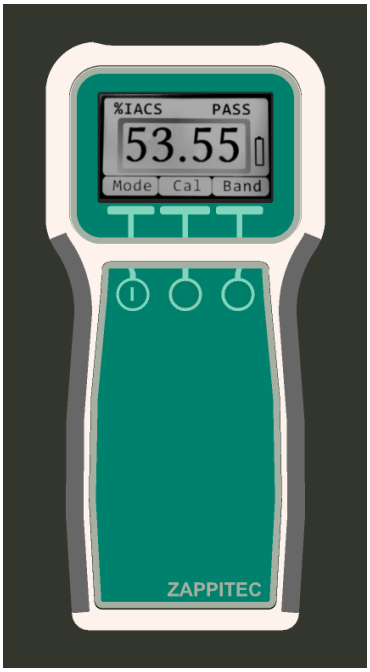
ZAPPITEC

Inline Eddy Current Conductivity Meter Mod. 12A



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1 Introduction

The Inline Eddy Current Conductivity Meter ZAPPITEC mod 12A is a stand-alone, automatic instrument intended for sorting serialized parts by Electrical Conductivity.

The Electrical Conductivity is a property of solids which describes its ability to allow the flow of electrical currents. The higher the conductivity, the lower are the energy losses in a current-carrying conductor

The SI unit for conductivity is the S/m (**S**iemens per **m**eter). Since metals are very good conductors their conductivity is usually given in MS/m (**M**ega **S**iemens per **m**eter).

The conductivity of metals changes significantly with temperature. To allow easy comparison between different metals the conductivity is normally standardized at a temperature of 20°C (293K or 68°F).

Measurements are usually made in %IACS units, an acronym than means:

" **%** of **I**nternational **A**nnealed **C**opper **S**tandard"

In this unit the standard annealed copper is by definition 100 %IACS at 20°C, while very pure copper can reach up to 102.7 %IACS at 20°C.

Conductivity units can be converted using the following formula:

$$0.58 \cdot \sigma_{\%IACS} = \sigma_{MS/m}$$

Where:

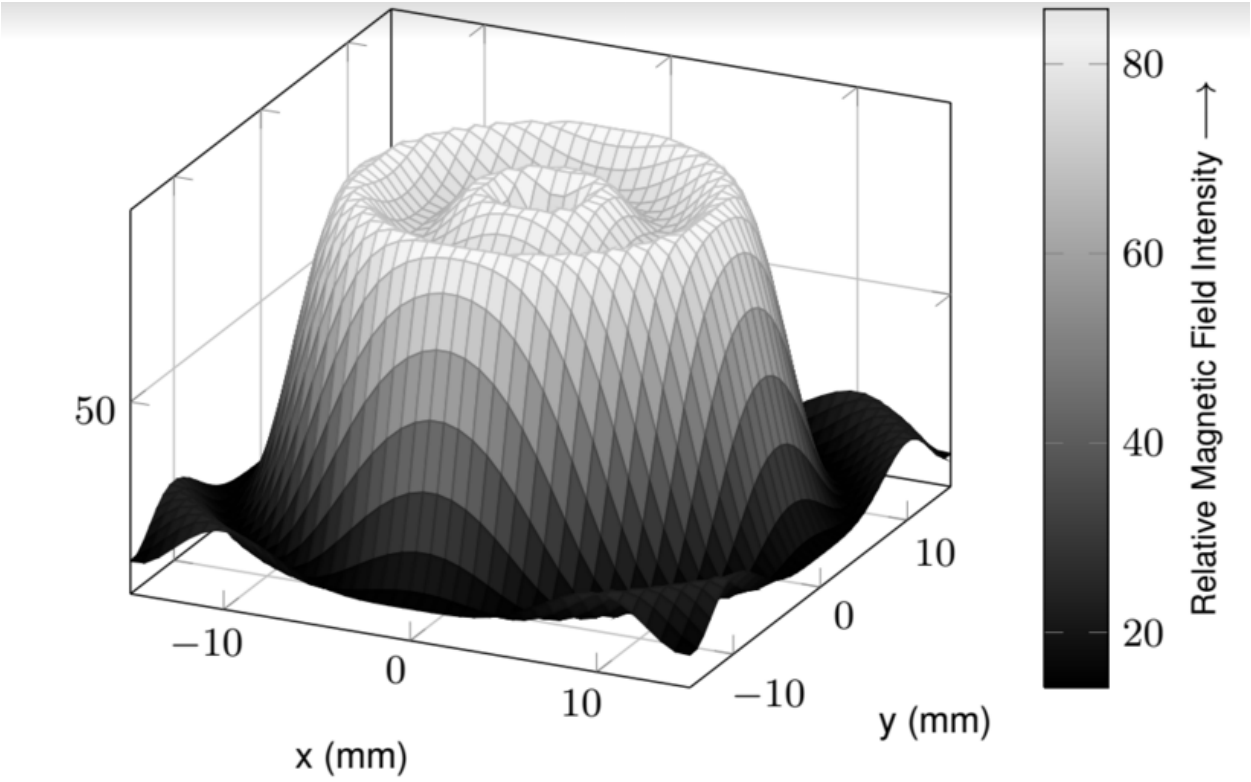
$\sigma_{\%IACS}$ = Conductivity in %IACS

$\sigma_{MS/m}$ = Conductivity in MS/m

2 Principle of operation

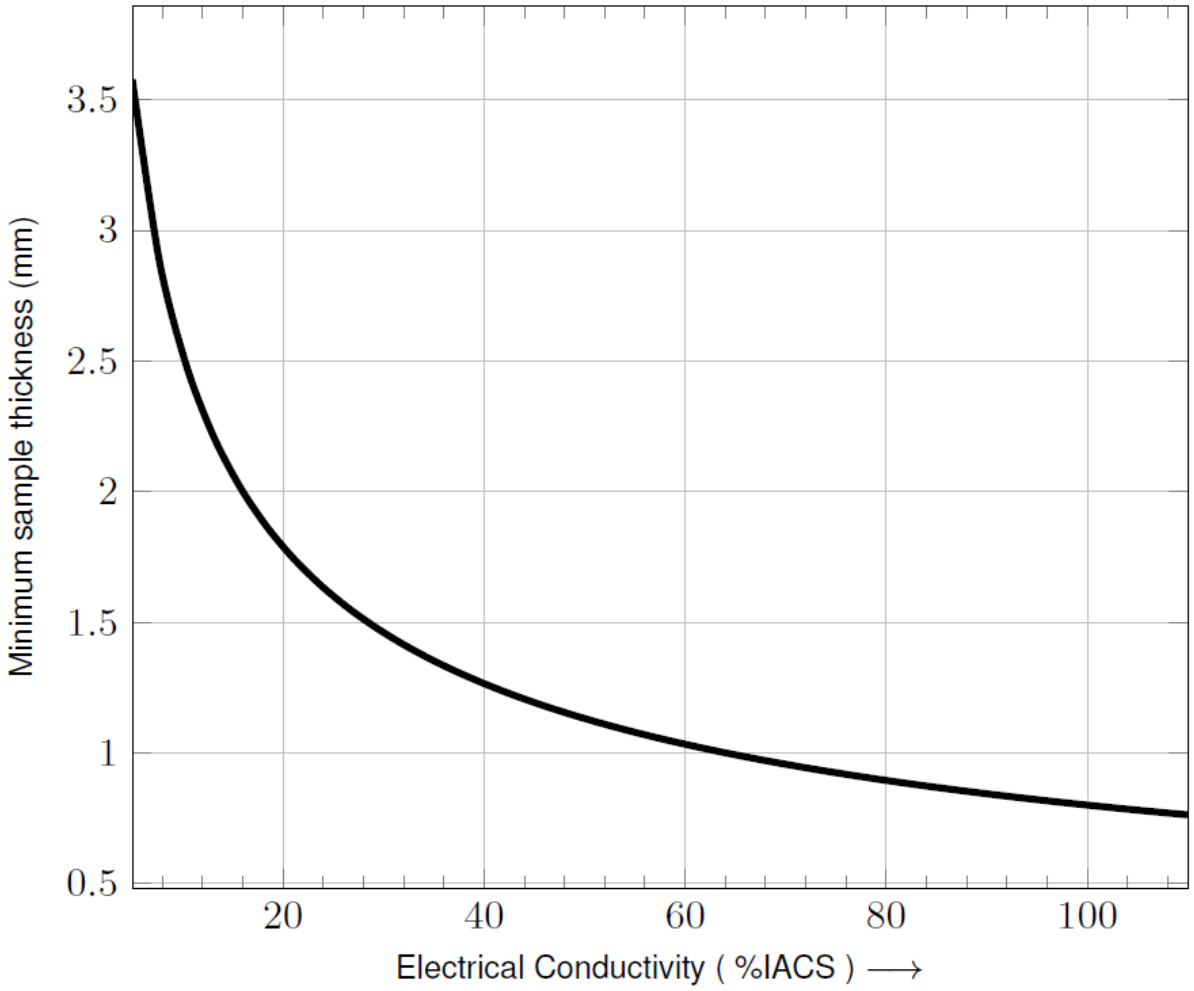
A high-frequency magnetic field (60 kHz) is generated by the 12A sensor which induces eddy currents in the bulk of the sample to be tested. There is no need of contact between the sensor and the sample, allowing true non-contact measurement. The main advantage is to avoid sensor erosion, allowing for much greater life of the sensor.

A simulation of the relative intensity of the magnetic field generated by the sensor is shown below. This field is restricted to a circular area 10mm in diameter.



Magnetic field generated by the ZAPPITEC model 12A sensor

The minimum sample thickness for proper measurement depends on the conductivity of the material and it can be determined from the graph below:



Minimum sample thickness vs Electrical Conductivity

3 Operating instructions

3.1 General description

Front Panel

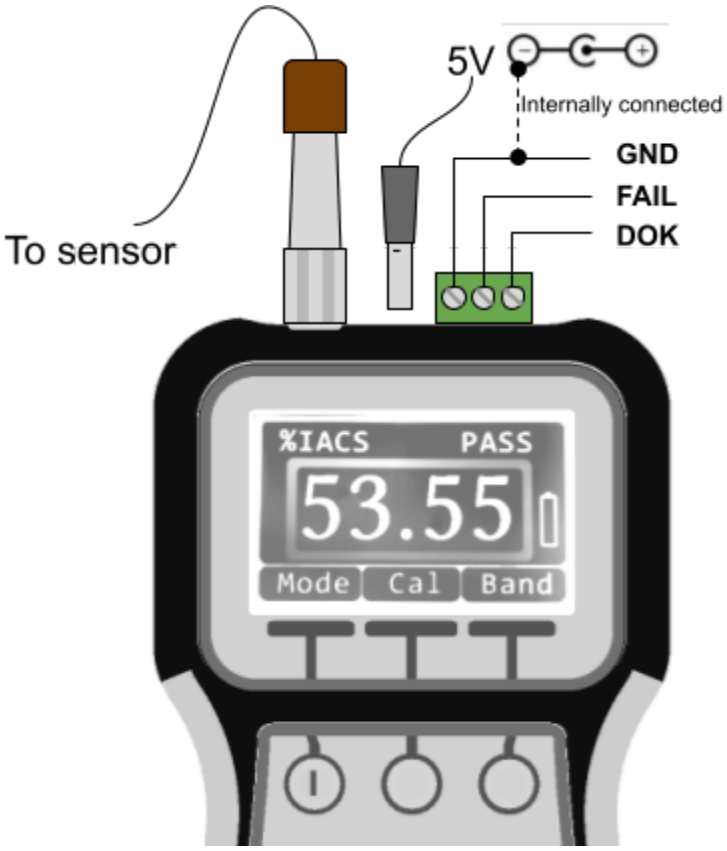
The Conductivity Meter model 12A has three context-sensitive buttons and a high resolution LCD display. The function of each button is shown in the lower part of the display.

The left button enters the ***Mode*** menu, the central button performs Calibration (***Cal***) and the right button enables the user to adjust the conductivity values for the Pass ***Band***.

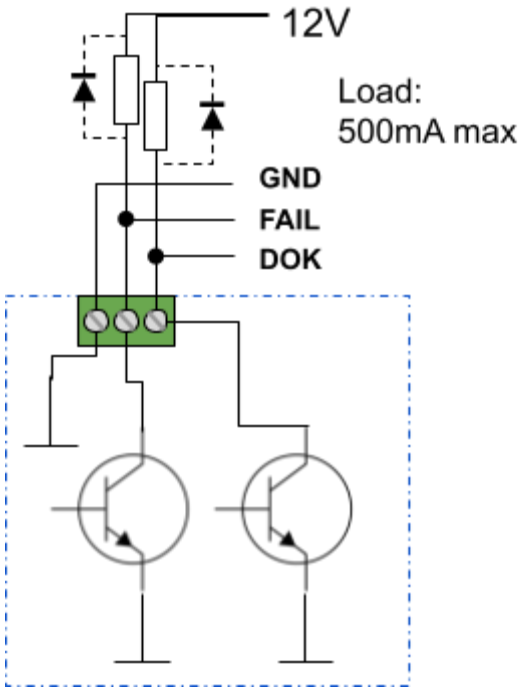
Top Panel (connections)

The connections for automation are shown in the diagram below. The instrument should be supplied with stabilized 5V (6.5V max) on a 2×5.5mm barrel connector, with positive center. The negative is internally connected to the Ground (GND) output. The two automation outputs are open collector, 12V nominal, 500mA maximum load.

The sensor is provided with a 3m cable. The cables are interchangeable but the sensor needs to be calibrated together with its instrument. Please contact Zappitec if sensor replacement is needed.



Outputs



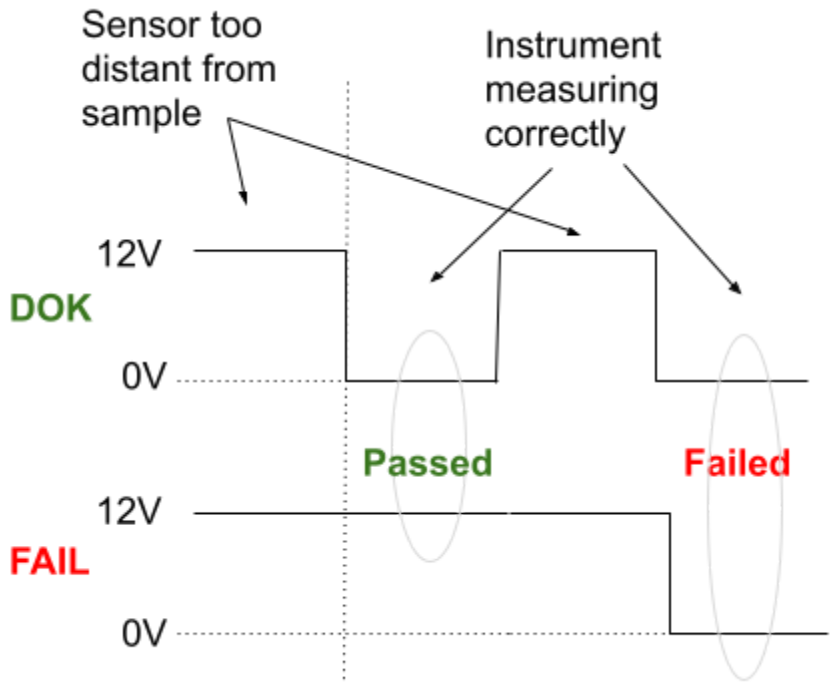
The Model 12A has two **active low** open collector outputs (**FAIL** and **DOK**). Ground (**GND**) is internally connected to the negative terminal of the 5V power supply. The outputs are **not** isolated.

Do not exceed 12V 500mA load. If the load is inductive (relay or solenoid) please add a flywheel diode (1N4007 or similar, shown with dotted lines in the diagram above) to protect the outputs from the transient generated by inductors at turn off.

The **FAIL** output (active low) indicates when a part has been rejected. Rejection happens when the measured conductivity value is not within the limits set in the Band menu (see Pass Band Setup).

The **DOK** (Distance OK Output, active low) indicates the instrument's sensor is within the measuring range of the sample.

Examples:



Outputs		
DOK (Distance OK) Output	**FAIL Output**	**Result**
High	High (or Low)	Sensor too distant from test object (more than 500 µm)
Low	High	Test object passed conductivity test
Low	Low	Test object failed conductivity test

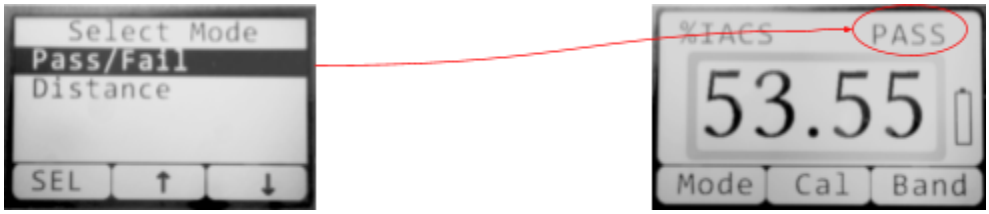
3.2 Setup

Modes of operation

The Model 12A has two modes of operation, selectable when pressing "Mode" on the main screen. The modes are selected by pressing the arrows and pressing "SEL" when the intended mode is highlighted.

In the first mode, ***Pass/Fail*** (default after turn-on) causes the unit to show the word "PASS or FAIL" on the screen.

For visibility purposes, the first line of the display in normal measuring mode will become highlighted (dark background with white letters) when a part fails the test.



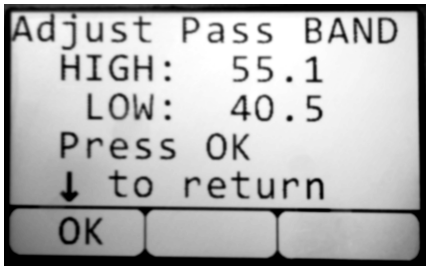
The mode ***Distance*** will show the distance between the tip of the sensor and the part under test in µm. This mode is useful for set-up purposes, to adjust the line mechanically. Changing the mode has no effect on the outputs.

Pass Band setup

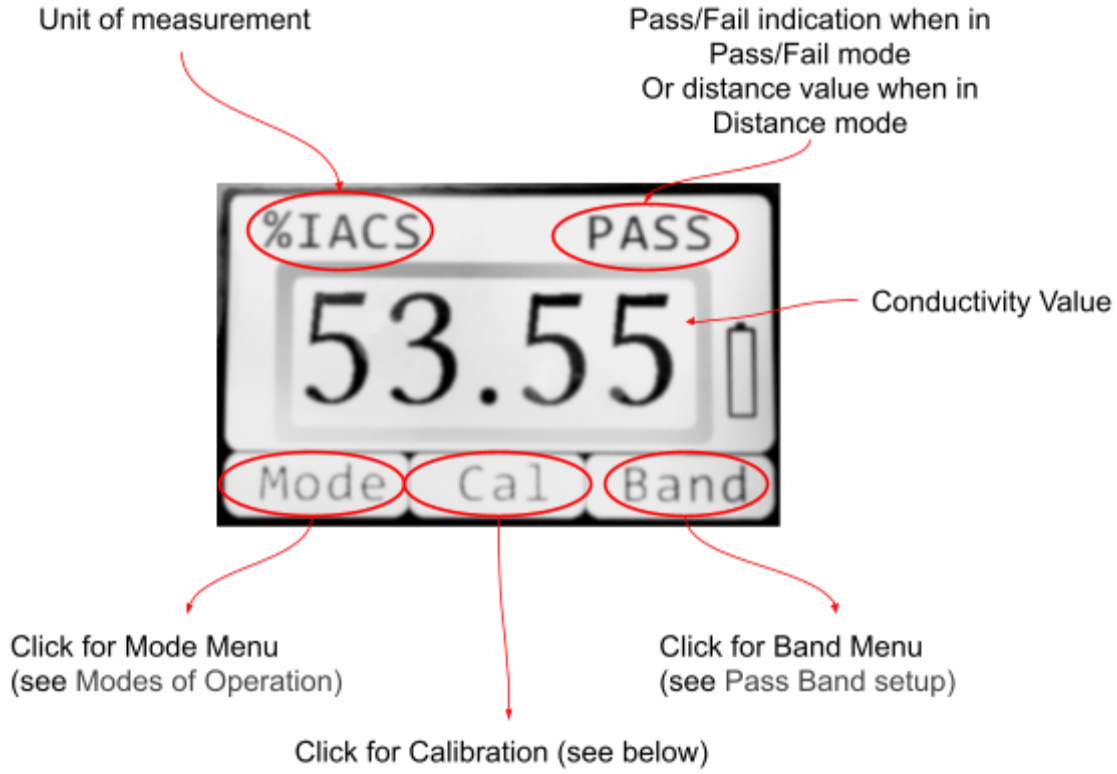
The Pass Band setup menu is available when pressing "Band" on the main mode. This menu allows the setup of a "pass band", a range of conductivity which is considered appropriate for the material being tested.

This menu has 4 options: setup of the HIGH end of the pass band, setup of the LOW end of the pass band, "Confirm Changes" to make the changes permanent and "Discard Changes" to discard most recent changes. Once selecting either the HIGH or the LOW values they can be adjusted by pressing **+** or **-**. Once the desired value is reached press OK:

Once the changes are confirmed or discarded press OK to return to normal operation:



3.3 Normal operation



Calibration

It is advisable perform user calibration periodically to verify the precision of measurements. To calibrate, keep the probe in contact with the supplied standard and press "Cal". A message will appear on the display confirming the procedure. The supplied standard should be at the same

temperature of the probe. The conductivity value of the supplied standard is stored in the instrument.

The instrument compensates for temperature variations automatically. The sensor should be at the same temperature of the measured parts for compensation to occur.

In-line measurements

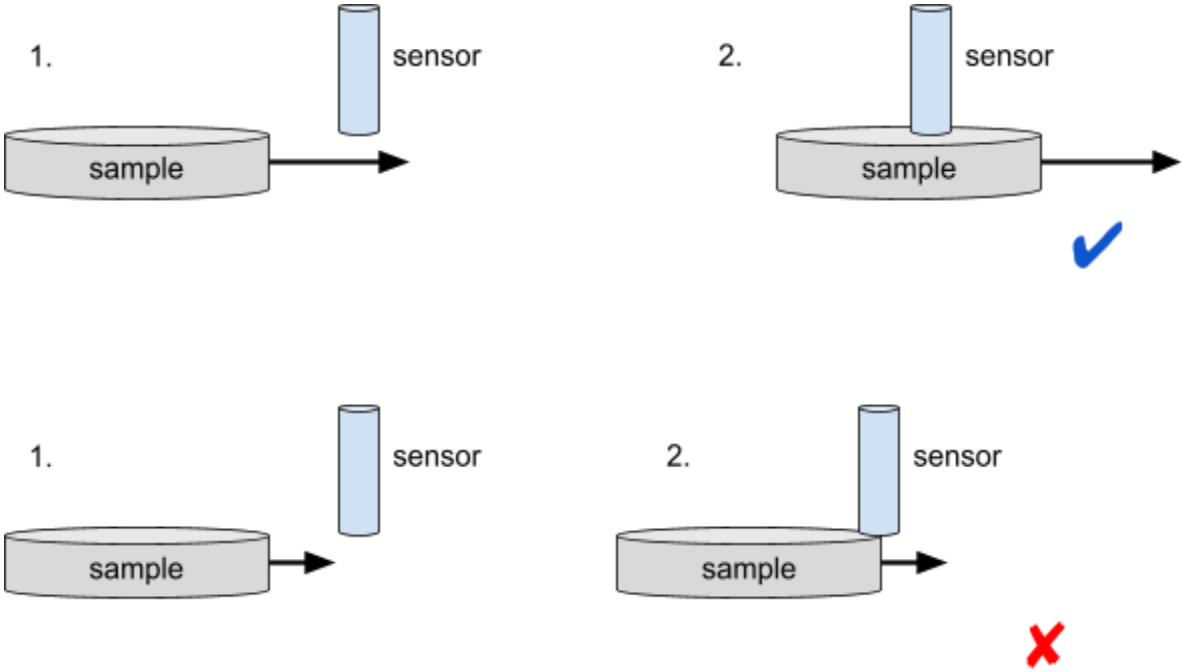
The Conductivity Meter **ZAPPITEC** mod 12A allows to measure parts in a production line automatically. There are two possible approaches:

Static sample:

The sample is static and the probe is moved towards the sample. In this case the first measurement will occur when the probe is within the distance range. It is convenient not to allow the sensor to touch the sample to extend the sensor's life.

Moving sample:

The sample is moved and the sensor is static. In this case care should be taken to move the sample quickly enough to avoid having only part of the sample exposed to the field, which could lead to error in measurements:



The recommended gap between sensor and sample is less than 500µm, preferably around 400µm.

For a consistent measurement, the sensor should be within 500µm of the sample for at least 500ms.

4 Specifications

Measurement Range:	5 - 110 %IACS
Resolution:	0.1% IACS (65-110 %IACS) 0.05 %IACS (30-65 %IACS) 0.02%IACS (10-30 %IACS) 0.01%IACS (5-10 %IACS
Measuring distance:	0.5 mm max (1.5% precision) 0 - 0.4 mm (1 % precision)
Time of measurement	500ms
Outputs (open collector) 1A 12 V max	***DOK*** - Distance OK ***F*** - Failed Test
Power supply	5V DC stabilized 100mA max