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TELEPERM **IS** SYSTEM

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I. INTRODUCTION

The TELEPERM SYSTEM is an all electronic control system created in the earliest days of system development. Having a variety of practical uses, it has established a reputation in almost every field of industry over a long period.

FUJI has recentry placed on sale the TELEPERM **IS** SYSTEM, a new version of the TELEPERM SYSTEM, which incorporates a semiconductor straingauge and a newly completed intrinsic safety explosion-proof structure for instrumetation system.

The trade name TELEPERM **IS** SYSTEM originates from the exsiting TELEPERM SYSTEM combined with the initials Intrinsic Safety, Semiconductor Straingauge. In addition to its extremely simplified structure based on its operating principle, the rational design features engineered into its mechanism, and its many high-performance capabilities, this modern device is easy to handle and can save manpower on maintenance.

II. FEATURES OF **IS** SYSTEM

1. Adoption of Semiconductor Straingauge (*Fig. 1*)

1) The major transmitters in this system adopt straingauges incorporating semiconductors which deliver high-output signal, vastly simplifying their mechanism and electronic circuits. This has succeeded in making the transmitters lightweight and small scaled.

2) Installation and temperature compensation of the straingauges are unique, ensuring the gauges high performance capabilities.

3) The sturdily constructed transmitters can completely withstand shocks and vibrations, assuring' high reliability.

4) A wide selection of materials such as tantalum, titanium, monel metal, Hastelloy, and others are used in the transmitter part contacted by a variety of fluids.

5) The damping device, an electrical type unaffected by changes in temperature, provides stable damping characteristic.

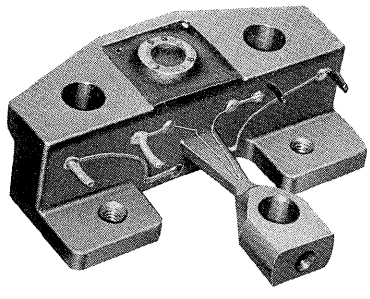


Fig. 1 Measuring lever equipped with semicoductor straingauge

2. Intrinsically Safe, Exprosionproof Structure for Total Instrumentation System

1) The TELEPERM **IS** SYSTEM is the first of its kind to be authorized as an embodiment of intrinsic safety, explosionproof structure for instrumentation system (Certificate of Ministry of Labor (Japan) No. 1323 and No. 2251)

2) This is the highest-level explosionproof system applicable to any explosive atmosphere ; for example, even usable in an atmosphere containing hydrogen and in division zero hazardous locations.

3) Standard instruments and ordinary wiring jobs may be installed even in hazardous locations where gas explosions may occur. This reduces the cost and simplifies handling and maintenance procedures of the instruments.

3. Flexible Selection of Signals

1) The output signal to be delivered by the transmitter is available in two types : 4 to 20 mA DC or 10 to 50 mA DC signal currents.

2) Although the standard input signal supplied to the receiving instrument is voltage ranging from 1 to 5 V DC, the instrument can directly receive output signals delivered by a thermocouple, resistance bulb, or straingauge.

4. Two-wire Type EMF Transmitter for Installation at Work Areas

1) In addition to the instrument panel installation type, there is another type of EMF transmitter which

employs a two-wire transmission system and is available for installation at work areas.
2) The temperature signal, which accounts for nearly half of all detected signals can be transmitted by the same unified signal current—obtained from the two-wire transmission system—as other detected quantities.

5. Shallow-scaled Panel Instruments

1) All TELEPERM **IS** SYSTEM panel instruments have a unified depth of 390 mm. This is accomplished by improved design of their mechanism, simplified by adopting integrated electronic circuits.
2) This construction reduces the net weight of the instrument and enables its installation on a desk front.

6. Controller Suitable for Final Control Element

1) The controller suitable for the final control element is available in two types: a continuous controller delivering a DC output signal current and a step controller delivering a pulse-width output signal current suitable for driving the electric final control element.
2) The step controller is best suited for motor driving valves and others which have an integral characteristic.
3) Compared with the servodrive method, system construction of step controller can be simplified and its reliability improve.
4) High-level control method such as shortest-time control, control of systems accompanied with dead time, control of selection of multiple loops, automatic control of plant starting time, and so on can be readily devised.

7. Noncontact Type, Self-balancing Instrument

1) A unique, simplified balancing unit has been completed by adopting a servomotor combined with an induction potentiometer IC is incorporated in the amplifier
2) Adoption of the balancing unit further increases reliability of the self-balancing instrument installed on this system.

8. Controller with High Information Processing Ability

1) The controller, with a highly efficient ability to process information, can fully provide—as a component of a highly efficient measurement control system—the function of exchanging information with external machinery and equipment.
2) It can be completely coupled with electronic computers for backing up DDC (Direct Digital Control) application and SCC (Supervisory Computer Control) application.
3) It can readily provide such complicated functions as feed-forward control, selective control, and so on.
4) Since the control made can be selected by external instructions, it proves convenient when starting a process and other operations.

9. Distributor Easy for Inspection and Wiring

1) The unit is provided with a distributor which simplifies procedures for installing wiring within an instrument panel and for conducting inspection and maintenance of each control loop.
2) All external connections between the transmitter, the final control element, and all connections between each receiving instrument, the power source, and the signal transmission lines are assembled at the distributor to simplify their inspection and maintenance procedures.
3) Wiring for each instrument is assembled from the distributor by cables with screw connectors, facilitating their inspection and installation procedures.
4) The power source for the transmitter, the barrier ensuring the intrinsically safe structure for the system, and the devices for computing units and conversion of input signals are all contained in the distributor, permitting the panel back and the racks for input and output signals to be constructed compactly and orderly.

III. COMPOSITION OF TELEPERM IS SYSTEM

1. The TELEPERM IS SYSTEM is Composed of the Folowing Groups of Equipment: (*Fig. 2*)

1) A group of transmitters which detect a variety of temperature, flow, level and pressure of process

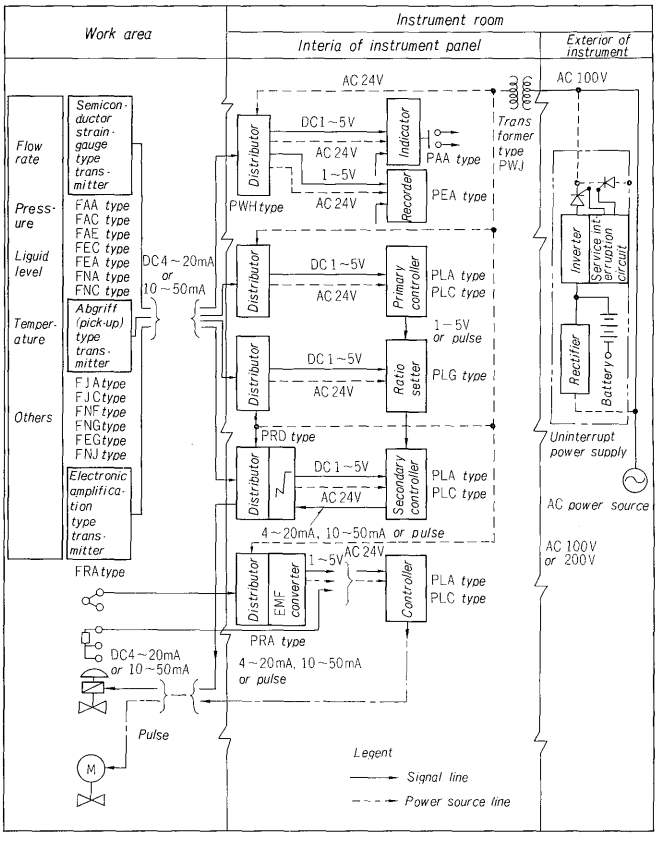


Fig. 2 Block diagram of TELEPERM **IS** SYSTEM

equipment, convert them into signal currents ranging from 4 to 20 mA DC or from 10 to 50 mA DC, and transmit such signals.
2) The distributor which supplies DC power to the transmitter, converts the signal current from the transmitter into signal voltages ranging from 1 to 5 V DC, and distributes such voltages along with AC power to each receiving instrument.
3) A group of receiving instruments which provide the function of indication, recording, integration, control, computing, and so on.
4) The final control element which operates in accordance with the manipulating from the controller.

2. Signal Transmission by Current and Signal Reception by Voltage

Delivered by the transmitter in the work area and supplied to the instrument room, signals are transmitted in the form of current. Capable of minimizing resistance offered by the wiring and noise, this current is best suited for long-distance transmission. Such signal current is received in the form of voltage by each receiving instrument, proving advantageous to instrumentation.

Wiring between the transmitter and the instrument room is two-wire type (partially three-wire type). The receiving instruments receive signals in parallel which have been converted by the distributor into signal voltages ranging from 1 to 5 V DC. Since the input impedance of receiving instrument—including that of the newly developed, moving coil type indicating meter—is sufficiently high, no problem exists in producing the signal voltage.

3. Flexible Selection of Signals

The signal current transmitted from the transmitter at the work area to the instrument room is available in two types: a current whose value ranges from 4 to 20 mA DC and another whose value ranges from 10 to 50 mA DC.

Employing a straingauge type transmitter, either of the above signals can be readily adopted simply by modifying the power transistor of amplifier. Since the two signal types are received after having been converted to voltages ranging from 1 to 5 V DC, there is no difference between them as far as the receiving sides are concerned.

In addition to the above-mentioned signal transmission, mV signals delivered by a thermocouple etc. and resistance signals delivered by a resistance bulb etc. can be supplied as direct input to receiving instruments. To handle such low-level signals, a vertical type controller incorporating a preamplifier with a high input impendance and IC (Integrated circuit) construction has been developed.

The TELEPERM **IS** SYSTEM is a flexible system capable of complying with the customer's wishes and which is consistent with the maker's specifications.

4. Feed of 24 V AC Power to Group of Receiving Instruments

The power source for the group of receiving instruments mounted on the instrument panel and for the distributor specifies 24 V AC. This renders the panel interior hazard free so that it can be inspected without anxiety. Also, since an AC power source is employed, the circuits of each receiving instrument can be designed simpler and more reliable than DC power systems. Power for the instrument panel is supplied externally by installing a separate, exclusive power transformer at the entrance of the panel which steps down an AC voltage of 100 or 200 V to 24 V A new interruptible power supply system has been developed exclusively for the **IS** SYSTEM. This is AC an power source with static transfer switch and consists of a silicon rectifier, battery cells, and a thyristor inverter which are combined; it is best suited for the **IS** SYSTEM because of its high reliability. This device, if utilized, will make the most substantial backup power source in case of a service interruption.

5. Adoption of Distributor

The distributor has been developed for streamlining the equipment composition and the wiring installation inside the control panel.

Each loop of instruments has one distributor in which a DC power source for transmitter, resistance for signal conversion, barrier for the intrinsically safe, explosionproof structure for the system, power source switch, fuses, terminals for wiring and so on are arranged compactly and integrally with each other, enabling the panel interior to be orderly constructed.

Since wiring between the distributor and receiving instruments consists of a cord with screw connector, its installation can be accomplished easily and securely. In addition to its signal distributing function, the distributor also has the function of supplying AC power. Wiring between the distributor and each piece of equipment is installed by using the distribtor as the point of origin, requiring a check at only distributor. This greatly simplifies its inspection and maintenance procedures.

6. Two Types of Controllers Suitable for Final Control Element

The controller is available in two types: the continuous controller delivering DC current output and the step controller suited for driving the electric final control element, making it possible to install an instrumentation consistent with requirements for the processer equipment.

The continuous controller is a continuous current output signal controller with PID operation. It can be used to operate electro-pneumatic final control elements. The step controller is a feedback com-

pensating on-off controller with output in the form of a pulse width. It can be used for driving operating parts such as motor driven final control elements which have integral characteristics.

In addition to the common standard signal input for both controllers direct input of such as thermocouples and thermoresistances bulb. Connection to computers has also been considered and a man/machine interface is being completed.

7. Adoption of Intrinsically Safe, Explosionproof Structure for Electronic Control System

Adoption of a barrier type safety apparatus has provided the IS system—whose power source is 24 V DC and signal level 4 to 20 mA DC—with an intrinsic safety, exposionproof structure. This allows the system to freely combine every instrument; as a result, the margin of its safety and the range of application has been vastly increased.

The TELEPERM barrier is a type of Zener barrier consisting of resistance, transistors, a Zener diode, etc. The safety voltage is a very high 100 V AC. The barrier can be employed in boundry points (input/output of instrumentation panels) for signal distribution in both dangerous and safe locations. Even when there is a fault in a hazardous location, the energy flowing is held down to a safe level. The instruments on the signal receiving side from the barrier can be optionally combined.

This intrinsically safe, explosionproof construction has the following advantages when compared with other explosionproof structures:

1) Safety is very high. The equipment can also be used in hydrogen gas class explosive atmospheres as places where explosive gas is normally present at all times.

2) Maintenance is easy and the interior can be inspected at the site (hazardous location) just by removing the cover.

3) Ordinary wiring is sufficient which makes the equipment very economical.

The TELEPERM IS system has passed the inspection required by law in Japan for explosionproof structures and conducted by the Research Institute of Industrial Safety of the Ministry of Labor. With this system, the user can freely select the instrument to match his requirements.

IV. OUTLINE OF TELEPERM BASIC CONFIGULATION

1. Transmitter Group

Common specification is given in *Table 1*. A list of types in *Table 2* and an outerview of a typical semiconductor straingauge type transmitter is given in *Fig. 3*. The majority of pressure, differential pressure, and liquid level transmitters employ the semiconductor straingauge type and a TELEPERM pick-up is used at the liquid level and other few transmitters.

An electronic amplifying transmitter is provided at the site to convert the output of the thermocouple and thermo resistance bulb to uniform input signals and transmit the signals. The exterior appearance, dimensions, and weight of the transmitter are much smaller than former types and overall accuracy, overload characteristics, temperature characteristics and shock resistance characteristics are superb. Adjustment is also electrically performed (adjustment of variable resistors) and handling is easy. The permissible signal line resistance is up to 100 Ω in the case of 4~20 mA DC. When the signal line resistance is especially high, the permissible resistance can be made up to 300 Ω by using a repeater. Up to 350 Ω is possible in the case of 10~50 mA DC. When a resistance greater than this is required, up to 430 Ω with respect to the line resistance is permissible by using a repeater.

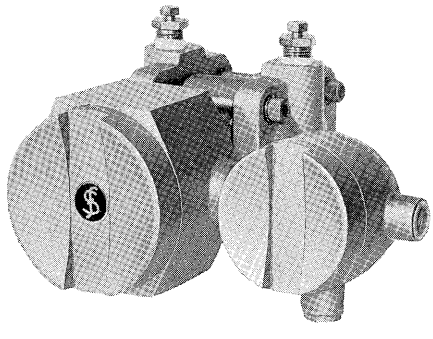
Table 1 **Common specifications of transmitters**

Tolerance	0.5% of span	
Transmitter signal	4~20 mA DC	10~50 mA DC
Allowable load resistance	0~350 Ω	0~450 Ω
Source voltage	24 V DC	48 V DC
Transmission	2-wire system	2-wire system
Ambient temperature	−30~80°C (straingauge system)	−10~60°C
	−10~80°C (TELEPERM pick up system)	−10~60°C
Ambient humidity	Less than 90% RH	
Water proof construction	All-weather type (JIS F 8001 class)	
Exprosionproof construction	System intrinsic safety (for 4~20 mA DC)	
Color	Silver	
Instllation	Pipe construction	
Zero and range adjustment	Continuously variable	
Output check	Check terminals included in the the terminal box.	

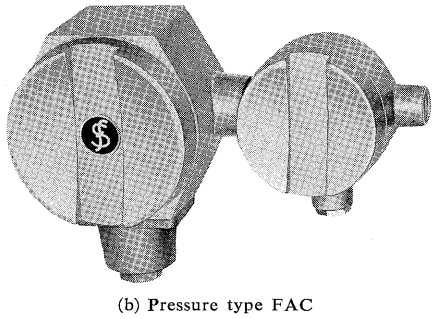
Table 2 **IS system transmitters**

Name	Type	Measure range	Pressure
TELEPERM pressure transmitter	F A C	0~0.064,.....640 kg/cm²	
〃 absolute pressure transmitter	F A A	0~8,.....1,500 mm Hg abs	(0~8...45 mm Hg range: self-balancing type)
〃 low differential pressure transmitter	F E A	0~10,.....640 mm H_2O	0.5, 2.5 kg/cm²
〃 differential pressure transmitter	F E C	0~64,.....200,000 mm H_2O	25, 100, 200, 500 kg/cm²
〃 area flow transmitter*	F J A	0~50,.....150,000 ℓ/h	10, 20, 30, 63 kg/cm²
〃 weir flow transmitter *	F J C	0~100,.....320 mm Aq	
〃 liquid level transmitter (displacement type)	F N C	0~300,.....3,000 mm	10, 30, 63 kg/cm²
〃 liquid level transmitter (flange type)	F N A	0~640,.....20,000 mm H_2O	10, 30, 63 kg/cm²
〃 liquid level transmitter (float type)*	F N F	0~0.5,.....50 m	
〃 height transmitter *	F N G	0~0.5,.....50 m	
〃 position transmitter *	F R J	0~90°, 0~120°	
〃 EMF transmitter **	F R A	over 3 mV DC width	
〃 pneumato-electric converter	F A E	0.2~1.0 kg/cm²	

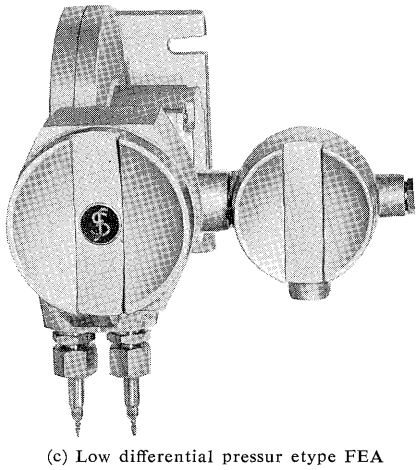
Remarks * : Pickup type
** : Electronic amplifying type
other: Semiconductor straingauge type



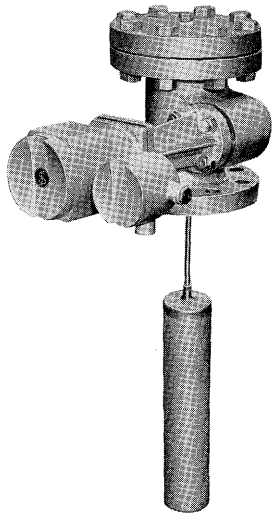
(a) Differential pressure type FEC



(b) Pressure type FAC



(c) Low differential pressur etype FEA



(d)
Displacement Type FNC

Fig. 3 Semiconductor straingauge type transmitter

2. Receivers and Controllers

Table 3 gives common specifications, *Table 4* a list of types and *Figs. 4* and *5* typical outerviews The panel instruments have a short standard depth of 390 mm and can also be attached to a desk. The front surface dimensions and the panel attachment hole dimensions are the same as the former type S series and SV series and are interchangeable.

Features of the indicators and recorders include the application of a moving coil (alarm) indicator with a high input resistance (more than 500 kΩ), no contact operation of a self-balancing mechanism, more simplified mechanism and improved reliability.

There are two types of controllers: the continuous controller for current output and the step control-

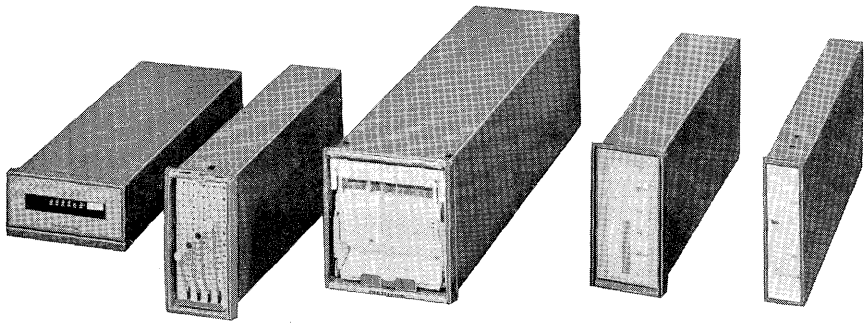


Fig. 4 Indicator and recorder

Table 3 **Common specifications of receiving instruments and controllers**

Tolerance	±0.5% of full scale (±1.0% indication tolerance for moving coil type) (±0.3% setting tolerance for controller available)
Input signal	1~5 V DC
	4~20 mA DC
	10~50 mA DC
	over 10 mV DC width (over 4 mV DC width for self-balancing indicator and recorder)
	P_t 100 Ω (at 0°C) over 50 degree
Output signal (controller)	4~20 mA DC (load resistance 700 Ω)
	10~50 mA DC (load resistance 280 Ω)
	1~5 V DC (Cascade signal as the set point of another controller)
	Pulse width signal (step controller, and manual selector)
Ambient temperature	0~45°C
Ambient humidity	over 90% RH
Color	Munsel 7.5 BG 3.2/0.8
Supply source	24 V AC $\pm^{15}_{10}$% or 100 V AC ±10% 50/60 Hz

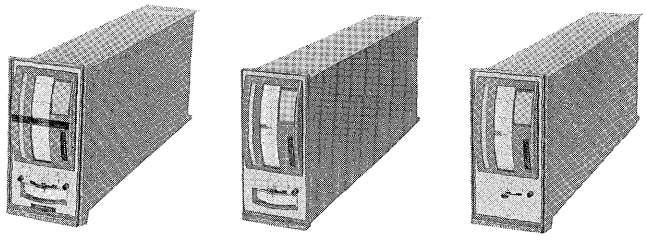


Fig. 5 Controller and related instruments

Table 4 **IS system receiving instruments and controllers**

Name	Type	Remarks
TELEPERM moving coil indicator	P A A	with upper/lower limit alarm
〃 self-balancing indicator	P A E	with vpper/lower limit alarm
〃 self-balancing recorder	P E A	1~4 pens, with upper/lower limit alarm, each
〃 input selector	P E C	for 10, 20, 40 points
〃 continuous integrator	P J A	with pulse transmitter
〃 continuous controller	P L A	with deviation alarm, upper/lower limit alarm
〃 step controller	P L C	with deviation alarm, upper/lower limit alarm
〃 ratio setter	P L G	
〃 setter	P L F	
〃 manual selector (continuous output)	P L B	
〃 manual selector (step output)	P L D	
〃 manual control unit	P L H	

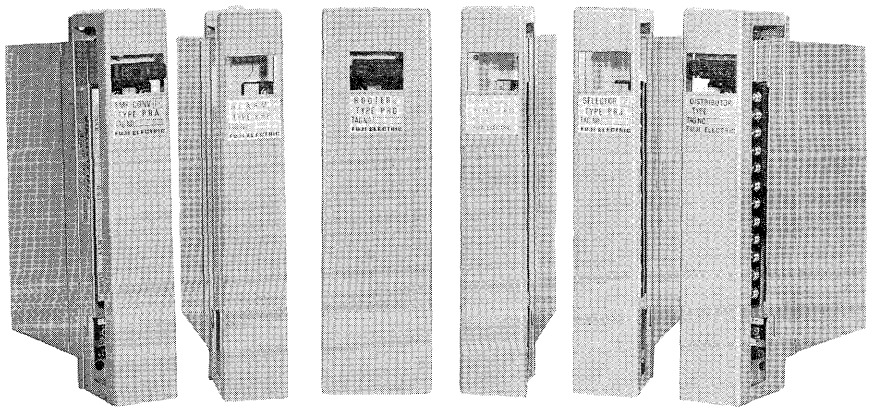
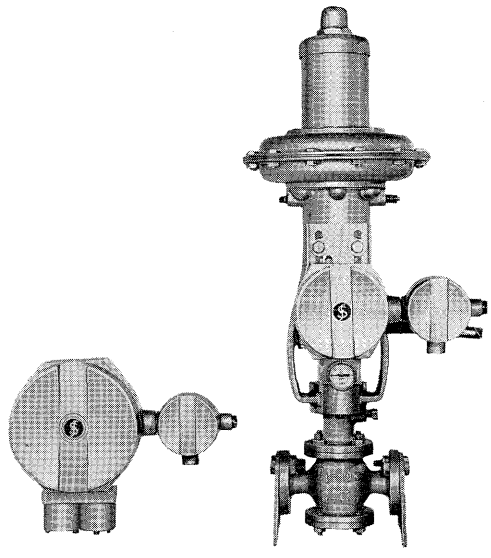


Fig. 6 Computing unit



(For operation cyilnder) (For diaphragm valve)

Fig. 7 Positioners

Table 5 **Common specification of converter and computing units**

Input signal and input resistance	1~5 V DC, bias current $<1\ \mu A$
	4~20 mA DC (input resistance 250 Ω)
	10~50 mA DC (input resistance 100 Ω)
Output signal	1~5 V DC
Output resistance	under 0.5 Ω
Tolerance	±0.5% (±0.25% available if necessary)
Supply source	24 V AC $^{+13}_{-10}$%, 50/60Hz
Ambient temperarure	0~45°C
Ambient humidity	under 90% RH
Installation	on the rack
Color	silver

ler for pulse width signals. There are also related types of ratio setters, manual selectors and setters suitable for these series.

The IS System controller can be composed multiple control loop, SCC or DCC. In addition to the standard types, cascade primary controllers, ratio control controllers and DDC backup controllers can also be employed. Other functions include setting by external signals, switching of operating modes and feed forward control.

3. Converter, Computing Element and Distributor

The common specifications for the converter and computing element are given in *Table 5* and a list of types including distributors is given in *Table 6*.

As can be seen in *Fig. 6*, the standard widths of the cases for these devices are 44 mm or 74 mm. They can be accomodated very compactly on the back of a panel or in a rack. When a large number of computing elements are to be used, the printed boards of the computer part can be fitted into shelves on a rack.

Table 6 **IS system converter, computing units and distributors**

Name	Type	Remarks
TELEPERM EMF transducer	P R A	mV,for ressitance input
// adder	P R B	Add/subtract, max./min. selection
// multiplier	P R C	$V_1 \times V_2 / V_3$
// root extractor	P R D	
// flowrate compensator	P R E	
// reversing converter	P R G	
// repeater	P R H	
// converter (insulation type)	P R F	Voltage/current, current/current conversion
// autoselector	P R J	Selection of max./min. voltage of 3 inputs
// alarm unit	P R P	
// distributor	P W H	
// distributor	P W L	Intrinsic safety, exprosionproof

Table 7 **Specifications of positioners**

Input signal and input resistance	4 to 20 mA DC and approx. 200Ω (at 20°C); 10 to 50 mA DC and approx. 55Ω (at 20°C)	
Types	Single acting type (ZLA1) for diaphragm valve	Double acting type (ZLA2) for operating cylinder
Output signal	0.2 to 1.0 kg/cm²	0 to 4……6 kg/cm²
	0.4 to 1.2 kg/cm²	
	0.4 to 2.0 kg/cm²	
Accuracy	under ±1%	under ±2%
Lift adjusting range	10 to 100 mm	30 to 90° (rotary angle)
Ambient temperature	−20 to 80°C	−10 to 60°C
Ambient humidity	under 95% RH	under 95% RH
Pressure of feed air	1.4±0.2 kg/em²	4 to 6 kg/cm²
	1.6±0.2 kg/em²	
	2.4±0.2 kg/em²	
Standard air consumption	27 Nl/min (at feeding pressure of 1.4 kg/cm²)	112 Nl/min (at feeding pressure of 5 kg/cm²)
Waterproof structure	All-weather type (JIS F 8001 class)	All weather type (JIS F 8001 class)
Explosionproof structure	Intrinsic safety, explosionproof structure	Intrinsic safety, explosionproof structure

There are many types of computing elements and devices with a permissible difference of ±0.25% can be used for all types of computing elements and converters.

4. Electro-pneumtic Positioners

The electro-pneumatic positioners are of the single acting type with operating pressures of up to 2 kg/cm² and the double acting type with operating pressure of up to 6 kg/cm² which employ large output operating cylinders. *Fig. 7* shows outerviews of positioners and *Table 7*, specifications respectively.

Both types of positioners for 4 to 20 mA DC are designed for intrinsically safe explosionproof construction and have passed official inspections. The input resistance for the 4 to 20 mA DC units is approximately 200 Ω and that for the 10 to 50 mA DC units is approximately 55 Ω. For each controller output, a maximum of three or four positioners can be connected.