UDC [681.327.8:621.369.9:621.868] :658.5.011.56

DATA CARRIER APPLICATION TO FACTORY AUTOMATION

Keiichiro Ueda
Kazuji Kurita

1. FOREWORD

Recently, the environmental change in the manufacturing field to diversification and individualization has been amazing. This has made coping with multiproduct, small lot production indispensable.

In the increasingly complexity of the production process, an important problem in advancing automation of the line is how to match the flow of objects and data. Its most positive method is to accompany the objects with the data.

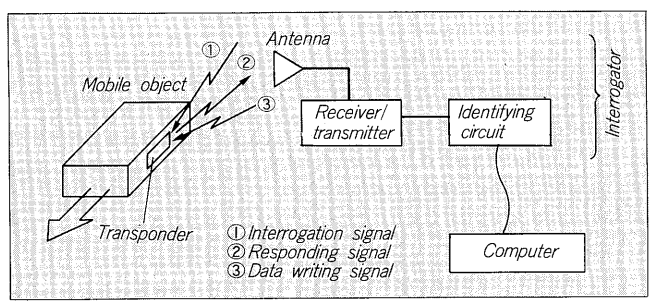
Presently, a method that identifies objects by bar code is widely used as one solution. However, recently, a data carrier system that does not stop with an automatic identification function, but can also read and write data with non-contact and can store various data related to the object with radio frequencies, etc. as the communication media. In Europe and the United States, the data carrier system is called RF-ID (Radio Frequency IDentification).

2. OUTLINE OF DATA CARRIER SYSTEM

2.1 System basic configuration

Basically, a data carrier system consists of a transponder installed to the mobile object and a fixed interrogator. The identification codes and data are written in the transponder. When a transponder arrives in the vicinity of an interrogator that is transmitting an interrogation signal, it transmits its own code and data in response to the interrogation. The interrogator receives the responding signal and identifies the contents in the transponder and exchanges data with the transponder. The block diagram is shown in *Fig. 1.*

Fig. 1 Data carrier system block diagram



2.2 System features

The data carrier system has the following features compared to the conventional bar code, etc.

(1) Since data access is bidirectional, data can be read and written.
(2) Large data volume.
(3) Environment-resistance is good and trouble does not occur even if oil or dust get on the equipment.
(4) Since the accessible area is wide, the transponder and interrogator can be installed freely. Reading and writing are possible even while moving.
(5) An open space is unnecessary bewteen the interrogator and transponder.

3. DATA CARRIER SYSTEM POSITIONING

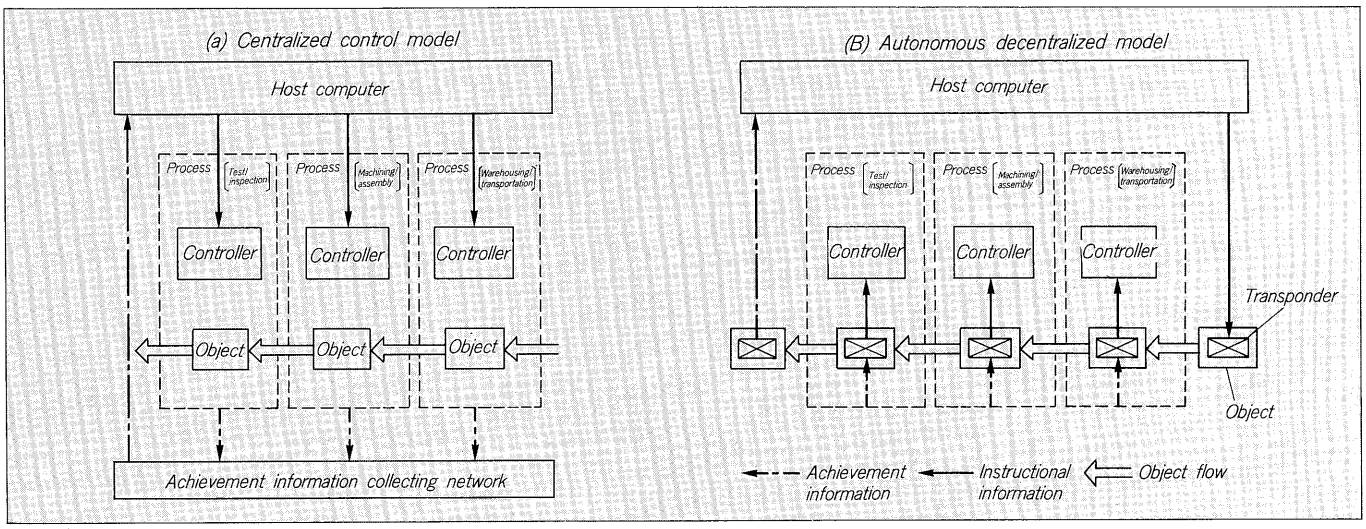
Production management systems tend to have a CIM (Computer Integrated Manufacturing) construction. To make CIM more effective, data transmission between the shop floor where data of various forms is generated at intervals and the production management system must be performed efficiently.

Fig. 2 shows models of the data and object flow in FA. (a) is a centralized control model built by network and (b) is an autonomous decentralized model built by data carrier.

For (a), the instructional information needed at production is given from the host computer to each process controller for each object. On the other hand, the achievement information is transmitted to the host computer via an achievemet information collecting network as the results of processing and machining of the object. Therefore, to perform one process, both object input and output and input and output of the information corresponding to that object are necessary.

However, for (b), since the production instructional

Fig. 2 Model of information and object flow in FA



information is prewritten in the transponder installed to the object, the instruction information is given to the controller from the transponder in the process and the achievement information generated in the process is written to the transponder from the process. Therefore, to perform one process, only object input and output are necessary. Since the information for the object accompanies the object and information matching is also easy. That is, since the necessary information can be received only at the required place at the required time, autonomous decentralized control which can complete each job without exchanging unnecessary information with the host computer is possible.

As a result, the data processing system is simple and flexible and provides the following benefits:

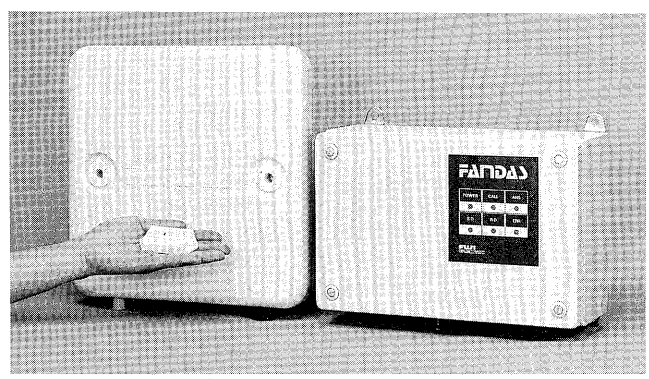
(1) Reduction of the host computer load by data dispersion.
(2) Speeding up of processing by reduction of data transmission between the shop floor and the host computer.
(3) Avoidance of shutdowns which effect the entire system and improvement of shop floor maintainability by autonomous decentralized control.
(4) Coping with object removal and sequence changes, etc. on the line by appending of information and simplification of system start-up.

4. FUJI ELECTRIC DATA CARRIER SYSTEM FAMDAS

Fuji Electric has commercialized data carrier systems under the name FAMDAS (Fuji Advanced Mobile DAta Carrier) and the interrogator is called DAC (DAta Terminal) Storage system). The transponder is called DAC (DAta Carrier) and the interrogator is called DAC (DAta Terminal) and consists of a control unit and antenna. (*Fig. 3*)

FAMDAS is intended for application to FA, etc. and is a type that uses medium frequency band radiowaves and can read and write online from a distance of 50cm.

Fig. 3 FAMDAS-100



N89-5258-9

The product specifications of the FAMDAS-100 are shown in *Table 1.*

Presently, DAC and DAT with a data capacity of 1 000 bytes are being developed as the FAMDAS-1000. A 17cm squre small antenna and a portable antenna with read and write start switch so that the operator can move the antenna are also available.

5. APPLICATION OF DATA CARRIER IN FA FIELD

Typical examples of application of the Fuji Electric data carrier system in the FA field are outlined here.

5.1 Application to sheet-metal working line

This is an example of application to the sheet-metal shop for an automatic vending machine. The shop is shown in *Fig. 4.* The taransponder is installed to the iron pallet used to move the iron sheet and interrogators are installed at the iron sheet entrance and warehouse exit.

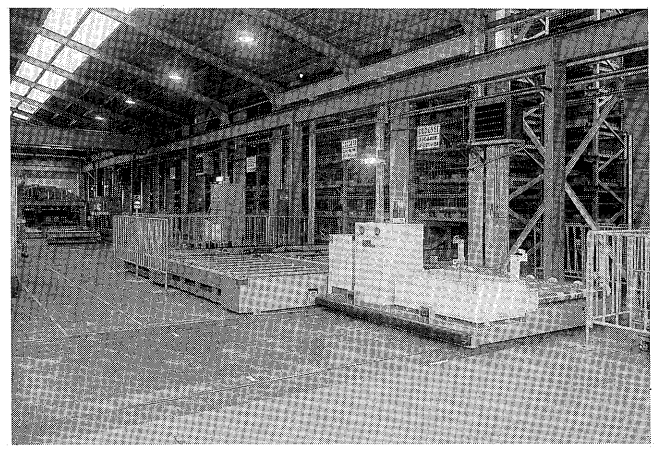
When the iron sheet cut to the specified dimensions is placed on a pallet at the iron sheet entrance, the object (pallet containing the iron sheet) and data (machining specifications) are correlated by means of the pallet number

Table 1. FAMDAS-100 production specifications

DAT-DAC communication specification	Communication distance	Max. 50cm (practical use 25cm)
	Data capacity	Max. 800 bits + ID 32 bits
	DAT transmission speed	Call/write: 1,200bps, read: 4,800bps
DAT control unit	Dimensions and weight	300 x 240 x 120(mm), approx. 5.5kg
	Power requirement (power consumption)	AC100V 50/60Hz (15VA)
	Environment	Operating temperature range: 0 ~ +55°C
		Humidity: 30 ~ 85% RH, no condensation
	Host computer interface	RS-232-C
	I/O function	DI: 8 channels, DO: 8/16 channels (options)
DAT antenna	Dimensions and weight	300 x 300 x 30(mm), approx. 2kg
	Environment	Operating temperature range: −10 ~ +60°C
		Humidity: JIS G 0920 Class 4 waterproof
	Standard accessory cable length	3m
DAC	Dimensions and weight	32 x 52 x 13(mm) (excluding mount), approx. 35g
	Power supply life	Lithium battery, 800bits 1,000,000 continuous transmissions
	Environment	Operating temperature range: −10 ~ +60°C
		Humidity: JIS C 0920 Class 4 waterproof

read automatically from the transponder and the machining specifications data input from the bar code of the slip attached to the iron sheet and registered at the factory management computer. After being stored in the warehouse together with the pallet, the iron sheet is disbursed and machining by punch press machine in accordance with the production plan. At the warehouse exit, erroneous disbursement is prevented by reading and collating the pallet number automatically. By using an automatic identification system that withstands oil and other adverse environments, automatic identification and collation of the pallet number is possible and as a result, labor-saving and reliability are improved.

Fig. 4 Sheet-metal working plant



N89-4944-26

5.2 Application to parts assembly line

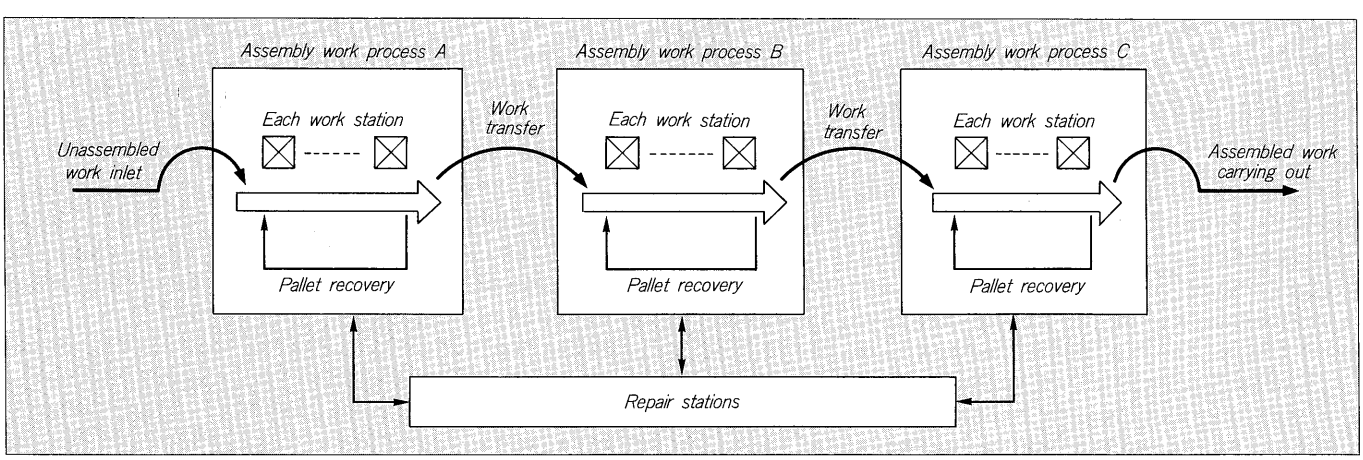
This is an example of application to an automobile, etc. parts assembly plant. The line configuration is shown in *Fig. 5*. The transponder is installed to the pallet mounting the assembly work and in interrogator is installed at each assembly work station.

When the unassembled work is mounted on the pallet at the head of the line, the various data in the transponder is initialized and the work specifications of the inlet work are newly written.

Each work station automatically reads the work specifications from the transponder and performs assembly work matched to that work. The OK/NG check flag and ancillary data are written to the transponder as the work record in accordance with the results of the work.

Since a pallet suitaed to each work is used in the work processes of the line, when the work process is changed, transfer between the work pallets is necessary. In this case, the information is read of the pallet of the preceding process is read and the same information is written to the

Fig. 5 Line configuration of parts assembly plant



pallet of the next process and the transfer of information between transponders is synchronized.

Defective work is sent to the repair station. Since offline work is the nucleus at the repair station, working ease is considered and access to the transponder is performed by portable type data terminal with built-in battery.

Because the work record at each station is recorded at the pallet transponders, work removal and re-entry can be performed smoothly. Since a larger amount of infomration is taken and modification of the information is performed automatically and easily, compared to the conventional dog system, system correspondence is flexible and expandable.

5.3 Application to product inspection line

This is an example of appliacation to a home electrical appliance production inspection line. The system configuration is shown in *Fig. 6*. The transponder is installed to the inspection pallet and an interrogator is installed at the arrangement station and each insepction station and each branch station.

When the product is transferred to an inspection pallet at the arrangement station, each information in the transponder is initialized and the product code, serial number. etc. of the product are written. At each inspection station the product code is read automatically from the transponder and inspectiom matched to that product code is performed. The OK/NG work record is written to the transponder in accordance with the inspection result.

When there are stations at which inspection is unnecessary, depending on the product, those stations can be passed. If the past serious accident flag is set during inspection, all the subsequent inspection stations can be passed.

Since the inspection record at each station is recorded at the pallet transponder, pallet removal is possible on the line and recovery after line trouble is easy. Because each inspection station is completely independent, station expansion and line changes can also be coped with easily.

5.4 Application to transportation

This is an example of application to the roll paper supply electric truck of a printing plant. The line configuration is shown in *Fig. 7*. A transponder is installed to each electric truk and an interrogator is installed at the roll paper loading station and the unloading station of each printer.

When the roll paper is transferred to the electric truck at the loading station, the destination and load contents inormation are written at the transponder. At each branch point, the information is read from the transponder and the route is selected automatically from the destination information and the electric truck is sent to the objective unloading station.

Since the destination accompanies the electric truck, the ground controller branch control program is simplified and standardized.

Fig. 6 Product inspection line system configuration

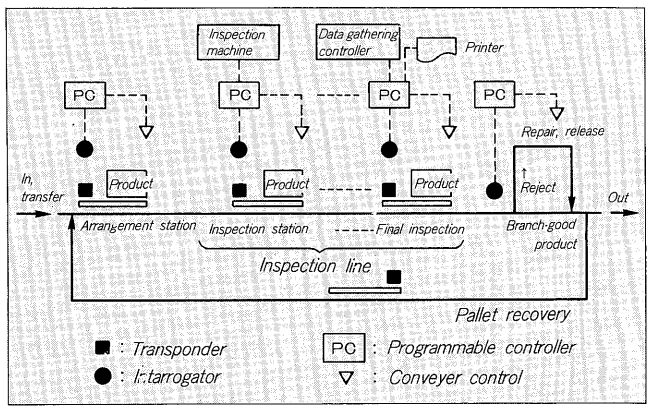
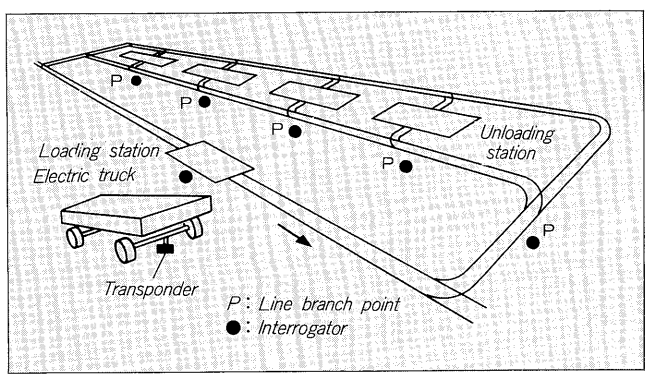


Fig. 7 Electric truck system line configuration



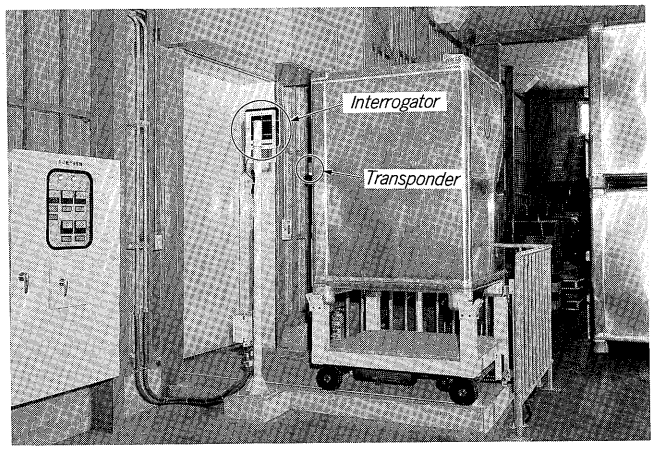
5.5 Application to automatic warehouse

This is an example of application to an automatic warehouse for powder raw material of a food processing plant. The raw material is loaded on corrosion resistant aluminum alloy containers. A transponder is installed to each container. An interrogator is installed at the automatic warehouse entrance/exit and tilt station. An interrogator is also installed to the raw material loading station separate from the warehouse. The automatic warehouse entrance/exit is shown in *Fig. 8*.

When the raw material is loaded into the container at the raw material loading station, the raw material name, raw material number, net weight, and other information are written at the transponder. When the container enters the automatic warehouse, each information is read automatically from the container transponder and is stored to the warehouse control computer. Once the container has been housed in the warehouse, it is unstored to the tilt station to discharge the raw material in accordance with the production plan. At the tilt station, the raw material information is read automatically from the transponder and the objective container is collated and erroneous operation is prevented.

Since a transponder is used as a portable memory between the raw material loading station and warehouse, the station and warehouse do not have to be connected by an online network and the information system is simplified.

Fig. 8 Powder container automatic warehouse entrance/exit



Because pallet automatic identification is performed without affecting the environment in which a powder is handled, labor saving and reliability are improved.

6. CONCLUSION

The advantages of the data carrier systems are coincidence of the flow of objects and information, remote access, large information amount, ease of reading and writing, and other advanced functions. We think that a data carrier with such features will permeate to the FA field as common basic technology for total FA construction.

We plan to expand the application range with the guidance of our curstomers.