

BATTERY POWER PRODUCTS & TECHNOLOGY

Solutions for OEM Design Engineers, Integrators & Specifiers of Power Management Products

In the World of Power Supplies, Don't Mistake MTBF for Life Expectancy

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For machine system designers needing to evaluate which power supplies will best fit a specific machine design or application, it's standard practice to compare each unit's mean time between failures (MTBF) rating. Most people believe that MTBF is the number of operating hours that will elapse before a unit fails. In reality, MTBF is the total functional life of a system component, divided by the number of failures: a measurement of reliability. Examining reliability of a power supply is important because the MTBF can have a significant impact on overall system performance and efficiency. Yet, engineers and designers often make the mistake of assuming that MTBF can automatically be equated with a unit's life expectancy.

In reality, there is no direct correlation between MTBF and the actual operating life of a product. In fact, it's possible to find a power supply with extremely high MTBF but very low operating life span, depending on the types of components used and actual operating conditions.

Why the Discrepancy?

The expected life of a power supply is often misunderstood, because operating life can be affected by many factors, such as the average load rate, vibration and ambient temperature. A power supply's MTBF also is closely linked to the quality and life of a unit's internal electrolytic capacitors, the devices that store energy. Capacitors can be used to guard against sudden losses of voltage in circuits. So, for example, while a certain power supply may have a calculated MTBF of more than 600,000 hours, its electrolytic capacitors may have a MTBF rating of as little as 50,000 hours. Yet, because manufacturers cannot predict how their products will be used in the end user's operating environment, the industry still relies heavily on MTBF ratings.

Getting a More Accurate Picture of Life Expectancy

To get a better idea of the actual life span of a power supply, engineers and system designers evaluating different options examine which method the manufacturer uses to create its MTBF ratings. It's important to find out, for example, whether or not the power supply was rated at its full load.

If a power supply is tested at less than full load under continuous operation, it will likely operate cooler and have no thermal cycling, yielding a much longer life than would likely occur in normal operating conditions. Similarly, MTBF ratings should be conducted at a high ambient temperature, such as 40°C (104°F), to duplicate actual operating conditions.

Most manufacturers today rely on one of two standards to determine MTBF ratings: the Siemens-norm SN 29500 and the MIL-HDBK-217F prediction method. Because factors such as temperature and power load can have such a dramatic impact on capacitor life span, the SN 29500 can be particularly helpful for evaluating MTBF rating. The SN 29500 method takes into account the following key factors:

- The number of components in a given design
- The full power load that each component will carry
- Actual operating temperature

MTBF ratings generally assume perfect manufacturing conditions and proper application of product - key factors that can drastically offset MTBF numbers. A better way to measure the MTBF of power supplies is to take a closer look at the electrolytic capacitors used in the product. Capacitors have a wear-out mechanism, meaning they generally have a limited life, and this can affect the power supply life span.

How long an electrolytic capacitor will last generally depends on three key factors:

- **Component Rating** - A measure of how much voltage the unit can safely handle.
- **Operating Temperature** - The hotter the operating conditions, the shorter the life.
- **Size of Capacitor** - In general, the larger a capacitor's diameter, the longer the life.

Understanding the Relationship Between Temperature and Life Span

To ensure the best possible MTBF, system engineers should look for power supply products that have been tested in a manner that fits with how the products will actually be used. For example, manufacturers like Rockwell Automation test power supplies under replicated, customer-application conditions to accurately predict the life span of a power supply.

Heat generated by system components can significantly affect a power supply's life span. In fact, studies show that the life of a capacitor reduces 50 percent for every 10 degrees Celsius (50 degrees Fahrenheit). Rockwell Automation uses advanced testing methods in which thermocouples measure heat locally at each capacitor within a power supply. Such measurements help the manufacturer calculate how long capacitors can function at different operating temperatures. In general, the higher the operating temperature, the shorter the life - depending on the type and size of capacitor.

Tests using thermocouples can be particularly helpful for system designers, who can consult manufacturer data sheets based on thermocouple testing. Using the data sheets to find out how long each product will hold up at specific temperatures, designers can get a more accurate picture of how long a given power supply might last in a real-world application.

Putting Knowledge to Work

Armed with a more complete range of data and life-span estimates, system designers can work to create applications and manufacturing environments designed to provide long-term reliability and efficiency. Such steps provide a more accurate look at MTBF and its true relationship to both product life span and system uptime.

Contact Rockwell Automation at www.ab.com/industrialcontrols/products/power_supplies.