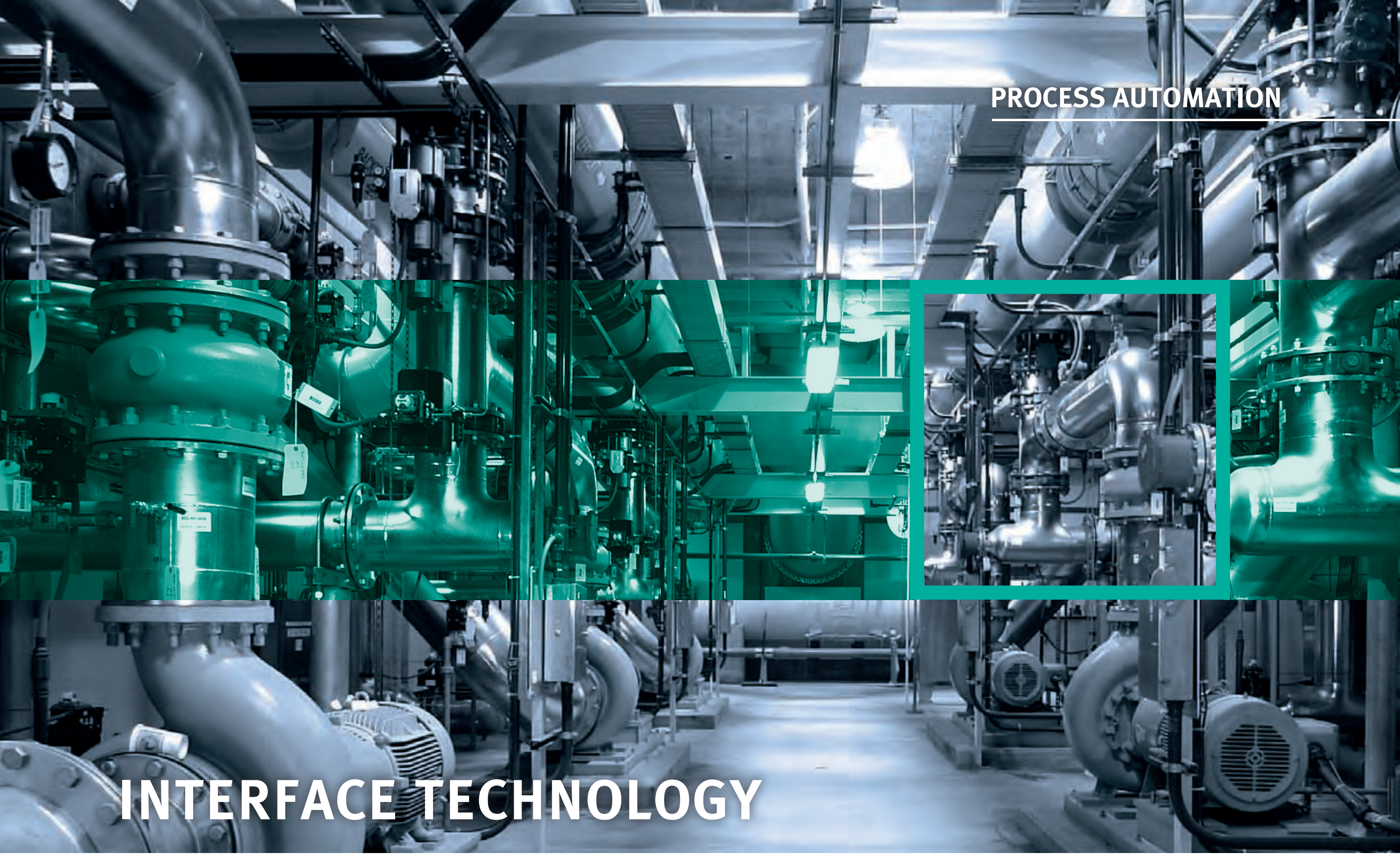
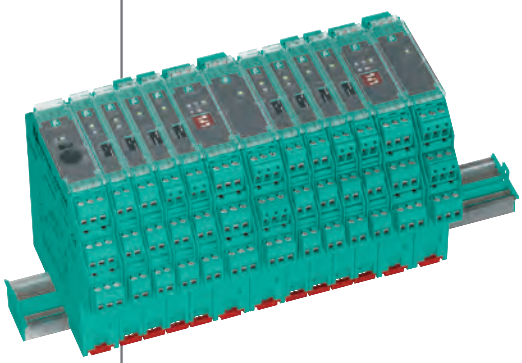


PROCESS AUTOMATION

INTERFACE TECHNOLOGY

ENGINEER'S GUIDE

SIGNAL CONDITIONING



PEPPERL+FUCHS
PROTECTING YOUR PROCESS

Pepperl+Fuchs – Unbeatable for quality, selection, and performance

We have been setting global standards for process automation equipment for over sixty years, and we are the market leader for electronic interface modules, intrinsic safety barriers and hazardous location protection technology.

PROTECTING YOUR PROCESS

The Process Automation division invests in the future so our customers benefit from the latest breakthroughs in signal transfer and intrinsic safety protection, fieldbus, remote I/O, HMI, level control, corrosion monitoring, purge/pressurization, and system & solutions. We are the recognized experts in our technologies — Pepperl+Fuchs has earned a strong reputation by supplying the world's largest process industry companies with the broadest line of proven components and solutions for a diverse range of applications.

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As a global leader, the Factory Automation division offers one of the largest ranges of industrial sensors that provide comprehensive coverage for virtually every application in machine and system construction. Our product line includes an extensive range of inductive identification systems, barcode scanners, AS-Interface, and a line of rotary encoders that will perform in virtually every industry equipment.

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A global presence enables Pepperl+Fuchs to offer the best of both worlds: extremely high engineering standards combined with efficient, low-cost manufacturing facilities.

A worldwide presence means we have exactly what you need to make your process efficient and reliable. It means the most advanced technical expertise in the business is standard with every Pepperl+Fuchs product.

It means we have the largest and most ingenious staff of seasoned and skilled engineers and field representatives in the industry. It means we're there when you need us – anywhere in the world.

Pepperl+Fuchs offers proven industry expertise through market-based, customer-focused products that provide answers to the toughest application problems. Our target industries are involved with chemicals, pharmaceuticals, oil & gas, petrochemicals, and other areas including wastewater treatment and power technology. In all industrial areas, Pepperl+Fuchs is both a supplier and partner for end users, control systems manufacturers, system integrators and engineering contractors. We set the standard by offering the best product, service and support in the world. From our expert application analysis and global key account management, to our on-site engineering of new systems and technical support after the sale, we stand solidly behind every product we build.

North and Central America
Twinsburg, Ohio, USA

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Middle East and India
Dubai

Northern Europe
Oldham, UK

Southern and Eastern Europe
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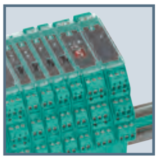
South America
São Paulo, Brazil

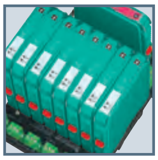
Germany
Committed to engineering excellence, our worldwide headquarters is located in Mannheim, Germany. More than 600 specialists are dedicated to continuing our heritage of high quality and innovation.

Interface Technology



Interface technology guarantees a safe, reliable, and efficient signal transmission between your field device and the control system. We offer intrinsic safety isolated barriers, HART interface solutions, and zener barriers in DIN rail styles or Termination Board solutions; signal conditioners for general-purpose areas; and a wide variety of power supplies and accessories.

Fieldbus Infrastructure



FieldConnex® is a comprehensive fieldbus infrastructure that provides solutions for connecting your instruments to a controller. A wide range of interface products are designed for fast installation and commissioning. A unique High-Power Trunk concept uses Segment Protectors and FieldBarriers to provide power to each device. The Advanced Diagnostic Module lets you monitor the physical layer remotely, in real time.

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Remote I/O systems provide a way to communicate effectively with a modern DCS and proven legacy field devices. RPI and LB/FB Remote I/O connect a wide range of digital and analog sensors and actuators to process control systems over a fieldbus. A variety of gateways are available to make use of different bus protocols.

Purge and Pressurization

Purge/pressurization products offer a safe and economical approach to installing electrical equipment in hazardous locations. By creating a safe area inside an enclosure, general-purpose equipment can be used in hazardous areas. Pepperl+Fuchs offers a full range of Type X, Y, Z, Ex nP, and Ex px purge and pressurization equipment for use in Zones/Divisions 1 and 2.

Level Measurement and Corrosion Monitoring

Our measurement devices are available in 4 mA ... 20 mA, FOUNDATION Fieldbus and PROFIBUS PA interfaces. They are designed for point and continuous applications and are suitable for a wide range of materials and industries. CorrTran MV is a 2-wire, multivariable HART transmitter that evaluates general and localized (pitting) corrosion on line and in real time.

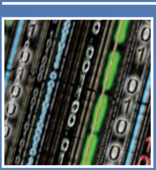
Visualization and HMI

HMI systems enable optimum control, operation, and monitoring of production processes. Our product line provides industrial PC components and visualization equipment used in hazardous areas focusing on equipment used for the human interface to automation systems. These include intrinsically safe electronic display and control device systems, Ex PC systems, intrinsically safe weighing and dosing terminals, and intrinsically safe data collection systems.

Cabinet Solutions

Our cabinet solutions unit offers expert development, manufacture and commissioning of a wide range of solutions including marshalling cabinets, displays and annunciators, distribution panels, control room cabinets, fieldbus panels, custom operator interface solutions, standard and customer fieldbus junction boxes and fieldbus power cabinets.

Signal Conditioning



Signal conditioning is an important part of any automation system where electrical isolation, electronic signal conversion, and measurement accuracy are critical characteristics of the control loop architecture.

We are pleased you have selected the Pepperl+Fuchs' Signal Conditioners Engineer's Guide as your application-solution resource. This document is much more than a catalog of data sheets and specifications. It contains a wealth of information on basic principles, applications, and functional safety. We hope this Engineer's Guide is used a valuable resource in your daily activities and that Pepperl+Fuchs is your first choice for signal conditioning for the Process Automation industry.

Technology

The Technology portion of this catalog is divided into three sections: Basic Principles, Applications/Practical Solutions and Safety Integrity Level (SIL).

The Basic Principles section presents a technical summary relating to the transmission of measured information between interface modules. Digital, analog, and temperature sensor signals are discribed in a very detailed manner.

As part of the Application/Practical Solutions section, the major process applications are detailed in easy-to-read and easy-to-understand examples using many of the products contained in this Engineer's Guide. This section summarizes applications for digital input/output and analog input/output. It should be used whenever you require application assistance for any of our K-System signal conditioners.

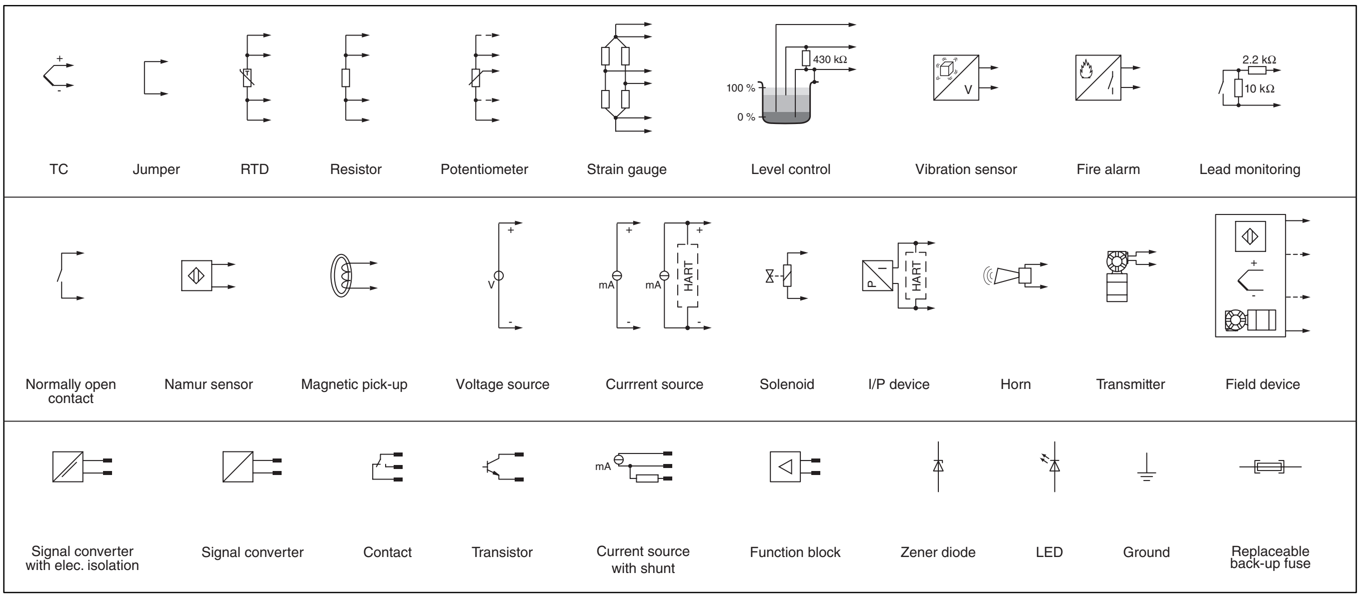
The final section discusses functional safety and provides a brief overview of SIL within the process industry. The key standards are summarized and many of the important terms and definitions are discussed including **P**robability of **F**ailure on **D**emand (PFD), T_{proof}, and **S**afe **F**ailure **F**raction (SFF). Some examples involving Pepperl+Fuchs products are also analyzed in order to provide a clear understanding of how our equipment can be used in SIL loops.

Symbology

The following symbol is used for the Signal Conditioners Group:

Signal Conditioners

The following chart shows electrical symbols used in the connection diagrams:

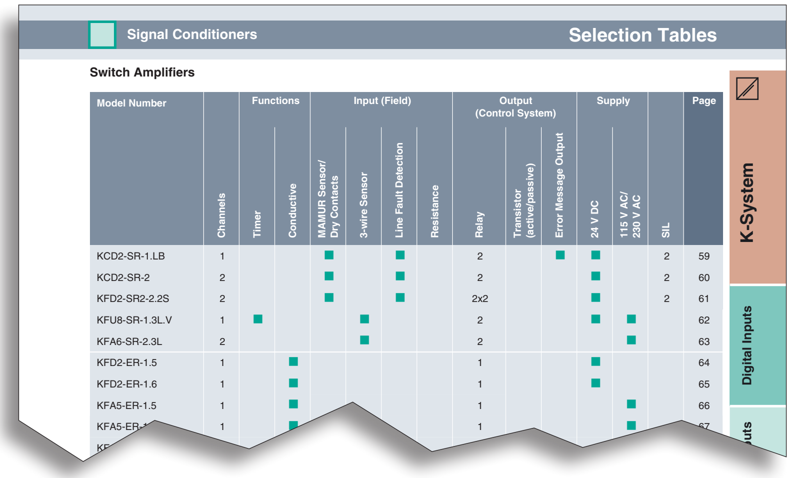


Product Selection Tables

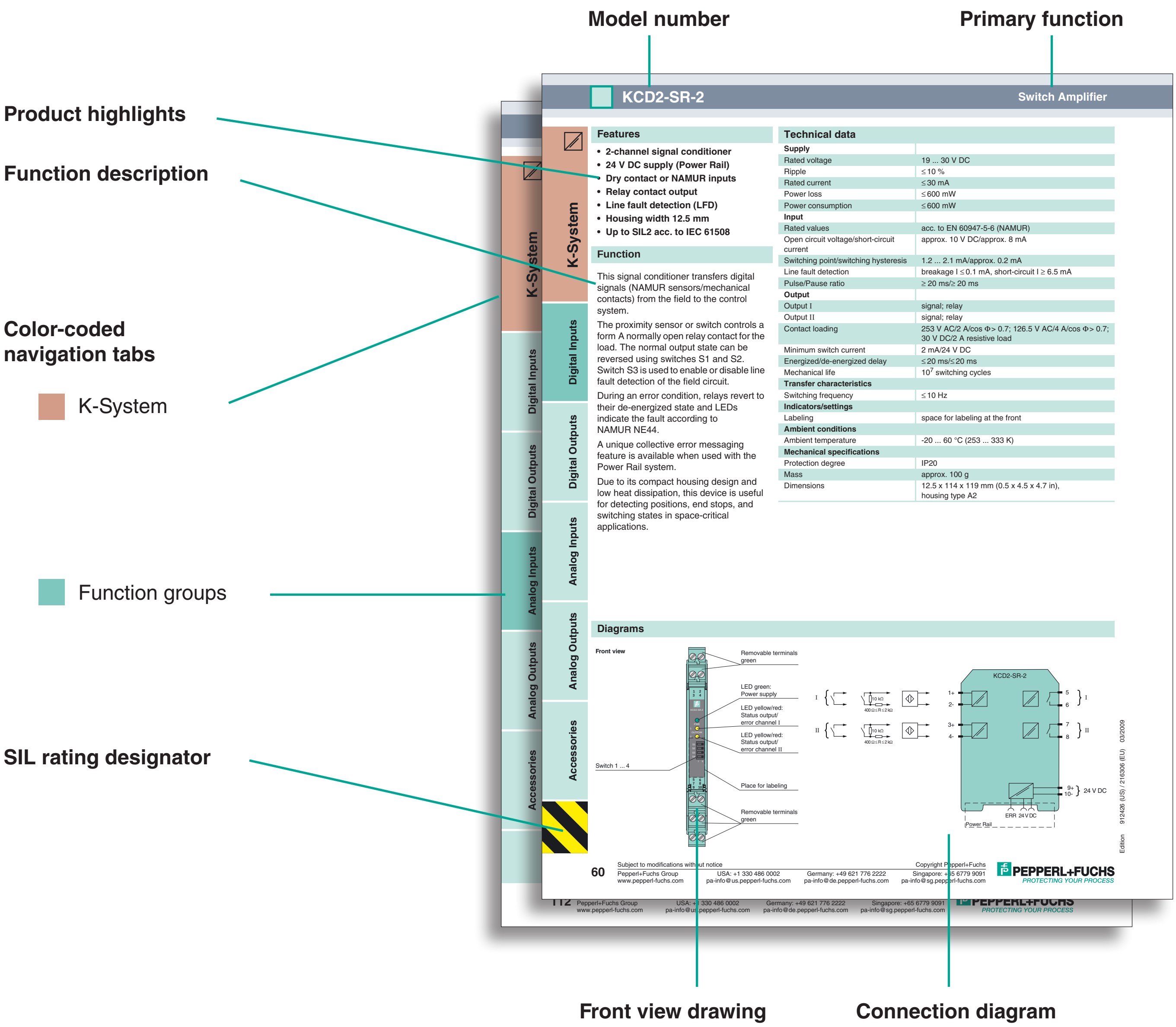
Product selection tables are located at the beginning of each section, making it easy to find the product you need.

Product Data Pages

The product data sheets contain all of the relevant data necessary to select and specify the equipment. It includes four major sections: Features, Function, Technical Data, and Diagrams. Surrounding these key elements are navigation tools necessary to help identify the product including special colors, markings, and symbols. We hope you find the information valuable, accurate, and easy to understand.



Model Number	Channels	Timer	Conductive	NAMUR Sensor/ Dry Contacts	3-wire Sensor	Line Fault Detection	Resistance	Relay	Transistor (active/passive)	Error Message Output	24 V DC	115 V AC/ 230 V AC	SIL	Page
KCD2-SR-1.LB	1			■		■		2		■	■		2	59
KCD2-SR-2	2			■		■		2			■		2	60
KFD2-SR2-2.2S	2			■		■		2x2			■		2	61
KFU8-SR-1.3L.V	1	■			■			2			■	■		62
KFA6-SR-2.3L	2				■			2				■		63
KFD2-ER-1.5	1		■					1			■			64
KFD2-ER-1.6	1		■					1			■			65
KFA5-ER-1.5	1		■					1				■		66



Technology

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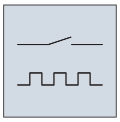
Basic Principles

Digital Signals



In control and regulation technology, the task of monitoring static states (positions) and rotating or oscillating movements is extremely important. Movements, such as lifting or swiveling, as well as quantities, rotational speeds or flow-through need to be evaluated and monitored. A large number of sensors and interface modules are available for the different tasks. It is not always easy to choose the right sensor system and the associated evaluation electronics, so this question must be considered carefully.

The measurement chain generally consists of an element for detecting the position, rotational speed or pulses and an interface module for the sensor power supply and signal processing. Sensors mounted on rotating shafts or on machines with a linear movement can be used to provide the pulses.

How are static signals evaluated and recorded without time reference and frequency signals?

Static Signals

In the case of static signals, the frequency information is not evaluated. Switch amplifiers or controls, only transfer and interpret the current switch state. The only change that can be made to a static input signal is the introduction of a delay. In the case of timers, the digital input signal is used to trigger one-shot functions, for example. However, the counting of pulses for batch processes tends to be classified among the static signals.

Device Functions

The previous section described the detection of static pulse signals. Depending on the application, numerous device functions are available for processing the relevant pulse form.

Switch Amplifier

The switch amplifier powers the sensor, monitors the input signal (Figure 1, a) for line faults and transfers the input signal 1:1 to the output side (Figure 1, b).

Serial Switching Function

In principle, the serial switching function is the same as the switch amplifier function. In the case of the logic control units, the input pulses are switched 1:1 to the output. This means that the input pulses can be processed on counters, for example for service purposes (Figure 1, b).

Pulse Divider Function

In the case of the logic control units, the input pulses are divided by the selected divider and switched to the output (Figure 1, c). A constant frequency is not output, but rather, a number of pulses per time unit. The output pulses can occur at irregular intervals. If there are packages of pulses at the input that cannot be transferred to the output quickly enough, these are accumulated in the device and delivered to the output during pauses. The pulse divider function can be used to switch scaled consumption to a display when measuring flow, for example of eccentric gear counters.

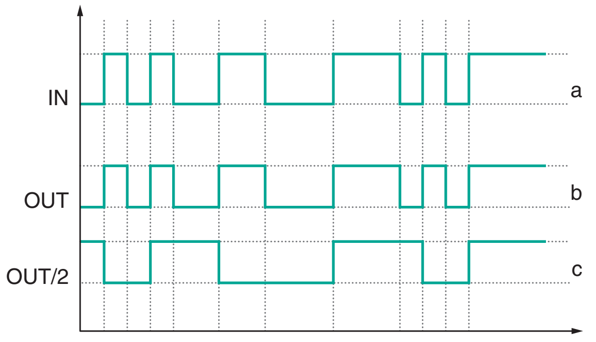


Figure 1 Static signals

Rotation Direction Detection

If the rotation direction of the machine is important, this is determined from two input signals at different times. In the case of worm drives or tunnel ventilation systems it is essential that the correct direction of rotation is monitored.

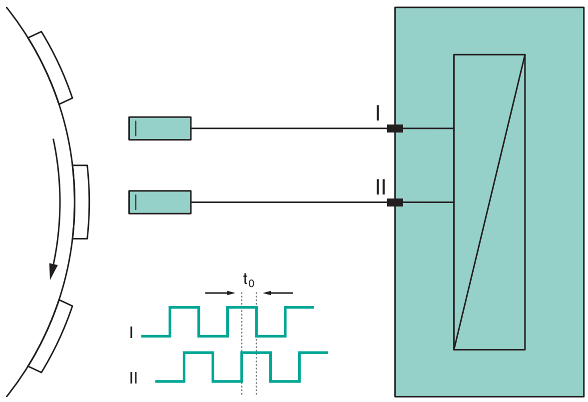


Figure 2 Determining the direction of rotation

In order to reliably determine the direction of rotation, the two input signals must have minimal "overlap". If one of the two input signals is missing, then it is not possible to provide information about the direction of rotation.

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This can happen if

- the sensor is incorrectly adjusted (no overlap),
- the sensor is never damped ("dropped"),
- the sensor is faulty,
- the system vibrates and oscillates around the switch point of an input without the second input being damped. This would give the false impression of an input frequency. For the evaluation this means "no overlap".

If an intermittent overlap is detected due to vibrations, this can cause the direction of rotation relay to "flutter". This is remedied by the reset input, which stops the relay while the system is idle.

Synchronization Monitoring

Pulse sequences are compared during synchronization monitoring. If the difference exceeds a set trip value, an output is switched. When short slippage is measured, the pulse difference is not reset.

Application example

Synchronous drives are important for the spindle lifting equipment shown in Figure 3. The pulse sequences for every spindle are recorded and compared for this purpose. The maximum permissible deviation of the pulse reading is set as the trip value. If the trip value (differential pulse number) is exceeded, the relay de-energizes and the drive that is running fast is slowed. When the difference has reached zero, the relay energized again.

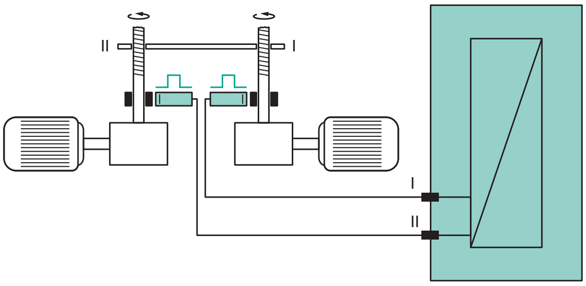

Figure 3 Monitoring spindle lifting equipment for misalignment

Change of direction input

What happens if the direction of the lifting equipment changes? As illustrated, more input pulses have been counted at input I (Figure 4). In the event of a change of direction, drive I would need to run faster to prevent misalignment. However, this would mean even more pulses at input I. As soon as the trip value would be exceeded, drive II would start, increasing misalignment. For this reason, the "change of direction" input must be activated when changing direction. The sign in front of the difference is changed, so that drive I can execute twice as many pulses up to the trip value. The change of direction input is level-triggered:

- if it is inactive, the difference = pulse I – pulse II, while
- if it is active the difference = pulse II – pulse I.

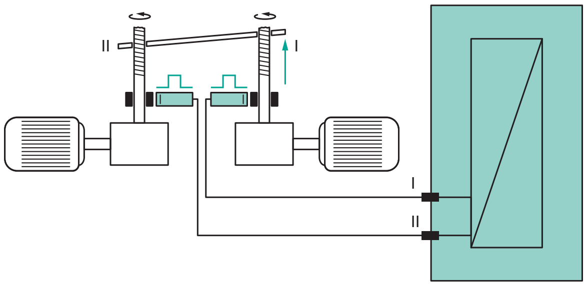

Figure 4 Monitoring for misalignment with change of direction

Frequency Signals

When a time link between the input pulses needs to be recorded, we refer to a frequency evaluation. Evaluating the frequency of digital signals is a complex and technically demanding procedure. The frequency can range from a few mHz (0.001 Hz) to several kHz (12 kHz). If an evaluation factor such as pulse/revolution is taken into account, the input frequency can also be displayed in rpm. Examples of interface modules that measure frequency are speed monitors and frequency converters. How is the frequency of a pulse sequence evaluated?

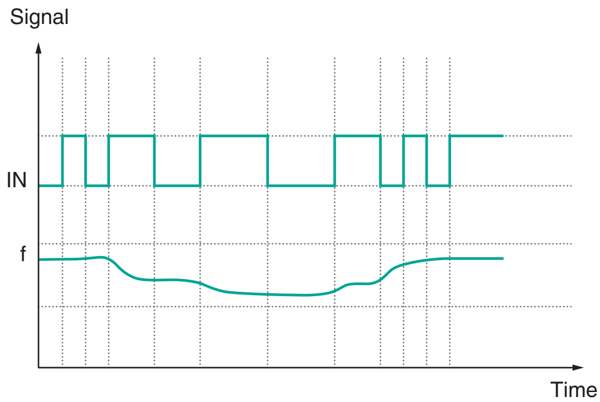

Figure 5 Frequency evaluation

Measurement Using Retriggerable Time Relay

This is the simplest kind of measurement; however, it is only used for monitoring. In this method of measurement, a time relay is started with a time base corresponding to the rotational speed to be monitored. Every new input pulse resets the time of the time relay before it expires. If the time relay is not reset, it runs to the end and switches. This corresponds to underspeed.

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Procedure for Measuring Cycle Duration

The procedure for measuring cycle duration involves measuring the period between two or more consecutive input pulses. This yields the frequency for

Frequency = Pulse/Measured Time

This makes it possible to identify any deviation from a set frequency even after just two pulses. This measurement principle also enables acceptable response times in applications with relatively long pulse intervals. If the response time is to be reduced, the number of pulses per revolution must be increased. This can be achieved by fitting a cam plate, for example. However, it is necessary to ensure that the intervals between the cams are constant, as otherwise variations arise in measurements.

The measuring period depends directly on the duration of the input pulses, i. e., the more input pulses generated per revolution, the shorter the measuring period. Precise monitoring of rotational speed requires that the segment plates, switching targets or switching cams should be distributed evenly. At higher frequencies, variations can be balanced by the formation of mean values (integration). The response time of the measurement becomes very long at low frequencies.

Formation of Mean Values

To suppress signal jumps in non-symmetrical damping elements it is possible to form a floating mean for the number of cycles. The diagram shows a pulse sequence with cycles of varying duration.

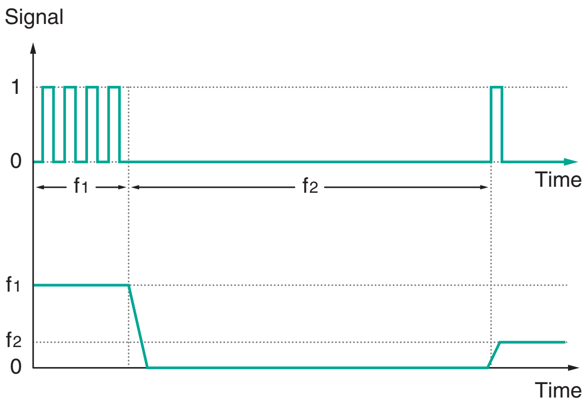

Figure 6 Pulse sequence with cycles of varying duration

Without the formation of mean values, every cycle would be calculated on the basis of a different rotational speed and the result would vary enormously.

By forming a mean value over several cycles, it is possible to damp the signal, although larger variations will still be apparent. Effects with different cycle durations generally only occur with non-symmetrically formed segment plates; even differently aligned screw heads on a shaft can lead to variations in cycle duration. That's why it often makes sense to work with just one object per revolution at higher rotational speeds.

Limits to the Procedure for Measuring Cycle Duration

What happens if the rotational speed drops sharply, i. e., the machine quickly fails? To start, it is not possible to detect any further pulses. An integrated measuring procedure must be activated for this purpose. Even when the machine is stopped, the frequency cannot be immediately set to 0 Hz. In theory, the asymptotically decreasing process can take an infinite amount of time.

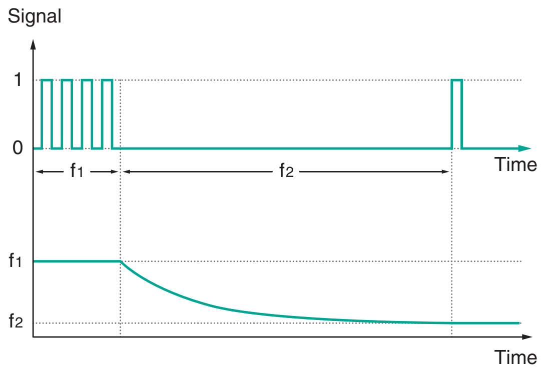

Figure 7 Sharp drop in rotational speed

Overrun Protection

For noise immunity, a filter is inserted in front of most pulse inputs of frequency converters. Input frequencies (including noise frequencies) higher than the limiting frequency of this filter can no longer be processed. Thus the device immediately detects a standstill (no pulses). This unwelcome situation can be avoided if a safety range is taken into account above the measuring range in which no more monitoring takes place, but incoming pulses are still detected and are not switched off unintentionally. In this case it is also important to note the pulse width for narrow pulses. This means that rotational speeds that exceed the upper end of the set measuring range are not reported as errors provided they are within the frequency limit of the filter.

Device Functions

The previous sections described the detection of dynamic pulse signals (frequency measurement). Depending on the application, numerous device functions are available for processing the relevant impulse form.

Standstill and Rotational Speed Monitoring

Trip value monitoring involves detecting whether the input frequency rises above or drops below a given trip value (Min/Max Alarm).

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Min/Max Alarm

In the case of the Min Alarm (Figure 8), the measurement value is monitored for failure to reach a switch point, while Max Alarm monitors whether this value is exceeded. A hysteresis is entered to prevent the output from constantly changing its status when the value measured oscillates around the switch point. The direction of operation indicates whether the switch outputs are active or passive after the switch point is reached.

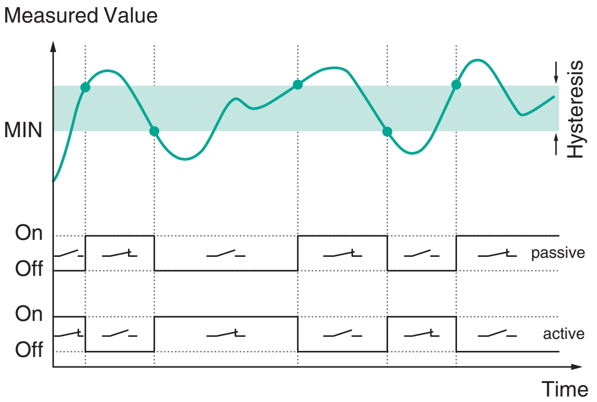

Figure 8 Measurement overrange (Min Alarm)

Start-up Override

If a machine is monitored for standstill (Min Alarm), the relevant output relay indicates a fault if the frequency level drops below the minimum setting. The fault prevents the machine from restarting. Start-up override enables trip value monitoring to be suppressed for a given period. The relay is set to OK status for the duration of the start-up override. This prevents the set rotational speed from being exceeded in this phase. Figure 9 shows how the relay responds to the relevant start-up override time. If the time is too short (t_c < T), the relay will switch briefly before the set frequency is reached and an alarm will be output.

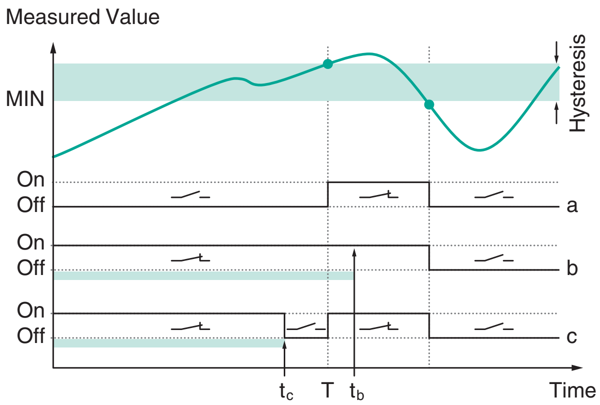

Figure 9 Start-up override time

The start-up override flank-triggered. If the contact is closed after the time has expired, the start-up override only becomes active again when the contact is opened briefly. The triggering by the signal flank means that it is possible to start the start-up override once at Power ON.

Frequency Current Conversion

If the rotational speed is to be measured and processed in a control application, then conversion to a standard signal is normally required. Figure 10 shows the conversion to a 0/4 mA ... 20 mA standard signal. However, it can also be converted to a 0/2 V … 10 V standard signal.

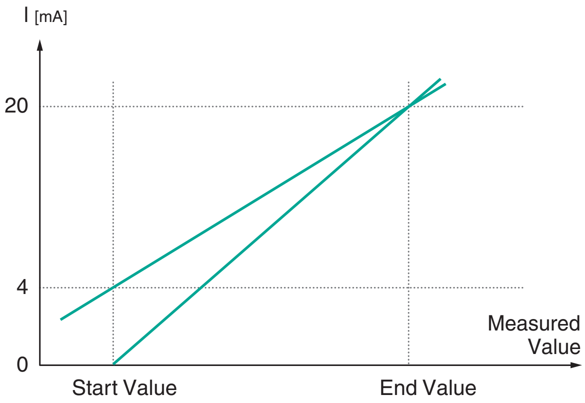

Figure 10 Frequency current conversion

Slip Monitoring

Two input frequencies are compared during slip monitoring. An alarm is emitted if the difference is continuously too great. Brief overranges in startup procedures are ignored.

Application example 1

A conveyor belt is to be monitored for slippage in order to limit wear and tear or even to prevent the risk of fire. If the belt is blocked, then the two input frequencies will differ. If a trip value is set to the maximum permissible slip, this relay will switch if the value is exceeded and thus allows the drive to be switched off safely. A restart inhibit feature prevents continuous activation/deactivation.

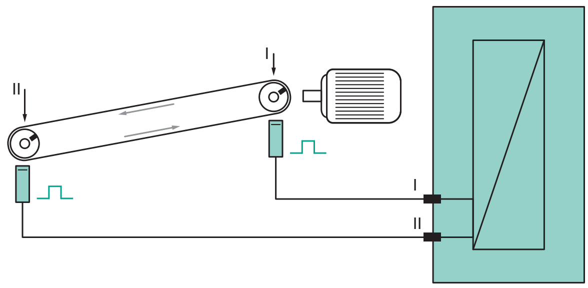

Figure 11 Slip monitoring for a conveyor belt

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If there is a conversion ratio (Figure 12) between two frequencies, this can be taken into account with an internal divider.

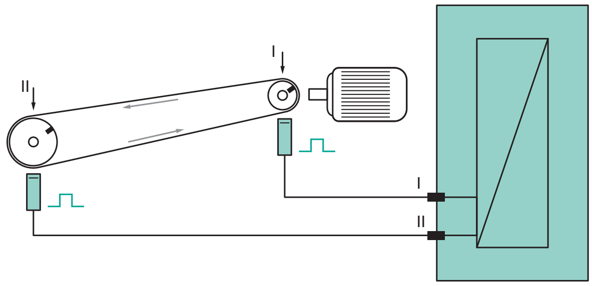


Figure 12 Slip monitoring for a conveyor belt with conversion ratio

Application example 2

A sliding clutch should be monitored for slip. If the drive is blocked, then the two input frequencies will differ. If a trip value is set to the maximum permissible slip, this relay will switch if the value is exceeded and thus allows the drive to be switched off safely.

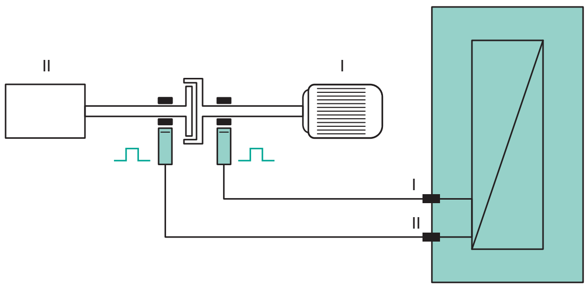
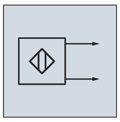


Figure 13 Slip monitoring for a sliding clutch

Electrical Features

Sensors are available in many different physical measurement principles and in many different electrical versions. This section only considers the electrical interface between the sensor and evaluation device. The details of the different measuring principles can be found in the documents provided by the relevant sensor manufacturers. The electrical interface between the sensor and sensor power supply is largely standardized and can be divided into 2 variants. Depending on the application, sensors with 2- or 3-wire connections are used.

2-Wire (NAMUR) Sensors (in Accordance with IEC 60947-5-6)



2-wire sensors in accordance with IEC 60947-5-6 are powered by means of the circuit and are resistant to short circuiting and overloading. They need a small independent power supply (typically 0.8 mA) to ensure functionality. Its two connector lines generally allow you to replace a mechanical switch directly. A DC interface in accordance with IEC 60947-5-6 (electric travel sensor, DC interface for travel sensor and switch amplifier) is widely used as the standard interface in the chemicals and petrochemicals sector and is the generally recognized standard for so-called NAMUR sensors. Because of its advantages, this interface is used in an increasing number of non hazardous applications. The 2-wire sensor operates on a quasi-analog basis.

The current in the sensor circuit is influenced by the distance from a metal object. The switching points for the analog input signal up to this point will be formed or evaluated in the interface modules with a digital input, such as a switch amplifier or frequency converter. These switch points are set in standard IEC 60947-5-6 (between 1.2 mA and 2.1 mA at typically. 8.2 V). This definition guarantees cross-manufacturer compatibility in the sensors and interface modules.

Because sensors of this type have a defined minimum and maximum current, it is easy to implement sensor line monitoring for lead breakages and short circuiting with two more values (below the minimum current and above the maximum current). Here too, IEC 60947-5-6 specifies the standard values (lead breakage in the control circuit is I < 0.1 mA, short circuiting is I > 6 mA). Figure 14 shows the typical characteristic curve for a NAMUR sensor according to IEC 60947-5-6.

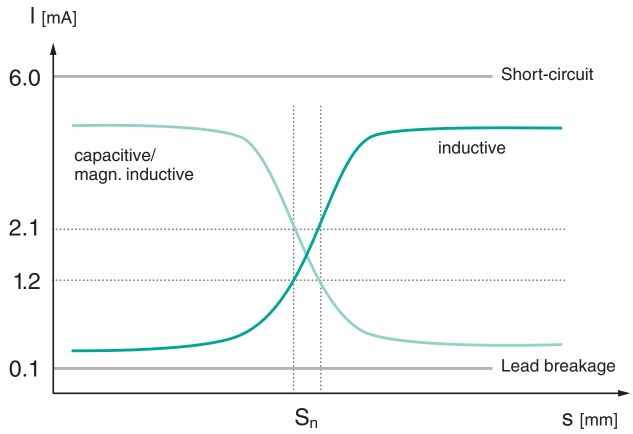


Figure 14 Characteristic curve for a NAMUR sensor according to IEC 60947-5-6.

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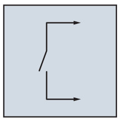
The upper and lower straight lines show the values for lead breakage and short circuiting, while the middle lines represent the values for the switch points (the hysteresis lies between the switch points). Because NAMUR sensors do not include signal evaluation, they have far fewer components than similar sensors with their own switch output. This again is the reason for the smaller size in some cases (shorter threaded tubes on cylindrical sensors). NAMUR sensors (in accordance with IEC 60947-5-6) are currently available with all the most common physical principles, such as

- inductive sensors,
- capacitive sensors,
- magnetic inductive sensors, and
- photoelectric sensors.

Because of this, the NAMUR sensor is also ideally suited to applications with higher switching frequencies.

Mechanical Switches



Digital switching signals can also be created with a switch contact. These can be mechanical contacts or transistor switches, which are the starting point for a sensor unit. The disadvantage of mechanical switches over electronic transistors is their limited service life. Mechanical switches have a negligible resistance when closed of 0 Ω and when open of ∞ Ω. When these switches are used with switch amplifiers, controls or logic control units, it should be noted that it is not possible to monitor leads without additional elements.

If a resistor is connected in parallel with the switch, this results in a low base current, which is used to detect lead breakages (Figure 15, channel I). An additional serial resistor reduces the maximum switching current under the threshold below which a line short circuiting is detected. This auxiliary circuit also allows the benefits of line monitoring to be used with switch contacts (Figure 15, channel II).

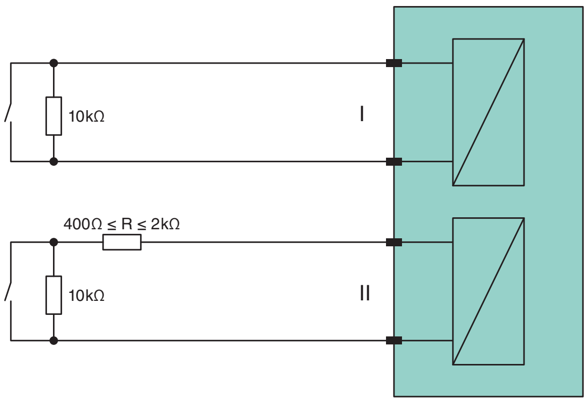
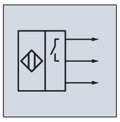


Figure 15 Auxiliary circuit for line fault detection

3-Wire Sensors

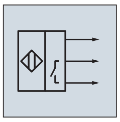
3-wire sensors are supplied by two connectors, while the third lead transfers the switching signal. 3-wire sensors have an output that is switched high (PNP switch), switched low (NPN switch) or pull-push switched. Depending on the switching power of the output stage, loads can be connected directly to the sensor. 3-wire sensors are encountered in almost all areas of factory automation and are almost standard sensors.

High Switched Sensor (PNP)



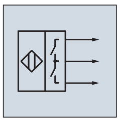
In the case of the high switched 3-wire sensor, the switch output is switched against the supply line. If the signal is processed in interface modules or control inputs, then care should be taken to ensure that the relevant input is designed for the circuit with the supply voltage.

Low Switched Sensor (NPN)



The low switched 3-wire sensor draws the switching signal to ground. If the signal is processed in interface modules or control inputs here, then a pull-up resistor is required for passive inputs. The low switched sensor is rarer in practice.

Push-Pull Switched Sensor



In the case of the push-pull switched 3-wire sensor, the signal switches between the supply voltage and the minus lead. This switch is mainly used for fast switching processes, as in rotary encoders, for example.

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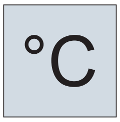
Temperature Signals



Temperature is a very frequently measured physical value and is difficult to record in process technology and automation technology. From system monitoring to process optimization, temperature measurement plays a vital role. The use of electrical temperature sensors ranges from the most diverse chemical processes and applications in mechanical engineering to temperature measurement in energy production. Process and response speeds, material consumption, return, product properties and quality all depend on the accuracy, reliability and speed with which temperatures are measured. Temperature has a decisive influence on process effectiveness, energy consumption and other process parameters, such as solvent requirements or drying level. The service life of machinery is also influenced by temperature conditions.

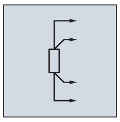
In many branches of industry, the main issue is to be able to use the information from reliable temperature measurements for control and regulatory functions. The increased demand for precision and reliability in temperature measurements in recent years has led to a situation in which many system operators have also had to review the suitability and performance of their temperature measuring equipment.

Temperature Sensors

The most commonly used sensors for industrial temperature measurement are resistance thermometers and thermocouples. These types of detectors enable almost all the most common industrial measurement requirements to be met.

Resistance thermometers are recognized as the most accurate and stable (in terms of measuring properties) temperature sensors. The various types of thermocouples can be used to measure temperatures from -250 °C to +3000 °C. Thermocouples are regarded as robust and versatile. Resistance thermometers can be used in the range between -200 °C and +850 °C. One key shared property is that their values are available in the form of electrical signals that are relatively easy to transfer to measurement and control instruments for processing and display. Resistance thermometers and thermocouples can be produced with very small tolerances. Because they can be interchanged directly, these sensors are very commonly used.

Resistance Thermometers



While thermocouples are used to measure temperature differences, the electrical resistance of a metallic conductor depends on the absolute temperature. There is no reference point for a known temperature as with thermocouples. The following effect is used to determine the temperature using electrical resistance: resistance increases as the temperature rises. Platinum is commonly used as a metallic resistor in industrial metrology. It has a high chemical resistance, is relatively easy to process and has reproducible electrical properties. Platinum resistors are standardized in EN 60751 and IEC 751. This ensures their interchangeability. As with thermocouples, the signal strengths of resistance thermometers are relatively low.

Variants of Platinum Resistors

For platinum resistors with a nominal resistance of 100 Ω (Pt100) at 0 °C the changes are approximately 0.4 Ω/K. With a nominal resistance of 100 Ω and a measured current of 1 mA, the output signal is about 400 μV/K. Thus, the output signals of the resistance thermometers are still one or two sizes bigger than those of the thermocouples. Signal deviations of about 4 Ω/K can be achieved with Pt1000 platinum resistors that have a nominal resistance of 1000 Ω at 0 °C. However, these resistors are very susceptible to mechanical stresses at high temperatures because extremely thin wires are used. Pt10 resistors are preferred for measurements over 600 °C because they use comparatively thick wires that are robust at high temperatures.

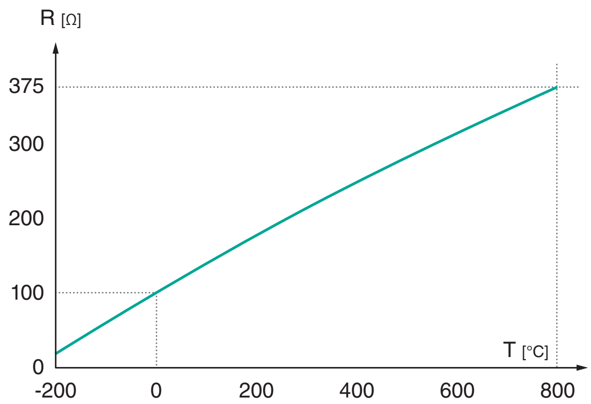


Figure 16 Resistance temperature characteristic curve Pt100

Technology
Basic Principles
Applications
Functional Safety

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Measurement Methods

With modern, digital interface modules that allow very precise results to be achieved with minimal measuring currents, it is not typically necessary to build measuring bridges. Temperature recording uses high-precision digital A/D conversion circuits. Thus, the problem lies not in the recording of the measuring signal but rather in falsification by wire resistances. In the case of industrial applications, there are often long distances between the measurement location and the evaluation units. These distances are bridged with copper instrument cables. From a metrology perspective, the wire is a resistor connected in series in relation to the measuring resistor. This wire resistance has a direct impact on the measurement result and must, therefore, be taken into account. In the simplest scenario, the wire resistance represents a constant additive contribution to the result. It can easily be taken into consideration by measuring the line resistance during startup and subtracting this value from the overall resistance. However, this method cannot be used to record the temperature-related variations in wire resistances. In order to be able to take account of errors caused by this effect in metrology terms, resistance thermometers for precision measurements are mostly equipped with one or two additional connection wires (3- or 4-wire connection).

2-wire connection

In the case of the 2-wire connection, a constant current I is applied to the process circuit. The voltage drop over the process circuit resistance 2 x R_L + R_T yields U_1. The wire resistance must be extrapolated to determine the temperature. The contributions of wire resistances 2 x R_L to the overall resistance can only be determined by means of a separate measurement (without measurement resistor). For this, the measurement lines are short circuited directly on the measurement resistor and measured U_x.

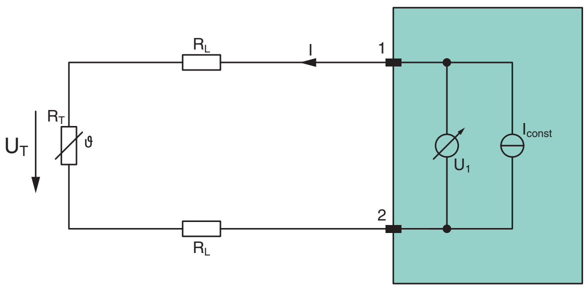

Figure 17 The principle of 2-wire connection

The measured value results from:

$$U_T = U_1 - U_x$$

Continuous correction of the lead resistance is not possible during measurement. This is why the field cables should not be longer than about 100 m in the case of the 2-wire connection. The resistance of a 1 m copper cable with a diameter of 1 mm² is around 0.017 Ω. Consequently, in this case, a wire resistance of about 1.7 Ω can be expected. Changes to the resistance due to the influence of the temperature are included in the result. If the cable lengths are greater, so that higher wire resistances are unavoidable, you should use 3- or 4-wire connections.

3-wire connection

To record wire resistance R_L and its changes, a third wire is laid directly to the connector point at the measurement resistor. The wire resistance of this line has no influence on measurement because the supply current does not pass through it. Thus, the voltage is measured directly on the measurement resistor.

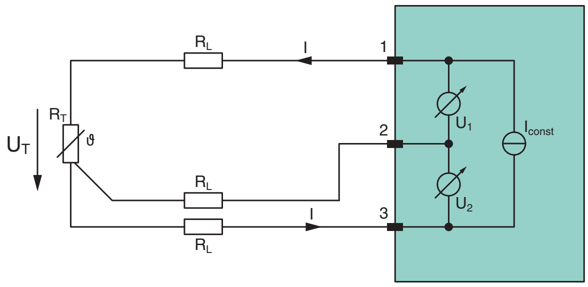

Figure 18 The principle of 3-wire connection

The voltage U_2 can be used to determine the line resistance R_L in the current path at terminal 3. Because the voltage drops of the wires are identical at terminals 1 and 3, the measured value U_T can be determined:

$$U_T = U_1 - U_2$$

In this method the wire resistances are not determined individually. Instead, it is assumed that the wire resistances are the same in both circuit paths. Thus, the key requirements for precise results are that the specific resistance and thermo-electric properties of the supply cables should be constant over the entire effective length. Naturally all wires must be subject to the same temperature gradients. In practice, 3-wire connections are used on cable lengths up to about 500 m. The wire resistances are almost 10 Ω.

4-wire connection

In the setup shown in Figure 19, it is ensured that 2 measurement lines are applied to terminals 2 and 3. The circuit is used to suppress the error caused by the wire resistances, however a good constant current source is required.

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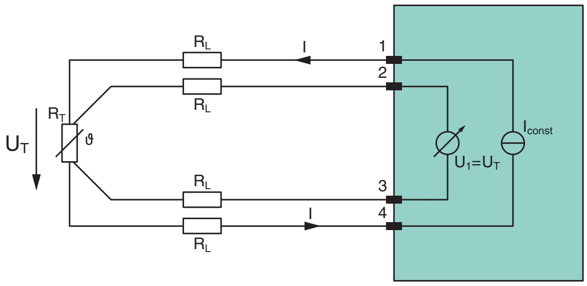


Figure 19 The principle of the 4-wire connection

This means that the wire resistance is no longer of any significance and even different resistances on the individual wires do not falsify the measured result.

$U_T = U_1$

When designing resistance thermometers with 3- and 4-wire connections, it is necessary to ensure that the supply cables are connected directly to the measurement resistor, which is not the case with all thermometers. This link is often made in the connection head in such constructions. This once again produces the problems with the wire resistance and temperature-dependent influences over the length of the actual thermometer. Because of the comparatively small distance between the connection head and the measurement resistor, these errors are much smaller than with the 2-wire connection.

Thermocouples

The Seebeck Effect

If an electrical conductor is in a temperature gradient, a stream of electrons occurs inside the conductor, caused by an electromotive force (EMC) proportionate to the temperature gradient. The magnitude and direction of this electromotive force depend on the extent of the temperature gradient and the conductor material (Figure 20). The measured voltage between the two free ends of the conductor yields a voltage difference that depends on the temperature difference and the thermoelectric properties of the conductor. This phenomenon, known as the Seebeck effect, was discovered in 1822 by T. J. Seebeck.

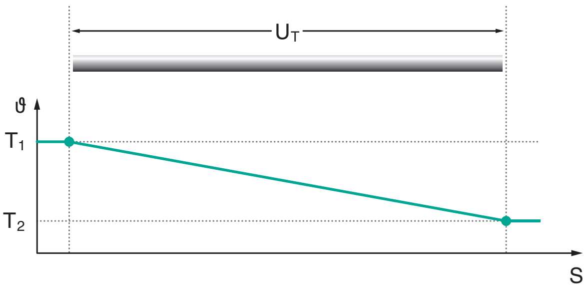
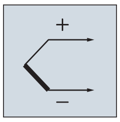


Figure 20 Link between temperature gradient and conductor material

The Thermocouple



To get a usable thermocouple for metrology purposes, two metal conductors with different thermo-electrical properties are connected at one end (measuring point). A voltage is then formed between the two free conductor ends which depends on the temperature difference between the connection point, the free ends and the two conductor materials. Hence the name thermocouple. In this case it is important that the thermo-electrical forces are produced in the range of the temperature gradients and not just, as is often incorrectly assumed, at the connection point (measuring point) of the two conductors.

This is important for the practical application of thermocouples because this gives rise to a demand for conductors with physically and chemically homogeneous properties along the entire length. The resulting thermal voltage U_T results irrespective of the intermediate temperature profile, provided that the two conductors in the thermocouple have uniform thermo-electrical characteristics over their entire length.

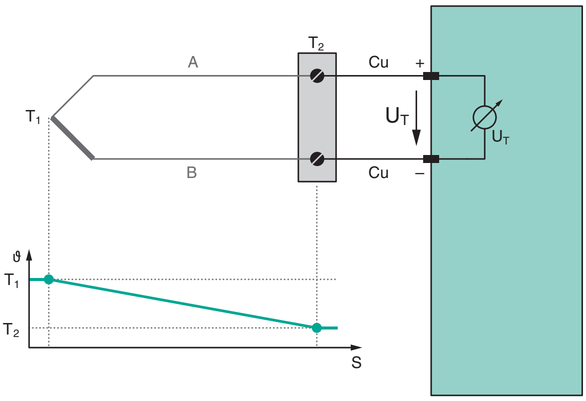


Figure 21 Thermal voltage U_T

Likewise, the connection points at which the thermocouple (A/B) is connected with connection leads or a display device must share the same temperature (T_2). If this condition is not met, this leads to unwanted thermal voltages at the connection points, so that the measurement results are falsified.

The measuring point (T_1) is the point where the two thermo wires are welded, soldered or twisted together. This is the actual sensor in the medium to be measured. The two thermal elements are connected to the compensating or thermo wires at the two contact points, so that the thermocouple is connected to the reference junction (T_2). In Figure 21, the reference junction is the end of the copper leads at which the thermal voltage U_T is finally measured. A thermocouple is a device for measuring temperature difference. It should not be confused with a temperature sensor for measuring absolute temperature. It is only by measuring the temperature at the junction that it is possible to draw a conclusion about the absolute temperature of the measuring point.

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There are many different thermocouples available on the market with different Seebeck coefficients. Figure 22 shows Seebeck coefficients for a number of thermocouples whose thermal voltages are in the range of a few µV per degree of temperature difference. A number of tables showing the basic values of the thermal voltages for all commonly used thermocouples for the temperatures in their areas of application are available, enabling the temperature values to be determined.

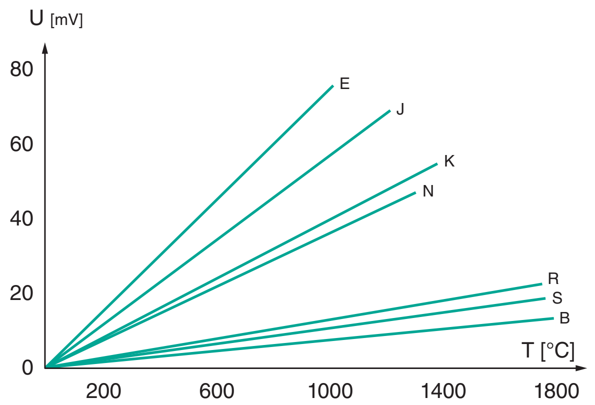

Figure 22 Seebeck coefficients for thermocouples

Summary of the functioning principle

- The combination of two different metals in a temperature gradient produces an electrical thermal voltage.
- Thermocouples only produce an output signal in the area of the temperature gradient.
- Thermocouples are temperature sensors that measure a difference in temperature. They cannot be used to determine absolute temperatures.

Reference Junction Compensation

As already mentioned, the output signal of thermocouples is a measure of the temperature difference between the measurement point and reference junction. To use thermocouples to determine absolute temperature, it is necessary to keep the reference junction at a constant and, above all, known temperature.

One easy way to maintain a constant reference junction temperature is commonly used in laboratory applications: the reference junction is immersed in iced water that is in a thermodynamically balanced state. If this is pure iced water, a constant temperature level with a safety of 1 mK is established at 0 °C.

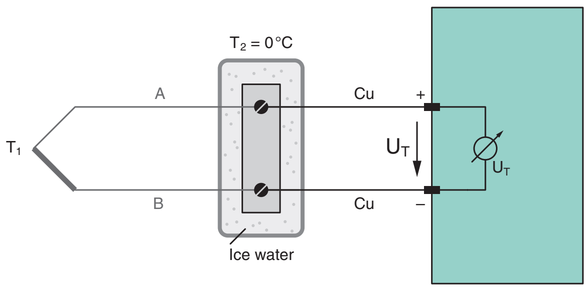

Figure 23 Reference junction with iced water

All that is required for a practical application is a thermos vessel filled with ice. This method was also used to determine the basic values of the thermocouples. This is why the thermal voltages of the basic values are based on a temperature of 0 °C. However, this method requires the constant checking of the iced water and the replenishment of the ice. It is, therefore, clearly unsuitable for industrial applications. The fact is that a reference junction temperature of 0 °C is just a random definition because this temperature can be achieved with comparative ease. However, any temperature can be used as the reference junction temperature. Thermostats were developed for industrial use in order to be able to keep the reference junction at a known and constant temperature.

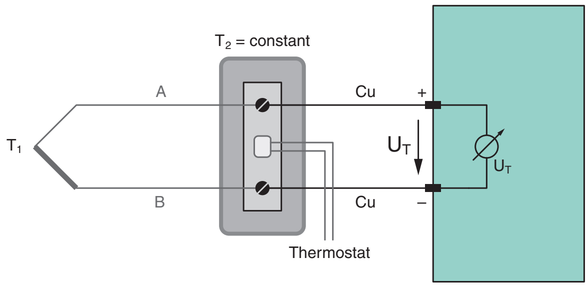

Figure 24 Structural principle of a thermostat

The devices use the Peltier effect. In this case, the temperature at the reference junction is kept at 0 °C by means of thermo-electrical semi-conductor elements that produce a cooling effect. The controlled Peltier elements, together with the reference junction are contained in an insulated vessel. The measurement errors when this method is used are less than ± 0.1 K. For practical reasons, other temperatures are also used as reference junction temperatures in industrial metrology. The method of continuously measuring the reference junction temperature rather than regulating it is even easier. If the terminal temperature is known and is identical at both terminals, this can be used as the reference junction temperature.

Internal and External Junction Compensation

As discussed before, two methods are used for reference junction compensation in industrial metrology. During internal junction compensation, the temperature at the terminal is measured with a separate temperature sensor and is used as the reference junction temperature when performing corrections.

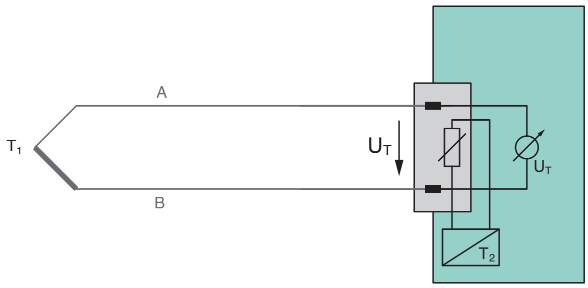

Figure 25 Internal junction compensation

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In the other case, external junction compensation, the reference junction is contained in a tempered device, the reference junction thermostat. The temperature is kept constant through heating or cooling. Such a device is only practical if the signals from several thermocouples need to be transferred over a long distance. In this case it is only necessary to wire the distance from the temperature sensor to the thermostat with high-grade thermal material.

The distance from the thermostat to the measuring station can be bridged with much less expensive copper cables. Many of the current interface modules developed for operation with thermocouples have connection points for connecting thermocouples directly without the need for a separate reference junction. Such instruments have a separate internal reference point where the terminal temperature is measured with an integrated measurement resistor.

Comparison between Thermocouples and Resistance Thermometers.

While having many advantages, thermocouples also have a number of important disadvantages. Foremost among these is the inevitable lack of metallurgic homogenities in thermal wires. This has a direct influence on the achievable precision and the long-term stability of the sensors. In addition, thermocouples have a non-linear temperature/voltage ratio and exhibit signs of hysteresis. To this is added the additional costs for thermal wires and extension wires, the need for a reference point and, finally, the relatively weak output signal. Resistance thermometers are much more precise and stable than the thermocouples and also permit a much better resolution. At present, resistance thermometers offer the best possible measuring precision with electric temperature sensors. However, they can only be used in a very limited temperature range, usually between -200 °C and +350 °C. Special construction measures enable temperatures of +850 °C to be reached, while thermocouples made from special alloys can measure up to 2500 °C.

The temperature patterns of measurement resistors are much less complicated than the thermo-electric properties of thermocouples, making linearization and signal amplification much simpler. For example, a typical type Pt100 measurement resistor with a measurement current of 1 mA supplies an output signal of 3 mV to 4 mV with a temperature change of 10 K. On the other hand, resistance thermometers have their weaknesses. In comparison with the single-point measuring probe of the thermocouple, resistance thermometers measure the entire volume of the measurement resistor. They are less robust and respond more slowly than thermocouples. Resistance thermometers require a power source and the spontaneous heating effect must be taken into account during the design and installation phases. Resistance thermometers are two or three times more expensive than comparable thermocouples. However, modern thin film sensors are narrowing the performance gap between the two types of sensor.

Criterion	Properties of Thermocouples	Properties of Resistance Thermometers
Accuracy	Good	Very good
Area of application	Large temperature range	Small temperature range
Price	Economical	Relatively expensive
Measuring point	Single-point	Over the entire length of the measuring resistor
Response times	Short	Long
Dimensions	Very small versions are possible	Comparatively large sensor surface
Reference junction	Required	Not required
Surface temperature measurement	Suitable	Generally unsuitable
Vibration resistance	Very robust	Relatively sensitive
Supply with measured current	Not required	Required
Spontaneous heating	Does not occur	Must be taken into account
Long-term stability	Satisfactory	Excellent
Robustness	Very good	Good
Connection cables	Thermal material or special materials	Copper instrument cables

Table 1 Comparison between thermocouples and resistance thermometers.

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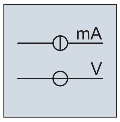
Pepperl+Fuchs Group www.pepperl-fuchs.com
USA: +1 330 486 0002 pa-info@us.pepperl-fuchs.com
Germany: +49 621 776 2222 pa-info@de.pepperl-fuchs.com
Singapore: +65 6779 9091 pa-info@sg.pepperl-fuchs.com

Standard Signal



The 0/2 V ... 10 V voltage signal and the 0/4 mA ... 20 mA current signal have established themselves as the standard. Analog sensor signals from temperature sensors, load cells, strain gauges, resistance measuring bridges, as well as digital frequency signals, are converted into one of the two standard signals for processing in a wide variety of measurement, regulatory and control tasks. This offers the measurement and control technician an easy-to-measure standard signal common to all manufacturers.

Measurement value signals are converted into standard signals in so-called signal converters. Figure 26 shows a signal converter (A) which converts a resistance signal into a standard signal for further processing in control (B). If the sensor and signal converter form a single unit, they are referred to as a transmitter.

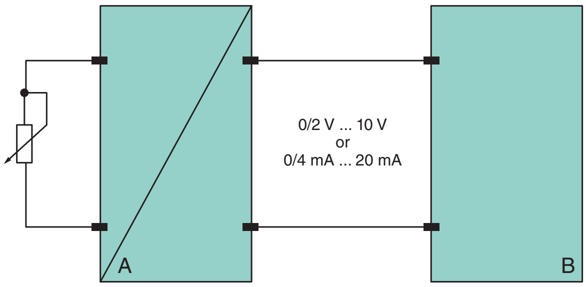


Figure 26 Conversion of sensor signals into standard signals

The sensor characteristic curve is assigned to the standard signal in the transmitter signal converter. The start of the measurement value (0 %) is assigned to the 0/4 mA or 0/2 V signal, while the end of the measurement value (100 %) is assigned accordingly to the 20 mA or 10 V signal. This scaling can also be carried out in the control with simple sensors.

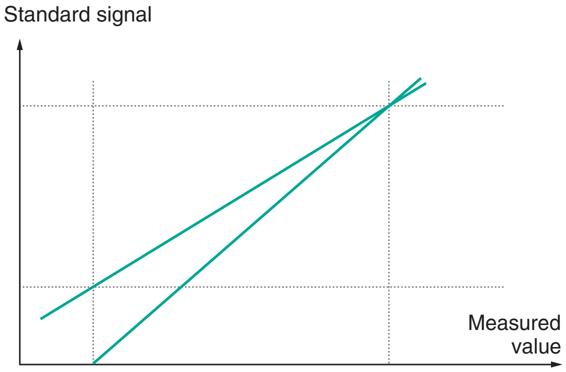


Figure 27 Assignment of measured values to standard signals

Value Ranges of Standard Signals

When we refer to the 0/4 mA ... 20 mA standard signal, we must also define whether this is a signal in the range 0 mA ... 20 mA or 4 mA ... 20 mA. What is the reason for the 4 mA ... 20 mA range? Wouldn't it be much easier always to start with 0 mA? It would then be much easier to convert measured current into a percentage of the measured value range. There are two reasons for using 4 mA as the starting value:

1. A loop powered signal converter or 2-wire transmitter uses the current range between 0 mA and 4 mA to supply its electronics and to evaluate the sensor measurement signal.
2. The initial value of 4 mA is used for the live zero detection of the measurement circuit. If a lead breakage occurs, for example, the measurement circuit returns to 0 mA. The valid current values must be higher in order to be able to identify this value clearly as a measurement circuit error.

For more diagnostic options, the NAMUR organization published NAMUR recommendation NE43, dividing the value range of the current signal into several areas.

Valid, defined measurement value information is transferred within the range from 3.8 mA to 20.5 mA. Failure information is available when the signal current is < 3.6 mA or > 21 mA, i. e., is outside of the range for measured value information.

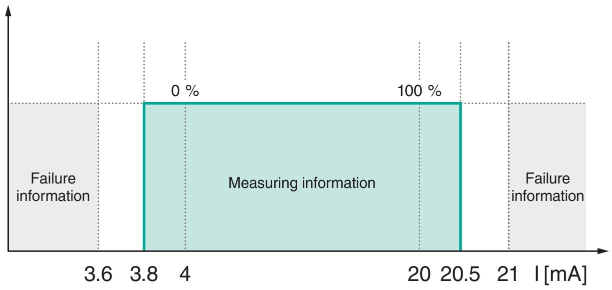
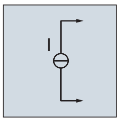


Figure 28 Validity range according to NAMUR NE43

The same applies to the 0/2 V ... 10 V standard signal.

The previous section explained the theory behind the standard signal. However, the application has little to do with ideal conditions, so that a number of important points have to be noted during project planning. The hardware for these two interfaces is described in detail below.

0/4 mA ... 20 mA Standard Signal



Two things should be noted with the 0/4 mA ... 20 mA interface. Which is the current source and which the current sink? We also refer to active and passive current output. As already discussed, the measurement value information relates to the amount of current, not its direction. For a better understanding, let's take a brief look at the electrical basis for the current output.

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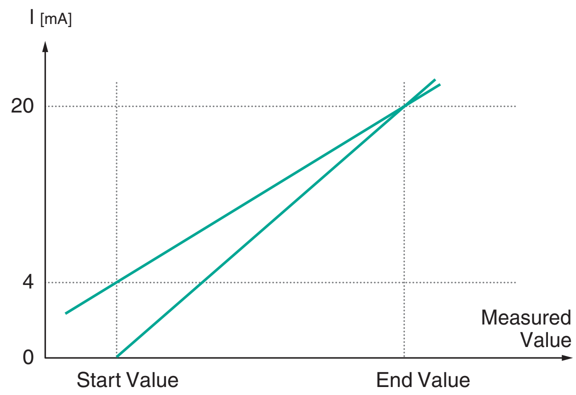

Figure 29 0/4 mA ... 20 mA standard signal

Active Current Output (Current Source)

The active current output (Figure 30, device B) tries to use the current source to output a value I_{const} that corresponds to the measured value. This current source can be located in a 4-wire transmitter or in an interface module. The current is transferred for evaluation to device A via the wiring with line resistance R_L. Evaluation always involves a measured resistance R_S and a component that measures voltage (display, A/D converter, etc.). The evaluation can be carried out in a control or measured value display, for example.

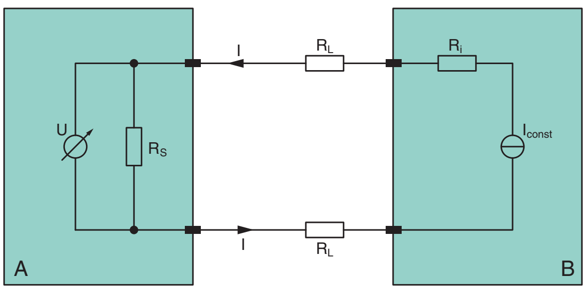

Figure 30 Active current output

Another application for current sources is the controlling of an actuator (e. g., valve). Instead of being measured, an output signal is controlled here. In the case of the valve, the opening cross section and thus the volume of flow between 0 % and 100 % is controlled by means of the analog standard signal.

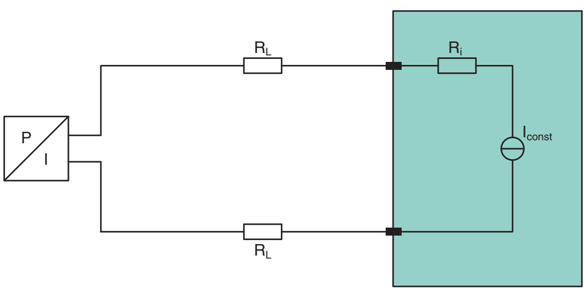

Figure 31 Valve control

In the case of the active current output (current source) as in Figure 30, the following should be noted. Current I in all resistance portions (R_L, R_S, R_i) of the current circuit causes a voltage drop. This minimum voltage must be supplied by the current source in order to be able to maintain the current. The following example should clarify this. Assuming that the current source has a maximum output voltage of 24 V, then the resistance in the current circuit with a current of 22 mA can be a maximum of

$$R = U/I = 24\ V/22\ mA = 1090\ \Omega$$

For this reason, you should note the maximum permissible load for devices with active current output (current source). This information is contained in the data sheets.

Passive Current Output (Current Sink)

The structure of the passive current output can be seen in Figure 32. Device A consists of power supply U and current measurement with measurement resistance R_S and voltmeter U. Device B is connected to device A by means of wiring R_L with a passive current output (current sink).

Device B can be a transmitter, a loop powered signal converter or an interface module with passive current output. Practically, device A is contained in a transmitter power supply. However, it can also be a voltage supply or the analog input of a programmable control.

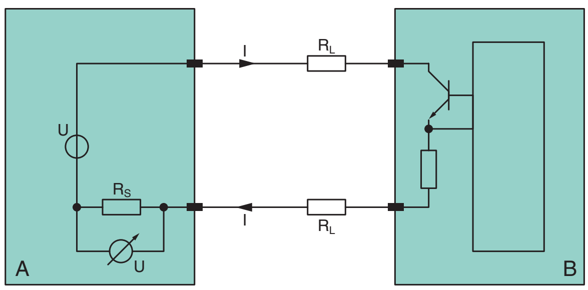

Figure 32 Passive current output

The passive current output (device B) changes its input resistance and thus the current in the conductor loop. The current value corresponds to the measured value to be transferred. This current value is converted into a voltage in the evaluation device A by means of measured resistance R_S and evaluated.

The following should be noted. If device B is a 2-wire transmitter, this still needs a certain voltage value for its own function in order to act as a current sink. Most 2-wire transmitters operate from voltages > 12 V. The wire resistances R_L should be taken into account. Restrictions also apply at maximum voltage. Energy is generated in the current sink (device B) that corresponds to the product of applied voltage and signal current. Details of the maximum voltage at the passive current output can be found in the data sheets.

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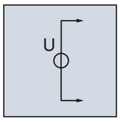
0/2 V ... 10 V Standard Signal



The 0/2 V ... 10 V standard signal is mainly used in factory and building automation. The transfer distances and required precision are not as great here as in process automation. As well as the 0/2 V ... 10 V signal, the 0/1 V ... 5 V signal is also occasionally encountered.

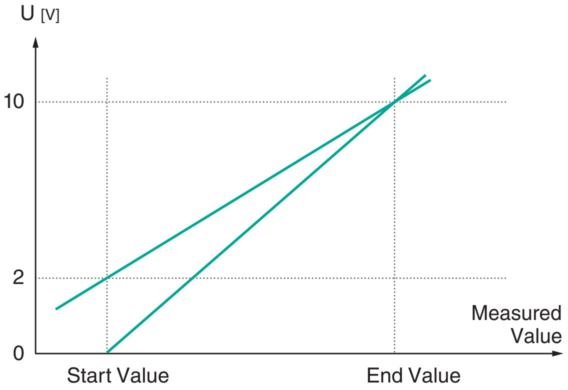


Figure 33 0/2 V ... 10 V standard signal

Figure 34 shows the principal structure of the transfer route with a transmitter (A) that converts a sensor signal into a 0/2 V ... 10 V standard signal and transfers it to the control (B).

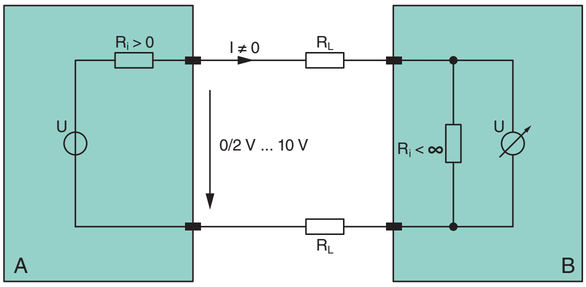


Figure 34 Signal transfer

The signal converter (A) outputs the signal value 0/2 V ... 10 V, which is transferred to the control (B) by means of the two lines. This voltage should be measured as precisely as possible in the control. The voltage measurement should have the highest possible resistance, but resistance should not be too high because of possible susceptibility to faults. Input resistance R_i for normal controls lies between 10 kΩ and 50 kΩ. When analyzing faults, an input resistance of 10 kΩ is assumed. With a signal of 10 V, the current is

$$I = U/R = 10\ V/10\ k\Omega = 1\ mA.$$

Because of the wire resistances, which can be approximately 50 Ω between signal converter A and control B, there is already a drop of 50 mV with a current of 1 mA. This corresponds to a transfer error of 0.5 %, which is acceptable for application in factory and building automation.

Conversion of a 0/4 mA ... 20 mA signal into a 0/2 V ... 10 V signal with a measurement resistor

If the signal converter (A) has a 0/4 mA ... 20 mA output, but control (B) has a 0/2 V ... 10 V input, the signal must be converted with a measurement resistance (250 Ω or 500 Ω).

With

$$U = R \times I = 500\ \Omega \times 20\ mA$$

the measured current can be converted into a measured voltage. This is possible in principle, however it leads to transfer errors that have to be corrected by re-scaling the control (B). The problem lies in the input resistor of the voltage input. Thus, the current is divided into 2 partial currents I_1 and I_2. Figure 35 shows the pattern with an input resistance of 10 kΩ. The signal current of 20 mA is not converted to 10 V, but simply to about 9.5 V. Rescaling is required in the control (B).

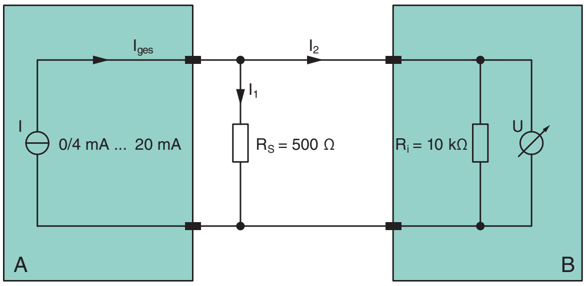


Figure 35 Current/voltage conversion with a measurement resistor

The solution with an additional active current/voltage converter in the current circuit is more elegant (Figure 36).

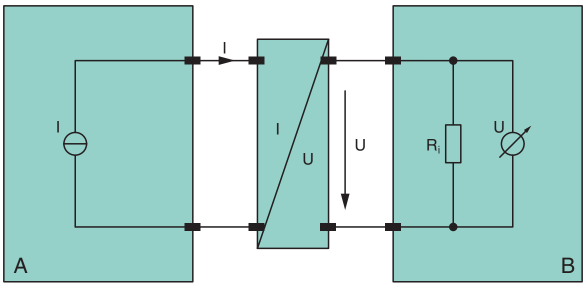


Figure 36 Current/voltage conversion with a signal converter

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Summary

Little Variance in the Signals

A lot of different measurement information is processed in the control applications. The conversion to a standard signal enables all measured values with multi-channel input cards of a single type to be recorded. This reduces the storage of various sensor input cards from temperature sensors (Pt100, thermocouples) to measuring bridge inputs.

Interoperability

As soon as all manufacturers convert their sensor signals to a standard signal, the user can evaluate these directly without complex adjustment and specification.

Ease of Measurement

Simple universal measuring devices with current and voltage inputs are sufficient when checking process circuits. Also, no knowledge of the sensor signal is required. It is enough to assign the input characteristic curve to the standard signal.

Reliable Transfer

The sensors are not normally located adjacent to the signal evaluation device. If high-resistance sensor signals are transferred over long cable distances, faults can occur.

Live Zero

Raising the standard signal to 2 V ... 10 V or 4 mA ... 20 mA enables line faults such as lead breakages or short circuiting to be detected.

Overlapping of digital Sensor Information

The 4 mA ... 20 mA standard signal can be overlapped with Digital HART signals in order to parameterize or read intelligent sensors.

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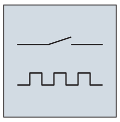
Applications and Practical Solutions

Pepperl+Fuchs offers a wide range of signal conditioners for process automation. These guidelines contain an overview of commonly used applications with signal conditioners.

Over 60 signal conditioners in the K-System meet the requirements for modern factory and process automation. The unique design permits simple additions to be made without requiring additional wiring and can be set up very easily for various redundant supply concepts. The K-System components meet the requirements of SIL according to IEC 61508, ensuring that international security standards for systems and processes can be met.

We at Pepperl+Fuchs develop and supply high-grade products that cater to the needs of our customers.

Digital Signals



Many applications use mechanical switch contacts and NAMUR sensors to detect the position of movable parts, valve movements, counters and door positions. The special applications include locking relays for pumps and standstill monitoring. In addition, special signal conditioners can be used to equip rotating machines, turbines and transmissions, which generally require frequency-based measurements. Conductive sensors are used to measure levels and to measure switching points after the electrodes have been triggered.

The signal conditioners shown are isolated from ground. These devices have an amplifier that transmits digital signals from NAMUR sensors, 3-wire sensors or mechanical contacts from the field side to the control side.

A NAMUR sensor has precisely defined electrical properties that are interpreted by a switch amplifier in order to indicate the existence of a particular material in front of the sensor face. A NAMUR sensor consumes very little energy and is very compact. Sensors that consume high levels of energy have a 3-wire interface. The power supply and signal transmission are separate. A distinction is made between plus, minus and push-pull circuits. A mechanical contact or switch can also be used in conjunction with a signal conditioner and installed together with resistors in parallel or series so as to simulate the operation of a NAMUR sensor. Most switch amplifiers allow line fault detection (lead breakage/short circuit).

The NAMUR sensor, 3-wire sensor or mechanical contact initiates a switch command at the switch amplifier output with a relay contact. All of these signal conditioners can be used in SIL2 applications according to IEC 61508. They can be used in SIL3 applications if they are installed in a redundant structure. The following illustrations shows some of the possible configurations.

The examples shown are not comprehensive. Only some of the possible solutions are shown. Numerous options include special features, voltage sources and channel configurations.

Switch Amplifier

Figure 1 shows a typical application with a 1-channel switch amplifier. The signal conditioner shown is operated with a 24 V DC current source, however other options are also available. This device can be connected to a NAMUR sensor or a mechanical contact. A form A (NO) relay contact is available to connect the load to the control system.

A sensor signal is connected to two outputs. The separate relay outputs can be used to initiate a wide range of control signals (e. g., for DCS, PLC or ESD).

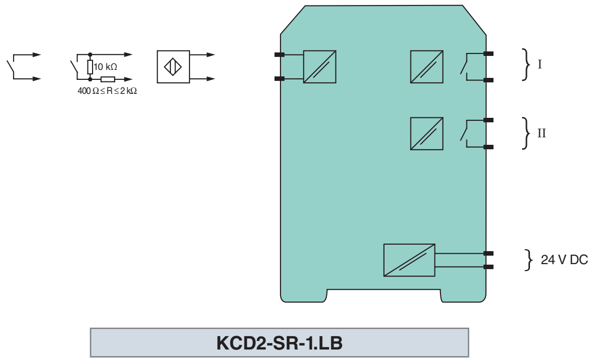


Figure 1

This signal conditioner is used in 2-channel applications. Figure 2 shows the block diagram with form A (NO) relay contacts.

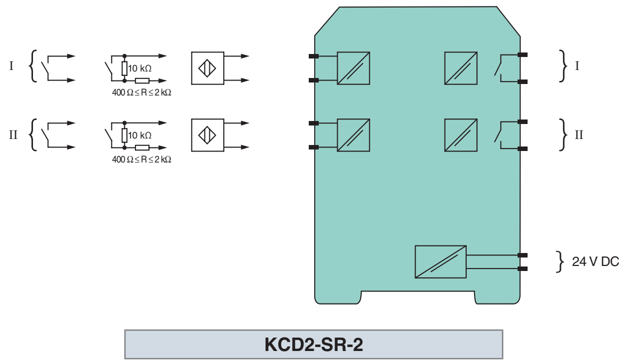


Figure 2

Technology
Basic Principles
Applications
Functional Safety

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1-channel and 2-channel switch amplifiers are available for supplying the 3-wire sensors. The 1-channel variant allows the ON characteristic of the relay to be delayed.

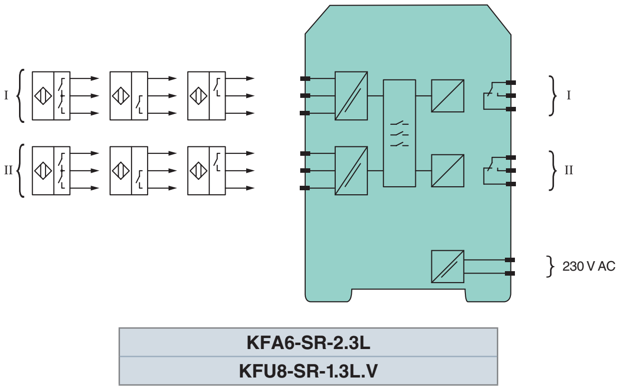

Figure 3

Conductive Switch Amplifier

Up to 3 electrodes can be connected to this signal conditioner. A switching signal is emitted as soon as the electrodes are covered by the medium. Conductive switch amplifiers have one relay for Min/Max controls or two relays for two switching points.

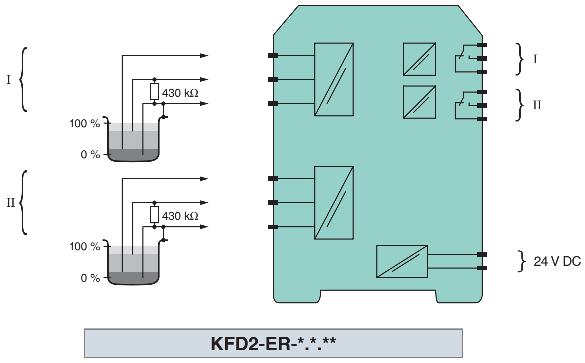

Figure 4

Note: *The AC versions of this device can be ordered using model numbers KFA5-ER-*.*.** (115 V AC) or KFA6-ER-*.*.** (230 V AC). Collective error message and Power Rail connection features are not available for these AC versions.*

Standstill Monitoring

This standstill monitor is used for applications with standstill and direction of rotation monitoring. This device has NAMUR sensors or mechanical contacts that are connected on the field side, as well as two contacts on the control side. To prevent unintentional triggering, this special signal conditioner can be configured with a startup override.

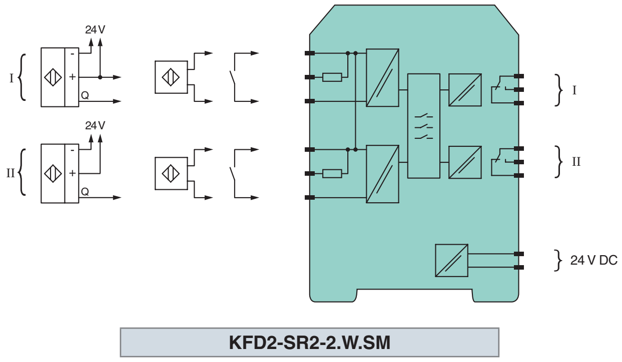

Figure 5

Rotational Speed Monitoring

It is often necessary to find out whether a process is under or over speed. The overspeed/underspeed monitor KFD2-DWB-1.D has relay outputs and a startup override. This signal conditioner is suitable for SIL2 applications according to IEC 61508.

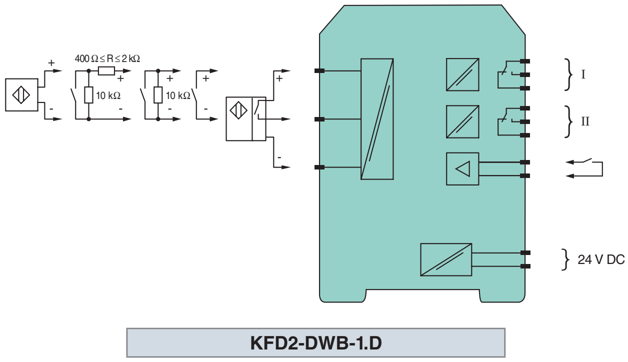

Figure 6

Note: *The AC and universal power supply versions of this device can be ordered using model numbers KFA5-DWB-1.D (115 V AC), KFA6-DWB-1.D (230 V AC) or KFU8-DWB-1.D (AC/DC wide range power supply). Collective error message and Power Rail connection features are not available for these versions.*

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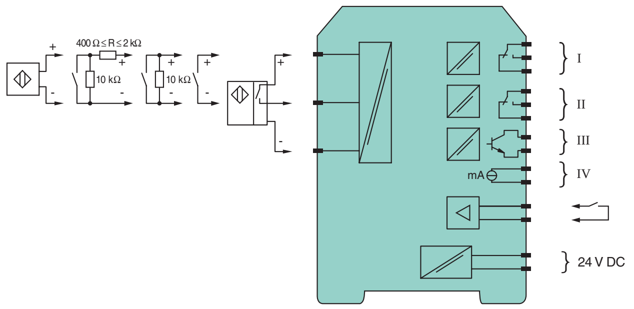
Universal Frequency Converter

This signal conditioner has display and keypad for simple programming at local level and transforms the signal of a NAMUR sensor, 3-wire sensor or mechanical contact into a 0/4 mA ... 20 mA analog output signal. The device is suitable for SIL2 applications according to IEC 61508.



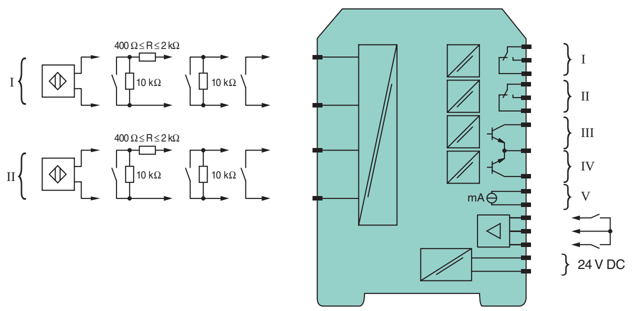
KFD2-UFC-1.D

Figure 7

Note: *The universal power supply version of this device can be ordered using model number KFU8-UFC-1.D (AC/DC wide range power supply). Collective error message and Power Rail connection features are not available for this version.*

Rotation Direction Indicator and Synchronization Monitor

This signal conditioner has display and keypad to simplify local programming and is used when the direction of rotation needs to be recorded or slip/ synchronization needs to be monitored. This device also has a 0/4 mA ... 20 mA analog output signal for frequency conversion.

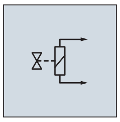


KFD2-UFT-2.D

Figure 8

Note: *The universal power supply version of this device can be ordered using model number KFU8-UFT-2.D (AC/DC wide range power supply). Collective error message and Power Rail connection features are not available for this version.*

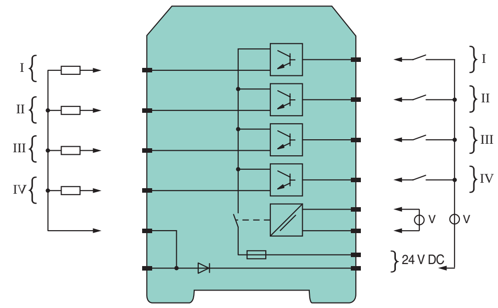
Solenoids, LEDs and Alarms



Many applications for automatic machines and processes encompass both basic On/Off functions and very complex processes. Solenoids are often used if the process involves linear or rotational movements. LEDs and alarms are used if simple identification or acoustic/optical signals are required.

Solenoid Driver with Logic Input

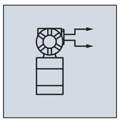
This 4-channel solenoid driver allows a load to be powered and can be activated and deactivated with a signal from a logical circuit. The device also enables line fault detection and collective error messages. This signal conditioner is suitable for SIL2 applications according to IEC 61508.



KFD2-SL-4

Figure 9

Transmitters



In the case of applications that require an electrical signal proportionate to a measured value (e. g., temperature, pressure or flow), a transmitter can supply the relevant 0/4 mA ... 20 mA signals. These transmitters, known as SMART transmitters, can be used to transmit other important process information by means of a digital signal that overlays the standard measuring signal.

SMART Transmitter Power Supply

The following are the block diagrams for galvanically isolated 2-wire SMART transmitter power supplies from Pepperl+Fuchs. This device group allows the signal to be separated between the field side and control side and also provides the required voltage for 2-wire SMART transmitters. Almost all field device manufacturers have been successfully tested with signal conditioners from Pepperl+Fuchs. Transmitters with an active current signal can be connected to most transmitter power supplies. These devices have a transmission accuracy of ≤ 20 µA. Transmitter power supplies can be used in SIL2 applications according to IEC 61508. They can be used in SIL3 applications if they are installed in a redundant structure.

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Transmitter Power Supply

The transmitter power supply has a galvanic isolation between the input, output and supply so as to ensure optimum signal integrity. The device can be used for 2-wire transmitters (0/4 mA ... 20 mA) and acts as a current source for a load in the safe area with an accuracy of ≤ 20 µA. This signal conditioner is suitable for SIL2 applications according to IEC 61508.

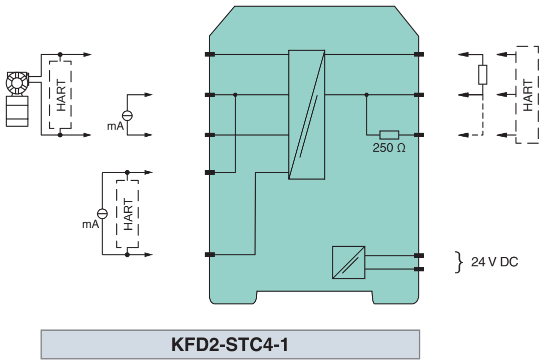

Figure 10

2-channel Transmitter Power Supply

This galvanically isolated 2-channel transmitter power supply has a galvanic isolation between the input, output and supply so as to ensure optimum signal integrity. The device supplies power to a 2-wire transmitter and transfers the 4 mA ... 20 mA analog signal to the control side. This signal conditioner is suitable for SIL2 applications according to IEC 61508.

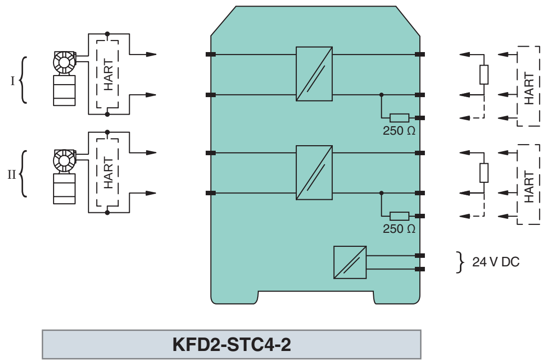

Figure 12

Transmitter Power Supply with 2 Outputs

This diagram shows a galvanically isolated transmitter power supply, as in Figure 10. However in this case the output for the safe area has two separate outputs. This signal conditioner is suitable for SIL2 applications according to IEC 61508.

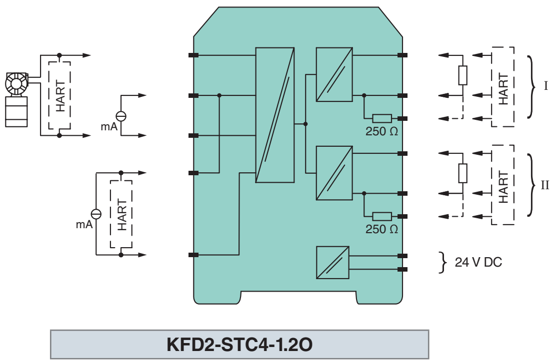

Figure 11

Transmitter Power Supply with Trip Values

This signal conditioner is a galvanically isolated transmitter power supply for a 2-wire transmitter or current source. It not only repeats the signal with 0/4 mA ... 20 mA, but also offers two programmable relay outputs. Line fault detection and collective error messages are also available. This signal conditioner is suitable for SIL2 applications according to IEC 61508.

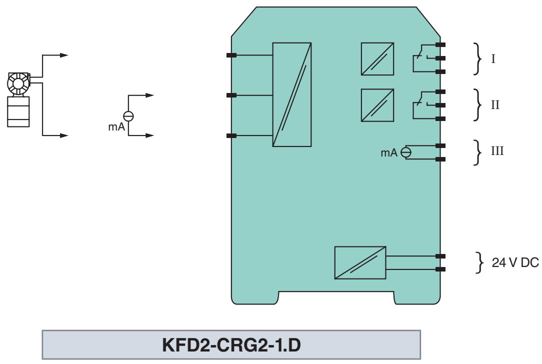

Figure 13

Note: *The universal power supply version of this device can be ordered using model number KFU8-CRG2-1.D (AC/DC wide range power supply). Collective error message and Power Rail connection features are not available for this version.*

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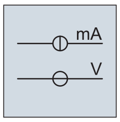
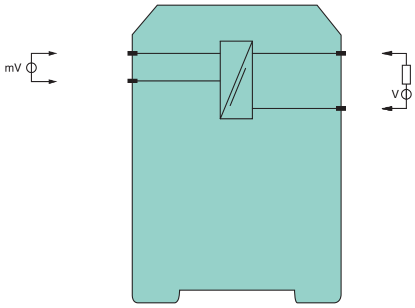
Current and Voltage



Signal converters are used in order to scale and amplify current or voltage signals, or convert these into standard signals. Galvanic isolation prevents interference and ensures reliable measured value acquisition.

Signal Converter

Signal converters are available for recording low voltages, e. g., from shunt measurements, which convert the measurement signal into a 0/4 mA ... 20 mA or 0/2 V ... 10 V standard signal.

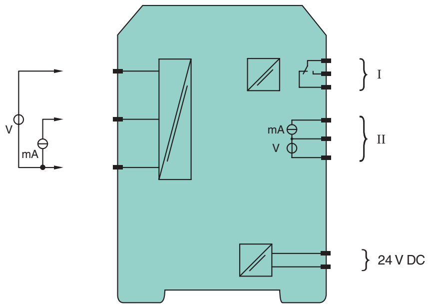


KFD0-CC-1
KFD0-VC-1.10

Figure 14

Signal Converter with Trip Value

Signal conditioners with output relays are used to record trip values from current and voltage signals. In the case of devices with displays, the measured value can be displayed in a predefined unit. These settings are entered by means of keypad, DIP switches or potentiometers.

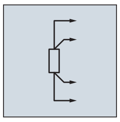


KFD2-GS-1.2W
KFD2-USC-1.D
KFU8-USC-1.D

Figure 15

Note: *The universal power supply version of device KFD2-USC-1.D can be ordered using model number KFU8-USC-1.D (AC/DC wide range power supply). Collective error message and Power Rail connection features are not available for this version.*

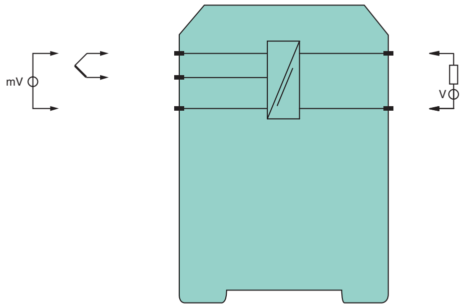
Temperature/Resistance



In certain applications, temperature and resistance are measured by sensors such as thermocouples, resistance temperature detectors (RTD) or potentiometers. These devices supply important feedback for processes that occur on turbines or overhead cranes.

Loop Powered Thermocouple Transmitter

The transmitter is galvanically isolated and offers an output with 4 mA ... 20 mA for several thermocouple inputs.
A thermocouple or an upscale or downscale lead breakage detection feature can be configured. The device also has potentiometers for setting the zero and span setting.

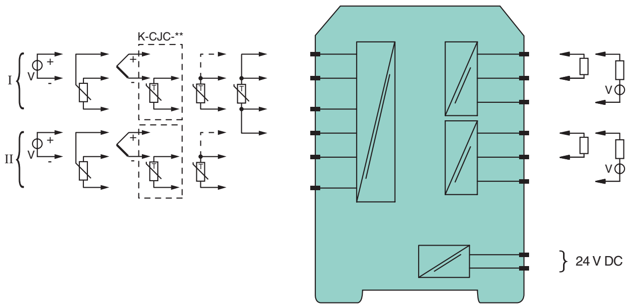


KFD0-TT-1

Figure 16

Universal Temperature Converter

Figure 17 shows a galvanically isolated universal temperature converter. This signal conditioner features high-level accuracy and temperature stability for the whole selected input range. A standard PC connection and a software package from Pepperl+Fuchs allow the thermocouple and RTD sensor type, conditions for lead breakage detection, measuring range, zero, tag information and user-specific data to be configured.



KFD2-UT2-*

Figure 17

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Temperature Trip Value

This galvanically isolated trip amplifier has two independent switching points for RTDs, thermocouples, voltage or current signals. A PC can be used to configure the trip point, hysteresis and high/low alarm for this device. The device not only offers the required isolation for intrinsic safety, but also a simple logical function for trip values.

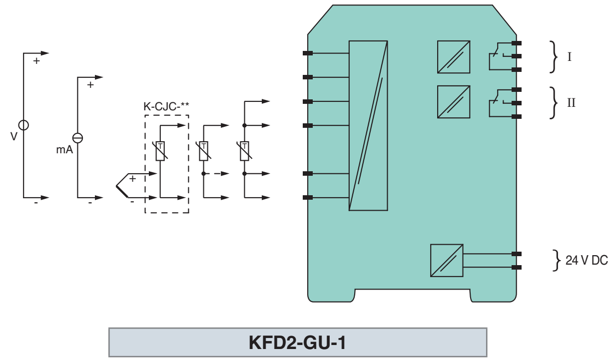


Figure 18

Temperature Converter with Trip Values

The galvanically isolated temperature converter has two independent switching points for RTDs, thermocouples, voltage or potentiometer signals. This intrinsically safe signal conditioner can be programmed using a PC or with keypad.

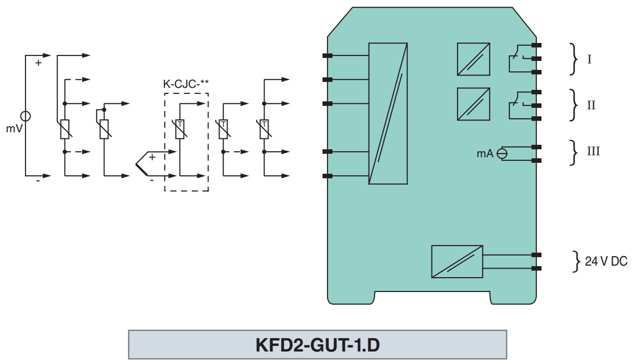


Figure 19

Note: *The universal power supply version of this device can be ordered using model number KFU8-GUT-1.D (AC/DC wide range power supply). Collective error message and Power Rail connection features are not available for this version.*

Loop Powered RTD Transmitter

The transmitter is galvanically isolated and has an output with 4 mA ... 20 mA for 2- or 3-wire RTDs. The device also has a potentiometer for setting the zero and span.

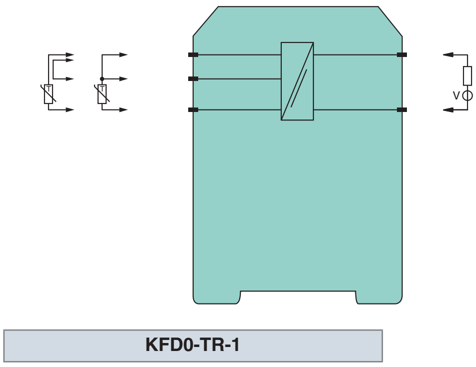
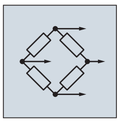


Figure 20

Weighing



Electronic load cells are preferred for most applications in current processing systems.

Strain Gauge Converter

Figure 21 shows a converter for strain gauge bridges. The transmitter has a galvanic isolation between the input, output and supply so as to ensure optimum support for a strain gauge. Depending on the accuracy required, the strain gauge can be configured with a 4- or 6-wire connection. The exciting voltage of the strain gauge, the mV signal range, the tare and the current range can be selected at local level on the device.

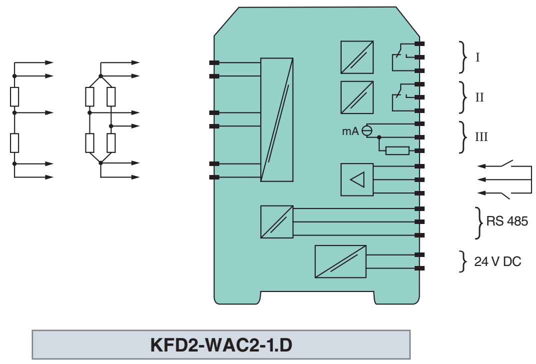


Figure 21

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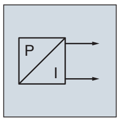
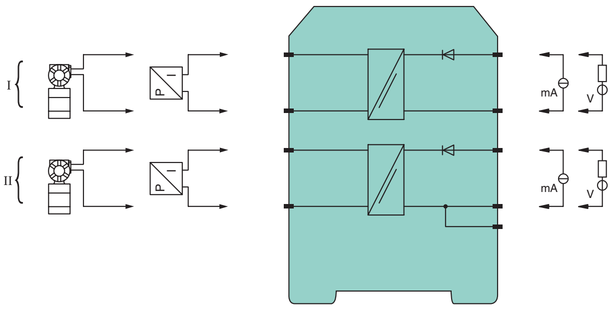
I/P Converters



An I/P converter is generally used in the case of applications that need a pneumatic output because of a current input. This can be used to control actuators and valves for checking fluid pressure or flow in certain applications.

Current Driver

The loop powered current driver is galvanically isolated and is, therefore easy to use. Although the device was originally primarily developed for fire detection, where accuracy is not such an issue, it is generally precise enough for I/P converters. This signal conditioner is suitable for SIL2 applications according to IEC 61508.

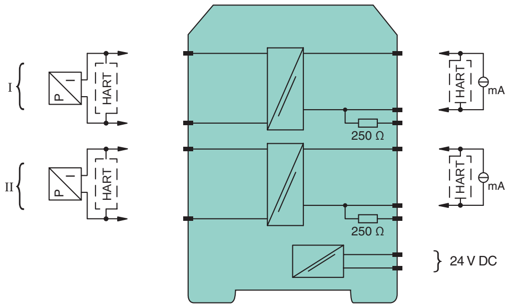


KFD0-CS-*.50

Figure 22

SMART Current Driver

The SMART current driver has a galvanic isolation between the input, output and supply. The current driver can control the electrical values of I/P converters and actuators and allows HART information to be transmitted in both directions. It also enables line fault detection. This signal conditioner is suitable for SIL2 applications according to IEC 61508.



KCD2-SCD-1

KFD2-SCD2-*.LK

Figure 23

Technology

Basic Principles

Applications

Functional Safety

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Functional Safety (SIL)

Risk

Risks in General

Risks are part of our daily lives and even the workplace is not free of danger. This makes it all the more important to detect risks to life and limb and wherever possible to exclude the dangers that can arise during production processes for example.

Risks are Subjective

A risk is the probability that a dangerous event will occur multiplied by the resulting consequences. These include consequences in the form of damage to health, as well as the physical damage caused by the incident and the associated costs.

It is impossible to provide absolute protection from risks. There will always be a residual risk that is evaluated on the basis of several factors:

- Country and region
- Social environment
- Legal position
- Incidental costs

The assessment of the residual risk is largely a question of subjective judgment.

Limiting Risks

Risks cannot be totally avoided, however it is possible to limit them efficiently. Under the controlled conditions of an industrial process in particular, a wide range of mechanical and electronic measures is available to reduce the probability of a hazardous incident, thus minimizing the residual risk to an acceptable extent.

To prevent negative impact on personnel, the environment and technical equipment, the first step is to determine the possible risks. Next, suitable protective measures need to be implemented. These measures can be very varied in nature.

- Structural measures
- Measures to spread risk
- Evacuation plans
- Safety-related controllers and protection devices

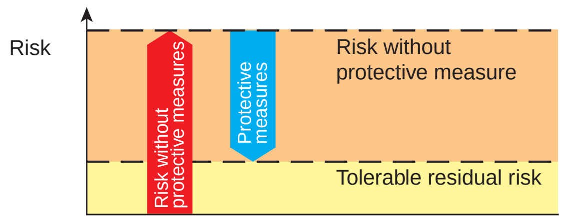

Figure 1 Presenting the risk reduction

Protective Measures on Different Levels

Measures to reduce the residual risk with a production system can be divided into different approaches, also referred to as production levels. These are hierarchical in structure and must each be considered in isolation.

The underlying principle is very simple: if one protective level fails, the next highest level is automatically activated to prevent, or at least limit, possible damage. The following level-based model shows the different types of protection measure and how they relate to each other:

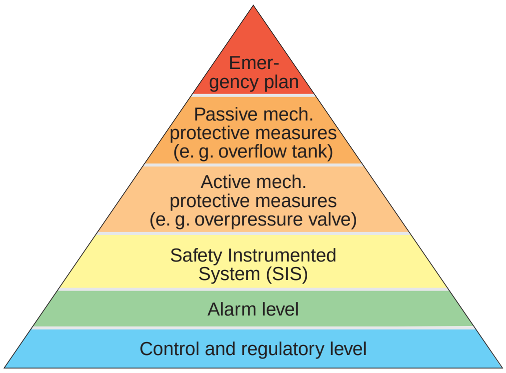

Figure 2 Protection levels on the system

The individual protection levels must operate absolutely independently of each other. Thus, for example, the controller and regulator technology on the lowest level cannot also be used for safety applications on a higher level. The reduction of the existing risk is the result of all measures on the various protection levels. The objective pursued here is to avoid possible damage insofar as possible and to reduce the unavoidable residual risk to an acceptable degree.

Risk Analysis

There are clear criteria for determining the risk associated with a processing system set down in IEC/EN 61511. The risk determined according to these criteria dictates the measures to be taken to reduce the risk. If this risk is limited with the help of installed automation technology, then the components used for this purpose must meet the criteria contained in IEC/EN 61508. Both standards divide the measures to reduce risks into four safety stages, which range from SIL1 for a low-level initial risk to SIL4 for a very high-level initial risk.

The following overview shows the link between the risk parameters and the **S**afety **I**ntegrity **L**evel (SIL) of the **S**afety **I**nstrumented **F**unctions (SIF).

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Consequence (severity)

C_1	minor injury or damage
C_2	serious injury or one death, temporary serious damage
C_3	several deaths, long-term damage
C_4	many dead, catastrophic effects

Frequency/exposure time

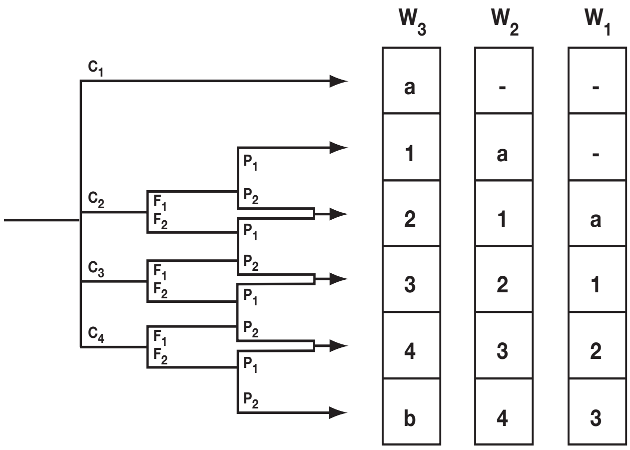
F_1	rare to quite often
F_2	frequent to continuous

Possibility of avoidance

P_1	avoidance possible
P_2	unavoidable, scarcely possible

Probability of occurrence

W_1	very low, rarely
W_2	low
W_3	high, frequent



1, 2, 3, 4	= Safety Integrity Level
-	= Tolerable risk, no safety requirements
a	= No special safety requirements
b	= A single E/E/PE is not sufficient

Figure 3 Risk graph

Safety Integrity Level (SIL)

The various parts of a processing system are associated with different risks. However, as a risk increases, the need for the availability of the **S**afety **I**nstrumented **S**ystem (SIS) also increases.

The higher the safety integrity level the greater the risk reduction. This means that the SIL is a measure of the probability that the safety system can meet the required safety functions for a particular period. There are different ways to determine the required SIL or a risk reduction measure (protective function). Standards IEC 61508 and IEC 61511 (sector standard for the process industry derived from IEC 61508) list different methods to determine the SIL.

Low Demand and High Demand Mode

The process industry and production industry have different requirements in relation to the safety system because the applications in these industrial areas are very different. The key distinguishing feature is the demand rate in relation to the safety system. Here a distinction is made between high demand and low demand mode.

Low Demand Mode

Low demand is understood as a mode with a low demand rate for the safety system. This classification requires that the safety system should not be demanded more than once per year.

SIL	PFD	Max. accepted failure of the SIS
SIL1	$> 10^{-2}$ to $< 10^{-1}$	Max. one dangerous failure per 10 requests
SIL2	$> 10^{-3}$ to $< 10^{-2}$	Max. one dangerous failure per 100 requests
SIL3	$> 10^{-4}$ to $< 10^{-3}$	Max. one dangerous failure per 1,000 requests
SIL4	$> 10^{-5}$ to $< 10^{-4}$	Max. one dangerous failure per 10,000 requests

Table 1 Failure limit values for a safety function operated in the Low Demand Mode.

High Demand Mode

This is a mode with a high demand rate or with continuous demand on the safety system. In practice, this means that the security system operates continuously or is demanded more than once per year.

SIL	PFH	Max. accepted failure of the SIS
SIL1	$> 10^{-6} > 10^{-5}$	Max. one dangerous failure per 100,000 hours
SIL2	$> 10^{-7} > 10^{-6}$	Max. one dangerous failure per 1,000,000 hours
SIL3	$> 10^{-8} > 10^{-7}$	Max. one dangerous failure per 10,000,000 hours
SIL4	$> 10^{-9} > 10^{-8}$	Max. one dangerous failure per 100,000,000 hours

Table 2 Failure limit values for a safety function operated in the mode with high or continuous demand rate (High Demand)

High Demand Mode (or continuous mode) is mostly used in production technology. In this case it is often necessary to monitor work processes continuously in order to ensure the safety of personnel and of the environment.

Low Demand Mode (on demand mode) is used in the process industry. Emergency stop systems are a typical example of this, only becoming active when the process runs out of control. This normally occurs less than once per year. This is why high demand mode is meaningless for process instrumentation in most cases.

The following descriptions thus relate solely to low demand systems.

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PFD Value

Details of the SIL or the individual components are not sufficient for planning safety systems. While, in the past, the safety chain was able to reach the requirement grade (AK acc. to DIN 19250) of the weakest component, today the SIL calculations must be carried out on the basis of the probability of failure. PFD (= **P**robability of **F**ailure on **D**emand) is of central significance here. The PFD is the average probability that a safety system will not be available just at the moment when this safety function is required.

Components' PFDs are determined in a complex analytical process, known as the FMEA (**F**ailure on **M**ode and **E**ffect **A**nalysis) in which analysis takes place down to an individual component level to ascertain what happens when a particular failure occurs and to establish whether this can be detected.

In the low demand systems considered here, the dangerous, undetected failure λ_{du} plays a significant role. Such failures are detected during the course of a proof test and eliminated. Inversely, a change to the interval for testing changes the probability of failure when a demand is made. Every driver is familiar with this situation when he takes his car for its two-year road-worthiness test. Naturally, performing this test at annual or semi-annual intervals would increase the safety of the car, but this would also entail higher costs. Sometimes, however, reducing the test interval T_{proof} is the only way to achieve a required SIL. The PFD value is used for allocation to a SIL, among other things.

SFF and HFT

Two other parameters are used to define the safety integrity of the device: the proportion of non-dangerous failures (SFF, **S**afe **F**ailure **F**raction) and the hardware failure tolerance (HFT, **H**ardware **F**ailure **T**olerance).

The SFF value expresses the proportion of non-dangerous failures in relation to the totality of all possible failures. A non-dangerous failure is defined as a failure that is either detected and/or that transfers the system to a safe state.

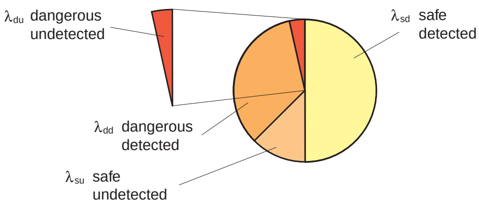

Figure 4 Proportion of non-dangerous failures (SFF)

Thus, for example, an SFF of 90 % indicates that only 10 % of the possible failures in a safety system would result in a dangerous state if they went undetected.

HFT describes the tolerance of a device or system in relation to hardware failures. Systems with no redundancy, in other words in which the safety function is no longer guaranteed if a single failure occurs, have a HFT = 0. With single redundancy the HFT = 1 and with double redundancy the HFT = 2.

The combination of the SFF and HFT parameters yields the SIL of a device. However, a distinction is made between simple devices (type A) in which all failures are known and describable and more complex devices (type B), in which not all failures are known and describable, as is the case with microprocessor systems or software solutions, for example.

Of the two different SILs yielded from the PFD and the combination of SFF and HFT, the lower value is assumed to be the SIL of the device or system.

Simple Devices

	HFT (Hardware Failure Tolerance)		
SFF (Safe Failure Fraction)	0	1	2
< 60 %	SIL1	SIL2	SIL3
60 % ... 90 %	SIL2	SIL3	SIL4
90 % ... 99 %	SIL3	SIL4	SIL4
> 99 %	SIL3	SIL4	SIL4

Table 3 The link between SFF and HFT in simple devices (type A)

Complex Devices

	HFT (Hardware Failure Tolerance)		
SFF (Safe Failure Fraction)	0	1	2
< 60 %	-	SIL1	SIL2
60 % ... 90 %	SIL1	SIL2	SIL3
90 % ... 99 %	SIL2	SIL3	SIL4
> 99 %	SIL3	SIL4	SIL4

Table 4 The link between SFF and HFT in more complex devices (type B)

Failure Types

In the case of a safety instrumented system (SIS), a distinction is made between systematic and random failures. In order to meet the required SIL criteria, both failure types must be analyzed separately.

Random Failures

Random failures are all failures that occur at random during operation and that are triggered by hardware defects. Such failures do not already exist at the time of delivery and may be the result of a short circuit, interruption, component movement, etc. Their probability and the associated failure rate can be calculated. The various hardware components of a SIS are analyzed separately and the PFD is calculated from the individual λ values; the PFD is in turn used to determine the SIL value.

Systematic Failures

Unlike random failures, systematic failures already exist upon delivery and are characteristic of every individual device or system. They typically involve development errors, installation errors or errors during planning, for example software errors, incorrect dimensioning, incorrect configuration of the measuring instrument, etc.

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The majority of systematic failures can be traced back to errors in the device software. The fundamental issue with systematic software errors is that programming errors can also lead to errors in the process. Systematic failures must, therefore be avoided when designing the SIS by taking particular steps. This is the purpose of a quality management system that constitutes a key component of EN 61508/61511. Thus, device manufacturers must provide details of SIL classification in relation to systematic failures. This information is generally contained in the declarations of conformity for the individual devices.

Depending on the SIL, the information is provided through certification by external, impartial organizations (TÜV, Exida). If the requirements for a particular SIL (e. g., SIL3) are to be met in relation to the systematic failure, the entire safety instrumented system (SIS) must be considered accordingly.

Common Cause Failures

So-called common cause failures are special systematic failures. This category includes all failures that apply simultaneously to all the components of a safety instrumented system (SIS) and are mostly caused by external influences, such as electromagnetic malfunctions (EMC), temperature, or mechanical stress. In order to cater for such failures, the standard places specific quality requirements on the development process, the change process and the hardware and software architecture of the device.

Depending on the measures implemented, you will get a larger or smaller percentage of common cause failures. This is specified as a beta factor.

Diverse Redundancy in the Case of Systematic Failures

It is also possible to use SIL2 components for SIL3 protective functions if measures have been taken that do not leave a systematic failure at SIL2 level. For example, if SIL2 pressure sensors are to be used in a SIL3 level safety instrumented system (SIS), it must be ensured that different device software is used. This can be achieved by using two different devices, for example. Diverse redundancy certainly exists if different technologies are used instead of different devices, for example with a pressure sensor and temperature sensor.

Error Distribution in the Safety Instrumented System (SIS)

A safety instrumented system (SIS) consists of several linked components all of which are part of the safety instrumented function (SIF). The PFD value derived from the SIL evaluation is distributed among all these relevant components, depending on the failure risk.

The sensors and actuators generally feature the highest risk of failure because they are installed in the field and are subject to chemical and physical stresses from external influences, such as process medium, pressure and temperature. Thus, 25 % of the entire PFD is set aside for sensors and 40 % for actuators. The fail-safe controller has a 15 % PFD share. The PFD value for the interface modules is assigned to the sensor or actuator circuit with 10 % each. However, the numeric values assumed here can vary depending on the application.

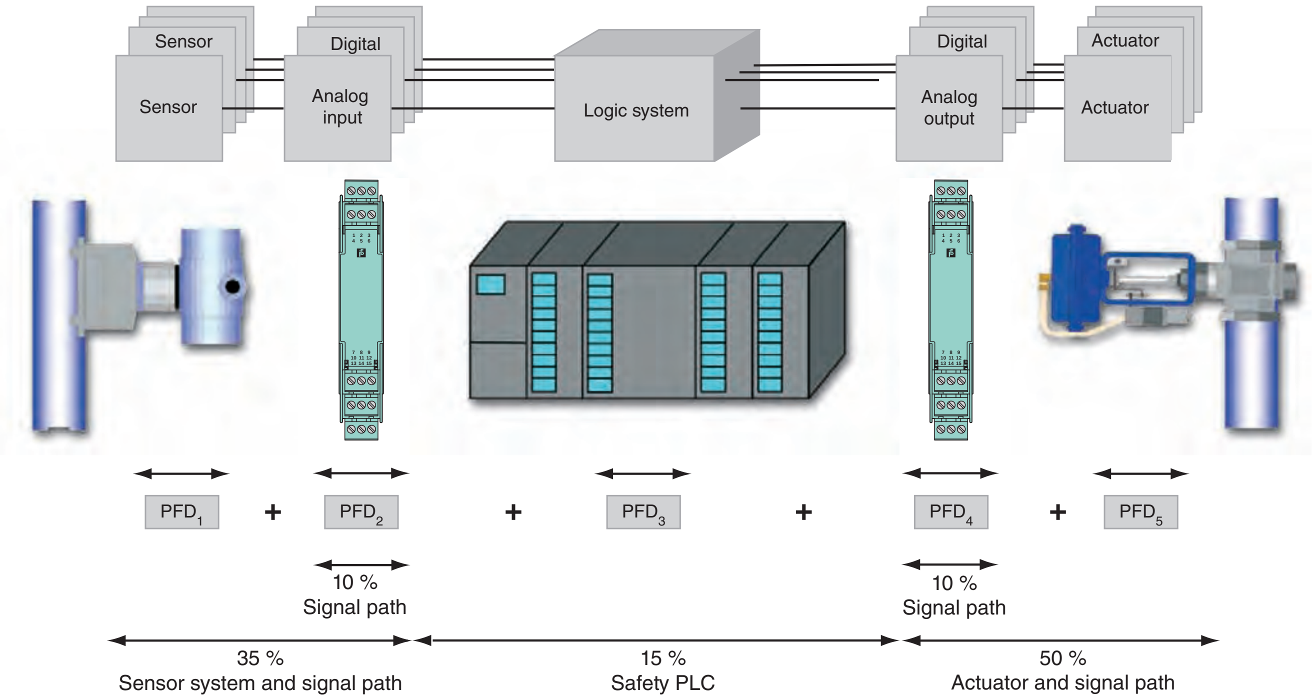

Figure 5 Error distribution in the safety instrumented system (SIS)

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Measures to increase the SIL of a Safety System

Reducing Test Intervals

In low demand safety systems, the test intervals T_{proof} are incorporated in the result in an almost linear pattern. Thus, reducing the testing intervals can increase the SIL. However, the increased frequency of testing also pushes up costs.

Configuring Redundancies

The redundancy used here can play a decisive role in improving the SIL. For example, we refer to 1oo2 (**1 o**ut **o**f **2**) or 2oo3 (**2 o**ut **o**f **3**) redundancies. If, for example, temperature is measured, a second, redundant measuring transmitter of the same type will reduce the likelihood of failure. However, this leads to the possibility that the two measuring transmitters will fail due to a common cause failure when they are under a shared load. This might be a systematic error in the measuring transmitter software that affects both devices at the same moment, for example when a certain measurement result occurs.

Redundant layout, 2-channel
with two identical devices

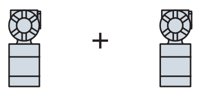

Figure 6 Configuring 2-channel redundancy

The most effective option is thus so-called diverse redundancies, which operate with different measuring devices and methods.

In such diverse redundancies, measuring transmitters from different manufacturers are used, possibly even with different measuring techniques. This reduces the probability of common cause failures. This also means that the beta factor is reduced.

Configure diverse redundancy
Two different devices
(this is to ensure that a systematic fault cannot occur simultaneously)

Two different technologies

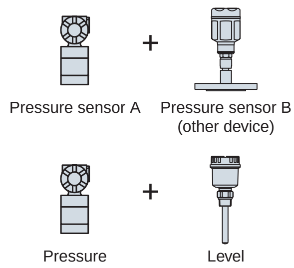

Figure 7 Configuring diverse redundancy

Questions about SIL

What is the Purpose of SIL Devices?

For manufacturers and users, the standard represents a common basis for monitoring the effectiveness of their development processes for example. For users, the decision in favor of devices with SIL certification from the manufacturer has the advantage that the relevant SIL will very probably be attained for their safety instrumented function (SIF). This makes it much easier for system operators to provide proof of risk reduction, as required by law in order to obtain permission to operate their systems.

It is not absolutely essential that products that already have SIL classification from the manufacturer should be used. However, this makes certification much easier because the risk of failure is already known for these products.

Is there any Advantage in having the highest possible SIL?

System operators are required to provide proof of the safety of their systems. The determination of the risk posed by a particular production system results in the demand for a particular SIL from a protective device. For cost reasons, system operators aim for the lowest possible SIL. However this not only yields a cost benefit, but also a much greater choice of devices. A high SIL is only necessary if it is unavoidable or if this would produce a cost benefit elsewhere, so that additional costs can be avoided (e. g., the avoidance of complex additional construction measures).

Which Devices are suitable for which SIL?

To achieve a particular SIL (SIL1 ... SIL4), the entire safety instrumented system (SIS) must meet the requirements in relation to systematic failures (in particular in the area of software) and random failures (in the area of the hardware). This means that the result of the calculation of the entire safety instrumented system must meet the required SIL. In practice, this mainly depends on the conceptual design of the system or of a particular process circuit. Thus, it may be possible to use SIL2 devices in a safety instrumented system requiring SIL3 because it is often less expensive to use two SIL2 devices than a single SIL3 device.

Is Redundancy still absolutely necessary with Devices with a higher SIL Classification?

Although it is theoretically possible to drop redundancy in this case, this is usually rejected by NAMUR*. This also makes sense in relation to field devices in particular because these usually come into direct contact with process media, resulting in risks that are difficult to calculate. In addition, just one device class is required that meets the requirements of SIL2.

These SIL2 devices are used both for protective devices and operational devices. SIL3 circuits should not be instrumented with a 1-channel with SIL3 devices, but rather with two SIL2 devices using 1oo2 redundancy. This permits uniform inventory management and limits the training required by service technicians to just a small number of devices.

* NAMUR is an association that represents users of automation technology in the process industry.

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SIL in Process Automation

Isolated Barriers and Zener Barriers

A variety of different solutions is possible in conjunction with intrinsically safe components and systems. The classic answer is direct point-to-point connections with Zener Barriers or isolated barriers. Zener Barriers act as simple, passive networks and are the simplest solution. However, circuits with Zener Barriers entail functional risks due to the longitudinal resistance and the ground connection of the equipotential bonding. That's why galvanic isolated barriers have been the preferred solution for some years now. The parameters required for planning purposes, such as PFD or testing intervals T_{proof} are documented in the relevant test reports or safety manuals.

However, the use of isolated barriers can cause a problem when configuring the safety chain. Because both the sensor circuit and actuator circuit contain another element, the PFD or the safety chain are incremented by these values. It is, therefore, advisable that an isolated barrier that can be used for safety circuits should take up a maximum of 10 % of the entire PFD value available for the required safety integrity level. Thus, for example, while a PFD value of 5 x 10^{-3} is sufficient for a SIL2, the corresponding isolating interface should "use" a maximum of 5 x 10^{-4}. If this is not possible or if there is no corresponding isolating interface available, the only alternative is redundancy as described above.

SIL and HART Communication

Special HART management systems are available for evaluating the HART data; these enable the HART signals to be gathered, loaded and evaluated by means of a HART Multiplexer. Because the HART Multiplexer intervenes in the safety circuit and could falsify the relevant analog process signals, it must naturally also have a SIL evaluation. The SIL evaluation of the HART Multiplexers does not include the use of the HART information for checking the safety chain, but rather the certification that it has no safety-related influence on the analog signal.

Summary

The aim of every safety concept is to reduce the risk appropriately. The use of standard structures means that less planning and certification effort is required when implementing process control protection equipment. On the other hand, there is enough freedom to enable the optimum configuration of protection equipment in terms of function and cost using the benefits of the quantitative approach of IEC 61511. This concept has proven very effective in large chemicals businesses in recent years.

IEC 61511 has proven itself an excellent, practical tool. One of the main advantages for globally active businesses in particular lies in its worldwide applicability and the associated uniform evaluation benchmarks for process control protection equipment.

SIL levels 1 and 4 are not used in large chemical businesses. SIL4 is defined in IEC 61511-1 as the highest possible value that can be achieved using process control resources.

However, it should be pointed out at the same time that, with such a high value, the relevant process should be checked and/or mechanical protection equipment should be used before installing process control protection equipment.

For SIL3 circuits, IEC 61511 requires a hardware tolerance (HFT) of 1. This should prevent 1-channel protective circuits from being planned and implemented on the basis of dubious λ_{du} values, particularly at higher risks. This requirement largely corresponds to the previous national procedure for configuring low risk protective functions (< SIL3) with 1-channel and higher risk protection functions (SIL3) with multiple channels. Because of the small proportion, representing less than 1 % of all process control functions, the demand for field devices for use in SIL3 protection circuits is low. Consequently, it could prove worthwhile developing special devices with SIL3 according to IEC 61508 for use in protection equipment, particularly for special applications. However, because of a lack of experience with non-safety applications, the additional storage capacity needed for spare devices and, not least, because of the necessarily high prices, such special devices are not necessarily the optimum solution.

Pepperl+Fuchs and SIL

What are the Advantages of Pepperl+Fuchs Devices?

- Standard range devices
- No added cost for users
- No changes to approval values
- Uniform certificates of intrinsic safety
- Uniform device documentation
- Simple stores and spares inventory
- Excellent worldwide parts availability
- Easy planning and commissioning
- Tried-and-tested devices

Information on SIL Values

The SIL evaluations for Pepperl+Fuchs devices can be downloaded from the Internet free of charge either as a full version (15 to 20 pages), or as a management summary (2 pages) (www.pepperl-fuchs.com/selector/index.html).

Figure 8 All Pepperl+Fuchs devices with SIL evaluation are devices from the standard range.

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Singapore: +65 6779 9091 pa-info@sg.pepperl-fuchs.com

SIL-Certified Devices from Pepperl+Fuchs

Model Number	Function		SIL Rating
K-System, Isolated Barriers and Signal Conditioners			
KCD2-SR-***.**	DI	Switch Amplifier	2
KF**-SR2-***.**.**	DI	Switch Amplifier	2
KFD2-ST2-***.**	DI	Switch Amplifier	2
KF**-SOT2-***.**	DI	Switch Amplifier	2
K***-SH-Ex1.*.**	DI	Safety Switch Amplifier	3
KFD2-SR2-**2.W.SM	DI	Standstill Monitor	2
KF**-DWB-***.*	DI	Overspeed/Underspeed Monitor	2
KF**-UFC-***.*	DI	Frequency Converter with Trip Value	2
KCD0-SD-Ex1.1245	DO	Solenoid Driver	3
KFD0-SD2-***.****	DO	Solenoid Driver	3
KFD2-SL2-***.**.****	DO	Solenoid Driver	2
KFD2-SL-4	DO	Solenoid Driver	2
KFD0-RSH-1	DO	Relay Module	3
KCD2-STC-**1	AI	SMART Transmitter Power Supply	2
KFD2-STC4-***.**	AI	SMART Transmitter Power Supply	2
KFD2-STV4-***.**	AI	SMART Transmitter Power Supply	2
KFD2-CR4-*.**	AI	Transmitter Power Supply	2
KF**-CRG2-***.*	AI	Transmitter Power Supply	2
KFD2-UT2-***-*-*	AI	Universal Temperature Converter	2
KF**-GUT-***.*	AI	Temperature Converter with Trip Values	2
KCD2-SCD-**1	AO	SMART Current Driver	2
KFD2-SCD*-***.**	AO	SMART Current Driver	2
KFD2-CD*-***.**-**	AO	Current Driver	2
KFD0-SCS-***.**	AO	SMART Current Driver	2
KFD0-CS-***.***	AO	Current Driver	2
H-System, Isolated Barriers			
HiC282*	DI	Switch Amplifier	2
HiC2851	DI	Safety Switch Amplifier	3
HiD282*	DI	Switch Amplifier	2
HiD284*	DI	Switch Amplifier	2
HiC2871	DO	Solenoid Driver	3
HiD2871, HiD2872	DO	Solenoid Driver	2/3 [x]
HiD2875, HiD2876	DO	Solenoid Driver	2/3 [x]
HiD2881	DO	Solenoid Driver	2
HiC2025	AI	SMART Transmitter Power Supply	2
HiD2025**, HiD2026**	AI	SMART Transmitter Power Supply	2
HiD2029**, HiD2030**	AI	SMART Transmitter Power Supply	2
HiC2031	AO	Current Driver	2
HiD2033, HiD2034	AO	Current Driver	2
HiD2037, HiD2038*	AO	SMART Current Driver	2
HART Interface Solutions			
HiD Mux2700	HART	HART Multiplexer Master	3
KFD2-HMM-16	HART	HART Multiplexer Master	3
KFD0-HMS-16	HART	HART Multiplexer Slave	3
Surge Protection			
P-LB-*.*.******	SURGE	Surge Protection Barrier	3

DI = Digital Input, DO = Digital Output, AI = Analog Input, AO = Analog Output
[x] if loop powered

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Model Number	Function		SIL Rating
Field Devices			
LHC-M20/M40	A	Hydrostatic Pressure Sensor	2
LTC***	A	Guided Microwave	2
PPC-M**	A	Process Pressure Sensor	2
LVL-M* with FEL51 ... FEL58	D	Vibration Limit Switch	2
NCB2-12GM35-N0	D	Inductive Sensor	2
NCB2-V3-N0	D	Inductive Sensor	2
NCB5-18GM40-N0	D	Inductive Sensor	2
NCN3-F25*-SN4***	D	Inductive Safety Sensor	3
NCN4-12GM35-N0	D	Inductive Sensor	2
NCN4-V3-N0	D	Inductive Sensor	2
NCN8-18GM40-N0	D	Inductive Sensor	2
NJ10-30GK-SN***	D	Inductive Safety Sensor	3
NJ15-30GK-SN***	D	Inductive Safety Sensor	3
NJ15S+U*+N***	D	Inductive Safety Sensor	3
NJ20S+U*+N***	D	Inductive Safety Sensor	3
NJ2-11-SN***	D	Inductive Safety Sensor	3
NJ2-11-SN-G***	D	Inductive Safety Sensor	3
NJ2-12GK-SN***	D	Inductive Safety Sensor	3
NJ3-18GK-S1N***	D	Inductive Safety Sensor	3
NJ40-FP-SN***	D	Inductive Safety Sensor	3
NJ4-12GK-SN***	D	Inductive Safety Sensor	3
NJ5-18GK-SN***	D	Inductive Safety Sensor	3
NJ5-30GK-S1N***	D	Inductive Safety Sensor	3
NJ6-22-SN***	D	Inductive Safety Sensor	3
NJ6-22-SN-G***	D	Inductive Safety Sensor	3
NJ6S1+U*+N1***	D	Inductive Safety Sensor	3
NJ8-18GK-SN***	D	Inductive Safety Sensor	3
SC3.5-N0	D	Inductive Sensor	2
SJ2-N	D	Inductive Sensor	2
SJ2-S1N***	D	Inductive Safety Sensor	3
SJ2-SN***	D	Inductive Safety Sensor	3
SJ3.5-N	D	Inductive Sensor	2
SJ3.5-S1N***	D	Inductive Safety Sensor	3
SJ3.5-SN***	D	Inductive Safety Sensor	3

A = Analog Sensor, D = Digital Sensor

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Signal Conditioners

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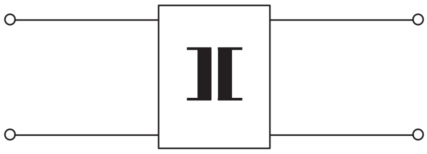
PEPPERL+FUCHS
PROTECTING YOUR PROCESS

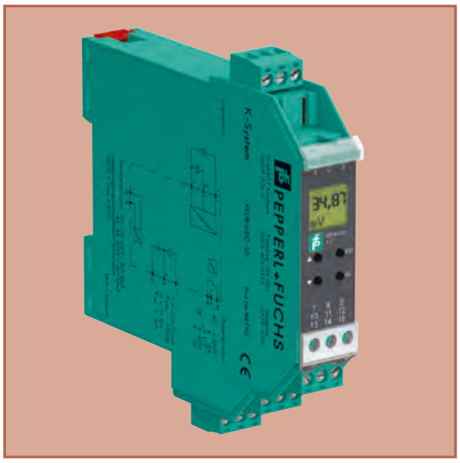
With the variety of process control systems available, it is often necessary to convert an input signal into a format that the system will accept. Signal conditioners take signals from an assortment of field instruments such as thermocouples and RTDs, and convert those signals into any of several standard instrument signals (1 V ... 5 V, 4 mA ... 20 mA, etc.). Signal conditioners are also beneficial to the accurate transfer of these signals, isolation, and the elimination of ground loops.

Operating principle



The key to process control is accuracy both in measurement and in signal conditioning. The biggest and most overlooked threat to effective process control is the presence of ground loops. Whenever analog data is transferred through long cable runs, there is a high probability that ground loop problems will occur. A ground loop exists when multiple earth ground connections are made in a system. A difference in potential between the grounds (V_{GND}) generates an extraneous current flow in the signal conductor. The result is commonly known as noise. In its mildest form, noise in the signal line causes measurement offsets, incorrect sensor readings, and general signal corruption. In its most severe form, however, noise contamination can deteriorate communication to a point where control of the process is lost. Isolation between the ground circuits is essential to the prevention of ground loop currents and, therefore, the elimination of noise. Signal conditioners provide the necessary isolation as well as amplification, filtering, and linearity corrections.

K-System



- Broad range with 3-port isolation
- SIL rated for safety instrumented systems
- Limit detection with dual form C alarm contacts
- Logic functions: pushbutton programmable
- Fault detection and alarming
- Loop-powered and analog isolators
- Field configurable for flexibility
- Removable terminals reduce maintenance

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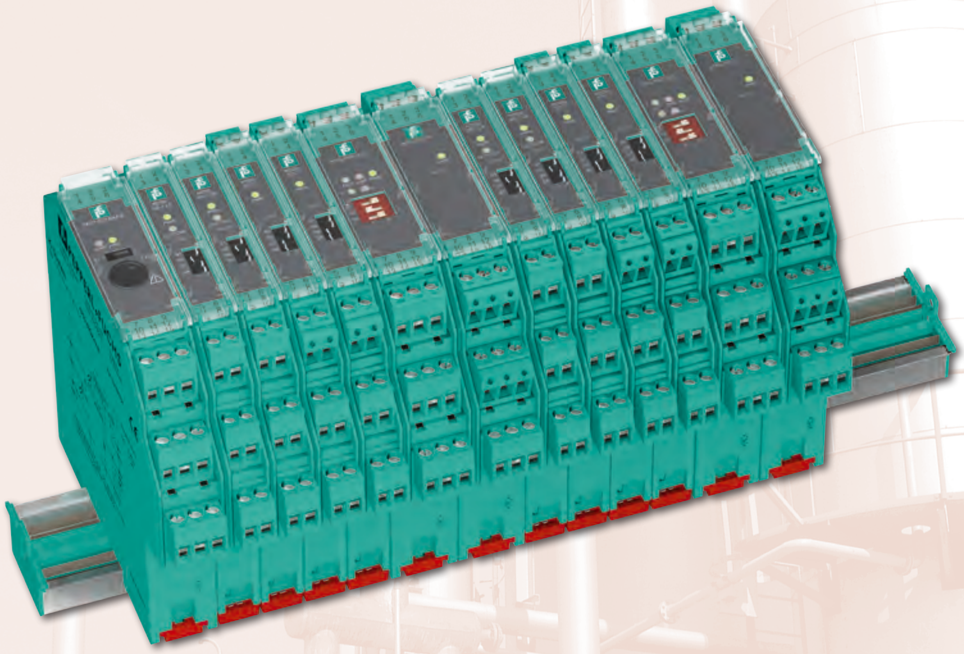
K-System



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Introduction

The K-System consists of wide range of signal conditioners suitable for mounting on 35 mm DIN rail. K-System is easy to specify, integrate and expand and has become synonymous with safety and reliability. Our extensive line of signal conditioner for safety location applications contains over 60 different models, each containing industry leading features and benefits. Low heat dissipation allows vertical or horizontal mounting.

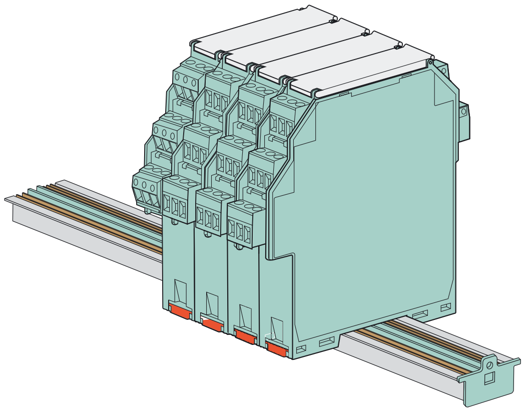

Figure 1 K-System on Power Rail

Housing types

Depending on the functionality and application, K-System has different housing widths. Interoperability between modules is guaranteed and each signal conditioner contains the same features and benefits. Whether it is the 12.5 mm KC modules or the well-proven 20 mm KF modules, the electrical and mechanical characteristics of the K-System are maintained. This collection of modules provides a wide range of interface barriers that can be combined on Power Rail.

KC module housing

Used for high signal integrity

- Compact housing, only 12.5 mm wide
- Single loop integrity
- Power loss only 0.8 W per device

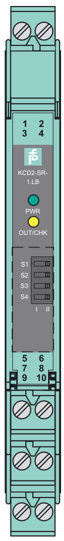

Figure 2 12.5 mm housing (KC module)

KF module housings

Used for high channel density

- 20 mm housing
- Highest packing density on the market
- As low as 5 mm per channel

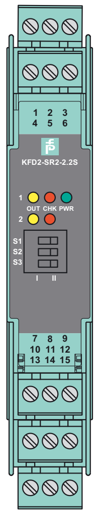

Figure 3 20 mm housing (KF module)

Used for applications with high functionality

- Logic controls determine and monitor speed, direction of rotation, slip, flow rates and time
- Analog controls monitor transmitter signals, strain gauges, temperature and load cells
- Configured using **PACT***ware*™ or by push button
- Universal power supply

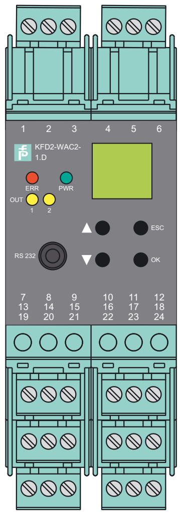

Figure 4 40 mm housing (KF module)

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Supply voltage

K-System signal conditioners are available with different supply voltages. The most widely used rating is 24 V DC; however, 115 V AC and 230 V AC are also available for applications when DC power is not available.
The universal supply units carry the complete range from 20 V DC to 90 V DC and 48 V AC to 230 V AC on the same input terminals. The supported supply voltage for each barrier is identified on the side plate.

Mounting

The K-System is mounted on a 35 mm DIN rail acc. to EN 60715. To reduce wiring and installation costs, Power Rail is the optimum solution.

Power Rail

The Power Rail is a plastic insert into a standard DIN rail and contains two leads that deliver power to the modules. Power is sent through the rail by a power feed module that delivers 24 V DC at 4 A. The module uses a 5 A fuse to protect the barriers. The Power Rail virtually eliminates the risk of wiring faults and facilitates easy expansion. Power Rail is available in two versions:

- UPR-03: 3-lead version supplies power and error signals
- UPR-05: 5-lead version supplies three leads for power and error signal and two leads for serial data exchange.

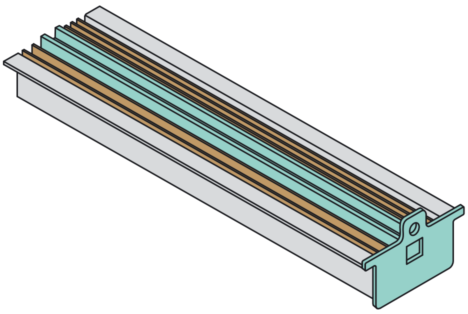

Figure 5 Universal Power Rail UPR-05

Mounting on Power Rail

As shown in the figure, the isolation modules are snapped onto the Universal Power Rail in a vertical downward movement.

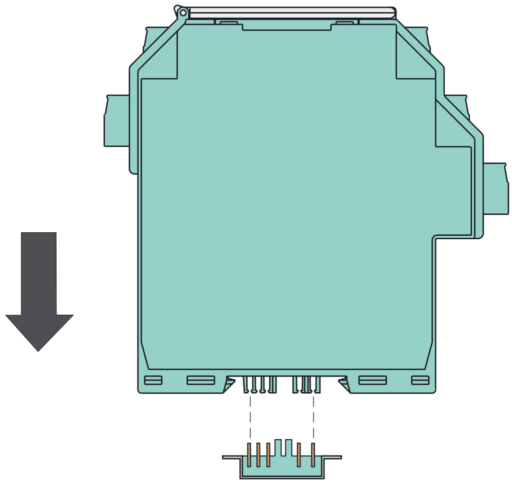

Figure 6 Proper K-System mounting

CORRECT: Device snapped on vertically.

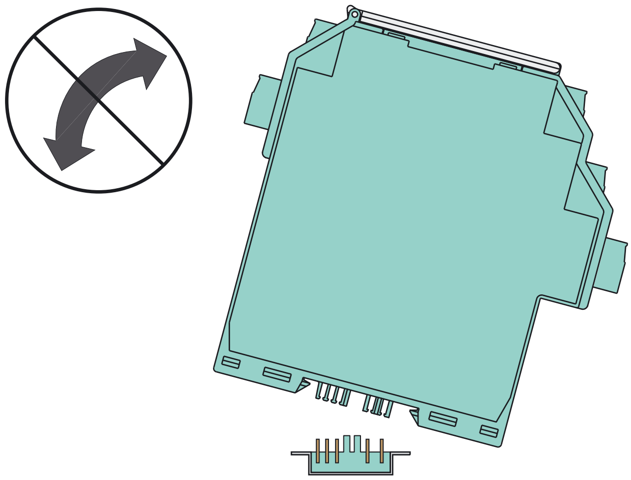

Figure 7 Improper K-System mounting

INCORRECT: Device snapped on from the side.

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Power connection to K-System

Conventional power supply without Power Rail

Conventional power supplies create complicated and expensive wiring systems. After all signal conditioners are connected, there is a significant amount of wiring and more wiring must be added for features such as lead breakage and short-circuit monitoring.

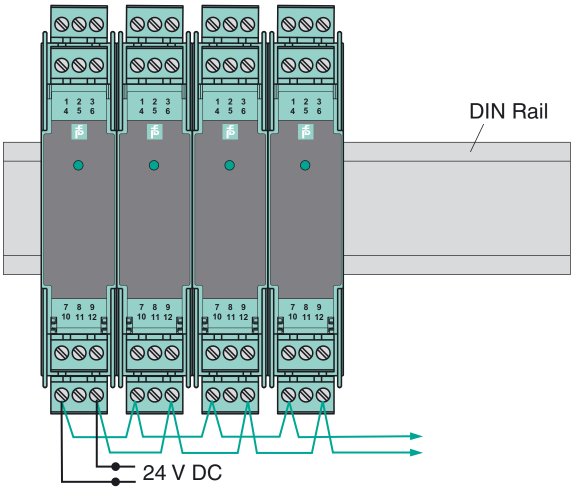

Figure 8 Conventional installation

Power supply with Power Rail

Supply with Power Feed Modules

The Pepperl+Fuchs Power Rail eliminates wiring hassles and reduces expense. The power feed module mounts on the Power Rail for easy and reliable distribution of power to all connected isolated modules. This method eliminates all of the parallel power wiring necessary on a conventional installation without Power Rail.

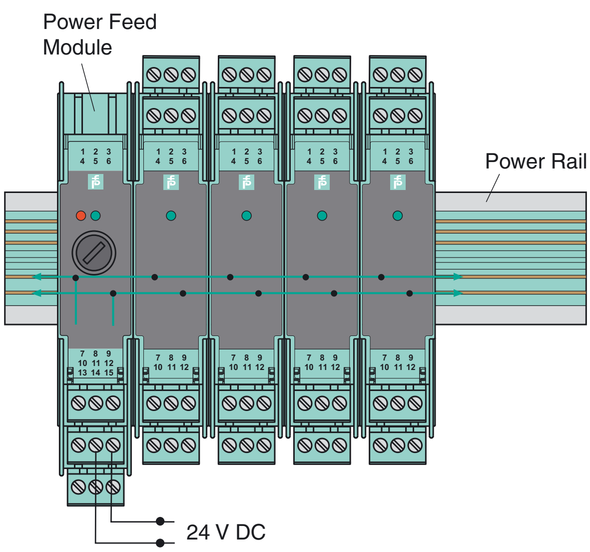

Figure 9 Power Rail installation

Redundant Supply with Power Feed Modules

Two power supplies or a redundant power supply with two power feed modules offers a high degree of safety and reliability. If a power supply is damaged or a fuse opens in a power feed module, the redundant power feed module continues to energize the isolators through their Power Rail connection.

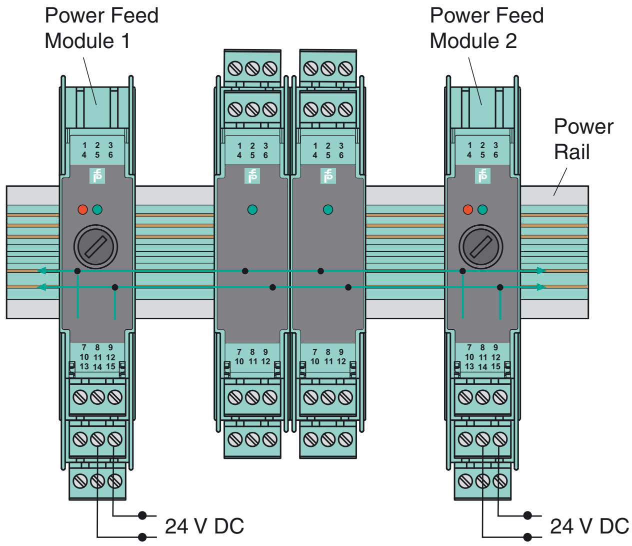

Figure 10 Redundant power connections

Direct Supply with Power Supplies

A complete power solution for a K-System installation is possible by using a 115/230 V AC to 24 V DC/4 A power supply with the KFA6-STR-1.24.4 or by using the KFA6-STR-1.24.500 that provides 24 V DC/500 mA. The power supplies snap-on the Power Rail to easily and efficiently distribute power to the signal conditioners.

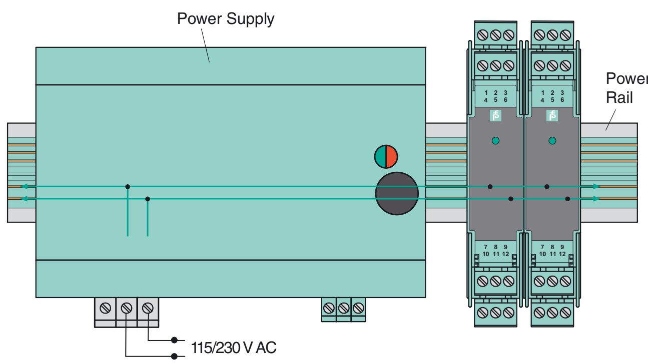

Figure 11 Integrated power supply (4 A)

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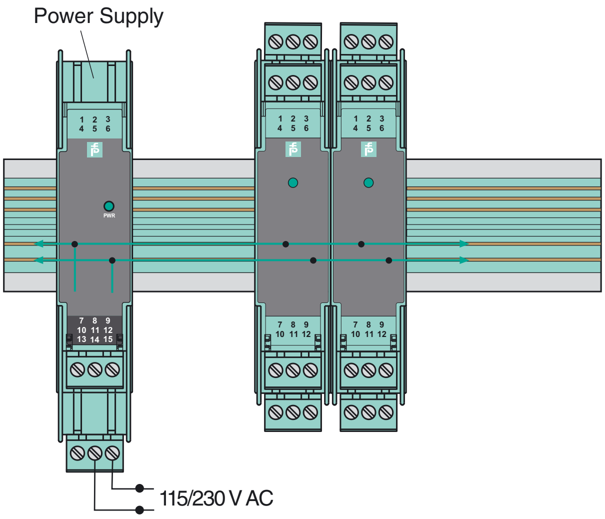

Figure 12 Integrated power supply (500 mA)

Collective error messaging

Collective error messaging enables lead breakage and short-circuit monitoring for isolator modules without additional wiring expenses. During a fault condition of the field circuit, an interrupt signal from an isolator module is transferred to the Power Rail. The power feed module evaluates the signal and transfers the interrupt signal to the control system via a relay contact.

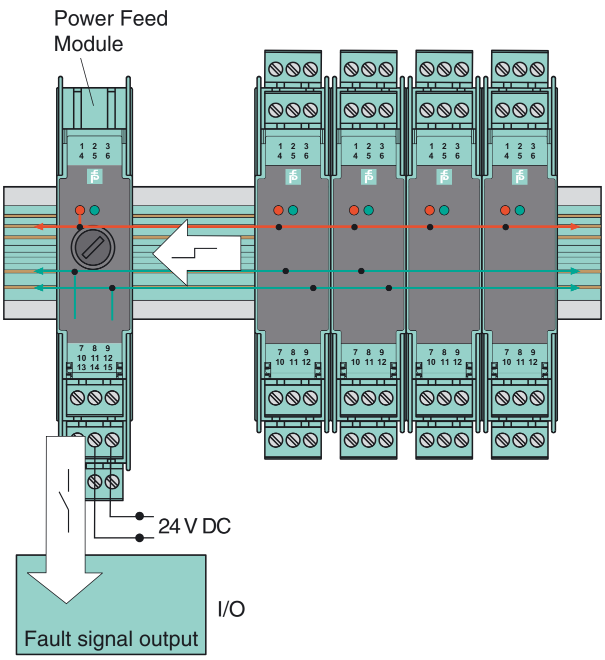

Figure 13 Collective error message via power feed module

Terminals

Removable terminals

The removable terminals simplify control cabinet construction and allow the units to be replaced while they are energized. These screw-secured, cage-clamp terminals allow space for the connection of leads with core cross-sections of up to 2.5 mm^2 (14 AWG). The connectors are coded with red pins so misconnection of a terminal block is eliminated. With the KF-CP terminal block coding pins (available separately), additional terminal block styles with test sockets or cage spring release can be easily coded and inserted into an signal conditioner.

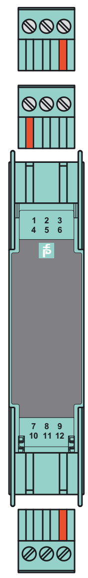

Figure 14 K-System removable terminal blocks

Terminal designation

Please reference appropriate model for terminal designation.

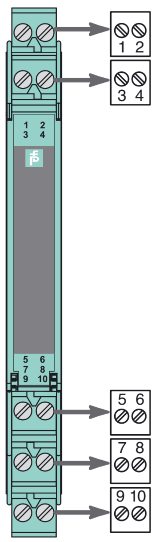

Figure 15 12.5 mm housing (KC module)

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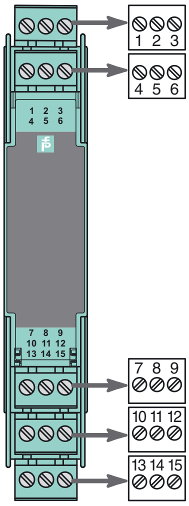

Figure 16 20 mm housing (KF module)

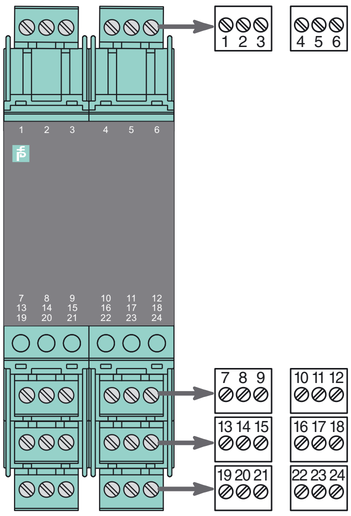

Figure 17 40 mm housing (KF module)

Color designation

The color identification of the devices has the following meaning:

- green indicates devices with DC power supply
- black indicates devices with AC power supply
- grey indicates devices with universal power supply of 20 V DC to 90 V DC or 48 V DC to 253 V AC

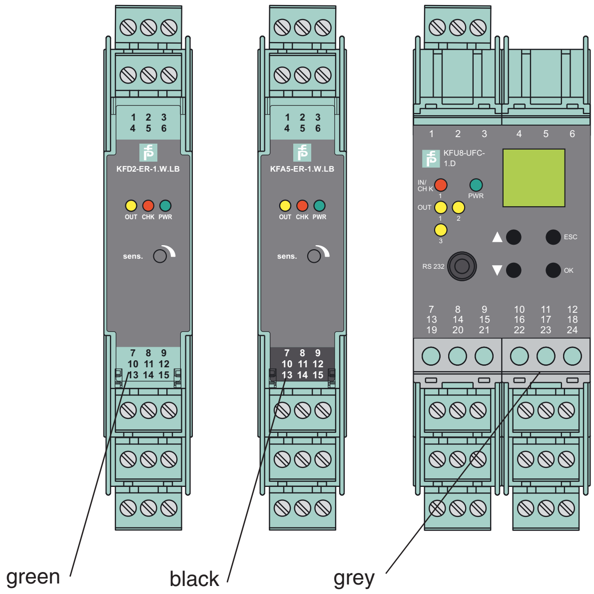

Figure 18 Color identification of devices

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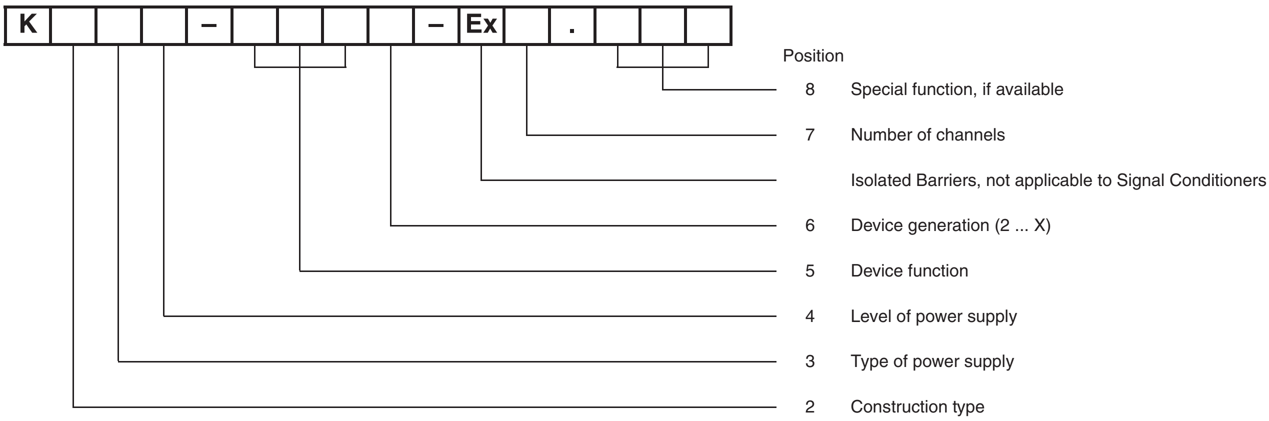
Model number description



Position 1	K	=	K-System
Position 2	C	=	Version with removable terminals, 12.5 mm width
	F	=	Version with removable terminals, 20 mm or 40 mm width
	H	=	Version without removable terminals, 20 mm or 40 mm width
Position 3	D	=	DC power supply
	A	=	AC power supply
	U	=	AC-/DC power supply
Position 4	0	=	without power supply
	2	=	24 V
	4	=	100 V
	5	=	115 V
	6	=	230 V
	8	=	20 V DC to 90 V DC, 48 V AC to 253 V AC
Position 5	CC	=	Converter for current/voltage
	CD	=	Current driver, active
	CR	=	Transmitter power supply device, current output
	CRG	=	Transmitter power supply device with trip value output
	CS	=	Current driver, passive
	DU	=	Switch amplifier, timer relay
	DWB	=	Rotational speed monitor, logic control unit
	EB	=	Power feed module
	ELD	=	Ground fault detection
	GS	=	Trip amplifier for current/voltage
	GU	=	Universal trip amplifier
	GUT	=	Temperature converter with trip values
	HLC	=	HART Loop Converters
	HMM	=	HART Multiplexer Master
	HMS	=	HART Multiplexer Slave
	PT	=	Potentiometer converter
	RC	=	Converter for resistors
	RO	=	Relay module
	RR	=	Repeater for resistance measuring sensor
	RSH	=	Relay module in safety application
	SCD	=	SMART current driver
	SCS	=	SMART current driver/repeater
	SD	=	Solenoid driver
	SH	=	Safety switch amplifier
	SL	=	Solenoid driver module with logic input
	SOT	=	Switch amplifier with passive, potential free transistor output
	SR	=	Switch amplifier with relay output
	SRA	=	Switch amplifier with relay output, 2:1 operation mode
	SRT	=	Switch amplifier with active transistor and relay output
	ST	=	Switch amplifier with active transistor output
	STC	=	SMART transmitter power supply with current output
	STR	=	Power supply
	STV	=	SMART transmitter power supply with voltage output
	TR	=	Converter for resistance measuring sensor
	TT	=	Converter for thermocouple/mV
	UFC	=	Universal frequency converter
	UFT	=	Frequency converter with direction and synchronization monitoring
	USC	=	Universal signal converter with trip values
	UT	=	Universal temperature converter
	VC	=	Converter for current/voltage
	VCR	=	Transmitter power supply, repeater for current/voltage
	VD	=	Solenoid driver
	VM	=	Solenoid driver
	VR	=	Voltage repeater
	WAC	=	Converter for strain gauges

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Safety information

The corresponding data sheets, the Declaration of Conformity, the EC-Type Examination Certificate and applicable certificates (see data sheet) are an integral part of this document.

Intended use

Laws and regulations applicable to the usage or planned purpose of usage must be observed. Devices are only approved for proper usage in accordance with intended use. Improper handling will result in voiding of any warrantee or manufacturer's responsibility.

These devices are used in C&I technology for the galvanic isolation of C&I signals, such as 20 mA and 10 V unit signals, and also for the adaptation and/or standardisation of signals.

The devices are not suitable for the isolation of signals in power engineering, unless this is specifically referred to in the respective data sheet.

Protection of operating personnel and the system is not ensured if the product is not used in accordance with its intended use.

Installation and commissioning

Commissioning and installation must be carried out by specially trained and qualified personnel only.

Installation of the interface devices in the safe area

The devices are constructed to satisfy the IP20 protection classification and must be protected from adverse environmental conditions such as water spray or dirt exceeding the pollution degree 2.

The devices must be installed outside the hazardous area!

Installation and commissioning of the interface devices within Zone 2/Div. 2 of the hazardous area

Only devices with the corresponding manufacturer's Declaration of Conformity or separate certificate of conformity can be installed in Zone 2/Div. 2.

The individual data sheets indicate whether these conditions are met.

For US and Canada installations, in Zone 2/Div. 2 follow the NEC and CEC wiring methods. The enclosure must be able to accept Zone 2/Div. 2 wiring methods. The referenced product certification control drawing must be observed.

For all other applications, the devices should be installed in a switch or junction box that:

- meets at least IP54 in accordance to EN 60529.
- meets to the requirements of resistance to light and resistance to impact according to EN 60079-0/ IEC 60079-0.
- meets to the requirements of thermal endurance according to EN 60079-15/IEC 60079-15.
- must not cause ignition danger by electrostatic charge during intended use, maintenance and cleaning.

The EC-Type Examination Certificates, standard certificates/approvals or the manufacturer's Declaration of Conformity should be observed. It is especially important to observe the "special conditions" if these are included in the certificates.

Repair and maintenance

The transfer characteristics of the devices remain stable over long periods of time. This eliminates the need for regular adjustment. Maintenance is not required.

Fault elimination

No changes can be made to devices that are operated in hazardous areas. Repairs on the device are not allowed.

Isolation coordinates for installations for galvanic isolation according to EN 50178 and EN 61140

The devices of the K-System are electronic equipment for use in secluded electrical operating sites where only skilled personnel or electrically instructed personnel will have admission or access.

The devices are assessed for pollution degree 2 and overvoltage category II according to EN 50178.

For additional details, see data sheets.

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Technical data

Electrical data

Control circuit signals

- 0/4 mA to 20 mA signal level acc. to NE43
- Current output HART compatible
- Current input HART compatible
- Digital output: active or, passive electronic output 100 mA/30 V, short circuit protected
- Relay output 2 A, minimum load 1 mA/24 V
- Logic level 24 V acc. to IEC 60946
- Functional isolation or safe isolation acc. to EN 50178 and NAMUR NE23

For additional details, see data sheets.

Field circuit signals

- Transmitter power supply up to 17 V DC
- Current input HART compatible
- Pt100, in 2-, 3-, (4-)wire technology
- Resistor 0 Ω to 400 Ω with freely definable characteristic
- Potentiometer
- Thermocouples of all types, internal cold junction, external reference
- Current output HART compatible
- Digital input NAMUR EN 60947-5-6

For additional details, see data sheets.

Mechanical data

Mounting

- Snap-on 35 mm standard DIN rail acc. to EN 60715. Can be mounted horizontally or vertically, side by side.
- Panel mount: The lugs on the base of the modules must be extended and used for mounting purposes with 3 mm screws.
- K-MS mounting base for screw attachment

Housing material

Polycarbonate (PC)

Dimensions

Housing drawings please refer to the appendix.

Protection degree

IP20 acc. to EN 60529

Connection

- KH*-modules:
  self-opening connection terminals for max. core diameter of 1 x 2.5 mm^2 (14 AWG)
- KF*-and KC*-modules:
  removable connector with integrated self opening device terminals for leads of up to a max. of 1 x 2.5 mm^2 (14 AWG)

Labeling

place for labeling on the front side, label:

- KC-modules (12.5 mm): 22 mm x 9 mm
- KF-modules (20 mm): 22 mm x 16.5mm
- KF-modules (40 mm): 18 mm x 8 mm

Ambient conditions

Ambient temperature

-20 °C to 60 °C (253 K to 333 K)

Exceptions see data sheets.

Storage temperature

-40 °C to 90 °C (233 K to 363 K)

Reference conditions for adjustment

22.5 °C ± 2.5 °C (295.5 K ± 2.5 K)

Relative humidity

max. 95 % without moisture condensation

Vibration resistance

acc. to EN 60068-2-6, 10 Hz to 150 Hz, 1 g, high crossover frequency

Shock resistance

acc. to EN 60068-2-27, 15 g, 11 ms, half-sine

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Conformity with standards and directives

General

- EMC acc. to NAMUR NE21 and EN 61326
- LEDs acc. to NAMUR NE44
- Software acc. to NAMUR NE53
- Switch-on pulse suppression
- Devices K*D2:
  - Supply voltage 20 V DC to 30 V DC via Power Rail or supply terminals
  - Fault signals via Power Rail
- Devices K*A and K*U:
  - Supply voltage 115 V/230 V AC ±10 %
- Safety devices acc. to VDE 0660 T.209, AK acc. to DIN 19250

Digital inputs/outputs in accordance with NAMUR

The standards references for this interface have changed many times:

German standard (old): **DIN 19234**: Electrical distance sensors – DC interface for distance sensors and switch amplifiers; 1990-06

European standard (old): **EN 50227**: Low voltage switch gear and control gear – control devices and switching elements – proximity switches, DC interface for proximity sensors and switch amplifiers (NAMUR), 1996-10

German version (old): **DIN EN 50227**: Low voltage switch gear – control devices and switching elements – proximity switches, DC interface for proximity sensors and switch amplifiers (NAMUR), 1997, German nomenclature VDE 0660, part 212

Current designation: DIN EN 60947-5-6: Low voltage switch gear – control devices and switching elements – proximity switches, DC interface for proximity sensors and switch amplifiers (NAMUR), 2000, German nomenclature. VDE 0660 part 212

Current IEC designation: IEC 60947-5-6: Low voltage switch gear and control gear – part 5-6: Control circuit devices and switching elements – DC interface for proximity sensors and switching amplifiers (NAMUR), 1999.

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Switch Amplifiers

Model Number	Channels	Functions: Timer	Functions: Conductive	Input (Field): MAMUR Sensor/ Dry Contacts	Input (Field): 3-wire Sensor	Input (Field): Electrode	Input (Field): Line Fault Detection	Output (Control System): Relay	Output (Control System): Transistor (active/passive)	Output (Control System): Error Message Output	Supply: 24 V DC	Supply: 115 V AC/ 230 V AC	SIL	Page
KCD2-SR-1.LB	1			■			■	2		■	■		2	59
KCD2-SR-2	2			■			■	2			■		2	60
KFD2-SR2-2.2S	2			■			■	2x2			■		2	61
KFU8-SR-1.3L.V	1	■			■			2			■	■		62
KFA6-SR-2.3L	2				■			2				■		63
KFD2-ER-1.5	1		■			■		1			■			64
KFD2-ER-1.6	1		■			■		1			■			65
KFA5-ER-1.5	1		■			■		1				■		66
KFA5-ER-1.6	1		■			■		1				■		67
KFA6-ER-1.5	1		■			■		1				■		68
KFA6-ER-1.6	1		■			■		1				■		69
KFD2-ER-1.W.LB	1		■			■	■	1		■	■			70
KFD2-ER-2.W.LB	2		■			■	■	2		■	■			71
KFA5-ER-1.W.LB	1		■			■	■	1		■		■		72
KFA5-ER-2.W.LB	2		■			■	■	2		■		■		73
KFA6-ER-1.W.LB	1		■			■	■	1		■		■		74
KFA6-ER-2.W.LB	2		■			■	■	2		■		■		75

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Frequency Converters

Model Number	Functions			Input (Field)		Output (Control System)				Supply			Page
	Speed Monitor	Frequency Conversion	Special Functions	MAMUR/ Dry Contacts	Line Fault Detection	Relay	Transistor (active/passive)	Error Message Output	0/4 mA ... 20 mA	24 V DC	115 V AC/ 230 V AC	SIL	
KFD2-SR2-2.W.SM	■		■	■	■	2				■		2	76
KFD2-DWB-1.D	■			■	■	2				■		2	77
KFA5-DWB-1.D	■			■	■	2					■	2	78
KFA6-DWB-1.D	■			■	■	2					■	2	79
KFU8-DWB-1.D	■			■	■	2				■	■	2	80
KFD2-UFC-1.D	■	■	■	■	■	2	1	■	1	■		2	81
KFU8-UFC-1.D	■	■	■	■	■	2	1	■	1	■	■	2	82
KFD2-UFT-2.D	■	■	■	■	■	2	2		1	■			83
KFU8-UFT-2.D	■	■	■	■	■	2	2		1	■	■		84

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Technical data

Supply	
Rated voltage	19 ... 30 V DC
Ripple	≤ 10 %
Rated current	≤ 30 mA
Power loss	≤ 500 mW
Power consumption	≤ 500 mW
Input	
Rated values	acc. to EN 60947-5-6 (NAMUR)
Open circuit voltage/short-circuit current	approx. 10 V DC/approx. 8 mA
Switching point/switching hysteresis	1.2 ... 2.1 mA/approx. 0.2 mA
Line fault detection	breakage I ≤ 0.1 mA, short-circuit I ≥ 6.5 mA
Pulse/Pause ratio	≥ 20 ms/≥ 20 ms
Output	
Output I	signal; relay
Output II	signal or error message; relay
Contact loading	253 V AC/2 A/cos Φ > 0.7; 126.5 V AC/4 A/cos Φ > 0.7; 30 V DC/2 A resistive load
Minimum switch current	2 mA/24 V DC
Energized/de-energized delay	≤ 20 ms/≤ 20 ms
Mechanical life	10^7 switching cycles
Transfer characteristics	
Switching frequency	≤ 10 Hz
Indicators/settings	
Labeling	space for labeling at the front
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	12.5 x 114 x 119 mm (0.5 x 4.5 x 4.7 in), housing type A2

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Dry contact or NAMUR inputs**
- **Relay contact output**
- **Fault relay contact output**
- **Line fault detection (LFD)**
- **Housing width 12.5 mm**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner transfers digital signals (NAMUR sensors/mechanical contacts) from the field to the control system.

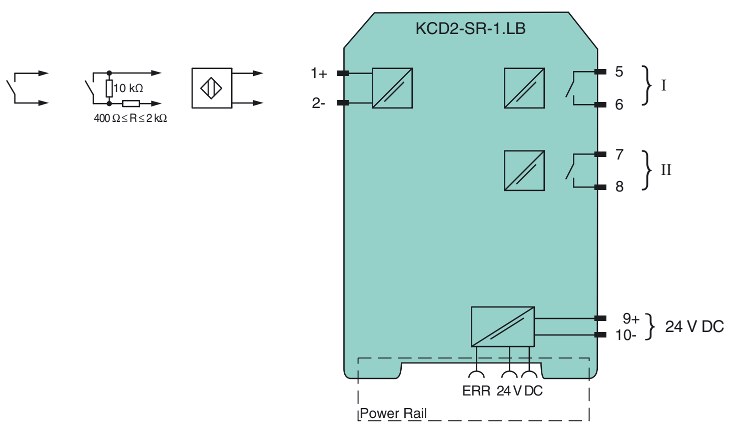
The proximity sensor or switch controls a form A normally open relay contact for the load. The normal output state is reversed using switch S1. Switch S2 allows output II to be switched between a signal output and an error message output. Switch S3 enables or disables line fault detection of the field circuit.

During an error condition, relays revert to their de-energized state and LEDs indicate the fault according to NAMUR NE44.

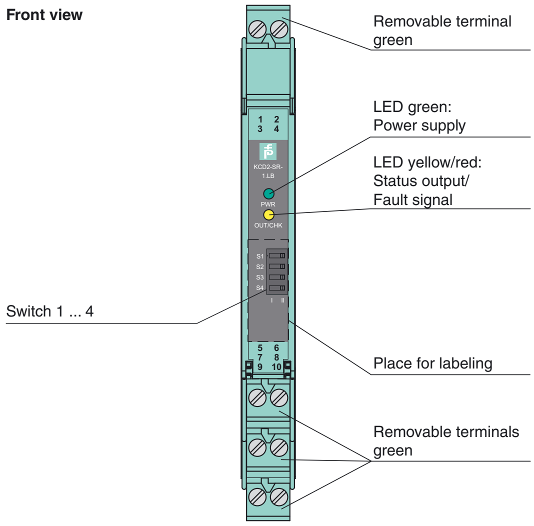
A unique collective error messaging feature is available when used with the Power Rail system.

Due to its compact housing design and low heat dissipation, this device is useful for detecting positions, end stops, and switching states in space-critical applications.

Diagrams



Front view



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Features

- **2-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Dry contact or NAMUR inputs**
- **Relay contact output**
- **Line fault detection (LFD)**
- **Housing width 12.5 mm**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner transfers digital signals (NAMUR sensors/mechanical contacts) from the field to the control system.

The proximity sensor or switch controls a form A normally open relay contact for the load. The normal output state can be reversed using switches S1 and S2. Switch S3 is used to enable or disable line fault detection of the field circuit.

During an error condition, relays revert to their de-energized state and LEDs indicate the fault according to NAMUR NE44.

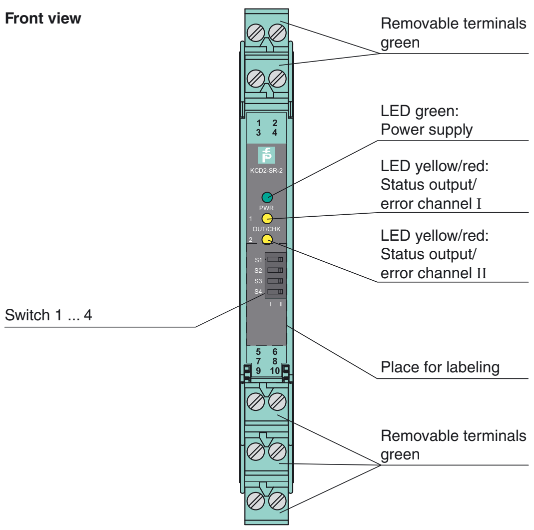
A unique collective error messaging feature is available when used with the Power Rail system.

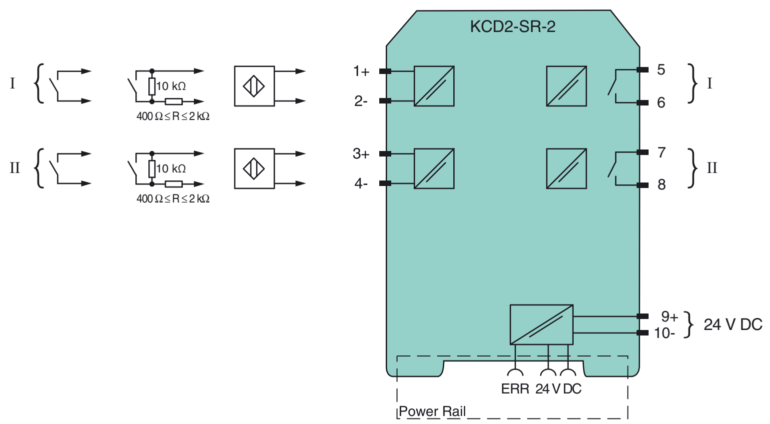
Due to its compact housing design and low heat dissipation, this device is useful for detecting positions, end stops, and switching states in space-critical applications.

Technical data

Supply	
Rated voltage	19 ... 30 V DC
Ripple	≤ 10 %
Rated current	≤ 30 mA
Power loss	≤ 600 mW
Power consumption	≤ 600 mW
Input	
Rated values	acc. to EN 60947-5-6 (NAMUR)
Open circuit voltage/short-circuit current	approx. 10 V DC/approx. 8 mA
Switching point/switching hysteresis	1.2 ... 2.1 mA/approx. 0.2 mA
Line fault detection	breakage I ≤ 0.1 mA, short-circuit I ≥ 6.5 mA
Pulse/Pause ratio	≥ 20 ms/≥ 20 ms
Output	
Output I	signal; relay
Output II	signal; relay
Contact loading	253 V AC/2 A/cos Φ> 0.7; 126.5 V AC/4 A/cos Φ> 0.7; 30 V DC/2 A resistive load
Minimum switch current	2 mA/24 V DC
Energized/de-energized delay	≤ 20 ms/≤ 20 ms
Mechanical life	10^7 switching cycles
Transfer characteristics	
Switching frequency	≤ 10 Hz
Indicators/settings	
Labeling	space for labeling at the front
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	12.5 x 114 x 119 mm (0.5 x 4.5 x 4.7 in), housing type A2

Diagrams





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Technical data

Supply	
Rated voltage	20 ... 30 V DC
Ripple	≤ 10 %
Rated current	≤ 50 mA
Power loss	1 W
Power consumption	< 1.3 W
Input	
Rated values	acc. to EN 60947-5-6 (NAMUR)
Open circuit voltage/short-circuit current	approx. 8 V DC/approx. 8 mA
Switching point/switching hysteresis	1.2 ... 2.1 mA/approx. 0.2 mA
Line fault detection	breakage I ≤ 0.1 mA, short-circuit I > 6 mA
Pulse/Pause ratio	≥ 20 ms/≥ 20 ms
Output	
Collective error message	Power Rail
Contact loading	50 V AC/1 A/cos Φ > 0.7; 40 V DC/1 A resistive load
Minimum switch current	1 mA/24 V DC
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Mechanical life	10^8 switching cycles
Transfer characteristics	
Switching frequency	≤ 10 Hz
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Features

- **2-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Dry contact or NAMUR inputs**
- **2 x 2 relay contact outputs with AND logic**
- **Line fault detection (LFD)**
- **Reversible mode of operation**
- **Up to SIL2 acc. to IEC 61508**

Function

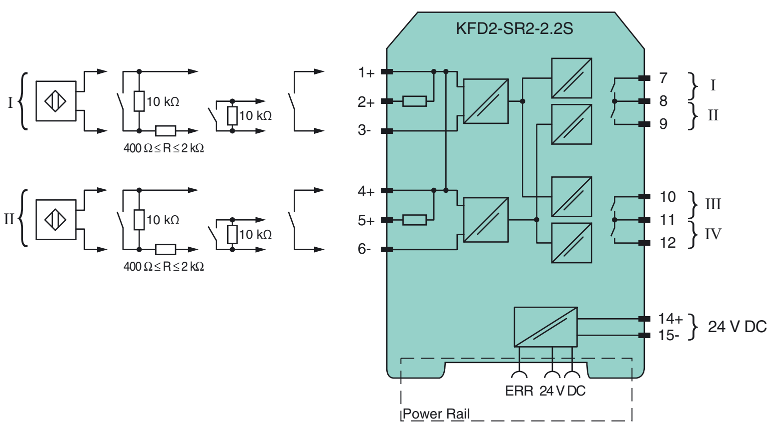
This signal conditioner transfers digital signals (NAMUR sensors/mechanical contacts).

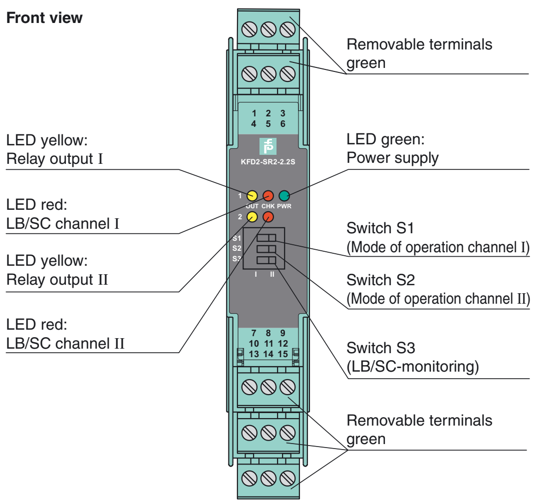
Each sensor or switch controls two form A normally open relay contacts. The normal output state can be reversed using switches S1 and S2. Switch S3 is used to enable or disable line fault detection of the field circuit.

During an error condition, the relays revert to their de-energized state and the LEDs indicate the fault according to NAMUR NE44.

A unique collective error messaging feature is available when used with the Power Rail system.

Diagrams





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Features

- **1-channel signal conditioner**
- **AC/DC wide range supply**
- **3-wire PNP/NPN sensor or push-pull input**
- **2 relay outputs with 1 changeover contact each**
- **DIP switch selectable functions**
- **Rotary switch selectable time base**
- **Available from September 2009**

Function

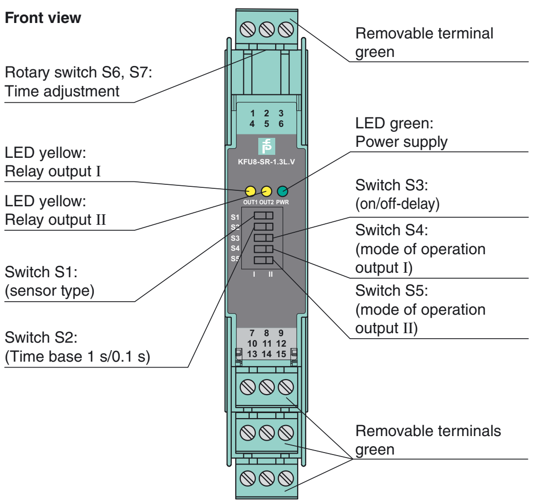
This signal conditioner converts the state of 3-wire sensors (PNP or NPN) or sensors with push-pull output stages into two relay outputs.

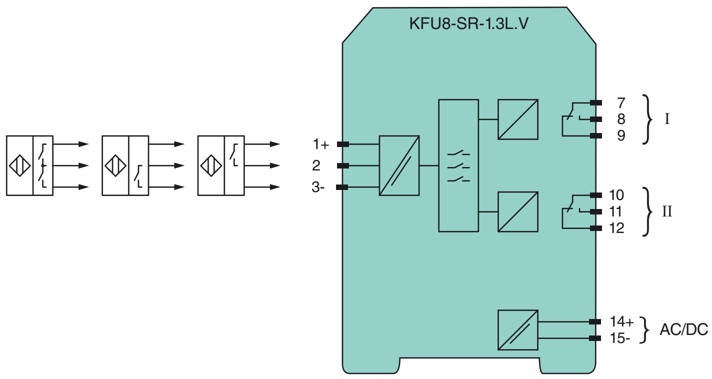
It has one input and two form C changeover relay outputs.

Technical data

Supply	
Rated voltage	20 ... 60 V DC or 90 ... 253 V AC, 45 ... 65 Hz
Rated current	≤ 230 mA
Power loss	2.3 W
Power consumption	≤ 4.5 W
Input	
Rated values	22 ... 24 V DC/100 mA
Short-circuit current	≤ 125 mA
Output	
Output I, II	
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 125 V AC/4 A/ cos Φ > 0.7; 40 V DC/2 A
Transfer characteristics	
Switching frequency	≤ 10 Hz for time base 0.1 s and time adjustment 0.0 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Diagrams





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Technical data

Supply	
Rated voltage	90 ... 253 V AC, 45 ... 65 Hz
Rated current	≤ 150 mA
Power loss	2.5 W
Power consumption	≤ 7 W
Input	
Rated values	22 ... 24 V DC/100 mA
Short-circuit current	110 mA
Output	
Output I, II	
Contact loading	250 V AC/4 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Energized/de-energized delay	max. 6 ms
Mechanical life	10^7 switching cycles
Transfer characteristics	
Switching frequency	≤ 10 Hz
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Features

- **2-channel signal conditioner**
- **230 V AC supply**
- **3-wire PNP/NPN sensor or push-pull input**
- **Relay contact output**
- **DIP switch selectable functions**
- **Minimum/maximum control**

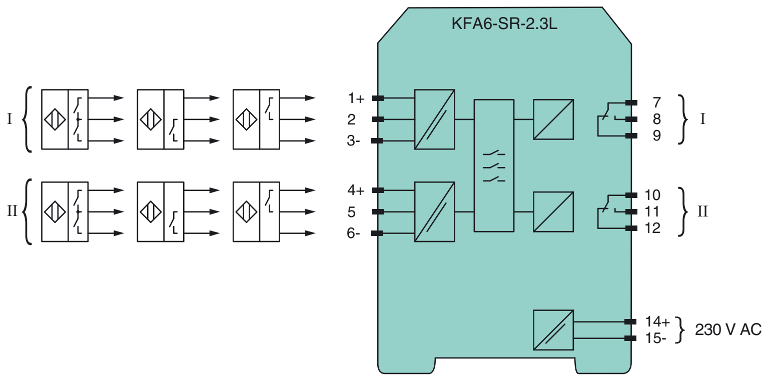
Function

This signal conditioner converts the state of 3-wire sensors (PNP or NPN) or sensors with push-pull output stages into a relay output.

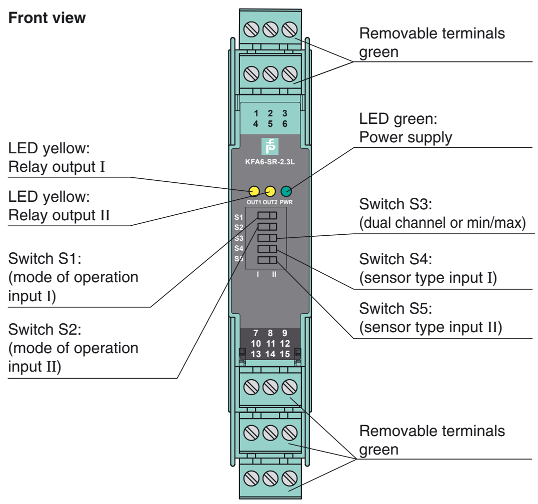
It has two inputs and two form C changeover relay outputs.

It can be used either as dual channel isolated amplifier or as a two-point level controller.

Diagrams



Front view



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Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Level sensing input**
- **Adjustable range 1 kΩ ... 30 kΩ**
- **Latching relay output**
- **Minimum/maximum control**

Function

This signal conditioner provides the AC measuring voltage for the level-sensing electrodes.

Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

The module is voltage and temperature stabilized and guarantees defined switching characteristics. An electronic holding circuit is used that allows minimum/maximum control. Since the conductance of the media may vary, the relay response sensitivity is adjustable.

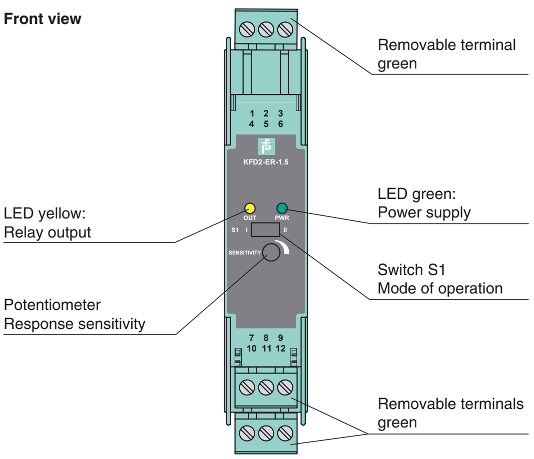
The normal output state can be reversed through the mode of operation switch S1.

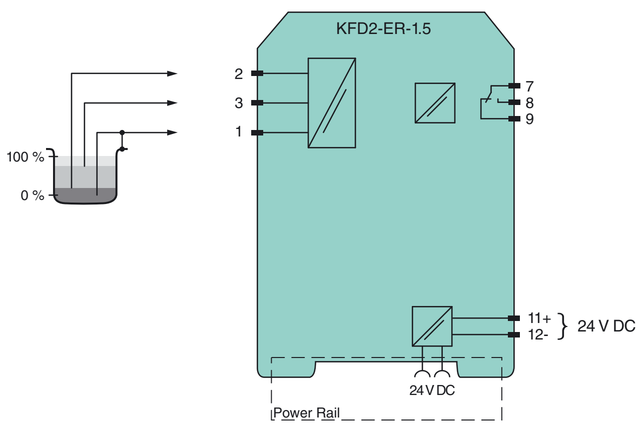
Technical data

Supply	
Rated voltage	20 ... 30 V DC
Input	
Open circuit voltage/short-circuit current	approx. 10 V AC (approx. 1 Hz)/approx. 5 mA
Control input	min./max. control system: terminals 1, 2, 3 on/off control system: terminals 1, 3
Response sensitivity	1 ... 30 kΩ, adjustable via potentiometer (20 turns)
Output	
Output	1 changeover contact
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Energized/de-energized delay	approx. 1 s/approx. 1 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 110 g
Dimensions	20 x 107 x 115 mm (0.8 x 4.2 x 4.5 in), housing type B1
Mounting	Power Rail or pull-out latches using for screw mounting
Indication and operation	
Operating elements	switch S1 Position I open circuit current: In the open circuit current principle, the relay becomes active when the limit is reached. Position II closed circuit current: In closed circuit current principle, the relay is activated when power is applied. The relay is deactivated when the limit is reached.

Diagrams

Front view





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Technical data

Supply	
Rated voltage	20 ... 30 V DC
Input	
Open circuit voltage/short-circuit current	approx. 10 V AC (approx. 1 Hz)/approx. 5 mA
Control input	min./max. control system: terminals 1, 2, 3 on/off control system: terminals 1, 3
Response sensitivity	5 ... 150 kΩ, adjustable via potentiometer (20 turns)
Output	
Output	1 changeover contact
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Energized/de-energized delay	approx. 1 s/approx. 1 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 110 g
Dimensions	20 x 107 x 115 mm (0.8 x 4.2 x 4.5 in), housing type B1
Mounting	Power Rail or pull-out latches using for screw mounting
Indication and operation	
Operating elements	switch S1 Position I open circuit current: In the open circuit current principle, the relay becomes active when the limit is reached. Position II closed circuit current: In closed circuit current principle, the relay is activated when power is applied. The relay is deactivated when the limit is reached.

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Level sensing input**
- **Adjustable range 5 kΩ ... 150 kΩ**
- **Latching relay output**
- **Minimum/maximum control**

Function

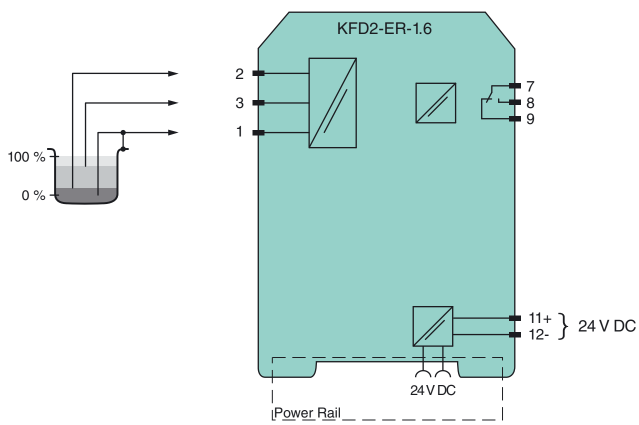
This signal conditioner provides the AC measuring voltage for the level-sensing electrodes.

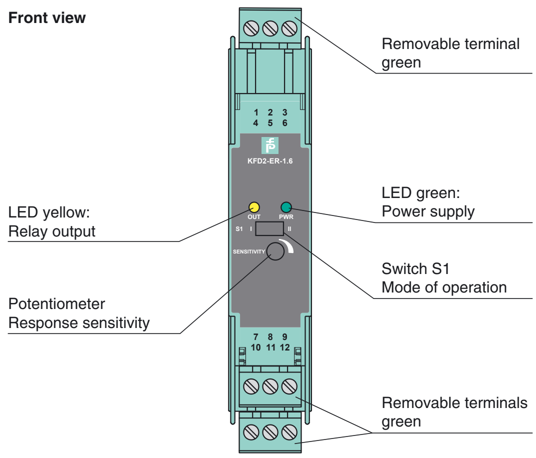
Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

The module is voltage and temperature stabilized and guarantees defined switching characteristics. An electronic holding circuit is used that allows minimum/maximum control. Since the conductance of the media may vary, the relay response sensitivity is adjustable.

The normal output state can be reversed through the mode of operation switch S1.

Diagrams





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Features

- **1-channel signal conditioner**
- **115 V AC supply**
- **Level sensing input**
- **Adjustable range 1 kΩ ... 30 kΩ**
- **Latching relay output**
- **Minimum/maximum control**

Function

This signal conditioner provides the AC measuring voltage for the level-sensing electrodes.

Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

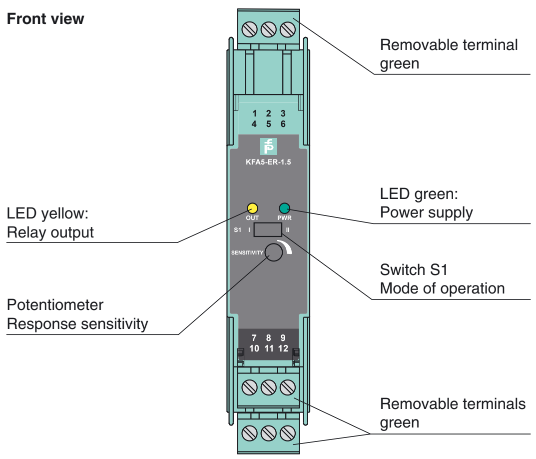
The module is voltage and temperature stabilized and guarantees defined switching characteristics. An electronic holding circuit is used that allows minimum/maximum control. Since the conductance of the media may vary, the relay response sensitivity is adjustable.

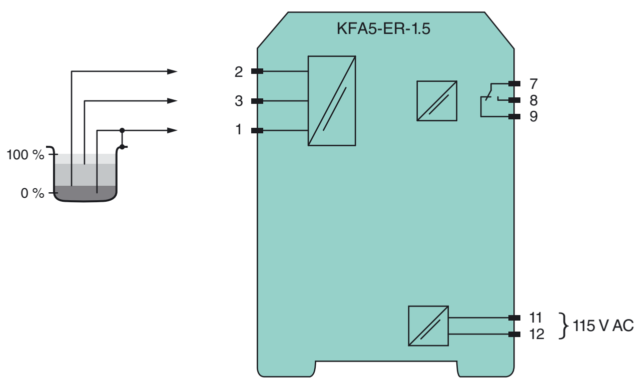
The normal output state can be reversed through the mode of operation switch S1.

Technical data

Supply	
Rated voltage	103.5 ... 126 V AC, 45 ... 65 Hz
Power consumption	approx. 0.8 W
Input	
Open circuit voltage/short-circuit current	approx. 10 V AC (approx. 1 Hz)/approx. 5 mA
Control input	min./max. control system: terminals 1, 2, 3 on/off control system: terminals 1, 3
Response sensitivity	1 ... 30 kΩ, adjustable via potentiometer (20 turns)
Output	
Output	1 changeover contact
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Energized/de-energized delay	approx. 1 s/approx. 1 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 110 g
Dimensions	20 x 107 x 115 mm (0.8 x 4.2 x 4.5 in), housing type B1
Mounting	pull-out latches using for screw mounting
Indication and operation	
Operating elements	switch S1 Position I open circuit current: In the open circuit current principle, the relay becomes active when the limit is reached. Position II closed circuit current: In closed circuit current principle, the relay is activated when power is applied. The relay is deactivated when the limit is reached.

Diagrams





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Technical data

Supply	
Rated voltage	103.5 ... 126 V AC, 45 ... 65 Hz
Power consumption	approx. 0.8 W
Input	
Open circuit voltage/short-circuit current	approx. 10 V AC (approx. 1 Hz)/approx. 5 mA
Control input	min./max. control system: terminals 1, 2, 3 on/off control system: terminals 1, 3
Response sensitivity	5 ... 150 kΩ, adjustable via potentiometer (20 turns)
Output	
Output	1 changeover contact
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Energized/de-energized delay	approx. 1 s/approx. 1 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 110 g
Dimensions	20 x 107 x 115 mm (0.8 x 4.2 x 4.5 in), housing type B1
Mounting	pull-out latches using for screw mounting
Indication and operation	
Operating elements	switch S1 Position I open circuit current: In the open circuit current principle, the relay becomes active when the limit is reached. Position II closed circuit current: In closed circuit current principle, the relay is activated when power is applied. The relay is deactivated when the limit is reached.

Features

- **1-channel signal conditioner**
- **115 V AC supply**
- **Level sensing input**
- **Adjustable range 5 kΩ ... 150 kΩ**
- **Latching relay output**
- **Minimum/maximum control**

Function

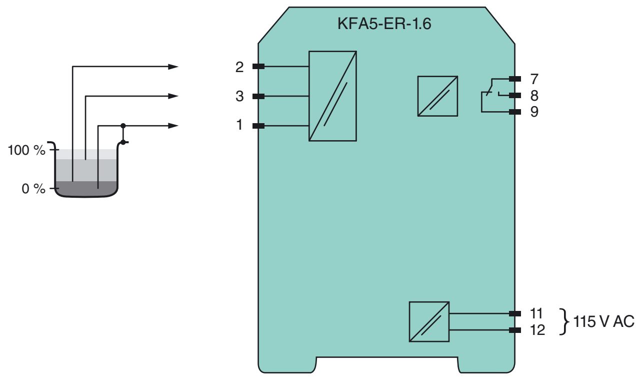
This signal conditioner provides the AC measuring voltage for the level-sensing electrodes.

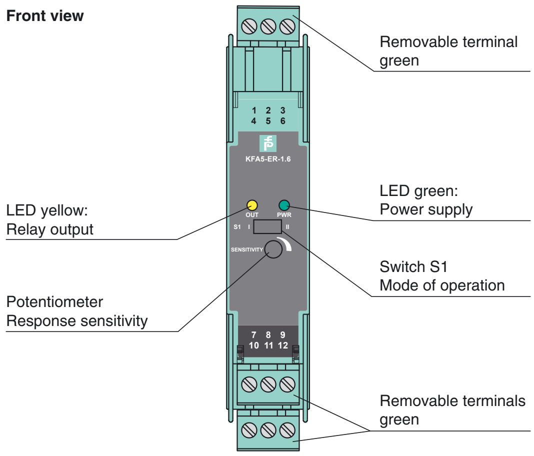
Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

The module is voltage and temperature stabilized and guarantees defined switching characteristics. An electronic holding circuit is used that allows minimum/maximum control. Since the conductance of the media may vary, the relay response sensitivity is adjustable.

The normal output state can be reversed through the mode of operation switch S1.

Diagrams





Edition 912426 (US) / 216306 (EU) 04/2009

Features

- **1-channel signal conditioner**
- **230 V AC supply**
- **Level sensing input**
- **Adjustable range 1 kΩ ... 30 kΩ**
- **Latching relay output**
- **Minimum/maximum control**

Function

This signal conditioner provides the AC measuring voltage for the level-sensing electrodes.

Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

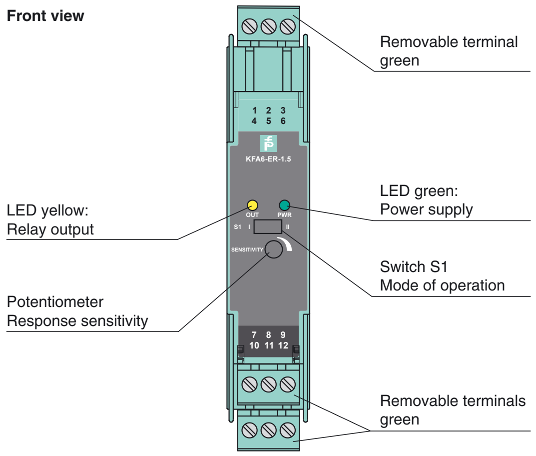
The module is voltage and temperature stabilized and guarantees defined switching characteristics. An electronic holding circuit is used that allows minimum/maximum control. Since the conductance of the media may vary, the relay response sensitivity is adjustable.

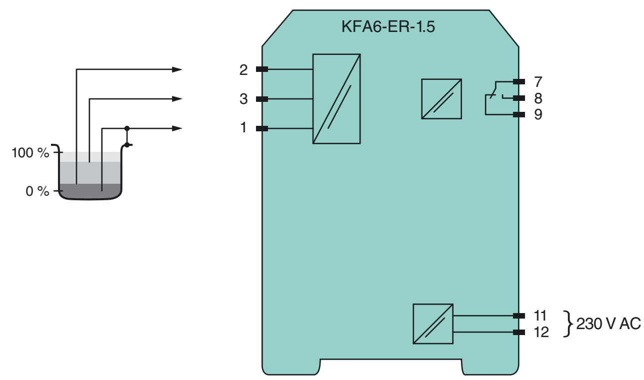
The normal output state can be reversed through the mode of operation switch S1.

Technical data

Supply	
Rated voltage	207 ... 253 V AC, 45 ... 65 Hz
Power consumption	approx. 0.8 W
Input	
Open circuit voltage/short-circuit current	approx. 10 V AC (approx. 1 Hz)/approx. 5 mA
Control input	min./max. control system: terminals 1, 2, 3 on/off control system: terminals 1, 3
Response sensitivity	1 ... 30 kΩ, adjustable via potentiometer (20 turns)
Output	
Output	1 changeover contact
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Energized/de-energized delay	approx. 1 s/approx. 1 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 110 g
Dimensions	20 x 107 x 115 mm (0.8 x 4.2 x 4.5 in), housing type B1
Mounting	pull-out latches using for screw mounting
Indication and operation	
Operating elements	switch S1 Position I open circuit current: In the open circuit current principle, the relay becomes active when the limit is reached. Position II closed circuit current: In closed circuit current principle, the relay is activated when power is applied. The relay is deactivated when the limit is reached.

Diagrams





Edition 912426 (US) / 216306 (EU) 04/2009

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Technical data

Supply	
Rated voltage	207 ... 253 V AC, 45 ... 65 Hz
Power consumption	approx. 0.8 W
Input	
Open circuit voltage/short-circuit current	approx. 10 V AC (approx. 1 Hz)/approx. 5 mA
Control input	min./max. control system: terminals 1, 2, 3 on/off control system: terminals 1, 3
Response sensitivity	5 ... 150 kΩ, adjustable via potentiometer (20 turns)
Output	
Output	1 changeover contact
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Energized/de-energized delay	approx. 1 s/approx. 1 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 110 g
Dimensions	20 x 107 x 115 mm (0.8 x 4.2 x 4.5 in), housing type B1
Mounting	pull-out latches using for screw mounting
Indication and operation	
Operating elements	switch S1 Position I open circuit current: In the open circuit current principle, the relay becomes active when the limit is reached. Position II closed circuit current: In closed circuit current principle, the relay is activated when power is applied. The relay is deactivated when the limit is reached.

Features

- **1-channel signal conditioner**
- **230 V AC supply**
- **Level sensing input**
- **Adjustable range 5 kΩ ... 150 kΩ**
- **Latching relay output**
- **Minimum/maximum control**

Function

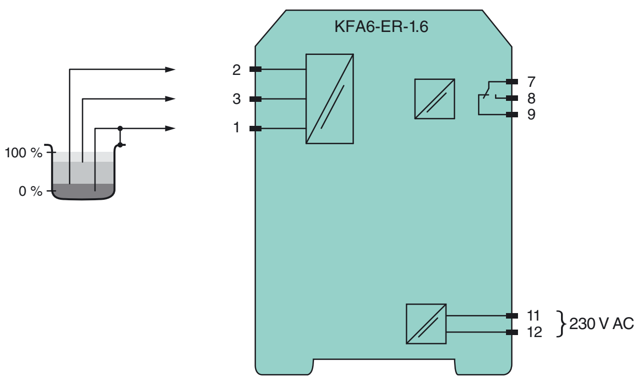
This signal conditioner provides the AC measuring voltage for the level-sensing electrodes.

Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

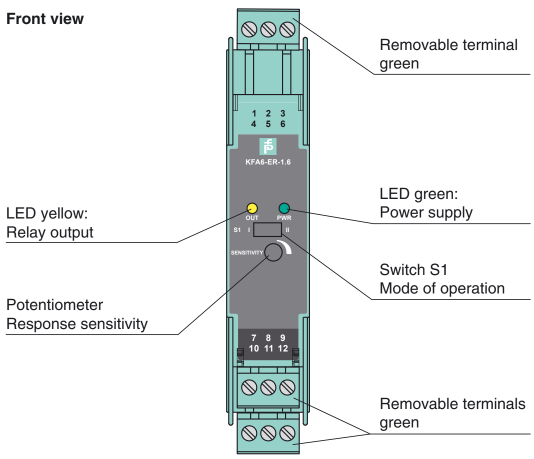
The module is voltage and temperature stabilized and guarantees defined switching characteristics. An electronic holding circuit is used that allows minimum/maximum control. Since the conductance of the media may vary, the relay response sensitivity is adjustable.

The normal output state can be reversed through the mode of operation switch S1.

Diagrams



Front view



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Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Level sensing input**
- **Adjustable range 1 kΩ ... 150 kΩ**
- **Latching relay output**
- **Adjustable time delay up to 10 s**
- **Minimum/maximum control**
- **Line fault detection (LFD)**

Function

This signal conditioner provides the AC measuring voltage for the level sensing electrodes.

Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

The module is voltage and temperature stabilized and guarantees a defined switching characteristic.

It can be used for on/off control or minimum/maximum control. A signal delay feature is available and is adjustable between 0.5 s and 10 s.

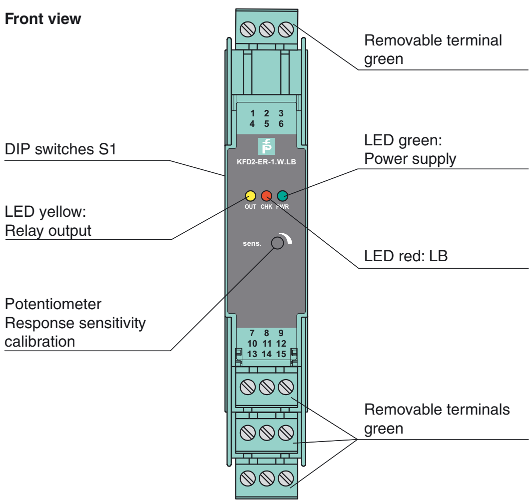
This module can also monitor the field circuit for lead breakage (LB). LB is indicated by a red LED. If LB monitoring is selected, output II serves as the fault signal output; otherwise, it will follow the function of output I.

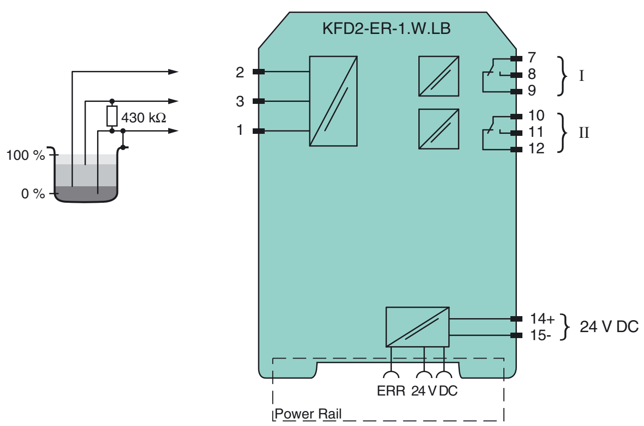
A unique collective error messaging feature is available when used with the Power Rail system.

Technical data

Supply	
Rated voltage	20 ... 30 V DC
Rated current	30 ... 40 mA
Input	
Control input	min./max. control system: terminals 1, 2, 3 on/off control system: terminals 1, 3
Response sensitivity	1 ... 150 kΩ, adjustable via potentiometer
Output	
Switch power	max. 192 W, 2000 VA
Output	relay
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Time constant for signal damping	0.5 s, 2 s, 5 s, 10 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2
Mounting	Power Rail or pull-out latches using for screw mounting

Diagrams





Edition 912426 (US) / 216306 (EU) 04/2009

Technical data

Supply	
Rated voltage	20 ... 30 V DC
Rated current	30 ... 40 mA
Input	
Control input	min./max. control system: terminals 1, 2, 3; 4, 5, 6 on/off control system: terminals 1, 3; 4, 6
Response sensitivity	1 ... 150 kΩ, adjustable via potentiometer
Output	
Switch power	max. 192 W, 2000 VA
Output	relay
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Time constant for signal damping	0.5 s, 2 s, 5 s, 10 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2
Mounting	Power Rail or pull-out latches using for screw mounting

Features

- **2-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Level sensing input**
- **Adjustable range 1 kΩ ... 150 kΩ**
- **Latching relay output**
- **Adjustable time delay up to 10 s**
- **Minimum/maximum control**
- **Line fault detection (LFD)**

Function

This signal conditioner provides the AC measuring voltage for the level sensing electrodes.

Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

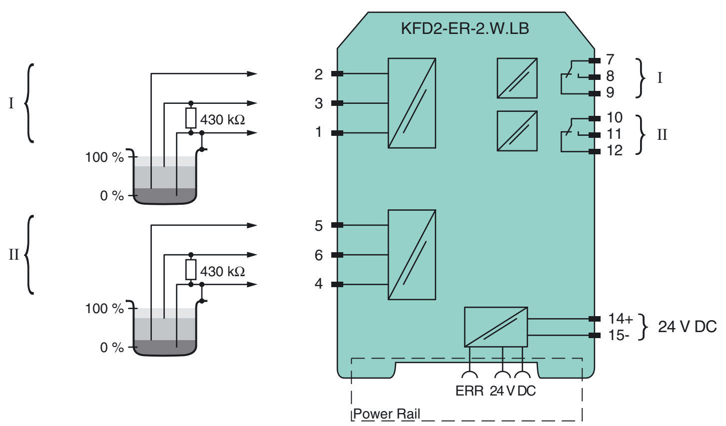
The module is voltage and temperature stabilized and guarantees a defined switching characteristic.

It can be used for on/off control or minimum/maximum control. A signal delay feature is available and is adjustable between 0.5 s and 10 s.

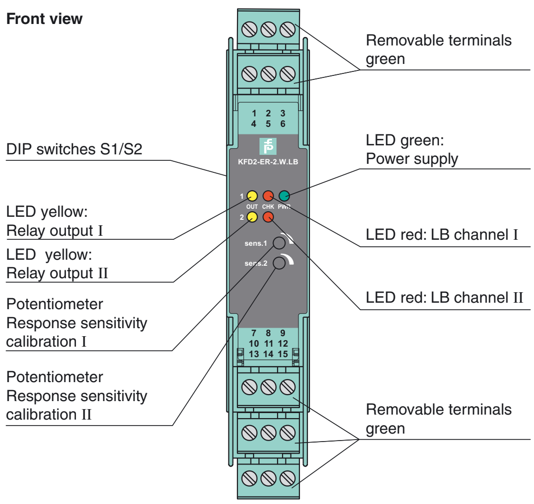
This module can also monitor the field circuit for lead breakage (LB). LB is indicated by a red LED. This function can be deactivated with DIP switches.

A unique collective error messaging feature is available when used with the Power Rail system.

Diagrams



Front view



K-System
Digital Inputs
Digital Outputs
Analog Inputs
Analog Outputs
Accessories

Edition 912426 (US) / 216306 (EU) 04/2009

Features

- **1-channel signal conditioner**
- **115 V AC supply**
- **Level sensing input**
- **Adjustable range 1 kΩ ... 150 kΩ**
- **Latching relay output**
- **Adjustable time delay up to 10 s**
- **Minimum/maximum control**
- **Line fault detection (LFD)**

Function

This signal conditioner provides the AC measuring voltage for the level sensing electrodes.

Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

The module is voltage and temperature stabilized and guarantees a defined switching characteristic.

It can be used for on/off control or minimum/maximum control. A signal delay feature is available and is adjustable between 0.5 s and 10 s.

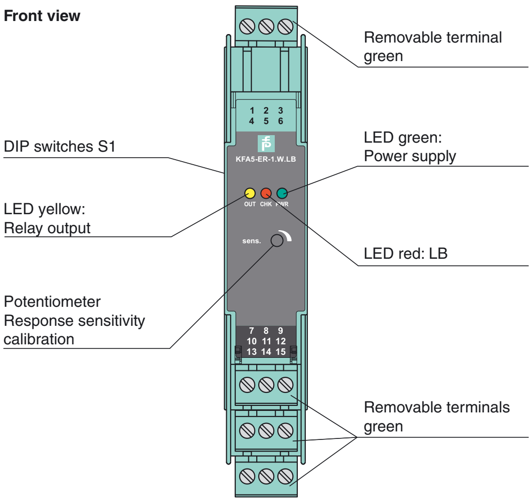
This module can also monitor the field circuit for lead breakage (LB). LB is indicated by a red LED. If LB monitoring is selected, output II serves as the fault signal output; otherwise, it will follow the function of output I.

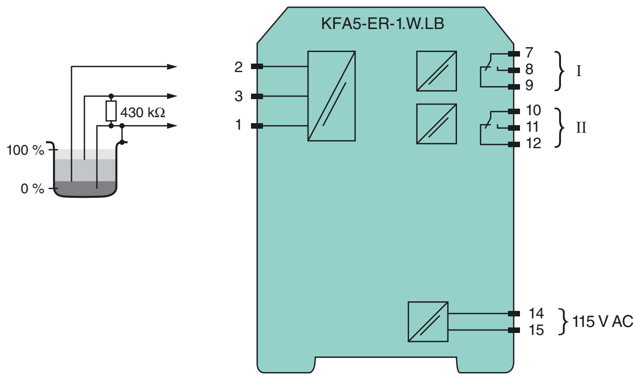
Technical data

Supply	
Rated voltage	103.5 ... 126 V AC, 45 ... 65 Hz
Rated current	12 mA
Power consumption	< 1.2 W
Input	
Control input	min./max. control system: terminals 1, 2, 3 on/off control system: terminals 1, 3
Response sensitivity	1 ... 150 kΩ, adjustable via potentiometer
Output	
Switch power	max. 192 W, 2000 VA
Output	relay
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Time constant for signal damping	0.5 s, 2 s, 5 s, 10 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2
Mounting	pull-out latches using for screw mounting

Diagrams

Front view





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Technical data

Supply	
Rated voltage	103.5 ... 126 V AC, 45 ... 65 Hz
Rated current	12 mA
Power consumption	< 1.2 W
Input	
Control input	min./max. control system: terminals 1, 2, 3; 4, 5, 6 on/off control system: terminals 1, 3; 4, 6
Response sensitivity	1 ... 150 kΩ, adjustable via potentiometer
Output	
Switch power	max. 192 W, 2000 VA
Output	relay
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Time constant for signal damping	0.5 s, 2 s, 5 s, 10 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2
Mounting	pull-out latches using for screw mounting

Features

- **2-channel signal conditioner**
- **115 V AC supply**
- **Level sensing input**
- **Adjustable range 1 kΩ ... 150 kΩ**
- **Latching relay output**
- **Adjustable time delay up to 10 s**
- **Minimum/maximum control**
- **Line fault detection (LFD)**

Function

This signal conditioner provides the AC measuring voltage for the level sensing electrodes.

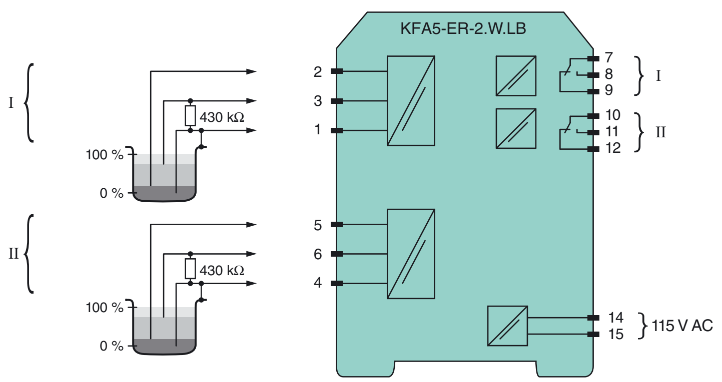
Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

The module is voltage and temperature stabilized and guarantees a defined switching characteristic.

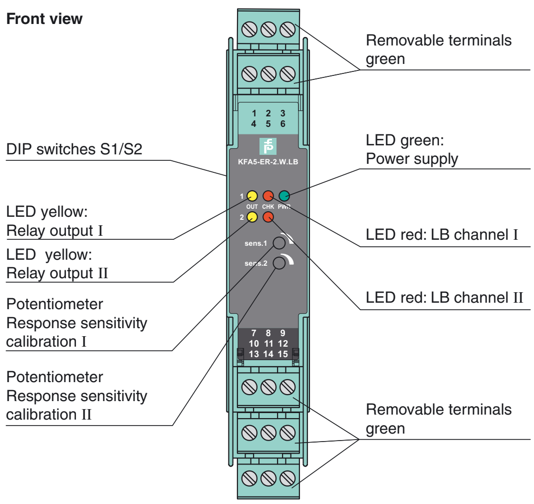
It can be used for on/off control or minimum/maximum control. A signal delay feature is available and is adjustable between 0.5 s and 10 s.

This module can also monitor the field circuit for lead breakage (LB). LB is indicated by a red LED. This function can be deactivated with DIP switches.

Diagrams



Front view



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Features

- **1-channel signal conditioner**
- **230 V AC supply**
- **Level sensing input**
- **Adjustable range 1 kΩ ... 150 kΩ**
- **Latching relay output**
- **Adjustable time delay up to 10 s**
- **Minimum/maximum control**
- **Line fault detection (LFD)**

Function

This signal conditioner provides the AC measuring voltage for the level sensing electrodes.

Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

The module is voltage and temperature stabilized and guarantees a defined switching characteristic.

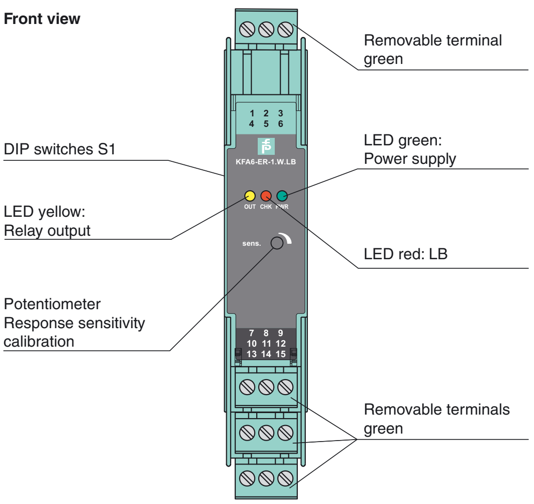
It can be used for on/off control or minimum/maximum control. A signal delay feature is available and is adjustable between 0.5 s and 10 s.

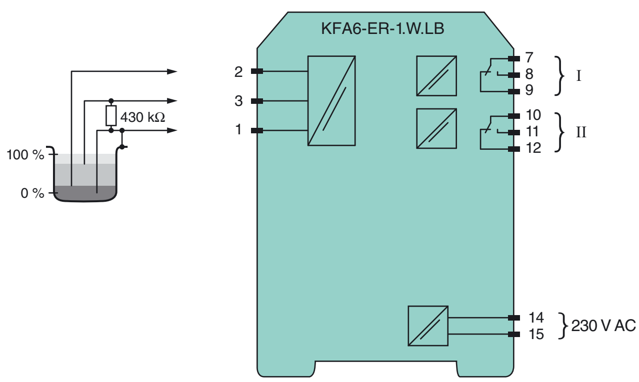
This module can also monitor the field circuit for lead breakage (LB). LB is indicated by a red LED. If LB monitoring is selected, output II serves as the fault signal output; otherwise, it will follow the function of output I.

Technical data

Supply	
Rated voltage	207 ... 253 V AC, 45 ... 65 Hz
Rated current	≤7 mA
Power consumption	< 1.2 W
Input	
Control input	min./max. control system: terminals 1, 2, 3 on/off control system: terminals 1, 3
Response sensitivity	1 ... 150 kΩ, adjustable via potentiometer
Output	
Switch power	max. 192 W, 2000 VA
Output	relay
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Time constant for signal damping	0.5 s, 2 s, 5 s, 10 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2
Mounting	pull-out latches using for screw mounting

Diagrams





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Technical data

Supply	
Rated voltage	207 ... 253 V AC, 45 ... 65 Hz
Rated current	≤7 mA
Power consumption	< 1.2 W
Input	
Control input	min./max. control system: terminals 1, 2, 3; 4, 5, 6 on/off control system: terminals 1, 3; 4, 6
Response sensitivity	1 ... 150 kΩ, adjustable via potentiometer
Output	
Switch power	max. 192 W, 2000 VA
Output	relay
Contact loading	253 V AC/2 A/cos Φ> 0.7; 40 V DC/2 A resistive load
Time constant for signal damping	0.5 s, 2 s, 5 s, 10 s
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Connection	screw connection, max. 2.5 mm^2
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2
Mounting	pull-out latches using for screw mounting

Features

- **2-channel signal conditioner**
- **230 V AC supply**
- **Level sensing input**
- **Adjustable range 1 kΩ ... 150 kΩ**
- **Latching relay output**
- **Adjustable time delay up to 10 s**
- **Minimum/maximum control**
- **Line fault detection (LFD)**

Function

This signal conditioner provides the AC measuring voltage for the level sensing electrodes.

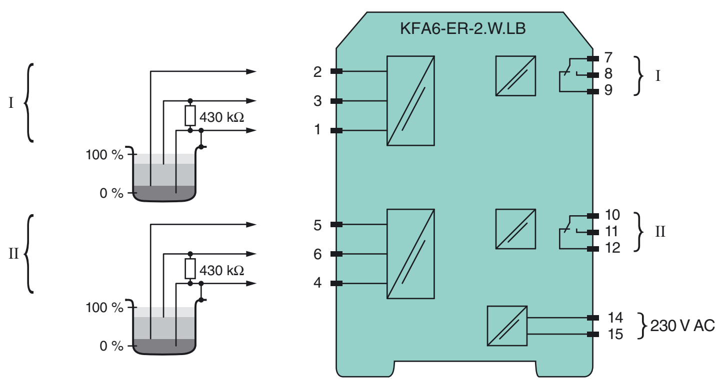
Once the measured medium reaches the electrodes, the unit reacts by energizing a form C changeover relay contact.

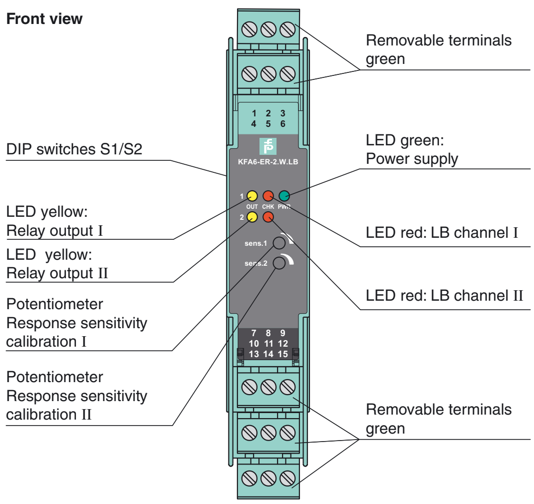
The module is voltage and temperature stabilized and guarantees a defined switching characteristic.

It can be used for on/off control or minimum/maximum control. A signal delay feature is available and is adjustable between 0.5 s and 10 s.

This module can also monitor the field circuit for lead breakage (LB). LB is indicated by a red LED. This function can be deactivated with DIP switches.

Diagrams





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Features

- 1-channel signal conditioner
- 24 V DC supply (Power Rail)
- PNP/push-pull, dry contacts or NAMUR inputs
- Selectable frequency trip values
- 2 relay contact outputs
- Startup override
- Selectable mode of operation
- Up to SIL2 acc. to IEC 61508

Function

This signal conditioner is a zero speed/standstill monitor that accepts input frequency pulses and triggers an output when the frequency drops below a selected value.

Two startup override values are available. This unit can also be used to determine rotation direction.

During an error condition, relays revert to their de-energized state and LEDs indicate the fault according to NAMUR NE44.

The available diagnostic LEDs show rotation detection, limit trip indicator, power on, and hardware error indication.

The unit is easily programmed via switches mounted on the front of the unit.

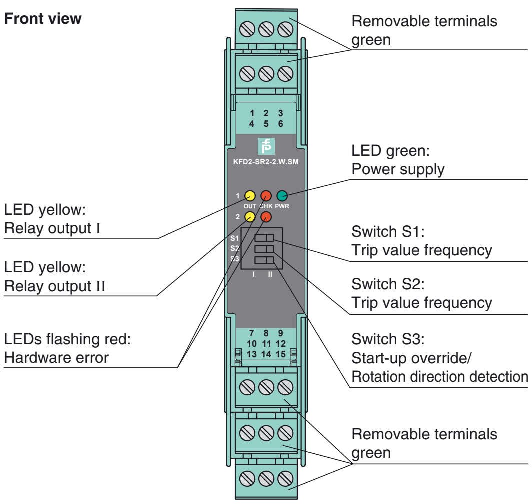
For additional information, refer to www.pepperl-fuchs.com.

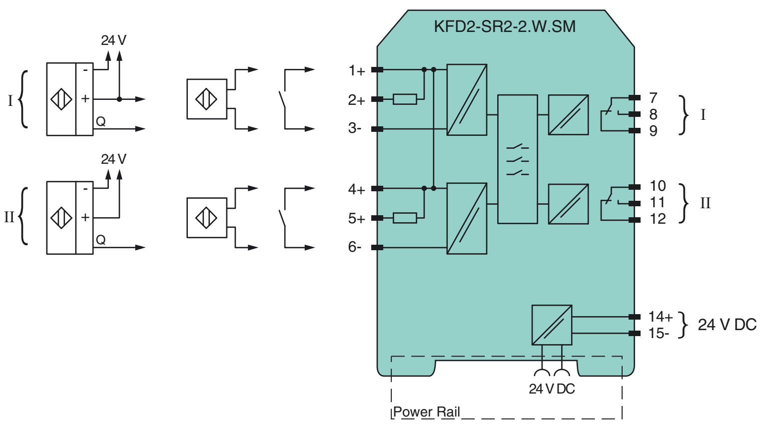
Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power consumption	≤ 1.5 W
Input	
Rated values	acc. to EN 60947-5-6 (NAMUR)
Switching point/switching hysteresis	x ≤ 1.2 mA or x ≥ 2.1 mA/approx. 0.9 mA
Control input	sensor power supply approx. 8.2 V, impedance 1.2 kΩ
Lead monitoring	not available
Pulse duration	> 200 µs for standstill monitoring, > 250 µs for rotation direction detecion
Output	
Relay	2 changeover contacts
Contact loading	253 V AC/2 A /cos Φ> 0.7; 40 V DC/2 A resistive load
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Mechanical life	5 x 10^6 switching cycles
Trip value f_{max}	for standstill monitoring: 0.1 Hz; 0.5 Hz; 2 Hz; 10 Hz adjustable via DIP switch (S1 and S2)
Transfer characteristics	
Accuracy	± 5 %
Startup override	5 seconds or 20 seconds, programmable
Frequency range	≤ 2 kHz
Rotation direction detection	90° phase difference between pulse input signal 1 and 2, overlapping ≥ 125 µs
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Diagrams

Front view





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Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power loss/power consumption	≤ 1.8 W/1.8 W
Input	
Input I	sensor acc. to EN 60947-5-6 (NAMUR) or mechanical contact
Open circuit voltage/short-circuit current	22 V/40 mA
Input resistance	4.7 kΩ
Switching point/switching hysteresis	logic 1: > 2.5 mA; logic 0: < 1.9 mA
Pulse duration	> 50 µs
Input frequency	0.001 ... 12000 Hz
Lead monitoring	breakage I ≤ 0.15 mA; short-circuit I > 4 mA
Input II	startup override: 1 ... 1000 s, adjustable in steps of 1 s
Active/passive	I > 4 mA (for min. 100 ms)/I < 1.5 mA
Open circuit voltage/short-circuit current	18 V/5 mA
Output	
Collective error message	Power Rail
Output I, II	signal, relay
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 40 V DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Transfer characteristics	
Input I	
Measuring range	0.001 ... 12000 Hz
Resolution	0.1 % of measured value, ≥ 0.001 Hz
Accuracy	0.1 % of measured value, > 0.001 Hz
Measuring time	< 100 ms
Influence of ambient temperature	0.003 %/°C (30 ppm)
Output I, II	
Response delay	≤ 200 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Dry contact or NAMUR inputs**
- **Input frequency 1 mHz ... 12 kHz**
- **2 relay contact outputs**
- **Startup override**
- **Configurable by keypad**
- **Line fault detection (LFD)**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner monitors for an overspeed or underspeed condition of a digital signal (NAMUR sensor/mechanical contact) by comparing the input frequency to the user programmed reference frequency.

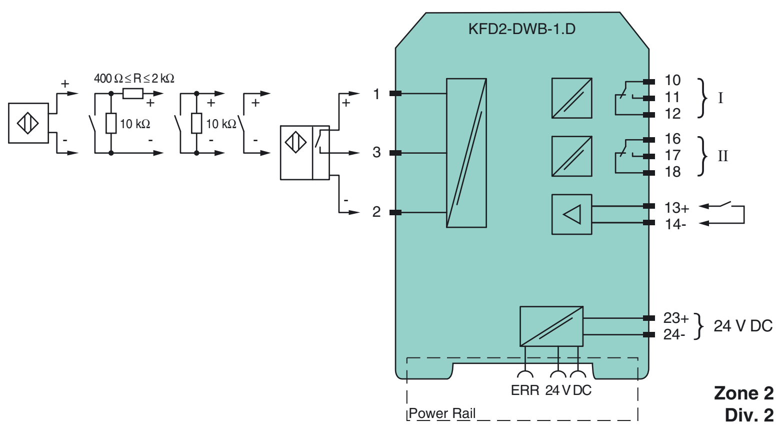
An overspeed or underspeed condition is signaled via the relay outputs. Line fault detection of the field circuit is indicated by a red LED, Power Rail and/or relay. The startup override feature sets relay outputs to default conditions programmed by the user for up to 1,000 seconds.

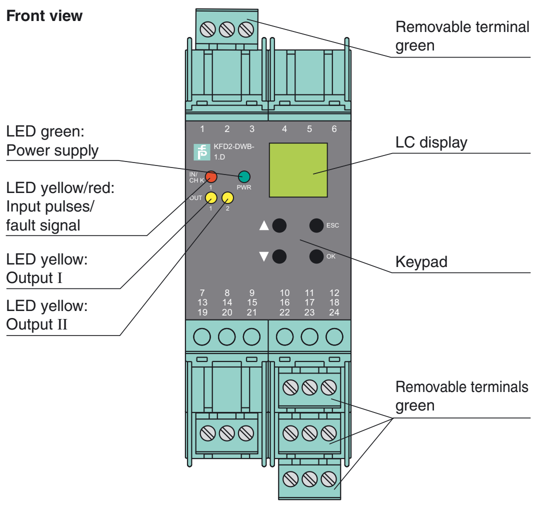
The unit is easily programmed by the use of a keypad located on the front of the unit.

A unique collective error messaging feature is available when used with the Power Rail system.

For additional information, refer to the manual and www.pepperl-fuchs.com.

Diagrams





Edition 912426 (US) / 216306 (EU) 04/2009

Features

- **1-channel signal conditioner**
- **115 V AC supply**
- **Dry contact or NAMUR inputs**
- **Input frequency 1 mHz ... 12 kHz**
- **2 relay contact outputs**
- **Startup override**
- **Configurable by keypad**
- **Line fault detection (LFD)**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner monitors an overspeed or underspeed condition of a digital signal (NAMUR sensor/mechanical contact) by comparing the input frequency to the user programmed reference frequency.

An overspeed or underspeed condition is signaled via the relay outputs. Line fault detection of the field circuit is indicated by a red LED and/or relay. The startup override feature sets relay outputs to default conditions programmed by the user for up to 1,000 seconds.

The unit is easily programmed by the use of a keypad located on the front of the unit.

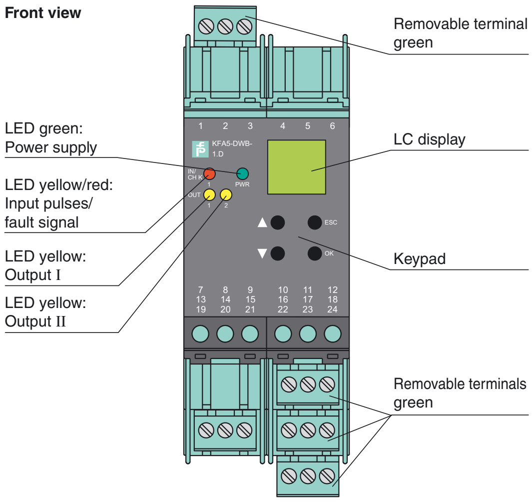
For additional information, refer to the manual and www.pepperl-fuchs.com.

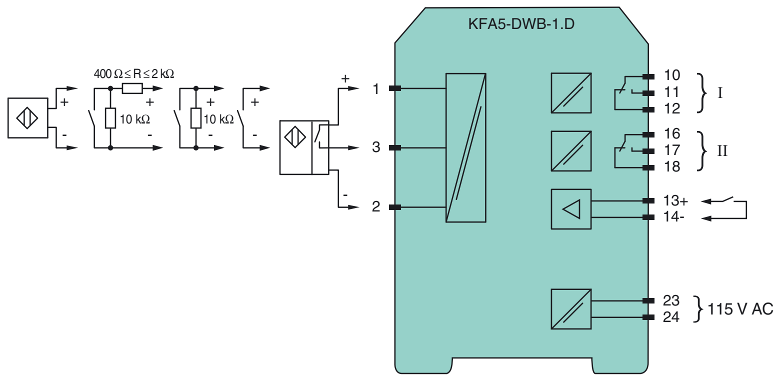
Technical data

Supply	
Rated voltage	115 V AC ± 10 %
Power loss/power consumption	≤ 2 VA/2 VA
Input	
Input I	sensor acc. to EN 60947-5-6 (NAMUR) or mechanical contact
Open circuit voltage/short-circuit current	22 V/40 mA
Input resistance	4.7 kΩ
Switching point/switching hysteresis	logic 1: > 2.5 mA; logic 0: < 1.9 mA
Pulse duration	> 50 µs
Input frequency	0.001 ... 12000 Hz
Lead monitoring	breakage I ≤ 0.15 mA; short-circuit I > 4 mA
Input II	startup override: 1 ... 1000 s, adjustable in steps of 1 s
Active/passive	I > 4 mA (for min. 100 ms)/ I < 1 mA
Open circuit voltage/short-circuit current	18 V/5 mA
Output	
Output I, II	signal, relay
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 40 V DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Transfer characteristics	
Input I	
Measuring range	0.001 ... 12000 Hz
Resolution	0.1 % of the measurement value, ≥ 0.001 Hz
Accuracy	0.1 % of the measurement value, > 0.001 Hz
Measuring time	< 100 ms
Influence of ambient temperature	0.003 %/°C (30 ppm)
Output I, II	
Response delay	≤ 200 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Diagrams

Front view





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Technical data

Supply	
Rated voltage	230 V AC ± 10 %
Power loss/power consumption	≤ 2 VA/2 VA
Input	
Input I	sensor acc. to EN 60947-5-6 (NAMUR) or mechanical contact
Open circuit voltage/short-circuit current	22 V/40 mA
Input resistance	4.7 kΩ
Switching point/switching hysteresis	logic 0: > 2.5 mA; logic 0: < 1.9 mA
Pulse duration	> 50 µs
Input frequency	0.001 ... 12000 Hz
Lead monitoring	breakage I ≤ 0.15 mA; short-circuit I > 4 mA
Input II	startup override: 1 ... 1000 s, adjustable in steps of 1 s
Active/passive	I > 4 mA (for min. 100 ms)/ I < 1 mA
Open circuit voltage/short-circuit current	18 V/5 mA
Output	
Output I, II	signal, relay
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 40 V DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Transfer characteristics	
Input I	
Measuring range	0.001 ... 12000 Hz
Resolution	0.1 % of measured value, ≥ 0.001 Hz
Accuracy	0.1 % of measured value, > 0.001 Hz
Measuring time	< 100 ms
Influence of ambient temperature	0.003 %/°C (30 ppm)
Output I, II	
Response delay	≤ 200 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Features

- **1-channel signal conditioner**
- **230 V AC supply**
- **Dry contact or NAMUR inputs**
- **Input frequency 1 mHz ... 12 kHz**
- **2 relay contact outputs**
- **Startup override**
- **Configurable by keypad**
- **Line fault detection (LFD)**
- **Up to SIL2 acc. to IEC 61508**

Function

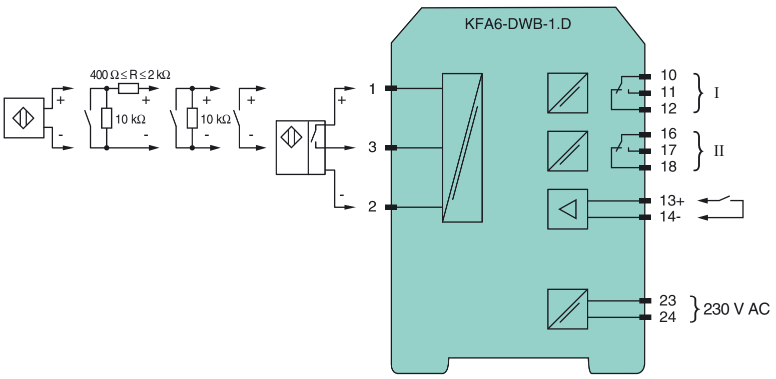
This signal conditioner monitors an overspeed or underspeed condition of a digital signal (NAMUR sensor/mechanical contact) by comparing the input frequency to the user programmed reference frequency.

An overspeed or underspeed condition is signaled via the relay outputs. Line fault detection of the field circuit is indicated by a red LED and/or relay. The startup override feature sets relay outputs to default conditions programmed by the user for up to 1,000 seconds.

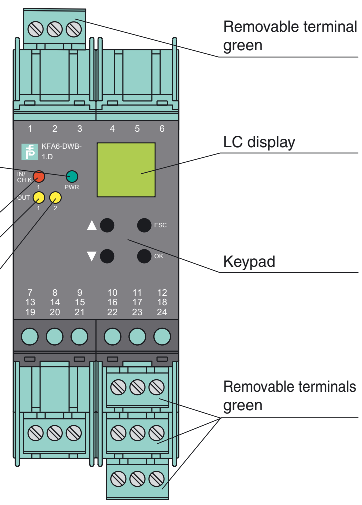
The unit is easily programmed by the use of a keypad located on the front of the unit.

For additional information, refer to the manual and www.pepperl-fuchs.com.

Diagrams



Front view



Edition 912426 (US) / 216306 (EU) 04/2009

Features

- 1-channel signal conditioner
- AC/DC wide range supply
- Dry contact or NAMUR inputs
- Input frequency 1 mHz ... 12 kHz
- 2 relay contact outputs
- Startup override
- Configurable by keypad
- Line fault detection (LFD)
- Up to SIL2 acc. to IEC 61508

Function

This signal conditioner monitors an overspeed or underspeed condition of a digital signal (NAMUR sensor/mechanical contact) by comparing the input frequency to the user programmed reference frequency.

An overspeed or underspeed condition is signaled via the relay outputs. Line fault detection of the field circuit is indicated by a red LED and/or relay. The startup override feature sets relay outputs to default conditions programmed by the user for up to 1,000 seconds.

The unit is easily programmed by the use of a keypad located on the front of the unit.

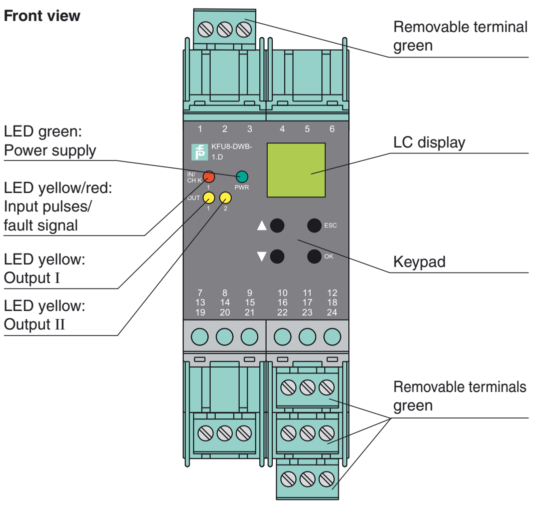
For additional information, refer to the manual and www.pepperl-fuchs.com.

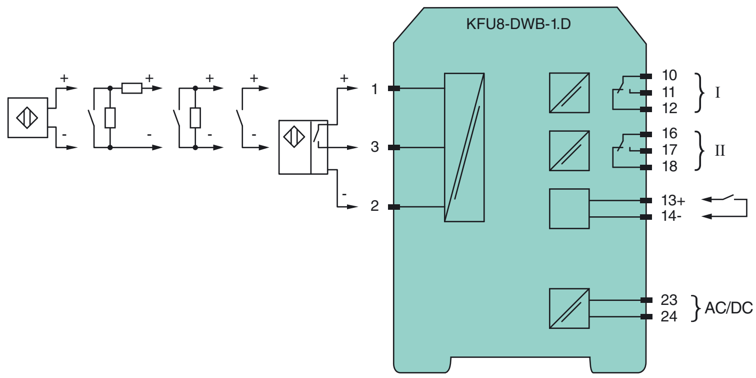
Technical data

Supply	
Rated voltage	20 ... 90 V DC/48 ... 253 V AC 50 ... 60 Hz
Power loss/power consumption	≤ 1.8 W; 2 VA/1.8 W; 2 VA
Input	
Lead monitoring	breakage I ≤ 0.15 mA; short-circuit I > 6.5 mA
Input I	sensor acc. to EN 60947-5-6 (NAMUR) or mechanical contact
Open circuit voltage/short-circuit current	22 V/40 mA
Input resistance	4.7 kΩ
Switching point/switching hysteresis	logic 1: > 2.5 mA; logic 0: < 1.9 mA
Pulse duration	> 50 µs
Input frequency	0.001 ... 12000 Hz
Lead monitoring	breakage I ≤ 0.15 mA; short-circuit I > 4 mA
Input II	startup override: 1 ... 1000 s, adjustable in steps of 1 s
Active/passive	I > 4 mA (for min. 100 ms)/I < 1.5 mA
Open circuit voltage/short-circuit current	18 V/5 mA
Output	
Output I, II	signal, relay
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 40 V DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Transfer characteristics	
Input I	
Measuring range	0.001 ... 12000 Hz
Resolution	0.1 % of measured value, ≥ 0.001 Hz
Accuracy	0.1 % of measured value, > 0.001 Hz
Measuring time	< 100 ms
Influence of ambient temperature	0.003 %/°C (30 ppm)
Output I, II	
Response delay	≤ 200 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Diagrams

Front view





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PEPPERL+FUCHS
PROTECTING YOUR PROCESS

Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power loss/power consumption	≤ 2 W/2.2 W
Input	
Input I	sensor acc. to EN 60947-5-6 (NAMUR) or mechanical contact
Open circuit voltage/short-circuit current	22 V/40 mA
Input resistance	4.7 kΩ
Switching point/switching hysteresis	logic 1: > 2.5 mA; logic 0: < 1.9 mA
Pulse duration	> 50 µs
Input frequency	0.001 ... 12000 Hz
Lead monitoring	breakage I ≤ 0.15 mA; short-circuit I > 4 mA
Input II	startup override: 1 ... 1000 s, adjustable in steps of 1 s
Active/passive	I > 4 mA (for min. 100 ms)/I < 1.5 mA
Open circuit voltage/short-circuit current	18 V/5 mA
Output	
Collective error message	Power Rail
Output I, II	signal, relay
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 40 V DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Output III	electronic output, passive
Contact loading	40 V DC
Signal level	1-signal: (L+) -2.5 V (50 mA, short-circuit/overload proof) 0-signal: blocked output (off-state current ≤ 10 µA)
Output IV	analog
Current range	0 ... 20 mA or 4 ... 20 mA
Open circuit voltage	≤ 24 V DC
Load	≤ 650 Ω
Fault signal	downscale I ≤ 3.6 mA, upscale ≥ 21.5 mA (acc. NAMUR NE43)
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Dry contact or NAMUR inputs**
- **Input frequency 1 mHz ... 12 kHz**
- **Current output 0/4 mA ... 20 mA**
- **Relay and transistor output**
- **Startup override**
- **Configurable by PACT*ware*™ or keypad**
- **Line fault detection (LFD)**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner is an universal frequency converter that changes a digital input (NAMUR sensor/mechanical contact) into a proportional free adjustable 0/4 mA ... 20 mA analog output and functions as a switch amplifier and a trip alarm.

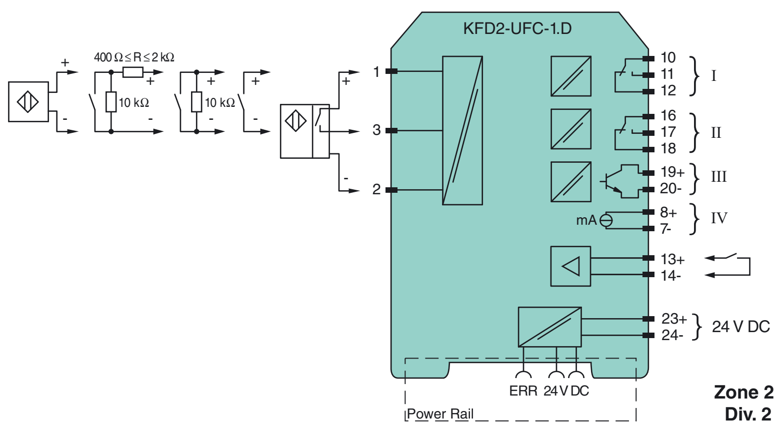
Also the functions of the switch outputs (2 relay outputs and 1 potential free transistor output) are easily adjustable [trip value display (min/max alarm), serially switched output, pulse divider output, error signal output].

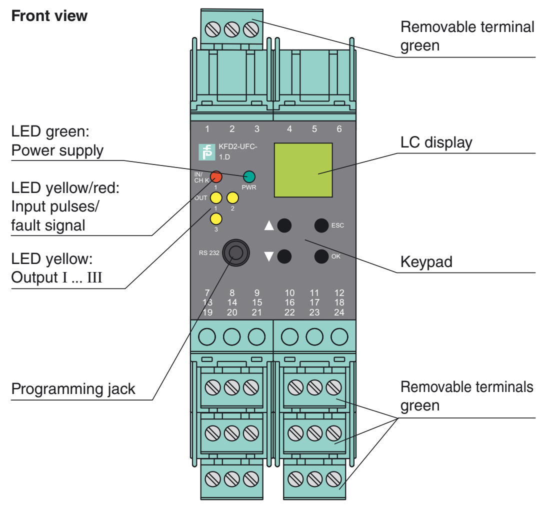
The unit is easily programmed by the use of a keypad located on the front of the unit or with the **PACT*ware*™** configuration software.

Line fault detection of the field circuit is indicated by a red LED and through the collective error output via Power Rail.

For additional information, refer to the manual and www.pepperl-fuchs.com.

Diagrams





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Features

- **1-channel signal conditioner**
- **AC/DC wide range supply**
- **Dry contact or NAMUR inputs**
- **Input frequency 1 mHz ... 12 kHz**
- **Current output 0/4 mA ... 20 mA**
- **Relay and transistor output**
- **Startup override**
- **Configurable by PACT*ware*™ or keypad**
- **Line fault detection (LFD)**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner is an universal frequency converter that changes a digital input (NAMUR sensor/mechanical contact) into a proportional free adjustable 0/4 mA ... 20 mA analog output and functions as a switch amplifier and a trip alarm.

Also the functions of the switch outputs (2 relay outputs and 1 potential free transistor output) are easily adjustable [trip value display (min/max alarm), serially switched output, pulse divider output, error signal output].

The unit is easily programmed by the use of a keypad located on the front of the unit or with the **PACT***ware*™ configuration software.

Line fault detection of the field circuit is indicated by a red LED.

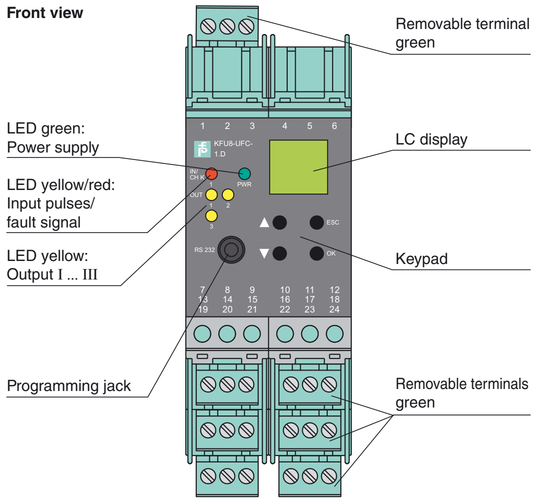
For additional information, refer to the manual and www.pepperl-fuchs.com.

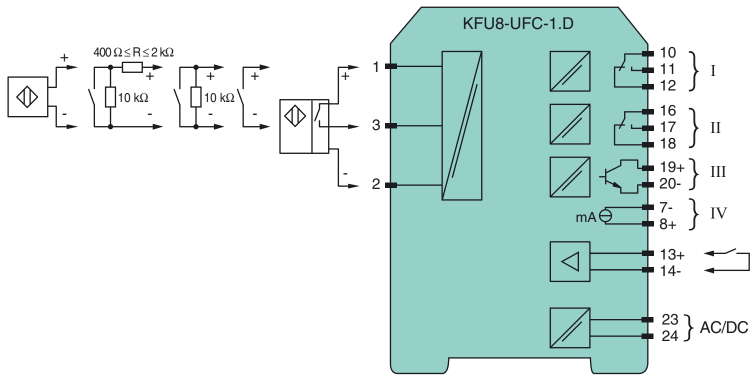
Technical data

Supply	
Rated voltage	20 ... 90 V DC/48 ... 253 V AC 50 ... 60 Hz
Power loss/power consumption	≤ 2 W; 2.5 VA/2.2 W; 3 VA
Input	
Input I	sensor acc. to EN 60947-5-6 (NAMUR) or mechanical contact
Open circuit voltage/short-circuit current	22 V/40 mA
Input resistance	4.7 kΩ
Switching point/switching hysteresis	logic 1: > 2.5 mA; logic 0: < 1.9 mA
Pulse duration	> 50 µs
Input frequency	0.001 ... 12000 Hz
Lead monitoring	breakage I ≤ 0.15 mA; short-circuit I > 4 mA
Input II	startup override: 1 ... 1000 s, adjustable in steps of 1 s
Active/passive	I > 4 mA (for min. 100 ms)/I < 1.5 mA
Open circuit voltage/short-circuit current	18 V/5 mA
Output	
Output I, II	signal, relay
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 40 V DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Output III	electronic output, passive
Contact loading	40 V DC
Signal level	1-signal: (L+) -2.5 V (50 mA, short-circuit/overload proof) 0-signal: blocked output (off-state current ≤ 10 µA)
Output IV	analog
Current range	0 ... 20 mA or 4 ... 20 mA
Open circuit voltage	≤ 24 V DC
Load	≤ 650 Ω
Fault signal	downscale I ≤ 3.6 mA, upscale ≥ 21.5 mA (acc. NAMUR NE43)
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Diagrams

Front view





Edition 912426 (US) / 216306 (EU) 04/2009

Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power consumption	2.5 W
Input	
Input I, II	sensor acc. to EN 60947-5-6 (NAMUR) or mechanical contact
Open circuit voltage/short-circuit current	8.2 V/10 mA
Switching point/switching hysteresis	logic 1: > 2.5 mA; logic 0: < 1.9 mA
Input frequency	rotation direction monitoring 0.001 ... 1000 Hz slip monitoring 10 ... 1000 Hz
Lead monitoring	breakage I ≤ 0.15 mA; short-circuit I > 4 mA
Input III, IV	
Active/passive	I > 4 mA (for min. 100 ms)/I < 1.5 mA
Open circuit voltage/short-circuit current	18 V/5 mA
Output	
Collective error message	Power Rail
Output I, II	signal, relay
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 40 DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Output III and IV	signal, electronic output, passive
Contact loading	40 V DC
Signal level	1-signal: (L+) -2.5 V (50 mA, short-circuit/overload proof) 0-signal: blocked output (off-state current ≤ 10 µA)
Output V	analog
Current range	0 ... 20 mA or 4 ... 20 mA
Load	max. 650 Ω
Fault signal	downscale I ≤ 3.6 mA, upscale I ≥ 21.5 mA (acc. NAMUR NE43)
Programming interface	
Connection	programming jack
Interface	RS 232
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Features

- **2-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Dry contact or NAMUR inputs**
- **Input frequency 1 mHz ... 1 kHz**
- **Current output 0/4 mA ... 20 mA**
- **Relay and transistor output**
- **Startup override**
- **Configurable by PACT*ware*™ or keypad**
- **Line fault detection (LFD)**

Function

This signal conditioner analyzes 2 digital signals (NAMUR sensor/mechanical contact) and functions as a rotation direction indicator, slip monitor, frequency monitor or synchronization monitor.

Each proximity sensor or switch controls a passive transistor output. The 2 relay outputs indicate if the input signal is above or below the trip value or the rotational direction.

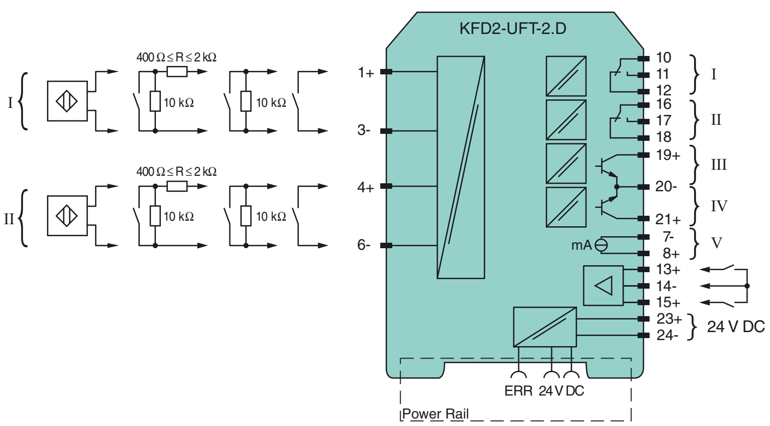
The analog output can be programmed to be proportional to the input frequency or slip differential.

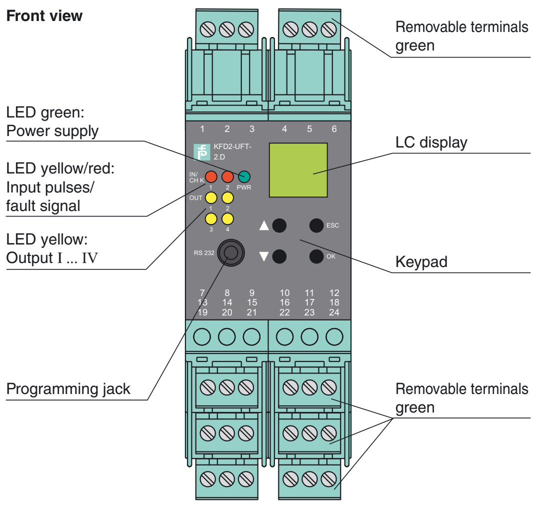
The unit is easily programmed by the use of a keypad located on the front of the unit or with the **PACT*ware*™** configuration software.

Line fault detection of the field current is indicated by a red LED and through the collective error output via Power Rail.

For additional information, refer to the manual and www.pepperl-fuchs.com.

Diagrams





K-System
Digital Inputs
Digital Outputs
Analog Inputs
Analog Outputs
Accessories

Edition 912426 (US) / 216306 (EU) 04/2009

Features

- **2-channel signal conditioner**
- **AC/DC wide range supply**
- **Dry contact or NAMUR inputs**
- **Input frequency 1 mHz ... 1 kHz**
- **Current output 0/4 mA ... 20 mA**
- **Relay and transistor output**
- **Startup override**
- **Configurable by PACT*ware*TM or keypad**
- **Line fault detection (LFD)**

Function

This signal conditioner analyzes 2 digital signals (NAMUR sensor/mechanical contact) and functions as a rotation direction indicator, slip monitor, frequency monitor or synchronization monitor.

Each proximity sensor or switch controls a passive transistor output. The 2 relay outputs indicate if the input signal is above or below the trip value or the rotational direction.

The analog output can be programmed to be proportional to the input frequency or slip differential.

The unit is easily programmed by the use of a keypad located on the front of the unit or with the **PACT***ware***™** configuration software.

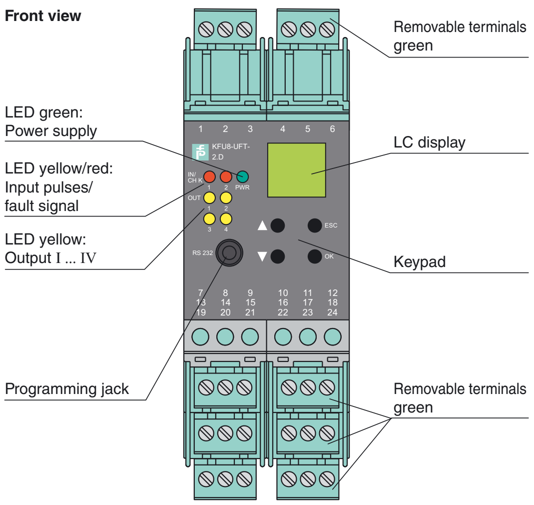
Line fault detection of the field current is indicated by a red LED.

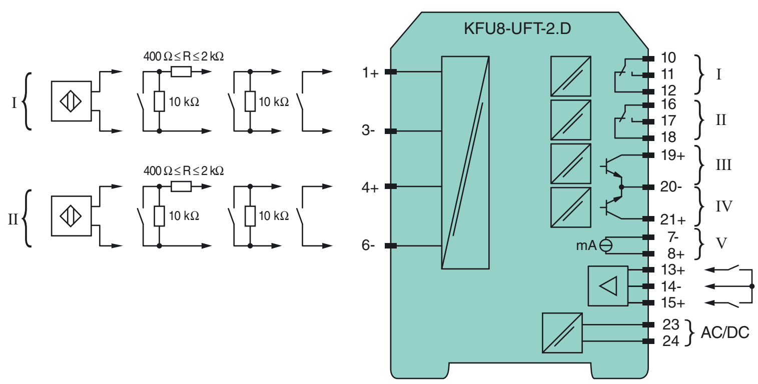
For additional information, refer to the manual and www.pepperl-fuchs.com.

Technical data

Supply	
Rated voltage	20 ... 90 V DC/48 ... 253 V AC 50 ... 60 Hz
Power consumption	2.5 W/4 VA
Input	
Input I, II	sensor acc. to EN 60947-5-6 (NAMUR) or mechanical contact
Open circuit voltage/short-circuit current	8.2 V/10 mA
Switching point/switching hysteresis	logic 1: > 2.5 mA; logic 0: < 1.9 mA
Input frequency	rotation direction monitoring 0.001 ... 1000 Hz slip monitoring 10 ... 1000 Hz
Lead monitoring	breakage I ≤ 0.15 mA; short-circuit I > 4 mA
Input III, IV	
Active/passive	I > 4 mA (for min. 100 ms)/I < 1.5 mA
Open circuit voltage/short-circuit current	18 V/5 mA
Output	
Output I, II	signal, relay
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 40 DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Output III and IV	signal, electronic output, passive
Contact loading	40 V DC
Signal level	1-signal: (L+) -2.5 V (50 mA, short-circuit/overload proof) 0-signal: blocked output (off-state current ≤ 10 µA)
Output V	analog
Current range	0 ... 20 mA or 4 ... 20 mA
Open circuit voltage	max. 24 V DC
Load	max. 650 Ω
Fault signal	downscale I ≤ 3.6 mA, upscale I ≥ 21.5 mA (acc. NAMUR NE43)
Programming interface	
Connection	programming jack
Interface	RS 232
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Diagrams





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Solenoid Drivers

Model Number	Channels	Input (Control System)		Output (Field)		Supply 24 V DC	SIL	Page
		Loop Powered	Logic Input	Voltage (V)	Max. Current (mA)			
KFD2-SL-4	4		■	24	600	■	2	86

Relay Outputs

Model Number	Channels	Input (Control System)		Output (Field)	Supply		SIL	Page
		Loop Powered	Logic Input	Relay	24 V DC	Loop Powered		
KFD0-RSH-1	1	■	■	1		■	3	87

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Features

- **4-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Output 600 mA at 0.2 V DC supply voltage**
- **Logic input, non-polarized**
- **Emergency shutdown input**
- **Line fault detection (LFD)**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner is a 4-channel barrier with outputs that switch 600 mA to high-power solenoids. It is also used as power amplifier up to a switching frequency of 1 kHz.

Two channels per module can be paralleled. The output current of a parallel combination is 1.2 A. If the supply voltage falls below 18 V, the outputs will be switched off.

Lead breakage and short circuit, which is selected via DIP switch, is indicated by a red LED and through the collective error output via Power Rail.

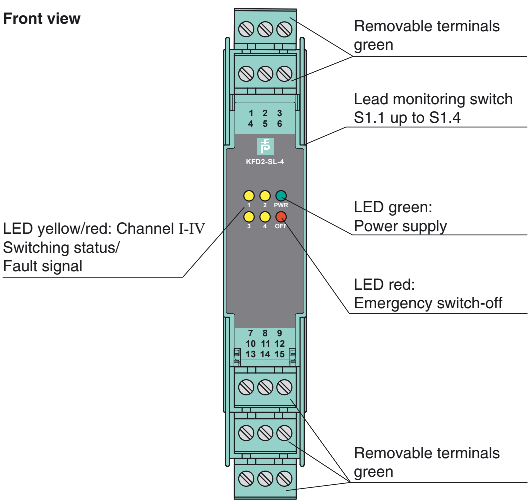
With the emergency shut down input (terminals 11 and 12), the auxiliary power for all 4 channels can be switched off simultaneously. This central switch-off is also indicated by a red LED and reported as an error signal to the Power Rail.

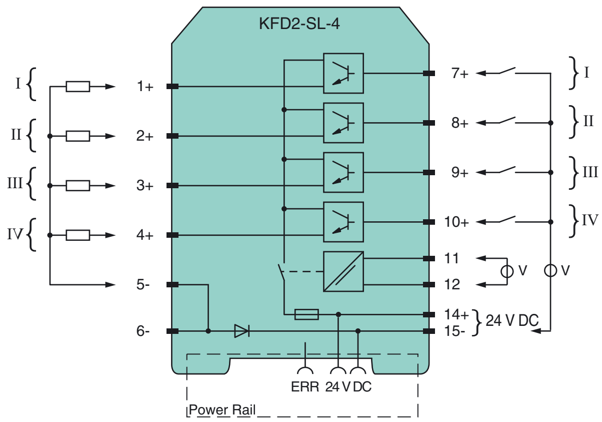
Technical data

Supply	
Rated voltage	20 ... 30 V DC
Input	
Input current	approx. 2 mA at 24 V DC
Signal level	0-signal: 0 ... 5 V DC 1-signal: 16 ... 30 V
Emergency-stop input	
Input current	≤ 50 mA at 24 V, depolarized currentless state: downscale of the outputs
Safely switch on	≥ 15 V (ascending voltage)
Safely switch off	≤ 5 V (descending voltage)
Output	
Internal resistor	0 Ω
Open circuit voltage	24 V DC
Switching frequency f	1 kHz
Output rated operating current	600 mA
Output signal	0 ... 600 mA (operating voltage - 0.2 V)
Off-state current I_r	< 1 mA at 24 V DC
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Diagrams

Front view





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Technical data

Supply	
Power consumption	< 1.5 W
Input	
Pulse/Pause ratio	≥ 20 ms/≥ 20 ms
Signal level	0-signal: 0 ... 5 V DC 1-signal: 16 ... 30 V
Rated current I_e	approx. 50 mA
Output	
Contact loading	230 V AC/2 A/cos Φ0.7; 40 V DC/2 A resistive load
Minimum switch current	2 mA/24 V DC
Energized/de-energized delay	approx. 10 ms/approx. 5 ms
Mechanical life	5 x 10^6 switching cycles
Transfer characteristics	
Switching frequency	< 10 Hz
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Features

- **1-channel signal conditioner**
- **24 V DC supply (loop powered)**
- **Fail-safe relay contact output**
- **Logic input 16 V DC ... 30 V DC, non-polarized**
- **Up to SIL3 acc. to IEC 61508**

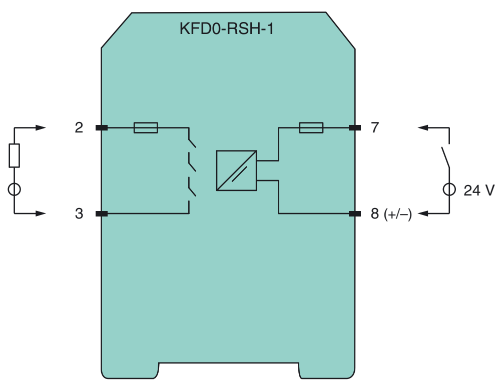
Function

This signal conditioner is a relay module that is suitable for safely switching applications of a load circuit. The device isolates load circuits up to 230 V and the 24 V control interface.

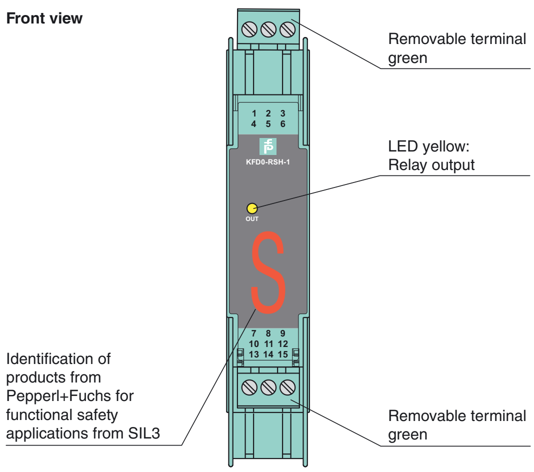
The output is galvanically isolated from the input and is protected against contact welding by a fuse.

The three relays are of diverse design, but have a common effect on the switch output.

Diagrams



Front view



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Transmitter Power Supplies

Model Number	Channels	Input (Field)		Output (Control System)				Specials		Supply		SIL	Page
		2-wire Transmitters	Current Source	0/4 mA ... 20 mA (Source)	0/4 mA ... 20 mA (Sink)	1 V ... 5 V	0/2 V ... 10 V	SMART	Signal Splitting (1 input – 2 outputs)	24 V DC	115 V AC/ 230 V AC		
KCD2-STC-1	1	■	■	■	■	■		■		■		2	91
KFD2-STC4-1	1	■	■	■				■		■		2	92
KFD2-STV4-1-1	1	■	■			■		■		■		2	93
KFD2-CR4-1	1	■	■	■						■		2	94
KFD2-STC4-1.2O	1	■	■	2				■	■	■		2	95
KFD2-CR4-1.2O	1	■	■	2					■	■		2	96
KFD2-STC4-2	2	■		2				■		■		2	97
KFD2-STV4-2-1	2	■				2		■		■		2	98
KFD2-CR4-2	2	■		2						■		2	99

Transmitter Power Supplies with Trip Values

Model Number	Channels	Input (Field)		Output (Control System)			Supply		SIL	Page
		2-wire Transmitters	Current Source	0/4 mA ... 20 mA (Source)	Relay	SMART	24 V DC	115 V AC/ 230 V AC		
KFD2-CRG2-1.D	1	■	■	1	2		■		2	100
KFU8-CRG2-1.D	1	■	■	1	2		■	■	2	101

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Current and Voltage Converters

Model Number	Channels	Input (Field)					Output (Control System)			Supply			SIL	Page
		mV	-10 V ... 10 V	0/2 V ... 10 V	0/4 mA ... 20 mA	Strain Gauge	0/4 mA ... 20 mA	0/2 V ... 10 V	Relay	24 V DC	Loop Powered	115 V AC/ 230 V AC		
KFD0-CC-1	1			■	■		■				■			102
KFD2-USC-1.D	1	■		■	■		■	■	■	■				103
KFU8-USC-1.D	1	■		■	■		■	■	■	■		■		104
KFD2-GS-1.2W	1			■	■				2	■				105
KFD2-WAC2-1.D	1	■				■	■		2	■				106
KFD0-VC-1.10	1		■				■				■			107

Temperature Converters and Repeaters

Model Number	Channels	Input (Field)				Output (Control System)			Supply		SIL	Page
		RTD	TC	Potentiometer	V	0/4 mA ... 20 mA	0/1 V ... 5 V	Resistance	24 V DC	Loop Powered		
KFD2-UT2-1	1	■	■	■	■	■			■		2	108
KFD2-UT2-1-1	1	■	■	■	■		■		■		2	109
KFD2-UT2-2	2	■	■	■	■	2			■		2	110
KFD2-UT2-2-1	2	■	■	■	■		2		■		2	111
KFD0-TR-1	1	■				■				■		112
KFD0-TT-1	1		■			■				■		113

Temperature Converters with Trip Values

Model Number	Channels	Input (Field)					Output (Control System)		Supply		SIL	Page
		RTD	TC	Potentiometer	V	mA	4 mA ... 20 mA	Relay	24 V DC	115 V AC/ 230 V AC		
KFD2-GU-1	1	■	■		■	■	■	2	■			114
KFD2-GUT-1.D	1	■	■	■	■		■	2	■		2	115
KFU8-GUT-1.D	1	■	■	■	■		■	2	■	■	2	116

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Technical data

Supply	
Rated voltage	19 ... 30 V DC
Power consumption	≤ 1.1 W
Input	
Input signal	4 ... 20 mA limited to approx. 30 mA
Voltage drop U_d	approx. 5 V on terminals 3+, 4-
Available voltage	≥ 15 V at 20 mA terminals 1+, 2-
Output	
Load	0 ... 300 Ω (source mode)
Output signal	4 ... 20 mA or 1 ... 5 V (on 250 Ω , 0.1 % internal shunt) 4 ... 20 mA (sink mode), operating voltage 15.5 ... 26 V
Ripple	20 mV_{rms}
Transfer characteristics	
Deviation	at 20 °C (293 K) ≤ ± 0.1 % incl. non-linearity and hysteresis (source mode 4 ... 20 mA) ≤ ± 0.2 % incl. non-linearity and hysteresis (sink mode 4 ... 20 mA) ≤ ± 0.2 % incl. non-linearity and hysteresis (source mode 1 ... 5 V)
Influence of ambient temperature	< 2 µA/°C (0 ... +60 °C); < 4 µA/°C (-20 ... 0 °C) (source mode and sink mode 4 ... 20 mA) < 0.5 mV/°C (0 ... +60 °C); < 1 mV/°C (-20 ... 0 °C) (source mode 1 ... 5 V)
Frequency range	bandwidth with 0.5 V_{pp}-signal 0 ... 3 kHz (-3 dB)
Rise time	10 to 90 % ≤ 20 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	12.5 x 114 x 125 mm (0.5 x 4.5 x 4.9 in), housing type A2

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **2-wire SMART transmitters or current sources**
- **Output 4 mA ... 20 mA or 1 V ... 5 V**
- **Sink or source mode**
- **Housing width 12.5 mm**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner provides 2-wire SMART transmitters with power and transfers the analog values. It can also be used with 2-wire SMART current sources.

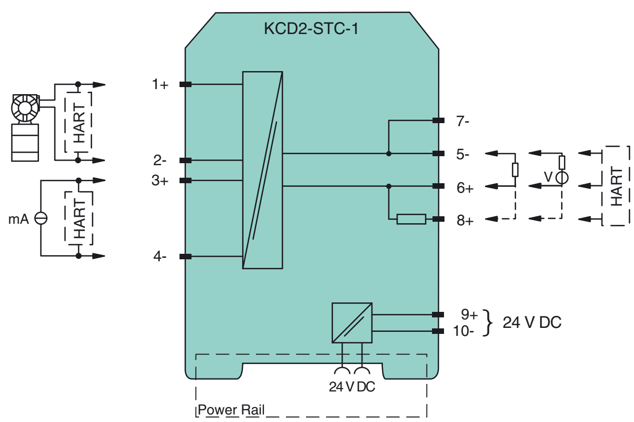
Digital signals may be superimposed on the analog values and are transferred bi-directionally.

Selectable output of current source, sink mode, or voltage output is available via DIP switches.

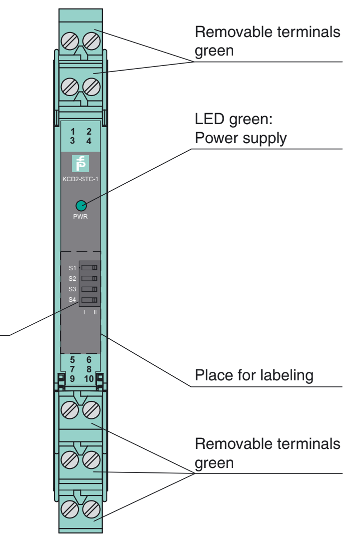
If the loop resistance is too low, an internal resistor of 250 Ω between terminals 6 and 8 is available, which may be used as the HART communication resistor.

Sockets for the connection of a HART communicator are integrated into the terminals of the device.

Diagrams



Front view



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Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **2-wire SMART transmitters or current sources**
- **Output 4 mA ... 20 mA**
- **Terminals with test points**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner provides a 2-wire SMART transmitter with power, transfers the analog signal as an isolated current source and provides isolation for non-intrinsically safe applications. It can also be used with 2-wire SMART current sources.

Digital signals may be superimposed on the analog values and are transferred bi-directionally.

If the loop resistance is too low, an internal resistor of 250 Ω between terminals 8 and 9 is available, which may be used as the HART communication resistor.

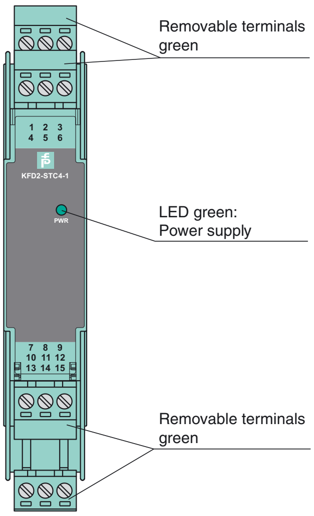
Sockets for the connection of a HART communicator are integrated into the terminals of the device.

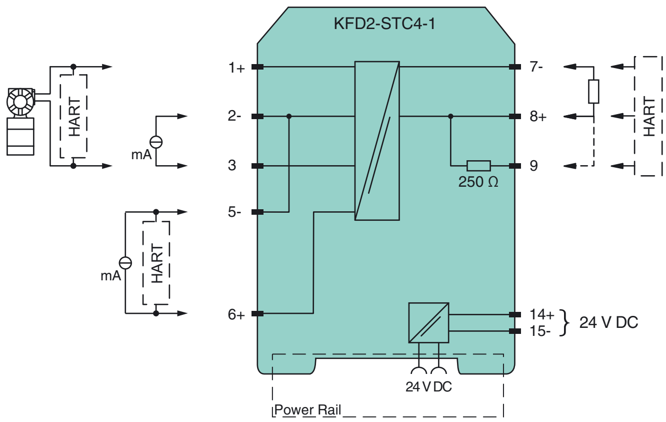
Technical data

Supply	
Rated voltage	20 ... 35 V DC
Power consumption	1.9 W
Input	
Input signal	4 ... 20 mA
Input resistance	≤ 64 Ω terminals 2-, 3
Available voltage	≥ 16 V at 20 mA, terminals 1+, 3
Output	
Load	0 ... 800 Ω
Output signal	4 ... 20 mA (overload > 25 mA)
Ripple	≤ 50 µA$_{rms}$
Transfer characteristics	
Deviation	at 20 °C (293 K), 4 ... 20 mA ≤ 10 µA incl. calibration, linearity, hysteresis, loads and fluctuations of supply voltage
Influence of ambient temperature	≤ 20 ppm/K
Frequency range	input to output: bandwidth with 0.5 V$_{pp}$-signal 0 ... 7.5 kHz (-3 dB) output to input: bandwidth with 0.5 V$_{pp}$-signal 0.3 ... 7.5 kHz (-3 dB)
Settling time	200 µs
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 200 g
Dimensions	20 x 124 x 115 mm (0.8 x 4.9 x 4.5 in), housing type B2

Diagrams

Front view





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Technical data

Supply	
Rated voltage	20 ... 35 V DC
Power consumption	1.9 W
Input	
Input signal	0/4 ... 20 mA
Input resistance	≤ 64 Ω terminals 2-, 3; ≤ 500 Ω terminals 1+, 3 (250 Ω load)
Available voltage	≥ 16 V at 20 mA terminals 1+, 3
Output	
Load	output resistance: 250 Ω
Output signal	0/1 ... 5 V
Ripple	≤ 12.5 mV
Transfer characteristics	
Deviation	at 20 °C (293 K), 0/1 ... 5 V ≤ 5 mV incl. calibration, linearity, hysteresis, loads and fluctuations of supply voltage
Influence of ambient temperature	≤ 20 ppm/K
Frequency range	hazardous area to safe area: bandwidth with 0.5 V_{pp} signal 0 ... 7.5 kHz (-3 dB) safe area to hazardous area: bandwidth with 0.5 V_{pp} signal 0.3 ... 7.5 kHz (-3 dB)
Rise time	20 µs
Settling time	200 µs
De-energized delay	20 µs
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 200 g
Dimensions	20 x 124 x 115 mm (0.8 x 4.9 x 4.5 in), housing type B2

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **2-wire SMART transmitters or current sources**
- **Output 0/1 V ... 5 V**
- **Terminals with test points**
- **Up to SIL2 acc. to IEC 61508**

Function

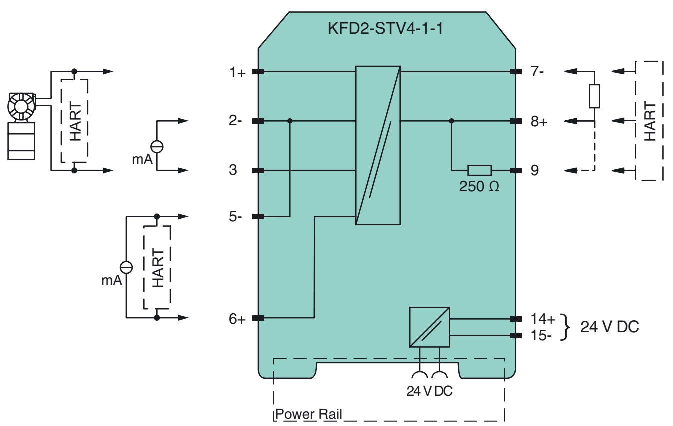
This signal conditioner provides a 2-wire SMART transmitter with power and transfers the analog signal as an isolated voltage source. It can also be used with 2-wire SMART current sources.

Digital signals may be superimposed on the analog values and are transferred bi-directionally.

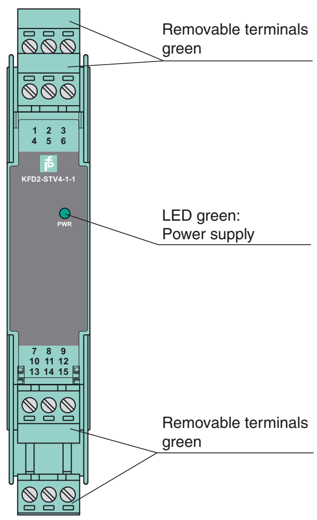
If the loop resistance is too low, an internal resistor of 250 Ω between terminals 8 and 9 is available, which may be used as the HART communication resistor.

Sockets for the connection of a HART communicator are integrated into the terminals of the device.

Diagrams



Front view



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Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **2-wire transmitters or current sources**
- **Output 0/4 mA ... 20 mA**
- **Accuracy 0.1 %**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner provides a 2-wire transmitter with power, transfers the analog signal as an isolated current source and provides isolation for non-intrinsically safe applications. It can also be used with 2-wire current sources.

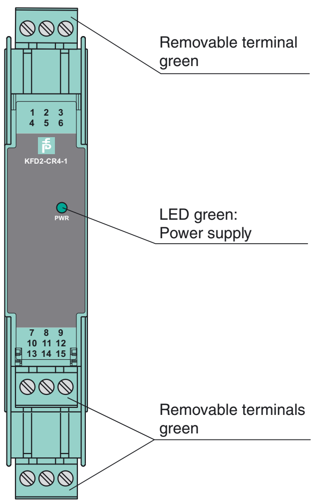
The output provides a 0/4 mA ... 20 mA current corresponding to the input signal. The minimum available voltage is 16 V at 20 mA.

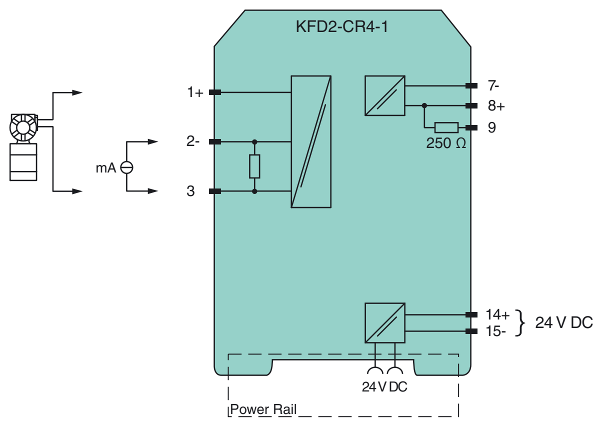
Technical data

Supply	
Rated voltage	20 ... 35 V DC
Power consumption	1.6 W
Input	
Input signal	0/4 ... 20 mA
Input resistance	≤ 64 Ω terminals 2-, 3; ≤ 500 Ω terminals 1+, 3 (250 Ω load)
Available voltage	≥ 16 V at 20 mA terminals 1+, 3
Ripple	50 mV_{pp} at 20 mA
Output	
Load	0 ... 800 Ω
Output signal	0/4 ... 20 mA
Ripple	≤ 50 μA_{rms}
Transfer characteristics	
Deviation	at 20 °C (293 K), 4 ... 20 mA ≤ 10 µA incl. calibration, linearity, hysteresis, loads and fluctuations of supply voltage
Influence of ambient temperature	0.25 µA/°C
Rise time	20 µs
Settling time	200 µs
De-energized delay	20 µs
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Diagrams

Front view





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Technical data

Supply	
Rated voltage	20 ... 35 V DC
Power consumption	2.5 W
Input	
Input signal	0/4 ... 20 mA
Input resistance	≤ 50 Ω terminals 2-, 3
Available voltage	≥ 16 V at 20 mA, terminals 1+, 3
Ripple	≤ 50 mV_{pp} at 20 mA
Output	
Load	0 ... 550 Ω
Output signal	0/4 ... 20 mA (overload > 25 mA)
Ripple	≤ 50 μA_{rms}
Transfer characteristics	
Deviation	at 20 °C (293 K), 4 ... 20 mA ≤ ± 10 µA incl. calibration, linearity, hysteresis, loads and supply voltage fluctuations
Influence of ambient temperature	≤ 20 ppm/K
Frequency range	input in output: bandwidth with 1 mA_{pp} signal 0 ... 7.5 kHz (-3 dB) output in input: bandwidth with 1 V_{pp}-signal 0.3 ... 7.5 kHz (-3 dB)
Rise time	20 µs
Settling time	200 µs
De-energized delay	20 µs
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 200 g
Dimensions	20 x 124 x 115 mm (0.8 x 4.9 x 4.5 in), housing type B2

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **2-wire SMART transmitters or current sources**
- **Dual output 0/4 mA ... 20 mA**
- **Terminals with test points**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner provides a 2-wire SMART transmitter with power, transfers the analog signal as two isolated current sources, and provides isolation for non-intrinsically safe applications. It can also be used with 2-wire SMART current sources.

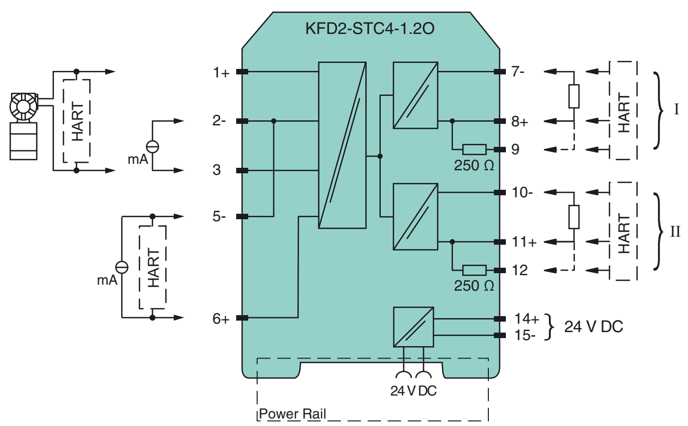
Digital signals may be superimposed on the analog values and are transferred bi-directionally.

If the loop resistance is too low, an internal resistor of 250 Ω between terminals 8, 9 and 11, 12 is available, which may be used as the HART communication resistor.

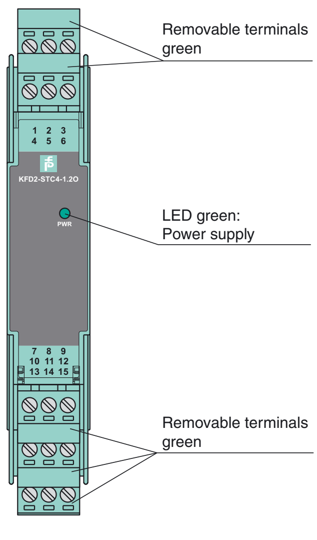
Sockets for the connection of a HART communicator are integrated into the terminals of the device.

Voltage output versions are available upon request.

Diagrams



Front view



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K-System
Digital Inputs
Digital Outputs
Analog Inputs
Analog Outputs
Accessories

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **2-wire transmitters or current sources**
- **Dual output 0/4 mA ... 20 mA**
- **Accuracy 0.1 %**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner provides a 2-wire transmitter with power, transfers the analog signal as two isolated current sources, and provides isolation for non-intrinsically safe applications. It can also be used with 2-wire current sources.

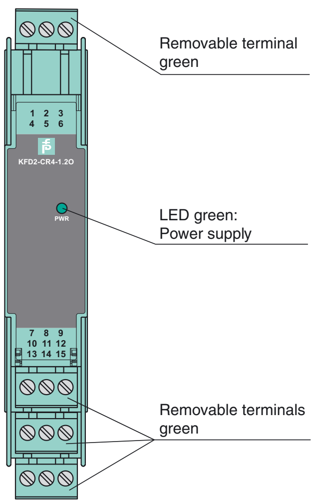
Both outputs provide a 0/4 mA ... 20 mA current corresponding to the input signal. The minimum available voltage is 16 V at 20 mA.

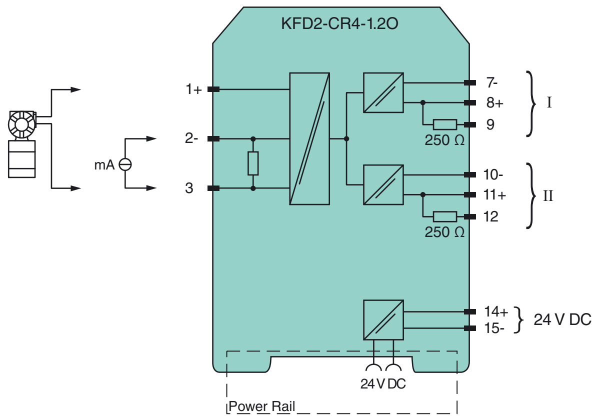
Technical data

Supply	
Rated voltage	20 ... 32 V DC
Power consumption	approx. 2.5 W
Input	
Input signal	0/4 ... 20 mA
Input resistance	≤ 85 Ω terminals 2-, 3
Available voltage	≥ 16 V at 20 mA terminals 1+, 3
Ripple	50 mV_{pp} at 20 mA
Output	
Load	0 ... 550 Ω
Output signal	0/4 ... 20 mA
Ripple	≤ 50 μA_{rms}
Transfer characteristics	
Deviation	at 20 °C (293 K), 4 ... 20 mA ≤ 10 µA incl. calibration, linearity, hysteresis, loads and fluctuations of supply voltage
Influence of ambient temperature	0.25 µA/°C
Rise time	20 µs
Settling time	200 µs
De-energized delay	20 µs
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Diagrams

Front view





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Technical data

Supply	
Rated voltage	20 ... 35 V DC
Power consumption	≤ 2.8 W
Input	
Input signal	4 ... 20 mA
Available voltage	≥ 16 V at 20 mA, terminals 1+, 3
Output	
Load	0 ... 550 Ω
Output signal	4 ... 20 mA (overload > 25 mA)
Ripple	≤ 50 µA$_{rms}$
Transfer characteristics	
Deviation	at 20 °C (293 K), 4 ... 20 mA ≤ 10 µA incl. calibration, linearity, hysteresis, loads and fluctuations of supply voltage
Influence of ambient temperature	0.25 µA/°C
Frequency range	input to output: bandwidth with 1 V$_{pp}$-signal 0 ... 7.5 kHz (-3 dB) output to input: bandwidth with 1 V$_{pp}$-signal 0.3 ... 7.5 kHz (-3 dB)
Rise time	20 µs
Settling time	200 µs
De-energized delay	20 µs
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 124 x 115 mm (0.8 x 4.9 x 4.5 in), housing type B2

Features

- **2-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **2-wire SMART transmitter**
- **Output 4 mA ... 20 mA**
- **Terminals with test points**
- **Up to SIL2 acc. to IEC 61508**

Function

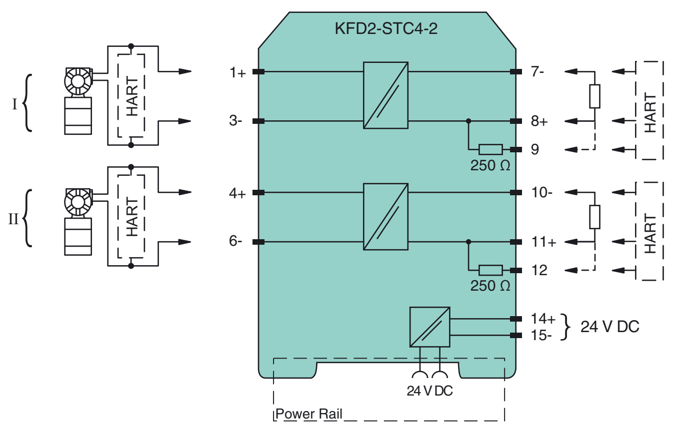
This signal conditioner provides a 2-wire SMART transmitter with power, transfers the analog signal as an isolated current source and provides isolation for non-intrinsically safe applications.

Digital signals may be superimposed on the analog values and are transferred bi-directionally.

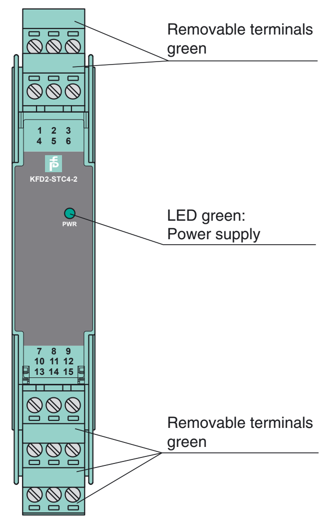
If the loop resistance is too low, an internal resistor of 250 Ω between terminals 8, 9 and 11, 12 is available, which may be used as the HART communication resistor.

Sockets for the connection of a HART communicator are integrated into the terminals of the device.

Diagrams



Front view



Edition 912426 (US) / 216306 (EU) 04/2009

KFD2-STV4-2-1

SMART Transmitter Power Supply

Features

- **2-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **2-wire SMART transmitter**
- **Output 1 V ... 5 V**
- **Terminals with test points**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner provides a 2-wire SMART transmitter with power, transfers the analog signal as an isolated voltage source and provides isolation for non-intrinsically safe applications.

Digital signals may be superimposed on the analog values and are transferred bi-directionally.

If the loop resistance is too low, an internal resistor of 250 Ω between terminals 8, 9 and 11, 12 is available, which may be used as the HART communication resistor.

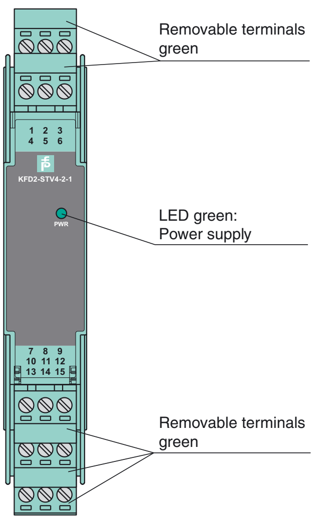
Sockets for the connection of a HART communicator are integrated into the terminals of the device.

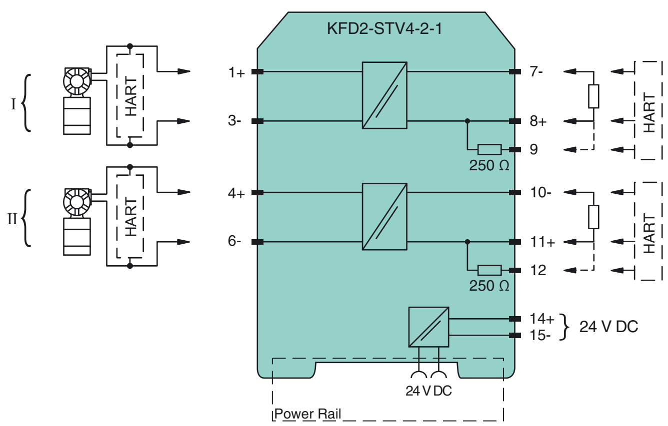
Technical data

Supply	
Rated voltage	20 ... 35 V DC
Power consumption	≤ 2.5 W
Input	
Input signal	0/4 ... 20 mA
Available voltage	≥ 16 V at 20 mA
Output	
Load	output resistance: 250 Ω
Output signal	0/1 ... 5 V
Ripple	≤ 12.5 mV
Transfer characteristics	
Deviation	at 20 °C (293 K), 0/1 ... 5 V ≤ 5 mV incl. calibration, linearity, hysteresis, loads and fluctuations of supply voltage
Influence of ambient temperature	≤ 20 ppm/K
Frequency range	hazardous area to safe area: bandwidth with 0.5 V_{pp} signal 0 ... 7.5 kHz (-3 dB) safe area to hazardous area: bandwidth with 0.5 V_{pp} signal 0.3 ... 7.5 kHz (-3 dB)
Rise time	20 µs
Settling time	200 µs
De-energized delay	20 µs
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	20 x 124 x 115 mm (0.8 x 4.9 x 4.5 in), housing type B2

Diagrams

Front view





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Technical data

Supply	
Rated voltage	20 ... 35 V DC
Power consumption	≤ 2.8 W
Input	
Input signal	0/4 ... 20 mA
Input resistance	≤ 500 Ω terminals 1+, 3- (250 Ω load)
Available voltage	≥ 16 V at 20 mA, terminals 1+, 3
Ripple	50 mV_{pp} at 20 mA
Output	
Load	0 ... 550 Ω
Output signal	0/4 ... 20 mA
Ripple	≤ 50 μA_{rms}
Transfer characteristics	
Deviation	at 20 °C (293 K), 4 ... 20 mA ≤ 10 µA incl. calibration, linearity, hysteresis, loads and fluctuations of supply voltage
Influence of ambient temperature	0.25 µA/°C
Rise time	20 µs
Settling time	200 µs
De-energized delay	20 µs
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Features

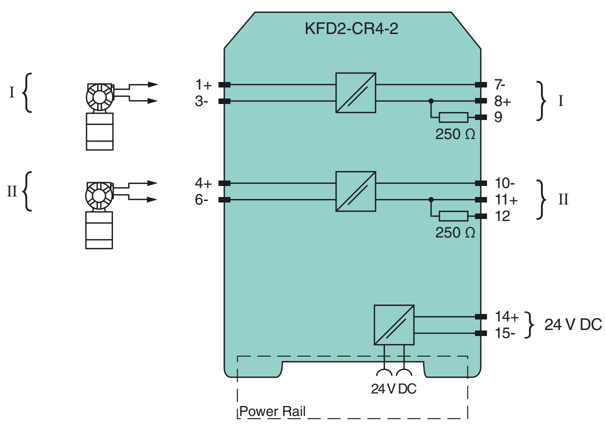
- **2-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **2-wire transmitter**
- **Output 0/4 mA ... 20 mA**
- **Accuracy 0.1 %**
- **Up to SIL2 acc. to IEC 61508**

Function

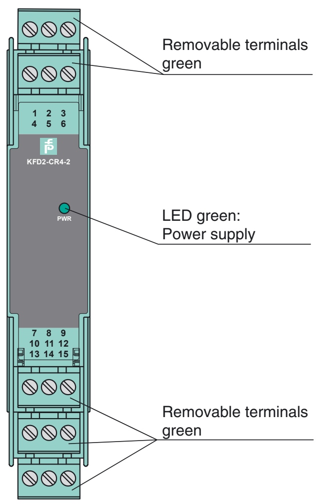
This signal conditioner provides a 2-wire transmitter with power, transfers the analog signal as an isolated current source and provides isolation for non-intrinsically safe applications.

The output provides a 0/4 mA ... 20 mA current corresponding to the input signal. The minimum available voltage is 16 V at 20 mA.

Diagrams



Front view



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Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **2-wire transmitters or current sources**
- **Output 0/4 mA ... 20 mA**
- **2 relay contact outputs**
- **Programmable high/low alarm**
- **Linearization function (max. 20 points)**
- **Line fault detection (LFD)**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner is suitable for a variety of measuring tasks.

Active power supplies as well as 2-wire transmitters can be connected. Two relays and an active 0/4 mA ... 20 mA current source are available as outputs.

The relay contacts and the current output can be integrated in security-relevant circuits. The current output is easily scaled. The input has a line fault detection.

On the display the measured value can be indicated in various physical units.

The unit is easily programmed by the use of a keypad located on the front of the unit or with the **PACT***ware*™ configuration software.

A unique collective error messaging feature is available when used with the Power Rail system.

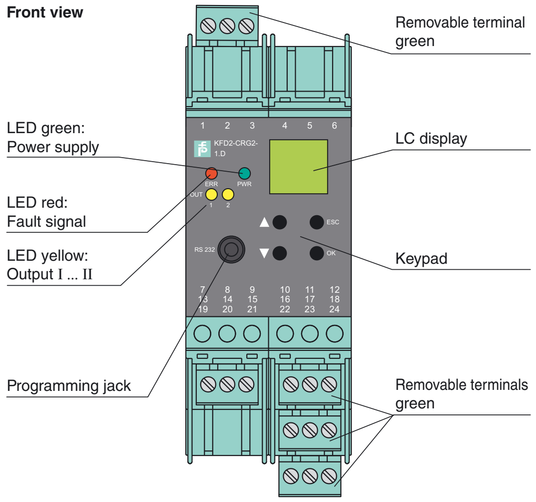
For additional information, refer to the manual and www.pepperl-fuchs.com.

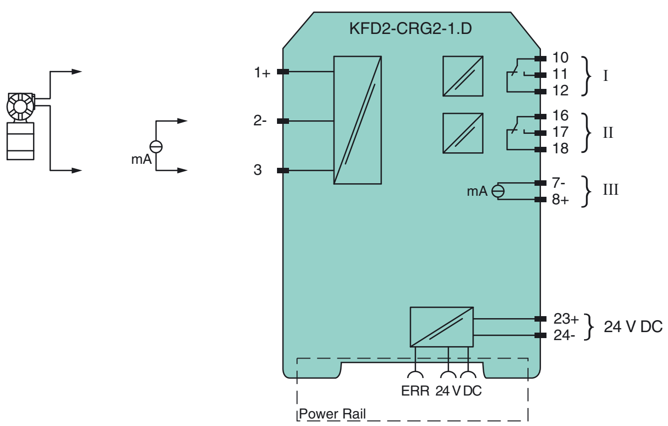
Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power consumption	2.5 W
Input	
Input I	
Input signal	0 ... 20 mA
Available voltage	≥ 15 V at 20 mA
Open circuit voltage/short-circuit current	24 V/33 mA
Input resistance	45 Ω (terminals 2, 3)
Lead monitoring	breakage I < 0.2 mA; short-circuit I > 22 mA acc. to NAMUR NE43
Output	
Output signal	0 ... 20 mA or 4 ... 20 mA
Output I, II	signal, relay
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 40 V DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Output III	signal, analogue
Current range	0 ... 20 mA or 4 ... 20 mA
Open circuit voltage	≤ 24 V DC
Load	≤ 650 Ω
Fault signal	downscale I ≤ 3.6 mA, upscale I ≥ 21.5 mA (acc. NAMUR NE43)
Transfer characteristics	
Input I	
Accuracy	< 30 µA
Measuring time	< 100 ms
Influence of ambient temperature	0.003 %/°C (30 ppm)
Output III	
Resolution	≤ 10 µA
Accuracy	< 20 µA
Influence of ambient temperature	0.005 %/°C (50 ppm)
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Diagrams

Front view





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Technical data

Supply	
Rated voltage	20 ... 90 V DC or 48 ... 253 V AC
Power consumption	2.2 W/4 VA
Input	
Input I	
Input signal	0 ... 20 mA
Available voltage	> 15 V at 20 mA
Open circuit voltage/short-circuit current	24 V/33 mA
Input resistance	45 Ω (terminals 2, 3)
Lead monitoring	breakage I < 0.2 mA; short-circuit I > 22 mA acc. to NAMUR NE43
Output	
Output signal	0 ... 20 mA or 4 ... 20 mA
Output I, II	signal, relay
Contact loading	250 V AC/2 A/cos Φ≥ 0.7; 40 V DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Output III	signal, analogue
Current range	0 ... 20 mA or 4 ... 20 mA
Open circuit voltage	≤ 24 V DC
Load	≤ 650 Ω
Fault signal	downscale I ≤ 3.6 mA, upscale I ≥ 21.5 mA (acc. NAMUR NE43)
Transfer characteristics	
Input I	
Accuracy	< 30 µA
Measuring time	< 100 ms
Influence of ambient temperature	0.003 %/°C (30 ppm)
Output III	
Resolution	≤ 10 µA
Accuracy	< 20 µA
Influence of ambient temperature	0.005 %/°C (50 ppm)
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Features

- **1-channel signal conditioner**
- **AC/DC wide range supply**
- **2-wire transmitters or current sources**
- **Output 0/4 mA ... 20 mA**
- **2 relay contact outputs**
- **Programmable high/low alarm**
- **Linearization function (max. 20 points)**
- **Line fault detection (LFD)**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner is suitable for a variety of measuring tasks.

Active power supplies as well as 2-wire transmitters can be connected. Two relays and an active 0/4 mA ... 20 mA current source are available as outputs.

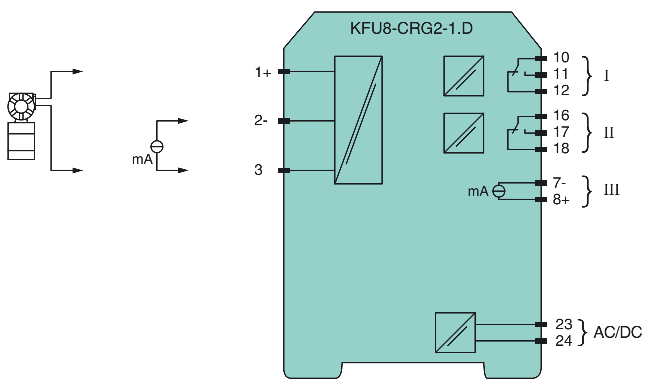
The relay contacts and the current output can be integrated in security-relevant circuits. The current output is easily scaled. The input has a line fault detection.

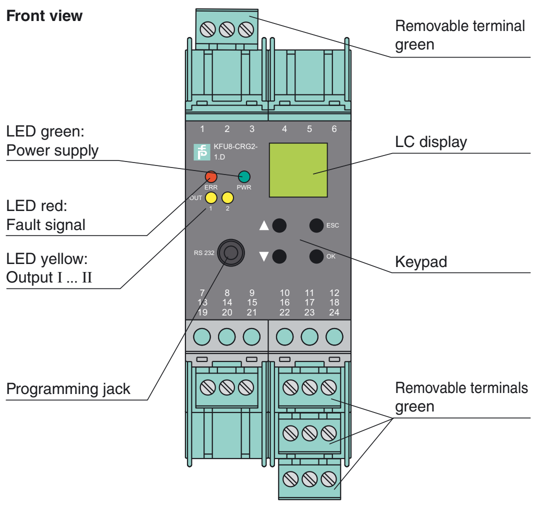
On the display the measured value can be indicated in various physical units.

The unit is easily programmed by the use of a keypad located on the front of the unit or with the **PACT***ware*™ configuration software.

For additional information, refer to the manual and www.pepperl-fuchs.com.

Diagrams





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Features

- **1-channel signal conditioner**
- **24 V DC supply (loop powered)**
- **Current or voltage output**
- **Output: 4 mA ... 20 mA**
- **DIP switch selectable ranges**
- **Line fault detection (LFD)**

Function

This signal conditioner converts a 2-wire voltage or current to a 4 mA ... 20 mA signal and provides isolation for non-intrinsically safe applications.

The device can be used to double signals in 20 mA measurement circuits due to the limited current signal input load of 50 Ω.

DIP switches and potentiometers make field calibration easy.

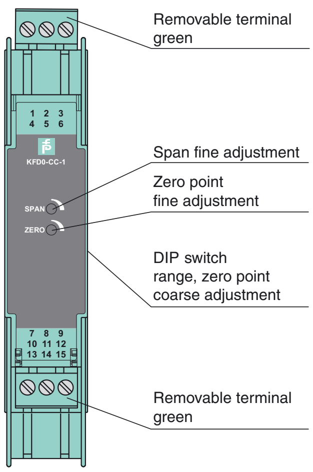
Since this isolator is loop-powered, use the technical data to verify that the proper voltage is available to the field devices.

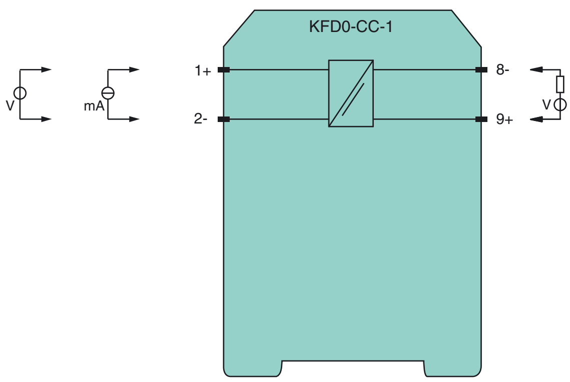
Technical data

Supply	
Rated voltage	12 ... 35 V DC loop powered
Input	
Voltage range	0 ... 10 V, load ≥ 100 kΩ
Output	
Load	(U -12 V)/0.02 A
Current output	4 ... 20 mA, limited to ≤ 35 mA
Fault signal	downscale ≤ 3 mA
Transfer characteristics	
Deviation	
After calibration	0.1 % of full-scale value
Temperature effect	span: 0.050 % of span /K; zero point: 0.060 % of span /K
Linearisation	≤ 0.04 % of full-scale value
Influence of supply voltage	6.5 ppm/V
Rise time	250 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Diagrams

Front view





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Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power consumption	≤ 1.6 W
Input	
Input resistance	voltage: 1 MΩ , current: ≤ 100 Ω
Limit	30 V
Current	0 ... 20 mA
Voltage	0 ... 10 V/0 ... 60 mV
Resolution	15 Bit
Output	
Output I	signal, relay
Contact loading	250 V AC/2 A/cos Φ0.7; 40 V DC/2 A
Mechanical life	2 x 10^7 switching cycles
Energized/de-energized delay	approx. 10 ms/approx. 10 ms
Output II	analog
Load	current: ≤ 550 Ω, voltage: ≥ 1 kΩ
Analog voltage output	0/1 ... 5 V, 0/2 ... 10 V
Analog current output	0/4 ... 20 mA
Transfer characteristics	
Deviation	0.1 % of full-scale value
Resolution/accuracy	current: 1 µA/20 µA voltage: 0.5 mV/10 mV mV: 3 µV/60 µV
Influence of ambient temperature	0.003 %/°C (30 ppm)
Response time	≥ 150 ms/≤ 300 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B3

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Scaleable current or voltage input**
- **Current or voltage output**
- **Relay contact output**
- **Configurable by keypad**
- **Line fault detection (LFD)**

Function

This signal conditioner is suitable for the connection of current and voltage signals and provides isolation for non-intrinsically safe applications.

The input ranges include 0 mA ... 20 mA, 0 V ... 10 V or 0 mV ... 60 mV. Subranges from the input ranges are selectable.

The output measuring signals are 0/4 mA ... 20 mA, 0/2 V ... 10 V or 0/1 V ... 5 V.

The output relay serves as trip value contact.

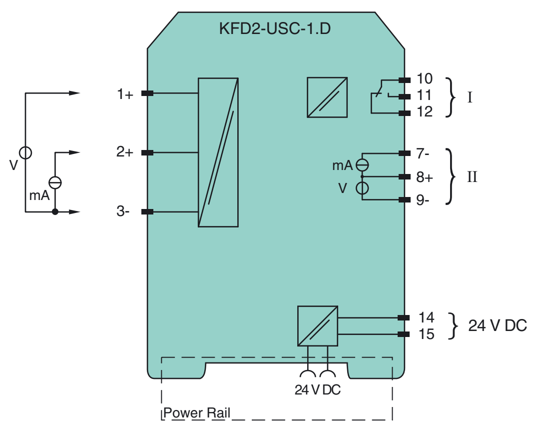
On the display the measured value can be indicated in various physical units.

The unit is easily programmed by the use of a keypad located on the front of the unit.

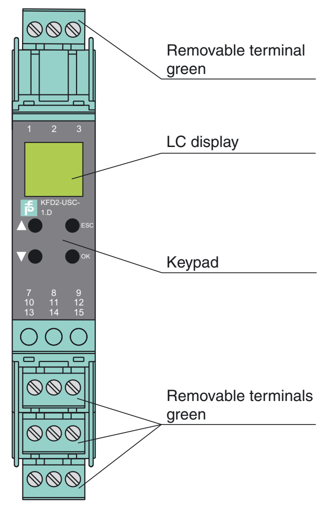
For additional information, refer to the manual and www.pepperl-fuchs.com.

K-System
Digital Inputs
Digital Outputs
Analog Inputs
Analog Outputs
Accessories

Diagrams



Front view



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Features

- **1-channel signal conditioner**
- **AC/DC wide range supply**
- **Scaleable current or voltage input**
- **Current or voltage output**
- **Relay contact output**
- **Configurable by keypad**
- **Line fault detection (LFD)**

Function

This signal conditioner is suitable for the connection of current and voltage signals and provides isolation for non-intrinsically safe applications.

The input ranges include 0 mA ... 20 mA, 0 V ... 10 V or 0 mV ... 60 mV. Subranges from the input ranges are selectable.

The output measuring signals are 0/4 mA ... 20 mA, 0/2 V ... 10 V or 0/1 V ... 5 V.

The output relay serves as trip value contact.

On the display the measured value can be indicated in various physical units.

The unit is easily programmed by the use of a keypad located on the front of the unit.

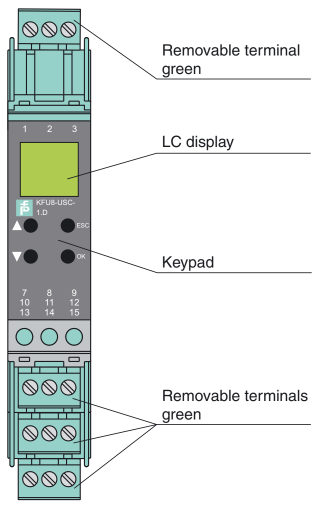
For additional information, refer to the manual and www.pepperl-fuchs.com.

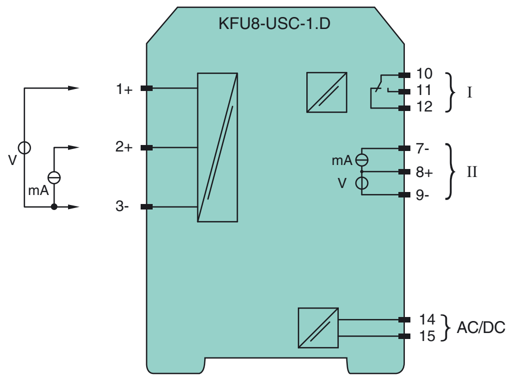
Technical data

Supply	
Rated voltage	20 ... 90 V DC/48 ... 253 V AC
Power consumption	≤ 1.6 W/≤ 2.6 VA
Input	
Input resistance	voltage: 1 MΩ , current: ≤ 100 Ω
Limit	30 V
Current	0 ... 20 mA
Voltage	0 ... 10 V/0 ... 60 mV
Resolution	15 Bit
Output	
Output I	signal, relay
Contact loading	250 V AC/2 A/cos Φ 0.7; 40 V DC/2 A
Mechanical life	2 x 10^7 switching cycles
Energized/de-energized delay	approx. 10 ms/approx. 10 ms
Output II	analog
Load	current: ≤ 550 Ω, voltage: ≥ 1 kΩ
Analog voltage output	0/1 ... 5 V, 0/2 ... 10 V
Analog current output	0/4 ... 20 mA
Transfer characteristics	
Deviation	0.1 % of full-scale value
Resolution/accuracy	current: 1 µA/20 µA voltage: 0.5 mV/10 mV mV: 3 µV/60 µV
Influence of ambient temperature	0.003 %/°C (30 ppm)
Response time	≥ 150 ms/≤ 300 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B3

Diagrams

Front view





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Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power consumption	2.25 W (typ. 1.68 W)
Input	
Measuring range	terminals 1+, 3-; voltage: 0/1 ... 5 V; 50 kΩ or 0/2 ... 10 V; 100 kΩ terminals 2+, 3-; current: 0/4 ... 20 mA; 50 Ω
Output	
Output I	trip value: terminals 7, 8, 9
Output II	trip value: terminals 10, 11, 12
Contact loading	250 V AC/5 A/1250 VA; 125 V DC/5 A/150 W
Transfer characteristics	
Deviation	≤ 0.5 %
Influence of ambient temperature	0.01 %/K of adjusted trip value
Input delay	100 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 120 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Current and voltage input**
- **2 relay contact outputs**
- **Programmable high/low alarm**
- **DIP switch programmable**
- **Terminals with test points**

Function

This signal conditioner is a trip alarm with two independently adjustable trip points that provides isolation for non-intrinsically safe applications.

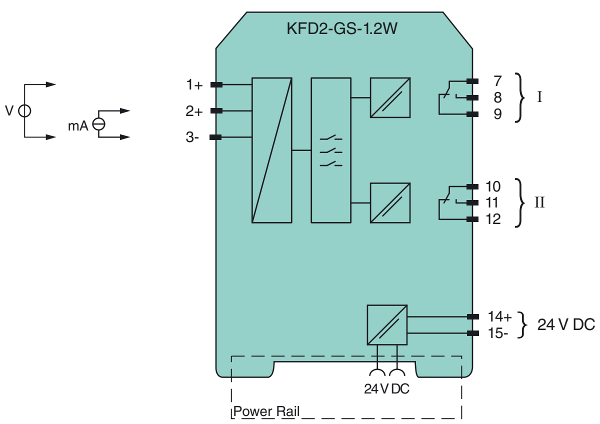
The unit actuates a relay output when it reaches a user-programmed input level.

DIP switches are used to program voltage input low alarms and high alarms.

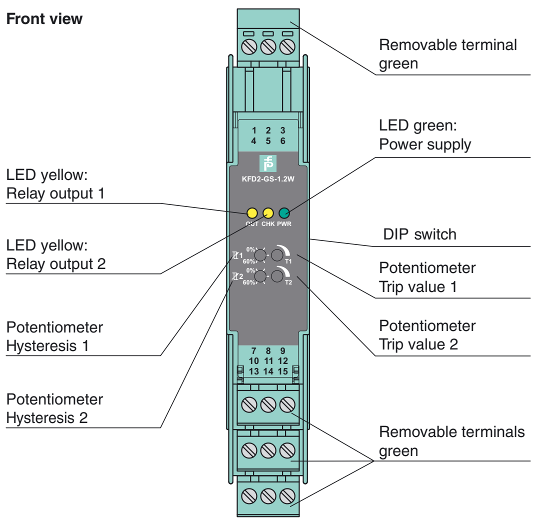
The hysteresis, the operating mode of the relay outputs, and the type of alarm are selectable for each trip point.

For addtional information, refer to www.pepperl-fuchs.com.

Diagrams



Front view



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Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Strain gauge input**
- **Output 0 mA ... ± 20 mA or 0 V ... ± 10 V**
- **Relay contact output**
- **Programmable high/low alarm**
- **Configurable by PACT*ware*™ or keypad**
- **RS 485 interface**
- **Line fault detection (LFD)**

Function

This signal conditioner is used with strain gauges, load cells and resistance measuring bridges and provides isolation for non-intrinsically safe applications.

Designed to provide 5 V excitation voltage, this barrier's high quality A/D converter allows it to be used with those devices requiring 10 V.

The unit is easily programmed by the use of a keypad located on the front of the unit or with the **PACT*ware*™** configuration software. The actual measurement for tare, zero point, and final value can be entered in this manner.

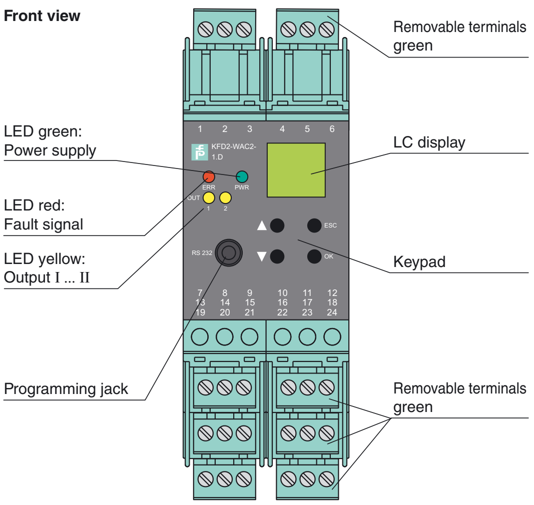
A unique collective error messaging feature is available when used with the Power Rail system.

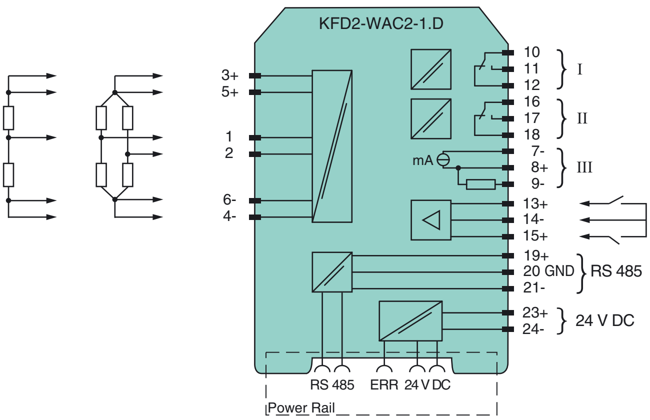
For additional information, refer to the manual and www.pepperl-fuchs.com.

Technical data

Supply	
Rated voltage	20 ... 35 V DC
Power consumption	≤ 3 W
Interface	
Type	RS 485
Programming interface	RS 232 programming jack
Field circuit	
Line resistance	≤ 25 Ω per lead
Input I	
Connection	terminals 1+, 2-
Sensor supply	1 ... 5 V
Connection	terminals 3+, 4-, 5+, 6-
Short-circuit current	50 mA
Load	≥ 116 Ω up to 5V, ≥ 85 Ω up to 4V
Input	
Programmable Tare	0 ... 500 % of span
Input I	signal, analogue
Input signal	-100 ... 100 mV
Input resistance	> 1 MΩ for voltage measurement
Input II, III	tare adjustment, calibration and zero
Open circuit voltage/short-circuit current	18 V/5 mA
Active/passive	I > 4 mA/I < 1.5 mA
Output	
Output I, II	relay output
Mechanical life	2 x 10^7 switching cycles
Output III	analogue output
Current range	-20 ... 20 mA
Load	≤ 550 Ω
Analog voltage output	0 ... ± 10 V; output resistance 500 Ω (bridge between terminal 7 and 9)
Analog current output	0 ... ± 20 mA or 4 ... 20 mA; load 0 ... 550 Ω (terminals 7 and 8)
Line fault detection	downscale -21.5 mA (-10.75 V) or 2 mA (1 V), upscale 21.5 mA (10.75 V)
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 250 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Diagrams





Edition 912426 (US) / 216306 (EU) 04/2009

Technical data

Supply	
Rated voltage	12 ... 35 V DC loop powered
Input	
Voltage range	-10 ... 10 V (factory adjustment)
Output	
Load	≤ (supply voltage -12 V)/0.02 A
Current output	4 ... 20 mA, limited to ≤ 35 mA
Transfer characteristics	
Measuring range f_n	-10 ... +10 V, zero point ± 1 % of full-scale value, span ± 1.5 % of full-scale value
Deviation	
After calibration	0.1 % of full-scale value
Temperature effect	span: 0.050 % of span /K zero point: 0.060 % of span /K
Linearisation	≤ 0.04 % of full-scale value
Influence of supply voltage	6.5 ppm/V
Rise time	250 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Features

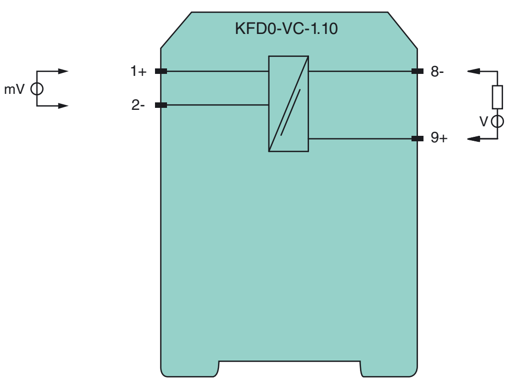
- **1-channel signal conditioner**
- **24 V DC supply (loop powered)**
- **Voltage input -10 V ... 10 V**
- **Output 4 mA ... 20 mA**
- **Span and zero point adjustment**

Function

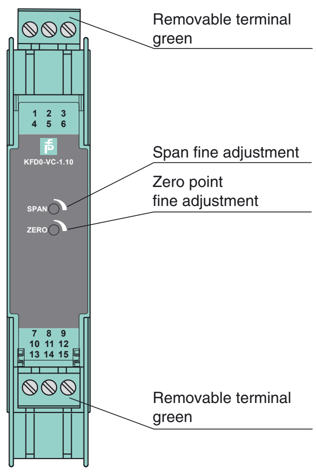
This signal conditioner receives a -10 V ... 10 V voltage input, produces a 4 mA ... 20 mA signal output. It also provides isolation for non-intrinsically safe applications.

Fine adjustment for zero and span are performed with the potentiometers on top of the unit.

Diagrams



Front view



Edition 912426 (US) / 216306 (EU) 04/2009

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **TC, RTD, potentiometer or voltage input**
- **Current output 0/4 mA ... 20 mA**
- **Sink or source mode**
- **Configurable by PACT*ware*™**
- **Line fault (LFD) and sensor burnout detection**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner is designed to connect RTDs, thermocouples, or potentiometers, and provide a proportional 0/4 mA ... 20 mA signal.

The barrier offers 3-port isolation between input, output, and power supply.

A removable terminal block K-CJC-** is available for thermocouples when internal cold junction compensation is desired.

A fault is indicated by a red flashing LED per NAMUR NE44 and user-configured fault outputs.

The unit is easily programmed with the **PACT*ware*™** configuration software.

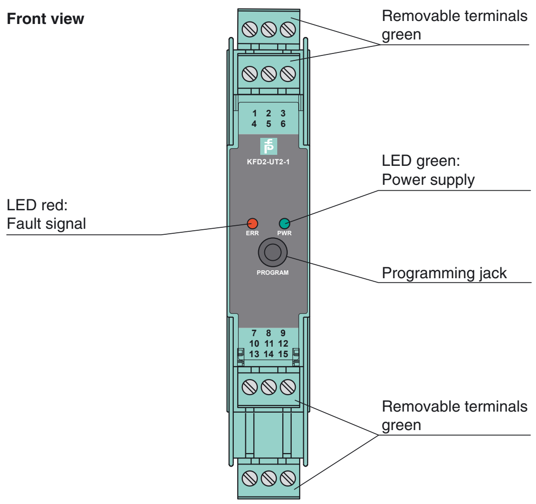
A unique collective error messaging feature is available when used with the Power Rail system.

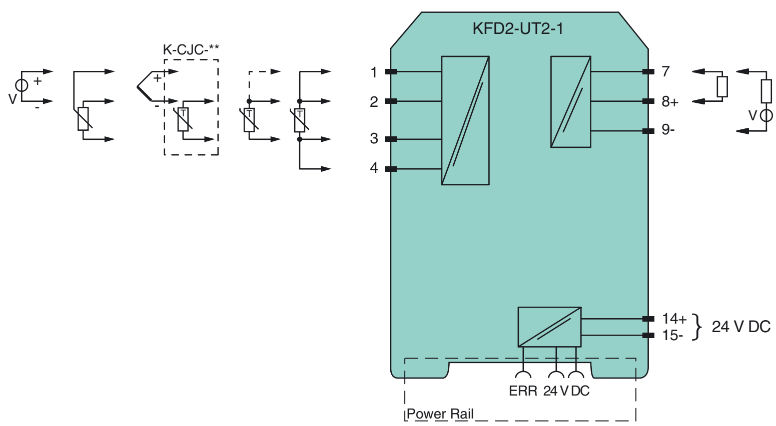
For additional information, refer to the manual and www.pepperl-fuchs.com.

Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power loss/power consumption	≤ 0.95 W/0.95 W
Input	
RTD	type Pt10, Pt50, Pt100, Pt500, Pt1000 (EN 60751: 1995) type Pt10GOST, Pt50GOST, Pt100GOST, Pt500GOST, Pt1000GOST (6651-94) type Cu10, Cu50, Cu100 (P50353-92) type Ni100 (DIN 43760)
Measuring current	approx. 200 µA with RTD
Types of measuring	2-, 3-, 4-wire connection
Line resistance	≤ 50 Ω per lead
Measuring circuit monitoring	sensor burnout, sensor short-circuit
Thermocouples	type B, E, J, K, N, R, S, T (IEC 584-1: 1995) type L (DIN 43710: 1985) type TXK, TXKH, TXA (P8.585-2001)
Cold junction compensation	external and internal
Measuring circuit monitoring	sensor burnout
Voltage	selectable within the range -100 ... 100 mV
Potentiometer	0 ... 20 kΩ (2-wire connection), 0.8 ... 20 kΩ (3-wire connection)
Input resistance	≥ 1 MΩ (-100 ... 100 mV)
Output	
Output	analog current output
Current range	0 ... 20 mA or 4 ... 20 mA
Fault signal	downscale 0 or 2 mA, upscale 21.5 mA (acc. NAMUR NE43)
Source	load 0 ... 550 Ω open circuit voltage ≤ 18 V
Sink	Voltage across terminals 5 ... 30 V. If the current is supplied from a source > 16.5 V, series resistance of ≥ (V - 16.5)/0.0215 Ω is needed, where V is the source voltage. The maximum value of the resistance is (V - 5)/0.0215 Ω
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 130 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Diagrams





Edition 912426 (US) / 216306 (EU) 04/2009

Universal Temperature Converter — KFD2-UT2-1-1

Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power loss/power consumption	≤ 0.9 W/0.95 W
Input	
RTD	type Pt10, Pt50, Pt100, Pt500, Pt1000 (EN 60751: 1995) type Pt10GOST, Pt50GOST, Pt100GOST, Pt500GOST, Pt1000GOST (6651-94) type Cu10, Cu50, Cu100 (P50353-92) type Ni100 (DIN 43760)
Measuring current	approx. 200 µA with RTD
Types of measuring	2-, 3-, 4-wire connection
Line resistance	≤ 50 Ω per lead
Measuring circuit monitoring	sensor burnout, sensor short-circuit
Thermocouples	type B, E, J, K, N, R, S, T (IEC 584-1: 1995) type L (DIN 43710: 1985) type TXK, TXKH, TXA (P8.585-2001)
Cold junction compensation	external and internal
Measuring circuit monitoring	sensor burnout
Voltage	selectable within the range -100 ... 100 mV
Potentiometer	0 ... 20 kΩ (2-wire connection), 0.8 ... 20 kΩ (3-wire connection)
Input resistance	≥ 1 MΩ (-100 ... 100 mV)
Output	
Voltage output	0 ... 5 V or 1 ... 5 V; output resistance: ≤ 5 Ω ; load: ≥ 10 kΩ
Fault signal	downscale 0 V or 0.5 V, upscale 5.375 V
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 130 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **TC, RTD, potentiometer or voltage input**
- **Voltage output 0/1 V ... 5 V**
- **Configurable by PACT*ware*™**
- **Line fault (LFD) and sensor burnout detection**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner is designed to connect RTDs, thermocouples, or potentiometers, and provide a proportional 0/1 V ... 5 V signal.

The barrier offers 3-port isolation between input, output, and power supply.

A removable terminal block K-CJC-** is available for thermocouples when internal cold junction compensation is desired.

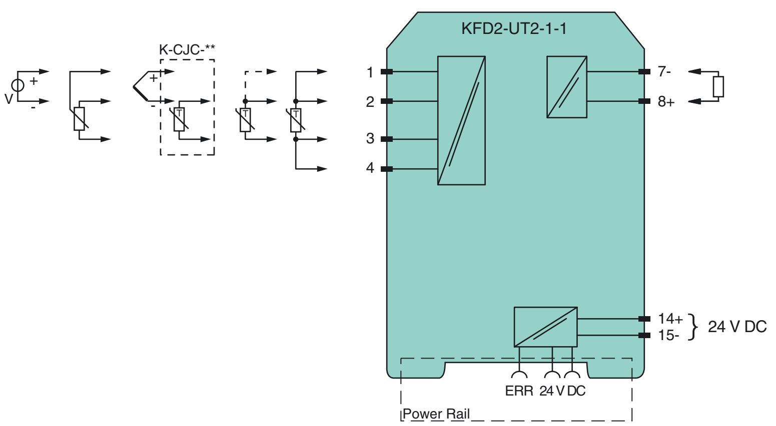
A fault is indicated by a red flashing LED per NAMUR NE44 and user-configured fault outputs.

The unit is easily programmed with the **PACT*ware*™** configuration software.

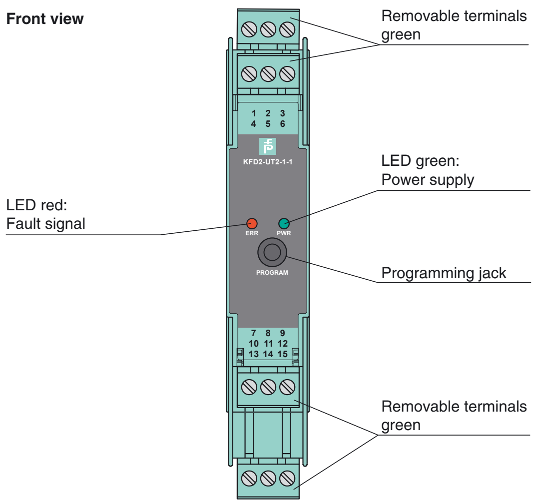
A unique collective error messaging feature is available when used with the Power Rail system.

For additional information, refer to the manual and www.pepperl-fuchs.com.

Diagrams



Front view



Edition 912426 (US) / 216306 (EU) 04/2009

Features

- 2-channel signal conditioner
- 24 V DC supply (Power Rail)
- TC, RTD, potentiometer or voltage input
- Current output 0/4 mA ... 20 mA
- Sink or source mode
- Configurable by PACT*ware*™
- Line fault (LFD) and sensor burnout detection
- Up to SIL2 acc. to IEC 61508

Function

This signal conditioner is designed to connect RTDs, thermocouples, or potentiometers, and provide a proportional 0/4 mA ... 20 mA signal.

The barrier offers 3-port isolation between input, output, and power supply.

A removable terminal block K-CJC-** is available for thermocouples when internal cold junction compensation is desired.

A fault is indicated by a red flashing LED per NAMUR NE44 and user-configured fault outputs.

The unit is easily programmed with the **PACT***ware***™** configuration software.

A unique collective error messaging feature is available when used with the Power Rail system.

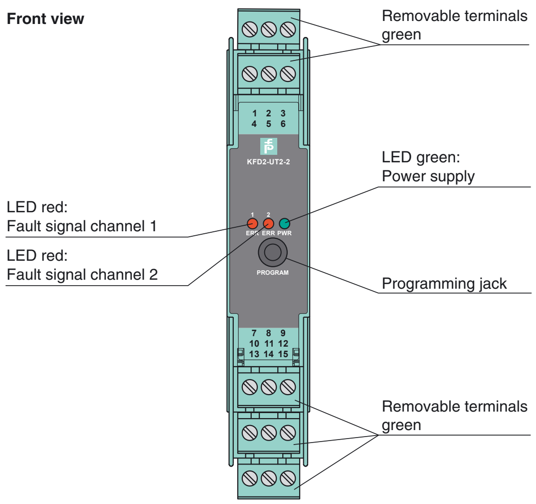
For additional information, refer to the manual and www.pepperl-fuchs.com.

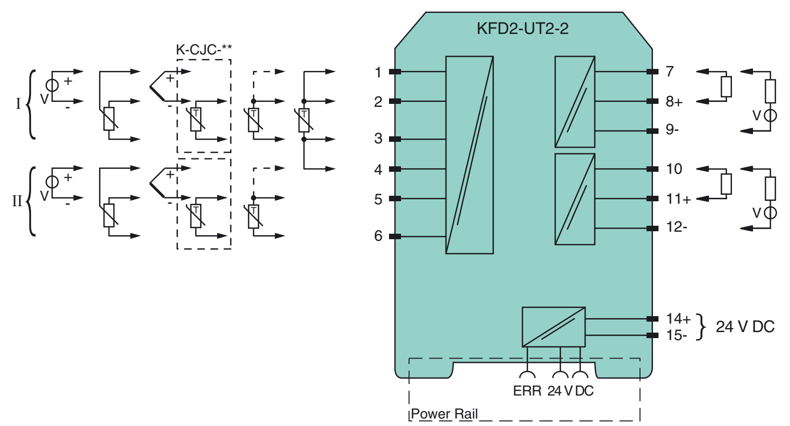
Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power loss/power consumption	≤ 1.5 W/1.5 W
Input	
RTD	type Cu10, Cu50, Cu100, Pt10, Pt50, Pt100, Pt500, Pt1000, Ni100 (EN 60751: 1995) type Pt10GOST, Pt50GOST, Pt100GOST, Pt500GOST, Pt1000GOST (P50353-92)
Measuring current	approx. 200 µA with RTD
Types of measuring	2-, 3-wire technology
Line resistance	≤ 50 Ω per lead
Measuring circuit monitoring	sensor burnout, sensor short-circuit
Thermocouples	type B, E, J, K, N, R, S, T (IEC 584-1: 1995) type L (DIN 43710: 1985) type TXK, TXKH, TXA (P8.585-2001)
Cold junction compensation	external and internal
Measuring circuit monitoring	sensor burnout
Voltage	selectable within the range -100 ... 100 mV
Potentiometer	0 ... 20 kΩ (2-wire connection), 0.8 ... 20 kΩ (3-wire connection)
Input resistance	≥ 1 MΩ (-100 ... 100 mV)
Output	
Output I, II	analog current output
Current range	0 ... 20 mA or 4 ... 20 mA
Fault signal	downscale 0 or 2 mA, upscale 21.5 mA (acc. NAMUR NE43)
Source	load 0 ... 550 Ω open circuit voltage ≤ 18 V
Sink	Voltage across terminals 5 ... 30 V. If the current is supplied from a source > 16.5 V, series resistance of ≥ (V - 16.5)/0.0215 Ω is needed, where V is the source voltage. The maximum value of the resistance is (V - 5)/0.0215 Ω
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 130 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Diagrams

Front view





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Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power loss/power consumption	≤ 1.4 W/1.5 W
Input	
RTD	type Pt10, Pt50, Pt100, Pt500, Pt1000 (EN 60751: 1995) type Pt10GOST, Pt50GOST, Pt100GOST, Pt500GOST, Pt1000GOST (6651-94) type Cu10, Cu50, Cu100 (P50353-92) type Ni100 (DIN 43760)
Measuring current	approx. 200 µA with RTD
Types of measuring	2-, 3-wire technology
Line resistance	≤ 50 Ω per lead
Measuring circuit monitoring	sensor burnout, sensor short-circuit
Thermocouples	type B, E, J, K, N, R, S, T (IEC 584-1: 1995) type L (DIN 43710: 1985) type TXK, TXKH, TXA (P8.585-2001)
Cold junction compensation	external and internal
Measuring circuit monitoring	sensor burnout
Voltage	selectable within the range -100 ... 100 mV
Potentiometer	0 ... 20 kΩ (2-wire connection), 0.8 ... 20 kΩ (3-wire connection)
Input resistance	≥ 1 MΩ (-100 ... 100 mV)
Output	
Voltage output	0 ... 5 V or 1 ... 5 V; output resistance: ≤ 5 Ω ; load: ≥ 10 kΩ
Fault signal	downscale 0 V or 0.5 V, upscale 5.375 V
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 130 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Features

- **2-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **TC, RTD, potentiometer or voltage input**
- **Voltage output 0/1 V ... 5 V**
- **Configurable by PACT*ware*™**
- **Line fault (LFD) and sensor burnout detection**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner is designed to connect RTDs, thermocouples, or potentiometers, and provide a proportional 0/1 V ... 5 V signal.

The barrier offers 3-port isolation between input, output, and power supply.

A removable terminal block K-CJC-** is available for thermocouples when internal cold junction compensation is desired.

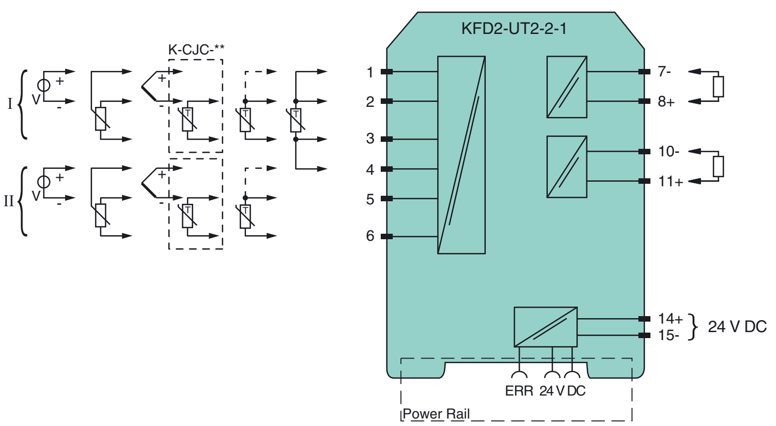
A fault is indicated by a red flashing LED per NAMUR NE44 and user-configured fault outputs.

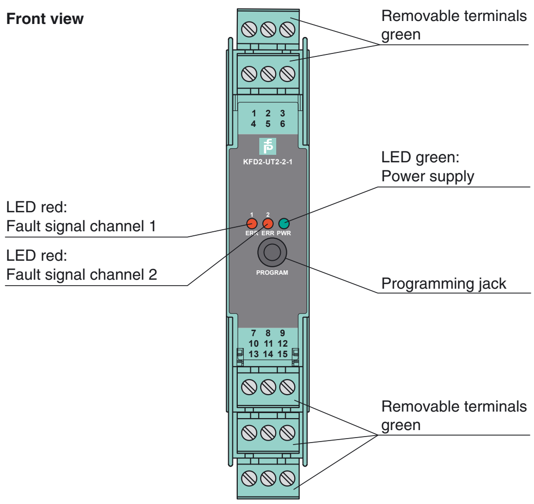
The unit is easily programmed with the **PACT*ware*™** configuration software.

A unique collective error messaging feature is available when used with the Power Rail system.

For additional information, refer to the manual and www.pepperl-fuchs.com.

Diagrams





Edition 912426 (US) / 216306 (EU) 04/2009

Features

- **1-channel signal conditioner**
- **24 V DC supply (loop powered)**
- **2- or 3-wire Pt100 RTD input**
- **Output 4 mA ... 20 mA, temperature linearization selectable**
- **DIP switch selectable ranges**
- **Sensor burnout detection**

Function

This isolated signal conditioner is a loop-powered isolator that converts the resistance from a 3-wire RTD to a 4 mA ... 20 mA signal and provides isolation for non-intrinsically safe applications.

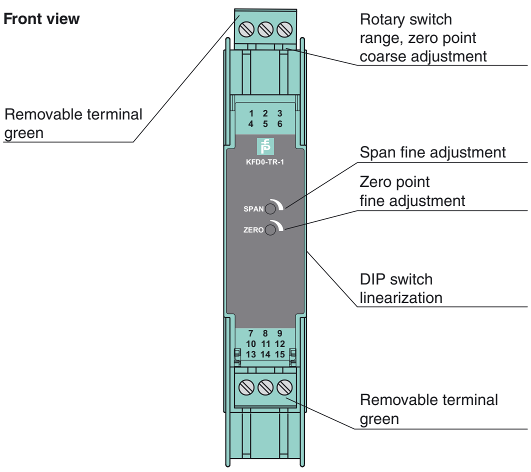
A selectable analog linearization ensures a temperature linear 4 mA ... 20 mA output between 25 °C ... 375 °C.

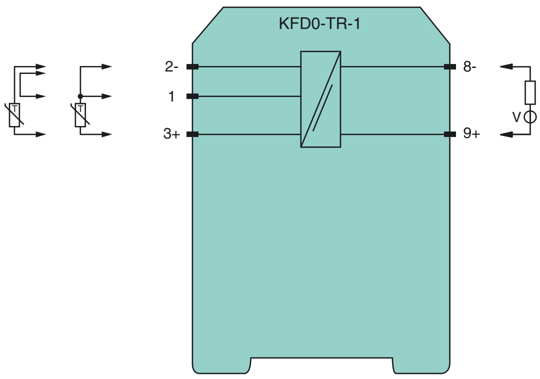
It also features conveniently located DIP switches and potentiometers to make field calibration easy.

Technical data

Supply	
Rated voltage	12 ... 35 V DC loop powered
Input	
Line resistance	≤ 100 Ω per lead
Measuring current	approx. 1 mA
Output	
Load	(U -12 V)/0.02 A
Current output	4 ... 20 mA, limited to ≤ 35 mA
Fault signal	sensor burnout: upscaling ≥ 22 mA, limited to ≤ 35 mA
Transfer characteristics	
Measuring range f_n	span without linearization 25 ... 800 °C/ with linearization 25 ... 375 °C zero point without linearization -200 ... 400 °C/ with linearization -30 ... 375 °C span and zero point adjustable
Deviation	
After calibration	0.1 % of full-scale value
Influence of ambient temperature	span and zero point 0.015 %/K or ± 10 mΩ/K
Influence of supply voltage	6.5 ppm/V
Rise time	250 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Diagrams





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Technical data

Supply	
Rated voltage	12 ... 35 V DC loop powered
Input	
Line resistance	≤ 100 Ω per lead
Current	lead monitoring ON: ≤ 15 nA; OFF: ≤ 1 nA
Output	
Load	(U -12 V)/0.02 A
Current output	4 ... 20 mA, limited to ≤ 35 mA
Fault signal	downscale ≤ 3 mA, upscaling ≥ 22 mA
Transfer characteristics	
Measuring range f_n	span 4 ... 100 mV, zero point -12 ... 60 mV, both adjustable
Deviation	
After calibration	0.1 % of full-scale value ± 1 °C for the cold junction
Temperature effect	temperature deviation 0.015 % of the span/K or 1.5 µV/K cold junction ± 2.0 °C (calibrated at T_{amb} = 20 °C)
Influence of supply voltage	6.5 ppm/V
Characteristic curve	the output voltage is linearly proportionate to the input voltage (not to temperature)
Rise time	250 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Features

- **1-channel signal conditioner**
- **24 V DC supply (loop powered)**
- **Thermocouple input**
- **Output 4 mA ... 20 mA**
- **Internal cold junction compensation**
- **Sensor burnout detection**
- **DIP switch selectable ranges**

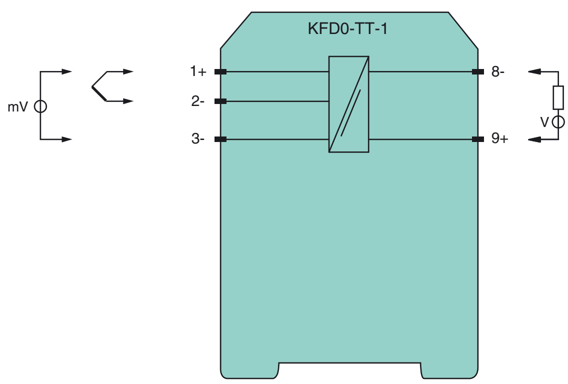
Function

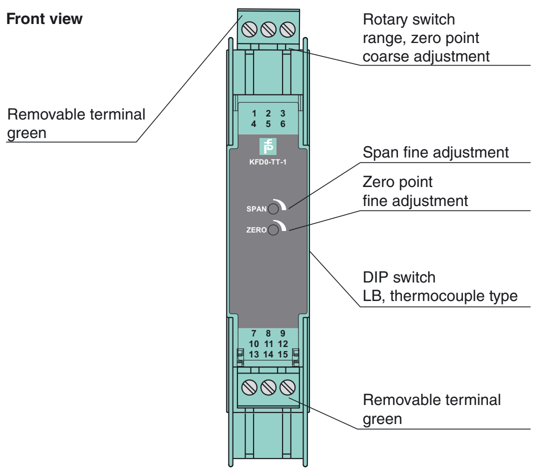
This isolated signal conditioner is a loop-powered isolator that converts thermocouple inputs to a 4 mA ... 20 mA signal and provides isolation for non-intrinsically safe applications.

The internal cold junction compensation can be bypassed by using terminals 1 and 3.

The output current is linear to input voltage, not proportional to temperature. Zero, span, and burnout detection are field-configurable.

Diagrams





K-System
Digital Inputs
Digital Outputs
Analog Inputs
Analog Outputs
Accessories

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Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Thermocouple, RTD, voltage or current input**
- **2 relay contact outputs**
- **Programmable high/low alarm**
- **Configurable by PACT*ware*™**
- **Sensor burnout detection**

Function

This signal conditioner accepts a variety of inputs including RTDs or thermocouples and provides a relay trip whenever it reaches a user-programmed set point. It also provides isolation for non-intrinsically safe applications.

A removable terminal block K-CJC-** is available for thermocouples when internal cold junction compensation is desired.

A fault is indicated by a red flashing LED per NAMUR NE44 and user-configured fault outputs.

The unit is easily programmed with the **PACT*ware*™** configuration software.

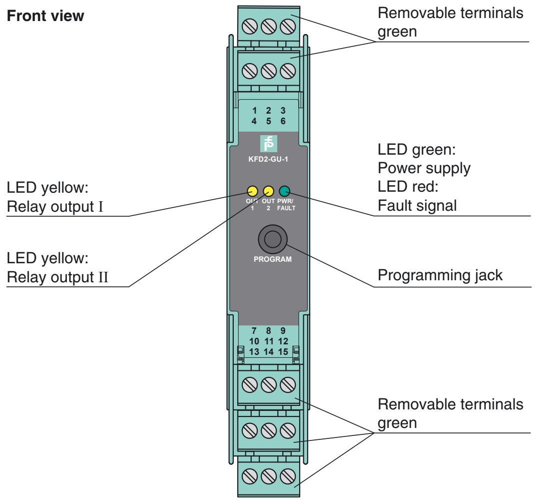
For additional information, refer to the manual and www.pepperl-fuchs.com.

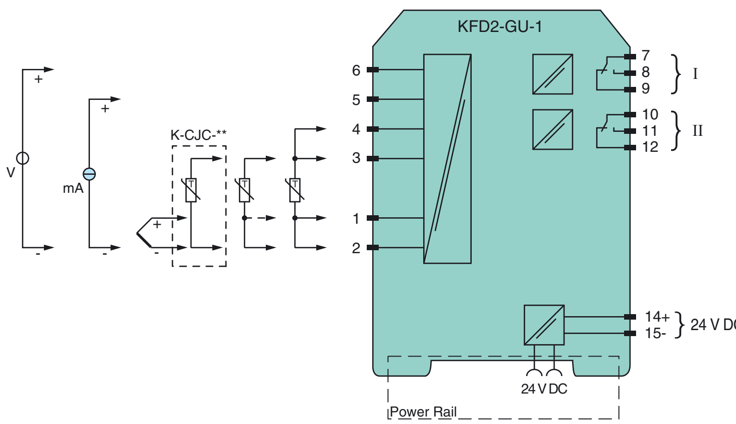
Technical data

Supply	
Rated voltage	19 ... 35 V DC
Power consumption	0.8 W
Input	
Line resistance	≤ 50 Ω per lead
Measuring current	for Pt100: approx. 400 µA; current for lead monitoring switched off during the measurement
Load	20 Ω for 20 mA; 200 kΩ for 10 V
Output	
Output I, II	
Contact loading	253 V AC/2 A/500 VA/cos Φ min. 0.7; 40 V DC/2 A resistive load
Mechanical life	2 x 10^7 switching cycles
Transfer characteristics	
Deviation	
Voltage input	± 0.02 % of 10 V measuring range
Resistance input	± 0.025 % of measuring range (4-wire connection)
Current input	± 0.02 % of 20 mA measuring range
Pt100	± 0.01 % of abs. temperature value of switching point in K + 0.2 K (4-wire connection)
Thermocouple	± 0.05 % of abs. temperature value of switching point in K + 1.1 K (1.2 K for thermocouple types R and S) this includes ± 0.8 K error of the cold junction compensation (+0.9 K for thermocouple types R and S).
Influence of ambient temperature	
Pt100	± (0.0015 % of abs. temperature value of switching point in K + 0.01 K)/KΔT_{amb}*)
Thermocouple	± (0.004 % of abs. temperature value of switching point in K + 0.01 K)/KΔT_{amb}*)
Thermocouple type R and S	± (0.005 % of abs. temperature value of switching point in K + 0.01 K)/KΔT_{amb}*)
Voltage source	± (0.007 % of the switching point voltage)/KΔT_{amb}*)
Current source	± (0.007 % of the switching point current)/KΔT_{amb}*) * ΔT_{amb} = ambient temperature change referenced to 23 °C (296 K)
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Diagrams

Front view





Edition 912426 (US) / 216306 (EU) 04/2009

Technical data

Supply	
Rated voltage	20 ... 30 V DC
Power loss/power consumption	≤ 2 W/2.2 W
Input	
RTD	Pt100, Pt500, Pt1000, Ni100, Ni1000
Types of measuring	2-, 3-, 4-wire technology
Line resistance	≤ 50 Ω
Measuring circuit monitoring	sensor burnout, sensor short-circuit
Thermocouples	type B, E, J, K, L, N, R, S, T
Cold junction compensation	external and internal
Measuring circuit monitoring	sensor burnout
Voltage	0 ... 10 V, 2 ... 10 V, 0 ... 1 V, -100 ... 100 mV
Potentiometer	0.8 ... 20 kΩ
Types of measuring	2-, 3-, 5-wire technology
Input resistance	≥ 250 kΩ (0 ... 10 V) ≥ 1 MΩ (0 ... 1 V, -100 ... 100 mV)
Measuring current	approx. 400 µA with resistance measuring sensor
Output	
Output I, II	relay
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 40 DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Output III	analog current output
Current range	0 ... 20 mA or 4 ... 20 mA
Open circuit voltage	≤ 24 V DC
Load	≤ 650 Ω
Fault signal	downscale I ≤ 3.6 mA, upscale I ≥ 21 mA (acc. NAMUR NE43)
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **TC, RTD, potentiometer or voltage input**
- **Current output 0/4 mA ... 20 mA**
- **2 relay contact outputs**
- **Line fault (LFD) and sensor burnout detection**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner is a universal input trip alarm that converts the signal of an RTD, thermocouple, potentiometer, or voltage source to a proportional output current. It also provides a relay trip whenever it reaches a user-programmed set point and isolation for non-intrinsically safe applications.

A removable terminal block K-CJC-** is available for thermocouples when internal cold junction compensation is desired.

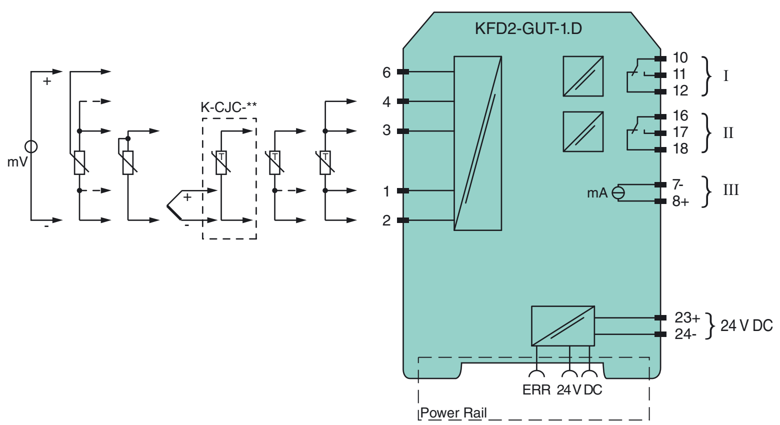
A fault is indicated by a red flashing LED per NAMUR NE44 and user-configured fault outputs.

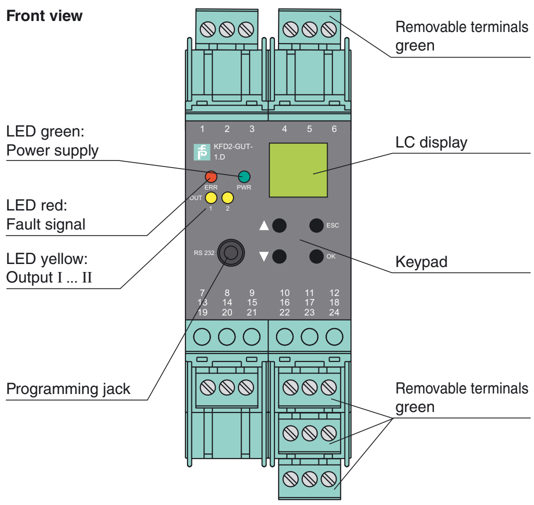
The unit is easily programmed by the use of a keypad located on the front of the unit or with the **PACT***ware*™ configuration software.

A unique collective error messaging feature is available when used with the Power Rail system.

For additional information, refer to the manual and www.pepperl-fuchs.com.

Diagrams





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Features

- **1-channel signal conditioner**
- **AC/DC wide range supply**
- **TC, RTD, potentiometer or voltage input**
- **Current output 0/4 mA ... 20 mA**
- **2 relay contact outputs**
- **Line fault (LFD) and sensor burnout detection**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner is a universal input trip alarm that converts the signal of an RTD, thermocouple, potentiometer, or voltage source to a proportional output current. It also provides a relay trip whenever it reaches a user-programmed set point and isolation for non-intrinsically safe applications.

A removable terminal block K-CJC-** is available for thermocouples when internal cold junction compensation is desired.

A fault is indicated by a red flashing LED per NAMUR NE44 and user-configured fault outputs.

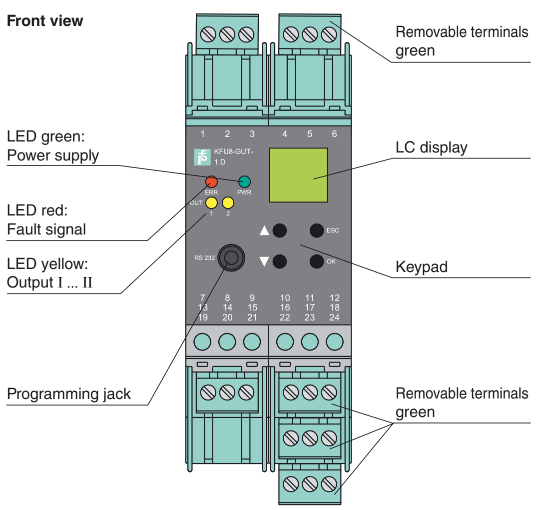
The unit is easily programmed by the use of a keypad located on the front of the unit or with the **PACT***ware*™ configuration software.

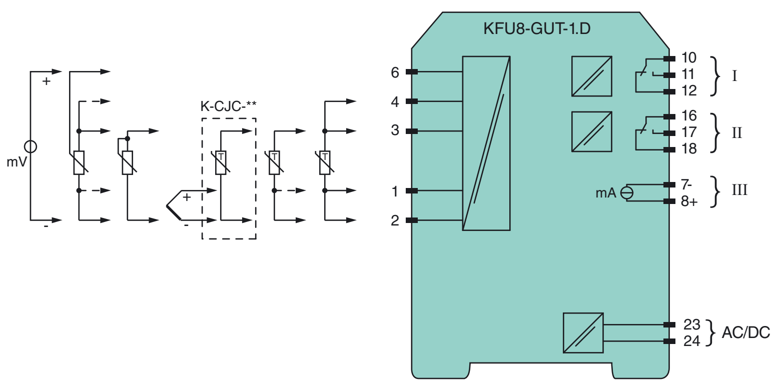
For additional information, refer to the manual and www.pepperl-fuchs.com.

Technical data

Supply	
Rated voltage	20 ... 90 V DC/48 ... 253 V AC
Power loss/power consumption	≤ 2 W; 2.5 VA/2.2 W; 3 VA
Input	
RTD	Pt100, Pt500, Pt1000, Ni100, Ni1000
Types of measuring	2-, 3-, 4-wire technology
Line resistance	≤ 50 Ω
Measuring circuit monitoring	sensor burnout, sensor short-circuit
Thermocouples	type B, E, J, K, L, N, R, S, T
Cold junction compensation	external and internal
Measuring circuit monitoring	sensor burnout
Voltage	0 ... 10 V, 2 ... 10 V, 0 ... 1 V, -100 ... 100 mV
Potentiometer	0.8 ... 20 kΩ
Types of measuring	2-, 3-, 5-wire technology
Input resistance	≥ 250 kΩ (0 ... 10 V) ≥ 1 MΩ (0 ... 1 V, -100 ... 100 mV)
Measuring current	approx. 400 µA with resistance measuring sensor
Output	
Output I, II	relay
Contact loading	250 V AC/2 A/cos Φ ≥ 0.7; 40 DC/2 A
Mechanical life	5 x 10^7 switching cycles
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Output III	analog current output
Current range	0 ... 20 mA or 4 ... 20 mA
Open circuit voltage	≤ 24 V DC
Load	≤ 650 Ω
Fault signal	downscale I ≤ 3.6 mA, upscale I ≥ 21 mA (acc. NAMUR NE43)
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	300 g
Dimensions	40 x 119 x 115 mm (1.6 x 4.7 x 4.5 in), housing type C3

Diagrams





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Current Drivers

Model Number	Channels	Input (Control System)		Output (Field)			SMART	Supply		SIL	Page
		4 mA ... 20 mA	0 V ... 10 V	mA	0 V ... 10 V	Line Fault Detection		24 V DC	Loop Powered		
KCD2-SCD-1	1	■		■			■	■		2	118
KFD2-SCD2-1.LK	1	■		■		■	■	■		2	119
KFD2-SCD2-2.LK	2	■		■		■	■	■		2	120
KFD0-CS-1.50	1	■		■					■	2	121
KFD0-CS-2.50	2	■		■					■	2	122

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KCD2-SCD-1

SMART Current Driver

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Current output up to 650 Ω load**
- **HART I/P and valve positioner**
- **Accuracy 0.1 %**
- **Housing width 12.5 mm**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner drives SMART I/P converters, electrical valves, and positioners and provides isolation for non-intrinsically safe applications.

Digital signals may be superimposed on the analog values and are transferred bi-directionally.

Current transferred across the DC/DC converter is repeated at terminals 1 and 2.

An open circuit on the field wiring will result in the barrier generating a high impedance condition on the input.

If the loop resistance is too low, an internal resistor of 250 Ω between terminals 6 and 8 is available, which may be used as the HART communication resistor.

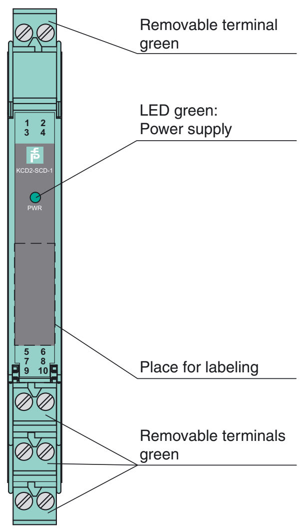
Sockets for the connection of a HART communicator are integrated into the terminals of the device.

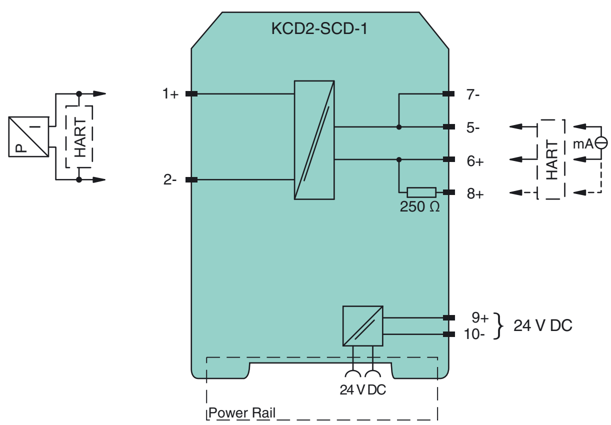
Technical data

Supply	
Rated voltage	19 ... 30 V DC
Power consumption	≤ 700 mW
Input	
Input signal	4 ... 20 mA limited to approx. 30 mA
Voltage drop U_d	approx. 6 V or internal resistance 300 Ω at 20 mA
Input resistance	> 100 kΩ at max. 23 V, with field wiring open
Output	
Current	4 ... 20 mA
Load	0 ... 650 Ω
Voltage	≥ 13 V at 20 mA
Ripple	20 mV_{rms}
Transfer characteristics	
Deviation	at 20 °C (293 K), 4 ... 20 mA ≤ ± 0.1 % incl. non-linearity and hysteresis
Influence of ambient temperature	< 2 µA/°C (0 ... +60 °C); < 4 µA/°C (-20 ... 0 °C)
Frequency range	bandwidth with 0.5 V_{pp}-signal 0 ... 3 kHz (-3 dB)
Rise time	10 to 90 % ≤ 100 ms
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	12.5 x 114 x 125 mm (0.5 x 4.5 x 4.9 in), housing type A2

Diagrams

Front view





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Technical data

Supply	
Rated voltage	10 ... 35 V DC
Power consumption	1 W at 20 mA
Input	
Voltage drop U_d	approx. 4 V or internal resistance 200 Ω at 20 mA
Input resistance	> 100 kΩ, when wiring resistance in the field < 50 Ω or > 800 Ω at 20 mA
Current	4 ... 20 mA limited to approx. 25 mA
Output	
Current	4 ... 20 mA
Load	100 ... 700 Ω
Voltage	≥ 14 V at 20 mA
Transfer characteristics	
Deviation	
After calibration	at 293 K (20 °C): 10 µA incl. non-linearity, calibration, hysteresis, supply and load changes
Influence of ambient temperature	1 µA/°C
Rise time	< 100 µs (bounce from 10 ... 90 %)
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 124 x 115 mm (0.8 x 4.9 x 4.5 in), housing type B2

Features

- **1-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Current output up to 700 Ω load**
- **HART I/P and valve positioner**
- **Line fault detection (LFD)**
- **Accuracy 0.05 %**
- **Terminals with test points**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner drives SMART I/P converters, electrical valves, and positioners and provides isolation for non-intrinsically safe applications.

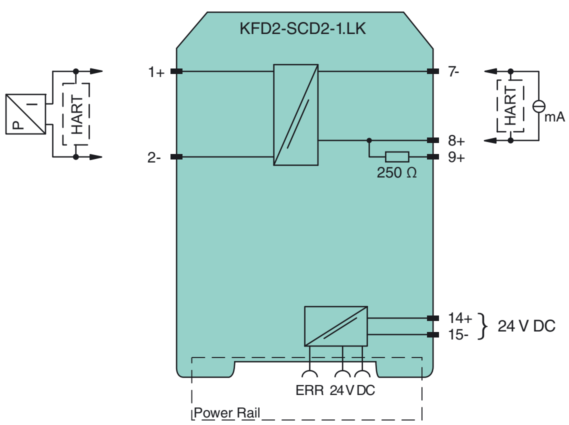
Digital signals may be superimposed on the analog values and are transferred bi-directionally.

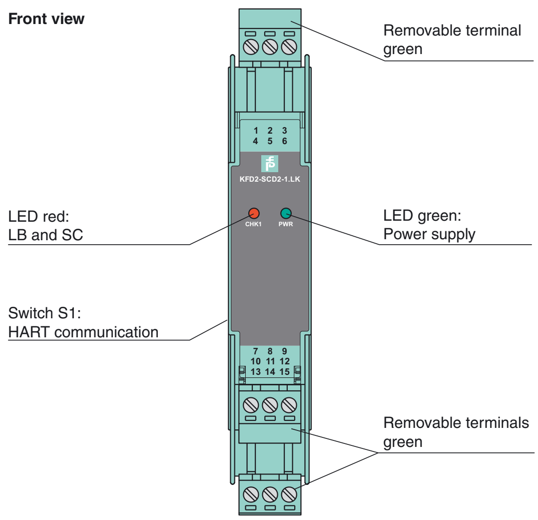
Current transferred across the DC/DC converter is repeated at terminals 1 and 2.

If the loop resistance is too low, an internal resistor of 250 Ω between terminals 8 and 9 is available, which may be used as the HART communication resistor.

Sockets for the connection of a HART communicator are integrated into the terminals of the device.

Diagrams





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Features

- **2-channel signal conditioner**
- **24 V DC supply (Power Rail)**
- **Current output up to 700 Ω load**
- **HART I/P and valve positioner**
- **Line fault detection (LFD)**
- **Accuracy 0.05 %**
- **Terminals with test points**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner drives SMART I/P converters, electrical valves, and positioners and provides isolation for non-intrinsically safe applications.

Digital signals may be superimposed on the analog values and are transferred bi-directionally.

Current transferred across the DC/DC converter is repeated at terminals 1, 2 and 4, 5.

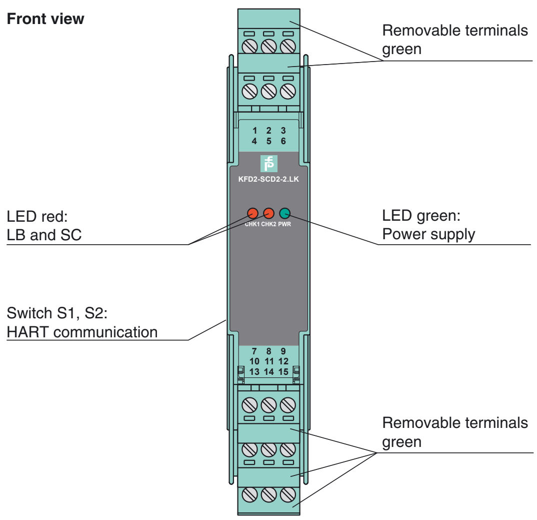
If the loop resistance is too low, an internal resistor of 250 Ω between terminals 8, 9 and 11, 12 is available, which may be used as the HART communication resistor.

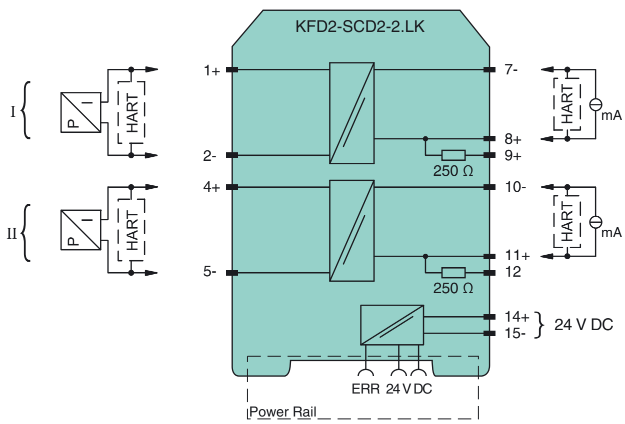
Sockets for the connection of a HART communicator are integrated into the terminals of the device.

Technical data

Supply	
Rated voltage	10 ... 35 V DC
Power consumption	1.8 W at 20 mA
Input	
Voltage drop U_d	approx. 4 V or internal resistance 200 Ω at 20 mA
Input resistance	> 100 kΩ, when wiring resistance in the field < 50 Ω or > 800 Ω at 20 mA
Current	4 ... 20 mA limited to approx. 25 mA
Output	
Current	4 ... 20 mA
Load	100 ... 700 Ω
Voltage	≥ 14 V at 20 mA
Transfer characteristics	
Deviation	
After calibration	at 293 K (20 °C): 10 µA incl. non-linearity, calibration, hysteresis, supply and load changes
Influence of ambient temperature	1 µA/°C
Rise time	< 100 µs (bounce from 10 ... 90 %)
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 150 g
Dimensions	20 x 124 x 115 mm (0.8 x 4.9 x 4.5 in), housing type B2

Diagrams





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Technical data

Supply	
Rated voltage	loop powered
Input	
Rated voltage U_i	10 ... 35 V
Rated current I_e	4 ... 20 mA
Power loss	< 150 mW per channel at 25 mA and U < 26.1 V < 400 mW per channel at 25 mA and U > 26.1 V
Output	
Voltage	≥ 0.9 x U_{in} - (0.23 x current in mA) - 0.7 for 10 V < U_{in} < 26.1 V ≥ 23 V - (0.23 x current in mA) for U_{in} > 26.1 V
Short-circuit current	≤ 100 mA
Transfer current	≤ 25 mA
Transfer characteristics	
Deviation	
After calibration	U_{in} ≥ 5 V ± 20 µA/U_{in} ≤ 5 V ± 50 µA incl. calibration, linearity, hysteresis and output load fluctuations at 20 °C (293 K)
Influence of ambient temperature	≤ 2 µA/K (0 ... +50 °C); ≤ 5 µA/K (-20 ... +60 °C)
Rise time	≤ 5 ms at 4 ... 20 mA and U_{in} = input voltage < 26 V
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	20 x 107 x 115 mm (0.8 x 4.2 x 4.5 in), housing type B1

Features

- **1-channel signal conditioner**
- **24 V DC supply (loop powered)**
- **Current input/output 4 mA ... 20 mA**
- **I/P or transmitter power supply**
- **Accuracy 0.1 %**
- **Up to SIL2 acc. to IEC 61508**

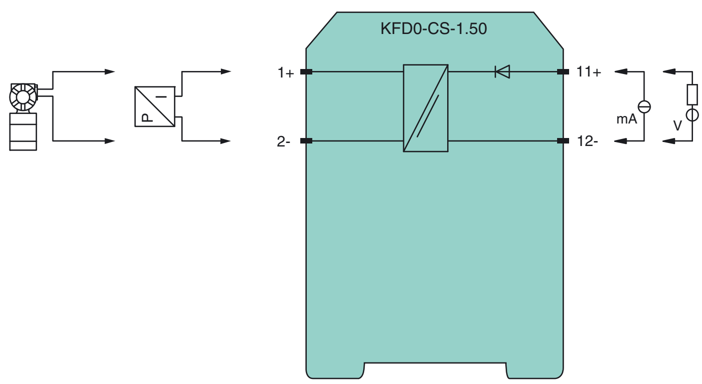
Function

This signal conditioner transfers DC signals from fire alarms, smoke alarms, and temperature sensors and provides isolation for non-intrinsically safe applications. It can also be used to control I/P converters, power solenoids, LEDs, and audible alarms.

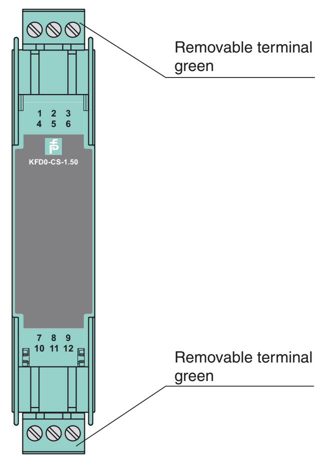
Since this isolator is loop powered, use the technical data to verify that proper voltage is available to the field devices.

K-System
Digital Inputs
Digital Outputs
Analog Inputs
Analog Outputs
Accessories

Diagrams



Front view



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Features

- **2-channel signal conditioner**
- **24 V DC supply (loop powered)**
- **Current input/output 4 mA ... 20 mA**
- **I/P or transmitter power supply**
- **Accuracy 0.1 %**
- **Up to SIL2 acc. to IEC 61508**

Function

This signal conditioner transfers DC signals from fire alarms, smoke alarms, and temperature sensors and provides isolation for non-intrinsically safe applications. It can also be used to control I/P converters, power solenoids, LEDs, and audible alarms.

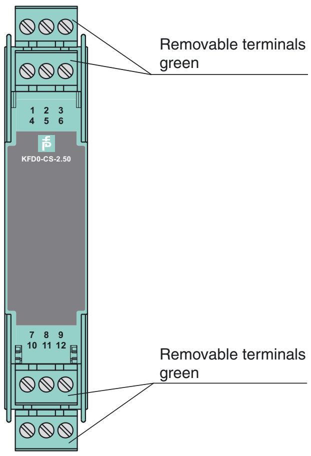
Since this isolator is loop powered, use the technical data to verify that proper voltage is available to the field devices.

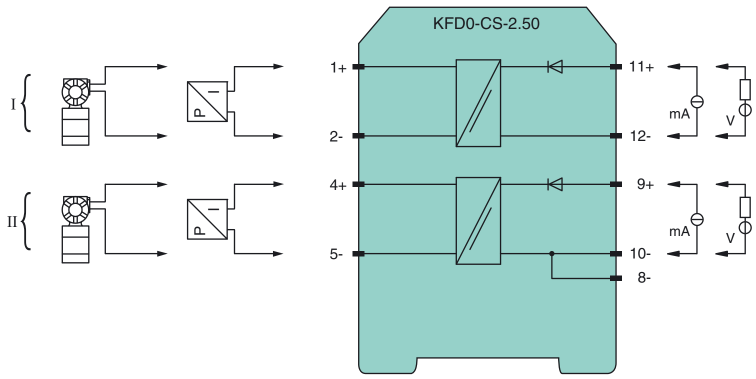
Technical data

Supply	
Rated voltage	loop powered
Input	
Rated voltage U_i	10 ... 35 V
Rated current I_e	4 ... 20 mA
Power loss	< 150 mW per channel at 25 mA and U < 26.1 V < 400 mW per channel at 25 mA and U > 26.1 V
Output	
Voltage	$\geq$ 0.9 x U_{in} - (0.23 x current in mA) - 0.7 for 10 V < U_{in} < 26.1 V $\geq$ 23 V - (0.23 x current in mA) for U_{in} > 26.1 V
Short-circuit current	$\leq$ 100 mA
Transfer current	$\leq$ 25 mA
Transfer characteristics	
Deviation	
After calibration	$U_{in} \geq 5$ V ± 20 µA/$U_{in} \leq 5$ V ± 50 µA incl. calibration, linearity, hysteresis and output load fluctuations at 20 °C (293 K)
Influence of ambient temperature	$\leq$ 2 µA/K (0 ... +50 °C); $\leq$ 5 µA/K (-20 ... +60 °C)
Rise time	$\leq$ 5 ms at 4 ... 20 mA and U_{in} = input voltage < 26 V
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	20 x 107 x 115 mm (0.8 x 4.2 x 4.5 in), housing type B1

Diagrams

Front view





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Power Supplies

Model Number	Description	Page
KFA6-STR-1.24.500	Power Supply, 24 V, 500 mA	124
KFA6-STR-1.24.4	Power Supply, 24 V, 4 A	125
KFD2-EB2	Power Feed Module	126
KFD2-EB2.R4A.B	Redundant Power Feed Module	127
UPR-03-*	Universal Power Rail	128
UPR-05-*	Universal Power Rail	129
UPR-E	End Cap for UPR-**-*	128, 129
K-DUCT-GY-UPR-03	Cable Duct with UPR-03-* Insert, 3-conductor	130
K-DUCT-GY-UPR-05	Cable Duct with UPR-05-* Insert, 5-conductor	131
UPR-I	Insulation Spacer for UPR-**-*	132

Terminal Blocks

Model Number	Description	Page
K-CJC-BK	Terminal Block with Cold Junction Compensation, 3-pin, black, for KF Modules	132
KC-ST-5GN	Terminal Block, 2-pin, green, for KC Modules	133
KF-ST-5BK	Terminal Block, 3-pin, black, for KF Modules	133
KF-ST-5GN	Terminal Block, 3-pin, green, for KF Modules	133
KC-STP-5GN	Terminal Block with Test Sockets, 2-pin, green, , for KC Modules	134
KF-STP-5GN	Terminal Block with Test Sockets, 3-pin, green, for KF Modules	134
KC-CTT-5GN	Terminal Block with Test Sockets, 2-pin, green, for KC Modules	135
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Other Accessories

Model Number	Description	Page
KF-SEAL	Adhesive Sticker	136
TS 35 Typ 12	End Bracket	136
E/AL-NS35	End Bracket	137
K-MS	Mounting Socket	137
KFD0-LGH-GN	Place Holder Barrier, KF Modules	138
F-MPN-1	Pickup NAMUR Converter	139
K-ADP-USB	Adapter with USB Interface	140
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Features

- **115/230 V AC supply**
- **Output 24 V DC, 500 mA**
- **Electronic short circuit protection**
- **Power Rail connection**

Function

This regulated power supply provides 24 V DC, at 500 mA.

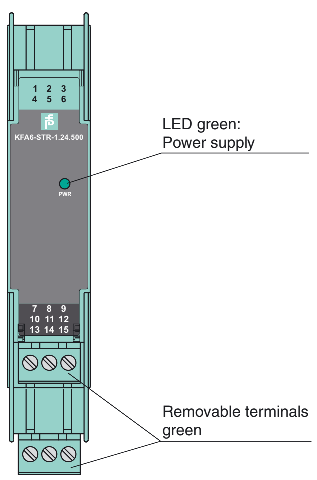
The KFA6-STR-1.24.500 features removable terminals and mounts directly on the Power Rail. This allows usage as Power Rail supply as well as stand alone power supply.

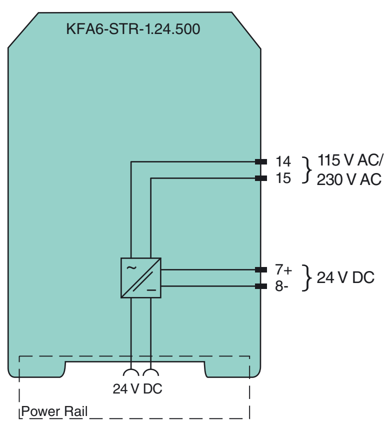
Technical data

Supply	
Rated voltage	90 ... 253 V AC, 48 ... 63 Hz
Power loss	2.5 W
Output	
Connection	Power Rail or terminals 7+, 8-
Current	500 mA at 60 °C , permanent short-circuit protection (electronically)
Voltage	24 V ± 0.5 V
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 140 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2

Diagrams

Front view





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Technical data

Supply	
Rated voltage	92 ... 265 V AC, 47 ... 63 Hz
Rated current	2.1 ... 0.84 A
Failure override time	> 75 ms/230 V AC; 5 ms/115 V AC
Output	
Current	0 ... 4 A, Power Rail limiting by means of fuse 4 AT, electron. limitation typ. 4.6 A
Voltage	23.28 ... 24.72 V DC
Ripple	< 100 mV_{pp}
Efficiency	typ. 87 %
Overvoltage protection	< 28 V DC
Electromagnetic compatibility	
Safety	acc. to VDE 0805/EN 60950
Radio-interference supression	acc. to VDE 0875 Part 11, EN 55011 class B
Electrostatic discharge	acc. to IEC 60801-2
Contact discharging	8 kV
Air discharging	15 kV
Electromagnetic fields	acc. to IEC 801-3, 10 V/m
Burst IEC 60801-4	Input: 4 kV; output/capacitively coupled: 2 kV
Surge IEC 60801-5	asymmetrical: L, N -> PE 4 kV; symmetrical: L -> N 2 kV
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 800 g
Dimensions	140 x 103.5 x 99 mm (5.5 x 4.1 x 3.9 in)
Mounting	clamping element for snap-mounting on DIN rail as per EN 60715
Connection possibilities	self-opening connection terminals, max. core cross-section 2 x 2.5 mm^2
Data for application in conjunction with hazardous areas	
UL approval	UL recognized E185902

Features

- **115/230 V AC supply**
- **Output 24 V DC, 4 A**
- **Fused output**
- **Power Rail connection**

Function

This regulated power supply provides 24 V DC, at 4 A. It features removable terminals, LED fault indication, and mounts directly on the Power Rail.

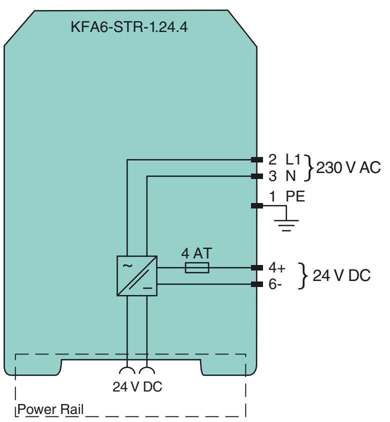
Designed with a replaceable fuse and LED, it will provide a green visual indication for normal operation or a flashing red indication if a fault occurs.

Attention: Ignoring the safety instructions (i. e., touching hot sections when the device is open, handling malpractices) can be extremely dangerous.

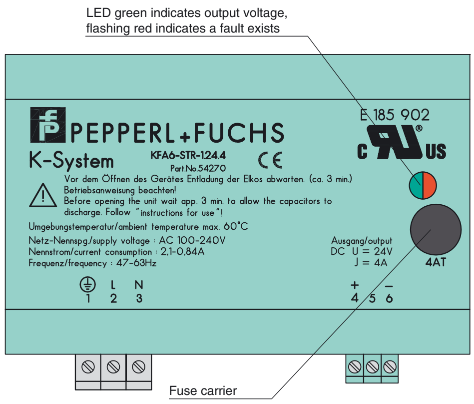
When exceeding the values stated in the technical data, there is a danger of overheating. As a result, the operation of the power supply and its electrical safety may be impaired.

Before starting installation or service, switch mains off. Do not plug or unplug powered!

Diagrams



Front view



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Features

- **Interface for Power Rail**
- **Supply rating 4 A, external fused**
- **Relay contact output, reversible**
- **LED status indication**

Function

The power feed module interfaces 24 V DC power to the Power Rail at a maximum current of 4 A. The twin input terminals allow for daisy-chaining of supply (max. 10 A).

A green LED on the front of the unit indicates that power is on, and a red LED illuminates during error conditions.

In the event of a field wiring or barrier fault from any barrier on the Power Rail, the integral collective error messaging relay alerts the controller via a single discrete I/O point.

This relay can be configured as normally open or normally closed.

In the sense of functional safety (SIL) the device provides no dangerous failures. Thereby the safe condition of the supplied barrier must be defined as the powerless state. Thus the device will not influence the safety calculation or the SIL value.

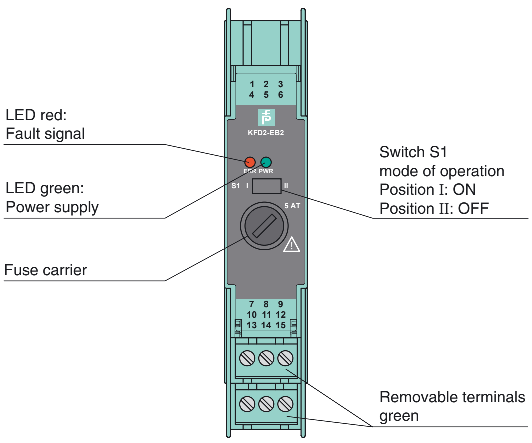
This device is compatible with all versions of the Power Rail.

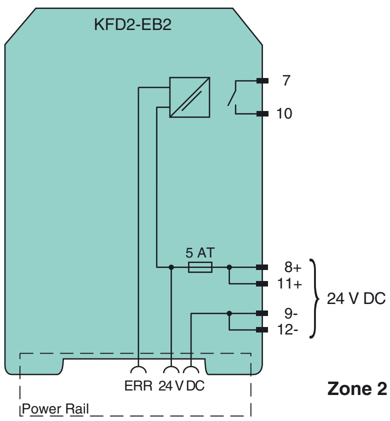
Technical data

Supply	
Rated voltage	20 ... 30 V DC The maximum rated operational voltage of the devices plugged onto the Power Rail must not be exceeded.
Power loss	≤ 1 W
Output	
Power Rail feed	output current: ≤ 4 A
Fault signal	relay output: NO
Contact loading	40 V DC; 2 A
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Fusing	5 AT
Ambient conditions	
Ambient temperature	-25 ... 60 °C (248 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in) , housing type B2
Data for application in conjunction with hazardous areas	
Statement of conformity	Pepperl+Fuchs
Group, category, type of protection, temperature classification	Ⓔx II 3G Ex nA nC IIC T4 X
FM control drawing	116-0160
CSA control drawing	116-0160
Approved for	Class I, Division 2, Groups A, B, C, D; Class I, Zone 2, IIC

Diagrams

Front view





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Technical data

Supply	
Rated voltage	20 ... 30 V DC The maximum rated operational voltage of the devices plugged onto the Power Rail must not be exceeded.
Power loss	≤ 2.4 W
Output	
Power Rail feed	output current: ≤ 4 A
Fault signal	relay output: NO
Contact loading	40 V DC; 2 A
Energized/de-energized delay	approx. 20 ms/approx. 20 ms
Fusing	5 AT
Ambient conditions	
Ambient temperature	-25 ... 60 °C (248 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 100 g
Dimensions	20 x 119 x 115 mm (0.8 x 4.7 x 4.5 in), housing type B2
Data for application in conjunction with hazardous areas	
Statement of conformity	Pepperl+Fuchs
Group, category, type of protection, temperature classification	Ex II 3G Ex nA nC IIC T4 X
FM control drawing	116-0160
CSA control drawing	116-0160
Approved for	Class I, Division 2, Groups A, B, C, D; Class I, Zone 2, IIC

Features

- **Interface for Power Rail**
- **Used for redundant configuration**
- **Supply rating 4 A, external fused**
- **Relay contact output, reversible**

Function

The power feed module interfaces 24 V DC power to the Power Rail at a maximum current of 4 A and is designed for applications requiring redundant power. The twin input terminals allow for daisy-chaining of supply (max. 10 A).

A green LED on the front of the unit indicates that power is on, and a red LED illuminates during error conditions.

In the event of a field wiring or barrier fault from any barrier on the Power Rail, the integral collective error messaging relay alerts the controller via a single digital I/O point. This relay can be configured as normally open or normally closed.

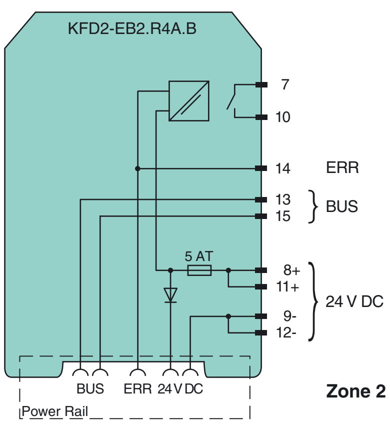
Additionally, the bus implemented in the Power Rail is forwarded to the outside terminals 13 and 15 for usage with KFD2-WAC2-Ex1.D RS 485 connection. Terminal 14 is only for test purposes.

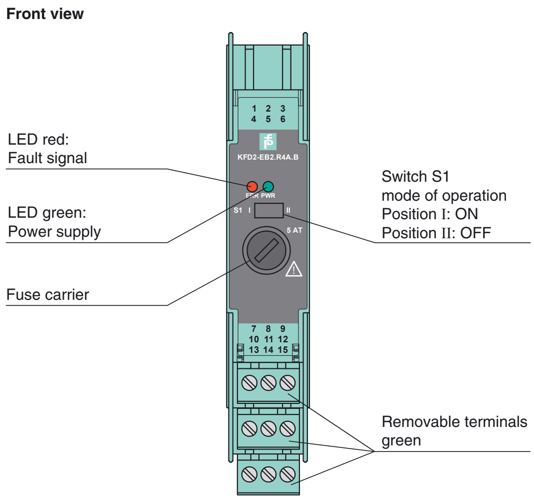
In the sense of functional safety (SIL) the device provides no dangerous failures. Thereby the safe condition of the supplied barrier must be defined as the powerless state. Thus the device will not influence the safety calculation or the SIL value.

This device is compatible with all versions of the Power Rail and provides group fusing.

Note: Redundant systems require two KFD2-EB.R4A.B modules.

Diagrams





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Singapore: +65 6779 9091 pa-info@sg.pepperl-fuchs.com

Features

- **Gold plated 3-conductor insert in 35 mm DIN rail acc. to EN 60715**
- **Provides DC supply voltage to all equipped K-System modules**
- **Standard length 0.8 m (2.6 ft) or 2 m (6 ft), simple to customize to application space**
- **Eliminates daisy-chains**

Function

The Power Rail is a plastic insert with integral gold-plated conductors that fits into its own integral, 35 mm DIN rail and supplies components with power.

The Power Rail UPR-03-* has two conductors for power and one conductor for collective error messaging.

The Power Rail reduces wiring and maintenance costs because it eliminates the need to daisy-chain the wires. It also simplifies expansion — just snap in a new module when you're ready to expand a system.

The universal Power Rail comes in 2 m segments (UPR-03) and in 0.8 m segments (UPR-03-S) but can be cut to any size.

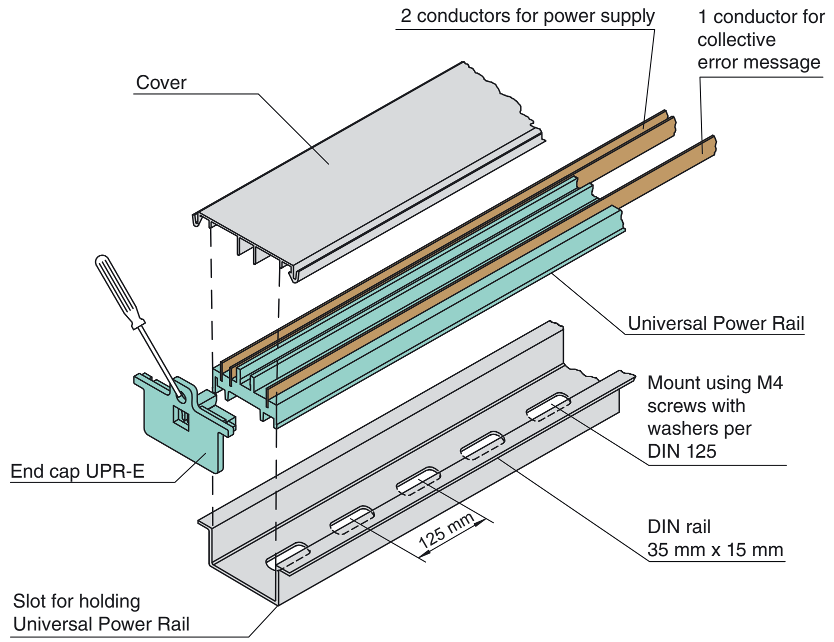
The Power Rail is delivered with two UPR-E end caps. More end caps can be ordered separately.

Accessories

UPR-E

End cap for UPR-03-* and UPR-05-*

Dimensions



Technical data

Electrical specifications	
Rated voltage	24 V DC
Rated current	4 A
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Dimensions	35 x 15 x 800 mm (1.4 x 0.6 x 31.5 in) 35 x 15 x 2000 mm (1.4 x 0.6 x 78.7 in)
Mounting	mounting in 35 mm DIN rail acc. to DIN EN 60715

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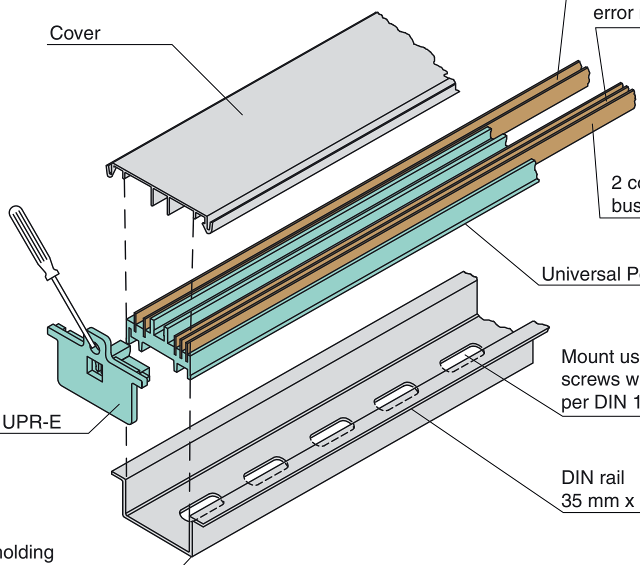
Dimensions



Technical data

Electrical specifications	
Rated voltage	24 V DC
Rated current	4 A
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Dimensions	35 x 15 x 800 mm (1.4 x 0.6 x 31.5 in) 35 x 15 x 2000 mm (1.4 x 0.6 x 78.7 in)
Mounting	mounting in 35 mm DIN rail acc. to DIN EN 60715

Features

- **Gold plated 5-conductor insert in 35 mm DIN rail acc. to EN 60715**
- **Provides DC supply voltage and bus connection to all equipped K-System modules**
- **Standard length 0.8 m (2.6 ft) or 2 m (6 ft), simple to customize to application space**
- **Eliminates daisy-chains**

Function

The Power Rail is a plastic insert with integral gold-plated conductors that fits into its own integral, 35 mm DIN rail and supplies components with power.

The Power Rail UPR-05-* has two conductors for power, one conductor for collective error messaging, and two conductors for bus connections.

The Power Rail reduces wiring and maintenance costs because it eliminates the need to daisy-chain the wires. It also simplifies expansion — just snap in a new module when you're ready to expand a system.

The universal Power Rail comes in 2 m segments (UPR-05) and in 0.8 m segments (UPR-05-S) but can be cut to any size.

The Power Rail is delivered with two UPR-E end caps. More end caps can be ordered separately.

Accessories

UPR-E

End cap for UPR-03-* and UPR-05-*

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Features

- **Cable trunking with integrated Power Rail UPR-03**
- **Safe spacious separation of field and control signals**
- **No additional cable guides necessary**
- **Provides DC supply voltage to all equipped K-System modules**

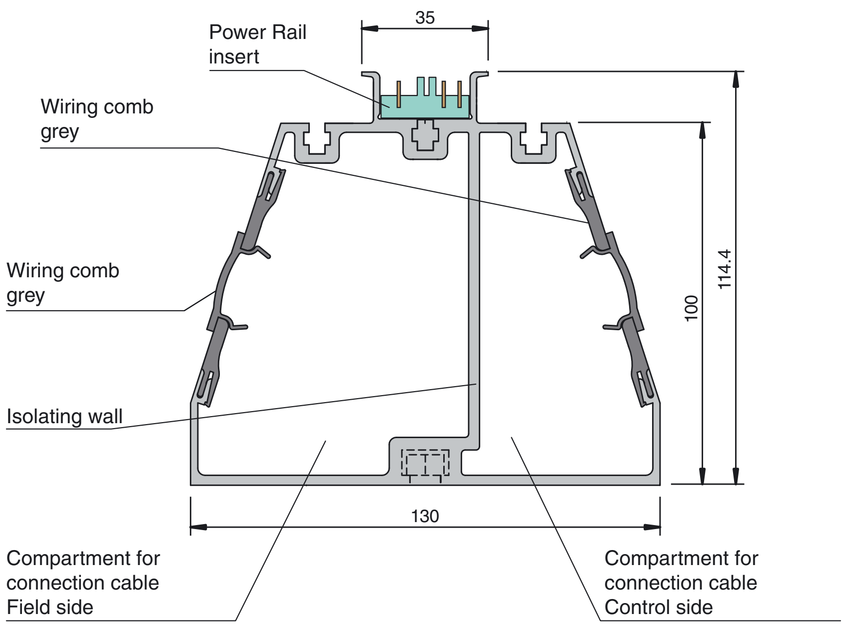
Function

The profile rail can be used to provide space-saving mounting for interface modules and accommodate the associated wiring. The system and field cables are easily installed in the integral cable ducts of the profile rail. Thus no additional cable guides are necessary.

The power supply to the individual modules is preferably provided via the Power Rail UPR-03 that is integrated into the system. Additionally the Power Rail UPR-03 has one lead for collective error messaging.

The asymmetrical segmented wiring comb can be changed dependent on the required space by turning the profile rail. Please note that the Power Rail insert must be also rotated.

Dimensions



Technical data

Mechanical specifications	
Dimensions	130 x 114.4 x 1800 mm (5 x 4.5 x 71 in)

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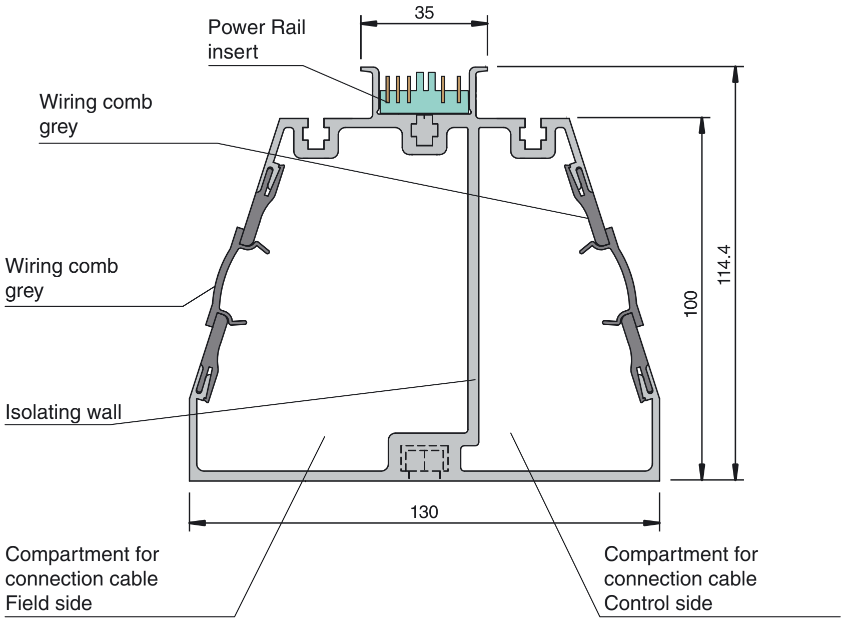
Dimensions



Technical data

Mechanical specifications	
Dimensions	130 x 114.4 x 1800 mm (5 x 4.5 x 71 in)

Features

- **Cable trunking with integrated Power Rail UPR-05**
- **Safe spacious separation of field and control signals**
- **No additional cable guides necessary**
- **Provides DC supply voltage and bus connection to all equipped K-System modules**

Function

The profile rail can be used to provide space-saving mounting for interface modules and accommodate the associated wiring. The system and field cables are easily installed in the integral cable ducts of the profile rail. Thus no additional cable guides are necessary.

The power supply to the individual modules is preferably provided via the Power Rail UPR-05 that is integrated into the system. Additionally the Power Rail UPR-05 has one lead for collective error messaging and two leads for bus connections.

The asymmetrical segmented wiring comb can be changed dependent on the required space by turning the profile rail. Please note that the Power Rail insert must be also rotated.

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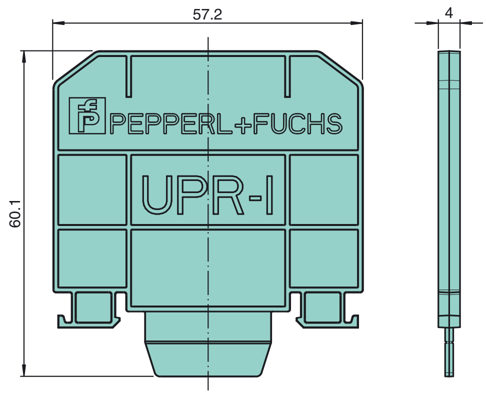
Insulation Spacer for UPR-**-*
UPR-I



Features

- **Electrical insulation of segmented Power Rail inserts**

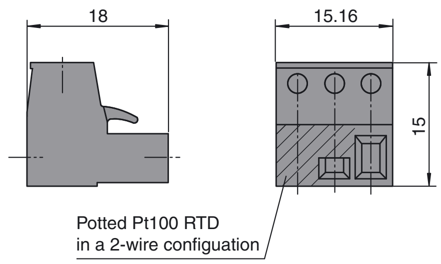
Function

The insulation spacer mounts onto a 35 mm DIN rail. It is used for electrical insulation of segmented Power Rail inserts.

Technical data

Mechanical specifications	
Material	Polycarbonate
Mass	approx. 20 g
Dimensions	4 x 57 x 60 mm (0.16 x 2.24 x 2.36 in)
Mounting	mounting on 35 mm DIN rail acc. to DIN EN 60715

Terminal Block with Cold Junction Compensation
K-CJC-BK



Features

- **3-pin screw terminal**
- **For KF modules**
- **Integrated Cold Junction Compensation**
- **Packaging unit: 1 piece, black**

Function

The terminal block is suitable for K-System applications.

The black terminal block is used for connection of field signals as well as the connection of control signals.

This terminal block has an integrated encapsulated Pt100 RTD for cold junction compensation.

The terminal block can be coded with the provided coding pins KF-CP.

Technical data

Mechanical specifications	
Core cross-section	max. 2.5 mm^2
Mass	approx. 5 g
Dimensions	15.2 x 15 x 18 mm (0.6 x 0.6 x 0.7 in)
Construction type	removable screw terminal with integrated cold junction compensation

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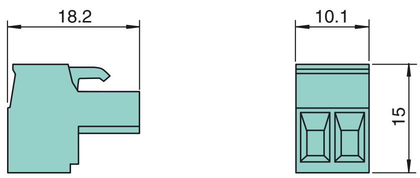


Terminal Block KC-ST-5GN

Features

- **2-pin screw terminal**
- **For KC modules**
- **Packaging unit: 5 pieces, green**

Function

The terminal block is suitable for K-System applications.

The green terminal block is used for connection of field signals as well as the connection of control signals.

The terminal block can be coded with the provided coding pins KF-CP.

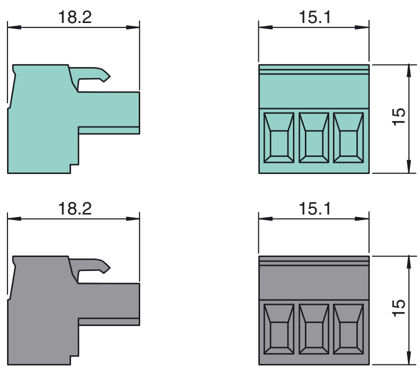
Technical data

Mechanical specifications	
Core cross-section	max. 2.5 mm^2
Mass	approx. 4 g
Dimensions	10.1 x 15 x 18.2 mm (0.4 x 0.5 x 0.7 in)
Construction type	removable screw terminal

Notes

The removable terminals guarantee protection from direct contact by means of a strengthened insulation. This applies to design insulation voltages with the occurrence of maximum overvoltages in accordance with overvoltage category III of EN 50178 (1500 V AC).

The voltage is to be switched off in the case of design insulation voltages greater than 50 V AC before connecting or disconnecting the device connectors.



Terminal Block KF-ST-5BK KF-ST-5GN

Features

- **3-pin screw terminal**
- **For KF modules**
- **Packaging unit: 5 pieces, black**
- **Packaging unit: 5 pieces, green**

Function

The terminal block is suitable for K-System applications.

The green terminal block is used for connection of field signals as well as the connection of control signals.

The terminal block can be coded with the provided coding pins KF-CP.

Technical data

Mechanical specifications	
Core cross-section	max. 2.5 mm^2
Mass	approx. 5 g
Dimensions	15.1 x 15 x 18.2 mm (0.5 x 0.5 x 0.7 in)
Construction type	removable screw terminal

Notes

The removable terminals guarantee protection from direct contact by means of a strengthened insulation. This applies to design insulation voltages with the occurrence of maximum overvoltages in accordance with overvoltage category III of EN 50178 (1500 V AC).

The voltage is to be switched off in the case of design insulation voltages greater than 50 V AC before connecting or disconnecting the device connectors.

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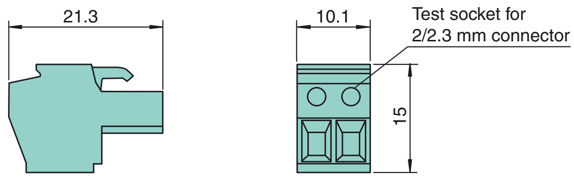
Terminal Block with Test Points KC-STP-5GN



Features

- 2-pin screw terminal
- For KC modules
- Integrated test points for connection of HART communicators
- Packaging unit: 5 pieces, green

Function

The terminal block is suitable for K-System applications.

The green terminal block is used for connection of field signals as well as the connection of control signals.

This terminal block has integrated test points for connection of HART communicators.

The terminal block can be coded with the provided coding pins KF-CP.

Technical data

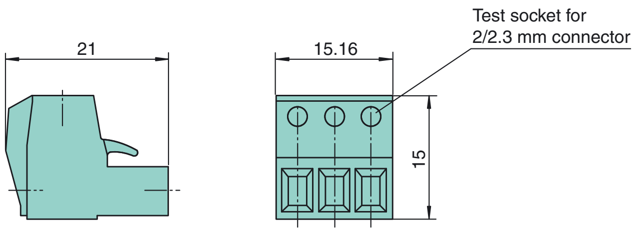
Mechanical specifications	
Core cross-section	max. 2.5 mm^2
Mass	approx. 4 g
Dimensions	10.1 x 15 x 21.3 mm (0.4 x 0.5 x 0.84 in)
Construction type	removable screw terminal with integrated test points

Notes

The removable terminals guarantee protection from direct contact by means of a strengthened insulation. This applies to design insulation voltages with the occurrence of maximum overvoltages in accordance with overvoltage category III of EN 50178 (1500 V AC).

The voltage is to be switched off in the case of design insulation voltages greater than 50 V AC before connecting or disconnecting the device connectors.

Terminal Block with Test Points KF-STP-5GN



Features

- 3-pin screw terminal
- For KF modules
- Integrated test points for connection of HART communicators
- Packaging unit: 5 pieces, green

Function

The terminal block is suitable for K-System applications.

The green terminal block is used for connection of field signals as well as the connection of control signals.

This terminal block has integrated test points for connection of HART communicators.

The terminal block can be coded with the provided coding pins KF-CP.

Technical data

Mechanical specifications	
Core cross-section	max. 2.5 mm^2
Mass	approx. 5 g
Dimensions	15.2 x 15 x 21 mm (0.6 x 0.6 x 0.83 in)
Construction type	removable screw terminal with integrated test points

Notes

The removable terminals guarantee protection from direct contact by means of a strengthened insulation. This applies to design insulation voltages with the occurrence of maximum overvoltages in accordance with overvoltage category III of EN 50178 (1500 V AC).

The voltage is to be switched off in the case of design insulation voltages greater than 50 V AC before connecting or disconnecting the device connectors.

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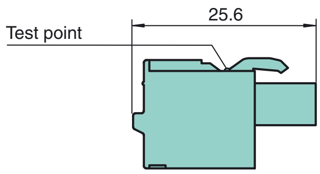
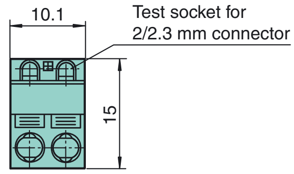




Technical data

Mechanical specifications	
Core cross-section	max. 2.5 mm^2
Mass	approx. 4 g
Dimensions	10.1 x 15 x 25.6 mm (0.4 x 0.5 x 1 in)
Construction type	removable cage clamp terminal with integrated test points

Notes

The removable terminals guarantee protection from direct contact by means of a strengthened insulation. This applies to design insulation voltages with the occurrence of maximum overvoltages in accordance with overvoltage category III of EN 50178 (1500 V AC).

The voltage is to be switched off in the case of design insulation voltages greater than 50 V AC before connecting or disconnecting the device connectors.

Terminal Block with Test Points KC-CTT-5GN

Features

- **2-pin cage clamp terminal**
- **For KC modules**
- **Integrated test points for connection of HART communicators**
- **Packaging unit: 5 pieces, green**

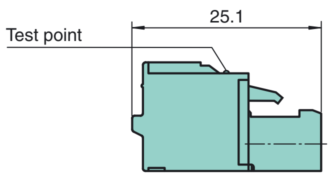
Function

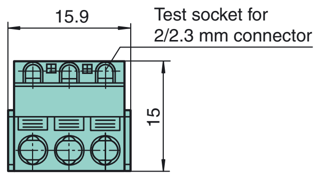
The terminal block is suitable for K-System applications.

The green terminal block is used for connection of field signals as well as the connection of control signals.

This terminal block has integrated test points for connection of HART communicators.

The terminal block can be coded with the provided coding pins KF-CP.





Technical data

Mechanical specifications	
Core cross-section	max. 2.5 mm^2
Mass	approx. 5 g
Dimensions	15.9 x 15 x 25.1 mm (0.63 x 0.6 x 1 in)
Construction type	removable cage clamp terminal with integrated test points

Notes

The removable terminals guarantee protection from direct contact by means of a strengthened insulation. This applies to design insulation voltages with the occurrence of maximum overvoltages in accordance with overvoltage category III of EN 50178 (1500 V AC).

The voltage is to be switched off in the case of design insulation voltages greater than 50 V AC before connecting or disconnecting the device connectors.

Terminal Block with Test Points KF-CTT-5GN

Features

- **3-pin cage clamp terminal**
- **For KF modules**
- **Integrated test points for connection of HART communicators**
- **Packaging unit: 5 pieces, green**

Function

The terminal block is suitable for K-System applications.

The green terminal block is used for connection of field signals as well as the connection of control signals.

This terminal block has integrated test points for connection of HART communicators.

The terminal block can be coded with the provided coding pins KF-CP.

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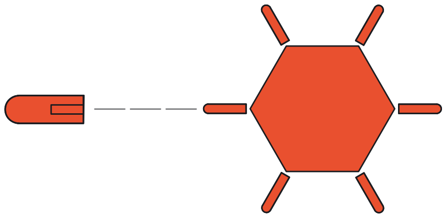
Coding Pins
KF-CP

Features

- **Coding of K-System terminal blocks**
- **Packaging unit: 100 x 6 coding pins**

Function

The terminals can be coded with an coding pin by inserting the red tab into a particular slot of the terminal block.



Technical data

Mechanical specifications	
Material	insulating material, red
Mass	approx. 1 g per coding pin
Dimensions	0.5 x 2 x 8 mm (0.02 x 0.08 x 0.3 in)

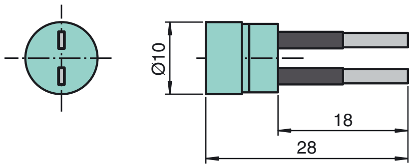
Measuring resistor
K-500R0%1

Features

- **1-channel**
- **High precision resistor**
- **Conversion of 4 mA ... 20 mA/ 2 V ... 10 V**

Function

A 500 Ω 0.1% high-precision resistor that can be used to convert 4 mA ... 20 mA to 2 V ... 10 V.



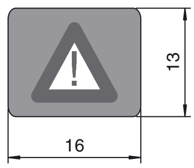
Technical data

Electrical specifications	
Measuring resistor	500 Ω, 0.1 %, TK10
Mechanical specifications	
Dimensions	Ø10 x 28 mm (0.4 x 1.1 in)

Adhesive Sticker
KF-SEAL

Features

- **Destructive, removable Scotchmark sticker 3812, white, matte**
- **For securing front-side programming switches and sockets as well as potentiometers, designed to match the K-system**
- **Packaging unit: 20 pieces**



Technical data

Mechanical specifications	
Dimensions	16 x 13 mm (0.63 x 0.5 in)

End Bracket
TS 35 Typ 12

Features

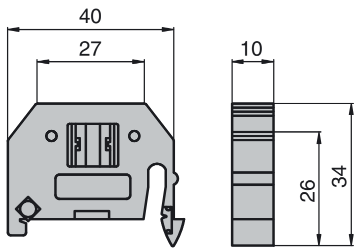
- **End Bracket as termination for DIN rail**

Function

TS 35 Type 12 end brackets are used as terminations when K devices are mounted on the DIN rail.

Note: This component is not supplied by Pepperl+Fuchs.

Supplier: Wago



Technical data

Mechanical specifications	
Mass	approx. 10 g
Dimensions	10 x 34 x 40 mm (0.4 x 1.34 x 1.57 in)
Mounting	mounting on 35 mm DIN rail acc. to DIN EN 60715

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End Bracket
E/AL-NS35

Features

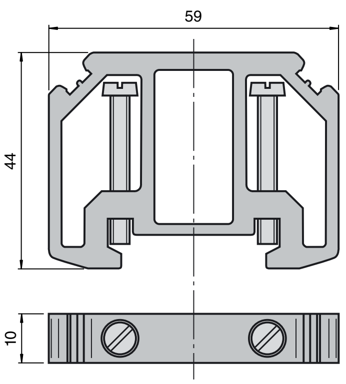
- **For end support**

Function

The end bracket is used for end support of devices on the 35 mm DIN rail. It is pushed onto DIN rail and fixed with two screws.

Note: This component is not supplied by Pepperl+Fuchs.

Supplier: Phoenix Contact



Technical data

Mechanical data	
Material	aluminium
Mass	approx. 25 g
Dimensions	10 x 44 x 59 mm (0.4 x 1.7 x 2.3 in)
Mounting	mounting on 35 mm DIN rail acc. to DIN EN 60715

Mounting Socket
K-MS

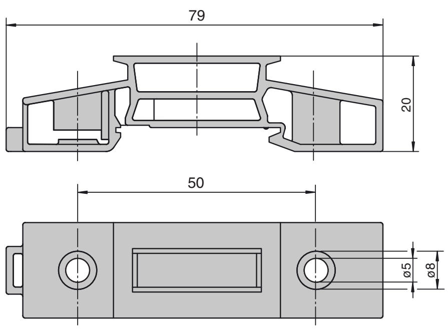
Features

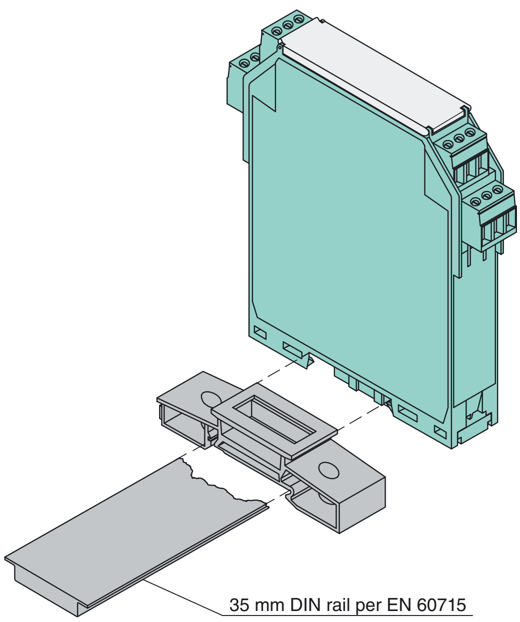
- **1-channel**
- **KF module DIN rail isolation block**
- **Snaps on to 35 mm DIN rail**
- **Easy panel mounting**

Function

This mounting socket enables the "snap-on" mounting of K devices on a 35 mm DIN rail when there is not enough space to install the Power Rail device contacts.

Sockets can be mounted in rows, so mounting can be accomplished with a minimum loss of space. The socket may also be used to cover unused mounting positions on the Power Rail.





Technical data

Mechanical specifications	
Material	Polyamide PA 66
Mass	approx. 30 g
Dimensions	20 x 20 x 79 mm (0.8 x 0.8 x 3.1 in)
Mounting	mounting on 35 mm DIN rail acc. to DIN EN 60715

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KFD0-LGH-GN

Features

- **Non-IS K-System place holder module**
- **Housing width 20 mm**
- **Marshalling for field and control side circuits**
- **Jumper configurable**

Function

This place holder barrier is a module for use in cable distribution cables. It improves accessibility and compactness within a control cabinet.

Different configurations are possible by using solder bridges.

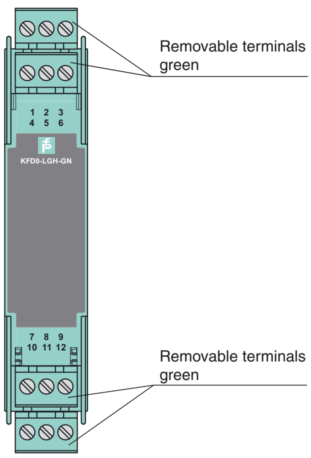
Safe area circuits can be connected to the terminals.

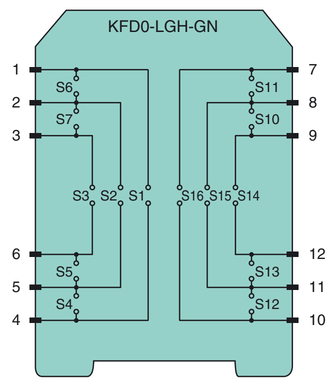
Technical data

Electrical specifications	
Rated voltage	≤ 50 V
Rated current	≤ 2 A
Conformity	
Protection degree	IEC 60529
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Protection degree	IP20
Mass	approx. 120 g
Dimensions	20 x 112 x 115 mm (0.8 x 4.4 x 4.5 in), housing type B1
Data for application in conjunction with hazardous areas	
Statement of conformity	Pepperl+Fuchs
Group, category, type of protection, temperature classification	Ex II 3G Ex nA II T4 X

Diagrams

Front view





Zone 2

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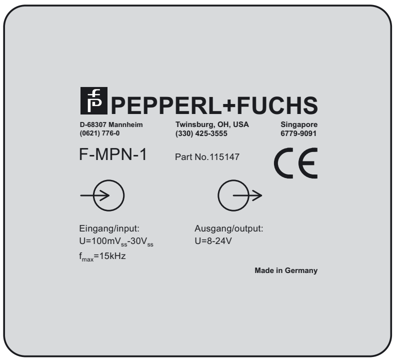
Assembly



Features

- **1-channel**
- **Loop powered**
- **Magnetic pickup switch input**
- **Switching frequency max. 15 kHz**
- **NAMUR output**

Function

This magnetic pickup-NAMUR device converts the alternating voltage signals produced by magnetic-inductive sensors into NAMUR-compliant signals according to EN 60947-5-6.

The signals from magnetic inductive sensors are then able to be evaluated by devices with NAMUR inputs, such as switch amplifiers.

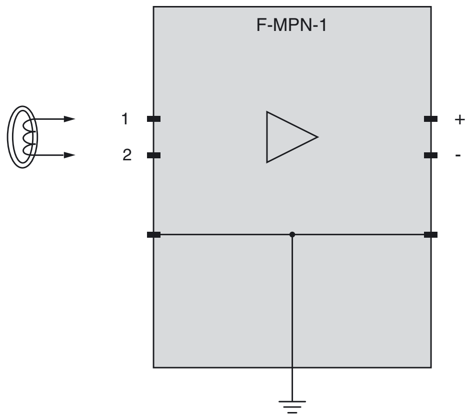
The switching frequency must not exceed a maximum of 15 kHz. The F-MPN-1 is powered from the NAMUR circuit and requires no external supply.

The connection leads are fed into the aluminum die-cast housing via two PG cable glands.

Technical data

Supply	
Rated voltage	supply via NAMUR circuit 7.7 ... 24 V
Input	
Signal level	> 100 mV_{pp}
Input resistance	5 kΩ
Input frequency	≤ 15 kHz
Resistance	< 30 V_{pp}
Output	
Internal resistor	≤ 1050 Ω
Signal level	0-signal: ≤ 1.2 mA 1-signal: ≥ 2.1 mA
Directive conformity	
Electromagnetic compatibility	
Directive 89/336/EC	EN 61326
Conformity	
Protection degree	IEC 60529
Ambient conditions	
Ambient temperature	-25 ... 60 °C (248 ... 333 K)
Mechanical specifications	
Protection degree	IP65
Dimensions	58 x 64 x 34 mm (2.3 x 2.5 x 1.3 in)

Electrical connection



K-System
Digital Inputs
Digital Outputs
Analog Inputs
Analog Outputs
Accessories

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Features

- **Isolated USB interface cable**
- **Used with K-, E- and H-System devices**
- **Used with PACT*ware*™**

Function

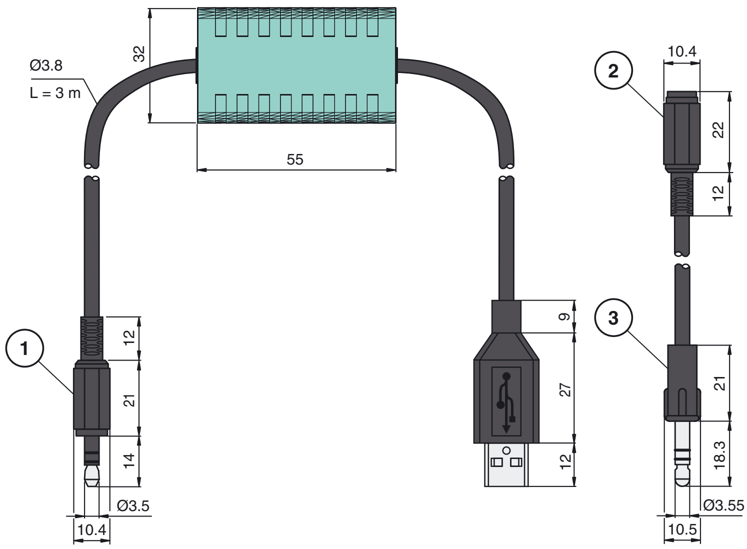
The K-ADP-USB is a programming adapter that connects the USB interface of a PC/notebook for the **PACT***ware***™** configuration software and can be used to program K-, E- and H system barriers via the programming socket on the front panel of these barriers.

As K-, E- and H-System devices have formerly been equipped with programming sockets with different standard dimensions (3.55 mm x 18.3 mm, see drawing, pos. 3 – newer devices 3.5 mm x 14 mm, pos. 1), an adapter (pos. 2) for the parameterisation of all devices is attached to K-ADP-USB.

The 18.3 mm version can still be used for urgent service assignments. However, the user must be aware of the fact that the plug protrudes from new units by approx. 4 mm. Extensive pushing of the plug may lead to damage on units.

For information about programming and software, refer to www.pepperl-fuchs.com.

Dimensions



Technical data

Electrical specifications	
Current consumption	50 mA
Electrical isolation	functional insulation acc. to IEC 62103, rated insulation voltage 50 V_{rms}
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Connection	to the PC: USB type A to the device: connector 3.5 mm and 3.55 mm
Cable	
Length L	3 m

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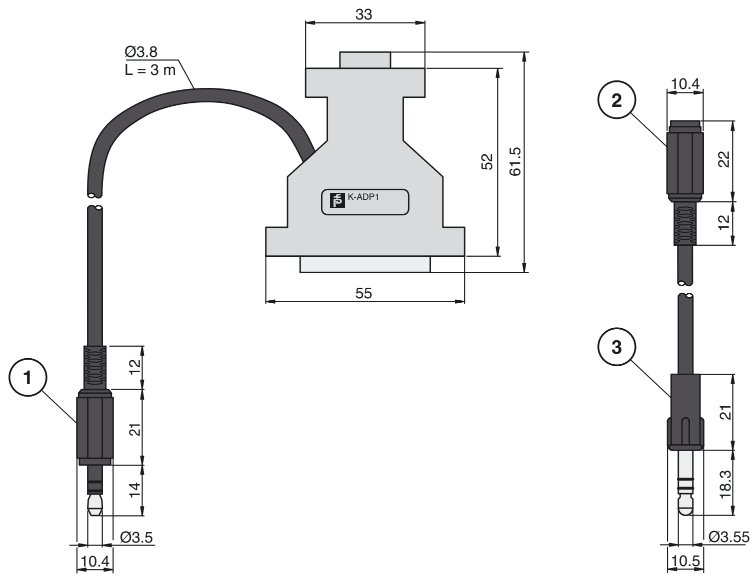
Dimensions



Technical data

Electrical specifications	
Electrical isolation	functional insulation acc. to IEC 62103, rated insulation voltage 50 V_{rms}
Ambient conditions	
Ambient temperature	-20 ... 60 °C (253 ... 333 K)
Mechanical specifications	
Connection	to the PC: 9-pin and 25-pin to the device: connector 3.5 mm and 3.55 mm
Cable	
Length L	3 m

Features

- **Isolated RS 232 interface cable**
- **Used with K-, E- and H-System devices**
- **Used with PACT*ware*TM**

Function

The K-ADP1 is an interface adapter that connects the serial interface of a PC/notebook for the **PACT*ware*™** configuration software and can be used to program K-, H-, and E-System barriers via the programming socket on the front panel of these barriers.

As K-, E- and H-System devices have formerly been equipped with programming sockets with different standard dimensions (3.55 mm x 18.3 mm, see drawing, pos. 3 – newer devices 3.5 mm x 14 mm, pos. 1), an adapter (pos. 2) for the parameterisation of all devices is attached to K-ADP1.

The 18.3 mm version can still be used for urgent service assignments. However, the user must be aware of the fact that the plug protrudes from new units by approx. 4 mm. Extensive pushing of the plug may lead to damage on units.

For information about programming and software, refer to www.pepperl-fuchs.com.

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Features

- **Universal DTM host platform**
- **For all DTMs of Pepperl+Fuchs**
- **Approved FDT/DTM technology**
- **Free of charge**
- **Internet download possible**

Function

Manufacturer and fieldbus independent configuration tool with FDT interface (**F**ield **D**evice **T**ool)

- Based on FDT technology
- Device Type Manager (DTMs) available for all Pepperl+Fuchs devices and systems
- Commissioning, configuration and parameter assignment independent of the process control system
- Communication DTMs available for serial interfaces and fieldbus systems
- Maintenance, diagnostics and error correction
- In accordance with VDI/VDE 2187

Accessories

Microsoft®.NET

Technical data

Interface	
Connection	adapter with RS 232 interface K-ADP1 or USB interface K-ADP-USB (for K-System) adapter for gateways with RS 232 intrface K-ADP2 (for RPI-System) adapter for gateways with RS 485 interface K-ADP4 (for RPI-System) USB/RS 485 interface converter (for LB-System)
Software	
Hardware requirements	PACTware 3.X requires 50 MBytes hard drive memory and a minimum of 40 MBytes main memory. Depending on the complexity of the projects and the used DTMs the main memory requirement can be multiple larger. A computer with a Pentium IV 450 MHz processor or better is recommended, XGA graphics and a Microsoft-compatible mouse or equivalent pointing device.
Software requirements	PACTware 3.X runs in operating systems Windows 2000 and Windows XP. The software .NET Framework 1.1 SP1 must be installed. For printing and online help, MS Internet-Explorer 4.0 or higher is required.
Languages	German, English, French, Spanish, Russian can be selected
Licencing	PACTware 3.X does not require licensing. Please take the license conditions of the DTMs out of the data sheets of the corresponding DTMs.
Configuration	
Representation of the system configuration	Graphic representation of all communication and device DTMs in the tree structure. In case of online operation colour code for identification of defective units and simulation operation. Multiple windows can be open simultaneously. It is therefore possible to view the set device parameters, to monitor the measurement value and to display the device diagnostic simultaneously.
System planning, application processing	Generation of a configuration by means of a graphical application processing menu. Editing of available projects. Selection switch markings for each channel. Offline configuration, saving of project data to hard disk or disk. Automatic comparison of the project plan to the actual available system when establishing connections on the device and parameter levels.
Associated products	CD-ROM with PACTware 3.X and complete DTM-Collection of all available DTMs of the Pepperl+Fuchs H-, K-, and E-System devices, HART Multiplexers, Remote I/O-Systems, FieldConnex devices, and level devices.

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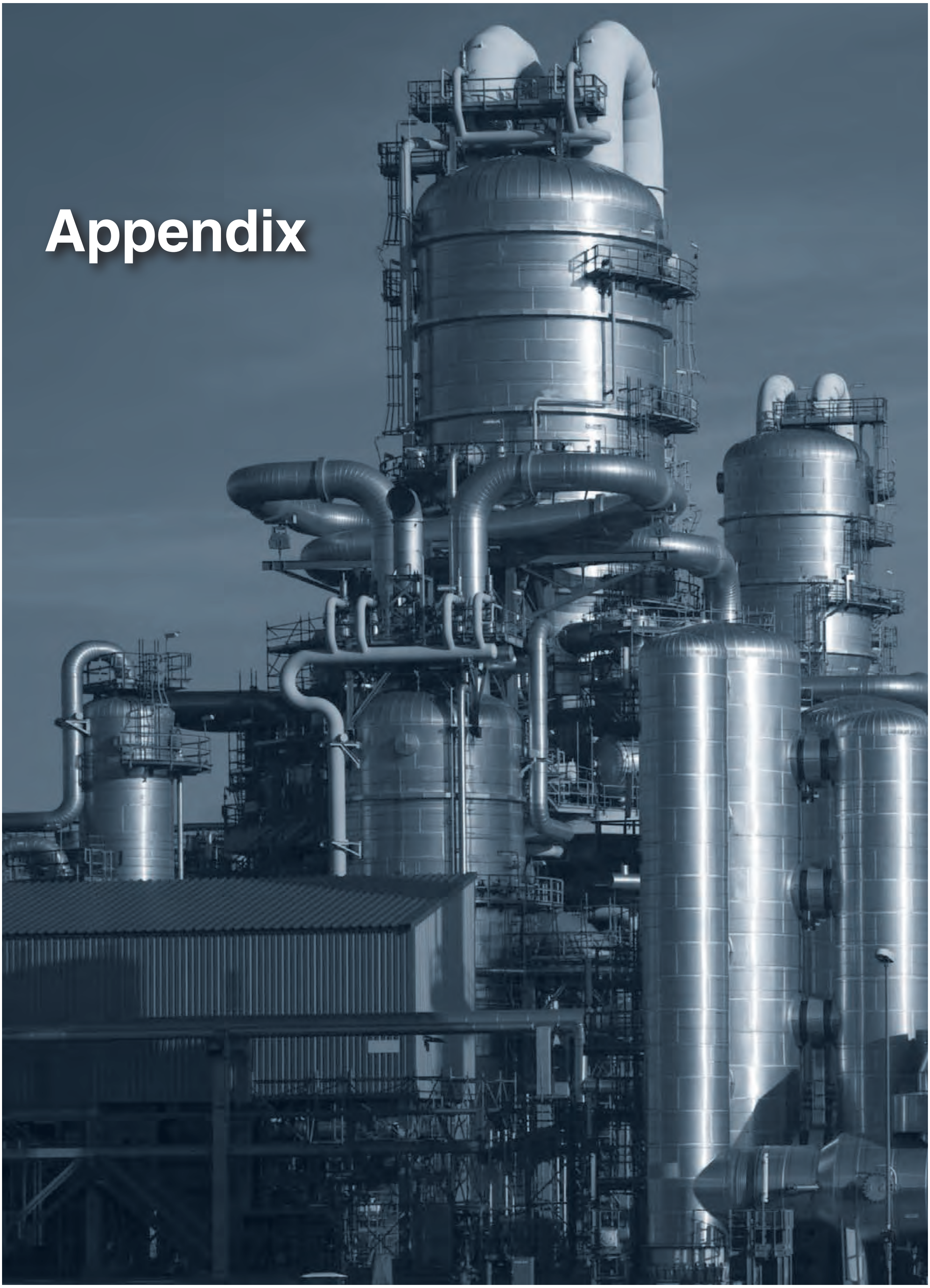
Appendix



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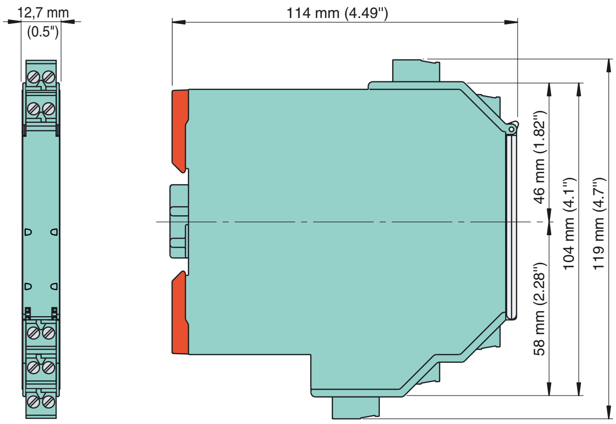
Appendix
Housing Styles
Function Index
Model Number Index

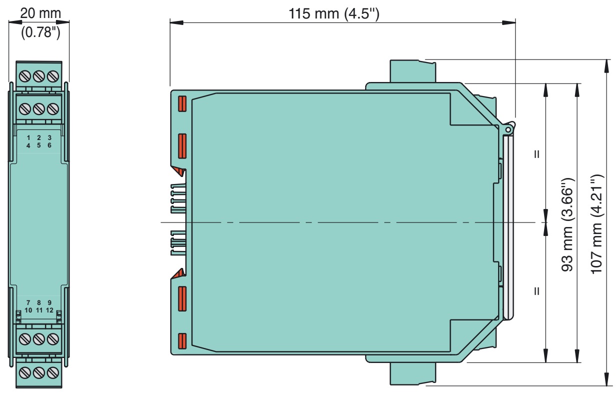
Housing types K-System

Housing type A2



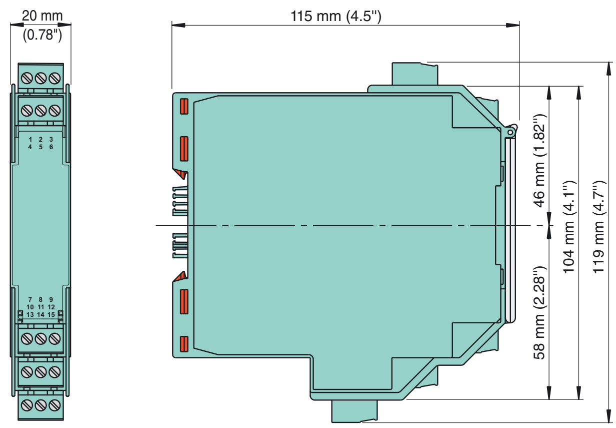
Number of terminals max. 5
When using HART terminals (8.5 mm (0.3 in)) the device is 122 mm (4.8 in) in height.

Housing type B1 (symmetrical version)



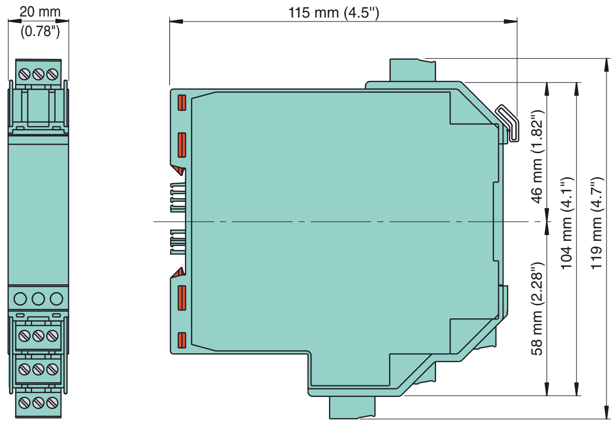
Number of terminals max. 4
When using HART terminals (8.5 mm (0.3 in)) the device is 110 mm (4.3 in) in height.

Housing type B2 (symmetrical version)



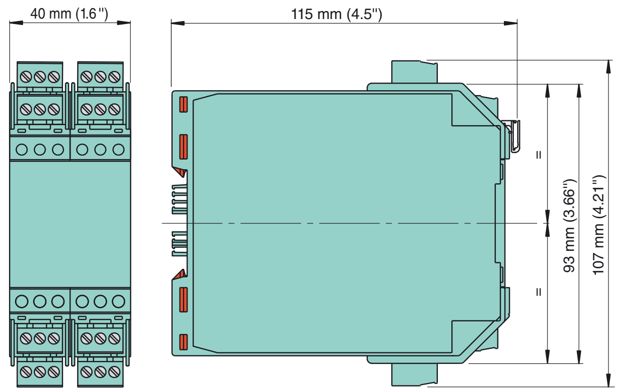
Number of terminals max. 5
When using HART terminals (8.5 mm (0.3 in)) the device is 122 mm (4.8 in) in height.

Housing type B3 (asymmetrical version)



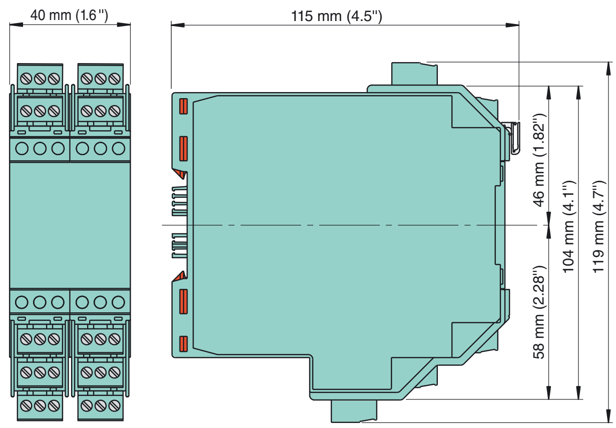
Number of terminals max. 5
When using HART terminals (8.5 mm (0.3 in)) the device is 122 mm (4.8 in) in height.

Housing type C1 (symmetrical version)



Number of terminals max. 8
When using HART terminals (8.5 mm (0.3 in)) the device is 110 mm (4.3 in) in height.

Housing type C2 (symmetrical version)



Number of terminals max. 10
When using HART terminals (8.5 mm (0.3 in)) the device is 122 mm (4.8 in) in height.

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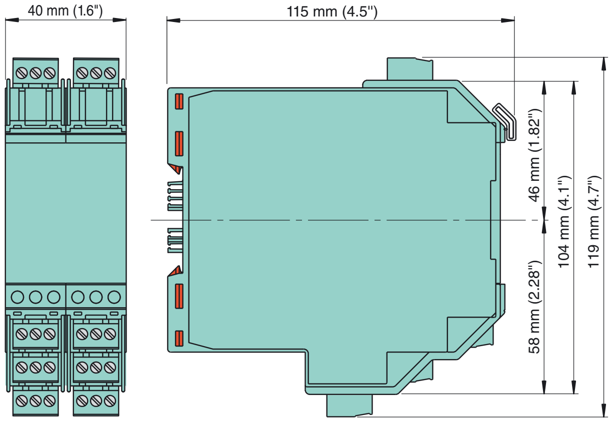
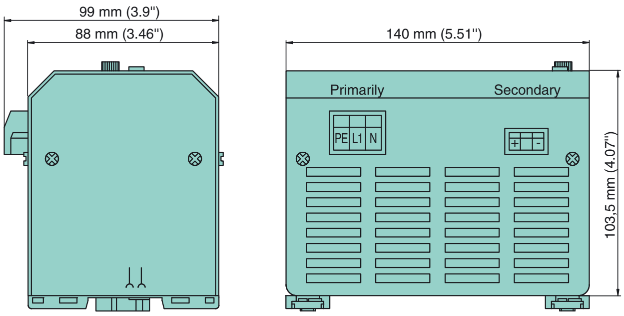
Housing type C3 (asymmetrical version)



Number of terminals max. 10
When using HART terminals (8.5 mm (0.3 in)) the device is 122 mm (4.8 in) in height.

Housing Power Supply 4 A



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Digital Outputs

Analog Inputs

Analog Outputs

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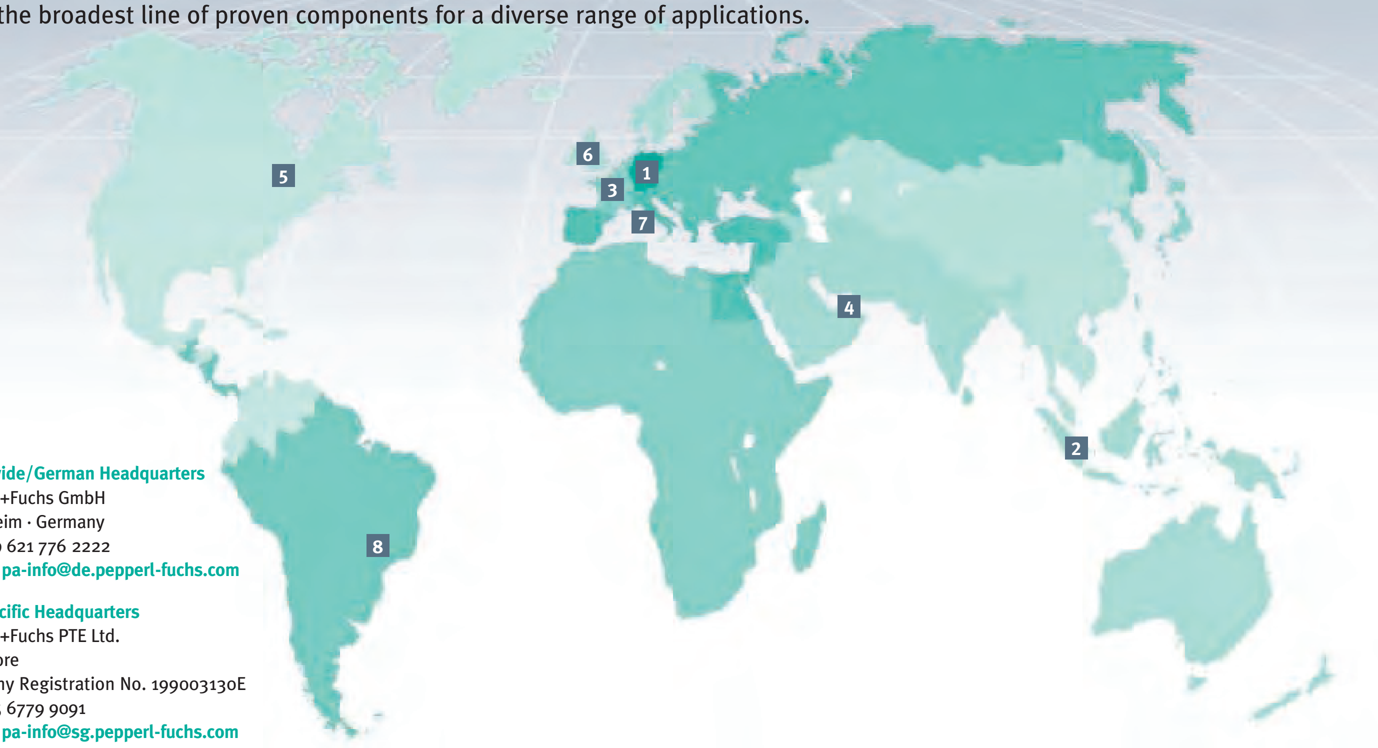

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