**Technical Data 10907**

**Effective April 2019**

**HCM1A2213V2**

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]
- Inductance range from 0.47 μH to 100 μH
- Current range from 6.4 A to 100 A
- 22.78 mm x 22.30 mm footprint surface mount package in a 13.0 mm height
- Moisture Sensitivity Level (MSL): 1
- Alloy powder core material

**Applications**

- Body electronics
  - Central body control module
  - 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
  - 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
- Chassis and safety electronics
  - Airbag control unit
  - Electronic stability control system (ESC)
  - Electric parking brake
  - Electronic power steering (EPS)/ Anti-locking braking system (ABS)
- 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

---

**Eaton**

Powering Business Worldwide
Technical Data 10907
Effective April 2019

Automotive grade high current power inductors

www.eaton.com/electronics

Part marking: 1A2213V2, xxx=inductance value in μH, R=decimal point. If no R is present then last character equals number of zeros. xxxx=Lot 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

Product specifications

<table>
<thead>
<tr>
<th>Part number&lt;sup&gt;a&lt;/sup&gt;</th>
<th>OCL&lt;sup&gt;b&lt;/sup&gt; (μH) ± 20%</th>
<th>FLL&lt;sup&gt;c&lt;/sup&gt; (μH)</th>
<th>I&lt;sub&gt;rms&lt;/sub&gt; (A)</th>
<th>I&lt;sub&gt;sat&lt;/sub&gt; (A)</th>
<th>DCR (mΩ) typical @ +20 °C</th>
<th>DCR (mΩ) maximum @ +20 °C</th>
<th>SRF (MHz) typical</th>
<th>K-factor&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCM1A2213V2-R47-R</td>
<td>0.47</td>
<td>0.30</td>
<td>66</td>
<td>100</td>
<td>0.40</td>
<td>0.50</td>
<td>52</td>
<td>111</td>
</tr>
<tr>
<td>HCM1A2213V2-1R0-R</td>
<td>1.0</td>
<td>0.64</td>
<td>50</td>
<td>71</td>
<td>0.67</td>
<td>0.84</td>
<td>34</td>
<td>53</td>
</tr>
<tr>
<td>HCM1A2213V2-2R2-R</td>
<td>2.2</td>
<td>1.41</td>
<td>42.5</td>
<td>48</td>
<td>1.05</td>
<td>1.25</td>
<td>17</td>
<td>33</td>
</tr>
<tr>
<td>HCM1A2213V2-3R3-R</td>
<td>3.3</td>
<td>2.11</td>
<td>34</td>
<td>41</td>
<td>1.6</td>
<td>1.77</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>HCM1A2213V2-4R7-R</td>
<td>4.7</td>
<td>3.0</td>
<td>33</td>
<td>37</td>
<td>1.68</td>
<td>1.85</td>
<td>10</td>
<td>28</td>
</tr>
<tr>
<td>HCM1A2213V2-6R8-R</td>
<td>6.8</td>
<td>4.35</td>
<td>29.5</td>
<td>36</td>
<td>2.5</td>
<td>3.0</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>HCM1A2213V2-100-R</td>
<td>10</td>
<td>6.4</td>
<td>20</td>
<td>32.5</td>
<td>3.7</td>
<td>4.1</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>HCM1A2213V2-150-R</td>
<td>15</td>
<td>9.6</td>
<td>17</td>
<td>24</td>
<td>4.92</td>
<td>6.0</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>HCM1A2213V2-220-R</td>
<td>22</td>
<td>14.1</td>
<td>13.5</td>
<td>16</td>
<td>8.1</td>
<td>10</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>HCM1A2213V2-330-R</td>
<td>33</td>
<td>21.1</td>
<td>11</td>
<td>16</td>
<td>13.2</td>
<td>15.5</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>HCM1A2213V2-470-R</td>
<td>47</td>
<td>30.1</td>
<td>10</td>
<td>15</td>
<td>15.2</td>
<td>17.7</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>HCM1A2213V2-750-R</td>
<td>75</td>
<td>48.0</td>
<td>7.5</td>
<td>10</td>
<td>27.6</td>
<td>32.5</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>HCM1A2213V2-820-R</td>
<td>82</td>
<td>52.5</td>
<td>7.0</td>
<td>9.5</td>
<td>29.9</td>
<td>34.3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>HCM1A2213V2-101-R</td>
<td>100</td>
<td>64.0</td>
<td>6.4</td>
<td>8.0</td>
<td>36.0</td>
<td>39.5</td>
<td>1.9</td>
<td>5</td>
</tr>
</tbody>
</table>

1. Open Circuit Inductance (OCL) Test Parameters: 100 kHz, 0.25 V<sub>rms</sub>, 0.0 A<sub>dc</sub>, +25 °C
2. Full Load Inductance (FLL) Test Parameters: 100 kHz, 0.25 V<sub>rms</sub>, <i>I</i><sub>sat</sub>, +25 °C
3. <i>I</i><sub>rms</sub>: 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. <i>I</i><sub>sat</sub>: Peak current for approximately 20% rolloff @ +25 °C
5. K-factor: Used to determine <i>B</i><sub>p-p</sub> for core loss (see graph). <i>B</i><sub>p-p</sub> = K * L * ΔI (Gauss), K: (K-factor from table), L: (Inductance in μH), ΔI (Peak to peak ripple current in Amps). K-factor: Used to determine <i>B</i><sub>p-p</sub> for core loss (see graph). <i>B</i><sub>p-p</sub> = K * L * ΔI (Gauss), K: (K-factor from table), L: (Inductance in μH), ΔI (Peak to peak ripple current in Amps).
6. Part Number Definition: HCM1A2213V2-xxx-R
HCM1A2213V2 = 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: 1A2213V2, xxx=inductance value in μH, R=decimal point. If no R is present then last character equals number of zeros. xxxx=Lot 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
HCM1A2213V2
Automotive grade high current power inductors

Packaging information (mm)
Drawing not to scale
Supplied in tape and reel packaging, 100 parts per 13” diameter reel

Core loss vs $B_{p-p}$

HCMA12213V2-R47-R

HCMA12213V2-1R0-R

HCMA12213V2-2R2-R

HCMA12213V2-3R3-R
Core loss vs $B_{p-p}$

**HCM1A2213V2-4R7-R**

- 1.0 MHz
- 700 kHz
- 500 kHz
- 300 kHz

**HCM1A2213V2-6R8-R**

- 1.0 MHz
- 700 kHz
- 500 kHz
- 300 kHz

**HCM1A2213V2-100-R**

- 1.0 MHz
- 700 kHz
- 500 kHz
- 300 kHz

**HCM1A2213V2-150-R**

- 1.0 MHz
- 700 kHz
- 500 kHz
- 300 kHz

**HCM1A2213V2-220-R**

- 1.0 MHz
- 700 kHz
- 500 kHz
- 300 kHz

**HCM1A2213V2-330-R**

- 1.0 MHz
- 700 kHz
- 500 kHz
- 300 kHz
Core loss vs $B_{op}$

HCM1A2213V2-470-R

HCM1A2213V2-750-R

HCM1A2213V2-750-R

HCM1A2213V2-101-R
Inductance and impedance vs. frequency

HCM1A2213V2-R47-R

HCM1A2213V2-1R0-R

HCM1A2213V2-2R2-R

HCM1A2213V2-3R3-R

HCM1A2213V2-4R7-R

HCM1A2213V2-6R8-R
HCM1A2213V2
Automotive grade high current power inductors

Inductance and impedance vs. frequency

- HCM1A2213V2-100-R
- HCM1A2213V2-150-R
- HCM1A2213V2-220-R
- HCM1A2213V2-330-R
- HCM1A2213V2-470-R
- HCM1A2213V2-750-R
### Inductance and Impedance vs. Frequency

- **HCM1A2213V2-820-R**
  - Frequency (MHz) vs. Inductance (µH)
  - Frequency (MHz) vs. Impedance (Ω)

- **HCM1A2213V2-101-R**
  - Frequency (MHz) vs. Inductance (µH)
  - Frequency (MHz) vs. Impedance (Ω)

### Inductance and Temperature Rise vs. Current

- **HCM1A2213V2-R47-R**
  - Idc (A) vs. Inductance (µH)
  - Idc (A) vs. Temperature rise (℃)

- **HCM1A2213V2-1R0-R**
  - Idc (A) vs. Inductance (µH)
  - Idc (A) vs. Temperature rise (℃)

- **HCM1A2213V2-2R2-R**
  - Idc (A) vs. Inductance (µH)
  - Idc (A) vs. Temperature rise (℃)

- **HCM1A2213V2-3R3-R**
  - Idc (A) vs. Inductance (µH)
  - Idc (A) vs. Temperature rise (℃)
Inductance and temperature rise vs. current

**HCM1A2213V2-4R7-R**
- Inductance vs. Idc (A)
- Temperature rise vs. Idc (A)

**HCM1A2213V2-6R8-R**
- Inductance vs. Idc (A)
- Temperature rise vs. Idc (A)

**HCM1A2213V2-100-R**
- Inductance vs. Idc (A)
- Temperature rise vs. Idc (A)

**HCM1A2213V2-150-R**
- Inductance vs. Idc (A)
- Temperature rise vs. Idc (A)

**HCM1A2213V2-220-R**
- Inductance vs. Idc (A)
- Temperature rise vs. Idc (A)

**HCM1A2213V2-330-R**
- Inductance vs. Idc (A)
- Temperature rise vs. Idc (A)
Inductance and temperature rise vs. current

HCM1A2213V2-470-R

HCM1A2213V2-750-R

HCM1A2213V2-820-R

HCM1A2213V2-101-R
Automotive grade high current power inductors

Solder reflow profile

**Table 1 - Standard SnPb solder \((T_c)\)**

<table>
<thead>
<tr>
<th>Package thickness</th>
<th>Volume (&lt;350) mm(^3)</th>
<th>Volume (\geq 350) mm(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;2.5) mm</td>
<td>235 °C</td>
<td>220 °C</td>
</tr>
<tr>
<td>(\geq 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 (\geq 2000) mm(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;1.6) mm</td>
<td>260 °C</td>
<td>260 °C</td>
<td>260 °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>Temperature min. ((T_{smin}))</td>
<td>100 °C</td>
</tr>
<tr>
<td></td>
<td>Temperature max. ((T_{smax}))</td>
<td>150 °C</td>
</tr>
<tr>
<td></td>
<td>Time ((T_{smin} to T_{smax}))</td>
<td>60-120 seconds</td>
</tr>
<tr>
<td>Average ramp up rate (T_{smax}) to (T_p)</td>
<td>3 °C/ second max.</td>
<td>3 °C/ second max.</td>
</tr>
<tr>
<td>Liquidious 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_{smax}))</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.