Development Of New Serial Interface Servo Amplifier

Izumi Yui Tsuyoshi Kobayashi Hideki Netsu Tetsuya Hayashi

1. Introduction

In a majority of electric servo applications the conventional analog speed command or pulse type position instructions (along with hard-wired I/O) are used for the interface between the servo amplifier and the host controller.

In recent years the demand for a high-speed serial interface with the following functions has rapidly increased in the factory automation market: wire saving interface, dynamic parameter changes, and cancellation of drift and difference, etc.

In order to satisfy these demands, the servo amplifier with SERCOS interface and the servo amplifier with Device Net, etc. have been designed and taken to market. Our company originally developed a LSI gate-array to implement such a serial interface. Servo amplifiers equipped with this gate array have already been offered to the market.

The GA1060, based on our original gate-array technology has been developed for use in the Q series servo amplifier, which was developed last year. This document introduces the LSI gate-array itself and the new serial interface servo amplifier equipped with LSI.

2. LSI GA1060 for Serial Communication

2.1 Evolution Of Gate-Array For Serial Communication

SANYO DENKI developed the original LSI gate-arrays for serial communications as shown below:

1) GA1022 (transfer rate 2.5Mbps, 6Byte) developed for PZ series servo amplifier
2) GA1045 (transfer rate 4Mbps, 10Byte) developed for PY series servo amplifier

The newly developed GA1060 is a third generation LSI gate-array for serial communication as shown in Fig. 1. It was developed for use in the Q series servo amplifier to provide the highest performance serial communication.

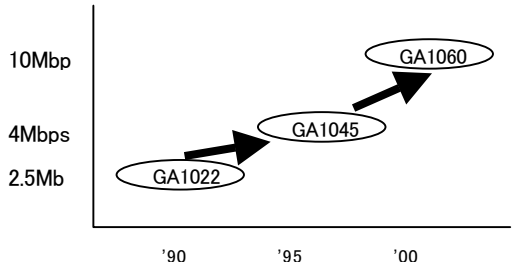

Fig.1 Evolution of Gate-Array for Serial Communication

2.2 Features of GA1060

The comparison between the second generation GA1045 for serial communications and newly developed GA1060 is shown in Table 1.

The main characteristics of GA1060 are:

- Space-saving by using Plastic 100Pin QFP package
- Higher speed (160MHz) of internal logic operation with built-in PLL
- High transfer speed (10Mbps, 2.5 times more than the conventional)
- Transfer data up to 20Byte (2 times more than the conventional)
- Built-in sending and receiving buffer memory for 16 axes (1 axis conventionally)
- Synchronization pulse output function with independent timer in three systems in the synchronous function between primary and secondary station (1 system conventionally)
- Automatic transmission function of data with built-in timer (did not exist conventionally)
- Batch transmission function to multiple axes (did not exist conventionally)
- Output function at reception side of port input signal of sending end (did not exist conventionally)

Moreover, to avoid collision of communication data in the half-duplex communication line in the previous gate-array implementation, the data transmission (execution of the response) from the secondary station to the primary station was assumed to be a communication unit. However, it has the following problems:

1) When the number of secondary stations is small, it can speed-up the update cycle of data comparatively, but it cannot speed-up as the number of secondary stations increases.
2) As the result, it takes time (turnaround time) from the execution of the command at the primary station until the reception of the response from the secondary station.

Table 1 Comparison of GA1045 and GA1060

	Item	GA1045 conventional	GA1060 new
1	Physical	PlasticQFP-80Pin Lead Pitch:0.5mm Package:12mm × 12mm	PlasticQFP-100Pin Lead Pitch:0.5mm Package:14mm × 14mm
2	Tip Process	0.8 μm Silicon Gate Process	0.35 μm Silicon Gate CMOS Process
3	Power Voltage	5V±5	3.3V±0.3
4	External Clock	32MHz	20MHz (Operate by 160MHz Internally by PLL(8times)
5	Serial Transmit Baud Rate	4Mbps	10 bps
6	Transfer Data Length	Select from 10Byte and 6Byte	Select from 20Byte, 10Byte
7	Transfer Time of 1 Frame	28.25 μsec 10Byte	19.45 μsec 20Byte 11.45 μsec 10Byte
8	Data Transmission Method	Manchester encoded synchronous transmission	←
9	Error Check	CRC 8bit	←
10	Synchronization Method between Primary-Secondary Station	One synchronization pulse output terminal with special synchronous frame Delay time can be set from 1 to 1024 μsec (1 μsec/LSB)	← Three synchronization pulse output terminals Delay time of 3 terminals can be set (0.5 μsec-32.767msec(0.5 μsec/LSB)) (One of three terminals operates as an automatic transmission starting trigger)
11	Automated Sending Function	No	Yes
12	Number of Specified Destination Addresses	00H-1EH 31Axis	←
13	Data Bus Length	Select from 8bit, 16bit	Select from 16bit, 32bit
14	Sending and Receiving Buffer Memory	Built in Memory for one Axis	Built in Memory for 16 Axes
15	Sending and Receiving Mode	The sending and receiving of each individual axis from CPU is specified.	The sending and receiving in batch with multiple axes (The scanning mode depends on the composition of the communication protocol)

These issues are a substantive problem since the factory automation market is expected to push for technology enhancements such as high accuracy, high speed, and multifunction servo systems in the future.

In order to solve this problem, the following functions were added to the development of GA1060:

1) Execute the command from the primary station to multiple secondary stations in bulk (scanning transmission mode).
2) The secondary station doesn't begin transmission until receiving the command from the primary station, but the transmission is scheduled in GA1060 beforehand (automatic transmission mode).

By installing these functions into the GA1060, the update speed of the communication data between the primary station and the secondary station was increased. It can connect up to ten axes with an update cycle of 500 μsec where three axes was the previous limit.

3. Outline of the Servo Amplifier with GA1060 Installed

The new serial interface servo amplifier with GA1060 installed was produced to enhance the interface of the Q series servo amplifier, which was announced last year.

The main features are as follows:

- The multifunctional parameters of the Q series can be changed dynamically via this serial interface (can be set any time during motor operation).
- The parallel I/O (two points for each) in which any function can be selected is also provided via serial communications.
- As a high-speed multipoint communication method, the serial communications conforms to the general RS485 (RS422A) standard. Expensive cables etc. are unnecessary, and a low cost daisy chain (multi-drop) can be configured (Fig. 2).
- The amplifier is controlled with a built-in CPU and does not require a separate CPU for serial communications. As a result, the serial interface could be installed without raising the cost, and the high performance and simple configuration of the Q series is maintained.
- The communication method is backward compatible so that customers who used the older versions GA1022 and GA1045 can easily upgrade to the new Q series servo amplifier with the new GA1060 gate-array for serial interface.

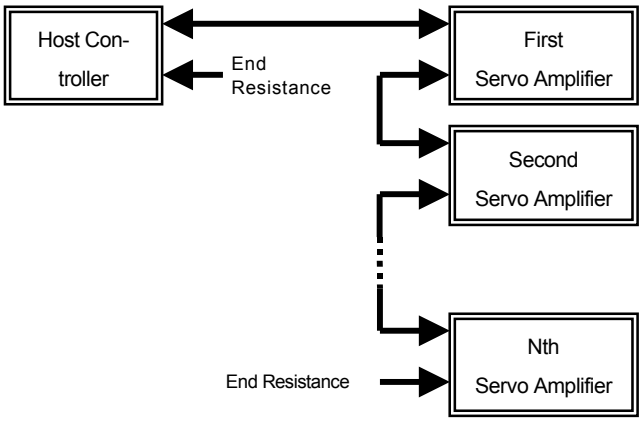

Fig.2 Daisy Chain (Multidrop)

4. Conclusion

This document explains the features of GA1060, the LSI gate-array for the serial interface and the servo amplifier equipped with GA1060 to provide the serial interface.

The demands of the servo amplifier market are varied. SANYO DENKI will continue the effort to develop the serial interface for servo amplifiers in order to satisfy the market demands and those of our customers.

Izumi Yui

Joined company in 1986
Servo Systems Division, 2nd Design Dept.
Worked on the development and design of servo amplifier

Tsuyoshi Kobayashi

Joined company in 1990
Servo Systems Division, 2nd Design Dept.
Worked on the development and design of servo amplifier

Hideki Netsu

Joined company in 1989
Servo Systems Division, 2nd Design Dept.
Worked on the development and design of servo amplifier

Tetsuya Hayashi

Joined company in 1999
Servo Systems Division, 2nd Design Dept.
Worked on the development and design of servo amplifier