Automotive Digital Isolators

Analog Devices’ iCoupler® digital isolators have demonstrated excellent reliability and quality, with over 750 million channels shipped to customers over the past 10 years. Quality is assured through Analog Devices’ commitment to quality, as established through rigorous qualification and characterization processes. Yet, for the demanding challenges in the automotive industry, an extra level of reliability and quality is required. Today, many hybrid electric vehicles on the road use iCoupler digital isolators to monitor battery levels and to drive the efficient electric motor. In our efforts to achieve 0 ppm defect rates for these applications, we take extra measures to limit defects in production. These include the following steps taken, in addition to Analog Devices’ standard production flow:

- Wafer level probe
- Part average testing (PAT)
- Additional production test passes
- Production test at multiple temperatures
- Dedicated assembly production flow
- Integrity gates at assembly
- Qualification per AEC-Q100 standards

In addition to those extra steps, all ADI production facilities employed in the production of iCoupler digital isolators are TS-16949 certified. All such products are designated with a “W” following the base part number (for example, ADuM1401WSRWZ is the automotive grade equivalent of the ADuM1401ARWZ).

**Wafer Level Probe and Part Average Testing**

Wafer level probe allows for an extra pass of testing in order to mitigate potential test escapes, and it also enables part average testing (PAT). PAT is a methodology by which a distribution is generated for a production batch. Units are rejected that fall outside the standard distribution of that sample, even if those units fall within the limits of the full population. This approach identifies those units as being sufficiently different, or “maverick,” for that lot and, therefore, could pose a quality risk. The reject rate for PAT is low, indicating a high level of overall quality and minimal impact to cost. Wafer level probe also allows for the generation of wafer maps that can be used to exclude good units that are adjacent to clusters of reject units, further eliminating units that might otherwise pose a risk.

**Additional Production Test Passes and Production Test at Multiple Temperatures**

Additional test passes further reduce the likelihood of test escapes that might occur at the single-digit ppm level. Additional test passes performed at different temperatures further increase overall quality. Standard production testing is performed at room temperature with sufficient limit guard bands to ensure operation over the specified temperature range; however, to achieve 0 ppm, multiple temperatures may be used for added insurance.

**Dedicated Assembly Production Flow and Integrity Gates**

To provide the highest level of quality, automotive grade iCoupler products are assembled on a dedicated production line with additional quality controls. One example of these quality controls is an integrity gate employed as a lot acceptance test. A sample of assembled products are screened to look for voids between the plastic mould compound and the silicon die and metal lead frame. Those units are then subjected to the equivalent of three solder reflow profiles and then reinspected for voids. Should any units in that sample fail the final inspection, the entire assembly lot is quarantined.

**Qualification per AEC-Q100**

AEC-Q100 is an industry-recognized standard for automotive components. This standard calls out reliability testing that is consistent with ADI’s internal qualification standards. Additional life tests and/or different conditions may be applied. All of the automotive grade iCoupler digital isolators comply with the AEC-Q100 standards.

All ADI automotive grade iCoupler digital isolators use the same foundry processes, packaging, and test equipment as their commercial grade counterparts. In most cases, the silicon die is exactly the same, and the quality levels for those commercial grade products have been demonstrated to be excellent in over 10 years of production. The steps added to automotive grade digital isolators provide extra insurance for the millions of iCoupler digital isolators that are used in vehicles around the world.