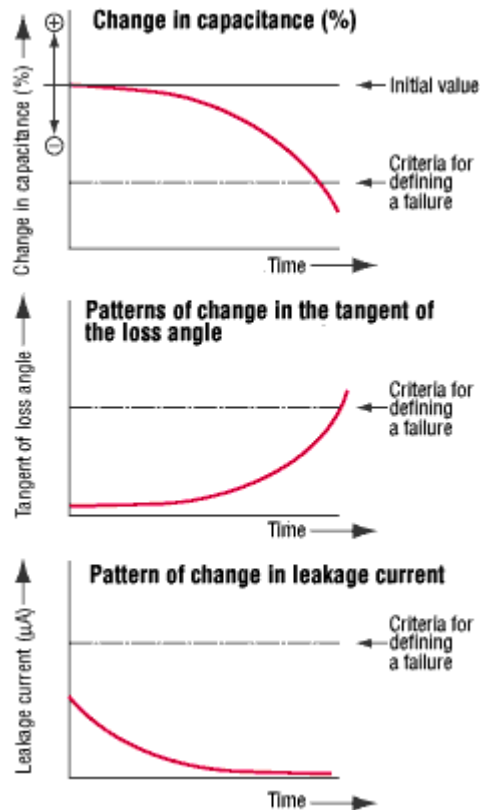


[1] Drift of Aluminum Electrolytic Capacitors Over Time

The aluminum electrolytic capacitor has a limited life span. This occurs because the electrolyte in the element eventually dissipates.

The changes in performance over time can be described as follows:

1. Eventually, the capacitance begins to drop off.
2. The tangent of the loss angle begins to increase.
3. Generally, when voltages are applied, the leakage current begins to drop.
4. Finally, at the end of the life span, the capacitor enters an open-circuit mode as the dielectric dries up.



[2] Criteria for Defining Failures in Aluminum Dielectric Capacitors

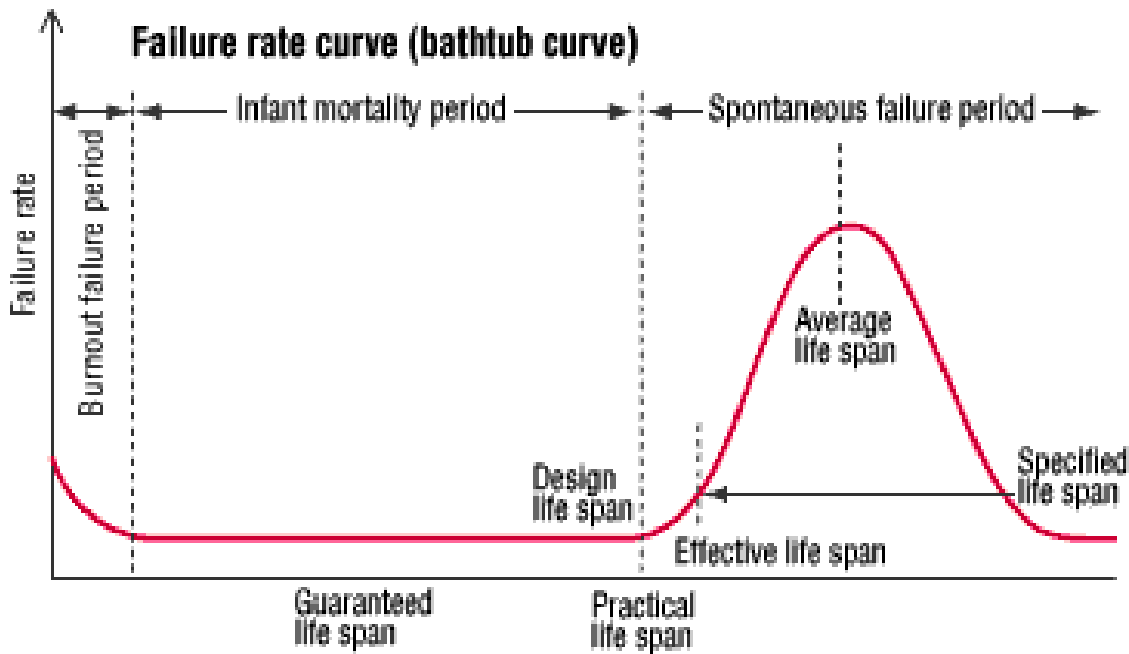
The criteria for defining failures are established for each individual product series. In general, the standards for establishing the guaranteed life span are as follows:

1. Changes in capacitance: A failure is defined as a change in capacitance from the initial capacitance level beyond the specified range. The change is generally $\pm 20\%$ to $\pm 30\%$.
2. Changes in the tangent of the loss angle: A failure is defined as the component exceeding the specified range. Usually, this range is 1.5 to 3.0 times the initial value.
3. Change in leakage current: The definition of failure occurs when there is an excess of the specification values.

[3] Definitions of Life Span for the Aluminum Electrolytic Capacitor

The following five life span definitions of aluminum electrolytic capacitors are used at Elna:

1. **Guaranteed Life Span** – The life span that is set in the product transactions. (The period of time where the specified performance will be maintained.)
2. **Design Life Span** – A targeted life span specified at the design stage.
3. **Practical Life Span** – A precursory period of time where the component enters into the burnout failure phase.
4. **Effective Life Span** – The period of time where the capacitor has gone beyond the infant mortality stage and has entered the burnout failure stage. At this stage, the number of failures is less than the specified values.
5. **Average Life Span** – The average of the five life spans prior to the burnout failures.



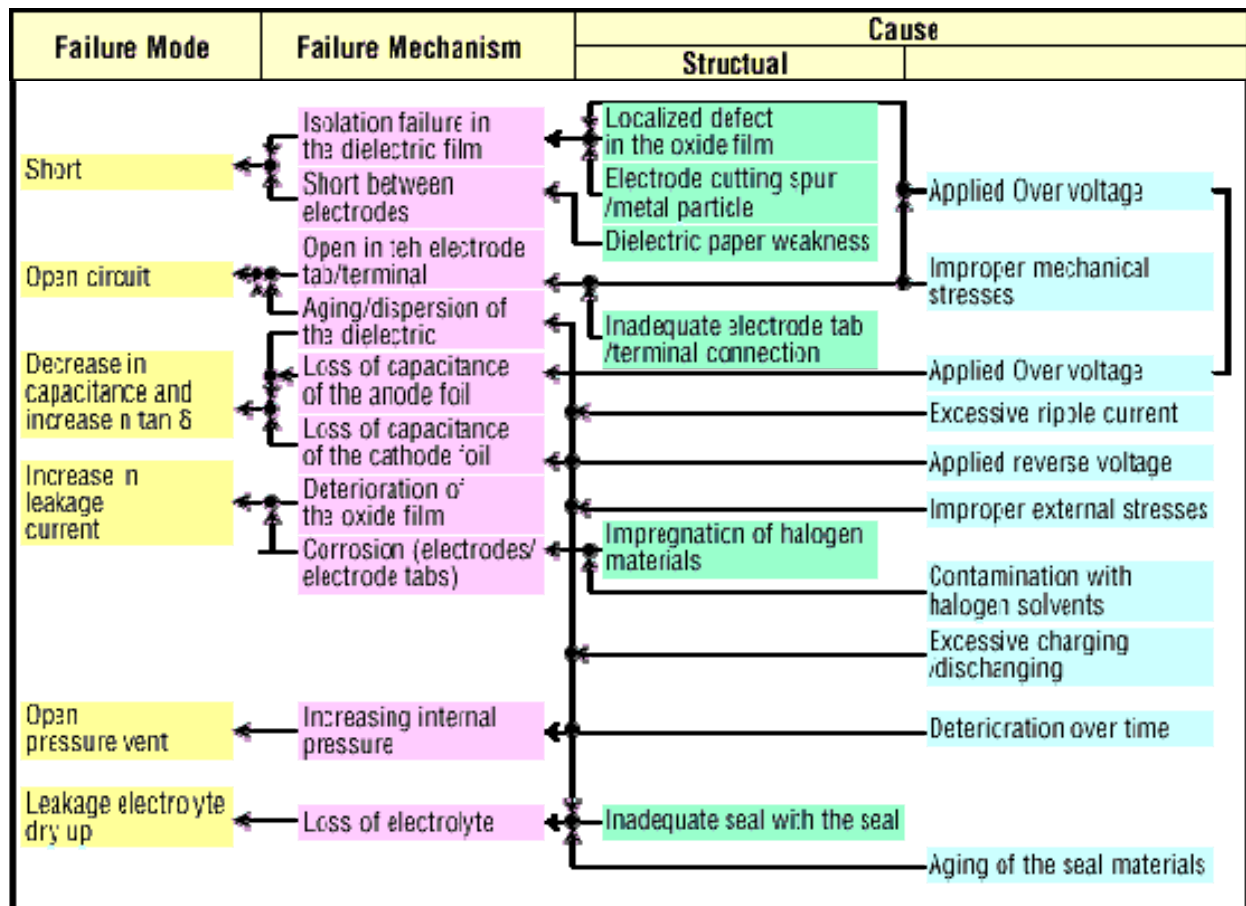
There are five different definitions for "life span."

These definitions share a relationship in terms of the length of their life spans:

- Guaranteed life span • Design life span • Practical life span • Effective life span • Average life span

[4] Typical Aluminum Electrolytic Capacitor Failure Modes and Their Causes

The failure mode and cause analysis diagram is shown below:



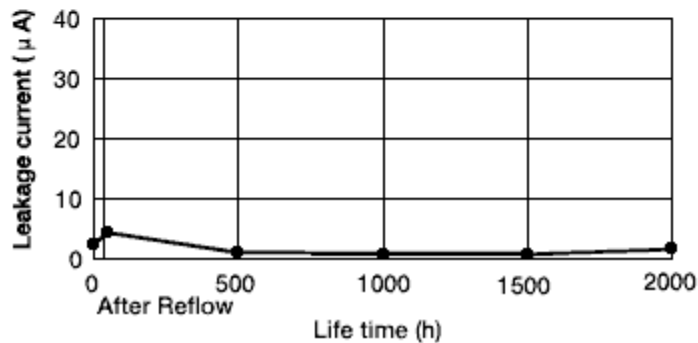
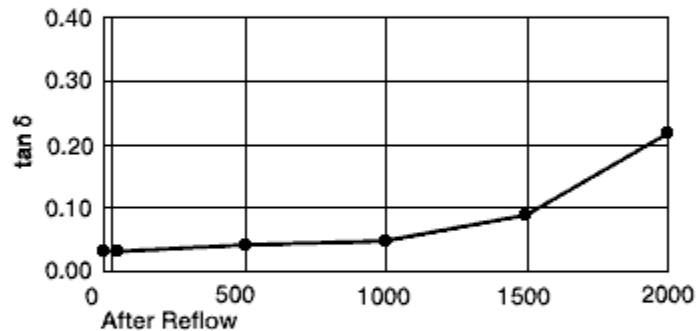
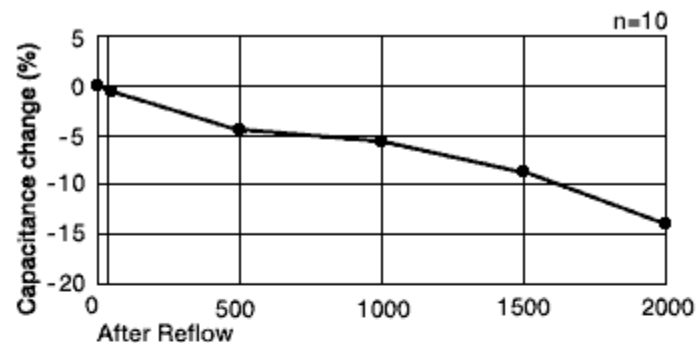
[5] Various Types of Reliability Data

Reliability data for typical Elna aluminum dielectric capacitors are shown below (*note* – all data shown are representative measurements, not guaranteed values):

RVK Series: 125°C vertical chip aluminum electrolytic capacitor *Durability (high temperature charge)*

Endurance (Ripple superposed) at 125°C

Series	Ratings	Case size	Ripple current (100kHz)
RVK	35V 47 μ F	ϕ 8 x 10L	55mA rms

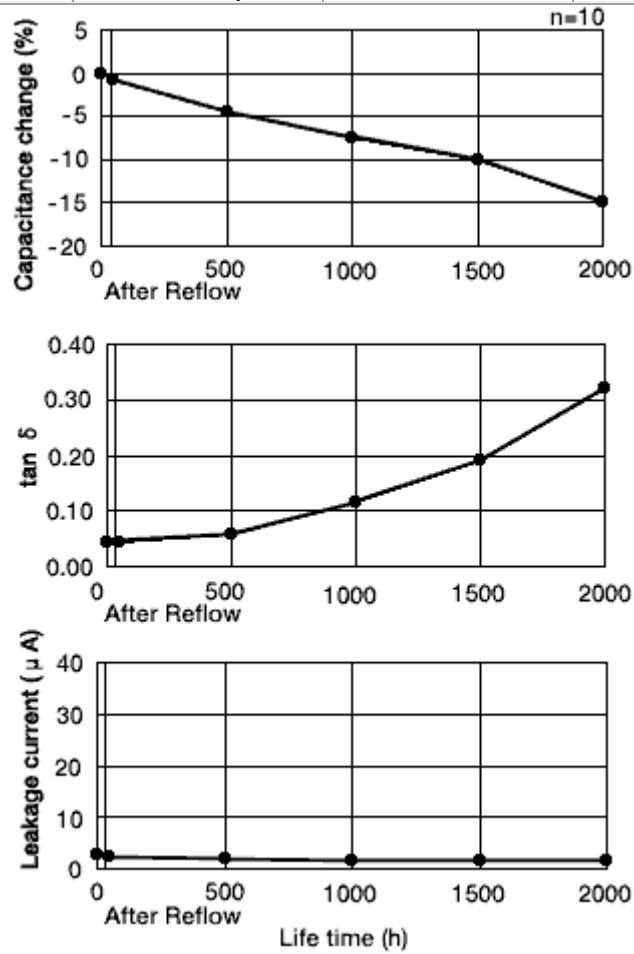


Reliability of Aluminum Electrolytic Capacitors

RVK Series: 125°C vertical chip aluminum electrolytic capacitor
Durability (high temperature charge)

Endurance (Ripple superposed) at 125°C

Series	Ratings	Case size	Ripple current (100kHz)
RVK	35V 100μF	Φ10 x 10L	102mA _{rms}

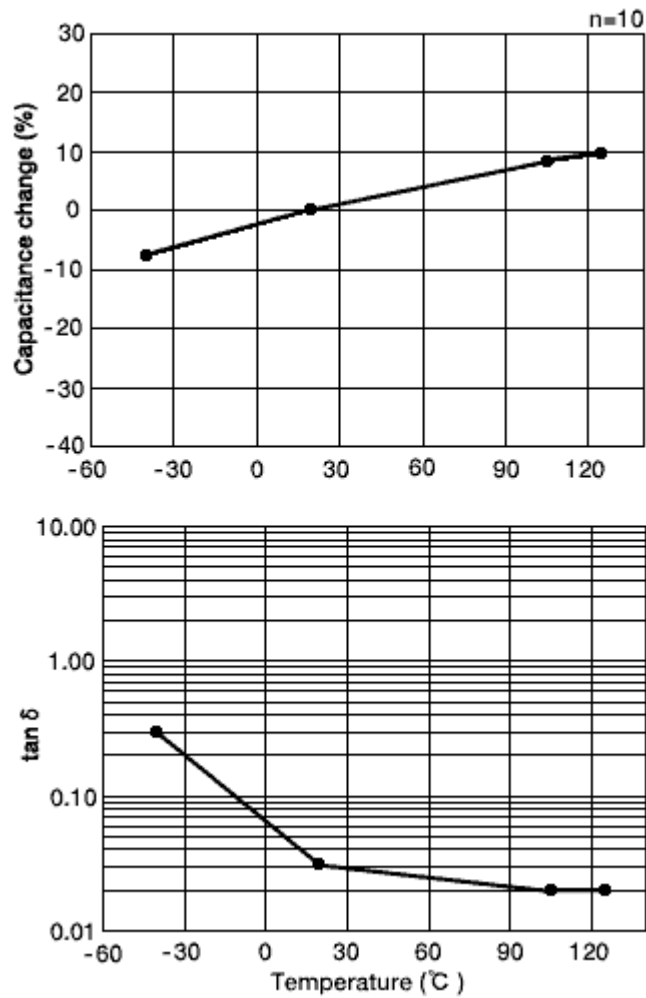


Reliability of Aluminum Electrolytic Capacitors

RVK Series: 125°C vertical chip aluminum electrolytic capacitor
High temperature and low temperature characteristics

Temperature Characteristics

Series	Ratings	Case size
RVK	35V 47 μ F	ϕ 8 x 10L

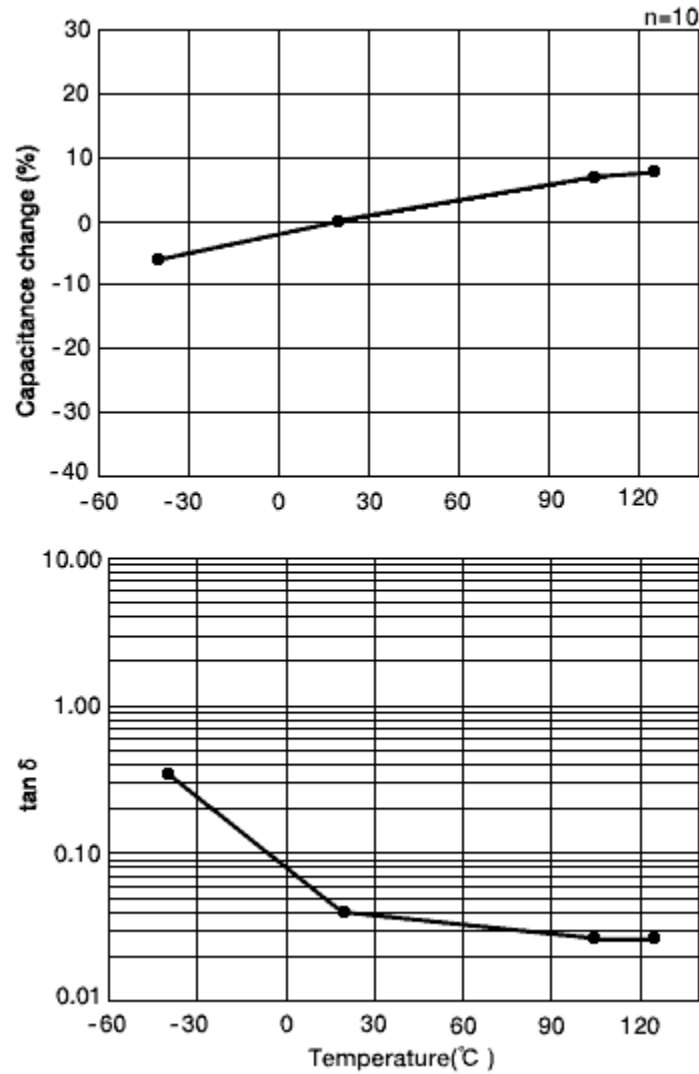


Reliability of Aluminum Electrolytic Capacitors

RVK Series: 125°C vertical chip aluminum electrolytic capacitor
High temperature and low temperature characteristics

Temperature Characteristics

Series	Ratings	Case size
RVK	35V 100μF	φ10 x 10L

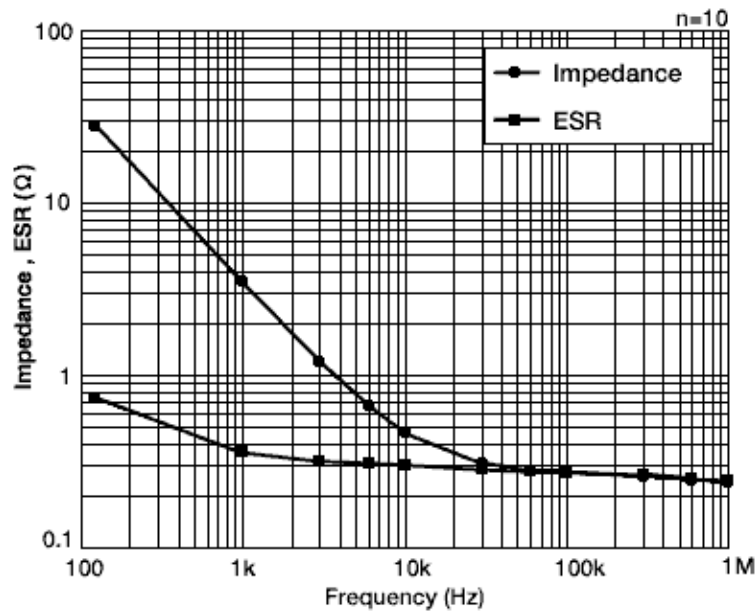


Reliability of Aluminum Electrolytic Capacitors

RVK Series: 125°C vertical chip aluminum electrolytic capacitor Frequency characteristic

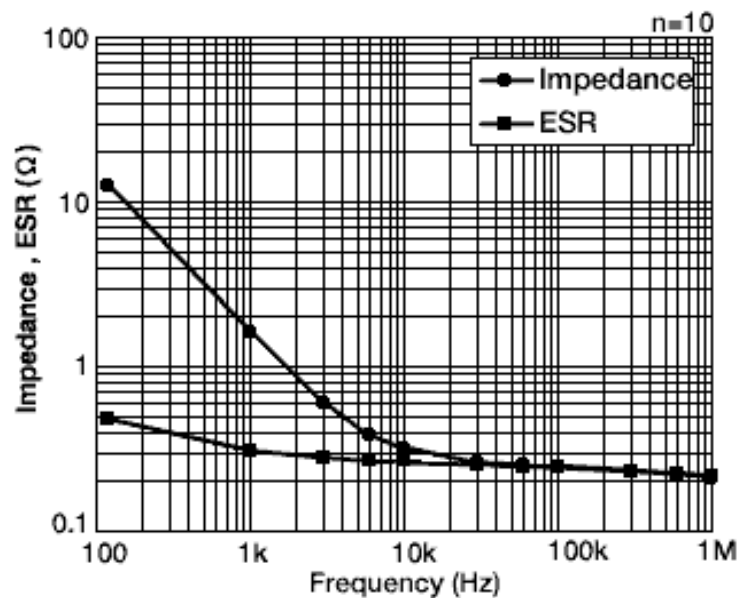
Temperature Characteristics at 20°C

Series	Ratings	Case size
RVK	35V 47 μ F	ϕ 8 x 10L



Temperature Characteristics at 20°C

Series	Ratings	Case size
RVK	35V 100 μ F	ϕ 10 x 10L

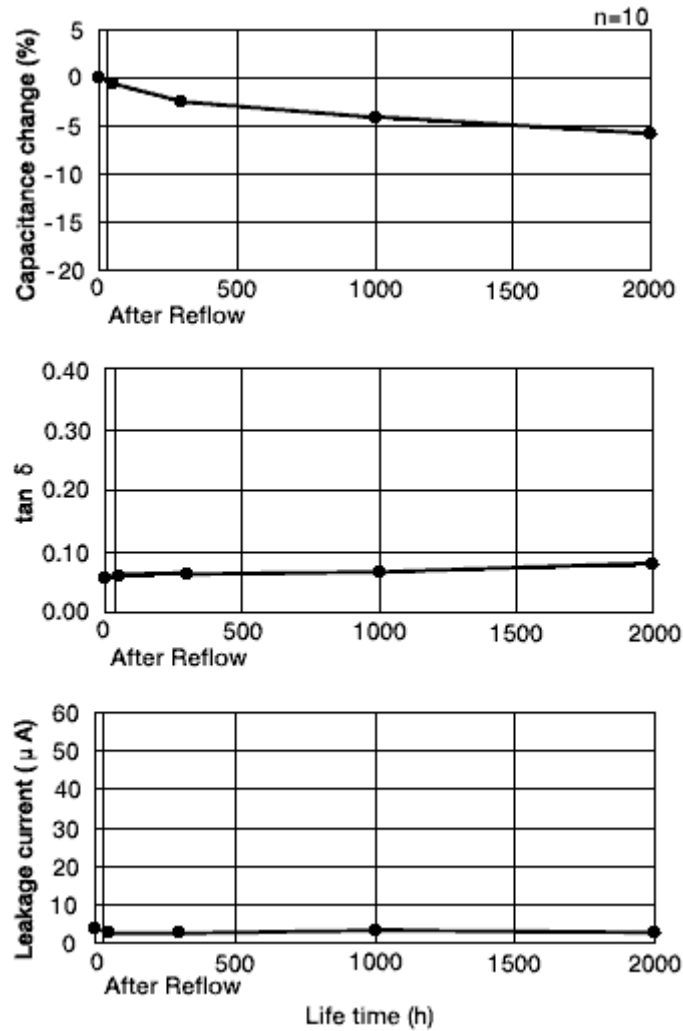


Reliability of Aluminum Electrolytic Capacitors

RYP Series: 125°C horizontal chip aluminum electrolytic capacitor
Durability (high temperature charge)

Endurance (Ripple superposed) at 125°C

Series	Ratings	Case size	Ripple current (100kHz)
RYP	35V 220μF	φ9.5 x 24L	230mA _{rms}

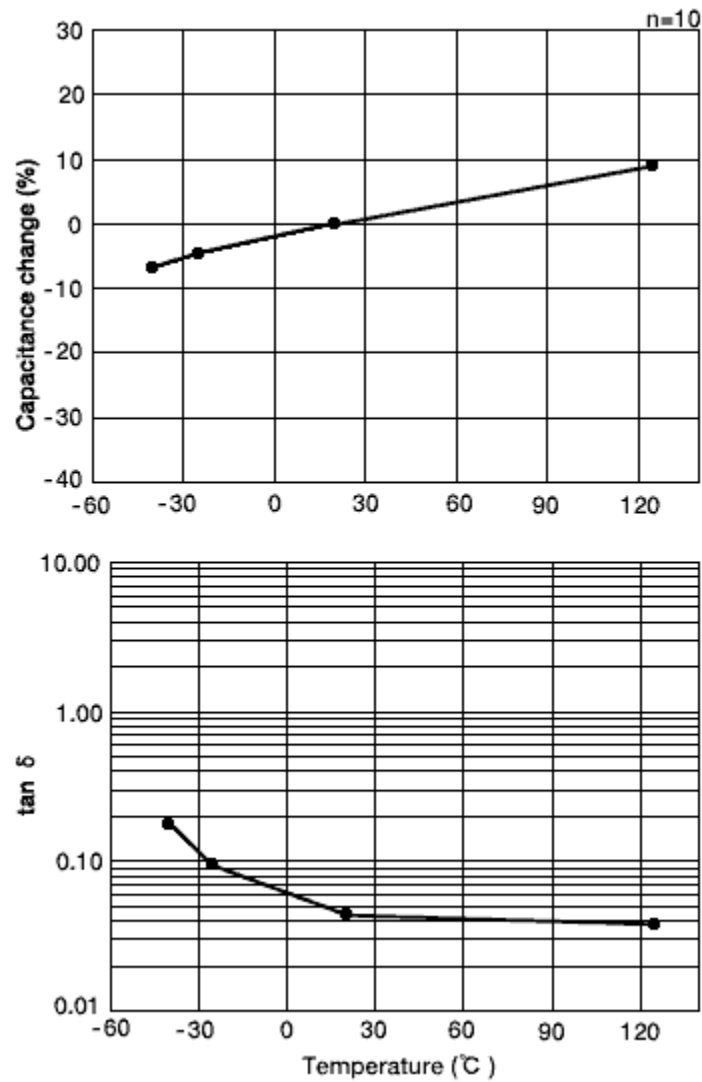


Reliability of Aluminum Electrolytic Capacitors

RYK Series: 125°C horizontal chip aluminum electrolytic capacitor
High temperature and low temperature characteristics

Temperature Characteristics

Series	Ratings	Case size
RYK	35V 220μF	φ9.5~24L

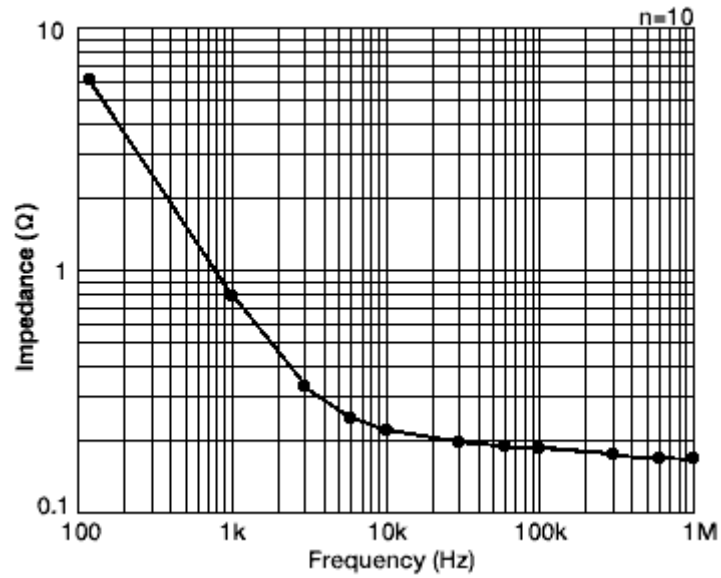


Reliability of Aluminum Electrolytic Capacitors

RYP Series: 125°C horizontal chip aluminum electrolytic capacitor
Frequency characteristic

Frequency Characteristics at 20°C

Series	Ratings	Case size
RYP	35V 220μF	φ10 x 20L

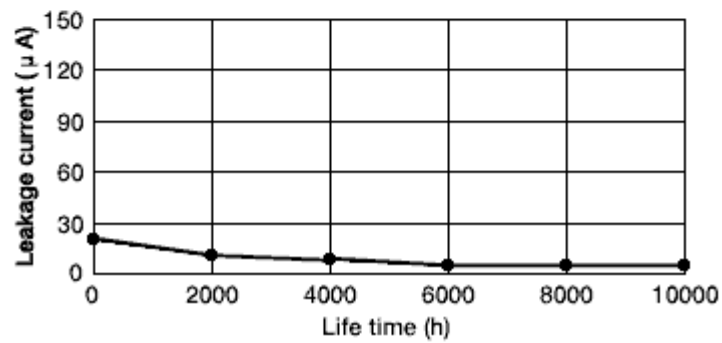
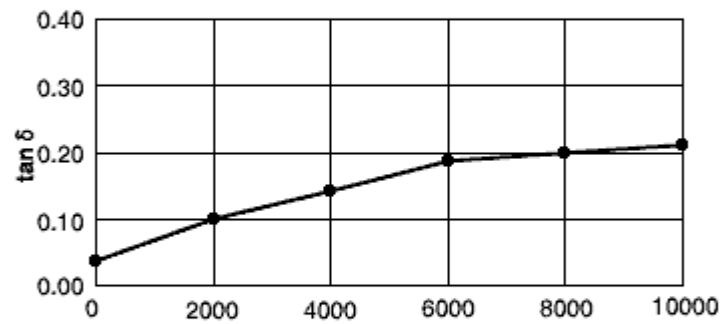
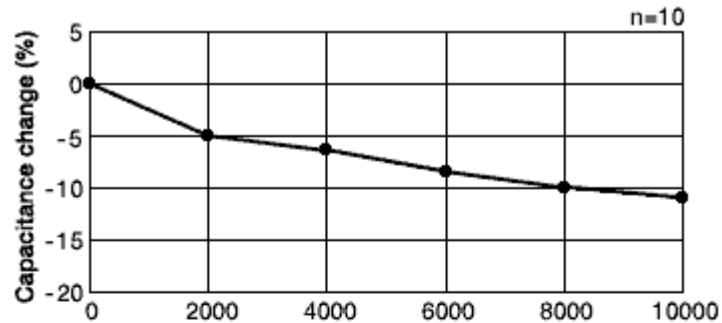


Reliability of Aluminum Electrolytic Capacitors

RK Series: 125°C small footprint aluminum electrolytic capacitor
Durability (high temperature charge)

Endurance (Ripple superposed) at 125°C

Series	Ratings	Case size	Ripple current (100kHz)
RK	25V 1000 μ F	ϕ 12.5~25L	1260mA _{rms}

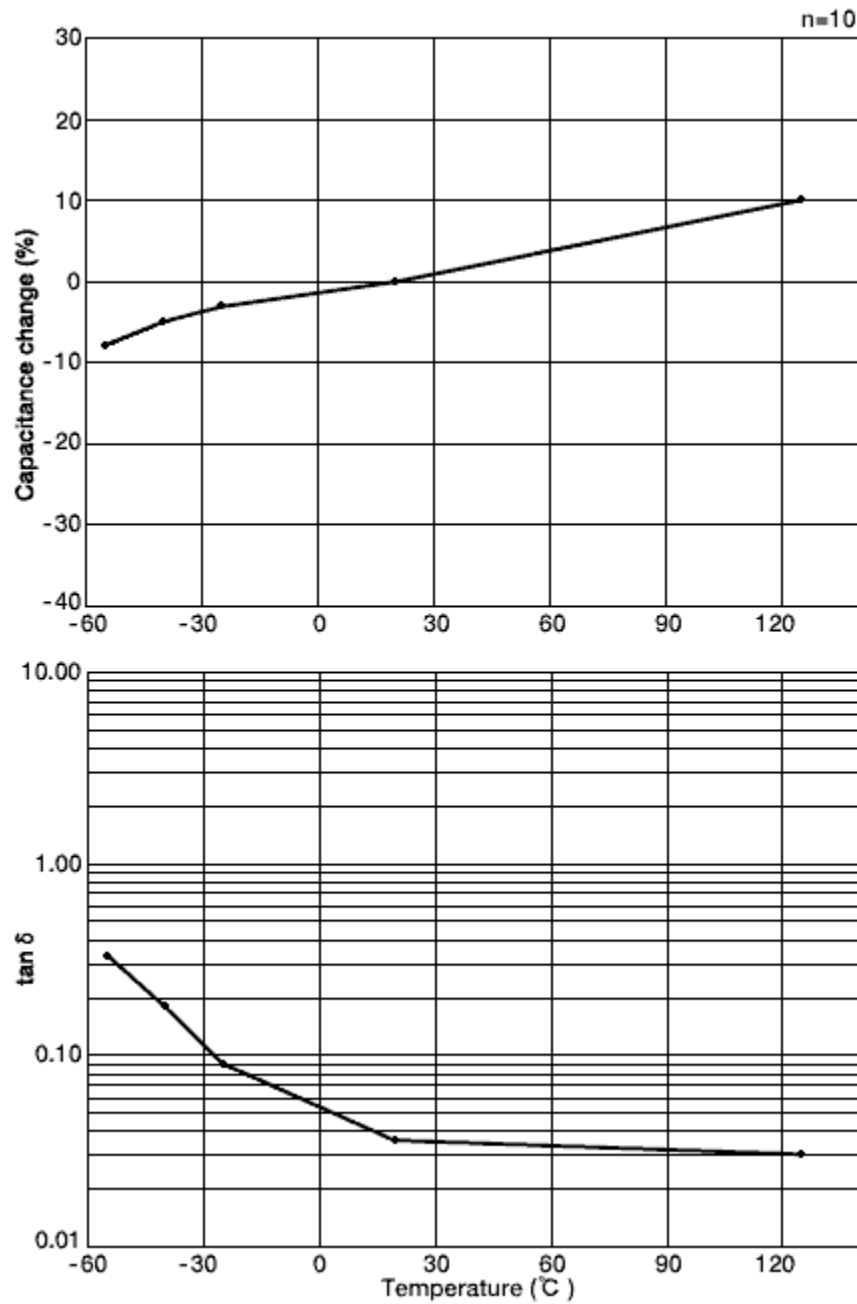


Reliability of Aluminum Electrolytic Capacitors

RK Series: 125°C small footprint aluminum electrolytic capacitor
High temperature and low temperature characteristics

Temperature Characteristics

Series	Ratings	Case size
RK	25V 1000 μ F	ϕ 12.5 x 25L

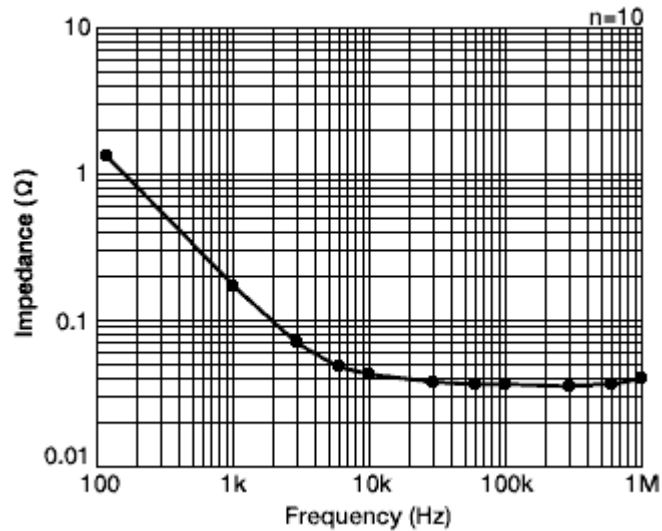


Reliability of Aluminum Electrolytic Capacitors

RK Series: 125°C small footprint aluminum electrolytic capacitor
Frequency characteristic

Frequency Characteristics at 20°C

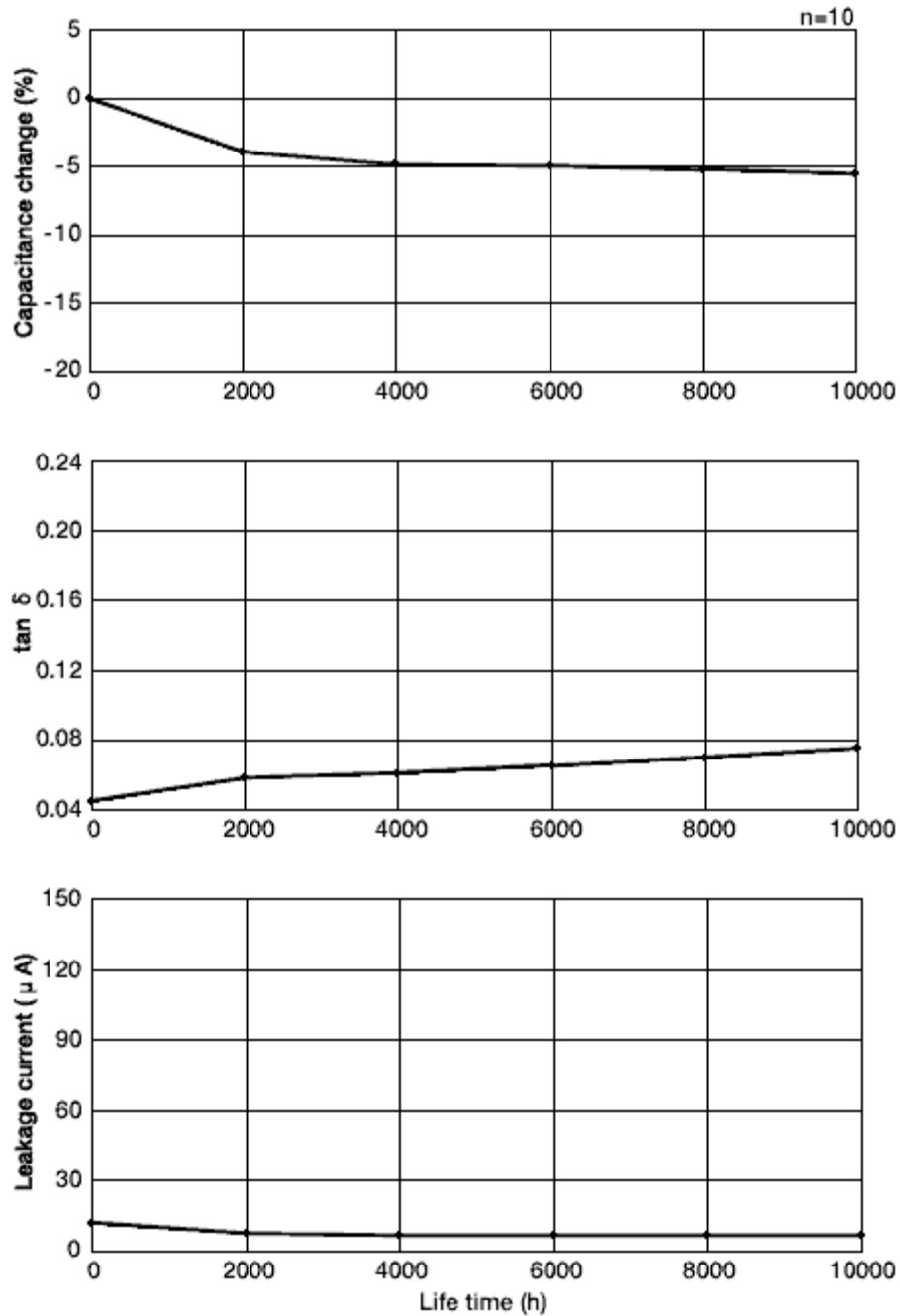
Series	Ratings	Case size
RK	25V 1000 μ F	ϕ 12.5 x 25L



RJB Series: 105°C small footprint high reliability low impedance aluminum electrolytic capacitor
Durability (high temperature charge)

Endurance (Ripple superposed) at 105°C

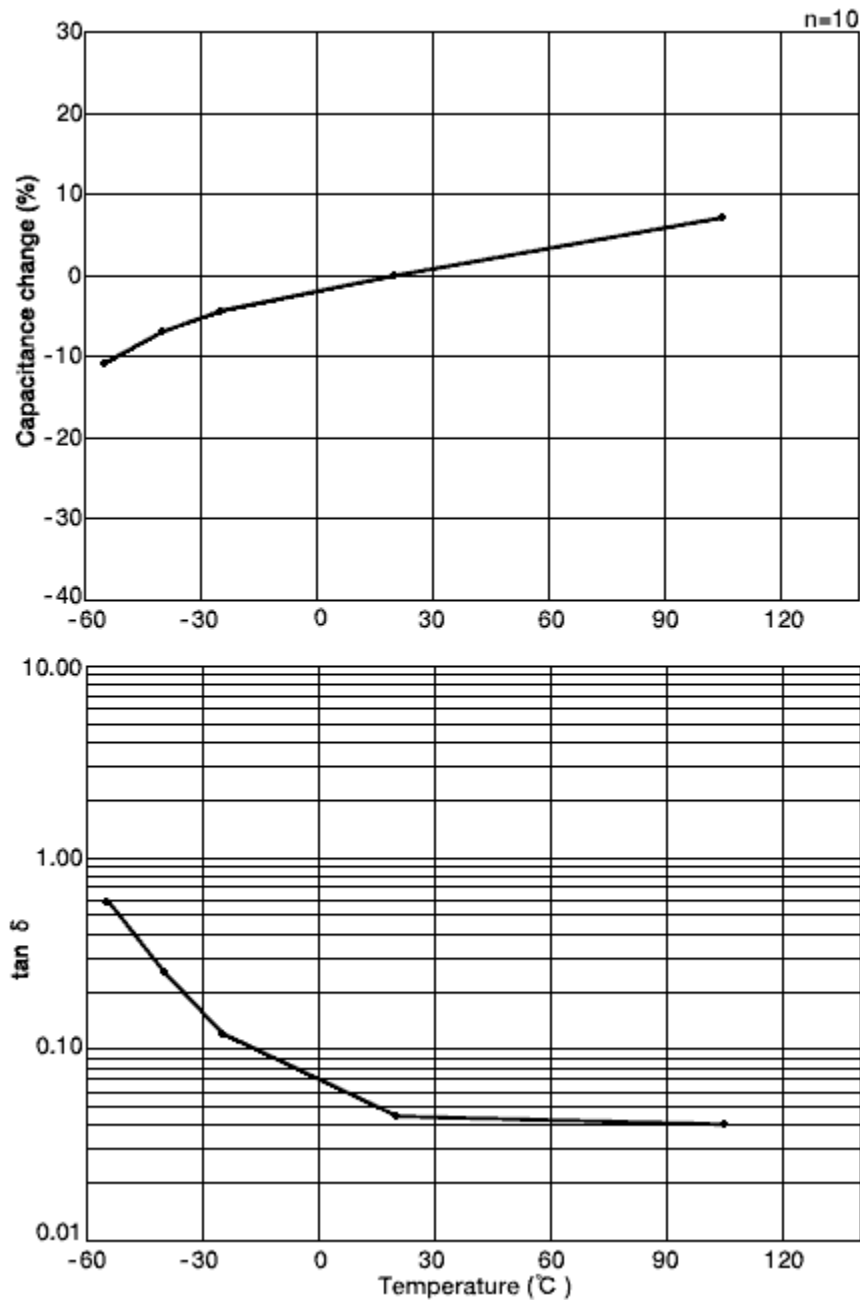
Series	Ratings	Case size	Ripple current (100kHz)
RJB	35V 470μF	Φ10 x 20L	1440mA _{rms}



RJB Series: 105°C small footprint high reliability low impedance aluminum electrolytic capacitor
High temperature and low temperature characteristics

Temperature Characteristics

Series	Ratings	Case size
RJB	35V 470μF	φ10 x 20L



Reliability of Aluminum Electrolytic Capacitors

RJB Series: 105°C small footprint high reliability low impedance aluminum electrolytic capacitor
Frequency characteristic

Frequency Characteristics at 20°C

Series	Ratings	Case size
RJB	35V 470μF	ϕ10 x 20L

