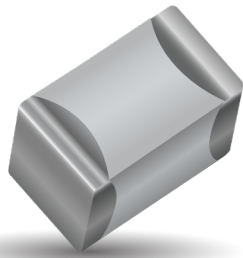


# Automotive MLCC with FLEXITERM®, KAF Series

## General Specifications



### GENERAL DESCRIPTION

With increased requirements from the automotive industry for additional component robustness, KYOCERA AVX recognized the need to produce a MLCC with enhanced mechanical strength. It was noted that many components may be subject to severe flexing and vibration when used in various under the hood automotive and other harsh environment applications.

To satisfy the requirement for enhanced mechanical strength, KYOCERA AVX had to find a way of ensuring electrical integrity is maintained whilst external forces are being applied to the component. It was found that the structure of the termination needed to be flexible and after much research and development, KYOCERA AVX launched FLEXITERM®. FLEXITERM® is designed to enhance the mechanical flexure and temperature cycling performance of a standard ceramic capacitor. The industry standard for flexure is 2mm minimum. Using FLEXITERM®, KYOCERA AVX provides up to 5mm of flexure without internal cracks. Beyond 5mm, the capacitor will generally fail "open".

As well as for automotive applications FLEXITERM® will provide Design Engineers with a satisfactory solution when designing PCB's which may be subject to high levels of board flexure.

### PRODUCT ADVANTAGES

- High mechanical performance able to withstand, 5mm bend test guaranteed
- Increased temperature cycling performance, 3000 cycles and beyond
- Flexible termination system
- Reduction in circuit board flex failures
- Base metal electrode system
- Automotive or commercial grade products available
- AECQ200 Qualified
- Approved to VW 80808 Specification

### APPLICATIONS

#### High Flexure Stress Circuit Boards

- e.g. Depanelization: Components near edges of board.

#### Variable Temperature Applications

- Soft termination offers improved reliability performance in applications where there is temperature variation.
- e.g. All kind of engine sensors: Direct connection to battery rail.

#### Automotive Applications

- Improved reliability.
- Excellent mechanical performance and thermo mechanical performance.

### HOW TO ORDER

| KAF                                               | 31                                                                                                     | G                                 | R7                                                                            | 1H                                                                                                                                                                                               | 475                                                                                                                      | K                                                                                                                                                                     | U                                   |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>Series</b><br>AEC-Q200<br>FLEXITERM®<br>SERIES | <b>Size</b><br>15 = 0603<br>21 = 0805<br>31 = 1206<br>32 = 1210<br>42 = 1808<br>43 = 1812<br>55 = 2220 | <b>Thickness</b><br>See Cap Chart | <b>Dielectric</b><br>CG = COG<br>R7 = X7R<br>R8 = X8R<br>L8 = X8L<br>G8 = X8G | 0J = 6.3V<br>1A = 10V<br>1C = 16V<br>1E = 25V<br>1H = 50V<br>2A = 100V<br>2D = 200V<br>2E = 250V<br>2H = 500V<br>2J = 630V<br>3A = 1000V<br>3N = 1500V<br>3D = 2000V<br>3E = 2500V<br>3U = 3000V | <b>Capacitance Code (in pF)</b><br>2 Significant Digits<br>+Number of zeros<br>eg 10uF = 106<br>10nF = 103<br>47pF = 470 | <b>Capacitance Tolerance</b><br>B = ± 0.1pF (<10pF)*<br>C = ± 0.25pF (<10pF)*<br>D = ± 0.5pF (<10pF)*<br>F = ± 1%*<br>G = ± 2%*<br>J = ± 5%<br>K = ± 10%<br>M = ± 20% | <b>Packaging</b><br>See Table Below |

NOTE: Contact factory for availability of Tolerance Options for Specific Part Numbers.

### PACKAGING CODES

| Code | EIA (inch) | IEC (mm) | 7" Paper | 7" Embossed | 13" Paper | 13" Embossed |
|------|------------|----------|----------|-------------|-----------|--------------|
| 15   | 0603       | 1608     | T        | U           | M         | L            |
| 21   | 0805       | 2012     | T        | U           | M         | L            |
| 31   | 1206       | 3216     | T        | U           | M         | L            |
| 32   | 1210       | 3225     | T        | U           | M         | L            |
| 42   | 1808       | 4520     |          | Y           |           | K            |
| 43   | 1812       | 4532     |          | V           |           | S            |
| 55   | 2220       | 5750     |          | V           |           | S            |

\*thickness determines paper or plastic embossed packaging

\*COG only

# Automotive MLCC with FLEXITERM®, KAF Series

## Specifications and Test Methods

### PERFORMANCE TESTING

#### AEC-Q200 Qualification:

- Created by the Automotive Electronics Council
- Specification defining stress test qualification for passive components

#### Testing:

Key tests used to compare soft termination to AEC-Q200 qualification:

- Bend Test
- Temperature Cycle Test



### BOARD BEND TEST RESULTS

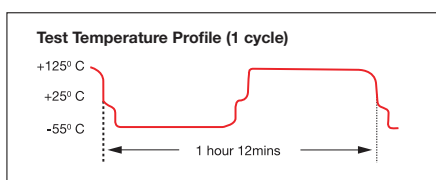
| Style | Conventional Termination | FLEXITERM® |
|-------|--------------------------|------------|
| 0603  | >2mm                     | >5mm       |
| 0805  | >2mm                     | >5mm       |
| 1206  | >2mm                     | >5mm       |

### TEMPERATURE CYCLE TEST PROCEDURE

Test Procedure as per AEC-Q200:

The test is conducted to determine the resistance of the component when it is exposed to extremes of alternating high and low temperatures.

- Sample lot size quantity 77 pieces
- TC chamber cycle from -55°C to +125°C for 1000 cycles
- Interim electrical measurements at 250, 500, 1000 cycles
- Measure parameter capacitance dissipation factor, insulation resistance



### BOARD BEND TEST PROCEDURE

According to AEC-Q200

Test Procedure as per AEC-Q200:

Sample size: 20 components  
Span: 90mm Minimum deflection spec: 2 mm

- Components soldered onto FR4 PCB (Figure 1)
- Board connected electrically to the test equipment (Figure 2)

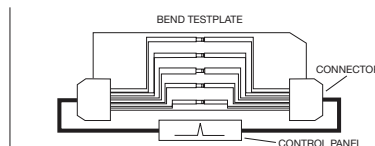


Fig 1 - PCB layout with electrical connections

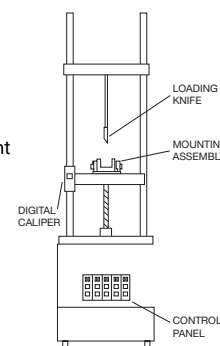
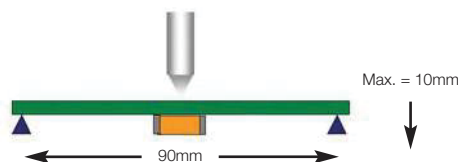


Fig 2 - Board Bend test equipment

### ENHANCED SOFT TERMINATION BEND TEST PROCEDURE

#### Bend Test

The capacitor is soldered to the printed circuit board as shown and is bent up to 10mm at 1mm per second:



- The board is placed on 2 supports 90mm apart (capacitor side down)
- The row of capacitors is aligned with the load stressing knife

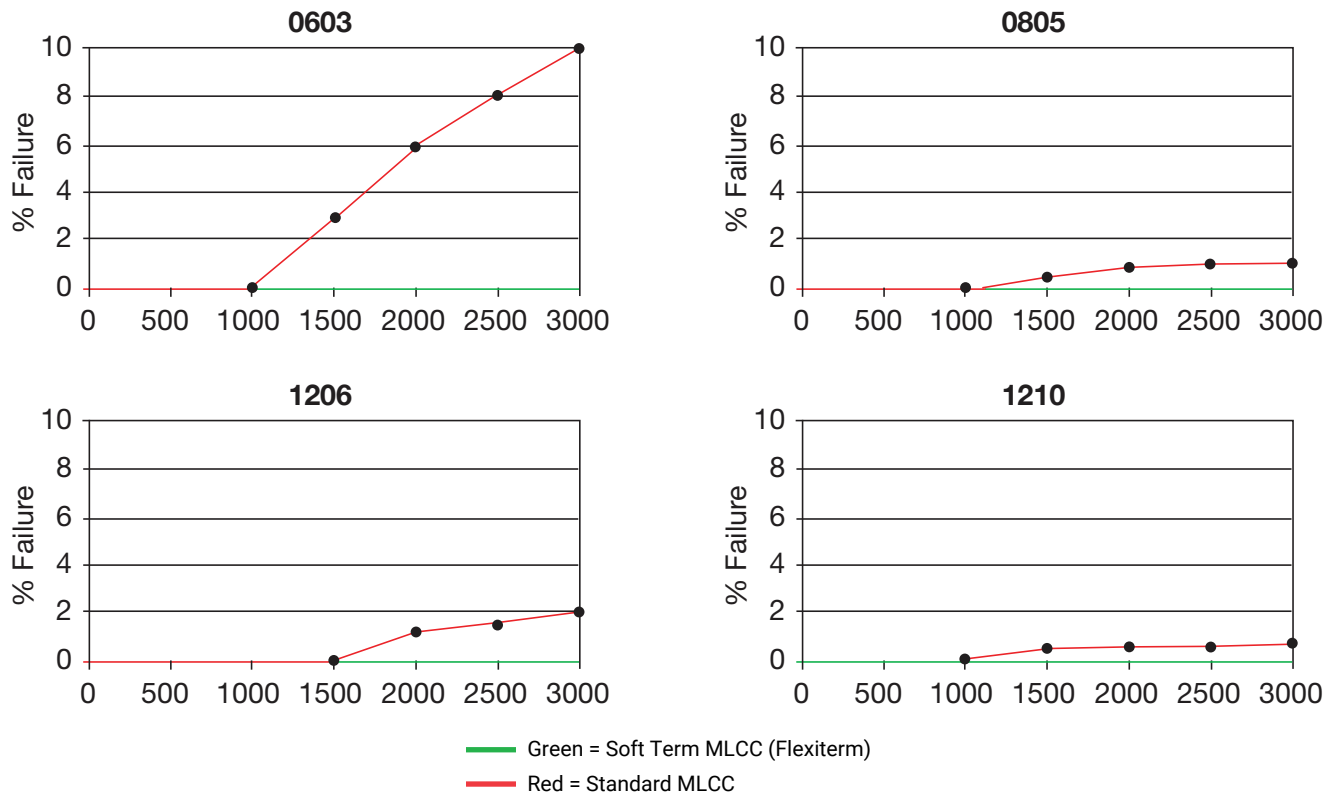


- The load is applied and the deflection where the part starts to crack is recorded (Note: Equipment detects the start of the crack using a highly sensitive current detection circuit)
- The maximum deflection capability is 10mm

# Automotive MLCC with FLEXITERM®, KAF Series

## Specifications and Test Methods

### BEYOND 1000 CYCLES: TEMPERATURE CYCLE TEST RESULTS



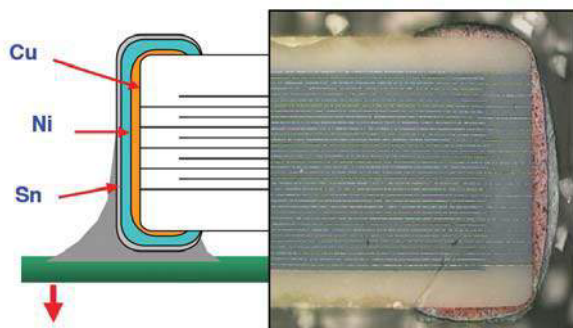
**Soft Term - No Defects up to 3000 cycles**

**AEC-Q200 specification states 1000 cycles compared to 3000 temperature cycles.**

### FLEXITERM® TEST SUMMARY

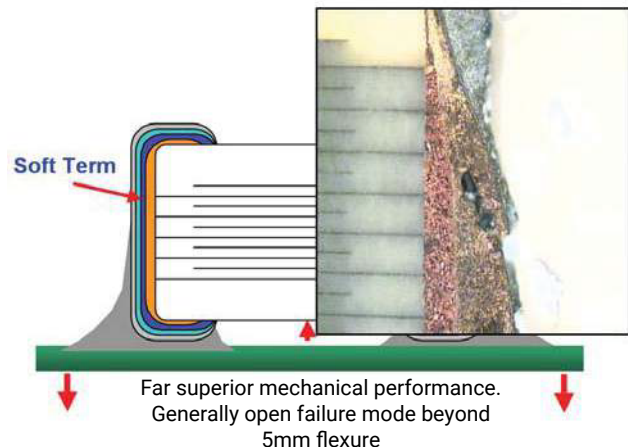
- Qualified to AEC-Q200 test/specification with the exception of using 3000 temperature cycles (up to +150°C bend test guaranteed greater than 5mm).
- FLEXITERM® provides improved performance compared to standard termination systems.
- Board bend test improvement by a factor of 2 to 4 times.
- Temperature Cycling:
  - 0% Failure up to 3000 cycles
  - No ESR change up to 3000 cycle

#### WITHOUT SOFT TERMINATION



Major fear is of latent board flex failures.

#### WITH SOFT TERMINATION



# Automotive MLCC with FLEXITERM® - NP0

## Capacitance Range

| SIZE         |          | 0603                           |     |      |      |      |      |       |     | 0805                          |      |      |      |      |       |     |     | 1206                         |      |      |      |      |       |     |      | 1210                         |      |      |      |       |  |  |  |
|--------------|----------|--------------------------------|-----|------|------|------|------|-------|-----|-------------------------------|------|------|------|------|-------|-----|-----|------------------------------|------|------|------|------|-------|-----|------|------------------------------|------|------|------|-------|--|--|--|
| Soldering    |          | Reflow/Wave                    |     |      |      |      |      |       |     | Reflow/Wave                   |      |      |      |      |       |     |     | Reflow/Wave                  |      |      |      |      |       |     |      | Reflow/Wave                  |      |      |      |       |  |  |  |
| (L) Length   | mm (in.) | 1.6 ± 0.15<br>(0.063 ± 0.006)  |     |      |      |      |      |       |     | 2.01 ± 0.2<br>(0.079 ± 0.008) |      |      |      |      |       |     |     | 3.2 ± 0.2<br>(0.126 ± 0.008) |      |      |      |      |       |     |      | 3.2 ± 0.2<br>(0.126 ± 0.008) |      |      |      |       |  |  |  |
| (W) Width    | mm (in.) | 0.81 ± 0.15<br>(0.032 ± 0.006) |     |      |      |      |      |       |     | 1.25 ± 0.2<br>(0.049 ± 0.008) |      |      |      |      |       |     |     | 1.6 ± 0.2<br>(0.063 ± 0.008) |      |      |      |      |       |     |      | 2.5 ± 0.2<br>(0.098 ± 0.008) |      |      |      |       |  |  |  |
| (t) Terminal | mm (in.) | 0.35 ± 0.15<br>(0.014 ± 0.006) |     |      |      |      |      |       |     | 0.5 ± 0.25<br>(0.02 ± 0.01)   |      |      |      |      |       |     |     | 0.5 ± 0.25<br>(0.02 ± 0.01)  |      |      |      |      |       |     |      | 0.5 ± 0.25<br>(0.02 ± 0.01)  |      |      |      |       |  |  |  |
| WVDC         |          | 25V                            | 50V | 100V | 200V | 250V | 630V | 1000V | 25V | 50V                           | 100V | 200V | 250V | 630V | 1000V | 25V | 50V | 100V                         | 200V | 250V | 500V | 630V | 1000V | 50V | 100V | 200V                         | 250V | 500V | 630V | 1000V |  |  |  |
| 0R5          | 0.5      | A                              | A   | A    | A    |      |      |       | B   | B                             | B    | B    |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 1R0          | 1.0      | A                              | A   | A    | A    |      |      |       | B   | B                             | B    | B    |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 100          | 10       | A                              | A   | A    | A    |      |      |       | B   | B                             | B    | B    |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 120          | 12       | A                              | A   | A    | A    |      |      |       | B   | B                             | B    | B    |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 150          | 15       | A                              | A   | A    | A    |      |      |       | B   | B                             | B    | B    |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 180          | 18       | A                              | A   | A    | A    |      |      |       | B   | B                             | B    | B    |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 220          | 22       | A                              | A   | A    | A    |      |      |       | B   | B                             | B    | B    |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 270          | 27       | A                              | A   | A    | A    |      |      |       | B   | B                             | B    | B    |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 330          | 33       | A                              | A   | A    | A    |      | B    | B     | B   | B                             | B    | B    |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 390          | 39       | A                              | A   | A    | A    |      | B    | B     | B   | B                             | B    | B    |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 470          | 47       | A                              | A   | A    | A    |      | B    | B     | B   | B                             | B    | B    |      | A    | A     |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 560          | 56       | A                              | A   | A    | A    | A*   | B    | B     | B   | B                             | B    | B    |      | A    | A     |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 680          | 68       | A                              | A   | A    | A    | A*   | B    | B     | B   | B                             | B    | B    |      | A    | A     |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 820          | 82       | A                              | A   | A    | A    | A*   | B    | B     | B   | B                             | B    | B    |      | A    | A     |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 101          | 100      | A                              | A   | A    |      | A*   | B    | B     | B   | B                             | B    | B    |      | A    | A     |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 121          | 120      |                                |     |      | A*   | A*   | B    | B     | B   | B                             | B    | B    |      | A    | A     |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 151          | 150      |                                |     |      | A*   | A*   | B    | B     | B   | B                             | B    | B    |      | A    | A     |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 181          | 180      |                                |     |      | A*   | A*   | B    | B     | B   | B                             | B    | B    |      | A    | A     |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 221          | 220      |                                |     |      | A*   | A*   | B    | B     | B   | B                             | B    | B    |      | A    | A     |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 271          | 270      |                                |     |      | A*   | A*   | B*   |       | B   | B                             | B    | B    |      | A    | A     |     |     |                              |      |      |      |      | N     |     |      |                              |      |      |      |       |  |  |  |
| 331          | 330      |                                |     |      | A*   | A*   | B*   |       |     |                               | B    |      |      | A    | A     |     |     |                              |      |      |      |      | N     |     |      |                              |      |      |      |       |  |  |  |
| 391          | 390      |                                |     |      | A*   | A*   | B*   |       |     |                               | B    |      |      | A    | A     |     |     |                              |      |      |      |      | N     |     |      |                              |      |      |      |       |  |  |  |
| 471          | 470      |                                |     | A*   | A*   | A*   | B*   |       |     |                               | B    |      |      | A    | A     |     |     |                              |      |      |      |      | N     |     |      |                              |      |      |      |       |  |  |  |
| 561          | 560      |                                |     | A*   | A*   | A*   | B*   |       |     |                               | B    |      |      | A    | A     |     |     |                              |      |      |      |      | N     |     |      |                              |      |      |      |       |  |  |  |
| 681          | 680      |                                |     | A*   | A*   | A*   | B*   |       |     |                               | B    |      |      | A    | A     |     |     |                              |      |      |      |      | N     |     |      |                              |      |      |      |       |  |  |  |
| 821          | 820      | A*                             | A*  | A*   | A*   | A*   | B*   |       |     |                               | B    |      |      | A    | A     |     |     |                              |      |      |      |      | N     |     |      |                              |      |      |      |       |  |  |  |
| 102          | 1000     | A*                             | A*  | A*   | A*   | A*   | B*   |       |     |                               | B    |      |      | A    | A     |     |     |                              |      |      |      |      | N     |     |      |                              |      |      | K*   | K*    |  |  |  |
| 122          | 1200     | A*                             | A*  | A*   | A*   | A*   |      |       |     |                               |      |      |      | A    | A     |     |     |                              |      |      |      |      | N     |     |      |                              |      |      | C*   | C*    |  |  |  |
| 152          | 1500     | A*                             | A*  | A*   | A*   | A*   |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      | N     |     |      |                              |      |      | G*   | G*    |  |  |  |
| 182          | 1800     | A*                             | A*  | A*   |      |      |      |       |     |                               | B    | B    | B    |      |       |     |     |                              |      |      |      |      | N     |     |      |                              |      |      | G*   | G*    |  |  |  |
| 222          | 2200     | A*                             | A*  | A*   |      |      |      |       |     |                               | B    | B    | B    |      |       |     |     |                              |      |      |      |      | N     |     |      |                              |      | G*   | G*   | G*    |  |  |  |
| 272          | 2700     | A*                             | A*  |      |      |      |      |       |     |                               | A    | A    | A    | A    |       |     |     |                              |      |      |      |      | B     | B   | B    | B                            | B    | B    | G*   | G*    |  |  |  |
| 332          | 3300     | A*                             | A*  |      |      |      |      |       |     |                               | A    | A    | A    | A    |       |     |     |                              |      |      |      |      | G     | G   | G    | G                            | G    | G    | G*   | G*    |  |  |  |
| 392          | 3900     | A*                             | A*  |      |      |      |      |       |     |                               | A    | A    | A    | A    |       |     |     |                              |      |      |      |      | G     | G   | G    | G                            | G    | G    | G*   | G*    |  |  |  |
| 472          | 4700     | A*                             | A*  |      |      |      |      |       |     |                               | A    | A    | A    | A    |       |     |     |                              |      |      |      |      | G     | G   | G    | G                            | G    | G    | G*   | G*    |  |  |  |
| 562          | 5600     | A*                             | A*  |      |      |      |      |       |     |                               | A    | A    |      |      |       |     |     |                              |      |      |      |      | G     | G   | G    | G                            | G    | G    | G*   | G*    |  |  |  |
| 682          | 6800     | A*                             | A*  |      |      |      |      |       |     |                               | A    | A    |      |      |       |     |     |                              |      |      |      |      | G     | G   | G    | G                            | G    | G    | K*   | K*    |  |  |  |
| 822          | 8200     | A*                             |     |      |      |      |      |       |     |                               | A    | A    |      |      |       |     |     |                              |      |      |      |      | G     | G   | G    | G                            | G    | G    | K*   | K*    |  |  |  |
| 103          | 10000    | A*                             |     |      |      |      |      |       |     |                               | A    | A    |      |      |       |     |     |                              |      |      |      |      | G     | G   | G    | G                            | G    | G    | K*   | K*    |  |  |  |
| 123          | 12000    |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      | G     | G   | G    | G                            | G    |      | K*   | K*    |  |  |  |
| 153          | 15000    |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      | G     | G   | G    | G                            | G    |      | L*   | L*    |  |  |  |
| 183          | 18000    |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      | G     | G   | G    | G                            | G    |      | L*   | L*    |  |  |  |
| 223          | 22000    |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      | G     | G   | G    |                              |      |      | L*   | L*    |  |  |  |
| 273          | 27000    |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      | G     | G   | G    |                              |      |      | L*   | L*    |  |  |  |
| 333          | 33000    |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      | G     | G   | G    |                              |      |      | L*   | L*    |  |  |  |
| 393          | 39000    |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      | G     | G   |      |                              |      |      | L*   | L*    |  |  |  |
| 473          | 47000    |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      | G     | G   |      |                              |      |      | L*   | L*    |  |  |  |
| 563          | 56000    |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      | G     | G   |      |                              |      |      |      |       |  |  |  |
| 683          | 68000    |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 823          | 82000    |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| 104          | 100000   |                                |     |      |      |      |      |       |     |                               |      |      |      |      |       |     |     |                              |      |      |      |      |       |     |      |                              |      |      |      |       |  |  |  |
| WVDC         |          | 25V                            | 50V | 100V | 200V | 250V | 630V | 1000V | 25V | 50V                           | 100V | 200V | 250V | 630V | 1000V | 25V | 50V | 100V                         | 200V | 250V | 500V | 630V | 1000V | 50V | 100V | 200V                         | 250V | 500V | 630V | 1000V |  |  |  |
| Size         |          | 0603                           |     |      |      |      |      |       |     | 0805                          |      |      |      |      |       |     |     | 1206                         |      |      |      |      |       |     |      | 1210                         |      |      |      |       |  |  |  |

\* These dimensions differ from the standard in table above and are:

0603 L= 1.6 ± 0.2 mm, W = 0.8 ± 0.2 mm

1206 L= 3.2 ± 0.4 mm, W = 1.6 ± 0.3 mm

1210 L= 3.2 ± 0.4 mm, W = 2.5 ± 0.3 mm

| Case Size               | 0603<br>(KAF15) |       | 0805<br>(KAF21) |      | 1206<br>(KAF31) |      |          | 1210<br>(KAF32) |      |      |      |
|-------------------------|-----------------|-------|-----------------|------|-----------------|------|----------|-----------------|------|------|------|
| Thickness Letter        | A               | B     | B               | A    | B               | N    | G        | C               | G    | K    | L    |
| Max Thickness (mm)      | 0.90            | 0.95  | 0.94            | 1.45 | 0.94            | 1.27 | 1.78     | 1.27            | 1.78 | 2.29 | 2.80 |
| Carrier Tape            | PAPER           | PAPER | PAPER           | EMB  | PAPER           | EMB  | EMB      | EMB             | EMB  | EMB  | EMB  |
| Packaging Code 7" reel  | T               | T     | T               | U    | T               | U    | U        | U               | U    | U    | U    |
| Packaging Code 13" reel | M               | M     | M               | L    | M               | L    | L        | L               | L    | L    | L    |
|                         | PAPER           |       |                 |      |                 |      | EMBOSSED |                 |      |      |      |

# Automotive MLCC with FLEXITERM® - X8R / X8L

## Capacitance Range

KYOCERA AVX has developed a range of multilayer ceramic capacitors designed for use in applications up to 150°C. These capacitors are manufactured with an X8R and an X8L dielectric material. X8R material has capacitance variation of  $\pm 15\%$  between -55°C and +150°C. The X8L material has capacitance variation of  $\pm 15\%$  between -55°C to 125°C to 125°C and +15/40% from +125°C to +150°C.

The need for X8R and X8L performance has been driven by customer requirements for parts that operate at elevated temperatures. They provide a highly reliable capacitor with low loss and stable capacitance over temperature.

They are ideal for automotive under the hood sensors, and various industrial applications. Typical industrial application would be drilling monitoring system. They can also be used as bulk capacitors for high temperature camera modules.

### X8R

| SIZE         |             | 0603                           |     |      | 0805                          |     |      | 1206                         |     |      |
|--------------|-------------|--------------------------------|-----|------|-------------------------------|-----|------|------------------------------|-----|------|
| Soldering    |             | Reflow/Wave                    |     |      | Reflow/Wave                   |     |      | Reflow/Wave                  |     |      |
| (L) Length   | mm<br>(in.) | 1.6 ± 0.15<br>(0.063 ± 0.006)  |     |      | 2.01 ± 0.2<br>(0.079 ± 0.008) |     |      | 3.2 ± 0.2<br>(0.126 ± 0.008) |     |      |
| (W) Width    | mm<br>(in.) | 0.81 ± 0.15<br>(0.032 ± 0.006) |     |      | 1.25 ± 0.2<br>(0.049 ± 0.008) |     |      | 1.6 ± 0.2<br>(0.063 ± 0.008) |     |      |
| (t) Terminal | mm<br>(in.) | 0.35 ± 0.15<br>(0.014 ± 0.006) |     |      | 0.5 ± 0.25<br>(0.02 ± 0.01)   |     |      | 0.5 ± 0.25<br>(0.02 ± 0.01)  |     |      |
| WVDC         |             | 25V                            | 50V | 100V | 25V                           | 50V | 100V | 25V                          | 50V | 100V |
| 271          | Cap 270     | A                              | A   | A    |                               |     |      |                              |     |      |
| 331          | (pF) 330    | A                              | A   | A    | B                             | B   | B    |                              |     |      |
| 471          | 470         | A                              | A   | A    | B                             | B   | B    |                              |     |      |
| 681          | 680         | A                              | A   | A    | B                             | B   | B    |                              |     |      |
| 102          | 1000        | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 152          | 1500        | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 182          | 1800        | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 222          | 2200        | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 272          | 2700        | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 332          | 3300        | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 392          | 3900        | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 472          | 4700        | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 562          | 5600        | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 682          | 6800        | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 822          | 8200        | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 103          | Cap 0.01    | A                              | A   | A    | B                             | B   | B    | B                            | B   |      |
| 123          | (uF) 0.012  | A                              | A   |      | B                             | B   | B    | B                            | B   |      |
| 153          | 0.015       | A                              | A   |      | B                             | B   | A    | B                            | B   |      |
| 183          | 0.018       | A                              | A   |      | B                             | B   | A    | B                            | B   |      |
| 223          | 0.022       | A                              | A   |      | B                             | B   | A    | B                            | B   |      |
| 273          | 0.027       | A                              | A   |      | B                             | B   |      | B                            | B   |      |
| 333          | 0.033       | A                              | A   |      | B                             | B   |      | B                            | B   |      |
| 393          | 0.039       | A                              | A   |      | B                             | B   |      | B                            | B   |      |
| 473          | 0.047       | A                              | A   |      | B                             | B   |      | B                            | B   |      |
| 563          | 0.056       | A                              |     |      | A                             | A   |      | N                            | N   |      |
| 683          | 0.068       | A                              |     |      | A                             | A   |      | N                            | N   |      |
| 823          | 0.082       |                                |     |      | A                             | A   |      | N                            | N   |      |
| 104          | 0.1         |                                |     |      | A                             | A   |      | N                            | N   |      |
| 124          | 0.12        |                                |     |      | A                             | A   |      | N                            | N   |      |
| 154          | 0.15        |                                |     |      | A                             | A   |      | N                            | N   |      |
| 184          | 0.18        |                                |     |      | A                             |     |      | N                            | N   |      |
| 224          | 0.22        |                                |     |      | A                             |     |      | N                            | N   |      |
| 274          | 0.27        |                                |     |      |                               |     |      | N                            | N   |      |
| 334          | 0.33        |                                |     |      |                               |     |      | N                            | N   |      |
| 394          | 0.39        |                                |     |      |                               |     |      | E                            | G   |      |
| 474          | 0.47        |                                |     |      |                               |     |      | E                            | G   |      |
| 684          | 0.68        |                                |     |      |                               |     |      | G                            | G   |      |
| 824          | 0.82        |                                |     |      |                               |     |      | G                            | G   |      |
| 105          | 1           |                                |     |      |                               |     |      | G                            | G   |      |
| WVDC         |             | 25V                            | 50V | 100V | 25V                           | 50V | 100V | 25V                          | 50V | 100V |
| SIZE         |             | 0603                           |     |      | 0805                          |     |      | 1206                         |     |      |

| Case Size              | 0603(KAF15) |       | 0805(KAF21) |                | 1206(KAF31) |      |      |      | 1210(KAF32) | 2220(KAF55) |
|------------------------|-------------|-------|-------------|----------------|-------------|------|------|------|-------------|-------------|
| Thickness Letter       | A           | B     | B           | A              | B           | N    | E    | G    | L           | C           |
| Max Thickness          | 0.90        | 0.95  | 0.94        | 1.45           | 0.94        | 1.27 | 1.52 | 1.78 | 2.79        | 2.80        |
| Carrier Tape           | PAPER       | PAPER | PAPER       | EMB            | PAPER       | EMB  | EMB  | EMB  | EMB         | EMB         |
| Packaging Code 7"reel  | T           | T     | T           | U              | T           | U    | U    | U    | U           | V           |
| Packaging Code 13"reel | M           | M     | M           | L              | M           | L    | L    | L    | L           | S           |
| PAPER                  |             |       |             | EMBOSSED (EMB) |             |      |      |      |             |             |

### X8L

| SIZE       |       |       | 0603                           |     |      | 0805                          |     |      | 1206                         |     |     |      | 1210                         |     |     |      | 2220                           |      |  |
|------------|-------|-------|--------------------------------|-----|------|-------------------------------|-----|------|------------------------------|-----|-----|------|------------------------------|-----|-----|------|--------------------------------|------|--|
| Soldering  |       |       | Reflow/Wave                    |     |      | Reflow/Wave                   |     |      | Reflow/Wave                  |     |     |      | Reflow/Wave                  |     |     |      | Reflow Only                    |      |  |
| (L) Length | mm    |       | 1.6 ± 0.15<br>(0.063 ± 0.006)  |     |      | 2.01 ± 0.2<br>(0.079 ± 0.008) |     |      | 3.2 ± 0.2<br>(0.126 ± 0.008) |     |     |      | 3.2 ± 0.2<br>(0.126 ± 0.008) |     |     |      | 5.7 ± 0.5<br>(0.224 ± 0.02)    |      |  |
|            | (in.) |       | 0.81 ± 0.15<br>(0.032 ± 0.006) |     |      | 1.25 ± 0.2<br>(0.049 ± 0.008) |     |      | 1.6 ± 0.2<br>(0.063 ± 0.008) |     |     |      | 2.5 ± 0.2<br>(0.098 ± 0.008) |     |     |      | 5 ± 0.4<br>(0.197 ± 0.016)     |      |  |
| (W) Width  | mm    |       | 0.35 ± 0.15<br>(0.014 ± 0.006) |     |      | 0.5 ± 0.25<br>(0.02 ± 0.01)   |     |      | 0.5 ± 0.25<br>(0.02 ± 0.01)  |     |     |      | 0.5 ± 0.25<br>(0.02 ± 0.01)  |     |     |      | 0.64 ± 0.39<br>(0.025 ± 0.015) |      |  |
|            | (in.) |       |                                |     |      |                               |     |      |                              |     |     |      |                              |     |     |      |                                |      |  |
| WVDC       |       |       | 25V                            | 50V | 100V | 25V                           | 50V | 100V | 16V                          | 25V | 50V | 100V | 10V                          | 25V | 50V | 100V | 25V                            | 50V  |  |
| 271        | Cap   | 270   | A                              | A   |      |                               |     |      |                              |     |     |      |                              |     |     |      |                                |      |  |
| 331        | (pF)  | 330   | A                              | A   | A    | B                             | B   | B    |                              |     |     |      |                              |     |     |      |                                |      |  |
| 471        |       | 470   | A                              | A   | A    | B                             | B   | B    |                              |     |     |      |                              |     |     |      |                                |      |  |
| 681        |       | 680   | A                              | A   | A    | B                             | B   | B    |                              |     |     |      |                              |     |     |      |                                |      |  |
| 102        |       | 1000  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 152        |       | 1500  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 182        |       | 1800  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 222        |       | 2200  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 272        |       | 2700  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 332        |       | 3300  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 392        |       | 3900  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 472        |       | 4700  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 562        |       | 5600  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 682        |       | 6800  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 822        |       | 8200  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 103        | Cap   | 0.01  | A                              | A   | A    | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 123        | (uF)  | 0.012 | A                              | A   |      | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 153        |       | 0.015 | A                              | A   |      | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 183        |       | 0.018 | A                              | A   |      | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 223        |       | 0.022 | A                              | A   |      | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 273        |       | 0.027 | A                              | A   |      | B                             | B   | B    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 333        |       | 0.033 | A                              | A   |      | B                             | B   | A    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 393        |       | 0.039 | A                              | A   |      | B                             | B   | A    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 473        |       | 0.047 | A                              | A   |      | B                             | B   | A    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 563        |       | 0.056 | A                              | A   |      | B                             | B   | A    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 683        |       | 0.068 | A                              | A   |      | B                             | B   | A    |                              | B   | B   | B    |                              |     |     |      |                                |      |  |
| 823        |       | 0.082 | A                              | A   |      | B                             | B   | A    |                              | B   | B   | N    |                              |     |     |      |                                |      |  |
| 104        |       | 0.1   | A                              | A   |      | B                             | B   | A    |                              | B   | B   | N    |                              |     |     |      |                                |      |  |
| 124        |       | 0.12  |                                |     |      | B                             | A   |      |                              | B   | B   | N    |                              |     |     |      |                                |      |  |
| 154        |       | 0.15  |                                |     |      | B                             | A   |      |                              | B   | B   | N    |                              |     |     |      |                                |      |  |
| 184        |       | 0.18  |                                |     |      | A                             | A   |      |                              | B   | B   | B    | G                            |     |     |      |                                |      |  |
| 224        |       | 0.22  |                                |     |      | A                             | A   |      |                              | B   | B   | B    | G                            |     |     |      |                                |      |  |
| 274        |       | 0.27  |                                |     |      | A                             | A   |      |                              | B   | N   | N    |                              |     |     |      |                                |      |  |
| 334        |       | 0.33  |                                |     |      | A                             | A   |      |                              | B   | N   | E    |                              |     |     |      |                                |      |  |
| 394        |       | 0.39  |                                |     |      | A                             | A   |      |                              | N   | N   | E    |                              |     |     |      |                                |      |  |
| 474        |       | 0.47  |                                |     |      | A                             | A   |      |                              | N   | N   | E    |                              |     |     |      |                                |      |  |
| 684        |       | 0.68  |                                |     |      | A                             | A   |      |                              | N   | G   | G    |                              |     |     |      |                                |      |  |
| 824        |       | 0.82  |                                |     |      | A                             | A   |      |                              | N   | G   | G    |                              |     |     |      |                                |      |  |
| 105        |       | 1     |                                |     |      | A                             | A   |      |                              | N   | G   | G    |                              |     |     |      |                                |      |  |
| 155        |       | 1.5   |                                |     |      |                               |     |      |                              | G   | G   | G    |                              |     |     |      |                                |      |  |
| 225        |       | 2.2   |                                |     |      |                               |     |      |                              | G   | G   | G    |                              |     | L   | L    | C                              | C    |  |
| 475        |       | 4.7   |                                |     |      |                               |     |      |                              | G   | G   |      |                              |     | L   |      |                                |      |  |
| 106        |       | 10    |                                |     |      |                               |     |      |                              |     |     |      | L                            | L   | L   |      |                                |      |  |
| WVDC       |       |       | 25V                            | 50V | 100V | 25V                           | 50V | 100V | 16V                          | 25V | 50V | 100V | 10V                          | 25V | 50V | 100V | 200V                           | 250V |  |
| SIZE       |       |       | 0603                           |     |      | 0805                          |     |      | 1206                         |     |     |      | 1210                         |     |     |      | 2220                           |      |  |

# Automotive MLCC with FLEXITERM® - X8R / X8L

## General Specifications

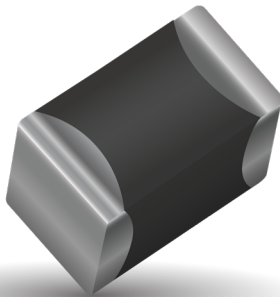
### APPLICATIONS FOR X8R AND X8L CAPACITORS

- All market sectors with a 150°C requirement
- Automotive on engine applications
- Oil exploration applications
- Hybrid automotive applications
  - Battery control
  - Inverter / converter circuits
  - Motor control applications
  - Water pump
- Hybrid commercial applications
  - Emergency circuits
  - Sensors
  - Temperature regulation



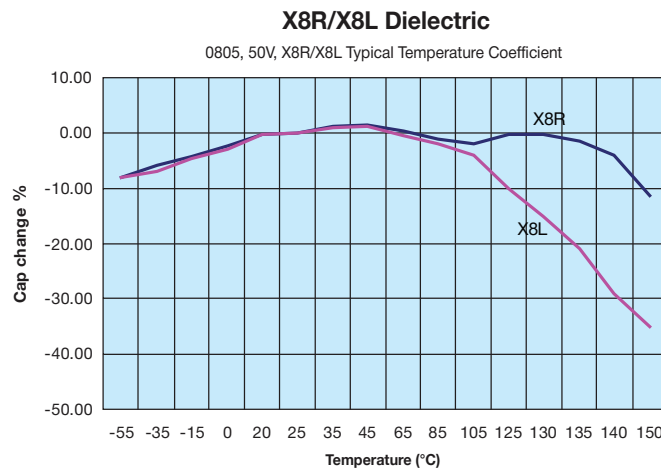
### ADVANTAGES OF X8R AND X8L MLC CAPACITORS

- Both ranges are qualified to the highest automotive AEC-Q200 standards
- Excellent reliability compared to other capacitor technologies
- RoHS compliant
- Low ESR / ESL compared to other technologies
- Tin solder finish
- FLEXITERM® available
- 100V range available



### ENGINEERING TOOLS FOR HIGH VOLTAGE MLC CAPACITORS

- Samples
- Technical Articles
- Application Engineering
- Application Support



Automotive MLCC with FLEXITERM® - X7R , 4V to 500V  
Capacitance Range



| SIZE         |             | 0402                         |     |     |     | 0603                           |     |     |     | 0805                          |      |      |      | 1206                         |     |     |     | 1210                         |      |      |      | 1812                           |     |     |      | 2220                           |      |     |      |     |     |      |      |      |      |
|--------------|-------------|------------------------------|-----|-----|-----|--------------------------------|-----|-----|-----|-------------------------------|------|------|------|------------------------------|-----|-----|-----|------------------------------|------|------|------|--------------------------------|-----|-----|------|--------------------------------|------|-----|------|-----|-----|------|------|------|------|
| Soldering    |             | Reflow/Wave                  |     |     |     | Reflow/Wave                    |     |     |     | Reflow/Wave                   |      |      |      | Reflow/Wave                  |     |     |     | Reflow Only                  |      |      |      | Reflow Only                    |     |     |      | Reflow Only                    |      |     |      |     |     |      |      |      |      |
| (L) Length   | mm<br>(in.) | 1.0 ± 0.2<br>(0.039±0.008)   |     |     |     | 1.6 ± 0.15<br>(0.063 ± 0.006)  |     |     |     | 2.01 ± 0.2<br>(0.079 ± 0.008) |      |      |      | 3.2 ± 0.2<br>(0.126 ± 0.008) |     |     |     | 3.2 ± 0.2<br>(0.126 ± 0.008) |      |      |      | 4.5 ± 0.3<br>(0.177 ± 0.012)   |     |     |      | 5.7 ± 0.5<br>(0.224 ± 0.02)    |      |     |      |     |     |      |      |      |      |
| (W) Width    | mm<br>(in.) | 0.5± 0.2<br>(0.02±0.008)     |     |     |     | 0.81 ± 0.15<br>(0.032 ± 0.006) |     |     |     | 1.25 ± 0.2<br>(0.049 ± 0.008) |      |      |      | 1.6 ± 0.2<br>(0.063 ± 0.008) |     |     |     | 2.5 ± 0.2<br>(0.098 ± 0.008) |      |      |      | 3.2 ± 0.2<br>(0.126 ± 0.008)   |     |     |      | 5 ± 0.4<br>(0.197 ± 0.016)     |      |     |      |     |     |      |      |      |      |
| (t) Terminal | mm<br>(in.) | 0.25 ± 0.15<br>(0.010±0.006) |     |     |     | 0.35 ± 0.15<br>(0.014 ± 0.006) |     |     |     | 0.5 ± 0.25<br>(0.02 ± 0.01)   |      |      |      | 0.5 ± 0.25<br>(0.02 ± 0.01)  |     |     |     | 0.5 ± 0.25<br>(0.02 ± 0.01)  |      |      |      | 0.61 ± 0.36<br>(0.024 ± 0.014) |     |     |      | 0.64 ± 0.39<br>(0.025 ± 0.015) |      |     |      |     |     |      |      |      |      |
| WVDC         |             | 10V                          | 16V | 25V | 50V | 6.3V                           | 10V | 16V | 25V | 50V                           | 100V | 200V | 250V | 6.3V                         | 10V | 16V | 25V | 50V                          | 100V | 200V | 250V | 16V                            | 25V | 50V | 100V | 200V                           | 250V | 50V | 100V | 25V | 50V | 100V | 200V | 250V | 500V |
| 101          | 100         |                              |     |     |     |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 221          | 220         | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 271          | 270         | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 331          | 330         | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 391          | 390         | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 471          | 470         | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 561          | 560         | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 681          | 680         | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 821          | 820         | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 102          | 1000        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 122          | 1220        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 152          | 1500        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 182          | 1800        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 222          | 2200        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 272          | 2700        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 332          | 3300        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 392          | 3900        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 472          | 4700        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 562          | 5600        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 682          | 6800        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 822          | 8200        | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 103          | Cap 0.01    | A                            | A   | A   | A   |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 123          | (F) 0.012   | A                            | A   |     |     |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 153          | 0.015       | A                            | A   |     |     |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 183          | 0.018       | A                            | A   |     |     |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 223          | 0.022       | A                            | A   |     |     |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 273          | 0.027       | A                            | A   |     |     |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 333          | 0.033       | A                            | A   |     |     |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 393          | 0.039       |                              |     |     |     |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |
| 473          | 0.047       |                              |     |     |     |                                |     |     |     |                               |      |      |      |                              |     |     |     |                              |      |      |      |                                |     |     |      |                                |      |     |      |     |     |      |      |      |      |

\*The dimensions are:  
Length (mm) 3.2 ± 0.4  
Width (mm) 1.6 ± 0.3

| Case Size              | 0402 (KAF05) |       | 0603(KAF15) |       | 0805(KAF21) |      | 1206(KAF31) |      |      |      |     | 1210(KAF32)    |      |      |      |      | 1812(KAF43) |      |      |      |      | 2220(KAF55) |      |
|------------------------|--------------|-------|-------------|-------|-------------|------|-------------|------|------|------|-----|----------------|------|------|------|------|-------------|------|------|------|------|-------------|------|
| Thickness Letter       | A            | A     | B           | B     | K           | A    | B           | N    | E    | G    | H   | Q              | C    | F    | G    | K    | L           | Y    | Z    | G    | J    | A           | C    |
| Max Thickness(mm)      | 0.56         | 0.90  | 0.95        | 0.94  | 1.40        | 1.45 | 0.94        | 1.27 | 1.52 | 1.78 | 1.9 | 0.94           | 1.27 | 1.52 | 1.78 | 2.29 | 2.80        | 1.02 | 1.27 | 2.29 | 2.80 | 2.29        | 2.80 |
| Carrier Tape           | PAPER        | PAPER | PAPER       | PAPER | EMB         | EMB  | PAPER       | EMB  | EMB  | EMB  | EMB | PAPER          | EMB  | EMB  | EMB  | EMB  | EMB         | EMB  | EMB  | EMB  | EMB  | EMB         | EMB  |
| Packaging Code 7"reel  | H            | T     | T           | T     | U           | U    | T           | U    | U    | U    | U   | T              | U    | U    | U    | U    | U           | V    | V    | V    | V    | V           | V    |
| Packaging Code 13"reel | N            | M     | M           | M     | L           | L    | M           | L    | L    | L    | L   | M              | L    | L    | L    | L    | L           | S    | S    | S    | S    | S           | S    |
|                        | PAPER        |       |             |       |             |      |             |      |      |      |     | EMBOSSED (EMB) |      |      |      |      |             |      |      |      |      |             |      |



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# Automotive MLCC with FLEXITERM® - X7R, 630V to 3000V

## Capacitance Range



| Case Size    |             | 1206                         |      |      |      |      | 1210                         |      |      |      | 1808                           |      |      |      |      |      | 1812                           |      |      |      |      |      | 2220                           |      |      |      |      |
|--------------|-------------|------------------------------|------|------|------|------|------------------------------|------|------|------|--------------------------------|------|------|------|------|------|--------------------------------|------|------|------|------|------|--------------------------------|------|------|------|------|
| Soldering    |             | Reflow/Wave                  |      |      |      |      | Reflow/Wave                  |      |      |      | Reflow Only                    |      |      |      |      |      | Reflow Only                    |      |      |      |      |      | Reflow Only                    |      |      |      |      |
| (L) Length   | mm<br>(in.) | 3.2 ± 0.2<br>(0.126 ± 0.008) |      |      |      |      | 3.2 ± 0.2<br>(0.126 ± 0.008) |      |      |      | 4.57 ± 0.25<br>(0.18 ± 0.01)   |      |      |      |      |      | 4.5 ± 0.3<br>(0.177 ± 0.012)   |      |      |      |      |      | 5.7 ± 0.5<br>(0.224 ± 0.02)    |      |      |      |      |
| (W) Width    | mm<br>(in.) | 1.6 ± 0.2<br>(0.063 ± 0.008) |      |      |      |      | 2.5 ± 0.2<br>(0.098 ± 0.008) |      |      |      | 2.03 ± 0.25<br>(0.08 ± 0.01)   |      |      |      |      |      | 3.2 ± 0.2<br>(0.126 ± 0.008)   |      |      |      |      |      | 5 ± 0.4<br>(0.197 ± 0.016)     |      |      |      |      |
| (t) Terminal | mm<br>max   | 0.5 ± 0.25<br>(0.02 ± 0.01)  |      |      |      |      | 0.5 ± 0.25<br>(0.02 ± 0.01)  |      |      |      | 0.61 ± 0.36<br>(0.024 ± 0.014) |      |      |      |      |      | 0.61 ± 0.36<br>(0.024 ± 0.014) |      |      |      |      |      | 0.64 ± 0.39<br>(0.025 ± 0.015) |      |      |      |      |
| Voltage (V)  |             | 630                          | 1000 | 1500 | 2000 | 2500 | 630                          | 1000 | 1500 | 2000 | 630                            | 1000 | 1500 | 2000 | 2500 | 3000 | 630                            | 1000 | 1500 | 2000 | 2500 | 3000 | 630                            | 1000 | 1500 | 2000 | 3000 |
| Cap (pF)     | 101 100     | B                            | B    | B    | B    | B    |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |
|              | 121 120     | B                            | B    | B    | B    | B    |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |
|              | 151 150     | B                            | B    | B    | B    | B    |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |
|              | 181 180     | B                            | B    | B    | B    | B    |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |
|              | 221 220     | B                            | B    | B    | B    | B    |                              |      |      |      | B                              | B    | B    | B    | B    | B    |                                |      |      |      |      |      |                                |      |      |      |      |
|              | 271 270     | B                            | B    | B    | B    | B    | H                            | H    | H    | H    | B                              | B    | B    | B    | B    | B    |                                |      |      |      |      |      |                                |      |      |      |      |
|              | 331 330     | B                            | B    | B    | B    | B    | H                            | H    | H    | H    | B                              | B    | B    | B    | B    | B    | E                              |      |      |      |      |      |                                |      |      |      |      |
|              | 391 390     | B                            | B    | B    | B    | B    | H                            | H    | H    | H    | B                              | B    | B    | B    | B    | B    | E                              |      |      |      |      |      |                                |      |      |      |      |
|              | 471 470     | B                            | B    | B    | B    | B    | H                            | H    | H    | H    | B                              | B    | B    | B    | B    | B    | E                              | E    | E    | E    | E    | E    |                                |      |      |      |      |
|              | 561 560     | B                            | B    | B    | B    | B    | H                            | H    | H    | H    | B                              | B    | B    | B    | B    | B    | E                              | E    | E    | E    | E    | E    |                                |      |      |      |      |
|              | 681 680     | B                            | B    | B    | B    | B    | H                            | H    | H    | H    | B                              | B    | B    | B    | B    | B    | E                              | E    | E    | E    | E    | E    |                                |      |      |      |      |
|              | 821 820     | B                            | B    | B    | B    | B    | H                            | H    | H    | H    | B                              | B    | C    | C    | C    | C    | E                              | E    | E    | E    | E    | E    |                                |      |      |      |      |
|              | 102 1000    | B                            | B    | B    | B    | B    | H                            | H    | H    | H    | B                              | B    | C    | C    | C    | C    | E                              | E    | E    | E    | E    | E    | Z                              | Z    | Z    | Z    | C    |
|              | 122 1220    | D                            | A    | A    | A    |      | H                            | H    | H    | H    |                                |      |      |      |      |      | F                              | F    | F    | F    | F    |      | Z                              | Z    | Z    | Z    | C    |
|              | 152 1500    | D                            | A    | A    | A    |      | H                            | H    | H    | H    |                                |      |      |      |      |      | F                              | F    | F    | F    | F    |      | Z                              | Z    | Z    | Z    | C    |
|              | 182 1800    | D                            | A    | A    |      |      | H                            | H    | H    | H    |                                |      |      |      |      |      | F                              | F    | F    | F    | F    |      | Z                              | Z    | Z    | Z    | C    |
|              | 222 2200    | D                            | A    | A    |      |      | H                            | H    | H    | H    |                                |      |      |      |      |      | F                              | F    | F    | F    | F    |      | Z                              | Z    | Z    | Z    | C    |
|              | 272 2700    | D                            | A    | A    |      |      | H                            | H    | H    | H    |                                |      |      |      |      |      | F                              | F    | F    | F    |      |      | Z                              | Z    | Z    | Z    |      |
|              | 332 3300    | D                            | A    |      |      |      | H                            | H    | H    | H    |                                |      |      |      |      |      | F                              | F    | F    | F    |      |      | Z                              | Z    | Z    | Z    |      |
|              | 392 3900    | D                            | A    |      |      |      | H                            | H    | H    |      |                                |      |      |      |      |      | F                              | F    | F    | F    |      |      | Z                              | Z    | Z    | Z    |      |
|              | 472 4700    | D                            | A    |      |      |      | H                            | H    | H    |      |                                |      |      |      |      |      | F                              | F    | J    | J    |      |      | Z                              | Z    | Z    | Z    |      |
|              | 562 5600    | D                            | A    |      |      |      | H                            | H    | H    |      |                                |      |      |      |      |      | F                              | F    | J    | J    |      |      | Z                              | Z    | Z    | Z    |      |
|              | 682 6800    | A                            | A    |      |      |      | H                            | H    |      |      |                                |      |      |      |      |      | F                              | F    | J    | J    |      |      | Z                              | Z    | Z    | Z    |      |
|              | 822 8200    | A                            |      |      |      |      | H                            | H    |      |      |                                |      |      |      |      |      | F                              | F    | J    | J    |      |      | Z                              | Z    | C    | C    |      |
|              | 103 0.01    | A                            |      |      |      |      | H                            | H    |      |      |                                |      |      |      |      |      | F                              | F    | J    |      |      |      | C                              | C    | C    | C    |      |
|              | 123 0.012   |                              |      |      |      |      | H                            | H    |      |      |                                |      |      |      |      |      | F                              | F    | J    |      |      |      | C                              | C    | C    | C    |      |
|              | 153 0.015   |                              |      |      |      |      | H                            | H    |      |      |                                |      |      |      |      |      | F                              | F    | J    |      |      |      | C                              | C    | C    | C    |      |
|              | 183 0.018   |                              |      |      |      |      | H                            |      |      |      |                                |      |      |      |      |      | F                              | F    |      |      |      |      | C                              | C    | C    | C    |      |
|              | 223 0.022   |                              |      |      |      |      | H                            |      |      |      |                                |      |      |      |      |      | F                              | F    |      |      |      |      | C                              | C    | C    | C    |      |
|              | 273 0.027   |                              |      |      |      |      | H                            |      |      |      |                                |      |      |      |      |      | F                              | F    |      |      |      |      | C                              | C    | C    |      |      |
|              | 333 0.033   |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      | F                              |      |      |      |      |      | C                              | C    |      |      |      |
|              | 393 0.039   |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      | F                              |      |      |      |      |      | C                              | C    |      |      |      |
|              | 473 0.047   |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      | F                              |      |      |      |      |      | C                              | C    |      |      |      |
|              | 563 0.056   |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      | C                              | C    |      |      |      |
|              | 683 0.068   |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      | C                              | C    |      |      |      |
|              | 823 0.082   |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      | C                              | C    |      |      |      |
|              | 104 0.1     |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      | C                              | C    |      |      |      |
|              | 124 0.12    |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      | C                              |      |      |      |      |
|              | 154 0.15    |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      | C                              |      |      |      |      |
|              | 224 0.22    |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |
|              | 334 0.33    |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |
|              | 474 0.47    |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |
|              | 684 0.68    |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |
|              | 105 1       |                              |      |      |      |      |                              |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |      |                                |      |      |      |      |
| WVDC         |             | 630                          | 1000 | 1500 | 2000 | 2500 | 630                          | 1000 | 1500 | 2000 | 630                            | 1000 | 1500 | 2000 | 2500 | 3000 | 630                            | 1000 | 1500 | 2000 | 2500 | 3000 | 630                            | 1000 | 1500 | 2000 | 3000 |
| Size         |             | 1206                         |      |      |      |      | 1210                         |      |      |      | 1808                           |      |      |      |      |      | 1812                           |      |      |      |      |      | 2220                           |      |      |      |      |

NOTE: Contact factory for non-specified capacitance values

| Case Size               | 1206(KAF31) |      |      | 1210(KAF32) |      | 1808(KAF42) |                | 1812(KAF43) |      |      | 2220(KAF55) |  |
|-------------------------|-------------|------|------|-------------|------|-------------|----------------|-------------|------|------|-------------|--|
| Thickness Letter        | B           | D    | A    | H           | B    | C           | E              | F           | J    | Z    | C           |  |
| Max Thickness           | 0.94        | 1.45 | 1.80 | 1.80        | 1.80 | 2.21        | 1.80           | 2.21        | 2.80 | 2.21 | 2.80        |  |
| Carrier Tape            | PAPER       | EMB  | EMB  | EMB         | EMB  | EMB         | EMB            | EMB         | EMB  | EMB  | EMB         |  |
| Packaging Code 7" reel  | T           | U    | U    | U           | Y    | Y           | V              | V           | V    | V    | V           |  |
| Packaging Code 13" reel | M           | L    | L    | L           | K    | K           | S              | S           | S    | S    | S           |  |
|                         | PAPER       |      |      |             |      |             | EMBOSSED (EMB) |             |      |      |             |  |