
| C/I2NDI | C/I 1 MHz adjacent to image channel, EDR, $\pi/4$ DQPSK |  | -43  |  | dB  |  |
| C/ICO   | Co-channel C/I, EDR, 8PSK                               |  | 20   |  | dB  |  |
| C/I1ST  | ACS C/I 1MHz, EDR, 8PSK                                 |  | 0    |  | dB  |  |
| C/I2ND  | ACS C/I 2MHz, EDR, 8PSK                                 |  | -20  |  | dB  |  |
| C/I3RD  | ACS C/I 3MHz, EDR, 8PSK                                 |  | -45  |  | dB  |  |
| C/I1STI | ACS C/I Image channel, EDR, 8PSK                        |  | -18  |  | dB  |  |
| C/I2NDI | C/I 1 MHz adjacent to image channel, EDR, 8PSK          |  | -33  |  | dB  |  |

- (1) HVIN & HVOUT are input & output of a high voltage LDO which is integrated in YC1178, 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 YC1178 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[20:30] is up to 100mA, 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) 16M, 24M, 26M, 32M crystal supported, 24M by default

## Crystal Oscillator

The crystal oscillator requires a crystal with an accuracy of  $\pm 30$  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<br>(Condition) | Min | Typ         | Max      | Unit   | Comment |
|-------------------------------|--------------------------|-----|-------------|----------|--------|---------|
| Frequency                     |                          |     | 24          |          | MHz    |         |
| Oscillation mode              |                          |     | Fundamental |          |        |         |
| Frequency tolerance           | @25 °C                   |     | $\pm 10$    | $\pm 30$ | ppm    |         |
| Tolerance stability over temp | @0 °C to +70 °C          |     | $\pm 10$    | $\pm 30$ | ppm    |         |
| Load capacitance              |                          |     | 20          |          | pF     |         |
| Operating temperature range   |                          | -20 |             | +70      | degree |         |
| Drive Level                   |                          |     | 100         |          | uW     |         |

## Audio DAC

| Parameter          | Min | Typ | Max | Unit | Test condition                                         |
|--------------------|-----|-----|-----|------|--------------------------------------------------------|
| Frequency Response | 20  |     | 20k | Hz   | 1kHz/0dB<br>10kohm loading<br>With A-Weighted Filter   |
| THD+N              |     | -75 |     | dB   |                                                        |
| S/N                |     | 100 |     | dB   |                                                        |
| Output Swing       |     | 1   |     | Vrms |                                                        |
| Dynamic Range      |     | 90  |     | dB   | 1kHz/-60dB<br>10kohm loading<br>With A-Weighted filter |
| DAC Output Power   | 12  |     |     | mV   | 32ohm loading                                          |

## Audio ADC

| Parameter     | Min | Typ | Max | Unit | Test condition                                         |
|---------------|-----|-----|-----|------|--------------------------------------------------------|
| Dynamic Range |     | 80  |     | dB   | 1kHz/-60dB<br>10kohm loading<br>With A-Weighted filter |
| S/N           |     | 80  |     | dB   |                                                        |
| THD+N         |     | -75 |     | dB   |                                                        |

## Power consumption

| W/O DC-DC    | Parameter                                                            | Average Current | Unit |
|--------------|----------------------------------------------------------------------|-----------------|------|
| Sleep        | /                                                                    | 700             | nA   |
| Sniff        | 500ms interval                                                       | 21.99           | uA   |
| Discoverable | ADV interval: 640ms<br>Scan interval: 1280ms<br>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<br>Scan interval: 1280ms<br>Scan window: 11.25ms | 89.5            | uA   |

## Bluetooth Security

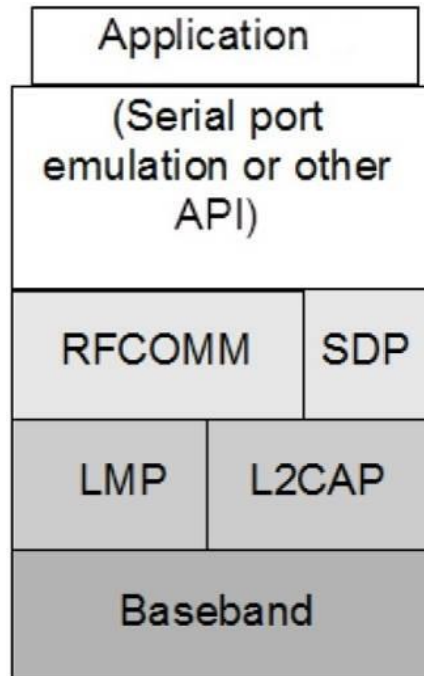
1. Pairing
  - Pin Code
2. Security Simple Pairing
  - Just Work(No input)
  - Keyboard
  - DisplayYesNo

## MFi

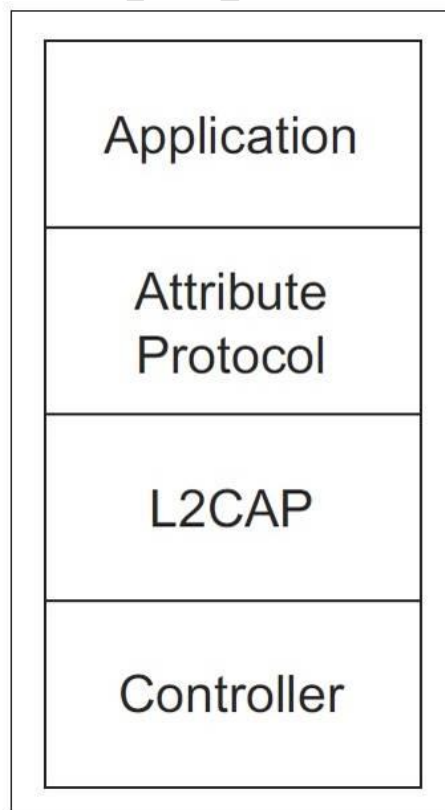
Support Apple's MFi authentication and iAP1/iAP2 protocols.

## Bluetooth Stack

### 1. Serial Port Profile

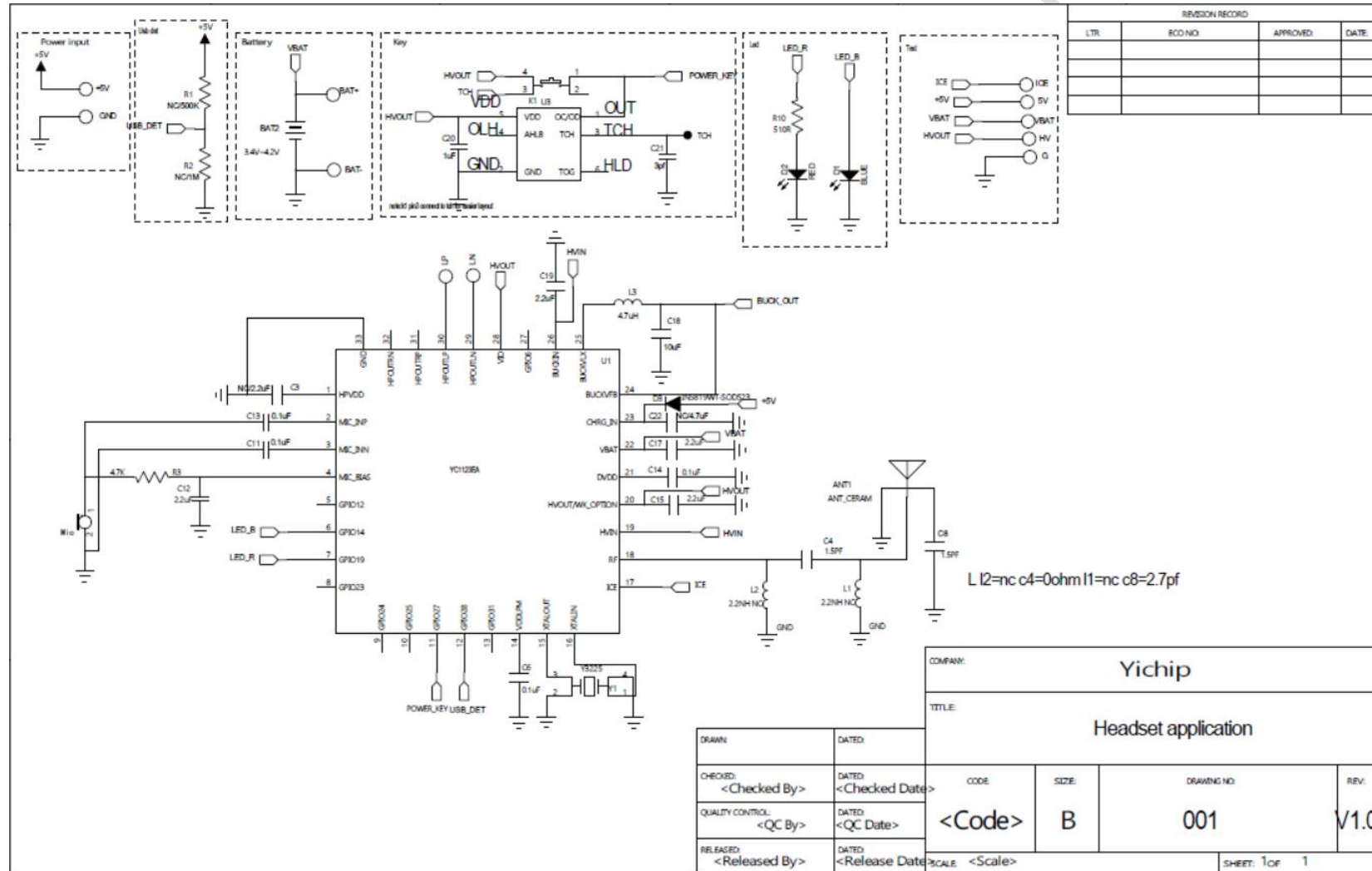


### 2. Generic Attribute Profile

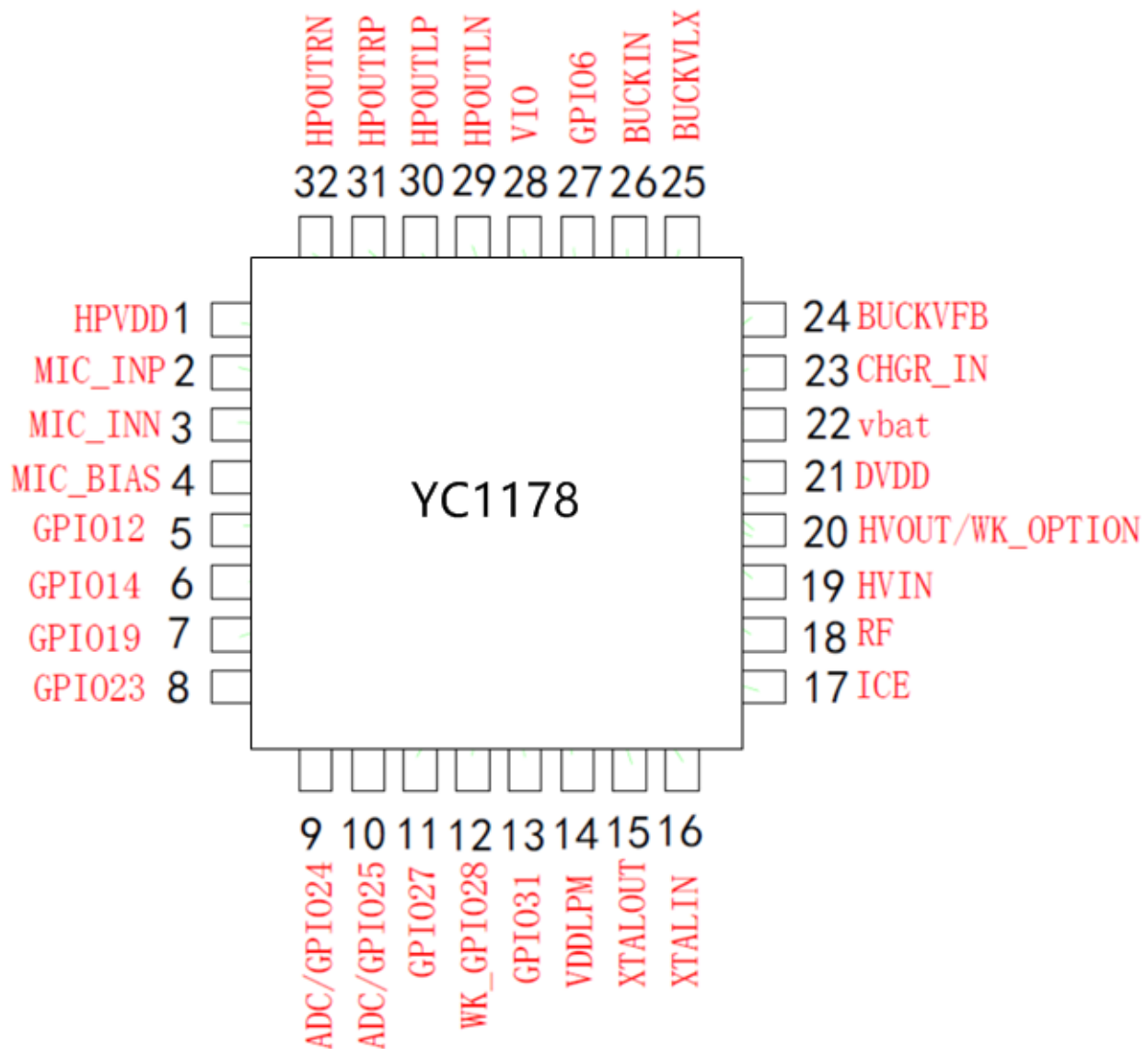


## Application Schematic

### 1.The headset application



## Package Information



| 4x4 32L | Pin Name | Type    | Function Description                                      |
|---------|----------|---------|-----------------------------------------------------------|
|         | NC       |         |                                                           |
| 1       | HPVDD    | Power_O | Connect an external decouple cap here 4.7uF can optional. |
| 2       | MIC_INP  | Ana_I   | ADC positive input.                                       |
| 3       | MIC_INN  | Ana_I   | ADC negative input.                                       |
| 4       | MIC_BIAS | Ana_O   | Power output for mic,1.5-2.8v, need 1uF bypass cap.       |
| 5       | GPIO12   | Dig_IO  | pls check "sheet: GPIO_Muxing"                            |
| 6       | GPIO14   | Dig_IO  | pls check "sheet: GPIO_Muxing"                            |
| 7       | GPIO19   | Dig_IO  | pls check "sheet: GPIO_Muxing"                            |
| 8       | GPIO23   | Dig_IO  | pls check "sheet: GPIO_Muxing"                            |
| 9       | GPIO24   | Dig_IO  | pls check "sheet: GPIO_Muxing", or ADC                    |
| 10      | GPIO25   | Dig_IO  | pls check "sheet: GPIO_Muxing" or ADC                     |

|    |             |           |                                                                                                                                                                            |
|----|-------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11 | GPIO27      | Dig_IO    | pls check "sheet: GPIO_Muxing"                                                                                                                                             |
| 12 | GPIO28      | Dig_IO    | pls check "sheet: GPIO_Muxing"                                                                                                                                             |
| 13 | GPIO31      | Dig_IO    | pls check "sheet: GPIO_Muxing"                                                                                                                                             |
| 14 | VDDLPM      | Power_O   | internal LDO output, 1.2V. Need an external bypass cap here 0.1uF.                                                                                                         |
| 15 | XTALOUT     | Ana_O     | XTAL port.                                                                                                                                                                 |
| 16 | XTALIN      | Ana_I     | XTAL port, or external CLK in.                                                                                                                                             |
| 17 | ICE         | Dig_IO    | debug port, Tx & Rx.                                                                                                                                                       |
| 18 | RFIO        | RF Port   | ANT port.                                                                                                                                                                  |
| 19 | HVIN        | Power_I   | HVLDO input, 3.6~5.5V, 2.2uF bypass cap.                                                                                                                                   |
| 20 | HVOUT       | Power_O   | HVLDO output, 3.3V. Bypass cap need here 2.2uF, max output current 150mA@3.3V.                                                                                             |
| 21 | DVDD        | Power_O   | internal LDO output, 1.2V. Need an external bypass cap here 0.1uF.                                                                                                         |
| 22 | CHGOUT      | Power_O   | Charger Output Pin. Connect this pin to the battery and charge current be set at 40mA. provides charge to 4.2V.                                                            |
| 23 | CHGIN       | Power_I   | Positive Input Supply Voltage. provides power to the charger, Chrgin can range from 4.25V to 5.5V need bypassed with at least a 1uF capacitor and series a Schottky diode. |
| 24 | VIN/BUCKOUT | Power_O   | Buckout pin output 1.8~3.6V internal connect to VIN, 10uF bypass cap.                                                                                                      |
| 26 | BUCKIN      | Power_I   | Buck input 3.6~4.2V, 10uF bypass cap.                                                                                                                                      |
| 25 | BUCKVLX     | Power_adj | Need an external bypass inductor here 10uH connect to buckout.                                                                                                             |
| 27 | GPIO6       | Dig_IO    | pls check "sheet: GPIO_Muxing"                                                                                                                                             |
| 28 | VDDIO       | Power_O   | GPIO power supply, need an external bypass cap here 10nF.                                                                                                                  |
| 29 | HPOUTLN     | Ana_O     | DAC left channel negative output.                                                                                                                                          |
| 30 | HPOUTLP     | Ana_O     | DAC left channel positive output.                                                                                                                                          |
| 31 | HPOUTRP     | Ana_O     | DAC right channel positive output.                                                                                                                                         |
| 32 | HPOUTRN     | Ana_O     | DAC right channel negative output.                                                                                                                                         |

**Note:** All GPIOs are by default configured to input status after power-on reset, and ICE are by default configured to high level by pull up. If a GPIO is not used as well as it is not configured to output, it can be connected to GND.

PWM, UART, SPI and other digital peripherals can be flexibly configured to any GPIO port.

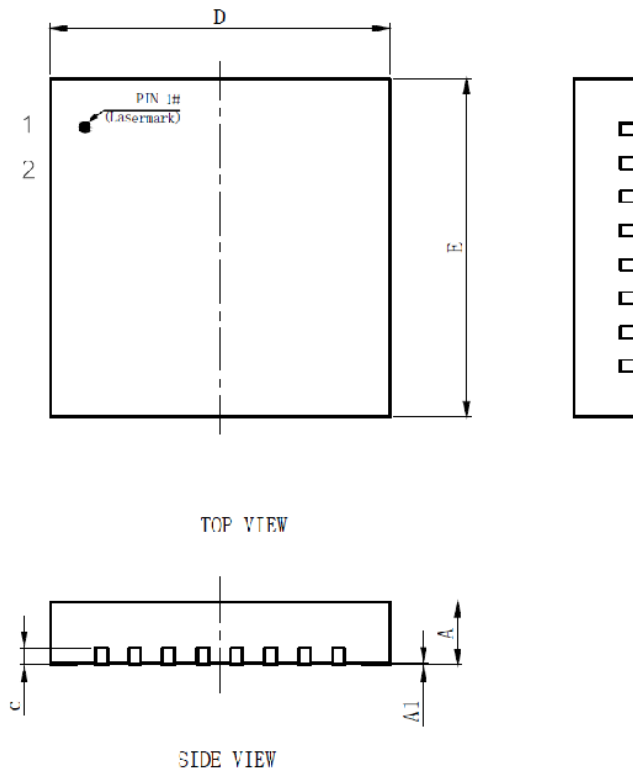
## GPIO Muxing Table

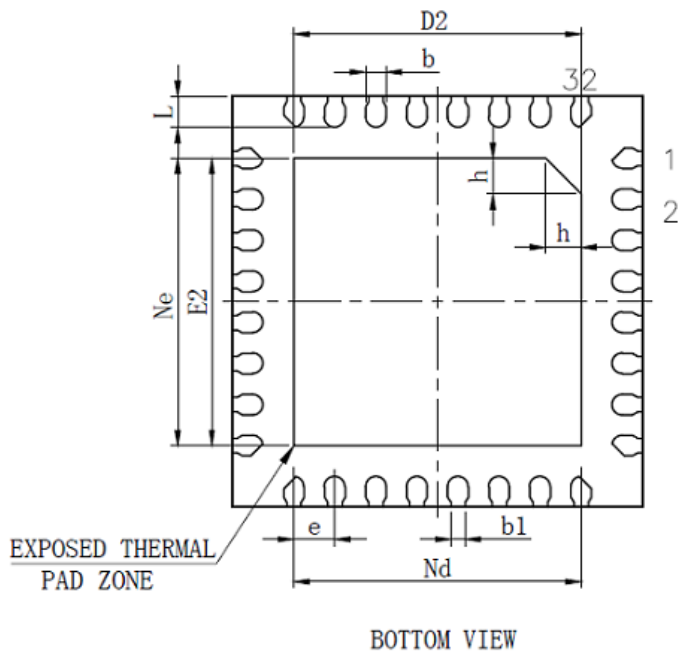
| GPIOs   | Function1 | Function2 |
|---------|-----------|-----------|
| GPIO[0] |           |           |
| GPIO[1] |           |           |
| GPIO[2] |           |           |
| GPIO[3] |           |           |
| GPIO[4] |           |           |
| GPIO[5] |           |           |
| GPIO[6] | EXEN      |           |

|          |         |         |
|----------|---------|---------|
| GPIO[7]  |         |         |
| GPIO[8]  |         |         |
| GPIO[9]  |         |         |
| GPIO[10] |         |         |
| GPIO[11] |         |         |
| GPIO[12] |         |         |
| GPIO[13] |         |         |
| GPIO[14] |         |         |
| GPIO[15] |         |         |
| GPIO[16] |         |         |
| GPIO[17] |         | adc0    |
| GPIO[18] |         | adc1    |
| GPIO[19] |         |         |
| GPIO[20] |         | adc2    |
| GPIO[21] |         | adc3    |
| GPIO[22] |         | adc4    |
| GPIO[23] | SPI-IO2 | adc5    |
| GPIO[24] | SPI-IO1 | adc6    |
| GPIO[25] | SPI-NCS | adc7    |
| GPIO[26] | SPI-IO3 |         |
| GPIO[27] | SPI-SCK | wakeup1 |
| GPIO[28] | SPI-IO0 | wakeup2 |
| GPIO[29] | SDA     |         |
| GPIO[30] | SCL     |         |
| GPIO[31] |         |         |
| GPIO[32] |         |         |
| GPIO[33] |         |         |
| GPIO[34] |         |         |
| GPIO[35] |         |         |
| GPIO[36] |         |         |
| GPIO[37] |         |         |
| GPIO[38] |         |         |
| GPIO[39] |         |         |

Note: Drive capability of GPIO[20:40] is up to 100mA, other GPIO's drive capability is 10mA; Micbias output 1.5-2.8V@3mA.

## Package Physical Dimension (QFN4x4\_32L)

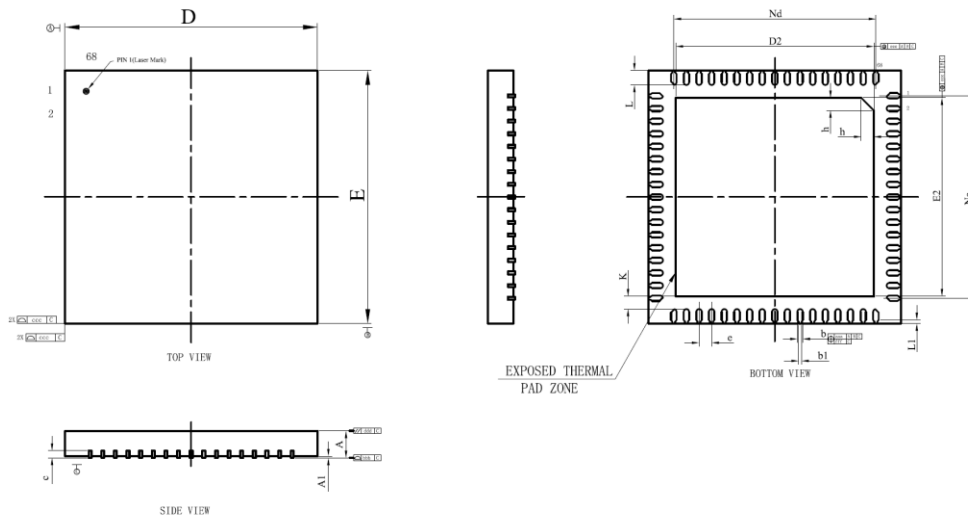




| SYMBOL  | MILLIMETER |      |      |
|---------|------------|------|------|
|         | MIN        | NOM  | MAX  |
| A       | 0.70       | 0.75 | 0.80 |
|         | 0.80       | 0.85 | 0.90 |
|         | 0.85       | 0.90 | 0.95 |
| A1      | 0          | 0.02 | 0.05 |
| b       | 0.15       | 0.20 | 0.25 |
| b1      | 0.14REF    |      |      |
| c       | 0.18       | 0.20 | 0.25 |
| D       | 3.90       | 4.00 | 4.10 |
| D2      | 2.70       | 2.80 | 2.90 |
| e       | 0.40BSC    |      |      |
| Ne      | 2.80BSC    |      |      |
| Nd      | 2.80BSC    |      |      |
| E       | 3.90       | 4.00 | 4.10 |
| E2      | 2.70       | 2.80 | 2.90 |
| L       | 0.25       | 0.30 | 0.35 |
| h       | 0.30       | 0.35 | 0.40 |
| L/F载体尺寸 | 122X122    |      |      |



## Package Physical Dimension (QFN7x7\_68L)



| SYMBOL       | MILLIMETER |      |      |
|--------------|------------|------|------|
|              | MIN        | NOM  | MAX  |
| A            | 0.70       | 0.75 | 0.80 |
| A1           | —          | 0.02 | 0.05 |
| b            | 0.10       | 0.15 | 0.20 |
| b1           | 0.08REF    |      |      |
| c            | 0.18       | 0.20 | 0.25 |
| D            | 6.90       | 7.00 | 7.10 |
| D2           | 5.39       | 5.49 | 5.59 |
| e            | 0.35BSC    |      |      |
| Ne           | 5.60BSC    |      |      |
| E            | 6.90       | 7.00 | 7.10 |
| E2           | 5.39       | 5.49 | 5.59 |
| L            | 0.35       | 0.40 | 0.45 |
| L1           | 0.10REF    |      |      |
| K            | 0.20       | —    | —    |
| h            | 0.30       | 0.35 | 0.40 |
| aaa          | 0.07       |      |      |
| bbb          | 0.08       |      |      |
| ccc          | 0.10       |      |      |
| ddd          | 0.10       |      |      |
| eee          | 0.10       |      |      |
| fff          | 0.05       |      |      |
| L/P载体尺寸 (mm) | 232*232    |      |      |