SLAC Magnetic Measurement Plan and Traveler for 150 A Unipolar LCLS-II Quadrupoles of Type 3.94Q17 (SA-342-102-31)

Initial Release Oct. 25, 2018

This traveler is intended to cover mechanical fiducialization and magnetic measurements of the 3.94Q17 quadrupole magnets needed for LCLS-II. There are a total of 4 of these magnets needed for the LCLS-II. The MAD names of the 150 A unipolar 3.94Q17 quadrupoles are QDMP1, QDMP2, QDMP1B, and QDMP2B. QDMP1, QDMP2, QDMP1B, and QDMP2B have "negative" polarity.

Receiving:

The following information is to be noted upon receipt of the magnets by the SLAC MFD group:

Received by (MMG initials):	SDA
Date received (dd-mm-yyyy):	1/16/2019
SLAC barcode number:	4224
Vendor serial number on the magnet:	QD-54-CU-4-002

Preparation:

A beam direction arrow, with text "beam direction", is to be applied to the top and/or connector side of the magnet with a sticker supplied by LCLS-II (J. Amann will determine the direction).

Beam-direction arrow in place (initials):	SDA

Fiducialization:

Fiducialization may be done before or after magnetic measurements. The magnet is to be fiducialized by the CMM group. This will require the installation of removable tooling balls, location of the geometric axis of the poles of the magnet, and location of tooling balls with respect to the center of this geometric axis when the poles are aligned precisely horizontal.

CMM technician (initials):	

URL of on-line CMM fiducialization data (please modify or correct if necessary):

Magnetic Measurements:

Enter URL of on-line magnetic measurements data (please modify or correct if necessary):

http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS-II/Quad/4224

1) Determine the connection polarity (with main supply outputting positive current) which produces a "negative" field polarity for QVB1B and QVB3B (below right), as shown below:

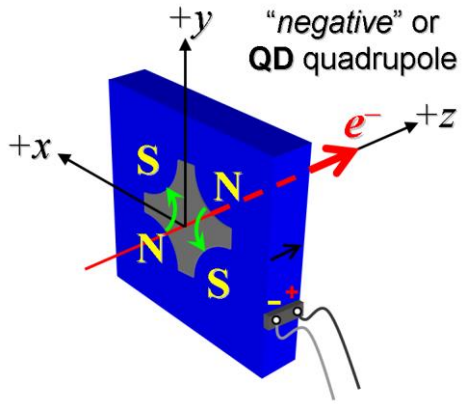

Figure 1. The QDMP1, QDMP2, QDMP1B, and QDMP2B are "negative".

2) Mark the polarity near the magnet leads with clear "+" and "–" labels as shown above.

Magnet polarity chosen from Fig. 1 is (P or N):	N

3) Connect the magnet to the LCW supply. At a deltaP of 108 psi per circuit, the total magnet flow should be 0.6gpm. Record the actual deltaP required to achieve a total flow rate 0.6gpm below.

deltaP (psi) to achieve a total flow rate of 0.6gpm	115 psi

4) Connect the magnet terminals in the correct polarity as established above, to a unipolar power supply with maximum current $I \geq 150$ A.

5) Run the magnet up to 150 A for ~30 minutes to warm it up (record temperature).

Ambient temperature (°C):	19.1 °C
Final magnet temperature (°C):	18.6 °C

6) Standardize the magnet, starting from zero to 150 A and back to zero, through three full cycles, finally ending at zero, with a flat-top pause time (at both 0 and 150 A) of 10 seconds. Use a three-linear ramp rate of 20 A/sec, if possible, and record the ramp rate used.

Standardization complete (initials):	SDA
Ramp rate used (A/sec):	3 Linear 20 A/sec

7) If the power supply can be run as low as 2 A with <10-mA (0.5%) rms current regulation, then measure $\int Gdl$ from 0 to 20 A in 2-A steps (11 'up' measurements), and then continue monotonically in 20-A steps from 20 A to 150 A (9 more 'up' measurements) and then back down from 150 A to 20 A in –20-A steps (9 'down' measurements), and finally 20 A to 0 in –2-A steps (11 more 'down' measurements). Measure harmonics at 20, 100 and 150 A.

Filename & run number of $\int Gdl$ up & down data:	Strdat.ru1, strplt.ru1
Filename & run number of Harmonics data:	hardat.ru1, harplt.ru1

8) Confirm the pole-tip field using a Hall probe at an excitation current of 150 A.

Hall probe pole-tip field at 150 A (mean of 4 poles):	0.449 T at 150.017 A

9) For one magnet only, perform a final thermal test. Run the current up to 150 A. Measure the magnet temperature after it stabilizes (2-4 hours?). Record the temperature below.

Ambient temperature (°C):	Measured on 4226
Final stable magnet temperature at 150 A (°C):	Measured on 4226

10) Measure the inductance and resistance of the magnet:

Inductance of coil (mH):	61.026 mH
Resistance of coil (Ohms):	0.1664 Ohm
Ambient temperature in degrees C	21.1 ºC

11) Upon completion of tests, email URL of on-line data to Mark Woodley. Mark Woodley will determine if the magnet is accepted. Upon acceptance of magnet, analysis data will be placed in on-line data folder.

Magnet accepted and Analysis file(s) put into on-line data folder (initials):	SDA
Assigned beamline location (MAD-deck name):	QDMP2