

# SFMC28-461 EMI Input Filters

## 28 VOLT INPUT – 2.7 AMP

### FEATURES

- Attenuation 60 dB at 500 kHz, typical
- Operating temperature -55° to +125°C
- Qualified to MIL-PRF-38534 Class H and K
- Passive components used for maximum tolerance in space environments
- Nominal 28 V input, 0 V to 50 V operation
- Up to 2.7 A throughput current
- Compliant to MIL-STD-461C CE-03
- Compatible with MIL-STD-704 B-E 28 V power bus



SFCS28-461	
INPUT (V)	CURRENT (A)
28	2.7

### DESCRIPTION

The SFMC28-461™ EMI filters provide an off-the-shelf filtering solution compliant to MIL-PRF-38534, Class H or Class K, for use in your space system. SFMC28-461 filters reduce the input line reflected ripple current of our switching DC-DC converters. Use an SFMC28-461 filter with our SMTR, SMHF and SMSA series of DC-DC converters to meet MIL-STD-461C levels of conducted emission (CE01, CE03). The SFMC filters are designed exclusively with passive components providing maximum tolerance for space environments.

### SCREENING

The SFMC28-461 EMI filters offer environmental screening levels to Space Prototype (O), Class H, or Class K requirements. Radiation tolerant to Radiation Hardness Assurance (RHA) levels of “-” (O) or “H”, per MIL-PRF-38534. Interpoint model numbers use an “O” in the RHA designator position to indicate the “-” (dash) Radiation Hardness Assurance level of MIL-PRF-38534, which is defined as “no RHA”. See Table 6 on page 8 and Table 7 on page 9 for more information.

### RIPPLE REDUCTION

The SFMC28-461 EMI filter, when used with Interpoint's converters, reduces reflected input ripple current by a minimum of 55 dB at 500 kHz and 60 dB at 1 MHz. The filter and converter combination performance exceeds the CE03 requirements of MIL-STD-461C.

### INSERTION LOSS

The maximum DC insertion loss for the SFMC28-461 filter (at a load of 22 watts) represents a power loss of less than 2% at nominal input voltage.

### FILTER DESIGN

SFMC28-461 filters incorporate thick-film hybrid technology and use only high quality ceramic capacitors for reliable high temperature operation.

All SFMC28-461 filters are built to the same assembly drawing regardless of environmental screening or radiation tolerance level. Filters designated level OO, indicating standard environmental screening, are electrically comparable to filters designated level KH, the highest environmental screening level. This ensures consistency between your prototype or test system using level OO filters and your flight system using filters with higher levels of environmental screening and radiation tolerance. Element evaluation (screening at the component level) of Class H or Class K filters ensures even greater reliability. See Table 6 on page 8 and Table 7 on page 9 for more information.

### OPERATING TEMPERATURE

The filter operates at full load over the temperature range of -55°C to +125°C case. Above +125°C, the current must be derated as specified on page two.

### PACKAGING

SFMC28-461 EMI filters are encased in high-reliability, hermetically-sealed metal packages and weigh just 48 grams. A small footprint of 2.100 Inches (53.34 mm) by 1.115 inches (28.32 mm) by 0.400 inches (10.16 mm) minimizes the board area needed for the filter.

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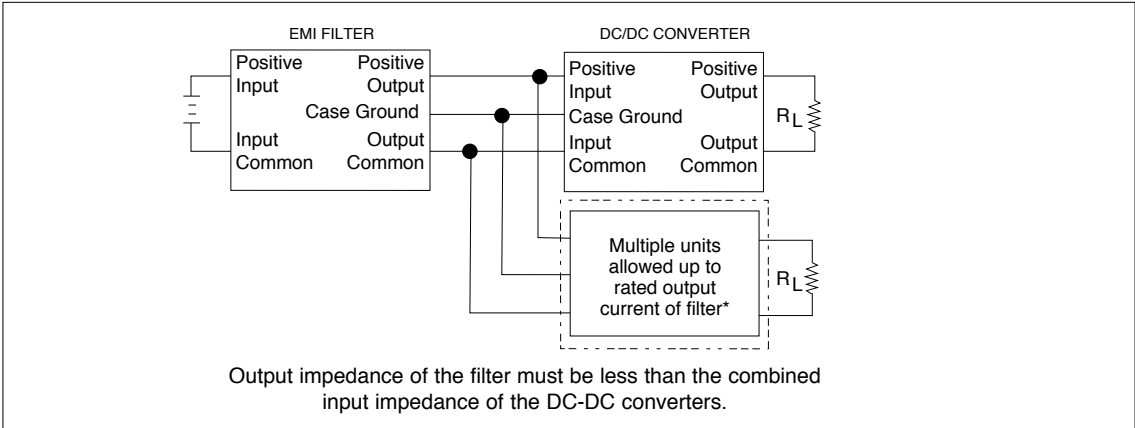
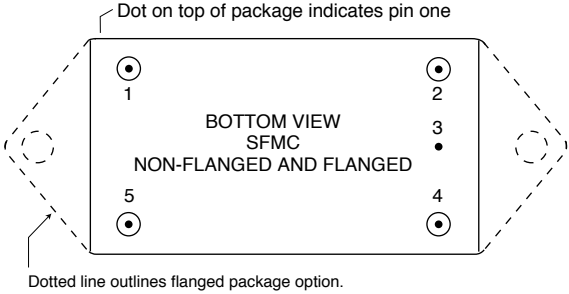


FIGURE 1: Connection Diagram

PIN OUT	
Pin	Designation
1	Positive Input
2	Positive Output
3	Case Ground
4	Output Common
5	Input Common

TABLE 1: Pin Out



See Figure 7 on page 6 and Figure 8 on page 7 for dimensions.

FIGURE 2: PIN OUT

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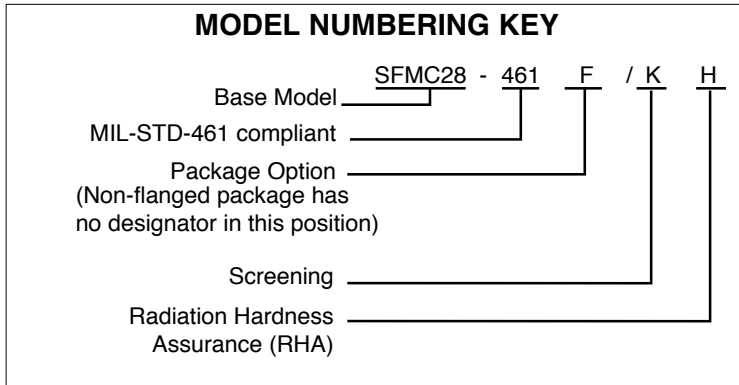


FIGURE 3: MODEL NUMBERING KEY

DLA NUMBERS	
DLA DRAWING (5915)	SFMC28-461 SIMILAR PART
94010H02HXC	SFMC28-461/HH
94010H02HZC	SFMC28-461F/HH
94010H02HXC	SFMC28-461/KH
94010H02HZC	SFMC28-461F/KH
For exact specifications for a DLA product, refer to the DLA drawing. DLA drawings can be downloaded from: <a href="https://landandmaritimeapps.dla.mil/programs/smcr/">https://landandmaritimeapps.dla.mil/programs/smcr/</a>	

TABLE 2: DLA Cross Reference

<b>MODEL SELECTION</b>				
ON THE LINES BELOW, ENTER ONE SELECTION FROM EACH CATEGORY TO DETERMINE THE MODEL NUMBER.				
CATEGORY	SFMC28-461 Base Model and Input Voltage	_____ / _____ Case Option <sup>1</sup>	/ _____ Screening <sup>2</sup>	_____ RHA <sup>3</sup>
SELECTION	SFMC28-461 is the only available selection	(Standard, leave blank) F (flanged)	O H K	O H
Notes: 1. Case Options: For the standard case, Figure 7 on page 6, leave the case option blank. For the flanged case option, Figure 8 on page 7, insert the letter F in the Case Option position. 2. Screening: A screening level of O is a Space Prototype and is only used with RHA O. See Table 6 on page 8 and Table 7 on page 9 for more information. "H" indicates Class H and "K" indicates Class K of MIL-PRF-38534. 4. RHA: Interpoint model numbers use an "O" in the RHA designator position to indicate the "-" (dash) Radiation Hardness Assurance level of MIL-PRF-38534, which is defined as "no RHA." RHA O is only available with Screening level O. See Table 7 on page 9 for more information.				

TABLE 3: Model Number Options

# SFMC28-461 EMI Input Filters

## 28 VOLT INPUT – 2.7 AMP

TABLE 4: OPERATING CONDITIONS: 28 VIN, UNLESS OTHERWISE SPECIFIED.

PARAMETER	CONDITIONS	SFMC28-461			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	FULL POWER	-55	–	+125	°C
	ABSOLUTE <sup>1</sup>	-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

## Notes

1. Guaranteed by characterization test and/or analysis. Not a production test.

TABLE 5: ELECTRICAL CHARACTERISTICS: -55 TO +125°C CASE, 28 VIN, UNLESS OTHERWISE SPECIFIED.

MODEL	PARAMETER	CONDITIONS	SFMC28-461			UNITS
			MIN	TYP	MAX	
	INPUT VOLTAGE	CONTINUOUS	0	28	50	V
	NOISE REJECTION	500 kHz	55	60	–	dB
		1 MHz	60	–	–	
		5 MHz	55	–	–	
	DC RESISTANCE (R <sub>DC</sub> )	T <sub>C</sub> = 25°C	–	–	0.2	Ω
	OUTPUT VOLTAGE <sup>2</sup>	STEADY STATE	$V_{OUT} = V_{IN} - I_{IN} (R_{DC})$			V
	CAPACITANCE	ANY PIN TO CASE EXCEPT CASE PIN	–	–	48,000	pF
	T <sub>C</sub> = 25°C					
	OUTPUT CURRENT	STEADY STATE	–	–	2.7	A
	REFLECTED RIPPLE CURRENT <sup>1</sup>	FROM CONVERTER TO FILTER	–	–	1.0	A <sub>RMS</sub>
	POWER DISSIPATION <sup>1</sup>	T <sub>C</sub> = 25°C	–	–	1.5	W

## Notes

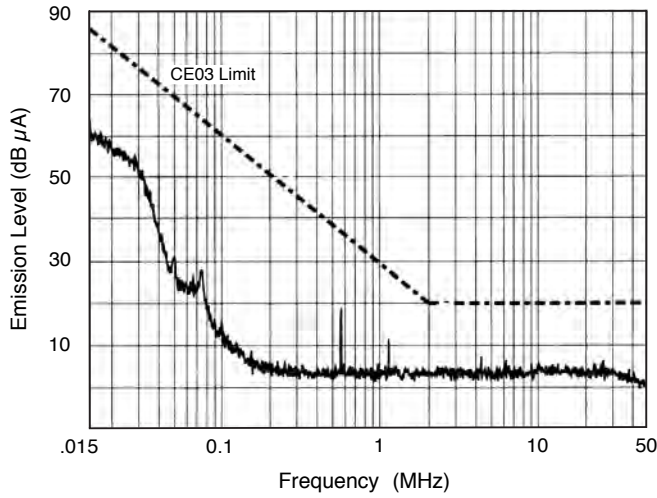
1. Guaranteed by characterization test and/or analysis. Not a production test.

2. Typical applications result in V<sub>out</sub> within 2% of V<sub>in</sub>.

# SFMC28-461 EMI Input Filters

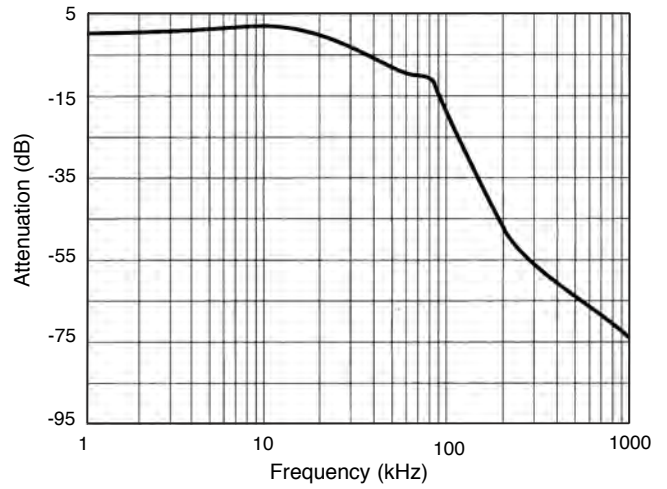
## 28 VOLT INPUT – 2.7 AMP

TYPICAL PERFORMANCE PLOTS: 25°C CASE, 28 VIN, 100% LOAD, FREE RUN, UNLESS OTHERWISE SPECIFIED.  
FOR REFERENCE ONLY, NOT GUARANTEED SPECIFICATIONS.



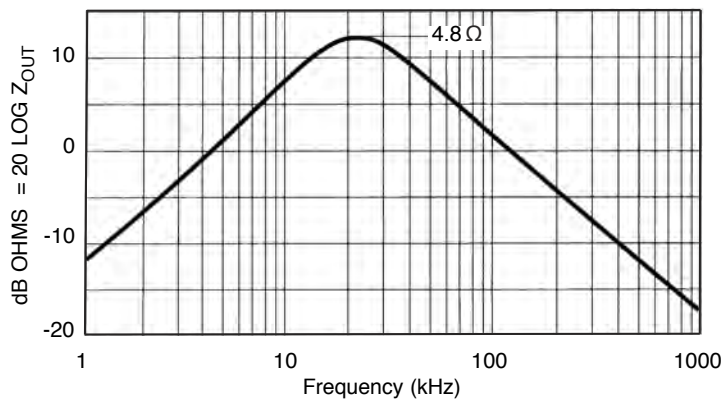
DC-DC Converter Typical Worst Case EMI With SFMC28-461 Filter

FIGURE 4



SFMC28-461 Typical Amplitude Response vs. Frequency

FIGURE 5



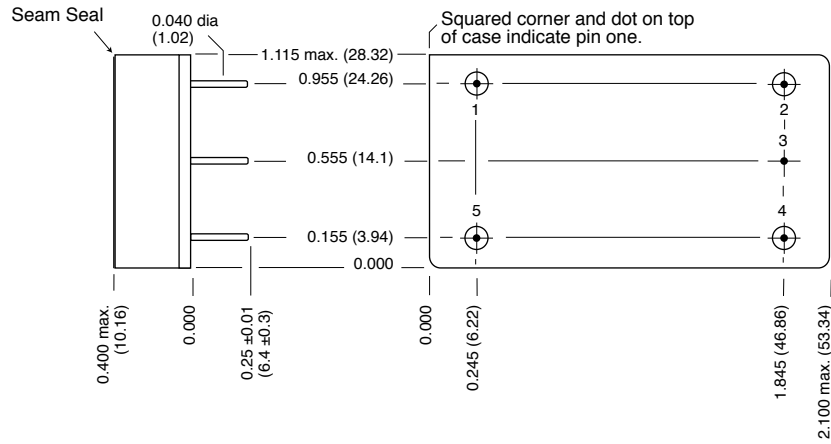
Typical Output Impedance (Z) With Input Shorted

FIGURE 6

# SFMC28-461 EMI Input Filter Cases

## 28 VOLT INPUT – 2.7 AMP

BOTTOM VIEW CASE H1



**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  
 Seal hole 0.120  $\pm 0.002$  (3.05  $\pm 0.05$ )

Please refer to the numerical dimensions for accuracy.

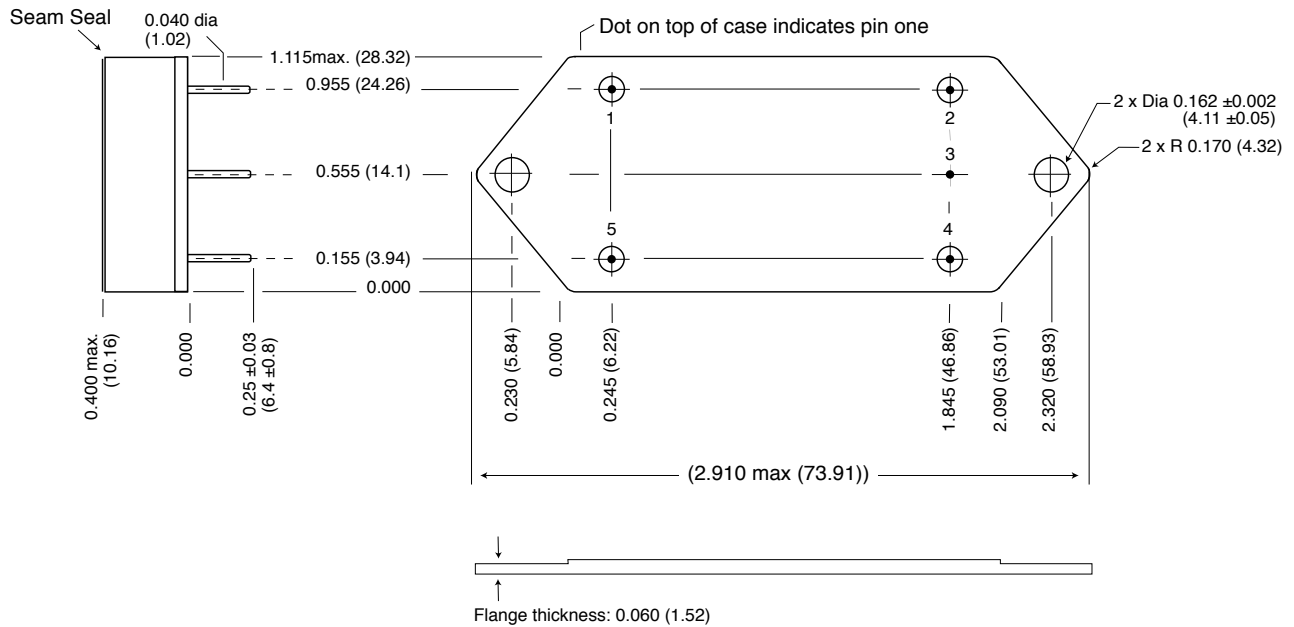
FIGURE 7: CASE H1

# SFMC28-461 EMI Input Filter Cases

## 28 VOLT INPUT – 2.7 AMP

### BOTTOM VIEW CASE K2

Flanged cases: Designator "F" required 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, ceramic seal.  
 Seal Hole: 0.120 ±0.002 (3.04 ±0.05)

Please refer to the numerical dimensions for accuracy.

FIGURE 8: CASE K2

# SFMC28-461 EMI Input Filters

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### ELEMENT EVALUATION SPACE EMI FILTERS PROTOTYPE, CLASS H AND CLASS K

COMPONENT-LEVEL TEST PERFORMED	NON-QML <sup>1</sup>	QML	
	PROTOTYPE	CLASS H	CLASS K
	/O	/H	/K
		P <sup>2</sup>	P <sup>2</sup>
Element Electrical	■	■	■
Visual		■	■
Temperature Cycling			■
Constant Acceleration			■
Voltage Conditioning Aging			■
Visual Inspection			■
Final Electrical		■	■

#### Notes

1. Non-QML products may not meet all of the requirements of MIL-PRF-38534.
2. P = Passive components, Class H and K element evaluation.

#### Definitions

Element Evaluation: Component testing/screening per MIL-STD-883 as determined by MIL-PRF-38534

TABLE 6: ELEMENT EVALUATION



# SFMC28-461 EMI Input Filters

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### ENVIRONMENTAL SCREENING SPACE EMI FILTERS PROTOTYPE, CLASS H AND CLASS K, MIL-PRF-38534 AND RHA<sup>1</sup>

TEST PERFORMED	NON-QML <sup>2</sup>	QML <sup>3</sup>	
	PROTOTYPE <sup>4</sup>	CLASS H	CLASS K
	/OO <sup>5</sup>	/HH <sup>5</sup>	/KH <sup>5</sup>
<b>Pre-cap Inspection, Method 2017, 2032</b>	■	■	■
<b>Temperature Cycle (10 times)</b> Method 1010, Cond. C, -65°C to +150°C, ambient	■	■	■
<b>Constant Acceleration</b> Method 2001, 3000 g	■	■	■
<b>PIND, Test Method 2020, Cond. A</b>		■ <sup>6</sup>	■
<b>Pre burn-in test, Group A, Subgroups 1 and 4</b>	■	■	■
<b>Burn-in Method 1015, +125°C case, typical<sup>7</sup></b>			
96 hours	■		
160 hours		■	
2 x 160 hours (includes mid-BI test)			■
<b>Final Electrical Test, MIL-PRF-38534, Group A,</b>			
Subgroups 1 and 4: +25°C case	■		
Subgroups 1 through 6, -55°C, +25°C, +125°C case		■	■
<b>Hermeticity Test, Method 1014</b>			
Gross Leak, Cond. B <sub>2</sub> , Kr85			■
Gross Leak, Cond. C <sub>1</sub> , fluorocarbon	■	■	
Fine Leak, Cond. B <sub>1</sub> , Kr85			■
Fine Leak, Cond. A <sub>2</sub> , helium	■	■	
<b>Radiography, Method 2012</b>			■
<b>Post Radiography Electrical Test, +25°C case</b>			■ <sup>6</sup>
<b>Final visual inspection, Method 2009</b>	■	■	■
<b>Radiation tolerant<sup>1, 8</sup></b>			
Passive components, radiation tolerant by design		■	■

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

#### Notes

- Our Redmond facility has a DLA approved RHA plan for Interpoint power products.
- Non-QML products prototype, A and B may not meet all of the requirements of MIL-PRF-38534.
- All processes are QML qualified and performed by certified operators.
- "O" in the RHA designator position in Interpoint model numbers indicates DLA RHA "-" defined as no RHA.
- Our EMI filters are designed exclusively with passive components providing maximum tolerance for space environment requirements.
- Not required by DLA but performed to assure product quality.
- Burn-in temperature designed to bring the case temperature to +125°C minimum. Burn-in is a powered test.
- Interpoint EMI filters are designed exclusively with passive components providing maximum tolerance for space environment requirements.

TABLE 7: ENVIRONMENTAL SCREENING