HCM1A4020V2
Automotive grade high current power inductors

Product features
- AEC-Q200 qualified
- High current carrying capacity
- Magnetically shielded, low EMI
- DC-DC converter applications up to 1 MHz
- Filtering applications up to Self Resonant Frequency (SRF) [See product specification table]
- 4.75 mm x 4.45 mm footprint surface mount package in a 2.0 mm height
- Moisture Sensitivity Level (MSL): 1
- Alloy powder core material

Applications
- Body electronics
  - Central body control module
  - Vehicle access control system
  - Headlamps, tail lamps and interior lighting and LED lighting
  - Heating ventilation and air conditioning controllers (HVAC)
  - Doors, window lift and seat control
- Advanced driver assistance systems
  - 77 GHz radar system
  - Basic and smart surround, and rear and front-view camera
  - Adaptive cruise control (ACC)
  - Automatic parking control
  - Collision avoidance system/ Car black box system
- Infotainment and cluster electronics
  - Audio subsystem: head unit and trunk amp
  - Digital instrument cluster
  - In-vehicle infotainment (IVI) and navigation
  - Port power/USB HUB for front and rear passengers
- Chassis and safety electronics
  - Airbag control unit
- Engine and Powertrain Systems
  - Electric pumps, motor control and auxiliaries
  - Powertrain control module (PCU)/ Engine Control unit (ECU)
  - Transmission Control Unit (TCU)

Environmental data
- Storage temperature range (Component): -55 °C to +155 °C
- Operating temperature range: -55 °C to +155 °C (ambient plus self-temperature rise)
- Solder reflow temperature: J-STD-020 (latest revision) compliant
Technical Data 10908

Effective May 2019

Automotive grade high current power inductors

www.eaton.com/electronics

HCM1A4020V2

Part marking: 2xy, x=Part marking designator (see product specifications table), y=Bi-weekly date code

All soldering surfaces to be coplanar within 0.1 millimeters

Tolerances are ±0.3 millimeters unless stated otherwise

Pad layout tolerances are ±0.1 millimeters unless stated otherwise

DCR measured from point “a” to point “b”

Do not route traces or vias underneath the inductor

Part specifications

<table>
<thead>
<tr>
<th>Part number⁴</th>
<th>Part marking designator</th>
<th>OCL¹ (μH) ± 20%</th>
<th>FLL² (μH) minimum</th>
<th>I⁴ (A)</th>
<th>DCR (mΩ) typical @ +20 °C</th>
<th>DCR (mΩ) maximum @ +20 °C</th>
<th>SRF (MHz) typical</th>
<th>K-factor⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCM1A4020V2-R10-R</td>
<td>A</td>
<td>0.10</td>
<td>0.056</td>
<td>16</td>
<td>22</td>
<td>3.1</td>
<td>4.0</td>
<td>350</td>
</tr>
<tr>
<td>HCM1A4020V2-R22-R</td>
<td>B</td>
<td>0.22</td>
<td>0.123</td>
<td>11</td>
<td>17</td>
<td>5.5</td>
<td>6.6</td>
<td>200</td>
</tr>
<tr>
<td>HCM1A4020V2-R33-R</td>
<td>C</td>
<td>0.33</td>
<td>0.185</td>
<td>8.5</td>
<td>12</td>
<td>7.5</td>
<td>9.0</td>
<td>140</td>
</tr>
<tr>
<td>HCM1A4020V2-R47-R</td>
<td>D</td>
<td>0.47</td>
<td>0.263</td>
<td>7.3</td>
<td>11</td>
<td>10.5</td>
<td>13.0</td>
<td>120</td>
</tr>
<tr>
<td>HCM1A4020V2-R56-R</td>
<td>E</td>
<td>0.56</td>
<td>0.314</td>
<td>7.3</td>
<td>10</td>
<td>12.0</td>
<td>15.0</td>
<td>95</td>
</tr>
<tr>
<td>HCM1A4020V2-R68-R</td>
<td>F</td>
<td>0.68</td>
<td>0.381</td>
<td>6.7</td>
<td>9</td>
<td>12.5</td>
<td>16.0</td>
<td>80</td>
</tr>
<tr>
<td>HCM1A4020V2-1R0-R</td>
<td>G</td>
<td>1.0</td>
<td>0.56</td>
<td>5.6</td>
<td>7</td>
<td>20</td>
<td>24</td>
<td>60</td>
</tr>
<tr>
<td>HCM1A4020V2-1R2-R</td>
<td>H</td>
<td>1.2</td>
<td>0.67</td>
<td>5.3</td>
<td>6.8</td>
<td>23</td>
<td>28</td>
<td>55</td>
</tr>
<tr>
<td>HCM1A4020V2-1R5-R</td>
<td>I</td>
<td>1.5</td>
<td>0.84</td>
<td>4.5</td>
<td>6.0</td>
<td>25</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>HCM1A4020V2-2R2-R</td>
<td>J</td>
<td>2.2</td>
<td>1.23</td>
<td>4.6</td>
<td>5.0</td>
<td>40</td>
<td>48</td>
<td>40</td>
</tr>
<tr>
<td>HCM1A4020V2-3R3-R</td>
<td>K</td>
<td>3.3</td>
<td>1.85</td>
<td>3.1</td>
<td>4.0</td>
<td>71</td>
<td>85</td>
<td>32</td>
</tr>
<tr>
<td>HCM1A4020V2-4R7-R</td>
<td>L</td>
<td>4.7</td>
<td>2.63</td>
<td>2.5</td>
<td>3.2</td>
<td>98</td>
<td>118</td>
<td>27</td>
</tr>
<tr>
<td>HCM1A4020V2-6R8-R</td>
<td>M</td>
<td>6.8</td>
<td>3.8</td>
<td>1.7</td>
<td>2.6</td>
<td>167</td>
<td>192</td>
<td>23</td>
</tr>
<tr>
<td>HCM1A4020V2-100-R</td>
<td>N</td>
<td>10.0</td>
<td>5.6</td>
<td>1.8</td>
<td>2.2</td>
<td>245</td>
<td>281</td>
<td>17</td>
</tr>
<tr>
<td>HCM1A4020V2-150-R</td>
<td>O</td>
<td>15.0</td>
<td>8.4</td>
<td>1.3</td>
<td>1.8</td>
<td>320</td>
<td>384</td>
<td>14</td>
</tr>
</tbody>
</table>

1. Open Circuit Inductance (OCL) Test Parameters: 100 kHz, 1.0 Vrms, 0.0 Adc, +25 °C
2. Full Load Inductance (FLL) Test Parameters: 100 kHz, 1.0 Vrms, I⁴, +25 °C
3. I⁴: DC current for an approximate temperature rise of 30 °C without core loss. Derating is necessary for AC currents.
PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed +155 °C under worst case operating conditions verified in the end application.
4. I⁴: Peak current for approximately 30% rolloff @ +25 °C
5. K-factor: Used to determine Bp-p for core loss (see graph). Bp-p = K * L * ΔΔI (Gauss), K: (K-factor from table), L: (Inductance in μH), ΔΔI: (Peak to peak ripple current in Amps).
6. Part Number Definition: HCM1A4020V2-xxx-R
   HCM1A4020V2 = Product code and size
   xxx = inductance value in μH, R= decimal point,
   If no R is present then last character equals number of zeros
   -R suffix = RoHS compliant

Dimensions (mm)

Recommended pad layout

Schematic

Part marking: 2xy, x=Part marking designator (see product specifications table), y=Bi-weekly date code

All soldering surfaces to be coplanar within 0.1 millimeters

Tolerances are ±0.3 millimeters unless stated otherwise

Pad layout tolerances are ±0.1 millimeters unless stated otherwise

DCR measured from point “a” to point “b”

Do not route traces or vias underneath the inductor

www.eaton.com/electronics
HCM1A4020V2
Automotive grade high current power inductors

Packaging information (mm)
Drawing not to scale
Supplied in tape and reel packaging, 3000 parts per 13” diameter reel

Core loss vs $B_{p-p}$

**HCM1A4020V2-R10-R**

- 700 kHz
- 500 kHz
- 300 kHz
- 100 kHz
- 50 kHz

**HCM1A4020V2-R22-R**

- 700 kHz
- 500 kHz
- 300 kHz
- 100 kHz
- 50 kHz

**HCM1A4020V2-R33-R**

- 700 kHz
- 500 kHz
- 300 kHz
- 100 kHz
- 50 kHz

**HCM1A4020V2-R47-R**

- 700 kHz
- 500 kHz
- 300 kHz
- 100 kHz
- 50 kHz
Core loss vs $B_{p-p}$

HCM1A4020V2-R56-R

HCM1A4020V2-R68-R

HCM1A4020V2-1R0-R

HCM1A4020V2-1R2-R

HCM1A4020V2-1R5-R

HCM1A4020V2-2R2-R

www.eaton.com/electronics
Core loss vs $B_{pp}$

- **HCM1A4020V2-3R3-R**
  - 50 kHz
  - 100 kHz
  - 300 kHz
  - 500 kHz
  - 700 kHz

- **HCM1A4020V2-4R7-R**
  - 50 kHz
  - 100 kHz
  - 300 kHz
  - 500 kHz
  - 700 kHz

- **HCM1A4020V2-6R8-R**
  - 50 kHz
  - 100 kHz
  - 300 kHz
  - 500 kHz
  - 700 kHz

- **HCM1A4020V2-100-R**
  - 50 kHz
  - 100 kHz
  - 300 kHz
  - 500 kHz
  - 700 kHz

- **HCM1A4020V2-150-R**
  - 50 kHz
  - 100 kHz
  - 300 kHz
  - 500 kHz
  - 700 kHz
Inductance and impedance vs. frequency

HCM1A4020V2-R10-R

HCM1A4020V2-R22-R

HCM1A4020V2-R33-R

HCM1A4020V2-R47-R

HCM1A4020V2-R56-R

HCM1A4020V2-R68-R
Inductance and impedance vs. frequency

HCM1A4020V2-1R0-R

HCM1A4020V2-1R2-R

HCM1A4020V2-1R5-R

HCM1A4020V2-2R2-R

HCM1A4020V2-3R3-R

HCM1A4020V2-4R7-R
Inductance and impedance vs. frequency

- **HCM1A4020V2-6R8-R**
- **HCM1A4020V2-100-R**
- **HCM1A4020V2-150-R**
Inductance and temperature rise vs. current

HCM1A4020V2
Automotive grade high current power inductors

Effective May 2019

www.eaton.com/electronics
Inductance and temperature rise vs. current
HCM1A4020V2
Automotive grade high current power inductors

HCM1A4020V2-6R8-R
Inductance vs. Idc (A)

HCM1A4020V2-100-R
Inductance vs. Idc (A)

HCM1A4020V2-150-R
Inductance vs. Idc (A)
Solder reflow profile

![Graph showing the solder reflow profile with temperature and time axes.]

Table 1 - Standard SnPb solder ($T_c$)

<table>
<thead>
<tr>
<th>Package thickness</th>
<th>Volume $&lt;350$ mm$^3$</th>
<th>Volume $\geq350$ mm$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt;2.5$ mm</td>
<td>$235$ °C</td>
<td>$220$ °C</td>
</tr>
<tr>
<td>$&gt;2.5$ mm</td>
<td>$220$ °C</td>
<td>$220$ °C</td>
</tr>
</tbody>
</table>

Table 2 - Lead (Pb) Free Solder ($T_c$)

<table>
<thead>
<tr>
<th>Package thickness</th>
<th>Volume $&lt;350$ mm$^3$</th>
<th>Volume $350 - 2000$ mm$^3$</th>
<th>Volume $&gt;2000$ mm$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt;1.6$ mm</td>
<td>$260$ °C</td>
<td>$250$ °C</td>
<td>$245$ °C</td>
</tr>
<tr>
<td>$1.6 - 2.5$ mm</td>
<td>$260$ °C</td>
<td>$250$ °C</td>
<td>$245$ °C</td>
</tr>
<tr>
<td>$&gt;2.5$ mm</td>
<td>$250$ °C</td>
<td>$245$ °C</td>
<td>$245$ °C</td>
</tr>
</tbody>
</table>

Reference J-STD-020

<table>
<thead>
<tr>
<th>Profile feature</th>
<th>Standard SnPb solder</th>
<th>Lead (Pb) free solder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preheat and soak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Temperature min. ($T_{\text{min}}$)</td>
<td>$100$ °C</td>
<td>$150$ °C</td>
</tr>
<tr>
<td>• Temperature max. ($T_{\text{max}}$)</td>
<td>$150$ °C</td>
<td>$200$ °C</td>
</tr>
<tr>
<td>• Time ($T_{\text{min}}$ to $T_{\text{max}}$) ($t_s$)</td>
<td>$60$-$120$ seconds</td>
<td>$60$-$120$ seconds</td>
</tr>
<tr>
<td>Average ramp up rate ($T_{\text{max}}$ to $T_p$)</td>
<td>$3$ °C/second max.</td>
<td>$3$ °C/second max.</td>
</tr>
<tr>
<td>Liquidous temperature ($T_L$)</td>
<td>$183$ °C</td>
<td>$217$ °C</td>
</tr>
<tr>
<td>Time at liquidous ($t_L$)</td>
<td>$60$-$150$ seconds</td>
<td>$60$-$150$ seconds</td>
</tr>
<tr>
<td>Peak package body temperature ($T_P$)*</td>
<td>Table 1</td>
<td>Table 2</td>
</tr>
<tr>
<td>Time ($T_p$)** within $5$ °C of the specified classification temperature ($T_c$)</td>
<td>$20$ seconds**</td>
<td>$30$ seconds**</td>
</tr>
<tr>
<td>Average ramp-down rate ($T_p$ to $T_{\text{max}}$)</td>
<td>$6$ °C/second max.</td>
<td>$6$ °C/second max.</td>
</tr>
<tr>
<td>Time $25$ °C to peak temperature</td>
<td>$6$ minutes max.</td>
<td>$8$ minutes max.</td>
</tr>
</tbody>
</table>

* Tolerance for peak profile temperature ($T_p$) is defined as a supplier minimum and a user maximum.

** Tolerance for time at peak profile temperature ($t_p$) is defined as a supplier minimum and a user maximum.

Life Support Policy: Eaton does not authorize the use of any of its products for use in life support devices or systems without the express written approval of an officer of the Company. Life support systems are devices which support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.

Eaton reserves the right, without notice, to change design or construction of any products and to discontinue or limit distribution of any products. Eaton also reserves the right to change or update, without notice, any technical information contained in this bulletin.

Eaton is a registered trademark. All other trademarks are property of their respective owners.