ZERO FLUX TRANSDUCTOR REQUIREMENTS

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Brief Summary

This Specification describes a precision current measuring device (DCCT) that will measure bipolar DC currents produced by magnet power supplies in the Stanford Synchrotron Radiation Laboratory's (SSRL) Linac Coherent Light Source free electron laser. Seller shall design, manufacture, perform quality assurance, test, package, and deliver the DCCTs in accordance with the requirements of this Specification and the Purchase Order.

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1.0 SCOPE
1.1 The following specifications describe a precision current measuring device that will measure bipolar DC currents or AC currents. The device hereafter referred to as a DC current transductor (DCCT) for use in the Stanford Synchrotron Radiation Laboratory’s (SSRL) Linac Coherent Light Source free electron laser. SSRL is a division within the Stanford Linear Accelerator Center (SLAC). Both SSRL and SLAC are hereinafter simply referred to as Purchaser.

1.2 Seller shall design, manufacture, perform quality assurance, test, package, and deliver the DCCTs in accordance with the requirements of this Specification and the Purchase Order.

2.0 AMBIENT CONDITIONS
2.1 Prevailing ambient conditions at Purchaser’s site located in Stanford, California are:
   Location …………… Indoors in Power Supply Building 118
   Temperature ………. 40 °F (4 °C) minimum to 113 °F (45 °C)
   Elevation ………….. 900 ft above sea level
   Humidity …………… 10% to 100% relative humidity with a 50 °F dew point

3.0 ELECTRICAL SPECIFICATIONS
3.1 The DCCT shall work on the zero flux detection principle, in which a magnetic core is excited with a modulating frequency and is returned to zero net flux whenever even harmonics of the modulating frequency are present.

3.2 The DCCT nominal (In) current rating shall be +/- 150 A, or +/- 600 A in the quantities listed in the Purchase Order.

3.3 The DCCT shall provide complete galvanic isolation between an insulated or bare conductor that carries the current being measured and an analog output signal that indicates the level of the current.

3.4 The DCCT operating life shall be 20 years (174,000 hours) at continuous full-load duty.

3.5 Input power for the DCCT will be +/- 15V DC +/- 5 %. It shall be permissible to apply the input power in any polarity sequence without affecting the performance of the DCCT.

3.6 150A rated DCCTs shall provide a full-scale current (FSI) analog output signal = +/- 200 mA DC for $I_n = +/- 150$ A.

3.7 600A rated DCCTs shall provide a full-scale current (FSI) analog output signal = +/- 400 mA DC for $I_n = +/- 600$ A.

3.8 The DCCT output voltage compliance shall be $\geq +/- 1.0$ V.

3.9 Purchaser’s burden resistor will be = 5.0 $\Omega$ for 150 A rated, 200 mA FSI DCCTs.

3.10 Purchaser’s burden resistor will be = 5.0 $\Omega$ for 600 A rated DCCTs used in 300 A circuits where FSI will be +/- 200 mA.

3.11 Purchaser’s burden resistor will be = 2.5 $\Omega$ for 600 A rated DCCTs used in 600 A circuits where FSI will be +/- 400 mA.
3.12 Zero offset error as a function of FSI:
   Initial: < 20 ppm at 25 °C
   Vs. temperature: < 0.5 ppm / °C
   Vs. time: < 5.0 ppm / month
3.13 Linearity error < 4 ppm of FSI
3.14 Stability shall be < 3.0 ppm of FSI.
3.15 The small signal bandwidth shall be from DC to 100 kHz.
3.16 The output slew rate shall be > 5 kA / msec.
3.17 RMS noise voltage shall be:
   < 0.1 ppm of FSI from 0.1 Hz to 10 Hz.
   < 6.0 ppm of FSI from 10.0 Hz to 10 kHz
   < 20 ppm of FSI from 10 kHz to 50 kHz.
3.18 Insulation between cable carrying In and DCCT head windings:
   Nominal (operating) 1.5 kV DC
   Test 3.0 kV RMS @ 60 Hz for 1 min
3.19 Output change vs. supply voltage < 0.4 ppm of FSI for a 1% change.
3.20 The noise feedback from the transducer to the load current carrying conductor shall be < 10 µV RMS.
3.21 The DCCT shall be capable of withstanding a 10% temporary increase in load current above FSI. The accuracy and linearity specifications for the normal operating range are not applicable during the overload condition. However, do not clamp the output signals at +/- 200 mA DC or, +/- 400 mA DC. The output signal shall continue to increase proportional to load current within the overload range.
3.22 A signal shall be provided to indicate a valid output. This signal shall be active low and capable of driving one TTL load (1.6 mA @ 0.6 V). Either a normally open relay contact or an opto-coupled transistor may be used. The signal must present high impedance whenever the DCCT is not able to provide the specified accuracy, such as when 15 V power is not present or when the load current exceeds the range of the internal amplifiers.
3.23 The DCCT shall contain a metal or metallized shield that surrounds the whole assembly.

4.0 MECHANICAL SPECIFICATIONS
4.1 The DCCT shall consist of one integrated assembly that houses the measuring head and electronics. A 1” diameter aperture shall be provided to accept Purchaser's load cable.
4.2 The DCCT shall be convection air cooled and shall operate over the specified ambient temperature range.
4.3 Seller shall specify the minimum clearances and distances to nearby power cables. In any case, the DCCT head design shall be such that a parallel current-carrying return conductor of the same rating as the current being monitored may be installed not less than 2” away from any part of the DCCT.
4.4 In addition to a nameplate identifying the DCCT rating, the DCCT head shall have an arrow or other indicator showing the direction of current that will yield a positive output signal.
4.5 The DCCT inputs and outputs shall be available from a single D-type connector.

4.6 Maximum overall dimensions shall be $\leq 5'' \times 4'' \times 2.5''$, exclusive of any supplied bus bars.

5.0 DOCUMENTATION

5.1 Provide a DCCT instruction manual in portable document format (pdf) electronic format. The manual shall discuss installation, operation, maintenance and shall include specifications, outline dimensions, theory of operation, circuit descriptions, schematics, and troubleshooting suggestions, and reduced size copies of subassemblies.

5.3 Seller shall furnish a certified copy of all test results with each delivered DCCT.