

■ Limited Application

1. Equipment Intended for Use

The products listed in this catalog are intended for general-purpose and standard use in general electronic equipment for consumer (e.g., AV equipment, OA equipment, home electric appliances, office equipment, information and communication equipment including, without limitation, mobile phone, and PC) and other equipment specified in this catalog or the individual product specification sheets, or the equipment approved separately by TAIYO YUDEN.

TAIYO YUDEN has the product series intended for use in the following equipment. Therefore, when using our products for these equipment, please check available applications specified in this catalog or the individual product specification sheets and use the corresponding products.

Application	Product Series		Quality Grade ^{*3}
	Equipment ^{*1}	Category (Part Number Code ^{*2})	
Automotive	Automotive Electronic Equipment (POWERTRAIN, SAFETY)	A	1
	Automotive Electronic Equipment (BODY & CHASSIS, INFOTAINMENT)	C	2
Industrial	Telecommunications Infrastructure and Industrial Equipment	B	2
Medical	Medical Devices classified as GHTF Class C (Japan Class III)	M	2
	Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)	L	3
Consumer	General Electronic Equipment	S	3

*Notes: 1. Based on the general specifications required for electronic components for such equipment, which are recognized by TAIYO YUDEN, the use of each product series for the equipment is recommended. Please be sure to contact TAIYO YUDEN before using our products for equipment other than those covered by the product series.

2. On each of our part number, the 2nd code from the left is a code indicating the "Category" as shown in the above table. For details, please check the explanatory materials regarding the part numbering system of each of our products.

3. Each product series is assigned a "Quality Grade" from 1 to 3 in order of higher quality. Please do not incorporate a product into any equipment with a higher Quality Grade than the Quality Grade of such product without the prior written consent of TAIYO YUDEN.

2. Equipment Requiring Inquiry

Please be sure to contact TAIYO YUDEN for further information before using the products listed in this catalog for the following equipment (excluding intended equipment as specified in this catalog or the individual product specification sheets) which may cause loss of human life, bodily injury, serious property damage and/or serious public impact due to a failure or defect of the products and/or malfunction attributed thereto.

- (1) Transportation equipment (automotive powertrain control system, train control system, and ship control system, etc.)
- (2) Traffic signal equipment
- (3) Disaster prevention equipment, crime prevention equipment
- (4) Medical devices classified as GHTF Class C (Japan Class III)
- (5) Highly public information network equipment, data-processing equipment (telephone exchange, and base station, etc.)
- (6) Any other equipment requiring high levels of quality and/or reliability equal to the equipment listed above

3. Equipment Prohibited for Use

Please do not incorporate our products into the following equipment requiring extremely high levels of safety and/or reliability.

- (1) Aerospace equipment (artificial satellite, rocket, etc.)
- (2) Aviation equipment ^{*1}
- (3) Medical devices classified as GHTF Class D (Japan Class IV), implantable medical devices ^{*2}
- (4) Power generation control equipment (nuclear power, hydroelectric power, thermal power plant control system, etc.)
- (5) Undersea equipment (submarine repeating equipment, etc.)
- (6) Military equipment
- (7) Any other equipment requiring extremely high levels of safety and/or reliability equal to the equipment listed above

*Notes: 1. There is a possibility that our products can be used only for aviation equipment that does not directly affect the safe operation of aircraft (e.g., in-flight entertainment, cabin light, electric seat, cooking equipment) if such use meets requirements specified separately by TAIYO YUDEN. Please be sure to contact TAIYO YUDEN for further information before using our products for such aviation equipment.

2. Implantable medical devices contain not only internal unit which is implanted in a body, but also external unit which is connected to the internal unit.


4. Limitation of Liability

Please note that unless you obtain prior written consent of TAIYO YUDEN, TAIYO YUDEN shall not be in any way responsible for any damages incurred by you or third parties arising from use of the products listed in this catalog for any equipment that is not intended for use by TAIYO YUDEN, or any equipment requiring inquiry to TAIYO YUDEN or prohibited for use by TAIYO YUDEN as described above.

Medical Application Guide

According to the medical devices classified as GHTF Classes A to C (Japan Classes I to III), we have the corresponding product series (the part number code of 2nd digit from the left side is "M" or "L") intended for use in the medical devices. Therefore, when using our products for the medical devices, please be sure to check the classification based on the GHTF Rules and use the corresponding product series.

On the other hand, we don't have the product series intended for use in (i) all medical devices classified as GHTF Class D (Japan Class IV) and (ii) implantable medical devices (bone-anchored hearing aid, artificial retina system, and external unit which is connected to internal unit which is implanted in a body, etc.). Therefore, please do not incorporate our products into these medical devices. Should you have any questions on this matter, please contact us.

Risk Level		Low  High			
Japan	Classification according to the PMD Act of Japan (based on the GHTF Rules)	Class I General Medical Devices (GHTF Class A)	Class II Controlled Medical Devices (GHTF Class B)	Class III Specially-controlled Medical Devices (GHTF Class C)	Class IV Specially-controlled Medical Devices (GHTF Class D)
		Medical devices with extremely low risk to the human body in case of problems [Ex.] • In Vitro Diagnostic Devices • Nebulizer • Blood Gas Analyzer • Plethysmographs • Breathing Sensor • AC-powered Operating Table • Surgical Light • Cholesterol Analysis Device • Blood Type Analysis Device, etc.	Medical devices with relatively low risk to the human body in case of problems [Ex.] • Electronic Thermometer • Electronic Blood Pressure Gauge • Electronic Endoscope • Hearing Aid • Electrocardiograph • MRI • Ultrasonic Diagnostic System • Diagnostic Imaging Equipment • X-ray Diagnostic Equipment • Central Monitor • Pulse Oximeter, etc.	Medical devices with relatively high risk to the human body in case of problems [Ex.] • Dialysis Machine • Radiation Therapy Equipment • Infusion Pump • Respirator • Glucose Monitoring System • AED (Automated External Defibrillator) • Skin Laser Scanner • Electric Surgical Unit • Insulin Pump, etc.	Medical devices highly invasive to patients and with life-threatening risk in case of problems [Ex.] • Cardiac Pacemaker • Video Flexible Angioscope • Implantable Infusion Pump • Cardiac Electrosurgical Unit • Inspection Device with Cardiac Catheter • Defibrillator, etc.
U.S.A.	FDA Classification	Class I General Controls	Class II General Controls and Special Controls	Class III General Controls and Premarket Approval	
		Medical devices without the possibility of causing serious injury or harm to the patient or user even if there is a defect or malfunction in such medical devices	Medical devices with the possibility of causing injury or harm to the patient or user if there is a defect or malfunction in such medical devices	Medical devices with the possibility of causing serious injury, disability or death to the patient or user if a defect or malfunction occurs in such medical devices	
Corresponding TAIYO YUDEN Product Series	Product Series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II) (Part Number Code of 2nd Digit from the Left Side: "L")		Product Series for Medical Devices classified as GHTF Class C (Japan Class III) (Part Number Code of 2nd Digit from the Left Side: "M") (See the Note below.)		N / A

* Note : It is prohibited that our products are used in some medical devices such as implantable medical devices even if such medical

Multilayer Ceramic Capacitors

for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

REFLOW

PART NUMBER

M	L	A	S	U	3	1	L	B	B	5	1	0	6	K	T	N	A	0	1
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩										

①Series

Code (1)(2)(3)(4)	
MLAS	Multilayer Ceramic Capacitor (High dielectric type) for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II) Multilayer Ceramic Capacitor (Temperature compensating type) for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II) Medium-High Voltage Multilayer Ceramic Capacitor for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)
MLAY	Low distortion design/Audible/Good bias Multilayer Ceramic Capacitor for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)
MLRL	LW Reversal Decoupling Low ESL Capacitor(LWDC™) for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

(1) Product Group

Code	
M	Multilayer Ceramic Capacitor

(2) Category

Code	Recommended equipment	Quality Grade
L	Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)	3

(3) Type

Code	
A	2 terminals
R	LW reversal

(4) Features, Characteristics

Code	
S	Standard/General
Y	Low distortion design/Audible/Good bias
L	Low ESL

②Rated voltage

Code	Rated voltage [VDC]
P	2.5
A	4
J	6.3
L	10
E	16
T	25
G	35
U	50
H	100
Q	250
S	630
X	2000

④Thickness

Code	Thickness [mm]
H	0.13 (1.5 max ※)
E	0.18 (1.1 max ※)
2	0.2
3	0.3
K	0.45
5	0.5
8	0.8
9	0.85
Q	1.15
G	1.25
L	1.6
N	1.9 (0.088 ※)
Y	2.0 max
M	2.5

Note : ※LW reverse type (MLRL)

③Dimension

Code	(L × W) [mm]	JIS(mm)	EIA(inch)
04	0.4 × 0.2	0402	01005
06	0.6 × 0.3	0603	0201
1L	1.0 × 0.5	1005	0402
10	1.0 × 0.5	1005	0402
	0.52 × 1.0 ※	0510	0204
16	1.6 × 0.8	1608	0603
	0.8 × 1.6 ※	0816	0306
21	2.0 × 1.25	2012	0805
	1.25 × 2.0 ※	1220	0508
31	3.2 × 1.6	3216	1206
32	3.2 × 2.5	3225	1210
45	4.5 × 3.2	4532	1812

Note : ※LW reverse type (MLRL)

⑤Dimension tolerance

Code	Dimension code	L[mm]	W[mm]	T[mm]	Thickness code
A	06	0.6±0.05	0.3±0.05	0.3±0.05	3
	10	1.0±0.10	0.5±0.10	0.5±0.10	5
	16	1.6+0.15/-0.05	0.8+0.15/-0.05	0.8+0.15/-0.05	8
	21	2.0+0.15/-0.05	1.25+0.15/-0.05	1.25+0.15/-0.05	G
	31	3.2±0.20	1.6±0.20	1.6±0.20	L
	32	3.2±0.30	2.5±0.30	2.5±0.30	M
	45	4.5±0.40	3.2±0.30	2.0+0/-0.30	Y
B	06	0.6±0.09	0.3±0.09	0.3±0.09	3
	10	1.0+0.15/-0.05	0.5+0.15/-0.05	0.5+0.15/-0.05	5
	16	1.6+0.20/-0	0.8+0.20/-0	0.8+0.20/-0	8
	21	2.0+0.20/-0	1.25+0.20/-0	1.25+0.20/-0	G
	31	3.2±0.30	1.6±0.30	1.6±0.30	L
C	10	1.0+0.20/-0	0.5+0.20/-0	0.5+0.20/-0	5
E	06	0.6+0.25/-0	0.3+0.25/-0	0.3+0.25/-0	3
H	31	3.2±0.15	1.6±0.15	0.85±0.10	9
				1.15±0.10	Q
J	16	1.6+0.20/-0	0.8+0.20/-0	0.45±0.05	K
	21	2.0+0.15/-0.05	1.25+0.15/-0.05	0.85±0.10	9
	32	3.2±0.30	2.5±0.20	0.85±0.10 1.15±0.10	9 Q
L	21	2.0+0.20/-0	1.25+0.20/-0	0.85±0.10	9
	31	3.2±0.20	1.6±0.20	0.85±0.10	9
S	04	0.4±0.02	0.2±0.02	0.2±0.02	2
	06	0.6±0.03	0.3±0.03	0.3±0.03	3
		1.0±0.05	0.5±0.05	0.5±0.05	5
	10	0.52±0.05 ※	1.0±0.05	0.3±0.05	3
		1.6±0.10	0.8±0.10	0.8±0.10	8
	16	0.8±0.10 ※	1.6±0.10	0.5±0.05	5
		2.0±0.10	1.25±0.10	0.85±0.10 1.25±0.10	9 G
	21	1.25±0.15 ※	2.0±0.15	0.85±0.10	9
		3.2±0.15	1.6±0.15	1.6±0.20	L
	32	3.2±0.30	2.5±0.20	2.5±0.20 1.9±0.20	M N
4.5±0.40		3.2±0.30	2.5±0.20	M	
T	16	1.6±0.10	0.8±0.10	0.45±0.05	K
X	1L	1.0±0.05	0.5±0.05	0.13±0.02	H
				0.18±0.02	E
				0.2±0.02	2
Y	1L	1.0±0.05	0.5±0.05	0.3±0.03	3

Note :※LW reverse type (MLRL)

⑥ Temperature characteristics code

■ High dielectric type (SD: Excluding Low distortion design/Audible/Good bias Multilayer Ceramic Capacitor)

Code	Applicable standard		Temperature range [°C]	Ref. Temp. [°C]	Capacitance change	Capacitance tolerance	Tolerance code
B5	JIS	B	-25 ~ + 85	20	± 10%	± 10%	K
						± 20%	M
	EIA	X5R	-55 ~ + 85	25	± 15%	± 10%	K
						± 20%	M
B7	EIA	X7R	-55 ~ + 125	25	± 15%	± 10%	K
						± 20%	M
C6	EIA	X6S	-55 ~ + 105	25	± 22%	± 10%	K
						± 20%	M
C7	EIA	X7S	-55 ~ + 125	25	± 22%	± 10%	K
						± 20%	M
LD(※)	EIA	X5R	-55 ~ + 85	25	± 15%	± 10%	K
						± 20%	M

Note : ※.LD: Low distortion design/Audible/Good bias Multilayer Ceramic Capacitor

■ Temperature compensating type

Code	Applicable standard		Temperature range [°C]	Ref. Temp. [°C]	Capacitance change	Capacitance tolerance	Tolerance code		
CG	JIS	CG	-55 ~ + 125	20	0 ± 30ppm/°C	± 0.05pF	A		
						± 0.1pF	B		
	± 0.25pF	C							
	± 0.5pF	D							
	EIA	C0G		25		± 5%	J		
	JIS	CH		-55 ~ + 125		20	0 ± 60ppm/°C	± 0.1pF	B
								± 0.25pF	C
EIA	C0H		25			± 0.5pF		D	
						± 5%		J	
CJ	JIS		CJ	-55 ~ + 125		20	0 ± 120ppm/°C	± 0.05pF	A
								± 0.1pF	B
	EIA	C0J			25			± 0.25pF	C
CK	JIS	CK		-55 ~ + 125	20		0 ± 250ppm/°C	± 0.05pF	A
								± 0.1pF	B
	EIA	C0K			25			± 0.25pF	C

⑥ Series code

• Low distortion design/Audible/Good bias Multilayer Ceramic Capacitor

Code	Series code
SD	Standard

• Medium-High Voltage Multilayer Ceramic Capacitor

Code	Series code
SD	Standard

⑦ Nominal capacitance

Code (example)	Nominal capacitance
0R5	0.5pF
010	1pF
100	10pF
101	100pF
102	1,000pF
103	0.01μF
104	0.1μF
105	1μF
106	10μF
107	100μF

Note : R=Decimal point

⑧ Capacitance tolerance

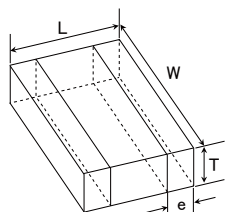
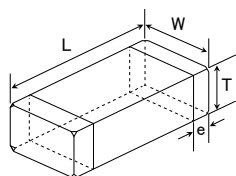
Code	Capacitance tolerance
A	± 0.05pF
B	± 0.1pF
C	± 0.25pF
D	± 0.5pF
G	± 2%
J	± 5%
K	± 10%
M	± 20%

⑨ Packaging

Code	Packaging
F	φ178mm Taping (2mm pitch)
T	φ178mm Taping (4mm pitch)
P	φ178mm Taping (4mm pitch, 1000 pcs/reel) 3225 type (Thickness code M)
R	φ178mm Embossed Taping 1005type (2mm pitch) 1608type (4mm pitch)
W	φ178mm Embossed Taping (1mm pitch) 0402type

⑩ Internal code

STANDARD EXTERNAL DIMENSIONS



※LW reverse type

Type	JIS (mm)	EIA (inch)	Dimension [mm]				
			L	W	T	*1	e
MLAS□04	0402	01005	0.4 ± 0.02	0.2 ± 0.02	0.2 ± 0.02	2	0.1 ± 0.03
MLAS□06	0603	0201	0.6 ± 0.03	0.3 ± 0.03	0.3 ± 0.03	3	0.15 ± 0.05
MLAS□1L	1005	0402	1.0 ± 0.05	0.5 ± 0.05	0.13 ± 0.02	H	0.25 ± 0.10
					0.18 ± 0.02	E	
					0.2 ± 0.02	2	
					0.3 ± 0.03	3	
MLAS□10	1005	0402	1.0 ± 0.05	0.5 ± 0.05	0.5 ± 0.05	5	0.25 ± 0.10
MLAY□1L	1005	0402	1.0 ± 0.05	0.5 ± 0.05	0.3 ± 0.03	3	0.25 ± 0.10
MLAY□10	1005	0402	1.0 ± 0.05	0.5 ± 0.05	0.5 ± 0.05	5	0.25 ± 0.10
MLRL□10 ※	0510	0204	0.52 ± 0.05	1.0 ± 0.05	0.3 ± 0.05	3	0.18 ± 0.08
MLAS□16	1608	0603	1.6 ± 0.10	0.8 ± 0.10	0.45 ± 0.05	K	0.35 ± 0.25
					0.8 ± 0.10	8	
MLAY□16	1608	0603	1.6 ± 0.10	0.8 ± 0.10	0.8 ± 0.10	8	0.35 ± 0.25
MLRL□16 ※	0816	0306	0.8 ± 0.10	1.6 ± 0.10	0.5 ± 0.05	5	0.25 ± 0.15
MLAS□21	2012	0805	2.0 ± 0.10	1.25 ± 0.10	0.85 ± 0.10	9	0.5 ± 0.25
MLAY□21					1.25 ± 0.10	G	
MLRL□21 ※	1220	0508	1.25 ± 0.15	2.0 ± 0.15	0.85 ± 0.10	9	0.3 ± 0.2
MLAS□31	3216	1206	3.2 ± 0.15	1.6 ± 0.15	0.85 ± 0.10	9	$0.5 + 0.35 / - 0.25$
					1.15 ± 0.10	Q	
					1.6 ± 0.20	L	
MLAY□31	3216	1206	3.2 ± 0.15	1.6 ± 0.15	1.15 ± 0.10	Q	$0.5 + 0.35 / - 0.25$
					1.6 ± 0.20	L	
					0.85 ± 0.10	9	
MLAS□32	3225	1210	3.2 ± 0.30	2.5 ± 0.20	1.15 ± 0.10	Q	0.6 ± 0.3
					1.9 ± 0.20	N	
					$1.9 + 0.1 / - 0.20$	Y	
					2.5 ± 0.20	M	
					1.9 ± 0.20	N	
MLAY□32	3225	1210	3.2 ± 0.30	2.5 ± 0.20	1.9 ± 0.20	N	0.6 ± 0.3
					2.5 ± 0.20	M	
					$2.0 + 0 / - 0.30$	Y	
MLAS□45	4532	1812	4.5 ± 0.40	3.2 ± 0.30	$2.0 + 0 / - 0.30$	Y	0.6 ± 0.4
					2.5 ± 0.20	M	

Note :※LW reverse type (MLRL), *1.Thickness code

■ STANDARD QUANTITY

Type			Thickness		Standard quantity [pcs]	
Code	JIS(mm)	EIA(inch)	[mm]	Code	Paper tape	Embossed tape
04	0402	01005	0.2	2	—	40000
06	0603	0201	0.3	3	15000	—
1L	1005	0402	0.13	H	—	20000
			0.18	E	—	15000
			0.2	2	20000	—
			0.3	3	15000	—
10	1005	0402	0.5	5	10000	—
	0510 ※	0204 ※	0.3	3		
16	1608	0603	0.45	K	4000	—
			0.8	8		
	0816 ※	0306 ※	0.5	5	—	4000
21	2012	0805	0.85	9	4000	—
			1.25	G	—	3000
	1220 ※	0508 ※	0.85	9	4000	—
31	3216	1206	0.85	9	4000	—
			1.15	Q	—	3000
			1.6	L	—	2000
32	3225	1210	0.85	9	—	2000
			1.15	Q		
			1.9	N		
			2.0 max	Y		
			2.5	M		
45	4532	1812	2.0 max	Y	—	1000
			2.5	M	—	500

Note : ※.LW Reverse type (MLRL)

PARTS NUMBER

Low distortion design/Audible/Good bias Multilayer Ceramic Capacitors (CF LD) for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

● 1608TYPE

【Temperature Characteristic LD : X5R (−55~+85°C)】 0.8mm thickness

New part number	Old part number (for reference)	Rated voltage [V]	Temperature characteristics	Capacitance [F]	Capacitance tolerance [%]	tan δ [%]	HTLT	Thickness*3 [mm]	Note
							Rated voltage x %		
MLAYU168BLD224□TNA01	UMK107BLD224□A-T	50	X5R	0.22 μ	±10, ±20	10	150	0.8+0.20/-0	
MLAYT168BLD474□TNA01	TMK107BLD474□A-T	25	X5R	0.47 μ	±10, ±20	10	150	0.8+0.20/-0	
MLAYT168BLD105□TNA01	TMK107BLD105□A-T	25	X5R	1 μ	±10, ±20	10	150	0.8+0.20/-0	

● 2012TYPE

【Temperature Characteristic LD : X5R (−55~+85°C)】 1.25mm thickness

New part number	Old part number (for reference)	Rated voltage [V]	Temperature characteristics	Capacitance [F]	Capacitance tolerance [%]	tan δ [%]	HTLT	Thickness*3 [mm]	Note
							Rated voltage x %		
MLAYG21GSLD105□TNA01	GMK212 LD105□G-T	35	X5R	1 μ	±10, ±20	10	150	1.25±0.10	
MLAYG21GBLD225□TNA01	GMK212BLD225□G-T	35	X5R	2.2 μ	±10, ±20	10	150	1.25+0.20/-0	

● 3216TYPE

【Temperature Characteristic LD : X5R (−55~+85°C)】 1.6mm thickness

New part number	Old part number (for reference)	Rated voltage [V]	Temperature characteristics	Capacitance [F]	Capacitance tolerance [%]	tan δ [%]	HTLT	Thickness*3 [mm]	Note
							Rated voltage x %		
MLAYU31LSLD105□TNA01	UMK316 LD105□L-T	50	X5R	1 μ	±10, ±20	10	150	1.6±0.20	
MLAYG31LBLD475□TNA01	GMK316BLD475□L-T	35	X5R	4.7 μ	±10, ±20	10	150	1.6±0.30	
MLAYT31LBD106□TNA01	TMK316BLD106□L-T	25	X5R	10 μ	±10, ±20	10	150	1.6±0.30	

● 3225TYPE

【Temperature Characteristic LD : X5R (−55~+85°C)】 1.9mm thickness

New part number	Old part number (for reference)	Rated voltage [V]	Temperature characteristics	Capacitance [F]	Capacitance tolerance [%]	tan δ [%]	HTLT	Thickness*3 [mm]	Note
							Rated voltage x %		
MLAYU32NSLD105□TNA01	UMK325 LD105□N-T	50	X5R	1 μ	±10, ±20	10	200	1.9±0.20	

【Temperature Characteristic LD : X5R (−55~+85°C)】 2.5mm thickness

New part number	Old part number (for reference)	Rated voltage [V]	Temperature characteristics	Capacitance [F]	Capacitance tolerance [%]	tan δ [%]	HTLT	Thickness*3 [mm]	Note
							Rated voltage x %		
MLAYU32MSLD475□PNA01	UMK325 LD475□M-P	50	X5R	4.7 μ	±10, ±20	10	200	2.5±0.20	

Multilayer Ceramic Capacitors

PACKAGING

① Minimum Quantity

● Taped package

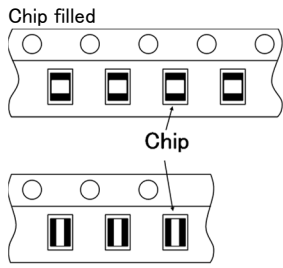
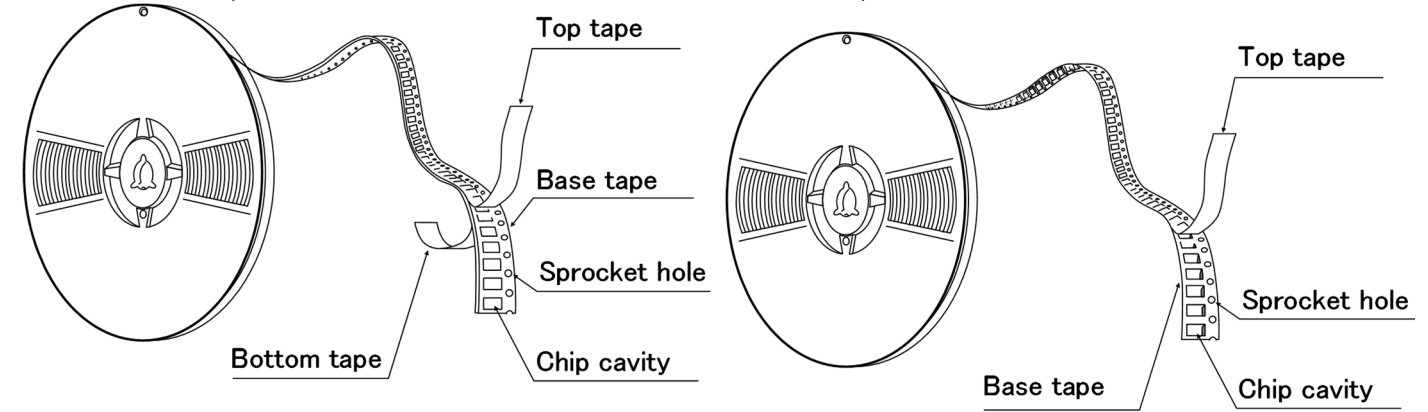
Type			Thickness		Standard Quantity [pcs]	
Code	JIS(mm)	EIA(inch)	[mm]	Code	Paper tape	Embossed tape
02	0201	008004	0.125	1	—	50000
04	0402	01005	0.2	2	—	40000
06	0603	0201	0.3	3	15000	—
1L	1005	0402	0.13	H	—	20000
			0.18	E	—	15000
			0.2	2	20000	—
			0.3	3	15000	—
10	1005	0402	0.5	5	10000	—
	0510 ※	0204	0.3	3	10000	—
16	1608	0603	0.45	K	4000	—
			0.7	7		
			0.8	8		
			0.8	8	3000 (Soft Termination)	3000 (Soft Termination)
	0816 ※	0306	0.5	5	—	4000
21	2012	0805	0.85	9	4000	—
			1.25	G	—	3000
			1.25	G	—	2000 (Soft Termination)
	1220 ※	0508	0.85	9	4000	—
31	3216	1206	0.85	9	4000	—
			1.15	Q	—	3000
			1.6	L	—	2000
32	3225	1210	0.85	9	—	2000
			1.15	Q		
			1.9	N		
			2.0 max	Y		
			2.5	M	—	500(T), 1000(P)
45	4532	1812	2.0 max	Y	—	1000
			2.5	M	—	500

注: ※LW Reverse type (MSRL, MCRL, MBRL, MLRL, MMRL)

② Taping material

※No bottom tape for pressed carrier tape

- Card board carrier tape
- Embossed tape

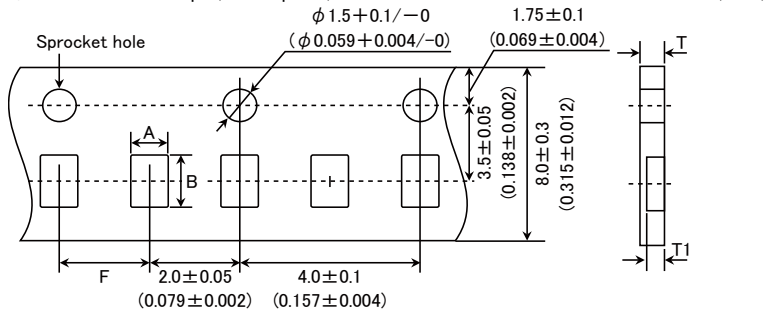


※ LW Reverse type.

③ Representative taping dimensions

● Paper Tape (8mm wide)

● Pressed carrier tape (2mm pitch)

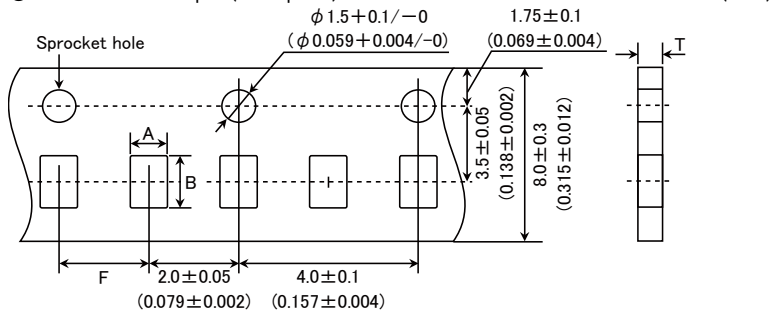


Type(EIA)	Chip Cavity		Insertion Pitch F	Tape Thickness	
	A	B		T	T1
0603 (0201)	0.37	0.67	2.0±0.05	0.45max.	0.42max.
0510 (0204) ※	0.65	1.15		0.4max.	0.3max.
1005 (0402) (*1 2)				0.45max.	0.42max.
1005 (0402) (*1 3)					

Note *1 Thickness, 2:0.2mm, 3:0.3mm. ※ LW Reverse type.

Unit: mm

● Punched carrier tape (2mm pitch)

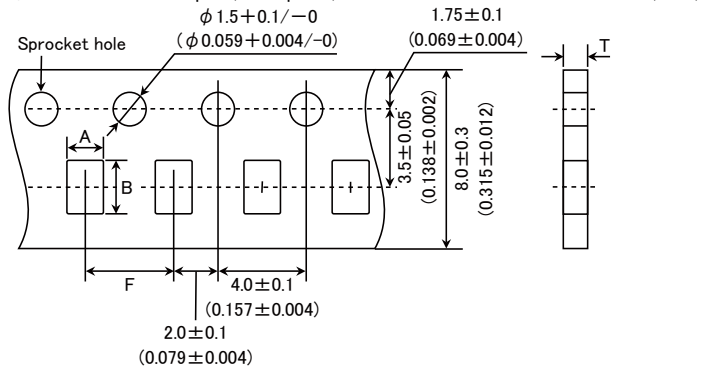


Type(EIA)	Chip Cavity		Insertion Pitch F	Tape Thickness
	A	B		T
1005 (0402)	0.65	1.15	2.0±0.05	0.8max.

Unit: mm

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● Punched carrier tape (4mm pitch)

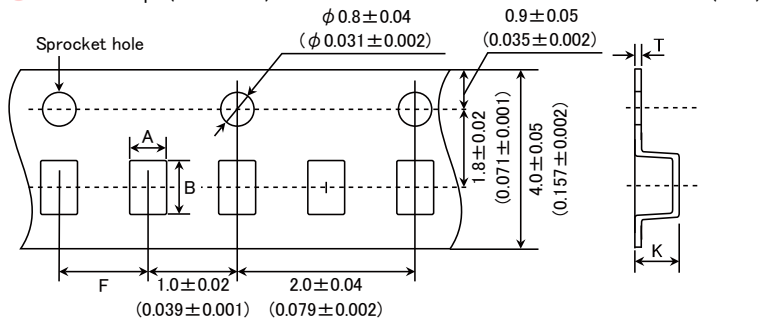


Type(EIA)	Chip Cavity		Insertion Pitch F	Tape Thickness	
	A	B		K	T
1608 (0603)	1.0	1.8	4.0 ± 0.1	1.1max.	1.1max.
0816 (0306) ※					
2012 (0805)					
1220 (0508) ※	1.65	2.4	4.0 ± 0.1	1.1max.	1.1max.
3216 (1206)	2.0	3.6			

Note: Taping size might be different depending on the size of the product. ※ LW Reverse type.

Unit: mm

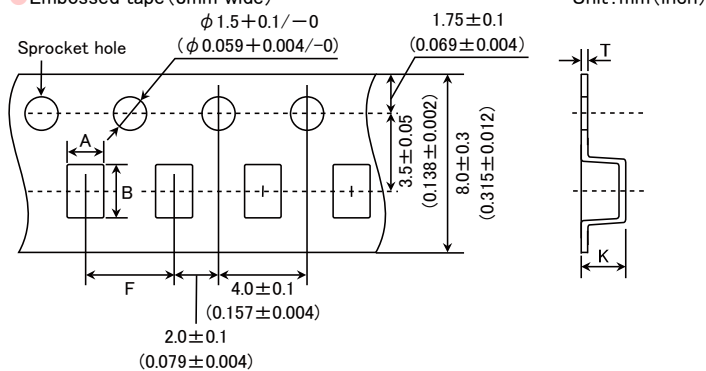
● Embossed tape (4mm wide)



Type(EIA)	Chip Cavity		Insertion Pitch F	Tape Thickness	
	A	B		K	T
0201 (008004)	0.135	0.27	1.0 ± 0.02	0.5max.	0.25max.
0402 (01005)	0.23	0.43			

Unit: mm

● Embossed tape (8mm wide)



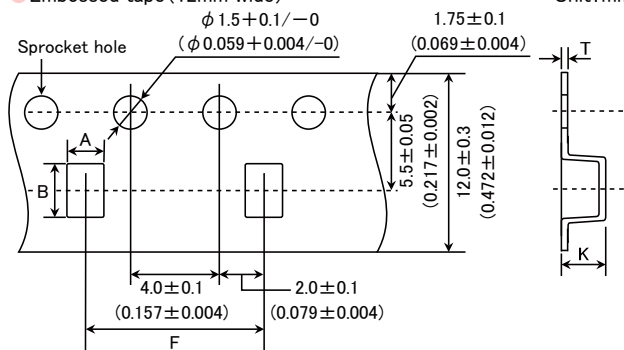
Type(EIA)	Chip Cavity		Insertion Pitch F	Tape Thickness	
	A	B		K	T
1005 (0402)	0.6	1.1	2.0 ± 0.1	0.6max	0.2 ± 0.1
0816 (0306) ※	1.0	1.8	4.0 ± 0.1	1.3max.	0.25 ± 0.1
2012 (0805)	1.65	2.4			
3216 (1206)	2.0	3.6		3.4max.	0.6max.
3225 (1210)	2.8	3.6			

Note: ※ LW Reverse type.

Unit: mm

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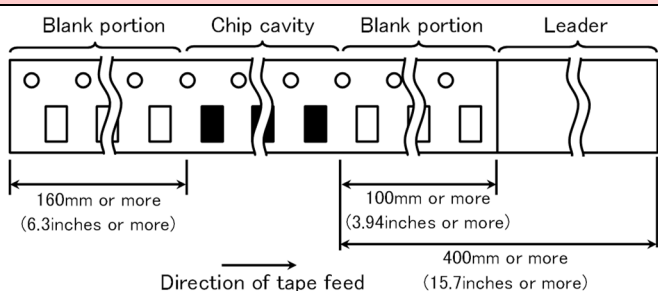
● Embossed tape (12mm wide) Unit: mm (inch)



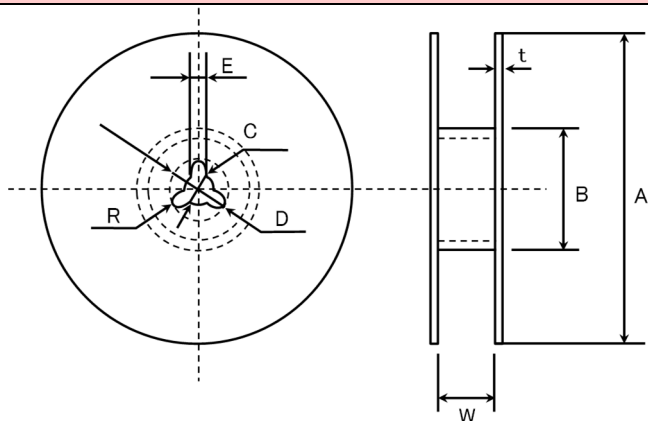
Type(EIA)	Chip Cavity		Insertion Pitch	Tape Thickness	
	A	B		K	T
3225 (1210)	3.1	4.0	8.0 ± 0.1	4.0max.	0.6max.
4532 (1812)	3.7	4.9	8.0 ± 0.1	4.0max.	0.6max.

Unit: mm

④ Trailer and Leader



⑤ Reel size



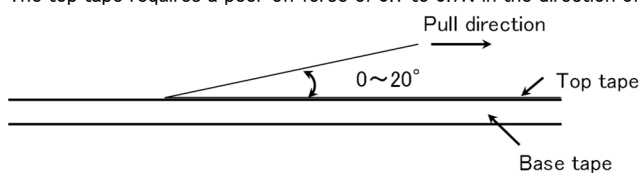
A	B	C	D	E	R
$\phi 178 \pm 2.0$	$\phi 50 \text{min.}$	$\phi 13.0 \pm 0.2$	$\phi 21.0 \pm 0.8$	2.0 ± 0.5	1.0

	T	W
4mm wide tape	1.5max.	5 ± 1.0
8mm wide tape	2.5max.	10 ± 1.5
12mm wide tape	2.5max.	14 ± 1.5

Unit: mm

⑥ Top Tape Strength

The top tape requires a peel-off force of 0.1 to 0.7N in the direction of the arrow as illustrated below.



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**Low distortion design/Audible/Good bias Multilayer Ceramic Capacitors
for General Electronic Equipment for Consumer**
**Low distortion design/Audible/Good bias Multilayer Ceramic Capacitors
for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)**

■ RELIABILITY DATA

1. Operating Temperature Range

Specified Value		Specification	Temperature Range
	LD	X5R	-55~+85°C
	SD	-	-55~+125°C

2. Storage Temperature Range

Specified Value		Specification	Temperature Range
	LD	X5R	-55~+85°C
	SD	-	-55~+125°C

3. Rated Voltage

Specified Value	6.3VDC, 10VDC, 16VDC, 25VDC, 35VDC, 50VDC
-----------------	---

4. Dielectric Withstanding Voltage (Between terminals)

Specified Value	No breakdown or damage	
Test Methods and Remarks	Applied voltage	: Rated voltage × 2.5(LD), Rated voltage × 3(SD)
	Duration	: 1 to 5 sec.
	Charge/discharge current	: 50mA max.

5. Insulation Resistance

Specified Value Note 1	10000 MΩ or 500MΩ μF, whichever is smaller	
Test Methods and Remarks	Applied voltage	: Rated voltage
	Duration	: 60±5 sec.
	Charge/discharge current	: 50mA max.

6. Capacitance (Tolerance)

Specified Value	±10% or ±20%	
Test Methods and Remarks	Measuring frequency	: 1kHz±10%
	Measuring voltage	: 1±0.2Vrms
	Bias application	: None

7. Dissipation Factor

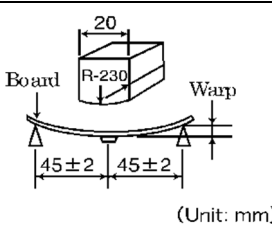
Specified Value	10% max (LD), 0.1% max (SD)	
Test Methods and Remarks	Measuring frequency	: 1kHz±10%
	Measuring voltage	: 1±0.2Vrms
	Bias application	: None

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8. Temperature Characteristic (Without voltage application)

Specified Value	Specification		Capacitance change	Reference temperature	Temperature Range
	LD	X5R	± 15%	25°C	-55~+85°C
Test Methods and Remarks	Capacitance at each step shall be measured in thermal equilibrium, and the temperature characteristic shall be calculated from the following equation.				
	Step	X5R			
	1	Minimum operating temperature			
	2	25°C			
	3	Maximum operating temperature			
	$\frac{(C-C_2)}{C_2} \times 100(\%)$		C :Capacitance value in Step1 or Step3 C ₂ :Capacitance value in Step2		

9. Bending Strength

Specified Value	Appearance : No abnormality Capacitance change : Within ± 12.5% (LD), Within ± 5% (SD)
Test Methods and Remarks	<p>Warp : 1mm Speed : 0.5mm/second Duration : 10 seconds Test board : glass epoxy resin substrate Thickness : 1.6mm</p>  <p>Capacitance measurement shall be conducted with the board bent.</p>

10. Adhesive Force of Terminal Electrodes

Specified Value	Terminal electrodes shall be no exfoliation or a sign of exfoliation.
Test Methods and Remarks	Applied force : 5N Duration : 30 ± 5 seconds

11. Vibration

Specified Value	Initial performance shall be satisfied.
Test Methods and Remarks	Preconditioning : Thermal treatment (at 150°C for 1hr) Note2 (Only LD) Frequency range : 10 to 55 Hz Overall amplitude : 1.5 mm Sweeping method : 10 to 55 to 10 Hz for 1 min Two hours each in X, Y, Z directions: 6 hrs in total

12. Solderability

Specified Value	At least 95% of terminal electrode is covered by new solder.		
Test Methods and Remarks		Eutectic solder	Lead-free solder
	Solder type	H60A or H63A	Sn-3.0Ag-0.5Cu
	Solder temperature	230 ± 5°C	245 ± 3°C
	Duration	4 ± 1 sec.	

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13. Resistance to Soldering Heat

Specified Value	Appearance	: No abnormality	
	Capacitance change	: Within $\pm 7.5\%$ (LD), Within $\pm 2.5\%$ (SD)	
Specified Value	Dissipation factor	: Initial value	
	Insulation resistance	: Initial value	
Specified Value	Withstanding voltage (between terminals)	: No abnormality	
	Test Methods and Remarks		LD
		1608、2012type	3216、3225type
Preconditioning		Thermal treatment (at 150°C for 1 hr) Note 2	
Preheating conditions		80 to 100°C 2 to 5 min 150 to 200°C 2 to 5 min	80 to 100°C 5 to 10 min 150 to 200°C 5 to 10 min
Solder temp.		270 \pm 5°C	
Duration		3 \pm 0.5 sec.	
Measurement shall be conducted		24 \pm 2hrs under the standard condition Note 5	
		SD	
		1005、1608、2012type	3216type
Preheating conditions		80 to 100°C 2 to 5 min 150 to 200°C 2 to 5 min	80 to 100°C 5 to 10 min 150 to 200°C 5 to 10 min
Solder temp.	270 \pm 5°C		
Duration	3 \pm 0.5 sec.		
Measurement shall be conducted	24 \pm 2hrs under the standard condition Note 5		

14. Temperature Cycle (Thermal Shock)

Specified Value	Appearance	: No abnormality																	
	Capacitance change	: Within $\pm 7.5\%$ (LD), Within $\pm 2.5\%$ (SD)																	
Specified Value	Dissipation factor	: Initial value																	
	Insulation resistance	: Initial value																	
Specified Value	Withstanding voltage (between terminals)	: No abnormality																	
	Test Methods and Remarks		LD	SD															
Preconditioning		Thermal treatment (at 150°C for 1 hr) Note 2	None																
1 cycle			<table border="1"> <thead> <tr> <th>Step</th> <th>temperature (°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Minimum operating temperature</td> <td>30 \pm 3 min.</td> </tr> <tr> <td>2</td> <td>Normal temperature</td> <td>2 to 3 min.</td> </tr> <tr> <td>3</td> <td>Maximum operating temperature</td> <td>30 \pm 3 min.</td> </tr> <tr> <td>4</td> <td>Normal temperature</td> <td>2 to 3 min.</td> </tr> </tbody> </table>	Step	temperature (°C)	Time (min.)	1	Minimum operating temperature	30 \pm 3 min.	2	Normal temperature	2 to 3 min.	3	Maximum operating temperature	30 \pm 3 min.	4	Normal temperature	2 to 3 min.	
		Step	temperature (°C)	Time (min.)															
		1	Minimum operating temperature	30 \pm 3 min.															
		2	Normal temperature	2 to 3 min.															
3	Maximum operating temperature	30 \pm 3 min.																	
4	Normal temperature	2 to 3 min.																	
Number of cycles	5 time																		
Measurement shall be conducted	24 \pm 2hrs under the standard condition Note 5																		

15. Humidity (Steady state)

Specified Value Note 1	Appearance	: No abnormality	
	Capacitance change	: Within $\pm 12.5\%$ (LD), $\pm 5\%$ Within(SD)	
Specified Value	Dissipation factor	: 20%max(LD), 0.5%max(SD)	
	Insulation resistance	: 50M Ω μ F or 1000M Ω , whichever is smaller	
Test Methods and Remarks		LD	SD
	Preconditioning	Thermal treatment (at 150°C for 1 hr) Note 2	None
	Temperature	40 \pm 2°C	
	Humidity	90 to 95% RH	
	Duration	500 +24/-0 hrs	
	Measurement shall be conducted	24 \pm 2hrs under the standard condition Note 5	

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16. Humidity Loading

Specified Value Note 1	Appearance	: No abnormality	
	Capacitance change	: Within $\pm 12.5\%$ (LD), Within $\pm 7.5\%$ (SD)	
	Dissipation factor	: 20%max (LD), 0.5%max (SD)	
	Insulation resistance	: 25M Ω μ F or 500M Ω , whichever is smaller	
Test Methods and Remarks		LD	SD
	Preconditioning	Voltage treatment (Rated voltage are applied for 1 hour at 40 °C) Note 3	
	Temperature	40 \pm 2°C	
	Humidity	90 to 95% RH	
	Duration	500 +24/−0 hrs	
	Applied voltage	Rated voltage	
	Charge/discharge current	50mA max	
	Measurement shall be conducted	24 \pm 2hrs under the standard condition Note 5	

17. High Temperature Loading

Specified Value Note 1	Appearance	: No abnormality	
	Capacitance change	: Within $\pm 12.5\%$ (LD), Within $\pm 3\%$ (SD)	
	Dissipation factor	: 20%max (LD), 0.35%max (SD)	
	Insulation resistance	: 50M Ω μ F or 1000M Ω , whichever is smaller	
Test Methods and Remarks		LD	SD
	Preconditioning	Voltage treatment (Twice the rated voltage shall be applied for 1 hour at 85°C or 125°C) Note 3, Note 4	
	Temperature	Maximum operating temperature	
	Duration	1000 +48/−0 hrs	
	Applied voltage	Rated voltage x 2 Note 4	Rated voltage x 2
	Charge/discharge current	50mA max	
	Measurement shall be conducted	24 \pm 2hrs under the standard condition Note 5	

Note 1 The figures indicate typical specifications. Please refer to individual specifications in detail.

Note 2 Thermal treatment : Initial value shall be measured after test sample is heat-treated at 150+0/−10°C for an hour and kept at room temperature for 24 \pm 2hours.

Note 3 Voltage treatment : Initial value shall be measured after test sample is voltage-treated for an hour at both the temperature and voltage specified in the test conditions, and kept at room temperature for 24 \pm 2hours.

Note 4 150% of rated voltage is applicable to some items. Please refer to their specifications for further information.

Note 5 Standard condition: Temperature: 5 to 35°C, Relative humidity: 45 to 85 % RH, Air pressure: 86 to 106kPa When there are questions concerning measurement results, in order to provide correlation data, the test shall be conducted under the following condition.

Temperature: 20 \pm 2°C, Relative humidity: 60 to 70 % RH, Air pressure: 86 to 106kPa Unless otherwise specified, all the tests are conducted under the "standard condition".

Multilayer Ceramic Capacitors

PRECAUTIONS

1. Circuit Design

- Precautions**
- ◆ Verification of operating environment, electrical rating and performance
 1. A malfunction of equipment in fields such as medical, aerospace, nuclear control, etc. may cause serious harm to human life or have severe social ramifications. Therefore, any capacitors to be used in such equipment may require higher safety and reliability, and shall be clearly differentiated from them used in general purpose applications.
 - ◆ Operating Voltage (Verification of Rated voltage)
 1. The operating voltage for capacitors must always be their rated voltage or less.
 - If an AC voltage is loaded on a DC voltage, the sum of the two peak voltages shall be the rated voltage or less.
 - For a circuit where an AC or a pulse voltage may be used, the sum of their peak voltages shall also be the rated voltage or less.
 2. Even if an applied voltage is the rated voltage or less reliability of capacitors may be deteriorated in case that either a high frequency AC voltage or a pulse voltage having rapid rise time is used in a circuit.

2. PCB Design

- Precautions**
- ◆ Pattern configurations (Design of Land-patterns)
 1. When capacitors are mounted on PCBs, the amount of solder used (size of fillet) can directly affect the capacitor performance. Therefore, the following items must be carefully considered in the design of land patterns:
 - (1) Excessive solder applied can cause mechanical stresses which lead to chip breaking or cracking. Therefore, please consider appropriate land-patterns for proper amount of solder.
 - (2) When more than one component are jointly soldered onto the same land, each component's soldering point shall be separated by solder-resist.
 - ◆ Pattern configurations (Capacitor layout on PCBs)

After capacitors are mounted on boards, they can be subjected to mechanical stresses in subsequent manufacturing processes (PCB cutting, board inspection, mounting of additional parts, assembly into the chassis, wave soldering of the boards, etc.). For this reason, land pattern configurations and positions of capacitors shall be carefully considered to minimize stresses.

Technical considerations

- ◆ Pattern configurations (Design of Land-patterns)

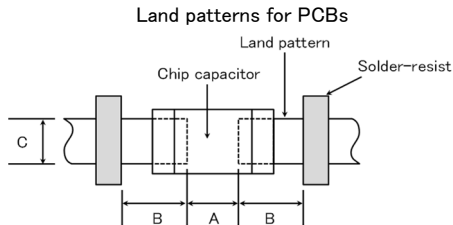
The following diagrams and tables show some examples of recommended land patterns to prevent excessive solder amounts.

(1) Recommended land dimensions for typical chip capacitors

 - Multilayer Ceramic Capacitors : Recommended land dimensions (unit: mm)

Wave-soldering

Type	1608	2012	3216	3225	
Size	L	1.6	2.0	3.2	3.2
	W	0.8	1.25	1.6	2.5
A	0.8 to 1.0	1.0 to 1.4	1.8 to 2.5	1.8 to 2.5	
B	0.5 to 0.8	0.8 to 1.5	0.8 to 1.7	0.8 to 1.7	
C	0.6 to 0.8	0.9 to 1.2	1.2 to 1.6	1.8 to 2.5	



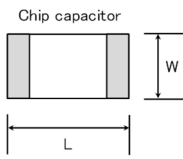
Reflow-soldering

Type	0201	0402	0603	1005	1608	2012	3216	3225	4532
Size	L	0.25	0.4	0.6	1.0	1.6	2.0	3.2	4.5
	W	0.125	0.2	0.3	0.5	0.8	1.25	1.6	3.2
A	0.095~0.135	0.15~0.25	0.20~0.30	0.45~0.55	0.6~0.8	0.8~1.2	1.8~2.5	1.8~2.5	2.5~3.5
B	0.085~0.125	0.10~0.20	0.20~0.30	0.40~0.50	0.6~0.8	0.8~1.2	1.0~1.5	1.0~1.5	1.5~1.8
C	0.110~0.150	0.15~0.30	0.25~0.40	0.45~0.55	0.6~0.8	0.9~1.6	1.2~2.0	1.8~3.2	2.3~3.5

Note: Recommended land size might be different according to the allowance of the size of the product.

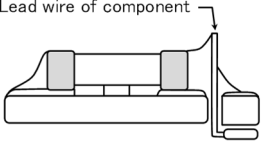
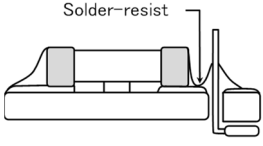
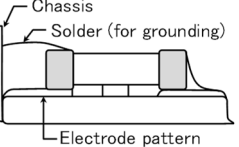
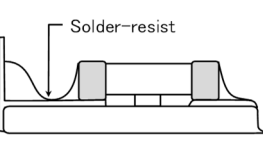
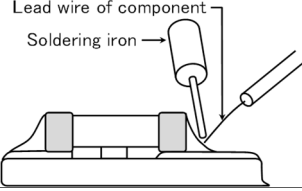
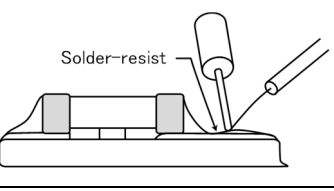
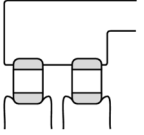
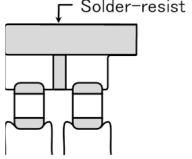
 - LWDC: Recommended land dimensions for reflow-soldering (unit: mm)

Type	0510	0816	1220	
Size	L	0.52	0.8	1.25
	W	1.0	1.6	2.0
A	0.18~0.22	0.25~0.3	0.5~0.7	
B	0.2~0.25	0.3~0.4	0.4~0.5	
C	0.9~1.1	1.5~1.7	1.9~2.1	



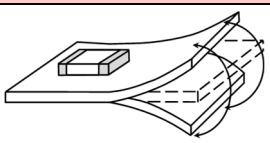
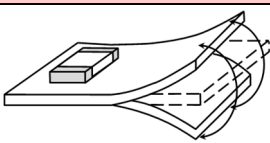
▶ This catalog contains the typical specification only due to the limitation of space. When you consider the purchase of our products, please check our specification. For details of each product (characteristics graph, reliability information, precautions for use, and so on), see our Web site (<http://www.ty-top.com/>).

(2) Examples of good and bad solder application

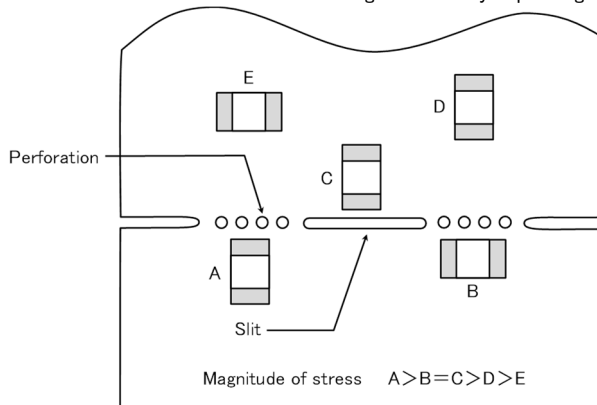
Item	Not recommended	Recommended
Mixed mounting of SMD and leaded components		
Component placement close to the chassis		
Hand-soldering of leaded components near mounted components		
Horizontal component placement		

◆ Pattern configurations (Capacitor layout on PCBs)

1-1. The following is examples of good and bad capacitor layouts ; capacitors shall be located to minimize any possible mechanical stresses from board warp or deflection.

Items	Not recommended	Recommended
Deflection of board		 Place the product at a right angle to the direction of the anticipated mechanical stress.

1-2. The amount of mechanical stresses given will vary depending on capacitor layout. Please refer to diagram below.



1-3. When PCB is split, the amount of mechanical stress on the capacitors can vary according to the method used. The following methods are listed in order from least stressful to most stressful: push-back, slit, V-grooving, and perforation. Thus, please consider the PCB, split methods as well as chip location.

3. Mounting

Precautions

◆ Adjustment of mounting machine

- When capacitors are mounted on PCB, excessive impact load shall not be imposed on them.
- Maintenance and inspection of mounting machines shall be conducted periodically.

◆ Selection of Adhesives

- When chips are attached on PCBs with adhesives prior to soldering, it may cause capacitor characteristics degradation unless the following factors are appropriately checked : size of land patterns, type of adhesive, amount applied, hardening temperature and hardening period. Therefore, please contact us for further information.