

# C0G (NP0) Dielectric, KGM Series

## General Specifications



C0G (NP0) is the most popular formulation of the “temperature-compensating,” EIA Class I ceramic materials. Modern C0G (NP0) formulations contain neodymium, samarium and other rare earth oxides.

C0G (NP0) ceramics offer one of the most stable capacitor dielectrics available. Capacitance change with temperature is  $0 \pm 30 \text{ ppm}/^\circ\text{C}$  which is less than  $\pm 0.3\%$  C from  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ . Capacitance drift or hysteresis for C0G (NP0) ceramics is negligible at less than  $\pm 0.05\%$  versus up to  $\pm 2\%$  for films. Typical capacitance change with life is less than  $\pm 0.1\%$  for C0G (NP0), one-fifth that shown by most other dielectrics.

### HOW TO ORDER

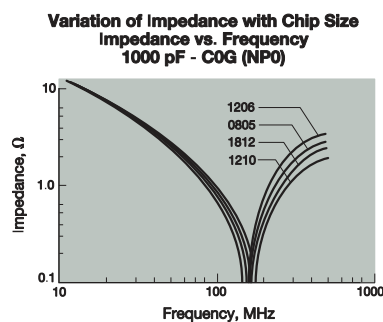
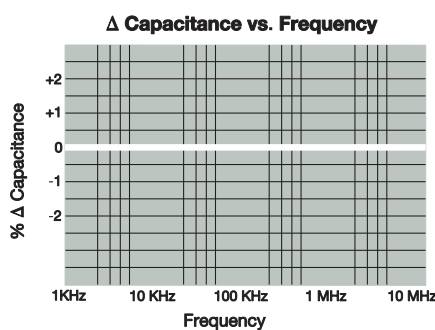
| KGM                                  | 21                                                                                                                           | A             | CG       | 2J                                                                                                          | 102                                                                                                                 | F                                                                                                                                                                                                                                                                                                                          | L               |
|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------|----------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| General Purpose<br>Tin/Nickel Finish | Size                                                                                                                         | See Cap Chart | CG = C0G | Voltage                                                                                                     | Capacitance<br>Code Code (in pF)                                                                                    | Capacitance<br>Tolerance                                                                                                                                                                                                                                                                                                   | See Table Below |
|                                      | 02 = 0101 32 = 1210<br>03 = 0201 43 = 1812<br>05 = 0402 44 = 1825<br>15 = 0603 55 = 2220<br>21 = 0805 56 = 2225<br>31 = 1206 |               |          | 0G = 4.0V 1H = 50V<br>0J = 6.3V 2A = 100V<br>1A = 10V 2D = 200V<br>1C = 16V 2E = 250V<br>1E = 25V 2H = 500V | 2 Significant Digits<br>+Number of zeros<br>eg. $10\mu\text{F} = 106$<br>$10\text{nF} = 103$<br>$47\text{pF} = 470$ | B = $\pm 10\text{pF}$ ( $<10\text{pF}$ )*<br>C = $\pm 25\text{pF}$ ( $<10\text{pF}$ )*<br>D = $\pm 50\text{pF}$ ( $<10\text{pF}$ )*<br>F = $\pm 1\%$ ( $\geq 10\text{pF}$ )*<br>G = $\pm 2\%$ ( $\geq 10\text{pF}$ )*<br>J = $\pm 5\%$ ( $\geq 10\text{pF}$ )*<br>K = $\pm 10\%$ ( $\geq 10\text{pF}$ )*<br>M = $\pm 20\%$ |                 |



### PACKAGING CODES

| Code | EIA (inch) | IEC(mm) | 7" Paper | 7" Embossed | 13" Paper | 13" Embossed |
|------|------------|---------|----------|-------------|-----------|--------------|
| 02   | 0101       | 0402    | H        |             | n/a       |              |
| 03   | 0201       | 0603    | H        |             | N         |              |
| 05   | 0402       | 1005    | H        |             | N         |              |
| 15   | 0603       | 1608    | T        |             | M         |              |
| 21   | 0805       | 2012    | T        | U           | M         | L            |
| 31   | 1206       | 3216    | T        | U           | M         | L            |
| 32   | 1210       | 3225    |          | U           |           | L            |
| 43   | 1812       | 4532    |          | V           |           | S            |
| 44   | 1825       | 4564    |          | V           |           | S            |
| 55   | 2220       | 5750    |          | V           |           | S            |
| 56   | 2225       | 5763    |          | V           |           | S            |

\*thickness determines paper or plastic embossed packaging

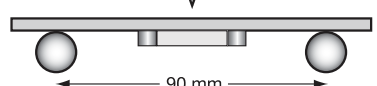


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TDS-SMDMLCC-0036 | Rev 7

# COG (NP0) Dielectric, KGM Series

## Specifications and Test Methods

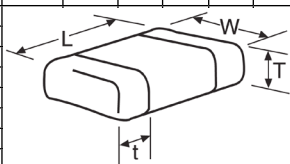
| Parameter/Test                 |                       | NP0 Specification Limits                                                                            | Measuring Conditions                                                                                                                                                                                                                                                           |                    |
|--------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Operating Temperature Range    |                       | -55°C to +125°C                                                                                     | Temperature Cycle Chamber                                                                                                                                                                                                                                                      |                    |
| Capacitance                    |                       | Within specified tolerance                                                                          | Freq.: 1.0 MHz $\pm$ 10% for cap $\leq$ 1000 pF                                                                                                                                                                                                                                |                    |
| Q                              |                       | <30 pF: Q $\geq$ 400+20 x Cap Value<br>$\geq$ 30 pF: Q $\geq$ 1000                                  | 1.0 kHz $\pm$ 10% for cap > 1000 pF                                                                                                                                                                                                                                            |                    |
| Insulation Resistance          |                       | 10,000M $\Omega$ or 500M $\Omega$ - $\mu$ F, whichever is less                                      | Voltage: 1.0Vrms $\pm$ .2V                                                                                                                                                                                                                                                     |                    |
| Dielectric Strength            |                       | No breakdown or visual defects                                                                      | Charge device with rated voltage for 60 $\pm$ 5 secs @ room temp/humidity                                                                                                                                                                                                      |                    |
| Resistance to Flexure Stresses | Appearance            | No defects                                                                                          | <p>Deflection: 2mm<br/>Test Time: 30 seconds<br/>1mm/sec</p>                                                                                                                                |                    |
|                                | Capacitance Variation | $\pm$ 5% or $\pm$ .5 pF, whichever is greater                                                       |                                                                                                                                                                                                                                                                                |                    |
|                                | Q                     | Meets Initial Values (As Above)                                                                     |                                                                                                                                                                                                                                                                                |                    |
|                                | Insulation Resistance | $\geq$ Initial Value x 0.3                                                                          |                                                                                                                                                                                                                                                                                |                    |
| Solderability                  |                       | $\geq$ 95% of each terminal should be covered with fresh solder                                     | Dip device in eutectic solder at 230 $\pm$ 5°C for 5.0 $\pm$ 0.5 seconds                                                                                                                                                                                                       |                    |
| Resistance to Solder Heat      | Appearance            | No defects, <25% leaching of either end terminal                                                    | Dip device in eutectic solder at 260°C for 60sec- onds. Store at room temperature for 24 $\pm$ 2 hours before measuring electrical properties.                                                                                                                                 |                    |
|                                | Capacitance Variation | $\leq$ $\pm$ 2.5% or $\pm$ .25 pF, whichever is greater                                             |                                                                                                                                                                                                                                                                                |                    |
|                                | Q                     | Meets Initial Values (As Above)                                                                     |                                                                                                                                                                                                                                                                                |                    |
|                                | Insulation Resistance | Meets Initial Values (As Above)                                                                     |                                                                                                                                                                                                                                                                                |                    |
|                                | Dielectric Strength   | Meets Initial Values (As Above)                                                                     |                                                                                                                                                                                                                                                                                |                    |
| Thermal Shock                  | Appearance            | No visual defects                                                                                   | Step 1: -55°C $\pm$ 2°                                                                                                                                                                                                                                                         | 30 $\pm$ 3 minutes |
|                                | Capacitance Variation | $\leq$ $\pm$ 2.5% or $\pm$ .25 pF, whichever is greater                                             | Step 2: Room Temp                                                                                                                                                                                                                                                              | $\leq$ 3 minutes   |
|                                | Q                     | Meets Initial Values (As Above)                                                                     | Step 3: +125°C $\pm$ 2°                                                                                                                                                                                                                                                        | 30 $\pm$ 3 minutes |
|                                | Insulation Resistance | Meets Initial Values (As Above)                                                                     | Step 4: Room Temp                                                                                                                                                                                                                                                              | $\leq$ 3 minutes   |
|                                | Dielectric Strength   | Meets Initial Values (As Above)                                                                     | Repeat for 5 cycles and measure after 24 hours at room temperature                                                                                                                                                                                                             |                    |
| Load Life                      | Appearance            | No visual defects                                                                                   | <p>Charge device with twice rated voltage in test chamber set at 125°C <math>\pm</math> 2°C for 1000 hours (+48, -0).</p> <p>Remove from test chamber and stabilize at room temperature for 24 hours before measuring.</p>                                                     |                    |
|                                | Capacitance Variation | $\leq$ $\pm$ 3.0% or $\pm$ .3 pF, whichever is greater                                              |                                                                                                                                                                                                                                                                                |                    |
|                                | Q<br>(C=Nominal Cap)  | $\geq$ 30 pF: Q $\geq$ 350<br>$\geq$ 10 pF, <30 pF: Q $\geq$ 275 +5C/2<br><10 pF: Q $\geq$ 200 +10C |                                                                                                                                                                                                                                                                                |                    |
|                                | Insulation Resistance | $\geq$ Initial Value x 0.3 (See Above)                                                              |                                                                                                                                                                                                                                                                                |                    |
|                                | Dielectric Strength   | Meets Initial Values (As Above)                                                                     |                                                                                                                                                                                                                                                                                |                    |
| Load Humidity                  | Appearance            | No visual defects                                                                                   | <p>Store in a test chamber set at 85°C <math>\pm</math> 2°C/ 85% <math>\pm</math> 5% relative humidity for 1000 hours (+48, -0) with rated voltage applied.</p> <p>Remove from chamber and stabilize at room temperature for 24 <math>\pm</math> 2 hours before measuring.</p> |                    |
|                                | Capacitance Variation | $\leq$ $\pm$ 5.0% or $\pm$ .5 pF, whichever is greater                                              |                                                                                                                                                                                                                                                                                |                    |
|                                | Q                     | $\geq$ 30 pF: Q $\geq$ 350<br>$\geq$ 10 pF, <30 pF: Q $\geq$ 275 +5C/2<br><10 pF: Q $\geq$ 200 +10C |                                                                                                                                                                                                                                                                                |                    |
|                                | Insulation Resistance | $\geq$ Initial Value x 0.3 (See Above)                                                              |                                                                                                                                                                                                                                                                                |                    |
|                                | Dielectric Strength   | Meets Initial Values (As Above)                                                                     |                                                                                                                                                                                                                                                                                |                    |

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## Capacitance Range



| SIZE         | 0101*            | 0201            | 0402            | 0603             | 0805                 | 1206                     |
|--------------|------------------|-----------------|-----------------|------------------|----------------------|--------------------------|
| Soldering    | Reflow Only      | Reflow Only     | Reflow/Wave     | Reflow/Wave      | Reflow/Wave          | Reflow/Wave              |
| Packaging    | All Paper        | All Paper       | All Paper       | All Paper        | Paper/Embossed       | Paper/Embossed           |
| (L) Length   | mm 0.4 ± 0.02    | 0.60 ± 0.03     | 1.0 ± 0.10      | 1.60 ± 0.15      | 2.01 ± 0.20          | 3.20 ± 0.20              |
| (in.)        | (0.016 ± 0.0008) | (0.024 ± 0.001) | (0.040 ± 0.004) | (0.063 ± 0.006)  | (0.079 ± 0.008)      | (0.126 ± 0.008)          |
| (W) Width    | mm 0.20 ± 0.02   | 0.30 ± 0.03     | 0.50 ± 0.10     | 0.81 ± 0.15      | 1.25 ± 0.20          | 1.60 ± 0.20              |
| (in.)        | (0.008 ± 0.0008) | (0.011 ± 0.001) | (0.020 ± 0.004) | (0.032 ± 0.006)  | (0.049 ± 0.008)      | (0.063 ± 0.008)          |
| (t) Terminal | mm 0.10 ± 0.04   | 0.15 ± 0.05     | 0.25 ± 0.15     | 0.35 ± 0.15      | 0.50 ± 0.25          | 0.50 ± 0.25              |
| (in.)        | (0.004 ± 0.0016) | (0.006 ± 0.002) | (0.010 ± 0.006) | (0.014 ± 0.006)  | (0.02 ± 0.010)       | (0.020 ± 0.010)          |
| WVDC         | 16               | 25 50           | 16 25 50        | 16 25 50 100 200 | 16 25 50 100 200 250 | 16 25 50 100 200 250 500 |
| Cap 0.5 (pF) | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 1.0          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 1.2          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 1.5          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 1.8          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 2.2          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 2.7          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 3.3          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 3.9          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 4.7          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 5.6          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 6.8          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 8.2          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 10           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 12           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 15           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 18           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 22           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 27           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 33           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 39           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 47           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 56           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 68           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 82           | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 100          | A                | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 120          |                  | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 150          |                  | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 180          |                  | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 220          |                  | A A             | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 270          |                  |                 | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 330          |                  |                 | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 390          |                  |                 | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 470          |                  |                 | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 560          |                  |                 | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 680          |                  |                 | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 820          |                  |                 | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 1000         |                  |                 | A A A           | A A A A          | B B B B B B          | B B B B B B B            |
| 1200         |                  |                 |                 | B B B B          | B B B B B B          | B B B B B B B            |
| 1500         |                  |                 |                 | B B B B          | B B B B B B          | B B B B B B B            |
| 1800         |                  |                 |                 | B B B B          | B B B B B B          | B B B B B B B            |
| 2200         |                  |                 |                 | B B B B          | A A A A A A          | B B B B B B B            |
| 2700         |                  |                 |                 | B B B B          | A A A A A A          | B B B B B B B            |
| 3300         |                  |                 |                 | B B B B          | A A A A A A          | B B B B B B B            |
| 3900         |                  |                 |                 | B B B B          | A A A A A A          | B B B B B B B            |
| 4700         |                  |                 |                 | B B B B          | A A A A A A          | B B B B B B B            |
| 5600         |                  |                 |                 |                  | A A A A A A          | B B B B B B B            |
| 6800         |                  |                 |                 |                  | A A A A A A          | B B B B B B B            |
| 8200         |                  |                 |                 |                  | A A A A A A          | B B B B B B B            |
| 0.010        |                  |                 |                 |                  | A A A A A A          | D A A A A A              |
| (μF) 0.012   |                  |                 |                 |                  |                      | H H H H H                |
| 0.015        |                  |                 |                 |                  |                      | H H H H H                |
| 0.018        |                  |                 |                 |                  |                      | H H H H H                |
| 0.022        |                  |                 |                 |                  |                      | H H H H H                |
| 0.027        |                  |                 |                 |                  |                      | H H H H H                |
| 0.033        |                  |                 |                 |                  |                      | H H H H H                |
| 0.039        |                  |                 |                 |                  |                      | H H H H H                |
| 0.047        |                  |                 |                 |                  |                      | H H H H H                |
| 0.068        |                  |                 |                 |                  |                      | H H H H H                |
| 0.082        |                  |                 |                 |                  |                      | H H H H H                |
| 0.100        |                  |                 |                 |                  |                      | H H H H H                |
| WVDC         | 16               | 25 50           | 16 25 50        | 16 25 50 100 200 | 16 25 50 100 200 250 | 16 25 50 100 200 250 500 |
| SIZE         | 0101*            | 0201            | 0402            | 0603             | 0805                 | 1206                     |



| Case Size              | 0101 (KGM 02) | 0201 (KGM03) | 0402 (KGM05) | 0603 (KGM15) | 0805 (KGM21)   | 1206 (KGM31)                  |
|------------------------|---------------|--------------|--------------|--------------|----------------|-------------------------------|
| Thickness Letter       | A             | A            | A            | A B          | B E A          | B V T D A H                   |
| Max Thickness (mm)     | 0.22          | 0.33         | 0.56         | 0.90 0.95    | 0.94 1.35 1.45 | 0.94 1.22 1.35 1.45 1.80 1.90 |
| Carrier Tape           | PAPER         | PAPER        | PAPER        | PAPER PAPER  | PAPER EMB EMB  | PAPER EMB EMB EMB EMB EMB     |
| Packaging Code 7"reel  | H             | H            | H            | T T          | T U U          | T U U U U U                   |
| Packaging Code 13"reel | n/a           | N            | N            | M M          | M L L          | M L L L L L                   |
|                        | PAPER         |              |              |              | EMBOSS (EMB)   |                               |

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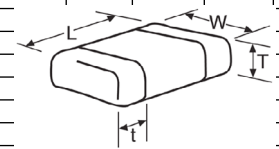
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# C0G (NP0) Dielectric, KGM Series

## Capacitance Range



| SIZE      |            | 1210            |    |     |     |     | 1812            |    |     |     |     | 1825            |     |     | 2220            |     |     | 2225            |     |     |
|-----------|------------|-----------------|----|-----|-----|-----|-----------------|----|-----|-----|-----|-----------------|-----|-----|-----------------|-----|-----|-----------------|-----|-----|
| Soldering |            | Reflow Only     |    |     |     |     | Reflow Only     |    |     |     |     | Reflow Only     |     |     | Reflow Only     |     |     | Reflow Only     |     |     |
| Packaging |            | All Embossed    |    |     |     |     | All Embossed    |    |     |     |     | All Embossed    |     |     | All Embossed    |     |     | All Embossed    |     |     |
| (L)       | mm         | 3.20 ± 0.20     |    |     |     |     | 4.50 ± 0.30     |    |     |     |     | 4.50 ± 0.30     |     |     | 5.70 ± 0.40     |     |     | 5.72 ± 0.25     |     |     |
| Length    | (in.)      | (0.126 ± 0.008) |    |     |     |     | (0.177 ± 0.012) |    |     |     |     | (0.177 ± 0.012) |     |     | (0.225 ± 0.016) |     |     | (0.225 ± 0.010) |     |     |
| (W)       | mm         | 2.50 ± 0.20     |    |     |     |     | 3.20 ± 0.20     |    |     |     |     | 6.40 ± 0.40     |     |     | 5.00 ± 0.40     |     |     | 6.35 ± 0.25     |     |     |
| Width     | (in.)      | (0.098 ± 0.008) |    |     |     |     | (0.126 ± 0.008) |    |     |     |     | (0.252 ± 0.016) |     |     | (0.197 ± 0.016) |     |     | (0.250 ± 0.010) |     |     |
| (t)       | mm         | 0.50 ± 0.25     |    |     |     |     | 0.61 ± 0.36     |    |     |     |     | 0.61 ± 0.36     |     |     | 0.64 ± 0.39     |     |     | 0.64 ± 0.39     |     |     |
| Terminal  | (in.)      | (0.020 ± 0.010) |    |     |     |     | (0.024 ± 0.014) |    |     |     |     | (0.024 ± 0.014) |     |     | (0.025 ± 0.015) |     |     | (0.025 ± 0.015) |     |     |
| WVDC      | WVDC       | 25              | 50 | 100 | 200 | 500 | 25              | 50 | 100 | 200 | 500 | 50              | 100 | 200 | 50              | 100 | 200 | 50              | 100 | 200 |
|           | Cap 3.9    |                 |    |     |     |     |                 |    |     |     |     |                 |     |     |                 |     |     |                 |     |     |
|           | (pF) 4.7   |                 |    |     |     |     |                 |    |     |     |     |                 |     |     |                 |     |     |                 |     |     |
|           | 5.6        |                 |    |     |     |     |                 |    |     |     |     |                 |     |     |                 |     |     |                 |     |     |
|           | 6.8        |                 |    |     |     |     |                 |    |     |     |     |                 |     |     |                 |     |     |                 |     |     |
|           | 8.2        |                 |    |     |     |     |                 |    |     |     |     |                 |     |     |                 |     |     |                 |     |     |
|           | 10         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 12         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 15         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 18         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 22         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 27         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 33         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 39         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 47         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 56         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 68         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 82         | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 100        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 120        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 150        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 180        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 220        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 270        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 330        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 390        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 470        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 560        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 680        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 820        | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   |                 |     |     |                 |     |     |                 |     |     |
|           | 1,000      | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 1200       | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 1500       | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 1800       | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 2200       | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 2700       | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 3300       | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 3900       | E               | E  | E   | E   | E   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 4700       | E               | E  | E   | H   | H   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 5600       | E               | E  | E   | H   | H   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 6800       | E               | E  | E   | H   | H   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 8200       | E               | E  | E   | H   | H   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | Cap 0.010  | E               | H  | H   | J   | J   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | (μF) 0.012 | H               | H  | H   | J   | J   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 0.015      | H               | H  | J   | L   | L   | B               | B  | B   | B   | B   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 0.018      | J               | J  | L   | L   |     | B               | B  | E   | F   | F   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 0.022      | J               | L  | L   | L   |     | B               | B  | E   | F   | F   | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 0.027      | L               | L  | L   | L   |     | E               | E  | F   | J   |     | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 0.033      | L               | L  | L   | L   |     | E               | E  | F   |     |     | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 0.039      | L               | L  | L   |     |     | J               | J  | J   |     |     | C               | C   | C   | Z               | Z   | Z   | D               | D   | D   |
|           | 0.047      | L               | L  | L   |     |     | J               | J  | J   |     |     | C               | C   | C   | Z               | Z   | C   | D               | D   | D   |
|           | 0.068      |                 |    |     |     |     | J               | J  | J   |     |     | C               | C   | F   | Z               | Z   | C   | D               | D   | G   |
|           | 0.082      |                 |    |     |     |     | J               | J  | J   |     |     | C               | F   |     | Z               | C   |     | D               | D   | G   |
|           | 0.100      |                 |    |     |     |     | J               | J  | J   |     |     | F               | F   |     | C               | C   |     | D               | G   | G   |
| WVDC      | WVDC       | 25              | 50 | 100 | 200 | 500 | 25              | 50 | 100 | 200 | 500 | 50              | 100 | 200 | 50              | 100 | 200 | 50              | 100 | 200 |
| SIZE      | SIZE       | 1210            |    |     |     |     | 1812            |    |     |     |     | 1825            |     |     | 2220            |     |     | 2225            |     |     |



| Case Size              | 1210 (KGM 32) |     |      |      |  | 1812 (KGM 43) |     |      |      |      | 1825 (KGM 44) |      | 2220 (KGM 55) |      |      | 2225 (KGM 56) |      |
|------------------------|---------------|-----|------|------|--|---------------|-----|------|------|------|---------------|------|---------------|------|------|---------------|------|
| Thickness Letter       | E             | H   | J    | L    |  | B             | E   | F    | J    | C    | F             | Z    | C             | D    | G    | E             | G    |
| Max Thickness (mm)     | 1.45          | 1.8 | 2.21 | 2.80 |  | 1.45          | 1.8 | 2.21 | 2.80 | 2.21 | 2.80          | 2.21 | 2.80          | 2.21 | 2.80 | 2.29          | 2.80 |
| Carrier Tape           | EMB           | EMB | EMB  | EMB  |  | EMB           | EMB | EMB  | EMB  | EMB  | EMB           | EMB  | EMB           | EMB  | EMB  | EMB           | EMB  |
| Packaging Code 7"reel  | U             | U   | U    | U    |  | V             | V   | V    | V    | V    | V             | V    | V             | V    | V    | V             | V    |
| Packaging Code 13"reel | L             | L   | L    | L    |  | S             | S   | S    | S    | S    | S             | S    | S             | S    | S    | S             | S    |
| EMBOSS (EMB)           |               |     |      |      |  |               |     |      |      |      |               |      |               |      |      |               |      |