HVDC 시스템의 프로피버스 통신 디자인

JIANG LILI,이일화,문준모
LS산전중앙연구소HVDC C&P팀

Field Bus communication design in HVDC System

LILI JIANG,YILHWA.LEE,JUNMO.MOON
LS Industry System Research Center HVDC C&P Team

ABSTRACT

This paper introduces the application of Profibus field bus communication in HVDC power system. Discusses about the configuration of HVDC system and the structure of control and protection system. Analyzes and designs the network configuration of field device level. Using OPAS engineering tool to config IO system and at the same time monitor data in SCADA HMI.

1. Introduction

With the development of power grid, HVDC has widely been used in long distance power transmission field compare with AC power transmission system, So HVDC has a obvious advantage in long distance power transmission in worldwide. HVDC has been used in the world for almost 30 years. Up to now, there are more than 40 countries successfully operate the HVDC system. ABB, Siemens, Alstom as the main HVDC development companies, hold the Core technology in the world.

Field bus has been widely used in all the power and industry system .it can accommodate to bad working environment and complicated communication occasion. HVDC control and protection system needs the field data that is acquired from field device, this requires communication system has high performance and high quality. Our system use Profibus-DP communication method, salve IO device is connected with master board through VME bus sending data to CPU board for control and monitor.the following will state the detail design of Profibus communication system.

2. FieldBus communication design in HVDC System

2.1 HVDC System Configuration

HVDC system can be divided into 3 levels: 1.operator control level. 2.control and protection level.3.field device level. Operator control level is the top level which is mainly used to communicate between user and machine. The main function of this level is to control and monitor the status of the whole system, It also contain the GPS server printer and other related devices. Control and protection level contains the core technology of HVDC system. It has current control ,power control and voltage control, tap changer control and so on . all the control function work together in order to transmit the power set by system. Field device level is the lowest level in HVDC system .Data is sent to C&P system by Profibus communication. At the same time, get the control command from C&P system and carry out the real action. This 3 level work together to make the whole system perform perfect.

The role of field bus level is to acquire data in time and correctly send to control and protection processor Also it should has the ability to avoid interference of noise from outside.

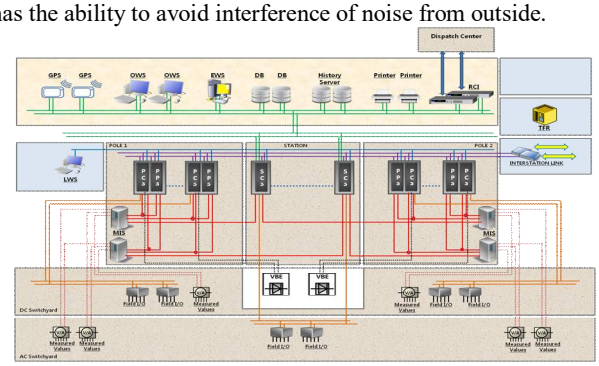

Fig. 1 HVDC System Configuration

2.2 Fieldbus Communication System Design

Overall design scheme: from the description and system structure we can see that our whole system has been devided into 3 kinds of controller with different control function. so that means for profibus system we need to gathering a lot of data for different uses and configurate the structure of IO device. Our HVDC system has station control , phase control ,and protection control. Here we give a network topology of field bus system design:

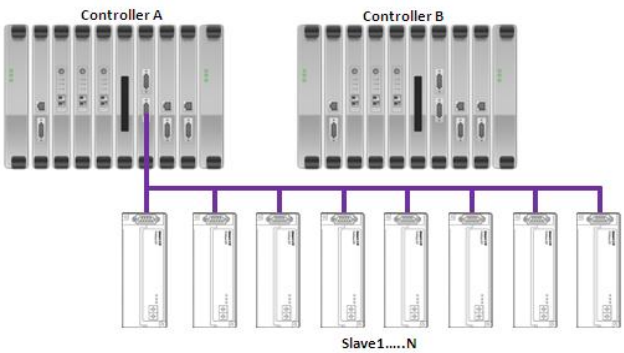

Fig.2 Profibus communication configuration

Each field bus master board connects with a number of slaves using field bus cable which has the shield function to avoid noise.

2.2.1 Hardware system

Our system uses SST-PFB3-VME-MASTER board as master station and smart IO device of LSIS as slave station. Each field bus system consists of:

-One master board : SST-PFB3-VME-MASTER
-Several slaves smart I/O:GPL_TR4A_B_C
GPL_AC8C
GPL_D24A_C
-Bus connectors(switch setting: terminal(ON),middle(OFF))
-Profibus IO interface board.

Cubicle type	Master board	Slave board	Interface board
SCS A	SST-PFB3-VME-MASTER	GPL_D24A_C	DI interface board
SCS B	SST-PFB3-VME-MASTER	GPL_D24A_C	DI interface board
PCS A	SST-PFB3-VME-MASTER	GPL_TR4A_B_C GPL_AC8C GPL_D24A_C	DI interface board DO interface board AI interface board
PCS B	SST-PFB3-VME-MASTER	GPL_TR4A_B_C GPL_AC8C GPL_D24A_C	DI interface board DO interface board AI interface board
PPS A	SST-PFB3-VME-MASTER	GPL_D24A_C	DI interface board
PPS B	SST-PFB3-VME-MASTER	GPL_D24A_C	DI interface board

Fig.3 Profibus hardware configuration

The function of master station is gathering data from slave board through profibus communication and storing it in the memory area of master card. CPU that linked with profibus master card will read data from memory through VME bus each 1 ms. Master station has 2 serial port, 1 port is used for download the profibus system configuration file, the other serial port is used to connect the field bus connector. There is a indicator LED that show the status of communication process which is convenience for debug and checking. Slave station is smart IO product of LSIS, it is powered by 24V DC, and all the slave

device should be numbered by the switch for configuration.

Data exchange is performed with a data rate of 1.5 Mbit/s. nodes(master+slave)max 1 master, max 126 slaves, slave per bus segment max.31.each slave has its own memory address in master board. The memory address in OPAS and configuration file should be same.

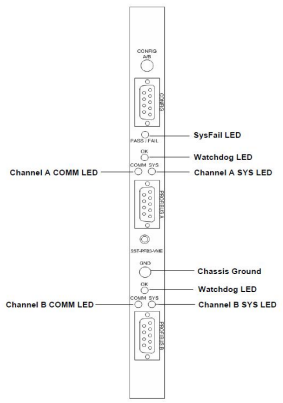

Fig3. Profibus master board

2.2.2 Redundancy Function

The Converter Control system is configured as redundant system where one system is active and the other is in standby mode at any given time. Each of the redundant systems is equipped with its own Field Bus interface connected to individual Field Buses. The active and the standby control system are running in parallel, this means that both systems are updated by the connected slaves. In other word the active and the passive system of a redundant control system, communicate via their own Field Bus interface with the slaves.

Slave sends the collected input information simultaneously to the active and the standby control system to guarantee that both control systems always have the same information.

In the other direction the output slave device forward output information to the connected peripherals and equipment. The standby control system sends the same information via the standby Field Bus. All the input and output data are connected to IO interface board, the real output point is decided by the COL device. COL send select signal to interface board and only the output of active system can be used by field device and at the same time all the A and B system the input data can be gathered and only the data of active system can be used for control. Our system using hot standby method, so at the same time both active and standby system has exactly same data.

2.2.3 Profibus system configuration file

Field bus system configuration file should be configured by special software and using serial port download to master board. Each salve device has its own GSD file so first add GSD file to software then select the device that we want to use. It is necessary to define the station ID of master and slave device that must be matched with the switch on the real device. Then make BinCfg file and download by serial port.

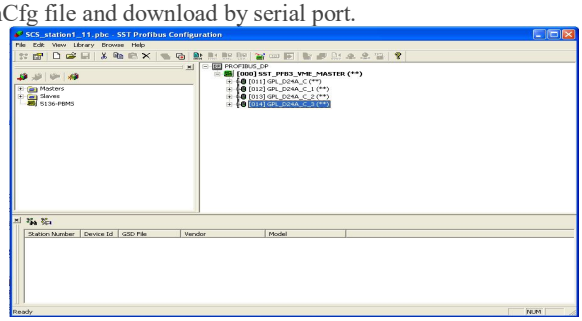

Fig4. Profibus configuration setting

2.2.4 OPAS Engineer tool Configuration

OPAS is the engineering software of LSIS company. This software contains profibus configuration function. Add profibus master station and slave station, assign their memory address that is same in configuration file and then compile and download io logic to CPU. By doing this we can read data from field device and send output data to field device. Especially pay attention to the memory address setting when DI or DO is more than one.

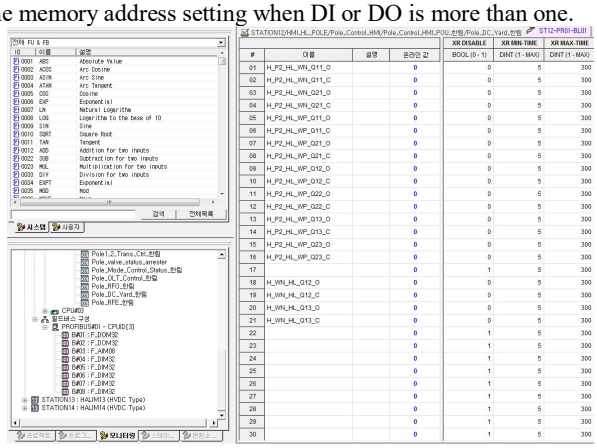

Fig5. OPAS profibus configuration

2.2.5 Profibus HMI monitoring

In HMI system we have one part used for monitor the status of controller and system status. In this part we also monitor profibus communication. Operator can use this to check and monitor whether Profibus system works correctly or not. All the controllers gather the status and send it to SCADA PC. Profibus master board and slave board can be monitored. green means ok and red means alarm. If slave is not used then display gray.

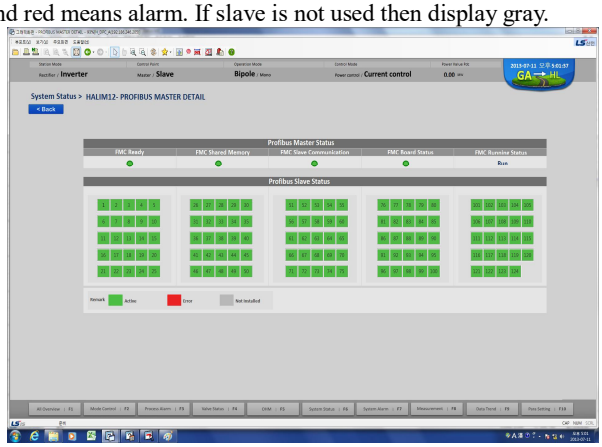

Fig6. HMI profibus monitoring

2.3 Test result

Because field bus reduce the cable and workload on-site, make less breakdown and improve the diagnosis ability, it can correctly find the alarm point in our system, from LED light can we check the problem if communication is not good or slave device has error.

3. Conclusion

Using Profibus communication for field IO device can make sure that our system can get data in time assure the safty of data as hot standby system. Also our COL can select active data that send to slave board to make sure redundancy system function.

Reference

[1] Edition1.0-1998.PROFIBUS Specification Normative Parts of PROFIBUS-FMS\EP\PA.

[2] 715-0080_SST-PFB3-VME and SST-PFB3-VME-2 Hardware Reference Guide.