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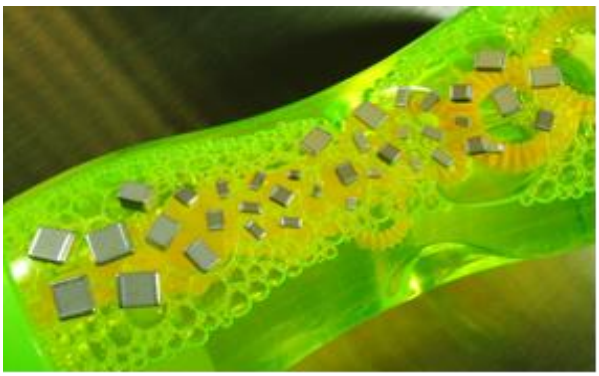
AC250 Range: Non-Safety AC MLCC for use at Mains Voltages

Introduction



Industry wide standard multilayer ceramic capacitors are supplied with a DC rating only. For AC use Surge and Safety capacitors with an AC rating of 250Vac have been available but the capacitance range is limited as a result of the strict impulse and VP requirements in the international standards.

Knowles offers a solution in both our original and PSL range for operation up to 250Vac 60Hz continuous use provided for non-safety critical applications where extended capacitance ranges are required.

Background

Behaviour of dielectrics is well defined for DC bias:

C0G or Ultra Stable Class 1 dielectric types have little or no variation with applied voltage.

X7R or Stable Class 2 dielectrics are not quite as straightforward but still have subcategories into which they can be classified:

EIA dielectric type X7R (CECC 2R1) has no voltage coefficient requirement,

CECC 2C1/MIL BZ are +20%-30%

CECC 2X1/MIL BX are +15-25% with rated DC voltage applied.

For all of the above dielectrics there is no dielectric classification to define capacitance change under AC voltage conditions.

DC rated capacitors have always been used in AC environments but by de-rating a DC capacitor one merely gains the required reliability and not the knowledge of how the capacitance will change under operational conditions. The aim of the Syfer 250Vac range is to provide parts which are reliable and consistent in their AC behaviour.

Another consideration which has to be made is that of self heating effects; this is dependant on case size capacitance and dissipation factor along with frequency and amplitude of the applied voltage.

Testing

Knowles has carried out extensive testing to define the behaviour of MLCC under AC conditions. Current flow, capacitance change and temperature rise have all been measured in order to provide the circuit designer with the data required to simulate the behaviour of the component under operating conditions. Temperature rise at room temperature is restricted to a maximum of 25°C, given appropriate mounting to a PCB which provides no heating to the system under operational conditions.

Accelerated life testing has also been carried out at maximum rated voltage and frequency at elevated temperatures to ensure that the parts supplied meet Knowles' high quality standards.

Test Data

To aid the designer to get an understanding of the circuit behaviour when using AC250 chip capacitors in AC application, this section describes the testing conducted to demonstrate the change of current flow through the AC250 capacitors under applied ac sinusoidal voltage variations.

The current flow through the capacitor is defined as:

$$I = \frac{V_{rms}}{X_c} \qquad (1)$$

Reactance is related to frequency and capacitance value.

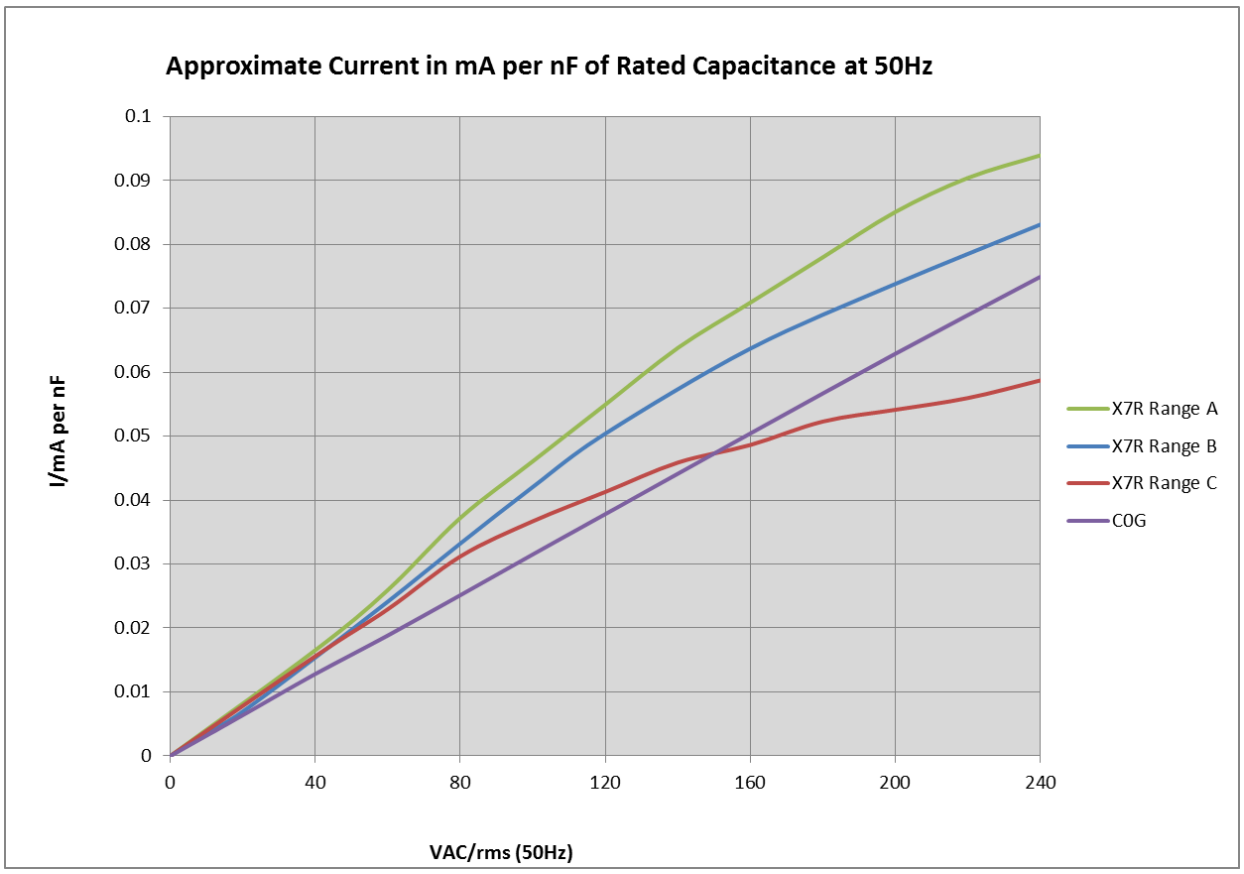
$$X_c = \frac{1}{2\pi fC} \qquad (2)$$

X_c is Capacitive Reactance in Ohms, f is frequency in Hertz and C is capacitance in Farads.

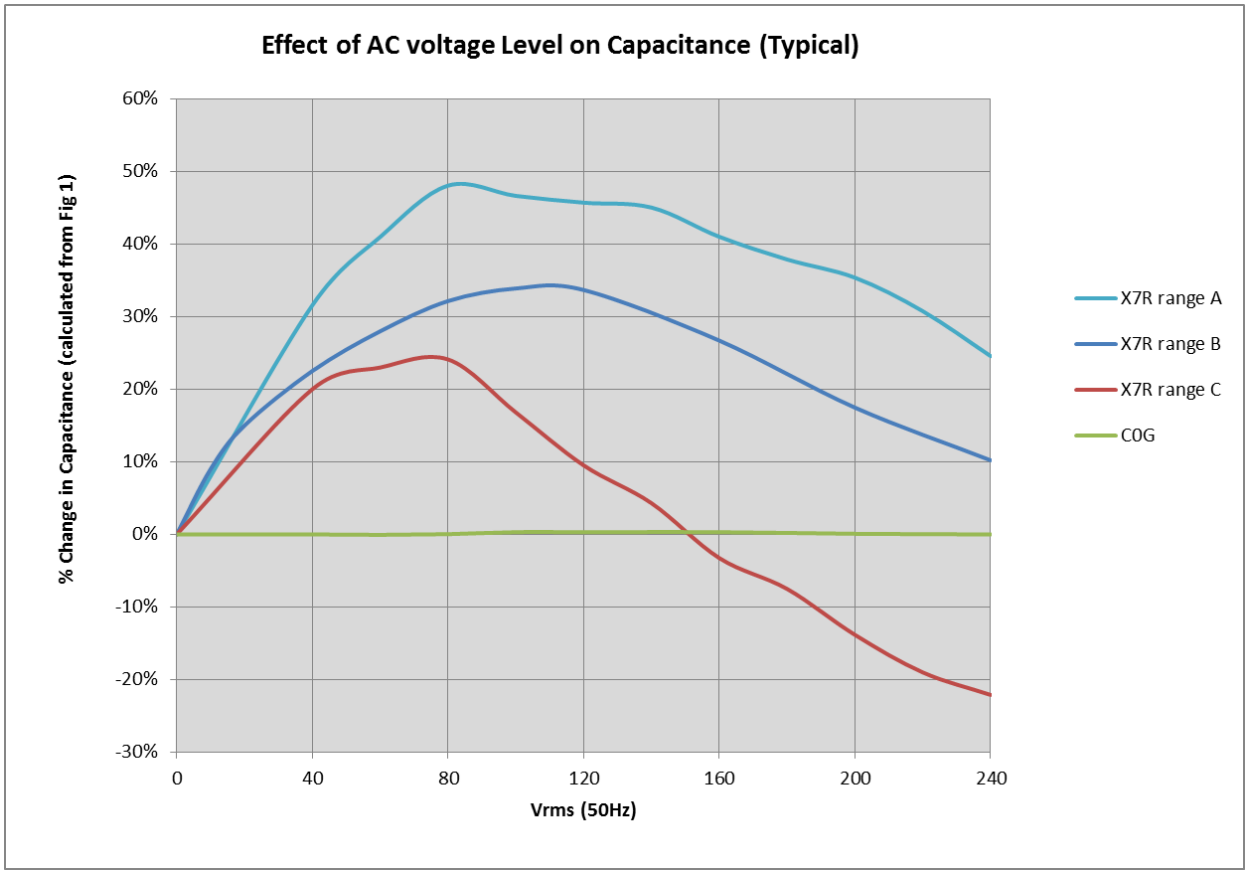
Testing has been undertaken with various samples of different case sizes and capacitance. Starting at 0 V, successively with higher AC rms voltages at 50Hz and current going through the capacitor is measured. The measurement is then plotted with current per capacitance (using initial capacitance) against the applied voltage.

Equipment used: DVM for Voltage and Current readings; True RMS AC Voltage supply to the test circuit is generated by Chroma 6400 series Programmable AC Power Source.

The below plots can be extrapolated to calculate the in circuit current for the capacitance values. For example: 1812 56nF capacitor, 4.76mA (0.085 mA/nF x 56nF) current is expected to flow into it while at the instantaneous rms voltage of 200V. By rearranging equation 1 above, the capacitance reactance can be calculated: $X_c = {}^{200}/_{4.76^{-3}}$ => 42016.81ohms. From which a theoretical capacitance value of 76nF is calculated.



Note: Values are typical and will vary with temperature and tolerance



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Specific information regarding individual values may be available upon request, contact Knowles for more details.

Ranges

Case sizes 0805 to 2220 are available in both X7R and C0G dielectrics with capacitances of up to 120nF. The capacitance ranges are divided into four groups, C0G which has negligible capacitance shift with applied voltage and three subgroups of X7R A, B & C, with ±30%, +30%-50% and +30-80% maximum capacitance shift respectively between 0V-240V 50Hz. X7R dielectric subgroups A and C are available in both original and PSL range.

Ordering Information

The 250Vac Capacitors can be ordered by using a standard Syfer product code with the voltage code A25.

Examples: 1206YA250473KJT or 2220JA250102JCT

1206	Case Size
Y	Polymer Termination FlexiCap™
A25	250V AC Rated up to 60Hz

0473 47nF	Capacitance Value
K	10% Capacitance Tolerance
J	PSL range - X7R Dielectric (Use code X for Original Range)
T	Taped and Reeled
2220	Case Size
J	Nickel Barrier with Matte Tin Finish
A25	250V AC Rated up to 60Hz
0102 1nF	Capacitance Value
J	5% Capacitance Tolerance
C	C – C0G/NP0 Dielectric
T	Taped and Reeled

This Range is complementary to Syfer's range of Surge and Safety Certified capacitors, Y2/X1 and X2 rated components are available in case sizes 1808, 1812, 2211, 2215 and 2220 with certifications from TÜV and UL for standard terminations and our FlexiCap™ flexible polymer termination.

All other specifications and properties are as Syfer standard product.

For further information or technical assistance please contact our Sales Department on +44 1603 723310 or by Email at SyferSales@knowles.com