

PRELIMINARY DATA SHEET

SKY65052-372LF: 0.45-6.0 GHz Low Noise Transistor

Applications

- Wireless infrastructure: WLAN, WiMAX, broadband, cellular base stations
- Test instrumentation
- LNA for GPS receivers
- Satellite receivers

Features

- Externally matched for wideband operation
- Noise Figure = 0.6 dB @ 2.4 GHz of device only
- Noise figure = 0.85 dB @ 2.4 GHz including matching network loss
- Gain = 16 dB @ 2.4 GHz
- OIP3 = +34 dBm @ 2.4 GHz
- P1dB = +19 dBm @ 2.4 GHz
- Adjustable supply current, 15 to 100 mA
- Unconditionally stable to 18 GHz with reference design circuit
- Small, SC-70 (4-pin, 2.20 x 1.35 x 1.10 mm) Pb-free package (MSL3, 260 °C per JEDEC J-STD-020)

NEW



Skyworks Green™ products are RoHS (Restriction of Hazardous Substances)-compliant, conform to the EIA/EICTA/JEITA Joint Industry Guide (JIG) Level A guidelines, are halogen free according to IEC-61249-2-21, and contain <1,000 ppm antimony trioxide in polymeric materials.

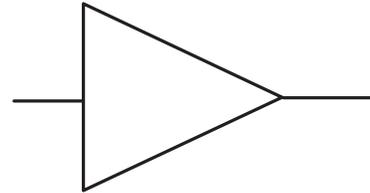


Figure 1. SKY65052-372LF Block Diagram

Description

The SKY65052-372LF is a high performance, n-channel low-noise transistor. The device is fabricated from Skyworks advanced depletion mode pHEMT process and is provided in a 2.20 x 1.35 x 1.10 mm, 4-pin SC-70 package.

The transistor's low Noise Figure (NF), high gain, and excellent 3rd Order Intercept Point (IP3) allow the device to be used in various receiver and transmitter applications.

A functional block diagram is shown in Figure 1. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

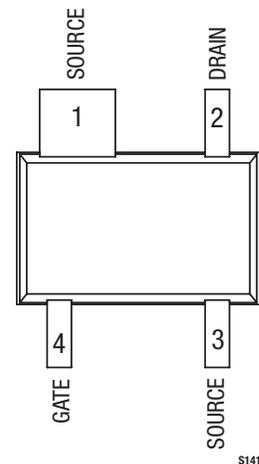


Figure 2. SKY65052-372LF Pinout – 4-Pin SC-70 (Top View)

Table 1. SKY65052-372LF Signal Descriptions

| Pin # | Name | Description | Pin # | Name | Description |
|-------|--------|---|-------|--------|--|
| 1 | SOURCE | Source lead. Provides DC self-biasing point and AC ground. | 3 | SOURCE | Source lead. Provides DC self-biasing point and AC ground. |
| 2 | DRAIN | RF output. Supply voltage required through external RF choke. | 4 | GATE | RF input |

Functional Description

The SKY65052-372LF is a depletion mode pHEMT designed for low noise, high frequency applications. The SKY65052-372LF has a typical NF of 0.6 dB tested at the 2.4 GHz wireless LAN frequency band. A gain of 15.5 dB typical is achieved using the same circuit. If the frequency of operation is lowered to the 1 GHz range, NF performance of the device can approach 0.85 dB including input matching network losses.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY65052-372LF are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Table 4.

Performance characteristics for the SKY65052-372LF are illustrated in Figures 3 through 7.

Table 2. SKY65052-372LF Absolute Maximum Ratings

| Parameter | Symbol | Minimum | Typical | Maximum | Units |
|-------------------------|------------------|---------|---------|---------|-------|
| Supply voltage | V _{DD} | | 6 | | V |
| Input power | P _{IN} | | +15 | | dBm |
| Gate to source voltage | V _{GS} | | -5.0 | | V |
| Gate to drain voltage | V _{GD} | | -5.0 | | V |
| Drain to source current | I _{DS} | | 110 | | mA |
| Gate to drain current | I _{GD} | | 100 | | μA |
| Power dissipation | P _{DIS} | | 240 | | mW |
| Junction temperature | T _J | | 150 | | °C |
| Storage temperature | T _{STG} | -65 | | +125 | °C |
| Operating temperature | T _{OP} | -40 | | +85 | °C |
| Thermal resistance | Θ _{JC} | | 220 | | °C/W |

Note: Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value.

Table 3. SKY65052-372LF Recommended Operating Conditions

| Parameter | Symbol | Minimum | Typical | Maximum | Units |
|---------------------|-----------------|---------|---------|---------|-------|
| Operating frequency | f | 0.45 | | 6.0 | GHz |
| Supply voltage | V _{DD} | 2.00 | 5.00 | 5.25 | V |
| Supply current | I _{DD} | 15 | 55 | 100 | mA |

Table 4. SKY65052-372LF Electrical Specifications

($T_{OP} = +25\text{ }^{\circ}\text{C}$, Characteristic Impedance [Z_0] = 50 Ω , $V_{DD} = 5\text{ V}$, $I_{DD} = 55\text{ mA}$, Parameters Include Recommended Matching Networks, Unless Otherwise Noted)

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|--|------------------------------|--|-------|--------------|-------|---------------|
| Saturated drain current | I_{DSS} | $V_{DS} = 6\text{ V}$, $V_{GS} = 0\text{ V}$ | 80 | 100 | 120 | mA |
| Pinchoff voltage | V_P | $V_{DS} = 6\text{ V}$, $I_{DS} = 2.5\%$ of I_{DSS} | -0.95 | -0.80 | -0.65 | V |
| Transconductance | g_M | $V_{DS} = 6\text{ V}$, $g_M = \Delta I_{DS} / \Delta V_{GS}$, measured at $I_{DS} = 20\%$ of I_{DSS} | 80 | 120 | 160 | mS |
| Gate leakage current | I_{GSS} | $V_{GD} = V_{GS} = -3\text{ V}$ | | 1 | 200 | μA |
| Noise Figure | NF1 (Note 1) NF2 (Note 2) | | | 0.60 0.85 | | dB dB |
| Gain | S21 | | | 16 | | dB |
| Input return loss | S11 | | | -15 | | dB |
| Output return loss | S22 | | | -9 | | dB |
| Reverse isolation | S12 | | | -25 | | dB |
| 3 rd Order Output Intercept Point | OIP3 | $P_{OUT} = +5\text{ dBm/tone}$, 1 MHz spacing | | +34 | | dBm |
| 3 rd Order Input Intercept Point | IIP3 | $P_{OUT} = +5\text{ dBm/tone}$, 1 MHz spacing | | +18 | | dBm |
| 1 dB Output Compression Point | OP1dB | | | +19 | | dBm |
| 1 dB Input Compression Point | IP1dB | | | +4 | | dBm |
| Stability | | Unconditionally stable up to 18 GHz | | >1 | | K |

Note 1: NF of device only. Input RF connector, board, and input matching network loss de-embedded from measurement.

Note 2: NF of device and matching network. Input RF connector and board loss de-embedded from measurement.

Typical Performance Characteristics

($T_{OP} = +25\text{ }^{\circ}\text{C}$, Characteristic Impedance [Z_0] = 50 Ω , $V_{DD} = 5\text{ V}$, $I_{DD} = 55\text{ mA}$, Includes Recommended 2.4 GHz Matching Network, Unless Otherwise Noted)

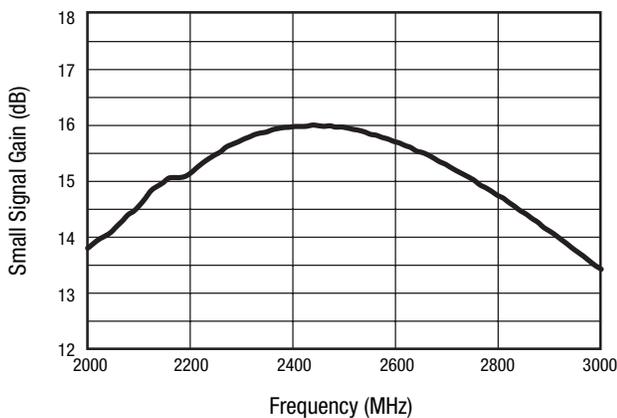


Figure 3. Small Signal Gain vs Frequency Over Temperature
($P_{IN} = -20\text{ dBm}$)

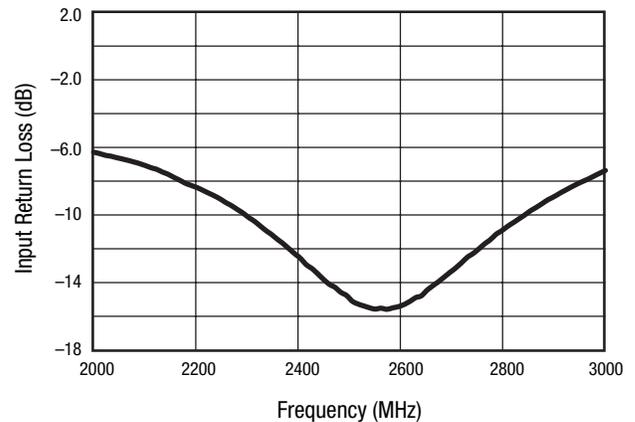


Figure 4. Input Return Loss vs Frequency Over Temperature
($P_{IN} = -20\text{ dBm}$)

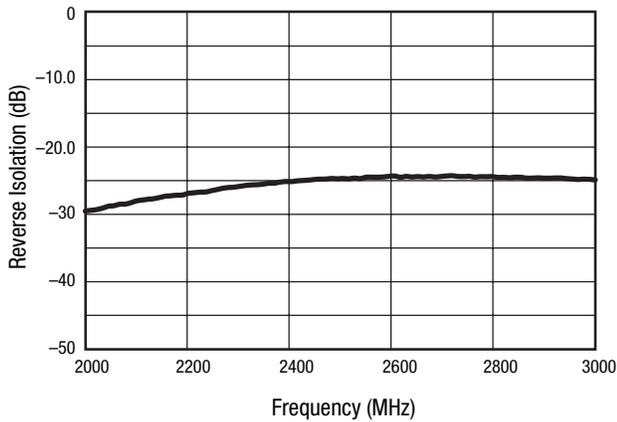


Figure 5. Reverse Isolation vs Frequency Over Temperature (P_{IN} = -20 dBm)

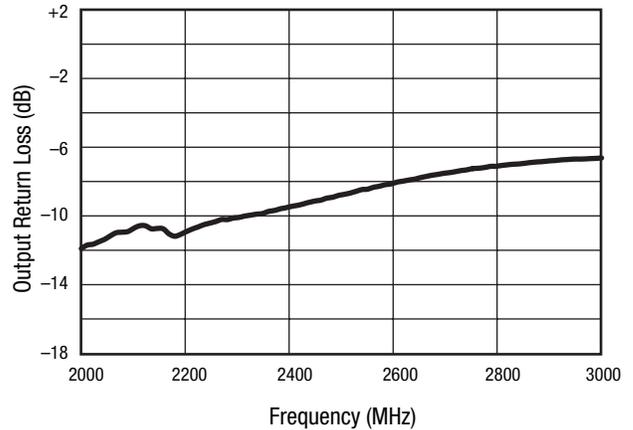


Figure 6. Output Return Loss vs Frequency Over Temperature (P_{IN} = -20 dBm)

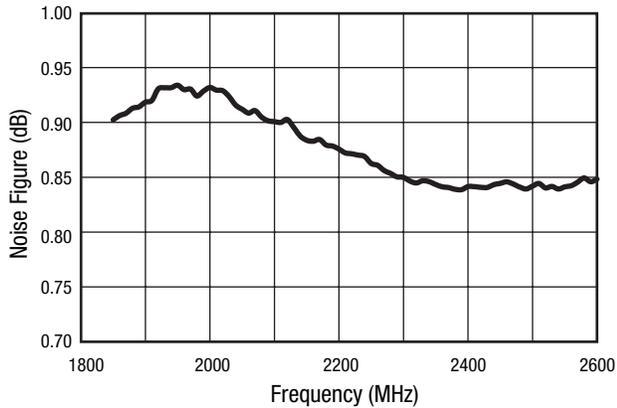


Figure 7. Noise Figure vs Frequency, Input RF Connector and Board Trace De-Embedded From Measurement

Evaluation Board Description

The SKY65052-372LF Evaluation Board is used to test the performance of the SKY65052-372LF low noise transistor. An assembly drawing for the Evaluation Board is shown in Figure 8. The Evaluation Board schematic diagram is shown in Figure 9. Table 5 provides the Bill of Materials (BOM) list for Evaluation Board components.

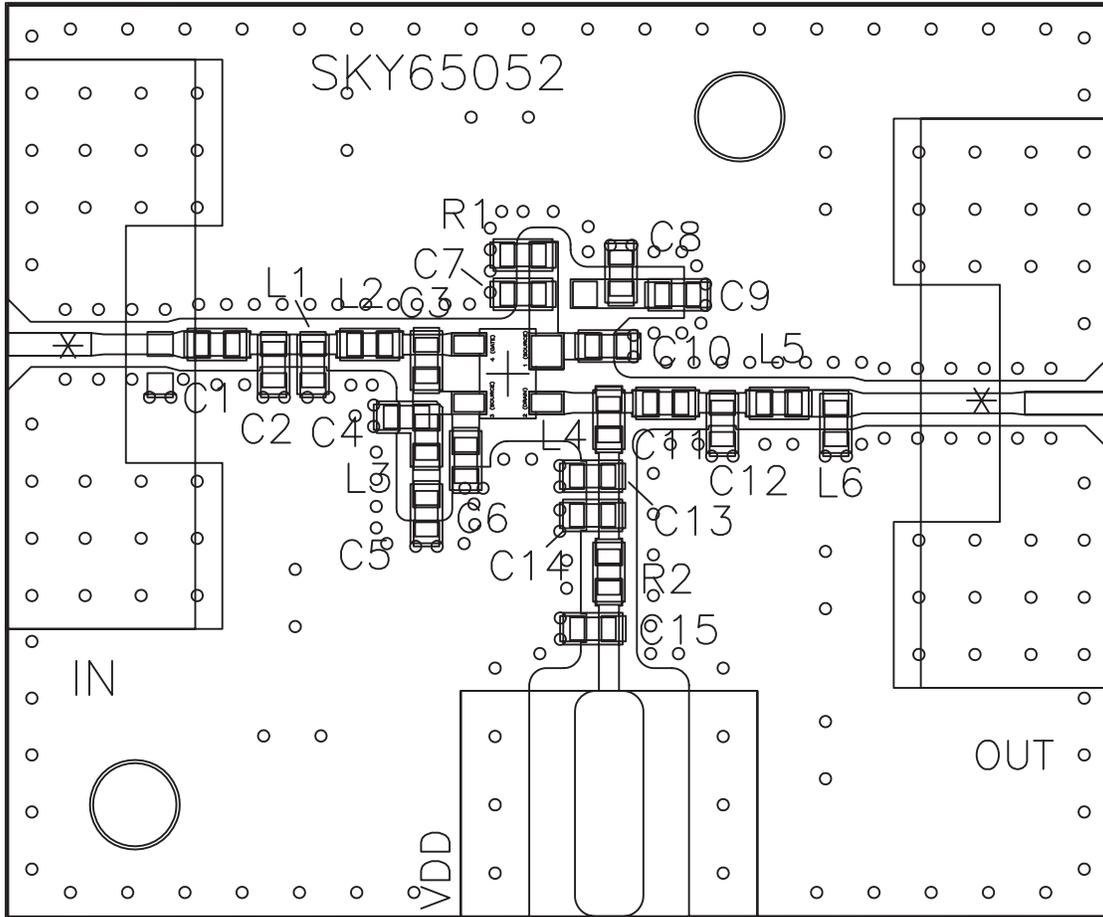
Circuit Design Considerations

Input and output traces have been minimized to reduce losses. All surface mount components are 0402-sized to reduce component parasitics. Use of 0603 or larger components is not recommended. Component spacing has also been minimized. The board is provisioned with two RF connectors and a DC launch. RF connector and board loss up to component C1 is approximately 0.1 dB at 2.4 GHz.

Board material is 10 mil VT47 FR4 with 1 oz. copper cladding. The RF traces are 50 Ω.

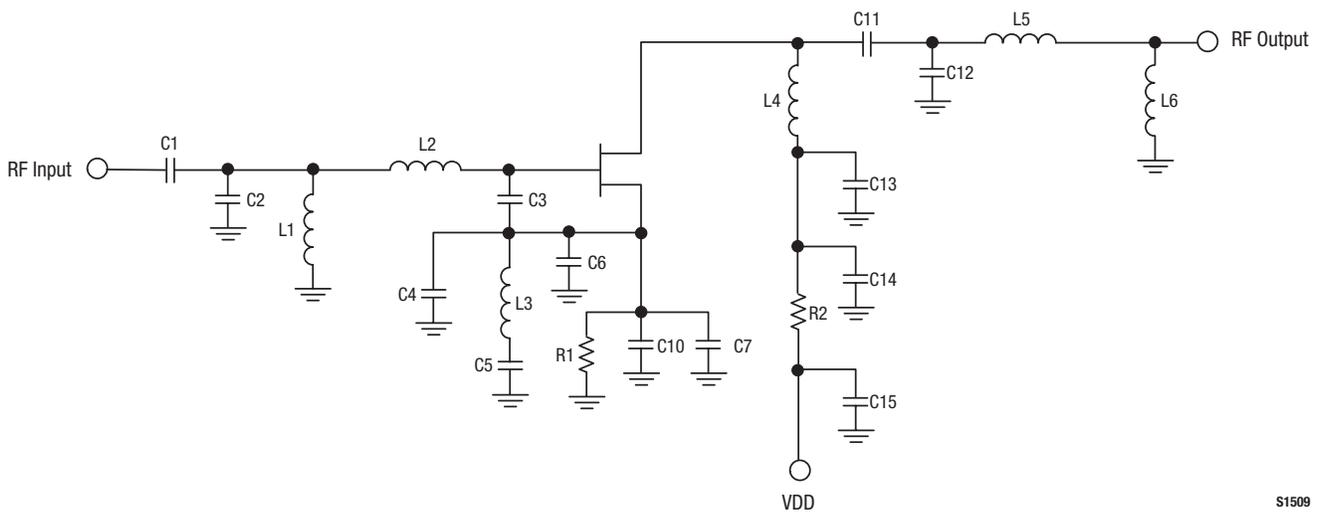
Evaluation Board Test Procedure

- Step 1: Connect RF test equipment to amplifier input/output SMA connectors.
- Step 2: Connect DC ground.
- Step 3: Connect VDD to a +5 V supply with a current limit of 100 mA. Verify that the board draws approximately 55 mA.
- Step 4: Apply RF signal or noise source.



S1511

Figure 8. SKY65052-372LF Evaluation Board Assembly Diagram



S1509

Figure 9. SKY65052-372LF Evaluation Board Schematic

Table 5. SKY65052-372LF Evaluation Board Bill of Materials

| Component | Value | Size | Manufacturer/Part Series |
|---------------------|----------|------|--------------------------|
| C1 | 33 pF | 0402 | Murata GRM015 |
| C2 | 1.2 pF | 0402 | Murata GJM015 |
| C3 | 0.3 pF | 0402 | Murata GJM015 |
| C4, C5, C8, C9, C14 | DNP | | |
| C6 | 10000 pF | 0402 | Murata GRM015 |
| C7 | 10000 pF | 0402 | Murata GRM015 |
| C10 | 10000 pF | 0402 | Murata GRM015 |
| C11 | 4.7 pF | 0402 | Murata GJM015 |
| C12 | 0.3 pF | 0402 | Murata GJM015 |
| C13 | 3.9 pF | 0402 | Murata GRM015 |
| C15 | 1000 pF | 0402 | Murata GRM015 |
| L1 | 12 nH | 0402 | Coilcraft HP |
| L2 | 2 nH | 0402 | Coilcraft HP |
| L3 | DNP | | |
| L4 | 5.6 nH | 0402 | Coilcraft HP |
| L5 | 0 Ω | 0402 | Panasonic |
| L6 | 6.8 nH | 0402 | Taiyo Yuden HK |
| R1 | 4.7 Ω | 0402 | Panasonic |
| R2 | 7.5 Ω | 0402 | Panasonic |

Package Dimensions

The PCB layout footprint for the SKY65052-372LF is shown in Figure 10. Typical case markings are shown in Figure 11. Package dimensions for the 4-pin SC-70 are shown in Figure 12, and tape and reel dimensions are provided in Figure 13.

Package and Handling Information

Since the device package is sensitive to moisture absorption, it is baked and vacuum packed before shipping. Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

THE SKY65052-372LF is rated to Moisture Sensitivity Level 3 (MSL3) at 260 °C. It can be used for lead or lead-free soldering.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format. For packaging details, refer to the Skyworks Application Note, *Discrete Devices and IC Switch/Attenuators Tape and Reel Package Orientation*, document number 200083.

Electrostatic Discharge (ESD) Sensitivity

The SKY65052-372LF is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.

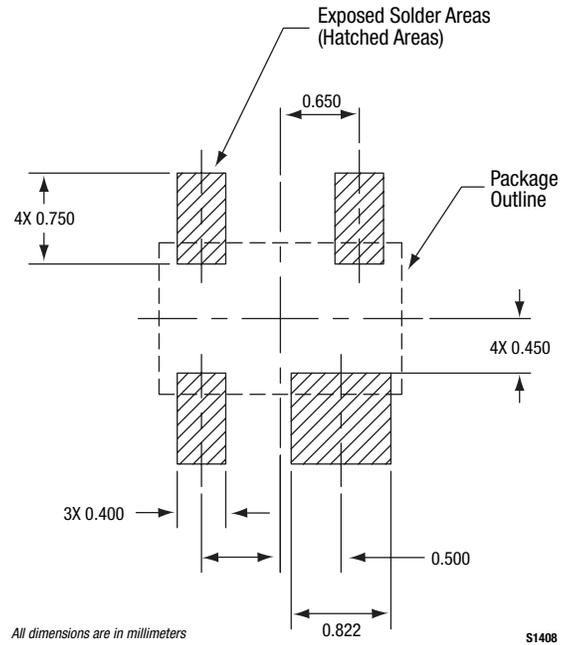


Figure 10. SKY65052-372LF PCB Layout Footprint

**** TBD ****

Figure 11. Typical Case Markings (Top View)

Ordering Information

| Model Name | Manufacturing Part Number | Evaluation Kit Part Number |
|-------------------------------------|----------------------------------|----------------------------|
| SKY65052-372LF Low Noise Transistor | SKY65052-372LF (Pb-free package) | *** TBD *** |

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