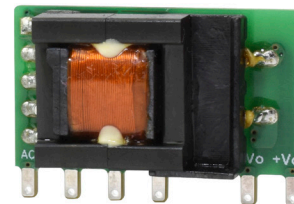


**SERIES:** PBO-5C | **DESCRIPTION:** INTERNAL AC-DC POWER SUPPLY

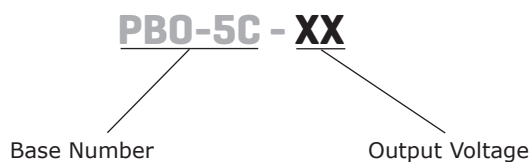
**FEATURES**

- wide input range (85 ~ 305 Vac)
- wide operating temperature range (-40 to +85 C)
- IEC/EN/UL 62368 certified
- designed to meet 61558 & 60335 safety standards
- 1,000,000 hour MTBF
- flexible implementations to power a wide array of applications



MODEL	output voltage (Vdc)	output current		output power max (W)	ripple and noise <sup>1</sup> typ (mVp-p)	efficiency <sup>2</sup> typ (%)
		min (A)	max (A)			
PBO-5C-3	3.3	0.1	1.0	3.3	150	69.0
PBO-5C-5	5.0	0.1	1.0	5.0	150	76.0
PBO-5C-9	9.0	0.056	0.56	5.0	150	77.0
PBO-5C-12	12.0	0.042	0.42	5.0	150	79.0
PBO-5C-15	15.0	0.034	0.34	5.0	150	79.0
PBO-5C-24	24.0	0.021	0.21	5.0	150	81.0

Note: 1. At full load, nominal input, 20 MHz bandwidth oscilloscope, see Application Circuit 10% -100% load.  
 2. At 230 Vac input.

**PART NUMBER KEY**


## INPUT

parameter	conditions/description	min	typ	max	units
voltage	ac input	85		305	Vac
	dc input	70		430	Vdc
frequency		47		63	Hz
current	at 115 Vac			0.2	A
	at 230 Vac			0.1	A
inrush current	at 115 Vac		20		A
	at 230 Vac		40		A
no load power consumption	at 230 Vac			0.15	W

## OUTPUT

parameter	conditions/description	min	typ	max	units
capacitive load	3.3 Vdc output models			2,200	μF
	5 Vdc output models			1,500	μF
	9 Vdc output models			680	μF
	12 Vdc output models			470	μF
	15 Vdc output models			330	μF
	24 Vdc output models			100	μF
initial set point accuracy	10% ~ 100% load		±5		%
line regulation	at rated load		±1.5		%
load regulation	10% ~ 100% load		±3		%
temperature coefficient			±0.15		%/°C

## PROTECTIONS

parameter	conditions/description	min	typ	max	units
over current protection	auto recovery	110			%
short circuit protection	continuous, auto recovery, hiccup				

## SAFETY & COMPLIANCE

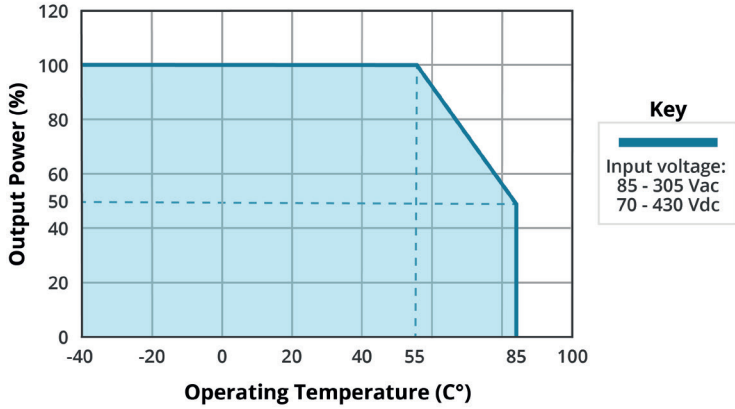
parameter	conditions/description	min	typ	max	units
isolation voltage	input to output for 1 minute, leakage current <5mA	3,600			Vac
safety approvals	certified to 62368: IEC, EN, UL/cUL				
	designed to meet 61558: IEC, EN				
	designed to meet 60335: IEC, EN				
safety class	class II				
EMI/EMC	CISPR32/EN55032 CLASS A (Recommended circuit 1, 4) CISPR32/EN55032 CLASS B (Recommended circuit 2, 3)				
ESD	IEC/EN 61000-4-2 Contact ±6KV perf. Criteria B				
radiated immunity	IEC/EN61000-4-3 10V/m perf. Criteria A				
EFT/burst	IEC/EN61000-4-4 ±2KV (Recommended circuit 1, 2) perf. Criteria B				
	IEC/EN61000-4-4 ±4KV (Recommended circuit 3, 4) perf. Criteria B				
surge	IEC/EN61000-4-5 line to line ±1KV (Recommended circuit 1, 2) perf. Criteria B				
	IEC/EN61000-4-5 line to line±2KV (Recommended circuit 3, 4) perf. Criteria B				
conducted immunity	IEC/EN61000-4-6 10Vr.m.s perf. Criteria A				
voltage dips and interruptions	IEC/EN61000-4-11 0%, 70% perf. Criteria B				
MTBF	as per MIL-HDBK-217F at 25 °C	1,000,000			hours
RoHS	yes				

## ENVIROMENTAL

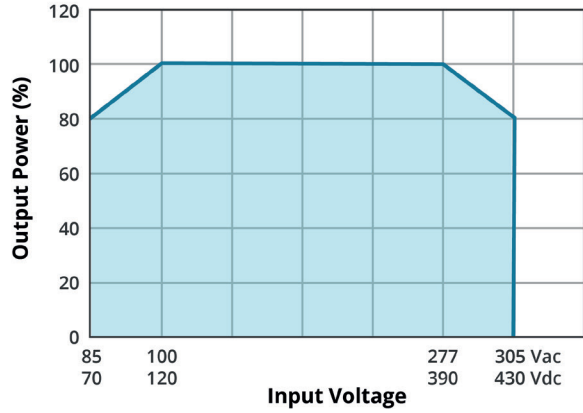
parameter	conditions/description	min	typ	max	units
operating temperature		-40		85	°C
storage temperature		-40		105	°C
storage humidity				95	%

## DERATING CURVES

**TEMPERATURE DERATING CURVE**

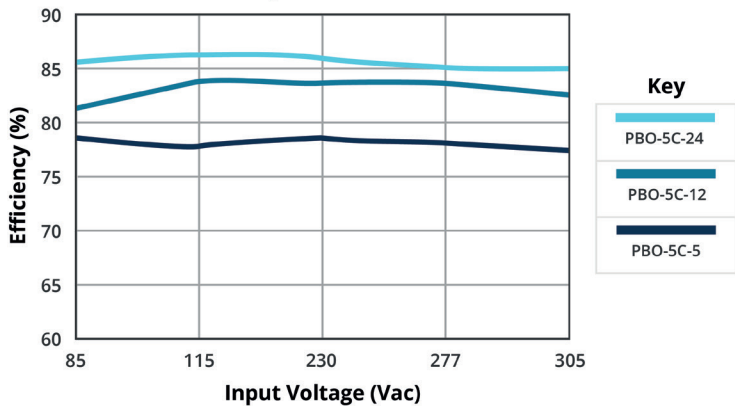


**INPUT VOLTAGE DERATING CURVE (25°C)**

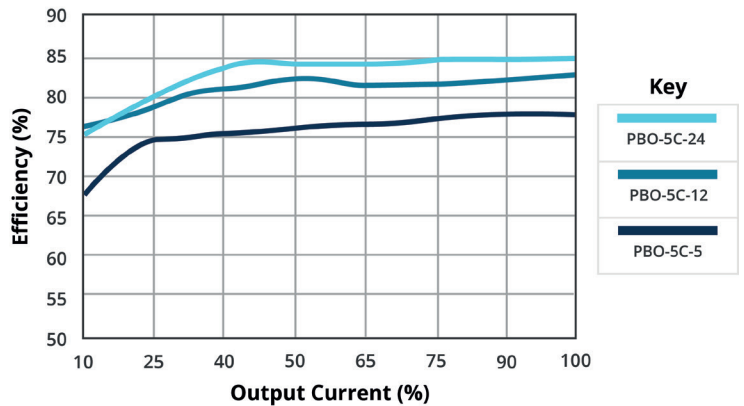


## EFFICIENCY CURVES

**EFFICIENCY VS INPUT VOLTAGE (full load)**



**EFFICIENCY VS OUTPUT LOAD (Vin = 230 VAC)**



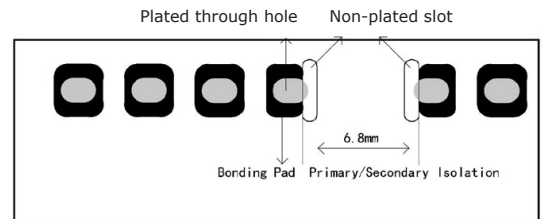
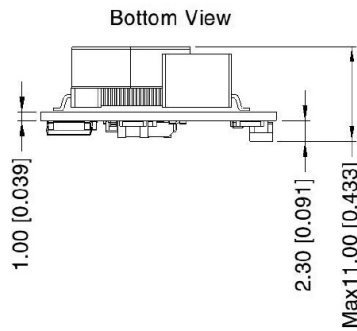
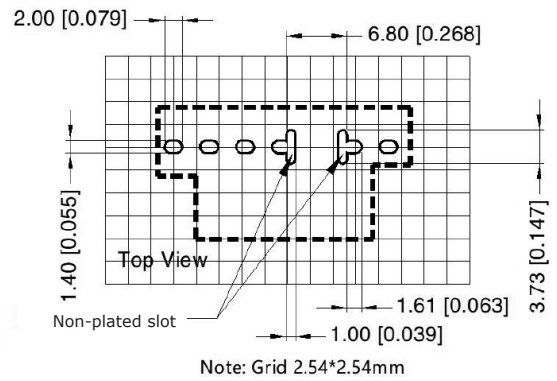
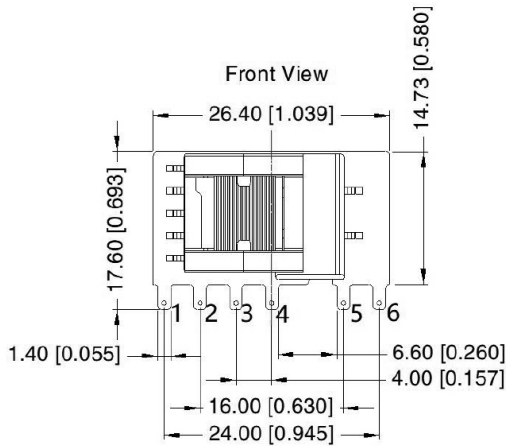
## MECHANICAL

parameter	conditions/description	min	typ	max	units
dimensions	26.40 x 14.73 x 11.00 (1.039 x 0.579 x 0.433 inches)				mm
weight			5.2		g
cooling	free air convection				

## MECHANICAL DRAWING

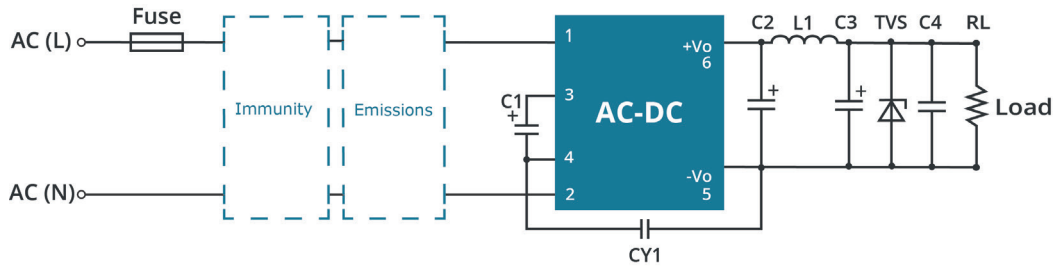
units: mm [inch]  
 general tolerance: ±1.00 [±0.039]

PIN CONNECTIONS	
PIN	Function
1	AC (L)
2	AC (N)
3	+V (cap)
4	-V (cap)
5	-Vo
6	+Vo



Note: There are two, non-metallic/non-plated, slots located between pins 4 and 5 that are required to maintain proper creepage distance and isolation between primary and secondary circuits.

## APPLICATION DESIGN REFERENCE



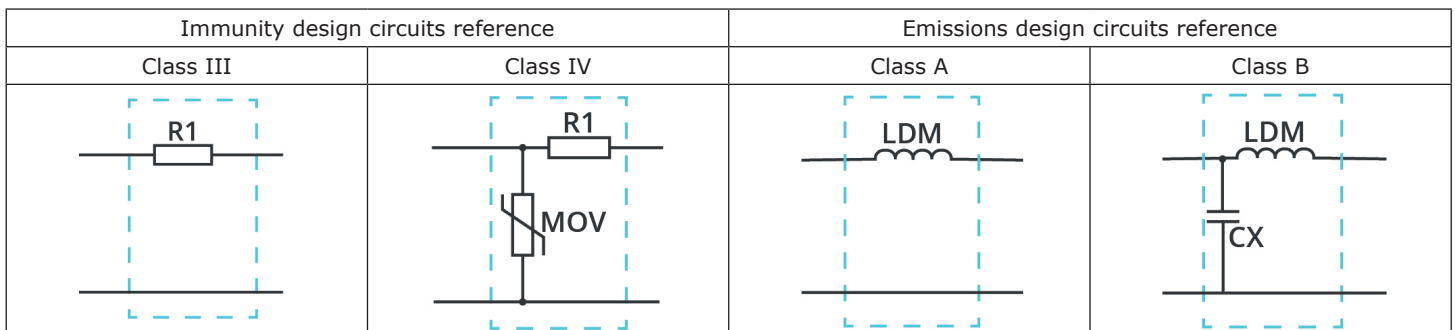
PBO-5C Series additional component selection guide (no EMC devices)

Part no.	C1 <sup>1</sup> (required)	C2 (required)	L1 (required)	C3 <sup>2</sup> (required)	C4	CY1 (required)	TVS <sup>3</sup>
PBO-5C-3	22µF/450V (-40°C to 85°C with 85-305 Vac input)	820µF/6.3V (solid-state capacitor)	4.7µH max 60mΩ/ 2.2A	100µF/ 35V	0.1µF/ 50V (ceramic capacitor)	1.0nF/ 400Vac	SMBJ7.0A
PBO-5C-5		470µF/16V (solid-state capacitor)					SMBJ7.0A
PBO-5C-9	10µF/450V (-25°C to 85°C with 85-305 Vac input, or -40°C to 85°C with 165-305 Vac input)	270µF/16V (solid-state capacitor)		47µF/ 35V			SMBJ12A
PBO-5C-12		220µF/35V					SMBJ20A
PBO-5C-15							SMBJ20A
PBO-5C-24		SMBJ30A					

- Note:
1. Recommended to use a capacitor with ripple current >200 mA at 100 kHz.
  2. Recommended to use a high frequency, low ESR, electrolytic capacitor (<= 1.1Ω at -40 C) with at least 20% margin on voltage rating.
  3. A suppressor diode (TVS) is recommended to protect the downstream application in case of converter failure and should be rated for a minimum of 1.2 times the converter's output voltage.

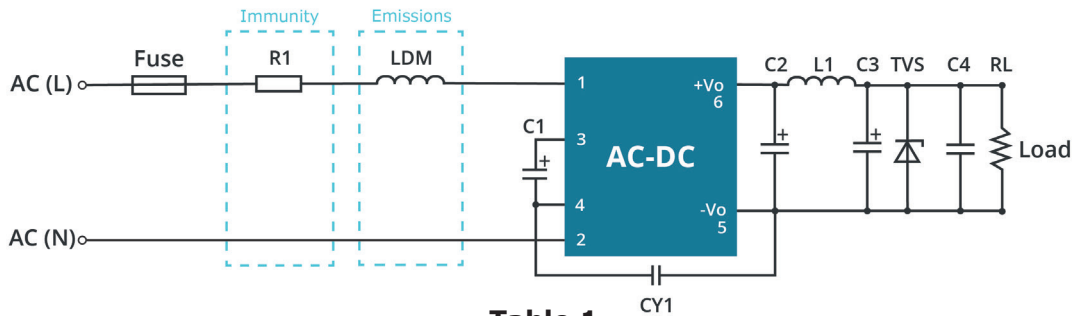
PBO-5C Series Enviromental and EMC selection guide

Recommended circuit	Application enviromental	Typical industry	Input voltage range	Enviroment temperature	Emissions	Immunity
1	Basic application	None	85~305Vac	-40°C to 85°C	Class A	Class III
2	Indoor civil enviroment	Smart home/Home appliances (2 Y-caps)		-25°C to 55°C	Class B	Class III
	Indoor general enviroment	Intelligent building/ Intelligent agriculture		-25°C to 55°C	Class B	Class IV
3	Indoor industrial enviroment	Manufacturing workshope		-40°C to 85°C	Class A	Class IV



## APPLICATION DESIGN REFERENCE (CONTINUED)

**Circuit 1**



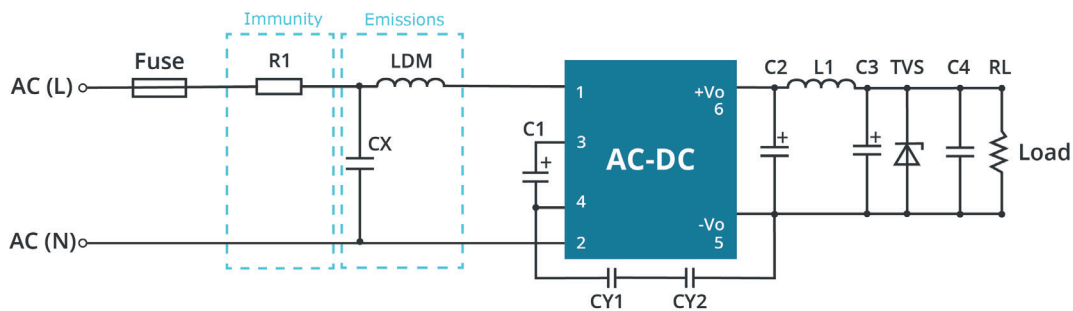
**Table 1**

Application enviromental	Ambient temperature range	Imunity Class	Emissions Class
Basic application	-40°C ~ 85°C	Class III	Class A

Component	Recommended value
FUSE (required)	1A/300V, slow blow
R1 (wire-wound resistor, required)	12Ω/3W
LDM	4.7mH/15Ω max/0.2A min

Note: R1 must be a wire-wound resistor; do not use a chip or carbon film resistor.

**Circuit 2**



**Table 2**

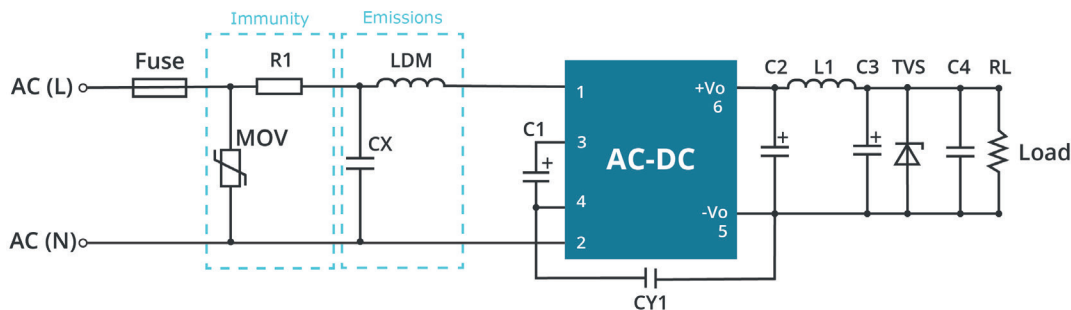
Application enviromental	Ambient temperature range	Imunity Class	Emissions Class
Indoor civil / general	-25°C ~ 55°C	Class III	Class B

Component	Recommended value
R1 (wire-wound resistor, required)	12Ω/3W
LDM	1.2mH/ 4Ω/0.2A
CX	0.1μF/310Vac
FUSE (required)	1A/300V, slow-blow

Note: 1. For Smart Home and Home Appliance applications two Y-capacitors are required in series (2.2 nF/250 Vac each) to meet 60335 household safety requirements.  
 2. Many safety standards require a bleeder resistor no greater than 3.8MΩ in parallel with the X-capacitor.  
 3. R1 must be a wire-wound resistor; do not use a chip or carbon film resistor.

## APPLICATION DESIGN REFERENCE (CONTINUED)

**Circuit 3**



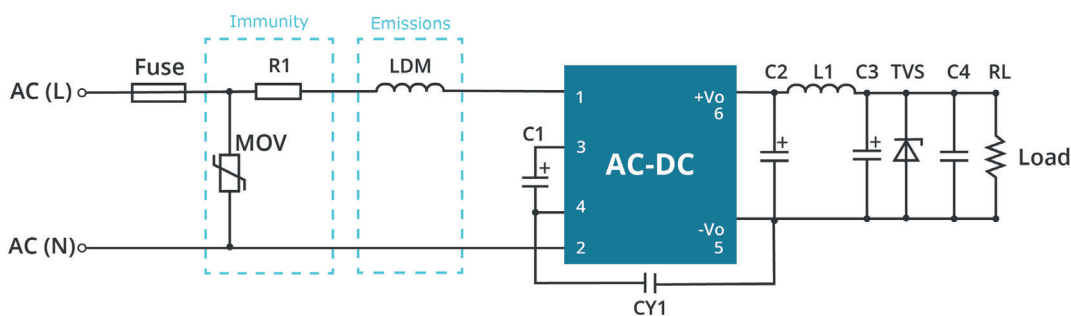
**Table 3**

Application enviromental	Ambient temperature range	Imunity Class	Emissions Class
Indoor industrial	-25°C ~ 55°C	Class IV	Class B

Component	Recommended value
MOV	S14K350
CX	0.1μF/310Vac
LDM	1.2mH/ 4Ω/0.2A
R1 (wire-wound resistor, required)	12Ω/3W
FUSE (required)	2A/300V, slow-blow

Note: 1. Many safety standards require a bleeder resistor no greater than 3.8MΩ in parallel with the X-capacitor.  
 2. R1 must be a wire-wound resistor; do not use a chip or carbon film resistor.

**Circuit 4**



**Table 4**

Application enviromental	Ambient temperature range	Imunity Class	Emissions Class
Outdoor general enviroment	-40°C ~ 85°C	Class IV	Class A

Component	Recommended value
MOV	S14K350
LDM	4.7mH/ 15Ω/0.2A
R1 (wire-wound resistor, required)	12Ω/2W
FUSE (required)	2A/300V, slow-blow

Note: R1 must be a wire-wound resistor; do not use a chip or carbon film resistor.

## REVISION HISTORY

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rev.	description	date
1.0	initial release	11/18/2020
1.01	derating and efficiency curves updated	01/20/2022
1.02	UKCA mark added	05/26/2022
1.03	isolation voltage updated	02/23/2023

The revision history provided is for informational purposes only and is believed to be accurate.



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