250 W AC-DC Converters with PFC

KP-Family

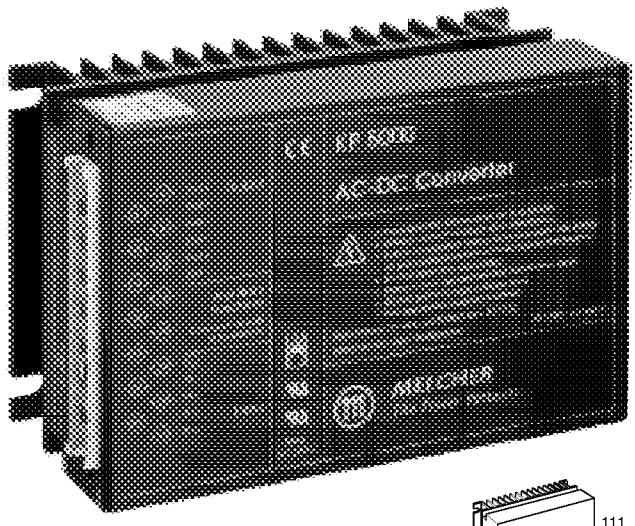
Preliminary

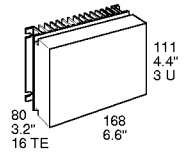
Input to output isolation
Double output: LKP 5000

- Power factor >0.95, harmonics < IEC/EN61000-3-2
- Output power up to 280 W
- Input over- and undervoltage lock-out
- Efficient input filter and built-in surge and transient suppression circuitry
- 4000 V_{rms} input to output electric strength test
- Fully isolated outputs
- Outputs open- and short-circuit proof

Safety according to IEC/EN 60950

Approvals in progress





Summary

The KP family is an extension of the K-family of AC-DC converters with an increased output power level of up to 280 W depending on the operating ambient temperature requirements. The KP converters are optimized for use in 230 V AC mains applications and feature high efficiency, high reliability, low output voltage noise and excellent dynamic response to load/line changes.

The converter inputs are protected against surges and transients occuring at the source lines. An input over- and undervoltage lock-out curcuitry disables the outputs if the input voltage is outside the specified range. The LKP types include an inrush current limitation preventing circuit breakers and fuses from being damaged at switch-on.

The outputs are open- and short-circuit proof and are protected against overvoltages by means of a built-in suppressor diode. The outputs can be inhibited by a logic signal applied to the connector pin 18 (i). If the inhibit function is not used pin 18 must be connected with pin 14 to enable the outputs (fail safe).

LED indicators display the status of the converter and allow visual monitoring of the system at any time.

Full input to output, input to case, output to case and output to output isolation is provided. The modules are designed and built according to the international safety standards IEC/EN 60950.

The case design allows operation up to an operating ambient temperatur of 71 °C with reduced output power. Depending on the ambient temperature requirements, however, the output power can be up to 280 W.

An internal temperature sensor generates an inhibit signal which disables the outputs if the case temperature T_C exceeds the specified limit. The outputs are automatically re-enabled when the temperature drops below the limit.

Various options are available to adapt the converters to individual applications. Especially for battery charger applications an external temperature sensor has been designed to allow for temperature compensated battery charging.

The modules may either be plugged into 19" rack systems according to DIN 41494 or be chassis mounted.

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Type Survey and Key Data

Non standard input/output configurations or special custom adaptations are available on request. See also *Commercial Information: Inquiry Form for Customized Power Supply.*

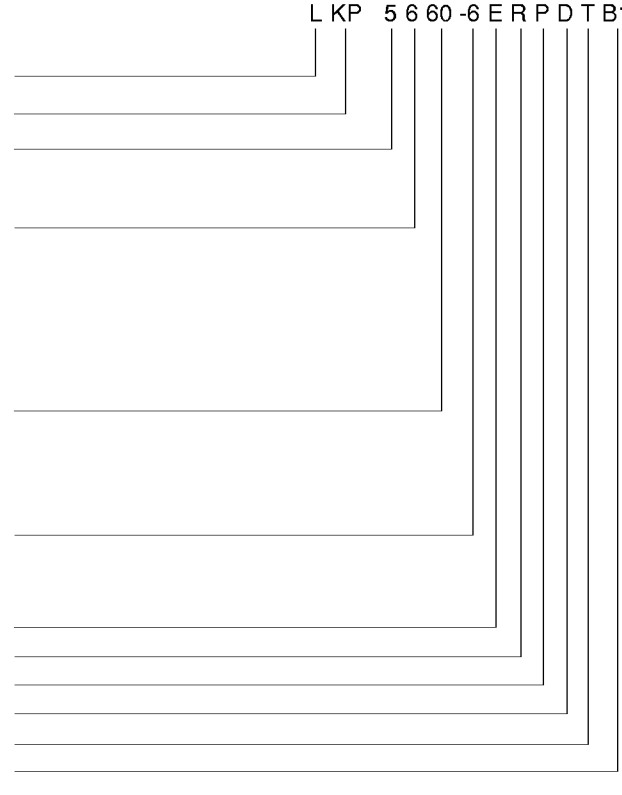
Table 1: Type survey

Nominal output voltage $U_{o\,nom}$ [V]	Output current $I_{o\,nom}$ [A]	Input voltage range U_i	Type designation	Options
24 [1]	10.4	187…255 V AC 47...63 Hz	LKP 5660-6R	-5, -7 E D P [4] T B1
25.25...28.25 [1]	9		LKP 5740-6R [3]	
24, 24	5.2, 5.2		LKP 5660-6R	
48 [2]	5.2		LKP 5660-6R	
50.5...56.5 [2]	4.5		LKP 5740-6R [3]	

[1] Parallel connection of U_{o1} and U_{o2}.
[2] Series connection of U_{o1} and U_{o2}.
[3] Designed for battery charging. Needs external temperature sensor.
[4] Option P not available for LKP 5740-6R.

Type Key and Product Marking

Type Key



Input voltage range U_i:
187…255 V AC, 47...63 Hz L
Family ..... KP
Number of outputs (5 for double outputs) 5
Nominal voltage output 1
rectifier version 6
battery charger version 7
Other specifications ..... 0...9
Symmetrical double output units:
Nominal voltage output 1/output 2, $U_{o1/2\,nom}$
24 V/24 V (48 V series connection) ..... 60 [1]
25.25...28.25 V (50.5...56.5 V ser. conn.) ..... 70 [1]
other symmetrical voltages ..... 80...99
Operational ambient temperature range T_A:
–25…50 °C ..... -5
–25…60 °C ..... -6
–25…71 °C ..... -7
Auxiliary functions and options:
Output voltage control input ..... R [2]
Inrush current limitation ..... E
Potentiometer (output voltage adjustment) ..... P [2]
Save data signal (D0...DD, to be specified) ... D
Current sharing ..... T
Cooling plate B1

[1] External wiring of main and second output depending upon the desired output configuration (see *R-Function for different output configurations.*
[2] Feature R excludes option P and vice versa. Option P not available for LKP 5740-6R.

Example: LKP 5740-6RD3: Power factor corrected AC-DC converter, input voltage range 187...255 V AC, double output, each providing 25.25...28.25 V/4.5 A, equipped with option R, undervoltage monitoring option, operational ambient temperature range –25...60 °C.

Product Marking

Main face: Basic type designation, applicable safety approval and recognition marks, CE mark, warnings, pin allocation, Melcher patents and company logo.

Front plate: Identification of LED's, test sockets and potentiometers.

Back plate: Specific type designation, input voltage range, nominal output voltages and output currents, pin allocation of options and auxiliary functions, fuse specification and degree of protection.

Rear face: Label with batch no., serial no. and data code including production site, modification status and date of production. Confirmation of successfully passed final test.

Auxiliary Functions

i Inhibit for Remote On and Off

Note: With open i input: Output is disabled (U_o = off).

The outputs of the module may be enabled or disabled by means of a logic signal (TTL, CMOS, etc.) applied between the inhibit input i and the negative pin of output 1 (Vo1–). In systems with several units, this feature can be used, for example, to control the activation sequence of the converters. If the inhibit function is not required, connect the inhibit pin 18 to pin 14 to enable the outputs (active low logic, fail safe). For output response refer to *Hold-up Time and Output Response*.

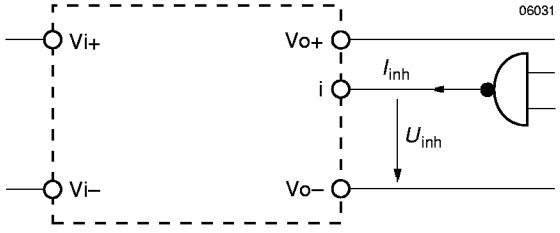


Fig. 1
Definition of U_{inh} and I_{inh}.

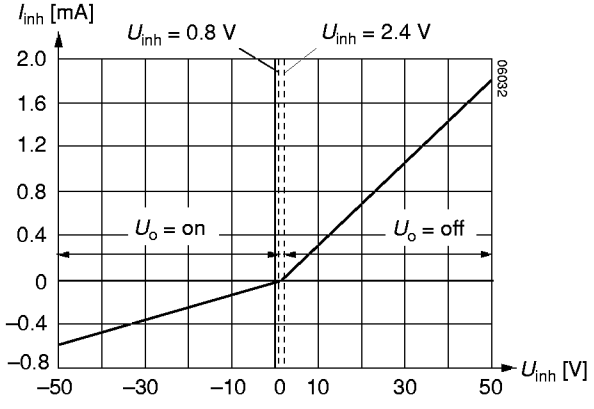


Fig. 2
Typical inhibit current I_{inh} versus inhibit voltage U_{inh}

Table 2: Inhibit characteristics

Characteristic			Conditions	min	typ	max	Unit
U_{inh}	Inhibit voltage	U_o = on	$U_{i\,min}$ ... $U_{i\,max}$	–50		0.8	V
		U_o = off		2.4		50	
I_{inh}	Inhibit current		U_{inh} = 0			–400	µA
t_r	Rise time				30		ms
t_f	Fall time		depending on I_o				

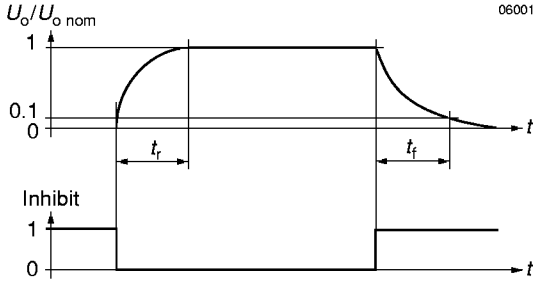


Fig. 3
Output response as a function of inhibit control

Thermal Considerations

If a converter is located in free, quasi-stationary air (convection cooling) at the indicated maximum ambient temperature $T_{A\,max}$ (see table *Temperature specifications)* and is operated at its nominal input voltage and output power, the temperature measured at the *Measuring point of case temperature* T_C (see *Mechanical Data*) will approach the indicated value $T_{C\,max}$ after the warm-up phase. However, the relationship between T_A and T_C depends heavily on the conditions of operation and integration into a system. The thermal conditions are influenced by input voltage, output current, airflow and temperature of surrounding components and surfaces. $T_{A\,max}$ is therefore, contrary to $T_{C\,max}$, an indicative value only.

Caution: The installer must ensure that under all operating conditions T_C remains within the limits stated in the table *Temperature specifications.*

Notes: Sufficient forced cooling or an additional heat sink allows T_A to be higher than 60°C (e.g. 70°C) if $T_{C\,max}$ is not exceeded.

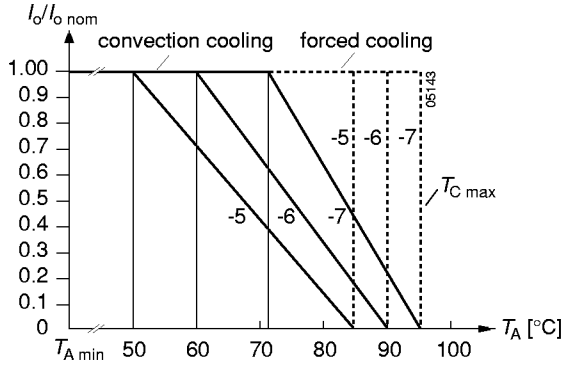


Fig. 4
Output current derating versus temperature for -5, -6 and -7 units.

Thermal Protection

A temperature sensor generates an internal inhibit signal which disables the outputs if the case temperature exceeds $T_{C\,max}$. The outputs are automatically re-enabled if the temperature drops below this limit.

Preliminary

Programmable Output Voltage (R-Function)

As a standard feature, the modules offer an adjustable output voltage, identified by letter R in the type designation. The control input R (pin 16) accepts either a control voltage U_{ext} or a resistor R_{ext} to adjust the desired output voltage. When not connected, the control input automatically sets the output voltage to $U_{o\,nom}$.

a) Adjustment by means of an external control voltage U_{ext} between pin 16 (R) and pin 14:

The control voltage range is 0...2.75 V DC and allows an output voltage adjustment in the range of approximately 0...110% $U_{o\,nom}$.

$$U_{ext} = \frac{U_o}{U_{o\,nom}} \cdot 2.5\ V \text{ (approximate formula)}$$

b) Adjustment by means of an external resistor:

Depending upon the value of the required output voltage the resistor shall be connected

either: Between pin 16 and pin 14 ($U_o < U_{o\,nom}$) to achieve an output voltage adjustment range of approximately 0...100% $U_{o\,nom}$

or: Between pin 16 and pin 12 ($U_o > U_{o\,nom}$) to achieve an output voltage adjustment range of approximately 100...110% $U_{o\,nom}$.

Warning:
- U_{ext} shall never exceed 2.75 V DC.
- The value of R'_{ext} shall never be less than the lowest value as indicated in table R'_{ext} (for $U_o > U_{o\,nom}$) to avoid damage to the unit!

Table 3a: R_{ext} for $U_o < U_{o\,nom}$; approximate values ($U_{i\,nom}$, $I_{o\,nom}$, series E 96 resistors); $R'_{ext} = \infty$

$U_{o\,nom}$ = 24 V		
U_o [V] [1]		R_{ext} [kΩ]
4	8	0.825
6	12	1.33
8	16	1.96
10	20	2.87
12	24	3.83
14	28	5.61
16	32	8.25
18	36	12.1
20	40	19.6
22	44	46.4

Table 3b: R'_{ext} for $U_o > U_{o\,nom}$; approximate values ($U_{i\,nom}$, $I_{o\,nom}$, series E 96 resistors); $R_{ext} = \infty$

$U_{o\,nom}$ = 24 V		
U_o [V] [1]		R'_{ext} [kΩ]
24.25	48.5	3160
24.5	49.0	1620
24.75	49.5	1100
25.0	50.0	825
25.25	50.5	681
25.5	51.0	562
25.75	51.5	511
26.0	52.0	464
26.25	52.5	422
26.4	52.8	383

[1] First column: single output units or double output units with separated outputs, second column: outputs in series connection

Remarks:
- The R-Function excludes option P (output voltage adjustment by potentiometer).
- If the output voltages are increased above $U_{o\,nom}$ via R-input control, option P setting, remote sensing or option T, the output current(s) should be reduced accordingly so that $P_{o\,nom}$ is not exceeded.
- The R-input (as well as option P) is related to the main output.
- With double output units the second output follows the value of the controlled main output. Resistor values as indicated for the single output units should be used.
- For correct output voltage adjustment of double output units the external wiring of the outputs should be according to *R-function for different output configurations* depending upon the desired output configuration.
- In case of parallel connection the output voltages should be individually set within a tolerance of 1...2%.

Battery Charging/Temperature Sensor

The LKP 5740-6R are intended for lead acid battery charger applications. For optimum battery charging and life expectancy of the battery an external temperature sensor may be connected to the R-input. The sensor is mounted as close as possible to the battery pole and adjusts the output voltage of the LKP unit according to the temperature of the battery (which is related to the load of the battery and the ambient temperature).

Depending on the cell voltage and the temperature coefficient of the battery, different sensor types are available.

For more information please ask Melcher.

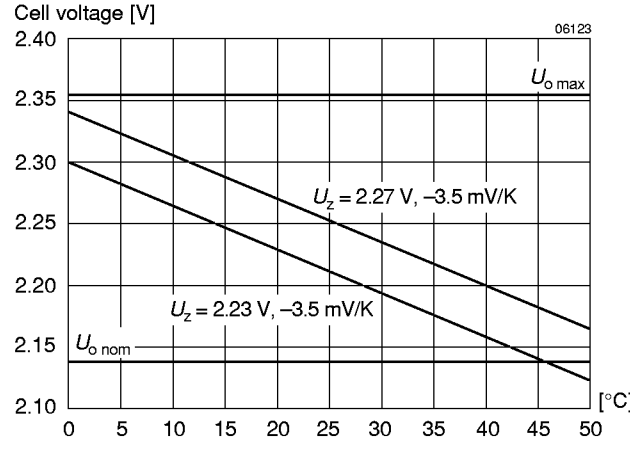


Fig. 5
Dependance of output voltage vs. temperature for defined temperature coefficient.

R-Function for different output configurations

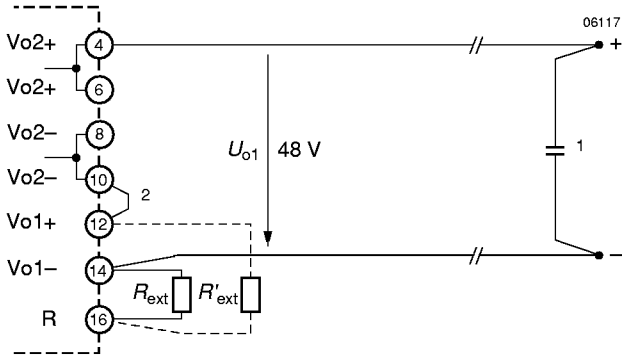


Fig. 6a
LKP 5000 with H15 connector. R-input for output voltage control. Wiring for output voltage 48 V with main and second output connected in series.

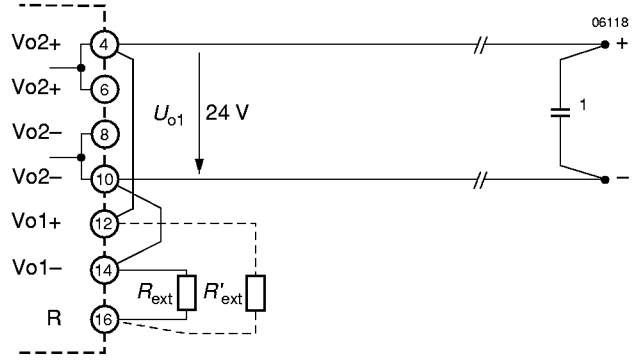


Fig. 6b
LKP 5000 with H15 connector. R-input for output voltage control. Wiring for output voltage 24 V with main and second output connected in parallel.

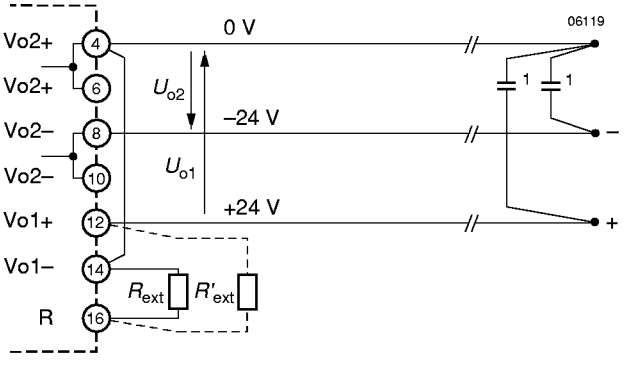


Fig. 6c
LKP 5000 with H15 connector. R-input for output voltage control. Wiring of main and second output for two symmetrical output voltages U_{o1} and U_{o2}: ±24 V.

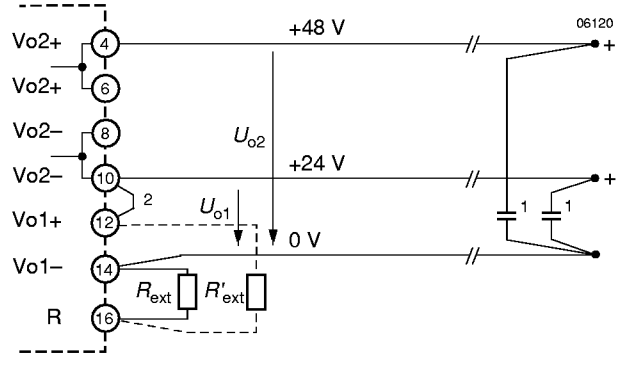


Fig. 6d
LKP 5000 with H15 connector. R-input for output voltage control. Wiring of main and second output for two output voltages U_{o1} and U_{o2}: +24 V and +48 V.

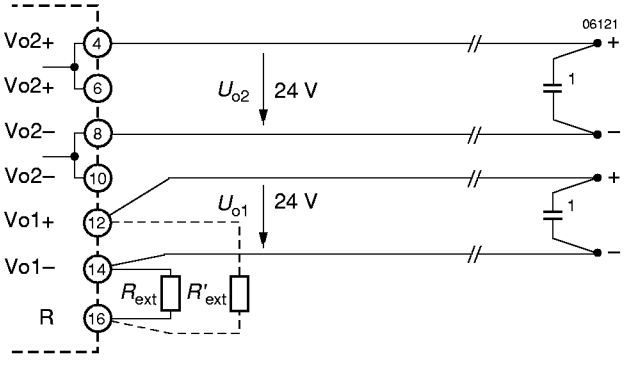


Fig. 6e
LKP 5000 with H15 connector. R-input for output voltage control. Wiring of main and second output for two output voltages U_{o1} and U_{o2}: 24 V/24 V, the outputs are galvanically isolated.

[1] A ceramic multilayer capacitor connected across the load reduces ripple and spikes.
[2] Shortest possible wiring for series connection at the female connector

Remarks:

Double output units fitted with H15 connectors have the output pins of the second output, pins 4/6 and 8/10, internally paralleled.

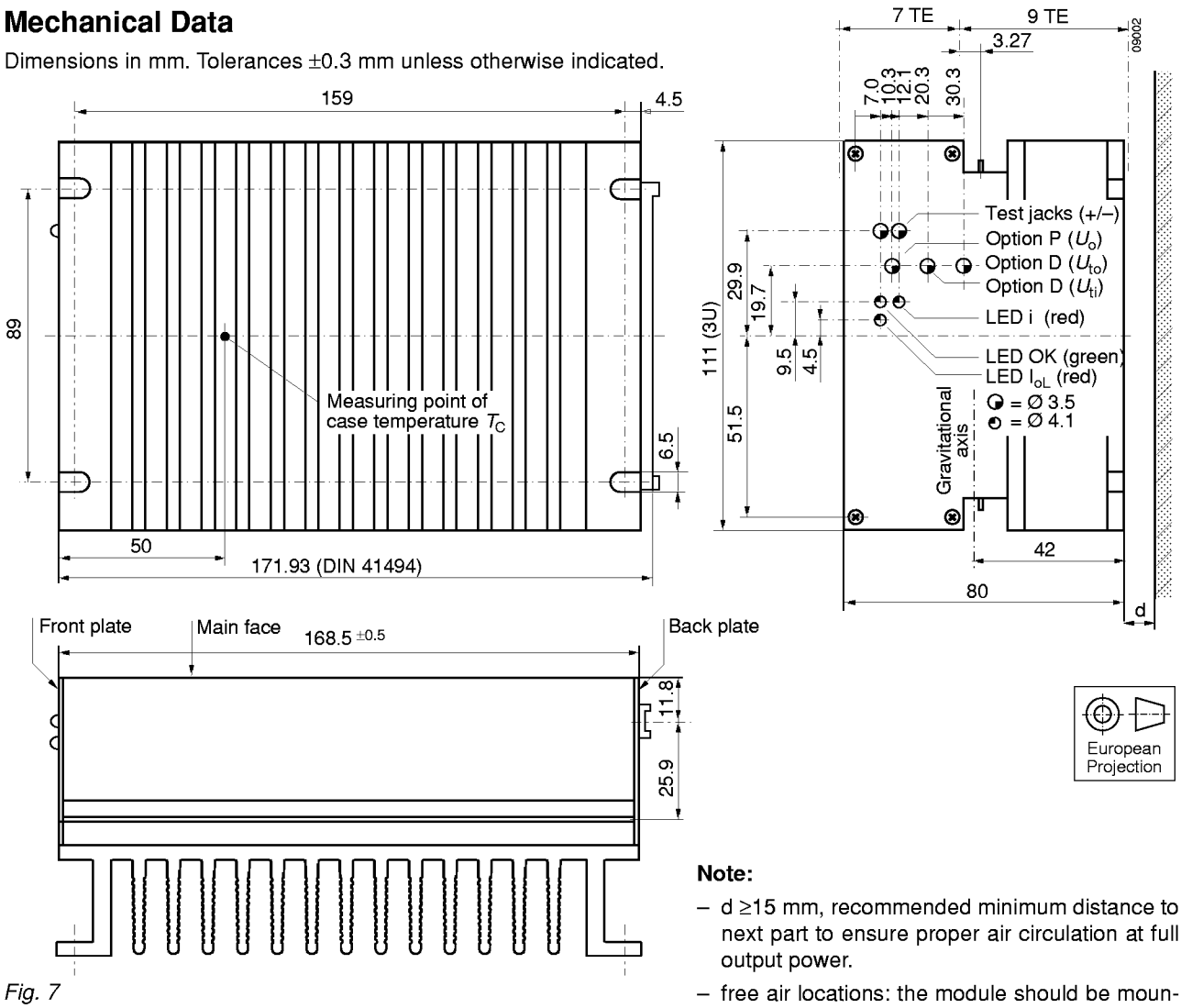
It is recommended that pins 4/6 and 8/10 be directly paralleled at the female connector as well to reduce the voltage drop across the connector.

Please note: U_{o2} varies depending upon its own load and the load on output 1.

Preliminary

Mechanical Data

Dimensions in mm. Tolerances ±0.3 mm unless otherwise indicated.



Note:

- d ≥15 mm, recommended minimum distance to next part to ensure proper air circulation at full output power.
- free air locations: the module should be mounted with fins in vertical position to achieve a maximum air flow through the heat sink.

Fig. 7
Case K02 with heatsink, case aluminium, black finish and self cooling, weight: approx. 1.55 kg

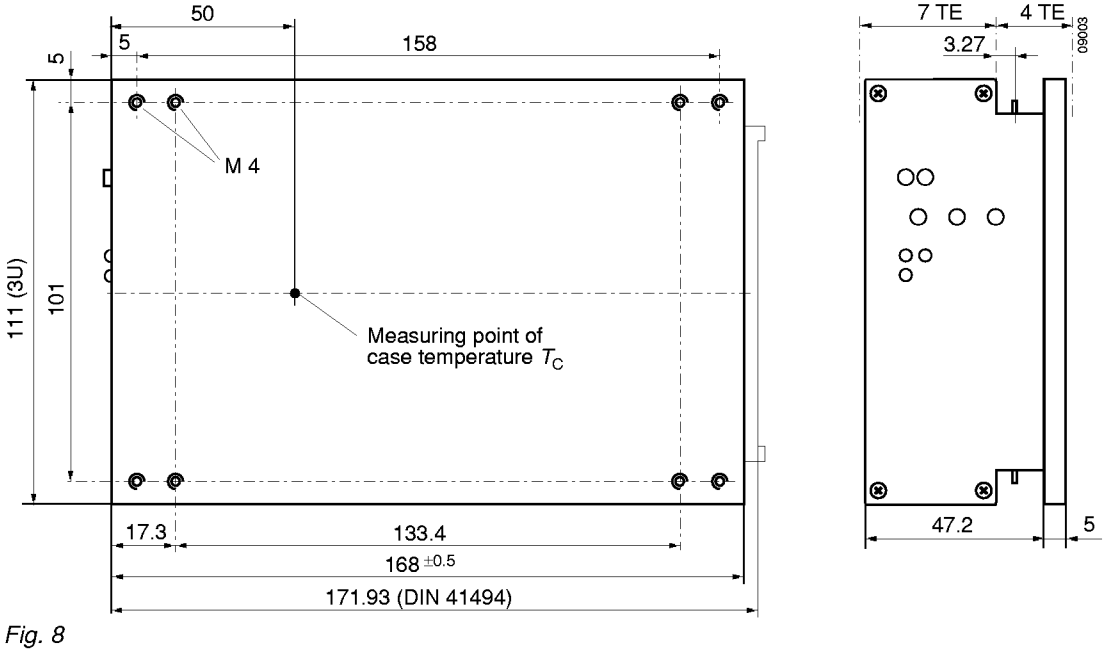


Fig. 8
Case K02 with option B1 (cooling plate), case aluminium, black finish and self cooling, weight: Approx. 1.15 kg

Safety and Installation Instructions

Connector Pin Allocation

The connector pin allocation table defines the electrical potentials and the physical pin positions on the H15 connector. Pin no. 24, the protective earth pin present on all LKP AC-DC converters is leading, ensuring that it makes contact with the female connector first.

Table 4: H15 and H15 S2 Connector pin allocation

Pin No.	Connector type H15	
	LKP 5000	
4	Vo2+	Output 2
6	Vo2+	Output 2
8	Vo2–	Output 2
10	Vo2–	Output 2
12	Vo1+	Output 1
14	Vo1–	Output 1
16	R [1]	Control of U_{o1}
18	i	Inhibit
20	D	Save data
22	T	Current sharing
24 [2]	⏚	Protective earth
26	N ~	Neutral
28	N ~	Neutral
30	P ~	Phase
32	P ~	Phase

[1] Feature R excludes option P and vice versa
[2] Leading pin (pregrounding)

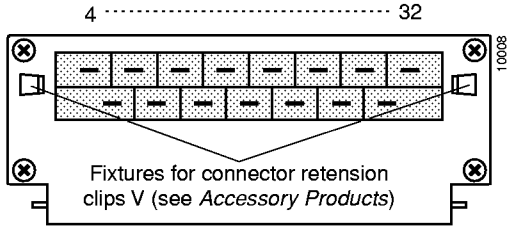


Fig. 9
View of module's male connectors

Protection Degree

Condition: Female connector fitted to the unit.
IP 30: All units except those with option P, and except those with option D with potentiometer.
IP 20: All units fitted with option P, or with option D with potentiometer.

Installation Instructions

The KP-family 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.

Connection to the system shall be made via the female connector H15 (see *Accessories*). Other installation methods may not meet the safety requirements.

The AC-DC converters are provided with pin no. 24 (⏚), which is reliably connected with their case. For safety reasons it is essential to connect this pin with the protective earth of the supply system.

An input fuse is built-in in the connection from pins no. 30 and 32 (P~) 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 might be necessary in the wiring to one or both input potentials, pins nos. 26 and 28 and/or nos. 30 and 32.

Important: Whenever the inhibit function is not in use, pin no. 18 (i) should be connected to pin no. 14 (Vo1–) to enable the output(s).

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

Due to high current values, all LKP units provide two internally parallel connected contacts for certain paths (pins 4/6, 8/10, 26/28 and 30/32, respectively). It is recommended to connect load and supply to both female connector pins of each path in order to keep the voltage drop across the connector pins to an absolute minimum and to not overstress the connector contacts if currents are higher than approx. 8 A. The connector contacts are rated 8 A over the whole temperature range.

Make sure that there is sufficient air flow available for convection cooling. This should be verified by measuring the case temperature when the unit is installed and operated in the end-use application. The maximum specified case temperature $T_{C\,max}$ shall not be exceeded. See also *Thermal Considerations.*

Check for hazardous voltages before altering any connections.

The output provides a hazardous energy level according to IEC/EN 60950.

Ensure that a unit failure (e.g. by an internal short-circuit) does not result in a hazardous condition. See also *Safety of operator accessible output circuit.*

Cleaning Agents

In order to avoid possible damage, any penetration of cleaning fluids is to be prevented, since the power supplies are not hermetically sealed.

Preliminary

Standards and Approvals

All AC-DC converters correspond to class I equipment. They 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. (Approvals in progress)

The units have been evaluated for:

- Building in
- Basic insulation between input and case, based on 250 V AC and 400 V DC
- Double or reinforced insulation between input and output, based on 250 V AC and 400 V DC
- Operational insulation between output and case.
- Operational insulation between output and output
- The use in a pollution degree 2 environment
- Connecting the input to a primary or secondary circuit which is subject to a maximum transient rating of 2500 V (overvoltage category III based on a 110 V primary circuit, overvoltage category II based on a 230 V primary circuit).

The AC-DC converters are subject to manufacturing surveillance in accordance with the above mentioned UL, CSA, EN and ISO 9001 standards. (nor yet established, expected for June 98)

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.

Important: Testing by applying AC voltages will result in high and dangerous leakage currents flowing through the Y-capacitors (see fig. *Block diagram*).

Table 5: Isolation

Characteristic		Input to case	Input to output	Output to case	Output to output	Unit
Electric strength test voltage	Required according to IEC/EN 60950	1.5	3.0	–	–	kV_{rms}
		2.1	4.2	–	–	kV DC
	Actual factory test 1 s	2.8	5.6 [1]	1.4	0.14	
	AC test voltage equivalent to actual factory test	2.0	4.0 [1]	1.0	0.1	kV_{rms}
Insulation resistance at 500 V DC		>300	>300	>300	>100 [2]	MΩ

[1] In accordance with IEC/EN 60950 only subassemblies are tested in factory with this voltage.
[2] Tested at 100 V DC.

For creepage distances and clearances refer to *Technical Information: Safety.*

Leakage Currents in AC-DC operation

Leakage currents flow due to internal leakage capacitance and RFI suppression Y-capacitors. The current values are proportional to the mains voltage and nearly proportional to the mains frequency and are specified at an input voltage of 254 V (50 Hz) where phase, neutral and protective earth are correctly connected as required for class I equipment.

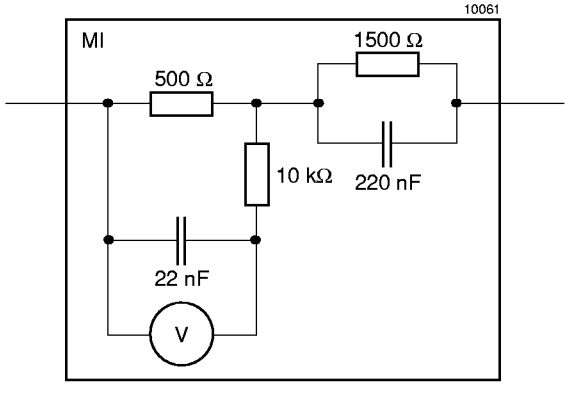


Fig. 10
Measuring instrument (MI) for earth leaking current tests according to IEC/EN 60950.

Under test conditions the leakage current flows through a measuring instrument (MI) as described in fig. *Measuring instrument for earth leakage current tests*, which takes into account impedance and sensitivity of a person touching unearthed accessible parts. The current value is calculated by dividing the measured voltage by 500 Ω. If inputs of K-units are connected in parallel, their individual leakage currents are added.

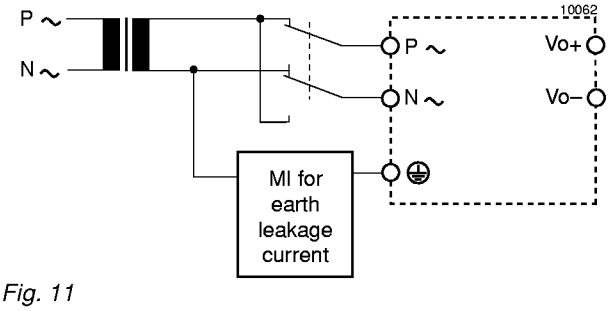


Fig. 11
Test set-up

Table 6: Leakage currents

Characteristic		Class I LKP 5000	Unit
Maximum earth leakage current	Permissible according to IEC/EN 60950	3.5	mA
	Specified value at 254 V, 50 Hz	0.82	

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 an K-family 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 36 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 7: Safety concept leading to an SELV output circuit

Conditions	AC-DC converter	Installation	Result
Nominal voltage	Grade of insulation between input and output 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 case [1] and installation according to the applicable standards	SELV circuit

[1] The earth connection has to be provided by the installer according to the relevant safety standards, e.g. IEC/EN 60950.

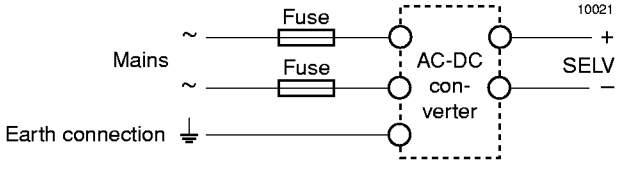


Fig. 12
Schematic safety concept. Use fuses and earth connection as per Installation Instructions and table Safety concept leading to an SELV output circuit.

Preliminary

Description of Options

Table 8: Survey of options

Option	Function of Option	Characteristics
E	Electronic inrush current limitation circuitry	Active inrush current limitation
P [1, 2]	Potentiometer for fine adjustment of output voltage	Adjustment range +10/–60 % of $U_{o\,nom}$ excludes R input
D	Input and/or output undervoltage monitoring circuitry	Safe data signal output (Versions D0...DD)
T	Current sharing	Interconnect T-pins if paralleling outputs (3 units max.)
B1	Cooling plate	Replaces standard heat sink, allowing direct chassis-mounting

[1] Option R excludes option P and vice versa.
[2] Option P not available for LKP 5740-6R

Option T Current Sharing

This option ensures that the output currents are approximately shared between all paralleled modules and increases system reliability. To use this facility, simply interconnect the T pins of all modules. The load leads should have equal length and cross section to ensure equal voltage drops. Not more than 5 units should be connected in parallel. If output voltage adjustment is requested we strongly recommend to use the R-input instead of option P, as with option P the required setting accuracy is difficult to achieve. The output voltages must be individually set prior to paralleling to within a tolerance of 1...2% or the R pins should be connected together.

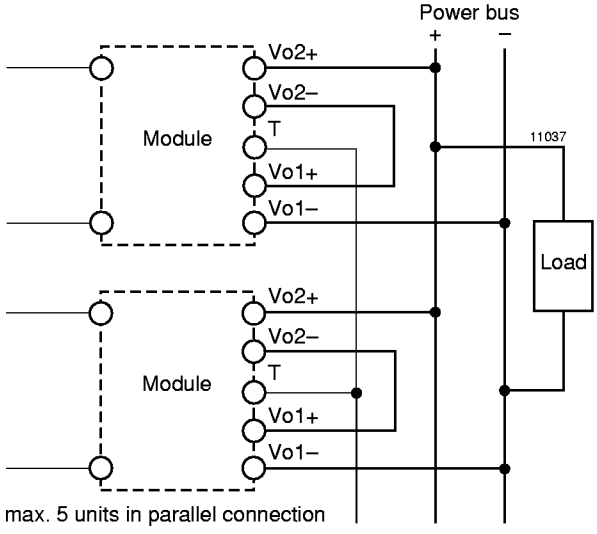


Fig. 13
Paralleling of double output units using option T with Power Bus

Option P Potentiometer

The potentiometer provides an output voltage adjustment range of +10/–60% of $U_{o\,nom}$ and is accessible through a hole in the front cover. This feature enables compensation for voltage drops across the connector and wiring. Option P is not recommended if units are connected in parallel.

Option P excludes the R-function. With double output units both outputs are affected by the potentiometer setting (doubling the voltage setting if the outputs are in series).

If the output voltages are increased above $U_{o\,nom}$ via R-input control, option P setting, remote sensing or option T, the output current(s) should be reduced accordingly so that $P_{o\,nom}$ is not exceeded.

E Inrush Current Limitation

The converters may be supplemented by an electronic circuit (option E, replacing the standard built-in NTC) to achieve an enhanced inrush current limiting function.

Table 9: Inrush current characteristics with option E

Characteristics U_i = 230 V AC		LKP typ	LKP max	Unit
$I_{inr\,p}$	Peak inrush current	–	21.7	A
t_{inr}	Inrush current duration	35	50	ms

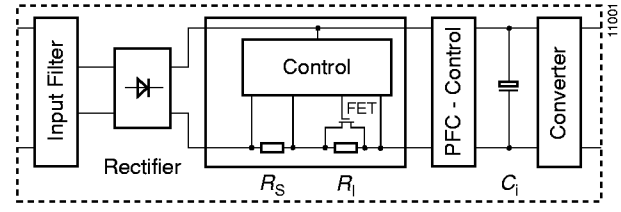


Fig. 14
Option E block diagram

Precaution:
Subsequent switch-on cycles at start-up are limited to max. 10 cycles during the first 20 seconds (cold unit) and at continuing on/off (T_C = 95°C) max. 1 cycle every 8 sec.

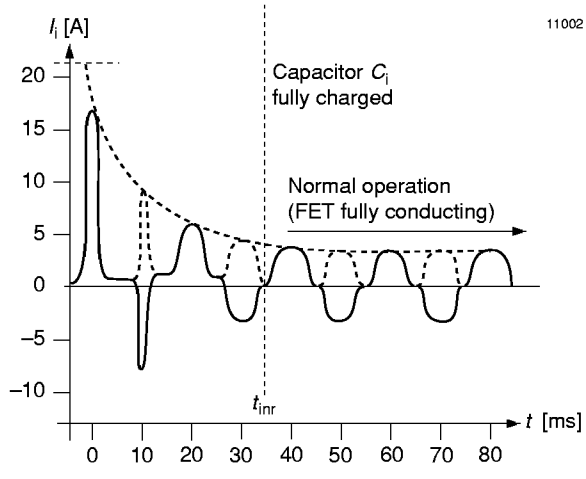


Fig. 15
Inrush current with option E, U_i = 230 V AC, $P_o = P_{o\,nom}$

Option D Undervoltage Monitor

The input and/or output undervoltage monitoring circuit operates independently of the built-in input undervoltage lockout circuit. A logic "low" (JFET output) or "high" signal (NPN output) is generated at pin 20 as soon as one of the monitored voltages drops below the preselected threshold level U_t. The return for this signal is Vo1–. The D output recovers when the monitored voltage(s) exceed(s) $U_t + U_h$. The threshold level U_{ti} is adjusted in the factory. The threshold level U_{to} is either adjusted by a potentiometer, accessible through a hole in the front cover, or factory adjusted to a fixed value specified by the customer.

Option D exists in various versions D0...DD as shown in the following table.

Table 10: Undervoltage monitoring functions

Output type JFET	Output type NPN	Monitoring U_i	Monitoring U_{o1}	Minimum adjustment range of threshold level U_t U_{ti}	Minimum adjustment range of threshold level U_t U_{to}	Typical hysteresis U_{ho} [% of U_t] for $U_{t\,min}$...$U_{t\,max}$ U_{ho}
D1	D5	no	yes	-	3.5...40 V [1]	2.5...0.6
D2	D6	yes	no	355V DC [4]	-	-
D3	D7	yes	yes	355V DC [4]	(0.95...0.985 U_{o1}) [2]	"0"
D4	D8	no	yes	-	(0.95...0.985 U_{o1}) [2]	"0"
D0	D9	no	yes	-	3.5...40 V [3]	2.5...0.6
		yes	yes	355V DC [4]	3.5...40 V [3]	2.5...0.6
	DD	yes	yes	355V DC [4]	3.5...40 V [1]	2.5...0.6

[1] Threshold level adjustable by potentiometer
[2] Fixed value. Tracking if U_{o1} adjusted via R-input, option P or sense lines.
[3] The threshold level permanently adjusted according to customer specification ±2% at 25 °C. Any value within the specified range is basically possible but causes a special type designation in addition to the standard option designations (D0/D9)!
[4] Option D monitors the boost regulator output voltage. The trigger level is adjusted in the factory to 355 V DC.

JFET output (D0…D4):

Connector pin D is internally connected via the drain-source path of a JFET (self-conducting type) to the negative potential of output 1. $U_D \leq 0.4$ V (logic low) corresponds to a monitored voltage level (U_i and/or U_{o1}) $< U_t$. The current I_D through the JFET should not exceed 2.5 mA. The JFET is protected by a 0.5 W Zener diode of 8.2 V against external overvoltages.

U_i, U_{o1} status	D output, U_D
U_i or $U_{o1} < U_t$	low, L, $U_D \leq 0.4$ V at $I_D = 2.5$ mA
U_i and $U_{o1} > U_t + U_h$	high, H, $I_D \leq 25$ µA at $U_D = 5.25$ V

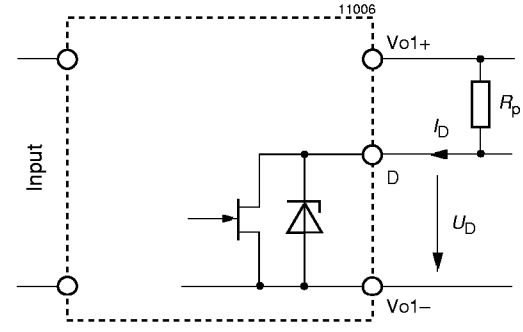


Fig. 16
Option D0...D4: JFET output, $I_D \leq 2.5$ mA

NPN output (D5...DD):

Connector pin D is internally connected via the collector-emitter path of a NPN transistor to the negative potential of output 1. $U_D < 0.4$ V (logic low) corresponds to a monitored voltage level (U_i and/or U_{o1}) $> U_t + U_h$. The current I_D through the open collector should not exceed 20 mA. The NPN output is not protected against external overvoltages. U_D should not exceed 40 V.

U_i, U_{o1} status	D output, U_D
U_i or $U_{o1} < U_t$	high, H, $I_D \leq 25$ µA at $U_D = 40$ V
U_i and $U_{o1} > U_t + U_h$	low, L, $U_D \leq 0.4$ V at $I_D = 20$ mA

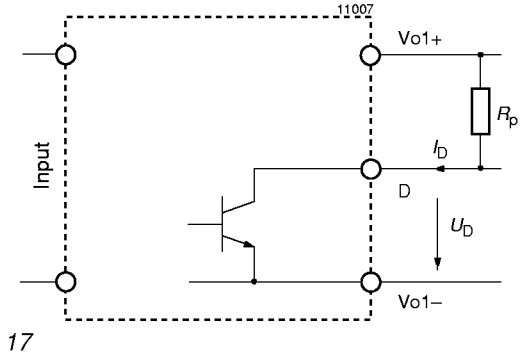


Fig. 17
Option D5...DD: NPN output, $U_{o1} \leq 40$ V, $I_D \leq 20$ mA

Table 11: D-output logic signals

Version of D	$U_i < U_t$ resp. $U_o < U_t$	$U_i > U_t + U_h$ resp. $U_o > U_t$	Configuration
D1, D2, D3, D4, D0	low	high	JFET
D5, D6, D7, D8, D9, DD	high	low	NPN