

# EMI INPUT FILTERS 28 VOLT INPUT

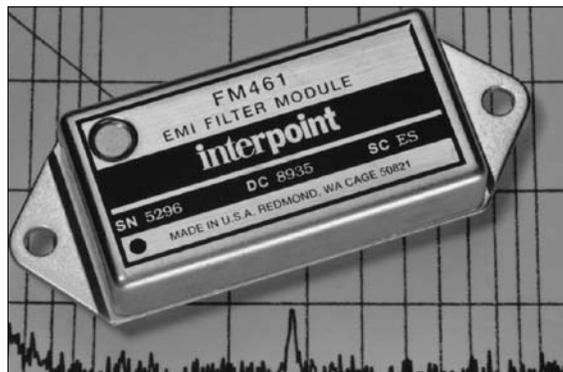
FM-461, FMA-461  
AND FMB-461  
1.75 TO 5 AMP

**NOT RECOMMENDED FOR NEW DESIGNS**

## FEATURES

Attenuation 40 dB from 110 kHz to 50 MHz

- Operating temperature -55° to +85°C
- Nominal 28 V input, 0 V to 40 V operation
- 1.75 to 5 A throughput current
- Transient suppression
- Compliant to MIL-STD-461C CE-03



MODELS INPUT VOLTAGE AND CURRENT	
INPUT (V)	CURRENT (A)
0 - 40	1.75
0 - 40	3.8
0 - 40	5.0

Size (max.): Non-flanged case

H3 - FM-461 2.110 x 1.120 x 0.417 inches (53.59 x 28.45 x 10.59 mm)

H5 - FMA/FMB 2.110 x 1.120 x 0.495 inches (53.59 x 28.45 x 12.57\* mm)

Flanged case

K4 - FM-461 2.910 x 1.115 x 0.417 inches (73.91 x 28.32 x 10.59\* mm)

K6 - FMA/FMB 2.910 x 1.115 x 0.495 inches (73.91 x 28.32 x 12.57 mm)

Weight: Maximum – FM-461 38 grams, FMA-461 42 grams, FMB-461 43 grams

Screening: Standard or ES. See screening table for more information.

## DESCRIPTION

The FM-461, FMA-461, and FMB-461 EMI filter modules have been specifically designed to reduce the input line reflected ripple current of Interpoint's MTO, MTW, MHE, MLP, and MFW Series of DC/DC converters. They are intended for use in applications of high frequency (100 kHz) switch-mode DC/DC converters which must meet MIL-STD-461C levels of conducted power line noise.

These filters are built using thick-film hybrid technology and are sealed in metal packages for military, aerospace, and other high-reliability applications. See Section B8, cases H3, H5, K4, and K6 for dimensions. See Section C2 for screening options.

## MIL-STD NOISE MANAGEMENT

When used in conjunction with Interpoint's DC/DC converters (see connection diagram, Figure 2), the input ripple current will be reduced by 40 dB within the frequency band of 100 kHz to 50 MHz. This gives the filter/converter combination a performance which exceeds the CE03 test limit of MIL-STD-461C. The CE03 performance of a model MHE2805S converter with and without the FM-461 filter is shown in Figures 6 and 7.

## FILTER OPERATION

A fast-reacting (1 picosecond) transient suppressor clamps the input voltage at approximately 47 V, protecting the DC/DC converter from line induced transients.

The filters are rated to operate, with no degradation of performance, over the temperature range of -55°C to +85°C (as measured at the baseplate). Above 85°C, input voltage and current must be derated as specified in "Derating" on the following page. The maximum power dissipation of the filters at maximum input current represents a power loss of less than 3% at typical input voltage.

## LAYOUT REQUIREMENTS

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

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## ABSOLUTE MAXIMUM RATINGS

### Input Voltage

- 0 to 40 VDC continuous

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

- 300°C

### Storage Temperature Range (Case)

- -55°C to +135°C

### Isolation

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

## RECOMMENDED OPERATING CONDITIONS

### Input Voltage Range

- 0 to 40 VDC continuous

### Case Operating Temperature (Tc)

- -55°C to +85°C full power
- -55°C to +125°C absolute

## DERATING

### Input Voltage

Derate linearly from 100% at 85°C case to the 33 VDC at 125°C case

### Input Ripple Current

Derate linearly from 100% at 85°C case to the following at 125°C case

- 270 mA rms FM-461
- 400 mA rms FMA-461
- 480 mA rms FMB-461

### DC Input and Output Current

Derate linearly from 100% at 85°C case to the following at 125°C case

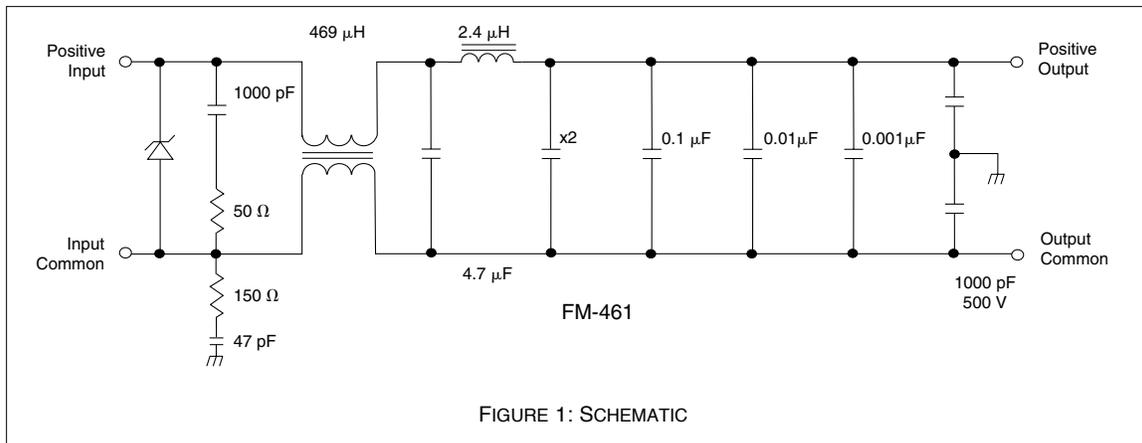
- 750 mA FM-461
- 1.7 A FMA-461
- 1.7 A FMB-461

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

PARAMETER	CONDITIONS	FM-461			FMA-461			FMB-461			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
INPUT VOLTAGE	CONTINUOUS	0	28	40	0	28	40	0	28	40	VDC
INPUT CLAMPING VOLTAGE	-55°C	38.9	43.2	47.5	38.9	43.2	47.5	38.9	43.2	47.5	VDC
	+25°C	42.3	47.0	51.7	42.3	47.0	51.7	42.3	47.0	51.7	
	+125°C	44.9	49.9	54.8	44.9	49.9	54.8	44.9	49.9	54.8	
INPUT CURRENT	DC	—	—	1.75	—	—	3.8	—	—	5.0	A
	RIPPLE	—	—	0.67	—	—	1.0	—	—	1.2	A rms
NOISE REJECTION	15 kHz TO 50 MHz	—	40	—	—	40	—	—	40	—	dB
DC RESISTANCE (R <sub>DC</sub> )	STEADY STATE	—	0.38	0.42	0.07	0.10	0.15	0.07	0.09	0.10	Ω
CAPACITANCE	ANY PIN TO CASE	1900	—	2200	3700	—	4400	6450	—	8000	pF
OUTPUT VOLTAGE <sup>1</sup>	STEADY STATE	$V_{OUT} = V_{IN} - I_{IN}(R_{DC})$									VDC
OUTPUT CURRENT	STEADY STATE	—	—	1.75	—	—	3.8	—	—	5.0	A
POWER DISSIPATION	MAX CURRENT	—	—	1.3	—	—	1.6	—	—	2.5	W

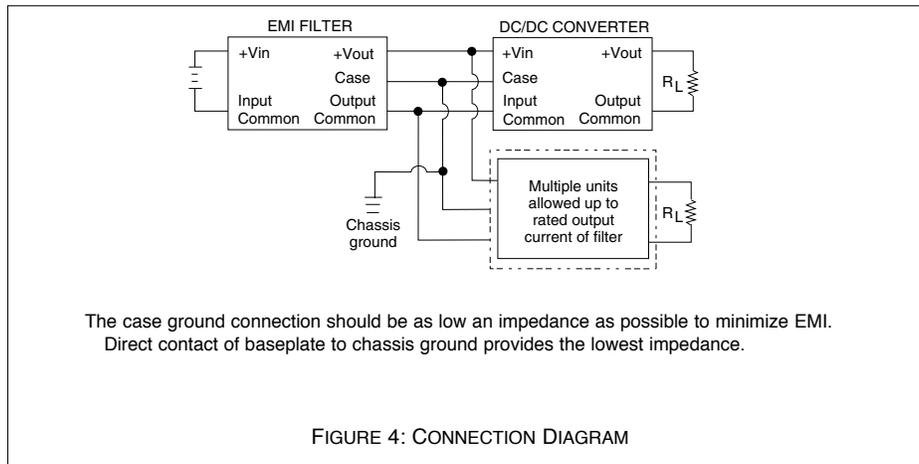
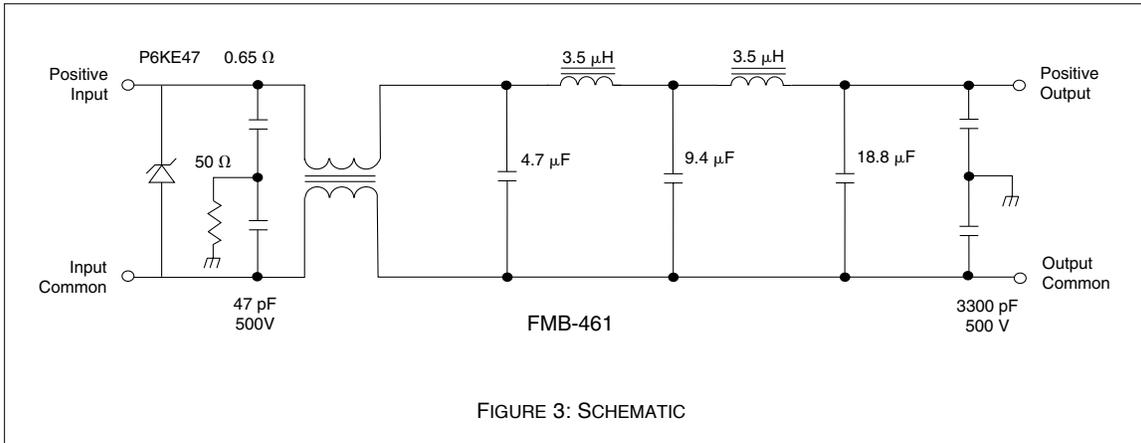
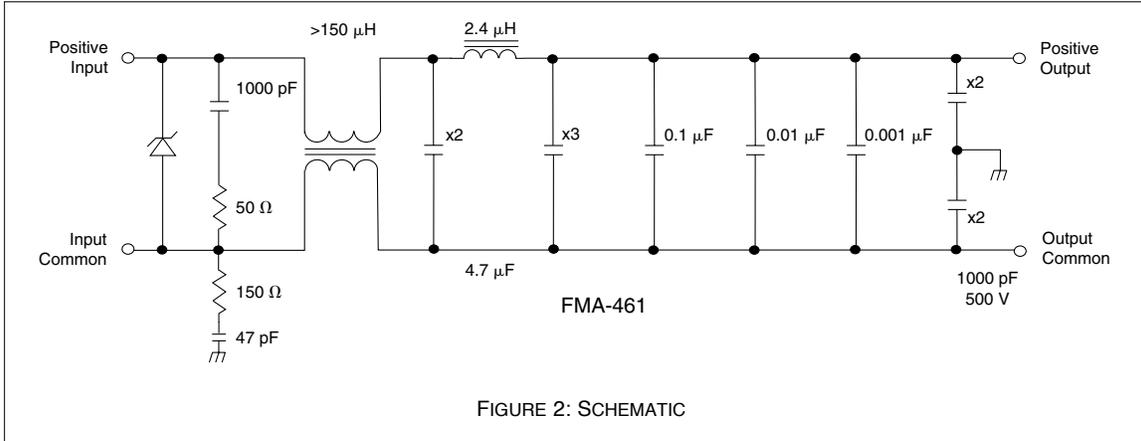
### Note

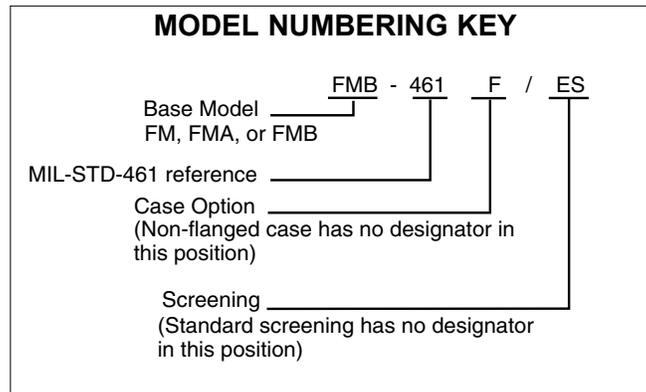
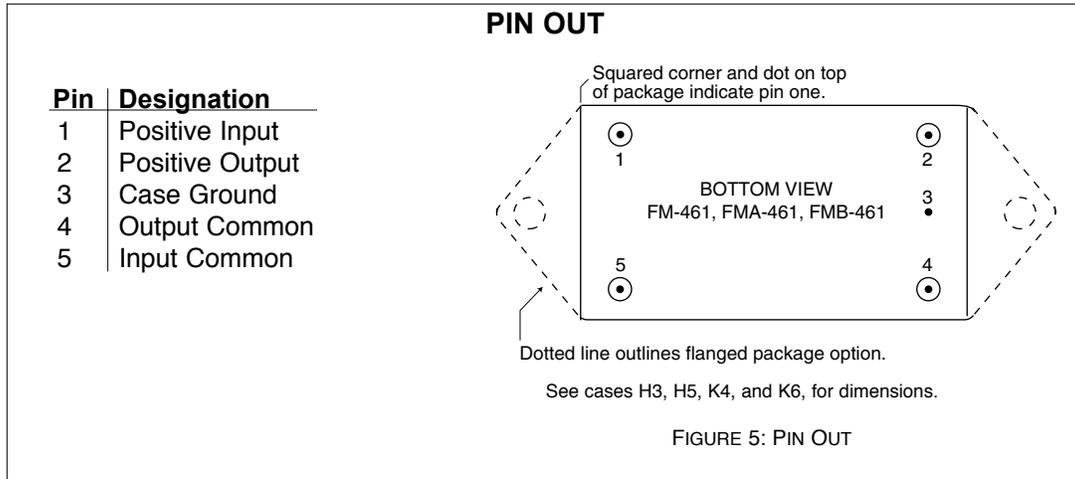
1. Typical applications result in Vout within 2% of Vin.



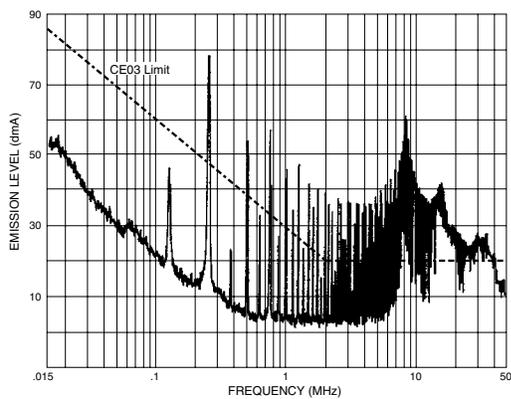
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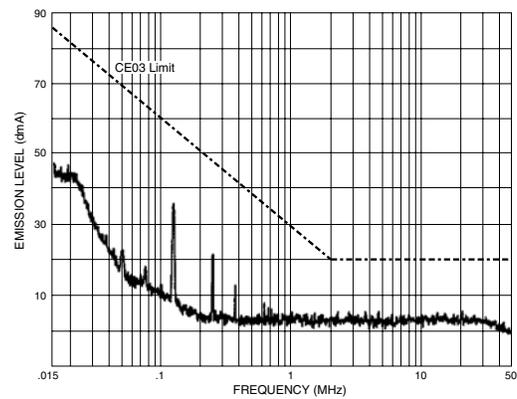




Typical Performance Curves: 25°C Tc , nominal Vin, unless otherwise specified.



MHE Converter Without Filter  
FIGURE 6



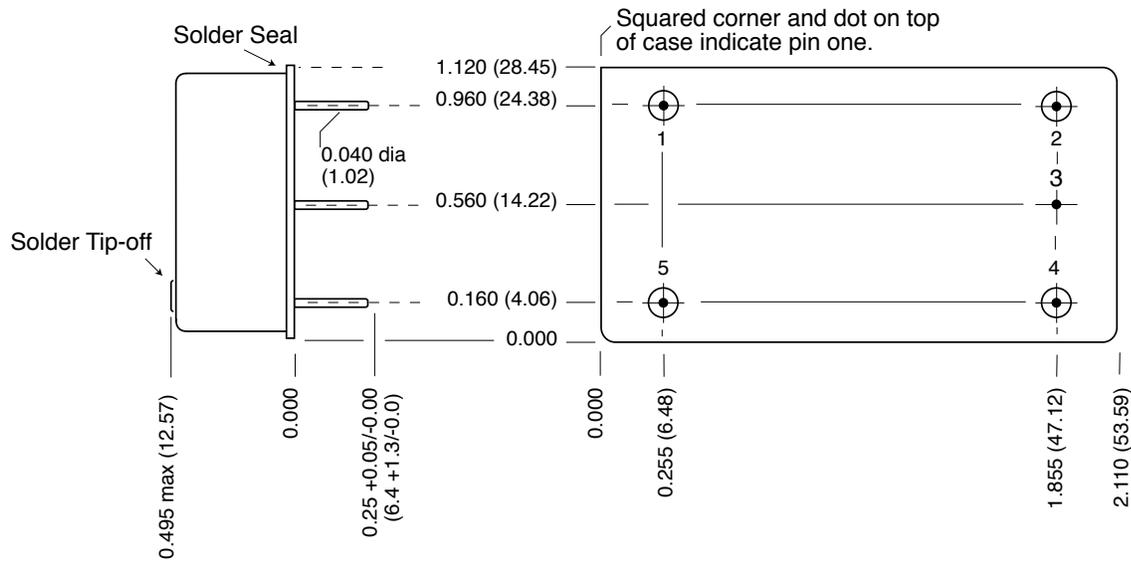
MHE Converter With FM-461 EMI Filter  
FIGURE 7



# EMI INPUT FILTERS

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## BOTTOM VIEW CASE H5



### 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/Tin  
Cover Cold Rolled Steel/Nickel/Tin  
Pins #52 alloy, compression glass seal

Case H5, Rev C - 20100211

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 9: CASE H5 - FMA/FMB-461 NON-FLANGED

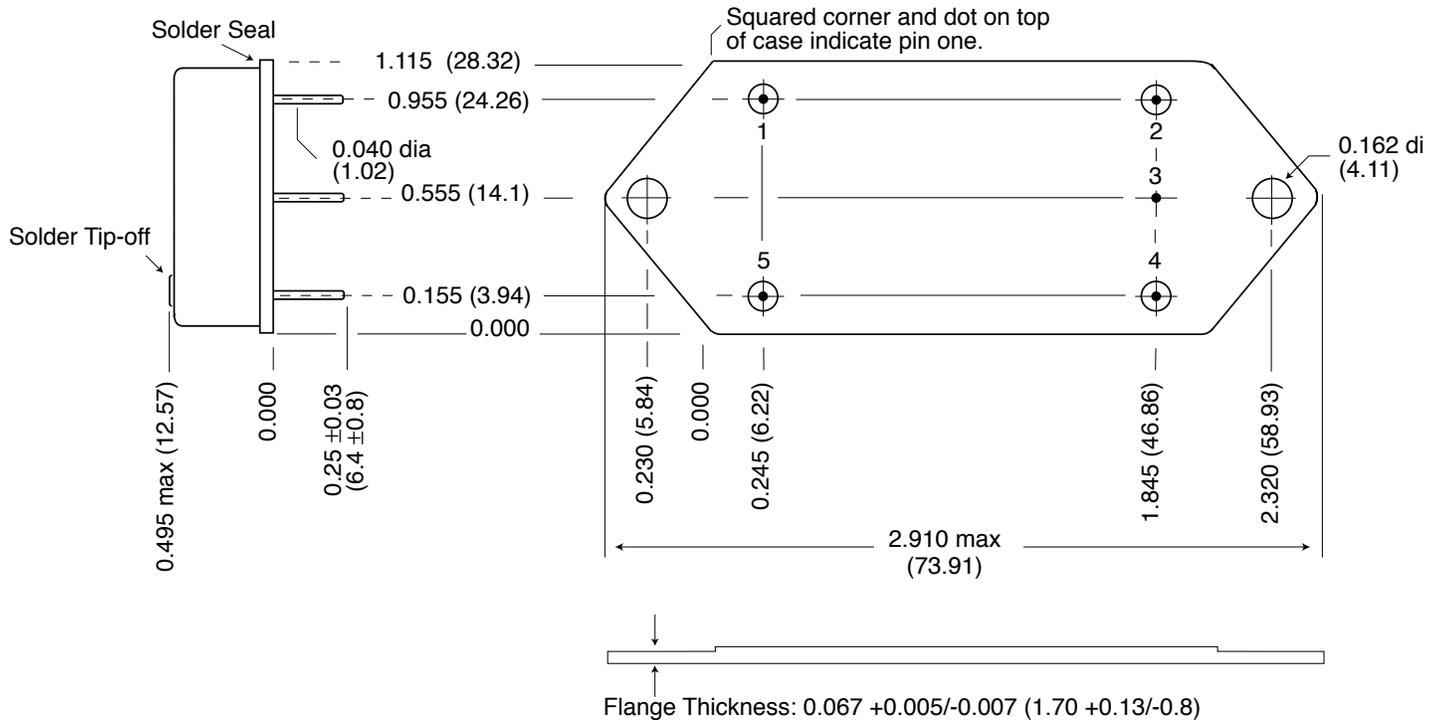


# EMI INPUT FILTERS

FM-461, FMA-461  
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## BOTTOM VIEW CASE K6

\*Flanged case: 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.

Case K6, Rev E - 20100211

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FIGURE 11: CASE K6 - FMA/FMB-461 FLANGED

## 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 85°C.