EMI INPUT FILTERS
28 VOLT INPUT

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

NOT RECOMMENDED FOR NEW DESIGNS

FEATURES

- –55°C to +85°C operation
- 0 to 40 VDC volt input
- Up to 40 dB attenuation
  110 kHz to 50 MHz
- Transient suppression
- Compliant to
  MIL-STD-461C, CE03

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 or H5
2.125 x 1.125 x 0.495* inches (53.98 x 28.58 x 12.57* mm)
Flanged case K4 or K6
2.910 x 1.125 x 0.495* inches (73.91 x 28.58 x 12.57* mm)
See cases H3, H5, K4, and K6, for dimensions.
*Height varies depending on model.
Weight: Maximum – FM-461 38 grams, FMA-461 42 grams, FMB-461 43 grams
Screening: Standard or ES. See "85°C Non-QML Products–Environmental Screening (Standard & ES)" 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.

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.

		FM-461			FMA-461			FMB-461			UNITS
PARAMETER	CONDITIONS	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_{DC})	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[1]	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.

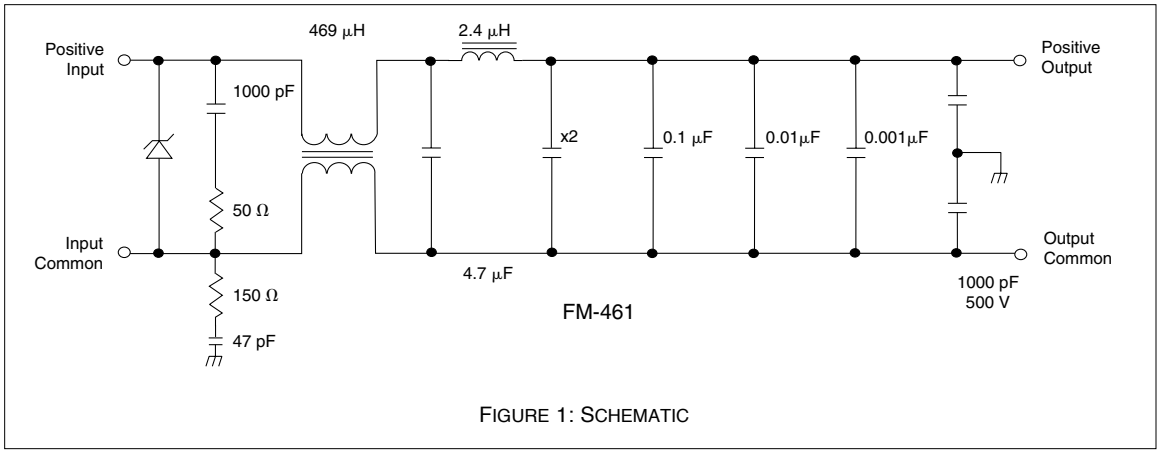


FIGURE 1: SCHEMATIC

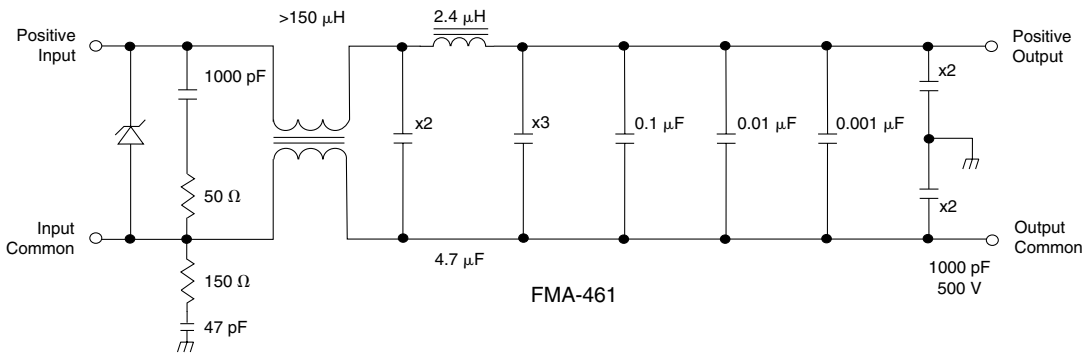


FIGURE 2: SCHEMATIC

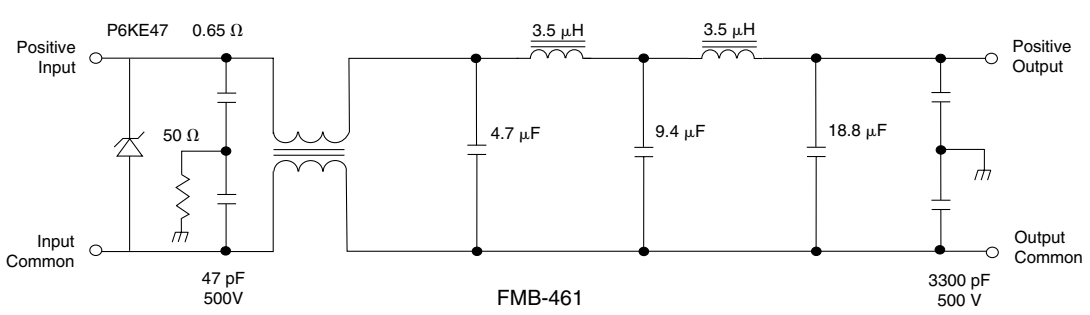
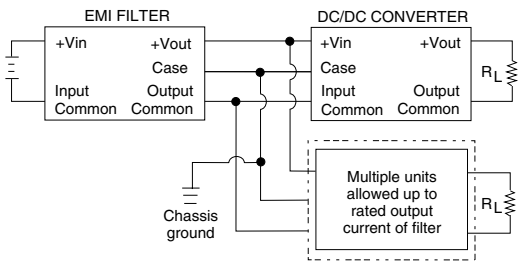


FIGURE 3: SCHEMATIC

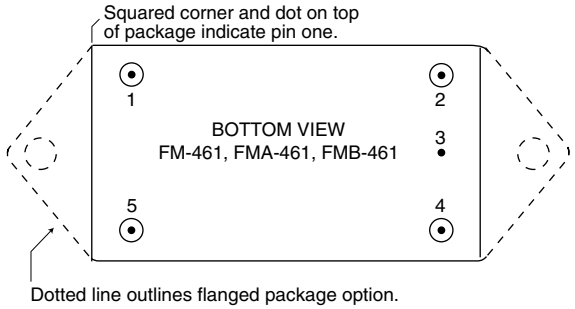


The case ground connection should be as low an impedance as possible to min mize EMI. Direct contact of baseplate to chassis ground provides the lowest impedance.

FIGURE 4: CONNECTION DIAGRAM

PIN OUT

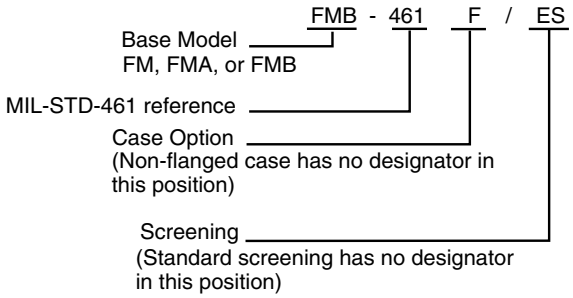
Pin	Designation
1	Positive Input
2	Positive Output
3	Case Ground
4	Output Common
5	Input Common



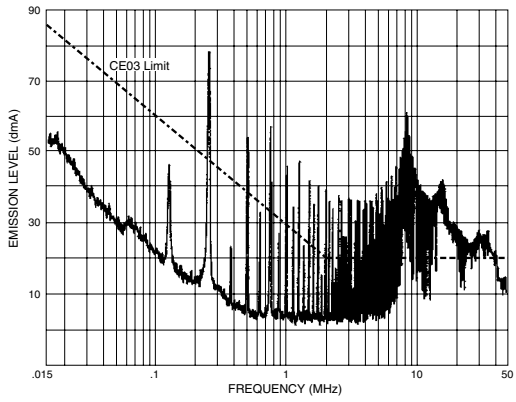
See cases H3, H5, K4, and K6, for dimensions.

FIGURE 5: PIN OUT

MODEL NUMBERING KEY

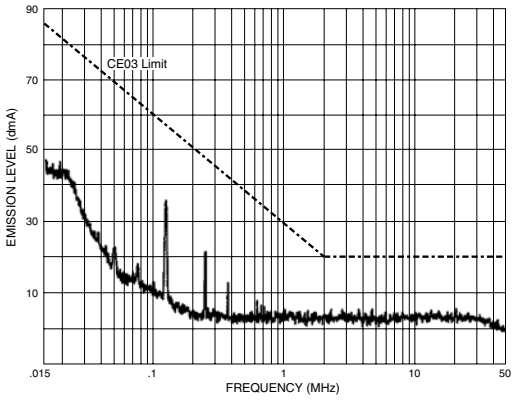


Typical Performance Curves: 25°C Tc , nominal Vin, unless otherwise specified.



MHE Converter Without Filter

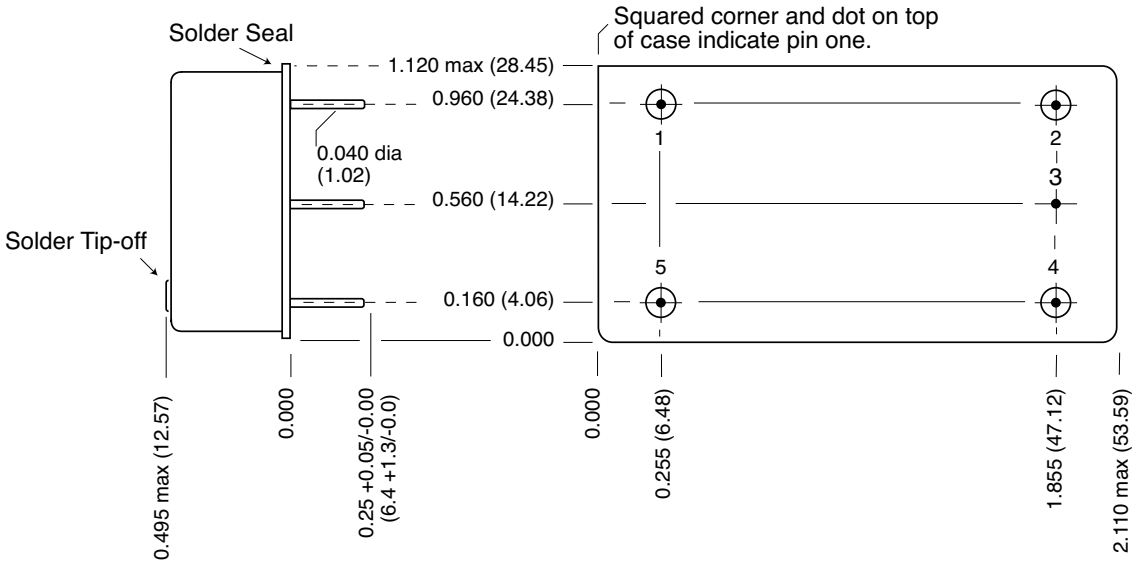
FIGURE 6



MHE Converter With FM-461 EMI Filter

FIGURE 7

BOTTOM VIEW CASE H3



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.

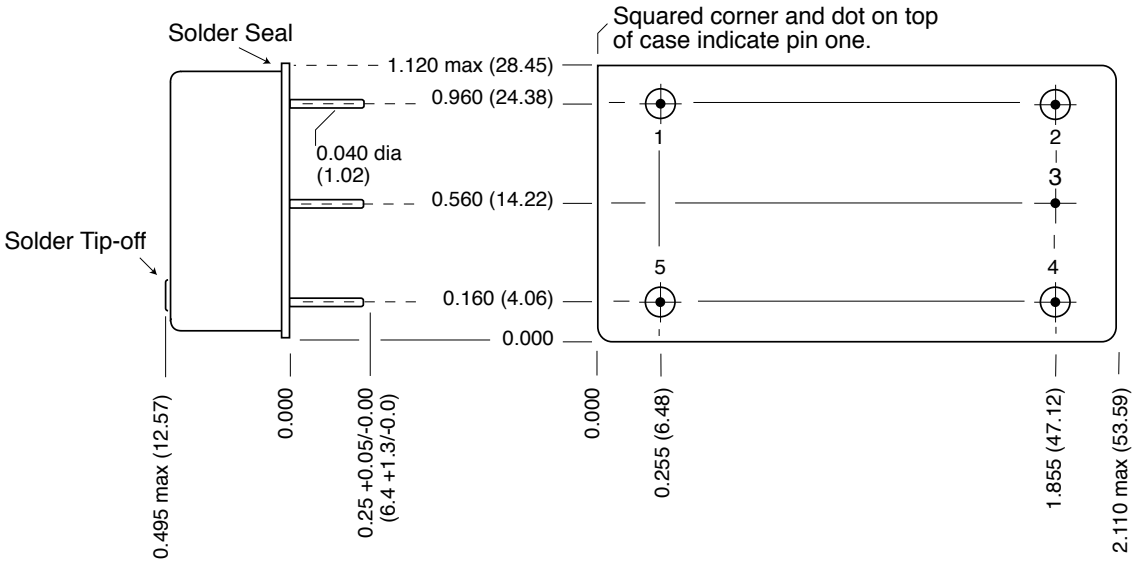
Materials

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

Case H3, Rev B - 20060801
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.

FIGURE 8: CASE H3 - FM-461 NON-FLANGED

BOTTOM VIEW CASE H5



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

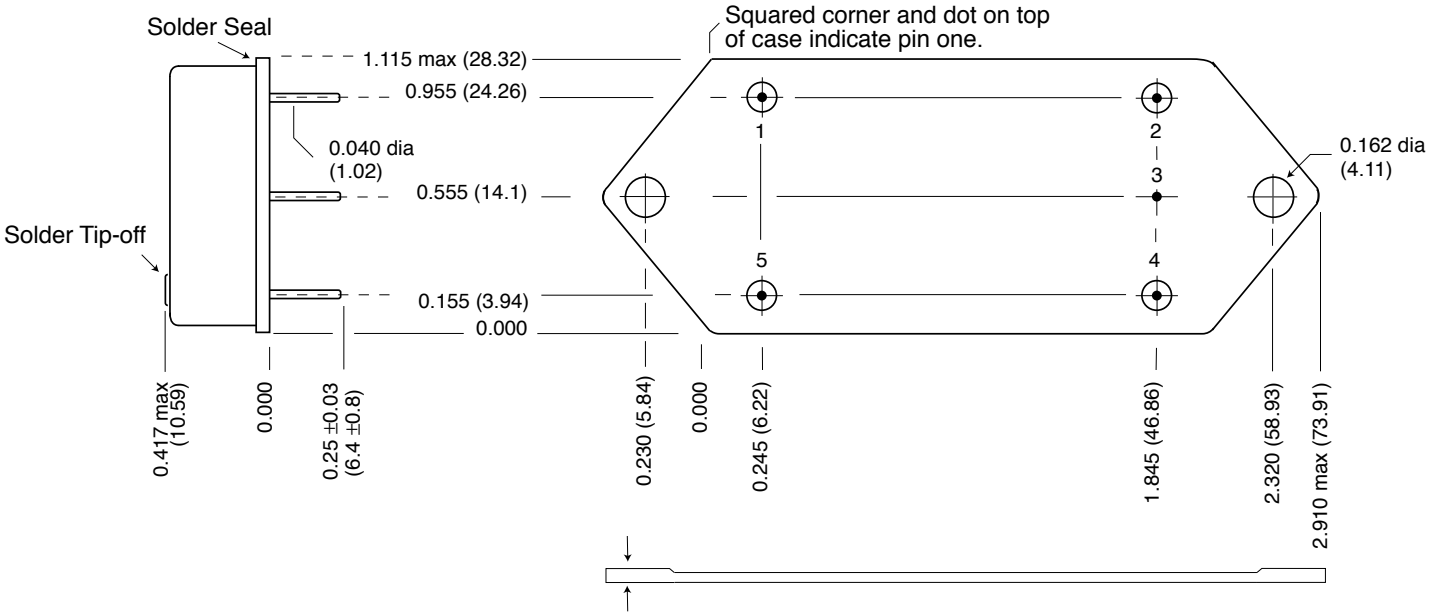
Header	Cold Rolled Steel/Nickel/Tin
Cover	Cold Rolled Steel/Nickel/Tin
Pins	#52 alloy, compression glass seal

Case H5, Rev B - 20060801
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.

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

BOTTOM VIEW CASE K4

*Flanged case: Designator “F” required in Case Option position of model number.



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

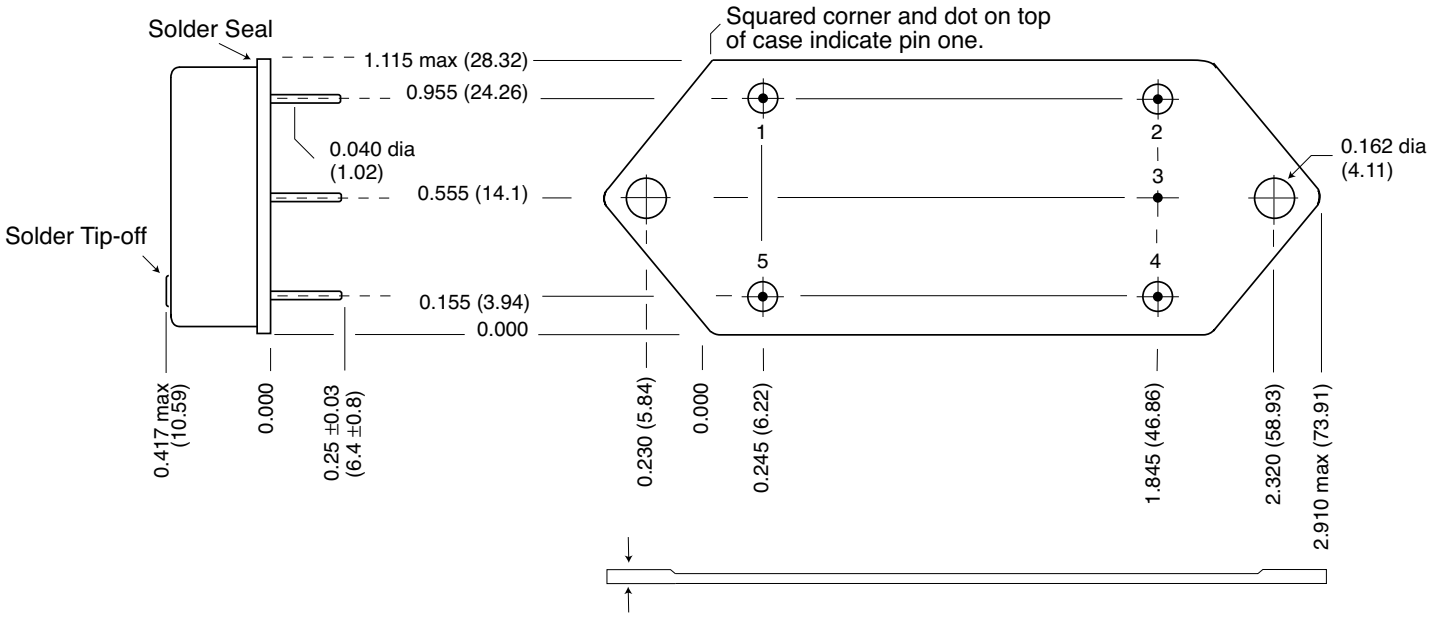
Header	Cold Rolled Steel/Nickel/Tin
Cover	Cold Rolled Steel/Nickel/Tin
Pins	#52 alloy, compression glass seal

Case K4, Rev C - 20060801
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.

FIGURE 10: CASE K4 - FM-461 FLANGED

BOTTOM VIEW CASE K6

*Flanged case: Designator “F” required in Case Option position of model number.



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

Case K6, Rev C - 20060801
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.

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

85°C NON-QML PRODUCTS– ENVIRONMENTAL SCREENING (STANDARD & ES)

TEST	85°C STANDARD non QML[1]	85°C /ES non QML[1]
Pre-cap Inspection		
Method 2017	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		
96 hours, typical case temperature 85°C case[2]	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	no	yes
Gross Leak, Method 1014, Cond. C	no	yes
Gross Leak, Dip (1 x 10^{-3})	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. Non-QML products do not meet all of the requirements of MIL-PRF-38534
2. Burn-in is still air with an ambient temperature designed to bring the case temperature to 85°C