

# FM-704A HP EMI Input Filter and Transient Suppression Module

## 28 VOLT INPUT – 160 WATT

### FEATURES

#### Active transient suppression

#### Undervoltage lockout

- Up to 60 dB attenuation at 500 kHz
- Operating temperature -55° to +125°C
- Nominal 28 V input, 16 V to 40 V operation
- Inhibit function
- Compliant to MIL-STD-461A - F



#### MODEL

FM-704A HP	160 WATT
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### DESCRIPTION

The Interpoint™ FM-704A HP™ EMI Filter and Transient Suppression Module combines EMI filtering and transient protection to handle the demanding requirements of military, aerospace and industrial applications. As an EMI filter the FM-704A HP filter reduces the reflected ripple current from DC/DC switching converters. As a protection module, it suppresses input transients on the power bus to protect the converter and other downstream components.

### MIL-STD NOISE MANAGEMENT

When used in conjunction with Interpoint converters, the FM-704A HP EMI filter reduces reflected input ripple current by a minimum of 60 dB at 500 kHz and 55 dB at 1 MHz (see Electrical Characteristics table on page 5 and Figures on page 6). This attenuation gives the converter/filter combination performance exceeding MIL-STD-461C's CE03 test. Although the FM-704A HP filter effectively attenuates the ripple generated by switching converters, it will not suppress RF applied to its input terminals.

### TEMPERATURE OPERATION

FM-704A HP filters are rated to operate from -55°C to +125°C baseplate temperature. To meet MIL-STD-1275A and MIL-STD-704A requirements, derate output power linearly from 160 watts at 105°C to 80 watts at 125°C. See Figure 9.

### PROTECTION

To provide protection for itself and converters, the FM-704A HP filter blocks transients as required by the following standards:

- MIL-STD-704A
- MIL-STD-461 A-F
- MIL-STD-1275

Refer to the Electrical Characteristics table on the page 5 for more information.

Reverse polarity spikes of up to 100 V will not damage the filter, however the spikes will not be blocked by the filter.

### INTERNAL POWER DISSIPATION

To keep internal power dissipation to safe operating levels, the input current should never exceed 10 amps at 16 Vin or 4 amps at 40 Vin. When the FM-704A HP filter is used with PWM (Pulse Width Modulated) converters, Iline will vary as Power / Vline and 10 amps maximum at 16 Vin will reduce to approximately 4 amps maximum at 40 Vin. The maximum value allowed may be less than 4 amps as determined by line transients and the safe operating area of Figure 9.

Figure 9 illustrates the maximum allowed internal dissipation for the FM-704A HP filter. To calculate watts dissipated, subtract 40 volts from the transient (VT) to determine the maximum voltage across the filter and multiply the result by the current (the filter's output power, Pout divided by 40):

$$W = (VT - 40) \times P_{out} / 40$$

For example, with 20 watts output and a transient of 400 volts:

$$W = (400 - 40) \times 20 / 40 = 180$$

The curve of Figure 9 shows that 300 W can be dissipated for up to 60 milliseconds.

### FEATURES

The inhibit function allows the FM-704A HP filter to be used as a high-side switch. When the inhibit terminal (pin 6) is left open or pulled high, the FM-704A HP filter is enabled. When the terminal is grounded, the filter shuts off output power.

A soft start function helps reduce inrush current and start-up overshoot when the filter is initially powered or when it is released from the inhibit mode.

An undervoltage lockout feature shuts off output power when input voltage falls below a specified level. Refer to Figure 8 for more information.

### LAYOUT REQUIREMENTS

To minimize EMI, common mode noise, the case of the filter must be connected to the case of the converter through a low impedance connection.

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### OPERATING CONDITIONS AND CHARACTERISTICS

#### Input Voltage Range

- 16 to 40 VDC continuous for 160 W load

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

- 300°C

#### Storage Temperature Range (Case)

- -65°C to +150°C

#### Case Operating Temperature ( $T_C$ )

- -55°C to +125°C full power

#### Derating Output Power/Current

- Linearly from 160 W at 105°C to 80 W at 125°C to meet MIL-STD-1275A (AT) and MIL-STD-704A

#### Capacitance

- 0.065  $\mu$ F max, any pin to case

#### Undervoltage lockout

- 7 VDC min, 15 VDC max

#### Isolation ( $T_C = 25^\circ\text{C}$ )

- 100 megohm minimum at 500 V
- Any pin to case, except case pin

### INHIBIT

- Active low (output disabled)
  - Active low 0.8 V max
  - Inhibit pin will source 0.6 mA max.
- Active high (output enabled)
  - Open collector
  - Open pin voltage 5.5 V max.

### MECHANICAL AND ENVIRONMENTAL

#### Size (maximum)

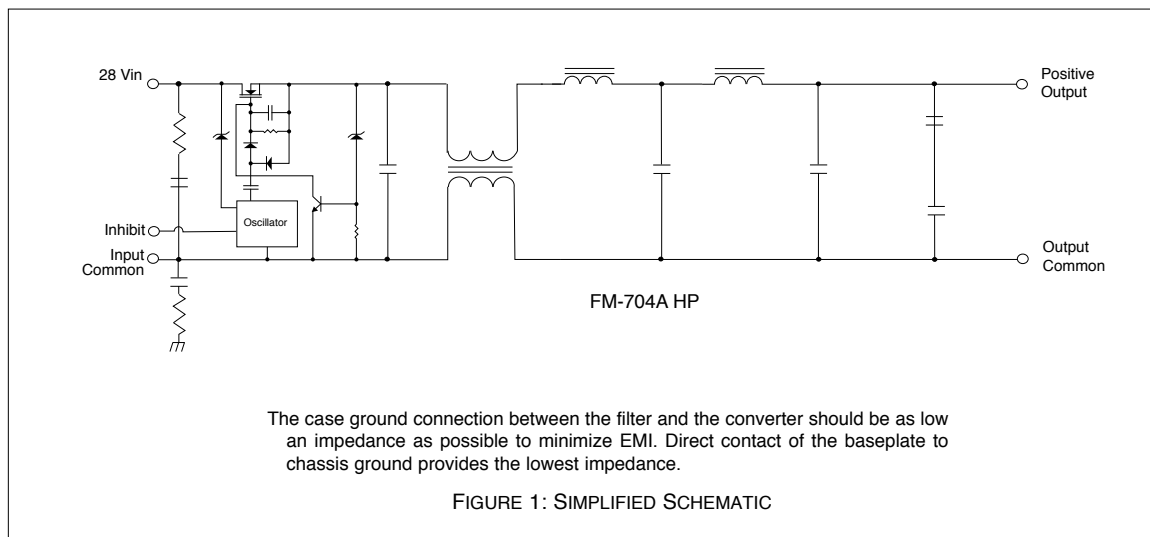
- 3.005 x 1.505 x 0.400 inches (76.33 x 38.23 x 10.16 mm)
- See case U for dimensions.

#### Weight (maximum)

- 86 grams typical

#### Screening

- Standard or ES, see Screening Table 1 for more information.



**FM-704A HP EMI Input Filter and Transient Suppression Module**

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PIN OUT	
Pin	Designation
1, 2	28 Vin
3	Inhibit
4, 5, 6	Input Common
7, 8, 9	Output Common
10, 11, 12	Positive Output

PINS NOT IN USE	
Inhibit	Leave unconnected

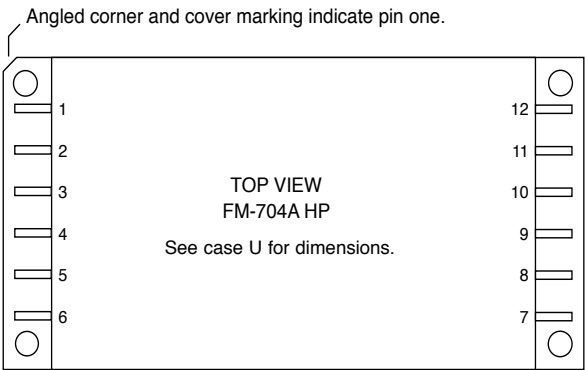
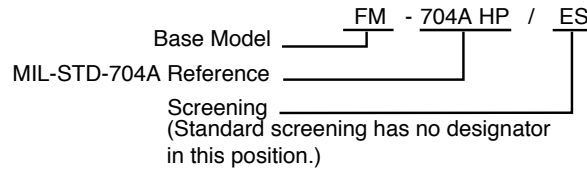


FIGURE 2: PIN OUT

# FM-704A HP EMI Input Filter and Transient Suppression Module

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### MODEL NUMBERING KEY



### MODEL NUMBER OPTIONS <sup>1</sup>

TO DETERMINE THE MODEL NUMBER  
ENTER ONE OPTION FROM EACH CATEGORY  
IN THE FORM BELOW.

CATEGORY	Base Model and Input Voltage	Screening <sup>2</sup>
OPTIONS	FM-704A HP	(standard, leave blank) ES
FILL IN FOR MODEL #	<u>FM-704A</u> HP /	<u>          </u>

Notes:

1. See Model Numbering Key above for an example of a model number.
2. Screening: For standard screening leave the screening option blank. For other screening options, insert the desired screening level. For more information see Screening Table 1.

# FM-704A HP EMI Input Filter and Transient Suppression Module

## 28 VOLT INPUT – 160 WATT

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

PARAMETER	CONDITIONS	FM-704A HP			UNITS
		MIN	TYP	MAX	
INPUT VOLTAGE	NO LOAD	0	28	40	VDC
	160 W LOAD	16 <sup>1</sup>	28	40 <sup>1</sup>	
	UNDERVOLTAGE LOCKOUT	7	–	15	
INPUT CURRENT	16 V <sub>IN</sub> <sup>1</sup>	–	–	10	A
	40 V <sub>IN</sub> <sup>1</sup>	–	–	4.0	
	NO LOAD <sup>1</sup>	–	–	5	mA
	INHIBITED <sup>1</sup>	–	–	2	
INPUT SURGE	160 W, 100 V, 0.5 Ω Z <sub>S</sub> , 60 ms <sup>1</sup>	42	–	48	V <sub>OUT</sub>
INPUT SPIKE	160 W, 100 V, 0.5 Ω Z <sub>S</sub> , 60 ms <sup>1, 2</sup>	–	–	48	V <sub>OUT</sub>
DIFFERENTIAL MODE NOISE REJECTION	500 kHz	60	–	–	dB
	1 MHz	55	–	–	
DC RESISTANCE (R <sub>DC</sub> ) <sup>1</sup>	T <sub>C</sub> = 25°C	–	–	0.1	ohms
OUTPUT VOLTAGE	STEADY STATE <sup>1</sup>	V <sub>OUT</sub> = V <sub>IN</sub> - I <sub>IN</sub> (R <sub>DC</sub> )			VDC
	INHIBITED	–	–	1	
OUTPUT CURRENT <sup>1</sup>	16 V <sub>IN</sub>	–	–	10	A
	40 V <sub>IN</sub>	–	–	4.0	
INTERNAL POWER DISSIPATION <sup>1</sup>	PEAK	T <sub>C</sub> = 105°C	–	–	W
		T <sub>C</sub> = 125°C	–	–	
	CONTINUOUS ( > SEC)	T <sub>C</sub> = 105°C	–	–	
		T <sub>C</sub> = 125°C	–	–	

Notes

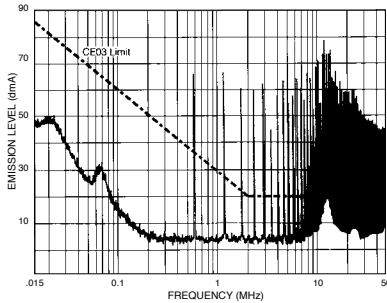
1. Guaranteed by design, not tested.

2. Meets MIL-STD-1275A (AT) Surge and Figure 8 and 9 of MIL-STD-704A. For these standards derate output power linearly from 160 W at 105°C to 80 W at 125°C.

# FM-704A HP EMI Input Filter and Transient Suppression Module

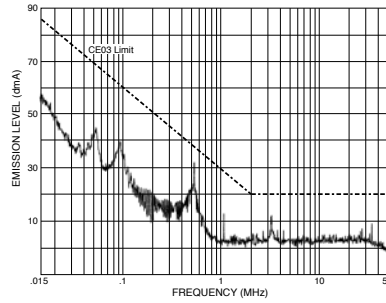
## 28 VOLT INPUT – 160 WATT

Typical Performance Curves: 25°C T<sub>C</sub>, nominal V<sub>in</sub>, unless otherwise specified.



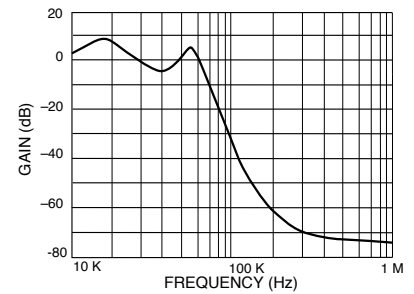
MHF+ Converter without Filter

FIGURE 3



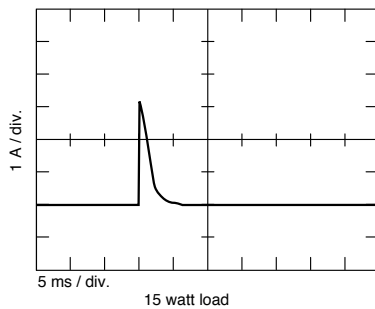
MHF+ Converter with Filter

FIGURE 4



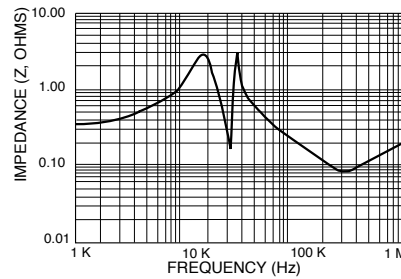
Differential Mode Response

FIGURE 5



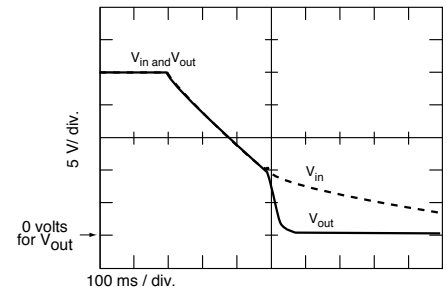
Inrush Current

FIGURE 6



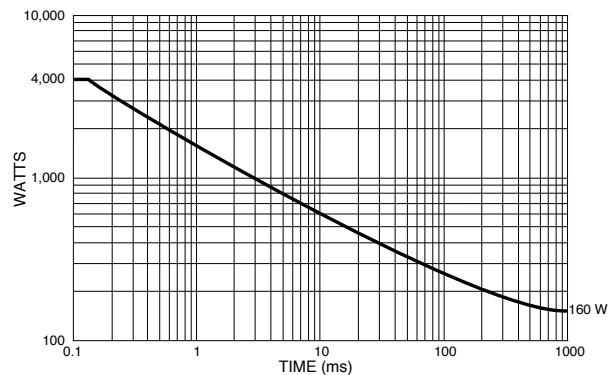
Typical Output Impedance (Z)  
with Input Shorted

FIGURE 7



Undervoltage Lockout

FIGURE 8



Derate power linearly to 50% at 125°C. Operation below this curve ensures a maximum junction temperature rise of 40°C or less.

Maximum Allowed Internal Power Dissipation  
105°C case temperature

FIGURE 9

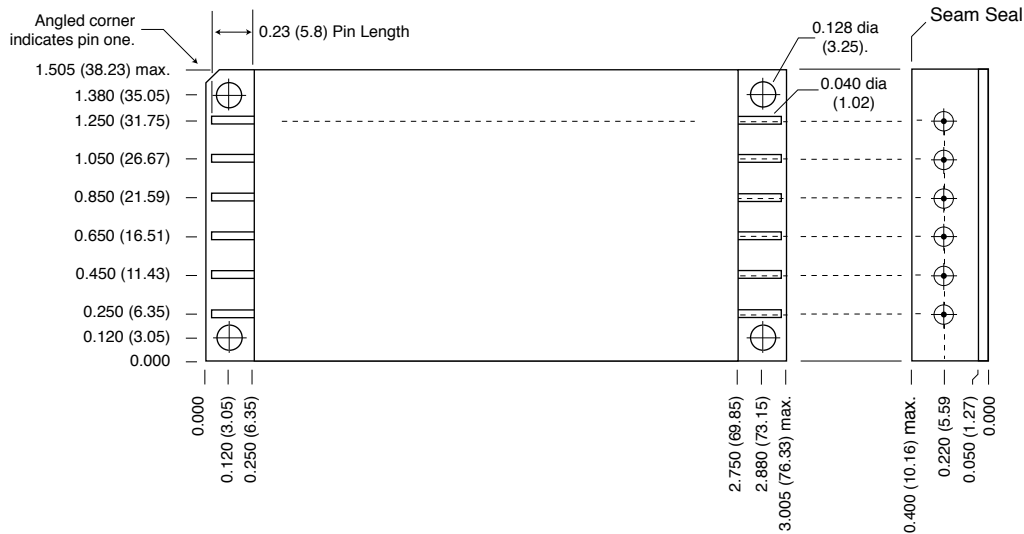
# FM-704A HP EMI Input Filter and Transient Suppression Module

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### 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 F, 20100503

FIGURE 10: CASE U

# FM-704A HP EMI Input Filter and Transient Suppression Module

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### STANDARD AND /ES (NON-QML) ENVIRONMENTAL SCREENING <sup>1, 2</sup>

TEST PERFORMED	NON-QML	
	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</b> Method 1015 <sup>3</sup> 96 hours		■
<b>Final Electrical Test MIL-PRF-38534, Group A</b> Subgroups 1 and 4: +25°C case	■	■
<b>Hermeticity Test</b> Fine Leak, Method 1014, Cond. A Gross Leak, Method 1014, Cond. C 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. "Non-QML" Refers to products that do not offer QML screening.
2. Standard and /ES, non-QML products, may not meet all of the requirements of MIL-PRF-38534.
3. Burn-in temperature designed to bring the case temperature to +125°C minimum. Burn-in is a powered test. Refer to the specific product information for the maximum case temperature.

SCREENING TABLE 1: ENVIRONMENTAL SCREENING