



PHI-CON

# 60 W AC-DC Converter PAC60E-Series

- PCB-mountable plastic case
- Universal input 85..264 V<sub>AC</sub> or 100..370 V<sub>DC</sub>
- Continuously short circuit protected
- Over current protected
- Output over voltage protection
- Input under voltage protection
- Input/output isolation voltage test 4 kV<sub>AC</sub>
- Safety standard EN 62368-1, CLASS I



## Model guide

Type	Output voltage [V <sub>DC</sub> ]	Output current [mA] max.	Output power [W] max.	Efficiency @ full load [%] typ.	Output load capacitance [μF] max.	Stand by consumption [W] max.
PAC60E05S	5	10000	50	82	50000	0.5
PAC60E12S	12	5000	60	86	10000	0.5
PAC60E15S	15	4000	60	86	8000	0.5
PAC60E24S	24	2500	60	86	2700	0.5
PAC60E48S	48	1250	60	86	680	0.65

## Specification

Input	
Voltage range	85 ... 264 V <sub>AC</sub> , 100 ... 370 V <sub>DC</sub>
Line frequency range	47...63 Hz
Full load input current	≤ 1400 mA @ 115 V <sub>AC</sub> ≤ 800 mA @ 230 V <sub>AC</sub>
Inrush current	45 A typ. @ 115 V <sub>AC</sub> 90 A typ. @ 230 V <sub>AC</sub>
Recommended fuse	3.15 A / 250 V, time delayed type
Isolation voltage, 1 minute, ≤ 5mA leakage current	
Input to output	4000 V <sub>AC</sub>
Input to PE	2000 V <sub>AC</sub>
Output to PE	500 V <sub>AC</sub>
Isolation resistance	10 <sup>8</sup> Ω
Leakage current, Input to output	≤ 0.25 mA @ 250 V <sub>AC</sub> , 50 Hz
Output	
Voltage accuracy	± 2 %
Line regulation	± 0.5 %
Load regulation	± 1 %, typ. @ load 0 %...100 %
Load minimum	0 %
Output voltage trim range	± ± 10 %
Ripple & noise, BW 20 MHz	≤ 150 mVpp (see Figure 3)
Temperature coefficient	± 0.02 % / °C, typ.
Minimum load	Not required
Hold-up time	8 ms, typ. @ 115 V <sub>AC</sub> 65 ms, typ. @ 230 V <sub>AC</sub>
Protection	
Short circuit	Continuous, hiccup, auto recovery
Over current	≥ 110 %, of rated load
Output over voltage protection (Output voltage clamp or turn off)	PAC60E05S ≤ 9 V <sub>DC</sub> PAC60E12S ≤ 16 V <sub>DC</sub> PAC60E15S ≤ 24 V <sub>DC</sub> PAC60E24S ≤ 35 V <sub>DC</sub> PAC60E48S ≤ 60 V <sub>DC</sub>
General	
Switching frequency	100 kHz, typ.
Reliability calculated MTBF MIL-HDBK-217 @ 25 °C	≥ 300000 h

EMC compliance		
CE	EN 55032, CISPR 32	Class B
RE	EN 55032, CISPR 32	Class B
ESD	EN-, IEC 61000-4-2	air ± 8 kV, contact ± 6 kV, Perf. Criteria B
RS	EN-, IEC 61000-4-3	10 V/m Perf. Criteria A
EFT	EN-, IEC 61000-4-4	± 4 kV Perf. Criteria B
Surge	EN-, IEC 61000-4-5	Line to line ± 2 kV Line to GND ± 4 kV Perf. Crit. B (see Figure 1)
	EN-, IEC 61000-4-5	Line to line ± 4 kV Line to GND ± 6 kV Perf. Crit B (see Figure 2)
CS	EN-, IEC 61000-4-6	10 Vrms. Perf. Criteria A
PFM	EN-, IEC 61000-4-8	10 A/m Perf. Criteria A
Voltage dips, short interruption and voltage variations EN-, IEC 61000-4-11		0...70 % Perf. Criteria B
Safety standard		EN 62368-1
Safety Class		Class I
Environmental		
Operating ambient temperature		-40...70 °C, see derating diagram
Storage temperature		-40...85 °C
Operating case temperature		90 °C, max.
Storage humidity		95 %, non condensing
Cooling		Free air convection, ≥ 35 LFM
Physical		
Version mounting on		Dimensions [mm]
PCB	PAC60ExxS	109 x 58.5 x 30
Chassis	PAC60ExxSA2	135 x 70 x 38.5
Din Rail	PAC60ExxSA4	137 x 70 x 44
Case material		Black plastic, UL94V-0 rated
Wave soldering temperature		≤ 265 °C, peak duration ≤ 10 s, ≥ 1.5 mm distance from case
Manual soldering temperature		≤ 370 °C, duration ≤ 5 s, ≥ 1.5 mm distance from case
Hot swap		Not usable
		Weight [g]
PCB		300
Chassis		390
Din Rail		460

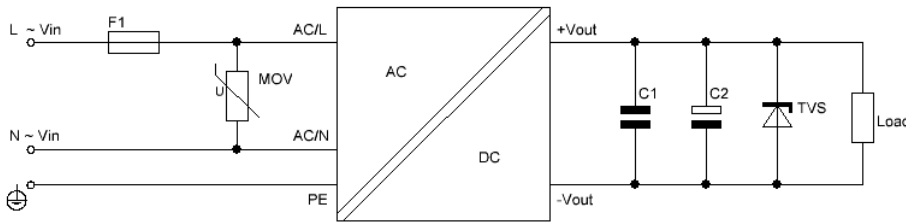
Part number structure												
Brand		Type		Output power		Series	Output voltage		Outputs		Mounting	
P	PHI-CON	AC	AC/DC-Converter	60	60 W	E	05	5 V	S	single	Blank	PCB
							12	12 V			A2	Chassis
							15	15 V			A4	DIN-Rail
							24	24V				
							48					
Example: PAC60E24S PHI-CON AC/DC-Converter, Pout 60 W, E-Serie, Vin 85..264 VAC, Vout 24 V, Single Output, for PCB mounting												

## Note:

1. Unless otherwise specified are all values specified at Ta 25 °C, humidity < 75 % and rated output load current.
2. The outputs of the AC/DC converters are not suitable for parallel operation.

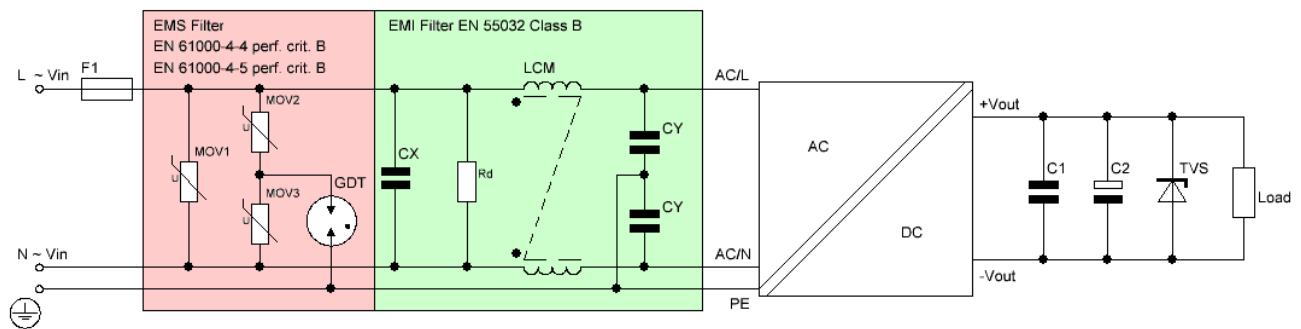
# 60 W AC-DC Converter PAC60E-Series

Figure 1 Typical application circuit



Component list for the typical application circuit Figure 1					
Type	F1 (time delayed)	MOV	C1	C2	TVS
PAC60E05S	3.15 A, 250 V~	S14K300	1 $\mu$ F, MLCC	680 $\mu$ F	SMBJ7.0A
PAC60E12S	3.15 A, 250 V~	S14K300	1 $\mu$ F, MLCC	330 $\mu$ F	SMBJ20A
PAC60E15S	3.15 A, 250 V~	S14K300	1 $\mu$ F, MLCC	330 $\mu$ F	SMBJ20A
PAC60E24S	3.15 A, 250 V~	S14K300	1 $\mu$ F, MLCC	200 $\mu$ F	SMBJ30A
PAC60E48S	3.15 A, 250 V~	S14K300	1 $\mu$ F, MLCC	100 $\mu$ F	SMBJ64A

Figure 2 Application circuit and example for ripple and noise reduction under harsh EMC conditions



Type	TVS type	C2 El. cap.	C1 Cer. cap.	CY	LCM Com.-mode	Rd	CX	GDT Gas discharge tube	MOV2 MOV3 type	MOV1 type	F1 Fuse
PAC60E05S	SMBJ7.0A	680 $\mu$ F	1 $\mu$ F	2.2 nF, 400V~	2.2 mH	1 M $\Omega$ , 2 W	0.15 $\mu$ F, 300 V~	B5G3600	S14K350	S20K300	6.3 A, 250 V~ time delayed type
PAC60E12S	SMBJ20A	330 $\mu$ F									
PAC60E15S	SMBJ20A	330 $\mu$ F									
PAC60E24S	SMBJ30A	200 $\mu$ F									
PAC60E48S	SMBJ64A	100 $\mu$ F									

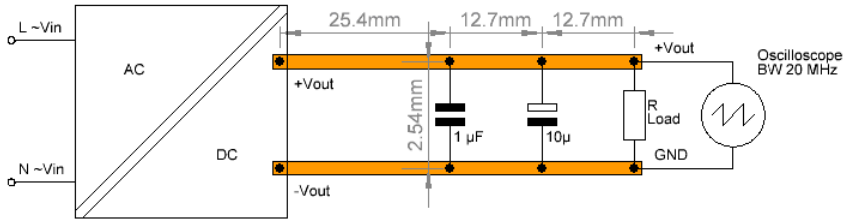
**Note:**

1. Output filtering capacitors C2 is a electrolytic capacitor. It is recommended to use high frequency and low impedance electrolytic capacitors. For capacitance and current of capacitor please refer to manufacture's datasheet. Voltage derating of capacitor should be 80 % or above. C1 is ceramic capacitor. It is used to filter high frequency noise. TVS is a recommended component to protect post-circuits in case of a converter failure.

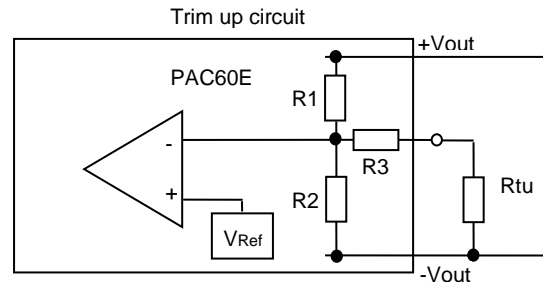
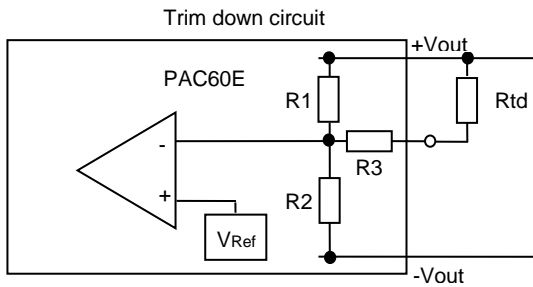
2. For standard EMC requirement, please refer to figure 1. If higher an EMC requirement, please refer to figure 2.

# 60 W AC-DC Converter PAC60E-Series

Figure 3 Measure circuit for output ripple and noise (BW 20 MHz)



## Application note for trim option



## Calculation for trim down resistor (Rtd) or trim up resistor (Rtu)

Model series	R1 [kΩ]	R2 [kΩ]	R3 [kΩ]	V Ref [V]	Rtd min. [kΩ]	Rtu min. [kΩ]
PAC60Exx05S	3.3	3.3	1	2.5	12.2	15.5
PAC60Exx12S	3.83	1	1	2.5	24	7.5
PAC60Exx15S	7.5	1.5	1	2.5	54	11.5
PAC60Exx24S	8.66	1	1	2.5	64	8.62
PAC60Exx48S	33	1.8	1	2.5	260	17.5

Maximum output voltage adjust range  $\pm 10\%$  of Vout nominal, see min. Rtd / Rtu

### Trim down resistor formula

$$b = \frac{V_{out} - V_{ref}}{V_{ref}} * R2$$

$$R_{td} = \frac{R1 * b}{R1 - b} - R3$$

### Trim up resistor formula

$$a = \frac{V_{ref}}{V_{out} - V_{ref}} * R1$$

$$R_{tu} = \frac{R2 * a}{R2 - a} - R3$$

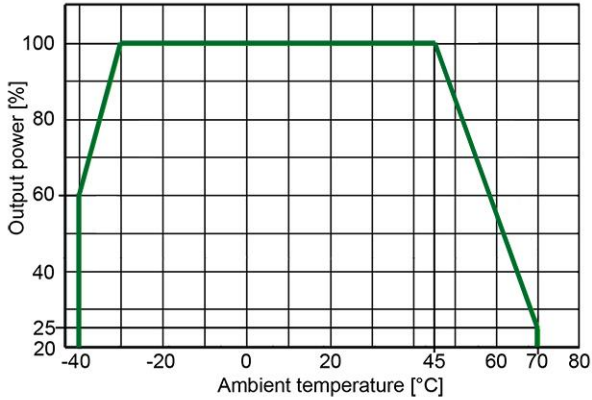


PHI-CON

# 60 W AC-DC Converter PAC60E-Series

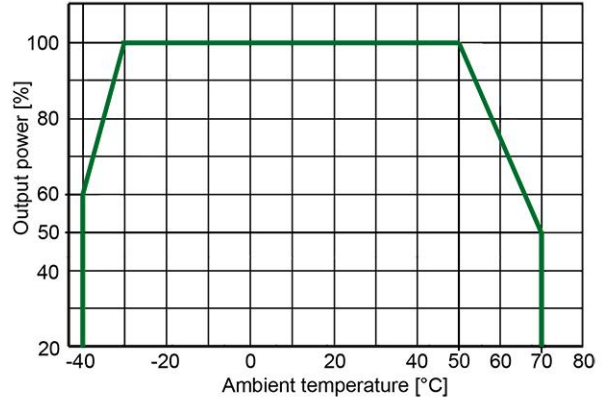
PAC60E05S

Power derating vs ambient temperature at  
Vin 85...264V<sub>AC</sub> or 100...370 V<sub>DC</sub>



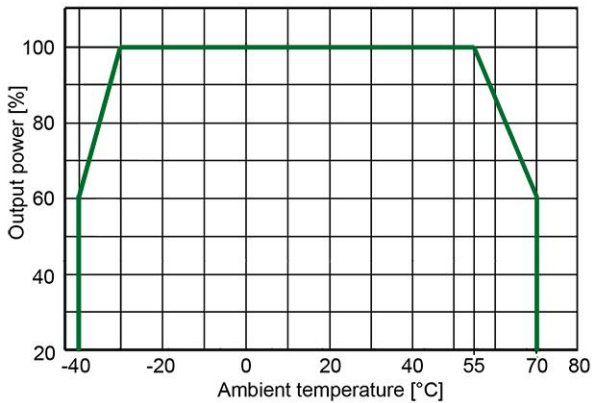
PAC60E12S, PAC60E15S

Power derating vs ambient temperature at  
Vin 85...264V<sub>AC</sub> or 100...370 V<sub>DC</sub>



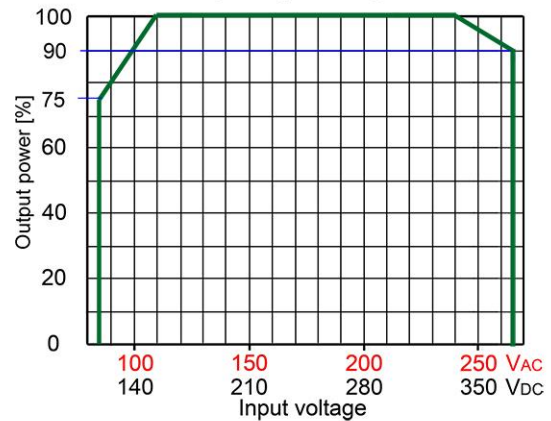
PAC60E24S, PAC60E48S

Power derating vs ambient temperature at  
Vin 85...264V<sub>AC</sub> or 100...370 V<sub>DC</sub>



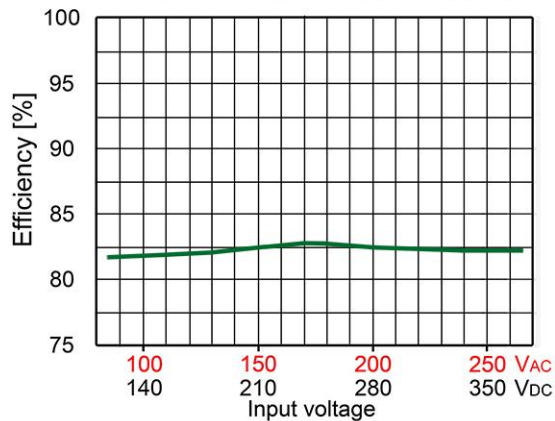
PAC60Exx - Series

Power derating vs input voltage at Ta 25 °C



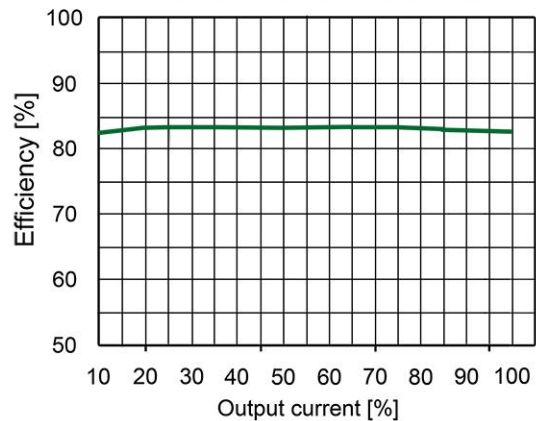
PAC60E05S

Efficiency vs input voltage at full load

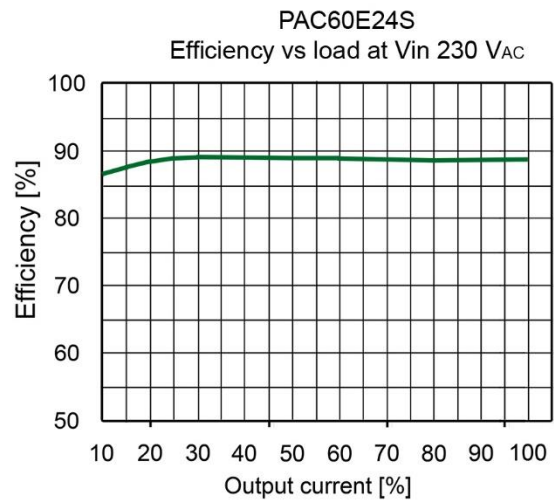
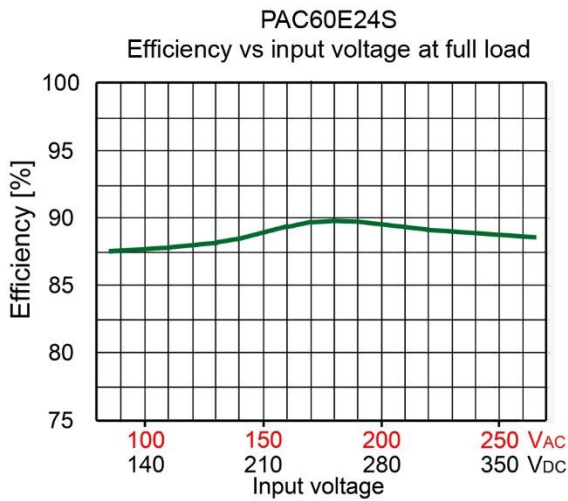
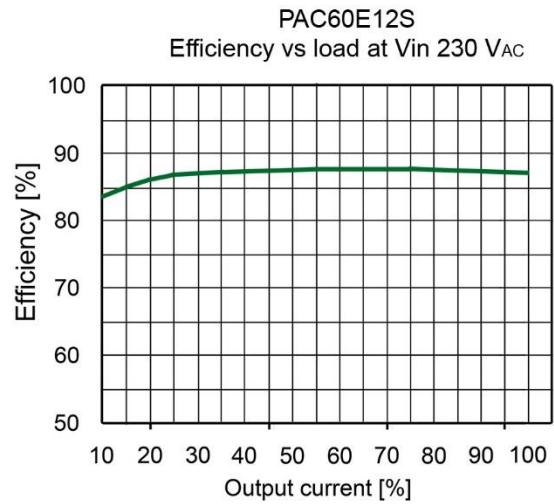
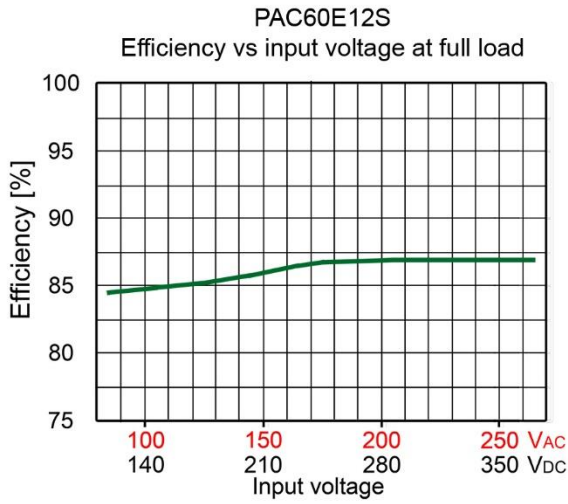


PAC60E05S

Efficiency vs load at Vin 230 V<sub>AC</sub>



# 60 W AC-DC Converter PAC60E-Series

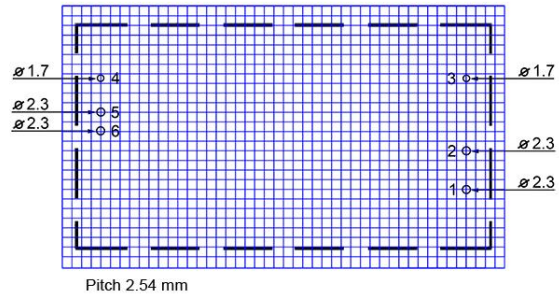
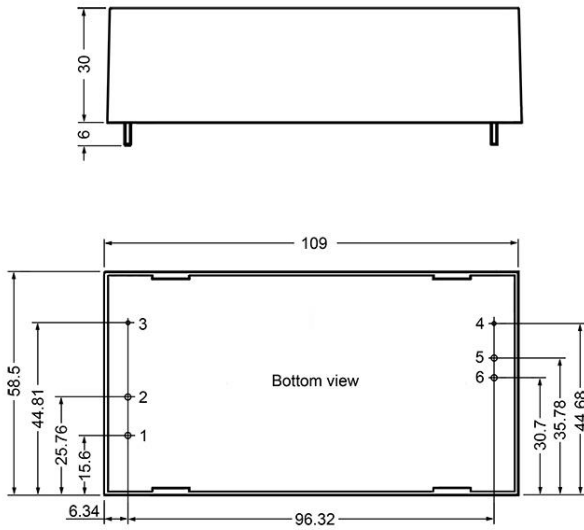




PHI-CON

# 60 W AC-DC Converter PAC60E-Series

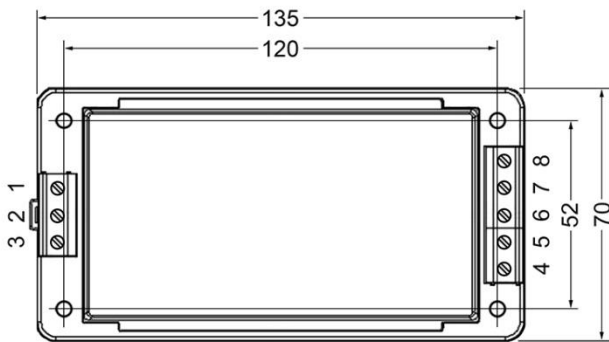
Mechanical dimensions mountable PCB version



Unit: in mm  
 Pin diameter tolerance:  $\pm 0.1$  mm  
 Pin length tolerance:  $\pm 1.5$  mm  
 General tolerances:  $\pm 0.5$  mm

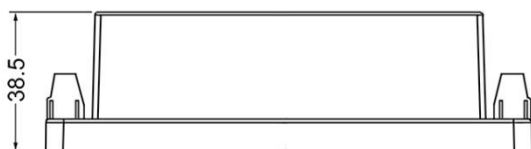
Pin assignment	
1	Input AC (N)
2	Input AC (L)
3	Protective earth
4	Trim input
5	- V output
6	+ V output

Mechanical dimensions chassis mountable version A2



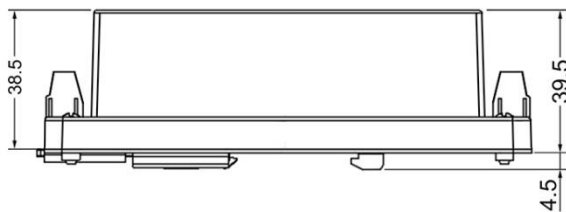
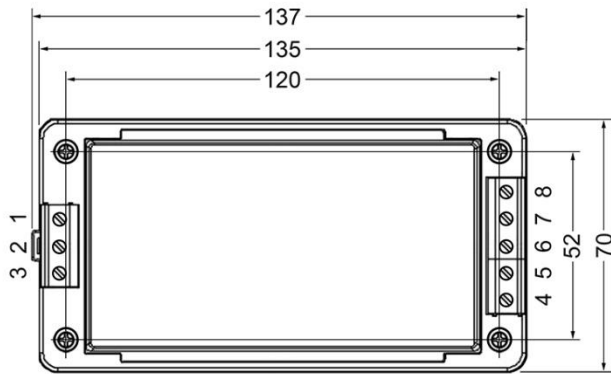
Terminal assignment	
1	Input AC (N)
2	Input AC (L)
3	Protective earth
4	Trim input
5	- V output
6	+ V output
7	Not connected
8	Not connected

Unit: in mm  
 Wire range: 12...24 AWG  
 Tightening torque:  $\leq 0.4$  Nm  
 General tolerances:  $\pm 1$  mm



# 60 W AC-DC Converter PAC60E-Series

Mechanical dimensions Din-Rail mountable version A4



Unit: in mm  
 Wire range: 12...24 AWG  
 Tightening torque:  $\leq 0.4$  Nm  
 The Din Rail must be connected with protective earth  
 General tolerances:  $\pm 1$  mm

Terminal assignment	
1	Input AC (N)
2	Input AC (L)
3	Protective earth
4	Trim input
5	- V output
6	+ V output
7	Not connected
8	Not connected

PHI-CON is a trademark of HY-LINE Holding GmbH.

Only for professional use by professionals! Not for resale or distribution to the general public in any way! Read the instructions carefully before using!

*Life Support Policy:* HY-LINE does not authorize the use of any of its products for use in life support devices or systems without the express written approval of an officer of the Company. Life support systems are devices which support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.

Rev: 20211001 f