Transko
Cal Crystal Comclok

# TMH

RoHS Compliant

## MEMS HIGH FREQUENCY OSCILLATOR

### ■ FEATURES

- Output frequency from 80M~220MHz
- Low phase jitter : 0.5ps (12KHz to 20MHz)
- LVCMOS/HCMOS outputs
- Industry-standard packages: 2.5x2.0, 3.2x2.5, 5.0x3.2, 7.0x5.0
- RoHS and REACH compliant

### ■ APPLICATIONS

- 10G Ethernet, SONET, Networking
- SATA, SAS, Storage, PCI-Express
- Telecom, Industrial Control

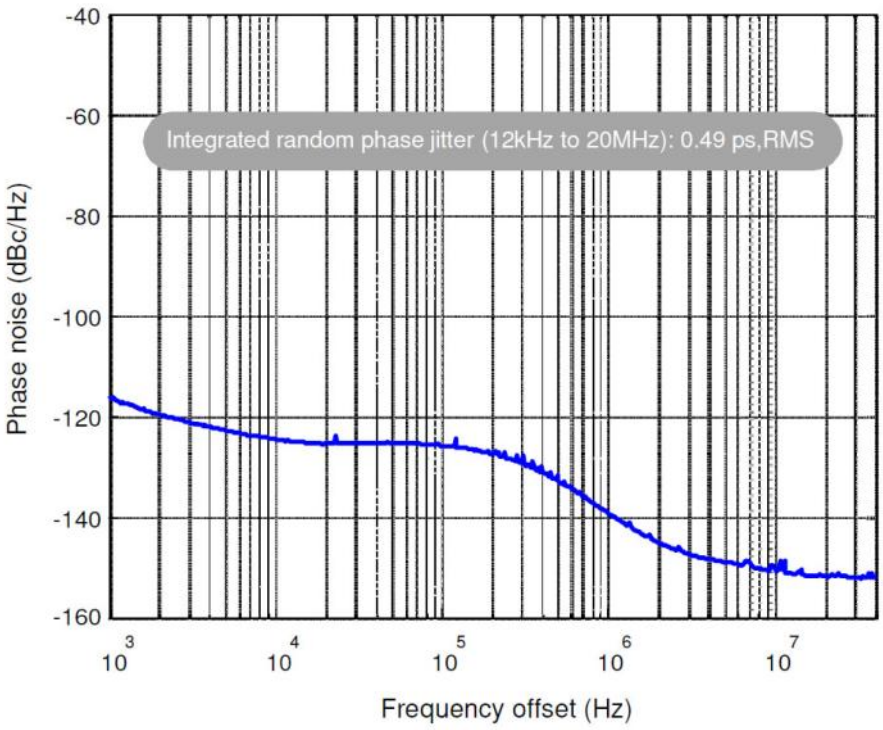
### ■ ELECTRICAL CHARACTERISTICS

| Parameters | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| **Frequency Range** | | | | | | |
| Output Frequency Range | f | 80 | – | 220 | MHz | |
| **Frequency Stability and Aging** | | | | | | |
| Frequency Stability | F_stab | -10 | – | +10 | ppm | Inclusive of initial tolerance at 25°C, 1st year aging at 25°C, and variations over operating temperature, rated power supply voltage and load. |
| | | -20 | – | +20 | ppm | |
| | | -25 | – | +25 | ppm | |
| | | -50 | – | +50 | ppm | |
| First Year Aging | F_aging | -1.5 | - | +1.5 | Ppm | @ 25°C |
| 10 Year Aging | | -5 | - | +5 | ppm | |
| **Operating Temperature Range** | | | | | | |
| Operating Temperature Range | T_use | -20 | – | +70 | °C | Extended Commercial |
| | | -40 | – | +85 | °C | Industrial |
| **Supply Voltage and Current Consumption** | | | | | | |
| Supply Voltage | Vdd | 1.71 | 1.8 | 1.89 | V | |
| | | 2.25 | 2.5 | 2.75 | V | |
| | | 2.52 | 2.8 | 3.08 | V | |
| | | 2.97 | 3.3 | 3.63 | V | |
| Current Consumption | Idd | – | 34 | 36 | mA | No load condition, f = 100 MHz, Vdd = 2.5V, 2.8V, 3.3V |
| | | – | 30 | 33 | mA | No load condition, f = 100 MHz, Vdd = 1.8V |
| OE Disable Current | I_OD | – | – | 31 | mA | Vdd = 2.5V, 2.8V, 3.3V, OE = GND, Output is weakly pulled down |
| | | – | – | 30 | mA | Vdd = 1.8V, OE = GND, Output is weakly pulled down |
| Standby Current | I_std | – | - | 70 | µA | $\overline{ST}$ = GND, Vdd = 2.5V, 2.8V, 3.3V, Output is weakly pulled down |
| | | – | - | 10 | µA | $\overline{ST}$ = GND, Vdd = 1.8V, Output is weakly pulled down |
| **LVCMOS Output Characteristics** | | | | | | |
| Duty Cycle | DC | 45 | – | 55 | % | All Vdds. f <= 165MHz |
| | | 40 | – | 60 | % | All Vdds. f > 165MHz |
| Rise/Fall Time | Tr, Tf | – | 1.2 | 2 | ns | 15pF load, 10% - 90% |
| Output High Voltage | VOH | 90% | – | – | Vdd | IOH = -6 mA, IOL = 6 mA, (Vdd = 3.3V, 2.8V, 2.5V)<br>IOH = -3 mA, IOL = 3 mA, (Vdd = 1.8V) |
| Output Low Voltage | VOL | – | – | 10% | Vdd | |
| **Input Characteristics** | | | | | | |
| Input High Voltage | VIH | 70% | – | – | Vdd | Pin 1, OE or $\overline{ST}$ |
| Input Low Voltage | VIL | – | – | 30% | Vdd | Pin 1, OE or $\overline{ST}$ |
| Input Pull-up Impedance | Z_in | | 100 | 250 | kΩ | Pin 1, OE logic high or logic low, or $\overline{ST}$ logic high |
| | | 2 | – | – | MΩ | Pin 1, $\overline{ST}$ logic low |
| **Startup and Resume Timing** | | | | | | |
| Startup Time | T_start | – | 7 | 10 | ms | Measured from the time Vdd reaches its rated minimum value |
| Enable/Disable Time | T_oe | – | – | 115 | ns | f = 80 MHz. For other frequencies, T_oe = 100 ns + 3 cycles |
| Resume Time | T_resume | – | – | 10 | ms | Measured from the time $\overline{ST}$ pin crosses 50% threshold |
| **Jitter** | | | | | | |
| RMS Period Jitter | T_jitt | – | 1.5 | 2 | ps | f = 156.25MHz, Vdd = 2.5V, 2.8V, or 3.3V |
| | | – | 2 | 3 | ps | f = 156.25MHz, Vdd = 1.8V |
| RMS Phase Jitter (random) | T_phj | – | 0.5 | 1 | ps | f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz |

- All Min and Max limits are specified over temperature and rated operating voltage with 15 pF output load unless otherwise stated.
- Typical values are at 25°C and nominal supply voltage.

## ■ TYPICAL PHASE NOISE

156.25MHz, 3.3V LVCMOS




## ■ ABSOLUTE MAXIMUM LIMITS

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

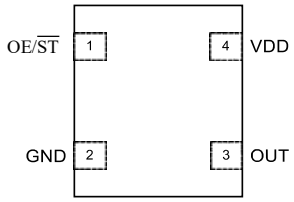
| Parameter | Min. | Max. | Unit |
|---|---|---|---|
| Storage Temperature | -65 | 150 | °C |
| Vdd | -0.5 | 4 | V |
| Electrostatic Discharge | – | 2000 | V |
| Soldering Temperature (follow standard Pb free soldering guidelines) | – | 260 | °C |
| Junction Temperature | – | 150 | °C |

## ■ PIN DESCRIPTION

| Pin | Symbol | | Function |
|---|---|---|---|
| 1 | OE/$\overline{ST}$ | Output Enable | H or OPEN[1]: specified frequency output<br>L: output is high impedance. Only output driver is disabled. |
| | | Standby | H or OPEN[1]: specified frequency output<br>L: output is low (weak pull down). Device goes to sleep mode.<br>Supply current reduces to I_std. |
| 2 | GND | Power | Electrical ground[2] |
| 3 | OUT | Output | Oscillator output |
| 4 | VDD | Power | Power supply voltage[2] |

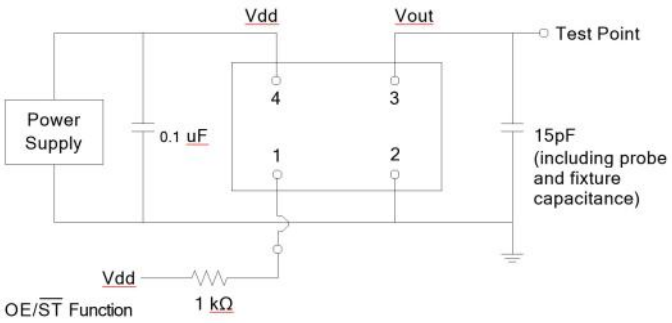
## ■ PIN ASSIGNMENTS

TOP VIEW

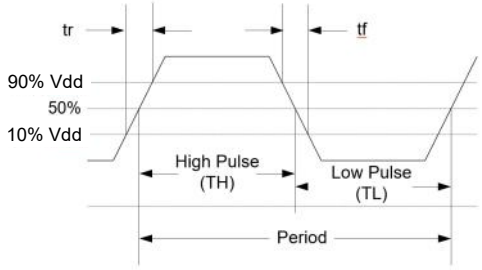



1. A pull-up resistor of <10 kΩ between OE/ ST pin and Vdd is recommended in high noise environment.
2. A capacitor of value 0.1 µF or higher between Vdd and GND is required

## ■ TEST CIRCUIT



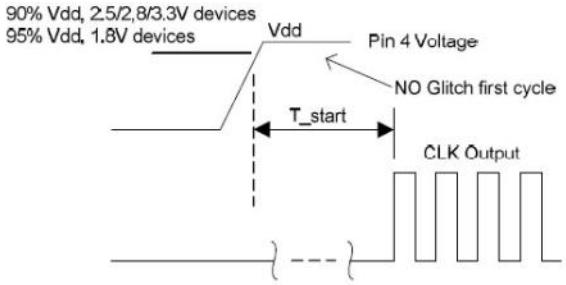

## ■ WAVEFORM




Duty Cycle is computed as Duty Cycle = TH/Period.

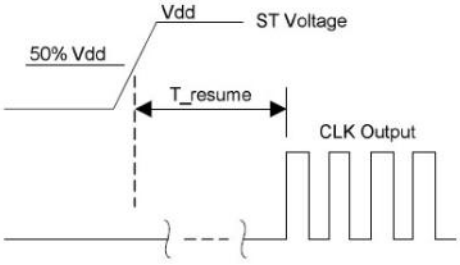
## ■ TIMING DIAGRAMS

### Startup Timing (OE / $\overline{ST}$ Mode)



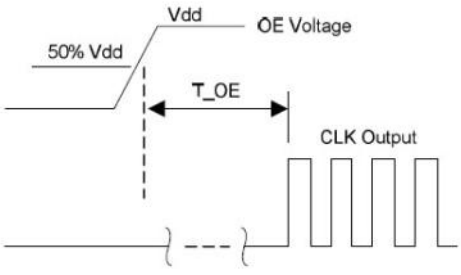

T_start: Time to start from power-off

### Standby Resume Timing ( $\overline{ST}$ Mode Only)



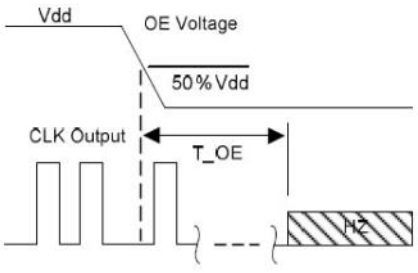

T_resume: Time to resume from ST

### OE Enable Timing (OE Mode Only)




T_OE: Time to re-enable the clock output

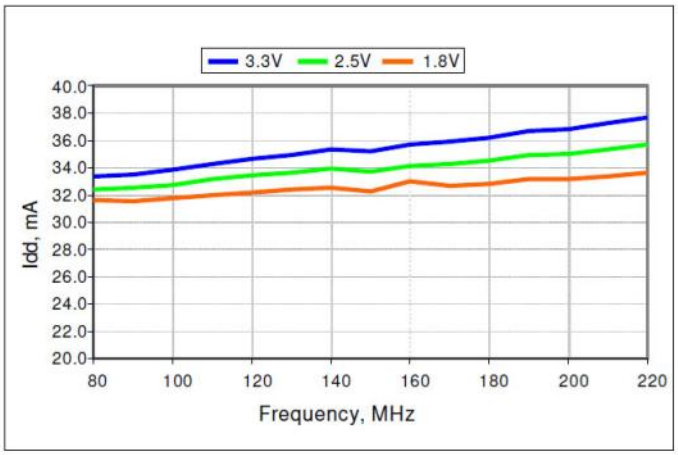
### OE Disable Timing (OE Mode Only)



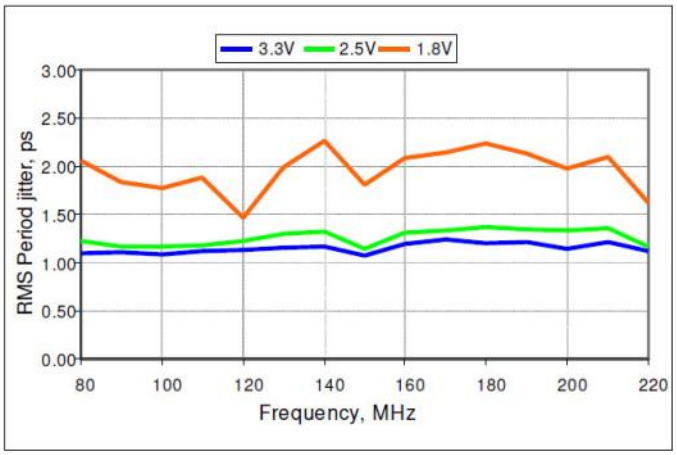

T_OE: Time to put the output drive in High Z mode

## ■ PERFORMANCE PLOTS

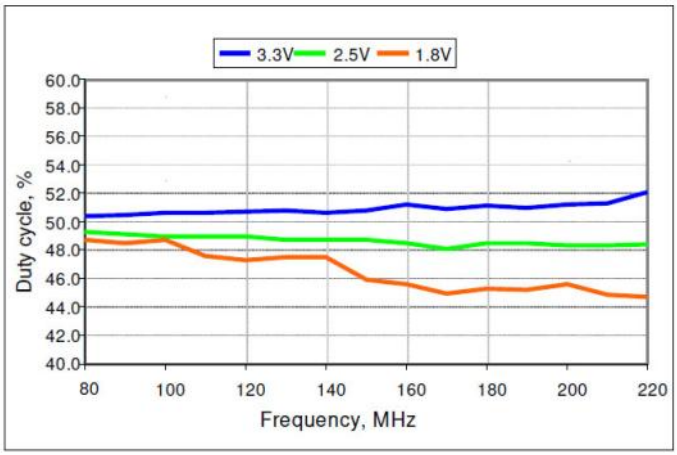
All plots are measured with 15 pF load at room temperature, unless otherwise stated.



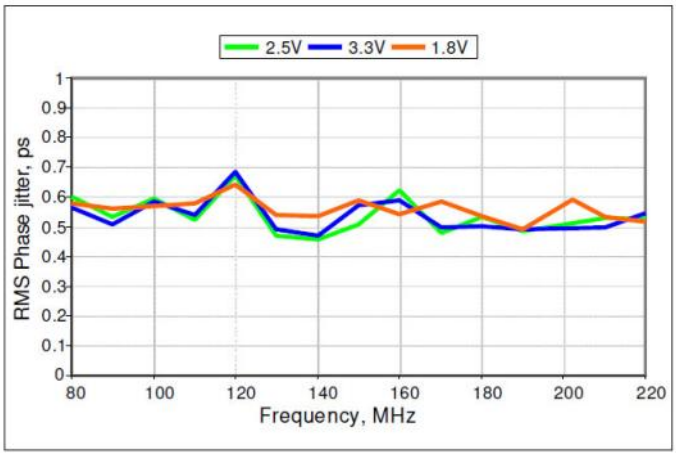

**Idd vs Frequency**



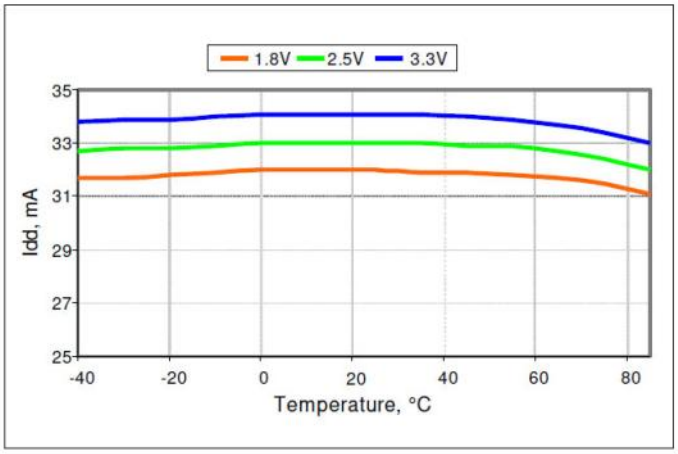

**RMS Period Jitter vs Frequency**



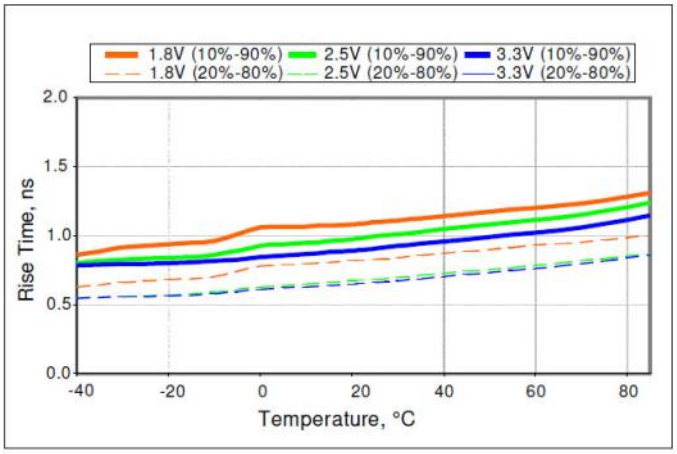

**Duty Cycle vs Frequency**




**RMS Phase Jitter vs Frequency**




**Idd vs Temperature, 100MHz Output**




**Rise Time vs Temperature 100MHz Output**

## ■ OUTPUT DRIVE STRENGTH—RISE / FALL TIME OPTIONS

| Rise/Fall Time Typ (ns) Vdd = 1.8V | | | | | |
|---|---|---|---|---|---|
| Drive Strength \ CLOAD | 5 pF | 15 pF | 30 pF | 45 pF | 60 pF |
| L | 12.45 | 17.68 | 19.48 | 46.21 | 57.82 |
| A | 6.50 | 10.27 | 16.21 | 23.92 | 30.73 |
| R | 4.38 | 7.05 | 11.61 | 16.17 | 20.83 |
| B | 3.27 | 5.30 | 8.89 | 12.18 | 15.75 |
| S | 2.62 | 4.25 | 7.20 | 9.81 | 12.65 |
| D | 2.19 | 3.52 | 6.00 | 8.31 | 10.59 |
| T | 1.76 | 3.01 | 5.14 | 7.10 | 9.15 |
| E | 1.59 | 2.59 | 4.49 | 6.25 | 7.98 |
| U | 1.49 | 2.28 | 3.96 | 5.55 | 7.15 |
| F | 1.22 | 2.10 | 3.57 | 5.00 | 6.46 |
| W | 1.07 | 1.88 | 3.23 | 4.50 | 5.87 |
| G | 1.01 | 1.64 | 2.95 | 4.12 | 5.40 |
| X | 0.96 | 1.50 | 2.74 | 3.80 | 4.98 |
| K | 0.92 | 1.41 | 2.56 | 3.52 | 4.64 |
| Y | 0.88 | 1.34 | 2.39 | 3.25 | 4.32 |
| Q | 0.86 | 1.29 | 2.24 | 3.04 | 4.06 |
| Z or "-": Default | 0.82 | 1.24 | 2.07 | 2.89 | 3.82 |
| M | 0.77 | 1.20 | 1.94 | 2.72 | 3.61 |
| N | 0.66 | 1.15 | 1.84 | 2.58 | 3.41 |
| P | 0.51 | 1.09 | 1.76 | 2.45 | 3.24 |

| Rise/Fall Time Typ (ns) Vdd = 2.5V | | | | | |
|---|---|---|---|---|---|
| Drive Strength \ CLOAD | 5 pF | 15 pF | 30 pF | 45 pF | 60 pF |
| L | 8.68 | 13.59 | 18.36 | 32.70 | 42.06 |
| A | 4.42 | 7.18 | 11.93 | 16.60 | 21.38 |
| R | 2.93 | 4.78 | 8.15 | 11.19 | 14.59 |
| B | 2.21 | 3.57 | 6.19 | 8.55 | 11.04 |
| S | 1.67 | 2.87 | 4.94 | 6.85 | 8.80 |
| D | 1.50 | 2.33 | 4.11 | 5.68 | 7.33 |
| T | 1.06 | 2.04 | 3.50 | 4.84 | 6.26 |
| E | 0.98 | 1.69 | 3.03 | 4.20 | 5.51 |
| U | 0.93 | 1.48 | 2.69 | 3.73 | 4.92 |
| F | 0.90 | 1.37 | 2.44 | 3.34 | 4.42 |
| W | 0.87 | 1.29 | 2.21 | 3.04 | 4.02 |
| G or "-": Default | 0.67 | 1.20 | 2.00 | 2.79 | 3.69 |
| X | 0.44 | 1.10 | 1.86 | 2.56 | 3.43 |
| K | 0.38 | 0.99 | 1.76 | 2.37 | 3.18 |
| Y | 0.36 | 0.83 | 1.66 | 2.20 | 2.98 |
| Q | 0.34 | 0.71 | 1.58 | 2.07 | 2.80 |
| Z | 0.33 | 0.65 | 1.51 | 1.95 | 2.65 |
| M | 0.32 | 0.62 | 1.44 | 1.85 | 2.50 |
| N | 0.31 | 0.59 | 1.37 | 1.77 | 2.39 |
| P | 0.30 | 0.57 | 1.29 | 1.70 | 2.28 |

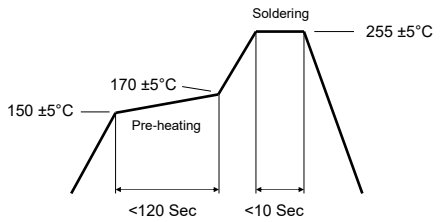
| Rise/Fall Time Typ (ns) Vdd = 2.8V | | | | | |
|---|---|---|---|---|---|
| Drive Strength \ CLOAD | 5 pF | 15 pF | 30 pF | 45 pF | 60 pF |
| L | 7.93 | 12.69 | 17.94 | 30.10 | 38.89 |
| A | 4.06 | 6.66 | 11.04 | 15.31 | 19.80 |
| R | 2.68 | 4.40 | 7.53 | 10.29 | 13.37 |
| B | 2.00 | 3.25 | 5.66 | 7.84 | 10.11 |
| S | 1.59 | 2.57 | 4.54 | 6.27 | 8.07 |
| D | 1.19 | 2.14 | 3.76 | 5.21 | 6.72 |
| T | 1.00 | 1.79 | 3.20 | 4.43 | 5.77 |
| E | 0.94 | 1.51 | 2.78 | 3.84 | 5.06 |
| U | 0.90 | 1.38 | 2.48 | 3.40 | 4.50 |
| F | 0.87 | 1.29 | 2.21 | 3.03 | 4.05 |
| W | 0.62 | 1.19 | 1.99 | 2.76 | 3.68 |
| G or "-": Default | 0.41 | 1.08 | 1.84 | 2.52 | 3.36 |
| X | 0.37 | 0.96 | 1.72 | 2.33 | 3.15 |
| K | 0.35 | 0.78 | 1.63 | 2.15 | 2.92 |
| Y | 0.33 | 0.67 | 1.54 | 2.00 | 2.75 |
| Q | 0.32 | 0.63 | 1.46 | 1.89 | 2.57 |
| Z | 0.31 | 0.60 | 1.39 | 1.80 | 2.43 |
| M | 0.30 | 0.57 | 1.31 | 1.72 | 2.30 |
| N | 0.30 | 0.56 | 1.22 | 1.63 | 2.22 |
| P | 0.29 | 0.54 | 1.13 | 1.55 | 2.13 |

| Rise/Fall Time Typ (ns) Vdd = 3.3V | | | | | |
|---|---|---|---|---|---|
| Drive Strength \ CLOAD | 5 pF | 15 pF | 30 pF | 45 pF | 60 pF |
| L | 7.18 | 11.59 | 17.24 | 27.57 | 35.57 |
| A | 3.61 | 6.02 | 10.19 | 13.98 | 18.10 |
| R | 2.31 | 3.95 | 6.88 | 9.42 | 12.24 |
| B | 1.65 | 2.92 | 5.12 | 7.10 | 9.17 |
| S | 1.43 | 2.26 | 4.09 | 5.66 | 7.34 |
| D | 1.01 | 1.91 | 3.38 | 4.69 | 6.14 |
| T | 0.94 | 1.51 | 2.86 | 3.97 | 5.25 |
| E | 0.90 | 1.36 | 2.50 | 3.46 | 4.58 |
| U | 0.86 | 1.25 | 2.21 | 3.03 | 4.07 |
| F or "-": Default | 0.48 | 1.15 | 1.95 | 2.72 | 3.65 |
| W | 0.38 | 1.04 | 1.77 | 2.47 | 3.31 |
| G | 0.36 | 0.87 | 1.66 | 2.23 | 3.03 |
| X | 0.34 | 0.70 | 1.56 | 2.04 | 2.80 |
| K | 0.33 | 0.63 | 1.48 | 1.89 | 2.61 |
| Y | 0.32 | 0.60 | 1.40 | 1.79 | 2.43 |
| Q | 0.32 | 0.58 | 1.31 | 1.69 | 2.28 |
| Z | 0.30 | 0.56 | 1.22 | 1.62 | 2.17 |
| M | 0.30 | 0.55 | 1.12 | 1.54 | 2.07 |
| N | 0.30 | 0.54 | 1.02 | 1.47 | 1.97 |
| P | 0.29 | 0.52 | 0.95 | 1.41 | 1.90 |

## ■ ENVIRONMENTAL COMPLIANCE

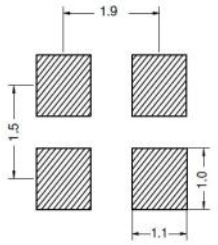
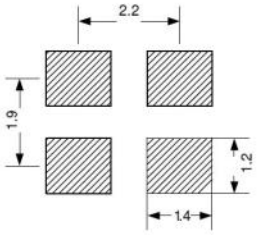
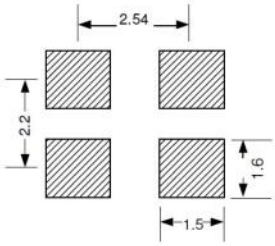
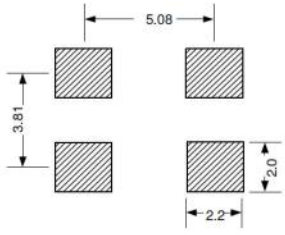
| Parameter | Condition / Test Method |
|---|---|
| Mechanical Shock | MIL-STD-883F, Method2002 |
| Mechanical Vibration | MIL-STD-883F, Method 2007 |
| Temperature Cycle | JESD22, Method A104 |
| Solderability | MIL-STD-883F, Method2003 |
| Moisture Sensitivity Level | MSL1 @ 260°C |

## ■ REFLOW PROFILE




*Note: Consult factory for detail*

## ■ PACKAGE OPTIONS / LAND PATTERN (Unit:mm)

| | | |
|---|---|---|
| PACKAGE 22 | 2.7 x 2.4 x 0.75 mm (100% compatible with 2.5 x 2. 0 mm footprint) |  |
| PACKAGE 32 | 3.2 x 2.5 x 0.75 mm |  |
| PACKAGE 53 | 5.0 x 3.2 x 0.75 mm |  |
| PACKAGE 75 | 7.0 x 5.0 x 0.90 mm |  |

**MARKING**

Y = FACTORY CODE
XXXX = LOT CODE
O = PIN 1 LOCATION

A capacitor of value 0.1 µF or higher between Vdd and GND is required.

**Transko Electronics, Inc.** 3981 E. Miraloma Ave. Anaheim, CA 92806 USA
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## ■ PART NUMBERING GUIDE