# DC-CT® C1040-M34
# Industrial Smart 1000 A Current Transducer

The C1040-M34 is an industrial, galvanically isolated, precision, closed-loop Smart current transducer based on ISOTEL's DC-CT® proprietary technology and the patented Platiše Flux Sensor (PFS). It integrates IEEE 1451.4 TEDS for plug-and-play self-identification and self-description, ISOTEL I-Wire diagnostic interface, and a fail-safe range/fault signal bringing smart sensor capability to industrial current measurement.

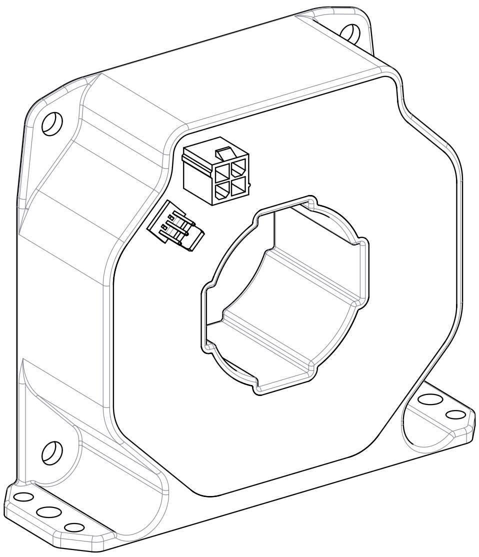
It features standard Molex 3 and 4-pin interfaces, a 40 mm bus bar opening that accepts a 38 mm round conductor, and delivers a bandwidth of 250 kHz with a total error below 500 ppm FS over the entire temperature range. Standby power consumption is 0.75 W. The transducer operates from a bipolar $\pm 12$ to $\pm 24$ V supply and provides an analogue current output.

### Key Specifications

- Sensitivity Accuracy <250 ppm over $T_a$
- Total Offset <250 mA over $T_a$
- Bus bar opening 40 mm and 38 mm round
- Bandwidth 250 kHz
- Low Noise $1\ \mathrm{mA_{rms}}$ @ $BW = 10$ kHz and $5\ \mathrm{mA_{rms}}$ @ $BW = 250$ kHz
- I-Wire TEDS and diagnostic interface IEEE 1451.4 compliant
- Fail-safe range/fault signal
- Operates from Bipolar ±12 . . . ±24 V Supply
- Standby power consumption 0.75 W
- Typical power consumption 7.5 W at rated $I_P$
- High Pulse/Overload Capacity 100 kA, 1 ms
- Withstands rated current and surge currents without damage when unpowered
- Operating temperature range -40 to 85 °C

### Applications

- Power quality monitoring, harmonic analysis, and energy metering
- Precise AC current sensing in substations and industrial distribution
- Precision low-noise current monitoring
- Variable-speed AC drives and servo drives including commissioning and tuning
- Inverters, UPS, BMS, and switched-mode power supplies
- Predictive maintenance / motor current signature analysis (MCSA): current spectrograms for bearing, rotor-bar, and load-related fault detection
- Wind turbines, traction and railway converters



# 1 Electrical Characteristics

| Description | Symbol | Min $-5\sigma$ | Typ $\mu$ | Max $5\sigma$ | Unit | Fig |
|---|---|---|---|---|---|---|
| **Absolute Maximum Ratings** | | | | | | |
| Power Supply Voltage | | | | $\pm 27$ | V | |
| Power Supply Inrush Current | | | | TBD | mA | |
| Primary Steady Current DC | $I_{Pmax}$ | $-1000$ | .. | $+1000$ | A | |
| Max Pulsed Primary Overload Current, 1 ms | $I_{ov}$ | | | 100 | kA | |
| Max Pulsed Secondary Overload Current | $I_{SOV}$ | | | 20 | A | |
| Max Primary Conductor Temperature | | | | 100 | °C | |
| **DC Accuracy** | | | | | | |
| Rated/Nominal Measuring Current DC | $I_P$ | $-1000$ | .. | $+1000$ | A | |
| Peak Measuring Range DC @ $T_a = 23$ °C | $I_{PM}$ | $-1500$ | .. | $+1500$ | A | |
| Nominal Secondary Current at $I_P$ | $I_S$ | $-200$ | .. | $+200$ | mA | |
| Measuring Resistance at $I_{Pmax}$ | $R_M$ | 0 | 10 | 70 | Ω | 14 |
| Transformer Ratio | $N$ | | 5000 | | turns | |
| Sensitivity | $S$ | | 0.2 | | mA/A | |
| Sensitivity Error including Off-Centre over $T_a$ | $\epsilon_S$ | | 150 | 250 | ppm | 2 |
| Magnetic Offset with Hysteresis over $T_a$ RTI | $I_{OM}$ | | $\pm 100$ | $\pm 200$ | mA | 1 . . . 4 |
| Electrical Offset over $T_a$ RTI | $I_O$ | | $\pm 10$ | $\pm 50$ | mA | 1 . . . 4 |
| **AC Accuracy** | | | | | | |
| Gain Accuracy @ $50/60$ Hz, $I_P = 35$ A$_{RMS}$ | | | TBD | | ppm | |
| ... $I_P = 710$ A$_{RMS}$ | | | 150 | 250 | ppm | 5 |
| Frequency Bandwidth @ -3 dB, $I_P = 0.7$ A$_{RMS}$ | $f_{-3dB}$ | | 250 | | kHz | 7 |
| AC Flatness $< 10$ kHz | | | $< 0.1$ | | dB | 7 |
| ... $< 100$ kHz | | | $< 3$ | | dB | |
| Phase Shift $< 10$ kHz | | | $< 2°$ | | deg | 8 |
| ... $< 100$ kHz | | | $< 5°$ | | deg | |
| Reaction Time at 10% of the final $I_{Pmax}$ | | | 56 | | ns | 6 |
| Reaction Time at 90% of the final $I_{Pmax}$ | | | 157 | | ns | 6 |
| Typical RMS Noise at 10 kHz BW RTI | | 0.6 | $\approx 1$ | | mA | 9, 10 |
| ... 250 kHz BW RTI | | | $\approx 5$ | | mA | |
| Platiše Flux Sensor Amplitude RTI @ $f_{PFS} = 220$ kHz | $A_{PFS}$ | | $< 10$ | | mA | |
| **Immunity** | | | | | | |
| Common Mode Rejection @ 100 kHz RTI | | | *TBD* | | $\mu$A/V | |
| External Magnetic Immunity @ 5 mT in any direction RTI | $I_{XB}$ | | *TBD* | *TBD* | mA | |
| **I-Wire and Signal Integrity** | | | | | | |
| Fast Out-of-Range & Fault Detection to Status Asserted | | | 300 | | $\mu$s | |
| I-Wire Max Current | | | 10 | 25 | mA | |
| I-Wire Max Voltage referred to 0 V | | $-30$ | | 30 | V | |

| Description | Symbol | Min $-5\sigma$ | Typ $\mu$ | Max $5\sigma$ | Unit | Fig |
|---|---|---|---|---|---|---|
| **Power Supply** | | | | | | |
| Power Supply Voltage | | $\pm12$ | $\pm15$ | $\pm24$ | V | |
| Power Supply Maximum Inrush/Working Current @ $\pm24$ V | | | | $< 0.5$ | A | |
| Current Consumption | | | $25 + I_p/5$ | | mA | |
| **Environmental Conditions** | | | | | | |
| Isolation CAT II / CAT III non-insulated primary conductor | | | 1000 | | V | |
| Isolation CAT II / CAT III insulated primary conductor | | | 1000 / 1500 | | V | |
| Dielectric Withstand Voltage (Primary to Secondary), 1 min | | | 3.5 | | kV | |
| Clearance / Creepage | | | 20 | | mm | |
| Weight | $m$ | | 0.5 | | kg | |
| Storage and Operating Temperature Range | $T_A$ | $-40$ | | $+85$ | °C | |

## Abbreviations

**BW** Bandwidth

**DC-CT®** Brand that uses the PFS for a magnetic flux sensor

**FS** Full-Scale

**PFS** Platiše Flux Sensor

**RTI** Referred to Input

**TEDS** IEEE 1451.4 Transducer Electronic Data Sheet

## 1.1 Accuracy

The total sensor error $E$ is characterised by the linear sum of error components referred to the input (RTI):

$$E = \epsilon_S \cdot I_P + I_{OM} + I_O$$

For worst-case error budgeting, the maximum total error $E_{max}$ is obtained by summing the maximum values from the Electrical Characteristics table:

$$E_{max} = \epsilon_{S,max} \cdot I_P + I_{OM,max} + I_{O,max}$$

### 1.1.1 DC Sensitivity and Total Offset including Hysteresis

The following typical characteristics were obtained at a nominal power supply of $\pm$15 V, a measurement resistor $R_M$ of 2.5 $\Omega$, an ambient temperature $T_A$ of 23 $\pm$5 °C unless specified, and a primary conductor consisting of a 35 mm diameter round bar in the central position.

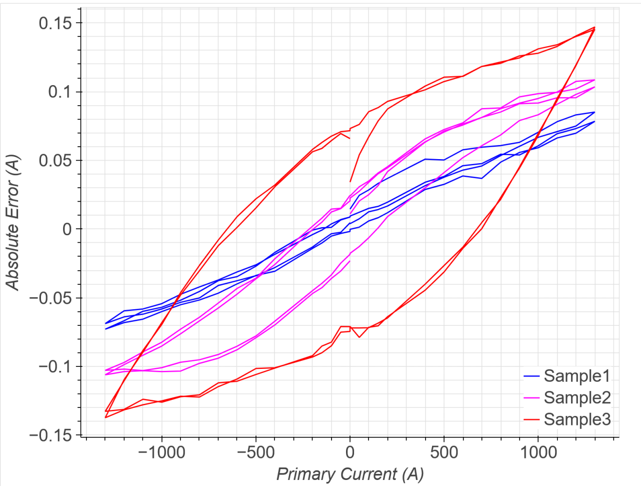



Figure 1: Typical Accuracy Conductor Centred

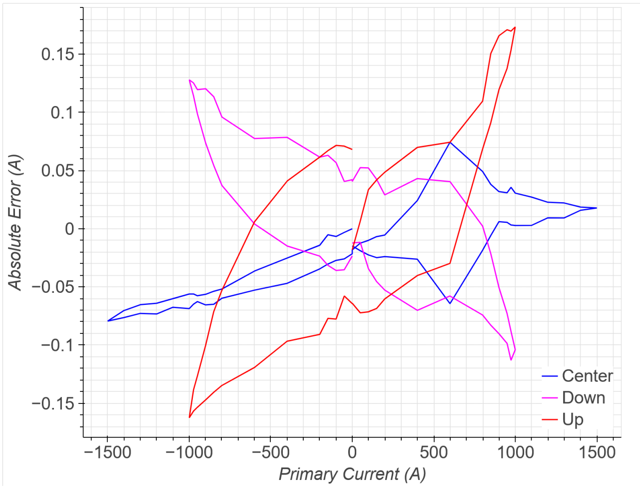



Figure 2: Typical Accuracy Conductor Off-Centred

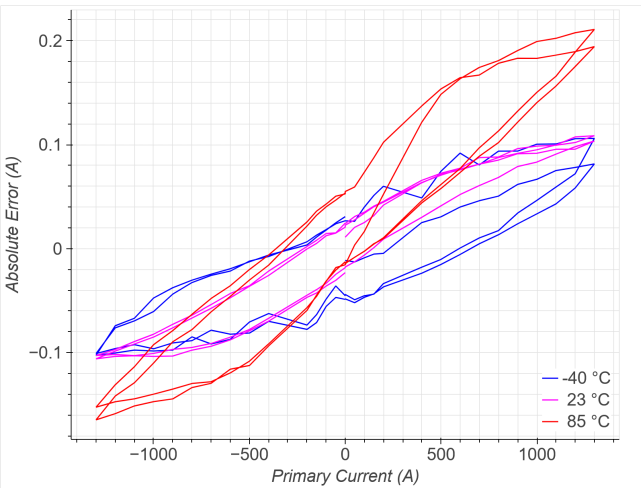



Figure 3: Typical Accuracy over $T_a$

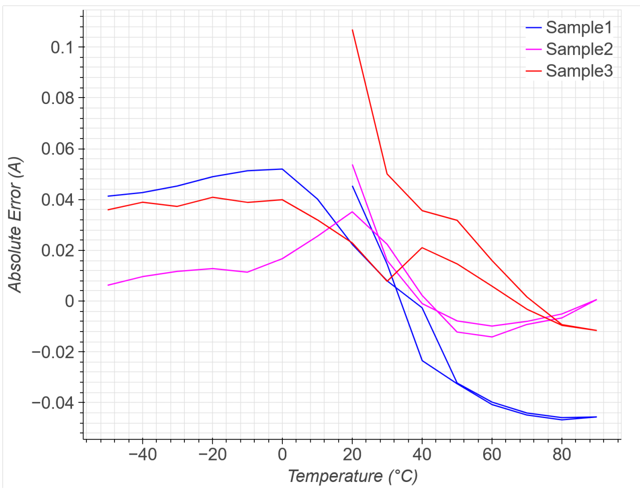



Figure 4: Typical Drift at $I_P$=500 A over $T_a$

### 1.1.2 AC Sensitivity Accuracy and Reaction Time

Figures 5 shows the AC sensitivity error up to 150 Hz. Figure 6 shows a pulse test measurement from which filtered signal reaction times at 10% and 90% were measured.

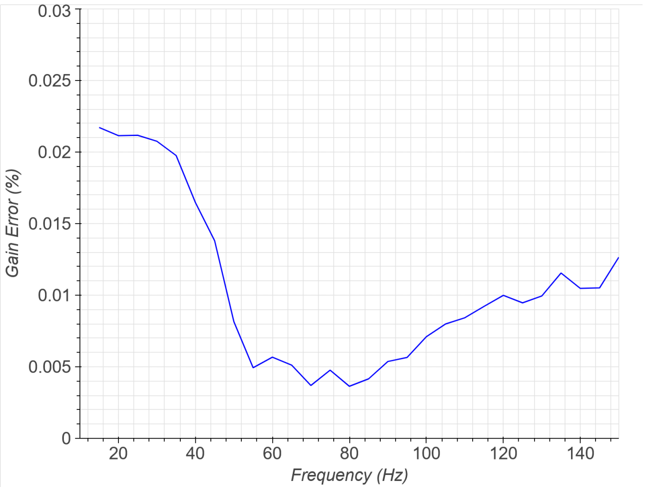



Figure 5: Large Signal AC Sensitivity Gain Error at $I_P = 700$ A$_{RMS}$

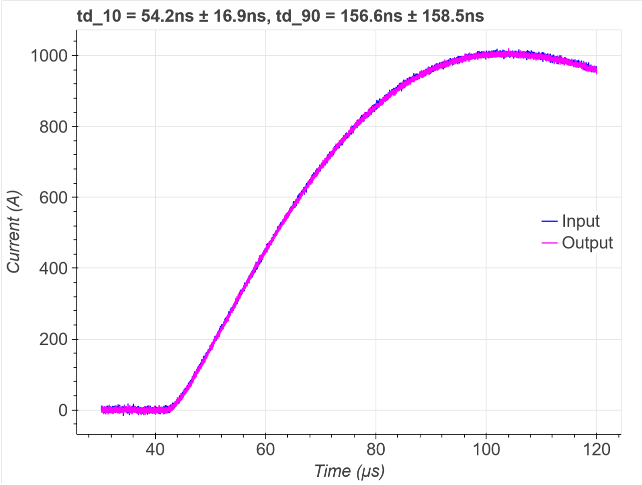



Figure 6: Pulse Test RTI, Reaction Time, $dI/dt = 20$ A$/\mu$s

### 1.1.3 AC Frequency Response

Figures 7 and 8 depict the typical small-signal response at 0.7 $A_{RMS}$.

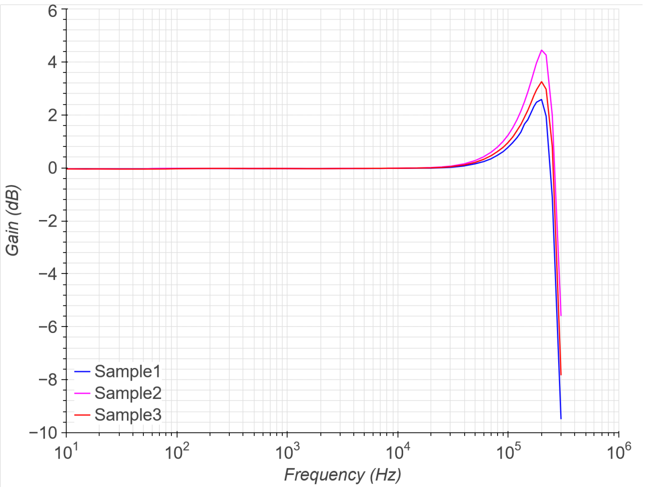



Figure 7: Small Signal AC Gain Response at $I_P \approx 0.7$ A$_{RMS}$

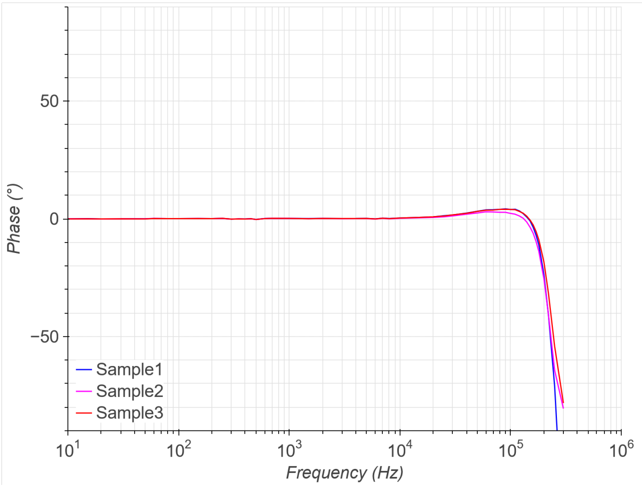



Figure 8: Small Signal AC Phase Response at $I_P \approx 0.7$ A$_{RMS}$

## 1.2 Noise

The best noise performance is obtained with a lower-value measuring burden resistor. The following charts represent typical noise performance at 2.5 and 100 $\Omega$, and $I_P = 0$ A. As noise represents an important feature for predictive maintenance and spectrography, a typical legacy noise performance from a closed-loop Hall sensor competitor is provided alongside.

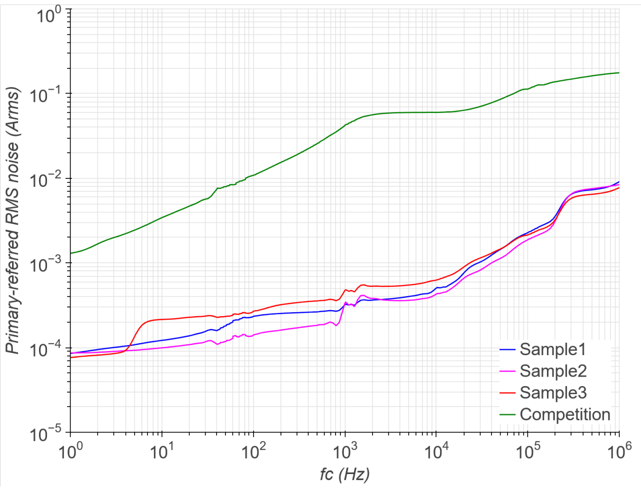



Figure 9: RMS Noise RTI at burden $R_b = 2.5\ \Omega$

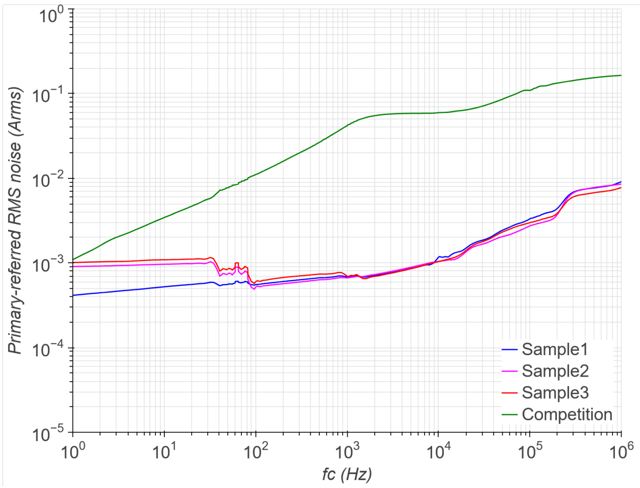



Figure 10: RMS Noise RTI at burden $R_b = 100\ \Omega$

## 1.3 Time Stability

Measured at an ambient temperature $T_A$ of 23 $\pm$5 °C; the measurement includes a start-up warm-up drift.

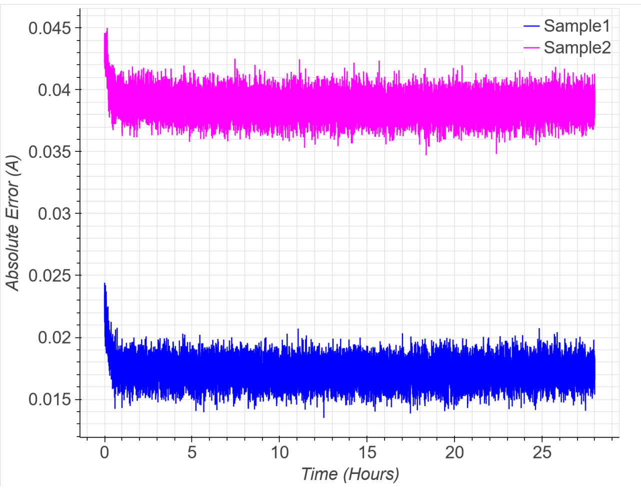



Figure 11: Time Stability at 0 A

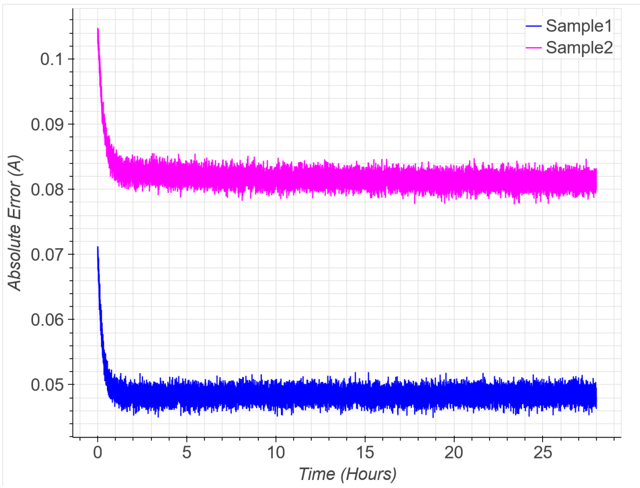



Figure 12: Time Stability at 500 A

# 2 Connection and Operation of the Transducer

Figure 13 presents a block and wiring diagram of the C1040 for the 3-pin Molex 6410 and 4-pin Molex 5566 connectors. The 4-pin connector additionally provides ISOTEL I-Wire diagnostic interface, featuring:

- TEDS: IEEE 1451.4 Transducer Electronic Data Sheet compliant digital ID for self-identification and transducer description for plug-and-play configuration
- Temperature Sensor
- Primary Tracking Loss, Temperature Range, Voltage Supply Range, and Current Fault Signals
- Fast Out of Range Error

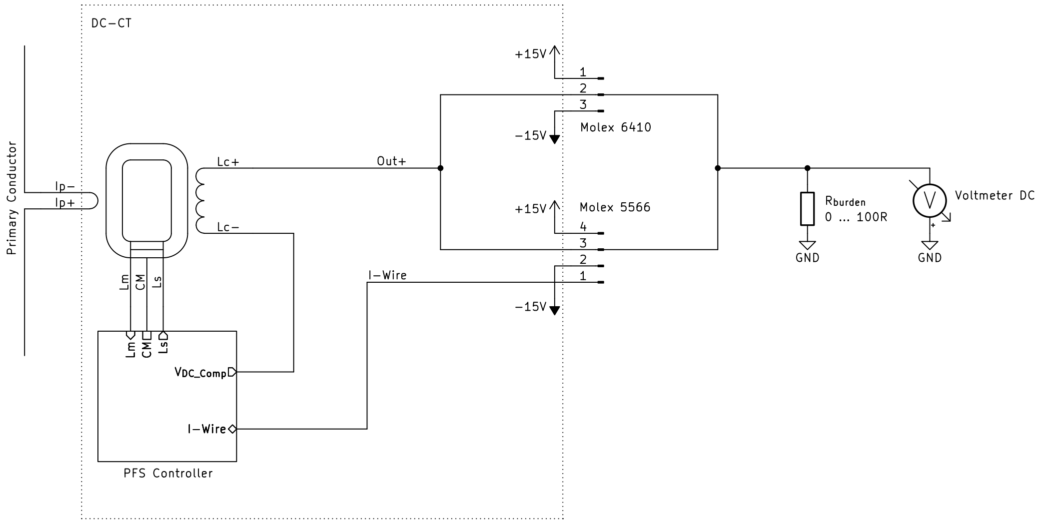



Figure 13: Block and Wiring Diagram

A bipolar $\pm12$ to $\pm24$ V supply is required to power the unit. At the same time, the sensor output represents the return ground, on which path a measurement resistor is to be inserted, whose value determines the measuring range as shown in Figure 14.

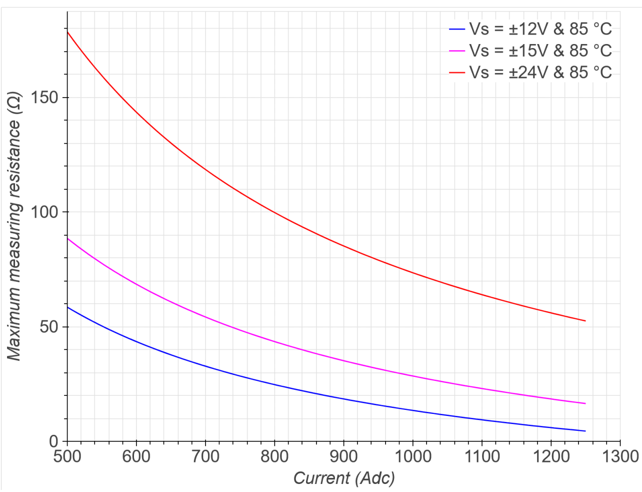



Figure 14: Max Measuring Resistance

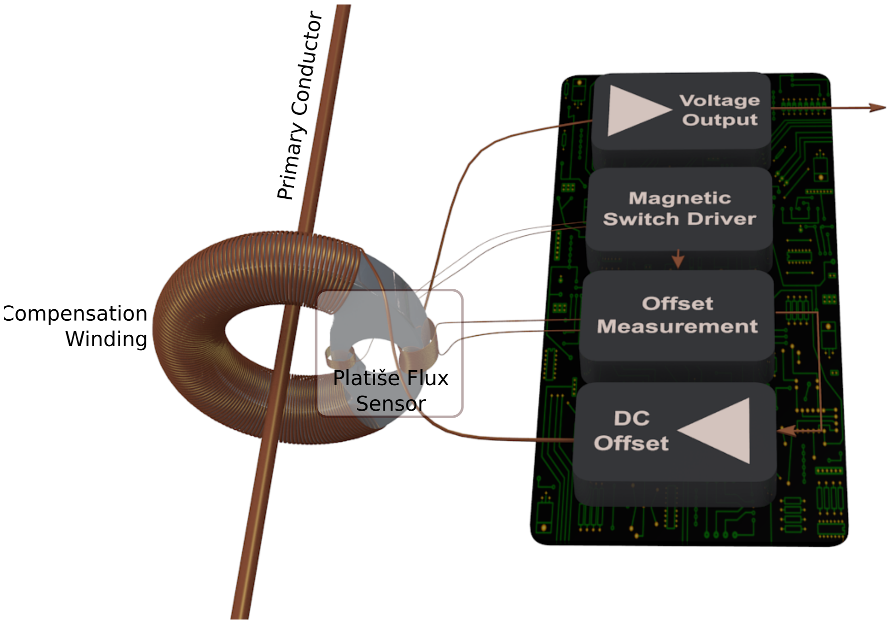
# 3 About the Patented Platiše Flux Sensor and the DC-CT®

The DC-CT® transducers utilise a novel Platiše Flux Sensor (PFS) technology, marketed under the PFS brand.

The PFS is implemented on a single magnetic core, similar to Hall-effect or single-chip GMR sensors, but critically, without an air-gap. This unique architecture allows it to match or exceed the performance of traditional, bulky multi-core flux-gate sensors. By eliminating complex multi-core constructions, the DC-CT® delivers laboratory-grade accuracy in a highly compact industrial form factor. Consequently, the Platiše Flux Sensor provides a definitive solution for demanding applications requiring accuracies from 0.01% to 0.1%.

Uroš Platiše invented this patented measurement principle and its foundational mechanism, Current Controlled Variable Reluctance. This mechanism actively redirects magnetic flux, efficiently converting constant (DC) flux into a measurable AC signal at a rate defined by the PFS frequency. Crucially, the PFS is inherently temperature-stable. Any minor variations are dictated mostly by the base magnetic material, meaning the sensor's performance inherently improves alongside advancements in metallurgy.

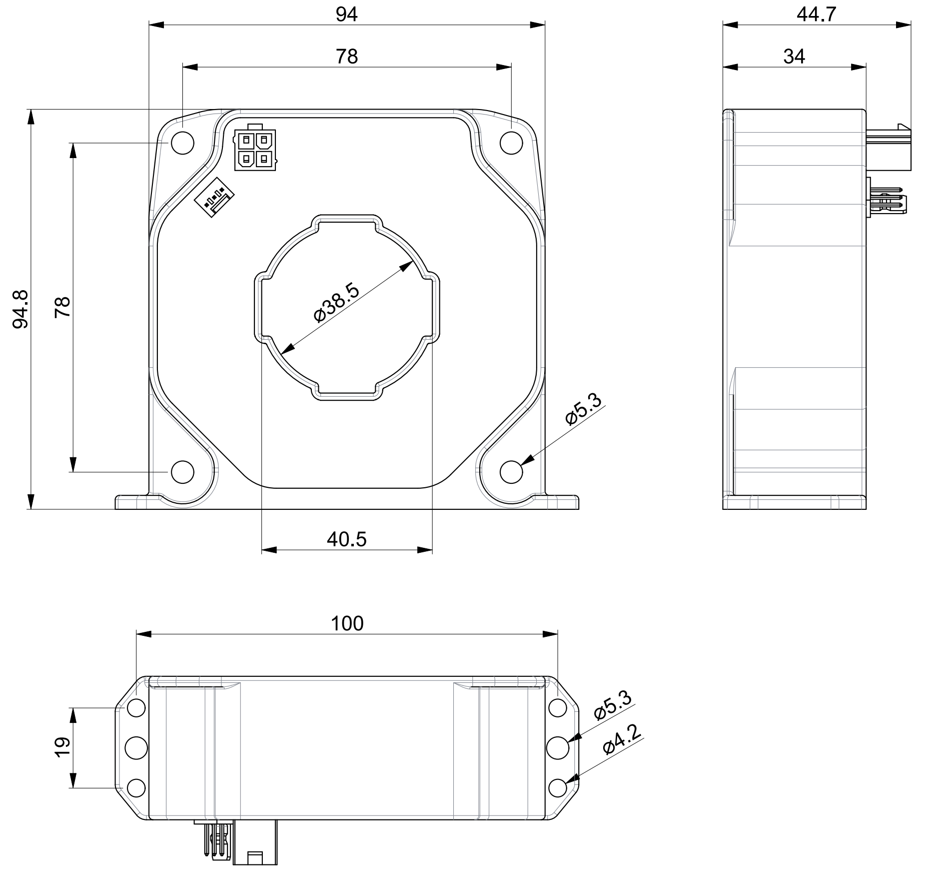
To achieve ultimate precision, the C1040 employs a zero-flux (null) method, actively compensating for magnetic non-linearities like advanced closed-loop transducers, but with superior bandwidth. The operational principle is illustrated in the following figure:




The primary current flows through a magnetic core wound with a secondary compensating winding of $N$ turns, establishing the transformation ratio. A modulating winding, driven by a magnetic switch, and a sensing winding are applied to a localized section of the core. The offset measurement circuitry detects residual flux, which the output amplifier integrates to nullify the DC component. Meanwhile, the AC component bypasses this compensation loop, passing directly to the output to preserve wide bandwidth and rapid reaction times.

More information about this patented technology can be found at www.dc-ct.com.

# 4 Dimensions




# 5 Ordering Information

| Ordering Code | Description |
|---|---|
| DC-CT-C1040-M34 | Molex 6410 (3-pin) and 5566 (4-pin) connectors |

## Disclaimer