

DATA SHEET
SE2425U : 2.4 GHz Bluetooth Power Amplifier IC

Applications

- Bluetooth™ wireless technology (Class 1)
- USB dongles, PCMCIA, flash cards, Access Points
- Enhanced data rate

Features

- Integrated input and inter-stage match
- +25 dBm GFSK Output Power
- +19.5 dBm 8DPSK Output Power
- Low current: 110 mA typical @ P_{OUT} = +20 dBm
- Ultra low quiescent current: 28 mA
- Digital Enable for direct interface to standard CMOS processors
- Mode-control for easy switching between standard and EDR modes
- Lead Free and RoHS Compliant
- Ultra thin package: 0.5 mm
- 3.3 V single supply operation

Product Description

A monolithic, high-efficiency, silicon-germanium power amplifier IC, the SE2425U is designed for 2.4 GHz wireless applications, including Bluetooth™ Class 1 basic rate and enhanced data rate applications. It delivers +25 dBm output power in standard rate GFSK mode and +19.5 dBm output power in enhanced rate 8DPSK.

The SE2425U provides a digital mode control input for boosting the linear performance for enhanced data rate applications.

The SE2425U operates at 3.3 V DC with a peak efficiency of 43 % in basic rate and 21 % in enhanced rate mode. The internal bias management allows the part to only draw 28 mA in Class 2 output power levels.

Output match integrates the high Q inductors to reduce component count and bill of materials. It uses two external capacitors to allow for varying loads, such as switches and filters, in different applications.

The silicon/silicon-germanium structure of the SE2425U, and its exposed die-pad package, soldered to the system PCB, provide high thermal conductivity and a subsequently low junction temperature. This device is capable of operating at a duty cycle of 100 percent.

Ordering Information

Type	Package	Remark
SE2425U	3 x 3 x 0.5 mm QFN	Sample
SE2425U-R	3 x 3 x 0.5 mm QFN	Tape & Reel
SE2425U-EK1	N/A	Evaluation Kit

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Functional Block Diagram

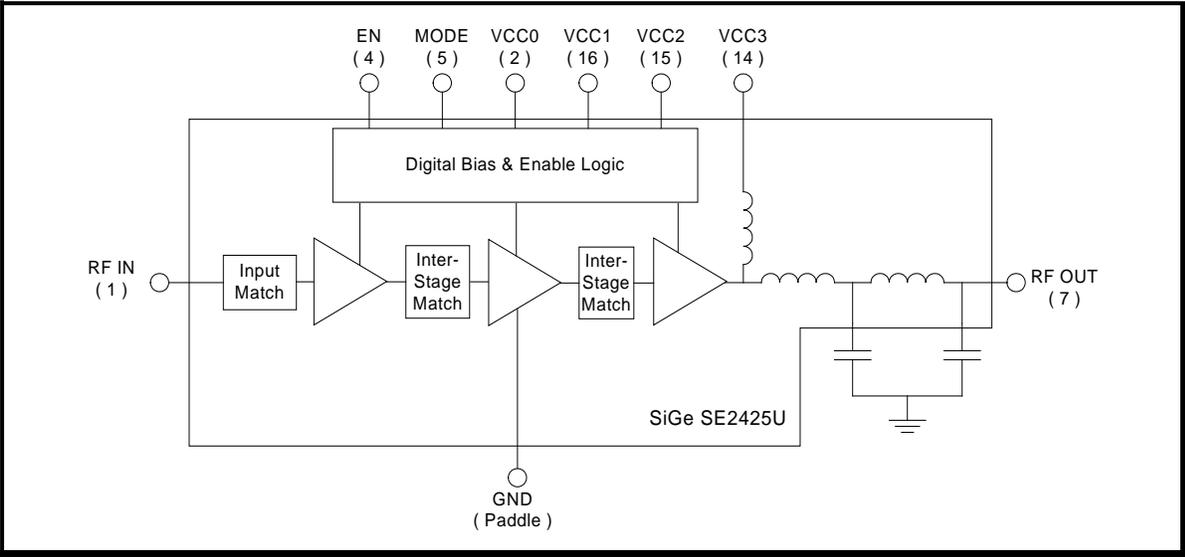


Figure 1: SE2425U Block Diagram

Pin-Out Diagram

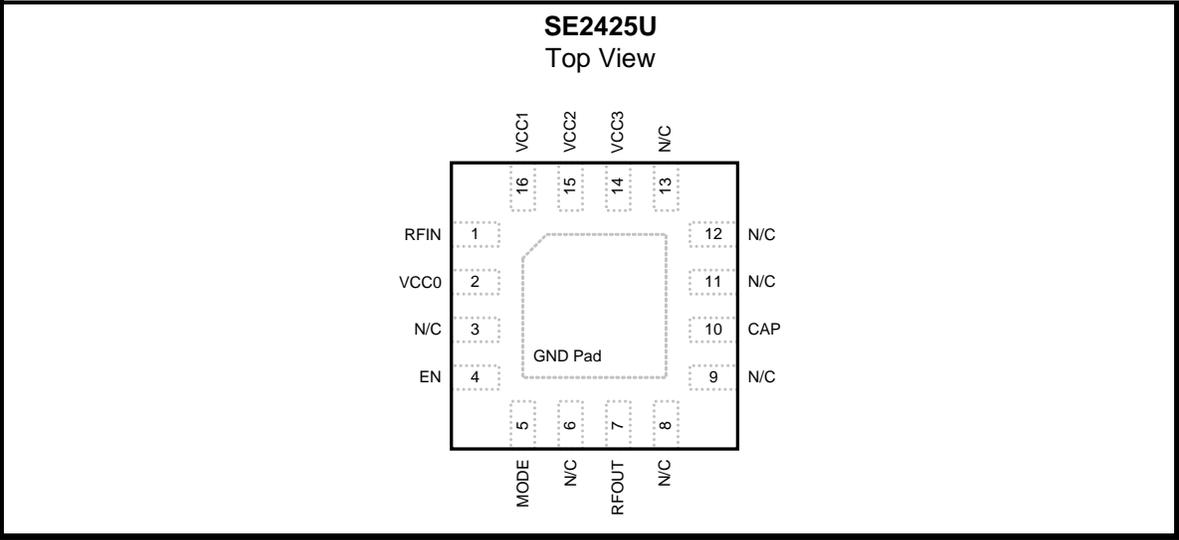


Figure 2: SE2425U Pin-Out

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Pin Out Description

Pin No.	Name	Description
1	RF _{IN}	Power amplifier RF input, DC blocking is required
2	V _{CC0}	Bias Power Supply
3	N/C	Do Not Connect
4	EN	PA Enable
5	MODE	Mode switch
6	N/C	Do Not Connect
7	RF _{OUT}	RF output Note: Requires external DC blocking and optional shunt capacitor (typically 0p75 0402)
8	N/C	Do Not Connect
9	N/C	Do Not Connect
10	CAP	Matching capacitor (typically 1p3 0402)
11	N/C	Do Not Connect
12	N/C	Do Not Connect
13	N/C	Do Not Connect
14	V _{CC3}	Stage 3 collector supply voltage
15	V _{CC2}	Stage 2 collector supply voltage
16	V _{CC1}	Stage 1 collector supply voltage
GND Pad	GND	Heat slug Ground Pad

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	Parameter	Min.	Max.	Unit
V _{CC}	Supply Voltage	-0.3	+4.2	V
V _{LOGIC}	Logic Voltage	-0.3	V _{CC}	V
IN	RF Input Power	-	0	dBm
T _C	Case Temperature Range	-40	+85	°C
T _{STG}	Storage Temperature Range	-40	+150	°C
T _J	Maximum Junction Temperature	-	+150	°C

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DC Electrical Characteristics

Conditions: $V_{CC0} = V_{CC1} = V_{CC2} = V_{CC3} = 3.3\text{ V}$, $T_c = 25\text{ }^\circ\text{C}$, $f = 2.45\text{ GHz}$, as measured on Skyworks Solutions' SE2425U-EV1 evaluation board unless otherwise noted.

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{CC}	Supply Voltage	2.7	3.3	3.6	V
I_{CC}	Supply Current $V_{MODE} = \text{Low}$, $P_{OUT} = 20\text{ dBm}$	-	110	-	mA
	Supply Current $V_{MODE} = \text{Low}$, No RF	-	28	-	mA
	Supply Current $V_{MODE} = \text{High}$, No RF	-	81	-	mA
	Supply Current $V_{MODE} = \text{High}$, $P_{OUT} = 19.5\text{ dBm}$	-	123	-	mA
I_{EN}	Current sunk by EN pin (logic high)	-	-	1	μA
I_{MODE}	Current sunk by MODE pin (logic high)	-	-	1	μA
V_{LOGIC}	Logic High Voltage ($V_{LOGIC} \leq V_{CC}$)	2.0	2.8	3.6	V
	Logic Low Voltage	0	-	0.8	V
I_{stdby}	Leakage Current when $V_{EN} = V_{MODE} = 0\text{ V}$, No RF	-	1	10	μA

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AC Electrical Characteristics

Conditions: $V_{EN} = V_{CC0} = V_{CC1} = V_{CC2} = V_{CC3} = 3.3\text{ V}$, $V_{MODE} = \text{Low}$, $P_{IN} = -6\text{ dBm}$, $T_C = 25\text{ }^\circ\text{C}$, $f = 2.45\text{ GHz}$, as measured on Skyworks Solutions' SE2425U-EV1 evaluation board, unless otherwise noted

Standard Rate Mode					
Symbol	Parameter	Min.	Typ.	Max.	Unit
f_{L-U}	Frequency Range	2400	-	2500	MHz
P_{OUT_MAX}	GFSK Maximum Output Power ($P_{IN} = 0\text{ dBm}$)	-	25	-	dBm
	EDR Maximum Output Power (Meets ACPR1/2 specification)	-	17.5	-	dBm
ΔP_{temp}	Output Power variation over temperature ($-40\text{ }^\circ\text{C} < T_A < +85\text{ }^\circ\text{C}$)	-	0.5	-	dB
G	Gain @ $P_{IN} = -25\text{ dBm}$ Gain @ $P_{IN} = -6\text{ dBm}$	-	29.5 28.2	-	dB
G_{VAR}	Gain Variation over band (2400-2500 MHz)	-	0.3	1.0	dB
2f	Harmonics	-	-39	-	dBc
3f		-	-45	-	
IS _{11I}	-	10	-	-	dB
IS _{21OFF}	Isolation in "OFF" State, $V_{EN} = 0\text{ V}$	-	36	-	dB
IS _{12I}	Reverse Isolation	-	42	-	dB
STAB	Stability ($P_{IN} = -6\text{ dBm}$, Load VSWR = 4:1)	All non-harmonically related outputs less than -50 dBc			

Conditions: $V_{EN} = V_{CC0} = V_{CC1} = V_{CC2} = V_{CC3} = 3.3\text{ V}$, $V_{MODE} = \text{High}$, $T_C = 25\text{ }^\circ\text{C}$, $f = 2.45\text{ GHz}$, as measured on Skyworks Solutions' SE2425U-EV1 evaluation board, unless otherwise noted.

Enhanced Rate Mode					
Symbol	Parameter	Min.	Typ.	Max.	Unit
P_{OUT_MAX}	Output Power (Meets ACPR1/2 specification)	-	19.5	-	dBm
ΔP_{temp}	Output Power variation over temperature ($-40\text{ }^\circ\text{C} < T_A < +85\text{ }^\circ\text{C}$) for $P_{IN} = -15\text{ dBm}$	-	1.5	-	dB
G	Gain @ $P_{IN} = -25\text{ dBm}$	-	30.5	-	dB
G_{VAR}	Gain Variation over band, $P_{IN} = -25\text{ dBm}$	-	0.25	1.5	dB
ACPR1	2 Mbps, $\pi/4$ -DQPSK, $F_C \pm 2\text{ MHz}$, BW = 1 MHz	-	-	-20	dBm
	3 Mbps, 8DPSK, $F_C \pm 2\text{ MHz}$, BW = 1 MHz	-	-	-20	dBm
ACPR2	2 Mbps, $\pi/4$ -DQPSK, $F_C \pm 3\text{ MHz}$, BW = 1 MHz	-	-	-40	dBm
	3 Mbps, 8DPSK, $F_C \pm 3\text{ MHz}$, BW = 1 MHz	-	-	-40	dBm

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Typical Performance Characteristics

Low Mode

Test Conditions: $V_{EN} = V_{CC0} = V_{CC1} = V_{CC2} = V_{CC3} = 3.3\text{ V}$, MODE = Low, $T_c = 25\text{ }^\circ\text{C}$, $f = 2.45\text{ GHz}$, as measured on Skyworks' SE2425U-EV1 evaluation board otherwise noted

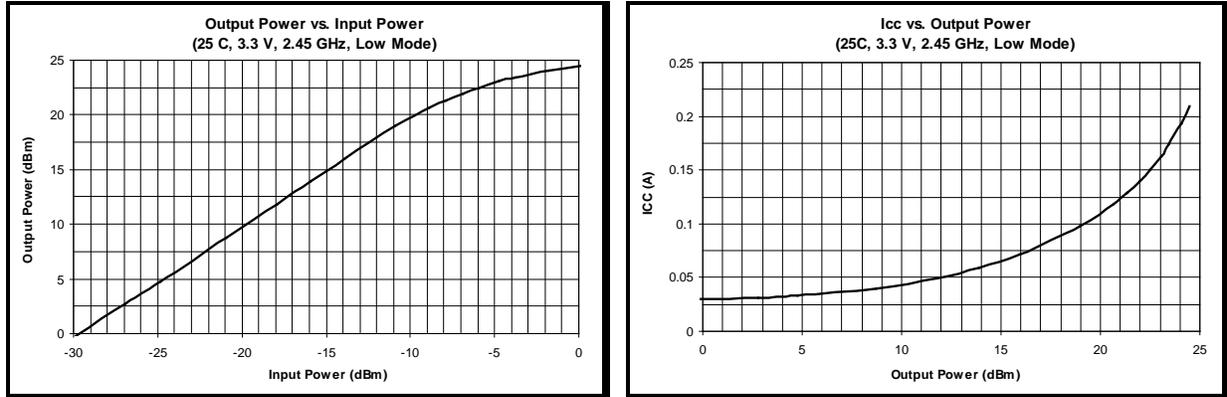


Figure 3: Typical Performance Data in Low Mode (a) Output Power vs. Input Power, (b) Current vs. Output Power

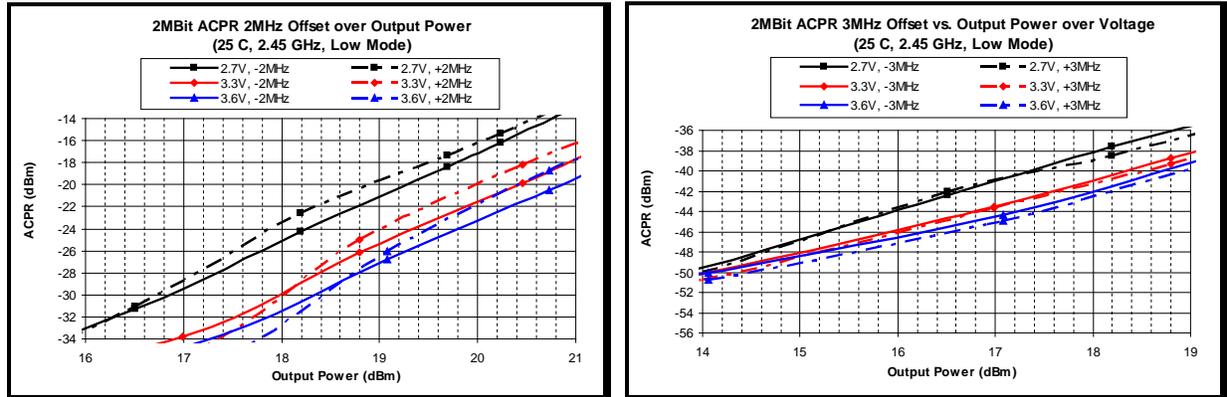


Figure 4: Typical 2 Mbps Enhanced Data Rate (EDR) Performance Data in Low Mode (a) ACPR @ 2 MHz Offset vs. Output Power over Voltage (b) ACPR @ 3 MHz Offset vs. Output Power over voltage

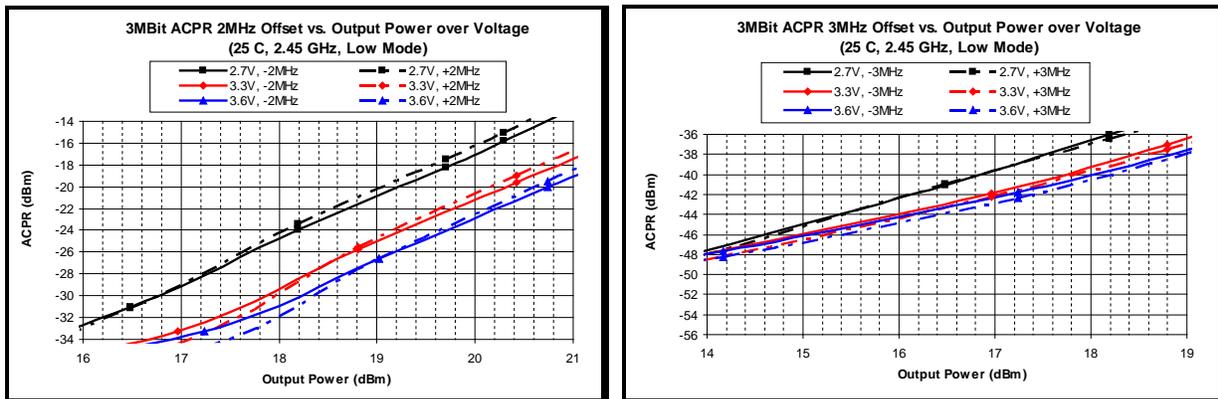


Figure 5: Typical 3 Mbps Enhanced Data Rate (EDR) Performance Data in Low Mode (a) ACPR @ 2 MHz Offset vs. Output Power over Voltage (b) ACPR @ 3 MHz Offset vs. Output Power over voltage

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High Mode

Test Conditions: $V_{EN} = V_{CC0} = V_{CC1} = V_{CC2} = V_{CC3} = 3.3\text{ V}$, MODE = High, $T_c = 25\text{ }^\circ\text{C}$, $f = 2.45\text{ GHz}$, as measured on Skyworks' SE2425U-EV1 evaluation board otherwise noted

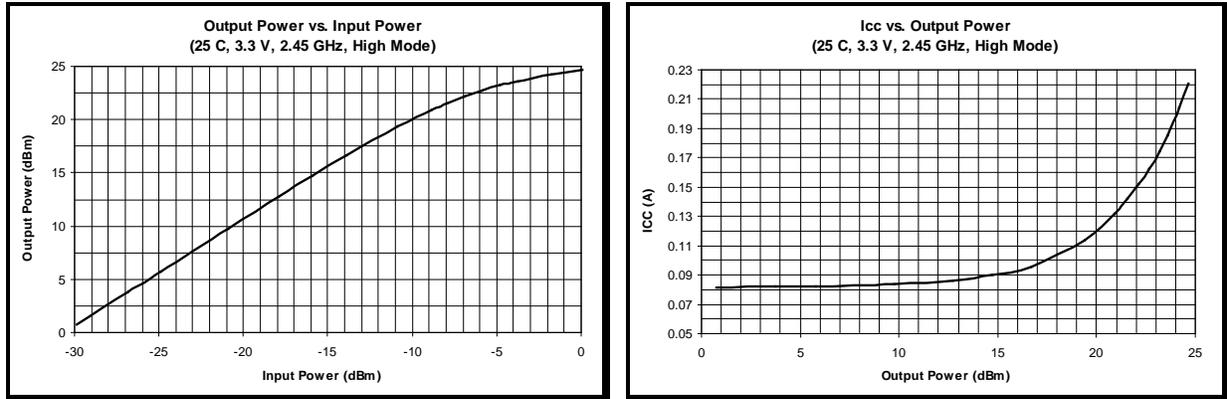


Figure 6: Typical Performance Data in High Mode (a) Output Power vs. Input Power , (b) Current vs. Output Power

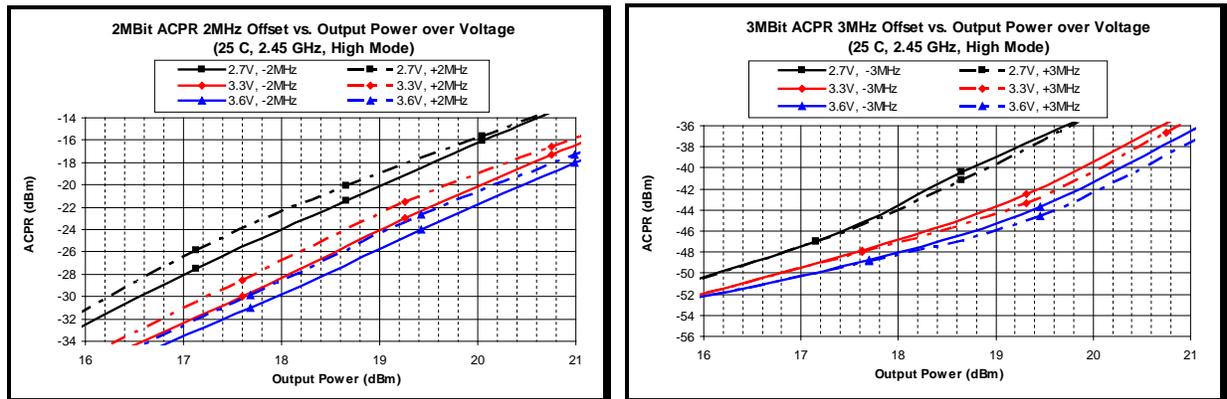


Figure 7: Typical 2 Mbps Enhanced Data Rate (EDR) Performance Data in High Mode (a) ACPR @ 2 MHz Offset vs. Output Power over Voltage (b) ACPR @ 3 MHz Offset vs. Output Power over Voltage

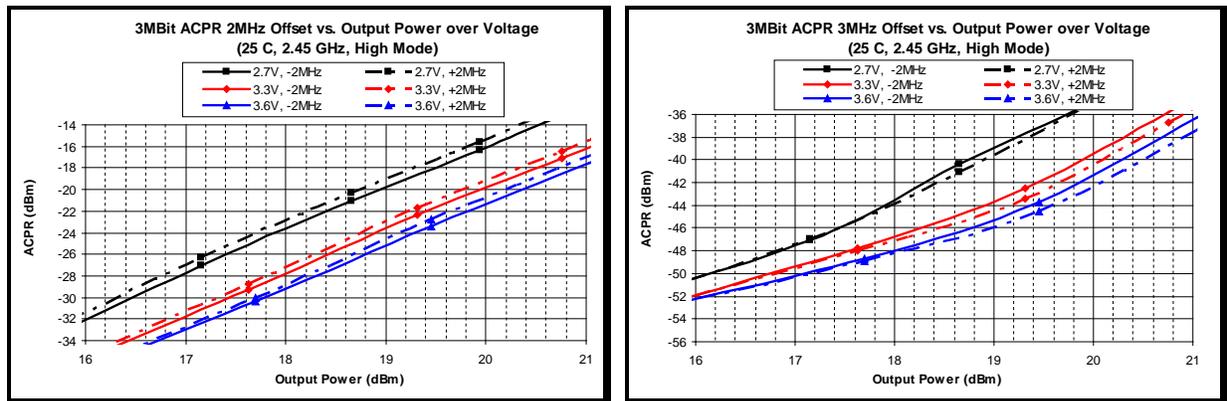


Figure 8: Typical 3 Mbps Enhanced Data Rate (EDR) Performance Data in High Mode (a) ACPR @ 2 MHz Offset vs. Output Power over Voltage (b) ACPR @ 3 MHz Offset vs. Output Power over Voltage

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Harmonic Performance

Test Conditions: $V_{EN} = V_{CC0} = V_{CC1} = V_{CC2} = V_{CC3} = 3.3\text{ V}$, $T_c = 25\text{ }^\circ\text{C}$, $f = 2.45\text{ GHz}$, as measured on Skyworks' SE2425U-EV1 evaluation board otherwise noted

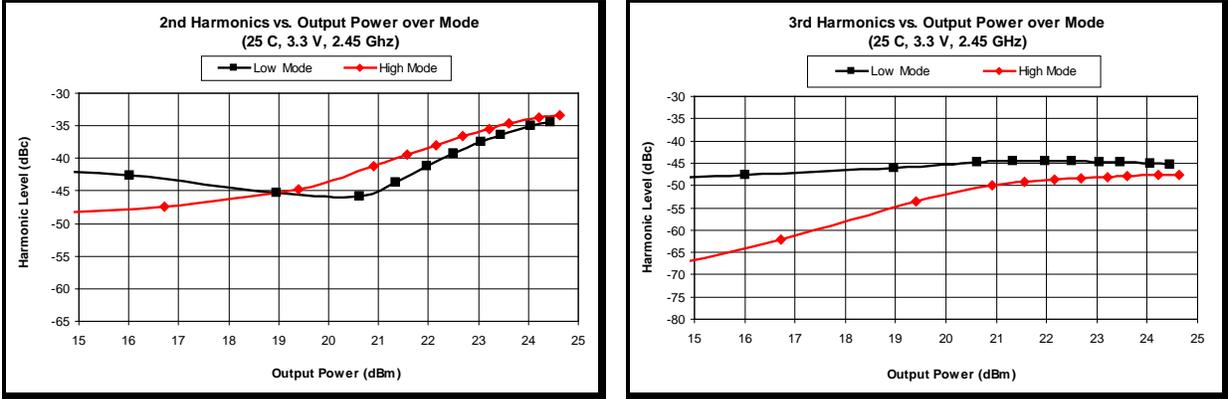


Figure 9: Typical Harmonic Performance Data in Low and High Mode (a) 2nd Harmonic Performance in Low and High Mode (b) 3rd Harmonic Performance in Low and High Mode

Branding Information

Figure 10 shows the SE2425U branding.

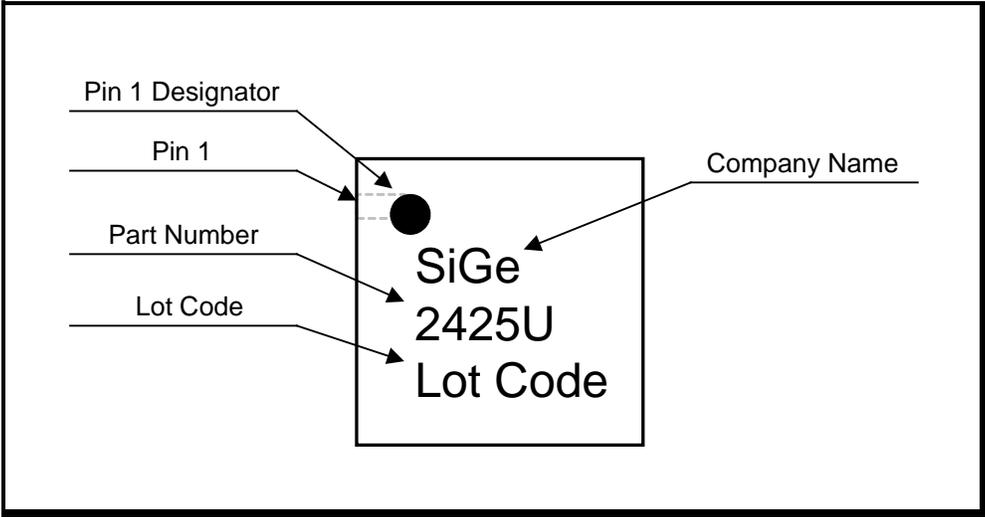


Figure 10: SE2425U Branding Information

Package Information

This package is lead free.

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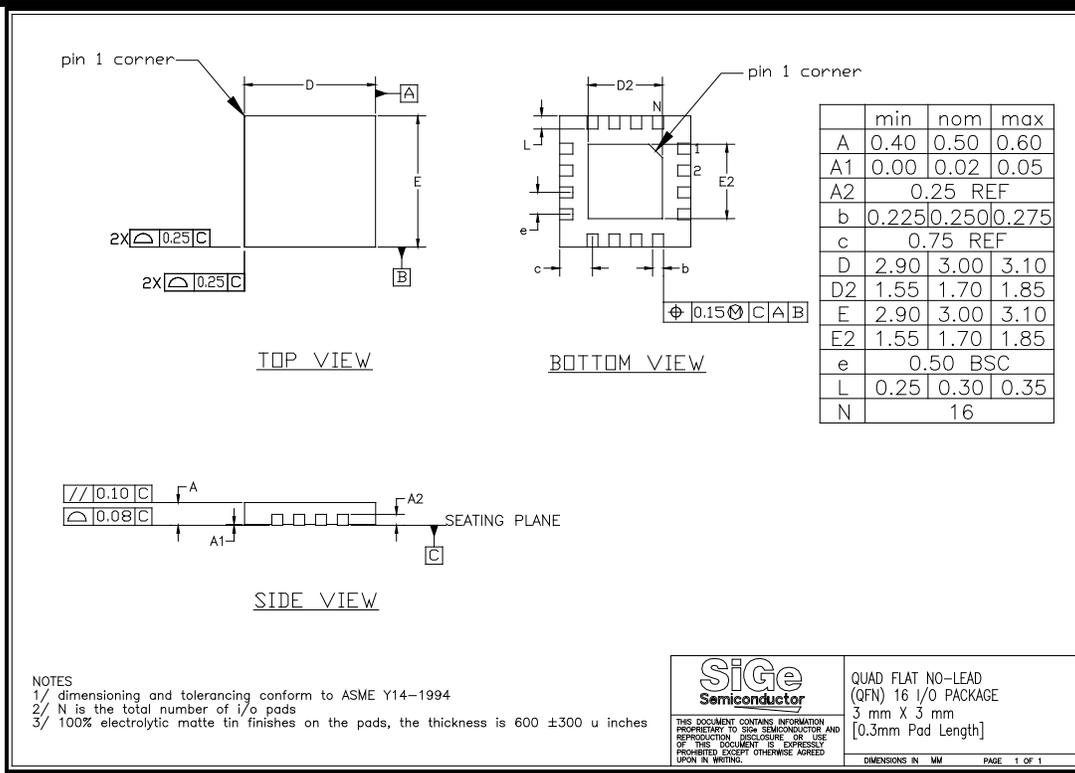


Figure 11: SE2425U Package Drawing

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