

APPLICATION NOTE

10 mm Robust Lead Isolators

Introduction

Skyworks has successfully developed the world's smallest stripline junction isolator with a junction size of only 10 mm in diameter. The isolators are available in two variations; a 5 W reverse power design, the SKYFR-000812 (shown in Figure 1) and a 30 W reverse power design, the SKYFR-000727 (shown in Figure 2). Both variants are housed in a surface mount, "robust lead" package and are shipped on carrier tapes.

These packages use a unique vertical lead to connect the center conductor of the isolator to the PCB. Firmly encased inside a high temperature plastic, the robust lead design ensures excellent coplanarity.

This Application Note describes the Skyworks reliability test plan and predictive reliability calculations for the 10 mm robust lead isolators that help to maintain a high standard of reliability throughout the product life cycle. Also defined are the proper manufacturing handling and processing requirements.

Technology Innovation

The key to the extremely small junction size is a new, high dielectric ferrite material developed by Trans-Tech scientists for Skyworks. Trans-Tech has created a new range of materials to enable size reduction of ferrite devices by manipulating the garnet structure to give much higher dielectric constants than previously available.

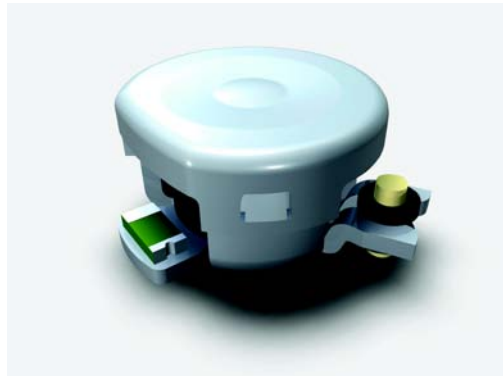
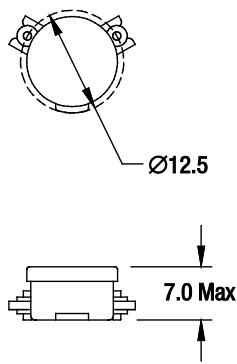


Figure 1. 5 W Reverse Power Isolator Design (SKYFR-000812)

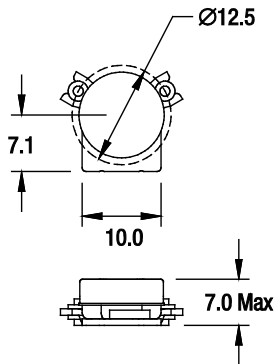


Figure 2. 30 W Reverse Power Isolator Design (SKYFR-000727)

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By substituting ions of higher polarizability into the structure, while simultaneously keeping magnetocrystalline anisotropy low, it has been possible to achieve low magnetic and dielectric losses without compromising temperature, non-linear, and power stability.

Magnetizations of up to 1850 Gauss are possible with this new range of materials with dielectric constants up to 31. New nano-level powder processing techniques are an integral part of the manufacture of these materials. Patents on all aspects of the design, manufacture, and application of these materials are pending.

Reliability

The best-in-class performance of Skyworks ferrite isolators and circulators is achieved through a systematic approach that emphasizes quality and reliability from product development through volume production. Six Sigma tools and methodologies are used to build quality into our designs, to control manufacturing processes, and to drive continuous improvement.

The reliability of Skyworks isolator and circulator products is assured by completing extensive stress testing during the qualification stage of all new product designs.

Reliability Test Plan

Figure 3 illustrates the reliability testing process for the 10 mm robust lead isolator platform. All units met all specifications both before and after the environmental stress tests.

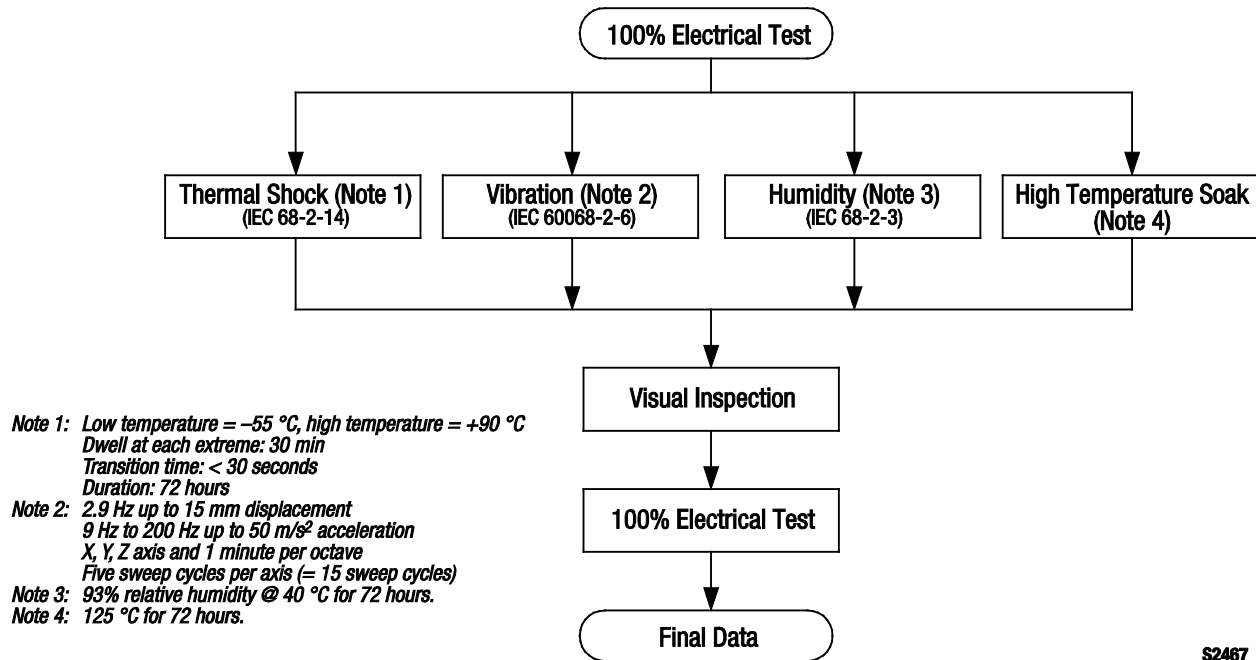
Reliability Prediction/FIT Calculation

The reliability prediction calculations used the method described in Telcordia SR-332. Calculation parameters were:

- Operating temperature: -10 °C to +85 °C
- Environment: ground benign, controlled
- Operation stress: 50%
- Method: Method I, Case 3

Failures in Time (FIT) @ 25 °C = 456 fails/10⁹ hours

Mean Time Between Failures (MTBF) @ 25 °C = 250 years



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Figure 3. Reliability Test Plan Process Flow

Handling and Storage Precautions

Appropriate handling precautions should be observed. The typical shelf life of these components is 24 months. However, corrosive, salty, or high humidity atmospheres can have an adverse effect on the solderability of contacts. Excessive manual handling of the components is not recommended. The Moisture Sensitivity Level (MSL) of these isolators is Level 1.

General Soldering Guidelines

Observe the following instructions to minimize thermal stress:

- Always preheat the device. Failure to do so can cause excessive thermal shock and stress that can result in damage to the device.
- Limit the temperature in the reflow stage.
- Allow the device to cool naturally for at least five minutes after completing the soldering process. Gradual cooling should be used since the use of forced cooling increases the temperature gradient and may result in latent failure due to mechanical stress.
- Avoid any mechanical stress or shock to the solder joints and devices during cooling.

Stencil Selection

A stencil should be used to apply the optimal amount of solder paste to the pads of the PCB footprint. The amount and thickness of solder paste directly affects the quality of the joint and are critical to ensure proper solder connection between the base of the package and the board.

A stencil that is 0.1 mm to 0.2 mm thick is recommended for most applications.

Reflow Profile

Robust lead circulators and isolators are reflowed using a typical convection reflow profile. The profile reflects the three distinct heating stages or zones (preheat, reflow, and cooling) recommended in automated reflow processes to ensure reliable solder joints.

The profile may vary among soldering systems. Other factors that can affect the profile include the density and types of components on the board, type of solder used, and type of board or substrate material.

Refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164, for further information on reflow guidelines.

Aqueous Wash

A no-clean solder is recommended since the package style is not suitable for aqueous cleaning.

Rework Guidelines

To remove a circulator from a board assembly, use localized heat on the contact points while applying a lifting force to the component. The heat applied to the circulator during removal should not exceed the recommended peak temperature of 260 °C.

ESD Protection

Units are shipped in black conductive polycarbonate or polystyrene carrier tape on a standard 13-inch reel. The carrier tapes meet or exceed the requirements defined in EIA-481 and EIA-541, and are static dissipative.

Mechanical Design

Isolators are housed in cold rolled steel plated with silver. The robust lead pins are brass, plated with gold.

The isolator uses a permanent magnet to bias the ferrite disks. Therefore, the isolator performance may change if the magnetic field near the unit is disturbed. Do not allow any magnetic material within 3 mm of the isolator.

A 3D mechanical model, in STEP format, is available on request.

Test Fixtures

Test fixtures are available from Skyworks for customer evaluation of samples.

Outline	Test Fixture
ODX-00080 (see Figure 1)	PCB-00022
ODX-00085 (see Figure 2)	PCB-00034

Sustainability

All Skyworks circulators and isolators are compliant with RoHS (EU directive 2011/65/EC) and with REACH (EU regulation 1907/2006).

Shipping/Transport

Export Control Classification Number (ECCN): 5A991g.

Harmonized Tariff Schedule (HTS): 8517.70.0000.

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