

# FMD28-461 EMI Input Filters

## 28 VOLT INPUT – 7 AMP

### FEATURES

#### Attenuation to 50 dB at 500 kHz

- Operating temperature -55° to +125°C
- Nominal 28 V input, 0 to 50 V operation
- Transient rating to 100 V for 100 ms
- Up to 7 A throughput current
- Compliant to MIL-STD-461C, CE03
- Compatible with MIL-STD-704 A-E 28 VDC power bus



### DESCRIPTION

The FMD28 Series™ EMI filters are specifically designed to reduce the reflected input ripple current of Interpoint's high frequency DC/DC converters. FMD filters minimize electromagnetic interference (EMI) for the MOR, MFL, MTR, MHV, MHF+, MHF, MTO and MHE Series of converters. These filters are intended for use in 28 volt applications which must meet MIL-STD-461C CE03 levels of conducted emissions. One filter can be used with multiple converters up to the rated output current of the filter.

### 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.

Where low noise currents are required to meet CE03 of MIL-STD-461C a power line filter reduces the common mode and differential noise generated by the converters. FMD28-461 filters reduce input ripple current by as much as 50 dB at 500 kHz when used in conjunction with Interpoint's 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.

### TRANSIENTS

A transient of 100 V 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 less than 1.3%.

### PACKAGING

FMD28-461 filters are sealed in metal hermetic, down-leaded packages (case J4). Also available in a side-leaded package (case U).

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### OPERATING CONDITIONS AND CHARACTERISTICS

#### Input Voltage Range

- 0 to 50 VDC continuous
- Transient +100 V for 100 ms

#### Lead Soldering Temperature (10 sec per lead)

- 300°C

#### Storage Temperature Range (Case)

- -65°C to +150°C

#### Case Operating Temperature (T<sub>C</sub>)

- -55°C to +125°C full power
- -55°C to +135°C absolute

#### Derating Input/Output Current

- Linearly from 100% at 125°C to 0% at 135° C

#### Isolation

- 100 megohm minimum at 500 VDC

### MECHANICAL AND ENVIRONMENTAL

#### Size (maximum)

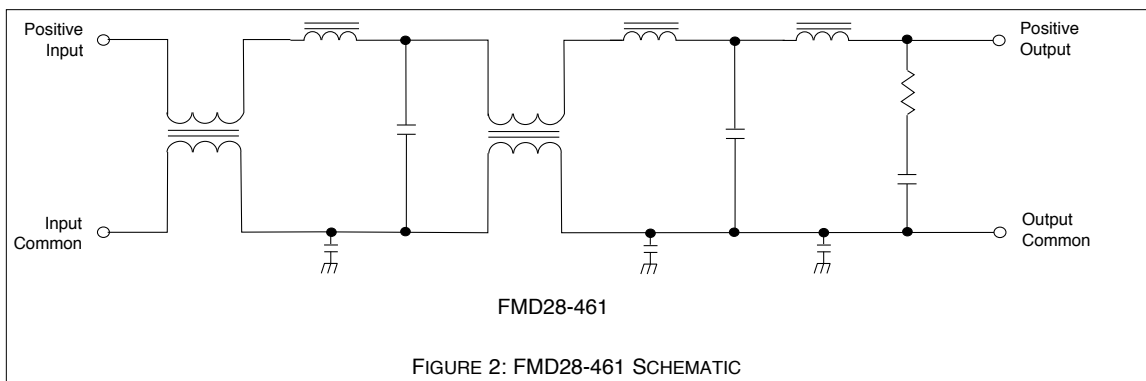
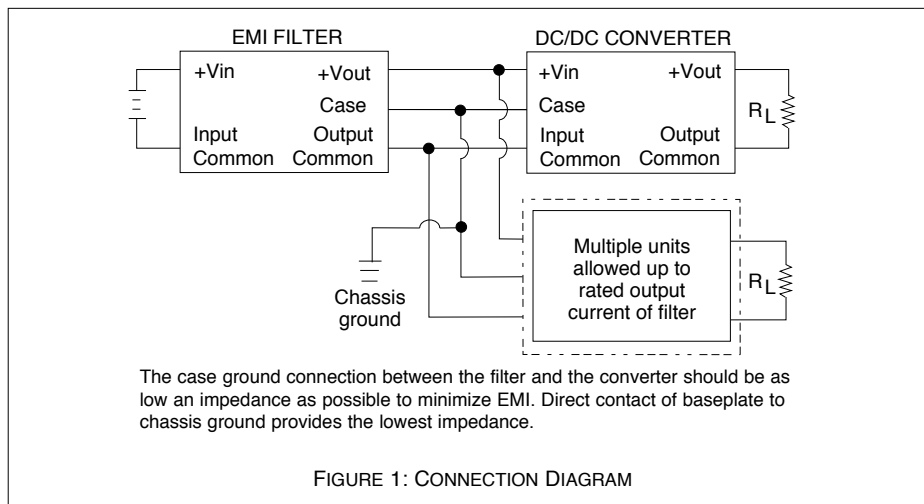
- Case J4, FMD28-461
  - 2.720 x 1.350 x 0.505 inches (69.09 x 34.29 x 12.83 mm)
  - Shown on page 1 in Case J4 (down-ledged).
- Case U, FMD28-461SL
  - 3.005 x 1.505 x 0.400 inches (76.33 x 38.23 x 10.16 mm)

#### Weight (maximum)

- Case J4: 55 grams typical
- Case U: 77 grams typical

#### Screening

FMD28 is offered with 125°C Standard and /ES, non-QML screening. See Standard and /ES (non-QML) screening tables for more information on page 8.



# FMD28-461 EMI Input Filters

## 28 VOLT INPUT – 7 AMP

### PIN OUT DOWN-LEADED MODEL

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

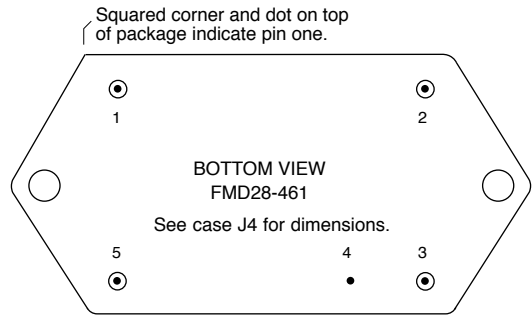


FIGURE 3: PIN OUT FMD28-461

**Note**

1. 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.

### PIN OUT SIDE-LEADED MODELS

Pin <sup>1</sup>	Designation
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>

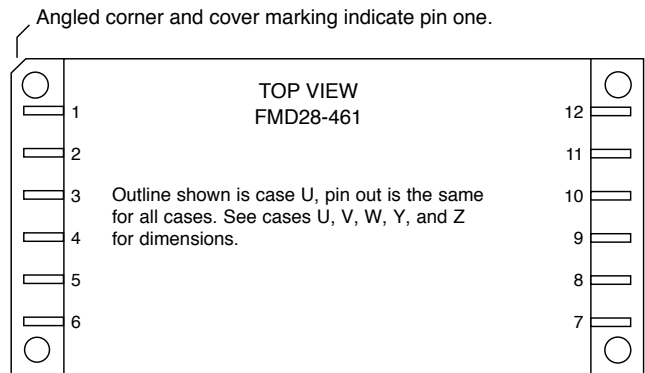


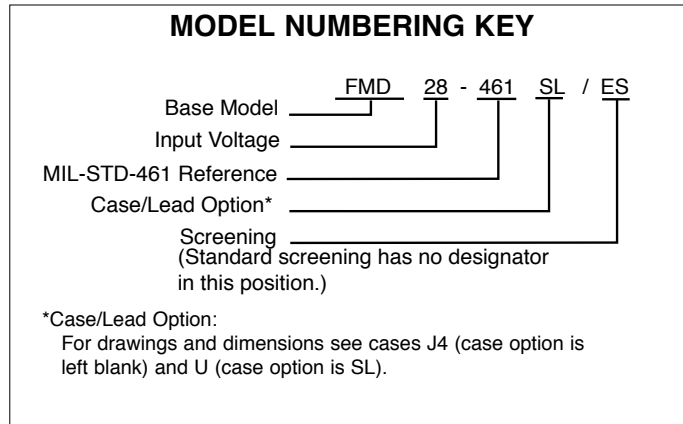
FIGURE 4: PIN OUT FMD28-461SL

**Notes**

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

# FMD28-461 EMI Input Filters

## 28 VOLT INPUT – 7 AMP



<b>MODEL SELECTION</b>					
ON THE LINES BELOW, ENTER ONE SELECTION FROM EACH CATEGORY TO DETERMINE THE MODEL NUMBER.					
CATEGORY	FMD28 BASE MODEL AND INPUT VOLTAGE	-461 MIL-STD-461 REFERENCE	_____ / CASE/LEAD OPTION <sup>1</sup>	/	_____ / SCREENING <sup>2</sup>
<b>SELECTION</b>	“FMD28” is the only available selection	“-461” is the only available selection	Down-leded (leave blank) SL (case U, side-leded)		Standard (leave blank) ES
Notes: 1. Case J4 is the standard, down-leded case. Leave the option blank for case J4. Refer to the case drawings on pages 6 and 7 for other case options. 2. Leave blank for standard screening. Use “ES” for “ES” screening. See the table on page 8 for more information.					

# FMD28-461 EMI Input Filters

## 28 VOLT INPUT – 7 AMP

Electrical Characteristics: 25°C T<sub>C</sub>, nominal V<sub>in</sub>, unless otherwise specified.

MODEL		FMD28-461			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	
INPUT VOLTAGE	CONTINUOUS	0	28	50 <sup>1</sup>	VDC
	TRANSIENT 100 ms <sup>1, 2</sup>	-100	—	100	V
NOISE REJECTION	500 KHZ	50	60	—	dB
	1 MHZ	45	55	—	
DC RESISTANCE (R <sub>DC</sub> ) AT MAXIMUM CURRENT <sup>1</sup>	T <sub>C</sub> = 25°C	—	—	0.12	Ω
	T <sub>C</sub> = 125°C	—	—	0.15	
CAPACITANCE <sup>1</sup>	ANY PIN TO CASE		20,000		pF
OUTPUT VOLTAGE	STEADY STATE	$V_{OUT} = V_{IN} - I_{IN} (R_{DC})$			VDC
OUTPUT CURRENT	STEADY STATE	—	—	7	A
POWER DISSIPATION AT MAXIMUM CURRENT <sup>1</sup>	T <sub>C</sub> = 25°C	—	—	6.0	W
	T <sub>C</sub> = 125°C <sup>1</sup>	—	—	7.4	

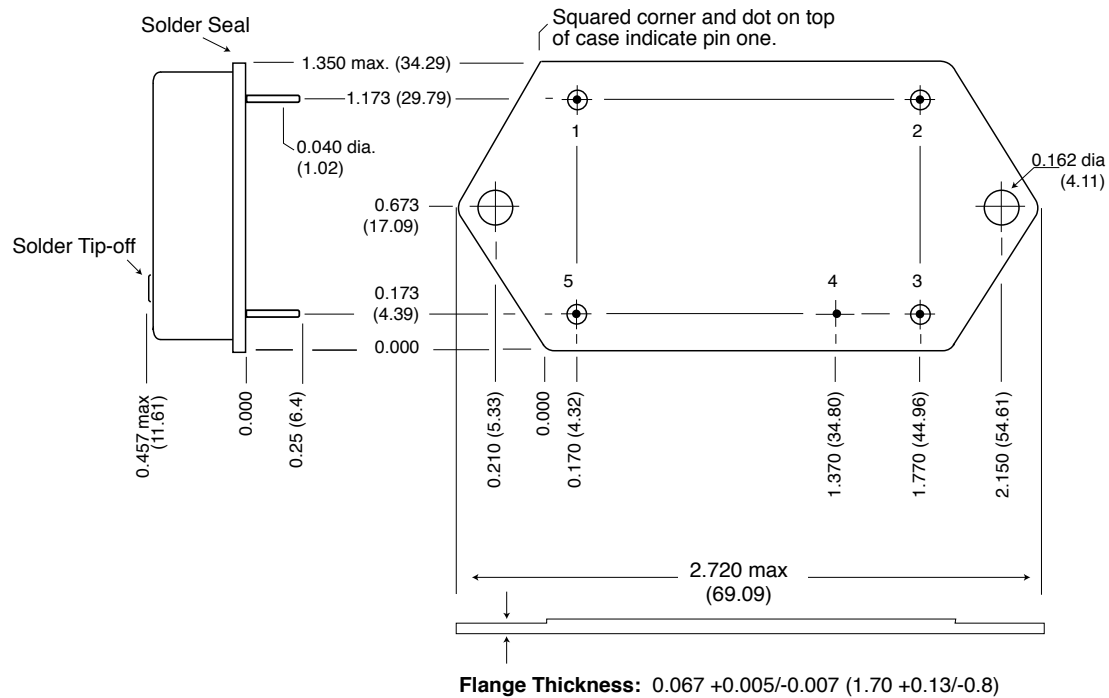
Note

1. Guaranteed by design, not tested.
2. 0.5 ohm source impedance

# FMD28-461 EMI Input Filters – Cases

## 28 VOLT INPUT – 7 AMP

### BOTTOM VIEW CASE J4



#### 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 compression glass seal.  
 Seal Hole: 0.091  $\pm$ 0.002 (2.31  $\pm$ 0.05)

Case J4 FMD, Rev F, 20091105

Please refer to the numerical dimensions for accuracy. All information is believed to be accurate, but no responsibility is assumed for errors or omissions. Interpoint reserves the right to make changes in products or specifications without notice. Copyright © 1999-2009 Interpoint Corp. All rights reserved.

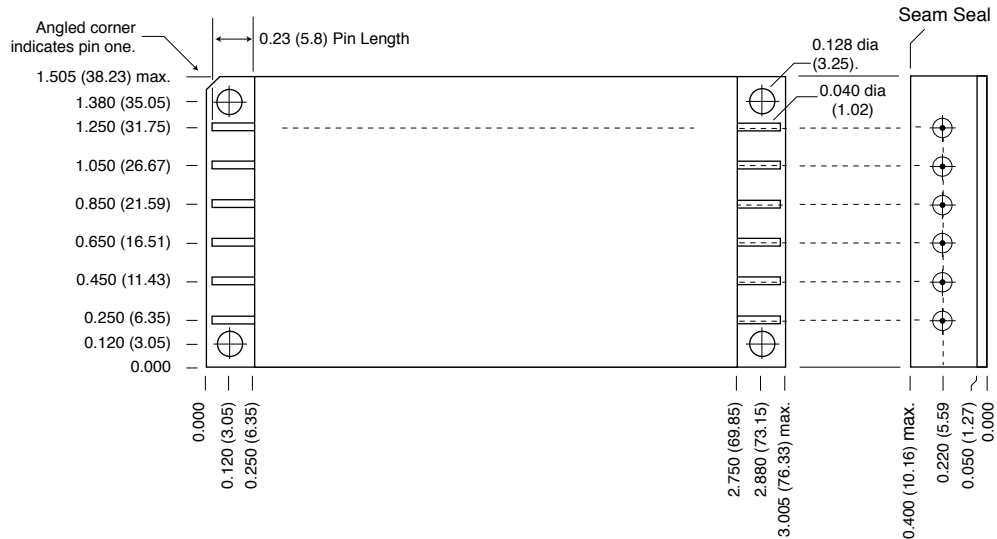
FIGURE 5: CASE J4 - FMD28-461

# FMD28-461 EMI Input Filters – Cases

## 28 VOLT INPUT – 7 AMP

### TOP VIEW CASE U\* Flanged case, short-leaded

\*Does not require designator in Case Option position of model number.



#### 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, compression glass seal  
 Seal Hole:  $0.100 \pm 0.002$  ( $2.54 \pm 0.05$ )

Case U, Rev E, 20100401

Please refer to the numerical dimensions for accuracy. All information is believed to be accurate, but no responsibility is assumed for errors or omissions. Interpoint reserves the right to make changes in products or specifications without notice.  
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FIGURE 6: CASE U - FMD28-461SL

# FMD28-461 EMI Input Filters

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### STANDARD AND /ES (NON-QML) PRODUCTS ENVIRONMENTAL SCREENING <sup>1</sup>

TEST PERFORMED	STANDARD NON-QML <sup>2</sup>	/ES NON-QML <sup>2</sup>
Pre-cap Inspection Method 2017, 2032	yes	yes
Temperature Cycle (10 times) Method 1010, Cond. B, -55°C to +125°C, ambient	no	yes
Constant Acceleration Method 2001, 500 g	no	yes
Burn-in Method 1015 <sup>3</sup> 96 hours	no	yes
Final Electrical Test MIL-PRF-38534, Group A Subgroups 1 and 4: +25°C case	yes	yes
Hermeticity Test Fine Leak, Method 1014, Cond. A Gross Leak, Method 1014, Cond. C Gross Leak, Dip (1 x 10 <sup>-3</sup> )	no no yes	yes yes no
Final visual inspection Method 2009	yes	yes

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

Notes:

1. Refers to products that do not offer QML screening.
2. Standard and /ES, non-QML products, do not meet all of the requirements of MIL-PRF-38534.
3. Burn-in 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.