

## Science City Research Alliance – Energy Efficiency Project equipment/facilities

### Smart Grids, School of Electronic, Electrical and Computer Engineering, University of Birmingham (Custodian: Dr Xiao-Ping Zhang)

Equipment item	Description	Location	Contact	Booking System	Status
Real Time Power Grid Simulator	<p>A real-time power grid simulator that provides the capability to realistically simulate smart power grids with the integration of distributed power generation including wind, wave and fuel cell generation systems. The simulator combines hardware and software to provide monitoring and control capability as well as real-time information integration, monitoring, protection and closed-loop control functions.</p> <p>The Real-time Power Grid Simulator is a fully digital electromagnetic transient power system simulator. The simulator can be used:</p> <ul style="list-style-type: none"> <li>– to conduct closed-loop testing of physical devices such as protection equipment, control equipment, IEC 61850 devices;</li> <li>– to perform analytical system studies;</li> <li>– and to educate operators, engineers, or students.</li> </ul> <p>The laboratory can be used for research on:</p> <ul style="list-style-type: none"> <li>– Operation and control methods for power grids;</li> <li>– Control techniques for distributed energy generation and interconnection;</li> <li>– Controllers and protection devices and algorithms for individual components; and</li> <li>– Technical barriers to the integration of renewable energy generated from distributed sources in to the power grid;</li> <li>– Technical integration of Electric Vehicles (EVs);</li> <li>– Systems with Power Electronic Controllers (FACTS);</li> <li>– Systems with HVDC Technologies</li> </ul>	School of Electronic, Electrical and Computer Engineering, University of Birmingham.	Dr Xiao-Ping Zhang Email: x.p.zhang@bham.ac.uk Tel: +44 (0) 121 414 4298	Paper-based through Dr Xiao-Ping Zhang	Available
Power Amplifiers	<ul style="list-style-type: none"> <li>• The system generates, in conjunction with a suitable waveform generator, the high current and voltage waveforms required in research and development of product, prototype testing and real time simulation of power systems. The amplifiers can be used in combination with any protection test set or in conjunction with digital real time power system network simulators</li> </ul>	School of Electronic, Electrical and Computer Engineering, University of Birmingham.	Dr Xiao-Ping Zhang Email: x.p.zhang@bham.ac.uk Tel: +44 (0) 121 414 4298	Paper-based through Dr Xiao-Ping Zhang	Available

Power Grid Power Electronic  
Controllers and Development  
Kits

- These controllers consist of four AC/DC modules for power grid control, reactive compensation, interface for energy storage and distributed generation.
- Advanced Power Electronic Controllers - FACTS configuration
- HVDC system configuration
- Rapid product development
  - AC-DC, DC-DC or DC-AC
  - Bi-directional functionality
  - Current or voltage source
- Scalable design
  - Series and/or parallel operation
  - Fiber optic communication
  - Standard building blocks
- Flexible architecture
  - Rapid software and parameter configuration
  - Serial and CAN protocols
  - Expandable Programmable
  - One unit does multi-functions
- Software application modules
  - Remote programmability
- Self-supportive
  - Powered from DC bus Integrated protection

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Power Grid Controller Analysis  
and Design Software Package

This software package tool can provide analyses and advanced dynamics modelling capabilities in the design and operation of reliable power networks. The software tool is an integrated, interactive program for simulating, analysing, and optimising power system performance.

- Features
  - Synchronized via GPS
  - Revenue Accuracy: 0.025%
  - Power Quality: Harmonics, Flicker, Interruptions
  - Phasor Measurements for Stability & Flow Analysis
  - System Time & Frequency Deviation
  - Internal Data/Event Logging
- Revenue Metering
- Power Quality Monitoring
- System Control and Monitoring
- Synchronization

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Real-Time Power Grid  
Measurement Units with  
Synchronisation of Signals  
(Two Sets) and two GPS  
receivers

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Available

Real-Time Power Grid  
Protection Test System

- Data and Event Logging
- Protection test set and universal calibrator in one device
- Testing of all relay generations (electromechanical, static, numerical, IEC 61850 IEDs)
- The signal sources are the reference; no additional reference meters are required
- Up to 22 voltage/current generators in one device
- Test Universe software with unrivaled manual and automatic testing functionality
- Protection Testing Library - test templates for the most important relays
- End-to-End testing with GPS or IRIG-B (typical error < 1  $\mu$ s)
- Highest quality, safety, reliability and robustness
- Protection Relay Test Set
  - IEC 61850 IEDs
  - Numerical relays
  - Static relays
  - Electromechanical relays (high burden relays / single phase)
  - Relay panels
  - Busbar protection (22 generators)
  - Wide area protection
- Power System Simulator
  - Transient fault simulation
  - Power swing
  - CT saturation simulation
  - CB simulation
  - Rogowski coil simulation
  - Compensated network
  - Transient playback (e.g. COMTRADE)
- Substation Commissioning
  - IEC 61850 IEDs
  - Numerical relays
  - Static relays
  - Checking SCADA annunciations
  - Burden measurement
  - CT/VT polarity checker
  - Wiring checker
  - Event recording
- Programmable Voltage and Current Source
- Universal Calibrator
  - Transient fault simulation

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- Electricity meters, 4 quadrants, class 0.2; Transducers
- Power quality meters according to IEC 61000; Synchrophasor measurement devices
- SCADA measuring equipment
- Protection relays; Transient recorders (incl. time stamp accuracy)
- Any measuring equipment for V, I, f, S, P, Q ...
- Portable 10-Channel Measurement Device
  - Transient recording (trigger: binary, PQ, GPS)
  - Multi meter for: I, V, f, S, P, Q,  $\cos \phi$  ...
  - Trend recording for: I, V, f, S, P, Q
  - Harmonics analysis

NI Development and Control Platform for Power Grid Information Integration	<p>Graphical programming environment used by millions of engineers and scientists to develop sophisticated measurement, test, and control systems using intuitive graphical icons and wires that resemble a flowchart. LabVIEW offers unrivaled integration with thousands of hardware devices and provides hundreds of built-in libraries for advanced analysis and data visualization. The LabVIEW platform is scalable across multiple targets and operating systems, and since its introduction in 1986 has become an industry leader.</p> <p>NI labVIEW suite is a fundamental system measurements, test and control platform which can be used to integrate power grid measurements and control and provide a versatile testing platform.</p>	School of Electronic, Electrical and Computer Engineering, University of Birmingham.	Dr Xiao-Ping Zhang Email: x.p.zhang@bham.ac.uk Tel: +44 (0) 121 414 4298	Paper-based through Dr Xiao-Ping Zhang	Available
LoProgrammable 3 Channel High P Control Systems	Programmable 3 Channel High-Performance Power Supply	School of Electronic, Electrical and Computer Engineering, University of Birmingham.	Dr Xiao-Ping Zhang Email: x.p.zhang@bham.ac.uk Tel: +44 (0) 121 414 4298	Paper-based through Dr Xiao-Ping Zhang	Available
Signal Generator	25 / 50 MHz Arbitrary Function Generator	School of Electronic, Electrical and Computer Engineering, University of Birmingham.	Dr Xiao-Ping Zhang Email: x.p.zhang@bham.ac.uk Tel: +44 (0) 121 414 4298	Paper-based through Dr Xiao-Ping Zhang	Available