

## TECHNICAL BULLETIN

**[Issue No.]** FA-A-0018-A

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**[Title]** Recommendation of preventive maintenance and inspection for MELSEC programmable controllers

**[Date of Issue]** Mar. '08

**[Relevant Models]** All MELSEC programmable controllers

Thank you for your continued support of Mitsubishi programmable controllers, MELSEC series.

We summarized the concept on the life and preventive maintenance of the programmable controller for planned execution of preventive maintenance.

### 1. Useful life of the programmable controller

The standard useful life of the programmable controller, excluding limited life parts (aluminum electrolytic capacitor, relay, switch, battery, fuse, etc.) is ten years.

Note that the useful life is a duration in which the programmable controller can perform proper functions/performance.

### 2. Necessity of preventive maintenance

The recommended replacement cycle as part of preventive maintenance is five years for modules using aluminum electrolytic capacitor as an important part, and from five to ten years for other modules.

The programmable controller consists of various electronic components, and can perform the best functions and performance by operating them normally. To achieve it, finding a sign of programmable controller failure early by daily/periodic inspections and taking the corrective action are required. Especially, limited life parts cannot be used indefinitely. Using them exceeding the years specified according to each part type (useful life) may affect the characteristics of programmable controller, resulting in a malfunction or a failure of the devices.

Particularly, when aluminum electrolytic capacitor life ends, the noise durability lowers due to capacity low or the printed-circuit board is damaged due to liquid leak, resulting in an erroneous input or output or a malfunction of the programmable controller.

An aim of preventive maintenance is to prevent a device failure as far as possible by replacing parts/modules in every certain period.

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**3. Years of use and failure occurrence**

Generally, the failure rate of electronic device such as programmable controller is expressed by bathtub curve as Figure 1. The curve is divided into the three stages: initial failure, random failure, and wear-out failure.

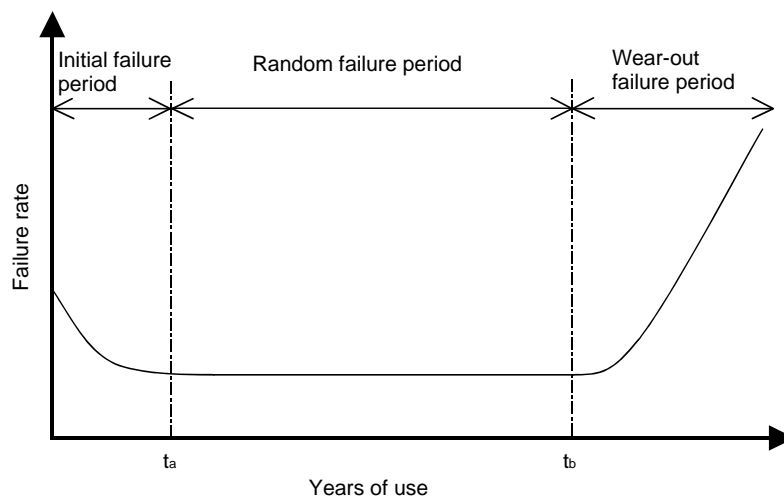


Figure 1 Relationship between years of use and failure rate

Initial failure occurs during initial operation, which includes faulty part and a defect in manufacture found after first use of the product. We make every effort to prevent the initial failure by pre-shipment test.

Random failure is unexpected and accidental failure that occurs before deterioration or wear proceeds within useful life of the device. It is named after its eventuality from the viewpoint of statistics and genesis phenomenon. Handle the failure by corrective maintenance; that is, preparing spare parts.

Wear-out failure occurs at the end of useful life as a result of deterioration or wear, and failure rate in this period drastically increases as the elapse of the time. We recommend replacing our programmable controller within every ten years (rough guide), which corresponds to the point at  $t_b$  on Figure 1.

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#### 4. Limited life parts and preventive maintenance

Limited life parts used with our programmable controller are aluminum electrolytic capacitor, relay, switch, battery, and fuse, etc.

##### (1) Aluminum electrolytic capacitor

An aluminum electrolytic capacitor is used with various modules such as power supply module.

Operating ambient temperature affects a life of the aluminum electrolytic capacitor. According to "Arrhenius law (10°C double rule)", when the temperature increases by 10°C, the life shortens to half. Meanwhile, when the temperature decreases by 10°C, the life lengthens to twice.

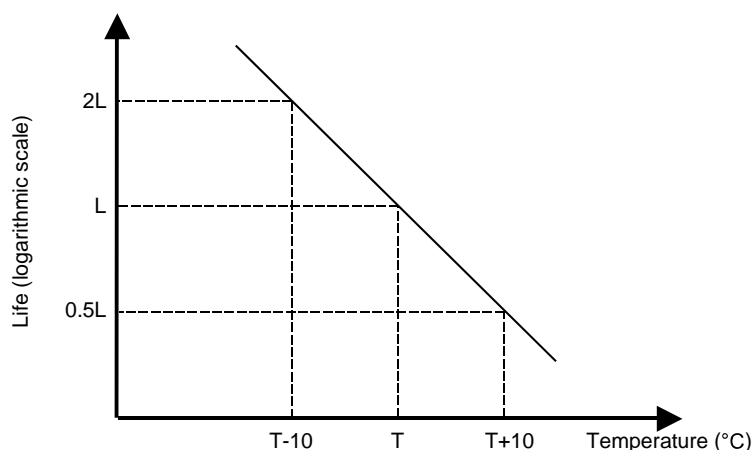


Figure 2 Arrhenius law

The aluminum electrolytic capacitor used with our programmable controller is designed to satisfy around 10-year life under an environment of average ambient temperature of 40°C.

However, the following preventive maintenance/maintenance and inspection are recommended, according to achievements in the market, operating environment, and application of the aluminum electrolytic capacitor.

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1) Power supply module

Since the aluminum electrolytic capacitor is used for smoothing 100/200V and 5V output, replace the module in every five years (rough guide) as part of periodic preventive maintenance.

When the aluminum electrolytic capacitor life ends, the power supply may become unstable, resulting in a malfunction of the programmable controller.

2) CPU module and I/O module

Since the aluminum electrolytic capacitor is mainly used for eliminating ripple noise, replace the module in every five to ten years (rough guide) as part of periodic preventive maintenance.

When the aluminum electrolytic capacitor life ends, noise durability lowers due to capacity low or the printed-circuit board is damaged due to liquid leak, resulting in an erroneous input or output or a malfunction.

Due to the reason described 1) above, replace the CPU module with power supply module in every five years (rough guide).

3) Other modules such as special function module or intelligent function module

Since the aluminum electrolytic capacitor is mainly used for eliminating ripple noise, replace the module in every five to ten years (rough guide) as part of periodic preventive maintenance.

When the aluminum electrolytic capacitor life ends, noise durability lowers due to capacity low or the printed-circuit board is damaged due to liquid leak, resulting in a malfunction of the programmable controller.

In some cases, the aluminum electrolytic capacitor is used for smoothing internal power supply (example: analog output module, positioning module, and network module (including remote I/O)). Replace these modules in every five years (rough guide) as part of periodic preventive maintenance.

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(2) Relay (contact)

The life of the output module of contact output type depends on worn-out status of a contact.

There are two types of the life: mechanical life depending on the number of switching times and electrical life relying on switching current value and inductance of the load (L). Figure 3 shows the typical electrical life curve. For details, refer to User's Manual of each module.

Generally, when switching the rated current, the electrical life becomes shorter than mechanical life. If considering the life, suppress the maximum switching frequency within 3600 times/hour.

Replace the modules before the relay life ends as part of periodic preventive maintenance.

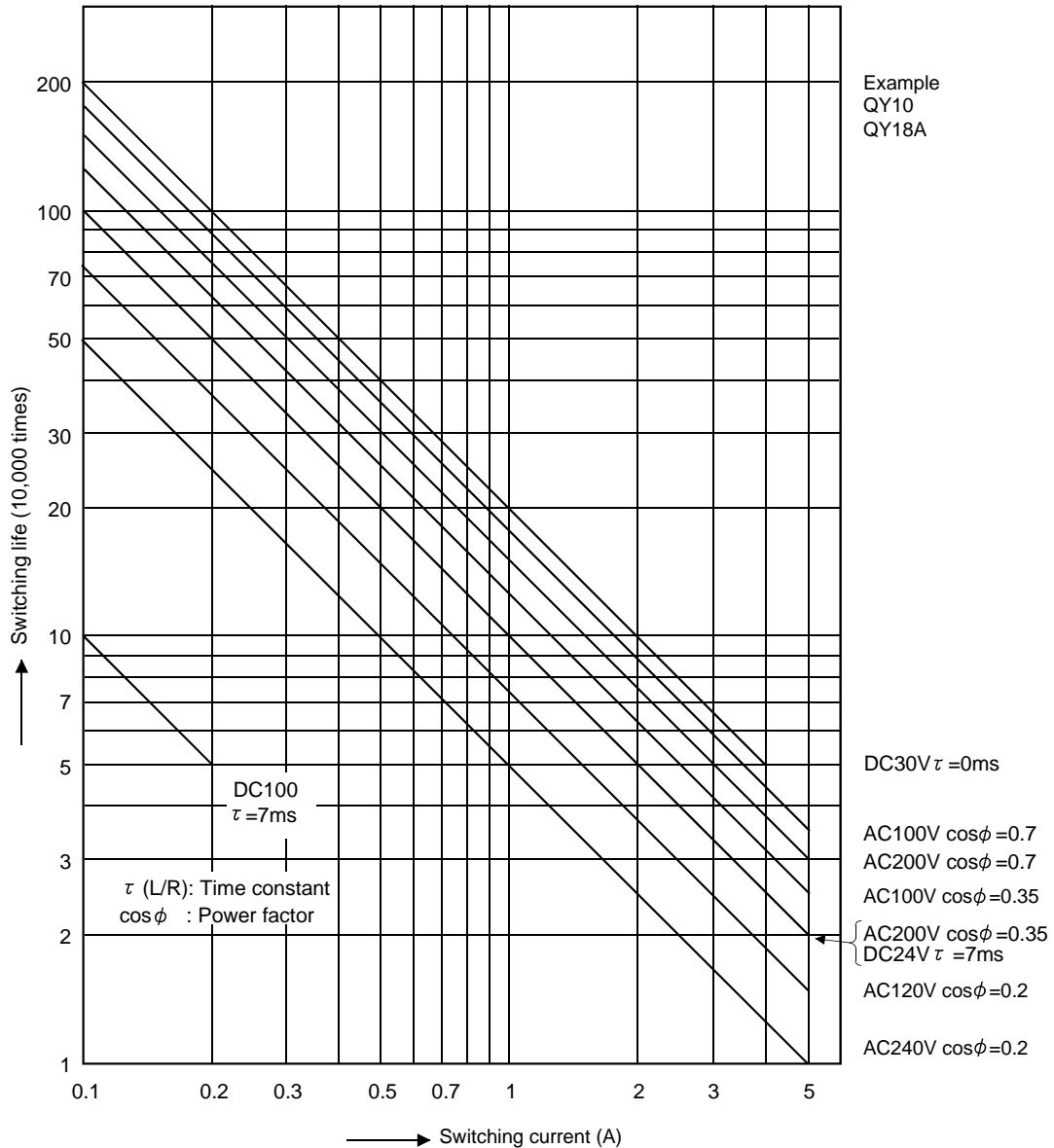


Figure 3 Electrical life of a relay

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### (3) Switch

Parts with contact used for the programmable controller such as a switch and socket may cause poor contact depending on the operating environment.

Under an environment where dust and oil mist is subject to enter, foreign material may attach on the contact surface.

Under an environment where corrosive gas exists, chemical film may be generated on the contact surface. This may cause poor contact of the contact.

Moreover, under an environment where structural parts inside the switches are under a load due to such as a temperature, humidity, vibration, and shock, the internal mechanical precision may not be retained, resulting in poor contact of the contact.

To prevent a malfunction due to poor contact, replace the modules in every ten years (rough guide) as part of periodic preventive maintenance.

### (4) Battery

Built-in batteries of the CPU module, special function module, and intelligent function module are used to back up (power failure compensation) the memories storing programs, parameters, and control data in case of power-off or power failure.

The battery life depends on module type.

A battery error occurs when battery capacity lowers and a voltage is equal to or less than the specified value. Since there is the retention time from several tens to hundred hours after battery error, replace the battery within the time.

For checking method of battery errors, refer to User's Manual of each module.

### (5) Fuse

Fuse is used to protect the input side of power supply module and the external output element of output module.

Especially when the output module is AC load, some loads causes inrush current reaching several to 10 times higher than the rated load current, and an element fatigues, resulting in fuse blown. The value, frequency, and number of occurrences of inrush current affect its life.

A spare fuse is attached to our programmable controller to which a fuse can be replaced. Even if a fuse is not blown, replace the fuses or modules in every ten years (rough guide) as part of periodic preventive maintenance.

## 5. When the programmable controller system has not been used for a long period of time

To prevent accidents such as electric leakage due to the end of service life or deterioration or insulation failure, be sure to turn off the power of the programmable controller system if it will not be used for a long period of time.

## 6. Module replacement before the end of service life

Before the expected service life is reached, consider replacing your programmable controller module with a new one or the latest series module as preventive maintenance.

## 7. Other information

To shorten recovery time required for programmable controller failure, preparing spare parts is recommended.

For inspection, contact your local Mitsubishi sales office or representative. For items and descriptions of daily/periodic inspections, refer to User's Manual of each module.