

# FMD28-461 EMI Input Filters

## 28 VOLT INPUT – 7 AMP

### FEATURES

- Attenuation 50 dB at 500 kHz, minimum
- Operating temperature -55° to +125°C
- Nominal 28 volt input, 0 to 50 volt operation
- Transient rating to 100 volts current
- Compliant to MIL-STD-461C, CE03
- Compatible with MIL-STD-704 A-E 28 volt power bus



### DESCRIPTION

The Interpoint® FMD28 Series™ of EMI filters offers up to 7 amps of throughput current in a low profile package. The FMD28 filters are manufactured in our fully certified and qualified MIL-PRF-38534 Class H production facility and packaged in hermetically sealed steel cases. They are ideal for use in programs requiring high reliability and small size. The FMD28 filter is specifically designed to reduce the input line reflected ripple current of Interpoint high frequency DC-DC converters such as MFX, MTR, MWR, MHF+, MHV and MOR Series. One filter can be used with multiple converters up to the rated output current of the filter. These filters are intended for use in 28 volt applications which must meet MIL-STD-461C CE03 levels of conducted emissions.

### INPUT RIPPLE AND EMI

Switching DC-DC converters naturally generate two noise components on the power input line: differential noise and common mode noise. Input ripple current refers to both of these components. Differential noise occurs between the positive input and input common. Most Interpoint converters have an input filter that reduces differential noise which is sufficient for many applications. Common mode noise occurs across stray capacitances between the converter's power train components and the baseplate (bottom of the package) of the converter. See Figure 1 on page 2

Where low noise currents are required to meet CE03 of MIL-STD-461C a power line filters reduces the common mode and differential noise generated by the converters. FMD28-461 filters reduce input ripple current by a minimum of 50 dB at 500 kHz when used in conjunction with Interpoint DC-DC converters. Place the filter as close as possible to the converter for optimum performance. The baseplates of the filter and the converter should be connected with the shortest and widest possible conductors. See Figure 2 on page 2.

### TRANSIENTS

A transient of 100 volts for up to 100 ms with a 0.5 ohm source impedance will not damage the filter.

### OPERATION OVER TEMPERATURE

The FMD28-461 Series filters are rated for full power operation from -55°C to +125°C case temperature. Current is derated linearly to zero at +135°C case temperature.

### INSERTION LOSS

The maximum dc insertion loss at full load and nominal input voltage represents a power loss of 3%.

### PACKAGING

FMD28-461 filters are available in a standard, flanged down-leaded case shown in Figure 6 on page 6. Also available in a side-leaded case, Figure 7 on page 7.

# FMD28-461 EMI Input Filters

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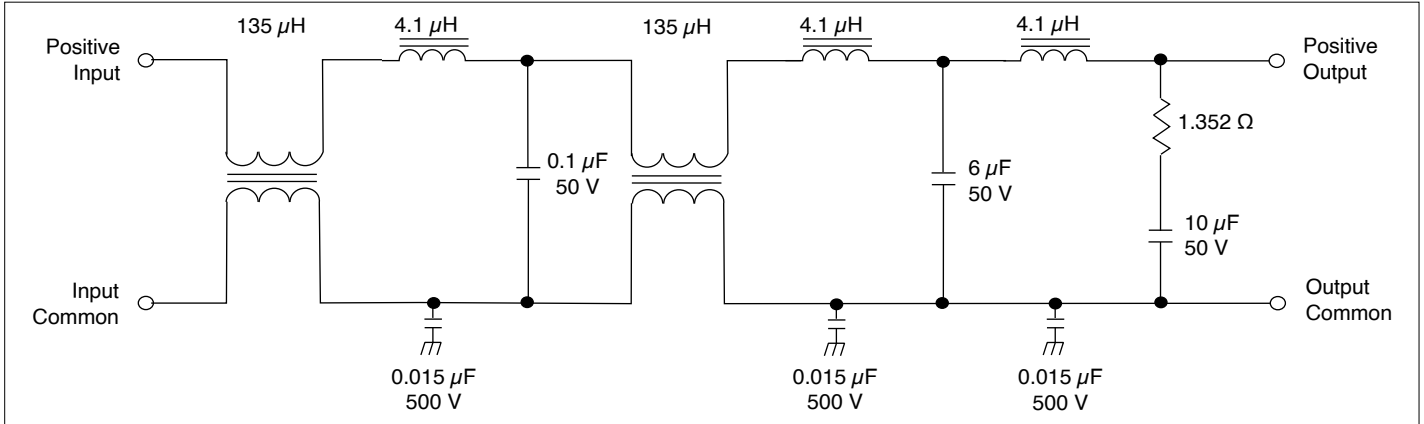


FIGURE 1: FMD28-461 BLOCK DIAGRAM

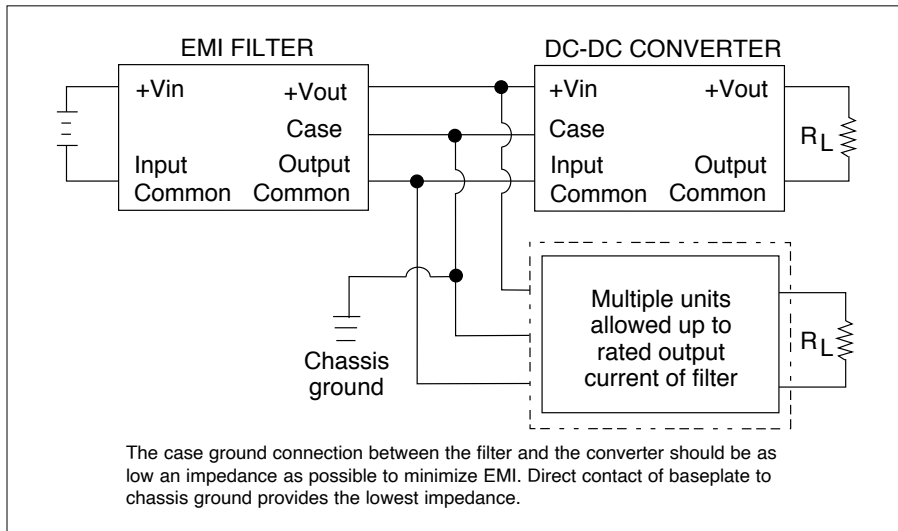


FIGURE 2: CONNECTION DIAGRAM

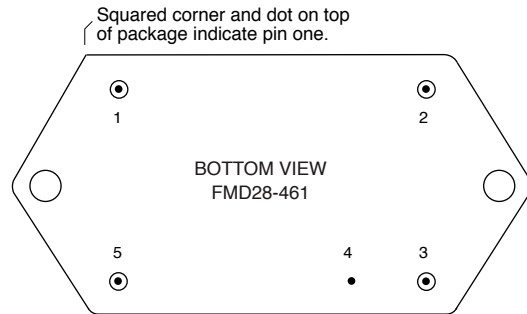
# FMD28-461 EMI Input Filters

## 28 VOLT INPUT – 7 AMP

Pin	FMD28-461
1	Positive Input
2	Positive Output
3	Output Common
4	Case Ground <sup>1</sup>
5	Input Common

Although the down-leaded packages can be connected to chassis ground with the case ground lead, direct contact of the base plate to chassis improves EMI performance.

TABLE 1: PIN OUT FMD28-461



See Figure 6 on page 6 for dimensions.

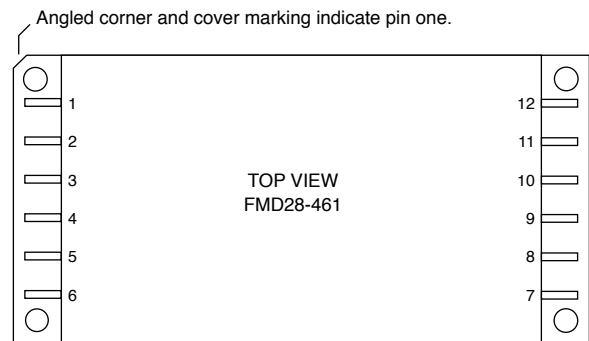
FIGURE 3: PIN OUT FMD28-461

Pin <sup>1</sup>	FMD28-461SL
1, 2, 3	Positive Input
4, 5, 6	Input Common
7, 8, 9	Output Common
10, 11, 12	Positive Output
—	Case Ground <sup>2</sup>

Notes

1. All pins must be connected.
2. The baseplate is the only case ground connection and should directly contact chassis ground.

TABLE 2: PIN OUT FMD28-461SL



See Figure 7 on page 7 for dimensions.

FIGURE 4: PIN OUT FMD28-461SL

# FMD28-461 EMI Input Filters

## 28 VOLT INPUT – 7 AMP

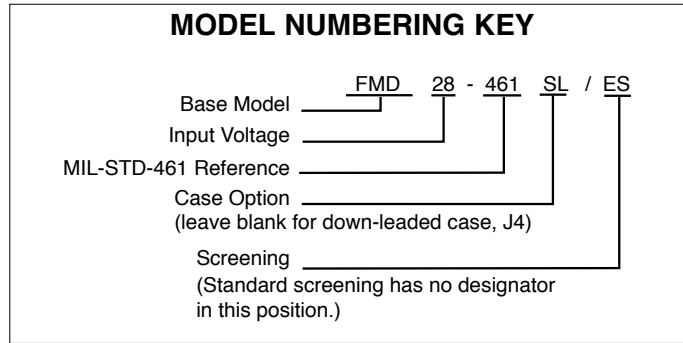


FIGURE 5: MODEL NUMBERING KEY

<b>MODEL NUMBER OPTIONS <sup>1</sup></b> <b>TO DETERMINE THE MODEL NUMBER</b> <b>ENTER ONE OPTION FROM EACH CATEGORY IN THE FORM BELOW.</b>			
CATEGORY	Base Model and Input Voltage	Case Option <sup>2</sup>	Screening <sup>3</sup>
<b>OPTIONS</b>	<b>FMD28-461</b>	(down-leaded case, J4, leave blank) SL (side-leaded case, U)	Standard (leave blank) /ES
<b>FILL IN FOR MODEL <sup>4</sup></b>	<b>FMD28-461</b>	_____	/ _____
<p>Notes:</p> <p>1. See Model Numbering Key above for an example of a model number.</p> <p>2. Case Options: Leave the case option blank for the standard, flanged, down-leaded case, Figure 6 on page 6. Use SL in the case option position for the side-leaded case, Figure 7 on page 7.</p> <p>3. Screening: For standard screening leave the screening option blank. For other screening options, insert the desired screening level. For more information see Table 6 on page 8.</p> <p>4. If ordering by model number add a "-Q" to request solder dipped leads (FMD28-461/ES-Q).</p>			

TABLE 3: MODEL NUMBER OPTIONS

# FMD28-461 EMI Input Filters

## 28 VOLT INPUT – 7 AMP

TABLE 4: OPERATING CONDITIONS 25°C CASE, 28 VIN, UNLESS OTHERWISE SPECIFIED

PARAMETER	CONDITIONS	FMD28-461			UNITS
		MIN	TYP	MAX	
LEAD SOLDERING TEMPERATURE <sup>1</sup>	10 seconds max.	—	—	300	°C
STORAGE TEMPERATURE <sup>1</sup>		-65	—	+150	°C
CASE OPERATING TEMPERATURE <sup>1</sup>	FULL POWER	-55	—	+125	°C
	ABSOLUTE	-55	—	+135	
DERATING OUTPUT POWER/CURRENT <sup>1</sup>	LINEARLY	From 100% at 125°C to 0% at 135°C			
ISOLATION, ANY PIN TO CASE EXCEPT CASE PIN	@ 500 VDC AT 25°C	100	—	—	Megohms

Note

1. Guaranteed by design and/or analysis. Not an in-line test.

TABLE 5: ELECTRICAL CHARACTERISTICS 25°C CASE, 28 VIN, UNLESS OTHERWISE SPECIFIED

PARAMETER	CONDITIONS	FMD28-461			UNITS
		MIN	TYP	MAX	
INPUT VOLTAGE	CONTINUOUS	0	28	50 <sup>1</sup>	V
	TRANSIENT 100 ms <sup>1, 2</sup>	-100	—	100	
NOISE REJECTION	500 kHz	50	60	—	dB
	1 MHz	45	55	—	
DC RESISTANCE (R <sub>DC</sub> )	T <sub>C</sub> = 25°C	—	—	0.12	Ω
CAPACITANCE <sup>1</sup>	ANY PIN TO CASE		20,000		pF
OUTPUT VOLTAGE	STEADY STATE	$V_{OUT} = V_{IN} - I_{IN} (R_{DC})$			V
OUTPUT CURRENT	STEADY STATE	—	—	7	A
POWER DISSIPATION <sup>1</sup>	T <sub>C</sub> = 25°C	—	—	6.0	W

Note

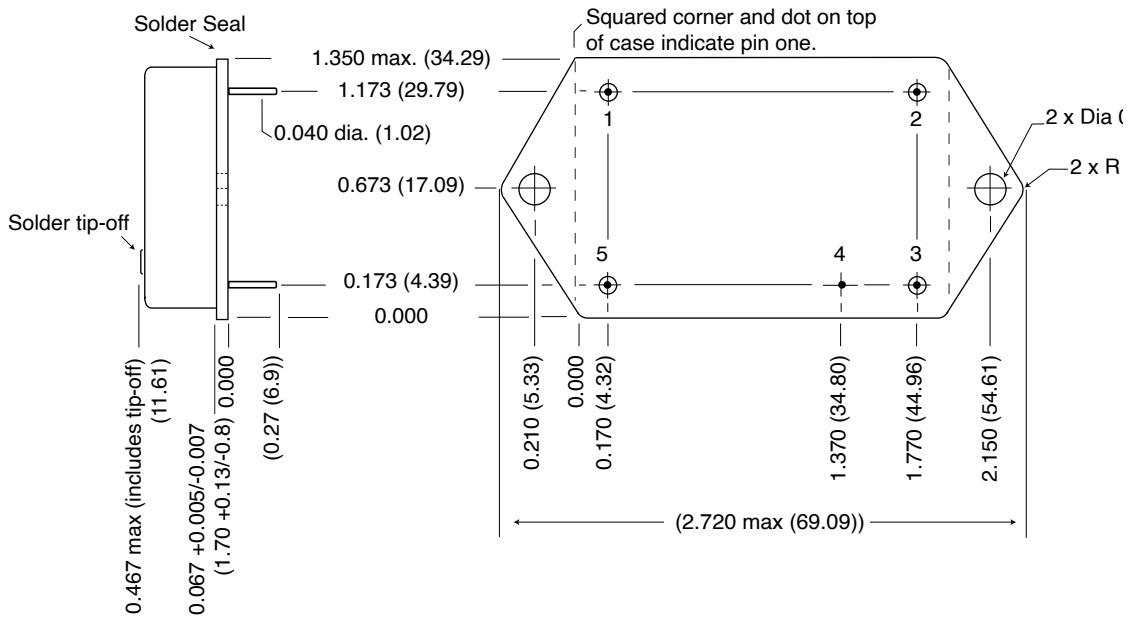
1. Guaranteed by design and/or analysis. Not an in-line test.

2. 0.5 ohm source impedance. The transient will not damage the filter but will be passed to the converter.

# FMD28-461 EMI Input Filters

## 28 VOLT INPUT – 7 AMP

### BOTTOM VIEW CASE J4



**Weight:** 55 grams typical

**Case dimensions in inches (mm)**

Tolerance  $\pm 0.005$  (0.13) for three decimal places  
 $\pm 0.01$  (0.3) for two decimal places  
 unless otherwise specified

**CAUTION**

Heat from reflow or wave soldering may damage the device. Solder pins individually with heat application not exceeding 300°C for 10 seconds per pin.

**Materials**

- Header Cold Rolled Steel/Nickel/Tin
- Cover Kovar/Nickel/Tin
- Pins #52 alloy/Gold compression glass seal.  
 Gold plating of 50 - 150 microinches included in pin diameter.  
 Seal Hole: 0.091  $\pm 0.002$  (2.31  $\pm 0.05$ )

Please refer to the numerical dimensions for accuracy.

FIGURE 6: CASE J4 - FMD28-461

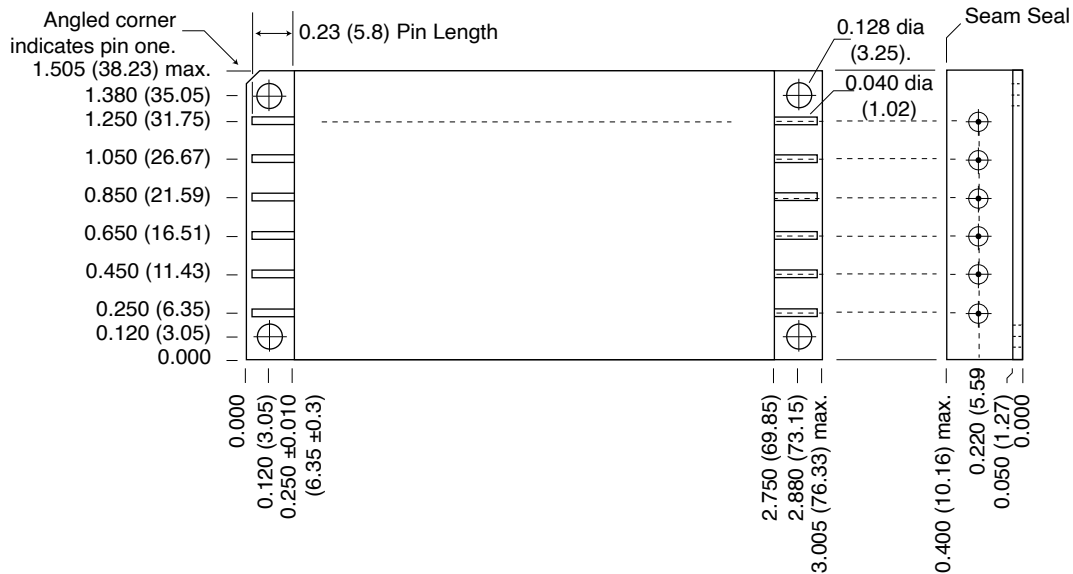
# FMD28-461 EMI Input Filters

## 28 VOLT INPUT – 7 AMP

### TOP VIEW CASE U

Flanged case, short leads

Case "U" does not require an option in the Case Option position of the model number.



**Weight:** 86 grams maximum

#### Case dimensions in inches (mm)

Tolerance  $\pm 0.005$  (0.13) for three decimal places  
 $\pm 0.01$  (0.3) for two decimal places  
 unless otherwise specified

#### CAUTION

Heat from reflow or wave soldering may damage the device. Solder pins individually with heat application not exceeding 300°C for 10 seconds per pin.

#### Materials

Header Cold Rolled Steel/Nickel/Gold  
 Cover Kovar/Nickel  
 Pins #52 alloy/Gold ceramic seal  
 Gold plating of 50 - 150 microinches is included in pin diameter  
 Seal Hole: 0.120  $\pm$ 0.002 (3.05  $\pm$ 0.05)

Please refer to the numerical dimensions for accuracy.

FIGURE 7: CASE U - FMD28-461SL

# FMD28-461 EMI Input Filters

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### ENVIRONMENTAL SCREENING DC-DC CONVERTERS AND EMI FILTERS STANDARD AND /ES <sup>1</sup>

TEST PERFORMED	STANDARD	/ES
<b>Pre-cap Inspection</b> Method 2017, 2032	■	■
<b>Temperature Cycle (10 times)</b> Method 1010, Cond. B, -55°C to +125°C, ambient		■
<b>Constant Acceleration</b> Method 2001, 500 g		■
<b>Burn-in Method 1015 <sup>2</sup></b> 96 hours		■
<b>Final Electrical Test MIL-PRF-38534, Group A</b> Subgroups 1 and 4: +25°C case	■	■
<b>Hermeticity Test</b>		
Gross Leak, Cond. C <sub>1</sub> , fluorocarbon		■
Fine Leak, Cond. A <sub>2</sub> , helium		■
Gross Leak, Dip	■	
<b>Final visual inspection</b> Method 2009	■	■

Test methods are referenced to MIL-STD-883 as determined by MIL-PRF-38534.

#### Notes

1. Standard and /ES products may not meet all of the requirements of MIL-PRF-38534.
2. Burn-in temperature designed to bring the case temperature to the maximum case temperature of the product. Refer to the specific product information for the maximum case temperature. Burn-in is a powered test.

TABLE 6: ENVIRONMENTAL SCREENING