VOTRONIC

Installation and Operating Manual

DC-DC converters

DCDC 1224-25	**Input Voltage 12 V**	**Output 24 V / 25 A**	**No. 3341**
DCDC 2412-25	**Input Voltage 24 V**	**Output 12 V / 25 A**	**No. 3342**
DCDC 1212-45	**Input Voltage 12 V**	**Output 12 V / 45 A**	**No. 3336**
DCDC 2412-45	**Input Voltage 24 V**	**Output 12 V / 45 A**	**No. 3338**

Please read this operating and installation manual thoroughly prior to connection and start-up.

The values being indicated in parentheses () apply to 24 V operation.

It is not allowed to use the units for charging of 12 V or 24 V batteries at the output, since neither mechanisms for battery protection nor for limiting have been provided.

DC-DC converters for intervention vehicles and special purpose vehicles, campers, marine field and offgrid purposes, f.e. in cottages.

The VOTRONIC DC-DC converter of series DCDC allow a safe operation of consumer loads with 12 V or 24 V board mains supply, without requiring an own battery system.
Short-time operation with up to 30 % overload is possible, so that inrush current, peak current or starting current of the different consumer loads can be compensated.
Protection against 24 V /12 V punctures, defective ground cables etc. is ensured by a **galvanic isolation** between input and output side. Even in case of long connection cables, perfect ground ratios being independent of each other are ensured on both sides, which is advisable for large vehicles, containers, roll containers, trailers etc.
After activation of the DC-DC converter at the ON/OFF control input, which can be effected either by a switch signal, vehicle ignition or D+, the voltage control of the battery is also ready for operation (charging recognition at the starter battery, undervoltage disconnection).
Output voltage:
It is stabilized and smoothed. Thus, it is most suitable even for sensitive consumer loads. The output voltage can be set to three fixed, stabilized output voltage rates.
In the fourth switch position, the rate of the input voltage at the output will be reproduced variably. During this operating mode, also operation of such consumers is advantageous, which get further information from the operating voltage (12 V or 24 V), such as starter battery is charged, driving or stationary mode, automatic disconnection in case of low voltage and battery discharge etc. (small appliances, charging trays, lamps).

Further Characteristics of the Unit:

- The **output voltage** is **stabilised, free from peaks, smoothed** and **filtered**.
- **Galvanic isolation between input and output:**
  Complete separation of consumer loads and battery circuit, also in case of failure. This is a particularly important feature for operation of 12 V consumer loads of a higher 24 V system voltage:
  - ✓ No destruction of 12 V consumer loads in case of overvoltage due to disruptive discharge 24 V.
  - ✓ No overvoltage at the output. Thus, the consumer loads are protected in case of loss of the ground cable.
  - ✓ Neat, undisturbed ground ratio, even with long supply cables.
  - ✓ Always stable operating voltage during mobile operation, such as containers, trailers, roll containers etc.
  - ✓ Filtering and interference suppression of input and output side.
- **Fully automatic continuous operation:** The DC-DC converter may be connected continuously to the battery and the consumer loads. According to the set mode, manual mode or automatic mode is possible.
- **Unattended operation:** Multiple protection against overload, overheating, overvoltage, short circuit, incorrect behaviour and deep discharge of the battery by electronically controlled gradual reduction down to complete separation **by integrated safety relays**.
- **Compensation of the supply cables:** Voltage losses on the cables are considered.
- **Integrated On-board Mains Suppression Filter:** Unproblematic parallel operation of solar systems, wind and petrol-driven generators, mains supply chargers etc. at a single battery.

Safety Regulations:

Appropriate Application:

The DC-DC converter has been designed according to the valid safety regulations.

Appropriate application is restricted to:

1. **Lead-acid, lead-gel, lead-AGM or LiFePO4-batteries of the indicated nominal voltage.**
2. **With the indicated cable cross-sections for inputs and outputs.**
3. **Fuses of the indicated capacity are to be provided near the battery to protect the cabling between battery and connections of the DC-DC converter.**
4. **Technically faultless condition.**
5. **Installation in a well-ventilated room, protected from rain, humidity, dust, aggressive battery gases, as well as in an environment being free from condensation water.**
6. **If the driver and other road users are not affected.**

Never use the unit at locations where the risk of gas or dust explosion exists!
Never use the unit's output for battery charging!

- Open-air operation of the unit is not allowed.
- Lay the cables in a way, that damage is avoided and observe to fasten them tightly.
- Never lay 12 V (24 V) cables and 230 V mains supply cables into the same cable conduit (empty conduit).
- Check live cables or leads periodically for insulation faults, points of break or loosened connections. Occurring defects must be remedied immediately.
- The unit is to be disconnected from any connection prior to execution of electrically welding or work on the electric system.
- If the user is not able to draw from the manual, which characteristic values are valid for a unit or which regulations are to be observed, a specialist is to be consulted.
- The user/buyer is obliged to observe any construction and safety regulations.
- **The unit does not contain any parts, which can be replaced by the user.** Even after having been switched-off, the unit may be live for an extended period (particularly in case of failure).
- Keep children away from the DC-DC converter and the batteries.
- Observe the safety regulations of the battery manufacturer; deaerate the battery room.
- Non-observance may result in injury or material damage.
- The manufacturer's warranty is 60 months from delivery.
- Improper use, operation outside the technical specifications, improper operation or third-party intervention will void the warranty or manufacturer's guarantee. No liability is accepted for any resulting damage. The exclusion of liability also extends to any services provided by third parties that were not commissioned by us in writing. Services exclusively provided by VOTRONIC Elektronik-Systeme GmbH, Lauterbach.

Installation of the Unit:

The DC-DC converter can be installed at any location, which is clean and which is protected from humidity and dust on an even and hard mounting surface. The installation place of the unit should be chosen in such a way, that the cables to battery and consumer loads can be as short as possible.
Despite the DC-DC converter’s high efficiency, heat is produced, which is brought out of the casing by means of the built-in fans.
Ensure sufficient **ventilation** in the **environment of the unit,** so that the heat can be removed. Protect the unit from aggressive battery gas.
The unit can be installed in any position. However, the **vent holes** of the casing (front panel and rear panel) should never be covered to ensure the full charging capacity (**minimum distance: 10 cm**).

Description of the Functions:

The DC-DC converter is connected at the **input side** (Battery IN) to the corresponding battery system, for instance to the starter battery of the vehicle.

The desired consumer loads are connected at the **output side** (OUT) to the connections + and –.

The galvanic isolation between input and output side reliably avoids influences of the two electric circuits among each other.

Output voltage:

It is stabilised, smoothed and free from peaks.

The output voltage can be set in 4 stages. Also refer to **Table 2**: "How to set the output voltage for consumer loads".

This paragraph describes 3 fixed, stabilised output voltages.

In the fourth switch position, the rate of the input voltage at the output will be reproduced variably. During this operating mode, also operation of such consumers is advantageous, which get further information from the operating voltage (12 V or 24 V), such as starter battery is charged, driving or stationary mode, automatic disconnection in case of low voltage and battery discharge etc. (small appliances, charging trays, lamps).

Input voltage, control of the DC-DC converter:

Control input "ON/OFF":

The unit is activated with this input. The 12 V (24 V) signal is supplied or it is switched-off completely without signal.

For automatic operation with running motor, the D+ signal of the active generator is preferably to be used. If this signal does not exist (in modern vehicles), the signal "Ignition ON" (terminal 15) can be used for automatic unit control.

Combined with a simple OFF switch, a vehicle main switch or similar, the control of the DC-DC converter can be realised also manually via this input, if required.

Voltage Input "Sense Battery":

This input continuously supervises the input voltage of the battery with activated DC-DC converter.

The switching-on and switching-off voltage rates can be set in 4 stages. Also refer to **table 3**: "How to set the input voltage rate (battery control)".

This paragraph indicates the delay times of the switching thresholds against short voltage fluctuations and malfunctions.

Operating Modes:

The combination of **control input** and **voltage** input allows different modes of operation.

In any case, **both** inputs must be connected (see connection plan).

The unit is automatically switched-**on**, as soon as voltage is supplied to the control input "ON/OFF" **and** the voltage at the voltage input “Sense Battery“ is higher than the set voltage rate “"ON".

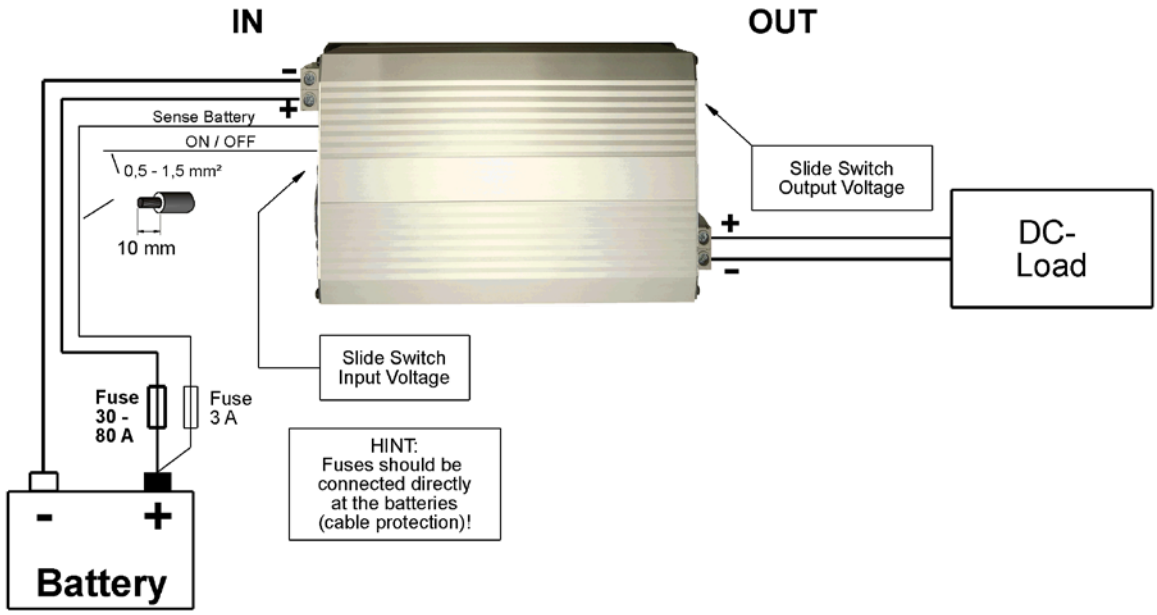
The unit is automatically switched-**off**, as soon as voltage at the control input "ON/OFF" is missing **or** the voltage at the voltage input “Sense Battery“ is lower than the set voltage rate "OFF".

The delay times avoid a premature reaction to voltage peaks or voltage drops.

Thus, the DC-DC converter can be activated by ignition ON, and the operation with the voltage rate, which had been set correspondingly high, will not be started, before the starter battery has reached a certain voltage level (charge). If the voltage rate is set low, the transformer would start the operation immediately.

A mere voltage-controlled operating mode is also possible. This mode is activated, if a plus signal is continuously supplied to the control input "ON/OFF" (unit in stand-by mode) and the DC-DC converter is only controlled by the operating voltage. This is advisable, if a further control signal is not available. Please observe the higher current requirement during stand-by mode!

Connection Plan:



First connect the DC-DC converter, after that the battery.

Table 1: Cable cross-sections at the input side "Battery IN":

Cable Cross-Section +/- Pole	DCDC 1212-45	DCDC 1224-25	DCDC 2412-25	DCDC 2412-45
6 mm²	-	-	up to 11.0 m	-
10 mm²	up to 5.0 m	up to 5.0 m	up to 18.0 m	up to 10.0 m
16 mm²	up to 8.0 m	up to 8.0 m	-	up to 16.0 m

Tightening torque 1,2 Nm!

Information Ground Connection:
Input "IN" and **output "OUT"** of the unit are separated by **galvanic isolation**, i. e. there is no conductive connection between the minus and plus connections from input to output. Thus, the terminal (-) minus load out can again be connected at any location near the consumer loads to the (-) ground of the vehicle, (roll) container or similar. This prevents falsification of the voltage on the ground and ensures neat, undisturbed ground ratio.

Installation Output: OUT (Output Voltage for Consumer Loads):

1. The **correct polarity (+ and -) must imperatively be observed**! Incorrect polarity will destroy the consumer loads.
2. Observe, that the cable cross-sections for the consumer loads are sufficient (manifold, 4-6 mm² for execution 25 A, 10 mm² for execution 45 A).
3. Connect the terminal (-) minus load out with the "new" ground, if required (refer to the information ground connection).
4. The unit output is short circuit-proof and overload-proof.
5. **Slide Switch "Output Voltage":** Select 1 of 4 output voltage rates for the consumer loads for the start-up of the unit, see **table 2**.

Installation Input: Battery IN (Supply Voltage):

1. The **correct polarity (+ and -) must imperatively be observed**! **Incorrect polarity will destroy the unit!**
2. Observe, that the **cable cross-sections** are **sufficient** (see **table 1**)!
3. Insert **fuses** for protection of the connection cables.
4. **Terminal "Sense Battery":**
   Must be connected, since the battery voltage for automatic unit control is measured. Therefore, imperatively lead separate voltage sensor lines "Sense" to the + battery in case of long connection cables. In case of short, strong cables "Sense Battery" can also be connected directly to the (+) plus terminal "Battery IN".

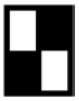
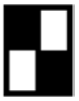
5. **Terminal "ON/OFF":**

   Must be connected, since the unit is activated with it. For instance, for automatic activation preferably with D+ for active generator or ignition "ON" (terminal 15) or similar, or manually with the plus signal of a dashboard switch, vehicle main switch or similar. In case of voltage control of the unit exclusively by the battery voltage, the terminal must be connected directly to the terminal "Sense Battery".

6. **Slide Switch "Input Voltage":** Select 1 of 4 connection voltage rates for the start-up of the unit, see **table 3**.

Table 2: How to set the output voltage for consumer loads

Move the **2 slide switches LOAD OUT** at the front panel to the desired position using a small screw-driver.

Switch Position **"Output Voltage"**	 **1**	 **2**	 **3**	 **4**, see Information *
Output Voltage **Output 12 V**	**12.5 V**	**13.0 V**	**13.5 V**	**equals Vin** with input 12 V **equals Vin / 2** with input 24 V
Output Voltage **Output 24 V**	**25.0 V**	**26.0 V**	**27.0 V**	**equals Vin x 2** with input 12 V **equals Vin** with input 24 V

Information *, Operating Mode 4:

In this switch position, the output voltage is not fixed to a fixed value, but it is calculated from the input voltage and put out. The DC-DC converter reproduces a 12 V/24 V battery and is thus able to indirectly communicate information, such as battery charge, battery low voltage, deep discharge, overvoltage etc., from the input side to the connected consumer loads. However, for protection of the consumer loads, the output voltage will always be limited to max. 15.0 V or 30.0 V, also with higher input voltage rates.

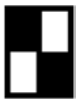
DCDC 1212-: The output voltage equals the input voltage and it is limited to max. 15.0 V.

DCDC 1224-: The output voltage is twice as high than the input voltage and it is limited to 30.0 V.

DCDC 2412-: The output voltage is half as high as the input voltage and it is limited to max. 15.0 V.

Table 3: How to set the input voltage, terminal "Sense Battery"

Move the **2 slide switches BATTERY IN** at the rear panel to the desired position using a small screw-driver.

Switch Position **"Input Voltage"**					
Input 12 V Voltage thresholds and delay	**ON**	**11.8 V / 2 s**	**12.8 V / 2 s**	**13.2 V / 2 s**	**13.5 V / 2 s**
	OFF	**10.6 V / 10 s**	**11.8 V / 10 s**	**12.6 V / 10 s**	**12.9 V / 10 s**
Input 24 V Voltage thresholds and delay	**ON**	**23.6 V / 2 s**	**25.6 V / 2 s**	**26.4 V / 2 s**	**27.0 V / 2 s**
	OFF	**21.2 V / 10 s**	**23.6 V / 10 s**	**25.2 V / 10 s**	**25.8 V / 10 s**
Battery Load		The battery capacity can be used completely until the discharge; the unit is to be controlled with the signal at the terminal "ON/OFF"	The battery will only be discharged to such a level, that the starting capacity is still ensured, even if the signal at terminal "ON/OFF" is still available.	The battery will only be discharged slightly, even if the signal at terminal "ON/OFF" is still available.	No battery discharge. The DC-DC converter will only be operating in case of battery charging; the signal at terminal "ON/OFF" only serves as main switch.

Start-up and Function Test:

After the connection has been executed, the DC-DC converter is ready for operation and the functions can be tested.

Depending on the chosen installation, activation of the unit is effected either by motor start (D+), ignition on (terminal 15) or actuation of an external switch.

This is indicated by the red LED "Power" and a short running test of the unit fan.

In order to be able to supply the output voltage, the battery voltage of the DC-DC converter must now be higher than the value "Input Voltage", which had been set via the slide switch. After that, the LED "IN" will be lighting.

If this is the case, the output voltage, which had been set by means of the two slide switches "Output Voltage", will be generated and the LED "OUT" will be lighting.

The supplied output capacity is indicated by the three LEDs "Overload, < 100%, <50% (see Pilot Lamps).

Option: Several Consumer Loads at the Output OUT:

Operation or parallel connection of several consumer loads at the output is admissible.
But it is to be observed, that the total power consumption **does not** exceed the maximum admissible total current rate.

Further actions or maintenance of the unit are not required.

Pilot Lamps:

"< 50%" (Capacity display, **green**)**:**

- If it is on: The load of the DC-DC converter is less than 50 % output capacity.

"< 100%" (Capacity display, **yellow**)**:**

- If it is on: The load of the DC-DC converter is in the range between 50 and 100 % output capacity .

"**Overload**" (Capacity display, **red**)**:**

- If it is on: The DC-DC converter is operated in the overload range.
  Reduce the consumer load for the long term, since there will be a reduction to 100 % nominal capacity after approx. 5 s.

"IN" (Input voltage, **yellow**)**:**

- If it is on: The DC-DC converter is activated and the input voltage is sufficient.
- Off: Disconnection of the battery protection:
  The battery voltage is below the set voltage "Input voltage" or it exceeds the maximum admissible voltage at the input.
  The operation will be restarted automatically after exceeding the set voltage rate or after the overvoltage at the input had been dropped to an admissible value.

"OUT" (Output voltage, **yellow**)**:**

- If it is on: Output side Load OUT is active and works faultlessly.
- If it is flashing: Disconnection unit protection:
  The DC-DC converter had been switched-off due to overvoltage at the output. Check for possible external voltage supply. Automatic reconnection is effected after drop of the output voltage to the nominal value.
- Off: Output is switched-off.

"Power" (Function, **red)**:

- If it is on: The DC-DC converter has been activated by a signal at terminal "ON/OFF" and is ready for operation.
- If it is flashing: The unit detected, that the inside temperature was too high and has switched-off. Check the consumer load or installation (ventilation).
  Or a wrong polarity of external voltage had been detected at the output.
- Off: Unit has been switched-off completely.

Operating Instructions:

- **Overvoltage limitation, overvoltage protection of the consumers:**
  The DC-DC converter protects itself and the connected consumer loads against excessive output voltage. This might also be caused by external power supply or other failures.
  The output of the DC-DC converter will be switched-off after approx. 2 s.
  During the operating mode "4", see table 2, the output voltage will always be limited to max. 15.0 V (30.0 V) for protection of the consumer loads.
- **Overvoltage protection at the input of the DC-DC converter:**
  The DC-DC converter is immediately switched-off, if the max. admissible input voltage is exceeded.
- **Overload / Overheating Protection:**
  The DC-DC converter is equipped with a double electronic protection against overload and with an automatic protection against adverse installation conditions (e. g. insufficient ventilation, excessive ambient temperatures) by gradual reduction of the output capacity.

Technical Data	**DCDC 1212-45**	**DCDC 1224-25**
Input Battery IN:		
Nominal Voltage Battery Input:	12 V	12 V
Recommended Battery Capacity min.:	60 Ah	60 Ah
Nominal Power Consumption max.:	730 W	800 W
Power Consumption, short-time, max.:	960 W	1040 W
Nominal Current Draw:	53 A	58 A
Current Draw, short-time, max.:	70 A	75 A
Current Draw: "OFF", "ON/OFF" without signal:	0.6 mA	0.6 mA
During Stand-by: „Sense Battery“ low, "ON/OFF" with signal:	0.08 A	0.08 A
Active without Load: „Sense Battery“ high, "ON/OFF" with signal:	0.44 A	0.42 A
Four (4) Adjustable Voltage Thresholds "ON":	See table 3	See table 3
Delay "ON":	2 s	2 s
Four (4) Adjustable Voltage Thresholds "OFF":	See table 3	See table 3
Delay "OFF":	10 s	10 s
Voltage Operating Range Contin.:	10.6 V - 16.0 V	10.6 V - 16.0 V
Voltage Operating Range, Short-time 10 s:	9.0 V - 16.0 V	9.0 V - 16.0 V
Output OUT:		
Nominal Voltage:	12 V	24 V
Three (3) Adjustable Output Voltage Rates:	See table 2	See table 2
Output Voltage Variable In Operating Mode 4 "Uin":	10.6 V - 15.0 V	21.2 V - 30.0 V
Ditto short-time 10 s:	9.0 V - 15.0 V	18.0 V - 30.0 V
Output Current max. Duration:	45 A	25 A
Output Current Peak max. Short-time 5 s:	58 A	33 A
Ripple Factor Voltage:	< 30 mV rms	< 50 mV rms
Protection against Short Circuit/Overload/Overtemp.:	Yes	Yes
Fitting Position of Unit:	any	any
Temperature Range:	-20 / +45 °C	-20 / +45 °C
Speed-controlled, temperature-controlled Fan:	Yes	Yes
Grad. Reduction in Case of Overtemperature:	Yes	Yes
Safety Disconnection in Case of Overheating:	Yes	Yes
System of Protection	IP 2X	IP 2X
Weight:	1800 g	1800 g
Dimensions incl. mounting flanges/feet, without connections:	270 x 139 x 74 mm	
Ambient Conditions, Humidity of Air:	max. 95 % RH, no condensation	
Tightening Torque Terminal Screws “IN” and “’OUT”:	1.2 Nm	
Tightening Torque Terminal “ON/OFF” and “Sense Battery”:	0.5 Nm	

Declaration of Conformity:

In accordance with the provisions of the statutory requirements and the relevant directives, Electrical Equipment (Safety) Regulations 2016, Electromagnetic Compatibility Regulations 2016, The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 this product complies with the following standards or normative documents:
BS EN55014-1; BS EN61000-6-1; BS EN61000-4-2; BS EN61000-4-3; BS EN61000-4-4; BS EN60335-1; BS EN50498, BS EN IEC 63000.

Technical Data	**DCDC 2412-25**	**DCDC 2412-45**
Input Battery IN:		
Nominal Battery Voltage Input:	24 V	24 V
Recommended Battery Capacity min.:	50 Ah	50 Ah
Nominal Power Consumption max.:	400 W	730 W
Power Consumption, Short-time, max.:	530 W	960 W
Nominal Current Draw max.:	15 A	26 A
Current Draw, short-time, max.:	22 A	35 A
Current Draw: "OFF", "ON/OFF" without signal:	0.8 mA	0.8 mA
During Stand-by: „Sense Battery“ low, "ON/OFF" with signal:	0.07 A	0.08 A
Active without Load: „Sense Battery“ high, "ON/OFF" with signal:	0.22 A	0.28 A
Four (4) Adjustable Voltage Thresholds "ON":	See table 3	See table 3
Delay "ON":	2 s	2 s
Four (4) Adjustable Voltage Thresholds "OFF":	See table 3	See table 3
Delay "OFF":	10 s	10 s
Voltage Operating Range Contin.:	21.2 V - 32.0 V	21.2 V - 32.0 V
Voltage Operating Range, Short-time 10 s:	18.0 V - 32.0 V	18.0 V - 32.0 V
Output OUT:		
Nominal Voltage:	12 V	12 V
Three (3) Adjustable Output Voltage Rates:	See table 2	See table 2
Output Voltage Variable In Operating Mode 4 "Uin":	10.6 V - 15.0 V	10.6 V - 15.0 V
dito short-time 10 s:	9.0 V - 15.0 V	9.0 V - 15.0 V
Output Current max. Duration:	25 A	45 A
Output Current Peak max. Short-time 5 s:	33 A	58 A
Ripple Factor Voltage:	< 30 mV rms	< 30 mV rms
Protection ag. Short Circuit/Overload/Overtemp.:	Yes	Yes
Fitting Position of Unit:	any	any
Temperature Range:	-20 / +45 °C	-20 / +45 °C
Speed-controlled, temperature-controlled Fan:	Yes	Yes
Grad. Reduction in Case of Overtemperature:	Yes	Yes
Safety Disconnection in Case of Overheating:	Yes	Yes
System of Protection	IP 2X	IP 2X
Weight:	1450 g	1800 g
Dimensions incl. mounting flanges/feet, without connections:	270 x 139 x 74 mm	
Ambient Conditions, Humidity of Air:	max. 95 % RH, no condensation	
Tightening Torque Terminal Screws “IN” and “’OUT”:	1.2 Nm	
Tightening Torque Terminal “ON/OFF” and “Sense Battery”:	0.5 Nm	

Declaration of Conformity:
In accordance with the provisions of Directives 2014/35/EU, 2014/30/EU, 2009/19/EC, this product complies with the following standards or normative documents:
EN55014-1; EN61000-6-1; EN61000-4-2; EN61000-4-3; EN61000-4-4; EN60335-1; EN50498.

The product must not be disposed of in the household waste.

The product is RoHS compliant. It complies with the directive 2015/863/EU for Reduction of Hazardous Substances in electrical and electronic equipment.

Quality Management System
DIN EN ISO 9001

Recycling:
At the end of its useful life, you can send us this device for professional disposal:
You can find more information about this on our website at **www.votronic.de/recycling**

Delivery Scope:
1 DC-DC Converter
1 Installation and Operating Manual

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