Technical Specification – DC Beam Current Transformer Systems for AP2.1

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1. Purpose and application

The Low Energy Beam Transport (LEBT) section of the new 18 GHz ECR ion source at GSI shall be equipped with two DC Beam Current Transformer (DCCT) systems. The systems shall provide non-destructive measurement of the average and DC beam current during commissioning and operation.

Each system shall comprise a UHV-compatible in-flange DCCT sensor, the associated signal-processing electronics, a 30 m radiation-resistant sensor-to-electronics cable and all power-supply components required for operation.

Each system shall be delivered as a complete, matched, calibrated and fully operational sensor-electronics unit. Each DCCT system shall be supplied with two electronics cassettes and two power supplies, one of each serving as a spare.

2. Technical requirements

The DCCT sensors shall be designed for in-flange installation in a UHV beam line. The electrical, mechanical and vacuum requirements are specified below.

Electrical parameters

Parameter	Requirement
Beam current measurement range	±2 mA
Analogue output	±10 V
Output overrange	At least ±12 V
Bandwidth (−3 dB)	DC to at least 1 kHz
RMS current noise	<1 µA RMS, High Resolution
Linearity error	<0.1%
Output accuracy	±0.1%, plus contributions from zero offset, external magnetic fields and temperature drift
Nominal output impedance	100 Ω
Maximum output current	10 mA, source and sink
Measurement output	Galvanically isolated analogue output via BNC connector
Calibration facility	Integrated, floating calibration winding
Calibration connection	Galvanically isolated BNC connector
Sensor-to-electronics connection	Radiation-resistant 30 m cable supplied as part of each complete system
Sensor temperature coefficient	Typical value shall be stated; reference value 10 µA/K
Electronics temperature coefficient	Typical value shall be stated; reference value <0.5 µA/K
External magnetic-field sensitivity	Values for axial and radial external fields shall be stated
Magnetic saturation limits	Limits for axial and radial external fields shall be stated; typical reference values: 10 mT axial and 2 mT radial

The supplier shall state the number of turns, calibration factor, permissible excitation current and impedance of the calibration winding.

Manufacturer-specific connectors between the sensor and its electronics are permissible if all required connectors and cables are included.

Complete connector assignments, calibration factors and interface descriptions shall be provided.

Mechanical and vacuum parameters

Parameter	Requirement
Sensor configuration	In-flange DCCT sensor
Vacuum interfaces	CF160
Clear aperture	At least 147.6 mm
Flange material	Stainless steel AISI 304
Operating vacuum	Suitable for operation at pressures below 1×10^{-8} mbar
Leak rate	Less than 2×10^{-9} mbar·l/s per sensor assembly

All vacuum-facing materials shall be UHV-compatible.

The supplier shall state all materials exposed to the vacuum. Dimensional drawings showing the flange geometry, clear aperture, external dimensions, connector positions and mass shall be provided.

The DCCT sensors and the associated 30 m interconnection cables shall be suitable for operation in a radiation protection area. The supplier shall state the qualified or guaranteed radiation tolerance of the proposed sensors and cables, including the applicable test conditions.

3. Factory testing and test reports

A separate, serial-number-specific factory test report shall be supplied for each DCCT system.

Each factory test report shall include the system-specific calibration records.

Each test report shall identify the system and sensor serial numbers, test date, test methods, measuring equipment, measured results, pass/fail assessment and testing body. A general datasheet or declaration of conformity does not replace the required test report.

4. Scope of Supply

- 2× DCCT sensors with CF160 interfaces
- 4× signal-processing electronics cassettes, including 2 spares
- 2× radiation-resistant sensor-to-electronics cables, each 30 m long, including all required connectors
- 4× power-supply units, including 2 spares, with mains cables suitable for operation at 230 V AC, 50 Hz
- 2× serial-number-specific factory test reports, including system-specific calibration records
- 1 set of operating manuals, interface descriptions, dimensional drawings and electrical documentation