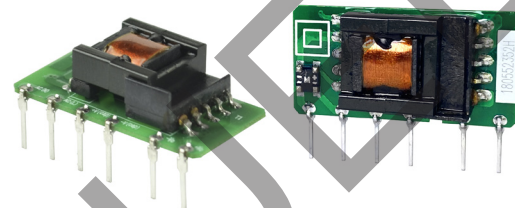


SERIES: PBO-3 | **DESCRIPTION:** AC-DC POWER SUPPLY**FEATURES**

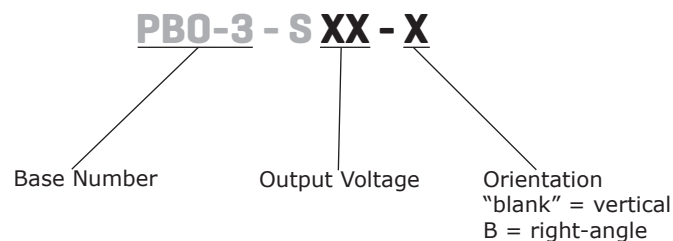
- up to 3 W continuous power
- ultra-compact SIP package
- available in straight-pin and bent-pin configurations
- wide input voltage range
- over current and short circuit protections
- 3,000 Vac isolation
- IEC, EN, UL 62368 safety approvals
- efficiency up to 77%



MODEL	output voltage (Vdc)	output current		output power max (W)	ripple and noise ¹ max (mVp-p)	efficiency ² typ (%)
		min (mA)	max (mA)			
PBO-3-S3.3 ^{4,5}	3.3	60	600	1.98	150	65
PBO-3-S5 ^{4,5}	5	60	600	3	150	70
PBO-3-S9 ⁴	9	33.3	333	3	150	73
PBO-3-S12 ^{4,5}	12	25	250	3	150	74
PBO-3-S15 ⁵	15	20	200	3	150	75
PBO-3-S24 ^{4,5}	24	12.5	125	3	150	77

Notes:

1. At full load, nominal input, 20 MHz bandwidth oscilloscope, with a 1 μ F ceramic and 10 μ F electrolytic capacitor on the output.
2. At 230 Vac input.
3. All specifications are measured at $T_a=25^\circ\text{C}$, humidity <75%, 115 or 230 Vac input voltage, and rated output load unless otherwise specified.
4. Discontinued model - vertical pin version.
5. Discontinued model - right-angle pin version.

PART NUMBER KEY

INPUT

parameter	conditions/description	min	typ	max	units
voltage		85 70		305 430	Vac Vdc
frequency		47		63	Hz
current	at 115 Vac at 277 Vac			0.12 0.06	A A
inrush current	at 115 Vac at 277 Vac		13 23		A A
no load power consumption	at 230 Vac			0.25	W

OUTPUT

parameter	conditions/description	min	typ	max	units
capacitive load	3.3 Vdc output models			820	μF
	5 Vdc output models			680	μF
	9/12 Vdc output models			470	μF
	15 Vdc output models			330	μF
	24 Vdc output models			100	μF
initial set point accuracy	3.3 Vdc output models all other models			±6 ±5	% %
line regulation	at full load 3.3 Vdc output models all other models		±2.5 ±1.5		% %
load regulation	from 10~100% load 24 Vdc output models all other models		±6 ±3		% %
switching frequency				65	kHz
temperature coefficient			±0.15		%/°C

PROTECTIONS

parameter	conditions/description	min	typ	max	units
over current protection	auto recovery	110		500	%
short circuit protection	continuous, auto recovery				

SAFETY & COMPLIANCE

parameter	conditions/description	min	typ	max	units
isolation voltage	input to output for 1 minute	3,000			Vac
safety approvals	certified to 62368: IEC, EN, UL				
safety class	class II				
conducted emissions	CISPR22/EN55022 Class A, (recommended circuit 1,2,6)				
	CISPR22/EN55022 Class B, (recommended circuit 3,4,5)				
radiated emissions	CISPR22/EN55022 Class A, (recommended circuit 1,2,6)				
	CISPR22/EN55022 Class B, (recommended circuit 3,4,5)				
ESD	IEC/EN61000-4-2, contact ±4 kV, perf. Criteria B				
radiated immunity	IEC/EN61000-4-3, 10V/m, perf. Criteria A				
EFT/burst	IEC/EN61000-4-4, ±2 kV (recommended circuit 1,2,3), perf. Criteria B				
	IEC/EN61000-4-4, ±4 kV (recommended circuit 4,5,6), perf. Criteria B				
	IEC/EN61000-4-5, line to line ±1 kV (recommended circuit 1,2), perf. Criteria B				
	IEC/EN61000-4-5, line to line ±2 kV (recommended circuit 6), perf. Criteria B				
surge	IEC/EN61000-4-5, line to line ±1 kV/line to ground ±2 kV (recommended circuit 3) perf. Criteria B				
	IEC/EN61000-4-5, line to line ±2 kV/line to ground ±4 kV (recommended circuit 4,5) perf. Criteria B				
conducted immunity	IEC/EN61000-4-6 Class A, 10 Vr.m.s, perf. Criteria A				

SAFETY & COMPLIANCE (CONTINUED)

parameter	conditions/description	min	typ	max	units
voltage dips & interruptions	IEC/EN61000-4-11, 0%-70%, perf. Criteria B				
MTBF	as per MIL-HDBK-217F at 25 °C	300,000			hours
RoHS	2011/65/EU				

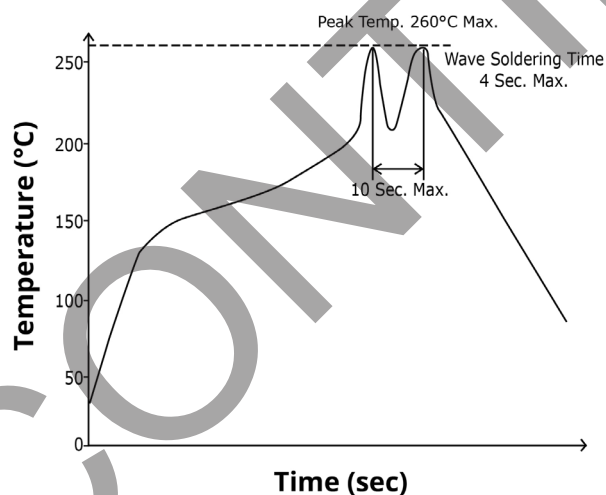
Notes: 1. The power supply is considered a component which will be installed into final equipment. The final equipment still must be tested to meet the necessary EMC directives.

ENVIRONMENTAL

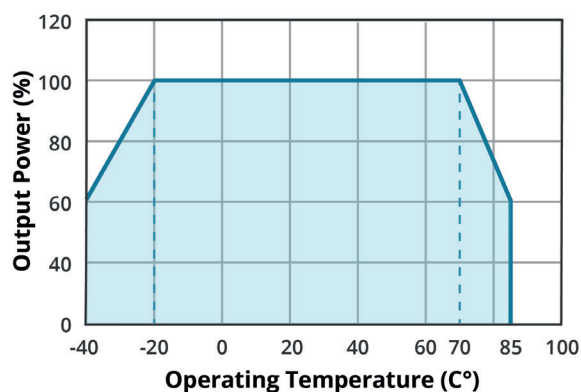
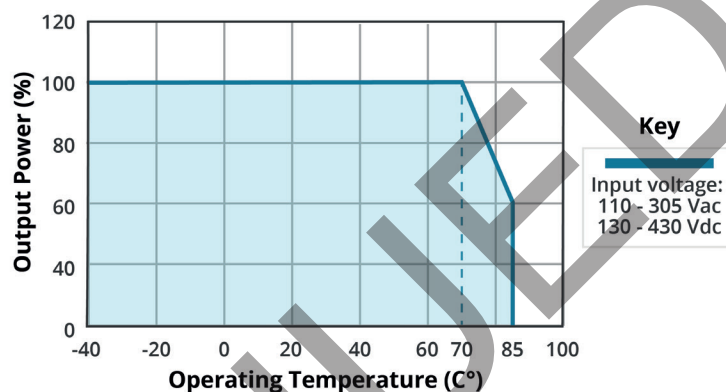
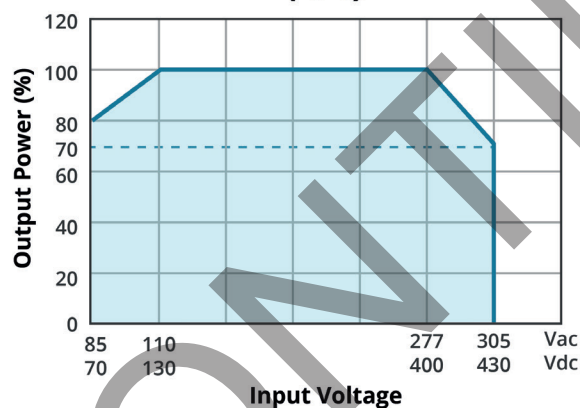
parameter	conditions/description	min	typ	max	units
operating temperature	see derating curves	-40		85	°C
storage temperature		-40		105	°C
storage humidity	non-condensing			85	%

SOLDERABILITY

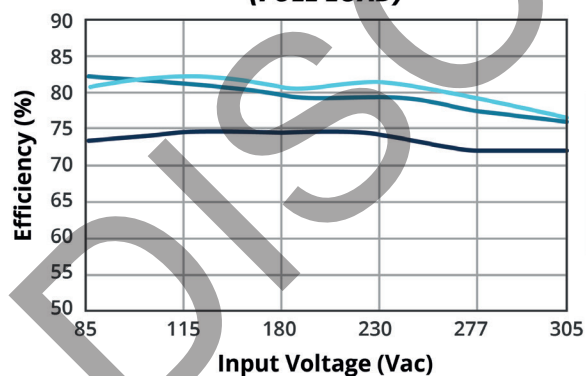
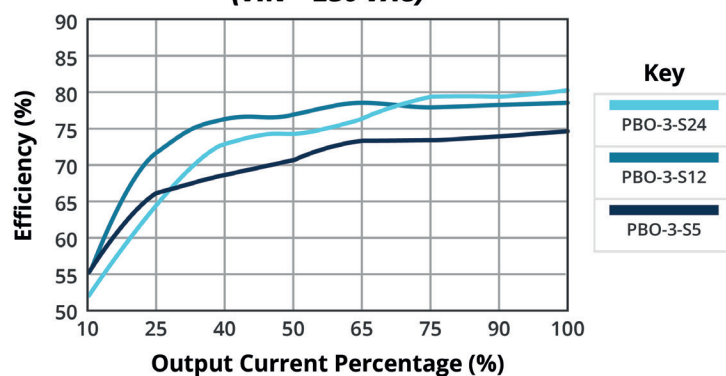
parameter	conditions/description	min	typ	max	units
hand soldering	for 3~5 seconds	350	360	370	°C
wave soldering	for 5~10 seconds	255	260	265	°C

WAVE SOLDERING PROFILE

DERATING CURVES

TEMPERATURE DERATING CURVE**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	vertical models: 35.00 x 11.00 x 18.00 (1.38 x 0.43 x 0.71 inches)				mm
	right-angle models: 35.00 x 18.00 x 11.00 (1.38 x 0.71 x 0.43 inches)				mm
weight			6		g

MECHANICAL DRAWING

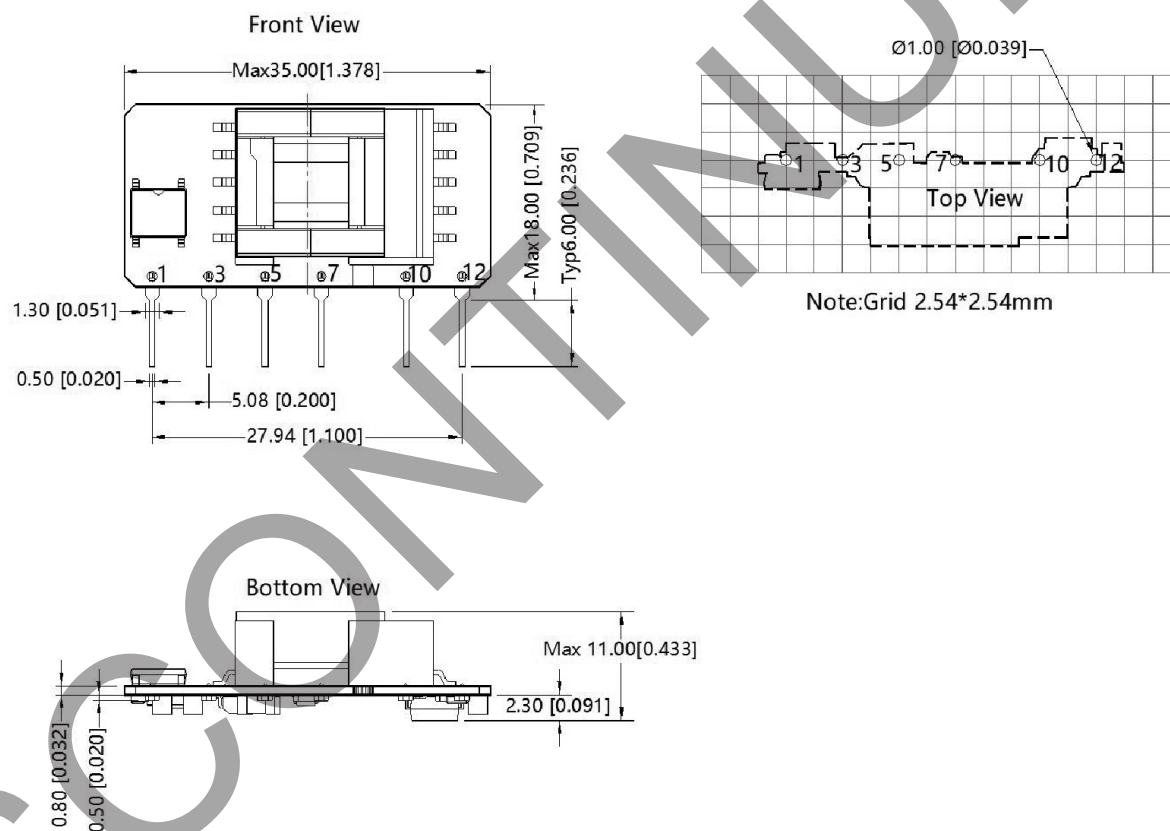
Vertical Orientation

units: mm[inch]

pin section tolerance: ± 0.10 [± 0.004]tolerance: ± 0.50 [± 0.020]

PIN CONNECTIONS	
PIN	Function
1	AC (N)
3	AC (L)
5	+V(CAP)
7	-V(CAP)
10	-Vo
12	+Vo

Note: 1. It is required to add C1 between pins 5 & 7 (see application circuits).



MECHANICAL DRAWING (CONTINUED)

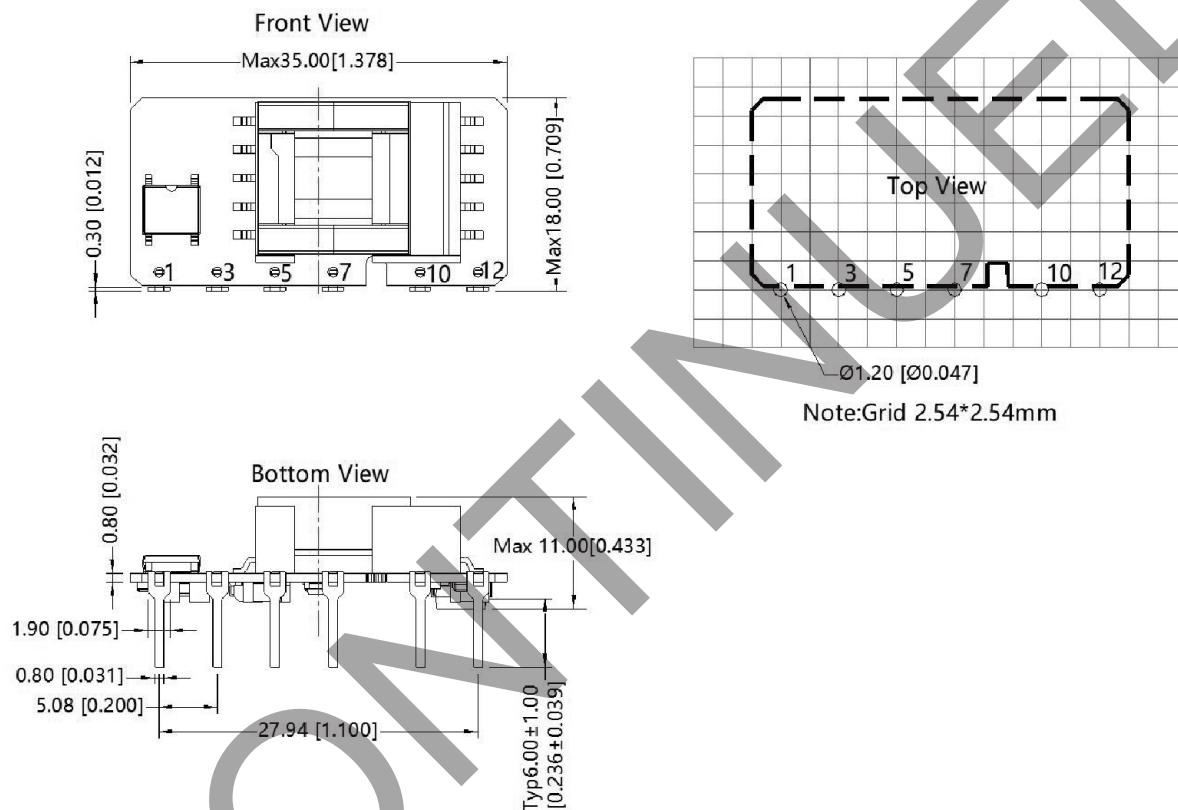
Right-angle Orientation

units: mm[inch]

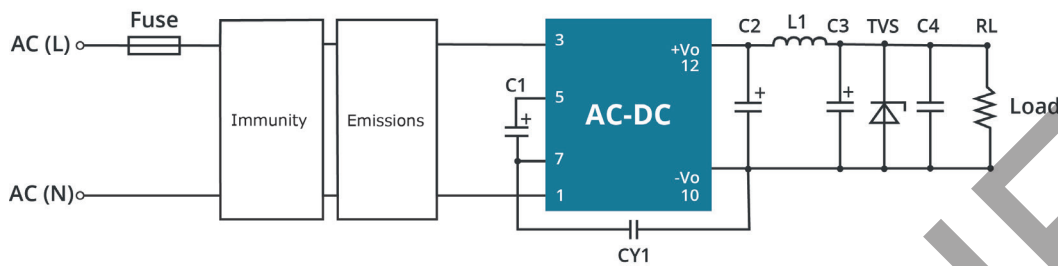
pin section tolerance: $\pm 0.10[\pm 0.004]$ tolerance: $\pm 0.50[\pm 0.020]$

PIN CONNECTIONS	
PIN	Function
1	AC (N)
3	AC (L)
5	+V(CAP)
7	-V(CAP)
10	-Vo
12	+Vo

Note: 1. It is required to add C1 between pins 5 & 7 (see application circuits).



APPLICATION DESIGN REFERENCE



PBO-3 series additional circuits design reference

Immunity design circuits for reference		Emissions design circuits for reference	
Class III	Class IV	Class A	Class B

PBO-3 Series additional component selection guide

Part no.	FUSE (required)	C1 (required)	C2 (required)	L1 (required)	C3 (required)	C4	CY1 (required)
PBO-3-S3.3	1A/300V	10μF/450V (-20°C~85°C) 22μF/450V (-40°C~85°C)	270μF/16V (solid-state capacitor)	4.7μH (max 60mΩ)	120μF/25V	0.1μF/50V	1.0nF/400 Vac
PBO-3-S5					68μF/35V		
PBO-3-S9					68μF/35V		
PBO-3-S12					68μF/35V		
PBO-3-S15					68μF/35V		
PBO-3-S24					68μF/35V		

Note: 1. C1: Input capacitors, C2: output storage capacitors, must be connected externally.

2. It is recommended using an electrolytic capacitor with high frequency and low ESR rating for C3. Combined with C2, L1, they form a pi-type filter circuit.

Choose a capacitor voltage rating with at least 20% margin, in other words not exceeding 80%. C4 is a ceramic capacitor, used for filtering high frequency noise.

A suppressor diode (TVS) is a recommended to protect the application in case of a converter failure and specification should be 1.2 times of the output voltage.

PBO-3 Series Environmental and EMC selection guide

Recommended circuit	Application environment	Typical industry	Input voltage range	Environment temperature	Emissions	Immunity
1/2	Basic application	None	85 ~ 305 Vac	-40° ~ 88°C	Class A	Class III
3	Indoor civil environment	Smart home / Home appliances (2Y)		-25° ~ 55°C	Class B	Class III
4/5	Indoor general environment	Intelligent building / Intelligent agriculture		-25° ~ 55°C	Class B	Class IV
6	Outdoor general environment	ITS / Video monitoring / Charging point / Communication / Security and protection		-40° ~ 85°C	Class A	Class IV

EMC RECOMMENDED CIRCUIT

Circuit 1

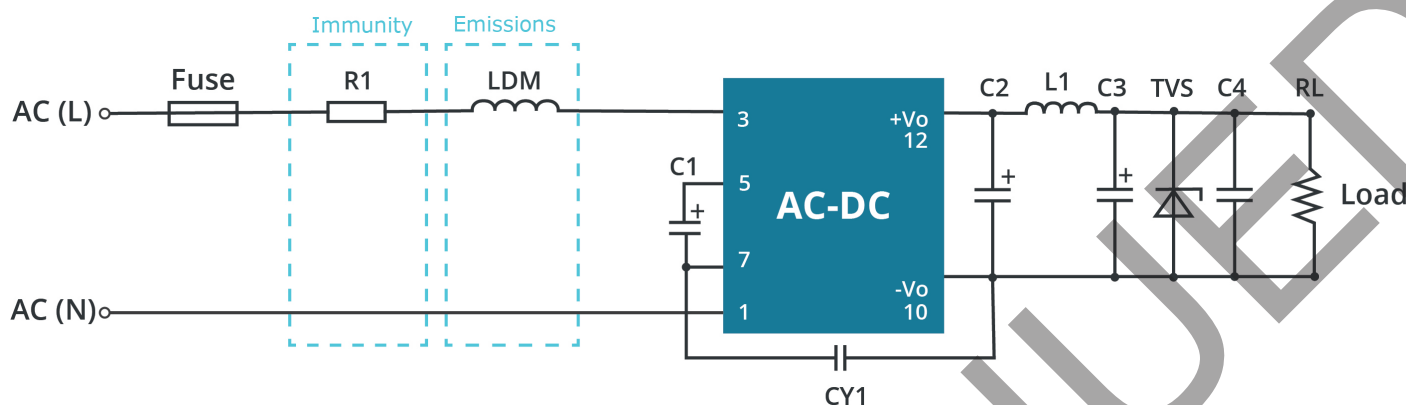


Table 1

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

Component	Recommended value
R1	12Ω/3W
LDM	4.7mH
FUSE (required)	1A/300V, slow-blow

Circuit 2

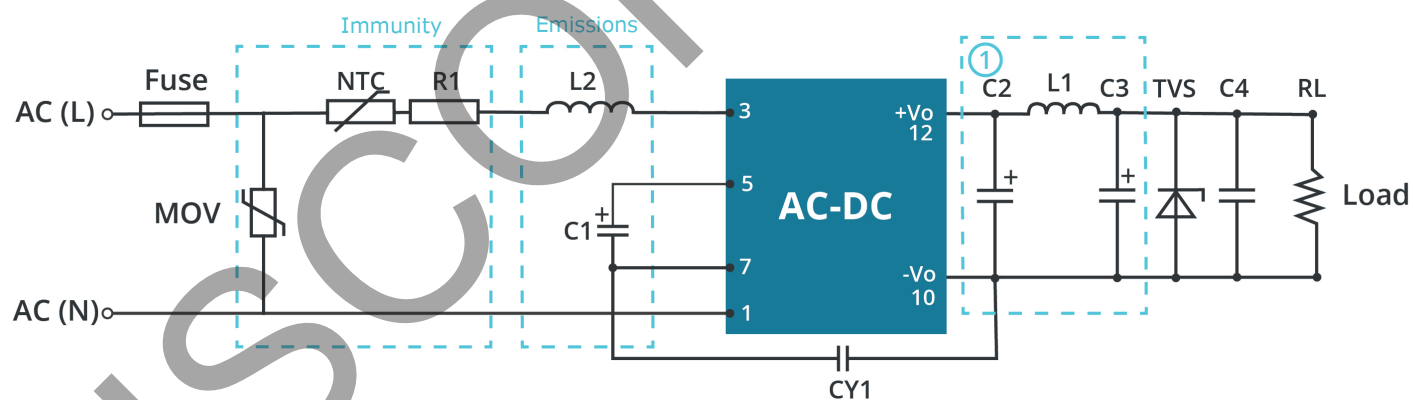


Table 2

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

Component	Recommended value
R1	12Ω/2W
L2	4.7mH
NTC	13D-5
MOV	S14K350
FUSE (required)	1A/300V, slow-blow

EMC RECOMMENDED CIRCUIT (CONTINUED)

Circuit 3

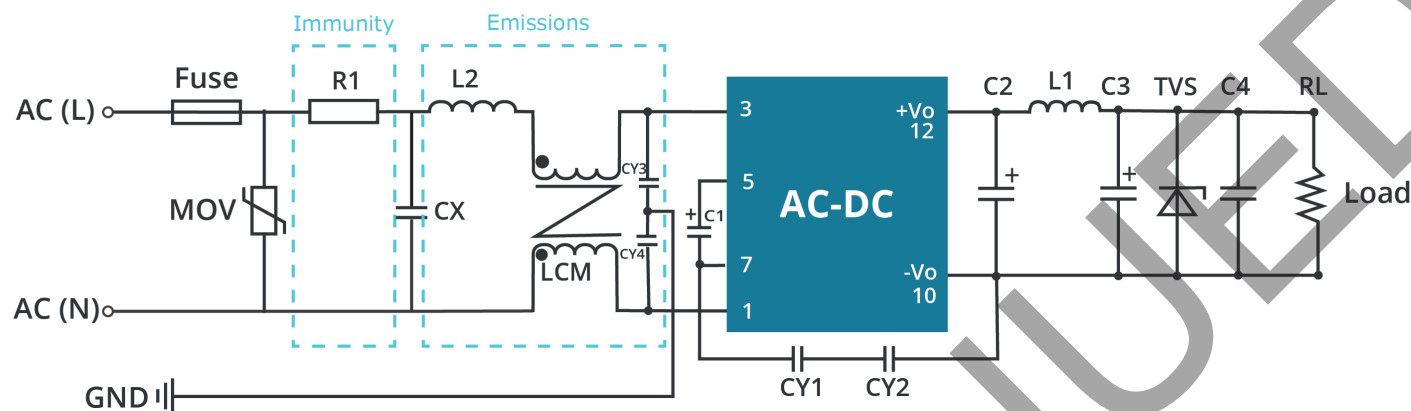
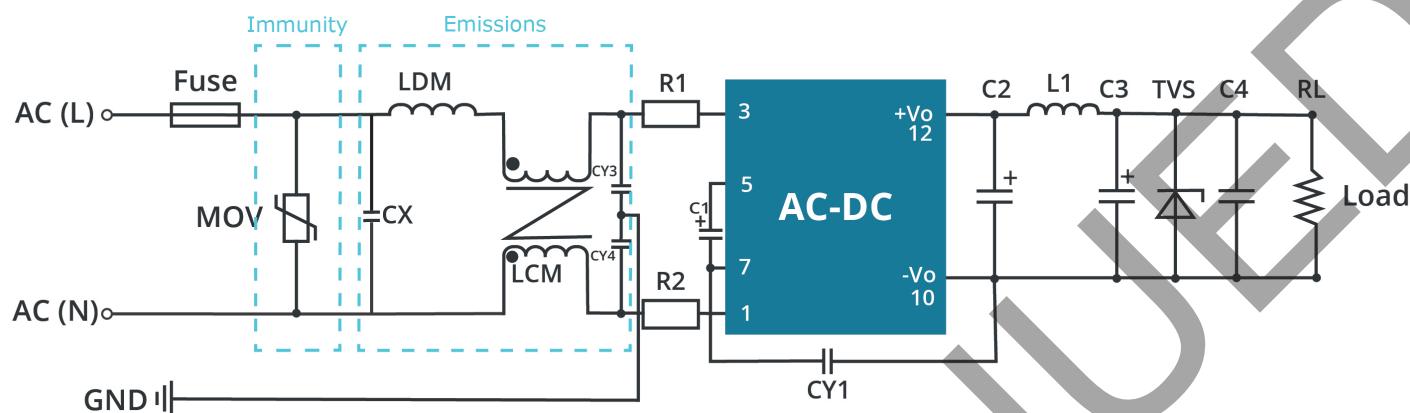


Table 3

Application enviromental	Ambient temperature range	Immunity Class	Emissions Class
Indoor civil / general	-40°C ~ 55°C	Class III	Class B

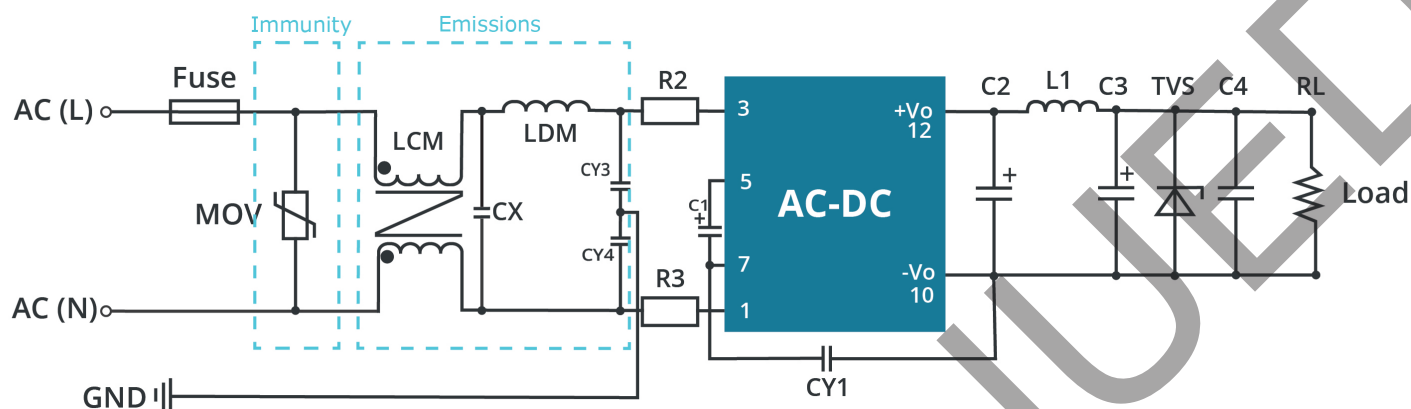
Component	Recommended value
R1	12Ω/3W
CY1 (CY2)	1.0nF/400Vac
LCM	3.5mH
LDM	0.33mH
CX	0.1μF/310Vac
CY3, CY4	0.56nF/400Vac
FUSE (required)	1A/300V, slow-blow

Note: In the home appliance application enviroment, the two Y capacitors of the primary and secondary need to be externally connected (CY1/CY2, value at 2.2nF/400Vac) which can meet the EN60335 certification. In other industries, only one Y capacitor is required.

EMC RECOMMENDED CIRCUIT (CONTINUED)**Circuit 4****Table 4**

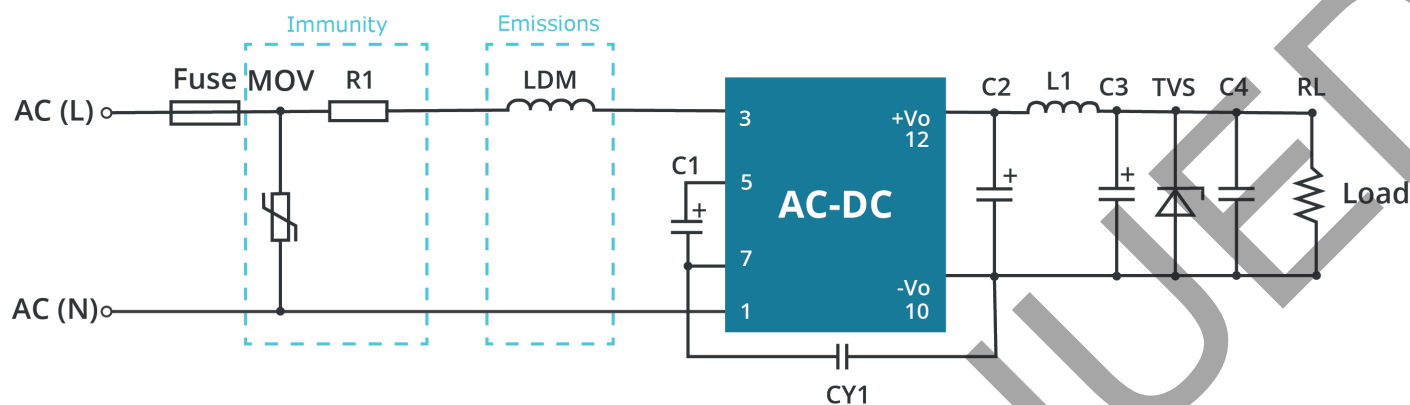
Application enviromental	Ambient temperature range	Immunity Class	Emissions Class
Indoor industrial	-25°C ~ 55°C	Class IV	Class B

Component	Recommended value
MOV	S14K350
C1	450V/22uF
CY1	2.2nF/400Vac
CX	0.1μF/310Vac
LCM	3.5mH
LDM	0.33mH
R1, R2	12Ω/2W
CY3, CY4	0.56nF/400Vac
FUSE (required)	2A/300V, slow-blow

EMC RECOMMENDED CIRCUIT (CONTINUED)**Circuit 5****Table 5**

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

Component	Recommended value
MOV	S14K350
C1	450V/22uF
CY1	2.2nF/400Vac
CY3/CY4	0.56μF/400Vac
CX	0.1μF/310Vac
LCM	3.5mH
LDM	0.33mH
R2/R3	12Ω/2W
FUSE (required)	2A/300V, slow-blow

EMC RECOMMENDED CIRCUIT (CONTINUED)**Circuit 6****Table 6**

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

Component	Recommended value
MOV	S14K350
C1	450V/22uF
LDM	4.7mH
R1	12Ω/3W
FUSE (required)	2A/300V, slow-blow

REVISION HISTORY

rev.	description	date
1.0	initial release	10/18/2016
1.01	internal IC changed	05/11/2017
1.02	updated efficiency curves	02/05/2018
1.03	datasheet update, safety approvals updated to match 62368 certification, PCN-656-95022R-01	10/12/2020
1.04	product image updated	09/16/2021
1.05	derating curves updated	01/18/2022
1.06	product image updated	03/10/2022
1.07	UKCA mark added	05/25/2022
1.08	discontinued models PBO-3-S3.3, PBO-3-S3.3-B, PBO-3-S5, PBO-3-S5-B, PBO-3-S9, PBO-3-S12, PBO-3-S12-B, PBO-3-S15, PBO-3-S15-B, PBO-3-S24, PBO-3-S24-B	09/13/2022

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



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