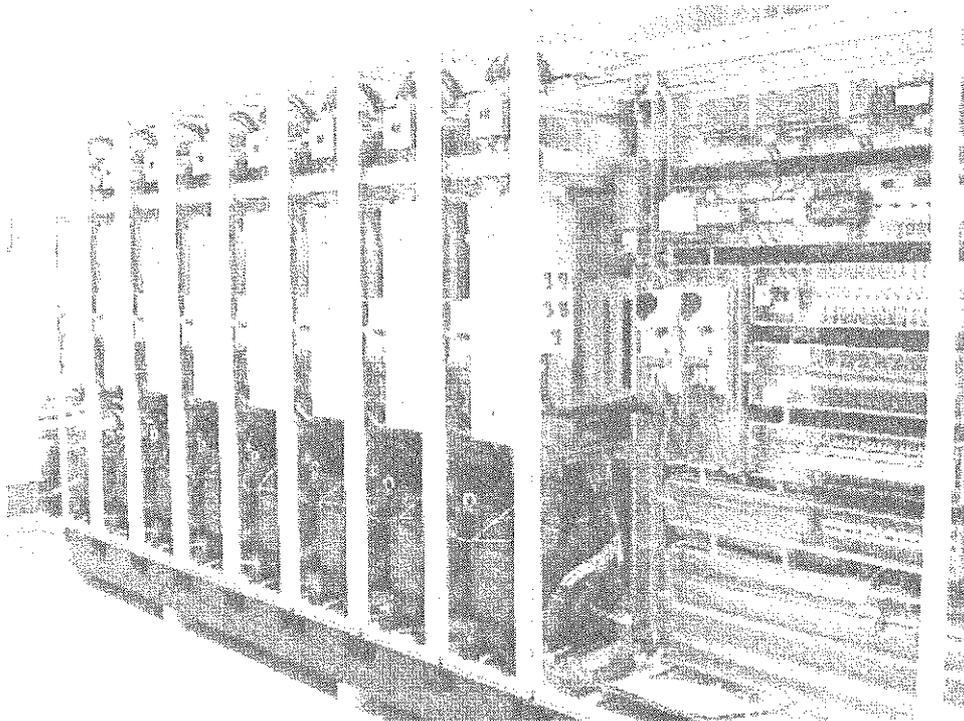


Unidrive SPV Solar Inverter



Installation Guide

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1. Aim of the manual

This manual is written for electricians in photovoltaic business. The manual should be used for installing SPV inverter.

Commissioning, Operating and Maintenance are described in separate documents.

Version	Date	Name	Remarks
0.1		M. Müller	Initial Beta Release
0.2	29.10.2009	M. Müller	Data of Brake chopper included Information about wiring the separated SPV included
0.3	17.11.2009	M. Müller	Number of DC Connection points added Power usage for day and night added Max Fusing for ext. Control Power Error correction incorrect article number DC fuses Error correction dimensions of cabinets
0.4	15.01.2010	M. Müller	Connection of Brake Chopper reviewed Connection between AC Side and Control in Separated SPV Assignment of brake resistor reviewed
0.5	19.02.2010	M. Müller	Screw size of DC filter included Connection of DC Cabling on AC side for separated version included Environmental conditions reviewed Maximum losses reviewed

2. Safety

2.1. Warnings and signs



A WARNING contains information that is important to avoid hazards!



The "CAUTION" sign (*Vorsicht*) draws attention to information that is important for the avoidance of damage to the installation and motor.



A NOTE sign (*Hinweis*) contains information that is particularly important for the procedure of the described action.

2.2. General remarks



Attention: It is not allowed to install the SPV outside switching rooms. Access to this room must be restricted to qualified specialist personnel (definition of specialist personnel according to IEC 364).



- All work relating to transport, storage, installation, connection, start-up and service must only be completed by qualified specialist personnel under due consideration of the corresponding documentation, installation-specific stipulations and requirements as well as national and regional safety and accident prevention regulations.
- The people responsible for safety are the operator and the qualified specialist personnel (definition of specialist personnel according to IEC 364).
- An operator is any natural and legal person that uses the installation or uses it on their behalf. The operator and/or their safety appointee must ensure the following:
 - All valid regulations, notices and laws are observed.
 - The converter is only operated by qualified personnel.
 - These Operating Instructions are available to the personnel.
 - Unqualified personnel are not allowed to work with the converter.
- Qualified personnel are personnel who, on account of their training, experience and knowledge of the requisite standards and regulations, accident prevention rules and operating conditions, have been authorized by the person responsible for the safety of the installation and who are familiar with the execution of the above-described work.

- Read these installation and start-up instructions prior to installation and start-up. An incorrect procedure can result in the injury of people and/or damage to property. Ensure that the technical data and details relating to the connection conditions are strictly observed.
- Control and power connections can be live, even if a motor connected to the converter is not operating.
- Under no circumstances should electrical connections within the converter installation be disconnected whilst live because the resulting electric arcs could injure people and damage contact elements (e.g. disconnect in the intermediate circuit).
- Wait at least 10 minutes after the converter installation has been switched off before energized equipment is touched or connections disconnected. The intermediate circuit capacitors can still be charged with dangerous voltage levels up to 10 minutes after they were switched off. The actual time can even be much longer, depending on the mains unit employed. Measure the voltage of the power supply (DC BUS) for safety reasons and wait until the voltage has dropped below 40V.
- The converter installation contains components that are endangered by an electrostatic charge. Ensure that your body is completely electro statically discharged before touching the electronic components.
- Avoid contact with highly insulating materials (e.g. synthetic fibres, plastic films).

Further-going guidelines such as BG AV2 and EN60204, must be observed in connection with all work!

3. Legal remarks

3.1. General remarks

These Operating Instructions conform to the current status at the time of going to print and are subject to continuous updating in keeping the technical findings and requirements.

No claims for already delivered drives can be derived from the details in these Operating Instructions.

3.2. Use in conformity with the intended application

The converter installations described in these Operating Instructions are exclusively intended for the operation of engine test stands. The converter installations must only be used for the ordered and confirmed purpose and only under the operating conditions stipulated in these Operating Instructions. Operation outside the performance limits is impermissible.

3.3. Warranty

Control Techniques GmbH must be immediately notified of discovered defects or faults. All warranty claims are subject to the Sales and Delivery Conditions of Control Techniques GmbH and the contractual stipulations in the confirmation of the order.

3.4. Transport damage

The converter installations leave Control Techniques GmbH in a perfect condition. Check the completeness and intactness of the supplied consignment on the basis of the delivery note.

A written protocol must be drawn up if the consignment is found to be incomplete.

If damage is discovered that has obviously been caused by transport, then a corresponding damage report must be drawn up in the presence of the transport company, and meaningful photos must be taken, and this must be confirmed with the signature of the recipient and the transport company.

An independent expert must be called in if this signed confirmation is refused.

Depending on the extent of the damage, start-up must be excluded or only carried out after consulting Control Techniques GmbH.

4. Packaging, transport, storage and installation

4.1. Packaging

The packaging protects the converter installation from external damage provided that requisite regulations are observed and due care is taken during road, rail or air transport.

Packaging for sea freight is also possible upon request.

4.2. Transport



Transport and installation must be carried out with due care and under observation of the requisite regulations by specialist personnel specifically trained for this purpose (see Safety Section).

Converter installations must only be transported in an upright position. They must not be tilted to prevent damage due to centre-of-gravity changes when the position of heavy components is changed.



Fig. 1

WARNING!

Expect the converter installation to be top heavy so that corresponding measures must be taken to prevent tilting during transport.

Vehicles suitable for the existing road conditions must be selected for land transport, i.e. possibly air-suspension.

In addition to the customary tools for transport and in-situ installation (e.g. screwdrivers, wrenches, hammers, pliers, etc.), the following special tools and facilities are required:

Transport: Crane (optional) or forklift or lifting trucks

Installation: Welding gear, drawing facilities to align converter installations

After the packaging has been removed (this should be carried out just before the converter installation is to be set up), converter installations can be transported to the point of installation by their lifting lugs (optional) with a crane or by a lifting/forklift truck.

Important information when using carrying ropes

- The lifting capacity of the carrying ropes must be sufficient, i.e. the lifting capacity of each carrying rope must equal $\frac{1}{2} \times$ the cabinet weight. This also applies to the carrying ropes of the lifting gear.
- The carrying ropes must be sufficiently long to ensure that the angle between the carrying rope and the top edge of the cabinet = 45° - in conformity with DIN 580. This angle is reduced when the carrying ropes are too short so that unnecessary high stresses arise at the transport lugs which could even be torn out.
- Ensure that the cabinet does not swing around on the end of the carrying rope.

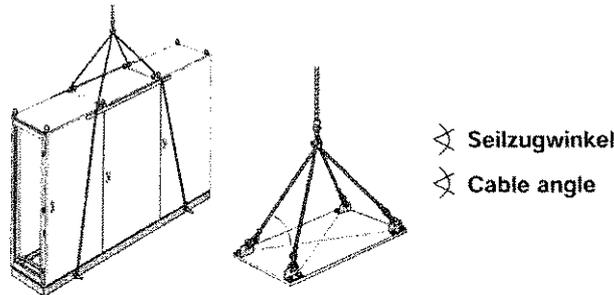


Fig. 2
Correct lifting with a crane and lifting gear

..... transport is also possible after the packaging has been removed and without the wooden pallet otherwise envisaged for this purpose. To ensure safe lifting without knocking or tilting the switch cabinet, the lifting arms

- Must be spread as far apart as is possible with the given floor structure.
- Must be moved in directly and without any tilt from the front underneath the cabinet.
- Must be adequately long.

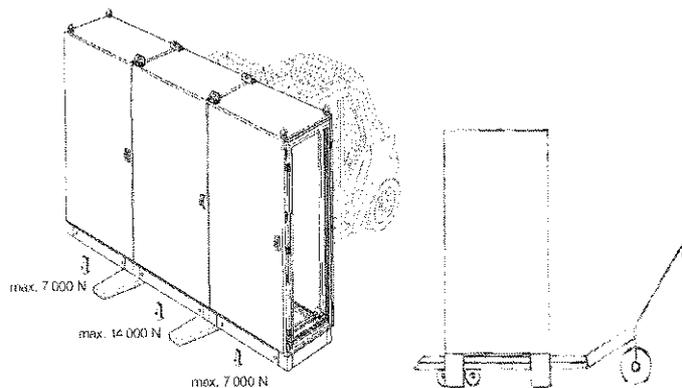


Fig. 5
Forklift/lifting truck



CAUTION: When fork lifting the SPV make sure the distance between the forks is correct. This should be a third of the length of the SPV

Transport by a forklift or lifting truck must be limited to what is unavoidably necessary, especially at the point of the converter installation and on an even ground. Transport by crane should be preferred wherever this is possible.

Ensure the following when the converter installation is lowered:

- Lower slowly and with the utmost care without knocking the installation.
- Ensure that the ground is adequately level, does not slope and is of sufficient carrying capacity.

- Do not slant or tilt the converter installation and do not deposit it on any material that may be lying around.

When transporting the equipment at the location without pallets with forklift trucks or lifting trucks, pad the lifting arms with microcellular rubber or similar material in order to prevent damage to the base, especially when slotted base plates are used.

Metal on metal invariably gives rise to the very considerable danger of slipping!

4.3. Storage

Converter installations must be protected against water, condensation, dust and damage due to electrical influences.

- Storage temperature –40°C - +50°C max. 12 months
- Storage temperature –40°C - +45°C max. 24 months
- Storage temperature –40°C - +40°C max. 36 months

The limits for humidity are 5-95% (none condensing).

4.4. Installation and connection

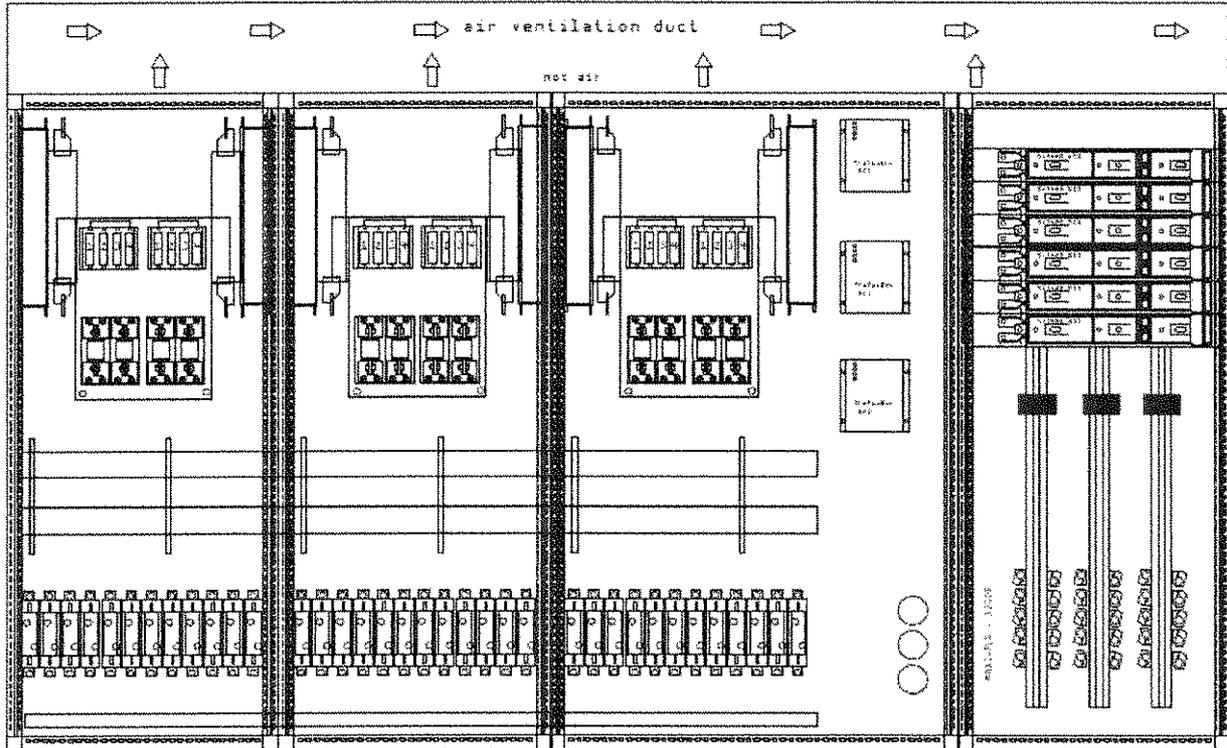


Carry out the installation and cabling work with due care and observation of the requisite safety regulations by specialist personnel specifically trained for this purpose (see Safety Section)

The following must be taken into account when setting up the converter installation:

- The ambient conditions described in these Operating Instructions must be fulfilled at the point of switch cabinet installation.
- The converter installation must be set up in such a manner that the contractually assured degree of protection can be observed.
- If the converter installation has ventilation slots in its rear panel, then a distance of at least 50 mm to the wall must be observed.
- Signs mounted on the converter installation and which refer to the given mounting work must be observed (e.g. subsequent lifting of the switch cabinet roof or the insertion of slotted base plates to improve cooling).
- Before cables are connected they must be checked for correct design (cross-section, current capacity in conformity with the manner they are laid, voltage drop, cable capacity in relation to the line length) as well as national regulations.
- Special attention must be paid to the electrical protective measures when the cables are connected (PE connections, potential equalization) and observance of the EMC Guidelines (screening).

5.1.3. DC-side

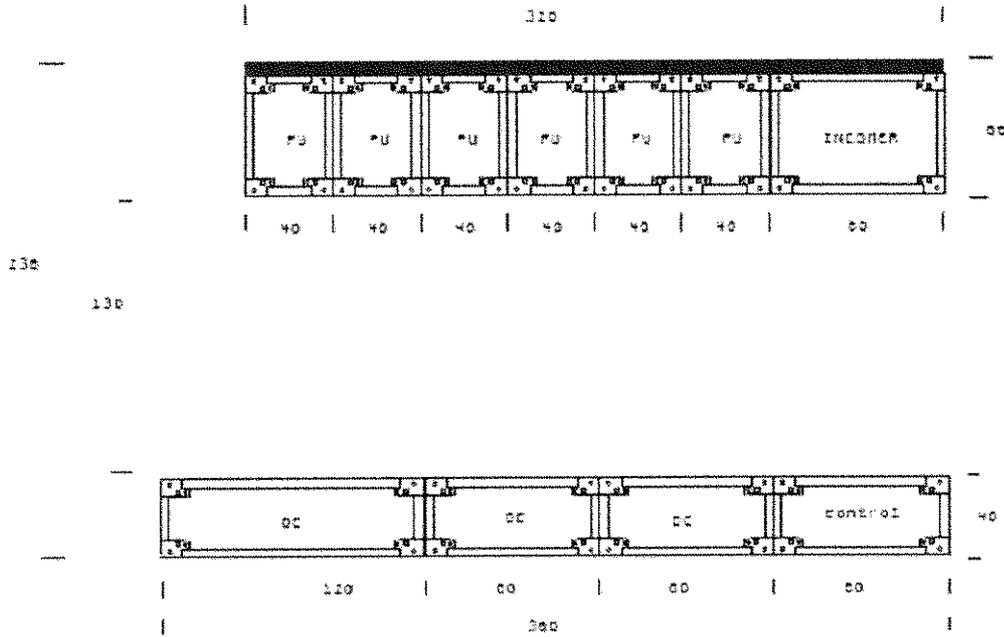


5.1.4. Dimensions

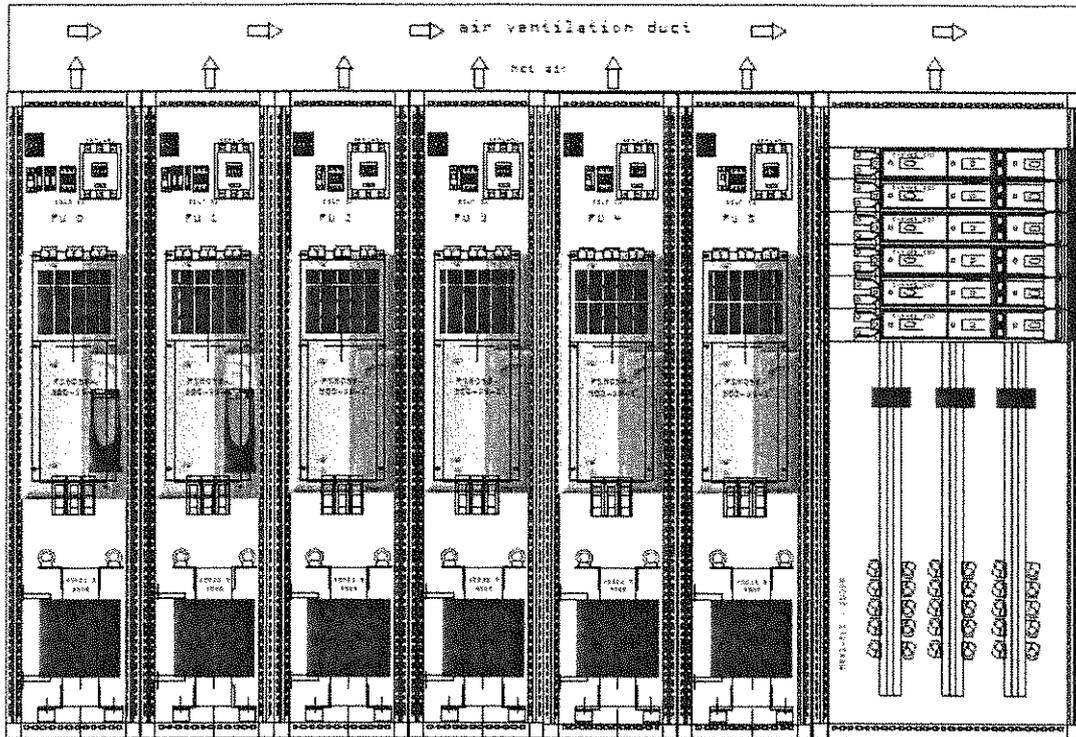
	Length mm	Width mm	High mm	Weight kg
SPV 145	2000	600	2000	1150
SPV 175	2000	600	2000	1200
SPV 350	1600	1000	2000	1800
SPV 530	2000	1000	2000	2300
SPV 700	3200	1000	2000	3200
SPV 880	3600	1000	2000	3600
SPV 1060	4000	1000	2000	4000
SPV 1230	4800	1000	2000	5200
SPV 1410	5200	1000	2000	5600
SPV 1590	5600	1000	2000	6000

5.2. SPV Separated

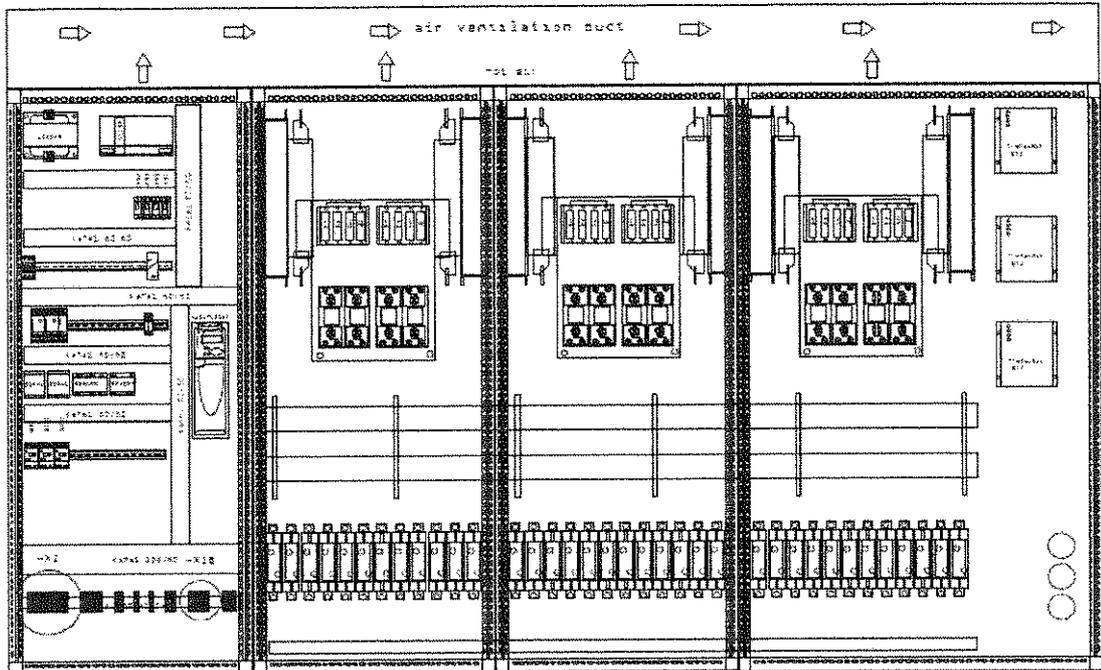
5.2.1. Bottom View



5.2.2. AC Side



5.2.3. DC-side



5.2.4. Dimensions AC

	Length mm	Width mm	High mm	Weight kg
SPV 145	2000	600	2000	1150
SPV 175	2000	600	2000	1200
SPV 350	1600	660	2000	1800
SPV 530	2000	660	2000	2300
SPV 700	2800	660	2000	3200
SPV 880	3200	660	2000	3600
SPV 1060	3600	660	2000	4000
SPV 1230	4400	660	2000	5200
SPV 1410	4800	660	2000	5600
SPV 1590	5200	660	2000	6000

5.2.5. Dimensions DC

	Length mm	Width mm	High mm	Weight Kg
SPV 145	No separate DC Part			
SPV 175	No separate DC Part			
SPV 350	2000	400	2000	1800
SPV 530	2400	400	2000	2300
SPV 700	3200	400	2000	3200
SPV 880	3600	400	2000	3600
SPV 1060	4000	400	2000	4000
SPV 1230	4800	400	2000	5200
SPV 1410	5200	400	2000	5600
SPV 1590	5600	400	2000	6000

5.3. Electrical Data

Type	No. of Modules	AC Current	DC Current	Rated Power	AC Voltage *)
SPV145	1	245 A	300 A	145 kW	340 V +/- 5 %
SPV175	1	300 A	350 A	175 kW	340 V +/- 5 %
SPV350	2	600 A	700 A	350 kW	340 V +/- 5 %
SPV530	3	900 A	1050 A	525 kW	340 V +/- 5 %
SPV700	1 PLI + 4 FLI	1200 A	1400 A	700 kW	340 V +/- 5 %
SPV880	1 PLI + 5 FLI	1500 A	1750 A	875 kW	340 V +/- 5 %
SPV1060	1 PLI + 6 FLI	1800 A	2100 A	1060 kW	340 V +/- 5 %
SPV1230	2 PLI + 7 FLI	2100 A	2450 A	1230 kW	340 V +/- 5 %
SPV1410	2 PLI + 8 FLI	2400 A	2800 A	1410 kW	340 V +/- 5 %
SPV1590	2 PLI + 9 FLI	2700 A	3150 A	1590 kW	340 V +/- 5 %

*) For other voltages please contact CT. The AC System must be isolated without relation to earth.

Type	Max. Losses	Mains Frequency	Control Power Consumption (Max) **)	Power Consumption (Night) ***)
SPV145	3,7 kW	50 Hz	1000 VA	50 VA
SPV175	4,9 kW	50 Hz	1000 VA	50 VA
SPV350	9,8 kW	50 Hz	1300 VA	50 VA
SPV530	15 kW	50 Hz	1800 VA	50 VA
SPV700	20 kW	50 Hz	2100 VA	50 VA
SPV880	25 kW	50 Hz	2500 VA	50 VA
SPV1060	30 kW	50 Hz	2800 VA	50 VA
SPV1230	34 kW	50 Hz	3200 VA	50 VA
SPV1410	40 kW	50 Hz	3500 VA	50 VA
SPV1590	44 kW	50 Hz	3800 VA	50 VA

***) The control power consumption is a worst case. This will be reduced if the SPV is not running at full power. The consumption can be reduced with better cooling.

****) Power consumption from the AC-Bus bars, if the control power is applied externally.

5.4. Brake Resistor

	Resistance	Peak Power	Rated Power	Size (bxhxt)	Weight *)
SPV 145	9,4 Ω*)	69 kW *)	1 kW *)	395x460x490 mm *)	12 kg *)
SPV 175	9,4 Ω*)	69 kW *)	1 kW *)	395x460x490 mm *)	12 kg *)
SPV 350	4.8 Ω *)	139 kW *)	2 kW *)	395x460x490 mm *)	16 kg *)
SPV 530	2 x 4.8 Ω *)	2 x 139 kW *)	2 x 2 kW *)	395x460x490 mm *)	21 kg *)
SPV 700	2 x 4.8 Ω	2 x 139 kW	2 x 2 kW	395x460x490 mm	21 kg
SPV 880	3 x 4.8 Ω	3 x 139 kW	3 x 2 kW	395x460x490 mm	25 kg
SPV 1060	3 x 4.8 Ω	3 x 139 kW	3 x 2 kW	395x460x490 mm	25 kg
SPV 1230	1.09 Ω	554 kW	69 kW	595x460x490 mm	30 kg
SPV 1410	1.09 Ω	554 kW	69 kW	595x460x490 mm	30 kg
SPV 1590	1.09 Ω	554 kW	69 kW	595x460x490 mm	30 kg

*) The Brake resistor is optional

5.5. Number of STC connectors

The numbers in the tables below are the maximum number of connection points. The actual number in the SPV is customised for each order.

	Max. Number of Fuse Holder	Max. Number of Connection Points
SPV145	4	2
SPV175	4	2
SPV350	12	6
SPV530	18	9
SPV700	30	15
SPV880	36	18
SPV1060	42	21
SPV1230	54	27
SPV1410	60	30
SPV1590	66	33

5.6. AC Transformer

The SPV has special filter on AC side therefore there are no special requirements in regard to the transformer. Please note the harmonics of the inverter. The virtual star point of AC voltage is alternating connected to +/- DC. This causes a common mode voltage regarding to earth.

The SPV is not designed to work in parallel with other consumer. Each SPV should have an own transformer winding. The Voltage needs to be isolated from earth.

If additional consumers need to work in parallel with the SPV, e.g. lighting of control room, this needs to be galvanic isolated from the SPV.



Note: The star point of the transformer is not allowed to be earthed. An IT network must be produced.

5.7. Ambient Conditions

5.7.1. Ambient Temperature

Ambient temperature operating range:
0°C to 50°C.

The output current is decreased by 1% / K at temperatures >45°C .

A warning is produced at a temperature of 45 °C.

The SPV trips at a temperature of 50 °C

Minimum temperature:

0°C

Maximum humidity: 95% non-condensing

5.7.2. Altitude

Altitude range: 0 to 3,000m, subject to the following conditions:

1,000m to 3,000m above sea level: derate the maximum output current from the specified figure by 1% per 100m above 1000m. For example at 3000m the output current of the SPV would have to be derated by 20%.

5.8. Air Flow

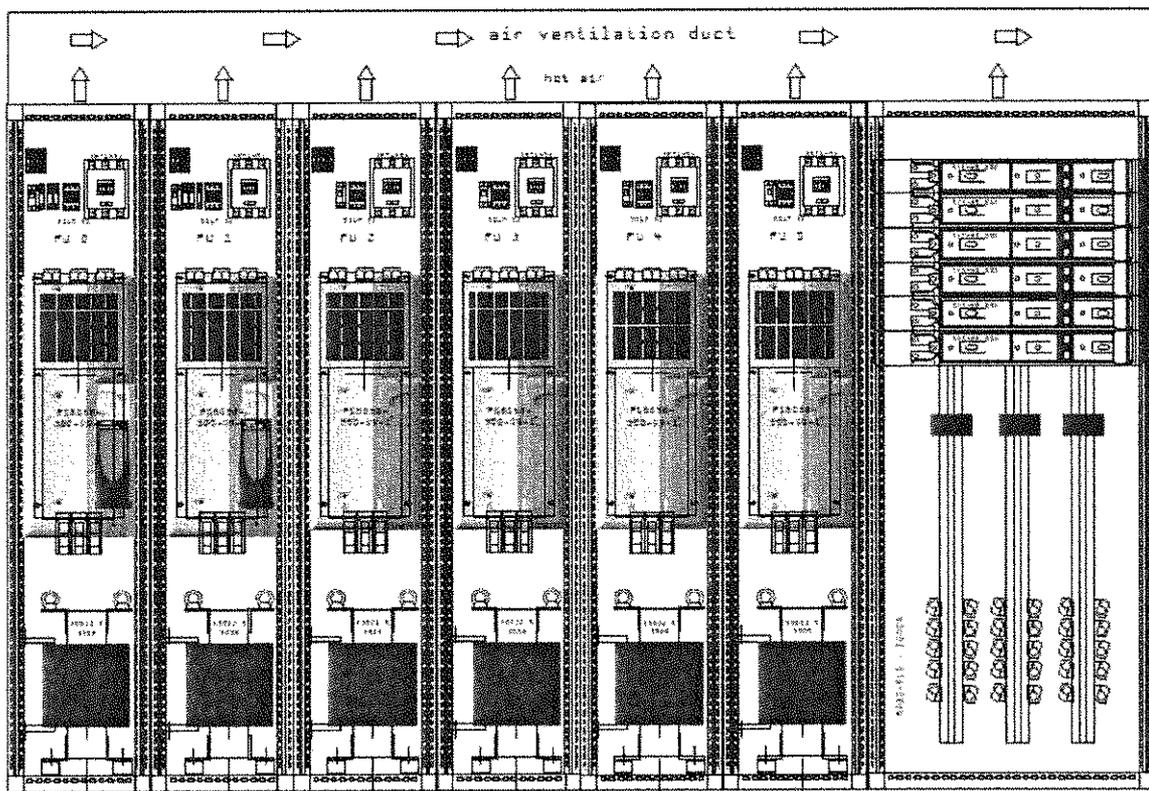
5.8.1. Minimum clearance to ambient walls

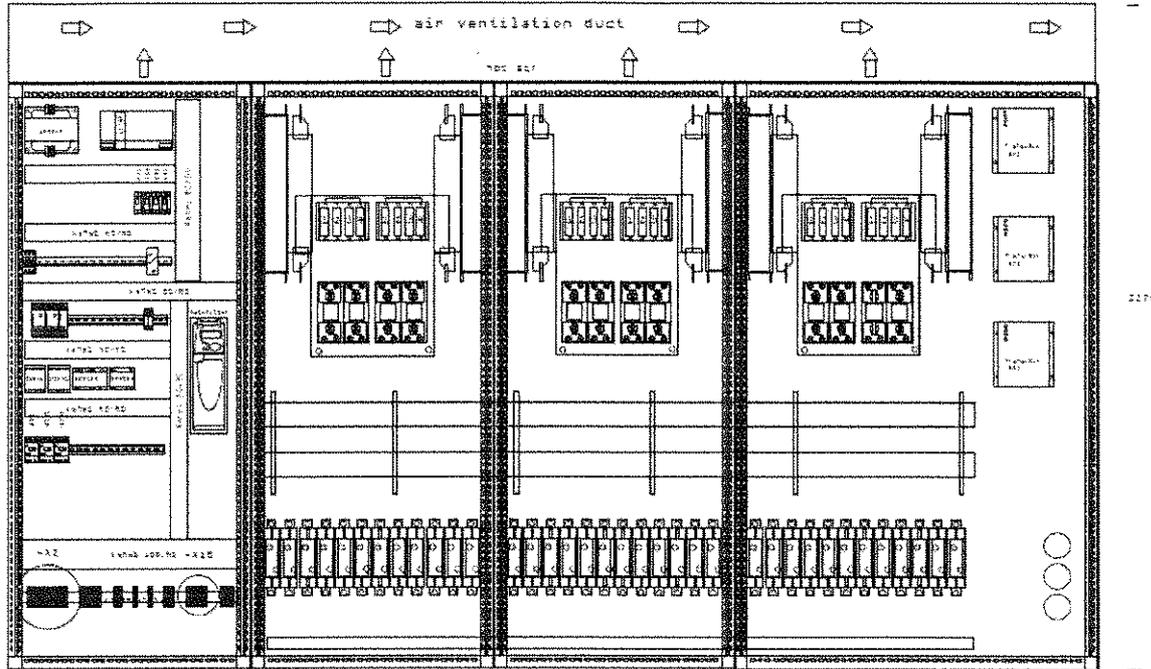
With control techniques PV-Inverters you have no clearance, beside the space in front for the emergency exit, to ambient walls.

5.8.2. Air Flow Management

The SPV is designed to inject cool air on the front side as shown in the figures below. No air flow is requested from the back side. Therefore a differentiation for the SPV inverter types is not necessary. The hot air should be exhausted from the top of the cabinets.

It is recommended build a ventilation duct on top of the inverter to produce a defined air flow. The requested amount of air is shown in the table below.





Type	Airflow on AC Side	Airflow on DC Side
SPV145	2000 Nm3/h	
SPV175	2500 Nm3/h	
SPV350	4400 Nm3/h	350 Nm3/h
SPV525	6600 Nm3/h	700 Nm3/h
SPV700	8800 Nm3/h	1000 Nm3/h
SPV875	11000 Nm3/h	1400 Nm3/h
SPV1060	13000 Nm3/h	1800 Nm3/h
SPV1230	15500 Nm3/h	2100 Nm3/h
SPV1410	17500 Nm3/h	2900 Nm3/h
SPV1590	20000 Nm3/h	3300 Nm3/h

Nm3 means normal cubic meter. This means a cubic meter of air at 1.01325 bar, 0 % humidity and 15 °C Temperature (normalised conditions from ISO2533).

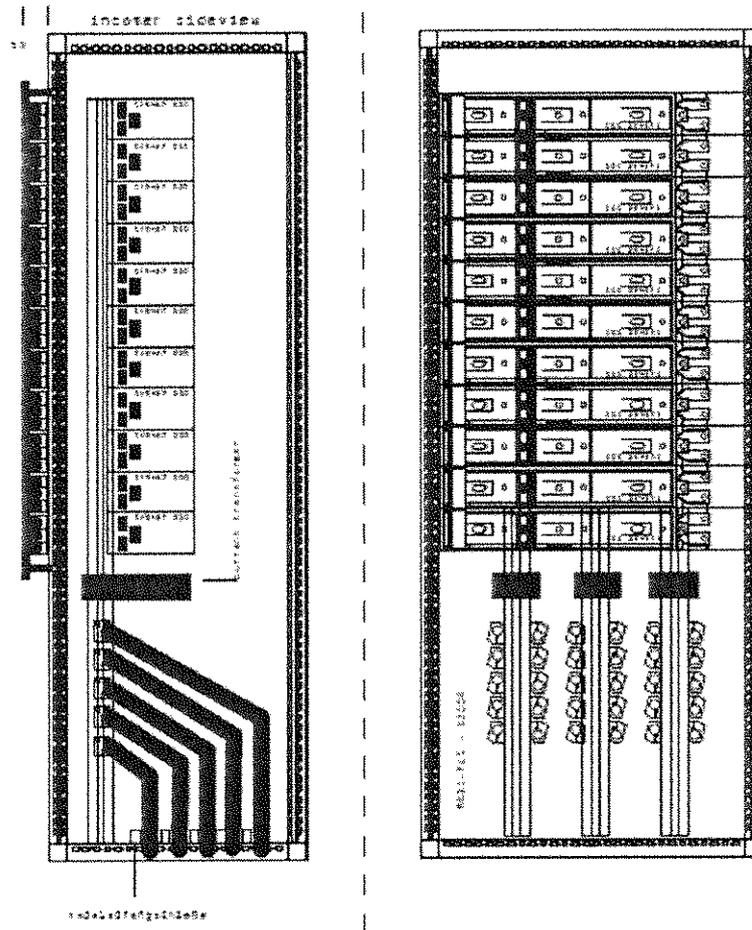


Note: The cooling air must be filtered for particles > 10 µm. It is recommended to use Filter with class G4 from DIN EN 779.
The control room should be kept clean swept.
Concentrations of corrosive gases must not exceed the levels given in:

- Table A2 of EN 50178
- Class 3C2 of IEC 60721-3-3

6. Electrical connection

6.1. Incomer connection



In the upper picture is shown the incomer of a SPV 1590.

Here it is possible to bring on 10 cables, per phase, with 300mm² dimensions (Copper or Aluminium).

The Cabinet is designed like, that the cables are coming from bottom (maybe an underground distribution chamber). For connection SV9640.325 from Rittal GmbH are used. The nut torque is 25 Nm3. It is possible to turn the connection clamps in every angle you want. It's not necessary to bend the cables 90°. As shown in the picture, its only essential 45°.

For further information, concern number of clamps in other PV inverters, please look at the following schedule.

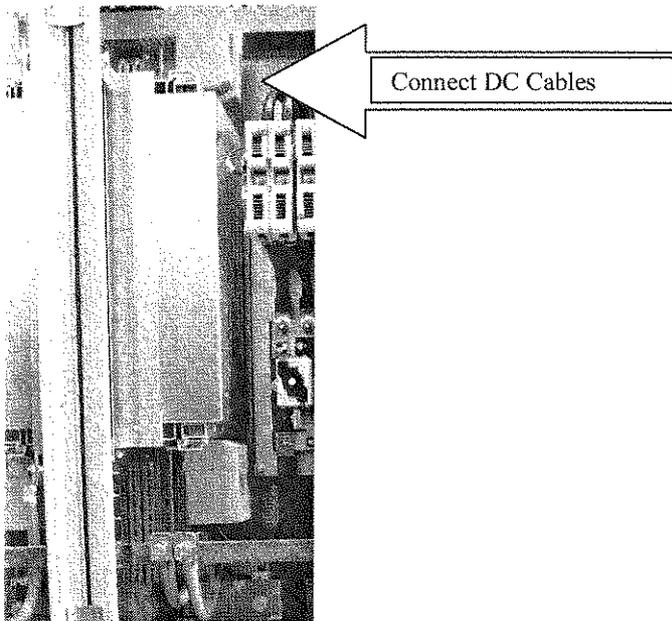
Type	No. of Clamps
SPV145	2 *)
SPV175	2 *)
SPV350	3
SPV530	4
SPV700	5
SPV880	6
SPV1060	7
SPV1230	8
SPV1410	9
SPV1590	10

*) The connection is not done with bus bars. The connection needs to be done directly on the AC fuse holder

6.2. Connecting AC and DC side (Only with SPV separated)

6.2.1. Power Cabling

The cables for the power connection between AC and DC Side come with the accessories of the SPV. They are 2 x 150 mm² shielded cable and 1 x 95 mm² Earth. On side to connect to the AC side is preconfigured with cable shoes. The Connection on the DC Side need to be configures for M16 lugs.



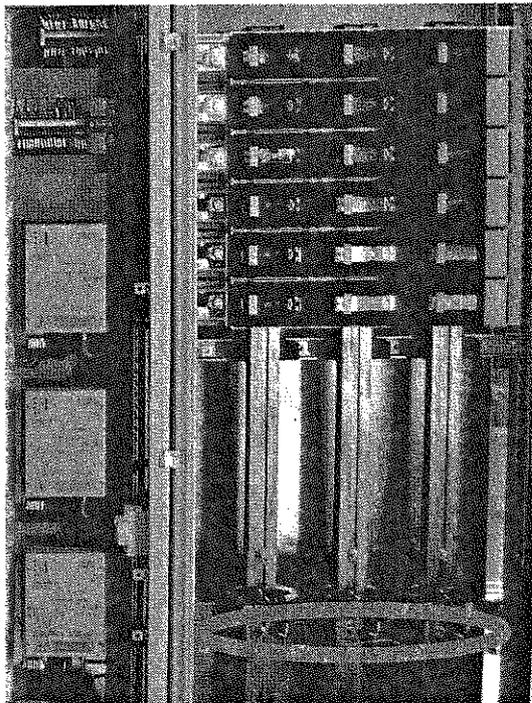
Note: Please separate the DC Link cables from control cables. The cable length is optimised to connect AC and DC Part via the roof.

6.2.2. Control Cables

In the separated version the AC side is separated from the control cabinet. Therefore a set of connection cables is included to the SPV.

All cables are prepared for the connection with plugs on each side. The NSGAFÖU is prepared with cable shoes.

Cable	Type	AC-Side	Control cabinet	Comment
-W77	2 x Ölflex 18 x 1,5	+AC-X77	=ALL+CON-X77	Control Signals
-W78	Ölflex 18 x 1,5	+AC-X78	=ALL+CON-X78	Control Signals Brake Chopper
-W99	7 x 1,5	+AC-X99	=ALL+CON-X99	Current Sensor
-W1	NSGAFÖU 3 x 16mm ² (single wire)	Incommer (See attached figure)	=ALL+CON-X1	Auxiliary Power (Mains Monitoring)
-W88	2 x Ölflex 5 x 6 Ölflex 65 x 1,5	+AC-X88	=ALL+CON-X88	Control Signals
	CTNet	All ready Connected	=ALL+CON-A122 SLOT1 Clamp 6,7,8	Internal Communication

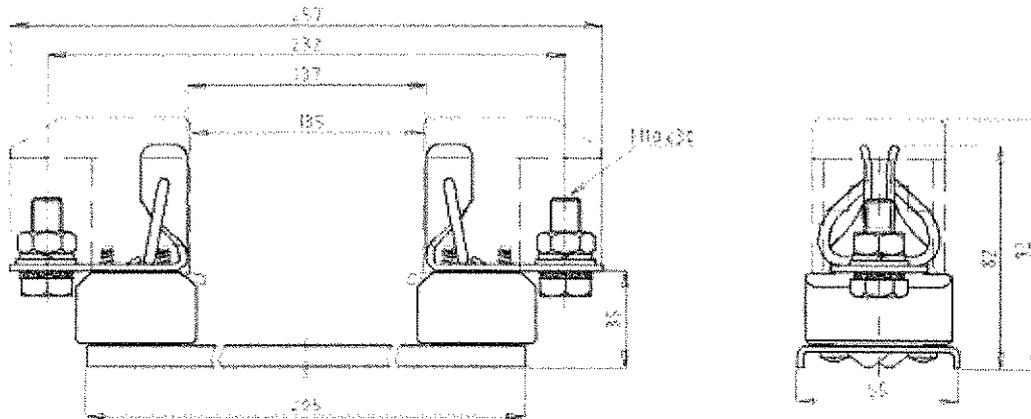


Connection of /W1 at the Incomer

6.3. Connecting of SCB (option)

The SPV can be prepared for direct connection of String Connection Boxes. For this reason fuse holders are built into the cabinet. Your cables from the SCB should be directly connected to this fuse holder. The poles (+/-) are identified beside the holder.

The mechanical dimensions are shown in the figure below.



Electrical Characteristics of the fuse holder:

Rated voltage: 1100 V/DC (L/R=10ms)

Breaking capacity: 30 kA/DC

Rated current: 50A – 200A

Be aware that the fuses are not part of the SPV. For recommended fuses see Chap 6.5.1

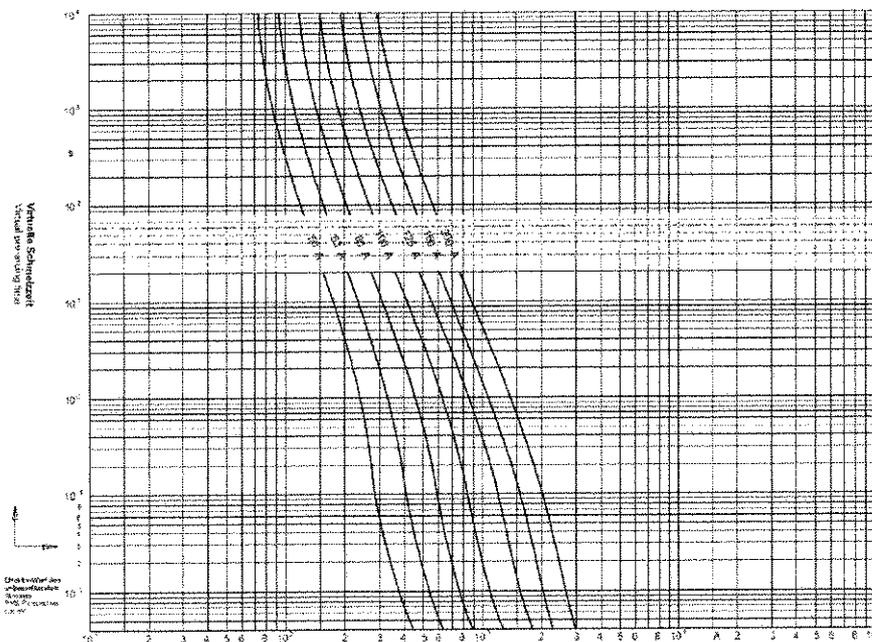
6.3.1. Recommended fuses for connecting the DC field



Note: Control Techniques GmbH is not responsible for the choice of the correct fuse. This chapter give only a hint for fuses possible to use in solar applications. Please make sure that your fusing matches the cable characteristics.

Fa. SIBA is producing fuses for photovoltaic applications, which are mechanically fitting to the used fuse holder. The article number is 2002820.xxx. The data of these fuses is shown in the figures below.

Bemessungsstrom Rated current	Schmelzintegral Pre-arcing I ² t-value	Ausschaltintegral total I ² t - value	Prüfspannung Zeitkonstante L/R Test voltage time constant L/R	Leistungsabgabe Power Loss
[A]	[A ² s]	[A ² s]		[W]
50	480	3200	DC 1000V (10ms)	12
63	900	6200	DC 1000V (10ms)	14
80	1900	13000	DC 1000V (10ms)	16
100	3600	24500	DC 1000V (10ms)	19
125	6700	45400	DC 1000V (10ms)	21
160	11200	76500	DC 1000V (10ms)	30
200	20000	144000	DC 1000V (10ms)	34



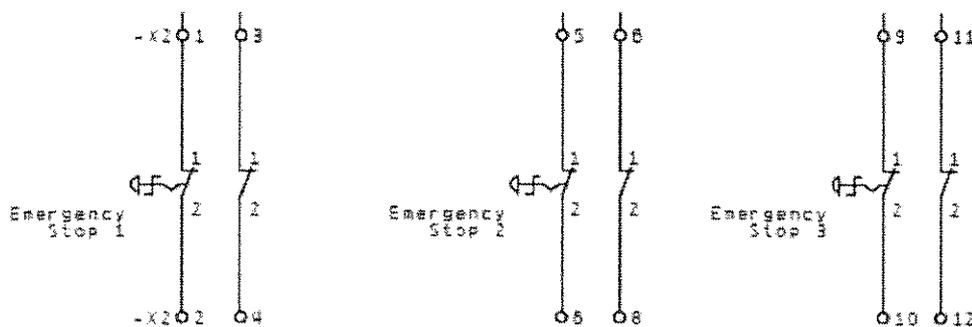
6.4. Control - and Secondary Energy Connections

6.4.1. Connection of Emergency Stop

Emergency stop is connected to terminal block =ALL+CON-X2.

Clamp Number	Comment
1	Emergency Stop Button 1 Contact 1
2	
3	Emergency Stop Button 1 Contact 2
4	
5	Emergency Stop Button 2 Contact 1
6	
7	Emergency Stop Button 2 Contact 2
8	
9	Emergency Stop Button 3 Contact 1
10	
11	Emergency Stop Button 3 Contact 2
12	
13	External Emergency Stop, e.g. wiring monitoring from string connection boxes
14	
15	External Emergency Stop, e.g. wiring monitoring from string connection boxes
16	
17	Reserved

You can connect directly up to three Emergency stop switches. They have to connect as shown in the Picture on left side and under this text –X2. (or the circuit diagram) up on the picture. If you want to install less then three, you have to set jumpers on the open terminals.



NOTE: The emergency stop need to be realised with two poles

6.4.2. Control Voltage Supply

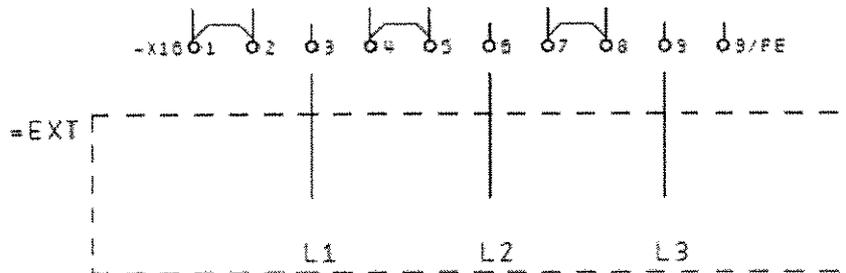
The SPV has two options for supplying control voltage.

1. The control voltage is taken from the main power bus bars. (Default)
2. The control voltage is taken from external supply.

To change between this options Transformer =ALL+CON-T51 and =ALL+CON-T56 have to be connected correctly. In addition the Jumper on =ALL+CON-X16 have to be changed.

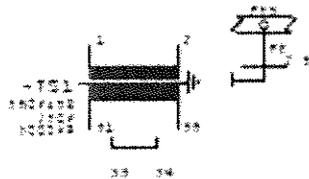
Setting for option 1 (Power for control voltage from internal bus bars):

=All+CON-X16



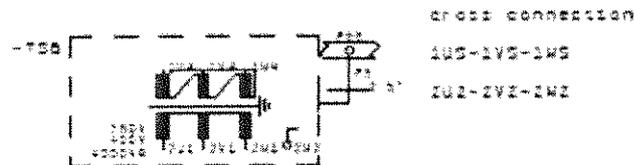
=ALL+CON -T51

This is the situation with internal supply.
On primary side 1, 2 are connected.



=ALL+CON -T56

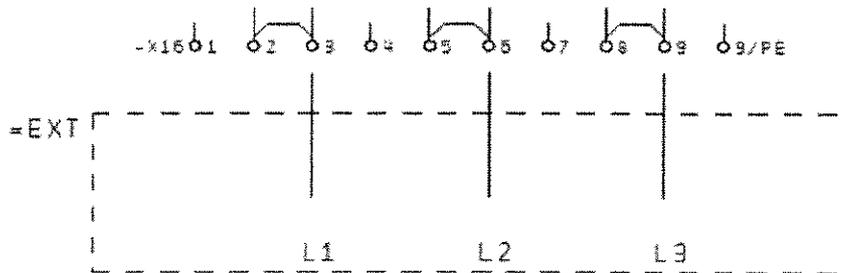
This is the situation with internal supply 1U5-1V5-1W5 is bridged.
On primary side you only have to change the jumpers



Setting for option 2 (External Supply):

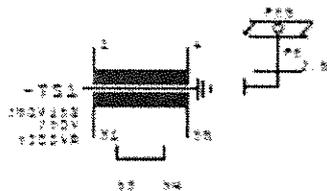


NOTE: The max. fusing for external power supply is 32 A.



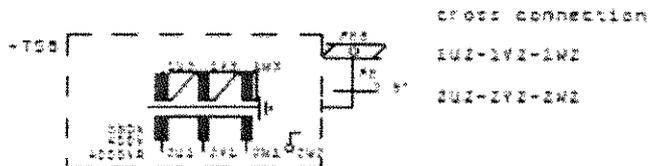
=ALL+CON -T51

With the external supply the connection on the primary side
Change to 1, 4.



=ALL+CON -T56

With the external supply the jumpers have to change to
1U2-1V2-1W2 .



6.5. Power Control Signals from Supply Company

The SPV is prepared to allow 4 signals for power control to be connected. The interface is designed for relays contacts. For description of functionality see operating manual, please.

=ALL+CON –X5

Clamp Number	Comment
1	Control Voltage + 24 V
2	Input 1
3	Input 2
4	Input 3
5	Input 4

These terminals are usually used to connect a Radio Ripple Control Receiver

	Comment
Voltage Range	0 V to + 24 V
Absolute Maximum Voltage Range	+/- 30 V
Input load (Approximately)	< 2 mA @ 15 Vdc
Threshold	+ 10 V +/- 1 V

6.6. Additional Control Signals

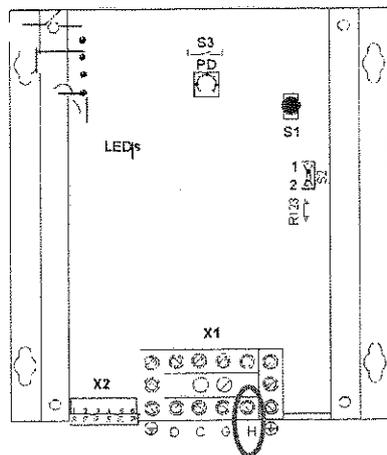
The SPV is prepared to allow 9 external signals for to be connected. The interface is designed for relays contacts. For description of functionality see operating manual, please.

=ALL+CON –X6

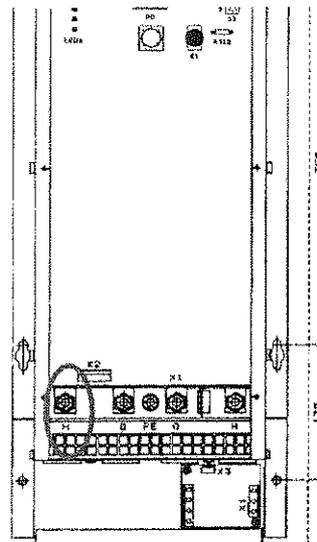
Clamp Number	Comment
1	Control Voltage + 24 V
2	Input 1
3	Input 2
4	Input 3
5	Input 4
6	Input 5
7	Input 6
8	Input 7
9	Input 8
10	Input 9

Electrical Data:

	Comment
Voltage Range	0 V to + 24 V
Absolute Maximum Voltage Range	+/- 30 V
Input load (Approximately)	2.2 mA
Threshold	+ 10 V +/- 1 V



Schematic of brake chopper 110BC2/575



Schematic of brake chopper 550BC2/575

Since electrical energy is converted into heat, heating up of the exhaust air and of the enclosure at the air outlet is inevitable. The highest allowable temperature at the resistor element may be maximum 400°C beyond the ambient temperature. Since the cooling of the devices is accomplished by convection, the above mentioned aspects have absolutely to be considered.

In cases of insufficient cooling or false mounting

- The resistor or the surrounding devices could be overheated or ruined.

2. The given typical power values and temperatures in our technical documentation are valid for 100% duty cycle factor (DCF) (continuous dissipation) according to DIN VDE 0660 part 100 and part 102. The mentioned excess temperatures for enclosure and exhaust air are 200 K and based on our 100% typical power value. They are valid under the following conditions:

- Temperature rise of 200 K at the surface of fixed resistor enclosures (degree of protection > IP00)
- Temperature rise of 300 K at the surface of fixed resistor elements (degree of protection IP00). The temperature rise of slide resistors is only 250K.
- Maximum ambient temperature 40°C

Warning: If the ambient temperature is higher than 40°C, you have to lower the continuous dissipation for 4% per 10 K temperature rise!

- Unhindered access of cooling air
- unhindered diverting of warmed up air (mind a minimum separation distance of approx. 200 mm to neighbouring components/walls and of approx. 300 mm to components above/ceiling)