


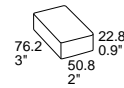
10 and 25 Watt AC-DC Converters

HR Series GR Series

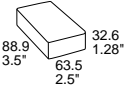
Single and dual output

- Universal AC input
- Class II equipment (double insulation) 
- 3000 V AC input to output electric strength test
- High efficiency up to 86%
- Short circuit protection
- High level of electromagnetic compatibility

Safety according to IEC/EN 60950



LHR



LGR

Summary

The HR/GR series of flyback switching power modules consists of single and dual output AC-DC converters. Fully encapsulated case, compact size and high reliability make the HR/GR series an excellent choice when a print mountable AC-DC converter in space critical applications is required. The universal input range and a built-in input Pi-Filter allows flexible operation in a wide variety of electronic

equipment. Fine output voltage trimming is achieved by an additional trim pin. Safety approvals and EMC fully comply with world wide requirements.

Key applications

Typical applications include, but are not limited to factory automation, off-site test and measurement, and communications equipment.

Type Survey and Key Data

Table 1: Type survey

Output 1		Output 2		Output power $T_A = 50^\circ\text{C}$ $P_{o\max}$ [W]	Input voltage range $U_{i\min} \dots U_{i\max}$	Efficiency ¹ typ [%]	Type designation
$U_{o\text{nom}}$ [V DC]	$I_{o\text{nom}}$ [mA]	$U_{o\text{nom}}$ [V DC]	$I_{o\text{nom}}$ [mA]				
3.3	3000	-	-	10	85...265 V AC 47...400 Hz	73	LHR 1101-2
3.3	7000	-	-	23		75	LGR 1101-2
5	2000	-	-	10	110...330 V DC	73	LHR 1001-2
5	5000	-	-	25		76	LGR 1001-2
12	840	-	-	10		75	LHR 1301-2
12	2100	-	-	25		78	LGR 1301-2
15	670	-	-	10		75	LHR 1501-2
15	1700	-	-	25		80	LGR 1501-2
24	420	-	-	10		77	LHR 1601-2
24	1000	-	-	25		77	LGR 1601-2
+5	1000	+12	420	10		73	LHR 2020-2
+5	2500	+12	1000	24.5		78	LGR 2020-2
+12	420	-12	420	10	77	LHR 2320-2	
+12	1000	-12	1000	25	78	LGR 2320-2	
+15	335	-15	335	10	77	LHR 2540-2	
+15	800	-15	800	25	78	LGR 2540-2	

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

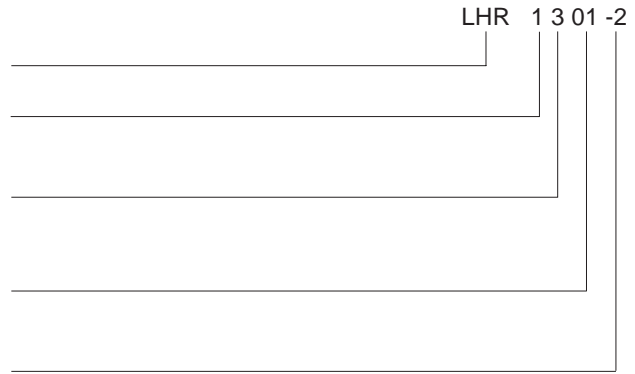
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Type Key

Type Key

Series	10 W	LHR
	25 W	LGR
Number of outputs	1, 2
Output 1	3.3 V DC	1
	5 V DC	0
	12 V DC	3
	15 V DC	5
	24 V DC	6
Output 2	12 V DC	20
	15 V DC	40
Ambient temperature range T_A :		
	-10...50°C	-2



Example: LHR 1301-2 = AC-DC converter providing 12 V/840 mA, 10 W output

Functional Description

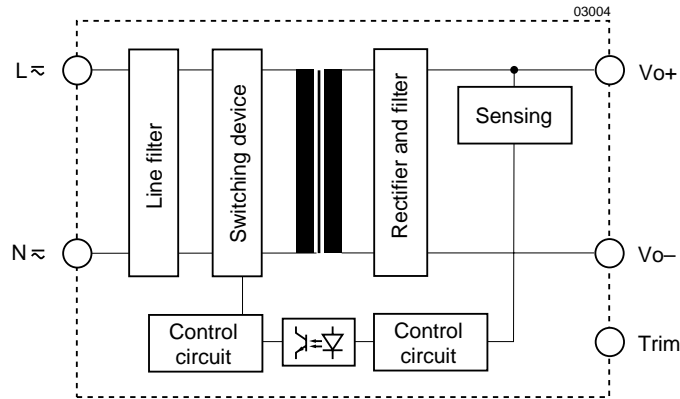


Fig. 1
Block diagram LHR, LGR with single output

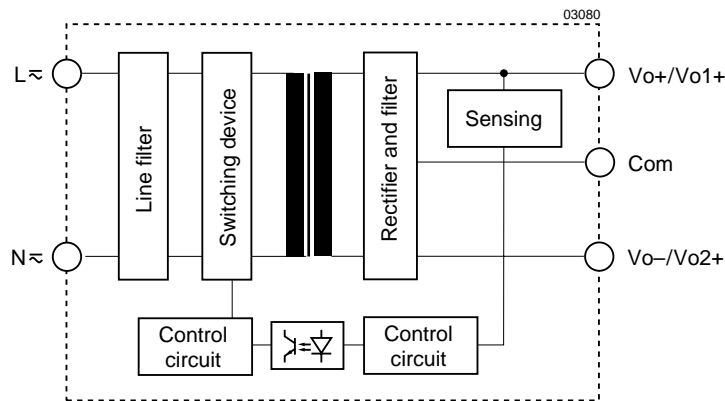


Fig. 2
Block diagram LHR, LGR with dual output

Electrical Input Data

General Condition: $T_A = 25^\circ\text{C}$ unless otherwise specified

Table 2: Input data

Characteristics		LHR	LGR	Unit
$U_{i \text{ rated}}$	Rated input voltages	100/230	100/230	V AC
U_i	Input voltage range	85...265	85...265	
		110...330	110...330	V DC
f_i	Line frequency	47...63	47...63	Hz
$I_{i \text{ max}}$	Input current at 100/230 V AC ¹	0.3/0.2	0.6/0.4	A
$I_{inr \text{ max}}$	Inrush current	25	30	

¹ At $I_{o \text{ nom}}$.

Electrical Output Data

General Condition:

- $T_A = 25^\circ\text{C}$ unless otherwise specified.
- Trim input not connected.

Table 3a: Output data for single output units

Output			LHR 1101-2			LHR 1001-2			LHR 1301-2			Unit
Characteristics	Conditions		min	typ	max	min	typ	max	min	typ	max	
U_o	Output voltage	$U_{i \text{ rated}}, I_{o \text{ nom}}$	3.3			4.9	5	5.1	11.76	12	12.24	V
$U_{o \text{ adj}}$	Adjustable voltage range		± 10			± 10			± 10			%
$I_{o \text{ nom}}$	Nominal output current	$U_{i \text{ min}} \dots U_{i \text{ max}}$	3000			2000			840			mA
u_o	Output voltage noise (BW = 20 MHz)	$U_{i \text{ rated}}, I_{o \text{ nom}}$	100	150		100	150		100	150		mV _{pp}
$U_{o \text{ U}}$	Static line regulation	$U_{i \text{ min}} \dots U_{i \text{ max}}, I_{o \text{ nom}}$	± 1			± 1			± 1			%
$U_{o \text{ L}}$	Static load regulation	$U_{i \text{ rated}}, I_o = 0 \leftrightarrow I_{o \text{ nom}}$	± 2			± 2			± 2			
t_r	Transient recovery time	$I_o = 1 \leftrightarrow 0.5 I_{o \text{ nom}}$	500			500			500			μs
$t_{h \text{ typ}}$	Hold-up time	110/230 V	10/80			10/80			10/80			ms
U_o	Temperature coefficient	$U_{i \text{ rated}}, I_{o \text{ nom}}$	± 0.05			± 0.05			± 0.05			%/K
f_s	Switching frequency		90	110		90	110		90	110		kHz

Table 3b: Output data for single output units

Output			LHR 1501-2			LHR 1601-2			Unit
Characteristics	Conditions		min	typ	max	min	typ	max	
U_o	Output voltage	$U_{i \text{ rated}}, I_{o \text{ nom}}$	14.7	15	15.3	23.52	24	24.48	V
$U_{o \text{ adj}}$	Adjustable voltage range		± 10			± 10			%
$I_{o \text{ nom}}$	Nominal output current	$U_{i \text{ min}} \dots U_{i \text{ max}}$	670			420			mA
u_o	Output voltage noise (BW = 20 MHz)	$U_{i \text{ rated}}, I_{o \text{ nom}}$	100	150		100	150		mV _{pp}
$U_{o \text{ U}}$	Static line regulation	$U_{i \text{ min}} \dots U_{i \text{ max}}, I_{o \text{ nom}}$	± 1			± 1			%
$U_{o \text{ L}}$	Static load regulation	$U_{i \text{ rated}}, I_o = 0 \leftrightarrow I_{o \text{ nom}}$	± 2			± 2			
t_r	Transient recovery time	$I_o = 1 \leftrightarrow 0.5 I_{o \text{ nom}}$	500			500			μs
$t_{h \text{ typ}}$	Hold-up time	110/230 V	10/80			10/80			ms
U_o	Temperature coefficient	$U_{i \text{ rated}}, I_{o \text{ nom}}$	± 0.05			± 0.05			%/K
f_s	Switching frequency		90	110		90	110		kHz

Table 3c: Output data for single output units

Output		Conditions	LGR 1101-2			LGR 1001-2			LGR 1301-2			Unit
Characteristics	min		typ	max	min	typ	max	min	typ	max		
U_o	Output voltage	$U_{i rated}, I_o nom$	3.3			4.9	5	5.1	11.76	12	12.24	V
$U_o adj$	Adjustable voltage range		±10			±10			±10			%
$I_o nom$	Nominal output current	$U_{i min...} U_{i max}$	7000			5000			2100			mA
u_o	Output voltage noise (BW = 20 MHz)	$U_{i rated}$ $I_o nom$	100	150		100	150		100	240		mV _{pp}
$U_o U$	Static line regulation	$U_{i min...} U_{i max}$ $I_o nom$	±1			±1			±1			%
$U_o I$	Static load regulation	$U_{i rated}$ $I_o = 0 \leftrightarrow I_o nom$	±2			±2			±2			%
t_r	Transient recovery time	$I_o = 1 \leftrightarrow 0.5 I_o nom$	500			500			500			µs
$t_{h typ}$	Hold-up time	110/230 V	15/90			15/90			15/90			ms
U_o	Temperature coefficient	$U_{i rated}, I_o nom$	±0.05			±0.05			±0.05			%/K
f_s	Switching frequency		80	120		80	120		80	120		kHz

Table 3d: Output data for single output units

Output		Conditions	LGR 1501-2			LGR 1601-2			Unit
Characteristics	min		typ	max	min	typ	max		
U_o	Output voltage	$U_{i rated}, I_o nom$	14.7	15	15.3	23.52	24	24.48	V
$U_o adj$	Adjustable voltage range		±10			±10			%
$I_o nom$	Nominal output current	$U_{i min...} U_{i max}$	1700			1000			mA
u_o	Output voltage noise (BW = 20 MHz)	$U_{i rated}$ $I_o nom$	150	300		150	300		mV _{pp}
$U_o U$	Static line regulation	$U_{i min...} U_{i max}$ $I_o nom$	±1			±1			%
$U_o I$	Static load regulation	$U_{i rated}$ $I_o = 0 \leftrightarrow I_o nom$	±2			±2			%
t_r	Transient recovery time	$I_o = 1 \leftrightarrow 0.5 I_o nom$	500			500			µs
$t_{h typ}$	Hold-up time	110/230 V	15/90			15/90			ms
U_o	Temperature coefficient	$U_{i rated}, I_o nom$	±0.05			±0.05			%/K
f_s	Switching frequency		80	120		80	120		kHz

Table 3e: Output data for dual output units

Output		Conditions	LHR 2020-2						LHR 2320-2						Unit
Characteristics	min		typ	max	min	typ	max	min	typ	max	min	typ	max	min	
U_o	Output voltage	$U_{i rated}, I_o nom$	4.9	5	5.1	11.76	12	12.24	11.76	12	12.24	-11.76	-12	-12.24	V
$I_o nom$	Nominal output current	$U_{i min...} U_{i max}$	1000			420			420			420			mA
u_o	Output voltage noise (BW = 20 MHz)	$U_{i rated}$ $I_o nom$	120	240		120	240		120	240		120	240		mV _{pp}
$U_o U$	Static line regulation	$U_{i min...} U_{i max}$ $I_o nom$	±1			±1			±1			±1			%
$U_o I$	Static load regulation	$U_{i rated}$ $I_o = 0.2 \leftrightarrow I_o nom$	±2			±2			±2			±2			%
t_r	Transient recovery time	$I_o = 1 \leftrightarrow 0.5 I_o nom$	500			500			500			500			µs
$t_{h typ}$	Hold-up time	110/230 V	10/80						10/80						ms
U_o	Temperature coefficient	$U_{i rated}, I_o nom$	±0.05			±0.05			±0.05			±0.05			%/K
f_s	Switching frequency		90	110		90	110		90	110		90	110		kHz

Table 3f: Output data for dual output units

Output			LHR 2540-2				Unit		
Characteristics		Conditions	Output 1		Output 2				
			min	typ	max	min	typ	max	
U_o	Output voltage	$U_{i \text{ rated}}, I_{o \text{ nom}}$	14.7	15	15.3	-14.7	-15	-15.3	V
$I_{o \text{ nom}}$	Nominal output current	$U_{i \text{ min}} \dots U_{i \text{ max}}$	335		335				mA
u_o	Output voltage noise (BW = 20 MHz)	$U_{i \text{ rated}}$ $I_{o \text{ nom}}$	120 240		120 240				mV _{pp}
$U_{o \text{ U}}$	Static line regulation	$U_{i \text{ min}} \dots U_{i \text{ max}}$ $I_{o \text{ nom}}$	±1		±1				%
$U_{o \text{ I}}$	Static load regulation	$U_{i \text{ rated}}$ $I_o = 0.2 \leftrightarrow I_{o \text{ nom}}$	±2		±2				
t_r	Transient recovery time	$I_o = 1 \leftrightarrow 0.5 I_{o \text{ nom}}$	500		500				µs
$t_{h \text{ typ}}$	Hold-up time	110/230 V	10/80						ms
U_o	Temperature coefficient	$U_{i \text{ rated}}, I_{o \text{ nom}}$	±0.05		±0.05				%/K
f_s	Switching frequency		90	110	90	110			kHz

Table 3g: Output data for dual output units

Output			LGR 2020-2				LGR 2320-2				Unit				
Characteristics		Conditions	Output 1		Output 2		Output 1		Output 2						
			min	typ	max	min	typ	max	min	typ	max				
U_o	Output voltage	$U_{i \text{ rated}}, I_{o \text{ nom}}$	4.9	5	5.1	11.76	12	12.24	11.76	12	12.24	-11.76	-12	-12.24	V
$I_{o \text{ nom}}$	Nominal output current	$U_{i \text{ min}} \dots U_{i \text{ max}}$	2500		1000		1000		1000						mA
u_o	Output voltage noise (BW = 20 MHz)	$U_{i \text{ rated}}$ $I_{o \text{ nom}}$	100 150		120 240		120 240		120 240						mV _{pp}
$U_{o \text{ U}}$	Static line regulation	$U_{i \text{ min}} \dots U_{i \text{ max}}$ $I_{o \text{ nom}}$	±1		±1		±1		±1						%
$U_{o \text{ I}}$	Static load regulation	$U_{i \text{ rated}}$ $I_o = 0.2 \leftrightarrow I_{o \text{ nom}}$	±2		±2		±2		±2						
t_r	Transient recovery time	$I_o = 1 \leftrightarrow 0.5 I_{o \text{ nom}}$	500		500		500		500						µs
$t_{h \text{ typ}}$	Hold-up time	110/230 V	15/90				15/90						ms		
U_o	Temperature coefficient	$U_{i \text{ rated}}, I_{o \text{ nom}}$	±0.05		±0.05		±0.05		±0.05						%/K
f_s	Switching frequency		80	120	80	120	80	120	80	120	80	120			kHz

Table 3h: Output data for dual output units

Output			LGR 2540-2				Units		
Characteristics		Conditions	Output 1		Output 2				
			min	typ	max	min	typ	max	
U_o	Output voltage	$U_{i \text{ rated}}, I_{o \text{ nom}}$	14.7	15	15.3	-14.7	-15	-15.3	V
$I_{o \text{ nom}}$	Nominal output current	$U_{i \text{ min}} \dots U_{i \text{ max}}$	800		800				mA
u_o	Output voltage noise (BW = 20 MHz)	$U_{i \text{ rated}}$ $I_{o \text{ nom}}$	150 300		150 300				mV _{pp}
$U_{o \text{ U}}$	Static line regulation	$U_{i \text{ min}} \dots U_{i \text{ max}}$ $I_{o \text{ nom}}$	±1		±1				%
$U_{o \text{ I}}$	Static load regulation	$U_{i \text{ rated}}$ $I_o = 0.2 \leftrightarrow I_{o \text{ nom}}$	±2		±2				
t_r	Transient recovery time	$I_o = 1 \leftrightarrow 0.5 I_{o \text{ nom}}$	500		500				µs
$t_{h \text{ typ}}$	Hold-up time	110/230 V	15/90						ms
U_o	Temperature coefficient	$U_{i \text{ rated}}, I_{o \text{ nom}}$	±0.05		±0.05				%/K
f_s	Switching frequency		80	120	80	120			kHz

Thermal Considerations

If an AC-DC converter, mounted on a PCB, is located in free, quasi-stationary air (convection cooling) at the indicated maximum ambient temperature $T_{A \text{ max}}$ (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 $T_{C \text{ max}}$ 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, air-flow, temperature of surrounding components and surfaces and the properties of the printed circuit board. $T_A \text{ max}$ is therefore, contrary to $T_{C \text{ max}}$, an indicative value only.

The relation between the maximum allowed output power $P_o \text{ allowed}$ and the temperature T_A of the surrounding air is given in fig.: *Maximum allowed output power vs. ambient temperature*. The rates apply if the AC-DC converter is located in free, quasi-stationary air (convection cooling).

Note: Sufficient forced cooling or an additional heat sink allows T_A to be higher than the value given in the table if $T_{C \text{ max}}$ according to the table is not exceeded.

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

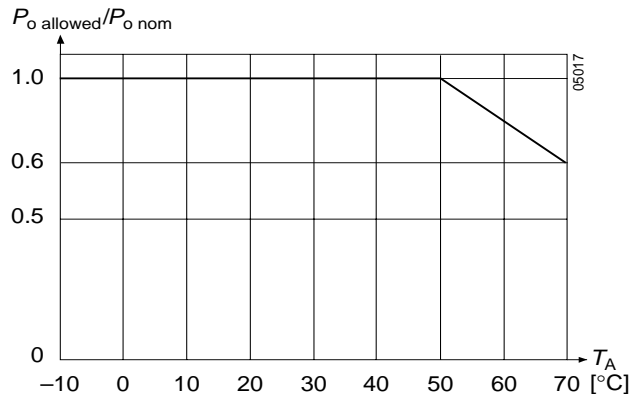


Fig. 3 *Maximum allowed output power vs. ambient temperature.*

Auxiliary Functions

Output Voltage Adjustment

The output voltage may be adjusted within $\pm 10\%$ of $U_{o \text{ nom}}$ by means of an external potentiometer or fixed resistor (for samples see table). If the output voltage setting should be excessively high, the overvoltage protection circuit may shut-down the output.

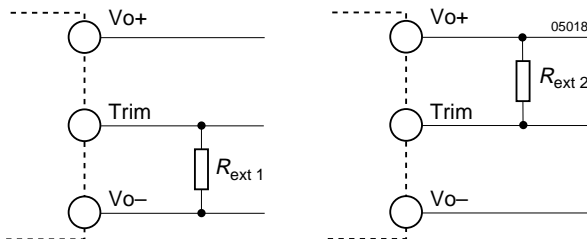


Fig. 4 *Output voltage adjustment for single output types*

Table 4: *Typical resistor values for various output voltage adjustment settings.*

Type	$R_{\text{ext 1}}$		$R_{\text{ext 2}}$	
	$U_{o \text{ nom}} + 5\%$	$U_{o \text{ nom}} + 10\%$	$U_{o \text{ nom}} - 5\%$	$U_{o \text{ nom}} - 10\%$
LHR 1001-2	5.2 kΩ	1 kΩ	4.6 kΩ	100 Ω
LHR 1301-2	8.2 kΩ	390 Ω	49 kΩ	18.9 kΩ
LHR 1501-2	26 kΩ	9.9 kΩ	148 kΩ	66.3 kΩ
LHR 1601-2	10 kΩ	820 Ω	140 kΩ	61 kΩ
LGR 1001-2	5.2 kΩ	1 kΩ	4.6 kΩ	100 Ω
LGR 1301-2	8.2 kΩ	490 Ω	48.3 kΩ	18.9 kΩ
LGR 1501-2	18 kΩ	1.7 kΩ	141 kΩ	58 kΩ

Outputs Connected in Series

Two or more units supplying the same or different output voltages may be connected in series. The value of the maximum output current to be taken is defined by that unit providing the lowest current limiting value. It should be assured that the outputs do not feed backwards into each other caused by their different rise/fall times at switch-on/off cycles by adding reverse polarity diodes across each output.

Output Overload Protection

An overload protection is provided by a current limiting device using a foldback characteristic. After removal of overload or short circuit the unit will resume normal operation automatically.

Protection Scheme

The LHR and LGR series is continuously short circuit protected by means of input power limitation. The unit will not be damaged if started up into a short circuit. After removal of the short circuit, it will resume normal operation.

The LHR and LGR series is also no-load proof, meaning that the regulation is still effective with no load and the output voltage does not rise. However, due to component tolerances, oscillation could occur and ripple and noise can be outside of specified values. If the converter is used in sensitive electronic circuits with no-load conditions, it is recommended to pre-load the outputs of dual output models with at least 20% of the specified nominal load.

Electromagnetic Compatibility (EMC)

Immunity

A metal oxide VDR together with an external input fuse and the internal input filter form an effective protection against high input transient voltages which typically occur

in most installations, but especially in mobile applications. The HR/GR-series has been successfully tested to the following specifications:

Table 5: Immunity type tests

Phenomenon	Standard	Class	Coupling ³	Value applied	Waveform	Source Imped.	Test procedure	In oper.	Per-Level form. ¹	mod
Electrostatic	IEC/EN	4	air discharge	15 kV _p	1/50 ns	330 Ω	positive and	yes	A discharge	6140
				_p	bursts of 5/50 ns	50 Ω	min positive	yes	A transient/burst	6140
				_p	1.2/50 μs and 5 neg.		yes	²	A61400-4-5 surges p	

¹ Normal operation, no deviation from specifications
² No load
³ i = input, o = output

Emission

Internal input filtering keeps the conducted noise of the units within the frequency range of 10 kHz to 30 MHz be-

low level B according to EN 55011 and EN 55022 standards (CISPR 11/22 respectively).

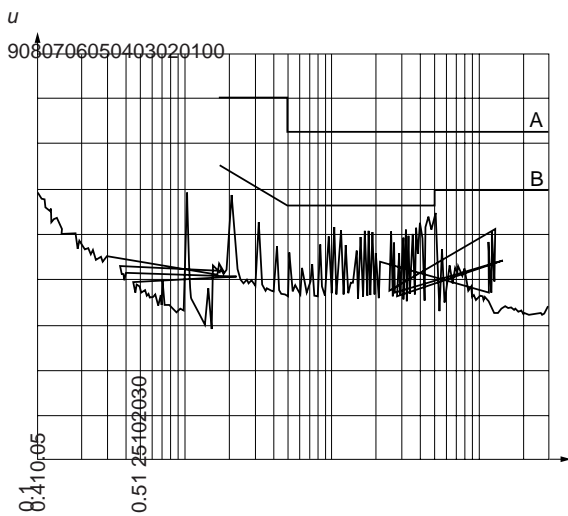


Fig. 5 Typical disturbance voltage (quasi-peak) at the input according to CISPR 11/22 and EN 55011/22, measured at $U_{i,nom}$ and $I_{o,nom}$. e.g. LHR 2540-2, $U_i = 230$ V AC.

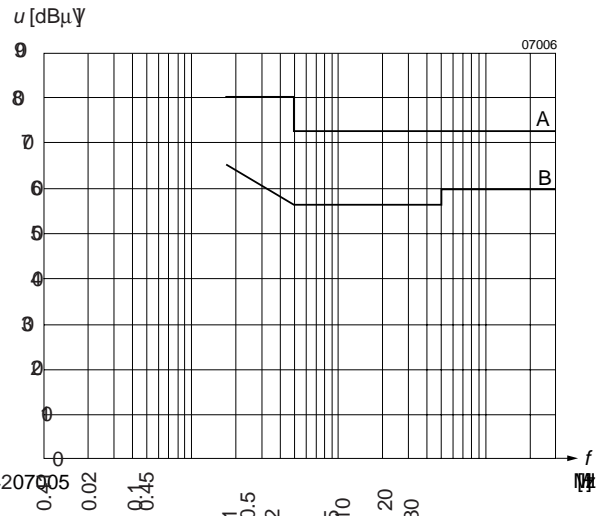


Fig. 6 Typical disturbance voltage (quasi-peak) at the input according to CISPR 11/22 and EN 55011/22, measured at $U_{i,nom}$ and $I_{o,nom}$. e.g. LHR 2020-2, $U_i = 230$ V AC.

Immunity to Environmental Conditions

Table 6: Mechanical stress

Test method	Test conditions	Status
Damp heat steady state	Temperature: 40 ±2 °C Relative humidity: 93 +2/-3 % Duration: 21 days	Operating
Shock (half-sinusoidal)	Acceleration amplitude: 20 g _n = 196.2 m/s ²	Operating
Vibration (sinusoidal)	Acceleration amplitude: 0.14 mm (10...60 Hz) 2 g _n = 19.6 m/s ² (60...150 Hz) Frequency (1 Oct/min): 10...150 Hz Test duration: 4 h (1.3 h each axis)	Operating

Table 7: Temperature specifications

Characterisitcs		Conditions	min	max	Unit
T _A	Ambient temperature	Operational ¹	-10	50	°C
T _C	Case temperature		-10	80	
T _S	Storage temperature	Non operational	-40	85	

¹ See Termal Consideration.

Table 8: MTBF Values

MTBF	Type	Ground benign	Ground fixed		Ground mobile
		T _C = 30°C	T _C = 40°C	T _C = 70°C	T _C = 45°C
According to MIL-HDBK-217F, notice 2	LHR	7'180'000 h	863'000 h	340'000 h	363'000 h
	LGR	5'660'000 h	707'000 h	291'000 h	303'000 h

Mechanical Data

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

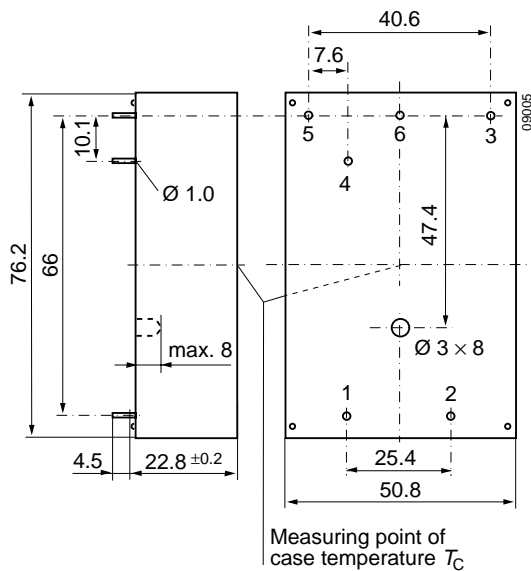
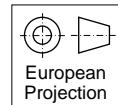


Fig. 7
LHR, weight 160g

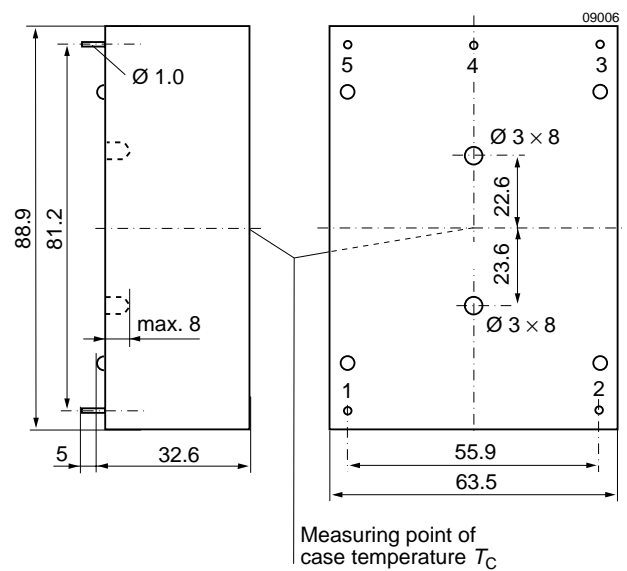


Fig. 8
LGR, weight 310g

Safety and Installation Instructions

Connector pin Allocation

The connector pin allocation table defines the electrical potentials of the AC-DC converters. For mechanical positions of pins see: *Mechanical Data*.

Table 9: Connector pin allocation and designation

Pin no.	Electrical determination	LHR		LGR		
		Single	Dual	Single	Dual +/-	Dual +/-
1	Input voltage	L \approx	L \approx	L \approx	L \approx	L \approx
2	Input voltage	N \approx	N \approx	N \approx	N \approx	N \approx
3	Output voltage (positive)	Vo+	Vo+	Vo+	Vo+	Vo1+
4	Output voltage (return potential)	-	-	Vo-	-	-
	Output voltage (common return)	-	-	-	Com	Com
	Control input	Trim	-	-	-	-
5	Output voltage (negative or positive)	-	Vo-	-	Vo-	Vo2+
	Output voltage (return potential)	Vo-	-	-	-	-
	Control input	-	-	Trim	-	-
6	Output voltage	n.c.	Com	-	-	-

Installation Instructions

The LHR and LGR-families of DC-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 a printed circuit board according to *Connector pin allocation* and *Mechanical Data*. Check for hazardous voltages before altering any connections.

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*.

To prevent excessive current flowing through the input supply lines in case of a short-circuit across the converter input, an external fuse suitable for the application and in compliance with the local requirements should be installed in the wiring to one or both input pins (no. 1 and/or no. 2). We recommend a slow-blow fuse T1.25A for LHR types, T2.0A for LGR types.

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

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*.

Cleaning Agents

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

Standards and approvals

LHR and LGR AC-DC converters correspond to class II equipment. All types 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
- Double or reinforced insulation between input and output, based on 250 V AC
- Operational insulation between the outputs (common return)
- The use in a pollution degree 2 environment
- Connecting the input to a primary circuit with 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 with ISO 9001 standards.

Isolation

The electric strength test is performed as a 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/warranty claims resulting from electric strength field tests.

Table 10: Isolation

Characteristic		Input to output	Unit
Electric strength test voltage	Required according to IEC/EN 60950	3.0	kV _{rms}
		4.2	kV DC
	Actual factory test 2 s	3.0	kV _{rms}
Typical coupling capacitance	LHR	≈2.4	nF
	LGR	≈ 5.0	
Insulation resistance at 500 V DC		>300	MΩ

¹ For creepage distances and clearances refer to *Technical Information: Safety*.

Protection Degree

Condition: Mounted on a PCB. IP 40: All units.

Leakage Current 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 230 V (50 Hz).

Under test conditions, the leakage current flows through a measuring instrument (MI) as described in fig.: *Measuring instrument (MI) for earth leakage current tests according to IEC/EN 60950* which takes into account earth 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 and outputs of LHR/LGR-units are connected in parallel, their individual leakage currents are added.

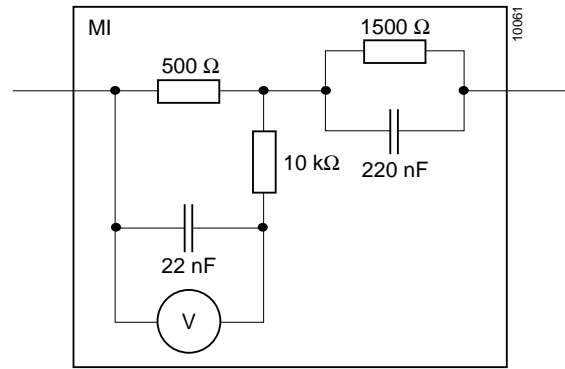


Fig. 9
Measuring instrument (MI) for earth leakage current tests according to IEC/EN 60950.

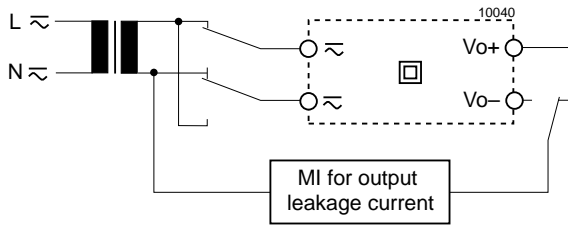


Fig. 10
Test set-up for class II equipment.

Table 11: Leakage currents

Characteristic		LHR	LGR	Unit
Output leakage current	Permissible according to IEC/EN 60950	0.25	0.25	mA
	Typical value at 230 V, 50 Hz	0.14	0.24	

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 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 12: Safety concept leading to an SELV output circuit

Conditions	AC-DC converter	Installation	Result
Supply voltage	Grade of isolation 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	Installation according to the applicable standards	SELV circuit

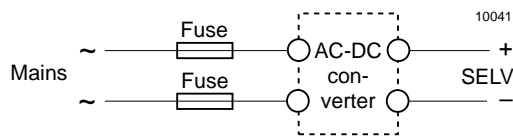


Fig. 11
Schematic safety concept
Use fuse(s) as per. Installation Instructions.