

EE36 SERIES

- Measuring water content in mineral transformer oil or non-mineral and lubrication oil.



*BASIC THEORY OF
MOISTURE MEASUREMENT
IN OIL*

3 TYPES OF WATER IN OIL

- dissolved water in oil $0 < a_w < 1$
- emulsion or suspension water in oil $a_w = 1$
- “free” water in oil $a_w = 1$



EE36 SERIES MEASURES DISSOLVED WATER IN OIL !!

TECHNICAL IMPORTANT

„FREE“ WATER IN LUBRICATION OR HYDRAULIC OIL:

- causes corrosion of metal parts
- degrades lubrication performance
- control of a_w useful (a_w has to be less than 1)



HIGH WATER CONTENT IN TRANSFORMER OIL:

- degrades insulation performance
e.g. 28kV @ x = 5ppm
 6kV @ x = 60ppm
- control of x is useful



WATER ACTIVITY a_w WATER CONTENT x

WATER ACTIVITY a_w = RELATIVE SATURATION of oil with dissolved water

$$a_w = \frac{e_w}{e_{ws}} = \frac{erh\%}{100} \quad [1]$$

WATER CONTENT x = TOTAL AMOUNT of water in the oil

$$x = \frac{\text{mass of water}}{\text{mass of sample}} \quad [\%] \text{ or } [\text{ppm}]$$

EE36 SERIES



EE36 TYPES

| | | | |
|---|----|-------------|-----|
| Temperature | T | [degC / °F] | (B) |
| Water activity | aw | [] | (K) |
| Water content in mineral transformer oil | x | [ppm] | (L) |
| Water content in lubrication or non-mineral transformer oil ¹⁾ | x | [ppm] | (M) |

Option 1:

| | | |
|-----------------------|----|-----|
| OUT 1: temperature | T | (B) |
| OUT 2: water activity | aw | (K) |

Option 2:

| | |
|---|---------|
| OUT 1: temperature T / water activity aw | (B)/(K) |
| OUT 2: water content in mineral transformer oil x | (L) |

Option 3:

| | |
|---|---------|
| OUT 1: temperature T / water activity aw | (B)/(K) |
| OUT 2: water content in lubrication / non-mineral oil x (A,B) | (M) |

EE36 WORKING PRINCIPLE

EE36 MEASURES:

- a_w capacitive sensor (HC1000-400)
 - T temperature sensor (Pt1000 DIN A)
-

EE36 CALCULATES:

- in mineral transformer oil:

with linear sorption isotherms: $x(T) = a_w * x_s(T)$

- in lubrication or non-mineral oil:

with specific parameters A, B $x(T) = a_w * 10(A/T+B)$
(e.g. A= -1186, B= 6,29)

WATER CONTENT X IN LUBRICATION OR NON-MINERAL OIL

For calculation of X oil specific parameters A and B are essential.
So there are 3 possibilities:

- A and B of used oil known by the customer
-

- A and B parameter can be provided by oil manufacturer
-

- **A and B can be determined by E+E Elektronik:**

Sample: 1 litre of used oil necessary

Process: time consuming / costly process (3 wks)

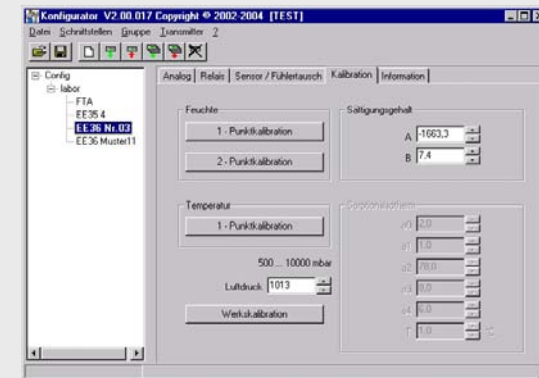
EE36 FEATURES

EASY CONFIGURATION VIA RS232-INTERFACE:

ANALOG OUTPUTS:

2 totally free configurable outputs
(scaling & signal)

Standard 0-20mA, 4-20mA, 0-5V, 0-10V



ALARM OUTPUT:

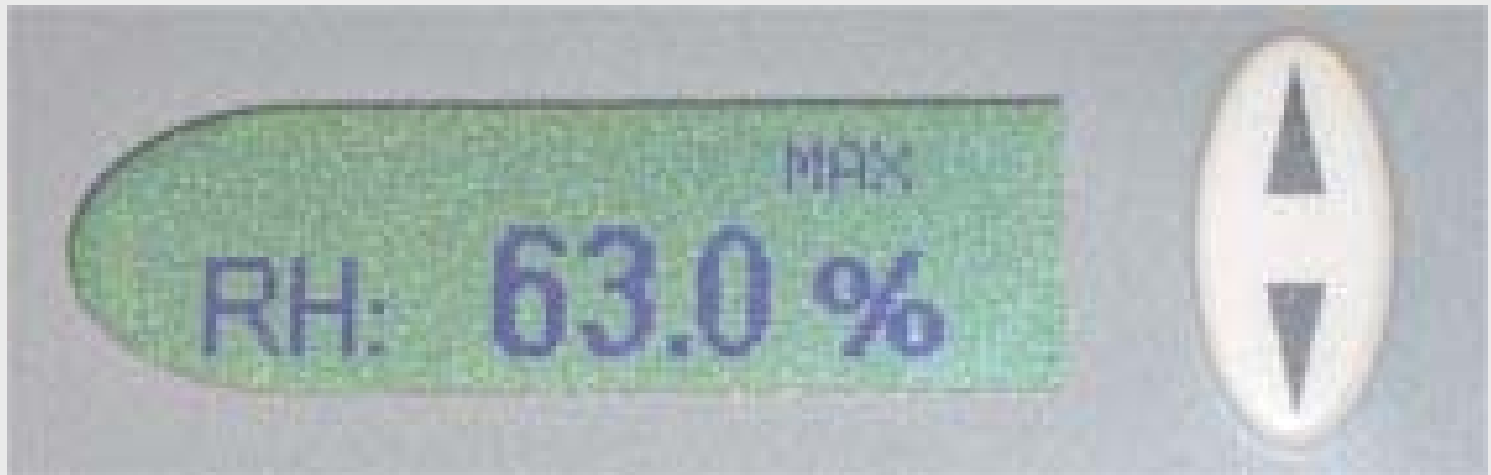
2 relays with no/nc contacts
up to 250VAC 6A or 28VDC 6A
level / hysteresis configurable via software



EE36 FEATURES

LCD- DISPLAY (OPTIONAL):.

aw, T, x **PRESS PUSH BUTTONS**
MIN, MAX **PRESS PUSH BUTTON FOR 5 SEC.**



EE36 FEATURES

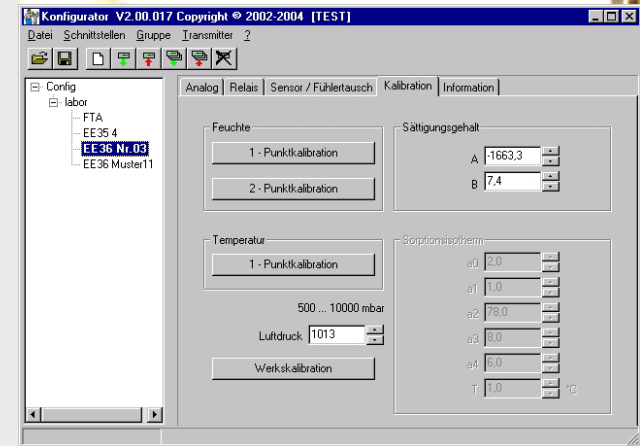
REPLACEABLE REMOTE PROBE (OPTIONAL):



EE36 FEATURES

2-POINT CALIBRATION (SIMILAR EE29/31 – SERIES):

- PUSH BUTTONS on PCB
- CONFIGURATION SOFTWARE



BUT HOW TO CALIBRATE ?

NO PROBLEM, SIMILAR TO RH / T TRANSMITTERS

- Remove from process (ball valve mounting!):
- Clean probe:
strongly recommended to decrease calibration time (n-Hexane)
- Probe into HUMIDITY REFERENCE SYSTEM
- Calibration via PCB or CONFIGURATION SW (similar EE29/31)



TECHNICAL DATA

- **Measuring Range:**

| | |
|-------|------------------|
| Temp. | - 40°C ... 180°C |
| a_w | 0.00 ... 1.00 |
| x | 0 ... 500 ppm |

- **Accuracy a_w :**

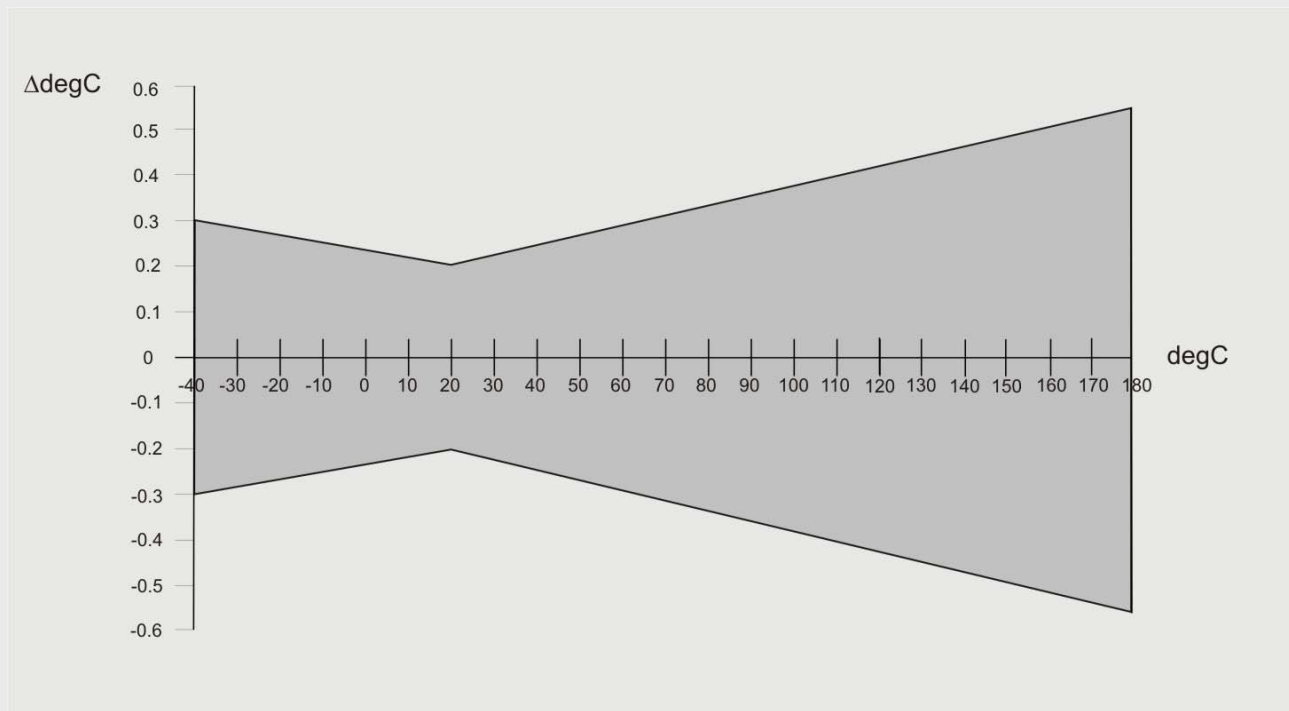
| | |
|--------------------------|-------------------------|
| std.calibration | ± 0.02 (0 ... 0.9) |
| | ± 0.03 (0.9 ... 1) |
| with special calibration | ± 0.01 (0 ... 0.9) |
| | ± 0.02 (0.9 ... 1) |

- **Power Supply:**

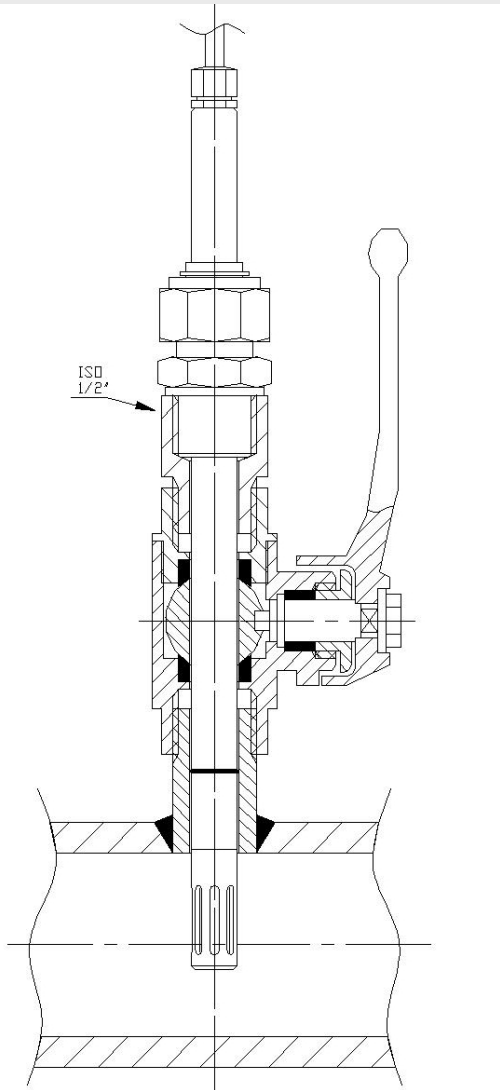
| | |
|--------------|------|
| 8 ... 48VDC | SELV |
| 12 ... 35VAC | SELV |

TECHNICAL DATA

- Accuracy Temperature : $\pm 0.2^{\circ}\text{C}$ @ 25°C



EE36 MECHANICS

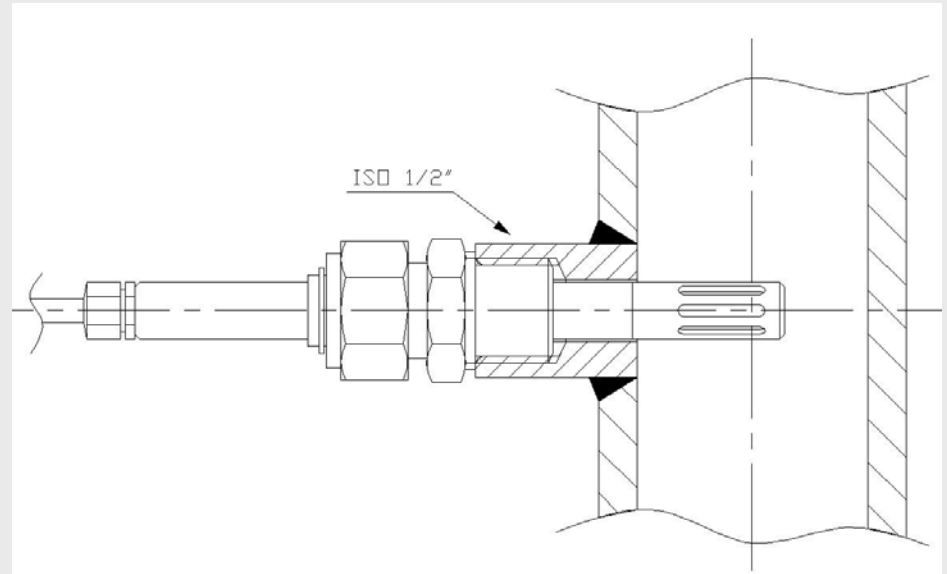


ball valve mounting

up to 10bar

fixed mounting

1/2" ISO (BSPP) or 1/2" NPT available



APPLICATIONS

Monitoring of dielectric fluids (electrical insulating)

- transformers (energy supply)
- power switches
- capacitors with oil dielectric
- oil cable
- rectifiers
- medical equipment (NMR, X-Ray)
- high- voltage fuses
- sonar
- etc.



APPLICATIONS

Monitoring of lubrication oil in:

- hydraulic machinery
- power generators
- paper mills
- ship engines

