

## MEMS OSCILLATOR

### ■ FEATURES

- Output frequency from 1M~137MHz
- Low power consumption of 3.5 mA typical at 1.8V
- Available LVCMOS/HCMOS outputs
- Industry-standard packages: 2.0x1.6, 2.5x2.0, 3.2x2.5, 5.0x3.2, 7.0x5.0
- RoHS and REACH compliant, Pb-free, Halogen-free and Antimony-free

### ■ APPLICATIONS

- DSC, DVC, DVR, IP CAM, SSD, GPON, EPON, USB
- SATA, SAS, Firewire, 100M / 1G / 10G Ethernet
- Tablets, e-Books



### ■ ELECTRICAL CHARACTERISTICS

Parameters	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>Frequency Range</b>						
Output Frequency Range	f	1	–	137	MHz	
<b>Frequency Stability and Aging</b>						
Frequency Stability	F <sub>stab</sub>	-20	–	+20	ppm	Inclusive of initial tolerance at 25°C, 1 <sup>st</sup> year aging at 25°C, and variations over operating temperature, rated power supply voltage and load.
		-25	–	+25	ppm	
		-50	–	+50	ppm	
<b>Operating Temperature Range</b>						
Operating Temperature Range	T <sub>use</sub>	-20	–	+70	°C	Extended Commercial
		-40	–	+85	°C	Industrial
<b>Supply Voltage and Current Consumption</b>						
Supply Voltage	V <sub>dd</sub>	1.62	1.8	1.98	V	
		2.25	2.5	2.75	V	
		2.52	2.8	3.08	V	
		2.7	3.0	3.3	V	
		2.97	3.3	3.63	V	
		2.25	–	3.63	V	
Current Consumption	I <sub>dd</sub>	–	3.8	4.5	mA	No load condition, f = 20 MHz, V <sub>dd</sub> = 2.8V to 3.3V
		–	3.7	4.2	mA	No load condition, f = 20 MHz, V <sub>dd</sub> = 2.5V
		–	3.5	4.1	mA	No load condition, f = 20 MHz, V <sub>dd</sub> = 1.8V
OE Disable Current	I <sub>OD</sub>	–	–	4.2	mA	V <sub>dd</sub> = 2.5V to 3.3V, OE = GND, Output in high-Z state
		–	–	4.0	mA	V <sub>dd</sub> = 1.8V, OE = GND, Output in high-Z state
Standby Current	I <sub>std</sub>	–	2.1	4.3	μA	$\overline{ST}$ = GND, V <sub>dd</sub> = 2.8V to 3.3V, Output is weakly pulled down
		–	1.1	2.5	μA	$\overline{ST}$ = GND, V <sub>dd</sub> = 2.5V, Output is weakly pulled down
		–	0.2	1.3	μA	$\overline{ST}$ = GND, V <sub>dd</sub> = 1.8V, Output is weakly pulled down
<b>LVCMOS Output Characteristics</b>						
Duty Cycle	DC	45	–	55	%	All V <sub>dds</sub> . See Waveform figure
Rise/Fall Time	T <sub>r</sub> , T <sub>f</sub>	–	1	2	ns	V <sub>dd</sub> = 2.5V, 2.8V, 3.0V or 3.3V, 20% - 80%
		–	1.3	2.5	ns	V <sub>dd</sub> = 1.8V, 20% - 80%
		–	–	2	ns	V <sub>dd</sub> = 2.25V - 3.63V, 20% - 80%
Output High Voltage	VOH	90%	–	–	V <sub>dd</sub>	IOH = -4 mA (V <sub>dd</sub> = 3.0V or 3.3V) IOH = -3 mA (V <sub>dd</sub> = 2.8V and V <sub>dd</sub> = 2.5V) IOH = -2 mA (V <sub>dd</sub> = 1.8V)
Output Low Voltage	VOL	–	–	10%	V <sub>dd</sub>	IOL = 4 mA (V <sub>dd</sub> = 3.0V or 3.3V) IOL = 3 mA (V <sub>dd</sub> = 2.8V and V <sub>dd</sub> = 2.5V) IOL = 2 mA (V <sub>dd</sub> = 1.8V)
<b>Input Characteristics</b>						
Input High Voltage	V <sub>IH</sub>	70%	–	–	V <sub>dd</sub>	Pin 1, OE or $\overline{ST}$
Input Low Voltage	V <sub>IL</sub>	–	–	30%	V <sub>dd</sub>	Pin 1, OE or $\overline{ST}$
Input Pull-up Impedance	Z <sub>in</sub>	50	87	150	kΩ	Pin 1, OE logic high or logic low, or $\overline{ST}$ logic high
		2	–	–	MΩ	Pin 1, $\overline{ST}$ logic low
<b>Startup and Resume Timing</b>						
Startup Time	T <sub>start</sub>	–	–	5	ms	Measured from the time V <sub>dd</sub> reaches its rated minimum value
Enable/Disable Time	T <sub>oe</sub>	–	–	130	ns	f = 110 MHz. For other frequencies, T <sub>oe</sub> = 100 ns + 3 * cycles
Resume Time	T <sub>resume</sub>	–	–	5	ms	Measured from the time $\overline{ST}$ pin crosses 50% threshold
<b>Jitter</b>						
RMS Period Jitter	T <sub>jitt</sub>	–	1.8	3	ps	f = 75 MHz, V <sub>dd</sub> = 2.5V, 2.8V, 3.0V or 3.3V
		–	1.8	3	ps	f = 75 MHz, V <sub>dd</sub> = 1.8V
Peak-to-peak Period Jitter	T <sub>pk</sub>	–	12	25	ps	f = 75 MHz, V <sub>dd</sub> = 2.5V, 2.8V, 3.0V or 3.3V
		–	14	30	ps	f = 75 MHz, V <sub>dd</sub> = 1.8V
RMS Phase Jitter (random)	T <sub>phj</sub>	–	0.5	0.9	ps	f = 75 MHz, Integration bandwidth = 900 kHz to 7.5 MHz
		–	1.3	2	ps	f = 75 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.

## ■ ABSOLUTE MAXIMUM LIMITS

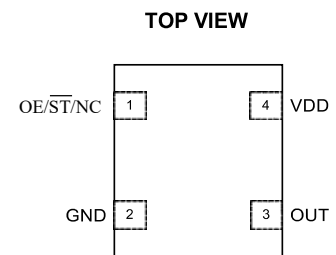
Attempted operation outside the absolute maximum ratings may cause permanent damage to the part. Actual performance of the IC is only guaranteed within the operational specifications, not at absolute maximum ratings.

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/ $\overline{ST}$ /NC	Output Enable	H <sup>[1]</sup> : specified frequency output L: output is high impedance. Only output driver is disabled.
		Standby	H <sup>[1]</sup> : specified frequency output L: output is low (weak pull down). Device goes to sleep mode. Supply current reduces to I <sub>std</sub> .
		No Connect	Any voltage between 0 and Vdd or Open <sup>[1]</sup> : Specified frequency output. Pin 1 has no function.
2	GND	Power	Electrical ground
3	OUT	Output	Oscillator output
4	VDD	Power	Power supply voltage <sup>[2]</sup>

## ■ PIN ASSIGNMENTS



1. In OE or  $\overline{ST}$  mode, a pull-up resistor of 10 k $\Omega$  or less is recommended if pin 1 is not externally driven. If pin 1 needs to be left floating, use the NC option.
2. A capacitor of value 0.1  $\mu$ F or higher between Vdd and GND is required

### Pin 1 Configuration Options (OE, $\overline{ST}$ , or NC)

Pin 1 can be factory-programmed to support three modes: Output Enable (OE), Standby ( $\overline{ST}$ ) or No Connect (NC).

#### Output Enable (OE) Mode

In the OE mode, applying logic Low to the OE pin only disables the output driver and puts it in Hi-Z mode. The core of the device continues to operate normally. Power consumption is reduced due to the inactivity of the output. When the OE pin is pulled High, the output is typically enabled in <1  $\mu$ s.

#### Standby ( $\overline{ST}$ ) Mode

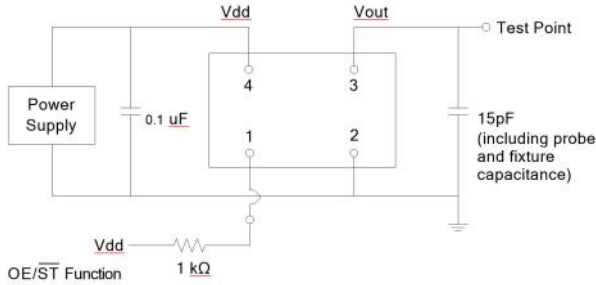
In the  $\overline{ST}$  mode, a device enters into the standby mode when Pin 1 pulled Low. All internal circuits of the device are turned off. The current is reduced to a standby current, typically in the range of a few  $\mu$ A. When  $\overline{ST}$  is pulled High, the device goes through the "resume" process, which can take up to 5 ms.

#### No Connect (NC) Mode

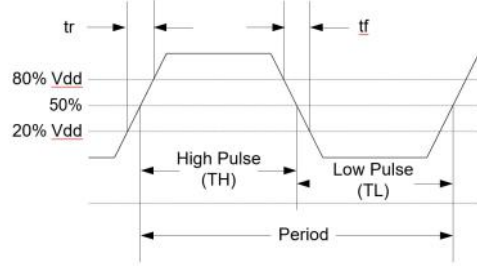
In the NC mode, the device always operates in its normal mode and outputs the specified frequency regardless of the logic level on pin 1.

	OE	$\overline{ST}$	NC
Active current 20 MHz (max, 1.8V)	4.1 mA	4.1 mA	4.1 mA
OE disable current (max, 1.8V)	4 mA	N/A	N/A
Standby current (typical 1.8V)	N/A	0.6 $\mu$ A	N/A
OE enable time at 77.76 MHz (max)	138 ns	N/A	N/A
Resume time from standby (max, all frequency)	N/A	5 ms	N/A
Output driver in OE disable/standby mode	High Z	weak pull-down	N/A

■ TEST CIRCUIT



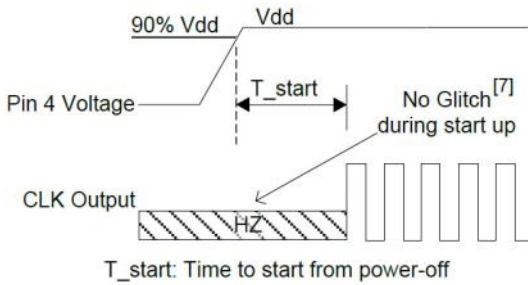
■ WAVEFORM



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

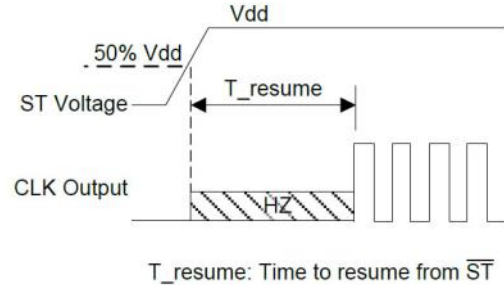
■ TIMING DIAGRAMS

Startup Timing (OE / ST Mode)



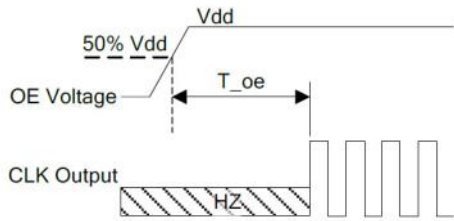
T\_start: Time to start from power-off

Standby Resume Timing (ST Mode Only)



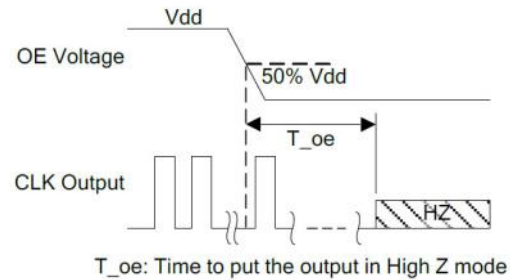
T\_resume: Time to resume from ST

OE Enable Timing (OE Mode Only)



T\_oe: Time to re-enable the clock output

OE Disable Timing (OE Mode Only)

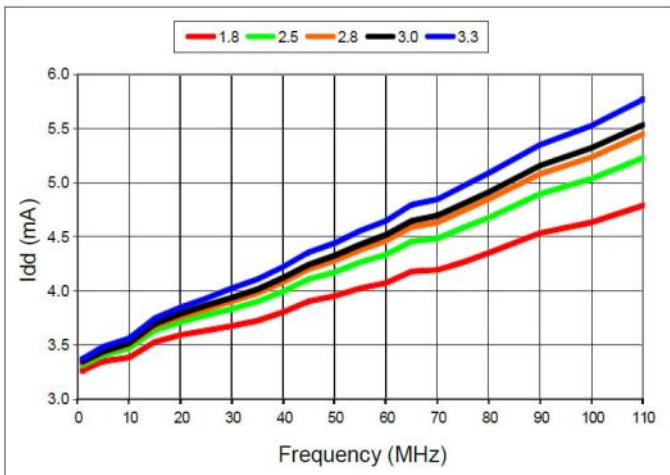


T\_oe: Time to put the output in High Z mode

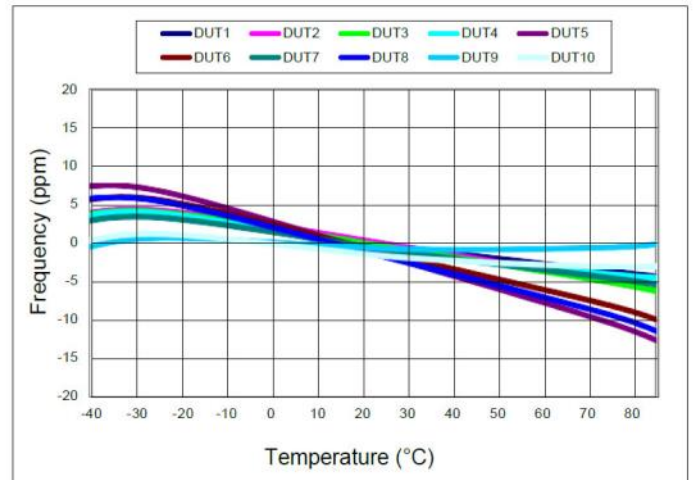
■ PERFORMANCE PLOTS

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

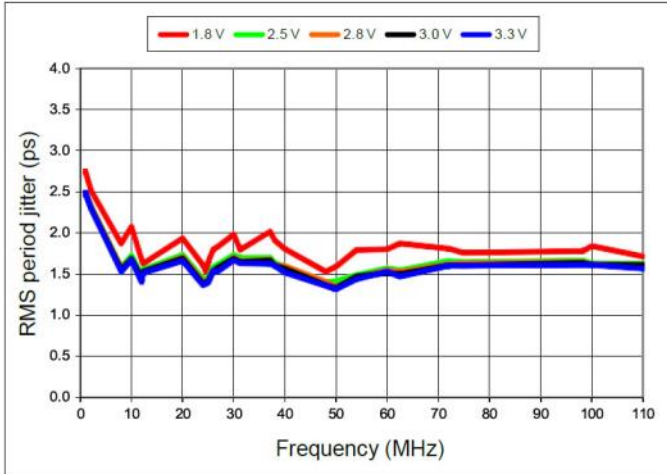
Phase noise plots are measured with Agilent E5052B signal source analyzer. Integration range is up to 5 MHz for carrier frequencies below 40 MHz.



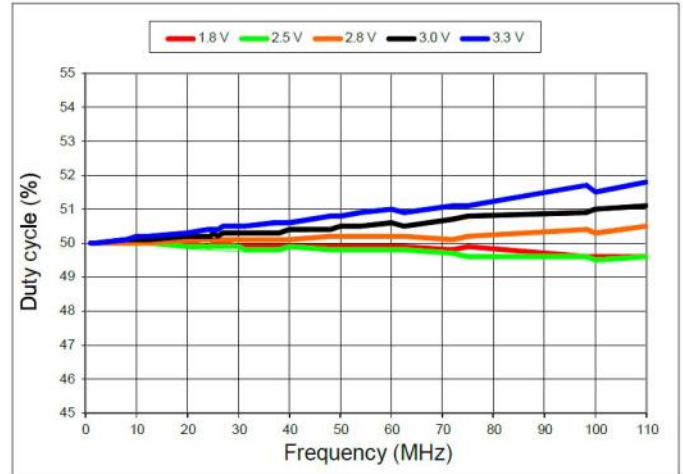
Idd vs Frequency



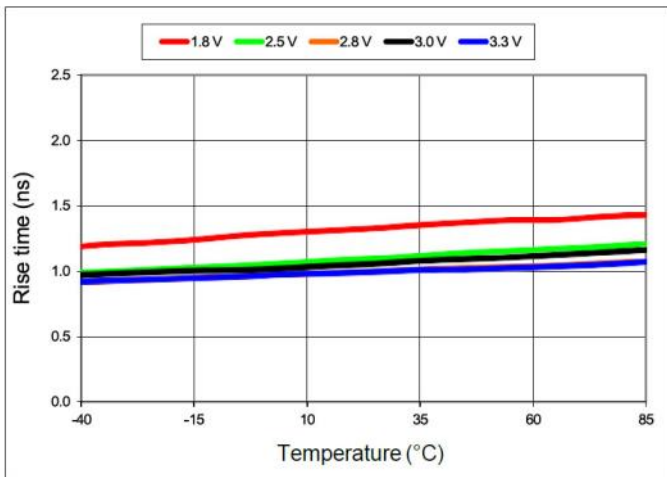
Frequency vs Temperature



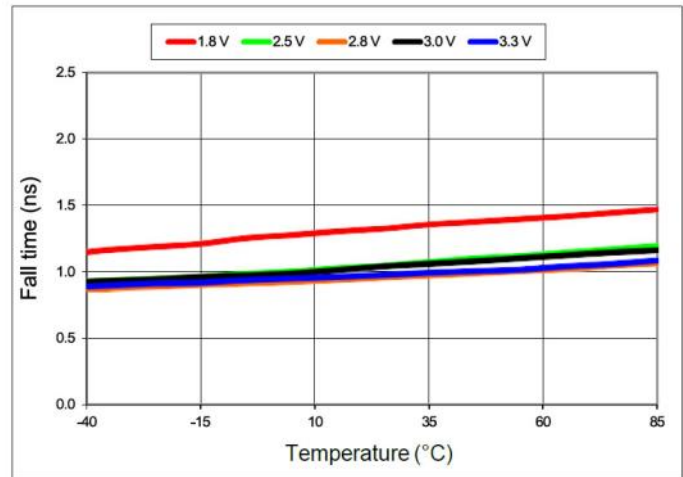
**RMS Period Jitter vs Frequency**



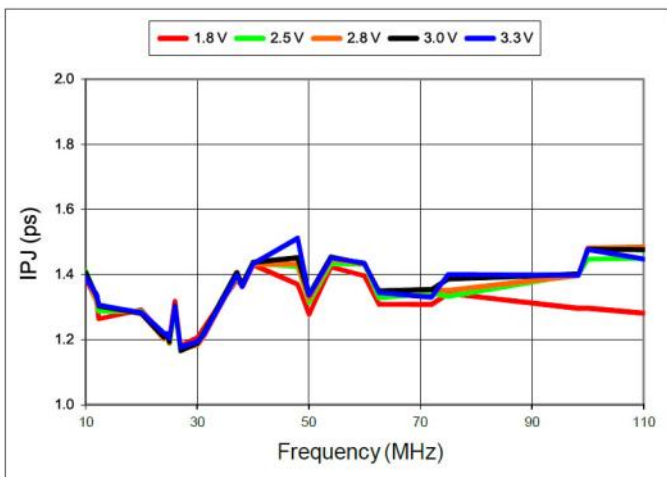
**Duty Cycle vs Frequency**



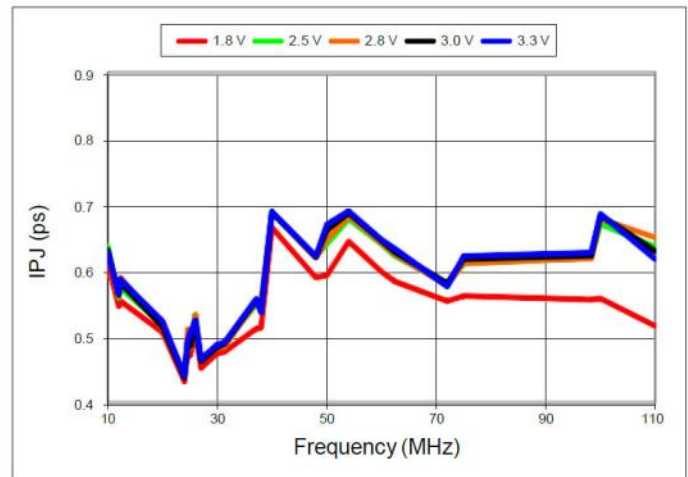
**RMS Period Jitter vs Frequency**



**Duty Cycle vs Frequency**



**RMS Integrated Phase Jitter Random  
(12 kHz to 20M Hz) vs Frequency**



**RMS Integrated Phase Jitter Random  
(900 kHz to 20 MHz) vs Frequency**

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

Rise/Fall Time Typ (ns) Vdd = 1.8V					
Drive Strength \ C <sub>LOAD</sub>	5 pF	15 pF	30 pF	45 pF	60 pF
L	6.16	11.61	22.00	31.27	39.91
A	3.19	6.35	11.00	16.01	21.52
R	2.11	4.31	7.65	10.77	14.47
B	1.65	3.23	5.79	8.18	11.08
T	0.93	1.91	3.32	4.66	6.48
E	0.78	1.66	2.94	4.09	5.74
U	0.70	1.48	2.64	3.68	5.09
F or BLANK: default	0.65	1.30	2.40	3.35	4.56

Rise/Fall Time Typ (ns) Vdd = 2.5V					
Drive Strength \ C <sub>LOAD</sub>	5 pF	15 pF	30 pF	45 pF	60 pF
L	4.13	8.25	12.82	21.45	27.79
A	2.11	4.27	7.64	11.20	14.49
R	1.45	2.81	5.16	7.65	9.88
B	1.09	2.20	3.88	5.86	7.57
T	0.62	1.28	2.27	3.51	4.45
E or BLANK: default	0.54	1.00	2.01	3.10	4.01
U	0.43	0.96	1.81	2.79	3.65
F	0.34	0.88	1.64	2.54	3.32

Rise/Fall Time Typ (ns) Vdd = 2.8V					
Drive Strength \ C <sub>LOAD</sub>	5 pF	15 pF	30 pF	45 pF	60 pF
L	3.77	7.54	12.28	19.57	25.27
A	1.94	3.90	7.03	10.24	13.34
R	1.29	2.57	4.72	7.01	9.06
B	0.97	2.00	3.54	5.43	6.93
T	0.55	1.12	2.08	3.22	4.08
E or BLANK: default	0.44	1.00	1.83	2.82	3.67
U	0.34	0.88	1.64	2.52	3.30
F	0.29	0.81	1.48	2.29	2.99

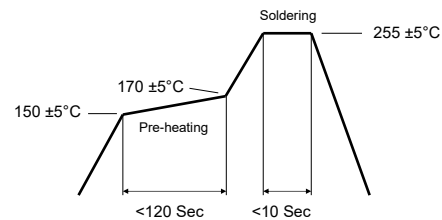
Rise/Fall Time Typ (ns) Vdd = 3.0V					
Drive Strength \ C <sub>LOAD</sub>	5 pF	15 pF	30 pF	45 pF	60 pF
L	3.60	7.21	11.97	18.74	24.30
A	1.84	3.71	6.72	9.86	12.68
R	1.22	2.46	4.54	6.76	8.62
B	0.89	1.92	3.39	5.20	6.64
T or BLANK: default	0.51	1.00	1.97	3.07	3.90
E	0.38	0.92	1.72	2.71	3.51
U	0.30	0.83	1.55	2.40	3.13
F	0.27	0.76	1.39	2.16	2.85

Rise/Fall Time Typ (ns) Vdd = 3.3V					
Drive Strength \ C <sub>LOAD</sub>	5 pF	15 pF	30 pF	45 pF	60 pF
L	3.39	6.88	11.63	17.56	23.59
A	1.74	3.50	6.38	8.98	12.19
R	1.16	2.33	4.29	6.04	8.34
B	0.81	1.82	3.22	4.52	6.33
T or BLANK: default	0.46	1.00	1.86	2.60	3.84
E	0.33	0.87	1.64	2.30	3.35
U	0.28	0.79	1.46	2.05	2.93
F	0.25	0.72	1.31	1.83	2.61

## ■ ENVIRONMENTAL COMPLIANCE

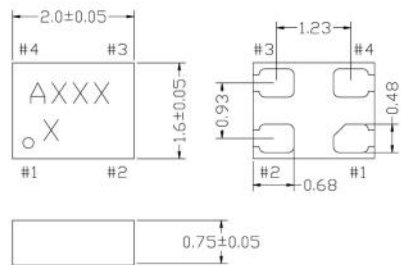
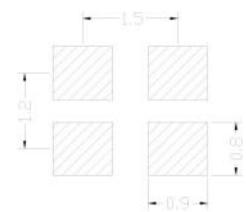
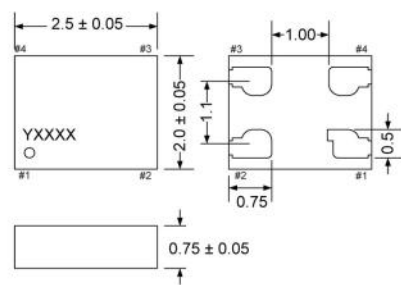
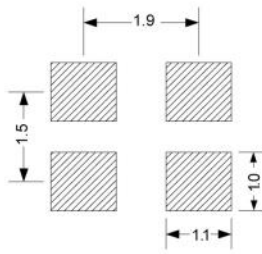
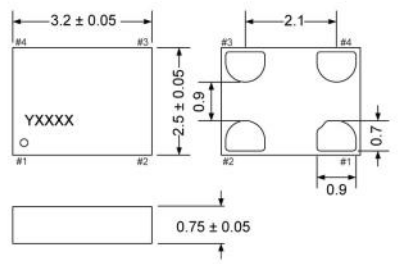
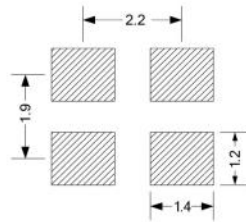
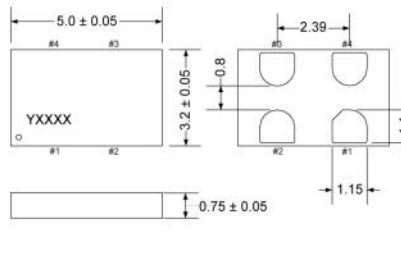
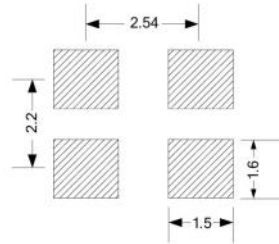
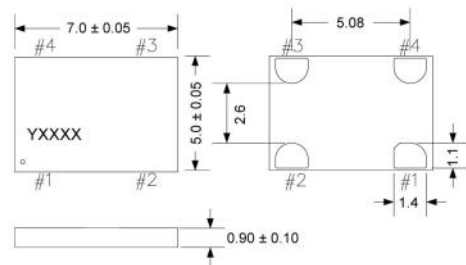
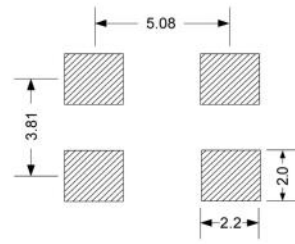
Parameter	Condition / Test Method
Mechanical Shock	MIL-STD-883F, Method2002
Mechanical Vibration	MIL-STD-883F, Method 2007
Temperature Cycle	JESD22, Method A104
Solderability	MIL-STD-883F, Method2003
Moisture Sensitivity Level	MSL1 @ 260°C

## ■ REFLOW PROFILE



Note: Consult factory for detail

■ PACKAGE OPTIONS / LAND PATTERN (Unit:mm)

<p><b>PACKAGE 21</b></p>	<p>2.0 x 1.6 x 0.75 mm</p> 	
<p><b>PACKAGE 22</b></p>	<p>2.5 x 2.0 x 0.75 mm</p> 	
<p><b>PACKAGE 32</b></p>	<p>3.2 x 2.5 x 0.75 mm</p> 	
<p><b>PACKAGE 53</b></p>	<p>5.0 x 3.2 x 0.75 mm</p> 	
<p><b>PACKAGE 75</b></p>	<p>7.0 x 5.0 x 0.90 mm</p> 	

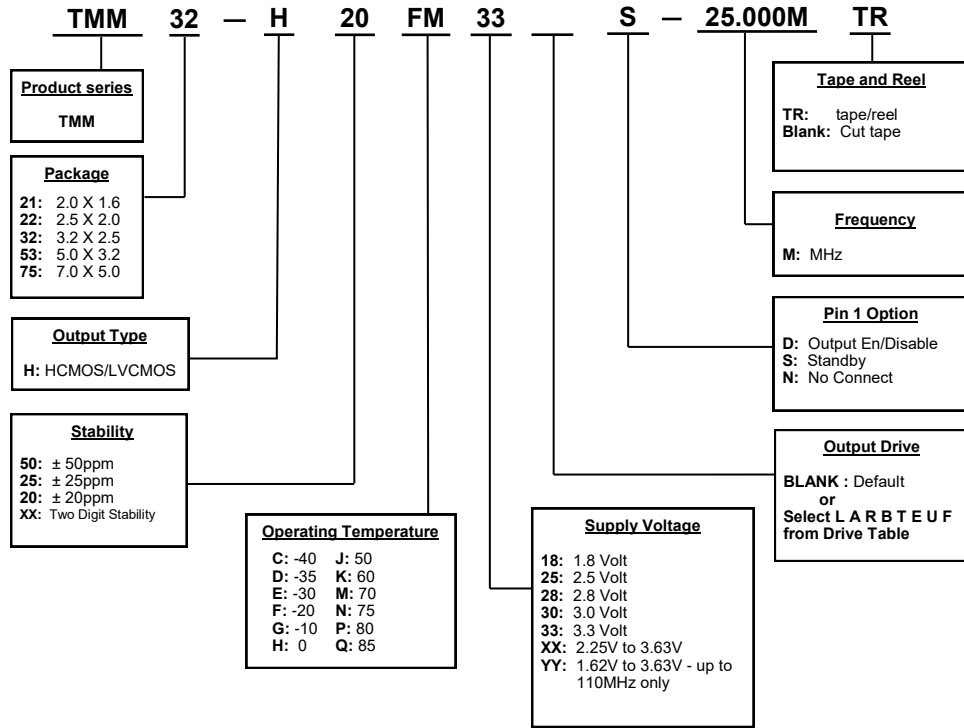
**MARKING**

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

A capacitor of value 0.1  $\mu$ F or higher between Vdd and GND is required.



■ PART NUMBERING GUIDE



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