

Using EDAQ530

Szeged, 2010

Preparing the PC

- All USB port devices require drivers
- The device can only be used with the dedicated software

Rules and conditions of using the hardware

- This an experimental individual development
- Not marketed officially
- We cannot offer an official warranty, yet we shall try to help if any problems arise
- It may be used only in the way we have demonstrated and only for the purposes of education

Guide to handling the hardware

- A low-voltage electronic device
- Supply voltage: the 5 V of the USB port, current limited
- **Protection against electric shock: earthing the PC is essential!!!**
- **Unearthed PC: 115 V appears on the metal parts!!!**

Guide to handling the hardware

- The connected sensors must not be damp; do not place them upon conducting materials
- Do not touch the input pins: static charge may cause damage
- Disconnect the device when it is not in use
- Do not use an external power supply or other external devices
- The sensor leads are thin

Guide to handling the hardware

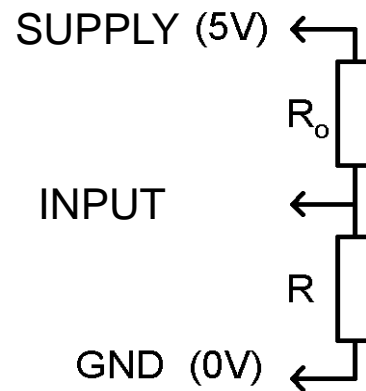
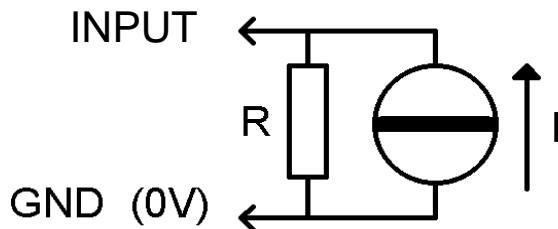
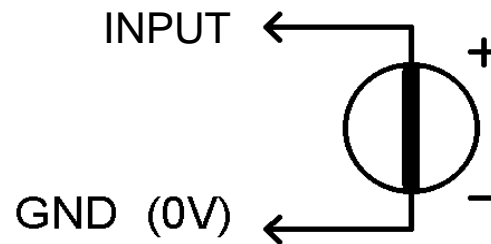
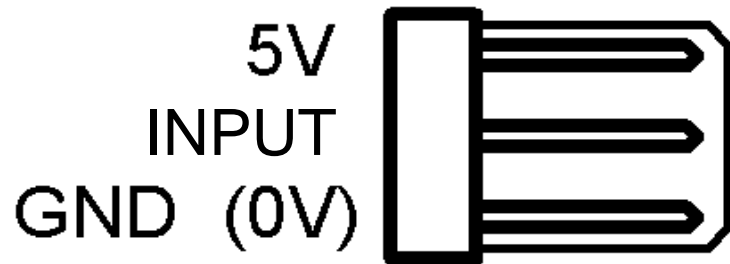
- Wait 5–10 seconds after connecting the device
- Use the same USB port if possible
- Do not use a patched USB cable
- Do not connect another device to the port
- Whilst measuring, preferably do not run other programs

Using the measurement inputs

The EDAQ530 architecture

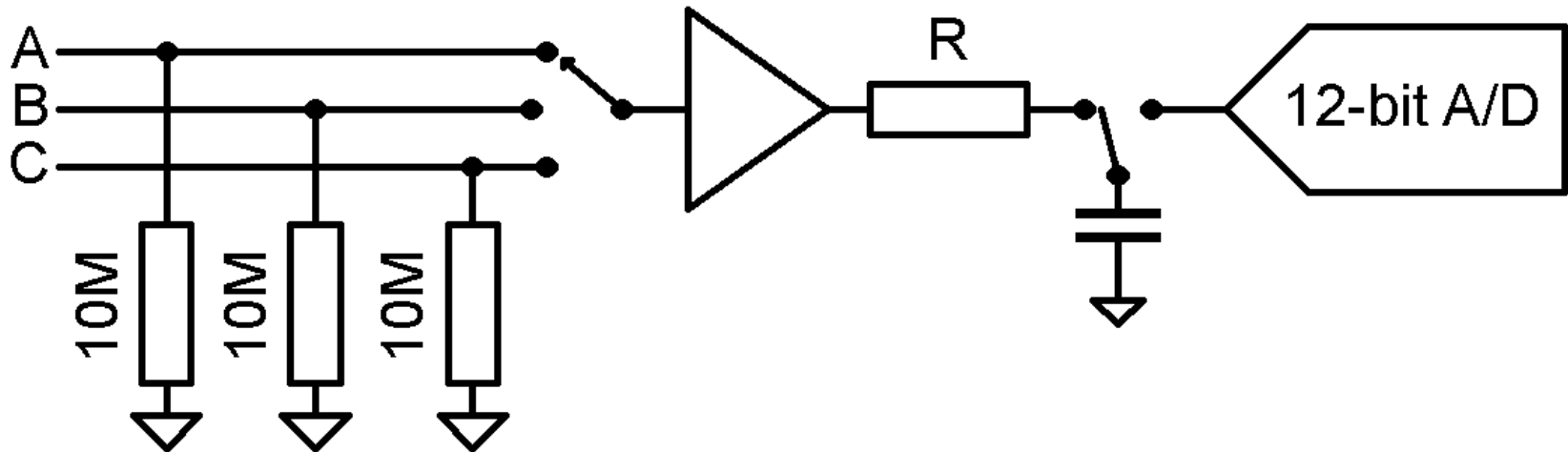
- Universal inputs to connect various sensors
- Measuring voltage, current or resistance
 - Voltage: directly
 - Current: from the voltage across a resistor
 - Resistance: with a voltage divider

Input characteristics: only voltage can be measured



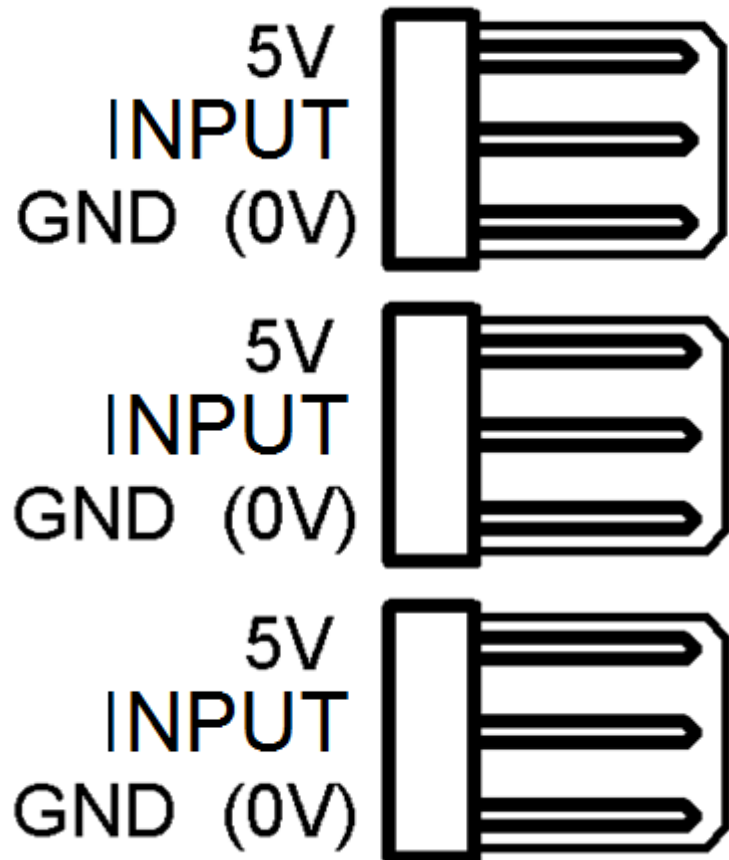
A/D converter properties

- 12-bit resolution
- $2^{12} = 4096$ levels
- $1/4096 = 0.0244\%$
- $5V/4096 = 1.22 \text{ mV}$
- Sampling
- 1000 samples/s
- 3 signals measured alternately



Input connectors

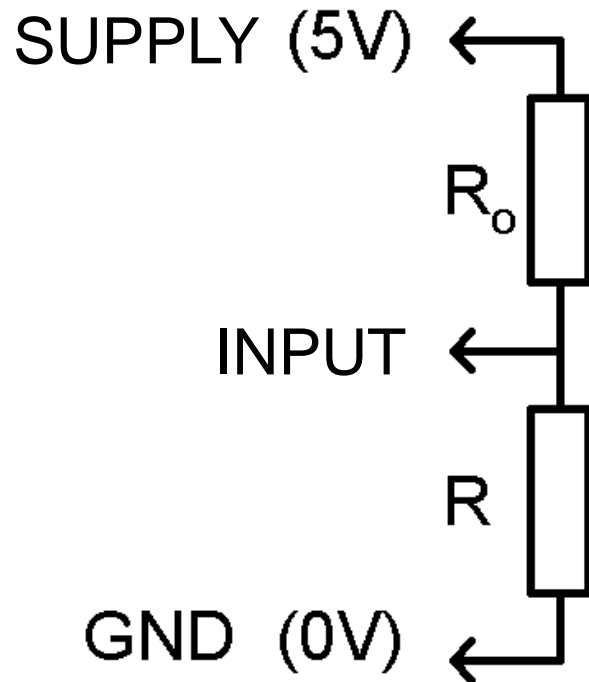
- 3 identical connectors
- Pins:
 - GND
 - Signal
 - 5 V
- What kind of connector can be connected?
 - H2510-03
 - Product number: 53-12-57
 - www.ret.hu



Measuring voltage

- Input voltage measurement range: 0 V–5 V
- Input resistance: 10 M Ω
- 12-bit data, resolution: 5 V/4096=1.22 mV
- External voltages

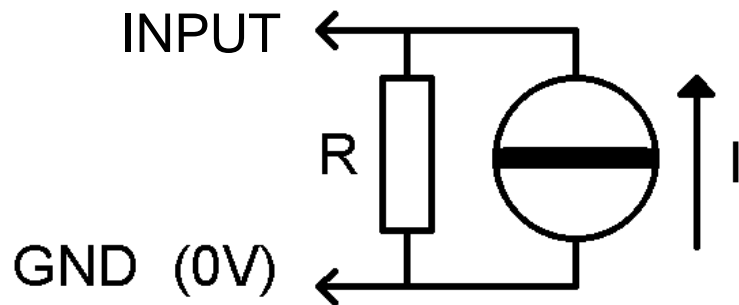
Measuring resistance: in a voltage divider with a known resistance



$$U = 5 \text{ V} \frac{R}{R + R_0},$$

$$R = \frac{U}{5 \text{ V}} \frac{R_0}{1 - \frac{U}{5 \text{ V}}}$$

Measuring current



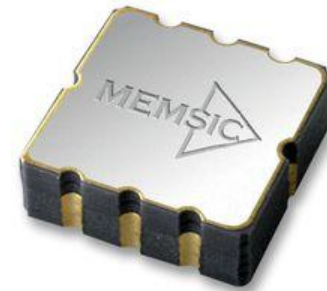
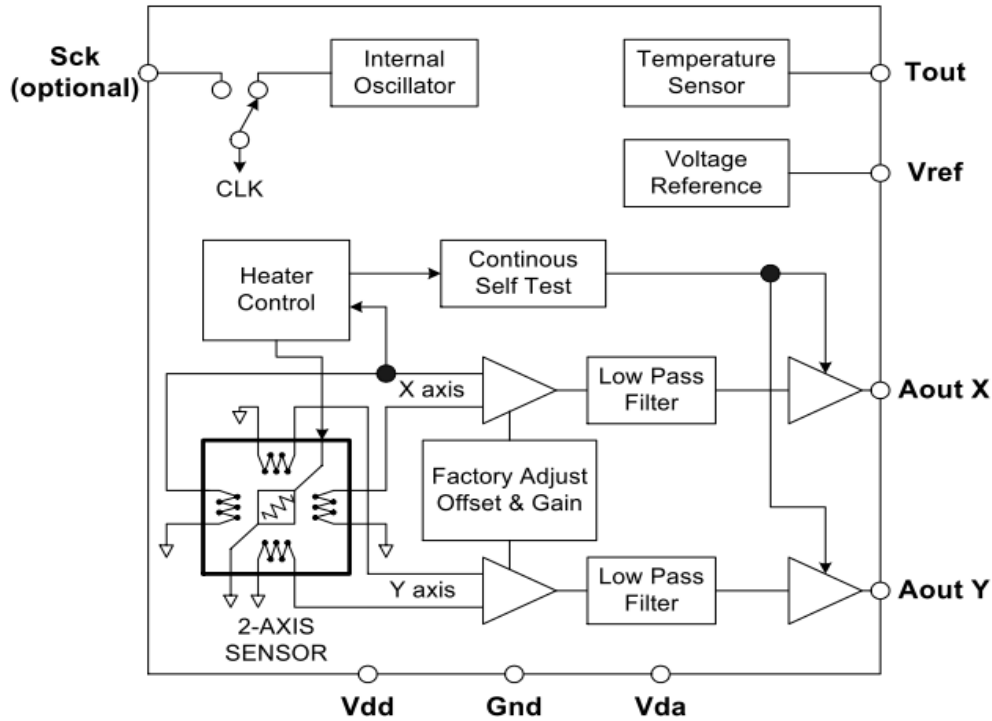
- The current flows through a known resistance
- Voltage $< 5\text{ V}$
- Resolution: 1.22 mV

Using sensors

Accelerometer: MXA2300

- Two-axis accelerometer
- Operating principle
- Axis orientation
- Measuring acceleration and position angles

MXA2300



Accelerometer: MXA2300

- Connexion:
 - 5 V reference voltage
 - Output signal: voltage, two signals
- Take temperature difference into consideration
- Calibrating the sensor regularly before measurements is recommended

$$U = A \cdot a + B$$

$$A \approx \frac{0.3 \text{ V}}{9.81 \frac{\text{m}}{\text{s}^2}}$$

$$B \approx 2.5 \text{ V}$$

Calibration

- Let the input values be g and $-g$
- Position the sensors exactly (fixing the sensor is recommended)
- Let the sensor equilibrate
- You are advised to calibrate the sensor regularly

Availability

- www.fdh.hu
 - <http://www.fdh.hu/product/show/250988>
 - 1200 Ft+VAT

Thermistor



$$T = \frac{1}{\frac{1}{298.16 \text{ K}} + \frac{1}{B} \ln\left(\frac{R}{R_{25}}\right)},$$

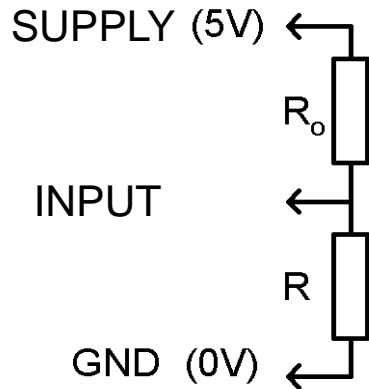
$$R_{25} = 10^4 \Omega \pm 5\%$$

$$B = 3977 \text{ K}$$

Thermistor

- Be aware of:
 - Acclimatisation period
 - Self-heating ($(2.5 \text{ V})^2/10^4 \Omega=0.625 \text{ mW}$)
 - Protecting the terminals
 - Proper heat contact

Connecting the thermistor



- Measurement range: $-40-120\text{ }^{\circ}\text{C}$
- Sensitivity

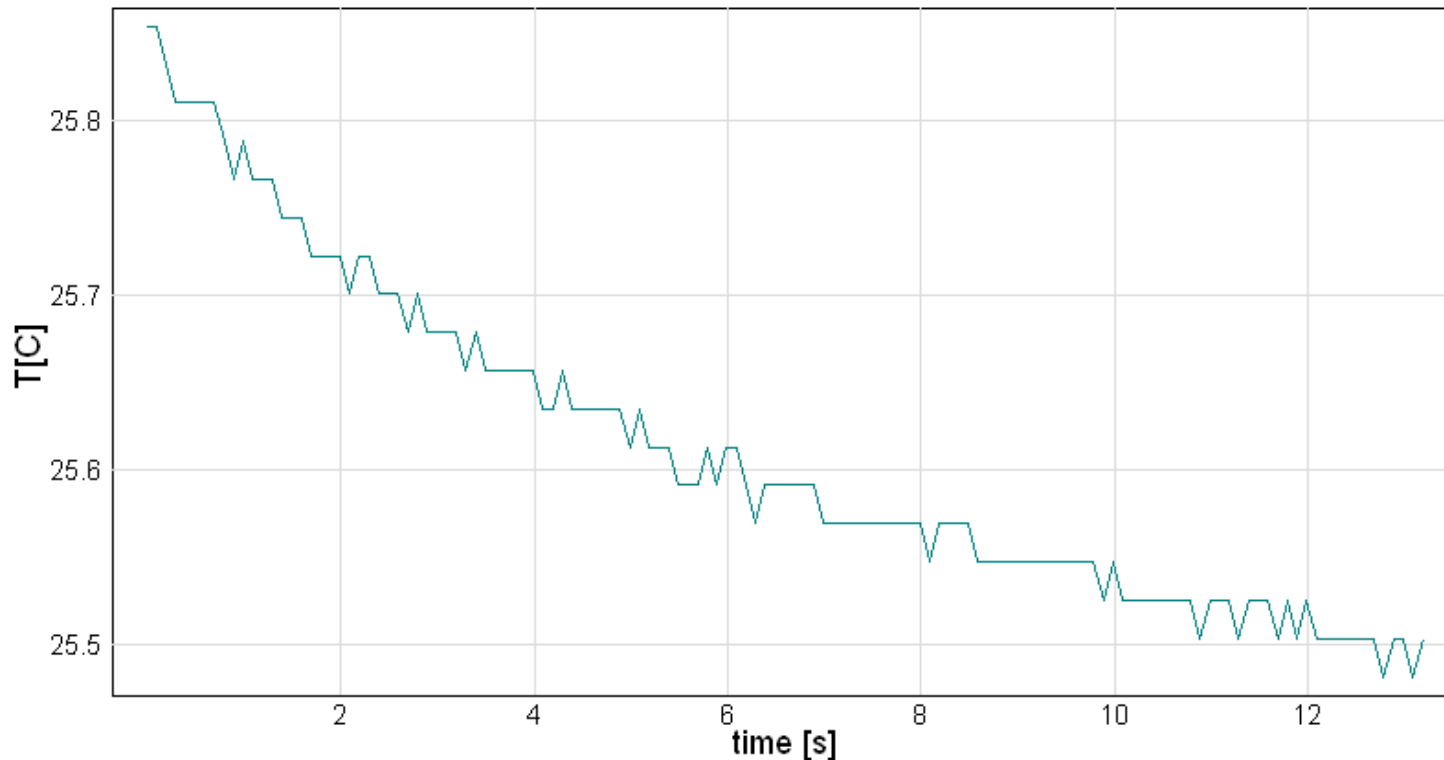
$$U = 5\text{ V} \frac{R}{R + R_0},$$

$$R = \frac{U}{5\text{ V}} \frac{R_0}{1 - \frac{U}{5\text{ V}}}$$

$$R_0 = 10^4\ \Omega \pm 1\%$$

Properties of temperature measurements

- Measurement range: $-40\text{ }^{\circ}\text{C} - 125\text{ }^{\circ}\text{C}$
- Sensitivity at room temperature $\approx 0.02\text{ }^{\circ}\text{C}$



Calibration

- May be rather precise even without calibration
- Special care should be taken during calibration
- No need to calibrate frequently
- In a liquid with considerable mass, during a very slow change (cooling is preferred to heating)
- Using a calibrated external thermometer

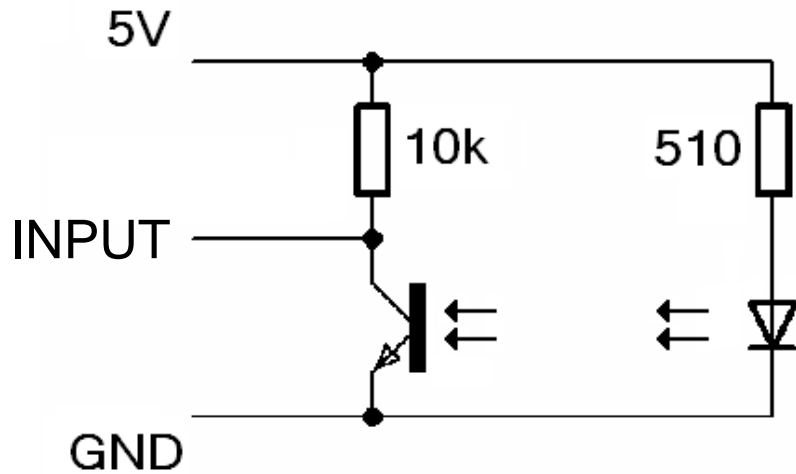
Availability

- www.ret.hu
 - Product number: 09-00-15
 - 82 Ft + VAT

Photogate

- Infra-red range
- LED and phototransistor
- LED: 5 V across a resistor
- Phototransistor: as switch
- Two-state signal
- For detecting time instances of events or measuring time periods
- Take care of:
 - Proper illumination

Photogate



- If the path of the light is blocked, voltage is greater
- If the path is open, lower voltage can be measured
- Infra LED (LD274)
- Phototransistor (BPV11F)

Availability

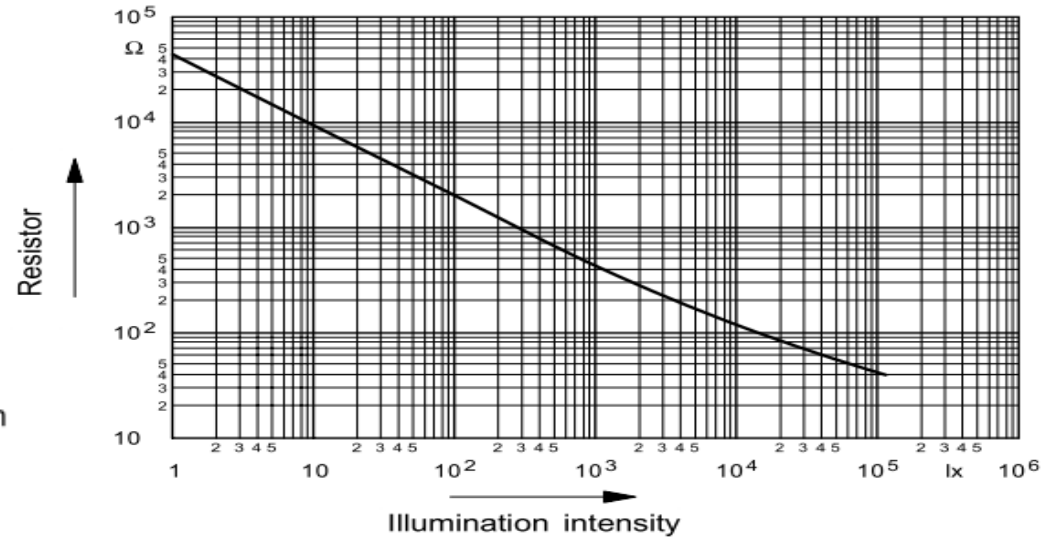
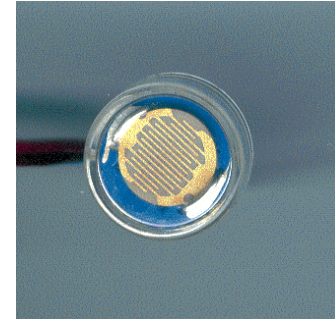
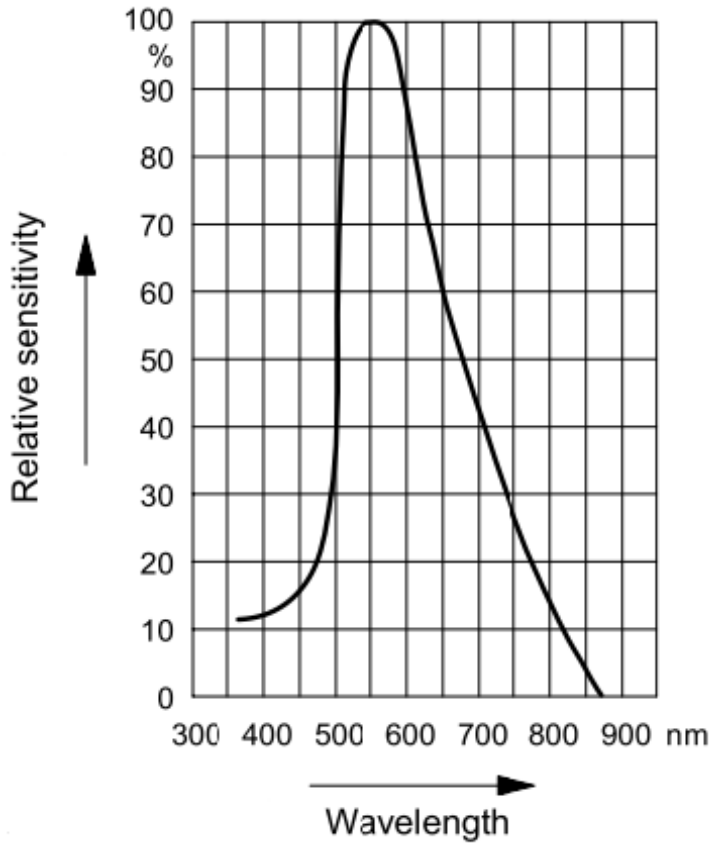
- www.ret.hu
- LD274-3
 - Product number: 48-00-97
 - 51 Ft + VAT
- BPV11 NF
 - Product number : 48-00-97
 - 109 Ft + VAT

Further sensors

Photoresistor

- When illuminated, its conductivity increases
- Resistance measurement
- Non-linear
- Not for precise measurements
- To detect changes, as a photogate

Photoresistor



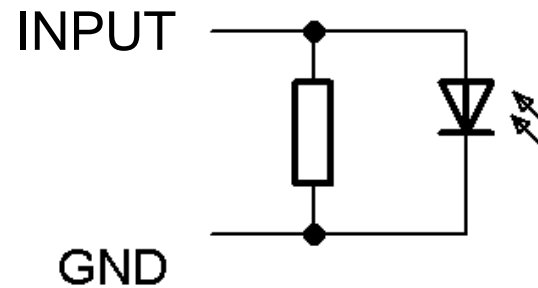
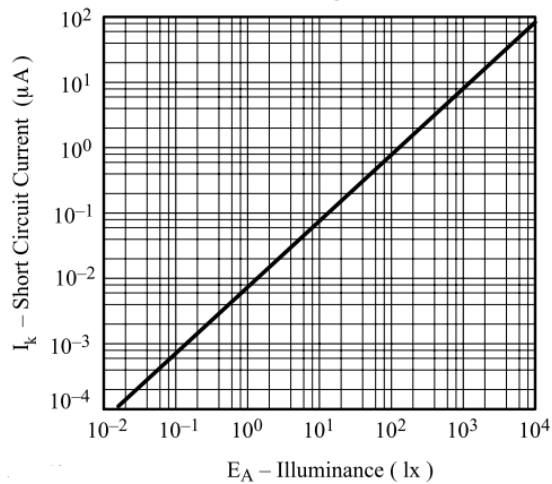
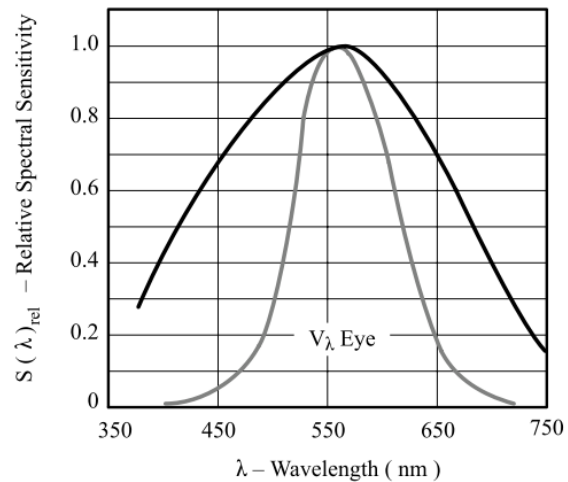
Available types

- www.ret.hu
- www.fdh.hu

Photodiode

- When the diode is illuminated, reverse current increases
- Approximately linear
- For precise light intensity measurements
- As photogate
- Take care of:
 - obscuration

Photodiode (BPW21)

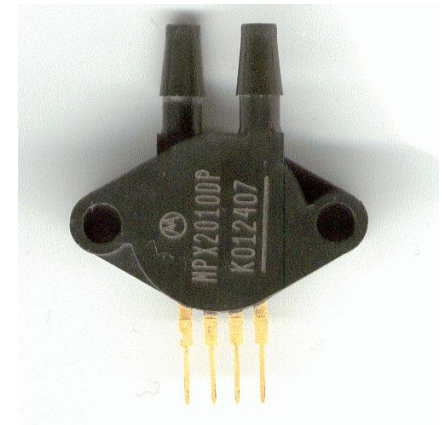


Available types

- www.ret.hu
- www.fdh.hu

Pressure sensor

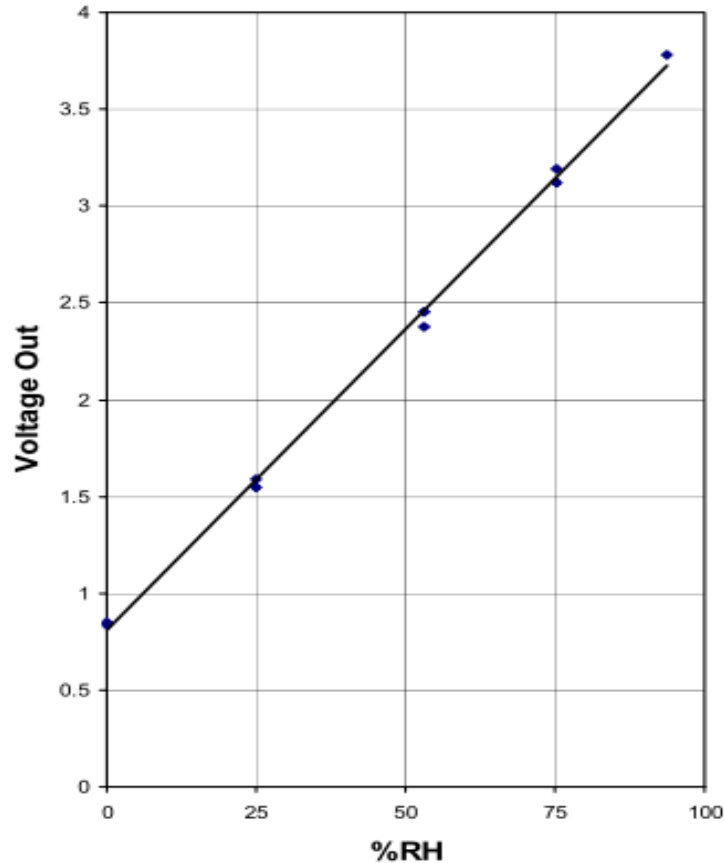
- Absolute:
MPXH6115 (115 kPa)
- Differential:
MPX2010DP (10 kPa)



Available types

- www.ret.hu
 - MPXH6115A6U, product number: 500066, 4390 Ft
 - MPX2010DP, product number : 500045, 3080 Ft
- www.fdh.hu
 - MPXH6115A6U, product number : 1457169, 4400 Ft
 - MPX2010DP, product number : 1608910, 3300 Ft

Humidity sensor



- Voltage output
- Can be measured directly
- 5 V supply voltage

Availability

- www.ret.hu
 - HIH-4000, product number: 50-01-15
 - 3404 Ft + VAT

Magnetic field

- KMZ51. KMZ52, magnetoresistive
www.nxp.com (Philips)
- HMC1051, HMC1052, magnetoresistive
www.honeywell.com (Honeywell)
- A 1302, Hall effect
www.allegromicro.com (Allegro MicroSystems)
- AD22151, Hall effect
www.analog.com (Analog Devices)

Available types

- www.fdh.hu

Precise accelerometers

- One-, two- or three-axis
- Similar to MXA2300, but more precise
- ADXL103 one-axis
- ADXL203 two-axis

Available types

- www.fdh.hu

Thermocouples

- Need amplification
- With two leads, the cold junction is within the device
- With three leads, the cold junction is external
- We have to set off the reference level



Available types

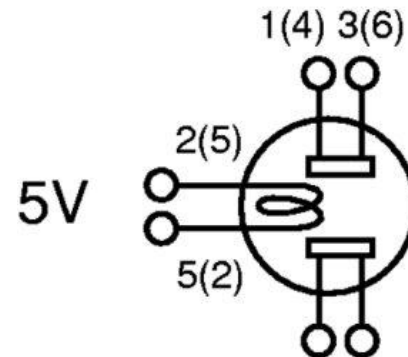
- www.soselectronic.hu
(VA3409, product number:72147)
- www.conrad.hu
- www.fdh.hu

Gas sensors

- Their resistance depends on gas concentration
- For various gases
- Need heating (electric, 5 V)



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Available types

- www.hestore.hu
- www.roselectronic.hu
- www.conrad.hu