APPLICATION NOTE

Robust Lead Circulators and Isolators

This Application Note describes the robust lead design for Skyworks circulators and isolators. These are high performance devices provided in low-cost surface mount packages.

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

These devices are supplied in industry-standard carrier tape packages for automated "pick and place." Refer to the product Data Sheet for each device for carrier tape specifications. Table 1 provides physical details for Skyworks robust lead circulators.

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 affect on the solderability of contacts. Excessive manual handling of the components is not recommended.

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.
- After completing the soldering process, allow the device to cool naturally for at least five minutes. 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.

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.

Power Handling

Robust lead package are designed to handle up to 200 W of continuous power. To verify this, a number of parts were connected to a 200 W power supply for 30 minutes. S-parameters were measured before and after to confirm that the circulators were not damaged.

Table 1. Robust Lead Circulators

Section	Material	Plating
Leads	Brass	Gold or silver
Housing	Steel	Silver or tin
Lead insulation	Fortron 1140A1	N/A

Test Fixture Used

The test fixture consisted of an aluminum base with a Rogers 4350 PCB mounted on top. Typical SMA connectors were mounted to the side of the aluminum base and soldered to the tracks on the edge of the PCB. Additional thermal heat dissipation was provided by mounting the fixture on an aluminum heat sink with cooling fins. This setup is illustrated in Figure 1.

A block diagram that shows the test setup procedure is provided in Figure 2. The hardware used for this test is provided in Table 2.

All parts meet all specifications. No significant difference is noted in S-parameter performance after power testing.

Power Testing Procedure

1. Set up test stand (refer to Figure 2).
2. Solder circulator to test fixture.
3. Measure S-parameters.
4. Input 200 W of CW RF signal for 30 minutes.
5. Monitor test fixture base temperature to ensure it does not exceed +85 °C.
6. Measure S-parameters again.

A photograph of the test stand is shown in Figure 3.

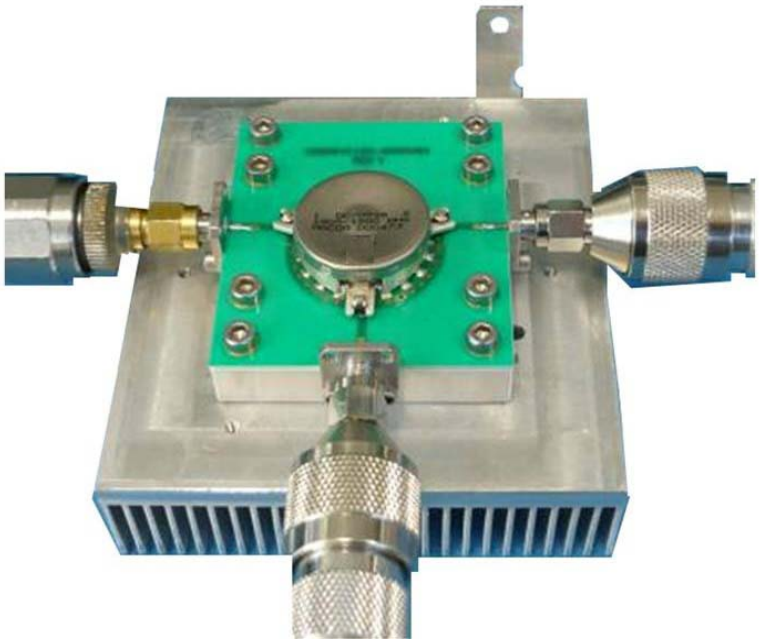

Figure 1. Test Fixture Setup

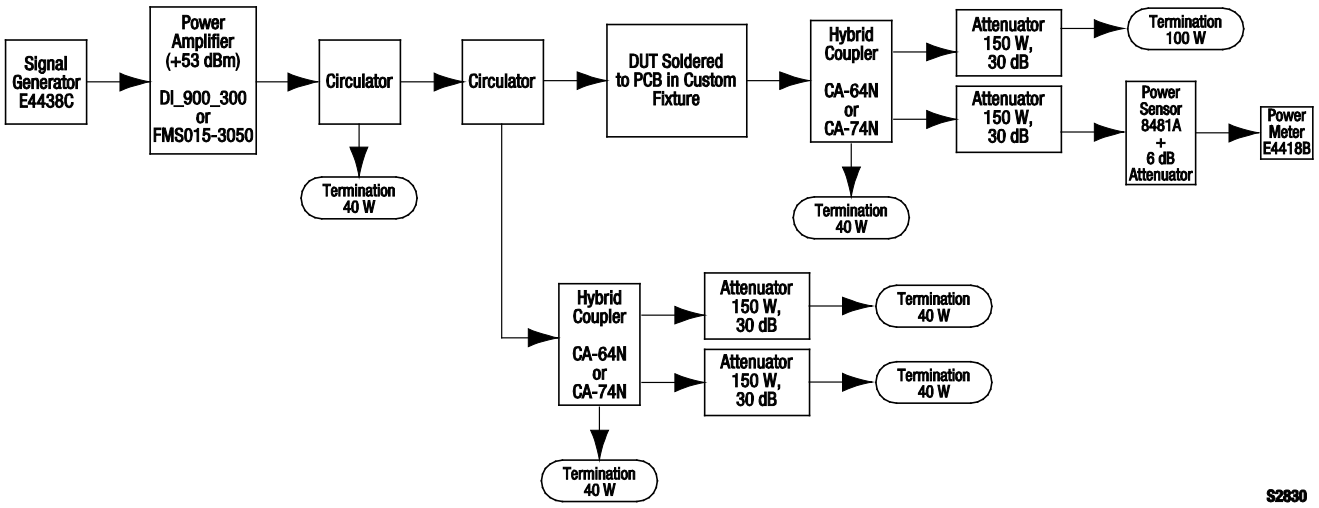

Figure 2. Test Setup

Table 2. Hardware for Test Setup

Description	Manufacturer	Model Number	Quantity
Signal generator	Agilent	E4438C	1
RF amplifier, 200 W	Dudley Labs	DL900-300	1
RF amplifier, 200 W	Freshfield	FMS015-3050	1
Power meter	Agilent	E4418B	1
Power sensor	Agilent	8481B	1
Attenuator, 6 dB	Narda	765-6	1
Hybrid coupler, 700 to 1000 MHz	Microlab	CA-64N	3
Hybrid coupler, 1700 to 2000 MHz	Microlab	CA-74N	3
Circulator	Skyworks	custom design	1
Attenuator	Narda	769-30	6
100 W load	MECA	490-2	1
Termination, 40 W	Narda	376BNM	8
Test fixture	Skyworks	custom design	1

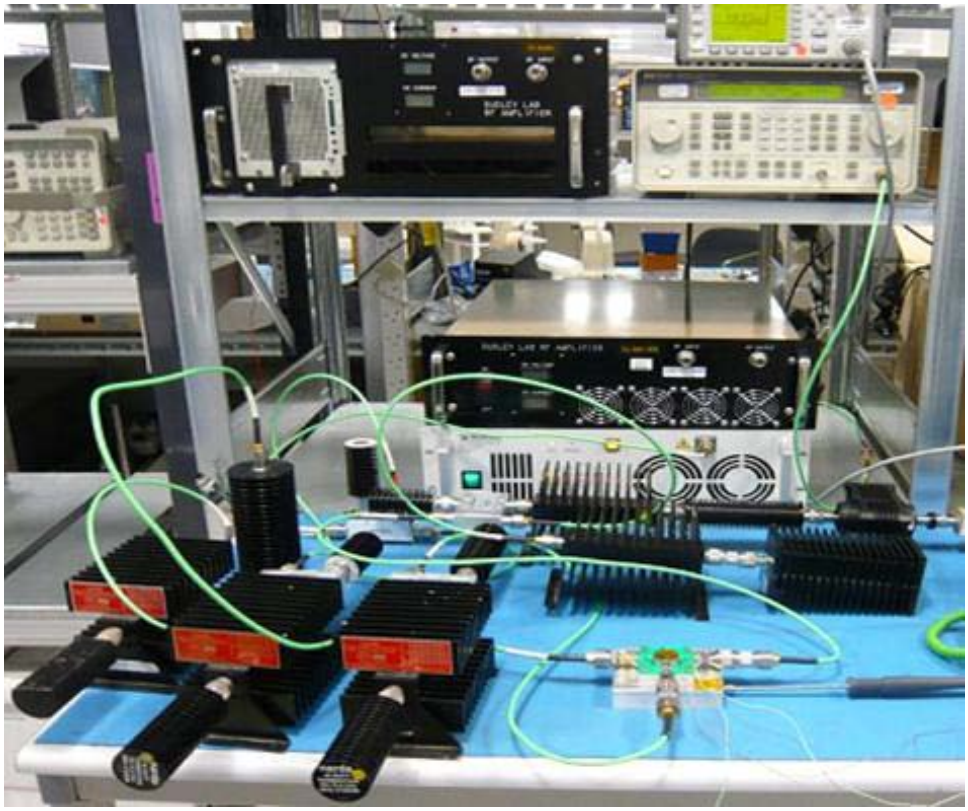

Figure 3. Test Stand