

High Temperature Encoder Performance

Encoder Products Company has been an industry leader supplying high temperature encoders since the mid 1980's. Many companies use these products with temperature ratings as high as 120°C. In the majority of applications the encoder is mounted on the back of a high performance servo motor for position and velocity feedback. The following information is intended to help understand these types of applications with regard to temperature considerations.

Most high temperature electronic components such as comparators, LED's, voltage regulators, and line driver IC's have a maximum rated ambient operating temperature of 120° to 125°C. There are a number of factors that increase the actual temperature of the encoder electronics elevating it above the ambient temperature the unit is operated in. Tests show that there is typically a 3° to 10°C temperature rise in the encoder due to a combination of factors when the ambient temperature is near 120°C. These factors must be considered when extreme temperature performance is required.

The following are some of the variables that generate heat in an encoder.

- 1. Shaft speed and encoder to motor alignment.** The higher the speed the more heat is generated in the encoder bearings. Mounting misalignment which causes vibration also increases encoder temperature.
- 2. Output frequency and cable lengths.** Both higher electrical switching frequency and longer cable lengths can cause a considerable amount of heat generation inside the encoder housing at the line driver IC's. See technical specifications for cable considerations in EPC's catalog.
- 3. Electrical loading and termination of the ABZ and UVW output channels.** Encoders with commutation options have more electronics inside. The power consumption of the encoder increases by roughly 30 to 40 percent when commutation is included. There are six outputs possible (twelve, if using differential) in an encoder with commutation so the loading on each channel will affect the heat generated inside the encoder.
- 4. Supply voltage range of ± 10 percent:** A unit running at 5.5 VDC has increased current consumption over a unit at 5 VDC which results in higher internal IC temperatures and heat generation inside the encoder.
- 5. Motor and Shaft Temperature.** The motor housing where the encoder is mounted will play a significant role in the encoder temperature. The material and design of the motor and enclosure surrounding the encoder will typically transfer heat into the encoder. In some design configurations the encoder temperature may be 20°C cooler than the motor temperature, however in other cases it may be much closer depending on the thermal characteristics of the overall design.

The variables mentioned above contribute differently to the actual temperature of the encoder and will vary from application to application. The combination of these factors will typically increase the encoder temperature (measured at the encoder bearing housing) by 3° to 10°C. Most high temperature industrial electronics IC's have a maximum ambient rating of 120° to 125°C. These devices are not intended to be operated above their maximum temperature rating or the life of the component will be reduced and damage to the device may occur. Based on ratings of IC's and extensive testing the following specification should be followed for 120°C operation:

The temperature measured at the encoder case where the flex mount attaches to the bearing housing should not exceed 120°C maximum. (for a 120°C rated unit)

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In a steady state condition the bearing housing temperature is the most practical place to measure the temperature of the encoder. This provides the best indication of the combination of electrical and mechanical conditions that influence temperature. If the bearing housing temperature is kept below 120°C this reduces the situations where the internal electronics exceed the maximum specification of components in most operating conditions.

The following photograph shows where a thermal couple can easily be attached to monitor the temperature during evaluation and qualification.

A thermocouple can be attached between the bearing housing and flex mount.



For further assistance please contact Applications Engineering at Encoder Products Company.

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