

## Power supply Testing and specification: Student Programme

This document contains a programme for a proposed student visit to Daresbury during which they will collect experimental data about precision power supplies. There follows a detailed outline of the practical procedures to be followed and the document concludes with specific assignment tasks for the students.

### Proposed Programme - Daresbury Laboratories March 31/06

9.15	Arrive, access to site and safety session
10.00	Discussion of laboratory equipment to be used and experiments to be performed.
11.00 - 11.15	BREAK
11.15 - 12.30	Setting up first experiment
12.30 - 1.30	LUNCH
1.30 - 2.00	Download data set up second run
2.00 - 3.30	Inspection of (a) Septum/Kicker Magnets + P/S (b) Dipole Magnets and P/S hall
3.30 - 3.45	BREAK
3.45 - 4.30	Collection of experimental data - depart

### Equipment needed (as specified by J Theed of the Power Supply group)

- 2 x DCCTS + interfaces
- 1 x 40A Power supply
- 2 x Precision DVMS
- 2 Precision reference voltages

Lab view equipment  
 Connecting leads  
 Location Lab 21?

## Power supply Testing: Description of a specimen investigation including experimental procedures.

The power converters were evaluated against the main performance parameters detailed in the following table.

<i>Magnet</i>	<i>Minimum</i>	<i>Maximum</i>
Voltage across magnet	13.27 V	21.30 V
Current through magnet	181.8 A	181.8 A
Rated Voltage per magnet (+15%)	15.32 V	24.61 V
Rated Current per magnet (+10%)	200.0 A	200.0 A
Max. power of converter	3.07 kW	4.92 kW
Resistance	73.0 mΩ	117.2 mΩ
Inductance	0.69 mH	1.37 mH
Operating Range		0-100 %
Stability		± 10 ppm
Reproducibility		± 20 ppm
Accuracy		± 50 ppm
Resolution		18 bit
Current ripple <=300 Hz		± 2 ppm

The warm-up period of any power converter was considered during the evaluation process.

## Apparatus

### Test Rig

The experimental test rig comprised of the following equipment:

- 2 Precision voltmeters with GPIB interfaces
- Industrial PC with LabView software and interface
- Precision DCCT
- Mains Analyser for harmonic and power factor calculations
- 117.2 mΩ, 5 kW test load
- Analog filter for eliminating ripple and common mode noise

The two precision voltmeters used were Agilent 3548 8½ digit voltmeters (serial numbers US280 299942 & US280 29944). In order to be able to verify the performance of the power converters to the required resolution, it is necessary to have a 8½ digit voltmeters.

*It is recommended that an 8½ digit digital voltmeter be used for any independent stability measurement or accuracy measurement of the prototype or final quadrupole power converters.*

The presence of common mode noise on the outputs of the power supplies may require the use of an analogue filter consisting of a simple LC circuit and/or the use of a large integration time in the DVMs internal circuitry.

*It is recommended that the DVM be set to a large integration time. The minimum setting should be 100 power line cycles or 2 seconds integration time. This can be set using the front panel controls on the DVM.*

The DCCTs used were a DANFYSIK ULTRASTAB 860R with a 860S range selector unit and a HYTEC ULTRAC. These had a measurement range of 0 to 600 A with an accuracy of 50 ppm and a stability of better than 12 ppm over one year. The units were stable with temperature, varying be less than 1 ppm per Kelvin.

*It is recommended that a high precision DCCT is used for any testing of these power supplies. It is recommended in the present market, that the DCCTs are obtained from DANFYSIK or HYTEC.*

*It is recommended that the temperature of the power supply under test be controlled to within 2.0°C.*