

Design of Communicating Section of FlexRay Bus Based on MFR4310

Liao Zili¹, Gao Qiang^{1,a}, Yuan Dong¹, Li Jiaqi¹

¹21 Court, Dujiakan, Fengtai District, Beijing, P.R. of China

^agq900526@163.com

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Abstract: The development of the car bus is introduced and then the communicating sections of FlexRay are constructed by the use of TMS320F28335 DSP, MFR4310 and TJA1080. The methods of design and communication are analyzed. And the FlexRay model is programmed.

Introduction

With a fast development of car's electric technology, the electronic equipment of vehicle also has an increasingly growth. The vehicle has been changed into another controlling method called X-by-wire. The traditional CAN bus has a limitation in bus bandwidth and communication protocol so that it cannot meet the need of the instantaneity and reliability. The need is much higher in the control of vehicle's driving system, such as the steering, braking, accelerating and decelerating. The new FlexRay of vehicle bus has a better bandwidth and fault-tolerant mechanism for the future development.

This paper established a method to build the FlexRay section. The host controller adopted DSP TMS320F28335, the communication controller adopted the MFR4310 of Freescale, FlexRay bus transceiver adopted TJA1080.

FlexRay bus

FlexRay bus has some important characteristics as a new vehicle bus technology.

(1) A higher communicating bandwidth. FlexRay cannot be limited by protocol. It can be even communicated in a 10Mbps bandwidth. And it can reach 20Mbps when the dual channel redundant communication is adopted.

(2) A higher flexibility. FlexRay can be in a few topological structures such as bus topology, star topology, cascade star topology and hybrid topology. And it can also be in time-triggered and event trigger communicating method.

(3) A good timeliness. FlexRay adopted a time-division multiplexing data transmission method based on cycle period.

(4) Fault-tolerant data transmission. FlexRay has a professional fault-tolerant protocol. It can ensure the reliability of data transmission.

(5) Distributed clock synchronization. FlexRay bus adopted a method based on clock synchronization. And the clock synchronization established and synchronized automatically through the protocol. The accuracy can get to $1\mu s$.

Hardware design of FlexRay section

The structure of FlexRay section. The FlexRay section is mainly consists of controlling model and driving model. The controlling model includes the host controller and communication controller. The driving model includes the bus transceiver. All of the section are shown as fellow in Fig.1.

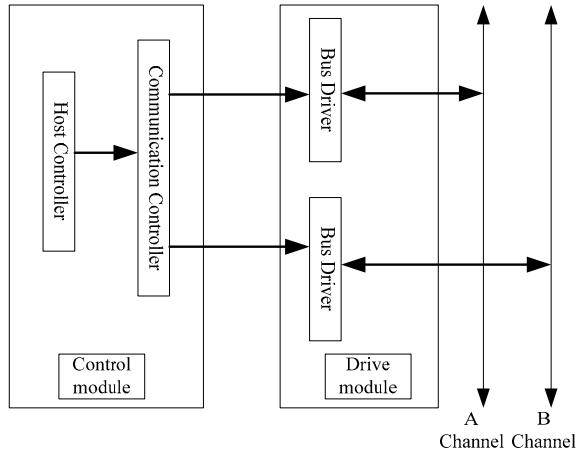


Fig.1 The structure of FlexRay section

The controlling model is used to control the FlexRay section. The host controller controls the communicating controller to distribute and transceiver. The communicating controller controls the FlexRay bus by programming a program based on communicating protocol of FlexRay. The bus actuator is a device, which performed like coder and decoder, connected to FlexRay bus directly. The data comes to bus through coder, and comes to communicating controller through decoder.

The host controller. TMS320F28335 DSP is a kind of digital signal processor established by TI Company. Its frequency can reach 150MHz. The CPU adopted a 32-bit fixed-point including a single precision floating point unit and a 18-road PWM output port. All of it can offer a better service for its better work and control. Inner the chip, it has two 12-bit 8-channel ADC, the exchange time can reach 80ns. And it also has 88 independent input/output port and 4 working modes. It has not only the advantages of DSP, but also the difficult calculation. Above all, this kind of DSP is accuracy, cheap, low power. And also have a bigger storage space and a faster AD exchange.

The communicating controller. The communicating controller in this paper is MFR4310 of Freescale. MFR4310 is an independent FlexRay controller which is consists of FlexRay, PIM, power source, CRG and so on. It is shown as Fig.2 as fellow.

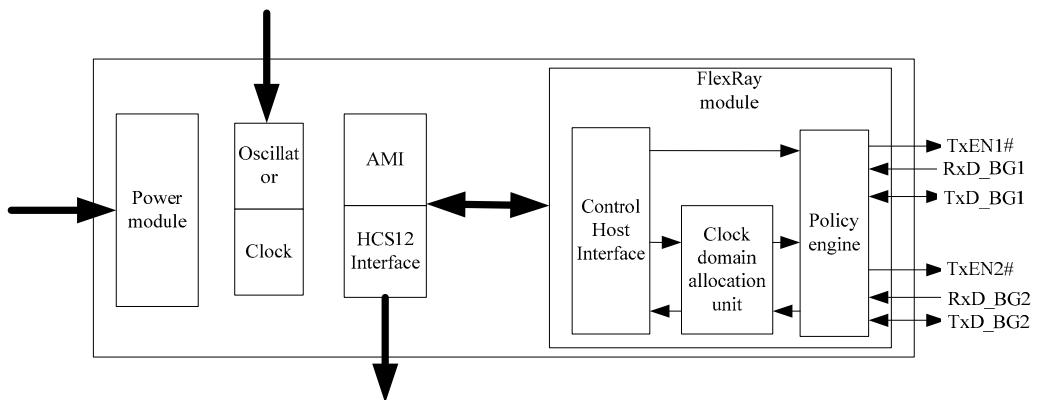


Fig.2 The structure of MFR

Bus actuator. TJA1080, which used in communicating system between 1Mbps and 10Mbps, is a FlexRay bus transceiver produced by NXP Company. It can also supply a high-tech port between the bus of FlexRay network and the protocol controller. In this paper, it is changed into a transceiver device to work alone, which means to receive and transmit only but alone with other devices.

Design of circuitry

The mainly circuitry is designed as Fig.3 shown as fellow based on all the main chips.

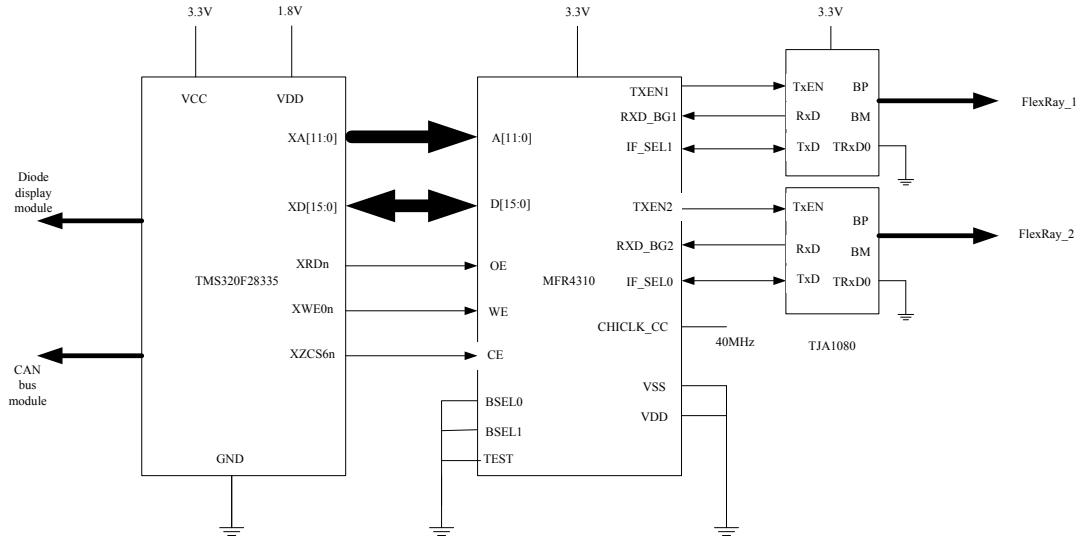


Fig.3 Design of circuitry

In order to realize the section communication, the data bus XD [15:0] of DSP and the data port D [15:0] of MFR4310 are connected. The address bus XA [11:0] of DSP and the address port A [11:0] of MFR4310 are connected. The BSEL0 and BSEL1 of MFR4310 are set in low level. At this time, the XZCS6n is chip selected signal, the XWE0n is read signal and the XRDn is write signal.

MFR4310 can supply two independent channels to match the dual-channel communication of FlexRay bus. The IF_SEL0 is set in high level and the IF_SEL1 is set in low level to make the MFR4310 to work in AMI mode. At this time, the data exchange is controlled by CE, WE and OE. WE used to indicate the direction of data exchange. When the MFR4310 works to read, OE can transmit the data to microcontroller from AMI and coder the inner storage by the use of CE and A [11:0]. The TXEN [1:2] of MFR4310 is in high level because of the TXEN's effectiveness of TJA1080.

In real time, the ISO7220CD should be added between MFR4310 and TJA1080 as Fig.4 shows as fellow.

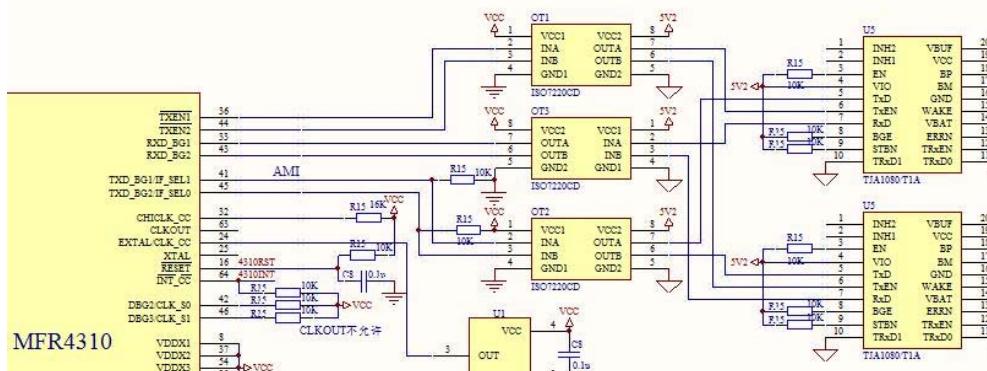


Fig.4 Base of ISO7220CD

ISO7220CD is a photon coupled isolator. The signal in circuitry is easy to disturb it because of the high frequency transmission signal. Hence, the coupled photon is in need to isolate them. The ISO7220CD is normally closed. When the input signal changed between high level and low level, the chip deliver a changeable light signal, which can produce electronic signal in a photosensitive device, to isolate the magnetic disturb of the circuitry.

Programming of communicating model of FlexRay

After the initialization of FlexRay, the DSP will analyze if there is a data read or written. If there is a break in port, the break is produced by TJA1080 in reading process. If there is a break in software in the data transmission, then it will be transmitted to TJA1080. When there is no reading

or writing process, the DSP will detect TJA1080 about its fault output pins to make sure if the TJA1080 is working normally or not. The programming is shown in Fig.6 as fellow.

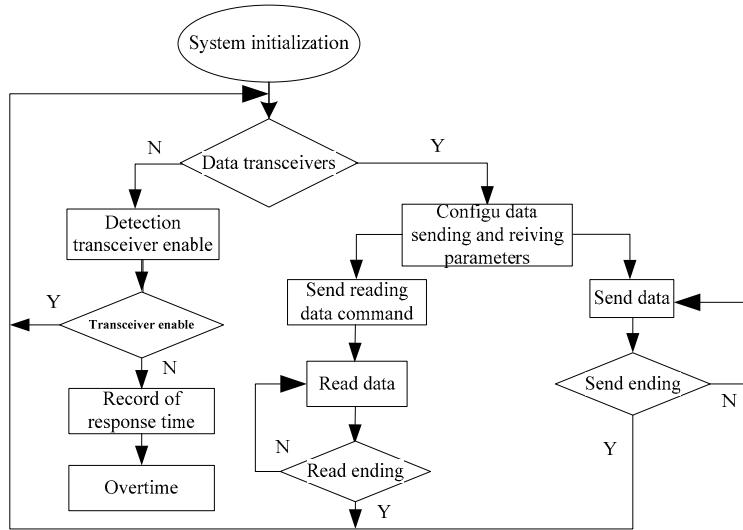


Fig.6 Process of data communication

Summary

According to the need of communicating system of vehicle bus, select some chips to establish the communicating circuitry of FlexRay. The data in FlexRay bus is transmit-received by FlexRay section which consists of TMS320F28335, MFR4310 communicating controller and TJA1080 transceiver. The process of programming is clearness and easy to use. The whole system is simple and effectiveness.

Reference

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