

STANDARD SENSING DEVICES FOR FACTORY AUTOMATION

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1. FOREWORD

In recent years, automation of various industrial fields has been noticeable and FA, FMS, or CIM, etc. have become widely popular. With the advance of automation, a rise in the demand for sensors as the main components of automation systems.

Generally, in factory production FA points to automation of machining, manufacture, material handling, and inspection. The facilities used here are machine tools, industrial robots, automatic material handling system, automatic testing, maintenance and inspection system, computer system, etc.

Sensors, and controllers and actuators, are the most important of all FA automation system components. As the case may be, sensors are also said to support the system.

2. TECHNICAL TREND OF GENERAL-PURPOSE FA SENSORS

Typical general-purpose FA sensors are the contactless detection inductive proximity switch (sensor), ultrasonic sensor, image sensor, photoelectric switch (sensor), bar code reader, contact detection type proximity switch, rotary encoder, vibration sensor, pressure sensor, etc. An exterior view of the main sensors is shown in Fig. 1.

Fig. 1 General-purpose sensors

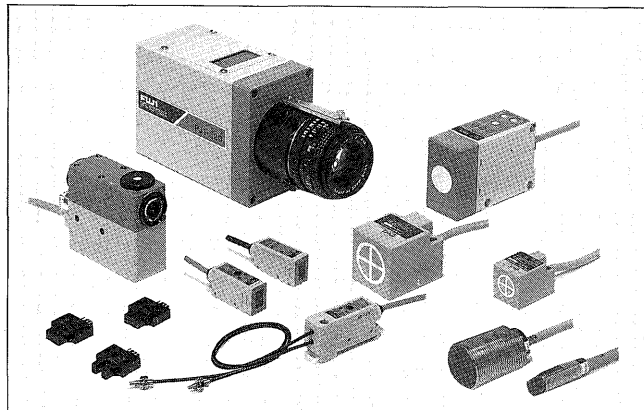


Table 1 Examples of sensors by FA work

Work	Operation	Sensor							
		Image	Light	Proximity	Ultrasonic	Magnetism	Pressure	Rotation	Contact
Machining	Positioning	○	○	○				○	○
	Machining precision measurement		○*			○	○		○
Manufacture	Shape measurement	○							
	Position and force control		○	○	○		○	○	○
Material handling	Movement guidance control		○	○	○	○		○	○
	Handling control		○	○	○		○		○
	Pattern measurement	○	○						
Inspection	Defect inspection	○	○		○				
	Abnormality sensing	○							

*: Laser used

The sensors used by FA work process are listed in Table 1.

The following are given as the technical trends of general purpose FA sensors:

- (1) System application
- (2) High precision and fast response
- (3) High reliability and long life
- (4) Advances functions
- (5) Small size
- (6) Low power consumption and excellent environment resistance

Besides the above, there is the desire for a contactless detection system and low price.

For system application, specifications and construction which allow connection to a programmable controller (PLC), etc. are necessary. Sensors which can follow the high speed for improving the efficiency of systems are also demanded. The small size of the sensor from the standpoint of reducing the size of facilities, the sensor which has excellent environment resistance from the standpoint of maintenance and inspection, and the contactless sensor which does not cause any mechanical wear are desirable.

The main general purpose FA sensors are outlined below.

3. OUTLINE OF GENERAL PURPOSE FA SENSORS

(1) Image sensor

An image sensor detects the image data of the judgment objective by means of a line CCD image sensor device and arithmetically processes this data by means of a micro-computer and a control circuit made up of a special LSI, and performs presence/absence judgment, size judgment, pattern judgment, etc. of the judgment objective.

Detection is performed by measuring the shadow on the CCD by blocking of the light from a light source by the measurement object or by detecting the light from the measurement object illuminated by a light source by means of a CCD. The functions of the Fuji image sensor as shown in Table 2. The Fuji image sensor uses a 2,048 bit CCD and has a high resolution.

(2) Color mark sensor

The color mark sensor is used to detect color bars, register marks, etc. on the foodstuffs, packing machinery, or material handling line, and judges the difference of the detectable/undetectable color.

The Fuji color mark sensor uses an original near infrared detection system to also detect color differences that were difficult to detect in the past.

(3) RF oscillation type proximity switch

This is a sensor that detects the presence/absence of a metal object, and is one of the sensors widely used in machine tool machining position detection, conveying position detection on the machining line, and other FA fields.

When a metal object in an RF magnetic field oscillated from a sensing coil is approached, the oscillation condition changes and this change is detected.

Fuji proximity switches with a cylindrical type and square type as standard, and which mechatronics-applied subminiature 4 mm diameter is available. Functions with such features as LED display, European standards (CENELEC), DC two-wire system, reverse connection, built-in surge protection, npn, pnp connection, or thin close mounting, etc. are also available.

(4) Ultrasonic switch

Ultrasonic waves are transmitted from an internal oscillator and if the objective article is present, the ultrasonic waves are reflected from its surface and are received by the same oscillator. The advantages of the ultrasonic sensor are that the limits on the detection objective article are small, most objects can be detected, etc.

Fuji supplies many kinds of ultrasonic switches to

the market. These switches have a precise and narrow directivity. A large number switches with a detection distance of 30 cm, 1 m, and 6 m are available. These switches feature small size, easy handling and setting, etc.

(5) Photoelectric switches

Photoelectric switches are sensors which sense the blockage, or reflected change, of the light from a light source (LED, etc.) by the detected object by means of a light receiver (phototransistor, etc.) and performs detection of the presence/absence and light/dark of the detected object. Compared to other sensors, the detection distance is long and if contamination of the lens by dust, oil etc., its weak point, is excluded, its adaptability is high.

Fuji photoelectric switches have a fast response of 1 ms and feature close mounting by mutual interference prevention circuit, simple stable level adjustment, short circuit protection function, small size, watertightness, etc.

(6) Photo microswitch

This is a photoelectric sensor with a miniaturized photoswitch and perfect for small objects and it can be attached in small spaces.

The Fuji photo microswitches expand the application range by using minimizing the the affect of external disturbance light by using a modulated light system and feature expansion of the power supply range, fast response, operation display, abundant detection systems, convenient connector connection system, etc.

(7) Rotary encoder

There are optical type and magnetic type rotary encoders, but many general-purpose types are optical. There is also an incremental type, which detects relative rotary position, and an absolute type, which detects absolute position. However, most general-purpose types are incremental.

Fuji rotary encoders have an incremental oilproof construction and have a high environment resistance and are applicable to the FA field.

(8) Linear sensors

These sensors measure the distance up to the objective.

Fuji offers a complete line of magnetic type, ultrasonic type, and optical type linear sensors. The detected analog quantity is linearized and distance is measured.

(9) Vibration sensors

These sensors are installed directly to machinery, equipment, etc. and detect and output the vibration state during operation in analog form. They are small, which makes them perfect for maintenance and inspection, and have economical high precision.

(10) Semiconductor pressure sensor

Semiconductor pressure sensors use the piezoresistance effect of silicon and feature the small size, light weight, excellent productivity, etc. of semiconductors. They are used widely in pressure measurement in the hole appliances, industrial, automotive, and medical fields. Fuji has commercialized pressure sensors with a strain gauge, amplifier, temperature compensation circuit, etc. integrated on one chip by using IC technology and micromachining technology.

Table 2 Functions of image sensor

PJ1-E series	PJ1-H series
<ul style="list-style-type: none"> • Presence/absence judgment • Size judgment • Pattern judgment • Size of largest part or smallest part 	<ul style="list-style-type: none"> • Length judgment • Number judgment • Division field of view judgment • Coordinates judgment • Unit area judgment • Window judgment