**DESCRIPTION**

The MHF Series™ of DC/DC converters offer up to 12 watts of power from single or dual outputs in a single package over the full military temperature range. Thick film hybrid manufacturing technology produces high levels of miniaturization, giving the MHF Series converters a low profile (0.330 inch), small board area (1.65 square inches), and high power density (22 watt/in³). The parts are packaged in hermetically sealed steel enclosures, making them ideal for use in military, aerospace, and high reliability industrial applications.

**DESIGN METHODOLOGY**

The MHF converters are switching regulators which use a quasi-square wave, single ended forward converter design with a nominal switching frequency of 600 kHz. Isolation between input and output circuits is provided with a transformer in the forward power loop and a temperature insensitive optical link in the feedback control loop. Output regulation is accomplished with constant frequency pulse width modulation. Both line and load regulation are typically within 10 mV.

On dual output models, the positive output is independently regulated and the negative output is cross-regulated. Figures 7 and 8 illustrate what effects load changes have on the negative output.

Indefinite short circuit protection and overload protection are provided by sensing output load current and restricting the output current to approximately 125% of full load output current. Since the output current is sensed in the secondary stage, the result is a predictable, constant output current control with no foldback characteristics. MHF converters are provided with internal filtering elements on both the input and output to help reduce the need for external components. For information about filtering to meet MIL-STD-461's CE03 test, contact your Interpoint representative.

**WIDE VOLTAGE RANGE**

The MHF Series is designed to provide full power operation over the input voltage range of 16 to 40 volts. The 15 volt models provide a 19 to 40 volt range. Operation below 16 volts (or 19 volts for the 15 volt models), including operation in MIL-STD-704E emergency power conditions, is possible with derated output power. Please refer to the low line drop-out graphs, Figures 9 and 10.

**MILITARY TEMPERATURE RANGE**

The MHF Series provides full power operation at case temperatures from –55°C up to +125°C. All 12 and 15 volt models in both single and dual output configurations provide full power operation at +125°C with derated power to 135°C. The +5 volt model provides full power at 110°C derated to 0% at 130°C. Depending on operating levels, air flow, and ambient temperature, heat sinking may be required.

**INHIBIT FEATURE**

An inhibit terminal is provided that can be used to disable internal switching, resulting in a very low quiescent input current. An open collector TTL compatible low (≤0.8V) is required to control the inhibit function. This level may be supplied by an open collector gate since the inhibit pin is provided with an internal pull-up resistor.
**MHF SERIES**

**12 WATT**

**DC/DC CONVERTERS**

### ABSOLUTE MAXIMUM RATINGS

- **Input Voltage**
  - 16 to 40 VDC (19 to 40 VDC 15 volt output)
- **Output Power**
  - 12 watts (10 watts MHF2805S)
- **Lead Soldering Temperature (10 sec per lead)**
  - 300°C
- **Storage Temperature Range (Case)**
  - -55°C to +130°C

### INHIBIT

- **Inhibit TTL Open Collector**
  - Logic low (output disabled)
  - Logic low 0.8 V max
  - Inhibit pin current 4 mA max
  - Referenced to input common
  - Logic high (output enabled)
  - Open collector

### TYPICAL CHARACTERISTICS

- **Output Voltage Temperature Coefficient**
  - 150 ppm/°C, typical
- **Input to Output Capacitance**
  - 50 pF, typical
- **Current Limit**
  - 125% of full load, typical
- **Isolation**
  - 100 megohm minimum at 500 V
- **Conversion Frequency**
  - 600 kHz typical
- **Inhibit Pin Voltage (unit enabled)**
  - 8 to 11 V

### RECOMMENDED OPERATING CONDITIONS

- **Input Voltage Range**
  - 16 to 40 VDC continuous
  - 19 to 40 VDC 15 volt outputs continuous
  - 50 V for 50 msec transient
- **Case Operating Temperature (Tc)**
  - -55°C to +125°C full power
  - -55°C to +110°C full power for MHF2805S
  - -55°C to +135°C absolute
  - -55°C to +130°C absolute for MHF2805S
- **Derating Output Power/Current**
  - Linearly from 100% at 125°C to 0% at 135°C
  - Linearly from 100% at 110°C to 0% at 130°C for MHF2805S

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

<table>
<thead>
<tr>
<th>SINGLE OUTPUT MODELS</th>
<th>MHF2805S</th>
<th>MHF2812S</th>
<th>MHF2815S</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PARAMETER</strong></td>
<td><strong>CONDITIONS</strong></td>
<td><strong>MIN</strong></td>
<td><strong>TYP</strong></td>
</tr>
<tr>
<td><strong>OUTPUT VOLTAGE</strong></td>
<td>4.95</td>
<td>5.0</td>
<td>5.05</td>
</tr>
<tr>
<td><strong>OUTPUT POWER</strong></td>
<td>—</td>
<td>—</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>OUTPUT RIPPLE</strong></td>
<td>MIN. TO MAX. Vin</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>LINE REGULATION</strong></td>
<td>10 kHz to 2 MHz</td>
<td>—</td>
<td>40</td>
</tr>
<tr>
<td><strong>LOAD REGULATION</strong></td>
<td>MIN. TO MAX. Vin</td>
<td>—</td>
<td>10</td>
</tr>
<tr>
<td><strong>INPUT VOLTAGE</strong></td>
<td>NO LOAD TO FULL</td>
<td>—</td>
<td>10</td>
</tr>
<tr>
<td><strong>INPUT CURRENT</strong></td>
<td>CONTINUOUS</td>
<td>16</td>
<td>28</td>
</tr>
<tr>
<td><strong>TRANSPORT 50 ms</strong></td>
<td>—</td>
<td>—</td>
<td>50</td>
</tr>
<tr>
<td><strong>INPUT RIPPLE CURRENT</strong></td>
<td>NO LOAD</td>
<td>—</td>
<td>20</td>
</tr>
<tr>
<td><strong>COMPLETE LOAD</strong></td>
<td>FULL</td>
<td>—</td>
<td>483</td>
</tr>
<tr>
<td><strong>EFFICIENCY</strong></td>
<td>POWER DISSIPATION</td>
<td>74</td>
<td>77</td>
</tr>
<tr>
<td><strong>LOAD FAULT</strong></td>
<td>OVERLOAD</td>
<td>10 kHz TO 2 MHz</td>
<td>—</td>
</tr>
<tr>
<td><strong>SHORT CIRCUIT</strong></td>
<td>—</td>
<td>—</td>
<td>5</td>
</tr>
<tr>
<td><strong>START-UP DELAY</strong></td>
<td>DELAY</td>
<td>—</td>
<td>180</td>
</tr>
</tbody>
</table>

**Notes**

1. Indefinite short circuit protection not guaranteed above 125°C case temperature (110°C case for MHF2805S).
## Electrical Characteristics: 25°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CONDITION</th>
<th>MHF2812D MIN</th>
<th>MHF2812D TYP</th>
<th>MHF2812D MAX</th>
<th>MHF2815D MIN</th>
<th>MHF2815D TYP</th>
<th>MHF2815D MAX</th>
<th>UNITS</th>
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<tbody>
<tr>
<td>OUTPUT VOLTAGE</td>
<td>+VOUT</td>
<td>11.88</td>
<td>12.0</td>
<td>12.12</td>
<td>14.85</td>
<td>15.0</td>
<td>15.15</td>
<td>VDC</td>
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<tr>
<td></td>
<td>−VOUT</td>
<td>11.82</td>
<td>12.0</td>
<td>12.18</td>
<td>14.77</td>
<td>15.0</td>
<td>15.23</td>
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<tr>
<td>OUTPUT CURRENT1,2</td>
<td>+VOUT</td>
<td>—</td>
<td>0.5</td>
<td>1.0</td>
<td>—</td>
<td>0.4</td>
<td>0.8</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>−VOUT</td>
<td>—</td>
<td>—</td>
<td>10.8</td>
<td>—</td>
<td>—</td>
<td>10.8</td>
<td>W</td>
</tr>
<tr>
<td>OUTPUT POWER2</td>
<td>+VOUT</td>
<td>—</td>
<td>—</td>
<td>10.8</td>
<td>—</td>
<td>—</td>
<td>10.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>−VOUT</td>
<td>—</td>
<td>—</td>
<td>10.8</td>
<td>—</td>
<td>—</td>
<td>10.8</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>—</td>
<td>—</td>
<td>12</td>
<td>—</td>
<td>—</td>
<td>12</td>
<td></td>
<td></td>
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<tr>
<td>OUTPUT RIPPLE VOLTAGE</td>
<td>10 kHz TO 2 MHz</td>
<td>—</td>
<td>30</td>
<td>60</td>
<td>—</td>
<td>30</td>
<td>60</td>
<td>mV p-p</td>
</tr>
<tr>
<td>LINE REGULATION</td>
<td>MIN. TO MAX. VIN</td>
<td>+VOUT</td>
<td>—</td>
<td>5</td>
<td>50</td>
<td>—</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>LOAD REGULATION</td>
<td>NO LOAD TO FULL</td>
<td>+VOUT</td>
<td>—</td>
<td>5</td>
<td>50</td>
<td>—</td>
<td>10</td>
<td>50</td>
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<tr>
<td>CROSS REGULATION</td>
<td>20% TO 80% LOAD3</td>
<td>—</td>
<td>5</td>
<td>10</td>
<td>—</td>
<td>4</td>
<td>8</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>50% LOAD4</td>
<td>—</td>
<td>4</td>
<td>5</td>
<td>—</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>INPUT VOLTAGE</td>
<td>CONTINUOUS</td>
<td>16</td>
<td>28</td>
<td>40</td>
<td>19</td>
<td>28</td>
<td>40</td>
<td>VDC</td>
</tr>
<tr>
<td></td>
<td>NO LOAD TO FULL</td>
<td>TRANSIENT 50 ms</td>
<td>—</td>
<td>—</td>
<td>50</td>
<td>—</td>
<td>—</td>
<td>50</td>
</tr>
<tr>
<td>INPUT CURRENT</td>
<td>NO LOAD</td>
<td>—</td>
<td>25</td>
<td>35</td>
<td>—</td>
<td>25</td>
<td>35</td>
<td>mA</td>
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<td></td>
<td>FULL LOAD</td>
<td>—</td>
<td>—</td>
<td>550</td>
<td>—</td>
<td>—</td>
<td>536</td>
<td></td>
</tr>
<tr>
<td>INPUT RIPPLE CURRENT</td>
<td>10 kHz TO 2 MHz</td>
<td>—</td>
<td>175</td>
<td>240</td>
<td>—</td>
<td>175</td>
<td>240</td>
<td>mA p-p</td>
</tr>
<tr>
<td>EFFICIENCY</td>
<td>—</td>
<td>78</td>
<td>81</td>
<td>—</td>
<td>80</td>
<td>83</td>
<td>—</td>
<td>%</td>
</tr>
<tr>
<td>LOAD FAULT5</td>
<td>POWER DISSIPATION</td>
<td>SHORT CIRCUIT</td>
<td>—</td>
<td>2.8</td>
<td>—</td>
<td>2</td>
<td>—</td>
<td>W</td>
</tr>
<tr>
<td>START-UP DELAY</td>
<td>—</td>
<td>150</td>
<td>250</td>
<td>—</td>
<td>150</td>
<td>250</td>
<td>ms</td>
<td></td>
</tr>
</tbody>
</table>

### Notes

1. Applies to both outputs.
2. Maximum combined output power is 12 watts. A maximum of 90% is available from either output.
3. 20% to 80% load on the positive output and 80% to 20% on the negative output. See Figure 8.
4. 50% load on the positive output and 50% to 20% load on the negative output. 50% load on the negative output and 50% to 20% load on the positive output. See Figure 7.
5. Indefinite short circuit protection not guaranteed above 125°C case temperature.

---

### PIN OUT

- **Squashed corner and dot on top of cover indicate pin one.**

### MODEL NUMBER KEY

- **Base Model**
- **Input Voltage**
- **Output Voltage**
- **Number of Outputs**
  - (S = single, D = dual)
- **Screening**
  - (Standard screening has no designator in this position.)

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**See Section B8, case E1, for dimensions.**

**FIGURE 1: PIN OUT**

---

**CRANE**

**interpoint**

**B2-79**
MHF SERIES 12 WATT DC/DC CONVERTERS

Typical Performance Curves: 25°C Tc, 28V DC Vin, 100% load, unless otherwise specified.

**FIGURE 2**
MHF2805S Efficiency

**FIGURE 3**
MHF2812S Efficiency

**FIGURE 4**
MHF2815S Efficiency

**FIGURE 5**
MHF2812D Efficiency

**FIGURE 6**
MHF2815D Efficiency

**FIGURE 7**
Condition A: 50% Load Pos. Vout, 50% to 20% Neg. Vout
Condition B: 50% Load Neg. Vout, 50% to 20% Pos. Vout
MHF Negative Output Voltage Cross Regulation

**FIGURE 8**
Negative Output Voltage Change (%)
Output Load (%)
Positive Output 20% to 80% Load
Negative Output 80% to 20% Load
MHF Dual Negative Output Voltage Cross Regulation

**FIGURE 9**
50 mV Drop
Output Power (Watts)
MHF Single Low Line Dropout

**FIGURE 10**
50 mV Drop
Output Power (Watts)
MHF Dual Low Line Dropout

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21821-001-DTS Rev A  DQ# 1011
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CASE E

**Materials**
- **Header**: Cold Rolled Steel/Nickel/Gold
- **Cover**: Kovar/Nickel
  - **SMHF Series**: Cold Rolled Steel/Nickel/Gold
- **Pins**: #52 alloy/Gold
- **Seal**: compression glass seal

**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.

**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.
### 125°C PRODUCTS

| TEST (125°C Products) | STANDARD | /ES | /883 (Class H)* |
|-----------------------|----------|-----|----------------
| PRE-CAP INSPECTION    |          |     |                |
| Method 2017, 2032     | yes      | yes | yes            |
| TEMPERATURE CYCLE (10 times) |        |     |                |
| Method 1010, Cond. C, -65°C to 150°C | no | no  | yes            |
| Method 1010, Cond. B, -55°C to 125°C | no | yes | no             |
| CONSTANT ACCELERATION |          |     |                |
| Method 2001, 3000 g   | no       | no  | yes            |
| Method 2001, 500 g    | no       | yes | no             |
| BURN-IN               |          |     |                |
| Method 1015, 160 hours at 125°C | no | no  | yes            |
| 96 hours at 125°C case (typical) |    | yes | no             |
| FINAL ELECTRICAL TEST MIL-PRF-38534, Group A |    |     |                |
| Subgroups 1 through 6: -55°C, +25°C, +125°C | no | no  | yes            |
| Subgroups 1 and 4: +25°C case | yes | yes | no             |
| 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 | yes            |

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

*883 products are built with element evaluated components and are 100% tested and guaranteed over the full military temperature range of -55°C to +125°C.

Applies to the following products:

- MOR Series
- MFLHP Series
- MFL Series
- MHP Series
- MTR Series
- MQO Series
- MHF Series
- MQO Series
- FMGA EMI Filter
- MHD Series
- MHV Series
- MHF+ Series
- MGF Series
- MGA Series
- MSA Series
- FM-704A EMI Filter
- FMD**/FME EMI Filter
- FMCA EMI Filter
- HUM Modules**
- LCM Modules**
- LIM Modules
- FMH EMI Filter

**MFLHP Series, MQO Series, MHF Series, FMD EMI Filters, Hum Modules, and LCM Modules do not offer '883' screening.