# New-PCT

## *New Parametric Current Transformer*

### *DC beam current non-destructive measurement*

**Four ranges ±20mA, ±200mA, ±2A and ±20A**
**<0.5uA/√Hz noise, i.e. resolution, on option**
**DC to 10 kHz (-3dB) frequency response**
**< 0.1% linearity error**
**NPCT package includes spares for all electronics**

**Application**

The Parametric Current transformer is used on most particles accelerators in the world to measure the average beam current. It is an essential instrument for accelerator tuning and operation.

It is primarily used on particle sources, cyclotrons, medical synchrotrons, HEP research accelerators and light sources.

It is often the only intrinsically calibrated beam instrument in an accelerator and serves as a reference to calibrate other beam diagnostics.

**Operating principle**

The NPCT works on the second harmonic detection principle. Two cores are modulated to deep saturation in opposite phase. A primary DC current flowing through the cores shifts the cores' working point in opposite polarity which generates a second harmonic of the modulator frequency. The primary current AC component is detected by an AC Hereward transformer. The two circuits are cascaded in a common feedback loop to generate a magnetic flux which always cancel the primary current flux. The NPCT output is the voltage developed by the feedback current passing through a precision resistor.

*New-PCT Chassis with NPCT-E electronics and power supplies*

*The New Parametric Current Transformer is the latest evolution of the Unser Transformer, commonly called DCCT, developed at CERN in 1966 by Klaus B. Unser.*

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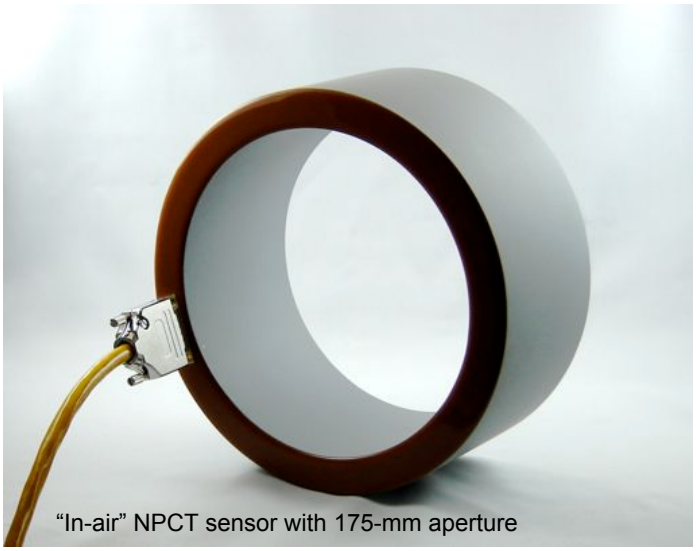
**In-flange.NPCT** to mount in the beam line

In-flange.NPCT with 96-mm aperture

**NPCT sensor** for "in-air" installation

A typical installation is over the vacuum chamber; it requires a "gap" to prevent the wall current from flowing through the sensor aperture, bellows, a wall current bypass, which can serve as RF shield. It often requires an external magnetic shield.



"In-air" NPCT sensor with 175-mm aperture

## Specifications

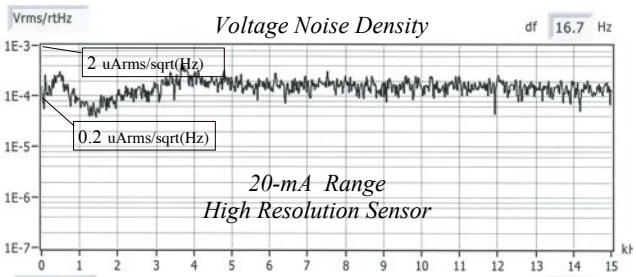
| | |
|---|---|
| Full scale ranges | ±20mA, ±200 mA, ±2A, ±20A |
| Range control | 2 TTL lines on rear panel DB9 |
| Output | ±10 V |
| Output over range | up to ±12V |
| Output bandwidth (-3dB) | 8 kHz in 20-mA Range<br>10 kHz in other ranges |
| Response time (@ 90%) | < 50 us |
| Resolution | |
| Standard model | < 5 uA/sqrt(Hz) |
| High Resolution model | < 1 uA/sqrt(Hz) |
| Very High Resolution model | < 0.5 uA/sqrt(Hz) |
| Output accuracy | ± 0.1% ± zero-offset<br>± magnetic field sensitivity<br>± temperature drift |
| Linearity error | < 0.1% |
| Temperature coefficient | < 0.5uA/K typ. |
| Operating temperature | -40...80°C |
| Output impedance | 100 Ω |
| Output current | 10mA max, source or sink |
| Output connectors | Isolated BNC on rear panel and front panel |
| Test function | Injects +100mA in sensor |
| Test control | TTL line on rear panel (DB9) |
| Calibration winding | 10-turn floating calibration winding on sensor |
| Calibration current | from external source (2A max, Z > 100 Ω) |
| Calibration connectors | Isolated BNC on rear panel and front panel |

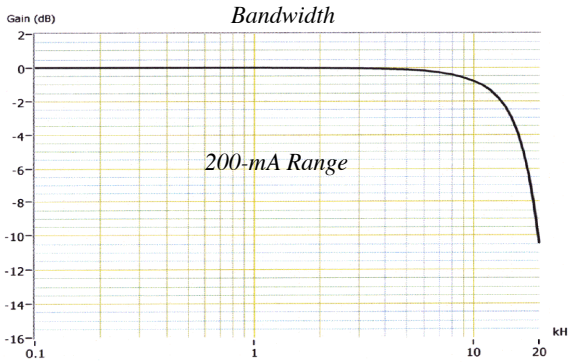
## Sensor head

| | |
|---|---|
| Connector | DB15 male |
| Temperature coefficient | 5 uA/K typ. |
| Sensor baking | < 100°C, 212F. |
| Destructive level | DC current: Unlimited<br>Pulse charge > 100 mC |
| Sensor saturation flux | 10 mT (axial) typ.<br>2 mT (radial) typ. |
| Sensor sensitivity to external magnetic fields | 10 uA/mT (axial) typ.<br>1 mA/mT (radial) typ. |

## NPCT package includes:

One NPCT sensor head
One interconnect cable
One 19" 3U RF-shielded chassis, with
Two power supplies, autorange AC input (one as spare)
Two NPCT electronics cassettes (one as spare)




## Dimensions & Ordering codes

| **In-flange.NPCT** order code: | Pipe Ø nom. | Mating flange: | ID (mm) | H (axial) |
|---|---|---|---|---|
| NPCT-CF2"1/8-22.2-120-UHV- | 1" | DN25 NW25CF | 22.2 | 120.0 |
| NPCT-CF2"3/4-34.9-120-UHV- | 1"1/2 | DN40 NW35CF | 34.9 | 120.0 |
| NPCT-CF4"1/2 -60.4-120-UHV- | 2"1/2 | DN63 NW63CF | 60.4 | 120.0 |
| NPCT-CF6"-96.0-120-UHV- | 4" | DN100 NW100CF | 96.0 | 120.0 |
| NPCT-CF8"-147.6-120-UHV- | 6" | DN160 NW150CF | 147.6 | 120.0 |
| NPCT-CF10"-198.4-120-UHV- | 8" | DN200 NW200CF | 198.4 | 120.0 |
| **NPCT "in-air"** order code: | OD (mm) | Clears over flange: | ID (mm) | H (mm |
| NPCT-055- | 98 | DN16 NW16CF | 55 | 108 |
| NPCT-075- | 118 | DN40 NW35CF | 75 | 108 |
| NPCT-115- | 158 | DN63 NW50/63CF | 115 | 108 |
| NPCT-130- | 175 | DN63 NW50/63CF | 130 | 108 |
| NPCT-175- | 222 | DN100 NW100CF | 175 | 108 |
| NPCT-195- | 250 | Mitsubishi PT | 197 | 108 |
| NPCT-203- | 248 | DN160 NW150CF | 203 | 108 |
| NPCT-245- | 298 | DN200 reduced | 245 | 108 |
| **Cable** | Units | Type | | |
| -Cxxxx<br>-RHCxxx | meters<br>meters | Polypropylene FR-LS<br>Siltem Radiation-tolerant R.I.>7 | | |
| **Sensor options** (In-flange.NPCT only) | | | | |
| -ARB#xxx<br>-316LN | Arbitrary (noncircular) aperture drawing#<br>Made out of AISI 316LN instead of 304 | | | |
| **Higher resolution options** (applies to all sensors): | | | Noise density | |
| -HR<br>-VHR | High Resolution<br>Very High Resolution | | < 1uArms/rtHz<br><0.5uArms/rtHz | |
| **Radiation tolerant option** (applies to sensor only) | | | | |
| -H | Improved radiation tolerance | Improves critical materials radiation tolerance by 2-3 orders of magnitude | | |

## Distributors

**U.S.A.** : GMW Associates
955 Industrial Rd.
San Carlos, CA 94070, U.S.A.
Fax: (650) 802-8298 - Tel.: (650) 802-8292
sales@gmw.com www.gmw.com

**Japan** : REPIC Corporation
28-3 Kita Otsuka 1-Chome
Toshima-ku, Tokyo 170-0004, Japan
Fax: 03-3918-5712 - Tel.: 03-3918-5326
sales@repic.co.jp www.repic.co.jp

## Manufacturer

BERGOZ Instrumentation
Espace Allondon Ouest
01630 Saint Genis Pouilly, France
Fax: +33-450.426.643 - Tel.: +33-450.426.642
sales@bergoz.com www.bergoz.com

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*Instrumentation*

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