

MI2000ERU Series



Wide 4:1 Input, 20W Miniature 1" x 1" DC/DC Converters

Key Features:

- 20W Output Power
- 4:1 Input Voltage Range
- Miniature 1" x 1" Case
- 1,500 VDC Isolation
- Meets CISPR 32/EN 55032
- Single & Dual Outputs
- -40°C to +95°C Operation
- Industry Standard Pin-Out
- Chassis & DIN Rail Mount



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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	24 VDC Input	9.0	24.0	36.0	VDC
	48 VDC Input	18.0	48.0	75.0	
Input Start-up Threshold	24 VDC Input			9.0	VDC
	48 VDC Input			18.0	
Under Voltage Shutdown	24 VDC Input	5.5	6.5		VDC
	48 VDC Input	12.0	15.5		
Start Up Time	See Note 2		10		mS
Reflected Ripple Current			30		mA
Input Filter	Pi (π) Filter				
Output					
Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy			±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	120	mV P - P
Cross Regulation	See Note 4				
Transient Recovery Time , See Note 5	25% Load Step Change		300	500	μSec
Transient Response Deviation			±3.0	±5.0	%
Temperature Coefficient			±0.02		%/°C
Over Temperature Protection			110		°C
Output Over Load Protection			150		%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	100 kHz, 0.1V		1,000		pF
Switching Frequency			320		kHz
Environmental					
Parameter	Conditions	Min.	Typ.	Max.	Units
Operating Temperature Range	Ambient	-40		+95	°C
Storage Temperature Range		-55		+125	°C
Cooling	Free Air Convection				
Humidity	RH, Non-condensing			95	%
Physical					
Case Size,Module, Chassis /DIN Rail Mount	See Mechanical Diagrams (Page 5, 6)				
Case Material	Aluminum (UL94-V0)				
Weight, Module, Chassis /DIN Rail Mount	See Mechanical Diagrams (Pages 5,6)				
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
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)	24 VDC Input			50.0	VDC
	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.

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							
MI2024S-03ERU	24	9.0 - 36.0	781	30	3.3	5,000	0.0	88	10,000	---	1,600
MI2024S-05ERU	24	9.0 - 36.0	925	35	5.0	4,000	0.0	90	10,000	---	2,000
MI2024S-12ERU	24	9.0 - 36.0	925	6	12.0	1,667	0.0	90	1,600	---	2,000
MI2024S-15ERU	24	9.0 - 36.0	915	6	15.0	1,333	0.0	91	1,000	---	2,000
MI2024S-24ERU	24	9.0 - 36.0	915	10	24.0	833	0.0	91	500	---	2,000
MI2024D-05ERU	24	9.0 - 36.0	957	10	±5.0	±2,000	±0.0	87	2,000	CE	2,000
MI2024D-12ERU	24	9.0 - 36.0	925	10	±12.0	±833	±0.0	90	800	CE	2,000
MI2024D-15ERU	24	9.0 - 36.0	925	10	±15.0	±667	±0.0	90	600	CE	2,000
MI2024D-24ERU	24	9.0 - 36.0	936	10	±24.0	±417	±0.0	89	300	CE	2,000
MI2048S-03ERU	48	18.0 - 75.0	390	10	3.3	5,000	0.0	88	10,000	---	800
MI2048S-05ERU	48	18.0 - 75.0	462	15	5.0	4,000	0.0	90	10,000	---	1,000
MI2048S-12ERU	48	18.0 - 75.0	458	20	12.0	1,667	0.0	91	1,600	---	1,000
MI2048S-15ERU	48	18.0 - 75.0	458	3	15.0	1,333	0.0	91	1,000	---	1,000
MI2048S-24ERU	48	18.0 - 75.0	458	4	24.0	833	0.0	91	500	---	1,000
MI2048D-05ERU	48	18.0 - 75.0	473	5	±5.0	±2,000	±0.0	86	2,000	CE	1,000
MI2048D-12ERU	48	18.0 - 75.0	462	5	±12.0	±833	±0.0	90	800	CE	1,000
MI2048D-15ERU	48	18.0 - 75.0	462	5	±15.0	±667	±0.0	90	600	CE	1,000
MI2048D-24ERU	48	18.0 - 75.0	462	5	±24.0	±417	±0.0	90	300	CE	1,000

For the A2S adapter board option, add suffix "A2S" to the model no. (i.e. MI2024D-05ERU-A2S)

For the A4S adapter board option, add suffix "A4S" to the model no. (i.e. MI2048S-24ERU-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 for single output units and from each output to common for dual output models. From 0% - 5% output load, ripple & noise is 5% max.
- 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.
- 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 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:

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

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

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

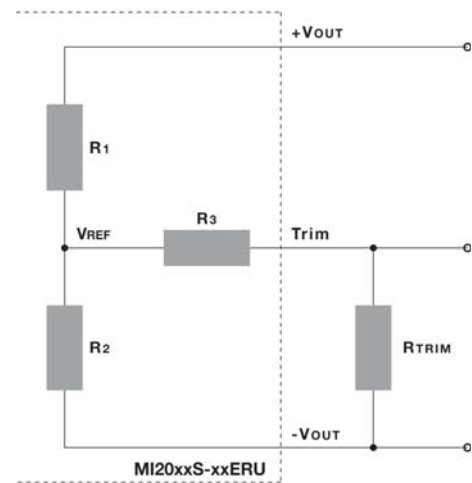
The values of R₁, R₂, R₃ and V_{REF} are given in the table below.

Output Trim Resistor Values

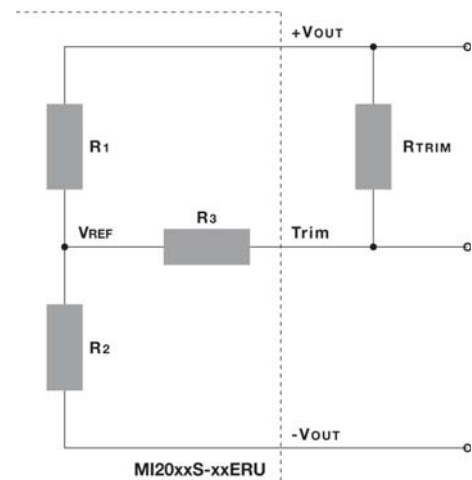
Parameter	Output Voltage (VDC)				
	3.3	5.0	12	15	24
R ₁ (kΩ)	4.829	2.894	11.000	14.494	24.872
R ₂ (kΩ)	2.870	2.870	2.870	2.870	2.870
R ₃ (kΩ)	15.00	10.00	17.40	17.40	20.00
V _{REF} (V)	1.24	2.50	2.50	2.50	2.50

External Trim

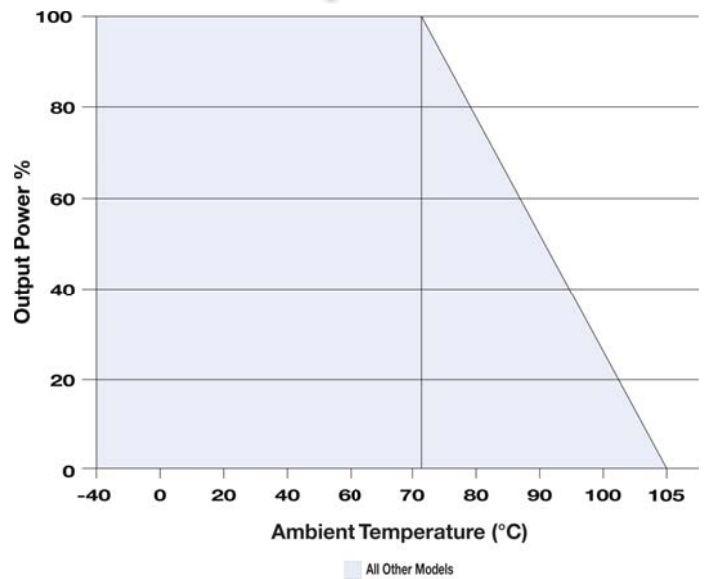
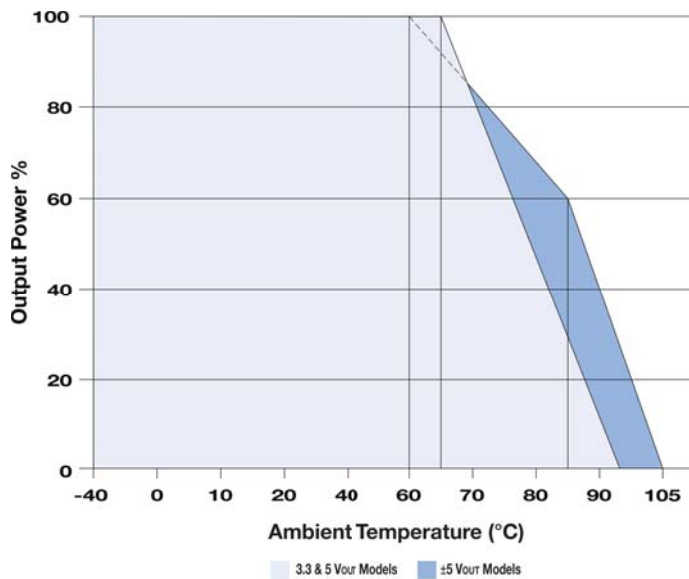
Trim Up



Trim Down



Derating Curves



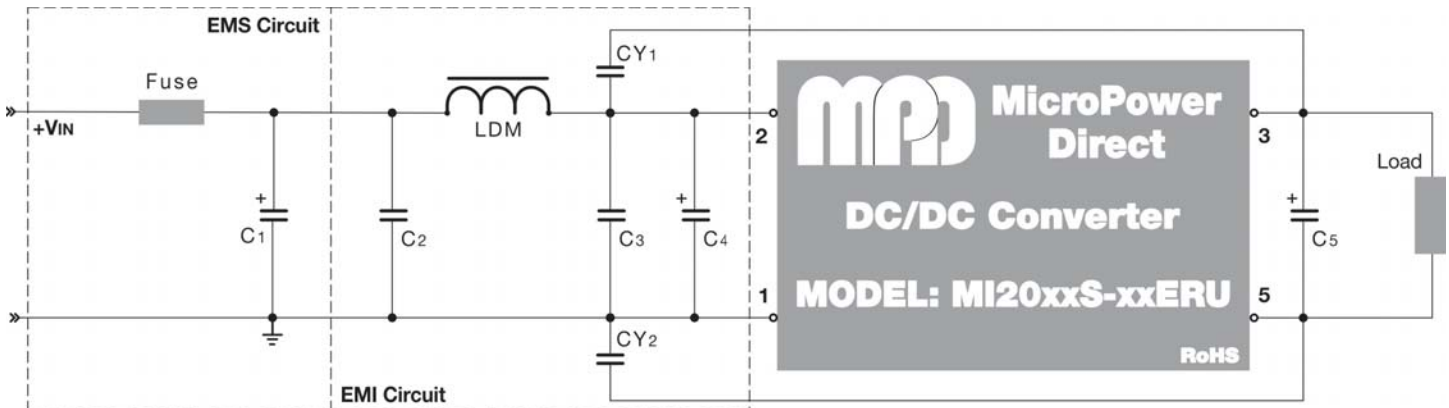
EMI Characteristics

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, ±4 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 **MI2000xERU** 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:

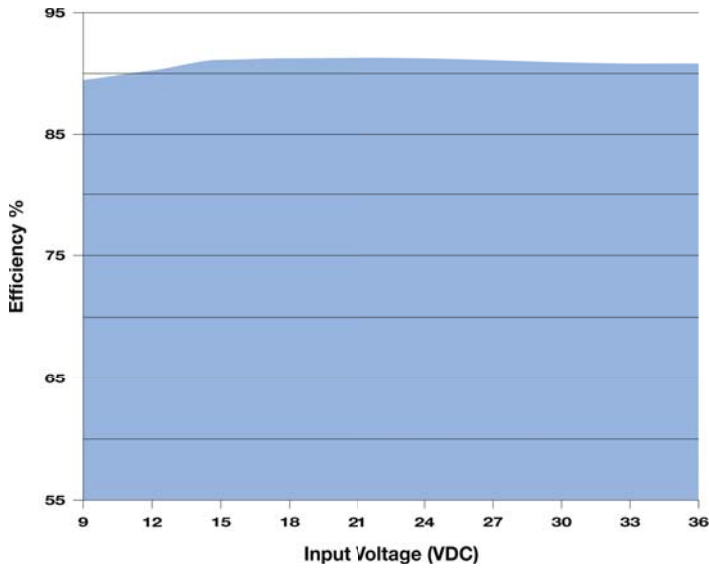
Component	24 VIN	48 VIN
C1	330 μ F/50V	330 μ F/100V
C2	4.7 μ F/50V	4.7 μ F/100V
LDM (Single Out.)	2.2 μ H	2.2 μ H
LDM (Dual Out.)	4.7 μ H	4.7 μ H
C3	4.7 μ F/50V	4.7 μ F/100V
C4	330 μ F/50V	330 μ F/100V
CY1	1 nF/2 kV	1 nF/2 kV
CY2	1 nF/2 kV	1 nF/2 kV
C5	See Note 5	

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	Single Output		Dual Output	
	24 VIN	48 VIN	24 VIN	48 VIN
CIN	100 μ F	100 μ F	100 μ F	10 - 47 μ F
COU				
3.3 VDC	100 μ F	100 μ F		
5 VDC	100 μ F	100 μ F		
12 VDC	100 μ F	100 μ F		
15 VDC	100 μ F	100 μ F		
24 VDC	47 μ F	47 μ F		
±5 VDC			10 μ F	10 μ F
±12 VDC			10 μ F	10 μ F
±15 VDC			10 μ F	10 μ F
±24 VDC			10 μ F	10 μ F

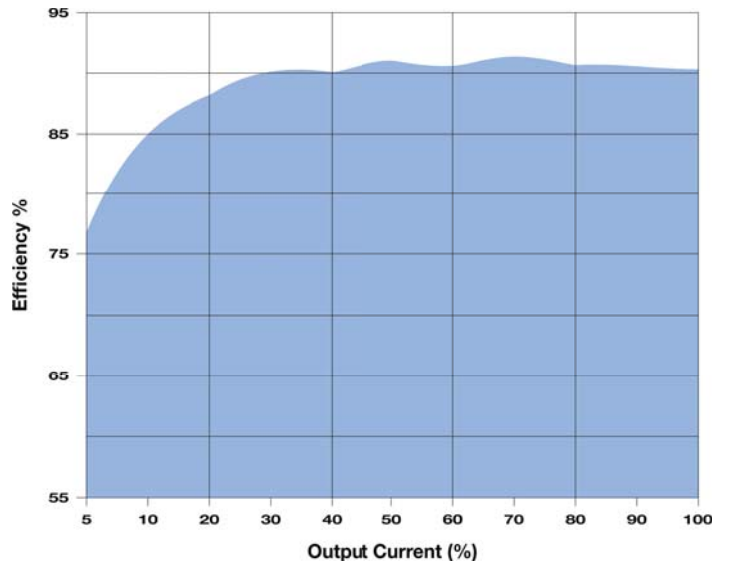
Efficiency Curves: Efficiency vs Input Voltage

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

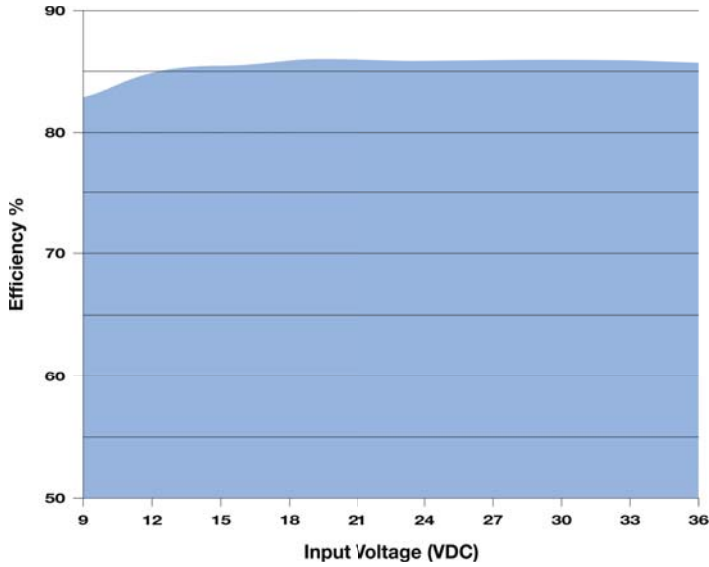


Efficiency Curves: Efficiency vs Output Voltage

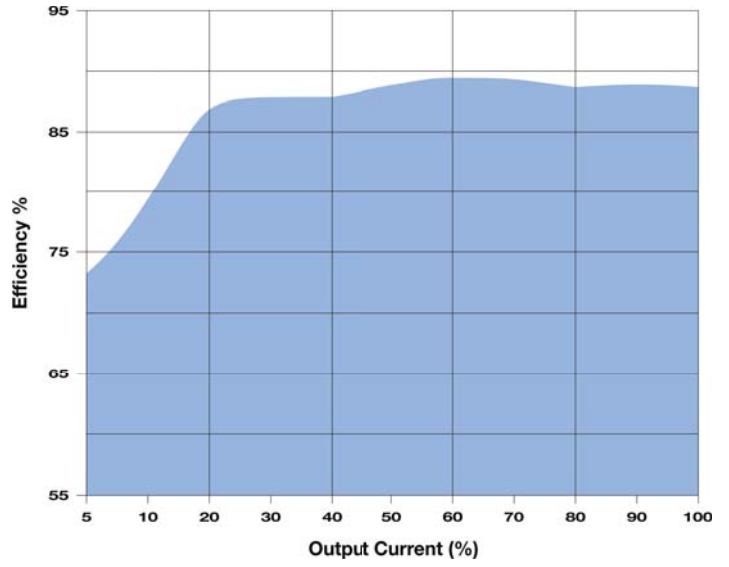
MI2024S-15ERU (24 V_{IN} - 15 V_{OUT})



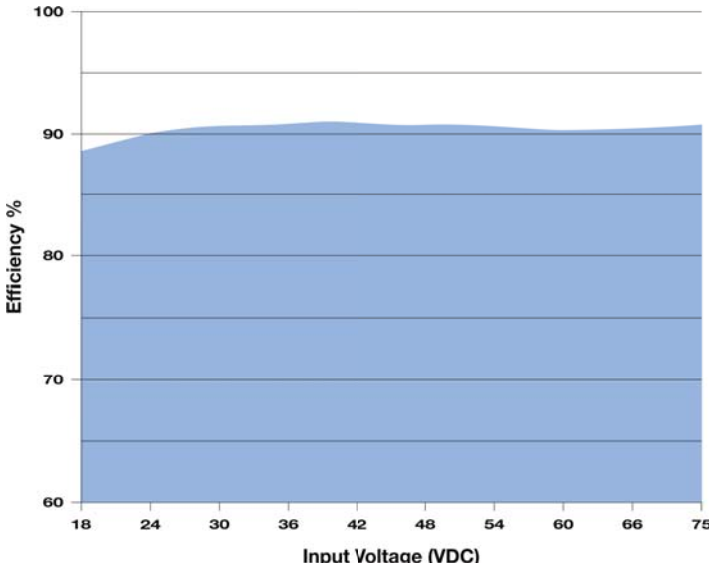
MI2024D-05ERU (24 V_{IN} - ±5 V_{OUT})



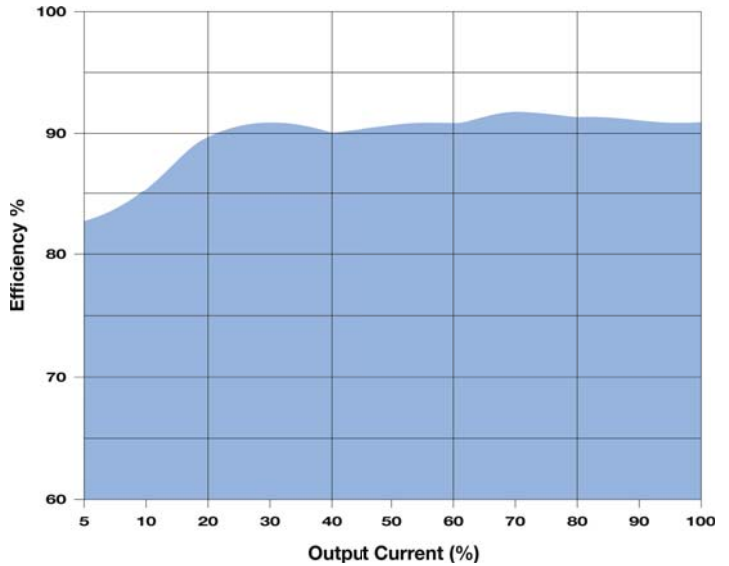
MI2024D-05ERU (24 V_{IN} - ±5 V_{OUT})



MI2048S-12ERU (48 V_{IN} - 12 V_{OUT})

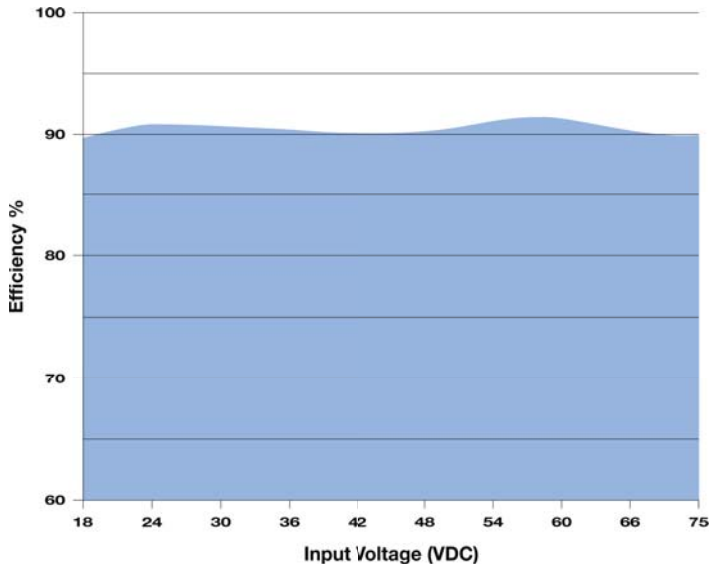


MI2048S-12ERU (48 V_{IN} - 12 V_{OUT})



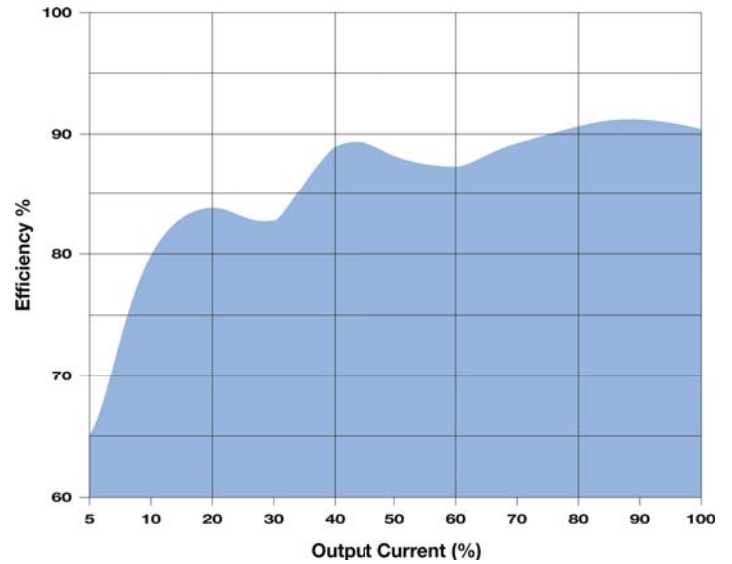
Efficiency Curves: Efficiency vs Input Voltage

MI2048D-24ERU (48 VIN - ±24 VOUT)

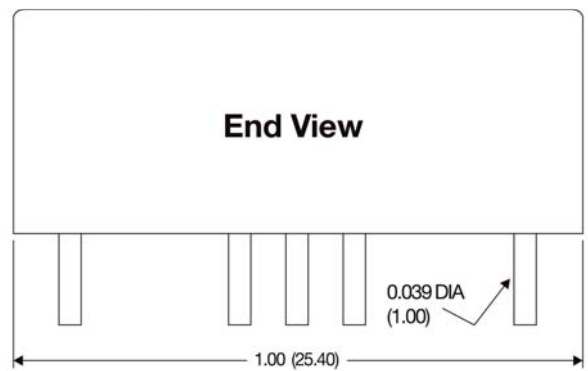
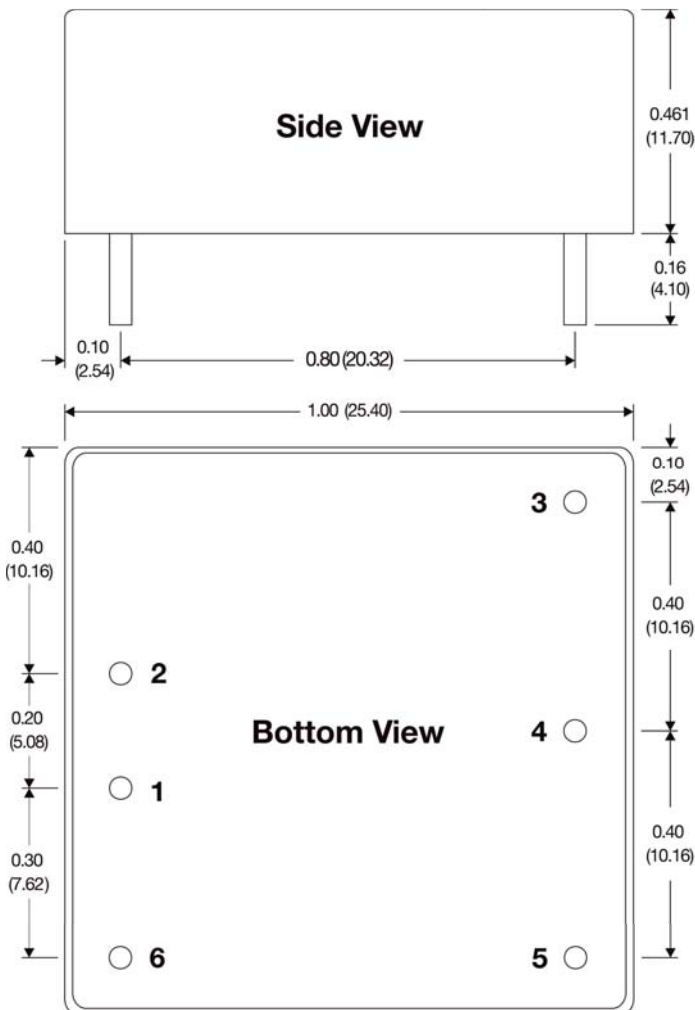


Efficiency Curves: Efficiency vs Output Voltage

MI2048D-24ERU (48 VIN - ±24 VOUT)



Mechanical Dimensions



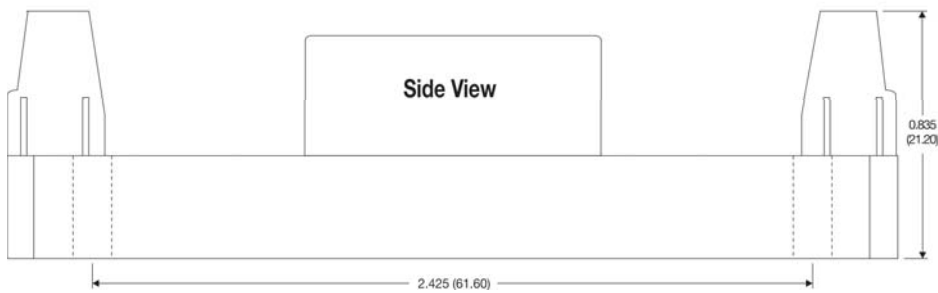
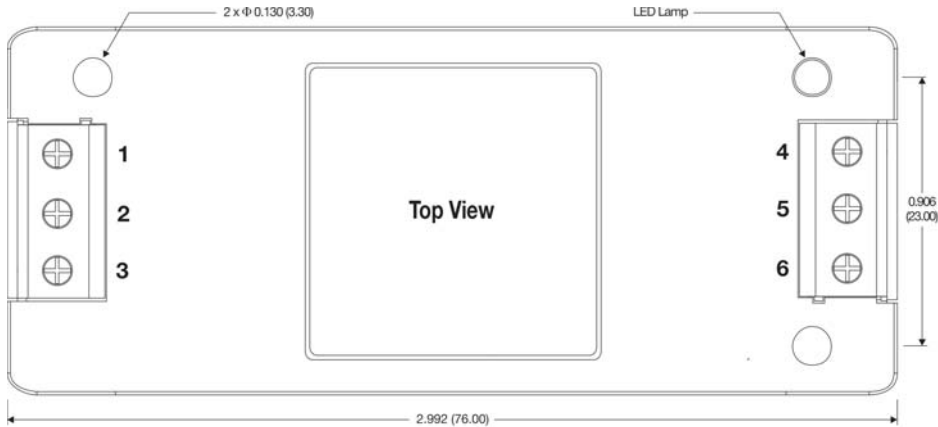
Pin Connections

Pin	Single Output	Pin	Dual Output
1	-VIN	1	-VIN
2	+VIN	2	+VIN
3	+VOUT	3	+VOUT
4	Trim	4	Common
5	-VOUT	5	-VOUT
6	Remote On/Off	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

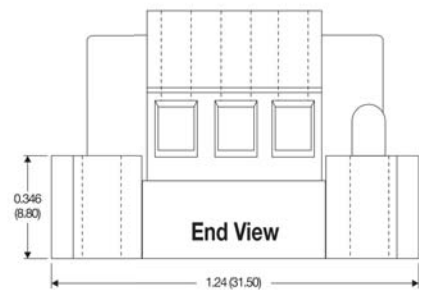


Pin Connections

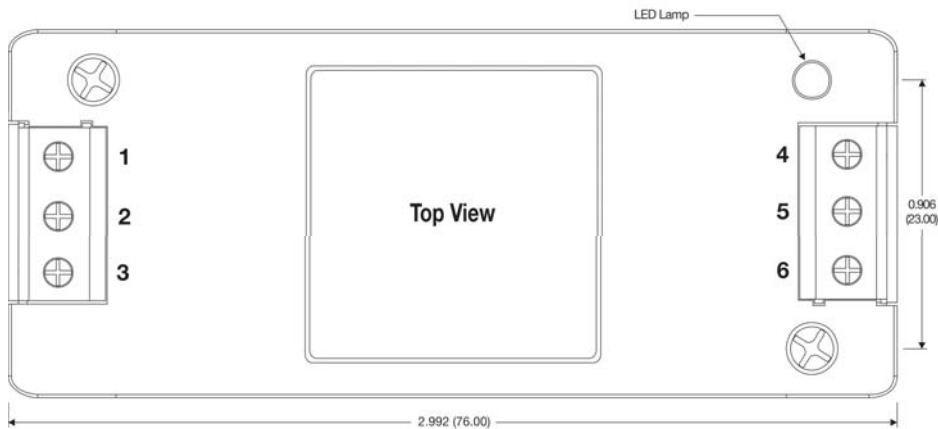
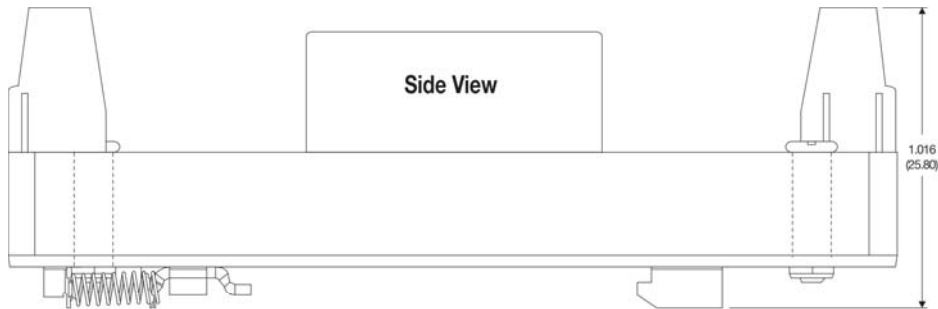
Pin	Single Output	Pin	Dual Output
1	Remote On/Off	1	Remote On/Off
2	-VIN	2	-VIN
3	+VIN	3	+VIN
4	-VOUT	4	-VOUT
5	Trim	5	Common
6	+VOUT	6	+VOUT

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