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1. Scope

I. This document defines requirements for the installation and use of the DCCT and ADC in power converters class 3 – the total deviation (precision) is defined as 100ppm=1E-4 absolute (ABS).

2. Definitions

I. Definition of terms used in this Technical Guideline are presented in following groups:
   a. General Terms and Objects Definitions - Table 1

Table 1 General Terms and Objects Definitions

Term	Definitions and Abbreviations
Company	GSI/FAIR
DCCT	(Zero-Flux) Direct Current Current Transducer
ADC	Analogue-to-Digital Converter module
ACU	Adaptive Control Unit – power converter control system In case of the class 3 the ACU includes slots for the ADC and DCCT modules
ABS	Absolute precision; calculated with respect to the Full Scale (Nominal Current)
Class 1 (precision)	The accuracy budget is defined as the ABS 10ppm =0.1E-4
Class 2 (precision)	The accuracy budget is defined as the ABS 50ppm =0.5E-4
Class 3 (precision) Normal accuracy	The accuracy budget is defined as the ABS 100ppm =1E-4; the configuration of the class 3 system is presented in Figure 1
primary bus-bar	bus-bar or cable through the DCCT head
in-situ	on the place of installation

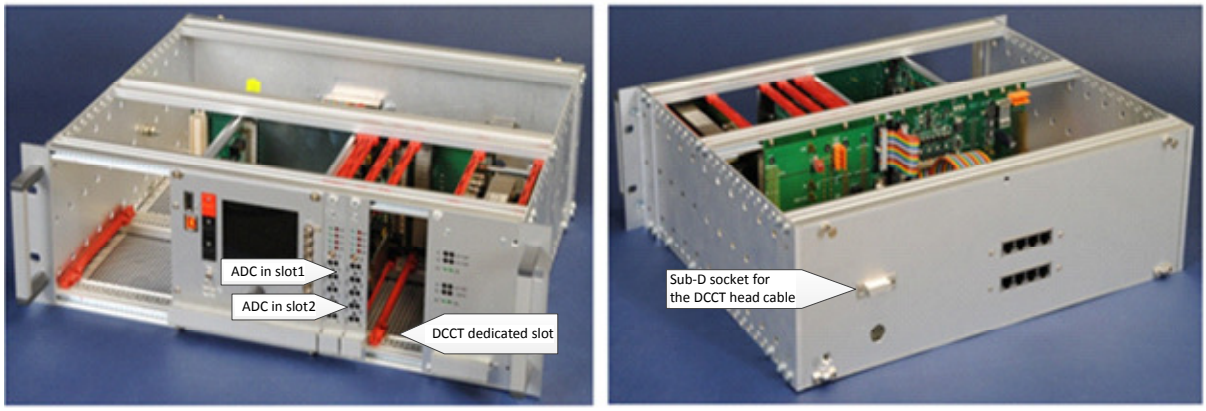

Figure 1. Configuration of the class 3 system: ACU create with DCCT and ADC modules

3. Requirements for the power converter (design)

3.1. Installation and de-installation (easy access)

I. The ACU 19" rack must be installed in a way that easy access (easy installation and de-installation) to the ADC and DCCT modules are guaranteed. The same applies to the DCCT head. De-installation and installation shall be possible without necessity of disconnection/de-installation of any other systems (besides primary bus-bar in case of the DCCT head).

II. Installation and de-installation of the DCCT and ADC modules is required due to service and calibration (external) activities.

3.2. Requirements for the Power Converter

I. The Contractor must provide details about the integration of the DCCT head and the ACU 19" rack (DCCT and ADC modules included); drawings with distances between the DCCT head or the ACU 19" rack and:
   a. power cables/bus-bars,
   b. main inductive components (transformers, inductors),
   during the Preliminary Design Review and the Final Design Review of a power converter.

II. The distance between a head and a (single) return bus-bar in any direction cannot be smaller than 30mm up to 1kA and above 1kA – 30mm per 1kA
   when more symmetrical return bus-bars are used the allowed distance is smaller (e.g. when 2 symmetrical return bus-bars are used the distances required above can be reduce by factor 2).

III. The primary bus-bar through the DCCT head must be easy to disassemble and the DCCT head can be easily removed.

IV. A configuration/design of bus-bars shall allow removing the primary bus-bar from the DCCT head and install another primary bus-bar connected to an external current source for in-situ DCCT testing. The length of this external primary bus-bar is 2x60mm+head thickness up to 1kA and 2x120mm+head thickness up to 2kA. For power converters with an output current of more than 2kA the installation of such a bus bar is not required.

3.3. Magnetic field inside a power converter

I. Magnetic stray field of inductive components and bus-bars shall be considered to define the location of the DCCT head and the ACU 19" rack. The effect of these fields to the DCCT head and the ACU 19" rack shall be as low as possible.

4. Further requirements

4.1. Installation

I. The installation of the DCCT head and electronics shall be done according to the DCCT manual.
II. The primary bus-bar must be in the centre of the head bore.
III. The position of the primary bus-bar must be fixed.

4.2. DCCT Safety Precautions

I. Is not allowed to have a current in the primary bus-bar:
   a. when the DCCT head is disconnected from the DCCT electronic
      in this case a high voltage across the open secondary (and calibration) winding may reach the range of kV which may cause arcing: danger condition for an operator and equipment; the precision of the DCCT is affected permanently (head properties),
   b. when the DCCT electronic is turned-OFF but head is connected to DCCT
      in this case a high voltage should not appear but the head properties (offset) is affected.
II. The only possibility to power a circuit with the DCCT head disconnected from the electronics or the DCCT electronic is turned-off when the secondary or calibration winding (when exist) is short-circuited.
III. In case of an event during testing of the power converters at the contractors site that the circuit with the DCCT head is powered when:
   a. the DCCT head is not connected to the DCCT electronics or
   b. the secondary or the calibration winding of the DCCT head is not short-circuited or
   c. the DCCT electronic is turned off,

the Company must be informed about this event due to mandatory DCCT recalibration.

4.3. DCCT Acceptance Criteria for Power Converter

I. A power converter must fulfil the acceptance criteria related to the DCCT as follows:
   a. easy access and de-installation/ installation (see section 3.1)
   b. appropriate distances and primary bus-bar configuration (see section 3.2)
   c. stray magnetic field around the DCCT head and ACU 19” rack must be as low as possible (see 3.3); the company reserve the right to perform magnetic measurements during SAT.

I. Document Development

Rev.	Date	Author	Chapters	Description of Changes
0.0	2017-06-29	A.Stafiniak	All	Draft version
0.2	2017-07-12	A.Stafiniak H.Welker	All	Preliminary version
1.0	2017-07-17	A.Stafiniak	All	Ready for approval