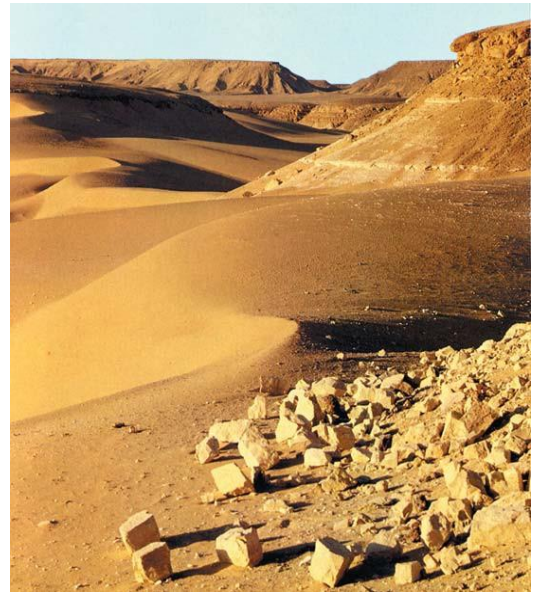


ALTERNATIVE DC-POWER SYSTEMS

Pipelines, well casings or other metal structures are often laid in remote areas, where AC power grid to supply transformer rectifiers is unavailable or simply too costly and galvanic anode systems would provide insufficient current for cathodic protection.

Our alternative DC power systems have been designed to withstand the harsh environments which are common in the oil and gas industry. The systems have a long standing reputation for being both efficient and extremely reliable.

Engineered to be inherently flexible, all of our systems have been designed for optimum operation in many different applications and virtually any environment. The ease of operation, installation and maintenance associated with our products makes them extremely practical for use at even the most remote sites.



Solar Power Units



Thermo-Electric Generators



Hybrid Power



Wind Generators



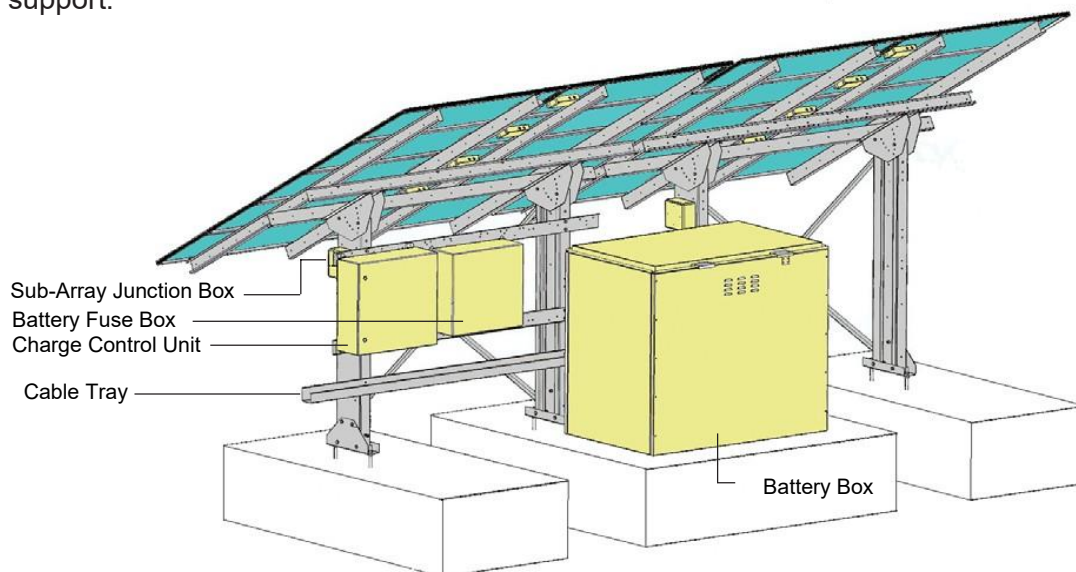
Array Support Structure

A galvanised steel array support structure supplied in kit for easy site assembly. Suited for medium to large scale solar arrays the high level (HL) array support provides an elevated platform to keep arrays away from ground vegetation and other objects which may cause shading.

The photovoltaic modules are held at the optimum tilt angle (determined by site location) and consist of a kit of components that can be readily handled and assembled on site. These structures are designed to withstand adverse environmental conditions with minimal maintenance and can be coupled together to make up an array of any number of modules.

General

- Hot-dip galvanised steel, bolts, nuts and washers
- The structure can also be supplied in Stainless Steel 304 or 316 (e.g. for offshore applications)
- Maximum continuous wind-loading 150 km/h.
- Fixed tilt angle or tilt able from 10° - 50°.
- The array support structure is of a modular configuration
- Flexible in use and applicable for systems from 4 up to 1000 modules
- Enclosures can be easily connected to the support.



Solar Power Modules

The PW modules use multi-crystalline technology. The solar cells are individually characterized and electronically matched prior to interconnection. Encapsulation is realised between the high transmission tempered glass and the resistant thermal setting Tedlar®. The encapsulate, ethylene vinyl acetate, cushions the solar cells within the laminate and protect the cells from etching. The rear surface of the module is completely sealed from moisture and mechanical damage by a continuous high strength polymer sheet.



The PWX modules are designed with the double glass technology, with an optimum configuration that fulfils the most demanding PV applications. That type of heavy duty construction ensures the product electrical isolation and high durability, including in marine and tropical environments.

The PWX modules benefit from excellent mechanical properties and reliability due to its glass both sides. The self-supporting frame made from anodised aluminium was designed to allow it to be easily mounted either from the front or from the rear.

Poly-crystalline - 6 inch range	Modules		PW6-110	PW6-123	PW6-230
	Encapsulation		glass / tedlar	glass / tedlar	glass / tedlar
	Size of cells	mm	150 x 150	150 x 150	150 x 150
	Number of cells	pcs	36	36	72
	Typical power*	W	110	123	230
	Minimum Power	W	106	119	223
	Nominal battery voltage	V	12	12	24 (12 optional)
	Voltage at typical power*	V	17.2	17.6	34.9
	Current at typical power*	A	6.4	7.0	6.6
	Open circuit power*	V	21.7	21.9	43.6
	Short circuit current*	A	6.9	7.6	7.2
	Noct (0.8 kW/m ² , 20 °C, 1m/s)	°C	45	45	45
	Connection		Cable or Jbox	Cable or Jbox	Cable or Jbox
	Diodes		2 By-Pass	2 By-Pass	4 By-Pass
	Frame length	mm	1424	1424	1885
	Frame width	mm	655	655	962
	Frame depth	mm	38	38	38
	Frame depth with junction box	mm	45	45	45
	Weight (net)	kg	12.5	12.5	25
	Operational & Storage temperature	°C	-40 / +85	-40 / +85	-40 / +85
	Warranty	Years	25**		

*STC (Standard Test Conditions): 1000 W/m², AM 1.5 @ 25 °C

** 10 years for marine and tropical environments: on request

Solar Power Modules

Poly-crystalline - 5 inch range	Modules		PW-850			PW-1250			PW-1650		
	Encapsulation		glass / tedlar			glass / tedlar			glass / tedlar		
	Size of cells	mm	125.50 x 125.50			125.50 x 125.50			125.50 x 125.50		
	Number of cells	pcs	36			54			72		
	Typical power*	W	75	80	85	115	125	135	155	165	175
	Minimum Power	W	70.1	75.1	80.1	110	120	130	150	160	170
	Nominal battery voltage	V	12	12	12	18	18	18	24 ⁽¹⁾	24 ⁽¹⁾	24 ⁽¹⁾
	Voltage at typical power*	V	17.0	17.3	17.6	25.4	25.9	26.4	34	34.4	35.0
	Current at typical power*	A	4.4	4.6	4.8	4.5	4.8	5.1	4.6	4.8	5.0
	Open circuit power*	V	21.5	21.6	21.6	31.9	32.3	32.4	43	43.2	43.2
	Short circuit current*	A	4.7	5.0	5.2	4.7	5.0	5.3	4.8	5.1	5.3
	Noct (0.8 kW/m², 20 °C, 1m/s)	°C	45			45			45		
	Connection		Jbox			Cable or Jbox			Cable or Jbox		
	Diodes		2 By-Pass			3 By-Pass			4 By-Pass		
	Frame length	mm	1237			1237			1237		
	Frame width	mm	556			822			1082		
	Frame depth	mm	24.5			38			38		
	Frame depth with junction box	mm	45			45			45		
	Weight (net)	kg	7.8			12.5			18.0		
	Operational & Storage temperature	°C	-40 / +85			-40 / +85			-40 / +85		
	Warranty	Years	25**								

Poly-crystalline - 4 inch range	Modules		PW-100		PW-200		PW-500			PW-1000		
	Encapsulation		glass / tedlar		glass / tedlar		glass / tedlar			glass / tedlar		
	Size of cells	mm	50.6 x 50.6		101.25 x 50.6		101.25 x 101.25			101.25 x 101.25		
	Number of cells	pcs	36		36		36			72		
	Typical power*	W	12		22		45	50	55	100	105	110
	Minimum Power	W	10		18		40.1	45.1	50.1	95.1	100.1	105.1
	Nominal battery voltage	V	12		12		12	12	12	24 ⁽¹⁾	24 ⁽¹⁾	24 ⁽¹⁾
	Voltage at typical power*	V	17.0		17.0		16.9	17.2	17.3	34.4	34.6	34.8
	Current at typical power*	A	0.65		1.30		2.65	2.9	3.2	2.9	3.05	3.15
	Open circuit power*	V	21.5		21.5		21.6	21.6	21.7	43.2	43.2	43.4
	Short circuit current*	A	0.72		1.44		2.95	3.1	3.45	3.0	3.15	3.4
	Noct (0.8 kW/m², 20 °C, 1m/s)	°C	45		45		45			45		
	Connection		Cable or Jbox		Cable or Jbox		Jbox			Jbox		
	Diodes		No		No		2 By-Pass ⁽²⁾			3 By-Pass ⁽³⁾		
	Frame length	mm	546		551		1007			1335		
	Frame width	mm	256		462		462			673		
	Frame depth	mm	24.5		24.5		24.5			24.5		
	Frame depth with junction box	mm	-		-		45			45		
	Weight (net)	kg	2.20		3.4		5.5			10.5		
	Operational & Storage temperature	°C	-40 / +85		-40 / +85		-40 / +85			-40 / +85		
	Warranty	Years	25**									

 *STC (Standard Test Conditions): 1000 W/m², AM 1.5 @ 25 °C

** 10 years for marine and tropical environments: on request

(1) 24/12 V optional

(2) Optional

(3) 3 By-Pass optional

Solar Power Modules

Poly-crystalline - 4 inch range (PWX-850) 5 inch range	Modules		PWX-100	PWX-200	PWX-500			PWX-850		
	Encapsulation		double glass	double glass	double glass			double glass		
	Size of cells	mm	50.6 x 50.6	101.25 x 50.6	101.25 x 101.25			125.5 x 125.5		
	Number of cells	pcs	36	36	36			36		
	Typical power*	W	12	22	45	50	55	75	80	85
	Minimum Power	W	10	18	40.1	45.1	50.1	70.1	75.1	80.1
	Nominal battery voltage	V	12	12	12	12	12	12	12	12
	Voltage at typical power*	V	17.0	17.0	16.9	17.2	17.3	17.0	17.3	17.6
	Current at typical power*	A	0.65	1.30	2.65	2.9	3.2	4.4	4.6	4.8
	Open circuit power*	V	21.5	21.5	21.6	21.6	21.7	21.5	21.6	21.6
	Short circuit current*	A	0.72	1.44	2.95	3.1	3.45	4.7	5.0	5.2
	Noct (0.8 kW/m², 20 °C, 1m/s)	°C	45	45	45			45		
	Connection		Jbox	Jbox	Jbox			Jbox		
	Diodes		No	No	2 By-Pass ⁽¹⁾			2 By-Pass		
	Frame length	mm	582	720	1042			1272		
	Frame width	mm	262	370	462			556		
	Frame depth	mm	39	39	39			39		
	Frame depth with junction box	mm	45	45	45			45		
	Weight (net)	kg	3.40	5.20	9.2			13		
	Operational & Storage temperature	°C	-40 / +85	-40 / +85	-40 / +85			-40 / +85		
	Warranty	Years	25**							

 *STC (Standard Test Conditions) : 1000 W/m² , AM 1.5 @ 25 °C

(1) Optional

** 10 years for marine and tropical environments: on request

ALTERNATIVE DC-POWER SYSTEMS

Solar Power Units

Document No.: PSE-02-100-R622

Sheet: 5 of 18

OPzV Batteries

OPzV batteries are suitable for a broad range of applications including telephony, telecommunications, cathodic protection systems, power generating stations and distribution systems, railway, airport and seaport signalling, computing, emergency lighting, automation and measuring systems.

The OPzV range are valve regulated lead-acid cells which use a proven combination of GEL and tubular technologies to offer a very high level of reliability. These single cells benefit from an optimised plate design which gives capacities in excess of the DIN standard values. In addition, the OPzV range offers both a long float life and a high cycle life for a truly flexible solution.



Construction

- Positive tubular plate with lead-calcium-tin alloy
- Negative flat plate with lead-calcium alloy grid
- Separators in low resistance microporous material
- Container and lid in ABS; optional flame retardant ABS available (UL94 V-0) Sulphuric acid, immobilised as a gel
- Terminals with brass insert and M10 stainless steel bolts. Coloured washers are provided for easy polarity recognition

- Insulated solid copper connector (30x3mm) for vertical installations or insulated flexible cable connectors (70mm²) for horizontal installations. Each connector design is of the bolt-on type and allows for voltage measurements
- One-way pressure relief valve with integral flame arrestor

Installation and Operation

- Recommended float charge voltage: 2.25V per cell (20°C)
- Cells can be installed horizontally to minimise use of floor space
- Optional racking offers easy installation and space saving accommodation

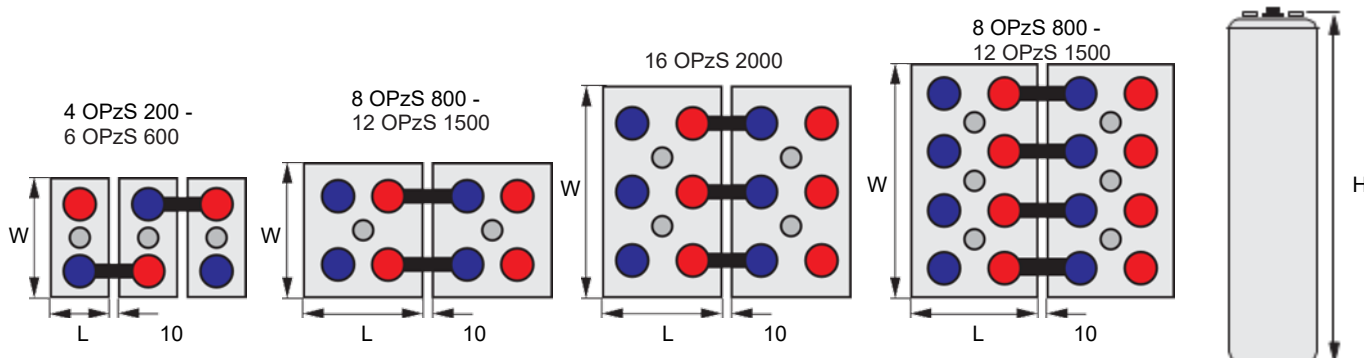
Standards

- Tested according to international standard IEC 60896-21 and compliant to defined requirements of IEC 60896-22
- Conforms to the DIN standard 40742 (valve regulated OPzV single cells) Classified as 'long life' according to the EUROBAT guide 1999
- Proof against deep discharge according to DIN 43539 Part 5
- Low ventilation requirement according to EN 50272-2
- Manufacturing facilities are certified to ISO 9001:2000

General Specification

Type	Nominal Voltage (V)	Terminal Pairs	10 hr rate to 1.8 Vpc @ 20° C	Length (L)		Width (W)		Height (H)		Weight		Short circuit current (A)	Internal Resistance (mΩ)
				mm	in	mm	in	mm	in	kg	lbs		
4 OPzV 200	2	1	215	103	4.1	206	8.1	403	15.8	19.5	43.0	2195	0.95
5 OPzV 250	2	1	265	124	4.9	206	8.1	403	15.8	23.5	51.9	2737	0.76
6 OPzV 300	2	1	320	145	5.7	206	8.1	403	15.8	28.0	61.8	3175	0.66
5 OPzV 350	2	1	385	124	4.9	206	8.1	520	20.3	31.0	68.4	3410	0.61
6 OPzV 420	2	1	465	145	5.7	206	8.1	520	20.3	36.5	80.5	4043	0.51
7 OPzV 490	2	1	540	166	6.5	206	8.1	520	20.3	42.0	92.6	4607	0.45
6 OPzV 600	2	1	705	145	5.7	206	8.1	695	27.3	50.0	110.3	3796	0.55
8 OPzV 800	2	2	940	210	8.2	191	7.5	695	27.3	68.0	150.0	5200	0.40
10 OPzV 1000	2	2	1170	210	8.2	233	9.2	695	27.3	82.0	180.8	6460	0.32
12 OPzV 1200	2	2	1410	210	8.2	275	10.8	695	27.3	97.0	213.9	7675	0.27
12 OPzV 1500	2	2	1580	210	8.2	275	10.8	845	33.3	120.0	264.6	7510	0.28
16 OPzV 2000	2	3	2110	212	8.3	397	15.6	820	32.3	165.0	363.8	10048	0.21
20 OPzV 2500	2	4	2640	212	8.3	487	19.2	820	32.3	200.0	441.0	12608	0.17
24 OPzV 3000	2	4	3170	212	8.3	576	22.3	820	32.3	240.0	529.2	14964	0.14

The electrical values shown in the table relate to loadings from a fully charged condition at ambient temperature of +20°C.



ALTERNATIVE DC-POWER SYSTEMS

Solar Power Units

Document No.: PSE-02-100-R622

Sheet: 6 of 18

OPzS Batteries

OPzS batteries are suitable for a broad range of applications including, telephony, telecommunications, cathodic protection systems, power generating stations and distribution systems, railway, airport and seaport signalling, computing, emergency lighting, automation and measuring systems.

The OPzS range of single vented tubular cells has been designed for use in all standby power applications which demand the highest levels of reliability and security.

OPzS cells benefit from an optimised plate design which results in increased capacity compared to the requirements of the internationally recognised DIN standard. In addition, the tubular plate technology offers excellent cycling performance together with a proven long life under float voltage conditions, for a truly flexible solution.

Construction

- Positive electrodes - die-cast tubular plates with low antimony lead alloy for longer life
- Negative electrodes - pasted flat plates provide perfect balance with the positive plates to give maximum performance
- Separators - special microporous material
- Containers - moulded from durable, transparent styrene acrylonitrile (SAN) to allow electrolyte level and cell condition to be monitored visually
- Cell lids - made of opaque SAN sealed to container to ensure no electrolyte leakage
- Electrolyte - diluted sulphuric acid with a specific gravity of 1.240 ± 0.010 (max. level) at 20°C for a fully charged cell
- Terminals - lead alloy leak-proof pole with copper insert designed to give minimum resistance and maximum current flow

- Vent plugs - safety plugs equipped with flame arrestors. Special vent plugs allowing topping-up and S.G. reading without the need to remove them, are available on request
- Connectors - insulated, lead-tin plated, solid copper inter-cell connectors allow voltage measurements

Installation and Operation

- Recommended float charge voltage: 2.23Vpc (20°C - 25°C)
- Recommended temperature range: +10°C to +30°C (preferred value 20°C)
- Topping-up intervals of about 3 years in standby operation mode thanks to large electrolyte reserve

Standards

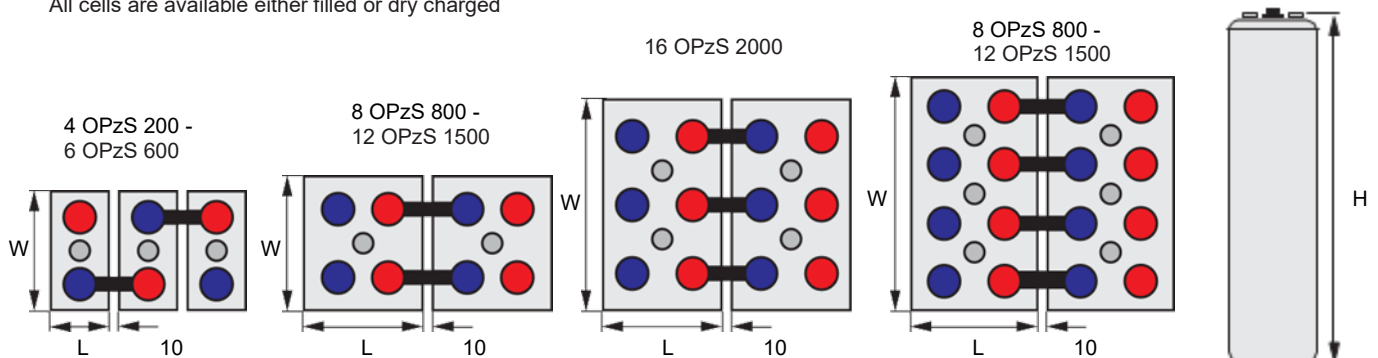
- Compliant with both the international standard IEC 60896-1 and DIN standard 40736-1
- Batteries must be installed in accordance with safety standard EN 50272-2 and national regulations
- Manufacturing facilities are certified to ISO 9001:2000



General Specification

Type	Nominal Voltage (V)	Terminal Pairs	10 hr rate to 1.8 Vpc @ 20° C	Length (L)		Width (W)		Height (H)		Weight		Electrolyte Volume (Litres)	Short circuit current (A)	Internal Resistance (mΩ)
				mm	in	mm	in	mm	in	Dry kg	Acid Filled kg			
4 OPzS 200	2	1	216	103	4.1	206	8.1	403	15.8	12.4	17.2	3.9	2400	0.85
5 OPzS 250	2	1	270	124	4.9	206	8.1	403	15.8	14.8	20.8	4.9	3000	0.68
6 OPzS 300	2	1	324	145	5.7	206	8.1	403	15.8	17.1	24.3	5.8	3600	0.57
5 OPzS 350	2	1	390	124	4.9	206	8.1	520	20.3	19.0	26.9	6.7	3400	0.60
6 OPzS 420	2	1	468	145	5.7	206	8.1	520	20.3	22.1	31.5	8.0	4075	0.50
7 OPzS 490	2	1	546	166	6.5	206	8.1	520	20.3	25.2	36.1	9.3	4750	0.43
6 OPzS 600	2	1	660	145	5.7	206	8.1	695	27.3	31.9	44.8	11.1	5000	0.40
8 OPzS 800	2	2	880	210	8.2	191	7.5	695	27.3	44.4	61.3	14.5	6650	0.30
10 OPzS 1000	2	2	1100	210	8.2	233	9.2	695	27.3	53.5	74.6	18.1	8300	0.24
12 OPzS 1200	2	2	1320	210	8.2	275	10.8	695	27.3	62.8	88.0	20.6	9950	0.20
12 OPzS 1500	2	2	1680	210	8.2	275	10.8	845	33.3	80.2	114.3	27.3	9600	0.21
16 OPzS 2000	2	3	2240	212	8.3	397	15.6	820	32.3	105	151.5	39.0	12800	0.15
20 OPzS 2500	2	4	2800	212	8.3	487	19.2	820	32.3	134	193	47.6	16000	0.12
24 OPzS 3000	2	4	3300	212	8.3	576	22.3	820	32.3	163	234.5	56.4	19200	0.10

The electrical values shown in the table relate to loadings from a fully charged condition at ambient temperature of +20°C. All cells are available either filled or dry charged



CCU- Charge Control Unit 12/24/48 V**General**

An off-grid solar system generally consists of solar modules, mounted on a support structure, a charge control unit, cabling and a battery bank with enclosure. An array field consists of several solar modules wired into strings (series or parallel).

The CCU-Charge Control Unit regulates the incoming power from the solar modules to the battery bank and the outgoing power from the battery bank to the load(s). The CCU- Charge Control Unit is available in many versions with various options, covering a wide range of solar module input and power handling capacity.

A basic CCU-controller consists of one Master Unit, which is mounted in an (IP66) enclosure. The Master unit is provided with a maximum of three separate switchable solar sub array inputs.

The basic configuration can be extended by one or more slave units. Each slave unit adds three solar sub-array inputs to the controller (see typical block diagram CCU- Charge Control Unit).

Options are amongst others, metering, alarm relays, 60A (12 or 24V) or 40A (48V) output relay, output voltage stabiliser, etc.

Standard available IP66 enclosures are:

- Enclosure 1 for one Master Unit and one other optional (no power dissipating) unit.
- Enclosure 3 for one Master, one slave and one other optional (no power dissipating) unit.
- Enclosure 6 for one Master, two slaves and three other optional (no power dissipating) units.

Enclosures can be equipped with 1 or 2 optional alarm relays.

Also available are enclosures for hazardous area with full Explosion Proof Zone 1 certification according ATEX.

For larger power systems, or upon request, project-special solutions can be provided. Configurations up to 50 kWp solar module power are possible.

The operating principle of all versions is basically the same; refer to the example circuit diagram descriptions in following sheets.

Main protection features

The Master unit can switch off the load by means of a relay 25A max. (12-24V version) or 16A max. (48V version). This relay is integrated in the Master Unit, or by means of a 60A max. Solid State Output Relay option.



Figure of a typical enclosure with 1 master control, 1 slave unit and 1-meter unit

It switches off:

- a) the load in case of battery excessive deep discharge
- b) the load in case of system high voltage
- c) the solar arrays in case of battery overcharge

Operating principle of the CCU-Charge Control Unit

The CCU-Charge Control Unit is a charge regulator for medium and large size photovoltaic systems for industrial applications.

Functions:

Protection against

- battery overcharge
- battery excessive discharge
- overload and short-circuit
- reversed polarity protection of electronics in case of reversing the battery, array or both.
- reverse current during night
- system high voltage

Features:

- Advanced temperatures compensated boost and float battery charge process.
- Three solar array inputs with separate solid state on/ off switches, which are controlled by the charge circuit.
- Load output with SOC dependent switch-off limit (excessive discharge protection).
- Load current compensated switch-off limit.
- Reverse polarity protection on battery and solar array inputs.
- Over-voltage protection for load.
- Field adjustable float charge level.

CCU- Charge Control Unit 12/24/48 V

- LED indicators for: Battery charged, Sub-array 1, 2 and 3 disconnect, Pre-warning low voltage, general alarm / Load disconnects.
- "Flip of the switch" system diagnostic capabilities.
- Maintenance-free operation for many years.
- A central connection point for all major system components.
- Optional alarm relay(s).
- Optional slave units to increase array input current.
- Optional Meter unit for on-line diagnostics purposes.
- Optional Output Relay capable of switching 60 A (constant current).
- Optional data logger for measuring hour averages.
- Optional Output Regulator for voltage limiting or output regulator for Cathodic Protection.
- Optional large-voltage transient protection of electronics with transient voltage suppressor.
- Customized options are available upon request.

Description

The CCU-Charge Control Unit is a solid-state controller that regulates the charge from the solar modules to the battery, and the discharge to the user's load.

It protects the battery against the damaging effects of over-charge and excessive discharge by keeping the charge/ discharge cycle within prescribed limits. The special charge regulating technique enables a more efficient use of the available energy and the battery is charged faster compared to conventional controllers.

The CCU-Charge Control Unit is housed in a fibre-glass reinforced polyester (GRP) IP 66 enclosure and includes for each individual cable clearly indicated terminals to interconnect all the system components. The system voltage of this controller is nominal 12, 24 or 48 VDC.

The modules can be split up into 3 different groups and can be connected separately.

A combined external battery voltage and temperature sensor is standard. The connection diagram of the voltage and temperature sensor is shown in a separate diagram.

Operation:

The charge process is regulated by the charge controller, which can switch on and -off one, two, or three module strings.

For maximum battery efficiency the charge controller performs a boost and float charge process. This means that initially the battery is charged to a

somewhat higher voltage, after that, the voltage is kept at a float charge level by selecting the appropriate number of module strings. The charge voltage levels are temperature compensated.

The switching frequency and resulting electro-magnetic field complies with EMC-regulations.

When the battery connection is interrupted the modules will switch off within 0.1 seconds to avoid any damage to the appliances by the higher open circuit voltage of the modules. A battery (system) voltage of more than the given values (System High Voltage), see table below, will switch off the load relay.

At low State of Charge of the battery the Charge Control Unit will switch off the load.

When the batteries are charged to a higher state of charge afterwards, the load is switched on again automatically. A circuit breaker safeguards the output(s) against overload and short circuit.

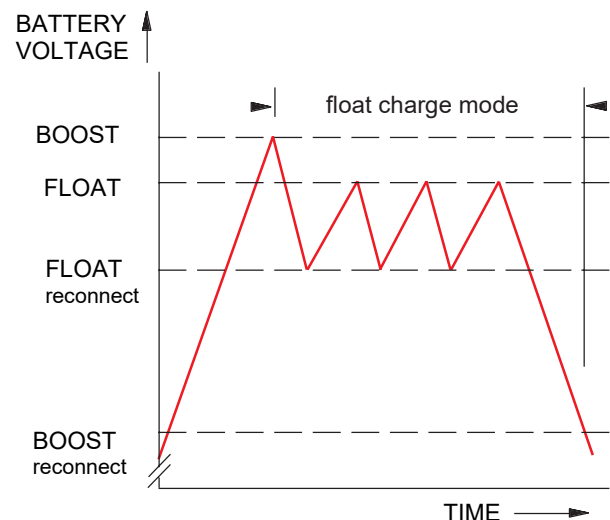


Figure of the charge process

CCU- Charge Control Unit 12/24/48 V
Specifications

Type:	12 V	24 V	48 V
Absolute maximum ratings			
Modules input	40 V	50 V	90 V
Battery input	25 V	45 V	65 V
Input current (with 2 slaves)	162 A max. (9 x 18 A max.)	162 A max. (9 x 18 A max.)	90 A max. (9 x 10 A max.)
Nominal values			
System voltage	12 Vdc	24 Vdc	48 Vdc
Array input current	9 x 18 A	9 x 18 A	9 x 10 A
Output current	25 A (standard)	25 A (standard)	16 A (standard)
- with Output Relay	60 A (option)	60 A (option)	40 A (option)
- combined	25 + 60 A	25 + 60 A	16 + 40 A
Operating Current Master	10 mA	10 mA	10 mA
- Slave	3 mA	3 mA	3 mA
- Metering Unit	10 mA	10 mA	10 mA
- Output Relay	3 mA	3 mA	3 mA
Overload max. (incl. Output Relay)	100 A (1 min.)	100 A (1 min.)	80 A (1 min.)
Operating temperature	-10° C to +65° C	-10° C to +65° C	-10° C to +65° C
Storage temperature	-30° C to +70° C	-30° C to +70° C	-30° C to +70° C
Enclosure	IP 66	IP 66	IP 66

Values below are standard settings and are given for information only.
In most cases these values are site and battery specific.

Settings	12 V	24 V	48 V
System high voltage	15.3 V	30.5 V	61.0 V
Boost @ 20° C	14.5 V	29.0 V	58.0 V
Float @ 20° C	14.2 V	28.4 V	56.8 V
Pre-warning low voltage	11.8 V	23.6 V	47.2 V
Disconnect output	11.5 V	23.0 V	46.0 V
Temperature compensation	-5 mV/°C/cell	-5 mV/°C/cell	-5 mV/°C/cell

Optional

Alarm relays with voltage-free contacts for pre-warning low voltage and general alarm. The alarm status for different system conditions is as follows:

Condition (at 24 V)	Pre-warning alarm relay	General alarm relay	Load (at 24 V)
Normal	Off	Off	On
Vbat < 23.6 V	Active	Off	On
Vbat < 23.0 V	Active	Active	Off
Vbat > 30.5 V	Off	Active	Off

CCU- Master Control Unit 12/24/48 V

Indicators, controls and functions

■ **YELLOW “OPERATIONAL” LED:**

Yellow operational LED indicates that the external power supply is present in the correct polarity and the internal power supply, reference voltage and non-replaceable fuse on the PCB are OK.

■ **UPPER GREEN “BATTERY CHARGED” LED:**

Upper green LED, battery charged is “on” if the boost charge voltage level is reached and indicates that the controller is in float charge mode. Normally this LED stays on until the battery is discharged with a few percentage of the total battery capacity, e.g., during the night.

■ **THREE GREEN “SUB-ARRAY DISCONNECTED” LED’S:**

Three green sub-array disconnect LED’s: one or more LED’s can be “on” during float charge mode and indicates the specific subarray is disconnected. The CCU selects the number of connected sub-arrays in such a way that charge current is as high as possible without exceeding the float charge (gassing) voltage. The controller will react on changing solar radiation conditions within seconds. During boost charge mode all the green LED’s are “off” If one or more slave units are operational the corresponding LED’s on those units will follow the master.

■ **RED “PRE-WARNING LOW-VOLTAGE” LED:**

Red pre-warning low voltage LED will be “on” if battery voltage dropped dramatically and in a properly sized system it indicates an abnormal situation. This can be caused by an extreme long low insolation period, dirty/damaged solar panels or higher energy consumption by the load. If the option pre-warning low voltage alarm relay is mounted, this will be activated together with the LED. If an optional “non-essential load” output is available, it will be disconnected.

■ **RED “GENERAL ALARM/LOAD DISCONNECT” LED:**

If this LED is “on” the internal 25A (12-24V version) or 16A (48V version) output relay, or the optional 60A output relay (12-24 Vdc) or 40A output relay (48 Vdc), will disconnect the load(s) and the optional alarm relay will be activated.

The alarm can be caused by two different situations:

A- Battery low voltage:

In this case the general alarm/load disconnect LED is “on” and the corresponding alarm relay is activated. For reasons see pre-warning low voltage.

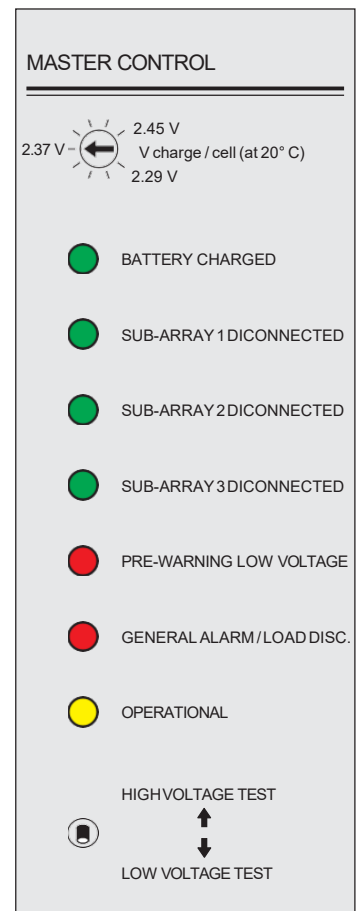
B- System high voltage:

In this case the general alarm/load disconnect LED and all green LED’s are “on” Possible reasons for this situation are disconnected batteries cable, defective battery fuse, defective master control or slave unit.

Test switch

The test switch simulates a high or a low battery voltage (not a system high voltage). The system voltage is measured on battery power terminals inside the controller. With this switch the main functions of the controller can be tested. Moving the switch to the high voltage position, the green LED’s will be “on” and the sub arrays be disconnected immediately (also on the slaves if present). The switch will return to its neutral position when released. The controller will need up to 15 seconds to resume normal operation.

After moving and holding the switch to the low voltage position the pre warning low voltage LED will be “on” after a few seconds and 5 to 15 seconds later the general alarm LED is “on” and the output relay(s) is (are) activated. After releasing the switch the controller needs up to 15 seconds to resume normal operation.



Master Control Unit

CCU- Master Control Unit 12/24/48 V**Voltage charge/cell potentiometer**

The potentiometer is standard in the calibrated neutral position, i.e. 2.37 V/cell.

The potentiometer affects both float and boost charge voltage setting. Dependent of the battery type, capacity, load and operating conditions the recharge time and water usage (flooded types) of the battery is optimised by adjusting the float charge setting. Therefore, we recommend consulting GCP first before adjusting the float charge setting of the controller.

Alarm relays: see pre-warning low voltage and general alarm LED's.

When the battery connection is interrupted the modules will switch off within 0.1 seconds to avoid any damage to the appliances by the higher open circuit voltage of the modules. A battery (system) voltage of more than the given values (System High Voltage), see table below, will switch off the load relay.

At low State of Charge of the battery the Charge Control Unit will switch off the load.

When the batteries are charged to a higher state of charge afterwards, the load is switched on again automatically. A circuit breaker safeguards the output(s) against overload and short circuit.

CORROCONTROL OUTPUT REGULATOR (CCOR)

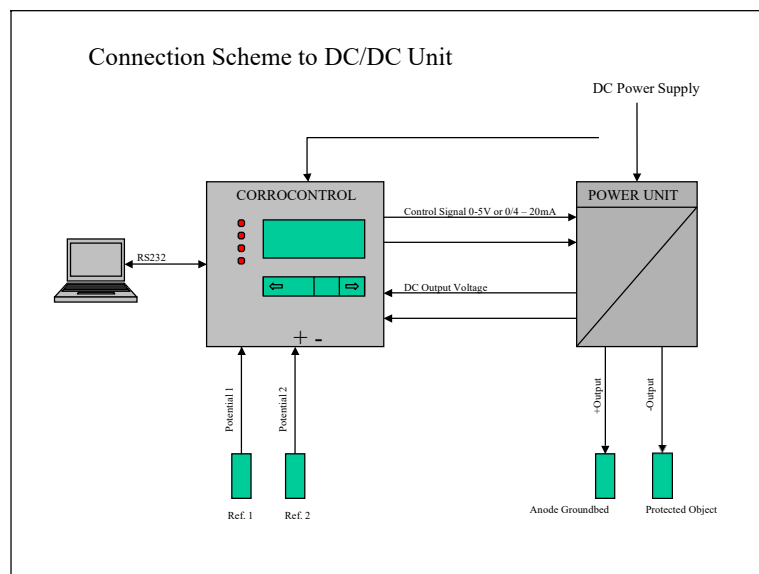
For technical details note Chapter 10 Document 10-100-R0

The computerised output controller unit is equipped with a programmable micro-processor, which controls the functions of the transformer rectifier. The following output control modes are selectable by the on screen guided menus shown on the LCD-display:

- **Constant voltage mode**
Automatic control to maintain the DC output voltage at the set value continuously from zero to maximum rated voltage.
- **Constant current mode**
Automatic control to maintain the DC output current at the set value continuously from zero to maximum rated current.
- **Potential control mode**
Automatic control to maintain the structure to electrolyte potential at the set level.
- **Current Interrupter mode**

Option

- **REMOTE MONITORING AND CONTROL SYSTEMS (RMCS)**



CCU- Slave Unit 12/24/48 V

General

To extend the module input capacity of a CCU-Charge Control Unit, Slave units can be added. The maximum number of solar modules, which can be handled, is almost unlimited: systems up to 50 kWp are proven in the field.

The Slave unit is fully solid state with no moving parts or other sensitive components, resulting in very high reliability under extreme climatologic conditions.

Description

Slave units have three inputs for solar modules. Each input is suitable for 18A max, or total 54A per 12/24V unit (for 48V this is 15A max. or total 45A). A Slave unit includes the power switches only and is controlled by the Master Control unit.

Function

Three green LED indicators show the on/off status of the solar module input power switches. LED "on" indicates that the corresponding solar module sub-array is switched off.

A yellow LED indicates the unit is operational and at least one sub-array supplies sufficient input voltage to charge the battery.

During the night a slave unit shuts down automatically and the yellow operational LED will be off in order to save energy. The same will happen in case the solar array switch is switched off.

Specification

Type	12 / 24 V	48 V
Absolute maximum ratings		
Modules input	50 V	90 V
Battery input	40 V	65 V
Input current	162 A max.	162 A max.
Nominal values		
System voltage	12/24 Vdc	48 Vdc
Total array input current	54 A	45 A
Output current	54 A	45 A
Operating Current	3 mA	3 mA
Operating temperature	-10° C to +55° C	-10° C to +55° C
Storage temperature	-30° C to +70° C	-30° C to +70° C
Enclosure	Open frame	Open frame

SLAVE UNIT

 SUB-ARRAY 1 DISCONNECTED

 SUB-ARRAY 2 DISCONNECTED

 SUB-ARRAY 3 DISCONNECTED

 OPERATIONAL

CCU- Meter Unit

General

The intelligent meter unit measures the key performance parameters of a PV solar power system. Due to its flexibility it can be easily adapted to special project needs.

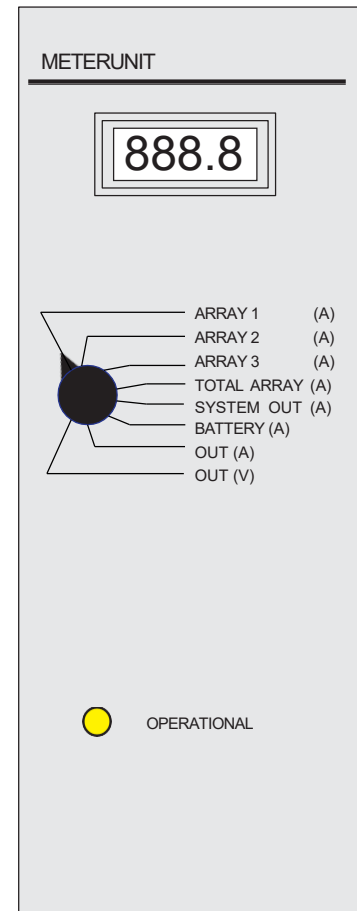
Operating principle

The various input signals are connected to input channels, which make the signals suitable to be processed by the optional micro controller based data logger. A maximum of 8 different signals can be processed.

The meter unit can perform a number of intelligent operations on the signals. E.g. multi sub array currents are added to total array current, battery current is calculated from load and array current. The results are showed on the display.

Operating principle

Type	12 / 24 V	48 V
Absolute maximum ratings		
Battery input	40 V	65 V
Input for current	20 V	20 V
Input for voltage	65 V	65 V
Nominal values		
System voltage	12/24 Vdc	48 Vdc
Operating current	3 mA	3 mA
Accuracy	± 2%	± 2%
Operating temperature	-10° C to +55° C	-10° C to +55° C
Storage temperature	-30° C to +70° C	-30° C to +70° C
Enclosure	Open frame	Open frame
Ranges / Input		
3 x Array current	60/100 mV (depend on shunt value)	
1 x System current	60/100 mV (depend on shunt value)	
1 x Battery voltage	40 V	60 V
1 x Output current	60/100 mV (depend on shunt value)	
1 x Output voltage	40 V	60 V
Typical ranges on display		
3 x Array current	60 A	
1 x Total array current	200 A	
1 x System current	60 A	
1 x Battery current	-200 A to +200 A	
1 x Battery voltage	40 V	
1 x Output current	60 A	
1 x Output voltage	40 V	



CCU- Meter Unit

Data logging for CCU-Meter Unit

General

An 8 analogue input data logger with a memory size of 32.000 readings is available for the Meter Unit as an option which can be connected to the meter unit.

An optional GSM modem is available for remote downloading, saving of recordings, SMS alarm messages and remote display of all inputs/output values by sending a SMS request from a GSM. The user-friendly Windows™ software allows for configuration of the data logger and for processing recorded measurements.

Measured values can be exported to e.g. Microsoft Excel for further processing.

Additional 8 digital inputs and 8 digital outputs are also available; the digital output can be controlled remotely.

Technical specifications:

- Memory capacity: 32.000 readings as standard or 250.000 readings (option)
- Recording interval: 1 second to 60 seconds, averaged each hour. (on configuration)
- Accuracy: $\pm 2\%$
- Possible to download while still recording
- Communication: RS232 interface, Modbus
- Temperature: working -20°C to $+65^{\circ}\text{C}$
- Software: under Windows (98, 2000, XP); recorder configuration, download and saving of recordings, graphic plot, real-time display of measurements, export of recordings to Excel, etc.

GSM/GPRS Options:

- Actual readings and data logger values download via GSM
- 8 analogue inputs
- 8 digital inputs (alarm status etc.)
- 8 digital outputs for remote control
- SMS messages (status, alarm etc.)
- Conformity to 50081-1 and 50082-1

Other data loggers are available upon request.

CCU- Output Relay Unit

General

To extend the output capacity of a Charge Control Unit, Output relays can be added.

The Output relay is fully solid state with no moving parts or other sensitive components, resulting in very high reliability under extreme climatologic conditions.

Description

The Output relay switches the output off when a general alarm occurs and is controlled by the Master unit. This is to prevent the battery for overcharging or excessive discharge. It will switch on the output automatically when the alarm is de-activated.

Features:

Built in protection features are:

- Reversed polarity protection
- Short-circuit and overload protection

Function:

A yellow LED "operational" indicates the unit is operational.

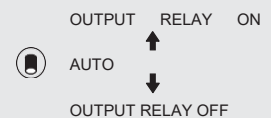
The red LED "overload" indicates that there is a short-circuit or overload at the output.

Specification

Type	12 / 24 V	48 V
Absolute maximum ratings		
Battery input	35 V	65 V
Input current	60 A max. V	40 A
Nominal values		
System voltage	12/24 Vdc	48 Vdc
Output current (nominal)	60 A	40 A
Output current (max.)	100 A (1 min.)	80 A (1 min.)
Operating current	3 mA	3 mA
Operating temperature	-10° C to +55° C	-10° C to +55° C
Storage temperature	-30° C to +70° C	-30° C to +70° C
Enclosure	Open frame	Open frame

OUTPUT RELAY

-  OVERLOAD
-  OUTPUT RELAY ON
-  OUTPUT RELAY OFF
-  OPERATIONAL



RCR-Charge Regulator

General

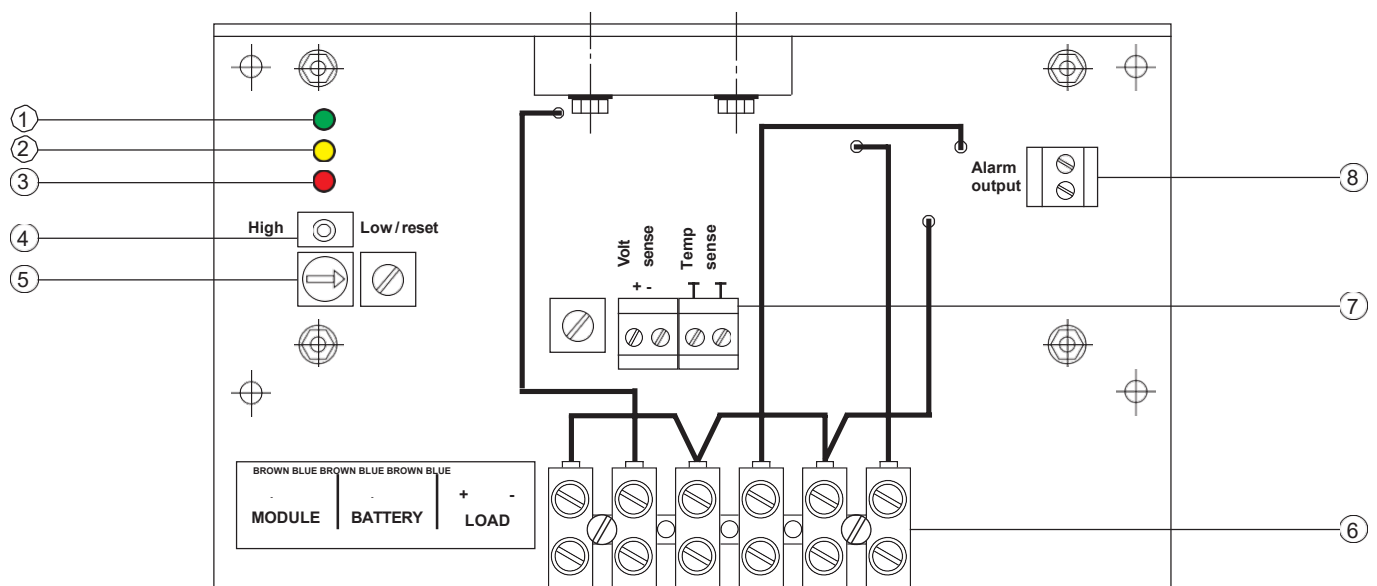
The RCR is a battery charge regulator for small size solar PV systems, which is used for industrial applications.

The RCR features all functions necessary in the industrial field to safeguard an optimum PV system performance and battery lifetime. It is provided with an external temperature/voltage sensor for an advance temperature compensated "boost and float" charge battery charge process. A unique facility enables field-testing on the proper functioning of its overcharge and deep discharge functions. It is characterized by its extremely low energy consumption.

Features

- Reverse polarity protection on battery and solar modules inputs.
- Fully automatic operation.
- Protection against overcharge and excessive discharge of the battery.
- Protection against discharge of the battery through the solar module (at night).
- LED indicators for: operational, battery charge, load disconnect.
- Functional test facility.
- 25A output MOSFET, fully electronic protected.
- Possibility to connect alarm relays (general and/or pre-warning).
- Overload and short circuit protection.
- Advanced temperature compensated "boost and float" battery charge process.

Figure of RCR in standard version (open frame)



- 1 Battery charged indicator (LED green)
- 2 Operational indicator (LED yellow)
- 3 Load disconnect indicator (LED red)
- 4 Test/Reset overload switch
- 5 Charge voltage adjustment
- 6 Terminal connection block
- 7 Sense connection block (for volt - temp. sense)
- 8 Connection block (for external alarm)

RCR-Charge Regulator

Operation

For maximum battery efficiency, the charge regulator performs a “boost and float” charge process.

Boost charge mode

The battery is first charged up to the boost voltage. The upper green LED lights as soon as the battery voltage reaches the boost level and stays on as long as the voltage is above the boost reconnect level.

Charge float mode

The operational indicator (yellow LED) lights up as soon as the battery is connected. The module current is switched “off” and “on” at float and float-reconnect level.

Excessive discharge indicator

If all the available energy is used, the RCR switches off all loads, which is indicated by the red LED. If the battery is then sufficiently charged, the RCR automatically reconnects the loads.

Alarm relays

Optional alarm relays with voltage-free contacts (suppressor diodes recommended) for pre-warning low voltage and general alarm can be connected.

On the alarm output terminal, the minus connection of an alarm relay can be connected (max. current 20mA). The positive side of the alarm relay should be connected to the positive output terminal via a 50mA fuse). In the event that an alarm occurs the controller will switch on the alarm relay.

The alarm status for different system conditions is as follows:

Condition (at 24 V)	Pre-warning Alarm relay	General Alarm relay	Load (at 24 V)
Normal	Off	Off	On
Vbat<	Active	Off	On
Vbat<	Active	Active	Off

Important

To ensure a long battery lifetime, the green LED should be on for a couple of hours every month.

If the loads are switched off by the RCR, the user should also manually switch off the loads, which are used at that moment.

After the battery has been recharged, the regulator will switch the loads on again automatically. This can happen at any time.

In case of short circuit or overload of the output, an electronic fuse will be activated and will prevent any current flowing to the load, without other visible indication. This situation will be persistent until reset of the electronic fuse.

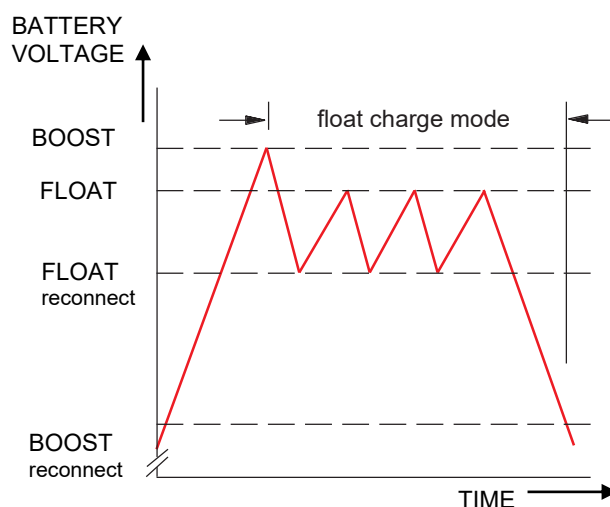


Figure of the charge process

Reset procedure:

- Disconnect or switch off all the loads connected to the output and resolve the cause of the overload.
- Wait a few minutes in order to cool down the fuse.
- Move and hold the test/reset switch to the “low” position until the red led is on. Wait two seconds extra and release the switch.
- As soon as the red led is off, test the loads by switching them on, one by one.

RCR-Charge Regulator

Electrical specifications @ 20°C

Regulator type	RCR 1212	RCR 1224
Nom. Voltage (V)	12	24
Maximum current per solar input (A)	15	15
Number of solar module inputs	1	1
Maximum continuous output current (A) at $I_{in} = 12$ (A)	12	12
Maximum continuous output current (A) at $I_{in} = 15$ (A)	5	5
Maximum peak output current (A) (for < 5 sec.)	25	25
Energy consumption (mA)	5	5
Dissipation at full input and output current (W)	7.2	7.2
Temperature compensation (mV/°C)	-30	-60
Current compensation (mV/A)	10	20
Maximum alarm relay output current	20 mA	15 mA
Boost level (V)	14.5	29.0
Float level (V)	14.2	28.4
Float reconnect level (V)	13.7	27.4
Boost reconnect level (V)	12.8	25.6
Pre-warning low voltage level (V)	11.8	23.6
Load disconnect / general alarm level (V)	11.5	23.0
Load reconnect level (V)	12.2	24.4
Fuse	Electronic	Electronic

Environmental specifications

Operating temperature

-10 °C to + 50 °C ambient

Storage and transit temperature

-30 °C to + 70 °C ambient

Mechanical specifications
(standard - open frame version)

Dimensions (l x w x h)

173 x 102 x 60 mm

Weight

340 g

Terminals (power)

Screw type with wire protection for max. 6 mm² Screw type with wire protection for max. 1.5 mm²

Terminals (volt/temp sensor/alarms)

173 x 102 x 60 mm

Displays

Operational

High efficiency LEDs

Yellow

Battery charged (*float charge mode*)

1 Green

Load disconnect (*battery discharged*)

Red

Control

Momentary type test/reset switch

Left: Overcharge circuit (*green LED on*), reset electronic fuse

Right: Load disconnect circuit (*red LED on*)

Field adjustable float charge voltage

External, to be mounted on minus (-) pole battery

Battery temp./voltage sensor