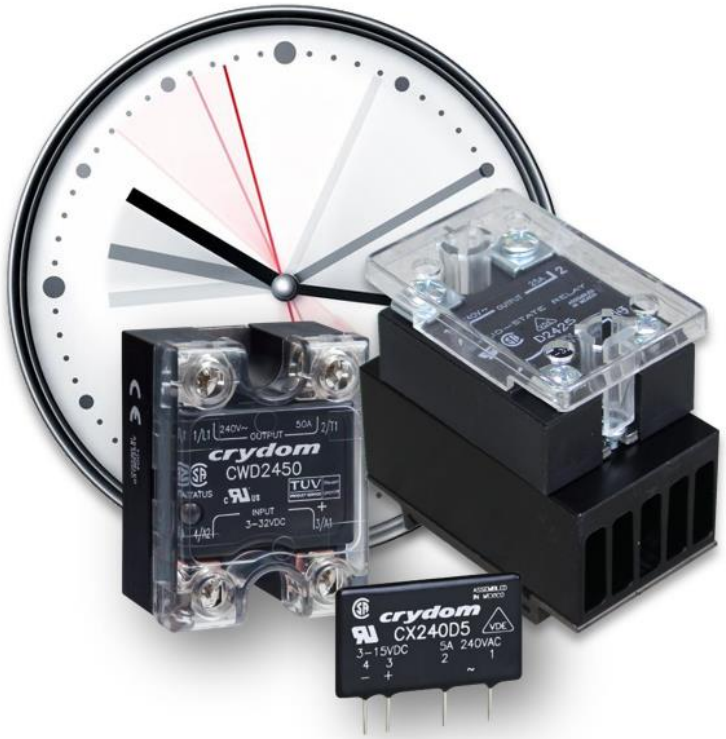
MTBF: The Life Expectancy of Solid State Relays & Power Controllers



MTBF (mean time between failures) is a rating often applied to power controllers and solid state relays to provide an estimate of how long the relay will last within a given application. By definition, MTBF is the predicted elapsed time between inherent failures of a mechanical or electrical system during normal operation. This is a bit of a misnomer for solid state relays, since MTBF implies that the system is repairable, which, in almost every case, doesn't apply to a solid state relay. A more accurate term would be MTTF (mean time to failure). However, given the fact that the life expectancy of a solid state relay is much longer than the life expectancy of a human, and that SSR and power controller manufacturers are free to take narrative license with their specifications, MTBF will suffice.

MTBF is commonly used to compare the life expectancy of a solid state relay to an equivalent rated electromechanical relay, contactor or mercury relay. Since mechanical relays contain moving parts, their life-expectancy is relatively simple to calculate and usually given as the number of operations the relay can perform before a failure will occur. Solid state relays have no moving parts. Therefore, multiple variables are involved in determining their life expectancy. Chief amongst them is thermal excursions – how rapidly the relay heats and cools during normal operation throughout its life. Since the amount of heating and cooling a solid state relay is subjected to is determined by how the relay is used within an application and the overall environment of the application (ambient temperature, heat sink, mounting techniques, etc.), MTBF can vary from customer to customer.

However, even with a variable MTBF, the life expectancy of a solid state relay will almost always significantly exceed that of an electromechanical relay. For example, the estimated lifespan of an EMR rated for 300k cycles and switching power to a load twice a minute for 40 hours per week is somewhere around 62 weeks. Conversely, a solid state relay or power controller has an MTBF of 7 million hours when used within specifications in a 60°C ambient temperature. That's 799 years, or 41,522 weeks, which is 670 times longer than the EMR from the previous example.

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Understanding the basic concept of MTBF ratings for solid state relays and power controllers provides engineers with a valuable tool for determining the total cost of ownership (TCO) of an SSR. This is a topic for a future TechTip but, in short, if a solid state power controller has an initial cost of $40 compared to an EMR at $15, then a system designer may be tempted to go with the electromechanical solution. However, it's only an overall savings until the EMR has to be replaced more than once. After the second replacement, they'll have spent a total of $45 on the EMR solution, excluding costs associated with down-time and field service personnel. Therefore, although initially more expensive, the TCO of a solid state relay can be much lower than that of a less-expensive EMR.

More detailed information on solid state relays and MTBF ratings can be found in the SSR Reliability white paper published by Paul Bachman, a former Fellow Engineer at Crydom. You can also contact our support team @ 800.879.7918 / support@hbcontrols.com if you'd like to discuss your application and MTBF ratings in more detail.