明緯企業股份有限公司
MEAN WELL ENTERPRISES CO., LTD.
TEL:886-2-2299-6100
FAX:886-2-2299-6200
E-mail: info@meanwell.com
http://www.meanwell.com.tw
24891 新北市五股區五權三路28號 No.28, Wuquan 3rd Rd., Wugu Dist., New Taipei City 24891, Taiwan (R.O.C.)

MEAN WELL MTBF Optimization

Date: 2021.11.30

By：Simon Kuo/Technical Service Center
simon.kuo@meanwell.com

MEAN WELL, established in 1982, has been known for superior quality and high cost-performance in the power supply industry for nearly four decades. For switched-mode power supplies, the number of the components could be from dozens to hundreds, depending on the wattage and topology. Each component is applied to the design with its necessity. The assurance of exact lifetime and evaluation of the reliability is the know-how in the power supply industry. We could assess the quality of a power supply or whether the product is well examined by checking MTBF or life cycle parameters. This article will analyze the MTBF and the lifecycle parameters generally considered in the early product implementation phase.

MTBF (Mean Time Between Failure) and Life Cycle are both indicators of reliability. MTBF can be calculated by two different methodologies: "part count" and "stress analysis". The regulations of MIL-HDBK-217F Notice 2 and TELCORDIA SR/TR-332(Bellcore) are commonly used to calculate MTBF. MIL-HDBK-217F is a United States military standard, and TELCORDIA SR/TR-332(Bellcore) is commercial regulation. Life Cycle is founded by using the temperature rise of electrolytic capacitors under maximum operating temperature at full load condition to estimate the approximate life of the power supply. Both parameters have a certain reference value. The only difference is that they are derived from differential equations.

Unlike the Life Cycle that only utilizes parameters from the temperature rise of electrolytic capacitors for its equation, MTBF is more complicated than that. As we all know, the equation for electrical component failure rate during MTBF calculation contains many variations, as shown in Eq. 1, including quality factor, environment factor, basic failure factor…etc. When these factors combine with the stress or the number of the components, the result turns differently. But people don't know is that some of the factors improve over time. The following paragraph will explain in more detail.

$$\lambda P = \lambda G \times \pi Q \times \pi S \times \pi T$$

Equation of electrical component generic failure rate

Continuous pursuit of innovation and optimization has been a mission to MEAN WELL since day one. As a result, MEAN WELL keeps evolving and reaching a higher level of quality by improving research volume and strictly selecting the components and suppliers. The MTBF reading of the MEAN WELL products has been relatively conservative. The reading no longer matches the quality nowadays, which makes no advantage when competing with other brands, especially when customers face government bids or project competitions. Fortunately, the quality guarantee with a long lifecycle and warranty still maintains MEAN WELL's competitive edge in the market. To resolve the issue that continuously encounters, to fulfil our mission "Continuous pursuit of innovation and optimization", MEAN WELL re-examined the MTBF parameters of TELCORDIA SR/TR-332(Bellcore) and implemented an optimization. MEAN WELL reviewing the

supplier quality policy and accompanying with IQC/OQC/FQC…etc., all the ways to after-sales service, ensure preventing recurrence, which not only brings the quality of MEAN WELL products to another level, but it also changes the status of the quality factor πQ of the MTBF equation as shown in Table 1 according to TELCORDIA SR/TR-332(Bellcore) regulation. Leading the MTBF reading can be optimized from Level 0~I to Level I~II.

Table 9-4 Device Quality Level Description and Factor π_Q

QUALITY LEVEL 0 — This level shall be assigned to commercial-grade, reengineered, remanufactured, reworked, salvaged, or gray-market components that are procured and used without device qualification, lot-to-lot controls, or an effective feedback and corrective action program by the primary equipment manufacturer or its outsourced lower-level design or manufacturing subcontractors. However, steps must have been taken to ensure that the components are compatible with the design application. **Quality Factor π_Q = 6**
QUALITY LEVEL I — This level shall be assigned to commercial-grade components that are procured and used *without* thorough device qualification or lot-to-lot controls by the equipment manufacturer. However, **(a)** steps must have been taken to ensure that the components are compatible with the design application and manufacturing process; and **(b)** an effective feedback and corrective action program must be in place to identify and resolve problems quickly in manufacture and in the field. **Quality Factor π_Q = 3**
QUALITY LEVEL II — This level shall be assigned to components that meet requirements (a) and (b) of Quality Level I, plus the following: **(c)** purchase specifications must explicitly identify important characteristics (electrical, mechanical, thermal, and environmental) and acceptable quality levels (i.e., AQLs, DPMs, etc.) for lot control; **(d)** devices and device manufacturers must be qualified and identified on approved parts/manufacturer's lists (device qualification must include appropriate life and endurance tests); **(e)** lot-to-lot controls, either by the equipment manufacturer or the device manufacturer, must be in place at adequate AQLs/DPMs to ensure consistent quality. **Quality Factor π_Q = 1**
QUALITY LEVEL III — This level shall be assigned to components that meet requirements (a) through (e) of Quality Levels I and II, plus the following: **(f)** device families must be requalified periodically; **(g)** lot-to-lot controls must include early life reliability control of 100% screening (temperature cycling and burn-in), which, *if the results warrant it*, may be reduced to a "reliability audit" (i.e., a sample basis) or to an acceptable "reliability monitor" with demonstrated and accepted cumulative early failure values of less than 200 ppm out to 10,000 hours; **(h)** where burn-in screening is used, the Percent Defective Allowed (PDA) shall be specified and shall not exceed 2%; and **(i)** an ongoing, continuous reliability improvement program must be implemented by both the device and equipment manufacturers. **Quality Factor π_Q = 0.8**

Table 1. Device Quality Level Description and Factor of TELCORDIA SR/TR-332(Bellcore)

MEAN WELL continuously announces long warranty products (7 yeas warranty of HLG series/6 years warranty of HEP series/5 years warranty of DPU/DRP series…etc.) because of the lifecycle parameters and warranty closer to general user's expectation of quality control. Either MTBF or lifecycle is a commitment of product design. Through this event, MEAN WELL re-examined the parameters and optimized the MTBF of TELCORDIA SR/TR-332(Bellcore), making the MTBF closer to the high quality of MEAN WELL's products today. Improve the overall competitiveness of MEAN WELL products from specification aspects.