

MI2000ERW Series

Miniature 1" x 1" 20W, Ultra-Wide 2:1 Input DC/DC Converters



Key Features:

- 20W Output Power
- 2:1 Input Voltage Range
- Miniature 1" x 1" Case
- 1,500 VDC Isolation
- Meets CISPR 32/EN 55032
- High Efficiency
- -40°C to +90°C Operation
- Industry Standard Pin-Out
- Chassis & DIN Rail Mount

RoHS



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Electrical Specifications

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

Input						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Input Voltage Range	12 VDC Input	9.0	12.0	18.0	VDC	
	24 VDC Input	18.0	24.0	36.0		
	48 VDC Input	36.0	48.0	75.0		
Input Start Voltage	12 VDC Input			9.0	VDC	
	24 VDC Input			18.0		
	48 VDC Input			36.0		
Input Under Voltage Protection	12 VDC Input	5.5	6.5		VDC	
	24 VDC Input	12.0	15.5			
	48 VDC Input	26.0	30.0			
Reflected Ripple Current			30		mA	
Start Up Time	See Note 2		10		mS	
Input Filter	Pi (π) Filter					
Output						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Output Voltage Accuracy	I _{OUT} = 0% to 100%		±1.0	±3.0	%	
Line Regulation	V _{IN} = Min to Max		±0.2	±0.5	%	
Load Regulation	I _{OUT} = 5% to 100%		±0.5	±1.0	%	
Ripple & Noise (20 MHz)	See Note 3		50	100	mV P - P	
Transient Recovery Time			300	500	μSec	
Transient Response Deviation	See Note 4	3.3 & 5V Output	±5.0	±8.0	%	
		All Other Models	±3.0	±5.0		
Temperature Coefficient				±0.03	%/°C	
Output Over Voltage Protection		110		160	%V _{OUT}	
Output Over Current Protection		110	150	190	%I _{OUT}	
Output Short Circuit	Continuous (Autorecovery)					
General						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Isolation Voltage, See Note 5	60 Seconds	1,500			VDC	
Isolation Resistance	500 VDC	1,000			MΩ	
Isolation Capacitance	Input/Output 100 KHz/0.1V		2,000		pF	
Switching Frequency	See Note 6		270		kHz	
Environmental						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Operating Temperature Range	Ambient	-40	+25	+90	°C	
Storage Temperature Range		-55		+125	°C	
Cooling	Free Air Convection					
Humidity	RH, Non-condensing			95	%	
Remote On/Off						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Unit On	See Note 7	3.5		12.0	VDC	
Unit Off		0		1.2	VDC	
Off Idle Current			2.0	7.0	mA	
Physical						
Case Size, Module, Chassis /DIN Rail Mount	See Mechanical Drawings (Starting Page 5)					
Case Material	Aluminum (UL94-V0)					
Weight, Module, Chassis /DIN Rail Mount	See Mechanical Drawings (Starting Page 5)					
Reliability Specifications						
Parameter	Conditions	Min.	Typ.	Max.	Units	
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	1.0			MHours	
Vibration	10-55 Hz, 5G, 7.5 mm, 30 Min along X, Y & Z Axis					
Absolute Maximum Ratings						
Parameter	Conditions	Min.	Typ.	Max.	Units	
Input Voltage Surge (1 Sec)	12 VDC Input			25.0	VDC	
	24 VDC Input			50.0		
	48 VDC Input			100.0		
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)	Fuse Rating Slow-Blow (mA)
	Voltage (VDC)		Current (mA)		Voltage (VDC)	Current (mA, Max)	Current (mA, Min)			
	Nominal	Range	Full-Load	No-Load						
MI2012S-03ERW	12	9.0 - 18.0	1,598	40	3.3	5,000	0.0	86	10,000	3,000
MI2012S-05ERW	12	9.0 - 18.0	1,872	45	5.0	4,000	0.0	89	10,000	3,600
MI2012S-12ERW	12	9.0 - 18.0	1,872	7	12.0	1,667	0.0	89	1,600	3,600
MI2012S-15ERW	12	9.0 - 18.0	1,852	7	15.0	1,333	0.0	90	1,000	3,600
MI2012S-24ERW	12	9.0 - 18.0	1,852	12	24.0	833	0.0	90	500	3,600
MI2024S-03ERW	24	18.0 - 36.0	781	30	3.3	5,000	0.0	88	10,000	1,500
MI2024S-05ERW	24	18.0 - 36.0	926	35	5.0	4,000	0.0	90	10,000	1,800
MI2024S-12ERW	24	18.0 - 36.0	926	6	12.0	1,667	0.0	90	1,600	1,800
MI2024S-15ERW	24	18.0 - 36.0	916	6	15.0	1,333	0.0	91	1,000	1,800
MI2024S-24ERW	24	18.0 - 36.0	916	10	24.0	833	0.0	91	500	1,800
MI2048S-03ERW	48	36.0 - 75.0	391	15	3.3	5,000	0.0	88	10,000	800
MI2048S-05ERW	48	36.0 - 75.0	463	20	5.0	4,000	0.0	90	10,000	900
MI2048S-12ERW	48	36.0 - 75.0	459	3	12.0	1,667	0.0	91	1,600	900
MI2048S-15ERW	48	36.0 - 75.0	459	3	15.0	1,333	0.0	91	1,000	900
MI2048S-24ERW	48	36.0 - 75.0	459	4	24.0	833	0.0	91	500	900

For the A2S adapter board option, add suffix "A2S" to the model no. (i.e. MI2024S-05ERW-A2S)

For the A4S adapter board option, add suffix "A4S" to the model no. (i.e. MI2048S-24ERW-A4S)

Notes:

- The specified maximum capacitive load is for each output.
- Specified at nominal input voltage and a constant, resistive load.
- When measuring output ripple & noise, it is recommended that an external capacitor (10 µF) be placed from the +Vout to the -Vout pins.
- Transient recovery is measured to within a 1% error band for a load step change of 25%.
- The insulation level from Input/Output to case is 1 kVDC. This is measured with a test time of 60 Sec and a leakage current of 1 mA max.
- The switching frequency of 3.3 & 5 VDC output models is typically 300 kHz.
- The voltage at the Remote On/Off pin (Pin 6) is referenced to the -Vin input (Pin 1). If the on/off pin is left open, the unit operates. If it is grounded, the unit will shut off.
- Operation at no-load will not damage these units. However, they may not meet all specifications.
- 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.

External Trim

On single output units, an external resistor can be used to adjust the converter output up/down by about 10%. The connection is shown in the diagram at left. The required resistor value is calculated by the formulas:

$$\text{Trim Up} = R_{\text{TRIM}} = \frac{A \times R_2}{R_2 - A} - R_3 \quad \text{Where } A = \frac{V_{\text{REF}}}{V_{\text{OUT}} - V_{\text{REF}}} \times R_1$$

$$\text{Trim Down} = R_{\text{TRIM}} = \frac{A \times R_1}{R_1 - A} - R_3 \quad \text{Where } A = \frac{V_{\text{OUT}} - V_{\text{REF}}}{V_{\text{REF}}} \times R_2$$

Where R_{TRIM} = The value of the external trim resistor
 A = A is defined as shown above

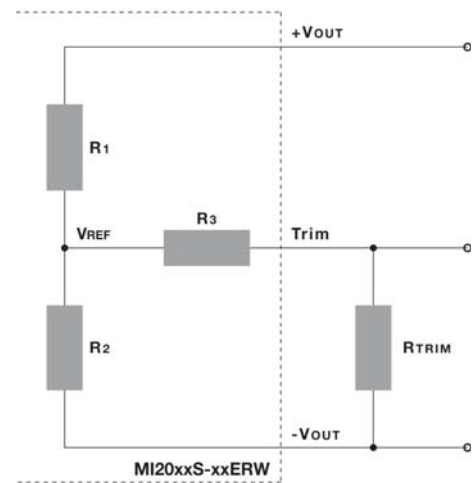
The values of R₁, R₂, R₃ and V_{REF} are given in the table below.

Output Trim Resistor Values

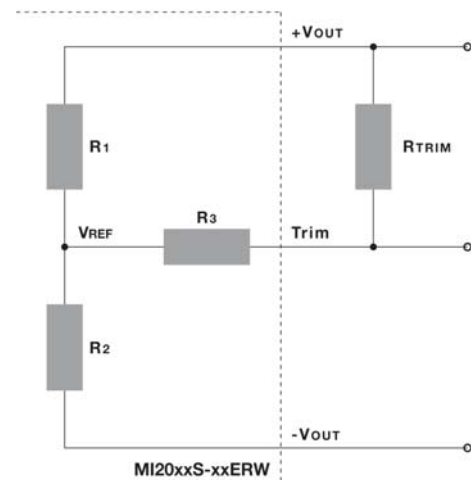
Parameter	Output Voltage (VDC)				
	3.3	5.0	12	15	24
R ₁ (kΩ)	4.829	2.894	11.000	14.494	24.872
R ₂ (kΩ)	2.870	2.870	2.870	2.870	2.870
R ₃ (kΩ)	15.00	10.00	17.40	17.40	20.00
V _{REF} (V)	1.24	2.50	2.50	2.50	2.50

External Trim

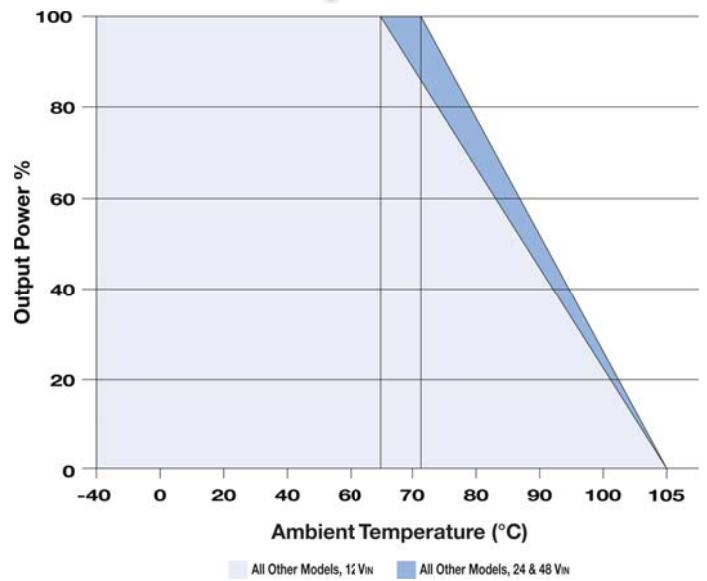
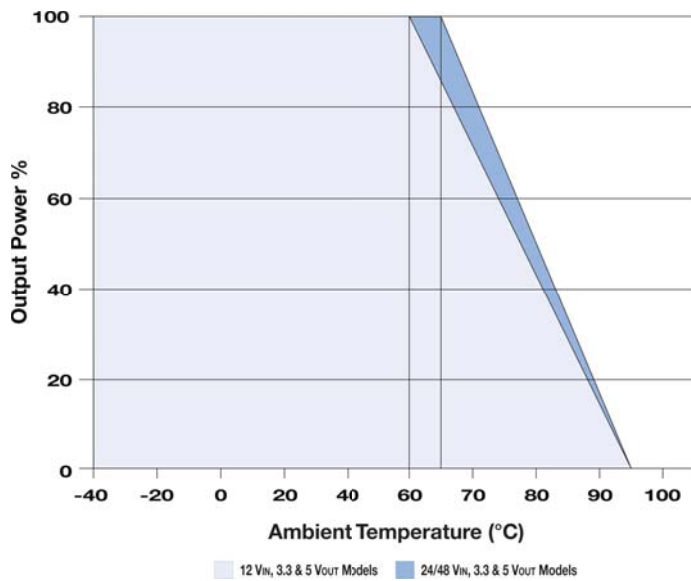
Trim Up



Trim Down



Derating Curves



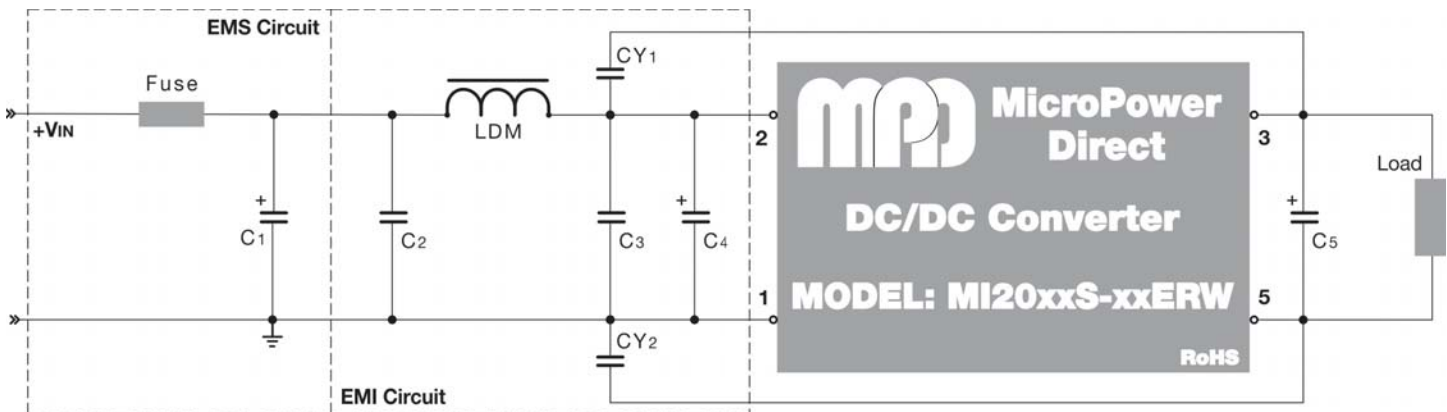
EMI Characteristics

Parameter	Standard	Criteria	Level
Radiated Emissions, See Note 1	CISPR 32/EN 55032		Class B (See Typical Connection below)
Conducted Emissions, See Note 1	CISPR 32/EN 55032		Class B (See Typical Connection below)
ESD	EN 61000-4-2	B	±8 kV Air, ±6 kV Contact
RS	EN 61000-4-3	A	10V/m
EFT, See Note 2	EN 61000-4-4	A	±2 kV
Surge, See Note 3	EN 61000-4-5	B	±2 kV
CS	EN 61000-4-6	A	3 Vrms

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 **MI2000xERW** 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:

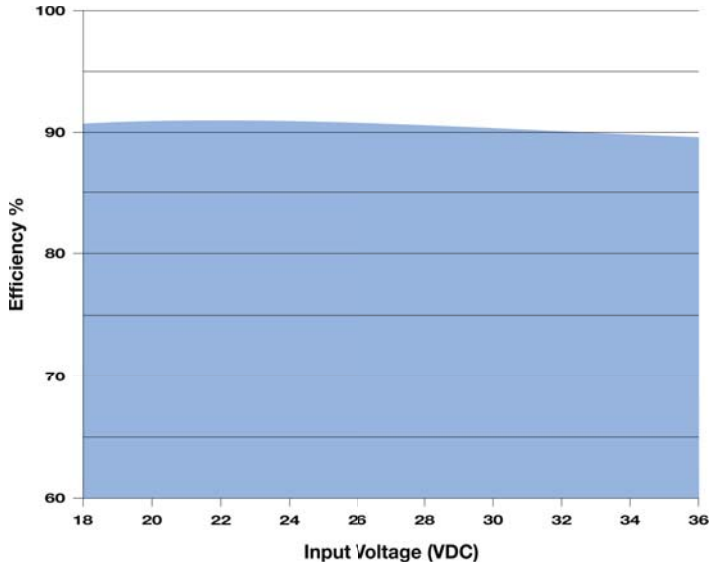
Component	12 VIN	24 VIN	48 VIN
C1	330 μF/50V	330 μF/50V	330 μF/100V
C2	4.7 μF/50V	4.7 μF/50V	4.7 μF/100V
LDM	2.2 μH	2.2 μH	2.2 μH
C3	4.7 μF/50V	4.7 μF/50V	4.7 μF/100V
C4	330 μF/50V	330 μF/50V	330 μF/100V
CY1	1 nF/2 kV	1 nF/2 kV	1 nF/2 kV
CY2	1 nF/2 kV	1 nF/2 kV	1 nF/2 kV
C5	See Note 5		

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	12 VIN	24 VIN	48 VIN
CIN	100 μF	100 μF	100 μF
COU			
3.3 VDC	100 μF	100 μF	100 μF
5 VDC	100 μF	100 μF	100 μF
12 VDC	100 μF	100 μF	100 μF
15 VDC	100 μF	100 μF	100 μF
24 VDC	47 μF	47 μF	47 μF

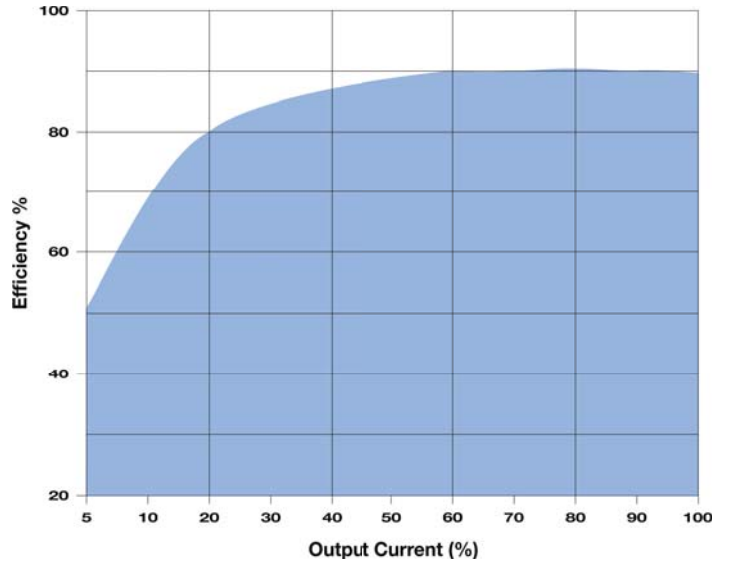
Efficiency Curves: Efficiency vs Input Voltage

MI2024S-05ERW (24 V_{IN} - 5 V_{OUT})

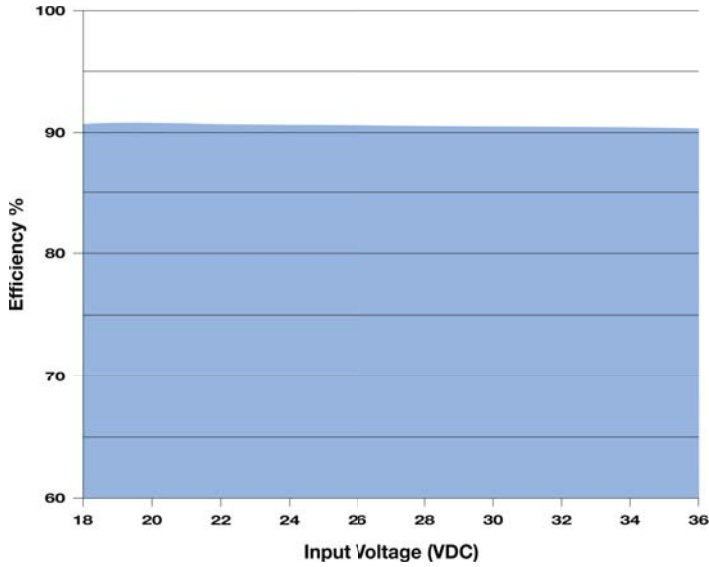


Efficiency Curves: Efficiency vs Output Voltage

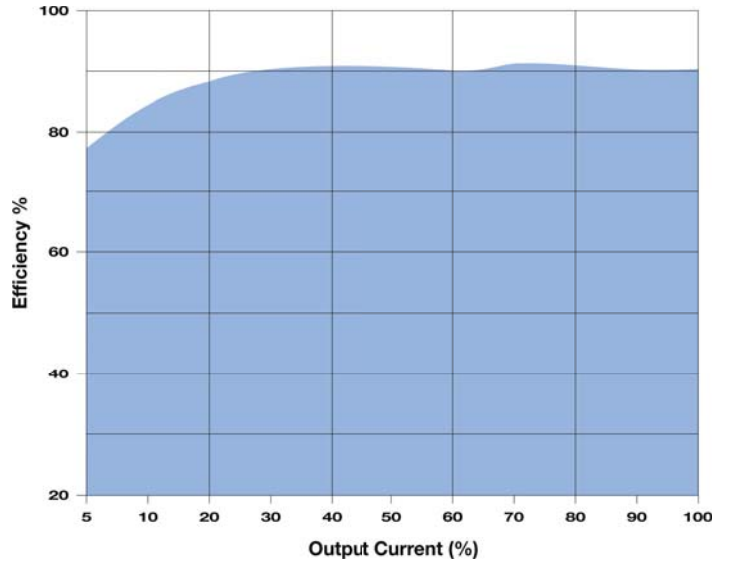
MI2024S-05ERW (24 V_{IN} - 5 V_{OUT})



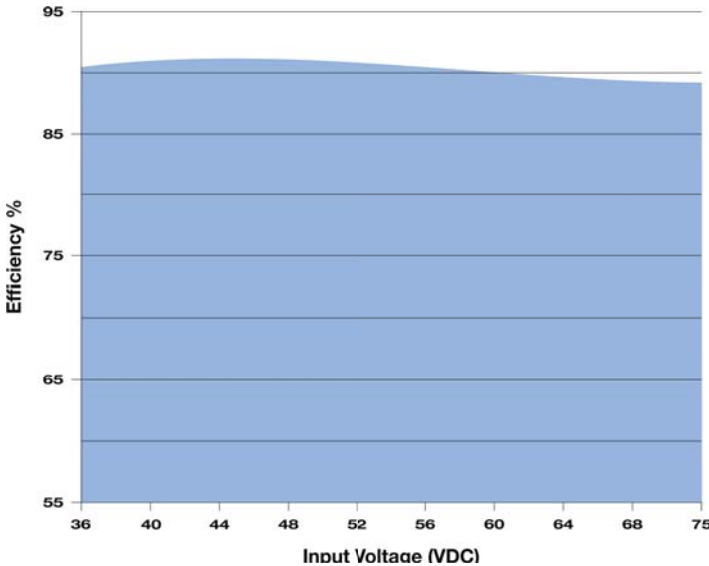
MI2024S-15ERW (24 V_{IN} - 15 V_{OUT})



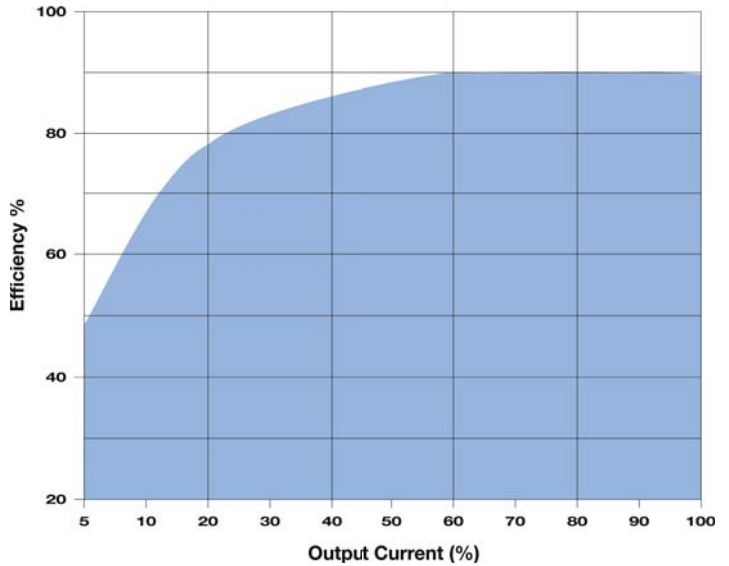
MI2024S-15ERW (24 V_{IN} - 15 V_{OUT})



MI2048S-05ERW (48 V_{IN} - 5 V_{OUT})

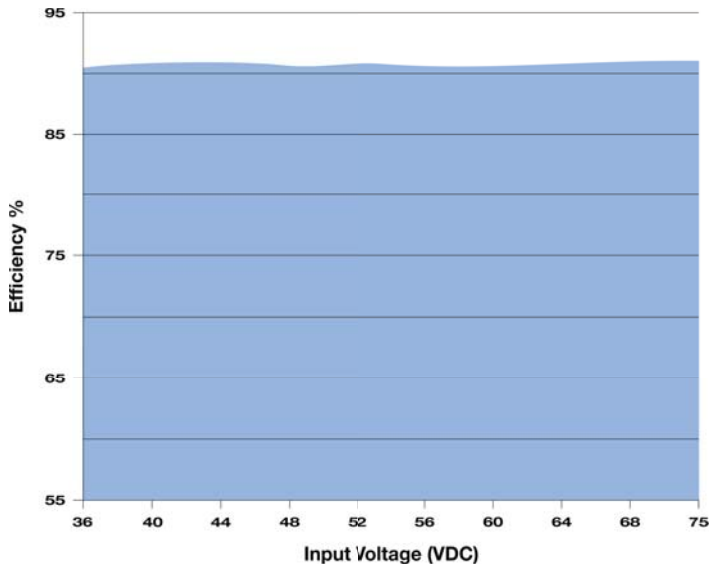


MI2048S-05ERW (48 V_{IN} - 5 V_{OUT})



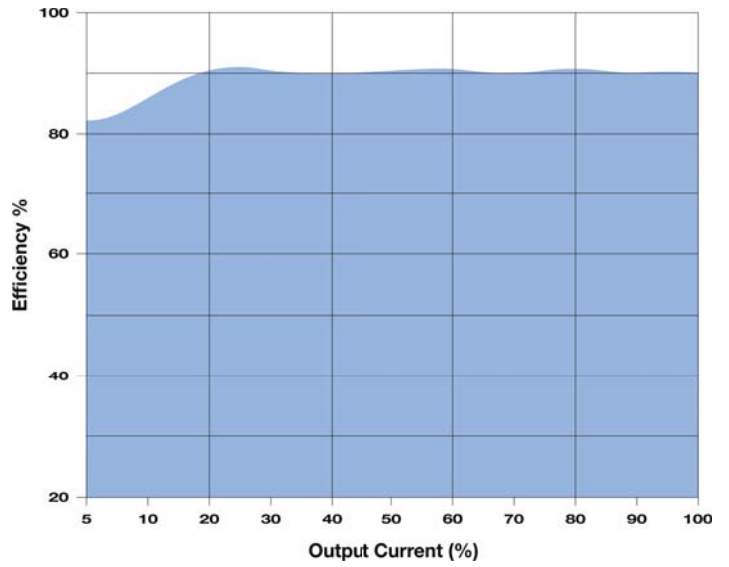
Efficiency Curves: Efficiency vs Input Voltage

MI2048S-12ERW (48 VIN - 12 VOUT)

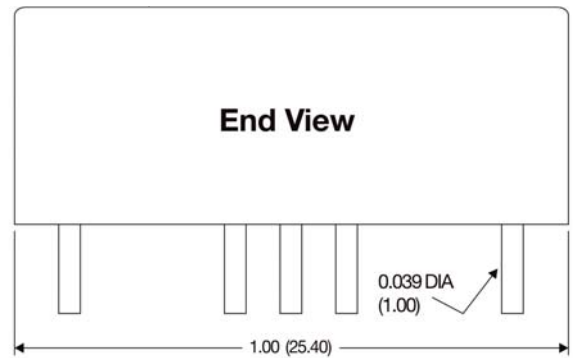
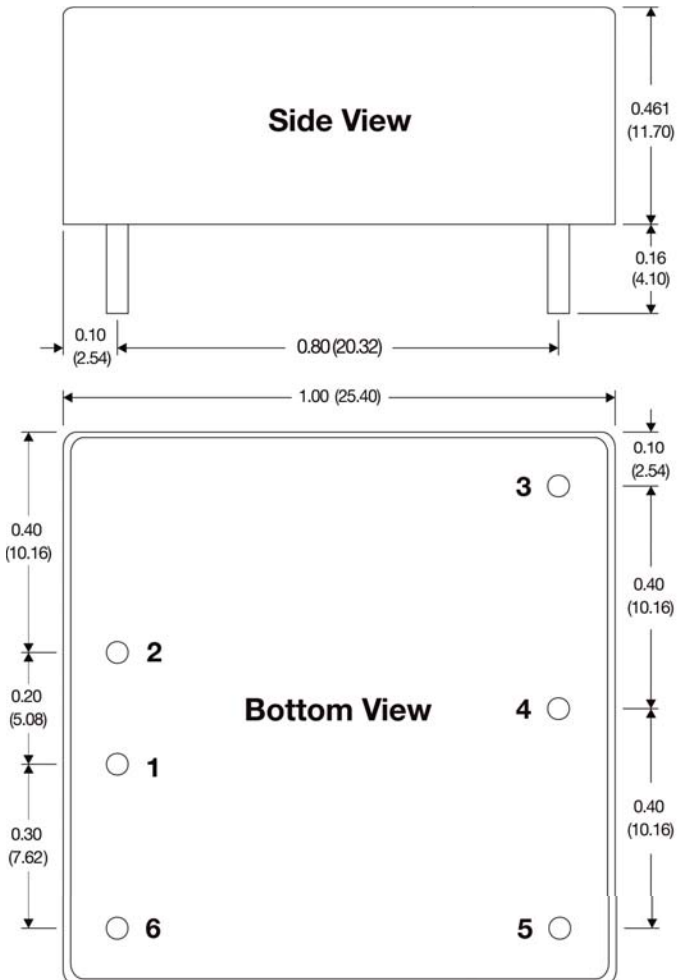


Efficiency Curves: Efficiency vs Output Voltage

MI2048S-12ERW (48 VIN - 12 VOUT)



Mechanical Dimensions



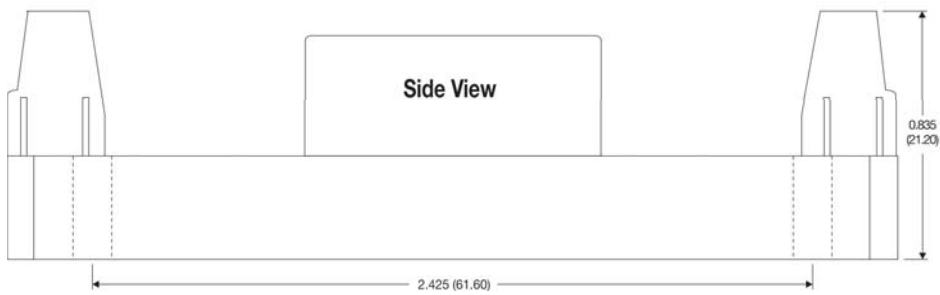
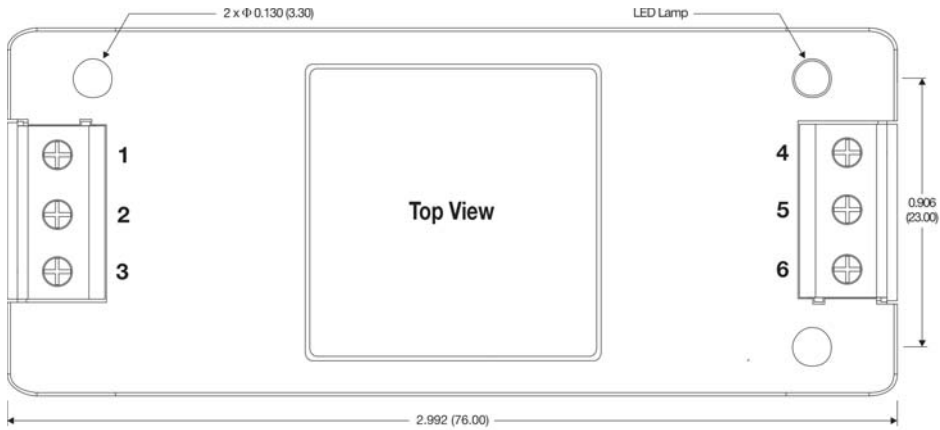
Pin Connections

Pin	Function
1	-VIN
2	+VIN
3	+VOUT
4	Trim
5	-VOUT
6	Remote On/Off

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

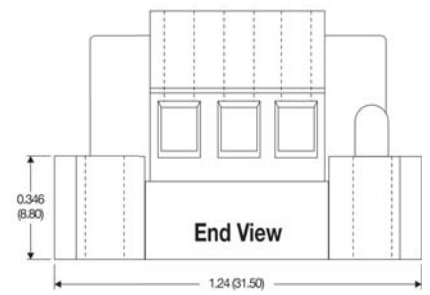


Pin Connections

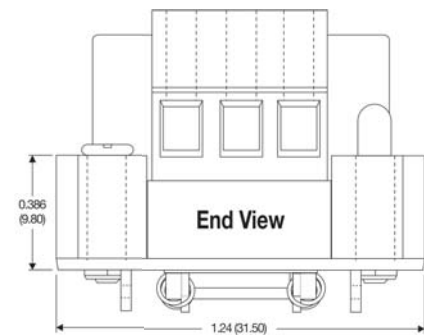
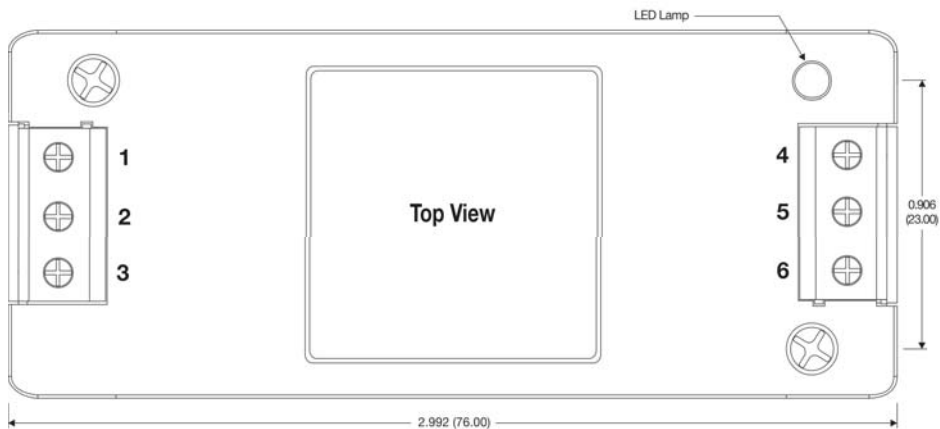
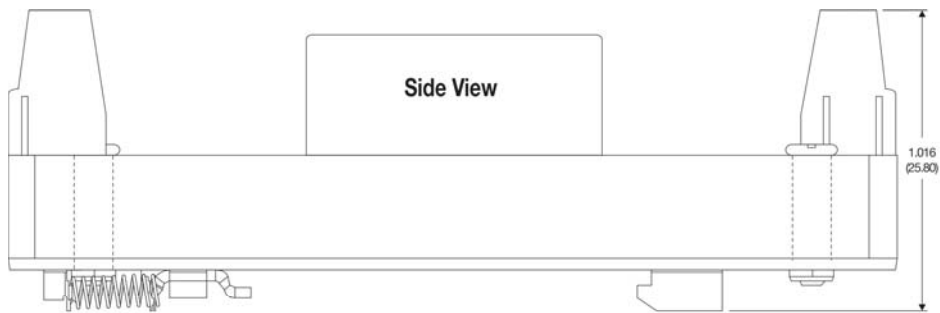
Pin	Function
1	Remote On/Off
2	-VIN
3	+VIN
4	-VOUT
5	Trim
6	+VOUT

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	Function
1	Remote On/Off
2	-VIN
3	+VIN
4	-VOUT
5	Trim
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")