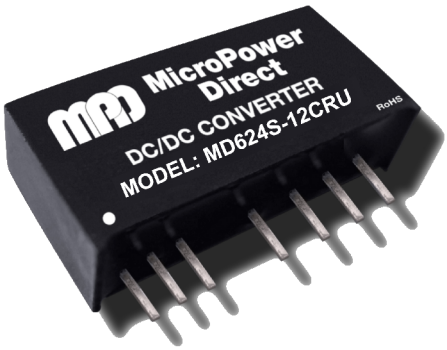
MD624S-12CRU

6W, Isolated DC/DC Converters
Single & Dual Output · 4:1 Wide Input



Key Features:

- 6W Isolated DC/DC Converter
- Ultra-Wide 4:1 Input Range
- 9 – 36 VDC / 18 – 75 VDC
- Single & Dual Output Models
- Efficiency to 87%(S) / 85%(D)
- No-Load Power 0.12W (S) / 0.24W (D)
- Remote On/Off Control
- Industry-Standard SIP-8 Pin-Out
- > 1.0 Million Hour MTBF
- –40°C to +105°C(S) / +85°C(D)
- EN 62368-1 / BS EN 62368-1

CE

RoHS

Electrical Specifications

Typical @ +25°C, nominal input voltage & rated output load, unless noted. (S) = single-output models, (D) = dual-output models; where a single value is shown it applies to both.

INPUT

Parameter	Conditions	Min.	Typ.	Max.	Units
Input Voltage Range	24 VDC Nominal Series	9	24	36	VDC
	48 VDC Nominal Series	18	48	75	
Absolute Max. Input [1]	24 VDC Series (Non-Operating)	—	—	40	VDC
	48 VDC Series (Non-Operating)	—	—	80	
Start-Up Voltage	24 VDC Series	—	—	9	VDC
	48 VDC Series	—	—	18	
Input Under-Voltage Protection	24 VDC Series (Recovery)	5.5	6.5	—	VDC
	48 VDC Series (Recovery)	13	14.5	—	
Surge Voltage [2]	24 VDC Series (1 s Max.)	–0.7	—	50	VDC
	48 VDC Series (1 s Max.)	–0.7	—	100	
Reflected Ripple Current	—	—	50	—	mA
Input Filter	Capacitive Filter				—
Remote On/Off (Ctrl) [3]	Module On — Ctrl Open or High	3.5 – 12 VDC (referenced to input GND)			VDC
	Module Off — Ctrl Pulled Low to GND	0 – 1.2 VDC			
Input Current when Off	Ctrl Low	—	6	10	mA
Hot Plug	Unavailable				—

OUTPUT

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy [4]	Single Output, 24 VDC Series, 5 – 100% Load	—	±1	±2	%
	Single Output, 48 VDC Series, 5 – 100% Load	—	—	±3	
	Dual, V_{O1}, 5 – 100% Load	—	±1.5	±2	
	Dual, V_{O2}, 5 – 100% Load	—	±2	±3	
Line Regulation	Single Output, Low–High V_{in}, Full Load	—	±0.5	±1	%
	Dual, V_{O1}	—	±0.5	±1	
	Dual, V_{O2}	—	±1.0	±1.5	
Load Regulation [5]	Single Output, 5 – 100% Load	—	±0.5	±1.5	%
	Dual, V_{O1}, 5 – 100% Load	—	±0.8	±1.5	
	Dual, V_{O2}, 5 – 100% Load	—	±1.2	±2	
Cross Regulation (D)	V_{O1} at 50%, V_{O2} 25 – 100% Load	—	—	±5	%
Transient Recovery Time	Single, 25% Load Step, Nom. V_{in}	—	300	500	µs
	Dual, 25% Load Step, Nom. V_{in}	—	450	500	
Transient Response Deviation	3.3 / 5 V (±5 V) Output	—	±5	±8	%
	Other Outputs	—	±3	±5	
Temperature Coefficient	Full Load	—	—	±0.03	%/°C
Ripple & Noise [6]	Single, 20 MHz BW, 5 – 100% Load	—	50	100	mV p-p
	Dual, 20 MHz BW, 5 – 100% Load	—	120	150	
Over-Current Protection	% of Rated I_O, Over Input Range	110	160	230	$\%I_O$
Short-Circuit Protection	Continuous, Automatic Self-Recovery				—

GENERAL

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	Input – Output, 60 s, Leakage < 1 mA	1,600 (S)	—	—	VDC
		1,500 (D)	—	—	
Insulation Resistance	Input – Output at 500 VDC	1,000	—	—	MΩ
Isolation Capacitance	Input – Output at 100 kHz / 0.1 V	—	1,000	—	pF
Operating Temperature	Derate per Fig. 1 – 6	–40	—	+105 (S)	°C
		–40	—	+85 (D)	
Storage Temperature	—	–55	—	+125	°C
Storage Humidity	Non-Condensing	5	—	95	%RH
Switching Frequency [7]	PWM Mode, Full Load	—	500	—	kHz
Full-Load Efficiency	Nominal Input — see Model Selection Guide	—	to 87 (S)	—	%
		—	85 (D)	—	
No-Load Power Consumption	Nominal Input	—	0.12 (S)	—	W
		—	0.24 (D)	—	
Pin Soldering Resistance	1.5 mm from Case, 10 s	—	—	+300	°C
Vibration	10 – 150 Hz, 0.75 mm, X / Y / Z	—	—	5	G
MTBF	MIL-HDBK-217F @ 25°C	1.0	—	—	MHrs
Case Material / Cooling	Black Flame-Retardant Plastic (UL 94V-0) · Free Air Convection				—
Dimensions	0.866 × 0.374 × 0.472 in [22.00 × 9.50 × 12.00 mm]				—
Weight	4.7 g [0.166 oz] (S) / 4.6 g [0.162 oz] (D) (Typ.)				—

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Model Selection Guide

Listed models are certified to EN 62368-1 / BS EN 62368-1. Input current and efficiency are typical, at nominal input and full load.

Model Number	Input				Output			Efficiency (%, Typ.)	Capacitive Load (µF, Max.)
	Nominal (VDC)	Range (VDC)	Full-Load (mA, Typ.)	No-Load (mA, Typ.)	Voltage (VDC)	Current (mA, Max.)	Current (mA, Min.)		
MD624S-03CRU	24	9 – 36	238	5	3.3	1350	0	78	1800
MD624S-05CRU	24	9 – 36	305	5	5	1200	0	82	1000
MD624S-09CRU	24	9 – 36	298	10	9	667	0	84	470
MD624S-12CRU	24	9 – 36	298	10	12	500	0	85	470
MD624S-15CRU	24	9 – 36	298	10	15	400	0	85	220
MD624S-24CRU	24	9 – 36	298	10	24	250	0	85	100
MD624D-05CRU	24	9 – 36	313	12	±5	±600	±0	80	470
MD624D-09CRU	24	9 – 36	301	12	±9	±333	±0	83	220
MD624D-12CRU	24	9 – 36	301	12	±12	±250	±0	83	120
MD624D-15CRU	24	9 – 36	301	12	±15	±200	±0	83	100
MD624D-24CRU	24	9 – 36	305	12	±24	±125	±0	82	68
MD648S-03CRU	48	18 – 75	158	5	3.3	1600	0	79	1200
MD648S-05CRU	48	18 – 75	158	5	5	1200	0	83	680
MD648S-09CRU	48	18 – 75	143	10	9	667	0	84	330
MD648S-12CRU	48	18 – 75	143	10	12	500	0	86	330
MD648S-15CRU	48	18 – 75	143	10	15	400	0	87	150
MD648S-24CRU	48	18 – 75	143	10	24	250	0	87	68
MD648D-15CRU	48	18 – 75	147	5	±15	±200	±0	85	68

Dual-output current and capacitive-load values apply identically to the positive and negative outputs. Exceeding the Absolute Max. Input (page 1) may cause permanent damage (see Note 1).

Notes

1. Exceeding the maximum input voltage may cause permanent damage. The Absolute Max. Input is a survival (non-operating) limit; continuous operation must remain within the Input Voltage Range.
2. Surge Voltage is withstood for 1 s maximum; it is not an operating condition.
3. The Ctrl pin voltage is referenced to input GND. Leaving Ctrl open (or pulling it high, 3.5 – 12 VDC) turns the module on; pulling it low to GND (0 – 1.2 VDC) turns it off.
4. Under 0 – 5% load, maximum output voltage accuracy is ±3% for single-output and V_{O1} of dual-output models, and ±5% for V_{O2} of dual-output models.
5. Load regulation over 0 – 100% load is ±3% (single output); for dual output it is ±4% (V_{O1}) and ±4.5% (V_{O2}).
6. Output ripple & noise is measured at 20 MHz bandwidth using the “parallel-cable” method. Under 0 – 5% load, ripple & noise does not exceed 150 mV (S) / 180 mV (D).
7. Switching frequency is measured at full load. The module reduces switching frequency at light load (below 50%) to improve efficiency.
8. Unless otherwise specified, parameters are measured at Ta = 25°C, humidity < 75% RH, nominal input voltage and rated output load. To further reduce input/output ripple, add external filter capacitors (see Typical Application Circuit, Fig. 11 / 12) without exceeding the Max. Capacitive Load.

Temperature Derating Curves

Derate output power linearly beyond the knee temperature per the curves below. Single-output models operate to +105°C; dual-output models to +85°C. Natural convection unless stated (Fig. 3 shown with 1 m/s forced air).

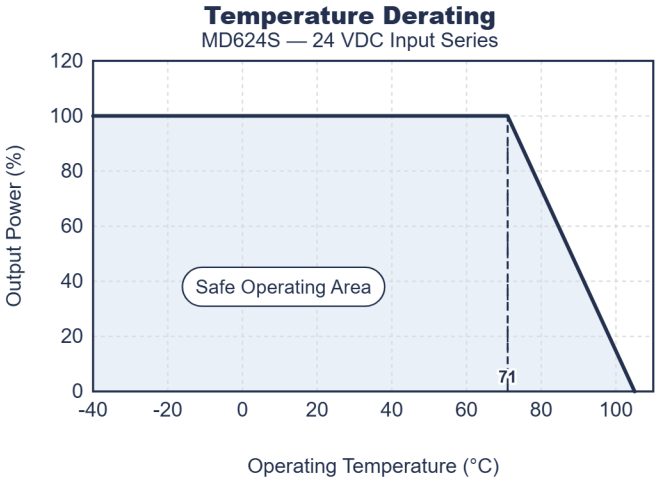


Fig. 1 — MD624S (24 VDC Input Series)

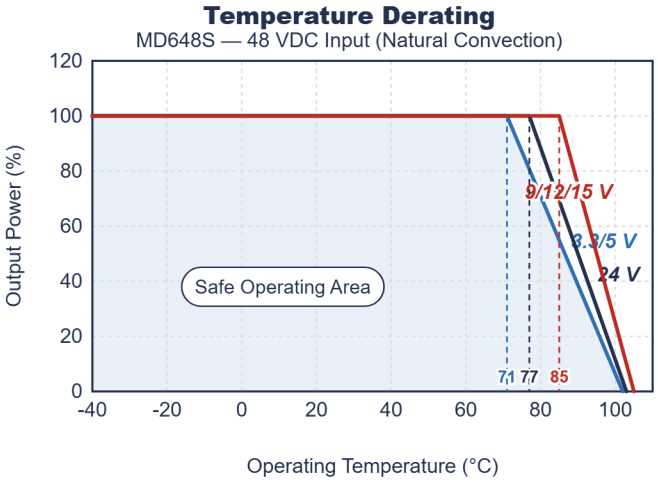


Fig. 2 — MD648S (48 VDC In, Natural Convection)

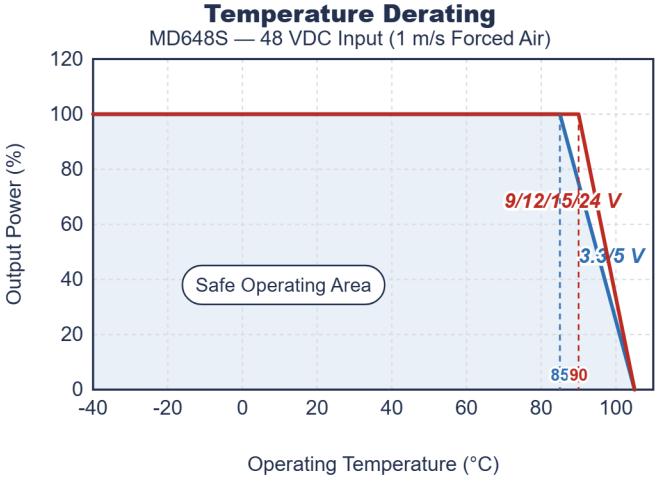


Fig. 3 — MD648S (48 VDC In, 1 m/s Forced Air)

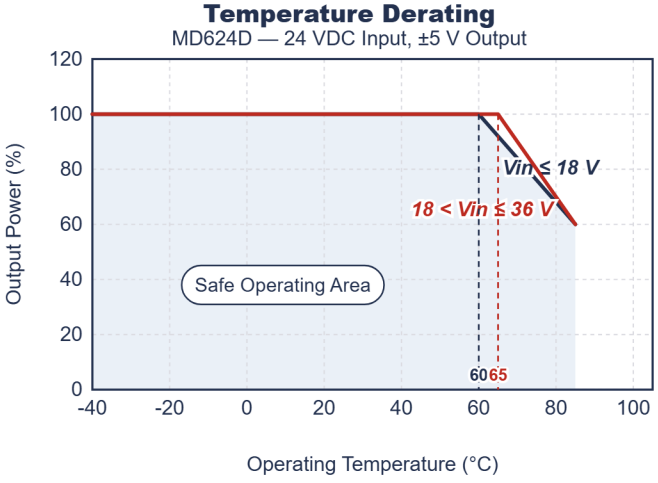


Fig. 4 — MD624D (24 VDC In, ±5 V Output)

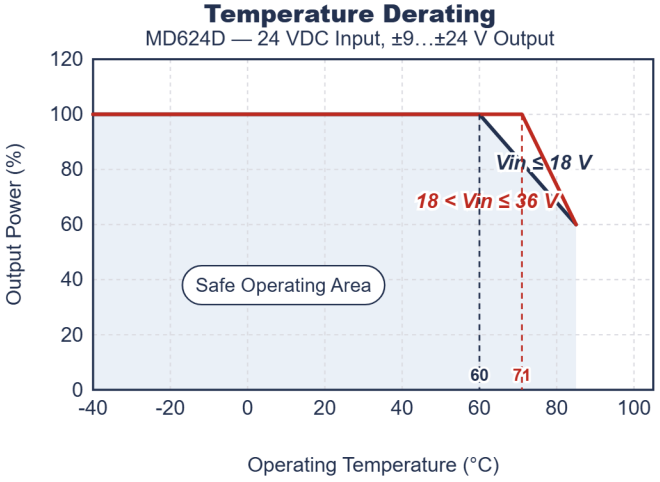


Fig. 5 — MD624D (24 VDC In, ±9…±24 V Output)

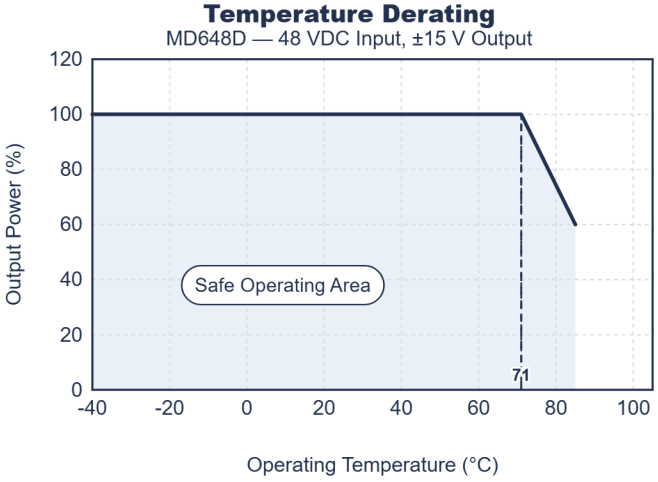


Fig. 6 — MD648D (48 VDC In, ±15 V Output)

The maximum capacitive load values in the Model Selection Guide are tested across the full input voltage range at full load. For reliable operation keep the total output capacitance at or below the listed maximum — excessive capacitance can cause start-up problems.

Efficiency Curves

Typical efficiency measured at Ta = 25°C for two representative dual-output models. Other models in the family exhibit similar characteristics; see the Model Selection Guide for each model's full-load efficiency.

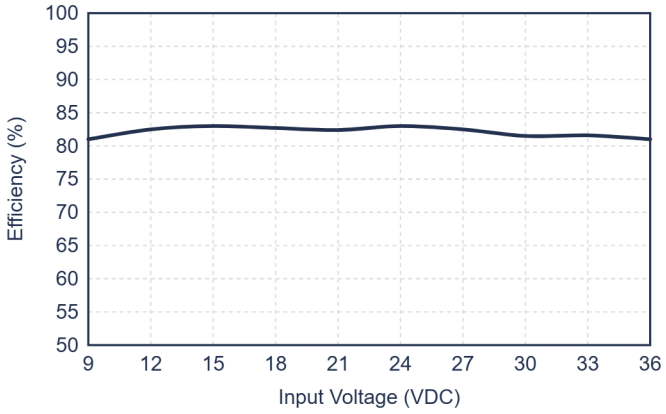


Fig. 7 — Efficiency vs. Input Voltage (Full Load)
MD624D-05CRU

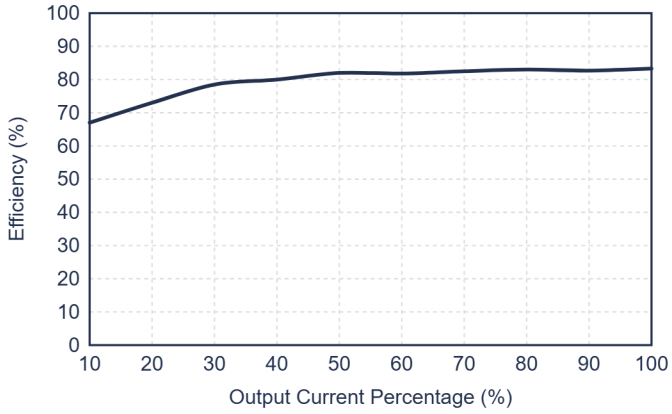


Fig. 8 — Efficiency vs. Output Load (V_{in} = 24 VDC)
MD624D-05CRU

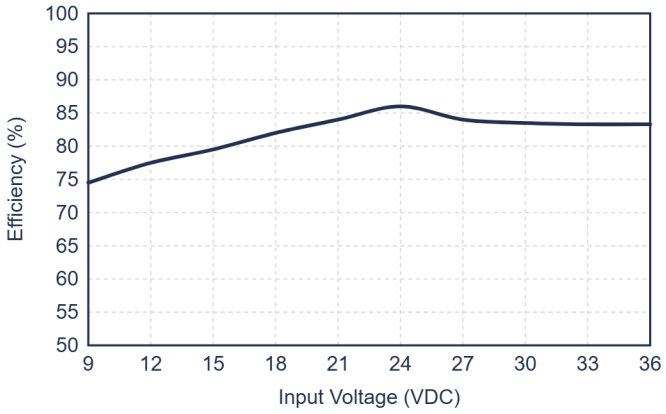


Fig. 9 — Efficiency vs. Input Voltage (Full Load)
MD624D-24CRU

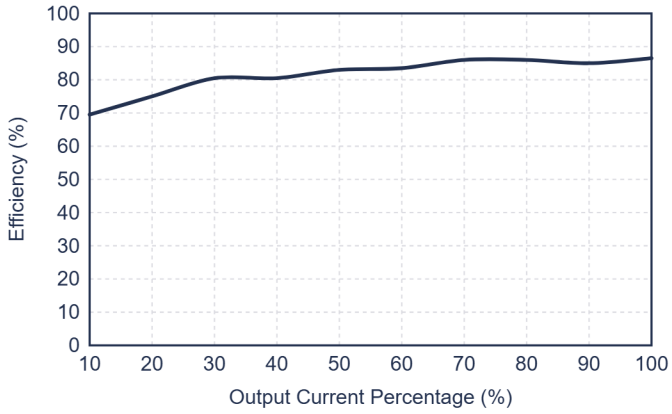


Fig. 10 — Efficiency vs. Output Load (V_{in} = 24 VDC)
MD624D-24CRU

Electromagnetic Compatibility (EMC)

Phenomenon	Standard	Test Level	Criteria
Conducted Emissions (CE)	CISPR 32 / EN 55032	Class B	—
Radiated Emissions (RE)	CISPR 32 / EN 55032	Class B	—
ESD	IEC/EN 61000-4-2	Contact ±4 kV	B
Radiated Susceptibility (RS)	IEC/EN 61000-4-3	10 V/m	A
EFT / Burst	IEC/EN 61000-4-4	±2 kV	B
Surge	IEC/EN 61000-4-5	Line-to-Line ±2 kV	B
Conducted Susceptibility (CS)	IEC/EN 61000-4-6	3 $V_{r.m.s}$	A

Emissions met with the recommended external filter circuits: 24 VDC series — Fig. 13 (S) / Fig. 14 (D), Part ② for emissions and Part ① for immunity; 48 VDC series — Fig. 15 (S) / Fig. 16 (D), Part ①. The converter is a component to be installed in end equipment; confirm all EMC tests with the final product.

Typical Application Circuit

Input and/or output ripple can be further reduced by increasing C_{in} / C_{out} and/or selecting low-ESR capacitors, without exceeding the Max. Capacitive Load in the Model Selection Guide.

Fig. 11 — Single Output

V_{in}	Output	C_{in}	C_{out}
24 VDC	3.3 / 5 / 9 V	100 µF / 100 V	22 µF / 16 V
	12 / 15 V		22 µF / 25 V
	24 V		22 µF / 50 V
48 VDC	3.3 / 5 V	100 µF / 100 V	22 µF / 16 V
	9 / 12 / 15 / 24 V		10 µF / 50 V

Fig. 12 — Dual Output

V_{in}	C_{in}	C_{out} (each output)
24 VDC	100 µF / 100 V	22 µF / 50 V
48 VDC	100 µF / 100 V	22 µF / 50 V

Dual-output models do not support output paralleling. All DC/DC converters in this series are tested before delivery using the recommended circuit shown above.

Design reference. To ensure efficient, reliable operation, add the input and output filter capacitors shown above as close to the module pins as practical. C_{in} limits reflected input ripple current and stabilizes the input rail; C_{out} reduces output ripple & noise. Use low-ESR types for best high-frequency attenuation. When more filtering is required, the values may be increased provided the total output capacitance stays at or below the Max. Capacitive Load listed for each model in the Model Selection Guide.

EMC Compliance Circuits

Recommended external filter networks. For the 24 VDC figures (Fig. 13 / 14), use Part ① for the immunity tests and Part ② for the emissions tests; the 48 VDC figures (Fig. 15 / 16) use Part ① for both. Select components based on need and choose the input fuse according to the actual input current.

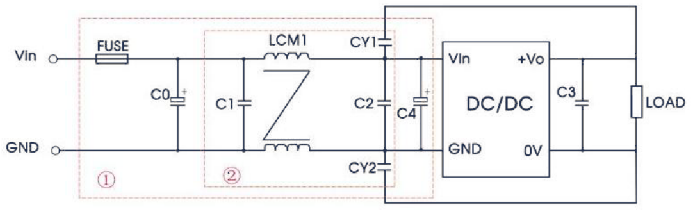


Fig. 13 — 24 VDC Input Series, Single Output

Component	Value (V_{in} = 24 VDC)
FUSE	Per actual input current
C0 / C4	330 µF / 50 V
C1 / C2	10 µF / 50 V
C3	22 µF / 50 V
LCM1	470 µH
CY1 / CY2	1 nF / 400 VAC

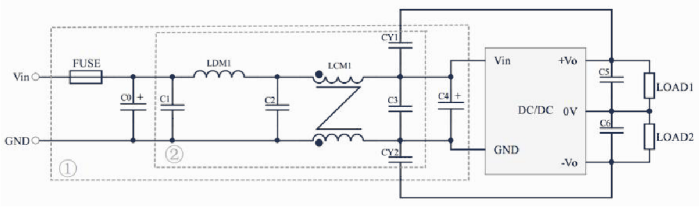


Fig. 14 — 24 VDC Input Series, Dual Output

Component	Value (V_{in} = 24 VDC)
FUSE	Per actual input current
C0 / C4	330 µF / 100 V
C1 / C2 / C3	10 µF / 50 V
LDM1	10 µH
LCM1	1.4 – 1.7 mH
CY1 / CY2	1 nF / 2 kV

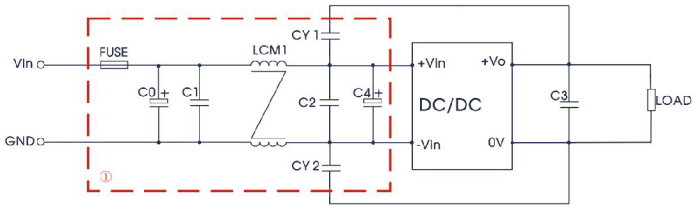


Fig. 15 — 48 VDC Input Series, Single Output

Component	Value (V_{in} = 48 VDC)
FUSE	Per actual input current
C0	200 µF / 100 V
C1 / C2	10 µF / 100 V
C3	22 µF / 100 V
C4	330 µF / 100 V
LCM1	470 µH
CY1 / CY2	1 nF / 400 VAC

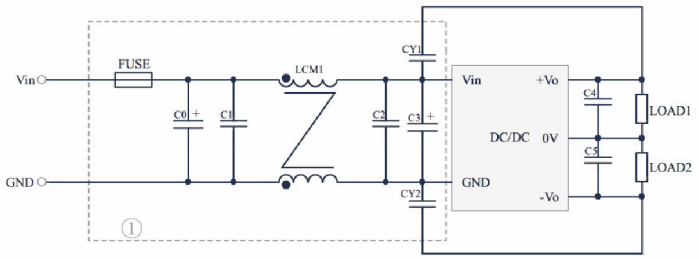
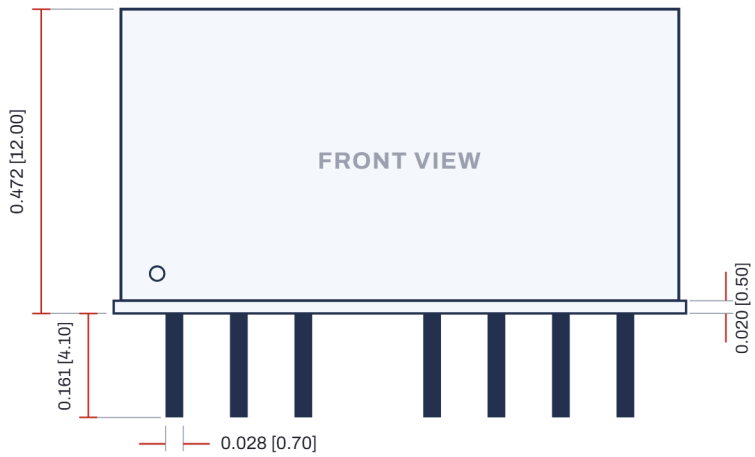
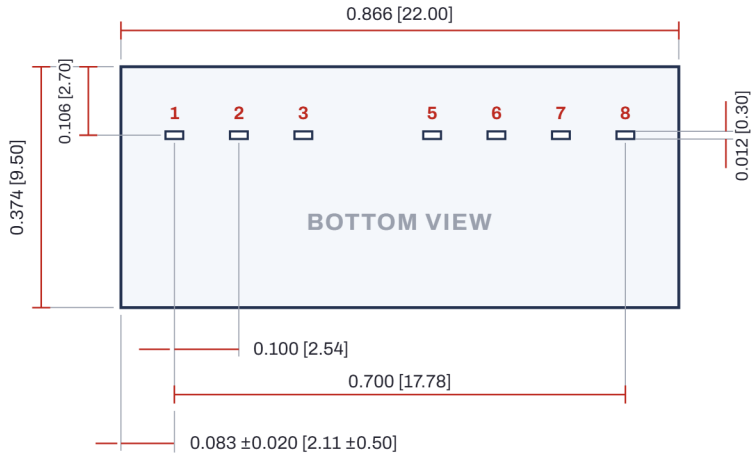


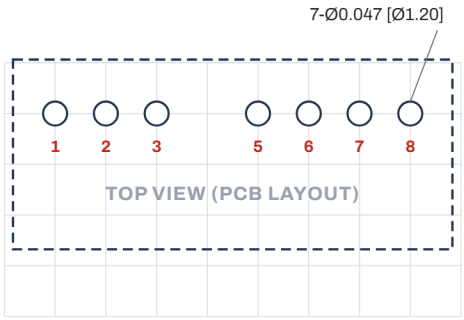
Fig. 16 — 48 VDC Input Series, Dual Output

Component	Value (V_{in} = 48 VDC)
FUSE	Per actual input current
C0	200 µF / 100 V
C1 / C2	10 µF / 100 V
C3	330 µF / 100 V
C4 / C5	22 µF / 50 V
LCM1	470 µH
CY1 / CY2	1 nF / 400 VAC

Dimensions and Recommended Layout — Units: inch [mm] · Third-Angle Projection







Top View (PCB Layout) · Grid 0.100 × 0.100 in [2.54 × 2.54 mm]
Hole Ø0.039 in [Ø1.00 mm] single-output / Ø0.047 in [Ø1.20 mm] dual-output

PIN	SINGLE (S)	DUAL (D)
1	GND	GND
2	V_{in}	V_{in}
3	Ctrl	Ctrl
5	NC	NC
6	$+V_O$	$+V_O$
7	0V	0V (Common)
8	NC	$-V_O$

- Overall: 0.866 × 0.374 × 0.472 in [22.00 × 9.50 × 12.00 mm] · pin span 0.700 in [17.78 mm], 0.100 in [2.54 mm] pitch.
- PCB hole diameter: Ø0.039 in [Ø1.00 mm] single-output / Ø0.047 in [Ø1.20 mm] dual-output.
- Pin section tolerance ±0.004 in [±0.10 mm]; general tolerance ±0.020 in [±0.50 mm]. Pin 4 not fitted. NC pins should not be connected and should be isolated from external circuitry.
- Weight 4.7 g [0.166 oz] single-output / 4.6 g [0.162 oz] dual-output (Typ.). Case: black flame-retardant, heat-resistant plastic (UL 94V-0).

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