PRELIMINARY DATA SHEET

SKY65401: 0.7-1.0 GHz Balanced Low Noise Amplifier Module

Applications

- GSM (U.S. cellular and EGSM900)
- CDMA (U.S. cellular)
- WCDMA (bands V, VI, and VIII)

Features

- 0.7 to 1.0 GHz operating range
- Noise Figure: 1.05 dB typical @ 0.85 GHz
- S11 return loss: –19 dB typical @ 0.85 GHz
- S22 return loss: –22 dB typical @ 0.85 GHz
- Single, +5 V nominal operating voltage
- Gain: 24 dB typical @ 0.85 GHz
- Very high linearity: OIP3 = +38 dBm typical @ 0.85 GHz
- No external components required
- Unconditionally stable under any load impedance
- Small, MCM (16-pin, 8 x 10 mm) Pb-free package (MSL1, 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.

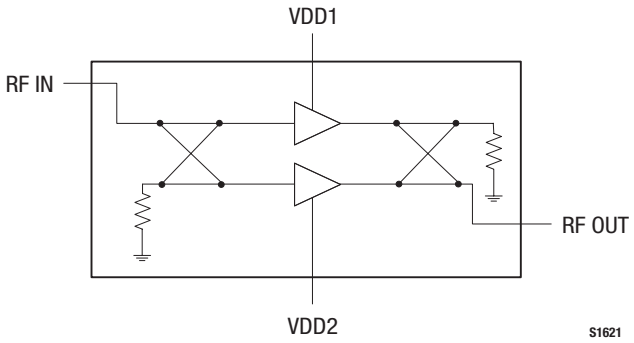


Figure 1. SKY65401 Block Diagram

Description

The SKY65401 is a high performance, balanced Low Noise Amplifier (LNA) optimized for use in the 0.7 to 1.0 GHz frequency range. The device consists of two independent high linearity LNA stages, hybrid 90-degree couplers, and low noise input and load matching structures.

Also included are DC bypassing, blocking, and biasing components housed in an 8 x 10 mm, 16-pin Multi-Chip Module (MCM) package. This package allows for a reduced external SMT count, a smaller PCB board space, and improvied thermal properties.

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.

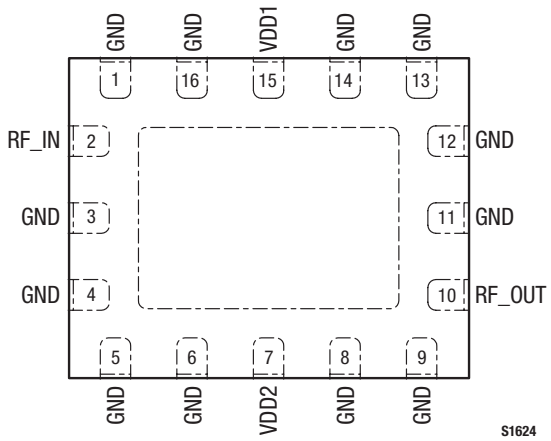


Figure 2. SKY65401 Pinout – 16-Pin MCM (Top View)

Table 1. SKY65401 Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	GND	Ground	9	GND	Ground
2	RF_IN	RF input to LNA	10	RF_OUT	RF output of LNA
3	GND	Ground	11	GND	Ground
4	GND	Ground	12	GND	Ground
5	GND	Ground	13	GND	Ground
6	GND	Ground	14	GND	Ground
7	VDD2	Power supply connection to 2nd amplifier	15	VDD1	Power supply connection to 1st amplifier
8	GND	Ground	16	GND	Ground

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY65401 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 SKY65401 are illustrated in Figures 3 through 9.

Table 2. SKY65401 Absolute Maximum Ratings

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage	V_{DD}		5.5		V
RF input power	P_{IN}		+16		dBm
Junction temperature	T_J		150		°C
Storage temperature	T_{STG}	–40		+125	°C
Operating temperature	T_{OP}	–40		+85	°C
Thermal resistance	Q_{JC}		75		°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. Exceeding any of the limits listed here may result in permanent damage to the device.

***CAUTION**: Although this device is designed to be as robust as possible, Electrostatic Discharge (ESD) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.*

Table 3. SKY65401 Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage	VDD1, VDD2	4.7	5.0	5.2	V

Table 4. SKY65401 Electrical Specifications (Note 1)
(T_{OP} = +25 °C, Characteristic Impedance [Z_O] = 50 Ω, V_{DD} = 5 V, P_{IN} = –30 dBm, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Small signal gain	|S21|	0.776 to 0.824 GHz 0.824 to 0.849 GHz 0.872 to 0.925 GHz 0.700 to 1.000 GHz	 22.0	24.5 24.0 23.5		dB dB dB dB
Noise Figure (Note 2)	NF	0.776 to 0.824 GHz 0.824 to 0.849 GHz 0.872 to 0.925 GHz 0.700 to 1.000 GHz		1.10 1.05 1.10	 1.20	dB dB dB dB
Input return loss	|S11|	0.776 to 0.925 GHz		19		dB
Output return loss	|S22|	0.776 to 0.925 GHz		21		dB
1 dB Input Compression Point	IP1dB	0.850 GHz		–1		dBm
1 dB Output Compression Point	OP1dB	0.850 GHz		+22		dBm
3rd Order Input Intercept Point	IIP3	0.850 GHz, Δf = 1 MHz, +10 dBm/tone		+14		dBm
3rd Order Output Intercept Point	OIP3	0.850 GHz, Δf = 1 MHz, +10 dBm/tone		+38		dBm
Supply voltage	V_{DD}1, V_{DD}2		4.7		5.2	V
Supply current	I_{DD}			160		mA

Note 1: Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.

Note 2: NF measured with Agilent MXA N9020A Spectrum Analyzer with internal pre-amplifier. Noise source was Agilent N4001A Smart Noise Source. T-cold measured automatically by the N4001A and uploaded to the MXA N9020A during measurement.

Typical Performance Characteristics

(T_{OP} = +25 °C, Characteristic Impedance [Z_O] = 50 Ω, V_{DD} = 5 V, P_{IN} = –30 dBm, Unless Otherwise Noted)

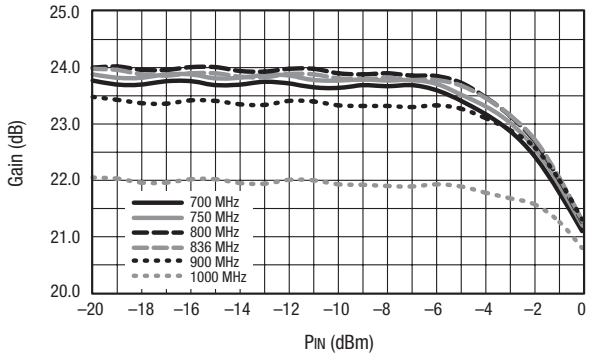


Figure 3. Gain vs. Input Power Over Frequency

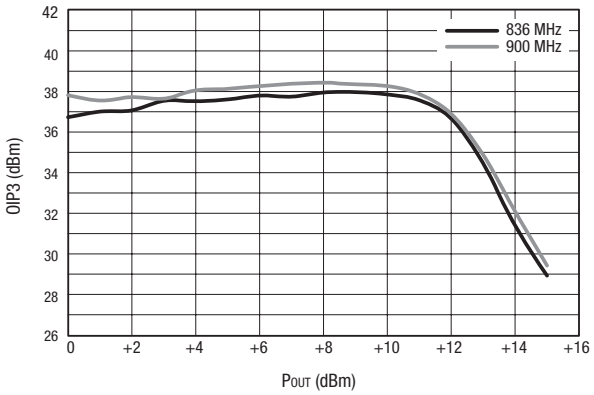


Figure 4. OIP3 vs Output Power Over Frequency (Δf = 1 MHz)

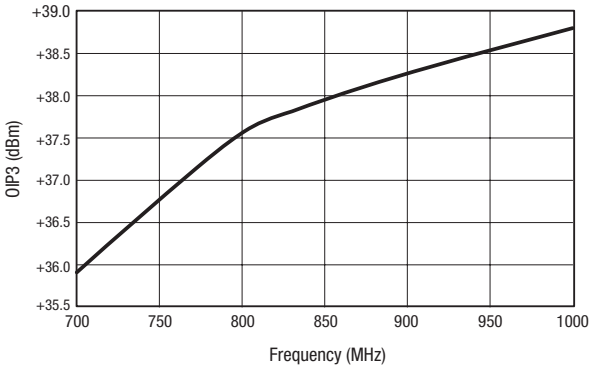


Figure 5. OIP3 vs Frequency (Δf = 1 MHz, P_{OUT} = +10 dBm/Tone)

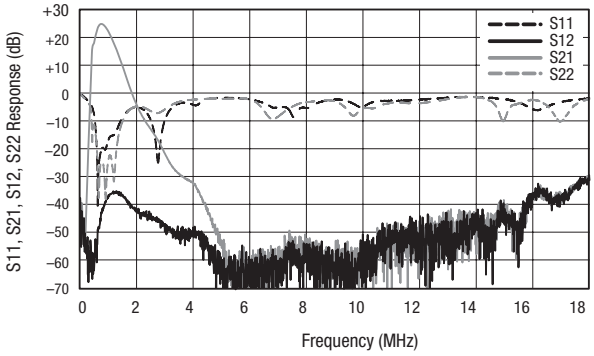


Figure 6. Broadband Response

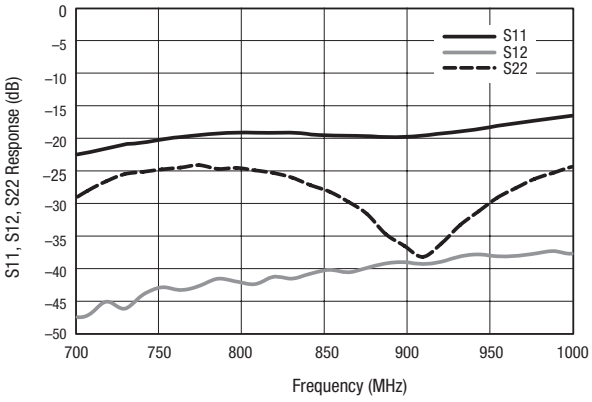


Figure 7. Narrowband Response

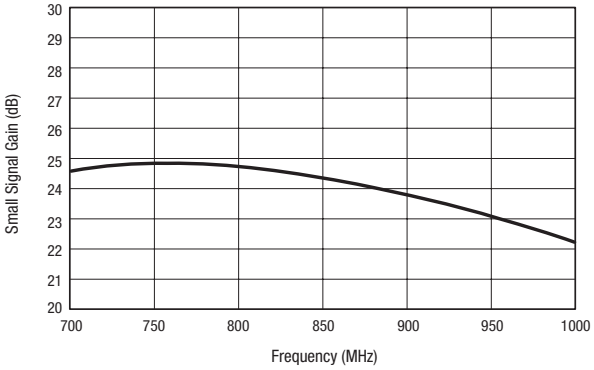


Figure 8. Narrowband Small Signal Gain Response

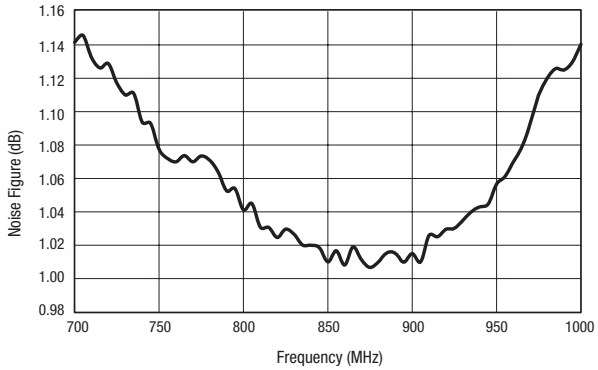


Figure 9. Noise Figure vs Frequency

Evaluation Board Description

The SKY65401 Evaluation Board is used to test the performance of the SKY65401 LNA. An assembly drawing for the Evaluation Board is shown in Figure 10.

Input and output trace lengths have been minimized to reduce losses. All surface mount components are 0402-sized to reduce component parasitics. The 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.

It is very important to place multiple ground vias as close to shunt components as possible. This ensures proper grounding and circuit performance.

Board material is 10 mil thick VT47 FR4 with 1 oz. copper cladding. RF input and output 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 200 mA. Verify that the board draws approximately 160 mA.

Step 4: Apply RF signal or noise source.

Package Dimensions

The PCB layout footprint for the SKY65401 is shown in Figure 11. Typical case markings are shown in Figure 12. Package dimensions for the 16-pin MCM are shown in Figure 13, and tape and reel dimensions are provided in Figure 14.

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 SKY65401 is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *PCB Design & SMT Assembly/Rework Guidelines for MCM-L Packages*, document number 101752.

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, *Tape and Reel Information – RF Modules*, document number 101568.

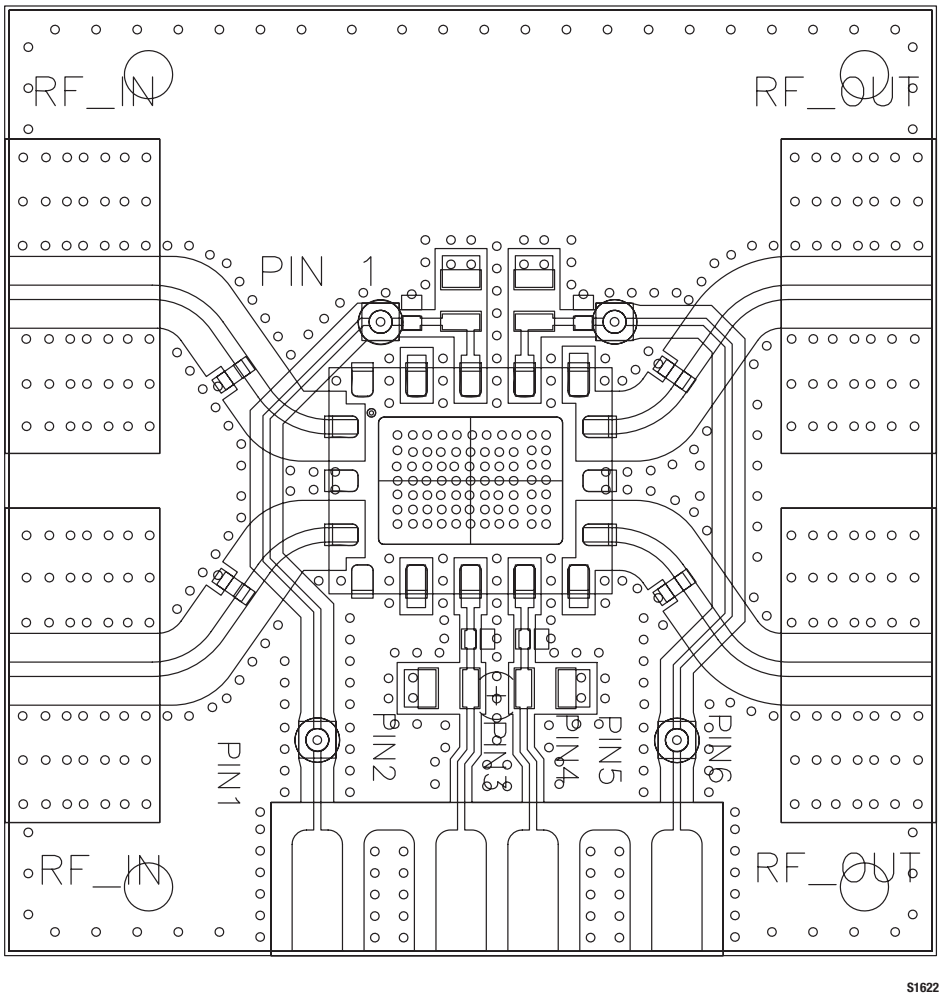


Figure 10. SKY65401 Evaluation Board Assembly Diagram

*** TBD ***

Figure 11. SKY65401 PCB Layout Footprint

*** TBD ***

Figure 12. Typical Case Markings
(Top View)

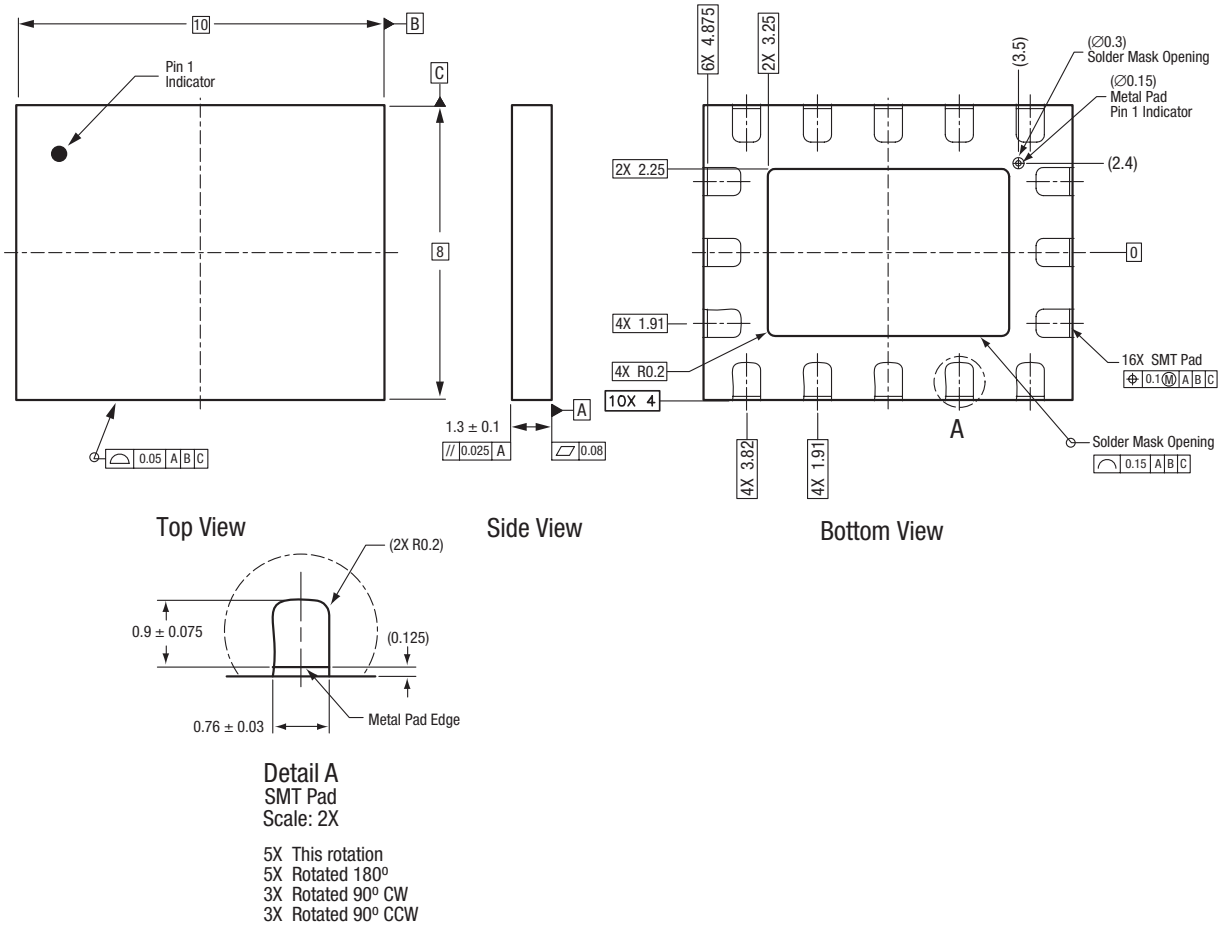
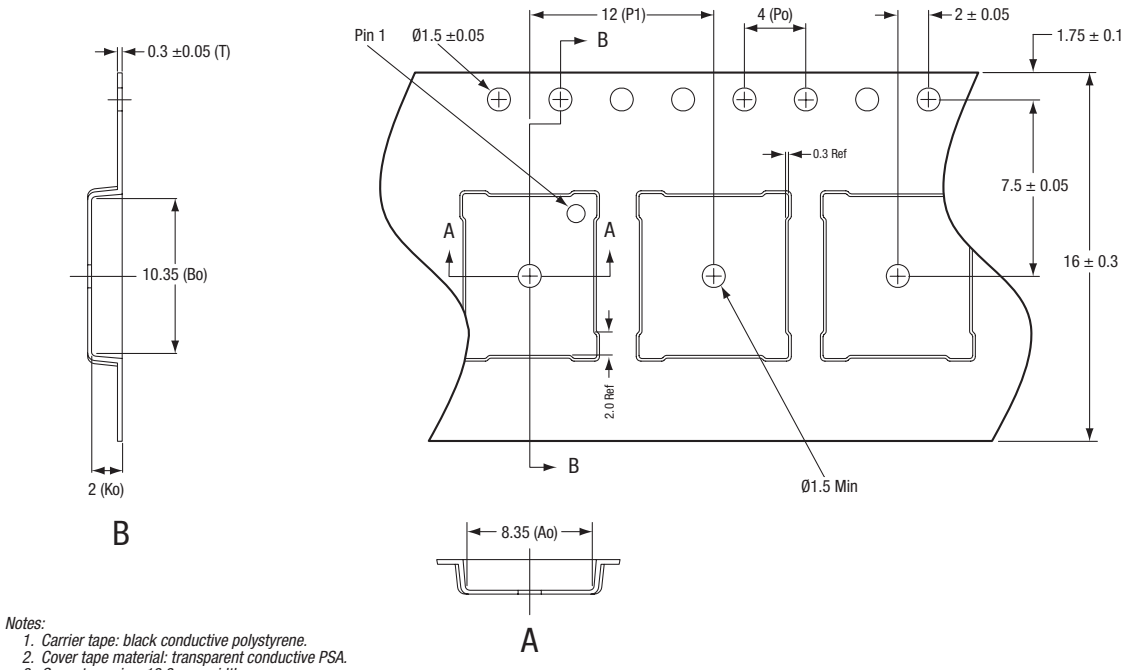


Figure 13. SKY65401 16-Pin MCM Package Dimensions



Notes:
1. *Carrier tape: black conductive polystyrene.*
2. *Cover tape material: transparent conductive PSA.*
3. *Cover tape size: 13.3 mm width.*
4. *Po/P1, 10 pitches cumulative tolerance on tape ±0.20 mm.*
5. *Ao and Bo measurement point to be 0.3 mm from bottom pocket.*
6. *All measurements are in millimeters.*

S1625

Figure 14. SKY65401 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Kit Part Number
SKY65401 Low Noise Amplifier	SKY65401 (Pb-free and Green package)	SK41124-2, rev. 2

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