

**DATA SHEET**

# SE5023L: 5 GHz, +26 dBm Power Amplifier with Power Detector

## Applications

- DSSS 5 GHz WLAN (IEEE 802.11ac)
- DSSS 5 GHz WLAN (IEEE 802.11n)
- Access points, PCMCIA, PC cards

## Features

- 5 GHz matched +24 dBm 802.11ac power amplifier
- External analog reference voltage (VREF) for maximum flexibility
- Buffered, temperature compensated power detector
- 1.8% EVM, +24 dBm, 256 QAM, 802.11ac  
3% EVM, +26 dBm, 64 QAM, 802.11n
- 32 dB Gain
- Lead-free, RoHS-compliant and halogen-free (20-pin, 4 × 4 × 0.9 mm) QFN package (MSL1, 260 °C per JEDEC J-STD-020)

## Description

The SE5023L is a 5 GHz power amplifier offering high linear power for wireless LAN applications.

The SE5023L offers a high level of integration for a simplified design, providing quicker time to market and higher application board production yield. The device integrates all matching elements, a temperature compensated, load insensitive power detector with 15 dB of dynamic range and a 3.8 GHz notch filter.

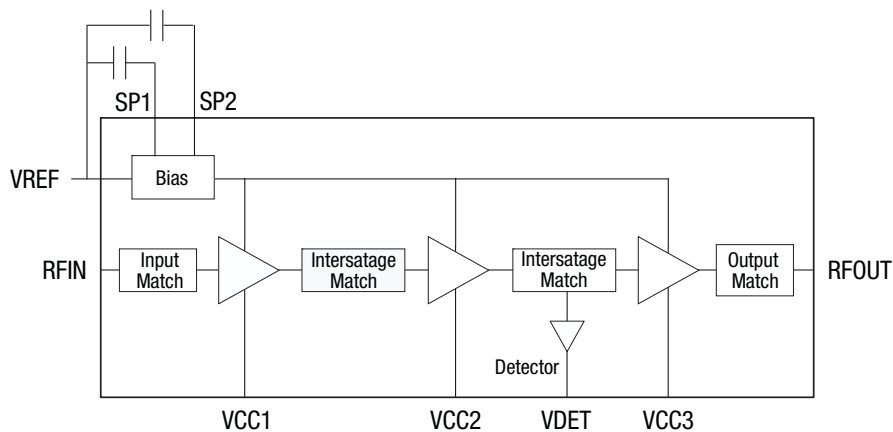
For wireless LAN applications, the device meets the requirements of IEEE 802.11ac and 802.11n, and delivers approximately +24 dBm of 802.11ac output power or +26 dBm of 802.11n output power at 5 V.

A 2.85 V reference voltage on VREF is all that is required to enable or disable the power amplifier.

A block diagram of the SE5023L is shown in Figure 1. The device pinout for the 20-pin QFN are shown in Figure 2. Signal pin assignments and functional pin descriptions are described in Table 1.



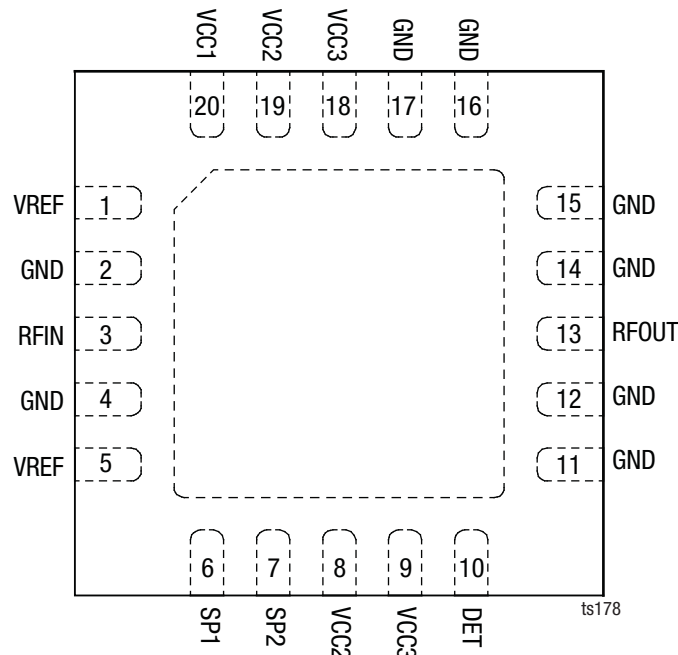
Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.



Note: RFIN and RFOUT include DC shunt to Ground.  
External blocking capacitors are recommended.

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**Figure 1. SE5023L Block Diagram**



**Figure 2. SE5023L Pinout – 20-Pin QFN (Top View)**

**Table 1. SE5023L Signal Descriptions**

| Pin | Name | Description  | Pin            | Name  | Description                  |
|-----|------|--|----------------|-------|------------------------------|
| 1   | VREF | Reference voltage                                  | 9              | VCC3  | Third stage supply voltage   |
| 2   | GND  | Ground   | 10             | DET   | Analog power detector output |
| 3   | RFIN | Power amplifier RF input, DC block required        | 11, 12         | GND   | Ground                       |
| 4   | GND  | Ground   | 13             | RFOUT | Power amplifier RF output    |
| 5   | VREF | Reference voltage                                  | 14, 15, 16, 17 | GND   | Ground                       |
| 6   | SP1  | Port for optional capacitor to improve dynamic EVM | 18             | VCC3  | Third stage supply voltage   |
| 7   | SP2  | Port for optional capacitor to improve dynamic EVM | 19             | VCC2  | Second stage supply voltage  |
| 8   | VCC2 | Second stage supply voltage                        | 20             | VCC1  | First stage supply voltage   |

### Electrical and Mechanical Specifications

The absolute maximum ratings of the SE5023L are provided in Table 2. Recommended operating conditions are specified in

Table 3. Electrical specifications are provided in Tables 4 through 6. Figure 3 shows the power detector characteristics.

**Table 2. SE5023L Absolute Maximum Ratings (Note 1)**

| Parameter  | Symbol | Minimum | Maximum | Units |
|--|--------|---------|---------|-------|
| Supply voltage on pins VCC3                                  | VCC    | -0.3    | +6      | V     |
| Supply voltage on pins VCC1, VCC2                            |        | -0.3    | VCC3    | V     |
| Power amplifier enable and reference voltage                 | VREF   | -0.3    | +3.6    | V     |
| RF input power, RFOUT into 50 Ω match, TCASE_MAX = 85 °C     | RFIN   |         | +6      | dBm   |
| Storage temperature range                                    | TSTG   | -40     | +160    | °C    |
| Maximum junction temperature                                 | TJ     |         | +160    | °C    |
| Electrostatic discharge:<br>Human Body Model (HBM), Class 1B | ESD    |         | 500     | 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. SE5023L Recommended Operating Conditions**

| Parameter                 | Symbol    | Minimum | Maximum | Units |
|---------------------------|-----------|---------|---------|-------|
| Supply voltage VCC3       | VCC       | 3.0     | 5.5     | V     |
| Supply voltage VCC1, VCC2 |           | 3.0     | VCC3    | V     |
| Maximum case temperature  | TCASE_MAX | -40     | +85     | °C    |
| Reference voltage         | VREF      | 2.8     | 2.9     | V     |

**Table 4. SE5023L Electrical Specifications: DC Characteristics (Note 1)**

(VCC = 5.0 V, VREF = 2.85 V, TA = +25 °C as Measured on Skyworks' SE5023L-EK1 Evaluation Board, Unless Otherwise Noted)

| Parameter                  | Symbol           | Test Condition                                     | Min  | Typical | Max | Units |
|----------------------------|------------------|--|------|---------|-----|-------|
| Supply current             | ICC_802.11a      | POUT = 26 dBm, 54 Mbps, 64 QAM,                    |      |         | 600 | mA    |
| Quiescent current          | IQC              | No RF  | 150  |         | 300 | mA    |
| Supply current             | I <sub>OFF</sub> | VREF = 0 V, no RF                                  |      | 0.5     | 10  | μA    |
| Bias control current       | IEN              | VREF = VREF_H,<br>Internal 2 kΩ pull down resistor |      | 10      |     | mA    |
| Reference voltage enabled  | VREF_H           |  | 2.80 | 2.85    | 2.9 | V     |
| Reference voltage current  | IREF             | VREF voltage set to 2.85 V                         |      | 10      |     | mA    |
| Reference voltage disabled | VREF_L           |  | 0    |         | 0.5 | V     |

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

**Table 5. SE5023L Electrical Specifications: AC Characteristics (Note 1)**  
**(V<sub>CC</sub> = 5.0 V, V<sub>REF</sub> = 2.85 V, f = 5.4 GHz, T<sub>A</sub> = +25 °C as Measured on the SE5023L-EK1 Evaluation Board, Unless Otherwise Noted)**

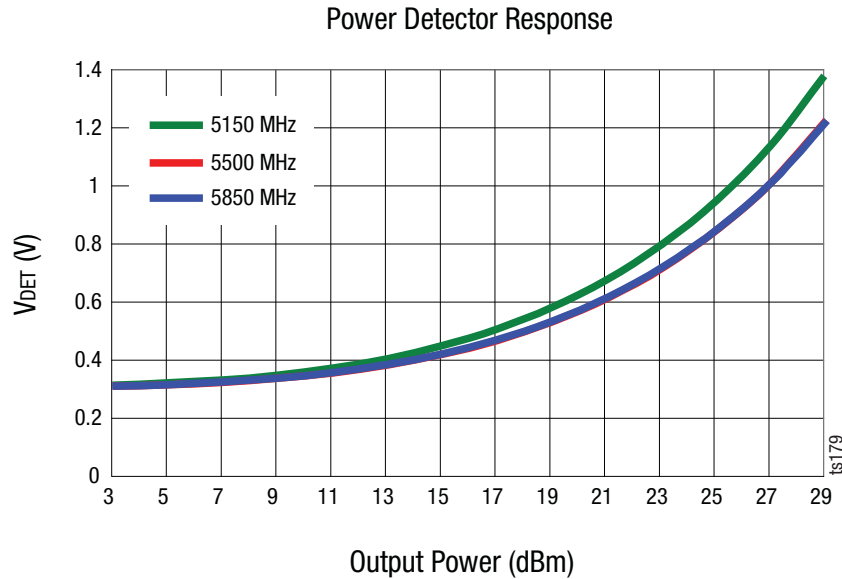
| Parameter  | Symbol                          | Test Condition   | Min   | Typical    | Max  | Units      |
|--|---------------------------------|--|---|------------|------|------------|
| Frequency range  | f <sub>L</sub> _U               |  | 5.15  |            | 5.85 | GHz        |
| Output power   | P <sub>OUT</sub>                | MCS9, -35 dB DEVM,<br>UNII-1<br>UNII-2 & 3   | +17<br>+22  | +19<br>+24 |      | dBm<br>dBm |
|  |                                 | MCS9, -30 dB DEVM<br>UNII-1<br>UNII-2 & 3  | +22<br>+24  | +24<br>+26 |      | dBm<br>dBm |
|  |                                 | MCS0, mask limited<br>UNII-1<br>UNII-2 & 3   | +25<br>+27  | +27<br>+29 |      | dBm<br>dBm |
| Output 1 dB compression point                          | P <sub>1dB</sub>                | No modulation  |   | +34        |      | dBm        |
| Small signal gain                                      | S <sub>21</sub>                 | P <sub>IN</sub> = -25 dBm  | 28  | 32         | 34   | dB         |
| Small signal gain variation                            | ΔS <sub>21</sub>                | Within each UNII Band  |   | 3          |      | dB         |
| Gain at 3.8 GHz  | S <sub>21_3.8</sub>             | P <sub>IN</sub> = -25 dBm  |   |            | 0    | dB         |
| Harmonic   | 2f                              | P <sub>OUT</sub> = +26 dBm, 5 V  |   |            | -45  | dBm/MHz    |
|  | 3f                              |  |   |            |      |            |
| Rise and fall time                                     | t <sub>R</sub> , t <sub>F</sub> |  |   | 0.15       | 0.3  | μs         |
| Stability  | STAB                            | P <sub>OUT</sub> = +26 dBm, V <sub>CC</sub> = 5 V, 54 Mbps, 64QAM,<br>VSWR = 6:1, all phases | All non-harmonically related outputs<br>less than -50 dBc/100 kHz |            |      |            |
| Tolerance to constant input power into a mismatch load | Ruggedness                      | P <sub>IN</sub> = -10 dBm, CW, VSWR = 6:1, all phases  | No damage   |            |      |            |

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

**Table 6. SE5023L Electrical Specifications: Power Detector Characteristics (Note 1)**  
**(V<sub>CC</sub> = 5.0 V, V<sub>REF</sub> = 2.85 V, f = 5.4 GHz, T<sub>A</sub> = +25 °C as Measured on the SE5023L-EK1 Evaluation Board, Unless Otherwise Noted)**

| Parameter                     | Symbol              | Test Condition   | Min  | Typical | Max              | Units |
|-------------------------------|---------------------|--|------|---------|------------------|-------|
| P <sub>OUT</sub> detect range | P <sub>DR</sub>     |  | 0    |         | P <sub>1dB</sub> | dBm   |
| Detector voltage              | V <sub>DET</sub>    | P <sub>OUT</sub> = +26 dBm   | 0.8  |         | 1.2              | V     |
|                               |                     | P <sub>OUT</sub> = No RF   | 0.22 |         | 0.33             | V     |
| Detector accuracy             | ERR <sub>DET</sub>  | ΔP <sub>OUT</sub> at constant V <sub>DET</sub> ,<br>5.15 GHz to 5.70 GHz | -0.5 |         | +0.5             | dB    |
|                               |                     | 5.70 GHz to 5.85 GHz   | -0.5 |         | +0.5             | dB    |
|                               |                     | ΔP <sub>OUT</sub> at constant V <sub>DET</sub> , VSWR = 3:1              | -1.5 |         | +1.5             | dB    |
| Output impedance              | PDZ <sub>OUT</sub>  |  |      | 0.7     |                  | kΩ    |
| DC load impedance             | PDZ <sub>LOAD</sub> |  |      | 26.5    |                  | kΩ    |

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



**Figure 3. SE5023L Power Detector Characteristic over Frequency**

### Package Dimensions

The PCB layout footprint for the SE5023L is provided in Figure 4. Typical part markings are shown in Figure 5. Package dimensions for the 20-pin QFN are shown in Figure 6, and carrier tape dimensions are provided in Figure 7.

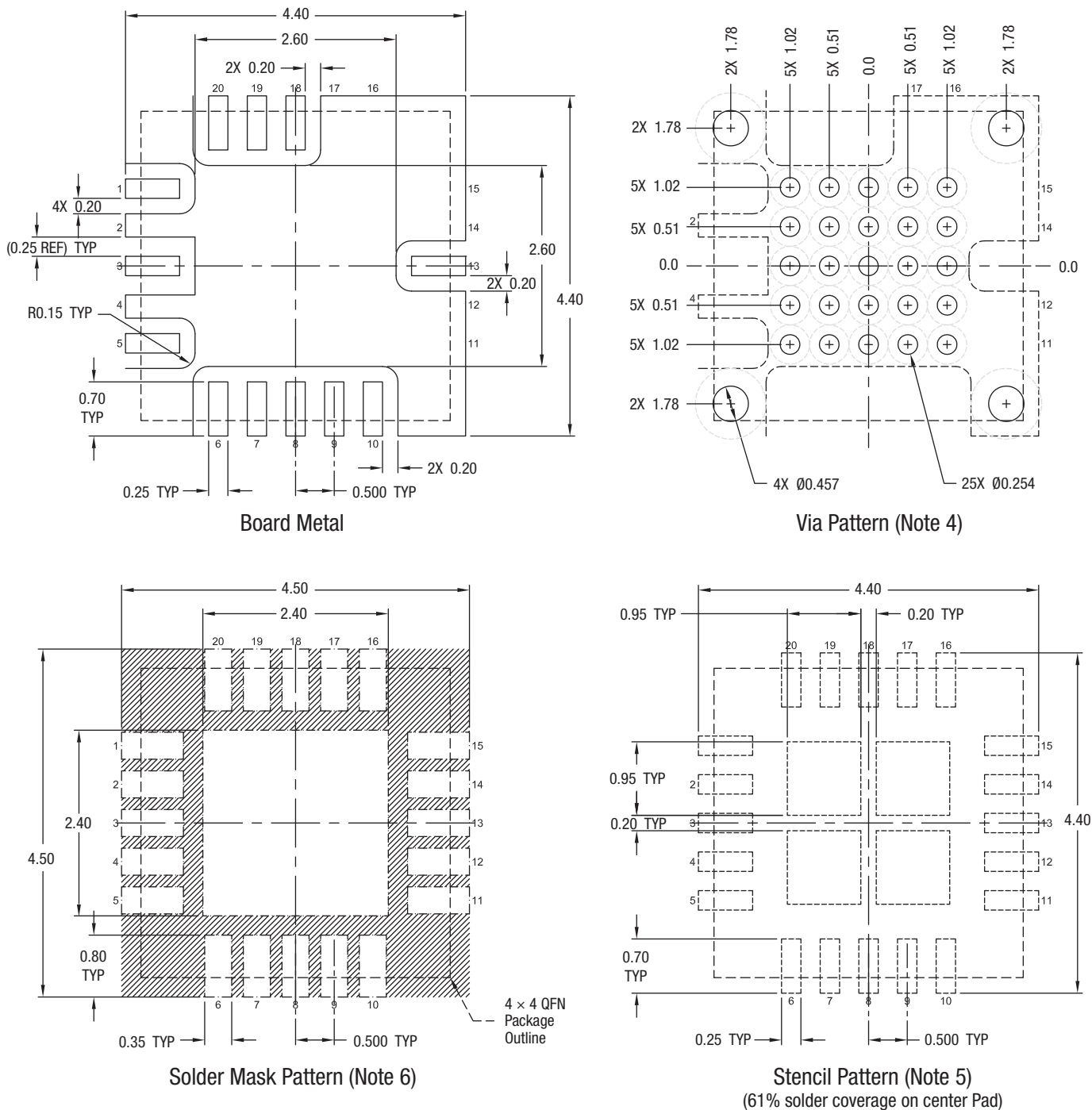
### Package Handling Information

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 temperature during solder assembly.

The SE5023L is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

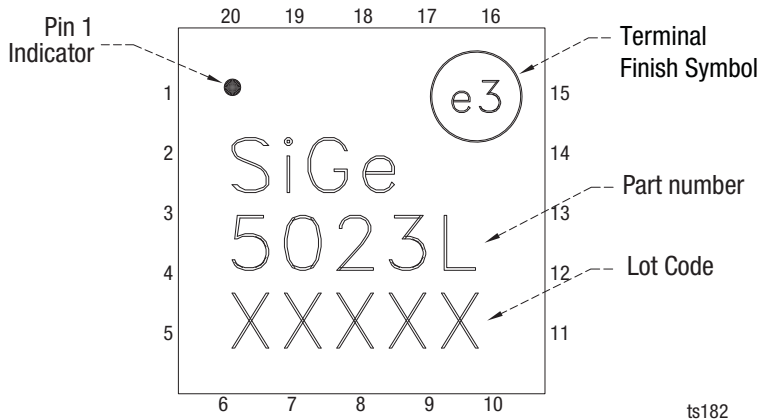
Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.



- Notes:
1. All dimensions are in millimeters.
  2. Interpret dimensioning and tolerancing 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 holes 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 will offer better paste release.
  6. Solder mask recommendations: contact board fabricator for recommended solder mask offset and tolerance.

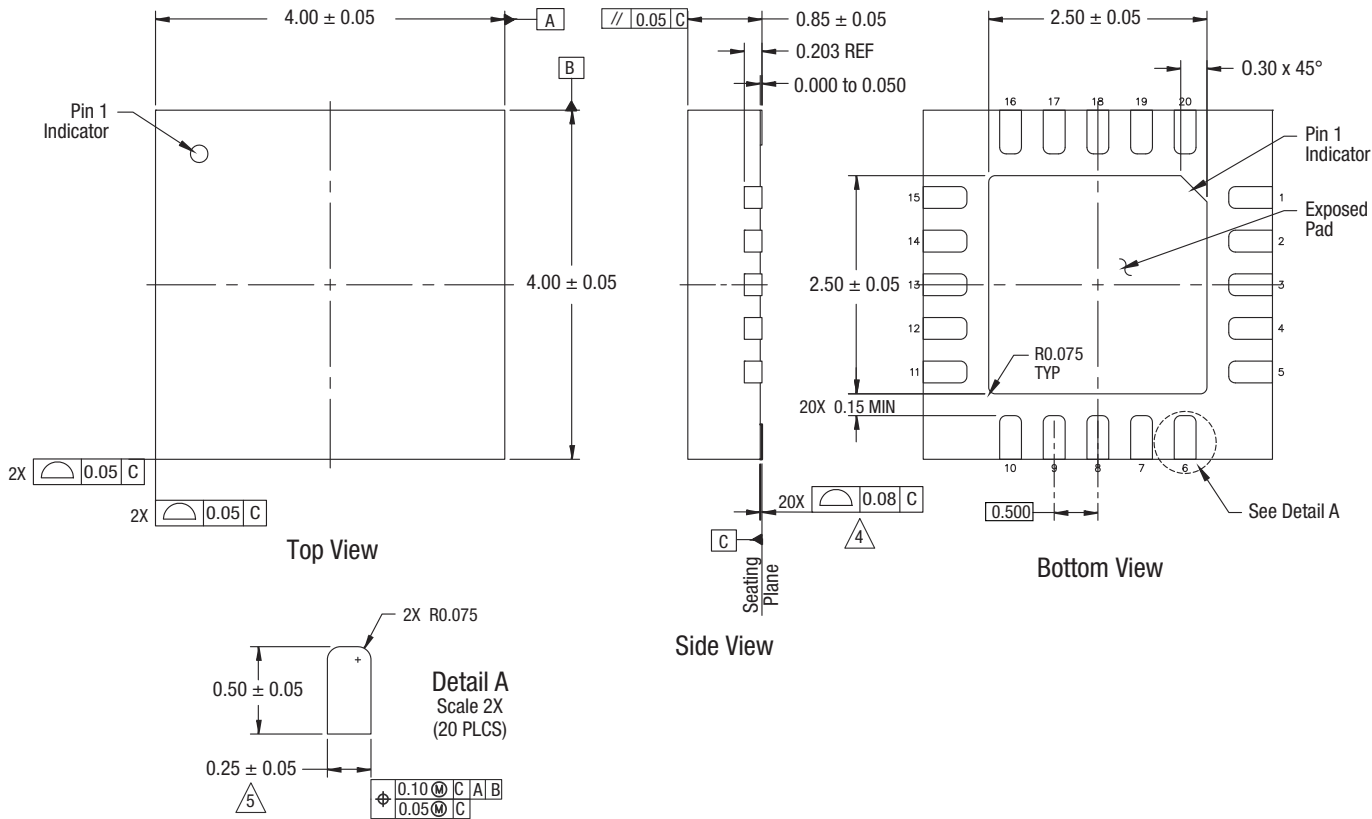
Figure 4. PCB Layout Footprint for the SE5023L

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Figure 5. Typical Part Markings (Top View)



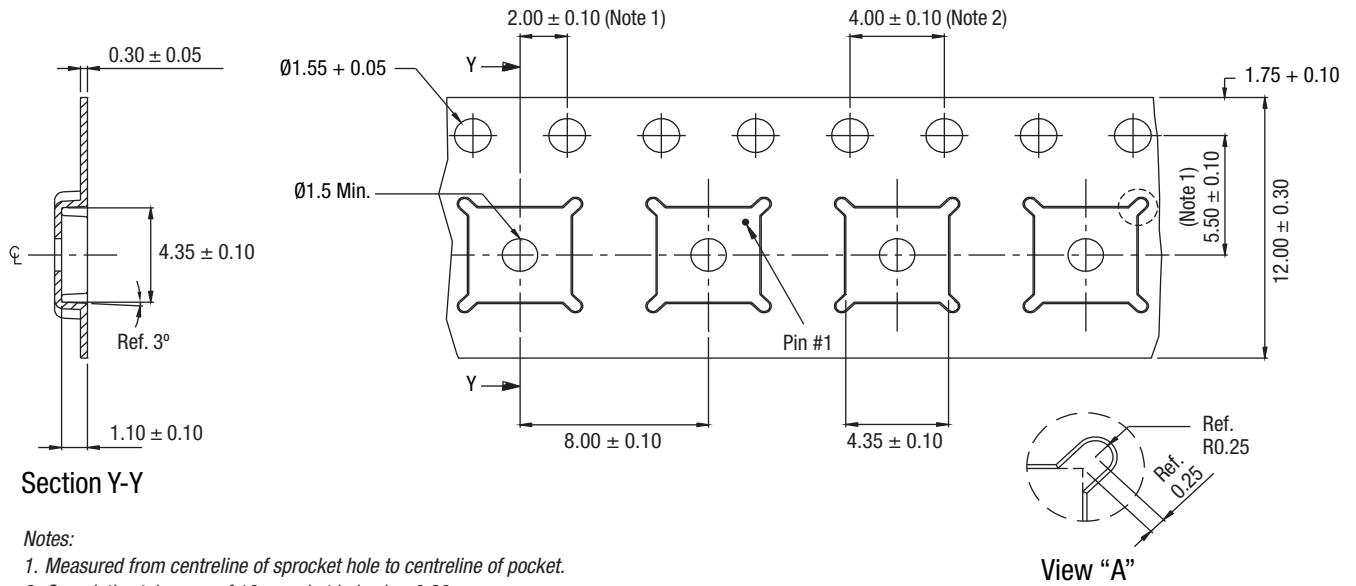
Notes:

1. All measurements are in millimeters.
2. Dimensioning and tolerancing according to ASME Y14.5M-1994.
3. Tolerancing (unless otherwise specified):  
 Decimal Tolerance: X.X (1 PLC) ± 0.1 mm  
 X.XX (2 PLCs) ± 0.05 mm  
 X.XXX (3 PLCs) ± 0.025 mm  
 Angular Tolerance: ±1°/2°
4. Coplanarity applies to the exposed center ground pad as well as the terminal.
5. Dimension applies to metalized terminal. If the terminal has a radius, the dimension should not be measured in the radius area.
6. Plating requirements per source control drawing (SCD) 2504.
7. Unless specified, dimensions are symmetrical about center lines.

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Figure 6. SE5023L 20-Pin QFN Package Dimensions

**DATA SHEET • SE5023L: POWER AMPLIFIER WITH POWER DETECTOR**



**Section Y-Y**

**Notes:**

1. Measured from centreline of sprocket hole to centreline of pocket.
2. Cumulative tolerance of 10 sprocket holes is  $\pm 0.20$  mm.
3. Other material available.
4. All measurements are in millimeters unless otherwise stated.

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**Figure 7. SE5023L 20-pin QFN Carrier Tape Dimensions**



**Ordering Information**

| Model Name   | Manufacturing Part Number | Evaluation Board Part Number |
|--|---------------------------|------------------------------|
| SE5023L: 5 GHz, 26 dBm Power Amplifier with Power Detector | SE5023L                   | SE5023L-EK1                  |

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### Наши контакты:

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331