

# The Design and Development of Wireless Communication Module Based on Bluetooth Chip

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**Abstract:** By a comprehensive application of BlueCore2-External Bluetooth chip, FB2520 band-pass filter and balanced imbalance converters, LTCC ceramic antenna and so on, an industrial-grade Bluetooth wireless communication module is designed. The communications module can be used to instead of cable, effectively applied to complex and variable industrial field, realize wireless communication among field device, access point and Transcription Machine. The result of tests indicated the wireless communication module has been running steadily and working reliability.

**Keyword:** Bluetooth, BlueCore2-External, Wireless Communication Module

## 1. Introduction

Bluetooth is a very promising wireless transmission technology. There are already a large number of Bluetooth products on the market, such as with Bluetooth-enabled laptops, cell phones, headsets and so on. In the era of technology increasingly updated, Bluetooth continues to develop step by step toward higher performance<sup>[2]</sup>. In this paper, we have designed a high-speed Bluetooth module using the BlueCore2 Bluetooth chip supporting V1.1/V1.2 standard produced by CSR corporation. This module has some specific characters such as small, low power consumption, reliable performance, flexible network and so on. In addition, because of the terrible industrial conditions, this module can be embedded in industry field apparatus, the junction point, the hand holds and so on to realize wireless communication.

## 2. The Design of Bluetooth Module Hardware

The hardware architecture diagram of Bluetooth module includes the BlueCore2-External (BC212015) Bluetooth chip, the SST39VF800 FLASH chip, the FB2520 band pass filter + balanced imbalance converters, the LTCC ceramics antenna and so on as shown in Figure 1[5]. The power source introduced by the corollary main equipment provides +3.3V and +1.8V power source for the Bluetooth main chip, the memory, the band pass filter and balanced the switch and so on through the level-translation of power source. Each module will be separately introduced in the follow.

### 2.1 The Introduction of BlueCore2 Chip

The Bluetooth module has used the BlueCore2-

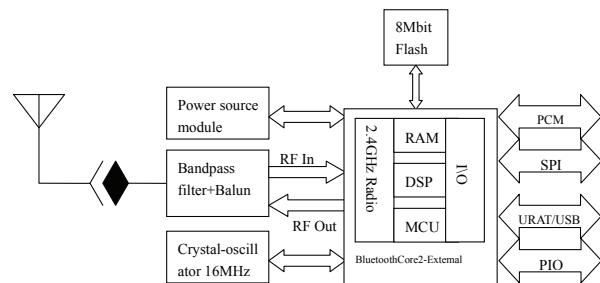


Figure 1. Bluetooth module hardware diagram

External (BC212015) chip. It is a single Bluetooth chip released by British CSR Corporation which works on 2.4GHz ISM (industry, science, medicine), the frequency band integration base band and the radio frequency.

Its main feature is as follows<sup>[1]</sup>:

- ◆ Conforms to Bluetooth V1.1 and V1.2 standard;
- ◆ 1.8V low working voltage;
- ◆ Least periphery component;
- ◆ 96 foot VFBGA LGA and LFBGA seal;
- ◆ 0.18um CMOS technology;
- ◆ Supports 8Mbit to expand flash;
- ◆ Complete Bluetooth agreement structure.

The internal structure of BlueCore2-External chip is as shown in Figure 1. The interior chip mainly integrates the 32Kbytes piece front RAM, DSP, MCU, the radio frequency as well as each kind of I/O port. Each kind of I/O port includes the connections of SPI, UART, USB,



tion register and controls register, specially this interface provided unification access mode to the Bluetooth base band. Loading these protocol layer module realize the complete Bluetooth link control and the embedded HCI agreement, shielded the radio frequency and the base band two hardware protocol layer, the later application development might start directly from the HCI level<sup>[5]</sup>. Through seals the HCI protocol layer, may produce the standard the

HCI connection function, and provides a complete platform for the upper formation application development.

Has UART or the USB connection in the exterior main engine, the Bluetooth module and in the main engine signal level compatible situation, does not need to increase other auxiliary circuits again, this Bluetooth module can connect with the main engine directly.

This is the main engine and the Bluetooth hardware

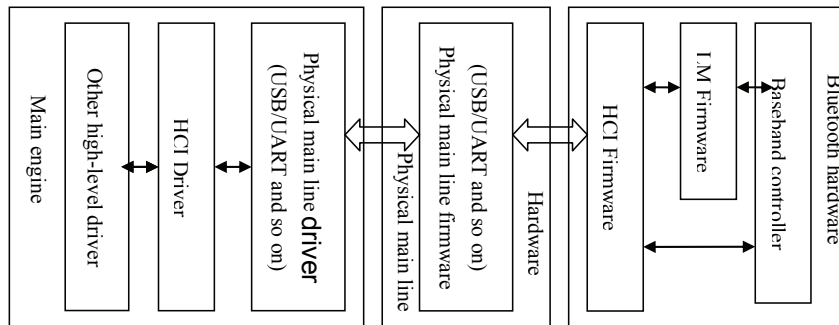


Figure 3. main engine and Bluetooth connection schematic drawing

connection schematic drawing as shown in Figure 3. The main engine controller connection (HCI) provided one kind general connection to visit the Bluetooth hardware. Through the visit to base band order, the link supervisor order and the hardware condition register, HCI carries out that order to Bluetooth hardware. Several middle tones which exist in the main engine system's HCI driver and between the Bluetooth's hardware HCI firmware, are also called the main engine controller transmission level, provides the ability to transmit data. This level's goal is the transparence, the main engine controller driver did not care that it is on UART or on USB, UART and USB transmit to the main engine controller driver to the main engine controller's data cannot carry on processing, such

main engine controller connection and the main engine controller may carry on the promotion, promotes cannot to transmit the level to have any influence.

### 3.2 Module initial parameter establishment

After the Bluetooth module loaded each kind of protocol layer, cannot work, but also needs to carry on the establishment according to the different hardware design to the module initial parameter. Initial parameter establishment based on the bluecore2 Bluetooth chip is called the PSK establishment. It can be implemented through the BLUELAB integrated development environment or PS Key software, as shown in the Figure 4.

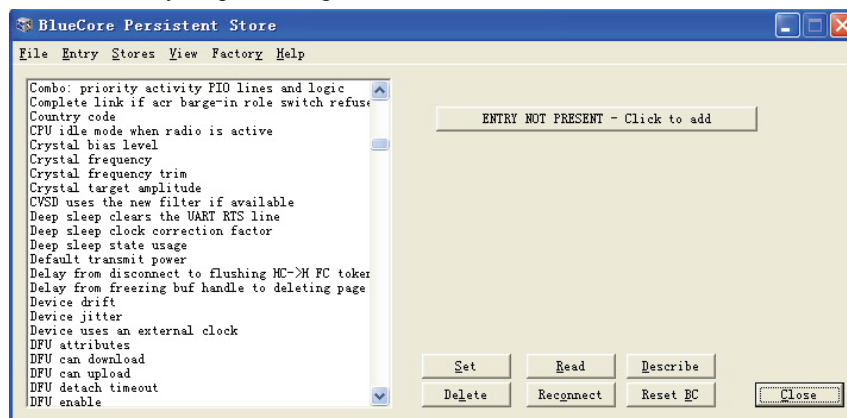


Figure 4. PS Key establishment contact surface

## 4 Bluetooth module application examples

As shown in Figure 4, take the Bluetooth valve locator and the Bluetooth manual operator for example. The Bluetooth module communicates with the control panel in

the valve locator by the serial port (UART) full-duplex and the valve locator's valve position value, the valve position upper limit and so on each kind of parameter delivers the Bluetooth module through the serial port and all the parameters are transmitted to the manual operator

by the way of Bluetooth wireless. The manual operator can modify the corresponding parameters through the related command dynamically. This has changed the traditional method of parameter settings and modifications. The Bluetooth modules in the valve locator's are set passive attended mode. The equipment started and the valve positioner collected the value of the position periodically and stored in the buffer of the device. When the Bluetooth manual operator search for valve locator, the Bluetooth manual operator send the link command to valve locator. After the link were established, the Bluetooth manual operator will obtain a link handle. Then enters the monitoring surface as shown in Figure 5, may carry out reads the valve position value, the valve position upper limit, as well as writes the upper limit three functions. When each function execute, the Bluetooth manual operator send a control command to Bluetooth module by UART. This instruction include the Bluetooth link handle, the function code (0x01-0x03 to aim at the above three functions respectively) as well as the CRC verification territory. After the valve locator receives the control command, judges the link handle firstly, then judges whether to receive this instruction, and carries out the corresponding task respectively according to the function code. We can read the valve of the valve locator through the Bluetooth manual operator as showed in the Figure 5. In addition, the Bluetooth manual operator may also to the Bluetooth electromagnetic flow meter, equipment and so on Bluetooth temperature transmitting instrument carry on the operation.

## 5 Conclusions

After the scene testing, this article designs a Bluetooth module that is stable property, easy to operate, usable, anti-interference ability, upgrade software according to the need, can insert in the field apparatus to replace the electric cable effectively, to carry on the wireless comm-

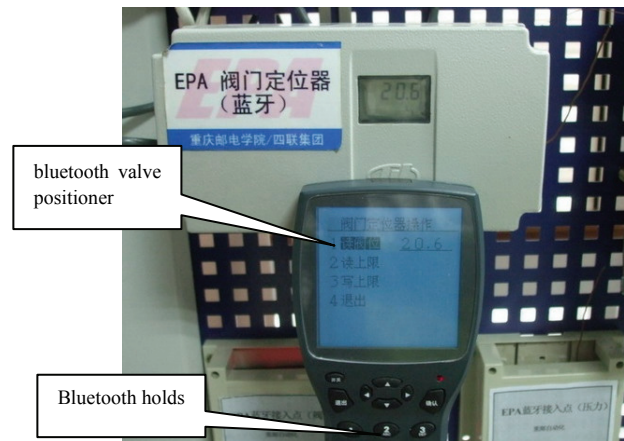


Figure 5. The Bluetooth holds and the Bluetooth valve locator application example chart

unication, extended the tradition industrial control bus, has provided one new networking method for the industry monitoring network.

## Acknowledgements

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