

# BC-TC

## HIGH POWER MODULAR BATTERY CHARGERS



POSITIVE PROBLEM SOLVING **+=**

The BC-TC range is a series of highly programmable modular battery chargers. The units are built into 19" racks and are available in 10kW, 16kW, 20kW and 32kW nominals.

Constant voltage, current and power operating modes are provided. Remote sense is provided to compensate for the voltage drop in the load lines. All regulation, monitoring and communication tasks are conducted by high performance micro-controllers and digital signal processors. This provides exceptional accuracy, reproducibility and long term stability.

- + Parallel, Series & Multi-load Operation**
- + Can be Optimised for Individual Loads**
- + Nominal Voltages from 52V to 1500V**
- + Output Power from 10kW to 2MW+**
- + Optional High Speed CAN Interface**
- + Full Digital Regulation**

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# STANDARD MODELS

## SELECTION TABLE

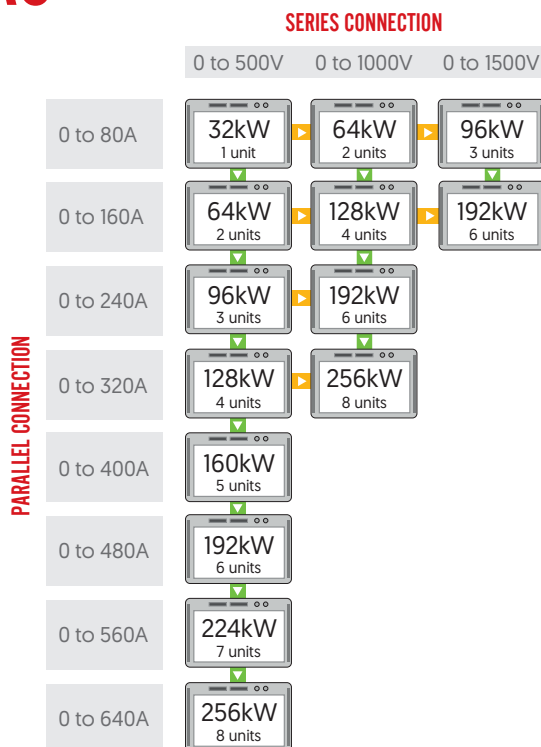
Part Number	Max. Power	Voltage Range	Current Range	Dimensions	Efficiency	Weight [kg]
BC-TC 10-52	10kW	0 - 52V	0 - 250A	19" x 6U x 450mm	92%	42
BC-TC 10-65	10kW	0 - 65V	0 - 193A	19" x 6U x 450mm	92%	42
BC-TC 10-100	10kW	0 - 100V	0 - 125A	19" x 6U x 450mm	92%	42
BC-TC 10-130	10kW	0 - 130V	0 - 96A	19" x 6U x 450mm	92%	42
BC-TC 10-200	10kW	0 - 200V	0 - 63A	19" x 6U x 450mm	92%	42
BC-TC 10-400	10kW	0 - 400V	0 - 31A	19" x 6U x 450mm	92%	42
BC-TC 10-500	10kW	0 - 500V	0 - 25A	19" x 6U x 450mm	92%	42
BC-TC 10-600	10kW	0 - 600V	0 - 20A	19" x 6U x 450mm	92%	42
BC-TC 10-800	10kW	0 - 800V	0 - 16A	19" x 6U x 450mm	92%	42
BC-TC 10-1000	10kW	0 - 1000V	0 - 13A	19" x 6U x 450mm	92%	42
BC-TC 16-52	16kW	0 - 52V	0 - 400A	19" x 6U x 450mm	92%	44
BC-TC 16-65	16kW	0 - 65V	0 - 308A	19" x 6U x 450mm	92%	44
BC-TC 16-100	16kW	0 - 100V	0 - 200A	19" x 6U x 450mm	92%	44
BC-TC 16-130	16kW	0 - 130V	0 - 153A	19" x 6U x 450mm	92%	44
BC-TC 16-200	16kW	0 - 200V	0 - 100A	19" x 6U x 450mm	92%	44
BC-TC 16-400	16kW	0 - 400V	0 - 50A	19" x 6U x 450mm	92%	44
BC-TC 16-500	16kW	0 - 500V	0 - 40A	19" x 6U x 450mm	92%	44
BC-TC 16-600	16kW	0 - 600V	0 - 32A	19" x 6U x 450mm	92%	44
BC-TC 16-800	16kW	0 - 800V	0 - 25A	19" x 6U x 450mm	92%	44
BC-TC 16-1000	16kW	0 - 1000V	0 - 20A	19" x 6U x 450mm	92%	44
BC-TC 20-52	20kW	0 - 52V	0 - 500A	19" x 9U x 525mm	95%	64
BC-TC 20-65	20kW	0 - 65V	0 - 385A	19" x 9U x 525mm	95%	64
BC-TC 20-100	20kW	0 - 100V	0 - 250A	19" x 9U x 525mm	95%	64
BC-TC 20-130	20kW	0 - 130V	0 - 192A	19" x 9U x 525mm	95%	64
BC-TC 20-200	20kW	0 - 200V	0 - 125A	19" x 9U x 525mm	95%	64
BC-TC 20-320	20kW	0 - 320V	0 - 80A	19" x 9U x 525mm	95%	64
BC-TC 20-400	20kW	0 - 400V	0 - 63A	19" x 9U x 525mm	95%	64
BC-TC 20-500	20kW	0 - 500V	0 - 50A	19" x 9U x 525mm	95%	64
BC-TC 20-600	20kW	0 - 600V	0 - 40A	19" x 9U x 525mm	95%	64
BC-TC 20-800	20kW	0 - 800V	0 - 32A	19" x 9U x 525mm	95%	64
BC-TC 20-1000	20kW	0 - 1000V	0 - 25A	19" x 9U x 525mm	95%	64
BC-TC 20-1200	20kW	0 - 1200V	0 - 20A	19" x 9U x 525mm	95%	64
BC-TC 32-52	32kW	0 - 52V	0 - 700A	19" x 9U x 525mm	95%	68
BC-TC 32-65	32kW	0 - 65V	0 - 600A	19" x 9U x 525mm	95%	68
BC-TC 32-100	32kW	0 - 100V	0 - 400A	19" x 9U x 525mm	95%	68
BC-TC 32-130	32kW	0 - 130V	0 - 308A	19" x 9U x 525mm	95%	68
BC-TC 32-200	32kW	0 - 200V	0 - 200A	19" x 9U x 525mm	95%	68
BC-TC 32-320	32kW	0 - 320V	0 - 125A	19" x 9U x 525mm	95%	68
BC-TC 32-400	32kW	0 - 400V	0 - 100A	19" x 9U x 525mm	95%	68
BC-TC 32-500	32kW	0 - 500V	0 - 80A	19" x 9U x 525mm	95%	68
BC-TC 32-600	32kW	0 - 600V	0 - 64A	19" x 9U x 525mm	95%	68
BC-TC 32-800	32kW	0 - 800V	0 - 50A	19" x 9U x 525mm	95%	68
BC-TC 32-850	32kW	0 - 850V	0 - 50A	19" x 9U x 525mm	95%	68
BC-TC 32-1000	32kW	0 - 1000V	0 - 40A	19" x 9U x 525mm	95%	68
BC-TC 32-1200	32kW	0 - 1200V	0 - 33A	19" x 9U x 525mm	95%	68

Different output ranges and application/user specific options are possible. Please contact ETPS Ltd. to discuss your requirements.

# MODULAR BATTERY CHARGERS

Up to 64 BC-TC modules can be arranged in series, parallel or matrix array configurations. Each module is able to operate independently, so that systems can be reconfigured, expanded or broken up as needs dictate. Inbuilt system comms allow users to switch between various set-ups.

The modular approach is useful for companies who regularly need to charge different sized energy storage devices. Individual modules can be used for the charging of multiple small devices, then grouped together for larger storage systems. The diagram shows all the possible combinations with eight 500V modules.



## CABINET OPTIONS

Units can be treated to a laboratory rack or flight case integration. Common options include mains cables, passive indication of any residual DC voltage, isolation monitoring of DC cables and a panel mounted emergency stop. Switch panels with removable DC links can be fitted for modular systems. This simplifies the reconfiguration between series, parallel or independent use. Simple wheeled cabinets are also available.

Having a high power battery charger mounted into a flight case on castors is often advantageous, especially when equipment is needed on multiple sites. Several power systems can be fitted into the same flight case. Door hangers are fitted for convenience. Existing ETPS systems can also be retrospectively integrated into new flight cases where requested.



# INPUT

## STANDARD FEATURES

TECHNICAL DATA	
Input Voltage	3 × 360 - 440 VAC
Line Frequency	48 - 62Hz
Mains Connection Type	3L + PE (no neutral)
Load Regulation (CV, CC)	<± 0.1%
Line Regulation (CV, CC)	<± 0.1% (Typical value for input voltage variation within 360-440 VAC, at constant load and temperature conditions.

## HIGHLIGHTED FEATURE



### POWER FACTOR CORRECTION

BC-TC modules have a Power Factor Correction (PFC) circuit integrated into the input stage as standard. This enhances the overall efficiency of the modules across the output power range when compared to a unit that does not have PFC. The current harmonics of the BC-TC meet the EN61000-12 regulations for a mains SCE  $\geq 120$  value. In practice, this means a significant lower peak current value, a decrease of RMS value of the phase current and less perturbations of other equipment running on the same grid.

The inbuilt PFC is also ideal for operating the charger from a generator. Generators tend to be sensitive against high current peaks, and their voltage controllers may have some stability problems with non-sinusoidal load currents. The PFC feature forms a lowpass filter and therefore, both the repetitive current peaks and also the harmonic content is enhanced. This will help the generator system maintain a stable and reliable output.

## OPTIONS

CODE	DESCRIPTION
/480	Input voltage range of 3 × 432-528Vac, 48-62Hz (for models $\geq 16$ kW)
/WR	Wide input of 3 × 360-528Vac, 50/60Hz (only available for 1kV units at 20kW or 32kW)
/FILTER	Input air filter

## HIGHLIGHTED OPTIONS

### + - CUSTOM DC INPUT

Where users only have access to a DC link, special BC-TC units have been produced with a DC input. The full functionality of the battery charger is still provided. To discuss this option further, please contact ETPS.

### ⚡ WIDE INPUT RANGE (/WR)

A 360-528Vac wide input range is possible for selected models. This is ideal for systems which may regularly travel to different countries, such as when using the BC-TC for a global motorsports series.

# GENERAL SPECIFICATIONS

## STANDARD FEATURES

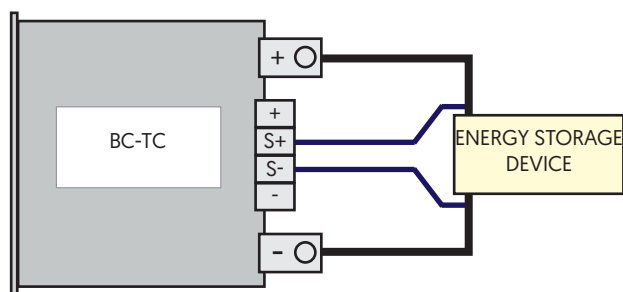
TECHNICAL DATA	
Operating Modes	Constant Voltage [0 - 100% of $V_{MAX}$ ] Constant Current [0 - 100% of $I_{MAX}$ ] Constant Power [5 - 100% of $P_{MAX}$ ]
Internal Resistance Range	Adjustable $\Omega_{MAX} = [V_{NOM} / I_{NOM}]$
Interfaces	Analogue & RS-232
Remote Sense	0 - $V_{MAX} + 2\%$
Efficiency	Up to 95%
Response time (10-90%)	<2ms
Over Voltage Protection	0 - 110% of $V_{MAX}$
Over Current Protection	0 - 110% of $I_{MAX}$
Output Ripple (300Hz Vrms)	<0.4% [Typical value at nominal ohmic load, line asymmetry < 1 Vrms].
Output Noise (40kHz-1MHz)	<0.1 Vrms [Typical value at nominal ohmic load, line asymmetry < 1 Vrms].
Stability (CV, CC)	< $\pm 0.05\%$ [Maximum drift over 8 hours after 30 minute warm-up time, at constant line input, load and temperature conditions].
Temperature Coefficient (CV)	<0.02% of full scale value per°C [Typical change of output values versus ambient temperature, at constant line input and load conditions].
Temperature Coefficient (CC)	<0.03% of full scale value per°C [Typical change of output values versus ambient temperature, at constant line input and load conditions].

## HIGHLIGHTED FEATURES



### SENSE COMPENSATION

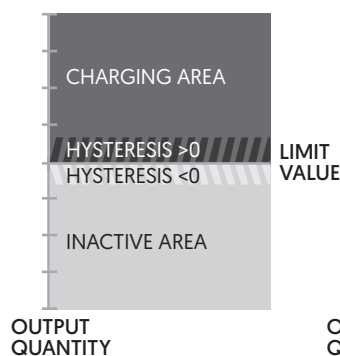
Sense plus terminals are built into the BC-TC for the connection of sense wire which compensates for voltage drops in the load lines. This has a number of advantages over traditional sense. It is permitted to interrupt the load line during operation (voltage on). The maximum voltage drop compensation is adjustable. The voltage difference between BC-TC output and sensing point is monitored. If a set limit is exceeded, the BC-TC unit shuts off. This is particularly useful for applications with long cables often prone to unwanted voltage drops.



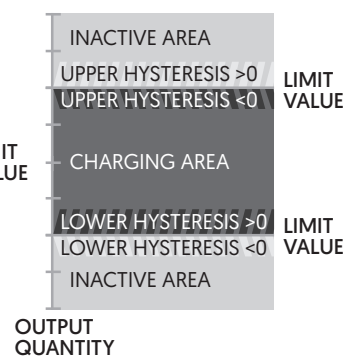
### VERSATILE LIMIT SETTING (VLS)

The VLS allows the BC-TC's output relays to be activated automatically when specific output values are met, protecting the battery from any damaging charge conditions. Output voltage, current and power values which exceed or fall below a given limit or operating window can be programmed to trigger the relays. Active and inactive areas of operation are defined by a limit value, hysteresis value or a directional designator for the hysteresis.

#### EXCEEDING A LIMIT



#### ENTERING A WINDOW



## OPTIONS

CODE	DESCRIPTION
/IRXTS	Maximum adjustable internal resistance range extended to 32,000mΩ
/CANCABLE	Connecting cable for multi-unit operation
/RMB	Remote Measure Box for higher dynamics in multi-unit operation

# INTERFACES



## STANDARD RS-232 INTERFACE

The RS-232 interface is configured as a Sub-D 9 pin connector (female) and is located on the front panel. This interface can be optionally moved to the rear panel. The graphical user interface, TopControl is operated via RS-232. The software runs on Windows and allows the user to control, measure and configure the charger.

### TECHNICAL DATA

Isolation to Electronics and Earth Configuration	125 Vrms
Baud Rate	38,400 baud
Resolution (programming & readback)	0.025% FS (for V & I), 0.1% FS (for P & Ri)

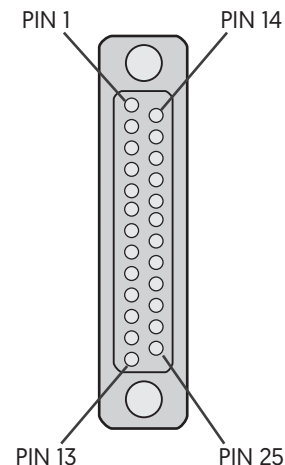


## STANDARD ANALOGUE INTERFACE

The control port is configured as a Sub-D 25 female connector and is located on the rear panel. It allows output values to be set and read proportionally using a 0-10Vdc analogue signal. Digital inputs and outputs enable various functions such as the interlock and output ON/OFF. A 10Vdc reference is provided for analogue control. Digital functions are switched via a high/low signal. A 24Vdc supply voltage is provided for these functions. The control port is labelled X105.

### TECHNICAL DATA

Isolation to Electronics and Earth	125 Vrms
Unit Ready/Error	Relay Contact
Resolution (programming & readback) for V, I, P, Ri	Relay Contact
Actual Voltage Readback 0 - 100%	0 to 10V
Actual Current Readback 0 - 100%	0 to 10V
Resolution (V, I, P, Ri)	0.2% FS
Output Voltage Off/On	0/24VAC/DC
2 Digital Application Inputs	0/24VAC/DC
Interlock Circuit	0/24VDC
Voltage Setting 0 to 100%	0 to 10V
Current Setting 0 to 100%	0 to 0V
Power Setting 0 to 100%	10 to 0V
Internal Resistance Setting	0 to 10V



PIN	SIGNAL	I/O	DESCRIPTION
1	AGND	I	Analogue ground for pins 2–4, 14–16
2	VREF	I	Voltage setpoint input 0–10 V
3	IREF	I	Current setpoint input 0–10 V
4	IACF	O	Current feedback output 0–10 V
5	0 VDC	O	0 VDC I/O ground for pin 25 <sup>1</sup>
6	+10 VDC	O	Analogue reference voltage
7	COM	I	(connected to pin 17) 0VDC DigIn; common ground for pins 8–9, 18–20, 24
8	APP_DIGITALIN_4; CLEAR_ERROR	I	Digital input 0-2V /10-24V DC
9	VOLTAGE_ON	I	Digital input 0-2/10-24V DC
10	OK/ALARM_b <sup>2</sup>	O	Relay output 1 normally open
11	OK/ALARM_a <sup>2</sup>	O	Relay output 1 common
12	RUN_b <sup>2</sup>	O	Relay output 2 normally open
13	RUN_a <sup>2</sup>	O	Relay output 2 common
14	PREF	I	Power limit analogue input 0–10 V
15	RREF	I	Ri-simulation analogue input 0–10 V

PIN	SIGNAL	I/O	DESCRIPTION
16	VACT	O	Voltage feedback output 0–10 V
17	COM	I	(connected to pin 7) Common ground to pins 8–9, 18–20, 24
18	APP_DIGITALIN_1	I	Digital input (low) 0-2 VDC/(high) 10–28 VDC
19	APP_DIGITALIN_2	I	Digital input (low) 0-2 VDC/(high) 10–28 VDC
20	APP_DIGITALIN_3; ANAOG_REFERENCE_SELECT	I	Digital input ((low) 0-2 VDC/(high) 10–28 VDC Analogue reference select
21	WARN_a <sup>2</sup>	O	Relay output 3 normally open
22	WARN_b <sup>2</sup>	O	Relay output 3 normally closed
23	WARN_c <sup>2</sup>	O	Relay output 3 common
24	INTERLOCK_IN_+	I	Input Interlock +
25	+24 VDC	O	24VDC I/O Aux power output 24 VDC, max. 0.2 A

<sup>1</sup> Pin 5 (0 VDC) is used as the reference earth for pin 25 (24 VDC) and is connected internally to the equipotential bonding via a 1 kΩ resistor to earth.

<sup>2</sup> Maximum switching current: 1 A; maximum switching voltage: 24 V.

## OPTIONAL INTERFACES

CODE	DESCRIPTION
/HMI	This provides front panel control and measurement via a menu driven LCD screen. Most users prefer their units to be fitted with HMI. For systems comprised of multiple units or where only remote control is required, cost can be saved by not including front panel controls and display.
/RS232REAR	RS-232 on front and rear panel (time shared mode with RS-232 on front).
/RS422	Differential serial interface (time shared mode with RS-232).
/IEEE	When specified, an integrated IEEE 488.2 interface is built into the rear panel (RS-232 only possible on rear panel). The programming terms employed are compliant with Standard Commands for Programmable Instrumentation (SCPI), making the BC-TC ideal for system integration.
/CANOPEN	On request an additional serial interface built to the CAN/CANopen standards can be integrated into the rear panel (RS-232 only possible on rear panel).
/CANMP	Integrated CANmp interface (RS-232 only possible on rear panel).
/OPTOLINK	Rear panel integrated fibre optic interface (RS-232 only possible on rear panel).
/USB	Integrated USB interface. (RS-232 only possible on rear panel). The graphical user interface, TopControl can be operated over the USB port. RS-232 and USB cannot be used at the same time.
/ETH	Ethernet interface with listener and talker functions over a LAN (RS-232REAR required).
/CAN+USB	Combined CAN and USB interface.

## HIGHLIGHTED OPTION

**CAN MP** CAN MULTI-PURPOSE INTERFACE (/CANMP)

CANmp is a high speed digital interface operating at 1kHz. The interface gives users the capability to customise the CAN protocol. Up to 50 messages are user configurable. Along with the CAN ID the data length code, byte order, start bit, data type and signal factor can be adjusted by the user. A DBC file is provided and messages can be easily configured within the standard windows software. Messages can be sent cyclically or upon receipt of a sync or syncID signal.

## SAFETY &amp; PROTECTION

## STANDARD FEATURES

TECHNICAL DATA	
Max. Reactive Load Voltage	≤ 110% Vmax
Mounted In Cabinet	Up to IP 53
Basic Construction	IP 20 (current bars on rear side excluded)
EMC Emission	EN 61000-6-4
EMC Immunity	EN 61000-6-2

## OPTIONS

CODE	DESCRIPTION
/ISR	Integrated safety relay for shutdown to EN 13849-1 Cat 2/3
/PACOB	Protection against accidental contact of output current bars
/RPP	External arrangement providing automatic voltage matching with reverse polarity protection

## HIGHLIGHTED OPTIONS

**AUTOMATIC VOLTAGE MATCHING WITH RPP (/RPP)**

An external arrangement providing Reverse Polarity Protection (RPP) is recommended for energy storage devices without an automatic voltage matching circuit. With the BC-TC energised but output off, the RPP senses the voltage of the connected energy storage device. A contactor is closed after matching the voltage, to prevent large inrush currents and arcing on start up.

**PROTECTION AGAINST OUTPUT BARS (/PACOB)**

A specially produced cover is available which provides protection against accidental contact of output current bars. This safety option can be provided for both the AC and the DC connections.

**INTEGRATED SAFETY RELAY (/ISR)**

For additional safety, a mechanical interlock is available for the mains input of the BC-TC. The integrated safety relay provides shutdown safety according to EN 13849-1 category 2/3. The ISR is connected to the external safety switch loop. If the external loop is opened, the DC-output of the charger is powered down immediately.



# SOFTWARE/SOFT TOOLS

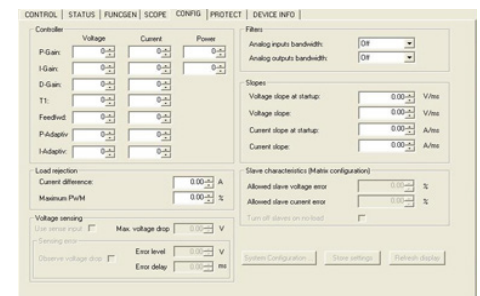
## STANDARD TOP CONTROL GUI

All BC-TC units come with a simple and intuitive TopControl operating GUI as standard. Live values of the battery charger are displayed graphically along with any warning and error messages. The software provides a variety of second level parameters, ideal for users who like to optimise their charging processes. In standard user mode the operator can remotely program set values, enable voltage output as well as the ability to analyse different variables including set and actual values via the integrated scope.

The scope function can simultaneously record up to 8 system variables. Recording can be started manually or by a defined trigger event from any variable of the system. All actual and set values [currents/voltages/power/internal resistance] can be recorded. Other recordable items include system temperatures, intermediate DC circuit, low voltage auxiliary power supplies, error related values and variables from the controller section.

A password protected section is available to the advanced user and service technician. In addition to the standard functions the authorised user is able to:

- + Program linear ramp functions at start up and set value steps during operation
- + Configure multi-unit operation
- + Program the PID controller parameters
- + Program the unit's limit values
- + Calibrate and adjust values as necessary
- + Update the firmware



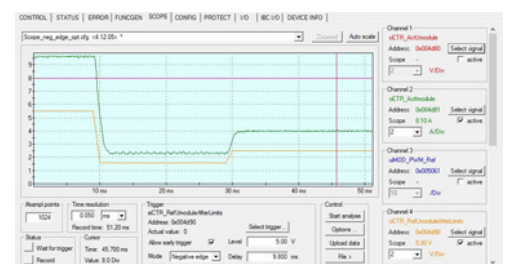
## OPTIONAL SOFTWARE

CODE	DESCRIPTION
/TFE	Integrated function generating engine with application area (parametric) programming
/BATCONTROL	GUI to implement specific battery/capacitor charge profiles

## HIGHLIGHTED OPTIONS

### FUNCTION GENERATOR (/TFE)

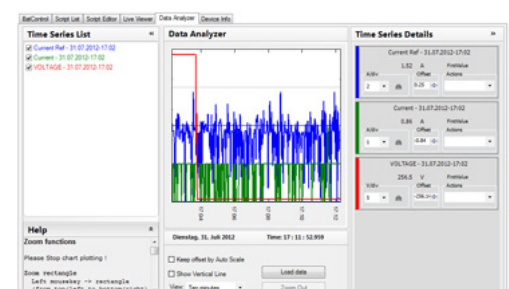
An embedded function generator allows exact DC waveforms to be implemented for pulsed charging. The tool allows users to deliver short burst of highly concentrated energy at user defined time intervals to the energy storage device. Pulse charging is thought to improve battery discharge capacity and help facilitate longer cycle life. Some studies have shown that pulse charging is also helpful in eliminating concentration polarisation.



Voltage/current and voltage/power relationships can also be programmed where necessary. This allows specific charge profiles to be plotted out for sensitive energy storage devices. Parametric programming is possible, where instead of the time axis, an input variable ( $V_{IN}$ ,  $I_{IN}$  or  $P_{IN}$ ) can be selected.

### ADVANCED BATTERY CHARGING (/BATCONTROL)

BatControl can implement specific charge profiles to your energy storage device. The GUI also allows a variety of performance issues to be investigated including lifetime tests, system degradation analysis, shot and burst overload tests among others.





# MECHANICAL

## STANDARD FEATURES

TECHNICAL DATA	
Dimensions [10kW & 16kW Modules]	19" x 6U x 450mm [W x H x D], a full cabinet integration service is available on request
Dimensions [20kW & 32kW Modules]	19" x 9U x 525mm [W x H x D], a full cabinet integration service is available on request
Weight [10kW & 16kW Modules]	42/44kg
Weight [20kW & 32kW Modules]	64/68kg
Line Input Connections [10kW & 16kW Modules]	Terminal block 4 x 10mm
Line Input Connections [20kW & 32kW Modules]	Terminal block 4 x 25mm
Output Terminals	Nickel-plated copper bars - Length: 40mm, 1 hole 9mm ø in each bar

## OPTIONS

CODE	DESCRIPTION
/LCAL	Integrated liquid cooling of the power stage
/RCU	The RCU provides the HMI functions via cable at a distance of up to 40m. The RCU is available in a compact desktop case or as a 19" rackmount unit.
/4062	Ruggedisation specification for vehicle mount projects

## HIGHLIGHTED OPTIONS



### RUGGEDISATION SPECIFICATION (/4062)

Ruggedisation of units to military standards is possible. Many previous modifications have been carried out for shipborne and vehicle projects. Our design team can work with you to meet specific requirements and standards. This ensures suitability in harsh conditions by providing protection against shock, vibration and humidity.

One previous modification included modifying a BC-TC system to withstand up to 30g of mechanical shock across X, Y and Z axes. The PSU also could operate from temperatures as low as -10°C all the way up to 55°C. For more information about what ruggedisations have previously been achieved, please contact ETPS.



### LIQUID COOLING (/LCAL)

Liquid cooling of the BC-TC's power stage is available for units which may be subject to naturally hot or uncontrolled environments. This enables operation up to 45°C with no performance derating.



### REMOTE CONTROL UNIT (/RCU)

The RCU is an external control unit for controlling multi-module systems, which reduces response times when implementing complex changes. The RCU is available as either a desktop unit or a 19" rackmounting module, with or without an emergency stop.

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.



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**WE ARE  
POSITIVE  
PEOPLE**  
”

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**