

# MI600ERU Series

## Miniature 1" x 1" 6W, Ultra-Wide 4:1 Input DC/DC Converters



### Key Features:

- 6W Output Power
- EN 60950 Approval
- 4:1 Input Voltage Range
- Miniature 1" x 1" Case
- 1,500 VDC Isolation
- Single & Dual Outputs
- -40°C to +85°C Operation
- Industry Standard Pin-Out
- Chassis & DIN Rail Mount



### MicroPower Direct

292 Page Street  
Suite D  
Stoughton, MA 02072  
USA

T: (781) 344-8226

F: (781) 344-8481

E: sales@micropowerelectronics.com

W: www.micropowerelectronics.com



### Electrical Specifications

Specifications typical @ +25°C, nominal input voltage & rated output current, unless otherwise noted. Specifications subject to change without notice.

Input		Conditions	Min.	Typ.	Max.	Units
Parameter	Input Voltage Range	24 VDC Input	9.0	24.0	36.0	VDC
		48 VDC Input	18.0	48.0	75.0	
Parameter	Input Start Voltage	24 VDC Input			9.0	VDC
		48 VDC Input			18.0	
Parameter	Input Under Voltage Protection	24 VDC Input	5.5	6.5		VDC
		48 VDC Input	12.0	15.5		
Parameter	Reflected Ripple Current			20		mA
Parameter	Input Filter	Pi (π) Filter				

Output		Conditions	Min.	Typ.	Max.	Units
Parameter	Output Voltage Accuracy, See Note 2	IOUT = 0% to 100%		±1.0	±3.0	%
		Positive Output		±0.2	±0.5	
Parameter	Line Regulation	VIN = Min to Max	Negative Output	±0.5	±1.0	%
			Positive Output	±0.5	±1.0	
Parameter	Load Regulation	IOUT = 5% to 100%	Negative Output	±0.5	±1.5	%
			Positive Output	±0.5	±1.5	
Parameter	Cross Regulation	See Note 3			±5.0	%
Parameter	Ripple & Noise (20 MHz)	See Note 4		60	85	mV P - P
Parameter	Transient Recovery Time			300	500	μSec
Parameter	Transient Response Deviation	See Note 5	3.3 & 5 VOUT Models	±5.0	±8.0	%
			All Other Models	±3.0	±5.0	
Parameter	Temperature Coefficient				±0.03	%/°C
Parameter	Output Over Voltage Protection		110		160	%VOUT
Parameter	Output Over Current Protection		110	140	190	%IOUT
Parameter	Output Short Circuit	Continuous (Autorecovery)				

General		Conditions	Min.	Typ.	Max.	Units
Parameter	Isolation Voltage	60 Seconds	1,500			VDC
Parameter	Isolation Resistance	500 VDC	1,000			MΩ
Parameter	Isolation Capacitance	Input/Output 100 KHz/0.1V		1,000		pF
Parameter	Switching Frequency			300		kHz

Environmental		Conditions	Min.	Typ.	Max.	Units
Parameter	Operating Temperature Range	Ambient	-40	+25	+85	°C
Parameter	Storage Temperature Range		-55		+125	°C
Parameter	Cooling	Free Air Convection				
Parameter	Humidity	RH, Non-condensing			95	%

Physical		Conditions	Min.	Typ.	Max.	Units
Parameter	Case Size, Module, Chassis /DIN Rail Mount		See Mechanical Drawings (Starting Page 4)			
Parameter	Case Material		Aluminum (UL94-V0)			
Parameter	Weight, Module, Chassis /DIN Rail Mount		See Mechanical Drawings (Starting Page 4)			

Reliability Specifications		Conditions	Min.	Typ.	Max.	Units
Parameter	MTBF	MIL HDBK 217F, 25°C, Gnd Benign	1.0			MHours
Parameter	Safety Standards	UL/cUL 60950-1 recognition (UL certificate)				
Parameter	Vibration	10-55 Hz, 10G, 7.5 mm, 30 Min along X, Y & Z Axis				

Absolute Maximum Ratings		Conditions	Min.	Typ.	Max.	Units
Parameter	Input Voltage Surge (1 Sec)	24 VDC Input			50.0	VDC
		48 VDC Input			100.0	
Parameter	Lead Temperature	1.5 mm From Case for 10 Sec			300	°C

Caution: Exceeding Absolute Maximum Ratings may damage the module. These are not continuous operating ratings.

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Model Number	Input				Output			Efficiency (% Typ)	Capacitive Load (µF, Max)	Certification	Fuse Rating Slow-Blow (mA)
	Voltage (VDC)		Current (mA)		Voltage (VDC)	Current (mA, Max)	Current (mA, Min)				
	Nominal	Range	Full-Load	No-Load							
MI624S-03ERU	24	9.0 - 36.0	316	5	3.3	1,500	0.0	79	1,800	UL/CE	600
MI624S-05ERU	24	9.0 - 36.0	301	5	5.0	1,200	0.0	83	1,000	UL/CE	600
MI624S-09ERU	24	9.0 - 36.0	294	5	9.0	667	0.0	85	680	UL/CE	600
MI624S-12ERU	24	9.0 - 36.0	287	5	12.0	500	0.0	87	470	UL/CE	600
MI624S-15ERU	24	9.0 - 36.0	284	5	15.0	400	0.0	88	220	UL/CE	600
MI624S-24ERU	24	9.0 - 36.0	284	5	24.0	250	0.0	88	100	UL/CE	600
MI624D-05ERU	24	9.0 - 36.0	301	5	±5.0	±600	±0.0	83	470	UL/CE	600
MI624D-12ERU	24	9.0 - 36.0	287	5	±12.0	±250	±0.0	87	100	UL/CE	600
MI624D-15ERU	24	9.0 - 36.0	284	5	±15.0	±200	±0.0	88	100	UL/CE	600
MI624D-24ERU	24	9.0 - 36.0	284	5	±24.0	±125	±0.0	88	100	UL/CE	600
MI648S-03ERU	48	18.0 - 75.0	158	4	3.3	1,500	0.0	79	1,800	UL/CE	300
MI648S-05ERU	48	18.0 - 75.0	150	4	5.0	1,200	0.0	83	1,000	UL/CE	300
MI648S-12ERU	48	18.0 - 75.0	144	4	12.0	500	0.0	87	470	UL/CE	300
MI648S-15ERU	48	18.0 - 75.0	142	4	15.0	400	0.0	88	220	UL/CE	300
MI648S-24ERU	48	18.0 - 75.0	142	4	24.0	250	0.0	88	100	UL/CE	300
MI648D-05ERU	48	18.0 - 75.0	150	4	±5.0	±600	±0.0	83	470	UL/CE	300
MI648D-12ERU	48	18.0 - 75.0	144	4	±12.0	±250	±0.0	87	100	UL/CE	300
MI648D-15ERU	48	18.0 - 75.0	142	4	±15.0	±200	±0.0	88	100	UL/CE	300

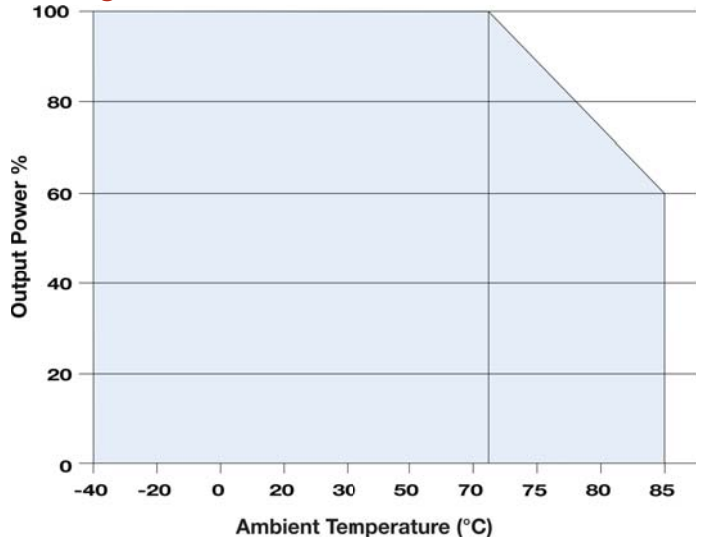
For the A2S adapter board option, add suffix "A2S" to the model no. (i.e. **MI624D-05ERU-A2S**)

For the A4S adapter board option, add suffix "A4S" to the model no. (i.e. **MI648S-24ERU-A4S**)

Notes:

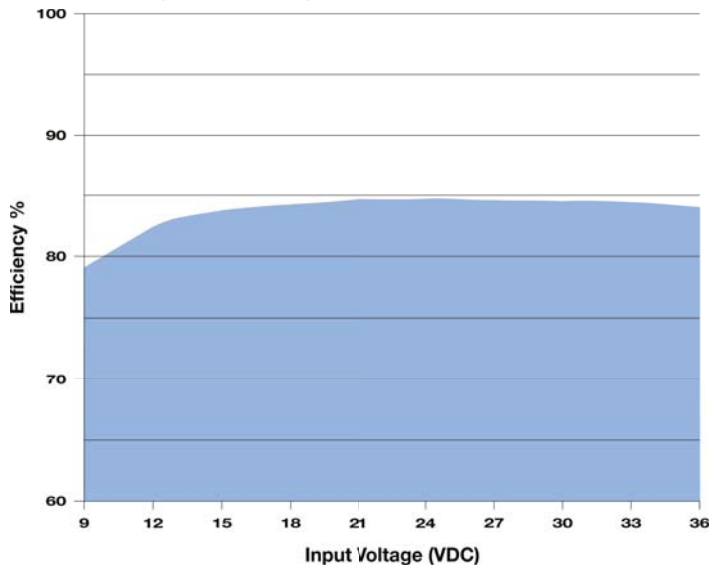
1. The specified maximum capacitive load is for each output.
2. From 0% - 5% load, the max voltage accuracy of ±5V units is ±5%.
3. Cross regulation is measured on dual output models with one output at 50% load while the other output is varied from 10% load to 100% load.
4. When measuring output ripple & noise, it is recommended that an external capacitor (10 µF) be placed from the +Vout to the -Vout pins for single output units and from each output to common for dual output models. From 0% - 5% output load, ripple & noise is 5% max.
5. Transient recovery is measured to within a 1% error band for a load step change of 25%.
6. Dual output units may be connected to provide a 10V, 24V, 30V or 48 VDC output. To do this, connect the load across the positive (+Vout) and negative (-Vout) outputs and float the output common.
7. Operation at no-load will not damage these units. However, they may not meet all specifications.
8. It is recommended that a fuse be used on the input of a power supply for protection. See the Model Selection table above for the correct rating.

Derating Curve

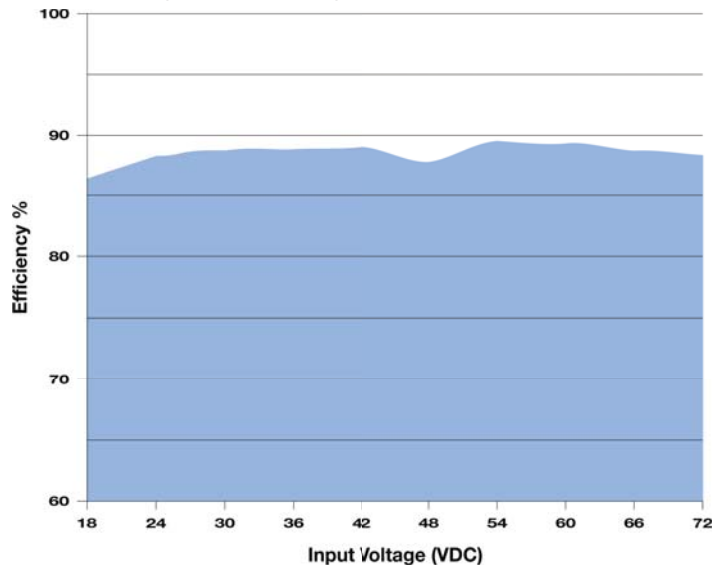


Efficiency Curves: Efficiency vs Input Voltage

MI624S-05ERU (24 VIN - 5 Vout)

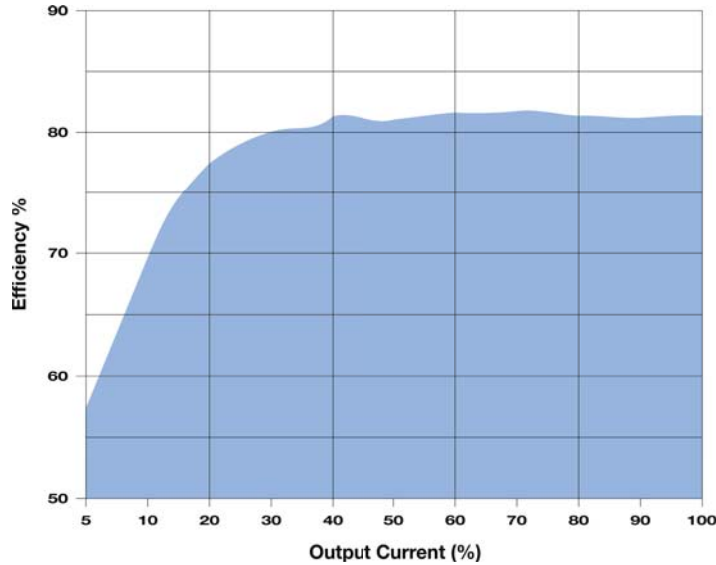


MI648D-05ERU (48 VIN - ±15 Vout)

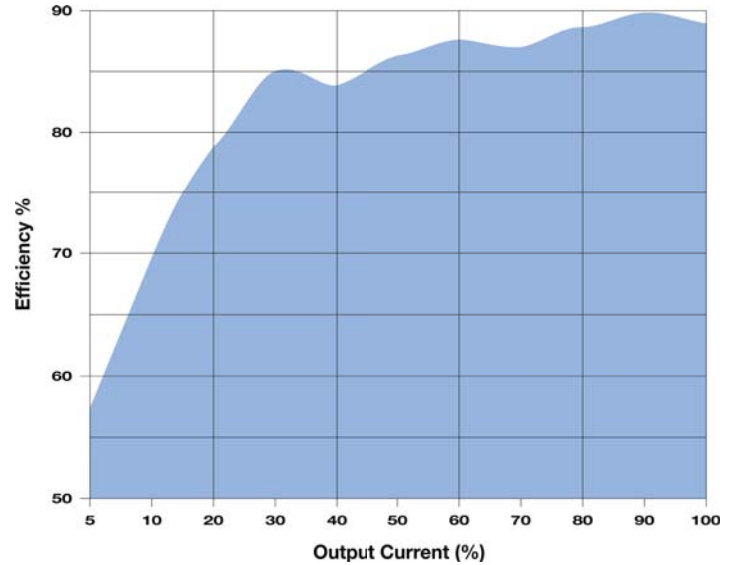


## Efficiency Curves: Efficiency vs Output Voltage

MI648S-05ERU (48 VIN - 5 Vout)



MI648D-15ERU (48 VIN - ±15 Vout)



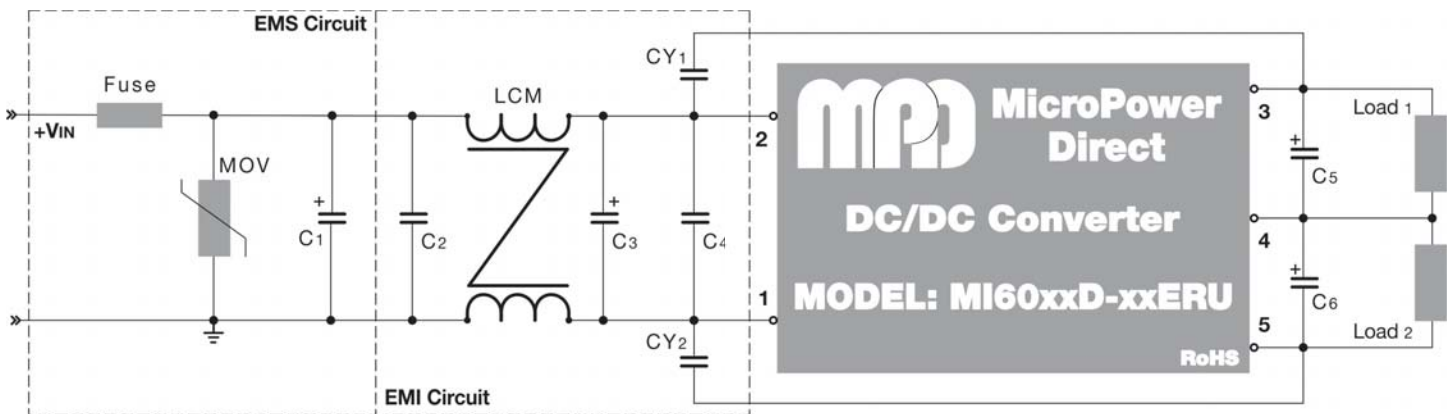
## EMI Characteristics

Parameter	Standard	Criteria	Level
Radiated Emissions, See Note 1	CISPR 22/EN 55022		Class A (without external components)
			Class B (See Typical Connection below)
Conducted Emissions, See Note 1			Class A (without external components)
			Class B (See Typical Connection below)
ESD	EN 61000-4-2	B	±4 kV Contact
RS	EN 61000-4-3	A	10V/m
EFT, See Note 2	EN 61000-4-4	B	±2 kV
Surge, See Note 3	EN 61000-4-5	B	±2 kV
CS	EN 61000-4-6	A	3 Vrms
Voltage Dips	EN 61000-4-29	B	0% - 70%

**Notes:**

1. If the application does not require that emissions meet international standards, simply adding capacitors to the input and output circuits may be sufficient to reduce ripple & noise. See note 5 below.
2. To meet the requirements of EN 61000-4-4, external components are needed. The connection diagram below shows an external input filter that would typically achieve this. Contact the factory for more information.
3. To meet the requirements of EN 61000-4-5, external components are needed. This can be done as shown in the connection diagram below. Contact the factory for more information.

## Typical Connection



For applications that require meeting EMC standards, the diagram above illustrates a typical connection of the MI60xxERU series. The units do not require external components to operate as specified. Some notes on this diagram (starting with the input circuit) are:

1. An external fuse should be used in all power module applications. The recommended fuse is shown in the model chart on page 2.
2. To protect against a surge, an external MOV is recommended on the input. A suggested value is given in the table at right.
3. All input/output filtering capacitors should have a low equivalent impedance. Any output capacitors used should be high frequency, low resistance electrolytic capacitors. Care must be taken in choosing this capacitor not to exceed the capacitive load specification for the unit. Voltage derating of all capacitors should be 60% or greater.

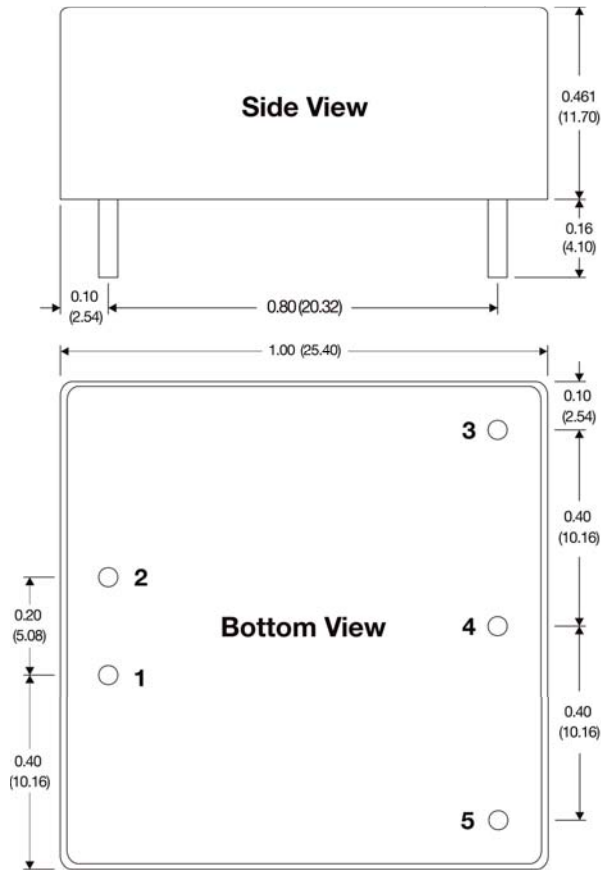
4. Recommended values for components are:

Component	24 VIN	48 VIN
MOV	S20K30	S14K60
C1	680 μF/50V	680 μF/100V
C2	1 μF/50V	1 μF/100V
LCM	4.7 mH	4.7 mH
C3	330 μF/50V	330 μF/100V
C4	4.7 μF/50V	4.7 μF/100V
CY1	1 nF/2 kV	1 nF/2 kV
CY2	1 nF/2 kV	1 nF/2 kV
C5	10 μF	10 μF
C6	10 μF	10 μF

5. In many applications simply adding input/output capacitors will enhance the input surge protection and reduce output ripple sufficiently. Suggested capacitor values are:

Input Voltage	24 VIN	48 VIN
CIN	100 μF	10 - 47 μF
COU	10 μF	10 μF

## Mechanical Dimensions



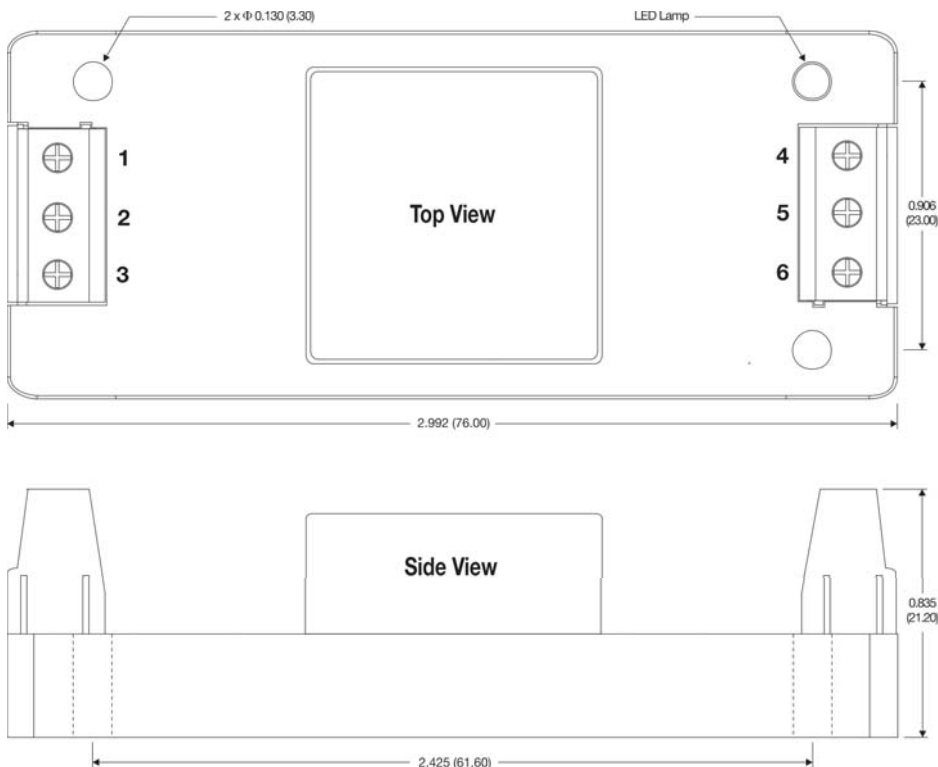
## Pin Connections

Pin	Single Output	Pin	Dual Output
1	-VIN	1	-VIN
2	+VIN	2	+VIN
3	+VOUT	3	+VOUT
4	No Pin	4	Common
5	-VOUT	5	-VOUT

### Notes:

- All dimensions are typical in inches (mm)
- Pin Section Tolerance x.xxx = ±0.004 (±0.100)
- General Tolerance x.xx = ±0.01 (±0.25)
- Weight: 0.49 Oz (14g)

## Mechanical Dimensions, A2S: With Chassis Mount & Power Good LED



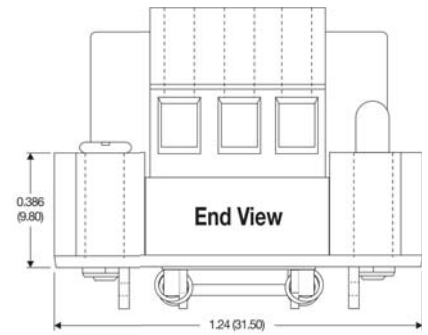
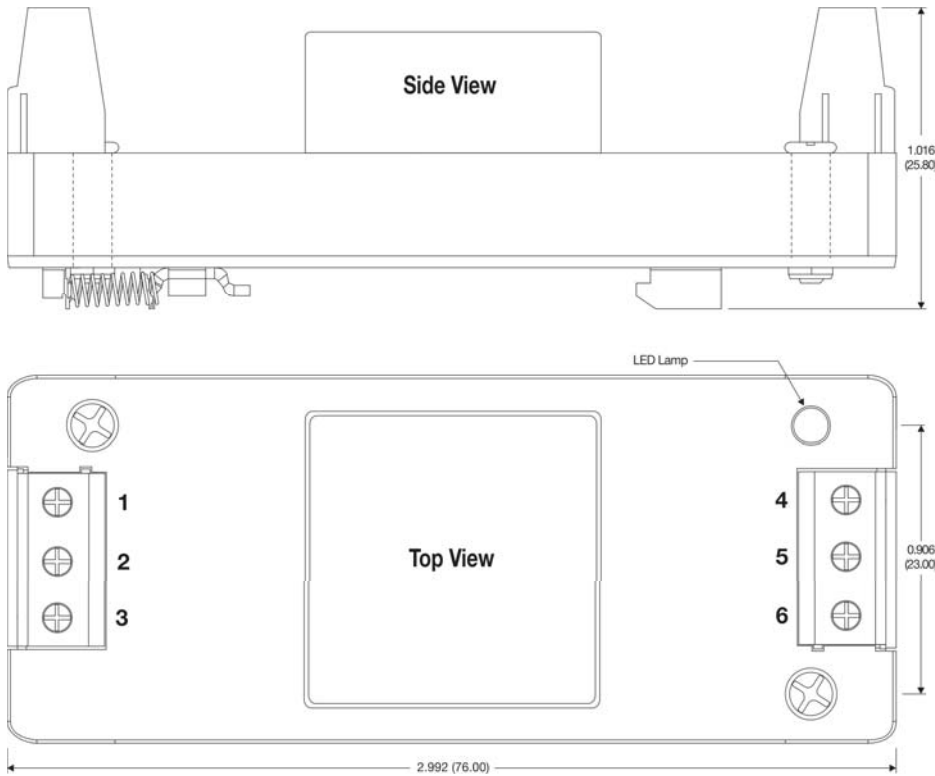
## Pin Connections

Pin	Single Output	Pin	Dual Output
1	No Connection	1	No Connection
2	-VIN	2	-VIN
3	+VIN	3	+VIN
4	-VOUT	4	-VOUT
5	No Connection	5	Common
6	+VOUT	6	+VOUT

### Notes:

- All dimensions are typical in inches (mm)
- General Dimension Tolerance x.xx = ±0.02 (±0.50)
- Wire Range: 12 to 24 AWG
- Tightening Torque: 0.4 Nm Max
- Weight: 1.26 Oz (36g)
- The LED indicates the output voltage is present (LED "On")

**Mechanical Dimensions, A4S:** With DIN Rail Mount Option & Power Good LED



**Pin Connections**

Pin	Single Output	Pin	Dual Output
1	No Connection	1	No Connection
2	-VIN	2	-VIN
3	+VIN	3	+VIN
4	-Vout	4	-Vout
5	No Connection	5	Common
6	+Vout	6	+Vout

**Notes:**

- All dimensions are typical in inches (mm)
- General Dimension Tolerance x.xx = ±0.02 (±0.50)
- Wire Range: 12 to 24 AWG
- Tightening Torque: 0.4 Nm Max
- Weight: 6.66 Oz (190g)
- For use with a TS35 type DIN rail
- The LED indicates the output voltage is present (LED "On")

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