



Site Battery Charging

Issue No.: AN022-01

Author: TEA Engineering



General

This AN is an attempt to explain the application of Base Station Site Battery Charging particularly as it applies to TB8100's.

Background

For many years customers have used T807 and T808 Power Supplies to float charge batteries and while this works there are a number of issues with this sort of solution i.e.:

- 1) no care taken of the batteries
- 2) no consideration of battery types (such as gel vs wet cell) and the different charging methods for them
- 3) no low voltage cutout, which ideally should be adjustable to cater for different chemistries
- 4) no temperature compensation
- 5) possible issues powering equipment and charging the batteries when batteries are in deep discharge.

For a number of reasons, with the demise of the T800, Tait has taken the decision to not provide battery charging facilities as part of our Base Station equipment offering. These reasons can be summarised as follows:

a) TB8000 Design Considerations

i) TB8000 with PMU

With the TB8100 series of Base Stations the design decision taken early on was to include 28V LDMOS FET technologies as these devices were used extensively in the cellular industry, were capable of broad bandwidths, had multiple manufacturer support and as such were less likely to be subject to the obsolescence issues faced by the T800 PA's. As a result of this decision to use 28V technologies the TB8100's require a PMU to provide the required voltages from mains and/or a variety of site DC supplies including 12, 24 and 48 VDC.

The PMU also provides extensive monitoring and management facilities beyond that of a standard power supply.

At the time of the TB8000 release there was some suggestion the 12VDC auxiliary supply could be used for some battery charging, but we rejected this suggestion because of the very limited current output, and for the other reasons outlined here.

In summary, the PMU is unable to supply any battery charging capabilities and there is no room within the TB8100 rackframe to incorporate additional battery charging equipment.

ii) TB8000 with 12V PA

As a result of a number of customers requiring TB8000's for 12 VDC only operation without the additional cost of the PMU Tait subsequently developed 12V PA versions of the Base Station.

The main uses for this type of equipment is when the site already has a 12VDC power system – either a properly dimensioned and designed standby power system or a solar power system. Either of these systems would normally already incorporate battery charging and management facilities and so the advanced features and cost of the TB8100 PMU are not required.

Having said that, the 12V PA Bases do have space to incorporate a proper battery charger and while we have had quotes to incorporate a battery charger into the TB8000 mechanical format the space limitations result in the quotes being approximately double the cost of commercially available units. This combined with the low level of demand for such a device preclude us from pursuing this as a marketable option

b) Customer Requirements

Over time our customers are demanding more from their radio systems particularly in terms of maintainability, alarm reporting, updated technology etc. Tait do not claim any particular expertise in regard to battery charging and standby power systems and believe our and our customers interests are best served by us sticking to our core competencies.

c) Range of Options Available

In today's market a large number of battery charging product options are available, from simple power supplies suitable for charging sealed batteries and incorporating limited features to power a single base. All for a few hundred dollars. Through to sophisticated battery management systems suitable for powering a complete site and providing sophisticated battery protection and management as well as monitoring and alarm capabilities.

As a result of these considerations, where sites require backup battery systems our recommendation is that the equipment owner consider their requirements and incorporate these requirements into a considered standby battery system incorporating dedicated battery charging facilities.

To provide some guidance and assistance to customers wishing to provide battery charging facilities on a site the following information is provided as a starting and reference point.

Appendix – Supporting Documentation

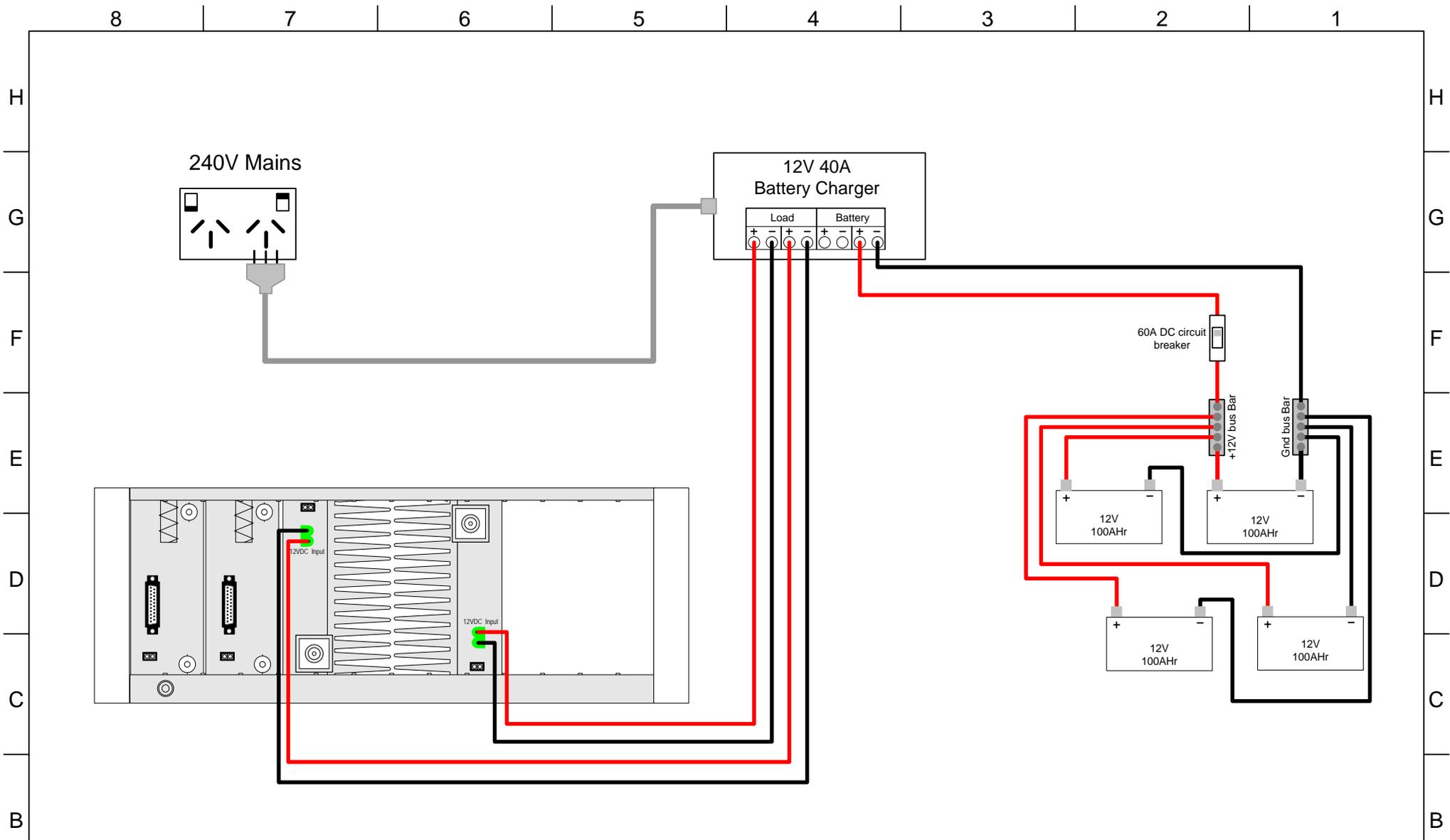
Suggestions for 12 Volt battery backup solutions for TB8100 base station systems.

There are a number of issues to consider when connecting a TB8100 to a 12V battery backup solution. The first choice is whether the TB8100's on the site are to be supplied as either:

- 1) TB8100 with 12V PA's – no PMU
- 2) TB8100 with 28V PA's – PMU required

Each of these alternatives is considered separately from a Battery Charging point of view below:

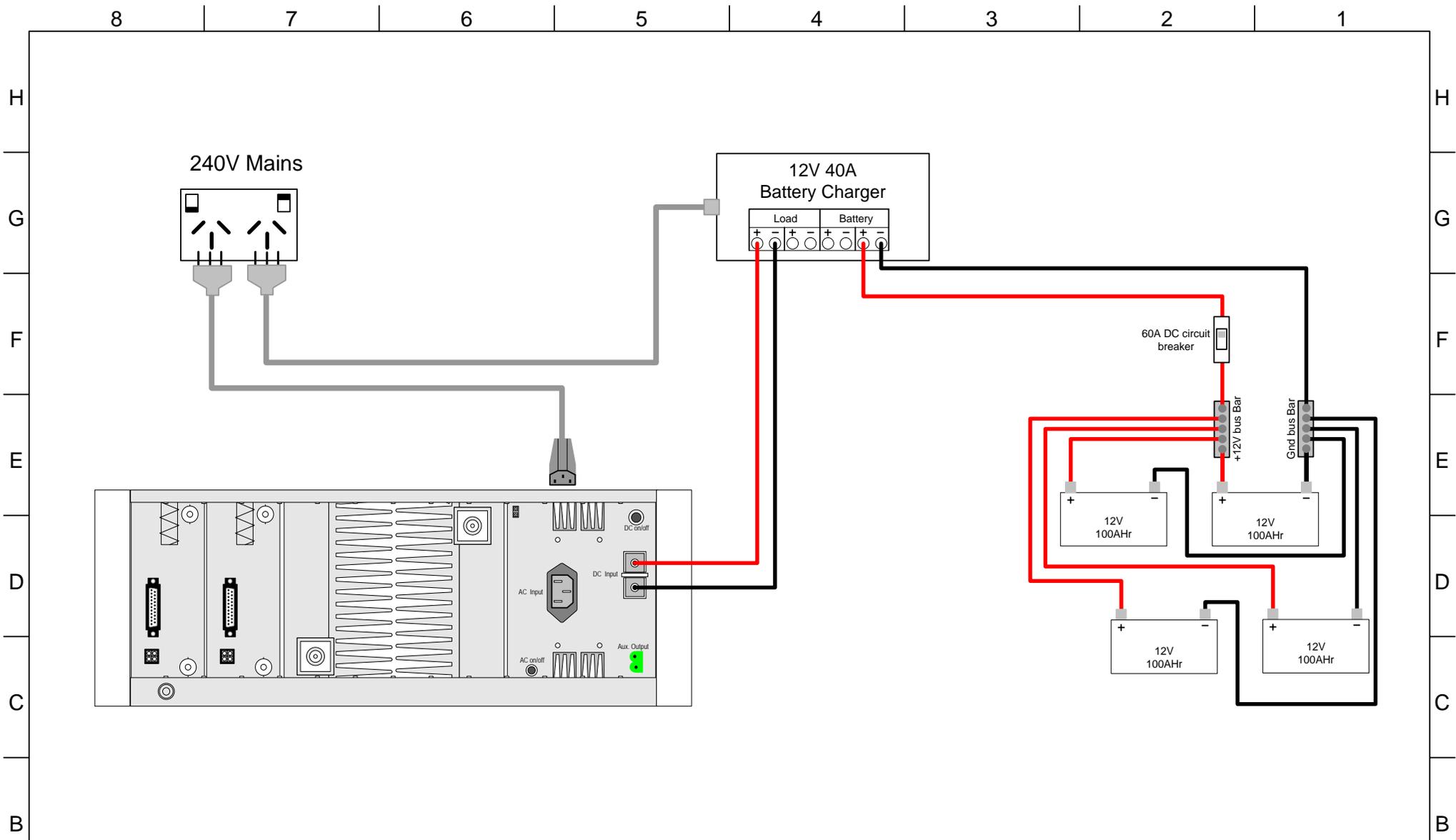
- 1) TB8100 system using 12V PA's - no TB8100 Power Management Unit (PMU) used.
 - No PMU required as the 12V TB8100's PA's are powered by external 12VDC and the PMU monitoring and management facilities are not required.
 - On a mains powered site the 12V is provided by a 12VDC power supply or 12V batteries & battery charger/power supply.
 - On a non mains powered site there will be a 12V backup battery arrangement with power supplied to the batteries by solar panels, wind generator, diesel generator or some combinations thereof. In general these methods inherently include battery charging functionality.
 - Refer to attached diagram “**Example AC and DC Connection to a Dual 12V PA TB8100 Rack (No PMU Required)**” for suggested methods of connecting the 12V battery backup system to the 12V PA TB8100's
- 2) TB8100 system using 28V PA's – requires TB8100 PMU (AC, DC or AC/DC).
 - A TB8100 system using the 28V PA's requires that a PMU be fitted to each TB8100 subrack. The PMU can convert 240VAC and/or 12VDC (or less commonly 24 or 48VDC) input into the 28VDC required for the TB8100 PA
 - For a mains powered site where battery backup facility is required in case of mains failure then the PMU can be provided as DC only in which case the TB8100 is connected via the load terminals on the battery charger.
 - If desired, on a mains powered site with battery backup, an AC/DC PMU can be used with the Base Station generally running from the mains but switching to DC in the event of mains failure.
 - For a non mains powered site the PMU is provided as DC only and the TB8100 is connected via the load terminals on the battery charger.
 - Batteries are sized based on load requirements – including load current, duty cycles, design power outage time, battery capacity and depth of discharge.
 - Battery Chargers need to be specified to provide for load current once mains is restored plus fully recharging the batteries within the design time period.
 - Refer to attached diagram “**Example AC and DC Connection to a Dual 28V PA TB8100 Rack**” for suggested methods of connecting the 12V battery backup system to the 28V PA TB8100's.



1.0	Original	31/7/06	MP
REV.	DESCRIPTION	DATE	BY



<i>TB8100 Backup Battery Configuration</i>			
Sample AC and DC connection to a dual 12V PA TB8100 rack (no PMU required)			
Size: A4	Project No:	Drawing Filename: <i>12V PA dual TB8100 ACDC battery connections.vsd</i>	
SCALE	NTS	SHEET	1 OF 1



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TB8100 Backup Battery Configuration			
Sample AC and DC connection to a dual 28V PA TB8100 rack			
Size: A4	Project No:	Drawing Filename: 28V PA dual TB8100 ACDC battery connections.vsd	
SCALE	NTS	SHEET	1 OF 1

Things to consider when thinking about TB8100's and Site Battery Charging:

The TB8100 PMU's do not charge batteries: There is a low current (3A) 12V auxiliary output available on some variants of the PMU, this output is designed for powering low current 12V devices like telephone interconnects, audio bridges, Rx amplifiers etc. This output is not suitable for charging batteries due to it's limited current capability

100W TB8100 PA's are only available as 28V PA (no 12V PA version) and therefore must use the PMU in the rack.

Cost: Following is a comparative cost example for a Base Station powered by an external battery bank and charger. For comparison we have compared:

- 1) TB8100 with 12VPA – no PMU
 - 2) TB8100 with 28VPA – AC/DC PMU
 - 3) T800 with T808 Power Supply – limited battery charging functionality.
- Example 1: TB8100 connected to a 12V battery charger and 400Ahr 12V battery bank and
 - the list price for a single 12VPA 50W UHF TB8100 subrack is \$5646.
 - Price for a 100Ahr SLA battery is \$300, so 4 x 100Ahrs = \$1200
 - Price for a 20A rackmount battery charger = \$1100
 - Total cost for equipment only for this setup would be **\$7,946.**
 - Example 2 : TB8100 connected to mains via the PMU AC input and a 12V battery bank via the PMU DC input. For normal operation the PMU is run via the mains and this then switches to the 12V battery on the PMU DC input when the mains fails
 - the list price for a single 28VPA 50W UHF, AC/DC PMU, TB8100 subrack is \$7498.
 - Price for 4 x 100Ahrs Battery (as above)= \$1200
 - Price for a 20A battery charger (as above) = \$1100
 - Total cost for equipment only for this setup would be **\$9,798.**
 - Example 3 : For comparative purposes. A T800 50W UHF rack with a T808 P.S. which as discussed does not provide the facilities of a dedicated battery charger, would be as follows:
 - the list price for a single T800 50W UHF rackframe package, DC powerd (ie. T-BD2ND00-40) was \$5968.
 - Price for a T808-10 was \$1368
 - Price for 4 x 100Ahrs Battery (as above)= \$1200
 - Total cost for equipment only for this setup would be **\$8,536.** (Does not include low volt cutout)

Power Consumption (relevant in non-mains powered applications): Power consumption figures of a single 12V PA TB8100 subrack are approximately 14-39%, depending on the power saving configurations used, better than the equivalent 28VDC PA TB8100 subrack. Typical single channel TB8100 subrack standby current consumption at 12V can be between 60mA and 1A depending on 12 or 28V PA, PMU options, level of power saving configured etc. For comparative purposes a typical single channel T800 subrack has a standby current consumption of 550mA.

PMU Diagnostics: If there is a requirement to monitor voltages and currents then a TB8100 Base Station with PMU provides this information to the TB8100 Service Kit Software.. If there is no requirement for the PMU diagnostics features that monitors values like current consumption, battery voltages etc then the 12V PA TB8100's may be more attractive on a 12V battery backup system.

Battery Charger Suppliers

Examples of power supplies/battery chargers available in Australia that would be suitable for backup battery operation of a TB8100 system with about 100-500AHrs of backup battery capacity.

- Powerbox - www.powerbox.com.au – Ph: 02 9457 2200
 - PB251 series ranging (at time of writing) from about \$600 for standalone 16A units to about \$1100 for 19" rack mount 20A units.
 - Various other capacity chargers and power supplies depending on requirement.
- Amtex - www.amtex.com.au – Ph: 02 9809 5022
 - CA-CX series of 12V chargers ranging from 14-60Amps\
 - Various other capacity chargers and power supplies depending on requirement.
- Powerhouse Systems – www.powerh.com.au - Ph: 07 3846 2644
 - SWS Series of 12V chargers from 20-40Amps.

Various other capacity chargers and power supplies depending on requirement

Following you will find some manufacturers information on these alternatives which may be of assistance when designing a site battery backup system.

NO-BREAK™ SR500/750 SMPS



SPECIFICATION

Power module basic specification as per standard single rail type - see P6

Dimensions as per standard single rail type - see P7

NO-BREAK FUNCTION

Functions	Battery charging, temperature compensation, battery low alarm, low battery disconnect, reverse polarity protection, rectifier fail alarm, battery electronic circuit breaker.
Available voltages	13.8V, 27.6V, 55.2V
Charge current setting	Maximum recharge rate adjustable internally, range 10 - 90% of total output: factory default 20%
Temperature compensation	-3.9mV / cell / °C via external sensor on 2 metre lead.
Battery System OK alarm	Relay opens at 80% of Vout (11V, 22V, 44V). Additionally detects open battery fuse.
Power OK alarm	Relay opens after loss of converter output for any reason
Low battery disconnect	Disconnects battery at 73% Vout (10V, 20V, 40V) Reconnects with return of mains power.
Reversed polarity protection	Internal battery fuse (automotive type). Activates alarm relay.
Electronic circuit breaker	<i>Normal:</i> Allows 150% loading without acting (psu at full loading and further 50% from battery). Battery system OK alarm will indicate battery discharging. <i>Short circuit:</i> Acts within 2mS (acts within 300mS for load >150%)

CX SERIES BATTERY CHARGERS



Battery Chargers 200 - 1000 Watts



Features

- Switched mode design
- Output options: 12V, 24V, 36V, 48V, 60V & 108V
- Power levels from 200 to 750 watts
- Constant voltage/constant current operation
- Overvoltage and overload protection
- Power Fail and Battery Low alarm signals
- Temperature compensation charging
- EMC to EN55022 and EN61000
- N+1 redundancy operation
- CE marked to Low Voltage Directive
- AS3260 safety approval: NCS7346N
- EMC approved
- Battery low volt disconnect

The CX series rectifiers offer the most comprehensive range of battery chargers for use in "DC Standby Systems".

We have redesigned our already popular ZX Series to include a new range of features such as battery under voltage disconnect, temperature compensation charging and power share signal, making them the complete charger for powering critical DC loads.

We can easily customise units to meet specific application requirements, and can offer complete systems with batteries, distribution breakers, meters etc., for small or large projects.

Rack Mounting Option



Specifications

INPUT VOLTAGE:	115/240 VAC standard, 400 VAC single phase - option 90 - 264 VAC with PFC - option DC input from 24V - 370DC - option
FREQUENCY:	44 - 66Hz (400Hz optional)
SWITCHING FREQUENCY:	CX200 - CX300 models: 33Kz, CX350 - CX750 models: 44Kz
INPUT PROTECTION:	On board input fuse and inrush current limiting
EFFICIENCY:	Model dependent, 86 - 95%
RIPPLE & NOISE:	<0.1% rms, <1% pk - pk
DYNAMIC REGULATION:	<1%, 1ms 10% load change
LOAD REGULATION:	<1% for 10 - 100% load change
LINE REGULATION:	<0.5%
VOLTAGE ADJUSTMENT:	On-board trim pot allows fine tuning ($\pm 5\%$) of battery float voltage
EMC EMISSIONS:	Conducted: EN55022 - B Radiated: EN55022 - A
EMC IMMUNITY:	EN61000 - 4 - 2 level 3 ESD EN61000 - 4 - 5 level 3 Surge EN61000 - 4 - 4 Burst EN50140 level 3 Radiated
ISOLATION:	Input - output 3750 VAC Input - chassis 2200 VDC Output - chassis 500 VDC
SAFETY:	Designed to meet EN60950, CE market to LVD
PROTECTION:	<ul style="list-style-type: none">• Overload/short circuit protection• Overvoltage protection• Over temperature protection
MTBF:	150,000 hrs per MIL - STD 217E @ 20°C
OPERATING TEMP:	0° to 40°C at rated power. Consult Amtex for derating from 40° to 70°C
HUMIDITY:	0% to 90% non-condensing
VIBRATION & SHOCK:	Operating: 5 - 50Hz 0.05mm pk - pk 50 - 100Hz 0.025mm pk - pk Non-operating: 100mm drop onto chassis face
PARALLEL OPERATION:	Consult Amtex for details
SERIES OPERATION:	Yes
SIGNALS & ALARMS:	<ul style="list-style-type: none">• Power Fail Alarm (voltage free contacts)• Battery Low Alarm (voltage free contacts)• Rectifier V out Test Point
COOLING:	CX200 & CX350 convection cooled CX300, CX550 & CX750 internal fan cooling
CONNECTIONS:	Screw terminals for input and output
DIMENSIONS & WEIGHT:	CX200: 235 x 160 x 55mm 1.5Kg. CX300: 235 x 170 x 80mm 1.7Kg. CX350: 300 x 190 x 65mm 2.5Kg. CX550 & CX750: 300 x 190 x 104mm 3.0Kg.



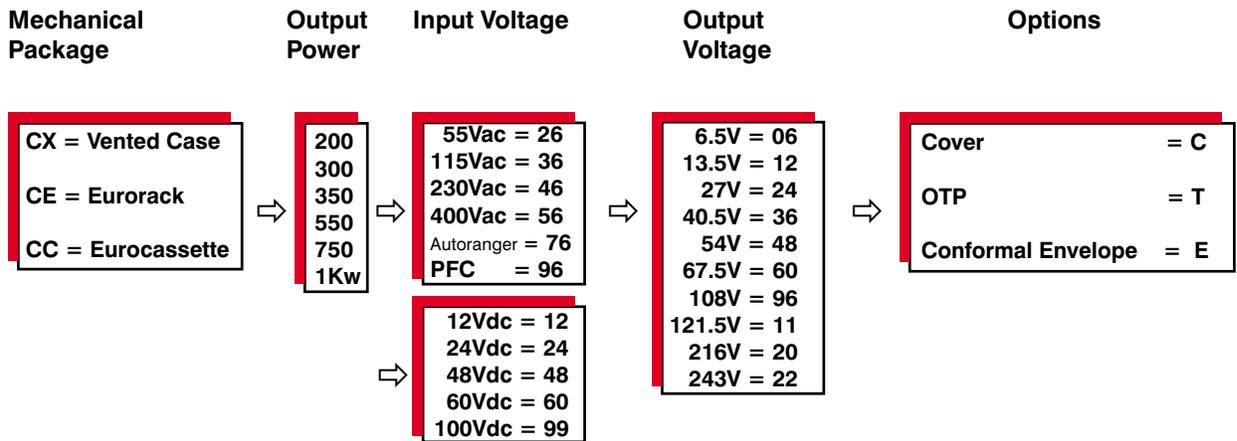
CX BATTERY CHARGERS



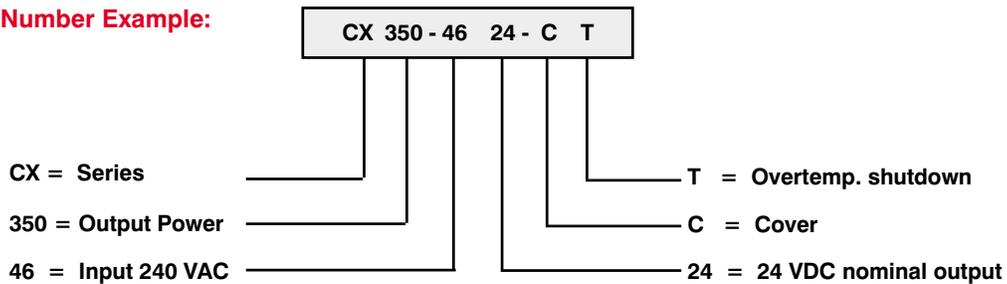
200 - 1000 Watts

Standard "CX" Series Battery Charging Table

Unit Output Code*	Battery Voltage				Unit Model (Watts)					
	Fail (1.75V/cell)	Nom (2V/cell)	Float (2V25/cell)	Boost (2V4/cell)	200W	300W	350W	550W	750W	1Kw
	Maximum Charging Current (A)									
06	5.25	6	6.75	7.2	30	45	52	82	---	---
12	10.5	12	13.5	14.4	18	25	30	45	62	---
24	21.0	24	27.0	28.8	9.0	13	15	23	31	40
36	31.5	36	40.5	43.2	6.0	9.0	10.4	15	21	27
48	42.0	48	54.0	57.6	4.5	6.6	7.8	12	16	20
60	52.5	60	67.5	72.0	3.7	5.3	6.2	9.2	13	17
96	84.0	96	108.0	115.0	2.3	3.3	4.0	5.7	7.8	10.6
11	94.5	108	121.5	129.6	2.0	3.0	3.5	5.0	7.0	9.4
20	168.0	192	216.0	230.0	1.2	1.7	2.0	2.9	3.9	5.3
22	189.0	216	243.0	259.0	1.0	1.5	1.8	2.6	3.5	4.7



Model Number Example:



Note: Not all input - output combinations available.

CX BATTERY CHARGERS



Battery Charging Using "CX" Series Rectifiers

The CX series rectifiers have been designed to operate in **constant current/constant voltage** mode for battery charging applications. These units will deliver a constant current when connected to a discharged battery until the float voltage is attained, the constant voltage mode of the unit will then maintain this level.

Example of 200W Unit Configured to charge a 24 cell (2V x 24 = 48V system) Lead Acid Battery:

The rectifier will charge at 5A until the constant voltage mode of the unit is achieved across the battery, (this is normally set to 2.25V/cell), in this case 54V. Thereafter the rectifier will maintain the 54V by way of its constant output voltage.

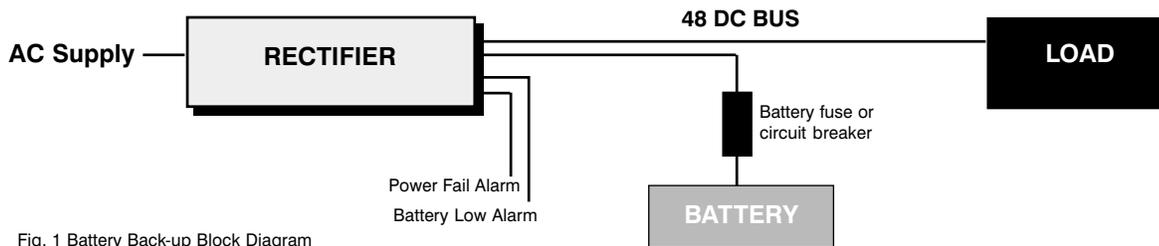


Fig. 1 Battery Back-up Block Diagram

Rectifier Selection:

Selecting the correct rectifier power rating is important for the long term reliability of the system and battery, using the following equation as a guide.

$$I_R = I_L + I_B$$

I_R = rectifier output current, I_L = load current, I_B = battery charge current (10 - 15% of AH capacity of the battery)

Battery Selection:

Selecting the right battery is just as important for optimum system performance. Usually we start by deciding what battery **back-up** time is required. Once this is decided, then using the following battery selection guide and battery manufactures data, the correct AH capacity and type of battery can be selected.

Manufacturer/Reference	.	.
Battery Capacity	.	Ah
Nominal Voltage	.	V
Float/Standby	.	V/cell
Boost/Cyclic	.	V/cell
Charging Current	.	A

Features:

The CX series rectifiers have been designed specifically for battery charging and standby DC systems and include the following features:

- Factory set 2.25V per cell float charge voltage. On board potentiometer allows for $\pm 5\%$ voltage adjustment
- Temperature charge compensation $-3\text{mV}/^\circ\text{C}/\text{cell}$
- Automatic boost voltage 2.4V per cell when output current is greater than 10% (optional)
- Supply/Power Fail alarm, via voltage free relay contacts (Power Fail = $<190/95\text{V}$, Power Good = $>200/100\text{V}$)
- Battery under voltage disconnect to avoid deep discharge (maximum disconnect current: 30A)
- Battery Low alarm, via voltage free relay contacts (Battery Low = $<1.75\text{V}/\text{cell}$, Battery Good = $>2\text{V}/\text{cell}$)
- Battery fail relay operates approximately 20 seconds before under voltage disconnect
- Output isolation (OR) diode for zero bleed on battery in UVD
- Power Share for N+1 redundancy operation

powerbox

Battery Chargers / DC UPS

PB251 & PB256



Features:

PB251 Delivers 13.8V at 275W or 27.6V at 330W

PB256 Delivers 13.8V or 27.6V at 140W

Battery Chargers with Uninterrupted Battery Backup

Wide Input Voltage Range (190-265Vac)

Switch Mode Design with High Efficiency

Low EMI & RFI - Class B

Battery Charge / Discharge Control and Protection

Natural Convection Cooled

High Reliability

Small Size & Light Weight



PB251 & PB256 FEATURES:

- PB251 and PB256 are complete DC uninterruptible power supplies (DC UPS)
When connected to lead-acid batteries, these units provide uninterrupted power to the load in the event of AC mains failure.
- A battery low voltage disconnect switch protects the battery against overdischarge.
- A battery charging current controller limits the battery charging current independently of the load current to extend battery life.
- A self-resetting electronic battery circuit breaker protects against nuisance blowing of the battery fuse on accidental load short circuits.
- DC OK and Battery OK alarms including voltage free changeover contacts.
- Natural convection cooling. No fan bearings to fail or filters which become blocked.
- PB251 series have very low output ripple and noise which is similar to a linear power supply and is suitable for powering radio equipment.
- PB251 series is available in chassis mount (CM) and 2RU 19" rack mount (-RML) variants.
- PB251 output power can be increased by attaching a heatsink to the unit (Option -H) or by cooling the the unit using the external mounting surface via a gear plate (Option -P).
- PB256 models with increased output power are available (PB256-1210CML and PB256-2405CML) for use where the external mounting surface can act as a heatsink.
- PB251-12B incorporates connectors suitable for direct connection to radio base station equipment.

PB251 / PB256 LIMITED BATTERY CHARGING CURRENT EXTENDS BATTERY LIFE

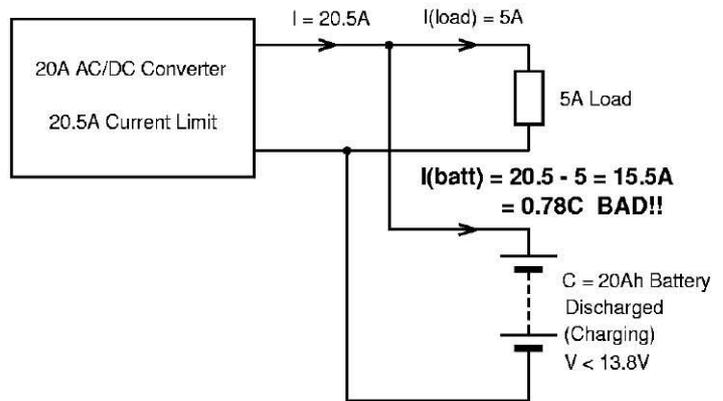
***** For Long Life, Maximum Battery Charging Current Should be Limited to 0.1C**

CONVENTIONAL DC POWER SUPPLY WITH BATTERY BACKUP

EXCESSIVE CHARGING CURRENT SHORTENS BATTERY LIFE

Battery charging current is the difference between the power converter current limit and the load.

This leads to excessive battery charging currents at light loads.



PB251 (PB256) DC UPS WITH LIMITED BATTERY CHARGING CURRENT

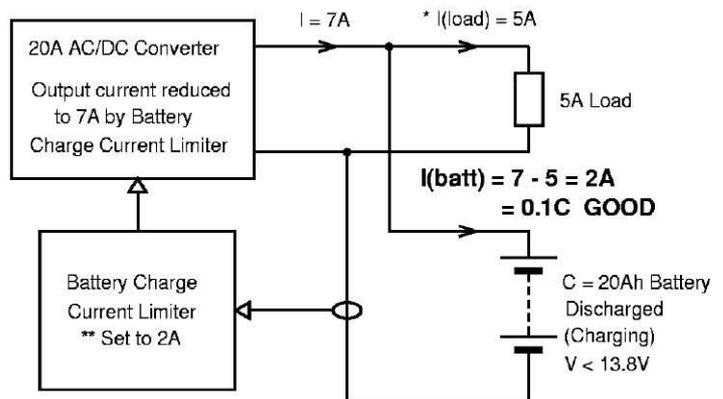
BATTERY CHARGING CURRENT IS CONTROLLED

Battery charge current limiter reduces output current from AC/DC converter to control battery charging current only.

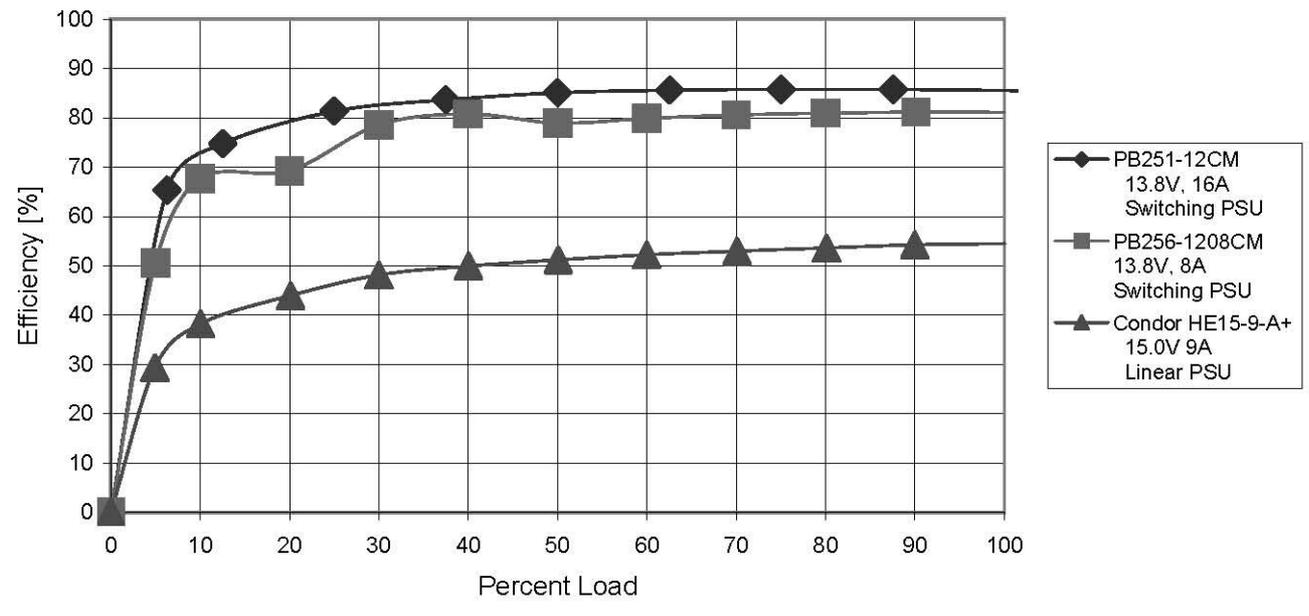
Maximum battery charging current is no longer excessive at light load currents.

* Load current can vary between 0A and 18.5A without affecting battery charging current.

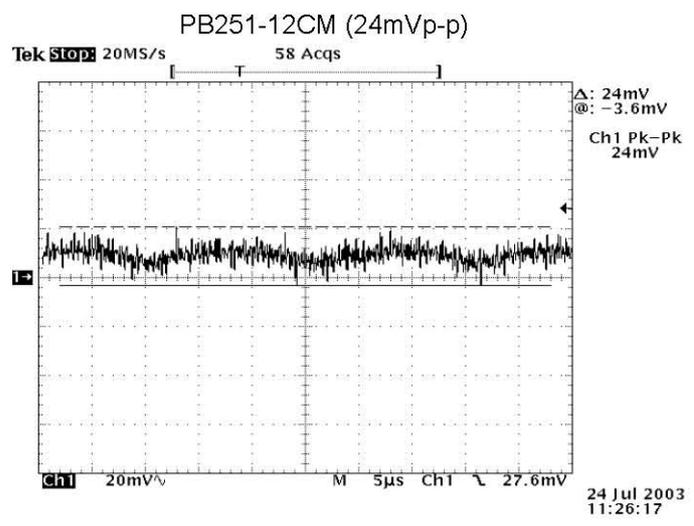
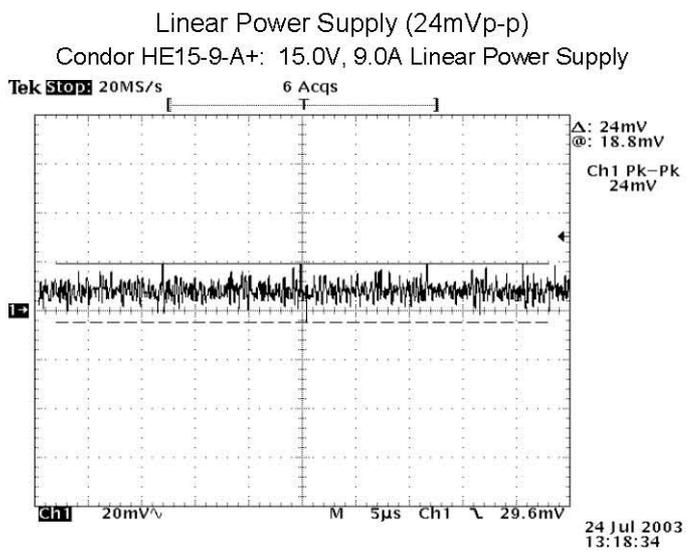
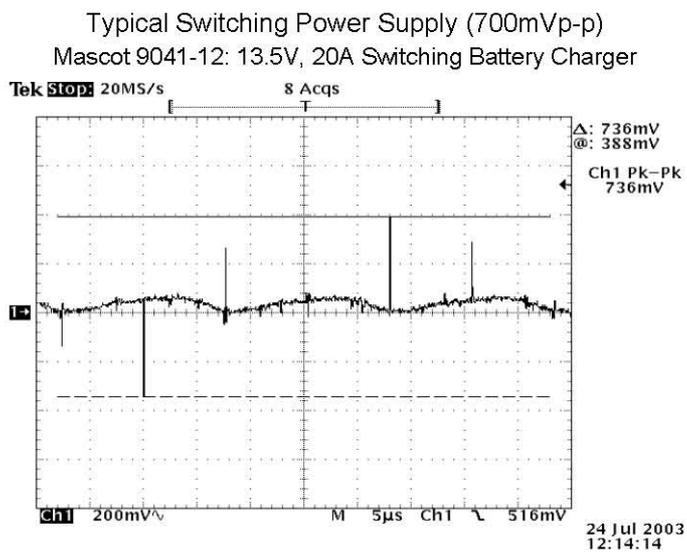
** PB251 series battery charge current limit is adjustable between 10% and 100% of AC/DC converter current rating.



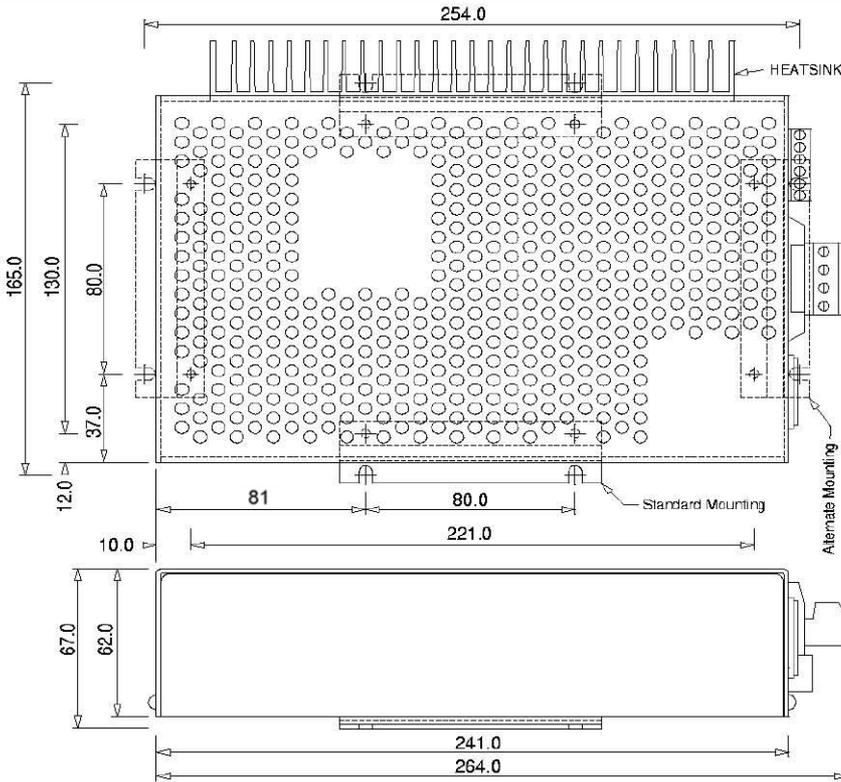
**PB251 / PB256 SERIES SWITCHING DC UPS HAVE HIGH EFFICIENCY
UNLIKE LINEAR POWER CONVERTERS**



PB251 SERIES VERY LOW OUTPUT NOISE IS SIMILAR TO LINEAR POWER CONVERTERS
***** PB251 Series is Suitable to Power Radio Equipment Unlike Most Switching Power Converters**



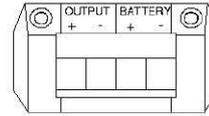
PB251-**CM (-H) MECHANICAL OUTLINE



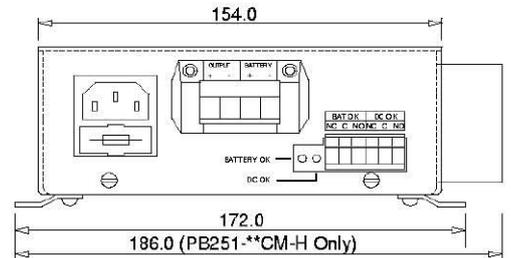
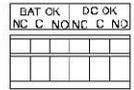
NOTES:

1. Mounting Centres: Suitable for M4 Hardware
Standard: 165 x 80 mm
Alternate: 254 x 80 mm
2. M3 threaded holes on bottom of base.
Standard: 130 x 80 mm centres
Alternate: 221 x 80 mm centres
3. AC Mains: 10A Class 1 IEC60320 power inlet
4. Output and Battery: 4W Pluggable Screw Terminal Block
Suitable for up to 4 sq. mm wire.
5. Alarms: 6W Pluggable Screw Terminal Block
Suitable for up to 1.5 sq. mm wire.

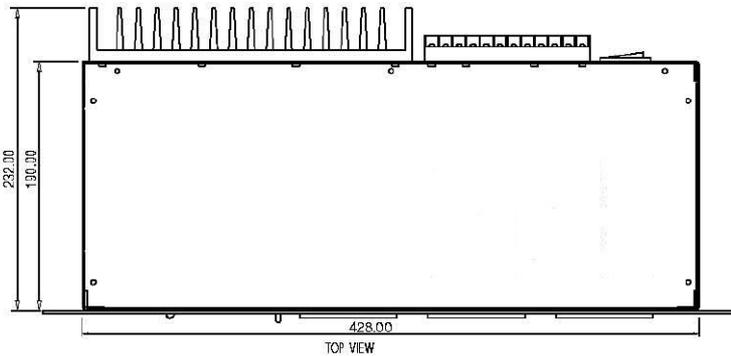
OUTPUT / BATTERY TERMINATIONS



ALARM TERMINATIONS



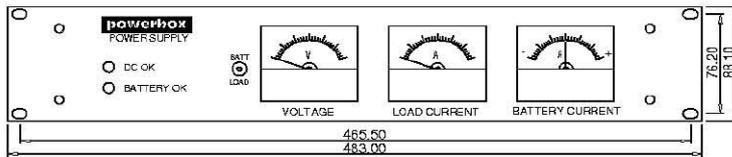
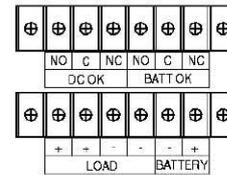
PB251-**RML & -12B MECHANICAL OUTLINE



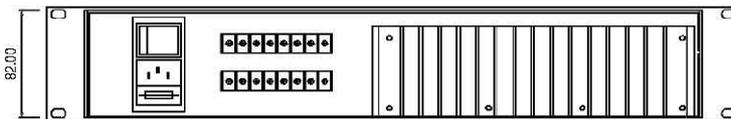
NOTES:

1. 2RU x 19" rack enclosure per IEC297
2. Mounting slots are suitable for M6 hardware.
3. Input connector is a 10A Class 1 IEC60320 inlet.
4. 2 meter IEC mains cord with Australian plug is supplied with unit.
5. PB251-12B alarm terminal is DB25 female.
6. PB251-12B output and battery connector is Hirose pin. HS28R-4A. Mating connector is Hirose pin. HS28P-4A (not supplied).
7. PB251-**RML alarm and output terminals are M3.5 screws suitable for ring or fork lugs up to 8 mm wide.

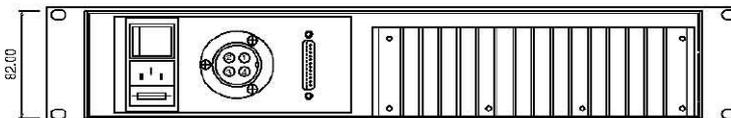
PB251-RML ALARM AND OUTPUT TERMINALS**



FRONT VIEW

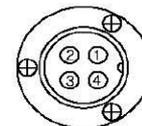


REAR VIEW (PB251-**RML)



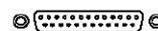
REAR VIEW (PB251-12B)

PB251-12B OUTPUT & BATTERY CONNECTOR



- PIN1: + OUTPUT
- PIN2: - OUTPUT
- PIN3: + BATTERY
- PIN4: - BATTERY

PB251-12B ALARM CONNECTOR



- PIN 1: COMMON
- PIN 6: DC OK (NC)
- PIN 15: BATTERY OK (NO)

PB256 Ordering Information

PB256 -12 08 CML
 1 2 3 4 5

- 1 Series name
- 2 Output voltage
12
24
- 3 Output current
- 4 Enclosure
CML: chassis mount
- 5 Optional
Non-standard battery charging current

MODEL	PB256-1208CML	PB256-1210CML	PB256-2404CML	PB256-2405CML
MAX OUTPUT [W]	110	140	110	140
DC OUTPUT	13.8V 8A	13.8V 10A	27.6V 4A	27.6V 5A

SPECIFICATIONS

	MODEL	PB256-1208CML	PB256-1210CML	PB256-2404CML	PB256-2405CML
INPUT	VOLTAGE [V]	AC190 - 265 1ø or DC190 - 400			
	CURRENT [A]	1.3 max.	1.4 max.	1.3 max.	1.4 max.
	FREQUENCY [Hz]	50/60 (45 - 65)			
	EFFICIENCY [%]	80 min.			
	INRUSH CURRENT [A]	15 max. (cold start)			
OUTPUT (AC Mains Operation)	VOLTAGE [VDC]	13.8		27.6	
	CURRENT [A] ¹	8.0	10.0 ²	4.0	5.0 ²
	CURRENT LIMIT [A] ¹	9.0 typ.	11.2 typ.	4.8 typ.	5.9 typ.
	BATTERY CHARGING CURRENT LIMIT [A] ³	2.0 typ.		1.0 typ.	
	LINE REGULATION [%]	0.2 typ.			
	LOAD REGULATION [%]	2.0 typ.			
	RIPPLE [mVp-p] ⁴	25 max		45 max.	
	NOISE [mVp-p] ⁴	20 max.		40 max.	
	OVERVOLTAGE SHUTDOWN	15.5 - 19.5 (Latching)		31.5 - 39.0 (Latching)	
	OUTPUT SHORT CIRCUIT PROTECTION	Indefinite (Autoresetting)			
	BATTERY CHARGER SHORT CIRCUIT PROTECTION	Indefinite (Autoresetting)			
	OVERTEMPERATURE SHUTDOWN [°C] ⁵	110 typ. (Autoresetting)			
OUTPUT (Battery Operation)	VOLTAGE DROP BATTERY TO OUTPUT [V]	0.4 typ.		0.2 typ.	
	LOW VOLTAGE DISCONNECT [V]	10.8 typ.		21.6 typ.	
	OUTPUT OVERLOAD PROTECTION	Battery Electronic Circuit Breaker			
	BATTERY REVERSE POLARITY PROTECTION	Internal Fuse			
DISPLAYS AND ALARMS	DC OK	LED (Green) ON=OK, Voltage-free Changeover Contact (32V, 1A) Alarm on loss of mains, failure of AC/DC Converter and over-temp.			
	BATTERY OK	LED (Green) ON=OK, Voltage-free Changeover Contact (32V, 1A) Alarm on battery low voltage or on failure of battery fuse.			
	Alarm Voltage (Falling) [V]	11.3		22.6	
ISOLATION	INPUT - OUTPUT	4242 VDC, 1 minute			
	INPUT - GROUND	2121 VDC, 1 minute			
	OUTPUT - GROUND	707 VDC, 1 minute			
SAFETY AND EMC	SAFETY	AS/NZS 60950, Class I			
	EMC	Complies with ACA EMC Scheme - C-Tick, IEC 61000-3-2 Class A Emissions Comply with AS/NZS CISPR11 Group1, Class B			
ENVIRONMENT AND OTHERS	OPERATING TEMP AND HUMIDITY	0 to 70°C, 5 to 90%RH (Non condensing) (Refer to DERATING CURVE)			
	CASE SIZE / WEIGHT	230 x 93 x 46mm(LxWxH) / 850g			
	COOLING METHOD	Natural Convection			

¹ Sum of load + batt. charging current

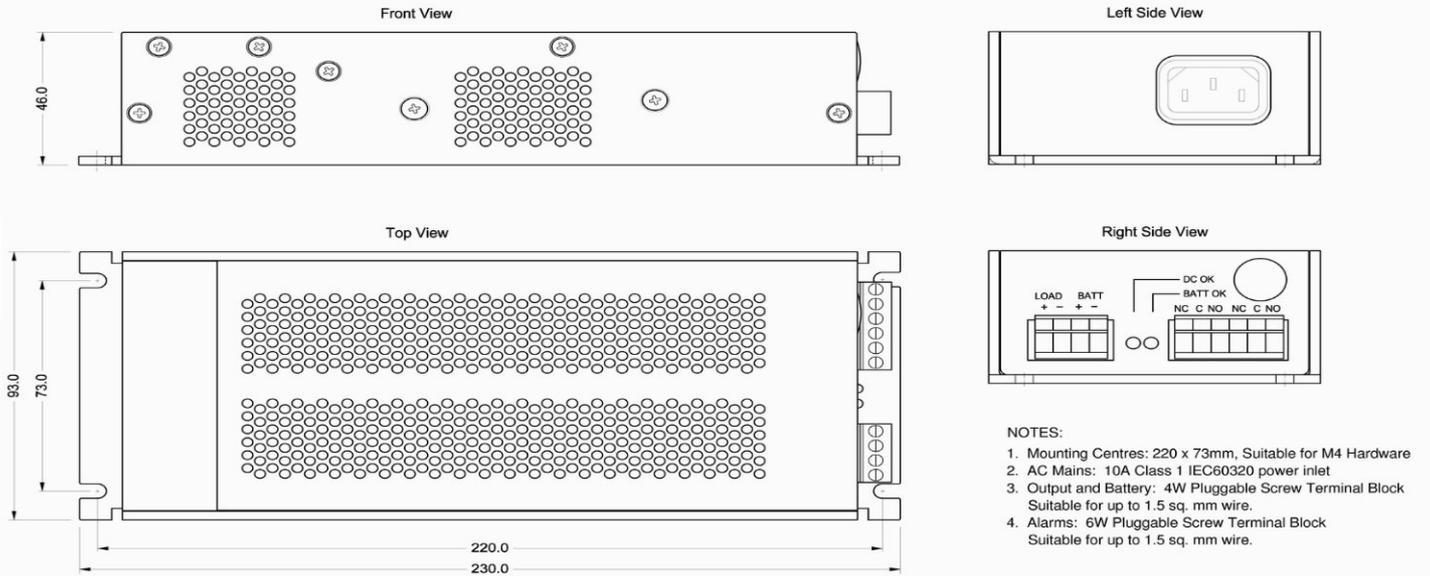
² To operate at maximum output current, these models must be attached to a 300 x 300 x 2mm Al plate or equivalent heatsink.

³ This feature limits batt. charging current but not load current.

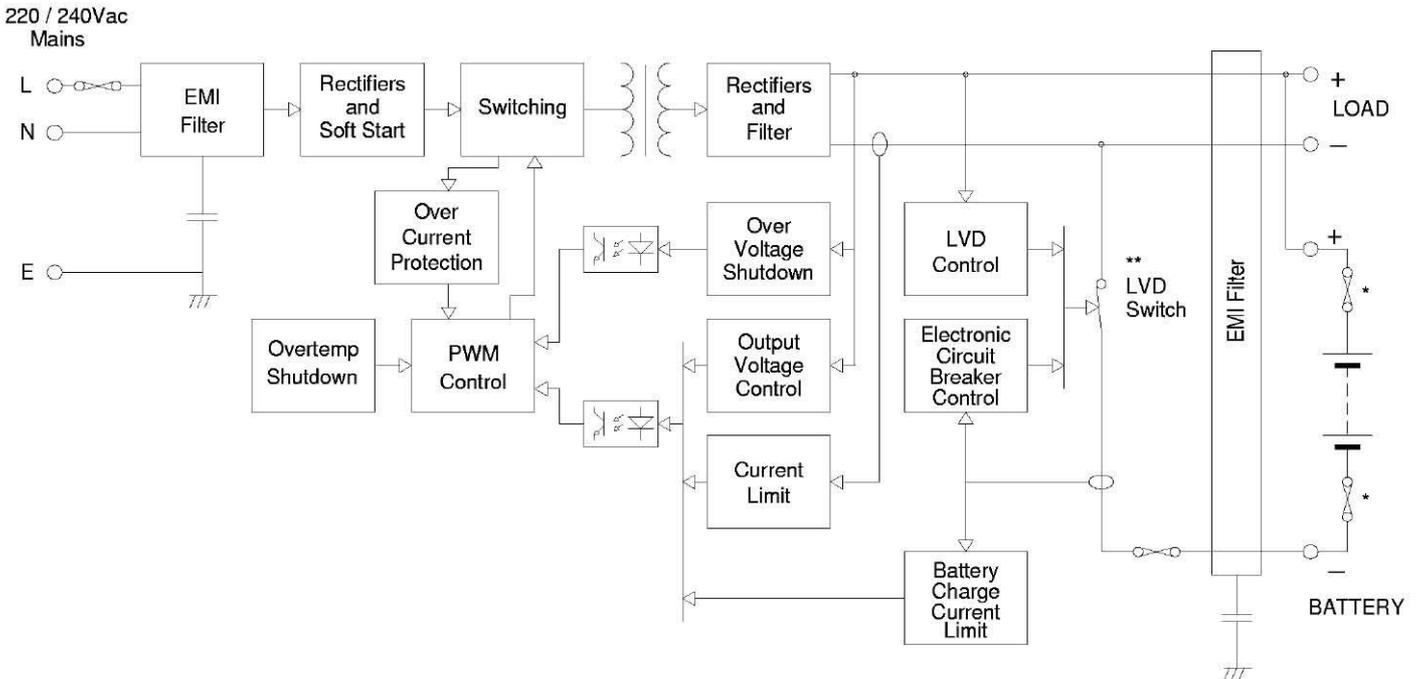
⁴ Using a 20MHz oscilloscope at the output terminals.

⁵ Internal air temperature

PB256-****CML MECHANICAL OUTLINE



PB251 / PB256 SERIES BLOCK DIAGRAM



* External battery fuses may be required in battery positive or negative leads depending upon system wiring and grounding.

** Low voltage disconnect switch is located in series with battery negative terminal. Battery negative terminal must not be connected to load negative terminal or the LVD and battery charge current limit will not operate.



FEATURES

- Automatic battery charger 12V 200-2000AH or
- Automatic battery charger 24V 100-1000AH
- Automatically switches from boost mode to float charge
- Temperature compensated charge voltage
- Protected against reverse polarity
- Short circuit proof, thermal protected
- Capable of charging completely flat batteries
- Lightweight and compact design

PRODUCT INFORMATION

The PBN8C series 12V and 24V chargers are able to accurately charge 200 to 2,000AH 12V batteries, or 24V 100 to 1000AH batteries. They automatically switch from quick charge at constant current to constant voltage float mode to ensure that batteries are always fully charged and not overcharged. They also have a temperature compensated charge voltage, the heat sensor located externally. With overall good protection, the PBN8C are ideal for charging batteries of boats, caravans, electric wheel chairs and electric fork-lifts.

INPUT SPECIFICATIONS

Input Voltage	198–264VAC
Frequency	47-63Hz

OUTPUT SPECIFICATIONS

Output Voltage	12V set to 13.8V float charge at 20°C 24V set to 27.8V float charge at 20°C Voltage is internally adjustable at ±5%
Charge Current	12V model: 40A constant current until the battery is fully charged, ie. Voltage reaches 15V at 20°C, then 13.8VDC 24V model: 20A constant current until the battery is fully charged, ie. Voltage reaches 30V at 20°C, then 27.6VDC

OPERATING SPECIFICATIONS

Efficiency	Typically 86%
Switching Frequency	67kHz
Leakage Current	Leakage current from battery when charger is not connected to Mains < 1mA
Protection	Short circuit proof Overtemperature: charge current will reduce to a safe level Reverse polarity protection Transient protection at mains with MOV
Temperature Coefficient	-3 to -4mV/°C per cell

ENVIRONMENTAL SPECIFICATIONS

Operating Temp	-25°C to +40°C at rated power
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STANDARDS AND APPROVALS

EMC Emission	EN50081-1
C-Tick	AS/NZS2064:1997, Group 1, Class A EMC filters supplied with some models
EMC Immunity	EN50082-1
Electrical Safety	EN60335-1, EN60035-2-9 Class 1 insulation with ground

MECHANICAL SPECIFICATIONS

Connector	IEC socket at input, screw terminals at output
Dimensions	289x115x153mm
Weight	3.46kg

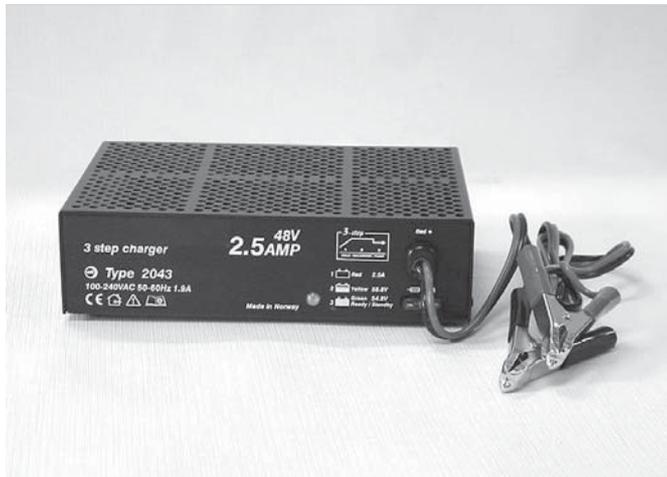
SELECTION TABLE

MODEL NUMBER	OUTPUT VOLTAGE (VDC)	CHARGE CURRENT (A)	RECOMM. BATT. CAPACITY (Ah)
PBN8C-12U	13.8	40	200-2000
PBN8C-24U	27.6	20	100-1000



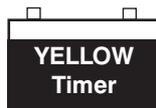
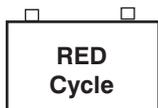
2043 - 2044 SERIES

Battery Chargers: 120 - 240 Watts



Features

- 3-step charge control with timer
- Universal input: 100~240 VAC (2043 Series)
- Power factor corrected 0.99 (2043 Series)
- Charge current not affected by input voltage fluctuations
- Protected against reverse polarity
- LED indicators with three different colours
- Safety approvals EN60335-2-29, AS3260 pending
- EMC approved, CE marked
- Leads with battery clips
- Field proven reliability
- 3 pin IEC320 input connector with mains cord

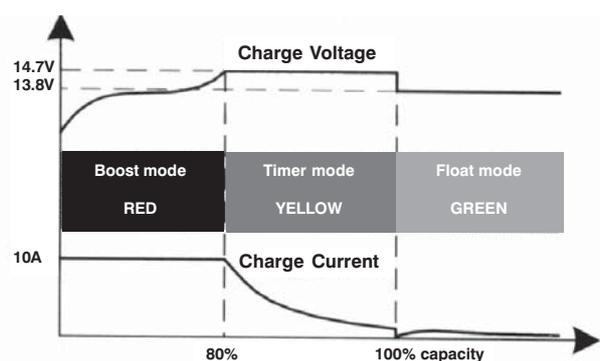


Specifications

INPUT VOLTAGE:	90~240 VAC (2043 series) 190~264 VAC (2044 series)
FREQUENCY:	47~63Hz
CHARGE VOLTAGE:	14.7V for 12V systems 29.4V for 24V systems, 54.8V for 48V systems • Other voltages on request
FLOAT VOLTAGE:	13.8V for 12V systems 27.4V for 24V systems 54.8V for 48V systems
POWER:	Maximum 120 to 240 watts
LOAD REGULATION:	Typically <200mV
LINE REGULATION:	Typically <100mV
SWITCHING FREQUENCY:	60 / 70kHz (2043 / 2044 models)
LEAKAGE CURRENT:	Model dependent max 4mA
OPERATING TEMPERATURE:	-25°C to +40°C
RIPPLE:	<100mV pk-pk
EFFICIENCY:	82% at rated load and input
CURRENT LIMITING:	Yes refer to table
INSULATION CLASS:	Class I
SAFETY STANDARD:	EN60335-2-29, AS3260 pending
EMC:	Emission: EN50081-1 Immunity: EN50082-1, EN55014
INDICATORS:	RED = Constant current YELLOW = Constant voltage timer on GREEN = Constant voltage float mode
TIMER:	Typically 4 hours ±30min,
IP CODE:	IP20, PCB tropic coated
DIMENSIONS:	148 x 210 x 58mm 1.55kg
OUTPUT TERMINALS:	Battery clips

MODEL	V out		A	Rec Batt AH
	Cycle	Float		
2043 - 12	14.7V	13.7V	10A	40-400
2043 - 24	29.5V	27.4V	5A	20-200
2043 - 36	44.1V	40.8V	3.3A	15-150
2043 - 48	58.8V	54.8V	2.5A	10-100
2044 - 12	14.7V	13.8V	20A	100-1000
2044 - 24	29.5V	27.4V	10A	50-500

Charging Diagram



9541 SERIES

12V & 24V Battery Chargers: 500 Watts



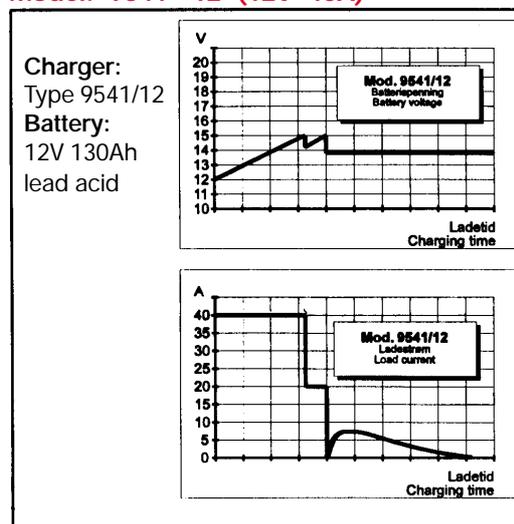
Features

- Automatic charging of lead-acid batteries
- Capable of charging completely flat batteries
- Two stage charge: quick charge at constant current with automatic switchover to constant voltage
- Temperature compensation charging
- Fully protected against short circuit and overload
- Switch mode design, compact lightweight package
- Accurately charges batteries from 100 - 200AH
- The unit consists of two charger modules in parallel, one module failure allows 50% capacity (250W)
- Meets relevant EMC standards.

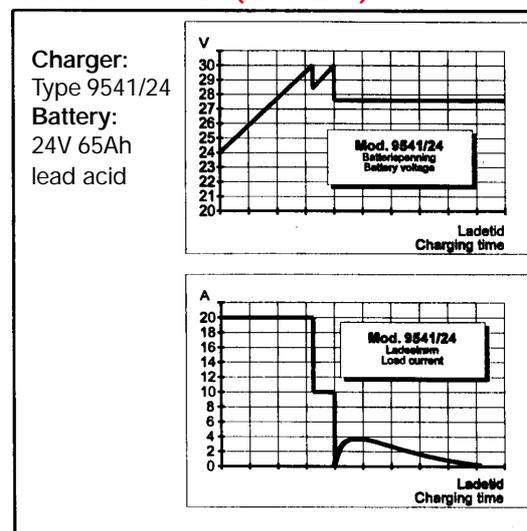
Specifications

INPUT VOLTAGE:	240 VAC (198 - 264)
FREQUENCY:	47- 63HZ
EFFICIENCY:	Typically 86%
OUTPUT POWER:	500 watts maximum
CHARGE VOLTAGE:	12V set to 13.8V float charge at 20°C 24V set to 27.6V float charge at 20°C Voltage is internally adjustable at ±5%
CHARGE CURRENT:	12V model: 40A constant current until the battery is fully charged, ie. voltage reaches 15V at 20°C. 24V model: 20A constant current until the battery is fully charged, ie. voltage reaches 30V at 20 °C
TEMP. CO-EFFICIENT:	-3mV to -4mV per °C per cell
SWITCHING FREQUENCY:	67kHz
LEAKAGE CURRENT:	Leakage current from battery when charger is not connected to mains < 1mA.
OPERATING TEMP:	-25°C to +40°C at rated power
EMC EMISSION:	EN50081-1 (EN55014, EN60555-2)
EMC IMMUNITY:	EN50082-1 (IEC801-2 -3 -4)
ELECTRICAL SAFETY:	EN60335-1, EN60335-2-9 Class I insulation with ground
PROTECTION:	<ul style="list-style-type: none"> • Short circuit proof • Overtemperature: charge current will reduce to a safe level • Reverse polarity protection • Transient protection at mains with MOV
INDICATOR:	None
CONNECTOR:	IEC socket at input, screw terminals at output
DIMENSIONS & WEIGHT:	289 x 115 x 153mm. 3.5kg.

Model: 9541 - 12 (12V 40A)

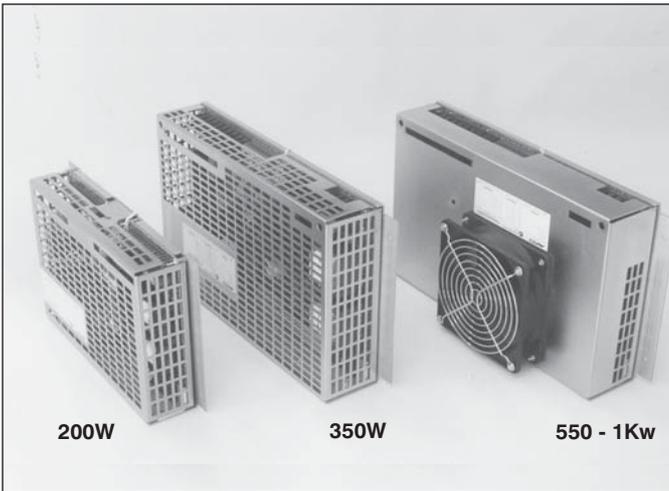


Model: 9541 - 24 (24V 20A)



CA-CX BATTERY CHARGERS

Battery Chargers 200 - 1000 Watts



Features

- Switched mode design
- Output options: 12V, 24V, 36V, 48V, 60V & 108V
- Power levels from 200 to 750 watts
- Constant voltage/constant current operation
- Overvoltage and overload protection
- Power Fail and Battery Low alarm signals
- Temperature compensation charging
- EMC to EN55022 and EN61000
- N+1 redundancy operation
- CE marked to Low Voltage Directive
- AS3260 safety approval: NCS7346N
- EMC approved
- Battery low volt disconnect

The CX series rectifiers offer the most comprehensive range of battery chargers for use in "DC Standby Systems".

We have redesigned our already popular ZX Series to include a new range of features such as battery under voltage disconnect, temperature compensation charging and power share signal, making them the complete charger for powering critical DC loads.

We can easily customise units to meet specific application requirements, and can offer complete systems with batteries, distribution breakers, meters etc., for small or large projects.

19" Rack Mounting option, with and without meters



Specifications

INPUT VOLTAGE:	115/240 VAC standard, 400 VAC single phase - option 90 - 264 VAC with PFC - option DC input from 24V - 370DC - option								
FREQUENCY:	44 - 66Hz (400Hz optional)								
SWITCHING FREQUENCY:	CX200 - CX300 models: 44KHz, CX350 - CX750 models: 33KHz								
INPUT PROTECTION:	On board input fuse and inrush current limiting								
EFFICIENCY:	Model dependent, 86 - 95%								
RIPPLE & NOISE:	<0.1% rms, <1% pk - pk								
DYNAMIC REGULATION:	<1%, 1ms 10% load change								
LOAD REGULATION:	<1% for 10 - 100% load change								
LINE REGULATION:	<0.5%								
VOLTAGE ADJUSTMENT:	On-board trim pot allows fine tuning ($\pm 5\%$) of battery float voltage								
EMC EMISSIONS:	Conducted: EN55022 - B Radiated: EN55022 - A								
EMC IMMUNITY:	EN61000 - 4 - 2 level 3 ESD EN61000 - 4 - 5 level 3 Surge EN61000 - 4 - 4 Burst EN50140 level 3 Radiated								
ISOLATION:	Input - output 3750 VAC Input - chassis 2200 VDC Output - chassis 500 VDC								
SAFETY:	Designed to meet EN60950, CE market to LVD								
PROTECTION:	<ul style="list-style-type: none"> • Overload/short circuit protection • Overvoltage protection • Over temperature protection 								
MTBF:	150,000 hrs per MIL - STD 217E @ 20°C								
OPERATING TEMP:	0° to 40°C at rated power. Consult Amtex for derating from 40° to 70°C								
HUMIDITY:	0% to 90% non-condensing								
VIBRATION & SHOCK:	Operating: 5 - 50Hz 0.05mm pk - pk 50 - 100Hz 0.025mm pk - pk Non-operating: 100mm drop onto chassis face								
PARALLEL OPERATION:	Consult Amtex for details								
SERIES OPERATION:	Yes								
SIGNALS & ALARMS:	<ul style="list-style-type: none"> • Power Fail Alarm (voltage free contacts) • Battery Low Alarm (voltage free contacts) • Rectifier V out Test Point: Monitors Vout before diode 1A max rating 								
COOLING:	CX200 & CX350 convection cooled CX300, CX550 & CX750 internal fan cooling								
CONNECTIONS:	Screw terminals for input and output								
DIMENSIONS & WEIGHT:	<table border="0"> <tr> <td>CA200: 260 x 160 x 55mm</td> <td>1.5Kg.</td> </tr> <tr> <td>CA300: 260 x 160 x 82mm</td> <td>1.7Kg.</td> </tr> <tr> <td>CA350: 340 x 190 x 65mm</td> <td>2.5Kg.</td> </tr> <tr> <td>CA550-CA1k: 340 x 190 x 104mm</td> <td>3.0Kg.</td> </tr> </table>	CA200: 260 x 160 x 55mm	1.5Kg.	CA300: 260 x 160 x 82mm	1.7Kg.	CA350: 340 x 190 x 65mm	2.5Kg.	CA550-CA1k: 340 x 190 x 104mm	3.0Kg.
CA200: 260 x 160 x 55mm	1.5Kg.								
CA300: 260 x 160 x 82mm	1.7Kg.								
CA350: 340 x 190 x 65mm	2.5Kg.								
CA550-CA1k: 340 x 190 x 104mm	3.0Kg.								

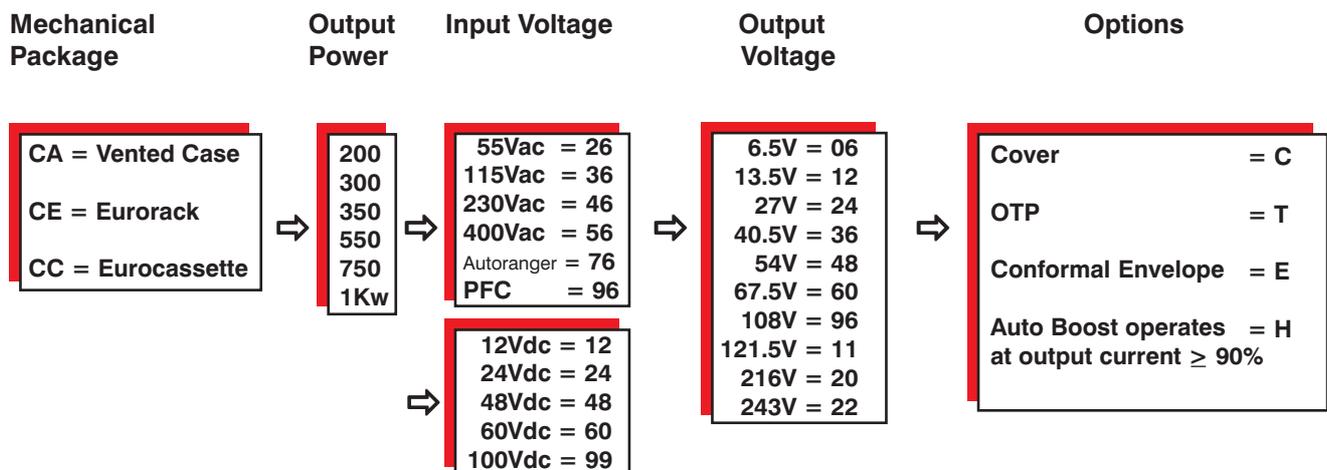


CA-CX BATTERY CHARGERS

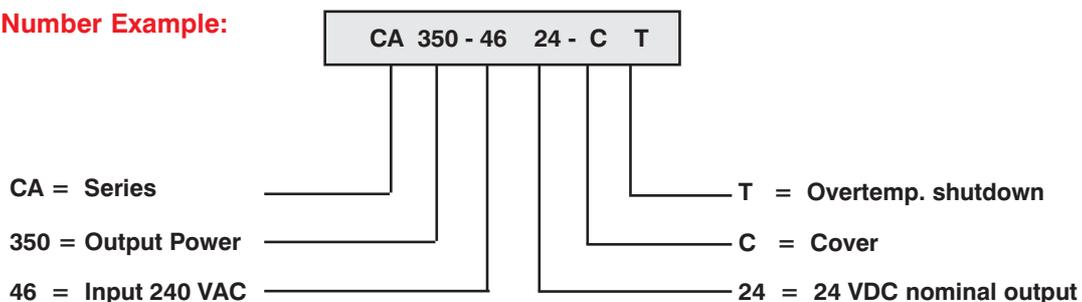
200 - 1000 Watts

Standard Series Battery Charging Table

Unit Output Code*	Battery Voltage				Unit Model (Watts)					
	Fail (1.75V/cell)	Nom (2V/cell)	Float (2V25/cell)	Boost (2V4/cell) (option)	200W	300W	350W	550W	750W	1Kw
					Maximum Charging Current (A)					
06	5.25	6	6.75	7.2	29.6	44.4	52.0	81.5	---	---
12	10.5	12	13.5	14.4	14.8	22.2	26.0	40.7	55.5	---
24	21.0	24	27.0	28.8	7.4	11.1	13.0	20.4	27.7	40.7
36	31.5	36	40.5	43.2	4.9	7.4	8.6	13.6	18.5	27.6
48	42.0	48	54.0	57.6	3.7	5.5	6.5	10.2	13.9	20.7
60	52.5	60	67.5	72.0	3.0	4.4	5.2	8.1	11.1	16.2
96	84.0	96	108.0	115.0	1.8	2.8	3.2	5.1	7.0	10.2
11	94.5	108	121.5	129.6	1.6	2.5	2.9	4.5	6.2	9.0
20	168.0	192	216.0	230.0	0.9	1.4	1.6	2.5	3.5	5.1
22	189.0	216	243.0	259.0	0.8	1.2	1.4	2.3	3.1	4.6



Model Number Example:



Note: Not all input - output combinations available.

CA-CX BATTERY CHARGERS

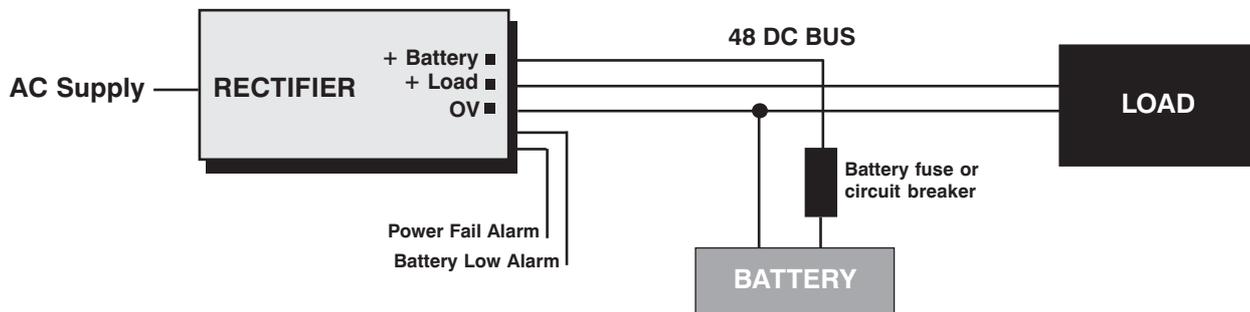
Battery Charging Using "CA" Series Rectifiers

The CA series rectifiers have been designed to operate in **constant current/constant voltage** mode for battery charging applications. These units will deliver a constant current when connected to a discharged battery until the float voltage is attained, the constant voltage mode of the unit will then maintain this level.

Example of 200W Unit Configured to charge a 24 cell (2V x 24 = 48V system) Lead Acid Battery:

The rectifier will charge at 5A until the constant voltage mode of the unit is achieved across the battery, (this is normally set to 2.25V/cell), in this case 54V. Thereafter the rectifier will maintain the 54V by way of its constant output voltage.

Fig. 1 Battery Back-up Block Diagram



Rectifier Selection:

Selecting the correct rectifier power rating is important for the long term reliability of the system and battery, using the following equation as a guide.

$$I_R = I_L + I_B$$

I_R = rectifier output current, I_L = load current, I_B = battery charge current (10 - 15% of AH capacity of the battery)

Battery Selection:

Selecting the right battery is just as important for optimum system performance. Usually we start by deciding what battery **back-up** time is required. Once this is decided, then using the following battery selection guide and battery manufactures data, the correct AH capacity and type of battery can be selected.

Manufacturer/Reference		
Battery Capacity		Ah
Nominal Voltage		V
Float/Standby		V/cell
Boost/Cyclic		V/cell
Charging Current		A

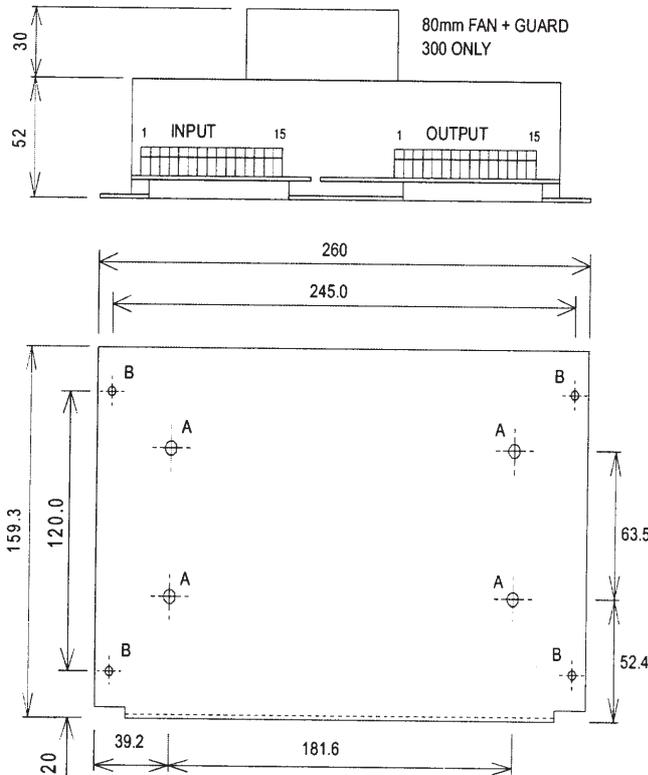
Features:

The CX series rectifiers have been designed specifically for battery charging and standby DC systems and include the following features:

- Factory set 2.25V per cell float charge voltage. On board potentiometer allows for $\pm 5\%$ voltage adjustment
- Temperature charge compensation $-3\text{mV}/^\circ\text{C}/\text{cell}$
- Automatic boost voltage 2.4V per cell when output current is greater than 90% - option **H**
- Supply/Power Fail alarm, via voltage free relay contacts (Power Fail = $<190/95\text{V}$, Power Good = $>200/100\text{V}$)
- Battery under voltage disconnect to avoid deep discharge (maximum disconnect current: 30A)
- Battery Low alarm, via voltage free relay contacts (Battery Low = $<1.75\text{V}/\text{cell}$, Battery Good = $>2\text{V}/\text{cell}$)
- Battery fail relay operates approximately 20 seconds before under voltage disconnect
- Alarm relay contact rating: 1A @ 24 VDC, 0.5A @ 120 VAC
- Output isolation (OR) diode for zero bleed on battery in UVD
- Power Share for N+1 redundancy operation

CA-CX BATTERY CHARGERS

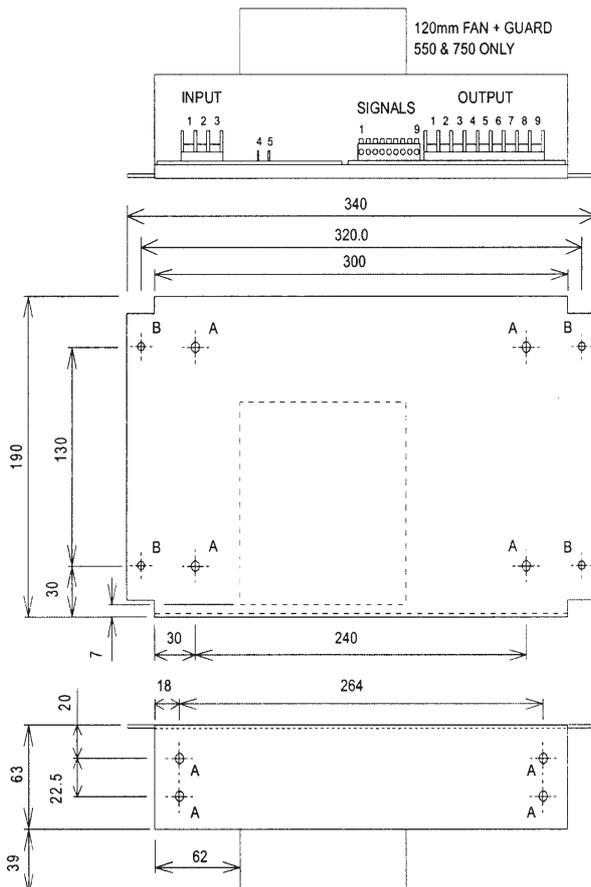
CA 200, CA300 (Fan not fitted to CA 200W)



Connections:

Input 5mm pitch	Signals/Output 5mm pitch
1: Earth	1: TEST
2: N/C	2: ROF
3: Neutral	3: Power share
4: N/C	4: Power fail COM
5: Line	5: Power fail N/C
6: N/C	6: Power fail N/O
7: 115V link	7: Batt fail COM
8: 115V link	8: Batt fail N/C
9: N/C	9: Batt fail N/O
10: N/C	10: 0V
11: N/C	11: 0V
12: N/C	12: +LOAD
13: N/C	13: +LOAD
14: N/C	14: +BATTERY
15: N/C	15: +BATTERY

CA 350, CA550, CA750, CA1Kw (Fan not fitted to CA350W)



Connections:

Input 9.5mm pitch	Output 9.5mm pitch
1: Earth	1: 0V
2: Neutral	2: 0V
3: Line	3: 0V
4: 115V link	4: +LOAD
5: 115V link	5: +LOAD
	6: +LOAD
	7: +BATTERY
	8: +BATTERY
	9: +BATTERY

Signals

- 1: TEST
- 2: Remote on-off
- 3: Power share
- 4: Power fail COM
- 5: Power fail N/C
- 6: Power fail N/O
- 7: Batt fail COM
- 8: Batt fail N/C
- 9: Batt fail N/O