

### 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<sub>OUT</sub> = +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.

### 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 |

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.

### Functional Block Diagram

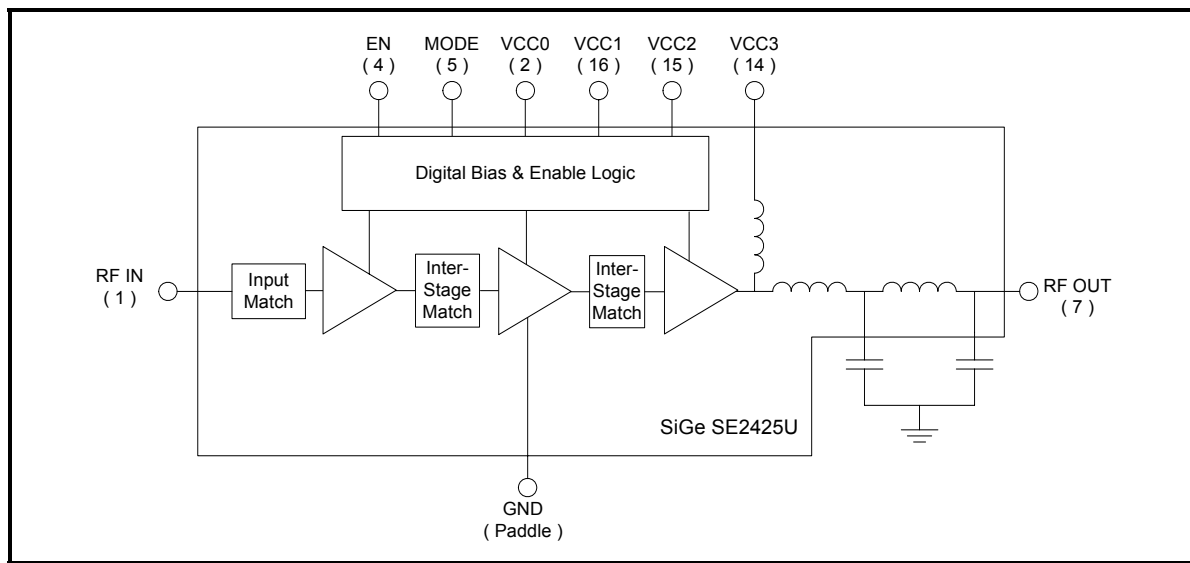
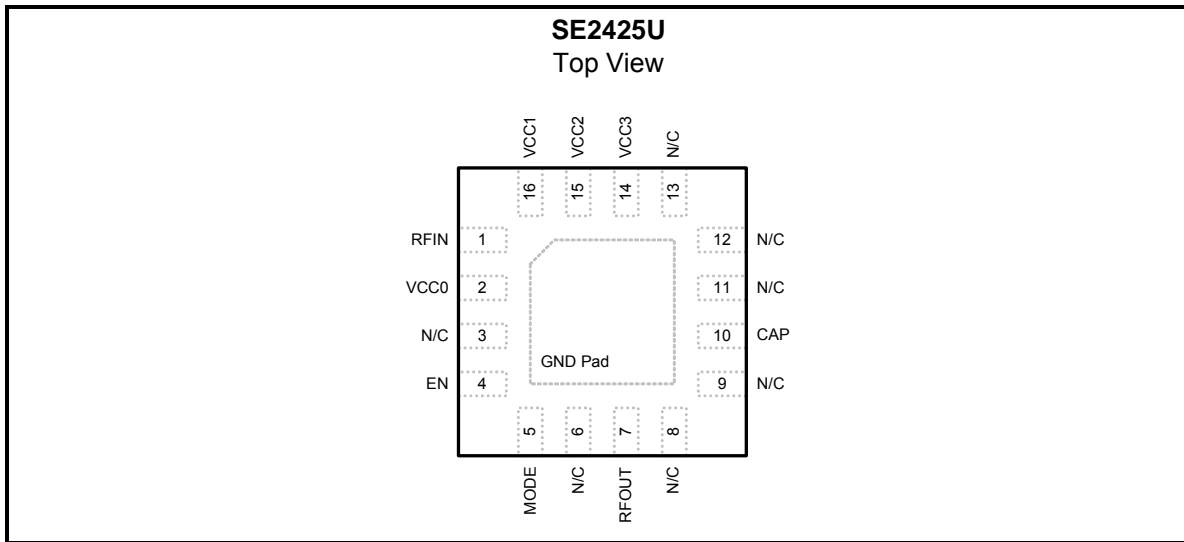


Figure 1: SE2425U Block Diagram

### Pin-Out Diagram



**Figure 2: SE2425U Pin-Out**

### Pin Out Description

| Pin No. | Name  | Description   |
|---------|-------|---|
| 1       | RFIN  | Power amplifier RF input, DC blocking is required   |
| 2       | VCC0  | Bias Power Supply   |
| 3       | N/C   | Do Not Connect  |
| 4       | EN    | PA Enable   |
| 5       | MODE  | Mode switch   |
| 6       | N/C   | Do Not Connect  |
| 7       | RFOUT | RF output<br>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      | VCC3  | Stage 3 collector supply voltage  |
| 15      | VCC2  | Stage 2 collector supply voltage  |
| 16      | VCC1  | 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 <sub>CC</sub>    | Supply Voltage               | -0.3 | +4.2            | V    |
| V <sub>LOGIC</sub> | Logic Voltage                | -0.3 | V <sub>CC</sub> | V    |
| IN                 | RF Input Power               | -    | 0               | dBm  |
| T <sub>C</sub>     | Case Temperature Range       | -40  | +85             | °C   |
| T <sub>STG</sub>   | Storage Temperature Range    | -40  | +150            | °C   |
| T <sub>J</sub>     | Maximum Junction Temperature | -    | +150            | °C   |

### DC Electrical Characteristics

Conditions: V<sub>CC0</sub> = V<sub>CC1</sub> = V<sub>CC2</sub> = V<sub>CC3</sub> = 3.3 V, T<sub>C</sub> = 25 °C, f = 2.45 GHz, as measured on SiGe Semiconductor's SE2425U-EV1 evaluation board unless otherwise noted.

| Symbol             | Parameter   | Min. | Typ. | Max. | Unit |
|--------------------|---|------|------|------|------|
| V <sub>CC</sub>    | Supply Voltage  | 2.7  | 3.3  | 3.6  | V    |
| I <sub>CC</sub>    | Supply Current V <sub>MODE</sub> = Low, P <sub>OUT</sub> = 20 dBm     | -    | 110  | -    | mA   |
|                    | Supply Current V <sub>MODE</sub> = Low, No RF                         | -    | 28   | -    | mA   |
|                    | Supply Current V <sub>MODE</sub> = High, No RF                        | -    | 81   | -    | mA   |
|                    | Supply Current V <sub>MODE</sub> = High, P <sub>OUT</sub> = 19.5 dBm  | -    | 123  | -    | mA   |
| I <sub>EN</sub>    | Current sunk by EN pin (logic high)                                   | -    | -    | 1    | μA   |
| I <sub>MODE</sub>  | Current sunk by MODE pin (logic high)                                 | -    | -    | 1    | μA   |
| V <sub>LOGIC</sub> | Logic High Voltage (V <sub>LOGIC</sub> ≤ V <sub>CC</sub> )            | 2.0  | 2.8  | 3.6  | V    |
|                    | Logic Low Voltage   | 0    | -    | 0.8  | V    |
| I <sub>stdby</sub> | Leakage Current when V <sub>EN</sub> = V <sub>MODE</sub> = 0 V, No RF | -    | 1    | 10   | μA   |

### 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 SiGe Semiconductor's 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  |
| $\Delta P_{temp}$  | Output Power variation over temperature ( $-40\text{ }^\circ\text{C} < T_A < +85\text{ }^\circ\text{C}$ ) | -  | 0.5          | -    | dB   |
| G                  | Gain @ $P_{IN} = -25\text{ dBm}$<br>Gain @ $P_{IN} = -6\text{ dBm}$                                       | -  | 29.5<br>28.2 | -    | dB   |
| $G_{VAR}$          | Gain Variation over band (2400-2500 MHz)  | -  | 0.3          | 1.0  | dB   |
| 2f                 | Harmonics   | -  | -39          | -    | dBc  |
| 3f                 |   | -  | -45          | -    |      |
| IS11I              | -   | 10   | -            | -    | dB   |
| IS21IOFF           | Isolation in "OFF" State, $V_{EN} = 0\text{ V}$   | -  | 36           | -    | dB   |
| IS12I              | 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 SiGe Semiconductor's 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  |
| $\Delta P_{temp}$  | 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  |

## 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 SiGe's SE2425U-EV1 evaluation board otherwise noted

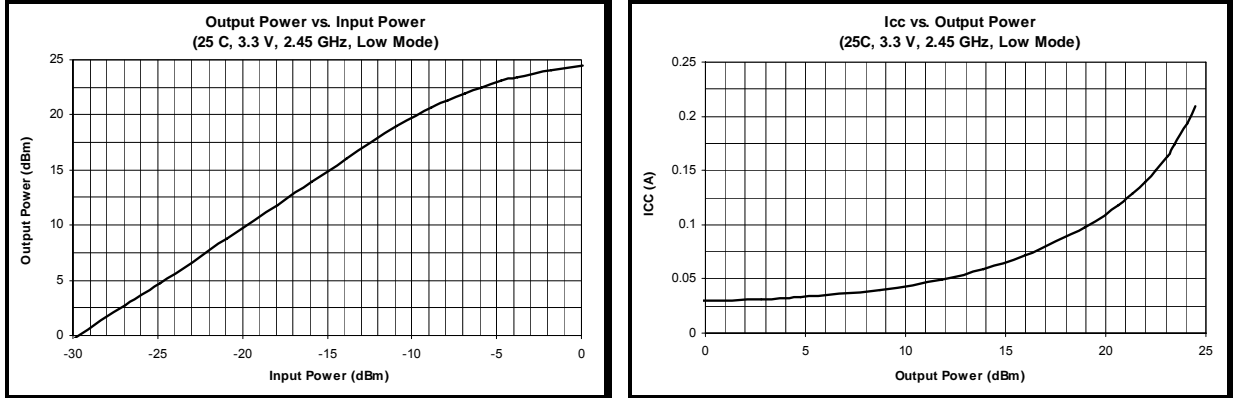


Figure 3: Typical Performance Data in Low Mode (a) Output Power vs. Input Power, (b) Current vs. Output Power

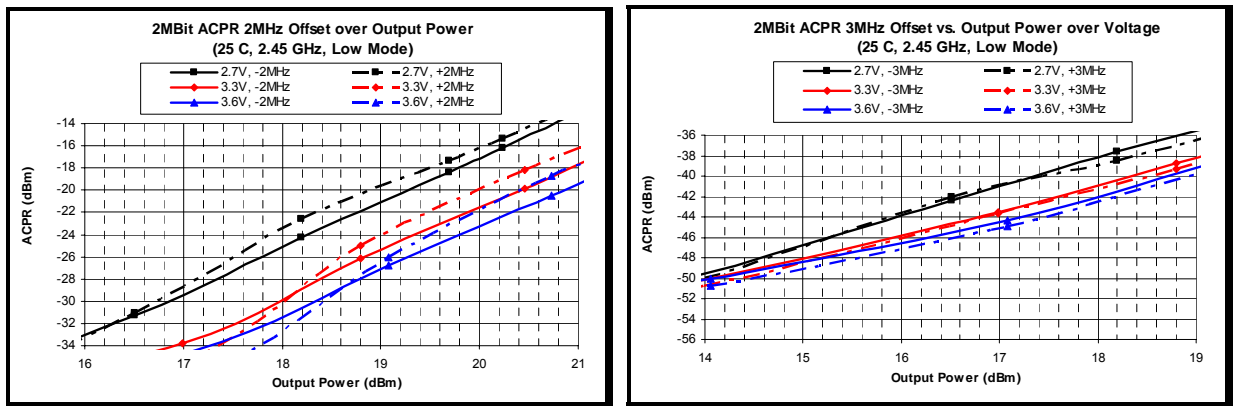


Figure 4: Typical 2 Mbps Enhanced Data Rate (EDR) Performance Data in Low Mode (a) ACPR @ 2 MHz Offset vs. Output Power over Voltage (b) ACPR @ 3 MHz Offset vs. Output Power over voltage

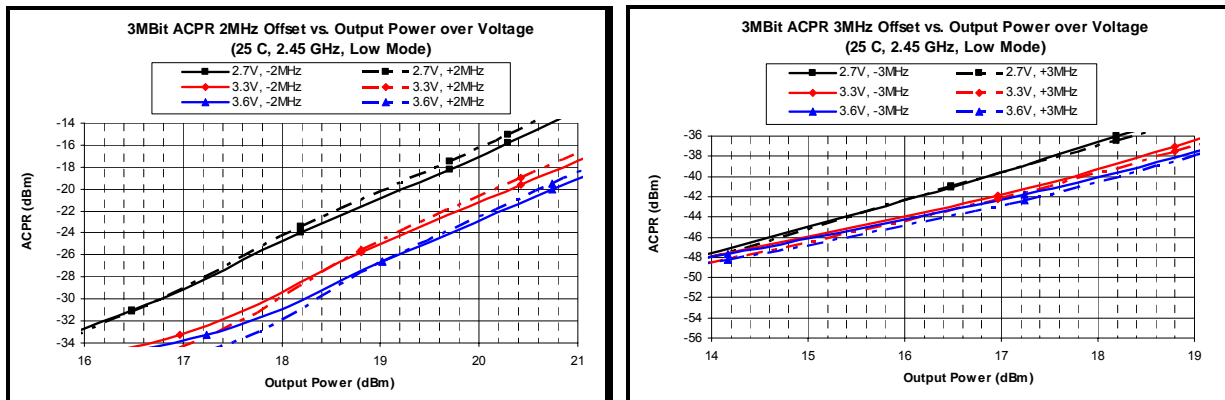
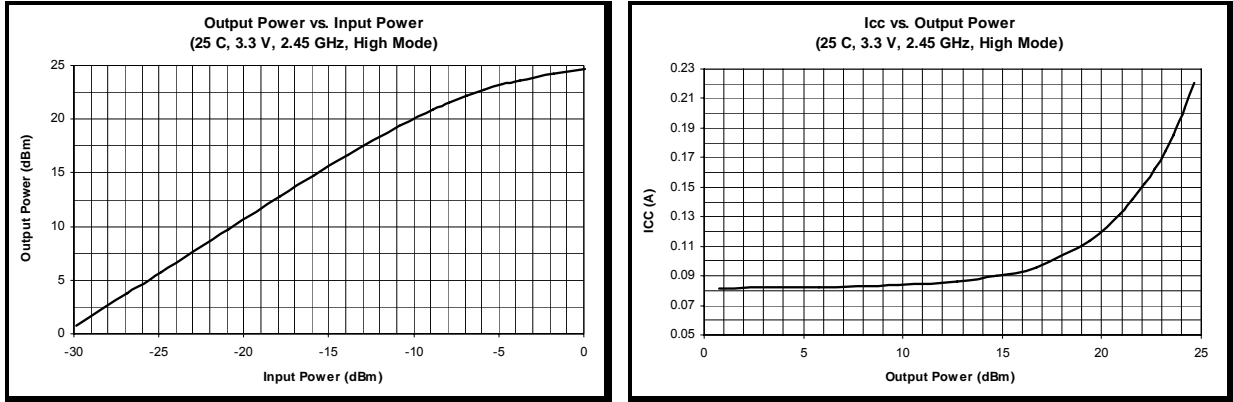


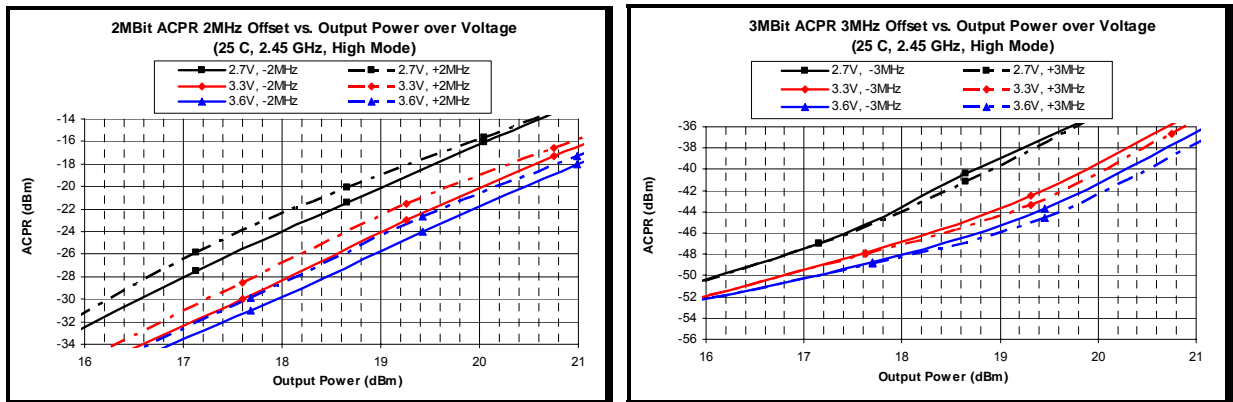
Figure 5: Typical 3 Mbps Enhanced Data Rate (EDR) Performance Data in Low Mode (a) ACPR @ 2 MHz Offset vs. Output Power over Voltage (b) ACPR @ 3 MHz Offset vs. Output Power over voltage

**High Mode**

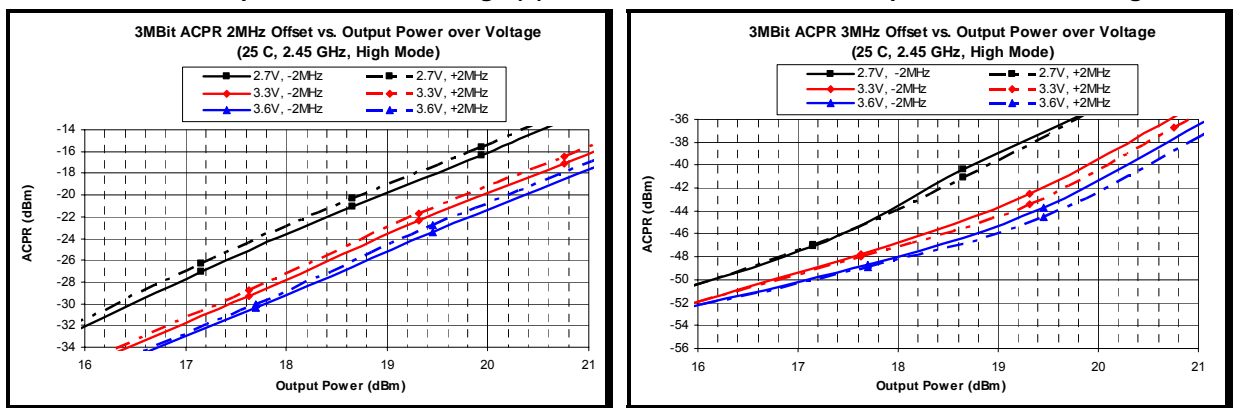
Test Conditions:  $V_{EN} = V_{CC0} = V_{CC1} = V_{CC2} = V_{CC3} = 3.3\text{ V}$ , MODE = High,  $T_c = 25\text{ }^\circ\text{C}$ ,  $f = 2.45\text{ GHz}$ , as measured on SiGe's SE2425U-EV1 evaluation board otherwise noted



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



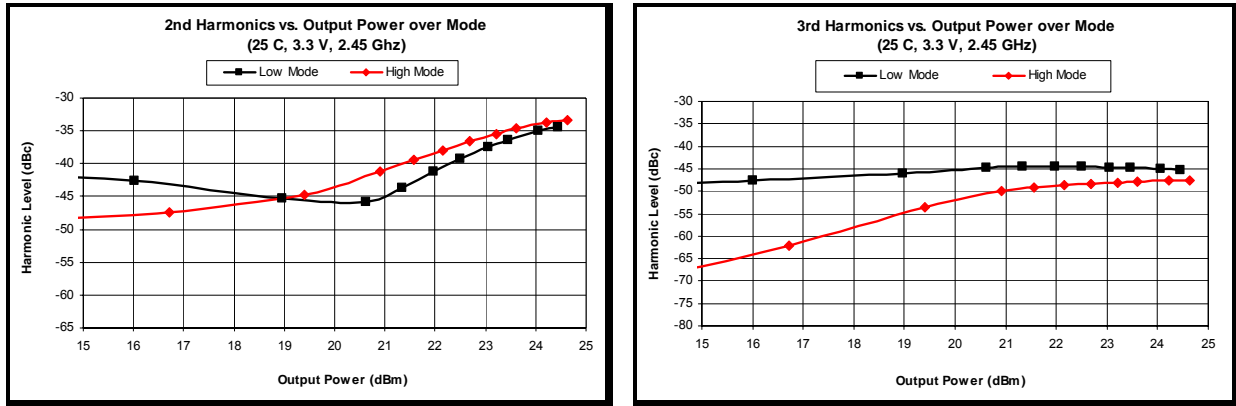
**Figure 7: Typical 2 Mbps Enhanced Data Rate (EDR) Performance Data in High Mode (a) ACPR @ 2 MHz Offset vs. Output Power over Voltage (b) ACPR @ 3 MHz Offset vs. Output Power over Voltage**



**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**

**Harmonic Performance**

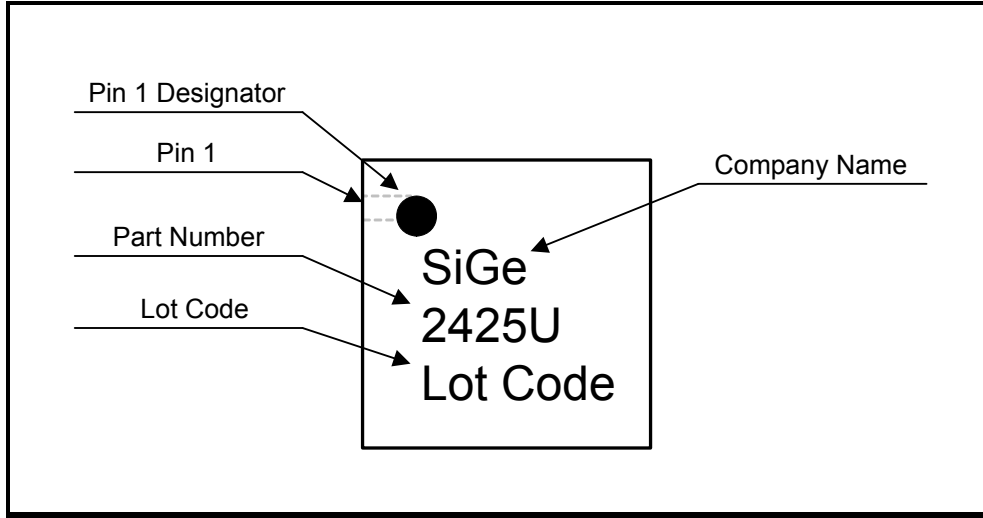
Test Conditions:  $V_{EN} = V_{CC0} = V_{CC1} = V_{CC2} = V_{CC3} = 3.3\text{ V}$ ,  $T_C = 25\text{ }^\circ\text{C}$ ,  $f = 2.45\text{ GHz}$ , as measured on SiGe's SE2425U-EV1 evaluation board otherwise noted



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

### Branding Information

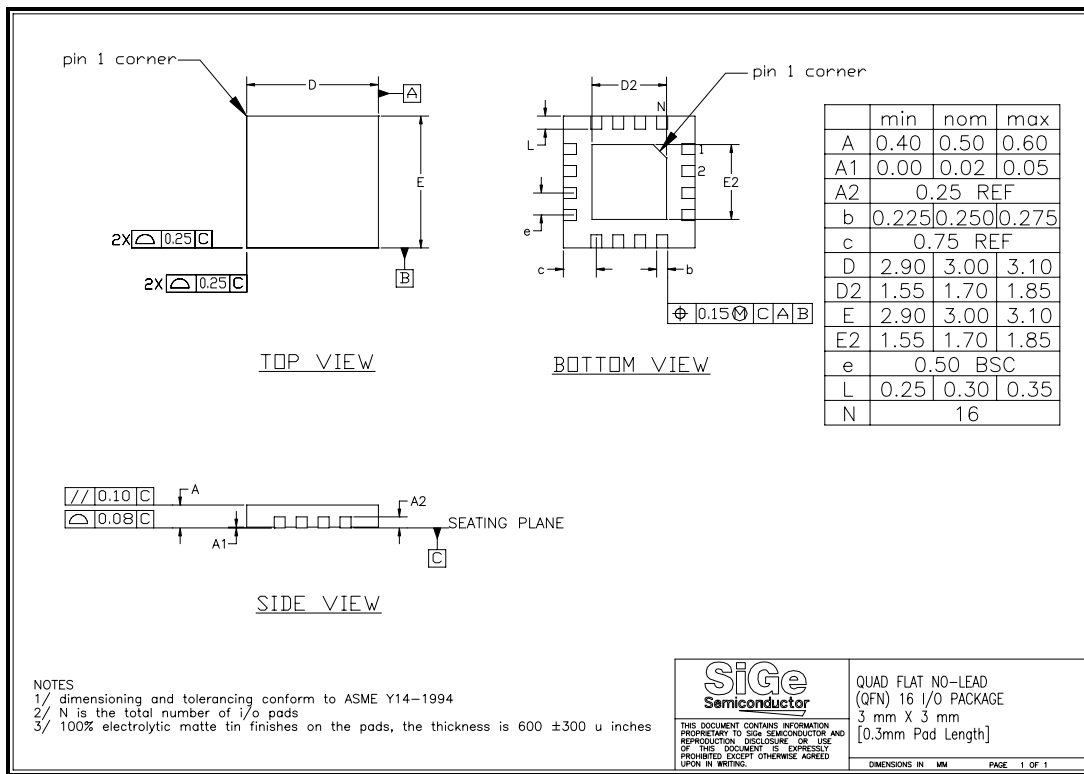
Figure 10 shows the SE2425U branding.



**Figure 10: SE2425U Branding Information**

### Package Information

This package is lead free.



**Figure 11: SE2425U Package Drawing**



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