SLAC Magnetic Measurement Plan and Traveler for Unipolar LCLS-II Quadrupoles of Type 1.26Q12 (SA-380-327-00)

Revision 2, Initial Release May 7, 2018 (Reviewed May 2, 2018 – P. Emma)

This traveler is intended to cover mechanical fiducialization and magnetic measurements of some of the 1.26Q12 quadrupole magnets needed for LCLS-II. There are a total of 10 of these magnets needed for the LCLS-II, 8 of which are unipolar and 2 are bipolar. The MAD names of the unipolar 1.26Q12 quadrupoles are QSP3H, QSP11H, QSP1S, QSP2S, QSP3S, QSP7S, QSP8S and QSP9S. QSP3H, QSP11H, QSP1S, QSP3S, QSP7S and QSP9S have "positive" polarity and QSP2S and QSP8S 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):	7/27/2018
SLAC barcode number:	4058
Vendor serial number on the magnet:	19

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):	KC

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

http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS-II/Fiducial%20Reports/4058_Fiducial_Report.pdf

Magnetic Measurements:

Enter URL of on-line magnetic measurements data (please modify ohttp://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS-II/Fiducial%20Reports/4053_Fiducial_Report.pdfr correct if necessary):

http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS-II/Quad/4058/

1) Determine the connection polarity (with main supply outputting positive current) which produces a "positive" field polarity for QSP3H, QSP11H, QSP1S, QSP3S, QSP7S and QSP9S (below left), but a "negative" field polarity for QSP2S and QSP8S (below right), as shown below:

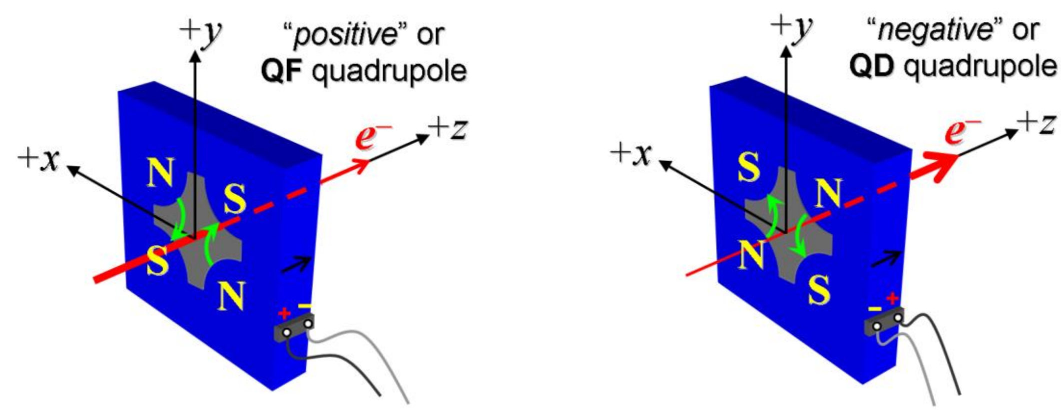

Figure 1. The QSP3H, QSP11H, QSP1S, QSP3S, QSP7S and QSP9S magnet is "positive" (left) while QSP2S and QSP8S are "negative" (right).

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):	P

3) Connect the magnet to the LCW supply. At a deltaP of 65 psi per circuit, the total magnet flow should be 3.3gpm. Record the actual deltaP required to achieve a total flow rate 3.3gpm below.

deltaP (psi) to achieve a total flow rate of 3.3gpm	Flow set to 3.3 gpm

4) Connect the magnet terminals in the correct polarity as established above, to a unipolar power supply with maximum current $I \geq 165$ A.

5) Run the magnet up to 165 A for ~30 minutes to warm it up (record temperature).

Ambient temperature (°C):	27.3 °C
Final magnet temperature (°C):	26.9 °C

6) Standardize the magnet, starting from zero to 165 A and back to zero, through three full cycles, finally ending at zero, with a flat-top pause time (at both 0 and 165 A) of 10 seconds. Use a three liner ramp rate of 20 A/sec, if possible, and record the ramp rate used.

Standardization complete (initials):	SDA
Ramp rate used (A/sec):	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 14.5-A steps from 20 A to 165 A (10 more 'up' measurements) and then back down from 165 A to 20 A in –14.5-A steps (10 'down' measurements), and finally 20 A to 0 in –2-A steps (11 more 'down' measurements).

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

8) For all magnets, with rotating coil, measure the magnet harmonics at 80 and 165 A current setting. Multipole values should be given as a percentage of the quadrupole moment evaluated at the probe radius.

Filename & run number of harmonic data:	Hardat.ru1, harplt.ru1
Probe radius used for harmonics (m):	0.0141349
Rotating Coil Designation (Name)	1.124DQB22

9) Confirm the pole-tip field using a Hall probe at an excitation current of 165 A.

Hall probe pole-tip field at 165 A (mean of 4 poles):	0.724+/- 0.005 T at 165.023 Amps

10) For one magnet only, perform a final thermal test. Run the current up to 165 A. Measure the magnet temperature after it stabilizes (2-4 hours?). Record the temperature below.

Ambient temperature (°C):	N/A
Final stable magnet temperature at 165 A (°C):	N/A

11) Measure the inductance and resistance of the magnet:

Inductance of coil (mH):	1.053 mH

Resistance of coil (Ohms):	0.0439 Ohm
Ambient temperature in degrees C	26.1 ºC

12) 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):	MDW via email
Assigned beamline location (MAD-deck name):	**QSP7S**