

# Current Transducer IT 405-S ULTRASTAB

$I_{PN} = 400 \text{ A}$

For ultra-high precision measurement of current: DC, AC, pulsed..., with galvanic separation between primary and secondary.



## Features

- Wide operating temperature range of -40 °C to 85 °C
- Closed loop (compensated) current transducer using an extremely accurate zero flux detector
- Electrostatic shield between primary and secondary circuit
- 9-pin D-Sub male secondary connector
- Optically insulated output (photocoupler type) indicates transducer state
- LED indicator confirms normal operation.

## Advantages

- Very high accuracy
- Excellent linearity
- Extremely low temperature drift
- Wide frequency bandwidth
- High immunity to external fields
- No insertion losses
- Low noise on output signal
- Low noise feedback to primary conductor.

## Applications

- Feed back element in high performance gradient amplifiers for MRI
- Feedback element in high-precision, high-stability power supplies
- Calibration unit
- Energy measurement
- Medical equipment.

## Standards

- EN 61000-6-2: 2005
- EN 61000-6-3: 2007
- EN 61010-1: 2010.

## Application Domains

- Industrial
- Laboratory
- Medical.

**Insulation coordination**

| Parameter   | Symbol      | Unit | Value | Comment  |
|---|-------------|------|-------|--|
| Rated insulation rms voltage, basic insulation      | $U_b$       | V    | 1600  | IEC 61010-1 conditions<br>- over voltage cat III<br>- pollution degree 2 |
| Rated insulation rms voltage, reinforced insulation | $U_b$       | V    | 300   | IEC 61010-1 conditions<br>- over voltage cat III<br>- pollution degree 2 |
| Rated insulation rms voltage, basic insulation      | $U_b$       | V    | 1000  | EN 50178 conditions<br>- over voltage cat III<br>- pollution degree 2    |
| Rated insulation rms voltage, reinforced insulation | $U_b$       | V    | 600   | EN 50178 conditions<br>- over voltage cat III<br>- pollution degree 2    |
| Rms voltage for AC insulation test, 50/60 Hz, 1 min | $U_d$       | kV   | 4.6   | Between primary and secondary + shield                                   |
| Insulation voltage between secondary and shield     |             | V DC | 200   | Between secondary and shield   |
| Insulation voltage between secondary status output  |             | V DC | 500   | Between secondary and status output                                      |
| Impulse withstand voltage 1.2/50 $\mu$ s            | $\hat{U}_w$ | kV   | 8.5   |  |
| Clearance (pri. - sec.)                             | $d_{Cl}$    | mm   | 9     | Shortest distance through air  |
| Creepage distance (pri. - sec.)                     | $d_{Cp}$    | mm   | 9     | Shortest path along device body  |
| Comparative tracking index                          | $CTI$       |      | 600   |  |

If insulated cable is used for the primary circuit, the voltage category could be improved with the following table (for single insulation) (IEC 61010-1 standard):

|                           |                |
|---------------------------|----------------|
| Cable insulated (primary) | Category       |
| HAR03                     | 1750 V CAT III |
| HAR05                     | 1850 V CAT III |
| HAR07                     | 1950 V CAT III |

**Environmental and mechanical characteristics**

| Parameter                     | Symbol | Unit | Min | Typ  | Max | Comment            |
|-------------------------------|--------|------|-----|------|-----|--------------------|
| Ambient operating temperature | $T_A$  | °C   | -40 |      | 85  |                    |
| Ambient storage temperature   | $T_S$  | °C   | -40 |      | 85  |                    |
| Relative humidity             | $RH$   | %    | 20  |      | 80  | Non-condensing     |
| Dimensions                    |        |      |     |      |     | See drawing page 6 |
| Mass                          | $m$    | kg   |     | 1.08 |     |                    |

**Electrical data**

 At  $T_A = 25\text{ °C}$ ,  $\pm U_C = \pm 15\text{ V}$ , unless otherwise noted.

 Lines with a \* in the comment column apply over the  $-40 \dots 85\text{ °C}$  ambient temperature range.

| Parameter   | Symbol       | Unit             | Min         | Typ      | Max         | Comment                                     |
|---|--------------|------------------|-------------|----------|-------------|---|
| Primary continuous direct current   | $I_{PNDC}$   | A                | -400        |          | 400         | *   |
| Primary nominal rms current   | $I_{PN}$     | A                |             |          | 400         | *   |
| Primary current, measuring range  | $I_{PM}$     | A                | -566        |          | 566         | * Peak limit                                |
| Measuring resistance over supply voltage range  | $R_M$        | $\Omega$         | 0           |          | 15          | See graph page 4                            |
| Secondary current   | $I_S$        | mA               | -377        |          | 377         | * Peak limit                                |
| Secondary nominal rms current   | $I_{SN}$     | mA               |             |          | 266         | *   |
| Conversion ratio  | $K_N$        |                  |             | 1:1500   |             | *   |
| Resistance of secondary winding   | $R_S$        | $\Omega$         |             | 11       |             |   |
| Overload capability <sup>1)</sup>   | $\hat{I}_P$  | A                | -2000       |          | 2000        | @ pulse of 100 ms                           |
| Supply voltage DC   | $U_C$        | V                | $\pm 14.25$ | $\pm 15$ | $\pm 15.75$ | *   |
| Current consumption   | $I_C$        | mA               |             | 122      | 128         | Add $I_S$ for total current consumption     |
|   |              |                  |             | 131      | 139         |   |
| Output rms noise current 0 ... 10 Hz <sup>2)</sup>  | $I_{no}$     | ppm              |             |          | 0.1         |   |
| Output rms noise current 0 ... 100 Hz <sup>2)</sup>   |              |                  |             |          | 1           |   |
| Output rms noise current 0 ... 1 kHz <sup>2)</sup>  |              |                  |             |          | 1.5         |   |
| Output rms noise current 0 ... 10 kHz <sup>2)</sup>   |              |                  |             |          | 4.5         |   |
| Output rms noise current 0 ... 50 kHz <sup>2)</sup>   |              |                  |             |          | 9           |   |
| Re-injected rms noise on primary bus bar  |              | $\mu\text{V}$    |             |          | 5           | 0 ... 50 kHz                                |
| Electrical offset current + self magnetization + effect of earth magnetic field <sup>2)</sup> | $I_{OE}$     | ppm              |             | $\pm 38$ | $\pm 48$    |   |
|   |              |                  |             | $\pm 42$ | $\pm 55$    |   |
| Offset stability <sup>2)</sup>  |              | ppm/month        |             |          | 1           |   |
| Linearity error <sup>2)</sup>   | $\epsilon_L$ | ppm              |             | $\pm 4$  | $\pm 11$    | @ $\pm I_{PNDC}$ range                      |
|   |              |                  |             | $\pm 5$  | $\pm 12$    |   |
| Step response time to 90 % of $I_{PNDC}$  | $t_r$        | $\mu\text{s}$    |             |          | 1           | $di/dt$ of 100 A/ $\mu\text{s}$             |
| $di/dt$ accurately followed   | $di/dt$      | A/ $\mu\text{s}$ |             | 100      |             |   |
| Frequency bandwidth ( $\pm 1\text{ dB}$ )   | $BW$         | kHz              |             | 200      |             | Small-signal bandwidth, 0.5 % of $I_{PNDC}$ |
| Frequency bandwidth ( $\pm 3\text{ dB}$ )   | $BW$         | kHz              |             | 300      |             | Small-signal bandwidth, 0.5 % of $I_{PNDC}$ |

**Notes:** <sup>1)</sup> Single pulse only, not AC. The transducer may require a few seconds to return to normal operation when autoreset system is running

<sup>2)</sup> All ppm figures refer to full-scale which corresponds to a secondary nominal rms current ( $I_{SN}$ ) of 266 mA.

### Overload protection - Electrical specification - Status

The overload occurs when the primary current  $I_p$  exceeds a trip level such that the fluxgate detector becomes completely saturated and, consequently, the transducer will switch from normal operation to overload mode.

This trip level is guaranteed to be greater than 110 % of  $I_{PM}$  and its actual value depends on operating conditions such as temperature and measuring resistance.

When this happens, the transducer will automatically begin to sweep in order to lock on the primary current again and the measuring can resume when the primary current returns in the measuring range between  $-I_{PM}$  and  $+I_{PM}$ .

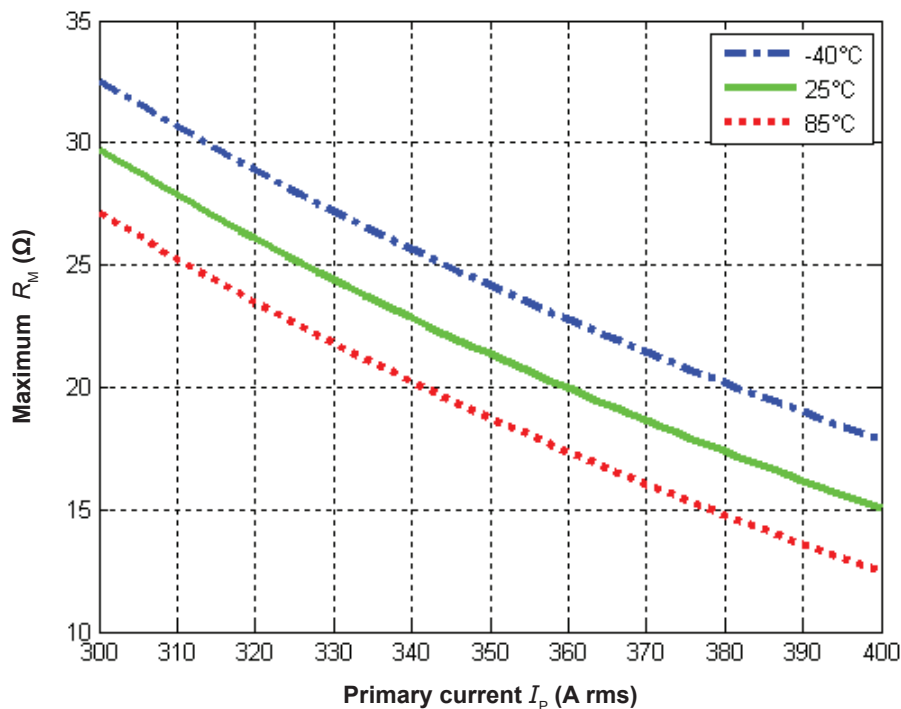
In overload mode, the secondary current  $I_s$  generated is a low frequency signal between  $-0.377$  A and  $0.377$  A.

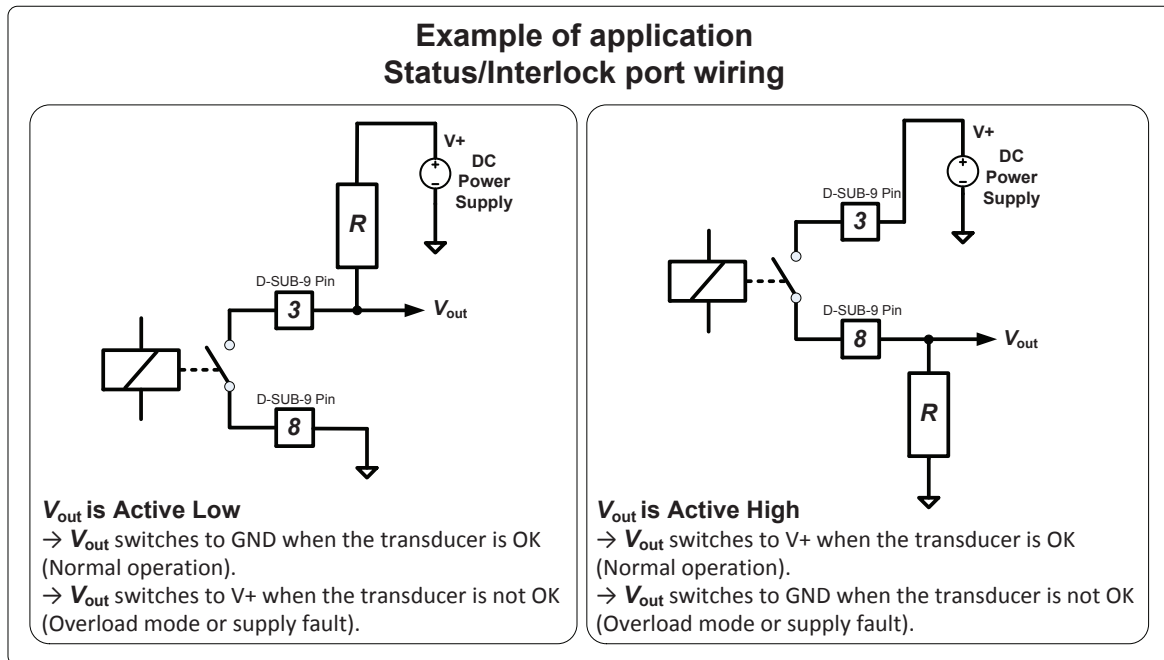
The overload conditions will be:

- The potential-free contact (normal operation status) between pin 3 and 8 (of the D-sub connector) switches off, this contact becomes open.
- The green LED indicator (normal operation status) turns off.

|  |             |
|--|-------------|
| Max voltage pin 3 and pin 8, off-State | 100 V       |
| Max current pin 3 and pin 8, on-State  | 1000 mA     |
| On-State resistance pin 3 and pin 8:   | 30 mΩ (max) |

### Maximum measuring resistor versus primary current and temperature



**Status/Interlock port wiring**

**Safety**

This transducer must be used in limited-energy secondary circuits according to IEC 61010-1.



This transducer must be used in electric/electronic equipment with respect to applicable standards and safety requirements in accordance with the manufacturer's operating instructions.



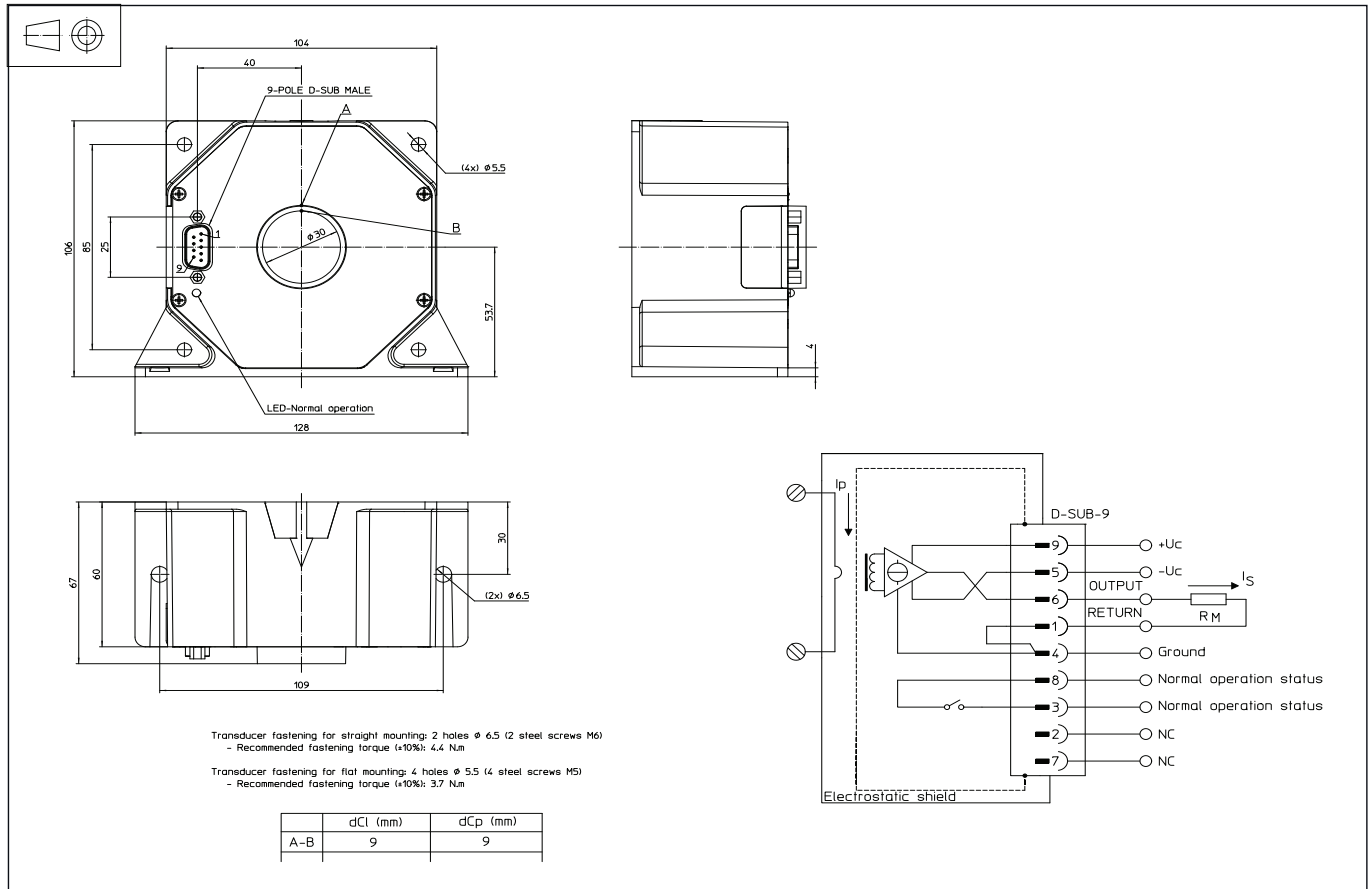
Caution, risk of electrical shock

When operating the transducer, certain parts of the module can carry hazardous voltage (eg. primary connection, power supply). Ignoring this warning can lead to injury and/or cause serious damage.

This transducer is a build-in device, whose conducting parts must be inaccessible after installation.

A protective housing or additional shield could be used.

Main supply must be able to be disconnected.

**Dimensions (in mm)**

**Connection**

- Normal operation status (Pins 3 and 8)  
 Normal operation means:
  - $\pm 15$  V ( $\pm U_C$ ) present
  - zero detector is working
  - primary current  $\leq 110$  % of  $I_{PM}$
  - green LED indicator is lit.

| Contact (Pins 3 and 8) | Description  |
|------------------------|--|
| Closed                 | The transducer is OK (Normal operation)                  |
| Open                   | The transducer is not OK (Overload mode or supply fault) |

**Remarks**

$I_S$  is positive when  $I_P$  flows in the direction of the arrow. We recommend that a shielded output cable and plug are used to ensure the maximum immunity against electrostatic fields. Pin 4 should be connected to cable and connector shield to maintain lowest output noise. Temperature of the primary conductor should not exceed 100 °C.

**Mechanical characteristics**

- General tolerance  $\pm 0.3$  mm
- Transducer fastening
  - Straight mounting: 2 holes  $\phi$  6.5 mm, 2  $\times$  M6 steel screws, Recommended fastening torque 4.4 N·m
  - Flat mounting: 4 holes  $\phi$  5.5 mm, 4  $\times$  M5 steel screws, Recommended fastening torque 3.7 N·m
- Connection of secondary on D-SUB-9, connector UNC 4-40
- All mounting recommendations are given for a standard mounting. Screws with flat and spring washers.
- Primary through hole  $\phi \leq 30$  mm
- Installation of the transducer must be done unless otherwise specified on the datasheet, according to LEM Transducer Generic Mounting Rules. Please refer to LEM document N°ANE120504 available on our Web site: [Products/Product Documentation](#).