Testing Digital Isolators

By Jim Paolucci

*i*Coupler digital isolators are tested in production to guarantee that both the isolation and data transmission conform to the data sheet specifications. This is done with a two-pass test performed on 100% of our products: a High Voltage test followed by a parametric test. This differs from most non-isolated ICs which are subjected only to parametric testing.

The High Voltage test[1] has two elements: guaranteeing the Isolation Rating and ensuring the integrity of the isolation barrier. "Isolation Rating" is the voltage (60 Hz rms) that can safely be applied across the inputs and outputs of a device for one minute. This rating is certified by regulatory agencies such as UL; typical isolation ratings guaranteed on *i*Coupler devices are 2.5 kV rms and 5 kV rms. A one minute test in production would be cost-prohibitive, so UL, for example, allows the test to be reduced to one second provided the test voltage is 120% of the specified isolation rating; for a 2.5 kV rms isolation rating, the production test is performed at 3 kV rms for one second, while a 6 kV rms test is performed to guarantee a 5 kV rms isolation rating.

During this test, we check for leakage that indicates that barrier has broken down, but leakage current can also be caused by capacitance across the isolation barrier. Most isolators rated at 2.5 kV rms have a leakage current less than 5 µA which is proportional to the voltage across the isolation barrier. This requires that we set test limits to account for these two main components of leakage current during high voltage testing.

The second element of High Voltage testing checks the integrity of the isolation barrier using a method known as Partial Discharge. This test detects defects, such as cavities or voids, in the insulation. Applying a high voltage induces breakdown in voids or cavities in the device and will transfer charge across the void. The repeated transfer of charge can make the void larger and eventually causes the insulation to fail. Charge transfer is measured in pico-Coulombs and a maximum limit of 5 pC at 1050 V peak is accepted per the applicable VDE standards. The 1050 V peak test voltage is calculated from as 1.875 times the maximum working voltage rating (e.g., 560 V peak times 1.875 to a meet 1 minute rating.

After High Voltage testing the part is then subjected to parametric testing performance (e.g., supply current, input signal current, propagation delay, Pulse Width Distortion, Data Rate, Supply voltage range, etc.). All parameters that have Min/Max limits on the data sheet are tested 100 % in production.

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[1] High voltage testing is performed by shorting together all the pins on one side of the isolation barrier and also shorting together all the pins on the other side of the isolation barrier. The test voltage is then applied between these two collections of shorted pins.