

FM-704A EMI Input Filter and Transient Suppression Module

28 VOLT INPUT – 40 WATT

FEATURES

- -55°C to +125°C operation
- 16 to 40 VDC input
- Up to 60 dB attenuation at 500 kHz.
- Active transient suppression
- Undervoltage lockout
- Inhibit function
- Compliant to MIL-STD-461C, CE03



MODEL

FM-704A	40 Watts
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DESCRIPTION

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

TEMPERATURE OPERATION

FM-704A filters are rated to operate from -55°C to +125°C base-plate temperature. To meet MIL-STD-1275A and MIL-STD-704A requirements, derate output power linearly from 40 watts at 105°C to 25 watts at 125°C. See Figure 9.

PROTECTION

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

MIL-STD-704A	Panavia SP-P-90001
MIL-STD-461B&C	British Standard BS3G100
MIL-STD-1275	Civil Aircraft D0160B

Refer to the Electrical Characteristics table on the following page 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 2.5 amps at 16 V_{in} or 1.0 amp at 40 V_{in}. When the FM-704A filter is used with PWM (Pulse Width Modulated) converters, I_{line} will vary as Power / V_{line} and 2.5 amps maximum at 16 V_{in} will reduce to approximately 1 amp maximum at 40 V_{in}. The maximum value allowed may be less than 1 amp 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 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, P_{out} divided by 40).

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

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 180 W can be dissipated for up to 4 milliseconds.

FEATURES

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

The case of the filter must be connected to the case of the converter through a low impedance connection to minimize EMI.

FM-704A EMI Input Filter and Transient Suppression Module

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OPERATING CONDITIONS AND CHARACTERISTICS

Input Voltage Range

- 16 to 40 VDC continuous for 40 W load

Lead Soldering Temperature (10 sec per pin)

- 300°C

Storage Temperature Range (Case)

- -65°C to +150°C

Case Operating Temperature (Tc)

- -55°C to +125°C full power

Derating Output Power/Current

- Linearly from 40 W at 105°C to 25 W at 125°C to meet MIL-STD-1275A (AT) and MIL-STD-704A

Capacitance

- 0.017 μF max, any pin to case

Undervoltage lockout

- 7 VDC min, 15 VDC max

Isolation

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

Inhibit Pin Voltage (unit enabled)

- 5.5 V max

INHIBIT TTL OPEN COLLECTOR

- Logic low (output disabled)
 - Logic low voltage ≤ 0.8 V
 - Logic low inhibit pin current 0.6 mA max
- Referenced to input common
- Logic high (output enabled)
 - Open collector

MECHANICAL AND ENVIRONMENTAL

Size (maximum)

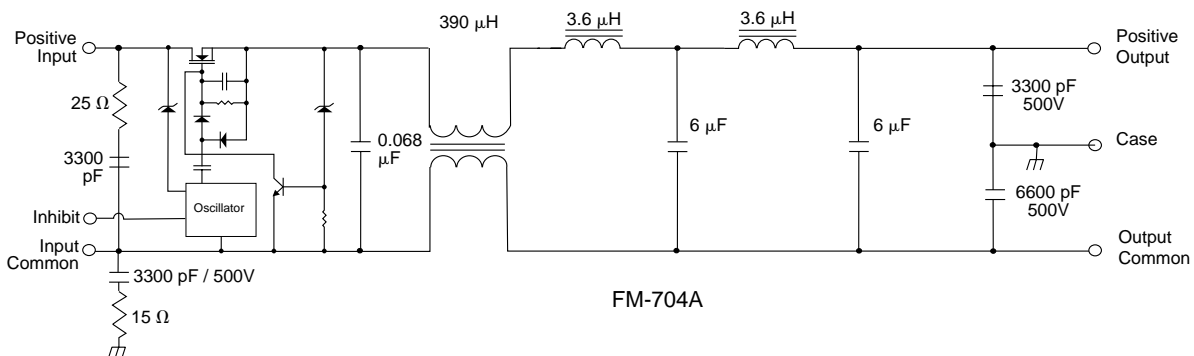
2.910 x 1.125 x 0.400 inches (73.91 x 28.58 x 10.16 mm)
See case K1 for dimensions.

Weight (maximum)

40 grams typical

Screening

Standard, ES, or 883 (Class H). See "883, Class H, QML Products – Element Evaluation" and "883, Class H, QML Products – Environmental Screening" for more information.



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: SCHEMATIC – TYPICAL VALUES

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PIN OUT		PINS NOT IN USE	
Pin	Designation	Inhibit	Leave unconnected
1	Positive Input		
2	Positive Output		
3	Case Ground		
4	Output Common		
5	Input Common		
6	Inhibit		

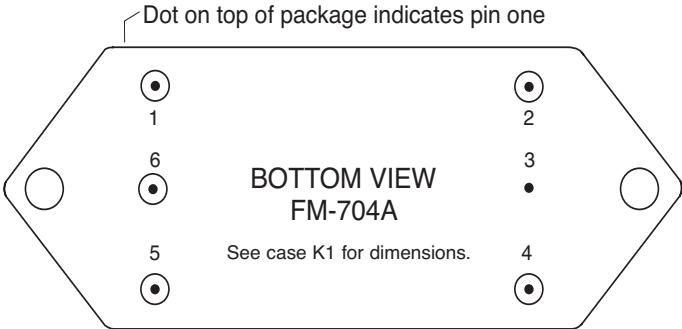
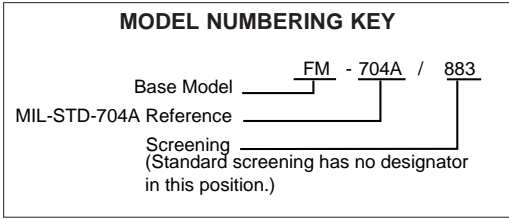


FIGURE 2: PIN OUT

FM-704A EMI Input Filter and Transient Suppression Module

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DSCC NUMBER

DSCC DRAWING (5915)	FM-704A FILTER SIMILAR PART
94028-01HXC	FM-704A/883

For exact specifications for an SMD product, refer to the SMD drawing. SMDs can be downloaded from:
<http://www.dsccl.dla.mil/programs/smcr>

Model Selection

<u>FM</u>	<u>704A</u>	<u> </u>
<i>Base model</i>	<i>MIL-STD-461 ref.</i>	<i>screening</i>

Choose one from each of the following rows

Screening	standard screening, leave blank	/ES (ES screening), /883 (Class H, QML)
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FM-704A EMI Input Filter and Transient Suppression Module

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

PARAMETER	CONDITIONS	FM-704A			UNITS
		MIN	TYP	MAX	
INPUT VOLTAGE	NO LOAD	0	28	40	VDC
	40 W LOAD	16	28	40	
	UNDERVOLTAGE LOCKOUT	7	—	15	
INPUT CURRENT	16 V _{IN}	—	—	2.5	A
	40 V _{IN}	—	—	1.0	
	NO LOAD	—	—	5	mA
	INHIBITED	—	—	2	
INPUT SURGE	40 W, 100 V, 0.5 Ω Z _S , 60 ms ¹	42	—	48	V _{OUT}
INPUT SPIKE	40 W, 400 V, 0.5 Ω Z _S , 5 μs ²	—	—	48	V _{OUT}
	40 W, 600 V, 50 Ω Z _S , 10 μs ³	—	—	48	
DIFFERENTIAL MODE NOISE REJECTION	500 kHz	60	—	—	dB
	1 MHz	55	—	—	
DC RESISTANCE (R _{DC})	Tc = 25°C	—	—	0.45	Ω
OUTPUT VOLTAGE	STEADY STATE	V _{OUT} = V _{IN} - I _{IN} (R _{DC})			VDC
	INHIBITED	—	—	1	
OUTPUT CURRENT	16 V _{IN}	—	—	2.5	A
	40 V _{IN}	—	—	1.0	
INTERNAL POWER DISSIPATION	PEAK	—	—	1000	W
	105°C	—	—	500	
	125°C	—	—	500	
	CONTINUOUS (> 10 SEC.)	—	—	30	
	105°C	—	—	30	
	125°C	—	—	15	

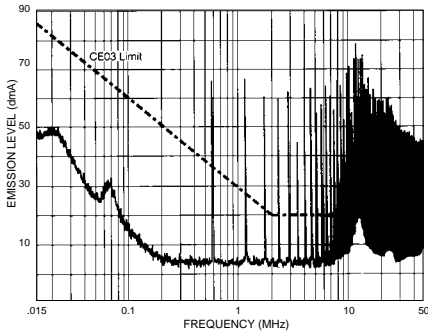
Notes

1. Meets MIL-STD-1275A (AT) Surge and Figure 8 and 9 of MIL-STD-704A. For these standards derate output power linearly from 40 W at 105°C to 25 W at 125°C.
2. Meets Panavia SP-P-90001, British Standard BS3G100 and Civil Aircraft D0160 Standards.
3. Meets MIL-STD-461C 1.2 CS06 limits.

FM-704A EMI Input Filter and Transient Suppression Module

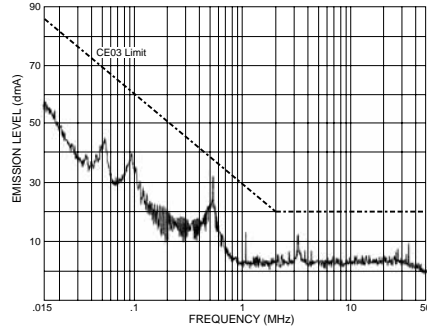
28 VOLT INPUT – 40 WATT

Typical Performance Curves: 25°C Tc , nominal Vin, unless otherwise specified.



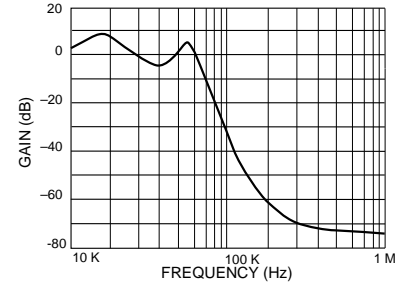
MHF+ Converter Without Filter

FIGURE 3



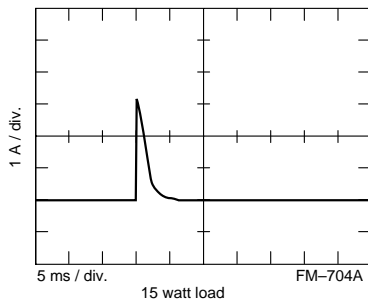
MHF+ Converter With FM-704A Filter

FIGURE 4



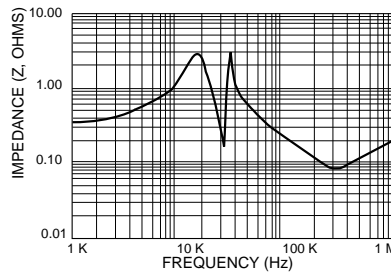
Differential Mode Response

FIGURE 5



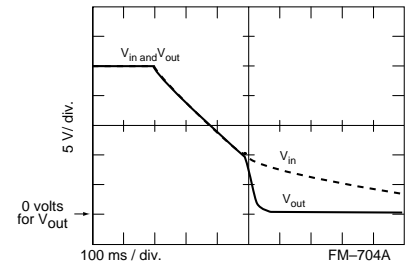
Inrush Current

FIGURE 6



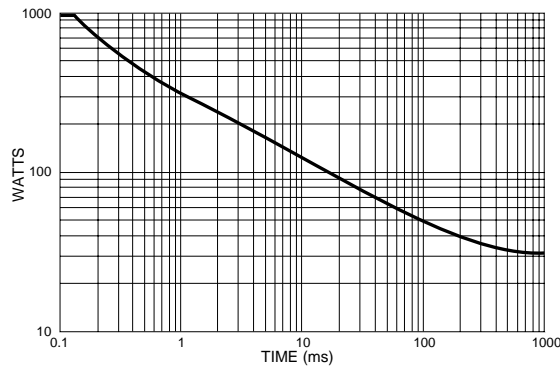
Typical Output Impedance (Z) With Input Shorted

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.

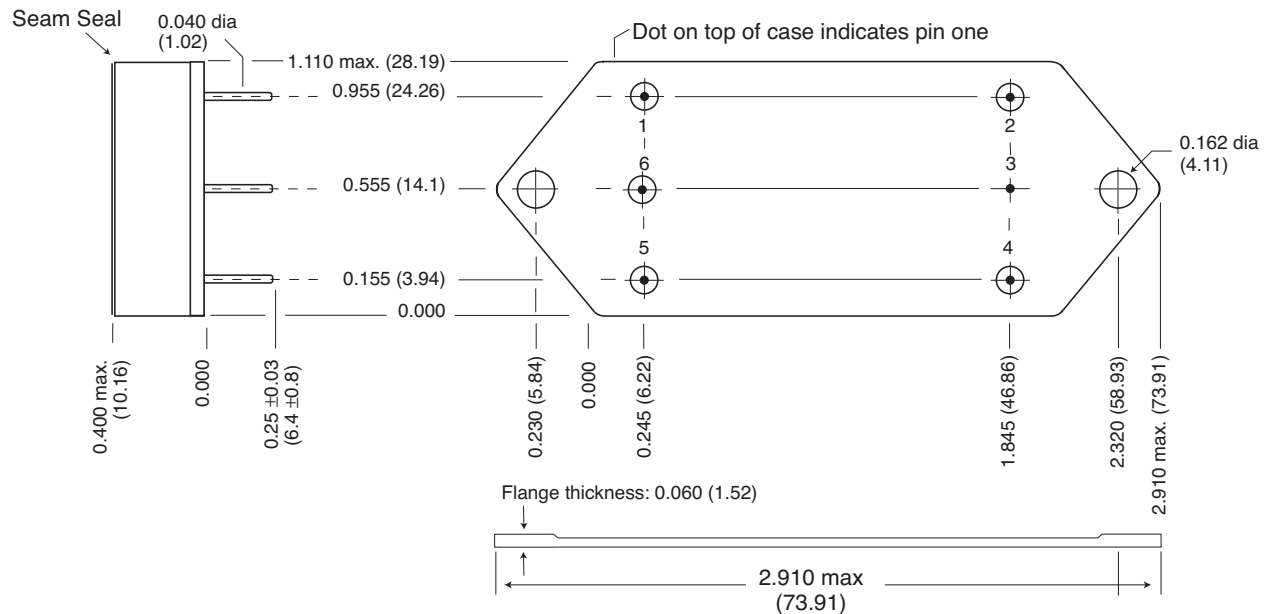
Maximum Allowed Internal Power Dissipation
105°C case temperature

FIGURE 9

FM-704A EMI Input Filter and Trans. Suppression Module Cases

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BOTTOM VIEW CASE K1



Case dimensions in inches (mm)

Tolerance ± 0.005 (0.13) for three decimal places
 ± 0.01 (0.2) 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 (all cases) ceramic seal

Case K1, Rev C, 20060125 FM704A only.

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 10: CASE K1

FM-704A EMI Input Filter and Transient Suppression Module

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883, CLASS H, QML PRODUCTS – ELEMENT EVALUATION

ELEMENT EVALUATION TEST PERFORMED (COMPONENT LEVEL)	STANDARD (NON-QML) ¹		CLASS H, QML	
	M/S ²	P ³	M/S ²	P ³
Element Electrical (probe)	yes	no	yes	yes
Element Visual	no	no	yes	yes
Internal Visual	no	no	yes	no
Final Electrical	no	no	yes	yes
Wire Bond Evaluation ⁴	no	no	yes	yes
SLAM™/C-SAM: Input Capacitors only (Add'l test, not req. by H or K)	no	no	no	yes

Definitions:

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

SLAM™: Scanning Laser Acoustic Microscopy

C-SAM: C - Mode Scanning Acoustic Microscopy

Notes:

1. Non-QML products do not meet all of the requirements of MIL-PRF-38534
2. M/S = Active components (Microcircuit and Semiconductor Die)
3. P = Passive components
4. Not applicable to EMI filters that have no wire bonds

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883, CLASS H, QML PRODUCTS – ENVIRONMENTAL SCREENING

TEST	125°C STANDARD non-QML	125°C /ES non-QML	Class H /883 QML
Pre-cap Inspection Method 2017, 2032	yes	yes	yes
Temperature Cycle (10 times) Method 1010, Cond. C, -65°C to 150°C, ambient Method 1010, Cond. B, -55°C to 125°C, ambient	no no	no yes	yes no
Constant Acceleration Method 2001, 3000 g Method 2001, 500g	no no	no yes	yes no
Burn-In Method 1015, 160 hours at 125°C case, typical 96 hours at 125°C case, typical	no no	no yes	yes no
Final Electrical Test MIL-PRF-38534, Group A Subgroups 1 through 6: -55°C, +25°C, +125°C case Subgroups 1 and 4: +25°C case	no yes	no yes	yes no
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	yes yes no
Final Visual Inspection Method 2009	yes	yes	yes

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