

# LAB-SCUBI

## SINGLE CHANNEL BIDIRECTIONAL PSU



POSITIVE PROBLEM SOLVING **+ =**

The LAB-SCUBI is a series of high power single channel Bidirectional PSUs. Each system is able to operate as either a DC source or a DC electronic load.

This integrated approach features high dynamics enabling the user to switch seamlessly between quadrants. When sinking energy from the unit under test the LAB-SCUBI automatically inverts the DC to AC and synchronises this output to the grid. An extended feature set includes voltage and current ripple below 0.1%, sense terminals for voltage drop compensation as well as a range of protection features. As standard soft tools are provided for LabVIEW integration.

- + Dedicated Battery Testing/Emulation Modes**
- + Seamless Transition Between Source/Sink**
- + Nominal Outputs from 60kW to 500kW**
- + Outputs up to 1000V and  $\pm 1000A$**
- + High Efficiencies up to 95%**

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## FURTHER DETAILS

A CANbus, Modbus and VNC over Ethernet interface are provided as standard for remote programming which operate at 100Hz. The fast sampling frequency allows users to record quickly changing data, so that they can identify what's happening at a particular point in time. Optional interfaces include Profibus, Profinet, SCPI over Ethernet, 0-10V analogue, as well as a high speed analogue interface which allows current setting at up to 500Hz.

A large TFT front panel screen displays programming functions and live values from the power supply. Current and voltage settings are adjustable via the panel as well as a host of other features. The screen provides users ease of access and speed when implementing their test programmes.

The robust design makes it extremely suitable for the rigours of industrial and production environments. A common application of the LAB-SCUBI is production testing of electric drives. The bidirectional nature of the system allows it actively decelerate the drive at the end of testing. This increases efficiency as you don't have to wait for a motor to freely spin and stop before you can test the next one. Other common test applications include electric motors, fuel cells, super capacitors, solar panels and powering two dynamometers back to back.

Dedicated application modes are available for battery cycling and emulation, which can be used to implement specific test routines. Outputs up to 2MW can be achieved when combining multiple systems in parallel. Besides the standard range, special voltage and current levels can be specified on request.

## HIGHLIGHTED FEATURES



### SENSE COMPENSATION

Terminals are built into the LAB-SCUBI for the connection of sense wire which compensates for voltage drops in the load lines. This is particularly useful for applications with long cables often prone to unwanted voltage drops.



### ADDITIONAL CURRENT RANGES

A second or third current range can be built into systems to give better accuracy and resolution for low current applications. This is particularly useful when testing high voltage equipment, such as electric vehicle battery packs, which typically produce low currents.



### BLOCKING DIODE

A blocking diode is available to provide protection for the device under test against any back EMF. This is particularly useful to prevent damage to unidirectional power sources such as fuel cells. The device provides protection up to 1000A and comes in its own wheeled cabinet with 2 voltmeters.



### DISCHARGE UNIT

Discharge units are available as an additional safety feature. When the DC output is turned off, energy from the device under test will be discharged into a resistor at up to 500kW per second. This ensures that there is no residual energy on the DC link when disconnecting a device under test. This feature also works when the emergency stop button is pressed.

## SELECTION TABLE

Part Number	Maximum Power	Voltage Range*	Current Range	Current Rise Time**
LAB-SCUBI 200-60-600	60kW	0 - 200V	0 ± 600A	<1ms
LAB-SCUBI 800-100-600	100kW	0 - 800V	0 ± 600A	<1ms
LAB-SCUBI 800-100-1000	100kW	0 - 800V	0 ± 1000A	<1ms
LAB-SCUBI 1000-100-600	100kW	0 - 1000V	0 ± 600A	<1.3ms
LAB-SCUBI 1000-100-1000	100kW	0 - 1000V	0 ± 1000A	<1.3ms
LAB-SCUBI 200-120-600	120kW	0 - 200V	0 ± 600A	<1ms
LAB-SCUBI 800-160-600	160kW	0 - 800V	0 ± 600A	<1ms
LAB-SCUBI 800-160-1000	160kW	0 - 800V	0 ± 1000A	<1ms
LAB-SCUBI 1000-160-600	160kW	0 - 1000V	0 ± 600A	<1.3ms
LAB-SCUBI 1000-160-1000	160kW	0 - 1000V	0 ± 1000A	<1.3ms
LAB-SCUBI 800-250-600	250kW	0 - 800V	0 ± 600A	<1ms
LAB-SCUBI 800-250-1000	250kW	0 - 800V	0 ± 1000A	<1ms
LAB-SCUBI 1000-250-600	250kW	0 - 1000V	0 ± 600A	<1.3ms
LAB-SCUBI 1000-250-1000	250kW	0 - 1000V	0 ± 1000A	<1.3ms
LAB-SCUBI 800-320-600	320kW	0 - 800V	0 ± 600A	<1ms
LAB-SCUBI 800-320-1000	320kW	0 - 800V	0 ± 1000A	<1ms
LAB-SCUBI 1000-320-600	320kW	0 - 1000V	0 ± 600A	<1.3ms
LAB-SCUBI 1000-320-1000	320kW	0 - 1000V	0 ± 1000A	<1.3ms
LAB-SCUBI 800-400-1000	400kW	0 - 800V	0 ± 1000A	<1ms
LAB-SCUBI 1000-400-600	400kW	0 - 1000V	0 ± 600A	<1.3ms
LAB-SCUBI 1000-400-1000	400kW	0 - 1000V	0 ± 1000A	<1.3ms
LAB-SCUBI 800-500-1000	500kW	0 - 800V	0 ± 1000A	<1ms
LAB-SCUBI 1000-500-600	500kW	0 - 1000V	0 ± 600A	<1.3ms
LAB-SCUBI 1000-500-1000	500kW	0 - 1000V	0 ± 1000A	<1.3ms

\* The max. current that can be sunk derates as the voltage reduces below 5V. Please contact ETPS for the characterisation values.

\*\* Typical time for a 10% to 90% load step.

## CABINET(S) DIMENSIONS

Part Number	Cabinet 1 Width	Cabinet 2 Width	Cabinet 3 Width	Cabinet(s) Height	Cabinet(s) Depth
LAB-SCUBI 200-60-600	1400mm	N/A	N/A	2200mm	800mm
LAB-SCUBI 800-100-600	1000mm	1000mm	N/A	2200mm	800mm
LAB-SCUBI 800-100-1000	1000mm	1200mm	N/A	2200mm	800mm
LAB-SCUBI 1000-100-600	1000mm	1200mm	N/A	2200mm	800mm
LAB-SCUBI 1000-100-1000	1000mm	1200mm	N/A	2200mm	800mm
LAB-SCUBI 200-120-600	1000mm	1000mm	N/A	2200mm	800mm
LAB-SCUBI 800-160-600	1000mm	1200mm	N/A	2200mm	800mm
LAB-SCUBI 800-160-1000	1200mm	1200mm	N/A	2200mm	800mm
LAB-SCUBI 1000-160-600	1200mm	1200mm	N/A	2200mm	800mm
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LAB-SCUBI 800-250-1000	1400mm	1200mm	N/A	2200mm	800mm
LAB-SCUBI 1000-250-600	1400mm	1200mm	N/A	2200mm	800mm
LAB-SCUBI 1000-250-1000	1400mm	1200mm	N/A	2200mm	800mm
LAB-SCUBI 800-320-600	1400mm	1000mm	N/A	2200mm	800mm
LAB-SCUBI 800-320-1000	1400mm	1200mm	N/A	2200mm	800mm
LAB-SCUBI 1000-320-600	1400mm	1200mm	N/A	2200mm	800mm
LAB-SCUBI 1000-320-1000	1400mm	1200mm	N/A	2200mm	800mm
LAB-SCUBI 800-400-1000	1200mm	1200mm	1200mm	2200mm	800mm
LAB-SCUBI 1000-400-600	1200mm	1200mm	1200mm	2200mm	800mm
LAB-SCUBI 1000-400-1000	1200mm	1200mm	1200mm	2200mm	800mm
LAB-SCUBI 800-500-1000	1200mm	1200mm	1200mm	2200mm	800mm
LAB-SCUBI 1000-500-600	1200mm	1200mm	1200mm	2200mm	800mm
LAB-SCUBI 1000-500-1000	1400mm	1200mm	1200mm	2200mm	800mm

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### TECHNICAL DATA

Rectifier Type	Isolation transformer, galvanically isolated					
Power Factor	>0.99 [at >55% load], >0.83 [at 10% load]					
AC Input Voltage/Frequency	400V <sup>1</sup> ± 10%, 3-phase, (N), PE, 50 / 60Hz ± 5%					
Maximum Output Voltage	See selection table					
Minimum Output Voltage	5V [typical] to sink full current within the maximum power capability					
Measuring Accuracy and Resolution	Voltage: 0.1% F.S. / 16 bit ADC, current: 0.1% F.S. / 16 bit ADC					
Control Accuracy <sup>2,3</sup>	Voltage: 0.1% F.S. , current: 0.1% F.S.					
Voltage Tolerance Dynamic	Battery simulator mode: <1% F.S. (0 - 100% I <sub>NOM</sub> in 3ms), Battery tester mode: <3% F.S. (0 - 100% I <sub>NOM</sub> in 3ms)					
Voltage Ripple <sup>4</sup>	≤0.1% rms F.S. (V > 10)					
Current Ripple <sup>5</sup>	≤0.1% rms F.S. (V > 10)					
Current Rise Time <sup>6</sup>	See selection table					
Isolation [Primary/Secondary]	5.3kVdc					
Isolation [Primary/Case]	2.8kVdc					
Isolation [Secondary/Case]	2.8kVdc [models ≤600Vdc], 3.1kVdc [models >600Vdc]					
Short Circuit Behaviour	Short circuit proof (I <sub>k</sub> <5kA)					
Standard Interfaces	CANbus, Modbus and VNC over Ethernet					
Overall Efficiency	Typically 92% to 95% [depending on system power]					
Permissible Ambient Temperature	0 - 40°C					
Climate Class	3K3 EN60721 [85% relative humidity non condensing, with cabinet heating up to 95% relative humidity without condensing]					
Cooling	Forced air cooling / air-water heat exchanger					
Minimum Distance from Wall	200mm [standard]					
Minimum Distance from Ceiling	300mm [standard], 0mm possible [optional]					
Installation	Operating area with restricted access					
Protection Class	IP20 [IP53 <sup>12</sup> ] IEC 60529					
Safety Features	Over voltage protection, under voltage protection, over temperature protection, over current protection					
Maximum Altitude	1000m above sea level with nominal load					
Acoustic Level at IP20	71dB [A]	73dB [A]	76dB [A]	78dB [A]	78dB [A]	78dB [A]
Safety	EN ISO 13849-1					
Basic Standard	EN 62040					
EMC	EN 61000-2-4 grid disturbances, EN 61000-6-2 interference immunity, EN 61000-6-4 interference emission, EN 61800-3 cat C2 [A1] variable - speed electrical drives					

<sup>1</sup> 380V, 415V, 420V, 440 and 480V inputs are available on request. <sup>2</sup> Via 16 bit digital controller. <sup>3</sup> Digital controller (± 600A = 15 bit + sign).

<sup>4</sup> Resistance as load, operation mode simulator (in constant voltage mode). <sup>5</sup> 48/96V battery (constant voltage mode).

<sup>6</sup> Measured at half nominal voltage with max. 5% overshoot (in constant current mode).

Every effort is made to ensure that the information provided within this technical summary is accurate. However, ETPS Ltd must reserve the right to make changes to the published specifications without prior notice. Where certain operating parameters are critical for your application we advise that they be confirmed at the time of order. ETPS Ltd specialises in modifying its proven platforms to suit your needs. Please contact our office if your requirement is non-standard. Please note that your actual unit may differ from those shown.



## OPTIONS

CODE	DESCRIPTION
/NSV	Non standard AC input voltage (eg. 690Vac).
/SCR	Second current range for improved resolution and accuracy in low current applications.
/TCR	Three current ranges for improved resolution and accuracy in low current applications.
/B-CAP-M-800	External metal box with switchable output capacitors for models $\leq 800V$ , with a selection of three different capacitor levels: step 1: 6600 $\mu F$ , step 2 13200 $\mu F$ , step 3 19800 $\mu F$ . The box comes in IP66 metal housing 380mm $\times$ 600mm $\times$ 350m [W $\times$ D $\times$ H] with connection cables.
/B-CAP-P-800	External plastic box with switchable output capacitors for models $\leq 800V$ , with a selection of three different capacitor levels: step 1: 6600 $\mu F$ , step 2 13200 $\mu F$ , step 3 19800 $\mu F$ . The box comes in IP66 metal housing 307mm $\times$ 614mm $\times$ 260m [W $\times$ D $\times$ H] with connection cables.
/DC-1000A-1000V	2 $\times$ DC disconnectors rated at 1500V performance level D.
/DCU-2-500	Protection unit which discharges energy from a device under test into a resistor when the output of the LAB-SCUBI is turned off. Resistance of 2 $\Omega$ at up to 500kW per second is switched via a thyristor. The discharge unit also functions when the emergency stop is pressed.
/SIM	Simulation mode allowing the LAB-SCUBI to emulate electrical characteristics of a battery pack.
/SIM-TEST	Allows the LAB-SCUBI to be switchable between battery testing mode and battery simulation mode.
/BRTS	External cabinet with software and data acquisition system which implements charge/discharge cycles to a battery pack. Allows the user to analyse discharge performance of the VI curve under different discharge rates and assess the endurance of the battery after many cycles. This can be specified with additional features such as a fast 480 channel data logger, enhanced impedance spectroscopy capability and a burst generator to stress the battery monitoring system.
/RPS	External cabinet with battery simulation software. Output voltage, internal resistance and current limits are set at the on the front panel display or through the CAN interface.
/PARALLEL	Master/slave interface for current balancing of up to 4 LAB-SCUBI systems in parallel connection.
/PDSB-1E-2A-600	External cabinet for splitting single output across 2 separate channels up to 1000V/600A. Cabinet is rated IP20 as standard with IP53 available on request. Dimensions are available on request. 2 emergency stops are provided. Up to 2 discharge units [/DCU-X-XX] can be built into the cabinet.
/PDSB-1E-2A-1000	External cabinet for splitting single output across 2 separate channels up to 1000V/1000A. Cabinet is rated IP20 as standard with IP53 available on request. Dimensions are available on request. 2 emergency stops are provided. Up to 2 discharge units [/DCU-X-XX] can be built into the cabinet.
/PDSB-2E-1A-1000	External cabinet for operating 2 $\times$ LAB-SCUBI systems in parallel up to 1000V/1000A. Cabinet is rated IP20 as standard with IP53 available on request. Dimensions are available on request. Up to 2 discharge units [/DCU-X-XX] can be built into the cabinet.
/PDSB-2E-1A-2000	External cabinet for operating 2 $\times$ LAB-SCUBI systems in parallel up to 1000V/2000A. Cabinet is rated IP20 as standard with IP53 available on request. Dimensions are available on request. Up to 2 discharge units [/DCU-X-XX] can be built into the cabinet.
/PDU-TEST-1000	Wall mounted cabinet rated to IP54 for the device under test up to 1000A. Dimensions are available on request. A 1000V voltmeter is included, as is a signal light post with indicator light to show insulation monitor status.
/PDU-TEST-2000	Wall mounted cabinet rated to IP54 for the device under test up to 2000A. Dimensions are available on request. A 1000V voltmeter is included, as is a signal light post with indicator light to show insulation monitor status.
/PDU-SIM-1000	Wall mounted cabinet rated to IP54 for the device under test up to 1000A. Dimensions are available on request. A 1000V voltmeter is included, as is a signal light post with indicator light to show insulation monitor status. Other features include an installed shorting link, 2 $\times$ MXP capacitor 280 $\mu F$ /1120Vdc and copper bar for additional LEM converter.
/PDU-SIM-1600	Wall mounted cabinet rated to IP54 for the device under test up to 1600A. Dimensions are available on request. A 1000V voltmeter is included, as is a signal light post with indicator light to show insulation monitor status. Other features include an installed shorting link, 2 $\times$ MXP capacitor 280 $\mu F$ /1120Vdc and copper bar for additional LEM converter.
/SCPI	SCPI interface over Ethernet operating at 100Hz for remote programming.
/PROFIBUS	PROFIBUS DP interface operating at 100Hz for remote programming.
/PROFINET	PROFINET interface for remote programming.
/ANALOGUE	0-10V analogue interface operating at 100Hz for remote programming.
/ANALOGUE-IPLUS	High speed 0-10V analogue interface with access to I+ controller for remote programming. The interface operates at 500Hz for models with $V_{NOM}$ of $\leq 800V$ , and 250Hz for models with $V_{NOM}$ of 1000V.
/IP21	Top and sides of cabinet rated to protection class IP21. Adds 80mm to the width and depth of the cabinet and 300mm to the height. Cable entry at the bottom of the cabinet is IP00. A protective rubber skirt is available on request.
/IP23	Top of cabinet is rated to protection class IP23. Airflow is front to top so that no distance between the cabinet and wall is needed.
/IP53	Air-water heat exchanger built on to the back and the roof of the cabinet, rated to protection class IP53. A minimum distance of 800mm from the rear of the cabinet to the wall is required for service and maintenance.
/SENSE-M	Sense cable connecting the LAB-SCUBI and the device under test or /PDU-XXX.
/CONTROL-M	Control cable connecting the LAB-SCUBI and the /PDU-XXX.
/DIODE-1000	Diode providing protection up to 1000A/1000V for the device under test. The diode is provided in a wheeled cabinet. Dimensions are available on request. The cabinet comes with a status indication lamp and 2 voltmeters.
/E-STOP	Emergency stop mushroom button on cabinet door.
/DOOR-STOP	Door fitted interlock. The LAB-SCUBI system shuts down when the cabinet door is opened.
/CAB-HALOGEN-FREE	Each cabinet is fitted with halogen free cables.
/CAB-HEATING-SEP	100W heating element at the bottom of the cabinet to help guard against condensation.

# LAB-SCUBI

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### CAPACITANCE VALUES

Switchable output capacitance is available to improve stability when operating in constant voltage mode. This is particularly useful to assist the fast current demands when testing drives. Some electric drives require a very stable voltage during a step change. If the voltage drop is too low it could damage the drive.

When choosing the /SIM and /SIM-TEST options an extra level of capacitance is provided. If a test routine requires fast dynamics in constant current mode, then the standard capacitance of the LAB-SCUBI can be used in the basic or battery tester operation modes. For people who frequently need to switch between battery tester and simulation modes the /SIM-TEST option is ideal. This provides a simple key switch to change between the lower and higher level of capacitance.

The /B-CAP-XXX options provide you with additional capacitance from an external box, which can be switched between 3 different levels depending on the requirements of the test application. As a result, users with long load lines can situate the box next to the device under test.

#### CAPACITANCE BUILT INTO LAB-SCUBI SYSTEMS ( $\leq 800V$ )

	Standard in Basic and Battery Tester Modes	/SIM-TEST and /SIM Options
Installed or Additional Capacitance	Installed: 1500 $\mu$ F	Additional 6600 $\mu$ F
Total	1500 $\mu$ F	8100 $\mu$ F

#### EXTERNAL CAPACITANCE BOXES FOR LAB-SCUBI SYSTEMS ( $\leq 800V$ )

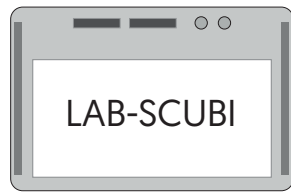
	/B-CAP-P-800 (Plastic Capacitance Box) Option	/B-CAP-M-800 (Metal Capacitance Box) Option
Installed or Additional Capacitance	Installed: 19800 $\mu$ F Steps possible 6600 $\mu$ F, 13200 $\mu$ F and 19800 $\mu$ F	Installed: 20360 $\mu$ F Steps possible 6600 $\mu$ F, 13200 $\mu$ F and 20360 $\mu$ F
Total	19800 $\mu$ F	20360 $\mu$ F

#### CAPACITANCE BUILT INTO LAB-SCUBI (1000V)

	Standard in Basic and Battery Tester Modes	/SIM-TEST and /SIM Options
Installed or Additional Capacitance	Installed: 2220 $\mu$ F	Additional 5400 $\mu$ F
Total	2220 $\mu$ F	7620 $\mu$ F



# TYPICAL APPLICATIONS



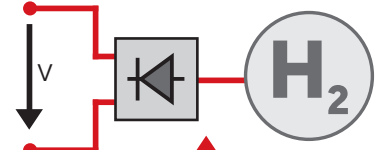
## DC SINK/SOURCE AS A BATTERY TESTER

- + Current rise time <math><1\text{ms}</math> (10 - 90%)
- + Output contactor for separation under load (option)
- + Current range switchable for smaller current range (option)
- + Increased accuracy up to 0.05% with control software



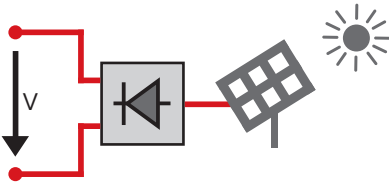
## INVERTER FOR FUEL CELL

- + Protection diode for safe sink operation



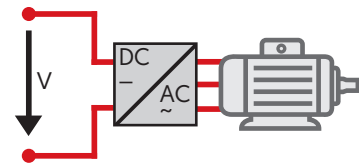
## INVERTER WITH WIDE INPUT RANGE FOR SOLAR FEEDING

- + Protection diode for safe sink operation



## DC SINK/SOURCE FOR BATTERY SIMULATION

- + Regulation time <math><2\text{ms}</math> (0 - 100% load change)
- + Protection of the DUT via discharge resistance (optional)



# APPLICATION SOFTWARE

## BATTERY TESTING

Optional software implements charge/discharge cycles to a battery pack. Using the software allows users to perform research and quality testing on batteries. This includes analysing discharge performance of the VI curve under different discharge rates and assessing the endurance of the battery after many cycles.

The user interface allows you to set voltage, current and power limits. On request a CMU data logger with up to 4800 temperature and voltage inputs is available. A burst generator to stress the battery monitoring system is also possible for more in-depth tests.

Another optional extra is the enhanced impedance spectroscopy capability. This technique measures the impedance of a battery over a range of frequencies, as well as the frequency response of the system. Using this method allows you to characterise battery packs including the energy storage capacity and dissipation properties.

## BATTERY SIMULATION

Battery simulation software is also available for the LAB-SCUBI which allows the system to emulate the electrical characteristics of a battery pack. Using the software increases reproducibility of experiments and reduces preparation time. Voltage and internal resistance levels can be set via the front panel screen.





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ETPS engineer electronic power supply and testing systems. Our problem solving skills provide the spark of innovation to some of the world's leading technology brands.



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POSITIVE PROBLEM SOLVING