AEG

Power supply systems

Operating Instructions
Switch Mode Power Supply
DC 1000 CAN
24/48/60 VDC

AEG Power Supply Systems GmbH
Department: PSS V131
Name: Gleitsmann / Schenuit
Revision: 01
Date: 13.09.2005

Table of Contents

Notes on these Operating Instructions

Duty to provide information

These operating instructions must be read carefully by all persons working with or on the switch mode power supply prior to installation and commissioning.

These operating instructions are a composite part of the switch mode power supply.

The owner of this unit is obliged to communicate the full content of these operating instructions to all personnel transporting or starting the switch mode power supply or performing maintenance or any other work on the unit.

Validity

These operating instructions comply with the current technical specifications of the switch mode power supply at the time of publication. The contents do not constitute a subject matter of the contract, but serve for information purposes only.

AEG reserves the right to make modifications with regard to contents and technical data in these operating instructions without prior notification. AEG cannot be held liable for any inaccuracies or inapplicable information in these operating instructions, as no obligation to continuously update the data and maintain their validity has been entered into.

Warranty

Our goods and services are subject to the general conditions of supply for products of the electrical industry, and our general sales conditions. We reserve the right to alter any specifications given in these operating instructions, especially with regard to technical data, operation, dimensions and weights. Claims in connection with supplied goods must be submitted within one week of receipt, along with the packing slip. Subsequent claims cannot be considered.

AEG will rescind all obligations such as warranty agreements, service contracts, etc. entered into by AEG or its representatives without prior notice in the event of maintenance and repair work being carried out with anything other than original AEG parts or spare parts purchased from AEG.

Handling

These operating instructions for the switch mode power supply are structured so that all work necessary for start-up, maintenance and repair of the unit can be performed by qualified personnel.

Illustrations are provided to clarify and facilitate certain steps.

If danger to personnel and equipment cannot be ruled out in the case of certain work, it is highlighted accordingly by pictograms explained in chapter 1, Safety Regulations.

Abbreviations

The following abbreviations are used in these operating instructions:
SMPS = Switch Mode Power Supply
PSC = Power Supply Controller

Hotline

Our service department is available on the hotline number given below:

AEG Power Supply Systems GmbH
Emil-Siepmann Strasse 32

D-59581 Warstein
Germany

☎ +49 (2902) 763 100

FAX +49 (2902) 763 680

http://www.aegpss.de

Copyright

1. Safety Regulations!

1.1 Important Instructions and Explanations

The instructions for operation and maintenance, as well as the following safety regulations must be complied with to ensure the safety of personnel as well as the continued availability of the unit. All personnel installing/dismantling, starting up, operating or servicing the units must be familiar with and observe these safety regulations. Only trained and qualified personnel may perform the work described, using tools, equipment, test equipment and materials intended for the purpose and in perfect working condition.

1.2 Accident Prevention Regulations

Compliance with the accident prevention regulations valid in the respective country of use and the general safety regulations in accordance with IEC 364 is mandatory.

The following must be observed prior to any work on the switch mode power supply:

- **Disconnect the unit from the power supply.**
- **Secure against reclosing.**
- **Verify that the unit is disconnected from the power supply.**
- **Earth and short circuit the unit.**
- **Provide protection by covers or barriers for any neighbouring live parts.**

1.3 Danger during Maintenance and Repair Work

CAUTION:
The voltage applied to the unit can be fatal. Prior to start-up and/or maintenance work, always **disconnect** the unit **from the power supply** and secure the unit **against reclosing**. The capacitors must be discharged. Free-standing and movable components can protrude into the work area and cause injuries.

ATTENTION:
Considerable damage can be caused to equipment if **unsuitable spare parts** are used for repair work, if work is carried out by unauthorised personnel, or the safety regulations are not observed.

NOTE:
Only trained and qualified personnel (refer to chapter 1.4) may work on or in the vicinity of the unit while **strictly observing** the **safety regulations**.

1.4 Qualified Personnel

The switch mode power supply may only be transported, installed, connected, started up, serviced and operated by qualified personnel who are familiar with the pertinent safety and installation regulations. All work performed must be inspected by responsible experts.

The qualified personnel must be authorised by the responsible safety officer of the installation to perform the work required.

Qualified personnel is defined as personnel

- having completed training and gained experience in the respective field,
- familiar with the pertinent standards, rules and regulations and accident prevention regulations,
- having received instruction on the mode of operation and operating conditions of the switch mode power supply,
- capable of recognising and preventing dangers.

Regulations and definitions for qualified personnel can be found in DIN 57105/VDE 0105 Part 1.

1.5 Safety Awareness

The personnel defined in chapter 1.4 are responsible for safety. They must also ensure that only suitably qualified persons are permitted to be in the proximity of the unit or permitted access to the safety area.

The following points must be observed:

All working procedures which are detrimental to the safety of persons and the operation of the switch mode power supply **in any way** are prohibited.

The unit may only be operated in perfect working condition.

Never remove or render inoperable any safety devices.

All necessary operational measures must be initiated prior to deactivating any safety device in order to perform maintenance, repair or any other work on the unit.

Safety awareness also entails informing colleagues of any unsuitable behaviour and reporting any faults detected to the respective authority or person.

1.6 Application

The switch mode power supply is designed for use in power supply systems and may only be used for a power supply in the described installation position and operating mode with the maximum permissible connection values as specified in these operating instructions. The unit may only be used for this intended purpose. It is not permitted to make any unauthorised modifications to the unit or to use any spare parts or replacement parts not approved by AEG, or to use the unit for any other purpose.

The person responsible for the installation must ensure that

- the safety instructions and operating instructions are readily available and are complied with,
- the operating conditions and technical data are observed,
- safety devices are used,
- the prescribed maintenance work is performed,
- maintenance personnel is informed without delay or that the unit is shut down immediately in the event of abnormal voltages or noise, high temperatures, vibrations or any similar effects, in order to detect the cause.

These operating instructions contain all the information required by qualified personnel for operating the unit. Additional information and explanations for unqualified persons and for the use of the unit in non-industrial applications are not included in these operating instructions.

The warranty obligations of the manufacturer are only applicable if these operating instructions are observed and complied with.

1.7 Liability

No liability is accepted if the switch mode power supply is used for applications not intended by the manufacturer. Any necessary measures for the prevention of injury or damage to equipment are the responsibility of the owner or user. In the event of any claims in connection with the switch mode power supply, please contact us quoting:

- Type designation
- Works number
- Reason for claim
- Period of use
- Ambient conditions
- Operating mode

1.8 Directives

The switch mode power supply units comply with the currently applicable DIN and VDE regulations. VBG4 is met on the basis of compliance with VDE 0106 Part 100.

The requirements of VDE 0100 Part 410, "Functional extra-low voltage with safe isolation", have been complied with where applicable.

The CE sign on the unit confirms compliance with the EC outline directives for 73/23 EEC – Low voltage and for 89/339 EEC – Electromagnetic compatibility if the installation and start-up instructions described in the operating instructions are observed.

2. General Information

2.1 System Description

The DC 1000 CAN switch mode power supply provides an output power of approx. 1 kW.
Typical applications include use as a DC power supply unit. In this case, it is possible to have positive earthing, negative earthing, earthing of the battery centre or even a non-earthed DC input or output busbar. The SMPS is a preassembled unit ready for connection.

The SMPS is intended for connection to a DC power supply system with 110 VDC or 220 VDC. There is electrical isolation between the DC input, the DC output as well as all signal terminals and serial interfaces.

The switch mode power supply can be operated both as a stand-alone unit and in parallel with several SMPS units of the same type. The characteristic curve slope of the output voltage results in an even current distribution.

The switch mode power supply works following a CVCC curve in acc. with DIN 41772 or DIN 41773.

The connections, DC input, DC output, a remote control input Remote OFF and a potential-free changeover contact for indicating faults can be accessed from the front. Furthermore, the front of the unit also features an RS232 service interface and a CAN bus interface. Several SMPS units can be controlled and monitored by a master control unit, the PSC100, by means of a CAN bus. The PSC100 offers many features, including a changeover of characteristic curves, charge voltage adjustment depending on the battery temperature, etc.

The display elements, LEDs for charging and fault messages, are installed in the front of the unit.

It is possible to view a data logger with a PC via the service interface.

Due to its excellent efficiency, the SMPS is of compact design as a 19 inch rack with 2 height modules.

The unit is ready for installation in module racks in accordance with DIN 41494.

2.2 Type Overview DC 1000 CAN

Type designation	Connection voltage	Output voltage	Output current
G110 G24/30 BWrg-Cpü	110 VDC	24 VDC	30 A
G220 G24/30 BWrg-Cpü	220 VDC	24 VDC	30 A
G110 G48/15 BWrg-Cpü	110 VDC	48 VDC	15 A
G110 G60/15 BWrg-Cpü	110 VDC	60 VDC	15 A
G220 G48/15 BWrg-Cpü	220 VDC	48 VDC	15 A
G220 G60/15 BWrg-Cpü	220 VDC	48 VDC	15 A

Table 1 Type overview DC 1000 CAN

2.3 Principle of Operation, Electrical

The switch mode power supply is powered by a DC voltage mains. A soft-start device limits the input current to the nominal current of the unit. Transistors generate a 80 kHz AC voltage from the rectified and stepped-up voltage. With the aid of a transformer, the following is accomplished:

- electrical isolation,
- voltage adjustment to the secondary side.

The 80 kHz AC voltage on the secondary side is rectified by diodes. The voltage ripple is reduced using a downstream output filter. The output voltage and output current are controlled via pulse-width modulation by the transistor switches on the primary side.

Power derating protects the SMPS from thermal overload if the heat sink temperature is too high.

The SMPS controls the voltage at the unit output terminals. The voltage step inclination of the CVCC curve is 1% in order to distribute the current between units connected in parallel. An SMPS Tool makes it possible to alter all the important operating parameters, such as the output voltage and output current, as well as various monitoring limit values.

On the front of the unit are located a green "Charging" LED and four red LEDs: "Fault", output overvoltage "U_O>", output undervoltage "U_O<" and overtemperature "Temp.>". A potential-free changeover contact configured as an open-circuit fault contact is used for signalling faults to remote equipment. There is a time delay between the "Fault" LED and the relay.

All control modules are powered by an auxiliary power supply which is in turn powered from the DC input side.

The SMPS is equipped with an isolated RS232 service interface operating close to the earth potential. This X13 interface enables the SMPS to be operated using a conventional PC and an SMPS Tool. Operation is described in detail in separate operating instructions.

The CAN interface is also potential-free and close to the earth potential. It makes it possible to connect several SMPS units in a system to a central controller, the PSC100. This control unit controls and monitors all connected SMPS units and forms the basis for active current distribution control. Furthermore, a central fault signal is generated. Simple wiring using the CAN bus ensures that the system can be set up quickly and tested in a straightforward manner. In operation with a PSC100, all SMPS units connected to the system must have addresses between 1 and 31; when operating without a PSC100, however, the SMPS address must always be set to 0. The address is set using the SMPS Tool. Operation and settings using the PSC100 are described in detail in separate operating instructions.

The unit can be switched off by jumpering X18.1 – X18.2 using a floating X18 Remote OFF control input.

The complete circuit diagram on the next page shows the functional units described here.

2.4 Complete Circuit Diagram

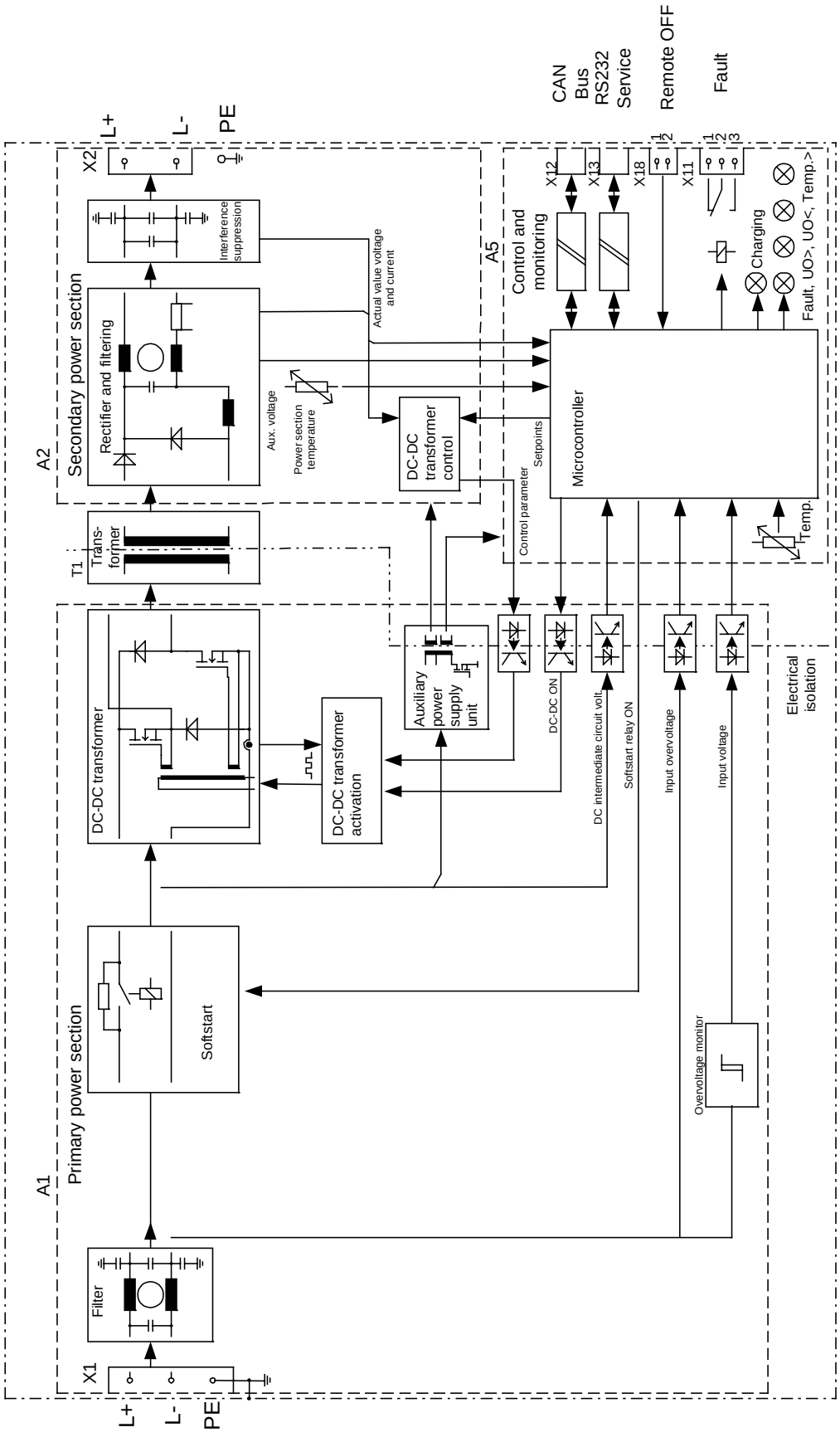

Figure 1 Complete circuit diagram DC 1000 CAN

3. Functional Description of the Unit

The respective unit settings can be found in the Technical Data Sheet (refer to chapter 8).

3.1 Input

The switch mode power supply DC 1000 CAN is operated on a 110 VDC or 220 VDC system. The SMPS can achieve its nominal output within the limits specified in the technical data.

The input is protected against short-circuits outside the unit. Protection must therefore be provided individually for each rack. It is essential to comply with the nominal amperage and fuse protection characteristics specified in the technical data!

An integrated run-up stage limits the making current of the switch mode power supply to a value smaller than the nominal input current.

CAUTION:
The unit must not be operated unearthed for safety reasons!

The auxiliary power supply of the SMPS starts operating when an input voltage is applied. The auxiliary power supply provides power to all electronics modules; the LEDs display the unit status and the SMPS can be operated via the serial interfaces.

3.2 Output / Characteristic Curve

The SMPS output is electrically isolated from the DC input, the interfaces and the fault relay contact. This means operation is possible with non-earthed DC voltage, an earthed positive pole or an earthed negative pole.

The output curve is a CVCC curve in accordance with DIN 41772 with approx. 1% voltage step inclination. Due to the inclination, the load can be distributed quite evenly when several SMPS units are operated in parallel.

The pivot of the inclined curve is at 50% I_{rated}. The nominal value of the output voltage is defined at 50% I_{rated}. The voltage step inclination in relationship to the output current is determined by the hardware.

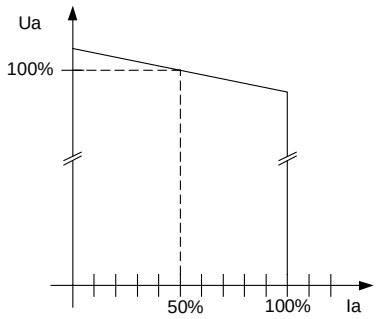

Figure 2 Output curve

3.3 Sequence Control

The auxiliary power supply of the SMPS goes into operation when the input voltage is connected and supplies all electronic modules.

The operating characteristics differ fundamentally according to whether operation is with CAN (address 1 to 31) or without CAN (address = 0).

In **operation without CAN**, the SMPS starts up after the input voltage is applied. However, it does not start up if it has been switched off using the SMPS Tool or via the Remote OFF remote control input. The voltage and current setpoints stored in the SMPS and the monitoring limit values for DC overvoltage and undervoltage are used.

In **operation with CAN**, the SMPS switches on when it receives an "ON" CAN command from the PSC100. However, it does not switch on if it has been switched off via the Remote OFF remote control input and with the SMPS Tool. Switch-on occurs after a 10-second delay if there is no CAN communication. The internal setpoints are used if there is no CAN communication; if CAN communication is functioning, the SMPS operates according to the values specified by the PSC100 control unit.

NOTE:
In operation with PSM/PSC100, the basic values for voltage, current, output overvoltage and output undervoltage monitoring are specified for the SMPS units by the PSM/PSC100.

The SMPS Tool PC software enables the SMPS units to be configured so that individual values will not be overwritten by the PSM/PSC100.

The default setting is that the PSM/PSC100 overwrites the basic values of the SMPS units!

No faults are ever signalled by an SMPS which has input power and is switched off; the monitoring systems are blocked, the fault relay goes over to fault-free status and the LEDs are off. The relay contact is configured as an open-circuit fault signal, i.e. a fault is signalled when it is de-energised. As a result, even a total SMPS failure, e.g. lack of input voltage, is detected. The signalling functions can be configured with the SMPS Tool.

The SMPS changes to the ON status when it is switched ON; the monitoring systems are active. Monitoring covers four different types of faults: Deactivating faults, self-acknowledging faults, signalling faults and faults which trigger a restart.

Deactivating faults cause the SMPS to be switched off permanently. They can only be acknowledged by OFF/ON (input voltage OFF/ON) or using the RESET or unlock functions of the SMPS Tool. An example of this type of fault is output overvoltage.
"Fault" LED flashing quickly

Self-acknowledging faults switch off the SMPS but restart it when the fault is no longer present. An example of this type of fault is input overvoltage.
"Fault" LED permanently lit

Signalling faults do not influence the control of the SMPS although a fault signal is generated. An example of this type of fault is output undervoltage.
The "Fault" LED flashes briefly with long pauses.

Faults which trigger a restart generate a hardware reset and restart the unit. The unit returns to its previous status.
The "Fault" LED and "Charging" LEDs flash alternately.

All faults activate the "Fault" LED and the fault signalling relay. All faults can be acknowledged by switching the unit OFF (input voltage OFF) or using the RESET or Unlock functions of the SMPS Tool.

The green "Charging" LED comes on when the unit is supplying output current.

The LEDs on the front of the unit have the following functions:

green	Charging (flashes if derating)
red	Fault (collective fault)
red	U_O< (output undervoltage)
red	U_O> (output overvoltage)
red	Temp.> (overtemperature)
Red, flashing	(Temp.>) - no CAN communication (only with addr. 1 to 31)
Red ("Fault") / green ("Charging") flashing alternately	Program fault (watchdog error)
Red ("Fault") / green ("Charging") flashing together	Device address only displayed when the input voltage is applied and the device is in the 'External off' state. The LEDs flash together 1-31 times.

Table 2 LEDs on the front of the unit

The relationships are illustrated in the "Phase diagram of sequence control" chart.

Status 'Unit STOP':
Fault signalling relay: No fault
Output voltage: No

Status 'Unit STOP, fault':
Fault signalling relay: Fault
Output voltage: No

Status 'Unit running':
Fault signalling relay: No fault
Output voltage: YES

Status 'Unit running, fault':
Fault signalling relay: Fault
Output voltage: YES

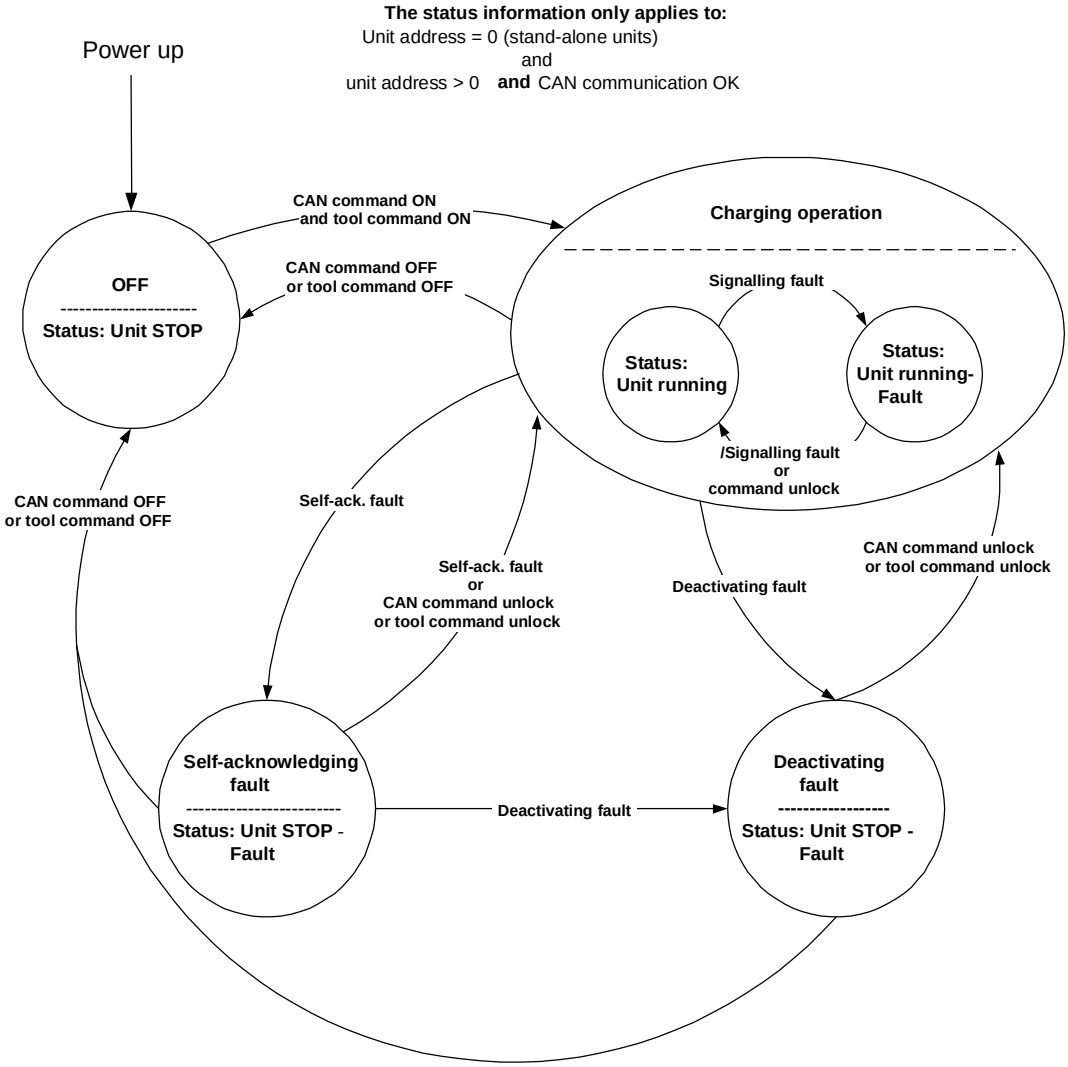

Figure 3 Phase diagram of sequence control

3.4 Monitoring Systems

The monitoring systems are divided into four groups: Deactivating faults set the unit to a STOP and can only be acknowledged by a restart (input voltage OFF/ON) or using the SMPS Tool to perform a RESET or Unlock function. Self-acknowledging faults set the unit to a STOP and start the unit again as soon as the fault is no longer present. Signalling faults only generate a signal; they do not further influence the control sequence of the unit. Various flashing sequences are used in order to differentiate between the monitoring groups using the LED message (see below).
A program fault in the microcontroller causes the unit to restart.

All faults activate the "Fault" LED and the remote fault signal (collective fault). All faults can be acknowledged by a restart. A program fault also requires acknowledgement by switching the input voltage off and back on, or using the SMPS Tools to unlock the unit.

The assignment of the monitoring systems to the fault types is as follows:

Deactivating faults:

"Fault" LED flashing quickly

Output overvoltage
Reference voltage fault (unit monitoring system)
Electronics power supply (unit monitoring system)
Heat sink temperature sensor (unit monitoring system)
Ambient temperature sensor (unit monitoring system)
Intermediate circuit fault (unit monitoring system)

Self-acknowledging faults:

"Fault" LED permanently lit

Undervoltage at input
Overvoltage at input
Heat sink overtemperature
Ambient temperature

Signalling faults:

Brief flashing of the "Fault" LED with long pauses

Output undervoltage
Power circuit faulty
Self-test (unit monitoring system)
CAN bus communication (unit monitoring system)

Monitoring systems which trigger a restart:

Red ("Fault") / green ("Charging") flashing alternately

Program fault = watchdog

3.4.1 Data Logger

The unit contains a data logger that stores all entries in a non-volatile memory. If the data logger is full (max. 100 entries), the entry of longest standing is overwritten. The data logger can be read out and deleted using the BLG-Tool.
Each monitoring function results in an entry in the data logger.

3.4.2 Input Voltage Monitoring System

The input voltage monitoring systems ensure the intrinsic safety of the unit against overloads and overvoltages. The monitoring systems are self-acknowledging. The "Fault" LED lights up if there is a fault. The SMPS "Unit STOP" is set if the input voltage is outside the permitted range.

Input undervoltage monitoring system:

The unit is set to a STOP if the input voltage falls below the minimum level.

Display: "Fault" LED is on
Message: Signalling relay "Fault"

Operation of the unit is restored after a delay when the input voltage once more exceeds the return value.

Input overvoltage monitoring system:

The "Unit STOP" is set if the input voltage exceeds the maximum level. Display: "Fault" LED
Message: Signalling relay "Fault"

Operation of the unit is restored after a delay when the input voltage once more falls below the return value.

3.4.3 Output Voltage Monitoring System

Output overvoltage monitoring system:

The output voltage monitoring system is both deactivating and self-acknowledging. The "Unit STOP" is set on the first occasion that the maximum output voltage is exceeded. The "Fault" and "U_O>" LEDs light up. The fault is acknowledged, the SMPS started and the "Fault" and "U_O>" LEDs are switched off if the voltage falls back below the return value within a certain period of time. However, the SMPS is switched off permanently if the overvoltage continues; the "Fault" LED flashes and the "U_O>" LED remains on. The SMPS "Unit STOP" is set and the unit may be restarted if overvoltage is once again detected following an automatic restart. Following the third switch-off, the "Unit STOP" is set permanently. The "Fault" LED flashes and the "U_O>" LED lights up.

Display: "Fault" and "U_O>" LEDs

Message: Signalling relay "Fault"

The monitoring system can be acknowledged by switching the unit OFF (input voltage OFF/ON). The monitoring limit values can be adjusted. The setting and the setting range are specified in the technical data.

Output undervoltage monitoring system:

The undervoltage monitoring system is a signalling system. A fault is generated if the output voltage falls below the minimum level; the SMPS is unaffected and continues to operate.

Display: "Fault" and "U_O<" LEDs

Message: Signalling relay "Fault"

When the output voltage rises above the return value, the fault is acknowledged. The monitoring limit value can be adjusted.

The green "Charging" LED will also flash if the output undervoltage monitoring system is triggered because the input voltage is too low and the power has to be derated.

3.4.4 Unit Temperature Monitoring System

The temperature in the power section and in the electronics of the unit is measured and monitored for the protection of the SMPS. The power is derated if the temperature exceeds a limit value.

Unit Temperature Monitoring System

If the temperature still continues to rise, the temperature monitoring system sets the SMPS "Unit STOP". This monitoring system is self-acknowledging.

Display: "Fault" and "Temp.>" LEDs lit
Message: Signalling relay "Fault"

The unit restarts and the fault message is acknowledged when the temperature drops back below a return value. In the event of a fault, a check must be performed to ensure that the cooling air temperature and quantity are sufficient. The triggering and return values cannot be altered.

3.4.5 Unit Monitoring Systems

Temperature sensors

This fault is deactivating. The "Unit STOP" is set if there is a cable break or a short circuit on the temperature sensors. No settings can be changed. Check for a discontinuity or short circuit in the sensor cables to the sensors. Fit new sensors if necessary.

Display: "Fault" LED flashes and "Temp.>" LED lights up
Message: Signalling relay "Fault"

The fault is acknowledged by switching the unit OFF/ON.

Reference voltage

This fault is deactivating. The reference voltage monitoring system detects an incorrect response of the internal reference voltage sources on the microprocessor card. The monitoring system sets the unit to a STOP. No settings can be changed.

Display: "Fault" LED flashes
Message: Signalling relay "Fault"

The fault is acknowledged by switching the unit OFF/ON. The SMPS should continue to be observed if it then operates without any faults. Send the SMPS back to the manufacturer if the fault reoccurs.

Power supply to electronics

This fault is deactivating. The monitoring system for the power supply to the electronics detects if there is a fault in the auxiliary power supply voltages and sets the unit to a STOP. No settings can be changed.

Display: "Fault" LED flashes
Message: Signalling relay "Fault"

The fault is acknowledged by switching the unit OFF/ON. The SMPS should continue to be observed if it then operates without any faults. Send the SMPS back to the manufacturer if the fault reoccurs.

Self-test

This monitoring system is a signalling system. When the input voltage is switched on, parameters stored in a non-volatile memory are checked for plausibility. In the event of an error, default values from the program memory are used in order to permit emergency operation of the unit. These values may not correspond to the original settings, so the defective SMPS should soon be replaced and returned to the manufacturer for checking. The "Fault" LED flashes.

The settings cannot be altered.

Display: "Fault" LED flashes
Message: Signalling relay "Fault"

Power circuit faulty

This is a signalling fault. The power circuit monitoring system detects a fault in the SMPS by monitoring an auxiliary voltage in the secondary circuit and in the unit output current. The auxiliary voltage is not backed-up from the DC busbar. Its value will be the same as that of the DC busbar if the unit is operating correctly. If a fault occurs in the power circuit, the auxiliary voltage drops to zero and no output current flows (in contrast to a short circuit).

Display: "Fault" LED flashes
Message: Signalling relay "Fault"

The monitoring system can be acknowledged by switching the unit OFF/ON.

No settings can be changed.

Watchdog

The watchdog monitors the microcontroller program to make sure it is running correctly. In the event of a program fault, a software RESET of the processor is triggered and a restart is generated. The unit behaves in the same way as on start-up following the connection of the input voltage, the only difference being that the signalling fault continues to be active. The program fault is signalled as follows: The red and green LEDs flash alternately.

Display: "Fault" and "Charging" LEDs flash alternately
Message: Signalling relay "Fault"

The monitoring system can be acknowledged by switching the unit OFF/ON.

No settings can be changed.

Communication CAN bus

This monitoring system is only active if a unit address greater than 0 is set, i.e. when operating with the PSC100.
In this operating mode, the control commands and voltage setpoints are received via the CAN bus. If there is no CAN command within a period of more than 10 seconds, the SMPS uses its internally stored value as the nominal voltage. A signalling fault is generated in order to indicate this.
The monitoring system is deactivated if the address is 0.

Display: "Temp.>" LED flashes
Message: Signalling relay "Fault"

3.5 Switching ON / OFF with SMPS Tool

The unit can be operated using the SMPS Tool in the same way as using an ON/OFF switch.
Switching OFF acknowledges all faults (except for the CAN bus fault) and the SMPS switches to fault-free status. In operation without a PSC100 (address = 0), the unit follows the "ON/OFF" control command directly. With a PSC100 (address 1 to 31), the unit can always be switched OFF. However, the SMPS only switches ON when it is switched on both on the SMPS Tool **and** the PSC100.
A unit which is switched off is only off from a logical standpoint; the electronics are still powered up and communication continues without disruption.

The control command from the SMPS Tool is stored in a non-volatile memory in the SMPS. This means the "old" command is still performed even after a hardware reset.
It may be a good idea to switch off a unit if it is being operated using one PSC100 together with several SMPS units, if it should not operate (e.g. backup unit) but is not allowed to generate a CAN bus fault which would be triggered if the SMPS were unpowered!
All SMPS units are delivered in the switched-on status. This means the units operate when the input voltage is applied!

3.6 Parallel Operation

Since the units can be connected in parallel, it is possible to build systems for redundant operation in accordance with the n+1 principle. Due to the inclination of the individual voltage curves, the load can be distributed quite evenly in the case of parallel operation of several switch mode power supply units (±10% of the nominal system current). An important prerequisite is that the unit outputs are connected to the load or the DC busbar with cables of the same cross section and length. Also, the output voltages must be set to the same values.

When operating with a PSC100, active current distribution control ensures that the load is evenly distributed, even when the wiring is unsymmetrical.

Selective DC monitoring of the individual switch mode power supply units is assured even without external decoupling diodes in the output.
If the switch mode power supply units are interconnected in the respective output without decoupling diodes or fuses, the system wiring must be dimensioned for the max. possible current.
When SMPS units are connected in parallel with decoupling diodes in the line to the DC busbar, the diodes should be in the non-earthed pole. The advantage of a system with decoupling diodes is that the cross-sections of the cables to the SMPS units only have to be selected for the current of one SMPS and, if one SMPS in the system fails due to DC overvoltage, there will not be any reverse voltage flowing back to the functioning SMPS units which could possibly damage them.

3.7 CAN Bus Interface X12

CAN bus plug X12 allows the Supervision PSC100 to take over all the control and monitoring systems of the units.

The X12 CAN bus is electrically isolated from other switching components and is kept close to the earth potential by means of resistors.

3.8 RS-232 Service Interface X13

The RS232 interface and a special "SMPS Tool" PC software enable all important operating parameters to be set. In addition, the SMPS can be controlled, faults acknowledged and the data logger can be read out and reset. Operation is described in detail in a separate document.

Interface X13 is electrically isolated from other switching components and is kept close to the earth potential by means of resistors.

3.9 Signalling

The following signals are indicated via LEDs on the front panel of the unit.

Green LED	Charging	Unit can output power, output voltage present
Red LED	Fault	Collective fault
Red LED	U_O<	Output undervoltage
Red LED	U_O>	Output overvoltage
Red LED	Temp.>	Overtemperature

Table 3 Signalling on the front of the unit

Remote signalling is implemented using a potential-free relay changeover contact. It is configured as an open-circuit fault contact. There is a time delay between the "Fault" LED display and the relay signal.
The max. contact load is specified in the technical data.

NOTE:
The SMPS Tool PC software enables the SMPS units to be configured so that individual faults do not affect the fault relay.
The default setting is that all faults activate the fault relay!

ATTENTION:
The relay contact has a gold-plated surface. This means signalling is also possible via "dry circuits", i.e. with low signal voltages and currents. However, applying a higher voltage or current to the relay contact will destroy the gold plating and prevent the signalling function from operating with "dry circuits"!

3.10 Pin Assignments

X1 DC input

Positive L+
Negative L-
Earth conductor

X2 DC output

Positive L+
Negative L-

Protective earth on housing

X11 remote signal, potential-free relay contact

1	NC
2	C
3	NO
"Fault"	In the event of a signal, X11:1 – 2 closes or X11:2 – 3 opens

X18 remote signal input Remote OFF

1
2

Bridge X18:1 – X18.2 switches the unit off

X12 CAN

1, 6, 7	CAN-Gnd
2, 5	R-Gnd
3	CAN-L
4	CAN-H
8,9,10	CAN supply +8 V
11, 12, 13	not used
14, 15	Control line

X13 Service RS-232

1 not assigned
2 TXD
3 RXD
4 not assigned
5 Gnd
6 not assigned
7 not assigned
8 not assigned
9 not assigned

4. Start-Up

4.1 Installation

The switch mode power supply units (SMPS) must be installed in suitable module racks in acc. with DIN 41494.

The SMPS functions with natural air cooling. The supply air temperature must not exceed 45 °C. If several units are installed one above the other in one cabinet, there must be either a forced-air cooling system installed, or a vertical distance between the units of at least 134 mm = 3 height modules must be guaranteed. Air guides must be installed between the installation levels in such a way that the air intake temperature of the individual installation levels does not exceed the permanently permissible ambient temperature. Cabinets must be designed for a maximum ambient temperature of 40 °C. The power loss per unit is approx. 150 W.

4.2 Connection

Before connecting the unit to the DC input voltage, ensure that the voltage given on the nameplate complies with the supplied DC voltage.

The DC input is connected with a 3-pin screw terminal (L+, L-, PE) on the front of the unit (X1). If one pin on the output side is grounded, the SMPS must be grounded via the separate PE connection on the front of the unit. In this case, the PE conductor on the input side must not be connected (ground loops). The cross-section of the PE conductor must be chosen in accordance with VDE 0100 Part 540 depending on the type of installation.

The DC connection is made using screw terminals (X2) on the front of the unit.

If decoupling diodes or fuses are used in the DC output connection, they must be installed in the non-earthed pole.

X11 for remote signalling, X18 for remote switching OFF and X12 CAN bus can be connected if required, however they are not required for operation.

ATTENTION:
Depending on the system configuration, the remote signalling connection may still carry a high voltage even when all other connections have been unplugged from the SMPS!

4.3 Connecting the DC Input / Loads

Prior to commissioning, it is essential to complete all the wiring and to check it! The unit setting must be altered if necessary (see 5.1).
The switch mode power supply has an amplified smoothing module with electrolytic capacitors in the output. Connecting the de-energised capacitors to the DC output busbar by engaging the DC output isolator or the DC output fuse results in a powerful charging current surge which could damage the SMPS. This high charging current should be avoided by switching the unit on before engaging the DC output isolator. This is the only way to ensure the capacitors are charged to the unit output voltage with a high charging stage.

It is only then possible to close the output circuit by engaging the DC output isolator or the DC output fuse.

The output circuit can be closed immediately in the case of units with an external decoupling diode in the connection to the DC output busbar.

ATTENTION:
Observe correct polarity of the DC lines.

4.4 Disconnection

CAUTION:
Even when switched off, the switch mode power supply can carry voltage from charged capacitors and external signals. For this reason, the terminals must be checked prior to dismantling the unit to ensure that they are de-energised.

The capacitors can be discharged using an external resistor on input terminals X1 or output terminals X2.

- Disconnect the input voltage.
- Disconnect the SMPS output from the loads / the battery
- Disconnect interfaces X12 and X13
- Disconnect plugs X11 and X18

5. Operation

The SMPS is delivered with the factory settings listed in the technical data.

5.1 Changing Unit Settings

If other output voltage settings are required or if the monitoring limits are to be changed, the required settings must be made using the SMPS Tool.
The SMPS is equipped with an electrically isolated RS232 service interface operating close to the earth potential. This X13 interface enables the SMPS to be operated with a conventional PC and the SMPS Tool.
For example, the values set for one SMPS can be downloaded, stored in a file and uploaded to other SMPS units. In this way, you can be certain that all the SMPS units in a system have the same settings.
When the SMPS units are operated with the PSC100 central controller, the units must be addressed using the SMPS Tool. Addresses between 1 and 31 are permitted; each address is only allowed to be assigned once in a system! The exact procedure is described in the operating instructions for the PSC100.
Operation of the SMPS Tool is described in detail in separate operating instructions.

ATTENTION:
Setting the SMPS incorrectly can result in (possibly irreparable) damage to the connected loads!

The setting ranges of the SMPS have been set to prevent the SMPS from being damaged.

6. Maintenance

CAUTION:

Disconnect the unit from the power supply prior to all maintenance work. Always observe the safety regulations! (Refer to chapter 1.)

The SMPS is made up of state-of-the-art components which are practically non-wearing. We do, however, recommend regular visual checks and functional tests of the unit to maintain its operational reliability and availability.

When visually inspecting the unit, check whether:

- there is any mechanical damage, or foreign bodies are present,
- any conductive dirt or dust has accumulated in the unit,
- Accumulation of dust affects heat supply and dissipation,

If large quantities of dust have accumulated, the unit should as a precaution be cleaned using dry compressed air, in order to ensure adequate heat dissipation.

The intervals at which visual checks should be performed are largely determined by the site conditions. The unit must not be operated in an aggressive atmosphere.

7. Troubleshooting

CAUTION:
All work on the unit may only be carried out by specially trained qualified personnel. Always observe the safety regulations! (Refer to chapter 1.)

7.1 No Output Voltage Present

- Input voltage present or correct polarity?
- Has the SMPS been switched off using the SMPS Tool?
- Is X18 Remote OFF activated? Disconnect the plug!
- Has the SMPS been switched off using the CAN bus? Disconnect the CAN, perform a hardware reset!
- Incorrect polarity or short circuit on output?
- With parallel operation: Ext. Polarity reversal on decoupling diodes?
- Has the Uo> monitoring system responded ("Uo>" LED is ON)? Perform a hardware reset and check the U_O> setting

If all aforementioned points are OK, proceed as follows:

- Unscrew the cover.
- Observe the safety instructions on the front of the unit!
- Check that the plug connectors are inserted correctly

It the fault cannot be eliminated, return the unit to the works for repair enclosing a fault description.

7.2 Output Voltage Deviation

- Is the unit operating with current limitation due to overload? Reduce the load!
- Is the unit operating with derating because the ambient temperature is too high?
  Improve the cooling!
- Is the U_O setting incorrect?
  Adjust the output voltage!

8. Technical Data

8.1 General Technical Data

Making current.....< nominal input current

Characteristic curve.....CVCC curve in acc. with DIN 41772 or 41773

Manufacturing and type test .....In acc. with DIN 60146 Part 1-1

Emitted interference to EN 61000-6-3

- Conducted interference .....In acc. with EN 55011/55022
  Input class "A"
  Output class "A"

- Emission .....In acc. with EN 55011/55022
  Class "B"

Immunity to interference in acc. with EN 61000-6-2

- Housing.....ESD test in acc. with EN 61000-4-2
  4 kV contact, 8 kV air discharge
  HF field in acc. with EN 61000-4-3
  10 V/m (80 MHz - 1 GHz)

- Power cables.....Burst test in acc. with
  EN 61000-4-4, 2 kV
  Surge test in acc. with
  EN 61000-4-5,
  0.5 kV asymmetrical;
  0.5 kV symmetrical
  Conducted HF 10 V
  in acc. with EN 61000-4-6

- Control cables .....Burst test in acc. with
  EN 61000-4-4, 1 kV
  Surge test in acc. with
  EN 61000-4-5, 1 kV asymmetrical
  Conducted HF 10 V
  in acc. with EN 61000-4-6

Extra-low voltage.....With safe isolation
in acc. with EN 50178

Dynamic response.....≤ 5% with sudden load fluctuations between 10% - 90% - 10% rated output current (adjustment time t < 1 ms)

Short circuiting.....Resistant to continued short circuits, 1 x nominal output current

Messages and displays	- Charging green LED - Fault red LED - U_o< red LED – U_o> red LED ⁻ Temp.> red LED - Fault message via potential-free relay contact. Message delay 10 seconds Max. contact load: 24 VDC 8 A 110 VDC < 0.4 A 220 VDC < 0.2 A 250 VAC < 8 A Min. contact load: 5 VDC 100 mA
Parallel operation	Max. 31 units when connected to a CAN bus, load distribution approx. 10% of nominal current
Design	19" x panel mounting unit for installation in module racks in acc. with DIN 41494
Protection class	IP 20
Cooling	Convection cooling
Ambient temperature	At U_o nom. and I_o nom. 0 °C to 45 °C for individual unit 0 °C to 40 °C for cabinet installation
Storage temperature	-20 °C to +70 °C
Ambient conditions	IEC 721 Part 3-3 Class 3K3 / 3Z1 / 3B1 / 3C2 / 3S2 / 3M2
Site altitude	Up to 1,000 m above sea level
Mechanical stability	
Surface painted with	RAL 7032 (front panel)
Dimensions (W x H x D)	483 x 88.8 x 212 mm (19" x 2 height modules)
Weight	approx. 5.0 kg

Connection system

DC input X1: ..... Screw terminals, 3-pin
Connection cross section:
0.5 - 10 mm^2 rigid
0.5 - 6 mm^2 flexible
AWG 20 - 7

DC output X2: ..... Screw terminals, 2-pin
Connection cross section:
0.5 - 10 mm^2 rigid
0.5 - 6 mm^2 flexible
AWG 20 - 7

Messages X11: ..... CombiCon type
MSTB 2.5/3-ST-5.08, 3-pin
Connection cross section:
0.5 - 2.5 mm^2 rigid
0.5 - 2.5 mm^2 flexible
AWG 22 - 12

Remote OFF X18: ..... CombiCon type
MSTB 2.5/2-ST-5.08, 2-pin
Connection cross section:
0.5 - 2.5 mm^2 rigid
0.5 - 2.5 mm^2 flexible
AWG 22 - 12

PE conductor: ..... M4 thread

CAN bus interface X12: ..... 16-pin female connector
Manufacturer e.g. Thomas & Betts
No. 622-1641

RS-232 service interface X13: ..... 9-pin SUB-D socket

8.2 Technical Data of the DC 1000 CAN Series

Type	**G110 G24/30 BWrg-Cpü**	**G220 G24/30 BWrg-Cpü**	**G110 G48/15 BWrg-Cpü**
E-number	3000000754	3000000755	3000000756
Nominal connection voltage	110 VDC -23% +30%	220 VDC -23% +30%	110 VDC -23% +30%
Nominal current consumption	approx. 8.3 A DC	approx. 4 A DC	approx. 8.5 A DC
Necessary mains fuse	12 A	6 A	12 A
Output voltage Value set	26.76 VDC ±1%	26.76 VDC ±1%	53.52 VDC ±1%
Setting range	20 to 30 VDC	20 to 30 VDC	40 to 60 VDC
Output current Value set	30 A DC ±2%	30 A DC ±2%	15 A DC ±2%
Setting range	1.5 to 30 A DC	1.5 to 30 A DC	0.75 to 1520 A DC
Derating at power section temp. > ...:	95 °C	95 °C	95 °C
Voltage ripple Interference voltage	< 50 mV pp	< 50 mV pp	< 50 mV pp < 2 mV in acc. with CCITT
Efficiency	91%	92%	92%
Monitoring systems			
Power section temperature Trigger / return value	Unit OFF ≥ 120 °C Unit ON ≤ 115 °C		
Ambient temperature Trigger / return value	Unit OFF ≥ 65 °C Unit ON ≤ 62 °C		
Input undervoltage	Unit OFF ≤ 80 V Unit ON ≥ 85 V	Unit OFF ≤ 159 V Unit ON ≥ 169 V	Unit OFF ≤ 80 V Unit ON ≥ 85 V
Setting range	Unit OFF ≤ 80 V to 110 V	Unit OFF ≤ 159 V to 220 V	Unit OFF ≤ 80 V to 110 V
Input overvoltage	Unit OFF ≥ 148 V Unit ON ≤ 143 V	Unit OFF ≥ 296 V Unit ON ≤ 286 V	Unit OFF ≤ 148 V Unit ON ≥ 143 V
Setting range	Unit OFF ≤110 V to 148 V	Unit OFF ≤220 V to 296 V	Unit OFF ≤110 V to 148 V
Output undervoltage Trigger / return value	≤ 24 V / ≥ 25 VDC	≤ 24 V / ≥ 25 VDC	≤ 48 V / ≥ 50 VDC
Setting range	20 VDC to 28 V with hysteresis 1 V	20 VDC to 28 V with hysteresis 1 V	40 VDC to 56 V with hysteresis 2 V
Output overvoltage Trigger / return value	Unit OFF ≥ 28 VDC Unit ON ≤ 27.2 VDC	Unit OFF ≥ 28 VDC Unit ON ≤ 27.2 VDC	Unit OFF ≥ 56 VDC Unit ON ≤ 54.4 VDC
Setting range	25 V to 36 VDC with hysteresis 0.8 V	25 V to 36 VDC with hysteresis 0.8 V	50 V to 72 VDC with hysteresis 1.6 V

Type	**G110 G60/15 BWrg-Cpü**	**G220 G48/15 BWrg-Cpü**	**G220 G60/15 BWrg-Cpü**
E-number	3000000812	3000000757	3000000813
Nominal connection voltage	110 VDC -23% +30%	220 VDC -23% +30%	220 VDC -23% +30%
Nominal current consumption	approx. 9.8 A DC	approx. 4 A DC	approx. 5 A DC
Necessary mains fuse	15 A	6 A	10 A
Output voltage Value set	66.9 VDC ±1%	53.52 VDC ±1%	66.9 VDC ±1%
Setting range	50 to 75 VDC	40 to 60 VDC	50 to 75 VDC
Output current Value set	15 A DC ±2%	15 A DC ±2%*	15 A DC ±2%*
Setting range	0.75 to 15 A DC	0.75 to 15 A DC	0.75 to 15 A DC
Derating at power section temp. > ...:	95 °C	95 °C	95 °C
Voltage ripple Interference voltage	< 50 mV pp < 2 mV in acc. with CCITT	< 50 mV pp < 2 mV in acc. with CCITT	< 50 mV pp < 2 mV in acc. with CCITT
Efficiency	92%	93%	93%
Monitoring systems			
Power section temperature Trigger / return value	Unit OFF ≥ 120 °C Unit ON ≤ 115 °C		
Ambient temperature Trigger / return value	Unit OFF ≥ 65 °C Unit ON ≤ 62 °C		
Input undervoltage	Unit OFF ≤ 80 V Unit ON ≥ 85 V	Unit OFF ≤ 159 V Unit ON ≥ 169 V	Unit OFF ≤ 159 V Unit ON ≥ 169 V
Setting range	Unit OFF ≤ 80 to 110 V	Unit OFF ≤ 159 V to 220 V	Unit OFF ≤ 159 V to 220 V
Input overvoltage	Unit OFF ≥ 148 V Unit ON ≤ 143 V	Unit OFF ≥ 296 V Unit ON ≤ 286 V	Unit OFF ≥ 296 V Unit ON ≤ 286 V
Setting range	Unit OFF ≤ 110 V to 148 V	Unit OFF ≤ 220 V to 296 V	Unit OFF ≤ 220 V to 296 V
Output undervoltage Trigger / return value	≤ 60 V / ≥ 62.5 VDC	≤ 48 V / ≥ 50 VDC	≤ 60 V / ≥ 62.5 V DC
Setting range	49 VDC to 68 V With hysteresis 2.5 V	40 VDC to 56 V With hysteresis 2 V	49 VDC to 68 V With hysteresis 2.5 V
Output overvoltage Trigger / return value	Unit OFF ≥ 70 VDC Unit ON ≤ 68 VDC	Unit OFF ≥ 56 VDC Unit ON ≤ 54.4 VDC	Unit OFF ≥ 70 VDC Unit ON ≤ 68 VDC
Setting range	62 V to 90 VDC With hysteresis 2 V	50 V to 72 VDC With hysteresis 1.6 V	62 V to 90 VDC With hysteresis 2 V

Table 4 Technical data

9. Dimensional Drawing

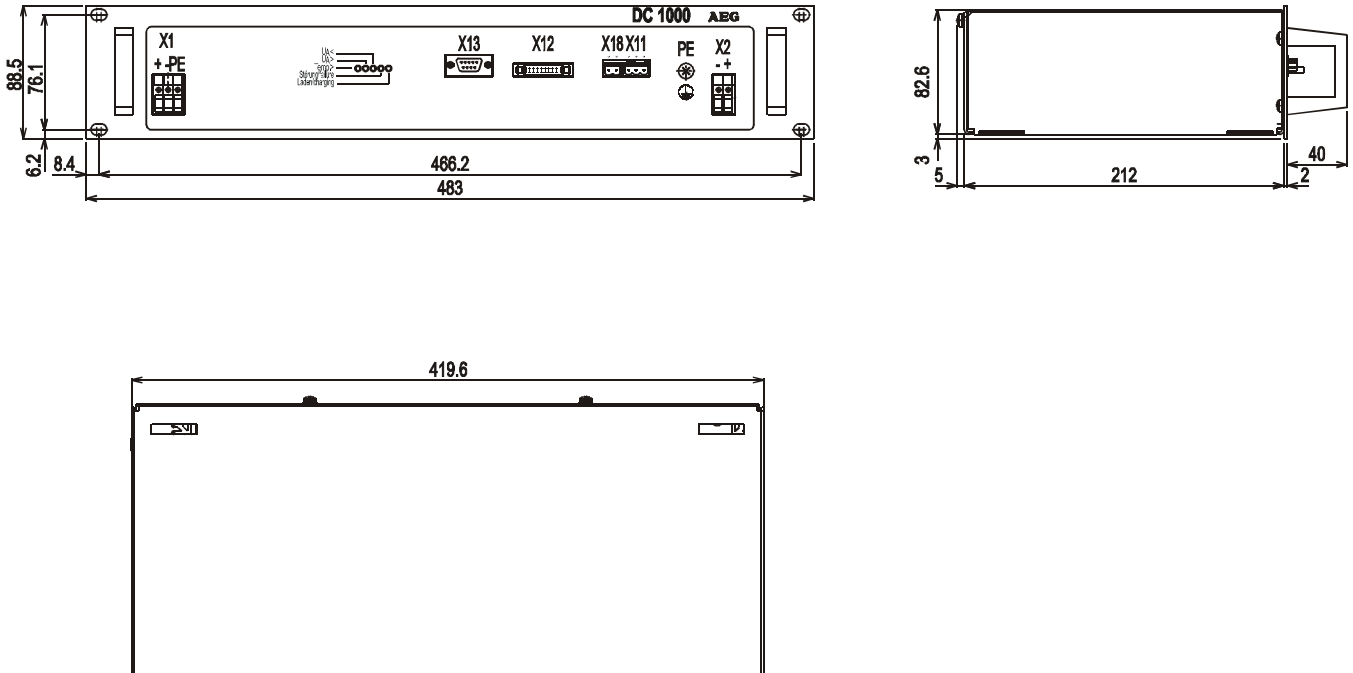

Figure 4 Dimensions