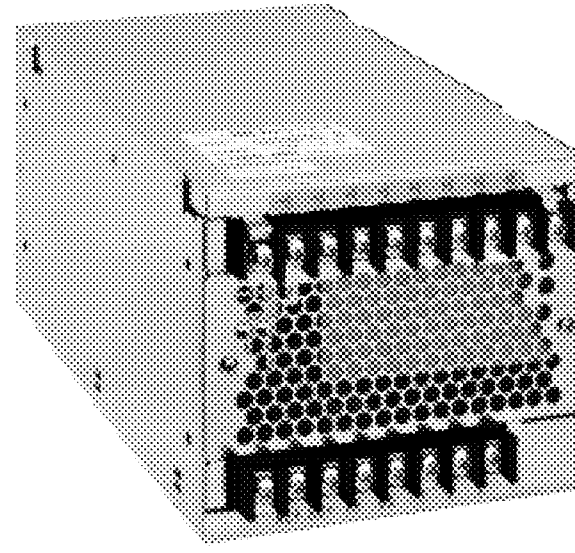
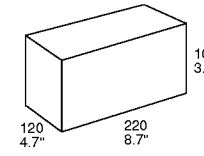
TOKO 300 W AC-DC Converters HK-Family

Single output

- Universal input: (85...264 V AC)
- Power factor corrected
- Special functions, as current sharing, power fail signal, remote control and sense lines
- Noise standards: EN 55011/55022 class B

Safety according to IEC/EN 60950





Summary

This design of the HK 300 allows for the use of smaller inductive components and filtering circuitry. The power MOSFET technology also reduces size and increases power density. For a new generation product or as a running design change, a manufacturer can replace a conventional power supply with a HK 300.

Key applications

The smaller-than-usual size of the HK 300 series makes them well suited to newer, smaller footprint personal computers as well as telecommunications equipment, instrumentation and control systems.

Type Survey and Key Data

Table 1: Type survey

Output $U_{o\ nom}$ [V DC]	Output $I_{o\ nom}$ [A]	Input voltage range $U_{i\ min}...U_{i\ max}$	Output power $T_A = 50°C$ $P_{o\ max}$ [W]	Power factor correction	Efficiency [1] η [%]	Type designation
5	60.0	85...264 V AC 47...63 Hz	300	0.95 (230 V AC)	74	HK 300-05
12	25.0				76	HK 300-12
15	20.0				78	HK 300-15
24	12.5				80	HK 300-24
36	9				80	HK 300-36
48	6.3				81	HK 300-48

[1] Efficiency at $U_{i\ rated}$ and $I_{o\ nom}$.

Table of Contents

Type Key and Product Marking

Type Key

Family ..... HK
Nominal output power [W] 300
Nominal output voltage [V] ..... 05…48

HK 300 - 12

Example: HK 300-12 = AC-DC converter providing 12 V/25 A, 300 W in a case with terminal strips.

Product Marking

Type designation, applicable safety approval and recognition marks, CE mark, specific type designation, input voltage range, nominal output voltage and current and pin allocation. Label with serial no. and data code.

Functional Description

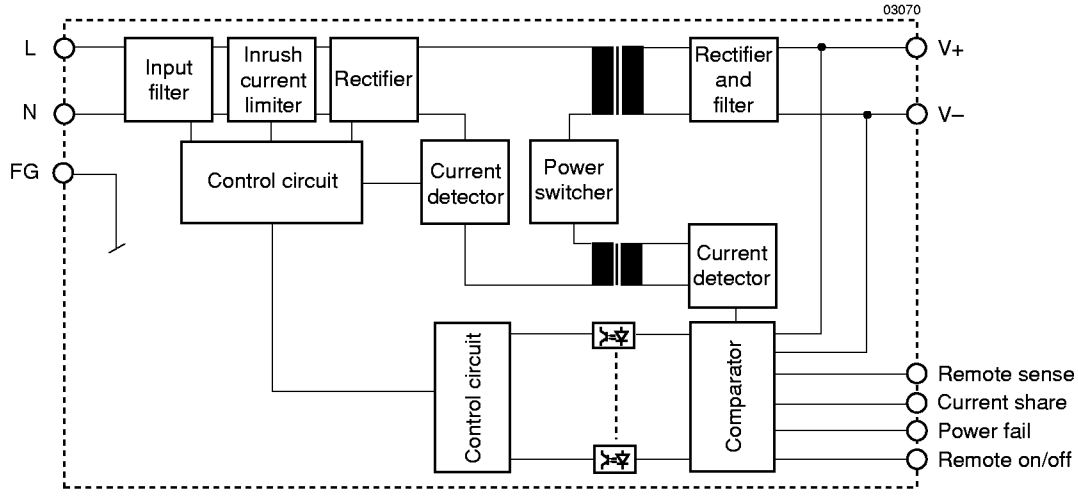


Fig. 1
Block diagram HK 300

Electrical Input Data

General condition: T_A = 25 °C unless otherwise specified

Table 2: Input Data

Characteristics			HK 300-..	Unit
U_i	Input voltage range		85...264	V AC
f_i	Line frequency		47...63	Hz
I_i	Input current (max.)	100/200 V AC	8/4	A
I_{inr}	Inrush current (max.)	100/200 V AC	15/30	
$I_{i\ leak}$	Leakage current (max.)	100/200 V AC	0.5/0.75	mA
PF	Power factor correction	min.	0.95	

Inrush Current

A thyristor is built-in to protect against excessive inrush current. Appropriate selection of the AC input switch is recommended. Repeating switching cycles within short period should be avoided.

Insulation and Dielectric Strength Test

Preshipment tests have been applied at the factory and further tests are not necessary.

Electrical Output Data

General condition: T_A = 25 °C unless otherwise specified

Table 3: Output data

Characteristics			HK 300-05	HK300-12	HK300-15	HK300-24	HK300-36	HK300-48	Unit
$U_{o\,nom}$	Output voltage	nom.	5	12	15	24	36	48	V
$U_{o\,adj}$	Adjustable output range		±10						%
I_o	Output current		60	25	20	12.5	9	6.3	A
$U_{o\,P}$	Overvoltage protection		6.0...6.9	13.5...15.5	17...20.0	27...31	40.5...46.5	53...59	V
$I_{o\,L}$	Output current limitation [1]		105						%
u_o	Ripple-noise	max.	120	150	150	200	200	400	mVp
$\Delta U_{o\,U}$	Line regulation		±3						%
$\Delta U_{o\,I}$	Load regulation	0...100%	±3						
$\Delta U_{o\,t}$	Drift (t = 0.5...8 hours)	typ.	±3						
α_{Uo}	Change in temp. 0...50 °C	typ.	±3						
	Remote sensing		standard						
	Remote on/off		standard						
	Current sharing		standard						
	Output indicator		LED on front panel						
	Power fail		standard						
$t_{o\,r}$	Rise time [2]	max.	500						ms
$t_{o\,h}$	Hold up time [2]	min.	20						
η	Efficiency [2]	typ.	74	76	78	80	80	81	%
	Cooling		forced air (fan built in)						

[1] Operate at 105% of rated current, CC method, automatic recovery
[2] At $U_{i\,rated}$ and $I_{o\,nom}$.

Thermal Considerations

The relation between the maximum allowed output power $P_{o\,allwed}$, the temperature T_A of the surrounding air and the mounting method is given in the *Installation Instruction*. The percentage rates apply if the AC-DC converter is located in free, quasi-stationary air (convection cooling).

The following figure shows the allowed output power of an AC-DC converter if mounting method A is used.

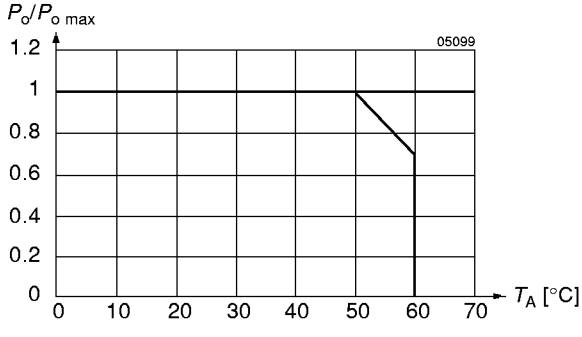


Fig. 2
Maximum allowed output power versus ambient temperature with mounting method A

For $P_{o\,max}$ values see *Type Survey and Key Data*. The thermal conditions are influenced by input voltage, output current, airflow and temperature of surrounding components and surface.

Caution: The installer must ensure that under all operating conditions T_A remains within the limits stated in the table.

Output Voltage Adjustment

The output voltage adjustment range (V_{ADJ} at the front panel) is ±10% of $U_{o\,nom}$. The actual output power should not exceed the specified maximum output power.

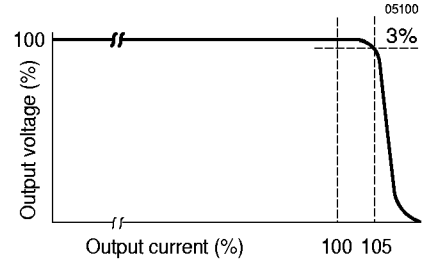


Fig. 3
Output voltage vs. output current

Output Current Limitation

When the output current exceeds 105% of the rated current the overcurrent limitation circuit operates. The output will recover automatically as soon as the overload condition is removed (constant current method).

Overvoltage Protection

If there is an overvoltage condition at the output, the internal latch circuit will operate and the output will be cut off. In this instance, turn off the input. At least 90 seconds should be allowed as recovery time.

Current Sharing/Parallel Connection

For higher power and n+1 systems, a current sharing facility allows several units to operate in parallel-connection with the assurance that a single fault will not lead to a system failure. Interconnection of the current sharing terminals CS causes the units to share the load current, resulting in lower stress and further improved reliability. Parallel-connected modules with interconnected CS terminals share their output currents within a tolerance of approx. ±20% of $I_{o\ nom}$. When operating with dynamic loads, the current sharing will be less accurate.

The current sharing and sense lines are wired as follows: Besides connecting the load with the terminals V+ and V–, another twisted wire pair is connected with S+ and S– respectively of each unit to be operated in parallel. A second wire should be connected between the negative side of the load and S–. This wire is twisted together with the current sharing wire to avoid noise pick-up.

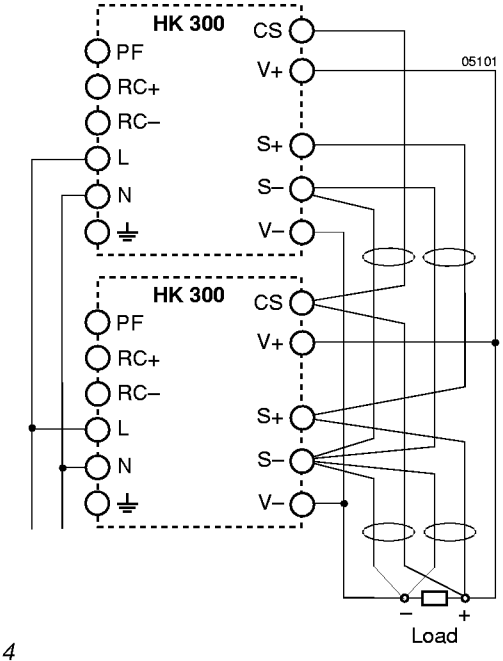


Fig. 4
Parallel connection of several modules, sense lines connected at connector side

Auxiliary Functions

Inhibit (i Input)

The outputs of the module may be enabled or disabled by means of a relay contact or opto-coupler between the inputs RC+ and RC–. If the inhibit function is not used, RC+ and RC– are not connected.

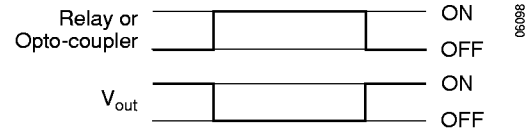


Fig. 5
Definition of inhibit signal

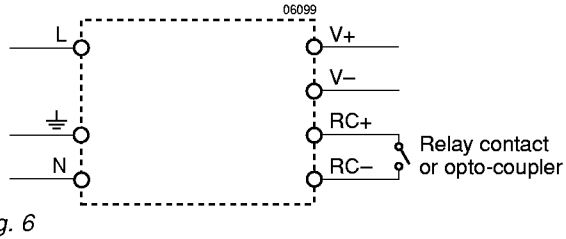


Fig. 6
Remote control (inhibit) connection

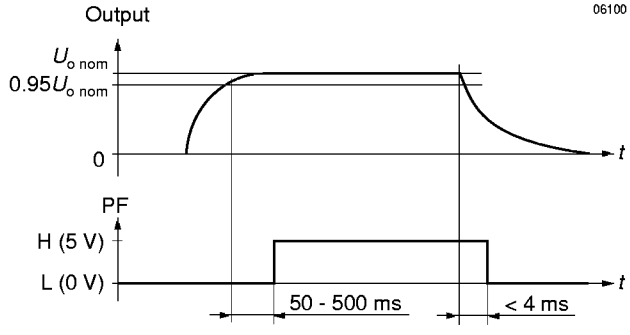


Fig. 7
Output response as a function of input voltage (on/off switching) or inhibit control

Power Fail Signal

The power fail signal toggles to high (H = 5 V) 50...500 ms after the output voltage has reached 95% of $U_{o\ nom}$. The sink current at 5 V is 1 mA. If the output voltage drops below 95% of $U_{o\ nom}$, the power fail signal drops to low (L = 0 V) after less than 4 ms.

Sense Lines

Note: Sense lines must always be connected!

This feature enables compensation of voltage drop across the connector contacts and the load lines including the diode in true redundant wired-OR system configurations.

Applying generously dimensioned cross-section load leads avoids troublesome voltage drop. To minimize noise pick-up, sense lines should be twisted and 330...470 µF capacitors connected between the voltage output and sense input. For unsymmetrical loads it is recommended to connect the sense lines directly at the terminals.

To ensure correct operation, both sense lines must be connected to their respective power output potential.

Fan Monitor

If the cooling fan is defective or mechanically blocked, the power supply is automatically turned-off. After fixing the problem the unit will return to normal operation. In case the fan monitor fails, the power supply is protected by over-temperature shut-down.

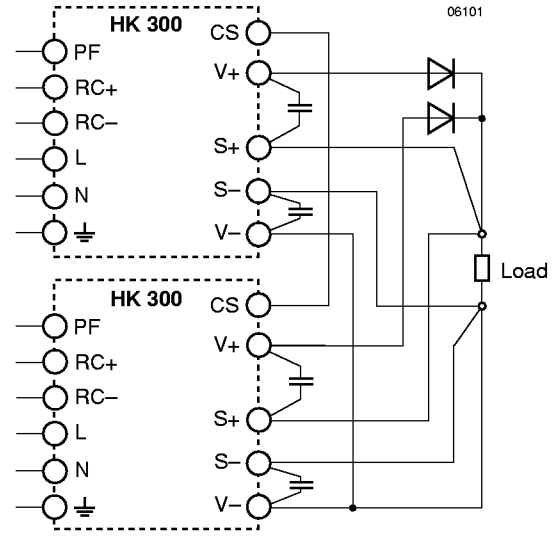


Fig. 8
Sense lines connection for redundant (n+1) or parallel operation using wired-OR diodes

Electromagnetic Compatibility (EMC)

A metal oxide VDR together with an input fuse and an input filter form an effective protection against high input transient voltages which typically occur in most installations, but especially in battery driven mobile applications. The HK family has been successfully tested to the following specifications:

Electromagnetic Immunity

Table 4: Immunity type tests

Phenomenon	Standard [1]	Level	Coupling mode [2]	Value applied	Waveform	Source imped.	Test procedure	In oper.	Perform.
Electrostatic discharge	IEC/EN 61000-4-2	x	air discharge to frame	6000 V_p	1/50 ns	330 Ω	10 positive and 10 negative discharges	yes	[3]
Electromagnetic field	IEC/EN 61000-4-3	x	antenna in 1 m distance	10 V/m	sine wave modulated w. 1 kHz		26...1000 MHz	yes	[3]
Electrical fast transient/burst	IEC/EN 61000-4-4	x	i/c, +i/–i	2000 V_p	5/50 ns	50 Ω	1 min positive 1 min negative transients per coupling mode	yes	[3]
Surge	IEC/EN 61000-4-5	x	i/c	2000 V_p	1.2/50 µs	12 Ω	5 pos. and 5 neg. surges per coupling mode	yes [4]	[3]

[1] Related and previous standards are referenced in *Technical Information: Standards*.
[2] i = input, c = case.
[3] Normal operation, no deviation from specifications.
[4] No load.

Electromagnetic Emissions

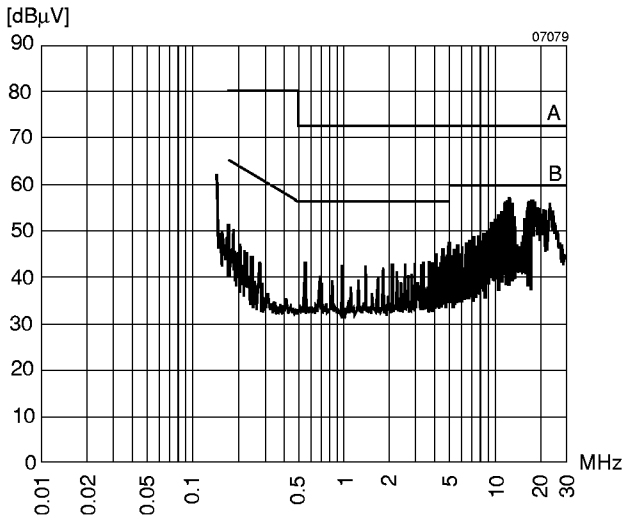


Fig. 9
Typical disturbance voltage (quasi-peak) at the input according to CISPR 11/22 and EN 55011/22, measured at $U_{i\ nom}$ and $I_{o\ nom}$. e.g. HK 300-48.

Immunity to Environmental Conditons

Table 5: Mechanical stress

Test		Parameters	
Ca	Humidity (no condensing)	Relative humidity:	30...85% Unit operating/storage
Ea	Shock	Acceleration: Bump duration: Number of bumps:	20 g_n (196 m/s^2) 11 ms, ±5 ms 18 (3 each direction) Unit not operating
Fc	Vibration	Frequency: Maximum vibration amplitude: Acceleration: Duration:	5...55 Hz 10 mm (5...10 Hz) 2 g_n (19.6 m/s^2, 10...55 Hz) 3 h (1 h each axis) Unit not operating

Table 6: Temperature specifications

Characteristic		min	max	Unit
T_A	Operating ambient temperature range without derating	0	50	°C
T_A	Operating ambient temperature range with derating (see *Thermal Considerations*)	0	60	
T_S	Storage temperature range	–20	75	

Table 7: MTBF Values

MTBF	Type	Ground Benign T_C =25°C
According to MIL-HDBK-217D	HK 300	122'000 h
	Fan (Life time)	30'000 h

Mechanical Data

Dimensions in mm. Tolerances ±1 mm unless otherwise indicated.

European Projection

09065

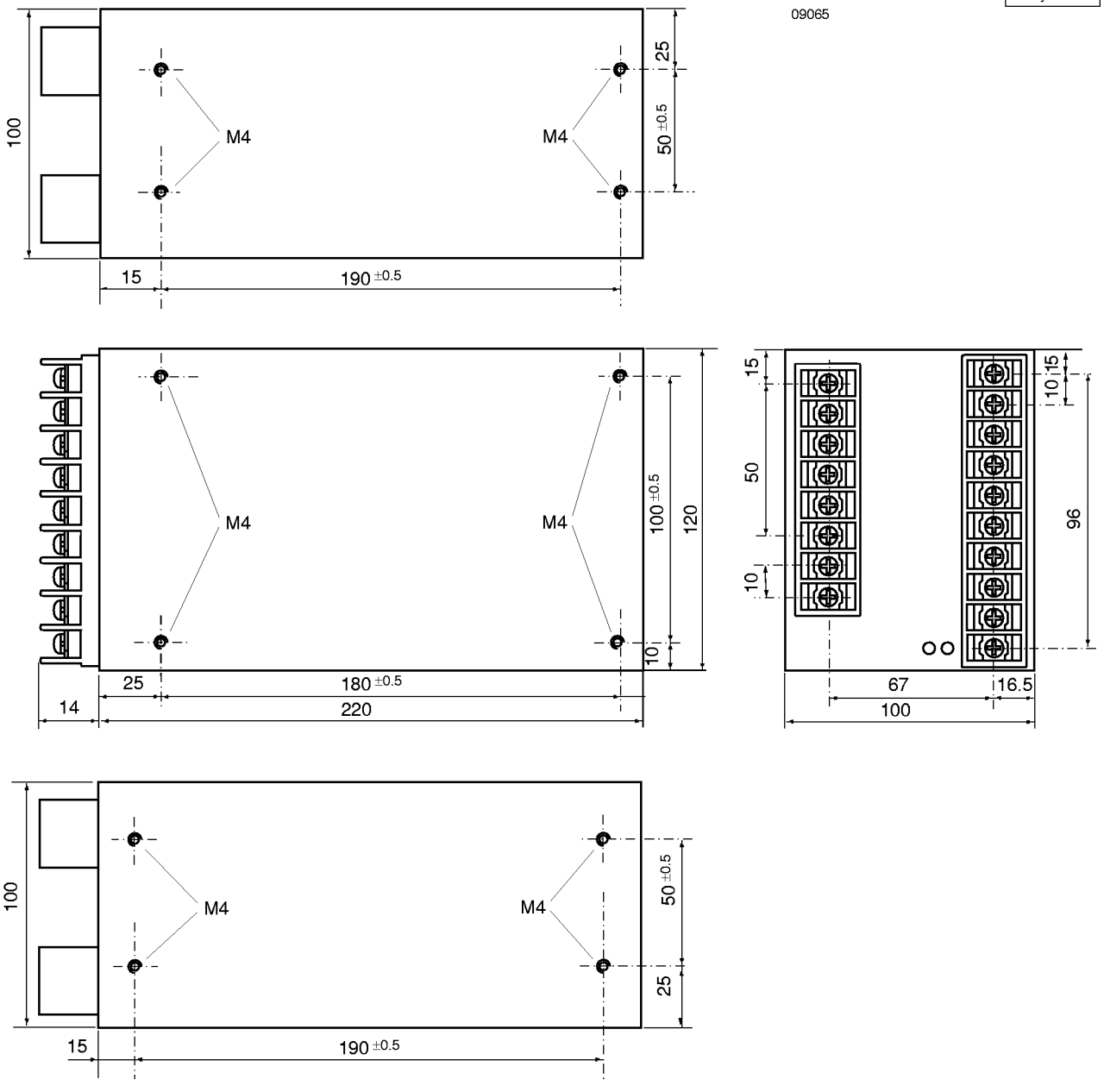


Fig. 10
HK 300, weight 2600 g

Safety and Installation Instructions

Installation Instructions

Our AC-DC converters are components, intended exclusively for inclusion within other equipment by an industrial assembly operation or by professional installers. Installation must strictly follow the national safety regulations in compliance with the enclosure, mounting, creepage, clearance, casualty, markings and segregation requirements of the end-use application. See also *Technical Information: Installation and Application.*

Connection to the system shall be made via the terminal block at the rear side of the unit according to *Terminal Assignment.*

For safety reasons it is essential to connect the FG and ACG terminals with protective earth. See also *Safety of operator accessible output circuit.*

A fuse is built-in in the connection from the L terminal of the unit. Since this fuse is designed to protect the unit in case of an overcurrent and does not necessarily cover all customer needs, an external fuse suitable for the application and in compliance with the local requirements should be installed in the wiring to the phase terminal L. A second fuse in the wiring to the neutral terminal N is needed if:

- Local requirements demand an individual fuse in each source line
- Neutral and earth impedance is high or undefined
- Phase and neutral of the mains are not defined or cannot be assigned to the corresponding terminals (L to phase and N to neutral)

Important: Do not open the modules, or guarantee will be invalidated.

Make sure that there is sufficient air flow possible for convection cooling. This should be verified by measuring the ambient temperature when the unit is installed and operated in the end-use application. The maximum specified ambient temperature $T_{A\,max}$ must not not be overriden, depending on output power and mounting method. See *Thermal Considerations* and table *Allowed output power by mounting method.*

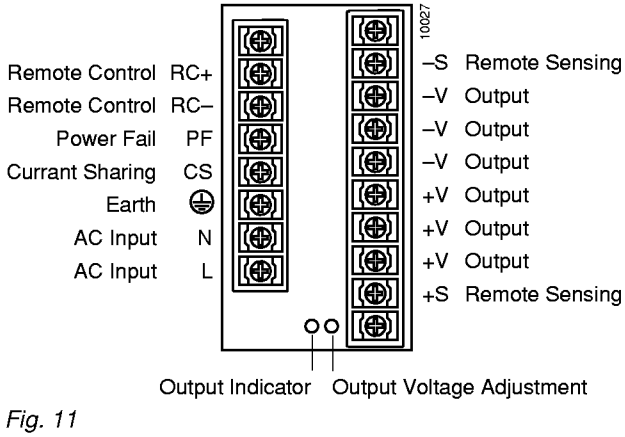


Fig. 11
Terminal designation of HK 300 types

Standards and approvals

The AC-DC converters correspond to class I equipment and are UL recognized according to UL 1950, UL recognized for Canada to CAN/CSA C22.2 No. 950-95 and LGA approved to IEC/EN 60950 standards.

The units have been evaluated for:

- Building in,
- Basic insulation between input and frame and double or reinforced insulation between input and output, based on their maximum input voltage.
- Operational insulation between output and frame,
- The use in a pollution degree 2 environment,
- Connecting the input to an overvoltage category II circuit if >150 V or an overvoltage category III circuit if ≤150 V.

The AC-DC converters are subject to manufacturing surveillance in accordance with the above mentioned UL, CSA, EN and with ISO 9001 standards.

Isolation

The electric strength test is performed as factory test in accordance with IEC/EN 60950 and UL 1950 and should not be repeated in the field. Melcher will not honour any guarantee claims resulting from electric strength field tests.

Table 8: Isolation

Characteristic	Input to frame	Input to output	Output to frame	Unit
Electric strength test voltage 1 s	3.0	3.0 [1]	-	kV_{rms}
	3.5	5.3 [1]	-	kV DC
Insulation resist. at 500 V DC	-	>100	>100	MΩ

[1] In accordance with IEC/EN 60950 only subassemblies are tested in factory with this voltage.

Protection Degree

The protection degree of the AC-DC converters is IP 20, exept in the vicinity ot the terminal block, where it depends on the installation.

Safety of operator accessible output circuit

If the output circuit of an AC-DC converter is operator accessible, it shall be an SELV circuit according to the IEC/EN 60950 related safety standards

The following table shows a possible installation configuration, compliance with which causes the output circuit of the AC-DC converter to be an SELV circuit according to IEC/EN 60950 up to a configured output voltage (sum of nominal voltages if in series or +/- configuration) of 44 V.

However, it is the sole responsibility of the installer to assure the compliance with the relevant and applicable safety regulations. More information is given in *Technical Information: Safety*.

Table 9: Safety concept leading to an SELV output circuit

Conditions	AC-DC converter	Installation	Result
Supply voltage	Grade of isolation, provided by the AC-DC converter	Measures to achieve the resulting safety status of the output circuit	Safety status of the AC-DC converter output circuit
Mains ≤250 V AC	Double or reinforced	Earthed frame	SELV circuit

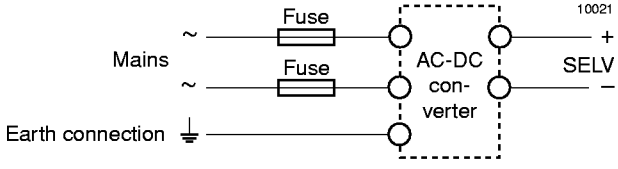


Fig. 12
Schematic safety concept
Use fuses and earth connection as per Installation Instructions *and table* Safety concept leading to an SELV output circuit.

Table 10: Safety approvals

Safety Approvals	UL 1950	CSA 234	TÜV [1]
HK 300	x	x	x

[1] IEC/EN 60950