The downsizing guide line
Murata Core Business - MLCC!

MLCCs overall

01005 Size
Market share 60%

1uF Min
Market share 40%

0201 Size
Market share 50%

For Automotive
Market share 45%

*Murata estimation
As a capacitors house

We will expand the business as a leading company of capacitors by M&A and alliance.
Extensive lineup of Murata capacitors

Small, Thin & High-Cap.

- **Ultra Small Size**
  - (008004, 01005, 015008, 0201)
  - Polymer Electrolysis
    - (~560uF, 2.5V~25V)
- **High Capacitance**
  - (~470uF, 2.5V~100V)
- **Low ESL**
  - (~27uF)

High Reliability

- **Automotive**
  - (ISO9001, AEC-Q200, TS16949)
- **Implant Class D**
  - (ISO9001, AEC-Q200, TS16949)
- **Soft Terminal**
  - (ISO9001, AEC-Q200, TS16949)
  - (~2kV, ~220uF)
- **Epoxy Coating**
  - (ISO9001, AEC-Q200, TS16949)
  - (~2kV, ~220uF)
- **Metal Terminal**
  - (ISO9001, AEC-Q200, TS16949)
  - (25V~1kV, ~100uF)

Application Specific

- **Silicon capacitors**
- **High temperature Film cap**
  - (450V, 500V)
- **Safety Recognized**
  - (Safety standard certified)
- **Wire bondable**
  - (0303, ~0.47uF)
- **High Q**
  - (25V~500V, 1GHz~10GHz)
- **Anti Acoustic noise**
  - (1608M, ~47uF)
MLCC technology road map

Higher Capacitance MLCC! by not only material, but also the accuracy improvement for stacking and printing process.

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>Current</th>
<th>Beyond</th>
</tr>
</thead>
<tbody>
<tr>
<td>470uF</td>
<td>1210</td>
<td></td>
</tr>
<tr>
<td>220uF</td>
<td>1206</td>
<td>0805</td>
</tr>
<tr>
<td>100uF</td>
<td>0805</td>
<td>0603</td>
</tr>
<tr>
<td>47uF</td>
<td>0603</td>
<td>0402</td>
</tr>
<tr>
<td>22uF</td>
<td>0603</td>
<td>0402</td>
</tr>
<tr>
<td>10uF</td>
<td>0402</td>
<td>0201</td>
</tr>
<tr>
<td>1uF</td>
<td>015008</td>
<td>01005</td>
</tr>
</tbody>
</table>

Expanding Cap Value!!

- B-B’ Cross section of 1210/330uF
- Dielectric layer thickness:1um
- Number of layer:1400
Rapid adoption of smaller MLCC size is expected. 0201 is major size in the market.
MLCC quantity comparison by size

1210: 3.2mm x 2.5mm x 2.5mm x 10 pcs = 200mm³

0201: 0.6mm x 0.3mm x 0.3mm x 3700 pcs = 200mm³
Proposal of downsizing

**Purpose**

> To realize more sufficient supply with increasing of the production quantity by downsizing.
> To support the optimization of your design.

**Approach**

**General application**

Low cap (<1uF): 0805/0603/0402 ➔ 0201 or less
High cap (≥1uF): Smallest case size is recommended.
## Summary of recommended products

<table>
<thead>
<tr>
<th>Series</th>
<th>Rated voltage</th>
<th>Class</th>
<th>Capacitance</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRM/GRJ series (General use)</td>
<td>≤100Vdc</td>
<td>*1)Class 1</td>
<td>All</td>
<td>The smallest case size in the product line-up.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*2)Class 2</td>
<td>Low cap. (&lt;1uF)</td>
<td>0201 case size or smaller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High cap. (≥1uF)</td>
<td>The smallest case size in the product line-up.</td>
</tr>
<tr>
<td>GC*/GRT series (Automotive use)</td>
<td>≤100Vdc</td>
<td>*1)Class 1</td>
<td>All</td>
<td>The smallest case size in the product line-up.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*2)Class 2</td>
<td>Low cap. (&lt;1uF)</td>
<td>0402 case size or smaller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High cap. (≥1uF)</td>
<td>The smallest case size in the product line-up.</td>
</tr>
</tbody>
</table>

*1)Class 1 : Temperature Compensating Type (e.g. C0G, U2J, X8G)
*2)Class 2 : High Dielectric Constant Type (e.g. X5R, X6S, X7R, X7S, X8R)

**Note**
This is a summary based on the product status.
For the details, please check the product status and specification of individual products in Murata web site.
<table>
<thead>
<tr>
<th>Price</th>
<th>Characteristics</th>
<th>Supply Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low –Cap(&lt;1uF)</td>
<td>depends on P/N</td>
<td>Not so significant difference</td>
</tr>
<tr>
<td>High-Cap(≥1uF)</td>
<td>depends on P/N</td>
<td>Remaining cap. is lower</td>
</tr>
</tbody>
</table>

Please kindly select higher capacitance value if you needed.
The impact in downsizing

**Electrical characteristics**

- **Impedance characteristics**
  Smaller case size is better than bigger case size

- **DC bias characteristics**
  Smaller case size is worse than bigger case size
  (Higher nominal capacitance might be required.)

**Mechanical stress**

- Need to pay attention when designing PCB with smaller case size MLCC.

**Mounting of 0201**

- Need to change the PCB design, assembly condition
Approaching of down-sizing

**Power Management**

**Micro-Controller**

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### High cap. products (≥1uF)
Smallest case size (0201 and more)

**Bulk Capacitor**

**Key function:**
To supply the electrical charge

**Key parameter:**
Effective capacitance at the operating condition

⇒ To check DC-bias, Temperature char.

### Low cap. products (<1uF)

**Decoupling Capacitor**

**Key function:**
Noise suppression

**Key parameter:**
Actual Impedance at the operating condition

⇒ To check Impedance char.
Web Service & Support

Support the design-in with the "SimSurfing" design support tool.
If you are looking for a capacitor, use Murata’s product search in "pSearch" on our web site.

Design tool "SimSurfing"

Find from the effective capacitance with DC bias and temperature
Netlist, S-parameter
Provide a dynamic simulation model

Product search "pSearch"

Comparison of multiple part number
Strong deflection crack resistant capacitor?
Find from the “Need” help!

URL: https://ds.murata.co.jp/simsurfing/mlcc.html?lcid=en-us
URL (How to use): https://www.murata.com/en-global/tool/howtousevideo
Guideline for Mechanical stress

Due to the increased risk of cracking caused by board bending, caution is required when switching from a 0402 size or larger capacitor to 0201 inch size and changing only the land size.

An explanation of the mechanism behind the risk increase and the measures to take for safe use are summarized in the following document.

Murata web site
The pad design of Printed Circuit Board and the design of Metal mask Opening

Murata recommended Pad design is following.
If you have any question, please feel free to contact Murata.

<table>
<thead>
<tr>
<th>Pad design</th>
<th>Pad / Mask Opening</th>
<th>Stencil thickness</th>
<th>Solder Particle size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A [μm]</td>
<td>B [μm]</td>
<td>C [μm]</td>
</tr>
<tr>
<td>GRM033 series 0.6(L)×0.3(W)×0.3(T) muRata Catalog design</td>
<td>200 ～ 300</td>
<td>200 ～ 350</td>
<td>200 ～ 400</td>
</tr>
<tr>
<td>GRM033 series Recommend Design</td>
<td>250</td>
<td>280</td>
<td>300</td>
</tr>
</tbody>
</table>

(*1) The filet type, mask thickness: less than 120μm,
The filet-less type, the mask thickness: less than 100μm

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### Pad Design

![Pad Design Diagram](image)

### Mask Opening Design

![Mask Opening Design Diagram](image)
Conclusion

**The request to reduce the concerning about MLCC delivery**

- Please select smallest products in murata web and line up.
- Please do not select NRND and TBD products for new project.

**Technical point for downsizing**

- Murata would like to suggest to clarify „Function of capacitors“ and focus on „Key parameters“ to consider the suitable alternative small case size product.
  - Low cap. products ➔ Decoupling ➔ Filter ➔ Impedance
  - High cap. Products ➔ Bulk cap ➔ Electrical charge ➔ DC-bias Char

- You can check the electrical characteristics on murata web site /simsurfing.
Thank you !!