

# SiT5001

## 1-80 MHz MEMS TCXO and VCTCXO

### Features

- Any frequency between 1 and 80 MHz accurate to 6 decimal places
- 100% pin-to-pin drop-in replacement to quartz-based (VC)TCXO
- Frequency stability as low as  $\pm 1.5$  PPM. Contact SiTime for  $\pm 1$  PPM option
- Ultra low phase jitter: 0.5 ps (12 kHz to 20 MHz)
- Voltage control option with pull range from  $\pm 12.5$  PPM to  $\pm 50$  PPM
- LVC MOS compatible output with SoftEdge™ option for EMI reduction
- Voltage control, standby, output enable or no connect modes
- Standard 4-pin packages: 2.5 x 2.0, 3.2 x 2.5, 5.0 x 3.2, 7.0 x 5.0 mm
- Outstanding silicon reliability of 2 FIT, 10 times better than quartz
- Pb-free, RoHs and REACH compliant

### Applications

- WiFi, 3G, LTE, SDI, Ethernet, SONET, DSL
- Telecom, networking, smart meter, wireless, test instrumentation



EXPRESS  
SAMPLES



GREEN  
SOLUTIONS



QUARTZ  
FREE

### Electrical Characteristics

| Parameter                       | Symbol  | Min.                           | Typ. | Max. | Unit       | Condition                                                                                                                                                                                                                                        |
|---------------------------------|---------|--------------------------------|------|------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Output Frequency Range          | f       | 1                              | –    | 80   | MHz        |                                                                                                                                                                                                                                                  |
| Initial Tolerance               | F_init  | -1                             | –    | 1    | PPM        | At 25°C                                                                                                                                                                                                                                          |
| Stability Over Temperature      | F_stab  | -1.5                           | –    | +1.5 | PPM        | Over operating temperature range at rated nominal power supply voltage and load. (see ordering codes on page 6)<br><br>$\pm 1.5$ PPM is available in -20 to 70 °C temp. range only.<br><b>Contact SiTime for <math>\pm 1</math> PPM options.</b> |
|                                 |         | -2                             | –    | +2   | PPM        |                                                                                                                                                                                                                                                  |
|                                 |         | -2.5                           | –    | +2.5 | PPM        |                                                                                                                                                                                                                                                  |
|                                 |         | -5                             | –    | +5   | PPM        |                                                                                                                                                                                                                                                  |
| Supply Voltage                  | F_vdd   | –                              | 50   | –    | PPB        | $\pm 10\%$ Vdd ( $\pm 5\%$ for Vdd = 1.8V)                                                                                                                                                                                                       |
| Output Load                     | F_load  | –                              | 0.1  | –    | PPM        | 15 pF $\pm 10\%$ of load                                                                                                                                                                                                                         |
| First year Aging                | F_aging | -1.5                           | –    | +1.5 | PPM        | 25°C                                                                                                                                                                                                                                             |
| 10-year Aging                   |         | -3.5                           | –    | +3.5 | PPM        | 25°C                                                                                                                                                                                                                                             |
| Stability vs. Temperature Slope | F_slope | –                              | 0.1  | –    | PPM/°C     |                                                                                                                                                                                                                                                  |
| Operating Temperature Range     | T_use   | -20                            | –    | +70  | °C         | Extended Commercial                                                                                                                                                                                                                              |
|                                 |         | -40                            | –    | +85  | °C         | Industrial                                                                                                                                                                                                                                       |
| Supply Voltage                  | Vdd     | 1.71                           | 1.8  | 1.89 | V          | Contact SiTime for any other supply voltage options.                                                                                                                                                                                             |
|                                 |         | 2.25                           | 2.5  | 2.75 | V          |                                                                                                                                                                                                                                                  |
|                                 |         | 2.52                           | 2.8  | 3.08 | V          |                                                                                                                                                                                                                                                  |
|                                 |         | 2.70                           | 3.0  | 3.3  | V          |                                                                                                                                                                                                                                                  |
|                                 |         | 2.97                           | 3.3  | 3.63 | V          |                                                                                                                                                                                                                                                  |
| Pull Range                      | PR      | $\pm 12.5, \pm 25, \pm 50$     |      |      | PPM        |                                                                                                                                                                                                                                                  |
| Upper Control Voltage           | VC_U    | Vdd-0.1                        | –    | –    | V          | All Vdds. Voltage at which maximum deviation is guaranteed.                                                                                                                                                                                      |
| Control Voltage Range           | VC_L    | –                              | –    | 0.1  | V          |                                                                                                                                                                                                                                                  |
| Control Voltage Input Impedance | Z_vc    | 100                            | –    | –    | k $\Omega$ |                                                                                                                                                                                                                                                  |
| Frequency Change Polarity       | –       | Positive slope                 |      |      | –          |                                                                                                                                                                                                                                                  |
| Control Voltage -3dB Bandwidth  | V_BW    | –                              | –    | 8    | kHz        |                                                                                                                                                                                                                                                  |
| Current Consumption             | Idd     | –                              | 31   | 33   | mA         | No load condition, f = 20 MHz, Vdd = 2.5V, 2.8V or 3.3V.                                                                                                                                                                                         |
|                                 |         | –                              | 29   | 31   | mA         | No load condition, f = 20 MHz, Vdd = 1.8V.                                                                                                                                                                                                       |
| OE Disable Current              | I_OD    | –                              | –    | 31   | mA         | Vdd = 2.5V, 2.8V or 3.3V, OE = GND, output is Weakly Pulled Down                                                                                                                                                                                 |
|                                 |         | –                              | –    | 30   | mA         | Vdd = 1.8 V. OE = GND, output is Weakly Pulled Down                                                                                                                                                                                              |
| Standby Current                 | I_std   | –                              | –    | 70   | $\mu$ A    | Vdd = 2.5V, 2.8V or 3.3V, ST = GND, output is Weakly Pulled Down.                                                                                                                                                                                |
|                                 |         | –                              | –    | 10   | $\mu$ A    | Vdd = 1.8V. ST = GND, output is Weakly Pulled Down.                                                                                                                                                                                              |
| Duty Cycle                      | DC      | 45                             | –    | 55   | %          | All Vdds                                                                                                                                                                                                                                         |
| LVC MOS Rise/Fall Time          | Tr, Tf  | –                              | 1.5  | 2    | ns         | LVC MOS option. Default rise/fall time, All Vdds, 10% - 90% Vdd.                                                                                                                                                                                 |
| SoftEdge™ Rise/Fall Time        |         | SoftEdge™ Rise/Fall Time Table |      |      | ns         | SoftEdge™ option. Frequency and supply voltage dependent.                                                                                                                                                                                        |
| Output Voltage High             | VOH     | 90%                            | –    | –    | Vdd        | OH = -7 mA, IOL = 7 mA, (Vdd = 3.3V, 3.0V)                                                                                                                                                                                                       |
| Output Voltage Low              | VOL     | –                              | –    | 10%  | Vdd        | IOH = -4 mA, IOL = 4 mA, (Vdd = 2.8V, 2.5V)                                                                                                                                                                                                      |
|                                 |         |                                |      |      |            | IOH = -2 mA, IOL = 2 mA, (Vdd = 1.8V)                                                                                                                                                                                                            |
| Input Voltage High              | VIH     | 70%                            | –    | –    | Vdd        | Pin 1, OE or ST                                                                                                                                                                                                                                  |
| Input Voltage Low               | VIL     | –                              | –    | 30%  | Vdd        | Pin 1, OE or ST                                                                                                                                                                                                                                  |
| Input Pull-up Impedance         | Z_in    | –                              | 100  | 250  | k $\Omega$ |                                                                                                                                                                                                                                                  |

# SiT5001

## 1-80 MHz MEMS TCXO and VCTCXO

### Electrical Characteristics (continued)

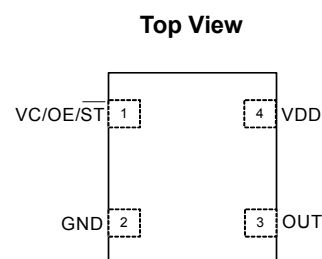
| Parameter                 | Symbol   | Min. | Typ. | Max. | Unit | Condition                                                      |
|---------------------------|----------|------|------|------|------|----------------------------------------------------------------|
| Startup Time              | T_start  | –    | –    | 10   | ms   | Measured from the time Vdd reaches its rated minimum value     |
| OE Enable/Disable Time    | T_oe     | –    | –    | 150  | ns   | f = 80 MHz. For other frequencies, T_oe = 100 ns + 3 cycles    |
| Resume Time               | T_resume | –    | 6    | 10   | ms   | Measured from the time ST pin crosses 50% threshold            |
| RMS Period Jitter         | T_jitt   | –    | 1.7  | 2    | ps   | f = 10 MHz, Vdd = 2.5V, 2.8V or 3.3V                           |
|                           |          | –    | 1.7  | 2    | ps   | f = 10 MHz, Vdd = 1.8V                                         |
| RMS Phase Jitter (random) | T_phj    | –    | 0.5  | 1    | ps   | f = 10 MHz, Integration bandwidth = 12 kHz to 20 MHz, All Vdds |

**Note:**

1. All electrical specifications in the above table are measured with 15pF output load, Contact SiTime for higher drive options.

### Pin Configuration

| Pin | Symbol                            | Functionality |                                                                                                                                                         |
|-----|-----------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | VC/OE/ $\overline{\text{ST}}$ /NC | V control     | Voltage control                                                                                                                                         |
|     |                                   | Output Enable | H or Open <sup>[2]</sup> : specified frequency output<br>L: output is high impedance. Only output driver is disabled.                                   |
|     |                                   | Standby       | H or Open <sup>[2]</sup> : specified frequency output<br>L: output is low (weak pull down). Device goes to sleep mode. Supply current reduces to I_std. |
|     |                                   | NC            | No connect (input receiver off)                                                                                                                         |
| 2   | GND                               | Power         | Electrical and case ground                                                                                                                              |
| 3   | CLK                               | Output        | Oscillator output                                                                                                                                       |
| 4   | VDD                               | Power         | Power supply voltage                                                                                                                                    |



**Note:**

2. A pull-up resistor of <10 k $\Omega$  between OE/ $\overline{\text{ST}}$  pin and Vdd is recommended in high noise environment when the device operates in OE/ $\overline{\text{ST}}$  mode.

### Absolute Maximum

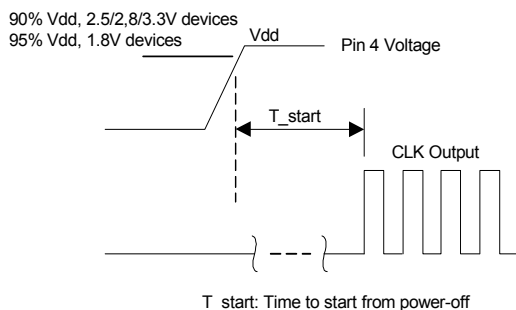
Attempted operation outside the absolute maximum ratings of the part may cause permanent damage to the part. Actual performance of the IC is only guaranteed within the operational specifications, not at absolute maximum ratings.

| Parameter                                                            | Min. | Max. | Unit |
|----------------------------------------------------------------------|------|------|------|
| Storage Temperature                                                  | -65  | 150  | °C   |
| VDD                                                                  | -0.5 | 4    | V    |
| Electrostatic Discharge                                              | –    | 2000 | V    |
| Soldering Temperature (follow standard Pb free soldering guidelines) | –    | 260  | °C   |

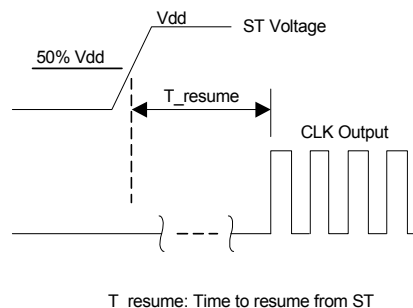
### Environmental Compliance

| Parameter                  | Condition/Test Method     |
|----------------------------|---------------------------|
| Mechanical Shock           | MIL-STD-883F, Method 2002 |
| Mechanical Vibration       | MIL-STD-883F, Method 2007 |
| Temperature Cycle          | JESD22, Method A104       |
| Solderability              | MIL-STD-883F, Method 2003 |
| Moisture Sensitivity Level | MSL1 @ 260°C              |

### Timing Diagram

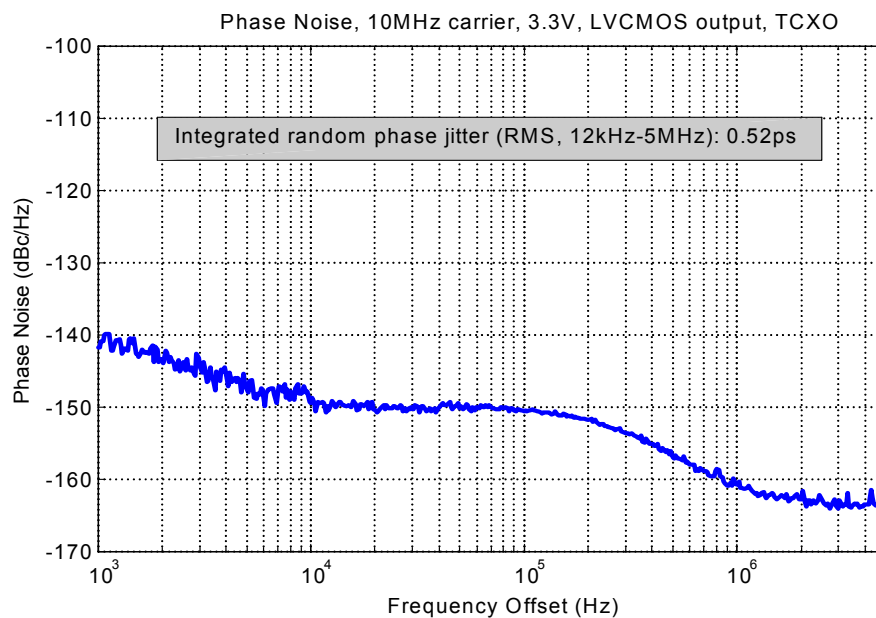


(ST/OE Mode)



(ST Mode Only)

### Phase Noise Plot



### SoftEdge™ Option

The SoftEdge™ output is available as a standard option for the SiT500x family of MEMS (VC)TCXOs. It is typically used for EMI reduction similar to that of the clipped sinewave output common to many quartz based TCXOs.

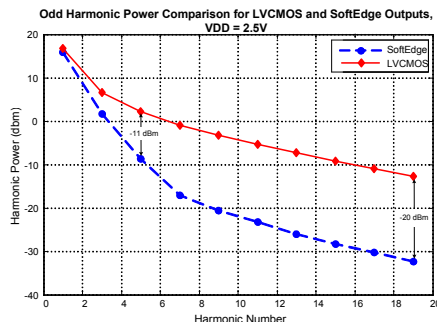
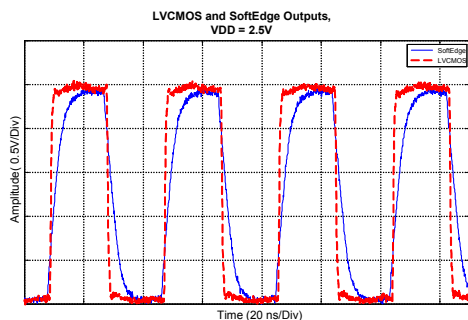
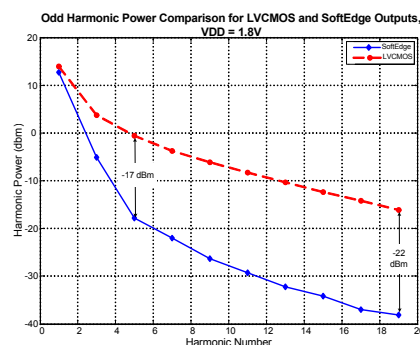
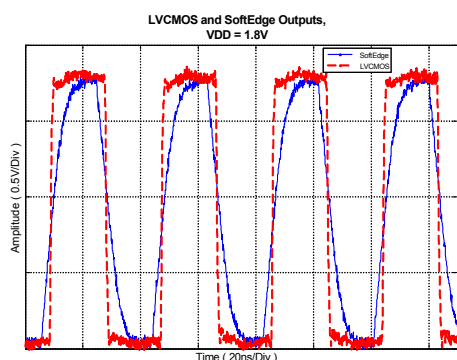
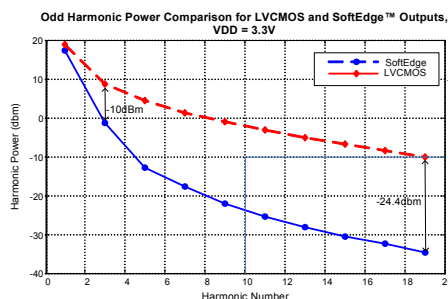
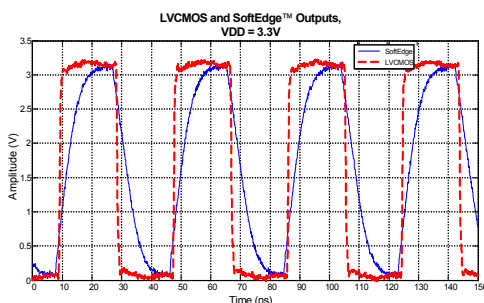
In the SoftEdge™ mode, the slower rise/fall edges of the output waveform reduce the higher clock harmonics in a digital clock signal, minimizing EMI radiation at these harmonics. The table below shows the actual rise/fall time in relation to the desired output frequency and the supply voltage with a 10 k $\Omega$  / 10pF load. Rail-to-rail swing of the output is maintained for these supported frequencies.

### Rise/Fall Time for SoftEdge™ Option

| Parameter      | Symbol | Min. | Typ. | Max. | Unit | Condition                                                     |
|----------------|--------|------|------|------|------|---------------------------------------------------------------|
| Rise/Fall Time | Tr, Tf | 4.0  | 6.5  | 9.5  | ns   | 1-26MHz, 1.8V, 3.0 and 3.3V, MHz 10k and 10 pF, 20%-80% Vd    |
|                |        | 2.5  | 4.0  | 6.0  | ns   | 1-26MHz, 2.5V and 2.8V, MHz 10k and 10 pF, 20%-80% Vdd        |
|                |        | 1.5  | 3.5  | 5.0  | ns   | 26-50MHz, 1.8V, 3.0V and 3.3V, MHz 10k and 10 pF, 20%-80% Vdd |
|                |        | 1.5  | 2.5  | 4.5  | ns   | 26-50 MHz, 2.5V and 2.8V, MHz 10k and 10 pF, 20%-80% Vdd      |

### SoftEdge™ Waveform Examples and Corresponding Harmonics Reduction

Figures below illustrate the harmonic power reduction as the rise/fall times are slowed from the standard squarewave output to that of the SoftEdge™ output. In general, the 1.8V device shows the lowest harmonics and provides best EMI performance comparing to devices with higher operating voltages.



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### Dimensions and Patterns

| Package Size – Dimensions (Unit: mm) <sup>[3]</sup>                             | Recommended Land Pattern (Unit: mm) <sup>[4]</sup> |
|---------------------------------------------------------------------------------|----------------------------------------------------|
| <p><b>2.7 x 2.4 x 0.75 mm (100% compatible with 2.5 x 2.0 mm footprint)</b></p> |                                                    |
| <p><b>3.2 x 2.5 x 0.75 mm</b></p>                                               |                                                    |
| <p><b>5.0 x 3.2 x 0.75 mm</b></p>                                               |                                                    |
| <p><b>7.0 x 5.0 x 0.90 mm</b></p>                                               |                                                    |

#### Notes:

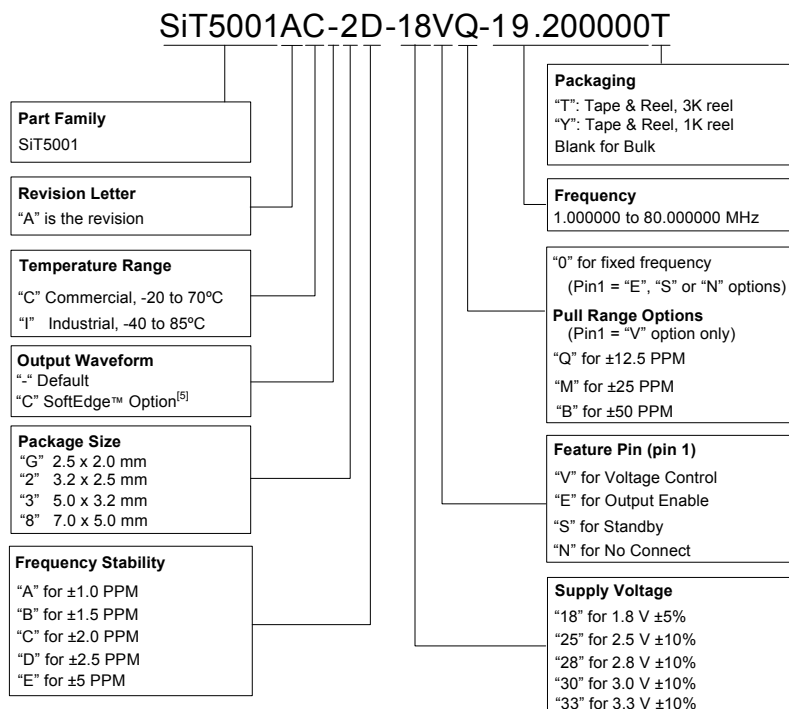
3. Top marking: Y denotes manufacturing origin and XXXX denotes manufacturing lot number. The value of "Y" will depend on the assembly location of the device.
4. A capacitor of value 0.1  $\mu$ F between Vdd and GND is recommended.

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## 1-80 MHz MEMS TCXO and VCTCXO

### Ordering Information

The Part No. Guide is for reference only. To customize and build an exact part number, use the SiTime [Part Number Generator](#).



**Note:**

5. SiTime's SoftEdge™ output waveform with 6 ns rise/fall time reduces EMI and is similar to clipped sine wave in functionality.

### Frequency Stability vs. Temperature Range Options

| Frequency Stability (PPM) | Temperature Range |                  |
|---------------------------|-------------------|------------------|
|                           | C (-20 to +70°C)  | I (-40 to +85°C) |
| ±5                        | ✓                 | ✓                |
| ±2.5                      | ✓                 | ✓                |
| ±2                        | ✓                 | ✓                |
| ±1.5                      | ✓                 | Contact SiTime   |
| ±1                        | Contact SiTime    | Contact SiTime   |

# SiT5001

## 1-80 MHz MEMS TCXO and VCTCXO



### Additional Information

| Document                      | Description                                                                                              | Download Link                                                                                                                                                                                                     |
|-------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Manufacturing Notes</b>    | Tape & Reel dimension, reflow profile and other manufacturing related info                               | <a href="http://www.sitime.com/component/docman/doc_download/85-manufacturing-notes-for-sitime-oscillators">http://www.sitime.com/component/docman/doc_download/85-manufacturing-notes-for-sitime-oscillators</a> |
| <b>Qualification Reports</b>  | RoHS report, reliability reports, composition reports                                                    | <a href="http://www.sitime.com/support/quality-and-reliability">http://www.sitime.com/support/quality-and-reliability</a>                                                                                         |
| <b>Performance Reports</b>    | Additional performance data such as phase noise, current consumption and jitter for selected frequencies | <a href="http://www.sitime.com/support/performance-measurement-report">http://www.sitime.com/support/performance-measurement-report</a>                                                                           |
| <b>Termination Techniques</b> | Termination design recommendations                                                                       | <a href="http://www.sitime.com/support/application-notes">http://www.sitime.com/support/application-notes</a>                                                                                                     |
| <b>Layout Techniques</b>      | Layout recommendations                                                                                   | <a href="http://www.sitime.com/support/application-notes">http://www.sitime.com/support/application-notes</a>                                                                                                     |

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#### Как с нами связаться

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