

## Long Life Technology for Aluminum non-solid electrolytic capacitors

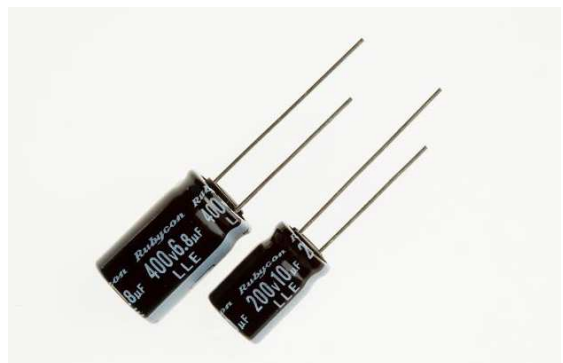
### [ Introduction ]

CO2 reduction efforts are carried out nationwide and corporate level toward the prevention of global warming. Also, Japanese Nuclear power generation plants stop operation one after another by change in thinking of it after the 3.11 East Japan Earthquakes. Thus, the possibility of electricity supply shortage increases throughout Japan, and it led Japanese people think much more about energy saving activities. Furthermore, global energy consumption continues increasing due to population growth and concentration into large cities especially in China and India. As the countermeasure of such energy consumption increase, the concepts of smart house, smart city, smart grid and etc. are started up among various business entities and also as nationwide projects. It is the worldwide shared recognition that one of the urgent tasks is global environmental and energy issues.

As means to achieve the prevention of global warming and energy saving, attention and expectation are paid toward LED (Light Emitting Diode). LED is now considered and adopted in many areas, and especially in the lighting industry, change from incandescent or fluorescent bulb to LED bulb is actively carried out as family actions to help prevention of warming, CO2 reduction and energy saving. The main features of LED lighting are energy saving and long life, so that those component parts to be used in LED lighting equipment are required to be designed as miniaturized and long life.

In the LED lighting equipment, Aluminum non-solid electrolytic capacitors (hereafter referred to as A.E. caps) are used. A.E. caps feature in wider operating temperature range, more miniaturized and larger capacitance values compared with other types of capacitors, but have a demerit of limited life time. Although A.E. caps are mandatory in the LED lighting equipment, because of the limited life time, they are the determining factor of life performance of the equipment.

Long life performance of A.E. caps has been in study as a major theme among manufacturers. Rubycon has developed a composition of high reliability electrolyte through its original technology and commercialized LLE series that realized miniaturized size and long life performance (see Picture-1). This article introduces to LLE series capacitors.



Picture-1: LLE series with miniaturization and long life.

#### [ Necessity of the long life performance of A.E. caps ]

Life time of A.E. caps highly depends upon temperature, and it is possible to extend the life time of the set by reducing the ambient temperature around the capacitors. Some circuit designs may be able to devise the arrangement of component parts to reduce the ambient temperature around the A.E. caps to satisfy the life time requirement of the set. However, LED lighting equipment (especially the bulb type) is designed to be very compact, and it is becoming difficult to satisfy the life time requirement by the devise of circuit design alone such as relocation of the component parts. Thus the A.E. caps to be used in the LED light bulb applications are recently required to have longer life time performance than 10,000hours at 105C, that does not satisfy the life time requirement of the set.

#### [ Features of LLE series ]

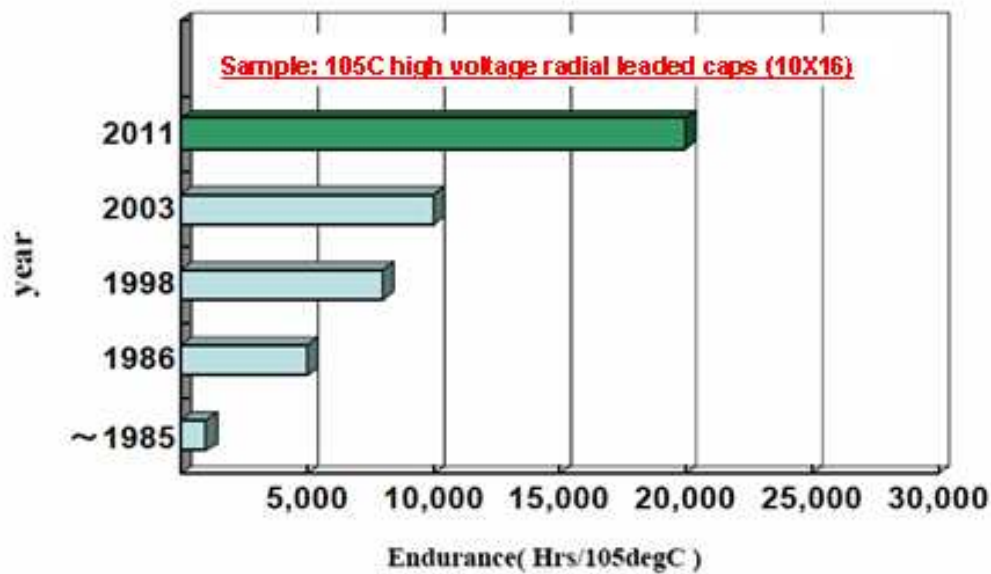
LLE series was developed for the main use in the LED lighting bulb applications where a long life performance requirement is strong. The features of this series are the longest life time in the industry from 12,000 to 20,000 hours with the range of the rated voltage range 160 to 400V, and case sizes from 6.3X11 to 10X16.

Table-1 compares the life time specs between LLE and BXC, the conventional long life capacitors that is widely used in the lighting equipment. It reveals that LLE series realized 1.8 to 2 times long life performance compared with BXC series, while LLE offers smaller size options where BXC did not have.

SIZE	LLE series	BXC series
6.3X11 8X9 10X9	12,000 hours	Not covered
8X11.5 10X12.5	15,000 hours	8,000 hours
10X16	20,000 hours	10,000 hours

Table-1: Life time comparison (hours/105C)

Graph-1 indicates the transition history of the life time performance in the area of high voltage radial leaded A.E. caps (size: 10X16). Much improvement has been made during the recent quarter of a century, and especially the improvement achieved by the LLE series is most significant.



Graph-1: Life time transition history

By using LLE series capacitors, the following are expected:

- (1) Longer life performance will be achievable even under severe operating conditions.
- (2) A.E. caps can be used where MLCC or film capacitors were used before, and cost reduction is expected.
- (3) Smaller sized capacitors can be used where the larger sized capacitors were used before, and contribute to downsizing of the set.
- (4) While component parts locations and heat radiation were devised due to high heat rise in the set before, it will be eased out in the circuit designs to make the set compact.

#### [ Technical factors of long life performance of LLE series ]

A.E. caps deteriorate mainly by electrolyte loss in evaporation through sealing material and characteristics change of electrolyte itself. Thus, main countermeasures for long life performance are to protect electrolyte from evaporation and to prevent deterioration of electrolyte composition inside the capacitors as well as decent amount of electrolyte to be initially contained in the capacitor case.

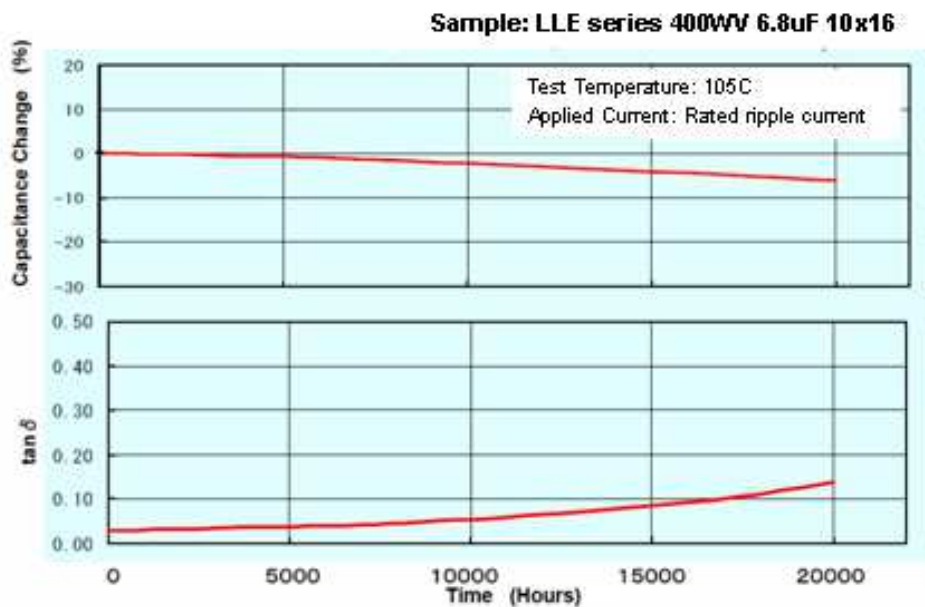
There are several different solvents that are used for electrolyte in A.E. caps. Among those, the ones with main solvent as Ethylene Glycol have been in research by many capacitor manufacturers, and much knowhow is accumulated. Rubycon has developed a composition of electrolyte that excels in long time stability in high temperature circumstances utilizing the knowhow of electrolyte composition technology accumulated over 50 years. This new electrolyte achieved the characteristic change rate over time to be less than 1/3 of the

conventional electrolyte, that means the thermal degradation of electrolyte itself was reduced to the minimal limit.

Also, sealing rubber is selected from the several composition options that have excellent airtight property as to make the best match with the electrolyte described above. Furthermore, the decent amount of electrolyte is secured to contain by the appropriate product design and production equipment developed in house.

Thus, LLE series has been realized with long life performance by consolidated technologies of material, product design and production equipment.

Graph-2 indicates the life test data (capacitance change and dissipation factor change) of 400WV 6.8uF 10X16 part. As indicated, electrical characteristics are stable for a long time.



**Graph-2: Life test data of LLE series**

#### [ Future efforts ]

LLE series was developed for the use in LED lighting bulb applications and its coverage in size and voltage ranges is limited. We plan to expand its coverage in order to be able to contribute widely to other long term and severe condition usage applications as we look into those requirements.

#### [ Conclusion ]

As equipment set continues on miniaturization, internal ambient temperature continues to rise. More and more component parts are required to stand such long term use. A.E. caps have been widely used in these equipment sets because of large capacitance value and cost performance, although the limited life time performance that gives a direct impact to the

equipment life performance. Longer life performance of A.E. caps is essential to secure the long term reliability of the electronic equipment. Significant improvement in life time performance of A.E. caps has been achieved over a long time, and further improvement will be made while taking advantage of it's strength, in the future.

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