

Design of Mine Locomotive System Based on CAN Bus

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Abstract: Based on CAN bus, this paper studies the system control and management system of locomotive in mine, analyzes the working principle of locomotive system, gives the CAN bus scheme, hardware circuit design and CAN communication protocol, and implements long-distance, high-reliability communication function and remote monitoring function. Experiments show that the auxiliary system based on CAN bus control easier, operation more secure, as well as improving the control performance and service life of the electric locomotive.

0 Introduction

With the development of power electronics technology, CAN bus technology to use, coal mine electric locomotive now the signal transmission system can't meet the requirements of the development of the times [1]. Electric locomotive now the auxiliary converter power supply has some shortcomings: Each device on the locomotive (transformers, air conditioning units, etc.) must individually lead a line to control the start and stop of the device, failure and all the feedback of the signal, and transmitted to the console, and automatic or manual control. As shown in Figure 1, the system for the auxiliary converter working principle, various devices, contactors, etc., with the key switch to control, then this is not only complicated wiring, maintenance inconvenience, the most important is still very easy to cause dangerous accidents. But we use the auxiliary converter system instead of the original system, combined with CAN bus technology, it is very convenient to achieve the above control, both to improve the efficiency, while the system also take into account advanced science and technology, and has a good use of value, there is a broad application market [2-3].

1 The overall structure of the system

Figure 1 shows a block diagram of the system-assisted converter, which is composed of phase-controlled

rectifiers, four inverters, and various electrical equipment (brake fan, traction machine, compressor, oil pump). And each device is controlled by a contactor (and a spare contactor). This system will first AC794 voltage through the phase-controlled rectifier into DC540V, and then

DC540V voltage inverter, inverted into AC380V supply equipment needed to use the device, in order to ensure normal operation of equipment.

In conjunction with Figure 1, we draw the CAN bus block diagram. As shown in picture 2, there are the start stop button and the display screen of each device on the driver's console, which can display the real-time status of each device. Before starting, the driver console receives phase fault rectifier fault signal and 4 inverter fault signal, if there is no fault, then start the phase-controlled rectifier, and then as needed to open the various inverter operation.

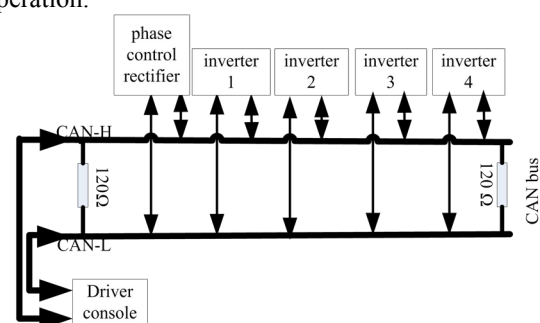


Figure 2 CAN bus system architecture

2 Hardware design

Figure 3 shows the CAN circuit block diagram, which phase control rectifier, four inverters are used a STM32F103ZET6 chip to control. STM32F103 chip comes with CAN controller used to achieve data transmission. CAN is STM32F1 comes with CAN controller, which supports CAN protocol 2.0A and CAN2.0B. This controller uses the smallest CPU load to

handle a large number of received packets, but also supports the priority of packet transmission [4].

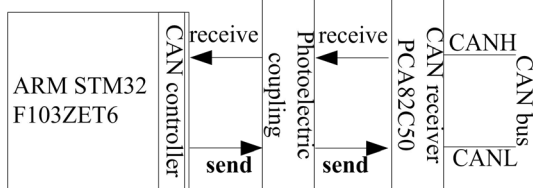


Figure 3 CAN circuit block diagram

2.1 CAN circuit design

Figure 4 for the separate power supply module, the use of "F0505D-1W" DC-DC converter, The 5V voltage is converted into a 5V power isolation, improve the noise immunity of the bus, isolated power supply CAN optocoupler isolation and transceiver ,and increased CAN bus stability and anti-jamming capability.

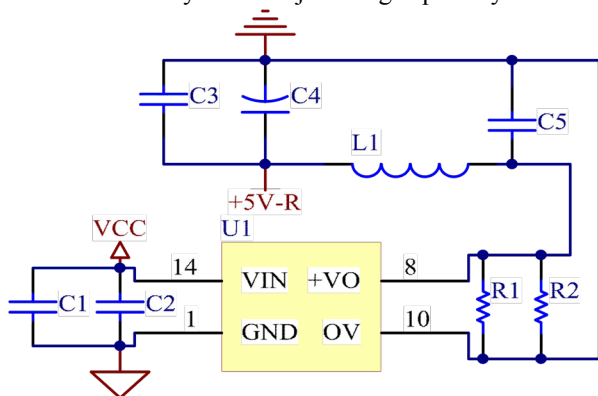


Figure 4 power supply module

Figure5 shows the optical isolation circuit, we use high-speed optocoupler 6N137, the chip sent by the signal CANTXD and received signal CANR, with optocoupler isolation, so that the speed of the CAN network can be achieved and the speed of the previous network drive the same,so that the signal transmission more timely, stable, reliable, the most important can improve the anti-jamming.

Figure 6 shows the CAN transceiver circuit, we use the PCA82C50 chip, the chip can provide differential transmission capacity of the bus, CAN controller to provide differential reception capability, and the chip to CAN in high-speed mode, so that the transmitter output stage transistors at the fastest possible opening and closing speed, improve the efficiency of the CAN. The chip in the circuit accepts the CANT, CANR signal from the optocoupler, will become a stable differential signal, after the follow-up filter circuit, the protection circuit sent to the CAN bus, which can improve the signal anti-jamming capability.

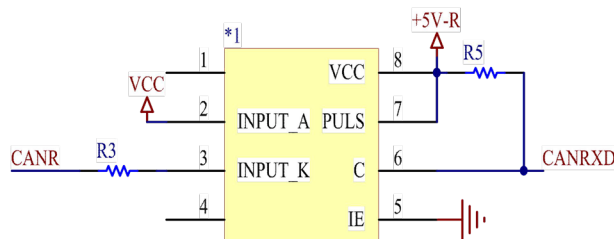
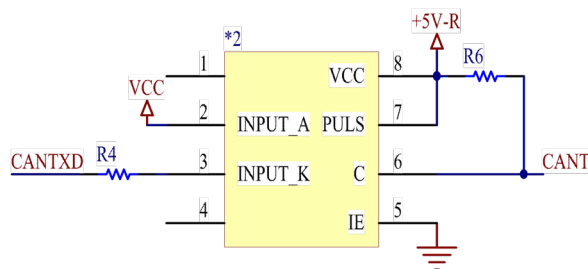


Figure 5 Optoelectronic isolation circuit

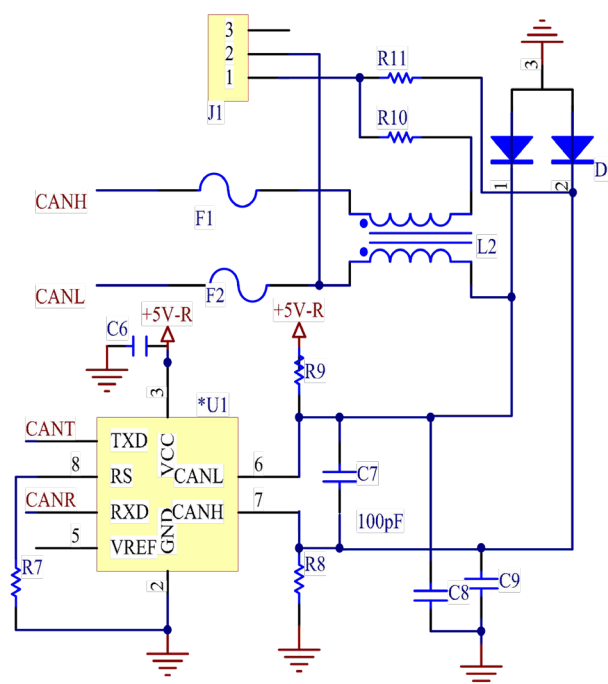


Figure 6 CAN Receiver PCA82C50 wiring diagram

3 CAN communication protocol

For CAN (Controller Area Network), it is a serial data communication protocol, with high performance, high reliability, easy to develop and low-cost field bus.It consists of CANH and CANL lines, the transmission medium can be unshielded twisted pair, cable and fiber, the communication rate up to 1Mb / S, and its transmission distance up to 10Km. [5-8]

In this system, set up the control station, phase control rectifier, the inverter's own frame number.The control station sends the rectifier, the inverter frame number is 0X80 instruction frame, receives the real-time data of each electrical equipment and sends the control command signal.The frame number sent by the phase control rectifier to the control station is 180H, and the

frame numbers sent by the four inverters to the console are 181H, 182H, 183H and 184H respectively. As the end of the Table 1, 2, 3 is the byte definition of each module

4 Experimental waveform

For different devices and contactors connected to them, we will be 24 hours continuous monitoring, and the parameters of each device for real-time collection. By testing our system can run continuously for 24 hours without interruption. The following figure is our test in the CAN bus data waveform and CAN bus data frame waveform, as shown in Figure 7,8.

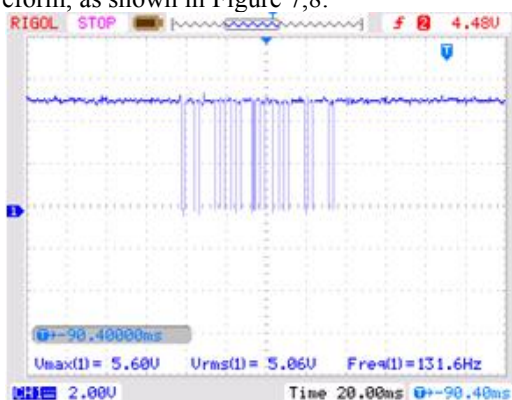


Figure 7 CAN bus data waveform

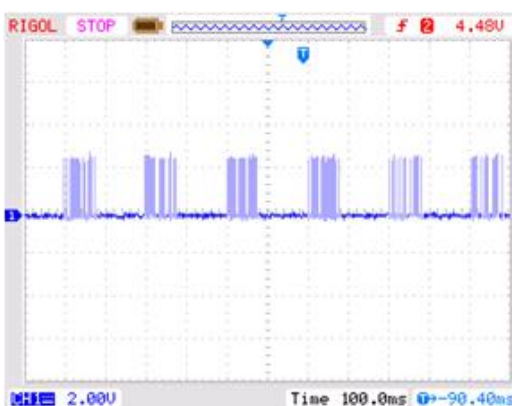


Figure 8 CAN bus data frame waveform

After 24 hours of uninterrupted monitoring of the console display, we found that the four frequency converter through the CAN bus transmission voltage, current, frequency, fault and other information more timely and effective, and information feedback more stable and reliable.

5 Conclusion

Aiming at the auxiliary converter used in the locomotive, this paper designs the information transmission system which uses CAN bus technology for real-time communication. CAN bus system is a good solution to the locomotive power equipment operating frequency, current, voltage, fault and other information transmission problems, and managers can timely and accurate through the console display to get the operating parameters of each electrical equipment, with fast and accurate, high reliability characteristics. Through the installation and commissioning and operation of the locomotive, the system of seismic, electromagnetic compatibility, reliability and other aspects of the design can meet the practical requirements. This paper provides a reliable basis for the use of CAN bus technology in locomotives, and has good marketing value.

Fund Project:

Hebei Province Science and Technology Support Project (16274603,16214408)
 Central University of basic scientific research business fees (3142017045,3142013101,3142016022)

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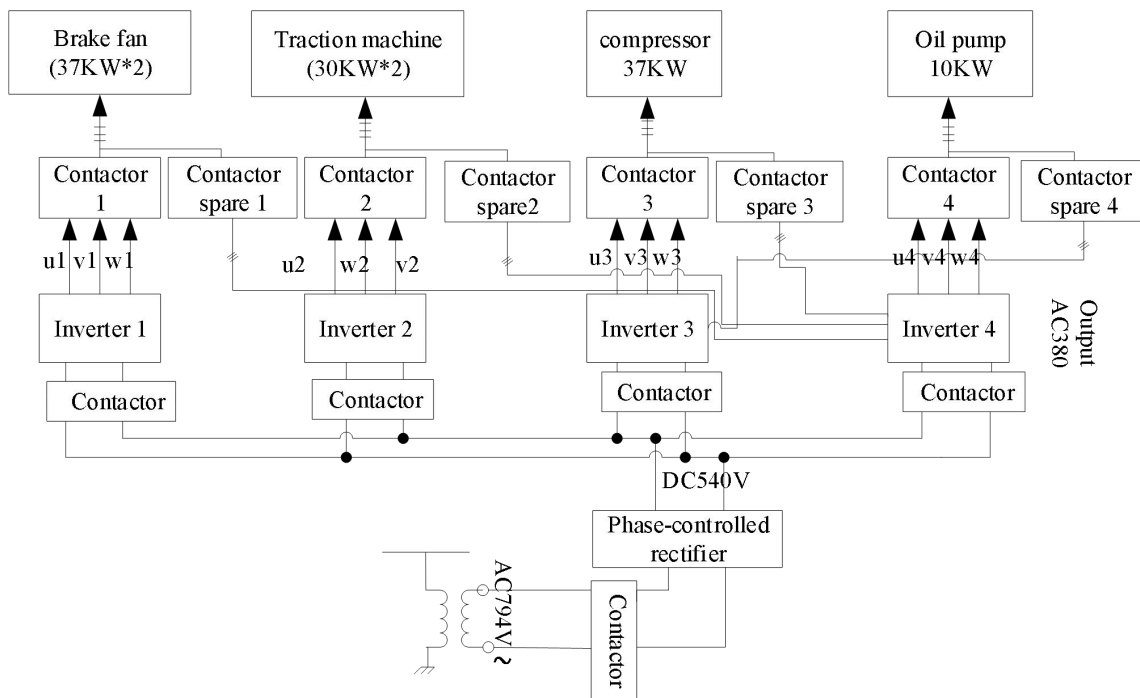


Figure 1 Auxiliary converter works

Table 1 Receive: Division console ID: 80

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte1	80H							
Byte2	08H							
Byte3	inverter1							run 1, stop 0
Byte4	inverter2							run 1, stop 0
Byte5	inverter3							run 1, stop 0
Byte6	inverter4							run 1, stop 0
Byte7	rectifier							run 1, stop 0
Byte8	reserved	reserved	reserved	reserved	reserved	reserved	reserved	normal 0 failure 1

Table 2 Send: Rectifier ID: 180H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte1	180H							
Byte2	08H							
Byte3	voltage low byte						Normal 0 overcurrent 1	
Byte4	voltage high byte							
Byte5	current							
Byte6	temperature							
Byte7	rectifier							
Byte8	reserved	reserved	reserved	reserved	reserved	reserved	reserved	normal 0 failure 1

Table 3 Send: inverter1/2/3/4 ID:181H/182H/183H/184H
 inverter1 ID: 181H

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte1	181H							
Byte2	08H							
Byte3	voltage low byte						normal 0 overcurrent 1	
Byte4	voltage high byte							
Byte5	current							
Byte6	temperature							
Byte7	rectifier							
Byte8	reserved	reserved	reserved	reserved	reserved	reserved	reserved	normal 0 failure 1

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