

Applications

- ❑ Cellular/3G/4G Infrastructure
- ❑ Fixed Wireless, WiMax & WiBro
- ❑ Microwave and satellite radio
- ❑ Test Instrumentation

Features

- 3.0 – 5.0 V Power Supply Operation
- 54 dBm IIP3
- 0.5 dB LSB Steps to 31.5 dB
- Low Insertion Loss
- Small 4 mm x 4 mm x 0.85 mm, package MSL1
- Pb-free, RoHS compliant and halogen free

Ordering Information

Part No.	Package	Remark
SE8013L-S	24 pin QFN	Samples
SE8013L-R	24 pin QFN	Tape & Reel
SE8013L-EK1	N/A	Evaluation kit

Product Description

The SE8013L is a silicon based 6-bit digital attenuator with serial logic control.

Covering a broad frequency range of 0.5 to 6.0 GHz, it features a superior combination of insertion loss and attenuator accuracy typically found in GaAs based equivalents. The silicon based architecture also enables integrated digital control within a small footprint

The attenuator bit values are 0.5 (LSB), 1, 2, 4, 8 and 16 dB for a total attenuation of 31.5 dB. Attenuation accuracy is excellent with an IIP3 of up to +54 dBm. Six bit digital control words are used to select each attenuation state.

The two RF ports can be used as the RF input or the RF output.

The SE8013L is comprised of 6 fixed attenuators in cascade, each of which having a bypass switch. Beginning at the LSB, which is 0.5 dB, each succeeding fixed attenuator produces twice the attenuation of the preceding stage. The state of each bypass switch is controlled by the logic level voltage applied to the associated control voltage input; a logic high voltage closes the associated switch, thereby bypassing that fixed attenuator stage, and a logic low opens the switch to force the input signal to that stage through the associated attenuator.

Functional Block Diagram:

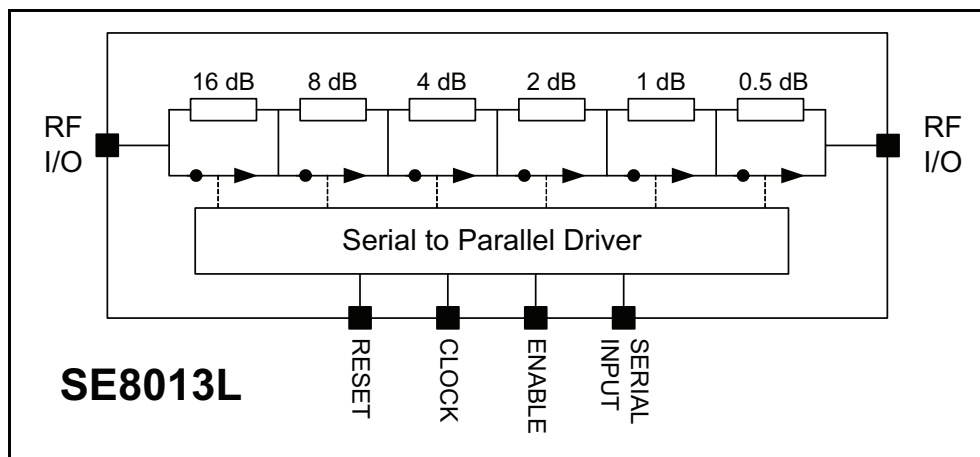


Figure 1: Functional Block Diagram

Pin-Out Diagram

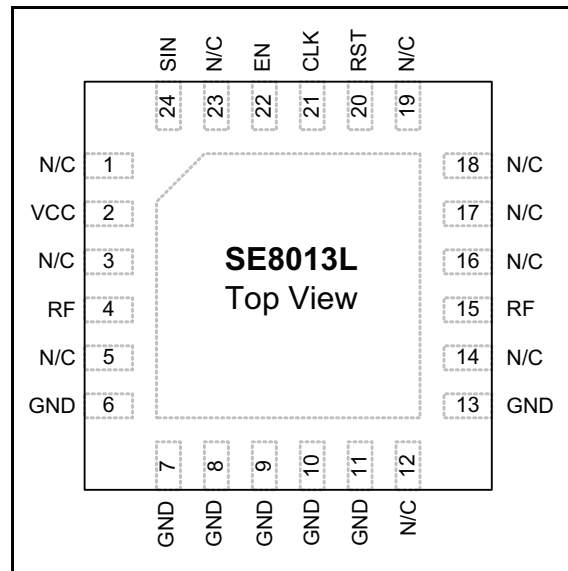


Figure 2: SE8013L Pin-Out

Pin-Out Description

Pin No.	Name	Description
1	N/C	No Connect
2	VCC	Power Supply Voltage
3	N/C	No Connect
4	RF	RF input/output, internally AC coupled
5	N/C	No Connect
6-11	GND	Connect to PCB ground
12	N/C	No Connect
13	GND	Connect to PCB ground
14	N/C	No Connect
15	RF	RF input/output, internally AC coupled
16	N/C	No Connect
17	N/C	No Connect
18	N/C	No Connect
19	N/C	No Connect
20	RST	Reset
21	CLK	Clock
22	EN	Latch Enable
23	N/C	No Connect
24	SIN	Serial Input

Absolute Maximum Ratings

These are stress ratings only. Exposure to stresses beyond these maximum ratings may cause permanent damage to, or affect the reliability of the device. Avoid operating the device outside the recommended operating conditions defined below. This device is ESD sensitive. Handling and assembly of this device should be at ESD protected workstations.

Symbol	Definition	Min.	Max.	Unit
VCC	Supply Voltage on VCC	-0.3	5.5	V
SIN EN CLK RST	Voltage on any digital Input	-0.3	5.5	V
Pin	Input Power at 50 ohms (500 MHz – 6 GHz)		+27	dBm
T _J	Maximum junction temperature		125	°C
T _{STG}	Storage Temperature Range	-40	125	°C
V _{ESD}	ESD voltage non-RF pins (HBM)		2000	V
	ESD voltage RF pins (HBM)		1500	V
	ESD voltage (Machine Model)		250	V

Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
T _A	Ambient temperature	-40	25	85	°C
VCC	Supply voltage on VCC	3.0	5.0	5.5	V

DC Electrical Characteristics

Conditions: VCC= 5V, T_A = 25 °C, as measured on SiGe Semiconductor's SE8013L-EK1 evaluation board (de-embedded to device), unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
VCC	Power Supply voltage		3.0	5.0	5.5	V
I _{DD}	Power supply current			100	350	uA
D _x	Digital Input High		1.5		5.5	V
D _x	Digital Input Low		0		0.7	V

Logic Characteristics

Conditions: VCC = 5 V, TA = 25 °C, as measured on SiGe Semiconductor's SE8013L-EK1 evaluation board (de-embedded to device), unless otherwise noted.

Logic Level	VCC (5V)
0	0 to 0.7 V
1	1.5 to 5.0 V

Note: Hysteresis included in Low-High and High-Low logic transition

Logic Truth Table: (Serial Input)

Sin	ENABLE	CLOCK	RESET	OUTCOME
X	X	X	L	Set attenuator to MAX attenuation (31.5 dB)
X	L	↑	H	Load Control Data
X	↑	X	H	Change Attenuation State

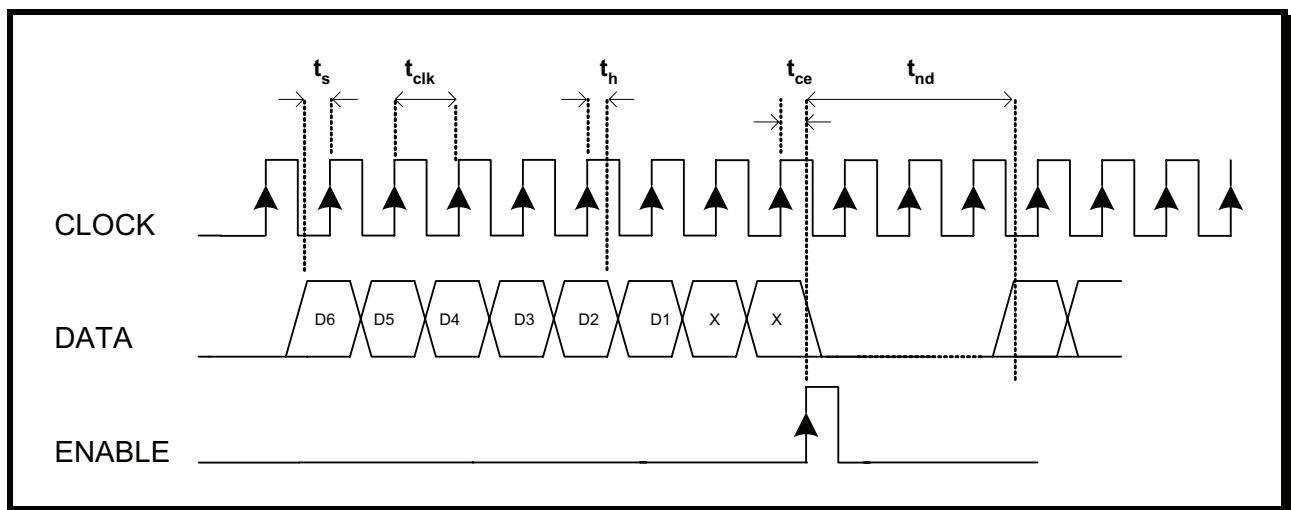
Truth Table:

Serial Control Inputs						RESET	Attenuation Setting RF to RF
D1	D2	D3	D4	D5	D6		
H	H	H	H	H	H	H	Insertion loss reference
L	H	H	H	H	H	H	0.5 dB
H	L	H	H	H	H	H	1.0 dB
H	H	L	H	H	H	H	2.0 dB
H	H	H	L	H	H	H	4.0 dB
H	H	H	H	L	H	H	8.0 dB
H	H	H	H	H	L	H	16 dB
L	L	L	L	L	L	H	31.5 dB
X	X	X	X	X	X	L	31.5 dB

Note: In start-up condition (prior to programming), attenuator is pre-set at maximum attenuation

Timing Definitions

	Symbol	MIN	MAX	Unit
Data Setup time	t_s	20		ns
Clock Frequency	$1 / t_{clk}$		30	MHz
Data Hold Time	t_h	0		ns
Clock to Enable time	t_{ce}	40		ns
New Data time	t_{nd}	30		ns



Electrical Specifications

Conditions: TA = 25°C, VCC = 5V as measured on SiGe Semiconductor's SE8013L-EK1 evaluation board (de-embedded to device), unless otherwise noted.

Symbol	Parameter	Note	Min	Typ.	Max.	Unit
Freq	Frequency Range		0.5		6	GHz
I _L	Insertion Loss (0.5 – 1.5 GHz)			1.5		dB
	Insertion Loss (1.5 - 3.0 GHz)			2		dB
	Insertion Loss (3.0 - 6.0 GHz)			3		dB
Att _{RNG}	Attenuation Range			31.5		dB
R _L	Return Loss	1		18		dB
Att _{ACY}	Attenuation Accuracy (0.5 - 4 GHz)		(0.15 + 2% of Attn Setting Max.)			dB
	Attenuation Accuracy (4.0 - 6.0 GHz)		(0.3 + 3% of Attn Setting Max.)			dB
IP1dB	Input Power			29		dBm
IIP3	Input 3rd Order Intercept Point (Pin = +10 dBm)	2		54		dBm
RF _{RISE} & RF _{FALL}	Rise and Fall time for RF (10% to 90%)			500		ns
TIM _{ESW}	Switching Time (50% DC Cntrl to 10% / 90% RF)			650		ns

Note: (1) Measured on the SE8013L-EK1 evaluation board.
(2) IIP3 performance measured in attenuator bypass mode.

AC Electrical Characteristics

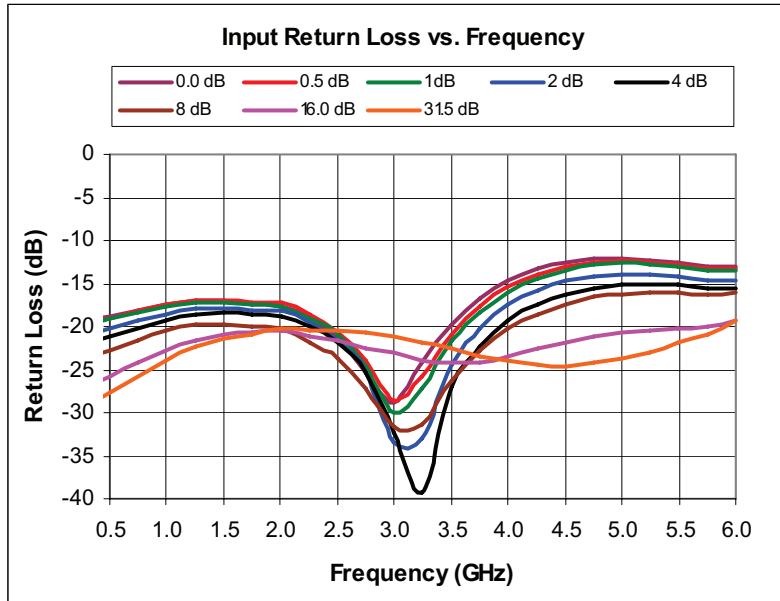


Figure 3: Input return loss over frequency

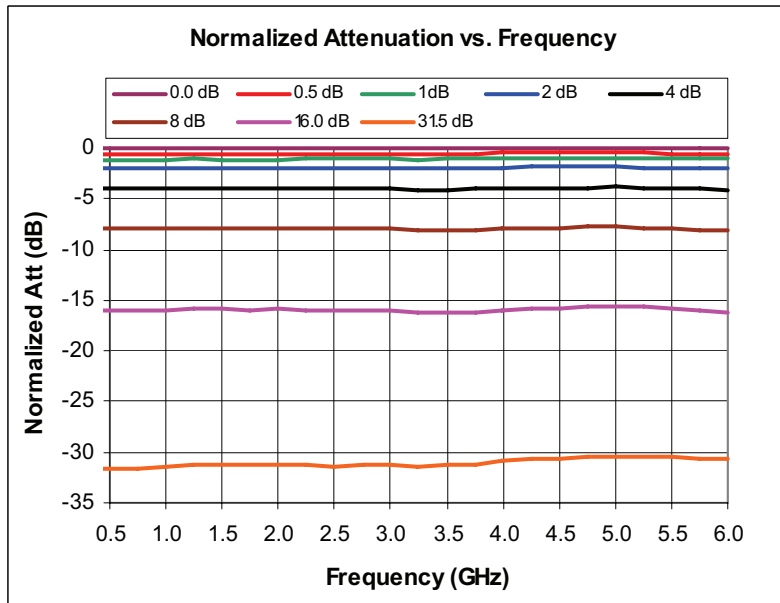


Figure 4: Attenuation versus frequency

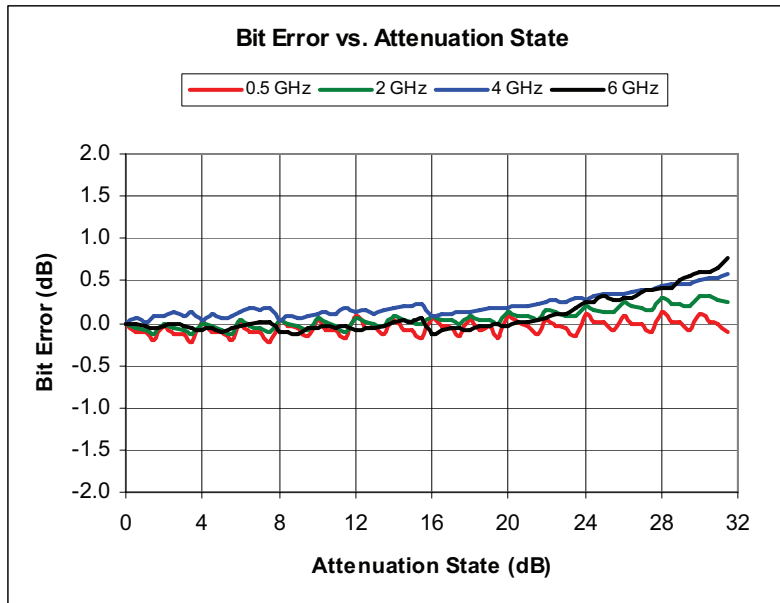


Figure 5: Bit error versus attenuation

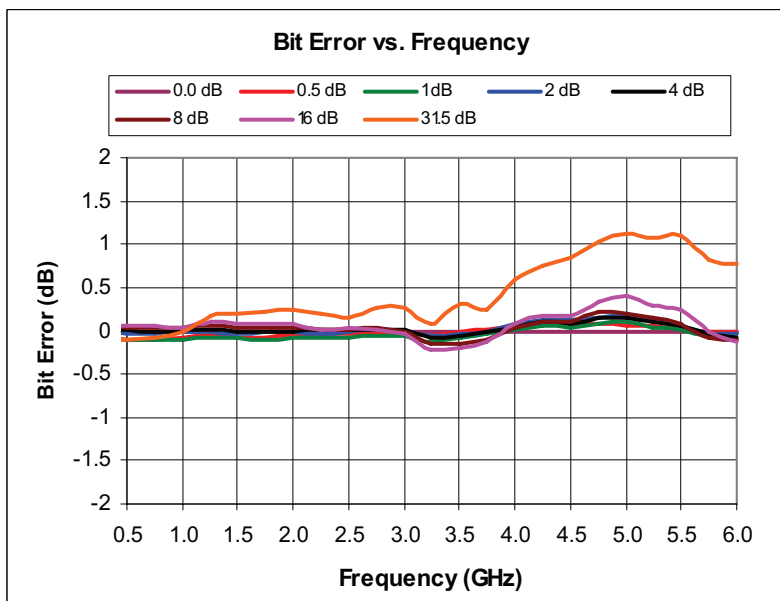


Figure 6: Bit error versus frequency

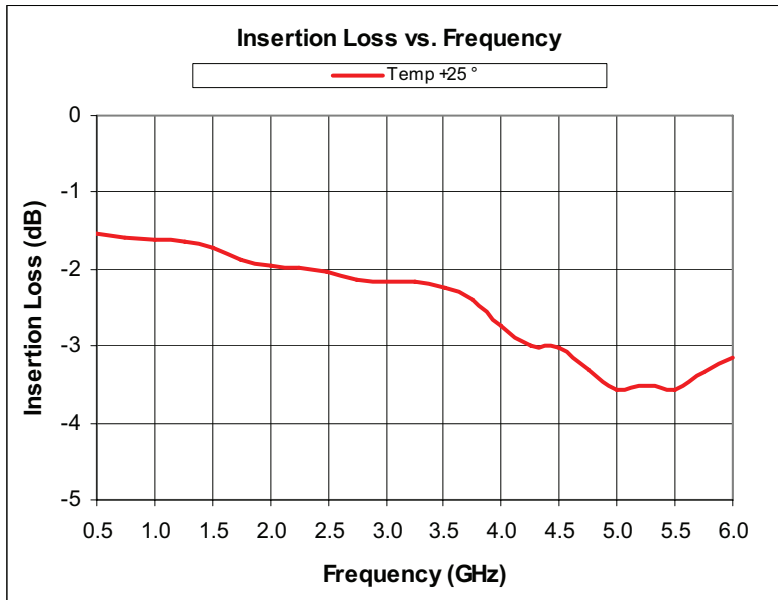


Figure 7: Insertion loss versus frequency

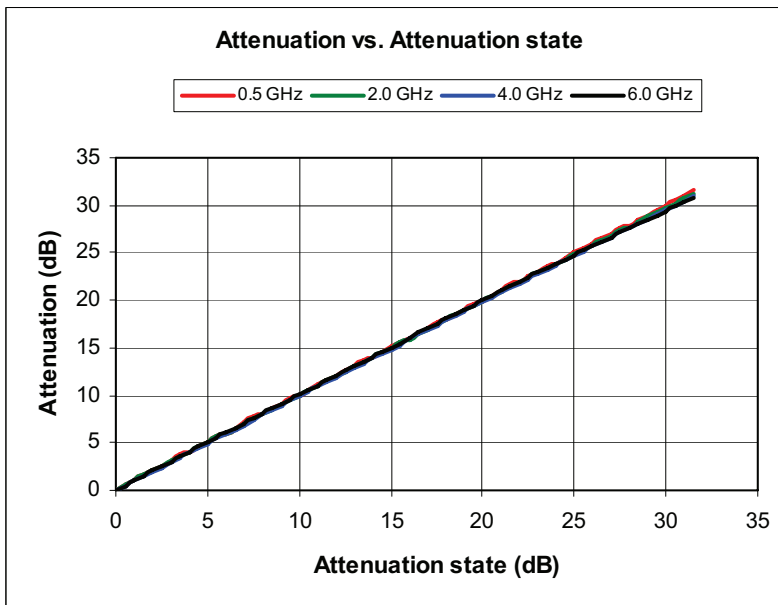


Figure 8: Attenuation vs. attenuation state

Package Information

This package is Pb free, RoHS compliant and halogen free. The product is also rated MSL 1.

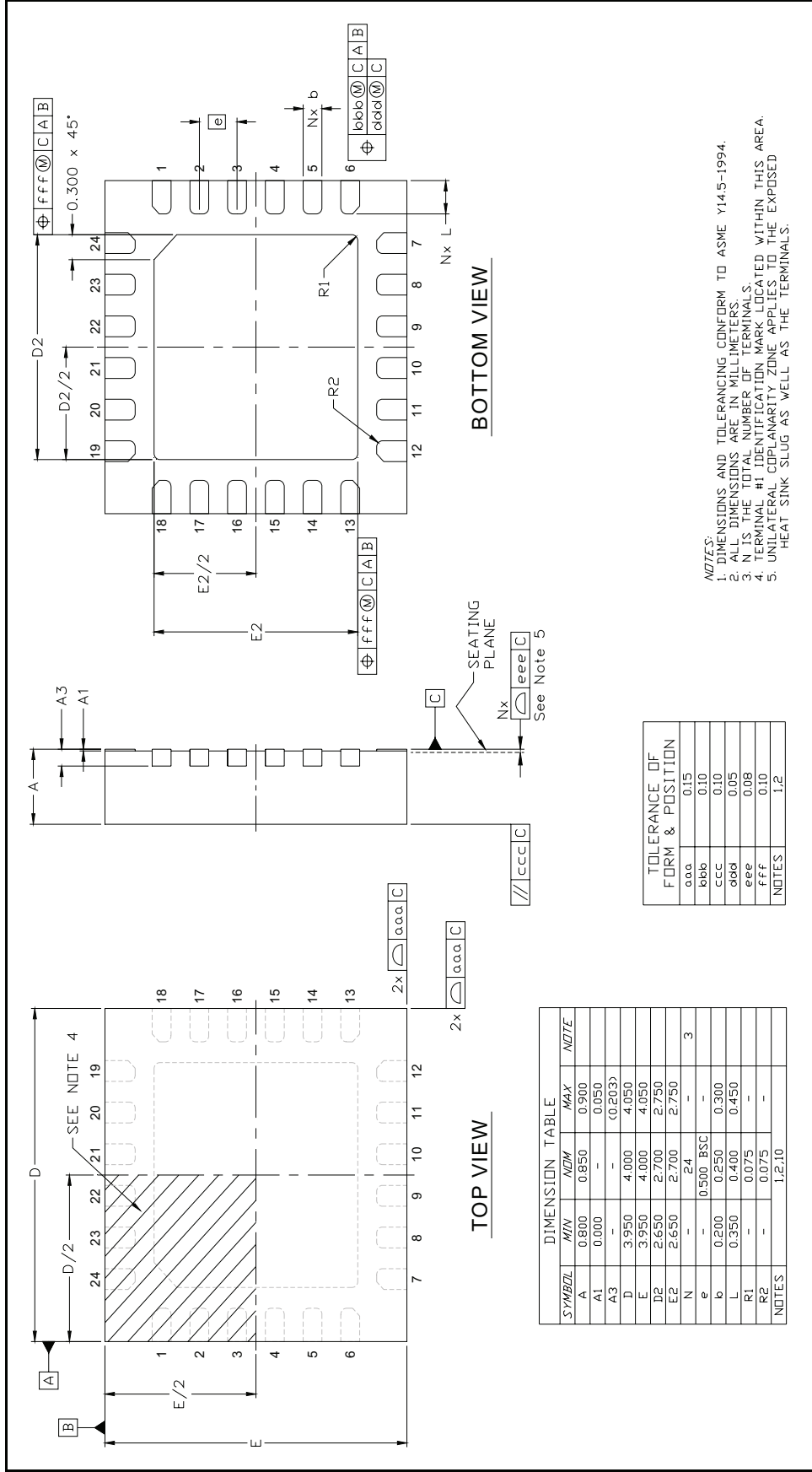


Figure 4: SE8013L Package Diagram

Branding Information:

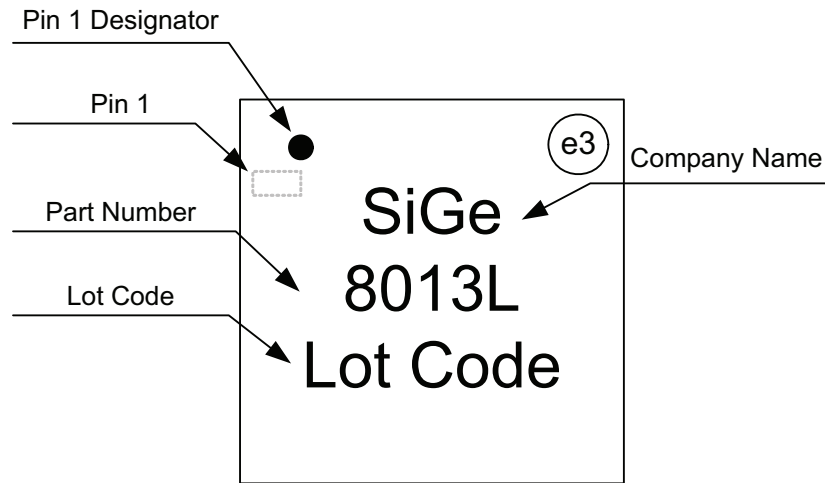


Figure 9: SE8013 L Branding

Tape and Reel Information

Parameter	Value
Devices Per Reel	3000
Reel Diameter	13 inches
Tape Width	12 millimeters

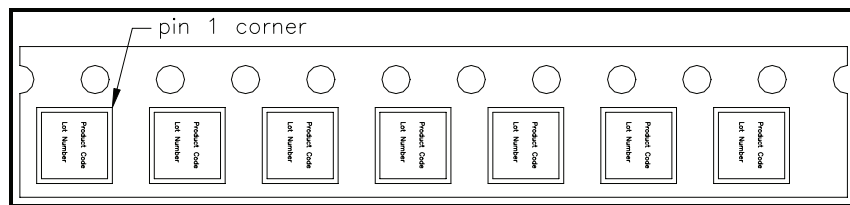


Figure 5: SE8013L-R Tape and Reel Information

Document Change History

Revision	Date	Notes
1.0	08-Aug-2009	Initial release
1.1	21-Sep-2010	Corrections to the pinout and package diagram
1.2	29-Nov-2010	Update Fig 9 (package branding)

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Product Preview

The datasheet contains information from the product concept specification. SiGe Semiconductor, Inc. reserves the right to change information at any time without notification.

Preliminary Information

The datasheet contains information from the design target specification. SiGe Semiconductor, Inc. reserves the right to change information at any time without notification.

Production testing may not include testing of all parameters.

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