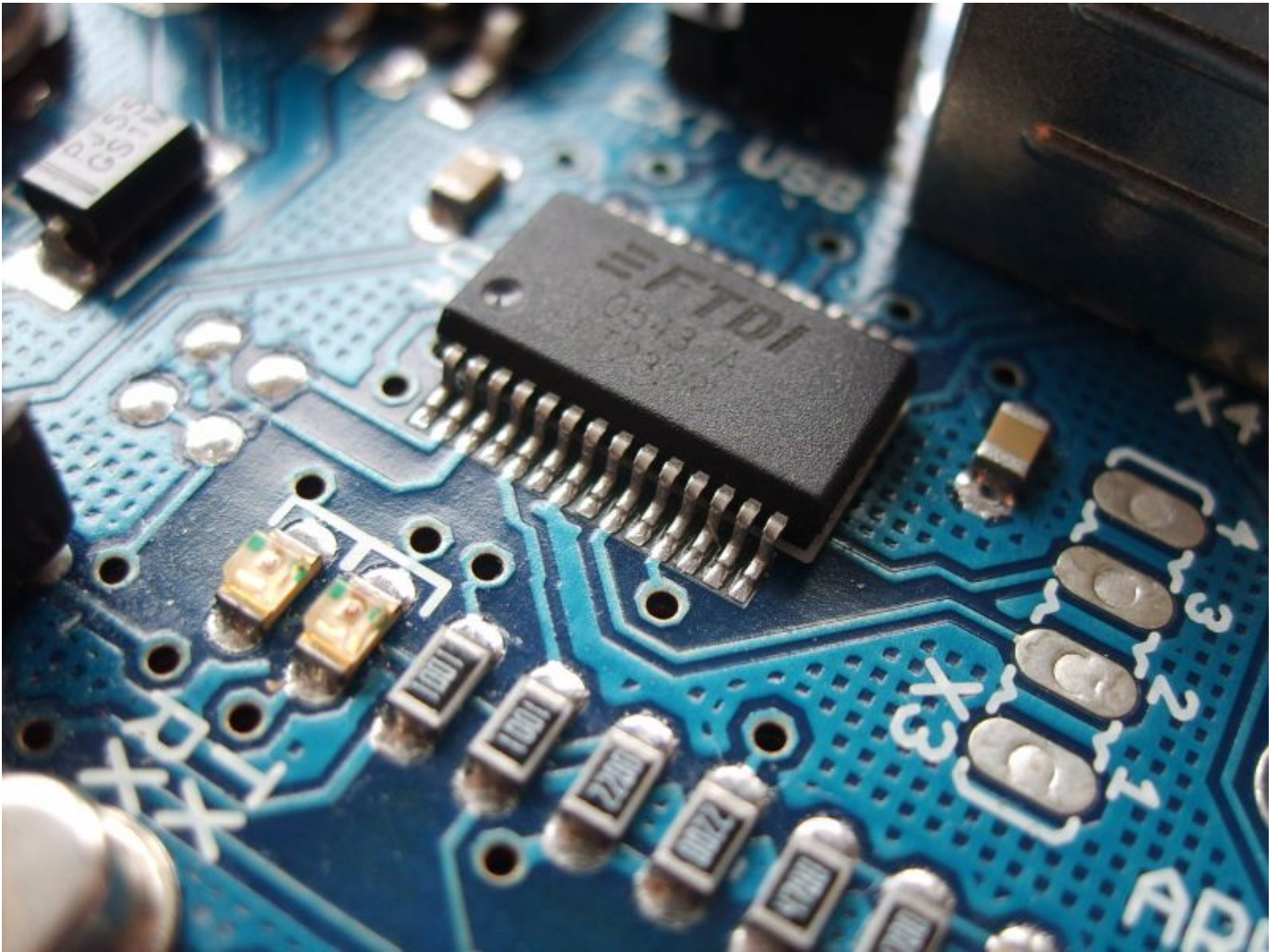


How Internal Temperature Affects Component Life

One of the most overlooked aspects of enclosure design is temperature control and heat reduction. While it's understandable that a prototype wouldn't need to weigh heat dissipation as heavily as a final production run, incorporating thermal control into your initial designs can prevent significant problems in the future. The common misconception that electrical components thrive in high temperatures doesn't take into consideration external factors, such as environmental conditions or practice uses that may limit natural airflow to the enclosure.



One of the most overlooked aspects of enclosure design is temperature control and heat reduction. While it's understandable that a prototype wouldn't need to weigh heat dissipation as heavily as a final production run, incorporating thermal control into your initial designs can prevent significant problems in the future. The common misconception that electrical components thrive in high temperatures doesn't take into consideration external factors, such as environmental conditions or practice uses that may limit natural airflow to the enclosure.

How Temperature Affects Components

According to a survey of electrical manufacturer's catalogs, the optimal operating temperature for the majority of electrical equipment is between 40 °C (105 °F) and 50 °C (122 °F). However, the higher the internal temperature of the component, [the faster its lifespan will decrease](#).

In the case of microprocessors, excessive heat can lead to leakage in the integrated circuits, but that typically doesn't lead to permanent damage. Industrial control systems and components that utilize capacitors or circuitry, however, are at great risk of shortened lifespans due to the high sustained heat.

Enclosure Cooling Options


Passive and active cooling methods can greatly improve the internal temperature of the component, whether it's through cooling fans to increase circulation or additional venting to low ambient temperature environments. Of course, active ventilation systems are dependent on low ambient temperature environments to ensure proper airflow and are not recommended for electrical enclosures that are heavily loaded or high temperature environments.

Controlling internal temperatures for electrical equipment in sealed enclosures is best achieved using an air-to-air heat exchanger or air conditioner.

How Lifespan is Impacted by Temperature

According to the Arrhenius equation, the failure rate of semiconductors increases in many multiples as temperature increases. As internal temperature increases from 40 °C to 60 °C, failure rate jumps from 10 times the norm to almost 30 times faster. At 80 °C, failure rate increases by a factor of 100 and reaches 300 times the normal failure rate of a semiconductor. [More information and detailed graphs are available here.](#)

To find out more about designing an enclosure with proper ventilation, check out our enclosure templates and samples in Front Panel Designer, [available here as a free download.](#)

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