

# MR2011S Series

## Ultra-Wide Input, 20W Compact, Railway DC/DC Converters



### Key Features:

- 20W Output Power
- 40 -160 VDC Input Range
- 1,500 VDC Isolation
- Efficiency to 89%
- Compact 1 x 2 Inch Case
- -40°C to +85°C Operation
- Industry Standard Pin-Out
- Chassis Mount Option
- DIN Rail Mount Option

RoHS



### 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		40.0	110.0	160.0	VDC
Input Start Voltage				39.8	VDC
Under Voltage Shutdown	I <sub>OUT</sub> = 100%	36.0			VDC
Input Filter	π (Pi) Filter				

#### Output

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy			±1.0	±3.0	%
Output Trim Range			±10		%
Line Regulation	V <sub>IN</sub> = Min to Max		±0.2	±0.5	%
Load Regulation	I <sub>OUT</sub> = 10% to 100%		±0.5	±1.0	%
Ripple & Noise (20 MHz)	See Note 1		75	100	mV P - P
Transient Recovery Time, See Note 2			500	800	μSec
Transient Response Deviation	25% Load Step Change		±3.0	±5.0	%
Output Power Protection		110	130	170	%
Temperature Coefficient			±0.02		%/°C
Output Short Circuit, See Note 3	Continuous (Autorecovery)				

#### General

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	60 Seconds	1,500			VDC
Isolation Resistance	500 VDC	1,000			MΩ
Isolation Capacitance	100 kHz/0.1V		2,000		pF
Switching Frequency			300		kHz

#### Environmental

Parameter	Conditions	Min.	Typ.	Max.	Units
Operating Temperature Range	Ambient	-40	+25	+85	°C
	Case			+105	
Storage Temperature Range		-55		+125	°C
Cooling	Free Air Convection				
Humidity	RH, Non-condensing			95	%

#### Physical

Case Size	See Mechanical Diagram (Page 4)				
Case Material	Aluminum Alloy With Non-Conductive Base (UL94-V0)				
Weight	0.99 Oz (28g)				

#### Remote On/Off

Parameter	Conditions	Min.	Typ.	Max.	Units
Unit On	See Note 4	2.5		12.0	VDC
Unit Off	See Note 4	0		1.2	VDC
Off Idle Current			1.0		mA

#### Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	1.0			MHours
Vibration, 5 - 150 Hz	Displacement Range			7.5 mm	
	Acceleration			2G	

#### Absolute Maximum Ratings

Parameter	Conditions	Min.	Typ.	Max.	Units
Input Voltage Surge (1 Sec)	24 VDC Input	-0.7		200.0	VDC
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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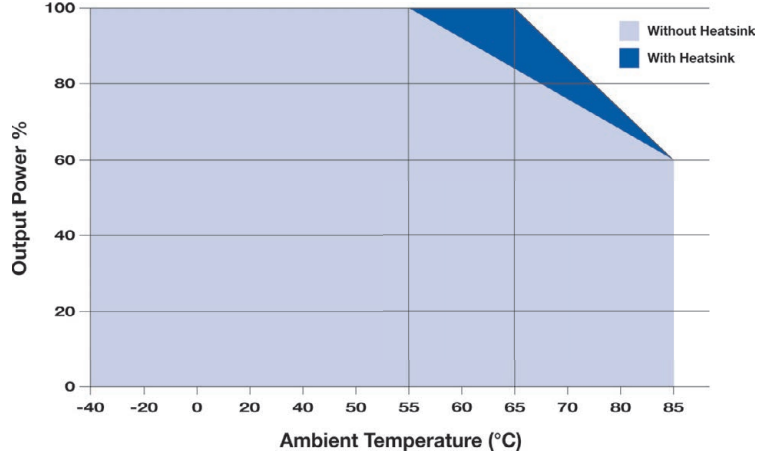
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Model Number	Input				Output			Efficiency (% Typ)	Over Voltage Protection (VDC Typ)	Capacitive Load (µF, Max)	Fuse Rating Slow-Blow (mA)
	Voltage (VDC)		Current (mA)		Voltage (VDC)	Current (mA, Max)	Current (mA, Min)				
	Nominal	Range	Full-Load	No-Load							
MR2011S-05RU	110	40 - 160	204	15	5.0	4,000	200	89	6.2	4,020	400
MR2011S-12RU	110	40 - 160	206	8	12.0	1,667	83	88	15.0	1,600	400
MR2011S-15RU	110	40 - 160	206	8	15.0	1,333	67	88	18.0	1,000	400
MR2011S-24RU	110	40 - 160	206	8	24.0	833	42	88	28.8	470	400

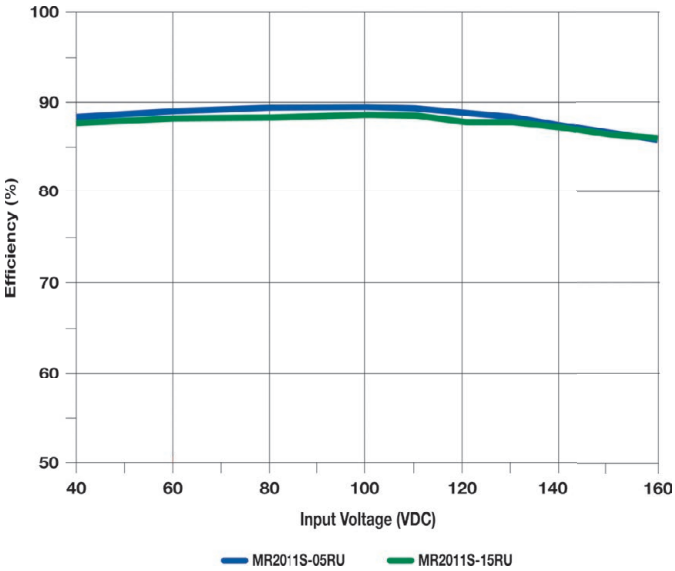
Notes:

- When measuring output ripple, it is recommended that an external ceramic capacitor (approx 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%.
- Short circuit protection is provided by a "hiccup mode" circuit.
- The maximum control current at the on/off pin (pin 6) during a logic high is 50 µA. The maximum control current to the on/off pin at logic low (-0.7V to 0.8V) is 1 mA. If the on/off pin is left open, the unit operates. If it is grounded, the unit will shut off.
- These units should not be operated with a load under 5% of full load. Operation at no-load will not damage the unit, but they may not meet all specifications.
- These units should not be operated over +85°C. Exceeding +85°C may damage the unit.
- 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.

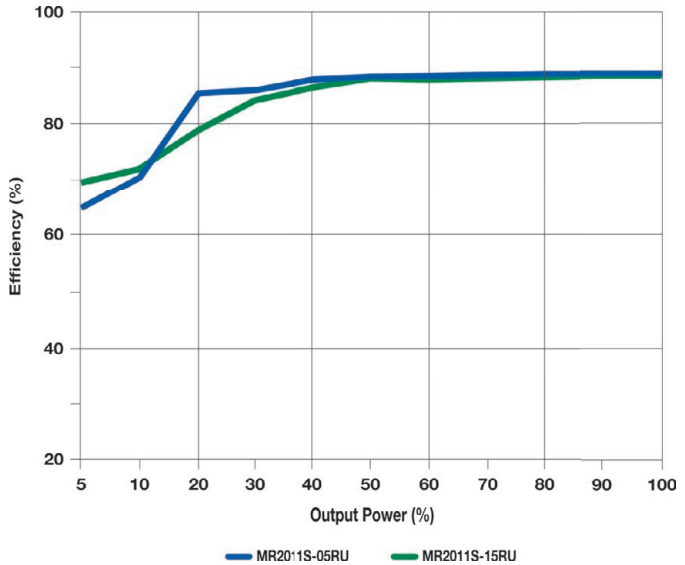
Derating Curve



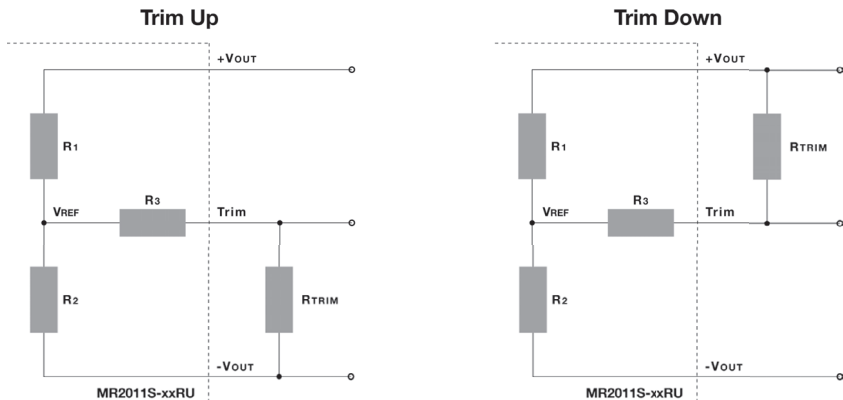
Efficiency vs Input Voltage (Full Load)



Efficiency vs Output Power (VIN = 110 VDC)



External Trim



External Trim Notes:

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:

$$\text{Trim UP} = R_{\text{TRIM}} = \frac{A \cdot R_2}{R_2 - A} - R_3 \quad \text{Where } A = \frac{V_{\text{REF}}}{V_{\text{TRIM}} - V_{\text{REF}}} \cdot R_1$$

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

Where RTRIM = The value of the external trim resistor

VTRIM = The amount of voltage adjustment required

The value of R1, R2, R3 and VREF are given in the table below.

Parameter	Output Voltage (VDC)			
	5.0	12	15	24
R1 (kΩ)	2.883	10.971	14.497	24.872
R2 (kΩ)	2.864	2.864	2.864	2.864
R3 (kΩ)	10.00	17.80	17.80	20.00
VREF (V)	2.50	2.50	2.50	2.50



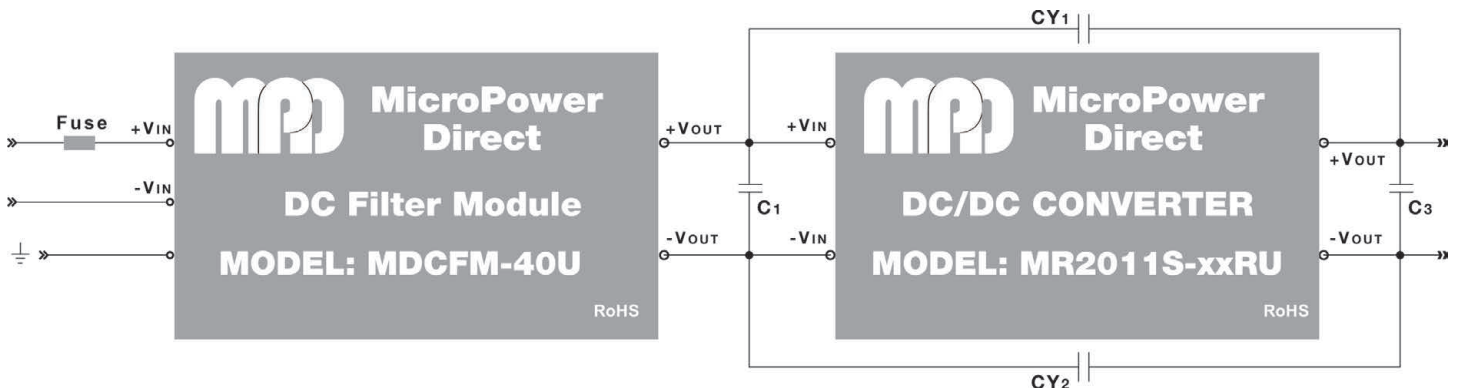
EMC Specifications

Parameter	Standard	Criteria	Specification
Transient Input Voltage	See Note 1	RIA 12	A 385V/20 mS
Maximum Input Voltage	See Note 1	EN 50155	B 1,800V (5/50 μS, 50 or 100Ω) B 8,400V (0.05/0.1 μS, 100Ω)
Radiated Emissions	See Note 2	EN 55022	Class B
Conducted Emissions	See Note 2	EN 55022	Class B
ESD	EN 61000-4-2	B	±4 kV Contact
RS	EN 61000-4-3	A	10V/m
EFT	See Note 3	EN 61000-4-4	B ±4 kV
Surge	See Note 4	EN 61000-4-5	B ±2 kV/±4 kV
CS	EN 61000-4-6	A	3 Vrms
Voltage Dips	EN 61000-4-29	B	0% - 70%

Notes:

1. With a pulse interval that is >60S. Requires the addition of the filter module **MDCFM-40U** (or a similar discrete circuit) as shown in the circuit/board layout diagrams below. Contact the factory for more information.
2. All units will meet class B with the addition of the filter module **MDCFM-40U** (or a similar discrete circuit) as shown in the circuit/board layout diagrams below. Contact the factory for more information.
3. To meet the requirements of EN 61000-4-4 (±4 kV), external components are needed. This can be done discretely, or with the addition of the **MDCFM-40U**. Contact the factory for more information.
4. To meet the requirements of EN 61000-4-5 (±2 kV/ ±4 kV), external components are needed. This can be done discretely, or with the addition of the **MDCFM-40U**. Contact the factory for more information.

Typical Connection



The diagram above illustrates a typical connection of the **MR2011S** series. The **MDCFM-40U** filter module is used to make the circuit compliant with input surge and EMC standards EN 55022, EN 61000 and EN 50155. This can also be accomplished by using external filter components as shown in the board layout drawing below. Some notes on these components are:

1. It is recommended that an external fuse be used. The recommended fuse is shown in the model chart on page 2.
2. An external MOV is recommended on the input to protect the unit in the event of a surge. A recommended value is given in the table at right.
3. An external TVS is recommended on the input to protect the unit in the event of a voltage spike. A recommended value is given in the table at right.
4. The output filtering capacitor (C3) is a high frequency, low resistance electrolytic capacitor. Care must be taken in choosing this capacitor not to exceed the capacitive load specification for the unit. Voltage derating of capacitors should be 80% or above.

5. Suggested component values are:

Component	Value
MOV	S14K35
L1	56 μH
TVS	SMCJ170
C1	100 μF/200V
C3	1.0 μF/50V
L2	4.7 μH
CY1, CY2	1,000 pF/2 kV

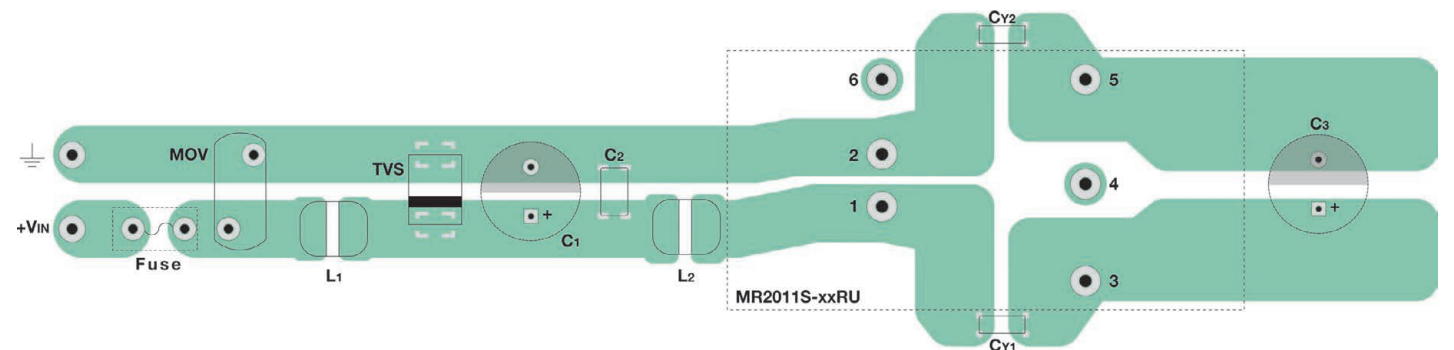
6. Input noise and surge suppression modules are available for a number of **MPD** DC/DC power supplies. For use with the **MRxxS** product series, the **MDCFM-40U** DC filter module is recom-

mended. A typical board layout with this module is shown in the figure below. For pricing or full technical information on these modules please contact the factory.

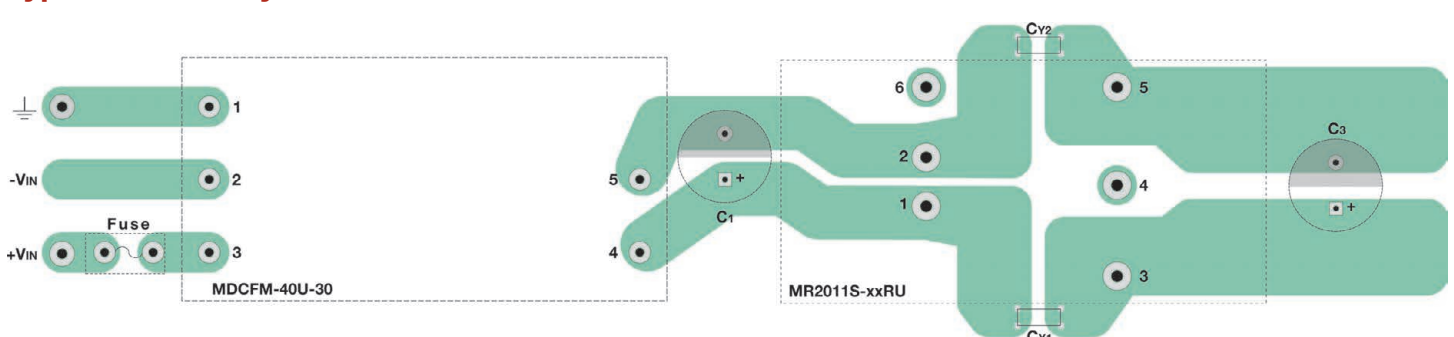
7. In many applications, simply adding input/output capacitors will enhance the input surge protection & and reduce output ripple sufficiently. In this case, capacitors C1 and C3 would be connected as shown, without the other filter components. Recommended capacitor values are given in the table above.

Vin (VDC)	Input Capacitor	Vout (VDC)	Output Capacitor
110	100 μF	5.0	470 μF
		12	220 μF
		15	220 μF
		24	100 μF

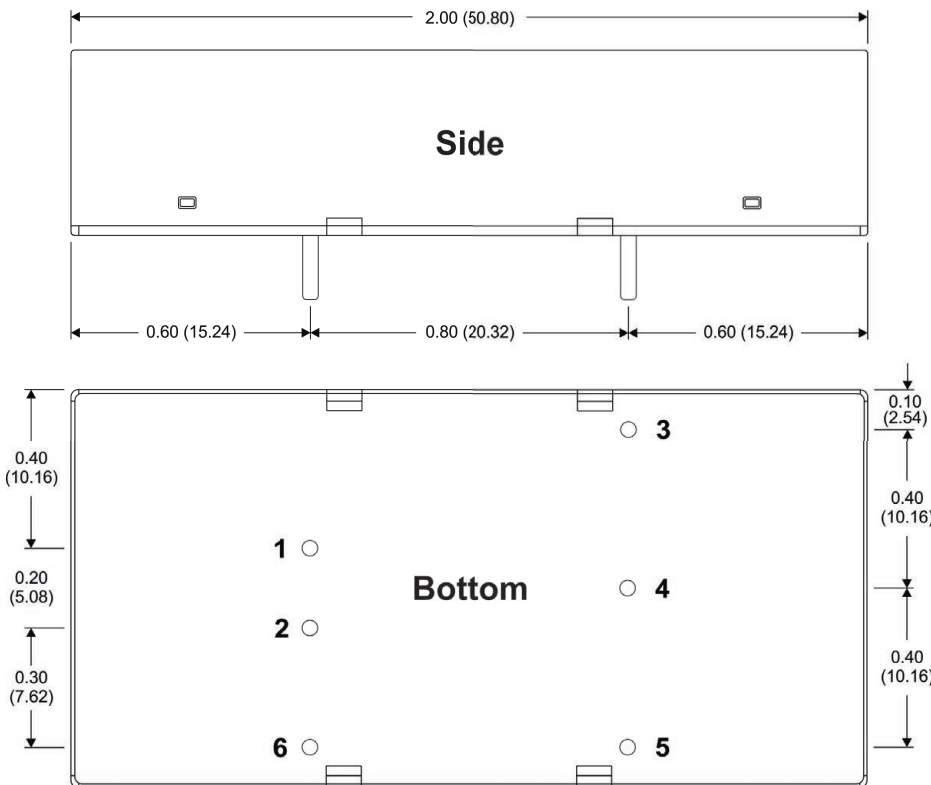
Typical Board Layout: With External Filter/Surge Components



Typical Board Layout: With External Filter Module



**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

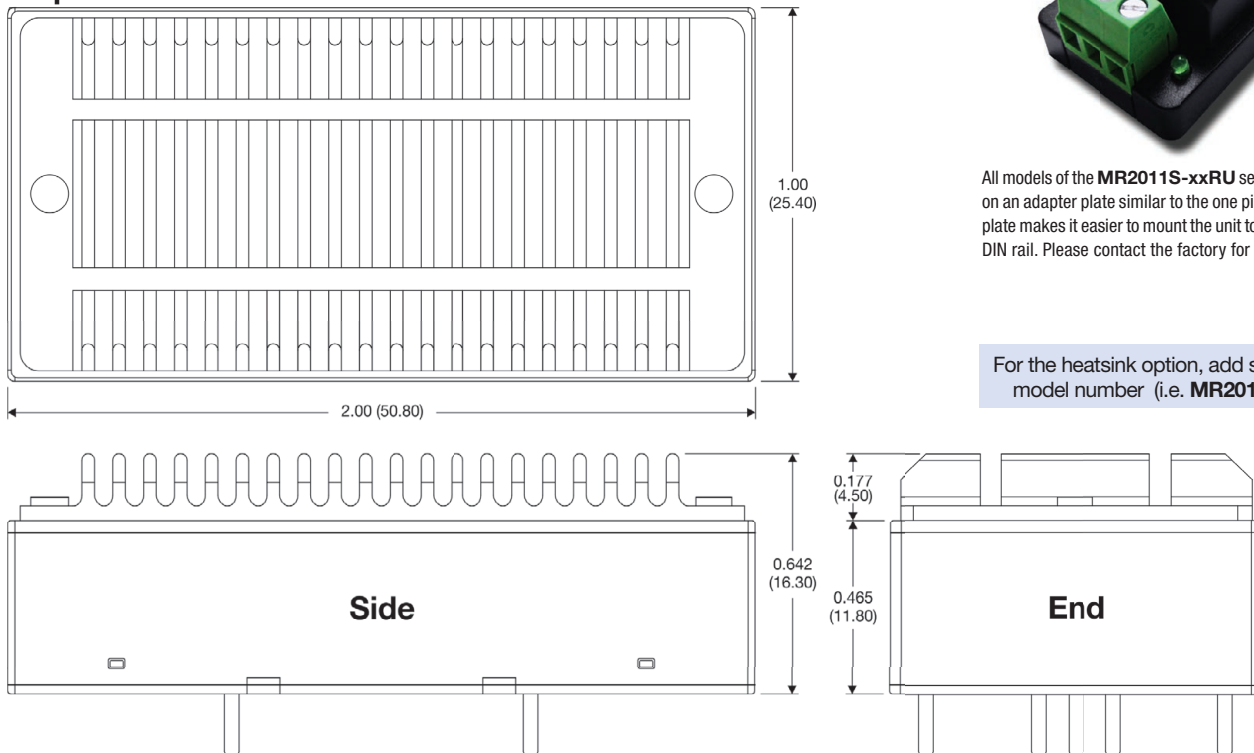
**Adapter Plate**



All models of the **MR2011S-xxRU** series are available mounted on an adapter plate similar to the one pictured above. The adapter plate makes it easier to mount the unit to a chassis or to a standard DIN rail. Please contact the factory for more information.

For the heatsink option, add suffix "H" to the model number (i.e. **MR2011S-05RU-H**)

**Mechanical Dimensions: With Optional Heatsink Top**



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**Notes:**

- All dimensions are typical in inches (mm)
- Tolerance x.xx = ±0.02 (±0.50)