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Calibration Experts

UNION
Instruments

Measured quantities

- Relative pressure
- Absolute pressure
- Differential pressure
- Barometer reading
- Temperature

Applications

- Problem analysis in the gas network
- Monitoring in gas pressure control and measuring systems
- Pipe network calculation
- Leak test G469 / W400-2




ESS3

Measuring and testing devices for pipe system monitoring

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Devices and systems for pipe system monitoring

UNION Instruments GmbH is a German company with a long tradition in measurement technology dating back to 1919. The different product lines and systems employed are:

- ESS3 (data logger) and DPK3 (test kit) Series for testing and monitoring pipe systems for gas and water supply, and in other areas
- CWD (calorimeter) Series for determining the energy content of gases, and
- INCA (gas analyser) Series for determining the composition of gases.

This brochure describes the system technology of the ESS3 and DPK3. Similar brochures are available for other product series.

ESS3 and DPK3 at a glance

The products of the ESS3 (3rd technical generation) and DPK3 (test kit) Series are used to measure pressure, pressure differences, temperature and volume in supply networks for gas, water and other media. Figure 1 presents an overview.

The battery-powered devices all have a modular design and consist of the components operating unit (housing, processor, software and display), sensor(s) and battery. The devices are approved for use in potentially explosive atmospheres (zones 1 and 2) and are designed with protection classes up to IP 68.

The operating units with one or two radial sensor connections (Types R1 and R2) or one axial sensor connection (Type A1) are almost identical. Figure 2 (top) shows Type R1. The special operating unit S4 (bottom) offers four vertical sensor connections and allows easy configuration of systems.

A lithium battery unit enables operation for many years under normal operating conditions. The battery status is constantly monitored.

The TfsWin III software (transfer memory) is Windows-based. The device can be operated either with this software via PC and the IrDA interface or alternatively via keyboard.

Figure 3 presents the technical data.

Device type	Device designation	Device configuration
Data logger for pressure or temperature	ESS3 R1	operating unit with one radial sensor connection
	ESS3 R2	operating unit with one radial sensor connection and one temperature sensor
	ESS3 A1	operating unit with one axial sensor connection
	ESS3 S4	operating unit with four vertical sensor connections
Test kit	DPK3	test kit for mobile pressure and leak testing
Sensors	pressure sensors	12 variants for different pressure ranges
	temperature sensors	6 variants for different temperature ranges and in various configurations

Figure 1: ESS3 and DPK3 Series

Figure 2: ESS3 R1 (top) and ESS3 S4 (bottom)

Data logger

Data loggers are processor-controlled memory units for cyclic recording and storing of data for later analysis and for long-term documentation. Data loggers generally consist of measurement hardware with an integrated sensor, a gateway for conversion of the analog sensor measurement values such as pressure or temperature into digital form, a memory unit and an operating and display unit (HMI, Human Machine Interface).

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Technical data ESS3

	Data logger (operating units)		
	ESS3 R1 and A1	**ESS3 R2**	**ESS3 S4**
Application	measurement and storage of data (pressure and temperature) for fault analysis, monitoring of pipe systems and gas pressure control systems	device for measurement and storage of data (pressure and temperature) for leak test applications	system for measurement and storage of data (pressure and temperature) from pump and pressure control stations and for alarm signaling
Sensor connections	one radial sensor connection (M30) for a pressure or temperature sensor	one radial sensor connection (M30) for a pressure or temperature sensor and one connection for a rod-type temperature sensor with 4 m cable	four vertical sensor connections (M30) for 1-4 pressure or temperature sensors; Up to 6 binary inputs (Reed, NAMUR)
Ex-proof class	II 2G Ex ib IIC T4 Gb		II 2G Ex ib IIB T4 Gb
Protection classes, housing	depending on the sensor: IP 67 for relative pressure IP 68 for absolute and differential pressure and temperature W x H x D [mm]: 108 x 162 x 80 Weight [kg]: 1.2		IP 54 W x H x D [mm]: 286 x 169 x 99 Weight [kg]: 3.5
Measuring ranges of pressure sensors	Relative pressure: 0 ... 100/250 mbar and 0 ... 1/2.5/10/25/100 bar Differential pressure: 0 ... 100 mbar, 0 ... 1/10 bar Further measuring ranges on request		
Measuring ranges of temperature sensors	-10°C ... +40°C and -30°C ... +150°C		
Measuring cycle	125 msec ... 6 hours	375 msec ... 6 hours	500 msec ... 6 hours
Measuring precision	Depending on the sensor (up to 0.05 % FS)		
Resolution	Up to 0.004 % FS		
Communication interfaces	IrDA; display; keyboard		IrDA; display; keyboard
Operating data	battery operation up to 8 years		battery operation up to 10 years
Display	actual value; maximum and minimum value and differential value, memory utilisation and battery status		
Settings	time and date; upper and lower alarm threshold averaging (2 ... 600 values); resolution; measuring location name (29 characters); storage method (rolling/static)		
Operation	via menu (via keyboard) via TfsWin III software (via IrDA interface cable)		
Storage	250,000 date-time values/512 kB		2,000,000 date-time values/4 MB
Typical range	2 years (thanks to data compression)	1 year (thanks to data compression)	8 years (thanks to data compression)
Software	TfsWin III for parameterisation, display, analysis and archiving of the data		

Figure 3: Technical data (FS: Full Scale)

Durch die DAkkS nach DIN EN ISO/IEC 17025:2005 akkreditiertes Laboratorium. Die Akkreditierung gilt nur für den in der Urkundenanlage D-K-15055-01-00 aufgeführten Akkreditierungsumfang.

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-K-15055-01-00

IrDA interface

An IrDA interface is a powerful and high-speed alternative to the more generally known serial interfaces.
It is used for wireless point-to-point data transmission using infrared light. The interface was standardised by the Infrared Data Association, a merger of several companies from this field. Particular features are a comparatively high data throughput, low energy consumption and use in the near distance range with visual contact.

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Test kit DPK3 for mobile leak testing

Application and technical data

The DPK3 Test Kit is used for leak testing on gas and water lines in accordance with DVGW G469 (B3 and C3 method) and W400-2 and for mobile pressure and leak testing on pipe systems, sewage channels, district heating lines and pressurised vessels. (EN 805, VdTÜV 1051, AGFW FW 602) See text box below and on page 5.

Scope of supply
Case, installed printer and replacement paper roll
ESS3 data logger with or without temperature sensor
Power supply unit; IrDA interface cable
TfsWin III PC software
Connecting hose 2 m (Minimess)
Adapter G1/2 to Minimess
Operating manual

Protection classes
Housing (depending on sensor):
IP 67 (relative pressure)
IP 68 (absolute and differential pressure)
IP 68 (temperature)
Ex-proof: II 2G Ex ib IIC T4 Gb

Scope of functions
See Figure 4

Figure 5: Test kit

The case
Housing class: IP 54
Ex-proof: None
W x H x D [mm]: 412 x 390 x 135
Weight [kg]: 4.2

		Test Kit DPK3 (scope of functions)
1	**Display**	actual value; maximum and minimum value and differential value, memory utilisation and battery status
2	**Settings**	time and date; upper and lower alarm threshold; averaging (2 ... 600 values); measured value resolution up to 25,000 steps; with measured value compression for memory conservation; measurement location name (29 characters); storage method (rolling/static)
3	**Measuring cycle**	375 ms ... 6 h
4	**Resolution**	1 mbar for measuring range 25 bar
5	**Operation**	via menu (via keyboard) via TfsWin III software (via IrDA interface cable)
6	**Storage**	250,000 date-time values/512 kB typical lifespan: 1 year/approx. 50 pressure tests (thanks to data compression)
7	**Software**	TfsWin III for parameterisation, display, analysis and archiving of the data

Figure 4: Scope of functions of the test kit

G469 is a code of practice from the regulations of the DVGW (Deutscher Verein des Gas- und Wasserfaches) and stipulates the pressure testing methods to be used for gas supply lines and systems. It also specifies which devices are approved for testing. The latest version of G469 is dated 2010.

W400 is a code of practice from the regulations of the DVGW and covers topics on water distribution systems: W 400-1 (Planning), W 400-2 (Construction and Leak Testing) and W 400-3 (Operation and Maintenance).

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Control, software, presentation of results

The data supplied by the sensor are processed directly in the sensor housing by highly integrated electronics. They are then displayed on the screen and are stored at the same time via a selective filter in the memory (Figure 8).
The storage medium is used very efficiently as the measured values are saved only when a significant change occurs. The filter with its variable thresholds (setpoint and resolution) provides the respective choices.
The data are transmitted via the IrDA interface of the memory to a computer for processing and display in curves and tables.

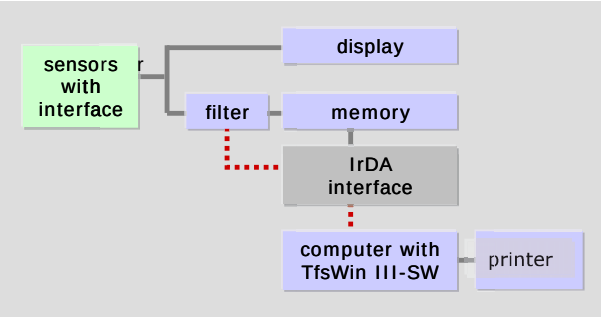

Figure 8: Data representation flowchart

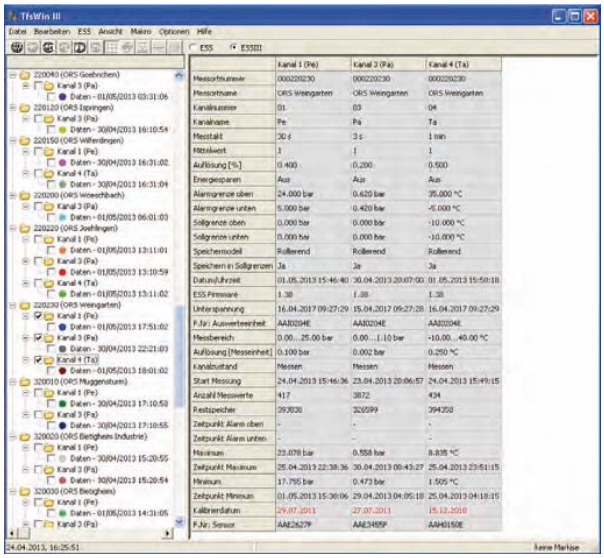

Figure 6: Parameterisation of a 3-channel ESS3 via TfsWin III

TfsWin III software

The Windows-based TfsWin III memory transfer software is available in 6 different languages (german, french, english, czech, spanish, dutch).
It provides the following functions:

- Transmission of the measured values from the memory to a computer
- Processing of the data into curve and table forms, and
- Enabling operation of the devices via the IreDA interface

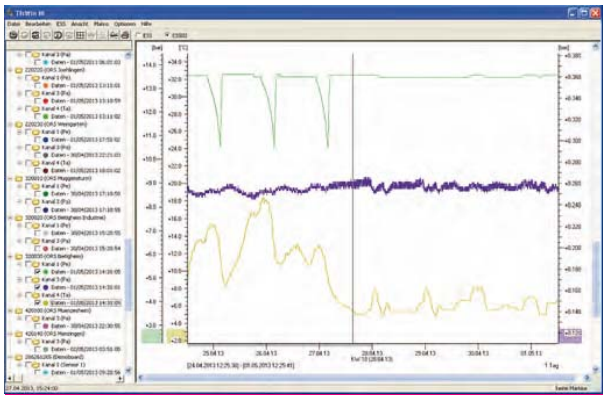

Figure 7: Representation of the measured data (pressure and temperature) of a 3-channel ESS3 S4

DIN EN 805:2000-03:	Water supply – Requirements for systems and components outside buildings; German version EN 805:2000
VdTÜV 1051:	Water pressure testing of piping laid in the ground using the pressure/temperature measuring method
AGFW FW 602:	Testing of district heating lines – Pressure tests on medium lines

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Sensors

User-friendly sensors

The sensor is the measurement system link to the application. The focus is therefore on performance and user friendliness:

- sensor can be changed by the user and is immediately ready for operation without calibration;
- stainless steel-encapsulated, piezo-resistive sensor with high long-term stability resistant to aggressive media ;
- high resolution of the measured values; several measuring ranges possible for one sensor – ratio max. 10:1 to the main measuring range;
- measurement of the medium's temperatures;
- high measuring rates thanks to high intrinsic resonance frequency;
- high pressure tightness and high bursting pressure
- special versions e. g. for O_2 measurement;
- expediently graduated fixed and user-variable measuring ranges and different precision classes down to ±0.05 % of range limit value.

Pressure sensors	Precision [% of FS][1]			
	Standard	Premium	Select	Select plus
Measuring range	±0.4 %	±0.09 %	±0.05 %	±0.05 % < 5 mbar[2]
0 ... 100 mbar rel.	x	x	~	~
0 ... 250 mbar rel.	x	x	~	~
0 ... 1 bar rel.	x	x	x	~
0 ... 2.5 bar rel.	x	x	x	~
0 ... 2.5 bar abs.	x	x	x	~
0 ... 10 bar rel.	x	x	x	~
0 ... 10 bar abs.	x	x	x	~
0 ... 25 bar abs.	x	x	x	x
0 ... 100 bar abs.	x	x	x	~
100 mbar ... 14 bar rel.[3]	x	x	x[4]	~
2.5 bar ... 200 bar abs.[3]	x	x	x[4]	~
0 ... 200 bar - 0 ... 700 bar abs.[3]	x	~	~	~
Vacuum	x	~	~	~

Figure 9: Pressure sensors

[1] FS: Full Scale
[2] deviation < 5 mbar with ambient temperature change of 15 K according to DVGW G469 Test method C3
[3] customised measuring range; freely variable within these limits
[4] on request

Temperature sensor Measuring range and type		Screw-in sensor	Cable sensor
–10 °C ... +40 °C	Rod sensor	~	x
–10 °C ... +40 °C	Immersion sleeve 90 mm	x	x
–10 °C ... +40 °C	Immersion sleeve 140 mm	x	x
– 30 °C ... +150 °C[1]	Rod sensor	~	x
– 30 °C ... +150 °C[1]	Immersion sleeve 90 mm	x	x
– 30 °C ... +150 °C[1]	Immersion sleeve 140 mm	x	x
Measuring precision		±0.3 °C	

[1] Freely variable measuring range within these limits

Figure 10: Temperature sensors

Calibration and gauging

The terms „gauging" and „calibration" are sometimes confused in general usage:
Calibration means that the deviation of the measured values of a measuring device from a normal is determined and attested.

Gaugingis the testing of devices prescribed by law by an official body using high-precision measurement technology. This determines whether the device can be gauged and complies with the requirements of a gauging directive or guideline. The gauging is officially confirmed and documented.

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Sensor calibration

Calibration allowing for the influence of the temperature

Professional calibration forms the basis for the very high measuring precision of the sensors. UNION Instruments employs the latest technology and methods:

- fully automated calibration stand with presetting of pressure and temperature;
- high-precision multi-point calibration with 2nd order polynomial and 11 measuring points;
- consideration for the temperature influence by calibration at 7 different ambient temperatures (curve set) in the range -20 °C to +40 °C of the ambient temperature;
- high-precision pressure reference by using pressure primary normals;
- automatic database-aided creation of works test certificates to DVGW G469;
- use of the DAkkS method
  The DAkkS is the national accreditation authority of the Federal Republic of Germany, formerly DKD. As an independent authority the DAkkS monitors the technical competence of accredited laboratories as well as inspection and certification authorities.

Figure 11 presents the main components of the calibration stand with calibrators, temperature cabinet and pressure balance (from left to right).

Fields of application

Pressure monitoring

Long-term monitoring in gas pressure control and measuring systems and in systems for water catchment and water distribution.
Preferred device types: ESS3 R1 and A1
For stations: ESS3 S4

Measurements and troubleshooting in pipe networks of all kinds

District heating, compressed air, cooling water, gas, water, process steam, hydraulic systems, etc.

Leak testing

in accordance with Codes of Practice G469/W 400-2 on the basis of specifications from the authorities or when handing over new networks to the operator. In both cases use of mobile measurement technology in the form of the DPK3 Test Kit.

Pipe network calculation

For optimal dimensioning, during initial installation or adaptations to modified consumption situations. Validation of computer-generated network models.

Condition-oriented maintenance

Assurance of a high availability and cost-effective operation of gas pressure control and measuring systems.

Differential pressure and volume measurements

at filters, orifices etc.

Testing of devices for preventing backflow

into the water supply in accordance with twin 02.
Use of device Types R1 and DeltaP sensor.

Figure 11: Calibration stand for sensors (components)

Resolution and precision

Resolution signifies the smallest change of a (analog) measured variable in the (digital) output signal that can still clearly be distinguished by a measuring device. The A/D converter used in the device (8 bit, 16 bit ...) influences the resolution.

Precision signifies how far the current measurement result deviates from a result considered to be determined correctly using a high-precision method or measurement device. The precision depends on the characteristics of the measuring device and its calibration.

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