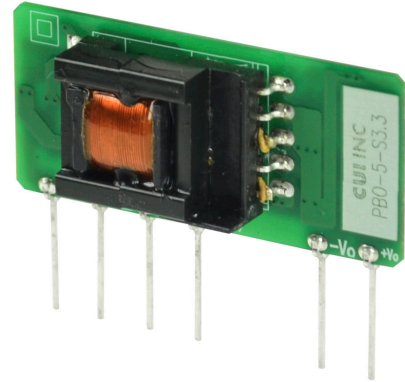


**SERIES:** PBO-5 | **DESCRIPTION:** AC-DC POWER SUPPLY

**FEATURES**

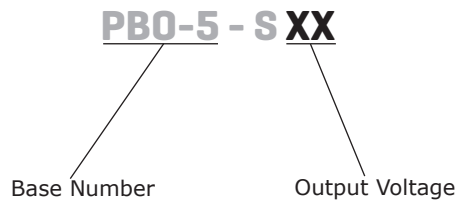
- up to 5 W continuous power
- ultra-compact SIP package
- wide input voltage range
- over current and short circuit protections
- 3,000 Vac isolation
- UL 60950-1, CE safety approvals
- efficiency up to 79%



MODEL	output voltage (Vdc)	output current		output power max (W)	ripple and noise <sup>1</sup> max (mVp-p)	efficiency <sup>2</sup> typ (%)
		min (mA)	max (mA)			
PBO-5-S3.3	3.3	0	1000	3.3	150	67
PBO-5-S5	5	0	1000	5	150	74
PBO-5-S9	9	0	560	5	150	75
PBO-5-S12	12	0	420	5	150	76
PBO-5-S15	15	0	340	5	150	77
PBO-5-S24	24	0	210	5	150	79

Notes: 1. At full load, nominal input, 20 MHz bandwidth oscilloscope, with a 1  $\mu$ F ceramic and 10  $\mu$ 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.

**PART NUMBER KEY**



## INPUT

parameter	conditions/description	min	typ	max	units
voltage		85 100		264 400	Vac Vdc
frequency		47		63	Hz
current	at 115 Vac at 230 Vac			0.2 0.1	A A
inrush current	at 115 Vac at 230 Vac		5 10		A A
leakage current	CY0 is 1 nF/400 Vac			0.25	mA
no load power consumption				0.5	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	3.3 Vdc output models			±3	%
	all other models			±2	%
line regulation	at full load			±0.5	%
load regulation	from 10~100% load			±1.5	%
hold-up time	at 115 Vac		20		ms
	at 230 Vac		80		ms
switching frequency			100		kHz
temperature coefficient			±0.02		%/°C

## PROTECTIONS

parameter	conditions/description	min	typ	max	units
over voltage protection	zener clamp diode				
over current protection	auto recovery	110			%
short circuit protection	continuous, auto recovery				

## SAFETY & COMPLIANCE

parameter	conditions/description	min	typ	max	units
isolation voltage	input to output at 5 mA for 1 minute	3,000			Vac
safety approvals	UL 60950-1, EN 60950-1				
safety class	class II				
conducted emissions	CISPR22/EN55022 Class A, (external circuit required, see figure 1)				
	CISPR22/EN55022 Class B, (external circuit required, see figure 2)				
radiated emissions	CISPR22/EN55022 Class B, (external circuit required, see figure 1 or 2)				
ESD	IEC/EN61000-4-2 Class B, ±4 kV				
radiated immunity	IEC/EN61000-4-3 Class A, 10V/m				
EFT/burst	IEC/EN61000-4-4 Class B, ±2 kV (external circuit required, see figure 1)				
	IEC/EN61000-4-4 Class B, ±4 kV (external circuit required, see figure 2)				
surge	IEC/EN61000-4-5 Class B, ±1 kV (external circuit required, see figure 1)				
	IEC/EN61000-4-5 Class B, ±1 kV/±2 kV (external circuit required, see figure 2)				
conducted immunity	IEC/EN61000-4-6 Class A, 3 Vr.m.s (external circuit required, see figure 2)				

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.

## SAFETY & COMPLIANCE (CONTINUED)

parameter	conditions/description	min	typ	max	units
PFM	IEC/EN61000-4-8 Class A, 10 A/m				
voltage dips & interruptions	IEC/EN61000-4-11 Class B, 0%-70%				
MTBF	as per MIL-HDBK-217F at 25 °C	300,000			hours
RoHS	2011/65/EU				

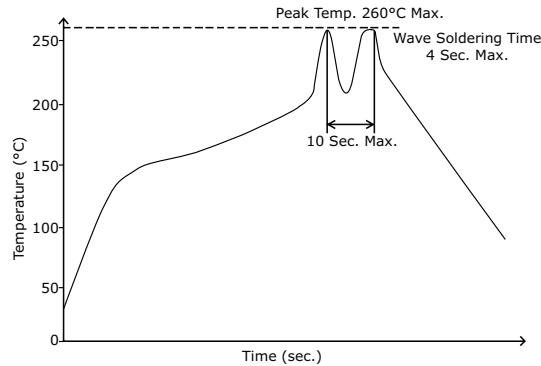
Notes: 1. The power supply is considered a component which will be installed into final equipment. The final equipment still must be tested to meet the necessary EMC directives.

## ENVIRONMENTAL

parameter	conditions/description	min	typ	max	units
operating temperature	see derating curves	-25		85	°C
storage temperature		-40		105	°C
storage humidity	non-condensing			85	%

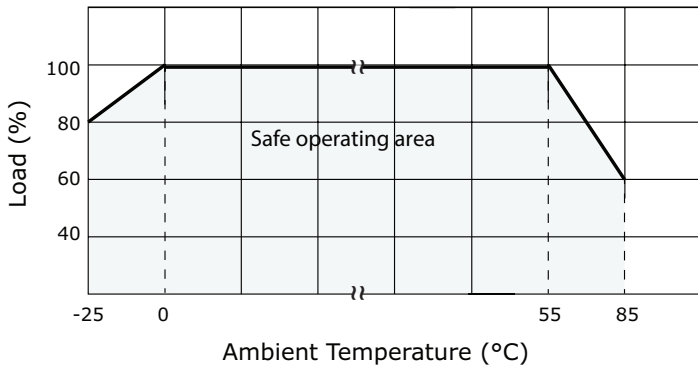
## SOLDERABILITY

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

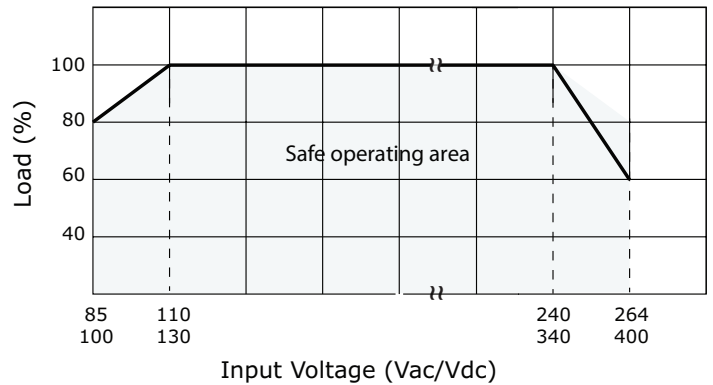


## DERATING CURVES

load vs. ambient temperature  
(at 110~240 Vac / 130~340 Vdc input voltage)

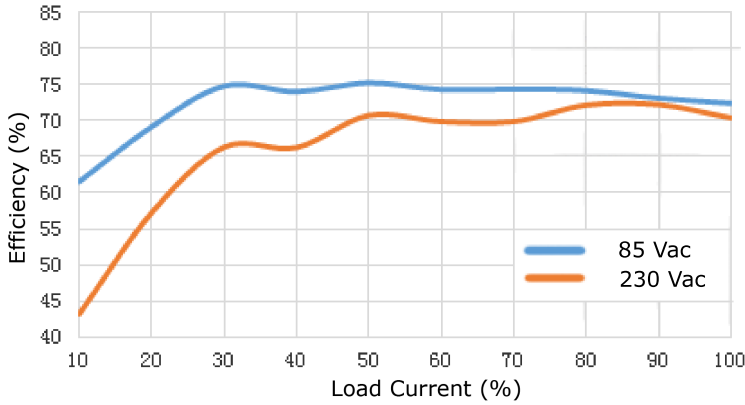


load vs. input voltage  
(at 25°C)

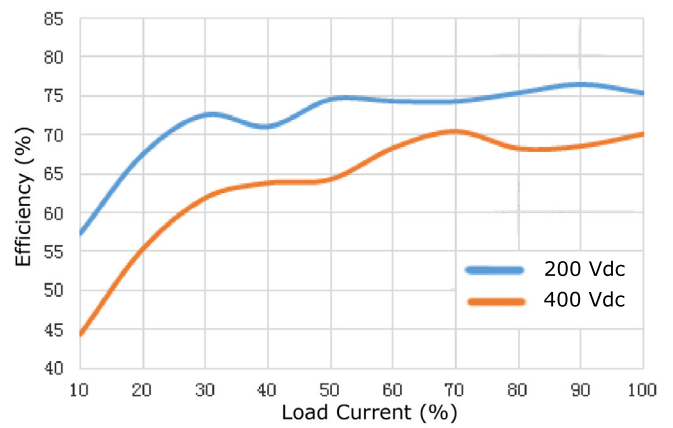


## EFFICIENCY CURVES

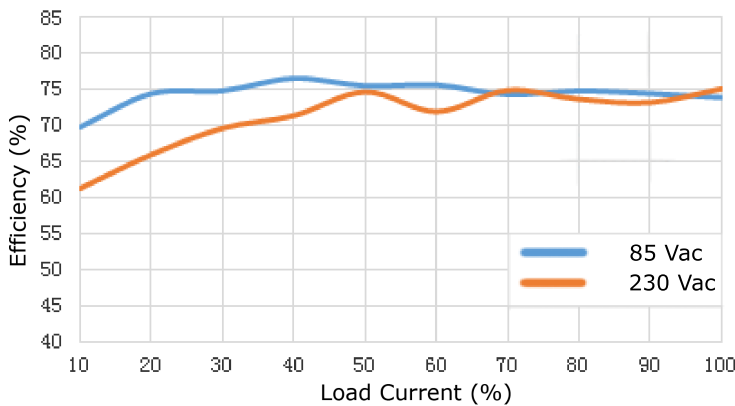
PBO-5-S3.3 AC Input Efficiency Curve  
(Efficiency vs. Load Current)



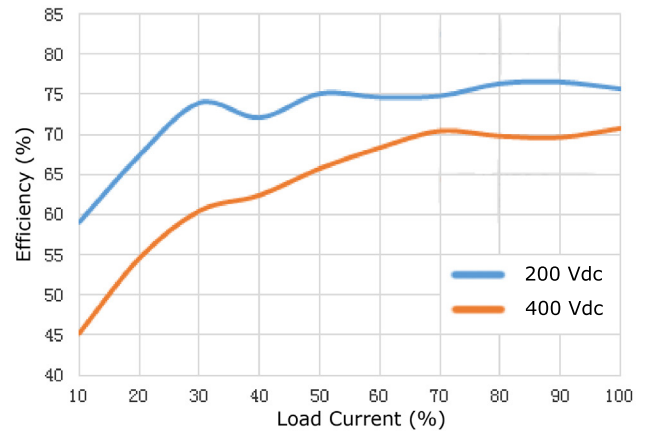
PBO-5-S3.3 DC Input Efficiency Curve  
(Efficiency vs. Load Current)



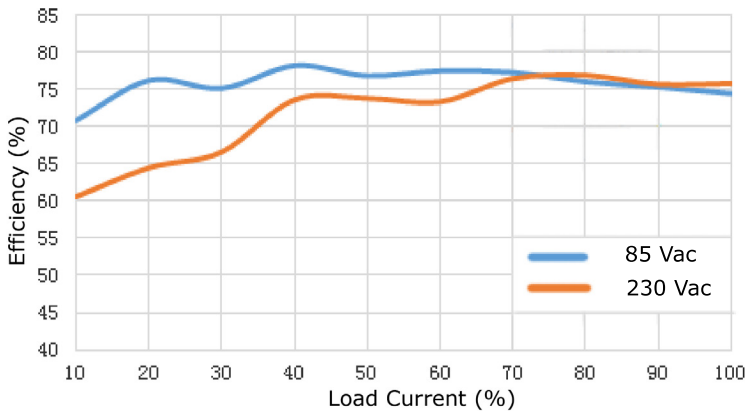
PBO-5-S5 AC Input Efficiency Curve  
(Efficiency vs. Load Current)



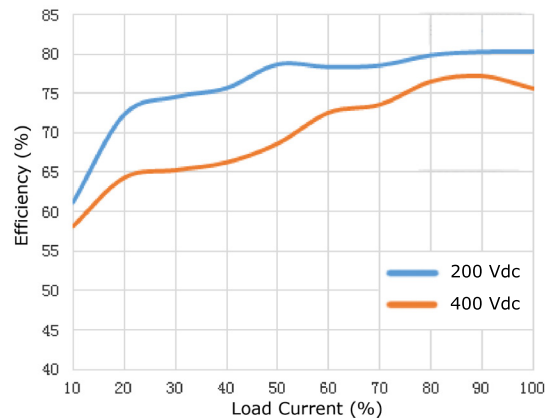
PBO-5-S5 DC Input Efficiency Curve  
(Efficiency vs. Load Current)



PBO-5-S9 AC Input Efficiency Curve  
(Efficiency vs. Load Current)

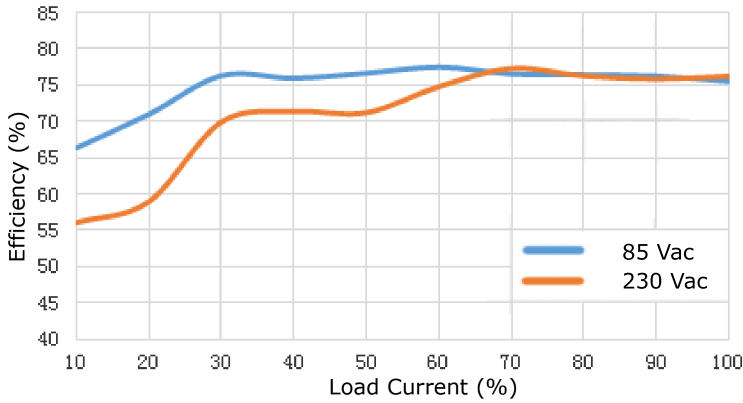


PBO-5-S9 DC Input Efficiency Curve  
(Efficiency vs. Load Current)

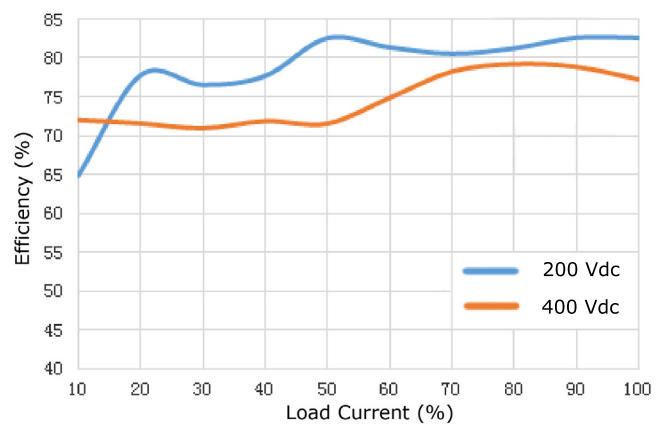


## EFFICIENCY CURVES (CONTINUED)

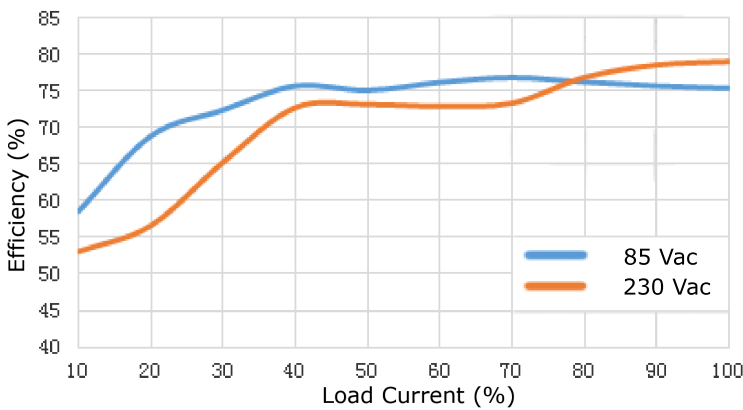
PBO-5-S12 AC Input Efficiency Curve  
(Efficiency vs. Load Current)



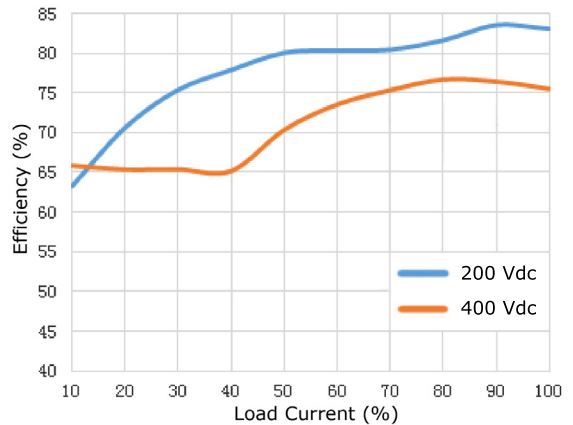
PBO-5-S12 DC Input Efficiency Curve  
(Efficiency vs. Load Current)



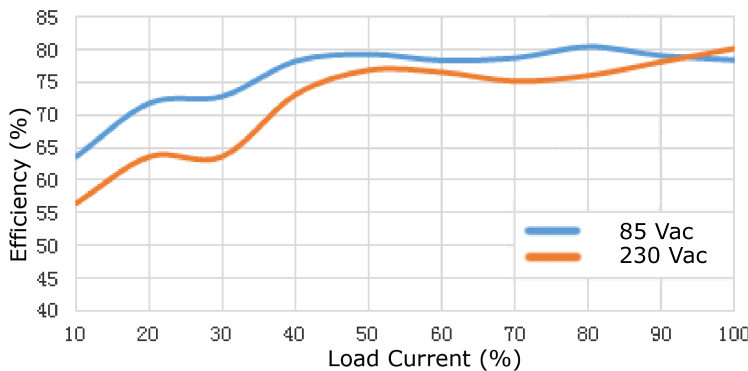
PBO-5-S15 AC Input Efficiency Curve  
(Efficiency vs. Load Current)



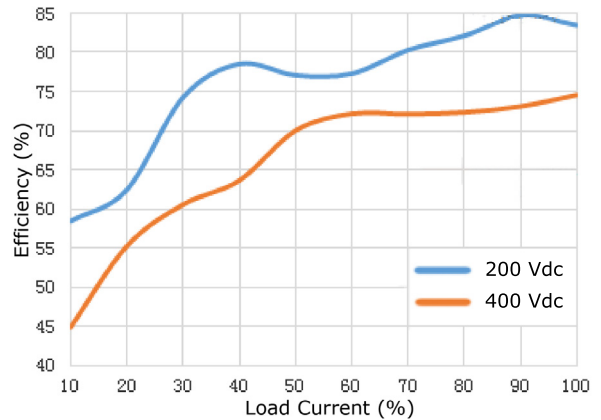
PBO-5-S15 DC Input Efficiency Curve  
(Efficiency vs. Load Current)



PBO-5-S24 AC Input Efficiency Curve  
(Efficiency vs. Load Current)



PBO-5-S24 DC Input Efficiency Curve  
(Efficiency vs. Load Current)



## MECHANICAL

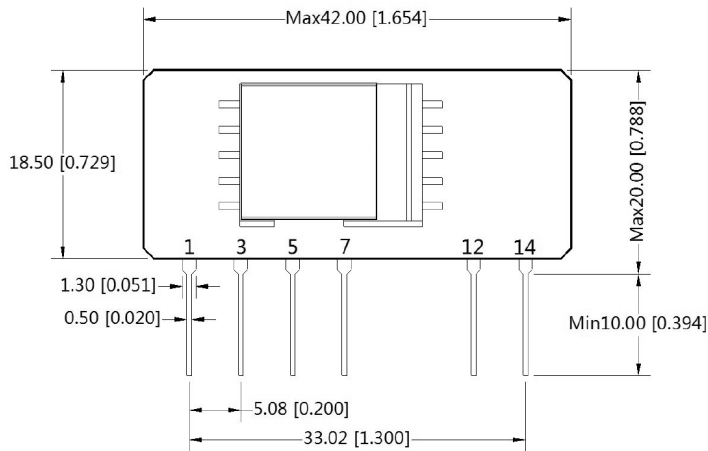
parameter	conditions/description	min	typ	max	units
dimensions	42.00 x 13.65 x 20.00 (1.65 x 0.54 x 0.79 inches)				mm
weight			7		g

## MECHANICAL DRAWING

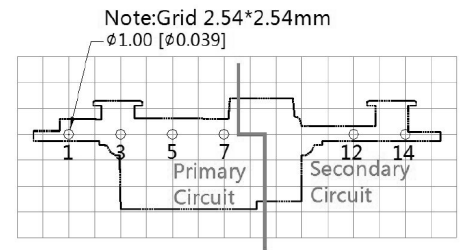
units: mm[inch]  
 tolerance:  $\pm 0.50[\pm 0.020]$   
 pin section tolerance:  $\pm 0.10[\pm 0.004]$

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

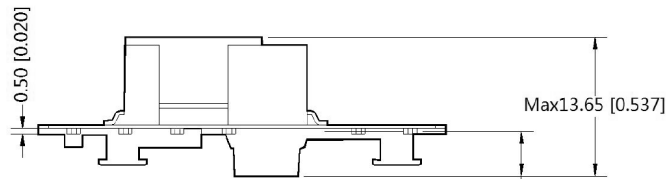
Note: 1. It is required to add C1 between pins 5 & 7 (see application circuits).



Front View



Top View  
PCB Layout



Bottom View

## APPLICATION CIRCUIT

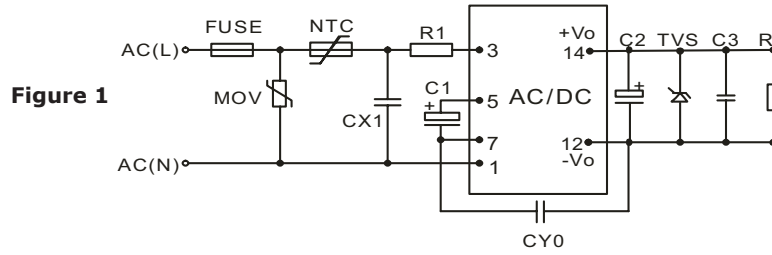


Table 1

Recommended External Circuit Components										
Vo (Vdc)	FUSE <sup>1</sup>	MOV	NTC	CX1	R1	C1 <sup>1</sup>	CY0	C2 <sup>1</sup>	TVS	C3
3.3	1A/250V	14D561K	13D-5	0.1 $\mu$ F/275Vac	12 $\Omega$ /2W	10 $\mu$ F/400V	1nF/400Vac	220 $\mu$ F/35V	SMBJ7.0A	100nF/50V
5	1A/250V	14D561K	13D-5	0.1 $\mu$ F/275Vac	12 $\Omega$ /2W	10 $\mu$ F/400V	1nF/400Vac	220 $\mu$ F/35V	SMBJ7.0A	100nF/50V
9	1A/250V	14D561K	13D-5	0.1 $\mu$ F/275Vac	12 $\Omega$ /2W	10 $\mu$ F/400V	1nF/400Vac	220 $\mu$ F/35V	SMBJ12A	100nF/50V
12	1A/250V	14D561K	13D-5	0.1 $\mu$ F/275Vac	12 $\Omega$ /2W	10 $\mu$ F/400V	1nF/400Vac	150 $\mu$ F/35V	SMBJ20A	100nF/50V
15	1A/250V	14D561K	13D-5	0.1 $\mu$ F/275Vac	12 $\Omega$ /2W	10 $\mu$ F/400V	1nF/400Vac	150 $\mu$ F/35V	SMBJ20A	100nF/50V
24	1A/250V	14D561K	13D-5	0.1 $\mu$ F/275Vac	12 $\Omega$ /2W	10 $\mu$ F/400V	1nF/400Vac	100 $\mu$ F/35V	SMBJ30A	100nF/50V

Note: 1. Required components.

## EMC RECOMMENDED CIRCUIT

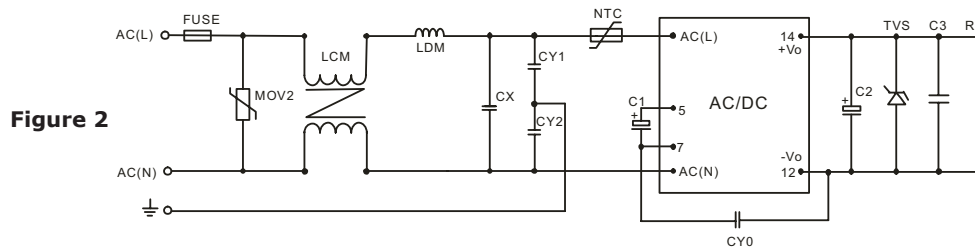


Table 2

Recommended External Circuit Components	
FUSE	1A/250V, slow fusing
MOV2	S14K320
LCM	3.5mH
LDM	330 $\mu$ H
CX	0.1 $\mu$ F/275 Vac
CY1, CY2	1nF/400 Vac
NTC	13D-5
C1	10 $\mu$ F/400V
CY0	1nF/400Vac

Note: Also refer to Table 1.

- Notes:
- C1 is required for both AC and DC inputs. For input voltages greater than 370 Vdc, the recommended value is 10  $\mu$ F / 450 V.
  - C2 is recommended to be a high frequency and low impedance capacitor. For capacitance and rated ripple current of capacitors, refer to the datasheets provided by the manufacturers. Voltage derating of capacitors should be 80% or above.
  - C3 is a ceramic capacitor used to filter high frequency noise.
  - TVS is a recommended post-component to protect post-circuits (if converter fails).
  - It is required to have a distance  $\geq 6.4$  mm for safety between external components in primary and secondary circuit.

## REVISION HISTORY

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rev.	description	date
1.0	initial release	10/18/2016

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



**CUI INC**<sup>®</sup>

**Headquarters**  
20050 SW 112th Ave.  
Tualatin, OR 97062  
**800.275.4899**

Fax 503.612.2383  
**cui.com**  
techsupport@cui.com

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