

## Part Numbering System



① Category code

Type	Code	
	2	3
Electrolytic Capacitor	E	
Conductive Polymer	S	

② Series code

Series name	Code	
	2	3
WH	W	H
CD11GE	G	E
CD11GES	G	X
CD11GAS	G	W
CD11GHS	G	S
NR	N	R
PZ	P	Z

③ Voltage code

WV (V <sub>dc</sub> )	Code	
	4	5
2.5	0	E
3	0	D
4	0	G
6.3	0	J
6.8	0	C
7	0	Q
7.5	0	A
10	1	A
12	1	T
16	1	C
25	1	E
35	1	V
40	1	G
50	1	H
63	1	J
80	1	B
100	1	K
120	2	B
160	2	C
180	2	L
200	2	D
220	2	N
250	2	E
315	2	F
350	2	V
380	2	P
400	2	G
420	2	T
450	2	W
500	2	H
550	2	J
600	2	K

④ Capacitance tolerance code

Tol. (%)	Code	
	6	
-10~+10	K	
-20~+20	M	
-10~+30	Q	
-10~+20	V	
0~+20	A	
-5~+20	C	
-10~-20	B	
-5~+5	D	
0~+10	E	
-5~-20	F	
-15~+5	N	

⑤ Capacitance code

Cap (μF)	Code		
	7	8	9
0.10	R	1	0
0.22	R	2	2
0.33	R	3	3
0.47	R	4	7
0.68	R	6	8
1	0	1	0
2.2	2	R	2
3.3	3	R	3
4.7	4	R	7
6.8	6	R	8
10	1	0	0
22	2	2	0
33	3	3	0
47	4	7	0
68	6	8	0
100	1	0	1
220	2	2	1
330	3	3	1
470	4	7	1
680	6	8	1
1000	1	0	2
2200	2	2	2
3300	3	3	2
4700	4	7	2
6800	6	8	2
10000	1	0	3
22000	2	2	3
33000	3	3	3
68000	6	8	3

⑥ Size code

ΦD (mm)	Code	
	10	
4	C	
5	D	
6.3	E	
8	F	
10	G	
11	H	
12	J	
12.5	W	
13	K	
14	X	
16	L	
18	M	
19	Z	
20	N	
22	O	
25	P	
30	Q	
35	R	
40	Y	
51.6	S	
64.3	T	
76.9	U	
91	V	
100	A	

L (mm)	Code	
	11	12
5	0	5
7	0	7
11	1	1
12	1	2
16	1	6
20	2	0
25	2	5
30	3	0
35	3	5
40	4	0
46	4	6
50	5	0
60	6	0
80	8	0
100	A	0
115	B	5
120	C	0
130	D	0
140	E	0
160	G	0
200	K	0
220	M	0
236	N	6
250	P	0

⑦ Terminal code

Specification	Code		
	13	14	15
Bulk packing	O	-	-
Taping (SMD Type)	D	0	0
Φ4~8 Taping F=5.0mm	P	5	0
Φ10~12.5 Taping F=5.0mm	B	5	0
Lead Cut L=3.5mm	C	3	5
Lead Cut L=11.0mm	C	B	0
Lead Forming & Cut L=4.5mm	F	-	-
Kink & Cut L=4.5mm	J	-	-
Snap-in type Terminal 4.0mm in length	K	-	-
Three Terminals	T	-	-
Ring clip mounting standard design	A	0	0
Ring clip mounting special design	S	-	-

⑧ Sleeve/Marking code

Sleeve/Marking	Code	
	16	
PVC	C	
PET	T	
Dark blue	B	
Bright red	R	
Sky-blue	S	
Light blue	T	
Pink	Z	
Black	H	
Purple-blue	V	
Red	O	

Lead Forming  
Taping Specifications

Fig.1 code: X



Fig.2 code: B



Fig.3 code: B



Fig.4 code: P



## Lead Forming

Specification Fig.1 & Fig.2 & Fig.3

Items	Symbol	Case size										Tolerance		
		4*5 4*7		5*5 5*7		5*11		6.3*5	6.3*7 6.3*9	6.3*11 6.3*12	8*5/7 8*9/11 8*11.5 8*12		8*16 8*20	10*9/12 10*12.5 10*13/16 10*20/25
Pin Code		X	B	X	B	X	B	B	B	B	B	B	B	
Lead wire diameter	Φd	0.45		0.45		0.5		0.45	0.5	0.5	0.45/0.5	0.6	0.6	±0.05
Pitch of body	P	12.7		12.7		12.7		12.7	12.7	12.7	12.7	12.7	12.7	±1.0
Feed hole pitch	P0	12.7		12.7		12.7		12.7	12.7	12.7	12.7	12.7	12.7	±0.2
Distance from hole center to lead	P1	5.1	5.6	5.1	5.35	5.1	5.35	5.1	5.1	5.1	4.6	4.6	3.85	±0.7
Distance from feed hole center to body center	P2	6.35		6.35		6.35		6.35	6.35	6.35	6.35	6.35	6.35	±1.0
Lead-to-lead distance	F	2.5	1.5	2.5	2.0	2.5	2.0	2.5	2.5	2.5	3.5	3.5	5.0	±0.5
Height of body from tape center	H	18.5		18.5		18.5		18.5	18.5	18.5	18.5	18.5	18.5	±0.75
Base tape width	W	18.0		18.0		18.0		18.0	18.0	18.0	18.0	18.0	18.0	±0.5
Adhesive tape width	W0	6.0		6.0		6.0		6.0	6.0	8.0	8.0	8.0	11.0	min
Hole position	W1	9.0		9.0		9.0		9.0	9.0	9.0	9.0	9.0	9.0	+0.75 -0.5
Hole down tape position	W2	3.0		3.0		3.0		3.0	3.0	3.0	3.0	3.0	3.0	max

Specification Fig.4

Items	Symbol	Case size									Tolerance
		4*5 4*7	5*5	5*7	5*11	6.3*5	6.3*7 6.3*9	6.3*11 6.3*12	8*5/7 8*9/11 8*11.5/12	8*16 8*20	
Pin Code		P	P	P	P	P	P	P	P	P	
Lead wire diameter	Φd	0.45	0.45	0.45	0.5	0.45	0.5	0.5	0.45/0.5	0.6	±0.05
Pitch of body	P	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	±1.0
Feed hole pitch	P0	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	±0.2
Distance from hole center to lead	P1	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	±0.7
Distance from feed hole center to body center	P2	6.35	6.35	6.35	6.35	6.35	6.35	6.35	6.35	6.35	±1.0
Lead-to-lead distance	F	1.5	2.0	2.0	2.0	2.5	2.5	2.5	3.5	3.5	±0.5
Lead to lead distance	F1	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	+0.8 -0.2
Height of body from tape center	H	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	±0.75
Lead wire clinch height	H0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	±0.5
Base tape width	W	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	±0.5
Adhesive tape width	W0	6.0	6.0	6.0	6.0	6.0	6.0	8.0	8.0	8.0	min
Hole position	W1	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	+0.75 -0.5
Hole down tape position	W2	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	max

### Lead Forming

#### Lead Forming & Cut

Code:C  
RANGE:  $\Phi 4\sim\Phi 18$



Code:F  
RANGE:  $\Phi 4\sim\Phi 8$



$\Phi D$	F	L	$\Phi D$	F	L
4	1.5	3.0~12.0	4	5.0	3.5, 4.5, 5.0, 7.0
5	2.0	3.0~12.0	5	5.0	3.5, 4.5, 5.0, 7.0
6.3	2.5	3.0~12.0	6.3	5.0	3.5, 4.5, 5.0, 7.0
8	3.5	3.0~12.0	8	5.0	3.5, 4.5, 5.0, 7.0
10	5.0	3.0~12.0	-	-	-
12.5	5.0	3.0~12.0	-	-	-
16	7.5	3.0~12.0	-	-	-
18	7.5	3.0~12.0	-	-	-

Code:J  
RANGE:  $\Phi 10\sim\Phi 18$



$\Phi D$	F	L
10	5.0	4.0, 4.5, 5.0
12.5	5.0	4.0, 4.5, 5.0
16	7.5	4.0, 4.5, 5.0
18	7.5	4.0, 4.5, 5.0

### Solering Recommendation

■ Flow Soldering(Radial Lead Type)



■ Reflow Soldering

- (For Polymer SMD Type)

#### Recommended Reflow Profile



Item	Preheating	T1(°C)	T2(°C)	T3(°C)	t1(sec.)	t2(sec.)	t3(sec.)	Reflow cycle
Condition 1	150°C to 180°C Within 90sec.	≤260	230	200	≤10	≤40	≤60	1
Condition 2		≤250	230	200	≤10	≤40	≤60	2

● (For Liquid SMD Type)

Case size:  $\Phi 6.3$ – $\Phi 10$ mm:

- Temperature at surface of capacitor shall not exceed  $T^{\circ}\text{C}$ .
- The duration for over  $200^{\circ}\text{C}$  temperature and  $T_1^{\circ}\text{C}$  at surface of capacitor shall not exceed  $t$  and  $t_1$  seconds, respectively.
- Preheat shall be done at  $100^{\circ}\text{C}$  to  $200^{\circ}\text{C}$  and for Maximum 180 seconds.



Case size (mm)	$T(^{\circ}\text{C})$ ①	$T_1(^{\circ}\text{C})$	$t(\text{sec.})$ ②	$t_1(\text{sec.})$ ③	Reflow cycle
$\Phi 6.3$	250	230	90	40	1
$\Phi 8$	240	230	90	30	1
$\Phi 10$	235	230	60	30	1

- ① Peak temperature
- ② The duration over  $200^{\circ}\text{C}$  (max.)
- ③ The duration over  $T_1^{\circ}\text{C}$
- Please contact us if capacitors are subject to the conditions other than the allowable range of reflow.

Case size:  $\Phi 12.5$ – $\Phi 18$ mm:

- Temperature at surface of capacitor shall not exceed  $T^{\circ}\text{C}$ .
- The duration for over  $200^{\circ}\text{C}$  temperature and  $T_1^{\circ}\text{C}$  at surface of capacitor shall not exceed  $t$  and  $t_1$  seconds, respectively.
- Preheat shall be done at  $100^{\circ}\text{C}$  to  $180^{\circ}\text{C}$  and for Maximum 150 seconds.



Case size (mm)	$T(^{\circ}\text{C})$ ①	$T_1(^{\circ}\text{C})$	$t(\text{sec.})$ ②	$t_1(\text{sec.})$ ③	Reflow cycle
$\Phi 12.5$ – $\Phi 18$	240	230	60	30	1

- ① Peak temperature
- ② The duration over  $200^{\circ}\text{C}$  (max.)
- ③ The duration over  $T_1^{\circ}\text{C}$
- Please contact us if capacitors are subject to the conditions other than the allowable range of reflow.

## ML series

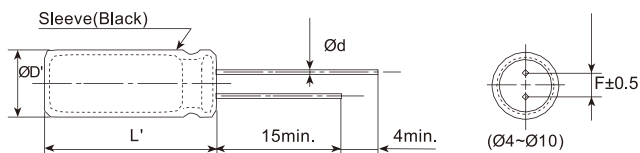
- Long life with 5mm to 9mm height.
- Endurance: +105°C 3,000–5,000 hours
- RoHS Compliant



### SPECIFICATIONS

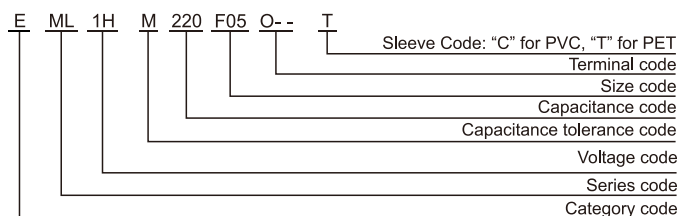
Items	Characteristics	
Category Temperature Range	-40~+105°C	
Rated Voltage Range	6.3~50 V <sub>dc</sub>	
Capacitance Tolerance	±20%(M) (at 20°C, 120Hz)	
Leakage Current	I ≤ 0.01CV or 3μA, whichever is greater. Where, I: Max. leakage current (μA), C: Nominal capacitance (μF), V: Rated voltage (V) (at 20°C after 2 minutes)	
Dissipation Factor (tanδ)	Rated Voltage (V <sub>dc</sub> )	6.3 10 16 25 35 50
	tanδ (max.)	0.40 0.35 0.30 0.25 0.20 0.20
	When nominal capacitance exceeds 1,000μF, add 0.02 to the value above for each 1,000μF increase. (at 20°C, 120Hz)	
Low Temperature Characteristics (Max. Impedance Ratio)	Rated Voltage (V <sub>dc</sub> )	6.3 10 16 25 35 50
	Z(-25°C)/Z(+20°C)	6 4 4 3 2 2
	Z(-40°C)/Z(+20°C)	12 10 8 6 4 4 (at 120Hz)
Endurance	The following specifications shall be satisfied when the capacitors are restored to 20°C after DC voltage plus the rated ripple current is applied for a specified period of time at 105°C.	
	Capacitance Change	≤±30% of the initial value
	D.F. (tanδ)	≤300% of the initial specified value
	Leakage Current	≤The initial specified value
Shelf Life	The following specifications shall be satisfied when the capacitors are restored to 20°C after exposing them for 1,000 hours at 105°C without voltage applied.	
	Capacitance Change	≤±30% of the initial value
	D.F. (tanδ)	≤300% of the initial specified value
	Leakage Current	≤200% of the initial specified value

### DIMENSIONS [mm]



ØD	4		5		6.3		8			10*9
	6.3*5	6.3*7	8*5	8*7	8*9					
Ød	0.45	0.45	0.45	0.5	0.45	0.5	0.5	0.5	0.6	
F	1.5	2.0	2.5	2.5	3.5	3.5	3.5	5.0		
ØD'	ØD+0.5max.									
L'	L+2max.									

### PART NUMBERING SYSTEM



### RATED RIPPLE CURRENT MULTIPLIERS

Frequency correction factor for ripple current

Freq. (Hz)	60(50)	120	500	1k	10k≤
Cap. < 2.2	0.50	1.00	1.20	1.30	1.50
2.2 ≤ Cap. < 10	0.65	1.00	1.20	1.30	1.50
10 ≤ Cap. < 100	0.80	1.00	1.20	1.30	1.50
Cap. ≥ 100	0.80	1.00	1.10	1.15	1.20

The endurance of capacitors is shortened with internal heating produced by ripple current at the rate of halving the lifetime with every 5°C rise. When long life performance is required in actual use, the rms ripple current has to be reduced.

# ML series

■ STANDARD RATINGS

WV (V <sub>dc</sub> )	Cap (μF)	Size ΦDxL(mm)	tanδ	Rated ripple current (mA <sub>rms</sub> /105°C, 120Hz)
6.3(0J)	27	4*5	0.40	25
	47	4*7	0.40	47
	56	5*5	0.40	50
	82	5*7	0.40	75
	120	6.3*5	0.40	80
	180	6.3*7	0.40	110
	220	8*5	0.40	125
	270	8*7	0.40	165
	470	8*7	0.40	190
	560	8*9	0.40	230
1000	10*9	0.40	480	
10(1A)	22	4*5	0.35	22
	33	4*7	0.35	43
	47	5*5	0.35	48
	56	5*7	0.35	68
	100	6.3*5	0.35	75
	120	6.3*7	0.35	100
	180	8*5	0.35	120
	220	8*7	0.35	160
	330	8*7	0.35	180
	470	8*9	0.35	210
680	10*9	0.35	470	
16(1C)	18	4*5	0.30	20
	22	4*7	0.30	40
	33	5*5	0.30	45
	39	5*7	0.30	65
	68	6.3*5	0.30	70
	100	6.3*7	0.30	95
	120	8*5	0.30	110
	150	8*7	0.30	125
	220	8*7	0.30	170
	330	8*9	0.30	195
470	10*9	0.30	460	
25(1E)	10	4*5	0.25	18
	15	4*7	0.25	35
	22	5*5	0.25	42
	27	5*7	0.25	57
	47	6.3*5	0.25	65
	56	6.3*7	0.25	85
	82	8*5	0.25	100
	100	8*7	0.25	112
	150	8*7	0.25	140
	220	8*9	0.25	190
330	10*9	0.25	450	

WV (V <sub>dc</sub> )	Cap (μF)	Size ΦDxL(mm)	tanδ	Rated ripple current (mA <sub>rms</sub> /105°C, 120Hz)
35(1V)	6.8	4*5	0.20	17
	10	4*7	0.20	28
	12	5*5	0.20	34
	18	5*7	0.20	48
	27	6.3*5	0.20	58
	39	6.3*7	0.20	76
	47	8*5	0.20	80
	56	8*7	0.20	105
	100	8*7	0.20	125
	150	8*9	0.20	180
	220	10*9	0.20	360
	50(1H)	1	4*5	0.20
2.2		4*5	0.20	11
3.3		4*5	0.20	14
4.7		4*7	0.20	23
6.8		5*5	0.20	25
10		5*7	0.20	30
12		6.3*5	0.20	37
18		6.3*7	0.20	50
22		8*5	0.20	62
33		8*7	0.20	75
56		8*7	0.20	115
82		8*9	0.20	160
120		10*9	0.20	315



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