PRELIMINARY DATA SHEET

SKY33100-360LF: BAW Band Pass Filter 2.4 GHz

Applications

- 802.11 b/g/n Tx band
- 2.4 GHz ISM band

Features

- Bandwidth: 70 MHz
- Low mid-band insertion loss: 1 dB typical
- High near-band rejection
- Input and output impedance: 50 Ω nominal
- Lead (Pb)-free and RoHS-compliant QFN 8L 2 x 2 mm package

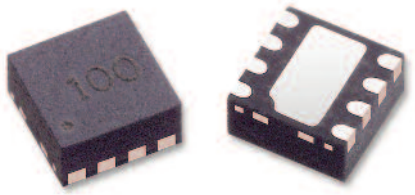
Description

The SKY33100-360LF is a bulk acoustic wave (BAW) band pass filter in a QFN 8L 2 x 2 mm package. This filter has very low in-band insertion loss, excellent near-band rejection and very low input and output return loss.

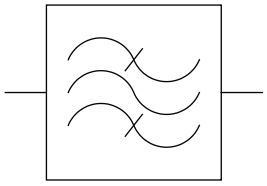
This filter is intended for use in the 2.4 GHz WLAN and ISM bands.

The filter can operate over the temperature range of -40 to +85 °C.

The SKY33100-360LF is available in a lead (Pb)-free, RoHS-compliant package.



Functional Block Diagram



NEW Skyworks offers lead (Pb)-free, RoHS (Restriction of Hazardous Substances)-compliant packaging.

Electrical Specifications

T = 25 °C, P_{INPUT} = 0 dBm, Z_0 = 50 Ω, unless otherwise noted

Parameter	Condition	Frequency	Min.	Typ.	Max.	Unit
Insertion loss	Pass band	2.402–2.472 GHz		2	3	dB
Return loss	Pass band	2.402–2.472 GHz	9	10		dB
Attenuation	Lower stop band Upper stop band	2.3900 GHz 2.4835 GHz	12 12	14 14		dB dB
DC withstand voltage				100		V

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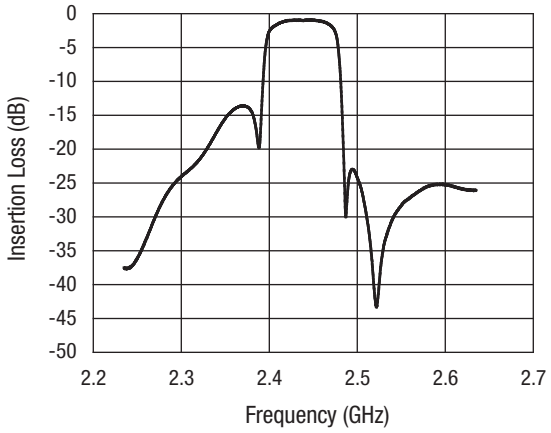
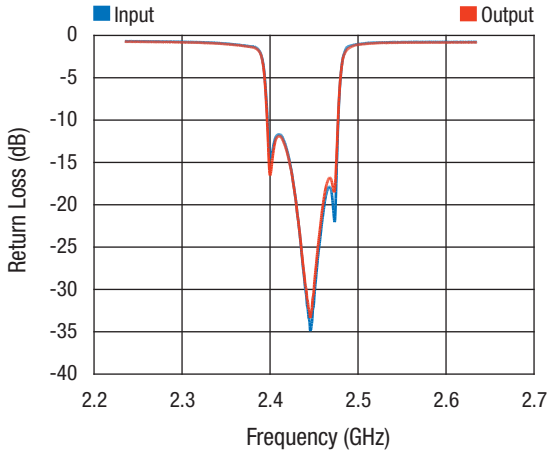
Typical Performance Data

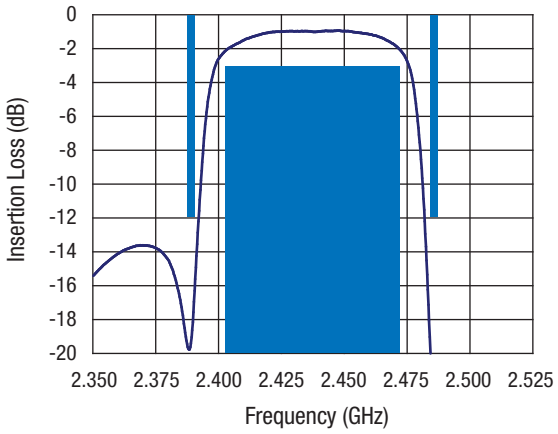
T = 25 °C, P_{INPUT} = 0 dBm, Z_0 = 50 Ω, unless otherwise noted



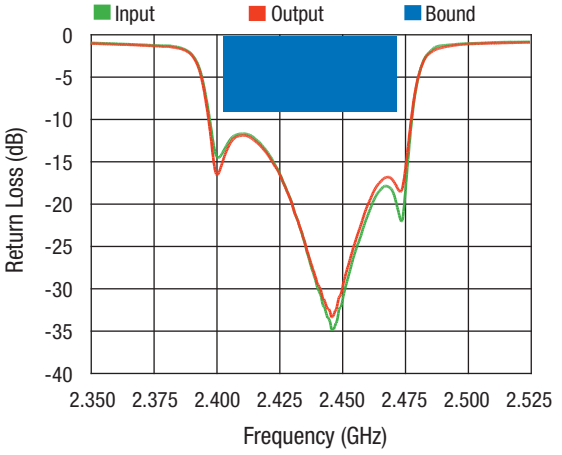
Insertion Loss vs. Frequency – Wide Band



Return Loss vs. Frequency – Wide Band

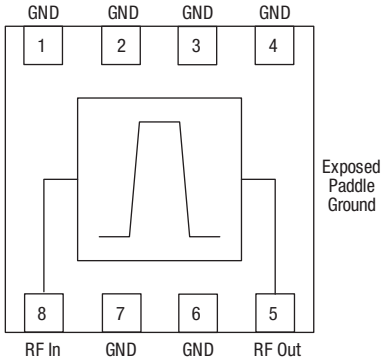


Insertion Loss vs. Frequency – Narrow Band

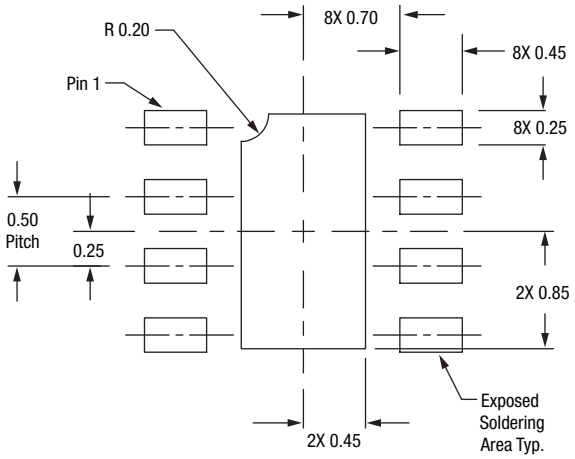


Return Loss vs. Frequency – Narrow Band

Pin Out (Bottom View)



Land Pattern



Absolute Maximum Ratings

Characteristic	Value
Input power	33 dBm
Operating temperature	-40 °C to +85 °C
Storage temperature	-40 °C to +125 °C
ESD HBM Machine Model	 1000 V 1500 V

Performance is guaranteed only under the conditions listed in the specifications table and is not guaranteed under the full range(s) described by the Absolute Maximum specifications. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void the warranty.

CAUTION: *Although this device is designed to be as robust as possible, ESD (Electrostatic Discharge) 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 must be employed at all times.*

Recommended Solder Reflow Profiles

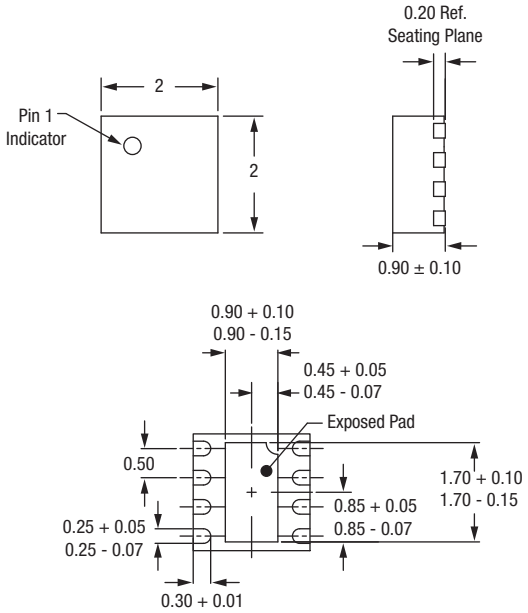
Refer to the *"Recommended Solder Reflow Profile"* Application Note.

Tape and Reel Information

Refer to the *"Discrete Devices and IC Switch/Attenuators Tape and Reel Package Orientation"* Application Note.

Part Marking (Top View)

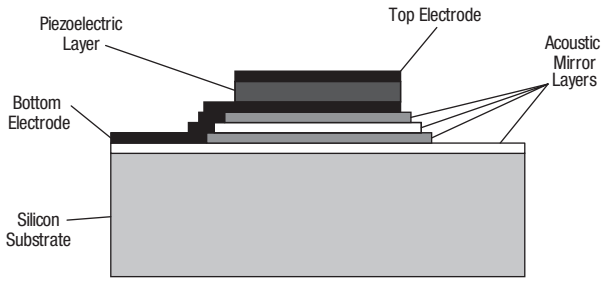
QFN 8L 2 x 2 mm Package



Theory of Operation

Bulk acoustic wave (BAW) filters make use of very low loss electromechanical resonators to perform very highly selective RF filtering. The typical configuration for a BAW filter is the ladder network, which contains series and shunt resonators with slightly differing resonant frequencies to form a band pass filter with steep near band rolloff.

BAW resonators consist of a thin film layer of piezoelectric material sandwiched between two metal electrodes. These layers are formed on top of an acoustic mirror comprised of several alternating layers of high and low acoustic impedance materials, the composition and thickness of which are both very tightly controlled.

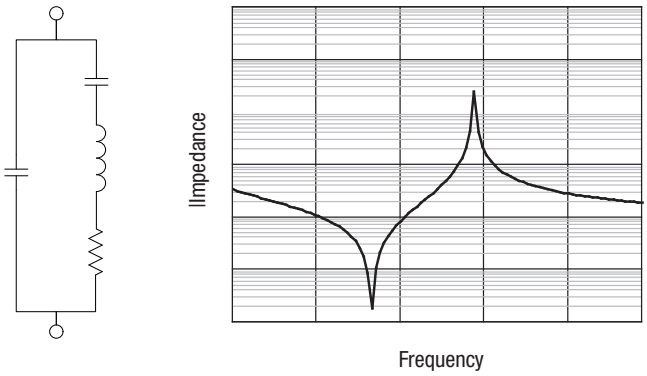


Simplified BAW Resonator Cross Section

Electrical signals are coupled into the piezoelectric layer via the electrodes and due to the piezoelectricity, that layer changes dimension, primarily thickness. The longitudinal acoustic wave created is resonant in the layered structure and as such the frequency of operation is dictated by the layer thicknesses and acoustic properties of the layers used. The large currents that result at the acoustic resonance produce the sizeable impedance changes that are used in the design RF filters.

The substrate on top of which the electrode-peizoelectric-electrode "sandwich" is formed is an important part of the BAW structure. Alternating layers of high and low acoustic impedance materials are deposited to a total thickness of about one fourth of the acoustic wavelength of the resonant frequency. These layers, known as the acoustic mirror or the Bragg Stack, act in a manner analogous to an electrical quarter-wave transmission line terminated in a short circuit. Construction of optimized acoustic reflections is vital to the low loss operation of BAW filters.

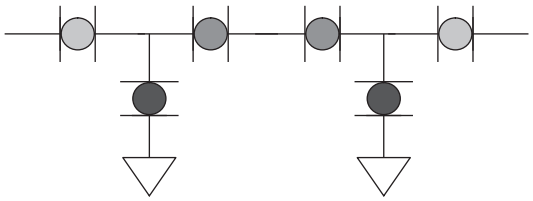
A simplified electrical equivalent circuit of a single BAW resonator and its impedance versus frequency are shown below.



BAW Resonator Equivalent Circuit and Impedance vs. Frequency

This structure produces a series resonance, f_{SERIES}, as well as a parallel resonance, $f_{PARALLEL}$. The spacing between resonance and antiresonance and the magnitude of the impedance excursions is determined by layer construction.

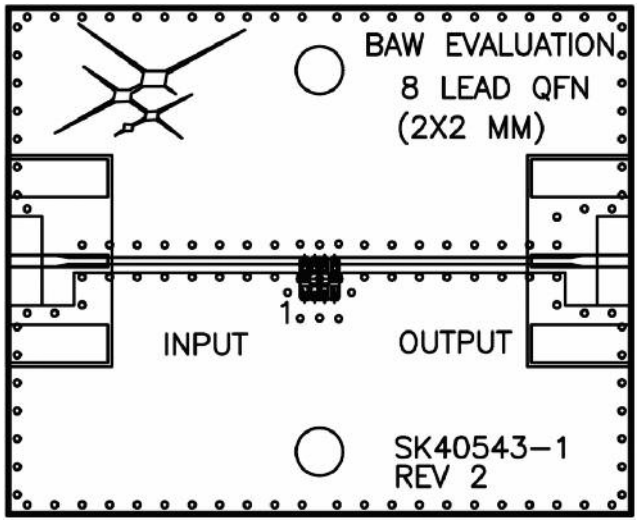
A filter is formed by cascading series and shunt resonators in a ladder configuration. Simplistically one places the series low impedance and the shunt high impedance frequencies roughly mid band resulting in a band pass shape. The number of segments used is determined by required rejection and tolerable insertion loss. The impedance, band shape, and out of band rejection of the filter are determined by optimizing the properties of the various resonators.



BAW Ladder Network

The construction of BAW resonators is similar to that of parallel plate capacitors. This geometry allows for very robust filters to be constructed, with tolerance of higher DC voltages and static discharges than those tolerated by typical SAW filters. BAW filter losses and temperature coefficients of frequency can also be lower than those of typical SAW filters so that more aggressive near band rejection requirements can be addressed.

Evaluation Board



The evaluation board for the SKY33100-360LF BAW filter allows the part to be fully exercised and evaluated. Although the RF ports on the evaluation board are marked "Input" and "Output", the filter is actually fully bilateral, so either RF port can be utilized as the RF input or the RF output with no degradation in performance.