



BREL **BREL INTERNATIONAL COMPONENTS**
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ALUMINUM ELECTROLYTIC CAPACITORS – AXIAL & RADIAL

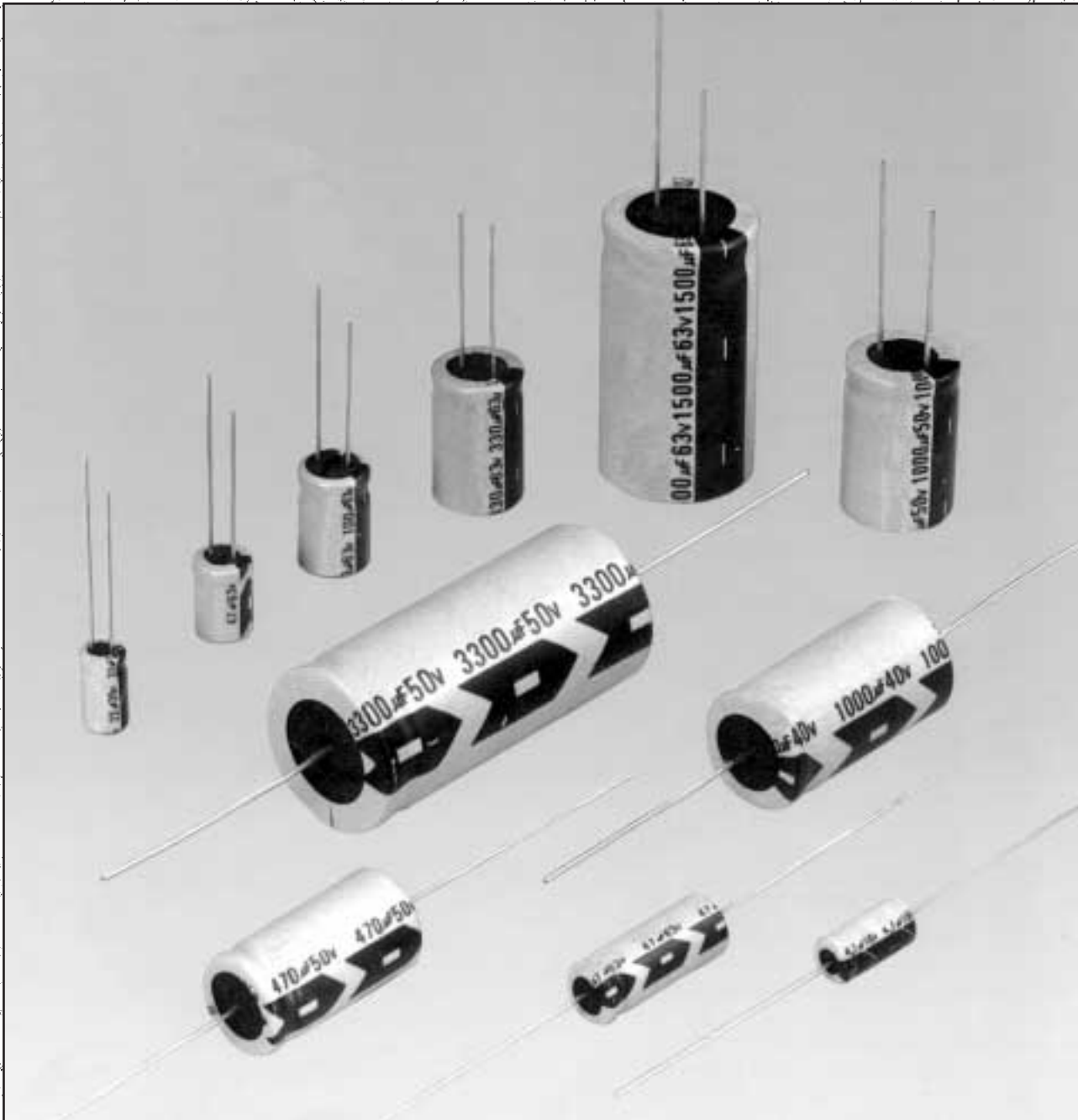


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General Purpose Radial – Type MSR

ALUMINUM ELECTROLYTIC CAPACITORS

The radial type is available in a capacitance range starting at 0.47UF through 10,000UF with a standard tolerance of ±20%.

Operating temperature range: -40°C ~ +85°C.

Capacitance and tolerance: Capacitance measurements shall be made by referred to a frequency of 120Hz⁺¹⁰₋₅Hz. The capacitance shall be within the specified tolerance of ±20%. (±10% units are available on request).

Leakage current: Measurement shall be made at rated DC voltage with an application of a steady source of power, such as a regulated power supply. A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for 5 minutes before making the leakage current measurements.

The maximum leakage current shall not exceed the value determined from the following equation or 4µA, whichever is greater:

$$I = 0.03CV$$

where: I = Leakage Current (µA)

C = Nominal Capacitance (µF)

V = Rated DC Voltage (V. DC)

Dissipation factor: Measured at a frequency of 120Hz⁺¹⁰₋₅ Hz, the dissipation factor shall be less than the values in Table 1.

Table 1.

Rated Voltage (V.DC)	Dissipation Factor (%)
6.3	22
10	19
16	16
25	14
35	12
50	10
63	9
80	9
100	8

In case the nominal capacitance of capacitor exceeds 1000µF, 2% per each 1000µF shall be added to the corresponding value listed in Table 1.

Low-temperature characteristics: The ratio of the impedance of -25°C to that of +20°C shall be less than the values in Table 2.

Table 2.

Rated Voltage (V.DC)	Ratio of Impedance	
	$\frac{Z @ -25^{\circ}C}{Z @ +20^{\circ}C}$	$\frac{Z @ -40^{\circ}C}{Z @ +20^{\circ}C}$
6.3	4	8
10	3	6
16	2	4
25	2	4
35	2	3
50	2	3
63	2	3
80	2	3
100	2	3

Life test: Rated voltage shall be applied to the capacitors in series with a one thousand ohm resistor. All tests shall be conducted in a dry oven with circulating air. Capacitors shall be separated by a distance not less than 2.5CM and air circulation shall be provided to prevent temperature within 15CM of any capacitors from departing more than +0°C-5°C from the nominal ambient temperature of the chamber. Capacitors shall not be exposed to direct radiation from heating elements.

Capacitors shall be subjected to for a period of 1000 hours at 85°C.

After the completion of the life test capacitors shall be returned to standard test conditions.

Table 3.

Leakage current	Same as specified under Leakage Current	
Capacitance	• 16WV or lower • Body Dia. ≤6mm	Within ±20% of initial measurement
	• 25WV or higher • Body Dia. >6mm	Within ±15% of initial measurement
Dissipation factor	150% less of values in Table 1.	
Appearance	Free from leakage of electrolyte and/or other noticeable deformation	

Shelf life test: Capacitors shall be subjected to +85°C ± 2°C for 1000±12 hours during which time no voltage shall be applied.

Following this period the capacitors shall be cool to room temperature and then D.C. rated voltage shall be applied to the capacitors for 30 minutes after which the capacitors shall be discharged.

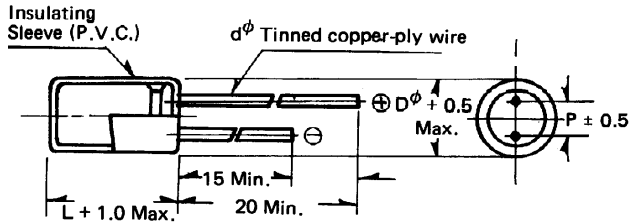
After completion of these procedures, the capacitors shall meet the requirements as listed in Table 3.



General Purpose Radial – Type MSR

● CONFIGURATION

Dimensions: mm



Outside Diameter	D ϕ	5	6	8	10	13	16	18	22	25
Lead Spacing	P	2.0	2.5	3.5	5.0	5.0	7.5	7.5	10	12
Lead Wire	d ϕ	0.5	0.5	0.6	0.6	0.6	0.8	0.8	0.8	1.0

RIPPLE CURRENT IN mA-RMS (at 120Hz, 85°C)—peak voltage not to exceed rated DC voltage—

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μ F)									
0.47	26	26	26	26	26	26	27	27	27
1	39	39	39	39	39	39	40	40	40
2.2	57	57	57	57	57	57	60	60	60
3.3	70	70	70	70	70	70	75	75	75
4.7	84	84	84	84	84	85	90	90	90
10	125	125	125	125	125	125	130	140	140
22	140	140	140	140	170	190	190	200	210
33	160	160	160	180	210	240	240	250	260
47	170	170	200	220	250	290	290	310	310
100	240	260	300	320	370	430	440	470	470
220	370	400	450	490	570	670	680	710	740
330	460	500	560	610	720	820	830	900	910
470	550	600	670	750	870	1020	1020	1090	1130
1000	820	920	1020	1130	1310	1500	1550	1560	1580
2200	1270	1410	1560	1740	1900	2100	2170	2180	
3300	1600	1770	1900	2220	2660	2940	3030	3060	
4700	1950	2000	2280	3100	3720	4120	4250		
10000	2800	2800	3190	4660					



General Purpose Radial – Type MSR

DIMENSIONS: Diameter (D^φ) x Length (L): mm

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μF)									
0.47	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
1	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
2.2	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
3.3	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
4.7	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
10	5x11	5x11	5x11	5x11	5x11	5x11	5x11	6x11	6x11
22	5x11	5x11	5x11	5x11	5x11	6x11	6x11	8x11.5	8x11.5
33	5x11	5x11	5x11	5x11	5x11	6x11	6x11	10x12.5	10x12.5
47	5x11	5x11	5x11	5x11	6x11	6x11	8x11.5	10x16	10x16
100	5x11	5x11	6x11	6x11	8x11.5	8x11.5	10x12.5	13x20	13x20
220	6x11	6x11	8x11	8x11.5	10x12.5	10x16	10x20	13x25	16x25
330	8x11.5	8x11.5	8x11.5	10x12.5	10x16	10x20	13x20	16x25	16x25
470	8x11.5	8x11.5	10x12.5	10x16	10x20	13x21.5	13x25	16x31.5	16x31.5
1000	10x16	10x16	10x18	13x20	13x20	16x25	16x31.5	18x40	22x40
2200	10x20	10x20	13x20	16x25	16x31.5	16x41	22x40	25x50	
3300	13x20	13x20	13x25	16x31.5	16x41	22x40	25x40	25x50	
4700	13x25	13x25	16x31.5	16x41	18x41	22x41	25x50		
10000	16x34.5	16x34.5	18x41	25x40					

**General Purpose Axial – Type MSA****ALUMINUM ELECTROLYTIC CAPACITORS**

The axial type is available in a capacitance range starting at 0.47UF through 10,000UF with a standard tolerance of $\pm 20\%$.

Operating temperature range: $-40^{\circ}\text{C} \sim +85^{\circ}\text{C}$.

Capacitance and tolerance: Capacitance measurements shall be made by referred to a frequency of 120Hz_{-5}^{+10} Hz. The capacitance shall be within the specified tolerance of $\pm 20\%$. ($\pm 10\%$ units are available on request).

Leakage current: Measurement shall be made at rated DC voltage with an application of a steady source of power, such as a regulated power supply. A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for 5 minutes before making the leakage current measurements.

The maximum leakage current shall not exceed the value determined from the following equation or $3\mu\text{A}$, whichever is greater:

$$I = 0.03CV$$

- where: I = Leakage Current (μA)
C = Nominal Capacitance (μF)
V = Rated DC Voltage (V. DC)

Dissipation factor: Measured at a frequency of 120Hz_{-5}^{+10} Hz, the dissipation factor shall be less than the values in Table 1.

Table 1.

Rated Voltage (V. DC)	Dissipation Factor (%)
6.3	22
10	19
16	16
25	14
35	12
50	10
63	9
80, 100	8

Low-temperature characteristics: The ratio of the impedance of -25°C to that of $+20^{\circ}\text{C}$ shall be less than the values in Table 2.

Table 2.

Rated Voltage (V. DC)	Ratio of Impedance			
	$\frac{Z @ -25^{\circ}\text{C}}{Z @ +20^{\circ}\text{C}}$		$\frac{Z @ -40^{\circ}\text{C}}{Z @ +20^{\circ}\text{C}}$	
	Body Dia. $\leq 16\text{mm}$	Body Dia. $> 18\text{mm}$	Body Dia. $\leq 16\text{mm}$	Body Dia. $> 18\text{mm}$
6.3	4	6	8	10
10	3	4	6	8
16	2	3	4	6
25	2	2	4	4
35	2	2	4	4
50, 63	2	2	4	4
80, 100	2	2	4	4

Life test: Rated voltage shall be applied to the capacitors in series with a one thousand ohm resistor. All tests shall be conducted in a dry oven with circulating air. Capacitors shall be separated by a distance not less than 2.5CM and air circulation shall be provided to prevent temperature within 15CM of any capacitors from departing more than $+0^{\circ}\text{C} - 5^{\circ}\text{C}$ from the normal ambient temperature of the chamber. Capacitors shall not be exposed to direct radiation from heating elements.

Capacitors shall be subjected to for a period of 1000 hours at 85°C .

After the completion of the life test capacitors shall be returned to standard test conditions.

Table 3.

Leakage current	Same as specified under Leakage Current
Capacitance	<ul style="list-style-type: none"> • 16WV or lower Within $\pm 20\%$ of initial measurement • Body Dia. $\leq 6\text{mm}$ • 25 WV or higher Within $\pm 15\%$ of initial measurement • Body Dia. $> 6\text{mm}$
Dissipation factor	150% less of values in Table 1.
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

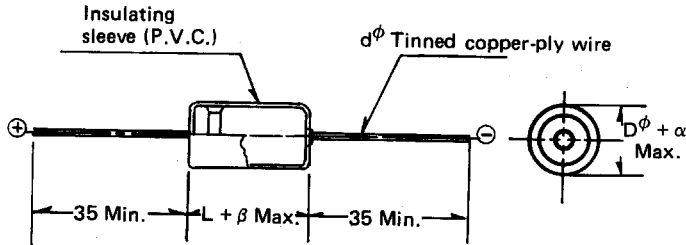
Shelf life test: Capacitors shall be subjected to $+85^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 1000 ± 12 hours during which time no voltage shall be applied.

Following this period the capacitors shall be cool to room temperature and then D.C. rated voltage shall be applied to the capacitors for 30 minutes after which the capacitors shall be discharged.

After completion of these procedures, the capacitors shall meet the requirements as listed in Table 3.

General Purpose Axial – Type MSA

● CONFIGURATION



DIMENSIONS: (mm)

Outside Diameter	D ϕ	6	8	10	13	16	18	22	25.4
Diameter Tolerance	α	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0
Length Tolerance	β	1	1	1	1	1	2	2	2
Lead Wire	d ϕ	0.6	0.6	0.6	0.6	0.8	0.8	0.8	0.8

RIPPLE CURRENT IN mA-RMS (at 120Hz, 85°C)—peak voltage not to exceed rated DC voltage—

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μ F)									
0.47	20	20	20	20	20	20	20	20	20
1	35	35	35	35	35	35	35	35	35
2.2	45	45	45	45	45	45	45	45	45
3.3	60	60	60	60	60	60	60	60	70
4.7	60	60	60	60	60	80	80	85	90
10	75	75	75	90	105	120	130	130	150
22	150	150	150	160	180	190	210	210	210
33	180	180	180	200	220	240	250	250	270
47	200	200	200	240	270	290	290	310	330
100	270	290	330	360	400	420	450	460	500
220	410	450	490	540	600	640	700	700	790
330	500	550	610	670	750	810	830	890	910
470	610	660	740	810	920	930	1050	1070	1180
1000	910	1000	1130	1130	1240	1420	1620	1330	1490
2200	1400	1560	1750	1870	2000	2080	2080	2680	2890
3300	1800	1960	2050	2020	2420	2860	3100	3530	
4700	2150	2190	2220	2690	3240	3700	4360		
10000	3180	3440	4070	5130	6040				

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SALES: (800) 237-4564 PHONE: (941) 355-9791 FAX: (941) 355-1530**General Purpose Axial – Type MSA****DIMENSIONS: Diameter (D^φ) x Length (L): mm**

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μF)									
0.47	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
1	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
2.2	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
3.3	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
4.7	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
10	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x16	6x16
22	6x12	6x12	6x12	6x12	6x12	6x12	6x16	8x16	8x16
33	6x12	6x12	6x12	6x12	6x16	6x16	6x16	8x16	8x20
47	6x12	6x12	6x12	6x16	6x16	6x16	8x16	8x20	10x21
100	6x12	6x12	6x16	6x16	8x16	8x16	8x20	10x26	10x26
220	6x16	6x16	8x16	8x16	8x20	10x20	10x26	13x26	13x31.5
330	8x16	8x16	8x16	8x20	10x20	10x25	13x26	13x26	16x25
470	8x16	8x16	8x20	10x20	10x26	13x25	13x26	16x31.5	16x41.5
1000	10x20	10x20	10x26	13x26	13x26	16x25	16x30	18x40	22x40
2200	13x25	13x25	13x30	16x25	16x30	18x40	22x40	25.4x52	25.4x61
3300	13x25	13x30	16x25	16x30	16x40	22x42	22x50	25.4x61	
4700	13x30	16x25	16x30	18x40	22x40	22x50	25.4x50		
10000	16x40	18x40	22x40	22x50	25.4x50				



Subminiature Radial – Type SMR

ALUMINUM ELECTROLYTIC CAPACITORS

The radial type capacitors are available over a capacitance range of 0.1UF through 220UF, with a standard capacitance tolerance of ±20%.

Operating temperature range: -40°C ~ +85°C.

Capacitance and tolerance: Capacitance measurements shall be made by referred to a frequency of 120Hz₋₅⁺¹⁰Hz. The capacitance shall be within the specified tolerance of ±20%. (±10% units are available on request).

Leakage current: Measurement shall be made at rated DC voltage with an application of a steady source of power, such as a regulated power supply. A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for a minimum of 30 minutes, 24 to 48 hours prior to making leakage current measurements.

The maximum leakage current at 5 minutes shall not exceed the value determined from the following equation or 3µA, whichever is greater:

$$I = 0.01CV$$

- where: I = Leakage Current (µA)
- C = Nominal Capacitance (µF)
- V = Rated DC Voltage (V. DC)

Dissipation factor: Capacitors shall be measured at a frequency of 120Hz at 20°C with a maximum of 1 volt RMS applied during measurement. The dissipation factor shall not exceed the values in Table 1.

Table 1.

Rated Voltage (V.DC)	Dissipation Factor (%)
6.3	24
10	20
16	16
25	14
35	12
50	10
63	10

Low-temperature characteristics: The ratio of the impedance of -25°C to that of +20°C shall be less than the values in Table 2.

Table 2.

Rated Voltage (V.DC)	Z @ -25°C	Z @ -40°C
	Z @ +20°C	Z @ +20°C
6.3	4	8
10	3	6
16	2	4
25	2	4
35	2	3
50	2	3
63	2	3

Life test: Rated voltage shall be applied to the capacitors in series with a one thousand ohm resistor. All tests shall be conducted in a dry oven with circulating air. Capacitors shall be separated by a distance not less than 2.5CM and air circulation shall be provided to prevent temperature within 15CM of any capacitors from departing more than +0°C-5°C from the normal ambient temperature of the chamber. Capacitors shall not be exposed to direct radiation from heating elements.

Capacitors shall be subjected to for a period of 1000 hours at 85°C.

After the completion of the life test capacitors shall be returned to standard test conditions.

Table 3.

Capacitance	Within ±20% of initial measurements
Dissipation factor	200% less of value in Table 1.
Leakage current	Same as specified under Leakage Current
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

Shelf life test: Capacitors shall be subjected to +85°C±2°C for 1000±12 hours during which time no voltage shall be applied.

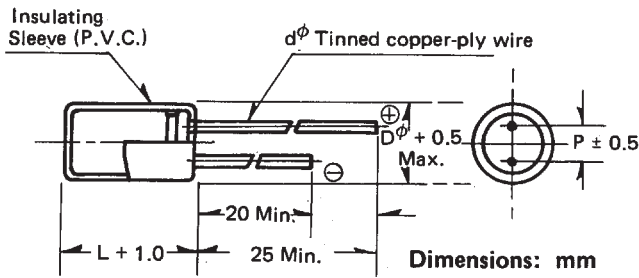
Following this period the capacitors shall be cool to room temperature and then D.C. rated voltage shall be applied to the capacitors for 30 minutes after which the capacitors shall be discharged.

After completion of these procedures, the capacitors shall meet the requirements as listed in Table 3.

Subminiature Radial – Type SMR

• CONFIGURATION

Dimensions: mm



Outside Diameter	D ϕ	4	5	6.3
Lead Spacing	P	1.5	2.0	2.5
Lead Wire	d ϕ	0.45	0.50	0.50

RIPPLE CURRENT IN mA-RMS (at 120Hz, +85°C)—peak voltage not to exceed rated DC voltage—

Rated Voltage (V)	6.3	10	16	25	35	50	63
Surge Voltage (V)	8	13	20	32	44	63	79
CAP. (μ F)							
0.1	1.0	1.0	1.0	1.0	1.0	1.0	1.3
0.22	2.3	2.3	2.3	2.3	2.3	2.3	2.9
0.33	3.5	3.5	3.5	3.5	3.5	3.5	4.4
0.47	5.0	5.0	5.0	5.0	5.0	5.0	6.3
1.0	10	10	10	10	10	10	13
2.2	19	19	19	19	19	19	21
3.3	24	24	24	24	24	24	26
4.7	24	24	24	24	24	29	33
10	29	29	29	33	36	44	
22	34	38	44	51	57	70	
33	42	47	57	63			
47	50	59	68				
100	77	105	120				
220	140						

DIMENSIONS: Diameter (D ϕ) x Length (L): mm

Rated Voltage (V)	6.3	10	16	25	35	50	63
Surge Voltage (V)	8	13	20	32	44	63	79
CAP. (μ F)							
0.1	4x7	4x7	4x7	4x7	4x7	4x7	4x7
0.22	4x7	4x7	4x7	4x7	4x7	4x7	4x7
0.33	4x7	4x7	4x7	4x7	4x7	4x7	4x7
0.47	4x7	4x7	4x7	4x7	4x7	4x7	4x7
1.0	4x7	4x7	4x7	4x7	4x7	4x7	4x7
2.2	4x7	4x7	4x7	4x7	4x7	4x7	4x7
3.3	4x7	4x7	4x7	4x7	4x7	4x7	4x7
4.7	4x7	4x7	4x7	4x7	4x7	4x7	5x7
10	4x7	4x7	4x7	4x7	5x7	6.3x7	
22	4x7	4x7	4x7	5x7	6.3x7	6.3x7	
33	4x7	5x7	5x7	6.3x7			
47	4x7	5x7	6.3x7				
100	5x7	6.3x7	6.3x7				
220	6.3x7						

TAPING FOR AUTOMATIC INSERTION AND LEAD FORMING ARE AVAILABLE ON REQUEST



Subminiature Low Leakage Radial – Type SMR/LL

ALUMINUM ELECTROLYTIC CAPACITORS

The radial type capacitors are available over a capacitance range of 0.1UF through 220UF, with a standard capacitance tolerance of $\pm 20\%$.

Operating temperature range: $-40^{\circ}\text{C} \sim +85^{\circ}\text{C}$.

Capacitance and tolerance: Capacitance measurements shall be made by referred to a frequency of $120\text{Hz}_{-5}^{+10}\text{Hz}$. The capacitance shall be within the specified tolerance of $\pm 20\%$. ($\pm 10\%$ units are available on request).

Leakage current: Measurement shall be made at rated DC voltage with an application of a steady source of power, such as a regulated power supply. A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for a minimum of 30 minutes, 24 to 48 hours prior to making leakage current measurements.

The maximum leakage current at 5 minutes shall not exceed the value determined from the following equation or $0.4\mu\text{A}$, whichever is greater:

$$I = 0.002CV$$

- where: I = Leakage Current (μA)
- C = Nominal Capacitance (μF)
- V = Rated DC Voltage (V. DC)

Dissipation factor: Capacitors shall be measured at a frequency of 120Hz at 20°C with a maximum of 1 volt RMS applied during measurement. The dissipation factor shall not exceed the values in Table 1.

Table 1.

Rated Voltage (V. DC)	Dissipation Factor (%)
6.3	20
10	17
16	13
25	10
35	10
50	8
63	8

Low-temperature characteristics: The ratio of the impedance of -25°C to that of $+20^{\circ}\text{C}$ shall be less than the values in Table 2.

Table 2.

Rated Voltage (V. DC)	Z @ -25°C	Z @ -40°C
	Z @ $+20^{\circ}\text{C}$	Z @ $+20^{\circ}\text{C}$
6.3	4	8
10	3	6
16	2	4
25	2	4
35	2	3
50	2	3
63	2	3

Life test: Rated voltage shall be applied to the capacitors in series with a one thousand ohm resistor. All tests shall be conducted in a dry oven with circulating air. Capacitors shall be separated by a distance not less than 2.5CM and air circulation shall be provided to prevent temperature within 15CM of any capacitors from departing more than $+0^{\circ}\text{C} - 5^{\circ}\text{C}$ from the nominal ambient temperature of the chamber. Capacitors shall not be exposed to direct radiation from heating elements.

Capacitors shall be subjected to for a period of 1000 hours at 85°C .

After the completion of the life test capacitors shall be returned to standard test conditions.

Table 3.

Capacitance	Within $\pm 20\%$ of initial measurements
Dissipation factor	200% less of value in Table 1.
Leakage current	Same as specified under Leakage Current
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

Shelf life test: Capacitors shall be subjected to $+85^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 1000 ± 12 hours during which time no voltage shall be applied.

Following this period the capacitors shall be cool to room temperature and then D.C. rated voltage shall be applied to the capacitors for 30 minutes after which the capacitors shall be discharged.

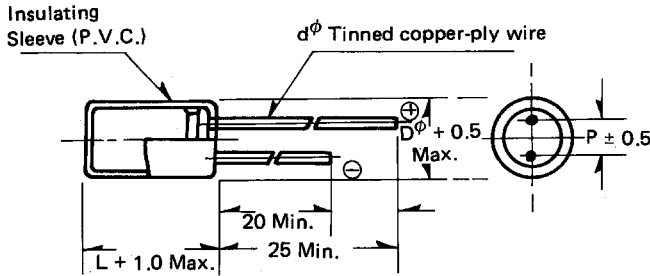
After completion of these procedures, the capacitors shall meet the requirements as listed in Table 3.



Subminiature Low Leakage Radial – Type SMR/LL

● CONFIGURATION

Dimensions: mm



Outside Diameter	D ϕ	4	5	6.3
Lead Spacing	P	1.5	2.0	2.5
Lead Wire	d ϕ	0.45	0.5	0.5

RIPPLE CURRENT IN mA-RMS (at 120Hz, +85°C)—peak voltage not to exceed rated DC voltage—

Rated Voltage (V)	6.3	10	16	25	35	50	63
Surge Voltage (V)	8	13	20	32	44	63	79
CAP. (μ F)							
0.1	1.0	1.0	1.0	1.0	1.0	1.0	1.3
0.22	2.3	2.3	2.3	2.3	2.3	2.3	2.9
0.33	3.5	3.5	3.5	3.5	3.5	3.5	4.4
0.47	5.0	5.0	5.0	5.0	5.0	5.0	6.3
1.0	10	10	10	10	10	10	13
2.2	19	19	19	19	19	19	21
3.3	24	24	24	24	24	24	26
4.7	24	24	24	24	24	29	33
10	29	29	29	33	36	44	
22	34	38	44	51	57	70	
33	42	47	57	63			
47	50	59	68				
100	77	105	120				
220	140						

DIMENSIONS: Diameter (D ϕ) x Length (L): mm

Rated Voltage (V)	6.3	10	16	25	35	50	63
Surge Voltage (V)	8	13	20	32	44	63	79
CAP. (μ F)							
0.1	4x7	4x7	4x7	4x7	4x7	4x7	4x7
0.22	4x7	4x7	4x7	4x7	4x7	4x7	4x7
0.33	4x7	4x7	4x7	4x7	4x7	4x7	4x7
0.47	4x7	4x7	4x7	4x7	4x7	4x7	4x7
1.0	4x7	4x7	4x7	4x7	4x7	4x7	4x7
2.2	4x7	4x7	4x7	4x7	4x7	4x7	4x7
3.3	4x7	4x7	4x7	4x7	4x7	4x7	5x7
4.7	4x7	4x7	4x7	4x7	4x7	4x7	5x7
10	4x7	4x7	4x7	5x7	6.3x7	6.3x7	
22	4x7	4x7	5x7	6.3x7	6.3x7		
33	5x7	5x7	6.3x7	6.3x7			
47	5x7	5x7	6.3x7				
100	5x7	6.3x7	6.3x7				
220	6.3x7						

TAPING FOR AUTOMATIC INSERTION AND LEAD FORMING ARE AVAILABLE ON REQUEST



Non-Polar For General Purpose – Radial Type-Series D – Type NDR

ALUMINUM ELECTROLYTIC CAPACITORS

Series D are suitable for use in circuits whose polarity is reversed or unknown or crossover networks which do not require tough characteristic requirements.

Operating temperature range: -40°C ~ +85°C.

Capacitance and tolerance: Capacitance measurements shall be made by referred to a frequency of 120Hz⁺¹⁰₋₅Hz. The capacitance shall be within the specified tolerance of ±20%. (±10% units are available on request).

Leakage current: Measurements shall be made at rated DC voltage with an application of a steady source of power, such as a regulated power supply. A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for 5 minutes before making the leakage current measurements.

The maximum leakage current shall not exceed the value determined from the following equation or 3µA, whichever is greater:

I = 0.03CV

- where: I = Leakage Current (µA)
- C = Nominal Capacitance (µF)
- V = Rated DC Voltage (V. DC)

Dissipation factor: Measurements at a frequency of 120 Hz⁺¹⁰₋₅Hz, the dissipation factor shall be less than the values in Table 1.

Table 1.

Rated Voltage (V. DC)	dissipation Factor (%)
6.3	24
10	20
16	16
25	15
35	14
50	12
63	10
80, 100	9

Low-temperature characteristics: The ratio of the impedance of -25°C to that of +20°C shall be less than the values in Table 2.

Table 2.

Rated Voltage (V)	Z @ -25°C	Z @ -40°C
	Z @ +20°C	Z @ +20°C
6.3	4	8
10	3	6
16	2	4
25	2	4
35	2	4
50 ~ 100	2	4

Life test: Rated voltage shall be applied to the capacitors in series with a one thousand ohm resistor. All tests shall be conducted in a dry oven with circulating air. Capacitors shall be separated by a distance not less than 2.5CM and air circulation shall be provided to prevent temperature within 15CM of any capacitors from departing more than +0°C-5°C from the nominal ambient temperature of the chamber. Capacitors shall not be exposed to direct radiation from heating elements.

Capacitors shall be subjected to for a period of 1000 hours at 85°C.

After the completion of the life test capacitors shall be returned to standard test conditions.

Table 3.

Leakage current	Same as specified under Leakage Current
Capacitance	Within ±20% of initial measurements
Dissipation factor	200% less of value in Table 1
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

Shelf life test: Capacitors shall be subjected to +85°C± 2°C for 1000±12 hours during which time no voltage shall be applied.

Following this period the capacitors shall be cool to room temperature and then D.C. rated voltage shall be applied to the capacitors for 30 minutes after which the capacitors shall be discharged.

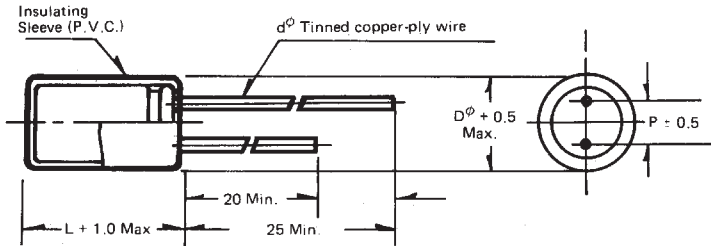
After completion of these procedures, the capacitors shall meet the requirements as listed in Table 3.



Non-Polar For General Purpose – Radial Type-Series D – Type NDR

• CONFIGURATION

Dimensions: mm



Outside Diameter	D ϕ	5	6	8	10	13	16
Lead Spacing	P	2.0	2.5	3.5	5.0	5.0	7.5
Lead Wire	d ϕ	0.5	0.5	0.6	0.6	0.6	0.8

DIMENSIONS: Diameter (D ϕ) x Length (L): mm

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μ F)									
0.47	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
1.0	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
2.2	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	6x11
3.3	5x11	5x11	5x11	5x11	5x11	5x11	5x11	6x11	6x11
4.7	5x11	5x11	5x11	5x11	5x11	5x11	6x11	6x11	6x11
10	5x11	5x11	5x11	5x11	5x11	6x11	6x11	8x11.5	8x11.5
22	5x11	5x11	5x11	6x11	6x11	8x11.5	8x11.5	10x16	10x16
33	5x11	5x11	5x11	6x11	8x11.5	8x11.5	10x12.5	10x16	13x20
47	5x11	5x11	6x11	6x11	8x11.5	10x12.5	10x16	10x20	13x20
100	6x11	6x11	8x11.5	8x11.5	10x16	10x20	13x20	13x25	16x25
220	8x11.5	8x11.5	10x12.5	10x16	13x20	13x25	16x25		
330	10x12.5	10x16	10x16	13x20	13x20	16x25			
470	10x16	10x16	10x20	13x20	13x25				
1000	13x20	13x20	13x25	16x25					

**Non-Polar For General Purpose – Axial Type-Series D – Type NDA****ALUMINUM ELECTROLYTIC CAPACITORS**

Series D are suitable for use in circuits whose polarity is reversed or unknown or crossover networks which do not require tough characteristic requirements.

Operating temperature range: $-40^{\circ}\text{C} \sim +85^{\circ}\text{C}$.

Capacitance and tolerance: Capacitance measurements shall be made by referred to a frequency of $120\text{Hz}_{-5}^{+10}\text{Hz}$. The capacitance shall be within the specified tolerance of $\pm 20\%$. ($\pm 10\%$ units are available on request).

Leakage current: Measurements shall be made at rated DC voltage with an application of a steady source of power, such as a regulated power supply. A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for 5 minutes before making the leakage current measurements.

The maximum leakage current shall not exceed the value determined from the following equation or $3\mu\text{A}$, whichever is greater:

$$I = 0.03CV$$

where: I = Leakage Current (μA)
 C = Nominal Capacitance (μF)
 V = Rated DC Voltage (V. DC)

Dissipation factor: Measured at a frequency of $120\text{Hz}_{-5}^{+10}\text{Hz}$, the dissipation factor shall be less than the values in Table 1.

Table 1.

Rated Voltage (V. DC)	Dissipation Factor (%)
6.3	30
10	25
16	20
25	17
35	17
50	15
63 ~ 100	15

Low-temperature characteristics: The ratio of the impedance of -25°C to that of $+20^{\circ}\text{C}$ shall be less than the values in Table 2.

Table 2.

Rated Voltage (V)	$Z @ -25^{\circ}\text{C}$	$Z @ -40^{\circ}\text{C}$
	$Z @ +20^{\circ}\text{C}$	$Z @ +20^{\circ}\text{C}$
6.3	4	10
10	3	8
16	2	6
25	2	4
35	2	4
50 ~ 100	2	4

Life test: Rated voltage shall be applied to the capacitors in series with a one thousand ohm resistor. All tests shall be conducted in a dry oven with circulating air. Capacitors shall be separated by a distance not less than 2.5CM and air circulation shall be provided to prevent temperature within 15CM of any capacitors from departing more than $+0^{\circ}\text{C} -5^{\circ}\text{C}$ from the nominal ambient temperature of the chamber. Capacitors shall not be exposed to direct radiation from heating elements.

Capacitors shall be subjected to for a period of 1000 hours at 85°C .

After the completion of the life test capacitors shall be returned to standard test conditions.

Table 3.

Leakage current	Same as specified under Leakage Current
Capacitance	Within $\pm 20\%$ of initial measurements
Dissipation factor	200% less of value in Table 1
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

Shelf life test: Capacitors shall be subjected to $+85^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 1000 ± 12 hours during which time no voltage shall be applied.

Following this period the capacitors shall be cool to room temperature and then D.C. rated voltage shall be applied to the capacitors for 30 minutes after which the capacitors shall be discharged.

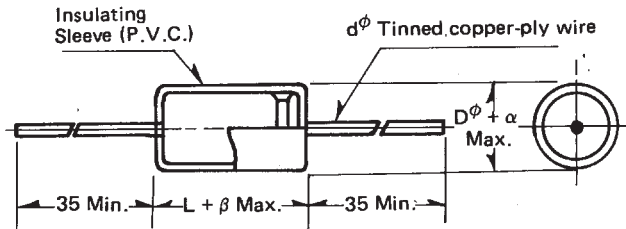
After completion of these procedures, the capacitors shall meet the requirements as listed in Table 3.



Non-Polar For General Purpose – Axial Type-Series D – Type NDA

• CONFIGURATION

Dimensions: mm



Outside Diameter	D ϕ	6	8	10	13	16
Diameter Tolerance	α	0.5	0.5	0.5	0.5	0.5
Length Tolerance	β	1.0	1.0	1.0	1.0	1.0
Lead Wire	d ϕ	0.6	0.6	0.6	0.6	0.8

DIMENSIONS: Diameter (D ϕ) x Length (L): mm

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μ F)									
0.47	6x19	6x19	6x19	6x19	6x19	6x19	6x19	6x19	6x19
1.0	6x19	6x19	6x19	6x19	6x19	6x19	6x19	6x19	6x19
2.2	6x19	6x19	6x19	6x19	6x19	6x19	6x19	6x19	6x19
3.3	6x19	6x19	6x19	6x19	6x19	6x19	6x19	6x19	6x19
4.7	6x19	6x19	6x19	6x19	6x19	6x19	6x19	6x19	8x19
10	6x19	6x19	6x19	6x19	6x19	6x19	8x19	8x19	10x21
22	6x19	6x19	6x19	6x19	8x19	10x21	10x21	10x25	10x25
33	6x19	6x19	6x19	8x19	8x19	10x21	10x25	10x25	13x30
47	6x19	6x19	8x19	8x19	10x21	10x25	10x25	10x30	13x30
100	6x19	6x19	10x21	10x25	10x30	13x30	13x30	13x30	16x30
220	10x21	10x21	10x25	13x30	13x30	16x30	16x30	16x41	
330	10x21	10x25	10x30	13x30	16x30	16x41	16x41		
470	10x25	10x30	13x30	16x30	16x41				
1000	13x30	13x30	16x30						
2200	16x30	16x41							
3300	16x41								



Low Leakage Radial – Type LLR

ALUMINUM ELECTROLYTIC CAPACITORS

- * It should be considered for applications where standard types of aluminum electrolytic capacitors cannot be utilized because of their high L.C.
- * Another application is the replacement of tantalum capacitors with aluminum electrolytic capacitors.

Operating temperature range: -40°C ~ +85°C.

Capacitance and tolerance: Capacitance measurements shall be made by referred to a frequency of 120Hz ± 10 /₋₅ Hz. The capacitance shall be within the specified tolerance of $\pm 20\%$. ($\pm 10\%$ units are available on request).

Leakage current: Measurement shall be made at rated DC voltage with an application of a steady source of power, such as a regulated power supply. A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for a minimum of 30 minutes, 24 to 48 hours prior to making leakage current measurements.

The maximum leakage current at 5 minutes shall not exceed the value determined from the following equation or 0.4 μ A, whichever is greater:

$$I = 0.002CV$$

- where: I = Leakage Current (μ A)
- C = Nominal Capacitance (μ F)
- V = Rated DC Voltage (V. DC)

Dissipation factor: Capacitors shall be measured at a frequency of 120Hz at 20°C with a maximum of 1 volt RMS applied during measurement. The dissipation factor shall not exceed the values in Table 1.

Table 1.

Rated Voltage (V. DC)	Dissipation Factor (%)
6.3	17
10	15
16	10
25	8
35	6
50 ~ 100	6

Low-temperature characteristics: The ratio of the impedance of -25°C to that of +20°C shall be less than the values in Table 2.

Table 2.

Rated Voltage (V. DC)	Z @ -25°C	Z @ -40°C
	Z @ +20°C	Z @ +20°C
6.3	3	5
10	2	4
16	1.5	3
25	1.5	2
35	1.5	2
50 ~ 100	1.5	2

Life test: Rated voltage shall be applied to the capacitors in series with a one thousand ohm resistor. All tests shall be conducted in a dry oven with circulating air. Capacitors shall be separated by a distance not less than 2.5CM and air circulation shall be provided to prevent temperature within 15CM of any capacitors from departing more than +0°C -5°C from the normal ambient temperature of the chamber. Capacitors shall not be exposed to direct radiation from heating elements.

Capacitors shall be subjected to for a period of 1000 hours at 85°C.

After the completion of the life test capacitors shall be returned to standard test conditions.

Table 3.

Capacitance	Within $\pm 15\%$ of initial measurements
Dissipation factor	150% less of value in Table 1
Leakage current	Same as specified under Leakage Current
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

Shelf life test: Capacitors shall be subjected to +85°C ± 2 °C for 1000 ± 12 hours during which time no voltage shall be applied.

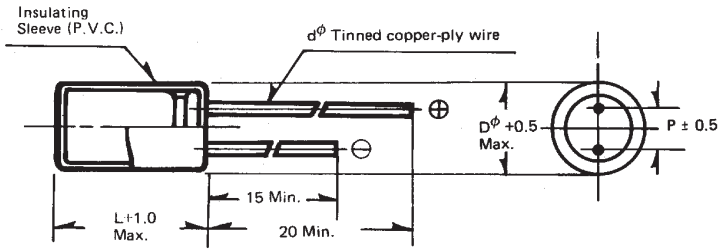
Following this period the capacitors shall be cool to room temperature and then D.C. rated voltage shall be applied to the capacitors for 30 minutes after which the capacitors shall be discharged.

After completion of these procedures, the capacitors shall meet the requirements as listed in Table 3.

Low Leakage Radial – Type LLR

• **CONFIGURATION**

Dimensions: mm



Outside Diameter	D ϕ	5	6	8	10
Lead Spacing	P	2.0	2.5	3.5	5.0
Lead Wire	d ϕ	0.5	0.5	0.6	0.6

DIMENSIONS: mm

RIPPLE CURRENT IN mA-RMS (at 120Hz +85°C)—peak voltage not to exceed rated DV voltage—

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μ F)									
0.47	24	24	24	24	24	24	24	26	26
1.0	36	36	36	36	36	36	36	38	38
2.2	50	50	50	50	50	50	50	55	60
3.3	65	65	65	65	65	65	65	70	75
4.7	68	68	68	68	70	80	80	90	90
10	75	75	75	90	105	125	125	135	135
22	105	105	120	140	165	185	190	200	
33	135	135	150	175	205	230	230		
47	165	165	185	215	245	275			
100	245	245	275	315					

DIMENSIONS: Diameter (D ϕ) x Length (L): mm

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μ F)									
0.47	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
1.0	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
2.2	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	6x11
3.3	5x11	5x11	5x11	5x11	5x11	5x11	5x11	6x11	8x11.5
4.7	5x11	5x11	5x11	5x11	5x11	6x11	6x11	8x11.5	8x11.5
10	5x11	5x11	5x11	6x11	6x11	8x11.5	8x11.5	10x12.5	10x16
22	5x11	5x11	6x11	8x11.5	8x11.5	10x12.5	10x16	10x16	
33	6x11	6x11	6x11	8x11.5	8x11.5	10x16	10x16		
47	6x11	6x11	6x11.5	10x12.5	10x12.5	10x16			
100	8x11.5	8x11.5	10x12.5	10x16					



Low Leakage Axial – Type LLA

ALUMINUM ELECTROLYTIC CAPACITORS

- * It should be considered for applications where standard types of aluminum electrolytic capacitors cannot be utilized because of their high L.C.
- * Another application is the replacement of tantalum capacitors with aluminum electrolytic capacitors.

Operating temperature range: -40°C ~ +85°C.

Capacitance and tolerance: Capacitance measurements shall be made by referred to a frequency of 120Hz $^{+10}_{-5}$ Hz. The capacitance shall be within the specified tolerance of ±20%. (±10% units are available on request).

Leakage current: Measurement shall be made at rated DC voltage with an application of a steady source of power, such as a regulated power supply. A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for a minimum of 30 minutes, 24 to 48 hours prior to making leakage current measurements.

The maximum leakage current at 5 minutes shall not exceed the value determined from the following equation or 1.0µA, whichever is greater:

$$I = 0.002CV$$

- where: I = Leakage Current (µA)
- C = Nominal Capacitance (µF)
- V = Rated DC Voltage (V. DC)

Dissipation factor: Capacitors shall be measured at a frequency of 120Hz at 20°C with a maximum of 1 volt RMS applied during measurement. The dissipation factor shall not exceed the values in Table 1.

Table 1.

Rated Voltage (V. DC)	Dissipation Factor (%) Value in Parenthesis for 5mm Dia. Case size
6.3	20
10	17
16	15
25	12
35	10
50 ~ 100	8

Low-temperature characteristics: The ratio of the impedance of -25°C to that of +20°C shall be less than the values in Table 2.

Table 2.

Rated Voltage (V. DC)	Z @ -25°C	Z @ -40°C
	Z @ +20°C	Z @ +20°C
6.3	4	8
10	3	6
16	2	4
25	2	4
35	2	4
50 ~ 100	2	4

Life test: Rated voltage shall be applied to the capacitors in series with a one thousand ohm resistor. All tests shall be conducted in a dry oven with circulating air. Capacitors shall be separated by a distance not less than 2.5CM and air circulation shall be provided to prevent temperature within 15CM of any capacitors from departing more than +0°C-5°C from the normal ambient temperature of the chamber. Capacitors shall not be exposed to direct radiation from heating elements.

Capacitors shall be subjected to for a period of 1000 hours at 85°C.

After the completion of the life test capacitors shall be returned to standard test conditions.

Table 3.

Capacitance	Within ±15% of initial measurements
Dissipation factor	150% less of value in Table 1
Leakage current	Same as specified under Leakage Current
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

Shelf life test: Capacitors shall be subjected to +85°C±2°C for 1000±12 hours during which time no voltage shall be applied.

Following this period the capacitors shall be cool to room temperature and then D.C. rated voltage shall be applied to the capacitors for 30 minutes after which the capacitors shall be discharged.

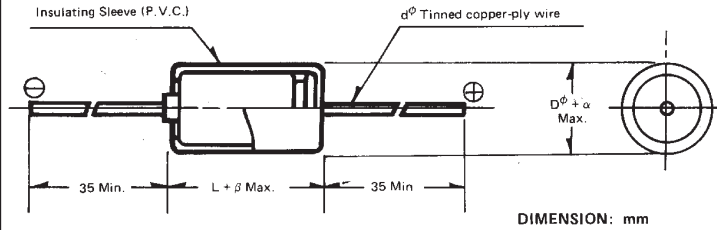
After completion of these procedures, the capacitors shall meet the requirements as listed in Table 3.



Low Leakage Axial – Type LLA

• CONFIGURATION

(mm)



Outside Diameter	D ϕ	6	8	10
Tolerance	α	0.5	0.5	0.5
Length Tolerance	β	1	1	1
Lead Wire	d ϕ	0.6	0.6	0.6

DIMENSION: mm

RIPPLE CURRENT IN mA-RMS (at 120Hz 85°C)—peak voltage not to exceed rated DC voltage—

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μ F)									
0.47	24	24	24	24	24	24	24	26	26
1.0	36	36	36	36	36	36	36	38	38
2.2	50	50	50	50	50	50	50	55	60
3.3	65	65	65	65	65	65	65	70	75
4.7	68	68	68	68	70	80	80	90	90
10	75	75	75	90	105	125	125	135	135
22	105	105	120	140	165	185	190	200	
33	135	135	150	175	205	230	230		
47	165	165	185	215	245	275			
100	245	245	275	315					

DIMENSIONS: Diameter (D ϕ) x Length (L): mm

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μ F)									
0.47	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
1.0	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
2.2	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x16
3.3	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	8x16
4.7	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x16	8x16
10	6x12	6x12	6x12	6x12	6x12	8x16	8x16	8x16	8x20
22	6x12	6x12	6x12	6x16	8x16	8x16	8x20	10x21	
33	6x12	6x12	6x16	8x16	8x16	8x20	10x21		
47	6x12	6x12	8x16	8x16	8x20	10x21			
100	8x16	8x16	8x16	8x20					



High-Voltage Type – Type HVR & HVA

ALUMINUM ELECTROLYTIC CAPACITORS

NITAI'S high voltage aluminum electrolytic capacitors are suited where needs miniature size, high CV product, low leakage and long operating life.

Rated voltages range from 160 V.DC through 450 V.DC.

Operating temperature range: -25°C~+85°C.

Capacitance and tolerance: Capacitance measurements shall be made by the bridge method at a frequency of 120_{-5}^{+10} Hz.

The capacitance shall be within the specified tolerance of $\pm 20\%$.

Leakage current: A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. The DC leakage current shall be measured after rated voltage has been applied for a period of five minutes.

The maximum leakage current for any capacitor shall not exceed the value determined from the following equation:

$$I = 0.06CV + 10$$

where: I = Leakage current (UA)
C = Nominal capacitance (UF)
V = Rated DC voltage (V.DC)

Dissipation factor: Measured at a frequency of 120_{-5}^{+10} Hz, the dissipation factor shall be less than the values in Table 1.

Table 1.

Rated Voltage (V.DC)	Dissipation Factor (%)
160 ~ 250	20
350 ~ 450	25

Low-temperature characteristics: The ratio of the impedance of -25°C to that of +20°C shall be less than the values in table 2.

Table 2.

Rated Voltage (V.DC)	Z @ -25°C
	Z @ +20°C
160	4
200~250	8
350~450	20

Life test: Full rated DC voltage shall be applied to the capacitors through a series protective resistor (1,000 ohms) for a period of 1,000 hours ± 12 hours, while the capacitors are maintained at an ambient temperature of +85°C $\pm 2^\circ$ C (shielded from direct heat radiation).

The capacitors shall then be removed from the test chamber and stabilized at room temperature and meet each of the values listed in Table 3.

Table 3.

Leakage current	Same as specified under the values mentioned in Leakage Current Item
Capacitance	Within $\pm 20\%$ of initial measurements
Dissipation factor	Less than 150% of values in Table 1.
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

Shelf life test: Prior to testing, each capacitor in the test group is measured for capacitance, dissipation factor and DC leakage current.

The capacitors are then stored with no voltage applied at a temperature of +85°C $\pm 2^\circ$ C for 1,000 hours ± 12 hours. Following this period the capacitors shall be removed from the test chamber and be allowed to stabilize at room temperature. Next they shall be connected to a series limiting resistor with DC rated voltage applied for 30 minutes after which the capacitors shall be discharged. After completion of these procedures the capacitors shall meet each of the requirements as listed in Table 3.

**BREL INTERNATIONAL COMPONENTS**1621 WEST UNIVERSITY PARKWAY, SARASOTA, FL 34243
SALES: (800) 237-4564 PHONE: (941) 355-9791 FAX: (941) 355-1530**High-Voltage – Type HVR & HVA**

RIPPLE CURRENT IN mA-RMS (at 120 Hz, +85° C)—peak voltage not to exceed rated DC voltage—

RADIAL TYPE

Rated Voltage (V)	160	200	250	350	400	450
Surge Voltage (V)	200	250	300	400	450	500
CAP. (μF)						
1.0	27	27	28	25	25	25
2.2	42	42	43	38	38	38
3.3	50	50	50	47	47	48
4.7	60	60	60	55	55	55
10	90	95	95	85	85	85
15	120	120	120	105	105	110
22	140	145	150	130	130	135
33	175	180	180	165	170	170
47	220	220	225	205	345	350
100	330	345	345	315	340	346
220	539	539	550			

AXIAL TYPE

Rated Voltage (V)	160	200	250	350	400	450
Surge Voltage (V)	200	250	300	400	450	500
CAP. (μF)						
1.0	27	27	28	25	25	25
2.2	42	43	43	38	38	38
3.3	50	50	50	47	47	47
4.7	60	60	60	55	55	55
10	95	95	95	85	85	85
15	115	115	120	105	105	110
22	140	145	150	130	135	135
33	175	180	185	160	170	180
47	220	220	225	205	214	220
100	335	345	360	330	340	355
150	440	440	465	435		
220	535	560	610			
330	720	740				
470	890					

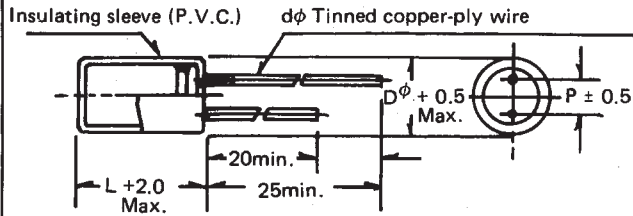


High-Voltage – Type HVR & HVA

RADIAL TYPE

● CONFIGURATION

Dimensions:mm

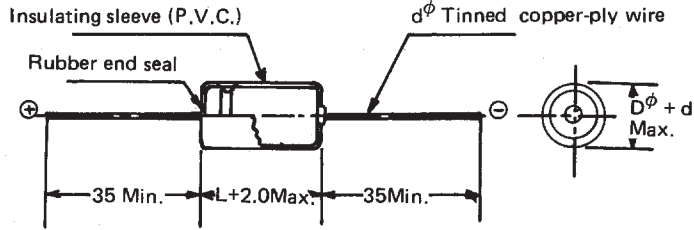


Outside Diameter	Dø	5	6	8	10	13	16	18	22
Lead Spacing	P	2.0	2.5	3.5	5.0	5.0	7.5	7.5	10
Lead Wire	dø	0.5	0.5	0.5	0.6	0.6	0.8	0.8	1.0

DIMENSIONS: Diameter (Dφ) x Length (L):mm

Rated Voltage (V)	160	200	250	350	400	450
Surge Voltage (V)	200	250	300	400	450	500
CAP. (μF)						
1.0	5x11	6x12	6x12	8x13	8x13	8x13
2.2	6x12	6x12	6x12	8x13	10x15	10x15
3.3	8x13	8x13	8x13	10x15	10x15	10x15
4.7	8x13	10x15	10x15	10x18	10x20	10x20
10	10x15	10x20	10x20	10x20	13x21	13x21
15	10x20	10x20	10x20	13x21	13x27	13x27
22	10x20	13x21	13x21	13x21	16x28	16x28
33	13x21	13x21	13x21	16x28	16x36	16x36
47	13x21	16x27	16x27	16x33	16x36	18x36
100	16x27	16x36	16x36	22x39	22x45	22x45
220	18x37	18x41	22x38			

High-Voltage – Type HVR & HVA

AXIAL TYPE


Outside Diameter	Dφ	6	8	10	13	16	18	22
Tolerance	α	0.5	0.5	0.5	0.5	0.5	1.0	1.0
Wire	dφ	0.6	0.6	0.6	0.6	0.8	0.8	0.8

DIMENSIONS: Diameter (Dφ) x Length (L): mm

Rated Voltage (V)	160	200	250	350	400	450
Surge Voltage (V)	200	250	300	400	450	500
CAP. (μF)						
1.0	6x12	6x12	6x12	8x13	8x13	8x13
2.2	6x12	8x13	8x13	8x16	10x16	10x16
3.3	8x13	8x13	8x13	10x16	10x16	10x16
4.7	8x13	10x16	10x16	10x21	10x21	10x21
10	10x16	10x21	10x21	10x21	13x23	13x23
15	10x21	10x21	10x21	13x22	13x27	13x27
22	10x21	13x22	13x22	13x27	16x29	16x29
33	13x22	13x27	13x27	16x28	16x37	16x37
47	13x27	16x28	16x28	16x34	16x37	18x38
100	16x33	16x37	16x37	18x42	22x45	22x45
150	18x36	18x40	18x45	22x45		
220	18x42	22x45	22x45			
330	22x45	22x45				
470	22x50					

**Wide Temperature Type – (General Purpose 105°C) Radial – Type MSR/ET (105° C)****ALUMINUM ELECTROLYTIC CAPACITORS**

* Same size, same specification as general purpose miniature aluminum capacitor and have wide temperature range.

* For switching regulator and automotive application.

Operating temperature range: -55°C~+105°C.

Capacitance and tolerance: Capacitance measurements shall be made by the bridge method at a frequency of 120Hz⁺¹⁰₋₅ Hz.

The capacitance shall be within the specified tolerance of ±20%.

Leakage current: A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for 5 minute before making the leakage current measurements.

The maximum leakage current for the capacitors shall not exceed the value determined from the following equation or 4UA, whichever is greater.

$$I = 0.03CV$$

where I = Leakage current (UA)
C = Nominal capacitance (UF)
V = Rated DC voltage (V.DC)

Dissipation factor: Measured at a frequency of 120Hz⁺¹⁰₋₅ Hz, the dissipation factor shall be less than the values in Table 1.

Table 1.

Rated Voltage (V.DC)	Dissipation Factor (%)
6.3	22
10	19
16	16
25	14
35	12
50	10
63	9
80	9
100	8

In case the nominal capacitance of capacitor exceeds 1000μF, 2% per each 1000μF shall be added to the corresponding value listed in Table 1.

Low-temperature characteristics: The ratio of the impedance of -25°C or -40°C to that of +20°C shall be less than the values listed in Table 2.

Table 2.

Rated voltage (V.DC)	Ratio of Impedance	
	$\frac{Z @ -25^{\circ}C}{Z @ +20^{\circ}C}$	$\frac{Z @ -40^{\circ}C}{Z @ +20^{\circ}C}$
6.3	3	6
10	2	5
16	2	3
25	2	3
35	2	3
50	2	3
63	2	3
80	2	3
100	2	3

Life test: Full-rated voltage shall be applied to the capacitor through a series protective resistor (1,000 ohms) for a period of 1,000 hours ±12 hours, while the capacitors are maintained at an ambient temperature of 105°C±2°C (shielded from direct heat radiation).

The capacitors shall then be removed from the test chamber and stabilized at room temperature for 2 hours after which they shall meet each of the values listed in Table 3.

Table 3.

Capacitance	≤16 W.V., within ±25% of initial measurements
	≥25 W.V., within ±20% of initial measurements
Leakage current	Same as specified under Leakage Current
Dissipation factor	200% less of values in Table 1.
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

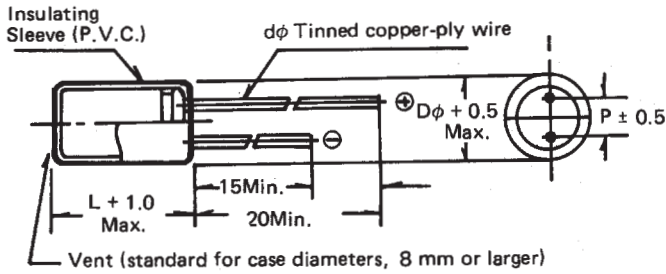
Shelf life test: Prior to testing, each capacitor in the test group is measured for capacitance, dissipation factor and DC leakage current.

The capacitors are then stored with no voltage applied at a temperature of 105°C ±2°C for 1,000 hours ±12 hours. Following this period the capacitors shall be removed from the test chamber and be allowed to stabilize at room temperature. Next they shall be connected to a series limited resistor with DC rated voltage applied for 30 minutes after which the capacitors shall be discharged. After completion of these procedures, the capacitors shall meet each of the requirements as listed in Table 3.

Wide Temperature Type – (General Purpose 105°C) Radial – Type MSR/ET (105° C)

• CONFIGURATION

Dimension: mm



Outside Diameter $D\phi$	5	6	8	10	13	16	18	22	25
Lead Spacing P	2.0	2.5	3.5	5.0	5.0	7.5	7.5	10	12
Lead Wire $d\phi$	0.5	0.5	0.6	0.6	0.6	0.8	0.8	0.8	1.0

DIMENSIONS: Diameter ($D\phi$) x Length (L): mm

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μ F)									
0.47	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
1	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
2.2	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
3.3	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
4.7	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11	5x11
10	5x11	5x11	5x11	5x11	5x11	5x11	5x11	6x11	6x11
22	5x11	5x11	5x11	5x11	5x11	6x11	6x11	8x11.5	8x11.5
33	5x11	5x11	5x11	5x11	5x11	6x11	6x11	10x12.5	10x12.5
47	5x11	5x11	5x11	5x11	6x11	6x11	8x11.5	10x16	10x16
100	5x11	5x11	6x11	6x11	8x11.5	8x11.5	10x12.5	13x20	13x20
220	6x11	6x11	8x11	8x11.5	10x12.5	10x16	10x20	13x25	16x25
330	8x11.5	8x11.5	8x11.5	10x12.5	10x16	10x20	13x20	16x25	16x25
470	8x11.5	8x11.5	10x12.5	10x16	10x20	13x21.5	13x25	16x31.5	16x31.5
1000	10x16	10x16	10x18	13x20	13x20	16x25	16x31.5	18x40	22x40
2200	10x20	10x20	13x20	16x25	16x31.5	16x41	22x40	25x50	
3300	13x20	13x20	13x25	16x31.5	16x41	22x40	25x40	25x50	
4700	13x25	13x25	16x31.5	16x41	18x41	22x41	25x50		
10000	16x34.5	16x34.5	18x41	25x40					



Wide Temperature Type – (General Purpose 105°C) Radial – Type MSR/ET (105° C)

RIPPLE CURRENT IN mA-RMS (at 120 Hz, 85°C)—peak voltage not to exceed rated DC voltage—

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (µF)									
0.47	6	6	6	6	6	6	10	10	10
1.0	12	12	12	12	12	12	15	15	15
2.2	18	18	18	18	18	18	22	22	22
3.3	22	22	22	22	22	22	27	27	27
4.7	27	27	27	27	27	27	30	34	36
10	39	39	39	39	39	39	50	57	61
22	49	49	49	49	60	65	85	101	106
33	56	56	56	68	73	93	105	133	142
47	60	60	76	81	101	112	145	158	184
100	99	99	129	137	172	207	252	280	300
220	155	171	225	260	306	371	414	450	533
330	225	246	298	347	417	455	551	651	702
470	265	326	392	458	535	652	725	808	809
1000	462	570	677	805	869	1021	1220	1370	1375
2200	790	960	1053	1234	1362	1735	2070	2320	
3300	1033	1194	1586	1630	2310	2940	3510	3940	
4700	1275	1423	1889	2770	3920	4990	5960		
10000	2044	2410	3210	4700					

Ripple current calculations: Electrolytic capacitors will withstand RMS ripple current at the frequency of 120Hz and a temperature of +105°C, as listed above.

1. When capacitors are operated at a temperature other than +105°C, the allowable RMS ripple current listed above must be multiplied by the factor shown below:

+70° C or less	+85° C	+105° C
2.8	2.2	1.0

2. If capacitors are used at a frequency other than 120Hz, the rated 120Hz RMS ripple current listed above must be multiplied by the appropriate factor shown below:

The CV Product (Cap. in µF x Rated V)	120Hz	300Hz	1kHz	100kHz
CV < 1,000	1.0	1.28	1.66	2.0
1,000 ≤ CV < 10,000	1.0	1.18	1.36	1.5
CV ≥ 10,000	1.0	1.14	1.22	1.3

**Wide Temperature Type – (General Purpose 105°C) Axial – Type MSA/ET (105° C)****ALUMINUM ELECTROLYTIC CAPACITORS****Operating temperature range:** -40°C ~ +105°C.**Capacitance and tolerance:** Capacitance measurements shall be made by the bridge method at a frequency 120Hz₋₅⁺¹⁰Hz. The capacitance shall be within the specified tolerance of ±20%.**Leakage current:** Measurements shall be made at rated DC voltage with an application of a steady source of power, such as a regulated power supply. A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for 5 minutes before making the leakage current measurements.

The maximum leakage current for the capacitors shall not exceed the value determined from the following equation or 3µA, whichever is greater:

$$I = 0.03CV$$

where: I = Leakage Current (µA)
C = Nominal Capacitance (µF)
V = Rated DC Voltage (V. DC)**Dissipation factor:** Measured at a frequency of 120 Hz₋₅⁺¹⁰Hz, the dissipation factor shall be less than the values in Table 1.**Table 1.**

Rated Voltage (V.DC)	Dissipation Factor (%)
6.3	22
10	19
16	16
25	14
35	12
50	10
63	9
80, 100	8

Low-temperature characteristics: The ratio of the impedance of -25°C or -40°C to that of +20°C shall be less than the values listed in Table 2.**Table 2.**

Rated Voltage (V. DC)	Ratio of Impedance	
	$\frac{Z@ - 25^{\circ}C}{Z@ + 20^{\circ}C}$	$\frac{Z@ - 40^{\circ}C}{Z@ + 20^{\circ}C}$
6.3	3	6
10	3	6
16	2	4
25	2	4
35	2	4
50	2	4
63	2	4
80	2	4
100	2	4

Life test: The capacitors shall be placed in an air-circulating thermostatic test chamber and be exposed to full-rated DC voltage through a series protective resistor (100 ohms) for a period of 1,000 hours ±24 hours at a temperature of +105°C ±2°C (shielded from direct heat radiation).

The capacitors shall then be removed from the test chamber and stabilized at room temperature for 2 hours after which they shall meet each of the values listed in Table 3.

Table 3.

Leakage current	Same as specified under Leakage Current
Capacitance	Within ±20% of initial measurements
Dissipation factor	200% less of values in Table 1
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

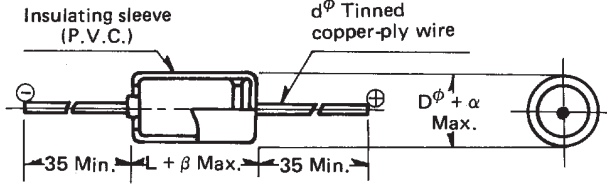
Shelf life test: Prior to testing, each capacitor in the test group is measured for capacitance, dissipation factor and DC leakage current.

The capacitors are then stored with no voltage applied at a temperature of +105°C ±2°C for 1,000 hours ±12 hours. Following this period the capacitors shall be removed from the test chamber and be allowed to stabilize at room temperature. Next they shall be connected to a series limiting resistor with DC rated voltage applied for 30 minutes after which the capacitors shall be discharged. After completion of these procedures, the capacitors shall meet each of the requirements as listed in Table 3.



Wide Temperature Type – (General Purpose 105°C) Axial – Type MSA/ET (105° C)

• CONFIGURATION



Dimensions: mm

Outside Diameter	D ϕ	6	8	10	13	16	18	22	25.4
Tolerance	α	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0
Length Tolerance	β	1	1	1	1	1	2	2	2
Lead Wire	d ϕ	0.6	0.6	0.6	0.6	0.8	0.8	0.8	0.8

RIPPLE CURRENT in mA-RMS (at 120Hz, +85°C)—peak voltage not to exceed rated DC voltage—

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μ F)									
0.47	28	28	28	28	28	28	28	28	28
1.0	41	41	41	41	41	41	41	41	41
2.2	61	61	61	61	61	61	61	63	63
3.3	75	75	75	75	75	75	75	77	77
4.7	89	89	89	89	89	89	89	94	94
10	115	115	115	115	115	125	135	140	140
22	165	165	165	165	175	190	200	210	210
33	185	185	185	200	220	230	250	260	260
47	200	200	220	250	260	290	310	320	320
100	300	300	330	370	400	430	460	490	490
220	450	450	510	560	610	650	710	800	800
330	560	560	630	730	770	830	890	930	930
470	690	690	770	870	1012	1023	1155	1177	1298
1000	1030	1400	1580	1580	1700	1980	2260	2080	2080
2200	1960	2180	2450	2610	2800	2910	2910	3750	4040
3300	2520	2740	2870	2870	3380	4000	4340	4940	
4700	3010	3060	3100	3760	4530	5180	6100		
10000	4450	4810	5690	7180	8450				

DIMENSIONS: Diameter (D ϕ) x Length (L): mm

Rated Voltage (V)	6.3	10	16	25	35	50	63	80	100
Surge Voltage (V)	8	13	20	32	44	63	79	100	125
CAP. (μ F)									
0.47	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
1.0	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
2.2	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
3.3	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
4.7	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x12
10	6x12	6x12	6x12	6x12	6x12	6x12	6x12	6x16	6x16
22	6x12	6x12	6x12	6x12	6x12	6x12	6x16	8x16	8x16
33	6x12	6x12	6x12	6x12	6x16	6x16	6x16	8x16	8x20
47	6x12	6x12	6x12	6x16	6x16	6x16	8x16	8x20	10x21
100	6x12	6x12	6x16	6x16	8x16	8x16	8x20	10x26	10x26
220	6x16	6x16	8x16	8x16	8x20	10x20	10x26	13x26	13x31.5
330	8x16	8x16	8x16	8x20	10x20	10x25	13x26	13x26	16x25
470	8x16	8x16	8x20	10x20	10x26	13x25	13x26	16x31.5	16x41.5
1000	10x20	10x20	10x26	13x26	13x26	16x25	16x30	18x40	22x40
2200	13x25	13x25	13x30	16x25	16x30	18x40	22x40	25.4x52	25.4x61
3300	13x25	13x30	16x25	16x30	16x40	22x42	22x50	25.4x61	
4700	13x30	16x25	16x30	18x40	22x40	22x50	25.4x50		
10000	16x40	18x40	22x40	22x50	25.4x50				



High Temperature +125°C – Type MSR/ET (125C) & MSA/ET (125C)

ALUMINUM ELECTROLYTIC CAPACITORS

Operating temperature range: -40°C + 125°C

Capacitance and tolerance: Capacitance measurements shall be made by the bridge method at a frequency of 120Hz⁺¹⁰₋₅ Hz.

The capacitance shall be within the specified tolerance of ±20%.

Leakage current: A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for 5 minutes before making the leakage current measurements.

The maximum leakage current for the capacitors shall not exceed the value determined from the following equation or 2µA, whichever is greater:

$I = 0.002CV$ where: I = Leakage Current (µA)
C = Nominal Capacitance (µF)
V = Rated DC Voltage (V.DC)

Dissipation factor: Measured at a frequency of 120Hz⁺¹⁰₋₅ Hz, the dissipation factor shall be less than the values in Table 1.

Table 1.

Rated Voltage (V.DC)	Dissipation Factor (%)
10	15
16	12
25	10
35	10
50	8

Low-temperature characteristics: The ratio of the impedance of -25°C or -40°C to that of +20°C shall be less than the values listed in Table 2.

Table 2.

Rated Voltage (V.DC)	Ratio of Impedance	
	$\frac{Z @ -25^{\circ}C}{Z @ +20^{\circ}C}$	$\frac{Z @ -40^{\circ}C}{Z @ +20^{\circ}C}$
10	3	6
16	2	4
25	2	4
35	2	4
50	2	4

Life test: The capacitors shall be placed in an air circulating thermostatic test chamber and be exposed to full rated DC voltage through a series protective resistor (100 ohms) for a period of 1,000 hours±12 hours at a temperature of +125°C±2°C (Shielded from direct heat radiation). The capacitors shall then be removed from the test chamber and stabilized at room temperature for 2 hours after which they shall meet each of the values listed in Table 3.

Table 3.

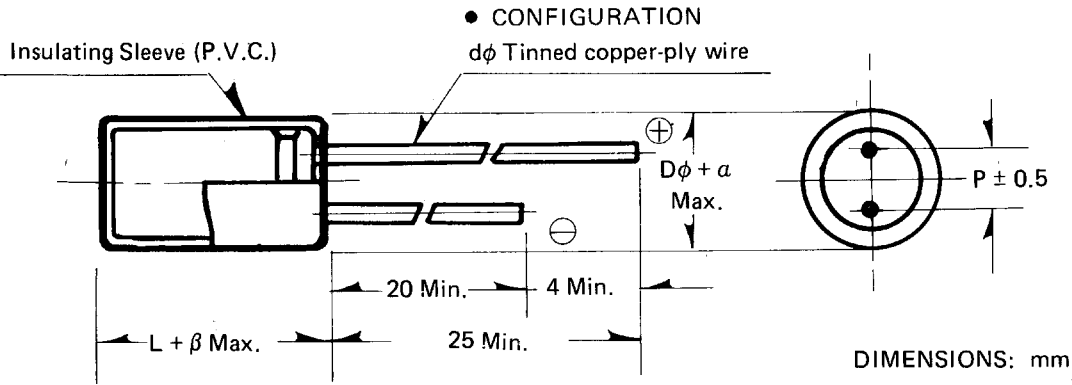
Leakage current	Same as specified under Leakage Current
Capacitance	Within ±20% of initial measurements
Dissipation factor	200% less of value in Table 1.
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

Shelf life test: Prior to testing, each capacitor in the test group is measured for capacitance, dissipation factor and DC leakage current.

The capacitors are then stored with no voltage applied at a temperature of +125°C ±2°C for 1,000 hours ± 12 hours. Following this period the capacitors shall be removed from the test chamber and be allowed to stabilize at room temperature. Next they shall be connected to a series limiting resistor with DC rated voltage applied for 30 minutes after which the capacitors shall be discharged. After completion of these procedures, the capacitors shall meet each of the requirements as listed in Table 3.



High Temperature +125°C – Type MSR/ET (125C) & MSA/ET (125C)



Outside Diameter (Dφ)	Lead Spacing (P)
8.0	3.5
10.0	5.0
13.0	5.0
16.0	7.5

RADIAL TYPE

DIMENSIONS: Diameter (Dφ) X Length (L): mm

Rated Voltage (V)	10	16	25	35	50
Surge Voltage (V)					
CAP. (μF)					
0.47	8x12.5	8x12.5	8x12.5	8x12.5	8x12.5
1.0	8x12.5	8x12.5	8x12.5	8x12.5	8x12.5
2.2	8x12.5	8x12.5	8x12.5	8x12.5	8x12.5
3.3	8x12.5	8x12.5	8x12.5	8x12.5	8x12.5
4.7	8x12.5	8x12.5	8x12.5	8x12.5	8x12.5
10	8x12.5	8x12.5	8x12.5	8x12.5	8x12.5
22	8x12.5	8x12.5	8x12.5	8x12.5	10x12.5
33	8x12.5	8x12.5	8x12.5	10x12.5	10x16
47	8x12.5	8x12.5	10x12.5	10x16	10x20
100	10x12.5	10x16	10x20	13x20	13x25
220	10x20	13x20	13x25	16x25	
330	13x20	13x25	16x25		
470	13x25	16x25			

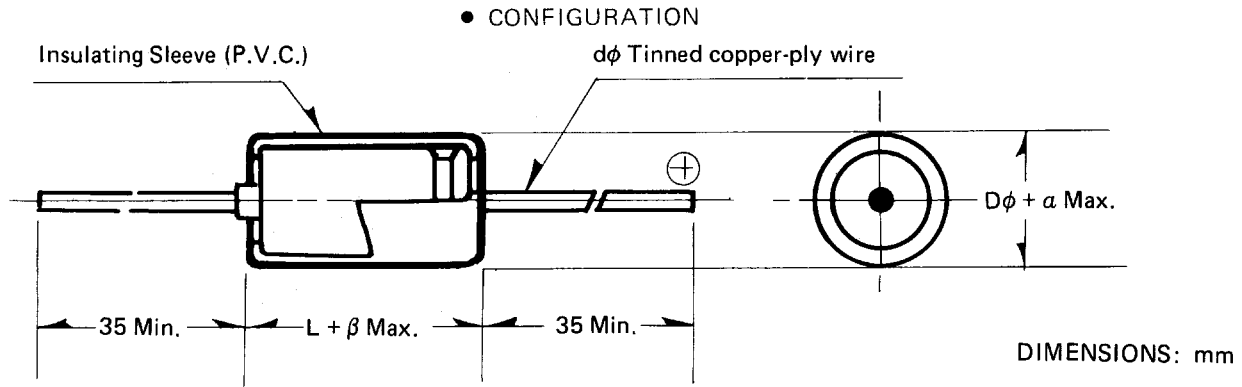
RIPPLE CURRENT in mA-RMS (at 120Hz, +85°C)—peak voltage not to exceed rated DC voltage.

RADIAL TYPE

Rated Voltage (V)	10	16	25	35	50
Surge Voltage (V)					
CAP. (μF)					
0.47	28	28	28	28	28
1.0	47	47	47	47	47
2.2	62	62	62	62	62
3.3	76	76	76	76	76
4.7	91	91	91	91	91
10	120	120	120	120	120
22	175	175	175	175	190
33	200	200	200	220	230
47	220	220	240	260	290
100	290	330	370	400	430
220	450	510	580	630	
330	560	650	710		
470	670	770			



High Temperature +125°C – Type MSR/ET (125C) & MSA/ET (125C)



AXIAL TYPE

DIMENSIONS: Diameter (Dφ) X Length (L): mm

Rated Voltage (V)	10	16	25	35	50
Surge Voltage (V)					
CAP. (μF)					
0.47	6x16	6x16	6x16	6x16	6x16
1.0	6x16	6x16	6x16	6x16	6x16
2.2	6x16	6x16	6x16	6x16	6x16
3.3	6x16	6x16	6x16	6x16	6x16
4.7	6x16	6x16	6x16	6x16	6x16
10	6x16	6x16	6x16	6x16	6x16
22	6x16	6x16	6x16	8x16	8x20
33	6x16	8x16	8x20	8x20	10x21
47	6x16	8x16	8x20	10x21	10x26
100	8x20	10x21	10x21	10x26	13x26
220	10x21	10x26	13x26	13x31.5	16x31.5
330	13x26	13x26	13x31.5	16x31.5	
470	13x31.5	13x31.5	16x31.5		

RIPPLE CURRENT in mA-RMS (at 120Hz, +85°C)—peak voltage not to exceed rated DC voltage.

AXIAL TYPE

Rated Voltage (V)	10	16	25	35	50
Surge Voltage (V)					
CAP. (μF)					
0.47	28	28	28	28	28
1.0	47	47	47	47	47
2.2	62	62	62	62	62
3.3	76	76	76	76	76
4.7	91	91	91	91	91
10	120	120	120	120	120
22	165	165	165	175	190
33	185	185	200	220	230
47	195	220	240	260	290
100	290	330	370	400	430
220	450	510	580	630	650
330	560	650	710	780	
470	670	770	870		



Low E.S.R. For Switching Regulators – Type LER

ALUMINUM ELECTROLYTIC CAPACITORS

- * Broad operating range excellent reliability good performance characteristics.
- * Low leakage current and low D.F.
- * Low impedance at high frequencies.
- * For high frequency filter circuits, data processing, telecommunications, high frequency switching regulators.

Operating temperature range: -55°C~+105°C.

Capacitance and tolerance: Capacitance measurements shall be made by the bridge method at a frequency of 120Hz⁺¹⁰₋₅ Hz.

The capacitance shall be within the specified tolerance of ±20%.

Leakage current: Measurement shall be made at rated DC voltage with an application of a steady source of power such as a regulated power supply. A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC voltage shall be applied to the capacitor for 5 minutes before making the leakage current measurements.

The maximum leakage current for the capacitors shall not exceed the value determined from the following equation or 2UA, whichever is greater.

$$I = 0.002CV$$

- Where: I = Leakage Current (UA)
C = Nominal Capacitance (UF)
V = Rated DC Voltage (V.DC)

Dissipation factor: Measured at a frequency of 120Hz⁺¹⁰₋₅ Hz, the dissipation factor shall be less than the values in Table 1.

Table 1.

Rated Voltage (V.DC)	Dissipation Factor (%)
6.3	12
10	10
16	8
25	7
35	7
50~100	6

Low-temperature characteristics: The ratio of the impedance of -25°C or -55°C to that of +20°C shall be less than the values listed in table 2.

Table 2.

Rated Voltage (V.DC)	Ratio of Impedance	
	Z @ -25°C Z @ +20°C	Z @ -55°C Z @ +20°C
6.3	3	5
10	2	4
16	2	3
25	2	3
35	2	3
50~100	2	3

Life test: Full-rated voltage shall be applied to the capacitors through a series protective resistor (1,000 ohms) for a period of 2,000 hours ±12 hours while the capacitors are maintained at an ambient temperature of +105°C ±2°C (shielded from direct heat radiation).

The capacitors shall then be removed from the test chamber and stabilized at room temperature and meet each of the values listed in Table 3.

Table 3.

Capacitance	85% or more of initial measurements
Dissipation factor	200% less of value in Table 1.
Leakage current	Same as specified under the values mentioned in Leakage Current Item
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

Shelf life test: Prior to testing, each capacitor in the test group is measured for capacitance, dissipation factor and DC leakage current.

Capacitors are then stored at +105°C ±2°C for 500 hours with no voltage applied. After 500 hours the capacitors shall be removed from the test chamber and allowed to be stabilized to room temperature. Following the shelf test, rated DC voltage will be applied to the capacitor for 30 minutes after which the capacitor will meet each of the requirements as listed in Table 4.

Table 4.

Capacitance	90% or more of initial measurements
Dissipation factor	115% less of value in Table 1.
Leakage current	Same as specified under Leakage Current
Appearance	Free from leakage of electrolyte and/or other noticeable deformation



Low E.S.R. For Switching Regulators – Type LER

RIPPLE CURRENT in mA-RMS (at 100kHz, +85° C) – peak voltage not to exceed rated DC voltage –

Rated Voltage (V) Surge Voltage (V) CAP. (μF)	6.3	10	16	25	35	50	63	100
1								70
2.2								100
3.3						130	130	130
4.7						150	150	160
10					220	220	220	220
22				330	330	340	340	350
33			350	410	410	420	430	450
47		370	420	480	480	510	520	550
100	510	560	630	730	750	780	820	
220	780	850	970	1,100	1,120	1,210		
330	970	1,060	1,210	1,410	1,480			
470	1,170	1,080	1,480	1,650				
1,000	1,670	1,970						

IMPEDANCE in OHMS (Ω) (at 100kHz, +20° C)

Rated Voltage (V) CAP. (μF)	6.3	10	16	25	35	50	63	100
1								30.80
2.2								14.00
3.3						9.30	9.30	9.30
4.7						6.30	6.50	6.50
10					3.20	3.10	3.10	3.10
22				1.45	1.45	1.40	1.40	1.40
33			1.28	0.97	0.97	0.93	0.93	0.93
47		1.12	0.92	0.68	0.68	0.65	0.65	0.65
100	0.67	0.57	0.45	0.34	0.34	0.32	0.32	
220	0.33	0.28	0.23	0.17	0.17	0.16		
330	0.24	0.20	0.16	0.12	0.12			
470	0.17	0.14	0.12	0.09				
1,000	0.09	0.07						

**Low E.S.R. For Switching Regulators – Type LER****ESR (Equivalent Series Resistance) in OHMS (Ω) 20°C at 120Hz**

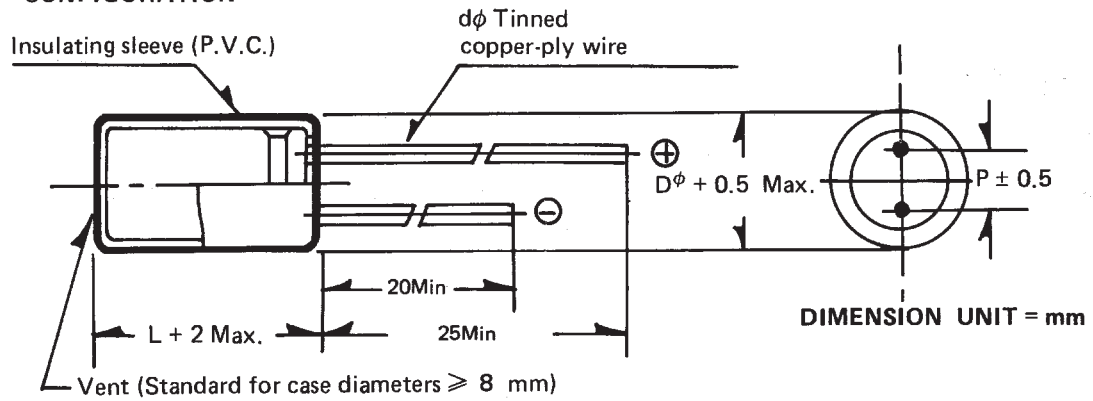
Rated Voltage CAP. (μ F)	6.3	10	16	25	35	50	63	100
1								66.00
2.2								30.00
3.3						20.00	20.00	20.00
4.7						14.00	14.00	14.00
10					8.00	6.60	6.60	6.60
22				3.60	3.60	3.00	3.00	3.00
33			3.20	2.40	2.40	2.00	2.00	2.00
47		2.80	2.30	1.70	1.70	1.40	1.40	1.40
100	1.59	1.33	1.06	0.80	0.80	0.66	0.66	
220	0.72	0.60	0.48	0.36	0.36	0.30		
330	0.48	0.40	0.32	0.24	0.24			
470	0.34	0.28	0.23	0.17				
1,000	0.16	0.13						

ESR (Equivalent Series Resistance) in OHMS (Ω) +20°C –at 1kHz–

Rated Voltage CAP. (μ F)	6.3	10	16	25	35	50	63	100
1								46.00
2.2								21.00
3.3						14.00	14.00	14.00
4.7						9.80	9.80	9.80
10					4.80	4.60	4.60	4.60
22				2.16	2.16	2.10	2.10	2.10
33			1.92	1.44	1.44	1.40	1.40	1.40
47		1.68	1.38	1.02	1.02	0.98	0.98	0.98
100	0.95	0.80	0.63	0.48	0.48	0.46	0.46	
220	0.43	0.36	0.29	0.22	0.22	0.21		
330	0.29	0.24	0.19	0.14	0.14			
470	0.20	0.17	0.14	0.10				
1,000	0.10	0.08						

Low E.S.R. For Switching Regulators – Type LER

• **CONFIGURATION**



Outside Diameter (Dφ)	Lead Spacing (P)	Lead Wire (dφ)
8.0	3.5	0.6
10.0	5.0	0.6
13.0	5.0	0.6

DIMENSIONS: Diameter (Dφ) x Length (L) = mm

Rated Voltage (V)	6.3	10	16	25	35	50	63	100
Surge Voltage (V)	8	13	20	32	44	63	79	125
CAP. (μF)								
1								8 x 11.5
2.2								8 x 11.5
3.3						8 x 11.5	8 x 11.5	8 x 11.5
4.7						8 x 11.5	8 x 11.5	10 x 12.5
10					8 x 11.5	8 x 11.5	8 x 11.5	10 x 16
22				8 x 11.5	10 x 12.5	10 x 12.5	10 x 16	13 x 20
33			8 x 11.5	10 x 12.5	10 x 16	10 x 16	10 x 20	13 x 25
47		8 x 11.5	10 x 12.5	10 x 12.5	10 x 16	10 x 20	13 x 20	13 x 34.5
100	10 x 12.5	10 x 16	10 x 16	10 x 20	13 x 20	13 x 25	13 x 34.5	
220	10 x 20	10 x 20	13 x 20	13 x 20	13 x 25	13 x 34.5		
330	13 x 20	13 x 20	13 x 25	13 x 25	13 x 34.5			
470	13 x 20	13 x 25	13 x 34.5	13 x 34.5				
1,000	13 x 25	13 x 34.5						



General Purpose Snap-In – Terminal HL, LL Series – Type HL&LL

ALUMINUM ELECTROLYTIC CAPACITORS

- * Large capacitance and low profile.
- * Assembly to the P.C. Board easily and steadily. Need not any mounting hardware or tool.
- * Excellent shock resistance.

Operating temperature range:

16~100WV: -40°C~+85°C
 160~450WV: -25°C~+85°C

Capacitance and tolerance:

Capacitance measurements shall be made by the bridge method at a frequency of 120Hz_{-5}^{+10} Hz. 25°C

The capacitance shall be within the specified tolerance of ±20%.

Leakage Current: Measurement shall be made at rated DC voltage with an application of a steady source of power. A current-limiting resistor of 1,000 ohms shall be connected in series with each capacitor under test. Rated DC working voltage shall be applied to the capacitor for 5 minutes before making the leakage current measurements.

The maximum leakage current shall not exceed the value determined from the following equation or 3000UA, whichever is greater:

$$I = 0.02CV$$

where : I = Leakage current (μA)
 C = Nominal capacitance (μF)
 V = Rated DC voltage (V.DC)

Dissipation Factor: Measured at a frequency of 120Hz_{-5}^{+10} Hz, the dissipation factor shall be less than the values in Table 1.

Table 1.

Rated Voltage (V.DC)	CV ≤ 100,000 Dissipation Factor (%)	CV ≤ 330,000 Dissipation Factor (%)	CV > 330,000 Dissipation Factor (%)
16, 25	40	50	60
35, 50, 63	30	40	50
80, 100, 160	25	35	45
180, 200, 250	20	30	40
350, 400, 450	30	—	—

Low temperature characteristics: The ratio of the impedance of -25°C or -40°C to that of +20°C shall be less than the values listed in Table 2.

Table 2.

Rated Voltage (V.DC)	Ratio of Impedance	
	$\frac{Z @ -40^\circ\text{C}}{Z @ +20^\circ\text{C}}$	$\frac{Z @ -25^\circ\text{C}}{Z @ +20^\circ\text{C}}$
16~100	12	3
160 ~ 450	—	3

Life test: The capacitors shall be placed in an air-circulating thermostatic test chamber and application of rated DC voltage through a series protective resistor (1,000 ohms) for a period of 1,000 hours at a temperature of 85°C±2°C (shielded from direct heat radiation). The capacitors shall then be removed from the test chamber and allowed to cool to room temperature after which they shall meet each of the requirements listed in Table 3.

Table 3.

Leakage current	Same as specified under Leakage Current
Capacitance	Within ±20% of initial measurements
Dissipation factor	150% less of values in Table 1.
Appearance	Free from leakage of electrolyte and/or other noticeable deformation

Shelf life test: Prior to testing, each capacitor in the test group is measured for capacitance, dissipation factor and DC leakage current.

The capacitors are then stored with no voltage applied at temperature of 85°C±2°C for 500 hours ±12 hours. Following this period the capacitors shall be removed from the test chamber and be allowed to stabilize at room temperature. Next they shall be connected to a series limiting resistor with DC rated voltage applied for 30 minutes after which the capacitors shall be discharged. After completion of these procedures, the capacitors shall meet each of the requirements as listed in Table 3.



BREL INTERNATIONAL COMPONENTS

1621 WEST UNIVERSITY PARKWAY, SARASOTA, FL 34243
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General Purpose Snap-In – Terminal HL, LL Series – Type HL&LL

RIPPLE CURRENT in Amp-RMS (at 120Hz, +85°C) – peak voltage not to exceed rated DC voltage –
HL SERIES

Rated Voltage (V)	16	25	35	50	63	80	100
Surge Voltage (V)							
CAP. (μF)							
470	0.52	0.52	0.52	0.52	0.52	0.52	0.56
680	0.56	0.56	0.56	0.56	0.56	0.68	0.76
1000	0.68	0.68	0.68	0.68	0.73	0.93	1.00
2200	0.87	0.87	1.08	1.23	1.32	1.63	1.80
3300	1.07	1.15	1.51	1.62	1.78	2.21	
4700	1.38	1.56	1.93	2.13	2.36		
6800	1.87	2.01	2.56	2.84			
10000	2.44	2.69	3.44				
15000	3.65	3.65					
22000	4.30						

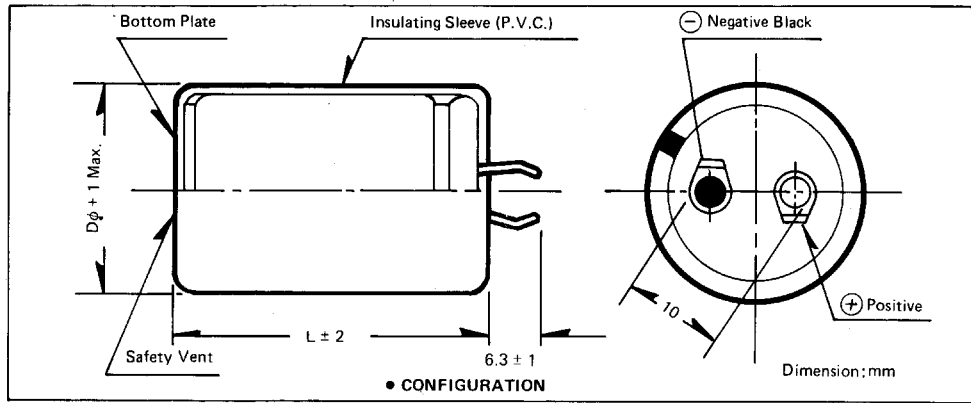
Rated Voltage (V)	160	180	200	250	350	400	450
Surge Voltage (V)							
CAP. (μF)							
22							0.15
33						0.19	0.20
47					0.24	0.25	0.26
68				0.34	0.35	0.35	0.35
100			0.47	0.49	0.49	0.50	0.51
220	0.78	0.81	0.87	0.89	0.90		
330	1.06	1.10	1.18				
470	1.40	1.45	1.55				
680	1.77	1.85					

LL SERIES

Rated Voltage (V)	16	25	35	50	63	80	100
Surge Voltage (V)							
CAP. (μF)							
1000	0.73	0.73	0.73	0.73	0.73	0.91	0.98
2200	1.08	1.08	1.08	1.21	1.30	1.60	
3300	1.15	1.15	1.48	1.59	1.75		
4700	1.37	1.54	1.90	2.09			
6800	1.85	1.98	2.51				
10000	2.40	2.64					
15000	3.23						

Rated Voltage (V)	160	180	200	250
Surge Voltage (V)				
CAP. (μF)				
220	0.72	0.80	0.85	0.89
330	0.98	1.05	1.10	1.18
470	1.25	1.40	1.45	1.52
680	1.68	1.78	1.83	2.01

General Purpose Snap-In – Terminal HL, LL Series – Type HL&LL



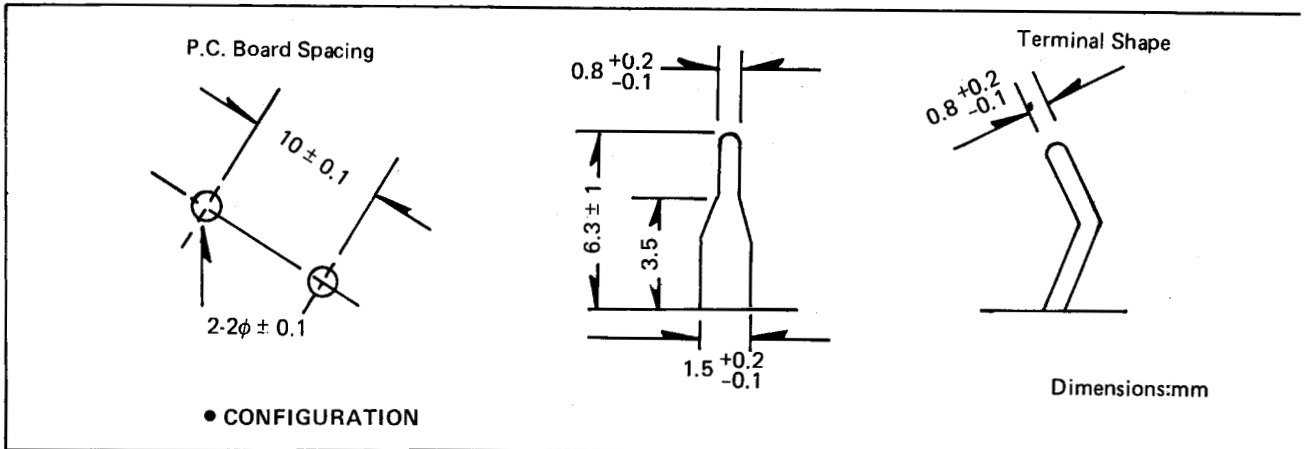
HL DIMENSIONAL TABLE

DIMENSIONS: Diameter (Dφ) x Length (L): mm

Rated Voltage (V)	16	25	35	50	63	80	100
Surge Voltage (V)	20	32	44	63	79	100	125
CAP. (μF)							
470	22x25	22x25	22x25	22x25	22x25	22x25	22x30
680	22x25	22x25	22x25	22x25	22x25	22x30	22x40
1000	22x25	22x25	22x25	22x25	22x30	22x40	25x40
2200	22x25	22x25	22x30	22x40	25x40	25x52	30x52
3300	22x25	22x30	22x40	25x40	25x52	30x52	
4700	22x30	22x40	25x40	25x52	30x52		
6800	22x40	25x40	25x52	30x52			
10000	25x40	25x52	30x52				
15000	30x52	30x52					
22000	30x52						

Rated Voltage (V)	160	180	200	250	350	400	450
Surge Voltage (V)	200	225	250	300	400	450	500
CAP. (μF)							
22							22x25
33						22x25	22x30
47					22x25	22x30	22x40
68				22x25	22x40	22x40	25x40
100			22x30	22x40	25x40	25x40	30x52
220	22x40	22x40	25x40	25x52	30x52		
330	25x40	25x40	25x52				
470	25x52	25x52	30x52				
680	30x52	30x52					

General Purpose Snap-In – Terminal HL, LL Series – Type HL&LL



LL DIMENSIONAL TABLE

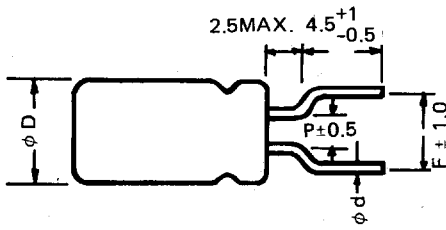
DIMENSIONS: Diameter (Dϕ) x Length (L): mm

Rated Voltage (V)	16	25	35	50	63	80	100
Surge Voltage (V)	20	32	44	63	79	100	125
CAP. (μF)							
1000	25x25	25x25	25x25	25x25	25x25	30x25	30x30
2200	25x25	25x25	25x25	30x25	30x30	35x30	
3300	25x25	25x25	30x25	30x30	35x30		
4700	25x25	30x25	30x30	35x30			
6800	30x25	30x30	35x30				
10000	30x30	35x30					
15000	35x30						

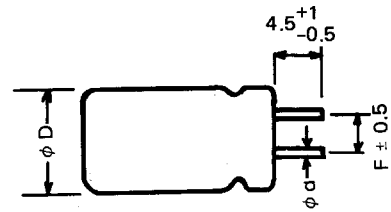
Rated Voltage (V)	160	180	200	250
Surge Voltage (V)	200	225	250	300
CAP. (μF)				
220	25x25	30x25	30x25	30x30
330	30x25	30x30	30x30	35x30
470	30x30	35x30	35x30	35x40
680	35x30	35x40	35x40	35x52

Lead Forming Styles

1



2

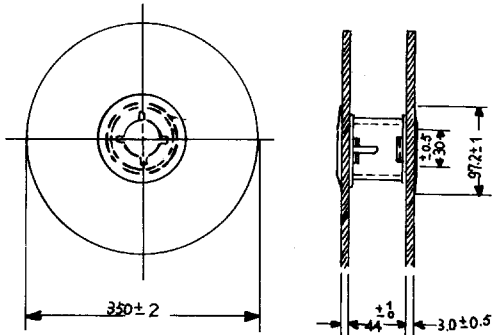
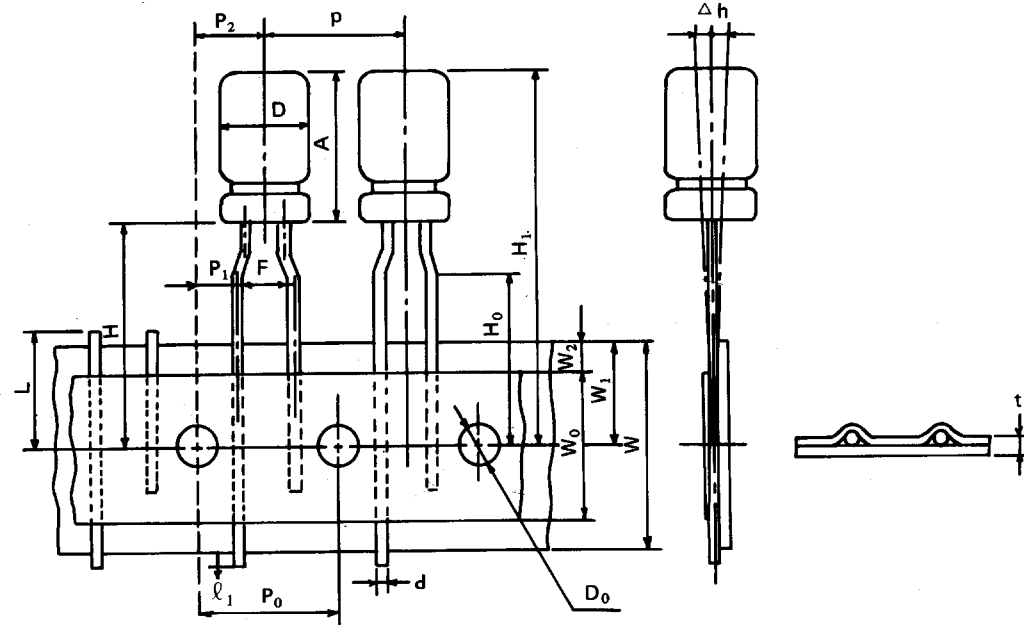


DIMENSIONS: mm

NO.				
	ϕD	F	P	ℓ
1	4	5	1.5	—
	5	5	2.0	—
	6 (6.3)	5	2.5	—
	8	5	3.5	—
2	10	5	—	—
	13	5	—	—
	16	7.5	—	—
	18	7.5	—	—

Radial Tape & Reel Specifications

ALUMINUM ELECTROLYTIC CAPACITORS

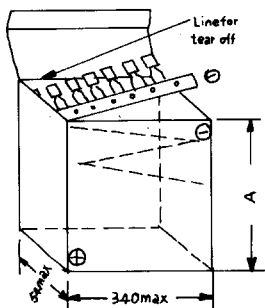


Dimensions: mm

D	5, 6, 8,	
A	12.5	
d	$\frac{0.5}{0.6}$	DIAMETER 5, 6 DIAMETER 8
P	12.7 ± 1.0	
P ₀	12.7 ± 0.3	
P ₁	3.85 ± 0.7	
P ₂	6.35 ± 1.3	
F	5.0 ^{+0.6} _{-0.2}	
Δh	0 ± 2.0	
W	18.0 ^{+1.0} _{-0.5}	
W ₀	12.5	
W ₁	9.0 ^{+0.75} _{-0.5}	
W ₂	3.0	
H	—	
H ₀	16.0 ± 0.5	
H ₁	32.25	
l ₁	2.0	Lead wire length extending beyond tape.
D ₀	4.0 φ ± 0.3	
t	0.7 ± 0.2	
L	11.0	The maximum lead residue of cut defect component.

Packing & quantity

Dia. of capacitor (mm)	Quantity (pcs.)
5	1,200
6	1,000
8	800



Packing & quantity

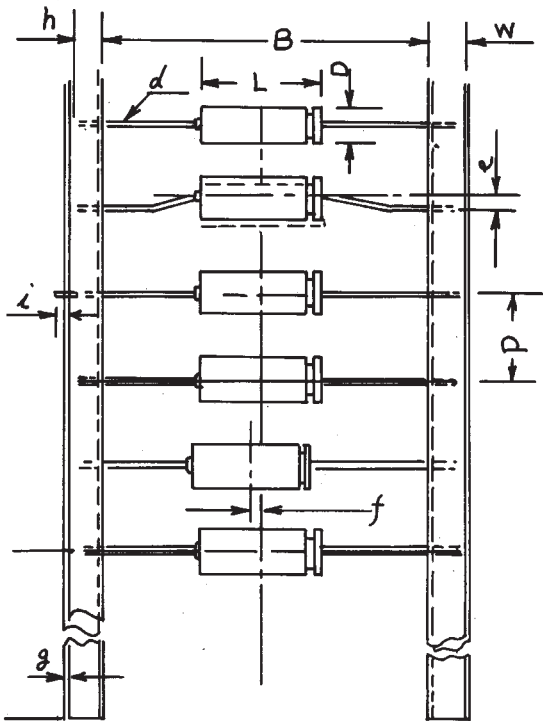
Dia. of capacitor	Packing quantity	Dimension "A"
5 mm	2000 pcs.	250
6	2000	290
8	1000	250



BREL INTERNATIONAL COMPONENTS

1621 WEST UNIVERSITY PARKWAY, SARASOTA, FL 34243
 SALES: (800) 237-4564 PHONE: (941) 355-9791 FAX: (941) 355-1530

Axial Tape & Reel Specifications



DIMENSIONS: mm

D	(D+0.9) MAX	
L	(L+1.5) MAX	
d	0.6	
P	10, 15	±0.5
B	56, 63, 73	±1.5
W	6.2	±0.5
e	1.2 MAX	
f	1.0 MAX	
g	0	+0.8
h	3.2 MIN	
i	1.5 MAX	

- D Case Diameter
- L Case Length
- d Lead Wire Length
- p Component Spacing
- B Distance between Two Tapes (Internal Side)
- W Tape Width
- e Maximum Off Alignment
- f Individual Component Deviates from Center of Components Row.
- g Deviation of Tape Overlap
- h Lead Wire Overlapped by Tape
- i Lead Wire Length Extending Beyond Tape

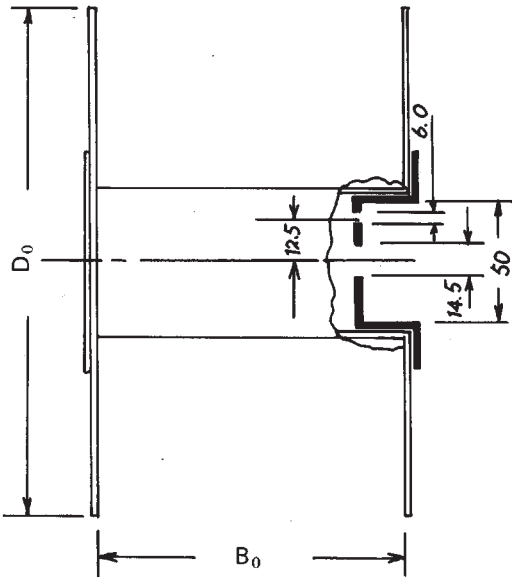
NOTES:

- 1) The lead tape shall be applied to the top and bottom of each lead and shall extend a minimum of 30CM beyond the first and the last component of the reel.
- 2) For polarized capacitors, the "+" lead tape is red color and the "-" lead is white.
- 3) A maximum of 1 component may be missing, provide this gap is followed by at least 6 consecutive components.
 Sequenced assembly tapes shall have no missing components within the sequence order. A space of 1 component shall separated each sequence order.

PACKING & QUANTITY:

CASE SIZE D X L	D ₀	B ₀	*W ₀	(PCS)
6 x 12	330	72	60	1000
6 x 16	330	83	60	1000
8 x 16	330	83	60	800
8 x 20	330	93	80	800
10 x 20	330	83	80	400

*W₀ : The width of paper interliner



BREL Precision Components

SMT Resistor Technology

- **Microminiature Leaded Film Resistors and Leaded Chip Resistors (the World's Smallest)** – RKL-2, 50mW, Cylindrical, D=0.8mm x L=2.2mm LMR, 125 to 350mW, Chip Resistor Substrate Size=0504, 0805 or 1206 with Wire Leads
- **Thin Film Chip Resistors** – Tol= ±0.05% to 1%, TC=5-25ppm, Silicon or Ceramic Substrate
- **Thin Film Networks** – Tol= ±0.02% to 1%, TC=5-25ppm, Custom Design, Surface Mount/Leaded
- **Thick Film Chip Resistors** – Size=0202 to 2512, Range=0.10Ω to 100GΩ, Trimming Style Available
- **Thick Film Networks** – Custom Circuit Design, Flexible Layout, Low Tracking TCR, Surface Mount/Leaded
- **Miniature SMT Coils** – Size=0603 to 1206 Range=1.8nH to 1200nH Tol= ±5% to ±20%
- **Temperature Sensor Chips** – Size=0402-1206, Range=1R00Ω to 10K0Ω Tol= ±0.5% to 20% TC= +1500ppm to +4000ppm
- **Precision Pressure Sensors in Thinfilm** – Measuring Range= 10bar to 2000bar Bridge Resistance= 10KΩ ±15% TC= ±50ppm/K
- **Thinfilm Substrates for Flip Chip Technique** – SnPb Bumps, Bump Height= 40NM to 50NM Combines Flip Chip Technique, US and TS-Wire Bonding Technique, and SMD Solder Technique in One Circuit

Additional Products

- **Tantalum Capacitors**
- **Ceramic Monolithic Chip Capacitors**

BREL Precision Components

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Website: <http://brelintl.com>

BREL International

Capacitor/Resistor Products

- **Aluminum Electrolytic** – Standard, Subminiature, Low Leakage, Non-Polar, Low ESR (Axial or Radial)
- **Plastic Film** – Polyester, Polypropylene, Polystyrene, Polycarbonate (Dipped, Encased, Axial-Wrap & Fill)
- **Ceramic** – Single Layer-Axial/Radial; Multilayer-Chip (Surface Mount – 0402 to 1812), Epoxy Dip (Thru Hole)
- **Resistors** – Carbon Film (1/8W-2W) ±2%, ±5%; Metal Film (1/8W-2W) ±0.1%, ±0.25%, ±0.5%, ±1% (25, 50, 100 ppm); Metal Oxide Film; Power: Wirewound-Cement Encased or Tubular-Epoxy Coated
- **Chip Resistors and Thick Film Resistor Networks** – Size=0402 to 2512, Tol= ±1%, ±2%, ±5%, TC=100-200ppm; SIP Network – 5 to 12 Pins
- **Potentiometers** – Rotary, Slide, Trimmer, Conductive Plastic, Custom Design – Multi-Section, Switched
- **Crystal Products** – Crystals, Oscillators – VCXO, TCXO, Dual-Output, Trimode, CMOS, TTL; Crystal Filters
- **Switches** – DIP Slide, Rocker, Toggle – Miniature Sizes
- **Jacks and Plugs** – DC Power, Earphone, Phono, DIN, Headphone Jacks, Stereo/Mono Plugs, DC Power Plugs
- **Cables and Connectors** – Line Cords, Computer Cables, RS-232, Centronics, Edge Card Connectors
- **Semiconductor Products** – Diodes, Rectifier, Small Signal, Zener, Schottkey & Rectifier Bridges

Specialized Products

LCR-Capacitors, Vogt AG – Stamped Metal Products, AB Electronic, Taitron Semiconductors, Potentiometers

BREL International Components

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