# PRODUCT SPECIFICATION SHEET




| | | | |
|---|---|---|---|
| **Customer** | | | |
| **Customer P/N** | TBA | | |
| **Product Type** | Temperature Compensated Crystal Oscillator | | |
| **Part Number** | 1T384H1001 | **Version** | S1 |
| **Part Description** | SMD TCXO 1.6 x 1.2 | | |
| **Nominal Frequency** | 38.400000MHz | | |

| | |
|---|---|
| **Prepared** | Kuro Peng |
| **Reviewed** | Kuro Peng |
| **Approved** | Jay Lee |
| **Date** | 2020/3/12 |

**Customer's Approval & Date：**

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RoHS COMPLIANT

Pb Lead-Free

**Moisture Sensitivity Level 1**

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## 1. History of Specification Revision

| Ver. | Contents | Date | Reviser | Remark |
|---|---|---|---|---|
| S0 | Initial released | 2020/2/19 | Kuro Peng | |
| S1 | Add parameters to Electrical Specifications | 2020/3/12 | Kuro Peng | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## 2. Electrical Specifications

### 2.1 Operation conditions

| # | Parameters | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| 1 | Nominal frequency | | 38.400000 | | MHz | |
| 2 | Supply voltage 1 ($V_{CC}$) | 1.71 | 1.8 | 1.89 | V | Normal operation condition |
| 3 | Supply voltage 2 ($V_{CC}$) | 2.66 | 2.8 | 2.94 | V | Operable condition |
| 4 | Current consumption | | | 2.0 | mA | |
| 5 | Operating temperature range | -40 | | 85 | ℃ | |
| 6 | Storage temperature range | -40 | | 85 | ℃ | |

### 2.2 Output characteristics

| # | Parameters | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| 1 | Output type | | Clipped sine wave | | - | |
| 2 | Standard output load | | 10 KΩ//10 pF | | - | ±10% load variation |
| 3 | Output level | 0.9 | | | $V_{pp}$ | |
| 4 | Duty cycle | 40 | 50 | 60 | % | |
| 5 | Spurious suppression | | | 5 | dBc | |
| 6 | Start-up time | | 2 | 5.0 | ms | See Note 1. |

### 2.3 Frequency stability characteristics

| # | Parameters | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| 1 | Nominal frequency | | 38.4 | | MHz | |
| 2 | Initial frequency tolerance | -1.5 | - | +1.5 | ppm | At 25±2°C after 2 times reflow, refer to nominal frequency |
| 3 | Frequency stability vs. temperature | -0.5 | - | +0.5 | ppm | Refer to frequency at 25°C within operating temperature range |
| 4 | Frequency slope vs. temperature 1 | -0.1 | - | +0.1 | ppm/°C | From -40 to -10°C. |
| 5 | Frequency slope vs. temperature 2 | -0.05 | - | +0.05 | ppm/°C | From -10 to 65°C. |
| 6 | Frequency slope vs. temperature 3 | -0.1 | - | +0.1 | ppm/°C | From 65 to 85°C. |
| 7 | Frequency stability vs. supply voltage | -0.2 | - | +0.2 | ppm | ±5% $V_{cc}$ variation. |
| 8 | Frequency stability vs. load variation | -0.2 | - | +0.2 | ppm | ±10% load variation. |
| 9 | Frequency slope vs. load variation | -0.02 | - | 0.02 | ppm/pF | ±0.25pF load variation. |
| 10 | Frequency drift under quick temperature variation 1 | -10 | - | +10 | ppb/s | From -40 to 10°C. See note 2, 3, and 4. |
| 11 | Frequency drift under quick temperature variation 2 | -5 | - | +5 | ppb/s | From -10 to 65°C. See note 2, 3, and 4. |
| 12 | Frequency drift under quick temperature variation 3 | -10 | - | +10 | ppb/s | From 65 to 85°C. See note 2, 3, and 4. |

## 2. Electrical Specifications (Cont.)

### 2.3 Frequency stability characteristics (Cont.)

| # | Parameters | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| 13 | Aging over 1st year | -1.0 | - | +1.0 | ppm | |
| 14 | Aging over 3 years | -2.0 | - | +2.0 | ppm | |
| 15 | Aging over 5 years | -3.0 | - | +3.0 | ppm | |

### 2.4 Phase noise and jitter characteristic

| # | Parameters | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| 1 | Phase noise at 1Hz offset | - | - | -56 | dBc/Hz | At 25±2°C. |
| 2 | Phase noise at 10Hz offset | - | - | -88 | dBc/Hz | At 25±2°C. |
| 3 | Phase noise at 100Hz offset | - | - | -115 | dBc/Hz | At 25±2°C. |
| 4 | Phase noise at 1kHz offset | - | - | -135 | dBc/Hz | At 25±2°C. |
| 5 | Phase noise at 10kHz offset | - | - | -150 | dBc/Hz | At 25±2°C. |
| 6 | Phase noise at 100kHz offset | - | - | -157 | dBc/Hz | At 25±2°C. |
| 7 | Phase noise at 1MHz offset | - | - | -157 | dBc/Hz | At 25±2°C. |
| 8 | Jitter | - | - | 7 | ps-rms | From 10 Hz to 1 MHz. |

### 2.5 Notes for testing condition

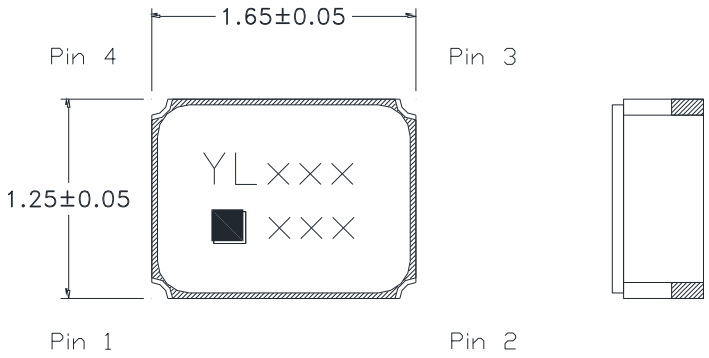
| # | Description |
|---|---|
| Note 1 | Time for 90% $V_{CC}$ to correct output frequency. |
| Note 2 | Temperature slew rate 0.15°C/second. |
| Note 3 | Sampling interval 1 second. |
| Note 4 | Testing setup for temperature stability test.   |

## 3. Product Design

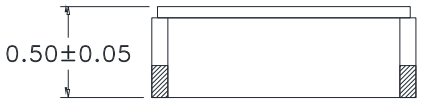
### 3.1 Package dimensions and pad functions

Top view

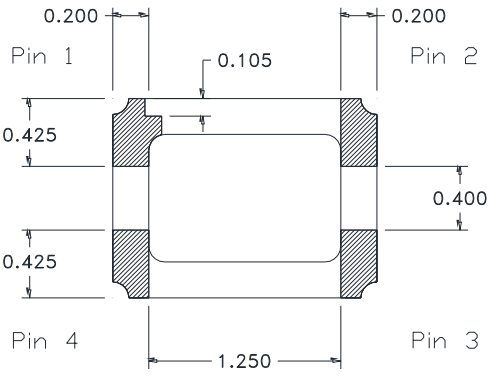
Unit : mm




Lateral view

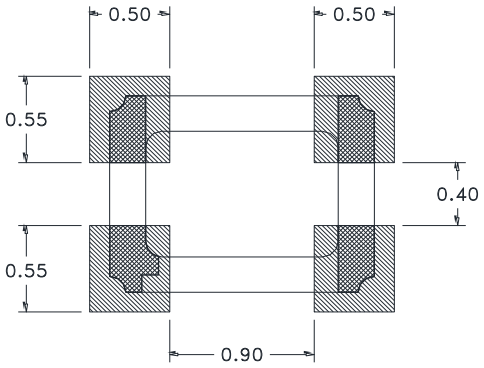



Bottom view



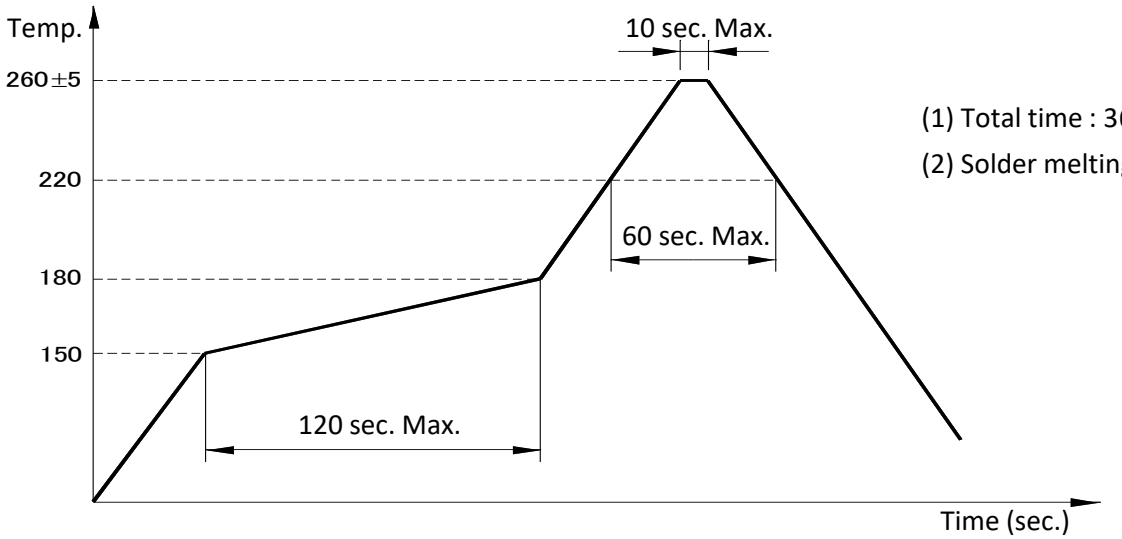

Unit : mm

### 3.2 Recommended land pattern




| Pad | Function | Symbol |
|---|---|---|
| 1 | Ground | GND |
| 2 | Ground | GND |
| 3 | Output | OUT |
| 4 | Supply voltage | $V_{CC}$ |

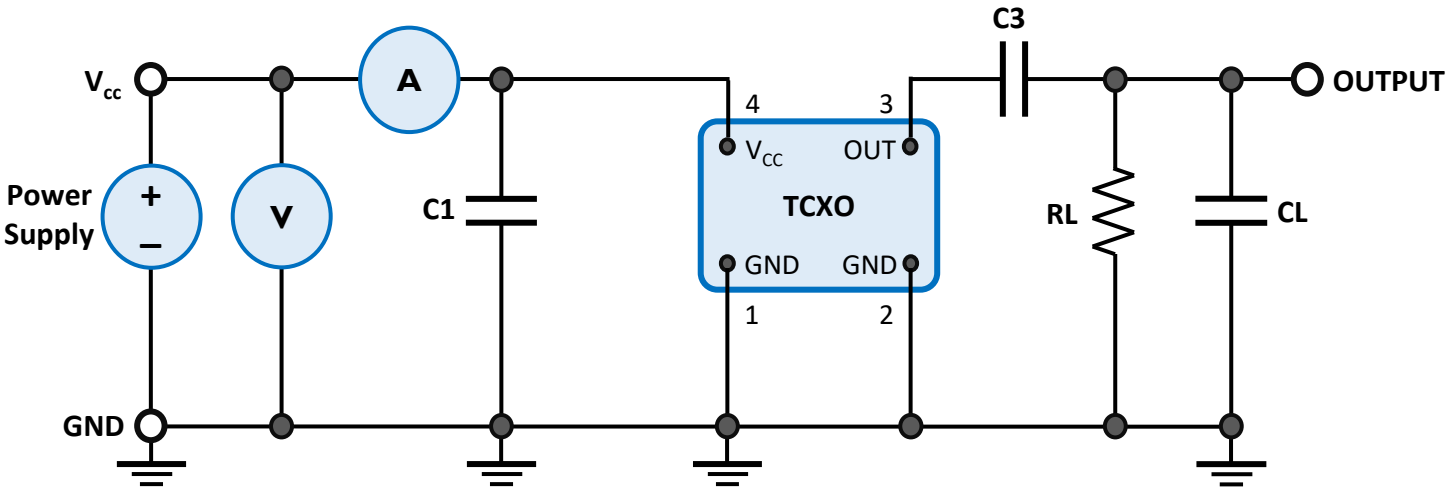
### 3.3 Recommended reflow profile




(1) Total time : 360 sec. Max.

(2) Solder melting point : 225℃

## 4. Testing Circuit




External Components:

| Parts | Function | Recommended |
|---|---|---|
| C1 | AC noise bypass for $V_{CC}$ | 10nF |
| C3 | DC block for output | 10nF |
| RL | Load resistance | 10KΩ |
| CL | Load capacitance | 10pF |

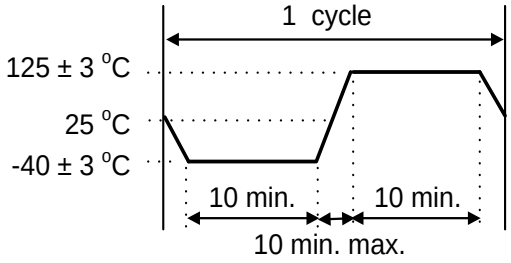
## 5. Reliability

### 5.1 Mechanical endurance

| # | Item | Test Condition | Reference |
|---|---|---|---|
| 1 | Drop test | Height : 150 cm height<br>Direction : fall freely<br>Test cycles : 3 cycles<br>Stainless plate | JIS C6701 |
| 2 | Shock test | Height : 150 cm height<br>Direction : X, Y, Z, 6 directions<br>Test cycles : 3 cycles<br>Concrete floor<br>Mounting on test fixture (total weight=150 g) | IEC-68-02-27 |
| 3 | Mechanical shock | Acceleration : 1000 g<br>Duration : 1.0 ms<br>Test cycles : 3 times for all 3 directions | MIL-STD-202F |
| 4 | Vibration | Acceleration : 20 g<br>Duration : 4 hours/each direction<br>Frequency range : 10 ~ 55 Hz<br>Amplitude : 1.52 mm<br>Direction : X, Y, Z, 3 directions<br>Sweep speed : 20 minutes/cycle | MIL-STD-883E |
| 5 | Gross Leak | Standard Sample For Automatic Gross Leak Detector.<br>Test Pressure: 2kg /$cm^2$ | MIL-STD-883E |
| 6 | Fine Leak | Helium bombing 4.5 kgf / cm2 for 2 hours | MIL-STD-883E |
| 7 | Solderability | Preheated temperature : 125°C ± 5°C<br>Preheated time : 120 sec<br>Soldering temperature : 245°C ± 5°C<br>Duration : 5 ± 1 second<br>Method : Solder bath method | MIL-STD-883E |

## 5. Reliability (Cont.)

### 5.2 Environmental endurance

| # | Item | Test Condition | Reference |
|---|---|---|---|
| 1 | High temperature storage | Temperature : +125°C ± 3°C<br>Duration : 168 hours | MIL-STD-883E |
| 2 | Low temperature storage | Temperature : -40°C ± 3°C<br>Duration : 500 hours | MIL-STD-883E |
| 3 | Thermal shock<br>(Air to Air) | Total 100 cycles of the following temperature cycle<br> | MIL-STD-883E |
| 4 | High temperature & humidity | Temperature : 85°C ± 3°C<br>Humidity: RH 85%<br>Duration : 168 hours | JIS C5023 |
| 5 | Aging | Temperature : 85°C ± 3°C<br>Duration : 500 hours<br>Voltage input by specification | JESD22-A108 |