



Assemblies, Instruments and Systems

*for Measurement, Control,
Regulating, Testing, Calibrating*

of

*Pressure
Mass flow
Volume flow
Flow rate
Leakage
Permeability*

About this Catalogue ...



Dear customer,

Our catalogue still is our most important sales instrument. Despite the internet and new media we hold on to having a printed catalogue, since it creates the first "tangible" connections to prospective customers and maintains the ties to companies who have been buying from us for years.

Our manufacturing and delivery programme addresses all customers dealing with measuring, inspection and control technology for air and gases. On 64 pages you will find our extensive programme of instruments and sensors. Many new instruments have been added, others have been improved substantially.

In the field of portable hand-held measuring instruments especially there is lots of news. In this catalogue we introduce a new generation of portable pressure and flow measuring instruments in a unique design. All of the series 3 instruments feature a microprocessor. This means enhanced accuracies, a data communication interface and functions that previously were impossible. Prepare for surprise!

Like previous editions, this new catalogue contains much additional information apart from mere product descriptions and ordering data. Explanations concerning physical principles and application techniques as well as many tables and diagrams will certainly help you to select the appropriate instrument. I hope not to have promised too much.

I wish much success for your projects in more difficult times ...

Your Peter Binder
Managing Director and Proprietor of SI

- Our new catalogue E2007 does not indicate pricing.
- Please request a pricelist by E-mail. It contains all Euro pricing for our instruments and services.
- This extended catalogue replaces the 52page E 2000 catalogue.
- Technical properties and prices are subject to change without notice.
- "Digima"® is a registered trademark of SI-special instruments GmbH.
- Catalogue version 1.1 (issued 03/2007)

Legend

The following symbols will help you to find your way in this catalog.



Marks new SI products, that appear in this catalogue for the first time.



Identifies a registered trademark of SI or another company.

The colours used in the catalogue will help you to find the desired product quickly:

	gray	General information
	yellow	Pressure measurement
	red	Pressure control
	brown	Accessories
	blue	Flow rate
	green	Flow volume
	mint	Calibration, services
	orange	Test instruments
	purple	Software



Please use our reply card to request detailed information and pricelists!

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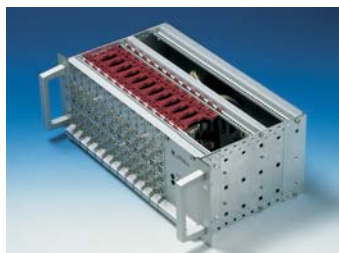
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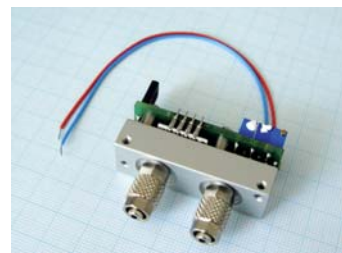
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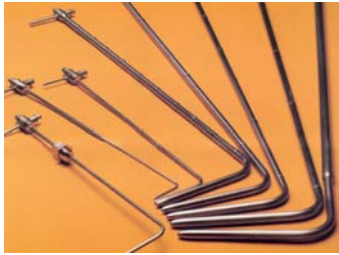
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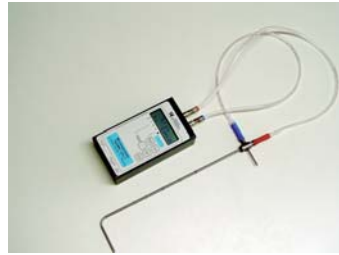
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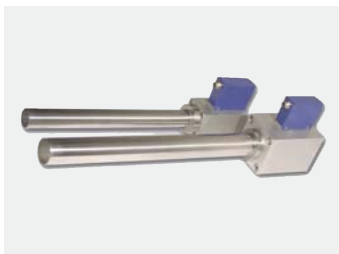
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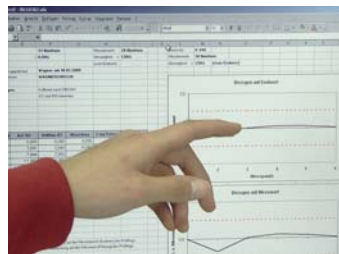
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About Our Company ...

As the proprietor and general manager of SI I am often asked to come for a visit, before customers decide to build a business relationship with us.



During such visits people always are interested in those details that are not written anywhere or can be read between the lines at best. That is why I have decided to pass on a little more information about "SI" in this catalogue than is generally done. It allows potential and current customers to learn more about SI. I hope this information will aid you in assessing us as a supplier.

More than 25 years ago I founded our company in Metzingen, Germany. Many a company history starts in a garage. Mine began on the kitchen table. With the development of a portable digital pressure gauge and the trademark "Digima" ® I managed to start up my business. 1983 I moved to Nördlingen. Here the company developed continuously, because time was ripe for innovative sensor technology and special measuring instruments. Now we employ about 10 people. Three of them are

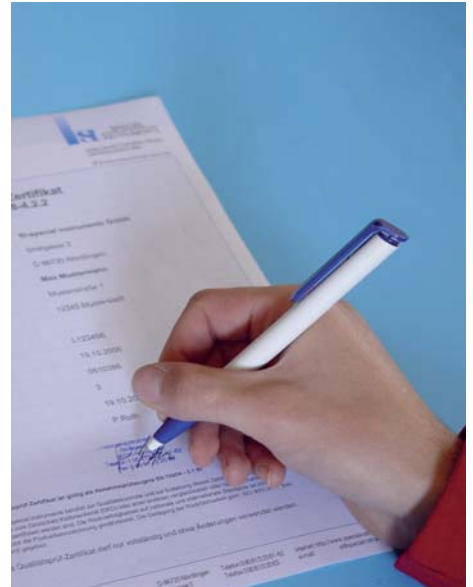
apprentices. For a number of years we have continuously trained industrial electronics and business clerks.

My employees are well trained specialists, and all of them come from this region of Germany. People here do not move very often and are loyal. Most of them therefore have been employed with SI-special instruments GmbH for more than 10 years. My company and you as its customer are profiting from such continuity.

Over the past years, my staff and I have developed numerous products around "pressure and flow". Our new extended E2007 catalogue presents our versatile program and may contain just the solution for your application. People keep asking me how I achieve so much with such a small company. My reply is part of the company philosophy:

"Small companies have to learn from the large, without repeating their mistakes!"

Development, final assembly, calibration and quality assurance are all inhouse. Everything else, however, that lies outside our core competence, is handled by strong partners and suppliers.



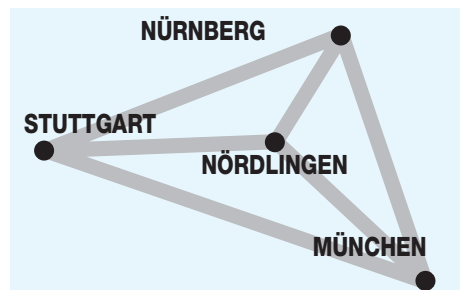
Since 1998 we are operating on the basis of a quality management system according to ISO 9001. For all instruments supplied by us we can also offer inhouse calibrations. For the works calibrations of our instruments, we use traceable reference standards which are subject to regular control of inspection, measuring and test equipment. This allows issuing works certificates to ensure the accuracy of your measuring and test instruments.

We guarantee proper functioning of all instruments manufactured by us. Additionally we will repair older instruments provided their maintenance is economically sensible.

Since we utilize materials from proficient suppliers, we have also extended our delivery programme to include instruments and services of other high-quality manufacturers. For the most part these are products we have successfully employed in special solutions before. Thus we can today offer a full range of products from a single source. The delivery programme of SI-special instruments GmbH thus certainly is unmatched in the measuring and regulating device market. And we endeavor to maintain a reasonable price level for our special offer.

In Germany we will supply to you directly from Nördlingen. Outside Germany you will be supplied by our foreign representatives (see catalogue page 63). Contacting "SI" and our sales representatives you can rest assured that we will take care of your technical problems. We will advise you competently and serve you courteously. This customer oriented attitude has made us grow and it has been a key factor in our business success. As the general manager of SI I will continue to cultivate this business principle in the future.

Our company is located in Nördlingen a small town in north-western Bavaria. On a map, you will find us at the centre between Stuttgart, Nuremberg and Munich. From the A7 motorway, Nördlingen is reached within half an hour.



In 2001 we moved from "Henkersgasse" to "Strelgasse 2". We bought and renovated an old town house. It offers more space for both management and production. Future expansion of the company have thus become possible.



These new premises as the previous ones are located at the heart of the romantic medieval part of town. The complete city wall with an uninterrupted walkway is unique in Germany. Visit us! A sketch outlining the way is found on our website.

The URL is:

<http://www.specialinstruments.com>

From the start we have endeavoured to keep our company website up to date in both German and English. In the future we plan to make all our datasheets available in PDF format for download in addition to the catalogue. All employees have their own e-mail addresses, which are found on our home page. For general correspondence please use the following e-mail address:

si@specialinstruments.com

As stated above the company trains apprentices in business operations and production. Additionally, we offer internship opportunities now and then.



Instruments made by SI are not only sold and used in Germany, but around the world. The most important fields of application are:

Training and research

Automotive industry

Railway

Chemistry and laboratory

Food stuffs

Aerospace

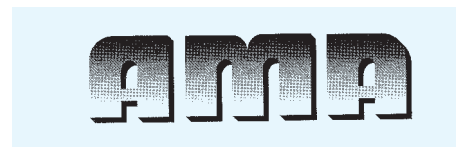
Medical apparatus

Military applications

Ship building

Special machinery

The professional association of our branch is called "AMA", Fachverband für Sensorik e.V. We are a member of this association. It aims to channel the diverse currents in the sensor industry and to make the results transparent to customers. One platform used to achieve this is the "SENSOR" exhibition in Nuremberg, held every two years.



SI is always represented there and on numerous other special fairs. During the last few years we found, however, that the cost/performance ratio of such fair participations has developed negatively. As a visitor you may have gained a similar impression.

In 2006 we celebrated our 25th company anniversary. That makes us a little proud and inspires optimism, especially since times have become harder to deal with.

Let me assure you:

"Also in the years to come we will endeavour to offer a special, high-performance programme at reasonable prices!"

Take advantage of it!



Pressure Basics

Besides temperature, pressure is one of the most important physical variables measured in research and technical applications. SI-special instruments has been making measuring instruments for pressures for 25 years. During this time we have developed numerous instruments for special applications and supplied these to customers. Most measuring instruments trace only one pressure, check an adjusted tolerance value, and output an alarm signal if that is desired.

However, intelligently employed pressure measurement allows to do much more than that. Some measuring tasks can be achieved by measuring pressure. The solution to the problem often is not a hand, because pressure is not considered a descriptive status value, but an auxiliary physical value.

The following is a list of numerous applications in which pressure measuring instruments of SI have been employed. It is a random selection and is not all inclusive.

Flow volume measurement

- with orifice plates, throttles, venturi tubes, pitot tubes
- with laminar flow elements (LFE)

Principle: Measurement of differential pressure on throttles. Conversion to standard conditions by additional measurement of the absolute pressure.

Filling level measurement

- from test tube to artificial lake, from depth of the sea to water level of a well
- in open and closed containers, even in pressurized containers
- bubbling-through measurement in case of contamination risk

Principle: Measurement of hydrostatic pressure of fluid.

Density measurement of fluids

- online measurement in processes

Principle: Change of differential pressure of two pressure transducers installed at different heights.

Measurement of weight and force

- load weight measurement on hydraulic forklifts and hoists
- pressing force measurement on presses

Principle: A formula connects weight and force to pressure acting on the hydraulically active cross section.

Distance measurement

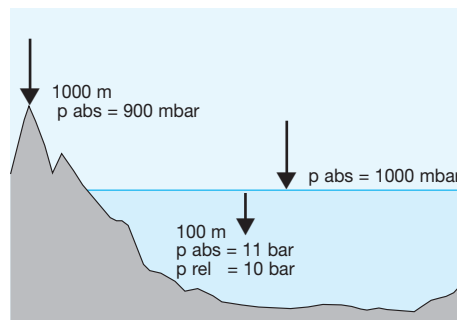
- interior diameter test with test pins
- pneumatic limit switches
- peak-to-valley height (roughing depth) measurement

Principle: Back pressure measurement on surfaces subjected to flow.

Measurement of heights and height differences up to < 1/100 mm

- electronic version of the classic hose level used in building construction, interior construction, gardening and landscaping. Allows levelling even around corners
- inclination measurement on tunnel drilling machines for constant drop
- alignment of large machines
- monitoring of settling processes on buildings, bridges and foundations
- monitoring of tectonic shifting, volcanic activity etc.

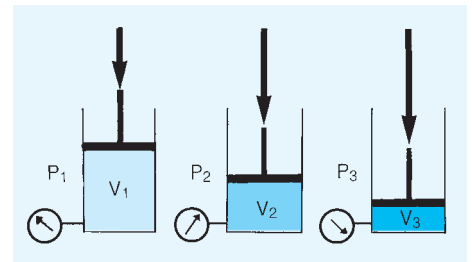
Principle: Measurement of hydrostatic pressure or differential pressure of fluid columns.



Absolute pressure measurement in the atmosphere

- local altitude, flight altitude
- climbing and descent speed (variometer)
- weather activity

Principle: Absolute pressure measurement of the atmospheric column or its differential.



Tightness inspection

- of containers, bottles, canisters and gas consuming devices
- of piping
- air efficiency of rooms
- sufficient combustion air supply (TRGI 86)

Principle: Measurement of pressure rise or drop versus time.

Mechanic durability test

- of welding seams of medical expendables
- of welding seams of food packages
- of glued parts

Principle: Peak value measurement of bursting pressure

Monitoring of contamination

- on air filters of any size

Principle: Measurement of differential pressure across test item

Permeability

- of paper, cardboard, textiles
- of soil samples, bottoming

Principle: Measurement of differential pressure across sample

Size of pores

- of filter materials, (bubble-point test)

Principle: Measurement of pressure change when wet pores are pressurized to force the fluid out

Volume measurement

- measurement of interior volume and combustion chamber volume of combustion engines

Principle: Compare measured value to pressure of a reference volume, application of the gas law

Conversion table for pressure

	N/m² Pa	bar daN/cm ²	mbar	kp/cm² at	atm	Torr mmHg	mm WS (conv.)	psi lb/in ²
1 N/m ² 1 Pa =	1	10 ⁻⁵	10 ⁻²	1.01971 ·10 ⁻⁵	0.98692 ·10 ⁻⁵	0.75006 ·10 ⁻²	1.01971 ·10 ⁻¹	1.45037 ·10 ⁻⁴
1 bar 1 daN/cm ² =	10 ⁵	1	10 ³	1.01971	0.98692	0.75006 ·10 ³	1.01971 ·10 ⁴	14.5037
1 mbar =	10 ²	10 ⁻³	1	1.01971 ·10 ⁻³	0.98692 ·10 ⁻³	0.75006	10.1971	1.45037 ·10 ⁻²
1kp/cm ² 1 at =	98.0665 ·10 ³	0.98066	0.98066 ·10 ³	1	0.96784	0.73555 ·10 ³	10 ⁴	14.2233
1 atm =	101.325 ·10 ³	1.01325	1.01325 ·10 ³	1.03322	1	760	10.3322 ·10 ³	14.6959
1 Torr 1 mmHg =	133.322	1.33322 ·10 ⁻³	1.33322	1.35951 ·10 ⁻³	1.31578 ·10 ⁻³	1	13.5951	1.93367 ·10 ⁻²
1 mmWS conven- tional =	9.8066	0.98066 ·10 ⁻⁴	0.98066 ·10 ⁻¹	10 ⁻⁴	0.96784 ·10 ⁻⁴	0.73555 ·10 ⁻¹	1	1.42233 ·10 ⁻³
1 psi 1 lb/in ² =	6.89475 ·10 ³	6.89475 ·10 ⁻²	68.9475	7.03069 ·10 ⁻²	6.80459 ·10 ⁻²	51.7149	7.03069 ·10 ²	1

To simplify the conversion of engineering units used in pressure measurement, we have provided the conversion table above. It allows quick conversion from popular to rather unusual units of measure.

Additionally, we offer a smart software for this purpose. On page 25 of this catalog you will find the ultimate conversion programme for units of measure.

For little money this programme converts most units of measure used in physical technical applications.

SI-special instruments does not manufacture sensors, but integrates sensors of reknown suppliers into its products. Pressure transducers are equipped with housings and pressure connections adapted to practical application. Measured value amplifiers and analog or digital interfaces are added. Some instruments are fitted with a measured value display.

The result is a host of assemblies, instruments and systems for a wide range of measuring tasks.

All units are subject to consistent quality assurance, are adjusted and calibrated to the measured value or engineering unit required. Reference standards used for calibration are certified by "DKD" and are monitored.

We have accumulated considerable application know-how gained in numerous projects. And we're pleased to pass these experiences on to other customers. Rest assured that you will be competently advised concerning the measuring task at hand and the proper selection of equipment required to achieve it.

If you should not find a suitable instrument in our programme, we may be able to present a customized solution. Just let us know! The cost generally is lower than most people would expect. In the pressure measurement applications discussed in this catalogue the following pressure types are repeatedly mentioned

"absolute pressure"
"relative pressure"
"differential pressure"

This catalogue lists appropriate devices for each of these pressure types.

Since the terms used for pressure types are frequently confused, we are giving our definitions below:

Absolute pressure measuring instruments

have only one pressure inlet and always measure with reference to the absolute vacuum. The sign of the measured value is therefore always positive. Upon power-up the instrument displays the atmospheric pressure.

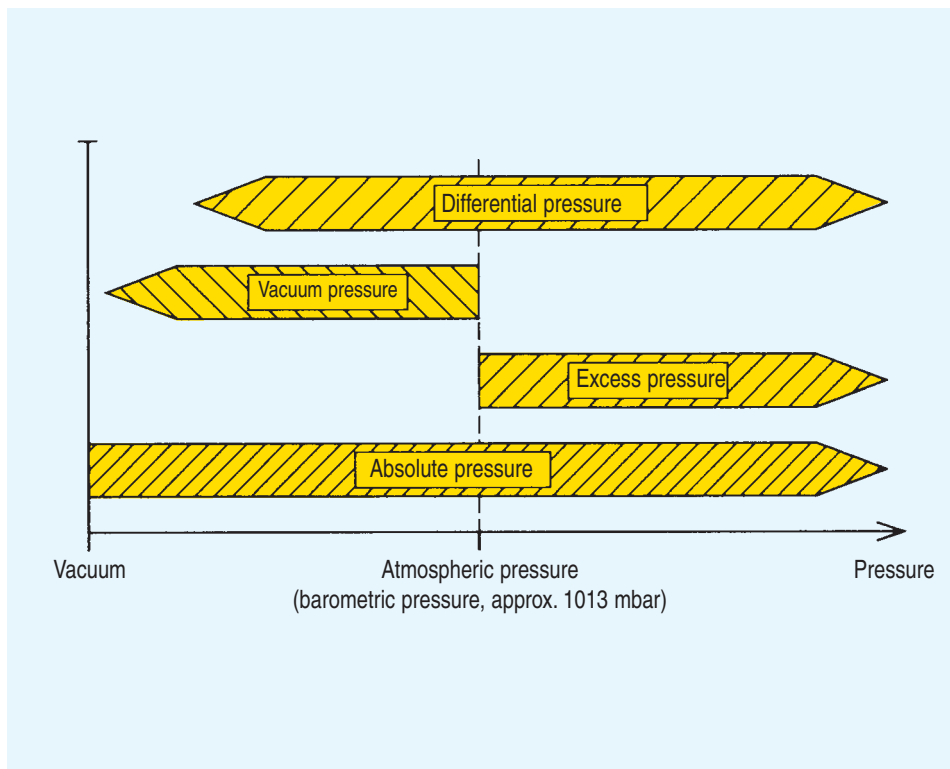
100 mbar excess pressure is displayed as (air pressure + 100 mbar).

Relative pressure measuring instruments

likewise have only one pressure inlet, but they measure the pressure relative to the surrounding air. The sign of the measured value may be positive (excess pressure) or negative (vacuum). Upon power-up, the instrument displays 000. An excess pressure of 100 mbar is displayed as +100.

Differential pressure measuring instruments

have two pressure inlets. They measure the pressure difference of the two inlets. The sign of the measured value may be positive or negative, depending on the relation to the reference connection. A differential pressure measuring instrument can easily be used to measure relative pressure when one inlet remains open to atmospheric pressure. This type therefore is a universal measuring instrument.



Digital Pocket Pressure Gauges

With its trademark "Digima" ® SI has made portable digital pressure gauges popular. Meanwhile SI offers a wide range of electronic hand-held pressure gauges. All units are available for differential pressure or absolute pressure measurement. SI's portable pressure gauges are characterized by the following design features:

Battery powered: Each device can be operated alternatively with batteries or rechargeable NiCd batteries. The designs used are standardised and available around the world. Meanwhile NiMH cells reach operating times that equal those of alkaline-manganese cells. Integrated battery monitoring is standard in all digital pressure gauges.

LCD displays are the most energy saving measured value displays. That's why we have generally installed them in all our portable units. The 7-segment display units allow a resolution of ± 2000 or ± 20000 counts. That explains why they have two measuring range stages.

Most units have an **analog output**. It supplies an electrical signal proportional to the pressure measured for processing by a printer, logger or oscilloscope. The output signal is supplied at low impedance and without reverse transfer. It always is a true representation of the actual pressure curve. This holds true even of fast pressure signals, because the integrated **piezoresistive pressure sensors** have a response time of only a few milliseconds. This is achieved by the small diaphragm surface and low dead volume. If you do not wish this fast response, most of our instruments allow to select electronic **damping**. A low-pass filter then calms the digital display and the signal output.

This page presents our analog instruments. These instruments are suitable for most applications.

For more complex measuring tasks requiring higher accuracy, more conformtable, signal processing and computer connection we offer digital instruments. These digital pocket pressure gauges (Digima premo 3 and UNI 3) feature a microprocessor. They are described on pages 12 and 13.

Please note that the instruments are exclusively designed to measure pressure of air and other non-aggressive gases.

If you need to measure wet media, we recommend using our "Digima premo SR 2" with integrated stainless steel sensor (order No. 1877) or one of our "Digima premo SR 2" units with an external stainless steel transducer for plug-in.

Digima Junior

This hand-held pressure gauge is our most favourably-priced instrument. It incorporates the excellent pressure transducer of the other units but not their measuring features. Still the instrument can be calibrated.



Single-range hand-held unit with integrated sensor
Measuring error max 0.5% f.s., no logger output
Manual zeroing with multi-turn potentiometer.
Plug-in pressure connection via quick-action couplings, enclosure type IP50

Units are supplied including quick-action couplings and battery

Order-No. Measuring ranges

1612	± 1.999 mbar / Diff.
1613	± 19.99 mbar / Diff.
1614	± 199.9 mbar / Diff.
1615	± 1.999 bar / Diff.
1616	± 7.00 bar / Diff.

1617	± 199.9 mbar / Abs.
1618	± 1999 mbar / Abs.
1619	± 7.00 bar / Abs.

Order-No. Options

752	Traceable calibration certificate for pressure, one measuring range Initial calibration
600	Adjustment to other measured variable

Order-No. Available accessories

2651	9V NiMH battery block
079	Plug-in charger for 9V NiMH battery block
1849	Storage and transport case with molded insert, small

Unit selection table

Digital pocket pressure gauge "Digima"

(high-precision portable reference units "Digima ULTRA" with an error limit of 0.02% f.s. are found on page 29)

		Junior	Premo 2 - SR	Premo 2 - SR-ext. sensor	Premo 2 - DR	Premo 3	UNI 3
Accuracy	0.1 % f.s.						●
	0.25% f.s.		●		●	●	
	0.5 % f.s.	●					
Pressure ranges	2 mbar	●	●		●	●	●
	20 mbar	●	●		●	●	●
	200 mbar	●	●		●	●	●
	2000 mbar	●	●	●	●	●	●
	7 bar	●	●		●		
	10 bar		●		●	●	●
For calibration of blood pressure measuring device	400 mmHg						●
For barometric applications	800...1200 hPa						●
Absolute pressure		●	●	●	●	●	●
Differential pressure (also for relative pressure)		●	●		●	●	●
Relative pressure	20 bar		●	●	●		
Unit with	1 measuring range	●	●	●			
Unit with	2 measuring ranges				●	●	●
Push-button zeroing			●	●	●	●	●
Selectable engineering units						●	●
Available for other engineering units		●	●	●	●	●	●
Selectable electronic damping			●	●	●	●	●
Connection option for plug-in power supply						●	●
Analog logger output			●	●	●	●	●
Serial interface RS 232						●	●
Enclosure type IP 64		●	●	●	●		
Battery operation	with 9 V block	●	●	●	●		
Battery operation	with 2 x 1.5 V Mignon cell					●	●



Digital pocket pressure gauge "Digima premo 2"

Digital pocket pressure gauges, type "Digima premo 2" have been offered by us for many years. These pressure gauges can be supplied for one or two ranges. Around the world they have come to be part of the basic mobile equipment of many machine fitters and service technicians, because these compact pressure measuring instruments are so robust and reliable. But also in laboratories and on the shop floor these units are used successfully for testing, because users can rely on their accuracy.

This instrument series features:

- most simple operation
- practical accuracy
- sealtight housing
- analog signal output
- push-button zeroing
- selectable low-pass filter
- long battery life
- available with works certificate
- pressure connection by quick-action couplings.

"Digima premo 2-SR" with ext. sensor

To achieve this device combination, we are employing a portable "Digima premo SR" as excitation source and display unit. Its integrated sensor is replaced by an external passive stainless steel sensor, that is plug-connected via a cable to the portable "premo". The stainless steel sensor can be connected to the measuring point using a standard thread or to a prepared miniature measuring connection.



Portable, battery-operated pressure measuring circuit, 1 measuring range consisting of a hand-held unit, external sensor with 1/4" thread, 2 m plug-in cable, 9V battery, measuring error max 0.5% f.s.

Order No. Measuring ranges

1880	-1.000...1.999	bar / Rel.
1881	- 1.00...19.99	bar / Rel.

1882	19.99	bar / Abs.
------	-------	------------

Order No. Options

600	Adjustment to other measured variable
752	Works certificate for pressure measuring instrument per measuring range, initial calibration

Order No. Available accessories for "premo 2" models

2651	9V NiMH battery block
079	Plug-in charger for 9V-NiMH battery
1849	Plastic storage and transport case with molded insert, small, space for measuring instrument and accessories
1849	Plastics storage and transport case with molded insert, large, for the measuring instrument and more space for accessories

"Digima" and "premo" ® are registered trademarks of SI-special instruments GmbH

"Digima premo 2-SR"

Hand-held unit with integrated sensor and 1 measuring range (single range)

LCD display with range of ± 1999

measuring error max. 0.25% f.s.

* max. 0.6 % f.s.

push-button zeroing, selectable damping,

logger output, enclosure type IP 65

Units are supplied including quick-action couplings and battery

Order No. Measuring ranges

1620	± 1.999	mbar / Diff.
1621	± 19.99	mbar / Diff.
1622	± 199.9	mbar / Diff.
1623	± 1999	mbar / Diff.
1624	$\pm 7.00 *$	bar / Diff.
1876	$\pm 10.00 *$	bar / Diff.

1886	-1.00...19.99	bar / Rel. (with stainless steel diaphragm, thereby also suitable for liquids)
------	---------------	---

Order No. Measuring ranges

1625	199.9	mbar / Abs.
1626	1999	mbar / Abs.
1627	7,00 *	bar / Abs.

Order No. Options

600	Adjustment to other measured variable
1654	Higher resolution of 19999 (not for No. 1620)
752	Traceable calibration certificate for pressure, one measuring range, initial calibration

"Digima premo 2-DR"

Hand-held unit with integrated sensor and 2 measuring ranges (dual range)

LCD display with range of ± 1999

measuring error max. 0.25% f.s.

* max. 0.6 % f.s.

push-button zeroing, selectable damping,

logger output, enclosure type IP 65

Supplied including quick-action couplings and battery

Order No. Measuring ranges

1628	$\pm 1.999 / 19.99$	mbar / Diff.
1629	$\pm 19.99 / 199.9$	mbar / Diff.
1630	$\pm 199.9 / 1999$	mbar / Diff.
1631	$\pm 7.00 *$	bar / Diff.
1878	$\pm 10.00 *$	bar / Diff.

1722	-1.999....19.99	bar / Rel. (with stainless steel diaphragm, therefore also suitable for liquids)
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Order No. Measuring ranges

1632	199.9/ 1999	mbar / Abs.
1633	1.99/ 7.00 *	bar / Abs.

Order No. Options

600	Adjustment to other measured variable
2507	Traceable calibration certificate for pressure, two measuring ranges initial calibration

The series 3 instruments... NEW

... are new in our programme. This new instruments series will replace the current "premo 2" devices.

The new instruments incorporate a microprocessor. This allows unit functions that were previously impossible or could only be achieved with substantial effort. The technology of the hardware and software is identical in all our new hand-held measuring instruments. This new device type is also incorporated in our micromanometers LPU3 and in the air flow measuring instruments prelo 3.

The new instruments retain the proven qualities of the previous series of hand-held pressure gauges. Special attention was given to leaving the operating procedures as they were. You will not really notice that an intelligent computer chip is now working in the background.

Data processing in a hand-held unit primarily means that the accuracy of measurement improves and that measured values can be communicated via a data interface.

Improved accuracy

Thanks to a linearisation function we can offer even more accurate pressure measuring instruments than before. Before shipment, each series 3 unit is crosschecked using high-precision reference units. Deviations from the ideal characteristic curve are detected and saved in the form of a correction value. The error limits indicated are thus always met.

The resolution is 20000 counts. The last digit can be shut off.

Data interface

The units offer a real bi-directional RS 232 interface operating at 19200 baud. It is protected against overvoltage and failures (ESD). This serial interface allows to read out the entire display contents (measured value, decimal point, sign and measured variable). Additionally, all functions of the instrument can be remote-controlled via this digital interface. A command interpreter for this purpose is provided. If you plan to integrate the instrument into an automatic measuring station, you will appreciate this feature.

Power supply

The new series 3 units are supplied with 3 V direct current. Two 1.5 V Mignon cells (AA) allow an operation time of more than 80 hours. If you decide to use rechargeable NiMH cells of the same size, this will save some money in the long-run and is a contribution to environmental protection by reduction of the amount of contaminants.

Digital pocket pressure gauge "Digima UNI 3"



As standard, the unit can be supplied via a jack connector in stationary operation. When a power supply unit is connected, the integrated battery supply is automatically switched off.

The integrated sensor assembly

A piezoresistive, temperature-compensated pressure sensor and the measuring amplifier are designed with SMD components screwed to an aluminium block. This design is mechanically stable and results in minimal dead volume at the pressure connections. Two M5 threads are provided on the sensor assembly. These are the pressure ports. As standard, they are furnished with connecting elements for quick-action couplings. If you are using different tube connectors, the connecting elements can be replaced easily.

The basic pressure measuring variable is "bar" or "mbar". Two further measured variables are provided for and are computed, displayed, and output via the signal outputs upon input of numeric conversion factors.

Analog signal output

If you are using line plotters, an analog output signal is just what you need. The ± 1 V signal is provided at 4 mm banana jacks at low impedance and without reverse transfer. It is as accurate as the digital display. If the partial range is selected, the full 1 V signal is also available for the partial range.

Damping of the measured value signal

If the measured pressure fluctuates, e. g. in case of a turbulent flow, this results in a "wriggly" display or signal output. The series 3 units allow calming of the measured value signal by activating a damping function. Numeric averaging allows for this.

"Digima premo 3" NEW

Hand-held instrument with integrated sensor and 1 measuring range
LCD display (7-segment) with flags

Measuring error in partial range 10...100% < 0.25% f.s.
Measuring error in partial range 0... 10% < 0.025 f.s.

Units are supplied including quick-action couplings and battery

Order No. **Measuring ranges**

2224	± 20.000	mbar/ Diff.
2225	± 200.00	mbar/ Diff.
2226	± 2000.0	mbar/ Diff.
2227	± 10.000	bar/ Diff.

2230 -1... 20.000 bar/ Rel.
(with stainless steel diaphragm, thereby also suitable for liquids)

2228	2000.0	mbar/ Abs.
2229	10.000	bar/ Abs.

Order No. **Options**

2508	Traceable calibration certificate for both partial ranges "Digima premo 3" initial calibration
2509	Supply of series 3 instrument in robust casted aluminium housing

"Digima UNI 3"



Hand-held instrument with integrated sensor and 1 measuring range, LCD display (7-segment) with flags

Measuring error in partial range 10...100% < 0.1% f.s.
Measuring error in partial range 0... 10% < 0.025 f.s.

Supplied including calibration certificate, quick-action couplings and battery

Order No. Measuring ranges

2233	± 20.00Q	mbar/ Diff.
2234	± 200.0Q	mbar/ Diff.
2235	± 2000.0	mbar/ Diff.
2236	± 10.00Q	bar/ Diff.

2739 -1 20.00Q bar/ Rel.
(with stainless steel diaphragm, therefore also suitable for liquids)

2231 +400.0 mmHg/Diff.
Instrument for calibration of blood pressure measuring instruments (engineering unit mmHg/torr/mbar) According to the requirements of the guideline for "Meßtechnische Kontrollen von Medizinprodukten mit Meßfunktion" (LMKM) as well as the "Medizinprodukte Betreiber Verordnung" (MPBetreibV)

2232 800.0...1200.0 hPa / Abs.
Instrument for measurement of barometric air pressure (hPa/ mbar/ inWG)

2237	2000.0	mbar/ Abs.
2238	10.00Q	bar/ Abs.

Order No. Options

2509 Supply of series 3 instruments in a robust casted aluminium housing

Interface USB ↔ RS232



Interface converter

As mentioned above these units include an RS 232 interface. This interface type and its programming are still the industrial standard among technical or scientific users. If your computer system should not support an RS232 interface, we can supply an interface cable incorporating an interface converter. Plugged into the connecting cable, this adapter makes the two standards compatible.

2510 Interface cable with 9pole SUB D-plug male to USB plug. Cable length 120 cm. The interface converter is excited via the USB plug.

Pressure calibrator DKG-4



The portable pressure calibrator DKG-4 is comprised of the calibration case and a digital pressure gauge "Digima UNI 3". The design of both components has been adapted to one another, but if necessary, they can also be used individually. The calibration case is suitable for all calibration tasks up to a pressure of max. 1 bar above atmospheric pressure. The required test pressure is adjusted statically using a hand pump and a variable bellows system. The hand pump is used for coarse pressure adjustment. The bellows system allows very fine variations of the test pressure.

DKG-4 Calibration case



The volume of the metallic bellows is adjusted using a hand wheel and spindle. Even lowest pressures in the mbar range can thus be adjusted easily (for further information about DKG-4 please refer to catalogue page 28).

Order No.

2335 DKG-4 Calibration case with manual pressure generation and a slot for a battery-operated digital pocket pressure gauge "Digima UNI 3"

... well protected and stored



Diverse accessories are available for the digital pocket pressure gauges type "premo 3" and "UNI 3".

Order No.

- 2511 Package with 2 pcs. 1.2 Volt NiMH rechargeable battery, capacity: 2300 mAh, international size LR 6 (Mignon) "charge and go" type, for 15 minutes charging time
- 2512 Plug-in charger for 2 pcs. 1.2V rechargeable battery NiMH, "charge and go" type, wide-range power supply unit, 120...240 VAC, 50...60 Hz, incl. 2 pcs. rechargeable battery
- 1849 Plastic storage and transport case with molded insert, small for the measuring instrument and some accessories.
- 1182 Plastic storage and transport case with molded insert, large; for the measuring instrument and more space for accessories.
- 2250 Wide-range plug-in power supply (100...240 VAC), stabilised 3.3 VDC with jack connector
- 2249 Interface cable RS232 SUB D 9, female to round connector on unit, 5 m long.

General accessories (tubes, tube connectors etc.) are found on page 26

Measuring instrument in robust housing



Normal pressure values vs geometric height acc. to DIN

0 m	corresp. to	1013.2 hPa	1200 m	corresp. to	877.2 hPa
100 m	corresp. to	1001.3 hPa	1400 m	corresp. to	856.0 hPa
200 m	corresp. to	989.5 hPa	1600 m	corresp. to	835.3 hPa
300 m	corresp. to	977.7 hPa	1800 m	corresp. to	814.9 hPa
400 m	corresp. to	966.1 hPa	2000 m	corresp. to	795.0 hPa
500 m	corresp. to	954.6 hPa	2200 m	corresp. to	775.4 hPa
600 m	corresp. to	943.2 hPa	2400 m	corresp. to	756.3 hPa
700 m	corresp. to	931.9 hPa	2600 m	corresp. to	737.5 hPa
800 m	corresp. to	920.8 hPa	2800 m	corresp. to	719.1 hPa
900 m	corresp. to	909.7 hPa	3000 m	corresp. to	701.1 hPa
1000 m	corresp. to	898.8 hPa	3200 m	corresp. to	683.4 hPa

Built-In Digital Pressure Gauges

In the electronic pressure gauges of the "FP" series, pressure sensor, measuring amplifier, digital display and signal output are integrated in one compact unit ready to be installed. In the high accuracy class, especially, and in the low pressure range, these electronic pressure measuring instruments have meanwhile become the industry standard. Profit from:

- higher accuracy and resolution
- clearer read-off
- delay-free conversion
- high insensitivity to overload
- a signal output for the measured value
- simple limit value generation
- low-cost special scaling

Built-in digital pressure gauges by SI are characterized by the following design features: The pressure sensor is permanently installed in the digital pressure gauge. The pressure is connected to the instrument by means of a tube. Therefore, this device type is the best choice for applications involving air. For fluids, aggressive media and high pressure, the combination of a transmitter and an excitation/display unit is the more practical and safer solution. If nothing else is stated, all electronic pressure gauges operate with piezo-resistive pressure sensors, that is, the measuring diaphragm is made of the semiconductor material silicon.

Please note that these sensors must be used exclusively for air or other non-corrosive gases! A Wheatstone-type measuring cell is edged onto the diaphragm. When the diaphragm is deformed under pressure, the measuring cell outputs a signal proportional to the pressure applied. After precise amplification, you receive a standard level voltage or current signal for evaluation by your instruments and systems. Depending on the instrument type, the measured values are displayed by an LCD or LED display. LED displays are red and can be read off even in complete darkness. All built-in pressure gauges can be operated on a 24 V direct current supply. Generally, operation on a 220 V supply is possible alternatively. Built-in digital pressure gauges by SI are available in two shapes.

For universal application in devices and plants, units in DIN housings have proven practical. All you need to install them, is a rectangular cut-out in the front panel of the device. The instrument is then held in place by retaining clamps. The circuit board with partial front panel is meant for installation in a 19" rack assembly system.



"Digima FP"

It has been designed as a front panel instrument with DIN dimensions. Requiring little space, the unit can be enhanced with optional functional modules. This allows to configure a problem-oriented device for the measuring and monitoring task at hand.

A wide range of measuring ranges for differential and absolute pressure measurement are available. And if needed, we are pleased to meet your special requirements and supply a unit for different engineering units, measuring ranges or with higher resolution. In addition to the digital display, a standard level signal output is always available for external processing of pressure values.

Built-in unit with integrated sensor and 1 measuring range
Measuring error max. 0.25 % f. s.
*max. 0.5 % f. s.

Basic units

Include the pressure transducer in DIN housing 96 x 48 mm, incl. retaining clamps, 24 V DC supply power, LCD display and voltage output ± 10 Volt

Order-No. Measuring ranges

265	± 19.99	mbar/Diff.
266	± 199.9	mbar/Diff.
267	± 1999	mbar/Diff.
270	$-1 \dots 10.00^*$	bar/Diff.
1889	$800 \dots 1200$	mbar/Abs.
268	1.999	bar /Abs.
605	10.00^*	bar /Abs.

Order-No. Options

606	Line power 220 VAC
607	Current output $\pm 0 \dots 20$ mA

608	Current output	$4 \dots 20$ mA
1654	Digital display with higher resolution (19999)	
609	Limit value switch, 1 trip point externally adjustable, relay output, floating switch-over contact, 2 A switching capacity	
610	Limit value switch, 2 trip points externally adjustable, relay outputs, one normally open contact each, 0.5 A switching capacity	
611	Square root extracting amplifier	
617	Display/signal damping (low pass of 2nd order)	

"Digima FP small"



Small built-in unit, front panel 96 x 24 mm, with integrated sensor and 1 measuring range, no extension possible.

Measuring error max. 0.25 % f. s.
*max. 0.5 % f. s.

supplied in DIN housing 96 x 24 mm, incl. retaining clamps, 3 1/2 digit LED display, 24 VDC supply power, signal output with ± 10 V and $0 \dots 20$ mA

Order-No. Measuring ranges

1520	± 19.99	mbar/Diff.
371	± 199.9	mbar/Diff.
372	± 1.999	bar/Diff.
1183	$-1 \dots 10.00^*$	bar/Diff.
373	1.999	bar/Abs.
1184	10.00^*	bar/Abs.

Instrument selection table

Built-in digital pressure gauges, 24 VDC supply

		Digima FP	Digima FP Champion N	Digima FP small	Digima FP auto zero	Digima 19" auto zero	2-channel pressure measuring board
Accuracy	0.1 % f.s.		•				
	0.25% f.s.	•		•	•	•	•
	0.5 % f.s.						
Pressure ranges	2 mbar				•	•	•
	20 mbar	•	•	•	•	•	•
	200 mbar	•	•	•	•	•	•
	2000 mbar	•	•	•			•
	10 bar	•		•			•
For barometric applications	800...1200 hPa	•					•
Absolute pressure		•	•	•			•
Differential pressure		•	•	•	•	•	•
Relative pressure		•	•	•	•	•	•
Unit with	1 measuring range	•	•		•		•
Unit with	2 measuring ranges				•	•	
Unit with	2 measuring channels						•
Unit with	auto zero function				•	•	
Front panel installation		•	•	•	•		
19" boards	(3 RU with partial front plate)					•	•
LCD display		•			•	•	
LED display			•	•			
Standard signal outputs		•	•	•	•	•	•
± output signal possible		•		•	•	•	•
Non-standard output signal		•		•	•		
Serial interface RS 232			•				
Adjustable to/can be ordered for other engineering units		•	•	•	•	•	•
Selectable electronic damping		•		•	•	•	•
Available with limit value switch		•					
Available with square root extracting amplifier		•					

Digima FP „Champion N“

Where high measuring accuracy is required, the built-in pressure gauge Champion N with a measuring error of only 0.1% is the right choice. In addition to the analog standard signal it offers a serial interface.

Built-in unit with integrated sensor and 1 measuring range measuring error max. 0.1% f.s.

Supplied in DIN housing 96 x 48 mm, incl. retaining clamps, 4 ½ digit LED display, supply power 24 VDC, tare function (not on absolute pressure instrument) signal output 0...10 Volt, system integration via RS 232 C interface. (RS 485-interface on request)

Order No. Measuring ranges

1521	19.999	mbar/Diff
564	199.99	mbar/Diff
565	1.9999	bar/Diff.
567	1.9999	bar/Abs.

Digima FP "Champion N"



Digima FP auto zero

We recommend this instrument as a long-term stable unit for very low differential pressures, such as occur on pitot tubes, LFEs or throttles. This instrument eliminates zero-point problems. An "auto zero" circuit periodically corrects the measured result if the zero point should have changed due to temperature fluctuations or aging.

Digima FP auto zero



Built-in unit with integrated sensor and 1 or 2 measuring ranges, measuring error max. 0.25% f.s.

The basic unit comprises the pressure transducer with measuring amplifier in a DIN housing 96 x 48 mm, incl. retaining clamps, 24 V = power supply, LCD display and voltage output ±10 Volt, current output 0...20 mA as well a selectable damping.

Order No. Single range instruments with measuring ranges from

539	± 1.999	mbar/Diff.
540	± 19.99	mbar/Diff.
612	± 199.9	mbar/Diff.

Order No. Two-range instruments with measuring ranges from

615	± 1.999 and 19.99	mbar/Diff.
616	± 19.99 and 199.9	mbar/Diff.

Order No. Options

541	Built-in power supply 220 VAC (not for No. 539 and No. 615)
-----	---

746 Limit value switch with two adjustable switching points, externally selectable by logic signal, relay output, potential-free change-over contact with 2 A switching capacity

Applicable for all built-in digital pressure gauges Digima FP:

Order No.

600	Adjustment to other measured variable
542	Special scaling (x mbar = 10 Volt)
752	Traceable calibration certificate for pressure, one measuring range, initial calibration
2507	Traceable calibration certificate for pressure, two measuring ranges initial calibration

"Digima"® is a registered trademark of SI-special instruments GmbH.

Built-In Pressure Gauge for 19" Racks

Desktop housing for built-in digital pressure gauge "Digima FP"

All built-in pressure gauges, type FP, can also be supplied in a desktop housing with line power supply. These make for a robust test and measuring instrument in your workshop and development department.

Order No. **Extra charge**

- 613 Works installation of an FP unit in a desktop housing. Electrically wired and with ready pneumatic tubing. All signals connected to a plug. (Order the FP version with line power supply, Options No. 606) incl. all counter plugs
- 614 Works installation of an FP unit as No. 613, however, with built-in power supply 220 V AC to 24 VDC

Installation in desktop housing



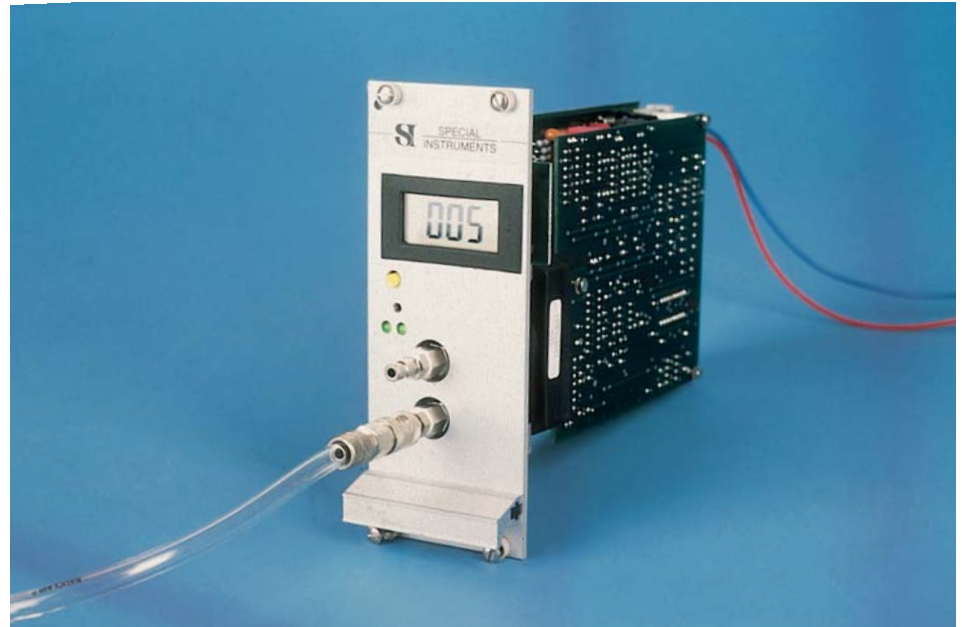
About variants and non standard items ...

This catalogue presents our standard programme, that is, standard instruments with defined properties. These products have an order number and a calculated price. Generally, they can be supplied short-term, within 1 or 2 weeks. But if you need our instruments with other measuring ranges or calibrated to another engineering unit, that is no problem. Such changes with calculable effort will be handled at fixed prices. This includes installation of front panel units in desktop housings as described above.

"But what if I need a combined unit for pressure and flow measurement in my company colors that operates on American line supply?"

Then you still are in touch with the right people. We are not irritated or shocked by such requirements. As a small, flexible industrial enterprise we are geared to fulfilling your wishes.

This is a signal of our readiness to adapt our products to solve your problems. Confront us with your problems! We will quickly and unbu-reaucratically present our quotation.



Digima FP 19" auto zero

19" technology has won a permanent position in the design of electronic measuring systems. Requiring very little space standard-size components allow building of complex systems. SI is one of the very few suppliers of electronic pressure measuring boards in Euro card format. These measuring boards allow uncompromising integration of pressure measurement into computerized 19" systems.

- 641 Submodule w/out digital display, 8 HP wide with selectable measuring ranges ± 19.99 mbar and ± 199.9 mbar
- 576 Submodule with digital display, 10 HP wide, 7-segment LCD display, 3 1/2 digit, (1999) 10 mm high with selectable measuring ranges ± 1.999 mbar and ± 19.99 mbar
- 642 Submodule with digital display, 10 HP wide, 7-segment LCD display, 3 1/2 digit, (1999) 10 mm high with selectable measuring ranges ± 19.99 mbar and ± 199.9 mbar

Inquire for submodules w/out "auto zero" function

Digima FP 19" auto zero

This unit for "low pressure" applications is designed as a submodule for a rack. Thanks to the "auto zero" function, it is stable over a long period of time. It incorporates the qualities of the built-in unit for DIN housings, but operates with a digital error correction memory. The "auto zero" function and switch-over of the measuring ranges can be remote controlled. Thus this assembly is easily integrated into measuring hook-ups and test devices.

Built-in unit with integrated sensor and 2 measuring ranges, measuring error max. 0.25% f.s.

The unit is designed as a 3 RU high 19" submodule. It incorporates the pressure sensor, a measuring amplifier, the "auto zero" circuit, the signal outputs with ± 10 Volt and ± 20 mA, as well as selectable damping of the measuring outputs. The assembly operates on a 24 VDC supply.

Order No.

- 575 Submodule w/out digital display, 8 HP wide with selectable measuring ranges ± 1.999 mbar and ± 19.99 mbar

Installation in desktop housing



Heavy-duty instruments for field application

When a team of engineers travels across the country to measure exhaust fume emissions precisely under inclement weather conditions, robust measuring instruments are a must.

For our customers we have packaged our "Digima FP 19" auto zero" modules into a robust, watertight die-cast housing. This instrument type has since made a name for its reliability. We'll be pleased to tackle your measuring problem, too.

2-Channel Pressure Measuring Board



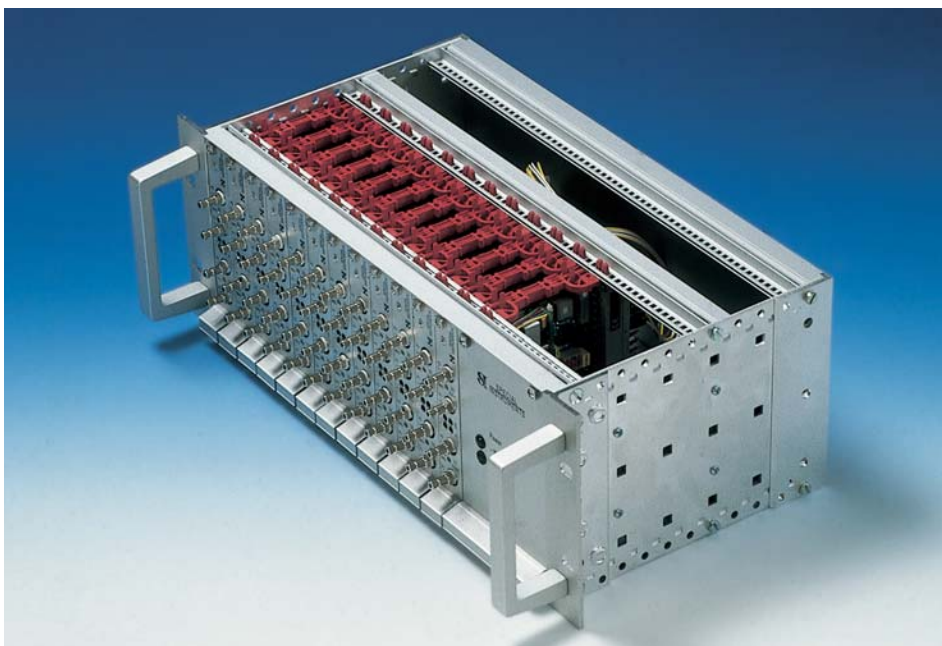
Pressure measuring boards in a 19" rack

This pressure measuring board - like many other SI products - has been developed to meet a customer's request. Today this customer is using many of these boards and measuring systems. The application will illustrate the advantages of this solution:

The customer is a large manufacturer of gas heaters. During final testing each heater is tested in a computer-controlled process to meet the specified QA programme. To acquire data from the multiple pressure measuring points, the company opted for the following procedure:

Use ready-wired 19" racks with many identical slots. Connect the output signals to an interface connector. Communicate the pressure measuring signals to a computer via a scanner.

Depending on the unit type to be tested, the rack is equipped with standardised pressure measuring boards.



The advantages of this system are:

- excellent price-performance-ratio
- accuracy, each board can be supplied with test certificate
- a large number of pressure measuring points can be processed on very little space
- modular design in 19" technology with short Euro card
- electrical and pneumatic plug connections

Since its introduction to the market these advantages have been understood and exploited by diverse institutes and companies.

A 2-channel pressure measuring board can be supplied with 2 pressure measuring channels. It is possible to provide one or two channels. The channels may be different. (Select standard ranges or request customer specific range). The total price for each board is made up of basic price and the cost of 1 or 2 pressure measuring channels.

Pressure measuring board in Euro card format, 3 RU, short with 100 mm depth, with anodised 4 HP aluminium front panel, labeled as equipped, 32pole connector rail according to DIN, front-side pressure connections with quick-action couplings. Supply voltage ± 15 VDC

Order No.

1893 Basic price for pressure measuring board
Pressure measuring channel in three-wire technology.
Signal output $0 \dots \pm 10$ V
adjustable variable signal damping
by low-pass filter,
measuring error max 0.25% f.s.
*max 0.5 % f.s.

Order No. **Measuring ranges**

1894	± 2	mbar / Diff.
1895	± 5	mbar / Diff.
1896	± 10	mbar / Diff.
1897	± 20	mbar / Diff.
1898	± 50	mbar / Diff.
1899	± 100	mbar / Diff.
1900	± 200	mbar / Diff.
1901	± 500	mbar / Diff.
1902	± 1	bar / Diff.
1903	± 2	bar / Diff.
1904	$-1 \dots 10^*$	bar / Diff.

1905	2000 mbar / Abs.
1906	800...1200 mbar / Abs. atmospheric air pressure

We also supply ready-wired racks according to your specifications.

Instrument selection table

Pressure transducers, 24 VDC supply

		Pressure transducer module 4	Pressure transducer 4 CL	Pressure transducer clic	Twin-pressure switch clic	Pressure transducer AP	Pressure transducer diff-cap	Pressure transducer baro-cap	Pressure transducer ATM/DTM	Pressure transducer DRS-XD	Pressure transducer DRS-WS
Accuracy	0.1 % f.s.								●	●	●
	0.25% f.s.		●	●	●	●	●		●	●	●
	0.5 % f.s.	●							●		
Total error or measured value	± 0.5 hPa							●			
Pressure ranges	1 mbar						●				
	2 mbar			●		●	●			●	
	5 mbar			●		●	●			●	
	10 mbar			●		●	●			●	
	20 mbar	●	●	●	●	●				●	
	50 mbar	●	●	●		●					●
	100 mbar	●	●	●		●					●
	200 mbar	●	●	●	●	●					●
	2000 mbar	●	●	●	●	●					●
	7 bar	●	●	●	●	●					
Diverse, between	100 mbar...1000 bar								●		
For barometric applications	800...1200 hPa			●		●		●			
Asolute pressure		●	●	●		●		●	●		
Relative pressure		●	●	●	●	●	●		●	●	●
Differential pressure		●	●	●	●	●	●			●	●
Two-wire technology, 4... 20 mA, standard signal		●	●						●	●	●
Three-wire technology, 0... 20 mA, 0...10 V standard signal				●	●	●	●		●	●	●
± output signal possible				●		●	●				
Non-standard output signal possible				●		●	●	●	●		●
Serial interface RS 232									●		
Selectable electronic damping				●	●	●	●				
Other pressure ranges/engineering units available		●	●	●	●	●	●		●	●	●
Available with limit value switches, max. 2 pcs.					●						
Available with square root extracting amplifier										●	●
For gaseous, non-aggressive media only		●	●	●	●	●	●	●		●	
For liquid media also, stainless steel version									●		●
Tube connections		●	●	●	●	●	●	●			
Screw-in thread									●		●
W/out housing		●									
Standard rail installation			●	●	●						
Enclosure type IP 65						●	●		●	●	●
Piezoresistive measuring cell		●	●	●	●	●			●		
Capacitive measuring cell							●	●			
Inductive measuring cell										●	●
High overload capacity at high static pressure							●			●	●
Available with explosion-protection									●	●	●
High-temperature version available (medium temp. 150 °C)									●	●	●

Pressure transducers convert the physical variable pressure into an electric output signal that is proportional to the pressure measured. The output may supply a current or voltage signal. In most cases it will be a standardized signal with defined level and adapted impedance. Standard signals allow to combine transducers, controllers, computers or stored programme controllers (SPC) of different manufacturers without incurring any problem. The standardization simplifies both our work as a manufacturer and yours as a designer or company operating instruments and systems.

Voltage signals are the most uncomplicated. An output level between 0...10 Volts is the most popular signal used. When the distance between transducer and evaluating device is short, and when there is little electromagnetic interference, the voltage signal 0...10 Volts can be used without second thoughts.

Current signals are generally used when the distance between transducer and evaluating device is long and when electromagnetic interference is expected. Transducers with current output supply a constant current related to the measured value. The correct current always flows, regardless of how high the electrical resistance of the measuring line is. Since current-driven measuring setups have less impedance than voltage-operated systems, noise and interference will have considerably less influence on them. The most widely used current signal level is 0...20 mA. You can use the advantages of this signal even if your system is not designed for current signals.

Tip: Connect a 500 Ohm resistor to a high-impedance voltage input! A 20 mA signal will then cause a voltage of exactly 10 Volt across the resistor.

More and more users realize and appreciate the advantages of the 4...20 mA current signal. A basic current of 4 mA represents the zero-point, while 20 mA represent the maximum or 100 % value. In addition to the other advantages of the current signal, a current < 4 mA can be defined to mean that a line failure has occurred. The most interesting advantage of the 4...20 mA signal comes into play when it is generated by a pressure transducer that functions in according to the 2-wire principle. The 4...20 mA signal - in this case also referred to as current loop - allows to achieve excitation and signal evaluation with just two wires.

Pressure Transducer Module 4

For this special technique, the 4 mA basic current is used to excite the transducer.

All other transducers operate with 3-wires. Two of these supply the excitation of the transducer. The third conductor carries the signal output. The negative conductor of the excitation voltage is generally also used as signal reference.

Unless indicated otherwise, SI products incorporate piezoresistive sensors. For normal accuracy and constancy requirements this technology allows practical devices at an excellent price-performance-ratio. However, if there are more stringent requirements concerning zero-point constancy and longterm stability, the physical limits of the piezoresistive sensor technology will be reached. This is especially true of low differential pressure or absolute pressure measurement in metrology. In such applications capacitive pressure transducers are the best choice. In these sensors, a diaphragm system forms an electric capacitor. When pressure is applied, the distance of the capacitor disks changes. The resulting change in capacitance makes the measuring voltage rise or fall proportional to the pressure. Sensors incorporating this classic measuring principle have unmatched characteristics and are among the best in measuring technology.

The differential pressure transducers, series DRS, operate with an inductive sensor system. Thanks to their construction these transducers feature high overload capacity and due to their mechanical design are capable of measuring lowest differential pressures at high static base pressure. (page 24)

We offer suitable instruments for excitation and display of the measured values supplied by pressure transducers. You will find different versions of these devices in this catalogue from page 60 on.

If you are not an electronics engineer or designer, or if you lack experience with electronic measuring technology, our explanations here will certainly not be sufficient! Do not hesitate to contact us! Our staff will be pleased to help you to come to a deeper understanding and will competently advise you concerning selection, planning and application of pressure transducers of diverse types.

The basis for the transducer module 4 is our pressure sensor module 1 supplying a standardised output signal. We have developed it into a 2-wire pressure transducer supplying a 4...20 mA standard signal.

The basic piezoresistive sensor used is excited by a precision constant current source. The bridge signal of the sensor is amplified by an instrument amplifier and then converted into a current of 4...20 mA, which is proportional to the pressure. Zero-point and measuring span are externally adjusted using a potentiometer. Based on the 2-point adjustment an accuracy of 0.25% f.s. is reached.

Pressure sensor and transducer circuit are made in a space-saving SMD design. The printed circuit is screwed to an aluminium block and sealed with O-rings. This assembly is rugged and has no mechanic influence on the sensor.

The transducer module can be directly flanged to devices or block constructions. This results in lowest dead volumes. Front panel installation meeting enclosure type IP 65 is likewise possible. In both installation variants the block is flanged to the unit with 2 screws and O-ring seals. The pressure source is connected at an M5 inside thread. This thread size keeps the design open to use of diverse connecting systems.

The available pressure ranges reach from 2 mbar to 7 bar for the differential pressure version. Absolute pressure measuring ranges reach from 200 mbar to 7 bar.

Transducer module, type 4, 2-wire system. (4...20 mA)
Sensor, SMD print with transducer electronics, robustly screwed to an aluminium connection block. Pressure connections with M5 threads,

Pressure sensor	piezoresistive
Measuring error	0.5% f.s.
Response time	$t_{90} \leq 2$ ms
Temperature range	0...50°C, compensated
Temperature error	0.02% f.s./°C
Media	all gaseous, non-aggressive media
Supply power	10...30 VDC
Burden	0...500 Ohm
Electr. connection	with 2 wires, red and blue
Pressure connections	M5 internal thread fitted with connections for 4x1 tube
Mech. fastening	diverse M3 threads at the front and underside
Installation position	any
Weight	40 grams
Dimensions	46.5 x 15 x 19 mm (L x W x H)

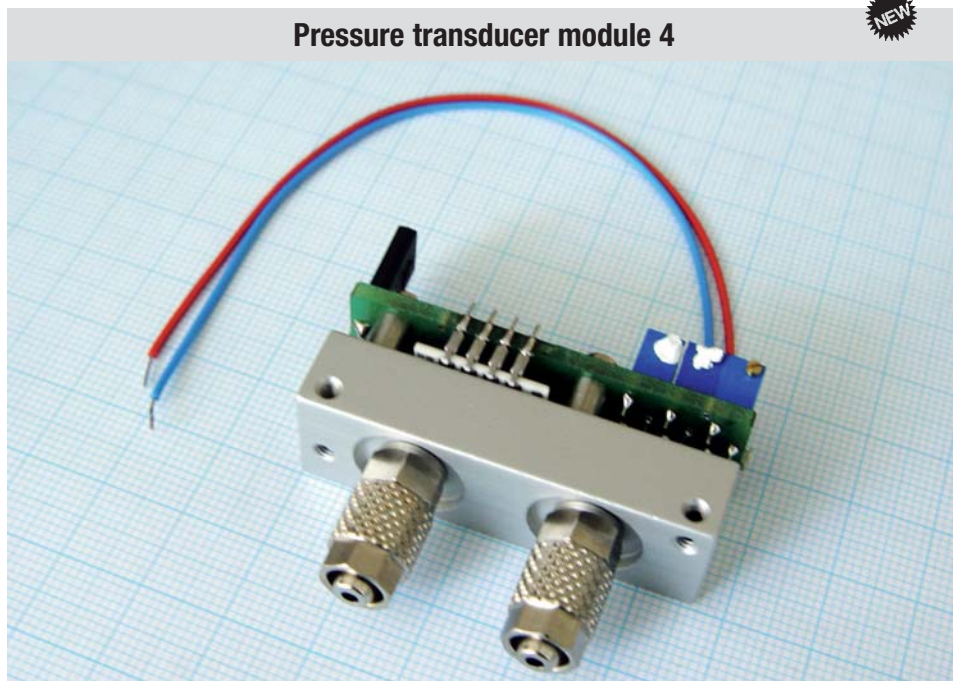
Available standard measuring ranges / differential pressure

Order No.	
2513	20 mbar / Diff.
2514	50 mbar / Diff.
2515	100 mbar / Diff.
2516	200 mbar / Diff.
2517	2 bar / Diff.
2518	7 bar / Diff.

Available standard measuring ranges / absolute pressure

Order No.	
2519	2 bar/ Abs.
2520	7 bar/ Abs.
542	Special scaling, $x \text{ mbar} = 4...20 \text{ mA}$ or $\pm \text{mbar} = 12 \pm 8 \text{ mA}$

Pressure transducer module 4



Pressure Transducers for Air and Gases



Pressure transducer 4CL

The pressure transducer 4CL is a sensor module 4 in a rugged black anodised aluminium casing. The pressure connections have M5 threads. In the factory they are equipped with connections for 4 x 1 tubes.

The electrical connections are wired to an M8 miniature sensor connector. We offer ready made connecting cables for this round connector.

Transducer, 2-wire system (4...20 mA current loop) shielded housing, M8 sensor connector pressure connections with M5 threads. Measuring error max. 0.25 % f.s.

Available standard measuring ranges / differential pressure

Order No.	
2521	20 mbar / Diff.
2522	50 mbar / Diff.
2523	100 mbar / Diff.
2524	200 mbar / Diff.
2525	2 bar / Diff.
2526	7 bar / Diff.

Available standard measuring ranges / absolute pressure

Order No.	
2527	2 bar / Abs.
2528	7 bar / Abs.

Options / accessories

0542	Special scaling x mbar = 4... 20 mA or ± mbar = 12 ± 8 mA
2529	Straight coupling M8
2530	Angle coupling M8
2531	Straight coupling with moulded on PUR line, 2 m long
2532	Angle coupling with moulded on PUR line, 2 m long

Installation option for standard rails

The pressure transducer 4CL can be used for fastening to standard rails, if it is ordered with the option order No. 2533.

2533	Mounting bracket with snap-on clip for standard rail mounting
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We are supplying traceable works certificates for any of our pressure transducers against payment.

752	Traceable works certificate for pressure, one measuring range initial calibration
-----	---

Suitable devices for excitation and display are found on catalogue pages 60 and 61.

"diff-cap"



This differential pressure transducer is equipped with a capacitive measuring cell. Even at lowest pressures this precision transducer functions with high-precision, noise free and long-term stable. We recommend to use this unit for measurements in connection with our laminar flow elements (LFE). Thanks to its design, this transducer is not destroyed even if the differential pressure rises to 1 bar. After such high overloading, however, the zero point must be readjusted.

Three-wire transducer, measuring error max. ± 0.25% f.s. Tempco < 0.025%/K, signal output ± 0...10 V or 0...20 mA or 4...20 mA, Housing enclosure type IP 65

Order No. Measuring ranges

725	± 0,5	mbar/Diff.
726	± 1	mbar/Diff.
727	± 2	mbar/Diff.
728	± 10	mbar/Diff.
730	± 20	mbar/Diff.

"baro-cap"

As the name already tells, this absolute pressure transducer is designed for the atmospheric air pressure range. The sensor is a capacitive system.

Measuring reliable atmospheric pressure values is important not only for meteorologists. Since the absolute pressure of a gas as a status parameter influences many physical formulas, precise measurement is of vital importance.

Transducer with wide atmospheric measuring range, three-wire system, highly accurate and longterm stable, 24 VDC excitation, signal output 0...5 V, total measuring error max. ± 0.5 mbar. (No other versions or measuring ranges are available)

Order No. Measuring range

731	800...1060 mbar
1324	600...1060 mbar

"baro-cap"



Pressure transducers “AP” and “clic”

These two transducer types are equipped with piezoresistive pressure sensors. Both types are furnished with a sophisticated universal electronic measuring amplifier. This circuit is capable of outputting a voltage and a current signal at the same time. When the pressure is negative, a negative measured value is output. A variable low-pass filter allows electrical damping of pressure pulses. Additionally, special scaling and measuring range extensions in the \pm range are available at low cost.

Pressure transducer “clic”



“clic”

The “clic” pressure transducer has been designed for installation on all popular assembly rails. Electrical connections and snap-on mounting resemble those of electrical switch-gear. Thus these pressure modules can be planned and processed just as easily. If you want to install this inexpensive transducer outside a control cabinet, a mounting plate can be supplied.

Three-wire pressure transducer, 24 VDC excitation, possible signal output ± 10 V / 0...20 mA / 4...20 mA measuring error max 0.25% f.s.
* max 0.5 % f.s.

Order No. Measuring ranges

1757	±	2 mbar / Diff.
1758	±	5 mbar / Diff.
1759	±	10 mbar / Diff.
300	±	20 mbar / Diff.
303	±	50 mbar / Diff.
304	±	100 mbar / Diff.
305	±	200 mbar / Diff.
308	±	...2 bar / Diff.
309	-	1...7* bar / Diff.
311		2 bar / Abs.
312		7* bar / Abs.
310		800...1200 mbar/Abs. air pressure

Order No. Options / available accessories

542	Special scaling (x mbar= full scale)
347	Mounting bracket for installation without standard rail

“AP”

Our pressure transducer AP is very robust and corresponds to enclosure type IP 65. This allows to install the transducer directly at the pressure measuring point, even if it meets with adverse installation and environmental conditions.

Three-wire pressure transducer, 24 VDC excitation, possible signal output
 ± 10 V / 0...20 mA / 4...20 mA
measuring error max 0.25% f.s.
* max 0.5 % f.s.

Order No. Measuring ranges

638	±	2 mbar / Diff.
210	±	5 mbar / Diff.
211	±	10 mbar / Diff.
212	±	20 mbar / Diff.
213	±	50 mbar / Diff.
214	±	100 mbar / Diff.
240	±	200 mbar / Diff.
241	±	2 bar / Diff.
1762	-	1...7* bar / Diff.
242		2 bar / Abs.
1763		800..1200 mbar/Abs. atmospheric air pressure

Order No. Options

542	Special scaling (x mbar= full scale)
1907	Connector instead of terminals and PG fittings
619	Power supply unit for 220 VAC/24 VDC for excitation of a transducer, IP 65 housing, flange-mounted.

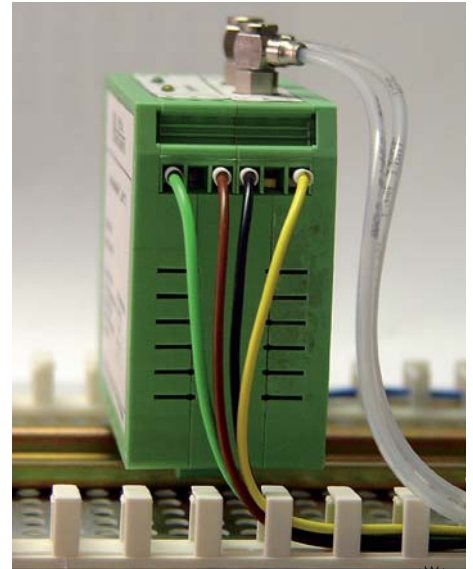
Pressure transducer “AP”



About compatibility with diverse media ...

All of the pressure transducers on these two pages are suitable exclusively for measurement of air and other non-aggressive and non-corrosive gases. Problematic gases and liquids will in the long run destroy the sensor and lead to faulty measuring results. The datasheets of the individual units contain detailed information on this. If you are in doubt, please contact us on the problem.

To measure aggressive gases or liquid media, we recommend to use transducers with media separation. The separation is achieved by a separating diaphragm and use of stainless steel. Choice of sealing materials adapted to the task at hand is obligatory. Such pressure transducers are our types ATM and DRS found on the catalogue pages 22 to 25.



Twin pressure switch “clic”

There is an addition to our programme of pressure transducers for standard rail assembly. In addition to the analog signal output these new pressure switches feature two adjustable limit values. The switching points can be adjusted finely between zero and the end of range value. Two floating switch-over contacts with 2 A/ 24 VDC switching capacity are integrated for switching. The piezoresistive sensor of the unit responds fast and with high precision. The pressure connections have M5 threads. In the factory they are equipped with connections for 4 x 1 mm tubes.

- Versions for differential and absolute pressure measurement are available.
- Colour LED indicates the trip point
- Standard signal output 0...10 V for measuring.
- To aid in adjustment the voltage of the limit value potentiometers can be measured from outside.
- The hysteresis can be set at a DIP switch
- One channel can be inverted, to allow achieving the function of a “window comparator”.

Three-wire pressure transducer, 24 VDC excitation, signal output 0...10 V, measuring error 0.25% f.s.
2 independently adjustable trip points
standard rail mounting

Order No. Measuring and switching ranges

2534	20 mbar/Diff.
2535	200 mbar/Diff.
2536	2000 mbar/Diff.
2537	7 bar /Diff
2538	2000 mbar/Abs.
2539	7 bar/Abs.

Order No. Accessory

347	Mounting bracket for installation without standard rail
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Screw-in transducer ATM

In some applications a pressure transducer with media separation is required or is the superior solution technically. This is particularly true of high pressure measurement, measuring of liquid or aggressive media and installations in the process environment.

For all of these measuring tasks ATM transducers are the best choice.

Product properties

- Piezoresistive measuring cell for relative or absolute pressure measurement
- Compact and robust stainless steel version 1.4435 (316L)
- Measuring ranges according to the DIN line between 0...50 mbar and 0...1000 bar
- Special calibration to all popular measuring units and output signals possible
- Conforms to EMC Directive 89/336/EEC
- High reliability
- Short delivery periods, even for customer specific versions due to modular design
- Reverse voltage and short-circuit protected, with integrated surge absorber
- Transducer version for medium temperatures up to 150 °C available

ATM transducers are designed modularly and are custom-made to meet your specifications. The delivery periods nonetheless are short. So just compose your ideal transducer. The total price results from the price of the basic unit and the extra cost for the different options selected.

Order No.	Basic unit
1908	Relative pressure transducer ATM
1909	Absolute pressure transducer ATM

Standard measuring ranges

100	mbar
160	mbar
250	mbar
400	mbar
600	mbar

1	bar
1.6	bar
2.5	bar
4	bar
6	bar
10	bar
16	bar
25	bar
40	bar
60	bar
100	bar
160	bar
250	bar
400	bar
600	bar
1000	bar

Order No.	Charged extra
2738	50 mbar/ rel. type
0542	Special calibration (x bar = full output signal)

When ordering be sure to indicate pressure range + connecting thread + plug type + output signal + options

Available standard connecting threads:

RP ¼"	Inside thread	Fig. 1
G ¼"	Outside thread	Fig. 2
G ½"	Outside thread	Fig. 4
G ¾"	Pressure gauge DIN 16288	Fig. 3
G 1"	Pressure gauge DIN 16288	Fig. 7
NPT ½"A	Outside thread	Fig. 8

Order No.	Charged extra	
1911	G ½"	Diaphragm on front side Fig. 5
1912	G ½"	Flush with front Fig. 6

Available plug connections

New: The mating connector is included in our scope of supply!

Round plug Binder, 5pole	Fig. 11
Cube plug DIN 43650, IP65	Fig. 10

Order No.	Charged extra	
1913	Round plug Binder 5pole installed to screwed cap, allows opening of the transducer for recalibration, enclosure type IP 67	Fig. 12

1914	Plug to MIL C 26482
1915	Cable permanently connected
1916	PUR cable per metre
1917	Teflon cable per metre

Available standard output signals:

0...5	VDC	Three-wire system
0...10	VDC	Three-wire system
0...20	mA	Three-wire system
4...20	mA	Two-wire system

Order No.	Charged extra	
1918	4...20 mA	Two-wire system with overvoltage protection (lightning)

Supplied standard accuracy

< 0.5% of end of scale value

Order No.	Charged extra	
1920	< 0.25% of end of scale value	
0969	< 0.1% of end of scale value (not for transducers with measuring range < 100 mbar)	

Standard temperature range

0...70 °C compensated
(admissible medium temperature 0...80 °C)

Order No.	Charged extra	
1922	- 25...85 °C compensated	(admissible medium temperature -25...100 °C)
1923	- 25...85 °C compensated	(admissible medium temperature -25...150 °C)

Order No. Miscellaneous options

1924	Throttle bore (only possible for pressure connections shown in Fig. 2, Fig. 4, or Fig. 7)
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Order No. Additional mating connectors

663	Round plug Binder, Series 723, 5pole
1925	Plug Binder, Series 723, 5pole, IP 67
1926	Round plug Lumberg,
1927	Cube plug DIN 43650, IP 65

Screw-in transducer ATM



Screw-in Transducer ATM/ex

These pressure transducers are required for application in environments entailing an explosion hazard.

This device features the same properties as all ATM 2-wire transducers, but additionally, it is approved for application in environments with explosion hazard due to its design with "failsafe" properties according to class EEx ib IIC4. The definition for this protection class is that no spark and no thermal effect of the 4...20 mA current loop may cause ignition of an explosive atmosphere during normal operation or in case of failure. The application in zone 1 is approved by Kema certificate No. Ex-92.C.9073

Order No. **Charged extra**

1928 ATM transducer with explosion protection



High-temperature version



If the medium temperatures rise above 100 °C, popular pressure transducers can no longer be used, since the electronic components of the measuring cell and the amplifier are heated up excessively. However, with this heat sink design the transducer can operate at a medium temperature of up to 150 °C without incurring problems.

Order No. **Charged extra**

1923 - 25...85 °C compensated
(admissible medium temperature -25...150 °C)

Screw-in transducer DTM

Our stainless steel screw-in transducers are also available with a digital serial interface. You can choose the classic RS232C interface for point-to-point connections or the RS 485 interface. This interface can operate on a bus and allows to address and query up to 32 transducers using one computer.

All DTM pressure transducers ≥ 0.5 bar are supplied with a standard accuracy of $\pm 0.1\%$ f.s.. The lower measuring ranges are only available with an accuracy of $\pm 0.25\%$ f.s.

DTM transducers are identified by unique serial numbers. Additionally the user can freely select his own identification. The measured value integration time is adjustable in the range between 1 ms and 20 s.

Order No. **Charged extra**

2540 Signal output RS 232 C
2541 Signal output RS 485

Typical applications for ATM and DTM transducers include:

- Machinery and plant systems
- Process industry
- Environmental applications
- Food stuffs industry
- Mobile hydraulics
- Testing and calibration

We are supplying ATM pressure transducers with:

- Special seals
- Special oil filling
- DIN or milk flanges
- As dip or level probes
- Integrated limit value switches

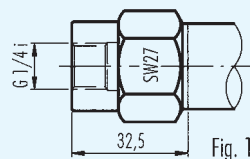
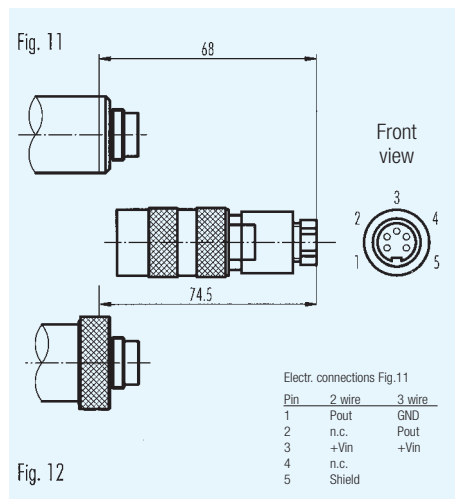
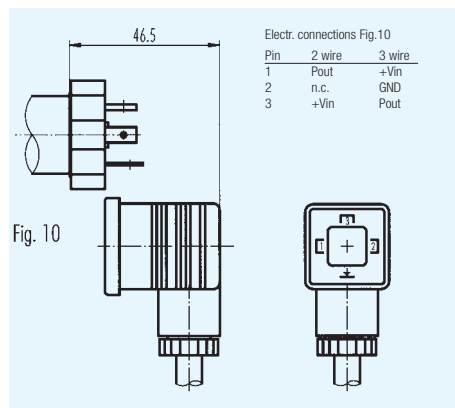


Fig. 1

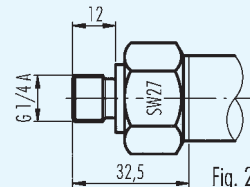


Fig. 2

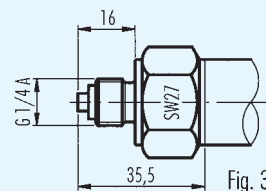


Fig. 3

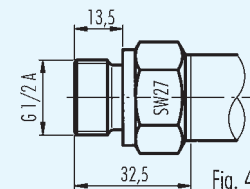


Fig. 4

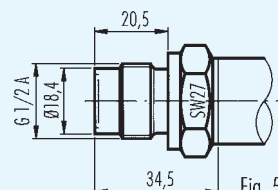


Fig. 5

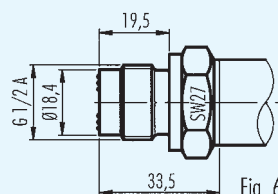


Fig. 6

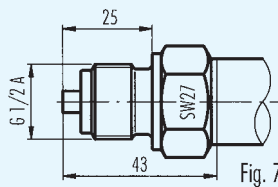


Fig. 7

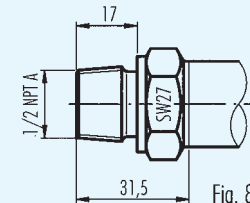


Fig. 8

If you require ready made connecting cables, please let us have the specification. We will be pleased to quote on it.



Differential pressure transducers DRS

LVDT functional principle

Differential pressure transducers, type DRS, work with an inductive measuring cell according to the LVDT principle (linear variable differential transformer). This transformer consists of a primary and two secondary coils which are arranged on either side of the primary coil. The measuring system generates a linear electrical output signal, if the mechanical position of a core moving inside the coils changes. When the primary coil is supplied with alternating current, alternating current voltages are induced in the two secondary coils. Since both secondary coils are switched in line with a phase shift of 180°, the output signal is zero when the core is centered. As soon as the core is shifted from the centre, the magnetic coupling between the primary and secondary coils changes. The output voltages of the two secondary coils no longer compensate one another. This results in a position related output signal with \pm sign. The two separation diaphragms of the differential pressure transducer DRS are connected. Their pressure-related movements thus directly lead to a signal output that is proportional to the pressure.

The differential pressure transducers, series DRS, are suitable for measurement of gases and liquids. The transducers allow measurement of low differential pressures at high system pressures. Additionally, the devices feature a high overload capacity on one end. Comparable differential pressure transducers with these qualities are much larger. For a user of differential pressure flow measuring instruments or manufacturer of leakage testers based on the differential pressure principle, the product qualities mentioned will be interesting. In such applications DRS unfolds its advantages.

Positive features of the DRS transducer:

- Lowest measuring range 1.6 mbar/Diff
- High accuracy (available for up to 0.1% f.s.)
- Compact design
- Low dead volumes
- Stainless steel construction
- Media separation by means of diaphragms
- Standard signal outputs

Accuracy
 $\pm 0.25\%$ f. s. (non-linearity and hysteresis)

Electrical connection
DIN cube plug (DIN 63650)

Pressure connections
2 x 1/8" inside thread (BSP)

Materials
housing, diaphragms of stainless steel 1.4316

Signal outputs
voltage or current signals, linear
voltage or current signal, square root extracted

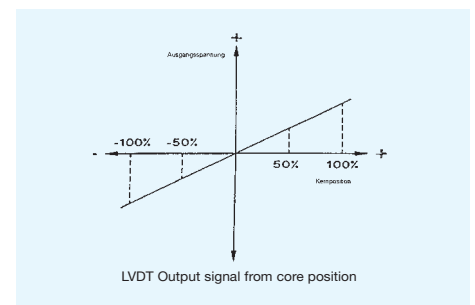
Damping
0.4 s analog RC module
(longer time constant upon request)

Dimensions
55 mm diameter, approx. 150 mm long

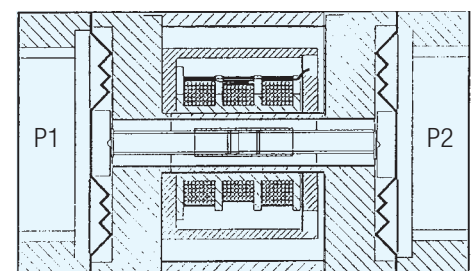
Excitation voltage
8...30 V two-wire system
15...30 V three-wire system

Operating temperature
transducer electronics $-10...+70\text{ }^{\circ}\text{C}$

Temperature error
measuring span (0...50 $^{\circ}\text{C}$) $\pm 0.02\%$ f.s. / $^{\circ}\text{C}$
zero point (0...50 $^{\circ}\text{C}$) $\pm 0.02\%$ f.s. / $^{\circ}\text{C}$



Since the forces acting on the two transducer ends compensate one another mechanically, high pressures may be applied to either side of the transducer. If one end is overloaded, the corrugated diaphragm reaches its mechanical end position and seals the oil filled connecting channel between the two diaphragms. Since the oil filling trapped behind the diaphragm cannot be compressed, high overloading capacity on only one end is likewise achieved.



Cross section of differential pressure transducer

DRS - Type XD



Differential pressure transducer with media separation, due to materials used only suitable for clean, non-corrosive gases

Measuring ranges 1.6 mbar...24 mbar/Diff.

High overload capacity, 25 bar on both ends
above 1.6 mbar measuring range 1 bar on one end
above 4 mbar measuring range 3 bar on one end
above 10 mbar measuring range 5 bar on one end

Order No. **Basic unit**

2542 DRS/XD ≤ 10 mbar measuring range

2543 DRS/XD > 10 mbar measuring range



DRS - Type WS

Differential pressure transducer with media separation, stainless steel diaphragms, for gases and low-viscosity liquids, "wet/wet" approved. Behind the diaphragm the sensor system is filled with silicone oil.

Measuring ranges 24 mbar...6 bar/Diff

High overload capacity, 25 bar on both ends
≥ 24 mbar measuring range 5 bar on one end
≥ 40 mbar measuring range 10 bar on one end

Order No. **Basic unit**

2544 DRS/WS

When ordering please indicate

Output signals/linear
0-5 V, 1-5 V or 0-10 V three-wire system
0-10 mA, 0-20 mA three-wire system
4-20 mA two-wire system

Output signal/square-root extracted
0-5 V, 1-5 V or 0-10 V three-wire system
0-10 mA, 0-20 mA three-wire system
4-20 mA two-wire system

Order No. **Extra for DRS options**

2545 Higher accuracy 0.1 % f.s.

2546 Special version for hydrogen applications

2547 Explosion protected version EEx ia II C T6
4...20 mA current loop
(in preparation)

2548 High-temperature version up to 150 °C
medium temperature
(in preparation)

Special versions with other specifications are possible upon request

Our computing software for PCs is readily accepted by our customers. It costs little money and keeps helping you daily. The first time you brood over a problem, the programme is paid. Now a new extended version of the pressure drop programme is available.

Engineering units converter

Conversion tables continue to be used widely in both office and workshop. This programme allows to convert numerous physical variables to virtually all standard engineering units. And it's fast. Of course you will also find all popular physical measured variables connected to pressure and flow measurement as well as a number of unknown engineering units.

Pressure drop

This programme offers a host of solutions to all those who deal professionally with pressure and flow. The software aids in solving application problems safely and physically correct. Using this software you don't need to be a mathematician to get correct results.

"Pressure drop" computes pressure drop caused by friction in liquids and gases flowing through pipes. Additionally you can compute pressure changes caused by geodetic height (rising pipes) and change in the kinetic energy. Besides pressure drop in simple pipes, you can also compute pressure drop caused by piping elements (change in flow direction etc.) and by diverse types of armatures (valves, expansion compensators).

The individual elements may be combined in any order and the overall pressure drop be computed. The computing results are output to a detailed, sortable computing table or to a concise computing display. The entire computing table may be copied to a spreadsheet programme (e. g. Excel) for further processing. In computing pipes, the programme handles both laminar and turbulent flow patterns. In computing piping elements (valves etc.), only turbulent flow patterns can be handled.

To be able to compute pressure drop, the programme needs data about the pipeline (internal diameter, roughness...) and about the media (density, viscosity).

For popular pipelines and many liquids and gases this data can be adopted from several databases incorporated in the programme. Part of these databases can be extended by the user as needed. A user-defined database allows saving of materials data of media used and retrieval for computing. In addition to these basic functions pressure drop offers the following functions:

- Rapid specification of pumps
- Database with pipe data according to diverse DIN and ANSI standards
- Calculation of pressure drop depending on the volume flow. (Display and printing of the characteristic curve)
- Computing of an economic pipe diameter for a given flow rate
- NPSH-calculation with integrated database for the required materials data (steam pressure and density)
- Computing of pipeline contents and filling time for an entire system or system section
- Conversion of the volume flow into flow velocity and vice versa for a given pipe diameter
- Conversion of standard m³ into operating m³
- Conversion of kv value into zeta value
- Conversion of Cv value into zeta value
- Input and output of data for piping elements and medium in diverse metric and US engineering units
- Zeta value database, can be extended by user as needed.
- Saving and loading of project files.

In a text section the mathematical formulas employed by the programme are explained. It also points to literature for further reading.

We can also supply the pressure drop software with operator interface in English. It can process metric and Anglo-American engineering units.



Both programmes are supplied on a CD. They run under Windows 98/ME/NT/ 2000/XP

Order No. **PC software**

1505	Engineering units converter	German
2549	Pressure drop	Vers. 6.0 German
2550	SF pressure drop	Vers. 6.0 English

Accessories

Anyone employing air as test or measuring medium, must rely on a host of accessories. Tubes, nipples, couplings and much more must be acquired for each measurement. Any technician probably remembers many times when he had the wrong connector or missed the proper thread size. Expensive working hours are lost searching and tailoring hardware. That is in no sound relation to the host of inexpensive helpers that should not miss in any workbench. If you order such articles right along, you will save time and have one acquisition source less.

Order No. Tubes

- 207 Silicone tube, highly flexible, 3 x 1.5 mm, for up to 0.3 bar
- 044 PVC tube, transparent, 4 x 1 mm, for up to 2 bar
- 344 PVC tube, with fabric inlay, 4 x 1 mm, for up to 10 bar
- 706 PU tube, 4x1 mm, for up to 10 bar

Tube dimensions = inside diameter x wall thickness

Order No. Quick-action couplings

- 097 Quick-action coupling, shut off in one direction, for tube 4 x 1 mm
- 718 Quick-action coupling, shut off in one direction, for tubes 3 x 1.5 mm
- 719 Receptacle for quick-action coupling, screw-in type M5

Order No.

- 219 Hydrophobic filter, for sensor protection; inserted into a tube size 6/4 mm, it allows gas exchange, but penetration of liquids is prevented.

Order No. Tube connectors

- 1889 Tube connector 1 connects tubes with 3 - 6 mm inside diameter to tubes with 7-10 mm inside diameter.
- 215 Tube connector 2 connects tubes with 3 - 6 mm inside diameter to tubes with 10-12 mm inside diameter.
- 217 Tube connector 3 connects tubes with 3 - 6 mm inside diameter to tubes with 3 - 6 mm inside diameter.

Prior to shipment all of our battery-operated instruments are furnished with batteries. You can immediately start working with your instrument. The new NiMH rechargeable batteries meanwhile reach the same battery life per charge as does a good alkaline manganese battery. Therefore, you may wish to equip your devices with these NiMH rechargeable batteries of the same size! The higher price is amortised after only a few charging cycles. Plus, these rechargeable batteries are more compatible with the environment.

Order No. Rechargeable batteries and charger for series 2

- 2651 9 V NiMH rechargeable battery (Varta)
- 079 Plug-in charger for 9 V rechargeable battery

Rechargeable batteries and charger for series 3

- 2511 Package with 2 pcs. 1.2 V NiMH rechargeable battery capacity: 2300 mAh, international size LR 6 (Mignon) "charge and go" type, for 15 minutes charging time

- 2512 Plug-in charger for 2 pcs. 1.2 V rechargeable battery NiMH "charge and go" type, wide-range power supply 120...240 VAC, 50...60 Hz, incl. 2 pcs. rechargeable battery

Order No. Plug-in power supply with jack connector

- 953 Plug-in power supply for premo/ UNI/ prelo 2 instrument
- 2250 Plug-in power supply for premo/ UNI/ prelo 3 instrument

Order No. Cable and adapter

- 2249 Interface cable RS232 to SUB D9 female connector for connection to round plug, SI instruments series premo3, prelo3 or LPU 3 5 m long

2510 Interface converter RS232 to USB

Interface cable with 9pole SUB D9 male connector to USB plug. Cable length 120 cm. The interface converter is excited via the USB plug.

Instrument cases



If you take our portable instruments out to the field, suitably sized cases are a must to protect the units.

Order No. Cases

- 1849 Plastics storage and transport case small, with molded insert, space for one pocket instrument with little accessories
- 378 Plastics storage and transport case, large, with molded insert, space for one pocket instrument and more accessories, a test pump if needed...

(Please state device type when ordering!)

Order No. Volumes

- 708 Volume 50 cm³,
- 2551 Volume 100 cm³

Order No. Thread adapters

- 2552 G ½" inside thread to G1/4" inside thread
- 2553 G ¼" inside thread to G 1/8" inside thread
- 2554 G ½" outside thread to G 1/4" outside thread
- 2555 G ¼" outside thread to G 1/8" outside thread

Order No. Seals

- 2556 Seal ring 1/2"
- 2557 Gasket 1/4"
- 2558 Gasket 1/8"

Information:

All tube connections on our portable and stationary instruments preferably have an M5 inside thread. In the factory we are equipping these with quick-action couplings and supply receptacles for 4x1 tubes free of charge. If you are using a different tube system in your company, the connectors can easily be replaced.

Accessories

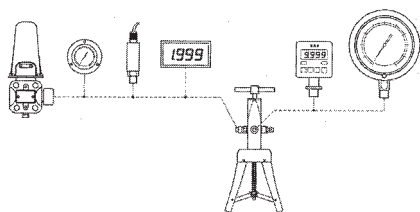


Pressure Calibration Equipment

Hand-held test pumps are ideal tools allowing to generate test pressures without complicated technology. Especially in mobile applications there is no replacement for this type of pump. We are supplying various kinds of air test pumps for positive and negative pressures. All versions generate the pressure by means of a single-stage piston pump. They are finetuned with an adjusting knob changing the volume by means of spindles and pistons. A drain valve is provided for quick reset to zero.

For calibration, the pressure measuring instrument and a more accurate reference instrument – the utility or works standard – are connected to the pump. Adjusting different test pressures allows to compare the reference unit and the test object enabling calculation of the measuring error of the test object.

In our catalogue you will find numerous suitable electronic reference units in diverse accuracy classes.



Hand-held test pump "Vario"

Due to the special design of the vario section, this test pump can be adjusted very finely. Although it can generate pressures up to 15 bar, values of only a few mbar can also be adjusted reproducibly. If the test volume is not too high, even low vacuum pressures of up to -200 mbar can be built up due to the expansion of the vario section.

- Order No.
- | | |
|------|--|
| 1147 | Hand-held test pump, type "Vario" for pressures up to 15 bar/-0.2 bar test object and reference instrument connections furnished with quick-action couplings |
| 1406 | Plastic transport and storage case with molded insert for pump "Vario", additional space for a digital pocket pressure gauge. |

Hand-held test pumps for low pressures, type 29

Depending on the task at hand There are test pumps for positive and negative pressures.

- Order No.
- | | |
|-----|---|
| 376 | Hand-held test pump, type 2911 for pressures up to 5 bar |
| 377 | Hand-held test pump, type 2941 for vacuum |
| 378 | Plastics transport and storage case with molded insert for pump type 29, additional space for a digital pocket pressure gauge |

... for low pressures, type 29



Hand-held test pump, series LPP 30



The hand-held test pump LPP 30 is the successor of the test pump TP1 we had in our delivery programme for many years. The new pump is more robustly designed than the earlier model. The new pump can achieve test pressures up to 35 bar.

The reference measuring instrument is screwed to the pump on the top (G1/2" inside thread) and the test object is connected via the connecting tube.

with G1/4" inside thread. With optional adapters the connections can be adapted to diverse threads.

- Order No.
- | | |
|------|--|
| 2559 | Hand-held test pump, type LPP 30 for generation of pressures of up to 35 bar max. switch-over to vacuum up to -0.95 bar max. Reference instrument connection G1/2" inside, Test object connecting tube G1/4" inside thread, with connecting tube included. |
| 2560 | Plastic case with foam inserts, fitting for LPP30 pump with cut-outs for reference unit, adapters and seals. |
| 2561 | Maintenance kit (O-rings, seals...) |
| 2562 | Adapter for reference instrument connection G1/2" to M5 inside thread |
| | Adapter for test object connection G1/4" |
| 2563 | BSP Adapter incl. O-rings |
| 2564 | NPT Adapter kit incl. O-rings |
| 2565 | Metric adapter kit incl. O-rings |
| 2566 | M5 Adapter incl. O-ring |

Pressure Calibrator DKG-4

The pressure calibrator DKG-4 is a combination of pressure transducer and digital pressure gauge. The design of both components has been adapted to another, but if necessary, they can also be used individually. The calibration case is suitable for all calibration tasks up to a pressure of max. 1 bar above atmospheric pressure.

The required test pressure is adjusted by means of a hand-held pump and a bellows system. The hand pump is used for coarse pressure adjustment. The bellows system allows finetuning of the test pressure. The volume of the metallic bellows is adjusted using a hand wheel and spindle. This method allows precision adjustment of the diverse pressure calibrating points with high accuracy and reproducibility. Even lowest pressures in the mbar range can be adjusted easily. A manually operated relief valve allows fast venting of the pneumatic system.

The pressure calibrator DKG-4 is marked by its very simple, straight-forward operation. The pressure reference and the pressure adjustment are functionally integrated in a compact case. It serves as both housing and transport vehicle for mobile application. The unit is battery-powered and allows more than 40 hours of operation independent of line supply.

The main application for the DKG-4 case is the calibration of blood pressure measuring instruments.

Calibrator for blood pressure measuring instruments

For this application of the calibrator, the electronic digital pressure gauge "Digima UNI3" type 2231 is used in conjunction with it. It has selectable measuring ranges of 0...400.0 mmHg (torr) and 0...600.0 mbar. With its error limit of 0.8 mmHg or 1 mbar, respectively, and the digital display with one fractional part digit it meets the requirements of the LMKM and the (German) Medizingerätebetriebsverordnung (medical appliances users regulation). To allow traceable calibrations, the reference pressure gauge "UNI3" is supplied with a traceable works certificate.

In connection with the pressure calibrator DKG-4 all medical appliances can be tested and calibrated in the pressure range indicated, e. g. pressure transducers for invasive blood pressure measurement, standard sleeve-type blood pressure measuring instruments, ventilators and respiratory pressure monitors. The case offers space for task-oriented accessories.

Optionally, a compensation vessel and a calibrated temperature transducer for resistance thermometers are available. These practical features make the DKG-4 instrument the ideal tool for medical device service technicians both in the workshop and out in the field.

Calibrator for general applications

The DKG-4 has also proven reliable for inspection and test applications in fields other than medical appliances. To achieve the desired pressure measuring range the slot in the case can be equipped with the appropriate UNI 3 reference unit. (This unit type is described in more detail on page 13 of this catalogue)

If the devices you need to calibrate operate in the pressure range <1000 mbar, DKG-4 is a most practical and cost-effective solution.

Order No.

- | | |
|------|--|
| 2335 | DKG-4 Calibration case with manual pressure generation and a slot for a battery-operated digital pocket pressure gauge "Digima UNI3" |
| 2418 | Additional compensation vessel, 500 ml |
| 2419 | Calibrated temperature transducer, type WMG-4 |

Order No.

- | | |
|------|---|
| 2231 | Digital pocket pressure gauge "Digima UNI3" with 2 measuring ranges 400.0 mmHg and 600.0 mbar
measuring error > 0.8 mmHg or 1 mbar.
Measured value resolution with 1 fractional part digit.
Push-button zeroing.
Supplied incl. traceable calibration certificate |
|------|---|

Other instruments available for calibration purposes with...

- | | |
|--|---|
| Measuring error in partial range 10...100% | < 0.1% f.s. |
| Measuring error in partial range 0... 10% | < 0.025 f.s. |
| 2224 | Digital pocket pressure gauge "Digima UNI3" measuring range ± 20.000 mbar/Diff. |
| 2225 | As above, measuring range ± 200.00 mbar/Diff. |
| 2226 | As above, measuring range ± 2000.0 mbar/Diff. |
| 2567 | Traceable calibration certificate for pressure measuring instrument UNI 3, recalibration for main and partial range |

Pressure Calibrator DKG-4





Pressure reference unit "Digima ULTRA"

This new pressure reference unit replaces our pressure transfer standard DTS 202.

In many a sales discussion we found that users are confronted with a dilemma. On the one hand their work calls for reference units of high accuracy, on the other hand their budget is too low to afford such accuracy.

With the development of "Digima ULTRA" we have addressed this problem. The new instrument is highly accurate and still favourably priced. Our experiences in sensor and microprocessor technology have enabled us to develop a problem solution and offer favourably priced pressure reference units.

An artificially aged piezoresistive measuring cell with stainless steel diaphragm and silicone oil filling serves as pressure transducer. This cell is precision calibrated at diverse pressure and temperature conditions. The deviations from the ideal condition are traced and saved. These curves are then saved in a correction table.

While measuring, the unit's processor reads the pressure and the correction value and continuously uses these to generate a high-precision measuring signal. The error limit in the temperature range between 10...30 °C is only 0.02% of the full scale value of the instrument. (This error incorporates the nonlinearity, hysteresis, repeatability and the temperature influence.)

The longterm stability is excellent. A DKD calibration certificate (21 measuring points upwards and downwards) is supplied with the reference unit.

Data interface

The unit offers a real bi-directional RS 232 interface operating at 19200 baud. It is protected against overvoltage and failures (ESD). This serial interface allows to read out the complete display content (measured value, decimal point, sign and measured variable). Additionally, the unit and all its functions can be remote controlled via this digital port. A command interpreter for this purpose is provided. If you want to integrate the device into an automatic measuring system, you will value this feature.

Power supply unit

The "Digima ULTRA" reference unit is supplied with 3 V direct current. Four 1.5 V Mignon cells (AA) allow an operating time of approx. 16 hours. For stationary operation, the unit can be supplied from a plug-in power supply unit. When a power supply unit is connected, the integrated battery supply is automatically switched off.

Information:

A stationary instrument with the same features and an integrated automatic pressure source is in development and will be available in course of the year 2007.

Device features

Housing	aluminium housing 235 x 170 x 55 mm (length x width x height)
Operation	via membrane keyboard
Display	LCD, alphanumeric, 2 lines with 16 characters each
Error limits	incl. linearity, hysteresis, repeatability and temperature influence
10...+ 30°C	Total error ± 0.02 % f.s.
0...+50 °C	Total error ± 0.04 % f.s.
Pressure measuring units	selectable: psi, bar, mbar, hPa, kPa, MPa, InHg, InH ₂ O, ftH ₂ O, cmH ₂ O
Initial calibration	DKD calibration included
Analog output	0...1 V (16 bit resolution) at 4 mm banana jacks
Data interface	RS 232, 19200 baud, 1 start bit, 8 data bits 1 stop bit, no parity bit at 9pole SUB-D plug, male
Polling rate	approx. 20 measurements/s
Damping	adjustable, floating mean value averaging
Pressure connection	G ½", inside thread
Overpressure connection	electronic overload monitoring, pressure relief of the sensor by solenoid valve, normally open, can be reset manu- ally after tripping.

Order No. Measuring ranges/positive pressure

2442	0... 5 psi/g	(0...350 mbar/rel)
2443	0... 15 psi/g	(0... 1 bar/rel)
2444	0... 30 psi/g	(0... 2 bar/rel)
2445	0...100 psi/g	(0... 7 bar/rel)

Order No. Measuring ranges/absolute pressure

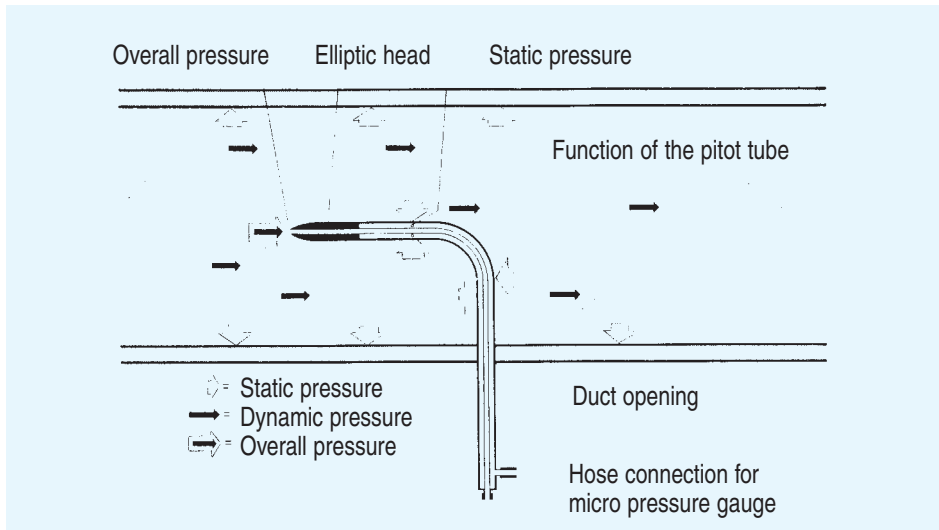
2446	0... 15 psi/a	(0... 1 bar/abs)
2447	0... 30 psi/a	(0... 2 bar/abs)
2448	0...100 psi/a	(0... 7 bar/abs)

Order No. Accessories

2511	Package with 2 pcs 1.2 V NiMH-rechargeable batteries, capacity: 2300 mAh, international size LR 6 (Mignon) "charge and go" type, for 15 minutes charging time
2512	Plug-in charger for 2 pcs 1.2 V rechargeable battery NiMH type "charge and go" wide-range power supply 120...240 VAC, 50...60 Hz, incl. 2 pcs rechargeable battery
2250	Wide-range plug-in power supply (100...240 VAC), stabilised 3.3 VDC with jack connector

Order No. Re-calibration (DKD)

1983	for positive and absolute pressure ranges Instrument with 1 measuring range, calibration with 21 measuring points (upward and downward)
------	---



Hardly any other physical measuring method has a longer tradition than the combination of pitot tube and inclined-tube pressure gauge. As a fundamental measuring method it is an integral subject in the education of engineers and is described in many technical handbooks. If you consider pitot tube measurement today, however, you should replace the inclined-tube pressure gauge by a modern electronic differential pressure measuring instrument. This setup eliminates the disadvantages of the sensitive fluid-filled glass tubes.

Pitot Tubes

In principle, a pitot tube is a thin tube exposed to a flow concentrically. For practical considerations this tube often is angular at the end, allowing it to be held in the flow direction more easily. If the end of the tube, which is exposed to the flow, (the pitot tube head) is shaped aerodynamically (elliptic shapes have proven best), then the exposure to flow is governed by the following formula:

$$V_m = \sqrt{\frac{2 \Delta P}{\text{Density}}}$$

Pitot tubes with only one bore in the direction of flow measure the so called overall pressure. That is the sum of ambient pressure and the dynamic component caused by the exposure to flow. Tubes of this type are simply called “pitot tubes”.

The pitot tubes offered by SI are “Prandtl”-type. Their design originates with the German Physicist Prandtl. These pitot tubes measure the static ambient pressure at the measuring point in addition to the overall pressure. A differential pressure measuring instrument can thus be used to measure component B relevant for the flow velocity.

Pitot tubes therefore allow spot measurement of flow velocity. Volume flow measurement in pipes and ducts can be achieved by measuring a network of individual points. In-depth descriptions of the respective procedures are found in the corresponding DIN standards. Pitot tubes supplied by SI are made completely of stainless steel. They can be used for measurements at temperatures of up to 550 °C. That allows almost any measurement in exhaust gas.

Our standard Prandtl-type pitot tubes are made in one piece that cannot be disassembled. They are available in various dimensions. This allows selecting a tube that is suitable for your application. Pitot tubes with lengths exceeding 3 m can be supplied in a severable two-part design.

If a pitot tube is to be installed permanently in a measuring set-up, it is best to use a stuffing box adapter. If you need such, let us know, because such pitot tubes must be ordered with the stuffing box included ex works. Later modification is impossible.

Order No. Pitot tubes, one piece

620	305 x 4 x 2.3 mm
621	305 x 4 mm
622	483 x 8 mm
623	795 x 8 mm
624	1000 x 8 mm
625	1220 x 9.5 mm
626	1523 x 9.5 mm
627	1830 x 12.8 x 9.5 mm
628	2130 x 19.1 x 9.5 mm
629	2440 x 19.1 x 9.5 mm
630	2740 x 19.1 x 9.5 mm

(length x tube Ø x head Ø)

Inquire for two-part pitot tubes and pitot tubes with stuffing box.



In our programme you will find a large number of pressure measuring instruments that allow to measure and evaluate differential pressures on pitot tubes.

The flow formula indicates that there is a quadratic function between the measured differential pressure and the air velocity. If you are interested in linear display of values, the measuring signal of the pitot tube must be square root extracted electronically.

$$v [m / s] = \sqrt{\frac{2 \cdot \Delta P}{\rho}} \quad (\text{Equation 1.0})$$

v : flow velocity [m / s]

ΔP : differential pressure in pascal [Pa]

ρ : density factor Rho [kg / m³]

"Is this the correct formula?" some may ask. If you enter the units of measure into the formula, you can easily check its plausibility:

$$v = \sqrt{\frac{\text{Pa}}{\frac{\text{kg}}{\text{m}^3}}} = \sqrt{\frac{\frac{\text{N}}{\text{m}^2}}{\frac{\text{kg}}{\text{m}^3}}} = \sqrt{\frac{\frac{\text{kg} \cdot \text{m}}{\text{m}^2 \cdot \text{s}^2}}{\frac{\text{kg}}{\text{m}^3}}} = \sqrt{\frac{\text{kg} \cdot \text{m} \cdot \text{m}^3}{\text{m}^2 \cdot \text{s}^2 \cdot \text{kg}}} = \sqrt{\frac{\text{m}^2}{\text{s}^2}} = \frac{\text{m}}{\text{s}}$$

Result:

Flow velocity is measured in m/s, if you compute with Pascal as the unit for pressure and kg/m³ for density.

Further information concerning volume measurement in air by means of pitot tubes is found on catalogue page 33.

"Digima LPU3"

Our new micromanometers "Digima LPU3" are portable differential pressure measuring instruments with computing function. When you enter the density of the gas, these devices will continuously compute the flow velocity in metres/second. Micromanometers type LPU3 are optimised for pitot tube measurements.

The integrated microprocessor linearises the sensor signal, computes the measured value, displays the result in different practical measured variables and calms the output signal by forming a floating average.

You may read the measured result from an alphanumeric display, use the precise analog output signal or transmit it to a computer system via an RS 232 interface.

Micromanometer "LPU3 profile"



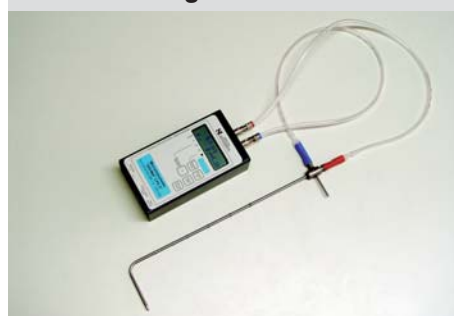
A traceable calibration certificate confirming the accuracy of the instrument is included in the scope of supply of the new micromanometers.

The LPU3 instrument is a micromanometer for normal requirements. To companies and organisations dealing with "air purity" we are offering an additional version with special properties.

LPU3 profile

Like our earlier LPU 250, the profile instrument is supplied in a robust casted aluminium housing. The pressure transducer is a piezoresistive twin-system. This sensor further reduces the dependability of the zero point on the position. When the zeroing button is pressed, not only is the measured value tared electronically, but additionally the pressure connections of the pitot tube are bridged by means of a solenoid valve. It is thus no longer needed to disconnect the tubes during operation.

"Digima LPU3"



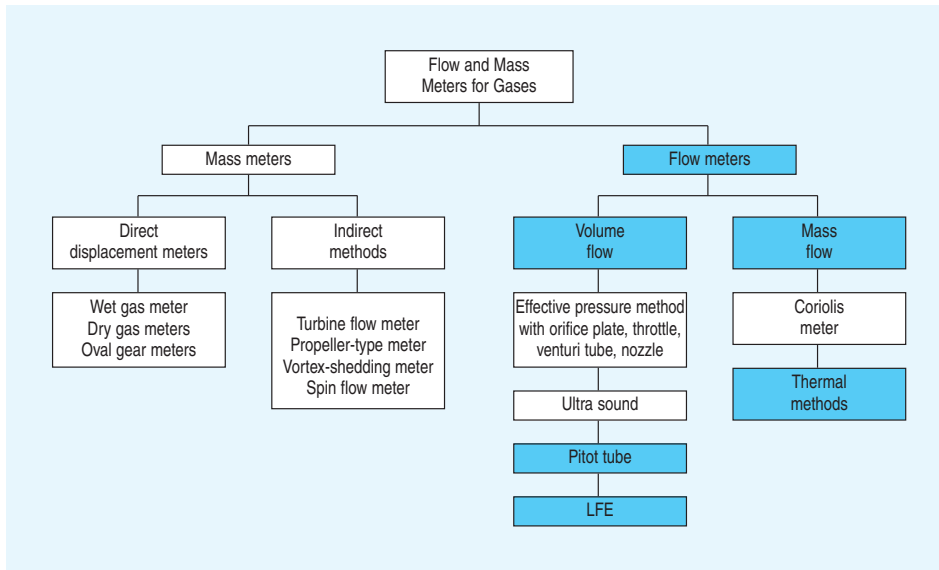
Micromanometer Digima LPU3 with the following measuring ranges:

Differential pressure measuring range	0...+5 kPa
Error limit for partial range	0....10% 1.5 Pa
Error limit in partial range	10...100% 5 Pa
Density, adjustable	0.3...1.7 kg/m ³
Flow velocity	0...100 m/s

Order No.

2305	Micromanometer Digima LPU3
2410	Micromanometer Digima LPU3 profile
	Instrument incl. quick-action couplings, batteries and calibration certificate
	Diverse accessories are available for the Micromanometer "Digima LPU 3"
2511	Package with 2 pcs 1.2 V NiMH rechargeable battery capacity: 2300 mAh, international size LR 6 (Mignon), type "charge and go", for 15 minute charging time,
2512	Plug-in charger for 2 pcs 1.2 V rechargeable battery NiMH type "charge and go", wide-range power supply 120...240 VAC, 50...60 Hz, incl. 2 pcs rechargeable battery
1849	Plastic storage and transport case with molded insert, small, for the instrument and accessories.
1182	Plastic storage and transport case with molded insert, large; for the measuring instrument and more space for accessories.
2250	Wide-range plug-in power supply (100...240 VAC), stabilised 3.3 VDC with jack connector
2249	Interface cable RS232 SUB D 9, female to round plug at the instrument, 5 m long.
2510	Interface cable with 9pole SUB D-plug male to USB plug. Cable length 120 cm. The interface converter is excited via the USB plug.
2647	Traceable calibration certificate for Micromanometer LPU 3 recalibration, for main and partial ranges

General accessories (tubes, tube connectors etc.) are found on page 26



General information, technologies, tables ...

Besides pressure measuring instruments, we are supplying numerous devices for measurement of volume and mass flow. We specialize in the measurement of gaseous media.

Exact measurement of air flow is one of the most difficult tasks in physical measurement engineering. In contrast with fluids, air can be compressed and expands substantially when heated.

Talking about air we think quiet normally of the medium surrounding us and which we breathe - air at atmospheric pressure and room temperature. This condition of air has therefore been made the standard to compare with. However, in technical applications air is rarely encountered in its standard condition. Depending on the application it is either heated or cooled. We are using "compressed air" or a more or less "vacuum" condition. When measuring air flow, we are thus not only interested in how much air flows, but also at which pressure and temperature the measurement is taken. Without this additional information any measurement is irrelevant or incomplete. Gas flows and volumes can only be compared when the measured values are converted to defined standard conditions. As mentioned above – only if all information required is available conversion of values to the standardised condition is possible.

In the general gas law the physical relations of pressure, p , temperature, t , and volume, V , are expressed in generally applicable terms. The gas law reads:

$$\frac{p_1 \times V_1}{t_1} = \frac{p_2 \times V_2}{t_2}$$

Using this formula you can convert any measured air volume to standard conditions. Please, note that absolute values for pressure and temperature must be used for calculations with this formula! (P_{abs} and $^{\circ}Kelvin$).

All effective pressure measuring methods, the widely used variable area flowmeters as well as laminar flow elements (LFE), are subject to the gas law. If the measurement is made under conditions that differ greatly from standard conditions, conversion is inescapable. Only after conversion to the standard condition, intake volume, consumption or leakage become comparable.

We have purposely repeated these elementary considerations, because we find they are often forgotten or ignored in daily measuring activity.

There are numerous measuring methods for flow and volume of air and other gases. Each method has its specific advantages and disadvantages, and no measuring principle is equally suitable for all applications. The overview on this page is an attempt at presenting a system of the most popular methods. As the chart shows, there are two main groups of flow measuring devices, volume meters and mass flow meters.

Volume flow meters

these read "litres/time" subject to the influence of pressure and temperature. All implications mentioned earlier apply to these instruments.

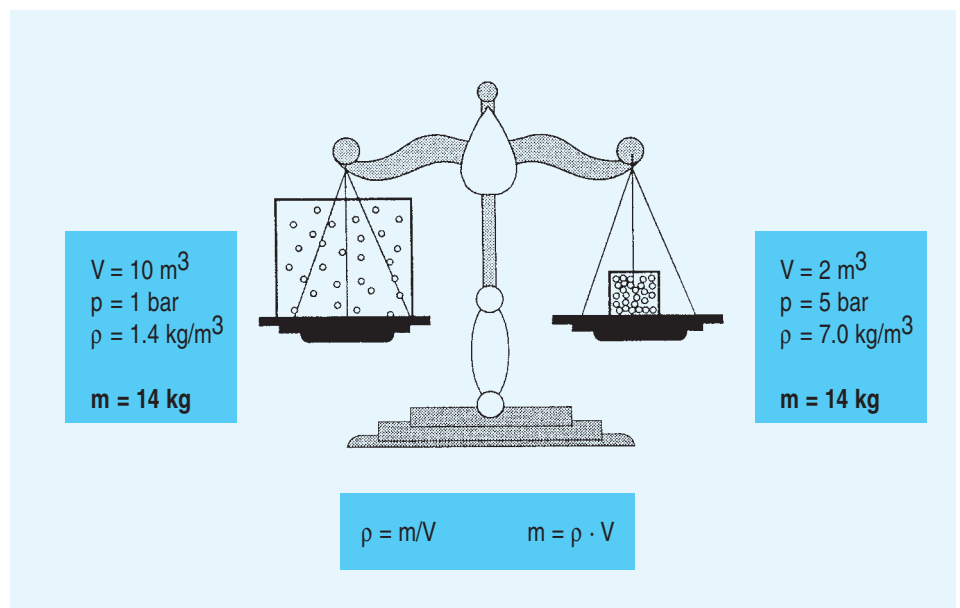
Mass flow meters

allow to read a standard litre signal without the need for conversion. Such devices measure the mass of the flowing gas in "grams/time". If the density of the gas is known, the instrument can be calibrated to "standard litres/time".

In this connection, please never forget that the readings of all flow measuring instruments are interrelated with the gas type measured. If the gas or its composition changes, the measured value changes.

We are offering interesting solutions for both areas, volume flow measurement and mass flow measurement.

As a supplier of differential pressure measuring instruments for low pressures we are familiar with various methods of effective pressure measurement.



The standard DIN 1952 describes some possibilities for use of orifice plates, venturi tubes etc.

Again and again the relatively high pressure loss and the quadratic function of flow and differential pressure troubled us. If half of the flow shows only as a quarter in the measuring result, the dynamics of the measuring setup are soon exhausted.

So we went looking for a method supplying a linear output signal at low pressure loss. Another vital requirement was very fast response. We found a suitable method in the field of medical technology. So-called pneumotachographs used for respiratory diagnosis since the 1920s met our requirements quite optimally. From a physical standpoint, these transducers are laminar flow elements. Such elements used together with high-precision differential pressure transducers are an ideal combination, suitable for many measuring tasks in which other instruments simply fail. During the past 20 years SI has made the LFE measuring technique popular in industrial applications and our study of the basics has sent out vital impulses.

When we began to develop instruments for mass flow measurement, we decided to use the thermal measuring principle. Like the LFE, this method allows to measure minimal flow. Since we measure directly in the flowing medium, the response times are shorter than usually, while screen laminators keep the pressure drop low. These qualities allow to supply devices avoiding the disadvantages of competing makes.

Characteristic features of our instruments:

- Numerous measuring ranges between (10 ml/minute... 1000 l/minute)
- Especially low and lowest flows
- Low pressure drop
- Fast response

Let us here alert you to the difficulty of precise air flow measurement. Most users are not aware of the measuring accuracies that can be achieved with different investments.

We are used to expect an accuracy < 0.5% of practically all measuring devices for physical variables. This is totally different for air flow measuring instruments, however. Please, note that the measuring error is a sum of many parameters. It may therefore be understanda-

ble that the reference units of DKD certification bodies reach an accuracy of "only" about 0.3 %. This error is passed on as inherent uncertainty.

Thus if you buy an instrument with an error of 1 % from us or a competitor, that is a very good value. Experience shows, however, that it is no problem to operate with instrument errors of 3 %.

Conversion table for flow

m ³ /s	m ³ /h	l/min	l/s	ft ³ /min (cfm)
1	3600	60000	1000	2118.64
0.28 x 10 ⁻³	1	16.6667	0.2778	0.5885
16.67 x 10 ⁻⁶	0.06	1	0.0167	127.116
1 x 10 ⁻³	3.6	60	1	2.1186
0.472 x 10 ⁻³	1.6992	28.32	0.4720	1

Air flow measurement with pitot tubes

The pitot tube measurement, as described on page 30-31, is normally used for spot measurement of air flow velocity. The air volume is determined by acquiring the flow speed distribution in the cross section of the measured duct and subsequent integration, or by determining the average flow velocity.

The continuity equation says that the cross-section of the duct and the average velocity determine the flow volume. If the flow is laminar, the average velocity is measured at a wall spacing of 0.124 mm. If the flow in tubes is turbulent, the measurement should be made at a diameter of 0.119. All values here given refer to full tubular flow, which is reached only after a certain flow distance.

The pitot tube measurement described is primarily used to measure flow volumes in pipes that are difficult to access or for short-term control measurements. The special advantages are the application without on-site calibration, the extremely low pressure drop and the possibility to measure at high temperatures.

In the field of emission measurement this method has been established for acceptance testing in environmental protection. A so-called network measurement is made at different points. Then the average velocity is computed. The method is described in detail in applicable DIN standards.

Another hint:

It is very practical to be able to compare the standard litre values from different devices and calibration institutes.

But standard does not equal standard. Meanwhile diverse gas standards have been established in technical and scientific environments. Be sure not to compare apples with pears.

When the definitions of DIN 1343 and DIN 102 are compared one finds a difference of 10%. We are calibrating our devices to meet the definition presented in DIN 1343. Just let us know, if you wish another calibration for yours.

Gas Standards		Temperature	Pressure	Humidity
Phys. standard	DIN 1343 *	0° C	1013 mbar	undefined
Techn. standard	DIN 6358 **	20° C	1000 mbar	65% r.H.
	DIN ISO 2533 ***	15° C	1013 mbar	undefined
	DIN 102/ISO 1-1975	20° C	981 mbar	undefined
Note:		* Is used as works standard by SI (the requirements of the semiconductor industries "Semi E 56 1296" refers to the same standard, DIN 1343.) ** Also referred to as the "A.N.R. standard reference atmosphere" (ISO 8778) *** These are also the values for the US standard atmosphere and the standard atmosphere of the ICAO (International Civil Aviation Organization)		

Laminar flow elements (LFE) are precision sensors for flow measurement of gaseous media in closed piping systems. Physically they belong in the group of effective pressure measuring devices. That is, when a medium flows through an LFE, a pressure drop can be measured at the LFE. While the pressure drop increases in a quadratic function with the flow in all other effective pressure measuring methods (orifice plate, throttle, venturi tube ...), the LFE has a linear characteristic. This is an immense advantage of this measuring method, because it allows a very wide flow range to be measured. In practical application it is better by 1:100 or more.

The pressure drop across the LFE must be measured with a differential pressure measuring instrument. The output value of this instrument may then be directly scaled to read in units of flow.

The principle of the LFE is based on Poiseuille's law, according to which the flow in a thin pipe is proportional to the pressure loss

per unit of length, provided the flow is laminar. This is ensured by selecting a pipe diameter resulting in a Reynold's number below 2000. For low flow volumes a single thin capillary may be used. To achieve a wider flow range, many of these capillaries are arranged in parallel, increasing the maximum volume that can be measured, while the pressure drop still remains low.

The extremely low pressure drop of our LFEs is another big advantage for air flow measurement. It is max. 0.7 mbar for each of the available measuring ranges. Prior to shipment, all our LFEs are individually measured. The exact relation of flow and differential pressure is indicated on the nameplate in three pairs of values.

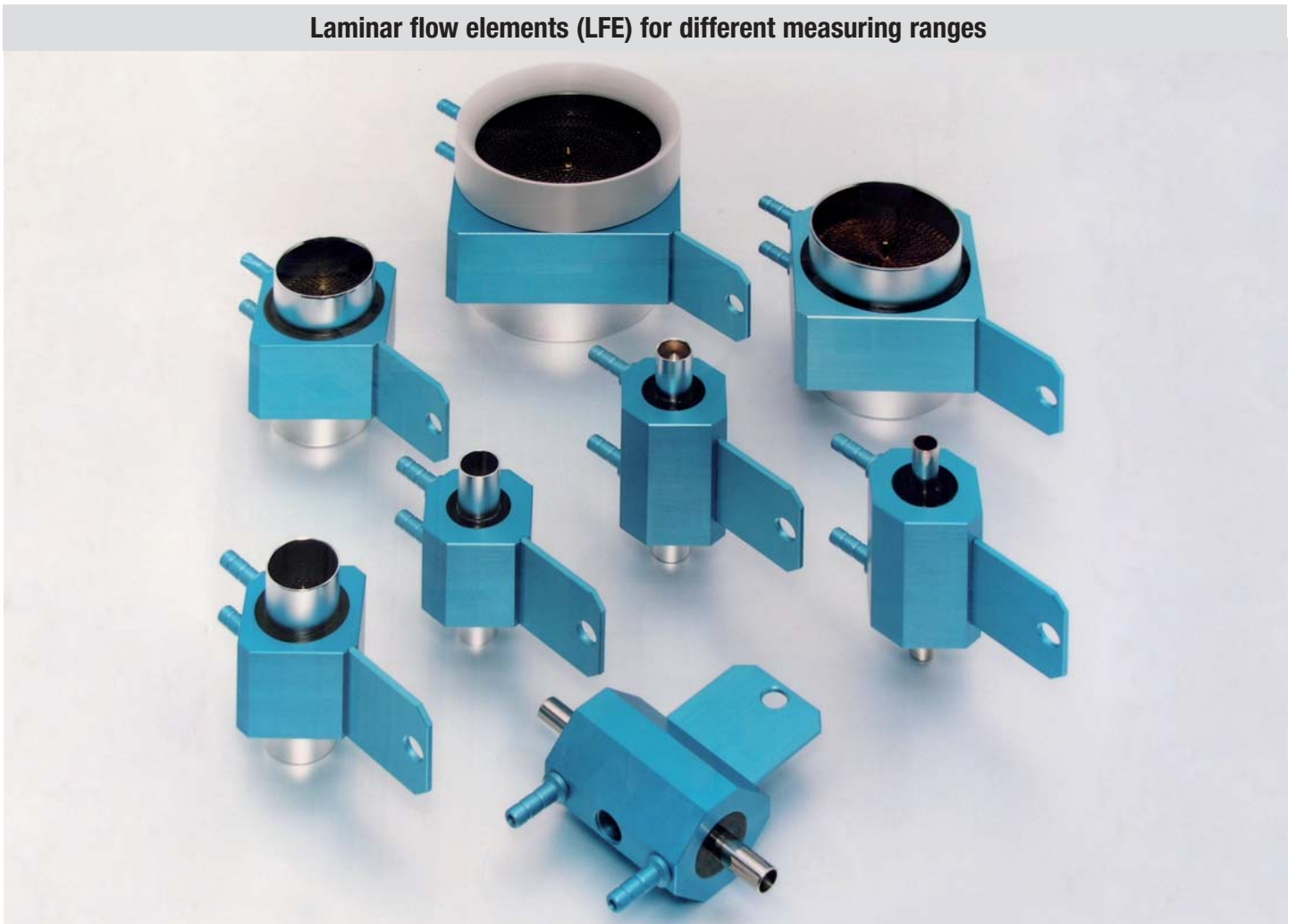
The extremely low pressure drop allows LFE applications that cannot be achieved with any other measuring instrument. A typical application is the measurement of respiratory air volume in medical lung function diagnostics. Our laminar flow elements are available for diverse measuring ranges between

20 ml/minute and 1200 l/minute. The field of application reaches from leak measurement to flow measurement on small fans.

Laminar flow elements respond quickly to flow volume changes. When combined with electronic differential pressure gauges, even very fast dynamic events can be traced. Rise times of only a few milliseconds are no problem for an LFE measurement setup. This virtually undelayed response allows high cycle rates in automatic flow testers.

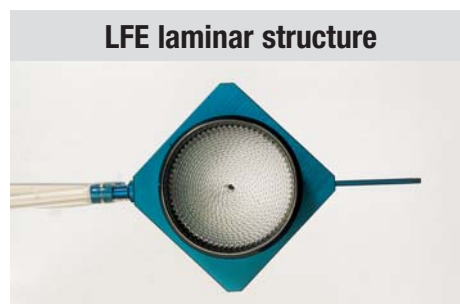
The laminar flow elements are calibrated for air at room temperature and atmospheric pressure. The resulting differential pressure is exclusively of the LFE-type and thus directly related to the viscosity of the medium. Therefore, please note that any change in viscosity also influences the measured value!

Laminar flow elements (LFE) for different measuring ranges



If flow must be measured with very high absolute accuracy, the influence of the temperature on the dynamic viscosity of the medium needs special attention. We'll be pleased to aid in the practical application of these complex relations.

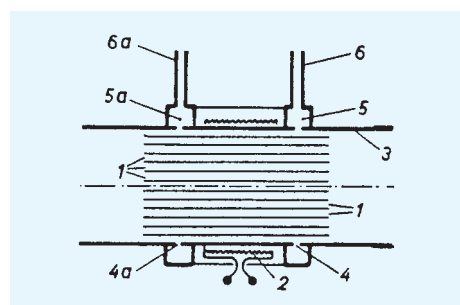
Media measured with LFEs must be well filtered, to prevent contamination of the element. Measurement of aggressive gases is not possible with our LFEs. Their capillary structure is not robust enough for such applications.



LFE laminar structure

Advantages of our LFE:

- Low pressure loss (<1 mbar)
- Good accuracy and linearity
- Measuring span >1:100
- Bi-directional flow measurements possible (signal shows correct sign)
- Resolution depends only on the pressure measuring instrument
- Undelayed response
- Highly dynamic signals can be measured
- Little dead space
- Heatable to prevent condensation
- Require only very short inlet and outlet paths



- 1.) Capillaries
- 2.) Heating
- 3.) Main tube
- 4a/b) Pressure extraction
- 5a/b) Circulation channel
- 6a/b) Connections for differential pressure

In our LFE description we pointed out that the low pressure drop and short response time of the LFEs are the major advantages of this measuring method. To exploit these positive qualities, you should employ a differential pressure measuring instrument that meets the consequential requirements, such as:

- Low measuring range of 1...2 mbar/Diff.
- Fast response
- Low measuring error, good zero-point stability

Our catalog contains numerous portable and stationary instruments that are suitable for this task.

We especially recommend the "diff-cap" transducer shown on page 20.

Pressure transducer "diff-cap"

This instrument operates with a capacitive measuring cell. It is highly accurate, noise resistant and super longterm stable. The 1 mbar type with order No. 726 no doubt is the ideal transducer for SI's laminar flow elements. This transducer can also operate at higher static pressures.

Conversion table:

20	l/s	1200	l/minute	72.000	l/h
11	l/s	660	l/minute	39.600	l/h
6.5	l/s	390	l/minute	23.400	l/h
2.5	l/s	150	l/minute	9.000	l/h
1	l/s	60	l/minute	3.600	l/h
0.25	l/s	15	l/minute	900	l/h
0.1	l/s	6	l/minute	360	l/h
40	ml/s	2.4	l/minute	144	l/h
15	ml/s	0.9	l/minute	54	l/h
10	ml/s	0.6	l/minute	36	l/h
3.33	ml/s	200	ml/minute	12	l/h
0.333	ml/s	20	ml/minute	1.2	l/h
0.033	ml/s	2	ml/minute	0.12	l/h

Type "FC" for lowest flow rates

This device type is especially suitable for leakage measurements in which a differential pressure measuring method is desirable.

Order No.			
537	LFE	20 ml/minute	size FC2
536	LFE	200 ml/minute	size FC3

LFE-Type PT, size 4



LFE Type PT

This type of laminar flow element is known as "pneumotachograph" in medical applications. Exploit the numerous advantages of this air flow transducer to solve your measuring problems!

Order No.			
526	1200 l/minute	size 5	Ø 78
527	660 l/minute	size 4	Ø 58
528	390 l/minute	size 3	Ø 43
529	150 l/minute	size 2	Ø 28
530	60 l/minute	size 1	Ø 18
531	15 l/minute	size 0	Ø 10
532	6 l/minute	size 00	Ø 9
533	2.4 l/minute	size 000	Ø 6
534	0.9 l/minute	size 0000	Ø 6
535	0.6 l/minute	size 00000	Ø 1.35

Accessories for PT

For the LFE sizes 2 and 3, conical rubber adapters are available which can be plugged onto the tube connections of the LFE. These adapters reduce the connection diameter to 25.4 mm (1") each.

Order No.	
1035	Conical adapter for size 2
960	Conical adapter for size 3

When these conical adapters are used, turbulences occur in front of the LFE impairing the accuracy. It is possible, however, to install metal screens as pre-laminators. This enhances the flow properties in the inlet path of the LFE.

Order No.	
1037	Metal screen for size 2
959	Metal screen for size 3

Please, always bear in mind that a definite flow profile is the alpha and omega of exact flow measurement. This does not only apply to measurements performed with LFEs, but also to all other methods.

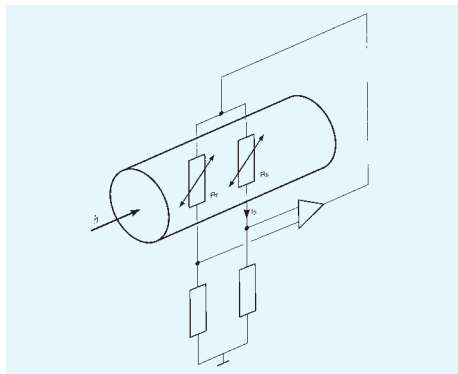
Flow Measurement

The basics of calorimetric mass flow measurement

There are different methods for measurement of mass flow in gases. SI is favourizing the calorimetric measuring principle, because it offers the best price-performance-ratio. Devices operating with this method supply a direct standard litre signal. The measured flow volume, pressure and temperature do not need to be corrected. Many a measuring task is dramatically simplified thereby.

When talking to our customers, we find that this measuring method is still quiet unknown. In case you do not know this method yet, I invite you to follow a fictitious experiment to get acquainted with it.

Imagine a small heated measuring point inside a tube. The measuring point is heated to approx. 150° C and the temperature is being



controlled. In this condition the measuring setup is at its zero-point. Now imagine 1 litre of air per minute (under atmospheric conditions at 1 bar abs.) flowing past the heated spot. A large number of air molecules will carry off heat from the measuring spot by convection. The temperature controller will respond by increasing the control output and the power consumption required to maintain the set temperature will increase. This increase in power consumption therefore is a measure for the air flow.

Now imagine air flowing past the measuring point at twice as high absolute pressure. That would mean twice as many air molecules passing, causing a stronger cooling effect. The heating output would increase. If we continue the fictitious experiment with heated air, we would find that it can contribute less to the cooling, because the molecules are on a higher energy level. The consequence is that the heating output required will be lower.

Mass Flow Measurement

Pressure therefore is proportional to the cooling effect, temperature is inversely proportional to the cooling effect. The measuring method thus integrates the general gas law. Please excuse this lax statement. But with it I like to illustrate that you do not need to look after pressure and temperature, when you use this method. Nonetheless, you will always receive comparable results.

In fact, this measuring method measures the mass flow, that is, grams of air per time interval. But since this unit of measure is not common to most users, we calibrate our mass flow instruments to standard litres.

That is possible when one calibrates the instruments to a known gas (e. g. air). However, to

achieve reliable measured values, one must only measure the same type of gas afterward. If other gases are to be measured, correction factors must be used.

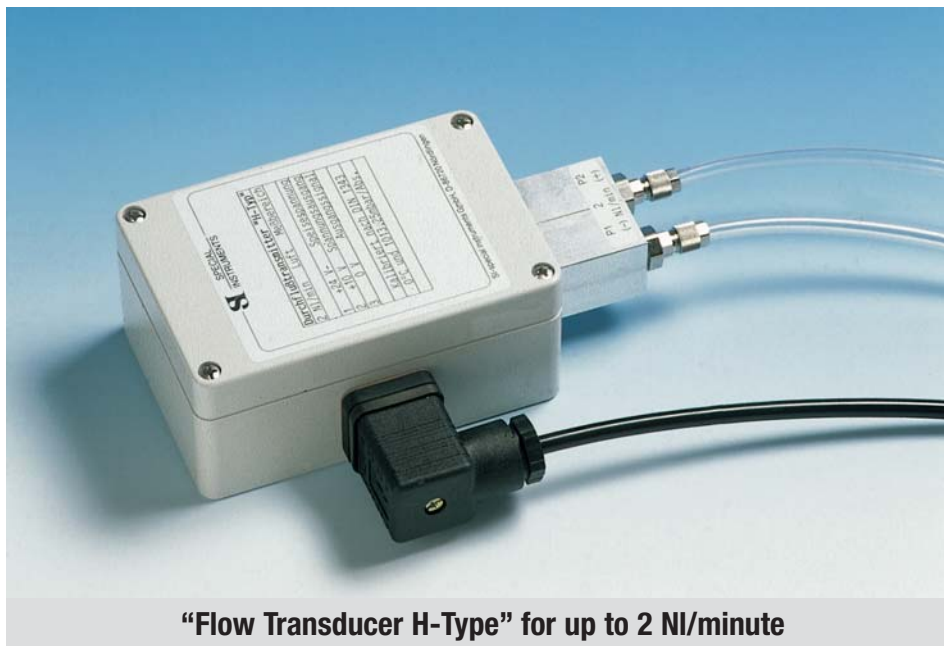
All of the instruments offered in this catalogue operate with the "inline technique". This is the principle already described above and illustrated in the sketch. The advantages of this principle are:

- Very low pressure loss
- Very short response time
- Low contamination hazard
- Favourable instrument price

Instrument selection table

Mass Flow Instruments

	Preflo FP	Preflo 3	Preflo 3P	Preflo 3 leak calibrator	Preflo H-type 2	Preflo H-type 20	red-y compact	red-y smart	Novaflo
Portable flow meter		•	•	•			•		
Transducer MFT	•				•	•		•	•
Controller MFC								•	•
Error limits 3 % f.s.	•				•	•			•
1 % f.s.								•	
1.5 % f.s.							•		
0....10% f.s. = 0.15% f.s.		•	•	•					
10...100% f.s. = 1.5 % f.s.		•	•	•					
Σ 0.5 % m.v.+ 0.3 % f.s.								•	
Measuring ranges 2 NmI/minute.....1 NI/minute		•	•	•					
20 NmI/minute.....2 NI/minute	•				•				
25 NmI/minute.....300 NI/minute							•	•	
5 NI/ minute.....20 NI/minute						•			
Novaflo MFT 20 NI/ minute...7500 NI/minute									•
Novaflo MFC 20 NI/ minute...1000 NI/minute									•
Measuring direction → uni-directional						•	•	•	•
↔ bi-directional	•	•	•	•	•				
Response time < 15 ms	•	•	•	•	•	•			
< 150 ms								•	
< 500 ms							•		
< 1000 ms									•
Excitation voltage 24 VDC	•				•	•	•	•	•
Battery operation		•	•	•			•		
Digital display standard	•	•	•	•			•		
optional									•
Combined instrument for flow/pressure			•						
Analog signal	•	•	•	•	•	•		•	•
Data interface		•	•	•				•	
Totaliser function		•					•		
Limit value transmitter	•						•		
Precision throttle				•			•		



“Flow Transducer H-Type” for up to 2 NI/minute

This series of flow transducers has been developed to measure air flow volumes of up to 20 NI/minute. Many standard measuring ranges between 20 Nml/minute and 2 NI/minute are available. Each “H-Type” transducer converts the physical variable “flow” to a standardized electrical output signal. That allows processing of the measuring signal by registration devices or controllers.

H-type transducers for up to 2 NI/minute can be operated bi-directionally. The flow direction will influence the sign of the measuring signal. This also allows for safe detection of backflow. The pressure loss caused by the flow is neglectably low. The transducers respond very quickly to flow changes. If that is not desired, the output signal can be dampened by an integrated electronic low-pass filter. The degree of dampening or filtering can be adjusted with a potentiometer across a wide range. These properties make the H-type ideally suitable for leakage measurement with the slip-stream or equalisation method.

H-type transducers with measuring ranges above 2 NI/minute have the same properties, however, they are meant for uni-directional flow only.

Advantages for you:

- Direct standard litre output signal
- Very fast response
- Very low pressure loss
- Calibrated accuracy
- Dust and watertight housing (IP 65)

Flow transducer, 3-wire system, 24 V= excitation, for air and other non-aggressive gases
Available output signal ± 10 V, 0... 20 mA, 4...20 mA, three-wire system, pressure resistant to 7 bar, measuring error max. 3% f.s., enclosure type IP65, all instruments are adjusted to process air.

Order No.	Measuring ranges
755	± 20 Nml/minute
1410	± 50 Nml/minute
1411	± 100 Nml/minute
756	± 200 Nml/minute
1412	± 500 Nml/minute
1413	± 1000 Nml/minute
758	± 2000 Nml/minute

759	5	NI/minute
760	10	NI/minute
761	20	NI/minute

Order No.	Options
542	Special scaling (x ml/minute = end of scale value)



H-Type up to 20 NI/minute

Flow transducer “preflo FP”

This “preflo” version is a compact design for front panel installation in a DIN housing. Requiring little space, the unit can be enhanced with optional functional modules.

Built-in unit with integrated sensor and 1 measuring range, measuring error max. 3% f.s., pressure resistant up to 7 bar.

Basic unit includes the flow sensor in DIN housing 96x48 mm, incl. retaining clamps,
24 VDC excitation (16...30 V) LCD display (1999)
and signal output ± 10 V

Order No.	Measuring ranges
374	± 19.99 Nml/minute
375	± 199.9 Nml/minute
674	± 1999 Nml/minute

Order No.	Options
606	Line power supply 220 VAC
607	Current output 0...20 mA
608	Current output 4...20 mA
609	Limit value switch, 1 trip point, externally adjustable, relay output, switch-over, 2 A switching current
610	Limit value switch, 2 trip points, externally adjustable, relay outputs, normally open contact, 0.5 A each
613	Desktop housing for installation of an FP unit, incl. electrical/pneumatic connections. All signals connected to a plug.
542	Special scaling (x ml/minute = full scale)



“preflo-FP”

Traceable works certificates are available for all of our flow measuring instruments. We are calibrating with air and are using the standard conditions defined in DIN 1343 (0 °C and 1013 mbar)

If you wish a certificate for a new instrument, this service should be ordered with the following number

Order No.	Options
1405	Works certificate for flow, per measuring range, initial calibration

Flow Measurement

SI offers the widest range of portable mass flow measuring instruments for low flow in the market.

"preflo" instruments avoid the disadvantages of classic measuring methods. Especially when measuring lowest flow volumes, where bubble-type flow meters were so far used, the advantages convince. With the qualities outlined these portable battery-powered devices are especially suitable for mobile applications in maintenance and taking into service of physical technical devices for medical use and environmental protection.

The series 3 instruments...

... are new in our programme. This new instrument series will replace the previous "preflo 2" devices.

The integrated sensor assembly

A calorimetric flow sensor measures the heat loss of an electronic microchip caused by the convection of the flow to be measured. (silicon on ceramic technology) The low chip dimensions allow a very short response time. The chip, inlet and outlet filter, flow separator and the needle valve are space-savings integrated into a single measuring block without need for additional tubes. This design is mechanically stable and ensures lowest possible dead volume between the flow connections. Two M5 threads are provided on the sensor block. In the factory these ports are furnished with connecting elements for quick-action couplings. If you are using different tube connectors, the connecting elements can be replaced easily.

The new instruments incorporate a microprocessor. This allows unit functions that were previously impossible or could only be achieved with substantial effort. The technology of the hardware and software is identical in all our new hand-held measuring instruments. This device type forms the basis for our digital pocket pressure gauges premo 3, UNI 3 and LPU 3. The new instruments retain the proven properties of the previous series of hand-held pressure gauges. Special attention was given to leaving the operating procedures as they were. You will not really notice that an intelligent computer chip is now working in the background.

Data processing in a hand-held unit primarily means that the accuracy of measurement improves and that measured values can be communicated via a data interface.

Pocket-Size Flow Meter "preflo 3"

Improved accuracy

Thanks to a linearisation function we can offer even more accurate flow measuring instruments than before. Before shipment, each series 3 unit is crosschecked using high-precision reference units. Deviations from the ideal characteristic curve are detected and saved in the form of a correction value. The error limits indicated are thus always met. The resolution is 20000 counts. The last digit can be shut off.

Data interface

The unit offers a real bi-directional RS 232 interface operating at 19200 baud. It is protected against overvoltage and failures (ESD). This serial interface allows to read out the complete display content (measured value, decimal point, sign and measured variable). Additionally, the unit and all its functions can be remote controlled via this digital port. A command interpreter for this purpose is provided. If you want to integrate the device into an automatic measuring system, you will value this feature.

Power supply

The new series 3 units are supplied with 3 V direct current. Two 1.5 V Mignon cells (AA) allow an operation time of more than 40 hours. If you decide to use rechargeable NiMH cells of the same size, this will save some money in the long-run and it is a contribution to environmental protection by reduction of the amount of contaminants.

As standard, the unit can be supplied via a jack bush in stationary operation. When a power supply unit is connected, the integrated battery supply is automatically switched off.

Analog signal output

If you are using line plotters, an analog output signal is just what you need. The ± 1 V signal is provided at 4 mm banana jacks at low impedance and without reverse transfer. It is as accurate as the digital display. If the partial range is selected, the full 1 V signal is also available for the partial range.

Damping of the measured value signal

If you do not wish the fast response of the mass flow sensor, you can reduce the refresh speed of the measured value signal and the display by a two-stage, switch-selectable damping.

The basic properties of all "preflo 3" instruments include:

- Push-button zeroing or taring
- Bi-directional measurement possible
- Low pressure loss
- Adjustment to different standard conditions via the interface (DIN 102, ISO 1343 etc.)
- Calibrated with air
- Operation at up to 10 bar system pressure

Pocket-size flow meter "preflo 3"



The basic flow measuring unit used in all “preflo 3” instruments is “Nml/minute” (standard litres per minute). Further measuring variables are possible and are computed by means of factors, displayed and transmitted to the signal outputs.

Pocket flow meter “preflo 3”

Hand-held unit with integrated sensor and one measuring range LCD display (7-segment version) with flags.

Accuracy in partial range 10...100% < 1.5 % f.s.
Accuracy in partial range 0... 10% < 0.2 % f.s.
Temperature influence on the measured value 0.1 % v.M / °C

With traceable works calibration certificate for both partial ranges, standard conditions to DIN 1343 (0°C and 1343 mbar), quick-action couplings and batteries included

Order No. Measuring ranges

2397	±	20.00Q	Nml/minute
2219	+	200.0Q	Nml/minute (- 20)
2221	+/-	300.0Q	Nml/minute (- 20)
2220	±	2000.0	Nml/minute (- 20)

Order No. Options

2382	Totaliser function (gas meter)
	- Start, stop and reset by push-button
	- Display of current air flow rate
	- Display of total air flow
	- Display of time (minutes and seconds)
2569	Supply of “preflo 3” instrument in a robust casted aluminium housing

Leak calibrator “preflo 3”

... the adjustable test leak for check-up and calibration of leak testers. By means of comparison, pressure drop is interpreted as leakage volume. The combination of a “preflo 3” flow meter with a precision needle-type valve allows for this. Any user of air leak testers should use this leak calibrator to monitor.

Hand-held unit with integrated sensor and one measuring range. LCD display (7-segment version) with flags. Extended by an integrated precision needle valve adapted to the measuring range.

Accuracy in partial range 10...100% < 1.5 % f.s.
Accuracy in partial range 0... 10% < 0.15 % f.s.
Temperature influence on the measured value 0.1 % m.v. / °C

With traceable works calibration certificate for both partial ranges, standard conditions to DIN 1343 (0°C and 1343 mbar), quick-action couplings and batteries supplied

Order No. Measuring ranges

2398	±	20.00Q	Nml/minute
2222	+	200.0Q	Nml/minute (- 20)

Order No. Option

2570	Supply of a “leak calibrator preflo 3” in a robust casted aluminium housing
------	---

Leak calibrator “preflo 3P”



We offer diverse accessories for the pocket flow meters “preflo 3”.

Order No.

2511	Package with 2 pcs. 1.2 Volt NiMH rechargeable batteries, capacity: 2300 mAh, international size, LR 6 (Mignon), type “charge and go”, for 15 minute charging time,
2512	Plug-in charger for 2 pcs 1.2 V rechargeable battery NiMH, type “charge and go”, wide-range power supply 120...240 VAC, 50...60 Hz, incl. 2 pcs rechargeable battery
1849	Plastic storage and transport case with molded insert, small, for the instrument and accessories.
1182	Plastic storage and transport case with molded insert, large, for the measuring instrument and more space for accessories.
2250	Wide-range plug-in power supply (100...240 VAC), stabilised 3.3 VDC with jack connector
2249	Interface cable RS232 SUB D 9, female to round plug at the instrument, 5 m long.

General accessories (tubes, tube connectors etc.) are found on page 26

Leak calibrator „preflo 3“ in robust housing



Leak calibrator “preflo 3P”

The leak calibrator “preflo 3P” is a combined instrument for flow and pressure. The pressure value is shown simultaneously with the flow value on the alphanumeric LCD display. The measuring range for pressure measurement is (-1. ...0... +10 bar/rel.) at an accuracy of ± 1 % f.s. The calibration certificate has been extended by a pressure certificate.

Order No. Measuring ranges

2399	±	20.00Q	Nml/minute	flow
	-	1...0...10	bar/rel	pressure
2325	+	200.0Q	Nml/minute (- 20)	flow
	-	1...0...10	bar/rel	pressure

Order No. Option

2571	Supply of a “leak calibrator preflo 3P” in a robust casted aluminium housing
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USB interface

As mentioned above these units include an RS 232 interface. This interface type and its programming are still the industrial standard among technical or scientific users. If your computer system should not support an RS232 interface, we can supply an interface cable incorporating an interface converter. Plugged into the connecting cable, this adapter makes the two standards compatible.

Order No.

2510	Interface cable with 9pole SUB D-plug male to USB plug. Cable length 120 cm. The interface converter is excited via the USB plug.
------	---

Let us introduce the electronic alternative to the classic floating element flow meter. The illustration shows the version with integrated needle valve for volume control. The large digital display indicates the flow in standard litres. The mass flow measurement is independent of pressure and temperature. The “red-y compact” device is battery-powered. It slumbers when there is no flow. This measure ensures the lithium battery keeps the device ready to operate for about 2 years. As an alternative to battery operation, a 24 VDC supply is available. Since the device is compact and does not need an additional feed path, it is easily integrated into existing systems.

Device features

- Mass flow measuring system with standard litre display
- Display independent of pressure and temperature
- Large, easy to read digital LCD display with additional bargraph
- No electrical signal output
- Highly dynamic and accurate
- Battery-powered, approx. 2 years of autonomous operation
- Uni-directional measurement
- No inlet paths required
- Small, compact design
- Position-independent installation
- Easy cleaning without re-calibration
- Calibrated for air, inquire for other gases

Optional extension by:

- Adjustable needle valve
- External power supply
- Intelligent watch-dog function “FlowSwitch”
- Totaliser function

Technical data

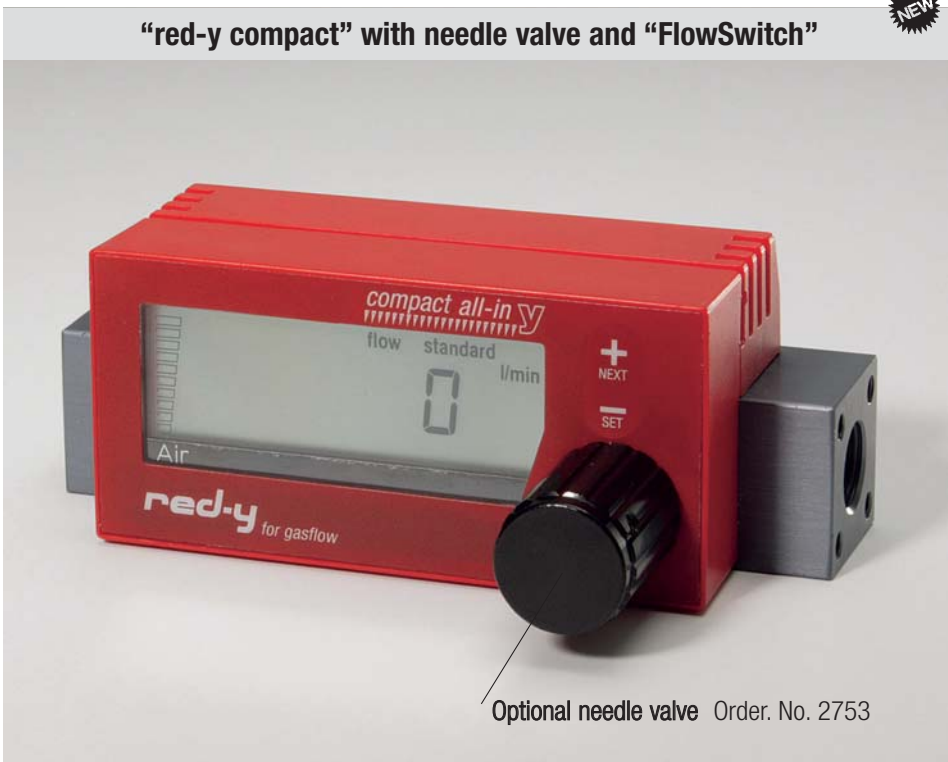
Accuracy ± 1% f.s.
Dynamic 1:50
Response time 500 ms

Pressure stability up to 10 bar
Test pressure 15 bar
Temperature 0...50 °C

Materials Aluminium as standard, stainless steel optionally, electropolished, measuring section PBT

Seals Viton, optional EPDM

Supply Lithium battery, type AA service life approx. 2 years optional external power supply with 24 VDC, ± 10%



Optional needle valve Order. No. 2753

Display	4digit LCD 7-segment display with unit indication and bargraph
Gas connection	inside thread G ¼" up to 50 NI/minute G ½" up to 300 NI/minute
Feed path	not required
Installation position	any, horizontal for >= 5 bar
Front panel dimensions	96 x 48 mm (to DIN)

Properties of the “FlowSwitch” option
The signal is output via a floating switch-over contact (24 VDC, 1 A)

- The following parameters can be set:
- Input via menu and ± membrane key
 - Minimum and maximum alarm
 - Limit values 0...100% freely adjustable
 - Failsafe mode selectable
 - Alarm suppression selectable
 - Alarm delay adjustable between 0...180 s
 - Alarm hysteresis freely adjustable
 - Automatic/manual alarm reset selectable

red-y compact flow meter GCM
Aluminium version, basic unit, battery-powered calibration with air, dynamic 1:50 accuracy ± 1% of end of scale value,

Order No.	Measuring ranges
2572	A/ GCM 25 NmI/ minute...500 NmI/minute
2573	B/ GCM to end of scale value 5 NI/minute
2574	C/ GCM to end of scale value 50 NI/minute
2575	D1/ GCM to end of scale value 100 NI/minute
2576	D2/ GCM to end of scale value 200 NI/minute
2577	D3/ GCM to end of scale value 300 NI/minute

red-y compact flow meter GCM
Stainless steel version, basic unit, battery-powered calibration with air, dynamic 1:50 accuracy ± 1% of end of scale value,

Order No.	Measuring ranges
2578	A/ GCM 25 NmI/minute...500 NmI/minute
2579	B/ GCM minute 5 NI/minute
2580	C/ GCM to end of scale value 50 NI/minute
2581	D1/ GCM to end of scale value 100 NI/minute
2582	D2/ GCM to end of scale value 200 NI/minute
2583	D3/ GCM to end of scale value 300 NI/minute

(Indicate desired end of scale value when ordering)

Order No.	Options
2584	Extra charge for 24 VDC supply
2585	Extra charge for alarm/watch-dog function “FlowSwitch” (only possible with 24 VDC supply option)
2586	Totaliser, no reset
2587	Totaliser, reset by power-down
2588	EPDM seals instead of Viton
2589	Traceable calibration protocol
2590	Spare lithium battery
2591	Mounting kit for switch-panel installation (IP 50)
2592	Mounting kit for switch-panel installation (IP 65)
2753	Needle valve (up to end of scale value 50 NI/minute)

The transducers and controllers of the "red-y smart" series have been designed for installation in the processing environment of machinery and plant systems. Thanks to their compact design, the assemblies are easily installed. The well thought-out design makes the devices maintenance and service friendly. "red-y smart" devices respond rapidly, feature very low pressure loss and are very dynamic and accurate.

Both the measuring and control circuits provide analog output signals and digital measured values. The standard RS 485 interface allow operation on a "Modbus". The "get-red-y" software supplied with every device surprises with its many practical additional functions.

Technical Specifications

Standard accuracy	± 1.5% f.s. dynamics of 1:30
Hi-Performance	sum of ± 0.5 % m.v. and ± 0.3 % f.s.
Accuracy	dynamics 1:100
Response time	< 150 ms
Pressure stability	up to 10 bar
Test pressure	15 bar
Pressure drift	< 0.2% /bar, typ. for air
Temperature	0...50 °C
Materials	aluminium or stainless steel electropolished, measuring element PBT
Seals	Viton, optionally EPDM
Supply power	24 VDC, ± 10%
Current consumption	Measuring circuit approx. 60 mA Controller approx. 170 mA
Signal outputs	of measuring and control circuit: standard 4...20 mA. (on request at no extra charge: 0...20 mA, 0...5 V, 1...5 V, 0...10 V)
Signal inputs	for controller only standard 4...20 mA. on request at no extra charge: 0...20 mA, 0...5 V, 1...5 V, 0...10 V
Digital interface	for measuring and control circuit included in scope of supply. RS 485, (Modbus RTU protocol for flow and temperature)
Optional	Profibus

Software "get red-y"	included in scope of supply:
	• read-out of actual values
	• flow and temperature
	• setpoint selection
	• input of control parameters
	• change of gas type
	• graphic representation of setpoints and actual values
	• logger function
	• totaliser

Electric connection D-Sub plug, 9pole

Gas connection	inside thread
	G 1/4" up to 50 NI/minute
	G 1/2" up to 450 NI/minute

Feed path	not required
Installation position	any, horizontal for >= 5 bar

Calibration protocol	traceable, 5 points, air included in scope of sup- ply. Real gas calibration for other gases on request and at extra charge
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Accessories	cable, power supply, display etc. on request
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**Mass flow transducer "red-y smart", GSM
Aluminium version, 24 VDC supply,**
calibration with air, dynamics 1:30
accuracy ± 1.5% of end of scale value,

Order No.	Measuring ranges
2593	A/ GSM 25 Nm/ minute 0.5 NI/minute
2594	B/ GSM to end of scale value 5 NI/minute
2595	C/ GSM to end of scale value 50 NI/minute
2596	D1/ GSM to end of scale value 100 NI/minute
2597	D2/ GSM to end of scale value 200 NI/minute
2598*	D3/ GSM to end of scale value 450 NI/minute

**Mass flow transducer "red-y smart", GSM
Stainless-steel version, 24 VDC excitation,**
calibration with air, dynamics 1:30
accuracy ± 1.5% of end of scale value

Order No.	Measuring ranges
2599	A/ GSM 25 Nm/ minute 500 NI/minute
2600	B/ GSM to end of scale value 5 NI/minute
2601	C/ GSM to end of scale value 50 NI/minute
2602	D1/ GSM to end of scale value 100 NI/minute
2603	D2/ GSM to end of scale value 200 NI/minute
2604*	D3/ GSM to end of scale value 450 NI/minute

**Mass flow controller "red-y smart", GSC
Aluminium version, 24 VDC supply,**
calibration with air, dynamics 1:30
accuracy ± 1.5% of end of scale value,

Order No.	Measuring ranges
2605	A/ GSM 25 Nm/ minute 0.5 NI/minute
2606	B/ GSM to end of scale value 5 NI/minute
2607	C/ GSM to end of scale value 50 NI/minute
2608	D1/ GSM to end of scale value 100 NI/minute
2609*	D2/ GSM to end of scale value 200 NI/minute

**Mass flow transducer "red-y smart", GSC
Stainless-steel version, 24 VDC excitation,**
calibration with air, dynamics 1:30
accuracy ± 1.5% of end of scale value

Order No.	Measuring ranges
2611	A/ GSM 25 Nm/ minute 0.5 NI/minute
2612	B/ GSM to end of scale value 5 NI/minute
2613	C/ GSM to end of scale value 50 NI/minute
2614	D1/ GSM to end of scale value 100 NI/minute
2615*	D2/ GSM to end of scale value 200 NI/minute

**(Indicate desired measuring range and out-
put signal when ordering)**

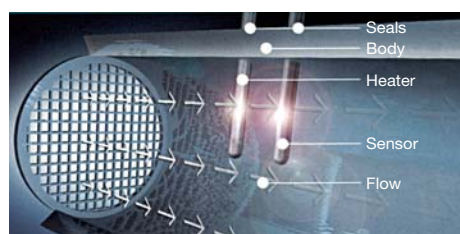
Order No.	Options
2617	Extra charge for higher accuracy Sum of ± 0.5 % m.v. and ± 0.3 % f.s. "Hi-Performance" version with dynamics of 1:100
2618	EPDM seals instead of Viton
2745	Profibus interface

*not available with higher accuracy

Mass flow transducer "red-y smart"



This additional series of mass flow measuring devices supplements our programme with measuring ranges of up to 7500 NI/minute. "Novaflo" transducers measure directly in the gas flow and therefore have only little pressure loss. The aluminium body of the basic unit is suitable for air and other non-aggressive gases. A stainless steel version extends the application range. The accuracy of $\pm 3\%$ is sufficient for most applications. Set-up of the devices is simple and robust, and allows virtually random positioning. Our "Novaflo" devices are available with integrated digital display for flow or gas volume. Be it the field of general mechanical engineering, the chemical industry or environmental protection, a convincing solution for all gas flow measuring applications is now available to designers. For use in the food processing industry the device can be sterilized. We hold a corresponding certificate.

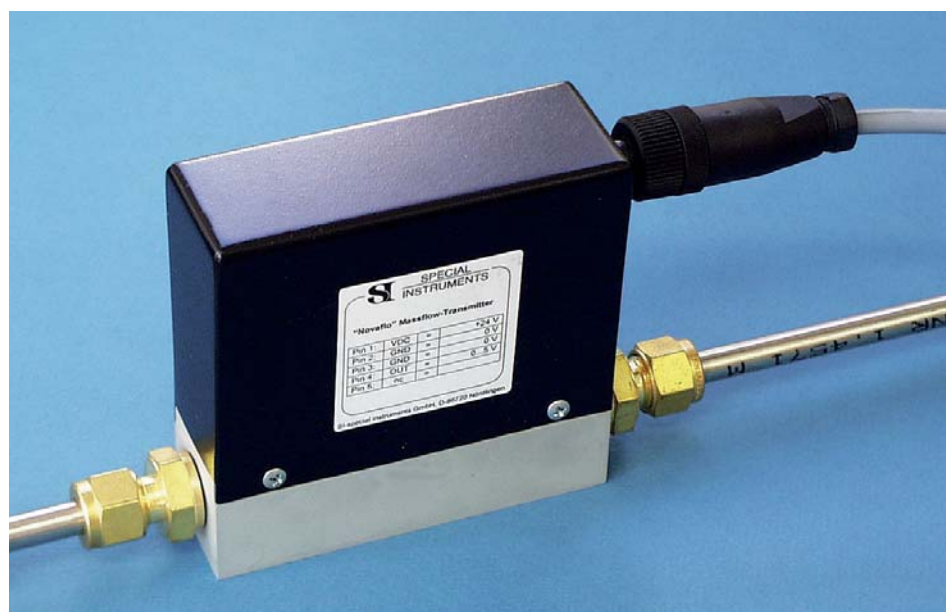


The devices consist of a metal body with a straight bore. Two sensors in stainless steel sleeves reach into the bore. One is a heater and the other a temperature sensor. Between the two sensors a constant temperature difference is maintained. The energy required to achieve this is dependent on the mass flow. This principle is outlined in detail on page 36 of this catalogue.

Mass flow transducer "Novaflo"

Aluminium version, 24 VDC supply
signal output 0...5 V, calibration with air,
accuracy $\pm 3\%$ f.s. at dynamics of 1:20

Order No.	Measuring ranges		
1958	20 NI/minute	NW8	G 1/4"
1155	50 NI/minute	NW8	G 1/4"
1148	100 NI/minute	NW8	G 1/4"
1959	100 NI/minute	NW16	G 1/2"
1157	200 NI/minute	NW16	G 1/2"
1158	400 NI/minute	NW16	G 1/2"
1864	500 NI/minute	NW32	G 1/2"
1810	1000 NI/minute	NW32	G 1/2"
1962	2000 NI/minute	NW32	G 1/2"
2619	3000 NI/minute	NW 56	G 1"
2620	4000 NI/minute	NW 56	G 1"
2621	5000 NI/minute	NW 56	G 1"
2622	6000 NI/minute	NW 84	G 1"
2623	7500 NI/minute	NW 84	G 1"



"Novaflo" mass flow transducer

Mass flow transducer "Novaflo"

Stainless steel version, 24 VDC supply
signal output 0...5 V, calibration with air,
accuracy $\pm 3\%$ f.s. at dynamics of 1:20

Order No.	Measuring ranges		
2624	20 NI/minute	NW8	G 1/4"
2625	50 NI/minute	NW8	G 1/4"
2626	100 NI/minute	NW8	G 1/4"
2627	100 NI/minute	NW16	G 1/2"
2628	200 NI/minute	NW16	G 1/2"
2629	400 NI/minute	NW16	G 1/2"
2630	500 NI/minute	NW32	G 1/2"
2631	1000 NI/minute	NW32	G 1/2"
2632	2000 NI/minute	NW32	G 1/2"

2633	3000 NI/minute	NW 56	G 1"
2634	4000 NI/minute	NW 56	G 1"
2635	5000 NI/minute	NW 56	G 1"

2636	6000 NI/minute	NW 84	G 1"
2637	7500 NI/minute	NW 84	G 1"

Order No. Options

1166	4...20 mA output signal
1164	Integrated LCD display for flow *
1964	Integrated LCD display for volume *
1163	Calibration to other measuring range or other gas type

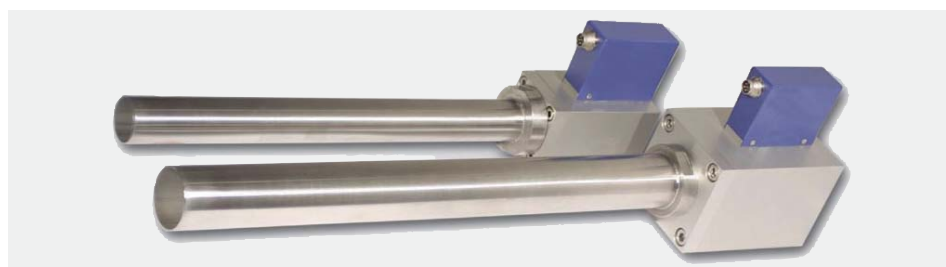
* only alternatively

Fittings not supplied. Inquire for if necessary.

"Novaflo" mass flow transducer for high flow volumes

The measuring range of these mass flow transducers has been extended. For the first time we are offering devices for measuring ranges > 2000 NI/minute. All Novaflo devices measure without bypass directly in the gas flow. The pressure loss thus is systematically lower than in other devices.

In applications with very low system pressure, e. g. in fuel gas supply systems for natural gas and oxygen, the pressure loss can be reduced further, when the components for flow enhancement are removed and permanent feed paths are added. The feed paths then are considered in the works calibration. This is necessary, since a definite flow profile is the alpha and omega of reliable flow measurement. We are pleased to offer devices that have been modified in this way.



“Novaflo” Mass Flow Controllers

Mass flow controllers are electronic control devices maintaining a set gas flow volume.

“Novaflo MFCs” incorporate the advantages discussed for the mass flow transducers. They have been extended by an electronic controller with PI characteristics and a proportional valve as actuator.

Up to a gas volume of 500 NI/minute (equivalent to air) the proportional valves are integrated into the electronics housing. External valves are used for higher flow rates.

The following kvs values are available as standard: 6.6 x 10 E-2, 0.35, 1.0 (inquire for higher values)

The nominal value is transmitted to the controller in the form of an analog electrical signal. The actual value of the measured flow is likewise available as an analog value. This signal allows to display and monitor the control output. “Novaflo-MFCs” are available in an aluminium or a stainless steel version.

NovaFlo transducers and controllers are calibrated with air, unless otherwise indicated. To use them for other gases a conversion factor is used. This factor is found by means of a complex equation. The values are known for a number of commonly used gases. Upon request, we will be pleased to provide these. Please note that the conversion of values for another gas increases the error.

Technical data for NovaFlo mass flow transducers and controllers

Standard accuracy	± 3% f.s. (dynamics 1:20)	
Time constant	sensor	0.7 s (63.2%)
Pressure stability	10 bar	
Pressure drift	0.2%/bar typically for air	
Test pressure	15 bar	
Temperature	0...70 °C	
Temp. influence	0.1%/°C	
Materials	aluminium, anodised stainless steel, AISI 316L	
Seals	Viton, optionally EPDM	
Supply	24 VDC ± 10%	
Current consumption	measuring circuit starting current 250 mA max. operation 175 mA max. controller + 250 mA max.	
Signal output	for measuring circuit and controller Standard 0... 5 V Optional 4...20 mA	
Signal inputs	for controller only Standard 0... 5 V Optional 4...20 mA	

Electr. connection round connector, 5pole

Gas connection Transducer
G 1/4" up to 100 NI/minute
G 1/2" up to 2000 NI/minute
G 1" up to 7500 NI/minute

Controller
G 1/4" up to 100 NI/minute
G 1/2" up to 1000 NI/minute

Feed path not required
Installation position any, horizontal for ≥ 5 bar
Calibration protocol traceable, 5 points, air included in scope of supply. Real gas calibration for other gases on request and at extra charge

Accessories cable, power supply, display etc. on request

Massflow controller (MFC) NovaFlo, calibration with air, aluminium version, with 24 VDC supply, setpoint input and actual value output 0..5 V, accuracy $\pm 3\%$ f.s. at dynamics of 1:20 parts in contact with medium made of aluminium, inside threads

Order No. Measuring and control range

1965	20 NI/minute	NW8	G 1/4"
1966	50 NI/minute	NW8	G 1/4"
1967	100 NI/minute	NW16	G 1/2"
1968	200 NI/minute	NW16	G 1/2"
1969	400 NI/minute	NW16	G 1/2"
1970	500 NI/minute	NW32	G 1/2"
1971	1000 NI/minute	NW32	G 1/2"

Massflow controller (MFC) NovaFlo, calibration with air, Stainless steel version, with 24 VDC supply, setpoint input and actual value output 0..5 V, accuracy $\pm 3\%$ f.s. at dynamics of 1:20 parts in contact with medium made of aluminium, inside threads

Order No. Measuring and control range

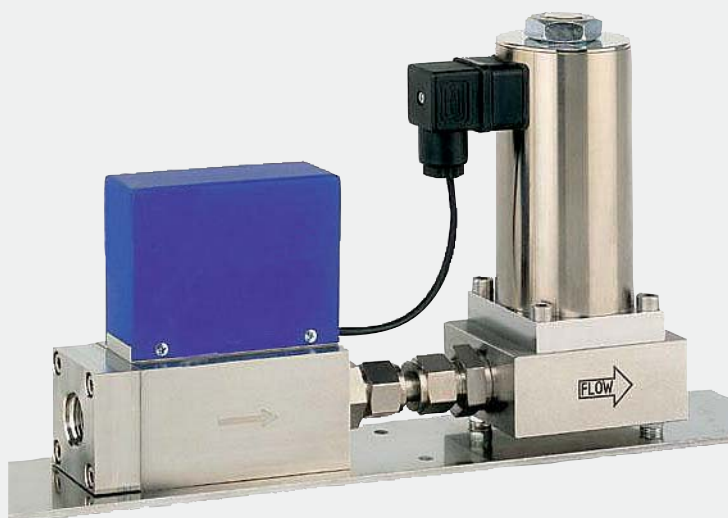
2638	20 NI/minute	NW8	G 1/4"
2639	50 NI/minute	NW8	G 1/4"
2640	100 NI/minute	NW16	G 1/2"
2641	200 NI/minute	NW16	G 1/2"
2642	400 NI/minute	NW16	G 1/2"
2643	500 NI/minute	NW32	G 1/2"
2644	1000 NI/minute	NW32	G 1/2"

Order No. Options

1974	4...20 mA setpoint input and actual value output
1163	Calibration to other measuring range or gas type

Fittings not included. Inquire for if necessary.

“Novaflo” MFC with control valve



Traceable calibration certificates are increasingly required by our customers. We have adapted to ISO 9000 and are supplying works certificates for our measuring instruments on request against payment. Upon initial or recalibration we are issuing a manufacturer test certificate M. (Its form corresponds to DIN 55350/Part 18). These calibration certificates certify the error limit of the measuring instrument at the time of calibration.

For calibration, the instrument is compared to a more accurate reference instrument, the utility or works reference. The deviations are noted and the measuring error is then computed. We are using a proprietary PC software for this task; it also outputs standardised protocols. These also show the deviations as an error curve. All our works standards are regularly inspected and certified by the DKD or another calibration authority of equal rank in the calibration hierarchy.

What is a calibration hierarchy?

In Germany the Physikalisch Technische Bundesanstalt (PTB, Federal Physical Technical Institute) is the highest national authority for metrology. As laid down in German law, it maintains reference standards of highest accuracy for all physical variables for calibration purposes.

If you would turn your measuring instrument in to PTB for calibration, your device would be compared to the most accurate standards available, however, that would cost lots of

money and take a few months. For these reasons, and because of the limited operating capacity of the institute, the German calibration service (DKD) has been established. A large number of DKD calibration labs in Germany are providing an adequate infrastructure for industrial metrology. Only a DKD lab can issue calibration certificates for utility or works standards.

Our works calibration lab therefore is the next authority below the DKD lab. On the basis of the continuously re-calibrated works standards and the fact that we have employees specially trained for this task, we are permitted to issue works certificates. Via the serial number of the inspected unit and documentation of the data of the works standard, the calibration can be traced to the national and international standards on the top levels of the hierarchy.

If your company is certified according to ISO 9000, among other things the following is required under the item "Control of inspection, measuring and test equipment" (section 4.11)...

- inspection, measuring and test equipment must be calibrated prior to release for use
- must be recalibrated periodically
- must have a valid relationship to recognized standards

If the number of instruments in use in your company that require calibration is high, we recommend to acquire a calibration instrument. We are offering various devices with DKD or works certificate for this purpose. For calibration of standard inspection, measuring and test equipment you do not need to use the most expensive device with the highest accuracy.

Also consider the following, please:

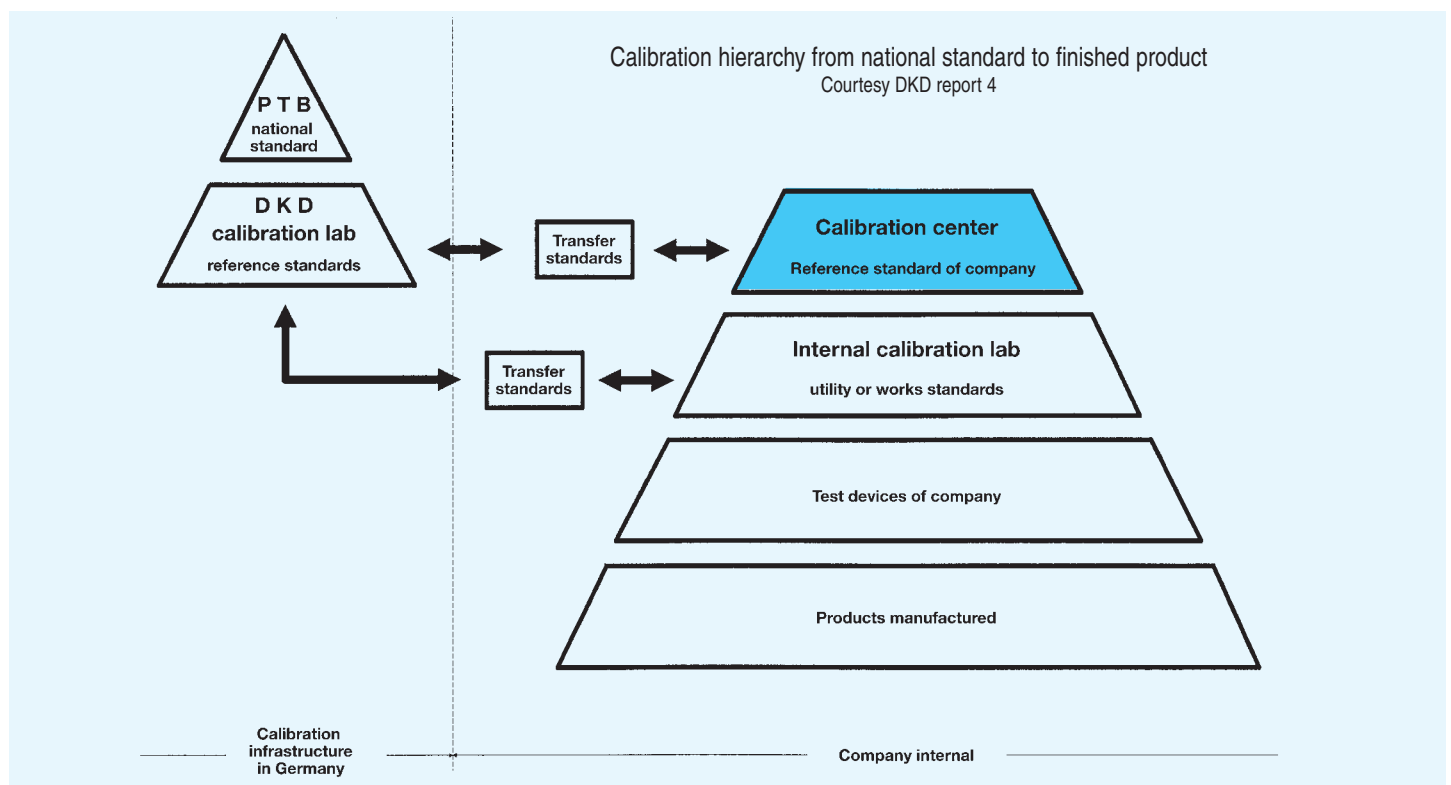
"You may also calibrate your devices with instruments that "only" have a works certificate!"

This is allowed, because such devices are traceable to recognized standards. If you prefer to have your measuring, inspection and test equipment calibrated by an external lab, you should carefully select the correct hierarchical level. Generally the higher hierarchical levels result in higher cost and longer downtime for instruments turned in.

Also consider the following, please:

"The measuring error of your device will not decrease just because a higher authority calibrates it!"

You can save a lot of money if you turn your measuring, inspection and test equipment in to an adequate authority for calibration. We are offering calibration of pressure and flow measuring devices as a service.



Works Calibrations

SI is entitled to issue traceable works calibration certificates for pressure and flow measuring instruments. We hold at our disposal reference instruments for the following measuring ranges.

Absolute pressure	1 bar.....20 bar
Relative pressure	2 mbar.....20 bar
Flow/air volume	3 Ncm ³ /minute...300 NI/minute

Initial calibration

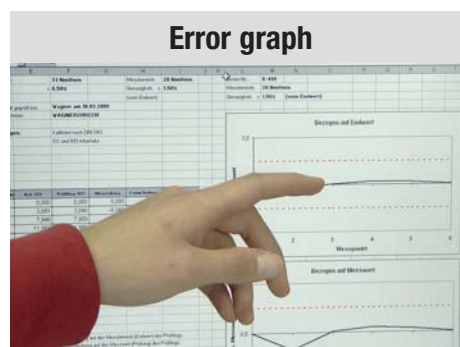
For many of our devices the initial calibration is already included in the scope of supply. If it is not, we are offering it:

Initial calibration of pressure measuring instruments

Order No.	
752	Traceable works certificate for pressure, one measuring range initial calibration
2507	Traceable calibration certificate for pressure, two measuring ranges initial calibration
2508	Traceable calibration certificate for pressure measuring instrument premo 3 initial calibration, main and partial range

Initial calibration of flow measuring instruments

Order No.	
1405	Works certificate for flow measuring instrument, initial calibration per measuring range



Recalibrations

We recommend to turn your measuring devices in regularly for inspection, adjustment, and calibration. This ensures you can always work with a tested measuring instrument. As the calibration interval you should plan a period of 1...2 years depending on the application. A comprehensive service package is included with every recalibration:

1. Functional check *
2. Adjustment, that is, we adjust the instrument to as low as possible an error deviation within the admissible error limits.

3. Documentation of measured values and deviations in a traceable calibration certificate in German and English as well as storage in a calibration database.
4. Marking of the measuring or test instrument with a calibration label

* If an error requiring repair should surface during the functional check, we will contact you, present a cost estimate and await your approval of the repair.

Recalibration of pressure measuring instruments

Order No.	
1975	Traceable calibration certificate for pressure, one measuring range recalibration
1976	Traceable calibration certificate for pressure, two measuring ranges recalibration
2645	Traceable calibration certificate for pressure measuring instrument premo 3 recalibration, main and partial range
2646	Traceable calibration certificate for pressure measuring instrument UNI 3 recalibration, main and partial range
2647	Traceable calibration certificate for micromanometer LPU 3 recalibration, main and partial ranges

Recalibration of flow measuring instruments

Order No.	
1977	Traceable calibration certificate for flow, one measuring range recalibration
1978	Traceable calibration certificate for flow, two measuring ranges recalibration
2648	Traceable calibration certificate for flow measuring instrument preffo 3 recalibration, main and partial range

We are also prepared to calibrate other brands. To do that, we need the operating and calibration manual for the device. The cost will be billed as incurred by us.

Order No.	
1407	Price per hour for pressure calibrations
1408	Price per hour for flow calibrations



Please note that we can perform repair and calibration exclusively in our works!

Calibrations of Higher Rank

Pressure calibrations by DKD

If you are required to have your measuring instruments calibrated by DKD, you will have to turn your measuring instruments in to a certified body (according to ISO 17025) for calibration. In Germany there are a number of these. However, very few of these offer calibrations from lowest to very high pressures. For many years we have been cooperation with a certified lab in the Netherlands which handles such tasks.

Now you may be wondering how the German calibration service works together with the Netherlands. It is quite simple: In the process of harmonization of European laws and regulations, certified calibration labs throughout the European Union have been granted equality. It must be mentioned that this lab works with primary standards, which are normally used only by the highest ranking national bodies (PTB in Germany or NMI in the Netherlands). The employees of this calibration lab are very competent, highly motivated and offer their services at a fair, calculable price.

Entrust us with your instruments. That is reasonable, because our cooperation with the lab allows you to get all the service you need: adjustment, calibration, repair and neutral calibration expertise. We are pleased to arrange a service package for you or mediate the first contact. Language is not a barrier, German and English are standard. The lab will calibrate pressure measuring instruments for the following ranges:

Relative pressure	5 Pa.... 500 MPa
Absolute pressure	5 kPa.... 500 MPa

For calibration of instruments with measured value display, it is first determined if the instrument can be calibrated at all and whether the accuracy is within the error limit indicated. The values found are then presented in a certificate.

Calibration of instruments with display in the excess pressure or absolute pressure range, incl. adjustment, if required.

Order No.	
1982	Instruments with 1 measuring range, calibration with 9 measuring points (upward and downward)
2649	Instruments with 2 measuring ranges, calibration with 9 measuring points each (upward and downward)
1983	Instruments with 1 measuring range, calibration with 21 measuring points (upward and downward)
2650	Instruments with 2 measuring ranges, calibration with 21 measuring points each (upward and downward)

As of 2007 we are also able to offer DKD calibrations for air flow measurement.

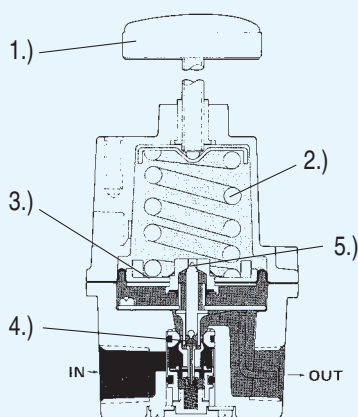
"Bellofram" Precision Pressure Regulators

Anyone employing air as operating medium, must rely on stable pressures. An adjusted pressure must remain constant, even if inlet pressure and consumption fluctuate strongly. This is the only way reproducible functions can be achieved with pneumatic control systems. Well-known pneumatic component manufacturers supply air service units including pressure relief valves keeping the supply pressure within tolerable limits.

But if the application involves air as test or measuring medium, such regulators reach their limits. This is the domain of fine pressure regulators. The American company "Bellofram" supplies a wide range of high-quality pressure regulators at favourable prices. We are using their regulators in our instruments. And for a number of years we have been distributing these products.

In this catalogue we are introducing the most important devices. And we would be pleased to send a catalogue for the entire delivery programme or detailed datasheets for individual regulators.

Example Type 70



Functional principle

The hand wheel (1) tensions a spring (2) applying a defined force on the diaphragm (3). The regulated pressure acts as compensating force on the underside of the diaphragm. When the output pressure drops because of air consumption, the spring pressure exceeds the compensating air pressure and opens the inlet valve (4) until the pressure balance is restored. Simple regulators have only this inlet valve. Too high output pressure can only be compensated for by air consumption. But fine pressure regulators have an additional pressure relief valve. If the regulated pressure rises too high, the diaphragm (3) lifts. The relief valve (5) opens, and the pressure decreases. Please,

note that the improved regulating accuracy requires a constant low air consumption. On these two pages you'll find manually adjustable regulators without auxiliary mechanical control energy. Almost all regulators are equipped with North American NPT threads. This tapered thread seals reliably with very low leakage. If you cannot use NPT threads, we can supply adapters for NPT to standard pipe unions.

Order No. Screw-in adapter

1417	1/8" NPT to R 1/8"
1692	1/4" NPT to R 1/4"
1419	3/8" NPT to R 3/8"

Filter/relief station type 51 FR

This compact pressure regulator with filter has been designed for decentralized supply of pneumatic actuators and controllers. The pressure relief station is equipped with a high volume filter/water collector system reliably removing condensate, oil, and contaminants such as rust, dust and scale, to prevent damage to costly measuring and regulating instruments. The regulator does not need to be removed from the line for cleaning.

Flow rate
(7 bar inlet pressure and
1.4 bar output pressure) 42 Nm³/h

Relieving capacity 0.85 Nm³/h
Pressure connections 1/4" NPT
Maximum inlet pressure 18 bar
Temperature range 0...50 °C
Material body aluminium alloy
interior stainless steel, Delrin, Buna
filter 40µ Nylon

Order No.	
1420	Range 0...2 bar
1145	Range 0...4 bar
1421	Range 0...7 bar
1431	mounting bracket

As type 51SS a stainless steel filter/relief station is available. Please inquire for it!

Type 51 FR



Precision regulator type 10

With its servo controlled force compensation system controlling the main valve by means of a pilot mechanism, the type 10 is the world's most precise pressure regulator.

In addition to the basic model, a low-pressure version type 10LR, the type 10HR with high reverse relieving capacity and the plunger-operated type 10PL are available. Please, observe that these regulators cannot control zero pressure.

Flow rate	10.10HR	25 Nm ³ /h
	10LR	7 Nm ³ /h
Relieving capacity	10.10LR	8 Nm ³ /h
	10HR	17 Nm ³ /h

Max. inlet pressure	10.10HR	10.5 bar
	10LR	3.5 bar

Materials	body	aluminium alloy
	interior	stainless steel brass, Buna

Order No.	10 LR	
1058	1/4"NPT	0.05 - 1.75 bar

Order No.	10 PL	
1443	1/8"NPT	0.15 - 1.75 bar
1444	1/4"NPT	0.15 - 1.75 bar
1445	3/8"NPT	0.15 - 1.75 bar

1446	1/8"NPT	0.15 - 4.0 bar
1447	1/4"NPT	0.15 - 4.0 bar
1448	3/8"NPT	0.15 - 4.0 bar

1449	1/8"NPT	0.15 - 8.0 bar
1450	1/4"NPT	0.15 - 8.0 bar
1451	3/8"NPT	0.15 - 8.0 bar

Type 10



Order No.	10	
1452	1/8"NPT	0.15 - 1.75 bar
1248	1/4"NPT	0.15 - 1.75 bar
1227	3/8"NPT	0.15 - 1.75 bar
1460	1/8"NPT	0.15 - 4.0 bar
1461	1/4"NPT	0.15 - 4.0 bar
1462	3/8"NPT	0.15 - 4.0 bar

1463	1/8"NPT	0.15 - 8.0 bar
1464	1/4"NPT	0.15 - 8.0 bar
1465	3/8"NPT	0.15 - 8.0 bar

Order No.	10 HR	
1466	1/8"NPT	0.15 - 8.0 bar
1467	1/4"NPT	0.15 - 8.0 bar
1468	3/8"NPT	0.15 - 8.0 bar

Subminiature pressure regulator, type 91

The type 91 is the dwarf in Bellofram's family of pressure regulators. It is ideal for applications with limited space and very low flow. Even at very low flow, this tiny regulator is highly accurate. That makes it the ideal regulator for mobile applications.

Pneumatic data @ 7 bar inlet and 1.4 bar output pressure
 Flow rate 4 Nm³/h
 Relieving capacity 0.2 Nm³/h
 Air consumption, max.* 1.4 l/minute
 Maximum inlet pressure 17.5 bar
 Temperature range -20...+ 60° C
 Material body anodized aluminium
 interior anodized aluminium, Viton
 Dimensions 22 mm diameter
 85 mm length

Order No. Connection/pressure range

1525	M5	0...0.35 bar
1432	M5	0...1 bar
1433	M5	0...2 bar
1434	M5	0...4 bar
1435	M5	0...7 bar

Subminiature pressure regulator, type 91



"Low bleed" version, type 91

In this special version of the type 91 the inescapable continuous air consumption of the fine pressure regulators has been reduced to 10% of the standard version. Thus it is especially suitable for portable analysers.

Pneumatic data @ 7 bar inlet and 1.4 bar output pressure
 Flow rate 2.4 Nm³/h
 Relieving capacity 0.2 Nm³/h
 Air consumption, max.* 0.14 l/minute
 Maximum inlet pressure 10 bar
 Temperature range -20...+ 60° C
 Material body anodized aluminium
 interior anodized aluminium, Viton
 Dimensions 22 mm diameter
 85 mm length

Order No. Connection/pressure range

2652	M5	0...0.35 bar
2653	M5	0...1 bar
2654	M5	0...2 bar
2655	M5	0...4 bar
2656	M5	0...7 bar

Order No. Options for both type 91 regulators

2657	No drain
2658	Screw driver adjustment

High flow regulator, type 70

The model 70 is the power horse among the precision air regulators of Bellofram. The output pressure is controlled up to an air flow capacity of 84 Nm³/h. This is possible because the actual pressure is traced by a sensor tube in the controller output connection, to allow for closed loop control. The rolling diaphragm allows the regulator to adapt very quickly to changes and still stable operation results.

Pneumatic data @ 7 bar inlet and 1.4 bar output pressure
 Flow rate size 1/4" NPT 67 Nm³/h
 size 3/8" NPT 84 Nm³/h
 Relieving capacity 8 Nm³/h
 Maximum inlet pressure 17.5 bar
 Temperature range 0...50 °C
 Material body aluminium alloy
 interior stainless steel, brass, Buna

Order No. Connection pressure range

1022	1/4" NPT	0... 0.15 bar
1436	3/8" NPT	0... 0.15 bar
964	1/4" NPT	0... 0.70 bar
1418	3/8" NPT	0... 0.70 bar
1080	1/4" NPT	0... 2.0 bar
1226	3/8" NPT	0... 2.0 bar
1013	1/4" NPT	0.07...4 bar
1437	3/8" NPT	0.07...4 bar
976	1/4" NPT	0.15...10 bar
1438	3/8" NPT	0.15...10 bar
1138	1/4" NPT	0.2...14 bar
1439	3/8" NPT	0.2...14 bar
1087	Mounting bracket for mod. 70	

Precision regulator type 41

The model 41 has the same technical properties and the accuracy of type 70 series. However, the regulator is only available for flow volumes up to 40 Nm³/h. Therefore it is smaller than the type 70.

Pneumatic data @ 7 bar inlet and 1.4 bar output pressure.
 Flow rate 42 Nm³/h
 Relieving capacity 0.85 Nm³/h
 Maximum inlet pressure 17.5 bar
 Temperature range 0...50 °C
 Material body aluminium alloy
 interior stainless steel, brass, Buna

Order No. Connection pressure range

1440	1/4" NPT	0...2 bar
1441	1/4" NPT	0...4 bar
1442	1/4" NPT	0...7 bar
1487	Mounting bracket for mod. 41	

Type 70/Type 41



Highflow pressure regulator, type 78

Most pressure regulators for high flow rates are not very accurate. The model 78 solves this problem, since this device series has been developed for applications that require accurate pressure regulation at high air flow rates. If the inlet pressure is sufficient, a change in the supply pressure of up to 7 bar will result only in a change of 20 mbar on the output end.

Pneumatic data @ 7 bar inlet and 1.4 bar output pressure
 Flow rate up to 350 Nm³/h depending on rated diameter
 Relieving capacity 24 Nm³/h
 Maximum inlet pressure 27.5 bar
 Temperature range 0...50°C
 Material body aluminium alloy
 interior stainless steel, brass, Buna

Type 78 for high flow rates



Order No. Connection pressure range

2659	3/8" NPT	0...0.14 bar
2660	1/2" NPT	0... 0.14 bar
2661	3/4" NPT	0...0.14 bar
2662	1" NPT	0...0.14 bar
2663	3/8" NPT	0...0.7 bar
2664	1/2" NPT	0...0.7 bar
2665	3/4" NPT	0...0.7 bar
2666	1" NPT	0...0.7 bar
2667	3/8" NPT	0... 2.1 bar
2668	1/2" NPT	0... 2.1 bar
2669	3/4" NPT	0... 2.1 bar
2670	1" NPT	0... 2.1 bar
2671	3/8" NPT	0... 4.1 bar
2672	1/2" NPT	0... 4.1 bar
2673	3/4" NPT	0... 4.1 bar
2674	1" NPT	0... 4.1 bar
2675	3/8" NPT	0... 8.6 bar
2676	1/2" NPT	0... 8.6 bar
2677	3/4" NPT	0... 8.6 bar
2678	1" NPT	0... 8.6 bar

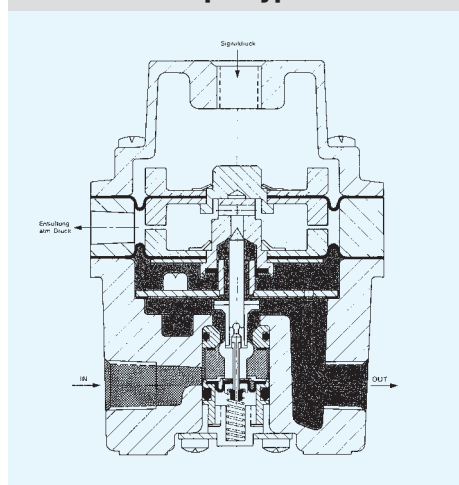
2679 Mounting bracket for mod. 78

All regulators are also available in a non-relieving version. Please inquire for these!

Pneumatic Booster Valves

... are also referred to as booster relays, pressure relays or "dome" pressure regulators. All of these designations describe the pneumatic control principle employed by this regulator type. In the design, the handwheel and bias spring of the mechanical precision air pressure regulator have been removed and replaced by a chamber, the "dome". When this chamber is filled with air, a pressure acts on the diaphragm via a "dome" instead of the bias spring. This is the only substantial difference to mechanical fine pressure regulators.

Example type 75



The pneumatic control capability allows for interesting system designs. The proportional relation of input and output allows to control high flow volumes with high precision at only low control air consumption.

On catalogue page 50 you find the EPC 1000 compact regulator. In this regulator, booster valves are used to increase the air flow rate.

Normally the ratio of control pressure and output pressure is 1:1. However, "Bellofram" also supplies special types with different defined transmission ratios (e. g. 1:4). This allows to achieve pneumatic multiplication. Such transmission ratios can be achieved by means of an adjustable bias spring. This function is important in pneumatic control and regulating. In explosion protected areas they cannot replace a computer, but they help achieve control functions with air as medium, that are otherwise impossible to achieve, or only with costly extensive setups.

Once you have studied the possibilities of pneumatic analog control technology, stunningly simple solutions often evolve. We know how to deal with this technology and are ready to aid you.

Booster valve, type 75

All of the above explanations fully apply to this Bellofram type. The pneumatically controlled pressure regulator is derived from the mechanical type 70 and therefore ideally suited to all applications requiring high flow, pressure boosting or remote pressure adjustment.

Pneumatic data @ 7 bar inlet pressure and 1.4 bar output pressure

Flow rate	size 1/4" NPT	67 Nm ³ /h
	size 3/8" NPT	84 Nm ³ /h

Relieving capacity 8 Nm³/h

Maximum inlet pressure 17.5 bar

Temperature range 0...50 °C

Material body	aluminium alloy
interior	stainless steel, brass, Buna

Order No.	Connection	Ratio
963	1/4" NPT	1:1
1469	3/8" NPT	1:1
1470	1/4" NPT	1:2
1471	3/8" NPT	1:2
1472	1/4" NPT	1:4
1473	3/8" NPT	1:4
1474	1/4" NPT	1:6
1475	3/8" NPT	1:6
Negative/difference relay		

Order No.	Connection	Ratio
1476	1/4" NPT	1:1
1477	1/4" NPT	1:2
1478	1/4" NPT	1:4
1479	1/4" NPT	1:6

Type 75



Booster Valve Type 79

This new booster valve has been developed for especially high air consumption. The relieving capacity is higher than usual.

Pneumatic data @ 7 bar inlet pressure and 1.4 bar output pressure

Flow rate 210 Nm³/h

Relieving capacity 65 Nm³/h

Max. inlet pressure 27.5 bar

Max. output pressure 13.8 bar

Temperature range -40...90°C

Material body	aluminium alloy
interior	stainless steel, brass, Buna

Order No.	Connection	Ratio
2681	1/2" NPT	1:1
2682	3/8" NPT	1:1
2683	3/4" NPT	1:1
2684	1" NPT	1:1

Type 79



Precision booster type 20

The booster type 20 is the pneumatically controlled equivalent of the mechanical type 10. In it the high regulating accuracy is achieved by the same servo-controlled force compensation system. In addition to the basic model, this booster is also offered in a version for high flow, the type 20 HF, and as type 20HR with high reverse relieving capacity.

On all models the differential pressure can be adjusted. It is possible to adjust a pressure difference of ± 2.1 bar between signal pressure and output pressure. Boosters are available exclusively with a 1:1 ratio.

Pneumatic data @ 7 bar inlet pressure and 1.4 bar output pressure

Flow rate	type 20.20HR	25 Nm ³ /h
	type 20HF	70 Nm ³ /h
Relieving capacity	type 20.120HF	8 Nm ³ /h
	type 20HR	17 Nm ³ /h

Max. inlet pressure	type 20.20HR	10.5 bar
	type 10LHF	3.5 bar

Control pressure max.	8 bar
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Material body	aluminium alloy
interior	stainless steel, brass, Buna

Order No.	Connection	Pressure range type 20
1480	1/8"NPT	0.15 - 8 bar
1481	1/4"NPT	0.15 - 8 bar
1482	3/8"NPT	0.15 - 8 bar

Order No.	Connection	Pressure range type 20 HR
1483	1/8"NPT	0.15 - 8 bar
1484	1/4"NPT	0.15 - 8 bar
1485	3/8"NPT	0.15 - 8 bar

Order No.	Connection	Pressure range type 20 HF
1486	3/8"NPT	0.15 - 3.5 bar

Type 20



Vacuum regulator type 77

This regulator is a Bellofram specialty. It allows constant regulating of vacuum pressures and atmospheric pressure. The following operating modes can be achieved.

Bypass regulating

The vacuum pump acts directly on the evacuated vessel. The recipient is thus evacuated as rapidly as the cross-section of the connecting lines allows. To maintain the set vacuum in this operating mode, the regulator meters missing air.

Shut-off regulating

In this operating mode the pump evacuates via the regulator. If a positive pressure is additionally connected to the regulator, the vessel pressure can be maintained constant across a continuous range between vacuum and positive pressure.

Flow rate	
in vacuum	4 Nm ³ /h
in positive pressure range	68 Nm ³ /h
Relieving capacity	10 Nm ³ /h
Maximum vacuum	- 950 mbar
Maximum inlet pressure	18 bar
Temperature range	5...95°C
Material body	cast aluminium
interior	stainless steel, bronze Delrin, Buna

Order No. Regulator with 1/4" NPT connection

947	Vac....+ 0.14 bar
1012	Vac....+ 0.70 bar
1137	Vac....+ 2.1 bar
1453	Vac....+ 7.0 bar
1454	Vac....+10.5 bar

Order No. Controller with 3/8" NPT connection

1455	Vac....+ 0.14 bar
1456	Vac....+ 0.70 bar
1457	Vac....+ 2.1 bar
1458	Vac....+ 7.0 bar
1459	Vac....+10.5 bar

Vacuum regulator, type 77



Motor-controlled pressure regulator

As a leading manufacturer of mechanical precision air pressure regulators, Bellofram also offers electrically adjustable systems. The

motor-controlled model 10 seems antique to many users. Unjustifiedly, we are convinced.

If the problem is to preset a controlled pressure, this solution has many advantages over purely electronically controlled systems. These regulators are still successfully employed in test rigs.

Purposely we have declined from listing all the available controller/motor combinations. (There are too many.) But if this solution seems just right for your application, we will certainly be able to offer a suitable version.

DKG-4 Calibration case



Further Bellofram products:

This catalogue only presents the most popular Bellofram products for measuring and control systems:

- Mechanical precision pressure regulators
- Pneumatically controlled pressure regulators (pressure relays, booster valves)
- Electronically controlled pressure regulators

Additionally Bellofram supplies:

- Rolling diaphragms
- Rolling diaphragm cylinders
- Valve position controllers/actuators

Please let us have your inquiry. We will be pleased to send technical descriptions and a quotation.

"Bellofram" regulators can be supplied short-term for test purposes. Your series requirement can be maintained on stock. This will also result in lower pricing.

Insider tips

In the past we have modified mechanically operated pressure regulators of other manufacturers to add pneumatic control for various special solutions. The direct proportionality and

the pressure relation between control pressure and output pressure is no longer maintained by such manipulated boosters. However, that does not matter when a booster is used as actuator in a pneumatic/electronic regulating loop. A typical operation is the combination of our control pressure regulator EPC 1000 with pneumatically controlled pressure control valves shown on page 50.

Vacuum booster valve

If you need a booster valve for vacuum pressure, you can use the mechanical Bellofram type 77. If you release the bias spring of this regulator and connect the control air to the "vent" connection, this regulator also functions with pneumatic control.

Precision pressure regulator for very low pressures

There are very few good precision pressure reducing valves in the market. Almost all manufacturers promise more in the millibar range than they can actually keep. Since the high-precision type 10LR by Bellofram only starts regulating at 50 mbar, we went looking for alternatives. We found a precision regulator for the range between 3...100 mbar. It is capable of supplying up to 65 NI/minute of air. Also, this mechanical regulator can be remote-controlled pneumatically and may thus be used as a pneumatic actuator. If you need high constancy and reproducibility, this device is well paid for.

Order No.

709	Precision pressure regulator for lowest pressures
Pressure range	3...100 mbar
Flow rate	65 NI/minute
with relieving capacity	
Pressure connections	G1/4"

For low pressures and high flow rates ...

Frequently we custom-design controllers for lowest pressures and high air volumes. A typical application is the test rig for functional inspection of filters, valves, nozzles and other components.

Low pressure regulators used in the gas industry are suitable as actuators in such applications. These can be integrated easily into the control loop.

The smallest regulator from this line is the following:

Order No.

716	Low-pressure booster valve
Pressure range	0...100 mbar
Flow rate	200 NI/Minute
without relieving capacity	
Pressure connections	R 1/2"
suitable for	air, natural gas or oxygen

Inquire for control valves with higher flow rates and larger dimensions.

incorporating control pressure regulators and booster valves

Mechanical pressure regulating valves are a good solution when the pressure does not need to be changed very often. But in automation technology, and especially in test field applications, more and more users require electrically adjustable pressure regulators. We can offer various solutions for this task.

On this page we are presenting a modular regulator concept. Our control pressure regulator 1000 and a properly selected booster valve solve unusual regulating problems flexibly at low cost.

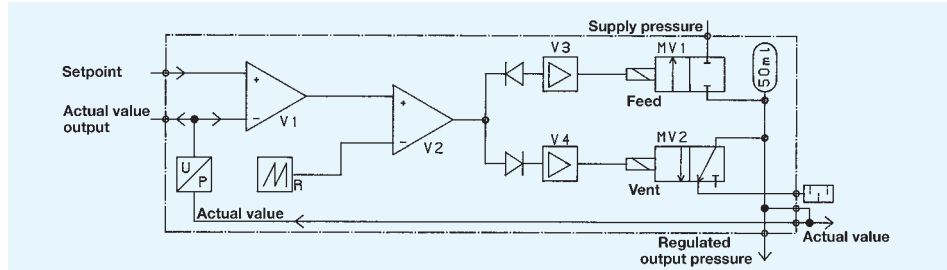
Functional principle:

A well regulated static pressure reference is generated by the control pressure regulator. A volume of 50 ml is controlled by quick-action solenoid valves. The valves are pulse-width controlled depending on regulator deviation; the result is a stable regulating characteristic. The control pressure generated is connected to the dome of the booster valve by means of a tube. The pressure acts on the diaphragm of the booster valve and softly opens and closes the process valve in the main flow.

If very precise regulation is required, the pressure line of the actual value sensor can be disconnected from the control pressure regulator and connected directly to the consumer controlled. Then the booster valve also reacts to pressure drop occurring in the consumer's supply line.

This regulator concept allows to achieve tasks impossible to solve with standard devices of other manufacturers. A possible application is a flow volume control loop.

Since pressure and flow are connected to one another, a pressure regulator can also be operated like a flow controller. All you need to do to achieve this is to replace the actual pressure



value for the control pressure regulator by an actual flow signal.

Regardless of the type of flow transducer, be it an LFE or a mass flow sensor, the system will always adjust to the pressure required to maintain the nominal flow volume. This also applies to regulating of pneumatic ejector pumps or vacuum generators.

"EPC 1000" control pressure regulator



Since the function of the electric and pneumatic modules is transparent, and since analog standard signals are consistently used, the overall function will always remain comprehensible.

"EPC 1000" control pressure regulator

This control pressure regulator supplies a stable pressure signal at low flow rates. In applications without air consumption it can be used as a stand-alone unit. A downstream booster valve supplies additional flow volume if required.

The compact regulator is housed in an enclosure type IP 65. It is supplied with 24 VDC. In addition to the internal pressure sensor it includes an actual value input for external signals. An actual value output allows to monitor the regulator function. All regulator signals can be configured as standard signals. A permanent regulator offset can be adjusted. All pneumatic connections are M5 size. The accuracy is $\pm 1\%$; when power fails, pressure is relieved. (failsafe operation)

Order No.	Electronic control pressure regulator
693	Regulating range 100 mbar / rel.
694	500 mbar / rel.
695	1 bar / rel.
696	2 bar / rel.
697	3 bar / rel.
698	4 bar / rel.
699	5 bar / rel.
700	6 bar / rel.
701	7 bar / rel.

Order No.	Electronic control pressure regulator without integrated pressure sensor
707	

Order No.	Options
499	Maintain pressure upon power failure
702	Absolute pressure regulator

Order No.	Available accessories
708	Additional volume of 50 ml, incl. retaining clamp
703	Tube connector M5 thread for tubes 6/4 mm
704	Tube connector M5 thread for tube 4.3/3 mm
705	Round plug, 7pole, counter part for electrical connection of the device

Compact pressure regulator EPC 1000

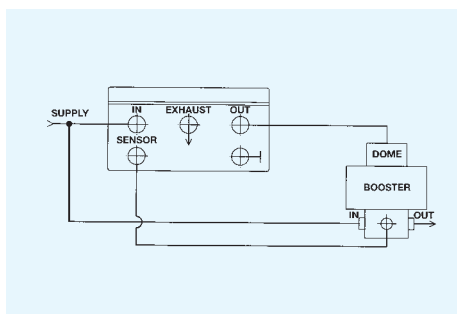
These electronic pressure regulators are the combination of a control pressure regulator EPC 1000 with a booster valve type 75. Both components are supplied ready to connect, that is, assembled, with pneumatic tubes, function tested.

Compact pressure regulator EPC 1000



Order No.	Compact pressure regulator EPC 1000 with internal sensor, regulating range
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501	0...1 bar/rel.
502	0...2 bar/rel.
503	0...3 bar/rel.
504	0...4 bar/rel.
505	0...5 bar/rel.
506	0...6 bar/rel.
507	0...7 bar/rel.



Electronic pressure regulator type 2000 by Bellofram

This new electronic pressure regulator operates highly accurately. Thanks to its integrated piezoresistive pressure sensor and piezo-ceramic nozzle/baffle plate system it reaches an accuracy of 0.25% f.s. The regulator has an excellent price/performance ratio. Due to its design, this device is insensitive to shock and operates reliably and accurately even under extreme installation and operating conditions.

Few electronic pressure regulators in the market can be configured and adjusted by the user. This feature makes the Bellofram type 2000 unique. With only a few basic types or pressure ranges numerous device variants can be set up. This allows drastic reductions in the number of units held on stock.

With these properties the model 2000 by Bellofram is excellently suited for use in all areas of air measurement and control. The device is primarily used in automation applications with stringent requirements.

For installation sites requiring explosion protection we can offer intrinsically safe versions (to ATEX class EEx ib IIC T4).

Configuration options

The following features can be set by means of DIP switches:

- Two- or three-wire measuring system

- Direct or inverse operation
direct operation
 0...100% signal = 0...100% pressure
inverse operation
 0...100% signal = 100%...0 pressure
- Selection of a splitting function (full/high/low)
Example for a 0...2 bar pressure range
 full 0...10 V = 0...2 bar
 low 0...10 V = 0...1 bar
 high 0...10 V = 1...2 bar

Potentiometers for zero point and measuring span
 Generally potentiometers are used to adjust and calibrate the integrated pressure transducer. Additionally, the electrical input signals can be adapted to the output pressure value.

Change of the pressure range

The potentiometers allow to change the limits of the pressure range. The range can be narrowed easily without loss in accuracy. The splitting function helps in this regard, too.

Amplification potentiometer

This potentiometer is used to adjust the regulating properties of the device. If low amplification is adjusted, the set pressure is adjusted softly without overshoot. High amplification results in faster regulating. Overshoot is possible, however. Depending on the load conditions at hand, you may adjust the optimal dynamic behaviour of the regulator.

Device features

Pressure ranges	0...350 mbar 0... 1 bar 0... 2 bar 0... 4 bar 0... 8.4 bar
Accuracy	0.25% f.s
Setpoint input	selectable with DIP switch
Three-wire system	0...5 V, 0...10 V 1...5 V, 1...9 V, 1...10 V
Two-wire system	4...20 mA
Excitation voltage	5...28 VDC for voltage input mode
Electr. connection	DIN plug, Hirschmann
Pneumatic ports	¼" BSPT
Supply pressure	350 mbar higher than pressure to be controlled minimum 1.4 bar
Constant air consumption	1.9 NI/minute
Flow rate	
0...350 mbar	312 NI/minute
0... 1 bar	538 NI/minute
0... 2 bar	595 NI/minute
0... 8.4 bar	595 NI/minute
Pressure relief	85 NI/minute

"Type 2000 S"



Electronic pressure control valve, type 2000 S

Hirschmann plug, I/O air connections ¼" BSPT
 Setpoint signal input selectable by DIP switch

Order No. S-type pressure ranges

2685	0...350 mbar
2686	0... 1 bar
2687	0... 2 bar
2688	0... 4 bar
2689	0... 8.4 bar

Electronic pressure control valve, type 2000 E

Explosion protected version/intrinsically safe/EEx ib IIC T4
 Hirschmann plug, I/O air connections ¼" BSPT
 Setpoint signal input and supply by 4...20 mA two-wire system

Order No. E-type pressure ranges

2690	0...350 mbar
2691	0... 1 bar
2692	0... 2 bar
2693	0... 4 bar
2694	0... 8.4 bar

Order No. Accessories

2695	Optional pre-filter 60 µ
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Servo valve technology by Kolvenbach

These servo valves permit designing highly precise and rapidly responding regulating systems. The heart of this series of electro-pneumatic regulator modules is a very fast rotary vane actuator. The rotary vane is powered by a position controlled direct current motor. Since there is no transmission system, the adjusting times are extremely short, in the millisecond range.

The basic actuator with motor control electronics is also sold individually. But normally a classical analog proportional plus integral plus derivative controller (PID) is added. The individual adjustability of the PID ratio and the short response time of these regulators allow applications that may have seemed impossible to achieve with air as control medium.

Typical applications for Kolvenbach servo valve systems

- Regulated reference pressure sources for calibration of pressure transducers. Automatic processing of pressure points for adjustment pressure switches.
- Position-controlled cylinder drives with a repeatability of 1/10 mm for handling and assembly tasks in production automation
- Precision pressure regulating with accuracy of up to 0.1 %, e. g. in brake control systems of textile and paper processing machinery, or tensile strength and pressure testing machines
- Generation of exact stroke/time profiles with pneumatic cylinders in the food stuffs industry or industrial processing
- Highly precise tensioning control on calendars of paper, textile or foil winders.

We are pleased to supply application sheets concerning the tasks mentioned. These describe typical solutions in detail. We also offer specific advice.

Kolvenbach servo valves are available with nominal sizes 4 mm and 6 mm. The field of application reaches from vacuum pressure to 10 bar system pressure. The dynamicity at $\pm 100\%$ is 70 Hz. This corresponds to a switching time of 5 milliseconds for 0...100%.



Compact servo valves KPS/KWS

Since the valve functions as a steady 3/3 directional valve, all variations of fast controlled or regulated pressure inlet and outlet are available. Please note, however, that a rotary vane valve needs some operating clearance and therefore cannot be free of leakage when it is closed.

In addition to the position-controlled basic actuators we can supply specially adapted electronic assemblies in 19" racks or customized compact regulators. We'll be pleased to support you in selecting and specifying your servo-pneumatic application.

Your advantages:

- Compact design
- High-precision
- Fast, in the milliseconds range
- Adjustable PID characteristics
- Favourably priced

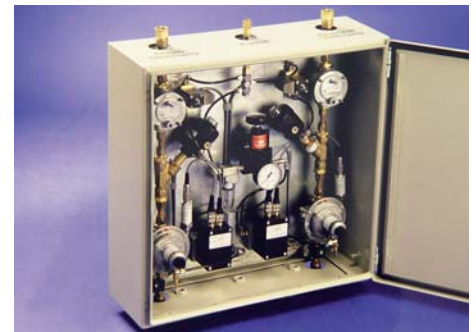
Application example of a servo valve with downstream booster valves

In the production of light bulbs, fuel gas and oxygen must be metered and mixed precisely to achieve even flame temperature for melting of glass. The process parameters must be well controlled, to ensure high bulb quality. For a large-scale bulb manufacturer we have designed control loops for fuel gas and oxygen. The two gas pressures are controlled with high precision although the pressure is low and the flow rate high.

However, when pressures are low and flow rates are high, even the Kolvenbach valve reaches its physical limits. Therefore we opted for

a combination of control pressure regulating valve and a booster relay.

Each control loop consists of a servo valve with PID controller, dome-controlled gas regulator and a pressure transducer for acquisition of



the actual value. In this setup the servo valve fills the control-dome with air and thereby regulates pressure with high precision.

Compact servo valves KPS/KWS

This series combines mechanical servo valve and electronic controller in one unit ready to connect.

Valve type	3/3 way servo valve
Pressure connections:	G 1/4" inside thread
Operating pressure:	vacuum to 10 bar
Medium:	dry and wet, oiled or oil-free air filtered to 5 μ
Linearity and hysteresis	< 1% each related to the valve position
Limit frequency	@ 100% control output approx. 70 Hz @ 50% control output approx. 110 Hz
Switching time	0...100% or 100% ...0 approx. 7 ms

Compact Servo Valves

Regulator type	analog PID controller proportional, integral, derivative components independently adjustable
Control accuracy	better than 0.1% with optimal controller settings, relating to the actual value input with normal voltage signals
Control	
Nominal value	0...10 V at 100 kOhm alternatively 0...20 mA at 500 Ohm
Nominal value	0...10 V at 100 kOhm alternatively 0...20 mA at 500 Ohm
Error messages "ERROR" output	open collector output to excitation voltage GND, min. load 1 kOhm. The output switches when the control error cannot be compensated for (for approx. 0.5 s)
"LIMIT" output	open collector output to excitation voltage GND, min. load 1 kOhm. The output switches when the actual value exceeds the set value between 0...100%.
Excitation voltage	24 VDC (21...30 VDC) approx. 0.8 A current consumption)
Enclosure type	IP 20
Temperature range	0...50 °C
Installation position	any
Mech. dimensions	100 x 60 x 85 mm (L x W x H)
Weight	approx. 1000 grams

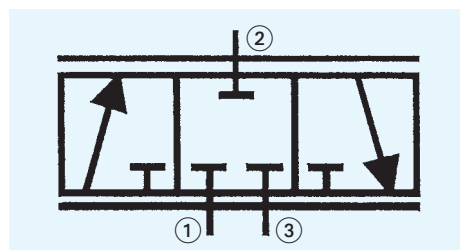
Pneumatic setup

The valves can be arranged freely in any pneumatic setup. (See table 1)
The most frequently used are the variations a and b. In these only the opening direction changes with the control signal:

Connecting variations/table 1

	①	②	③
a	R	A	P
b	R	A	P
c	A	P	B
d	A	R	B

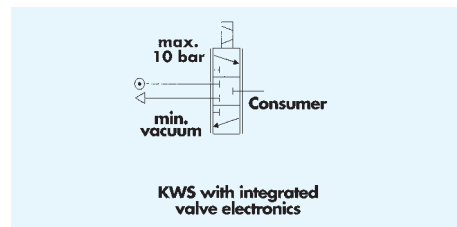
Low control signal connects the connections ① and ②



High control signal connects the connections ② and ③

Compact servo valve with position-controlled rotary vane

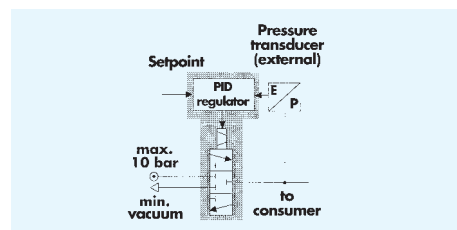
This compact unit comprises the basic actuator with electronic position control. It is easily integrated into servo-pneumatic control circuits.



Order No.	
1507	3/3 servo valve with 4 mm rated size Type KWS 3/4
1046	3/3 servo valve with 6 mm rated size Type KWS 3/6

Compact servo valve with position-controlled rotary vane and PID controller

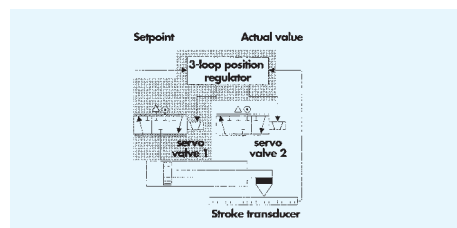
External transducers can be connected directly to this compact regulator. This allows setup of autonomous pneumatic pressure, flow, force, torque, or speed regulators.



Order No.	
739	3/3 Servo valve with PID controller and 4 mm rated size, type KPS 3/4
1222	3/3 Servo valve with PID controller and 6 mm rated size, type KPS 3/6

Compact "positioning servo valve"

This assembly incorporates all features required for controlling the position of pneumatic cylinders. A potentiometric stroke transducer can be directly connected to it.



Order No.	
1509	3/3 positioning servo valve with 4 mm rated size, type KXS 3/4
1510	3/3 positioning servo valve with 6 mm rated size, type KXS 3/6

Cartridge servo valve



The rotary vane actuator is also available as a cartridge valve. This allows space-saving integration of the valve into customized pneumatic control blocks.

We are supplying precisely dimensioned drawings for design integration. To allow normal installation, we can supply a valve housing for the servo cartridge.

The valve electronics can be installed either in the connector, as SMD module, or on a slim Euro-size circuit board. A PID controller and a position controller on Euro-size circuit boards are also available.

Order No. 3/3 cartridge servo valve with 4 mm rated size, incl 2 m cable, with valve electronics, type EWS

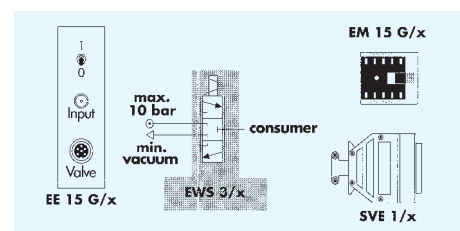
1195	... in SUB-D plug housing	SVE1
1033	... in SMD module	EM15G
1508	... on Euro-format board	EE15G

Order No. 3/3 cartridge servo valve with 6 mm rated size, incl 2 m cable, with valve electronics, type EWS

1517	... in SUB-D plug housing	SVE1
1518	... in SMD module	EM15G
1511	... on Euro-format board	EE15G

1034 Valve body VG 6
for installation of an EWS valve,
pneumat. connections with G 1/4" threads

1512 Extra charge for longer cable



Order No. External controller

1514	Analog PID controller on Euro-format board, type AR2-15/P
2697	Digital PID controller for assembly on carrying rail, 12 bit resolution with 3digit digital display and diagnosis function. type DRM 2-24P
1515	Position controller, 3 loops on Euro-format board ± 15 VDC type AR 3-15/U
1516	Position controller, 3 loops on Euro-format board +24 VDC type AR 3-24U

In virtually every branch of the industry, parts are made through which air, gas, water or other media will later flow. Depending on the application, the flow rate may be important, or it may be necessary to ensure nothing escapes to the environment. Often enough both conditions must be met to ensure the part will function properly. A typical example is the heat exchanger of a refrigerator. If the flow inside this part is impaired by a dent, the fridge will not reach the full cooling output. If the part leaks, cooling agent will be lost. Both of these errors are intolerable and must be detected in a part inspection.

This is a typical example of quality assurance and also a typical inspection task involving air.

A growing number of manufacturers are introducing 100 % inspections. Where random testing was standard previously, the zero-fault approach is the rule now. But this development has made inspection time a growing cost factor. Automatic inspection and test instruments help save time and money. All parts manufacturers normally employ specialists, who design the inspection facilities for internal use. We are aware of their problems, because many of them are our customers.

SI offers all the components required to solve inspection and measuring problems of this kind in the field of quality assurance. Through intensive discussions with our customers we have come to know their problems in course of time. The result of this learning process is a range of leak and flow inspection instruments employing air as test medium.

Most seal-proof or leakage testers used in technical applications operate with one of the

pressure drop methods. These measuring methods only supply the indirect quality statement "pressure drop / time interval". Since users are actually interested in the "leakage volume / time interval", conversion of measured values is obligatory to be able to compare the quality of different test objects. To allow for conversion, however, one needs to know the exact test volume, that is, the actual test volume as well as the dead volume of the measuring device and the dead volume of the connecting line. Only when these factors are known and correctly considered in the calculations, comparable measured values are possible. Experience shows that the procedure is not always applied correctly in practice. This problem is eliminated by the "slipstream method".

As a manufacturer of sensitive mass flow measuring instruments with experience in leakage test applications, we have made this test method popular under the designation "slipstream method". For the "slipstream method" the test object is likewise filled with air. Once the test pressure has been reached, it is maintained at a constant level by a precision pressure regulating valve. If there is a leak, the test pressure will have to be corrected. The pressure regulator will allow sufficient air flow to compensate for the pressure drop due to the leak. A "mass flow" meter is connected between the pressure regulator and the test object. It measures the leakage volume directly in millilitres/minute = ccm³/minute. The measured value is exclusively related to the test pressure and the size of the leak.

The test object's volume does not influence the measured value. Aside from that, the test procedure is similar to the one used in connection with pressure drop instruments. A timer controls the phases "filling, resting, measurement and venting". During the filling phase, the test object is filled via a bypass to the flow measuring device, to ensure short filling times. During the measuring phase the leakage value is compared to a preset limit value. This leads to an "accepted/rejected" evaluation.

The automatic leak tester "NSM1" performs the test described above automatically, programme-controlled. The instrument can be operated manually from a keypad or remote-controlled by a master controller. All signals required for control are available on a communication connector.

The advantages of this instrument:

- Automatic test procedure
- Simple operation
- Display of the leakage volume in NmL/minute
- No conversion required
- Short test cycles for large test objects
- Calibration certificate is part of the scope of supply

Automatic leak tester "NSM 1"

10 data records can be saved, programme-controlled adjustment of test pressure with electronic pressure regulating valve
incl. initial certification

Order No. **Pressure range/measuring range**

1267	0...2 bar/ 0...20 NmL/minute
1268	0...7 bar/ 0...20 NmL/minute
1269	0...2 bar/ 0...200 NmL/minute
1270	0...7 bar/ 0...200 NmL/minute

Automatic leak tester "NSM 1"

10 data record can be saved, manual adjustment of test pressure at pneumatic precision pressure regulator,
incl. initial certification

Order No. **Pressure range/measuring range**

1264	0.05...1.75 bar/ 0...20 NmL/minute
1265	0.15...7 bar/ 0...20 NmL/minute
1203	0.05...1.75 bar/ 0...200 NmL/minute
1266	0.15...7 bar/ 0...200 NmL/minute

Order No.

- 1271 Re-certification
traceable works certificate
for leak tester operating with the slip-stream method for the test pressure, the leakage volume as well as measurement of the inherent seal-tightness (to ISO 9000)

Automatic leak tester operating with the slipstream method "NSM1"



Manually operated, mobile leak tester "NSM1-portable"



The leak tester "NSM1-portable" is the manually operated, mobile version of the automatic tester described above. Using a precision pressure reducing valve the device generates a constant test pressure. It is used to fill the test object rapidly via a manually operated bypass. Once the pressure has been applied, the instrument will directly display the leakage volume.

Flow rate and test pressure are measured electronically and are displayed simultaneously. Both values are available at a data interface for further processing. The main fields of application of this instrument are leak testing of samples and manual testing of smaller lots. A very interesting application is troubleshooting for leakage in pneumatic system during commissioning and maintenance.

Manually operated, portable leak tester operating with the slip-stream method "NSM1 portable"

Order No. **Pressure range/measuring range**

2698	0...10 bar	0... 20 ml/minute
2699	0...10 bar	0...200 ml/minute

(inquire for other ranges)

Test device modules in 19" racks

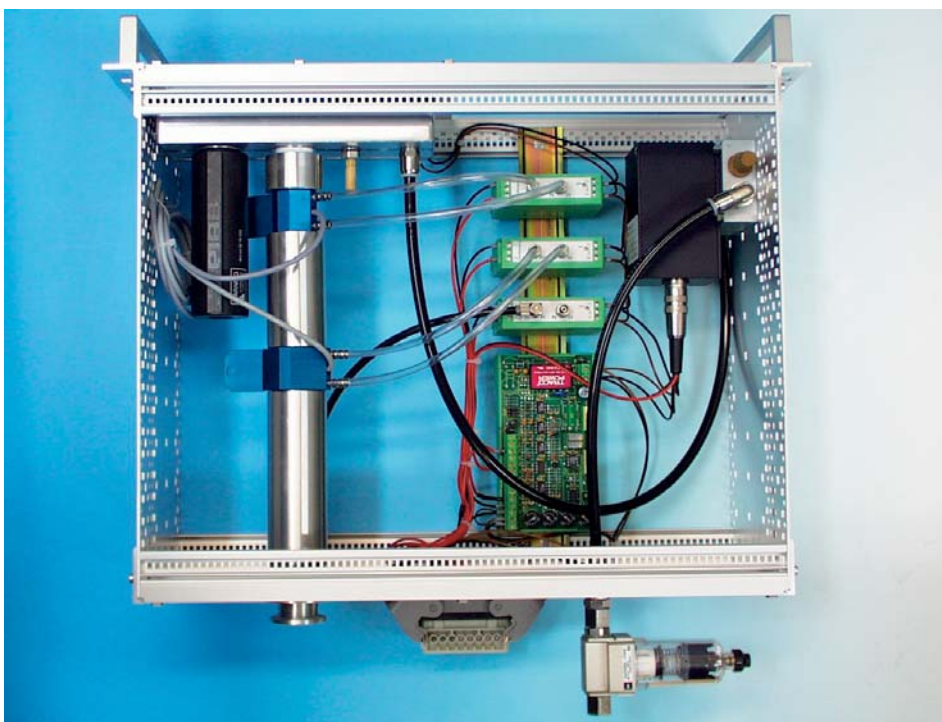


In the past SI has developed a number of test device modules for tightness and flow rate measurements. Diverse manufacturers of special machinery are employing this equipment in their systems. A typical test task, for instance, is an "open/closed" flow test of the ventilation valves of automobile engines. The test device modules contain the entire

measuring and control system for the respective task, but no built-in "intelligence". A minimum of control circuitry allows for remote control of the devices. The assemblies are controlled by a PLC that is on site anyway. This controller outputs the control commands for the test process. The module then sets the test parameters.

The result of the measurement is then read out as an analog standard signal and is further processed.

This procedure allows the system designer to concentrate on the automation task at hand. He does not need to deal with the details of the measuring technique involved and profits from our longterm experience in the field of pressure and flow measurement.



The picture here shows a module for testing with negative pressure. The test pressure is generated by a controlled ejector pump. The flow is measured in 2 channels by means of laminar flow elements (LFE).

Our standardised assemblies are installed in 19" racks (4 RU, 84 HP, depth 358 mm). As auxiliary energy sources you need a compressed air supply and a 24 VDC supply source. The devices have been tested and are supplied ready for installation. Traceable works certificates for the accuracy of the pressure and flow measuring system are part of the scope of supply.

If this type of solution makes sense to you, just let us know what the testing task is! We'll be pleased to discuss the optimal method for the test object. You'll get to know which measuring method is most advantageous and how it will reduce the test cycle time. If you wish, we will inspect samples to determine the test properties.



The "FlowAnalyser" - a compact universal instrument



...for measurement, test and analysis of ventilators, anaesthesia equipment and spirometers. The "FlowAnalyser" is not a medical product, but has been designed to serve as a universally applicable instrument for maintenance, monitoring and calibration by medical engineering departments. Manufacturers of medical apparatus employ the PF-300 in their research and design departments as well as for quality assurance.

The device offers multiple measuring options. Thanks to its numerous features it opens up many further fields of application in the technical field and training, also outside respiration technologies.

Any specialist dealing with air conducting assemblies, devices and systems requires a precise measuring instrument for pressure and flow. What a multimeter and oscilloscope are for an electronics engineer, the "FlowAnalyser" may be at your workplace. If you are working in development, customer service or quality assurance, the "FlowAnalyser" can serve as your universal problem solution. Despite the many functions of the instrument, its operation is intuitive and easy to familiarise with.

The instrument measures volume flow across a wide range. Media may flow through the two measuring tubes in both directions. Using the properties absolute pressure and air temperature, the "FlowAnalyser" computes the flow for all frequently needed standard conditions. Humidity and oxygen content provide information concerning the properties of the medium measured. A differential pressure transducer and a sensor for the system pressure complete the functions offered.

The measuring accuracy for each measured variable is so high that the instrument can be used as a reference unit. You may rely on the accuracies indicated for each measured variable since each "FlowAnalyser" is calibrated prior to shipment. A comprehensive traceable works certificate is included with the instrument. Since all pneumatic connections of the transducers integrated into the instrument are readily accessible, these can be individually connected to the test setup.

A large LCD graphics display with only few control elements allows intuitive operation. All measured values and properties are listed in alphabetic order. A simple presentation of characteristic curves is available. For each measured value you may choose from numerous engineering units. Additionally, the instrument provides the measuring results via computer interfaces for further processing. The instrument can also be remote-controlled via one of these interfaces. The remote-control option allows further applications of the instrument. A "FlowAnalyser" that is connected to a master computing system via the serial interface can be integrated easily into automatic test rigs. Mobile operation is likewise possible. An integrated rechargeable battery allows you to use the instrument in the field for several hours without a line supply connection. The instrument, a power supply and all accessories are stored protected from shock in a rugged transport case.

Practical software is available for the "FlowAnalyser" as well. Any computer with a "Windows" operating system and a USB interface can thus be transformed into a multi-channel oscilloscope and data acquisition

system. It allows you to display, record, analyse and assess pressure and flow characteristics in realtime. The functionality extends far beyond the limited capabilities of the instrument display. Of course, all respiration parameters can likewise be displayed. Graphic and numeric measured values and characteristic curves can be saved and printed. This additionally saves investment in an expensive multi-channel chart logger.

The "FlowAnalyser" is a product of the Swiss company Imtmedical AG. SI is competence partner for distribution to industrial users.

FlowAnalyser, Windows, and SI-specialinstruments are registered trademarks

- Order No. "FlowAnalyser" PF-300, including transport case, wide-range power supply 100...240 VAC power cord with country-specific plug, USB cable, 180 cm, operating manual in German or English, shipping carton.
- 2701 "FlowAnalyser" PF-301 VAC, like model 300, however, with additional pressure measuring channel ± 1000 mbar for precise measurement of negative and positive pressures.
- 2702 "FlowAnalyser" PF-302 LOW like model 300, however, with additional pressure measuring channel 0...5 mbar for precise measurement of lowest pressures.
- 2703 "FlowLab" software
- 2704 Recalibration for the FlowAnalyser scope of the "EasyCal" calibration:
- traceable works certificate for all measuring ranges
 - replacement of both measuring screens
 - replacement of the oxygen measuring cell
 - pick-up and delivery service by TNT Germany/Switzerland and back
 - delivery within one week



Multi-gas analyser sensor OR-703



If you are interested in measuring anaesthetic gases in addition to air and oxygen, an optional multi-functional gas sensor is available. The module is simply plugged to the gas inlet of the PF-300 and connected to the RS 232 interface of the "FlowAnalyser". The instrument display then indicates the gas concentration of CO₂, N₂O and of one further gas. For each

measurement you may select one of the following gases: halothane, enflurane, isoflurane, sevoflurane or desflurane.

This unique gas sensor turns your "FlowAnalyser" into a "MultiGasAnalyser"

Order No.
2705 Multigas analyser sensor OR-703

Values measured by sensors:

Low flow rate

range -20...+20 l/minute
accuracy $\pm 1.75\%$ of reading
or 0.05 l/minute

High flow rate

range -300...+ 300 l/minute
accuracy $\pm 1.75\%$ of reading
or 0.1 l/minute

Differential pressure

range - 150...+150 mbar/diff
accuracy $\pm 0.75\%$ of reading
or 0.1 mbar

High pressure

range 0...10 bar/rel
accuracy $\pm 1\%$ of reading
or 10 mbar

Atmospheric pressure

range 0...1150 mbar/abs
accuracy $\pm 1\%$ of reading
or 5 mbar

O₂ Concentration

range 0...100%
accuracy $\pm 1\%$ O₂

Temperature

range 0...100%
accuracy $\pm 1.75\%$ of reading
or 0.5 °C

Humidity

range 0...100% r.H.
accuracy $\pm 2\%$ r.H

Vacuum

(PF-301 VAC only)
range - 1000...+1000 mbar/rel
accuracy $\pm 0.5\%$ of reading
or ± 2 mbar

Low pressure (PF-302 LOW only)

range 0...5 mbar/rel
accuracy $\pm 1\%$ of reading
or ± 0.01 mbar

Values computed or derived by the instrument:

Dew point

range - 40...100 °C
accuracy $\pm 2\%$ of reading
or 1 °C

Respiratory volume

range 0...10 litres
accuracy $\pm 2\%$ of reading
or 0.02 sl

Plus the following parameters for measurements on ventilators:

Vti, Vte, ExpMinVol, Rate, I:E, Ti, Te, Ppeak, Pmean, Peep

Gas compatibility

Air, oxygen, N₂O and mixtures of these. All measured values can be displayed in various engineering units. By means of computing on the basis of the gas law, air volumes can be represented as current volume flow or for different defined standard conditions. (nL, sL...)

Note concerning accuracy

To find the accuracy at the measuring point, the measured value is computed with the percentage indicated. If the computed value is lower than the absolute error indicated, the higher of the two values applies.

Note concerning calibration

All measured properties traced by sensors have been calibrated traceably before shipment of the instrument. A certificate of accuracy evidencing the works calibration is supplied. Recalibration is offered at standard rates by the supplier.

Approvals

CE and CSA

Interfaces

USB for Windows software "FlowLab"
RS232 for remote-control or additional devices

The "FlowLab" software

In connection with a PC, the software allows logging of realtime curves, loops and numeric values. Diverse zoom functions, cursor, freeze and storage options.

Recording of curves in "single shot", standard or roll-over mode. Trend function for up to 100 hours. All data can be saved and printed.

Adjustment of resistance and leakage

Different airway resistances can be simulated simply by turning the connector. Leakage can also be adjusted by turning the side screw. No adapter is required for this purpose.



The "SmartLung" test lung

If you need to inspect ventilators and anaesthesia equipment, test lungs are a must.

But since good test lungs are expensive, complicated and require lots of space, improvised solutions are often used in practise. The new "SmartLung" is not a compromise, but a small, compact test lung with the properties of much larger devices. The price/performance ratio is unbeatable. The device is very compactly designed. It can thus be connected directly to the ventilator tubing system. A separate table for auxiliaries is not required.

Resistance (airway resistance), compliance (lung hardness) and leakage can be adjusted in different stages. Diverse bag sizes allow simulation of virtually any lung size, from baby to adult lung. It is especially useful that no additional adapter is required for this. The continuously adjustable leakage simulation allows check-up of ventilators for premature babies or mask ventilation. Even the sensitive function of patient flow triggering can be tested reliably with "SmartLung". Combined with the "FlowAnalyser" pressure, flow, and volume measurements can also be taken.

Order No.
2706 Standard test lung "SmartLung" Adult
2696 Test lung for infants "SmartLung" Infant



Technical data/standard adult

Resistance	5, 20, 50, 200 mbar/l/s
Compliance	13, 17.23, 30 ml/mbar
Volume	0...600 ml (with 1 l bag)
Leakage	0... 10 l/minute
Weight	275 grams
Dimensions	310 x 115 x 45 mm (L x W x H)

All components can be replaced and sterilised.

Custom-Designed Solutions

For many years SI has been specialising in the development and supply of pressure and flow measuring and control devices. We lead a wide range of products and may boast a good reputation. Our catalogue contains a host of instruments for most diverse requirements and applications.

It is part of our daily routine to modify these instruments to meet customer-specific requirements. Be it another measured variable, another range, other electric or pneumatic connections, or installation in a desktop housing, we're open to virtually any adaptation you may ask for.

Quite a few of our devices are meant to be modules, designed to solve specific measuring and regulating problems. Therefore, it is a matter of course for us to provide whatever advice is needed to help achieve your task. We'll also gladly accept orders for design of entire systems integrating various components.

Each of our products incorporates a lot of experience. Our employees carry "know-how" gained from numerous problems solved. Please, do not hesitate to discuss your problem with us! Our treasure of experience will be made available to you. By experience we also mean an in-depth understanding of the market and the products offered for measuring, control and regulating. We'll select the components best suited to the task at hand. Of course that may in some cases be a component offered by a competitor.

To an increasing extent we are employing computer technology to solve especially complex problems. The microprocessor integrated into many of our devices allows to achieve many a "stand alone" task. When it comes to design of systems, we generally limit our services to the core task of "measurement and control of pressure and flow". Additionally, we provide the required interfaces to allow you to read data from the system section designed by us and to allow remote-controlling it.

While cooperating with our customers we are faced with problems occurring in most diverse industrial fields. It's part of our approach to scrutinize the specific problem and its context, because this enhances the interdisciplinary cooperation and a certain amount of "lateral thinking". On the next few pages you'll find some of our recent solutions to puzzling problems of our customers. Possibly we have already solved one of your problems for someone else.

Each of the customer projects here presented has its own background story. Some devices have been built only once, others have become part of the series production of the respective customer.

We appreciate the good relations to our customers that have come with the cooperation. It has encouraged and motivated us to continuously seek new frontiers.

"We'd be pleased to win you as a new customer."

This filter test instrument ...

by means of a fan generates a volume flow between 0...80 m³/hour. The adjusted volume is maintained constant electronically.

The device is connected to the test object by a tube. Via the tube the device draws in the preset volume through the filter tested. During operation the following parameters are measured:

- volume flow 0... 80 m³/h
- differential pressure 0...500 Pa across filter
- air temperature 20... 80 °C
- air humidity 0...100 %

The measured values are digitally displayed at the front of the device. All values are saved with date by a logger and are output at the end of the measuring cycle via an RS 232 interface.



DIN 29053 ...

describes the technical options for measurement of the flow resistance of porous materials. The resistance of a sample allows to draw conclusions concerning air penetration and characterises the thermal and acoustic insulating properties of a material. For a university we built a test device that conforms to procedure A outlined in the standard.

The test device generates a controlled air flow rate between 0...(0.5)...25 standard litres/minute. It supplies the air flow to an installation that can hold samples of insulating materials of defined dimensions. The pressure drop across the insulation material sample

resulting from the flow is measured. The pressure measurement is performed in the range between 0...(20)...1000 Pa at a measured value resolution of 0.1 Pa. The measuring uncertainty for both measurements is $< \pm 5\%$ of the reading across the operating range. The measured values are then used to compute the flow resistance [kPa*s/m³].

The device is controlled by a microprocessor



and can be operated manually or by remote-control. All functions of the device are preset and monitored via a bi-directional RS 232 computer interface. The device has been installed in a compact desktop housing. Traceable calibration certificates for pressure and flow are included; this is standard for all of our custom-designed devices.

An extreme tightness inspection ...

Leakage tests according to the pressure-drop method have been state-of-the-art for a long time. Throughout the industry this method is used for testing.

Some time ago we solved a testing problem that took this method to its physical limits. The high sensitivity of the test was achieved by performing the tightness inspection at a test pressure of 20 bar. The test object was set up in a seal-tight dome, inside which a differential pressure test was performed. To enhance the sensitivity further and to minimise the influence of temperature differences, the pressure rise was measured under a coarse vacuum generated inside the dome. Each of these measures has contributed to reproducible and

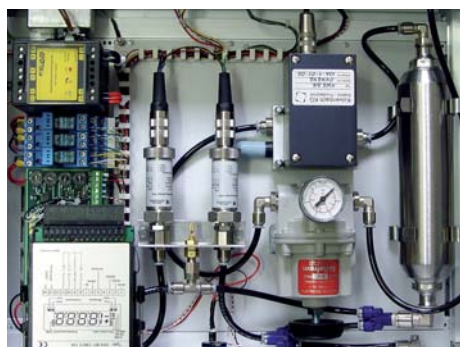


rapid measurement of lowest leakage rates. We supplied the entire measuring and control system as a "black box" to our customer, a manufacturer of special machinery. The process control and evaluation of the test, however, were achieved by the existing PLC of the plant. The pressure generation by means of a pressure transformer and the vacuum generation by an ejector pump were part of our scope of supply.

Suck, hold, blow off ...

these are the tasks handled by this precision pressure source. Such devices are needed for automatic robot-controlled pipetting of lowest liquid volume.

Our pressure control unit supplies any desired pressure value in the range between -500...+500 mbar fast and accurately. The integrated electrical pump system generates unregulated positive pressure and vacuum. A servo valve controls the pressure source to adjust the desired output pressure rapidly. The device is controlled by a microprocessor and can be operated manually or remote-controlled. All functions of the device are preset and monitored via a bi-directional RS 232 computer interface. The device has been installed in a compact desktop housing.



This flap...

is the actuator of a test device for medical ventilators. For a manufacturer of medical apparatus we have designed a pneumatic burden that allows to test the function of the air source in the test field.

This source supplies an air flow volume of max. 200 litres per minute, when it flows out openly to the atmosphere. When the outlet is closed, the source builds up a pressure of max. 25 mbar.

By means of the throttle flap in the air passage any desired flow rate can be set by our pneumatic load and the back pressure occurring

can then be measured. The characteristic of volume flow vs. pressure found thereby, characterises the proper function of the entire system.

The setpoint and actual value of the unit are analog standard signals. An electronic analog controller generates the position signal for the servo motor actuating the flap.

The entire device has been installed compactly in a half 19" rack.



Our bore hole tester ...

checks a very complex pneumatic component made by one of our customers for faulty bores. Some workpieces, after a number of processing steps, look like Swiss cheese. The inspection of such parts has proven difficult for its manufacturer. In our test lab we measured one of these parts and selected the physical property that yielded the most significant test results.

The test device incorporates an electronic flow controller. It tries to achieve a constant flow. When a test object is connected to the device, the constant flow generated results in a pressure drop across the test object. A good test object (all bores allow air passage) results in a reproducible pressure drop at a defined flow rate. If a bore is choked, this results in a higher flow resistance. Consequentially, the pressure drop across the test object increases. A limit value sensor evaluates the test result. Signal lamps indicate the test status.



"Low-volume" blower door tester

During the past few years, the "blower door" test has been established as a test procedure for the air-tightness of buildings. The procedure and the measuring conditions are described in EN 13829. For the test, the pressure inside the house is increased by means of a blower until the difference to the ambient atmospheric pressure reaches 50 Pa. When this measuring pressure is maintained constant, the flow volume needed by the blower to achieve this, is a measure for the leakage of the building.

Our customer wished to use the "blower door" test for seal-tightness inspection of components and assemblies for residential buildings (doors, windows, gap seals...). However, all BD testers available in the market were much too big for this task. The desired measuring range between 0...600 l/minute at 0...50 Pa pressure was too low for these devices and the measuring results not accurate enough. Therefore, we designed a "low-volume blower door tester" for this customer.

The test device supplied by SI is capable of generating a positive pressure between 0...60 Pa in the test chamber and to measure the leakage of the chamber between 0...600 litres per minute.



Our device consists of a blower and a display unit connected by a control line. The compact blower unit is screwed to a test chamber. Electronically controlled it aspirates the adjusted air volume from the ambient atmosphere and forces it through a laminar flow element into the test chamber. The air volume passing the LFE and the pressure inside the chamber are measured, the result is digitally displayed and output as a standard signal.

This was only a small selection of devices for measurement, regulating and control. If you have a problem currently, we would be pleased if you contacted us.

Display Units for Standard Signals

Most measuring instruments and measuring transducers on the market output standardised electrical signals for further processing. When buying measuring equipment, be sure it outputs current and voltage signals at the standardised levels and at impedances adapted to the signal type. Only when standard signals are used, transducers, controllers, computers or stored-programme controllers (PLC) of different manufacturers can be hooked up without problems.

Voltage signals

Voltage signals are most easily processed. An output level between 0...10 Volts is the most popular signal used. When the distance between transducer and evaluating device is short, and when there is little electromagnetic interference, the voltage signal of 0...10 Volts can be used without second thoughts.

Current signals

Current signals should be used when the distance between transducer and evaluating device is long and when electromagnetic interference must be expected. Current outputs drive a constant current dependent on the measured value. The correct current always flows, regardless of how high the electrical resistance of the measuring line is. Since current-driven measuring setups have less impedance than voltage-operated systems, noise and interference will have considerably less influence on them. The most widely used current signal is 0...20 mA. You can use the advantages of this signal even if your evaluation device is only designed for voltage signals. Connect a 500 Ohm resistor to a high-impedance voltage input! A 20 mA signal will then cause a voltage of exactly 10 Volt across the resistor.

More and more users realize and appreciate the advantages of the 4...20 mA current signal. A basic current of 4 mA represents the zero-point, while 20 mA represent the maximum or 100 % value. In addition to the other advantages of the current signal, a current <4 mA can be defined to mean that a line failure has occurred. The main boon of the 4...20 mA signal surfaces when it is generated by a measuring circuit with 2-wire setup. The 4...20 mA signal - in this case also referred to as current loop - allows to achieve excitation and signal evaluation with just two wires. For this special technique, the 4 mA basic current is used to excite the transducer. If you are not an electronics engineer or designer, or if you lack experience with electronic measuring technology, our explanations here will certainly not be sufficient! Do not hesitate to contact us! Our people will be pleased to help you come to a

closer understanding and will competently advise you concerning adaptation of our devices to your systems.

All of our pressure and flow measuring instruments, as well as all control systems, operate with standard signals. If the measured values are to be displayed on site, we can offer suitable control panel instruments. These devices feature standardised installation dimensions. Therefore, they are easily installed in control cabinets and desktop housings.

Built-in digital instruments

In this catalogue we are introducing three new device series from our large programme of built-in digital instruments. These instruments from our preferred programme have a number of properties in common, but differ in their measuring capabilities, accuracies and diverse additional functions. This will allow you to select a device that is just right for the measuring task at hand.

With our preferred programme you will certainly be able to solve most of your problems. Nonetheless, do not hesitate to inquire for your special device. We are able to offer further devices and variants. Other housing sizes, green LED displays, bargraph displays and any of the popular digital interfaces are no problem at all.

Common properties of our preferred programme:

- DIN housing, 96 x 48 mm front panel, max. depth 150 mm
- Installation cut-out 92 x 45 mm
- Unit of measure labels if desired
- Red 7-segment display, digit height 14 mm
- Membrane keypad
- Electrical connections on terminals
- Signal inputs for all popular standard signals
- End of scale values adjustable, decimal fraction can be set
- Available with optional sensor excitation and analog output

Built-in digital instrument with pressure transducer ATM



Built-in digital instrument DV3, 3½ digits

Dual slope measuring instrument
Display counts ± 1999
No trip points possible

Measuring span and offset adjustable with potentiometer.

Direct current voltage inputs

0....10 V $R_i = \text{approx. } 55 \text{ k}\Omega$
0.... 50 V
0...200 V
0...600 V

Direct current inputs

0..(4)..20 mA $R_i = \text{approx. } 100 \text{ }\Omega$
0... 200 mA

Measuring error $\pm 0.1\%$ of m.v. ± 1 digit

Built-in digital instrument PWE4, 4 digits

Processor-controlled measuring instrument
Display counts -999 ...9999
2 integrated limit value relays

Adjustment of measuring span and offset as well as taring with membrane keys

Direct current voltage input

0...10 V $R_i = \text{approx. } 100 \text{ k}\Omega$

Direct current input

0...(4)...20 mA $R_i = \text{approx. } 100 \text{ }\Omega$

Measuring error $\pm 0.2\%$ of m. v. ± 1 digit

Built-in digital instrument PU5, 5 digits

Processor-controlled measuring instrument
Resolution 24 bit, measuring rate up to 50/s
Display counts -9999...99999

Adjustment of measuring span and offset by membrane keys
30 point linearisation possible

Direct current voltage inputs

0... 5 V
0... 10 V $R_i = \text{approx. } 150 \text{ k}\Omega$
-0.5...2.5 V
bi-directional millivolt signals

Direct current input

0...(4)...20 mA $R_i = \text{approx. } 50 \text{ }\Omega$

Measuring error $\pm 0.01\%$ of m.v. ± 1 digit

Optional

2 or 4 limit value relays
Push-button taring
Digital interfaces RS 232/RS 485

Order No.	
2707	Built-in digital instrument DV3 supply voltage 230 V/115 VAC
2708	Built-in digital instrument DV3 supply voltage 24 VDC
2709	Built-in digital instrument DV3 supply voltage 24 VDC (galvanically separated)

Options

2710	Sensor excitation 24 VDC/50 mA with AC and DC device supply
2711	Sensor excitation 10 VDC/20 mA with AC and DC device supply
2712	Analog output 0...10 V/2 mA with AC and DC device supply
2713	Analog output 0...20 mA/burden 500 Ω m with AC and DC device supply
2714	Analog output 4...20 mA/burden 500 Ω m with AC and DC device supply

Galvanically separated sensor excitation and analog output on request.

Order No.	
2715	Built-in digital instrument PWE4 supply voltage 230 V/115 VAC
2716	Built-in digital instrument PWE4 supply voltage 24 VDC (galvanically separated)

Options

2717	Sensor excitation 24 VDC/50 mA with AC and DC device supply
2718	Sensor excitation 10 VDC/20 mA with AC and DC device supply
2719	Analog output 0...10 V/2 mA (12 bit) with AC and DC device supply
2720	Analog output 0...20 mA/burden 500 Ω m with AC and DC device supply
2721	Analog output 4...20 mA/burden 500 Ω m with AC and DC device supply

Galvanically separated sensor excitation and analog output on request.

Order No.	
2722	Built-in digital instrument PU5 supply voltage 230 VAC
2723	Built-in digital instrument PU5 supply voltage 115 VAC
2724	Built-in digital instrument PU5 supply voltage 24 VDC (galvanically separated)

Options

2725	Sensor excitation 24 VDC/50 mA with AC and DC device supply
2726	Sensor excitation 10 VDC/20 mA with AC and DC device supply
2727	Analog output 0...10 V/2 mA (12 bit) with AC and DC device supply
2728	Analog output 0...20 mA/burden 500 Ω m with AC and DC device supply
2729	Analog output 4...20 mA/burden 500 Ω m with AC and DC device supply

Galvanically separated sensor excitation and analog output on request.

2730	RS 232 interface, galvanically separated
2731	RS 485 interface, galvanically separated
2732	Taring function
2733	Limit value relays, 2 change-over contacts
2734	Limit value relays, 4 change-over contacts

In this catalogue you will find numerous measuring, test, and control devices. You may rest assured that we will not only advise you optimally before you place the order, but that we remain ready to serve you long after delivery. We are endeavoring to supply a well-made instrument, that has been optimally tested and measures within the specifications indicated. If you should find a fault during the 24 month warranty period, you are entitled to have the device reworked or repaired free of charge.

Repairs and service

All devices supplied by us are durable capital goods. Generally, repair makes sense even after many years of service. For repairs required after expiry of the warranty, the following procedure has proven most practical:

- 1.) Turn the instrument in with your repair order.
- 2.) You will then receive an acknowledgement detailing the estimated cost of the repair.
- 3.) Only a few days after your confirmation of the repair order, you will again hold your repaired unit in hands.
- 4.) If you do not confirm the repair order, we will return your instrument. Afterward you will be billed a lump sum for the diagnosis effort and the return shipment.

5.) If you buy a comparable new instrument, you will receive a credit note for the diagnosis lump sum.

Order No.	
1961	Diagnosis lump sum
1997	Price per repair hour
1991	Price per hour for technician
1992	Price per hour for engineer

Spare parts required for the repair are specified and invoiced as actually used.

Recalibrations

We recommend to turn your measuring devices in regularly for inspection, adjustment and calibration. This ensures you can always work with a tested measuring instrument. As the calibration interval you should plan a period of 1...2 years depending on the application. A comprehensive service package is included with every recalibration:

- 1.) Functional check
- 2.) Adjustment, that is, we adjust the instrument to as low as possible an error deviation within the admissible error limits.
- 3.) Documentation of measured values and deviations in a traceable calibration certificate in German and English as well as storage in a calibration database.
- 4.) Marking of the measuring or test instrument with a calibration label.

Please note that we can perform repair and calibrations only in our works!

Recalibration of pressure measuring instruments

Order No.	
1975	Traceable calibration certificate for pressure, one measuring range recalibration
1976	Traceable calibration certificate for pressure, two measuring ranges recalibration
2645	Traceable calibration certificate for pressure measuring instrument premo 3 recalibration, main and partial range
2646	Traceable calibration certificate for pressure measuring instrument UNI 3 recalibration, main and partial range
2647	Traceable calibration certificate for micromanometer LPU 3 recalibration, main and partial ranges

Recalibration of flow measuring instruments

Order No.	
1977	Traceable calibration certificate for flow, one measuring range recalibration
1978	Traceable calibration certificate for flow, two measuring ranges recalibration
2648	Traceable calibration certificate for flow measuring instrument preflo 3 recalibration, main and partial range

We are also prepared to calibrate other brands. To do that, we need the operating and calibration manual for the device. The cost will be billed as incurred by us.

Order No.	
1407	Price per hour for pressure calibrations
1408	Price per hour for flow calibrations

Shipping charges

Generally, all our devices are forwarded by UPS. The cost for the transport is paid by the customer. If you wish a different shipping mode, please indicate this clearly in the order.

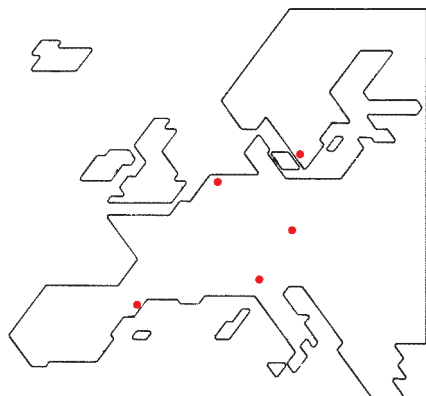
Your order

All repair and calibration work requires a written order of your company. Ordering information is found on the bottom of the next page. We are always endeavouring to ensure shortest possible delivery periods. Please be sure to talk to us, if you have only a limited time period available for repair or calibration. We will then organise whatever is possible, to keep you satisfied.

Professional repair and calibration of your instruments



Ordering Information ...



Italy

B.A.G.G.I. Srl.
Viale Campania, 29
I-20133 Milano

Tel. ++39/02715547
Fax ++39/027490571

Website www.baggi.com
Email baggi@baggi.com

The Netherlands

Minerva meettechniek B.V.
Chrysantstraat 1
NI-3812 WX Amersfoort

Tel. ++31/33 4622 000
Fax ++31/33 4622 218

Website www.minervaijm.com
Email info@minervaijm.com

Sweden

Ingeniörsfirman
MATELEKTRONIK
Konsulentvägen 25
S-23700 Bjärred

Tel. ++46/46 2935 89
Fax ++46/46 2935 89

mail lennart.johnsson@insatnet.nu

Spain

Grupo Sarea - SICO
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Email sico@sicocv.es

Czech Republic

Ekotechnika
Pacovská 31
CR-140 00 Praha 4

Tel. ++42/0241 733 583
Fax ++42/0241 733 587

Website www.ekotechnika.com
Email ekotechnika@ekotechnika.com

Representatives

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2-22-1 Higashi Shinkoiwa
Katsushika-Ku
J-124 Tokyo

Tel. ++81/33 6955 431
Fax ++81/33 6955 698

Website www.krone.co.jp
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Kocheok 1-Dong, Kuro Ku
152-081 Seoul (Korea)

Tel. ++82/2 2065 5100
Fax ++82/2 2065 8222

Website www.sunbees.co.kr
Email sunbees@unitel.co.kr

Normally ...

well thought-out general terms of delivery should be printed here. But we know - just like you most probably will - that they are rarely given much attention and often collide with your purchasing conditions. They may contain conflicting rules, because both parties have not agreed on them.

This situation will not change until influential authorities in the economy will have defined common purchasing conditions that will rule out contradictions. Until such regulations emerge, setting forth delivery conditions appears to be a question of prestige rather than of practical consequence. If a law suit actually evolves, the judge will have no choice but to base the verdict on the conditions defined in state law, as has frequently been the case in the past.

And those conditions are the primary basis of our terms of delivery. All problematic cases have been sufficiently clarified by the legislator. You will therefore certainly understand that we will save the study of printed purchasing conditions you may include with your order, but which have not been specifically adapted to the actual business transaction, and that we rather assume that you agree with our standpoint and elect to base the transaction on the conditions defined by state law.

If you are of different opinion please let us know immediately by a special letter to this effect. We will then have to do what we don't really like to do: to carefully consider your terms and protest clauses we consider unacceptable.

Payment:

30 days net.

The goods supplied remain the property of SI until they have been fully paid for.

We are reserving the right to adapt the prices to the market situation.

Warranty:

We are warranting all our products for 24 months, unless a longer warranty period is indicated.

The technical data listed in this catalogue is informative only. In case of doubt, the data in the current datasheet applies. The information is subject to technical change without notice.

Delivery:

Delivery is ex works, plus freight and packing. Shipments are made by UPS unless the customer specifies a different shipping mode.

Delivery periods:

All instruments are generally available within 2 to 3 weeks. If you require larger quantities or very urgent delivery, please call us on the telephone and inquire for the delivery period.

Prices:

In Germany net plus current value added tax.

Ordering options	by telephone 09081 22061 	by Email si@specialinstruments.com 
	by fax 09081 22063 	by mail SI special instruments GmbH Postfach 1451 D-86720 Nördlingen 

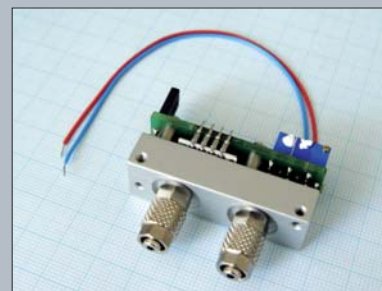
SPECIAL INSTRUMENTS

GESELLSCHAFT FÜR MESS- STEUER- UND REGELGERÄTE MBH

Product lines

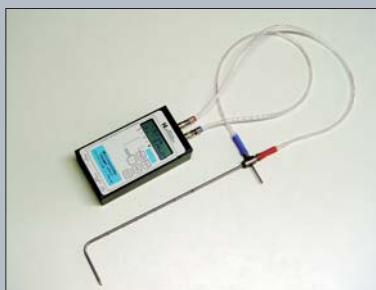
Pressure measurement

Pocket digital pressure gauges
DIN built-in units
Modules for standard rails
Assemblies in 19" racks
Pressure transducers
Micromanometers
Barometers
Differential pressure measuring instruments
Absolute pressure measuring instruments



Pressure calibration

Reference units
Pressure transfer standards
Hand-held test pumps
Autom. pressure setting devices
Traceable works calibrations for pressure



Air velocity measurement

Prandtl-type pitot tubes
Differential pressure measuring instruments
Micromanometers with square root extractor

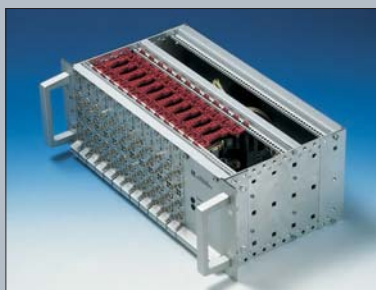


Air flow measurement

Laminar flow elements (LFE)
Evaluation units for these

Mass flow measurement in air

Portable mass flow meters
DIN built-in devices
Mass flow transducers (MFT)

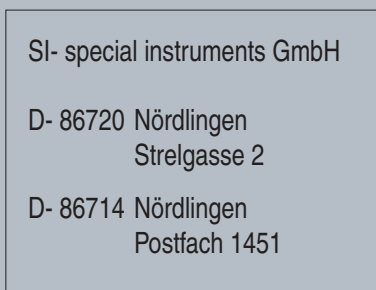


Air volume calibration

Portable leak calibrators
Traceable works calibrations for air volumes

Pressure regulators

Mechanical precision pressure control valves
Electronic precision pressure control valves
Electronic servo valves



Air volume controllers

Electronic precision pressure control valves
with actual value input for air volumes
Mass flow controllers (MFC)

Leak testers

operating with the slip-stream method

Custom design

measuring instruments, controllers
Calibration systems
Test instruments, test rigs

SI- special instruments GmbH

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<http://www.specialinstruments.com>