Automatic Power Interruption For Saving Energy And Life.

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هداء يعبر ولو عجز من الوفاء

إلى معلم البشرية ومنبع العلم ... نبينا عمد ( صلى الله عليه وسلم )
إلى ينبوع العطاء الذي زرع في نفسي الطموع ...
والذي العزيز
إلى نبع الخنان الذي لا ينضب ... أمي الغالية
إلى الذين روا بدمائهما ثرى فلسطين إلى منهم أفضل منا جميعا إلى الذين ارتفعوا إلى السموع ...
إلى الذين عشقوا الخيرية التي تفوح منها رائحة
الليمون والبرتقال والجرس ...
إلى الذين هم رمز للاستبسل والشجاعة ...
غزة هاشم وأطفالها وأطفال أهل اليرموك
إلى أعمدة العلم والمعرفة الذين خطوا لي ولآخرين ...
المعلم والمربياً الفاضل ...
سيرخضر
إلى القلوب الطاهرة الرقيقة والنفوس البريئة إلى ريحاني حياتي ...
Abstract:

As a result of accidents and the growing risks in the electricity there are many applications have been developed to provide. The survival of devices connected to the electric power source without the need for them disastrous problem is the drain part of the electrical energy and the occurrence of fires. Two models were used the first model to measure the minimum value of the electric current cell phone was used electronic pieces programmed within the form. Designed especially circuit to convert the current to read the voltage to facilitate dealing with a piece of electronic programmed will be compared in the electronic segment between the measured voltage value with the reference value represents the minimum amount of voltage during the removal of the cellular phone device from the charger with the survival of the charger socket and thus disconnect the charger as well as automatic optical sensor was used. The send a signal in the case of recharging the cell phone. The second model is to unplug electrical heater in the absence of movement in place and use thermal sensor inside the kinetic model of the motion sensor in place and send a signal to the electronic segment is programmed to disconnect the current of the heater automatically.
 نتيجة الحوادث والمخاطر المتزايدة من الكهرباء هناك العديد من التطبيقات التي طورت لتوفير

فِبقَ الَّذِيَ لَمْ ينصبَهُ البَصِيرَةُ لِلنَّاسِ، فَهْيَا هِيَ مَشْكِلَةٌ كَارُثَةٌ تَتمَثِّلُ فِي اسْتِنزَافٍ جَزءٍ مِن

الطاقة الكهربائية وحُدُوث حُرقٍ.

تم استخدام نموذجين النموذج الأول لقياس أدنى قيمة

للتيار الكهربائي للهواتف الخلوي حيث تم استخدام قطعة الإلكترونية مبرمجًا داخل النموذج.

دارة كهربائية خاصة لتحويل قراءة التيار الي جهد لتحسين التعامل مع القطعة الإلكترونية المبرمج،

يتم مقارنة داخل القطعة الإلكترونية بين قيمة الجهد المقاسة مع قيمة مرجعية تمثل ادنى مقدار للجهد أثناء ازالة

جهاز الهاتف الخلوي من الشاحن مع بقاء الشاحن بالمقبس وبالتالي فصل الشاحن آليًا وكذلک تم استخدام

محس ضوئي يقوم بارسل إشارة إلى حالة إعادة شحن الهاتف الخلوي.

النموذج الثاني يتم في فصل التيار الكهربائي عن الصوبيا الكهربائية في حال عدم وجود حركة في مكان

تواجدها.

الإلكترونية المبرمج لتاٍ فصل التيار عن الصوبيا بشكل آليًا.
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List of Abbreviation:

HSE : Health And Safety Executive.
LDR : Light Dependent Resistor.
DC : Direct Current.
AC : Alternate Current.
USB : Universal Serial Bus.
LED : Light Emitting Diode.
Chapter One: Introduction

1.1 Project Overview:

The project supports in the field of automatic interruption will be used for electronic items and sensors, particularly suitable for measuring the current and turn it into a voltage and comparing the reference value within the programmed electronic piece. As well as the result of the sensor comparing within software code.

1.2 Project Motivation:

1. Protect humanity from the risks related to electricity.
2. Protection devices and thus increase the lifespan of electrical devices.
3. Alleviate the burden of the citizens.

1.3 Project Objectives:

1. Providing a new way to protect your home.
2. Devices, which do not have a load such as cell phone charger will be interrupted automatically.
3. Electrical heater in the absence of traffic will be interrupted electronically using special sensors.

1.4 Literature Review:

Many previous applications were used alarm in the event of an electrical fault, but this method does not protect against the risk of the occurrence.

In addition, there are some electric heaters by the occurrence of interruption at risk but they have high cost device.

Automatic interruption features from the previous techniques that the interruption of
electrical energy for devices before the occurrence of the risk and therefore guarantee the security of home.

1.5 Time Plan:

The Table 1.1 shows the activities that done in the project, and the time of each one.

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Activities</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<td>System Design</td>
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<td>Results analysis and conclusion</td>
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</table>

**Table 1.1**: Activities Planning.

1.6: Project Cost:

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost JD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational amplifiers , Batteries , Switches , Resistors , Potentiometers , Transformer , connectors .</td>
<td>50.2 JD</td>
</tr>
<tr>
<td>Thermal and Ultrasonic sensor with extension cable , LCD display , Arduino .</td>
<td>144.4 JD</td>
</tr>
<tr>
<td>Total</td>
<td>195 JD</td>
</tr>
</tbody>
</table>

**Table 1.2**: Project cost.
2.1 Introduction:

In order to understand even the simplest concepts of electronics, the first understand what electricity is. After all, the whole purpose of electronics is to get electricity to do useful and interesting things. The concept of electricity is both familiar and mysterious. That electricity comes from power plants that burn coal, catch the wind, or harness nuclear reactions. It travels from the power plants to our houses in big cables hung high in the air or buried in the ground. Once it gets to our houses, it travels through wires through the walls until it gets to electrical outlets. From there, we plug in power cords to get the electricity into the electrical devices we depend on every day.

2.2 Dangers Of Electricity.

What are the risks from electricity?

Harm can be caused to any person when they are exposed to ‘live parts’ that are either touched directly or indirectly by means of some conducting object or material.

Voltages over 50 volts AC or 120 volts DC are considered hazardous.

Electricity can kill. Each year about 1000 accidents at work involving electric shocks or burns are reported to the (HSE). Around 30 of these are fatal, most of them arising from contact with overhead or underground power cables.

Shocks from faulty equipment can cause severe and permanent injury and can also lead to indirect injuries, due to falls from ladders, scaffolds, or other work platforms.

Faulty electrical appliances can also lead to fires. As well as causing injuries and loss of life, fires cause damage to plant, equipment and property.
Assessing the risks from electricity:

Consider the following hazards in your risk assessment:

Live parts Normal mains voltage, 230 volts AC, can kill. Also, contact with live parts can cause shocks and burns.

Fire Electrical faults can cause fires. This is particularly true where the equipment contains a heat source (e.g. heaters, including water heaters, washing machines, ovens, heat-seal packaging equipment).

Flammable or explosive atmospheres Electricity can be a source of ignition in a potentially flammable or explosive atmosphere, e.g. in spray paint booths or around refueling areas[1].

Where and how electricity is used?

The risks from electricity are greatest in harsh conditions. In wet conditions, unsuitable equipment can easily become live and can make its surroundings live.

While outdoors, equipment may not only become wet but may be at greater risk of damage. In cramped or confined spaces with a lot of earthed metalwork, such as inside tanks, ducts and silos, if an electrical fault develops it can be very difficult to avoid a shock. Types of equipment in use some items of equipment can also involve greater risk than others[2]. Extension leads are particularly liable to damage to their plugs and sockets, cables, and electrical connections. Other flexible leads, particularly those connected to equipment that is moved great deal, can suffer from similar problems.
2.3 Basic Electrical Safety.

Below are some minimum steps you should take to ensure electrical safety.

1) Maintain all electrical installations in good working order.

2) Avoid overloading socket-outlets – using adaptors can cause fires.

3) Provide an accessible and clearly identified switch ('Emergency Off' or 'EMO' button) near fixed machinery to cut off power in an emergency.

4) For portable equipment, connect to nearby socket-outlets so that it can be easily disconnected in an emergency.

5) Choose electrical equipment that is suitable for its working environment.

6) Ensure that equipment is safe when supplied and maintain it in a safe condition.

7) Ensure cable ends always have their outer sheaths firmly clamped to stop wires working loose from plugs or inside equipment.

8) Automatic cutter for electrical appliances when not needed to use them.

Purpose of Protection System:

Minimize damage, leave unaffected equipment in-service, maintain equipment operating limits and maintain electrical system stability.
Chapter Three : System Design And Analysis

3.1 Design Principles :

This project aims to design a complete circuit which can identify the circles to separate automatic for electrical appliances.

3.1.1 The Cell Phone Circuit.

1- At No Load.

Apply a small current in the circuit and then the value is converted to the voltage. After getting the voltage signal, the signal will inter Arduino environment and be compared with a reference voltage, if the input voltage is less to reference voltage, a programmable code will trigger stimulating pulses for electric switches. See Appendix A.

2- At Load.

When it is re-connect the mobile charger, the LDR sensor works and gives change in resistance, then it is transferred to the voltage. After getting the voltage signal, the signal will inter transistor, then to relay, and therefore electricity is connected to transformer again.
Figure 3.1: Electrical –Cellphone Circuit

Figure 3.2: General Block Diagram-Cellphone.
3.1.2 The Heater Circuit.

When someone enters the room, the ultrasonic sensor gives a signal and the thermal sensor analysis of human activities inside the room. If a person is sleeping or leaves the room, the sensors send a signal to the Arduino, programmable code will trigger stimulating pulses for electrical switches then be automatic interrupted. Otherwise, heater remain running. See Appendix B.

Figure 3.3: General Block Diagram-Heater.
3.2 Reduction Voltage Circuit:

As the main power supply voltage and the recommended stimulating intensity is 5 volt, a rail to rail op-amp should be used. LM741 op-amp was used since it is rail to rail with a wide range of single supply voltage with several acceptable specifications as power supply rejection ratio, common mode rejection ratio, input offset current and other characteristics as illustrated in Appendix C.

![Reduction Voltage Circuit](image)

**Figure 3.4:** Reduction Voltage Circuit.
3.3 Hardware Devices

3.3.1 Relay 5vdc RY5WFZ-K.

A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it). Many sensors are incredibly sensitive pieces of electronic equipment and produce only small electric currents. But often we need them to drive bigger pieces of apparatus that use bigger currents. Relays bridge the gap, making it possible for small currents to activate larger ones[3]. That means relays can work either as switches (turning things on and off) or as amplifiers converting small currents into larger ones as illustrated in Appendix D. See figure 3.5.

![Figure 3.5: Internal installation of relay.](image)

Figure 3.5: Internal installation of relay.
3.3.2 LDR Sensor

A photo resistor or photocell is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity, in other words, it exhibits photoconductivity. A photoresist or can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits.

A photo resistor is made of a high resistance semiconductor. In the dark, a photo resistor can have a resistance as high as several (MΩ), while in the light, a photo resistor can have a resistance as low as a few hundred ohms. If incident light on a photo resistor exceeds a certain frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electrons (and their hole partners) conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photo resistor can substantially differ among dissimilar devices. Moreover, unique photo resistors may react substantially differently to photons within certain wavelength bands.

See Figure 3.6.

Figure 3.6: LDR Sensor
A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, for example, silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire gap. Extrinsic devices have impurities, also called dopants, added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (that is, longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. Photo resistors are less light-sensitive devices then photodiodes or phototransistors: the two latter components are trues, while a photo resistor is a passive component and does not have a PN-junction. The photo resistivity of any photo resistor may vary widely depending on ambient temperature, making them unsuitable for applications requiring precise measurement of or sensitivity to light. Photo resistors also exhibit a certain degree of latency between exposure to light and the subsequent decrease in resistance, usually around 10 milliseconds. The lag time when going from lit to dark environments is even greater, often as long as one second. This property makes them unsuitable for sensing rapidly flashing lights, but is sometimes used to smooth the response of audio signal compression [4].

3.3.3 Ultrasonic Sensors.

Ultrasonic sensors provide excellent repeatability and linearity in detecting the precise position of objects. The sensors provide high precision performance on any material of any color, irrespective of external light levels.
They produce accurate results even when used with highly transparent objects such as film or glass surfaces and are completely unaffected by normal levels of soiling on the sensor surface. The sensors are also characterized by high sound intensity that makes it possible to detect even the smallest of objects with extremely high reliability. This ability to maintain outstanding performance and reliability, even with the presence of suspended particles or water vapors, means that BERNSTEIN ultrasonic sensors are in daily use all over the World in a diverse range of demanding industrial applications.

Advantages of ultrasonic sensors like as: Large detection range of up to 6000 mm (depending on design), high linearity, high repeatability, narrow sound beam of 8°, adaptive 0–10 V voltage or 4–20 Ma current output (analogue sensors), two switching outputs, can be used independently or together (switching sensors) and IP 67 type of protection, as illustrated in Appendix E.

Measuring principle of this sensor:

The sensor emits a sound pulse that is reflected from the object to be detected. The sensor reads in the reflected pulse and the distance to the object is determined by means of a runtime measurement routine. See figure 3.7.
3.3.4 Amplifier Transistors P2N2222A.

An electrical signal can be amplified by using a device which allows a small current or voltage to control the flow of a much larger current from a dc power source. Transistors are the basic device providing control of this kind. There are two general types of transistors, bipolar and field-effect. Very roughly, the difference between these two types is that for bipolar devices an input current controls the large current flow through the device, while for field-effect transistors an input voltage provides the control. In this experiment we will build a two-stage amplifier using two bipolar transistors. See figure 3.8[5]

![Figure 3.8: Transistor.](image-url)
3.3.5 D6T-44L / D6T-8L Thermal Sensor.

The D6T series sensors are made up of a cap with silicon lens, MEMS thermopile sensor chips, and dedicated analog circuit and a logic circuit for converting to a digital temperature value on a single board through one connector. The basic measuring operation is as follows: The silicon lens collects radiated heat (far-infrared ray) emitted from an object onto the thermopile sensor in the module, the radiated heat (far-infrared ray) produces an electromotive force on the thermopile sensor, the analog circuit calculates the temperature of an object by using the electromotive force value and a measured temperature value inside the module, the measured value is outputted through an I2C bus.

This sensor has many advantages as the non-contact temperature sensor measures the surface temperature of an object. D6T-44L-06 and D6T-8L-06 have sensor chip arrays of 16 channels (4x4) and 8 channels (1x8) respectively. By mounting the signal processing circuit closely to the sensor chip, a low noise temperature measurement is realized.

The module can also be used for detecting the presence of human beings. Omron’s non-contact temperature sensor can solve the shortcomings of a conventional pyroelectric sensor, which cannot catch the signal of a stationary person because the sensor detects the change of signal [in principle]. Moreover, Omron’s non-contact temperature sensor keeps detecting the far-infrared ray of an object, while the pyroelectric models do not. See figure 3.9
The non-contact temperature sensor achieves its sensitivity characteristic for an object view angle by using a silicon lens. FOV (Field Of View) – an indication of view angle – is generally specified as an area angle of 50% for maximum sensitivity. See figure 3.10

Figure 3.9: Difference between pyro electric and non-contact temperature sensors

Figure 3.10: Sensitivity characteristics: FOV Image
The sensitivity area is wider than the FOV specified area. When an object to be measured is smaller than the sensitivity area, the background temperature effects the measurements. Though Omron’s D6T sensor corrects a temperature measurement value by using a reference heat source (blackbody furnace), the measurement’s value is influenced by the emissivity of the specific material of the object to be measured, and the surface shape of the occupant relative to the sensitivity area. See figure 3.11[6]

Figure 3.11: Changing factor of measurement by distance
Chapter 4 : Software Design

Programming process for the project was build through the use of Arduino software to control the element and time in order to be applied later to the devises to achieve the necessary protection. The result of the hardware design are displayed at a 16x2 liquid crystal display, which supports the project requirements.

4.1 Arduino Uno:

Arduino is an open-source physical computing platform based on a simple I/O board and a development environment that implements Processing language.

The open-source Arduino environment makes it easy to write code and upload it to the I/O board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java, C, and other open-source software. The Arduino Uno is a microcontroller board based on the ATmega328. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. It can operate on (7-12) voltage supply, with a 16Mhz Clock Speed.

See figure 4.1[7]
Figure 4.1: Arduino Uno.

**The main parts:**

1. The AT mega processor: Main IC "ATmega328".

2. Power (USB / Barrel Jack): Every Arduino board needs a way to be connected to a power source. The Arduino Mega can be powered from a USB cable coming from your computer or a wall power supply that is terminated in a barrel jack.

3. Pins (5V, 3.3V, GND, Analog, Digital, PWM, AREF): The Arduino has several different kinds of pins.

   - **GND**: There are several GND pins on the Arduino, any of which can be used to ground the circuit.

   - **5V & 3.3V**: Most of the simple components used with the Arduino run happily off of 5 or 3.3 volts.
- **Analog**: The area of pins (A0 through A5) are "Analog In" pins. These pins can read the signal from an analog sensor and convert it into a digital value that we can read.

- **Digital**: 14 digital pins (0 through 13). These pins can be used for both digital input and digital output.

- **PWM**: These pins act as normal digital pins, but can also be used for something called Pulse - Width Modulation (PWM).

- **AREF**: Stands for Analog Reference. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

4 - **Reset Button**: Pushing it will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino.

5 - **Voltage Regulator**: It controls the amount of voltage that is let into the Arduino board.

6 - **TX RX LEDs**: TX is short for transmit, RX is short for receive. These LEDs will give us visual indications whenever the Arduino is receiving or transmitting data.

7 - **Power LED Indicator**.
4.2 Liquid Crystal Display

LCD (Liquid Crystal Display) screen is an electronic display module and have a wide range of applications. 16x2 LCD display is very basic module and is very commonly used in various devices and circuits as illustrated in Appendix F.

**Figure 4.2:** 16x2LCD display.

**Dimensions:**
- Width: 3.45 inches or 87mm
- Height: 2.35 inches or 60mm
- Display: view size 62mm x 26mm
### Table 4.1: LCD Pins Configuration

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Symbol</th>
<th>Level</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>VSS</td>
<td>0V</td>
<td>Ground</td>
</tr>
<tr>
<td>2</td>
<td>VDD</td>
<td>5V</td>
<td>Supply Voltage for logic</td>
</tr>
<tr>
<td>3</td>
<td>VO</td>
<td>(Variable)</td>
<td>Operating voltage for LCD</td>
</tr>
<tr>
<td>4</td>
<td>RS</td>
<td>H/L</td>
<td>H: DATA, L: Instruction code</td>
</tr>
<tr>
<td>5</td>
<td>R/W</td>
<td>H/L</td>
<td>H: Read ,L: Write</td>
</tr>
<tr>
<td>6</td>
<td>E</td>
<td>H,H&gt;L</td>
<td>Chip enable signal</td>
</tr>
<tr>
<td>7</td>
<td>DB0</td>
<td>H/L</td>
<td>Data bus line</td>
</tr>
<tr>
<td>8</td>
<td>DB1</td>
<td>H/L</td>
<td>Data bus line</td>
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<tr>
<td>9</td>
<td>DB2</td>
<td>H/L</td>
<td>Data bus line</td>
</tr>
<tr>
<td>10</td>
<td>DB3</td>
<td>H/L</td>
<td>Data bus line</td>
</tr>
<tr>
<td>11</td>
<td>DB4</td>
<td>H/L</td>
<td>Data bus line</td>
</tr>
<tr>
<td>12</td>
<td>DB5</td>
<td>H/L</td>
<td>Data bus line</td>
</tr>
<tr>
<td>13</td>
<td>DB6</td>
<td>H/L</td>
<td>Data bus line</td>
</tr>
<tr>
<td>14</td>
<td>DB7</td>
<td>H/L</td>
<td>Data bus line</td>
</tr>
<tr>
<td>15</td>
<td>A</td>
<td>5V</td>
<td>LED +</td>
</tr>
<tr>
<td>16</td>
<td>K</td>
<td>0V</td>
<td>LED-</td>
</tr>
</tbody>
</table>
4.3 Flow Chart.

4.3.1 Cell Phone

This diagrammatic representation is helpful for programming the Arduino Uno.

First of all, initialize the values of current by declare each of them by a variable. According to special software code and peripherals selection we will get voltage value. If the voltage value is less than the reference voltage value, this means that the device is inactive state, then a suitable interruption mode and time will be selected to achieve complete safety.
Figure 4.3: Flow Chart – Cellphone
4.3.2 Heater.

The second representation is also helpful for the heater process. First of all, initialize the values of sensor by declare each of them by a variable. According to special software code and elements selection we will get movement and heat value. If it does not have any movement, this means a suitable interruption mode and time will be selected to achieve safety.

![Flow Chart – Heater](image)

**Figure 4.4**: Flow Chart – Heater
int in = A0;
float out = 13;

int volt = 0;

void setup() {
  pinMode(in, INPUT);
  pinMode(out, OUTPUT);
} 

void loop(){
  volt = analogRead(in); // 0-1023
  volt = ((volt * 5.0) / 1023.0);
} 

if ( volt < 0.5){
  delay(1000*20);
  if ( volt < 0.5){
    digitalWrite(out, HIGH);
  }else{
    digitalWrite(out, LOW);
  }
}
delay(10);
Chapter Six: Future Work & Recommendations

6.1 Future Work.

- The energy interruption depending on relay which are responsible for the interruption circuit. More accuracy can be achieved if the use of other techniques.

- Arduino uses to control the interruption. More accuracy can be achieved if the use of other microcontroller for less energy consumption.

- Using rechargeable battery can increase the possibility of using the device for a longer period of time without battery repeated replacement.

- The system can be developed by the use other techniques with greater accuracy than LDR sensor.

- According to room condition, a study about the ability to find a relation between motion, heat and oxygen will be a brilliant solution for home safety.

- Additional electrical circuits can be included to increase the safety level of this device, as those which can open the system when there is an unexpected leakage from electrical components.

- The systems applied to the two load, will be a brilliant solution for home safety when it applied for all the loads in the home.
6.2 Challenges:

- Choose an appropriate element with design and suitable size for module structure.
- To determine the reference value for each device that will trigger interruption automatic.
- To provide the maximum level of safety as much as possible when applying electrotherapy by restricting with its principles.
- To persuade consumers with a new, unique method for interruption automatic with less cost.
Liquid Crystal LCD (12, 11, 5, 4, 3, 2);
Int trig Pin=13;
Int echo Pin=10;
Int maximum Range = 200;
Int minimum Range = 0;
Long duration, distance;

Void setup ()
{
  Serial .begin (9600)
  Pin Mode (trig Pin, OUTPUT);
  Pin Mode (echo Pin, INPUT);
  LCD. begin (16, 2);
  LCD. Set Cursor (0, 0);
  LCD. print ("heater :");
  Wire. Begin ();

  Serial. Begin (9600);
}
Int reading = 0;
Int count=0;
Char buff [3];

Void loop ()
{
  Digital Write (trig Pin, LOW);
Delay Microseconds (2);
Digital Write (trig Pin, HIGH);
Delay Microseconds (10);
Digital Write (trig Pin, LOW);
Duration = pulse in (echo Pin, HIGH);
Distance = duration/58.2;
If (distance >= maximum Range || distance <= minimum Range){
Serial. Print in ("-1");
LCD. Set Cursor (0, 1);
LCD. print (" off ");
}
Else {
Serial. Print in (distance);
LCD. Set Cursor (0, 1);
LCD. print (" on ");
}
delay(50);

Wire.beginTransmission (0x0a);
Wire. Write (byte (0x4c));
Wire.endTransmission (false);
Wire.requestFrom (0x0a, 32);
Count=0;

While (count<32)
{
    if (2 <= Wire. Available ())
    {
        Reading = Wire. Read ();
        Reading+= Wire. Read ()<<8;
        Serial. Print (reading);
        Serial. Print (" ");
        Count+=2;
    }
}
Reference:


http://www.colorado.edu/physics/phys3330/PDF/Experiment7.pdf


[7] Cover Photo Credit: Arduino Cake Copyright © 2011 Alan G. Smite All Rights Reserved.
APPENDIX A

Software design code- Cell Phone.
APPENDIX B

Software design code- Heater.
APPENDIX C

Datasheet for LM741 operational amplifier
APPENDIX D

Datasheet for Relay 5vdcRY5WFZ-K.
APPENDIX E

Datasheet for UltrasonicSensors.
APPENDIX F

Datasheet For Liquid Crystal Display.
**Order Code**

LED008  16 x 2 Alphanumeric Display  
FRM010  Serial LCD Firmware (optional)

**Contents**

1 x 16x2 Alphanumeric Display  
1 x data booklet

**Introduction**

Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

**Further Information**

Available as an optional extra is the Serial LCD Firmware, which allows serial control of the display. This option provides much easier connection and use of the LCD module. The firmware enables microcontrollers (and microcontroller based systems such as the PICAXE) to visually output user instructions or readings onto an LCD module. All LCD commands are transmitted serially via a single microcontroller pin. The firmware can also be connected to the serial port of a computer.

An example PICAXE instruction to print the text ‘Hello’ using the `serout` command is as follows:

\[\text{serout 7,T2400, ("Hello")}\]
Outline Dimension and Block Diagram

The tolerance unless classified ±0.3 mm

**MECHANICAL SPECIFICATION**

<table>
<thead>
<tr>
<th>Overall Size</th>
<th>84.0 * 44.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>View Area</td>
<td>61.0 * 15.8</td>
</tr>
<tr>
<td>Dot Size</td>
<td>0.56 * 0.66</td>
</tr>
<tr>
<td>Dot Pitch</td>
<td>0.60 * 0.70</td>
</tr>
</tbody>
</table>

**PIN ASSIGNMENT**

<table>
<thead>
<tr>
<th>Pin no.</th>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vss</td>
<td>Power supply (GND)</td>
</tr>
<tr>
<td>2</td>
<td>Vdd</td>
<td>Power supply (+5V)</td>
</tr>
<tr>
<td>3</td>
<td>V0</td>
<td>Contrast Adjust</td>
</tr>
<tr>
<td>4</td>
<td>RS</td>
<td>Register select signal</td>
</tr>
<tr>
<td>5</td>
<td>RW</td>
<td>Data read/write</td>
</tr>
<tr>
<td>6</td>
<td>E</td>
<td>Enable signal</td>
</tr>
<tr>
<td>7</td>
<td>DB0</td>
<td>Data bus line</td>
</tr>
<tr>
<td>8</td>
<td>DB1</td>
<td>Data bus line</td>
</tr>
<tr>
<td>9</td>
<td>DB2</td>
<td>Data bus line</td>
</tr>
<tr>
<td>10</td>
<td>DB3</td>
<td>Data bus line</td>
</tr>
<tr>
<td>11</td>
<td>DB4</td>
<td>Data bus line</td>
</tr>
<tr>
<td>12</td>
<td>DB5</td>
<td>Data bus line</td>
</tr>
<tr>
<td>13</td>
<td>DB6</td>
<td>Data bus line</td>
</tr>
<tr>
<td>14</td>
<td>DB7</td>
<td>Data bus line</td>
</tr>
<tr>
<td>15</td>
<td>A</td>
<td>Power supply for LED B/L (+)</td>
</tr>
<tr>
<td>16</td>
<td>K</td>
<td>Power supply for LED B/L (−)</td>
</tr>
</tbody>
</table>

**ABSOLUTE MAXIMUM RATING**

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply Voltage</td>
<td>Vdd−Vss</td>
<td>—</td>
<td>0</td>
<td>7</td>
<td>V</td>
</tr>
<tr>
<td>LCD Driving Supply Voltage</td>
<td>Vdd−Vee</td>
<td>—</td>
<td>0</td>
<td>13</td>
<td>V</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>Vin</td>
<td>—</td>
<td>−0.3</td>
<td>Vdd+0.3</td>
<td>V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>Toper</td>
<td>Nor</td>
<td>0</td>
<td>50</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>Tstg</td>
<td>Nor</td>
<td>−90</td>
<td>+70</td>
<td>°C</td>
</tr>
</tbody>
</table>

**ELECTRICAL CHARACTERISTICS (Vdd = +5V, Ta =25°C)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic Supply Voltage</td>
<td>Vdd</td>
<td>—</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>“H” Input Voltage</td>
<td>Vh</td>
<td>—</td>
<td>2.4</td>
<td>—</td>
<td>—</td>
<td>V</td>
</tr>
<tr>
<td>“L” Input Voltage</td>
<td>Vl</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.6</td>
<td>V</td>
</tr>
<tr>
<td>“H” Output Voltage</td>
<td>Voh</td>
<td>—</td>
<td>2.4</td>
<td>—</td>
<td>—</td>
<td>V</td>
</tr>
<tr>
<td>“L” Output Voltage</td>
<td>Vol</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.4</td>
<td>V</td>
</tr>
<tr>
<td>Supply Current</td>
<td>Idd</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>LCD Driving Voltage</td>
<td>Vdds</td>
<td>Vdd−Vss</td>
<td>4.3</td>
<td>—</td>
<td>4.8</td>
<td>V</td>
</tr>
</tbody>
</table>
### Electrical Characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Standard value</th>
<th>Unit</th>
<th>Applicable terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power voltage</td>
<td>Vdd</td>
<td></td>
<td>4.5 5.00 5.5</td>
<td>V</td>
<td>Vdd</td>
</tr>
<tr>
<td>Input H - level voltage</td>
<td>VIH</td>
<td></td>
<td>2.2 — Vdd</td>
<td>V</td>
<td>RS, R/W, E DB0~DB7</td>
</tr>
<tr>
<td>Input L - level voltage</td>
<td>VIL</td>
<td></td>
<td>0.3 — 0.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output H - level voltage</td>
<td>VOH</td>
<td>- IOH = 0.205 mA</td>
<td>2.4 — —</td>
<td>V</td>
<td>DB0~DB7</td>
</tr>
<tr>
<td>Output L - level voltage</td>
<td>VOL</td>
<td>IOL = 1.2 mA</td>
<td>— — 0.4</td>
<td>V</td>
<td>RS, R/W, E DB0~DB7</td>
</tr>
<tr>
<td>I/O leakage current</td>
<td>IIL</td>
<td>Vin = 0—Vdd</td>
<td>-1 — 1.0</td>
<td>μA</td>
<td>RS, R/W, E DB0~DB7</td>
</tr>
<tr>
<td>Supply current</td>
<td>Idd</td>
<td>Vdd = 5V</td>
<td>2 — — mA</td>
<td></td>
<td>Vdd</td>
</tr>
<tr>
<td>LCD operating voltage</td>
<td>VLCD</td>
<td>Vdd—V0</td>
<td>3.0 — 11.0</td>
<td>V</td>
<td>V0</td>
</tr>
</tbody>
</table>

### Timing Characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable cycle time</td>
<td>TCYCE</td>
<td>500</td>
<td>—</td>
<td>ns</td>
</tr>
<tr>
<td>Enable pulse width ('High' level)</td>
<td>PWEH</td>
<td>220</td>
<td>—</td>
<td>ns</td>
</tr>
<tr>
<td>Enable rise/fall time</td>
<td>TER, TEF</td>
<td>—</td>
<td>25</td>
<td>ns</td>
</tr>
<tr>
<td>Set-up time</td>
<td>RS, R/W, E</td>
<td>TAS</td>
<td>40</td>
<td>ns</td>
</tr>
<tr>
<td>Address hold time</td>
<td>TAH</td>
<td>10</td>
<td>—</td>
<td>ns</td>
</tr>
<tr>
<td>Data set-up time</td>
<td>TDSH</td>
<td>60</td>
<td>—</td>
<td>ns</td>
</tr>
<tr>
<td>Data delay time</td>
<td>TDDR</td>
<td>60</td>
<td>120</td>
<td>ns</td>
</tr>
<tr>
<td>Data hold time (writing)</td>
<td>TH</td>
<td>10</td>
<td>—</td>
<td>ns</td>
</tr>
<tr>
<td>Data hold time (reading)</td>
<td>TDRH</td>
<td>20</td>
<td>—</td>
<td>ns</td>
</tr>
<tr>
<td>Clock oscillating frequency</td>
<td>TOSC</td>
<td>270(Typ)</td>
<td>—</td>
<td>KHz</td>
</tr>
</tbody>
</table>

### Timing Chart

- **FIG.1 WRITE OPERATION**

- **FIG.2 READ OPERATION**

(Wrie Data from MPU to MODULE)
Interface with MPU

◆ Example of Interface with 8-bit MPU (Z80)

![Diagram of 8-bit MPU interface]

◆ Example of interface with 4-bit MPU

Interface with 4-bit MPU can be made through I/O port of 4-bit MPU. If there are enough I/O ports, data can be transferred by 8-bit, however, if there are not data transfer can be done by 4-bit in twice (select interface is 4-bit long), and timing sequence will be complicated in this case. Please take into account that 2 cycles of BF check is necessary, while 2 cycles of data transfer are also necessary.

![Diagram of 4-bit MPU interface]

Features

1. Interface with 8-bit or 4-bit MPU is available.
2. 192 kinds of alphabets, numerals, symbols, and special characters can be displayed by built-in character generator (ROM).
3. Other preferred characters can be displayed by character generator (RAM).
4. Various functions of instruction are available by programming.
   - Clear display
   - Cursor at home
   - On / off cursor
   - Blink character
   - Shift display
   - Shift cursor
   - Read / write display data...etc.
5. Compact and lightweight design which can be easily assembled in devices.
7. Low power consumption.
   - Interface between data bus line and 4-bit or 8-bit MPU is available. Data transfer are made in twice in case of 4-bit MPU, and once in case of 8-bit MPU.

◆ If interface data is 4-bit long

Data transfer are made through 4 bus lines from DB4 to DB7. (while the rest of 4 bus lines from DB0 to DB3 are not used.) Data transfer with MPU are completed when 4-bit data are transferred in twice. (first upper 4-bit data, then lower 4-bit data.)

◆ If interface data is 8-bit long

Data transfer are made through all of 8 bus lines from DB0 to DB7.
Example of Power Supply

- Normal Temperature Type

- Extended Temperature Type

Examples of Temperature Compensation Circuits for Extended Temp Type. (Only for reference)

Instructions

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Code</th>
<th>Description</th>
<th>Executed Time (max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Display</td>
<td>0 0 0 0 0 0 0 0 0 1</td>
<td>Clears all display and returns the cursor to the home position (Address 0)</td>
<td>1.64μs</td>
</tr>
<tr>
<td>Cursor At Home</td>
<td>0 0 0 0 0 0 0 0 1 *</td>
<td>Returns the cursor to the home position (Address 0). Also returns the display being shifted to the original position. DD RAM contents remain unchanged.</td>
<td>1.64μs</td>
</tr>
<tr>
<td>Entry Mode Set</td>
<td>0 0 0 0 0 0 0 0 1 1/D</td>
<td>Sets the cursor move direction and specifies on or not to shift the display. These operations are performed during data write and read.</td>
<td>40μs</td>
</tr>
<tr>
<td>Display On / Off Control</td>
<td>0 0 0 0 0 0 0 0 1 D C</td>
<td>Sets ON / OFF of all display (D), cursor NO / OFF (C), and blink of cursor position character (B).</td>
<td>40μs</td>
</tr>
<tr>
<td>Cursor / Display Shift</td>
<td>0 0 0 0 0 0 1 S/C RL * *</td>
<td>Moves the cursor and shifts the display without changing DD RAM contents.</td>
<td>40μs</td>
</tr>
<tr>
<td>Function Set</td>
<td>0 0 0 0 1 DL N F * *</td>
<td>Sets interface data length (DL) number of display lines (L) and character font (F)</td>
<td>40μs</td>
</tr>
<tr>
<td>CG RAM Address Set</td>
<td>0 0 0 1</td>
<td>ACG</td>
<td>Sets the CG RAM address. CG RAM data is sent and received after this setting.</td>
</tr>
<tr>
<td>DD RAM Address Set</td>
<td>0 0 1</td>
<td>ADD</td>
<td>Sets the DD RAM address. DD RAM data is sent and received after this setting.</td>
</tr>
<tr>
<td>Busy Flag / Address Read</td>
<td>0 1 BF</td>
<td>AC</td>
<td>Reads Busy flag (FB) indicating internal operation is being performed and reads address counter counts.</td>
</tr>
<tr>
<td>CG RAM / DD RAM Data Write</td>
<td>1 0</td>
<td>WRITE DATA</td>
<td>Writes data into DD RAM or CG RAM.</td>
</tr>
<tr>
<td>CG RAM / DD RAM Data Read</td>
<td>1 1</td>
<td>READ DATA</td>
<td>Reads data from DD RAM or CG RAM.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Executed Time (max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/D = 1: Increment</td>
<td>DL = 0: 4-bit</td>
<td>fcp or fosc = 250KHz. However, when frequency changes, execution time also changes. Example:</td>
</tr>
<tr>
<td>I/D = 0: Decrement</td>
<td>N = 1: 2-lines</td>
<td>1.64μs</td>
</tr>
<tr>
<td>S = 1: With display shift</td>
<td>F = 1: 5×10dots</td>
<td>1.64μs</td>
</tr>
<tr>
<td>S/C = 0: cursor movement</td>
<td>F = 0: 5×7dots</td>
<td>40μs</td>
</tr>
<tr>
<td>R/L = 1: Shift to the right</td>
<td>BF = 1: Internal operation is being performed</td>
<td>40μs</td>
</tr>
<tr>
<td>R/L = 0: Shift to the left</td>
<td>BF = 0: Instruction acceptable</td>
<td>40μs</td>
</tr>
<tr>
<td>DL = 1: 8-bit</td>
<td>DD RAM: Display Data RAM</td>
<td>40μs</td>
</tr>
<tr>
<td></td>
<td>CG RAM: Character Generator RAM</td>
<td>40μs</td>
</tr>
<tr>
<td></td>
<td>ACG: CG RAM Address</td>
<td>40μs</td>
</tr>
<tr>
<td></td>
<td>ADD: DD RAM Address Corresponds to cursor address</td>
<td>40μs</td>
</tr>
<tr>
<td></td>
<td>AC: Address Counter, used for both DD RAM and CG RAM</td>
<td>40μs</td>
</tr>
<tr>
<td></td>
<td>*: Invalid</td>
<td>40μs</td>
</tr>
</tbody>
</table>
Power Supply Reset

The internal reset circuit will be operated properly when the following power supply conditions are satisfied. If it is not operated properly, please perform initial setting along with the instruction.

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Measuring Condition</th>
<th>Standard Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply RISE Time</td>
<td>t Reef</td>
<td>— —</td>
<td>0.1 — —</td>
<td>10 mS</td>
</tr>
<tr>
<td>Power Supply CFF Time</td>
<td>t Off</td>
<td>— —</td>
<td>1 — —</td>
<td>mS</td>
</tr>
</tbody>
</table>

Reset function

◆ Initialization Made by Internal Reset Circuit

HD44780 automatically initializes (resets) when power is supplied (built-in internal reset circuit).
The following instructions are executed in initialization. The busy flag (BF) is kept in busy state until initialization ends. (BF = 1) The busy state is 10 ms after Vdd reaches to 4.5V.

1. Display clear
2. Function set
   DL = 1:8 bit long interface data
   DL = 0:4 bit
   F = 0.5 x 7 dots character font
   N = 1:2 lines
   N = 0:1 line
3. Display ON / OFF control
   D = 0:Display OFF     C = 0:Cursor OFF
   B = 0:Blank OFF
4. Entry mode set
   1 / D = 1: + 1 (increment)  S = 0: No shift

Note: When conditions stated in power supply conditions using internal reset circuit are not satisfied, the internal reset circuit will not operate properly and initialization will not be performed. Please make initialization using MPU along with instruction.

◆ Initialization along with instruction

If power supply conditions are not satisfied, which for proper operation of internal reset circuit, it is required to make initialization along with instruction. Please make following procedures.

- When interface is 8-bit long.
  - RS R/W DB8 DB4 DB0 DI8 DI4 DI0 DI6 DI2 DI4 DI6 DI8
  - Wait more than 15ms after Vdd rise to 4.5V
  - RS R/W DB8 DB4 DB0 DI8 DI4 DI0 DI6 DI2 DI4 DI6 DI8
  - BF cannot be checked before the instruction function set (interface is 8 bits long)
  - RS R/W DB8 DB4 DB0 DI8 DI4 DI0 DI6 DI2 DI4 DI6 DI8
  - BF cannot be checked before the instruction function set (interface is 8 bits long)
  - RS R/W DB8 DB4 DB0 DI8 DI4 DI0 DI6 DI2 DI4 DI6 DI8
  - BF cannot be checked before the instruction function set (interface is 8 bits long)

- When interface is 4-bit long.
  - RS R/W DB4 DB0 DI8 DI4 DI0 DI6 DI2 DI4 DI6 DI8
  - BF cannot be checked before the instruction function set (interface is 4 bits long)
  - RS R/W DB4 DB0 DI8 DI4 DI0 DI6 DI2 DI4 DI6 DI8
  - BF cannot be checked before the instruction function set (interface is 4 bits long)
  - RS R/W DB4 DB0 DI8 DI4 DI0 DI6 DI2 DI4 DI6 DI8
  - BF cannot be checked before the instruction function set (interface is 4 bits long)

- When interface is 2-bit long.
  - RS R/W DB4 DI0 DI6 DI2 DI4 DI6 DI8
  - BF cannot be checked before the instruction function set (interface is 2 bits long)
  - RS R/W DB4 DI0 DI6 DI2 DI4 DI6 DI8
  - BF cannot be checked before the instruction function set (interface is 2 bits long)
  - RS R/W DB4 DI0 DI6 DI2 DI4 DI6 DI8
  - BF cannot be checked before the instruction function set (interface is 2 bits long)

- When interface is 1-bit long.
  - RS R/W DB4 DI0 DI6 DI2 DI4 DI6 DI8
  - BF cannot be checked before the instruction function set (interface is 1 bit long)

Display OFF
Display ON
Entry Mode Set
### Standard Character Pattern (Powertip Module)

<table>
<thead>
<tr>
<th>Character Code (Hexadecimal)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>8</th>
<th>9</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
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<tbody>
<tr>
<td><strong>Higher 4-bit (D4 to Character Code (Hexadecimal))</strong></td>
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# LCD Display

## Standard Character Pattern (Elec & Eltek Module)

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<th>HLHH</th>
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<th>HLLL</th>
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</tbody>
</table>
LM741 Operational Amplifier

1 Features
- Overload Protection on the Input and Output
- No Latch-Up When the Common-Mode Range is Exceeded

2 Applications
- Comparators
- Multivibrators
- DC Amplifiers
- Summing Amplifiers
- Integrator or Differentiators
- Active Filters

3 Description
The LM741 series are general-purpose operational amplifiers which feature improved performance over industry standards like the LM709. They are direct, plug-in replacements for the 709C, LM201, MC1439, and 748 in most applications.

The amplifiers offer many features which make their application nearly foolproof: overload protection on the input and output, no latch-up when the common-mode range is exceeded, as well as freedom from oscillations.

The LM741C is identical to the LM741 and LM741A except that the LM741C has their performance ensured over a 0°C to +70°C temperature range, instead of −55°C to +125°C.

Device Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>PACKAGE</th>
<th>BODY SIZE (NOM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM741</td>
<td>TO-99 (8)</td>
<td>9.08 mm × 9.08 mm</td>
</tr>
<tr>
<td></td>
<td>CDIP (8)</td>
<td>10.16 mm × 6.502 mm</td>
</tr>
<tr>
<td></td>
<td>PDIP (8)</td>
<td>9.81 mm × 6.35 mm</td>
</tr>
</tbody>
</table>

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Typical Application
Note: Page numbers for previous revisions may differ from page numbers in the current version.

4 Revision History

Changes from Revision C (October 2004) to Revision D

- Added Applications section, Pin Configuration and Functions section, ESD Ratings table, Feature Description section, Device Functional Modes, Application and Implementation section, Power Supply Recommendations section, Layout section, Device and Documentation Support section, and Mechanical, Packaging, and Orderable Information section ................................................................. 1
- Removed NAD 10-Pin CLGA pinout ..................................................................................................................................... 3
- Removed obsolete M (S0-8) package from the data sheet ................................................................................................... 4
- Added recommended operating supply voltage spec ......................................................................................................... 4
- Added recommended operating temperature spec .............................................................................................................. 4

Changes from Revision C (March 2013) to Revision D

- Added Applications section, Pin Configuration and Functions section, ESD Ratings table, Feature Description section, Device Functional Modes, Application and Implementation section, Power Supply Recommendations section, Layout section, Device and Documentation Support section, and Mechanical, Packaging, and Orderable Information section ................................................................. 1
- Removed NAD 10-Pin CLGA pinout ..................................................................................................................................... 3
- Removed obsolete M (S0-8) package from the data sheet ................................................................................................... 4
- Added recommended operating supply voltage spec ......................................................................................................... 4
- Added recommended operating temperature spec .............................................................................................................. 4
5 Pin Configuration and Functions

Pin Functions

<table>
<thead>
<tr>
<th>PIN NAME</th>
<th>NO.</th>
<th>I/O</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>INVERTING INPUT</td>
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<td>I</td>
<td>Inverting signal input</td>
</tr>
<tr>
<td>NC</td>
<td>8</td>
<td>N/A</td>
<td>No Connect, should be left floating</td>
</tr>
<tr>
<td>NONINVERTING INPUT</td>
<td>3</td>
<td>I</td>
<td>Noninverting signal input</td>
</tr>
<tr>
<td>OFFSET NULL</td>
<td>1, 5</td>
<td>I</td>
<td>Offset null pin used to eliminate the offset voltage and balance the input voltages.</td>
</tr>
<tr>
<td>OUTPUT</td>
<td>6</td>
<td>O</td>
<td>Amplified signal output</td>
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<tr>
<td>V+</td>
<td>7</td>
<td>I</td>
<td>Positive supply voltage</td>
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<td>V−</td>
<td>4</td>
<td>I</td>
<td>Negative supply voltage</td>
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# 6 Specifications

## 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)\(^{(1)(2)(3)}\)

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<th>MAX</th>
<th>UNIT</th>
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<td>Supply voltage</td>
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<td>V</td>
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<tr>
<td>LM741C</td>
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<td>mW</td>
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<td>V</td>
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<tr>
<td>Input voltage (^{(5)})</td>
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<td>Output short circuit duration</td>
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<td>LM741, LM741A</td>
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<td>LM741C</td>
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<td>Soldering information</td>
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<td>CDIP or TO-99 package (10 seconds)</td>
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<td>Storage temperature, (T_{\text{stg}})</td>
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<td>°C</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

\(^{(2)}\) For military specifications see RETS741X for LM741 and RETS741AX for LM741A.

\(^{(3)}\) If Military/Aerospace specified devices are required, please contact the TI Sales Office/Distributors for availability and specifications.

\(^{(4)}\) For operation at elevated temperatures, these devices must be derated based on thermal resistance, and \(T_j = T_A + (\theta_{JA} P_D)\).

\(^{(5)}\) For supply voltages less than ±15 V, the absolute maximum input voltage is equal to the supply voltage.

## 6.2 ESD Ratings

<table>
<thead>
<tr>
<th>(V_{\text{ESD}})</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic discharge (HBM), per ANSI/ESDA/JEDEC JS-001(^{(1)})</td>
<td>±400</td>
<td>V</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Level listed above is the passing level per ANSI, ESDA, and JEDEC JS-001. JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

## 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>NOM</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (VDD-GND)</td>
<td>±10</td>
<td>±15</td>
<td>±22</td>
<td>V</td>
</tr>
<tr>
<td>LM741, LM741A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM741C</td>
<td>±10</td>
<td>±15</td>
<td>±18</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>−55</td>
<td>125</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>LM741, LM741A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM741C</td>
<td>0</td>
<td>70</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 6.4 Thermal Information

<table>
<thead>
<tr>
<th>THERMAL METRIC(^{(1)})</th>
<th>LM741</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LMC (TO-99)</td>
<td>NAB (CDIP)</td>
</tr>
<tr>
<td></td>
<td>8 PINs</td>
<td>8 PINs</td>
</tr>
<tr>
<td>(R_{\text{UA}}) \text{ Junction-to-ambient thermal resistance}</td>
<td>170</td>
<td>100</td>
</tr>
<tr>
<td>(R_{\text{UC(top)}}) \text{ Junction-to-case (top) thermal resistance}</td>
<td>25</td>
<td>—</td>
</tr>
</tbody>
</table>

\(^{(1)}\) For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report, SPRA953.
### 6.5 Electrical Characteristics, LM741

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input offset voltage</td>
<td>$R_S \leq 10 , k\Omega$</td>
<td>$T_A = 25^\circ C$</td>
<td>1</td>
<td>5</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td>$T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>6 mV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input offset voltage adjustment range</td>
<td>$T_A = 25^\circ C$, $V_S = \pm 20 , V$</td>
<td>15 mV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input offset current</td>
<td>$T_A = 25^\circ C$</td>
<td>20</td>
<td>200</td>
<td>nA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>85</td>
<td>500</td>
<td>nA</td>
<td></td>
</tr>
<tr>
<td>Input bias current</td>
<td>$T_A = 25^\circ C$</td>
<td>80</td>
<td>500</td>
<td>nA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>1.5</td>
<td>μA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input resistance</td>
<td>$T_A = 25^\circ C$, $V_S = \pm 20 , V$</td>
<td>0.3</td>
<td>2</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>Input voltage range</td>
<td>$T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>±12</td>
<td>±13</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Large signal voltage gain</td>
<td>$V_S = \pm 15 , V$, $V_O = \pm 10 , V$, $R_L \geq 2 , k\Omega$</td>
<td>$T_A = 25^\circ C$</td>
<td>50</td>
<td>200</td>
<td>V/mV</td>
</tr>
<tr>
<td></td>
<td>$T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output voltage swing</td>
<td>$V_S = \pm 15 , V$</td>
<td>$R_L \geq 10 , k\Omega$</td>
<td>±12</td>
<td>±14</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>$R_L \geq 2 , k\Omega$</td>
<td>±10</td>
<td>±13</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output short circuit current</td>
<td>$T_A = 25^\circ C$</td>
<td>25</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common-mode rejection ratio</td>
<td>$R_S \leq 10 , \Omega$, $V_{CM} = \pm 12 , V$, $T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>80</td>
<td>95</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Supply voltage rejection ratio</td>
<td>$V_S = \pm 20 , V$ to $V_O = \pm 5 , V$, $R_S \leq 10 , \Omega$, $T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>86</td>
<td>96</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Transient response</td>
<td>Rise time</td>
<td>$T_A = 25^\circ C$, unity gain</td>
<td>0.3</td>
<td>μs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overshoot</td>
<td>$T_A = 25^\circ C$, unity gain</td>
<td>5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slew rate</td>
<td>$T_A = 25^\circ C$, unity gain</td>
<td>0.5</td>
<td>V/μs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply current</td>
<td>$T_A = 25^\circ C$</td>
<td>1.7</td>
<td>2.8</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>$V_S = \pm 15 , V$</td>
<td>$T_A = 25^\circ C$</td>
<td>50</td>
<td>85</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td>$T_A = T_{A_{\text{MIN}}}$</td>
<td>60</td>
<td>100</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$T_A = T_{A_{\text{MAX}}}$</td>
<td>45</td>
<td>75</td>
<td>mW</td>
<td></td>
</tr>
</tbody>
</table>

(1) Unless otherwise specified, these specifications apply for $V_S = \pm 15 \, V$, $-55^\circ C \leq T_A \leq +125^\circ C$ (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to $0^\circ C \leq T_A \leq +70^\circ C$.

### 6.6 Electrical Characteristics, LM741A

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input offset voltage</td>
<td>$R_S \leq 50 , \Omega$</td>
<td>$T_A = 25^\circ C$</td>
<td>0.8</td>
<td>3</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td>$T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>4 mV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average input offset voltage drift</td>
<td>$T_A = 25^\circ C$, $V_S = \pm 20 , V$</td>
<td>15</td>
<td>μV/°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input offset voltage adjustment range</td>
<td>$T_A = 25^\circ C$, $V_S = \pm 20 , V$</td>
<td>±10</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input offset current</td>
<td>$T_A = 25^\circ C$</td>
<td>3</td>
<td>30</td>
<td>nA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average input offset current drift</td>
<td>$T_A = 25^\circ C$, $V_S = \pm 20 , V$</td>
<td>±10</td>
<td>nA/°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input bias current</td>
<td>$T_A = 25^\circ C$</td>
<td>30</td>
<td>80</td>
<td>nA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>0.21</td>
<td>μA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input resistance</td>
<td>$T_A = 25^\circ C$, $V_S = \pm 20 , V$</td>
<td>1</td>
<td>6</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>0.5</td>
<td>V/mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large signal voltage gain</td>
<td>$V_S = \pm 20 , V$, $V_O = \pm 15 , V$, $R_L \geq 2 , k\Omega$</td>
<td>$T_A = 25^\circ C$</td>
<td>50</td>
<td>V/mV</td>
<td></td>
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<tr>
<td></td>
<td>$T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_S = \pm 5 , V$, $V_O = \pm 2 , V$, $R_L \geq 2 , k\Omega$, $T_{A_{\text{MIN}}} \leq T_A \leq T_{A_{\text{MAX}}}$</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Unless otherwise specified, these specifications apply for $V_S = \pm 15 \, V$, $-55^\circ C \leq T_A \leq +125^\circ C$ (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to $0^\circ C \leq T_A \leq +70^\circ C$. 

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6.7 Electrical Characteristics, LM741C (1)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input offset voltage</td>
<td>Rs ≤ 10 kΩ, TA = 25°C, VS = ±20 V</td>
<td>≤2</td>
<td>6</td>
<td>≤7.5</td>
<td>mV</td>
</tr>
<tr>
<td>Input offset voltage</td>
<td>TMIN ≤ TA ≤ TMAX</td>
<td>≤15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>adjustment range</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input offset current</td>
<td>TA = 25°C, VS = ±20 V</td>
<td>20</td>
<td>200</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>TMIN ≤ TA ≤ TMAX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input bias current</td>
<td>TA = 25°C</td>
<td>80</td>
<td>500</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>TMIN ≤ TA ≤ TMAX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input resistance</td>
<td>TA = 25°C, VS = ±20 V</td>
<td>≤12</td>
<td>≤13</td>
<td></td>
<td>MO</td>
</tr>
<tr>
<td>Large signal voltage gain</td>
<td>VS = ±15 V, VO = ±10 V, RL ≥ 2 kΩ, TA = 25°C</td>
<td>20</td>
<td>200</td>
<td></td>
<td>V/mV</td>
</tr>
<tr>
<td>TMIN ≤ TA ≤ TMAX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output voltage swing</td>
<td>VS = ±15 V, RA ≥ 10 kΩ, RL ≥ 2 kΩ</td>
<td>≤12</td>
<td>≤14</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output short circuit current</td>
<td>TA = 25°C</td>
<td>≤25</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Common-mode rejection ratio</td>
<td>Rs ≤ 10 kΩ, VCM = ±12 V, TMIN ≤ TA ≤ TMAX</td>
<td>70</td>
<td>90</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Supply voltage rejection ratio</td>
<td>VS = ±20 V to VS = ±15 V, Rs ≤ 10 Ω, TMIN ≤ TA ≤ TMAX</td>
<td>77</td>
<td>96</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Transient response</td>
<td>TA = 25°C, Unity Gain</td>
<td>≤0.3</td>
<td></td>
<td></td>
<td>μs</td>
</tr>
<tr>
<td>Rise time</td>
<td></td>
<td>5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overshoot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slew rate</td>
<td>TA = 25°C, Unity Gain</td>
<td>≤0.5</td>
<td></td>
<td></td>
<td>V/μs</td>
</tr>
<tr>
<td>Supply current</td>
<td>TA = 25°C</td>
<td>≤1.7</td>
<td>2.8</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Power consumption</td>
<td>VS = ±15 V, TA = 25°C</td>
<td>≤50</td>
<td>85</td>
<td></td>
<td>mW</td>
</tr>
</tbody>
</table>

(1) Unless otherwise specified, these specifications apply for VS = ±15 V, −55°C ≤ TA ≤ +125°C (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to 0°C ≤ TA ≤ +70°C.
7 Detailed Description

7.1 Overview
The LM74 devices are general-purpose operational amplifiers which feature improved performance over industry standards like the LM709. It is intended for a wide range of analog applications. The high gain and wide range of operating voltage provide superior performance in integrator, summing amplifier, and general feedback applications. The LM741 can operate with a single or dual power supply voltage. The LM741 devices are direct, plug-in replacements for the 709C, LM201, MC1439, and 748 in most applications.

7.2 Functional Block Diagram

7.3 Feature Description

7.3.1 Overload Protection
The LM741 features overload protection circuitry on the input and output. This prevents possible circuit damage to the device.

7.3.2 Latch-up Prevention
The LM741 is designed so that there is no latch-up occurrence when the common-mode range is exceeded. This allows the device to function properly without having to power cycle the device.

7.3.3 Pin-to-Pin Capability
The LM741 is pin-to-pin direct replacements for the 709C, LM201, MC1439, and LM748 in most applications. Direct replacement capabilities allows flexibility in design for replacing obsolete parts.
7.4 Device Functional Modes

7.4.1 Open-Loop Amplifier

The LM741 can be operated in an open-loop configuration. The magnitude of the open-loop gain is typically large thus for a small difference between the noninverting and inverting input terminals, the amplifier output will be driven near the supply voltage. Without negative feedback, the LM741 can act as a comparator. If the inverting input is held at 0 V, and the input voltage applied to the noninverting input is positive, the output will be positive. If the input voltage applied to the noninverting input is negative, the output will be negative.

7.4.2 Closed-Loop Amplifier

In a closed-loop configuration, negative feedback is used by applying a portion of the output voltage to the inverting input. Unlike the open-loop configuration, closed loop feedback reduces the gain of the circuit. The overall gain and response of the circuit is determined by the feedback network rather than the operational amplifier characteristics. The response of the operational amplifier circuit is characterized by the transfer function.
8 Application and Implementation

NOTE
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information
The LM741 is a general-purpose amplifier than can be used in a variety of applications and configurations. One common configuration is in a noninverting amplifier configuration. In this configuration, the output signal is in phase with the input (not inverted as in the inverting amplifier configuration), the input impedance of the amplifier is high, and the output impedance is low. The characteristics of the input and output impedance is beneficial for applications that require isolation between the input and output. No significant loading will occur from the previous stage before the amplifier. The gain of the system is set accordingly so the output signal is a factor larger than the input signal.

8.2 Typical Application

Figure 1. LM741 Noninverting Amplifier Circuit

8.2.1 Design Requirements
As shown in Figure 1, the signal is applied to the noninverting input of the LM741. The gain of the system is determined by the feedback resistor and input resistor connected to the inverting input. The gain can be calculated by Equation 1:

\[ \text{Gain} = 1 + \frac{\text{R2}}{\text{R1}} \]  

The gain is set to 2 for this application. R1 and R2 are 4.7-k resistors with 5% tolerance.

8.2.2 Detailed Design Procedure
The LM741 can be operated in either single supply or dual supply. This application is configured for dual supply with the supply rails at ±15 V. The input signal is connected to a function generator. A 1-Vpp, 10-kHz sine wave was used as the signal input. 5% tolerance resistors were used, but if the application requires an accurate gain response, use 1% tolerance resistors.
Typical Application (continued)

8.2.3 Application Curve

The waveforms in Figure 2 show the input and output signals of the LM741 non-inverting amplifier circuit. The blue waveform (top) shows the input signal, while the red waveform (bottom) shows the output signal. The input signal is 1.06 Vpp and the output signal is 1.94 Vpp. With the 4.7-kΩ resistors, the theoretical gain of the system is 2. Due to the 5% tolerance, the gain of the system including the tolerance is 1.992. The gain of the system when measured from the mean amplitude values on the oscilloscope was 1.83.

![Figure 2. Waveforms for LM741 Noninverting Amplifier Circuit](image)

9 Power Supply Recommendations

For proper operation, the power supplies must be properly decoupled. For decoupling the supply lines, a 0.1-µF capacitor is recommended and should be placed as close as possible to the LM741 power supply pins.
10 Layout

10.1 Layout Guidelines
As with most amplifiers, take care with lead dress, component placement, and supply decoupling in order to ensure stability. For example, resistors from the output to an input should be placed with the body close to the input to minimize pick-up and maximize the frequency of the feedback pole by minimizing the capacitance from the input to ground. As shown in Figure 3, the feedback resistors and the decoupling capacitors are located close to the device to ensure maximum stability and noise performance of the system.

10.2 Layout Example

![Figure 3. LM741 Layout](image-url)
11 Device and Documentation Support

11.1 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

**TI E2E™ Online Community**  
*TI's Engineer-to-Engineer (E2E) Community.* Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support**  
*TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

11.2 Trademarks

E2E is a trademark of Texas Instruments.  
All other trademarks are the property of their respective owners.

11.3 Electrostatic Discharge Caution

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

11.4 Glossary

**SLYZ022 — TI Glossary.**  
This glossary lists and explains terms, acronyms, and definitions.

12 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.
## PACKAGING INFORMATION

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status (1)</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>Package Qty</th>
<th>Eco Plan (2)</th>
<th>Lead/Ball Finish</th>
<th>MSL Peak Temp (3)</th>
<th>Op Temp (°C)</th>
<th>Device Marking</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM741CH</td>
<td>ACTIVE</td>
<td>TO-99</td>
<td>LMC</td>
<td>8</td>
<td>500</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>0 to 70</td>
<td>(LM741CH ~ LM741CH)</td>
<td>Samples</td>
</tr>
<tr>
<td>LM741CH/NOPB</td>
<td>ACTIVE</td>
<td>TO-99</td>
<td>LMC</td>
<td>8</td>
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<td>P</td>
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<td>CU SN</td>
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<td>Call TI</td>
<td>-55 to 125</td>
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<td>Samples</td>
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<td>0 to 70</td>
<td>LM741CN</td>
<td>Samples</td>
</tr>
</tbody>
</table>

(1) The marketing status values are defined as follows:
- **ACTIVE**: Product device recommended for new designs.
- **LIFEBUY**: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
- **NRND**: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
- **PREVIEW**: Device has been announced but is not in production. Samples may or may not be available.
- **OBSOLETE**: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check [http://www.ti.com/productcontent](http://www.ti.com/productcontent) for the latest availability information and additional product content details.
- **TBD**: The Pb-Free/Green conversion plan has not been defined.
- **Pb-Free (RoHS)**: TI’s terms “Lead-Free” or “Pb-Free” mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
- **Pb-Free (RoHS Exempt)**: This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
- **Green (RoHS & no Sb/Br)**: TI defines “Green” to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Leads in true position within 0.010 (0.25) R @ MMC at seating plane.
D. Pin numbers shown for reference only. Numbers may not be marked on package.
E. Falls within JEDEC MO-002/10-99.
P (R-PDIP-T8)  PLASTIC DUAL-IN-LINE PACKAGE

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001 variation BA.
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<th>Applications</th>
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<td>Automotive and Transportation</td>
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<td>Wireless Connectivity</td>
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ULTRASONIC SENSORS

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
# Ultrasonic sensors

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<td>Series VariKont®</td>
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<td>Series -FP</td>
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<tr>
<td>Series -F12</td>
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## Type code (without series LUC...)*

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<th>U</th>
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<tr>
<td>B</td>
<td>Basic series</td>
</tr>
<tr>
<td>BE</td>
<td>Basic series through-beam sensors</td>
</tr>
<tr>
<td>C</td>
<td>Advanced series</td>
</tr>
<tr>
<td>CC</td>
<td>Advanced series, chemical-resistant sensors</td>
</tr>
<tr>
<td>J</td>
<td>Initiator</td>
</tr>
<tr>
<td>DB</td>
<td>Double sheet control (DBL: for label detection, DBK: splice detection)</td>
</tr>
</tbody>
</table>

### Upper limit of sensing range

- 300 mm (example)
- 6000 mm (example)

### Type of housing

- 12 mm cylindrical housing, diameter 12 mm
- 18 mm cylindrical housing, diameter 18 mm
- 30 mm cylindrical housing, diameter 30 mm
- U: square housing VariKont (U1, U9)
- FP: square housing FP (FP1, FP...P1, FP...P5)
- F42: square housing F42
- F43: square housing F43
- F54: square housing F54
- F64: square housing F64

### Threaded bushing (cylindrical type only)

- with specification of length in mm (example: GM75, length = 75 mm)

<table>
<thead>
<tr>
<th>GM</th>
<th>Metal</th>
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</thead>
<tbody>
<tr>
<td>GK</td>
<td>Plastic</td>
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</tbody>
</table>

### Electrical output

- E0: 1 x 3-wire, npn switching output, normally open
- E2: 1 x 3-wire, npn switching output, normally open
- E4: 1 x 3-wire, npn switching output, normally open/normally closed
- E5: 1 x 3-wire, npn switching output, normally open/normally closed
- E6: 2 x 3-wire, npn switching output, normally open/normally closed
- E7: 2 x 3-wire, npn switching output, normally open/normally closed
- E01: 2 x 3-wire, npn switching output, normally open/normally closed
- E23: 2 x 3-wire, npn switching output, normally open/normally closed
- A2: 2 x 3-wire, npn switching output, antivalent
- H1: for external evaluation, transmitter
- H2: for external evaluation, receiver
- H3: for external evaluation, transmitter/receiver
- I: Analogue output, 4 mA ... 20 mA
- U: Analogue output, 0/2 V ... 10 V
- IU: Analogue output, 4 mA ... 20 mA + 0/2 V ... 10 V or load-controlled
- IU E2: Analogue output, load-controlled IU and 1 switching output E2
- IU E0: Analogue output, load-controlled IU and 1 switching output E0
- 8B: 8 bit data output, parallel
- K: Relay output (2K = 2 relay outputs)
- R2 (RS): RS 232 interface (old designation)

### Design (optional)

- K: Transducer separate from evaluation unit
  - for use in restricted spaces

### Connections

- cable version
- V1: plug connector, 4-pin, M12 x 1
- V3: plug connector, 3-pin, M8 x 1
- V7: plug connector, 7-pin, PG13,5
- V15: plug connector, 5-pin, M12 x 1
- V17: plug connector, 8-pin, M12 x 1
- V95: plug connector, 5 pin, M18 x 1,5

---

* The type codes for the LUC series can be found on page 181.
## Selection table

<table>
<thead>
<tr>
<th>Detection range (max.)</th>
<th>Output</th>
<th>Connection</th>
</tr>
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<tr>
<td><strong>Sensors for separate evaluation units</strong></td>
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<td></td>
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<tr>
<td>Series -30GM</td>
<td>6000 mm</td>
<td>⚫</td>
</tr>
<tr>
<td>Series VariKont®</td>
<td>3000 mm</td>
<td>⚫</td>
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<td>Series -FP</td>
<td>6000 mm</td>
<td>⚫</td>
</tr>
<tr>
<td>Series -F54</td>
<td>2000 mm</td>
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<td><strong>Through beam sensors</strong></td>
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<td>Series -18GK</td>
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<td>Series -18GM40</td>
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<tr>
<td>Series -30GM</td>
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<td>Series VariKont</td>
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<tr>
<td><strong>Detection and reflection sensors</strong></td>
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<td>Series -12GM</td>
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<td>Series -18GM40</td>
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<td>Series -30GM</td>
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<tr>
<td>Series VariKont®</td>
<td>3000 mm</td>
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<td>Series -FP</td>
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<td>Series -F54</td>
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<td>Series -D1</td>
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<td>Series -LUC</td>
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<td>UH3-T1-KT</td>
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</tr>
<tr>
<td>DA5-IU...</td>
<td></td>
<td>⚫</td>
</tr>
</tbody>
</table>

1) on request
2) 10 ... 30 V DC without function of the current output
3) 10 ... 252 V DC / 20 ... 252 V AC
4) DC-Types: 10 ... 30 V DC, DC/AC-Types: 20 ... 253 V DC, 15 ... 253 V AC
5) only DC-Types

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<table>
<thead>
<tr>
<th>Supply voltage range</th>
<th>angled head</th>
<th>Error indicator</th>
<th>Timer function/ Pulse prolongation</th>
<th>N.C./N.O./ Window selectable mode</th>
<th>Synchronisation input</th>
<th>TEACH-IN/ Parameterisation</th>
<th>adjustable sound lobe width</th>
<th>Serial interface</th>
<th>Parallel interface (8 Bit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 ... 30 V DC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Operating principles and technology of ultrasonic sensors

Pepperl+Fuchs ultrasonic sensors operate with a piezoelectric transducer as the sound emitter and receiver. A patented decoupling layer in special material is used to decouple the ultrasonics to the air - an acoustically thin medium.

This ultrasonic transducer is embedded, watertight, into the sensor housing, in polyurethane foam.

The transducer transmits a packet of sonic pulses and converts the echo pulse into a voltage. The integrated controller computes the distance from the echo time and the velocity of sound. The transmitted pulse duration $\Delta t$ and the decay time of the sonic transducer result in an unusable area in which the ultrasonic sensor cannot detect an object. The ultrasonic frequency lies between 65 kHz and 400 kHz, depending on the sensor type; the pulse repetition frequency is between 14 Hz and 140 Hz.

The ultrasonic beam has an opening angle of around $\pm 5^\circ$. The sound pressure level outside of this cone is less than half (-6 dB) that of the value on the sensor axis.

The opening angle defines the spatially dimension of the sound cone. The diameter of the sound cone $D$ for a certain distance from the sensor $S$ can be calculated by

$$D = 2 \cdot \tan \alpha \cdot S$$

in a good approach.

In the formula above, only the angle between the curve and the centre-line ($0^\circ$) has to be inserted (half opening angle).

For a simple evaluation of the sound cone diameter $D$, you can use the list below, which shows the $\tan$-values for angles between $\alpha = 2^\circ$ and $\alpha = 20^\circ$ in $2^\circ$ intervals.

<table>
<thead>
<tr>
<th>angle $\alpha$</th>
<th>$\tan \alpha$</th>
<th>angle $\alpha$</th>
<th>$\tan \alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2^\circ$</td>
<td>0.035</td>
<td>$12^\circ$</td>
<td>0.213</td>
</tr>
<tr>
<td>$4^\circ$</td>
<td>0.07</td>
<td>$14^\circ$</td>
<td>0.249</td>
</tr>
<tr>
<td>$6^\circ$</td>
<td>0.105</td>
<td>$16^\circ$</td>
<td>0.287</td>
</tr>
<tr>
<td>$8^\circ$</td>
<td>0.141</td>
<td>$18^\circ$</td>
<td>0.325</td>
</tr>
<tr>
<td>$10^\circ$</td>
<td>0.176</td>
<td>$20^\circ$</td>
<td>0.364</td>
</tr>
</tbody>
</table>

The active range of the ultrasonic sensor is referred to as the sensing range $s_d$. This range is bounded by the lowest and highest sensing distances, whose values depend on the characteristics of the transducer. The highest sensing distance is given in the type code.

The ultrasonic sensor detects objects within its sensing range, regardless of whether these objects approach the sensor axially or move through the sound cone laterally.

Ultrasonic sensors are available with switching outputs and/or analogue outputs, various output functions are available according to type.
Operating principles and technology of ultrasonic sensors

The figure shows the response ranges of typical objects, rather than the intensity distribution of the ultrasonic beam. Within these ranges, the sensor detects the specified object A or B.

Example: UC6000-FP...

Where

A = flat plate, 100mm x 100 mm
B = round rod, diameter 25 mm

The details given in the type code relate to a flat standard plate, 100 mm x 100 mm. This plate must be placed at right angles to the axis of the beam. The packet of sound pulses is reflected away if the object is inclined to this axis and consequently the echo does not reach the sensor.

Due to the physical properties of sound propagation, the decay (range) and velocity of the ultrasonic beam is dependent on the:

- Air temperature
- Relative humidity
- Barometric pressure

The following chart shows the theoretical relationship between the air temperature and pressure and the velocity of sound.

As the signal echo time is evaluated in our ultrasonic sensors, most sensors are temperature-compensated. This eliminates most temperature effects on the sensor output.

This temperature compensation is performed by an electrical temperature sensor that is integrated into the sensor.

The sensor gives off a certain intrinsic heat that depends on the operating mode and the design. The result of this intrinsic heat is that the sensor has an additional temperature error of 2 % in the heating phase from 0.5 h ... 1 h.

As a result of the lag of the internal temperature sensor in reflecting the true current temperature, greater short-term fluctuations may occur than are specified on the data sheet due to a sudden change in the ambient temperature.

The relationships between the range of ultrasonic sensors and the air temperature, as well as that between the range and the relative humidity are shown in the following charts. The relationships shown here apply to sensors of the UC4000-30GM... and UC500-30GM... series, but with regard to the specific sensing range, apply in principle to all ultrasonic sensors.

The substantially increased sensor range at low temperatures is apparent, virtually independent of the relative humidity. The reduction in range at high temperatures, however, is subject to a strong influence by the relative humidity.

The sensing ranges stated in the data sheets for our ultrasonic sensors are based on an ambient temperature of +20 °C and a relative humidity of 50 %.
Sensor principle

Selecting the correct sensor

The range of ultrasonic sensor products is a large one due to their wide range of deployment. Important selection criteria are described in detail on the next five pages to assist you in selecting the correct sensor type for your specific applications:

1. Sensor principle
2. Output functions
3. Series
4. Electrical connections
5. Parameterisation

1. Sensor principle

The principle by which ultrasonic sensors yield measurements is that of evaluating the time taken for the sound to travel between transmission and reception (direct detection), or a process of checking whether the transmitted signal has been received (detection by beam interruption). The following distinctions are made between types of sensor function:

Detection by beam interruption

Through-beam sensor

The emitter and receiver are mounted facing each other. If the ultrasonic beam is broken by an object, then the switch output becomes active.

Properties:
- High range, as the ultrasonic beam only travels the signal distance once.
- Less susceptible to interference, thus suitable for difficult operating conditions.
- Greater installation complexity, as two separate units must be wired.

Double-sheet monitoring

Double-sheet monitoring is a special application involving through-beam sensors designed especially for this purpose. This application originated in the printing industry and uses an ultrasonic beam to monitor the thickness of paper or foils.

Ultrasonic sensors for double-sheet monitoring are suitable for distinguishing between:
- no sheet, a single sheet, a double sheet.
- Base material
- Base material with labels

Ultrasonic double-sheet monitoring is deployed in all situations in which the automatic, high-speed distinction between base material, labels, single and double sheets is required in order to protect machines or avoid waste production. A complete system consists of an ultrasonic emitter, an ultrasonic receiver and an evaluation unit. These units have been optimally tuned to one another at the factory and may not be used separately.

Properties:
- The sensing range covers 10 g/m² paper to 2000 g/m² carton.
- Thin plastic or metal foils can also be detected.
- TEACH-IN of various materials
- Suitable for use with glossy or transparent materials
- Automatic adaptation of the operation point to slow changes in ambient conditions
- Very high processing speed
- Insensitive to dust and dirt

Reflex sensor mode

The emitter and receiver are mounted in the same housing. The ultrasonic beam is reflected back to the receiver by a fixed reflector plate. Objects entering the sensing range are detected by:

- changes to the measured distances
- lack of signal from the reflector due to absorption or diffuse reflection

Properties:
- Only one measuring head
- High detection reliability of problematic objects (sound-absorbent objects or objects with angled surfaces)
- Less susceptible to interference, thus suitable for difficult operating conditions.
Direct detection

Reflection sensor

The emitter and receiver are mounted in the same housing (reflection sensor). The object acts as a sound reflector.

Properties:
- The sensing range depends on the reflectance of the object, i.e., the surface properties and the angle of incidence. Within limits, these influences can be compensated by adjusting the sensitivity.
- Simple installation, as the sensor consists of a single unit.
- Sensitive with regard to changes in the reflection properties of objects

Reflection sensor with twin-head

Emitter and receiver are separate, the axes of the emitter and receiver transducers intersect each other (reflex/direct detection). The use of separate units for the emitter and receiver reduces the unusable area considerably, as this arrangement is not subject to delays while waiting for oscillations of the emitter to die out.

Properties:
- It is possible to detect very small objects.
- Three-dimensional sensing range
- Insensitive with regard to unwanted reflections from objects outside the sensing range (background suppression)

Analogue distance measurement

The time of travel of the sound pulse is the means of measuring the distance of the object. The sensors operate in direct detection mode and have various analogue outputs, depending on the type:

- Analogue voltage output: 0 V ... 10 V
- Analogue current output: 4 mA ... 20 mA
- 8-bit parallel output
- Serial output, RS 232

Absolute: distance as a series of digits in [mm]
Relative: type ... RS: three-digit sequence (0 ... 254)
          type ... R2: four-digit sequence (0 ... 4095)

An arbitrary measuring window can be set within the near and far evaluation limits (lower/upper limit) of the sensor. The relative data determines the position of the object in the measuring window.
2. Output functions

Switching output

Switching distance mode

On sensors with two independent switch points, each output becomes active when the object passes the related switch point A1, A2. These switch points can be arbitrarily taught-in to the sensing range.

Window mode

In window mode the ultrasonic sensor changes its output state when the first detected echo, and thus the object, is within the switching window. The window limits A1 and A2 can be taught-in as required. If multiple echoes arrive at different times and one of these is before A1, the output will not switch, even if a later echo is within the switching window. The sensor only evaluates the first echo detected. Multiple echoes thus cannot be evaluated.

Reflex sensor mode

Reflex sensor mode is possible with each of our ultrasonic sensors, which support the window mode. Therefore by means of the switch points A1 and A2 a small window area is defined. Inside this area, the fixed reference reflector must be placed. An object outside of this defined window will cause reliably an output status change, independent of its reflection properties. The wished output function (normally open/normally closed) can be set, when adjusting a window operation in the opposite output function.

Example: to detect an object with normally open output function, a window mode with normally closed output function has to be set.

Double switching point mode (hysteresis mode)

The ultrasonic sensor maintains its previous switching state in the selected area of the evaluation window. The output switches when the object approaches the near switching point A1. It then does not switch back until the object passes the far switching point A2. The two switching points form a large range hysteresis.

Double switching point mode can be used in many applications (such as monitoring filling levels to perform tasks with a single output that would otherwise require two outputs in normal switching-distance mode.

Area monitoring

The ultrasonic sensor monitors the evaluation window. The output switches only if an object is detected in the window. Echoes other than those from the evaluation window are ignored by the sensor software. Thanks to this active masking of the foreground in the area monitoring mode, echoes from areas outside of the switching window (foreground) do not cause interference.

Example:

UC3000... \( \Delta_E > 2 \% \) of 3000 mm = 60 mm
UC6000... \( \Delta_E > 2 \% \) of 6000 mm = 120 mm

The area monitoring mode is supported by our UC... sensors.
Output functions

nnp/pnp output

The outputs of the ultrasonic sensors can be realised in nnp or in pnp technology. The sensors in this catalogue are mainly pnp types. In this case the load is connected to -L, at the switching output of the sensor +L is connected to the load.

 Relay output

A number of ultrasonic sensors feature relay outputs. Please refer to the individual data sheets for the maximum switching loads and electrical design of the sensors. Information related to the mechanical service life refers to the number of switching actions of the relay contacts in no-load condition. This value can also be reached with low electrical contact loads. At the rated load for the electrical contacts, the service life is reduced to the value indicated for the electrical service life. The life time data stated are MTBF values.

Analogue output: 4 mA ... 20 mA/0 V ... 10 V

This issues a current/voltage signal proportional to the distance. The limits of the analogue measuring window can be parameterised as required within the sensing range. Depending on the type, this can be realised by:

- TEACH-IN with programming wire or programming plug
- DIP switch
- RS 232 interface
- Two potentiometers

External evaluation

On these sensors an external synchronising pulse triggers the measuring cycle. The sensor transmits the ultrasonic pulse and, on receipt of the time-delayed echo, outputs a voltage pulse. The echo time evaluation is performed by the evaluation unit.

The following evaluation units are available:

- UH3-KHD2-4I (4 analogue outputs)
- UH3-KHD2-4E5 (4 switching outputs)
- UH3-T1-KT (1 relay output)

With the types UH3-KHD2..., 4 sensors can be used in synchronous or multiplex mode, thus permitting special applications such as the spatial detection of objects, increased sound-cone coverage, and multiple measuring ranges.

The type UH3-T1-KT features a clock-pulse output and 3 signal inputs. It has a relay output with adjustable pick-up and release delay.

Power is also supplied to the connected sensors by the evaluation unit.

Digital, parallel

The distance is issued in the form of an 8-bit data word in parallel on three lines.

Digital, serial

These ultrasonic sensors can be parameterised via a bi-directional RS 232 interface, or issue the measured distance in serial form.

Outputs:

- Absolute/relative distance in 8- or 12-bit resolution
- Switching states
- Object in measuring window (A1, A2 or NDE*, FDE*)
- Object in sensing range
- etc.

* NDE = Near Distance of Evaluation
  FDE = Far Distance of Evaluation

Parameterisation

- Switching distances A1, A2
- Measuring window (NDE, FDE)
- Rising/falling ramp of analogue output
- Normally open/normally closed function
- Filter (for adaptation to application)
- etc.

The parameterisation can be performed with the Ultra 2001 service program or a terminal program and individual commands. A list of valid commands is contained in the individual sensor data sheets.

Digital, serial/parallel

These ultrasonic sensor function in the same way as those with the serial interface, but also feature an 8-bit parallel output for the measured distance. The parallel interface is parameterisable via RS 232 using the Ultra 2001 application.
### 3. Types/housing shapes

#### Cylindrical form

**Design:** 12GM...
18GK...
18GM40... / 18GM40A...
18GM75...
30GM...

**Properties:**
- Material: Plastic, nickel-plated brass or stainless steel.
- Thread: M12 x 1, M18 x 1 or M30 x 1.5
- Active area on the axial face
  (18GM40 and 18GM75 also available with angled head)
- Installation: In an existing threaded hole or using Pepperl+Fuchs mounting aids (see Accessories section)

**Design:** UC...-30GM... -T-...

**Properties:**
- Thread: M30 x 1.5
- Active area on the axial face
- Best suitable for low-temperature applications
- Installation: In an existing threaded flange
- Teflon-coated ultrasonic sensor for deployment in chemically aggressive environments

**Design:** LUC...

**Properties:**
- Material: PBT.
- Thread: G1½A and 1½” NPT in stainless steel or polypropylene
- Active area on the axial face
- Installation: In existing threaded hole or using Pepperl+Fuchs mounting aids (see Accessories section)

**Design:** D1

The D1 type was designed specifically for single-hole mounting in container lids to monitor fill levels. The display and operating elements are located under the transparent, permanently attached screw cap.

**Properties:**
- Material (housing): Plastic
- Material (flange): Stainless steel
- Single-hole mounting
- Simple parameterisation via DIP switch
- Large operating voltage range
Cuboid shaped types

VariKont® (Designation: U1 and U9)

The VariKont® housing was developed by Pepperl+Fuchs and has been proven in millions of applications. It is extremely flexible due to the adjustability of the head (i.e. the active section) in five directions without changes to the mounting of the sensor. The electronics section can be replaced independently of the base of the sensor. Changing the wiring or adjustment is therefore not required.

Properties:
- Material: PBT
- Active section is adjustable in 5 directions without affecting the mounting of the sensor.
- The electronic section can be replaced without changes to the base of the sensor. The wiring and adjustment remain unaffected.
- Connection through terminal compartment
- Standardised mounting hole pattern as in mechanical roller-lever limit switches (compliant with EN 60947)

Design: FP

Design: F12

Properties:
- Robust housing, waterproof and nonbreakable Material: dy cast zinc, nickel plated, PC, PBT
- Active area on the front face
- Multiple installation possibilities by means of slotted hole and dove tail mount
- Best visible indicator LEDs at the front and at the rear side
Connection via 90° turnable connector, M12 x 1

Design: F42

Properties:
- Material: PBT
- Direct surface-installation without additional mounting bracket
- Easy programming via built in keypad. No external programming tool required
- LEDs for status indication and for user support through numerous programming routines
- Top-looker und side-looker designs available for ideal matching to the local conditions
- DC-versions with semiconductor switching outputs or analogue outputs
- AC/DC-versions with wide voltage supply range and relay output
Electrical connections

Design: F43

Double-sheet monitoring

The ultrasonic double-sheet monitor is a measuring system consisting of a cylindrical ultrasonic emitter unit and a receiver unit with built-in evaluation electronics in M18 threaded bushes or cylindrical ultrasonic emitter and receiver units (M18) with a separate cubical evaluation unit.

Properties:
- Material: PBT
- Direct surface mounting without additional mounting angles
- LEDs on the plug side
- No unusable area in the twin-head version

Design: F54

Properties:
- Cubical housing, material: PBT
- Direct surface mounting without additional mounting angles

Design: F64

Properties:
- Through-beam ultrasonic barrier
- Cubical housing, material: PA
- Direct surface mounting without additional mounting angles
4. Electrical connections

Direct voltage sensors, 3-wire (Type E)

3-wire sensors have separate connections for the power supply and load. The load can be switched to positive (pnp) or negative (npn). They are protected against overload, short circuit and reversal of polarity. The residual current is negligible.

Sensors with analogue output

are direct-voltage sensors that provide an output signal proportional to the measured value. They also have separate connections for the power supply and load. The output signal is in the 0/4 mA ... 20 mA (current output) or 0/2 V ... 10V (voltage output) range. Additionally, they can feature switching or control outputs and are protected against overload, short circuit and reversal of polarity.

Sensors with external evaluation

are direct voltage sensors with a clock pulse input that issue a pulse for the echo time at a separate output connection. The time at which the echo pulse is output is proportional to the echo time. A separate back-end unit is required for these sensors (see data section).

Sensors with serial interface

are direct voltage sensors that feature connections for an RS 232 interface in addition to the supply connections. This interface can be used for parameterisation, as well as to read out the sensor. Additional analogue or switching outputs may also be present.

Sensors with parallel interface

are direct voltage sensors that feature connections for the parallel output of the measured distance in addition to the supply connections. They can also feature control inputs, outputs, or a serial interface. Due to the large number of connections, these sensors are available with cable connections only.

Three different connection types are used on Pepperl+Fuchs ultrasonic sensors:

Cable connection - The lengths, wire diameters and cable materials are stated in the individual data sheets. Sensors with cable connections do not have a supplementary designation in the type code.

Terminal compartment - The VariKont ® (U1 or U9) and FP types are equipped with a terminal compartment. The maximum diameter of the cable or cross section of the wires is stated in the data sheet.

Plug - The type of plug is stated under V... in the type code (see illustration).
## Parameterisation

### Overview of electrical connections

<table>
<thead>
<tr>
<th>Typical electrical data</th>
<th>Type</th>
<th>Switching output/Remarks</th>
<th>Standard symbol (selection)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3-wire</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated operating voltage</td>
<td>E0</td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td>10 V ... 30 V DC</td>
<td>E1</td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td>Output 100 mA/200 mA</td>
<td>E01</td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>E4</td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>E7</td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>E2</td>
<td>PNP</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>E3</td>
<td>PNP</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>E23</td>
<td>PNP</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>E5</td>
<td>PNP</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>E6</td>
<td>PNP</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Analogue</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated operating voltage</td>
<td>IU</td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td>10 V ... 30 V DC</td>
<td></td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td>Output 4 mA ... 20 mA</td>
<td></td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td>Output 0 V ... 10 V</td>
<td></td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Serial</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated operating voltage</td>
<td>R2</td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td>10 V ... 30 V DC</td>
<td></td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td>(RS)</td>
<td></td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Parallel</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated operating voltage</td>
<td>8B</td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td>20 V ... 30 V DC</td>
<td></td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>External evaluation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated operating voltage</td>
<td>H1</td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td>10 V ... 30 V DC</td>
<td>H2</td>
<td>NPN</td>
<td><img src="#" alt="Diagram" /></td>
</tr>
<tr>
<td>Emitter*</td>
<td></td>
<td><img src="#" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Emitter/receiver</td>
<td></td>
<td><img src="#" alt="Diagram" /></td>
<td></td>
</tr>
</tbody>
</table>

Note: The standard symbols shown here are examples. The types marked with * are not shown.
5. Parameterisation

Switching distances A1 and A2 or the lower and upper limits of the measuring window of ultrasonic sensors in direct-detection mode can be parameterised in a variety of ways depending on their type.

Coding switch in terminal compartment

The near and far switching distances (A1 or A2) are set in steps using 4 DIP switches each. The step size of the adjustable switching distances is determined by the sensor software. For the sensor in the following example, the switch combinations 0000 ... 1000 correspond to 150 mm and for 1001 ... 1111 to 200 mm.

Different steps may apply to other sensors with coding switches (see the technical data for the relevant sensor type).

The following types are equipped with coding switches in terminal compartment:
- UC500+U9+E6/E7+R2, UC500+U9+IUE2/IUE0+R2
- UC3000+U9+E6/E7+R2, UC3000+U9+IUE2/IUE0+R2
- UB1000+FP1+E6
- UC6000-FFP-E6/E7-R2-P5, UC6000-FFP-IUE2/IUE0-R2-P5

Example 1: UC3000+U9+E6+R2
(sensor with 2 switching outputs or RS 232 interface)

Example 2: UB1000+FP1+E6
(sensor with 2 switching outputs or 1 switching output and switching window)

Programming plug

The following ultrasonic sensors are equipped with a programming plug with an integrated temperature probe. The plug can be connected in four different positions:

<table>
<thead>
<tr>
<th>Near</th>
<th>Far</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>S2</td>
</tr>
<tr>
<td>S3</td>
<td>S4</td>
</tr>
<tr>
<td>S5</td>
<td>S6</td>
</tr>
<tr>
<td>S7</td>
<td>S8</td>
</tr>
<tr>
<td>A1/mm</td>
<td>A2/mm</td>
</tr>
<tr>
<td>0000</td>
<td>300</td>
</tr>
<tr>
<td>0101</td>
<td>600</td>
</tr>
<tr>
<td>1111</td>
<td>2900</td>
</tr>
</tbody>
</table>

(S9 = ON, normally open)

Table:

<table>
<thead>
<tr>
<th>Sensor Switching mode</th>
<th>Operating behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>Output 1</td>
</tr>
<tr>
<td>OFF</td>
<td>Output 2</td>
</tr>
</tbody>
</table>

Table:

<table>
<thead>
<tr>
<th>Coding plug</th>
<th>E2/E3</th>
<th>(K)</th>
<th>V1</th>
<th>V15</th>
</tr>
</thead>
<tbody>
<tr>
<td>G5P</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G5S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N5P</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N5S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IU</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>IU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The switching distances A1 and A2 of the evaluation (E2/E3), or the lower and upper limits of the measuring window are set using TEACH-IN.

<table>
<thead>
<tr>
<th>Position</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Distance A1 is taught (switching distance or measuring window limit)</td>
</tr>
<tr>
<td>A2</td>
<td>Distance A2 is taught (switching distance or measuring window limit)</td>
</tr>
<tr>
<td>E2/E3</td>
<td>E2: individual switching distances/falling analogue ramp</td>
</tr>
<tr>
<td></td>
<td>E3: window/rising analogue ramp</td>
</tr>
<tr>
<td>T</td>
<td>Temperature compensation is activated</td>
</tr>
</tbody>
</table>

The state is stored when the plug is removed. The taught-in switching distances and functions are retained when power is switched off.
## General information

### Switching outputs: types ...E6R2/E7R2

1. **Switch point mode**
   - When A1 < A2, both switch outputs are activated as N.O. contacts.

   | A1 (N.O.) | Switch output 1 |
   | A2 (N.O.) | Switch output 2 |

   | A1 (N.C.) | Switch output 1 |
   | A2 (N.C.) | Switch output 2 |

2. **Window mode**
   - To exchange the switching distances is of no effect.

   | A1 (N.O.) | Switch output 1 |
   | A2 (N.C.) | Switch output 2 |

3. **Hysteresis mode**
   - To exchange the switching distances is of no effect.

   | A1 (N.O.) | Switch output 1 |
   | A2 (N.C.) | Switch output 2 |

### Analogue output: types ...-IU and ...-IUR2

1. **Window mode, normally open function**
   - A1 < A2:

   | A1 < A2: | Switch output 1, (N.O.) |
   | A2 < A1: | Switch output 2, (N.C.) |

2. **One switch point, normally open function**
   - A1 -> ∞:

   | A1 -> ∞, A2 -> ∞: | Detection of object presence |

3. **One switch point, normally closed function**
   - A2 -> ∞:

   | A1 -> ∞, A2 -> ∞: | Detection of object presence |

4. **Window mode, normally closed function**
   - A2 < A1:

   | A1 < A2: | Switch output 1, (N.O.) |

5. **One switch point, normally closed function**
   - A2 -> ∞:

   | A1 < A2: | Switch output 1, (N.O.) |

### Programming units UB-PROG 2/UB-PROG 3

#### Ultrasonic sensor of the types:

<table>
<thead>
<tr>
<th>UB500</th>
<th>UB2000</th>
<th>UB4000</th>
<th>UB6000</th>
</tr>
</thead>
<tbody>
<tr>
<td>18GM75</td>
<td>30GM</td>
<td>F54</td>
<td>V15</td>
</tr>
</tbody>
</table>

permit the UB-PROG 2/UB-PROG 3 programming units to be inserted into the supply circuit. This permits the switching distances A1 and A2 or the evaluation limits to be programmed in an elegant manner (TEACH-IN). Each switching point/each evaluation limit has its own button.
Ultra 2001 PC service program (RS 232, bi-directional interface)

The Ultra 2001 application can be used to parameterise, and read out the parameters and measured values, of ultrasonic sensors with the designation ...R2 (RS) in their type code.

The sensors must be connected to a PC/notebook using the supplied interface cable. Ultra 2001 is running with WINDOWS™ 32-Bit systems (WINDOWS 95™ and higher) and features a modern user interface. The operation of the program is mouse-based.

UC-F43-R2 programming adapter

The UC-F43-R2 programming adapter is designed to be inserted between sensors of the -F43- series and the supply lead. A 9-pin cable socket with 1 m of cable permit the sensor to be connected to the RS 232 interface of a PC with ease. The usual wiring requirements become superfluous with the use of the programming adapter.

The PC service program Ultra 2001 can be used for the actual programming of ultrasonic sensors of the -F43- series.

UC-30GM-R2 programming adapter

The interface cable UC-30GM-R2 permits the parameterisation of ultrasonic sensors series UC...-30GM-..R2-V15 using the PC service program ULTRA 2001. This cable connects the PC-internal RS 232-interface to the program/temperature socket of the sensor. During the parameterisation procedure, the program/temperature plug is unplugged.

UC-FP/U9-R2 programming adapter

The interface cable UC-FP/U9-R2 permits the parameterisation of ultrasonic sensors series VariKont (U9) and FP, which are equipped with a serial interface, (marked with R2 or RS in model number). This cable connects the PC-internal RS 232-interface to the according terminal screws in the sensor base.

6. General information

Resolution

Pepperl+Fuchs ultrasonic sensors of the UC... series are equipped with an integrated 12-bit DA converter. A resolution of 12 bits corresponds to 4096 steps. The echo time of an ultrasonic packet is determined with a resolution of 1 µs (sensors without an RS 232 interface) or 1.085 µs (sensors with an RS 232 interface) due to the clocking of the microcontroller. This corresponds to a physical resolution of 0.172 mm or 0.186 mm. This maximum sensor resolution is available if the measuring window (the range between A1 and A2 or between the lower and upper limits) is less than or equal to

\[
4096 \times 0.172 \text{ mm} = 705 \text{ mm}
\]

or

\[
4096 \times 0.186 \text{ mm} = 762 \text{ mm}
\]

Up to this window size, the resolution is solely dependent on the clock rate of the microcontroller. The DA converter controls the sensor resolution if a larger measuring window is selected. It can then be calculated using the following formula:

\[
\frac{(A2 - A1)}{4096}
\]

or

\[
\frac{(\text{upper limit} - \text{lower limit})}{4096}
\]

Example:

A UC4000-30GM-IUR2-V1 sensor has been set up with the following parameters:

- Upper limit: 3500 mm
- Lower limit: 800 mm

In this application, the physical resolution of the sensor amounts to

\[
\frac{(3500 \text{ mm} - 800 \text{ mm})}{4096} = 0.66 \text{ mm}.
\]

Ultrasonic sensors with 8-bit parallel output resolve the measuring window in 256 steps. Their resolution can be calculated as follows:

\[
\frac{(\text{upper limit} - \text{lower limit})}{256}
\]

if the measuring window has been set to a size greater than 44 mm. For smaller measuring windows, the resolution is 0.172 mm. The resolution given in the data sheet is based on the largest possible measuring window.

Accuracy (conformity error)

To determine the absolute accuracy of the measured value of an ultrasonic sensor, factors such as

- temperature
- atmospheric pressure
- relative humidity
- turbulence
- hot spots in the air surrounding the sensor
- Sensor in hot operating mode status

must be taken into consideration.
7. Notes for installation and operation

Ultrasonic sensors can be installed and operated in any position. Avoid installation positions that may lead to impaired functioning due to deposits of dust or dirt. When cleaning ultrasonic sensors, take care not to damage the sensor surface (decoupling layer) or the integral foam in which the transducer is embedded. Water drops or the formation of crusts on the decoupling layer will lead to an impairment of the ultrasonic sensor's function. Light dust deposits are uncritical.

Actuation direction

The objects to be detected can enter the sound beam from any arbitrary direction. The sensor ranges and response curves in the data sheets represent the maximum object sensing ranges.

For objects moving radially, i.e. at right angles or any other angle lateral to the sound cone axis, refer to the response curve of the data sheet to determine the switching distance.

Deflection of the sound cone

The sound cone can be deflected with smooth, even reflectors. Do not deflect the signal more than twice, however, as the signal damping that occurs with each deflection will result in reduced range.
An exact alignment of the reflector surfaces is required. Pepperl+Fuchs offers 45° reflectors for some sensor types to achieve a deflection of 90°.

**Mutual interference**

To prevent mutual interference, observe the minimum distances between sensors of the same type shown in the following drawings.

The indicated values should be regarded as guidelines. They apply if the sound cones are aligned parallel to one another and the surfaces of the objects are at right angles to the axes of the sound cones. The actually required spacing \( X \) is dependent on alignment, the nature of the target objects to be detected, and local conditions related to other objects located in the sound cone.

In the event that objects with an unfavourable alignment are to be detected, a greater spacing \( X \) must be used.

### Synchronisation

Mutual interference of sensors with synchronisation inputs can be prevented effectively by synchronising the sensors. A distinction is made between synchronised and multiplex mode.

#### Multiplex mode

In this operating mode, the sensors are activated for a brief period, consecutively and in a cyclic manner. Please note that in this operating mode the cycle time \( T \) is extended by a factor of \( N \), in which \( N \) stands for the number of sensors in the multiplex mode.

\[
T_{\text{multiplex}} = N \times T_{\text{sensor}} \quad \text{and} \quad f_{\text{Sync}} = \frac{1}{T_{\text{multiplex}}}
\]

If sensors of different types are used, the total cycle time is equal to the sum of the cycle times of the individual sensors.

\[
T_{\text{multiplex}} = T_{\text{sensor} 1} + T_{\text{sensor} 2} + \cdots + T_{\text{sensor} N}
\]

If the self-synchronisation option is used, the sensors work in multiplex mode.

#### Synchronised mode

In this mode, the synchronisation inputs of all sensors are connected to one another and controlled together. Unlike multiplex mode, the cycle time does not increase. In addition to the monitoring of large areas, the synchronised mode is above all suitable for the reduction of the required minimum lateral spacing of sensors of the same type, and for the operation of opposed sensors of the same type.

In the case of opposed sensor installation, observe the distances specified below.

### Measuring plate/objects

Objects to be detected by ultrasonic sensors can be solid, liquid or in powder form. The properties of the object's surface are important for the echo to be evaluated by the sensor. All level and smooth surfaces arranged at a right angle to the sound cone, provide an ideal reflection. An angular deviation of the measuring plate by a maximum of 3° is permissible for reliable detection.
Material properties such as transparency, colour, or surface finish (polished or matte) have no effect on detection reliability. The roughness of the object's surface, together with the sensor-specific transducer frequency, determines whether the echo is reflected or diffused. The following table contains a listing of the transducer frequencies used in Pepperl+Fuchs ultrasonic sensors and the associated degrees of surface roughness for the reflection or diffusion of the sensor signal.

The following rule applies:
If the sound wavelength is longer than the peak-to-valley height of the surface roughness, the directional share of the reflection will predominate. If it is shorter than the peak-to-valley height, the diffuse share will predominate.

<table>
<thead>
<tr>
<th>Transducer frequency</th>
<th>Degree of object surface roughness for a predominantly directional reflection</th>
<th>Degree of object surface roughness for a predominantly diffuse reflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>65 kHz</td>
<td>&lt; 1 mm</td>
<td>&gt; 25 mm</td>
</tr>
<tr>
<td>85 kHz (90 kHz)</td>
<td>&lt; 0.8 mm</td>
<td>&gt; 20 mm</td>
</tr>
<tr>
<td>120 kHz (130 kHz)</td>
<td>&lt; 0.5 mm</td>
<td>&gt; 13 mm</td>
</tr>
<tr>
<td>175 kHz</td>
<td>&lt; 0.4 mm</td>
<td>&gt; 10 mm</td>
</tr>
<tr>
<td>375 kHz (400 kHz)</td>
<td>&lt; 0.2 mm</td>
<td>&gt; 5 mm</td>
</tr>
</tbody>
</table>

The transition from directional to diffuse reflection is continuous. Depths of roughness between the indicated values will result in reflections with diffuse and directional shares. Objects with great surface roughness will result in a reduction of the ultrasonic sensor's sensing range. Greater degrees of surface roughness permit greater deviations of the angle of incidence from the ideal position. The reason for this is the predominately diffuse reflection of the ultrasonic signal. As a result, filling levels or pouring cones of coarse-grained materials can be detected at an angular deviation of up to 45° (at a reduced sensing range).

If you have any questions pertaining to difficult applications, simply give us a call. Take advantage of our help and experience. Our service team will be pleased to be of assistance.

Our contact addresses, you can find at the rear catalogue cover or in the chapter "Pepperl+Fuchs GmbH worldwide" beginning at page 246.
Series -12GM

<table>
<thead>
<tr>
<th>Model number</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UB400-12GM-E5-V1</td>
<td>400 mm</td>
<td></td>
</tr>
<tr>
<td>UB400-12GM-I-V1</td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>UB400-12GM-U-V1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Technical Data

### Ultrasonic sensor

- **TEACH-IN input**
- Temperature compensation
- Analogue output 0 V ... 10 V
- Analogue output 4 mA ... 20 mA
- Switch output
- 5 different output functions can be set
- Measuring window adjustable

### Suitable connector cables, mounting aids and more, you can find in chapter "Accessories".

### Technical Data Table

<table>
<thead>
<tr>
<th>Model number</th>
<th>UB400-12GM-..-V1</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Series</th>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>-12GM</td>
<td>Sensing range</td>
<td>30 ... 400 mm</td>
</tr>
<tr>
<td>-18GM</td>
<td>Adjustment range</td>
<td>50 ... 400 mm</td>
</tr>
<tr>
<td>-18GM</td>
<td>Unusable area</td>
<td>0 ... 30 mm</td>
</tr>
<tr>
<td>-18GM</td>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>-18GM</td>
<td>Transducer frequency</td>
<td>approx. 310 kHz</td>
</tr>
<tr>
<td>-18GM</td>
<td>Response delay</td>
<td>approx. 50 ms</td>
</tr>
<tr>
<td>-18GM</td>
<td>LED yellow</td>
<td>permanently yellow: object in the evaluation range</td>
</tr>
<tr>
<td>-18GM</td>
<td></td>
<td>yellow, flashing: TEACH-IN function, object detected</td>
</tr>
<tr>
<td>-18GM</td>
<td></td>
<td>indication of the switching state</td>
</tr>
<tr>
<td>-18GM</td>
<td></td>
<td>flashing: TEACH-IN function, object detected</td>
</tr>
<tr>
<td>-18GM</td>
<td>LED red</td>
<td>permanently red: Error</td>
</tr>
<tr>
<td>-18GM</td>
<td>Operating voltage</td>
<td>10 ... 30 V DC, ripple 10 %SS</td>
</tr>
<tr>
<td>-18GM</td>
<td></td>
<td>15 ... 30 V DC, ripple 10 %SS</td>
</tr>
<tr>
<td>-18GM</td>
<td>No-load supply current</td>
<td>≤ 30 mA</td>
</tr>
<tr>
<td>-18GM</td>
<td>Output type</td>
<td>1 analogue output 0 ... 10 V</td>
</tr>
<tr>
<td>-18GM</td>
<td></td>
<td>1 analogue output 4 ... 20 mA, short-circuit overload protected</td>
</tr>
<tr>
<td>-18GM</td>
<td></td>
<td>1 switch output E5, prep NO/NC, parameterisable</td>
</tr>
<tr>
<td>-18GM</td>
<td>Resolution</td>
<td>0.17 mm</td>
</tr>
<tr>
<td>-18GM</td>
<td>Deviation of the characteristic curve</td>
<td>± 1 % of full-scale value</td>
</tr>
<tr>
<td>-18GM</td>
<td>Repeat accuracy</td>
<td>≤ 1 %</td>
</tr>
<tr>
<td>-18GM</td>
<td>Rated operational current</td>
<td>100 mA, short-circuit overload protected</td>
</tr>
<tr>
<td>-18GM</td>
<td>Voltage drop</td>
<td>≤ 3 V</td>
</tr>
<tr>
<td>-18GM</td>
<td>Switching frequency</td>
<td>≤ 8 Hz</td>
</tr>
<tr>
<td>-18GM</td>
<td>Range hysteresis</td>
<td>1 % of the set operating distance</td>
</tr>
<tr>
<td>-18GM</td>
<td>Load impedance</td>
<td>&gt; 1 kΩ</td>
</tr>
<tr>
<td>-18GM</td>
<td>Temperature influence</td>
<td>0 ... 300 Ohm</td>
</tr>
<tr>
<td>-18GM</td>
<td>Input type</td>
<td>1 TEACH-IN input</td>
</tr>
<tr>
<td>-18GM</td>
<td></td>
<td>operating distance 1: -U₀ ... +1 V, operating distance 2: +6 V ... +U₀</td>
</tr>
<tr>
<td>-18GM</td>
<td></td>
<td>input impedance: &gt; 47 kΩ, TEACH-IN pulse: ≥ 1 s</td>
</tr>
<tr>
<td>-18GM</td>
<td></td>
<td>lower evaluation limit A₁: -U₀ ... +1 V, upper evaluation limit A₂: +4 V ... +U₀</td>
</tr>
<tr>
<td>-18GM</td>
<td></td>
<td>input impedance: &gt; 47 kΩ, pulse duration: ≥ 1 s</td>
</tr>
<tr>
<td>-18GM</td>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>-18GM</td>
<td>Ambient temperature</td>
<td>-25 ... 70 °C (248 ... 343 K)</td>
</tr>
<tr>
<td>-18GM</td>
<td>Storage temperature</td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td>-18GM</td>
<td>Protection degree</td>
<td>IP65</td>
</tr>
<tr>
<td>-18GM</td>
<td>Connection</td>
<td>VT connector (M12 x 1), 4-pin</td>
</tr>
<tr>
<td>-18GM</td>
<td>Housing</td>
<td>brass, nickel-plated</td>
</tr>
<tr>
<td>-18GM</td>
<td>Transducer</td>
<td>epoxy resin/hollow glass sphere mixture; foam polyurethane, cover PBT</td>
</tr>
<tr>
<td>-18GM</td>
<td>Mass</td>
<td>25 g</td>
</tr>
</tbody>
</table>

Subject to reasonable modifications due to technical advances.

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Date of edition: 08/18/2005

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
### Programmed switching output function

1. Window mode, normally open function
   
   \[ A_1 < A_2: \]
   
   \[ \text{object range} \]

2. Window mode, normally closed function
   
   \[ A_2 < A_1: \]
   
   \[ \text{object range} \]

3. One switch point, normally open function
   
   \[ A_1 \to \infty: \]
   
   \[ A_2 \]

4. One switch point, normally closed function
   
   \[ A_2 \to \infty: \]
   
   \[ A_1 \]

5. A1 \to \infty, A2 \to \infty: Detection of object presence
   
   Object detected: Switch output closed
   
   No object detected: Switch output open

### Programmed analogue output function

- Rising ramp
  
  \[ A_1 < A_2: \]

- Falling ramp
  
  \[ A_2 < A_1: \]

### Characteristic response curve

- Curve 1: flat surface 100 mm x 100 mm
- Curve 2: round bar, D 25 mm

### Technical Specification

- Torque: max. 10 Nm
- LED: 17
- M12x1: 6
- M12x1: 8

### Accessories

Core colours in accordance with EN 60947-5-2.

### Edition Information

Date of edition: 08/18/2005
### Output version E5:

**Adjusting the switching points**

The ultrasonic sensor features a switch output with two teachable switching points. These are set by applying the supply voltage -U_B or +U_B to the TEACH-IN input. The supply voltage must be applied to the TEACH-IN input for at least 1 s. LEDs indicate whether the sensor has recognised the target during the TEACH-IN procedure. Switching point A1 is taught with -U_B, A2 with +U_B.

Five different output functions can be set:

1. Window mode, normally-open function
2. Window mode, normally-closed function
3. One switching point, normally-open function
4. One switching point, normally-closed function
5. Detection of object presence

**TEACH-IN window mode, normally-open function**

- Set target to near switching point
- TEACH-IN switching point A1 with -U_B
- Set target to far switching point
- TEACH-IN switching point A2 with +U_B

**TEACH-IN window mode, normally-closed function**

- Set target to near switching point
- TEACH-IN switching point A1 with -U_B
- Set target to far switching point
- TEACH-IN switching point A2 with +U_B

**TEACH-IN switching point, normally-open function**

- Set target to near switching point
- TEACH-IN switching point A2 with +U_B
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A1 with -U_B

**TEACH-IN switching point, normally-closed function**

- Set target to near switching point
- TEACH-IN switching point A1 with -U_B
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A2 with +U_B

**TEACH-IN detection of objects presence**

- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A1 with -U_B
- TEACH-IN switching point A2 with +U_B

**Default setting of switching points**

A1 = blind range, A2 = nominal distance

### LED Displays

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Red LED</th>
<th>Yellow LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN switching point:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object detected</td>
<td>off</td>
<td>flashes</td>
</tr>
<tr>
<td>No object detected</td>
<td>flashes</td>
<td>off</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td>On</td>
<td>off</td>
</tr>
<tr>
<td>Normal operation</td>
<td>off</td>
<td>Switching state</td>
</tr>
<tr>
<td>Fault</td>
<td>on</td>
<td>Previous state</td>
</tr>
</tbody>
</table>
Output versions -I and -U:

Adjusting the evaluation limits

The ultrasonic sensor features an analogue output with two teachable evaluation limits. These are set by applying the supply voltage \(-U_B\) or \(+U_B\) to the TEACH-IN input. The supply voltage must be applied to the TEACH-IN input for at least 1 s. LEDs indicate whether the sensor has recognised the target during the TEACH-IN procedure. The lower evaluation limit A1 is taught with \(-U_B\), A2 with \(+U_B\).

Two different output functions can be set:
1. Analogue value increases with rising distance to object (rising ramp)
2. Analogue value falls with rising distance to object (falling ramp)

TEACH-IN rising ramp (A2 > A1):
- Position object at lower evaluation limit
- TEACH-IN lower limit A1 with \(-U_B\)
- Position object at upper evaluation limit
- TEACH-IN upper limit A2 with \(+U_B\)

TEACH-IN falling ramp (A1 > A2):
- Position object at lower evaluation limit
- TEACH-IN lower limit A2 with \(+U_B\)
- Position object at upper evaluation limit
- TEACH-IN upper limit A1 with \(-U_B\)

Default setting

A1: unusable area
A2: nominal sensing range

Mode of operation: rising ramp

LED Displays

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Red LED</th>
<th>Yellow LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN evaluation limit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object detected</td>
<td>off</td>
<td>flashes</td>
</tr>
<tr>
<td>No object detected</td>
<td>flashes</td>
<td>off</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Normal mode (evaluation range)</td>
<td>off</td>
<td>on</td>
</tr>
<tr>
<td>Fault</td>
<td>on</td>
<td>previous state</td>
</tr>
</tbody>
</table>

Default setting

A1: unusable area
A2: nominal sensing range

Mode of operation: rising ramp

LED Displays

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Red LED</th>
<th>Yellow LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN evaluation limit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object detected</td>
<td>off</td>
<td>flashes</td>
</tr>
<tr>
<td>No object detected</td>
<td>flashes</td>
<td>off</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Normal mode (evaluation range)</td>
<td>off</td>
<td>on</td>
</tr>
<tr>
<td>Fault</td>
<td>on</td>
<td>previous state</td>
</tr>
<tr>
<td>Series</td>
<td>Sensor function description</td>
<td></td>
</tr>
<tr>
<td>----------</td>
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<tr>
<td>-12GM</td>
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<td>-18GK/-18GM</td>
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<td>-30GM</td>
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<td>-F64</td>
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<td>-D1</td>
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<td>Double sheet monitoring</td>
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<tr>
<td>Control units/Power supplies</td>
<td></td>
<td></td>
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<tr>
<td>Accessories</td>
<td></td>
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## Series -18GK/-18GM

<table>
<thead>
<tr>
<th>Model number</th>
<th>Detection range</th>
<th>Page</th>
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<tbody>
<tr>
<td>UBE500-18GK-SE0-V1</td>
<td>500 mm</td>
<td>34</td>
</tr>
<tr>
<td>UBE500-18GK-SE2-V1</td>
<td></td>
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</tr>
<tr>
<td>UBE1000-18GM40-SE2-V1</td>
<td>1000 mm</td>
<td>36</td>
</tr>
<tr>
<td>UB300-18GM40-E5-V1</td>
<td>300 mm</td>
<td>38</td>
</tr>
<tr>
<td>UB300-18GM40-I-V1</td>
<td></td>
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</tr>
<tr>
<td>UB300-18GM40-U-V1</td>
<td>800 mm</td>
<td>40</td>
</tr>
<tr>
<td>UB800-18GM40-E5-V1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB800-18GM40-I-V1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB800-18GM40-U-V1</td>
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<td></td>
</tr>
<tr>
<td>UB300-18GM40A-E5-V1</td>
<td>300 mm</td>
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<td>UB300-18GM40A-I-V1</td>
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<td>UB300-18GM40A-U-V1</td>
<td>800 mm</td>
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<tr>
<td>UB800-18GM40A-E5-V1</td>
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</tr>
<tr>
<td>UB800-18GM40A-I-V1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB800-18GM40A-U-V1</td>
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<td></td>
</tr>
<tr>
<td>UB500-18GM75-E4-V15</td>
<td>500 mm</td>
<td>46</td>
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<tr>
<td>UB500-18GM75-E5-V15</td>
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</tr>
<tr>
<td>UB500-18GM75-I-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB500-18GM75-U-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB500-18GM75-E01-V15</td>
<td>500 mm</td>
<td>48</td>
</tr>
<tr>
<td>UB500-18GM75-E23-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB500-18GM75-E6-V15</td>
<td></td>
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<tr>
<td>UB500-18GM75-E7-V15</td>
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</tr>
<tr>
<td>UB500-18GM75-F-V15</td>
<td>500 mm</td>
<td>50</td>
</tr>
<tr>
<td>UB500-18GM75-BIT-V15</td>
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<td></td>
</tr>
<tr>
<td>UB500-18GM75-PWM-V15</td>
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<td></td>
</tr>
<tr>
<td>UB1000-18GM75-E4-V15</td>
<td>1000 mm</td>
<td>52</td>
</tr>
<tr>
<td>UB1000-18GM75-E5-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB1000-18GM75-I-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB1000-18GM75-U-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB1000-18GM75-E01-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB1000-18GM75-E23-V15</td>
<td>1000 mm</td>
<td></td>
</tr>
<tr>
<td>UB1000-18GM75-E6-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB1000-18GM75-E7-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB1000-18GM75-F-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB1000-18GM75-BIT-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB1000-18GM75-PWM-V15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For detailed function description, see page 54

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For detailed function description, see page 54

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### Through-beam ultrasonic barrier

**UBE500-18GK-...-V1**

- **High switching frequency**
- **Small, compact design**
- **Plastic housing**
- **Suited for applications for detection and counting of transparent objects** *(e.g. bottles and plastic-wrapping)*
- **Emitter and receiver included in the delivery package**

#### Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"

### Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UBE500-18GK-...-V1</th>
</tr>
</thead>
</table>

| Sensing range            | 0 ... 500 mm, distance emitter-receiver 15 mm ... 500 mm |
| Transducer frequency    | 400 kHz |
| LED yellow              | Indication of the switching state (receiver) |
| Operating voltage       | 18 ... 30 V DC, ripple ≤ 10 % (SS) |
| No-load supply current  | 20 mA receiver |
| Output type             | 1 switch output E0, npn NO |
| Rated operational current | 200 mA |
| Voltage drop            | ≤ 1.5 V |
| Switching frequency     | 100 Hz |
| Standards               | EN 60947-5-2 |
| Ambient temperature     | 0 ... 60°C (273 ... 333 K) |
| Storage temperature     | -40 ... 85°C (233 ... 358 K) |
| Protection degree       | IP65 |
| Connection              | V1 connector (M12 x 1), 4-pin |
| Housing                 | Polyamide (PA) |
| Mass                    | 50 g |

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---

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories".
Electrical connection

Standard symbol / Connection:

Receiver E2:

```
<table>
<thead>
<tr>
<th></th>
<th>1 (BN)</th>
<th>+U_k</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>(BK)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>(BU)</td>
<td>-U_k</td>
</tr>
</tbody>
</table>
```

Receiver E0:

```
<table>
<thead>
<tr>
<th></th>
<th>1 (BN)</th>
<th>+U_k</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>(BK)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>(BU)</td>
<td>-U_k</td>
</tr>
</tbody>
</table>
```

Emitter:

```
<table>
<thead>
<tr>
<th></th>
<th>1 (BN)</th>
<th>+U_k</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>(BU)</td>
<td>-U_k</td>
</tr>
</tbody>
</table>
```

Core colours in accordance with EN 60947-5-2.

Diagrams

Characteristic response curves

Mounting/Adjustment

- Parallel displacement: A ≤ 8 mm
- Angle displacement: α ≤ 5°

Thin foil detection

- Detection angle: ≥ 10°
**Ultrasonic sensor**

![Image of ultrasonic sensor]

- Short design, 40 mm
- Function indicators visible from all directions
- Switch output
- TEACH-IN input
- Integrated alignment aid

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories".

<table>
<thead>
<tr>
<th>Technical Data</th>
<th>UBE1000-18GM40-SE2-V1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model number</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Sensing range</strong></td>
<td>20 ... 1000 mm</td>
</tr>
<tr>
<td><strong>Standard target plate</strong></td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td><strong>Transducer frequency</strong></td>
<td>approx. 260 kHz</td>
</tr>
<tr>
<td><strong>LED yellow</strong></td>
<td>switched state</td>
</tr>
<tr>
<td><strong>LED red</strong></td>
<td>error, object uncertain</td>
</tr>
<tr>
<td><strong>LED green</strong></td>
<td>Power on</td>
</tr>
<tr>
<td><strong>Operating voltage</strong></td>
<td>10 ... 30 V DC, ripple 10 %&lt;sub&gt;ss&lt;/sub&gt;</td>
</tr>
<tr>
<td><strong>No load supply current</strong></td>
<td>≤ 20 mA</td>
</tr>
<tr>
<td><strong>Output type</strong></td>
<td>NO pnp</td>
</tr>
<tr>
<td><strong>Rated operational current</strong></td>
<td>200 mA, short-circuit overload protected</td>
</tr>
<tr>
<td><strong>Voltage drop</strong></td>
<td>≤ 3 V</td>
</tr>
<tr>
<td><strong>Switching frequency</strong></td>
<td>≤ 100 Hz</td>
</tr>
<tr>
<td><strong>Switch-on delay</strong></td>
<td>&lt; 5 ms</td>
</tr>
<tr>
<td><strong>Input type</strong></td>
<td>1 TEACH-IN input</td>
</tr>
<tr>
<td></td>
<td>operating distance 1: -U&lt;sub&gt;B&lt;/sub&gt; ... +1 V, operating distance 2: +6 V ... +U&lt;sub&gt;B&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>input impedance: &gt; 4.7 kΩ, TEACH-IN pulse: ≥ 1 s</td>
</tr>
<tr>
<td><strong>Standards</strong></td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>-25 ... 70 °C (248 ... 343 K)</td>
</tr>
<tr>
<td><strong>Storage temperature</strong></td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td><strong>Protection degree</strong></td>
<td>IP65</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>VT connector (M12 x 1), 4-pin</td>
</tr>
<tr>
<td><strong>Housing</strong></td>
<td>brass, nickel-plated</td>
</tr>
<tr>
<td><strong>Transducer</strong></td>
<td>epoxy resin/hollow glass sphere mixture; foam polyurethane, cover PBT</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>25 g</td>
</tr>
</tbody>
</table>

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**Dimensions**

UBE1000-18GM40-SE2-V1

---

**Electrical connection**

Standard symbol/Connection:
(version E2, prep)

Receiver:

1. (BN)  +UB
2. (WHS)  Teaching input
3. (BK)  Switching output
4.  -UB

Emitter:

1. (BN)  +UB
2. (WHS)  Test input
3. (BK)  n.c.
4.  -UB

Core colours in accordance with EN 60947-5-2.

---

**Diagrams**

**Characteristic response curve**

<table>
<thead>
<tr>
<th>Distance X [mm]</th>
<th>Distance Y [mm]</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
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<tr>
<td>200</td>
<td>10</td>
</tr>
<tr>
<td>400</td>
<td>5</td>
</tr>
<tr>
<td>600</td>
<td>0</td>
</tr>
<tr>
<td>800</td>
<td>-5</td>
</tr>
<tr>
<td>1000</td>
<td>-10</td>
</tr>
</tbody>
</table>

Obstacle: flat plate 100 mm x 100 mm

---

**Obstacle size**

<table>
<thead>
<tr>
<th>min. obstacle size d [mm]</th>
<th>distance X [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>200</td>
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<tr>
<td>60</td>
<td>400</td>
</tr>
<tr>
<td>80</td>
<td>600</td>
</tr>
<tr>
<td>100</td>
<td>800</td>
</tr>
</tbody>
</table>

---

Date of edition: 08/18/2005

---
Ultrasonic sensor UB...-18GM40-..-V1

- Short design, 40 mm
- Function indicators visible from all directions
- TEACH-IN input
- Temperature compensation
- Measuring window adjustable
- TEACH-IN function
- 5 different output functions can be set

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"

### Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Model number</th>
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<tbody>
<tr>
<td>Sensing range</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Uns usable area</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Response delay</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>LED yellow</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Output type</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Resolution</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Deviation of the characteristic curve</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td>UB...-18GM40-..-V1</td>
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<tr>
<td>Rated operational current</td>
<td>UB...-18GM40-..-V1</td>
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<tr>
<td>Voltage drop</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>UB...-18GM40-..-V1</td>
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<tr>
<td>Range hysteresis</td>
<td>UB...-18GM40-..-V1</td>
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<tr>
<td>Load impedance</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>UB...-18GM40-..-V1</td>
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<tr>
<td>Input type</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Standards</td>
<td>UB...-18GM40-..-V1</td>
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<tr>
<td>Ambient temperature</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>UB...-18GM40-..-V1</td>
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<tr>
<td>Protection degree</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Housing</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Transducer</td>
<td>UB...-18GM40-..-V1</td>
</tr>
<tr>
<td>Mass</td>
<td>UB...-18GM40-..-V1</td>
</tr>
</tbody>
</table>

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Date of edition: 08/18/2005
Dimensions

Electrical connection

Standard symbol/Connections:
(version I)

U
L(BN) + Uo
L(WH)
L(BC)
L(BL)
Teach input
Analogue output

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:
(version U)

U
L(BN) + Uo
L(WH)
L(BC)
L(BL)
Teach input
Analogue output

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:
(version E5, pnp)

U
L(BN) + Uo
L(WH)
L(BC)
L(BL)
Switch output

Core colours in accordance with EN 60947-5-2.

Programmed switching output function

1. Window mode, normally open function
A1 < A2:

2. Window mode, normally closed function
A2 < A1:

3. One switch point, normally open function
A1 → ∞:

4. One switch point, normally closed function
A2 → ∞:

5. A1 → ∞, A2 → ∞ — Detection of object presence
Object detected: Switch output closed
No object detected: Switch output open

Programmed analogue output function

Rising ramp
A1 < A2:

Falling ramp
A2 < A1:

Characteristics response curve

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Distance X [mm]
0 50 100 150 200 250 300 350 400 450 500

Distance Y [mm]
0 100 200 300 400 500

Characteristics response curve

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Distance X [mm]
0 200 400 600 800 1000 1200 1400

Distance Y [mm]
0 200 150 100 50 0 -50 -100 -150 -200

Date of edition: 08/18/2005

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:
(version U)

U
L(BN) + Uo
L(WH)
L(BC)
L(BL)
Teach input
Analogue output

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:
(version E5, pnp)

U
L(BN) + Uo
L(WH)
L(BC)
L(BL)
Switch output

Core colours in accordance with EN 60947-5-2.
### Technical Data

**Model number**

<table>
<thead>
<tr>
<th>Series</th>
<th>Model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>18GM</td>
<td>UB300-18GM40A-E5-V1</td>
</tr>
<tr>
<td>18GM</td>
<td>UB800-18GM40A-I-V1</td>
</tr>
<tr>
<td>18GM</td>
<td>UB800-18GM40A-U-V1</td>
</tr>
<tr>
<td>18GM</td>
<td>UB800-18GM40A-U-V1</td>
</tr>
<tr>
<td>18GM</td>
<td>UB800-18GM40A-U-V1</td>
</tr>
</tbody>
</table>

**Sensing range**

- 0...10 mm
- 0...100 mm
- 0...30 mm
- 0...800 mm

**Adjustment range**

- 0...10 mm
- 0...100 mm
- 0...30 mm
- 0...800 mm

**Unusable area**

- 0...30 mm
- 0...50 mm

**Standard target plate**

- 100 mm x 100 mm

**Transducer frequency**

- approx. 205 kHz
- approx. 300 kHz

**Response delay**

- approx. 100 ms
- approx. 30 ms

**LED yellow**

- permanently yellow: object in the evaluation range, yellow flashing: TEACH-IN function, object detected

**LED red**

- permanently red: Error, red, flashing: TEACH-IN function, object not detected

**Operating voltage**

- 15...30 V DC, ripple 10% SS

**No-load supply current**

- ≤ 20 mA

**Output type**

- 1 analogue output 0...10 V
- 1 analogue output 4...20 mA, short-circuit/load protected
- 1 switch output E5, npn N/O, parameterisable

**Default setting**

- Evaluation limit 1: 50 mm evaluation limit 2: 300 mm
- Evaluation limit 1: 70 mm evaluation limit 2: 800 mm
- Switch point A1: 50 mm Switch point A2: 300 mm
- Switch point A1: 70 mm Switch point A2: 800 mm

**Resolution**

- 0.4 mm at max. sensing range
- Deviation of the characteristic curve

- ± 1 % of full-scale value
- ± 0.5 % of full-scale value

**Repeatability**

- ± 1 %
- ± 0.5 % of full-scale value

**Rated operational current**

- 200 mA, short-circuit/load protected

**Voltage drop**

- ≤ 3 V

**Switching frequency**

- ≤ 13 Hz
- ≤ 4 Hz

**Range hysteresis**

- 1 % of the set operating distance

**Load impedance**

- > 1 kOhm
- 0...300 Ohm

**Temperature influence**

- ± 1.5 % of full-scale value

**Input type**

- 1 TEACH-IN input

**Input impedance**

- TEACH-IN pulse: ≥ 1 s
- TEACH-IN input

**Standards**

- EN 60947-5-2
- Storage temperature: -40...+60 °C (231...149 K)
- Ambient temperature: -25...+70 °C (248...343 K)
- Protection degree: IP66
- Connection: V1 connector (M12 x 1), 4-pin
- Housing: brass, nickel-plated
- Transducer: epoxy resin/hollow glass sphere mixture, foam polyurethane, cover PBT
- Mass: 25 g

5 different output functions can be set:
- 1 switch output E5, npn N/O, parameterisable
- 1 analogue output 4 mA...20 mA, short-circuit/load protected
- LED red

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories."
**Dimensions**

UB...-18GM40A-.-V1

**Electrical connection**

Standard symbol/Connections:
(version I)

- **U**
- **L** (BN)
- **E** (WH)
- **J** (BK)
- **J** (RU)

Teach input
Analog output

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:
(version U)

- **U**
- **L** (BN)
- **E** (WH)
- **J** (BK)
- **J** (RU)

Teach input
Analog output

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:
(version E5, pnp)

- **U**
- **L** (BN)
- **E** (WH)
- **J** (BK)
- **J** (RU)

Teach input
Analog output

Core colours in accordance with EN 60947-5-2.

**Programmed switching output function**

1. Window mode, normally open function
   - **A1** < **A2**

2. Window mode, normally closed function
   - **A2** < **A1**

3. One switch point, normally open function
   - **A1** → ∞

4. One switch point, normally closed function
   - **A2** → ∞

5. **A1** → ∞, **A2** → ∞: Detection of object presence
   - Object detected: Switch output closed
   - No object detected: Switch output open

**Programmed analogue output function**

- **R**ising ramp
  - **A1** < **A2**

- **F**alling ramp
  - **A2** < **A1**

**Diagrams**

**Characteristic response curve**

- **Distance X [mm]**
- **Distance Y [mm]**

**Curve 1**: flat surface 100 mm x 100 mm

**Curve 2**: round bar, Ø 25 mm

**Programmed switching output function**

- **A1** < **A2**
- **A2** < **A1**
- **A1** → ∞
- **A2** → ∞

**Programmed analogue output function**

- **A1** < **A2**
- **A1** < **A2**
- **A1** → ∞
- **A2** → ∞

**Double sheet monitoring**

- **Control units/** Power supplies
- **Accessories**

**Date of edition**: 08/18/2005

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
### Technical Data

#### Sensor Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UB500-18GM75-..-V15</th>
</tr>
</thead>
</table>

#### Sensing Range
- **Sensing range**: 30 ... 500 mm
- **Adjustment range**: 50 ... 500 mm
- **Unusable area**: 0 ... 30 mm
- **Standard target plate**: 100 mm x 100 mm
- **Response delay**: approx. 50 ms

#### LED Indications
- **LED yellow**: permanently yellow: object in the evaluation range, yellow, flashing: TEACH-IN function, object detected
- **LED red**: permanent red: Error, red, flashing: TEACH-IN function, object not detected

#### Operating Voltage
- **Operating voltage**: 10 ... 30 V DC , ripple 10 %
- **Rated voltage**: 15 ... 30 V DC , ripple 10 %

#### No-load Supply Current
- **No-load supply current**: ≤ 45 mA
- **Rated current**: ≤ 50 mA

#### Output Type
- **Output type**: 1 analogue output 0 ... 10 V
- **Other options**: 1 analogue output 4 ... 20 mA, 1 switch output E4, npn NO/NC, parameterisable, 1 switch output E5, npn NO/NC, parameterisable

#### Resolution
- **Resolution**: 0,11 mm at max. sensing range
- **Max. detection range**: 0,13 mm

#### Deviation of the Characteristic Curve
- **Deviation**: ± 1 % of full-scale value

#### Repeat Accuracy
- **Accuracy**: ± 0,1 % of full-scale value

#### Rated Operational Current
- **Rated current**: ≤ 200 mA, short-circuit overload protected

#### Power Consumption
- **Load current**: ≤ 1 kOhm
- **Temperature influence**: ≤ 0,03 %/deg C in full-scale range

#### Input Type
- **Input type**: 1 TEACH-IN input, operating range 1: -U_U4 ... +1 V, operating range 2: +4 V ... +U_U4
- **Input impedance**: > 12 kΩ, TEACH-IN pulse: ≥ 1 s

#### Synchronisation
- **Synchronisation**: 1 synchronous connection, bi-directional
- **Common mode operation**: ≤ 95 Hz
- **Multi-pulse operation**: ≤ 95 Hz, n = number of sensors

#### Environment
- **Temperature**: -25 ... 70 °C (223 ... 338 K)
- **Storage temperature**: -40 ... 85 °C (233 ... 358 K)

#### Protection
- **Protection degree**: IP65

#### Accessories
- **Connection**: connector V15 (M12 x 1), 5 pin
- **Mass**: 60 g

---

**Suitable connector cables, mounting aids and more, you can find in chapter “Accessories”**

---

**Technical Data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>30 ... 500 mm</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>50 ... 500 mm</td>
</tr>
<tr>
<td>Unusable area</td>
<td>0 ... 30 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Response delay</td>
<td>approx. 50 ms</td>
</tr>
<tr>
<td>LED yellow indication</td>
<td>permanently yellow: object in the evaluation range, yellow, flashing: TEACH-IN function, object detected</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 ... 30 V DC , ripple 10 %</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>≤ 45 mA</td>
</tr>
<tr>
<td>Output type</td>
<td>1 analogue output 0 ... 10 V</td>
</tr>
<tr>
<td>Resolution</td>
<td>0,11 mm at max. sensing range</td>
</tr>
<tr>
<td>Deviation of the characteristic curve</td>
<td>± 1 % of full-scale value</td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td>± 0,1 % of full-scale value</td>
</tr>
<tr>
<td>Rated current</td>
<td>≤ 200 mA, short-circuit overload protected</td>
</tr>
<tr>
<td>Power consumption</td>
<td>≤ 1 kOhm</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>≤ 0,03 %/deg C in full-scale range</td>
</tr>
<tr>
<td>Input type</td>
<td>1 TEACH-IN input, operating range 1: -U_U4 ... +1 V, operating range 2: +4 V ... +U_U4</td>
</tr>
<tr>
<td>Synchronisation</td>
<td>1 synchronous connection, bi-directional</td>
</tr>
<tr>
<td>Common mode operation</td>
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</tr>
<tr>
<td>Multi-pulse operation</td>
<td>≤ 95 Hz, n = number of sensors</td>
</tr>
<tr>
<td>Temperature</td>
<td>-25 ... 70 °C (223 ... 338 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
</tr>
<tr>
<td>Connection</td>
<td>connector V15 (M12 x 1), 5 pin</td>
</tr>
<tr>
<td>Mass</td>
<td>60 g</td>
</tr>
</tbody>
</table>
### Electrical connection

**Standard symbol/Connections:**
- **(version E4, npn)**
  - 1. (BN): Switch output
  - 2. (WH): Teaching input
  - 3. (GY): Synchronous
  - 4. (BU): U_B

Core colours in accordance with EN 60947-5-2.

**Standard symbol/Connections:**
- **(version E5, npn)**
  - 1. (BN): U_B
  - 2. (WH): Teaching input
  - 3. (GY): Synchronous
  - 4. (BU): Switch output

Core colours in accordance with EN 60947-5-2.

**Standard symbol/Connections:**
- **(version U)**
  - 1. (BN): U_B
  - 2. (WH): Teaching input
  - 3. (GY): Synchronous
  - 4. (BU): Analog output

Core colours in accordance with EN 60947-5-2.

### Diagrams

**Characteristic response curve**

- Flat surface 100 mm x 100 mm
- Round bar, Ø 25 mm

#### Programmed switching output function
1. Window mode, normally open function
   - A1 < A2: object range
   - A2 -> ∞:

2. Window mode, normally closed function
   - A2 < A1: object range
   - A1 -> ∞:

3. One switch point, normally open function
   - A1 -> ∞:

4. One switch point, normally closed function
   - A2 -> ∞:

5. A1 -> ∞, A2 -> ∞: Detection of object presence
   - Object detected: Switch output closed
   - No object detected: Switch output open

### Programmed analogue output function

- Rising ramp
  - A1 < A2: object range

- Falling ramp
  - A2 < A1: object range

**output versions -E4 and -E5**

**output versions -I and -U**
## Technical Data

### Sensing range
- 30 ... 500 mm

### Adjustment range
- 50 ... 500 mm

### Unusable area
- 0 ... 30 mm

### Standard target plate
- 100 mm x 100 mm

### Transducer frequency
- approx. 380 kHz

### Response delay
- approx. 50 ms

### LED yellow
- Indication of the switching state
  - Flashing: TEACH-IN function object detected

### LED red
- "Error", object uncertain
  - In TEACH-IN function: No object detected

### Operating voltage
- 10 ... 30 V DC, ripple 10 %SS

### No-load supply current
- ≤ 50 mA

### Output type
- 2 switch outputs npn, NO/NC, parameterisable
- 2 switch outputs pnp, NO/NC, parameterisable

### Repeat accuracy
- ≤ 1 %

### Rated operational current
- 2 x 100 mA, short-circuit overload protected

### Voltage drop
- ≤ 3 V

### Switching frequency
- max. 8 Hz

### Range hysteresis
- 1 % of the set operating distance

### Temperature influence
- ± 15 % of full-scale value

### Input type
- 1 TEACH-IN input:
  - Operating range 1: -U₀ − +1 V, operating range 2: +4 V ... +U₀
  - Input impedance: > 4.7 kΩ, TEACH-IN pulse: ≥ 1 s

### Standards
- EN 50847-5-2
- Ambient temperature: -25 ... 70 °C (248 ... 343 K)
- Storage temperature: -40 ... 85 °C (238 ... 358 K)
- Protection degree: IP68

### Connection
- Connector V15 (M12 x 1), 5 pin

### Housing
- Brass, nickel-plated

### Transducer
- Epoxy resin/hollow glass sphere mixture; foam polyurethane, cover PBT

### Mass
- 60 g

---

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Date of edition: 08/18/2005
### Electrical connection

**Standard symbol/Connections:**

<table>
<thead>
<tr>
<th>Version</th>
<th>Switch output 1</th>
<th>Switch output 2</th>
<th>Teaching input</th>
</tr>
</thead>
<tbody>
<tr>
<td>E7 (nPN)</td>
<td>U_2</td>
<td>U_1</td>
<td>U_5</td>
</tr>
<tr>
<td>E6 (pNP)</td>
<td>U_1</td>
<td>U_2</td>
<td>U_5</td>
</tr>
<tr>
<td>E01 (nPN)</td>
<td>U_5</td>
<td>U_2</td>
<td>U_1</td>
</tr>
<tr>
<td>E23 (pNP)</td>
<td>U_5</td>
<td>U_1</td>
<td>U_2</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

### Diagrams

#### Characteristic response curve

**Programmed switching output function**

1. Switch point 1: Switch point 2

   - Switch output 1 (N.O.)
   - Object range

2. Switch point 2: Switch point 1

   - Switch output 2 (N.C.)
   - Object range

3. Switch point 1 a. 2

   - Both switch outputs (N.O.)
   - Detection of object presence

Output versions -E6 and -E7

**Programmed switching output function**

1. Switch point 1: Switch point 2

   - Switch output 1 (N.O.)
   - Object range

2. Switch point 2: Switch point 1

   - Switch output 2 (N.C.)
   - Detection of object presence

3. Switch point 1 a. 2

   - Both switch outputs (N.O.)
   - Detection of object presence

Output versions -E01 and -E23
**Technical Data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensing range</strong></td>
<td>30 ... 500 mm</td>
</tr>
<tr>
<td><strong>Unusable area</strong></td>
<td>0 ... 30 mm</td>
</tr>
<tr>
<td><strong>Standard target plate</strong></td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td><strong>Transducer frequency</strong></td>
<td>approx. 380 kHz</td>
</tr>
<tr>
<td><strong>Response delay</strong></td>
<td>approx. 50 ms</td>
</tr>
<tr>
<td><strong>LED red</strong></td>
<td>flashing error (permanent: no object detected)</td>
</tr>
<tr>
<td><strong>Operating voltage</strong></td>
<td>10 ... 30 V DC, ripple 10 %&lt;sub&gt;SS&lt;/sub&gt;</td>
</tr>
<tr>
<td><strong>No-load supply current</strong></td>
<td>≤ 50 mA</td>
</tr>
<tr>
<td><strong>Output type</strong></td>
<td>1 frequency output, push/pull, parameterisable</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>1 mm</td>
</tr>
<tr>
<td><strong>Deviation of the characteristic curve</strong></td>
<td>± 1 % of full-scale value</td>
</tr>
<tr>
<td><strong>Repeat accuracy</strong></td>
<td>± 0.5 % of full-scale value</td>
</tr>
<tr>
<td><strong>Load impedance</strong></td>
<td>&gt; 1000 Ohm &lt; 100 kΩ</td>
</tr>
<tr>
<td><strong>Temperature influence</strong></td>
<td>± 1.5 % of full-scale value</td>
</tr>
<tr>
<td><strong>Input type</strong></td>
<td>1 Parameterisation input</td>
</tr>
<tr>
<td><strong>Input impedance</strong></td>
<td>&gt; 47 kΩ</td>
</tr>
<tr>
<td><strong>Synchronisation</strong></td>
<td>1 synchronous connection, bi-directional</td>
</tr>
<tr>
<td><strong>Common mode operation</strong></td>
<td>≤ 95 Hz</td>
</tr>
<tr>
<td><strong>Multiplex operation</strong></td>
<td>≤ 95 Hz n Hz, n = number of sensors</td>
</tr>
<tr>
<td><strong>Standards</strong></td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>-25 ... +70 °C (248 ... 343 K)</td>
</tr>
<tr>
<td><strong>Storage temperature</strong></td>
<td>-40 ... +85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td><strong>Protection degree</strong></td>
<td>IP65</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>Connector V15 (M12 x 1), 5 pin</td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>Housing: brass, nickel-plated</td>
</tr>
<tr>
<td><strong>Housing</strong></td>
<td>Transducer: epoxy resin/hollow glass sphere mixture; foam polyurethane, cover PBT</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>60 g</td>
</tr>
</tbody>
</table>

Note: Suitable connector cables, mounting aids and more, you can find in chapter "Accessories".

Date of edition: 08/18/2005
**Dimensions**

UB500-18GM75-...-V15

---

**Electrical connection**

Standard symbol/Connections:

1. U
2. (BN) Programming input
3. (WO) Synchronous
4. (BK) Output
5. (BU) - U

Core colours in accordance with EN 60947-5-2.

---

**Diagrams**

**Characteristic response curve**

Distance X [m]

Distance Y [m]

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

**Output characteristic**

Output version - PWM

Output version - F

Output version - BIT
### Ultrasonic sensor

**Model number**

<table>
<thead>
<tr>
<th>Series</th>
<th>Model number</th>
<th>ULB1000-18GM75-..-V15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series</td>
<td></td>
<td>UB1000-18GM75-E4-V15</td>
</tr>
<tr>
<td>Series</td>
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<td>UB1000-18GM75-E5-V15</td>
</tr>
<tr>
<td>Series</td>
<td></td>
<td>UB1000-18GM75-I-V15</td>
</tr>
<tr>
<td>Series</td>
<td></td>
<td>UB1000-18GM75-U-V15</td>
</tr>
</tbody>
</table>

- **Sensing range**: 70 ... 1000 mm
- **Adjustment range**: 90 ... 1000 mm
- **Unusable area**: 0 ... 70 mm
- **Standard target plate**: 100 mm x 100 mm
- **Transducer frequency**: approx. 20 kHz
- **Response delay**: approx. 125 ms
- **LED yellow**: permanently yellow: object in the evaluation range, yellow, flashing: TEACH-IN function, object detected
- **LED red**: permanently red: Error, red, flashing: TEACH-IN function, object not detected
- **Operating voltage**: 10 ... 30 V DC, ripple 10 %
- **No-load supply current**: ≤ 45 mA
- **Output type**: 1 analogue output 0 ... 10 V
- **Rated operational current**: 200 mA, short-circuit/overload protected
- **Load impedance**: ≤ 3 V
- **Temperature range**: -25 ... 70 °C
- **Protection degree**: IP65
- **Material housing**: brass, nickel-plated
- **Transducer**: epoxy resin/hollow glass sphere mixture; foam polyurethane, cover PBT
- **Mass**: 60 g

- **Selectible sound lobe width**
- **TEACH-IN input**
- **Synchronisation options**
- **Deactivation option**
- **Temperature compensation**
- **Very small unusable area**
- **Switch output**: 5 different output functions can be set
- **Analogue output**: 0 V ... 10 V
- **Analogue output**: 4 mA ... 20 mA

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories".

### Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 20 kHz</td>
</tr>
<tr>
<td>Response delay</td>
<td>approx. 125 ms</td>
</tr>
<tr>
<td>LED yellow</td>
<td>permanently yellow:</td>
</tr>
<tr>
<td></td>
<td>object in the evaluation range,</td>
</tr>
<tr>
<td></td>
<td>yellow, flashing:</td>
</tr>
<tr>
<td></td>
<td>TEACH-IN function, object</td>
</tr>
<tr>
<td></td>
<td>detected</td>
</tr>
<tr>
<td>LED red</td>
<td>permanently red:</td>
</tr>
<tr>
<td></td>
<td>Error, red, flashing:</td>
</tr>
<tr>
<td></td>
<td>TEACH-IN function, object</td>
</tr>
<tr>
<td></td>
<td>not detected</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 ... 30 V DC, ripple 10 %</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>≤ 45 mA</td>
</tr>
<tr>
<td>Output type</td>
<td>1 analogue output 0 ... 10 V</td>
</tr>
<tr>
<td></td>
<td>1 analogue output 4 ... 20 mA</td>
</tr>
<tr>
<td></td>
<td>1 switch output E4, np n NO/N C,</td>
</tr>
<tr>
<td></td>
<td>parameterisable</td>
</tr>
<tr>
<td></td>
<td>1 switch output E5, np p NO/N C,</td>
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<td></td>
<td>parameterisable</td>
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<tr>
<td>Resolution</td>
<td>0.35 mm</td>
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<tr>
<td>Deviation of the characteristic curve</td>
<td>± 1 % of full-scale value</td>
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<tr>
<td>Repeat accuracy</td>
<td>± 0.1 % of full-scale value</td>
</tr>
<tr>
<td>Rated operational current</td>
<td>200 mA, short-circuit/overload</td>
</tr>
<tr>
<td></td>
<td>protected</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 3 V</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>max. 3 Hz</td>
</tr>
<tr>
<td>Range hysteresis</td>
<td>1 % of the set operating distance</td>
</tr>
<tr>
<td>Load impedance</td>
<td>≤ 1 kOhm</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>± 1.5 % of full-scale value</td>
</tr>
<tr>
<td>Input type</td>
<td>1 TEACH-IN input:</td>
</tr>
<tr>
<td></td>
<td>operating range 1: -U₀, ... +1 V,</td>
</tr>
<tr>
<td></td>
<td>operating range 2: +4 V ... +U₀</td>
</tr>
<tr>
<td></td>
<td>input impedance: &gt; 4.7 kΩ, TEACH-IN pulse: &gt; 1 s</td>
</tr>
<tr>
<td></td>
<td>1 TEACH-IN input:</td>
</tr>
<tr>
<td></td>
<td>lower evaluation limit A1: -U₀,</td>
</tr>
<tr>
<td></td>
<td>... +1 V, upper evaluation limit</td>
</tr>
<tr>
<td></td>
<td>A2: +4 V ... +U₀</td>
</tr>
<tr>
<td></td>
<td>input impedance: &gt; 4.7 kΩ, pulse</td>
</tr>
<tr>
<td></td>
<td>duration &gt; 1 s</td>
</tr>
<tr>
<td>Synchronisation</td>
<td>birectional</td>
</tr>
<tr>
<td></td>
<td>0 level -U₀, ... +1 V, 1 level</td>
</tr>
<tr>
<td></td>
<td>+4 V, +U₀, input impedance &gt; 12 kOhm</td>
</tr>
<tr>
<td></td>
<td>synchronisation pulse &gt; 100 µs,</td>
</tr>
<tr>
<td></td>
<td>synchronisation interpulse period &gt; 2 ms</td>
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<tr>
<td>Common mode operation</td>
<td>≤ 40 Hz</td>
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<tr>
<td>Multiplex operation</td>
<td>≤ 40m</td>
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<td>connector V15 (M12 x 1), 5 pin</td>
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<tr>
<td>Housing</td>
<td>brass, nickel-plated</td>
</tr>
<tr>
<td>Material</td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>60 g</td>
</tr>
</tbody>
</table>

Subject to reasonable modifications due to technical advances. Copyright Pepperl+Fuchs, Printed in Germany
## Dimensions

UB1000-18GM75-..-V15

## Electrical connection

**Standard symbol/Connections:**

(version E4, npp)

<table>
<thead>
<tr>
<th>1</th>
<th>(BN)</th>
<th>U</th>
<th>Switch output</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>(WH)</td>
<td>U</td>
<td>Teaching input</td>
</tr>
<tr>
<td>3</td>
<td>(GY)</td>
<td>U</td>
<td>Synchronous</td>
</tr>
<tr>
<td>4</td>
<td>(BU)</td>
<td>U</td>
<td>switch output</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

**Standard symbol/Connections:**

(version E5, npn)

<table>
<thead>
<tr>
<th>1</th>
<th>(BN)</th>
<th>U</th>
<th>Switch output</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>(WH)</td>
<td>U</td>
<td>Teaching input</td>
</tr>
<tr>
<td>3</td>
<td>(GY)</td>
<td>U</td>
<td>Synchronous</td>
</tr>
<tr>
<td>4</td>
<td>(BU)</td>
<td>U</td>
<td>switch output</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

**Standard symbol/Connections:**

(version U)

<table>
<thead>
<tr>
<th>1</th>
<th>(BN)</th>
<th>U</th>
<th>Switch output</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>(WH)</td>
<td>U</td>
<td>Teaching input</td>
</tr>
<tr>
<td>3</td>
<td>(GY)</td>
<td>U</td>
<td>Synchronous</td>
</tr>
<tr>
<td>4</td>
<td>(BU)</td>
<td>U</td>
<td>switch output</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

## Diagrams

### Characteristic response curve

- **Distance X [mm]**
  - 0
  - 100
  - 200
  - 300
  - 400
  - 500
  - 600
  - 700
  - 800
  - 900
  - 1000

- **Distance Y [mm]**
  - 0
  - 100
  - 200
  - 300
  - 400
  - 500
  - 600
  - 700
  - 800

- **Flat surface 100 mm x 100 mm**
  - X
  - Y

- **Round bar, Ø 25 mm**
  - X
  - Y

- **Wide sound lobe**
- **Narrow sound lobe**

**1. Window mode, normally open function**

A1 < A2: object range

**2. Window mode, normally closed function**

A2 < A1: object range

**3. One switch point, normally open function**

A1 -> ∞: object range

**4. One switch point, normally closed function**

A2 -> ∞: object range

**5. A1 -> ∞, A2 -> ∞: Detection of object presence**

Object detected: Switch output closed

No object detected: Switch output open

**Programmed switching output function**

- **Programmed analogue output function**

**output versions -E4 and -E5**

- **output versions -I and -U**

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
**Ultrasonic sensor**

UB1000-18GM75-...-V15

- 2 switch outputs
- Selectable sound lobe width
- TEACH-IN input
- Temperature compensation
- Very small unusable area
- 3 different output functions can be set
  - UB1000-18GM75-E6-V15
  - UB1000-18GM75-E7-V15

**Technical Data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>70 ... 1000 mm</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>90 ... 1000 mm</td>
</tr>
<tr>
<td>Unsuitable area</td>
<td>0 ... 70 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 205 kHz</td>
</tr>
<tr>
<td>Response delay</td>
<td>approx. 1.25 ms</td>
</tr>
<tr>
<td>LED yellow</td>
<td>Flashing TEACH-IN function object detected</td>
</tr>
<tr>
<td>LED red</td>
<td>&quot;Error&quot;, object uncertain in TEACH-IN function: No object detected</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 ... 30 V DC, ripple 10 %</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>≤ 50 mA</td>
</tr>
<tr>
<td>Output type</td>
<td>2 switch outputs npn, normally open/closed</td>
</tr>
<tr>
<td></td>
<td>2 switch outputs npn, normally open/close selectable</td>
</tr>
<tr>
<td></td>
<td>2 switch outputs npn, normally open/close selectable</td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td>≤ 1 %</td>
</tr>
<tr>
<td>Rated operational current</td>
<td>2 x 100 mA, short-circuit overload protected</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 3 V</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>max. 3 kHz</td>
</tr>
<tr>
<td>Range hysteresis</td>
<td>1 % of the set operating distance</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>≤ 1.5 % of full-scale value</td>
</tr>
<tr>
<td>Input type</td>
<td>1 TEACH-IN input, input range 1.0 ... +1 V, operating range 2.0 ... +4 V ... +12 V</td>
</tr>
<tr>
<td></td>
<td>input impedance: &gt; 4.7 kΩ, TEACH-IN pulse: ≥ 1 s</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-25 ... 70 °C (325 ... 343 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
</tr>
<tr>
<td>Connection</td>
<td>connector V15 (M12 x 1), 5 pin</td>
</tr>
<tr>
<td>Material</td>
<td>Brass, nickel-plated</td>
</tr>
<tr>
<td>Housing</td>
<td>Epoxy resin/hollow glass sphere mixture; foam polyurethane, cover PBT</td>
</tr>
<tr>
<td>Mass</td>
<td>60 g</td>
</tr>
</tbody>
</table>

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
**Dimensions**

UB1000-18GM75-...-V15

---

**Electrical connection**

**Standard symbol/Connections:**

*version E7, npn*

```
<table>
<thead>
<tr>
<th></th>
<th>+ UB</th>
<th>- UB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

Core colours in accordance with EN 60947-5-2.

**Programmed switching output function**

1. Switch point 1 -> ∞: Switch output 1, (N.O.)
   - Detection of object presence

2. Switch point 2 -> ∞: Switch output 2, (N.O.)
   - Detection of object presence

3. Switch point 1, 2 -> ∞: Both switch outputs, (N.O.)
   - Detection of object presence

---

**Diagrams**

**Characteristic response curve**

Distance X [mm]

- Flat surface 100 mm x 100 mm
- Round bar, Ø 25 mm

---

**Programmed switching output function**

- Object range

---

Subject to reasonable modifications due to technical advances.
### Technical Data

**Model number**

<table>
<thead>
<tr>
<th>UB1000-18GM75-F-V15</th>
<th>UB1000-18GM75-PWM-V15</th>
<th>UB1000-18GM75-BIT-V15</th>
</tr>
</thead>
</table>

#### Sensing range

- 80 ... 1000 mm

#### Standard target plate

- 100 mm x 100 mm

#### Transducer frequency

- approx. 205 kHz

#### Response delay

- approx. 150 ms

#### Operating voltage

- 10 ... 30 V DC, ripple 10 %

#### No-load supply current

- ≤ 50 mA

#### Output type

- 1 frequency output, push/pull, parameterisable
- 1 PWM output, push/pull, parameterisable
- 1 serial output, push/pull, parameterisable

#### Resolution

- 1 mm

#### Deviation of the characteristic curve

- ± 1 % of full-scale value

#### Repeat accuracy

- ± 0.5 % of full-scale value

#### Load impedance

- > 1000 Ohm < 100 nF

#### Temperature influence

- ± 1.5 % of full-scale value

#### Input type

- 1 Parameterisation input
- Input impedance: > 4.7 kΩ

#### Synchronisation

- Bi-directional
  - 0 level: -U0, +1 V
  - 1 level: +4 V, -U0
- Input impedance: > 12 kΩ
- synchronisation pulse: ≥ 100 μs
- synchronisation interpulse period: ≥ 2 ms

#### Common mode operation

- ≤ 30 Hz

#### Multiplex operation

- ≤ 30 Hz, n = number of sensors

#### Standards

- EN 60947-5-2

#### Ambient temperature

- -25 ... +70 °C (248 ... 343 K)

#### Storage temperature

- -40 ... +85 °C (233 ... 358 K)

#### Protection degree

- IP65

#### Connection

- connector V15 (M12 x 1), 5 pin

#### Material

- Housing: brass, nickel-plated
- Transducer: epoxy resin/hollow glass sphere mixture; foamed polyurethane, cover PBT
- Mass: 60 g

---

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
Dimensions

UB1000-18GM75-...-V15

Electrical connection

Standard symbol/Connections:

<table>
<thead>
<tr>
<th>1</th>
<th>BN</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>WK</td>
<td>U</td>
</tr>
<tr>
<td>3</td>
<td>BK</td>
<td>Output</td>
</tr>
<tr>
<td>5</td>
<td>BU</td>
<td>U</td>
</tr>
</tbody>
</table>

Programming input
Synchronous
Output

Core colours in accordance with EN 60947-5-2.

Diagrams

Characteristic response curves

Output characteristic

Output characteristic

Output characteristic

Date of edition: 08/18/2005

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LED green
LED red
**Function**

A through-beam ultrasonic barrier always consists of a single emitter and a single receiver. The function of a through-beam ultrasonic barrier is based on the interruption of the sound transmission to the receiver by the object to be detected. The emitter sends an ultrasonic signal that is evaluated by the receiver. If the signal is interrupted or muted by the object to be detected, the receiver switches.

No electrical connections are required between the emitter and receiver.

The function of through-beam ultrasonic barriers is not dependent on the position of their installation. We recommend, however, to install the emitter below in the case of vertical installations to prevent the accumulation of dust particles.

**Installation tolerances**

The installation tolerances of the central axes of the emitter and receiver may not exceed the values specified in the illustration.

**Detection of thin foils**

For the detection of thin foils (< 0.1 mm), install the through-beam ultrasonic barrier at an angle of ≥ 10° from perpendicular to the foil.

**Caution**

Mount or replace emitter and receiver only in pairs. Both devices are optimally matched to each other by the manufacturer.

---

**UBE500-18GK-SE0-V1 and UBE500-18GK-SE0-V1**

**Function**

A through-beam ultrasonic barrier always consists of a single emitter and a single receiver. The function of a through-beam ultrasonic barrier is based on the interruption of the sound transmission to the receiver by the object to be detected. The emitter sends an ultrasonic signal that is evaluated by the receiver. If the signal is interrupted or muted by the object to be detected, the receiver switches.

No electrical connections are required between the emitter and receiver.

The function of through-beam ultrasonic barriers is not dependent on the position of their installation. We recommend, however, to install the emitter below in the case of vertical installations to prevent the accumulation of dust particles.

**Startup and parameterising**

For easy alignment of emitter and receiver towards each other, the receiver is equipped with an alignment aid. To activate the alignment aid, the TEACH-input of the receiver (pin 2) has to be connected to ground (-UB). The flashing frequency of the yellow LED indicates the strength of the received ultrasonic signal. The better the alignment, the stronger the signal.

Simultaneously the ultrasonic barrier evaluates the signal strength of the unobstructed signal path and generates the optimal switching threshold. When disconnecting the TEACH-input from -UB, this threshold is stored non-volatile in the receivers memory. In case of clear ultrasonic path (no object), all LEDs are off.

**TEACH-In of very small objects/obstacles**

Like shown in the curve "obstacle size", the ultrasonic barrier offers the possibility to detect very small objects at a distance of more than 300 mm.

- place the object to be detected in the desired distance inside the ultrasonic path
- connect TEACH-input of the receiver to +UB (yellow LED flashes slowly)
- disconnect TEACH-input

In case of successful TEACH-IN (object is detected reliable), the yellow LED is on and the taught detection threshold is stored non-volatile to the receivers memory.

In case of unsuccessful TEACH-IN (object too small or too porous for ultrasonic sound), the red LED flashes 5 times and the ultrasonic barrier continues normal operation with unmodified detection threshold value.

**Test function**

For test purpose, the ultrasonic emitter is equipped with a test input. In normal operation mode (test input not connected or connected to -UB), the green LED of the emitter is on. If the test input is connected to +UB, the ultrasonic emitter gets deactivated and its LED changes into red. Simultaneously the receiver switches and its yellow LED goes on.
Adjusting the switching points

The ultrasonic sensor features a switch output with two teachable switching points. These are set by applying the supply voltage \(-U_B\) or \(+U_B\) to the TEACH-IN input. The supply voltage must be applied to the TEACH-IN input for at least 1 s. LEDs indicate whether the sensor has recognised the target during the TEACH-IN procedure. Switching point A1 is taught with \(-U_B\), A2 with \(+U_B\).

Five different output functions can be set:
1. Window mode, normally-open function
2. Window mode, normally-closed function
3. One switching point, normally-open function
4. One switching point, normally-closed function
5. Detection of object presence

**TEACH-IN window mode, normally-open function**
- Set target to near switching point
- TEACH-IN switching point A1 with \(-U_B\)
- Set target to far switching point
- TEACH-IN switching point A2 with \(+U_B\)

**TEACH-IN window mode, normally-closed function**
- Set target to near switching point
- TEACH-IN switching point A2 with \(+U_B\)
- Set target to far switching point
- TEACH-IN switching point A1 with \(-U_B\)

**TEACH-IN switching point, normally-open function**
- Set target to near switching point
- TEACH-IN switching point A2 with \(+U_B\)
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A1 with \(-U_B\)

**TEACH-IN switching point, normally-closed function**
- Set target to near switching point
- TEACH-IN switching point A1 with \(-U_B\)
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A2 with \(+U_B\)

**TEACH-IN detection of objects presence**
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A1 with \(-U_B\)
- TEACH-IN switching point A2 with \(+U_B\)

Default setting of switching points
A1 = blind range, A2 = nominal distance

**LED Displays**

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Red LED</th>
<th>Yellow LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN switching point:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object detected</td>
<td>off</td>
<td></td>
</tr>
<tr>
<td>No object detected</td>
<td>flashes</td>
<td>flashes</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td>On</td>
<td>off</td>
</tr>
<tr>
<td>Normal operation</td>
<td>off</td>
<td>Switching state</td>
</tr>
<tr>
<td>Fault</td>
<td>on</td>
<td>Previous state</td>
</tr>
</tbody>
</table>

Adjusting the evaluation limits

The ultrasonic sensor features an analogue output with two teachable evaluation limits. These are set by applying the supply voltage \(-U_L\) or \(+U_L\) to the TEACH-IN input. The supply voltage must be applied to the TEACH-IN input for at least 1 s. LEDs indicate whether the sensor has recognised the target during the TEACH-IN procedure. The lower evaluation limit A1 is taught with \(-U_L\), A2 with \(+U_L\).

Two different output functions can be set:
1. Analogue value increases with rising distance to object (rising ramp)
2. Analogue value falls with rising distance to object (falling ramp)

**TEACH-IN rising ramp (A2 > A1)**
- Position object at lower evaluation limit
Series -18GK/-18GM  

Sensor function description

- TEACH-IN lower limit A1 with -UB
- Position object at upper evaluation limit
- TEACH-IN upper limit A2 with +UB

TEACH-IN falling ramp (A1 > A2):
- Position object at lower evaluation limit
- TEACH-IN lower limit A2 with +UB
- Position object at upper evaluation limit
- TEACH-IN upper limit A1 with -UB

Default setting
A1: unusable area
A2: nominal sensing range
Mode of operation: rising ramp

LED Displays

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Red LED</th>
<th>Yellow LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN evaluation limit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object detected</td>
<td>off</td>
<td>flashes</td>
</tr>
<tr>
<td>No object detected</td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td>off</td>
<td>on</td>
</tr>
<tr>
<td>Normal mode (evaluation range)</td>
<td>on</td>
<td>previous state</td>
</tr>
<tr>
<td>Fault</td>
<td>on</td>
<td>previous state</td>
</tr>
</tbody>
</table>

All UB...-18GM75-... types

Installation conditions
If the sensor is installed at places, where the environment temperature can fall below 0 °C, for the sensors fixation, one of the mounting flanges BF18, BF18-F or BF 5-30 must be used.

In case of direct mounting of the sensor in a through hole using the steel nuts, it has to be fixed at the middle of the housing thread. If a fixation at the front end of the threaded housing is required, plastic nuts with centering ring (accessories) must be used.

UB...-18GM75-..., output types -E4 and -E5 (1 switch output)

Synchronisation
The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. The synchronisation of multiple sensors can be realised as follows:

External synchronisation
The sensor can be synchronised by the external application of a square wave voltage. A synchronisation pulse at the synchronisation input starts a measuring cycle. The pulse must have a duration greater than 100 µs. The measuring cycle starts with the falling edge of a synchronisation pulse. A low level > 1 s or an open synchronisation input will result in the normal operation of the sensor. A high level at the synchronisation input disables the sensor.

Two operating modes are available
1. Multiple sensors can be controlled by the same synchronisation signal. The sensors are synchronised.
2. The synchronisation pulses are sent cyclically to individual sensors. The sensors operate in multiplex mode.

Internal synchronisation
The synchronisation connections of up to 5 sensors capable of internal synchronisation are connected to one another. When power is applied, these sensors will operate in multiplex mode. The response delay increases according to the number of sensors to be synchronised. Synchronisation cannot be performed during TEACH-IN and vice versa. The sensors must be operated in an unsynchronised manner to teach the switching point.

Note:
If the option for synchronisation is not used, the synchronisation input has to be connected to ground (0V) or the sensor has to be operated via a V1 cable connector (4-pin).

Adjusting the switching points
The ultrasonic sensor features a switch output with two teachable switching points. These are set by applying the supply voltage -UB or +UB to the TEACH-IN input. The supply voltage must be applied to the TEACH-IN input for at least 1 s. LEDs indicate whether the sensor has recognised the target during the TEACH-IN procedure. Switching point A1 is taught with -UB, A2 with +UB.

Five different output functions can be set
1. Window mode, normally-open function
2. Window mode, normally-closed function
3. One switch point, normally-open function
4. One switch point, normally-closed function
5. Detection of object presence

TEACH-IN window mode, normally-open function
Series -18GK/-18GM

- Set target to near switching point
- TEACH-IN switching point A1 with -UB
- Set target to far switching point
- TEACH-IN switching point A2 with +UB

TEACH-IN window mode, normally-closed function
- Set target to near switching point
- TEACH-IN switching point A2 with +UB
- Set target to far switching point
- TEACH-IN switching point A1 with -UB

TEACH-IN switching point, normally-open function
- Set target to near switching point
- TEACH-IN switching point A2 with +UB
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A1 with -UB

TEACH-IN switching point, normally-closed function
- Set target to near switching point
- TEACH-IN switching point A1 with -UB
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A2 with +UB

TEACH-IN detection of object presence
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A1 with -UB
- TEACH-IN switching point A2 with +UB

Default setting of switching points
A1 = unusable area
A2 = nominal sensing range

LED Displays

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Red LED</th>
<th>Yellow LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN switching point:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object detected</td>
<td>off</td>
<td>flashes</td>
</tr>
<tr>
<td>No object detected</td>
<td></td>
<td>off</td>
</tr>
<tr>
<td>Normal operation</td>
<td>off</td>
<td>on</td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adjusting the sound cone characteristics:
The ultrasonic sensor enables two different shapes of the sound cone, a wide angle sound cone and a small angle sound cone.

1. Small angle sound cone
- switch off the power supply
- connect the Teach-input wire to -UB
- switch on the power supply
- the red LED flashes once with a pause before the next.
- yellow LED: permanently on: indicates the presence of an object or disturbing object within the sensing range
- disconnect the Teach-input wire from -UB and the changing is saved

2. Wide angle sound cone
- switch off the power supply
- connect the Teach-input wire with +UB
- switch on the power supply
- the red LED double-flashes with a long pause before the next.
- yellow LED: permanently on: indicates an object or disturbing object within the sensing range
- disconnect the Teach-input wire from +UB and the changing is saved

UB...-18GM75-..., output types -E01 and -E23 (2 switch outputs)
Adjusting the switching points

The ultrasonic sensor features two switch outputs with one teachable switching point. The switching points are set by applying the supply voltage \(-U_B\) or \(+U_B\) to the TEACH-IN input. The supply voltage must be applied to the TEACH-IN input for at least 1 s. LEDs indicate whether the sensor has recognised the target during the TEACH-IN procedure. Switching point A1 is taught with \(-U_B\), A2 with \(+U_B\).

**TEACH-IN switching point for switch output 1**
- Set target of desired switching point for switch output 1
- TEACH-IN switching point for switch output 1 with \(-U_B\)

**TEACH-IN switching point for switch output 2**
- Set target of desired switching point for switch output 2
- TEACH-IN switching point for switch output 2 with \(+U_B\)

**TEACH-IN detection of object presence**
- Cover the sensor with your hand, or remove all objects from the sensing range
- TEACH-IN switching point for switch output 1 with \(-U_B\)
- TEACH-IN switching point for switch output 2 with \(+U_B\)

**Comments**

Only one switch output can be configured for detection of presence of objects. If the sensor detects an objects within the maximum detection range, the switch output switches.

Default setting of switching points

Switch output 1: unusable area
Switch output 2: nominal sensing range

**LED Displays**

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Red LED</th>
<th>LED 1 yellow</th>
<th>LED 2 yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TEACH-IN switching point 1</strong></td>
<td></td>
<td>flasheS</td>
<td>off</td>
</tr>
<tr>
<td>Object detected</td>
<td></td>
<td>off</td>
<td>on</td>
</tr>
<tr>
<td>No object detected</td>
<td></td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td></td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td><strong>TEACH-IN switching point 2</strong></td>
<td></td>
<td>off</td>
<td>flasheS</td>
</tr>
<tr>
<td>Object detected</td>
<td></td>
<td>off</td>
<td>on</td>
</tr>
<tr>
<td>No object detected</td>
<td></td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td></td>
<td>on</td>
<td>off</td>
</tr>
<tr>
<td>Normal operation</td>
<td></td>
<td>switch state 1</td>
<td>switch state 2</td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td>on</td>
<td>on</td>
</tr>
<tr>
<td></td>
<td></td>
<td>previous state</td>
<td>previous state</td>
</tr>
</tbody>
</table>

Adjusting the sound cone characteristics:

The ultrasonic sensor enables two different shapes of the sound cone, a wide angle sound cone and a small angle sound cone.

1. **Small angle sound cone**
   - switch off the power supply
   - connect the Teach-input wire to \(-U_B\)
   - switch on the power supply
   - the red LED flashes once with a pause before the next.
   - yellow LED: permanently on: indicates the presence of an object or disturbing object within the sensing range
   - disconnect the Teach-input wire from \(-U_B\) and the changing is saved

2. **Wide angle sound cone**
   - switch off the power supply
   - connect the Teach-input wire with \(+U_B\)
   - switch on the power supply
   - the red LED double-flashes with a long pause before the next.
   - yellow LED: permanently on: indicates an object or disturbing object within the sensing range
   - disconnect the Teach-input wire from \(+U_B\) and the changing is saved
Adjusting the switching points

The ultrasonic sensor features two switch outputs with one teachable switching point. The switching points are set by applying the supply voltage \(-U_B\) or \(+U_B\) to the TEACH-IN input. The supply voltage must be applied to the TEACH-IN input for at least 1 s. LEDs indicate whether the sensor has recognised the target during the TEACH-IN procedure. Switching point A1 is taught with \(-U_B\), A2 with \(+U_B\).

Three different output functions can be set:
1. normally-open function
2. normally-closed function
3. Detection of object presence

TEACH-IN normally-open function

Switching point for switch output 1 < switching point for switch output 2
- Set target of desired switching point for switch output 1
- TEACH-IN switching point for switch output 1 with \(-U_B\)
- Set target of desired switching point for switch output 2
- TEACH-IN switching point for switch output 2 with \(+U_B\)

Comments: The order doesn't make any difference. If you want, you can set only one switching point.

TEACH-IN normally-closed function

Switching point for switch output 2 < switching point for switch output 1
- Set target of desired switching point for switch output 1
- TEACH-IN switching point for switch output 1 with \(-U_B\)
- Set target of desired switching point for switch output 2
- TEACH-IN switching point for switch output 2 with \(+U_B\)

Comments: The order doesn't make any difference. If you want, you can set only one switching point. If both switching points are equal, the sensor works in close function.

TEACH-IN detection of object presence

- Cover the sensor with the palm, or remove all objects from the detection range of the sensor
- TEACH-IN switching point for switch output 1 with \(-U_B\)
- TEACH-IN switching point for switch output 2 with \(+U_B\)

Comments: Only one switch output can be configured for detection of presence of objects. If the sensor detects an object within the maximum detection range, the switch output switches.

Default setting of switching points

Switch output 1: unusable area
Switch output 2: nominal sensing range

LED Displays

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Red LED</th>
<th>LED 1 yellow</th>
<th>LED 2 yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN switching point 1:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object detected</td>
<td>off</td>
<td>flashes off</td>
<td>off</td>
</tr>
<tr>
<td>No object detected</td>
<td></td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td>on</td>
<td>off</td>
<td>on</td>
</tr>
<tr>
<td>TEACH-IN switching point 2:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object detected</td>
<td>off</td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>no object detected</td>
<td></td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td>on</td>
<td>off</td>
<td>on</td>
</tr>
<tr>
<td>Normal operation</td>
<td>off</td>
<td>switch state 1</td>
<td>switch state 2</td>
</tr>
<tr>
<td>Fault</td>
<td>on</td>
<td>previous state</td>
<td>previous state</td>
</tr>
</tbody>
</table>

Adjusting the sound cone characteristics:

The ultrasonic sensor enables two different shapes of the sound cone, a wide angle sound cone and a small angle sound cone.

1. **Small angle sound cone**
   - switch off the power supply
   - connect the Teach-input wire to \(-U_B\)
   - switch on the power supply
Series -18GK/-18GM

Sensor function description

- the red LED flashes once with a pause before the next.
- yellow LED: permanently on: indicates the presence of an object or disturbing object within the sensing range
- disconnect the Teach-input wire from \(-U_B\) and the changing is saved

2. Wide angle sound cone
   - switch off the power supply
   - connect the Teach-input wire with \(+U_B\)
   - switch on the power supply
   - the red LED double-flashes with a long pause before the next.
   - yellow LED: permanently on: indicates an object or disturbing object within the sensing range
   - disconnect the Teach-input wire from \(+U_B\) and the changing is saved

UB...-18GM75... output types -I and -U (analogue output)

Synchronisation
The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. The synchronisation of multiple sensors can be realised as follows:

External synchronisation
The sensor can be synchronised by the external application of a square wave voltage. A synchronisation pulse at the synchronisation input starts a measuring cycle. The pulse must have a duration greater than 100 µs. The measuring cycle starts with the falling edge of a synchronisation pulse. A low level > 1 s or an open synchronisation input will result in the normal operation of the sensor. A high level at the synchronisation input disables the sensor. Two operating modes are available:
1. Multiple sensors can be controlled by the same synchronisation signal. The sensors are synchronised.
2. The synchronisation pulses are sent cyclically to individual sensors. The sensors operate in multiplex mode.

Internal synchronisation
The synchronisation connections of up to 5 sensors capable of internal synchronisation are connected to one another. When power is applied, these sensors will operate in multiplex mode. The response delay increases according to the number of sensors to be synchronised. Synchronisation cannot be performed during TEACH-IN and vice versa. The sensors must be operated in an unsynchronised manner to teach the evaluation limits.

Note:
If the option for synchronisation is not used, the synchronisation input has to be connected to ground (0V) or the sensor has to be operated via a V1 cable connector (4-pin).

Adjusting the evaluation limits
The ultrasonic sensor features an analogue output with two teachable evaluation limits. These are set by applying the supply voltage \(-U_B\) or \(+U_B\) to the TEACH-IN input. The supply voltage must be applied to the TEACH-IN input for at least 1 s. LEDs indicate whether the sensor has recognised the target during the TEACH-IN procedure. The lower evaluation limit A1 is taught with \(-U_B\), A2 with \(+U_B\).

Two different output functions can be set:
1. Analogue value increases with rising distance to object (rising ramp)
2. Analogue value falls with rising distance to object (falling ramp)

TEACH-IN rising ramp (\(A2 > A1\))
   - Position object at lower evaluation limit
   - TEACH-IN lower limit A1 with \(-U_B\)
   - Position object at upper evaluation limit
   - TEACH-IN upper limit A2 with \(+U_B\)

TEACH-IN falling ramp (\(A1 > A2\))
   - Position object at lower evaluation limit
   - TEACH-IN lower limit A2 with \(+U_B\)
   - Position object at upper evaluation limit
   - TEACH-IN upper limit A1 with \(-U_B\)

Default setting
A1: unusable area
A2: nominal sensing range
Mode of operation: rising ramp

LED Displays
Adjusting the sound cone characteristics:

The ultrasonic sensor enables two different shapes of the sound cone, a wide angle sound cone and a small angle sound cone.

1. Small angle sound cone
   - switch off the power supply
   - connect the Teach-input wire to -U_B
   - switch on the power supply
   - the red LED flashes once with a pause before the next.
   - yellow LED: permanently on: indicates the presence of an object or disturbing object within the sensing range
   - disconnect the Teach-input wire from -U_B and the changing is saved

2. Wide angle sound cone
   - switch off the power supply
   - connect the Teach-input wire with +U_B
   - switch on the power supply
   - the red LED double-flashes with a long pause before the next.
   - yellow LED: permanently on: indicates an object or disturbing object within the sensing range
   - disconnect the Teach-input wire from +U_B and the changing is saved

UB...-18GM75...-, output type -F (frequency output)

Parameter assignment of the signal output
The ultrasonic sensor is equipped with a signal output that represents the distance determined to the object in the form of a frequency proportional to the distance of the object. The current path characteristic of this output signal follows a zero-point straight line, i.e. The extrapolated output frequency for the object distance 0 (which is not usable in practical terms) also corresponds to 0. As the object distance increases, the output frequency also increases.

The object distance can be calculated according to:

\[
\text{Object distance [mm]} = \text{output frequency [Hz]} / \text{gain [Hz/mm]}
\]

If no object is detected, the level 1 is permanently present on the output.

The frequency of the output channel is adjusted by the gain of the output characteristic line.

<table>
<thead>
<tr>
<th>Wiring arrangement of the parameterisation input</th>
<th>Gain of the output characteristic line</th>
</tr>
</thead>
<tbody>
<tr>
<td>-U_B</td>
<td>2 Hz/mm</td>
</tr>
<tr>
<td>Not used</td>
<td>1 Hz/mm</td>
</tr>
<tr>
<td>+U_B</td>
<td>4 Hz/mm</td>
</tr>
</tbody>
</table>

The sensor checks the parameterisation input when the operating voltage is switched on. A change in the wiring of the parameterisation input during ongoing operation has no effect on the signal output.

LED display
The sensor is equipped with 2 LEDs. Their meaning is as follows:

- LED green: Operating voltage applied
- LED red: No object detected

Synchronisation
The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. The synchronisation of multiple sensors can be implemented as follows:

External synchronisation
The sensor can be synchronised by the external application of a square wave voltage. A synchronisation pulse at the synchronisation input starts a measuring cycle. The pulse must have a duration greater than 100 µs. A low level > 1 s or an open synchronisation input results in normal operation of the sensor. A high level at the synchronisation input disables the sensor.

Two operating modes are available
Series -18GK/-18GM  Sensor function description

1) Multiple sensors can be controlled by the same synchronisation signal. The sensors work on the same clock rate.
2) The synchronisation pulses are sent cyclically to only one sensor at a time. The sensors operate in multiplex mode.

Internal synchronisation

The synchronisation connections of up to 5 sensors capable of internal synchronisation are connected to one another. When power is applied, these sensors operate in multiplex mode. The response delay increases according to the number of sensors to be synchronised.

Note

If the option for synchronisation is not used, the synchronisation input should be connected with ground (0 V) or the sensor should be operated with a V1 cable connector (4-pin).

UB...-18GM75-..., output type -PWM (pulse width modulation)

Parameter assignment of the signal output

The ultrasonic sensor is equipped with a signal output that represents the distance determined to the object in the form of a pulse-duty factor proportional to the distance of the object. The current path characteristic of this output signal follows a zero-point straight line, i.e. the extrapolated pulse-duty factor for the object distance 0 (not usable in practice) also corresponds to 0. As the distance to the object increases, the pulse-duty factor also increases. It is 50 % when the nominal sensing range is reached.

The object distance can be calculated according to:

\[
\text{Object distance [mm]} = 2 \times \text{sensing range [mm]} \times \text{pulse length [s]} \times \text{frequency [Hz]}
\]

If the object distance reaches or exceeds twice the nominal detection range, or if no object is detected, a level 1 is permanently present on the output.

The frequency of the output channel is adjusted by the wiring arrangement of the parameterisation input.

<table>
<thead>
<tr>
<th>Wiring arrangement of the parameterisation input</th>
<th>Output frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>-U_b</td>
<td>30 Hz</td>
</tr>
<tr>
<td>Not used</td>
<td>245 Hz</td>
</tr>
<tr>
<td>+U_b</td>
<td>1900 Hz</td>
</tr>
</tbody>
</table>

The sensor checks the parameterisation input when the operating voltage is switched on. A change in the wiring of the parameterisation input during ongoing operation has no effect on the signal output.

LED display

The sensor is equipped with 2 LEDs. Their meaning is as follows:

- LED green: Operating voltage applied
- LED red: No object detected

Synchronisation

The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. The synchronisation of multiple sensors can be implemented as follows:

External synchronisation

The sensor can be synchronised by the external application of a square wave voltage. A synchronisation pulse at the synchronisation input starts a measuring cycle. The pulse must have a duration greater than 100 µs. The measuring cycle starts with the falling edge of a synchronisation pulse. A low level > 1 s or an open synchronisation input results in normal operation of the sensor. A high level at the synchronisation input disables the sensor.

Two operating modes are available

1) Multiple sensors can be controlled by the same synchronisation signal. The sensors work on the same clock rate.
2) The synchronisation pulses are sent cyclically to only one sensor at a time. The sensors operate in multiplex mode.

Internal synchronisation

The synchronisation connections of up to 5 sensors capable of internal synchronisation are connected to one another. When power is applied, these sensors operate in multiplex mode. The response delay increases according to the number of sensors to be synchronised.

Note

If the option for synchronisation is not used, the synchronisation input should be connected with ground (0 V) or the sensor should be operated with a V1 cable connector (4-pin).
Parameter assignment of the signal output

The ultrasonic sensor is equipped with a signal output that represents the distance determined to the object in the form of a digital value proportional to the distance of the object. The current path characteristic of this output signal follows a zero-point straight line, i.e., the extrapolated digital value for the object distance 0 (which is not usable in practical terms) also corresponds to 0. As the object distance increases, the digital value also increases. The digital value is generated serially. A word consists of 1 start bit (level 1), 12 data bits (value), and 1 stop bit (level 0). The object distance can be calculated according to:

\[
\text{Object distance [mm]} = \frac{\text{Value}}{2}
\]

If no object is detected, a level 1 is permanently present on the output.

The bit width is adjusted by the wiring arrangement of the parameterisation input.

<table>
<thead>
<tr>
<th>Wiring arrangement of the parameterisation input</th>
<th>Bit width</th>
</tr>
</thead>
<tbody>
<tr>
<td>-UB</td>
<td>50 µs</td>
</tr>
<tr>
<td>Not used</td>
<td>100 µs</td>
</tr>
<tr>
<td>+UB</td>
<td>200 µs</td>
</tr>
</tbody>
</table>

The sensor checks the parameterisation input when the operating voltage is switched on. A change in the wiring of the parameterisation input during ongoing operation has no effect on the signal output.

**LED display**

The sensor is equipped with 2 LEDs. Their meaning is as follows:

- LED green: Operating voltage applied
- LED red: No object detected

**Synchronisation**

The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. The synchronisation of multiple sensors can be implemented as follows:

- **External synchronisation**
  - The sensor can be synchronised by the external application of a square wave voltage. A synchronisation pulse at the synchronisation input starts a measuring cycle. The pulse must have a duration greater than 100 µs. The measuring cycle starts with the falling edge of a synchronisation pulse. A low level > 1 s or an open synchronisation input results in normal operation of the sensor. A high level at the synchronisation input disables the sensor.
  - Two operating modes are available:
    1) Multiple sensors can be controlled by the same synchronisation signal. The sensors work on the same clock rate.
    2) The synchronisation pulses are sent cyclically to only one sensor at a time. The sensors operate in multiplex mode.

- **Internal synchronisation**
  - The synchronisation connections of up to 5 sensors capable of internal synchronisation are connected to one another. When power is applied, these sensors operate in multiplex mode. The response delay increases according to the number of sensors to be synchronised.

**Note**

If the option for synchronisation is not used, the synchronisation input should be connected with ground (0 V) or the sensor should be operated with a V1 cable connector (4-pin).
<table>
<thead>
<tr>
<th>Accessories</th>
<th>Control units/Power supplies</th>
<th>Double sheet monitoring</th>
<th>Series LUC</th>
<th>Series -D1</th>
<th>Series -F64</th>
<th>Series -F54</th>
<th>Series -F43</th>
<th>Series -F42</th>
<th>Series -F12</th>
<th>Series -FP</th>
<th>Series VarKont</th>
<th>Series -30GM</th>
<th>Series -18GM</th>
<th>Series -12M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series -30GM</td>
<td>Series -12GM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Date of edition: 08/18/2005
### Series -30GM

#### Comfort design (with RS 232 serial interface)

<table>
<thead>
<tr>
<th>Model number</th>
<th>Description</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC300-30GM-IUR2-V15</td>
<td></td>
<td>300 mm</td>
<td>66</td>
</tr>
<tr>
<td>UC300-30GM-E6R2-K-V15</td>
<td></td>
<td>300 mm</td>
<td>68</td>
</tr>
<tr>
<td>UC300-30GM-E7R2-K-V15</td>
<td></td>
<td>300 mm</td>
<td>68</td>
</tr>
<tr>
<td>UC300-30GM-IUR2-K-V15</td>
<td>for installation in confined spaces</td>
<td>500 mm</td>
<td>70</td>
</tr>
<tr>
<td>UC500-30GM-E6R2-V15</td>
<td></td>
<td>1000 mm</td>
<td>72</td>
</tr>
<tr>
<td>UC500-30GM-E7R2-V15</td>
<td></td>
<td>1000 mm</td>
<td>74</td>
</tr>
<tr>
<td>UC500-30GM-EUR2-V15</td>
<td>with chemical resistant transducer coating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UC2000-30GM-E6R2-V15</td>
<td></td>
<td>2000 mm</td>
<td>76</td>
</tr>
<tr>
<td>UC2000-30GM-E7R2-V15</td>
<td></td>
<td>2000 mm</td>
<td>78</td>
</tr>
<tr>
<td>UC2000-30GM-EUR2-V15</td>
<td>extended temperature range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UC4000-30GM-E6R2-V15</td>
<td></td>
<td>4000 mm</td>
<td>80</td>
</tr>
<tr>
<td>UC4000-30GM-E7R2-V15</td>
<td></td>
<td>4000 mm</td>
<td>84</td>
</tr>
<tr>
<td>UC4000-30GM-IUR2-V15</td>
<td></td>
<td>6000 mm</td>
<td>82</td>
</tr>
<tr>
<td>UC6000-30GM-E6R2-V15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UC6000-30GM-E7R2-V15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UC6000-30GM-IUR2-V15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Basic design

<table>
<thead>
<tr>
<th>Model number</th>
<th>Description</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UBE4000-30GM-SA2-V15</td>
<td>Ultrasonic through beam barrier</td>
<td>4000 mm</td>
<td>84</td>
</tr>
<tr>
<td>UB500-30GM-E4-V15</td>
<td></td>
<td>500 mm</td>
<td>86</td>
</tr>
<tr>
<td>UB500-30GM-E5-V15</td>
<td></td>
<td>500 mm</td>
<td></td>
</tr>
<tr>
<td>UB2000-30GM-E4-V15</td>
<td></td>
<td>2000 mm</td>
<td></td>
</tr>
<tr>
<td>UB2000-30GM-E5-V15</td>
<td></td>
<td>2000 mm</td>
<td></td>
</tr>
<tr>
<td>UB4000-30GM-E4-V15</td>
<td></td>
<td>4000 mm</td>
<td>88</td>
</tr>
<tr>
<td>UB4000-30GM-E5-V15</td>
<td></td>
<td>4000 mm</td>
<td></td>
</tr>
<tr>
<td>UB6000-30GM-E4-V15</td>
<td></td>
<td>6000 mm</td>
<td></td>
</tr>
<tr>
<td>UB6000-30GM-E5-V15</td>
<td></td>
<td>6000 mm</td>
<td></td>
</tr>
</tbody>
</table>

#### Ultrasonic sensors for external control units

<table>
<thead>
<tr>
<th>Model number</th>
<th>Description</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UB500-30GM-H3-V1</td>
<td>Emitter/receiver</td>
<td>500 mm</td>
<td>90</td>
</tr>
<tr>
<td>UB2000-30GM-H3-V1</td>
<td></td>
<td>2000 mm</td>
<td></td>
</tr>
<tr>
<td>UB4000-30GM-H3-V1</td>
<td></td>
<td>4000 mm</td>
<td></td>
</tr>
<tr>
<td>UB6000-30GM-H3-V1</td>
<td></td>
<td>6000 mm</td>
<td></td>
</tr>
</tbody>
</table>

For detailed function description, see page 92
## Technical Data

### Ultrasonic sensor

**Model number**

UC300-30GM-IUR2-V15

### Sensing range

15 .. 300 mm

### Adjustment range

15 .. 300 mm

### Unusable area

0 .. 15 mm

### Transducer frequency

approx. 380 kHz

### Response delay

21 ms minimum

### LED green

permanent: Power-on
flashing: Standby mode or TEACH-IN function object detected

### LED yellow 1

permanent: object in evaluation range
flashing: TEACH-IN function

### LED yellow 2

permanent: object in detection range
flashing: TEACH-IN function

### Temperature/TEACH-IN connector

temperature compensation, TEACH-IN for evaluation range, output function setting

### Operating voltage

10 ... 30 V DC, ripple 10 %

### Power consumption

≤ 900 mW

### Output type

1 current output 4 .. 20 mA
1 voltage output 0 .. 10 V

### Repeatability

≤ 0.1 % of full-scale value

### Deviation of the characteristic curve

≤ 0.2 % of full-scale value

### Resolution

evaluation range [mm]/4000, but ≥ 0.05 mm

### Load impedance

current output: ≤ 500 Ohm

Voltage output: > 1000 Ohm

### Temperature influence

≤ 2 % from full-scale value (with temperature compensation)

≤ 0.2 %/K (without temperature compensation)

### Synchronisation

bi-directional

0 level: 4 mA, +1 V

1 level: +4 V, -4 mA

input impedance: > 12 KOhm

synchronisation pulse: ≥ 100 µs, synchronisation interpulse period: ≥ 2 ms

### Standards

EN 60947-5-2

### Ambient temperature

0 .. 70 °C (273 .. 343 K)

### Storage temperature

-40 .. 85 °C (233 .. 358 K)

### Protection degree

IP65

### Connectors

connector V15 (M12 x 1), 5 pin

### Material

housing: stainless steel 1.4303
plastic parts: PBT

### Transducer

epoxy resin/hollow glass sphere mixture; polyurethane barn

### Mass

170 g

---

### Additional Information

- **Very small unusable area**
- **Parameterisation interface for the application-specific adjustment of the sensor setting via the service program ULTRA 2001**
- **Current and voltage output**
- **Synchronisation options**
- **Adjustable acoustic power and sensitivity**
- **Temperature compensation**

---

*Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"*

---

*Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com*
**Dimensions**

![Dimensions Diagram](image)

**Electrical connection**

Standard symbol/Connection:
(version IU)

<table>
<thead>
<tr>
<th>U</th>
<th>1 (BN)</th>
<th>+ Ua</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>(GY)</td>
<td>Sync.</td>
</tr>
<tr>
<td>3</td>
<td>(WH)</td>
<td>0-10 V</td>
</tr>
<tr>
<td>4</td>
<td>(BK)</td>
<td>4-20 mA</td>
</tr>
<tr>
<td>5</td>
<td>(BU)</td>
<td>Ua</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

**Diagrams**

**Characteristic response curve**

- Curve 1: flat surface 100 mm x 100 mm
- Curve 2: round bar, Ø 25 mm

**Programmed analogue output function**

Analogue function

- **Near distance of evaluation**
  - 1) 4 mA/0 V
  - 2) 20 mA/10 V
  - 3) 4 mA/0 V

- **Far distance of evaluation**
  - 20 mA/10 V

Date of edition: 08/18/2005

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
Ultrasonic sensor

UC300-30GM-...-K-V15

- Parameterisation interface for the application-specific adjustment of the sensor setting via the service program ULTRA 2001
- Synchronisation options
- Adjustable acoustic power and sensitivity
- Temperature compensation
- 2 switch outputs freely adjustable
- UC300-30GM-E6R2-K-V15, UC300-30GM-E7R2-K-V15
- Hysteresis mode selectable
- UC300-30GM-E6R2-K-V15, UC300-30GM-E7R2-K-V15
- Window function can be selected
- UC300-30GM-E6R2-K-V15, UC300-30GM-E7R2-K-V15
- Current and voltage output
- UC300-30GM-IUR2-K-V15

Technical Data

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
Dimensions

UC300-30GM-...-K-V15

Electrical connection

Standard symbol/Connection:
(version E8, pnp)

Core colours in accordance with EN 60947-5-2.

Diagrams

Characteristic response curve

Programmed analogue output function

Possible operating modes

1. Switch point mode
When A1 < A2, both switch outputs are activated as N.O. contacts.

2. Window mode
To exchange the switching distances is of no effect.

3. Hysteresis mode
To exchange the switching distances is of no effect.

output version -IUE2

output version -E6R2 and -E7R2
### Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>30 ... 500 mm</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>30 ... 500 mm</td>
</tr>
<tr>
<td>Unusable area</td>
<td>0 ... 30 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 380 kHz</td>
</tr>
<tr>
<td>Response delay</td>
<td>21 ms minimum, 63 ms factory setting</td>
</tr>
<tr>
<td>Focke Ident-Nr.</td>
<td>8763 161</td>
</tr>
<tr>
<td>LED green</td>
<td>permanent: Power-on, flashing: Stand-by mode or TEACH-IN function object detected</td>
</tr>
<tr>
<td>LED yellow 1</td>
<td>permanent: object in evaluation range, flashing: TEACH-IN function</td>
</tr>
<tr>
<td>LED yellow 2</td>
<td>permanent: object in detection range, flashing: TEACH-IN function</td>
</tr>
<tr>
<td>LED red</td>
<td>permanent: temperature/TEACH-IN plug not connected, flashing: fault or TEACH-IN function object not detected</td>
</tr>
<tr>
<td>Temperature/TEACH-IN connector</td>
<td>temperature compensation, TEACH-IN of the switch points, output function setting</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 ... 30 V DC, ripple 10 %</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>≤ 50 mA</td>
</tr>
<tr>
<td>Power consumption</td>
<td>≤ 900 mW</td>
</tr>
<tr>
<td>Output type</td>
<td>1 current output 4 ... 20 mA, 1 voltage output 0 ... 10 V</td>
</tr>
<tr>
<td>2 switch outputs npn, N/O, parameterisable</td>
<td></td>
</tr>
<tr>
<td>2 switch outputs npn, N/C, parameterisable</td>
<td></td>
</tr>
<tr>
<td>Rated operational current</td>
<td>200 mA, short-circuit overload protected</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 2.5 V</td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td>≤ 0.1 % of full-scale value</td>
</tr>
<tr>
<td>Range hysteresis</td>
<td>1 % of the adjusted operating range (default settings), programmably</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>≤ 7 Hz</td>
</tr>
<tr>
<td>Deviation of the characteristic curve</td>
<td>≤ 0.2 % of full-scale value</td>
</tr>
<tr>
<td>Resolution</td>
<td>evaluation range [mm]: 400,000, but ≥ 0.05 mm</td>
</tr>
<tr>
<td>Load impedance</td>
<td>current output: ≤ 500 Ohm, voltage output: ≥ 1000 Ohm</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>≤ 2 % from full-scale value (with temperature compensation)</td>
</tr>
<tr>
<td>≤ 0.2 °C/K (without temperature compensation)</td>
<td></td>
</tr>
<tr>
<td>Synchronisation</td>
<td>bi-directional</td>
</tr>
<tr>
<td>0 level: U2 = +1 V, 1 level: +4 V, U1, input impedance: &gt; 12 kOhm</td>
<td></td>
</tr>
<tr>
<td>Synchronisation pulse: &gt; 100 μs, synchronisation inter-pulse period: ≥ 2 ms</td>
<td></td>
</tr>
<tr>
<td>Common mode operation</td>
<td>≤ 95 Hz</td>
</tr>
<tr>
<td>Multiplex operation</td>
<td>≤ 95 Hz, n = number of sensors</td>
</tr>
<tr>
<td>Interface type</td>
<td>RS 232, 9600 Baud, non parity, 8 data bits, 1 stop bit</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-25 ... 70 °C (268 ... 343 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 85 °C (243 ... 358 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP 65</td>
</tr>
<tr>
<td>Connection</td>
<td>connector V15 (M12 x 1), 5 pin</td>
</tr>
<tr>
<td>Material Housing</td>
<td>stainless steel 1.4303, plastic parts: PBT</td>
</tr>
<tr>
<td>Transducer</td>
<td>epoxy resin/hollow glass sphere mixture; polyurethane foam</td>
</tr>
<tr>
<td>Mass</td>
<td>140 g</td>
</tr>
</tbody>
</table>

Subject to reasonable modifications due to technical advances.

Date of edition: 08/18/2005
**Electrical connection**

**Standard symbol/Connection:**
(version E6, pnp)

<table>
<thead>
<tr>
<th>U</th>
<th>Ua</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(BN)</td>
</tr>
<tr>
<td>2</td>
<td>(GY)</td>
</tr>
<tr>
<td>3</td>
<td>(WH)</td>
</tr>
<tr>
<td>4</td>
<td>(BL)</td>
</tr>
<tr>
<td>5</td>
<td>(GR)</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

**Characteristic response curve**

Distance X [m]

Distance Y [m]

0.00

0.20

0.10

0.05

0.00

-0.05

-0.10

-0.15

-0.20

0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

0.20

0.15

0.10

0.05

0.00

-0.05

-0.10

-0.15

-0.20

Curve 1: flat surface 100 mm x 100 mm

Curve 2: round bar, Ø 25 mm

**Programmed analogue output function**

**Analogue function**

**Near distance of evaluation**

**Far distance of evaluation**

1) 4 mA/0 V

20 mA/10 V

20 mA/10 V

2) 20 mA/10 V

4 mA/0 V

3) 4 mA/0 V

20 mA/10 V

A1= 0 mm

A2

**Possible operating modes**

1. **Switch point mode**

When A1 < A2, both switch outputs are activated as N.O. contacts.

- A 1 (N.O.)
  - Switch output 1
  - Switch output 2

- A 2 (N.O.)
  - Switch output 1
  - Switch output 2

2. **Window mode**

To exchange the switching distances is of no effect.

- A 1 (N.C.)
  - Switch output 1
  - Switch output 2

- A 2 (N.C.)
  - Switch output 1
  - Switch output 2

3. **Hysteresis mode**

To exchange the switching distances is of no effect.

- A 1 (N.O.)
  - Switch output 1
  - Switch output 2

- A 2 (N.C.)
  - Switch output 1
  - Switch output 2

**Output versions**

- E6R2 and -E7R2

- -IUR2

- -E6R2 and -E7R2

**Output version**

- -IUR2
Ultrasonic sensor

- Parameterisation interface for the application-specific adjustment of the sensor setting via the service program ULTRA 2001
- Synchronisation options
- Adjustable acoustic power and sensitivity
- Temperature compensation
- Current and voltage output
- 2 switch outputs freely adjustable
- Hysteresis mode selectable
- Window function can be selected

Model number

Sensing range 80 ... 1000 mm
Adjustment range 120 ... 1000 mm
Unusable area 0 ... 80 mm
Standard target plate 100 mm x 100 mm
Transducer frequency approx. 180 kHz
Response delay 65 ms minimum, 195 ms factory setting
LED green permanent: Power-on, flashing: Standby mode or TEACH-IN function object detected
LED yellow 1 permanent: Object in evaluation range, flashing: TEACH-IN function
LED yellow 2 permanent: Object in detection range, flashing: TEACH-IN function
LED red permanent: Temperature TEACH-IN plug not connected, flashing: fault or TEACH-IN function object not detected
Temperature/TEACH-IN connector temperature compensation, TEACH-IN function
Operating voltage 10 ... 30 V DC, ripple 10 %
Rated operational current ≤ 50 mA
Power consumption ≤ 900 mW
Output type 1 current output 4 ... 20 mA, 1 voltage output 0 ... 10 V
2 switch outputs/pnp, NO/NC, parameterisable
Repeat accuracy ≤ 0.1 % of full-scale value
Rated operational current 200 mA, short-circuit overload protected
Rated operational voltage ≤ 2.5 V
Voltage drop ≤ 0.1 % of full-scale value
Load impedance current output: ≤ 500 Ohm, voltage output: ≤ 1000 Ohm
Temperature influence ≤ 2 % from full-scale value (with temperature compensation)
≤ 0.2 %/K (without temperature compensation)
Synchronisation bi-directional
0 level: 0 V, 1 level: -4 V, +4 V, input impedance: 12 kOhm
synchronisation pulse: 100 µs, synchronisation inter-pulse period: ≥ 2 ms
Common mode operation ≤ 30 Hz
Multiplex operation ≤ 30 mHz, n = number of sensors
Interface type RS 232, 9600 Bits, no parity 8 data bits, 1 stop bit
Standards EN 60947-5-2
Ambient temperature -25 ... 70 °C (248 ... 343 K)
Storage temperature -40 ... 85 °C (233 ... 358 K)
Protection degree sensor head IP67
connector sensor head/controller unit IP22
Connection connector V15 (M12 x 1), 5 pin
Material Housing stainless steel 1.4303, plastic PBT
Transducer epoxy resin/hollow glass sphere mixture, polyurethane foam
Mass 210 g
260 g

Technical Data

Suitable connector cables, mounting aids and more, you can find in chapter *Accessories*

Subject to reasonable modifications due to technical advances.

Date of edition: 08/18/2005
**Dimensions**

![Dimensions Diagram](image)

**Electrical connection**

<table>
<thead>
<tr>
<th>Standard symbol/Connection:</th>
<th>Standard symbol/Connection:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(version E6, pnp)</td>
<td>(version IU)</td>
</tr>
</tbody>
</table>

![Electrical Connection Diagram](image)

**Possible operating modes**

1. **Switch point mode**
   - When $A_1 < A_2$, both switch outputs are activated as N.O. contacts.
   - $A_1$ (N.O.)
   - Switch output 1
   - $A_2$ (N.O.)
   - Switch output 2

2. **Window mode**
   - To exchange the switching distances is of no effect.
   - $A_1$ (N.C.)
   - Switch output 1
   - $A_2$ (N.C.)
   - Switch output 2

3. **Hysteresis mode**
   - To exchange the switching distances is of no effect.
   - $A_1$ (N.O.)
   - Switch output 1
   - $A_2$ (N.C.)
   - Switch output 2

**Programmed analogue output function**

- **Analogue function**
  - **Near distance of evaluation**
    - Curve 1: flat surface 100 mm x 100 mm
    - Curve 2: round bar, Ø 25 mm
  - **Far distance of evaluation**
    - 20 mA/10 V

- **Possible operating modes**
  - **Switch point mode**
    - When $A_1 < A_2$, both switch outputs are activated as N.O. contacts.
  - **Window mode**
    - To exchange the switching distances is of no effect.
  - **Hysteresis mode**
    - To exchange the switching distances is of no effect.

**Temperature probe**

- Temperature probe
- Coded plug

**Diagrams**

**Characteristic response curve**

![Characteristic Response Curve](image)

**Programmed analogue output function**

- **Analogue function**
  - **Near distance of evaluation**
    - 4 mA/0 V
    - 20 mA/10 V
  - **Far distance of evaluation**
    - 4 mA/0 V
    - 20 mA/10 V

**Possible operating modes**

- **Switch point mode**
  - When $A_1 < A_2$, both switch outputs are activated as N.O. contacts.
  - $A_1$ (N.O.)
  - Switch output 1
  - $A_2$ (N.O.)
  - Switch output 2

- **Window mode**
  - To exchange the switching distances is of no effect.
  - $A_1$ (N.C.)
  - Switch output 1
  - $A_2$ (N.C.)
  - Switch output 2

**Hysteresis mode**

- To exchange the switching distances is of no effect.
  - $A_1$ (N.O.)
  - Switch output 1
  - $A_2$ (N.C.)
  - Switch output 2

**Date of edition:** 08/18/2005
Ultrasonic sensor

- High chemical resistance through teflon-coated transducer surface
- Parameterisation interface for the application-specific adjustment of the sensor setting via the service program ULTRA 2001
- Synchronisation options
- Adjustable acoustic power and sensitivity
- Temperature compensation
- Current and voltage output
  - UCC1000-30GM-IUR2-V15
- 2 switch outputs freely adjustable
  - UCC1000-30GM-E6R2-V15
- Hysteresis mode selectable
  - UCC1000-30GM-E6R2-V15
- Window function can be selected
  - UCC1000-30GM-E6R2-V15

Suitable connector cables, mounting aids and more, you can find in chapter *Accessories*.

**Technical Data**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model number</td>
<td>UCC1000-30GM-..R2-V15</td>
</tr>
<tr>
<td>Sensing range</td>
<td>80 ... 1000 mm</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>100 ... 1000 mm</td>
</tr>
<tr>
<td>100 ... 1000 mm</td>
<td></td>
</tr>
<tr>
<td>Unusable area</td>
<td>0 ... 80 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 1.75 kHz</td>
</tr>
<tr>
<td>Response delay</td>
<td>65 ms minimum; 185 ms factory setting</td>
</tr>
<tr>
<td>LED green</td>
<td>permanent: Rove-on, flashing; Standby mode or TEACH-IN function object detected</td>
</tr>
<tr>
<td>LED yellow 1</td>
<td>permanent: object in evaluation range, flashing; TEACH-IN function</td>
</tr>
<tr>
<td>LED yellow 2</td>
<td>permanent: object in detection range, flashing; TEACH-IN function</td>
</tr>
<tr>
<td>Temperature/TEACH-IN connector</td>
<td>temperature compensation, TEACH-IN for evaluation range, output function setting</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 ... 30 VDC, ripple 10 %</td>
</tr>
<tr>
<td>No load supply current</td>
<td>50 mA</td>
</tr>
<tr>
<td>Power consumption</td>
<td>900 mW</td>
</tr>
<tr>
<td>Rated operational current</td>
<td>200 mA, short-circuit overload protected</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 2.5 V</td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td>≤ 0.1 % of full-scale value</td>
</tr>
<tr>
<td>Range hysteresis</td>
<td>1 % of the adjusted operating range (default settings), programmable</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>≤ 2.5 Hz</td>
</tr>
<tr>
<td>Deviation of the characteristic curve</td>
<td>≤ 0.2 % of full-scale value</td>
</tr>
<tr>
<td>Resolution</td>
<td>≤ 0.35 mm</td>
</tr>
<tr>
<td>Load impedance</td>
<td>current output ≤ 500 Ohm, voltage output ≤ 1000 Ohm</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>≤ 2 % from full-scale value with temperature compensation</td>
</tr>
<tr>
<td>Synchronisation</td>
<td>0 level: Tp = 1 V, 1 level: +4 V, +Ud, input impedance ≥ 12 KOhm</td>
</tr>
<tr>
<td>Common mode operation</td>
<td>≤ 30 Hz</td>
</tr>
<tr>
<td>Multiplex operation</td>
<td>≤ 30 Hz, n = number of sensors</td>
</tr>
<tr>
<td>Interface type</td>
<td>RS 232, 9600 Bits, no parity, 8 data bits, 1 stop bit</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60347-22</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0 ... 70 °C (273 ... 343 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 85 °C (233 ... 356 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
</tr>
<tr>
<td>Connector</td>
<td>connector V15 (M12 x 1), 5 pin</td>
</tr>
<tr>
<td>Housing</td>
<td>stainless steel 1.4305, plastic parts: PBT</td>
</tr>
<tr>
<td>Transducer</td>
<td>epoxy resin/hollow glass sphere mixture; polyurethane foam</td>
</tr>
<tr>
<td>Mass</td>
<td>140 g</td>
</tr>
<tr>
<td></td>
<td>170 g</td>
</tr>
</tbody>
</table>
Dimensions

![Image of dimensions](null)

**UCC1000-30GM-..R2-V15**

**Electrical connection**

Standard symbol/Connection:

- **UCC1000-30GM-..R2-V15**
  - Output version -E6R2
  - Output version -IUR2

Core colours in accordance with EN 60947-5-2.

**Diagrams**

**Characteristic response curves**

- Curve 1: flat plate 100 mm x 100 mm
- Curve 2: round bar, Ø 25 mm

**Programmed switching output function**

Position of insert
- Switch output 1
- Switch output 2

**Programmed analogue output function**

Analogue function
- Near distance of evaluation
- Far distance of evaluation

- 4 mA/0 V
- 20 mA/10 V
- 4 mA/0 V
- 20 mA/10 V

**Date of edition:** 08/18/2005

Subject to reasonable modifications due to technical advances.
Ultrasonic sensor

**UC2000-30GM-...-V15**

- Parameterisation interface for the application-specific adjustment of the sensor setting via the service program ULTRA 2001
- Synchronisation options
- Adjustable acoustic power and sensitivity
- Temperature compensation
- 2 switch outputs freely adjustable
- Hysteresis mode selectable
- Window function can be selected
- Current and voltage output
  - UC2000-30GM-IUR2-V15

### Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>80...2000 mm</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>120...2000 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 180 kHz</td>
</tr>
<tr>
<td>Response delay</td>
<td>65 ms minimum, 195 ms factory setting</td>
</tr>
<tr>
<td>LED green</td>
<td>permanent: Power-on, flashing: Standby mode or TEACH-IN function object detected</td>
</tr>
<tr>
<td>LED yellow 1</td>
<td>permanent: object in evaluation range, flashing: TEACH-IN function</td>
</tr>
<tr>
<td>LED yellow 2</td>
<td>permanent: switching state switch output 2, flashing: TEACH-IN function</td>
</tr>
<tr>
<td>Temperature/TEACH-IN connector</td>
<td>temperature compensation, TEACH-IN of the switch points, output function setting</td>
</tr>
<tr>
<td>Power consumption</td>
<td>≤50 mA</td>
</tr>
<tr>
<td>Output type</td>
<td>1 current output 4...20 mA, 1 voltage output 0...10 V</td>
</tr>
<tr>
<td>Rated operational current</td>
<td>≤2.5 V</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>≤2.5 Hz</td>
</tr>
<tr>
<td>Deviation of the characteristic curve</td>
<td>≤0.2 % of full-scale value</td>
</tr>
<tr>
<td>Resolution</td>
<td>evaluation range [mm]=4000, but ≤0.35 mm</td>
</tr>
<tr>
<td>Load impedance</td>
<td>current output: ≤500 Ohm, voltage output: ≤1000 Ohm</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>≤2 % from full-scale value (with temperature compensation)</td>
</tr>
<tr>
<td>Synchronisation</td>
<td>bi-directional</td>
</tr>
<tr>
<td>Common mode operation</td>
<td>0 level: -Ug, 1 level: +4 V, input impedance: &gt;12 KΩ</td>
</tr>
<tr>
<td>Multiplex operation</td>
<td>≤30 MHz, n = number of sensors</td>
</tr>
<tr>
<td>Interface type</td>
<td>RS232, 9600 Baud, no parity, 8 data bits, 1 stop bit</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-25...70 °C (248...343 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40...85 °C (233...358 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
</tr>
<tr>
<td>Connection</td>
<td>connector V15 (M12 x 1), 5 pin</td>
</tr>
<tr>
<td>Material</td>
<td>stainless steel 1.4303, plastic parts PBT</td>
</tr>
<tr>
<td>Transducer</td>
<td>epoxy resin/hollow glass sphere mixture, polyurethane, barn</td>
</tr>
<tr>
<td>Mass</td>
<td>140 g</td>
</tr>
</tbody>
</table>

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories".
**Electrical connection**

**Characteristic response curve**

**Programmed analogue output function**

**Possible operating modes**

1. **Switch point mode**
   - When $A_1 < A_2$, both switch outputs are activated as N.O. contacts.

2. **Window mode**
   - To exchange the switching distances is of no effect.

3. **Hysteresis mode**
   - To exchange the switching distances is of no effect.

**Output versions** - E6R2 and - E7R2

**Output version** - IUR2
Ultrasonic sensor

- Parameterisation interface for the application-specific adjustment of the sensor setting via the service program ULTRA 2001
- Synchronisation options
- Adjustable acoustic power and sensitivity
- Temperature compensation
- 2 switch outputs freely adjustable
- Hysteresis mode selectable
- Window function can be selected
- Current and voltage output

Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UC2000-30GM-...-T-V15</th>
</tr>
</thead>
</table>

- Sensing range: 80 ... 2000 mm
- Adjustment range: 1200 ... 2000 mm
- Standard target plate: 100 mm x 100 mm
- Transducer frequency: approx. 175 kHz
- Response delay: 65 ms minimum, 195 ms factory setting
- LED green: permanent: Power-on, flashing: Standby mode or TEACH-IN function object detected
- LED yellow 1: permanent: object in evaluation range, flashing: TEACH-IN function
- LED yellow 2: permanent: object in detection range, flashing: TEACH-IN function
- Temperature/TEACH-IN connector: temperature compensation, TEACH-IN for evaluation range, output function setting

Operating voltage: 10 ... 30 V DC, ripple 10 %
- No-load supply current: ≤ 50 mA
- Power consumption: ≤ 300 mW
- Output type: 1 current output 4 ... 20 mA, 1 voltage output 0 ... 10 V
- Rated operational current: 200 mA, short-circuit overload protected
- Voltage drop: ≤ 2.5 V
- Response accuracy: ≤ 0.1 % of full-scale value
- Range hysteresis: 1 % of the adjusted operating range (default settings), programmable
- Switching frequency: ≤ 2.5 Hz
- Deviation of the characteristic curve: ≤ 0.2 % of full-scale value
- Resolution: evaluation range [mm]: 1000, but ≥ 0.35 mm
- Load impedance: current output: ≤ 500 Ohm, voltage output: ≥ 1000 Ohm
- Temperature influence: ≤ 2 % of full-scale value (with temperature compensation)
- Synchronisation: bi-directional
- Common mode operation: ≤ 30 Hz
- Multiplex operation: ≤ 300 Hz, n = number of sensors
- Interface type: RS 232, 9600 Baud, no parity, 8 data bits, 1 stop bit
- Standards: EN 60947-5-2
- Ambient temperature: -25 ... 70 °C (248 ... 343 K)
- Storage temperature: -40 ... 85 °C (248 ... 343 K)
- Protection degree: IP65
- Material:
  - Housing: stainless steel 1.4301, plastic parts: PBT
  - Transducer: epoxy resin/hollow glass sphere mixture, polyurethane bim
  - Mass: 180 g

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
### Electrical connection

**Standard symbol/Connection:**
(version E6, pnp)

```
U
```

- **U**: Sync.
- Switch output 1
- Switch output 2

Core colours in accordance with EN 60947-5-2.

**Standard symbol/Connection:**
(version E7, npn)

```
U
```

- **U**: Switch output 1
- Switch output 2
- Sync.

Core colours in accordance with EN 60947-5-2.

**Standard symbol/Connection:**
(version IU)

```
U
```

- **U**: Sync.
- **U**: 0-10 V
- **U**: 4-20 mA

Core colours in accordance with EN 60947-5-2.

### Diagrams

#### Characteristic response curve

Curve 1: Flat surface 100 mm x 100 mm
Curve 2: Round bar, Ø 25 mm

#### Programmed analogue output function

**Analogue function**

- Near distance of evaluation
  - 1) 4 mA / 0 V
  - 2) 20 mA / 10 V
- Far distance of evaluation
  - 3) 4 mA / 0 V

**Possible operating modes**

1. **Switch point mode**
   - When A1 < A2, both switch outputs are activated as N.O. contacts.
   - A1 (N.O.) Switch output 1
   - A2 (N.O.) Switch output 2

2. **Window mode**
   - To exchange the switching distances is of no effect.
   - A1 (N.O.) Switch output 1
   - A2 (N.C.) Switch output 2

3. **Hysteresis mode**
   - To exchange the switching distances is of no effect.
   - A1 (N.O.) Switch output 1
   - A2 (N.C.) Switch output 2

**Possible operating modes**

- Switch point 1
- Switch point 2

#### Accessories

- Double sheet monitoring
- Control unit
- Power supply
- Temperature probe
- Coded plug

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### Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UC4000-30GM-...-V15</th>
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<tbody>
<tr>
<td>Sensing range</td>
<td>200...4000 mm</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>340...4000 mm</td>
</tr>
<tr>
<td>Unusable area</td>
<td>0...200 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 85 kHz</td>
</tr>
<tr>
<td>Response delay</td>
<td>145 ms minimum, 440 ms factory setting</td>
</tr>
<tr>
<td>LED green</td>
<td>permanent: Power-on, flashing: Standby mode or TEACH-IN function detected</td>
</tr>
<tr>
<td>LED yellow1</td>
<td>permanent: object in evaluation range, flashing: TEACH-IN function</td>
</tr>
<tr>
<td>LED yellow2</td>
<td>permanent: switching state switch output 1, flashing: TEACH-IN function</td>
</tr>
<tr>
<td>LED red</td>
<td>permanent: temperature/TEACH-IN plug not connected, flashing: fault or TEACH-IN function object not detected</td>
</tr>
<tr>
<td>Temperature/TEACH-IN connector</td>
<td>temperature compensation, TEACH-IN of the switch points, output function setting</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10...30 V DC, ripple 10 %SS</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>&lt; 50 mA</td>
</tr>
<tr>
<td>Power consumption</td>
<td>&lt; 900 mW</td>
</tr>
<tr>
<td>Output type</td>
<td>1 current output 4...20 mA, 1 voltage output 0...10 V</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>2 switch outputs, NO/NC, parameterisable</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 2.5 V</td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td>≤ 0.1 % of full-scale value</td>
</tr>
<tr>
<td>Range hysteresis</td>
<td>1 % of the adjusted operating range (default settings), programmable</td>
</tr>
<tr>
<td>Deviations of the characteristic curve</td>
<td>≤ 1 Hz</td>
</tr>
<tr>
<td>Resolution</td>
<td>≤ 0.2 % of full-scale value</td>
</tr>
<tr>
<td>Load impedance</td>
<td>current output: ≤ 500 Ohm, voltage output: ≥ 1000 Ohm</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>≤ ± 2 % from full-scale value (with temperature compensation)</td>
</tr>
<tr>
<td>Synchronisation</td>
<td>temperature compensation, TEACH-IN of the switch points, output function setting</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 0.2 % of full-scale value (without temperature compensation)</td>
</tr>
<tr>
<td>Synchronisation pulse</td>
<td>0 level, U₀, input impedance: &gt; 12 kOhm</td>
</tr>
<tr>
<td>Synchronisation interpulse period</td>
<td>&gt; 2 ms</td>
</tr>
</tbody>
</table>

### Accessories

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
Electrical connection

Standard symbol/Connection:
(version E6, pnp)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tr>
<td>4</td>
<td>(BU)</td>
<td>(BU)</td>
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<tr>
<td>5</td>
<td>(GY)</td>
<td>(GY)</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connection:
(version E7, npn)

<p>| | | |</p>
<table>
<thead>
<tr>
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<th></th>
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</thead>
<tbody>
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<td>3</td>
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<td>(BR)</td>
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<tr>
<td>4</td>
<td>(BU)</td>
<td>(BU)</td>
</tr>
<tr>
<td>5</td>
<td>(GY)</td>
<td>(GY)</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

Programmed analogue output function

Analogue function
Near distance<br>Far distance of evaluation of evaluation
1) 4 mA/<br>20 mA/10 V 0 V
2) 20 mA/<br>4 mA/0 V 10 V 0 V
3) 4 mA/<br>20 mA/10 V 0 V

A1= 0 mm A2

Possible operating modes
1. Switch point mode
When A1 < A2, both switch outputs are activated as N.O. contacts.
When A1 > A2, both switch outputs are activated as N.C. contacts.

2. Window mode
To exchange the switching distances is of no effect.

3. Hysteresis mode
To exchange the switching distances is of no effect.

Characteristic response curve

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

output version -IUR2
output versions -E6R2 and E7R2
Technical Data

Model number

- UC6000-30GM-...-V15
- UC6000-30GM-EB90-V15
- UC6000-30GM-E7R2-V15
- UC6000-30GM-IUR2-V15
- UC6000-30GM-E6R2-V15
- UC6000-30GM-E7R2-V15
- UC6000-30GM-IUR2-V15

Sensing range 350...6000 mm
Adjustment range 400...6000 mm
Unusable area 0...350 mm
Standard target plate 100 mm x 100 mm
Transducer frequency 85 kHz
Response delay 285 ms minimum, 850 ms factory setting
LED green permanent: Power-on, flashing: Standby mode or TEACH-IN function object detected
LED yellow 1 permanent: object in evaluation range, flashing: TEACH-IN function
permanent: switching state switch output 2, flashing: TEACH-IN function
LED yellow 2 permanent: object in detection range, flashing: TEACH-IN function
permanent: switching state switch output 1, flashing: TEACH-IN function
LED red permanent: temperature/TEACH-IN plug not connected, flashing: fault or TEACH-IN function object not detected
Temperature/TEACH-IN connector temperature compensation, TEACH-IN of the switch points, output function setting
No-load supply current ≤ 50 mA
Power consumption ≤ 900 mW
Output type 1 current output 4...20 mA, 1 voltage output 0...10 V
2 switch outputs npn, NO/NC, parameterisable
2 switch outputs npn, NO/NC, parameterisable
Rated operational current 200 mA, short-circuit overload protected
Voltage drop ≤ 2.5 V
Repeat accuracy ≤ 0.1 % of full-scale value
Range hysteresis 1 % of the adjusted operating range (default settings), programmable
Deviation of the characteristic curve ≤ 0.2 % of full-scale value
Resolution evaluation range [mm] 40000, but ≤ 0.35 mm
Load impedance current output ≤ 500 Ohm, voltage output ≤ 1000 Ohm
Temperature influence ≤ 0.2 %/K (without temperature compensation)
Synchronisation bi-directional 0 level: U0h = +1 V, 1 level: +4 V, U0l, input impedance > 12 KOhm
synchronisation pulse ≤ 100 µs, synchronisation interpulse period ≥ 2 ms
Common mode operation ≤ 7 Hz
Multiplex operation ≤ 7/n Hz; n = number of sensors
Interface type RS 232, 9600 Bits, no parity, 8 data bits, 1 stop bit
Standards EN 60947-5-2
Ambient temperature -25 ... 70 °C (248 ... 343 K)
Storage temperature -40 ... 85 °C (233 ... 358 K)
Protection degree IP65
Connection connector V15 (M12 x 1), 5 pin
Material stainless steel 1.4033, plastic parts PBT
Transducer epoxy resin/hollow glass sphere mixture, polyurethane barn
Mass 270 g

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Accessories

UC6000-30GM-...-V15
- UC6000-30GM-EB90-V15
- UC6000-30GM-E7R2-V15
- UC6000-30GM-IUR2-V15
- UC6000-30GM-E6R2-V15
- UC6000-30GM-E7R2-V15
- UC6000-30GM-IUR2-V15
Electrical connection

Standard symbol/Connection:
(version E6, pnp)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>Switch output 1</td>
</tr>
<tr>
<td>B</td>
<td>Switch output 2</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connection:
(version E7, npn)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>Switch output 1</td>
</tr>
<tr>
<td>B</td>
<td>Switch output 2</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connection:
(version IU)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>Switch output 1</td>
</tr>
<tr>
<td>B</td>
<td>Switch output 2</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

Diagrams

Characteristic response curve

Programmed analogue output function

Analogue function

1) 4 mA/0 V
   Near distance of evaluation
   20 mA/10 V
   Far distance of evaluation

2) 20 mA/10 V
   4 mA/0 V

3) 4 mA/0 V
   A1 = 0 mm
   A2
   20 mA/10 V

Possible operating modes

1. Switch point mode
   When A1 < A2, both switch outputs are activated as N.O. contacts.
   A1 (N.O.)
   Switch output 1
   A2 (N.O.)
   Switch output 2

2. Window mode
   To exchange the switching distances is of no effect.
   A1 (N.C.)
   Switch output 1
   A2 (N.C.)
   Switch output 2

3. Hysteresis mode
   To exchange the switching distances is of no effect.
   A1 (N.O.)
   Switch output 1

output version -IUR2

output versions -E6R2 and -E7R2
### Technical Data

#### Through-beam ultrasonic barrier

**UBE4000-30GM-SA2-V15**

- **Model number**: UBE 4000-30GM-SA2-V15

**Through-beam mode**: Single path ultrasonic switch

**Sensing range**: 0 ... 4000 mm, distance emitter-receiver 500 mm ... 4000 mm

**Transducer frequency**: 85 kHz

**Reference target**: receiver

**Through-beam mode**: Single path ultrasonic switch

**LED green**: alignment aid

**OFF**: no ultrasonic signal

**ON**: positive reception

**LED yellow**: switching state

**ON**: positive reception

**Switching frequency**: ≤ 15 Hz

**Switch-on delay**: 100 ... 3000 ms

**Operational voltage**: 18 ... 30 V DC, ripple 10 %

**No-load supply current**: 35 mA emitter

25 mA receiver

**Output type**: 2 switch outputs, normally open/closed (complementary)

**Rated operational current**: 200 mA

**Voltage drop**: ≤ 2.5 V

**Standards**: EN 60947-5-2

UL listed: 57M3, IND CONT. EQ., "Powered by Class 2 Power Source"

**Ambient temperature**: 0 ... 60 °C (273 ... 333 K)

**Storage temperature**: -40 ... 85 °C (233 ... 358 K)

**Protection degree**: IP65

**Connection**: connector V15 (M12 x 1), 5 pin

**Material**: brass, nickel-plated, plastic components PBT

**Housing**: 160 g each sensor

**Suitable connectors, mounting aids and more, you can find in chapter "Accessories"**
Dimensions

Dimensions:

Threaded pipe M30x1.5

Emitter: LED green

Internal distance regulator

Receiver: Dual-LED green/yellow

Plug connector

Potentiometer ON delay

Electrical connection

Standard symbol/Connection:
(version A2, pnp)

Receiver:

Emitter:

Core colours in accordance with EN 60947-5-2.

Diagrams

Characteristic response curves

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
## Ultrasonic Sensor

**Model number**: UB-30GM-V15

- **Sensing range**: 30 ... 500 mm
- **Adjustment range**: 120 ... 2000 mm
- **Unusable area**: 0 ... 30 mm
- **Standard target plate**: 100 mm x 100 mm
- **Transducer frequency**: approx. 180 kHz
- **Response delay**: approx. 150 ms
- **LED green**
  - Permanent: Power-on
  - Flashing: TEACH-IN function object detected
- **LED yellow**
  - Permanent: Switching state switch output
  - Flashing: TEACH-IN function
- **LED red**
  - Normal operation: "fault"
  - TEACH-IN function: no object detected
- **Operating voltage**: 10 ... 30 V DC, ripple 10 %
- **No-load supply current**: ≤ 50 mA
- **Output type**: 1 switch output E4, npn NO/NC, parameterisable
  - 1 switch output E5, pnp NO/NC, parameterisable
- **Rated operational current**: 200 mA, short-circuit overloaded protected
- **Voltage drop**: ≤ 2.5 V
- **Repeat accuracy**: ≤ 0.5 % of switching point
- **Range hysteresis**: 1 % of the set operating distance
- **Switching frequency**: ≤ 10 Hz
- **Temperature influence**: ≤ 2 % of full-scale value
- **Input type**: 1 TEACH-IN input
  - Operating range 1: -U0 ... +1 V, operating range 2: +4 V ... +U0
  - Input impedance: > 47 kΩ, TEACH-IN pulse: ≥ 1 s
- **Synchronisation**: bi-directional
  - 0 level: -U0 ... +1 V
  - 1 level: +4 V ... +U0
  - Input impedance: > 12 KΩ
  - Synchronisation pulse: ≥ 100 µs, synchronisation inter-pulse period: ≥ 2 ms
- **Common mode operation**: ≤ 30 Hz
  - ≤ 95 Hz
- **Multiplex operation**: ≤ 300 Hz, n = number of sensors
  - ≤ 950 Hz, n = number of sensors
- **Standards**: EN 60 - 947-5 - 2
- **Environmental temperature**: -25 ... 70 °C (248 ... 343 K)
- **Storage temperature**: -40 ... 85 °C (233 ... 358 K)
- **Protection degree**: IP65
- **Connection**: connector V15 (M12 x 1), 5 pin
- **Material**: housing: brass, nickel-plated, plastic components PBT
- **Transducer**: epoxy resin/hollow glass sphere mixture; polyurethane foam
- **Mass**: 135 g, 140 g

**Technical Data**

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<tr>
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<tbody>
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<td>Sensing range</td>
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<tr>
<td>Adjustment range</td>
<td>120 ... 2000 mm</td>
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<tr>
<td>Unusable area</td>
<td>0 ... 30 mm</td>
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<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
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<tr>
<td>Transducer frequency</td>
<td>approx. 180 kHz</td>
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<tr>
<td>Response delay</td>
<td>approx. 150 ms</td>
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<tr>
<td>LED green</td>
<td>Permanent: Power-on</td>
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<td></td>
</tr>
<tr>
<td>LED yellow</td>
<td>Permanent: Switching state switch output</td>
<td></td>
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<tr>
<td>LED red</td>
<td>Normal operation: &quot;fault&quot;</td>
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<tr>
<td>Operating voltage</td>
<td>10 ... 30 V DC, ripple 10 %</td>
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<tr>
<td>No-load supply current</td>
<td>≤ 50 mA</td>
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<td>Output type</td>
<td>1 switch output E4, npn NO/NC, parameterisable</td>
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<tr>
<td>Rated operational current</td>
<td>200 mA, short-circuit overloaded protected</td>
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<td></td>
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<tr>
<td>Voltage drop</td>
<td>≤ 2.5 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td>≤ 0.5 % of switching point</td>
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<tr>
<td>Range hysteresis</td>
<td>1 % of the set operating distance</td>
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<tr>
<td>Switching frequency</td>
<td>≤ 10 Hz</td>
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<tr>
<td>Temperature influence</td>
<td>≤ 2 % of full-scale value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input type</td>
<td>1 TEACH-IN input</td>
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<tr>
<td>Synchronisation</td>
<td>Bi-directional</td>
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<tr>
<td>Common mode operation</td>
<td>≤ 30 Hz</td>
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<td></td>
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</tr>
<tr>
<td>Multiplex operation</td>
<td>≤ 300 Hz, n = number of sensors</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Environmental temperature</td>
<td>-25 ... 70 °C (248 ... 343 K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection</td>
<td>Connector V15 (M12 x 1), 5 pin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Housing: brass, nickel-plated, plastic components PBT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transducer</td>
<td>Epoxy resin/hollow glass sphere mixture; polyurethane foam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>135 g, 140 g</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Dimensions**

![Dimensions Diagram]

**Electrical connection**

<table>
<thead>
<tr>
<th>Standard symbol/Connections: (version E4, npn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Connections Diagram]</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

**Diagrams**

**Characteristic response curve**

- Curve 1: flat surface 100 mm x 100 mm
- Curve 2: round bar, Ø 25 mm

**Programmed switching output function**

1. Window mode, normally open function
   - $A_1 < A_2$
   - $A_1 \rightarrow \infty$
   - $A_2 \rightarrow \infty$: Detection of object presence
   - Object detected: Switch output closed
   - No object detected: Switch output open

2. Window mode, normally closed function
   - $A_2 < A_1$
   - $A_2 \rightarrow \infty$
   - $A_1 \rightarrow \infty$

3. One switch point, normally open function
   - $A_1 \rightarrow \infty$

4. One switch point, normally closed function
   - $A_2 \rightarrow \infty$

5. $A_1 \rightarrow \infty$, $A_2 \rightarrow \infty$: Detection of object presence

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Ultrasonic sensor

- Switch output
- 5 different output functions can be set
- TEACH-IN input
- Synchronisation options
- Deactivation option
- Temperature compensation
- Insensitive to compressed air

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"

Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
<th>Model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>200 ... 4000 mm</td>
<td>UB4000-30GM-E4-V15</td>
</tr>
<tr>
<td></td>
<td>350 ... 6000 mm</td>
<td>UB4000-30GM-E5-V15</td>
</tr>
<tr>
<td></td>
<td>400 ... 4000 mm</td>
<td>UB6000-30GM-E4-V15</td>
</tr>
<tr>
<td></td>
<td>450 ... 6000 mm</td>
<td>UB6000-30GM-E5-V15</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>240 ... 4000 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>400 ... 6000 mm</td>
<td></td>
</tr>
<tr>
<td>Unusable area</td>
<td>0 ... 200 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 ... 350 mm</td>
<td></td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
<td></td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 65 kHz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>approx. 85 kHz</td>
<td></td>
</tr>
<tr>
<td>Response delay</td>
<td>approx. 325 ms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>approx. 650 ms</td>
<td></td>
</tr>
<tr>
<td>LED green</td>
<td>permanent: On</td>
<td></td>
</tr>
<tr>
<td></td>
<td>flashing: TEACH-IN function emitted</td>
<td></td>
</tr>
<tr>
<td>LED yellow</td>
<td>permanent: Switch state switch output</td>
<td></td>
</tr>
<tr>
<td></td>
<td>flashing: TEACH-IN function emitted</td>
<td></td>
</tr>
<tr>
<td>LED red</td>
<td>normal operation: &quot;but&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TEACH-IN function: no object detected</td>
<td></td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 ... 30 V DC, ripple 10 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+1 V, operating range 1: -UB ... +1 V</td>
<td></td>
</tr>
<tr>
<td>No-load supply current</td>
<td>≤ 50 mA</td>
<td></td>
</tr>
<tr>
<td>Output type</td>
<td>1 switch output: E4, pnp N/O, parameterisable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 switch output: E5, npn N/O, parameterisable</td>
<td></td>
</tr>
<tr>
<td>Rated operational current</td>
<td>≤ 200 mA, short-circuit overload protected</td>
<td></td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 2,5 V</td>
<td></td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td>≤ 0,5 % of switching point</td>
<td></td>
</tr>
<tr>
<td>Range hysteresis</td>
<td>≤ 1 % of the set operating distance</td>
<td></td>
</tr>
<tr>
<td>Switching frequency</td>
<td>≤ 0,8 Hz</td>
<td></td>
</tr>
<tr>
<td>Temperature influence</td>
<td>≤ 1,5 Hz</td>
<td></td>
</tr>
<tr>
<td>Input type</td>
<td>1 TEACH-IN input</td>
<td></td>
</tr>
<tr>
<td></td>
<td>operating range 1: -UB ... +1 V, operating range 2: +4 V ... +UB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>input impedance &gt; 47 kΩ, TEACH-IN pulse ≥ 1 s</td>
<td></td>
</tr>
<tr>
<td>Synchronisation</td>
<td>bidirectional</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 level: -UB, 1 level: +1 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 level: -4 V, -UB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>input impedance &gt; 12 kΩ, synchronisation pulse ≥ 100 µs, synchronisation interpulse period ≥ 2 ms</td>
<td></td>
</tr>
<tr>
<td>Common mode operation</td>
<td>≤ 13 Hz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤ 7 Hz</td>
<td></td>
</tr>
<tr>
<td>Multiplex operation</td>
<td>≤ 13 Hz, n = number of sensors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤ 7 Hz, n = number of sensors</td>
<td></td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-52</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-25 ... 70 °C (248 ... 343 K)</td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
<td></td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
<td></td>
</tr>
<tr>
<td>Connection</td>
<td>connector V15 (M12 x 1), 5 pin</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Brass, nickel-plated, plastic components PBT</td>
<td></td>
</tr>
<tr>
<td>Transducer</td>
<td>Epoxy resin/fillor glass sphere mixture, polyurethane foam</td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>180 g</td>
<td></td>
</tr>
<tr>
<td></td>
<td>250 g</td>
<td></td>
</tr>
</tbody>
</table>
**Dimensions**

UB4000-30GM...

UB6000-30GM...

**Electrical connection**

Standard symbol/Connections: (version E4, npn)

<table>
<thead>
<tr>
<th>1</th>
<th>(BN)</th>
<th>U_A</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>(WN)</td>
<td>Teaching input</td>
</tr>
<tr>
<td>3</td>
<td>(RL)</td>
<td>Synchronous</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections: (version E5, pnp)

<table>
<thead>
<tr>
<th>1</th>
<th>(BN)</th>
<th>U_A</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>(WH)</td>
<td>Teaching input</td>
</tr>
<tr>
<td>3</td>
<td>(RL)</td>
<td>Synchronous</td>
</tr>
<tr>
<td>4</td>
<td>(BU)</td>
<td>Switch output</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

**Characteristic response curve**

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

**Programmed switching output function**

1. Window mode, normally open function
A1 < A2:

2. Window mode, normally closed function
A2 < A1:

3. One switch point, normally open function
A1 -> ∞:

4. One switch point, normally closed function
A2 -> ∞:

5. A1 -> ∞, A2 -> ∞: Detection of object presence
Object detected: Switch output closed
No object detected: Switch output open
**Technical Data**

<table>
<thead>
<tr>
<th>Model number</th>
<th>UB...-30GMH3-V1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>200 ... 4000 mm</td>
</tr>
<tr>
<td></td>
<td>30 ... 500 mm</td>
</tr>
<tr>
<td></td>
<td>350 ... 6000 mm</td>
</tr>
<tr>
<td></td>
<td>80 ... 2000 mm</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>120 ... 2000 mm</td>
</tr>
<tr>
<td></td>
<td>240 ... 4000 mm</td>
</tr>
<tr>
<td></td>
<td>400 ... 6000 mm</td>
</tr>
<tr>
<td></td>
<td>50 ... 500 mm</td>
</tr>
<tr>
<td>Unusable area</td>
<td>0 ... 200 mm</td>
</tr>
<tr>
<td></td>
<td>0 ... 30 mm</td>
</tr>
<tr>
<td></td>
<td>0 ... 350 mm</td>
</tr>
<tr>
<td></td>
<td>0 ... 80 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. [kHz]</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 ... 30 V DC, ripple ≤ 10 %</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>≤ 30 mA</td>
</tr>
<tr>
<td>Output type</td>
<td>1 pulse output for echo run time, short-circuit proof</td>
</tr>
<tr>
<td>Rated operational current</td>
<td>15 mA, short-circuit overload protected</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>the echo propagation time: 0.17 %/ K</td>
</tr>
<tr>
<td>Input type</td>
<td>1 pulse input for transmitter pulse (clock)</td>
</tr>
<tr>
<td>Pulse length</td>
<td>20 ... 300 µs (typ. 200 µs)</td>
</tr>
<tr>
<td></td>
<td>40 ... 600 µs (typ. 500 µs)</td>
</tr>
<tr>
<td></td>
<td>5 ... 100 µs (typ. 50 µs)</td>
</tr>
<tr>
<td></td>
<td>50 ... 700 µs (typ. 500 µs)</td>
</tr>
<tr>
<td>Impedance</td>
<td>≥ 50 x pulse length</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-25 ... +60 °C (248 ... 358 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... +85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP67</td>
</tr>
<tr>
<td>Connection</td>
<td>V1 connector (M12 x 1), 4pin</td>
</tr>
<tr>
<td>Housing</td>
<td>brass, nickel-plated, plastic components PBT</td>
</tr>
<tr>
<td>Transducer</td>
<td>epoxy resin/hollow glass sphere mixture, polyurethane barrier</td>
</tr>
<tr>
<td>Mass</td>
<td>140 g</td>
</tr>
<tr>
<td></td>
<td>180 g</td>
</tr>
<tr>
<td></td>
<td>250 g</td>
</tr>
</tbody>
</table>

**Function**

The sensing range is determined in the downstream evaluation electronics (e.g. the units UH3-KHD2-4E5, UH3-KHD2-4OR UH3-T1-KT). PLC modules or other existing evaluation units can also be substituted for these units offered by Pepperl+Fichs.

The object distance in pulse-echo mode is obtained from the echo time.

1) The unusable area (blind range) BR depends on the pulse duration $T_p$.
   
   The unusable area reaches a minimum with the shortest pulse duration.

2) The sensors detection range depends on the pulse duration $T_p$.
   
   With pulse duration < typical pulse duration, the sensors detection range may be reduced.

---

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Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
Dimensions

Electrical connection

Standard symbol/Connection:

<table>
<thead>
<tr>
<th>Standard symbol/Connection:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Emitter pulse input</td>
</tr>
<tr>
<td>2 = Echo propagation time output</td>
</tr>
</tbody>
</table>

Core colours in accordance with EN 60947-5-2.

Diagrams

Characteristic response curves

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Characteristics response curves

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Characteristics response curves

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Characteristics response curves

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Date of edition: 08/18/2005

Subject to reasonable modifications due to technical advances.
Description of the sensor functions

This ultrasonic sensor features a four-pole temperature/TEACH-IN plug, that can be connected in four different positions. These have the following significance.

<table>
<thead>
<tr>
<th>Plug position</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>TEACH-IN evaluation limit A1</td>
</tr>
<tr>
<td>A2</td>
<td>TEACH-IN evaluation limit A2</td>
</tr>
<tr>
<td>E2/E3</td>
<td>Rising/falling ramp/output characteristic of</td>
</tr>
<tr>
<td></td>
<td>the voltage output by zero point</td>
</tr>
<tr>
<td>T</td>
<td>Temperature compensation</td>
</tr>
</tbody>
</table>

Description of the TEACH-IN procedure

**TEACH-IN the evaluation limits 1 or 2**

- Cut supply voltage
- Remove TEACH-IN plug
- Restore supply voltage (Reset)
- Set object to desired switching point
- Plug and remove the TEACH-IN plug in pos. A1 or A2. This teaches the evaluation limits A1 or A2.
  
  **Caution:** Removing the temperature/TEACH-IN plug, the values of the object position will be adopted.

  - The TEACH-IN procedure is controlled with the LED. The green LED flashes, when object is detected, the red LED flashes when no object is detected.
  
  - Connect TEACH-IN plug in pos. T. This completes the TEACH-IN procedure and saves the distance.

  - The sensor works in normal mode

**TEACH-IN the analogue function**

- Cut supply voltage
- Remove TEACH-IN plug
- Restore supply voltage (Reset)
- Connect TEACH-IN plug in pos. E2/E3. By multiple plugging, three different modes of operation can be set in cyclical sequence:
  1) rising ramp, LED A2 flashes,
  2) falling ramp, LED A1 flashes,
  3) zero line, LED A1 and A2 flash
- Connect TEACH-IN plug in pos. T. This completes the TEACH-IN procedure and saves the mode of operation.

  - The sensor works in normal mode

**Note:** If the temperature/TEACH-IN plug has not been plugged in within 5 minutes in position T, the sensor will return to normal mode (with the latest permanent stored values) without temperature compensation.

Synchronisation

The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. It can be synchronised by applying a square wave voltage. A falling edge leads to the transmission of a single ultrasonic pulse. A low level ≥ 1 s or an open synchronisation input will result in the normal operation of the sensor.

A high level > 1 s will result in the standby mode of the sensor (indicator green LED). The outputs pause in the latest status.

Synchronisation cannot be performed during TEACH-IN and vice versa.

Multiple operating modes are possible:

1. Two to five sensors can be synchronised by interconnecting their synchronisation inputs. In this case, the sensors alternately transmit ultrasonic pulses.
2. Multiple sensors can be controlled by the same synchronisation signal. The sensors are synchronised.
3. The synchronisation pulses are sent cyclically to individual sensors. The sensors operate in multiplex mode.
4. A high level at the synchronisation input disables the sensor.

The response time increases when the sensor is synchronised, because the synchronisation increases the measurement cycle time.

**Note:**

If the option for synchronisation is not used, the synchronisation input has to be connected to ground (0V) or the sensor has to be operated via a V1 cable connector (4-pin).

**Default setting**

A1: unusable area
A2: nominal sensing range
Mode of operation: rising ramp
LED Displays/Analogue output

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>LED yellow A1</th>
<th>LED yellow A2</th>
<th>analogue output</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN evaluation limit A1&lt;br&gt;object detected</td>
<td>flashing</td>
<td>off</td>
<td>unchanged</td>
</tr>
<tr>
<td>object not detected</td>
<td>flashing</td>
<td>off</td>
<td>unchanged</td>
</tr>
<tr>
<td>TEACH-IN evaluation limit A2&lt;br&gt;object detected</td>
<td>flashing</td>
<td>off</td>
<td>unchanged</td>
</tr>
<tr>
<td>object not detected</td>
<td>flashing</td>
<td>off</td>
<td>unchanged</td>
</tr>
<tr>
<td>TEACH-IN mode of operation (E2/E3)&lt;br&gt;bising ramp &lt;br&gt;falling ramp &lt;br&gt;zero line</td>
<td>on</td>
<td>off</td>
<td>unchanged</td>
</tr>
<tr>
<td>Normal mode&lt;br&gt;temperature compensated&lt;br&gt;plug pulled/shorted</td>
<td>on</td>
<td>off</td>
<td>unchanged</td>
</tr>
<tr>
<td>Standby&lt;br&gt;interference (e.g. compressed air)</td>
<td>flashing</td>
<td>off</td>
<td>unchanged</td>
</tr>
</tbody>
</table>

Note on communication with the UC-30GM-R2 interface cable

The UC-30GM-R2 interface cable allows for communication with the ultrasonic sensor using the ULTRA 2001 service program. The cable creates a connection between the PC-internal RS 232 interface and the plug-in connection for the temperature/program plug on the sensor. When setting up the connection on the sensor, make certain the plug is lined up correctly; otherwise no communication will be possible. The protrusion of the round plug must be inserted into the groove of the plug connection on the sensor side and not into the arrow symbol on the sensor.

Adjustable parameter with service program ULTRA 2001
- Evaluation limits A1 and A2
- Rising/falling ramp/zero line
- Mode of operation
- Sonic speed
- Temperature offset (The inherent temperature-rise of the sensor can be considered in the temperature compensation)
- Expansion of the unusable area (for suppression of unusable area echoes)
- Reduction of the detection range (for suppression of remote range echoes)
- Time of measuring cycle
- Acoustic power (interference of the burst duration)
- Sensitivity
- Behaviour of the sensor in case of echo loss
- Behaviour of the sensor in case of a fault
- Average formation via an allowed number of measuring cycles
- Selection of the parameter set, RS 232 or manually.
Series -30GM

Sensor function description

UC...-30GM-... , output versions -E6R2 and -E7R2 (with 2 switch outputs)

Description of the sensor functions
This ultrasonic sensor features a four-pole temperature/TEACH-IN plug, that can be connected in four different positions. These have the following significance.

<table>
<thead>
<tr>
<th>Plug position</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>TEACH-IN switching point A1</td>
</tr>
<tr>
<td>A2</td>
<td>TEACH-IN switching point A2</td>
</tr>
<tr>
<td>E2/E3</td>
<td>Switching: 2 independent switching points/window mode/hysteresis mode</td>
</tr>
<tr>
<td>T</td>
<td>Temperature compensation</td>
</tr>
</tbody>
</table>

Description of the TEACH-IN procedure

TEACH-IN of switching points 1 or 2
- Cut supply voltage
- Remove TEACH-IN plug
- Restore supply voltage (Reset)
- Set object to desired switching point
- Plug and remove the TEACH-IN plug in pos. A1 or A2. Switching point A1 or A2 is taught.
  
  **Caution:** Removing the temperature/TEACH-IN plug, the values of the object position will be adopted.

The TEACH-IN procedure is controlled with the LED. The green LED flashes, when object is detected, the red LED flashes when no object is detected.

Connect TEACH-IN plug in pos. T. The TEACH-IN procedure is completed, the sensor is working in normal mode.

TEACH-IN of switching function

- Cut supply voltage
- Remove TEACH-IN plug
- Restore supply voltage (Reset)
- Connect TEACH-IN plug in pos. E2/E3. By multiple plugging, three different modes of operation can be set in cyclical sequence:
  - switching point mode, LED A1 is flashing,
  - window mode, LED A2 is flashing
  - hysteresis mode, LED A1 and A2 are flashing
- Connect TEACH-IN plug in pos. T. The TEACH-IN procedure is completed, the sensor is working in normal mode.

**Note:** If the temperature/TEACH-IN plug has not been plugged in within 5 minutes in position T, the sensor will return to normal mode (with the latest permanent stored values) without temperature compensation.

Synchronisation
The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. It can be synchronised by applying a square wave voltage. A falling edge leads to the transmission of a single ultrasonic pulse. A low level \( \geq 1 \) s or an open synchronisation input will result in the normal operation of the sensor.

A high level \( > 1 \) s will result in the standby mode of the sensor (indicator green LED). The outputs pause in the latest status. Synchronisation cannot be performed during TEACH-IN and vice versa.

**Multiple operating modes are possible**

1. Two to five sensors can be synchronised by interconnecting their synchronisation inputs. In this case, the sensors alternate transmit ultrasonic pulses.
2. Multiple sensors can be controlled by the same synchronisation signal. The sensors are synchronised.
3. The synchronisation pulses are sent cyclically to individual sensors. The sensors operate in multiplex mode.
4. A high level at the synchronisation input disables the sensor.

The response time increases when the sensor is synchronised, because the synchronisation increases the measurement cycle time.

**Note:**
If the option for synchronisation is not used, the synchronisation input has to be connected to ground (0V) or the sensor has to be operated via a V1 cable connector (4-pin).

**Default setting**

| A1: | unusable area |
| A2: | nominal sensing range |
**Series -30GM**

**LED Displays**

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Dual LED green</th>
<th>LED red</th>
<th>LED yellow A1</th>
<th>LED yellow A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN of switching point A1</td>
<td>flashing off</td>
<td>off</td>
<td>flashing</td>
<td>off</td>
</tr>
<tr>
<td>object detected</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no object detected</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEACH-IN switching point A2</td>
<td>flashing off</td>
<td>off</td>
<td>flashing</td>
<td>off</td>
</tr>
<tr>
<td>object detected</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no object detected</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEACH-IN mode of operation (E2/E3)</td>
<td>on</td>
<td>off</td>
<td>flashing</td>
<td>off</td>
</tr>
<tr>
<td>two independent switching points</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>window mode</td>
<td>on</td>
<td>off</td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>Hysteresis mode</td>
<td>on</td>
<td>off</td>
<td>flashing</td>
<td>flashing</td>
</tr>
<tr>
<td>Normal mode</td>
<td>on</td>
<td>off</td>
<td>switching state A1</td>
<td>switching state A2</td>
</tr>
<tr>
<td>temperature compensated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>plug pulled or shorted</td>
<td>off</td>
<td>on</td>
<td>switching state A1</td>
<td>switching state A2</td>
</tr>
<tr>
<td>Interference (e.g. compressed air)</td>
<td>off</td>
<td>flashing</td>
<td>last or defined condition</td>
<td>last or defined condition</td>
</tr>
<tr>
<td>Standby</td>
<td>flashes off</td>
<td>off</td>
<td>previous state</td>
<td>previous state</td>
</tr>
</tbody>
</table>

LED ON indicates closed switch output.

**LED-Windows**

- **LED** yellow
- **Dual-LED** green/red
- **LED** yellow

**RS 232-connection**

- **V15-plug connector** (M12x1)
- **Groove**
- **1: TXD**
- **2: RXD**
- **3: not used**
- **4: GND**

**Note on communication with the UC-30GM-R2 interface cable**

The UC-30GM-R2 interface cable allows for communication with the ultrasonic sensor using the ULTRA 2001 service program. The cable creates a connection between the PC-internal RS 232 interface and the plug-in connection for the temperature/program plug on the sensor. When setting up the connection on the sensor, make certain the plug is lined up correctly; otherwise no communication will be possible. The protrusion of the round plug must be inserted into the groove of the plug connection on the sensor side and **not** into the arrow symbol on the sensor.

**Adjustable parameter with service program ULTRA 2001**

- Switching point 1 and 2
- NONC function
- Mode of operation
- Sonic speed
- Temperature offset (The inherent temperature-rise of the sensor can be considered in the temperature compensation)
- Expansion of the unusable area (for suppression of unusable area echoes)
- Reduction of the detection range (for suppression of remote range echoes)
- Time of measuring cycle
- Acoustic power (interference of the burst duration)
- Sensitivity
- Behaviour of the sensor in case of echo loss
- Behaviour of the sensor in case of a fault
- Average formation via an allowed number of measuring cycles
- On/off-delay
- Switching hysteresis
- Selection of the parameter set, RS 232 or manually.
Series -30GM

Description of the sensor functions

Remote potentiometer
The distance range of the through-beam ultrasonic barrier can be adjusted with the potentiometer integrated in the emitter, or via a remote potentiometer connected to the emitter. The remote potentiometer simplifies the adjustment of the distance range if the sensors are installed in an inaccessible location. A 10 kΩ/0.3 W potentiometer serves as the remote potentiometer. The connection is realised using the plug connector pins 2 and 4 of the emitter (see: Electrical Connection).

The following distance ranges can be set using the remote potentiometer:

<table>
<thead>
<tr>
<th>Adjustment of the internal distance regulator</th>
<th>Distance range adjustable via remote potentiometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum switching point</td>
<td>0 m ... 2 m</td>
</tr>
<tr>
<td>Maximum switching point</td>
<td>2 m ... 4 m</td>
</tr>
</tbody>
</table>

When operating without a remote potentiometer, the plug connector pins 2 and 4 must be bridged.

Alignment
When adjusting the emitter and receiver, take care to align them as precisely as possible.

Angular tolerance:

\[ \alpha < \pm 2° \]

maximum offset:

\[ s < \pm 5 \text{ mm} \]

A through-beam ultrasonic barrier consists of a single emitter and a single receiver.

Caution
Mount or replace emitter and receiver only in pairs. Both devices are optimally matched to each other by the manufacturer.

UB...-30GM-..., output types -E4 and -E5 (with 1 switch output)

Description of the sensor functions

Synchronisation
The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. The synchronisation of multiple sensors can be realised as follows:

External synchronisation:
The sensor can be synchronised by the external application of a square wave voltage. A synchronisation pulse at the synchronisation input starts a measuring cycle. The pulse must have a duration greater than 100 µs. The measuring cycle starts with the falling edge of a synchronisation pulse. Two operating modes are available:
1. Multiple sensors can be controlled by the same synchronisation signal. The sensors are synchronised.
2. The synchronisation pulses are sent cyclically to individual sensors. The sensors operate in multiplex mode.

Internal synchronisation:
The synchronisation connections of up to 5 sensors capable of internal synchronisation are connected to one another. When power is applied, these sensors will operate in multiplex mode.

The state of the switch output will not change until the switching threshold has been exceeded five times as an average of the five measurements is determined internally. A low level \( \text{UB} \) or an open synchronisation input will result in the normal operation of the sensor.

Synchronisation cannot be performed during TEACH-IN and vice versa. The sensors must be operated in an unsynchronised manner to teach the switching point.

A high level at the synchronisation input disables the sensor.

Note:
If the option for synchronisation is not used, the synchronisation input has to be connected to ground (0V) or the sensor has to be operated via a V1 cable connector (4-pin).

Adjusting the switching points
The ultrasonic sensor features an analogue output with two teachable evaluation limits. These are set by applying the supply voltage \(-UB\) or \(+UB\) to the TEACH-IN input. The supply voltage must be applied to the TEACH-IN input for at least 1 s. LEDs indicate whether the sensor has recognised the target during the TEACH-IN procedure. Evaluation limit A1 is taught with \(-UB\), A2 with \(+UB\). For simple setting the switching point and the output functions the programming unit UB-PROG2 can be used.

Five different output functions can be set:
1. Window mode, normally-open function
2. Window mode, normally-closed function
3. One switching point, normally-open function
4. One switching point, normally-closed function
5. Detection of object presence
Series -30GM

Sensor function description

TEACH-IN window mode, normally-open function
- Set target to near switching point
- TEACH-IN switching point A1 with \(-U_B\)
- Set target to far switching point
- TEACH-IN switching point A2 with \(+U_B\)

TEACH-IN window mode, normally-closed function
- Set target to near switching point
- TEACH-IN switching point A2 with \(+U_B\)
- Set target to far switching point
- TEACH-IN switching point A1 with \(-U_B\)

TEACH-IN one switching point, normally-open function
- Set target to near switching point
- TEACH-IN switching point A2 with \(+U_B\)
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A1 with \(-U_B\)

TEACH-IN one switching point, normally-closed function
- Set target to near switching point
- TEACH-IN switching point A1 with \(-U_B\)
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A2 with \(+U_B\)

TEACH-IN detection of object presence
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A1 with \(-U_B\)
- TEACH-IN switching point A2 with \(+U_B\)

Default setting
A1: unusable area
A2: nominal sensing range

LED Displays

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Green LED</th>
<th>Red LED</th>
<th>Yellow LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN switching point</td>
<td>flashes</td>
<td>off</td>
<td>flashes</td>
</tr>
<tr>
<td>Object detected</td>
<td>off</td>
<td>flashes</td>
<td>off</td>
</tr>
<tr>
<td>No object detected</td>
<td>off</td>
<td>flashes</td>
<td>off</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td>off</td>
<td>flashes</td>
<td>off</td>
</tr>
<tr>
<td>Normal operation</td>
<td>on</td>
<td>off</td>
<td>switching state</td>
</tr>
<tr>
<td>Interference</td>
<td>off</td>
<td>flashes</td>
<td>previous state</td>
</tr>
</tbody>
</table>

LED-Window

"Power on"/Disturbance
Switch output

Dual LED green/red
LED yellow
## Series VariKont®

### Model number | Description | Detection range | Page
--- | --- | --- | ---
UC500+U9+E6+R2 | Switching output + RS 232-interface | 500 mm | 100
UC500+U9+IUE2+R2 | Analogue output + RS 232-interface | | |
UC3000+U9+E6+R2 | Switching output + RS 232-interface | 3000 mm | 102
UC3000+U9+E7+R2 | | | |
UC3000+U9+IUE0+R2 | Analogue output + 1 Switching output + RS 232-interface | | |
UC3000+U9+IUE2+R2 | | | |
UJ3000+U1+8B+RS | 8 Bit parallel-interface | 3000 mm | 104
UBE6000+U1+SA2 | Through beam ultrasonic barrier | 6000 mm | 106
UB500+U9+H3 | for external control/evaluation units | 500 mm | 108
UB3000+U9+H3 | | 3000 mm | |

For detailed function description, see page 110
### Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UC500+U9+...+R2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensing range</strong></td>
<td>60 ... 500 mm</td>
</tr>
<tr>
<td><strong>Unusable area</strong></td>
<td>0 ... 60 mm</td>
</tr>
<tr>
<td><strong>Standard target plate</strong></td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td><strong>Transducer frequency</strong></td>
<td>approx. 380 kHz</td>
</tr>
<tr>
<td><strong>Response delay</strong></td>
<td>for factory setting: minimal (EM, NONE): ≤ 20 ms (2 measuring cycles); default (EM, MXM, 5, 2): ≤ 40 ms (4 measuring cycles); dynamic (EM, DYN): ≤ 30 ms (3 measuring cycles)</td>
</tr>
<tr>
<td><strong>LED yellow</strong></td>
<td>switching state: switch output 1, 2</td>
</tr>
<tr>
<td><strong>LED red/green</strong></td>
<td>permanently green: &quot;Power on&quot;, flashes during standby operation: red flashing, &quot;Error&quot; (e.g. background noise level too high)</td>
</tr>
<tr>
<td><strong>Operating voltage</strong></td>
<td>20 ... 30 V DC, ripple ≤ 10 %</td>
</tr>
<tr>
<td><strong>No-load supply current</strong></td>
<td>≤ 60 mA</td>
</tr>
<tr>
<td><strong>Output type</strong></td>
<td>1 switch output: E5: pp NONC switchable, analogue output, load-dependent: ( R_L \geq 500 \Omega ); current output 4 ... 20 mA; ( R_L \geq 1 \Omega ): voltage output 2 ... 10 V</td>
</tr>
<tr>
<td><strong>Rated operational current</strong></td>
<td>200 mA, short-circuit/overload protected</td>
</tr>
<tr>
<td><strong>Voltage drop</strong></td>
<td>≤ 3 V DC</td>
</tr>
<tr>
<td><strong>Deviations of the characteristic curve</strong></td>
<td>≤ 0.2 % of full-scale value</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>≤ 0.1 mm</td>
</tr>
<tr>
<td><strong>Repeatability accuracy</strong></td>
<td>≤ 0.1 % of full-scale value</td>
</tr>
<tr>
<td><strong>Range hysteresis</strong></td>
<td>≤ 1 % of the set operating distance</td>
</tr>
<tr>
<td><strong>Temperature influence</strong></td>
<td>≤ ± 2 %</td>
</tr>
<tr>
<td><strong>Synchronisation</strong></td>
<td>1 synchronous connection, bidirectional: ( 0 \text{V} ) = -( U_0 ), ( +U_0 ) = +1 V, ( -U_0 ) = 1 level; ( -U_0 ), ( +U_0 ) = 5 V</td>
</tr>
<tr>
<td><strong>Pulse length</strong></td>
<td>≥ 100 ( \mu )s</td>
</tr>
<tr>
<td><strong>Bus length</strong></td>
<td>≥ 2 ms</td>
</tr>
<tr>
<td><strong>Synchronisation frequency</strong></td>
<td>≤ 80 Hz, with external synchronisation</td>
</tr>
<tr>
<td><strong>Interface type</strong></td>
<td>RS 232, 9600 bits, no parity, 8 data bits, 1 stop bit</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>-25 ... 70 °C (248 ... 343 K)</td>
</tr>
<tr>
<td><strong>Storage temperature</strong></td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td><strong>Protection degree</strong></td>
<td>IP65</td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>Housing: PBT; Transducer: epoxy resin/hollow glass sphere mixture; polyurethane foam</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>180 g</td>
</tr>
</tbody>
</table>

**Accessories**

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories".

---

Subject to reasonable modifications due to technical advances.

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### Dimensions

![Dimensions Diagram]

**UC500+U9+...+R2**

**Date of edition:** 08/18/2005

---

### Electrical connection

**Standard symbol/Connection:**  
(Version E6, pnp)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sync. Input</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 1, TD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 2, RD</td>
<td></td>
<td></td>
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<tr>
<td></td>
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</tr>
</tbody>
</table>

**Standard symbol/Connection:**  
(Version IUE2, pnp)

<table>
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<th>2</th>
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<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td><strong>U</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sync. Input</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>E2 Output, TD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IU Output, RD</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

---

### Diagrams

**Characteristic response curves**

<table>
<thead>
<tr>
<th>Distance [m]</th>
<th>0</th>
<th>0.05</th>
<th>0.1</th>
<th>0.15</th>
<th>0.2</th>
<th>0.25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle [degrees]</td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>40</td>
</tr>
</tbody>
</table>

Curve 1: flat surface 100 mm x 100 mm  
Curve 2: round bar, Ø 25 mm

**LED-Window**

- **LED yellow**  
- Dual-LED green/red

**LED Window**

- **LED yellow**  
- Dual-LED green/red

**Switch status**

- A1: *Power on*/Disturbance
- A2: *Power on*/Disturbance

**Switch output**

**UB500+U9+UE6+R2**

**UC500+U9+UE2+R2**

---

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---

**Dimensions**  
Oblong hole 5.3 x 7.3

**Series**

- -12GM  
- -18GK/-18GM  
- -30GM  
- VariKont  
- -FP  
- -F42  
- -F43  
- -F54  
- -F64  
- -D1  
- LUC  

---

**Accessories**  
Double sheet monitoring  
Control unit Power supply  
Control unit Power supply
## Technical Data

### Model number

<table>
<thead>
<tr>
<th>Model number</th>
<th>UC3000+U9+...+R2</th>
</tr>
</thead>
</table>

### Sensing range
300 ... 3000 mm

### Unusable area
0 ... 300 mm

### Standard target plate
100 mm x 100 mm

### Transducer frequency
Approx. 130 kHz

### Response delay
- For factory setting:
  - Minimum (EM, NONE): ≤80 ms (2 measuring cycles)
  - Default (EM, MXN, 5, 2): ≤160 ms (4 measuring cycles)
- Dynamic (EM, DYN): ≤120 ms (3 measuring cycles)

### LED yellow
- Switching state switch output
- Switching state switch output 1
- Switching state switch output 2

### LED red/green
- Permanently green: "Power on", flashes during standby operation
- Red flashing: "Error", (e.g. background noise level too high)

### Operating voltage
20 ... 30 V DC, ripple 10 %

### No-load supply current
≤ 60 mA

### Output type
1. Switch output E0, npn, normally opened/closed switchable
2. Analogue output, load-dependent:
   - 1 switch output E5: npn, NO/NC switchable
   - 1 Analogue output, load-dependent:
   - 1 switch output E5: npn, NO/NC switchable

### Rated operational current
200 mA, short-circuit/overload protected

### Voltage drop
≤ 3 V DC

### Deviation of the characteristic curve
≤ 0.2 % of full-scale value

### Resolution
≤ 1 mm

### Repeat accuracy
≤ 0.1 % of full-scale value

### Range hysteresis
≤ 1 % of the set operating distance

### Temperature influence
≤ 2 %

### Synchronisation
1. Synchronous connection, bidirectional
   - 0-level: -U0, ... (-U0 + 1 V), 1-level: (-U0 + 5 V) ... +U0

### Pulse length
≥ 100 µs

### Pause length
≥ 2 ms

### Synchronisation frequency
- ≤ 20 Hz, with external synchronisation
- ≤ 80 Hz, with external synchronisation

### Interface type
- RS 232: 9600 bits, no parity, 8 data bits, 1 stop bit
- RS 232: 9600 bits, no parity, 8 data bits, 1 stop bit (S10 = OFF)

### Standards
- EN 60947-5-2
- Ambient temperature
  - -15 ... 70 °C (22 ... 348 K)
- Storage temperature
  - -40 ... 85 °C (233 ... 358 K)
- Protection degree
  - IP65

### Connection
- Terminal compartment, ≤ 2.5 mm² conductor csa

### Material
- Housing: PBT
- Transducer:
  - Epoxy resin/hollow glass sphere mixture, polyurethane
  - Mass: 180 g

### Accessories
- Suitable connector cables, mounting aids, and more, you can find in chapter "Accessories"
Dimensions

![Image of dimensions diagram]

Electrical connection

**Standard symbol/Connection:**

**Version E6, pnp**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
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<tbody>
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<td>Output 1, TD</td>
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<tr>
<td>Output 2, RD</td>
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</tbody>
</table>

**Standard symbol/Connection:**

**Version E7, npn**

<table>
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<tr>
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<tr>
<td>Output 1, TD</td>
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<td>Output 2, RD</td>
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</tbody>
</table>

**Standard symbol/Connection:**

**Version IUE0, npn**

<table>
<thead>
<tr>
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<th>3</th>
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<tbody>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sync. Input</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E2 Output, TD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IU Output, RD</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>U</td>
<td></td>
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</tr>
</tbody>
</table>

**Standard symbol/Connection:**

**Version IUE2, pnp**

<table>
<thead>
<tr>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
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<tbody>
<tr>
<td>U</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sync. Input</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E2 Output, TD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IU Output, RD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Characteristic response curves**

- **LED-Window**
  - LED yellow
  - Dual-LED green/red
  - LED yellow
  - Switch status A1
  - *Power on/Disturbance
  - output versions +E6 and +E7

- **LED-Window**
  - Dual-LED green/red
  - LED yellow
  - Switch status A2
  - *Power on/Disturbance
  - Switch output
  - output versions +IUE0 and +IUE2

**Diagrams**

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Curve 1: flat plate 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

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### Technical Data

#### Ultrasonic sensor

**Model number**: WJ3000+U1+8B+RS

- **8 bit output**
- **Absolute polarity reversal protection**
- **Test input**
- **Fault output**
- **Serial interface**
- **Parameterisable with ULTRA 2001**

**Ultrasonic sensor**

![Ultrasonic sensor](image)

### Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
Dimensions

Electrical connection

Standard symbol/Connection:

![Connection Diagram]

Legend:
- $U_U$ = Brown
- $U_B$ = Blue
- Test input = Grey/Pink
- Error output = Red/Blue

Interface:
- Receiver-Data RD = White/Green
- Transmit-Data TD = Brown/Green
- 8 bit output:
  - A1 = White
  - A2 = Yellow
  - A3 = Pink
  - A4 = Red
  - A5 = Green
  - A6 = Grey
  - A7 = Black
  - A8 = Violet

Diagrams

Characteristic response curves

- Curve 1: flat plate 100 mm x 100 mm
- Curve 2: round bar, Ø 25 mm

LED-Window

- LED green/red
- "Power on"/Error

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Through-beam ultrasonic barrier

• High switching frequency
• Complementary outputs
• Absolute polarity reversal protection
• Adjustable sensitivity

Suitable connector cables, mounting aids and more, you can find in chapter “Accessories”

## Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UBE6000+U1+SA2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>0 ... 6000 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 130 kHz</td>
</tr>
<tr>
<td>Operating range</td>
<td>0 ... 6000 mm</td>
</tr>
<tr>
<td>Reference target</td>
<td>receiver</td>
</tr>
<tr>
<td>LED yellow</td>
<td>switching state (receiver only)</td>
</tr>
<tr>
<td>LED green</td>
<td>Emitter: “Power on” mains ON</td>
</tr>
<tr>
<td>LED red</td>
<td>Receiver: “Power on” mains ON</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>20 ... 30 V DC, ripple 10 %&lt;sub&gt;max&lt;/sub&gt;</td>
</tr>
<tr>
<td>Power consumption</td>
<td>Emitter: ≤ 1.5 W, Receiver: ≤ 1 W</td>
</tr>
<tr>
<td>Output type</td>
<td>Receiver: Complementary output stage 200 mA, Short-circuit/overload protected</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>Receiver: U&lt;sub&gt;b&lt;/sub&gt; = 3 V</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>≤ 30 Hz</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-25 ... 70 °C (248 ... 343 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
</tr>
<tr>
<td>Connection</td>
<td>terminal compartment, ≤ 2.5 mm&lt;sup&gt;2&lt;/sup&gt; conductor csa</td>
</tr>
<tr>
<td>Housing</td>
<td>PBT</td>
</tr>
<tr>
<td>Transducer</td>
<td>epoxy resin/hollow glass sphere mixture, polyurethane foam</td>
</tr>
<tr>
<td>Mass</td>
<td>180 g each sensor</td>
</tr>
</tbody>
</table>
Dimensions

UBE6000+U1+SA2

Electrical connection

Standard symbol / Connection:
Emitter

Standard symbol / Connection:
Transceiver

Characteristics response curves

Indicating/operating means

LED-Window

LED-Window-Receiver
Technical Data

**Sensing range**
- 300 ... 3000 mm
- 60 ... 500 mm

**Unusable area**
- 0 ... 300 mm
- 0 ... 60 mm

**Standard target plate**
- 100 mm x 100 mm

**Transducer frequency**
- approx. 130 kHz
- approx. 380 kHz

**Operating voltage**
- 20 ... 30 V DC, ripple 10 %

**No-load supply current**
- ≤ 30 mA

**Output type**
- 1 pulse output for temperature
- 1-level: > 4 V (100 µA), 0-level: < 0.5 V (100 µA)
- 1-level output for echo propagation time
- 1-level: ≥ UB -3 V (< 10 mA), 0-level: ≤ 1 V (100 µA)

**Temperature influence**
- the echo propagation time: ≤ 0.17 % / K
- the echo propagation time: 0.17 % / K

**Pulse length**
- 10 µs/K + timer pulse, synchronisation with the timer pulse
- 1 pulse input for transmitter pulse, activation through open collector npn
- < 1 V: emitter active, > 4 V: emitter inactive
- 10 ... 100 µs (typ. 50 µs)
- 20 ... 500 µs (typ. 300 µs)

**Pause length**
- ≥ 50 x pulse length

**Ambient temperature**
- -25 ... 70 °C (248 ... 343 K)

**Storage temperature**
- -40 ... 85 °C (233 ... 358 K)

**Protection degree**
- IP65

**Connection**
- terminal compartment, ≤ 2.5 mm² conductor size

**Material**
- Housing: PBT
- Transducer: epoxy resin/hollow glass sphere mixture; polyurethane; barn

**Mass**
- 180 g

Description of the sensor functions

The sensing range is determined in the downstream evaluation electronics (e.g. the units UH3-KHD2-4E5, or UH3-KHD2-4I).

The sensing range is determined on the basis of the echo time of a transmitted pulse in pulse-echo mode.

Temperature compensation

A temperature pulse is available at the temperature output for external temperature compensation. It is synchronous to the externally applied clock pulse and has the length \( T_{temp} \) calculated as follows:

\[
T_{temp}[\mu s] = T_{echo}[\mu s] + T[K] \times 10 \mu s / K
\]

Put into the formula the temperature in Kelvin and the clock time in the unit µs.

1) The unusable area (blind range) BR depends on the pulse duration.
   The unusable area reaches a minimum with the shortest pulse duration.

2) The sensors detection range depends on the pulse duration.
   With pulse duration < typical pulse duration, the sensors detection range may be reduced.

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Dimensions

Electrical connection

Standard symbol/Connection:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
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<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>+</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
</tbody>
</table>

Measurements:
- X-axis: 90°
- Y-axis: 90°
- Oblong hole: 5.3 x 7.3

Diagrams

Characteristic response curves

Curve 1: flat plate 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Characteristic response curves

Curve 1: flat plate 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Date of edition: 08/18/2005

TTemp = TClock + TImp, where TImp = T [K] x 10 µs/K

Oblong hole: 5.3 x 7.3

X-axis: 90°

Y-axis: 90°

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**Series VariKont®**

**Sensor function description**

**UC500+U9+E6+R2**

**Description of the sensor functions**
The outputs of the sensor can be used in two different operating modes: Switching mode with 2 adjustable switching points, or RS 232 mode (RS 232, 9600, n, 8, 1). Select the operating mode with DIP switch 10. The switching points are set with the DIP switches 1-4 and 5-8 (see table). Switch 9 is used to set the close or open function of the switch outputs.

For further information on the sensor’s command set, please see the publication "Command Set for Ultrasonic Sensors with RS 232 Interface".

**Caution:** Ensure that DIP switch S10 is correctly set before connecting the RS 232 interface.

**Synchronisation**
The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. It can be synchronised by applying a square wave voltage. A falling edge leads to the transmission of a single ultrasonic pulse. A low level > 1 s or an open synchronisation input will result in the normal operation of the sensor. A high level > 1 s will result in the standby operation of the sensor (green LED).

Several functions are available:

- Two to five sensors can be synchronised by interconnecting their synchronisation inputs. In this case, the sensors alternately transmit ultrasonic pulses.
- Multiple sensors can be controlled by the same synchronisation signal. The sensors are synchronised.
- The synchronisation pulses are sent cyclically to individual sensors. The sensors operate in multiplex mode.

The response time increases when sensors are synchronised as the measuring cycle time is increased by the synchronisation.

**Adjustment of the evaluation window via coding switch in terminal compartment**

<table>
<thead>
<tr>
<th>Switch 1 2 3 4</th>
<th>NDE [mm]</th>
<th>Switch 5 6 7 8</th>
<th>FDE [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0 0</td>
<td>60</td>
<td>0 0 0 0</td>
<td>70</td>
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<tr>
<td>0 0 0 1</td>
<td>80</td>
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<td>0 1 1 1</td>
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<tr>
<td>1 1 1 0</td>
<td>455</td>
<td>1 1 1 0</td>
<td>465</td>
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<tr>
<td>1 1 1 1</td>
<td>490</td>
<td>1 1 1 1</td>
<td>500</td>
</tr>
</tbody>
</table>

**UC500+U9+UE2+R2**

**Description of the sensor functions**
The outputs of the sensor can be used in two different operating modes: Switching/analogue mode, or RS 232 mode (RS 232, 9600, n, 8, 1). Select the operating mode with DIP switch 10. The limits of the IU ramp are set with the DIP switches 1-4 and 5-8 (see table). Switch 9 is used to set the close or open function of the switch output.

For further information on the sensor’s command set, please see the publication "Command Set for Ultrasonic Sensors with RS 232 Interface".

**Caution:** Ensure that DIP switch S10 is correctly set before connecting the RS 232 interface.

**Synchronisation**
The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. It can be synchronised by applying a square wave voltage. A falling edge leads to the transmission of a single ultrasonic pulse. A low level > 1 s or an open synchronisation input will result in the normal operation of the sensor. A high level > 1 s will result in the standby operation of the sensor (green LED).

Several functions are available:

- Two to five sensors can be synchronised by interconnecting their synchronisation inputs. In this case, the sensors alternately transmit ultrasonic pulses.
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- The synchronisation pulses are sent cyclically to individual sensors. The sensors operate in multiplex mode.

The response time increases when sensors are synchronised as the measuring cycle time is increased by the synchronisation.
Adjustment of the evaluation window via coding switch in terminal compartment

<table>
<thead>
<tr>
<th>Switch</th>
<th>NDE [mm]</th>
<th>Switch</th>
<th>FDE [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4</td>
<td>0 0 0 0</td>
<td>5 6 7 8</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td></td>
<td>60</td>
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<td>60</td>
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<td>1 1 0 0</td>
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<td>1 1 0 1</td>
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<td>1 1 0 1</td>
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<td></td>
<td>1 1 1 0</td>
<td></td>
<td>1 1 1 0</td>
</tr>
<tr>
<td></td>
<td>1 1 1 1</td>
<td></td>
<td>1 1 1 1</td>
</tr>
</tbody>
</table>

1 ON, 0 OFF

UC3000+U9+... output versions +E6+R2 and +E7+R2

Description of the sensor functions

The outputs of the sensor can be used in two different operating modes: Switching mode with 2 adjustable switching points, or RS 232 mode (RS 232, 9600, n, 8, 1). Select the operating mode with DIP switch 10. The switching points are set with the DIP switches 1-4 and 5-8 (see table). Switch 9 is used to set the close or open function of the switch outputs.

For further information on the sensor's command set, please see the publication "Command Set for Ultrasonic Sensors with RS 232 Interface".

Caution: Ensure that DIP switch S10 is correctly set before connecting the RS 232 interface.

Synchronisation

The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. It can be synchronised by applying a square wave voltage. A falling edge leads to the transmission of a single ultrasonic pulse. A low level > 1 s or an open synchronisation input will result in the normal operation of the sensor. A high level > 1 s will result in the standby operation of the sensor (green LED).

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Adjustment of the evaluation window via coding switch in terminal compartment

Adjustment of the evaluation window via coding switch in terminal compartment

DIP Switches in Terminal Compartment: Adjustment of the Target Window

<table>
<thead>
<tr>
<th>Switch 1 2 3 4 5 6 7 8 9 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.O. IU-mode</td>
</tr>
<tr>
<td>N.C. RS 232-mode</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N/O</th>
<th>IU-mode</th>
<th>RS 232-mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.O.</td>
<td>IU-rising slope</td>
<td>IU-declining slope</td>
</tr>
<tr>
<td>N.C.</td>
<td>IU-switch point</td>
<td></td>
</tr>
</tbody>
</table>

Near span boundary < distant limit ⇒ IU-rising slope
Near span boundary > distant limit ⇒ IU-declining slope
Near span boundary = distant limit ⇒ IU-switch point

Switch point switch output:
(NDE + FDE)/2 (Preconfiguration)

DIP Switches in Terminal Compartment:

<table>
<thead>
<tr>
<th>Switch 1 2 3 4 5 6 7 8 9 10</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>N.C. RS 232-mode</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N/O</th>
<th>IU-mode</th>
<th>RS 232-mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.O.</td>
<td>IU-rising slope</td>
<td>IU-declining slope</td>
</tr>
<tr>
<td>N.C.</td>
<td>IU-switch point</td>
<td></td>
</tr>
</tbody>
</table>

Near span boundary < distant limit ⇒ IU-rising slope
Near span boundary > distant limit ⇒ IU-declining slope
Near span boundary = distant limit ⇒ IU-switch point

Switch point switch output:
(NDE + FDE)/2 (Preconfiguration)
Description of the sensor functions

The outputs of the sensor can be used in two different operating modes: Switching/analogue mode, or RS 232 mode (RS 232, 9600, n, 8, 1). Select the operating mode with DIP switch 10. The limits of the IU ramp are set with the DIP switches 1-4 and 5-8 (see table). Switch 9 is used to set the close or open function of the switch output.

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Adjustment of the evaluation window via coding switch in terminal compartment

<table>
<thead>
<tr>
<th>Switch</th>
<th>NDE [mm]</th>
<th>Switch</th>
<th>FDE [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0 0</td>
<td>300</td>
<td>0 0 0 0</td>
<td>300</td>
</tr>
<tr>
<td>0 0 0 1</td>
<td>450</td>
<td>0 0 0 1</td>
<td>450</td>
</tr>
<tr>
<td>0 0 1 0</td>
<td>600</td>
<td>0 0 1 0</td>
<td>600</td>
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<tr>
<td>0 0 1 1</td>
<td>750</td>
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<tr>
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<td>1 1 0 0</td>
<td>2400</td>
<td>1 1 0 0</td>
<td>2400</td>
</tr>
<tr>
<td>1 1 0 1</td>
<td>2600</td>
<td>1 1 0 1</td>
<td>2600</td>
</tr>
<tr>
<td>1 1 1 0</td>
<td>2800</td>
<td>1 1 1 0</td>
<td>2800</td>
</tr>
<tr>
<td>1 1 1 1</td>
<td>3000</td>
<td>1 1 1 1</td>
<td>3000</td>
</tr>
</tbody>
</table>

DIP Switches in Terminal Compartment: Adjustment of the Target Window

- Near span boundary < distant limit → IU-rising slope
- Near span boundary > distant limit → IU-declining slope
- Near span boundary = distant limit → IU-switch point

Switch point switch output:

- (NDE + FDE)/2 (Preconfiguration)
**Series VanKont®**

**Sensor function description**

**UJ3000+U1+8B+RS**

**Description of the sensor functions**

The measurement of the distance is realised using the echo time of the ultrasonic pulse. The μ processor calculates the distance on the basis of the echo time and the speed of sound. The distance is directly issued in parallel in the form of an 8-bit data word.

A serial interface (RS 232, 9 600, n, 8, 1) is also available.

The output functions can be set up flexibly. For further information on the sensor’s command set, please see the publication "Command Set for Ultrasonic Sensors with RS 232 interface".

In the event of interference that the sensor cannot handle, the sensor goes into failure mode in that the failure output opens and the 8-bit output retains the most recent measuring value. The dual LED goes into the red flashing state.

A 1 level at the test input causes the 8-bit output to switch from 00000000 to 11111111 and back every 200 ms.

**UBE6000+U1+SA2**

**Description of the sensor function**

This system consists of one emitter an one receiver, which are operating independent of each other.

For the handling of the wide dynamic range the sensitivity of the receiver can be adjusted by means of a built in potentiometer. The red LED can be used as adjustment aid.

**System adjustment**

Mount emitter and receiver in the desired distance. The detection area has to be unobstructed. Switch on supply voltage and turn potentiometer counter-clockwise until the red LED lights up permanently (strong signal). In case of short distance application, it may happen, that the red LED flashes at a frequency of approx. 2 Hz caused by multi sound reflections between the sensors transducers. In that case, turn the potentiometer clockwise, until the red LED goes off.

Make sure, that the receivers output is not activated (yellow LED off) when the detection area is unobstructed.

In the strong working range, the system is highly resistant against any interference. Only large objects can be detected. In the weak working range the systems resistance against interference is decreased, but the system is highly sensitive even to detect small objects.

**UB...+U9+H3**

**Description of the sensor functions**

The sensing range is determined in the downstream evaluation electronics (e. g. the units UH3-KHD2-4E5, or UH3-KHD2-4I). The sensing range is determined on the basis of the echo time of a transmitted pulse in pulse-echo mode.

**Temperature compensation**

A temperature pulse is available at the temperature output for external temperature compensation. It is synchronous to the externally applied clock pulse and has the length \( T_{\text{Temp}} \) calculated as follows:

\[
T_{\text{Temp}} [\mu s] = T_{\text{clk}} [\mu s] + T[K] \times 10 \mu s/K
\]

Put into the formula the temperature in Kelvin and the clock time in the unit μs.

1) The unusable area (blind range) \( BR \) depends on the pulse duration.
   The unusable area reaches a minimum with the shortest pulse duration.

2) The sensors detection range depends on the pulse duration.
   With pulse duration < typical pulse duration, the sensors detection range may be reduced.
<table>
<thead>
<tr>
<th>Series</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>-FP</td>
<td></td>
</tr>
<tr>
<td>-12GM</td>
<td></td>
</tr>
<tr>
<td>-168G/18GM</td>
<td></td>
</tr>
<tr>
<td>-30GM</td>
<td></td>
</tr>
<tr>
<td>-101K</td>
<td></td>
</tr>
<tr>
<td>-12FPP</td>
<td></td>
</tr>
<tr>
<td>-F12</td>
<td></td>
</tr>
<tr>
<td>-F42</td>
<td></td>
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<td>-F43</td>
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<tr>
<td>-F54</td>
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<tr>
<td>-F64</td>
<td></td>
</tr>
<tr>
<td>-D1</td>
<td></td>
</tr>
<tr>
<td>LUC</td>
<td></td>
</tr>
<tr>
<td>Double sheet monitoring</td>
<td></td>
</tr>
<tr>
<td>Control units/Power supplies</td>
<td></td>
</tr>
<tr>
<td>Accessories</td>
<td></td>
</tr>
</tbody>
</table>
## Series -FP

<table>
<thead>
<tr>
<th>Model number</th>
<th>Description</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC6000-FP-E6-R2-P5</td>
<td>2 switching outputs + RS 232 interface</td>
<td>6000 mm</td>
<td>116</td>
</tr>
<tr>
<td>UC6000-FP-E7-R2-P5</td>
<td>1 switching output + 1 switching output + RS 232 interface</td>
<td>6000 mm</td>
<td>116</td>
</tr>
<tr>
<td>UC6000-FP-IUE0-R2-P5</td>
<td>1 analogue output + 1 switching output + RS 232 interface</td>
<td>6000 mm</td>
<td>116</td>
</tr>
<tr>
<td>UC6000-FP-IUE2-R2-P5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UJ4000-FP-E2-P1</td>
<td>1 switching output</td>
<td>4000 mm</td>
<td>118</td>
</tr>
<tr>
<td>UJ6000-FP-8B-RS</td>
<td>8 bit parallel interface + RS 232 interface</td>
<td>4000 mm</td>
<td>120</td>
</tr>
<tr>
<td>UB1000+FP1+E6</td>
<td>Reflex sensor with switching output</td>
<td>1000 mm</td>
<td>122</td>
</tr>
<tr>
<td>UB6000-FP-H3</td>
<td>For external control/evaluation unit</td>
<td>6000 mm</td>
<td>124</td>
</tr>
</tbody>
</table>

For detailed function description, see page 126
### Technical Data

#### Ultrasonic sensor

<table>
<thead>
<tr>
<th>Feature</th>
<th>UC6000-FP-...-R2-P5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model number</td>
<td>UC6000-FP-IUE0-R2-P5</td>
</tr>
<tr>
<td></td>
<td>UC6000-FP-IUE2-R2-P5</td>
</tr>
<tr>
<td></td>
<td>UC6000-FP-E6-R2-P5</td>
</tr>
<tr>
<td></td>
<td>UC6000-FP-E7-R2-P5</td>
</tr>
<tr>
<td></td>
<td>UC6000-FP-FP-R2-P5</td>
</tr>
<tr>
<td></td>
<td>UC6000-FP-FP-R5-P5</td>
</tr>
<tr>
<td></td>
<td>UC6000-FP-FP-R5-P5</td>
</tr>
<tr>
<td></td>
<td>UC6000-FP-...-R2-P5</td>
</tr>
</tbody>
</table>

#### Sensing range
- 800 ... 6000 mm
- Unsuitable area: 0 ... 800 mm
- Standard target plate: 100 mm x 100 mm
- Transducer frequency: approx. 65 kHz
- Response delay:
  - for factory setting: minimal (EM, NONE): ≤ 180 ms (2 measuring cycles), default (EM, MIX, 5, 2): ≤ 360 ms (4 measuring cycles), dynamic (EM, DYN): ≤ 270 ms (3 measuring cycles)

#### Operating voltage
- 15 ... 30 V DC, ripple 10 %
- 20 ... 30 V DC, ripple 10 %

#### No-load supply current
- ≤ 60 mA

#### Rated operational current
- 200 mA, short-circuit overload protected
- ≤ 3 VDC
- Range hysteresis: ≤ 1 % of the set operating distance
- Deviation of the characteristic curve: ≤ 0.2 %
- Repeat accuracy: ≤ 0.1 % of full-scale value
- Resolution: ≤ 1 mm

#### Temperature influence
- ≤ 2 %

#### Synchronisation
- 1 synchronous connection, bidirectional
- 0/level: \( U_{0} \), -4/level: \( -U_{0} \), +1 V, -1 level: \( -U_{0} + 5 \) V, \( -U_{0} \), \( 4/level \)
- Pulse length: ≥ 100 µs
- Pause length: ≥ 2 ms
- Synchronisation frequency: ≤ 10 Hz, with external synchronisation

#### Interface type
- RS 232: 9600 bits, no parity, 8 data bits, 1 stop bit
- RS 232: 9600 bits, no parity, 8 data bits, 1 stop bit (S10 = OFF)

#### Standards
- EN 60947-5-2
- Ambient temperature: -25 ... 70 °C (248 ... 343 K)
- Storage temperature: -40 ... 85 °C (233 ... 358 K)

#### Protection degree
- IP65

#### Connection
- Terminal compartment, ≤ 2.5 mm² conductor size

#### Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
**Dimensions**

UC6000-FP...-R2-P5

![Diagram](image)

**Electrical connection**

**Standard symbol/Connection:**

(Version E6, pnp)

```
+ Ub
| 2 |
| 3 |
| 4 |
| 1 |
```

- Sync. Input
- Output 1, TD
- Output 2, RD
- Output 1, TD

(Version E7, npn)

```
+ Ub
| 2 |
| 3 |
| 4 |
| 1 |
```

- Sync. Input
- Output 1, TD
- Output 2, RD
- Sync. Input

(Version IUE0, npn)

```
+ Ub
| 2 |
| 3 |
| 4 |
| 1 |
```

- Sync. Input
- IU Output, RD
- IU Output, RD

(Version IUE2, pnp)

```
+ Ub
| 2 |
| 3 |
| 4 |
| 1 |
```

- Sync. Input
- IU Output, RD
- IU Output, RD

**Diagrams**

**Characteristic response curves**

- Curve 1: flat surface 100 mm x 100 mm
- Curve 2: round bar, Ø 25 mm

**LED-Window**

- LED yellow
- Dual-LED green/red

Switch status A1: *Power on/Disturbance*

Switch status A2: *Power on/Disturbance*

Output versions -E6 and -E7

**LED-Window**

- LED yellow
- Dual-LED green/red

Output versions -IUE0 and -IUE2
Ultrasonic sensor

- Absolute polarity reversal protection
- 1 switch output
- TEACH-IN input
- Reflex sensor function

Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UJ4000-FP-E2-P1</th>
</tr>
</thead>
</table>

Sensing range: 1000 ... 4000 mm
Operating range: 0 ... reflector distance \( s_R \) - 6 %
Standard target plate: 100 mm x 100 mm
Transducer frequency: approx. 85 kHz
Response delay: ≤ 90 ms, for TEACH-IN with +Ue
≤ 150 ms for TEACH-IN with -Ue
LED yellow: switching state switch output
LED red/green: green LED: Power on
red LED: flashing at 2 Hz: error (reflector incorrectly positioned)
Operating voltage: 20 ... 30 V DC, ripple 10 %
No-load supply current: ≤ 90 mA
Output type: 1 switch output, NO/NO
Rated operational current: 200 mA, short-circuit overload protected
Voltage drop: ≤ 3 V
Input type: 1 TEACH-IN input, operating distance 1: -Ue ... (Ue + 2 V), operating distance 2: (+Ue - 2 V) ... +Ue

Standards:
- EN 60947-5-2
- Ambient temperature: -10 ... 50 °C (263 ... 323 K)
- Storage temperature: -40 ... 85 °C (233 ... 358 K)
- Protection degree: IP65

Connection: terminal compartment, ≤ 2.5 mm² conductor size
Material:
- Housing: PBT
- Transducer: epoxy resin/hollow glass sphere mixture; polyurethane foam
Mass: 320 g

Description of the sensor functions

The measurement of the distance is realised using the echo time of ultrasonic pulses. After installation, the transmitter is taught with the distance to a stationary reflector and stores this value by shorting the TEACH-IN input with -Ue or +Ue (see Electrical Connection). The distance determined in this manner is retained for as long as required when the power supply is shut off. If an interruption of the barrier by an object is determined during operation, switch output is closed.

If objects smaller than the standard measuring plate are to be detected, the reflector must also be reduced in size accordingly. This may result in a reduction of range.
Dimensions

![Dimensions Diagram]

**Electrical connection**

Standard symbol/Connection:

```
+ U0
```

1. Teach input
2. Switch output
3. - U0

**Diagrams**

**Characteristic response curves**

- Curve 1: flat surface 100 mm x 100 mm
- Curve 2: round bar, Ø 25 mm

**LED-Window**

- Dual-LED green/red
- LED yellow
- "Power on"/Disturbance
- Switch output

Date of edition: 08/18/2005
The measurement of the distance is realised using the echo time of the ultrasonic pulse. The µ processor calculates the distance on the basis of the echo time and the speed of sound. The distance is directly issued in parallel in the form of an 8-bit data word. A serial interface (RS 232, 9600 bps, no parity, 8 data bits, 1 stop bit) is also available. The output functions can be set up flexibly. For further information on the sensor’s command set, please see the publication "Command Set for Ultrasonic Sensors with RS 232 interface".

In the event of interference that the sensor cannot handle, the sensor goes into failure mode in that the failure output opens and the 8-bit output retains the most recent measuring value. The dual LED goes into the red flashing state.

A 1 level at the test input causes the 8-bit output to switch from 00000000 to 11111111 and back every 200 ms.

Subject to reasonable modifications due to technical advances. Copyright Pepperl+Fuchs, Printed in Germany
### Dimensions

![Diagram of Dimensions]

### Electrical connection

**Standard symbol/Connection:**

```
+U0 8 bit output
-U0 Error output
+U1 Test input
Transmit-Data
Receiver-Data
```

**Legend:**

- +U0 = Brown Test input = Grey/Pink
- -U0 = Blue Error output = Red/Blue

**Interface:**

- Receiver-Data RD = White/Green
- Transmit-Data TD = Brown/Green
- 8 bit output:
  - A1 = White
  - A3 = Pink
  - A5 = Green
  - A7 = Black
  - A2 = Yellow
  - A4 = Red
  - A6 = Grey
  - A8 = Violet

### Diagrams

**Characteristic response curves**

- Curve 1: flat surface 100 mm x 100 mm
- Curve 2: round bar, Ø 25 mm

**LED-Window**

- Dual-LED green/red
- "Power on"/Disturbance

---

**Date of edition:** 08/18/2005

**Subject to reasonable modifications due to technical advances.**

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**Reflex sensor**

- Through-beam and direct detection modes
- 2 independent switch outputs
- 4 operating modes can be set

### Technical Data

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>200 ... 1000 mm</td>
</tr>
<tr>
<td>Unusable area</td>
<td>0 ... 200 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 175 kHz</td>
</tr>
<tr>
<td>Response delay</td>
<td>≤ 100 ms</td>
</tr>
<tr>
<td>LED green</td>
<td>Power on</td>
</tr>
<tr>
<td>LED yellow</td>
<td>switch output 1, switch output 2</td>
</tr>
<tr>
<td>LED red</td>
<td>fault (due to external noise or incorrect adjustment)</td>
</tr>
<tr>
<td>DIP-switch</td>
<td>S9=ON, S9=OFF/NC, S10=ON/Window operation (barrier mode), S10=OFF/independent switch points</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>20 ... 30 V DC, ripple 10 %, 20 ... 30 V AC</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>≤ 90 mA</td>
</tr>
<tr>
<td>Output type</td>
<td>2 switch outputs pnp, NPN, non-inverting</td>
</tr>
<tr>
<td>Rated operational current</td>
<td>200 mA, short-circuit overload protected</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 3 V DC</td>
</tr>
<tr>
<td>Range hysteresis</td>
<td>≤ 5 % of the set operating distance</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>≤ 5 Hz</td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td>≤ 1 %</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>≤ 0.17 %/K</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-10 ... 50 °C (263 ... 323 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
</tr>
<tr>
<td>Connection</td>
<td>terminal compartment, ≤ 2.5 mm conductor csa</td>
</tr>
<tr>
<td>Material</td>
<td>PBT</td>
</tr>
<tr>
<td>Housing</td>
<td>epoxy resin + hollow glass sphere mixture, polyurethane foam</td>
</tr>
<tr>
<td>Mass</td>
<td>338 g</td>
</tr>
</tbody>
</table>

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
**Dimensions**

![Dimensions Diagram]

**Electrical connection**

Standard symbol/Connection:

```
+ U2
Switch output 1
Switch output 2
- U9
```

**Diagrams**

**Characteristic response curves**

![Characteristic response curves Diagram]

- Curve 1: flat surface 100 mm x 100 mm
- Curve 2: round bar, Ø 25 mm

**Output functions**

- S9 S10
- A1 1 0
- A2 1 0
- A1 0 0
- A2 0 0
- A1 1 1
- A2 1 1
- A1 0 1
- A2 0 1

**LED-Window**

- LED yellow
- Dual-LED green/red
- LED yellow

- Switch status 2
  - "Power on"/Disturbance
- Switch status 1

Blind range (forbidden)
Output open
Output closed
**Technical Data**

<table>
<thead>
<tr>
<th>Model number</th>
<th>UB6000-FP-H3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensing range</strong></td>
<td>800 ... 6000 mm</td>
</tr>
<tr>
<td><strong>Unusable area</strong></td>
<td>0 ... 800 mm [1]</td>
</tr>
<tr>
<td><strong>Standard target plate</strong></td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td><strong>Transducer frequency</strong></td>
<td>approx. 65 kHz</td>
</tr>
<tr>
<td><strong>Operating voltage</strong></td>
<td>≤ 30 V DC, ripple 10 %</td>
</tr>
<tr>
<td><strong>No-load supply current</strong></td>
<td>≤ 30 mA</td>
</tr>
<tr>
<td><strong>Output type</strong></td>
<td>1 pulse output for temperature</td>
</tr>
<tr>
<td></td>
<td>1-level: &gt; 4 V (100 µA), 0-level: &lt; 0.5 V (100 µA)</td>
</tr>
<tr>
<td></td>
<td>1 pulse output for echo propagation time</td>
</tr>
<tr>
<td></td>
<td>1-level: &lt; U₁₀ -3 V (≤ 10 mA), 0-level: &lt; 1 V (100 µA)</td>
</tr>
<tr>
<td><strong>Temperature influence</strong></td>
<td>the echo propagation time: ≤ 0.17 % / K</td>
</tr>
<tr>
<td><strong>Pulse length</strong></td>
<td>10 µs/K + timer pulse, synchronisation with the timer pulse</td>
</tr>
<tr>
<td><strong>Input type</strong></td>
<td>1 pulse input for transmitter pulse, activation through open collector npn</td>
</tr>
<tr>
<td></td>
<td>&lt; 1 V: emitter active, &gt; 4 V: emitter inactive</td>
</tr>
<tr>
<td><strong>Pulse length</strong></td>
<td>50 ... 700 µs (typ. 500 µs) [2]</td>
</tr>
<tr>
<td><strong>Pulse length</strong></td>
<td>&gt; 50 x pulse length</td>
</tr>
<tr>
<td><strong>Standards</strong></td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>-25 ... 70 °C (248 ... 343 K)</td>
</tr>
<tr>
<td><strong>Storage temperature</strong></td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td><strong>Protection degree</strong></td>
<td>IP65</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>terminal compartment, ≤ 2.5 mm² conductor CSA</td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>Housing: PBT</td>
</tr>
<tr>
<td></td>
<td>Transducer: epoxy resin/hollow glass sphere mixture; polyurethane foam</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>320 g</td>
</tr>
</tbody>
</table>

### Description of the sensor functions

The sensing range is determined in the downstream evaluation electronics (e.g. the units UH3-KH2D-4E5, or UH3-KH2D-4I). The sensing range is determined on the basis of the echo time of a transmitted pulse in pulse-echo mode.

### Temperature compensation

A temperature pulse is available at the temperature output for external temperature compensation. It is synchronous to the externally applied clock pulse and has the length $T_{\text{Temp}}$ calculated as follows:

\[
T_{\text{Temp}} [\mu s] = T_{\text{Temp}} [\mu s] + T[K] \times 10 \mu s/K
\]

Put into the formula the temperature in Kelvin and the clock time in the unit µs.

1) The unusable area (blind range) BR depends on the pulse duration.
   The unusable area reaches a minimum with the shortest pulse duration.

2) The sensors detection range depends on the pulse duration.
   With pulse duration < typical pulse duration, the sensors detection range may be reduced.
Dimensions

UB6000-FP-H3

Electrical connection

Standard symbol/Connection:

![Standard symbol/Connection diagram]

Characteristics response curves

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm
Series -FP

Sensor function description

UC6000-FP-...-R2-P5, output versions -E6 and -E7

Description of the sensor functions
The outputs of the sensor can be used in two different operating modes: Switching mode with 2 adjustable switching points, or RS 232 mode (RS 232, 9600 n, 8, 1). Select the operating mode with DIP switch 10. The switching points are set with the DIP switches 1-4 and 5-8 (see table). Switch 9 is used to set the close or open function of the switch outputs.

For further information on the sensor's command set, please see the publication "Command Set for Ultrasonic Sensors with RS 232 Interface".

Caution: Ensure that DIP switch S10 is correctly set before connecting the RS 232 interface.

Synchronisation
The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. It can be synchronised by applying a square wave voltage. A falling edge leads to the transmission of a single ultrasonic pulse. A low level > 1 s or an open synchronisation input will result in the normal operation of the sensor. A high level > 1 s will result in the standby operation of the sensor (green LED).

Several functions are available:
- Two to five sensors can be synchronised by interconnecting their synchronisation inputs. In this case, the sensors alternately transmit ultrasonic pulses.
- Multiple sensors can be controlled by the same synchronisation signal. The sensors are synchronised.
- The synchronisation pulses are sent cyclically to individual sensors. The sensors operate in multiplex mode.

The response time increases when sensors are synchronised as the measuring cycle time is increased by the synchronisation.

Adjustment of the evaluation window via coding switch in terminal compartment

<table>
<thead>
<tr>
<th>Switch</th>
<th>NDE [mm]</th>
<th>Switch</th>
<th>FDE [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4</td>
<td>0 0 0 0</td>
<td>0 0 0 0</td>
<td>950</td>
</tr>
<tr>
<td>0 0 0 1</td>
<td>0 0 0 1</td>
<td>1 0 0 0</td>
<td>1250</td>
</tr>
<tr>
<td>0 0 1 0</td>
<td>0 0 1 0</td>
<td>1 0 0 0</td>
<td>1550</td>
</tr>
<tr>
<td>0 0 1 1</td>
<td>0 0 1 1</td>
<td>1 0 0 0</td>
<td>1850</td>
</tr>
<tr>
<td>0 1 0 0</td>
<td>0 1 0 0</td>
<td>2 0 0 0</td>
<td>2150</td>
</tr>
<tr>
<td>0 1 0 1</td>
<td>0 1 0 1</td>
<td>2 0 0 0</td>
<td>2450</td>
</tr>
<tr>
<td>0 1 1 0</td>
<td>0 1 1 0</td>
<td>2 0 0 0</td>
<td>2750</td>
</tr>
<tr>
<td>0 1 1 1</td>
<td>0 1 1 1</td>
<td>3 0 0 0</td>
<td>3050</td>
</tr>
<tr>
<td>1 0 0 0</td>
<td>1 0 0 0</td>
<td>3 0 0 0</td>
<td>3350</td>
</tr>
<tr>
<td>1 0 0 1</td>
<td>1 0 0 1</td>
<td>3 0 0 0</td>
<td>3650</td>
</tr>
<tr>
<td>1 0 1 0</td>
<td>1 0 1 0</td>
<td>4 0 0 0</td>
<td>4000</td>
</tr>
<tr>
<td>1 0 1 1</td>
<td>1 0 1 1</td>
<td>4 0 0 0</td>
<td>4400</td>
</tr>
<tr>
<td>1 1 0 0</td>
<td>1 1 0 0</td>
<td>4 0 0 0</td>
<td>4800</td>
</tr>
<tr>
<td>1 1 0 1</td>
<td>1 1 0 1</td>
<td>5 0 0 0</td>
<td>5200</td>
</tr>
<tr>
<td>1 1 1 0</td>
<td>1 1 1 0</td>
<td>5 0 0 0</td>
<td>5600</td>
</tr>
<tr>
<td>1 1 1 1</td>
<td>1 1 1 1</td>
<td>6 0 0 0</td>
<td>6000</td>
</tr>
</tbody>
</table>

UC6000-FP-...-R2-P5, output versions -IUE0 and -IUE2

Description of the sensor functions
The outputs of the sensor can be used in two different operating modes: Switching/analogue mode, or RS 232 mode (RS 232, 9600 n, 8, 1). Select the operating mode with DIP switch 10. The limits of the IU ramp are set with the DIP switches 1-4 and 5-8 (see table). Switch 9 is used to set the close or open function of the switch outputs.

For further information on the sensor's command set, please see the publication "Command Set for Ultrasonic Sensors with RS 232 Interface".

Caution: Ensure that DIP switch S10 is correctly set before connecting the RS 232 interface.

Synchronisation
The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. It can be synchronised by applying a square wave voltage. A falling edge leads to the transmission of a single ultrasonic pulse. A low level > 1 s or an open synchronisation input will result in the normal operation of the sensor. A high level > 1 s will result in the standby operation of the sensor (green LED).

Several functions are available:
- Two to five sensors can be synchronised by interconnecting their synchronisation inputs. In this case, the sensors alternately transmit ultrasonic pulses.
- Multiple sensors can be controlled by the same synchronisation signal. The sensors are synchronised.
- The synchronisation pulses are sent cyclically to individual sensors. The sensors operate in multiplex mode.

The response time increases when sensors are synchronised as the measuring cycle time is increased by the synchronisation.

Adjustment of the evaluation window via coding switch in terminal compartment

DIP Switches in Terminal Compartment

Switch distance
Switch distance
Switch output 1
Switch output 2
RS 232-mode
N.C.
ON
0
OFF
Series -FP

Sensor function description

The sensor is suitable for direct-detection mode as well as beam-interruption mode. The functions of the outputs can be set with switches S9 and S10 in accordance with the following table.

<table>
<thead>
<tr>
<th>Switch</th>
<th>NDE [mm]</th>
<th>Switch</th>
<th>FDE [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 0 0 0</td>
<td>5 6 7 8</td>
<td>0 0 0 0</td>
</tr>
<tr>
<td>0 0 0 1</td>
<td>1 1 0 0</td>
<td>0 0 0 1</td>
<td>1 1 0 0</td>
</tr>
<tr>
<td>0 0 1 0</td>
<td>1 4 0 0</td>
<td>0 0 1 0</td>
<td>1 4 0 0</td>
</tr>
<tr>
<td>0 0 1 1</td>
<td>1 7 0 0</td>
<td>0 0 1 1</td>
<td>1 7 0 0</td>
</tr>
<tr>
<td>0 1 0 0</td>
<td>2 0 0 0</td>
<td>0 1 0 0</td>
<td>2 0 0 0</td>
</tr>
<tr>
<td>0 1 0 1</td>
<td>2 3 0 0</td>
<td>0 1 0 1</td>
<td>2 3 0 0</td>
</tr>
<tr>
<td>0 1 1 0</td>
<td>2 6 5 0</td>
<td>0 1 1 0</td>
<td>2 6 5 0</td>
</tr>
<tr>
<td>0 1 1 1</td>
<td>3 0 0 0</td>
<td>0 1 1 1</td>
<td>3 0 0 0</td>
</tr>
<tr>
<td>1 0 0 0</td>
<td>3 3 5 0</td>
<td>1 0 0 0</td>
<td>3 3 5 0</td>
</tr>
<tr>
<td>1 0 0 1</td>
<td>3 7 0 0</td>
<td>1 0 0 1</td>
<td>3 7 0 0</td>
</tr>
<tr>
<td>1 0 1 0</td>
<td>4 0 5 0</td>
<td>1 0 1 0</td>
<td>4 0 5 0</td>
</tr>
<tr>
<td>1 0 1 1</td>
<td>4 4 0 0</td>
<td>1 0 1 1</td>
<td>4 4 0 0</td>
</tr>
<tr>
<td>1 1 0 0</td>
<td>4 8 0 0</td>
<td>1 1 0 0</td>
<td>4 8 0 0</td>
</tr>
<tr>
<td>1 1 0 1</td>
<td>5 2 0 0</td>
<td>1 1 0 1</td>
<td>5 2 0 0</td>
</tr>
<tr>
<td>1 1 1 0</td>
<td>5 6 0 0</td>
<td>1 1 1 0</td>
<td>5 6 0 0</td>
</tr>
<tr>
<td>1 1 1 1</td>
<td>6 0 0 0</td>
<td>1 1 1 1</td>
<td>6 0 0 0</td>
</tr>
</tbody>
</table>

UB1000+FP1+E6

Description of the sensor functions

The sensor is suitable for direct-detection mode as well as beam-interruption mode. The functions of the outputs can be set with switches S9 and S10 in accordance with the following table.

<table>
<thead>
<tr>
<th>Switch</th>
<th>Switching range</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>200 ... 300 mm</td>
</tr>
<tr>
<td>S2</td>
<td>300 ... 400 mm</td>
</tr>
<tr>
<td>S3</td>
<td>400 ... 500 mm</td>
</tr>
<tr>
<td>S4</td>
<td>500 ... 600 mm</td>
</tr>
<tr>
<td>S5</td>
<td>600 ... 700 mm</td>
</tr>
<tr>
<td>S6</td>
<td>700 ... 800 mm</td>
</tr>
<tr>
<td>S7</td>
<td>800 ... 900 mm</td>
</tr>
<tr>
<td>S8</td>
<td>900 ... 1000 mm</td>
</tr>
</tbody>
</table>

A continuous switching range must be selected when operating with independent switching points, A1 switches the upper limit and A2 the lower limit of the switching range.

Barrier mode

In barrier mode, primarily the range up to objects used as reflector will be evaluated (e.g., machine part). Objects entering the range between the sensor and reflector are detected. This includes objects of a strongly sound-absorbent nature and objects positioned at an angle to the sensor's active axis. In this case, no echo reaches the receiver. If the sound is reflected by an object, the reflection will have a different echo time from the regular reflector echo. The sensor detects the object on the basis of the shorter echo time or lack of an echo while in barrier mode.

For use as a barrier, set the close function (S9 = 1) and window mode (barrier mode) (S10 = 1). The distance between the sensor and the reflector determines the switching range which must be set using a switch between S1 and S8. Only one switch may be set to “ON”, resulting in a switching range of 100 mm.

The sensor and/or reflector should be adjusted in such a manner that output A1 is closed. The reflector should be positioned as close as possible to the sensor's near switching range limit. The sensor works in direct-detection mode in the area between the reflector and the sensor's near limit. A reliable evaluation is therefore not possible.

If an interruption of the barrier by an object is determined during operation, switch output A1 is opened. Output A2 is not taken into consideration as a rule, as it also works in direct-detection mode rather than beam-interruption mode.
### Model number table

<table>
<thead>
<tr>
<th>Model number</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UB800-F12P-EP-V15</td>
<td>800 mm</td>
<td>130</td>
</tr>
</tbody>
</table>
**Ultrasonic sensor**

UB800-F12P-EP-V15

- Push-pull output
- Selectable sound lobe width
- Synchronisation options
- Temperature compensation
- Very small unusable area

**Technical Data**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>30 ... 800 mm</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>50 ... 800 mm</td>
</tr>
<tr>
<td>Unusable area</td>
<td>0 ... 30 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 310 kHz</td>
</tr>
<tr>
<td>Response delay</td>
<td>approx. 100 ms</td>
</tr>
<tr>
<td>LED green</td>
<td>Operating display</td>
</tr>
<tr>
<td>LED yellow</td>
<td>switch output</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 ... 30 V DC, ripple 10 %</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>≤ 25 mA</td>
</tr>
<tr>
<td>Output type</td>
<td>Push-pull output, short-circuit proof, protected against reverse polarity</td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td>≤ 1 %</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 3 V</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>max. 4 Hz</td>
</tr>
<tr>
<td>Range hysteresis</td>
<td>1 % of the set operating distance</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>± 1.5 % of full-scale value</td>
</tr>
<tr>
<td>Input type</td>
<td>1 input for sound lobe adjustment</td>
</tr>
<tr>
<td></td>
<td>wide sound beam: -U₀ ... +1 V</td>
</tr>
<tr>
<td></td>
<td>narrow sound beam: +4 V ... +U₀</td>
</tr>
<tr>
<td></td>
<td>input impedance: &gt; 47 kΩ</td>
</tr>
<tr>
<td></td>
<td>switching delay: 1 s</td>
</tr>
<tr>
<td>Synchronisation</td>
<td>1 synchronous connection, bi-directional</td>
</tr>
<tr>
<td></td>
<td>0-level: -U₀ ... +1 V</td>
</tr>
<tr>
<td></td>
<td>1-level: +4 V ... +U₀</td>
</tr>
<tr>
<td></td>
<td>input impedance: &gt; 12 kΩ</td>
</tr>
<tr>
<td></td>
<td>synchronisation pulse: &gt; 100 µs,</td>
</tr>
<tr>
<td></td>
<td>synchronisation inter-pulse period: &gt; 2 ms</td>
</tr>
<tr>
<td>Common mode operation</td>
<td>≤ ±45 Hz</td>
</tr>
<tr>
<td>Multiplex operation</td>
<td>≤ 45 mHz, n = number of sensors</td>
</tr>
<tr>
<td>UL</td>
<td>listed</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-25 ... 70 °C (248 ... 343 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 85 °C (253 ... 358 K)</td>
</tr>
<tr>
<td>Connection</td>
<td>connector V15 (M12 x 1.5 pin)</td>
</tr>
<tr>
<td>Housing</td>
<td>frame: die-cast zinc, nickel-plated</td>
</tr>
<tr>
<td></td>
<td>Lateral: plastic PC, glass-fiber reinforced</td>
</tr>
<tr>
<td>Transducer</td>
<td>epoxy resin/hollow glass sphere mixture; foam polyurethane, cover PBT</td>
</tr>
<tr>
<td>Mass</td>
<td>60 g</td>
</tr>
</tbody>
</table>

Suitable connector cables, mounting aids and more, you can find in chapter *Accessories*.
Synchronisation
To suppress mutual influence, the sensor is equipped with a synchronisation connection. If this is not activated, the sensor works with an internally generated clock. Synchronisation of multiple sensors can be achieved in the following ways.

External synchronisation
The sensor can be synchronised by external application of a square wave voltage. A synchronisation impulse on the synchronisation input leads to the execution of one measurement cycle. The impulse width must be larger than 100 µs. The measurement cycle starts with the falling flank. A low level > 1 sec or an open synchronisation input puts the sensor in normal mode. A high level on the synchronisation input deactivates the sensor.

Two operational modes are possible
1. Multiple sensors are controlled using the same synchronisation signal. The sensors work in synchronisation mode.
2. The synchronisation impulses are cyclically fed to only one sensor at a time. The sensors work in multiplex mode.

Autosynchronisation
The synchronisation connections of up to 10 sensors are connected together with the option of autosynchronisation. These sensors work in multiplex mode after power is switched on. The activation delay is increased corresponding to the number of synchronised sensors.

Note:
If the synchronisation option is not used, the synchronisation input should be connected to ground (0V), or the sensor connected using a V1 connector cable (4-pin).

Selection of beam characteristics
By switching the beam input, the activation characteristics of the ultrasound sensor can be selected. If the beam input is open or connected to +UB, the sensor works with a wide ultrasonic cone. A beam input connected to -UB causes the sensor to work with a narrower ultrasonic cone. This setting is preferred when an object in the vicinity of the sensor is close to the ultrasonic beam, and should be suppressed. The characteristic of the ultrasonic cone can be changed during sensor operation. Switching the sound cone characteristics becomes active one second after the change to the signal level at the beam input.

Setting the switch point
The ultrasonic sensor possesses a switch output, of which the switching point can be set simply and precisely using the built-in 12-position potentiometer. Using the switch Q / Q which is also easy to find on the upper side of the sensor, the effective direction of the switching output can be selected.

There are two different output functions which can be selected
1. one switching point, normally open
2. one switching point, normally closed

LED display

<table>
<thead>
<tr>
<th>LED green:</th>
<th>Opening function (Q)</th>
<th>Closing function (Q)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Power On</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LED yellow:</th>
<th>Switch state</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Object outside switching area, or no object</td>
</tr>
</tbody>
</table>

| LED red: | Potentiometer for setting of switch point at "limit" |

<table>
<thead>
<tr>
<th>LED red flashing:</th>
<th>Ultrasonic error</th>
</tr>
</thead>
</table>

Subject to reasonable modifications due to technical advances.
### Series -F42

**UB...-F42-...V15**
(top looker)  
**UB...-F42S-...V15**
(side looker)

<table>
<thead>
<tr>
<th>Model number</th>
<th>AC-version/ relay output</th>
<th>side looker</th>
<th>top looker</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UB400-F42-UK-V95</td>
<td></td>
<td></td>
<td></td>
<td>400 mm</td>
<td>134</td>
</tr>
<tr>
<td>UB400-F42S-UK-V95</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB500-F42-E4-V15</td>
<td></td>
<td></td>
<td></td>
<td>500 mm</td>
<td>136</td>
</tr>
<tr>
<td>UB500-F42S-E4-V15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>UB500-F42-E5-V15</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB500-F42S-E5-V15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB500-F42-I-V15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB500-F42S-I-V15</td>
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<tr>
<td>UB500-F42-U-V15</td>
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<td></td>
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<tr>
<td>UB500-F42S-U-V15</td>
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<td></td>
<td></td>
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<tr>
<td>UB500-F42-E6-V15</td>
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<tr>
<td>UB500-F42S-E6-V15</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>UB500-F42-E7-V15</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB500-F42S-E7-V15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB1500-F42-UK-V95</td>
<td></td>
<td></td>
<td></td>
<td>1500 mm</td>
<td>138</td>
</tr>
<tr>
<td>UB1500-F42S-UK-V95</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB2000-F42-E4-V15</td>
<td></td>
<td></td>
<td></td>
<td>2000 mm</td>
<td>140</td>
</tr>
<tr>
<td>UB2000-F42S-E4-V15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB2000-F42-E5-V15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB2000-F42S-E5-V15</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>UB2000-F42-I-V15</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>UB2000-F42S-I-V15</td>
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</tr>
<tr>
<td>UB2000-F42-U-V15</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB2000-F42S-U-V15</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB2000-F42-E6-V15</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB2000-F42S-E6-V15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB2000-F42-E7-V15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB2000-F42S-E7-V15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB3000-F42-UK-V95</td>
<td></td>
<td></td>
<td></td>
<td>3000 mm</td>
<td>142</td>
</tr>
<tr>
<td>UB3000-F42S-UK-V95</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB4000-F42-E4-V15</td>
<td></td>
<td></td>
<td></td>
<td>4000 mm</td>
<td>144</td>
</tr>
<tr>
<td>UB4000-F42S-E4-V15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For detailed function description, see page 146
### Ultrasonic sensor

**Model number**

UB400-F42(S)-UK-V95

- Relay output for high power
- Extremely small unusable area
- TEACH-IN
- Interference suppression (adjustable width of sound cone in close range)
- Temperature compensation
- NO/NC selectable

### Technical Data

**Model number:** UB400-F42(S)-UK-V95

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>40 ... 400 mm</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>50 ... 400 mm</td>
</tr>
<tr>
<td>Unusable area</td>
<td>0 ... 40 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 390 kHz</td>
</tr>
<tr>
<td>Response delay</td>
<td>approx. 50 ms</td>
</tr>
<tr>
<td>LED green</td>
<td>permanently green: Power on</td>
</tr>
<tr>
<td>LED yellow</td>
<td>permanently: switching state switch output</td>
</tr>
<tr>
<td>Flashing TEACH-IN function</td>
<td></td>
</tr>
<tr>
<td>LED red</td>
<td>normal operation: &quot;Built&quot;</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>20 ... 253 V AC</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>≤ 60 mA</td>
</tr>
<tr>
<td>Output type</td>
<td>1 relay output</td>
</tr>
<tr>
<td>Rated operational current</td>
<td>3 A</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>≤ 8 Hz</td>
</tr>
<tr>
<td>Range hysteresis</td>
<td>1 % of the set operating distance</td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>± 1 °C</td>
</tr>
<tr>
<td>Repeatability</td>
<td>± 0.5 % of switching point</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-25 ... 70 °C (248 ... 343 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
</tr>
<tr>
<td>Connection</td>
<td>Connector V95 (7/8 -16 UN 2A), 5pin</td>
</tr>
<tr>
<td>Housing</td>
<td>PBT</td>
</tr>
<tr>
<td>Transducer</td>
<td>Epoxy resin/hollow glass sphere mixture; foam polyurethane, cover PBT</td>
</tr>
<tr>
<td>Mass</td>
<td>260 g</td>
</tr>
</tbody>
</table>
### Dimensions

#### UB400-F42(S)-UK-V95

![Dimensions Diagram]

#### Housing version -F42

- Membrane keys
- LED window

#### Housing version -F42S

- Membrane keys
- LED window

### Electrical connection

**Standard symbol/Connections:**

- **AC/DC**
  - 20 V ... 253 V
- **max. 250 V AC/120 V DC**
- **I_{max} = 3 A**

### Diagrams

**Characteristic response curves**

- Curve 1: flat plate 100 mm x 100 mm
- Curve 2: round bar, Ø 25 mm

**Possible operating modes**

1. **Switch point operation**
   - normally open: A1 \(\rightarrow\) ∞
   - normally closed: A2 \(\rightarrow\) ∞

2. **Window operation**
   - normally open: A1 < A2
   - normally closed: A2 < A1

3. **Hysteresis operation**
   - normally open: A1 < A2
   - normally closed: A2 < A1

4. **Object presence detection mode**
   - A1 \(\rightarrow\) ∞, A2 \(\rightarrow\) ∞: Sensor detects object presence within sensing range
   - Note: A1 \(\rightarrow\) ∞, A2 \(\rightarrow\) ∞ means: cover sensor with hand or remove all objects from sensing range

Date of edition: 08/18/2005
Ultrasonic sensor

- Extremely small unusable area
- TEACH-IN
- Interference suppression (adjustable width of sound cone in close range)
- Temperature compensation
- Synchronisation options
- **1 Switch output**
  - UB500-F42(S)-E4-V15
  - UB500-F42(S)-E5-V15
- **2 independent switch outputs**
  - UB500-F42(S)-E6-V15
  - UB500-F42(S)-E7-V15
- **Analogue output 0 V ... 10 V**
  - UB500-F42(S)-U-V15
- **Analogue output 4 mA ... 20 mA**
  - UB500-F42(S)-I-V15

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
### Dimensions

**Housing version -F42**

**Housing version -F42S**

### Electrical connection

#### Standard symbol/Connections:
- **(version E4, npn)**
  - Core colours in accordance with EN 60947-5-2.

#### Standard symbol/Connections:
- **(version E5, npn)**
  - Core colours in accordance with EN 60947-5-2.

#### Standard symbol/Connections:
- **(version E6, npn)**
  - Core colours in accordance with EN 60947-5-2.

#### Standard symbol/Connections:
- **(version E7, npn)**
  - Core colours in accordance with EN 60947-5-2.

#### Standard symbol/Connections:
- **(version U)**
  - Core colours in accordance with EN 60947-5-2.

### Diagrams

#### Characteristic response curve

#### Analogue output programmation

#### Switching output programmation

#### Programmable operation modes
### Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UB1500-F42(S)-UK-V95</th>
</tr>
</thead>
</table>

- **Sensing range**: 70 ... 1500 mm
- **Adjustment range**: 90 ... 1500 mm
- **Unusable area**: 0 ... 70 mm
- **Standard target plate**: 100 mm x 100 mm
- **Transducer frequency**: approx. 175 kHz
- **Response delay**: approx. 150 ms
- **LED green**: permanently green, Power on
- **LED yellow**: permanently, switching state, switch output flashing, TEACH-IN function
- **LED red**: normal operation: “Fault”, TEACH-IN function: no object detected
- **Operating voltage**: 20 ... 253 V AC
- **No-load supply current**: ≤ 60 mA
- **Output type**: 1 relay output
- **Rated operational current**: 3 A
- **Switching frequency**: ≤ 3 Hz
- **Range hysteresis**: 1% of the set operating distance
- **Repeatability accuracy**: ≤ 0.5% of switching point
- **Temperature influence**: ± 1% of full-scale value
- **Standards**: EN 60947-5-2
- **Ambient temperature**: -25 ... 70 °C (248 ... 343 K)
- **Storage temperature**: -40 ... 85 °C (233 ... 358 K)
- **Protection degree**: IP65
- **Connection**: Connector V95 (7/8"-16 UN 2A), 5-pin
- **Housing**: PBT
- **Transducer**: epoxy resin/hollow glass sphere mixture, foam polyurethane, cover PBT
- **Mass**: 260 g

---

**Relay output for high power**

- **Extremely small unusable area**
- **TEACH-IN**
- **Interference suppression (adjustable width of sound cone in close range)**
- **Temperature compensation**
- **NO/NC selectable**

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories".
### Dimensions

#### Dimensions Diagrams

- Membrane keys
- LED window

### Electrical connection

**Standard symbol/Connections:**

- **AC/DC**
- **20 V ... 253 V**
- **max. 250 V AC/120 V DC**
- **Imax = 3 A**

### Diagrams

#### Characteristic response curves

- **Distance [m]**
- **Angle [degrees]**

**Curve 1:** flat plate 100 mm x 100 mm
**Curve 2:** round bar, Ø 25 mm

#### Possible operating modes

1. **Switch point operation**
   - **normally open**
     - A1 -> ∞
   - **normally closed**
     - A2 -> ∞

2. **Window operation**
   - **normally open**
     - A1 < A2
   - **normally closed**
     - A2 < A1

3. **Hysteresis operation**
   - **normally open**
     - A1 < A2
   - **normally closed**
     - A2 < A1

4. **Object presence detection mode**
   - A1 -> ∞, A2 -> ∞: Sensor detects object presence within sensing range
   - **Note:** A1 -> ∞, A2 -> ∞ means: cover sensor with hand or remove all objects from sensing range
### Technical Data

#### Sensing range
- 60 ... 2000 mm

#### Adjustment range
- 90 ... 2000 mm

#### Unusable area
- 0 ... 60 mm

#### Standard target plate
- 100 mm x 100 mm

#### Transducer frequency
- approx. 175 kHz

#### Response delay
- approx. 150 ms

#### LED green
- permanently green: Power on

#### LED yellow
- permanent: object in evaluation range, flashing: TEACH-IN function

#### LED yellow1
- permanent: switching state switch output 1, flashing: TEACH-IN function

#### LED yellow2
- permanent: switching state switch output 2, flashing: TEACH-IN function

#### Operating voltage
- 10 ... 30 V DC, ripple 10 %

#### No-load supply current
- ≤ 50 mA

#### Output type
- 1 analogue output 0 ... 10 V
- 1 analogue output 4 ... 20 mA
- 1 switch output E5, npn NO/NC, parameterisable
- 2 switch outputs npn, normally open/closed selectable
- 2 switch outputs npn, normally open/closed selectable

#### Rated operational current
- 200 mA, short-circuit/overload protected

#### Voltage drop
- ≤ 2.5 V

#### Switching frequency
- ≤ 2.7 Hz

#### Range hysteresis
- 1 % of the set operating distance

#### Deviation of the characteristic curve
- ± 1 % of full-scale value

#### Repeat accuracy
- ± 0.5 % of swiching point

#### Resolution
- 0.7 mm

#### Load impedance
- > 1 kOhm

#### Temperature influence
- 0 ... 300 ppm

#### Synchronisation
- bi-directional
  - 0 level: +4 V... +UB
  - 1 level: +4 V... +UB

#### Common mode operation
- ≤ 30 Hz

#### Multiplex operation
- ≤ 300 Hz, n = number of sensors

#### Ambient temperature
- -25 ... 70°C (268 ... 343 K)

#### Storage temperature
- -40 ... 85°C (233 ... 358 K)

#### Protection degree
- IP54

#### Connection
- connector V5 (M12 x 1), 5 pin

#### Housing
- ABS

#### Transducer
epoxy resin/hollow glass sphere mixture; foam polyurethane, cover PB T

#### Mass
- 140 g

---

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
**Dimensions**

Housing version -F42

- Membrane keys
- LED window

Housing version -F42S

- Membrane keys
- LED window

**Electrical connection**

**Standard symbol/Connections:**

- (BU) Switch output
- (BK) Teaching input
- (GY) Synchronous
- (WH) -

Core colours in accordance with EN 60947-5-2.

**Diagrams**

**Characteristic response curve**

- Unusable area
- Object distance
- Analog output program
- Switching output program

**Programmable operation modes**

1. Switching point mode
2. Window mode
3. Hysteresis mode

Note: ** means cover transducer surface with your hand, while teaching the switching point.

If A1 = A2, the output works like A2 > A1
Ultrasonic sensor

- Relay output for high power
- Extremely small unusable area
- TEACH-IN
- Interference suppression (adjustable width of sound cone in close range)
- Temperature compensation
- NO/NC selectable

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories".

Technical Data

Model number: UB3000-F42-UK-V95

- Sensing range: 200 ... 3000 mm
- Adjustment range: 240 ... 3000 mm
- Unusable area: 0 ... 200 mm
- Standard target plate: 100 mm x 100 mm
- Transducer frequency: approx. 85 kHz
- Response delay: approx. 325 ms
- LED green: permanently green: Power on
- LED yellow: permanently: switching state switch output flashing: TEACH-IN function
- LED red: normal operation: "fault"

Operating voltage: 20 ... 253 V AC

No load supply current: ≤ 60 mA

Output type: 1 relay output

Rated operational current: 3 A

Switching frequency: ≤ 1.5 Hz

Range hysteresis: 1 % of the set operating distance

Repeat accuracy: ± 0.5 % of switching point

Temperature influence: ± 1 % of full-scale value

Standards: EN 60947-5-2

Ambient temperature: -25 ... +70 °C (248 ... 343 K)

Storage temperature: -40 ... +85 °C (233 ... 358 K)

Protection degree: IP65

Connection: Connector V56 (7/8"-16 UN 2A), 5-pin

Housing: PBT

Transducer: epoxy resin/hollow glass sphere mixture; foam polyurethane, cover PBT

Mass: 260 g

Date of edition: 08/18/2005

Subject to reasonable modifications due to technical advances.

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
Dimensions

UB3000-F42-UK-V95

Electrical connection

Standard symbol/Connections:

AC/DC
20 V ... 253 V
max. 250 V AC/120 V DC
I_{\text{max}} = 3 A

Diagrams

Characteristic response curves

Curve 1: flat plate 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Possible operating modes

1. Switch point operation
   normally open
   A1 → ∞
   normally closed
   A2 → ∞

2. Window operation
   normally open
   A1 < A2
   normally closed
   A2 < A1

3. Hysteresis operation
   normally open
   A1 < A2
   normally closed
   A2 < A1

4. Object presence detection mode
   A1 → ∞, A2 → ∞: Sensor detects object presence within sensing range
   Note: A1 → ∞, A2 → ∞ means: cover sensor with hand or remove all objects from sensing range
### Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>200 ... 4000 mm</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>240 ... 4000 mm</td>
</tr>
<tr>
<td>Unusable area</td>
<td>0 ... 200 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 85 kHz</td>
</tr>
<tr>
<td>Response delay</td>
<td>approx. 325 ms</td>
</tr>
<tr>
<td>LED green</td>
<td>permanently green, Power on</td>
</tr>
<tr>
<td>LED yellow</td>
<td>permanently: object in evaluation range, flashing: TEACH-IN function</td>
</tr>
<tr>
<td>LED yellow 1</td>
<td>permanently: switching state switch output, flashing: TEACH-IN function</td>
</tr>
<tr>
<td>LED yellow 2</td>
<td>permanently: switching state switch output 1, flashing: TEACH-IN function</td>
</tr>
<tr>
<td>LED red</td>
<td>normal operation: &quot;off&quot;</td>
</tr>
<tr>
<td>LED red</td>
<td>TEACH-IN function: no object detected</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 ... 30 V DC, ripple 10 %&lt;sub&gt;ss&lt;/sub&gt;</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>( \leq 60 \text{mA} )</td>
</tr>
<tr>
<td>Output type</td>
<td>1 analogue output 0 ... 10 V</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>( \leq 2.5 \text{V} )</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>( \leq 1.2 \text{Hz} )</td>
</tr>
<tr>
<td>Range hysteresis</td>
<td>1% of the set operating distance</td>
</tr>
<tr>
<td>Deviation of the characteristic curve</td>
<td>( \pm 1 % ) of full-scale value</td>
</tr>
<tr>
<td>Repeat accuracy</td>
<td>( \leq 0.5 % ) of switching point</td>
</tr>
<tr>
<td>Resolution</td>
<td>( \pm 0.1 % ) of full-scale value</td>
</tr>
<tr>
<td>Load impedance</td>
<td>( \leq 1 \text{kOhm} )</td>
</tr>
<tr>
<td>Load impedance</td>
<td>0 ... 300 Ohm</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>( \pm 1 % ) of full-scale value</td>
</tr>
<tr>
<td>Synchronisation</td>
<td>bi-directional</td>
</tr>
<tr>
<td>Common mode operation</td>
<td>( \leq 13 \text{Hz} )</td>
</tr>
<tr>
<td>Multiplex operation</td>
<td>( \leq 13 \text{Hz}, n = ) number of sensors</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2, IP54</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>(-25 ... 70 ) \text{°C} (\text{ES} ... 385 \text{K})</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>(-40 ... 85 ) \text{°C} (\text{ES} ... 355 \text{K})</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP54</td>
</tr>
<tr>
<td>Connection</td>
<td>conector V15 (MT2 x 1), 5 pin</td>
</tr>
<tr>
<td>Housing</td>
<td>ABS</td>
</tr>
<tr>
<td>Transducer</td>
<td>epoxy resin/hollow glass sphere mixture, foam, polyurethane, cover PBT</td>
</tr>
<tr>
<td>Mass</td>
<td>150 g</td>
</tr>
</tbody>
</table>

Suitable connector cables, mounting aids and more, you can find in chapter “Accessories”
Dimensions

Membrane keys

LED window

Electrical connection

Standard symbol/Connections:

(version E4, npn)

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:

(version E5, pnp)

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:

(version U)

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:

(version E6, pnp)

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:

(version E7, npn)

Core colours in accordance with EN 60947-5-2.

Diagrams

Characteristic response curve

Analogue output programmation

Switching output programmation

Programmable operation modes

Object distance

Unusable area

Variable width sonic beam

N. C. (A1 > A2):

Output 1

Output 2

Object presence detection:

Both outputs are active if object within detection range.

Switching window and switching point:

Output 1

Output 2

Switching window:

Output 1

Output 2

Unusable area

Variable width sonic beam

Detection limit

Object presence

A1, A2

N. O. (A1 < A2):

Output 1

Output 2

A1 = 0

A1 = 0

Note:

means cover transducer surface with your hand,

while programming the output.

If A1 = A2, the output works like A1 < A2

Note:

means cover transducer surface with your hand,

while teaching the switching point.

If A1 = A2, the output works like A2 > A1
Series -F42

Sensor function description

UB...-F42(S).... , output versions -UK

Safety notes:
The supply circuit is separated from the relay circuit by basic insulation. Safety class II is only guaranteed when using the accessoril connector cable. The connector cable may only be separated from the unit when the power is off.

CAUTION:
The UB...-F42(S)-UK-V95 ultrasonic sensor is not suitable for use in environments subject to explosion hazards.

Conformity: EN 60947-5-2
Housing insulation: Safety class II
Degree of contamination: 3
Overvoltage category: III

Parameterisation:
You can use 2 keys to parameterise the sensor. In order to start the switch point 1 learning mode, press the A1 key; in order to start the switch point 2 learning mode, press the A1 key.
If you keep both keys pressed as you switch on the power supply, the sensor will switch over to the sensitivity adjustment mode of operation.
In case the parameterisation procedure is not completed within 5 minutes, the sensor will discontinue the process and retain all previous settings.

Teaching in switch points:
Teaching in A1 switch point by pressing A1 key.
Keep A1 key pressed for > 2 s
Position target object in the desired distance
Briefly press the A1 key

Analogously, the A2 switch point is learned in the same fashion as described above using the A2 key.

Switching hysteresis operation mode <-> switch point/window operation mode:
Keep both A1 and A2 keys pressed
after 2 seconds:
Release keys

The sensor indicates the current operation mode through the green LED.
permanent green: Switch point/window operation mode
flashing green: Hysteresis operation mode

The sensor changes the operation mode which can be identified through the green LED.
permanent green: Switch point/window operation mode
flashing green: Hysteresis operation mode

The green LED of the sensor keeps indicating the operation mode selected for additional 5 seconds.
**Series -F42**

**Sensor function description**

**Suppression of disturbing targets**

Some types of installation or particular conditions during operation of an ultrasonic sensor may admit that undesired objects (such as shelf brow posts, edges of machines) are closer than the actual target as they enter the recording range. In this case, the sensor would normally detect these objects rather than the desired target. So in order to ensure an error-free operation, it may be necessary to suppress those objects.

Objects can be suppressed if they meet the following conditions:
- The disturbing target must not hide the actual target completely.
- The amplitude of the disturbing signal must be smaller than the amplitude of the desired signal.
- The disturbing target must remain in the edge region of the sound lobe and must not enter its center.

**Sound lobe**

The suppression of the disturbing target is effected through reduction of the response sensitivity. This figure shows its effect on the response characteristics of the sensor. The sensor is preset on step 1 by the manufacturer.

**Sensitivity adjustment for suppression of disturbing targets**

Remove the actual target object from the detection range.

- Keep A1 and A2 keys pressed as you switch on power supply: The sensor enters the sensitivity adjustment mode of operation.
  - The sensor sensitivity can be adjusted in 24 steps.
  - Step 1 = high response
  - Step 24 = low response

- Briefly press the A1 key: Response is increased. The LED lights indicate the actual state of the sensor.
  - flashing red: no disturbing target detected
  - flashing yellow: disturbing target detected
  - permanent red: upper setting limit is reached.

- Briefly press the A2 key: Response is decreased. The LED lights indicate the actual state of the sensor.
  - flashing red: no disturbing target detected
  - flashing yellow: disturbing target detected
  - permanent red: lower setting limit is reached.

- Press both A1 and A2 keys at once: Exiting sensitivity adjustment. The sensor response is saved in non-volatile memory. In the event the sensitivity adjustment is not exited through this procedure, the sensor will exit this operation mode automatically after 5 minutes, and the previous sensitivity value remains valid.
Functional Description

The sensor may be completely parameterised via two keys on the side panel of the housing. As a special feature provided by this sensor, the ultrasound beam width may be adapted to the environmental conditions at the place of operation of the sensor.

Default settings

A1: Minimum sensing range
A2: Nominal distance
window function
wide ultrasound beam

Specifying the switching points:

When specifying the switching points, the user determines at which points the switching output changes its state. The order of the switching points A1 > A2, or A1 < A2 also determines the direction of action (i.e. normally-closed/normally-open contact function).

Specifying the A1 switching point by pressing the A1 key

| Holding down the A1 key > 2 seconds | The sensor switches to learn mode and the user may specify the A1 switching point |
| Positioning the target object at the desired distance | The yellow LED of the sensor flashes fast to indicate that the target object has been recognised. The red LED flashes if the object has not been recognised. |
| Briefly pressing the A1 key | The sensor terminates the specification of the A1 switching point and saves it as a non-volatile value. The specified value is invalid if the object is uncertain (i.e. the red LED lights up at irregular intervals). The learn mode is exited. |

The A2 switching point is specified via the A2 key, analogous to the description above. Alternatively, the switching points may also be specified electrically via the learn input. To specify the A1 switching point, the learn input must be connected to -UB; to specify the A2 switching point, it must be connected to +UB. Specified values are saved upon the disconnection from the learn input.

Switching points may only be specified directly after Power on. A time lock secures the adjusted switching points against unintended modification 5 minutes after the last keypress. To modify the switching points later, the user may specify the desired values only after a new Power On.

Proceed as follows to parameterise the output function and the ultrasound beam width:

Press the A1 key during Power on and hold down the key for another second to ensure that the sensor starts the two-step parameterisation of the operating modes.

Step 1, parameterisation of the output function

The output function parameterised last is displayed. All output functions available may be selected via consecutive, brief strokes of the A2 key. These strokes are visualised via short flashes of the green LED.

Operating mode | Flash sequence of the green LED | A2 key
---|---|---
1 switching point/ object detection | | pause
Window function (default) | | pause
Hysteresis mode | | pause

Hold down the A1 key for 2 seconds to save the selected output mode, complete the parameterisation and ensure that the sensor returns to normal mode. Step 2 may be initiated by briefly pressing the A1 key (parameterisation of the ultrasound beam width).
Step 2, parameterisation of the ultrasound beam width

In the near range, via Step 2, the ultrasound beam width may be adapted to the requirements of the corresponding application. The beam width parameterised last is displayed first. Available beam width settings may be selected via consecutive, brief strokes of the A2 key. These strokes are visualised via the flash sequence of the red LED.

<table>
<thead>
<tr>
<th>Beam width</th>
<th>Flash sequence of the red LED</th>
<th>A2 key</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small beam</td>
<td>pause</td>
<td></td>
</tr>
<tr>
<td>Medium beam</td>
<td>pause</td>
<td></td>
</tr>
<tr>
<td>Large beam</td>
<td>pause</td>
<td></td>
</tr>
</tbody>
</table>

Hold down the A1 key for 2 seconds to save the selected beam shape, complete the parameterisation and ensure that the sensor returns to normal mode. Briefly press the A1 key to return to Step 1 (parameterisation of the output function).

If the parameterisation mode is not terminated within 5 minutes after last keypress (by holding down the A1 key for 2 seconds), the sensor aborts this mode without modifying the settings.

Synchronisation

The sensor has a synchronisation port to suppress mutual influencing. If this port has not been connected, the sensor works at an internally generated cycle rate. Several sensors may be synchronised via the following options.

External synchronisation:
The sensor may be synchronised via the external application of a square wave voltage. A synchronisation pulse on the synchronisation input initiates a measuring cycle. The pulse width must be greater than 100 µs. The measuring cycle is started with the falling edge. A low level > 1 s or an open synchronisation input initiate the transition to normal sensor mode. A high level on the synchronisation input deactivates the sensor.

Two modes are possible:
- Several sensors are controlled via the same synchronisation signal. The sensors work in common mode.
- The synchronisation pulses are forwarded at cyclic intervals to respectively one single sensor. The sensors work in multiplex mode.

Self-synchronisation:
The synchronisation ports of up to 5 sensors suitable for self-synchronisation are connected to each other. These sensors work in multiplex mode after Power on. The On delay increases depending on the number of sensors to be synchronised. While the learn mode is active, no synchronisation is possible (and vice-versa). To specify the switching points, the sensors must be operated in non-synchronised mode.

Note:
If the synchronisation option is not used, the synchronisation input must be connected to ground (0V) or the sensor must be operated with a (4-pole) V1 connecting cable.
Series -F42

Sensor function description

UB...-F42(S)..., output versions -E6 and -E7

Functional description
The sensor can be completely parameterised using 2 keys on the side of the housing. One special feature of this sensor is the option of adapting the ultrasonic beam width to the ambient conditions at the place where the sensor is used.

Default settings
A1: blind range
A2: nominal distance
2 x normally open function
Wide ultrasonic beam width

Teach-in of switching points:
Teach-in of switching points is used to determine the points at which the switching outputs will change their state. In addition, the order of switching points A1 < A2, or A1 > A2 also determines the effective direction (normally closed/open function) of the window in the output function (operating mode) "Window + Switching point" (see below).

<table>
<thead>
<tr>
<th>Teach-in of switching point A1 with key A1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press key A1 &gt; 2 seconds</td>
</tr>
<tr>
<td>Position the target object at the desired distance</td>
</tr>
<tr>
<td>Press key A1 briefly</td>
</tr>
</tbody>
</table>

The process for Teach-in of switching point A2 is similar to what was described above, using key A2.

Special feature for output function "Window + switching point"
In the case of the output function (operating mode) "Window + switching point" (see below), switching points A1 and A2 define the window limits of switch output 1. A third switching point A3 can also be defined here at which switch output 2 switches.

<table>
<thead>
<tr>
<th>Teach-in of switching point A3 with keys A1 and A2 (only for operating mode window + switching point, see below)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press key A1 + A2 &gt; 2 seconds</td>
</tr>
<tr>
<td>Position the target object at the desired distance</td>
</tr>
<tr>
<td>Press key A1 briefly (output 2: normally closed) or Press key A2 briefly (output 2: normally open)</td>
</tr>
</tbody>
</table>

Teach-in for switching points can only be performed within the first 5 minutes after turning on the power supply. If the switching points need to be changed at a later time, this cannot be done until there is a new Power On.

Parameter assignment of the output function and ultrasound beam width
If you press the A1 key while the power supply is being turned on and then hold it down for 1 second, the sensor goes into the two-level parameterisation of operating modes.
Level 1, parameterisation of the output function
Pressing the A2 key briefly will cause the possible output functions to be selected one after the other (depending on the last output function to be parameterised). The functions are indicated by a flashing sequence of the green LED.

<table>
<thead>
<tr>
<th>Operating mode</th>
<th>Flashing sequence of green LED</th>
<th>A2 key</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x normally open function (default)</td>
<td>![Flashing sequence]</td>
<td>![Pause]</td>
</tr>
<tr>
<td>2 x normally closed function</td>
<td>![Flashing sequence]</td>
<td>![Pause]</td>
</tr>
<tr>
<td>2 switching points n.o. (output 1) + n.c. (output 2)</td>
<td>![Flashing sequence]</td>
<td>![Pause]</td>
</tr>
<tr>
<td>Window (output 1) + switching point (output 2)</td>
<td>![Flashing sequence]</td>
<td>![Pause]</td>
</tr>
</tbody>
</table>

Pressing the A1 key for 2 seconds saves the selected output operating mode. The parameter assignment process is then complete and the sensor returns to normal mode. If you press the A1 key briefly instead, you go to Level 2 (parameter assignment of ultrasonic beam range).

Level 2, parameter assignment of ultrasonic beam width
The ultrasonic beam width can be adjusted to match the requirements of the application in Level 2. Pressing the A2 key briefly will cause the possible beam widths to be selected one after the other (depending on the last beam width to be parameterised). The functions are indicated by a flashing sequence of the red LED.

<table>
<thead>
<tr>
<th>Beam width</th>
<th>Flashing sequence of red LED</th>
<th>A2 key</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow beam width</td>
<td>![Flashing sequence]</td>
<td>![Pause]</td>
</tr>
<tr>
<td>Average beam width</td>
<td>![Flashing sequence]</td>
<td>![Pause]</td>
</tr>
<tr>
<td>Wide beam (default)</td>
<td>![Flashing sequence]</td>
<td>![Pause]</td>
</tr>
</tbody>
</table>

Pressing the A1 key for 2 seconds saves the selected type of beam width. The parameter assignment process is then complete and the sensor returns to normal mode. If you press the A1 briefly instead, you go back to Level 1 (parameter assignment of output function).

If parameterisation is not complete within 5 minutes (pressing the A1 key for 2 seconds), the sensor interrupts parameterisation mode without changing the settings.

Synchronisation
The sensor is equipped with a synchronisation connection to suppress mutual interaction. If it is not turned on, the sensor works at an internally generated cycle rate. Synchronisation of more than one sensor is possible in a number of different ways. External synchronisation:
The sensor can be synchronised by the application of a square wave voltage externally. A synchronisation pulse on the synchronisation input results in the execution of a measurement cycle. The pulse width must be greater than 100 µs. The measurement cycle must start with the falling signal edge. A Low level > 1 s or an open synchronisation input results in normal operation of the sensor. A High level on the synchronisation input deactivates the sensor.

Two different operating modes are possible:
- Multiple sensors can be controlled by the same synchronisation signal. The sensors work on synonymous cycle.
- Synchronisation pulses are sent cyclically to only one sensor each time. The sensors work in Multiplex mode.

Self synchronisation:
The synchronisation connections of up to 5 sensors with option for self-synchronisation are connected with each other. These sensors work after turning on the operating voltage in Multiplex mode. The On delay increases depending on the number of sensors to be synchronised. Synchronisation is possible during Teach-in and vice-versa. Sensors must be operated unsynchronised to perform Teach-in of switching points.

Note:
If the option for synchronisation is not used, the synchronisation input can be connected with ground (0 V) or the sensor can be operated with a V1 connection cable (4-pin).
Sensor function description

Series -F42

UB...-F42(S)...., output versions -I and -U

Functional description
The sensor can be completely parameterised using 2 keys on the side of the housing. One special feature of this sensor is the option of adapting the ultrasonic beam width to the ambient conditions at the place where the sensor is used.

Default settings
A1: blind range
A2: nominal distance
2 x normally open function
Wide ultrasonic beam width

Teach-in of switching points:
Teach-in of switching points is used to determine the points at which the switching outputs will change their state. In addition, the order of switching points A1 < A2, or A1 > A2 also determines the effective direction (normally closed/open function) of the window in the output function (operating mode) “Window + Switching point” (see below).

A third switching point A3 can also be defined here at which switch output 2 switches.

Parameter assignment of the output function and ultrasound beam width
If you press the A1 key while the power supply is being turned on and then hold it down for 1 second, the sensor goes into the two-level parameterisation of operating modes.
Series -F42

Sensor function description

Level 1, parameterisation of the output function
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<td>![Flashing sequence]</td>
<td>![Pause]</td>
</tr>
<tr>
<td>Window (output 1) + switching point (output 2)</td>
<td>![Flashing sequence]</td>
<td>![Pause]</td>
</tr>
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Pressing the A1 key for 2 seconds saves the selected output operating mode. The parameter assignment process is then complete and the sensor returns to normal mode. If you press the A1 key briefly instead, you go to Level 2 (parameter assignment of ultrasonic beam range).

Level 2, parameter assignment of ultrasonic beam width
The ultrasonic beam width can be adjusted to match the requirements of the application in Level 2. Pressing the A2 key briefly will cause the possible beam widths to be selected one after the other (depending on the last beam width to be parameterised). The functions are indicated by a flashing sequence of the red LED.

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Pressing the A1 key for 2 seconds saves the selected type of beam width. The parameter assignment process is then complete and the sensor returns to normal mode. If you press the A1 briefly instead, you go back to Level 1 (parameter assignment of output function).

If parameterisation is not complete within 5 minutes (pressing the A1 key for 2 seconds), the sensor interrupts parameterisation mode without changing the settings.

Synchronisation
The sensor is equipped with a synchronisation connection to suppress mutual interaction. If it is not turned on, the sensor works at an internally generated cycle rate. Synchronisation of more than one sensor is possible in a number of different ways.

External synchronisation:
The sensor can be synchronised by the application of a square wave voltage externally. A synchronisation pulse on the synchronisation input results in the execution of a measurement cycle. The pulse width must be greater than 100 µs. The measurement cycle must be started with the falling signal edge. A Low level > 1 s or an open synchronisation input results in normal operation of the sensor. A High level on the synchronisation input deactivates the sensor.

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Note:
If the option for synchronisation is not used, the synchronisation input can be connected with ground (0 V) or the sensor can be operated with a V1 connection cable (4-pin).
Notes
<table>
<thead>
<tr>
<th>Model number</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC300-F43-2KIR2-V17</td>
<td>300 mm</td>
<td>156</td>
</tr>
<tr>
<td>UC2000-F43-2KIR2-V17</td>
<td>2000 mm</td>
<td></td>
</tr>
</tbody>
</table>
**Ultrasonic sensor**

UC...-F43-2KIR2-V17

- Current output 4 mA ... 20 mA
- 2 relay outputs
- Serial interface
- Temperature compensation
- Reverse polarity protection
- Parameterisable with ULTRA 2001

![Ultrasonic sensor image]

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"

### Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UC2000-F43-2KIR2-V17</th>
<th>UC2000-F43-2KIR2-V17</th>
</tr>
</thead>
</table>

#### Sensing range
- 0 ... 300 mm
- 80 ... 2000 mm

#### Adjustment range
- 100 ... 2000 mm

#### Unusable area
- 0 mm

#### Standard target plate
- 100 mm x 100 mm

#### Transducer frequency
- approx. 175 kHz
- approx. 390 kHz

#### Response delay
- minimum (EM; NONE): ≤ 20 ms (2 measuring cycles)
- factory setting (EM, MIN, 5, 2): ≤ 60 ms (6 measuring cycles)
- dynamic (EM, DIN): ≤ 30 ms (3 measuring cycles)
- minimum (EM; NONE): ≤ 50 ms (2 measuring cycles)
- factory setting (EM, MIN, 5, 2): ≤ 150 ms (6 measuring cycles)
- dynamic (EM, DIN): ≤ 75 ms (3 measuring cycles)

#### LED green
- Continuous: object in the measuring window
- Flashing: object outside the measuring window

#### Operating voltage
- 10 ... 30 V DC
- Ripple ±10 %SS

#### Power consumption
- ≤ 2 W (all relays pulled-in, current output 20 mA)
- no-load power consumption < 0.7 W

#### Output type
- 2 relay outputs, 1 analogue output 4 ... 20 mA

#### Deviation of the characteristic curve
- < 0.2 % of full-scale value

#### Repeat accuracy
- ≤ 0.1 % of full-scale value

#### Resolution
- 0.2 mm
- 0.6 mm

#### Load impedance
- Current output:
  - ≤ 500 Ω at Uo ≥ 17 V
  - ≤ 200 Ω at Uo < 17 V

#### Range hysteresis
- 0 ... 15 % parameterisable with ULTRA 2001

#### Contact loading
- 60 V DC/1 A (max. 24 WDC), ohmic
- 60 V DC/1 A (max. 24 WDC), ohmic

#### Lifetime
- Electrical: 3 x 10^7 switching cycles at resistive load (1 A / 34 V DC)
- Mechanical: 10^7 switching cycles

#### Temperature influence
- ≤ 2 % of full-scale value

#### Interface type
- RS 232, 9600 bit/s, no parity, 8 data bits, 1 stop bit

#### Standards
- EN50087-52

#### Ambient temperature
- 0 ... 70 °C (273 ... 343 K)

#### Storage temperature
- -25 ... 70 °C (248 ... 343 K)
- -40 ... 85 °C (233 ... 358 K)

#### Protection degree
- IP65

#### Connection
- 8-pin round connector, Lumberg type RSF 8

#### Material
- Housing: PBT
- Transducer: epoxy resin/hollow glass sphere mixture; polyurethane barn

#### Mass
- 290 g

Subject to reasonable modifications due to technical advances.
Subject to reasonable modifications due to technical advances.

**Dimensions**

![Dimensions Diagram](image)

**Electrical connection**

Standard symbol/Connection:

![Electrical Connection Diagram](image)

Core colours in accordance with EN 60947-5-2.

**Diagrams**

**Characteristic response curve**

UC300-F43-2KIR2-V17

**Basic setting**

OM:
- Relay 1: NO
- Relay 2: NO

SD1/SD2:
- Switch point relay 1 = 25 mm
- Switch point relay 2 = 50 mm

NDE/FDE:
- Analogue output: 4 mA ⇒ 25 mm
- 20 mA ⇒ 300 mm

FSF:
- Error ⇒ Relay 1 and 2: latest state
- Analogue output: IOUT = 3,9 mA

NEF:
- No echo ⇒ error message

MA,S:
- Switching mode

UC2000-F43-2KIR2-V17

**Basic setting**

OM:
- Relay 1: NO
- Relay 2: NO

SD1/SD2:
- Switch point relay 1 = 100 mm
- Switch point relay 2 = 2000 mm

NDE/FDE:
- Analogue output: 4 mA ⇒ 100 mm
- 20 mA ⇒ 2000 mm

FSF:
- Error ⇒ Relay 1 and 2: latest state
- Analogue output: IOUT = 3,9 mA

NEF:
- No echo ⇒ error message

MA,S:
- Switching mode
Thanks to its extensive command set, the sensor can be configured to suit the application via the RS 232 interface.

### RS 232 command set (overview)

<table>
<thead>
<tr>
<th>Command</th>
<th>Meaning</th>
<th>Parameter</th>
<th>Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS0</td>
<td>Velocity of Sound at 0 °C</td>
<td>Velocity of sound at 0 °C in [km/s] (10000 ... 60000)</td>
<td>read and set</td>
</tr>
<tr>
<td>VS</td>
<td>Velocity of Sound</td>
<td>Velocity of sound VS in [km/s]</td>
<td>read</td>
</tr>
<tr>
<td>TO</td>
<td>Temperature Offset</td>
<td>TO in [°C] [200 ... 200]</td>
<td>read and set</td>
</tr>
<tr>
<td>TEM</td>
<td>TEMperature</td>
<td>TEM in [°C]</td>
<td>read and adapt to TO</td>
</tr>
<tr>
<td>REF</td>
<td>REFerence measurement</td>
<td>REF distance in [mm]</td>
<td>adaptation of VS0</td>
</tr>
<tr>
<td>SD1</td>
<td>Switching Distance 1</td>
<td>Switching position, relay 1 SD1 in [mm] [1 ... 800]</td>
<td>read and set</td>
</tr>
<tr>
<td>SD2</td>
<td>Switching Distance 2</td>
<td>Switching position, relay 2 SD2 in [mm] [1 ... 800]</td>
<td>read and set</td>
</tr>
<tr>
<td>SH1</td>
<td>Switching Hysteresis 1</td>
<td>Hysteresis, relay 1 in [%] [0 ... 15]</td>
<td>read and set</td>
</tr>
<tr>
<td>SH2</td>
<td>Switching Hysteresis 2</td>
<td>Hysteresis, relay 2 in [%] [0 ... 15]</td>
<td>read and set</td>
</tr>
<tr>
<td>NDE</td>
<td>Near Distance of Evaluation</td>
<td>Near measuring window limit in [mm] [1 ... 800]</td>
<td>read and set</td>
</tr>
<tr>
<td>FDE</td>
<td>Far Distance of Evaluation</td>
<td>Far measuring window limit in [mm] [1 ... 800]</td>
<td>read and set</td>
</tr>
<tr>
<td>SS1</td>
<td>SS1 binary [0: inactive, 1 active] (independent of OM)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS2</td>
<td>SS2 binary [0: inactive, 1 active] (independent of OM)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADB</td>
<td>Absolute Distance Binary</td>
<td>Distance in [mm] not as ASCII</td>
<td>read</td>
</tr>
<tr>
<td>RDB</td>
<td>Relative Distance Binary</td>
<td>Relative distance as number [0 ... 4095] not as ASCII</td>
<td>read</td>
</tr>
<tr>
<td>RTB</td>
<td>RunTime Binary</td>
<td>Echo runtime in machine cycles [1 machine cycle = 1.085 µs]</td>
<td>read</td>
</tr>
<tr>
<td>ER</td>
<td>Echo Received</td>
<td>Echo detected: no, yes [0]</td>
<td>read</td>
</tr>
<tr>
<td>VER</td>
<td>Version string</td>
<td>xxx</td>
<td>read</td>
</tr>
<tr>
<td>ID</td>
<td>IDentityfication</td>
<td>ID string: P&amp;F UC300-F43-2KIR2-V17 ...</td>
<td>read</td>
</tr>
<tr>
<td>DAT</td>
<td>Data</td>
<td>Date string: e.g. Date: 04/12/02</td>
<td>read</td>
</tr>
<tr>
<td>ST</td>
<td>Status</td>
<td>Status as hexadecimal string</td>
<td>read</td>
</tr>
<tr>
<td>RST</td>
<td>ReSet</td>
<td>Performs a reset</td>
<td>Command</td>
</tr>
<tr>
<td>DEF</td>
<td>DEFault settings</td>
<td>Restores defaults</td>
<td>Command</td>
</tr>
<tr>
<td>SUC</td>
<td>User Configuration</td>
<td>Stores all settings</td>
<td>Command</td>
</tr>
<tr>
<td>RUC</td>
<td>Recall User Configuration</td>
<td>Restores stored settings</td>
<td>Command</td>
</tr>
</tbody>
</table>
Thanks to its extensive command set, the sensor can be configured to suit the application via the RS 232 interface.

<table>
<thead>
<tr>
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<th>Meaning</th>
<th>Parameter</th>
<th>Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS0</td>
<td>Velocity of Sound at 0 °C</td>
<td>Velocity of sound at 0 ° centigrade VS0 in [cm/s] [12000 .. 60000]</td>
<td>read and set</td>
</tr>
<tr>
<td>VS</td>
<td>Velocity of Sound</td>
<td>Velocity of sound VS in [cm/s]</td>
<td>read</td>
</tr>
<tr>
<td>TO</td>
<td>Temperature Offset</td>
<td>TO in [°K]</td>
<td>read and set</td>
</tr>
<tr>
<td>TEM</td>
<td>TEMperature</td>
<td>TEM in [0..1K]</td>
<td>read and set</td>
</tr>
<tr>
<td>REF</td>
<td>REFerence measurement</td>
<td>REF distance in [mm] [100 .. 4000]</td>
<td>adaptation of VS0</td>
</tr>
<tr>
<td>SD1</td>
<td>Switching Distance 1</td>
<td>Switching point, relay 1 SD1 in [mm] (100 .. 4000)</td>
<td>read and set</td>
</tr>
<tr>
<td>SD2</td>
<td>Switching Distance 2</td>
<td>Switching point, relay 2 SD1 in [mm] (100 .. 4000)</td>
<td>read and set</td>
</tr>
<tr>
<td>SH1</td>
<td>Switching Hysteresis 1</td>
<td>Hysteresis, relay 1 in [%] [0 .. 15]</td>
<td>read and set</td>
</tr>
<tr>
<td>SH2</td>
<td>Switching Hysteresis 2</td>
<td>Hysteresis, relay 2 in [%] [0 .. 15]</td>
<td>read and set</td>
</tr>
<tr>
<td>NDE</td>
<td>Near Distance of Evaluation</td>
<td>Near measuring window limit in [mm] (100 .. 4000)</td>
<td>read and set</td>
</tr>
<tr>
<td>FDE</td>
<td>Far Distance of Evaluation</td>
<td>Far measuring window limit in [mm] (100 .. 4000)</td>
<td>read and set</td>
</tr>
<tr>
<td>BR</td>
<td>Unusable area (Blind Range)</td>
<td>Unusable area in [mm] [0 .. 4000]</td>
<td>read and set</td>
</tr>
<tr>
<td>RR</td>
<td>Range Reduction</td>
<td>reduces sensing range in [mm] [100 .. 4000]</td>
<td>read and set</td>
</tr>
<tr>
<td>CBT</td>
<td>Constant Burst Time</td>
<td>Burst length [0.1, 2.3]</td>
<td>read and set</td>
</tr>
<tr>
<td>CCT</td>
<td>Constant Cycle Time</td>
<td>Time in [ms] [0 .. 1000]</td>
<td>read and set</td>
</tr>
<tr>
<td>FTO</td>
<td>Filter TimeOut</td>
<td>Number of measurements without echo to be filtered [0 .. 255]</td>
<td>read and set</td>
</tr>
<tr>
<td>EM</td>
<td>Evaluation Method</td>
<td>Evaluation method { 0 = NON E; PT1[,f,p,c]; MXN[,m,n]; DYN[p] }</td>
<td>read and set</td>
</tr>
<tr>
<td>OMF</td>
<td>Output Mode</td>
<td>OM code [normally-open = 0, normally-closed = 1, inactive = I] (independent of OM)</td>
<td>read and set</td>
</tr>
<tr>
<td>FSF</td>
<td>Fail Safe Function</td>
<td>Failure function type e.g. FSF, [1,2], [fault current in 0 mA], -1 = current output indifferent</td>
<td>read and set</td>
</tr>
<tr>
<td>MD</td>
<td>Master Device</td>
<td>Function as master (0 = NONE), AD, RD, RT, SS, ADB, RDB, RTB</td>
<td>read and set</td>
</tr>
<tr>
<td>MA</td>
<td>Main Application</td>
<td>Determines whether the green LED orient on analogue output or switching outputs</td>
<td>read and set</td>
</tr>
<tr>
<td>NEF</td>
<td>No Echo Failure</td>
<td>Sensor behavior when no echo is present [0,1]</td>
<td>read and set</td>
</tr>
<tr>
<td>AD</td>
<td>Absolute Distance</td>
<td>Distance in [mm]</td>
<td>read</td>
</tr>
<tr>
<td>RD</td>
<td>Relative Distance</td>
<td>Relative distance as number [0 .. 4095]</td>
<td>read</td>
</tr>
<tr>
<td>RT</td>
<td>RunTime</td>
<td>Echo run time in machine cycles {1 machine cycle = 1.085µs}</td>
<td>read</td>
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<td>SS1</td>
<td>Switching State1</td>
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</tr>
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<td>Switching State2</td>
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<td>Relative distance as number [0 .. 4095] not as ASCII</td>
<td>read</td>
</tr>
<tr>
<td>RTB</td>
<td>RunTime Binary</td>
<td>Echo run time in machine cycles {1 machine cycle = 1.085µs} not as ASCII</td>
<td>read</td>
</tr>
<tr>
<td>ER</td>
<td>Echo Received</td>
<td>Echo detected: no, yes [0/1]</td>
<td>read</td>
</tr>
<tr>
<td>VER</td>
<td>Version</td>
<td>Version string: vx.x</td>
<td>read</td>
</tr>
<tr>
<td>ID</td>
<td>IDentification</td>
<td>ID string P&amp;S UC2000-F40-2KIR2-V17...</td>
<td>read</td>
</tr>
<tr>
<td>DAT</td>
<td>DAta</td>
<td>Date string: e.g. Date: 04/12/02 Time: 11:14:35</td>
<td>read</td>
</tr>
<tr>
<td>ST</td>
<td>Status</td>
<td>Status as hexadecimal string</td>
<td>read</td>
</tr>
<tr>
<td>RST</td>
<td>ReSeT</td>
<td>Performs a reset</td>
<td>Command</td>
</tr>
<tr>
<td>DEF</td>
<td>Default settings</td>
<td>Restores defaults</td>
<td>Command</td>
</tr>
<tr>
<td>SUC</td>
<td>Store User Configuration</td>
<td>Stores all settings</td>
<td>Command</td>
</tr>
<tr>
<td>RUC</td>
<td>Recall User Configuration</td>
<td>Restores stored settings</td>
<td>Command</td>
</tr>
</tbody>
</table>
Series -F54

<table>
<thead>
<tr>
<th>Model number</th>
<th>Description</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UB500-F54-E4-V15</td>
<td>Switching output</td>
<td>500 mm</td>
<td>162</td>
</tr>
<tr>
<td>UB500-F54-E5-V15</td>
<td></td>
<td>500 mm</td>
<td></td>
</tr>
<tr>
<td>UB2000-F54-E4-V15</td>
<td></td>
<td>2000 mm</td>
<td></td>
</tr>
<tr>
<td>UB2000-F54-E5-V15</td>
<td></td>
<td>2000 mm</td>
<td></td>
</tr>
<tr>
<td>UB500-F54-I-V15</td>
<td>Analogue output</td>
<td>500 mm</td>
<td>164</td>
</tr>
<tr>
<td>UB500-F54-U-V15</td>
<td></td>
<td>500 mm</td>
<td></td>
</tr>
<tr>
<td>UB2000-F54-I-V15</td>
<td></td>
<td>2000 mm</td>
<td></td>
</tr>
<tr>
<td>UB2000-F54-U-V15</td>
<td></td>
<td>2000 mm</td>
<td></td>
</tr>
<tr>
<td>UB500-F54-H3-V1</td>
<td>For external control/evaluation unit</td>
<td>500 mm</td>
<td>166</td>
</tr>
<tr>
<td>UB2000-F54-H3-V1</td>
<td></td>
<td>2000 mm</td>
<td></td>
</tr>
</tbody>
</table>

For detailed function description, see page 168
## Technical Data

### Sensing range
- 30 ... 500 mm
- 80 ... 2000 mm

### Adjustment range
- 100 ... 2000 mm
- 50 ... 500 mm

### Unusable area
- 0 ... 80 mm
- 0 ... 30 mm

### Standard target plate
- 100 mm x 100 mm

### Transducer frequency
- approx. 1.75 kHz
- approx. 380 kHz

### Response delay
- ≤ 150 ms
- ≤ 50 ms

### Operating voltage
- 10 ... 30 V DC
- ≤ 10 % ripple

### No-load supply current
- ≤ 55 mA

### Output type
- 1 switch output E4, npn: NO/NC
- 1 switch output E5, pnp: NO/NC

### Rated operational current
- 200 mA, short-circuit overload protected

### Voltage drop
- ≤ 3 V

### Switching frequency
- max. 10 Hz

### Range hysteresis
- ≤ 1 % of the set operating distance

### Repeatability accuracy
- 3 % of full-scale value

### Temperature influence
- ≤ 1.5 % of full-scale value

### Input type
- 1 TEACH-IN input:
  - switching point A1: -Ud ... +1 V, switching point A2: +4 V ... +Ud
  - input impedance: > 47 kΩ, TEACH-IN pulse ≥ 1 s

### Synchronisation
- 1 synchronous input
  - 0 level: -Ud ... +1 V, 1 level: +4 V ... +Ud
  - input impedance: > 12 kΩ, synchronisation pulse: 0.1 ... 28 ms
  - 1 synchronous input
  - 0 level: -Ud ... +1 V, 1 level: +4 V ... +Ud
  - input impedance: > 12 kΩ, synchronisation pulse: 0.1 ... 8 ms

### Common mode operation
- ≤ 100 Hz

### Multiplex operation
- ≤ 100 / n Hz, n = number of sensors
- ≤ 33 / n Hz, n = number of sensors

### Standards
- EN 60947-5-2

### Ambient temperature
- -25 ... +70 °C (248 ... 343 K)

### Storage temperature
- -40 ... +85 °C (233 ... 358 K)

### Protection degree
- IP66

### Connection
- connector V15 (M12 x 1), 5 pin

### Material
- housing: ABS
- transducer: epoxy resin/hollow glass sphere mixture; polyurethane foam

### Mass
- 100 g

---

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"
Dimensions

Bore hole and countersinking for screws/hexagon M4

UB500-F54-...

UB2000-F54-...

Electrical connection

Standard symbol/Connections:
(version E4, npn)

1. (BN) + U
2. (BY) Teaching input
3. (BU) Synchronous

Switch output

UB500-F54-...

UB2000-F54-...

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:
(version E5, pnp)

1. (BN) + U
2. (BY) Teaching input
3. (BU) Synchronous

Switch output

Core colours in accordance with EN 60947-5-2.

Diagrams

Characteristic response curve

Distance Y [m]

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Distance X [m]

1. Window mode, normally open function
   A1 < A2:
   Object range

2. Window mode, normally closed function
   A2 < A1:
   Object detected: Switch output closed
   No object detected: Switch output open

3. One switch point, normally open function
   A1 -> ∞:

4. One switch point, normally closed function
   A2 -> ∞:

5. A1 -> ∞, A2 -> ∞: Detection of object presence
   Object detected: Switch output closed
   No object detected: Switch output open

Programmed switching output function
### Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensing range</strong></td>
<td>30 ... 500 mm, 0 ... 300 mm, 80 ... 2000 mm, 0 ... 80 mm</td>
</tr>
<tr>
<td><strong>Adjustment range</strong></td>
<td>100 ... 2000 mm, 50 ... 500 mm</td>
</tr>
<tr>
<td><strong>Unusable area</strong></td>
<td>0 ... 30 mm, 0 ... 80 mm</td>
</tr>
<tr>
<td><strong>Standard target plate</strong></td>
<td>100 mm x 100 mm, 100 mm x 500 mm</td>
</tr>
<tr>
<td><strong>Transducer frequency</strong></td>
<td>approx. 175 kHz, approx. 380 kHz</td>
</tr>
<tr>
<td><strong>Response delay</strong></td>
<td>≤ 150 ms, ≤ 50 ms</td>
</tr>
<tr>
<td><strong>LED green</strong></td>
<td>permanently green, monitoring system, green flashing: TEACH-IN function</td>
</tr>
<tr>
<td><strong>LED yellow</strong></td>
<td>permanently yellow: object in the evaluation range, yellow flashing: TEACH-IN function, object detected</td>
</tr>
<tr>
<td><strong>LED red</strong></td>
<td>flashing: normal mode: error, TEACH-IN function: no object detected, permanently: TEACH-IN mode, object uncertain</td>
</tr>
<tr>
<td><strong>Operating voltage</strong></td>
<td>10 ... 30 V DC, ripple 10 %SS, 15 ... 30 V DC, ripple 10 %SS</td>
</tr>
<tr>
<td><strong>No-load supply current</strong></td>
<td>≤ 55 mA</td>
</tr>
<tr>
<td><strong>Output type</strong></td>
<td>1 analogue output 0 ... 10 V, 1 analogue output 4 ... 20 mA</td>
</tr>
<tr>
<td><strong>Deviation of the characteristic curve</strong></td>
<td>± 1 % of full-scale value, ± 0.1 % of full-scale value</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>0.13 mm, 0.11 mm, 0.5 mm, 0.47 mm</td>
</tr>
<tr>
<td><strong>Load impedance</strong></td>
<td>≥ 1 kOhm</td>
</tr>
<tr>
<td><strong>Temperature influence</strong></td>
<td>± 1.5 % of full-scale value, ± 0.1 % of full-scale value</td>
</tr>
<tr>
<td><strong>Default setting</strong></td>
<td>evaluation limit 1: 100 mm evaluation limit 2: 2000 mm, evaluation limit 1: 50 mm evaluation limit 2: 500 mm</td>
</tr>
<tr>
<td><strong>Input type</strong></td>
<td>1 TEACH-IN input, lower evaluation limit A1: -Ua ... +1 V, upper evaluation limit A2: +4 V ... +Ua</td>
</tr>
<tr>
<td><strong>Synchronisation</strong></td>
<td>1 synchronous input, 0 level: -Ua ... +1 V, 1 level: +4 V ... +Ua, input impedance: 12 kOhm, synchronisation pulse: 0.1 ... 8 ms</td>
</tr>
<tr>
<td><strong>Common mode operation</strong></td>
<td>≤ 100 Hz</td>
</tr>
<tr>
<td><strong>Multiplex operation</strong></td>
<td>≤ 100 / n Hz, n = number of sensors, ≤ 33 Hz / n = number of sensors</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>-25 ... 70 °C (248 ... 343 K)</td>
</tr>
<tr>
<td><strong>Storage temperature</strong></td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td><strong>Protection degree</strong></td>
<td>IP65</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>connector V15 (M12 x 1), 5 pin</td>
</tr>
<tr>
<td><strong>Material housing</strong></td>
<td>ABS</td>
</tr>
<tr>
<td><strong>Transducer</strong></td>
<td>epoxy resin/hollow glass sphere mixture; polyurethane foam</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>100 g</td>
</tr>
</tbody>
</table>

---

*Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"*

---

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**Ultrasonic sensor**

### Model number


---

**Series -12GM**

**Series -18GM/-18GM**

**Series -30GM**

**Series VariKont**

**Series -FP**

**Series -F12**

**Series -F42**

**Series -F43**

**Series -F54**

**Series -D1**

**Series LUC**

---

**Accessories**

---

**Double sheet monitoring**

---

**Contact limited Power supplies**

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**Date of edition:** 08/12/2005

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**Ultrasonic sensor**

### Measure window adjustable

- TEACH-IN input
- Synchronisation options
- Deactivation option
- Temperature compensation

**Analogous output 0 V ... 10 V**

- UB500-F54-U-V15
- UB2000-F54-U-V15

**Analogous output 4 mA ... 20 mA**

- UB500-F54-I-V15
- UB2000-F54-I-V15
Dimensions

UB...-F54-...-V15

Electrical connection

Standard symbol/Connections:

(version I)

U

1 (BN) + U

Teaching input

2 (WH)

Synchronous

3 (BK)

Analog output

4 (BU)

Core colours in accordance with EN 60947-5-2.

Standard symbol/Connections:

(version U)

U

1 (BN) + U

Teaching input

2 (WH)

Synchronous

3 (BK)

Analog output

4 (BU)

Core colours in accordance with EN 60947-5-2.

Date of edition: 08/18/2005

Bore hole and countersinking for screws/hexagon M4

Bore hole and countersinking for screws/hexagon M4

UB500-F54-...

UB2000-F54-...

Diagrams

Characteristic response curve

Distance Y [m]

0.20

0.15

0.10

0.05

0.00

-0.05

-0.10

-0.15

-0.20

0 0.5 1 1.5 2 2.5 3 3.5

X

Y

Curve 1: flat surface 100 mm x 100 mm

Curve 2: round bar, Ø 25 mm

UB500-F54-...

UB2000-F54-...

Characteristic response curve

Distance Y [m]

0.20

0.15

0.10

0.05

0.00

-0.05

-0.10

-0.15

-0.20

0 0.5 1 1.5 2 2.5 3 3.5

X

Y

Curve 1: flat surface 100 mm x 100 mm

Curve 2: round bar, Ø 25 mm

Programmed analogue output function

Rising ramp

A1 < A2:

Falling ramp

A2 < A1:

object range

A1

A2

A1

A2

UB500-F54-...

UB2000-F54-...
## Technical Data

### Model number
- UB500-F54-H3-V1
- UB2000-F54-H3-V1

### Function
The sensing range is determined in the downstream evaluation electronics (e.g., the units UH3-KHD2-4E5, UH3-KHD2-4I or UH3-T1-KT). PLC modules or other existing evaluation units can also be substituted for these units offered by Pepperl+Fuchs.

The object distance in pulse-echo mode is obtained from the echo time.

1) The unusable area (blind range) BR depends on the pulse duration $T_1$.
2) The sensors detection range depends on the pulse duration $T_1$.
   - With pulse duration $<$ typical pulse duration, the sensors detection range may be reduced.

### Sensing range
- 30 to 500 mm
- 80 to 2000 mm

### Adjustment range
- 100 to 2000 mm
- 50 to 500 mm

### Unusable area
- 0 to 30 mm ($^1$)
- 0 to 80 mm ($^1$)

### Standard target plate
- 100 mm x 100 mm

### Transducer frequency
- approx. 175 kHz
- approx. 380 kHz

### Operating voltage
- 10 to 30 V DC, ripple 10 %

### No-load supply current
- $\leq 30$ mA

### Output type
- 1 pulse output for echo runtime, short-circuit proof
- Open collector pnp with pull-down resistor = 22 kOhm
- Level 0 (no echo): $-U_B$
- Level 1 (echo detected): $+(+U_B-2 \text{ V})$

### Rated operational current
- 15 mA, short-circuit/overload protected

### Temperature influence
- The echo propagation time: 0.17 % / K

### Input type
- 1 pulse input for transmitter pulse (clock)
- 0-level (active): $< 5 \text{ V ($U_B > 15 \text{ V}$)}$
- 0-level (inactive): $> 10 \text{ V ($U_B > 15 \text{ V}$)}$
- 1-level (active): $< 10 \text{ V ($U_B < 15 \text{ V}$)}$
- 1-level (inactive): $> 23 \text{ V ($U_B < 15 \text{ V}$)}$

### Pulse length
- 20 to 300 $\mu$s (typ. 200 $\mu$s)
- 5 to 100 $\mu$s (typ. 50 $\mu$s)

### Pause length
- $\geq 50 \times$ pulse length

### Impedance
- 10 kOhm internal connected to $+U_B$

### Standards
- EN 60947-5-2

### Ambient temperature
- -25 to 85 °C (248 to 358 K)

### Storage temperature
- -40 to 85 °C (233 to 358 K)

### Protection degree
- IP67

### Connection
- V1 connector (M12 x 1), 4-pin

### Material
- Housing: ABS
- Transducer: epoxy resin/hollow glass sphere mixture; polyurethane foam

### Mass
- 110 g

### Date of edition: 08/18/2005

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com

---
Dimensions

UB500-F54-...  UB2000-F54-...

Bore hole and countersinking for screws/hexagon M4

Electrical connection

Standard symbol/Connection:

2 = Emitter pulse input
4 = Echo propagation time output

Core colours in accordance with EN 60947-5-2.

Characteristics response curves

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Date of edition: 08/18/2005
Sensor function description

UB...-F54..., output versions -E4 and -E5

Synchronisation
The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. The synchronisation of multiple sensors can be realised as follows:

External synchronisation
The sensor can be synchronised by the external application of a square wave voltage. A synchronisation pulse at the synchronisation input starts a measuring cycle. The pulse must have a duration greater than 100 µs. The measuring cycle starts with the falling edge of a synchronisation pulse. A low level > 1 s or an open synchronisation input will result in the normal operation of the sensor. A high level at the synchronisation input disables the sensor.

Two operating modes are available
1. Multiple sensors can be controlled by the same synchronisation signal. The sensors are synchronised.
2. The synchronisation pulses are sent cyclically to individual sensors. The sensors operate in multiplex mode.

Internal synchronisation
The synchronisation connections of up to 5 sensors capable of internal synchronisation are connected to one another. When power is applied, these sensors will operate in multiplex mode. The response delay increases according to the number of sensors to be synchronised. Synchronisation cannot be performed during TEACH-IN and vice versa. The sensors must be operated in an unsynchronised manner to teach the switching point.

Note:
If the option for synchronisation is not used, the synchronisation input has to be connected to ground (0V) or the sensor has to be operated via a V1 cable connector (4-pin).

Adjusting of switching points
The ultrasonic sensor features a switch output with two teachable switching points. These are set by applying the supply voltage -UB or +UB to the TEACH-IN input. The supply voltage must be applied to the TEACH-IN input for at least 1 s. LEDs indicate whether the sensor has recognised the target during the TEACH-IN procedure.

Switching point A1 is taught with -UB, A2 with +UB.

Five different output functions can be set
1. Window mode, normally-open function
2. Window mode, normally-closed function
3. One switching point, normally-open function
4. One switching point, normally-closed function
5. Detection of object presence

TEACH-IN window mode, normally-open function
- Set target to near switching point
- TEACH-IN switching point A1 with -UB
- Set target to far switching point
- TEACH-IN switching point A2 with +UB

TEACH-IN window mode, normally-closed function
- Set target to near switching point
- TEACH-IN switching point A2 with +UB
- Set target to far switching point
- TEACH-IN switching point A1 with -UB

TEACH-IN one switching point, normally-open function
- Set target to near switching point
- TEACH-IN switching point A2 with +UB
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A1 with -UB

TEACH-IN one switching point, normally-closed function
- Set target to near switching point
- TEACH-IN switching point A1 with -UB
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A2 with +UB

TEACH-IN detection of object presence
- Cover sensor with hand or remove all objects from sensing range
- TEACH-IN switching point A1 with -UB
- TEACH-IN switching point A2 with +UB

Default setting of switching points
A1 = unusable area
A2 = nominal sensing range

LED Displays

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Red LED</th>
<th>Yellow LED</th>
<th>Green LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN switching point:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object detected</td>
<td>off</td>
<td>flashes</td>
<td>flashes</td>
</tr>
<tr>
<td>No object detected</td>
<td>flashes on</td>
<td>off</td>
<td>flashes</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal operation</td>
<td>off</td>
<td>switching state</td>
<td>on</td>
</tr>
<tr>
<td>Fault</td>
<td>flashes</td>
<td>previous state</td>
<td>off</td>
</tr>
</tbody>
</table>
**Series -F54**

**Sensor function description**

**UB...-F54-..., output versions -I and -U**

**Synchronisation**
The sensor features a synchronisation input for the suppression of mutual interference. If this input is not used, the sensor will operate using an internally generated clock rate. The synchronisation of multiple sensors can be realised as follows:

1. **External synchronisation:**
   - The sensor can be synchronised by the external application of a square wave voltage. A synchronisation pulse at the synchronisation input starts a measuring cycle. The pulse must have a duration greater than 100 µs. The measuring cycle starts with the falling edge of a synchronisation pulse. A low level > 1 s or an open synchronisation input will result in the normal operation of the sensor. A high level at the synchronisation input disables the sensor.
   - Two operating modes are available:
     1. Multiple sensors can be controlled by the same synchronisation signal. The sensors are synchronised.
     2. The synchronisation pulses are sent cyclically to individual sensors. The sensors operate in multiplex mode.

2. **Internal synchronisation:**
   - The synchronisation connections of up to 5 sensors capable of internal synchronisation are connected to one another. When power is applied, these sensors will operate in multiplex mode.
   - The response delay increases according to the number of sensors to be synchronised.

**Note:**
If the option for synchronisation is not used, the synchronisation input has to be connected to ground (0 V) or the sensor has to be operated via a V1 cable connector (4-pin).

**Adjusting the evaluation range (analogue output)**
The ultrasonic sensor has an analogue output with programmable evaluation limits. These are set by applying the supply voltage \(-U_B\) or \(+U_B\) to the TEACH-IN input. The supply voltage must be applied to the TEACH-IN input for at least 1 s. LEDs indicate whether the sensor has recognised the target during the TEACH-IN procedure. The lower evaluation limit \(A_1\) is taught with \(-U_B\), \(A_2\) with \(+U_B\).

Two different output functions can be set:
1. Analog value increases with rising distance to object (rising ramp)
2. Analog value falls with rising distance to object (falling ramp)

**TEACH-IN rising ramp (A₁ > A₂):**
- Position object at lower evaluation limit
- TEACH-IN lower limit \(A_1\) with \(-U_B\)
- Position object at upper evaluation limit
- TEACH-IN upper limit \(A_2\) with \(+U_B\)

**TEACH-IN falling ramp (A₁ > A):**
- Position object at lower evaluation limit
- TEACH-IN lower limit \(A_2\) with \(+U_B\)
- Position object at upper evaluation limit
- TEACH-IN upper limit \(A_1\) with \(-U_B\)

**LED Displays**

<table>
<thead>
<tr>
<th>Displays in dependence on operating mode</th>
<th>Red LED</th>
<th>Yellow LED</th>
<th>Green LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACH-IN evaluation limit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object detected</td>
<td>off</td>
<td>flashes</td>
<td>flashes</td>
</tr>
<tr>
<td>No object detected</td>
<td>flashes on</td>
<td>off</td>
<td>flashes</td>
</tr>
<tr>
<td>Object uncertain (TEACH-IN invalid)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal mode (evaluation range)</td>
<td>off</td>
<td>on</td>
<td>on</td>
</tr>
<tr>
<td>Fault</td>
<td>flashes</td>
<td>previous state</td>
<td>off</td>
</tr>
</tbody>
</table>
Notes
<table>
<thead>
<tr>
<th>Model number</th>
<th>Connection type</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UBE500-F64-SE0</td>
<td>cable</td>
<td>500 mm</td>
<td></td>
</tr>
<tr>
<td>UBE500-F64-SE0-V3</td>
<td>M8 connector, 3-pin</td>
<td>500 mm</td>
<td></td>
</tr>
<tr>
<td>UBE500-F64-SE2</td>
<td>cable</td>
<td>500 mm</td>
<td></td>
</tr>
<tr>
<td>UBE500-F64-SE2-V3</td>
<td>M8 connector, 3-pin</td>
<td>500 mm</td>
<td></td>
</tr>
<tr>
<td>UBE1500-F64-SE0</td>
<td>cable</td>
<td>1500 mm</td>
<td></td>
</tr>
<tr>
<td>UBE1500-F64-SE0-V3</td>
<td>M8 connector, 3-pin</td>
<td>1500 mm</td>
<td></td>
</tr>
<tr>
<td>UBE1500-F64-SE2</td>
<td>cable</td>
<td>1500 mm</td>
<td></td>
</tr>
<tr>
<td>UBE1500-F64-SE2-V3</td>
<td>M8 connector, 3-pin</td>
<td>1500 mm</td>
<td></td>
</tr>
</tbody>
</table>
### Technical Data

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensing range</strong></td>
<td>0...1500 mm, distance emitter-receiver 20 mm...1500 mm</td>
</tr>
<tr>
<td><strong>Reference target</strong></td>
<td>receiver</td>
</tr>
<tr>
<td><strong>Transducer frequency</strong></td>
<td>200 kHz</td>
</tr>
<tr>
<td><strong>LED yellow</strong></td>
<td>Indication of the switching state (receiver)</td>
</tr>
<tr>
<td><strong>Operating voltage</strong></td>
<td>18...30 V DC, ripple 10%</td>
</tr>
<tr>
<td><strong>No-load supply current</strong></td>
<td>20 mA receiver, 12 mA emitter</td>
</tr>
<tr>
<td><strong>Output type</strong></td>
<td>1 switch output E0, npn NO</td>
</tr>
<tr>
<td><strong>Rated operational current</strong></td>
<td>200 mA</td>
</tr>
<tr>
<td><strong>Voltage drop</strong></td>
<td>≤0.5 V</td>
</tr>
<tr>
<td><strong>Switching frequency</strong></td>
<td>≤2 V</td>
</tr>
<tr>
<td><strong>Switch-on delay</strong></td>
<td>5 ms</td>
</tr>
<tr>
<td><strong>Switching frequency</strong></td>
<td>100 Hz</td>
</tr>
<tr>
<td><strong>Switching frequency</strong></td>
<td>120 Hz</td>
</tr>
<tr>
<td><strong>Switch-on delay</strong></td>
<td>&lt; 5 ms</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>0...60 °C (273...333 K)</td>
</tr>
<tr>
<td><strong>Storage temperature</strong></td>
<td>-40...85 °C (233...358 K)</td>
</tr>
<tr>
<td><strong>Protection degree</strong></td>
<td>IP54</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>Volt connector (M8 x 1), 3 pin, 2 m, PVC cable, emitter: 2 x 0.34 mm², receiver: 3 x 0.34 mm²</td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>Housing PA 6.6, Mass: 80 g per device</td>
</tr>
</tbody>
</table>

#### Function

A through-beam ultrasonic barrier always consists of a single emitter and a single receiver. The function of a through-beam ultrasonic barrier is based on the interruption of the sound transmission to the receiver by the object to be detected. The emitter sends an ultrasonic signal that is evaluated by the receiver. If the signal is interrupted or muted by the object to be detected, the receiver switches. No electrical connections are required between the emitter and receiver.

The function of through-beam ultrasonic barriers is not dependent on the position of their installation. We recommend, however, to install the emitter below in the case of vertical installations to prevent the accumulation of dust particles.

#### Installation tolerances

The installation tolerances of the central axes of the emitter and receiver may not exceed the values specified in the illustration.

#### Detection of thin foils

For the detection of thin foils (< 0.1 mm), install the through-beam ultrasonic barrier at an angle of ≥ 10° from perpendicular to the foil.

#### Caution

Mount or replace emitter and receiver only in pairs. Both devices are optimally matched to each other by the manufacturer.

---

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Through-beam ultrasonic barrier - Reliable detection of transparent materials, High switching frequency, Small angle of divergence, Small, compact design, Plastic housing, Emitter and receiver included in the delivery package.

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories".
Dimensions

![Diagram of Dimensions]

Electrical connection

Standard symbol/Connection:

- Receiver: version E0, npn
  - U: +U_b
  - 4: BK
  - 3: BU
  - 2: BN
  - U_a

- Receiver: version E2, pnp
  - U: +U_b
  - 4: BK
  - 3: BU
  - 2: BN
  - U_a

- Emitter:
  - U: +U_b
  - 3: BU
  - 2: BN
  - U_a

Core colours in accordance with EN 60947-5-2.

Diagrams

- Characteristic response curves

- Mounting/Adjustment
  - Parallel displacement A ≤ 8 mm
  - Angle displacement α ≤ 5°

- Thin foil detection

UBE...-F64-...
<table>
<thead>
<tr>
<th>Accessories</th>
<th>Control units/Power supplies</th>
<th>Double sheet monitoring</th>
<th>Series LUC</th>
<th>Series -D1</th>
<th>Series -F64</th>
<th>Series -F54</th>
<th>Series -F43</th>
<th>Series -F42</th>
<th>Series -F12</th>
<th>Series -FP</th>
<th>Series VarKont</th>
<th>Series -30GM</th>
<th>Series -18GK/-18GM</th>
<th>Series -12G M</th>
</tr>
</thead>
</table>

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Notes

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Date of edition: 08/18/2005
## Series -D1

<table>
<thead>
<tr>
<th>Model number</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC500-D1-3K-V7</td>
<td>500 mm</td>
<td>176</td>
</tr>
</tbody>
</table>
## Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UC500-D1-3K-V7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output type</td>
<td>3 relay outputs, normally open/closed, selectable</td>
</tr>
<tr>
<td>Contact loading</td>
<td>252 V AC, 10 V DC, 3 A (ohm, load)</td>
</tr>
<tr>
<td>Lifetime</td>
<td>Electrical: $10^6$ switching cycles at resistive load (3 A / 252 V AC or 3 A / 30 V DC) min. contact load: 100 μA / 100 μV DC mechanical: $20 \times 10^6$ switching cycles</td>
</tr>
<tr>
<td>Range hysteresis</td>
<td>20 mm</td>
</tr>
<tr>
<td>Temperature influence</td>
<td>&lt; 4 %</td>
</tr>
<tr>
<td>Sensing range</td>
<td>60 ... 550 mm</td>
</tr>
<tr>
<td>Unusable area</td>
<td>0 ... 60 mm</td>
</tr>
<tr>
<td>Standard target plate</td>
<td>100 mm x 100 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>approx. 380 kHz</td>
</tr>
<tr>
<td>Response delay</td>
<td>&gt; 10 s, relay; &lt; 1 s, LEDs</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>LED green/yellow</td>
<td>LED 2: overfill warning and normal operation</td>
</tr>
<tr>
<td>LED red</td>
<td>LED 1: overfill indication</td>
</tr>
<tr>
<td>DIP-switch</td>
<td>setting of the switch points/operating modes</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 ... 252 V DC</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>&lt; 30 mA with $U_{L1} = 30$ V DC</td>
</tr>
<tr>
<td></td>
<td>&lt; 110 mA at $U_{L2} = 10$ V DC</td>
</tr>
<tr>
<td></td>
<td>&lt; 25 mA at $U_{L3} = 220$ V AC</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-20 ... 60 °C (233 ... 333 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
</tr>
<tr>
<td>Connection</td>
<td>Cable connector 90° V7, (7-pin)</td>
</tr>
<tr>
<td>Housing</td>
<td>cover: PC</td>
</tr>
<tr>
<td></td>
<td>housing: PBT</td>
</tr>
<tr>
<td></td>
<td>threaded flange: stainless steel</td>
</tr>
<tr>
<td></td>
<td>installation connector/cable socket: PETP</td>
</tr>
<tr>
<td>Material</td>
<td>epoxy resin/hollow glass sphere mixture; polyurethane burn</td>
</tr>
<tr>
<td>Mass</td>
<td>700 g</td>
</tr>
</tbody>
</table>

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories."
Dimensions

Electrical connection

Standard symbol/Connection:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td></td>
</tr>
<tr>
<td></td>
<td>U_B</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>U_B</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Accessories

Series -12GM
Series -18GK/-18GM
Series -30GM
Series VariKont
Series -FP
Series -F12
Series -F42
Series -F43
Series -F54
Series -F64
Series -D1
Series LUC

Double sheet monitoring
Control units/Power supplies
Accessories

Characteristic response curves

Curve 1: flat surface 100 mm x 100 mm
Curve 2: round bar, Ø 25 mm

Indicators/operating means

<table>
<thead>
<tr>
<th>LED</th>
<th>S4 = OFF</th>
<th>S4 = ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (red)</td>
<td>full</td>
<td>full</td>
</tr>
<tr>
<td>2 (green/yellow)</td>
<td>high</td>
<td>normal</td>
</tr>
<tr>
<td>3 (green/yellow)</td>
<td>normal</td>
<td>low</td>
</tr>
<tr>
<td>4 (red)</td>
<td>empty</td>
<td>empty</td>
</tr>
</tbody>
</table>

switch output adjustment
overspill warning
normal operation
run-dry warning
TEACH-IN mode

Date of edition: 08/18/2005
Safety notes:
The supply circuit is separated from the relay circuit by basic insulation.
The cover may only be opened by specially trained personnel. Degree of contamination 2 is permissible when the cover is open. Ensure that the sealing ring of the cover is in good condition.

Safety class II is only guaranteed when using the accessorional cable box and the associated mounting screw with plastic head. When operating this device with operating voltage exceeding 42 V, you must replace the metal mounting screw by the supplied plastic head mounting screw to avoid electric treatment. The cable box may only be separated from the unit when the power is off.

CAUTION:
The UC500-D1-K3-V7 ultrasonic sensor is not suitable for use in environments subject to explosion hazards.

Conformity: EN 60947-5-2
Housing insulation: Safety class II
Degree of contamination: 4
Overvoltage category: III

TEACH-IN of switching points:

One switching point can be taught for each of the 3 switch outputs. Set DIP switch 5 to ON to put the sensor in TEACH-IN mode. The sensor indicates TEACH-IN mode with two lit red LEDs. The green-yellow LEDs are off.

Next, position a suitable target object at the desired switching point in front of the sensor and switch the DIP switch associated with the relevant switch output (switches 1-3). The sensor will now be flashing yellow or green in addition to the lit red LEDs. Flashing green indicates that the target object was detected; flashing yellow signals that it was not detected. The measured switching point will be transferred to RAM when the associated DIP switch is switched back while the LED is flashing green. Only the red LEDs should now be lit. This signals the user that the DIP switches 1-3 have been restored to their original positions. The other switching points are set in the same manner. The TEACH-IN procedure is completed by setting DIP switch 5 back to the OFF position. The measured switching points will then be transferred to the nonvolatile EEPROM.

Display during TEACH-IN:

<table>
<thead>
<tr>
<th>DIP1-3</th>
<th>one or more DIP switches changed</th>
<th>in normal state</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>on TEACH-IN active</td>
<td>TEACH-IN complete</td>
</tr>
</tbody>
</table>

The relays switch to the “safe state” (all relays open, regardless of close/open function) during TEACH-IN.

Setting the switching behaviour:

In normal mode (DIP switch 5 OFF), the DIP switches 1 to 3 can be used to set the switching behaviour of the switch outputs 1 to 3. If the associated DIP switch is ON, the associated switch output has a close function; if the switch is set to OFF the output has an open function. Close function means that the relay trips when the object distance is less than the associated switching point; in the case of open function, the relay trips when the object distance is greater than the switching point. The relays switch to the “safe state” (all relays open, regardless of close/open function) in the event of a failure.

Setting the display modes:

Two display modes can be selected with DIP switch 4:
Display mode 1: DIP switch 4 ON, underfill warning:

<table>
<thead>
<tr>
<th>Object distance x</th>
<th>x &lt; A1</th>
<th>A1 &lt; x &lt; A2</th>
<th>A2 &lt; x &lt; A3</th>
<th>x &gt; A3</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED 1, red (full)</td>
<td>flashes</td>
<td>off</td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>LED 2, green/yellow (normal)</td>
<td>off</td>
<td>lit green</td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>LED 3, green/yellow (low)</td>
<td>off</td>
<td>off</td>
<td>flashes yellow</td>
<td>off</td>
</tr>
<tr>
<td>LED 4, red (empty)</td>
<td>off</td>
<td>off</td>
<td>off</td>
<td>flashes</td>
</tr>
</tbody>
</table>

In this mode LED 1 (red) serves as the overfilling indicator, LED 2 (green) indicates the normal state, LED 3 (yellow) serves as the preliminary warning that the container is nearly empty and LED 4 (red) signalises the "container empty" state.

Display mode 2: DIP switch 4 OFF, overfill warning

<table>
<thead>
<tr>
<th>Object distance x</th>
<th>x &lt; A1</th>
<th>A1 &lt; x &lt; A2</th>
<th>A2 &lt; x &lt; A3</th>
<th>x &gt; A3</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED 1, red (full)</td>
<td>flashes</td>
<td>off</td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>LED 2, green/yellow (high)</td>
<td>off</td>
<td>flashes yellow</td>
<td>off</td>
<td>off</td>
</tr>
<tr>
<td>LED 3, green/yellow (normal)</td>
<td>off</td>
<td>off</td>
<td>lit green</td>
<td>off</td>
</tr>
<tr>
<td>LED 4, red (empty)</td>
<td>off</td>
<td>off</td>
<td>off</td>
<td>flashes</td>
</tr>
</tbody>
</table>

In this mode LED 1 (red) serves as the overfilling indicator, LED 2 (yellow) serves as the preliminary warning that the container is nearly full, LED 3 (green) indicates the normal state, and LED 4 (red) signalises the "container empty" state.

The relays switch to the "safe state" (all relays open, regardless of close/open function) in the event of a failure.
**Series LUC**

---

<table>
<thead>
<tr>
<th>Model number</th>
<th>Detection range</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUC4T-G5P-IU-V15</td>
<td>4000 mm</td>
<td>182</td>
</tr>
<tr>
<td>LUC4T-G5S-IU-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LUC4T-N5P-IU-V15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LUC4T-N5S-IU-V15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Type code/ordering information

- **LUC4T** - IU - V15

  - **Connection type (electrical)**: V15 - V15-connector (M12 x 1) 5-pin
  - **Electrical output**: IU - 4 mA ... 20 mA und 0 V ... 10 V
  - **Material of process connection**: S - Stainless steel 1.4571, P - Polypropylene
  - **Process connection**: G5 - screwed connection G 1½ A, N5 - screwed connection 1 ½" NPT
  - **Membrane surface material**: T - PTFE
  - **Measuring range**: 4 - 0.3 m ... 4 m

---

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---

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# Ultrasonic level sensor

**Technical Data**

<table>
<thead>
<tr>
<th>Model number</th>
<th>LUC4T-G5.-IU-V15</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output type</strong></td>
<td>1 analogue output 4 ... 20 mA, R&lt;sub&gt;L&lt;/sub&gt; ≤ 500 Ω, error ≥ 21 mA</td>
</tr>
<tr>
<td></td>
<td>1 voltage output 0 ... 10 V, R&lt;sub&gt;L&lt;/sub&gt; ≥ 1000 Ω, error ≥ 10.5 V</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>2 mm</td>
</tr>
<tr>
<td><strong>Deviation of the characteristic curve</strong></td>
<td>0.5 % of upper limit of measuring range</td>
</tr>
<tr>
<td><strong>Sensing range</strong></td>
<td>0.3 ... 4 m, with fluids</td>
</tr>
<tr>
<td><strong>Transducer frequency</strong></td>
<td>approx. 85 kHz</td>
</tr>
<tr>
<td><strong>Standards</strong></td>
<td>EN 60947-52</td>
</tr>
<tr>
<td><strong>LED green</strong></td>
<td>power on</td>
</tr>
<tr>
<td><strong>LED red</strong></td>
<td>2 Hz flashing, error</td>
</tr>
<tr>
<td><strong>Operating voltage</strong></td>
<td>≤ 1200 mW</td>
</tr>
<tr>
<td><strong>Power consumption</strong></td>
<td>20 ... 30 V DC, ripple 10 %&lt;sub&gt;pp&lt;/sub&gt;</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>-25 ... 70 °C (248 ... 343 K)</td>
</tr>
<tr>
<td><strong>Storage temperature</strong></td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td><strong>Protection degree</strong></td>
<td>IP65</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>connector V15 (M12 x 1), 5 pin</td>
</tr>
<tr>
<td><strong>Mounting</strong></td>
<td>screwed connection G1½A</td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>PBT, stainless steel 1.4571</td>
</tr>
<tr>
<td><strong>Housing</strong></td>
<td>PBT, polypropylene</td>
</tr>
<tr>
<td><strong>Transducer</strong></td>
<td>PTFE (diaphragm surface)</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>220 g</td>
</tr>
</tbody>
</table>

---

**Dimensions**

![Dimensions Diagram]

**Date of edition:** 08/18/2005
Additional information

Product description:
The LUC4T-... ultrasonic sensor is especially designed to measure the fill level of liquids. With its Teflon-coated surface, the sensor is outstandingly suited for use with corrosive liquids. The masking of fixed objects permits the sensor to be deployed in locations in which struts or other internal structures extend into the measuring field.

Sensors of the LUC4T-... series feature a 4 mA ... 20 mA current and 0 V ... 10 V voltage output as standard. The outputs have fail-safe behaviour in the event of a fault.

Function
The ultrasonic converter sends out an acoustic pulse. This pulse is reflected by the contents of the container and registered by the converter after traveling the measurement distance.

A microprocessor evaluates the echo signals and determines the fill level.

Sources of interference such as weld seams, fixed installations, etc. are suppressed reliably via the masking of fixed objects. Temperature-related changes of the velocity of sound are compensated.

Measuring system:
A measuring system consists of a LUC4T-...-IU-V15 ultrasonic level sensor and a DA5-... display unit or power supply. The LUC4T-...-IU-V15 ultrasonic level sensor can also be connected directly to a PLC.

Compensation:

<table>
<thead>
<tr>
<th>Compensation (not installed)</th>
<th>Compensation (installed)</th>
<th>Plug position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Empty TEACH-IN simulation of 0 % level (wait 15 s)</td>
<td>1. Empty TEACH-IN approach 0 % level in container (wait 15 s)</td>
<td>T</td>
</tr>
<tr>
<td>Accept empty value</td>
<td>Accept empty value</td>
<td>A1</td>
</tr>
<tr>
<td>Empty value accepted (red LED flashing)</td>
<td>Empty value accepted (red LED flashing)</td>
<td>A1</td>
</tr>
<tr>
<td>Empty TEACH-IN complete</td>
<td>Empty TEACH-IN complete</td>
<td>T</td>
</tr>
<tr>
<td>2. Full TEACH-IN simulation of 100 % level (wait 15 s)</td>
<td>2. Full TEACH-IN approach 100 % level in container (wait 15 s)</td>
<td>T</td>
</tr>
<tr>
<td>Accept full value</td>
<td>Accept full value</td>
<td>A2</td>
</tr>
<tr>
<td>Full value accepted (red LED flashing)</td>
<td>Full value accepted (red LED flashing)</td>
<td>A2</td>
</tr>
<tr>
<td>Full TEACH-IN complete</td>
<td>Full TEACH-IN complete</td>
<td>T</td>
</tr>
<tr>
<td>TEACH-IN complete</td>
<td>TEACH-IN complete</td>
<td>T</td>
</tr>
</tbody>
</table>
Series UDC / UDB

Applications:

The ultrasonic double-sheet monitor is deployed in all situations in which the automatic distinction between single and double sheets is required in order to protect machines or avoid waste production.

For example:

- Deployment in printing machines, in which the ultrasonic double-sheet monitor prevents damage to the complex mechanics by the inadvertent feed of two sheets or ensures that the second sheet does not remain in the machine.

- The monitoring of bonding sheets in labeling machines, in which the application of the sheets to a base material is detected and counted.

- Deployment in letter-opening machines to verify the complete emptying of the opened envelopes.

- Deployment in document counters, in which the ultrasonic double-sheet monitor ensures that bank deposit slips, for example, are properly counted.

- Deployment in packaging machines for the detection of splices in aluminium packaging foil and proper regulation of the machine speed.

- Detection of air, single and double sheet in paper processing machinery.

<table>
<thead>
<tr>
<th>Model number</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UDC-18GM-400-3E3</td>
<td>Optimised for double sheet detection with integrated evaluation unit</td>
<td>186</td>
</tr>
<tr>
<td>UDC-18GMA-400-3E3</td>
<td>Optimised for double sheet detection with integrated evaluation unit</td>
<td>190</td>
</tr>
<tr>
<td>UDB-18GM35-3E2</td>
<td>Optimised for double sheet detection</td>
<td>194</td>
</tr>
<tr>
<td>UDBL-18GM35-3E2</td>
<td>Optimised for label detection</td>
<td>196</td>
</tr>
<tr>
<td>UDBK-18GM35-3E2</td>
<td>Optimised for jointing/splice detection</td>
<td>198</td>
</tr>
</tbody>
</table>
Ultrasonic double sheet monitor

- Ultrasonic system for reliable detection of no, one, or two overlapping sheet materials, preferably papers
- No TEACH-IN required
- Function indicators visible from all directions
- Insensitive to printing, colours and shining surfaces
- Material weight from 10 g/m² up to over 2000 g/m²
- Very wide material spectrum, finest papers up to thin sheet metals as well as plastic- and metal foils
- Perpendicular or inclined sensor mounting relative to the sheet plane possible

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"

Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UDC-18GM-400-3E3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>20 ... 60 mm, optimal distance: 45 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>395 kHz</td>
</tr>
<tr>
<td>Focke Ident-Nr.</td>
<td>9 36 2 24 5</td>
</tr>
<tr>
<td>LED green</td>
<td>indicators: single sheet detected</td>
</tr>
<tr>
<td>LED yellow</td>
<td>Display: No sheet detected (Ai)</td>
</tr>
<tr>
<td>LED red</td>
<td>Indication: double sheet detected</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>18 ... 30 V DC, ripple 10 %SS</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>&lt; 80 mA</td>
</tr>
<tr>
<td>Time delay before availability</td>
<td>&lt; 500 ms</td>
</tr>
<tr>
<td>Output type</td>
<td>3 Switch outputs prg, normally-closed</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 2 V</td>
</tr>
<tr>
<td>Switch-on delay</td>
<td>approx. 25 ms</td>
</tr>
<tr>
<td>Switch-off delay</td>
<td>approx. 25 ms</td>
</tr>
<tr>
<td>Pulse extension</td>
<td>min. 120 ms parameterisable</td>
</tr>
<tr>
<td>Input type</td>
<td>Function input</td>
</tr>
<tr>
<td>Pulse length</td>
<td>≥ 100 ms</td>
</tr>
<tr>
<td>Impedance</td>
<td>&gt; 230 kΩ</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60 94 7-5-2</td>
</tr>
<tr>
<td>C-UL listed:</td>
<td>57 M3, IND CONT. EQ., &quot;Powered by Class 2 Power Source&quot;</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0 ... 60 °C (273 ... 333 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 70 °C (233 ... 343 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP67</td>
</tr>
<tr>
<td>Connection</td>
<td>2 m, PVC cable 0.14 mm²</td>
</tr>
<tr>
<td>Housing</td>
<td>brass, nickel-plated, plastic components PBT</td>
</tr>
<tr>
<td>Transducer</td>
<td>epoxy resin/hollow glass sphere mixture; polyurethane barn</td>
</tr>
<tr>
<td>Mass</td>
<td>150 g</td>
</tr>
</tbody>
</table>

Electrical connection, diagrams, additional information

Double sheet monitoring

Control unit

Mounting/Adjustment

Recommended distances

- a = 1 ... 15 mm
- b = 15 mm
- c = 40 ... 45 mm

Thin foil detection

- a < +/- 1 mm
### Description of sensor functions

The ultrasonic double sheet monitor is used for double sheet detection in all situations in which the automatic distinction between double and single sheets is required in order to protect machines or avoid waste production. The double-sheet monitor is based on the ultrasonic through-beam principle. The following can be detected:

- No sheet, i.e. air,
- Individual sheet
- Double sheet

A microprocessor system evaluates the signals. The appropriate switch outputs are set as a result of the evaluation. Changes in ambient conditions such as temperature and humidity are compensated for automatically. The interface electronics is integrated into a compact M18 metal housing together with a sensor head.

### Switching on

The sensor is equipped with 6 connections. The functionality of the connections is described in the following table. The function input (PK) is used to assign parameters to the sensor. (See Output pulse extension, Alignment aid and Program selection). During normal operation, the function input must always be securely connected with +UB or -UB, to avoid possible interference or improper functionality.

<table>
<thead>
<tr>
<th>Colour</th>
<th>Switching on</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>BN</td>
<td>+UB</td>
<td></td>
</tr>
<tr>
<td>WH</td>
<td>Switch output for single sheets</td>
<td>Pulse width corresponds to the event</td>
</tr>
<tr>
<td>BK</td>
<td>Switch output for double sheets</td>
<td>Pulse width corresponds to the event</td>
</tr>
<tr>
<td>GY</td>
<td>Switch output for air</td>
<td>Pulse width corresponds to the event</td>
</tr>
<tr>
<td>PK</td>
<td>-UB/-UB</td>
<td>Function input for parameter assignment/pulse prolongation</td>
</tr>
<tr>
<td>BU</td>
<td>-UB</td>
<td></td>
</tr>
</tbody>
</table>

### Normal mode

The sensor is working in normal mode if the function input (PK) is applied to -UB or +UB when the power source (Power-On) is supplied, as shown in the output pulse extension table (see below).

Displays:

- LED yellow: Detection of air
- LED green: Detection of single sheets
- LED red: Detection of double sheets

Switch outputs:

- The switch outputs are only active in normal operation!

White: WH Single sheet output
Black: BK Double sheet output
Gray: GY Air output
**Output pulse extension**

Switching the function input (PK) on to \(-U_B\) or \(+U_B\) makes it possible to select a minimum pulse width of 120 ms for all output pulses of the three switch outputs.

<table>
<thead>
<tr>
<th>Switching (PK)</th>
<th>Operating behaviour (after Power-On)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-U_B)</td>
<td>No output pulse extension for switch outputs</td>
</tr>
<tr>
<td>(+U_B)</td>
<td>Output pulse extension of all switch outputs to at least 120 ms</td>
</tr>
</tbody>
</table>

Please note:
This can result in a condition in which more than one switch output is switched through!

**Display Mode**

The selected parameter assignment of the sensor can be displayed by switching the function input (PK) to voltage-free during normal operation. The green LED displays the program number (the number of flashing pulses (1 ... 4) = the program number).

The outputs are inactive during this time.

If the function input (PK) is switched to voltage-free when power is supplied (Power-On), the sensor will also work in display mode.

If the unit is switched to voltage-free while the function input (PK) is in operation due to an error (broken cable, coming loose because of vibration), display mode acts as a fault display.

**Parameter assignment**

The sensor is equipped with 4 programs for different ranges of application. This makes it possible to work with a wide range of materials.

*The default setting, Program 1, is designed so that no change in the setting is required for most applications.*

<table>
<thead>
<tr>
<th>Program number</th>
<th>Notes:</th>
<th>Range of materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Default setting, standard paper</td>
<td>20 - 1200 g/m²</td>
</tr>
<tr>
<td>2</td>
<td>Thick paper, cardboard, fine corrugated boards (DIN 55 468-1) and thin sheet metal**</td>
<td>&gt; 100 g/m²</td>
</tr>
<tr>
<td>3</td>
<td>Thin paper</td>
<td>20 - 250 g/m²</td>
</tr>
<tr>
<td>4</td>
<td>Extremely fine paper</td>
<td>&lt; 40 g/m²</td>
</tr>
</tbody>
</table>

**Procedure for assigning parameters**

It is possible to switch to additional parameter assignment modes from the display mode:

- **Alignment mode -->**
- **Program selection mode -->**
- **Alignment aid mode -->** (for checking)

When the function input (PK) is applied to \(-U_B\) (for > 500 ms), the mode changes. When the *Program selection* mode is active, switching on function input (PK) on to \(+U_B\) (for > 500 ms) selects the next program level.

Disconnecting the power supply causes the system to exit the current mode with the selected program change.

The switch outputs are not active while parameters are being assigned to the sensor!
Modes

Alignment aid
During installation, the DSM can provide an adjustment aid for optimal alignment of the emitter to the receiver.

If the sensor detects an area of air (yellow LED is lit) the DSM will begin to display the intensity of the measured amplitude signal:
- If the signal is weak, the yellow LED will flash at a slow rate
- As the intensity of the signal increases, the rate at which the LED flashes becomes faster
- At optimal alignment (maximum signal intensity), the yellow LED is continuously lit.

The single sheet function (green LED) and double sheet function (red LED) continues to be active. This makes it possible to check for correct functionality of the double sheet control.

Program selection
In the program selection mode, the current program is displayed by the green LED (number of flashing pulses = program number).

Applying the adjustment input (PK) to $+U_B$ (for $>500$ ms) causes the next program to be selected in cyclic sequence (program 1 follows through to program 4).

Notes:
A complete device consists of an ultrasonic emitter and an evaluation unit with an ultrasonic emitter. The sensor heads are optimally adjusted to each other when they leave the factory. Therefore, they must not be used separately or exchanged with other devices of the same type. The plug connector on the emitter/receiver connection cable is only intended to be used for easier mounting, not to replace units.

Very light papers (for example handkerchiefs) or perforated papers are not always suitable for double sheet detection because of their physical characteristics.

If two or more double sheet controls are used in the immediate vicinity of each other, there may be mutual interference between them, which can result in improper functionality of the devices. Mutual interference can be prevented by introducing suitable countermeasures when planning systems.
Ultrasonic double sheet monitor

- Ultrasonic system for reliable detection of no, one, or two overlapping sheet materials, preferably papers
- No TEACH-IN required
- Function indicators visible from all directions
- Insensitive to printing, colours and shining surfaces
- Material weight from 10 g/m² up to over 2000 g/m²
- Very wide material spectrum, finest papers up to thin sheet metals as well as plastic- and metal foils
- Perpendicular or inclined sensor mounting relative to the sheet plane possible
- Automatic compensation of the single-sheet value in the case of slowly changing ambient conditions

Suitable connector cables, mounting aids and more, you can find in chapter “Accessories.”

Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing range</td>
<td>20 ... 60 mm, optimal distance: 45 mm</td>
</tr>
<tr>
<td>Transducer frequency</td>
<td>395 kHz</td>
</tr>
<tr>
<td>LED green</td>
<td>indication: single sheet detected</td>
</tr>
<tr>
<td>LED yellow</td>
<td>Display: No sheet detected (Air)</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>20 ... 30 V DC, ripple: 10 % UBS</td>
</tr>
<tr>
<td>No load supply current</td>
<td>≤ 80 mA</td>
</tr>
<tr>
<td>Time delay before availability</td>
<td>≤ 500 ms</td>
</tr>
<tr>
<td>Output type</td>
<td>3 Switch outputs: normally-closed</td>
</tr>
<tr>
<td>Rated operational current</td>
<td>3 x 100 mA, short-circuit-overload protected</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 2 V</td>
</tr>
<tr>
<td>Switch-on delay</td>
<td>approx. 25 ms</td>
</tr>
<tr>
<td>Switch-off delay</td>
<td>approx. 25 ms</td>
</tr>
<tr>
<td>Pulse extension</td>
<td>min. 120 ms parameterisable</td>
</tr>
<tr>
<td>Input type</td>
<td>Function input</td>
</tr>
<tr>
<td>Pulse length</td>
<td>≥ 100 ms</td>
</tr>
<tr>
<td>Impedance</td>
<td>≥ 230 kΩ</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>C-UL listed</td>
<td>S7M3, IND.CONT. EQ., “Powered by Class 2 Power Source”</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0 ... 60 °C (27 ... 333 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 70 °C (233 ... 343 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP67</td>
</tr>
<tr>
<td>Connection</td>
<td>2 m, PVC cable 0.14 mm²</td>
</tr>
<tr>
<td>Housing</td>
<td>brass, nickel-plated, plastic comp. RST</td>
</tr>
<tr>
<td>Transducer</td>
<td>epoxy resin/hollow glass sphere mixture; polyurethane foam</td>
</tr>
<tr>
<td>Mass</td>
<td>150 g</td>
</tr>
</tbody>
</table>

Electrical connection, diagrams, additional information
Additional information

Description of sensor functions
The ultrasonic double sheet monitor is used for double sheet detection in all situations in which the automatic distinction between double and single sheets is required in order to protect machines or avoid waste production. The double-sheet monitor is based on the ultrasonic through-beam principle. The following can be detected:
- No sheet, i.e. air,
- Individual sheet
- Double sheet

A microprocessor system evaluates the signals. The appropriate switch outputs are set as a result of the evaluation. Changes in ambient conditions such as temperature and humidity are compensated for automatically. The interface electronics is integrated into a compact M18 metal housing together with a sensor head. To ensure a reliable operation of the double sheet monitor, the detection threshold is adapted dynamically to the detected paper thickness.

Switching on
The sensor is equipped with 6 connections. The functionality of the connections is described in the following table. The function input (PK) is used to assign parameters to the sensor. (See Output pulse extension, Alignment aid and Program selection). During normal operation, the function input must always be securely connected with +UB or -UB, to avoid possible interference or improper functionality.

<table>
<thead>
<tr>
<th>Colour</th>
<th>Switching on</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>BN</td>
<td>+UB</td>
<td></td>
</tr>
<tr>
<td>WH</td>
<td>Switch output for single sheets</td>
<td>Pulse width corresponds to the event</td>
</tr>
<tr>
<td>BK</td>
<td>Switch output for double sheets</td>
<td>Pulse width corresponds to the event</td>
</tr>
<tr>
<td>GY</td>
<td>Switch output for air</td>
<td>Pulse width corresponds to the event</td>
</tr>
<tr>
<td>PK</td>
<td>-UB/+UB</td>
<td>Function input for parameter assignment/pulse prolongation</td>
</tr>
<tr>
<td>BU</td>
<td>-UB</td>
<td></td>
</tr>
</tbody>
</table>

Normal mode
The sensor is working in normal mode if the function input (PK) is applied to -UB or +UB when the power source (Power-On) is supplied, as shown in the output pulse extension table (see below).

Displays:
- LED yellow: Detection of air
- LED green: Detection of single sheets
- LED red: Detection of double sheets

Switch outputs:
The switch outputs are only active in normal operation!

<table>
<thead>
<tr>
<th>Colour</th>
<th>Switching on</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>WH</td>
<td>Single sheet output</td>
</tr>
<tr>
<td>Black</td>
<td>BK</td>
<td>Double sheet output</td>
</tr>
<tr>
<td>Gray</td>
<td>GY</td>
<td>Air output</td>
</tr>
</tbody>
</table>

Date of edition: 08/18/2005
Output pulse extension
Switching the function input (PK) on to \(-U_B\) or \(+U_B\) makes it possible to select a minimum pulse width of 120 ms for all output pulses of the three switch outputs.

<table>
<thead>
<tr>
<th>Switching on (PK)</th>
<th>Operating behaviour (after Power-On)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-U_B)</td>
<td>No output pulse extension for switch outputs</td>
</tr>
<tr>
<td>(+U_B)</td>
<td>Output pulse extension of all switch outputs to at least 120 ms</td>
</tr>
</tbody>
</table>

Please note:
This can result in a condition in which more than one switch output is switched through!

Display Mode
The selected parameter assignment of the sensor can be displayed by switching the function input (PK) to voltage-free during normal operation. The green and the red LED display alternately the program number and the operation mode.

- LED green: Number of blinking pulses = program number
- LED red: single flashing = continuous operation mode
double flashing = pulsed operation mode

The outputs are inactive during this time.
If the function input (PK) is switched to voltage-free when power is supplied (Power-On), the sensor will also work in display mode.
If the unit is switched to voltage-free while the function input (PK) is in operation due to an error (broken cable, coming loose because of vibration), display mode acts as a fault display.

Parameter assignment
The sensor is equipped with 4 programs for different ranges of application. This makes it possible to work with a wide range of material. The user can select the program best suited for a specific application.

*The default setting, Program 1, is designed so that no change in the setting is required for most applications.*

<table>
<thead>
<tr>
<th>Program number</th>
<th>Notes:</th>
<th>Range of materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Default setting, standard paper</td>
<td>20 - 1200 g/m²</td>
</tr>
<tr>
<td>2</td>
<td>Thick paper, cardboard, fine corrugated boards and thin sheet metal</td>
<td>&gt; 100 g/m²</td>
</tr>
<tr>
<td>3</td>
<td>Thin paper</td>
<td>20 – 250 g/m²</td>
</tr>
<tr>
<td>4</td>
<td>Extremely fine paper</td>
<td>&lt; 40 g/m²</td>
</tr>
</tbody>
</table>

Operation modes
The double sheet monitor offers the possibility to select between continuous operation mode and pulsed operation mode. Due to the pulsed operation mode is pre-selected as the standard mode, most applications need no modification.

Procedure for assigning parameters
It is possible to switch to additional parameter assignment modes from the display mode:

- Alignment mode -->
- Program selection mode -->
- Operation mode selection mode -->
- Alignment aid mode --> (for checking)

When the function input (PK) is applied to \(-U_B\) (for > 500 ms), the mode changes an the storage of the current parameter. Within the Modes "program selection" and "operation mode selection" you can scroll through the programs or modes by applying \(+U_B\) (for > 500 ms) to the function input (PK).

Disconnecting the power supply causes the system to exit the current mode with the selected program change.

The switch outputs are not active while parameters are being assigned to the sensor!
Modes

Alignment aid
During installation, the DSM can provide an adjustment aid for optimal alignment of the emitter to the receiver.
If the sensor detects an area of air (yellow LED is lit) after 3 seconds, the DSM will begin to display the intensity of the measured amplitude signal:
- If the signal is weak, the yellow LED will flash at a slow rate
- As the intensity of the signal increases, the rate at which the LED flashes becomes faster
- At optimal alignment (maximum signal intensity), the yellow LED is continuously lit.
The single sheet function (green LED) and double sheet function (red LED) continues to be active. This makes it possible to check for correct functionality of the double sheet control.

Program selection
In the program selection mode, the current program is displayed by the green LED (number of flashing pulses = program number).
Applying the adjustment input (PK) to +U_B (for > 500 ms) causes the next program to be selected in cyclic sequence (program 1 follows through to program 4).

Operation mode selection
In the operation mode selection mode, the current program is displayed by the red LED.
- single flashing: continuous operation mode
- double flashing: pulsed operation mode
Applying the adjustment input (PK) to +U_B (for > 500 ms) causes an alteration of the operation mode.

Notes:
A complete device consists of an ultrasonic emitter and an evaluation unit with an ultrasonic emitter. The sensor heads are optimally adjusted to each other when they leave the factory. Therefore, they must not be used separately or exchanged with other devices of the same type. The plug connector on the emitter/receiver connection cable is only intended to be used for easier mounting, not to replace units.
Very light papers (for example handkerchiefs) or perforated papers are not always suitable for double sheet detection because of their physical characteristics.
If two or more double sheet controls are used in the immediate vicinity of each other, there may be mutual interference between them, which can result in improper functionality of the devices. Mutual interference can be prevented by introducing suitable countermeasures when planning systems.
Ultrasonic double sheet monitor

- Ultrasonic system for detection of single sheet, no sheet and double sheet. Also detection of pasted double sheets.
- Weights of paper from 30 g up to cartons weighing over 1200 g can be detected.
- It is also possible to detect thin metal and plastic films.
- Various materials and thicknesses are programmed in via a TEACH-IN signal.
- Automatic compensation of the operating point in the case of slowly changing ambient conditions.
- Signal output via short-circuit proof PNP switch outputs.
- Very high processing speeds are possible.

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories".

Technical Data

Model number

<table>
<thead>
<tr>
<th>Technical Data</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transducer frequency</td>
<td>180 kHz</td>
</tr>
<tr>
<td>LED green</td>
<td>indication: single sheet detected</td>
</tr>
<tr>
<td>LED yellow</td>
<td>indication: no sheet detected</td>
</tr>
<tr>
<td>LED red</td>
<td>indication: double sheet or pasted double sheets detected</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>20 ... 30 V DC, ripple 10 %</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>&lt; 80 mA</td>
</tr>
<tr>
<td>Output type</td>
<td>3 switch outputs PNP, NO</td>
</tr>
<tr>
<td>Rated operational current</td>
<td>3 x 200 mA</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 2 V</td>
</tr>
<tr>
<td>Switch-on delay</td>
<td>≤ 5 ms</td>
</tr>
<tr>
<td>Switch-off delay</td>
<td>≤ 5 ms</td>
</tr>
<tr>
<td>Input type</td>
<td>1 pulse input for TEACH-IN</td>
</tr>
<tr>
<td>Pulse length</td>
<td>≥ 100 ms</td>
</tr>
<tr>
<td>Impedance</td>
<td>≥ 10 kΩ</td>
</tr>
<tr>
<td>Voltage</td>
<td>12 ... 30 V</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0 ... 60 °C (273 ... 333 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 70 °C (233 ... 343 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
</tr>
</tbody>
</table>
| Connection | emitter: V1-W connector with 2.5 m cable
receiver: 2.5 m fixed cable (not disconnected) S1, S2: 2 connectors V1-W M12x1 (included with delivery) |
| Housing | Makedon nickel-plated brass |
| Mass | 370 g |

Electrical connection, diagrams, additional information

Characteristic response curves

Mounting/Adjustment

Date of edition: 08/18/2005
Additional information

**Description of the sensor functions**

In addition to the printing industry, the ultrasonic double-sheet monitor is deployed in all situations in which the automatic distinction between single and double sheets is required in order to protect machines or avoid waste production. The double-sheet monitor is based on the ultrasonic through-beam principle. The following can be detected:

- No sheet
- Individual sheet
- Double sheet or pasted double sheet

A microprocessor system evaluates the signals. The appropriate switch outputs are set as a result of the evaluation. Changes in ambient conditions such as temperature and humidity are automatically compensated. The evaluation electronics are installed in a cuboid plastic housing separate from the sensor heads.

**Measuring system**

A complete system consists of an ultrasonic emitter, an ultrasonic receiver and an evaluation unit. These units have been optimally tuned to one another at the factory and may not be used separately.

**Alignment**

When adjusting the emitter and receiver, take care to align them as precisely as possible.

Distance of the sensor heads: \[ d = 20 \text{ mm} \ldots 80 \text{ mm} \]

Angular tolerance: \[ \alpha < \pm 2^\circ \]

Maximum offset: \[ s < \pm 2 \text{ mm} \]

To ensure their correct function, the sensor heads must be aligned at an angle of 20° ... 45° from vertical onto the paper surface. The paper is guided over the emitter at a distance of 5 mm ... 15 mm. The emitter is installed below in order to prevent dust deposits. Install the sensor heads using the included plastic nuts. The sound cone must be completely covered by the paper. This means that the sensor heads must be installed above the sheet of paper and at least 10 mm away from the side edge of the paper.

**Maximum feed speed of the sheet (approximate value)**

\[ v_{\text{max}} = \text{overlapping of sheets [m] / 5 m} \quad (\text{overlapping} > 20 \text{ mm}) \]

**TEACH-IN**

1. After the operating voltage has been applied, a single sheet can be fed in as the first sheet. It will automatically be programmed as a reference value by the system.
2. If a single sheet of paper is located between the ultrasonic emitter and receiver when the operating voltage is turned on, it will automatically be programmed as a reference value by the system.

**Automatic learning for thinner types of sheets**

If you are inserting a thinner type of sheet, you can dispense with the use of the TEACH-IN signal to program the system. In order to do this, a single sheet of paper must be between the emitter and receiver for at least 10 s.

**TEACH-IN for new type of sheet**

If you are inserting a single type of sheet that will result in double-sheet output, you can dispense with learning by means of the TEACH-IN signal. In order to do this, a single sheet of paper must be between the emitter and receiver for at least 10 s.

**Automatic learning for thicker types of sheets**

If you are inserting a thicker type of sheet but still not one that will result in double-sheet output, you can dispense with learning by means of the TEACH-IN signal. In order to do this, a single sheet of paper must be between the emitter and receiver for at least 10 s.

**Sensor system for ultrasonic double-sheet monitoring can also be delivered with a customised time response for optimal adaptation to specific applications.**

**Caution!**

The paper sheets may not touch the sensor heads during operation. Depending on physical conditions, reflections on the edge of a single sheet may result in double-sheet output. This is not an error, and can be masked out in the higher-level control system.

Sensor systems for ultrasonic double-sheet monitoring can also be delivered with a customised time response for optimal adaptation to specific applications.
Ultrasonic label control

**Ultrasonic system for detection of labels, carrier materials and double sheets.**

**Weights of paper from 30 g up to cartons weighing over 1200 g can be detected.**

**It is also possible to detect thin metal and plastic films.**

**Various materials and thicknesses are programmed in via a TEACH-IN signal.**

**No automatic switching threshold tracking in the case of slowly changing ambient conditions.**

**Signal output via short-circuit proof PNP switch outputs.**

**Very high processing speeds are possible.**

---

**Technical Data**

<table>
<thead>
<tr>
<th>Model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>UDBL-18GM35-3E2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transducer frequency</th>
<th>180 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED green</td>
<td>indication: carrier material detected</td>
</tr>
<tr>
<td>LED yellow</td>
<td>indication: label detected</td>
</tr>
<tr>
<td>LED red</td>
<td>indication: double sheet detected</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>20 ... 30 V DC, ripple 10 %</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>&lt; 80 mA</td>
</tr>
<tr>
<td>Time delay before availability</td>
<td>≥ 5 minutes</td>
</tr>
<tr>
<td>Output type</td>
<td>3 switch outputs, NO</td>
</tr>
<tr>
<td>Rated operational current</td>
<td>3 x 200 mA</td>
</tr>
<tr>
<td>Voltage drop</td>
<td>≤ 2 V</td>
</tr>
<tr>
<td>Switch-on delay</td>
<td>≤ 1 ms</td>
</tr>
<tr>
<td>Switch-off delay</td>
<td>≤ 1 ms</td>
</tr>
<tr>
<td>Input type</td>
<td>1 pulse input for TEACH-IN</td>
</tr>
<tr>
<td>Pulse length</td>
<td>≥ 100 ms</td>
</tr>
<tr>
<td>Impedance</td>
<td>≥ 10 kOhm</td>
</tr>
<tr>
<td>Voltage</td>
<td>12 ... 30 V</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-5-2</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0 ... 60 °C (27 ... 333 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 70 °C (233 ... 343 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
</tr>
<tr>
<td>Connection</td>
<td>emitter: V1-W connector with 2.5 m cable</td>
</tr>
<tr>
<td></td>
<td>receiver: 2.5 m fixed cable (not disconnected)</td>
</tr>
<tr>
<td></td>
<td>S1, S2: 2 connectors V1-W/M 2x1 (included with delivery)</td>
</tr>
<tr>
<td>Housing</td>
<td>Milled anodized-brass</td>
</tr>
<tr>
<td>Mass</td>
<td>370 g</td>
</tr>
</tbody>
</table>

---

**Electrical connection, diagrams, additional information**

---

**Mounting/Adjustment**

- **Receiver** (yellow cable)
- **Emitter** (black cable)
- **Angular alignment**
  - \( \alpha \leq \pm 2^\circ \)
  - **Sensor offset** \( s \leq \pm 2 \text{ mm} \)

---

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Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
Additional information

Description of the sensor functions

Ultrasonic double-sheet monitoring is used in all situations in which an automatic distinction must be made between labels and carrier material as well as double sheets in order to protect machines or avoid waste production. The double-sheet monitor is based on the ultrasonic through-beam principle. The following can be detected:

- Base material
- Label
- Double sheet

A microprocessor system evaluates the signals. The appropriate switch outputs are set as a result of the evaluation. The evaluation electronics are installed in a cuboid plastic housing separate from the sensor heads.

Measuring system

A complete system consists of an ultrasonic emitter, an ultrasonic receiver and an evaluation unit. These units have been optimally tuned to one another at the factory and may not be used separately.

Alignment

When adjusting the emitter and receiver, take care to align them as precisely as possible.

Distance of the sensor heads: \( d = 20 \text{ mm} \ldots 80 \text{ mm} \)

Angular tolerance: \( \alpha < \pm \quad 2^\circ \)

Maximum offset: \( s < \pm \quad 2 \text{ mm} \)

To ensure their correct function, the sensor heads must be aligned at an angle of \( 20^\circ \ldots 45^\circ \) from vertical onto the paper surface. The paper is guided over the emitter at a distance of \( 5 \text{ mm} \ldots 15 \text{ mm} \). The emitter is installed below in order to prevent dust deposits. Install the sensor heads using the included plastic nuts. The sound cone must be completely covered by the paper. This means that the sensor heads must be installed above the sheet of paper and at least \( 10 \text{ mm} \) away from the side edge of the paper.

Maximum feed speed of the sheet (approximate value)

Depends on the label and gap width as well as the materials in question.

Approximate value \( 10 \text{ m/s} \) while maintaining the required minimum sizes.

\[
\begin{align*}
  c & \geq 35 \text{ mm} \\
  g & \geq 2 \text{ mm} \\
  L_B & \geq 15 \text{ mm} \\
  L_L & \geq 15 \text{ mm}
\end{align*}
\]

TEACH-IN

Before starting a valid TEACH-IN a warm up period of approx. 5 min must be maintained. After the warm up period and a short-time reset of the operating voltage a valid value is automatically taught in, provided that a carrier material and label is between emitter and receiver.

TEACH-IN for new type of sheet

If a new type of label is used, the TEACH-IN procedure must be carried out. To do this, a label with carrier material is put between emitter and receiver and the teach-in is performed with reference to the label. After having applied the TEACH-IN-signal the value is adopted automatically.

Caution!

The paper sheets may not touch the sensor heads during operation. Depending on physical conditions, reflections on the edge of a single sheet may result in double-sheet output. This is not an error, and can be masked out in the higher-level control system.

Sensor system s for ultrasonic double-sheet monitoring can also be delivered with a customised time response for optimal adaptation to specific applications.

Dimensions

UDBL-18GM35-3E2

Date of edition: 08/18/2005

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Technical Data

Model number

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transducer frequency</td>
<td>180 kHz</td>
</tr>
<tr>
<td>Focke Ident-Nr.</td>
<td>7 002-464</td>
</tr>
<tr>
<td>LED green</td>
<td>single sheet detected</td>
</tr>
<tr>
<td>LED yellow</td>
<td>no sheet detected</td>
</tr>
<tr>
<td>LED red</td>
<td>double sheet or contact spot detected</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>20 ... 30 V DC, ripple 10 %FS</td>
</tr>
<tr>
<td>No-load supply current</td>
<td>&lt; 80 mA</td>
</tr>
<tr>
<td>Output type</td>
<td>3 switch outputs, NO</td>
</tr>
<tr>
<td>Rated operational current</td>
<td>3 x 200 mA</td>
</tr>
<tr>
<td>Switch-on delay</td>
<td>≤ 1 ms</td>
</tr>
<tr>
<td>Switch-off delay</td>
<td>≤ 100 ms</td>
</tr>
<tr>
<td>Input type</td>
<td>1 pulse input for TEACH-IN</td>
</tr>
<tr>
<td>Pulse length</td>
<td>≤ 100 ms</td>
</tr>
<tr>
<td>Impedance</td>
<td>≥ 10 kOhm</td>
</tr>
<tr>
<td>Voltage</td>
<td>12 ... 30 V</td>
</tr>
<tr>
<td>Standards</td>
<td>EN 60947-52</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0 ... 60 °C (273 ... 333 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 ... 70 °C (233 ... 343 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65</td>
</tr>
<tr>
<td>Connection</td>
<td>emitter: V1-W connector with 2.5 m cable, receiver: 2.5 m fixed cable (not disconnectable)</td>
</tr>
<tr>
<td>Housing</td>
<td>Metal/hot-dipped brass</td>
</tr>
<tr>
<td>Mass</td>
<td>370 g</td>
</tr>
</tbody>
</table>

Electrical connection, diagrams, additional information

Characteristic response curves

Mounting/Adjustment

Angular alignment

Sensor offset

Paper position:

Relative position

+UB

-UB

(courtesy of Steven Engineering, Inc.)
Additional information

Description of the sensor functions

Ultrasonic double-sheet monitoring to detect splice points is used in all situations in which an automatic distinction must be made between splice points and double sheets in order to protect machines or avoid waste production. Double-sheet monitoring for splice point detection is based on the ultrasonic through-beam principle. The following can be detected:

- No sheet
- Individual sheet
- Splice point or double sheet

A microprocessor system evaluates the signals. The appropriate switch outputs are set as a result of the evaluation. Changes in ambient conditions such as temperature and humidity are automatically compensated. The evaluation electronics are installed in a cuboid plastic housing separate from the sensor heads.

Measuring system

A complete system consists of an ultrasonic emitter, an ultrasonic receiver and an evaluation unit. These units have been optimally tuned to one another at the factory and may not be used separately.

Alignment

When adjusting the emitter and receiver, take care to align them as precisely as possible.

Distance of the sensor heads:

\[ d = 20 \text{ mm} ... 80 \text{ mm} \]

Angular tolerance:

\[ \alpha < \pm 2^\circ \]

Maximum offset:

\[ s < \pm 2 \text{ mm} \]

To ensure their correct function, the sensor heads must be aligned at an angle of 20° ... 45° from vertical onto the paper surface. The paper is guided over the emitter at a distance of 5 mm ... 15 mm. The emitter is installed in order to prevent dust deposits. Install the sensor heads using the included plastic nuts. The sound cone must be completely covered by the paper. This means that the sensor heads must be installed above the sheet of paper and at least 10 mm away from the side edge of the paper.

Feed speed of the sheet (approximate value)

\[ v_{\text{min}} = 0.035 \text{ m/s} \]

\[ v_{\text{max}} \text{ [m/s]} = \text{overlapping of sheets [mm]} / 1 \text{ m/s} \quad \text{(approx. value, overlapping > 20 mm)} \]

**TEACH-IN**

1. After the operating voltage has been applied, a single sheet can be fed in as the first sheet. It will automatically be programmed as a reference value by the system.

2. If a single sheet of paper is located between the ultrasonic emitter and receiver when the operating voltage is turned on, it will automatically be programmed as a reference value by the system.

Automatic learning for thinner types of sheets

If you are inserting a thinner type of sheet, you can dispense with the use of the TEACH-IN signal to program the system. In order to do this, a single sheet of paper must be between the emitter and receiver for at least 2 s.

Automatic learning for thicker types of sheets

If you are inserting a thicker type of sheet but still not one that will result in double-sheet output, you can dispense with learning by means of the TEACH-IN signal. In order to do this, a single sheet of paper must be between the emitter and receiver for at least 2 s.

**TEACH-IN for new type of sheet**

If you are inserting a new type of sheet that will result in double-sheet output, the system must be reprogrammed. To do this, a single sheet must be placed between the emitter and receiver. After the TEACH-IN signal has been applied, the corresponding reference value will be accepted.

Caution!

The paper sheets may not touch the sensor heads during operation. Depending on physical conditions, reflections on the edge of a single sheet may result in double-sheet output. This is not an error, and can be masked out in the higher-level control system.

Sensor systems for ultrasonic double-sheet monitoring can also be delivered with a customised time response for optimal adaptation to specific applications.
## Control units/Power supplies

<table>
<thead>
<tr>
<th>Model number</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>UH3-KHD2-4E5</td>
<td>Control/evaluation unit with 4 switching outputs</td>
<td>202</td>
</tr>
<tr>
<td>UH3-KHD2-4I</td>
<td>Control/evaluation unit with 4 analogue current outputs (4 mA ... 20 mA)</td>
<td>204</td>
</tr>
<tr>
<td>UH3-T1-KT</td>
<td>Control/evaluation unit with relay output for high power loads</td>
<td>206</td>
</tr>
<tr>
<td>DA5-IU-C</td>
<td>Process indication device</td>
<td>208</td>
</tr>
<tr>
<td>DA5-IU-2K-C</td>
<td>Process indication device</td>
<td>210</td>
</tr>
<tr>
<td>DA5-IU-2K-V</td>
<td>Process indication device</td>
<td>210</td>
</tr>
<tr>
<td>WE77-RE2</td>
<td>Isolated switch amplifier with power supply und 2 relay outputs</td>
<td>212</td>
</tr>
<tr>
<td>KFA6-STR-1.24.500</td>
<td>Power supply</td>
<td>214</td>
</tr>
</tbody>
</table>
### Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>UH3-KHD2-4E5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating modes</strong></td>
<td>with switch-over: multiple operation - consecutive activation of the channels synchronous operation - activation of the channels is simultaneously</td>
</tr>
<tr>
<td>Measuring frequency</td>
<td>dependent on the operating mode, number and longest range of the active sensors (see page multiple/synchronous operation)</td>
</tr>
<tr>
<td><strong>Standards</strong></td>
<td>EN 60 947-5-2</td>
</tr>
<tr>
<td><strong>LED green</strong></td>
<td>sensor type / channel active (4 items) NDINOTREF (2 items) switch point (1 item)</td>
</tr>
<tr>
<td><strong>LED yellow</strong></td>
<td>channel number A1 ... A4 / object in operating range (4 items)</td>
</tr>
<tr>
<td><strong>Operating voltage</strong></td>
<td>20 ... 30 V DC, ripple 10 % SS</td>
</tr>
<tr>
<td><strong>No-load supply current</strong></td>
<td>≤ 50 mA (without sensors) reverse-polarity protected, NONC-operation</td>
</tr>
<tr>
<td><strong>Output type</strong></td>
<td>4 switch outputs A1 ... A4 (max. 500 mA pnp)</td>
</tr>
<tr>
<td><strong>Repeat accuracy</strong></td>
<td>multiple operation ± 1 mm synchronous operation ± 3 mm</td>
</tr>
<tr>
<td><strong>Input type</strong></td>
<td>4 sensors for each of 4 connections +U1/-U1/echo (E) short-circuit proof with reverse-polarity protection attachable sensors UB500/2000/4000/6000...-H3 or -H1/-H2</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>-20 ... 70 °C (253 ... 343 K)</td>
</tr>
<tr>
<td><strong>Storage temperature</strong></td>
<td>-40 ... 85 °C (233 ... 358 K)</td>
</tr>
<tr>
<td><strong>Protection degree</strong></td>
<td>IP20</td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>terminal housing, suitable for 35 mm standard rail plug-in screw terminal 1.5 mm²</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>230 g</td>
</tr>
</tbody>
</table>

The UH3-KHD2-4E5 is an evaluation device for ultrasonic sensors with external interface electronics. Up to four sensors of type UB...-H3 or sensor pairs UB...-H1/-H2 can be connected to the device.

The evaluation unit issues the transmission pulses (cycle) for each sensor channel, then records the echo signal and forms the sensing range according to the echo time. A switch output is associated with each channel.

If the detected distance is less than the set switching point, the output of the associated channel is actuated according to the selected open/close action. This is indicated by the yellow LED assigned to the channel.

Sensors with a variety of detection ranges can be deployed on the four evaluation channels. One of the channels can be programmed as a reference measurement for temperature compensation.

**Note:**
The maximum cable-length between evaluation unit and sensor must not exceed 20 m!
**Dimensions**

![Dimensions Diagram]

**Electrical connection**

![Electrical Connection Diagram]

**Switch outputs:**
- Channel 1
- Channel 2
- Channel 3
- Channel 4

**Temperature sensor**
- 24 V DC
- \( +U_b \)
- \( -U_b \)

**Switch outputs: 24 V DC**
- Channel 1
- Channel 2
- Channel 3
- Channel 4

**Switch outputs: n.c.n.o.**
- Channel 1
- Channel 2
- Channel 3
- Channel 4

**Control unit Power supply**
- Channel 1
- Channel 2

**Accessories**
- Channel 3
- Channel 4

**Double sheet monitoring**
- Channel 1
- Channel 2

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Technical Data

Model number

Operating modes
with switch-over:
multiplex operation - consecutive activation of the channels
synchronous operation - activation of the channels simultaneously

Measuring frequency
dependent on the operating mode, number and longest range of the active sensors (see page multiplex/synchronous operation)

Standards
EN 60947-5-2

LED green
sensor type / channel active (4 items)
current slope: increasing / decreasing / REF (2 items)
measuring window limits near / far (2 items)

LED yellow
channel number A1 ... A4 / object in operating range (4 items)

No-load supply current
≤ 50 mA (without sensors)

Output type
4 analogue outputs A1 ... A4, 4 mA ... 20 mA (rising/falling ramp)

Repeat accuracy
multiplex operation ± 1 mm
synchronous operation ± 3 mm

Input type
for 4 sensors for each of 4 connections +U+/U-/clock (T) /echo (E) short-circuit proof with reverse-polarity protection

Ambient temperature
-20 ... 70 °C (253 ... 343 K)

Storage temperature
-40 ... 85 °C (233 ... 358 K)

Protection degree
IP20

Connection
terminal housing, suitable for 35 mm standard rail
plug-in screw terminal 1.5 mm²

Mass
230 g

The UH3-KHD2-4I is an evaluation device for ultrasonic sensors with external interface electronics. Up to four sensors of type UB...-H1, -H2 and -H3 can be connected to the device.

The evaluation unit issues the transmission pulses (cycle) for each sensor channel, then records the echo signal and forms a current value proportional to the echo time (4 mA ... 20 mA). An analogue output is associated with each channel.

An evaluation window and a rising or falling current ramp can be selected in the detection section for each output. If the distance determined is within the programmed measuring window, the output of the associated channel will deliver a value between 4 mA and 20 mA. The yellow LED associated with the channel will be lit.

Sensors with a variety of detection ranges can be deployed on the four evaluation channels. One of the channels can be programmed as a reference measurement for a temperature compensation.

Note:
The maximum cable-length between evaluation unit and sensor must not exceed 20 m!
**Dimensions**

![Dimensions Diagram](image)

**Electrical connection**

![Electrical Connection Diagram](image)

---

**Dimensions**

- **UH3-KHD2-4I**

**Series**

- VariKont
- -FP
- -F12
- -F42
- -F43
- -F54
- -F64
- -D1
- -LUC

**Accessories**

- Extendable latches
- Double sheet monitoring
- Control units/ Power supplies

**Analog outputs:**

- Channel 1:
  - (4 mA ... 20 mA / 20 mA ... 4 mA)
- Channel 2:
  - (4 mA ... 20 mA / 20 mA ... 4 mA)

**Reference potential -Ue**

- Channel 1:
  - (4 mA ... 20 mA / 20 mA ... 4 mA)
- Channel 2:
  - (4 mA ... 20 mA / 20 mA ... 4 mA)

**Temperature sensor**

- +Ue
- -Ue

**Control units/ Power supplies**

- Series -18GK/-18GM
- Series -30GM
- Series -12GM
The UH3-T1-KT is a back-end unit for ultrasonic sensors with external evaluation logic. It features direct-detection and through-beam operating modes. All sensors of the types H3, H1 and H2 can be connected to the unit.

When an object is detected, a relay trips a change-over contact. The action and release delays can be adjusted independently of one another. In direct-detection mode the unit generates a clock signal for the sensors and determines the object distance on the basis of the echo time. A switching point can be set in steps in the detection range.

In barrier mode the clock signal starts the ultrasonic pulse from the device in the transmitter/sender. The receiver generates an echo signal when it picks up the ultrasonic signal. If this echo signal is not received, the evaluation unit trips the output relay.
Dimensions

Electrical connection

20 ... 30 VDC  4  
GND  3  
Output (clock)  5  
Input 1 (echo)  7  
Input 2 (echo)  8  
Input 3 (echo)  9  

Sensor 1  
Sensor 2  
Sensor 3  

2 +Power 20 ... 30 VDC

1  
6  
250 VAC/8A

10 - Power GND

Date of edition: 08/18/2005
Digital display unit

- Bright, high contrast 5-digit LED indicator
- Leading zero suppression
- Adjustable decimal point
- Maximum- and minimum-value display

Suitable connector cables, mounting aids and more, you can find in chapter "Accessories"

Technical Data

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-selection</td>
<td>none</td>
</tr>
<tr>
<td>Data storage</td>
<td>10⁵ storage cycles or 10 years, EEPROM</td>
</tr>
<tr>
<td>Programming</td>
<td>keypad-driven menu</td>
</tr>
<tr>
<td>Type</td>
<td>7-segment LED display, red</td>
</tr>
<tr>
<td>Number of decades</td>
<td>5</td>
</tr>
<tr>
<td>Display value</td>
<td>digit height 8 mm</td>
</tr>
<tr>
<td>Display interval</td>
<td>-19999 ... 99999</td>
</tr>
<tr>
<td>Decimal point</td>
<td>freely adjustable</td>
</tr>
<tr>
<td>Resolution</td>
<td>14 Bit</td>
</tr>
<tr>
<td>Scale factor</td>
<td>via linear characteristic curve</td>
</tr>
<tr>
<td>Reset</td>
<td>maximum value, manually</td>
</tr>
<tr>
<td>Key interlock</td>
<td>-</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 ... 30 V DC</td>
</tr>
<tr>
<td>Power consumption</td>
<td>1.5 VA</td>
</tr>
<tr>
<td>Voltage</td>
<td>max. 30 DC</td>
</tr>
<tr>
<td>Analogue voltage input</td>
<td>0 ... 10 V / 2 ... 10 V DC</td>
</tr>
<tr>
<td>Analogue current input</td>
<td>0 ... 20 mA / 4 ... 20 mA</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-10 ... 80°C (263 ... 323 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-25 ... 70°C (248 ... 343 K)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>≤ 80 % (non-condensing)</td>
</tr>
<tr>
<td>Mounting</td>
<td>latch fastener/mounting frame</td>
</tr>
<tr>
<td>Connection</td>
<td>7-pin screw terminal</td>
</tr>
<tr>
<td>Dimensions</td>
<td>48 mm x 24 mm x 65 mm</td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 50 g</td>
</tr>
</tbody>
</table>

The DA5-IU-C permits a simple visual inspection by operating and maintenance personnel. It converts the analogue sensor output signal into a readable form for this purpose. Depending on the task or setting, 4 ... 20 mA or 0 ... 100 % values can be displayed.

Scope of delivery:
- Process control unit DA5-IU-C
- Screw terminal, 7-pin
- Clamp clip
- Seal
- 1 sheet of adhesive symbols

Date of edition: 09/13/2005
Dimensions

Electrical connection

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 ... 30 V DC</td>
<td>0 V (GND)</td>
<td>0 V LATCH</td>
<td>LATCH</td>
<td>Current input</td>
<td>0 V input signal</td>
<td>Voltage input</td>
</tr>
</tbody>
</table>
Process control and indication equipment  

DA5-IU-2K.

- 2 adjustable limit values
- 2 relay outputs
- Operation via keypad
- Programmable characteristics
- Resetting the outputs, automatic, manual or with external signal
- Connection via plug-in screw terminals
- Auxiliary power output for sensors (Only DA5-IU-2K-V)
- Protection degree IP65 in accordance with DIN EN 60529 (front only)
- Shock resistance in accordance with DIN EN 60068-2-27
- Vibration resistance in accordance with DIN EN 60068-2-6
- System hum suppression

Technical Data

- Model number
- DA5-IU-2K-C
- DA5-IU-2K-V

- Pre-selection: 2-fold
- Data storage: 10^6 storage cycles or 10 years, EEPROM
- Programming: keypad-driven menu
- Type: 7-segment LED display, red
- Number of decades: 5
- Display value: digit height 14.2 mm
- Display interval: -19999 ... 99999
- Decimal point: freely adjustable
- Resolution: 14 Bit
- Scale factor: via characteristic curve with up to 24 value pairs
- Reset: manually or external
- Operating voltage: with ‘high’ level at terminal ‘KEY’
- 10 ... 30 V DC
- 90 ... 260 V AC
- Power consumption: 2 W
- 7 VA
- Sensor supply: 24 V DC, 100 mA
- 2 x 250 V AC/300 V DC, 3 A, changeover contact
- Relay: 1 MΩ for voltage measurement
- < 50 Ω for current measurement
- Impedance: > 1 MΩ for voltage measurement
- < 50 Ω for current measurement
- Analogue voltage input: 0 ... 10 V DC, -10 ... 10 V DC
- Analogue current input: 0 ... 20 mA / 4 ... 20 mA
- Ambient temperature: -10 ... 50 °C (283 ... 323 K)
- Storage temperature: -25 ... 70 °C (248 ... 343 K)
- Relative humidity: < 80 % (non-condensing)
- Connection: 8-pin and 11-pin connectors with plug-in screw terminals
- Dimensions: 96 mm x 48 mm x 90 mm
- Mass: 220 g

The DA5-IU-2K... permits a simple visual inspection by operating and maintenance personnel. It converts the analogue sensor output signal into a readable form for this purpose. Depending on the task or setting, 4 mA ... 20 mA or 0 % ... 100 % values can be displayed.

Scope of delivery:

- Process control unit DA5-IU-2K...
- Screw terminals
- 1 RM 5.08 8-pole terminal for power supply and outputs
- 1 RM 3.81 11-pole terminal for measuring and control inputs
- Clamp clip
- Seal
- 1 sheet of adhesive symbols

Suitable connector cables, mounting aids and more, you can find in chapter “Accessories”.

![image of process control unit DA5-IU-2K]
Dimensions

Control panel cutout

Electrical connection

Connector S1/...
- Ammeter input S1/1
- Reference earth S1/2
- Voltmeter input S1/3
- Key lock-out "Key" S1/6
- Reference earth for reset S1/7
- Reset S1/8

Connector S2/...
- Auxiliary power output (only on DA5-IU-2K-V)
- OUT 1 S2/3
- OUT 2 S2/6
- Relay 2 S2/7
- Relay 1 S2/5
- 90 ... 260 V AC supply (...-V)
- 10 ... 30 V DC 0 V DC (...-C)

Date of edition: 08/18/2005
Isolated switch amplifier

- 2-channel isolated switch amplifier
- Control circuit designed for the direct current versions of ultrasonic sensors and proximity switches
- 230 V AC/115 V AC mains nominal voltage
- Switching frequency 10 kHz
- Each with 1 relay output with 1 changeover contact
- One LED status display for each output relay
- Modular housing
- For PNP-sensors the terminals 5 and 6, for NPN-sensors the terminals 6 and 7 are to short out
- Mode of operation: input closed - energising the relay/input open - relay de-energised

Suitable connector cables, mounting aids and more, you can find in chapter “Accessories”

Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>WE77-RE2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection</td>
<td>terminals 17, 18</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>98 ... 126 V AC / 198 ... 253 V AC / 45 ... 63 Hz, switchable</td>
</tr>
<tr>
<td>Power consumption</td>
<td>approx. 7 VA</td>
</tr>
<tr>
<td>Voltage</td>
<td>24 V DC ± 20%</td>
</tr>
<tr>
<td>Current</td>
<td>150 mA at 60 °C, short-circuit proof</td>
</tr>
<tr>
<td>Contact rating</td>
<td>AC: 250 V / 4 A / 500 VA / cos φ ≥ 0.7</td>
</tr>
<tr>
<td></td>
<td>DC: 220 V / 0.1 A / 60 V / 0.6 A / 24 V / 4 A</td>
</tr>
<tr>
<td>Energised/De-energised delay</td>
<td>approx. 20 ms / approx. 10 ms</td>
</tr>
<tr>
<td>Connection</td>
<td>terminals 1, 3, 5, 11, 12, 13, 14, 15</td>
</tr>
<tr>
<td>Mechanical life</td>
<td>10^7 switching cycles</td>
</tr>
<tr>
<td>Connection</td>
<td>terminals 2, 4</td>
</tr>
<tr>
<td>Input signal</td>
<td>high: 24 V DC ± 20% , 37 mA</td>
</tr>
<tr>
<td></td>
<td>low: &lt; 1 V DC , ≤ 0.5 mA</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>≤ 10 Hz</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-25 ... 60 °C (248 ... 333 K)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-25 ... 85 °C (248 ... 358 K)</td>
</tr>
<tr>
<td>Construction type</td>
<td>modular housing</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP30</td>
</tr>
<tr>
<td>Mounting</td>
<td>snap-on to 35 mm standard rail or screw fixing</td>
</tr>
<tr>
<td>Connection</td>
<td>self-opening apparatus connection terminals, max. conductor cross section 1 x 2.5 mm²</td>
</tr>
<tr>
<td>Dimensions</td>
<td>60 mm x 70 mm x 110 mm</td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 650 g</td>
</tr>
</tbody>
</table>

When using proximity switches (sensors) in pnp-technique (switched high), the connections 5 and 6 have to be bridged

When using proximity switches (sensors) in npn-technique (switched low), the connections 6 and 7 have to be bridged.

Mode of operation

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram of input energised" /></td>
<td><img src="image2" alt="Diagram of output energised" /></td>
</tr>
<tr>
<td><img src="image3" alt="Diagram of input de-energised" /></td>
<td><img src="image4" alt="Diagram of output de-energised" /></td>
</tr>
</tbody>
</table>
Electrical connection

Switching Input I Input II Input supply

Output I Output II Supply voltage

5 pnp 6 pnp 7 2 4 1+ 3-

11 12 10 14 15 13 16 17 ~ 18
### Technical Data

<table>
<thead>
<tr>
<th>Model number</th>
<th>KFA6-STR-1.24.500</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL/IEC 61508</td>
<td>No</td>
</tr>
<tr>
<td>Fault message output</td>
<td>No</td>
</tr>
<tr>
<td>Explosion protection</td>
<td>No Ex-protection</td>
</tr>
<tr>
<td>Connection</td>
<td>Terminals 14, 15</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>90 ... 253 V AC, 48 ... 63 Hz</td>
</tr>
<tr>
<td>Power loss</td>
<td>2.5 W</td>
</tr>
<tr>
<td>Number of channels</td>
<td>1</td>
</tr>
<tr>
<td>Connection</td>
<td>Power Rail or terminals 7+, 8-</td>
</tr>
<tr>
<td>Current</td>
<td>500 mA at 60 °C, permanent short-circuit protection (electronically)</td>
</tr>
<tr>
<td>Voltage</td>
<td>24 V ± 0.5 V</td>
</tr>
<tr>
<td>Power supply/Output</td>
<td>safe isolation acc. to DIN VDE 0106, rated insulation voltage 253 V_{eff}</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-20 ... 60 °C (253 ... 333 K)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP20</td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 140 g</td>
</tr>
</tbody>
</table>

### Function

The output voltage of the power supply is regulated and remains stable regardless of the size of the power supply and the load current.
Dimensions

KFA6-STR-1.24.500

Electrical connection

Power supply

Output

Power Rail

green

14

15

7+

8-

-286x-8
# Accessories

## Accessories Table

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kabeldosen</td>
<td>Ready-to-use and customisable</td>
<td>218</td>
</tr>
<tr>
<td>MH 04-3505</td>
<td>Mounting aid for series -FP sensors</td>
<td>223</td>
</tr>
<tr>
<td>MH 04-2681F</td>
<td>Mounting aid for series VarKont (+U1+ und +U9*) sensors</td>
<td>223</td>
</tr>
<tr>
<td>OMH 04</td>
<td>Mounting bracket for series -18GM sensors</td>
<td>224</td>
</tr>
<tr>
<td>MHW 11</td>
<td>Mounting bracket for series -FP und -F42 sensors</td>
<td>224</td>
</tr>
<tr>
<td>MH-UDB01</td>
<td>Rotatable mounting bracket for ultrasonic double sheet monitors</td>
<td>224</td>
</tr>
<tr>
<td>BF12, BF18, BF30</td>
<td>Mounting flanges for series -12GM, -18GM and -30GM sensors</td>
<td>225</td>
</tr>
<tr>
<td>M105</td>
<td>Mounting flanges for series -30GM sensors</td>
<td>226</td>
</tr>
<tr>
<td>BF18-F/BF30-F</td>
<td>Mounting flanges for series -18GM and -30GM sensors</td>
<td>226</td>
</tr>
<tr>
<td>PA02</td>
<td>Mounting flanges for series -FP sensors</td>
<td>227</td>
</tr>
<tr>
<td>BF 5-30</td>
<td>Universal mount for ø5 mm ... ø30 mm sensors</td>
<td>228</td>
</tr>
<tr>
<td>UVW90-K18 UVW90-K30</td>
<td>Redirection mirror for series -18GM and -30GM sensors</td>
<td>229</td>
</tr>
<tr>
<td>UVW90-M30</td>
<td>Focussing redirection mirror for series -30GM sensors</td>
<td>229</td>
</tr>
<tr>
<td>UC-30GM-TEMP</td>
<td>External temperature probe</td>
<td>230</td>
</tr>
<tr>
<td>LUC4-Z30-G2V LUC4-Z30-N2V</td>
<td>External temperature probe</td>
<td>230</td>
</tr>
<tr>
<td>FPI00</td>
<td>Remote potentiometer for through beam barrier UBE4000-30GM-SA2-V1</td>
<td>230</td>
</tr>
<tr>
<td>USB-0,8M-PVC ABG SUBD9</td>
<td>Interface adapter USB/RS 232</td>
<td>231</td>
</tr>
<tr>
<td>UC-F43-R2</td>
<td>RS 232 interface for series -F43 sensors</td>
<td>231</td>
</tr>
<tr>
<td>UC-30GM-R2</td>
<td>Interface cable for series -30GM sensors</td>
<td>232</td>
</tr>
<tr>
<td>UC-FP/U9-R2</td>
<td>Interface cable for series VarKont und -FP sensors</td>
<td>232</td>
</tr>
<tr>
<td>UC-30GM-PROG</td>
<td>Extension cable for the programming of UC...-30GM-... and LUC4T-... series sensors</td>
<td>232</td>
</tr>
<tr>
<td>UB-PROG2/UB-PROG3</td>
<td>Programming units for all UB...-sensors with -V15 connector, where the TEACH-input is at connector-pin 2 (UB-PROG2) or at connector-pin 5 (UB-PROG3).</td>
<td>233</td>
</tr>
<tr>
<td>ULTRA 2001</td>
<td>Service program for easy programming of ultrasonic sensors with RS 232 interfaces</td>
<td>234</td>
</tr>
</tbody>
</table>

**Date of edition:** 08/18/2005
### Accessories - cables, plugs, mating connectors

#### Non-pre-wired connectors in M8, M12, M18 and Rd24 x 1/8:

<table>
<thead>
<tr>
<th>Design</th>
<th>Order designation</th>
<th>Design</th>
<th>Connecting technique</th>
<th>Number of pins</th>
<th>Wire cross-section (mm²)</th>
<th>Fig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>M8</td>
<td>V3-GM</td>
<td>Socket, straight</td>
<td>Insulation piercing</td>
<td>3-pin</td>
<td>0.25 ... 0.34</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>V3-WM</td>
<td>Socket, angled</td>
<td>Insulation piercing</td>
<td>3-pin</td>
<td>0.25 ... 0.34</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>V3S-GM</td>
<td>Connector, straight</td>
<td>Insulation piercing</td>
<td>3-pin</td>
<td>0.25 ... 0.34</td>
<td>1</td>
</tr>
<tr>
<td>M12</td>
<td>V1-G 1)</td>
<td>Socket, straight</td>
<td>Screw terminal, PG7 cable gland</td>
<td>4-pin</td>
<td>max. 2.5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>V1-W 1)</td>
<td>Socket, angled</td>
<td>Screw terminal, PG7 cable gland</td>
<td>4-pin</td>
<td>max. 2.5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>V1S-G</td>
<td>Connector, straight</td>
<td>Insulation piercing</td>
<td>4-pin</td>
<td>max. 2.5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>V1S-W</td>
<td>Connector, angled</td>
<td>Insulation piercing</td>
<td>4-pin</td>
<td>max. 2.5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>V1-E-LED</td>
<td>LED board (npn)</td>
<td>suitable for mounting in V1-G and V1-W</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>V1-E2-LED</td>
<td>LED board (npn)</td>
<td>suitable for mounting in V1-G and V1-W</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>V1-G-Q2</td>
<td>Socket, straight</td>
<td>Insulation piercing</td>
<td>4-pin</td>
<td>0.24 ... 0.75</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>V1S-G-Q2</td>
<td>Connector, straight</td>
<td>Insulation piercing</td>
<td>4-pin</td>
<td>0.24 ... 0.75</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>V1-WV2A-PG9-Y42685 2)</td>
<td>Socket, angled</td>
<td>Screw terminal, PG7 cable gland</td>
<td>4-pin</td>
<td>max. 2.5</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>V15-PG9 1)</td>
<td>Socket, straight</td>
<td>Screw terminal, PG7 cable gland</td>
<td>5-pin</td>
<td>max. 0.75</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>V15-PG9 1)</td>
<td>Socket, straight</td>
<td>Screw terminal, PG7 cable gland</td>
<td>5-pin</td>
<td>max. 0.75</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>V15-WV2A-PG9-Y117132 2)</td>
<td>Socket, angled</td>
<td>Screw terminal, PG7 cable gland</td>
<td>5-pin</td>
<td>max. 0.75</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>V-W 1)</td>
<td>Socket with central screw, angled</td>
<td>Screw terminal, PG7 cable gland</td>
<td>5-pin</td>
<td>max. 2.5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>V-W-E2 1)</td>
<td>Socket with central screw, angled</td>
<td>Screw terminal, with integrated LED</td>
<td>5-pin</td>
<td>max. 2.5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>V-W-N</td>
<td>Socket with central screw, angled</td>
<td>Screw terminal, with integrated LED</td>
<td>5-pin</td>
<td>max. 2.5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>V7-W 1)</td>
<td>Socket with central screw, angled</td>
<td>Screw terminal, with integrated LED</td>
<td>7-pin</td>
<td>max. 2.5</td>
<td>6</td>
</tr>
</tbody>
</table>

1) not suitable for UC...-30GM...
2) suitable for UC...-30GM...

---

Fig. 1
Fig. 2
Fig. 31)  
Fig. 41)  
Fig. 5

Fig. 6
Fig. 72)
## Accessories - cables, plugs, mating connectors

### Technical data for connector with integrated cable

#### Connector and sockets

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of pins</td>
<td>2-, 3-, 4- or 5-pin</td>
</tr>
<tr>
<td>Locking</td>
<td>Screw locking</td>
</tr>
<tr>
<td>Self-locking</td>
<td>via O-ring in cap nut</td>
</tr>
<tr>
<td>Colour of handle</td>
<td>green</td>
</tr>
<tr>
<td>Material of handle</td>
<td>PUR</td>
</tr>
<tr>
<td>Material of contacts</td>
<td>CuSn/Au</td>
</tr>
<tr>
<td>Material of contact surface</td>
<td>Au</td>
</tr>
<tr>
<td>Material of cap nut</td>
<td>CuSn/Ni</td>
</tr>
<tr>
<td>Material of sealing ring</td>
<td>NBR</td>
</tr>
<tr>
<td>Protection class in accordance</td>
<td>IP68 in screwed state</td>
</tr>
<tr>
<td>with DIN 40050</td>
<td></td>
</tr>
<tr>
<td>Max. operating voltage</td>
<td>60 V DC or 250 V AC (for V13-...-types)</td>
</tr>
<tr>
<td>Max. operational current</td>
<td>4 A</td>
</tr>
<tr>
<td>Volume resistance</td>
<td>&lt; 5 mΩ</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>in acc. with VDE 0295</td>
</tr>
<tr>
<td>Test voltage</td>
<td>1500 Veff. AC, 50 Hz</td>
</tr>
</tbody>
</table>

#### Cable

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable structure</td>
<td>finely stranded, flexible</td>
</tr>
<tr>
<td>Wire cross-section</td>
<td>Cables for M12 connection: 0.34 mm² but NAMUR mating connectors: 0.50 mm² Cables for M8 connections: 0.25 mm²</td>
</tr>
<tr>
<td>Colour of sheath</td>
<td>grey</td>
</tr>
<tr>
<td>Temperature range for PVC</td>
<td>moving: -5 °C bis +70 °C non-moving: -30 °C bis +80 °C</td>
</tr>
<tr>
<td>Temperature range for PUR</td>
<td>moving: -5 °C bis +70 °C non-moving: -30 °C bis +105 °C</td>
</tr>
<tr>
<td>Minimum permissible bending</td>
<td>&gt; 10 x conductor diameter, appropriate for conveyor chains</td>
</tr>
<tr>
<td>radius</td>
<td></td>
</tr>
<tr>
<td>Sheath diameter</td>
<td>∅4.6 mm for M8 and ∅4.8 mm for M12, but ∅5.2 mm in 5-pin variant</td>
</tr>
<tr>
<td>Material of core insulation</td>
<td>PVC or in the case of halogen free cable synthetic material on polyester base</td>
</tr>
<tr>
<td>Core colours in acc. with VDE 293</td>
<td>2-pin: BN, BU 3-pin: BN, BU, BK 4-pin: BN, BU, BK, WH 5-pin: BN, BU, BK, WH, GY (GN/YE bei PE)</td>
</tr>
</tbody>
</table>

1) Please note reduced mechanical values for PUR cables at temperatures over +80 °C.
## Accessories - cables, plugs, mating connectors

### Core colours and connection assignment (EN 60947-5-2)

#### Colour assignment of ready-to-use cable sockets V1, V15, V3:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Colour</th>
<th>Abbrev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Brown</td>
<td>BN</td>
</tr>
<tr>
<td>2</td>
<td>White</td>
<td>WH</td>
</tr>
<tr>
<td>3</td>
<td>Blue</td>
<td>BU</td>
</tr>
<tr>
<td>4</td>
<td>Black</td>
<td>BK</td>
</tr>
<tr>
<td>5</td>
<td>Grey</td>
<td>GR</td>
</tr>
</tbody>
</table>

#### Colour assignment ready-to-use mating connectors V17, V7 and:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Colour</th>
<th>Abbrev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>White</td>
<td>WH</td>
</tr>
<tr>
<td>2</td>
<td>Brown</td>
<td>BN</td>
</tr>
<tr>
<td>3</td>
<td>Green</td>
<td>GN</td>
</tr>
<tr>
<td>4</td>
<td>Yellow</td>
<td>YW</td>
</tr>
<tr>
<td>5</td>
<td>Grey</td>
<td>GR</td>
</tr>
<tr>
<td>6</td>
<td>Pink</td>
<td>PK</td>
</tr>
<tr>
<td>7</td>
<td>Blue</td>
<td>BU</td>
</tr>
<tr>
<td>8</td>
<td>None (screening)</td>
<td></td>
</tr>
</tbody>
</table>

#### Mating connectors M8 type with metal cap nut

**Suitable for sensors with 2, 3 or 4 wires**

<table>
<thead>
<tr>
<th>Cable-sheath</th>
<th>Length (m)</th>
<th>No. of wires</th>
<th>Ø (mm²)</th>
<th>Design straight</th>
<th>Design angled with 2 LEDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUR, grey</td>
<td>2</td>
<td>3</td>
<td>0.25</td>
<td>V3-GM-5M-PUR</td>
<td>V3-WM-E2-2M-PUR</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>3</td>
<td>0.25</td>
<td>V3-GM-5M-PUR</td>
<td>V3-WM-E2-5M-PUR</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>3</td>
<td>0.25</td>
<td>V3-GM-10M-PUR</td>
<td>V3-WM-E2-10M-PUR</td>
</tr>
<tr>
<td>PVC, grey</td>
<td>2</td>
<td>3</td>
<td>0.25</td>
<td>V3-GM-2M-PVC</td>
<td>V3-WM-2M-PVC</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>3</td>
<td>0.25</td>
<td>V3-GM-5M-PVC</td>
<td>V3-WM-5M-PVC</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>3</td>
<td>0.25</td>
<td>V3-GM-10M-PVC</td>
<td>V3-WM-10M-PVC</td>
</tr>
<tr>
<td>PUR, grey</td>
<td>2</td>
<td>4</td>
<td>0.25</td>
<td>V31-... mating connectors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4</td>
<td>0.25</td>
<td>V31-GM-5M-PUR</td>
<td>V31-WM-5M-PUR</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>4</td>
<td>0.25</td>
<td>V31-... mating connectors</td>
<td></td>
</tr>
<tr>
<td>PVC, grey</td>
<td>2</td>
<td>4</td>
<td>0.25</td>
<td>V31-GM-2M-PVC</td>
<td>V31-WM-2M-PVC</td>
</tr>
</tbody>
</table>

1) M8 mating connectors with twist connect on demand.
## Accessories - cables, plugs, mating connectors

### Cable connectors in M12 design for DC sensors

<table>
<thead>
<tr>
<th>Cable-sheath</th>
<th>Length</th>
<th>No. of wires</th>
<th>Ø (mm²)</th>
<th>Design straight</th>
<th>Design angled</th>
<th>Design angled with 2 LEDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC, grey</td>
<td>2 m</td>
<td>4</td>
<td>0,34</td>
<td>V1-G-2M-PVC</td>
<td>V1-W-2M-PVC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 m</td>
<td>4</td>
<td>0,34</td>
<td>V1-G-5M-PVC</td>
<td>V1-W-5M-PVC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 m</td>
<td>4</td>
<td>0,34</td>
<td>V1-G-10M-PVC</td>
<td>V1-W-10M-PVC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 m</td>
<td>4</td>
<td>0,34</td>
<td>V1-G-2M-PUR</td>
<td>V1-W-2M-PUR</td>
<td>V1-W-A2-2M-PUR</td>
</tr>
<tr>
<td>PUR, grey</td>
<td>5 m</td>
<td>4</td>
<td>0,34</td>
<td>V1-G-5M-PUR</td>
<td>V1-W-5M-PUR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 m</td>
<td>4</td>
<td>0,34</td>
<td>V1-G-10M-PUR</td>
<td>V1-W-10M-PUR</td>
<td>V1-W-A2-10M-PUR</td>
</tr>
<tr>
<td>PVC, grey</td>
<td>2 m</td>
<td>3</td>
<td>0,34</td>
<td>V15-... mating connectors</td>
<td>V1-W-E2-2M-PUR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 m</td>
<td>3</td>
<td>0,34</td>
<td>V15-G-5M-PVC</td>
<td>V15-W-5M-PVC</td>
<td>V15-W-E-5M-PUR</td>
</tr>
<tr>
<td></td>
<td>10 m</td>
<td>3</td>
<td>0,34</td>
<td>V15-G-10M-PVC</td>
<td>V15-W-10M-PVC</td>
<td>V15-W-E2-10M-PUR</td>
</tr>
<tr>
<td>PUR, grey</td>
<td>2 m</td>
<td>5</td>
<td>0,34</td>
<td>V15-G-2M-PVC</td>
<td>V15-W-2M-PVC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 m</td>
<td>5</td>
<td>0,34</td>
<td>V15-G-5M-PVC</td>
<td>V15-W-5M-PVC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 m</td>
<td>5</td>
<td>0,34</td>
<td>V15-G-10M-PVC</td>
<td>V15-W-10M-PVC</td>
<td></td>
</tr>
<tr>
<td>PUR, grey screened</td>
<td>2 m</td>
<td>7</td>
<td>0,25</td>
<td>V17-G-2M-PUR</td>
<td>V15-W-2M-PUR</td>
<td>V15-W-2M-PUR</td>
</tr>
<tr>
<td></td>
<td>5 m</td>
<td>7</td>
<td>0,25</td>
<td>V17-G-5M-PUR</td>
<td>V15-W-5M-PUR</td>
<td>V15-W-5M-PUR</td>
</tr>
</tbody>
</table>

### Mating connectors in M12 design with cross-braided lead

<table>
<thead>
<tr>
<th>Cable-sheath</th>
<th>Length</th>
<th>No. of wires</th>
<th>Ø (mm²)</th>
<th>Design straight</th>
<th>Design angled</th>
<th>Design angled with 2 LEDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUR, halogen free, cross-braided, orange</td>
<td>2 m</td>
<td>4</td>
<td>0,34</td>
<td>V1-G-2M-PUR H/S</td>
<td>V1-W-2M-PUR H/S</td>
<td>V1-W-A2-2M-PUR H/S</td>
</tr>
<tr>
<td></td>
<td>5 m</td>
<td>4</td>
<td>0,34</td>
<td>V1-G-5M-PUR H/S</td>
<td>V1-W-5M-PUR H/S</td>
<td>V1-W-A2-2M-PUR H/S</td>
</tr>
</tbody>
</table>
Mating connectors 7/8''-16 UN 2A for AC sensors in series F42 (UB...F42(S)-UK-V95)

Pin out/wire colours

<table>
<thead>
<tr>
<th>Cable sheath</th>
<th>Length</th>
<th>Number of wires</th>
<th>Ø (mm²)</th>
<th>Design straight</th>
<th>Design angled</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC</td>
<td>2 m</td>
<td>5</td>
<td>0,75</td>
<td>upon request</td>
<td>V95-W-2M-PVC</td>
</tr>
</tbody>
</table>

Type code mating connectors

V1 - W - E2 - 2M - PVC

Cable material
- PVC
- PUR
- PUR H/S, halogen free cross-braided
- PUR S/PE cross-braided, with PE

Cable length
- 2.2 m
- 5 m
- additional length on demand

with/without LED
- E2 (for 3-wire pnp), 2 LEDs
- E0 (for 3-wire npn), 2 LEDs
- E2/E3 (contact 2 + 4 link), 2 LEDs
- A0 (for 4-wire npn), 2 LEDs
- A2 (for 4-wire pnp), 2 LEDs
- no designation = without LED

Design
- W angled
- G straight
- WM angled with cap nut
- WR angled with twist connect
- GR straight with twist connect

Connection method
- V1 M12 x 1, 4-pin, DC
- V1S M12 x 1, 4-pin, DC, connector
- V13 M12 x 1, 3-pin, AC
- V15 M12 x 1, 5-pin, DC
- V15S M12 x 1, 5-pin, DC, connector
- V16 Rd24 x 1/8, 7-pin, AC/DC
- V16S Rd24 x 1/8, 7-pin, AC/DC, connector
- V17 M12 x 1 7-pin, DC
- V18 M18 x 1, 4-pin, AC/DC
- V3 M8 x 1, 3-pin, DC
- V3S M8 x 1, 3-pin, DC, connector
- V31 M8 x 1, 4-pin, DC
- V31S M8 x 1, 4-pin, DC, connector
- V7 Amphenol-Tuchel C164 639F 7S22
- V95 7/8''-16 UN 2A, 4-pin, AC
- V with central screwed connection, 4-pin
### Accessories - mounting aids

#### MH 04-3505

Mounting accessory for the simple adjustment of -FP and -F42 series sensors

The type 04-3505 mounting accessory simplifies the adjustment of ultrasonic sensors of the -FP and -F42 series. It permits the completely installed and wired sensor to be swiveled by up to ±30° in 2 orthogonal axes. The sensor is locked in the desired position by tightening the mounting screws.

#### MH 04-2681F

Mounting accessory for the simple adjustment of VariKont® series sensors

Height in two-point installation approx. 28 mm

For ultrasound sensors (VariKont®, +U9+ series) compliant with DIN 43694, EN 50025 oder EN 50037.

The simple mounting is performed with traditional C-profile rails\(^1\) as in EN 50024 (15 x 30 x 1.5). For existing systems, the mounting accessories will also fit on C-rails\(^1\) that comply with the obsolete DIN 43662 standard (15 x 30 x 2). Generous scope for adjustment in the x and y directions and 360° rotation simplify and speed up installation and adjustment work. The adjustment of the sensor in the selected position is performed using the switch mounting screws (included). Provision has also been made for two-point mounting as an alternative to the C-rail. The required holes can be accessed through the central guide slot. M5 x 16 mm screws may be used for mounting.

### Technical data:

<table>
<thead>
<tr>
<th>Material</th>
<th>Injection molded zinc, chromated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible shock and</td>
<td>b &lt; 30 g, T &lt; 11 ms</td>
</tr>
<tr>
<td>Vibration loads</td>
<td>f &lt; 55 Hz, a &lt; 1 mm</td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 270 g</td>
</tr>
<tr>
<td></td>
<td>as per IEC 68-2-6 and IEC 68-2-27</td>
</tr>
</tbody>
</table>

\(^1\)Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com
## Accessories - mounting aids

### OMH 04

Universal mounting for all cylindrical ø18 mm sensors

**Material**
- Angle: sheet steel, galvanised
- Locking disc: sheet steel, galvanised
- Locking profile: aluminium, diecast

For installation on ø12 mm round rod or sheet material (thickness 1.5 mm ... 3 mm). Suitable for -18GM series sensors.

### MHW 11

Mounting angle for -FP and -F42 series sensors

**Material**: Stainless steel

### MH-UDB01

Rotatable mounting angle with angle scale for ultrasonic double-sheet monitors.

**Material**: Stainless steel
## Accessories - mounting aids

### Mounting flange with tumble mechanism

For sensors with an M18 threaded housing

- Rotation range: 360°
- Swing range: 10°

*(Delivery of mounting flange does not include sensor)*

### Universal mounting brackets with transparent upper part for all cylindrical sensors with ø12 mm, ø18 mm, or ø30 mm.

*Material: PBT*

<table>
<thead>
<tr>
<th>BF12</th>
<th>BF18</th>
<th>BF30</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>36</td>
<td>19</td>
</tr>
<tr>
<td>30</td>
<td>44</td>
<td>23</td>
</tr>
<tr>
<td>40</td>
<td>56</td>
<td>34</td>
</tr>
</tbody>
</table>

* Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com*
**Accessories - mounting aids**

**M105**

Universal mounting for cylindrical sensors with ø30 mm for sensors with front-end thread (UB/UC300. -500 and -2000.

- Secure mounting
- Easy installation
- Robust design
- Chemical-resistant

Material: PTFE

(Delivery of mounting asseccories does not include sensor)

**BF18-F**

**BF30-F**

Universal mounting for all cylindrical sensors with ø18/ø30 mm

- The flange is mounted using the oblong holes, the adjustment range is 8 mm at maximum.
- Suitable screws for installation of the mounting flange: M4
Mounting flange for all block type -FP series sensors

- Secure mounting
- Easy installation
- Robust design

(Delivery of mounting flange does not include sensor)

**Nut M12K-VE**
**Nut M18K-VE**
**Nut M30K-VE**

Plastic nuts with centering ring for vibration decoupled installation of cylindrical sensors with diameters of 12 mm, 18 mm and 30 mm.

These nuts should be used in applications, where the sensor is fixed at the front third of the housing, when ambient temperatures of < 0 °C can occur.

Material: PA
Packaging unit: 1 pair
Universal mounting for all cylindrical sensors with ø5 mm ... ø30 mm

- Secure mounting
- Easy installation
- Flexible 360° adjustment of measuring head and base
- Robust design

The BF 5-30 mounting flange is supplied with two mounting heads (ø18 mm, ø30 mm) and 4 sleeves (ø5 mm, ø8 mm, ø12 mm, ø14 mm).
Sound deflector for cylindrical -18GM and -30GM series ultrasonic sensors.

- Clamp mounting
- 90° sound deflection for difficult installation circumstances
- Universal installation position

On the underside of the slope the sound deflector has a hole over the complete width. Falling particle of dust can not congregate in the focusing attachment. The function is also guaranteed in dusty environment.

Material: PMMA

Focusing attachment for cylindrical -30GM series ultrasonic sensors.

- Universal installation options
- 90° sound deflection for difficult installation circumstances
- Universal installation position
- Focusing effect
- Detection range increase (through focusing)
  - approx. 40% with UB/UC500 (with dimension L = 10 mm)
  - approx. 20% with UB/UC2000 (with dimension L = 35 mm ± 5 mm)

Material: Stainless steel
**Accessories - external temperature probes, remote potentiometers**

**UC-30GM-TEMP**

External temperature probe

- For ultrasonic sensors of the UC-...-30GM-... and LUC4T-... series
- 8 mm plug connector
- Single-hole mounting with position locking

The external UC-30GM-TEMP temperature probe may be connected to ultrasonic sensors of the UC-...-30GM-... and LUC4T-... series as an alternative to the supplied temperature plug.

The use of the UC-30GM-TEMP permits the ambient temperature of the measuring area to be monitored independently of the installation conditions of the sensor in order to minimise temperature influences as effectively as possible.

**LUC4-Z30-G2V**

External temperature probe

- For ultrasonic level sensors of the LUC4T-... and UC-...-30GM-... series
- 8 mm plug connector
- Single-hole mounting in thread: G½A (LUC4-Z30-G2V) ½NPT (LUC4-Z30-N2V).

The external LUC4-Z30-G2V (with G½A thread) or LUC4-Z30-N2V (with ½NPT thread) temperature probes may be connected to ultrasonic sensors of the LUC4T-... and UC-...-30GM-... series as an alternative to the supplied temperature plug.

The use of the LUC4-Z30-... permits the ambient temperature of the measuring area to be monitored independently of the installation conditions of the sensor in order to minimise temperature influences as effectively as possible.

**FP100**

Remote potentiometer

Potentiometer for the adjustment of the sensing range of ultrasonic through-beam sensor UBE4000-30GM-SA2-V15.

The potentiometer connection occurs on the transmitter.
Modern notebooks and PCs are often not equipped with a standard RS 232 serial interface.

Anyhow, to allow the use of the multiple functions of the service program ULTRA 2001, the interface adapter USB-0,8M-PVC ABG-SUBD9 offers a simple solution.

The interface adapter USB-0,8M-PVC ABG-SUBD9 provides a RS 232 serial interface at a free USB port.

It can be connected to the USB port either directly or via the 800 mm USB cord, which is included in scope of delivery.

Our interface cables can be connected to the 9 pin SUB-D connector in the accustomed way.

RS 232 interface

- For the sensors UC300-F43-2KIR2-V17 and UC2000-F43-2KIR2-V17.
- Simple insertion in the sensor connection lead.

The unit can be switched from the V17 cable connection socket and the V17 plug connection on the sensor for the TEACH-IN procedure.

The parameterised functions are retained when the programming unit is removed and/or the power is switched off.
### Accessories - programming aids

#### UC-30GM-R2

Interface cable

The UC-30GM-R2 interface cable enables the parameterisation of ultrasonic sensors of types UC...-30GM-...R2-V15 using the ULTRA 2001 service software. The cable creates a connection between the PC-internal RS 232 interface and the connector of the temperature/programming plug on the sensor.

#### UC-FP/U9-R2

Interface cable

The UC-FP/U9-R2 interface cable enables the parameterisation of VariKont® and FP series ultrasound sensors using the ULTRA 2001 service software. The cable creates a connection between the PC-internal RS 232 interface and the interface connections in the terminal space of the sensor.

#### UC-30GM-PROG

Extension cable

The UC-30GM-PROG extension cable permits sensors of the UC...-30GM-... and LUC... series to be taught-in at inaccessible installation locations. The sensor-side end of the extension cable is connected to the sensor's temperature plug socket. The sensor can be programmed with the temperature plug at the other end of the cable.
Programming device

- For ultrasonic sensors series

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Feature</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB00</td>
<td>-12GM</td>
<td>-E4</td>
</tr>
<tr>
<td>USB400</td>
<td>-18GM40</td>
<td>-E5</td>
</tr>
<tr>
<td>USB500</td>
<td>-18GM75</td>
<td>-E7</td>
</tr>
<tr>
<td>USB800</td>
<td>-30GM</td>
<td>-I</td>
</tr>
<tr>
<td>USB1000</td>
<td>F42(S)</td>
<td>-U</td>
</tr>
<tr>
<td>USB2000</td>
<td>F42</td>
<td></td>
</tr>
<tr>
<td>USB4000</td>
<td>F54</td>
<td></td>
</tr>
<tr>
<td>USB6000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- whose teach-in input is on pin 2.

- Simple TEACH-IN of the switching distances A1/A2 or the measuring window.

- Simple selection of the output function:
  - Window mode, normally open/normally closed function.
  - One switching distance, normally open/normally closed function.
  - Monitoring of the detection range.

The unit can be switched from the V15 cable connection socket and the V15 plug connection on the sensor for the TEACH-IN procedure.

The switching distances/measuring window and output function can be taught in using the A1 and A2 buttons.

The taught-in switching distances and functions are retained when the programming unit is removed and/or the power is switched off.
ULTRA 2001

Service software

- WINDOWS™ user interface with up to 5 independent windows.
- For all ultrasonic sensors with RS 232 interfaces.
- Convenient parameterisation of all relevant sensor functions such as:
  - Evaluation process
  - Switching behaviour
  - Switching distances
  - Analogue output
  - Measuring window
  - Filter functions
  - Fault management
  - etc.

  to adapt the sensor optimally to its specific application.

- Logging functions for sensor parameter settings and recorded series of measurements.

Software and manual as free download:

http://www.pepperl-fuchs.com

Procedure:

- Select your product, which can be parameterised by ULTRA 2001 at our „Products“ page.
- Click on "1830288.zip" in the „Further documents“ section.
- Save and unpack the file on your local drive.

Use the appropriate interface or interface cable for communication between PC and sensor (see page 231)

Why use PC software for parameterisation?

Commands and parameters can be transferred to sensors via an RS 232 interface, if present. These commands can be used to output measured values, configure the evaluation process, switching outputs and/or analogue output, set and query parameters and control the general unit functions. This provides the user with an aid in adapting the sensor optimally to its specific application and visualising parameters or measured results.

Parameterisable sensors

Series: sensor types:
-30GM UC...-30GM-.R2-V15 VariKont® UC..+U9+E6/E7+R2 and UC..+U9+IUE0/E2+R2
-UJ3000+U1+...+RS
-FP UC6000-FP...-R2-P5 and UJ6000-FP...+RS
-F34 UC...-F34-2KIR2-V17

Brief description

The program features a multilingual, menu-based user interface with comprehensive help. It supports up to 5 independent windows. The windows can be displayed or hidden, and their size and position on the screen can be adjusted as required. The size and position of the windows is retained by the program.

Show It: Graphical display of the measured distance. The set switching distances are marked. Simulated LEDs display the switching states of the outputs.

Parameters: All parameters are editable here. Display and input fields permit commands or parameters to be changed at the click of the mouse without detailed knowledge of the relevant commands or their syntax.

Send command: Sensor parameters are set and queried here in the same manner as with a terminal program (alternative to the parameterisation window).

Port Monitor: Display of commands sent to the sensor and received by it.

Distance: Display of the currently measured distance in mm.

The program and sensor parameters read out by the program can be saved to the hard drive or a diskette. Measurement series can be started, the measurement data queried periodically and output to a printer or saved to the hard drive/diskette.

System requirements

The Ultra 2001 application will run on any PC or laptop. Windows 95/98/ME/NT4/2000 or XP, an EGA or VGA graphic boards and a free RS 232 interface are required.
Additional information

Standards

The proximity switches of Pepperl+Fuchs GmbH are developed and manufactured consistently according to applicable standards. Moreover, draft standards are taken into account during new development, redesign, and changes to existing products.

German standards

DIN VDE 0660 Part 208
Low-voltage switching devices, auxiliary power switches, supplement on inductive proximity switches

DIN VDE 0660 Part 209
Switching devices, low-voltage switching devices, supplement on contact-free position switches for safety applications

DIN VDE 0660 Part 212 (replaces DIN 19234)
Measurement, regulation, control - Electrical path sensors - DC interface for path sensors and switching amplifiers

European standards

EN 60947-5-2 Low-voltage switching devices
Part 5: Control devices and switching elements, main section 2: Proximity switches

EN 60947-5-6 Control devices and switching elements, proximity sensors - DC interface for proximity sensors and switching amplifiers (NAMUR)

International standards

IEC 60947-5-2 Low-voltage switching devices and control devices, Part 5 Control circuit devices and switching elements - Section 2, proximity switches

Draft IEC 61934 Control circuit devices and switching elements DC interface for proximity sensors and switching amplifiers (NAMUR)

Standards for electromagnetic compatibility

EN 50081 Basic technical standard for radiation interference
Part 1, Residential areas
Part 2, Industrial areas

EN 50082 Basic technical standard for interference resistance
Part 1, Residential areas
Part 2, Industrial areas

EN 61000-4 EMC, testing and measurement procedures
Parts 2, 3, 4, 5, and 6

Standards for explosion protection

DIN EN 50014 Electrical equipment for hazardous areas
General requirements

DIN EN 50020 Electrical equipment for explosion hazardous areas
Intrinsic safety "i"

EN 60079-10 Electrical equipment for gas explosion hazardous areas
Classification of hazardous areas

EN 60079-14 Electrical equipment for gas explosion hazardous areas
Electrical systems in explosion hazardous areas (excluding excavations)

Quality assurance standards

DIN ISO 9000-9004 EN 29000-29 004) Quality assurance (QA) for products and services

DIN ISO 9001 QA from development to production, installation, and customer service

Pepperl+Fuchs GmbH is DIN ISO 9001-certified.
The CE logo

The CE logo is a declaration by the manufacturer that the so designated product conforms to the European standards and directives that are applicable to the product. The following directives are applicable to Pepperl+Fuchs products:

89/336/EEC    EMC directive (EN 60 947-5-2)
73/23/EEC     Low-voltage directive (cf. VDE 0160, product standard EN 60947-5-2)

Directive 94/9/EC  Equipment and protective systems intended for use in potentially explosive atmospheres

Pepperl+Fuchs GmbH certifies the conformance of their products with applicable directives in a manufacturer declaration.

ALPHA

Pepperl+Fuchs GmbH is a member of ALPHA, an association for the testing and certification of low-voltage devices, e. V. This association promotes individual responsibility on the part of manufacturers of such devices through unified testing guidelines compliant with applicable standards, and thus supports high product quality. Through ALPHA’s membership in LOVAG (Low Voltage Agreement Group), government-recognised product certifications issued by ALPHA under certain conditions are also recognised in other European countries.

Resistance of our housing materials to chemical substances

The following tabular listing of the chemical resistances of our housing materials gives some indications for the application of our sensors in aggressive environmental conditions (next page).
## Chemical resistance

<table>
<thead>
<tr>
<th>Chemically resistant to</th>
<th>V2A</th>
<th>ABS</th>
<th>Epoxy</th>
<th>PBT</th>
<th>PC</th>
<th>POM</th>
<th>PP</th>
<th>PPS</th>
<th>PS</th>
<th>PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Formic acid</td>
<td>20 °C</td>
<td>40%</td>
<td>+</td>
<td>10%</td>
<td>-</td>
<td>-</td>
<td>85%</td>
<td>O</td>
<td>40%</td>
<td>50%</td>
</tr>
<tr>
<td>Ammonia</td>
<td>+</td>
<td>25%</td>
<td>O</td>
<td>10%</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>O</td>
</tr>
<tr>
<td>Petrol</td>
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<td>+</td>
<td>+</td>
<td>O</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>O</td>
</tr>
<tr>
<td>Benzene</td>
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<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Brake fluid</td>
<td>+</td>
<td>O</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Butane</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Butanol</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Calcium chloride</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>10%</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>60 °C</td>
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<tr>
<td>Chlorobenzene</td>
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<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Diesel oil</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>O</td>
<td>+</td>
<td>60 °C</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Acetic acid</td>
<td>20 °C</td>
<td>25%</td>
<td>O</td>
<td>+</td>
<td>10%</td>
<td>10%</td>
<td>70%</td>
<td>+</td>
<td>50%</td>
<td>40 °C</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>+</td>
<td>30%</td>
<td>50%</td>
<td>30%</td>
<td>-</td>
<td>+</td>
<td>40%</td>
<td>37%</td>
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<td>Frigene 113</td>
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</tr>
<tr>
<td>Fruit juice</td>
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<td>+</td>
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<td>Glycerine</td>
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<td>+</td>
<td>+</td>
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<td>O</td>
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<td>Hydraulic oil</td>
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<td>+</td>
<td>+</td>
<td>O</td>
<td>60 °C</td>
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</tr>
<tr>
<td>Caustic potash</td>
<td>-</td>
<td>50%</td>
<td>O</td>
<td>3%</td>
<td>-</td>
<td>+</td>
<td>50%</td>
<td>-</td>
<td>50%</td>
<td>60 °C</td>
</tr>
<tr>
<td>Potassium chloride</td>
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<td>60 °C</td>
</tr>
<tr>
<td>Potassium hydroxide</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
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<td>-</td>
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<td>Linseed oil</td>
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<td>+</td>
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<td>-</td>
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<td>O</td>
<td>+</td>
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<td>+</td>
<td>+</td>
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<td>+</td>
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<td>+</td>
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<td>+</td>
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<tr>
<td>Sodium chloride</td>
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<td>-</td>
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<td>+</td>
<td>-</td>
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<td>3%</td>
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<td>+</td>
<td>-</td>
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<td>+</td>
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<td>-</td>
<td>25%</td>
<td>-</td>
<td>10%</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
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<td>10%</td>
<td>20%</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>10%</td>
<td>O</td>
</tr>
<tr>
<td>Lubricating oil</td>
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<td>+</td>
<td>+</td>
<td>O/+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Carbon disulphide</td>
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<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>O</td>
<td>-</td>
</tr>
<tr>
<td>Sulphuric acid</td>
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<td>-</td>
<td>28%</td>
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<td>80%</td>
<td>50%</td>
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<td>70%</td>
</tr>
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<td>Sea water (cold)</td>
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<td>-</td>
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<td>+</td>
<td>+</td>
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<td>+</td>
</tr>
<tr>
<td>Seifenlaugse</td>
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<td>-</td>
<td>O</td>
<td>+</td>
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<td>+</td>
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</tr>
<tr>
<td>Detergent</td>
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<td>-</td>
<td>-</td>
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<td>+</td>
<td>-</td>
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<td>Turpentine</td>
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<td>O</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
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<td>-</td>
<td>-</td>
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<td>O</td>
</tr>
<tr>
<td>Toluene</td>
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<td>-</td>
<td>+</td>
<td>+</td>
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</tr>
<tr>
<td>Trichlorethylene</td>
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<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>O</td>
<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>Water</td>
<td>+</td>
<td>+</td>
<td>68 °C</td>
<td>68 °C</td>
<td>+</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>60 °C</td>
</tr>
<tr>
<td>Tartaric acid</td>
<td>20 °C</td>
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<td>+</td>
<td>-</td>
<td>+</td>
<td>10%</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>60 °C</td>
</tr>
<tr>
<td>Xylene</td>
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<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Zinc sulphate</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Citric acid</td>
<td>20 °C</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>10%</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

**Legend:**

+: resistant / O: resistant under some conditions / -: not resistant / ?: unknown

..°C: resistant up to .. °C / ..%: resistant up to a ..% solution
## Protective enclosures

(DIN VDE 0470 Part 1, EN 60529)

### Degree of protection against contact and foreign bodies

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Not protected</td>
</tr>
</tbody>
</table>
| 1    | Protected against contact with hazardous components with the backs of the hand  
- Protected against solid foreign bodies with a size and diameter of 50 mm and above |
| 2    | Protected against contact with hazardous components with fingers  
- Protected against solid foreign bodies with a size and diameter of 12.5 and above |
| 3    | Protected against contact with hazardous components with a tool  
- Protected against solid foreign bodies with a size and diameter of 2.5 mm and above |
| 4    | Protected against contact with hazardous components with a wire  
- Protected against solid foreign bodies with a size and diameter of 1.0 mm and above |
| 5    | Protected against contact with hazardous components with a wire  
- Dustproof |
| 6    | Protected against contact with hazardous components with a wire  
- Protected against dust |
| 7    | Protected against contact with hazardous components with a wire  
- Protected against temporary submersion in water |
| 8    | Protected against contact with hazardous components with a wire  
- Protected against continuous submersion in water |
| 9    | Protected against contact with hazardous components with a wire  
- Protected against water in high-pressure/steam-jet cleaning operations |

### Degree of protection against water

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Not protected</td>
</tr>
<tr>
<td>1</td>
<td>Protected against dripping water</td>
</tr>
<tr>
<td>2</td>
<td>Protected against dripping water when housing is tilted up to 15°</td>
</tr>
<tr>
<td>3</td>
<td>Protected against sprayed water</td>
</tr>
<tr>
<td>4</td>
<td>Protected against splash water</td>
</tr>
<tr>
<td>5</td>
<td>Protected against water jets</td>
</tr>
<tr>
<td>6</td>
<td>Protected against strong water jets</td>
</tr>
<tr>
<td>7</td>
<td>Protected against temporary submersion in water</td>
</tr>
<tr>
<td>8</td>
<td>Protected against continuous submersion in water</td>
</tr>
<tr>
<td>9</td>
<td>Protected against water in high-pressure/steam-jet cleaning operations</td>
</tr>
</tbody>
</table>

### Notes:

Wherever a code number is not required, the letter "X" must be used in its place.

Devices identified with a second digit 7 or 8 do not have to fulfil the requirements of the second digits 5 or 6 unless they have a double identification (e.g. IPX6/IPX7).
Additional information

**Glossary**

**ABS**  
Acrylonitrile butadiene styrol

**Accuracy of measurement**  
Maximum value of the deviation from the ideal characteristic. This is given for sensors used for distance measurement and is based on the maximum measuring range.

**Actuation direction**  
The objects can enter the sound beam from any arbitrary direction. All catalogue data on switching points relates to objects approaching the sensor along its axis.

**Adjustment accessories**  
⇒ Mounting accessories

**Adjustment range**  
The range within which the switching point of a sensor can be set.

**Air pressure**  
During normal atmospheric variation, (+5%) the speed of sound varies by about ±0.6% in a fixed location. The resulting changes in switching distances can normally be ignored.

**Ambient conditions**  
Pepperl+Fuchs ultrasonic sensor operate unaffected by dust, mist, rain, snow and audible sound. Deposits on the faces of the sensors are normally prevented by the self-cleaning effect of the oscillating decoupling layer.

**Ambient temperature**  
According to the applicable standards, ultrasonic sensors must be operational at temperatures from -25 °C to +70 °C. This corresponds to the standard temperature range of Pepperl+Fuchs sensors. The values appropriate to specific equipment are given on the relevant data sheet.

**Alarm**  
⇒ Temperature compensation

**Blind range**  
⇒ "Usable area" section

**Cable length**  
Cables of up to 300 m length can be used for sensors with internal evaluation. A maximum length of 100 m can be used if the cable is used for communication via the RS 232 interface. The cable should be shielded in the event of high interference levels. In the case of sensors without evaluation (H1/2/3 sensors), the cable length should not exceed 50 m.

**CE symbol**  
The CE symbol is a declaration by the manufacturer, that the so designated product conforms to the European and international standards and directives that are applicable to the product. The following standards and directives are applicable to Pepperl+Fuchs products:

- 89/336/EEC EMC-directive (see also IEC 801)  
- 73/23/EEC Low voltage directive (see VDE 0160, EN 60 947-5-2)  
- 94/9/EC Devices and protection systems for hazardous areas

**Concentration**  
The sound cone has an opening angle of approx. 5° at a sound pressure level of -6 dB. Further concentration of the ultrasonics, e.g. by placing a tube in front of the transducer, is not possible.

**Detectable object**  
⇒ Standard measuring plate

**Detection width hysteresis**  
This denotes the separation of the switching points between lateral approach and removal of the measuring plate, i.e. between approach and removal at right angles to the reference axis.

**Deviation of characteristic curve**
⇒ Accuracy of measurement

**Diffuse reflection**
⇒ Reflection

**EMC classification**  
Electromagnetic compatibility is the ability of an electrical device to function satisfactorily in an electromagnetic environment, without interfering with other devices and without receiving interference itself. The EMC classification is obtained from tests for emission and resistance to interference in various test gradings. Grade 3, for example, corresponds to a normal industrial environment.

(see EN 60947-5-2 Annex X).

**Fault indicator** (alarm)
Many ultrasonic sensors from Pepperl+Fuchs are equipped with a red LED to indicate faults. Faults are generally due to the incorrect adjustment of the sensor or excessive levels of interference. These are then indicated by the flashing red LED. In case of a fault, the last valid output state is "frozen". Output states remain in effect until the fault is corrected and the sensor is returned to normal operation.

**Humidity**  
The velocity of sound increases by 2% from dry to saturated air. As a result, switching distances decrease by a maximum of 2%. This can be disregarded under normal circumstances.

**Hysteresis**  
⇒ Range hysteresis  
⇒ Detection width hysteresis

**Impulse relay function**  
Time function for switching outputs in which an output pulse of a specified length is generated which is not affected by the length of the switching event.
⇒ Timer function


Additional information

Interference, mutual

Ultrasonic sensors operating simultaneously with overlapping detection areas may interfere with one another. For this reason, minimum distances between the sensors must be maintained.

- If the sensors are transmitting in the same direction, the lateral safety distance corresponds to around half the sensing range.
- In the case of opposed sensors, the distance should amount to slightly more than the sum of the sensors' sensing ranges.

The use of synchronisable sensors is recommended if these safety distances cannot be maintained.

Light emitting diodes

Pepperl+Fuchs' ultrasonic sensors are equipped with LEDs to signal a variety of states.

Please refer to the appropriate data sheets for the significance of the individual LEDs.

Linearity

⇒ Accuracy of measurement

Measuring output

Absolute: The measuring output indicates the distance of the object from the face of the sensor in millimeters. The output is either analogue (4 mA...20 mA, or 0 V ... 10 V) or digital (parallel 8-bit or serial RS232).

Relative: The measuring output gives the position of the object within the window area (A1/A2 or lower limit/upper limit).

Measuring range

Evaluation range of measuring sensors. The starting value of the measuring range is determined by the "lower limit" the end value by the "far limit" of the sensor.

Mounting accessories

The catalogue lists mounting brackets and angles for use with sensors, which can be adjusted relative to each other. These items simplify adjustment and alignment of the sensors.

No load power consumption

This is the power consumption of the sensor itself under no-load conditions.

Normally closed

If the sensor does not detect an object, then the output is energised. When an object is detected it is de-energised (normally closed, n.c.).

Normally open

If the sensor does not detect an object, then the output is de-energised. When an object is detected it is energised (normally open, n.o.).

Objects

The specification of a sensing range is normally based on a flat standard measuring plate measuring 100 x 100 mm which is positioned at right angles to the sensor axis. The sensing ranges for sensors for very small distances are sometimes based on smaller plates (see data sheets).

Solid materials, powders and liquids can be detected. When working with poorly reflecting materials (felt, cotton wool, foam rubber, coarse textiles), we recommend deploying ultrasonic sensors as reflex sensors.

Hot materials (>100 °C) are poor reflectors.

For sensors for very small distances to the sensor axis. The sensing ranges are sometimes based on smaller plates (see data sheets).

No load current

This represents the self current requirement of the sensor and is measured under conditions of zero load.

Protection class

EN 40050 classifies the protection of electrical apparatus against touch, penetration of objects or water through the housing, uncovering, and so on. The IP code consists of the letters "IP" (International Protection) and two digits:

1st digit:
Degree of protection against contact and foreign objects

2nd digit:
Degree of protection against entry of water

⇒ Table "Protective enclosures"

Pulse extension

Time function by means of which the switching time can be extended, provided it is shorter than the value of the pulse extension.

⇒ Timer function

Quality assurance

The standards DIN ISO 9000-9004 (EN 29000-29004) regulate the quality assurance (QA) of products and services.

Pepperl+Fuchs is certified in accordance with DIN ISO 9001.

Range hysteresis

This is the separation of the switch points between the condition when the measuring plate approaches the sensor and the condition when it is moving away from the sensor. The hysteresis is given as a percentage of the operating distance (range).

Range

Usable distance between the ultrasonic transmitter and receiver (through-beam), sensor and reflector (interrupted beam), or sensor and object (reflection sensor).

⇒ Sensing range

Rated operating current

This value represents the maximum operating current for continuous operation.
Sensor principle

Reflection

The term generally refers to the reversal of the direction of waves at the border between two media. A distinction is made between three types of reflection:
- Specular reflection: A reflection in which virtually the entire incoming radiation is reflected with the angle of incidence equaling the angle of reflection, as in a mirror.
- Predominately specular reflection: A mirror reflection with a diffuse share, e.g. from roughened surfaces.
- Diffuse reflection: A reflection in which the incoming radiation is reflected evenly in all directions.

The manner in which an ultrasonic beam is reflected depends on the ratio of the wavelength to the roughness of the surface.

> Section "Notes for installation and operation"

Reflective capability

The property of objects, depending on surface nature and structure, to reflect ultrasonic waves to a greater or lesser extent, directionally or diffusely. The non-reflected is absorbed or transmitted. In the case of reflection sensors, the attainable sensor range can be estimated using reflection tables for common materials.

Reflector range

Range within which the reflector of an ultrasonic sensor in beam-interruption mode must be positioned in order to be detected reliably. The reflector range extends from the end of the blind range to the end of the sensing range.

> Sensing range

Reflector

A reflector is a flat plate with good reflective properties which is positioned within the sensing range at right angles to the ultrasonic beam. The reflector acts as the reference object for ultrasonic reflection sensors used in interrupted-beam mode.

> Sensor principle

Repeat accuracy

(also: repeatability)

Repeatability is determined in an 8 hour test at 23 ±5 °C and at the rated operating voltage. The difference between two operating distances must not exceed 10% of the nominal operating distance.
Additional information

Sensor principle
Physical principle upon which the function of a sensor is based.

Setting
The sensitivity of a number of ultrasonic sensor types can be adjusted using a potentiometer to ensure that they are optimally suited to their deployment.

Short circuit protection
Many ultrasonic sensors in the Pepperl+Fuchs range are provided with pulsed short circuit protection. If the limiting current value is exceeded, the output is periodically blocked and then switched free again, until the short circuit has been eliminated.

Standard measuring plate
Standard measuring plates permit comparative measurements of the switching distances and sensing ranges of a variety of proximity switches. The following has been established for ultrasonic sensors:

- Through-beam and double-sheet monitor:
  - Receiver specified by manufacturer (corresponds to the receiver of the two-part sensor set)

- Reflection sensor:
  - Flat plate, 100 mm x 100 mm.

Switching difference
Differences in sensor range due to variations in the reflectance of the objects to be detected. This specification relates especially to ultrasonic sensors in direct detection mode.

Switching frequency f
The switching frequency is the maximum number of relevant events in a given interval that can be detected by the sensor. It applies for a sensing ratio of 50% and is indicated in Hertz (Hz).

Switching hysteresis
The hysteresis is the difference in the path between the switch-on and switch-off point, when an object moves toward or away from the sensor in the axial direction about a switching distance. This prevents a continual changeover at the boundary of the region.

Switch-off delay
(previously: switch-off time)
Period of time required by the sensor from the point at which the object is removed from the detection area, to the point at which switching occurs. (Switch-on delay is analogous to this)

Switch-on delay
(previously: response time)
Period of time required by the sensor from the point at which the object enters the detection area, to the point at which switching occurs. (Switch-off delay is analogous to this).

Switch-on pulse suppression
This device, with which all sensors are equipped, suppresses an output error signal when operating voltage is applied, during the readiness delay interval.

Synchronisation
In order to avoid mutual interaction between neighbouring sensors, many types use a synchronisation input. If this is unused or on zero potential, then the sensor operates asynchronously or with its internal clock-pulse generator.

A positive synchronisation pulse initiates a measuring cycle. It is started with the falling pulse edge. Pepperl+Fuchs can supply sensors with synchronisation inputs or outputs which can be linked together for the purpose of self-synchronisation with each other.

Temperature compensation
Many ultrasonic sensors from Pepperl+Fuchs are provided with automatic temperature compensation to reduce the effect of air temperature fluctuations.

⇒ Air temperature

Temperature effect
The effect of temperature on the output parameters and switching points of a sensor.

The data is given in mm/K.

Through-beam sensor (Type T)
Through-beam sensors consist of two separate, active devices, the ultrasonic transmitter and the receiver.

⇒ see section "Sensor principle"

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⇒ see section "Sensor principle"

Tightening torque
On fixed cylindrical sensors with threaded housings, the recommended tightening torque of 15 Nm should not be exceeded.

Timer function
Parameterisable time function for the switch output of a sensor.

⇒ Pulse extension

⇒ Impulse relay function

Type D
According to EN 60947-5-2, the designation for a Diffuse mode sensor.

Type R
According to EN 60947-5-2, the designation for a Reflective mode sensor.

Type T
According to EN 60947-5-2, the designation for a Through-beam sensor.

Unusable area
Range in which a reflection sensor, for example, cannot detect an object.

⇒ "Sensing range" section

Unusable area
Zone immediately in front of an ultrasonic sensor in which an object or reflector will not be detected.

⇒ Section "Sensing range"

Adjustment range
The voltage drop is measured across the active output of the sensor.

Watchdog function
In event of interruptions to the operating voltage or EMC effects, the watchdog function resets the internal microcontroller of the sensor to a defined initialisation status, i.e. a reset of the sensor's internal program is performed.

Window range
The switching output becomes active when an object is located in the area defined by the switching distances A1 and A2.
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<tr>
<td>Malaysia</td>
<td>Industrial Automation (M) SDN BHD</td>
<td>(Kuala Lumpur Office FA) 30-3 &amp; 30-4, Jalan Loke Yew 552000 KUALA LUMPUR</td>
<td>Telephone +60 0392 210511, Telefax +60 0392 212330, <a href="mailto:iakl@tm.net.my">iakl@tm.net.my</a></td>
</tr>
<tr>
<td></td>
<td>Miran Engineering Sdn Bhd</td>
<td>(PA Representation) No. 16 Jalan Astaka U8/82 Bukit Jelutong Commercial Area 40150 SHAH ALAM SELANGOR</td>
<td>Telephone +60 03 78473278, Telefax +60 03 78475236, <a href="mailto:zainuddin@trisys.com.my">zainuddin@trisys.com.my</a></td>
</tr>
<tr>
<td></td>
<td>Custom Control Ltd.</td>
<td>(PA Representation) 16 Mahunga Drive, Mangere Bridge Private Bag 92 902 ONEHUNGA, AUCKLAND 6</td>
<td>Telephone +64 9 9760226, Telefax +64 9 9760267, <a href="mailto:sales@unilink.co.nz">sales@unilink.co.nz</a></td>
</tr>
<tr>
<td></td>
<td>Multiplex Instrumentation &amp; Control Equipment Services</td>
<td>(PA Representation) 3378 A Lbarra Street W-11 Guadalupe Arcadia Square J. P. Rizal Ext.</td>
<td>Telephone +63 (2) 550 1473, Telefax +63 (2) 550 1475, <a href="mailto:multiplex@quickweb.com.ph">multiplex@quickweb.com.ph</a></td>
</tr>
<tr>
<td></td>
<td>Process Innovations, Inc.</td>
<td>(PA-Representative for Luzon)</td>
<td>Telephone +63 2 8826411, Telefax +63 2 8826357, <a href="mailto:pi-filters@surfshop.net.ph">pi-filters@surfshop.net.ph</a></td>
</tr>
<tr>
<td>New Zealand</td>
<td>Unilink Automation Ltd.</td>
<td>(FA Representation) PO Box 300785, Albany 10E Vega Place, Mairangi Bay 1130 AUCKLAND</td>
<td>Telephone +64 9 9760226, Telefax +64 9 9760267, <a href="mailto:sales@unilink.co.nz">sales@unilink.co.nz</a></td>
</tr>
<tr>
<td></td>
<td>Globe Royal Cavalier Corporation</td>
<td>(PA Representation) 6th Floor, 23 Jen Ai Road, Sec. 3 TAIPEI</td>
<td>Telephone +886 2 27718246, Telefax +886 2 27519032, <a href="mailto:grcc@ms19.hinet.net">grcc@ms19.hinet.net</a></td>
</tr>
<tr>
<td>Thailand</td>
<td>Industrial Electrical Co., Ltd</td>
<td>(FA Representation) 85/3 Soi Sot Phin San Rang Nam Road, Rajaheve BANGKOK 10400</td>
<td>Telephone +66 2 6427887, Telefax +66 2 6424249, <a href="mailto:iel@ie.co.th">iel@ie.co.th</a></td>
</tr>
<tr>
<td></td>
<td>Delta Elmech Co., Ltd.</td>
<td>(PA Representation) 72 Soi Pattanakarn 53, (Muangthong 2/3) Pattanakarn Road, Suanluang BANGKOK 10250</td>
<td>Telephone +66 2 322-5423, Telefax +66 2 322-1762, <a href="mailto:deltakbk@deltamech.co.th">deltakbk@deltamech.co.th</a></td>
</tr>
<tr>
<td>Vietnam</td>
<td>Provina Technology Co. Ltd.</td>
<td>(FA Representation) 148B Nam Ky Khoi Nghia Q1 TP HO CHI MINH CITY</td>
<td>Telephone +84 8 82998901, Telefax +84 8 8295486, <a href="mailto:provina@hcm.vnn.cn">provina@hcm.vnn.cn</a></td>
</tr>
</tbody>
</table>
MINIATURE RELAY
2 POLES—1 to 2 A (FOR SIGNAL SWITCHING)
RY SERIES

■ FEATURES
- Ultra high sensitivity
- UL, CSA recognized
- Conforms to FCC rules and regulations Part 68
  —Surge strength 1,500 V
- High dielectric strength type available (RY-WF type)
- Contact arrangement MBB type available (RY-D type)
- High reliability-bifurcated contacts
- Wide operating range
- DIL pitch terminals
- Plastic sealed type
- RoHS compliant since date code: 0438B9
  Please see page 8 for more information

■ ORDERING INFORMATION

[Example]  
RY – 12 WF – K

(a) Series Name  
(b) Nominal Voltage  
(c) Coil and Contact Function  
(d) Enclosure

Note: Actual marking omits the hyphen (-) of (*)
For movable and stationary contact with gold overlay type, add suffix “–OH”.

RoHS Compliant
### SAFETY STANDARD AND FILE NUMBERS

UL478, 508 (File No. E45026)
C22.2 No. 14 (File No. LR35579)

Please request when the approval markings are required on the cover.

Please note that UL/CSA ratings may differ from the standard ratings.

<table>
<thead>
<tr>
<th>Type</th>
<th>Nominal voltage</th>
<th>Contact rating*¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>RY-W</td>
<td>3 to 48 VDC</td>
<td>0.5 A 120 VAC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 A 24 VDC</td>
</tr>
<tr>
<td>RY-WZ</td>
<td></td>
<td>0.3 A 60 VDC</td>
</tr>
<tr>
<td>RY-WF</td>
<td>5 to 48 VDC</td>
<td>0.25 A 120 VAC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 A 48 VDC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.3 A 60 VDC</td>
</tr>
<tr>
<td>RY-WFZ</td>
<td>3 to 48 VDC</td>
<td>0.5 A 120 VAC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 A 30 VDC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.6 A 110 VDC</td>
</tr>
<tr>
<td>RY-D</td>
<td>4.5 to 48 VDC</td>
<td>0.3 A 120 VAC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.2 A 60 VDC</td>
</tr>
</tbody>
</table>

Note: *¹ Contact ratings mentioned above are subject to same polarity.
## SPECIFICATIONS

<table>
<thead>
<tr>
<th>Item</th>
<th>High Sensitive Type</th>
<th>500 mW Type</th>
<th>High Dielectric Strength</th>
<th>2 A Type</th>
<th>Continuous (MBB) Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact</td>
<td>RY-( ) W-K</td>
<td>RY-( ) WZ-K</td>
<td>RY-( ) WF-K</td>
<td>RY-( ) WFZ-K</td>
<td>RY-( ) D-K</td>
</tr>
<tr>
<td>Material</td>
<td>Gold overlay</td>
<td>Gold overlay</td>
<td>Gold overlay silver-palladium</td>
<td>Gold overlay</td>
<td>Gold overlay silver-palladium</td>
</tr>
<tr>
<td>Style</td>
<td>Bifurcated</td>
<td>Single</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance (initial)</td>
<td>Maximum 100 mΩ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Carrying Current</td>
<td>1.25 A</td>
<td>2 A</td>
<td>0.6 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rating</td>
<td>1 A 24 VD</td>
<td>1 A 24 VDC</td>
<td>2 A 30 VDC</td>
<td>0.15 A 48 VDC</td>
<td>0.3 A 120 VAC</td>
</tr>
<tr>
<td>Maximum Switching Power</td>
<td>60 VA/24 W</td>
<td>30 VA/24 W</td>
<td>62.5 VA/60 W</td>
<td>36 VA/7.2 W</td>
<td></td>
</tr>
<tr>
<td>Maximum Switching Voltage</td>
<td>120 VAC, 60 VDC</td>
<td>125 VAC, 150 VDC</td>
<td>120 VAC, 60 VDC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Switching Current</td>
<td>1 A</td>
<td>2 A</td>
<td>0.6 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Switching Load*1</td>
<td>0.01 mA 10 mVDC</td>
<td>0.1 mA 10 mVDC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitance</td>
<td>Approx. 0.9 pF</td>
<td>Approx. 1.4 pF</td>
<td>Approx. 1.9 pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coil</td>
<td>Nominal Power</td>
<td>0.15 to 0.30 W</td>
<td>0.5 to 0.58 W</td>
<td>0.45 to 0.46 W</td>
<td>0.5 to 0.58 W</td>
</tr>
<tr>
<td>Operate Power (at 20°C)</td>
<td>0.075 to 0.14 W</td>
<td>0.125 to 0.145 W</td>
<td>0.2 to 0.21 W</td>
<td>0.2 to 0.324 W</td>
<td>0.2 to 0.21 W</td>
</tr>
<tr>
<td>Operating Temperature (No frost)</td>
<td>−30°C to +90°C</td>
<td>−30°C to +60°C (refer to the CHARACTERISTIC DATA)</td>
<td>−30°C to +70°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Value</td>
<td>Operate (at nominal voltage)</td>
<td>Maximum 6 ms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation</td>
<td>Resistance (at 500 VDC)</td>
<td>Minimum 1,000 MΩ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dielectric Strength</td>
<td>between open contacts</td>
<td>AC 500 V 1 minute</td>
<td>1,000 VAC 1 minute</td>
<td>500 VAC 1 minute</td>
</tr>
<tr>
<td></td>
<td>between adjacent contacts</td>
<td>1,000 VAC 1 minute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>between coil and contacts</td>
<td>1,000 VAC 1 minute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life</td>
<td>Mechanical</td>
<td>2 × 10⁸ ops. min.</td>
<td>1 × 10⁷ operations minimum</td>
<td>1 × 10⁹ ops. min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrical (at contact rating)</td>
<td>2 × 10⁸ ops. min. (0.5 A 120 VAC)</td>
<td>5 × 10⁸ ops. min. ( 1 A 24 VD C)</td>
<td>5 × 10⁸ ops. min. (0.25 A 120 VAC 1 A 24 VDC)</td>
<td>1 × 10⁹ ops. min. (2 A 30 VDC)</td>
</tr>
<tr>
<td>Other</td>
<td>Vibration</td>
<td>Misoperation</td>
<td>10 to 55 Hz (double amplitude of 1.5 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shock</td>
<td>Misoperation</td>
<td>100 m/s² (11±1 ms)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>Approximately 5 g</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 Minimum switching loads mentioned above are reference values. Please perform the confirmation test with the actual load before production since reference values may vary according to switching frequencies, environmental conditions and expected reliability levels.
## COIL DATA CHART

<table>
<thead>
<tr>
<th>MODEL</th>
<th>Nominal voltage</th>
<th>Coil resistance (±10%)</th>
<th>Must operate voltage</th>
<th>Must release voltage</th>
<th>Nominal power</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Sensitive Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RY-4.5 W-K</td>
<td>4.5 VDC</td>
<td>135Ω</td>
<td>3.2 VDC</td>
<td>0.23 VDC</td>
<td>150 mW</td>
</tr>
<tr>
<td>RY- 5 W-K</td>
<td>5 VDC</td>
<td>165Ω</td>
<td>3.6 VDC</td>
<td>0.25 VDC</td>
<td>150 mW</td>
</tr>
<tr>
<td>RY- 6 W-K</td>
<td>6 VDC</td>
<td>240Ω</td>
<td>4.3 VDC</td>
<td>0.3 VDC</td>
<td>150 mW</td>
</tr>
<tr>
<td>RY- 9 W-K</td>
<td>9 VDC</td>
<td>540Ω</td>
<td>6.4 VDC</td>
<td>0.45 VDC</td>
<td>150 mW</td>
</tr>
<tr>
<td>RY- 12 W-K</td>
<td>12 VDC</td>
<td>960Ω</td>
<td>8.5 VDC</td>
<td>0.6 VDC</td>
<td>150 mW</td>
</tr>
<tr>
<td>RY- 18 W-K</td>
<td>18 VDC</td>
<td>1,620Ω</td>
<td>12.6 VDC</td>
<td>0.9 VDC</td>
<td>200 mW</td>
</tr>
<tr>
<td>RY- 24 W-K</td>
<td>24 VDC</td>
<td>2,880Ω</td>
<td>16.8 VDC</td>
<td>1.2 VDC</td>
<td>200 mW</td>
</tr>
<tr>
<td>RY- 48 W-K</td>
<td>48 VDC</td>
<td>7,680Ω</td>
<td>32.6 VDC</td>
<td>2.4 VDC</td>
<td>300 mW</td>
</tr>
<tr>
<td>High Dielectric Strength</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RY- 3 WZ-K</td>
<td>3 VDC</td>
<td>18Ω</td>
<td>1.5 VDC</td>
<td>0.15 VDC</td>
<td>500 mW</td>
</tr>
<tr>
<td>RY-4.5 WZ-K</td>
<td>4.5 VDC</td>
<td>36Ω</td>
<td>2.25 VDC</td>
<td>0.23 VDC</td>
<td>560 mW</td>
</tr>
<tr>
<td>RY- 5 WZ-K</td>
<td>5 VDC</td>
<td>45Ω</td>
<td>2.5 VDC</td>
<td>0.25 VDC</td>
<td>560 mW</td>
</tr>
<tr>
<td>RY- 6 WZ-K</td>
<td>6 VDC</td>
<td>66Ω</td>
<td>3.0 VDC</td>
<td>0.3 VDC</td>
<td>550 mW</td>
</tr>
<tr>
<td>RY- 9 WZ-K</td>
<td>9 VDC</td>
<td>140Ω</td>
<td>4.5 VDC</td>
<td>0.45 VDC</td>
<td>580 mW</td>
</tr>
<tr>
<td>RY- 12 WZ-K</td>
<td>12 VDC</td>
<td>280Ω</td>
<td>6.0 VDC</td>
<td>0.6 VDC</td>
<td>510 mW</td>
</tr>
<tr>
<td>RY- 18 WZ-K</td>
<td>18 VDC</td>
<td>560Ω</td>
<td>9.0 VDC</td>
<td>0.9 VDC</td>
<td>580 mW</td>
</tr>
<tr>
<td>RY- 24 WZ-K</td>
<td>24 VDC</td>
<td>1,070Ω</td>
<td>12.0 VDC</td>
<td>1.2 VDC</td>
<td>540 mW</td>
</tr>
<tr>
<td>RY- 48 WZ-K</td>
<td>48 VDC</td>
<td>4,000Ω</td>
<td>24.0 VDC</td>
<td>2.4 VDC</td>
<td>580 mW</td>
</tr>
<tr>
<td>2 A Type</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RY- 3 WF-K</td>
<td>3 VDC</td>
<td>18Ω</td>
<td>1.9 VDC</td>
<td>0.15 VDC</td>
<td>500 mW</td>
</tr>
<tr>
<td>RY-4.5 WFZ-K</td>
<td>4.5 VDC</td>
<td>36Ω</td>
<td>2.9 VDC</td>
<td>0.23 VDC</td>
<td>560 mW</td>
</tr>
<tr>
<td>RY- 5 WFZ-K</td>
<td>5 VDC</td>
<td>45Ω</td>
<td>3.2 VDC</td>
<td>0.25 VDC</td>
<td>560 mW</td>
</tr>
<tr>
<td>RY- 6 WFZ-K</td>
<td>6 VDC</td>
<td>66Ω</td>
<td>3.8 VDC</td>
<td>0.3 VDC</td>
<td>550 mW</td>
</tr>
<tr>
<td>RY- 9 WFZ-K</td>
<td>9 VDC</td>
<td>140Ω</td>
<td>5.7 VDC</td>
<td>0.45 VDC</td>
<td>580 mW</td>
</tr>
<tr>
<td>RY- 12 WFZ-K</td>
<td>12 VDC</td>
<td>280Ω</td>
<td>7.6 VDC</td>
<td>0.6 VDC</td>
<td>510 mW</td>
</tr>
<tr>
<td>RY- 18 WFZ-K</td>
<td>18 VDC</td>
<td>560Ω</td>
<td>11.4 VDC</td>
<td>0.9 VDC</td>
<td>580 mW</td>
</tr>
<tr>
<td>RY- 24 WFZ-K</td>
<td>24 VDC</td>
<td>1,070Ω</td>
<td>15.2 VDC</td>
<td>1.2 VDC</td>
<td>540 mW</td>
</tr>
<tr>
<td>RY- 48 WFZ-K</td>
<td>48 VDC</td>
<td>4,000Ω</td>
<td>36.0 VDC</td>
<td>2.4 VDC</td>
<td>580 mW</td>
</tr>
</tbody>
</table>

Note: All values in the table are measured at 20°C.
<table>
<thead>
<tr>
<th>MODEL</th>
<th>Nominal voltage</th>
<th>Coil resistance (±10%)</th>
<th>Must operate voltage</th>
<th>Must release voltage</th>
<th>Nominal power</th>
</tr>
</thead>
<tbody>
<tr>
<td>RY-4.5 D-K</td>
<td>4.5 VDC</td>
<td>45Ω</td>
<td>3.0 VDC</td>
<td>0.23 VDC</td>
<td>450 mW</td>
</tr>
<tr>
<td>RY-5 D-K</td>
<td>5 VDC</td>
<td>55Ω</td>
<td>3.3 VDC</td>
<td>0.25 VDC</td>
<td>450 mW</td>
</tr>
<tr>
<td>RY-6 D-K</td>
<td>6 VDC</td>
<td>80Ω</td>
<td>3.95 VDC</td>
<td>0.3 VDC</td>
<td>450 mW</td>
</tr>
<tr>
<td>RY-9 D-K</td>
<td>9 VDC</td>
<td>180Ω</td>
<td>5.9 VDC</td>
<td>0.45 VDC</td>
<td>450 mW</td>
</tr>
<tr>
<td>RY-12 D-K</td>
<td>12 VDC</td>
<td>320Ω</td>
<td>7.9 VDC</td>
<td>0.6 VDC</td>
<td>450 mW</td>
</tr>
<tr>
<td>RY-18 D-K</td>
<td>18 VDC</td>
<td>720Ω</td>
<td>11.8 VDC</td>
<td>0.9 VDC</td>
<td>450 mW</td>
</tr>
<tr>
<td>RY-24 D-K</td>
<td>24 VDC</td>
<td>1,280Ω</td>
<td>15.8 VDC</td>
<td>1.2 VDC</td>
<td>450 mW</td>
</tr>
<tr>
<td>RY-48 D-K</td>
<td>48 VDC</td>
<td>4,800Ω</td>
<td>31.8 VDC</td>
<td>2.4 VDC</td>
<td>480 mW</td>
</tr>
</tbody>
</table>

Note: All values in the table are measured at 20°C.

**CHARACTERISTIC DATA**
# REFERENCE DATA

- **Distribution of Operate & Release Voltage**
  - RY-12W/K
  - n = 100
  - Operate
  - Release

- **Distribution of Operate & Release Time**
  - RY-12W/K
  - n = 100
  - Operate
  - Release

- **Distribution of Operate & Release Time**
  - RY-12D/K
  - n = 50
  - Operate
  - Release

- **Distribution of Continuous Time**
  - RY-12W/K
  - n = 50
  - Operate
  - Release

- **Distribution of Contact Resistance**
  - RY-12W/K
  - n = 100
  - Make
  - Break

- **Distribution of Contact Resistance**
  - RY-12D/K
  - n = 50
  - Make
  - Break

- **Electrical Life Test**
  - RY-12W/K
  - n = 10
  - 120 Operation / Min
  - Operation (x 10^6)
  - Voltage (V)
  - Contact Resistance (mΩ)

- **Electrical Life Test**
  - RY-12W/K
  - n = 5
  - 30 Operation / Min
  - 120VAC, 0.5 A (Resistor)
  - Operation (x 10^3)
  - Voltage (V)
  - Contact Resistance (mΩ)

- **Electrical Life Test**
  - RY-12W/K
  - n = 8
  - 30 Operation / Min
  - 24VDC, 1A (Resistor)
  - Operation (x 10^3)
  - Voltage (V)
  - Contact Resistance (mΩ)

- **Electrical Life Test**
  - Wire Spring Relay, 48VDC, 0.10A
  - Operation (x 10^3)
  - Voltage (V)
  - Contact Resistance (mΩ)
■ DIMENSIONS

● Dimensions

● Schematics
(Bottom view)

● PC board mounting hole layout
(Bottom view)

Unit: mm
RoHS Compliance and Lead Free Relay Information

1. General Information

- Relays produced after the specific date code that is indicated on each data sheet are lead-free now. Most of our signal and power relays are lead-free. Please refer to Lead-Free Status Info. (http://www.fcai.fujitsu.com/pdf/LeadFreeLetter.pdf)
- Lead free solder paste currently used in relays is Sn-3.0Ag-0.5Cu. From February 2005 forward Sn-3.0Cu-Ni will be used for FTRB3 and FTR-B4 series relays.
- Most signal and some power relays also comply with RoHS. Please refer to individual data sheets. Relays that are RoHS compliant do not contain the 6 hazardous materials that are restricted by RoHS directive (lead, mercury, cadmium, chromium IV, PBB, PBDE).
- It has been verified that using lead-free relays in leaded assembly process will not cause any problems (compatible).
- “LF” is marked on each outer and inner carton. (No marking on individual relays).
- To avoid leaded relays (for lead-free sample, etc.) please consult with area sales office. We will ship leaded relays as long as the leaded relay inventory exists.

2. Recommended Lead Free Solder Profile

- Recommended solder paste Sn-3.0Ag-0.5Cu and Sn-3.0 Cu-Ni (only FTR-B3 and FTR-B4 from February 2005)

Refroid Solder condition

**Flow Solder condition:**
- Pre-heating: maximum 120°C
- Soldering: dip within 5 sec. at 260°C soler bath

**Solder by Soldering Iron:**
- Soldering Iron Temperature: maximum 360°C
- Duration: maximum 3 sec.

3. Moisture Sensitivity

- Moisture Sensitivity Level standard is not applicable to electromechanical realys.

4. Tin Whisker

- SnAgCu solder is known as low risk of tin whisker. No considerable length whisker was found by our in-house test.

5. Solid State Relays

- Each lead terminal will be changed from solder plating to Sn plating and Nickel plating. A layer of Nickel plating is between the terminal and the Sn plating to avoid whisker.
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