DC/DC CONVERTERS
12 AND 28 VOLT INPUT

MHE/MLP SERIES
20 WATT

FEATURES

- **–55°C to +85°C operation**
- **10 to 16 VDC input or**
  16 to 36 VDC input typical
- Fully isolated
- Opto-coupler feedback
- Fixed frequency 125 kHz typical
- Topology – Push-Pull Forward
- Transient protection
  50 V for up to 50 ms 28 Vin models
- Inhibit function
- Indefinite short circuit protection
- Trimmable output on single models
- Up to 83% efficiency

MODELS	
VDC OUTPUT	
SINGLE	DUAL
5	±12
12	±15
15	

Size (max.): Non-flanged 2.125 x 1.125 x 0.495 MHE (case H6) inches
or 0.417 MLP (case H4)
(53.98 x 28.58 x 12.57 (MHE) or 10.59 (MLP) mm)
Flanged 2.910 x 1.125 x 0.495 MHE (case K7) inches
or 0.417 MLP (case K5)
(73.91 x 28.58 x 12.57 (MHE) or 10.59 (MLP) mm)
See Section B8, cases H4, H6, K5, and K7, for dimensions.
Weight: 50 grams typical
Screening: Standard or ES. See Section C2 for screening options, see Section A5 for ordering information.

DESCRIPTION

The MHE Series™ and the MLP Series™ DC/DC converters offer the high efficiencies associated with switching regulators, yet have full isolation and the excellent regulation typical of linear regulators. No external components are required for operation. MHE Series and MLP Series converters are built using thick-film hybrid technology, and are sealed in metal packages for military, aerospace, and other high-reliability applications. Unscreened models are solder sealed and are guaranteed to pass a gross leak test (maximum leak rate of 1 x 10^{-3} atm.-cc/sec). Environmentally screened models are hermetically sealed and are screened as described in Section C2.

The MHE Series and MLP Series converters are pulse-width modulated switching regulators operating in the forward mode, with a nominal switching frequency of 125 to 140 kHz. Isolation is achieved through the use of a transformer in the forward power circuit, and an optocoupler is used in the feedback/control loop. The full load output power is available over the full input voltage range. Short-term transients of 50 volts will not impair normal operation for 28 volt input models.

The efficiency is typically greater than 80% over the entire input voltage range and from approximately 25% of full load to full load. This feature makes the MHE/MLP Series converters ideal for either battery or aircraft power applications.

An inhibit function is provided on MHE/MLP Series converters to allow power shutdown and startup from a logic input. The unit is inhibited when the inhibit input pin (pin 2) is connected to the input common (pin 10). The open circuit voltage of the inhibit pin is 8 to 10 VDC for 12 V input models or 11 to 13 VDC for 28 V input models. During inhibit, the input inhibit pin must sink approximately 1 mA. In the inhibit mode, converter output drops to less than 1 V and the input current is typically 8 mA.

Automatic current limiting circuitry protects the MHE/MLP Series converters against short circuits.

MHE/MLP Series converters are rated to operate at full load up to a case temperature of 85°C, with the output power derated linearly to zero at 115°C. Because of the unit's high efficiency, heat sinking requirements are minimized, but due consideration should be given to removing self-generated heat when operating the device at maximum ratings. To increase dissipation, heat conducting material (PCB, copper sheet, heat sink, etc.) should be brought into contact with the converter's baseplate.

When the MHE/MLP Series converters are used in applications requiring full power operation for extended periods of time, or in shock and vibration environments, it is highly recommended that the flange-mount option be used. This option provides improved thermal transfer capabilities as well as a mechanically secure mounting configuration.

DC/DC CONVERTERS

ABSOLUTE MAXIMUM RATINGS

Output Power
- 10 to 20 watts depending on model

Lead Soldering Temperature (10 sec per lead)
- 300°C

Storage Temperature Range (Case)
- –55°C to +125°C

INHIBIT

Inhibit TTL Open Collector
- Logic low (output disabled)
  Logic low voltage ≤0.8 V
- Referenced to input common
- Logic high (output enabled)
  Open collector

TYPICAL CHARACTERISTICS

Output Voltage Temperature Coefficient
- 150 ppm/°C, typical

Input to Output Capacitance
- 60 pF, typical

Current Limit
- 125% of full load, typical

Isolation
- 100 megohm minimum at 500 V

Conversion Frequency
- 125 kHz, typical

Inhibit Pin Voltage (unit enabled)
- 11 to 13 V MHE28XXX, MLP28XXX
- 8 to 10 V MHE12XXX

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range
Continuous
- 17 to 40 VDC MHE28XXX
- 10 to 16 VDC MHE12XXX
- 16 to 40 VDC MLP28XXX

Transient
- 50 V for 50 msec on 28 V input models

Case Operating Temperature (Tc)
- –55°C to +85°C full power

Derating Output Power/Current
- Linearly from 100% at 85°C to 0% at 115° C
- MHE28XXX models derate by 33% at 16 Vin

Electrical Characteristics: 25°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.

SINGLE OUTPUT MHE12XX MODELS		MHE1205S			MHE1212S			MHE1215S			
PARAMETER	CONDITION	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	UNITS
OUTPUT VOLTAGE		4.95	5.00	5.05	11.88	12.00	12.12	14.85	15.00	15.15	VDC
OUTPUT CURRENT	–55°C TO +85°C	—	—	3	—	—	1.25	—	—	1.0	A
OUTPUT POWER	–55°C TO +85°C	—	—	15	—	—	15	—	—	15	W
OUTPUT RIPPLE VOLTAGE	0 TO 1 MHz	—	35	70	—	35	70	—	35	70	mV p-p
LINE REGULATION	V_{IN} MIN TO MAX	—	2	5	—	3	10	—	3	10	mV
LOAD REGULATION	NO LOAD TO FULL	—	10	20	—	5	15	—	10	20	mV
INPUT VOLTAGE	CONTINUOUS	10	12	16	10	12	16	10	12	16	VDC
	TRANSIENT 50 ms	—	—	—	—	—	—	—	—	—	V
INPUT CURRENT	NO LOAD	—	—	24	—	—	32	—	—	32	mA
INPUT RIPPLE CURRENT	10 kHz – 2 MHz	—	30	80	—	30	80	—	30	80	mA p-p
EFFICIENCY		78	81	—	79	82	—	80	83	—	%

Electrical characteristics: 25°C Tc, 28 VDC Vin (12 Vin for 12 V models), 100% load, unless otherwise specified.

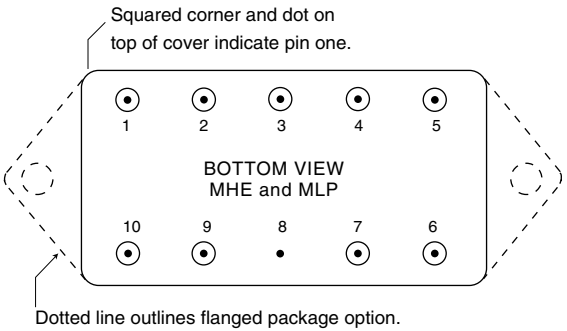
SINGLE AND DUAL MHE28XX MODELS		MHE2805S			MHE2812S			MHE2815S			MHE2812D			MHE2815D			
PARAMETER	**CONDITIONS**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**UNITS**
OUTPUT VOLTAGE		4.95	5.00	5.05	11.88	12.00	12.12	14.85	15.00	15.15	±11.88	±12.00	±12.12	±14.85	±15.00	±15.15	VDC
OUTPUT CURRENT[1]	–55 TO +85°C	—	—	3.0	—	—	1.67	—	—	1.33	—	—	±0.63	—	—	±0.5	A
OUTPUT POWER[1]	–55 TO +85°C	—	—	15	—	—	20	—	—	20	—	—	15	—	—	15	W
OUTPUT RIPPLE VOLTAGE	0 - 1 MHz	—	35	60	—	60	80	—	30	60	—	30	50	—	30	50	mV p-p
LINE REGULATION	V_{IN} MIN TO MAX	—	2	5	—	3	10	—	3	10	—	3	10	—	3	15	mV
LOAD REGULATION	NO LOAD TO FULL	—	10	20	—	5	15	—	5	15	—	5	15	—	5	15	mV
INPUT VOLTAGE	CONTINUOUS	17	28	40	17	28	40	17	28	40	17	28	40	17	28	40	VDC
	TRANSIENT 50 ms	—	—	50	—	—	50	—	—	50	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	—	18	—	—	30	—	—	30	—	—	35	—	—	35	mA
INPUT RIPPLE CURRENT	10 kHz - 2 MHz	—	20	50	—	25	50	—	25	50	—	25	50	—	25	50	mA p-p
EFFICIENCY		78	81	—	79	82	—	80	83	—	76	79	—	76	79	—	%

SINGLE AND DUAL MLP MODELS		MLP2805S			MLP2812S			MLP2815S			MLP2812D			MLP2815D			
PARAMETER	**CONDITIONS**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**UNITS**
OUTPUT VOLTAGE		4.95	5.00	5.05	11.88	12.00	12.12	14.85	15.00	15.15	±11.88	±12.00	±12.12	±14.85	±15.00	±15.15	VDC
OUTPUT CURRENT[1]	–55 TO +85°C	—	—	2	—	—	1.25	—	—	1	—	—	±0.41	—	—	±0.33	A
OUTPUT POWER[1]	–55 TO +85°C	—	—	10	—	—	15	—	—	15	—	—	10	—	—	10	W
OUTPUT RIPPLE VOLTAGE	0 - 1 MHz	—	25	60	—	30	50	—	30	50	—	30	60	—	30	60	mV p-p
LINE REGULATION	V_{IN} MIN TO MAX	—	2	5	—	3	10	—	3	10	—	3	10	—	3	10	mV
LOAD REGULATION	NO LOAD TO FULL	—	10	20	—	5	15	—	5	15	—	5	15	—	5	15	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	16	28	40	16	28	40	16	28	40	16	28	40	VDC
	TRANSIENT 50 ms	—	—	50	—	—	50	—	—	50	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	—	20	—	—	30	—	—	30	—	—	30	—	—	30	mA
INPUT RIPPLE CURRENT	10 kHz - 2 MHz	—	20	50	—	25	50	—	25	50	—	25	50	—	25	50	mA p-p
EFFICIENCY		78	81	—	79	82	—	80	83	—	78	81	—	78	81	—	%

Note
1. On dual output models at least 25% of the load should be on the positive output.

Pin	Single Output	Dual Output
1	Positive Input	Positive Input
2	Inhibit	Inhibit
3	Output Adjust	Positive Output
4	Output Common	Output Common
5	Positive Output	Negative Output
6	No connection	No connection
7	No connection	No connection
8	Case Ground	Case Ground
9	No connection	No connection
10	Input Common	Input Common

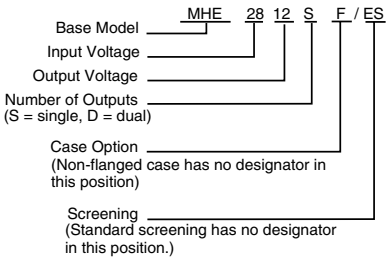
PIN OUT



See Section B8, case H4, H6, K5 and K7 for dimensions.

FIGURE 1: PIN OUT

MODEL NUMBERING KEY

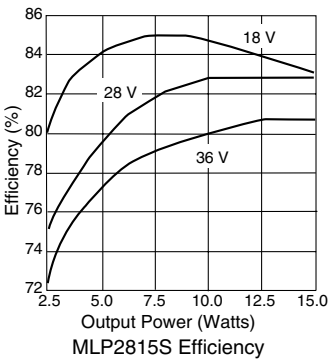


OUTPUT ADJUSTMENT RESISTOR VALUES FOR MHE2805S AND MLP2805S

Resistance Pin 3 to 4	Output Voltage Increase (%)
∞	0
390K	+1%
145K	+2%
63K	+3%
22K	+4%
0	+5%

Output Adjustment all single output models:
The output can be adjusted upward by using the output adjust (pin3). The resistance between output adjust (pin 3) and output common (pin 4) will determine the magnitude of the increase in the output. **The table above is applicable only to MHE2805S and MLP2805S.**

TYPICAL PERFORMANCE CURVE



MLP2815S Efficiency

FIGURE 2

22820-001-DTS Rev B

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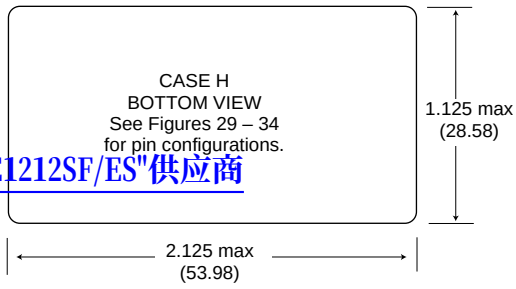

cases H1 and H2
Cold Rolled Steel/Nickel/Tin
cases H3, H4, and H5

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

BOTTOM VIEW CASE H1
FMC EMI Filter: Screening – Standard, ES, or 883
SFMC EMI Filter: Screening – Space Standard, H, or K

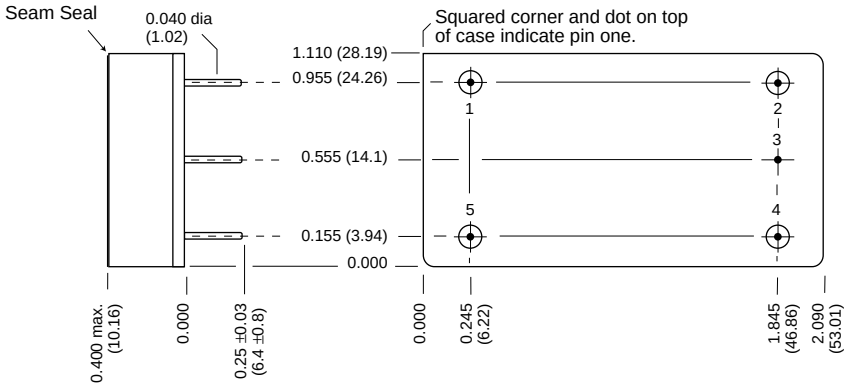

FIGURE 29: CASE H1

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 to the numerical dimensions for accuracy.

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B

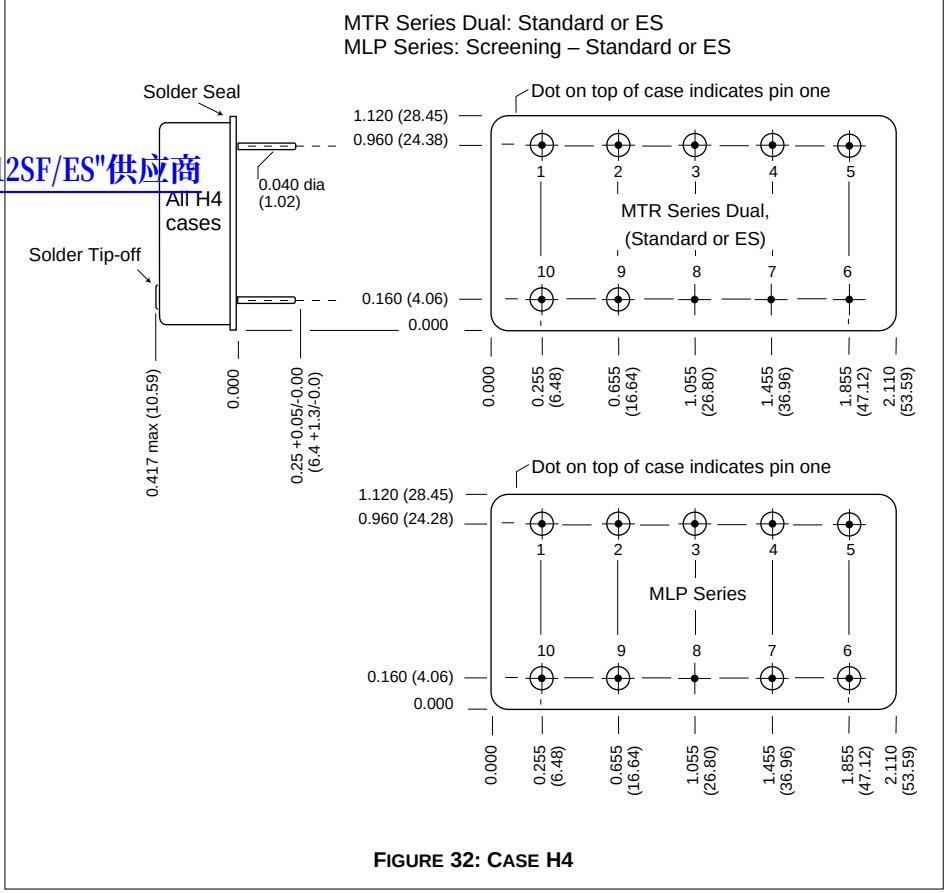


FIGURE 32: CASE H4

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

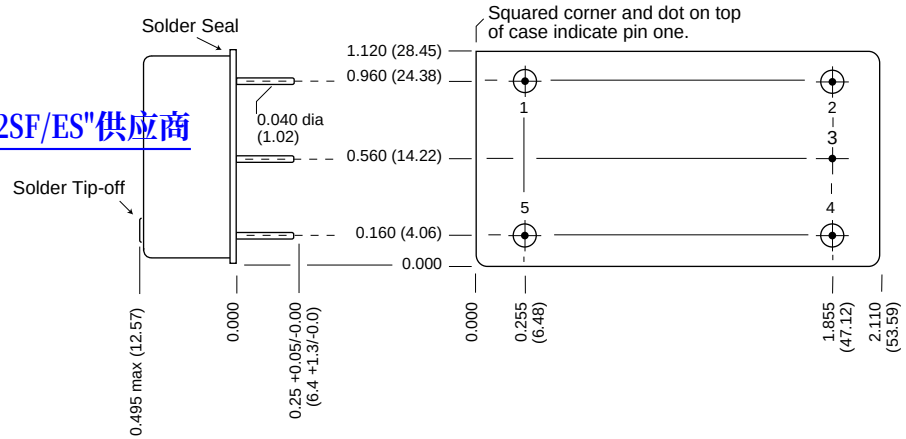


FIGURE 33: CASE H5

BOTTOM VIEW CASE H6

MHE Series: Screening – Standard or ES
HR151 Series and HR152 Series: no screening options

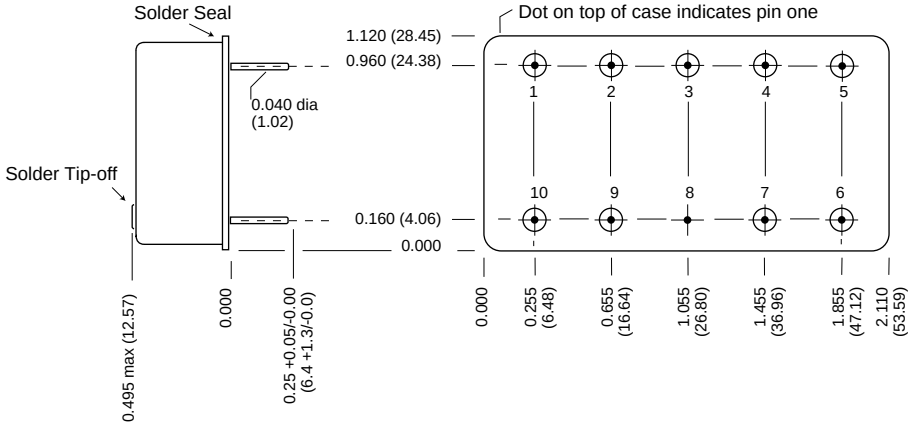
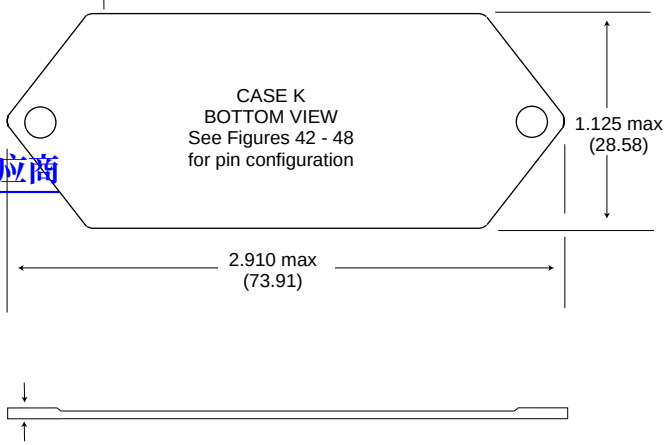


FIGURE 34: CASE H6



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

FM-461 EMI Filter: Screening – Standard or ES

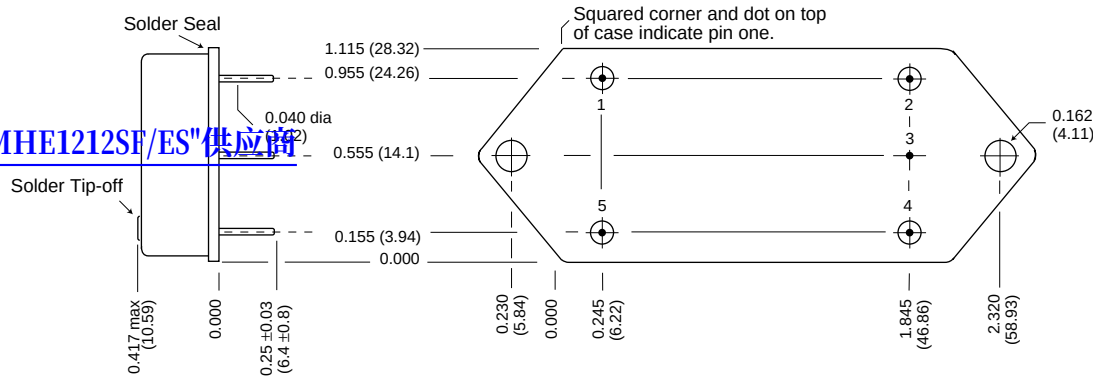


FIGURE 45: CASE K4

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

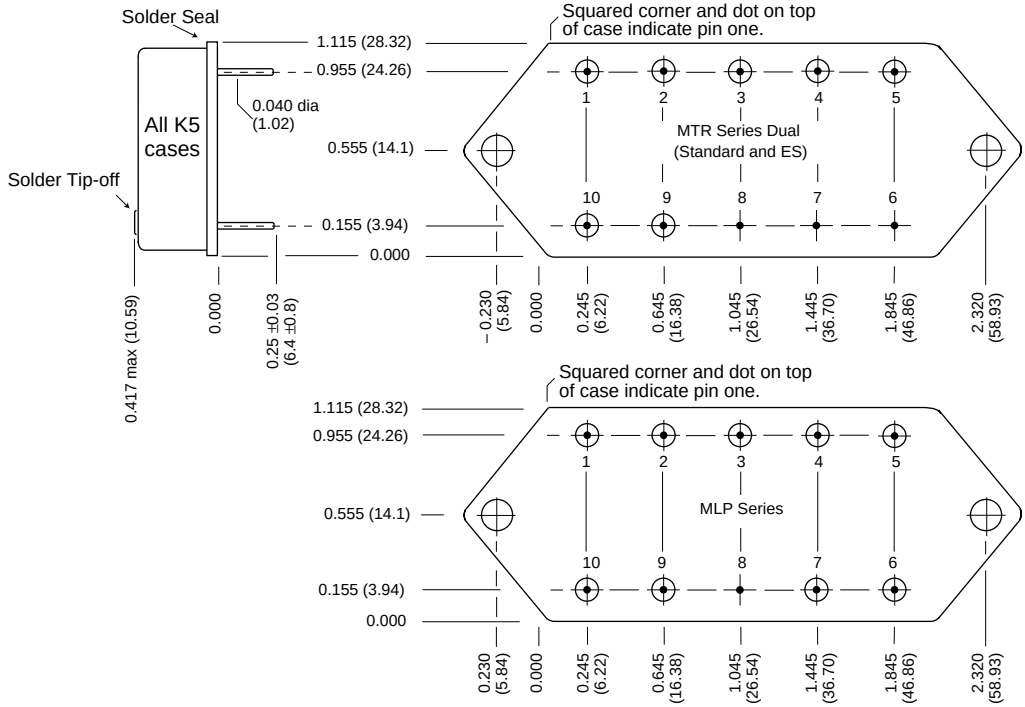


FIGURE 46: CASE K5

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

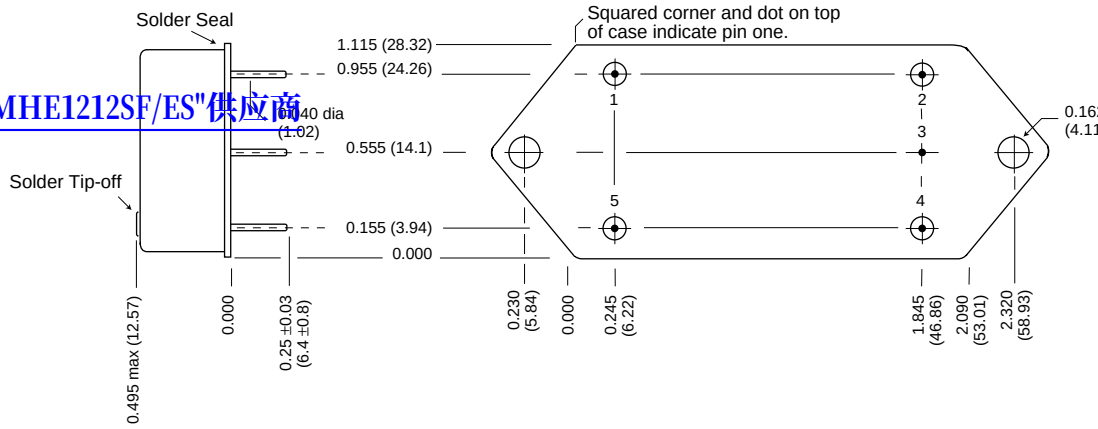


FIGURE 47: CASE K6

BOTTOM VIEW CASE K7

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

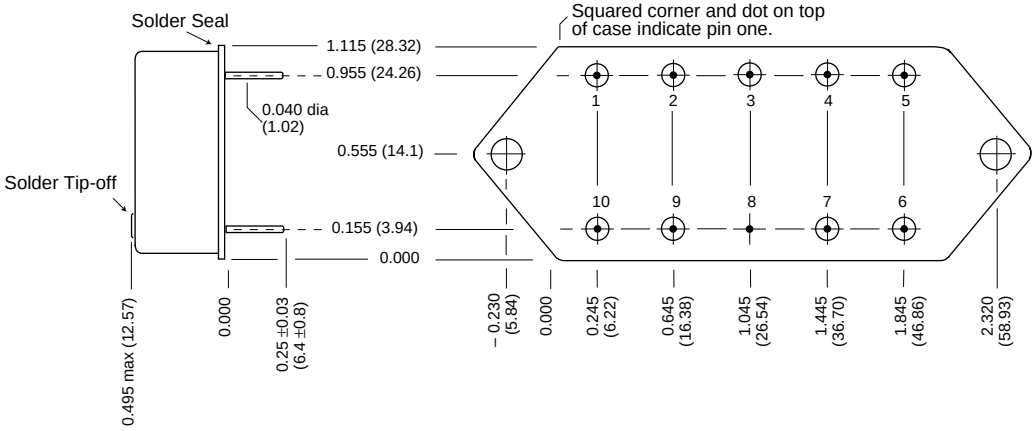


FIGURE 48: CASE K7

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