Development of the SERCOS Master with PLC Bus Connection

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1. Introduction

Our company has done the system development using SERCOS and has commercialized many SERCOS components.

Until now, only PC based controllers, including the "SANMOTION SMS-10", "SANMOTION SMS-30" and "SANMOTION SMS-15", have been developed. These controllers are based on AML, the object-oriented software motion descriptive language. Additionally, Sanyo Denki has produced many SERCOS slave components, including the "PV", "PQ-R", "PQ-M", "PE-W", and "PZ-W" servo amplifiers, plus the "SRU10D" I/O unit.

This time, a SERCOS controller was developed as a single PLC (Programmable Logic Controller) module for the Yokogawa Electric Works, Ltd. FA-M3 PLC. In this document, the FA-M3 SERCOS I/F module is introduced.

2. FA-M3 I/O Open

2.1 What is FA-M3?

The Yokogawa FA-M3 PLC is a next generation, open architecture controller. It features advanced functionality in a slim form factor.

However, it is the "I/O Opening" feature that distinguishes the FA-M3 from conventional PLCs. This flexible I/O feature allows us to develop new modules for the FA-M3 PLC. Generally, when external equipment that did not meet the PLC specifications was connected to a PLC, an external mastering unit was necessary. Because the FA-M3 allows customization for each module manufacturer, it is possible to connect the FA-M3 with external equipment without the external mastering unit. Our company also adopts the design rule of the "I/O opening" for the SERCOS I/F module. Fig. 1 shows the configuration diagram of FA-M3 including our development part.
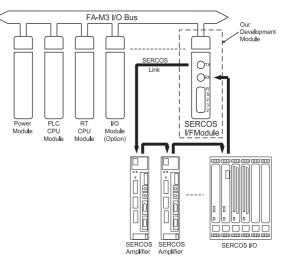

Fig. 1　Configuration Diagram of FA-M3

2.2 Feature of FA-M3

1) Ultra high-speed operation
 ・Scan time of ladder program 20K step/1msec
 ・Minimum scan time 200 μ sec
 ・Sensor control function: high-speed period 200 μ sec-
 ・High speed input to output: input response time 10 μ sec
 ・High speed interruption response time: interruption response time 100 μ sec

2) Super Small
 ・147(W)×100(H)×88(D)mm of size and 192 points of I/O

3) I/O Range Free
 ・Maximum 8192 points, device capacity 310K word range free
 ・Realization of more functions than large size PLCs with the price of Small-medium size PLCs.
 ・1000～2000 point class price ratio: 1/2～1/3

4) Outstanding Maintenance Support Function
 ・Remote OME (Operation Maintenance & Engineering) by using public line/Ethernet and E mail function
 ・Trouble analysis by the system log and user log function
 ・Trouble analysis function by sampling trace
 ・Common I/O spare parts to from medium to large size

5) Multiple CPU
 ・Division of work by multiple ladder CPU
 ・Information processing by BASIC CPU
 ・PC function by AT compatible CPU

6) I/O Opening
 ・Realization of I/O module design of user's own

7) FA-M 3 Program Development Tool "WideField2"
 ・Object ladder inherited structured programming
 ・Independence of block and macro which improves reusability greatly
 ・Structuring of a device
 ・Efficiency improvement of reusability by visibility
 ・Easy data exchange with Windows applications

8) BASIC Program Generation Tool M3 for Windows
 ・Offering a comfortable BASIC development environment under Windows

9) Program Generation Tool for SFC
 ・Support the International common language based on the IEC International Electro-technical Commission (IEC1131-3): SFC(Sequential Function Chart) and LD(Ladder Diagram)
 ・Realization of comfortable operation on Windows

3. FA-M3　SERCOS　I/F Module

Fig. 2 shows the SERCOS I/F module that adopted "I/O opening" developed by our company.

Fig. 2　SERCOS　I/F Module

3.1 Internal Block of SERCOS　I/F Module

Fig. 3 shows the internal block of the SERCOS I/F module. The command issued from the PLC-CPU module or the RT-CPU module is sent via the I/O bus to the I/O control ASIC on the SERCOS module. After the command data is processed, it is transmitted to the CPU (SH7044) inside of the SERCOS module via dual port RAM.

The module's CPU processes the command code, and writes the appropriate data into the SERCON816 (SERCOS communication ASIC), and the SERCOS communication is established with the slave devices. The module includes 128KB of SRAM of EEPROM for saving various parameters necessary for the multi axis control.
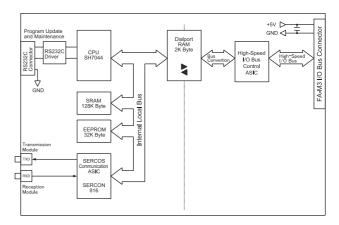

Fig. 3　Internal Block of the SERCOS

3.2 Feature of the SERCOS　I/F Module

1) SERCOS Interface
    The communication processing time was shortened by adopting the newly released SERCON816 ASIC, which can achieve a baud rate of 2, 4, 8, or 16Mbps. This makes it possible to use the module in high-axis count systems requiring fast response times.

2) Maintainability
    The flash microcomputer SH7044 made by Hitachi was selected as the CPU of for this module. Programs can be modified using a RS232C connector. Additionally, 256KB of memory is available for the user's program.

3) Load reduction of CPU module
    The SERCOS interface demands a real-time nature of some hundreds of μ sec order from the CPU that controls the SERCOS communication. Therefore, if a real time OS was not available, control was not possible. To overcome this, SERCOS communications are controlled by exclusive use of a CPU (SH2) in the SERCOS module. This frees the host CPU of SERCOS communications, and the load of the host CPU module is reduced greatly.

3.3 Basic Specifications

Table 1 shows the basic specification of the SERCOS I/F module.

Table 1 Basic Specifications

Item	Specifications
CPU	SH7044
Memory	SRAM 128KB EEPROM 32KB DPRAM 2KB
Protocol	IEC61491（SERCOS）compatible
Data Transfer Speed	Select from: 2M,4M,8M,16Mbps
Host Interface	High-speed I/O bus （Yokokawa Electric Works, Ltd.）
Power Voltage	DC4.75〜5.25V
Operation Temperature Range	0℃〜55℃

4. Conclusion

Though the PLC tends to decline in Europe and America as the trend of the controller industry, the PLC is still a main stream in Japan and China, and this PLC-based system, which adopts the SERCOS interface, is the of its kind in the country. This system will be useful for the industries (chiefly machine tool) requiring the synchronization of the system and the high response. In the future, it is expected that this system will help to spread the use of the SERCOS interface in this country.

* The product name of the document is a registered trademark or a trademark of each company.

Reference

(1) Yasuhiro Kyuma, Shin Nagata, others:"Servo Amplifier for SERCOS", SANYO DENKI Technical Report No.5,pp.38-41(1998-5)
(2) Hiroshi Yoshikawa:"Development and feature of AML language", SANYO DENKI Technical Report No.7,pp.28-36(1999-5)
IGS:「SERCOS interface I/O-Functions」

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