High Q and Low ESR Capacitors

HOW TO ORDER

HH	15	N	100	G	500	L	T
Series	**Size**	**Dielectric**	**Capacitance**	**Tolerance**	**Rated voltage**	**Termination**	**Packaging**
HH= High Q/ Low ESR	15=0402 (1005) 18=0603 (1608)	N=NP0 (C0G)	Two significant digits followed by no. of zeros. And R is in place of decimal point. eg.: R47=0.47pF 0R5=0.5pF 1R0=1.0pF 100=10x10⁰ =10pF	B=±0.1pF C=±0.25pF D=±0.5pF F=±1% G=±2% J=±5%	Two significant digits followed by no. of zeros. And R is in place of decimal point. 160=16 VDC 250=25 VDC 500=50 VDC 101=100 VDC	L=Ag/Ni/Sn	B=Bulk C=Bulk cassette T=7" reeled G=13" reeled

PACKAGING DIMENSION AND QUANTITY

Size	Thickness (mm)/Symbol		Paper tape	
			7" reel	13" reel
0402	0.50±0.05	N	10K	20K
0603	0.80±0.07	S	4K	10K

Unit: pieces

ELECTRICAL CHARACTERISTICS

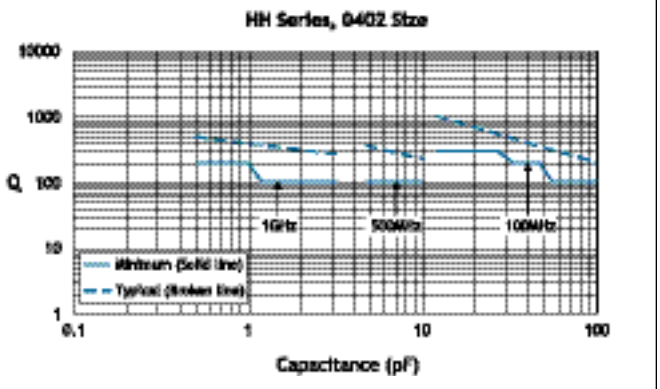

Fig. 2 Q factor specification vs. Specific frequency for 0402

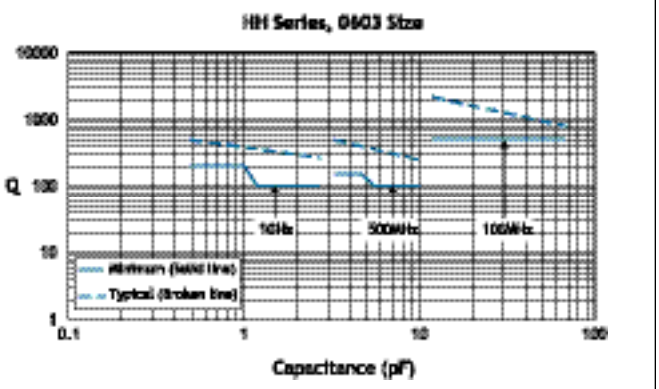

Fig. 3 Q factor specification vs. Specific frequency for 0603

High Q and Low ESR Capacitors

■ CAPACITANCE RANGE

Dielectric		NP0					
Size		0402			0603		
Rated Voltage (VDC)		16	25	50	16	50	100
Capacitance	0.5pF (0R5)			N		S	S
	0.6pF (0R6)			N		S	S
	0.7pF (0R7)			N		S	S
	0.8pF (0R8)			N		S	S
	0.9pF (0R9)			N		S	S
	1.0pF (1R0)			N		S	S
	1.2pF (1R2)			N		S	S
	1.5pF (1R5)			N		S	S
	1.8pF (1R8)			N		S	S
	2.2pF (2R2)			N		S	S
	2.7pF (2R7)			N		S	S
	3.3pF (3R3)			N		S	S
	3.9pF (3R9)			N		S	S
	4.7pF (4R7)			N		S	S
	5.6pF (5R6)			N		S	S
	6.8pF (6R8)			N		S	S
	8.2pF (8R2)			N		S	S
	10pF (100)			N		S	S
	12pF (120)			N		S	S
	15pF (150)			N		S	S
	18pF (180)			N		S	S
	22pF (220)			N		S	S
	27pF (270)			N		S	S
	33pF (330)			N		S	S
	39pF (390)			N		S	S
	47pF (470)			N		S	S
	56pF (560)			N		S	S
	68pF (680)			N		S	S
	82pF (820)			N		S	S
	100pF (101)			N		S	S
	120pF (121)			N		S	S
	150pF (151)			N		S	S
	180pF (181)		N	N		S	S
	220pF (221)		N	N		S	S
	270pF (271)	N				S	S
	330pF (331)	N				S	S
	390pF (391)	N				S	S
	470pF (471)	N				S	S
	560pF (561)					S	
	680pF (681)					S	
	820pF (821)					S	
	1,000pF (102)					S	
	1,200pF (122)				S		
	1,500pF (152)				S		
	1,800pF (182)				S		
	2,200pF (222)				S		
	2,700pF (272)				S		
	3,300pF (332)				S		

1. The letter in cell is expressed the symbol of product thickness.
2. For more information about products with special capacitance or other data, please contact WTC local representative.

Appendix I : Reliability Test Conditions and Requirements

<table>
<tr><th>NO.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>1.</td><td>Visual and Mechanical</td><td>---</td><td>* No remarkable defect.
* Dimensions to confirm to individual specification sheet.</td></tr>
<tr><td>2.</td><td>Capacitance</td><td rowspan="2">Class I : NP0
Cap≤1000pF 1.0±0.2Vrms, 1MHz±10%
Cap>1000pF 1.0±0.2Vrms, 1KHz±10%

Class II : X7R, X5R, Y5V
Cap≤10μF, 1.0±0.2Vrms, 1KHz±10%
Cap>10μF, 0.5±0.2Vrms, 120Hz±20%</td><td>* Shall not exceed the limits given in the detailed spec.</td></tr>
<tr><td>3.</td><td>Q/ D.F.
(Dissipation Factor)</td><td>NP0: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C
X7R, X5R:
<table>
<tr><th>Rated vol.</th><th>D.F.≤</th><th colspan="2">Exception of D.F.≤</th></tr>
<tr><td>≥50V</td><td>2.5%</td><td>3.0%</td><td>All 0201;0603≥0.047μF;0805≥0.18μF;
1206≥0.47μF</td></tr>
<tr><td rowspan="2">25V</td><td rowspan="2">3.5%</td><td>5.0%</td><td>0805≥1μF, 1210≥10μF</td></tr>
<tr><td>7.0%</td><td>0603≥0.33μF;TT series & Cap≥1μF</td></tr>
<tr><td rowspan="2">16V</td><td rowspan="2">3.5%</td><td>5.0%</td><td>0402≥0.033μF;0603≥0.15μF;
0805≥0.68μF;1206≥2.2μF</td></tr>
<tr><td>10%</td><td>TT series & Cap≥1μF</td></tr>
<tr><td>10V</td><td>5.0%</td><td>10.0%</td><td>TT series & Cap≥1μF;0805≥10μF</td></tr>
<tr><td>6.3V</td><td>10.0%</td><td>15.0%</td><td>0805≥22μF;1210≥100μF</td></tr>
</table>
Y5V:
<table>
<tr><th>Rated vol.</th><th>D.F.≤</th><th colspan="2">Exception of D.F.≤</th></tr>
<tr><td>≥50V</td><td>5.0%</td><td>---</td><td>---</td></tr>
<tr><td>35V</td><td>7.0%</td><td>---</td><td>---</td></tr>
<tr><td rowspan="2">25V</td><td rowspan="2">5.0%</td><td>7.0%</td><td>0603≥0.1μF; 0805≥0.33μF;
1206≥1μF; 1210≥4.7μF</td></tr>
<tr><td>9.0%</td><td>0402≥0.068μF</td></tr>
<tr><td>16V (C<1.0μF)</td><td>7.0%</td><td>9.0%</td><td>0402≥0.068μF; 0603≥0.68μF</td></tr>
<tr><td>16V (C≥1.0μF)</td><td>9.0%</td><td>12.5%</td><td>0805≥4.7μF;1206≥10μF;1210≥22μF</td></tr>
<tr><td>10V</td><td>12.5%</td><td>---</td><td>---</td></tr>
<tr><td>6.3V</td><td>20.0%</td><td>---</td><td>---</td></tr>
</table></td></tr>
<tr><td>4a.</td><td>Dielectric Strength</td><td>* To apply voltage (≤50V) 250%.
* Duration : 1 to 5 sec.
* Charge & discharge current less than 50mA.

* To apply voltage :
100V ≥3 times V DC
200V ~ 300V ≥2 times V DC
500V ~ 999V ≥1.5 times V DC
1000V ~ 3000V ≥1.2 times V DC
* Cut-off, set at 10mA
* TEST= 15 sec.
* RAMP=0</td><td>* No evidence of damage or flash over during test.</td></tr>
<tr><td>4b.</td><td>Dielectric Strength
(for X1/Y2 & X2/Y3)</td><td>* To apply 1500 VAC voltage.
* Duration: 60 sec.</td><td>* No evidence of damage or flash over during test.</td></tr>
<tr><td rowspan="3">5.</td><td rowspan="3">Insulation Resistance</td><td colspan="2">To apply rated voltage for max. 120 sec.</td><td>≥10GΩ or RxC≥500Ω-F whichever is smaller.</td></tr>
<tr><td>Rated voltage:
100 ~ 500V</td><td>To apply rated voltage for 60 sec.</td><td>≥10GΩ</td></tr>
<tr><td>Rated voltage:
> 500V</td><td>To apply 500V for 60 sec.</td><td>≥10GΩ</td></tr>
<tr><td>6.</td><td>Temperature Coefficient</td><td>With no electrical load.
<table>
<tr><th>T.C.</th><th>Operating Temp</th></tr>
<tr><td>NP0 (C0G)</td><td>-55~125°C at 25°C</td></tr>
<tr><td>NP0 (C0J)</td><td>-55~125°C at 25°C</td></tr>
<tr><td>X7R</td><td>-55~125°C at 25°C</td></tr>
<tr><td>X5R</td><td>-55~85°C at 25°C</td></tr>
<tr><td>Y5V</td><td>-25~85°C at 20°C</td></tr>
</table></td><td>
<table>
<tr><th>T.C.</th><th>Capacitance Change</th></tr>
<tr><td>NP0 (C0G)</td><td>Within ±30ppm/°C</td></tr>
<tr><td>NP0 (C0J)</td><td>Within ±120ppm/°C</td></tr>
<tr><td>X7R</td><td>Within ±15%</td></tr>
<tr><td>X5R</td><td>Within ±15%</td></tr>
<tr><td>Y5V</td><td>Within +30%/-80%</td></tr>
</table></td></tr>
<tr><td>7.</td><td>Adhesive Strength of Termination</td><td>* Pressurizing force:
0201: 2N
0402 & 0603: 5N
>0603: 10N
* Test time: 10±1 sec.</td><td>* No remarkable damage or removal of the terminations.</td></tr>
<tr><td>8.</td><td>Vibration Resistance</td><td>* Vibration frequency: 10~55 Hz/min.
* Total amplitude: 1.5mm
* Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.)</td><td>* No remarkable damage.
* Cap change and Q/D.F.: To meet initial spec.</td></tr>
</table>

Appendix I : Reliability Test Conditions and Requirements

<table>
<tr><th>NO.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>9.</td><td>Solderability</td><td>* Solder temperature: 235±5°C
* Dipping time: 2±0.5 sec.</td><td>95% min. coverage of all metalized area.</td></tr>
<tr><td>10.</td><td>Bending Test</td><td>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec.
* Measurement to be made after keeping at room temp. for 24±2 hrs.</td><td>* No remarkable damage.
* Cap change:
NP0: within ±5.0% or ±0.5pF whichever is larger.
X7R, X5R: within ±12.5%
Y5V: within ±30%
(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</td></tr>
<tr><td>11.</td><td>Resistance to Soldering Heat</td><td>* Solder temperature: 270±5°C
* Dipping time: 10±1 sec
* Preheating: 120 to 150°C for 1 minute before immerse the capacitor in an eutectic solder.
* Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 48±4 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs. (Class I) or 48±4 hrs. (Class II).</td><td>* No remarkable damage.
* Cap change:
NP0: within ±2.5% or ±0.25pF whichever is larger.
X7R, X5R: within ±7.5%
Y5V: within ±20%
* Q/D.F., I.R. and dielectric strength: To meet initial requirements.
* 25% max. leaching on each edge.</td></tr>
<tr><td>12.</td><td>Temperature Cycle</td><td>* Conduct the five cycles according to the temperatures and time.
<table>
<tr><th>Step</th><th>Temp. (°C)</th><th>Time (min.)</th></tr>
<tr><td>1</td><td>Min. operating temp. +0/-3</td><td>30±3</td></tr>
<tr><td>2</td><td>Room temp.</td><td>2~3</td></tr>
<tr><td>3</td><td>Max. operating temp. +3/-0</td><td>30±3</td></tr>
<tr><td>4</td><td>Room temp.</td><td>2~3</td></tr>
</table>
* Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 48±4 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs. (Class I) or 48±4 hrs. (Class II).</td><td>* No remarkable damage.
* Cap change:
NP0: within ±2.5% or ±0.25pF whichever is larger.
X7R, X5R: within ±7.5%
Y5V: within ±20%
* Q/D.F., I.R. and dielectric strength: To meet initial requirements.</td></tr>
<tr><td>13.</td><td>Humidity (Steady State)</td><td>* Test temp.: 40±2°C
* Humidity: 90~95% RH
* Test time: 500+24/-0hrs.
* Measurement to be made after keeping at room temp. for 24±2 hrs. (Class I) or 48±4 hrs. (Class II).</td><td>* No remarkable damage.
* Cap change: NP0: within ±5.0% or ±0.5pF whichever is larger.
X7R, X5R: ≥10V, within ±12.5%
6.3V, within ±25%
Y5V: within ±30%
* Q/D.F. value:
NP0: Cap≥30pF, Q≥350; 10pF≤Cap<30pF, Q≥275+2.5C
Cap<10pF; Q≥200+10C
X7R, X5R:
<table>
<tr><th>Rated vol.</th><th>D.F.≤</th><th colspan="2">Exception of D.F.≤</th></tr>
<tr><td>≥50V</td><td>3.0%</td><td>6.0%</td><td>0603≥0.047μF; 0805≥0.18μF; 1206≥0.47μF</td></tr>
<tr><td rowspan="2">25V</td><td rowspan="2">5.0%</td><td>10.0%</td><td>0805≥1μF, 1210≥10μF</td></tr>
<tr><td>14.0%</td><td>0603≥0.33μF</td></tr>
<tr><td>16V</td><td>5.0%</td><td>10.0%</td><td>0402≥0.033μF; 0603≥0.15μF; 0805≥0.68μF; 1206≥2.2μF</td></tr>
<tr><td>10V</td><td>7.5%</td><td>15.0%</td><td>0402≥0.056μF; 0603≥0.33μF; 0805≥2.2μF; 1206≥2.2μF, TT series & Cap≥1μF</td></tr>
<tr><td>6.3V</td><td>15.0%</td><td>30.0%</td><td>0805≥10μF; 1210≥100μF</td></tr>
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Y5V:
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<tr><th>Rated vol.</th><th>D.F.≤</th><th colspan="2">Exception of D.F.≤</th></tr>
<tr><td>≥50V</td><td>7.5%</td><td>---</td><td>---</td></tr>
<tr><td>35V</td><td>10.0%</td><td>---</td><td>---</td></tr>
<tr><td rowspan="2">25V</td><td rowspan="2">7.5%</td><td>≤10.0%</td><td>0603≥0.1μF; 0805≥0.33μF; 1206≥1μF; 1210≥4.7μF</td></tr>
<tr><td>≤12.5%</td><td>0402≥0.068μF</td></tr>
<tr><td>16V (C<1.0μF)</td><td>10.0%</td><td>≤12.5%</td><td>0402≥0.068μF; 0603≥0.68μF</td></tr>
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<tr><td>10V</td><td>15.0%</td><td>---</td><td>---</td></tr>
<tr><td>6.3V</td><td>30.0%</td><td>---</td><td>---</td></tr>
</table>
* I.R.: ≥10V 1GΩ or 50Ω-F whichever is smaller. 6.3V, 10Ω-F</td></tr>
</table>

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<tr><th>NO.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>14.</td><td>Humidity Load
(Damp Heat)</td><td>* Test temp.: 40±2°C
* Humidity: 90~95%RH
* Test time: 500+24/-0 hrs.
* To apply voltage: rated voltage (Max. 500V)
* Measurement to be made after keeping at room temp. for 24±2 hrs. (Class I) or 48±4 hrs. (Class II).</td><td>* No remarkable damage.
* Cap change: NP0: within ±7.5% or ±0.75pF whichever is larger.
X7R, X5R: ≥10V, within ±12.5%
6.3V, with ±25%
Y5V: ≥10V, within ±30%
6.3V, within +30 to -40%
* Q/D.F. value:
NP0: Cap≥30pF, Q≥200; Cap<30pF, Q≥100+10/3C
X7R, X5R:
<table>
<tr><th>Rated vol.</th><th>D.F.≤</th><th colspan="2">Exception of D.F.≤</th></tr>
<tr><td>≥50V</td><td>3.0%</td><td>6.0%</td><td>0603≥0.047μF;0805≥0.18μF;1206≥0.47μ</td></tr>
<tr><td rowspan="2">25V</td><td rowspan="2">5.0%</td><td>10.0%</td><td>0805≥1μF, 1210≥10μF</td></tr>
<tr><td>14.0%</td><td>0603≥0.33μF</td></tr>
<tr><td>16V</td><td>5.0%</td><td>10.0%</td><td>0402≥0.033μF; 0603≥0.15μF;
0805≥0.68μF; 1206≥2.2μF</td></tr>
<tr><td>10V</td><td>7.5%</td><td>15.0%</td><td>0402≥0.056μF; 0603≥0.33μF;
0805≥2.2μF; 1206≥2.2μF,
TT series & Cap≥1μF</td></tr>
<tr><td>6.3V</td><td>15.0%</td><td>30.0%</td><td>0805≥10μF;1210≥100μF</td></tr>
</table>
Y5V:
<table>
<tr><th>Rated vol.</th><th>D.F.≤</th><th colspan="2">Exception of D.F.≤</th></tr>
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<tr><td rowspan="2">25V</td><td rowspan="2">7.5%</td><td>10.0%</td><td>0603≥0.1μF; 0805≥0.33μF;
1206≥1μF; 1210≥4.7μF</td></tr>
<tr><td>12.5%</td><td>0402≥0.068μF</td></tr>
<tr><td>16V (C<1.0μF)</td><td>10.0%</td><td>12.5%</td><td>0402≥0.068μF; 0603≥0.68μF</td></tr>
<tr><td>16V (C≥1.0μF)</td><td>12.5%</td><td>---</td><td>---</td></tr>
<tr><td>10V</td><td>15.0%</td><td>---</td><td>---</td></tr>
<tr><td>6.3V</td><td>30.0%</td><td>---</td><td>---</td></tr>
</table>
* I.R.: ≥10V,500MΩ or 25Ω-F whichever is smaller.
6.3V, 5Ω-F</td></tr>
<tr><td>15.</td><td>High
Temperature
Load
(Endurance)</td><td>* Test temp.:
NP0, X7R: 125±3°C
X5R, Y5V: 85±3°C
* To apply voltage:
(1) 6.3V or C≥10μF (for X7R, X5R): 150% of rated voltage.
(2) 6.3V<V<500V and C<10μF (for X7R, X5R):
200% of rated voltage.
(3) 500V: 150% of rated voltage.
(4) V≥630V: 120% of rated voltage. (Max. 3600V)
* Test time: 1000+24/-0 hrs.
* Measurement to be made after keeping at room temp. for 24±2 hrs. (Class I) or 48±4 hrs. (Class II).</td><td>* No remarkable damage.
* Cap change: NP0: within ±3.0% or ±0.3pF whichever is larger.
X7R, X5R: ≥10V, within ±12.5%
6.3V, with ±25%
Y5V: ≥10V, within ±30%
6.3V, within +30 to -40%
* Q/D.F. value:
NP0: Cap≥30pF, Q≥350
10pF≤Cap<30pF, Q≥275+2.5C
Cap<10pF, Q≥200+10C
X7R, X5R:
<table>
<tr><th>Rated vol.</th><th>D.F.≤</th><th colspan="2">Exception of D.F.≤</th></tr>
<tr><td>≥50V</td><td>3.0%</td><td>6.0%</td><td>0603≥0.047μF; 0805≥0.18μF,
1206≥0.47μF</td></tr>
<tr><td rowspan="2">25V</td><td rowspan="2">5.0%</td><td>10.0%</td><td>0805≥1μF, 1210≥10μF</td></tr>
<tr><td>14.0%</td><td>0603≥0.33μF</td></tr>
<tr><td>16V</td><td>5.0%</td><td>10.0%</td><td>0402≥0.033μF; 0603≥0.15μF;
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0805≥2.2μF; 1206≥2.2μF
TT series & Cap≥1μF</td></tr>
<tr><td>6.3V</td><td>15.0%</td><td>30.0%</td><td>0805≥10μF; 1210≥100μF</td></tr>
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Y5V:
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<tr><td>16V (C≥1.0μF)</td><td>12.5%</td><td>---</td><td>---</td></tr>
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<tr><td>6.3V</td><td>30.0%</td><td>---</td><td>---</td></tr>
</table>
* I.R.: ≥10V,1GΩ or 50Ω-F whichever is smaller.
6.3V, 10Ω-F</td></tr>
</table>

Appendix II : General Information

◙ Constructions

No.	Name		NP0/X7R	X7R/X5R/Y5V
①	Ceramic material		$BaTiO_3$ based	
②	Inner electrode		AgPd alloy	Ni
③	Termination	Inner layer	Ag	Cu
④		Middle layer	Ni	
⑤		Outer layer	Sn (Matt)	

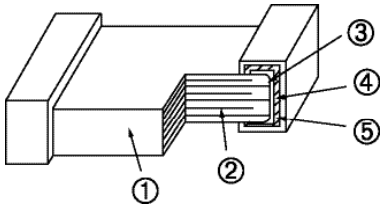

Fig.1 The construction of MLCC

◙ Storage and handling conditions

(1) To store products at 5 to 40°C ambient temperature and 20 to 70%. related humidity conditions.

(2) The product is recommended to be used within one year after shipment. Check solderability in case of shelf life extension is needed.

Cautions:

a. Don't store products in a corrosive environment such as sulfide, chloride gas, or acid. It may cause oxidization of electrode, which easily be resulted in poor soldering.

b. To store products on the shelf and avoid exposure to moisture.

c. Don't expose products to excessive shock, vibration, direct sunlight and so on.

◙ Recommended soldering conditions

The lead-free termination MLCCs are not only to be used on SMT against lead-free solder paste, but also suitable against lead-containing solder paste. If the optimized solder joint is requested, increasing soldering time, temperature and concentration of N_2 within oven are recommended.

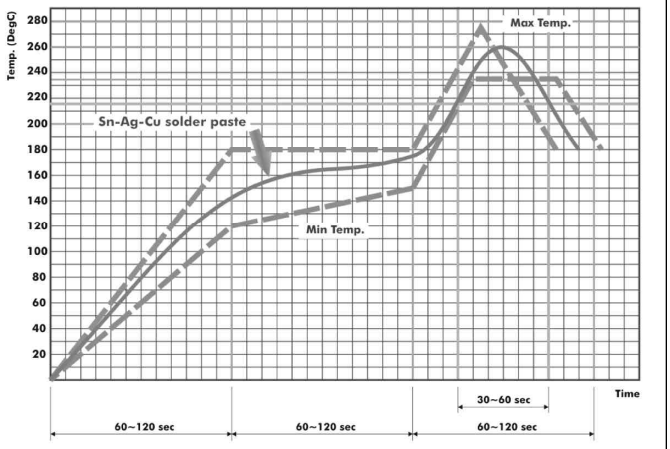

Fig. 2 IR reflow soldering profile for SMT process with SnAgCu series solder paste.

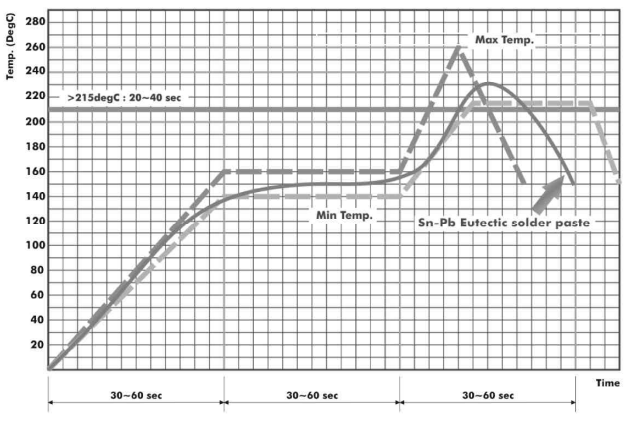

Fig. 3 IR reflow soldering profile for SMT process with eutectic SnPb solder paste.