EMI FILTER
HYBRID-HIGH RELIABILITY

Description
The AF100461 Series EMI filter is designed to provide full compliance with the input line reflected ripple current requirement specified by MIL-STD-461C and MIL-STD-461F over the extended temperature range while operating in conjunction with the corresponding ARA and ARE Series of DC-DC converters. The filter is offered as part of a family of high reliability conversion products that operate up to 110V input line. Other converters operating with a similar switching frequency could also benefit by use of this device.

The AF100461 filter is hermetically sealed in a seam welded enclosure utilizing axially oriented surface-mountable copper core pins which minimize resistive losses. The package is fabricated with IR HiRel’s rugged ceramic lead-to-package seal assuring long term hermetic seal integrity in harsh environments.

The filter is manufactured in a facility fully qualified to MIL-PRF-38534, and is available in two screening grades. The flight grade is designed with the requirements of MIL-PRF-38534 for class K.

Features
- Up to 300mA Output Current
- Attenuation > 70dB @ 400 kHz
- Low Profile Seam Welded Package
- Ceramic Insulated Copper Core Pins
- Operation Over the Temperature Range -55°C to 105°C without Power Derating - Note 3
- Class K Screened per MIL-STD-38534
- MIL-PRF-38534 Element Evaluated Components
- Enabling ARA and ARE Series DC-DC Converters to meet CE102 Requirements of MIL-STD-461C, F
- Derated per MIL-STD-1547 and EEE-INST-002 up to 105°C - Note 3

The EM grade are processed and screened to a lower grade requirement. Flight grade are tested to meet the complete group “A” test specifications over the wide temperature range with no derating. The filter is designed to meet the derating guidelines of MIL-STD-1547 and EEE-INST-002.

Typical Connection Diagram

Notes
1. One AF100461 filter is designed to accommodate up to two converters over rated voltage with rated load while not exceeding maximum power limit.
2. To obtain specified EMI performance, it is recommended that conductor length between filter and converter to be kept under 3 inches.
3. Meets derating under the following conditions: Nominal $V_{IN} = 100V$, Worst case $V_{IN} = 110V$ and Worst case temperature of 105°C.
Specifications

Absolute Maximum Ratings, Note 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Nom.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>-150V to +150V, Note 2</td>
<td></td>
<td></td>
<td></td>
<td>V DC</td>
</tr>
<tr>
<td>Input Current</td>
<td>300mA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead Soldering Temperature</td>
<td>+300°C for 10 seconds</td>
<td></td>
<td></td>
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<tr>
<td>Case Temperature-Operating</td>
<td>-55°C to +85°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case Temperature-Storage</td>
<td>-55°C to +135°C</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Electrical Characteristics  -55°C ≤ T CASE ≤ +85°C, -150V ≤ V IN ≤ +150V unless otherwise specified

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group A Subgroup</th>
<th>Conditions</th>
<th>Min.</th>
<th>Nom.</th>
<th>Max.</th>
<th>Unit</th>
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<tbody>
<tr>
<td>Input Voltage</td>
<td></td>
<td>Steady State</td>
<td>-100</td>
<td>—</td>
<td>+110</td>
<td>V DC</td>
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<tr>
<td>Output Voltage</td>
<td>1, 2, 3</td>
<td>Transient, Notes 2, 4</td>
<td>-150</td>
<td>—</td>
<td>+150</td>
<td>V DC</td>
</tr>
<tr>
<td>Output Voltage</td>
<td></td>
<td>Continuous</td>
<td>V OUT = V IN - I IN (R DC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Current</td>
<td></td>
<td></td>
<td></td>
<td>—</td>
<td>300</td>
<td>mA DC</td>
</tr>
<tr>
<td>DC Resistance</td>
<td>1</td>
<td>T C = 25°C, Note 3</td>
<td>—</td>
<td>—</td>
<td>700</td>
<td>mΩ</td>
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<tr>
<td>Power Dissipation</td>
<td>4, 5, 6</td>
<td>Worst case, Notes 6, 7</td>
<td>—</td>
<td>—</td>
<td>870</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal operation, Notes 6, 7</td>
<td>—</td>
<td>—</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>Noise Reduction 20·log10(V OUT / V IN)</td>
<td>4, 5, 6</td>
<td>1.0 kHz, Note 5</td>
<td>-1.0</td>
<td>0</td>
<td>+1.0</td>
<td>dB</td>
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<tr>
<td></td>
<td></td>
<td>10 kHz, Note 5</td>
<td>-4.0</td>
<td>-1.0</td>
<td>+1.0</td>
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<tr>
<td></td>
<td></td>
<td>50 kHz, Note 5</td>
<td>+8.0</td>
<td>+13</td>
<td>—</td>
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<tr>
<td></td>
<td></td>
<td>80 kHz, Note 5</td>
<td>+26</td>
<td>+30</td>
<td>—</td>
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<tr>
<td></td>
<td></td>
<td>100 kHz, Note 5</td>
<td>+36</td>
<td>+40</td>
<td>—</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>200 kHz, Note 5</td>
<td>+60</td>
<td>+70</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>300 kHz to 3 MHz, Notes 5, 6</td>
<td>+70</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.1 MHz to 10 MHz, Notes 5, 6</td>
<td>+60</td>
<td>—</td>
<td>—</td>
<td></td>
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<tr>
<td>Isolation</td>
<td>1</td>
<td>Any Pin to Case, Tested @ 500V DC</td>
<td>100</td>
<td>—</td>
<td>—</td>
<td>Ω</td>
</tr>
<tr>
<td>Capacitance</td>
<td>1, 2, 3</td>
<td>Measured between any Pin and Case (except Pins 3, 4, 5)</td>
<td>16</td>
<td>—</td>
<td>24</td>
<td>nF</td>
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<tr>
<td>Device Weight</td>
<td></td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>25</td>
<td>g</td>
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<tr>
<td>MTBF</td>
<td></td>
<td>MIL-HDBK-217- SF_35°C</td>
<td>—</td>
<td>48.7x10⁶</td>
<td>—</td>
<td>Hrs</td>
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</table>

Notes to Specifications

1. Maximum ratings specified here relate to the Filter assembly. Any connected converter/device will have its own limits to consider. Operation above maximum ratings may cause permanent damage to the device. Operation at maximum ratings may degrade performance and affect reliability.
2. Device can tolerate ± 150 Volt transient whose duration is ≤ 100ms when R GS ≥ 0.5Ω.
3. DC resistance is the total resistance of the device and includes the sum of the input to output resistance and the return in to return out resistance paths.
4. Derating guidelines do not apply for any input voltage transient conditions.
5. Tested at 1.0VRMS with 660nF load on V OUT (Pin 7), the equivalent capacitance of one ARX100XXX Converter input.
6. This parameter is not 100% tested, guaranteed by design.
7. The listed power dissipation is the peak value during conducted susceptibility testing when using 5.0VRMS signal injection and it occurs at approximately 7.0 kHz. For the nominal operating conditions, the nominal power dissipation is based on the maximum rated DC current and DC resistance.
Fig 1. Typical Attenuation with effects of L1-R1 ignored due to the absence of converter(s) Internal Capacitance

Fig 2. Typical Attenuation with the third filtering stage completed by connecting one ARX100XXX Converter.
Typical EMI Filter Performance Curves

(Temperature = 25°C, $V_{IN} = 100V$, with two ARE10015D operating at rated load, unless otherwise specified)

Fig 3. MIL-STD-461C CE03 without a filter, using only a series Input Impedance equivalent to $R1-L1$ ($20\Omega \parallel 22\mu H$) to establish $Z_{IN}$ before the two converters. (1dBµV = 1dBµA)

Fig 4. MIL-STD-461C CE03 with an AF100461 filter before the two converters. (1dBµV= 1dBµA)
Fig 5. MIL-STD-461F CE102 without a filter, using only a series Input Impedance equivalent to R1-L1 (20Ω || 22µH) to establish $Z_{IN}$ before the two converters.

Fig 6. MIL-STD-461F CE102 with an AF100461 filter before the two converters.
Mechanical Outline

Pin Designation

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Designation</th>
<th>Pin #</th>
<th>Designation</th>
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<tbody>
<tr>
<td>1</td>
<td>+ INPUT</td>
<td>6</td>
<td>CASE GROUND</td>
</tr>
<tr>
<td>2</td>
<td>INPUT RETURN</td>
<td>7</td>
<td>+ OUTPUT</td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td>8</td>
<td>OUTPUT RETURN</td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td>9</td>
<td>CASE GROUND</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
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### Device Screening

<table>
<thead>
<tr>
<th>Part Number Designator</th>
<th>/EM Ø</th>
<th>Flight No Suffix</th>
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<tbody>
<tr>
<td>Compliance Level</td>
<td>MIL-PRF-38534</td>
<td>—</td>
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<tr>
<td>Certification Mark</td>
<td>—</td>
<td>—</td>
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<tr>
<td>Screening Requirement</td>
<td>MIL-STD-883 Method</td>
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<td>Temperature Range</td>
<td>Room Temperature</td>
<td>-55°C to +85°C</td>
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<tr>
<td>Element Evaluation</td>
<td>MIL-PRF-38534</td>
<td>N/A</td>
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<tr>
<td>Non-Destructive Bond Pull</td>
<td>2023</td>
<td>N/A</td>
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<tr>
<td>Internal Visual</td>
<td>2017</td>
<td>IR Defined</td>
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<tr>
<td>Temperature Cycle</td>
<td>1010</td>
<td>N/A</td>
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<tr>
<td>Constant Acceleration</td>
<td>2001, Y1 Axis</td>
<td>N/A</td>
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<tr>
<td>PIND</td>
<td>2020</td>
<td>N/A</td>
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<tr>
<td>Burn-In</td>
<td>1015</td>
<td>N/A</td>
</tr>
<tr>
<td>Final Electrical (Group A)</td>
<td>MIL-PRF-38534 &amp; Specification</td>
<td>Room Temperature</td>
</tr>
<tr>
<td>PDA</td>
<td>MIL-PRF-38534</td>
<td>N/A</td>
</tr>
<tr>
<td>Seal, Fine and Gross</td>
<td>1014</td>
<td>N/A</td>
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<tr>
<td>Radiographic</td>
<td>2012</td>
<td>N/A</td>
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<tr>
<td>External Visual</td>
<td>2009</td>
<td>IR Defined</td>
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</table>

**Note:**

① “EM” grade parts are strictly intended to permit the customer to determine the electrical functionality of the device in the customer’s application in ambient conditions. The use of EM devices in production applications presents an unquantifiable risk of failure and IR HiRel disclaims all responsibility for such failure.

### Part Numbering

- **Model**: AF 100 461 /EM
- **Input Voltage**: Device Screening per Device Screening Table
- **Applicable Military Standard (MIL-STD-461)**: EM = Minimal Screening, Blank = Space Flight Model

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