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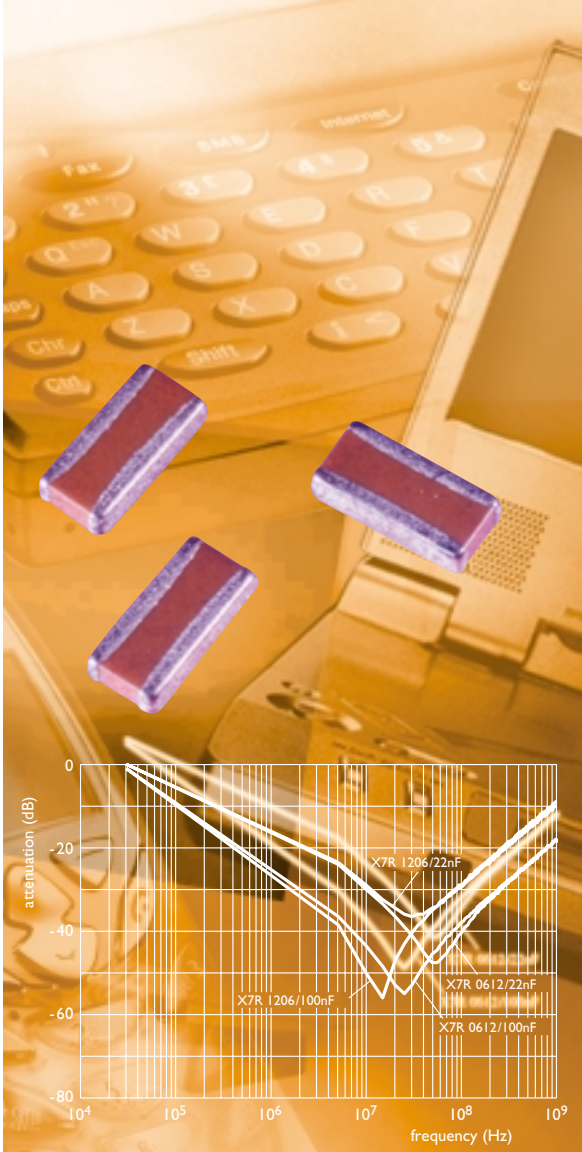
Low-inductance MLCCs for high-speed digital systems



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Phycomp

Low-inductance MLCCs for high-speed digital systems

SUMMARY

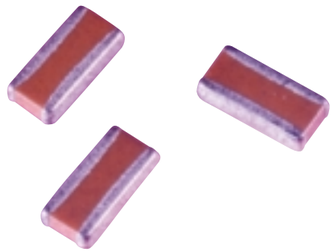
Yageo's Phycomp branded low-inductance MLCCs are ideal for decoupling in high-speed digital systems. With terminations on the longer sides, the capacitors exhibit significantly lower parasitic inductance than their conventional counterparts, making them particularly effective at suppressing noise and ripple on high-frequency circuits. The capacitors are also characterized by high series resonant frequency, providing the bonus of exceptionally broad bandwidth.

With clock frequencies of modern processors nowadays often exceeding 2 GHz, together with increasing processor currents, low equivalent series inductance (ESL) capacitors are now an essential requirement for decoupling and bypass circuits. Not only are low-inductance capacitors capable of operating over broader bandwidths than conventional versions, they are also more effective at suppressing HF noise and reducing ripple voltage on DC lines.

The latter quality, in particular, can be seen from the well-known relation between the voltage induced in an inductor L and the rate of change of current, i.e. $V = L\,(di/dt)$. In high-speed circuits, where di/dt can be quite large, the large voltage spikes generated in the power supply can lead to system abnormalities such as shut down or even complete failure. The magnitude of the voltage spikes can be minimized only by reducing ESL.

Phycomp's low-inductance chip capacitors offer the answer

The answer can be found with Phycomp's new range of low-inductance MLCCs in class II X7R dielectric. With terminations on the longer sides, the capacitors exhibit significantly lower parasitic inductance than their conventional counterparts. This is clear from Fig.1 which compares the parasitic inductances of standard 1206, 0603 and 0805 MLCCs with those of Phycomp's new 0612 and 0508 low-inductance MLCC series. It is important to note that this reduction is exclusively a function of the coupling between the terminations and is not related to the dielectric material or capacitance value.



Yageo's Phycomp branded low-inductance MLCC series

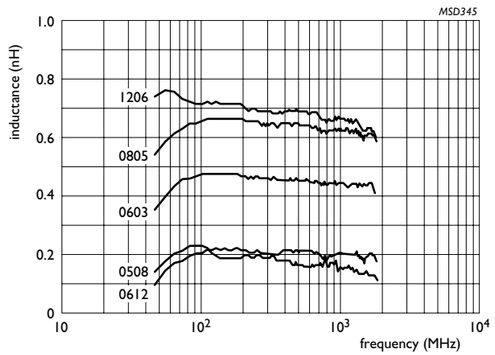


Fig.1 ESL measurements of X7R 100 nF MLCCs

Excellent high-frequency performance

Figure 2 shows the transmission characteristics of a bypass circuit and highlights the crucial importance of low parasitic inductance in bypass capacitors. The lower ESL of the 0612 capacitor results in higher resonant frequency than that in the equivalent 1206 capacitor, enabling the 0612 capacitor to operate over a significantly broader bandwidth.

Lower ESL, moreover, results in lower impedance, which implies superior HF noise-suppression characteristics.

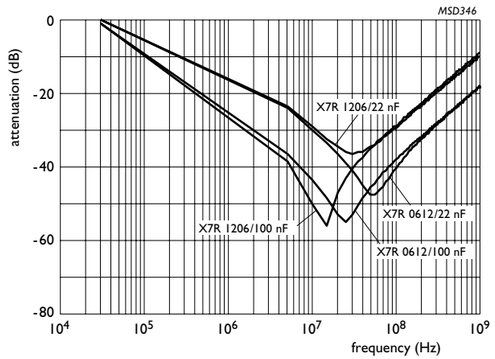


Fig.2 Comparison of transmission characteristics of standard MLCCs and Yageo's Phycomp branded low-inductance MLCCs

Excellent high-frequency performance

Figure 2 shows the transmission characteristics of a bypass circuit and highlights the crucial importance of low parasitic inductance in bypass capacitors. The lower ESL of the 0612 capacitor results in higher resonant frequency than that in the equivalent 1206 capacitor,

Benefits of Phycomp new low-inductance MLCCs

- Low ESL gives exceptionally broad bandwidths for HF decoupling and bypassing applications
- Superior suppression of noise and ripple compared with conventional capacitors

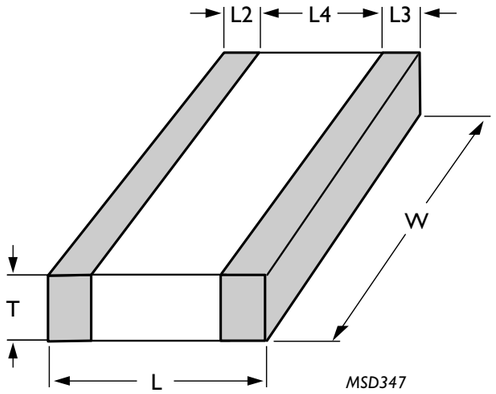
Typical applications

The outstanding properties of Yageo's Phycomp branded low-inductance MLCCs make them ideal for decoupling/bypassing functions in a broad range of modern equipment including:

- Notebook PCs
- Desktop PCs
- Hand-held computers
- Mobile phones
- Digital consumer equipment (e.g. DVD players, LCD monitors and camcorders)

	0508	0612
Capacitance range	10 nF to 100 nF, 25 V 100 nF to 220 nF, 16 V	10 nF to 100 nF
Capacitance tolerance	±10%	±10%
Rated voltage Ur (DC)	25 V/16 V	50 V
Test voltage (DC) for 1 minute	2.5 x U_r	2.5 x U_r
Tan δ	2.5%, 25V 3.5%, 16V	2.5%
Insulation resistance after 1 min. at U_r (DC)	RC > 1000 s	RC > 1000 s
ESL	600 pH (max.)	500 pH (max.)
Temperature coefficient	15%	15%
Ageing per decade	1% (typ.)	1% (typ.)
Operating temperature range	-55 °C to +125 °C	-55 °C to +125 °C
Terminations	Ni/Sn	Ni/Sn

Specifications and mechanical details



	L	W	T	L2, L3	L4 (min)
0508	1.25 ±0.20	2.00 ±0.20	0.85 ±0.10	0.13 to 0.46	0.38
0612	1.60 ±0.20	3.20 ±0.20	0.85 ±0.10	0.13 to 0.46	0.50

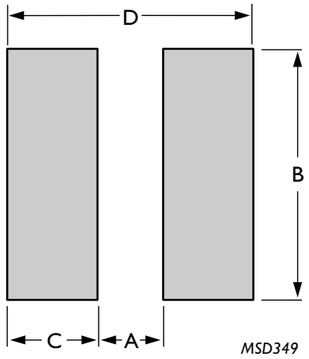
Fig.3 Phycomp's low-inductance MLCCs with terminations on the longer sides (dimensions in mm)

Component soldering

Reflow soldering

- Print solder paste to a thickness of 150 to 200 µm
- Use rosin-based flux, do not use activated flux (containing, for example, more than 0.2% by weight of chlorine)
- Use solder consisting of Sn/Pb in the proportions 63/37 or 60/40 or Sn/Pb/Ag in the proportion 62/36/2

Solder footprint



	0508	0612
A	0.50	0.80
B	2.00	3.20
C	1.00	1.00
D	2.50	2.80

Fig.4 Solder footprint (dimensions in mm)

Soldering conditions

Surface-mount components are tested for solderability at a temperature of 235 °C for 2 seconds. A typical example of a soldering process that provides reliable joints without any damage is given in Fig.5.

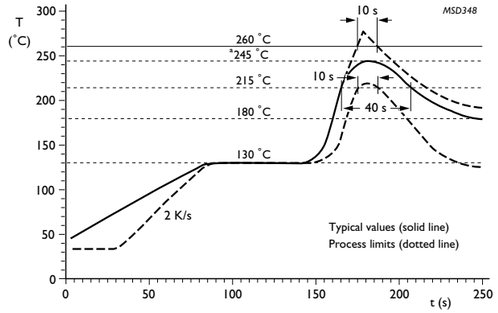


Fig.5 Soldering conditions (infrared soldering)

Handling precautions

Soldering precautions

- Note that this product will be easily damaged by rapid heating, rapid cooling or local heating
- Do not subject the product to thermal shock by the use of soldering temperatures greater than 100 °C. We recommend the use of preheating and annealing (gradual cooling) stages during the soldering cycle
- Wave soldering of this product is not recommended since this can lead to the formation of solder bridging due to the narrow pitch of the product

Solder gun precautions

Note the following precautions when using a solder gun for replacement:

- The tip temperature must not exceed 280 °C for 3 s. To ensure this, use a solder gun with a power of less than 30 W
- The solder gun tip must not come into direct contact with the product

Substrate handling precautions

- Ensure that the PC board is not flexed excessively after the product and other components have been soldered If necessary, use a support pin to prevent excessive flexing on the PC board
- Mount the products as far as possible from the break line of the PC board and from any line of large holes on the board
- Do not break the PC board by hand. We recommend the use of a machine or jig to break the board

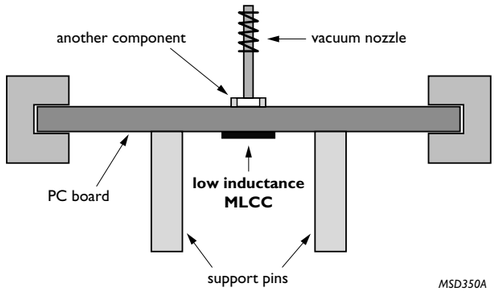


Fig.6 Precautions when handling substrate

Storage conditions

Note the following precautions when storing the product:

- Avoid high-temperature, high-humidity and dusty environments and atmospheres containing corrosive gases (e.g. hydrogen chloride, sulphuric acid gas, hydrogen sulphide) since these can degrade terminal solderability
- Keep the storage temperature less than 40 °C, relative humidity less than 70% and, if possible, do not keep in storage longer than 6 months
- Avoid direct heat and sunshine to prevent the packaging tape from melting and sticking to the product

More information

For more information and data contact your local Yageo sales representative (contact details on the back cover) or visit our web site on **http://www.yageo.com.**

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