DATA SHEET

General data
Surface-mount ceramic multilayer capacitors

Product specification
Supersedes data of 11th February 1999

2001 May 30 Rev.6

Phycomp
A YAGEO COMPANY

Surface-mount ceramic multilayer capacitors

General data

PACKING

Tape on reel

Packing conforms fully with *"IEC 60286-3"*, *"EIA 481-1"* and *"JIS C0806"* industrial standards.

Multilayer Chip Capacitors (MLCCs) are supplied on tape on reel or in bulk case. For MLCCs with a product thickness of <1 mm, paper tape is preferred. MLCCs with a product thickness of ≥1 mm, are supplied in embossed blister tape.

CARRIER TAPE

Polycarbonate.

Table 1 Properties of carrier tape

PARAMETER	WIDTH	
	8.1 ±0.2 mm	**12 ±0.2 mm**
Thickness	190 to 280 μm	240 ±20 μm
Tensile strength at break	>60 N/mm^2	>60 N/mm^2
Elongation at break	100 to 150%	100 to 150%
Surface resistance	>10^{12} Ω/sq.	>10^{12} Ω/sq.

COVER TAPE

Polyester (antistatic).

Table 2 Properties of cover tape

PARAMETER	WIDTH	
	5.5 ±0.1 mm	**9.5 ±0.1 mm**
Breaking force	≥10.7 N	≥17.6 N
Elongation at break	≥63%	≥63%
Surface resistance	<10^{10} Ω/sq.	<10^{10} Ω/sq.
Softening point	71 ±5 °C	71 ±5 °C
Thickness	62 μm	62 μm

General information

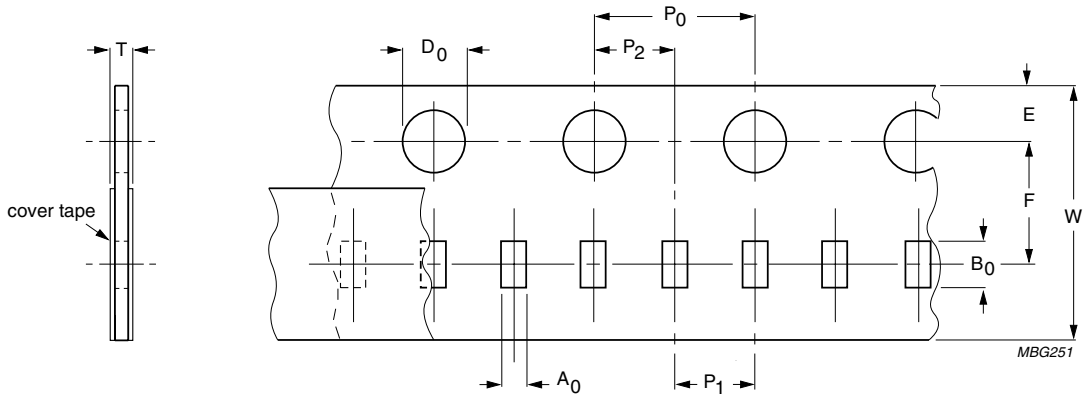
For the combination carrier/cover tape no electrostatic behaviour is observed (relative humidity ≥30%). The products do not stick to the cover tape.

The technical and thermal properties of polycarbonate tapes are excellent, so there is no change in dimensions as a function of time. The peel off force is very stable as a function of time and temperature, and it is defined as 0.1 to 0.7 N at a peel-off speed of 120 mm/minute.

Bulk packing

For bulk case; see Fig.5 and Table 7.

Paper tape specifications



For dimensions see Table 3.

Fig.1 Paper tape.

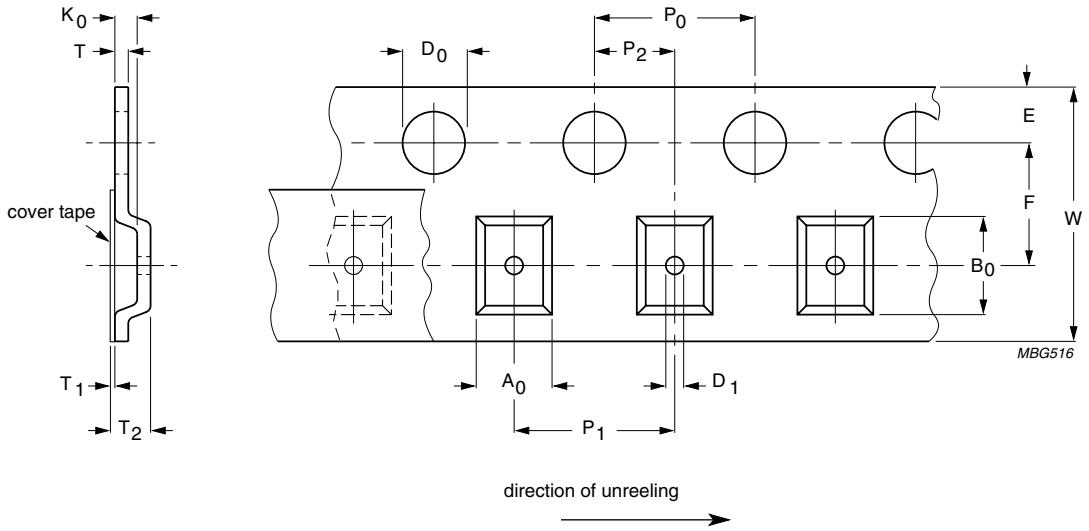
Table 3 Dimensions of paper tape for relevant product size; see Fig.1

SYMBOL	PRODUCT SIZE CODE								UNIT
	0402		0603		0805		1206		
	SIZE	TOL.	SIZE	TOL.	SIZE	TOL.	SIZE	TOL.	
A_0	0.62	±0.05	1.10	±0.05	1.65	±0.05	2.0	±0.1	mm
B_0	1.12	±0.05	1.90	±0.05	2.40	±0.05	3.5	±0.1	mm
W	8.0	±0.2	8.0	±0.2	8.0	±0.2	8.0	±0.2	mm
E	1.75	±0.1	1.75	±0.1	1.75	±0.1	1.75	±0.1	mm
F	3.5	±0.05	3.5	±0.05	3.5	±0.05	3.5	±0.05	mm
D_0	1.5	+0.1/–0	1.5	+0.1/–0	1.5	+0.1/–0	1.5	+0.1/–0	mm
P_0; note 1	4	±0.05	4	±0.05	4	±0.05	4	±0.05	mm
P_1	2	±0.05	4	±0.1	4	±0.1	4	±0.1	mm
P_2	2	±0.05	2	±0.05	2	±0.05	2	±0.05	mm
T_{max}	0.6	±0.05	0.95	±0.05	0.95	±0.05	0.95	±0.05	mm

Note

1. P_0 pitch tolerance over any 10 pitches is ±0.2 mm.

Blister tape specifications



K_0: so chosen that the orientation of the component cannot change.
For W = 8 mm: T_2 = 3.5 mm max.
For W = 12 mm: T_2 = 6.5 mm max.
For dimensions see Table 4.

Fig.2 Blister tape.

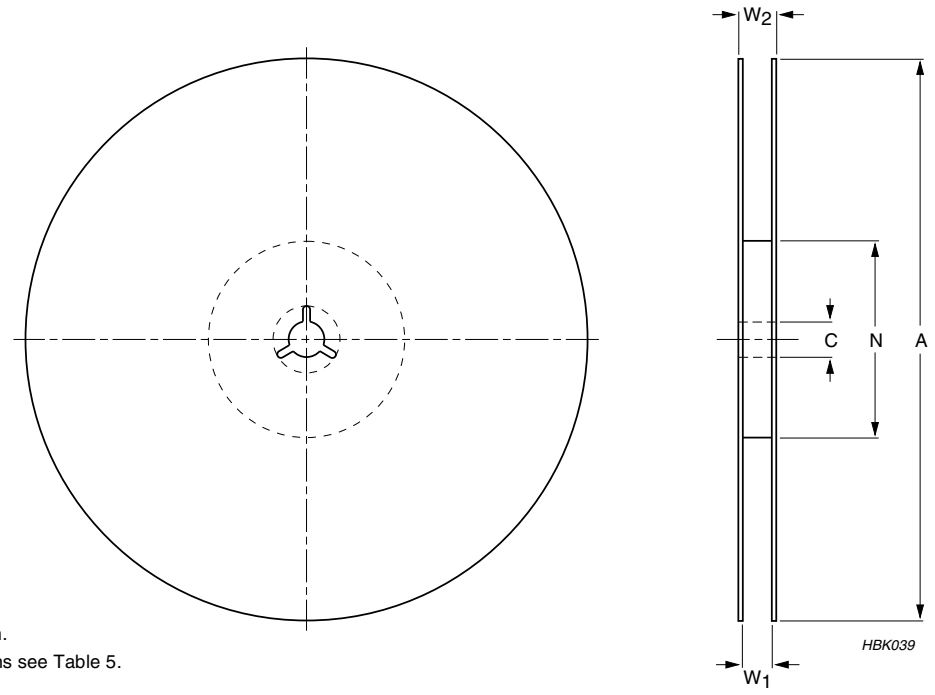
Table 4 Dimensions of blister tape for relevant product size code; see Fig.2

DIMENSION	PRODUCT SIZE CODE					TOLERANCE (mm)
	0805	1206	1210	1812	2220	
A_0 nominal clearance; note 1	0.20	0.30	0.30	0.40	0.40	–
B_0 nominal clearance; note 1	0.20	0.30	0.30	0.40	0.40	–
K_0 minimum clearance; note 1	0.05	0.05	0.05	0.05	0.05	–
W	8.1	8.1	8.1	12.0	12.0	±0.2
E	1.75	1.75	1.75	1.75	1.75	±0.1
F	3.5	3.5	3.5	5.5	5.5	±0.05
D_0	1.5	1.5	1.5	1.5	1.5	+0.1/–0.0
D_1	≥1	≥1	≥1	1.5	1.5	+0.1/–0.0
P_0; note 2	4	4	4	4	4	±0.1
P_1	4	4	4	8	8	±0.1
P_2	2	2	2	2	2	±0.05

Notes

1. Typical capacitor displacement in pocket.
2. P_0 pitch tolerance over any 10 pitches is ±0.2 mm.

Reel specifications



Dimensions in mm.
For reel dimensions see Table 5.

Fig.3 Reel.

Table 5 Reel dimensions; see Fig.3

TAPE WIDTH (mm)	A (mm)	N (mm)	C (mm)	W_1 (mm)	W_2 MAX. (mm)
8	180	62 ±1.5	12.75 +0.15/–0	8.4 +1.5/–0.0	14.4
8	330	62 ±1.5	12.75 +0.15/–0	8.4 +1.5/–0.0	14.4
12	180	62 ±1.5	12.75 +0.15/–0	12.4 +2/–0.0	18.4

Properties of reel

Material: polystyrene

Surface resistance: $<10^{10}$ Ω/sq.

Leader/trailer tape specification

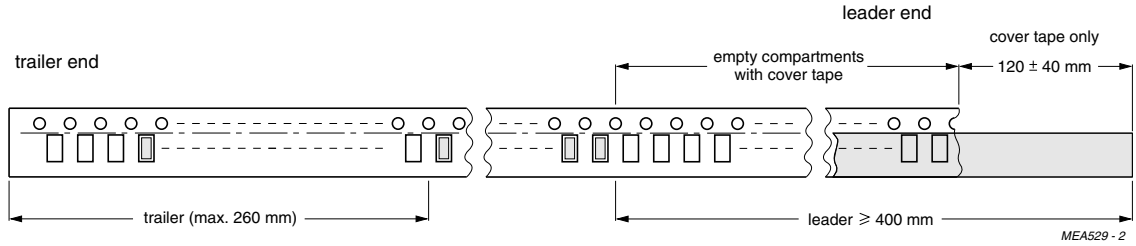


Fig.4 Leader/trailer tape.

Table 6 Leader/trailer tape data

DESCRIPTION	VALUE
Minimum length of empty compartments at leader end	≥400 mm of which a minimum 240 mm of empty compartments are covered with cover tape and 120 ±40 mm cover tape only
Minimum length of empty compartments at trailer end	208 mm or 260 mm. If the length is 260 mm an extra product is placed at 208 mm to mark this position.

Bulk case specification

In accordance with *"IEC 60286-6"*.

Features and benefits:

- Reduced costs
  - Storage
  - Transport
  - Machine handling
  - Packing
- Customized labelling (bar codes).

Table 7 Packing quantities for component size; see note 1 and Fig.5

SIZE CODE	DIMENSIONS OF CAPACITOR (mm)			QUANTITY
	L_1	W	T	
0402	1.0	0.5	0.5	50000
0603	1.6	0.8	0.8	15000
0805	2.0	1.25	0.6	10000
0805	2.0	1.25	0.9	8000
0805	2.0	1.25	1.25	5000

Note

1. Refer to the selection charts in product data for specific values.

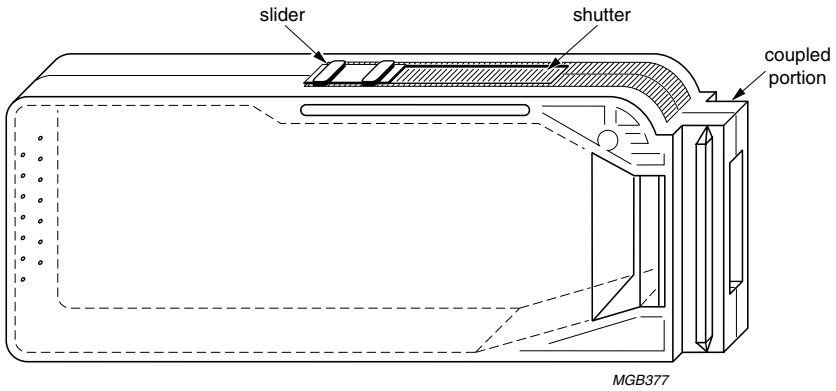


Fig.5 Bulk case outline.

Multi-pack box specification

Features and benefits:

- Minimum recycling costs
- Maximum environmental friendliness
- Reduced handling time
- Economic usage of packing
- Customized labelling (bar codes).

Table 8 Number of reels per box; see Fig.6

REEL SIZE (mm)	TAPE SIZE (mm)	QUANTITY PER BOX	
		MIN.	MAX.
∅180	8	5	25
	12	5	10
∅330	8	5	15

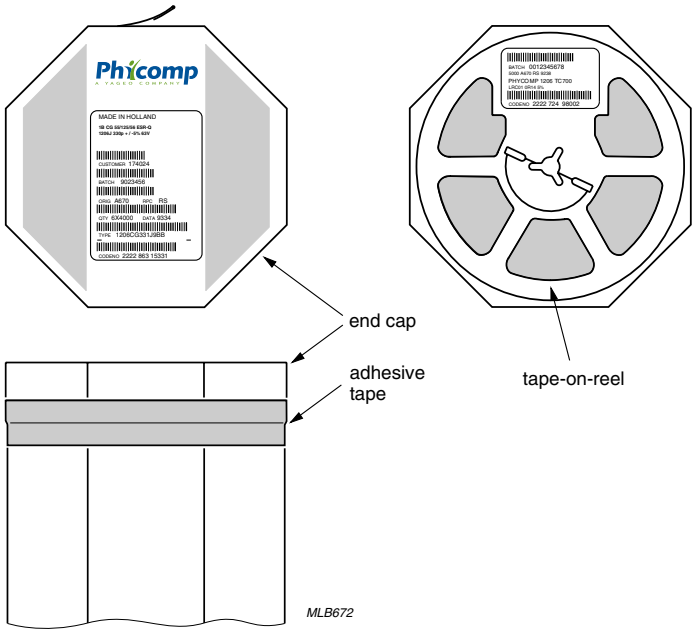
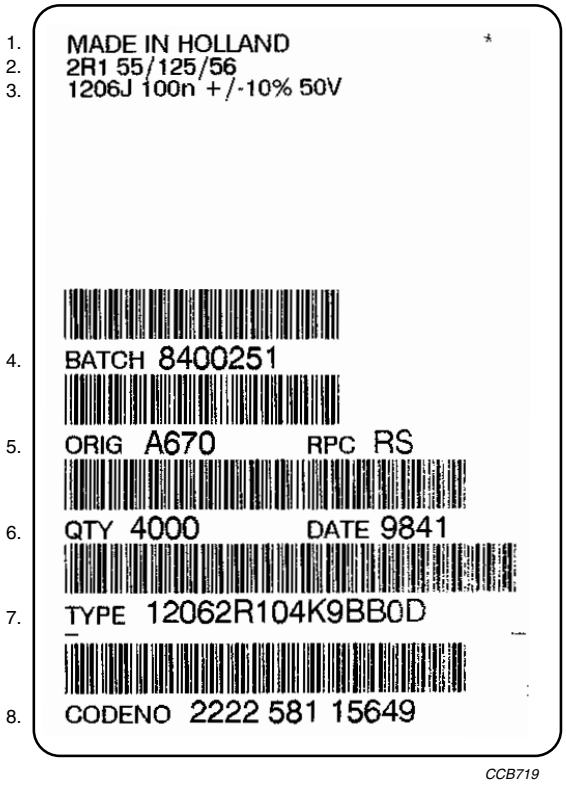


Fig.6 Multi-pack box outline.

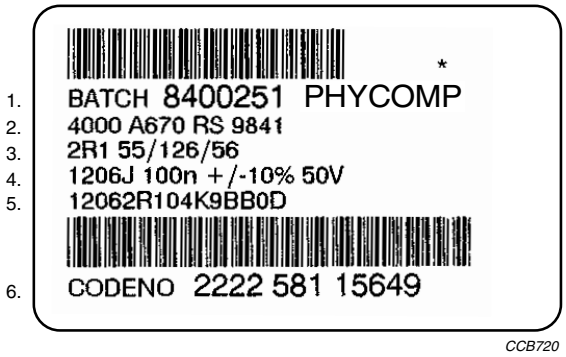
LABELLING

Label examples are shown in Figs 7 and 8 (bar code according to EN 800 code 39).



LINE	MARKING EXPLANATION
1.	Country of origin
2.	Material code and climatic category
3.	Size, termination code, value, tolerance and rated voltage
4.	Unique batch number
5.	Country of origin in code: A670 is Holland
6.	Quantity and production period, year and week code
7.	15-digit Clear Text Code (CTC)
8.	Catalogue number (12NC)

Fig.7 Packing label (example).



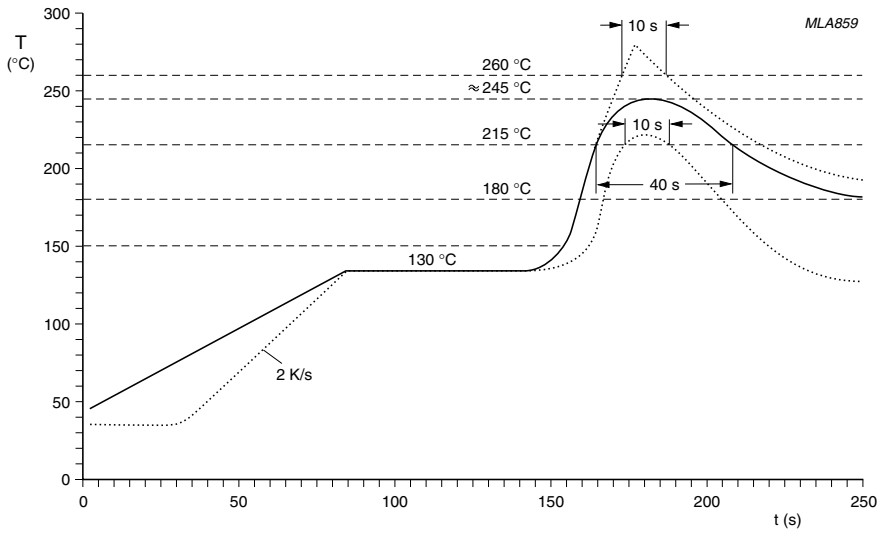
LINE	MARKING EXPLANATION
1.	Unique batch number
2.	Quantity and date code
3.	Material code and climatic category
4.	Size, termination code, value, tolerance and rated voltage
5.	15-digit Clear Text Code (CTC)
6.	Catalogue number (12NC)

Fig.8 Reel label (example).

METHOD OF MOUNTING AND FOOTPRINT DIMENSIONS

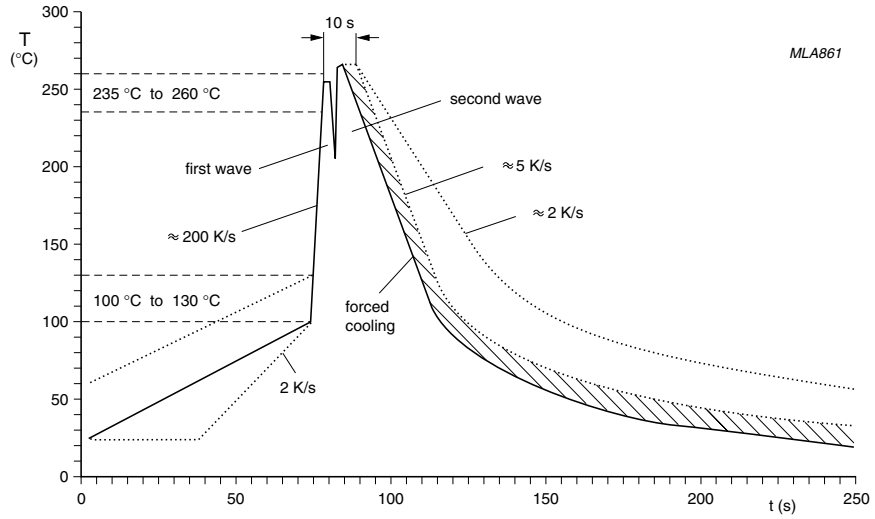
For normal use the capacitors may be mounted on printed-circuit boards or ceramic substrates by applying wave soldering, reflow soldering (including vapour phase soldering) or conductive adhesive in accordance with CECC 00802 classification A. For advised soldering profiles see Figs 9, 10 and 11.

An improper combination of soldering, substrate and chip size can lead to a damaging of the component. The risk increases with the chip size and with temperature fluctuations (>100 °C). Therefore, it is advised to use the smallest possible size and follow the dimensional recommendations given in Tables 9, 10 and 11 for reflow and wave soldering. More detailed information is available on request.



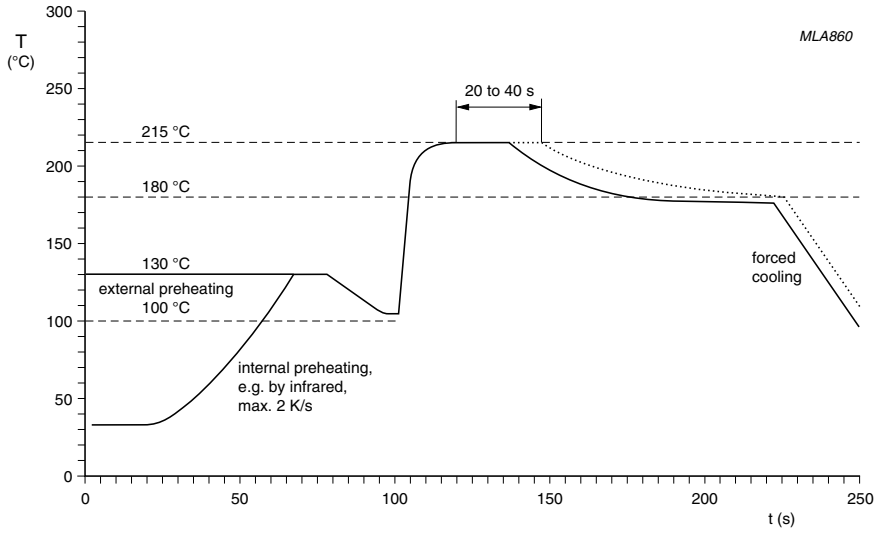
Typical values (solid line).
Process limits (dotted lines).

Fig.9 Reflow soldering.



Typical values (solid line).
Process limits (dotted lines).
The capacitors may be soldered twice in accordance with this method if desired.

Fig.10 Double wave soldering.



Typical values (solid line).
Process limits (dotted line).

Fig.11 Vapour phase soldering.

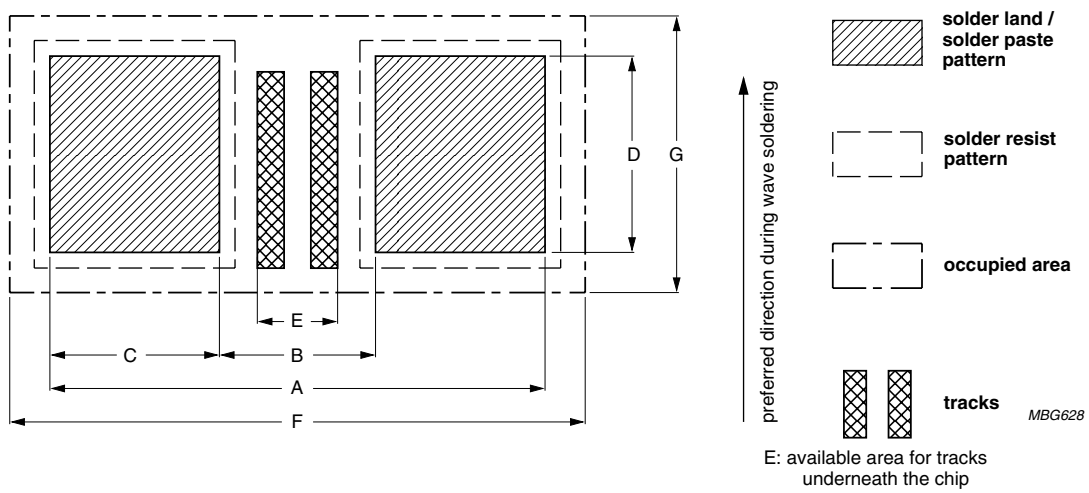


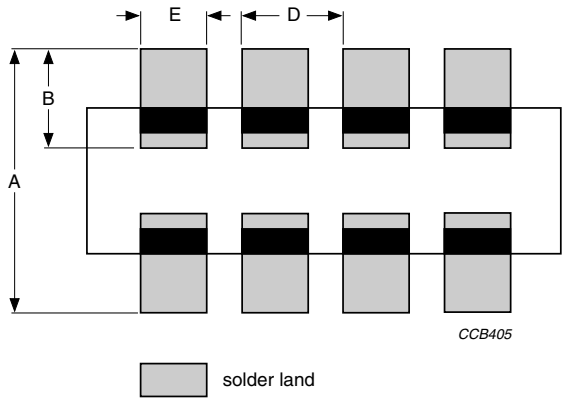
Fig.12 Recommended footprint dimensions.

Table 9 Reflow soldering; for footprint dimensions see Fig.12

SIZE CODE	FOOTPRINT DIMENSIONS (mm)							PROCESSING REMARKS	PLACEMENT ACCURACY (mm)
	A	B	C	D	E	F	G		
0402	1.5	0.5	0.5	0.5	0.10	1.75	0.95	IR or hot plate soldering	±0.15
0603	2.3	0.7	0.8	0.9	0.26	2.7	1.5		±0.15
0603	2.3	0.5	0.9	0.9	0.0	2.7	1.5		±0.25
0805	2.8	0.9	0.95	1.4	0.45	3.2	2.1		±0.25
1206	4.0	2.0	1.0	1.8	1.4	4.4	2.5		±0.25
1210	4.0	2.0	1.0	2.7	1.4	4.4	3.4		±0.25
1808	5.4	3.3	1.05	2.3	2.7	5.8	2.9	ceramic substrate only	±0.25
1812	5.4	3.3	1.05	3.5	2.7	5.8	4.1		±0.25
2220	6.6	4.5	1.05	5.3	3.9	7.0	5.9		±0.25

Table 10 Wave soldering (no dummy tracks allowed for ≥500 V); for footprint dimensions see Fig.12

SIZE CODE	FOOTPRINT DIMENSIONS (mm)							PROPOSED NUMBER AND DIMENSIONS OF DUMMY TRACKS (mm)	PLACEMENT ACCURACY (mm)
	A	B	C	D	E	F	G		
0603	2.4	1.0	0.7	0.8	0.2	3.0	1.9	$1 \times (0.2 \times 0.8)$	±0.10
0603	2.7	0.9	0.9	0.8	0.0	3.2	2.1	$1 \times (0.3 \times 0.8)$	±0.25
0805	3.2	1.4	0.9	1.3	0.36	4.1	2.5	$1 \times (0.3 \times 1.3)$	±0.15
0805	3.4	1.3	1.05	1.3	0.2	4.3	2.7	$1 \times (0.2 \times 1.3)$	±0.25
1206	4.8	2.3	1.25	1.7	1.25	5.9	3.2	$3 \times (0.25 \times 1.7)$	±0.25
1210	5.3	2.3	1.5	2.6	1.25	6.3	4.2	$3 \times (0.25 \times 2.6)$	±0.25



For dimensions see Table 11.

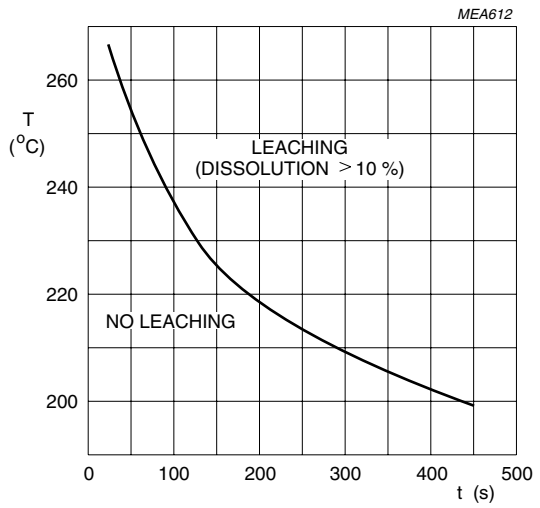
Fig.13 Recommended footprint dimensions for C-Array.

Table 11 C-Array footprint dimensions; see Fig.13

CASE SIZE	FOOTPRINT DIMENSIONS (mm)				
	A	**B**	**C**	**D**	**E**
0612 (4 × 0603)	2.54 ±0.15	0.89 ±0.10	0.76 ±0.10	0.80 ±0.10	0.45 ±0.10

TEST CONDITIONS IN STATIC SOLDER BATH

PARAMETER	DESCRIPTION
Solderability	
95% covered with smooth and bright solder coating	CECC requirement: 235 ±5 °C for 2 ±0.5 s
	IEC requirement: 215 ±3 °C for 3 ±0.3 s
Resistance to leaching	
10% of the metallization of the edges of the head face may be missing (inner electrodes are not visible)	260 ±5 °C for 30 ±1 s



For NiSn metallized terminations, the leaching resistance is a factor of 10 times better than shown in the graph.

Fig.14 Resistance to leaching of AgPd metallized terminations (in static solder bath) at various temperatures.

TESTS AND REQUIREMENTS

Table 12 Test procedures and requirements

IEC 60384-10/ CECC 32 100 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.4		mounting	the capacitors may be mounted on printed-circuit boards or ceramic substrates by applying wave soldering, reflow soldering (including vapour phase soldering) or conductive adhesive	no visible damage
4.5		visual inspection and dimension check	any applicable method using ×10 magnification	in accordance with specification

4.6.1		capacitance	class 1:
			$C \leq 1000$ pF, f = 1 MHz;
			$C > 1000$ pF, f = 1 kHz;
			NP0: measuring voltage
			1 V at 20 °C
			class 2:
			for all capacitors f = 1 kHz;
			X7R: measuring voltage
			1 V at 20 °C
			Y5V/Z5U: measuring voltage
			1 V at 25 °C
				within specified tolerance

4.6.2		tan δ	class 1:
			$C \leq 1000$ pF, f = 1 MHz;
			$C > 1000$ pF, f = 1 kHz;
			NP0: measuring voltage
			1 V at 20 °C
			class 2:
			for all capacitors f = 1 kHz;
			X7R: measuring voltage
			1 V at 20 °C
			Y5V/Z5U: measuring voltage
			1 V at 25 °C
				in accordance with specification

4.6.3		insulation resistance	at U_R (DC) for 1 minute	in accordance with specification
4.6.4		voltage proof	$U_R \leq 100$ V: $2.5 \times U_R$ for 1 minute; $U_R > 100$ V: $1.5 \times U_R$ +100 for 1 minute	no breakdown or flashover
4.7.1		temperature coefficient	class 1: between minimum and maximum temperature	in accordance with specification
4.7.2		temperature characteristic	class 2: between minimum and maximum temperature	in accordance with specification

IEC 60384-10/ CECC 32 100 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.8		adhesion	a force of 5 N applied for 10 s to the line joining the terminations and in a plane parallel to the substrate	no visible damage
4.9		bond strength of plating on end face	mounted in accordance with CECC 32 100, paragraph 4.4	no visible damage
			conditions: bending 1 mm at a rate of 1 mm/s, radius jig. 340 mm	ΔC/C: class 1: within ±10% class 2, X7R: within ±10% class 2, Y5V: within ±30%

4.10	Tb	resistance to soldering heat	260 ±5 °C for 10 ±0.5 s in a static solder bath	the terminations shall be well tinned after recovery
				ΔC/C:
				class 1: within ±0.5% or 0.5 pF whichever is greater
				class 2, X7R:
				>−5% and ≤10%
				class 2, Y5V:
				>−10% and ≤20%

		resistance to leaching	260 ±5 °C for 30 ±1 s in a static solder bath	using visual enlargement of ×10, dissolution of the terminations shall not exceed 10%
4.11	Ta	solderability	zero hour test, and test after storage (20 to 24 months) in original packing in normal atmosphere; unmounted chips completely immersed for 2 ±0.5 s in a solder bath at 235 ±5 °C	the terminations shall be well tinned

IEC 60384-10/ CECC 32 100 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.12	Na	rapid change of temperature	preconditioning, class 2 only: NP0/X7R: −55 to +125 °C; 5 cycles Y5V: −25 to +85 °C; 5 cycles	no visible damage after 24 hours recovery $\Delta C/C$: class 1: within ±1% or 1 pF class 2, X7R: within ±15% class 2, Y5V: within ±20%

4.14	Ca	damp heat	preconditioning, class 2 only:
			56 days at 40 °C;
			90 to 95% RH; U_R applied (max. 500 V)
				no visual damage
				after recovery
				class 1: 1 to 2 hours
				class 2: 24 hours
				$\Delta C/C$:
				class 1: within ±2% or 1 pF, whichever is greater
				class 2, X7R: within ±15%, ±20%
				class 2, Y5V: within ±30%, +30/−40% (according to Phycomp specification)
				tan δ:
				class 1: ≤2 × specified value
				class 2: X7R: ≤7%
				class 2: Y5V: ≤12.5%, 15% (according to Phycomp specification)
				R_{ins}:
				class 1:
				2500 MΩ or $R_i C_R \geq 25$ s, whichever is less
				class 2:
				1000 MΩ or $R_i C_R \geq 25$ s, whichever is less

IEC 60384-10/ CECC 32 100 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS

4.15		endurance	preconditioning, class 2 only:
			1000 hours at upper category temperature at:
			$2 \times U_R$ for $U_R \leq 50$ V;
			$1.5 \times U_R$ for other rated voltages
				no visible damage after 24 hours recovery:
				$\Delta C/C$:
				class 1: within ±2% or 1 pF, whichever is greater
				class 2, X7R: within ±20%
				class 2, Y5V: within ±30%, +30/−40% (according to Phycomp specification)
				tan δ:
				class 1: $\leq 2 \times$ specified value
				class 2: X7R: ≤7%
				class 2: Y5V: ≤12.5%, 15% (according to Phycomp specification)
				R_{ins}:
				class 1:
				4000 MΩ or $R_i C_R \geq 40$ s, whichever is less
				class 2:
				2 000 MΩ or $R_i C_R \geq 50$ s, whichever is less

REVISION HISTORY

Revision	Date	Change Notification	Description
Rev.6	2001 May 30	–	- Converted to Phycomp brand