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 filters 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_C)
- -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

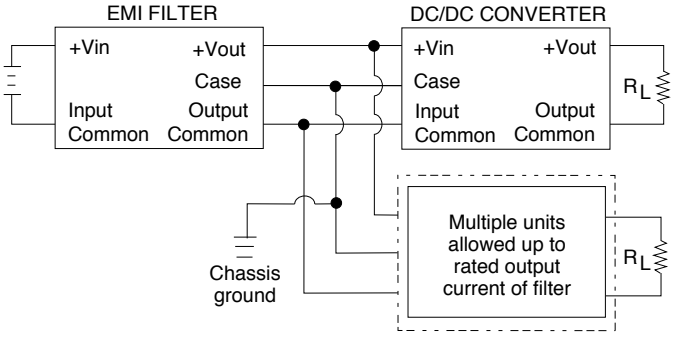
Isolation
- 100 megohm minimum at 500 VDC

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-leaded).
- Case U, FMD28-461SL
  3.005 x 1.505 x 0.400 inches (76.33 x 38.23 x 10.16 mm)

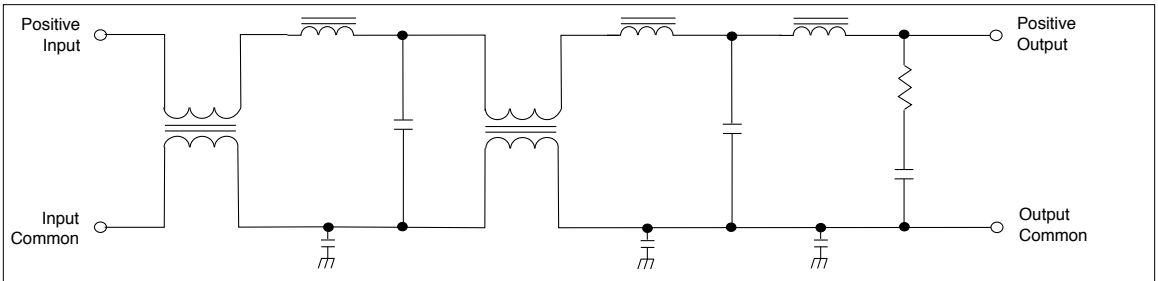
Weight (maximum)
- Case J4: 55 grams typical
- Case U: 77 grams typical

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.



The case ground connection between the filter and the converter should be as low an impedance as possible to minimize EMI. Direct contact of baseplate to chassis ground provides the lowest impedance.

FIGURE 1: CONNECTION DIAGRAM



FMD28-461

FIGURE 2: FMD28-461 SCHEMATIC

FMD28-461 EMI Input Filters

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PIN OUT DOWN-LEADED MODEL

Pin	Designation
1	Positive Input
2	Positive Output
3	Output Common
4	Case Ground [1]
5	Input Common

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.

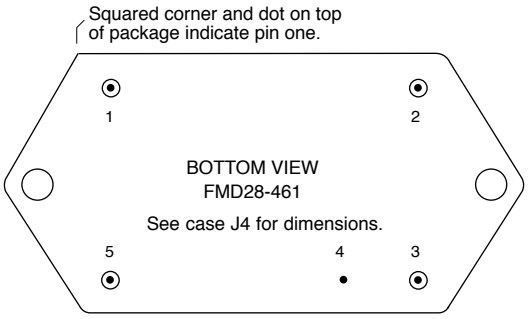


FIGURE 3: PIN OUT FMD28-461

PIN OUT SIDE-LEADED MODELS

Pin [1]	Designation
1, 2, 3	Positive Input
4, 5, 6	Input Common
7, 8, 9	Output Common
10, 11, 12	Positive Output
—	Case Ground [2]

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

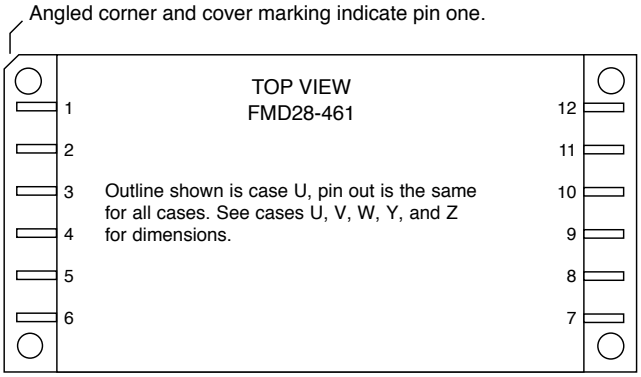
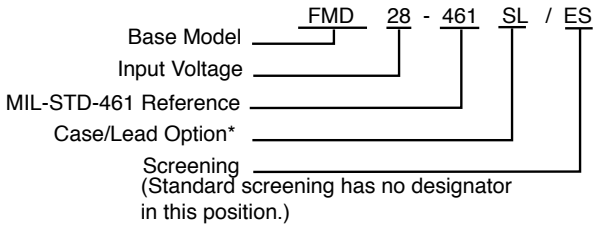


FIGURE 4: PIN OUT FMD28-461SL

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MODEL NUMBERING KEY



*Case/Lead Option:
For drawings and dimensions see cases J4 (case option is left blank) and U (case option is SL).

MODEL SELECTION

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 [1]	/	_____ SCREENING [2]
SELECTION	"FMD28" is the only available selection	"-461" is the only available selection	Down-leaded (leave blank) SL (case U, side-leaded)		Standard (leave blank) ES

Notes:
1. Case J4 is the standard, down-leaded 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.

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Electrical Characteristics: 25°C T_C, nominal Vin, unless otherwise specified.

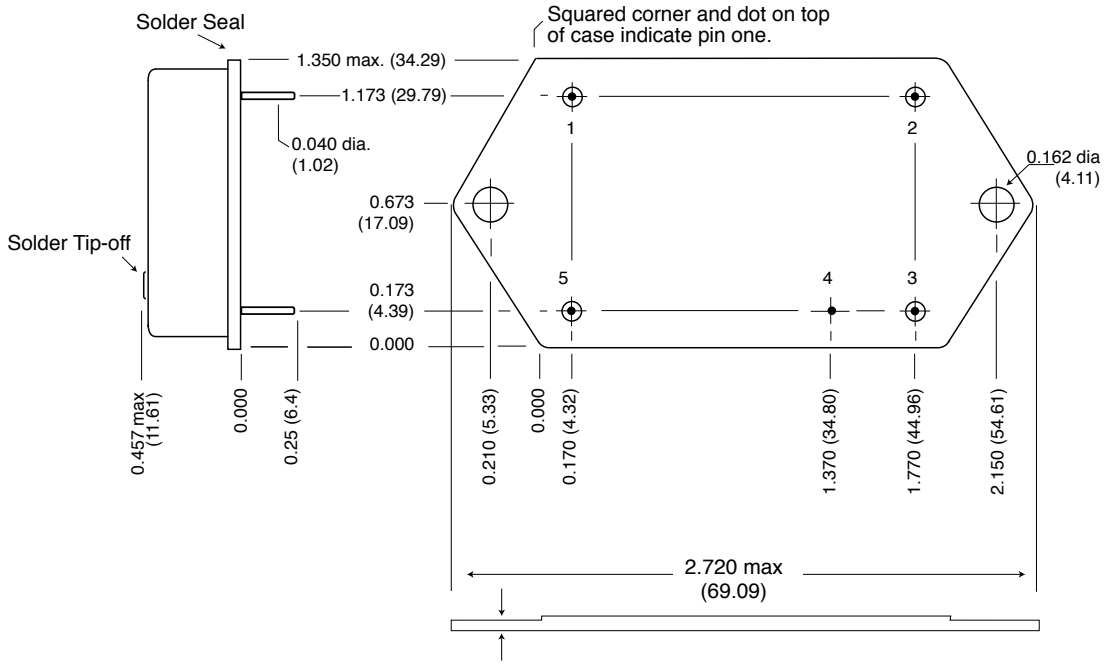
MODEL		FMD28-461			
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
INPUT VOLTAGE	CONTINUOUS	0	28	50 [1]	VDC
	TRANSIENT 100 ms [1, 2]	-100	—	100	V
NOISE REJECTION	500 KHz	50	60	—	dB
	1 MHz	45	55	—	
DC RESISTANCE (R_{DC}) AT MAXIMUM CURRENT [1]	T_C = 25°C	—	—	0.12	Ω
	T_C = 125°C	—	—	0.15	
CAPACITANCE [1]	ANY PIN 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 [1]	T_C = 25°C	—	—	6.0	W
	T_C = 125°C [1]	—	—	7.4	

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

FMD28-461 EMI Input Filters – Cases

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BOTTOM VIEW CASE J4



Flange Thickness: 0.067 +0.005/-0.007 (1.70 +0.13/-0.8)

Case dimensions in inches (mm)
Tolerance ±0.005 (0.13) for three decimal places
±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 ±0.002 (2.31 ±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.
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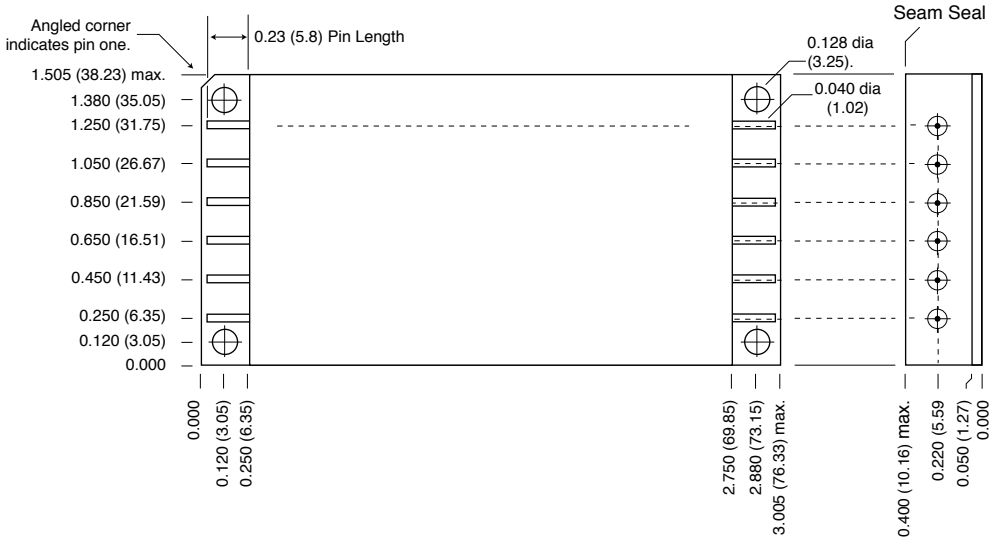
FIGURE 5: CASE J4 - FMD28-461

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 ±0.005 (0.13) for three decimal places
±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 ±0.002 (2.54 ±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

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STANDARD AND /ES (NON-QML) PRODUCTS ENVIRONMENTAL SCREENING [1]

TEST PERFORMED	STANDARD NON-QML[2]	/ES NON-QML[2]
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 [3] 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^{-3})	 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.

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