Digital Isolators Deliver Automotive Grade Quality and Reliability
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Automotive applications have some of the most stringent requirements for quality and reliability compared to other mainstream applications, and for good reason. In production, even the simplest component can shut down an assembly line if defect levels are more than a single part-per-million (ppm). In the field, a defect or reliability problem can lead to costly recalls and possibly jeopardize the safety of drivers and passengers.

To satisfy increasingly rigorous quality and reliability requirements, automotive systems designers are turning to digital isolators to replace optocouplers to provide safety isolation in hybrid electric vehicle (HEV) battery monitoring and power conversion applications. iCoupler® digital isolators from Analog Devices, Inc., adhere to a strict policy for automotive qualification based on AEC-Q100 standards. Unlike optocouplers which are based on compound semiconductors, iCoupler digital isolators are based on standard foundry CMOS semiconductor processing which has a proven track record in automotive systems. This article explains how Analog Devices serves the automotive market with our high quality industrial grade products that have nearly one billion channels of iCoupler isolation in the field. The article provides details on how we enhance these products with an extra level of qualification, additional inspections, and even greater test coverage.

QUALIFICATION
Analog Devices employs industry best practices when qualifying products. Qualification involves accelerated life testing to demonstrate the reliability of the process and the package. Tests include long-term stress testing under operating conditions at temperature extremes, storage under extreme humidity conditions, and thermal cycling, among other tests. To comply with the rigorous demands of automotive systems, Analog Devices follows the AEC-Q100 automotive methodology that calls for additional stress tests such as early life failure (ELF) under more extreme conditions. Post stress validation, while typically done at room temperature (+25°C), is also performed at cold (−40°C) and hot (+125°C) temperatures.

WAVER-LEVEL PROBE AND ASSEMBLY
When wafers come out of fab, Analog Devices adds another level of quality by performing wafer-level probing. Probing allows for detailed testing on individual components of the isolator. Probing also allows for direct measurement of the resistance and quality of the iCoupler transformers.

After probe, wafers are diced and assembled on a production line that includes additional inspection with operators trained to follow automotive production flows.

The final steps in production are high voltage and parametric testing. Analog Devices employs three procedures to bring quality close to zero ppm. First, test coverage is expanded by adding extra tests under different supply conditions. Second, testing is performed at different temperatures, similar to qualification testing described above. Third, Analog Devices employs part average testing, or PAT. This allows us to reject parts that seem good but which may be outliers. PAT works by looking at the distribution of a parameter and rejecting parts that fall outside the distribution for that wafer even if the parameter is within the limits. This is shown in the figure below where three batches each have distributions with different means and spreads. Outliers, or “maverick” parts, are shown as falling outside their corresponding distribution (shown by color) but still well within the production test and data sheet limits. In normal practice, without PAT, these parts would be shipped to customers and may never exhibit any defects; however, where zero ppm is essential, the additional test time and yield loss warrant this extra step.
QUALITY SYSTEMS AND SUPPORT

In addition to all these additional steps in production, Analog Devices follows best practices when working with customers to ensure that they have full support for their automotive applications. Analog Devices maintains a dedicated team of quality engineers trained to support customers with the appropriate automotive documentation and analyses including: AEC-Q100 Rev. G document, DFMEAs, PPAPs, 8Ds, and ASIL characterization.

RESOURCES
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