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Feature

High-Speed Serial Communication Using Dedicated LSI

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1. Introduction

The interface between a servo amplifier that drives a servo motor on the one hand and a host controller on the other has commonly been ensured by analog speed instructions or pulse string position instructions + parallel I/O. Before the importance of networking was emphasized, Sanyo Denki started to develop this portion. In 1991, the company came up with its original serial communications LSI (under the LSI designation of GA1022) and has since been selling servo amplifiers containing such LSIs.

On the other hand, market demand began to grow around 1994 for the ″ promotion of an open network. ″ Like many other firms, Sanyo Denki has since been marketing servo amplifiers designed for the SERCOS interface and servo amplifiers designed for Device Net, along with other models.

The company analyzed the market needs that it had identified during that marketing, added the advantages of the open network to the know-how that it had accumulated through the GA1022, and came up with something even faster and more functional: a serial communications LSI (under the LSI designation of GA1045). Since it was developed in 1997, it has been mounted in various servo amplifiers and used by many users.

This paper presents the company's unique communications LSI (GA1045) and the characteristics of servo amplifiers containing such LSIs.

2. Communications LSI

The specifications of the serial communications LSI, GA1045 are listed below.

① Communications system
As per RS-485 (422A). Half-duplex communications.

② Data transmission system
Manchester encoding system

③ Transfer speed
4Mbps maximum.

④ Error check
CRC system

⑤ Communications data length
80 bits or 112 bits

⑥ Synchronization between the primary and secondary stations
With a dedicated synchronization frame.

3. Servo amplifiers containing communications LSIs

This section presents the characteristics of servo amplifiers containing GA1045s.

3.1 Communications data

One example of a servo amplifier containing a GA1045 is a ″ PY ″ series E type. Its communications data is excerpted from the specifications and shown in Table 1.

Table 1. Communications data (excerpts) between a high-level controller and a servo amplifier

Data	Designation	Symbol	Action description
DAT2	Motor type code	MOCODE	Designates by a code, the motor model to be combined with a servo amplifier. For the motor model codes, see the attached table. Note 1) Specifying a motor code that is of a different combination to the amplifier capacity, results in a parameter error. Note 2) Specifying a non-existing motor code results in a parameter specification error.
DAT3	Sensor division count code	ENCODE	Designates by a code, the number of sensor divisions in the motor to be combined with a servo amplifier. For the codes for the sensor division count, see the attached table. Note 1) Specifying a non-existing sensor division count code results in a parameter specification error.

As shown in this example, a system with a servo amplifier containing a GA1045 allows the host controller to control various parameters of the servo amplifier. It therefore offers the following advantages:

a) Spares: With this system, it is sufficient to own as many spares of servo amplifiers as the varieties of servo amplifier capacities, instead of owning a spare servo amplifier for each combination motor as one used to.

b) Various gains: Fine control is possible because the high-level controller can specify any value for each communications period.

Furthermore, no analog signal is needed to convey instructions between the host controller and the servo amplifier. This obviates all the need of being concerned about the offset, drift and other issues peculiar to analog signals.

3.2 Wire saving

Fig. 1 shows a typical configuration of a serial interface containing a GA1045. In this example, the output line of the GA1045 is connected to n servo amplifiers with almost equivalent functional equivalence (a system which is called the multi-drop system). (Theoretically, n ≦ 31. Checks have been made for up to n=16.)

Next, comparison is illustrated between a connection diagram (Fig. 2) of a servo amplifier containing a GA1045 and a connection diagram (Fig. 3) of an interface of the traditional type (pulse string position instructions + parallel I/O).

A servo amplifier containing a GA1045, except for general-purpose I/O devices, contains one pair (two lines) of serial communication lines and one pair (two lines) of emergency stop lines for the wiring of the control signal system. One can thus see that the new interface saves overwhelmingly more wiring than traditional interfaces.

3.3 Functional enhancement

Fig. 4 shows a conceptual chart of communications between controller and servo amplifier using a GA1045.

The GA1045 is equipped with a synchronization frame, in addition to an ordinary frame designed for exchanging data, to ensure synchronization between the primary and secondary stations (i.e. ensure synchronization between the host controller and the servo amplifier), which the GA1022 could not achieve.

This has made it possible to ensure synchronization not only between controller and servo amplifier but also, indirectly, between servo amplifiers, thus greatly helping

improve the control characteristics of many axes.

4. Conclusion

This paper has presented the characteristics of the serial communications LSI (GA1045) and servo amplifiers containing such LSIs.

The presence of PC-base controllers is eye-catching in factory automation as well.

Like other firms, Sanyo Denki provides interface boards containing GA1045s and inserted directly into a PC slot (ISA bus) for use, thus offering an environment where PCs can be used as primary stations.

In addition, it is becoming possible that networks in the PC and consumer electronics fields, including IEEE1394 (commonly known as FireWire), can be used in factory automation as well. However, since factory automation has demands in reliability, long-term suppliability, pricing and other areas, the future focus will be to find an effective way to plan and implement interfaces while satisfying these requirements peculiar to factory automation.

The authors intend to continue to listen carefully to the voice of the market and keep asking themselves ″ what kind of interface is customer-friendly, ″ thus being committed to developing new interfaces.

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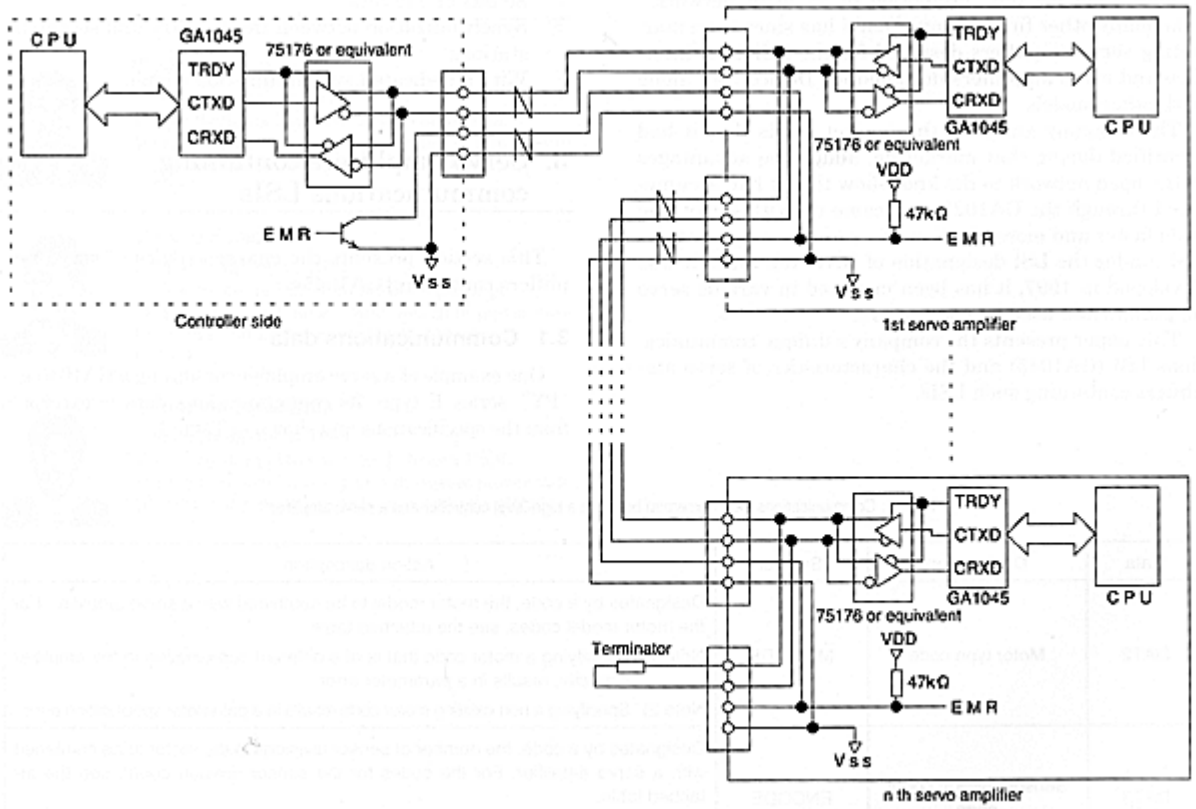

Fig. 1 A typical configuration of a multi-drop serial interface

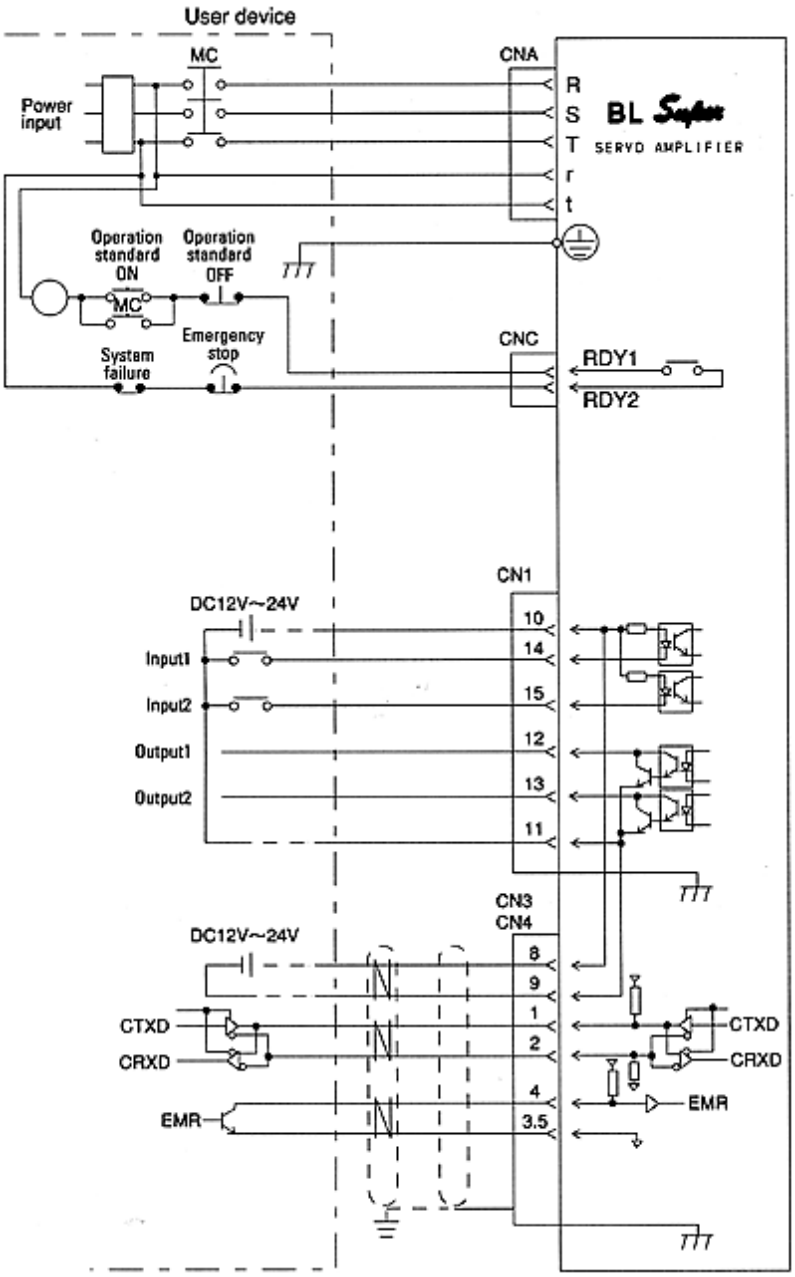

Fig. 2 Connection diagram of a servo amplifier containing a GA1045

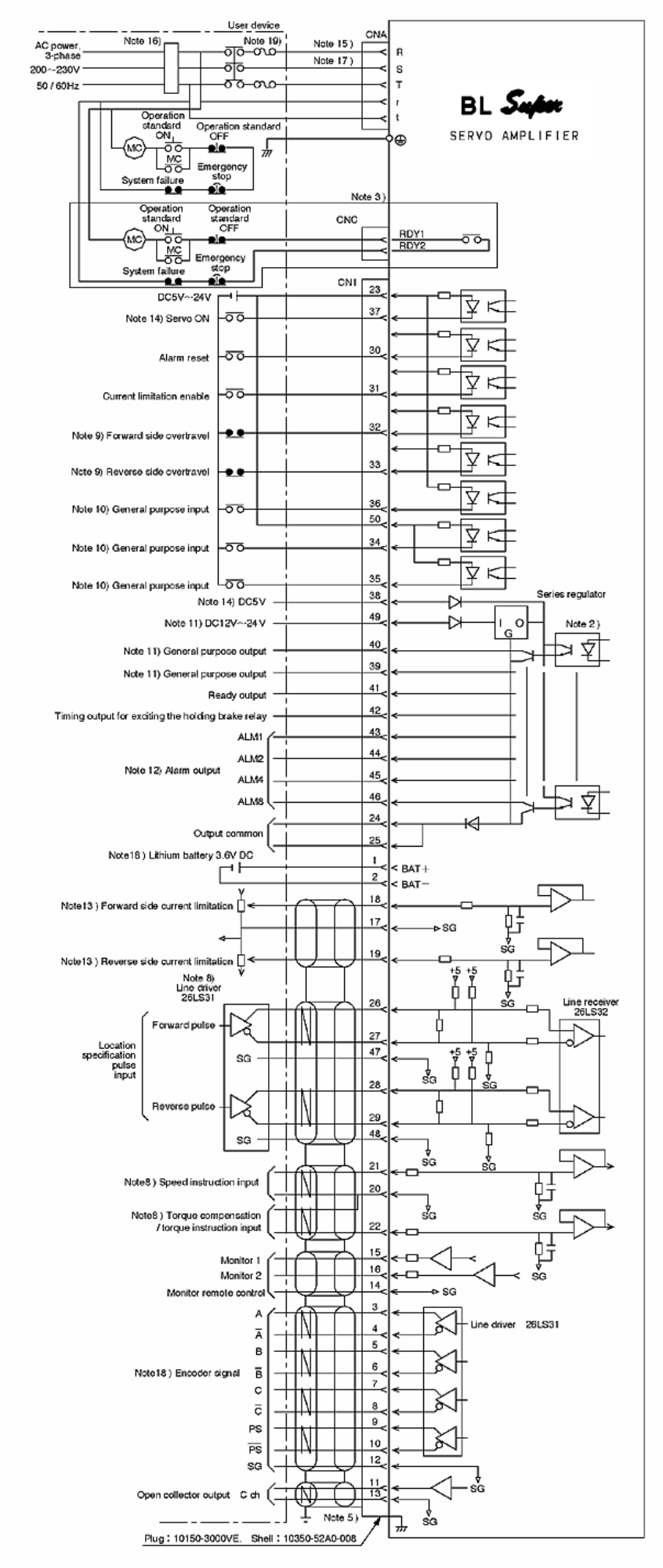

Fig. 3 Connection diagram of a servo amplifier (of the traditional system)
with an interface of the type of pulse string position instructions + parallel I/O

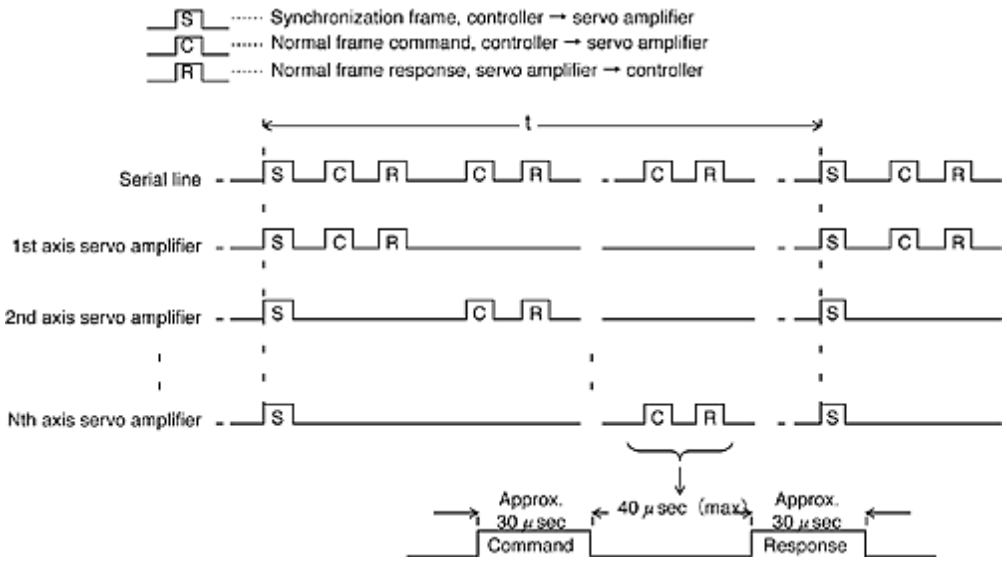

Fig. 4 Conceptual chart of normal-state communications between controller and servo amplifier