

SHMS Magnet Low Current Test Procedure

Rev C

April 28, 2016

Purpose: Low current excitation of a SHMS magnet to verify interlocks, calibrate Quench Detector and test Power Supply operations. Test Current will be limited to 100 Amps.

Equipment:

Hi-pot tester

Isolated Battery powered, calibrated DC voltage source

Isolation transformer

Chart recorders

Procedure:

Magnet should be at cryogenic temperature, full of Helium and LN2 and regulating its liquid levels for at least 24 hours prior to test.

Pretest verification:

Hi pot the circuit to the maximum dump voltage for that magnet.

Calibrate each of the four Quench Detector channels using the procedure title "SHMS Danfysik Quench Detector Setup Procedure"

Perform the magnet pre-operational checkout list.

Turn on Power supply and set maximum current limit to 10% of magnet's operating current. Use both ASCII command DA and laptop computer to set firmware limit and the front panel current limit button on the PSU.

I. Interlock Verification:

Test & verify the following hardware interlocks with the PSU mains on but without enabling current on to the magnet.

1. LCW flow switches to Power supply
2. LCW flow switch to DC bus Leads.
3. Broken signal cable interlock
4. PLC time out relay
5. Current lead He mass flow coolant interlock

Test & verify the following software interlocks before turning on PSU mains power. This may require using forced I/O signals

6. Helium liquid level

7. Helium pressure
8. OVC vacuum
9. Software slow discharge
10. Software fast discharge

Verify that

1. All forced I/O and routines are cleared from the controls software.
2. The current lead mass flow tracks with the PSU set current input command, without the PSU mains being turned on.
3. Fast Data logger is running and is being archived.
4. Strain Gauges are being monitored and logged

II: SHMS Danfysik Quench Detector Setup Procedure

Equipment:

Isolation transformer

Dual channel chart recorder

Calibrated voltage source (battery operated)

Leads

Multi-meter

Procedure:

Initial Setup: Disconnect magnets voltages taps from Quench Detector if needed to reduce signal noise.

Main coils channels in Bucked Mode:

Set dwell time to 0 milli-sec. (Can be raised later).

Pre-balance the coil's channels using an isolated calibrated voltage source.

Start with a +10 mV source; adjust gain and levels until both sub-channels, (upper and lower) interlock at the same level.

Reverse polarity and repeat adjustment.

If gains and balance differ significantly when reversing the polarity, average the difference.

Repeat process until upper and lower interlocks are in close agreement.

Current Leads channels in Absolute Mode:

Set dwell time to 0 milli-sec.

Wire calibrate voltage source for single voltage input.

Set voltage to 80 mV.

Adjust gain until interlock is generated.

Reverse Polarity and verify interlock repeats at same threshold, adjust balance if needed.

Main coil channels calibration when connected to Magnet.

Re-connect magnets voltage taps to QD if they were unconnected previously.

PSU should be limited to low currents, <10% of Maximum operating current.

Connect isolated chart recorder to test points 1 and 2. Use both channels of chart recorder: channel 1 of chart recorder to upper channel of QD, channel 2 of chart recorder to lower channel of QD.

Set chart recorder scale and chart speed as needed.

Ramp Magnet and observe output. Swap positive and negative leads on one of the channels to get signals to lie on top of each other.

Adjust balance until upper and lower channels overlay.

If interlocks occur, reduce gain until balance can be adjusted.

Alternative to using Chart recorder is to measure across test points 2&3 of QD channel during a slow ramp up and adjust balance until voltage is zero +/- few mV.

Ramp the magnet down and test that the voltage still lies around the zero volt.

If ramp up and down are not symmetrical, adjust so that the average is zero volts.

Using the isolated calibrated voltage source, apply an increasing signal to one of the QD channels. Note voltage when interlock turns on.

Set isolated voltage source to 10 mV and adjust gain until interlock comes on/goes off.

Remove voltage cables and continue to ramp magnet. Monitor voltages on chart recorder and control screens.

Reverse Magnet PSU polarity and ramp magnet, monitored and record voltages.

III Power Supply Operations via PLC.

For each step record and save voltage log plots.

1. Test Fast Dump Interlocks with 100A current in magnet.
2. Test Polarity Switch with no Current.
3. Test Polarity Switch with 100A in magnet.
4. Ramp Magnet in steps to test current, pausing 30 secs after each step. Repeat with opposite polarity.
5. Soak magnet at maximum allowable current for one hour. Monitor lead flow, temperatures and voltages. Use thermal gun to monitor DC bus leads connections temperatures.
6. Turn off PSU main
7. Turn off PSU. Note any spikes if any.