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

Revision 0, Initial Release May 2, 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 bipolar 1.26Q12 quadrupoles are QVM3B, QVM4B. QVM3B and QVM4B have "positive" 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):	9/6/2018
SLAC barcode number:	4060
Vendor serial number on the magnet:	20

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/4060_Fiducial_Report.pdf

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/4060/

1) Determine the connection polarity (with main supply outputting positive current) which produces a "positive" field polarity for QVM3B and QVM4B (below left), as shown below:

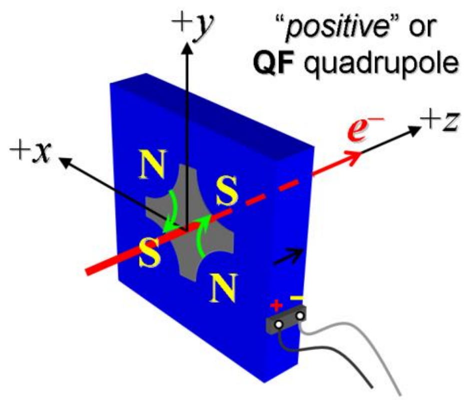

Figure 1. The QVM3B and QVM4B magnet is "positive" (left).

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	70 PSI

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):	26.2 °C
Final magnet temperature (°C):	25.0 °C

6) Standardize the magnet, starting from zero go to 165 A, and then go through three full cycles, from +165A to -165Afinally ending down at -165A from which the first operating current

will be reached. Use a flat-top pause time (at both -165 A 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 ∫*Gdl* from -165 to -20 A in 14.5-A steps (10 up measurements) then -20A to 20 A in 2-A steps (21 '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), then 20 A to -20 in –2-A steps (21 'down' measurements) and finally from -20 to -165 A in 14.5-A steps (10 'down' measurements).

Filename & run number of ∫*Gdl* up & down data:	Strdat.ru1, strplt.ru1

8) For all magnets, with rotating coil, measure the magnet harmonics at -165, -80, +80, +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 (cm):	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):	0.72 T at A

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):	Measurement done on 4059
Final stable magnet temperature at 165 A (°C):	Measurement done on 4059

11) Measure the inductance and resistance of the magnet:

Inductance of coil (mH):	1.026 mH
Resistance of coil (Ohms):	0.0434 Ohm
Ambient temperature in degrees C	21.8 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):	SDA
Assigned beamline location (MAD-deck name):	**QVM4B**