FEATURES
► Industry Standard DIP-16 Package
► I/O Isolation 4000VAC with Reinforced Insulation, rated for 300Vrms Working Voltage
► Low Leakage Current < 2µA
► Operating Ambient Temp. Range -25°C to +80°C
► Medical EMC Standard with 4th Edition of EMI EN 55011 and EMS EN 60601-1-2 Approved
► Medical Safety with 1xMOPP & 2xMOOP per 3rd Edition of IEC/EN 60601-1 & ANSI/AAMI ES60601-1 Approved
► UL/cUL/IEC/EN 60950-1 Safety Approval & CE Marking

PRODUCT OVERVIEW
The MINMAX MDHU100 series is a new range of 2W DC-DC converter modules providing a very high I/O isolation voltage of 4000 VAC with reinforced insulation, which rated for 300Vrms working voltage. The product comes in a small SMD-package. There are 15 models available with 5V, 12V or 24VDC input and single or dual output voltages. The MDHU100 DC-DC converters offer an economical solution for many applications in instrumentation, industrial controls, medical equipment and everywhere where a certified supplementary- or reinforced insulation system is required to comply with requested safety standards.

Model Selection Guide

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Input Voltage (Range)</th>
<th>Output Voltage</th>
<th>Output Current Max.</th>
<th>Output Current Min.</th>
<th>Input Current @Max. Load</th>
<th>Input Current @No Load</th>
<th>Load Regulation</th>
<th>Max. Capacitive Load</th>
<th>Efficiency (typ.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDHU102</td>
<td>VDC 5 (4.5 ~ 5.5)</td>
<td>VDC 5</td>
<td>mA</td>
<td>mA</td>
<td>mA (typ.)</td>
<td>mA (typ.)</td>
<td>% (max.)</td>
<td>µF</td>
<td>%</td>
</tr>
<tr>
<td>MDHU104</td>
<td>12</td>
<td>12</td>
<td>400</td>
<td>8</td>
<td>606</td>
<td>10</td>
<td>12</td>
<td>330</td>
<td>66</td>
</tr>
<tr>
<td>MDHU105</td>
<td>15</td>
<td>15</td>
<td>133</td>
<td>2.5</td>
<td>605</td>
<td>10</td>
<td>10</td>
<td>66</td>
<td>72</td>
</tr>
<tr>
<td>MDHU108</td>
<td>±12</td>
<td>±12</td>
<td>±83</td>
<td>±1.5</td>
<td>553</td>
<td>10</td>
<td>10</td>
<td>100#</td>
<td>72</td>
</tr>
<tr>
<td>MDHU109</td>
<td>±15</td>
<td>±66</td>
<td>±1</td>
<td>542</td>
<td>10</td>
<td>10</td>
<td>73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDHU112</td>
<td>5</td>
<td>5</td>
<td>400</td>
<td>8</td>
<td>253</td>
<td>12</td>
<td>12</td>
<td>330</td>
<td>66</td>
</tr>
<tr>
<td>MDHU114</td>
<td>12</td>
<td>12</td>
<td>165</td>
<td>3</td>
<td>250</td>
<td>10</td>
<td>10</td>
<td>66</td>
<td>73</td>
</tr>
<tr>
<td>MDHU115</td>
<td>15</td>
<td>15</td>
<td>133</td>
<td>2.5</td>
<td>252</td>
<td>10</td>
<td>10</td>
<td>66</td>
<td>74</td>
</tr>
<tr>
<td>MDHU118</td>
<td>±12</td>
<td>±12</td>
<td>±83</td>
<td>±1.5</td>
<td>224</td>
<td>10</td>
<td>10</td>
<td>100#</td>
<td>74</td>
</tr>
<tr>
<td>MDHU119</td>
<td>±15</td>
<td>±66</td>
<td>±1</td>
<td>220</td>
<td>10</td>
<td>10</td>
<td>75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDHU122</td>
<td>5</td>
<td>5</td>
<td>400</td>
<td>8</td>
<td>126</td>
<td>12</td>
<td>12</td>
<td>330</td>
<td>66</td>
</tr>
<tr>
<td>MDHU124</td>
<td>12</td>
<td>12</td>
<td>165</td>
<td>3</td>
<td>125</td>
<td>10</td>
<td>10</td>
<td>66</td>
<td>73</td>
</tr>
<tr>
<td>MDHU125</td>
<td>15</td>
<td>15</td>
<td>133</td>
<td>2.5</td>
<td>126</td>
<td>10</td>
<td>10</td>
<td>66</td>
<td>74</td>
</tr>
<tr>
<td>MDHU128</td>
<td>±12</td>
<td>±12</td>
<td>±83</td>
<td>±1.5</td>
<td>112</td>
<td>10</td>
<td>10</td>
<td>100#</td>
<td>74</td>
</tr>
<tr>
<td>MDHU129</td>
<td>±15</td>
<td>±66</td>
<td>±1</td>
<td>110</td>
<td>10</td>
<td>10</td>
<td>75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

# For each output

Input Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Model</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage Range</td>
<td>5V Input Models</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>VDC</td>
</tr>
<tr>
<td></td>
<td>12V Input Models</td>
<td>10.8</td>
<td>12</td>
<td>13.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24V Input Models</td>
<td>21.6</td>
<td>24</td>
<td>26.4</td>
<td></td>
</tr>
<tr>
<td>Input Surge Voltage (1 sec. max.)</td>
<td>5V Input Models</td>
<td>-0.7</td>
<td>---</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12V Input Models</td>
<td>-0.7</td>
<td>---</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24V Input Models</td>
<td>-0.7</td>
<td>---</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Input Filter</td>
<td>All Models</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

E-mail: sales@minmax.com.tw  Tel: 886-6-2923150
2018/05/07  REV:15  Page 1 of 4  www.minmax.com.tw
### Output Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Voltage Setting Accuracy</td>
<td></td>
<td>---</td>
<td>±2.0</td>
<td>±4.0</td>
<td>%/Vnom.</td>
</tr>
<tr>
<td>Output Voltage Balance</td>
<td>Dual Output, Balanced Loads</td>
<td>---</td>
<td>±0.1</td>
<td>±1.0</td>
<td>%</td>
</tr>
<tr>
<td>Line Regulation</td>
<td>Vin=Min. to Max. @Full Load</td>
<td>---</td>
<td>±1.2</td>
<td>±1.5</td>
<td>%</td>
</tr>
<tr>
<td>Load Regulation</td>
<td>Io=20% to 100%</td>
<td>See Model Selection Guide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ripple &amp; Noise</td>
<td>0-20 MHz Bandwidth</td>
<td>---</td>
<td>100</td>
<td>150</td>
<td>mVpp</td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td></td>
<td>---</td>
<td>±0.01</td>
<td>±0.02</td>
<td>%/°C</td>
</tr>
<tr>
<td>Short Circuit Protection</td>
<td>0.5 Second Max., Automatic Recovery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Isolation, Safety Standards

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O Isolation Voltage</td>
<td>Reinforced insulation, rated for 300Vrms working voltage</td>
<td>4000</td>
<td>---</td>
<td>---</td>
<td>VACrms</td>
</tr>
<tr>
<td>Leakage Current</td>
<td>240VAC, 60Hz</td>
<td>---</td>
<td>---</td>
<td>2</td>
<td>μA</td>
</tr>
<tr>
<td>I/O Isolation Resistance</td>
<td>500 VDC</td>
<td>10</td>
<td>---</td>
<td>---</td>
<td>GO</td>
</tr>
<tr>
<td>I/O Isolation Capacitance</td>
<td>100kHz, 1V</td>
<td>15</td>
<td>20</td>
<td>20</td>
<td>pF</td>
</tr>
</tbody>
</table>

Safety Standards:  
UL/cUL 60950-1, CSA C22.2 No. 60950-1
ANSI/AAMI ES 60601-1, CAN/CSA-C22.2 No. 60601-1
IEC/EN 60950-1, IEC/EN 60601-1 3rd Edition 1xMOPP & 2xMOOP

Safety Approvals:  
UL/cUL 60950-1 recognition (UL certificate), IEC/EN 60950-1 (CB-report)
ANSI/AAMI ES 60601-1 1xMOPP & 2xMOOP recognition (UL certificate), IEC/EN 60601-1 3rd Edition (CB-report)

### General Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching Frequency</td>
<td></td>
<td>50</td>
<td>80</td>
<td>100</td>
<td>KHz</td>
</tr>
<tr>
<td>MTBF (calculated)</td>
<td>MIL-HDBK-217F@25°C, Ground Benign</td>
<td>2,000,000</td>
<td>---</td>
<td>---</td>
<td>Hours</td>
</tr>
</tbody>
</table>

### Environmental Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Ambient Temperature Range (See Power Derating Curve)</td>
<td>Natural Convection</td>
<td>-25</td>
<td>+60</td>
<td>°C</td>
</tr>
<tr>
<td>Case Temperature</td>
<td></td>
<td></td>
<td>+105</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td></td>
<td>-50</td>
<td>+125</td>
<td>°C</td>
</tr>
<tr>
<td>Humidity (non condensing)</td>
<td></td>
<td>---</td>
<td>95</td>
<td>% rel. H</td>
</tr>
<tr>
<td>Cooling</td>
<td>Natural Convection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead Temperature (1.5mm from case for 10Sec.)</td>
<td></td>
<td>---</td>
<td>260</td>
<td>°C</td>
</tr>
</tbody>
</table>

### Power Derating Curve

![Power Derating Curve](image)
Notes

1. Specifications typical at Ta=+25°C, resistive load, nominal input voltage and rated output current unless otherwise noted.
2. These power converters require a minimum output loading to maintain specified regulation, operation under no-load conditions will not damage these modules; however they may not meet all specifications listed.
3. We recommend to protect the converter by a slow blow fuse in the input supply line.
4. Other input and output voltage may be available, please contact factory.
5. That “natural convection” is about 20LFM but is not equal to still air (0 LFM).
6. Specifications are subject to change without notice.

Package Specifications

<table>
<thead>
<tr>
<th>Pin Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>16</td>
</tr>
</tbody>
</table>

NC: No Connection

- All dimensions in mm (inches)
- Tolerance: X.X±0.25 (X.XX±0.01)
- X.XX±0.13 (X.XXX±0.005)
- Pin diameter Ø 0.5±0.05 (0.02±0.002)

Physical Characteristics

| Case Size      | 23.8x13.4x8.6mm (0.94x0.53x0.34 inches) |
| Case Material  | Non-Conductive Black Plastic (flammability to UL 94V-0 rated) |
| Pin Material   | Copper Alloy with Gold Plate Over Nickel Subplate |
| Weight         | 5.1g |

E-mail: sales@minmax.com.tw   Tel: 886-6-2923150
2018/05/07   REV:15   Page 3 of 4
**Test Setup**

**Input Reflected-Ripple Current Test Setup**

Input reflected-ripple current is measured with an inductor Lin (4.7μH) and Cin (220μF, ESR < 1.0Ω at 100 KHz) to simulate source impedance. Capacitor Cin, offsets possible battery impedance.

Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 KHz.

**Peak-to-Peak Output Noise Measurement Test**

Use a Cout 0.47μF ceramic capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC-DC Converter.

**Technical Notes**

**Maximum Capacitive Load**

The MDHU100 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. For optimum performance we recommend 100μF maximum capacitive load for dual outputs and 330μF capacitive load for single outputs. The maximum capacitance can be found in the data sheet.

**Input Source Impedance**

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup. Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 KHz) capacitor of a 2.2μF for the 5V input devices, a 1.0μF for the 12V input devices and a 0.47μF for the 24V input devices.

**Output Ripple Reduction**

A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 3.3μF capacitors at the output.

**Thermal Considerations**

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 105°C. The derating curves are determined from measurements obtained in a test setup.