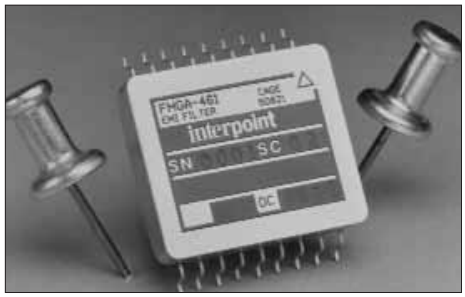
# FMSA/FMGA EMI Input Filters

## 28 VOLT INPUT – 0.8 AMP

### FEATURES

- –55°C to +125°C operation
- 50 dB min. attenuation at 500 kHz differential mode
- 45 dB min. attenuation at 5MHz common mode
- Compliant to MIL-STD-461C, CE03
- Compatible with MIL-STD-704E DC power bus
- Compatible with MIL-STD-704A through E (FMGA)


| MODEL | |
|---|---|
| FMSA-461 | 0.8 amp |
| FMGA-461 | 0.8 amp |




### FMSA SERIES™ EMI FILTER

The FMSA-461 EMI filter modules have been designed as a companion for Interpoint MSA flyback power converters. Multiple MSA power converters can be operated from a single filter provided the total power line current does not exceed the filter maximum rating. The FMSA filter will reduce the MSA's power line reflected ripple current to within the limit of MIL-STD-461C, Method CE03, as shown in the example of Figures 4 and 5.

The FMSA is fabricated using thick film hybrid technology and is sealed in a metal package for military, aerospace and other applications requiring EMI suppression. The filter uses only ceramic capacitors for reliable high temperature operation.

### OPERATION

The MSA power converter has an internal 2 $\mu$F capacitor across its input power terminals. When the MSA and FMSA filters are used together, this capacitor becomes part of the filter and forms its final LC output section. When 2 or 3 MSAs are used with a single filter, this capacitor becomes 4 $\mu$F or 6 $\mu$F respectively, rather than 2 $\mu$F, improving the rejection vs. frequency.

The FMSA filter can also be used with other types of Interpoint power converters (MHF, MHF+, MHE, MHD, and DCH series) to comply with CE03. For MHF, MHF+, MHD, and MHE models, the converter has an LC type line filter such that an inductor is seen looking into its positive input terminal. For these converters, it is necessary to terminate the filter with a capacitor to insure unconditionally stable operation. A capacitor across the filter output terminals of greater than 4$\mu$F or the optional damping circuit shown on the connection diagram will be adequate for stable operation. No capacitor is required for MSA, or DCH models.

### OPTIONAL DAMPING CIRCUIT

The optional damping circuit (Figure 2) can be used to prevent filter overshoot caused by MIL-STD-704A 80 V, or other, transients having rise times of less than 200 $\mu$Sec. This damping can be alternately provided with a 1.50 Ω resistor in series with the filter positive input where the additional line loss can be tolerated. For transients with rise times of greater than 200 $\mu$sec, there is no overshoot and the damping circuit is not required.

### LAYOUT REQUIREMENTS

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

# FMSA/FMGA EMI Input Filters

## 28 VOLT INPUT – 0.8 AMP

### FMGA SERIES™ EMI FILTER

Interpoint's surface mount FMGA-461™ EMI filter has been designed to work with Interpoint's surface mount MGA and MGH Series DC/DC converters. Multiple MGA or MGH Series converters can be operated from a single FMGA filter provided the total power line current does not exceed the filter's maximum rating. The FMGA filter will reduce the converter's power line reflected ripple current to within the limit of MIL-STD-461C, Method CE03 as shown in Figures 4 through 7. The filter uses only ceramic capacitors for reliable high-temperature operation.

### CONNECTION AND OPERATION

Where more than one pin has the same designation (e.g. pins 7, 8, and 9 are Positive Output), all of those pins must be connected for output performance to meet the specifications.

The MGA Series has an internal 2 $\mu$F capacitor its input terminals and the MGH Series has an internal 0.47 $\mu$F capacitor across its input power terminals. When the MGA or MGH converters are used with the FMGA filter, this capacitor becomes part of the filter and forms its final LC output section. When 2 or 3 MGA or MGH converters are used with a single filter, this capacitor becomes larger, improving the rejection versus frequency.

### TRANSIENT DAMPING

The optional damping circuit shown in Figure 2 will prevent filter overshoot caused by 80 V transients with rise times of less than 200 microseconds. The damping circuit can be used with a 1.50 Ω resistor in series with the filter's positive input where the additional line loss can be tolerated. For transients with rise times of greater than 200 microseconds, there is no overshoot and the damping circuit is not required.

### SURFACE MOUNT PACKAGE

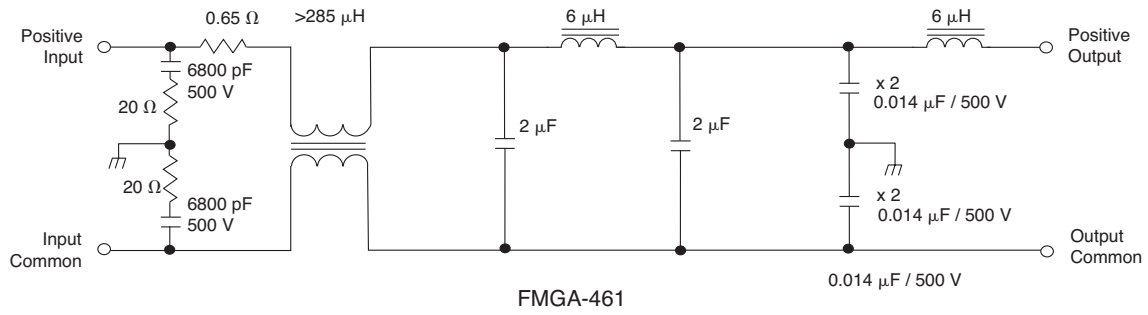
The FMGA EMI filter can be surface mounted with pick-and-place equipment or manually. It is recommended that the case be attached with flexible epoxy adhesive or silicone which is thermally conductive (>1 watt /meter/°K).

Internal components are soldered with SN96 (melting temperature 221°C) to prevent damage during reflow. Maximum reflow temperature for surface mounting the FMGA filter is 220°C for a maximum of 30 seconds. SN60, 62, or 63 are the recommended types of solder. Hand soldering should not exceed 300°C for 10 seconds per pin.

The hermetically sealed metal cases are available in two different lead configurations. See case B for dimensions and options.

### LAYOUT REQUIREMENTS

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




FMGA-461

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: FMGA TYPICAL SCHEMATIC**

# FMSA/FMGA EMI Input Filters

## 28 VOLT INPUT – 0.8 AMP

### DAMPING CIRCUITS

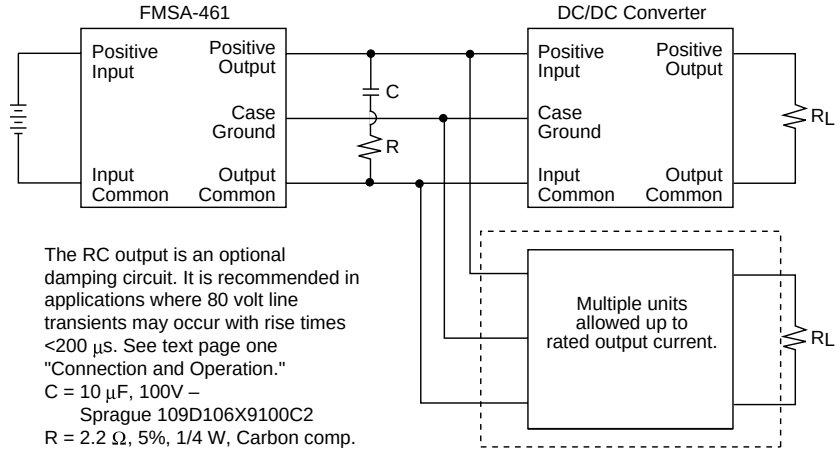



**FIGURE 2: FMSA DAMPING CIRCUIT**

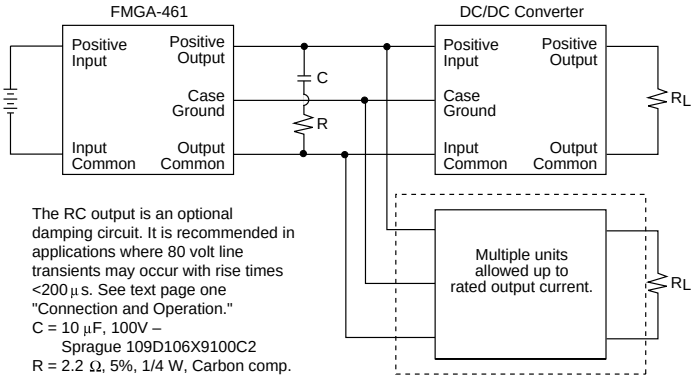



**FIGURE 3: FMGA DAMPING CIRCUIT**

# FMSA/FMGA EMI Input Filters

## 28 VOLT INPUT – 0.8 AMP

### OPERATING CONDITIONS AND CHARACTERISTICS

**Input Voltage Range**
- 0 to 50 VDC continuous FMSA models
  16 to 40 VDC continuous FMGA models
- 80 V for 100 ms transient

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

**Storage Temperature Range (Case)**
- –65°C to +150°C

**Case Operating Temperature (Tc)**
- –55°C to +125°C full power

**Derating Input/Output Current**
- Derate linearly from 100% at 100°C to 0.60 amps at 125°C case. Above 125°C derate to 0%.

**Capacitance**
- 0.045 µF max, any pin to case

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

### MECHANICAL AND ENVIRONMENTAL

**Size (maximum)**

FMSA models 0.980 x 0.805 x 0.270 (24.89 x 20.45 x 6.86 mm)
See case A1 for dimensions.

FMGA models 1.010 x 0.880 x 0.250 inches (25.65 x 22.35 x 6.35 mm)
Shown with "gull wing" lead option, also available with straight leads. See case B for dimensions and options.

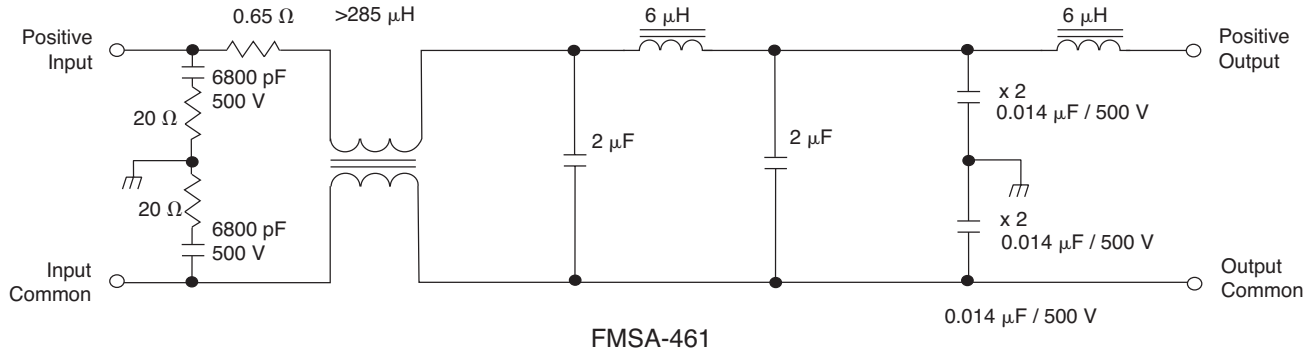
**Weight (maximum)**

10.3 grams typical, 11.5 grams maximum

**Screening***

Standard, ES. See "883, Class H, QML Products – Element Evaluation" and "883, Class H, QML Products – Environmental Screening" for more informa tion.

* FMGA model has the option of Class H screening, while FMSA does not.




FMSA-461

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.

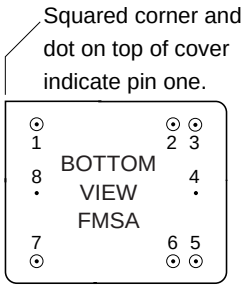
**FIGURE 4: FMSA SCHEMATIC – TYPICAL VALUES**

# FMSA/FMGA EMI Input Filters

## 28 VOLT INPUT – 0.8 AMP

### PIN OUT FMSA MODELS

| Pin | Designation |
|---|---|
| 1 | Positive Input |
| 2, 3 | Positive Output |
| 4 | Case Ground |
| 5, 6 | Output Common |
| 7 | Input Common |
| 8 | Case Ground |




See case A1 for dimensions.

**FIGURE 5: FMSA PIN OUT**

### PINS NOT IN USE

**FMSA:**

| | |
|---|---|
| Case ground | Connect to case ground for optimum fitting |

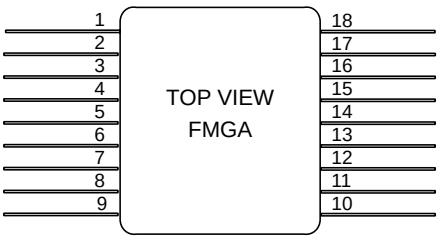
**FMGA:**

| | |
|---|---|
| Case ground (pin 5, 6, 13, 14) | Connect to case ground for optimum fitting |
| Pin 3, 4, 15, 16 (pins with no connection) | Connect to case ground for optimum fitting |

### PIN OUT FMGA MODELS

| Pin | Description |
|---|---|
| 1, 2 | Positive Input |
| 3, 4 | No Connection |
| 5, 6 | Case Ground |
| 7, 8, 9 | Positive Output |
| 10, 11, 12 | Output Common |
| 13, 14 | Case Ground |
| 15, 16 | No Connection |
| 17, 18 | Input Common |

To meet specified performance, all pins must be connected except “No Connection” pins.




Differently colored glass bead around pin one or dimple in header (bottom or side of case) indicates pin one.
Cover marking is oriented with pin one at the upper right corner.

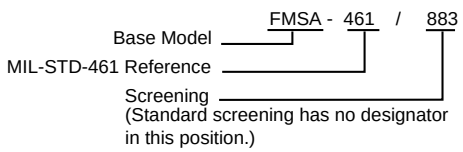
See case B for dimensions and “gull-wing” lead option.

**FIGURE 6: FMGA PIN OUT**

# FMSA/FMGA EMI Input Filters

## 28 VOLT INPUT – 0.8 AMP

**MODEL NUMBERING KEY**




**DSCC NUMBER**

| DSCC Drawing (5915) | FMSA-461 Filter Similar Part |
|---|---|
| 96003-01HXC | FMSA-461/883 |

For exact specifications for a DSCC product, refer to the DSCC drawing. DSCC drawings can be downloaded from: http://www.dscc.dla.mil/programs/smcr

## Model Selection

| FMSA | 461 | _____ |
|---|---|---|
| *Base model* | *MIL-STD-461 ref.* | *Screening* |

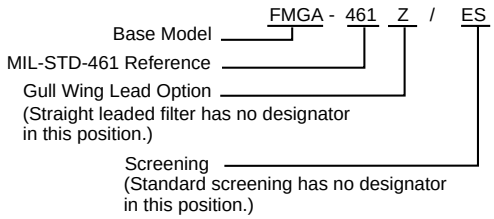
Choose one from each of the following rows

| | | |
|---|---|---|
| **Case option** | No case options | |
| **Screening** | standard screening, leave blank | /ES (ES screening), /883 (Class H, QML) |

# FMSA/FMGA EMI Input Filters

## 28 VOLT INPUT – 0.8 AMP

### MODEL NUMBERING KEY




### DSCC NUMBER

| DSCC DRAWING (5915) | FMGA-461 FILTER SIMILAR PART |
|---|---|
| 96003-01HYC | FMGA-461/883 |

For exact specifications for a DSCC product, refer to the DSCC drawing. For the gull wing lead option, replace the Y in the DSCC number (HYC) with a Z (HZC). DSCC drawings can be downloaded from:
http://www.dscc.dla.mil/programs/smcr

## Model Selection

| FMGA | 461 | _____ |
|---|---|---|
| *Base model* | *MIL-STD-461 ref.* | *Screening* |

Choose one from each of the following rows

| | | |
|---|---|---|
| **Case option** | straight leaded, leave blank | Gull Wing lead, “Z” |
| **Screening** | standard screening, leave blank | /ES (ES screening), /883 (Class H, QML) |

# FMSA/FMGA EMI Input Filters

## 28 VOLT INPUT – 0.8 AMP

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

| PARAMETER | CONDITIONS | FMSA-461 MIN | FMSA-461 TYP | FMSA-461 MAX | UNITS |
|---|---|---|---|---|---|
| INPUT VOLTAGE | CONTINUOUS | 0 | 28 | 40 | VDC |
| | TRANSIENT[1], 100 ms | — | — | 80 | V |
| INPUT CURRENT[1] | | — | — | 0.80 | A |
| NOISE REJECTION | 500 kHz | 50 | — | — | dB |
| | 1 MHz | 50 | — | — | |
| NOISE REJECTION | 5 MHz | 45 | — | — | dB |
| DC RESISTANCE ($R_{DC}$) | TC = 25°C | — | — | 1.2 | Ω |
| OUTPUT VOLTAGE | STEADY STATE | $V_{OUT} = V_{IN} - I_{IN} (R_{DC})$ | | | VDC |
| OUTPUT CURRENT | STEADY STATE (<100°C CASE) | — | — | 0.80 | A |
| INTERNAL POWER DISSIPATION | MAXIMUM CURRENT | — | — | 0.96 | W |

| PARAMETER | CONDITIONS | FMGA-461 MIN | FMGA-461 TYP | FMGA-461 MAX | UNITS |
|---|---|---|---|---|---|
| INPUT VOLTAGE[1] | CONTINUOUS | 0 | 28 | 40 | VDC |
| | TRANSIENT 100 ms | — | — | 80 | V |
| INPUT CURRENT[1] | | — | — | 0.80 | A |
| DIFFERENTIAL MODE | 500 kHz | 55 | — | — | dB |
| NOISE REJECTION | 5 MHz | 50 | — | — | |
| COMMON MODE NOISE REJECTION | 2 MHz - 50 MHz | 40 | — | — | dB |
| DC RESISTANCE ($R_{DC}$) | TC = 25°C | — | — | 1.2 | Ω |
| OUTPUT VOLTAGE | STEADY STATE | $V_{OUT} = V_{IN} - I_{IN}(R_{DC})$ | | | VDC |
| OUTPUT CURRENT[1] | STEADY STATE (<100°C CASE) | — | — | 0.80 | A |
| INTERNAL POWER DISSIPATION[1] | MAXIMUM CURRENT | — | — | 0.77 | W |

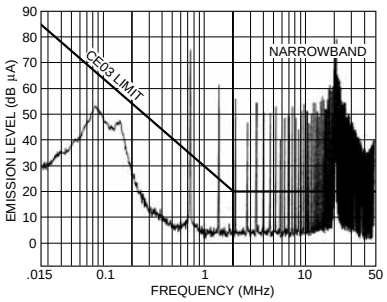
Notes:
1. Guaranteed by design, not tested.

# FMSA/FMGA EMI Input Filters

## 28 VOLT INPUT – 0.8 AMP

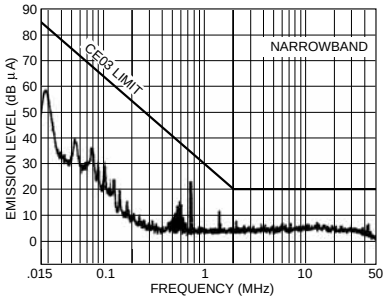
**Typical Performance Curves: 25°C Tc, nominal Vin, unless otherwise specified.**

### FMSA EMI FILTERS



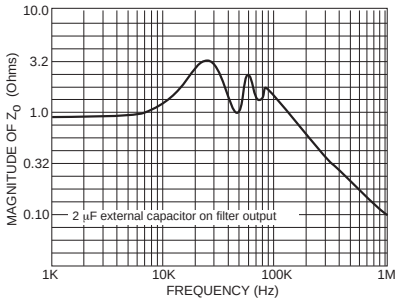

MSA2805S converter without a filter.

**FIGURE 7**




MSA2805S converters at full load with an FMSA-461 EMI filter

**FIGURE 8**




Typical Output Impedance (Z)
With Input Shorted
FMSA-461 EMI Filter

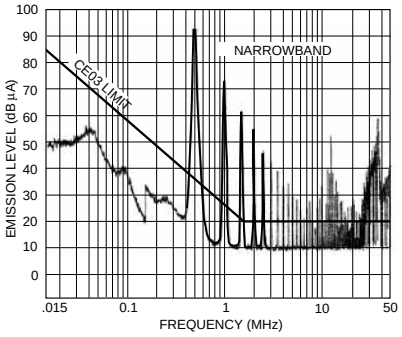
**FIGURE 9**

# FMSA/FMGA EMI Input Filters

## 28 VOLT INPUT – 0.8 AMP

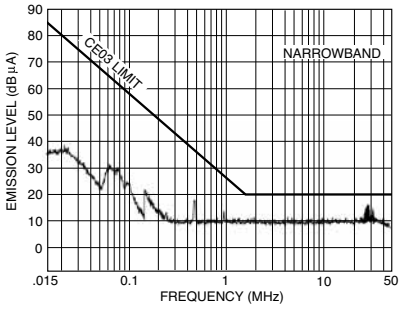
**Typical Performance Curves: 25°C Tc, nominal Vin, unless otherwise specified.**

### FMGA EMI FILTERS



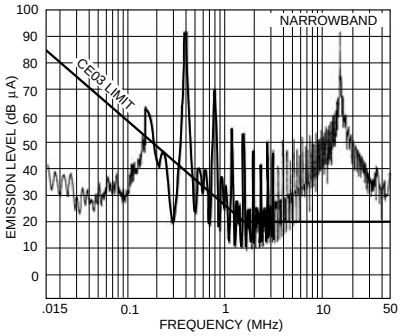

TWO MGA 2805S CONVERTERS AT FULL LOAD
WITHOUT FILTERING
TYPICAL POWER LINE SPECTRAL NOISE CURRENT

**FIGURE 10**



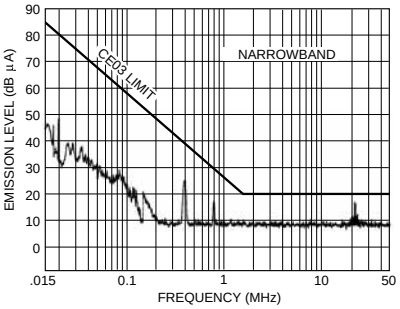

TWO MGA 2805S CONVERTERS AT FULL LOAD
WITH FMGA-461 POWER LINE FILTERING
TYPICAL POWER LINE SPECTRAL NOISE CURRENT

**FIGURE 11**



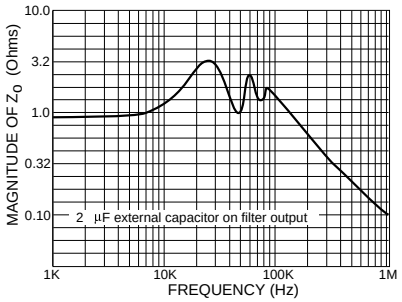

TWO MGH 2805S CONVERTERS AT FULL LOAD
WITHOUT FILTERING
TYPICAL POWER LINE SPECTRAL NOISE CURRENT

**FIGURE 12**




TWO MGH 2805S CONVERTERS AT FULL LOAD
WITH FMGA-461 POWER LINE FILTERING
TYPICAL POWER LINE SPECTRAL NOISE CURRENT

**FIGURE 13**



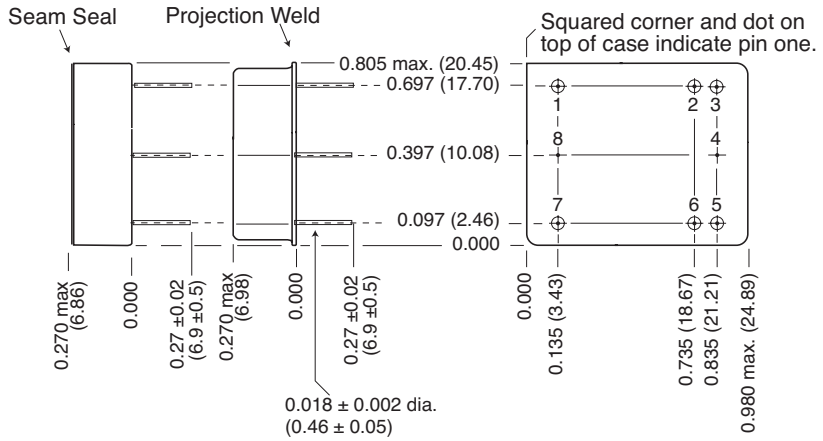

Typical Output Impedance (Z)
With Input Shorted - FMGA

**FIGURE 14**

# FMSA/FMGA EMI Input Filter Cases

## 28 VOLT INPUT – 0.8 AMP

BOTTOM VIEW CASE A1




Seal hole: 0.056 ±0.002 (1.42 ±0.05)

**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 | Kovar/Nickel/Gold |
| Cover | Kovar/Nickel |
| Pins | Kovar/Nickel/Gold matched glass seal |

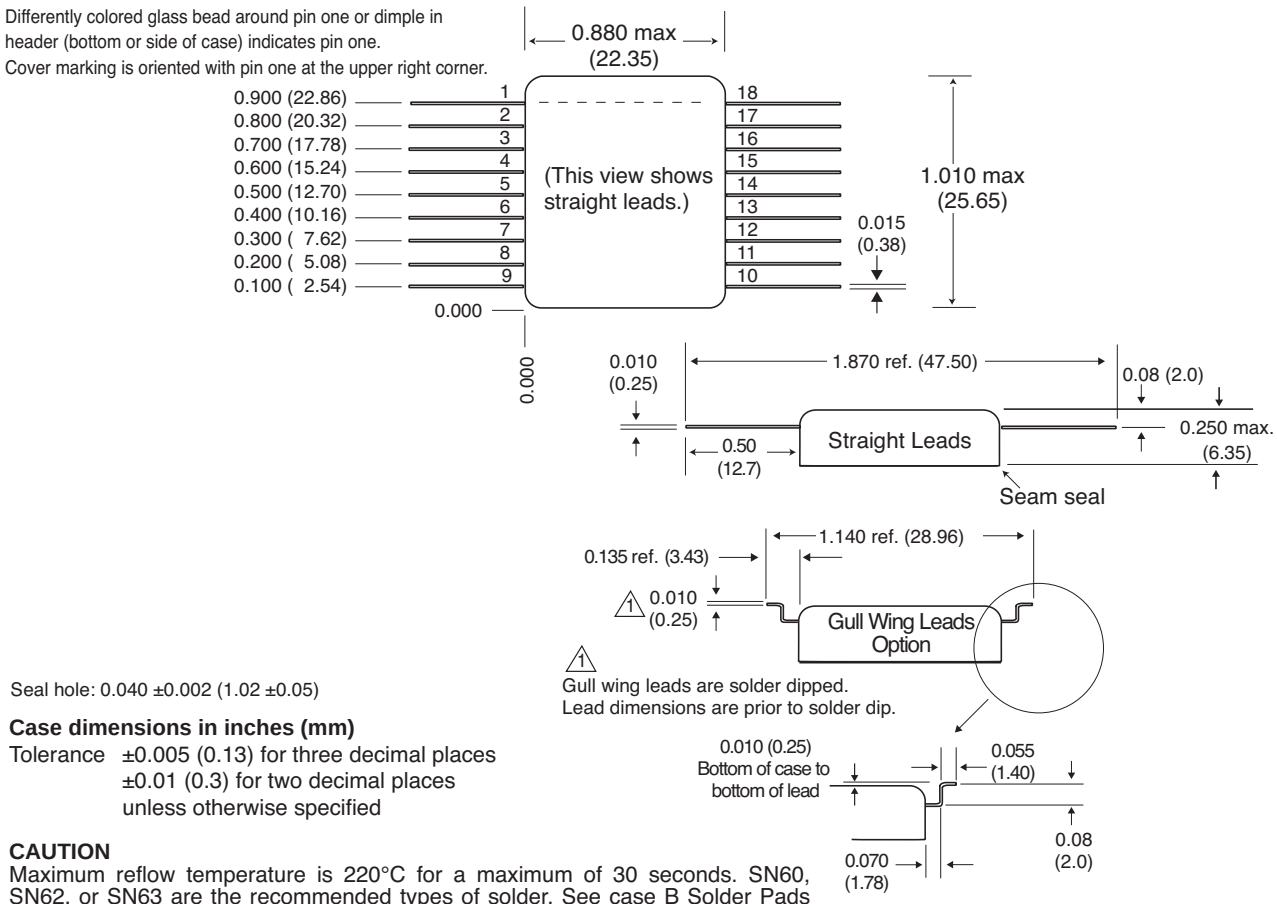
Case A1, Rev C, 20060110
Please refer to the numerical dimensions for accuracy. All information is believed to be accurate, but no responsibility is assumed for errors or omissions. Interpoint reserves the right to make changes in products or specifications without notice.


**FIGURE 15: CASE A1**

# FMSA/FMGA EMI Input Filter Cases

## 28 VOLT INPUT – 0.8 AMP

TOP VIEW CASE B




Seal hole: 0.040 ±0.002 (1.02 ±0.05)

**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**

Maximum reflow temperature is 220°C for a maximum of 30 seconds. SN60, SN62, or SN63 are the recommended types of solder. See case B Solder Pads for Solder Mask instructions.

Hand soldering should not exceed 300°C for 10 seconds per pin.

**Materials**

| | |
|---|---|
| Header | Kovar/Nickel/Gold |
| Cover | Kovar/Nickel |
| Pins | Kovar/Nickel/Gold matched glass seal |

Case B, Rev C, November 9, 2005



**FIGURE 16: CASE B**

# FMSA/FMGA EMI Input Filters

**28 VOLT INPUT – 0.8 AMP**

## 883, Class H, QML Products – Element Evaluation

| Element Evaluation<br><br>Test Performed<br>(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:<br>Input Capacitors only<br>(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 no 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

# FMSA/FMGA EMI Input Filters

**28 VOLT INPUT – 0.8 AMP**

## 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 | no | no | yes |
| Method 1010, Cond. B, -55°C to 125°C, ambient | no | yes | no |
| Constant Acceleration | | | |
| Method 2001, 3000 g | no | no | yes |
| Method 2001, 500g | no | yes | no |
| Burn-In | | | |
| Method 1015, 160 hours at 125°C case, typical | no | no | yes |
| 96 hours at 125°C case, typical | no | yes | no |
| Final Electrical Test MIL-PRF-38534, Group A | | | |
| Subgroups 1 through 6: -55°C, +25°C, +125°C case | no | no | yes |
| Subgroups 1 and 4: +25°C case | yes | yes | no |
| Hermeticity Test | | | |
| Fine Leak, Method 1014, Cond. A | no | yes | yes |
| Gross Leak, Method 1014, Cond. C | no | yes | yes |
| Gross Leak, Dip (1 x $10^{-3}$) | yes | no | no |
| Final Visual Inspection | | | |
| Method 2009 | yes | yes | yes |

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



CRANE AEROSPACE & ELECTRONICS