M-System’s I/P and P/I Transducers

M-System has delivered a total of 165,000 units since its release of the first model.

Count on us for fast and precise delivery.

As of the end of March 2017
Cumulative shipments 165,000 units
I/P Transducer: 78,722 units
P/I Transducer: 86,584 units

M-System CO., LTD.
www.m-system.com
M-System’s I/P Transducer uses the feedback of a semiconductor pressure sensor to

Control loop configuration with I/P transducer: Example of flow control

M-System’s I/P Transducer is an electro-pneumatic converter that uses a semiconductor pressure sensor with a built-in temperature compensation circuit. The sensor detects air pressure output as an electric signal and feeds back the signal to the input side. Compared with the conventional mechanical feedback system, this method makes it possible to obtain a much higher loop gain without being influenced by nozzle flapper and pilot valve characteristics, thus eliminating the drawback of the conventional mechanical feedback system.

![Functional block diagram of loop powered I/P transducer](image)

Sankei.com

Japan Market Trend of Pneumatic Control Valves Applicable with I/P Transducers

Actuators for control valves are classified into electrical actuators and pneumatic actuators. Electrical actuators (i.e., actuators driven electrically) are characterized by their high performance, compactness, and energy-saving features, the market share of which is increasing year by year. On the other hand, because of the trust for pneumatic actuators (i.e., actuators driven pneumatically) based on long established track records, there are still many users of pneumatic actuators, the trend of which is considered to continue for a while in the future (see the graph).

![Production volume of automatic valves](graph)

Survey report on valve industry overview issued by the Japan Valve Manufacturers’ Association

M-System has been offering I/P Transducers for 33 years as important auxiliary devices for pneumatic actuators, and will continue manufacturing them in the future to support the pneumatic actuator market.

We understand that I/P transducers will be used continuously in the future as well. But we also hear many manufacturers have now discontinued the products or they require a long delivery time.
achieve a high resolution with no positional errors.

Internal structure of I/P Transducer (Model: HVPN)
Semiconductor pressure sensor
(Manufactured by Nidec Copal Electronics)

Behavior explanation

- High air capacity up to 60 NL/minute (2.1 SCFM)
- High precision
- No positional errors
- High-density mounting

Loop Powered I/P Transducer
Model: HVPN

Survey report on valve industry overview

<table>
<thead>
<tr>
<th>Year</th>
<th>Production volume of automatic valves (× million yen)</th>
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<tbody>
<tr>
<td>2000</td>
<td>15,000</td>
</tr>
<tr>
<td>2005</td>
<td>20,000</td>
</tr>
<tr>
<td>2010</td>
<td>25,000</td>
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<tr>
<td>2015</td>
<td>30,000</td>
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<tr>
<td>2020</td>
<td>35,000</td>
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<tr>
<td>2025</td>
<td>40,000</td>
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Driving Control Valves by Pneumatic Actuator with Pneumatic Positioner

Why is the I/P Transducer not connected directly to the actuator?

Instrumentation systems employing pneumatic actuators and pneumatic positioners are still widely adopted today. A cost reduction of a system will be possible if a number of I/P Transducers are mounted integrally, compared with the use of field-mounted type.

Use of a positioner will improve response speed and precision. Most control valves are provided with positioners.

I/P positioners are available as well, but it is said that P/P positioners are more robust and resistive to vibrations.

Driving Control Valves in Hazardous Locations

What will happen if pneumatic control valves are in a hazardous area?

If I/P positioners for hazardous locations (intrinsic safety) are not available, I/P Transducers are installed in the non-hazardous (safe) areas to convert electric signals to pneumatic signals.

You can install I/P Transducers in non-hazardous areas.

They can be compactly accommodated with a mounting block into a control room cabinet.
Application Examples

**Remotely Setting Field-mounted Pneumatic Indicating Controllers**

We want to use DCS to control field instruments but can we still use existing pneumatic controllers?

In the case of cascade (remote) settings for field-mounted pneumatic indicating controllers from the DCS, the I/P Transducer will convert electrical signals into pneumatic signals.

![Diagram of I/P Transducer Application Examples](Image)

**Directly Driving Pneumatic Actuators**

We understand that M-System’s I/P Transducer can directly drive a small valve. What is a quick exhaust valve then?

The output of the I/P Transducer directly drives a pneumatic actuator with no pneumatic positioner used. If the length of air piping is long, install a quick exhaust valve(*) for response time improvements.

*(*) A quick exhaust valve is an auxiliary device used to quickly discharge air that flows backward from the actuator to the air pipe on site when the output pressure of the I/P Transducer is reduced.

![Diagram of Directly Driving Pneumatic Actuators](Image)
Many on-site pneumatic instruments are still in operation. By converting signals from these instruments into electrical signals and interfacing to a leading-edge control system (i.e., DCS/controller), the old assets can still be effectively used.

Compact Plug-in Style P/I Transducer
Model: M2PV (single output)
W2PV (two isolated outputs)

Retrieving Signals from Old Field-mounted Pneumatic Instruments into DCS

There are many old pneumatic instruments running on site, still in good condition. It may be necessary to replace the old pneumatic instruments with electronic instruments if we want to take these signals into the DCS.

You can solve the problem by using M-System's P/I Transducers to convert pressure signals from the existing pneumatic instruments.

It's an economical solution for effective use of your assets.

Retrieving Signals from Field-mounted Pneumatic Indicating Transmitters into DCS

We want to use DCS to control field instruments but we also want to keep the existing pneumatic transmitters. We like the existing pneumatic indicating transmitters. Their indicators are easy to read.

You can solve the problem by using M-System's P/I Transducers.

Pneumatic indicating transmitters can still be useful.

Output signals (pneumatic signals) from on-site pneumatic indicating transmitters are converted into electrical signals and taken into a DCS or a controller for the centralized monitoring of field signals.

Plug-in Style I/P Transducer
Model: PV
I/P Transducer
Operation of Pilot Valve

This pilot valve is of non-bleed type with low air consumption.

The illustration below shows how the pilot valve and other major parts will work and convert a changing input signal (electrical signals) into a pneumatic signal.

1. The interior of the pilot valve is divided into three chambers with diaphragms, and air flows into the upper chamber through a throttle mechanism. The inflowing air blows through the gap between the nozzle and the flapper. The air pressure received by the upper diaphragm at that time is called back pressure.

2. The gap between the nozzle and the flapper is controlled by the force motor, and the manipulated variable and the back pressure are proportional to each other at a high gain.

3. The manipulated variable of the force motor is proportional to the deviation of the output air pressure from the input signal level. Therefore, the input signal level and the output air pressure level are equal in the balanced state.

4. When the input signal increases, the core of the force motor will push the flapper in the direction of closing the flapper.

5. Then the back pressure will rise and push down the diaphragm.

6. The valve plug will be pushed down together with the diaphragm, the supply air will flow from the lower part of the valve plug to the output side, and the output air pressure will rise.

7. The change in the output air pressure will be detected by the semiconductor pressure sensor and fed back to the force motor through the servo amplifier.

8. A balanced state will occur when the input signal level and the output air pressure level are in agreement.

When Input Signal Goes Down

9. When the input signal level decreases, the core of the force motor will move in the direction to open the flapper.

10. Then the back pressure will drop and the diaphragm will be pushed up by the output air pressure.

11. When the diaphragm is pushed up, a clearance will be formed in the upper part of the valve plug, from which the output air pressure will be discharged.

12. The change in the output air pressure will be detected by the semiconductor pressure sensor and fed back to the force motor through the servo amplifier.

13. A balanced state will occur when the input signal level and the output air pressure level are in agreement.
the feedback of a semiconductor pressure sensor to

Japan Market Trend of Pneumatic Control Valves Applicable with I/P Transducers

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Control loop configuration with I/P transducer: Example of flow control

e valve characteristics, thus eliminating the drawback of the conventional mechanical feedback system.

Fluid will be used continuously 4 to 20 mA DC or they require a long delivery time.

Survey report on valve industry overview

Production volume of automatic valves

Solenoid valves

P/P positioner

amplifier

Z S Deviation

Pneumatic control valves

Hydraulic control valves

Electrical control valves

4 to 20 mA DC Input signal

Output pressure connection

Output signal

Pilot valve

Sensor

Flapper drive coil

I/P Transducer (image enlarged and processed to make the nozzle visible)

Nozzle flapper structure

I/P Transducer

Nozzle

I/P Transducer: 78,722 units

Plug-in Signal Conditioners

M-UNIT Series

Plug-in Signal Conditioners

H-UNIT Series

Loop Powered I/P Transducer

Mounting Block MB

16 units

9 units

1 unit

Dual-output (pneumatic and electrical) I/P Transducer

Pneumatic Signal Conditioners

P-UNIT Series

DC/Pneumatic Transducer PVS

TC/Pneumatic Transducer PTS

RTD/Pneumatic Transducer PRS

Potentiometer/Pneumatic Transducer PPMS

Space-saving Plug-in Signal Conditioners

H-UNIT Series

I/P Transducer HVP

Loop Powered I/P Transducer HVPN

Rack-mounted I/P Transducer

High-density Signal Conditioners 10-RACK Series

I/P Transducer 10VP

Loop Powered I/P Transducer 10VPN

Card-rack Signal Conditioners 11-RACK Series

I/P Transducer 11VP

I/P Transducer 11VPC

P/I Transducer

Plug-in Signal Conditioners

M-UNIT Series

Plug-in Signal Conditioners

H-UNIT Series

Space-saving Plug-in Signal Conditioners

P/I Transducer HPV

Super-mini Signal Conditioners Mini-M Series

P/I Transducer M2PV

Space-saving Dual Output Signal Conditioners Mini-MW Series

P/I Transducer W2PV

Space-saving Rack-mounted Signal Conditioners H-RACK Series

P/I Transducer GPV

P/I Transducer

P/I Transducer

P/I Transducer

Super-mini Two-wire Signal Conditioners T-UNIT Series

P/I Transducer TPV

Rack-mounted Two-wire Signal Conditioners B-RACK Series

P/I Transducer 3PV

Equipment built-in type Two-wire Signal Conditioners

P/I Transducer PVT

Other P/I Transducer

Pneumatic Signal Conditioners P-UNIT Series

Pneumatic Input Alarm PAS

Pneumatic/Frequency Converter PAP

Pneumatic/Square Root Extractor PFN

Rack-mounted P/I Transducer

High-density Signal Conditioners 10-RACK Series

P/I Transducer 10PV

Rack-mounted DCS Signal Conditioners 18-RACK Series

P/I Transducer 18PV

Dual Channel Input/Output Isolators 15-RACK Series

P/I Transducer 15PV

Card-rack Signal Conditioners 11-RACK Series

P/I Transducer 11PV

Specifications are subject to change without notice. When ordering, use the latest data sheets available at M-System web site: www.m-system.com