DATA SHEET

SKY16603-632LF: High-Linearity Dual PIN Diode Limiter 0.6 to 6.0 GHz

Applications

- 5G massive MIMO infrastructure
- Receiver protection
- Test instrumentation

Features

- Optimized for 0.6 to 6.0 GHz operation
- Low limiting threshold (+8 dBm typical)
- Low insertion loss
- Excellent IIP3 and low IM distortion
- Integrated dual PIN limiter diodes and DC blocks
- DFN (2-pin, 2.3 x 2.3 mm) Pb-free package, (MSL1, 260°C per JEDEC J-STD-020)

Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.

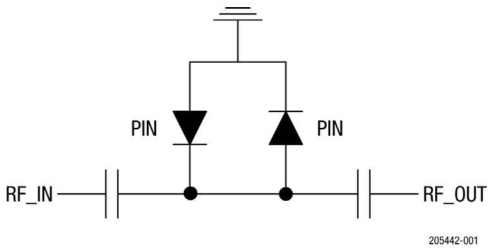

Figure 1. SKY16603-632LF Block Diagram

Description

The SKY16603-632LF is a fully integrated dual PIN diode high-linearity limiter module in a surface-mount package. It is designed for use as a passive receiver protector in wireless or other RF systems for frequencies up to 6 GHz. It features a low limiting threshold, low-insertion loss, excellent IIP3, and low IM distortion in a Dual Flat No Lead (DFN) package.

The SKY16603-632LF module is comprised of dual PIN limiter diodes and two DC blocking caps at the RF ports in a 2-lead DFN. The small package design reduces printed circuit board area.

The module can operate over the operating temperature range of -40°C to +105°C.

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.

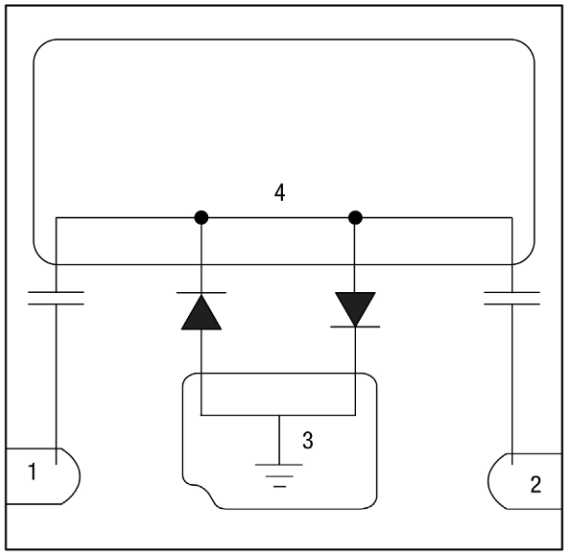

Figure 2. SKY16603-632LF Pinout
(Top View)

Table 1. SKY16603-632LF Signal Descriptions

Pin	Name	Description
1	RF_IN	RF input, AC coupled
2	RF_OUT	RF output, AC coupled
3	GND	Must be connected to chassis ground
4	PAD	Exposed pad **(must be isolated from ground)**

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY16603-632LF are provided in Table 2. Electrical specifications are provided in Table 3. The SKY16603-632LF schematic is shown in Figure 3, and typical performance characteristics are illustrated in Figures 4 and 5.

Figure 6 shows the power derating curve for the limiter. The temperature is referenced to the bottom of the DFN package.

Table 2. SKY16603-632LF Absolute Maximum Ratings[1]

Parameter	Symbol	Minimum	Maximum	Unit
CW power dissipation at T_{CASE} = 120°C	P_{DIS}		1	W
Storage temperature	T_{STG}	-65	150	°C
Operating temperature	T_{OP}	-40	105	°C
Electrostatic discharge:	ESD			
Charged-Device Model (CDM), Class 4			1000	V
Human Body Model (HBM), Class 1B			250	V
Machine Model (MM), Class A			150	V

1 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.

***ESD HANDLING**: 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 when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.*

Table 3. SKY16603-632LF Electrical Specifications
(T_{OP} = 25°C, Z_O = 50 Ω, as Measured in Skyworks Evaluation Board Optimized for Operation at 0.6 to 6.0 GHz, Unless Otherwise Noted)

Parameter	Symbol	Condition	Frequency	Min	Typ	Max	Units
Reverse voltage	V_R					20	V
Forward current	I_F					50	mA
Insertion loss	I_L	P_{IN} = 0 dBm	2.6 GHz		0.3	0.5	dB
Return loss	R_L	P_{IN} = 0 dBm	2.6 GHz		22		dB
Threshold level	T_L	P1dB	2.6 GHz	5	8		dBm
Maximum saturated CW input power[1]	P_{IN_MAX}	Tc = 120 °C	2.6 GHz		35		dBm
Flat leakage power[2]	F_L	P_{IN} = +15 dBm	2.6 GHz	5.5	9		dBm
Input third order intercept point	IIP3	Two CW tones, P_{IN} = -5 dBm per tone, spacing = 10 MHz	2.6 GHz	25	29		dBm
Recovery time[3]	t_R		2.6 GHz		1		ns
Thermal resistance	θ_{JC}	Junction-to-case (Tc = 120 °C)			52		°C/W

1 Saturated CW input power is defined as the point where the diode series resistance does not change with the rectified current. As the input power increases past this point, output power will increase until the diode reaches its maximum power limit.

2 Flat leakage power is defined as the power level after the limiter has fully turned on and the output pulse reaches a constant level.

3 Recovery time represents the transition time from the high-loss to low-loss state following the removal of high-power input. RF pulse modulation: 1 µs pulse width and 0.1% duty factor.

Theory of Operation

A limiter prevents overload by allowing RF signals that are below a certain threshold to pass through, but larger signals exceeding the threshold are increasingly attenuated. The SKY16603-632LF has a lower threshold level compared to a traditional self-bias limiter circuit with an inductor for a ground return.

The device accomplishes this by incorporating a pair of specially optimized PIN limiter diodes. The two internal DC input/output capacitors provide DC blocking needed for most applications.

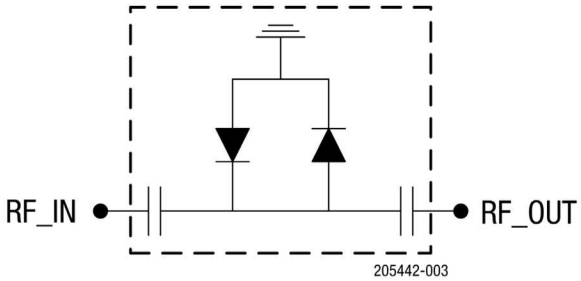

Figure 3. SKY16603-632LF Schematic

Typical Performance Characteristics
(T_{OP}=25 °C, Characteristic Impedance = 50 Ω)

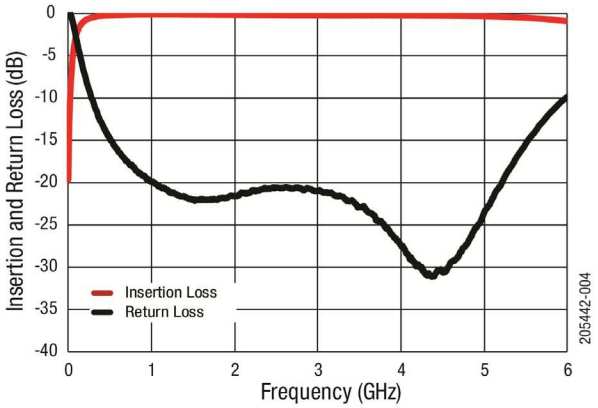

Figure 4. Small Signal Performance

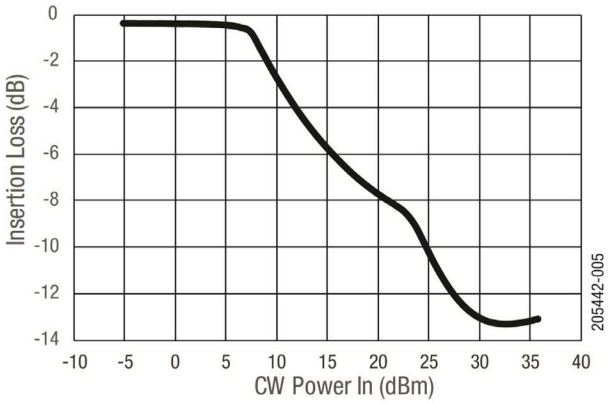

Figure 5. Insertion Loss vs CW Power In (f = 2.6 GHz)

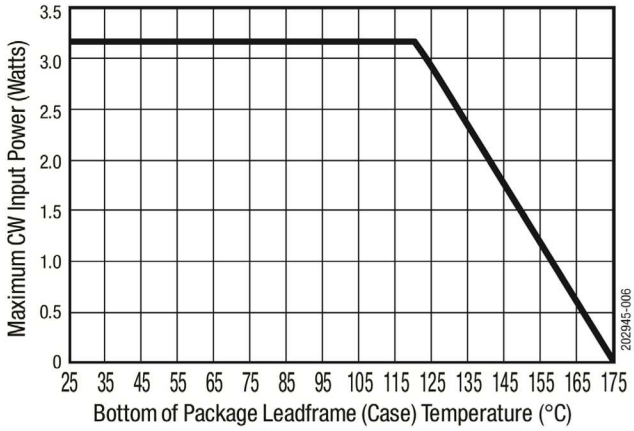

Figure 6. Power Derating Curve (Pd = 1 W @ 120 °C) vs Package Leadframe (Case) Temperature

Evaluation Board Description

The SKY16603-632LF Evaluation Boards are used to test the performance of the limiter. An assembly drawing for the Evaluation Board is shown in Figure 7. The Evaluation Board layer detail is provided in Figure 8.

Package Dimensions

The PCB layout footprint for the SKY16603-632LF is shown in Figure 9. Typical part markings are noted in Figure 10. Package dimensions are shown in Figure 11, and tape and reel dimensions are provided in Figure 12.

Package and Handling Information

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 SKY16603-632LF 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, Solder Reflow Information, document number 200164.

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.

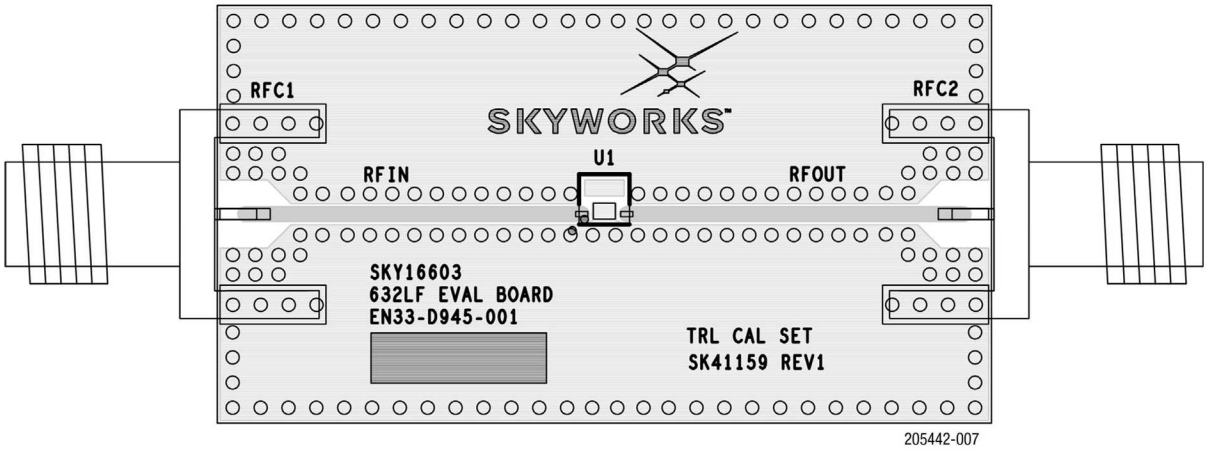

Figure 7. SKY16603-632LF Evaluation Board Assembly Diagram

Cross Section	Name	Thickness (in)	Material
	Top Solder mask		
	L1	(0.0028)	Cu foil
	Laminate	0.012 ± 0.0006	Rogers RO4003C Core
	L2	(0.0014)	Cu foil
	Laminate	(Note 1)	FR4 Prepreg
	L3	(0.0014)	Cu foil
	Laminate	0.010 ± 0.0006	FR4 Core
	L4	(0.0028)	Cu foil
	Bottom Solder mask		

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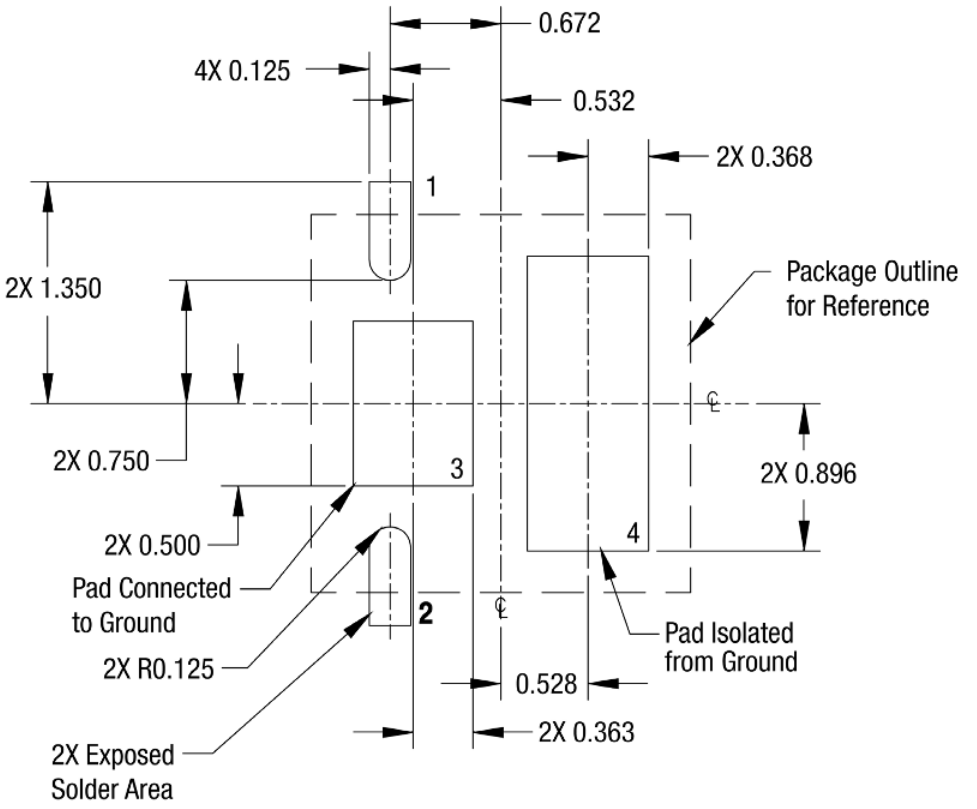
Note 1: Adjust this thickness to meet total thickness goal of 0.062 ± 0.005 inches.

Figure 8. Board Layer Detail Physical Characteristics



All dimensions are in millimeters

Figure 9. SKY16603-632LF PCB Layout Footprint

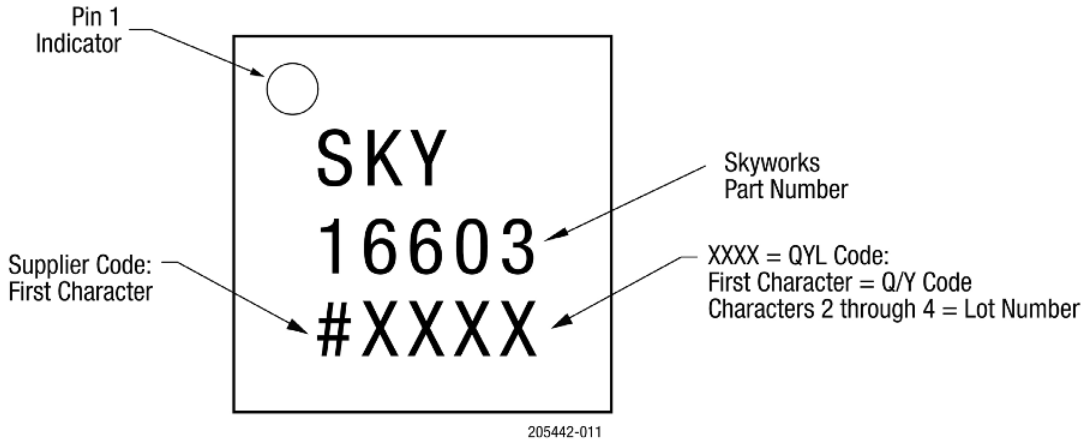
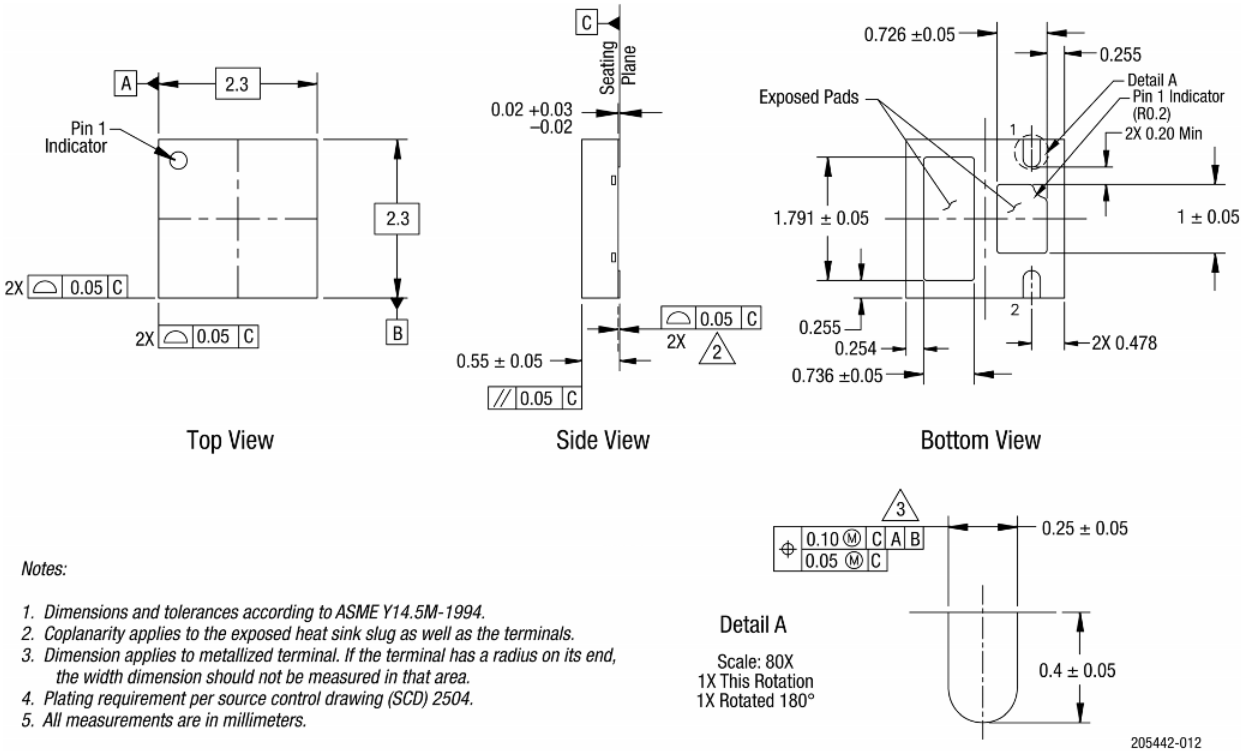


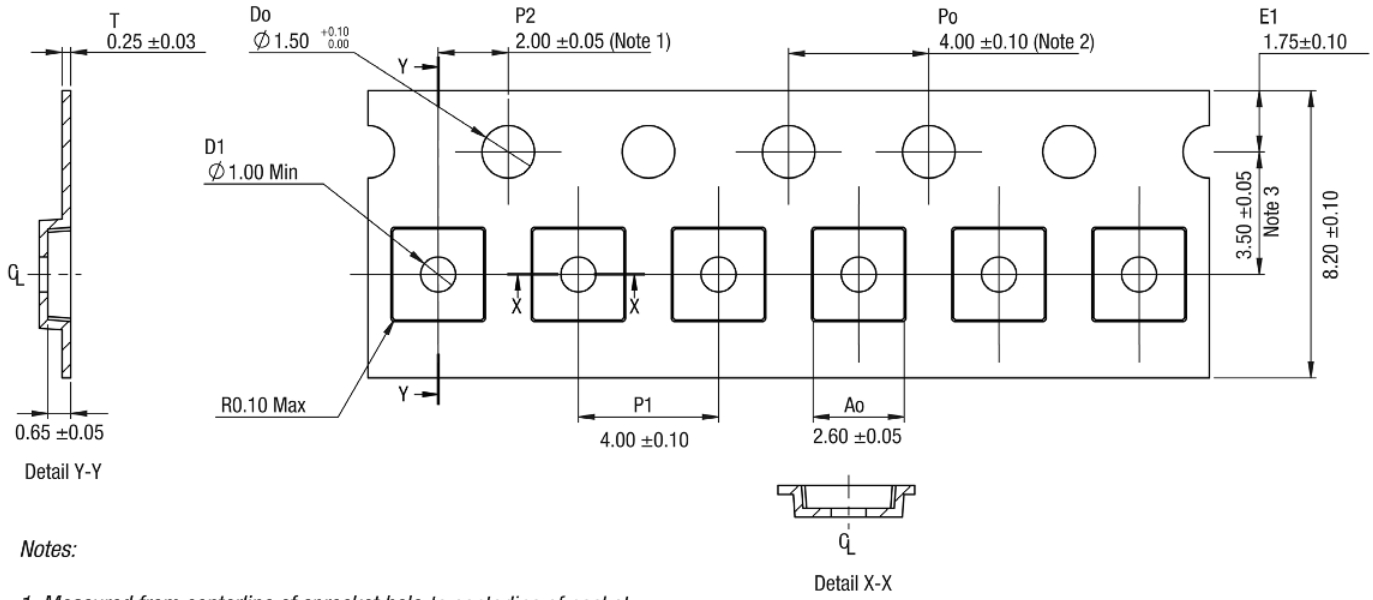
Figure 10. SKY16603-632LF Typical Part Markings



Notes:

1. *Dimensions and tolerances according to ASME Y14.5M-1994.*
2. *Coplanarity applies to the exposed heat sink slug as well as the terminals.*
3. *Dimension applies to metallized terminal. If the terminal has a radius on its end, the width dimension should not be measured in that area.*
4. *Plating requirement per source control drawing (SCD) 2504.*
5. *All measurements are in millimeters.*

Figure 11. SKY16603-632LF Package Dimensions



Notes:

1. *Measured from centerline of sprocket hole to centerline of pocket.*
2. *Cumulative tolerance of 10 sprocket holes is ±0.20.*
3. *Measured from centerline of sprocket hole to centerline of pocket.*
4. *Other material available.*
5. *All dimensions in millimeters unless otherwise stated.*

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Figure 12. SKY16603-632LF Tape and Reel Dimensions

Ordering Information

Part Number	Product Description	Evaluation Board Part Number
SKY16603-632LF	High-Linearity Dual PIN Diode Limiter 0.6 to 6.0 GHz	SKY16603-632EK1
SK41159	Calibration Board	TRL CAL SET