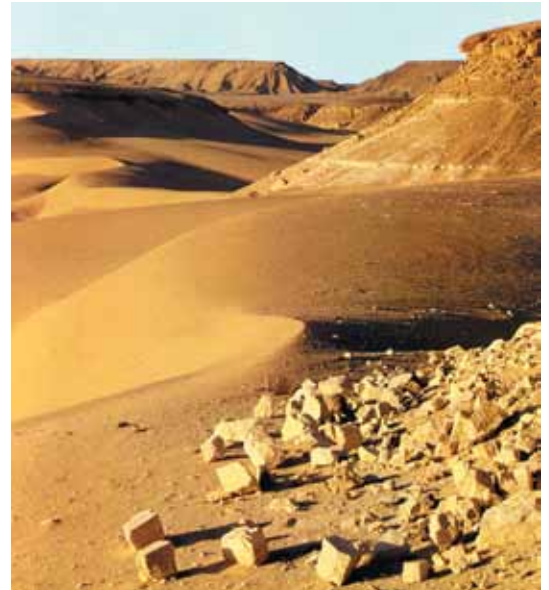


## ALTERNATIVE DC POWER SYSTEMS

Pipelines, well casings and other metal structures are often located in remote areas where there is no local AC mains grid to supply transformer rectifiers, and where galvanic anode systems would not provide sufficient input current for effective protection.

Our alternative DC power systems are designed for operation in harsh environments which are common in the oil and gas industry. Our systems have a long-standing reputation of efficiency and extremely reliability.

Our systems are designed and engineered to provide the best possible operating performance for a wide range of applications in virtually any environment. Their ease of operation, installation and maintenance mean that our systems are ideal for use at even the most remote sites.



### Solar power units



### Thermoelectric generators



### Wind generators



### Hybrid power systems



**Solar Power Modules**

**Consulting**

We want to provide our customers with only the best solar power solutions, and our consultancy service helps you to make right decisions.

We are proud to offer a comprehensive range of services - from feasibility studies to preliminary design, from solar system equipment data to site surveys - everything to ensure that our solutions are exactly suited to customer needs.

**Modules**

The modules use polycrystalline technology. The solar cells are individually characterised and electronically matched prior to connection. An ethylene vinyl acetate encapsulate cushions the solar cells within the laminate and protects them against scratching. The rear surface of the module is completely sealed against moisture and mechanical damage by a backsheet. The self-supporting frames are made of anodised aluminium and designed for easy installation.



*\* Specifications are subjected to change without further notice.*

Characteristics	Unit	P135	P140	P145
Maximum power (Pmax)	W	135	140	145
Power tolerance	W	0+5	0+5	0+5
Open circuit voltage (Voc)	V	22.0	22.2	22.4
Short circuit current (Isc)	A	8.00	8.06	8.63
Maximum power voltage (Vmp)	V	17.3	17.5	17.7
Maximum power current (Imp)	A	7.80	8.00	8.19
Module efficiency	%	13.5 ~ 14.0	14.0 ~ 14.5	14.5 ~ 15.0
Cell technology		Polycrystalline Silicon; 36 pcs (4 x 9)		
Operating temperature	°C	-40 to +85		
(NOCT)	°C	45 ±2		
Dimension	mm	1482 x 676 x 35		
Weight	kg	11.5		
Cable length	mm	900		
Bypass diodes	pcs	2		
Junction box		IP65		
Front glass	mm	3.2		
Frame		Anodised aluminium alloy		



NOCT: Nominal Operating Cell Temperature

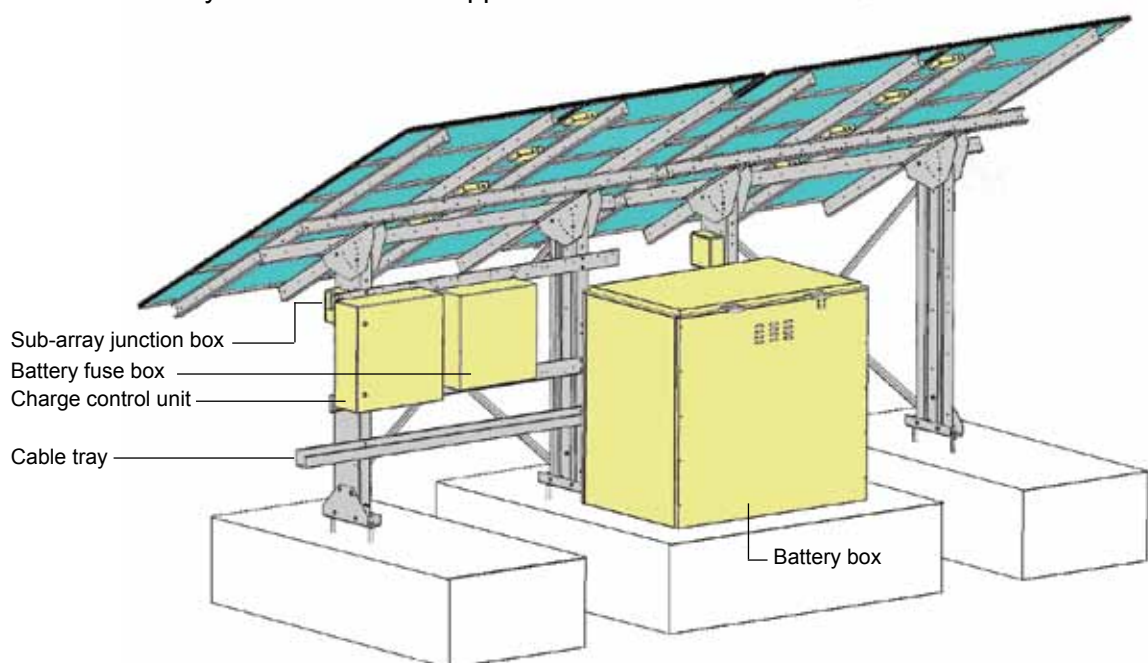
### Array Support Structure

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 easily 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-dipped 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 tiltable from 10° - 50°
- Modular configuration of the array support structure
- Flexible in use and suitable for systems from 4 up to 1000 modules
- Enclosures can be easily connected to the support





**OPzV Batteries**

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

The OPzV range consists of 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 inserts and M10 stainless steel bolts. Coloured washers are provided for easy polarity recognition

- Insulated solid copper connector (30x3mm) for vertical installation or insulated flexible cable connectors (70mm<sup>2</sup>) for horizontal installation. Bolt-on type connector design allows voltage measurements.
- One-way pressure relief valve with integral flame arrestor

**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

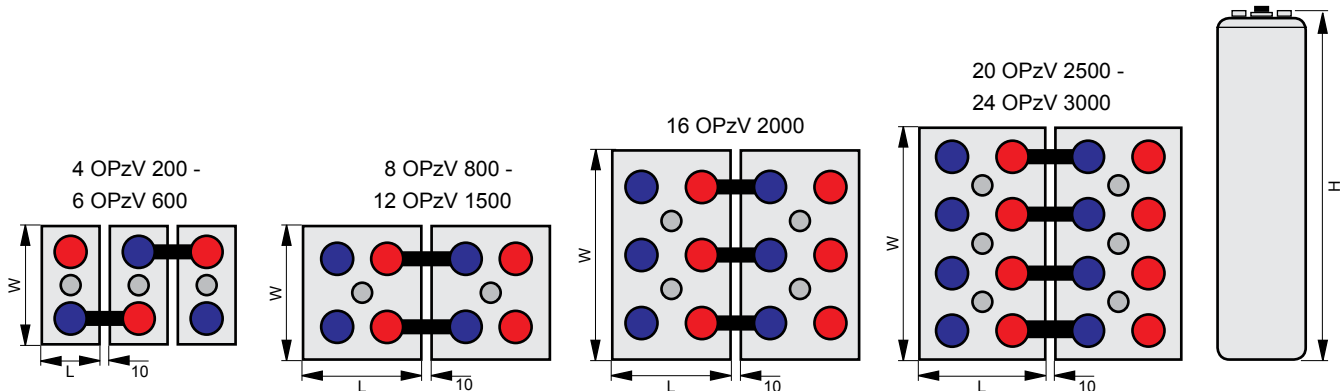
**Installation and Operation**

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

**General Specifications**

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	200	2	215	103	4.1	206	8.1	403	15.8	19.5	43.0	2195	0.95
5 OPzV 250	250	2	265	124	4.9	206	8.1	403	15.8	23.5	51.9	2737	0.76
6 OPzV 300	300	2	320	145	5.7	206	8.1	403	15.8	28.0	61.8	3175	0.66
5 OPzV 350	350	2	385	124	4.9	206	8.1	520	20.3	31.0	68.4	3410	0.61
6 OPzV 420	420	2	465	145	5.7	206	8.1	520	20.3	36.5	80.5	4043	0.51
7 OPzV 490	490	2	540	166	6.5	206	8.1	520	20.3	42.0	92.6	4607	0.45
6 OPzV 600	600	2	705	145	5.7	206	8.1	695	27.3	50.0	110.3	3796	0.55
8 OPzV 800	800	2	940	210	8.2	191	7.5	695	27.3	68.0	150.0	5200	0.40
10 OPzV 1000	1000	2	1170	210	8.2	233	9.2	695	27.3	82.0	180.8	6460	0.32
12 OPzV 1200	1200	2	1410	210	8.2	275	10.8	695	27.3	97.0	213.9	7675	0.27
12 OPzV 1500	1500	2	1580	210	8.2	275	10.8	845	33.3	120.0	264.6	7510	0.28
16 OPzV 2000	2000	2	2110	212	8.3	397	15.6	820	32.3	165.0	363.8	10048	0.21
20 OPzV 2500	2500	2	2640	212	8.3	487	19.2	820	32.3	200.0	441.0	12608	0.17
24 OPzV 3000	3000	2	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 an ambient temperature of +20°C





**OPzS Batteries**

OPzV batteries are suitable for a broad range of applications including: telecommunications; cathodic protection systems; power generating; 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 stand-by power applications which demand the highest levels of reliability and security. OPzS cells benefit from an optimised plate design which provide capacities which exceed the requirements of 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) for visual monitoring of electrolyte level and cell conditions
- Cell lids - made of SAN sealed 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 provide minimum resistance and maximum current flow

- Vent plugs - safety plugs equipped with flame arrestors. Special vent plugs which do not have to be removed during replenishment and S.G.-reading are available on request
- Connectors - insulated, lead-tin plated, solid copper inter-cell connectors allow voltage measurements

**Standards**

- Compliant with standards IEC 60896-1 and DIN 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

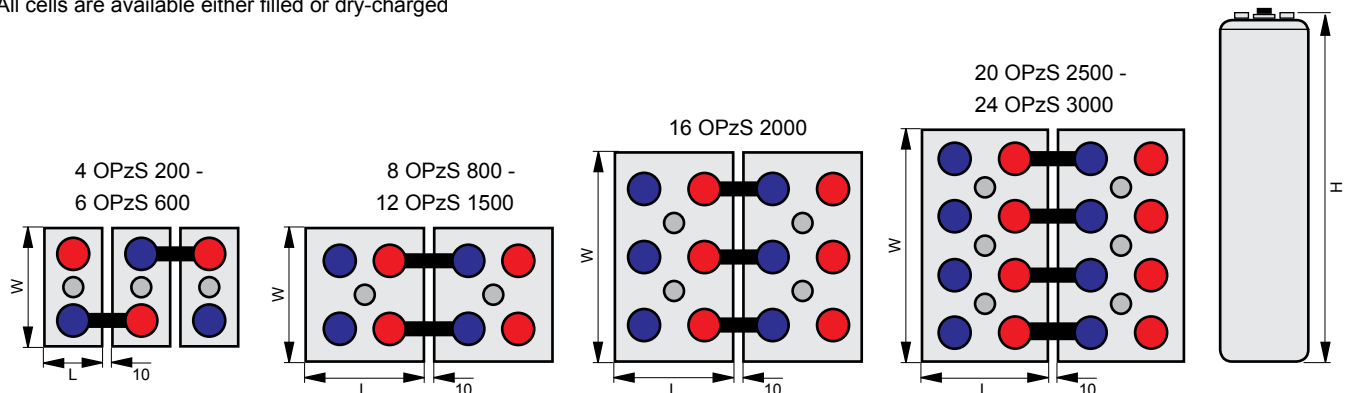
**Installation and Operation**

- 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 stand-by operation mode due to large electrolyte reserve

**General Specifications**

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	200	2	216	103	4.1	206	8.1	403	15.8	12.4	17.2	3.9	2400	0.85
5 OPzS 250	250	2	270	124	4.9	206	8.1	403	15.8	14.8	20.8	4.9	3000	0.68
6 OPzS 300	300	2	324	145	5.7	206	8.1	403	15.8	17.1	24.3	5.8	3600	0.57
5 OPzS 350	350	2	390	124	4.9	206	8.1	520	20.3	19.0	26.9	6.7	3400	0.60
6 OPzS 420	420	2	468	145	5.7	206	8.1	520	20.3	22.1	31.5	8.0	4075	0.50
7 OPzS 490	490	2	546	166	6.5	206	8.1	520	20.3	25.2	36.1	9.3	4750	0.43
6 OPzS 600	600	2	660	145	5.7	206	8.1	695	27.3	31.9	44.8	11.1	5000	0.40
8 OPzS 800	800	2	880	210	8.2	191	7.5	695	27.3	44.4	61.3	14.5	6650	0.30
10 OPzS 1000	1000	2	1100	210	8.2	233	9.2	695	27.3	53.5	74.6	18.1	8300	0.24
12 OPzS 1200	1200	2	1320	210	8.2	275	10.8	695	27.3	62.8	88.0	20.6	9950	0.20
12 OPzS 1500	1500	2	1680	210	8.2	275	10.8	845	33.3	80.2	114.3	27.3	9600	0.21
16 OPzS 2000	2000	3	2240	212	8.3	397	15.6	820	32.3	105	151.5	39.0	12800	0.15
20 OPzS 2500	2500	4	2800	212	8.3	487	19.2	820	32.3	134	193	47.6	16000	0.12
24 OPzS 3000	3000	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 an 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 an 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 configurations with various options, covering a wide range of solar module input and power-handling capacities.

A basic CCU-controller consists of a Master Unit mounted in an (IP 66) enclosure. Master units have a maximum of three separately 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.

Options include: metering; alarm relays; 60A (12 or 24V) or 40A (48V) output relay; output voltage stabiliser, etc.

**Standard IP66 enclosures:**

- 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 one optional (non 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 to ATEX.

Customised solutions can be provided for larger power systems or according to enduser specifications. Solar power modules can be configured up to 50 kWp

All variants use the same general operating principle.

**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.



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

**Disconnection if:**

- a) excessive deep discharge
- b) excessive system voltage
- c) battery overcharge of solar array

**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, the array or both.
- reverse current during night
- excessive system voltage

**Features:**

- Advanced temperature compensated boost and float battery charge process.
- Three solar array inputs with separate solid state on/off switches, controlled by the charge circuit.
- Load output with SOC-controlled 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 disconnect.
- "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 diagnosis.
- Optional output relay capable of switching 60 A (constant current).
- Optional datalogger for measuring hour averages.
- Optional output regulator for voltage limiting or Cathodic Protection.
- Optional high-voltage transient protection of electronics with transient voltage suppressor.
- Customised 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 connected load.

The CCU protects the battery against excessive charging and discharging by maintaining a charge/discharge cycle within designed level. Special charge regulations technology enables more efficient use of available energy and faster battery charging compared to conventional controllers.

The CCU is housed in a fibre-glass reinforced polyester (GRP) IP 66 enclosure. The terminals can be colour coded for easy interconnection of all individual cables and system components. The CCU is available with 12, 24 or 48 VDC.

The modules can be split up into 3 different groups for separate connection.

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 CCu operates a boost and float charge process to increase battery efficiency. The battery is charged to a slightly increased initial voltage and is then regulated at a float charge level by selecting the appropriate number of module strings. 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) will switch off the load relay.

The CCU will switch off when battery charge is too low.

The load is automatically switched on again once batteries have been re-charged. A circuit breaker protects against overloads and short circuits.

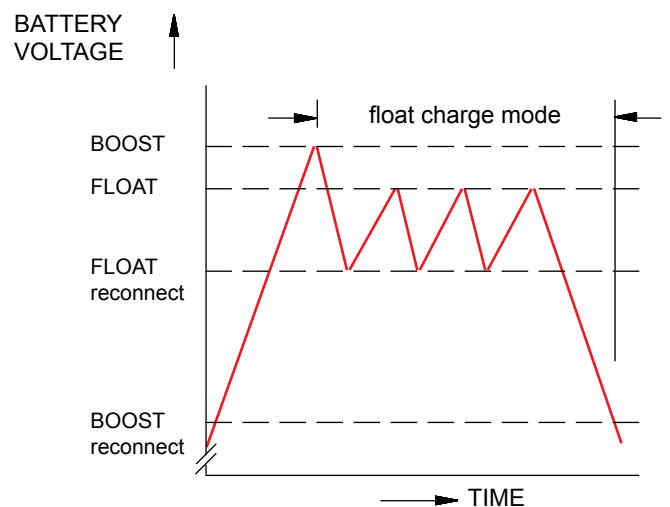


Figure of the charge process


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

Type:	12 V	24 V	48 V
<b>Absolute maximum ratings</b>			
Module 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.)
<b>Nominal values</b>			
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 master current	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.  
These values will vary according to site and battery conditions.

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) indicates that the boost charge voltage level has been reached and the battery is in float charge mode. 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:**

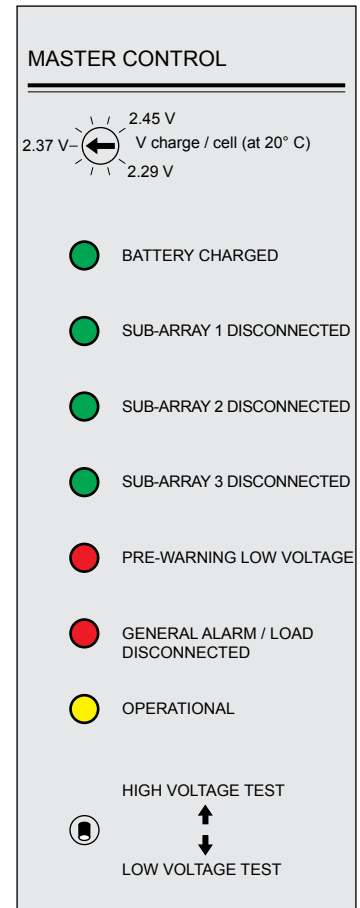
Three green sub-array disconnect LEDs: one or more LED’s may be lit during float charge mode and indicate the specific sub-array that is disconnected. The CCU selects the number of connected sub-arrays so that charge current is as high as possible without exceeding the float charge (gassing) voltage. The controller will react to changing solar radiation conditions within seconds. During boost charge mode all the green LEDs are unlit.

■ **Red “pre-warning low-voltage” LED:**

Red pre-warning low voltage LED will be lit if battery voltage drops dramatically or any other fault occurs and in a properly sized system it indicates an abnormal situation. This can include prolonged lack of direct sunlight, dirty/damaged solar panels or higher energy consumption. If installed, an optional pre-warning low voltage will be activated when this LED is lit. If an optional “non-essential load” output is available, it will be disconnected.

■ **Red “general alarm/load disconnect” LED:**

If this LED is lit the internal 25A (12-24V version), or 16A (48V version) output relays, 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.



Master Control Unit

The alarm can be caused by two different situations:

A- Battery low voltage:

In this case the general alarm/load disconnect LED is lit and the corresponding alarm relay is activated. See also the above section „pre-warning low voltage“.

B- Excess system voltage:

In this case the general alarm/load disconnect LED and all green LEDs are lit. Possible reasons for this situation are disconnected battery cables, defective battery fuse, defective master control or slave unit.

**Test switch**

The test switch simulates either high or a low battery voltage (not excess system voltage). The system voltage is measured at the battery power terminals inside the controller. This switch can be used to test the main functions of the controller.

Moving the switch to the high voltage position will switch on the green LEDs and immediately disconnect the sub-arrays (and also slave units if present). The switch returns to the neutral position when released. The controller will resume normal operation within 2 maximum of 15 seconds.

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

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

The potentiometer controls both float and boost charge voltage settings. Depending on the battery type, capacity, load and operating conditions, the recharge time and water usage (flooded types) of the battery can be optimised by adjusting the float charge setting. We recommend consulting GCP before adjusting the float charge setting of the controller.

Alarm relays: see pre-warning low voltage and general alarm LEDs.

When the battery connection is interrupted, the modules will switch off within 0.1 seconds to avoid any damage to the appliances caused 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.

The CCU will switch off the load when the battery reaches a low charge state.

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 against overloads and short circuits.

**CORROCONTROL OUTPUT REGULATOR (CCOR)**

*Further technical details can be found in Chapter 10*

*Document 10-100-R0*

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

- **Constant voltage mode**  
Automatically maintains DC output voltage at a preset level. Level can be stepless adjusted from any value between zero and maximum rating.
- **Constant current mode**  
Automatically maintains DC output current at a preset level. Level can be stepless adjusted from any value between zero and maximum rating.
- **Potential control mode**  
automatic control to maintain the structure-to-electrolyte potential at preset level in response by a signal from a reference electrode.
- **Current Interrupter mode**

**Option**

- Remote Monitoring and Control Systems (RMCS)





**CCU-Slave Unit 12/24/48 V**

**General**

Additional slave units can be added to increase the module input capacity of a CCU. 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 providing very high reliability under extreme meteorological conditions.

**Description**

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

**Function**

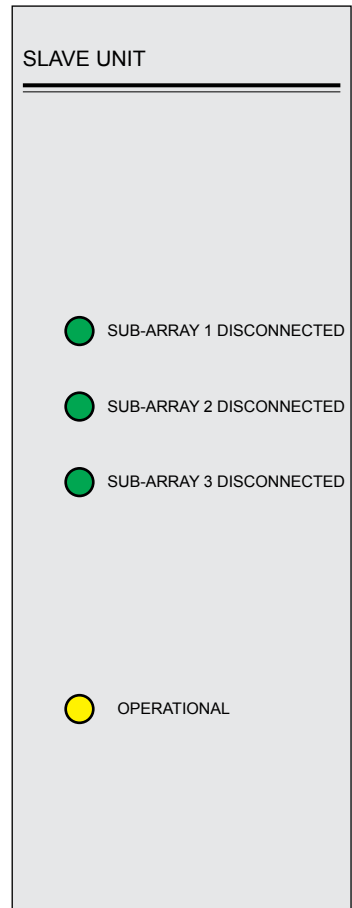
Three green LED indicators show the on/off status of the solar module input power switches. A lit indicates that the corresponding solar module sub-array is disconnected.

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

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

**Specifications**

Type	12 / 24 V	48 V
<b>Absolute maximum ratings</b>		
Modules input	50 V	90 V
Battery input	40 V	65 V
Input current	162 A max.	162 A max.
<b>Nominal values</b>		
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





**CCU-Meter Unit**

**General**

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

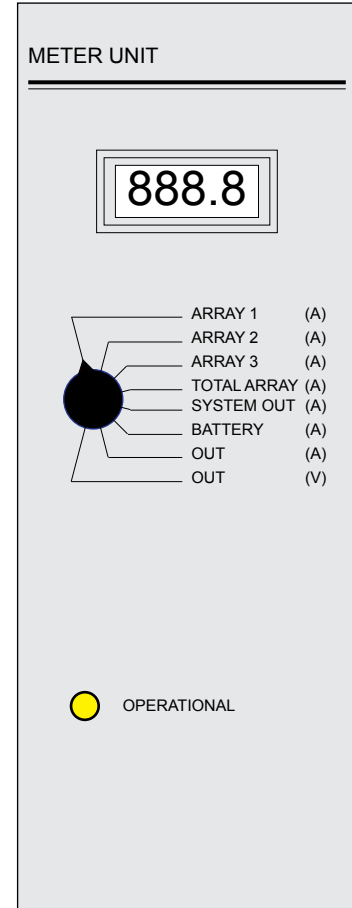
**Operating principle**

The various input signals are connected to separate channels. They can then be processed by an optional microcontroller based datalogger. A maximum of 8 different signals can be processed.

The meter unit can carry out a range of intelligent operations on signals received, such as addition of multi subarray currents to total array current or calculation of battery current on load and array currents. The results are shown on the display.

**Specifications**

Type	12 / 24 V	48 V
<b>Absolute maximum ratings</b>		
Battery input	40 V	65 V
Input for current	20 V	20 V
Input for voltage	65 V	65 V
<b>Nominal values</b>		
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
<b>Ranges / Input</b>		
3 x Array current	60/100 mV (depending on shunt value)	
1 x System current	60/100 mV (depending on shunt value)	
1 x Battery voltage	40 V	60 V
1 x Output current	60/100 mV (depending on shunt value)	
1 x Output voltage	40 V	60 V
<b>Typical ranges on display</b>		
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 analogue datalogger with 8 inputs and a capacity of 32,000 readings is available to the CCU 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 an SMS request from a GSM. The user-friendly Windows™ software allows for configuration of the datalogger 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: ± 2%
- Download possible during recording mode
- Connections: RS232 interface, Modbus
- Ambient temperature range: -20°C to +65°C
- Software: under Windows™ (98, 2000, XP); recorder configuration, downloading and saving of recordings, graphic plotting, real-time display of measurements, export of recordings to Excel, etc.

**GSM / GPRS options:**

- Actual readings and datalogger values downloadable 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 dataloggers are available upon request.



**CCU-Output Relay Unit**

**General**

Output relays can be added to extend the capacity of the CCU.

Output relays are fully solid-state with no moving parts or other sensitive components providing very high reliability under extreme meteorological conditions.

**Description**

The output relay switches the output off when a general alarm occurs and is controlled by the master unit. This protects the battery against overcharging and excessive discharging. The relay switches the output back on automatically when the alarm is deactivated.

Features:

Built in protection features include:

- Reversed polarity protection
- Short circuit and overload protection

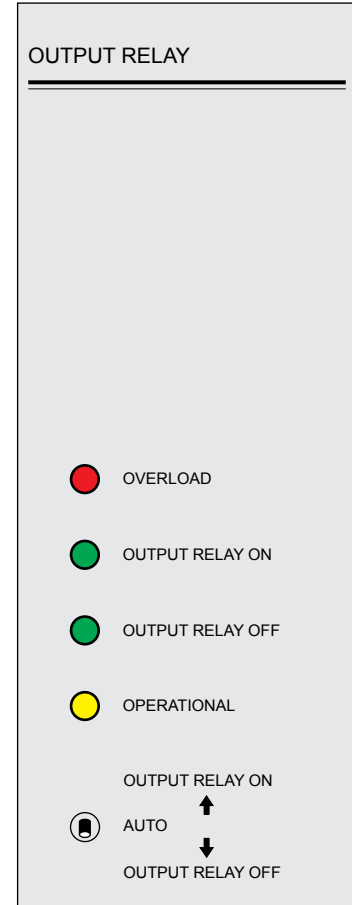
Function:

A yellow LED indicates the unit is operational.

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

**Specifications**

Type	12 / 24 V	48 V
<b>Absolute maximum ratings</b>		
Battery input	35 V	65 V
Input current	60 A max. V	40 A
<b>Nominal values</b>		
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



**RCR-Charge Regulator**

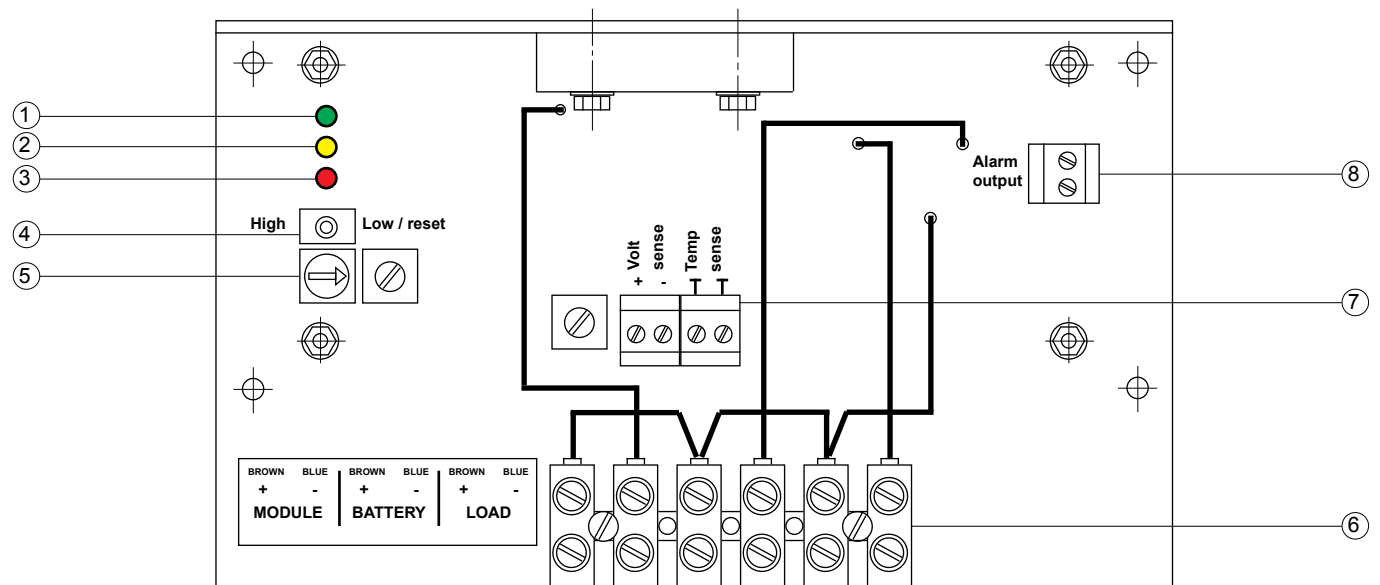
**General**

The RCR is a battery charge regulator for small size solar PV systems used in industrial applications. The RCR has all the necessary features to guarantee optimum PV system performance and safeguard battery lifetimes. It features a temperature/voltage sensor for an advanced, temperature-compensated “boost and float” battery charge process. A unique facility enables field-testing of the proper operation of its overcharge and deep discharge functions. It is characterised 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.

**Diagram 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 Connection block for temperature/voltage sensor
- 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**

First, the battery is charged up to the boost voltage. The upper green LED is lit once 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) is lit once 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. This is indicated by the red LED. If the battery is then sufficiently charged, the RCR automatically reconnects the loads.

**Alarm relays**

Optional alarm relay a with voltage-free contacts (suppressor diodes recommended) can be connected for pre-warning low voltage and general alarms. The minus connection of the alarm relay (maximum current 20 mA) can be connected to the output terminal. The positive connection of the alarm relay should be made to the positive output terminal via a 50 mA fuse. In the event of a fault, the controller will automatically 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 were in use when the fault occurred at the time.

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. No visual indication is given in this case and the situation will persist until the electronic fuse is reset.

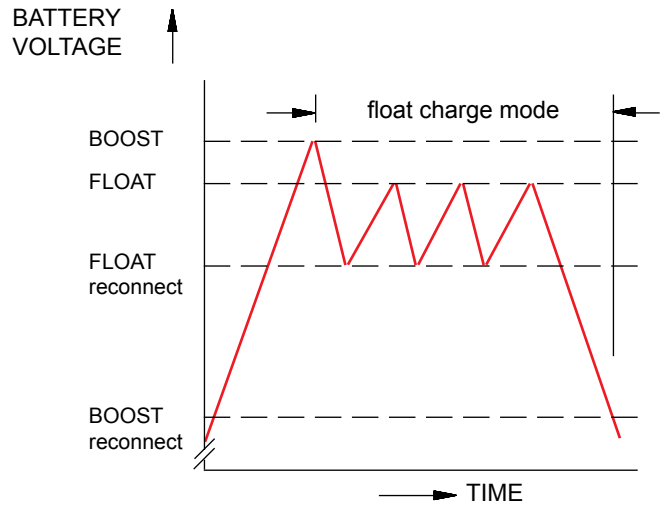


Diagram of the charge process

**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 lit. Wait two seconds and then release the switch.
- As soon as the red led is off, test the loads by switching them on one after another.





**RCR-Charge Regulator**

**Electrical specifications @ 20°C**

Regulator type	RCR 1212	RCR 1224
Nominal 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 mm<sup>2</sup>

Terminals (volt/temp sensor/alarms) Screw type with wire protection for max. 1.5 mm<sup>2</sup>

**Displays**

Operational

Battery charged (*float charge mode*)

Load disconnect (*battery discharged*)

**High efficiency LEDs**

Yellow

Green

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

Battery temp./voltage sensor

External, to be mounted on battery negative (-) terminal

# ALTERNATIVE DC POWER SYSTEMS

## Thermoelectric generators

Document No.: 03-200-R1

Sheet: 1 of 1

German Cathodic Protection



Thermo electric generators produce power by directly converting heat into electricity.

The heart of a thermoelectric generator is a hermetically sealed thermoelectric module (thermopile) which contains an array of lead-tin-telluride semiconductor elements. This durable module provides a chemically stable environment for the thermoelectric materials which ensures a long service life. A gas burner is installed on one side of the thermopile while the other side is cooled by aluminium cooling fins or a heat pipe assembly.

An operating generator maintains a temperature of approximately 540°C on the hot side and 140°C on the cold side. The heat flow through the thermopile creates continuous DC output with no moving parts.

The burners can be fuelled by propane, butane or natural gas and it is specially designed for low-maintenance operation. Air intakes and exhausts are protected against rain, dust and strong winds.



Natural gas pipelines are often protected with current supplied from thermoelectrical generators fuelled with natural gas tapped from the pipeline via suitable pressure reducing and valve arrangements.

Solid state DC-DC converters are used to control the output of the generators to provide constant current, constant voltage or constant pipe-to-soil potential, using a permanent reference electrode to provide a feedback signal.

Model	Power specifications	Electrical	Fuel	Environmental	
5030	Power ratings @ 20 °C 21 W @ 12 V 21 W @ 24 V	Adjustment 12 V 12 - 18 V 24 V 24 - 30 V	Natural gas 1000 BTU/SCF (37.7 MJ/SM <sup>3</sup> ) gas	2.1 m <sup>3</sup> /day	Ambient operation temperature Max. 55 °C Min. -55 °C
			Propane	3.0 l/day	
			Maximum supply pressure	1724 kPa (250 psi)	
			Minimum supply pressure	103 kPa (15 psi)	
5060	Power ratings @ 20 °C 60 W @ 6.7 V 54 W @ 12 V 54 W @ 24 V 54 W @ 48 V	Adjustment 6.7 V 6.7 - 11 V 12 V 12 - 18 V 24 V 24 - 30 V 48 V 48 - 60 V	Natural gas 1000 BTU/SCF (37.7 MJ/SM <sup>3</sup> ) gas	4.4 m <sup>3</sup> /day	Ambient operation temperature Max. 55 °C Min. -55 °C
			Propane	5.7 l/day	
			Maximum supply pressure	1724 kPa (250 psi)	
			Minimum supply pressure	103 kPa (15 psi)	
5120	Power ratings @ 20 °C 120 W @ 6.7 V 108 W @ 12 V 108 W @ 24 V 108 W @ 48 V	Adjustment 6.7 V 6.7 - 11 V 12 V 12 - 18 V 24 V 24 - 30 V 48 V 48 - 60 V	Natural gas 1000 BTU/SCF (37.7 MJ/SM <sup>3</sup> ) gas	8.8 m <sup>3</sup> /day	Ambient operation temperature Max. 55 °C Min. -55 °C
			Propane	11.4 l/day	
			Maximum supply pressure	1724 kPa (250 psi)	
			Minimum supply pressure	103 kPa (15 psi)	
5220	Power ratings @ 20 °C 220 W @ 12 V 176 W @ 24 V	Adjustment 12 V 12 - 18 V 24 V 24 - 30 V	Natural gas 1000 BTU/SCF (37.7 MJ/SM <sup>3</sup> ) gas	19.7 m <sup>3</sup> /day	Ambient operation temperature Max. 55 °C Min. -55 °C
			Propane	28.0 l/day	
			Maximum supply pressure	1724 kPa (250 psi)	
			Minimum supply pressure	241 kPa (35 psi)	
1500	Power ratings @ 20 °C 500 W @ 24 V	Adjustment 24 V 24 - 30 V	Natural gas 1000 BTU/SCF (37.7 MJ/SM <sup>3</sup> ) gas	48.0 m <sup>3</sup> /day	Ambient operation temperature Max. 50 °C Min. -50 °C
			Propane	n/a at this time	
			Maximum supply pressure	410 kPa (60 psi)	
			Minimum supply pressure	207 kPa (30 psi)	
8550	Power ratings @ 20 °C 480 W @ 12 V 550 W @ 24 V 480 W @ 48 V	Adjustment 12 V 12 - 18 V 24 V 24 - 30 V 48 V 47 - 57 V	Natural gas 1000 BTU/SCF (37.7 MJ/SM <sup>3</sup> ) gas	48.0 m <sup>3</sup> /day	Ambient operation temperature Max. 50 °C Min. -50 °C
			Propane	76.0 l/day	
			Ethylene	29.9 m <sup>3</sup> /day	
			Maximum supply pressure	1724 kPa (250 psi)	
			Minimum supply pressure	207 kPa (15 psi)	

Models shown are for standard configurations. The engineering department can design installations meeting different specifications, including custom voltages, fuel supply systems and non-standard operating temperatures.

Sizing a wind generator system for a cathodic protection station means determining how much energy is required for continuous system operation. A wind generator system must provide enough energy to replace that being consumed daily by the cathodic protection station.

Meteorological data from the proposed CP location is analysed and computerised design is used to optimise the type of wind generator, battery storage capacity, external circuit and anode groundbed parameters.

### Wind generator - WINDSEEKER 503

For a decade, Windseeker wind turbines have set the standard for affordable, reliable wind power. With their unique, patented upward-furling design, they dependably generate power year after year, in conditions from low wind to the extreme wind of stormy mountain tops.

#### Models available

- 3-bladed model - for smoother and quieter operation with glass reinforced polypropylene blades as standard
- Marine version - for coastal saltwater environments
- Industrial - for extreme conditions where winds are expected to exceed 120 mph

#### Features

- Double ball-bearing yaw shaft
- Durable powder-coated finish
- Light weight, corrosion-resistant cast aluminum and stainless steel construction
- Brushless neodymium permanent magnet alternator
- Precision, computer designed aircraft quality rotor
- Intelligent voltage regulator provides protection against dangerous voltage surges
- Military specification safety protection electronics regulates voltage and rotor RPM
- Polyurethane UV prop tape protects leading edge
- Easy-to-install, low-cost tower designs available

#### Operation

The Windseeker has an internal permanent magnet brushless alternator that rectifies the voltage and regulates the output. This allows better control of the alternator and minimises connections to the battery. This safety feature prevents turbine damage and safeguard operating personnel against excess voltage.



#### Regulation and control electronics

The electronics perform several functions to assure maximum output and safety. The control electronics maintain a constant load on the alternator to prevent turbine over speed regardless of battery condition. As the battery is charged, the sophisticated regulator periodically checks the line, compensating for voltage loss and monitoring the charge rate. Once the battery has reached its optimum charge level, the regulator shuts the current off, thus preventing the battery from being overcharged while still maintaining a continuous load on the alternator to prevent overspeeding.

Solid state DC-DC converters are used to control the output of the wind generator/battery system to provide constant current, constant voltage or constant pipe-to-soil potential, using a permanent reference electrode to provide a feedback signal.

#### CP-output regulator

CORROCONTROL OUTPUT REGULATOR (CCOR)  
Further technical details can be found in Chapter 10  
Document 10-100-R0

#### Mounting kits

Guyed tower kits, poles and anchors are available on request.

#### Specifications

Rotor diameter	1.52 m (60")
Weight	9 kg (20 lbs)
Start up wind speed	2 m/s (5 mph)
Voltage	12, 24, 48 V
Output	500 W
Output voltage (adjustable)	Preset 14.8 - 12 V model Preset 29.5 - 24 V model
Voltages available	12, 24, 48 V DC (standard)
Alternator	PM 3 phase brushless

\* Generators with outputs > 500 W available on request

Many renewable energy systems have developed into valuable alternatives to earlier technologies in certain applications and environments. Integrating solar and solar/wind-hybrid technology into your existing industrial installations can result in higher efficiency, easier maintenance and increased reliability. Examples of such applications are: stand-alone energy supply (off-grid, remote, onshore and offshore), cathodic protection e.g. of oil & gas pipelines, hazardous areas (ATEX compliant), telecommunications, signalling and warning, monitoring and instrumentation.

The advantage of a hybrid power system is that when one power source is at low levels the other source is usually at higher levels. On a cloudy, windy day when solar panels produce lower outputs, a wind generator may provide more energy. In contrast, on a bright cloudless day the solar panels will usually outproduce wind generators. Effective windgenerator use requires selecting a location with the night wind conditions. Balancing the power sources to achieve the highest level of system performance takes some experience. Each location must be assessed to determine sizing for optimum performance.

Meteorological data from the proposed CP location is analysed and computerised design is used to optimise the solar array, wind generator and battery storage capacity, external circuit and anode groundbed parameters.

### The components

The main components for a hybrid power system for a cathodic protection system are the solar array, the wind generator, the battery charge controller, the battery storage and the output regulator.

The entire system is modular and can be adapted to enduser requirements.

- **Solar modules**
- **Module support structure**
- **Wind generator with support structure**
- **Charge controller**
- **Battery and battery housing**
- **CP-output regulator**  
CORROCONTROL OUTPUT REGULATOR (CCOR)  
*Further technical details can be found in Chapter 10  
Document 10-100-R0*



### Advantages of hybrid power systems:

- **More consistent power supply**
- **Lower total system cost**
- **Compensation of weather fluctuations**
- **Reduced deepcycling of batteries**
- **Extended battery life**

Further technical details can be found in:  
Document No.: 03-100-R1 (Solar power units)  
Document No.: 03-300-R1 (Wind generators)