

Trusting Integrated Circuits in Metering Applications

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Electricity meter manufacturers are revolutionizing the industry by designing electronic meters in place of electromechanical meters. They need to be sure that the semiconductor components in these new designs meet high performance, quality, and reliability standards to ensure trouble-free performance in the field. Analog Devices designs safeguards into their integrated circuits (ICs) to prevent failures and thoroughly tests every product before shipping to customers. Using inferior products affects the brand image of an electronic meter and damages the critical trust between meter manufacturers and their customers.

INTEGRATED CIRCUITS

There are many benefits to using ICs compared with discrete components such as smaller size, lower power consumption, increased performance, better reliability, and lower costs. An IC shrinks a circuit board and all of its components into a die, which is often smaller than a fingernail. Final production testing of these complex products is a critical step to ensure parts with good performance and high reliability are shipped to the customer.

GUARANTEEING INTEGRATED CIRCUIT QUALITY

STACK¹ is an international standard for quality and reliability of integrated circuits. For an example of what to expect from a reputable IC manufacturer, Analog Devices posts a large amount of information regarding their quality control and reliability procedures to the public².

Reliability testing stresses parts to determine how the products will perform under extreme field conditions. The most common stress tests are High Temperature Operating Life (HTOL), Autoclave (PCT, or pressure cooker test), Electrostatic discharge (ESD), and Latch-up (LU). New products are tested before and after each stress test to look for parameter shifts, or grossly failing parts.

- HTOL is a simulation used to determine the products performance after many years of operation. Parts are operated in an oven (usually at 125 °C) for several thousand hours to simulate the performance over decades of field operation. This allows a supplier to prove the long-term reliability.
- Autoclave uses extreme pressure, humidity, and temperature conditions to test the package and die's protective capabilities. This stress test tests for die contamination, contact corrosion, and other phenomena and will uncover any packaging weaknesses.

¹ STACK International URL: <http://www.stackinternational.com/>

² Analog Devices Quality Information URL: <http://www.analog.com/>, then click "ADI Quality Systems"

- Electrostatic discharge can permanently damage an unprotected IC. In the ESD test, large voltages are discharged according to three different models through the part's pins. These discharges follow three models: human body model, machine model, and charged device model. Proprietary circuitry is designed inside an IC to protect the device from electrostatic discharges during board assembly and in the field.
- Latch-up is a parasitic IC problem causing a part to draw too much current, permanently damaging the part due to poor circuit design. The latch-up test applies electrical current to the pins of the part to look for this problem. If the part is not designed correctly, an internal electrical short-circuit can occur that seriously damages the functionality of the part in the field.

These stress tests and many more are performed to prove a products quality. Products that do not meet high standards are redesigned until they are robust. Analog Devices does not release products until they have passed strict quality and reliability testing.

VALIDATION OF INTEGRATED CIRCUIT PERFORMANCE

Analog Devices spends hundreds of hours evaluating ICs before releasing new products to the market. The performance of an IC is evaluated in laboratories with bench equipment, and on large Automatic Test Equipment (ATE). Laboratory evaluation is performed on a small number of parts over many test conditions. ATE systems integrate many kinds of lab equipment into one large computer test system. The ATE can test thousands of parts quickly and compare performance to the datasheet's specifications. A product's performance is characterized over process variations, temperature, supply voltage, clock frequency, logic levels, and many other parameters. Statistical analysis of test data from a large sample of parts is used to set up a final test program's limits, and to guarantee that only products that meet the specifications will ship to a customer.

FINAL PRODUCTION TESTS SCREEN FOR THE FEW BAD PARTS

The ADE family of energy metering ICs integrates several functions in one product. There are programmable amplifiers, analog-to-digital converters (ADCs), and a fixed-function digital signal-processing (DSP) core. A final test program is carefully designed to test each function of the part for performance and quality. Parts that pass the final test program using the ATE system are shipped to customers worldwide.

TRUSTED ICs COME FROM TRUSTED SUPPLIERS

Using low-quality and poor-performance electronic devices causes a loss in revenue due to inaccurate metering, and may result in more meters being replaced in the field. Without guaranteed products, meter production lines lose throughput and field failures may occur. Millions of meters rely on metering ICs for their core functions and companies like ADI strive to

give manufacturers comfort through rigorous testing and meeting high quality standards. Reputable IC manufacturers carefully design and then screen their products before shipping them to customers. Customers benefit from the minimal risk of receiving parts that do not meet specification (less than 30 parts per-million).

Semiconductor devices from Analog Devices are shipped as high quality, fully functional, and reliable products that will stand up to harsh environmental conditions. If meter manufacturers want quality and high performance in their electronic solutions, they must insist on strict international standards, such as STACK International, or investigate the practices of the semiconductor manufacturer. The investment by semiconductor manufacturers in reliability and testing should allow the customer to trust every product bought from authorized distributors.