SERIES: PQC60 | DESCRIPTION: DC-DC CONVERTER

FEATURES

- 60 W isolated output
- 4:1 input range (9~36 Vdc)
- single regulated outputs
- 1,500 Vdc isolation
- extended temperature range (-40 to +105 C)
- over-current, input under-voltage, over-voltage and output short-circuit protection
- optional heatsink available



RoHS

MODEL

MODEL	input voltage typ (Vdc)	input voltage range (Vdc)	output voltage (Vdc)	output current min (mA)	output current max (mA)	output power max (W)	ripple and noise[1] max (mVp-p)	efficiency[2] typ (%)
PQC60-24-S5	24	9~36	5	600	12,000	60	100	92
PQC60-24-S12	24	9~36	12	250	5,000	60	100	93
PQC60-24-S15	24	9~36	15	200	4,000	60	100	93.3
PQC60-24-S24	24	9~36	24	125	2,500	60	130	93

Notes:
1. Ripple and noise are measured at 20 MHz BW, 5%~100% load with 1 µF ceramic and 10 µF electrolytic capacitors on the output. 3% max from 0%-5% load. Measured at 20 MHz BW, 20MHz bandwidth, nominal input voltage.
2. Efficiency is measured at nominal input voltage and rated output load.

PART NUMBER KEY

PQC60 - 24 - SXX - X

- PQC60 - Base Number
- 24 - Input Voltage
- S - Output, S = single
- XX - Output Voltage
- X - Heatsink, "blank" = no heatsink, H = with heatsink

Please read our datasheet & drawing disclaimer here.

INPUT

parameter	conditions/description	min	typ	max	units
operating input voltage		9	24	36	Vdc
current (full load/no load)	at nominal input voltage		2718/25	2748/30	mA
start-up voltage				9	Vdc
absolute maximum continuous voltage				40	Vdc
surge voltage	for maximum of 1 second	-0.7		50	Vdc
CTRL[3]	module on (CTRL pin open or pulled high (3~12Vdc)				
	module off (CTRL pin pulled low to GND (0~1.2Vdc)				
filter	Pi filter				

Notes: 3. The CTRL pin voltage is referenced to input GND.

OUTPUT

parameter	conditions/description	min	typ	max	units
maximum capacitive load	5 Vdc output 12 Vdc output 15 Vdc output 24 Vdc output			20,000 6,000 4,000 2,000	µF µF µF µF
line regulation	full load, input voltage from low to high		±0.2	±0.5	%
load regulation	5% to 100% load		±0.5	±1	%
voltage accuracy	5% to 100% load 0% to 5% load		±1 ±2	±2 ±5	% %
switching frequency[4]	PWM mode		370		kHz
transient recovery time	25% load step change, nominal input voltage		250	500	µs
transient response deviation	25% load step change, nominal input voltage range 5 Vdc output voltage all other output models		 ±3 ±3	 ±10 ±5	 % %
temperature coeffecient	full load			±0.03	%/°C

Notes: 4. Switching frequency is measured at full load. The module reduces the switching frequency for light load (below 50%) efficiency improvement.

PROTECTIONS

parameter	conditions/description	min	typ	max	units
over voltage protection		110	140	160	%
over current protection		110	140	200	%
short circuit protection	auto recovery, continuous				

SAFETY AND COMPLIANCE

parameter	conditions/description	min	typ	max	units
isolation voltage	input to output for 1 minute at 1 mA max. input/output to case for 1 minute at 1 mA max.	1,500 1,000			Vdc Vdc
isolation resistance	input to output at 500 Vdc	100			MΩ
isolation capacitance	input to output at 100kHz/0.1V		2,200		pF
vibration	10-150Hz, 5G, 0.75mm. along X, Y and Z				
safety approvals	designed to meet 62368: EN, BS EN				
conducted emissions	CISPR32/EN 55032 Class A (Vout=12/15V see Fig. 2-1 for recommended circuit, Vout=05/24V see Fig. 2-3 for recommended circuit) / Class B (Vout=12/15V see Fig. 2-2 for recommended circuit, Vout=05/24V see Fig. 2-4 for recommended circuit)				
radiated emissions	CISPR32/EN 55032 Class A (Vout=12/15V see Fig. 2-1 for recommended circuit, Vout=05/24V see Fig. 2-3 for recommended circuit) / Class B (Vout=12/15V see Fig. 2-2 for recommended circuit, Vout=05/24V see Fig. 2-4 for recommended circuit)				
ESD	IEC/EN61000-4-2 Contact ±6KV/Air ±8KV, perf. Criteria B				

SAFETY AND COMPLIANCE (CONTINUED)

parameter	conditions/description	min	typ	max	units
radiated immunity	IEC/EN61000-4-3 10V/m, perf. Criteria A				
EFT/burst	IEC/EN61000-4-4 100KHz ±2KV (Vout=12/15V see Fig. 2-2 for recommended circuit, Vout=05/24V see Fig. 2-4 for recommended circuit), perf. Criteria A				
surge	IEC/EN61000-4-5 line to line ±2KV (Vout=12/15V see Fig. 2-2 for recommended circuit, Vout=05/24V see Fig. 2-4 for recommended circuit), perf. Criteria A				
conducted immunity	IEC/EN61000-4-6 10Vrms, perf. Criteria A				
MTBF	as per MIL-HDBK-217F @ 25°C	1,000,000			hours
RoHS	yes				

ENVIRONMENTAL

parameter	conditions/description	min	typ	max	units
operating temperature	see derating curve	-40		105	°C
storage temperature		-55		125	°C
storage humidity	non-condensing	5		95	%

SOLDERABILITY

parameter	conditions/description	min	typ	max	units
pin soldering resistance temperature	soldering spot is 1.5mm away from case for 10 seconds			300	°C

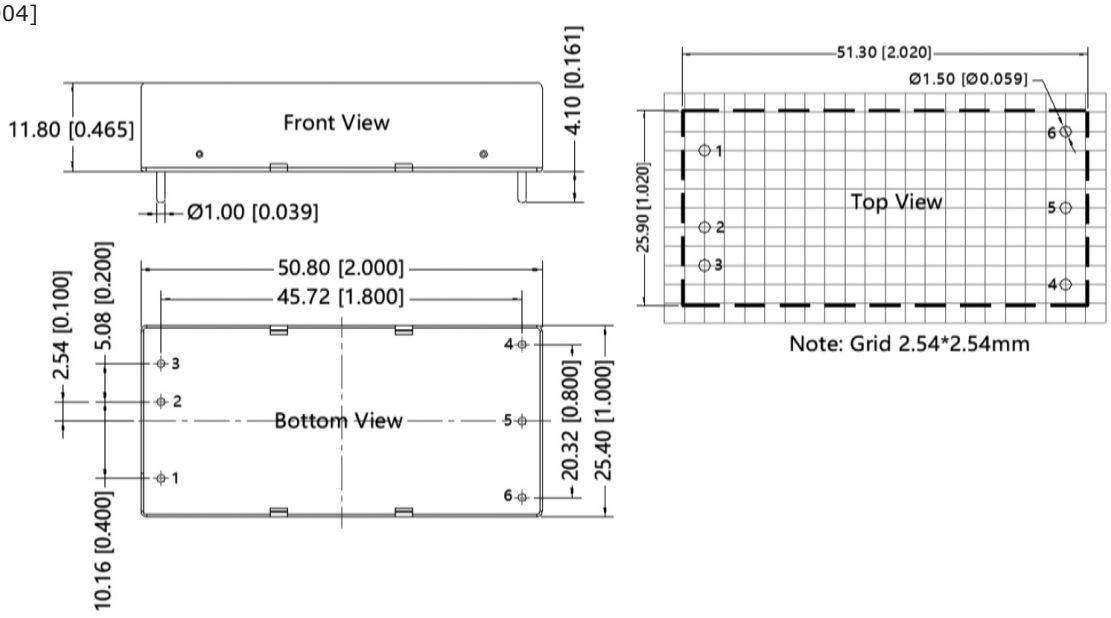
MECHANICAL

parameter	conditions/description	min	typ	max	units
dimensions	without heatsink: 50.80 x 25.40 x 11.80 [2.000 x 1.000 x 0.464 inch] with heatsink: 51.40 x 26.20 x 16.50 [2.023 x 1.031 x 0.650 inch]				mm mm
weight	without heatsink with heatsink		41.0 50.8		g g
cooling method	natural convection				

MECHANICAL DRAWING

units: mm[inch]
tolerance: ±0.50[±0.020]
pin section tolerance: ±0.10[±0.004]

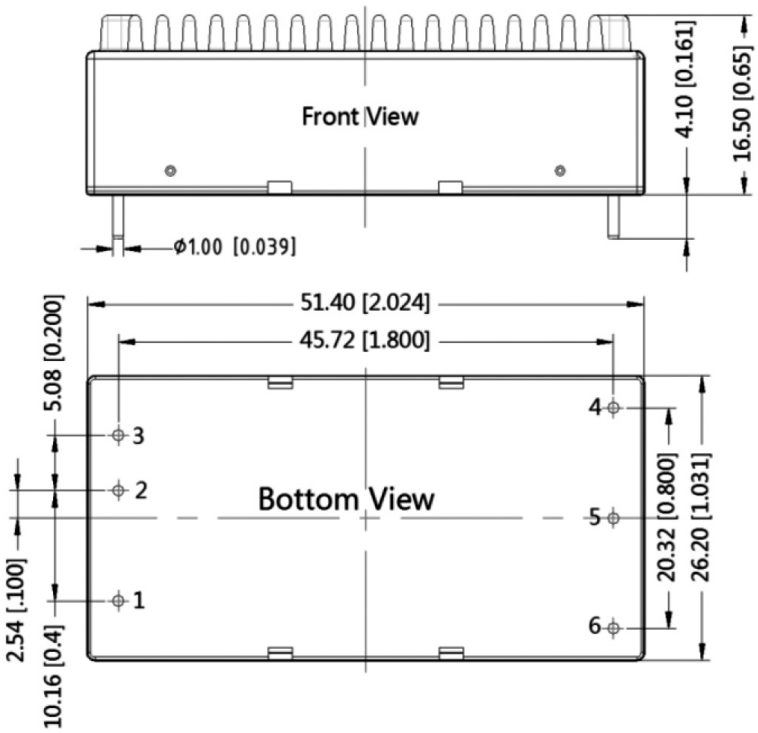
PIN CONNECTIONS	
PIN	Function
1	CTRL
2	GND
3	Vin
4	+Vo
5	0V
6	Trim



MECHANICAL DRAWING (CONTINUED)

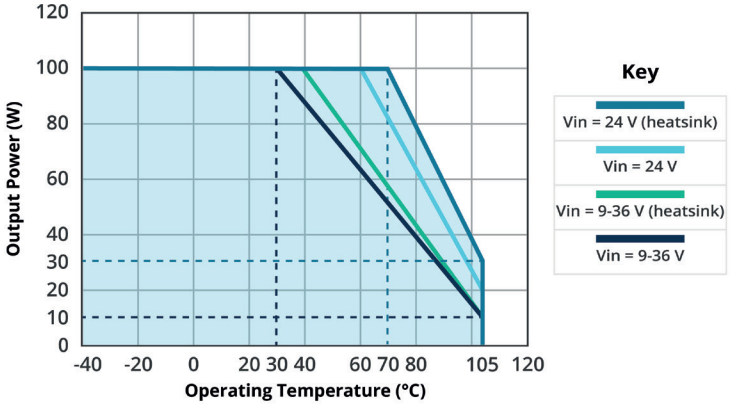
WITH HEATSINK
units: mm[inch]
tolerance: ±0.50[±0.020]

PIN CONNECTIONS	
PIN	Function
1	CTRL
2	GND
3	Vin
4	+Vo
5	0V
6	Trim

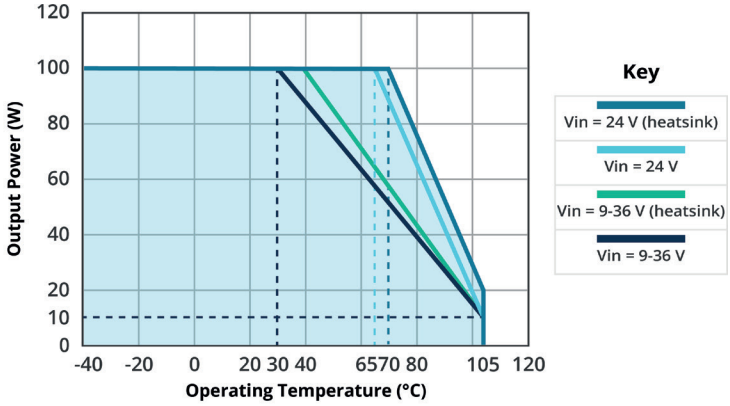


DERATING CURVES

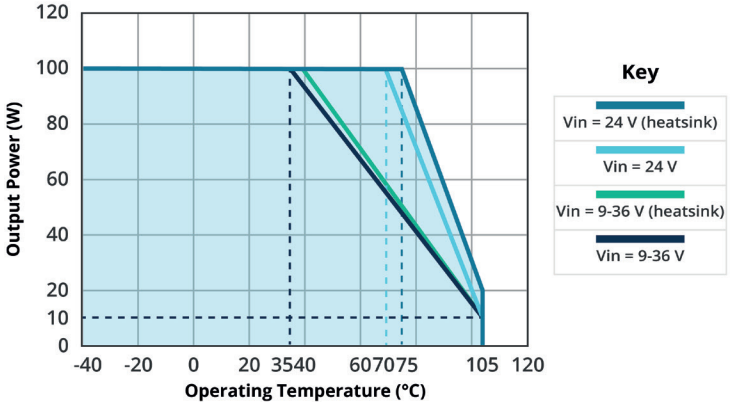
TEMPERATURE DERATING CURVE
PQC60-24-S5
(natural convection)



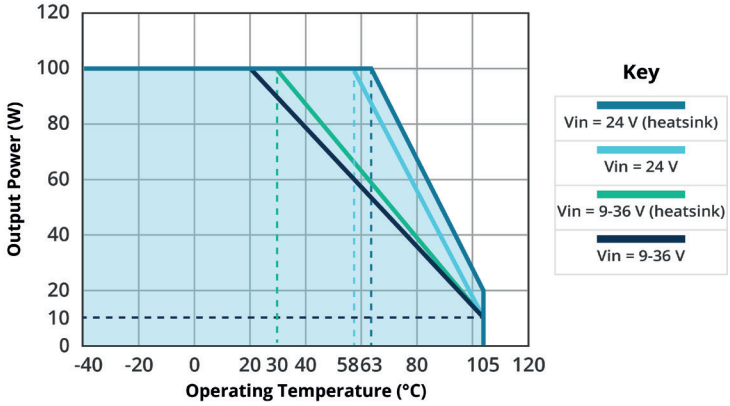
TEMPERATURE DERATING CURVE
PQC60-24-S12
(natural convection)



TEMPERATURE DERATING CURVE
PQC60-24-S15
(natural convection)

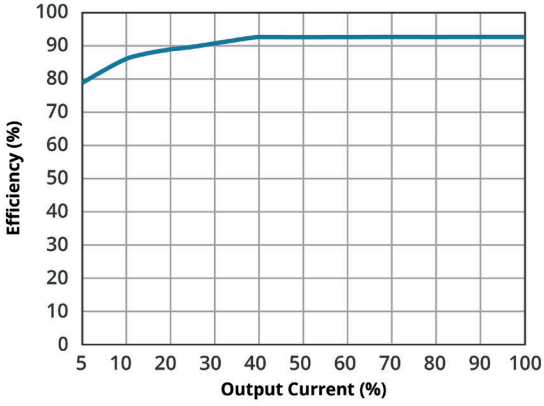


TEMPERATURE DERATING CURVE
PQC60-24-S24
(natural convection)

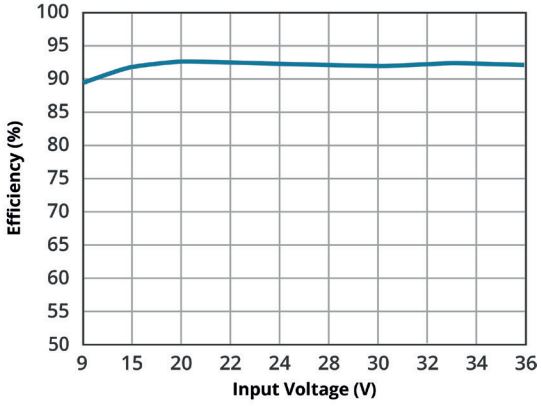


EFFICIENCY CURVES

EFFICIENCY VS OUTPUT LOAD
PQC60-24-S5(-H)
(Vin = 24V)

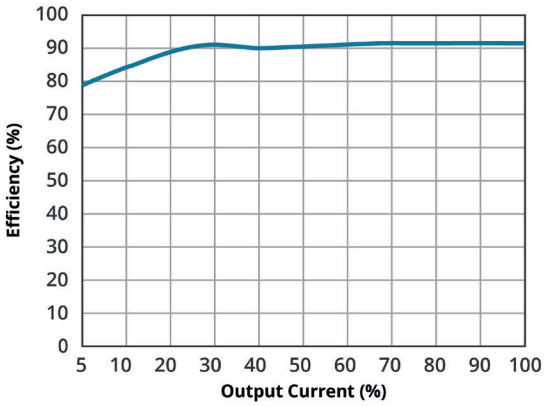


EFFICIENCY VS INPUT VOLTAGE
PQC60-24-S5(-H)
(full load)

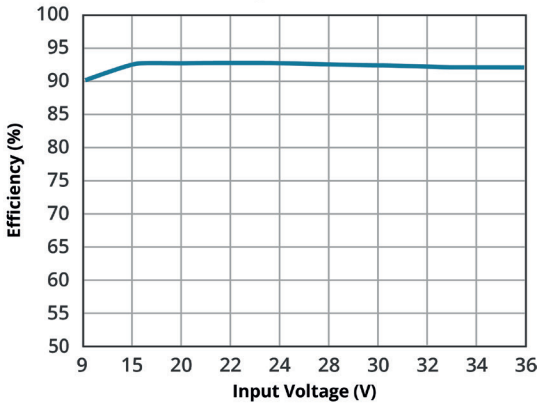


EFFICIENCY CURVES (CONTINUED)

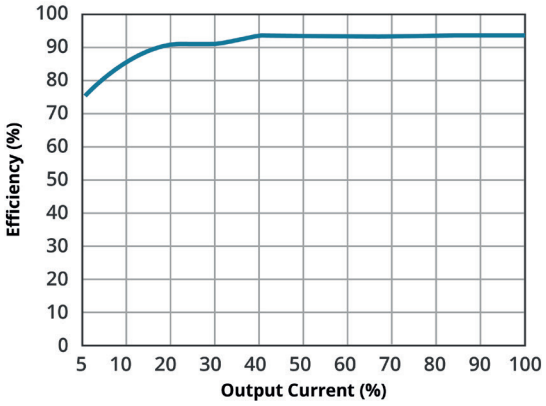
EFFICIENCY VS OUTPUT LOAD
PQC60-24-S12(-H)
(Vin = 24V)



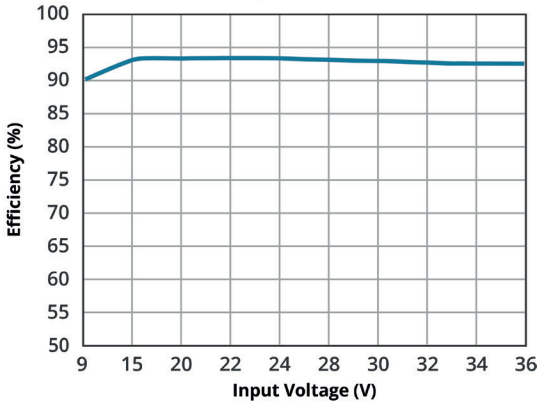
EFFICIENCY VS INPUT VOLTAGE
PQC60-24-S12(-H)
(full load)



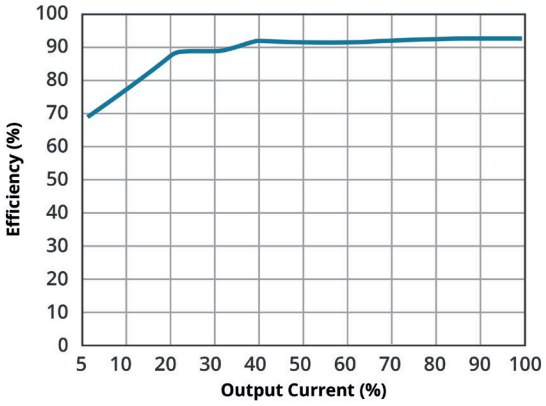
EFFICIENCY VS OUTPUT LOAD
PQC60-24-S15(-H)
(Vin = 24V)



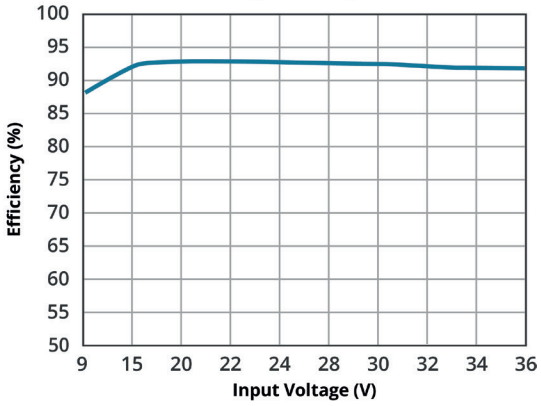
EFFICIENCY VS INPUT VOLTAGE
PQC60-24-S15(-H)
(full load)



EFFICIENCY VS OUTPUT LOAD
PQC60-24-S24(-H)
(Vin = 24V)



EFFICIENCY VS INPUT VOLTAGE
PQC60-24-S24(-H)
(full load)



APPLICATION NOTES

All the DC-DC converters of this series are tested before delivery using the recommended circuit shown in Fig. 1. Input and/or output ripple can be further reduced by appropriately increasing the input & output capacitor values Cin and Cout and/or by selecting capacitors with a low ESR (equivalent series resistance). Also make sure that the capacitance is not exceeding the specified max. capacitive load value of the product.

Figure 1

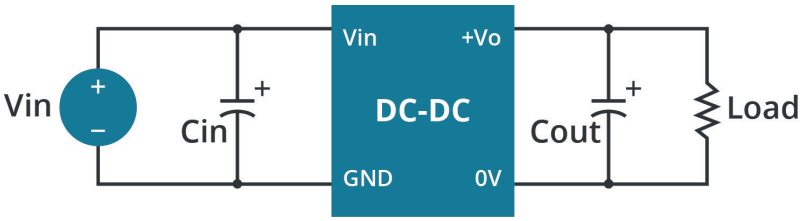


Table 1

Vin (Vdc)	Vout (Vdc)	Cin (µF/V)	Cout (µF)
24	5	100µF/50V	220µF/16V
	12/15		100µF/50V
	24		47µF/50V

EMC RECOMMENDED CIRCUIT

Figure 2-1

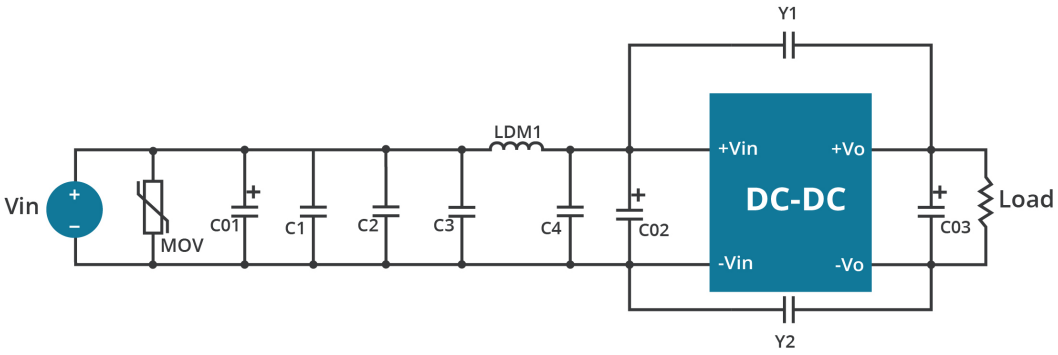


Table 2

Recommended external circuit components	
C1/C2	4.7µF/50V
C3/C4	10µF/50V
C01	680µF/50V
C02	330µF/50V
C03	100µF/100V
Y1/Y2	2.2nF/Y1
LDM1	2.2µH
MOV	14D470

Figure 2-2

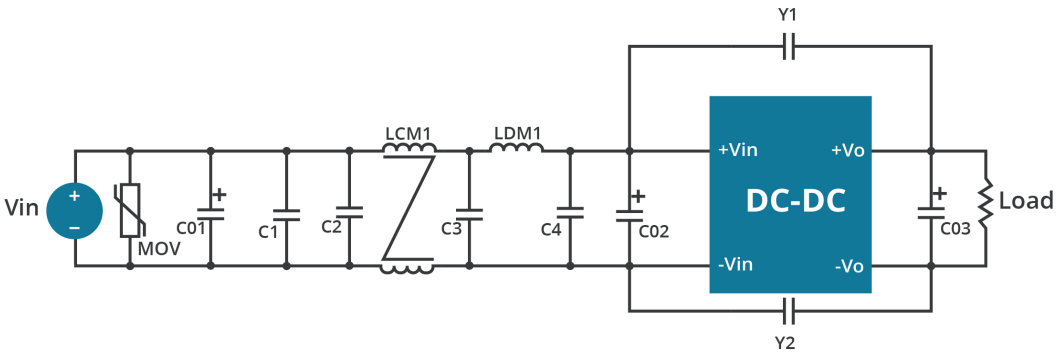


Table 3

Recommended external circuit components	
C1/C2	4.7µF/50V
C3/C4	10µF/50V
C01	680µF/50V
C02	330µF/50V
C03	100µF/100V
Y1/Y2	2.2nF/Y1
LCM1	2.2mH
LDM1	2.2µH
MOV	14D470

EMC RECOMMENDED CIRCUIT (CONTINUED)

Figure 2-3

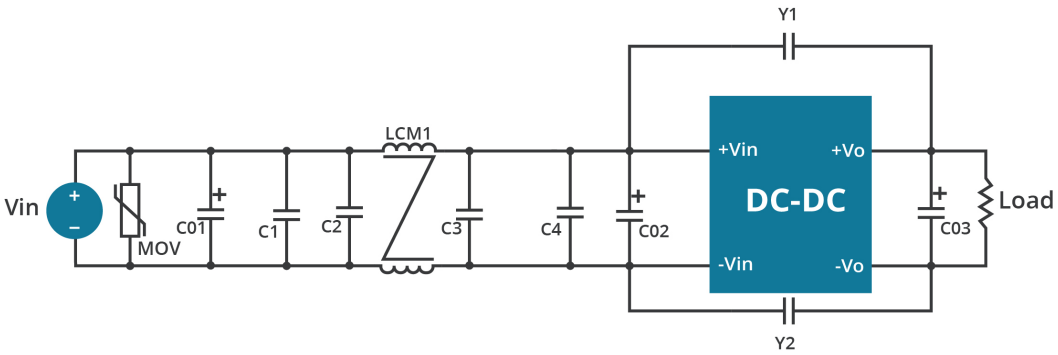


Table 4

Recommended external circuit components	
C1/C2	4.7µF/50V
C3/C4	10µF/50V
C01	680µF/50V
C02	330µF/50V
C03	100µF/100V
Y1/Y2	2.2nF/Y1
LCM1	10mH/ 10.0mH min/180mΩ max
MOV	14D470

Figure 2-4

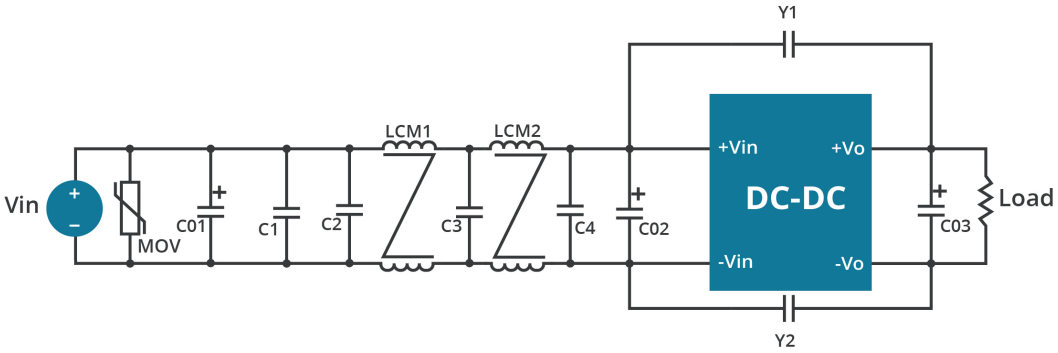


Table 5

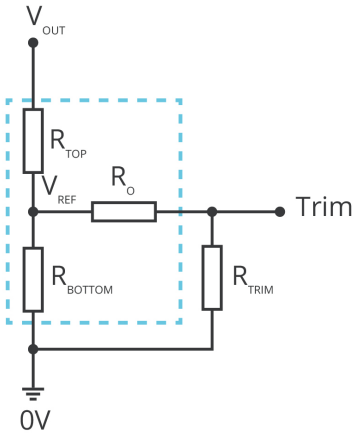
Recommended external circuit components		
C1/C2	4.7µF/50V	
C3	10µF/50V	
C4	PQC60-24-S5 PQC60-24-S24	10µF/50V 47µF/50V
C01	680µF/50V	
C02	330µF/50V	
C03	100µF/100V	
Y1/Y2	2.2nF/Y1	
LCM1/ LCM2	10mH/ 10.0mH min/180mΩ max	
MOV	14D470	

APPLICATION NOTES

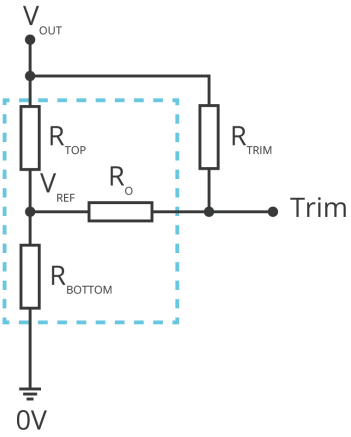
Trim Function for Output Voltage Adjustment (open if unused).

Figure 3

Trim up



Trim down



$$R_{TRIM} = \frac{a \cdot R_{BOTTOM}}{R_{BOTTOM} - a} - R_O \qquad a = \frac{V_{REF}}{V_{OUT} - V_{REF}} \cdot R_{TOP}$$

Formula for Trim up

$$R_{TRIM} = \frac{a \cdot R_{TOP}}{R_{TOP} - a} - R_O \qquad a = \frac{V_{OUT} - V_{REF}}{V_{REF}} \cdot R_{BOTTOM}$$

Formula for Trim down

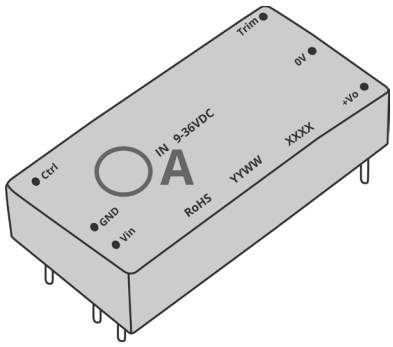
Table 6

V_{NOM}	R_{TOP}	R_{BOTTOM}	R_O	V_{REF}
(Vdc)	(kΩ)	(kΩ)	(kΩ)	(V)
5	2.97	2.87	6.1	2.5
12	10.91	2.87	6.1	2.5
15	14.35	2.87	6.1	2.5
24	24.77	2.87	6.1	2.5

Note: Value for R_{TOP}, R_{BOTTOM}, R_O, and V_{REF} refer to Table 6 (fixed internal values).
R_{TRIM}: Trim resistance
a: User-defined parameter, no actual meanings
V_{NOM}: Nominal output voltage
V_{OUT}: Target output voltage

RECOMMENDED SOLUTION FOR THERMAL TESTING

During the application process, the thermal design of the product can be evaluated in combination with the temperature derating curve of the product, or it can be determined by testing the temperature at point A, it is an safe operating area if the temperature lower than 100°C.



REFLECTED RIPPLE CURRENT TEST CIRCUIT

All DC-DC converters of this series are tested using the recommended circuit shown in Fig. 4. Test point.

Figure 4

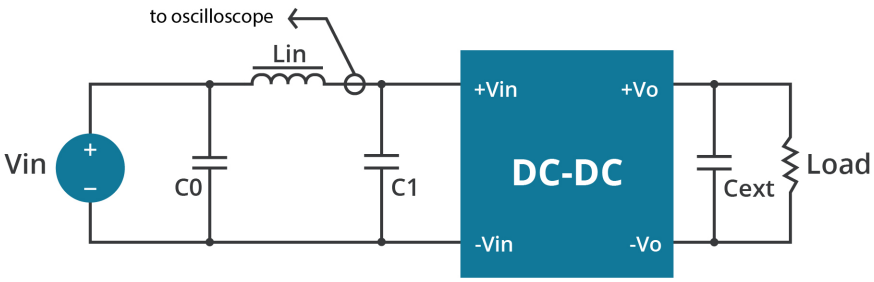


Table 7

Recommended external circuit components	
C0	220µF/100V
Lin	10µH/15V
C1	470µF/100V
Cext	470µF/63V

REVISION HISTORY

rev.	description	date
1.0	initial release	01/30/2023

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

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