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

EMI INPUT FILTERS 28 VOLT INPUT

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

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 Section B8, 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 Section C2 for screening options, see Section A5 for ordering 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.

FM-461 EMI FILTER 1.75 TO 5 AMP

EMI INPUT FILTERS

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)

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

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

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

		FM-461			FMA-461			FMB-461			
PARAMETER	**CONDITION**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**UNITS**
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 - 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.

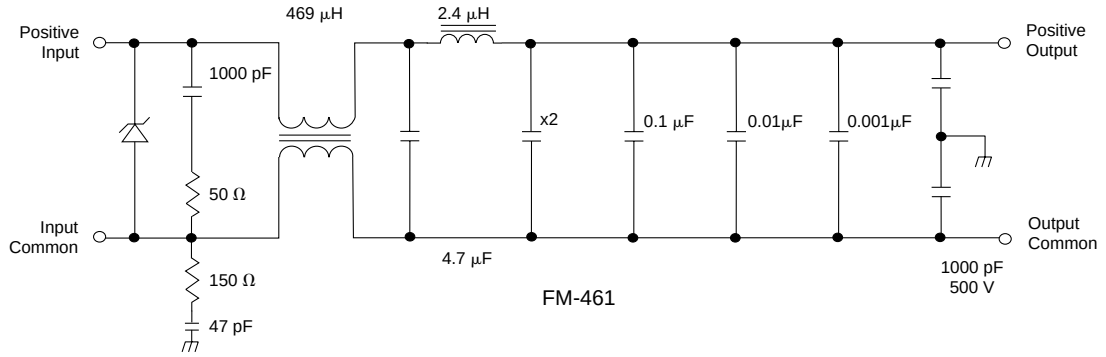


FIGURE 1: SCHEMATIC

CRANE interpoint A CRANE CO. COMPANY

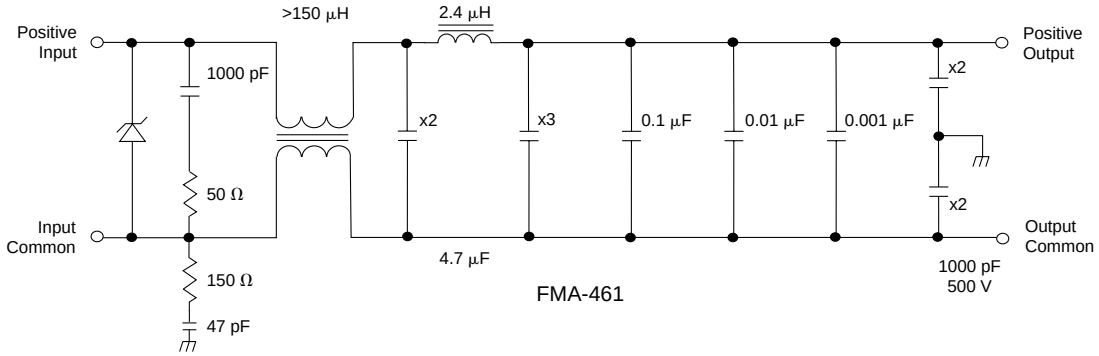


FIGURE 2: SCHEMATIC

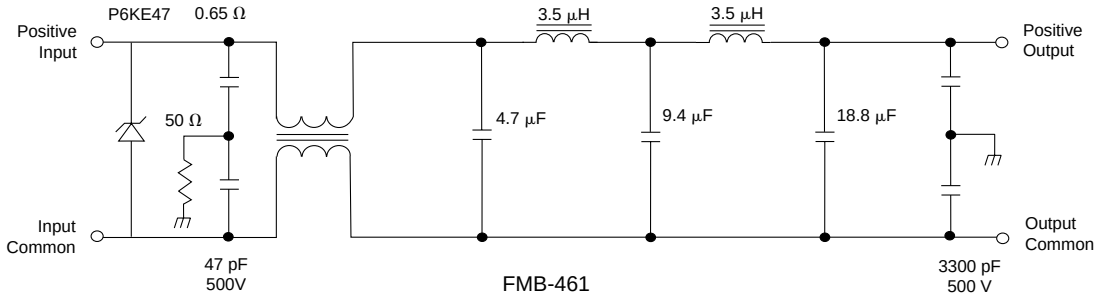
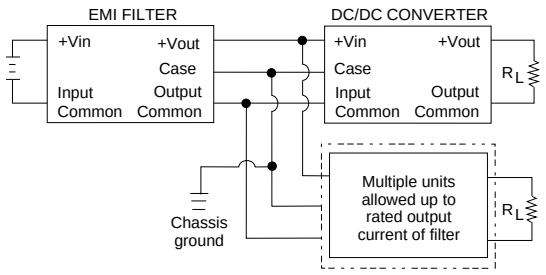


FIGURE 3: SCHEMATIC

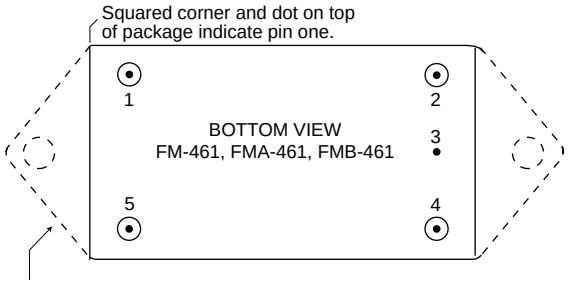


The case ground connection should be as low an impedance as possible to minimize EMI. Direct contact of baseplate to chassis ground provides the lowest impedance.

FIGURE 4: CONNECTION DIAGRAM

PIN OUT

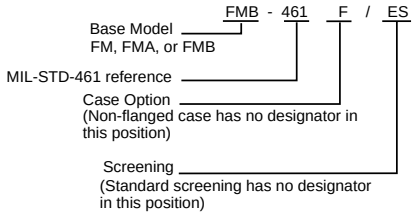
Pin	Designation
1	Positive Input
2	Positive Output
3	Case Ground
4	Output Common
5	Input Common



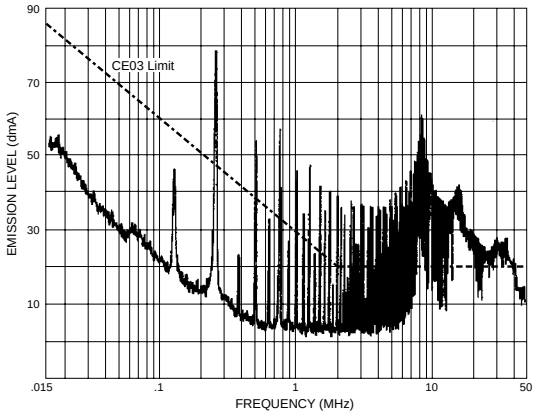
See Section B8, cases H3, H5, K4, and K6, for dimensions.

FIGURE 5: PIN OUT

MODEL NUMBERING KEY

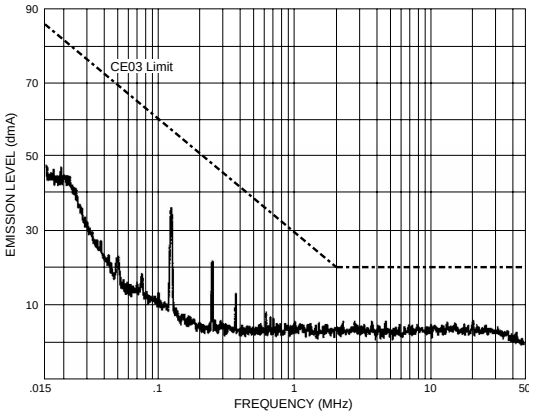


Typical Performance Curves: 25°C Tc , nominal Vin, unless otherwise specified.



MHE Converter Without Filter

FIGURE 6



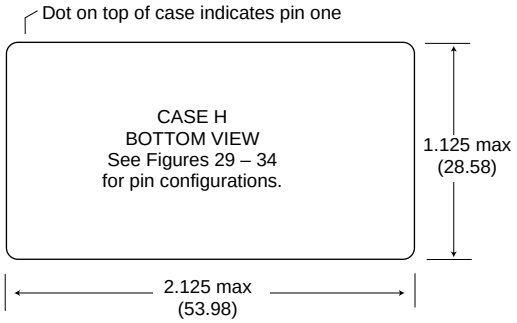
MHE Converter With FM-461 EMI Filter

FIGURE 7

26221-001-DTS Rev A DQ# 14006

CRANE

interpoint
A CRANE CO. COMPANY



Materials

Header Cold Rolled Steel/Nickel/Gold
cases H1 and H2
Cold Rolled Steel/Nickel/Tin
cases H3, H4, and H5

Cover Kovar/Nickel
cases H1 and H2
Cold Rolled Steel/Nickel/Tin
cases H3, H4, and H5

Pins #52 alloy
ceramic seal
case H1
case H2 (except MHV Series Single and Dual)
compression glass seal
MHV Series Single and Dual
case H3, H4, H5

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 dimensions in inches (mm)
Tolerance ±0.005 (0.13) for three decimal places
±0.01 (0.3) for two decimal places
unless otherwise specified

FIGURE 28: CASE H MAXIMUM DIMENSIONS

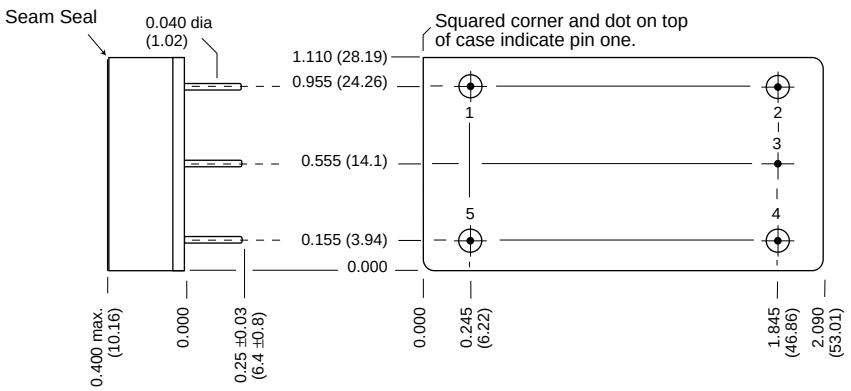


FIGURE 29: CASE H1

Note: Although every effort has been made to render the case drawings at actual size, variations in the printing process may cause some distortion. Please refer to the numerical dimensions for accuracy.

BOTTOM VIEW CASE H3

FM-461 EMI Filter: Screening – Standard of ES

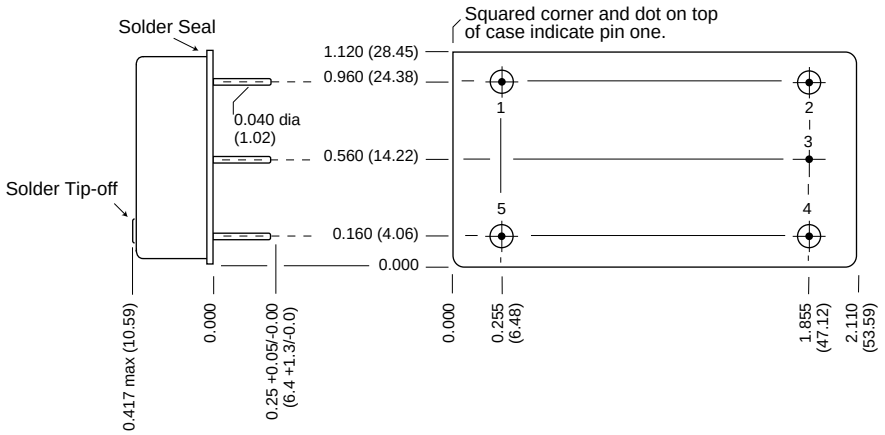


FIGURE 31: CASE H3

BOTTOM VIEW CASE H5

FMA-461and FMB-461 EMI Filter: Screening – Standard of ES

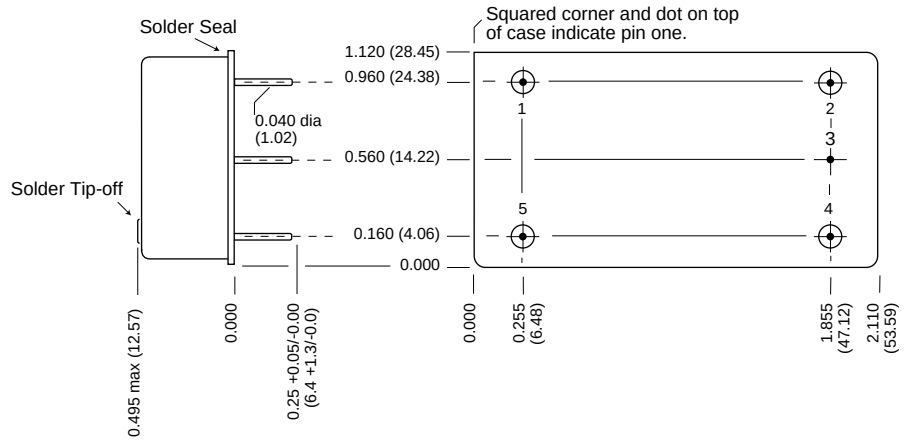


FIGURE 33: CASE H5

BOTTOM VIEW CASE H6

MHE Series: Screening – Standard or ES

HR151 Series and HR152 Series: no screening options

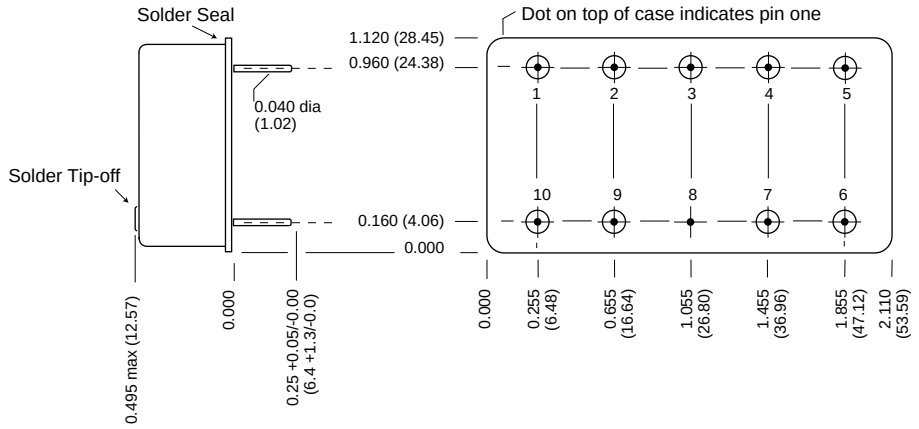
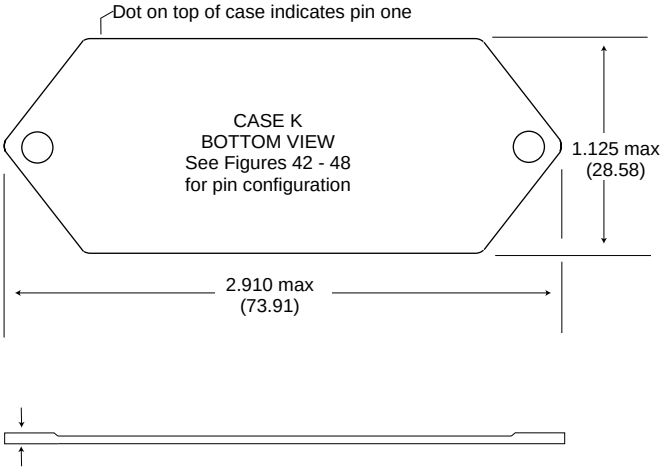


FIGURE 34: CASE H6

CASES



Flange Thickness:

Cases K1, K2, K3 and MLP Series (K5)
0.060 (1.52)
Cases K4, K5 (except MLP Series), K6, K7, and K8
0.067 +0.005/-0.007 (1.70 +0.13/-0.8)

Materials

Header Case K1 - K3
Cold Rolled Steel/Nickel/Gold
Cases K4 - K8
Cold Rolled Steel/Nickel/Tin
Cover Case K1 - K3
Kovar/Nickel
Case K4 - K8
Cold Rolled Steel/Nickel/Tin
Pins #52 alloy (all cases)
Case K1, K2, and K3 (except MHV Series Single and Dual)
ceramic seal
Cases K4 - K8 and MHV Series Single and Dual (K3)
compression glass seal

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.

FIGURE 41: CASE K MAXIMUM DIMENSIONS

BOTTOM VIEW CASE K4
Flanged case: Designator required in Case Option position of model number.
FM-461 EMI Filter: Screening – Standard or ES

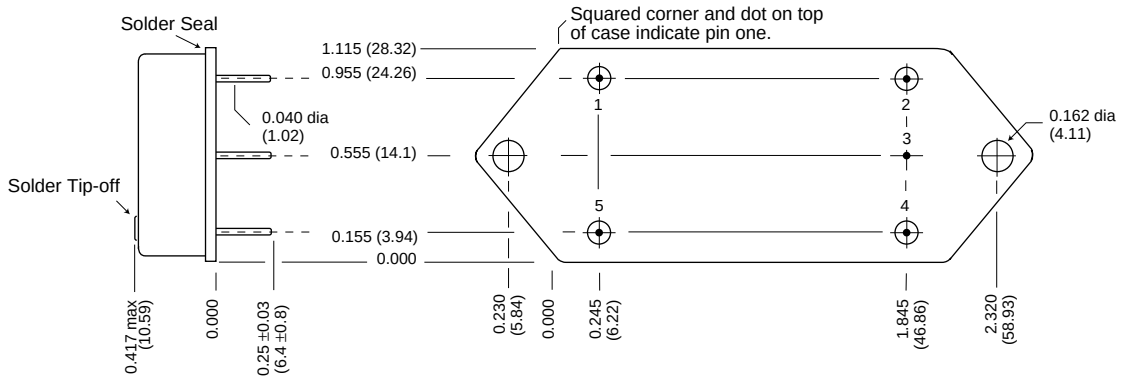


FIGURE 45: CASE K4

BOTTOM VIEW CASE K5
Flanged cases: Designator required in Case Option position of model number.
MTR Series Dual and MLP Series: Screening – Standard or ES

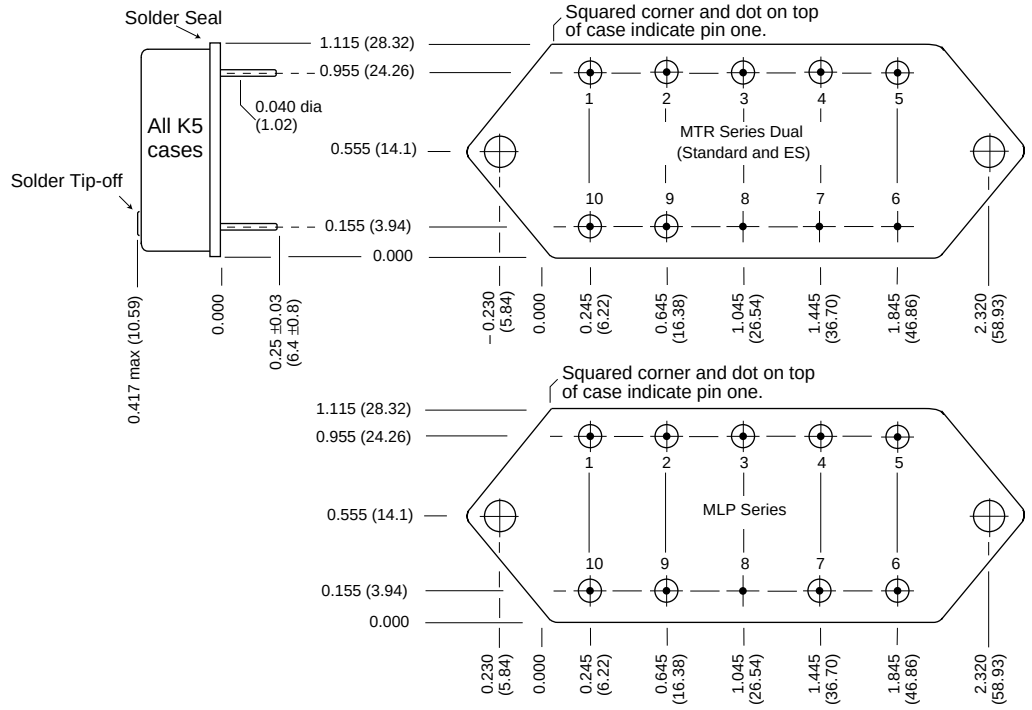


FIGURE 46: CASE K5

BOTTOM VIEW CASE K6

Flanged cases: Designator required in Case Option position of model number.
FMA-461 and FMB-461 EMI Filters: Screening – Standard or ES

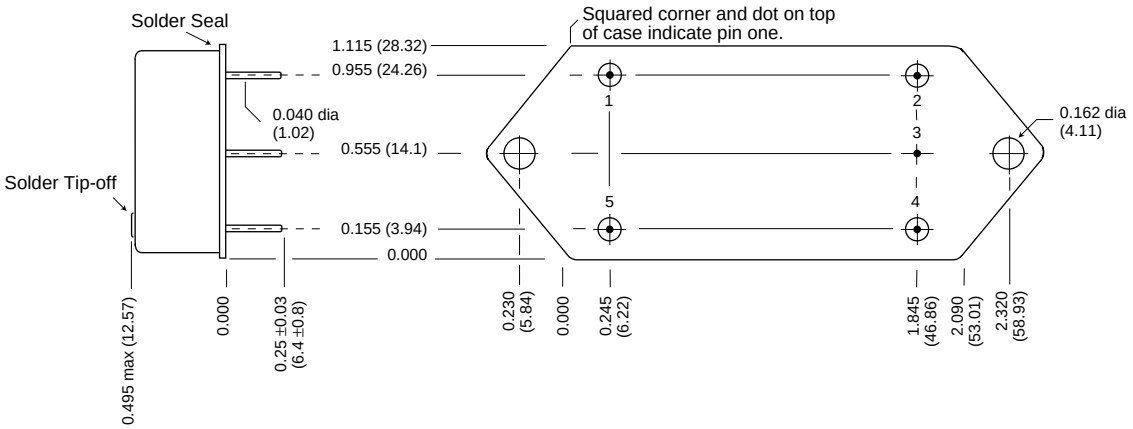


FIGURE 47: CASE K6

BOTTOM VIEW CASE K7

Flanged case: Designator required in Case Option position of model number.
MHE Series: Screening – Standard or ES

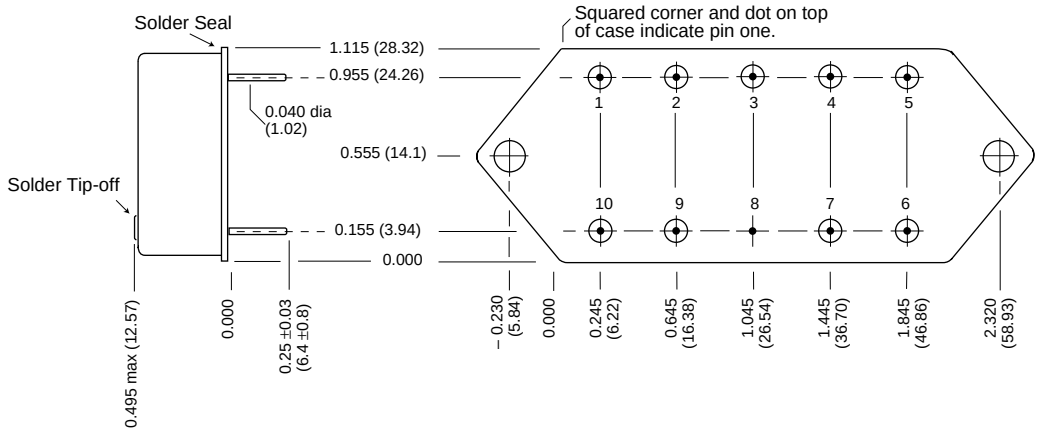


FIGURE 48: CASE K7

85°C PRODUCTS

TEST (85°C Products excluding HR products)	STANDARD	/ES
PRE-CAP INSPECTION		
Method 2017	yes	yes
TEMPERATURE CYCLE (10 times)		
Method 1010, Cond. B, -55°C to 125°C	no	yes
CONSTANT ACCELERATION		
Method 2001, 500 g	no	yes
BURN-IN		
96 hours at 70°C ambient (typical)	no	yes
FINAL ELECTRICAL TEST MIL-PRF-38534, Group A		
Subgroups 1 and 4: +25°C case	yes	yes
HERMETICITY TESTING		
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.

Applies to the following products:

MFW Series
MTW Series
MHE/MLP Series
MHL Series
MRH Series
MTO Series
MSR Series
DCH Series
FM/FMA/FMB EMI Filters
MSF EMI Filter

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