DATA SHEET

SE2442L: 902 to 928 MHz High-Power RF Front-End Module

Applications

- Smart meters
- In-home appliances
- Smart thermostats

Features

- Integrated PA with +30 dBm output power
- Receive pass-through
- Integrated antenna switching
- Single-ended 50 Ω Tx and Rx RF interface
- Fast turn-on / turn-off time < 1 µsec
- 2.0 V to 4.8 V supply operation
- Sleep mode current < 1 µA
- 4 x 4 x 0.9 mm 24-pin QFN
- Small QFN (24-pin, 4 mm x 4 mm x 0.9 mm) 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.

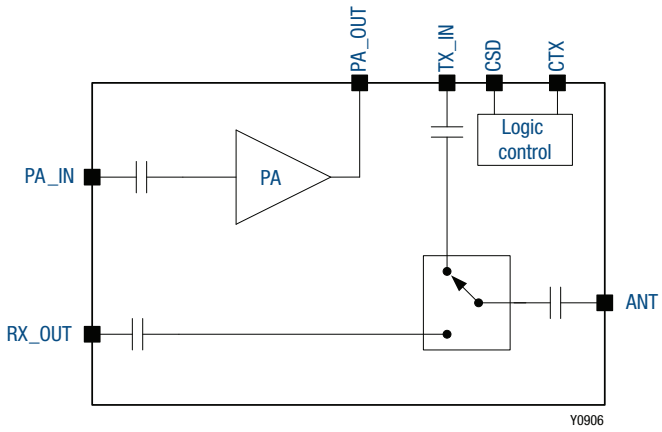


Figure 1. SE2442L Block Diagram

Description

The SE2442L is a high-performance, integrated RF front-end module designed for high-power ISM band applications operating in the 902 to 928 MHz frequency band.

The SE2442L is designed for ease of use and maximum flexibility, with fully matched 50 Ω input and output, and digital controls compatible with 1.6 to 3.6 V CMOS levels.

The RF blocks operate over a wide supply voltage range from 2.0 to 4.8 V, allowing the SE2442L to be used in battery powered applications over a wide spectrum of the battery discharge curve.

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.

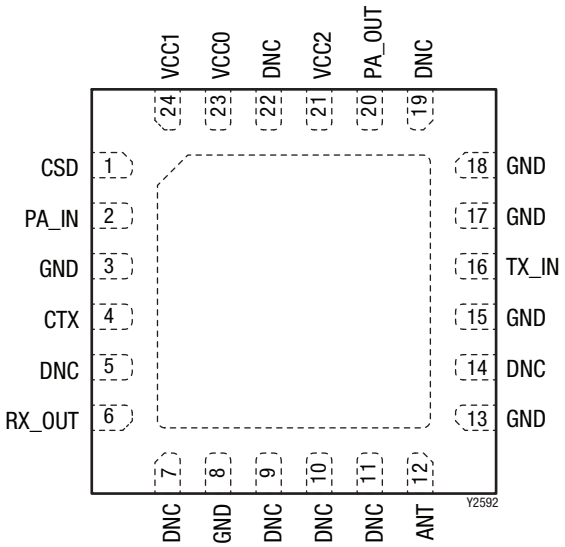


Figure 2. SE2442L Pinout (Top View)

Table 1. SE2442L Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	CSD	Shutdown control input	13	GND	Ground
2	PA_IN	PA input	14	DNC	Do not connect
3	GND	Ground	15	GND	Ground
4	CTX	Transmit enable control input	16	TX_IN	Tx signal to antenna switch (from OMN)
5	DNC	Do not connect	17	GND	Ground
6	RX_OUT	Receive signal to transceiver or SoC	18	GND	Ground
7	DNC	Do not connect	19	DNC	Do not connect
8	GND	Ground	20	PA_OUT	PA output (to OMN)
9	DNC	Do not connect	21	VCC2	Positive power supply, transmit section
10	DNC	Do not connect	22	DNC	Do not connect
11	DNC	Do not connect	23	VCC0	Positive power supply, receive section
12	ANT	Antenna port	24	VCC1	Positive power supply, transmit section
			Paddle	GND	Exposed die paddle; electrical and thermal ground (connect to PCB ground)

Electrical and Mechanical Specifications

The absolute maximum ratings of the SE2442L are provided in Table 2. The recommended operating conditions are specified in Table 3, and electrical specifications are provided in Tables 4 through 6.

The state of the SE2442L is determined by the logic provided in Table 7.

Table 2. SE2442L Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage receive	VCC0	–0.3	5.5	V
Supply voltage transmit – no RF	VCC1, VCC2	–0.3	5.5	V
Control pin voltages		–0.3	VCC0	V
Operating temperature	T_{OP}	–40	+85	°C
Storage temperature	T_{STG}	–40	+125	°C
Tx input power at PA_IN port	PIN_Tx_MAX		+10	dBm
Rx input power at ANT port	PIN_Rx_MAX		+10	dBm
Electrostatic discharge: Human Body Model (HBM)	ESD		 1000	 V

Note 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.

***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. Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Ambient temperature	T_A	–40	+25	+85	°C
Supply voltage on VCC0, VCC1, and VCC2	V_{CC}	2.0	3.6	4.8	V

Table 4. SE2442L Electrical Specifications: DC (Note 1)
(VCC = 3.6 V, T_A = +25 °C, as Measured on the Evaluation Board [De-Embedded to the Device], Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
TX supply current	I_{CC_TX30}	Tx mode P_{OUT} = +30 dBm CSD = CTX = high, VCC = 4.8 V		420		mA
TX supply current	I_{CC_TX27}	Tx mode P_{OUT} = 27 dBm CSD = CTX = high, VCC = 3.6 V		280		mA
Quiescent current	I_{CQ_TX}	No RF CSD = CTX = high		50		mA
RX supply current	$I_{CC\_RXBYPASS}$	Rx bypass mode CSD = HIGH, CTX = 0 V			280	µA
Sleep supply current	I_{CC_OFF}	No RF, CTX = CSD = 0 V		0.05	1	µA

Note 1: Performance is guaranteed only under the conditions listed in the above table.

Table 5. SE2442L Electrical Specifications: Logic Characteristics (Note 1)
(T_A = +25 °C, as Measured on the Evaluation Board [De-Embedded to the Device], Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Logic input high voltage	V_{IH}		1.6		VCC0	V
Logic input low voltage	V_{IL}		0		0.3	V
Logic input high current	I_{IH}				1	µA
Logic input low current	I_{IL}				1	µA

Note 1: Performance is guaranteed only under the conditions listed in the above table.

Table 6. SE2442L Electrical Specifications: AC Characteristics (Note 1)
(VCC = 3.6 V, T_A = +25 °C, as Measured on Evaluation Board [De-Embedded to the Device], All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Transmit (Tx)						
Frequency range	F_{IN}		902	-	928	MHz
Output power at ANT port	Pout_FEM	VCC = 4.8 V VCC = 4.0 V VCC = 3.6 V VCC = 3.0 V		31.5 30.0 29.0 27.5		dBm dBm dBm dBm
PA power added efficiency	PAE	Pout = +28 dBm at PA_OUT port, 915 MHz		64		%
Small signal gain	S_{21}	902 to 928 MHz	20			dB
Small signal gain variation	ΔS_{21}	Gain variation across frequency range			1	dBp-p
Output return loss	$S22_{ANT}$	Into 50 Ω, ANT port		-10	–6	dB
2nd harmonic	HD2	P_{OUT} = +27 dBm, CW			–22	dBc
3rd to 10th harmonics	HD3 to HD10	P_{OUT} = +27 dBm, CW			–72	dBc
Turn on time	T_{ON}	From 50% of CTX edge to 90% of final RF output power			1	µs
Turn off time	T_{OFF}	From 50% of CTX edge to 10% of final RF output power			1	µs
Stability	STAB	CW, P_{IN} = +6 dBm 0.1 GHz – 20 GHz Load VSWR = 6:1	All non-harmonically related outputs <–42.0 dBm/MHz			
Ruggedness	RU	CW, Pout = 27 dBm into 50 Ω, Load VSWR = 10:1	No permanent damage			
Receive (Rx) (Note 2)						
Frequency range	f_{IN}		902		932	MHz
Antenna port return loss	$S11_{ANT}$	Into 50 Ω, ANT port		–10	–6	dB
Turn on time	T_{ON}	From 50% of CTX edge			1	µs
Turn off time	T_{OFF}	From 50% of CTX edge			1	µs
Gain in bypass mode	G_bp	CTX = logic ‘0’ and CSD = logic ‘1’		–0.7		dB
Input 1-dB compression point in bypass mode	IP1dB	CTX = logic ‘0’ and CSD = logic ‘1’	10			dB
Antenna Functions						
Insertion loss from TX_IN to ANT	Tx_ANT	902 to 928 MHz	-	0.7	-	dB
Insertion loss from ANT to RX_OUT	Rx_ANT	902 to 928 MHz	-	0.7	-	dB

Note 1: Performance is guaranteed only under the conditions listed in this table.

Note 2: Receive section can operate with VCC0 = 2.8 V and VCC1 = VCC2 = 0 V

Table 7. SE2442L Logic Controls
(T_A = +25 °C)

Mode	Description	CSD	CTX
0	All off (sleep mode) (Notes 1 and 3)	0	0
1	Rx or Tx bypass mode (Notes 1 and 2)	1	0
3	Tx mode (Notes 1 and 2)	1	1

Note 1: Logic '0' level compliant to V_{IL} as specified in Table 5.

Note 2: Logic '1' level compliant to V_{IH} as specified in Table 5.

Note 3: All controls must be at logic '0' in order to achieve the specified sleep current.

Evaluation Board Description

The SE2442L Evaluation Board is used to test the performance of the SE2442L front-end module (FEM). An Evaluation Board schematic diagram is provided in Figure 3. A photograph of the Evaluation Board is shown in Figure 4. A Bill of Materials (BOM) for the Evaluation Board is provided in Table 8.

Evaluation Board Setup Procedure

Connect Supply

1. Connect J9, J10, and J11 to 50 Ω instruments. Terminate all unused ports (if applicable) with 50 Ω.
2. Connect the supply ground to Pin 1 of the J4 header.
3. Connect the DC power supply (2.0 to 4.8 V) to pin 2 of the J4 header.
4. Refer to Table 7 for information about selecting the required RF path.

Measure TX Performance

Apply an RF signal to connector J10 (PA_IN) to monitor the 900 to 930 MHz amplifier performance. Monitor the output power on connector J9 (ANT).

Measure RX Performance

Apply an RF signal to connector J9 (ANT) to monitor the 900 to 930 MHz RX path performance. Monitor the output signal on connector J11 (RX_OUT).

CAUTION: *Care should be taken not to overdrive the amplifier by applying too much RF on the input to the device. A suitable starting input power for the device is –20 dBm.*

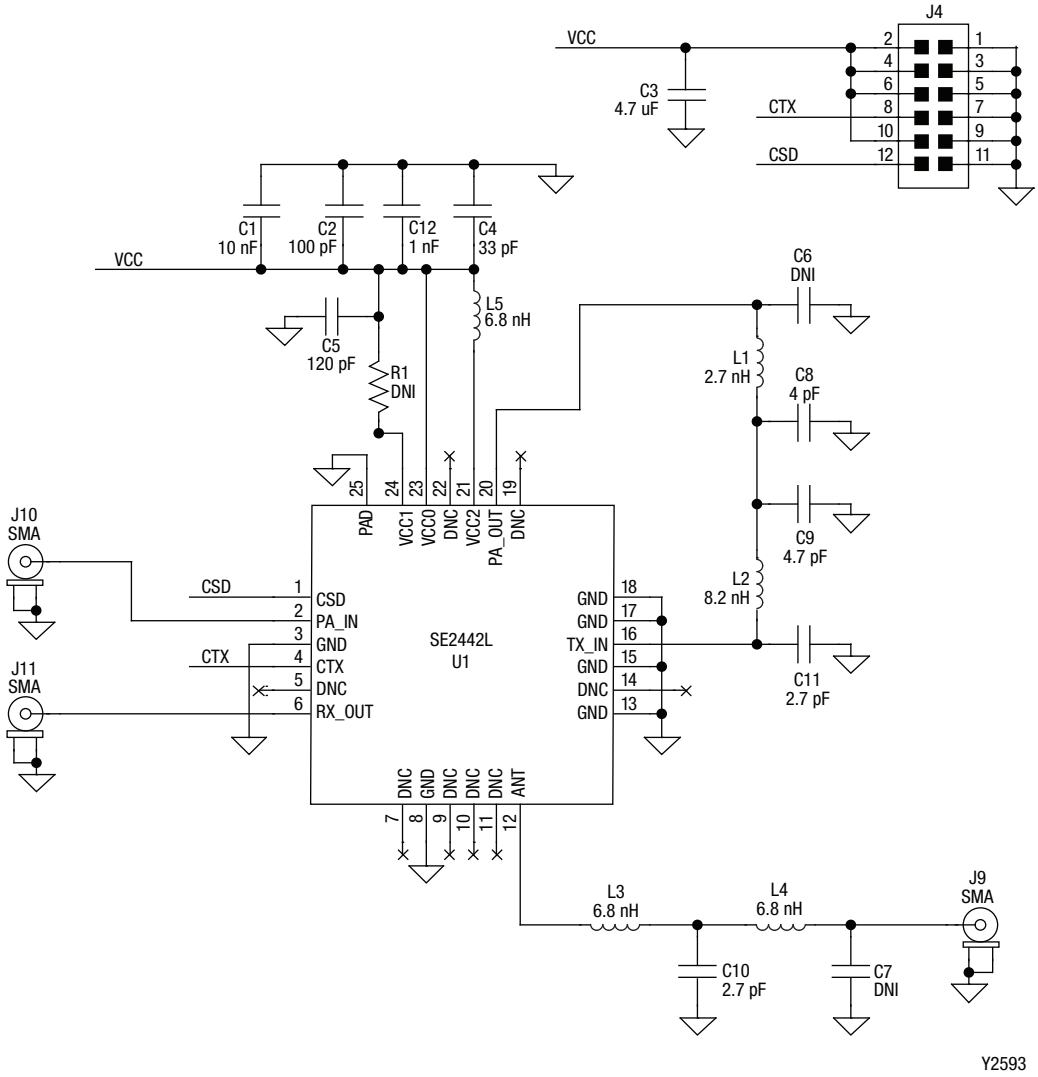


Figure 3. SE2442L Evaluation Board Schematic

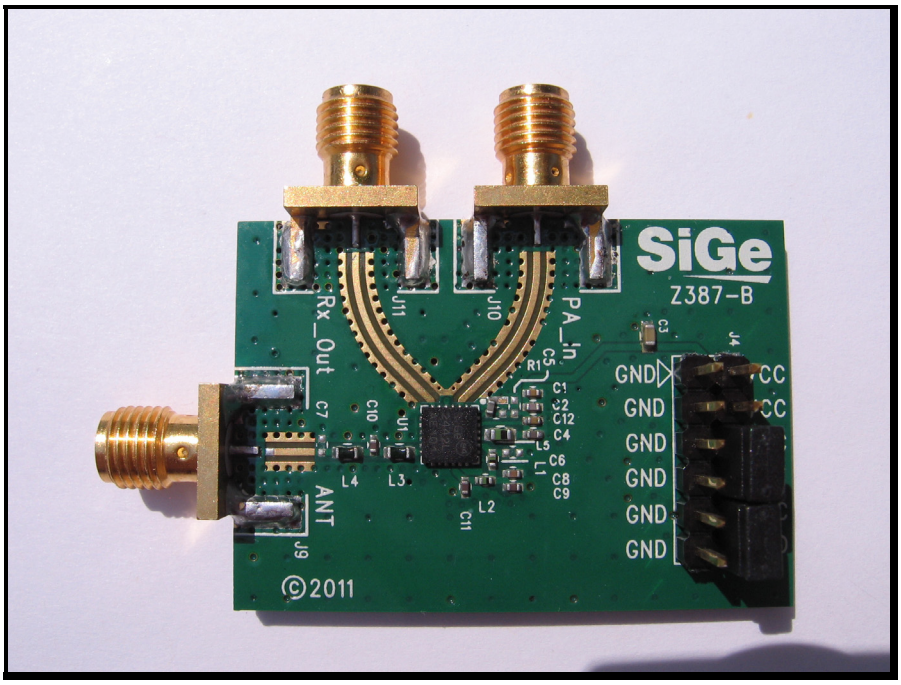


Figure 4. SE2442L Evaluation Board

Table 8. SE2442L Bill of Materials (BOM)

Component	Value	Manufacturer	Mfr Part Number	Package Size	Description
C1	10 nF	Murata	GRM155R71E103KA01	0402	Multilayer ceramic
C2	100 pF	Murata	GRM1555C1H101JZ01	0402	Multilayer ceramic
C3	4.7 uF	Murata	GRM188R60J475KE19	0402	Multilayer ceramic
C4	33 pF	Murata	GRM1555C1H330JZ01	0402	Multilayer ceramic
C5	120 pF	Murata	GRM1555C1H121JA01	0402	Multilayer ceramic
C6, C7	DNI			0402	Multilayer ceramic
C8	4 pF	Taiyo-Yuden	UMK105CG040CW	0402	Standard multilayer ceramic capacitor
C9	4.7 pF	Murata	GRM1555C1H4R7CZ01	0402	Multilayer ceramic
C10, C11	2.7 pF	Murata	GRM1555C1H2R7CZ01	0402	Multilayer ceramic
C12	1 nF	Murata	GRM155R71H102KA01	0402	Multilayer ceramic
J1, J2, J3	SMA	Johnson Components	142-0701-851	End launch	SMA end launch straight jack receptacle - tab contact
J4	6x2	Samtex	TSW-106-07-G-D	100 mil	100 mil header
L1	2.7 nH	Murata	LQG15HN2N7S02D	0402	Inductor
L2	8.2 nH	Murata	LQG15HN8N2J02D	0402	High frequency multilayer
L3, L4, L5	6.8 nH	Murata	LQG18HN6N8S00D	0603	High frequency multilayer
PCB1		Skyworks	Z387-B		PCB
R1	DNI			0402	Do not install
U1		Skyworks	SE2442L	QFN400x400	900-930 MHz High Power RF FEM

Package Dimensions

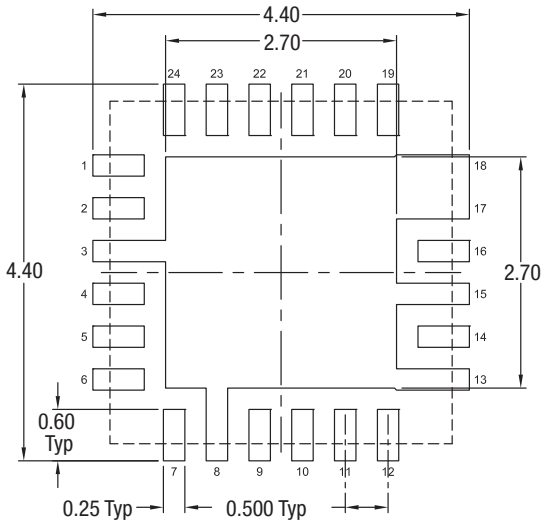
The PCB layout footprint for the SE2442L is provided in Figure 5. A typical part marking diagram is shown in Figure 6. Package dimensions are shown in Figure 7, and tape and reel dimensions are provided in Figure 8.

Package and Handling Information

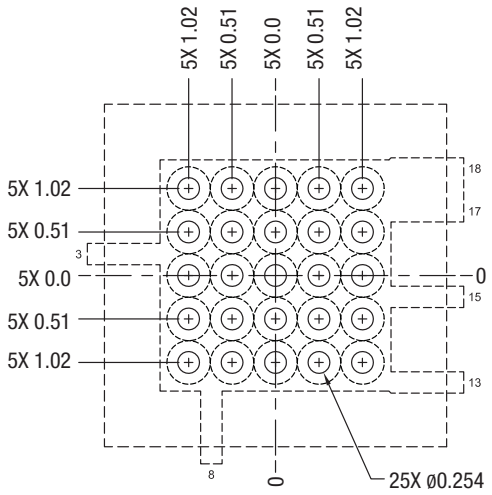
Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperatures during solder assembly.

The SE2442L is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C, and can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

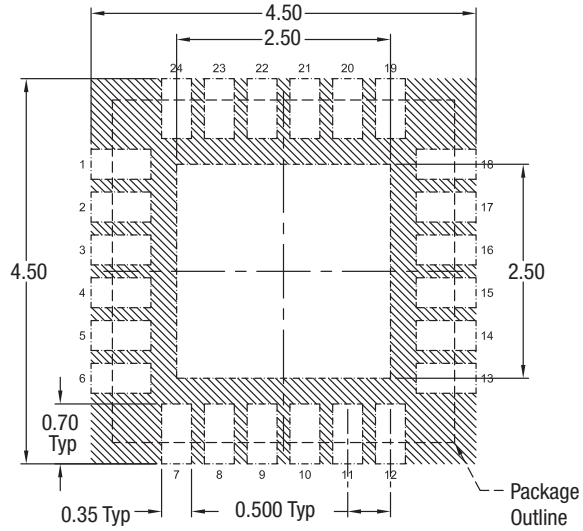
Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.



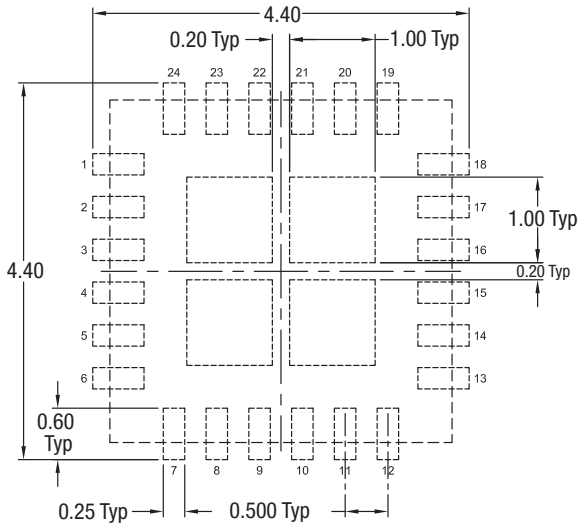
Board Metal



Via Pattern
(Note 4)



Solder Mask Pattern
(Note 6)



Stencil Pattern (Note 5)
64% Solder Coverage
on Center Pad

Notes:

1. *All dimensions are in millimeters.*
2. *Interpret dimensions and tolerances per ASME Y14.5M-1994.*
3. *Unless specified, dimensions are symmetrical about center lines.*
4. *Via hole recommendations:*
   0.025 mm Cu via wall plating (minimum), via hole to be filled with conductive paste and plated over.
5. *Stencil recommendations: 0.125 mm stencil thickness, laser cut apertures, trapezoidal walls and rounded corners offer the best paste release.*
6. *Solder mask recommendations: Contact board fabricator for recommended solder mask offset and tolerance.*

Y2596

Figure 5. PCB Layout Footprint

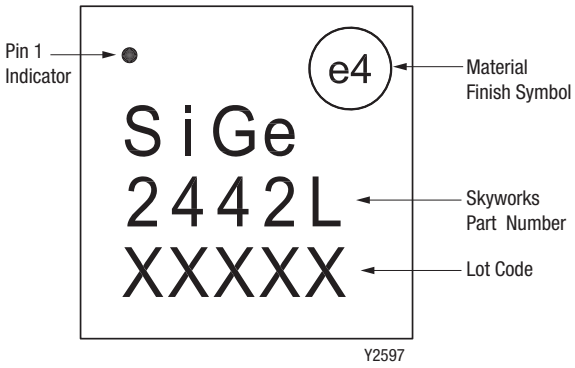
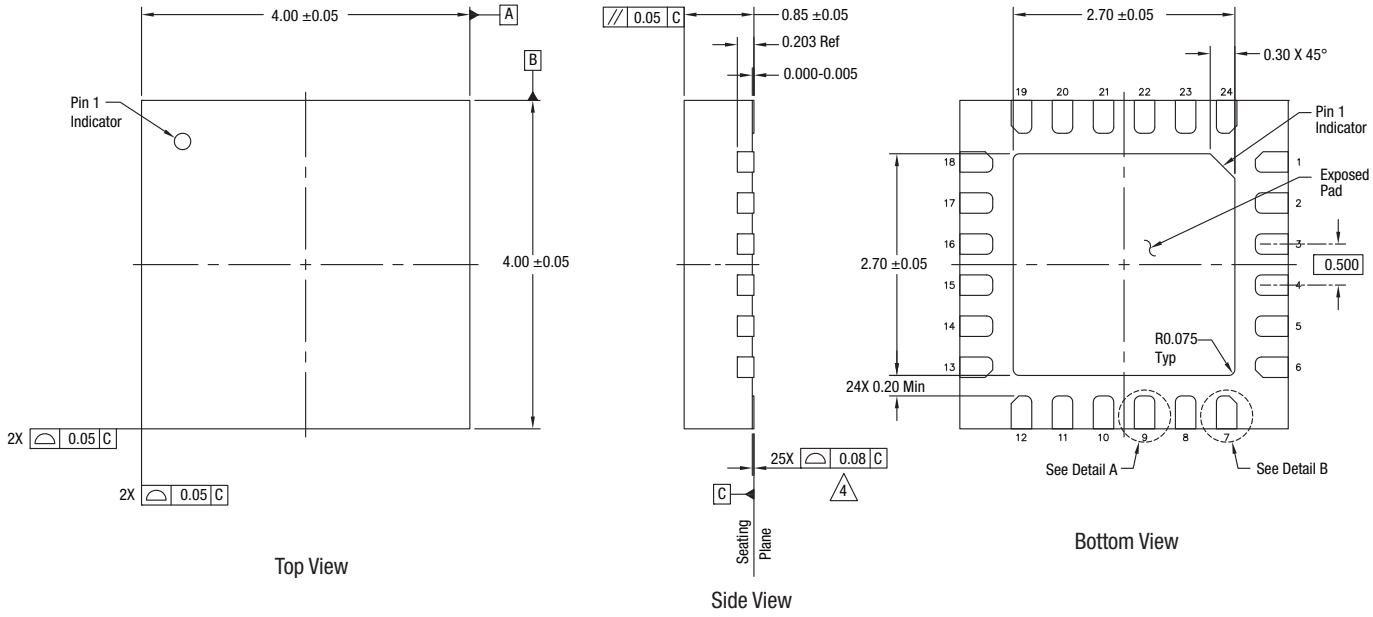


Figure 6. SE2442L Typical Part Marking



Notes:

1. *All measurements are in millimeters.*
2. *Dimensions and tolerances according to ASME Y14.5M-2009.*
3. *Unless otherwise specified, the following values apply:*
   Decimal Tolerance: Angular Tolerance:
   X.X (1 place) ± 0.1 mm ±1/2°
   X.XX (2 places) ± 0.05 mm
   X.XXX (3 places) ± 0.025 mm
4. *Coplanarity applies to the exposed center ground pad as well as the terminals.*
5. *Dimension applies to the metallized terminal. If the terminal has a radius, the dimension should not be measured in that radius area.*
6. *Plating requirements per Source Control Drawing (SCD) 2504.*
7. *Unless specified, dimensions are symmetrical about center lines.*

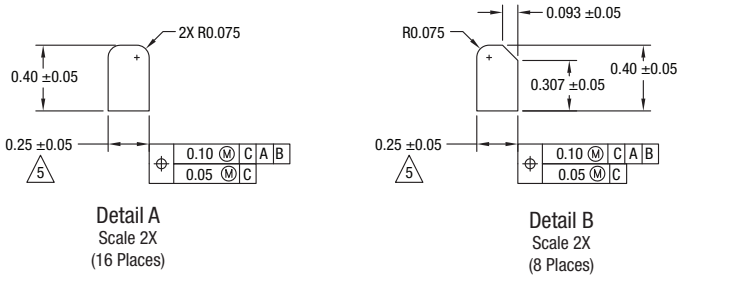
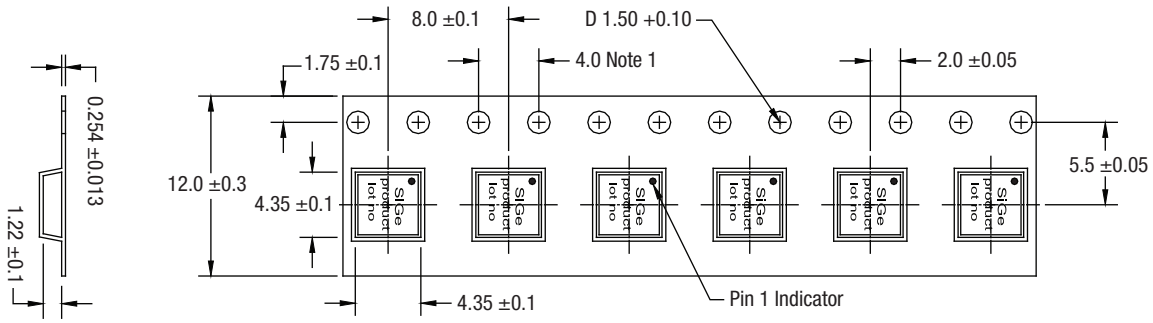


Figure 7. SE2442L Package Dimensions



Notes:

1. *10-Sprocket hole pitch cumulative tolerance ±0.2.*
2. *Camber in compliance with EIA-481.*

Y0086

Figure 8. SE2442L-R Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SE2442L: 902 to 928 MHz Front-End Module	SE2442L	SE2442L-EK1