



PHI-CON

# 60 W AC-DC Converter PAC60ExxS3-Series

- PCB-mountable plastic case
- Universal input 85..305 V<sub>AC</sub> or 100..430 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.
PAC60E05S3	5	10000	50	82	50000	0.5
PAC60E12S3	12	5000	60	86	10000	0.5
PAC60E15S3	15	4000	60	86	8000	0.5
PAC60E24S3	24	2500	60	86	2700	0.5
PAC60E48S3	48	1250	60	86	680	0.65

## Specification

Input	
Voltage range	85 ... 305 V <sub>AC</sub> , 100 ... 430 V <sub>DC</sub>
Line frequency range	47...63 Hz
Full load input current	≤ 1.4 A @ 115 V <sub>AC</sub> ≤ 0.8 A @ 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 mV <sub>pp</sub> (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)	PAC60E05S3 ≤ 9 V <sub>DC</sub> PAC60E12S3 ≤ 16 V <sub>DC</sub> PAC60E15S3 ≤ 24 V <sub>DC</sub> PAC60E24S3 ≤ 35 V <sub>DC</sub> PAC60E48S3 ≤ 60 V <sub>DC</sub>
General	
Switching frequency	65 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
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]   Weight [g]
PCB	PAC60ExxS3	109 x 58.5 x 30   300
Chassis	PAC60ExxS3A2	135 x 70 x 38.5   390
Din Rail	PAC60ExxS3A4	137 x 70 x 44   460
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

## Part number structure

Brand	Type	Output power	Series	Output voltage	Outputs	V <sub>in</sub> Range	Mounting
P	PHI-CON AC AC/DC-Converter	60   60 W	E	05   5 V 12   12 V 15   15 V 24   24 V 48   48 V	S   single	3   85...305 V~	Blank   PCB A2   Chassis A4   DIN-Rail
Example:	PAC60E24S3	PHI-CON AC/DC-Converter, Pout 60 W, E-Serie, Vout 24 V, Single Output, Vin 85..305 VAC, PCB mountable					

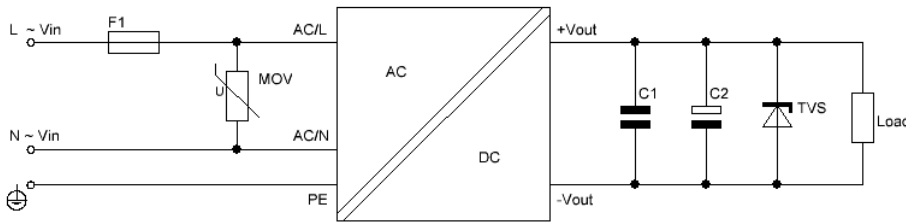
## Note:

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.



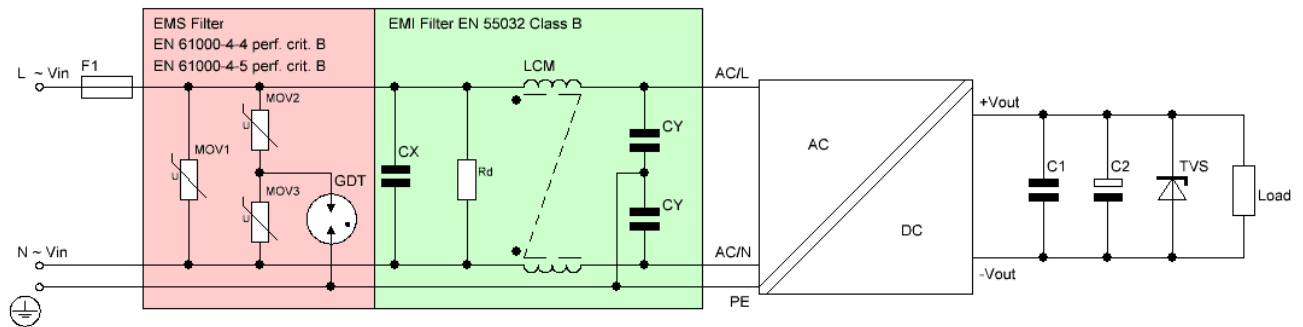
# 60 W AC-DC Converter PAC60ExxS3-Series

Figure 1 Typical application circuit



Component list for the typical application circuit Figure 1					
Type	F1 (time delayed)	MOV	C1	C2	TVS
PAC60E05S3	3.15 A, 300 V~	S14K350	1 $\mu$ F, MLCC	680 $\mu$ F	SMBJ7.0A
PAC60E12S3	3.15 A, 300 V~	S14K350	1 $\mu$ F, MLCC	330 $\mu$ F	SMBJ20A
PAC60E15S3	3.15 A, 300 V~	S14K350	1 $\mu$ F, MLCC	330 $\mu$ F	SMBJ20A
PAC60E24S3	3.15 A, 300 V~	S14K350	1 $\mu$ F, MLCC	200 $\mu$ F	SMBJ30A
PAC60E48S3	3.15 A, 300 V~	S14K350	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 Common-mode	Rd	CX	GDT Gas discharge tube	MOV2 MOV3 type	MOV1 type	F1 Fuse
PAC60E05S3	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	S10K350	S20K350	3.15 A, 300 V~ time delayed type
PAC60E12S3	SMBJ20A	330 $\mu$ F									
PAC60E15S3	SMBJ20A	330 $\mu$ F									
PAC60E24S3	SMBJ30A	200 $\mu$ F									
PAC60E48S3	SMBJ64A	100 $\mu$ F									

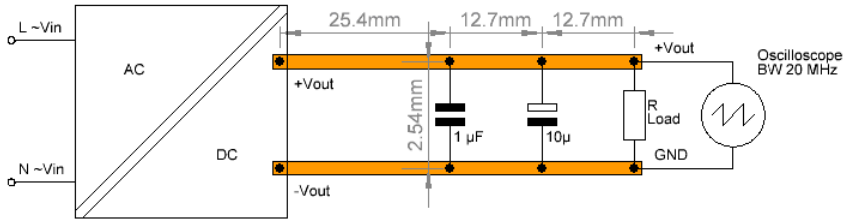
**Note:**

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.

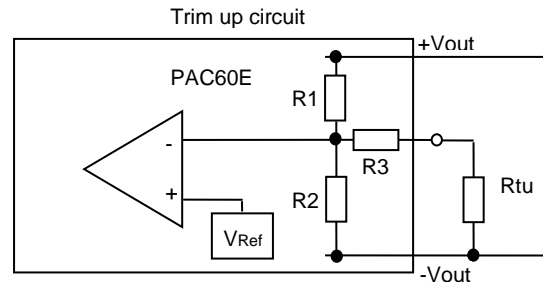
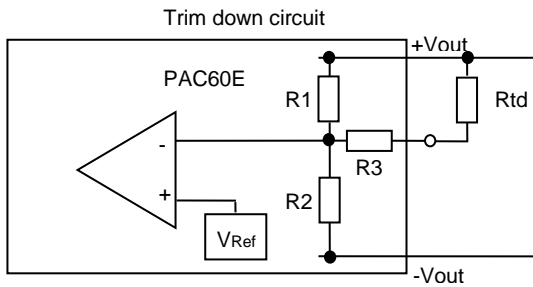
2. For standard EMC requirement, please refer to figure 1. If higher an EMC requirement, please refer to figure 2.

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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]
PAC60Exx05S3	3.3	3.3	1	2.5	12.2	15.5
PAC60Exx12S3	3.83	1	1	2.5	24	7.5
PAC60Exx15S3	7.5	1.5	1	2.5	54	11.5
PAC60Exx24S3	8.66	1	1	2.5	64	8.62
PAC60Exx48S3	33	1.8	1	2.5	260	17.5

Maximum output voltage adjust range ±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

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

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

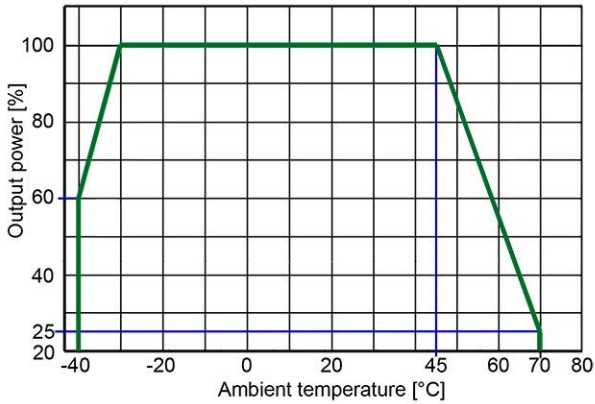
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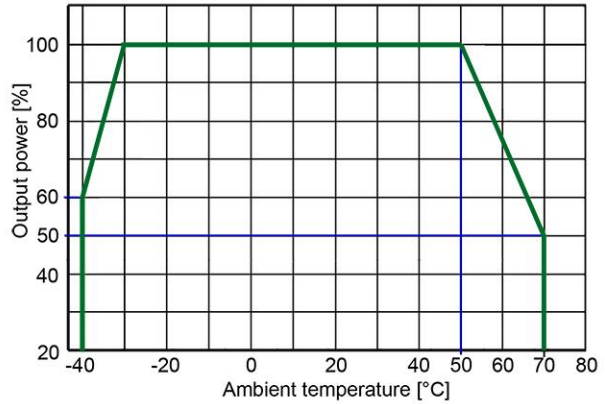
PAC60E05S3

Power derating vs ambient temperature at  
Vin 85...305 V<sub>AC</sub> or 100...430 V<sub>DC</sub>



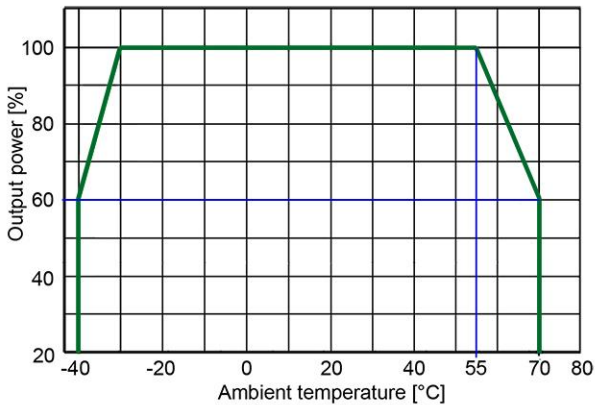
PAC60E12S3, PAC60E15S3

Power derating vs ambient temperature at  
Vin 85...305V<sub>AC</sub> or 100...430 V<sub>DC</sub>



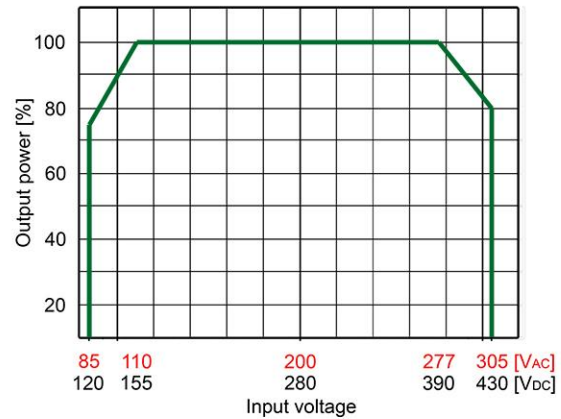
PAC60E24S3, PAC60E48S3

Power derating vs ambient temperature at  
Vin 85...305 V<sub>AC</sub> or 100...430 V<sub>DC</sub>



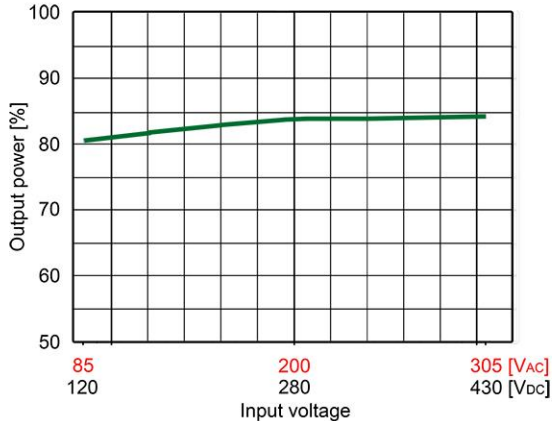
PAC60ExxS3 - Series

Power derating vs input voltage at Ta 25 °C



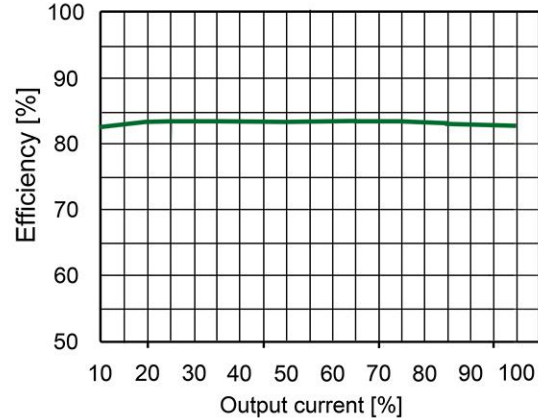
PAC60E05S3

Efficiency vs input voltage at full load



PAC60E05S3

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

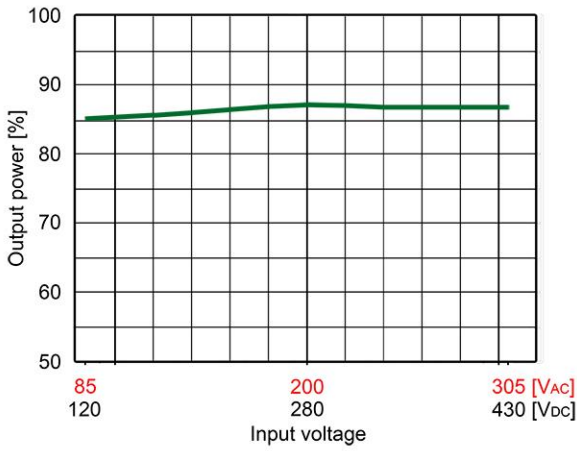


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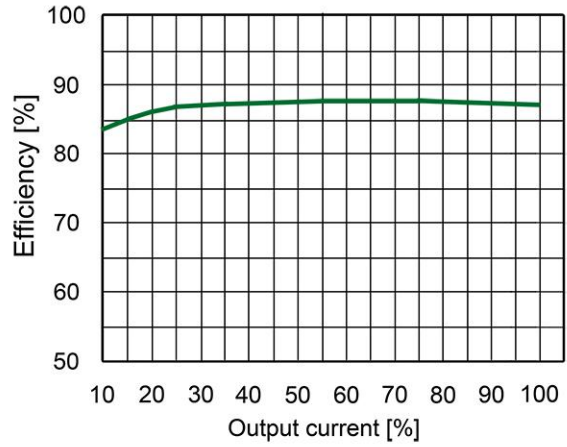


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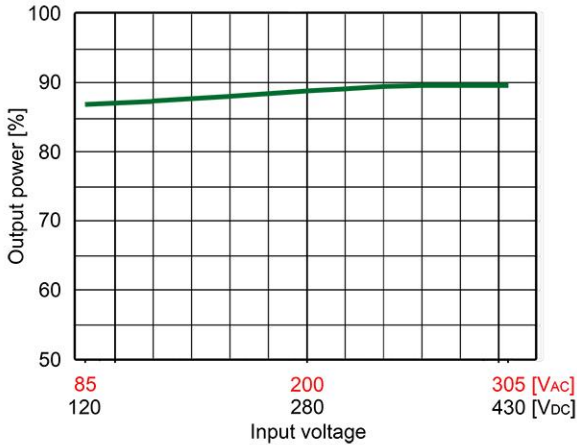
PAC60E12S3  
Efficiency vs input voltage at full load



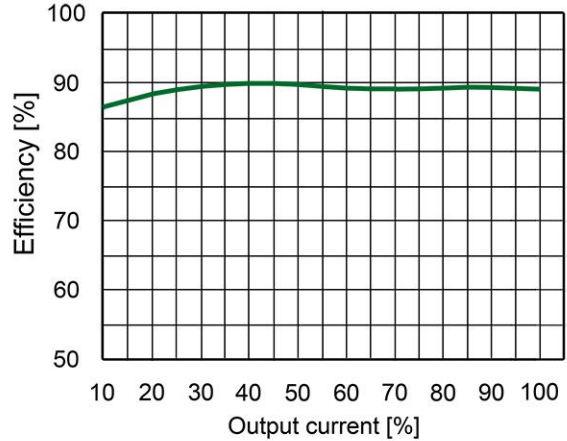
PAC60E12S3  
Efficiency vs load at Vin 230 V<sub>AC</sub>



PAC60E24S3  
Efficiency vs input voltage at full load



PAC60E24S3  
Efficiency vs load at Vin 230 V<sub>AC</sub>

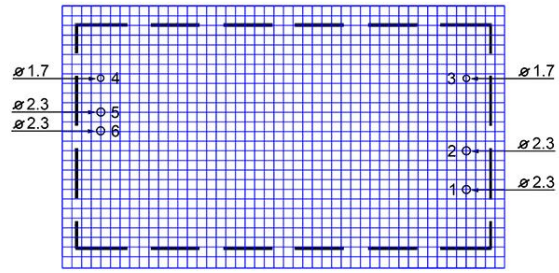
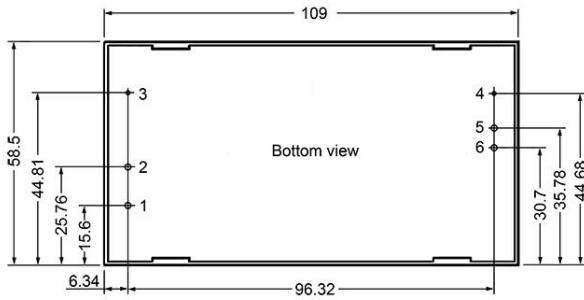
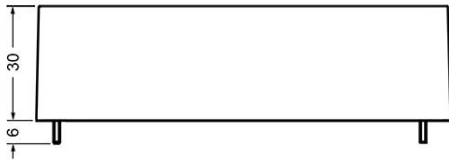




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# 60 W AC-DC Converter PAC60ExxS3-Series

Mechanical dimensions mountable PCB version

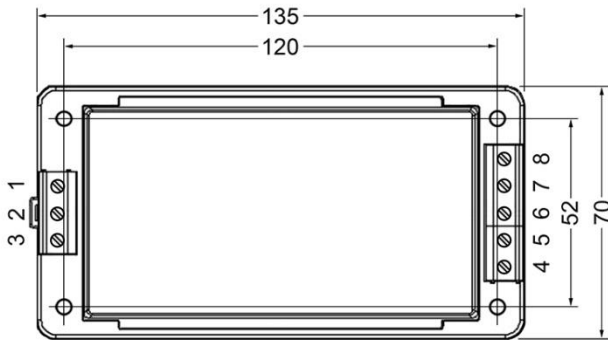


Pitch 2.54 mm

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

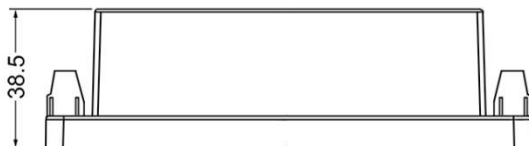
Pin assignment	
1	Input AC (N)
2	Input AC (L)
3	Protective earth
4	Trim input
5	- V output
6	+ V output

Mechanical dimensions chassis mountable version A2



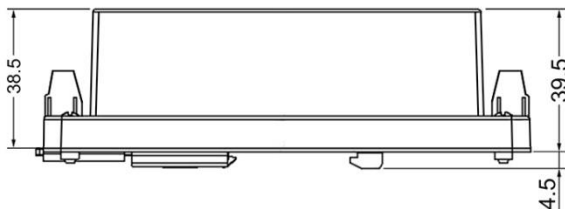
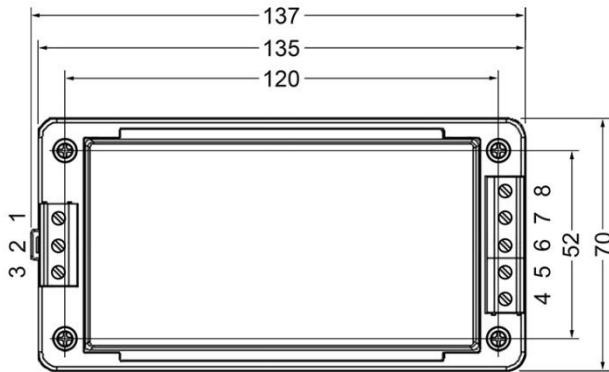
Terminal assignment	
1	Input AC (N)
2	Input AC (L)
3	Protective earth
4	Trim input
5	- V output
6	+ V output
7	Not connected
8	Not connected

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



# 60 W AC-DC Converter PAC60ExxS3-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

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 Rev: 20211004f