

Design Review

A leading provider of heating, air conditioning, and refrigeration services and products contracted a new supplier for the manufacture of two motor speed drivers for residential and light commercial heat pump applications. This was the first electronic design developed and manufactured for the client by this particular supplier.

The client hired Ansys Reliability Engineering Services (RES) to perform a design review of the two motor speed drivers manufactured by their new supplier.

/ Approach

Ansys RES focused its assessment on clearly defining reliability goals, performing product qualification tests and determining if the supplier's product design aligned to electronic industry best practices for optimum reliability performance.

/ Use Environment

Ansys RES gathered short-term ambient temperature data from the National Oceanic and Atmospheric Administration (US CLIM Data) to determine the worst-case maximum temperature use environment for residential and light commercial heat pump applications. Additionally, Ansys RES compared electrical use environment specifications against industry standards using ANSI standard C84.1 (2011) and Information Technology Industry Council data.

/ Circuit Analysis

Ansys RES reviewed the motor speed driver circuit boards in respect to component de-rating, function, ESD and EMC layout. In addition, Ansys RES performed a component stress analysis and reviewed critical components such as chip resistors, chip capacitors, electrolytic capacitors, film capacitors and the printed circuit board for common failure risk factors.

/ Design for Manufacturability

Ansys RES analyzed the device packaging, hole spacing, conformal coating material and package, solder material and part placement to determine if the designs met manufacturability best practices.

/ Design for Reliability

Ansys RES used Sherlock Automated Design Analysis software to assess design reliability under vibration, mechanical shock and thermal cycling (based on diurnal temperature variation).

/ Testing (Design Verification and Product Qualification)

Ansys RES reviewed the customer's qualification plan regarding its four subsections (reliability, electrical, environmental and mechanical testing) to determine if the design and manufacturing processes of the supplier were sufficiently robust for a 15-year product lifetime.

/ Results

The Ansys RES design review analysis provided the client with critical insight into the reliability risk of taking on the new supplier, actionable recommendations to improve the supplier designs and increase the life cycle of the product, and qualification test recommendations to validate vendor reliability claims. The issues identified included low voltage margins in the circuit analysis, coupling between choke modes, material placement and selection in conflict with industry best practices and inadequate mechanical support of the circuit board given the intended operational environment.