MERCURY
ELECTRONIC
瑪居禮電波

# MERCURY ELECTRONIC

# Catalog

Crystal Oscillators
Crystal Units / Crystal Filters
Frequency Control Products

# Contents



Specifications

## Crystal Units



## Clock Oscillators [ Product Code " H " Including CMOS , Differential Type : ( LVPECL , LVDS , HCSL , LPHCSL and CML ) Output ] ..... 15

# Contents

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# Mercury Company Profile

## Taiwan Plant


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- Established in 1973 .
- Proud to be a pioneer of the crystal industry in Taiwan .
- Corporate headquarters and volume production facility
- IATF 16949 + ISO9001 and 14001 certified .

## Kunshan Office


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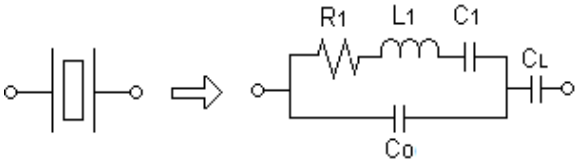
WeChat

- Established in 2002.
- The Sales Office.

# How To Specify A Quartz Crystal




| |
|---|
| $C_O$ : Shunt Capacitance |
| $C_1$ : Motional Capacitance |
| $L_1$ : Motional Inductance |
| $R_1$ : Equivalent Series Resistance |
| $C_L$ : Load Capacitance |

## Holder Type

### SMD Type

unit : mm

- ☐ X11 ( 1.65*1.25*0.30 )
- ☐ X21 ( 2.05*1.65*0.50 )
- ☐ X22 ( 2.55*2.05*0.60 )
- ☐ X32 ( 3.2*2.5*0.7 )
- ☐ MJ ( 5.0*3.2*0.8 )
- ☐ X2012 ( 2.05*1.2*0.55 )
- ☐ X3215 ( 3.2*1.5*0.8 )

unit : mm

- ☐ MQ ( 7.0*5.0*1.0 )
- ☐ M49 ( 12.4*4.5*4.0 )
- ☐ ML49 ( 12.4*4.5*3.0 )
- ☐ MP4 ( 12.9*4.5*4.0 )
- ☐ MP5 ( 12.9*4.5*5.0 )
- ☐ MP24 ( 11.4*5.0*4.0 )
- ☐ MP25 ( 11.4*5.0*5.0 )

### Thru - Hole Type

unit : mm

- ☐ H49 ( 10.7*4.5*13.2 )
- ☐ HUS ( 10.7*4.3*3.5 )
- ☐ HUSL ( 10.7*4.3*4.3 )
- ☐ U1 ( 7.8*3.2*8.0 )
- ☐ U5 ( 7.8*3.2*6.0 )
- ☐ T38 ( 3.0 $\phi$ *8.0 )
- ☐ T26 ( 2.0 $\phi$ *6.0 )

## A Basic Spec. must be specified

A-1 : Holder type: _____ ☐ Thru-Hole type ☐ SMD Leadless
A-2 : Frequency : _____MHz or _____ KHz
A-3 : Circuit Condition : ☐ Series ☐ Parallel
If ***Series*** resonance : Assign " **S** " as circuit load .
If ***Parallel*** : Specify CL ( Load Capacitance ) _____ pF ( Typical range is 8 to 32 pF ) .
A-4 : Calibration Tolerance: ± _____ ppm ( max.) at 25°C
A-5 : Frequency Stability: ± _____ ppm ( max.) over _____°C to _____ °C
A-6 : Maximum Equivalent Series Resistance (ESR): _____ ohms ( max. )

## B Other Spec. If not specified MEC standards will be applied.

B-1 : Shunt Capacitance (Co) : _____ pF ( max.)
B-2 : Motional Capacitance (C1) :_____ fF ± _____ %
B-3 : Motional Inductance (L1) : _____ mH ± _____ %
B-4 : Capacitance Ratio (Co/C1) : _____ ± _____ %
B-5 : Trim Sensitivity : _____ ppm / pF
B-6 : Frequency Pull Ability : When CL= _____ pF, _____ ppm ( max.) ; When CL= _____ pF, _____ ppm ( min.)
B-7 : Drive Level : _____ micro Watts (uW) ( max.).
B-8 : Crystal cutting angle type : ☐ AT - cut ☐ SL - cut ☐ XT - cut
B-9 : Mode of Oscillation : ☐ Fundamental mode ☐ 3rd overtone ☐ 5th overtone
B-10 : Spurious: _____ dB (or ohms) ( min.) in ± _____ kHz range of the main mode
B-11 : Crystal Q: _____ ( min.)
B-12 : Aging: _____ ppm per year ( max.)
B-13 : Shock: _____ ; Vibration: _____

## Part Number Format and Example

Example: X32 - 16.000 - 10 - 15 / 20 / -30+75 /100R  = User to specify

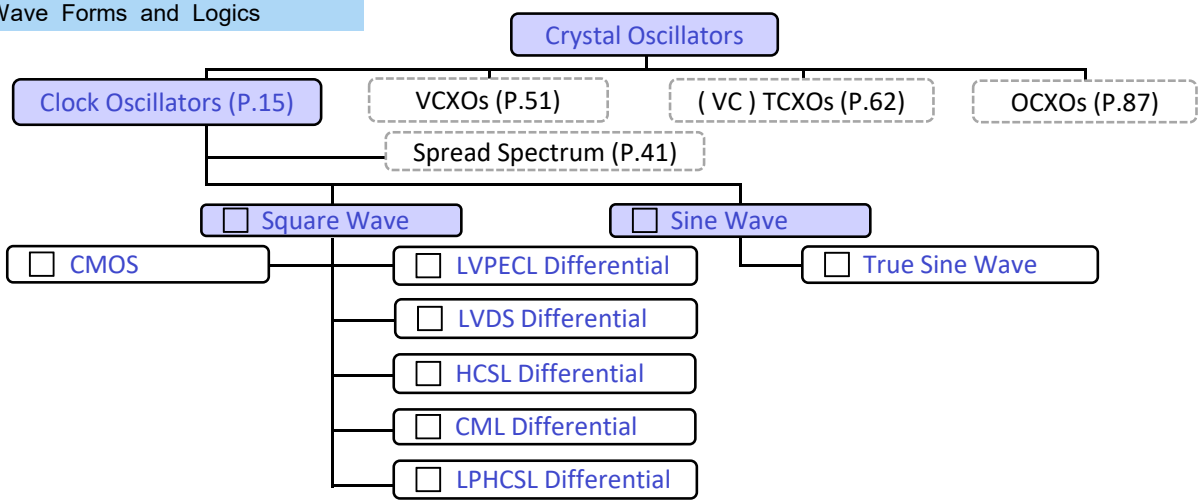
| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X32 | - | 16.000 | - | 10 | - | 15 | / | 20 | / | -30+75 | / | 100R | |
| (1) | | (2) | | (3) | | (4) | | (5) | | (6) | | (7) | |

(1) Package code ; (2) Frequency in MHz ; (3) Load Capacitance in pF or "**S**" for series resonance ; (4) Frequency tolerance at 25°C ; (5) Frequency stability ;

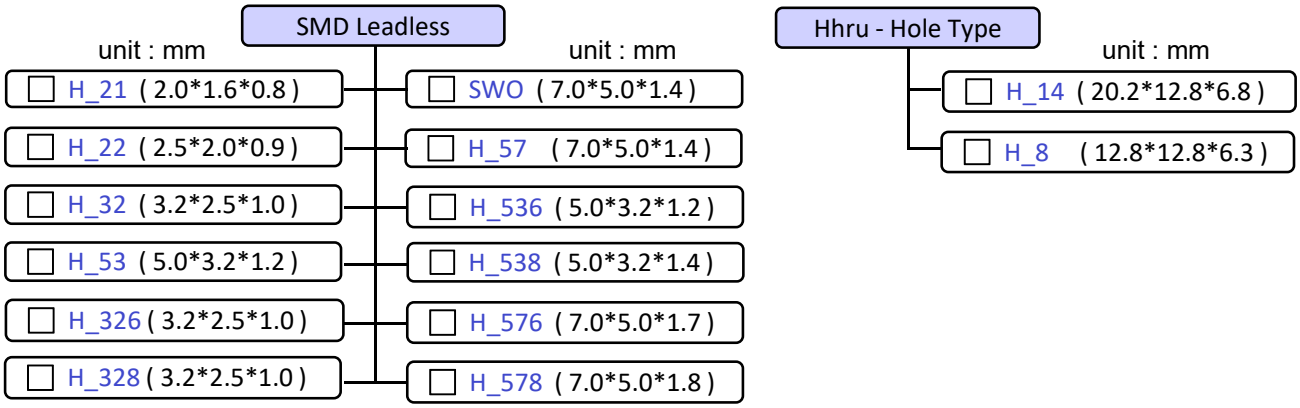
(6) Operating temperature range -30°C to +75°C in this example. Use " **X** " for -10°C ~ 60°C ; Use " **Y** " for -20°C ~ 70°C ; Use " **I** " for -40°C ~ 85°C' ; (7) ESR max.

# How To Specify A Crystal Oscillator

## Output Wave Forms and Logics




Part Number Format : " H " - - - for Oscillators
" _ " - - - represents PRODUCT SERIES selections in table 1and 2 below .




## Basic Spec. must be specified

1 : Holder type with output wave : _____ ☐ Thru-Hole type ☐ SMD type

| Table 1 - - - Square Wave | | |
|---|---|---|
| Output Wave | General Clock Oscillators | Switchable Output |
| ☐ CMOS | H_, SWO, HA, HM, HTF, HU, HW, HTJFN | HCTQF |
| ☐ LVPECL | HPK , HPQN , HPQF , HPJK , HPEK , HPRK , HPJFN | HCPQF |
| ☐ LVDS | HDK , HDQN , HDQF , HDJK , HDEK , HDRK , HDJFN | HCDQF |
| ☐ HCSL | HCK , HCJK , HCEK , HCRK , HCJFN | |
| ☐ CML | HQJF , HQJFN | |
| ☐ LPHCSL | HCLK | |

| Table 2 - - - Sine Wave | |
|---|---|
| Output Wave | Product Series |
| ☐ True Sine Wave | HS |

2 : Frequency : _____ MHz or _____ KHz

3 : Input Voltage : ☐ +5.0V ☐ +3.3V ☐ +3.0V ☐ +2.5V ☐ +1.8V ☐ +1.2V ☐ +1.0V ☐ others : _____

4 : Frequency Stability :

| Stability / Temp . | Commercial: -20°C ~ +70°C | Industrial: -40°C ~ +85°C | Extended Industrial: -40°C ~ +105°C |
|---|---|---|---|
| ± 25ppm | ☐ A | ☐ D | ☐ G |
| ± 50ppm | ☐ B | ☐ E | ☐ H |
| ± 100ppm | ☐ C | ☐ F | ☐ J |
| ☐ Custom ( ± _____ ppm over _____ to _____ ℃ ) | | | |

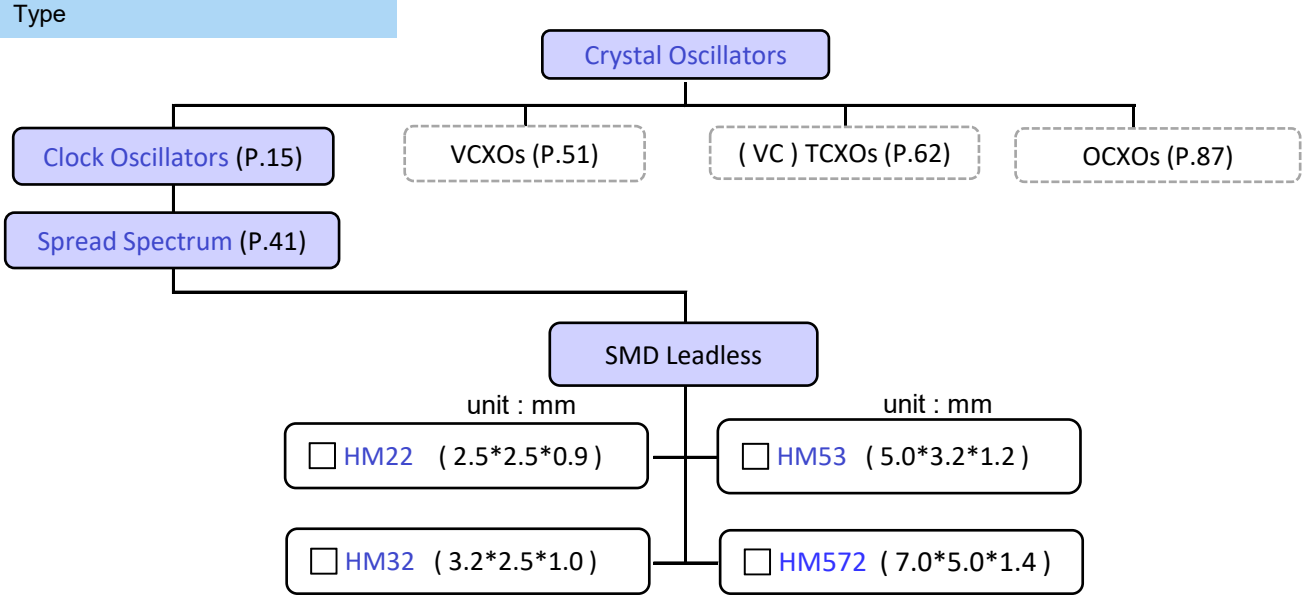
5 : Output Logic " 1 " _____ V ( min. ) ; Output Logic " 0 " _____ V ( max. )
6 : Rise time ( Tr ) and Fall time ( Tf ) : _____ nano seconds ( max. )
7 : Start-up time : _____ mini seconds ( max. )
8 : Current Consumption : _____ mA ( max. ) or _____ uA ( max. )
9 : Symmetry (Duty Cycle) : ☐ Standard ( 50%±10% ) ☐Option ( 50%±5% ) [ Add " S " at the end of part number ]
10 : Pin 1 options : ☐ No Connection ☐ Tri - state ( Output Enable ) ☐ Power-down ( Note : Tri-state is standard for SWO , H53 and H32 series )

## Part Number Format and Example

| Example: 3H14 - DT - 33.000 - S | | | | | | | | | = User to specify ★ = Option |
|---|---|---|---|---|---|---|---|---|---|
| ✎ | ✎ | | ✎ | ★ | | ✎ | | ★ | |
| 3 | H14 | - | D | T | - | 33.000 | - | S | |
| (1) | (2) | | (3) | (4) | | (5) | | (6) | |
| (1) Supply voltage code : " 3 " for "+3.3V ; " 5 " for "+5.0V ; | | | | | | | | | |
| (2) Package code ; (3) Frequency Stability ; (4) Tri-state option. Omit "T" if not required | | | | | | | | | |
| (5) Center Frequency in MHz ; (6) Add " S " for 50% ± 5% duty cycle . Omit " S " if not required . | | | | | | | | | |

# How To Specify A EMI Reduction Spread Spectrum Clock Oscillator

## Holder Type




## Basic Spec. must be specified

1 : Holder type: _____ ☐ Thru-Hole type ☐ SMD type

2 : Frequency : _____ MHz

3 : Input Voltage : ☐ +1.8V , ☐ +2.5V , ☐ +3.3V

4 : Output Wave : Square Wave ( CMOS )

5 : Frequency Stability :
( Exclude frequency modulation )

| Stability / Temp . | Commercial -20°C ~ +70 °C | Industrial -40°C ~ +85 °C |
|---|---|---|
| ± 25ppm | ☐ A | ☐ D |
| ± 50ppm | ☐ B | ☐ E |
| ± 100ppm | ☐ C | ☐ F |
| ☐ Custom ( ± _____ ppm over _____ to _____℃ ) | | |

6 : Group & Spread type :

(1) ☐ Group B

☐ Center spread : ☐ ±0.125 % ☐ ±0.375 % ☐ ±0.625 % ☐ ±0.875 % ☐ ±1.125 % ☐ ±1.375 % ☐ ±1.625 %
☐ ±0.875 % ☐ ±1.125 % ☐ ±1.375 % ☐ ±1.625 % ☐ ±1.875 % ☐ ±2.0 %

☐ Down spread : ☐ -0.25 % ☐ -0.75 % ☐ -1.25 % ☐ -1.75 % ☐ -2.25 % ☐ -2.75 % ☐ -3.25 %
☐ -3.75 % ☐ -4.0 %

(2) ☐ Group C

☐ Center spread : ☐ C0.25 : ± 0.25 % ☐ C0.75 : ± 0.75 % ☐ C1.0 : ± 1.0 %

☐ Down spread : ☐ D0.5 : -0.5 % ☐ D1.5 : - 1.5 % ☐ D2.0 : -2.0 %

## Part Number Format and Example

Examples of Low EMI Oscillator : 3HM572-DT-33.000B-C0.5 ✎ = User to specify ★ = Option

| ✎ | ✎ | | ✎ | ★ | | ✎ | ✎ | | ✎ | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | HM572 | - | D | T | - | 33.000 | B | - | C0.5 | |
| (1) | (2) | | (3) | (4) | | (5) | (6) | | (7) | |

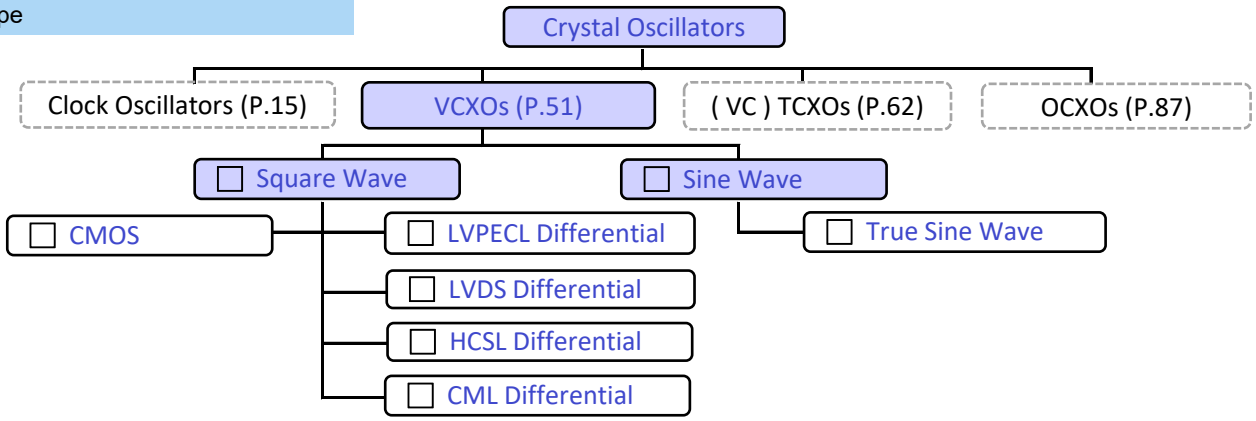
(1) Supply voltage code : " 3 " for +3.3V ; (2) Package code ; (3) Frequency stability ;

(4) Tri-state ; (5) Frequency in MHz ; (6) Group ;

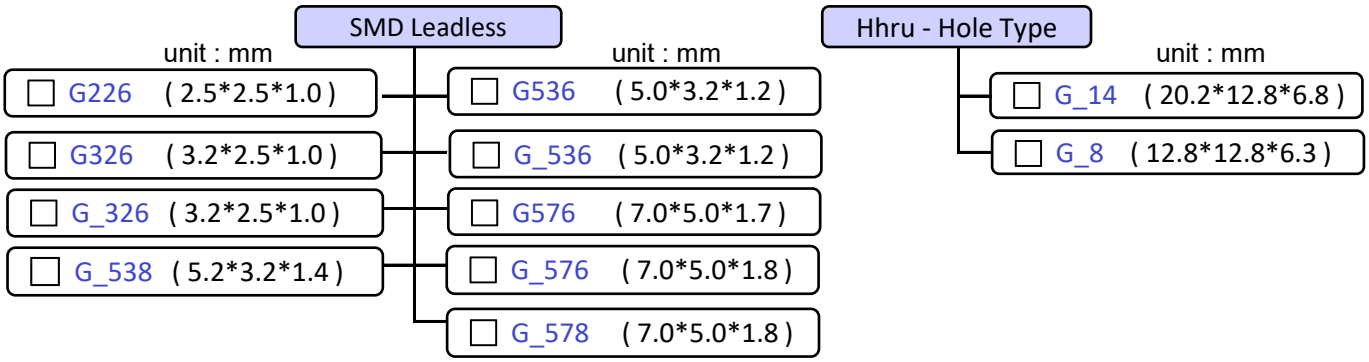
(7) Spread type & percentage : " C " for center spread , " D " for down spread. C0.5 represents center spread ± 0.5% ( total 1% ).

# How To Specify A VCXO

## Holder Type




Part Number Format : " G " - - - for VCXO
" _ " - - - represents PRODUCT SERIES selections in table 1and 2 below .




## Basic Spec. must be specified

1 : Holder type : _____ ☐ Thru-Hole type ☐ Leadless SMD type

| Table 1 - - - Square Wave | | |
|---|---|---|
| Output Wave | General VCXOs | Switchable Output |
| ☐ CMOS | G_ , GTQN , GTQF , GTJFN | GCTQF |
| ☐ LVPECL | GPQN , GPQF , GPJFN | GCPQF |
| ☐ LVDS | GDQN , GDQF , GDJFN | GCDQF |
| ☐ HCSL | GCJFN | GCPQF |
| ☐ CML | GQJFN | GCDQF |

| Table 2 - - - Sine Wave | |
|---|---|
| Output Wave | Product Series |
| ☐ True Sine Wave | GS |

2 : Frequency : _____ MHz

| 3 : Input Voltage : | ☐ +3.3V | ☐ +1.8V |
|---|---|---|
| 4 : Control Voltage center and range : | +1.65V ± 1.35V ( 0.3V ~ 3.0V ) | +0.9V ± 0.9V ( 0V ~ 1.8V ) |

5 : Frequency Stability :

| Stability / Temp . | Commercial: -20°C ~ +70°C | Industrial: -40°C ~ +85°C | Extended Industrial: -40°C ~ +105°C |
|---|---|---|---|
| ± 25ppm | ☐ A | ☐ D | ☐ G |
| ± 50ppm | ☐ B | ☐ E | ☐ H |
| ± 100ppm | ☐ C | ☐ F | ☐ J |
| ☐ Custom ( ± _____ ppm over _____ to _____ °C ) | | | |

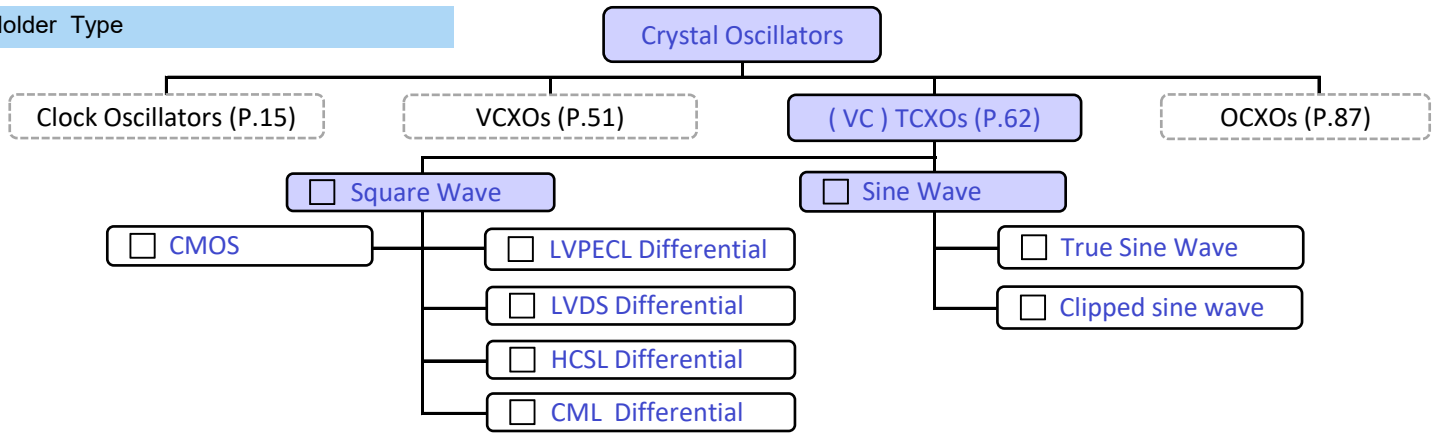
6 : Frequency deviation range : ± _____ ppm ☐ min. ☐ max. ☐ typical ( ± 20% ) .
7 : Linearity : _____ % ( max.)
8 : Input Impedance : _____ KΩ ( min.)
9 : Modulation band width : ± _____ KHz ( min.)

## Part Number Format and Example

| Examples of VCXO : 3G576 - D - 150M - 27.000 | | | | | | | = User to specify |
|---|---|---|---|---|---|---|---|
| ✎ | ✎ | | ✎ | | ✎ | | ✎ | |
| 3 | G576 | - | D | - | 150M | - | 27.000 | |
| (1) | (2) | | (3) | | (4) | | (5) | |
| (1) Supply Voltage code : " 18 " for +1.8V , " 3 " for +3.3V ; (2) Package code ; (3) Frequency stability ; | | | | | | | | |
| (4) Pulling range in ppm ( " N " : minimum , " M " : maximum , " T " : typical ) ; (5) Center Frequency in MHz | | | | | | | | |

# How To Specify A ( VC )TCXO

## Holder Type




Part Number Format : " M " for TCXO ; " VM " for VCTCXO (TCXO with voltage control function)

" _ " - - - represents PRODUCT SERIES selections in table 1and 2 below .

**SMD Leadless**

unit : mm

- ☐ (V)M21 ( 2.0*1.6*0.7 )
- ☐ (V)M22 ( 2.5*2.0*0.8 )
- ☐ (V)M32 ( 3.2*2.5*1.2 )
- ☐ (V)M53 ( 5.0*3.2*1.3 )
- ☐ (V)M_326 ( 3.2*2.5*1.6 )

unit : mm

- ☐ (V)M57 ( 7.0*5.0*2.0 )
- ☐ (V)M572 ( 7.0*5.0*2.3 )
- ☐ (V)M_538 ( 5.0*3.2*1.4 )
- ☐ (V)M_574 ( 7.0*5.0*2.5 )
- ☐ (V)M_576 ( 7.0*5.0*2.5 )

**Thru - Hole Type**

unit : mm

- ☐ (V)M_8 ( 12.8*12.8*6.3 )
- ☐ (V)M_9 ( 12.8*12.8*6.3 )
- ☐ (V)M_39 ( 18.4*11.7*4.7 )
- ☐ (V)M_14 ( 20.2*12.8*7.8 )
- ☐ (V)M_15 ( 20.2*12.8*7.8 )

## Basic Spec. must be specified

1 : ☐ TCXO ( code " M " series ) ☐ VCTCXO ( code " VM " series )

2 : Holder type: _____ ☐ Thru-Hole type ☐ SMD type

Output Wave type :

| Clipped Sine Wave | |
|---|---|
| TCXO | VCTCXO |
| M _ S | VM _ S |

| Square Wave | | |
|---|---|---|
| Output Wave | Product Series | |
| | TCXO - - - " M " | VCTCXO - - - " VM " |
| ☐ CMOS | M_T , MTF_T , ME_T , MQN_T , MQF_T | VM_T , VMTF_T , VMQN_T , VMQF_T |
| ☐ LVPECL | MQN_P , MQF_P , MJF_P | VMQN_P , VMQF_P , VMJF_P |
| ☐ LVDS | MQN_D , MQF_D , MJF_D | VMQN_D , VMQF_D , VMJF_D |
| ☐ HCSL | MJF_C | VMJF_C |
| ☐ CML | MJF_Q | VMJF_Q |

3 : Frequency : _____ MHz or _____ KHz

4 : Input Voltage : ☐ +3.3V ☐ +3.0V ☐ +2.5V ☐ +1.8V ☐ others : _____

5 : Frequency Stability :

| | | |
|---|---|---|
| ☐ ± 1.0ppm | ☐ ± 1.5ppm | ☐ ± 2.0ppm |
| ☐ ± 2.5ppm | ☐ ± 3.0ppm | ☐ ± 5.0ppm |

6 : Operating Temp. :

| | | | |
|---|---|---|---|
| ☐ 0 ˚C ~ +60 ˚C | ☐ 0 ˚C ~ +70 ˚C | ☐ -10 ˚C ~ +60 ˚C | ☐ -20 ˚C ~ +70 ˚C |
| ☐ -30 ˚C ~ +60 ˚C | ☐ -30 ˚C ~ +70 ˚C | ☐ -40 ˚C ~ +85 ˚C | |

7 : ● [ " ***T*** " series , Square Wave ] : Output Voltage " 1 ": _____ V ( min.) ; Output Voltage " 0 ": _____ V ( max.)

● [ " ***S*** " series , Clipped Sine Wave ] : Output Voltage Level : _____ Vp-p ( min.)

8 : Start-up time : _____ mini seconds ( max.) .

9 : Current Consumption : _____ mA ( max.)

10 : ● Mechanical frequency tuning (MFT) range : ± _____ ppm ( min.). For TCXOs and VCTCXOs.

● Electrical frequency tuning range (EFT) : ± _____ ppm ( min.). For VCTCXOs only.

● Control voltage center and range : ***1.5V ± 1.0V*** is standard for 3.3V, 1.5V supply voltages .

## Part Number Format and Example

Examples of VCTCXO : VM32S33-12.800-2.5/-30+85 = User to specify

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | customer to specify |
| V | M32 | S | 33 | - | 12.800 | - | 2.5 | / | -30+85 | |
| (1) | (2) | (3) | (4) | | (5) | | (6) | | (7) | |

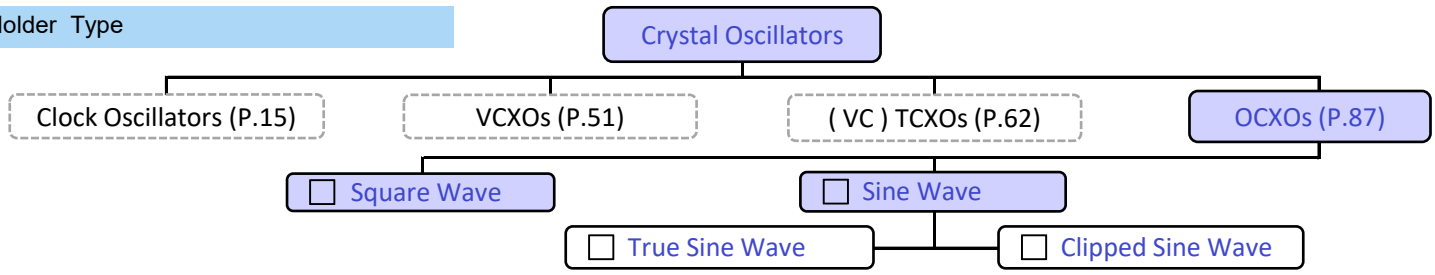
(1) " V " for VCTCXO ; Omit ' V " if TCXO ; (2) Package code

(3) Wave form code " *S* " for clipped sine wave ; (4) Supply voltage code: " 25 " for +2.5V , " *3* " for +3.0V , " *33* " for +3.3V

(5) Frequency in MHz ; (6) Frequency stability in ±ppm ; (7) Operating temperature range in °C. "-30+85" represents -30°C to +85°C operating temperature range.

# How To Specify A OCXO

## Holder Type




Part Number Format : " OC " for OCXO

unit : mm

**SMD Leadless**

- ☐ OC12 ( 25.4*22.1*11.0 )
- ☐ OC41 ( 14.5*9.6*6.5 )
- ☐ OC51 ( 9.7*7.5*4.1 )

**Thru - Hole Type**

unit : mm

- ☐ OC13 ( 25.4*25.4*12.7 )
- ☐ OC18 ( 20.6*20.6*11.0 )
- ☐ OC32 ( 36.3*27.2*12.7 )
- ☐ OC14 ( 20.3*12.7*11.0 )
- ☐ OC19 ( 20.6*20.6*11.0 )

## Basic Spec. must be specified

1 : Holder type: _____ ☐ SMD type ☐ Thru-Hole type

2 : Frequency : _____ MHz

3 : Input Voltage : ☐ +3.3V ☐ +5.0V

4 : Frequency Stability :

| | | | |
|---|---|---|---|
| ☐ ± 3.0ppm | ☐ ± 5.0ppm | ☐ ± 10.0ppm | |
| ☐ ± 20.0ppm | ☐ ± 30.0ppm | ☐ ± 50.0ppm | ☐ ± 100.0ppm |

5 : Operating Temp. :

| | | | |
|---|---|---|---|
| ☐ 0 ˚C ~ +70 ˚C | ☐ -20 ˚C ~ +70 ˚C | ☐ -30 ˚C ~ +70 ˚C | ☐ -40 ˚C ~ +85 ˚C |

6 : ● [ " ***T*** " series , Square Wave ] : Output Voltage " 1 ": _____ V ( min.) ; Output Voltage " 0 ": _____ V ( max.)

● [ " ***E*** " series , True Sine Wave ] : Output Voltage Level : _____ dBm ( typ.)

● [ " ***S*** " series , Clipped Sine Wave ] : Output Voltage Level : _____ Vp-p ( min.)

8 : Power Dissipation : _____ Watts ( max.) at Steady-State ; _____ mA ( max.) at Turn-On

9 : Electrical frequency tuning range (EFT) : ± _____ ppm ( min.).

## Part Number Format and Example

Examples of OCXO : OC51T3-10.000-20/-40+85 = User to specify

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | customer to specify |
| OC | 51 | T | 3 | - | 10.000 | - | 20 | / | -40+85 | |
| (1) | (2) | (3) | (4) | | (5) | | (6) | | (7) | |

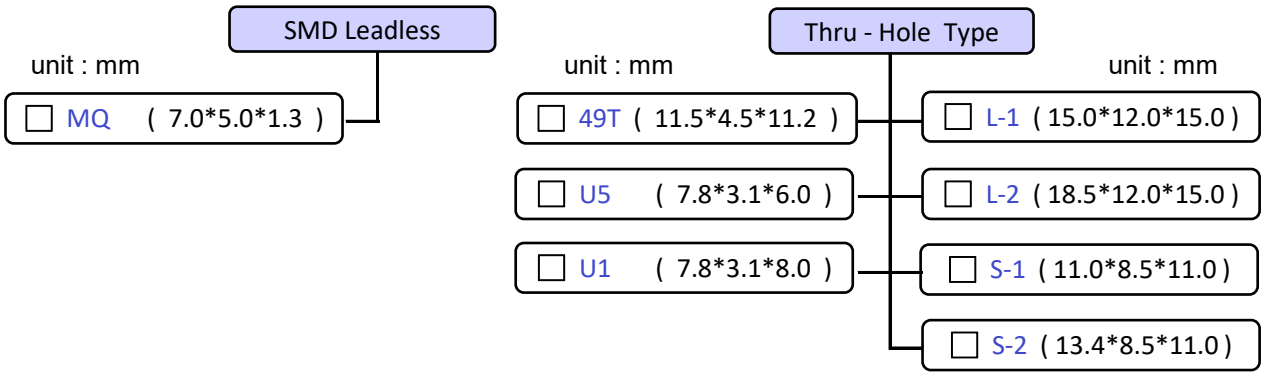
(1) " OC " for OCXO ; (2) Package code ; (3) Wave form code " T " for square wave

(4) Supply voltage code : " 3 " for +3.3V ; (5) Frequency in MHz

(6) Frequency stability in ±ppb ; (7) Operating temperature range in °C. "-40+85" represents -40°C to +85°C operating temperature range.

# How To Specify A Monolithic Crystal Filter

## Holder Type




## Basic Spec. must be specified

A-1 : Holder type: _____ ☐ SMD Leadless ☐ Thru-Hole type

A-2 : Frequency : _____ MHz ☐ 10.7 MHz ( 10.5 MHz ~ 11.000 MHz available only in 49T series )

☐ 21.400 MHz ☐ 21.700 MHz ☐ 45.000 MHz ☐ 50.850 MHz

A-3 : No. of poles : ☐ 2 poles ☐ 4 poles ☐ 6 poles ☐ 8 poles

A-4 : Pass Bandwidth : ☐ ±3.75 KHz ☐ ±6.0 KHz ☐ ±7.5 KHz ☐ ±15.0 KHz min at 3 dB

A-5 : Stop Bandwidth : ± _____ KHz max at _____ dB and ± _____ KHz max at _____ dB

A-6 : Ripple : _____ dB ( max. )

A-7 : Insertion Loss : _____ dB ( max. )

A-8 : Guaranteed Attenuation : fo + _____ KHz to fo - _____ KHz min. at _____ dB

A-9 : Terminating Impedance : _____ Ω // _____ pF

A-10 : Operating Temperature : _____ °C to _____ °C

## Part Number Format and Example

| Examples of quartz crystal : 21.7M15DU5 | | | | | | | | = User to specify ★ = Option |
|---|---|---|---|---|---|---|---|---|
| ✎ | | ✎ | | ✎ | | ✎ | | ✎ User to specify |
| 21.7 M | | 15 | | D | | U5 | | |
| (1) | | (2) | | (3) | | (4) | | |
| (1) Frequency code ; | | | | | | | | |
| (2) Pass Bandwidth code ( " 7.5 " for ±3.75 KHz band width, " 15 " for ±7.5 KHz band width, " 30 " for ±15.0 KHz band width ) ; | | | | | | | | |
| (3) No. of poles ( " *A* " for 2 poles , " *B* " for 4 poles , " *C* " for 6 poles , " *D* " for 8 poles ) ; | | | | | | | | |
| (4) Package code | | | | | | | | |

# Quartz Crystals

| X11 | X21 | X22 | X32 | Surface Mount | X11 , X21 , X22 , X32 | X22 , X32 |
|---|---|---|---|---|---|---|
| 1.65 * 1.25 * 0.30 | 2.05 * 1.65 * 0.50 | 2.55 * 2.05 * 0.60 | 3.20 * 2.50 * 0.70 | | Fundamental | 3rd Overtone |

## Features

Specifications

- The entire package can be grounded via the top metal lid and the two bottom pads
- Small footprint. Ideal for space constrained applications
- Exhibits extremely low aging with a high shock & vibration resistance


## General Specifications

| Item / Type | X11 | X21 | X22 | X32 |
|---|---|---|---|---|
| Package Dimensions | ( 1.65 * 1.25 * 0.30 mm ) | ( 2.05 * 1.65 * 0.50 mm ) | ( 2.55 * 2.05 * 0.60 mm ) | ( 3.20 * 2.50 * 0.70 mm ) |
| Frequency Range | 24.0 ~ 96.0 MHz ( Fund. ) | 16.0 ~ 64.0 MHz ( Fund. ) | 12.0 ~ 80.0 MHz ( Fund. ) | 8 ~ 96.0 MHz ( Fund. ) |
| | | | 50 ~ 200 MHz ( 3rd Overtone ) | 50 ~ 200 MHz ( 3rd Overtone ) |
| Crystal Cut // Load Capacitance | AT - Cut // Series or Parallel ( 8 to 32 pF ) resonance | | | |
| Drive Level | 10 μW ( typ.) 100 μW ( max.) | | | |
| Frequency Tolerance | ± 10 ppm , ± 20 ppm or ± 30 ppm ( max.) at 25°C | | | |
| Aging | △F / F : ± 3 ppm / year ( max.) | | | |
| Storage Temperature Range | - 50°C to 125°C | | | |

## ESR ( Equivalent Series Resistance )

| X11 | | X21 | | X22 | | | X32 | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency Range | E. S. R. | Frequency Range | E. S. R. | Frequency Range | E. S. R. | Oscillator Mode | Frequency Range | E. S. R. | Oscillator Mode |
| 24.0 ~ 29.9 MHz | 120 Ω max. | 16.0 ~ 23.9 MHz | 120 Ω max. | 12.0 ~ 15.9 MHz | 150 Ω max. | Fund. Mode | 8.0 ~ 9.9 MHz | 500 Ω max. | Fund. Mode |
| 30.0 ~ 39.9 MHz | 100 Ω max. | 24.0 ~ 29.9 MHz | 100 Ω max. | 16.0 ~ 29.9 MHz | 80 Ω max. | | 10.0 ~ 11.9 MHz | 200 Ω max. | |
| 40.0 ~ 96.0 MHz | 80 Ω max. | 30.0 ~ 37.9 MHz | 80 Ω max. | 30.0 ~ 80.0 MHz | 60 Ω max. | | 12.0 ~ 29.9 MHz | 80 Ω max. | |
| | | 38.0 ~ 64.0 MHz | 60 Ω max. | 50.0 ~ 200.0 MHz | 80 Ω max. | 3rd Overtone | 30.0 ~ 96.0 MHz | 40 Ω max. | |
| | | | | | | | 50.0 ~ 200.0 MHz | 60 Ω max. | 3rd Overtone |

## Frequency stability Vs Operating temperature range

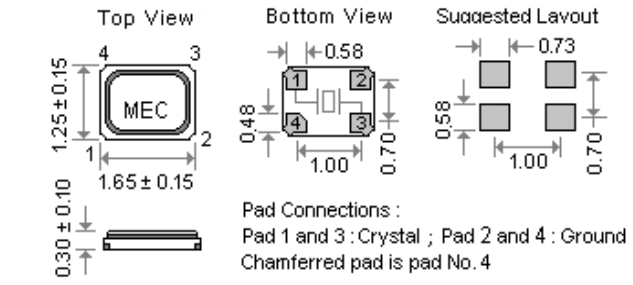
| Frequency stability Vs Operating temperature range | | | | | | | |
|---|---|---|---|---|---|---|---|
| Stability code | Temp. (°C) \ ppm | ± 5 | ± 10 | ± 15 | ± 20 | ± 25 | ± 30 |
| X | -10 to 60°C | ▲ | ○ | ○ | ○ | ○ | ○ |
| Y | -20 to 70°C | | ○ | ○ | ○ | ○ | ○ |
| I | -40 to 85°C | | | ○ | ○ | ○ | ○ |

○ : available

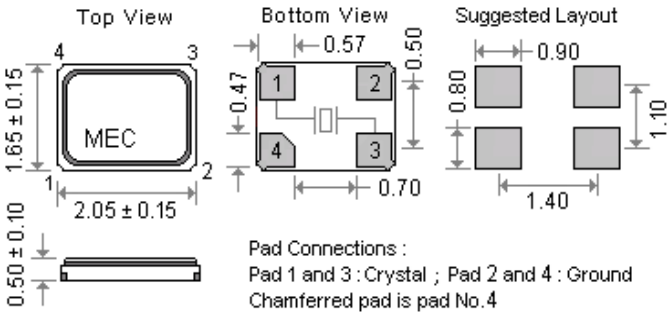
▲ : contact Mercury

## Outline Dimensions ( Unit : mm )

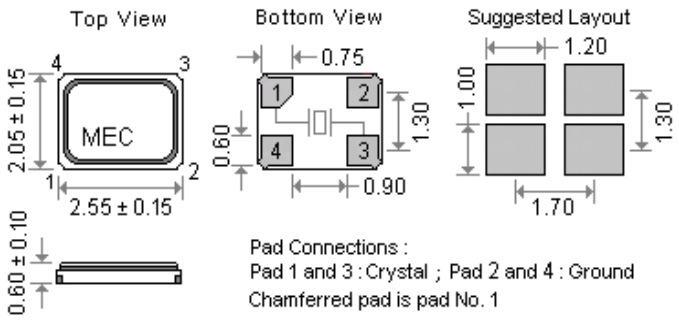
### X11



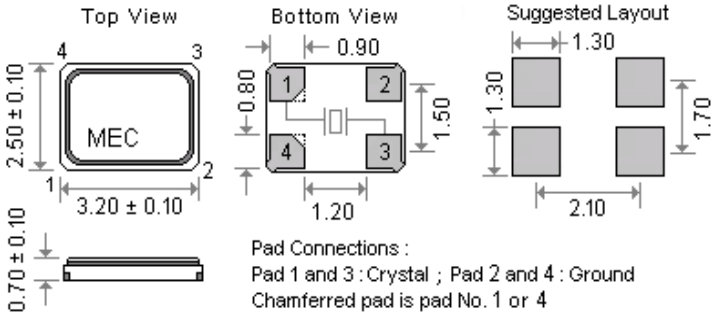

### X21




### X22




### X32



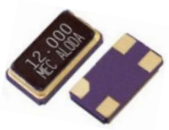
# Quartz Crystals

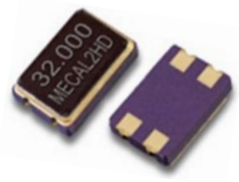
| MJ | MQ | Surface Mount | MJ , MQ | MJ , MQ |
|---|---|---|---|---|
| 5.0 * 3.2 * 0.9 | 7.0 * 5.0 * 1.0 | | Fundamental | 3rd Overtone |

## Features

Specifications

- Exhibits extremely low aging with a high shock and vibration resistance
- The entire package can be grounded via the top metal lid and the two bottom pads
- This low 0.7mm package height is ideal for height constrained applications






## General Specifications

| Item / Type | **MJ** series | **MQ** series |
|---|---|---|
| Package Dimensions | ( 5.0 * 3.2 * 0.9 mm ) | ( 7.0 * 5.0 * 1.0 mm ) |
| Frequency Range | 8.0 ~ 52.0 MHz ( Fund. ) | 6.0 ~ 50.0 MHz ( Fund. ) |
| | 50.0 ~ 200.0 MHz ( 3rd ) | 45.0 ~ 200.0 MHz ( 3rd ) |
| Crystal Cut | AT - Cut ; 3rd overtone | |
| Load Capacitance | Series or Parallel ( 8 to 32 pF ) resonance | |
| Drive Level | 10 μW ( typ.) 100 μW ( max.) | |
| Frequency Tolerance | ± 10 ppm , ± 20 ppm or ± 30 ppm ( max.) at 25°C | |
| Aging | △F / F : ± 3 ppm / year ( max.) | |
| Storage Temp. Range | - 50°C to 125°C | |

## ESR ( Equivalent Series Resistance )

| MJ | | | MQ | | |
|---|---|---|---|---|---|
| Freq. ( MHz ) | E.S.R. | Mode | Freq. ( MHz ) | E.S.R. | Mode |
| 8.0 ~ 9.9 | 100 Ω | Fund. | 6.0 ~ 8.0 | 80 Ω | Fund. |
| 10.0 ~ 14.9 | 60 Ω | | 8.1 ~ 11.0 | 60 Ω | |
| 15.0 ~ 19.9 | 50 Ω | | 11.1 ~ 14.0 | 50 Ω | |
| 20.0 ~ 52.0 | 40 Ω | | 14.1 ~ 50.0 | 40 Ω | |
| 50.0 ~ 200.0 | 80 Ω | 3rd | 40.1 ~ 45.0 | 60 Ω | 3rd |
| | | | 45.1 ~ 200.0 | 80 Ω | |

## Frequency stability Vs Operating temperature range

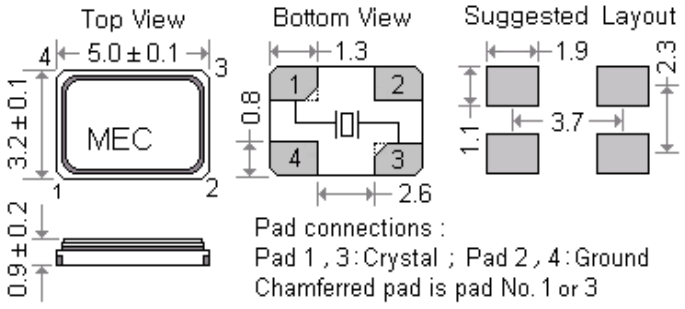
| Frequency stability vs Operating temperature range | | | | | | | |
|---|---|---|---|---|---|---|---|
| Stability code | Temp. (°C) \ ppm | ± 5 | ± 10 | ± 15 | ± 20 | ± 25 | ± 30 |
| X | -10 to 60°C | ○ | ○ | ○ | ○ | ○ | ○ |
| Y | -20 to 70°C | ▲ | ○ | ○ | ○ | ○ | ○ |
| I | -40 to 85°C | | | ○ | ○ | ○ | ○ |

○ : available

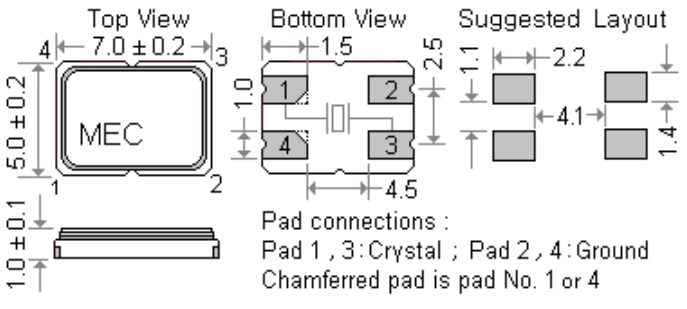
▲ : contact Mercury

## Outline Dimensions ( Unit : mm )

### MJ




### MQ



# Quartz Crystals

| M49 , ML49 | MP4 , MP5 | MP24 , MP25 | SMD | Fundamental | 3rd Overtone | Min. | Max. |
|---|---|---|---|---|---|---|---|
| 12.4 * 4.5 * 4.0 ( 3.0 ) mm | 12.9 * 4.5 * 5.0 ( 4.0 ) mm | 11.4 * 5.0 * 5.0 ( 4.0 ) mm | | | | 3.2 MHz | 100 MHz |

## Features

Specifications

- Withstands solder reflow and available in EIA-481A tape and reel
- AT-strip crystal inside. Optimized for low spurious.
- Lowest cost among all Mercury SMD crystals
- Designed for top board assembly and an one time solder reflow only
- Do not mount with the metal housing downward



## General Specifications

| Item / Type | **M49** ( 12.4 * 4.5 * 4.0 mm ) series | **MP4** ( 12.9 * 4.5 * 4.0 mm ) series | **MP5** ( 12.9 * 4.5 * 5.0 mm ) series |
|---|---|---|---|
| | **ML49** ( 12.4 * 4.5 * 3.0 mm ) series | **MP24** ( 11.4 * 5.0 * 4.0 mm ) series | **MP25** ( 11.4 * 5.0 * 5.0 mm ) series |
| Frequency Range & Crystal Cut | 3.200 ~ 48.000 MHz , AT-cut , Fundamental Mode ( see Table 1 )<br>30.000 ~ 100.000 MHz , AT-cut , 3rd overtone ( see Table 1 ) | | |
| Load Capacitance | Series or Parallel ( 8 to 32 pF ) resonance | | |
| Drive Level | 100 µW ( typ.) 500 µW ( max.) | | |
| Frequency Tolerance | ± 10 ppm , ± 20 ppm or ± 30 ppm ( max.) at 25°C | | |
| Frequency Stability | See Table 2 | | |
| Aging | △F / F : ±3 ppm / year ( max. ) | | |
| Storage Temperature Range | - 50°C to 105°C | | |

Table 1

| ESR ( Equivalent Series Resistance ) | | | | | |
|---|---|---|---|---|---|
| Freq.(MHz) | E.S.R. | Osc. Mode | Freq.(MHz) | E.S.R. | Osc. Mode |
| 3.2 ~ 3.4 | 300 Ω | AT , Fund. | 30.1 ~ 50.0 | 100 Ω | AT , 3rd |
| 3.5 ~ 6.0 | 120 Ω | | 50.1 ~ 100.0 | 80 Ω | |
| 6.1 ~ 10.0 | 60 Ω | | | | |
| 10.1 ~ 48.0 | 40 Ω | | | | |

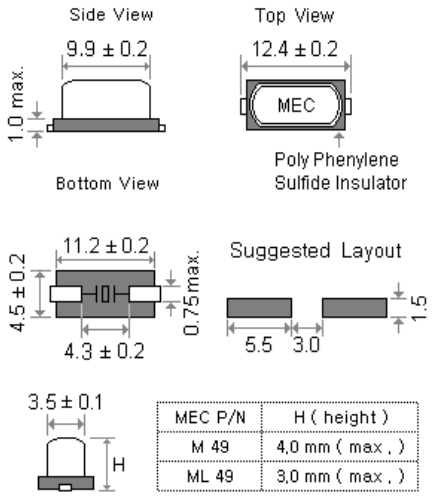
Table 2

| Frequency stability Vs Operating temperature range | | | | | | |
|---|---|---|---|---|---|---|
| Stability code | Temp. (ºC) \ ppm | ± 10 | ± 15 | ± 20 | ± 25 | ± 30 |
| X | -10 to 60°C | ○ | ○ | ○ | ○ | ○ |
| Y | -20 to 70°C | ▲ | ○ | ○ | ○ | ○ |
| I | -40 to 85°C | | ○ | ○ | ○ | ○ |

○ : available ; ▲ : contact Mercury

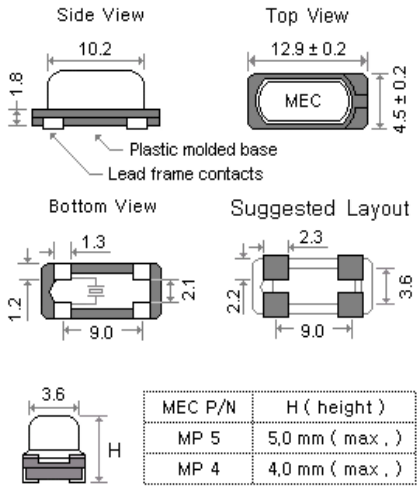
## Outline Dimensions ( Unit : mm )

### [ M49 ] ; [ ML49 ]



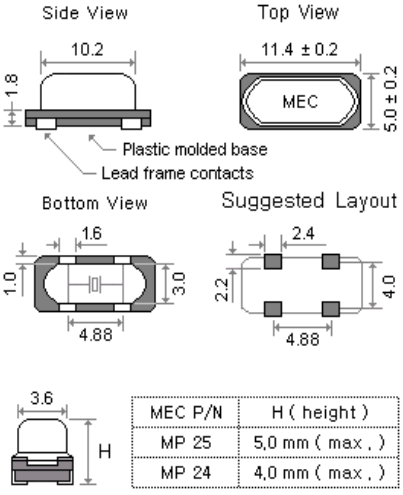

| MEC P/N | H ( height ) |
|---|---|
| M 49 | 4,0 mm ( max , ) |
| ML 49 | 3,0 mm ( max , ) |

### [ MP4 ] ; [ MP5 ]




| MEC P/N | H ( height ) |
|---|---|
| MP 5 | 5,0 mm ( max , ) |
| MP 4 | 4,0 mm ( max , ) |

### [ MP24 ] ; [ MP25 ]




| MEC P/N | H ( height ) |
|---|---|
| MP 25 | 5,0 mm ( max , ) |
| MP 24 | 4,0 mm ( max , ) |

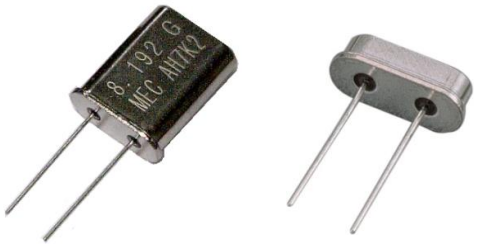
# Quartz Crystals

| H49 | HUS | HUSL | Thru - Hole | Fund. | 3rd O.T. | Min. | Max. |
|---|---|---|---|---|---|---|---|
| 10.7 * 4.5 * 13.2 mm | 10.7 * 4.3 * 3.5 mm | 10.7 * 4.3 * 2.5 mm | | | | 1.8 MHz | 100 MHz |

## Features

Specifications

- Tight tolerance and stability. Ideal for communication equipment
- RoHS complian
- H49 ( 13.2mm height ) & HUS ( 3.5mm height ) & HUSL ( 2.5mm height )
- Low cost and light weight




## General Specifications

| Item / Type | H49 ( 10.7 * 4.5 * 13.2 mm ) series | HUS ( 10.7 * 4.3 * 3.5 mm ) series | HUSL ( 10.7 * 4.3 * 2.5 mm ) series |
|---|---|---|---|
| Frequency Range & Crystal Cut | 1.8432 ~ 100.000 MHz ( see Table 1 ) | 3.200 ~ 48.000 MHz , AT-cut , Fundamental Mode ( see Table 2 )<br>30.000 ~ 100.000 MHz , AT-cut , 3rd overtone ( see Table 2 ) | |
| | For specific details , please feel free to contact us. | | |
| Load Capacitance | Series or Parallel ( 8 to 32 pF ) resonance | | |
| Drive Level | 100 µW ( typ.) 500 µW ( max.) | | |
| Frequency Tolerance | ± 10 ppm , ± 20 ppm or ± 30 ppm ( max.) at 25°C | | |
| Frequency Stability | See Table 3 | | |
| Aging | △F / F : ± 5 ppm & ± 3 ppm year ( max.) | | |
| Storage Temperature Range | - 55°C to 125°C | | |

Table 1

**H49** ESR ( Equivalent Series Resistance )

| Freq.(MHz) | E.S.R. | Osc. Mode | Freq.(MHz) | E.S.R. | Osc. Mode |
|---|---|---|---|---|---|
| 1.8 ~ 1.9 | 650 Ω | AT , Fund. | 4.0 ~ 4.9 | 70 Ω | AT , Fund. |
| 2.0 ~ 2.4 | 450 Ω | | 5.0 ~ 7.9 | 60 Ω | |
| 2.5 ~ 2.9 | 350 Ω | | 8.0 ~ 9.9 | 30 Ω | |
| 3.0 ~ 3.9 | 90 Ω | | 10.0 ~ 50.0 | 30 Ω | |
| | | | 30.0 ~ 100.0 | 60 Ω | AT , 3rd |

Table 2

**HUS** & **HUSL** ESR ( Equivalent Series Resistance )

| Freq.(MHz) | E.S.R. | Osc. Mode | Freq.(MHz) | E.S.R. | Osc. Mode |
|---|---|---|---|---|---|
| 3.2 ~ 3.4 | 300 Ω | AT , Fund. | 30.0 ~ 50.0 | 100 Ω | AT , 3rd |
| 3.5 ~ 6.0 | 120 Ω | | 50.1 ~ 100.0 | 80 Ω | |
| 6.1 ~ 10.0 | 60 Ω | | | | |
| 10.1 ~ 48.0 | 40 Ω | | | | |

Table 3

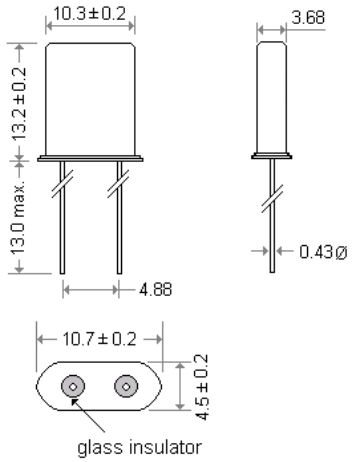
Frequency stability vs Operating temperature range

| Stability code | Temp. (ºC) \ ppm | ± 5 | ± 10 | ± 15 | ± 20 | ± 25 | ± 30 | ± 50 |
|---|---|---|---|---|---|---|---|---|
| X | -10 to 60°C | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Y | -20 to 70°C | ▲ | ○ | ○ | ○ | ○ | ○ | ○ |
| I | -40 to 85°C | | ▲ | ○ | ○ | ○ | ○ | ○ |

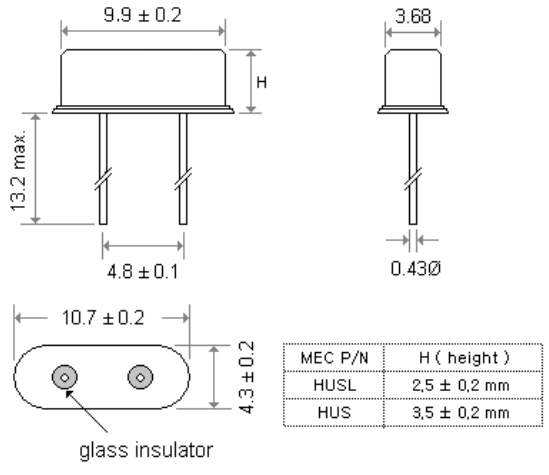
○ : available ; ▲ : contact Mercury

## Outline Dimensions ( Unit : mm )

H49




HUS / HUSL




| MEC P/N | H ( height ) |
|---|---|
| HUSL | 2,5 ± 0,2 mm |
| HUS | 3,5 ± 0,2 mm |

# Quartz Crystals

| U1 | U5 | Thru - Hole | Fund. | 3rd O.T. | Min. | Max. |
|---|---|---|---|---|---|---|
| 7.8 * 3.2 * 8.0 mm | 7.8 * 3.2 * 6.0 mm | | | | 3.2 MHz | 100 MHz |

## Features

Specifications

- Round shaped AT-Cut crystal plate inside
- Annealed and pre-aged for low frequency drift over long-term operation

## General Specifications

| Item / Type | U1 | U5 |
|---|---|---|
| Frequency Range | 3.2 ~ 100 MHz | 8.0 ~ 100 MHz |
| Load Capacitance | Series or Parallel ( 8 to 32 pF ) resonance | |
| Drive Level | 100 µW ( typ.)  500 µW ( max.) | |
| Frequency Tolerance | AT-cut :  ± 10 ppm , ± 20 ppm or ± 30 ppm ( max.) at 25°C | |
| Frequency Stability | See  Table 2 | |
| Aging | △F / F : ±3 ppm / year ( max.) | |
| Storage Temperature Range | - 55°C to 125°C | |

Table 1

| U1  ESR ( Equivalent Series Resistance ) | | |
|---|---|---|
| Freq.(MHz) | E.S.R. | Osc. Mode |
| 3.2 ~ 10.0 | 50 Ω | AT , Fund. |
| 10.1 ~ 50.0 | 30 Ω | |
| 30.0 ~ 100.0 | 40 Ω | AT , 3rd |

| U5  ESR ( Equivalent Series Resistance ) | | |
|---|---|---|
| Freq.(MHz) | E.S.R. | Osc. Mode |
| 8.0 ~ 45.0 | 30 Ω | AT , Fund. |
| 45.1 ~ 74.125 | 60 Ω | |
| 30.0 ~ 100.0 | 40 Ω | AT , 3rd |

Table 2

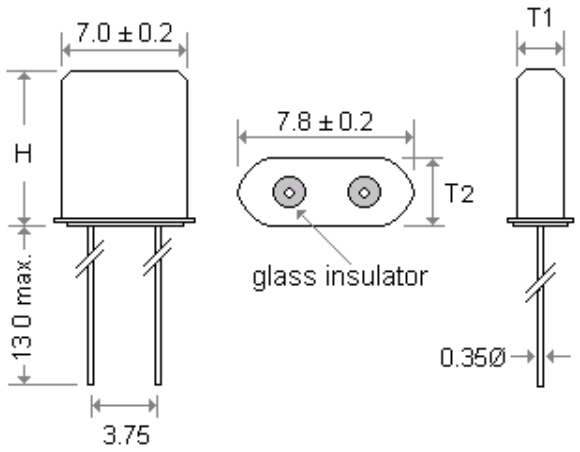
| Frequency stability vs Operating temperature range | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Stability code | Temp. (ºC) \ ppm | ± 5 | ± 10 | ± 15 | ± 20 | ± 25 | ± 30 | ± 50 |
| X | -10  to  60°C | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Y | -20  to  70°C | ▲ | ○ | ○ | ○ | ○ | ○ | ○ |
| I | -40  to  85°C | | ▲ | ○ | ○ | ○ | ○ | ○ |

○ : available

▲ : contact  Mercury

## Outline Dimensions ( Unit : mm )

### Thru - Hole  type  ( U1 , U5 )




| | H | T1 | T2 |
|---|---|---|---|
| U1 | 8.0 ± 0.2 | 2.2 ± 0.2 | 3.2 ± 0.2 |
| U5 | 6.0 ± 0.2 | 2.2 ± 0.2 | 3.2 ± 0.2 |

# Quartz Crystals

| Surface Mount | | Thru - Hole type | | | Frequency Tolerance options | | |
|---|---|---|---|---|---|---|---|
| **X2012** | **X3215** | **T26** | **T38** | **32.768 KHz** | **± 5 ppm** | **± 10 ppm** | **± 20 ppm** |
| [ 2.05 * 1.2 * 0.55 mm ] | [ 3.2 * 1.5 * 0.8 mm ] | [ 2.0ø * 6.0 mm ] | [ 3.0ø * 8.0 mm ] | | | | |

## Features

Specifications

Ultra compact, thin, and light weight tuning fork crystal unit

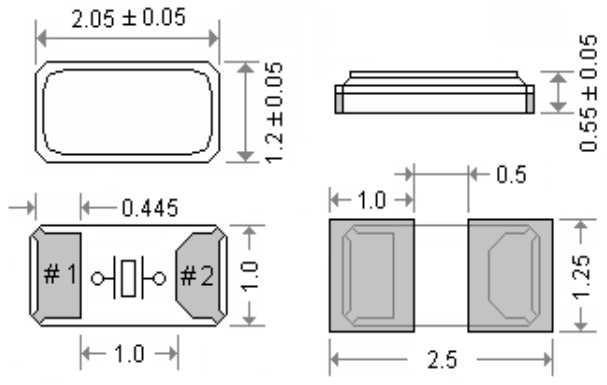
- Excellent heat resistance and environmental characteristics
- Excellent electrical performance optimum for mobile communications, OA ( office automation ) and AV ( audiovisual ) applications
- RoHS Comlipiant. Meets the re-flow profiling requirements using lead-free solder

## General Specifications

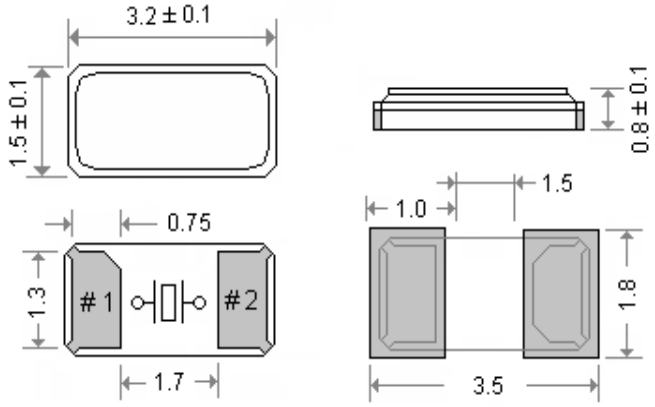
| Frequency Range | 32.768 KHz | | | |
|---|---|---|---|---|
| Hold type | Surface Mount Type | | Thru - Hole Type | |
| Item / Type | **X2012** | **X3215** | **T26** | **T38** |
| Package sizes | [ 2.05 * 1.2 * 0.55 mm ] | [ 3.2 * 1.5 * 0.8 mm ] | [ 2.0ø * 6.0 mm ] | [ 3.0ø * 8.0 mm ] |
| Shunt Capacitance | 1.3 pF ( typ.) / 1.5 pF ( max.) | 1.0 pF ( typ.) / 1.6 pF ( max.) | 1.5 pF ( max.) | 0.9 pF ( max.) |
| Equivalent series resistance | 80 KΩ ( max.) | | 40 KΩ ( max.) | 35 KΩ ( max.) |
| Temperature coefficient | - 0.04 x $10^{-6}$ / °C $^2$ ( max.) | | - 0.035 x $10^{-6}$ / °C $^2$ ( max.) | |
| Drive Level | 0.1 µW ( typ.) 0.5 µW ( max.) | | 1.0 µW ( typ.) | |
| Operating Temperature Range | - 40 °C to 85 °C | | - 10 °C to 60 °C | |
| Storage Temperature Range | - 40 °C to 125 °C | | - 40 °C to 85 °C | |
| Crystal Cut | XT - Cut | | | |
| Load Capacitance | 7 pF , 9 pF or 12.5 pF | | | |
| Frequency Tolerance | ± 5 ppm , ± 10 ppm , ± 20 ppm ( max.) at 25°C | | | |
| Turning POINT | + 25 °C ± 5 °C | | | |
| Insulation resistance | 500 MΩ min. | | | |

## Outline Dimensions ( Unit : mm )

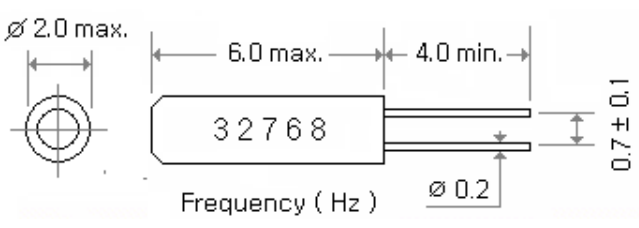
### X2012



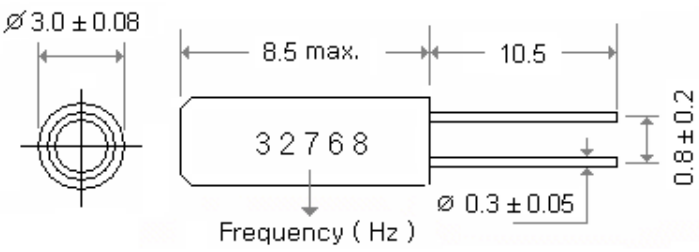

### X3215




### T26




### T38



# Mercury Crystal Oscillators ( XOs ) Products Lineup

## General Clock Oscillators Selection Guide

| Output Wave<br>Output Logic | Product Series | Supply Voltage | Frequency Range | Product Description / Features |
|---|---|---|---|---|
| Square Wave<br>**CMOS** | H ( SMD ) | 1.8 V / 2.5 V / 3.3 V / 5.0 V | 0.05 ~ 160 MHz | General Purpose Clock Oscillators. |
| | H ( Dip ) | | | |
| | HA | 1.8 V / 2.5 V / 3.3 V / 5.0 V | 27.3 ~ 100.0 KHz | Standard Frequncy 32.768 KHz , uA Current Consumption |
| | HEA | 1.8 V / 2.5 V / 3.3 V | 32.768 KHz | Ultra Low Current Consumption |
| | HU | 1.0 V / 1.2 V | 0.625 ~ 50 MHz | Low Supply Voltage |
| | HY | 1.8 V / 2.5 V / 3.3 V | 1.25 ~ 50 MHz | Wide Operating Temperature Over : -40 °C to +125 °C |
| | HJN | 1.8 V / 2.5 V / 3.3 V | 0.625 ~ 60 MHz | Ultra Low Jitter |
| | HTF | 1.8 V / 2.5 V / 3.3 V | 1.0 ~ 200 MHz | Programmable Quick Turn XO |
| | HTQN | 2.5 V / 3.3 V | 50 ~ 250 MHz | Low Jitter Oscillators , RMS Jitter : 0.6 psec ( typ. ) |
| | HTQF | 2.5 V / 3.3 V | 10 ~ 250 MHz | Quick - Turn Clock Oscillators , RMS Jitter : 0.8 psec ( typ. ) |
| | HTJFN | 1.8 V / 2.5 V / 3.3 V | 50 ~ 250 MHz | Quick - Turn Oscillators , Ultra Low Jitter : 150 fsec ( typ.) |
| | HM B | 2.5 V / 3.3 V | 3.0 ~ 200 MHz | Spread Spectrum Oscillators , Programmable Quick Turn XO |
| | HM C | 1.8 V / 2.5 V / 3.3 V | 16 ~ 40 MHz | Spread Spectrum Oscillators , Reduce EMI More Than 3 dB |
| | HCTQF | 2.5 V / 3.3 V | 10 ~ 250 MHz | 2 Frequency Switchablel Oscillators |
| | HCTJFN | 1.8 V / 2.5 V / 3.3 V | 15 ~ 250 MHz | 4 Frequencies Switchable Oscillators |
| Square Wave<br>**LVPECL** | HPK | 2.5 V / 3.3 V | 13.5 ~ 220 MHz | Differential XO with NO PLL , RMS Jitter : 0.2 psec ( typ.) |
| | HPRK | 2.5 V / 3.3 V | 100 ~ 250 MHz | Differential XO with NO PLL , RMS Jitter : 0.1 psec ( typ.) |
| | HPEK | 3.3 V | 13.5 ~ 220 MHz | Superb phase noise Differential XO , RMS Jitter : 98 fsec ( typ.) |
| | HPJK | 2.5 V / 3.3 V | 100 ~ 250 MHz | Ultra Low Jitter Differential XO , RMS Jitter : 50 fsec ( typ.) |
| | HPQN | 2.5 V / 3.3 V | 50 ~ 1,500 MHz | Low Jitter Oscillators , RMS Jitter : 0.6 psec ( typ. ) |
| | HPQF | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | Quick - Turn Clock Oscillators , RMS Jitter : 0.8 psec ( typ. ) |
| | HPJFN | 2.5 V / 3.3 V | 50 ~ 2,100 MHz | Quick - Turn Oscillators , Ultra Low Jitter : 150 fsec ( typ.) |
| | HCPQF | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | 2 Frequencies Switchable XO |
| | HCPJFN | 2.5 V / 3.3 V | 15 ~ 2,100 MHz | 4 Frequencies Switchable XO |
| Square Wave<br>**LVDS** | HDK | 1.8 V / 2.5 V / 3.3 V | 13.5 ~ 220 MHz | Differential XO with NO PLL , RMS Jitter : 0.2 psec ( typ.) |
| | HDRK | 1.8 V / 2.5 V / 3.3 V | 10 ~ 250 MHz | Differential XO with NO PLL , RMS Jitter : 0.1 psec ( typ.) |
| | HDEK | 2.5 V / 3.3 V | 13.5 ~ 220 MHz | Superb phase noise Differential XO , RMS Jitter : 98 fsec ( typ.) |
| | HDJK | 1.8 V / 2.5 V / 3.3 V | 100 ~ 250 MHz | Ultra Low Jitter Differential XO , RMS Jitter : 50 fsec ( typ.) |
| | HDQN | 2.5 V / 3.3 V | 50 ~ 1,500 MHz | High Frequency Oscillators , RMS Jitter : 0.6 psec ( typ.) |
| | HDQF | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | Quick - Turn Clock Oscillators , RMS Jitter : 0.8 psec ( typ. ) |
| | HDJFN | 1.8 V / 2.5 V / 3.3 V | 50 ~ 2,100 MHz | Quick - Turn Oscillators , Ultra Low Jitter : 150 fsec ( typ.) |
| | HCDQF | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | 2 Frequencies Switchable XO |
| | HCDJFN | 1.8 V / 2.5 V / 3.3 V | 15 ~ 2,100 MHz | 4 Frequencies Switchable XO |
| Square Wave<br>**HCSL** | HCK | 1.8 V / 2.5 V / 3.3 V | 13.5 ~ 220 MHz | Differential XO with NO PLL , RMS Jitter : 0.2 psec ( typ.) |
| | HCRK | 1.8 V / 2.5 V / 3.3 V | 20 ~ 220 MHz | Differential XO with NO PLL , RMS Jitter : 0.1 psec ( typ.) |
| | HCEK | 2.5 V / 3.3 V | 13.5 ~ 220 MHz | Superb phase noise Differential XO , RMS Jitter : 98 fsec ( typ.) |
| | HCJK | 1.8 V / 2.5 V / 3.3 V | 100 ~ 175 MHz | Ultra Low Jitter Differential XO , RMS Jitter : 50 fsec ( typ.) |
| | HCJFN | 1.8 V / 2.5 V / 3.3 V | 50 ~ 700 MHz | Quick - Turn Oscillators , Ultra Low Jitter : 150 fsec ( typ.) |
| | HCCJFN | 1.8 V / 2.5 V / 3.3 V | 15 ~ 700 MHz | 4 Frequencies Switchable XO |
| Low Power<br>**HCSL** | HCLK | 1.8 V / 2.5 V / 3.3 V | 95 ~ 180 MHz | Differential XO with NO PLL , RMS Jitter : 0.2 psec ( typ.) |
| Square Wave<br>**CML** | HQJFN | 1.8 V / 2.5 V / 3.3 V | 50 ~ 2,100 MHz | Quick - Turn Oscillators , Ultra Low Jitter : 150 fsec ( typ.) |
| | HCQJFN | 1.8 V / 2.5 V / 3.3 V | 15 ~ 2,100 MHz | 4 Frequencies Switchable XO |
| **Sine Wave** | HS | 3.3 V | 10 ~ 200 MHz | Output level is greater than 0 dBm into 50 Ω load . |
| | | 5.0 V | 10 ~ 156 MHz | Output level is greater than 0 dBm into 50 Ω load . |

# Crystal Oscillators — CMOS Output

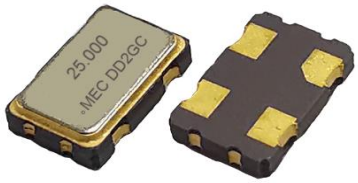
**Surface Mount type**

| H21 | H22 | H32 | H53 | SWO |
|---|---|---|---|---|
| 2.0 * 1.6 * 0.8 | 2.5 * 2.0 * 0.9 | 3.2 * 2.5 * 1.0 | 5.0 * 3.2 * 1.2 | 7.0 * 5.0 * 1.4 |

| CMOS | 1.8 V | 3.3 V | 2.5 V | 5.0 V | Min. | Max. |
|---|---|---|---|---|---|---|
| | | | | | 50 KHz | 160 MHz |

## Applications

- CPU , Graphics , Multimedia A / V clocks
- MPEG / DVD / HDTV clocks
- Laser engine pixel / set - top clocks
- SONET / SDH / ATM clocks
- Fast Ethernet and Gigabit Ethernet clocks
- NTSC / PAL encoder / decoder clocks
- PLL / synthesizer clocks
- Fibre channel and ADSL clocks




## General Specifications [ Ta = +25°C , $V_{DD}$= at specified voltage , Load : 15 pF ]

| Model | | " H21 " ; " H22 " ; " H32 " ; " H53 " and " SWO " series | | | | |
|---|---|---|---|---|---|---|
| Type | | " H21 " series | " H22 " series | " H32 " series | " H53 " series | " SWO " series |
| Dimensions | | 2.0 x 1.6 x 0.8 mm | 2.5 x 2.0 x 0.9 mm | 3.2 x 2.5 x 1.0 mm | 5.0 x 3.2 x 1.2 mm | 7.0 x 5.0 x 1.4 mm |
| Available Frequency Range by Voltage | 1.8 V | 1 MHz ~ 60 MHz | 0.0625 MHz ~ 160 MHz | 0.0625 MHz ~ 160 MHz | 0.05 MHz ~ 160 MHz | 0.05 MHz ~ 160 MHz |
| | 2.5 V | | | | | |
| | 3.3 V | | | | | |
| | 5.0 V | - - - - | 1 MHz ~ 50 MHz | 1 MHz ~ 50 MHz | 0.05 MHz ~ 135 MHz | 0.05 MHz ~ 135 MHz |

| Supply Voltage ( $V_{DD}$ ) | | +1.8 V ± 10% | +2.5 V ± 10% | +3.3 V ± 10% | +5.0 V ± 10% |
|---|---|---|---|---|---|
| | | code is " 18 " | code is " 25 " | code is " 3 " | code is " 5 " |
| Output Logic " High " , " 1 " | | 1.62 V ( min. ) | 2.25 V ( min. ) | 2.97 V ( min. ) | 4.5 V ( min. ) |
| Output Logic " Low " , " 0 " | | 0.18 V ( max. ) | 0.25 V ( max. ) | 0.33 V ( max. ) | 0.5 V ( max. ) |
| Current Consumption | < 25 MHz | 5 mA ( max. ) | 5 mA ( max. ) | 5 mA ( max. ) | 5 mA ( max. ) |
| | 25 ~ 50 MHz | 8 mA ( max. ) | 10 mA ( max. ) | 12 mA ( max.) | 16 mA ( max.) |
| | 51 ~ 100 MHz | 10 mA ( max. ) | 15 mA ( max. ) | 30 mA ( max. ) | 30 mA ( max. ) |
| | 101 ~ 160 MHz | 15 mA ( max. ) | 20 mA ( max. ) | 40 mA ( max. ) | 40 mA ( max. ) |
| Rise Time ( Tr ) / Fall Time ( Tf ) | | 6 nsec. ( max. ) | | | |
| | | Measured between 10% ⟷ 90% of wave form ( CL = 15pF ) | | | |

| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F " For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F30 " ± 30 ppm over -40°C to +85°C |
|---|---|---|---|---|---|
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| | |
|---|---|
| Output Load | 15 pF ; ( 30 pF and 50 pF load are also available for +3.3V and +5.0V $V_{DD}$ ) |
| Duty Cycle | Standard: 50% ± 10% ; Option: 50% ± 5%. Please add "**-S**" at the end of the part number for ± 5% . |
| Start -up Time | 1.0 ~ 32.0 MHz : 5 msec. ( max. ) ; 32.1 ~ 160.0 MHz : 10 msec. ( max. ) |
| Storage Temperature | -55°C to +125°C |
| Aging at Ta=+25°C | ± 3 ppm per year ( max. ) |
| Output Enable / Disable Function | 70% of $V_{DD}$ ( min. ) to enable output. |
| | 30% of $V_{DD}$ ( max.) to disable output. |
| | Disable current : 10 uA max. for OE ≦ 0.3V |

| Thru - Hole | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| H8 | H14 | CMOS | 1.8 V | 2.5 V | 3.3 V | 5.0 V | Min. | Max. |
| 12.8 * 12.8 * 6.3 | 20.2 * 12.8 * 5.8 | | | | | | 50 KHz | 160 MHz |

## Applications

- CPU , Graphics , Multimedia A / V clocks
- MPEG / DVD / HDTV clocks
- Laser engine pixel / set - top clocks
- SONET / SDH / ATM clocks
- Fast Ethernet and Gigabit Ethernet clocks
- NTSC / PAL encoder / decoder clocks
- PLL / synthesizer clocks
- Fibre channel and ADSL clocks

## General Specifications [ Ta = +25°C ]

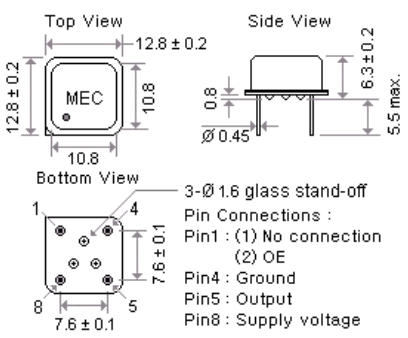
| Type | Thru - Hole type | | | |
|---|---|---|---|---|
| Model ( Dimensions ) | H8 ( 12.8 * 12.8 * 6.3 mm ) | | H14 ( 20.2 * 12.8 * 5.8 mm ) | |
| Supply Voltage ( $V_{DD}$ ) | + 1.8 V ± 10% | + 2.5 V ± 10% | + 3.3 V ± 10% | + 5.0 V ± 10% |
| | code is " 18 " | code is " 25 " | code is " 3 " | code is " 5 " |
| Frequency Range | 0.05 ~ 160 MHz | 0.05 ~ 160 MHz | 0.05 ~ 160 MHz | 0.05 ~ 135 MHz |
| Output Logic " High " , " 1 " | 1.62 V ( min. ) | 2.25 V ( min. ) | 2.97 V ( min. ) | 4.5 V ( min. ) |
| Output Logic " Low " , " 0 " | 0.18 V ( max. ) | 0.25 V ( max. ) | 0.33 V ( max. ) | 0.5 V ( max. ) |
| Current Consumption < 25 MHz | 5 mA ( max. ) | 5 mA ( max. ) | 5 mA ( max. ) | 5 mA ( max. ) |
| Current Consumption 50 MHz | 8 mA ( max. ) | 10 mA ( max. ) | 12 mA ( max. ) | 16 mA ( max. ) |
| Current Consumption 100 MHz | 10 mA ( max. ) | 15 mA ( max. ) | 30 mA ( max. ) | 30 mA ( max. ) |
| Current Consumption 160 MHz | 15 mA ( max. ) | 20 mA ( max. ) | 40 mA ( max. ) | 40 mA ( max. ) |
| Disable Current | 10 uA ( max. ) at OE ≦ 0.3V | | | |

| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F " For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F30 " ± 30 ppm over -40°C to +85°C |
|---|---|---|---|---|---|
| | Commercial ( -20°C to +70°C ) | A | B | C | |
| | Industrial ( -40°C to +85°C ) | D | E | F | |

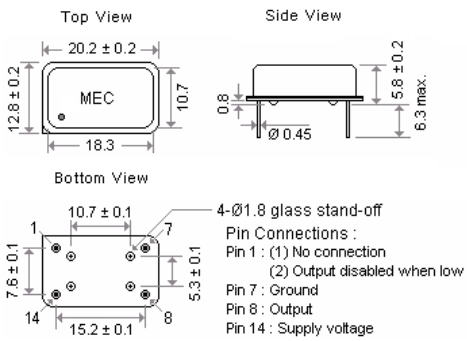
| | |
|---|---|
| Output Load | 15 pF ( max). ; 30 pF load for frequencies up to 70 MHz ; Contact Mercury for 50 pF load |
| Rise Time ( Tr ) | 10 nsec.( max.) ; 3 nsec.( typ.) . Measured between 10% to 90% waveform ( CL=15pF ) |
| Fall Time ( Tf ) | 10 nsec.( max.) ; 3 nsec.( typ.) . Measured between 10% to 90% waveform ( CL=15pF ) |
| Duty Cycle | 50% ± 10 % of waveform [ 50% ± 5% is also available , add " S " at the end of the part number ] |
| Start - Up Time | 10 msec. ( max.) ; 5 msec. ( typ.) |
| Storage Temperature | -55°C to +125°C |
| Aging at Ta=+25°C | ± 5.0 ppm per year ( max.) |
| Output Enable / Disable Function on pin1 | 70% of $V_{DD}$ ( min. ) to enable output. |
| | 30% of $V_{DD}$ ( max.) to disable output. |
| | Add " T " in part number for OE option |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

[ H8 ; H_8 ]




[ H14 ; H_14 ]



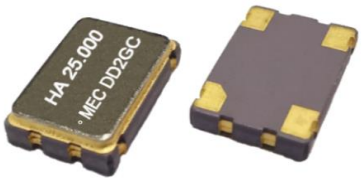
# Crystal Oscillators [ 32.768 KHz , 27.3 ~ 100.0 KHz ]

CMOS Output

| HA _ _ | 32.768 KHz<br>uA Current Consumption | SMD | CMOS | 1.8 V | 2.5 V<br>3.3 V | 5.0 V | Min.<br>27.3 KHz | Max.<br>100.0 KHz |
|---|---|---|---|---|---|---|---|---|

## Features

- Features an AT-Cut crystal for high frequency stability, while providing a low micro Amp ( μA ) current consumption that would normally only be available from an X-Cut tuning fork crystal
- 32.768 KHz is popular for Real Time Clocks and other timing applications
- For even tighter frequency stability ( ± 5 ppm over -40 to 85 °C ) and lower current consumption ( 1.2 uA at 3.3V ) , please contact Mercury




## General specifications of all available packages , at Ta=+25°C , CL=15pF

| Type | " HA " series [ SMD Type ] | | | |
|---|---|---|---|---|
| **Model** | **HA22** | **HA32** | **HA53** | **HA57** |
| Dimensions | 2.5 * 2.0 * 0.9 mm | 3.2 * 2.5 * 1.0 mm | 5.0 * 3.2 * 1.2 mm | 7.0 * 5.0 * 1.4 mm |

| | | | | |
|---|---|---|---|---|
| Frequency Output Range | 32.768 KHz ( standard ) | | | |
| | 27.3 KHz ~ 100 KHz | 27.3 KHz ~ 100 KHz | 27.3 KHz ~ 100 KHz | 27.3 KHz ~ 52 KHz |
| Supply Voltage | 1.8 V ± 10%<br>Voltage code is " 18 " | 2.5 V ± 10%<br>Voltage code is " 25 " | 3.3 V ± 10%<br>Voltage code is " 3 " | 5.0 V ± 10%<br>Voltage code is " 5 " |
| Current Consumption<br>( 32.768 KHz , Load 15pF ) | 32 uA ( typ. )<br>50 uA ( max. ) | 32 uA ( typ. )<br>50 uA ( max. ) | 33 uA ( typ. )<br>50 uA ( max. ) | 36 uA ( typ. )<br>60 uA ( max. ) |
| Output Logic " High " , " 1 " | 1.62 V ( min.) | 2.25 V ( min.) | 2.97 V ( min.) | 4.5 V ( min. ) |
| Output Logic " Low " , " 0 " | 0.18 V ( max.) | 0.25 V ( max.) | 0.33 V ( max.) | 0.5 V ( max. ) |
| Rise Time ( Tr ) / Fall Time ( Tf )<br>( 10 % ⟷ 90 % waveform ) | 20 nsec ( max. ) | 20 nsec ( max. ) | 12 nsec ( max. ) | 12 nsec ( max. ) |

| | | | | | |
|---|---|---|---|---|---|
| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F "<br>For example :<br>" C20 " ± 20 ppm over -20°C to +70°C ;<br>" F30 " ± 30 ppm over -40°C to +85°C |
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| | |
|---|---|
| Output Load | 15 pF |
| Start-up Time | 1.0 msec. ( typ. ) ; 5.0 msec. ( max. ) |
| Duty Cycle | 50% ± 5% |
| Output Enable / Disable Function | 70% of $V_{DD}$ ( min. ) to enable output. |
| | 30% of $V_{DD}$ ( max. ) to disable output. |
| | Disable current : 3 uA ( max.) for OE ≦ 0.3V |
| Storage Temperature | -55°C to +125°C |
| Aging at Ta=+25ºC | ± 3 ppm ( max. ) first year ; ± 2 ppm ( max. ) per year thereafter |

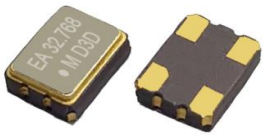
# Ultra Low Current Crystal Oscillators [ 32.768 KHz ]

CMOS Output

| HEA _ _ | 32.768 KHz<br>Ultra Low Current Consumption | SMD | CMOS | 15pF | 1.8 V | 2.5 V | 3.3 V |
|---|---|---|---|---|---|---|---|

## Features

- Suitable for wearable devices, clock counting use.
- Small package size for 2.5 x 2.0 mm
- If you require products with lower current consumption, please contact Mercury.



## General specifications of all available packages , at Ta=+25°C , CL=15pF

| Type | " HEA " series [ SMD Type ] | | | |
|---|---|---|---|---|
| **Model** | **HEA22** | **HEA32** | **HEA53** | **HEA57** |
| Dimensions | 2.5 * 2.0 * 0.9 mm | 3.2 * 2.5 * 1.0 mm | 5.0 * 3.2 * 1.2 mm | 7.0 * 5.0 * 1.4 mm |

| | | | |
|---|---|---|---|
| Frequency Output | 32.768 KHz | | |
| Supply Voltage | 1.8 V ± 10%<br>Voltage code is " 18 " | 2.5 V ± 10%<br>Voltage code is " 25 " | 3.3 V ± 10%<br>Voltage code is " 3 " |
| Current Consumption<br>( 32.768 KHz , No Load ) | 6 uA ( typ. )<br>10 uA ( max. ) | 6 uA ( typ. )<br>10 uA ( max. ) | 6 uA ( typ. )<br>10 uA ( max. ) |
| Output Logic " High " , " 1 " | 1.62 V ( min. ) | 2.25 V ( min. ) | 2.97 V ( min. ) |
| Output Logic " Low " , " 0 " | 0.18 V ( max. ) | 0.25 V ( max. ) | 0.33 V ( max. ) |
| Rise Time ( Tr ) / Fall Time ( Tf )<br>( 10 % ⟷ 90 % waveform ) | 7 nsec ( typ. )<br>20 nsec ( max. ) | 7 nsec ( typ. )<br>20 nsec ( max. ) | 6 nsec ( typ. )<br>20 nsec ( max. ) |

| | | | | | |
|---|---|---|---|---|---|
| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F "<br>For example :<br>" C20 " ± 20 ppm over -20°C to +70°C ;<br>" F30 " ± 30 ppm over -40°C to +85°C |
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| | |
|---|---|
| Output Load | 15 pF |
| Start-up Time | 5.0 msec. ( typ. ) ; 10.0 msec. ( max. ) |
| Duty Cycle | 50% ± 5% |
| Output Enable / Disable Function | 70% of $V_{DD}$ ( min. ) to enable output. |
| | 30% of $V_{DD}$ ( max. ) to disable output. |
| | Disable current : 5 uA ( max. ) for OE = GND |
| Storage Temperature | -55°C to +150°C |
| Aging at Ta=+25ºC | ± 3 ppm ( max. ) first year ; ± 2 ppm ( max. ) per year thereafter |

# Low Supply Voltage Crystal Oscillators — CMOS Output

| HU _ _ | Low Supply Voltage | SMD | CMOS | 1.0 V | 1.2 V | Min. 0.625 MHz | Max. 50 MHz |
|---|---|---|---|---|---|---|---|

## Features

- Low 1.0V to 1.2V supply voltage
- Low current consumption
- 2.5 x 2.0 mm small size package


## General specifications of all available packages , at Ta=+25°C , CL=15pF

| Model [ Output Logic ] | " HU " series [ CMOS ] | | | |
|---|---|---|---|---|
| Type | HU22 | HU32 | HU53 | HU57 |
| Dimemsions | 2.5 * 2.0 * 0.9 mm | 3.2 * 2.5 * 1.0 mm | 5.0 * 3.2 * 1.2 mm | 7.0 * 5.0 * 1.4 mm |
| Frequency Range | 0.625 ~ 50.0 MHz | | | |

| | | |
|---|---|---|
| Supply Voltage ( $V_{DD}$ ) | +1.0 V ± 5% | +1.2 V ± 5% |
| | Voltage code is " 10 " | Voltage code is " 12 " |
| Current Consumption | 1.0 mA ( typ. ) ; 3.0 mA ( max. ) | 1.3 mA ( typ. ) ; 3.0 mA ( max. ) |
| Current With Output Disable | 10 uA ( max. ) | 10 uA ( max. ) |
| Output Logic " High " , " 1 " | 0.8 V ( min. ) | 0.96 V ( min. ) |
| Output Logic " Low " , " 0 " | 0.2 V ( max. ) | 0.24 V ( max. ) |
| Rise Time ( Tr ) / Fall Time ( Tf ) | 8.0 nsec. ( max. ) | 6.0 nsec. ( max. ) |
| | Measured between 20 % ⟷ 80 % of $V_{DD}$ | |

| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F " |
|---|---|---|---|---|---|
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F30 " ± 30 ppm over -40°C to +85°C |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

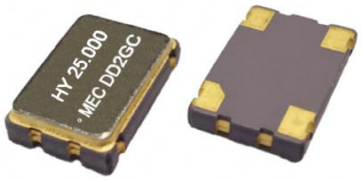
| | |
|---|---|
| Supply Voltage vs Freq. Sensitivity | ± 1.0 ppm ( max. ) |
| Output Load | 15 pF |
| Start-up Time | 0.8 msec ( typ. ) ; 5.0 msec ( max. ) |
| Duty Cycle | 50% ± 5% |
| Output Enable / Disable Function on pin1 | 70% of $V_{DD}$ ( min. ) to enable output. |
| | 30% of $V_{DD}$ ( max. ) to disable output. |
| Enable / Disable Time | Enable : 5.0 msec. ( max. ) |
| | Disable : 100 nsec. ( max. ) |
| Storage Temperature | -55°C to +150°C |
| Aging at Ta=+25ºC | ± 3 ppm ( max. ) first year |
| RMS Jitter [ 12 kHz ~ 20 MHz ] | 0.75 ps ( typ. ) |

| SSB Phase Noise | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz | 1 MHz | 5 MHz | 20 MHz |
|---|---|---|---|---|---|---|---|---|---|
| 25.000MHz [ 1.0V ] | dBc/Hz (typ.) | -75 | -107 | -128 | -138 | -141 | -149 | -153 | --- |
| 50.000MHz [ 1.2V ] | dBc/Hz (typ.) | -83 | -112 | -136 | -140 | -147 | -155 | -155 | -156 |

| HY _ _ | Wide Operating Temperature | SMD | CMOS | 1.8 V | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| | Over - 40 °C to + 125 °C | | | | | | 1.25 MHz | 50.0 MHz |

## Features

- Femtosecond RMS phase jitter. 150 fs typical ( 12 KHz ~ 5 MHz )
- Superior phase noise: -155 dBc/Hz at 10 KHz and -160 dBc/Hz at 100 KHz offset
- Wide Operating Temperature range from -40 °C to +125 °C

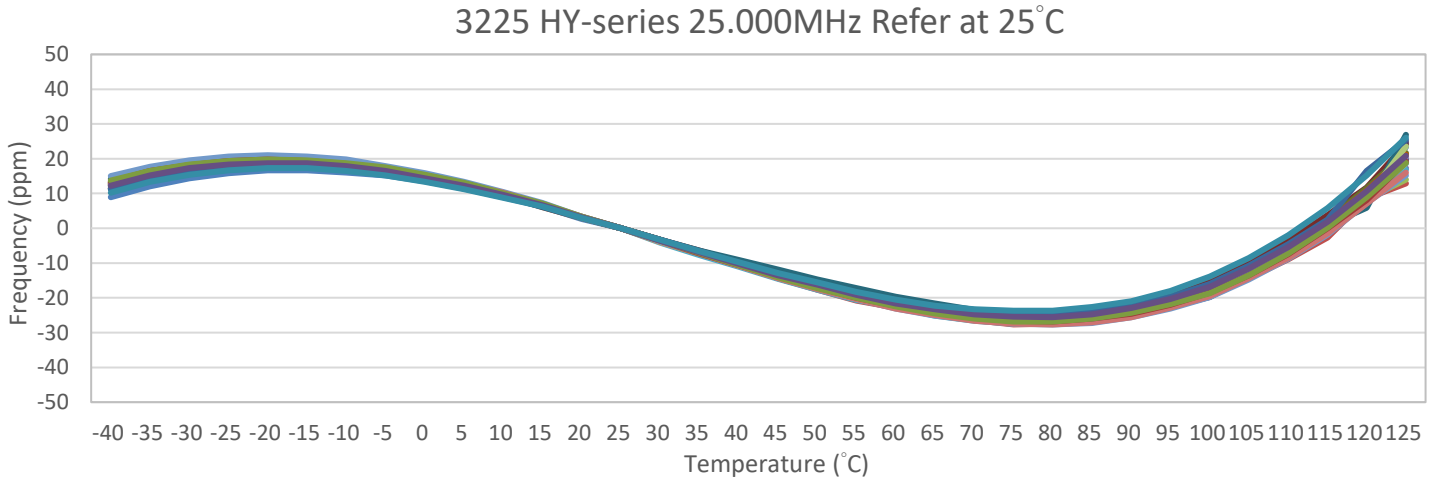



## General specifications of all available packages , at Ta=+25°C , CL=15pF

| Model [ Output Logic ] | | " HY " series [ CMOS ] | | | |
|---|---|---|---|---|---|
| Type | | HY22 | HY32 | HY53 | HY57 |
| Dimensions | | 2.5 * 2.0 * 0.9 mm | 3.2 * 2.5 * 1.0 mm | 5.0 * 3.2 * 1.2 mm | 7.0 * 5.0 * 1.4 mm |
| Available Frequency Range | | 1.25 ~ 50.0 MHz | | | |
| Supply Voltage ( $V_{DD}$ ) | | +1.8 V ± 10% | +2.5 V ± 10% | +3.3 V ± 10% | |
| Supply Voltage Code | | " 18 " | " 25 " | " 3 " | |
| Current Consumption [ 15pF load ] | 1.25 ~ 19.99 MHz | 2.0 mA ( max.) | 3.0 mA ( max.) | 4.0 mA ( max.) | |
| | 20.0 ~ 50.00 MHz | 4.0 mA ( max.) | 5.0 mA ( max.) | 6.0 mA ( max.) | |
| Frequency Stability Codes | Frequency Stability over | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " K " For example : " K40 " ± 40 ppm over -40°C to +125°C |
| | Car Grade ( -40°C to +125°C ) | --- | *K50* | *K100* | |
| Rise Time ( Tr ) / Fall Time ( Tf ) | | 10 nsec. ( max.) | | | |
| | | Measured between 10% ⟷ 90% of waveform ( CL = 15pF ) | | | |
| Output Load | | 15 pF | | | |
| Start-up Time | | 5.0 msec. ( max.) | | | |
| Duty Cycle | | Standard: 50% ± 10% ; Option: 50% ± 5%. Please add "-S" at the end of the part number for ± 5% . | | | |
| Output Enable / Disable Function | | 70% of $V_{DD}$ ( min.) to Enable Output. | | | |
| | | 30% of $V_{DD}$ ( max.) to Disable Output. | | | |
| Phase Jitter ( RMS ) [ 26 MHz , 3.3V ] | | 150 fsec ( typ. ) [ 12 KHz to 5 MHz integated ] | | | |

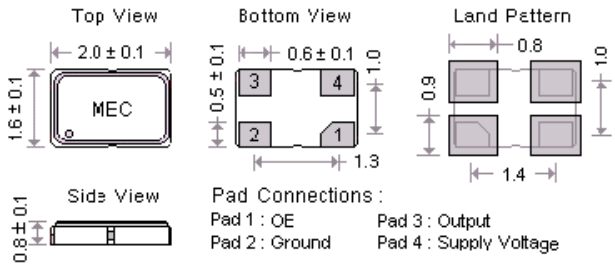
| SSB Phase Noise [ 26 MHz , 3.3V ] | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100KHz | 1 MHz | 5 MHz |
|---|---|---|---|---|---|---|---|---|
| | dBc / Hz ( typ.) | -94 | -127 | -142 | -156 | -161 | -163 | -163 |

| | |
|---|---|
| Storage Temperature | -65°C to +150°C |
| Aging at Ta=+25ºC | ± 2 ppm ( max.) for first year |

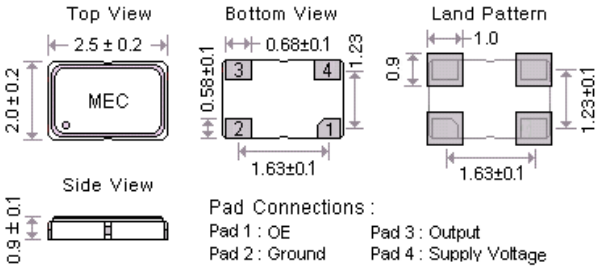


## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

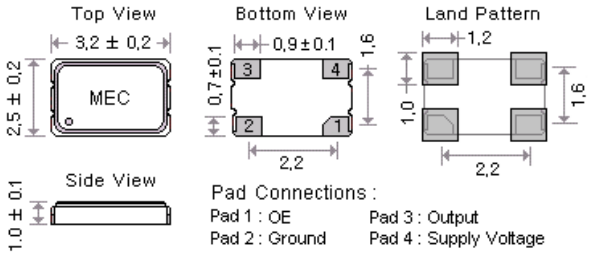
### [ H21 ]



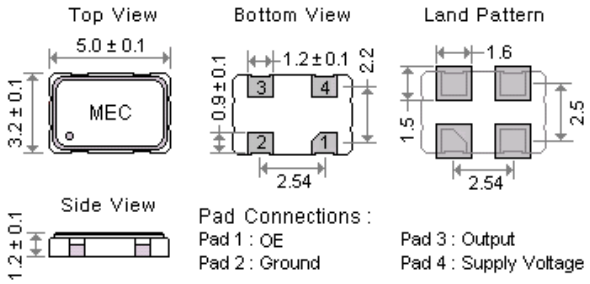

### [ H22 ; H_22 ]



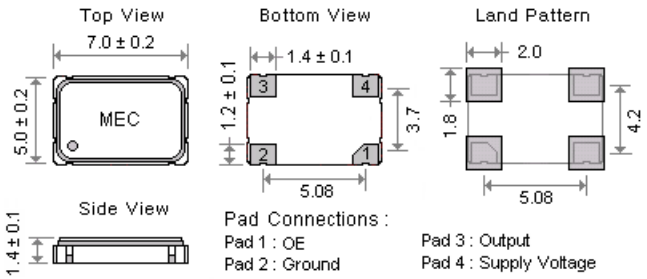

### [ H32 ; H_32 ]




### [ H53 ; H_53 ]




### [ SWO ; H_57 ]



## Part Number Format and Examples

| | [ 1 ] Supply Voltage | [ 2 ] Holder Type | - | [ 3 ] Frequency Stability | [ 4 ] OE Function | - | [ 5 ] Center Frequency |
|---|---|---|---|---|---|---|---|
| Examples (1) | 3 | SWO | - | D | T | - | 25.000 |
| (2) | 3 | HY32 | - | K50 | T | - | 24.000 |
| (3) | 18 | HA32 | - | B | T | - | 32.768K |
| (4) | 3 | H22 | - | E | T | - | 49.152 |

Ex (1) : 3SWO - DT - 25.000 [ 3.3V , H seires 7050 type , ±25ppm from -40°C to +85°C , OE Function , 25.000MHz ]

Ex (2) : 3HY32 - K50T - 24.000 [ 3.3V , HY seires 3225 type , ±50ppm from -40°C to +125°C , OE Function , 24.000MHz ]

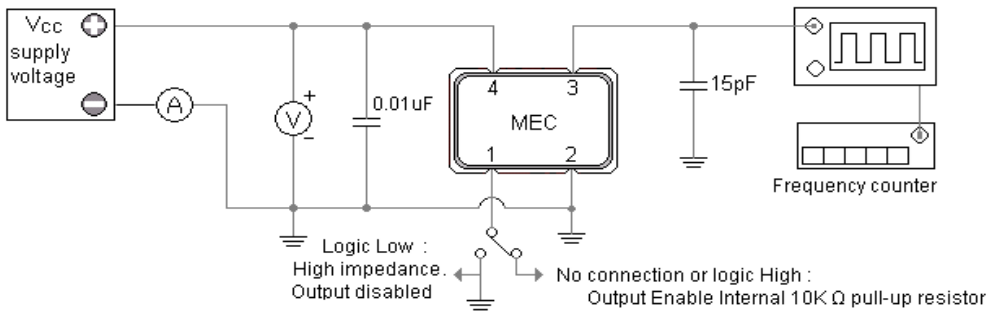
Ex (3) : 18HA32 - BT - 32.768K [ 1.8V , HA seires 3225 type , ±50ppm from -20°C to +70°C , OE Function , 32.768KHz ]

Ex (4) : 3H22 - ET - 49.152 [ 3.3V , H seires 2520 type , ±50ppm from -40°C to +85°C , OE Function , 49.152 MHz ]

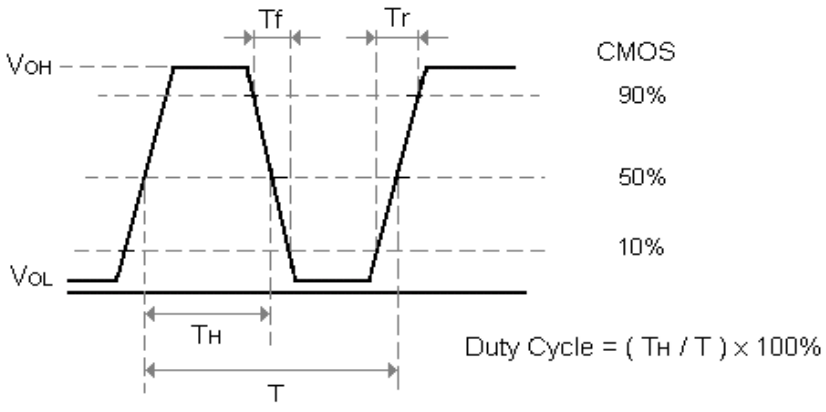
| | | |
|---|---|---|
| [1] | Supply voltage " 10 " for +1.0V ; " 12 " for +1.2V ; " 18 " for +1.8V ; " 25 " for +2.5V ; " 3 " for +3.3V ; " 5 " for +5.0V | |
| [2] | Holder Type | |
| [3] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " C " , example " C15 " : represents ±15ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " F " , example " F30 " : represents ± 30ppm over -40 to +85°C |
| [4] | " T " for OE Function , Leave this space blank if no connection on pad 1. | |
| [5] | Frequency in MHz | |

## Test Circuit & Test Waveform

### H ; H_ - series CMOS Test Circuit




### CMOS Output Waveform



# Crystal Oscillators [ 0.625 ~ 60.0 MHz ] — CMOS Output

| HJN _ _ | Ultra Low Jitter | SMD | CMOS | 1.8 V | 2.5 V | 3.3 V | Min. 0.625 MHz | Max. 60 MHz |
|---|---|---|---|---|---|---|---|---|

## Features

- The HJN series is Low jitter crystal oscillators.
- Compared with standard oscillator, Mercury's HJN series has much better phase noise and jitter. HJN series with output frequency 49.152MHz has phase jitter 57 fsec (RMS, 12 KHz to 20 MHz) when $V_{DD}$ at 3.3V.


## General specifications of all available packages , at Ta=+25°C , CL=15pF

| Model [ Output Logic ] | " HJN " series [ CMOS ] | | | |
|---|---|---|---|---|
| **Type** | **HJN22** | **HJN32** | **HJN53** | **HJN57** |
| Dimemsions | 2.5 * 2.0 * 0.9 mm | 3.2 * 2.5 * 1.0 mm | 5.0 * 3.2 * 1.2 mm | 7.0 * 5.0 * 1.4 mm |

| | | | |
|---|---|---|---|
| Supply Voltage ( $V_{DD}$ ) | 1.8 V ± 10%<br>Voltage code is " 18 " | 2.5 V ± 10%<br>Voltage code is " 25 " | 3.3 V ± 10%<br>Voltage code is " 3 " |
| Frequency Range | 0.625 ~ 50.0 MHz | 0.625 ~ 60.0 MHz | 0.625 ~ 60.0 MHz |
| Current Consumption | 2 mA ( typ. ) ; 5 mA ( max. ) | 3 mA ( typ. ) ; 7 mA ( max. ) | 5 mA ( typ. ) ; 10 mA ( max. ) |
| Current With Output Disable | 20 uA ( max. ) | 20 uA ( max. ) | 20 uA ( max. ) |
| Output Logic " High " , " 1 " | 1.62 V ( min. ) | 2.25 V ( min. ) | 2.97 V ( min. ) |
| Output Logic " Low " , " 0 " | 0.18 V ( max. ) | 0.25 V ( max. ) | 0.33 V ( max. ) |
| Rise Time ( Tr ) / Fall Time ( Tf )<br>( 10 % ⟷ 90 % waveform ) | 2.0 nsec. ( typ. )<br>5.0 nsec. ( max. ) | 1.0 nsec. ( typ. )<br>4.0 nsec. ( max. ) | 1.0 nsec. ( typ. )<br>3.0 nsec. ( max. ) |

| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " ; " F " ; " J " represents . For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F30 " ± 30 ppm over -40°C to +85°C ; " J40 " ± 40 ppm over -40°C to +105°C |
|---|---|---|---|---|---|
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |
| | Extended Industrial ( *-40°C to +105°C* ) | *G* | *H* | *J* | |

| | |
|---|---|
| Output Load | 15 pF |
| Start-up Time | 0.4 msec ( typ. ) ; 1.0 msec ( max. ) |
| Duty Cycle | 50% ± 5% |
| Output Enable / Disable Function on pin1 | 70% of $V_{DD}$ ( min. ) to enable output. |
| | 30% of $V_{DD}$ ( max. ) to disable output. |
| Enable / Disable Time | Enable : 1.0 msec. ( max. ) |
| | Disable : 200 nsec. ( max. ) |
| Storage Temperature | -55°C to +150°C |
| Aging at Ta=+25ºC | ± 3 ppm ( max. ) first year |
| RMS Jitter [ 12 kHz ~ 20 MHz ] | 57 fsec ( typ. ) @ 3.3V , 49.152MHz |

| SSB Phase Noise | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz | 1 MHz | 5 MHz | 20 MHz |
|---|---|---|---|---|---|---|---|---|---|
| 24.000MHz [ 3.3V ] | dBc/Hz ( typ. ) | -78 | -111 | -142 | -154 | -167 | -171 | -171 | --- |
| 49.152MHz [ 3.3V ] | dBc/Hz ( typ. ) | -83 | -113 | -137 | -151 | -166 | -171 | -171 | -171 |

## Part Number Format and Examples

| | [ 1 ] | [ 2 ] | - | [ 3 ] | [ 4 ] | - | [ 5 ] |
|---|---|---|---|---|---|---|---|
| | Supply Voltage | Holder Type | | Frequency Stability | OE Function | | Center Frequency |
| Examples (1) | 18 | HJN57 | - | D | T | - | 25.000 |
| (2) | 25 | HJN32 | - | A | T | - | 24.000 |
| (3) | 3 | HJN22 | - | H | T | - | 32.000 |

Ex (1) : 18HJN57 - DT - 25.000 [ 1.8V , HJN seires 7050 type , ±25ppm from -40°C to +85°C , OE Function , 25.000MHz ]

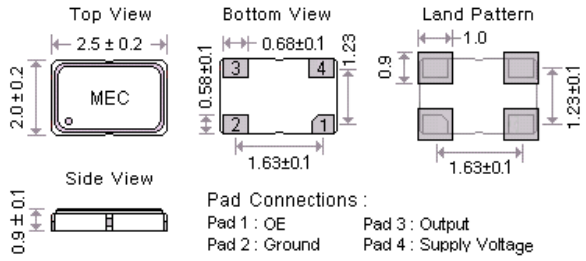
Ex (2) : 25HJN32 - AT - 24.000 [ 2.5V , HJN seires 3225 type , ±25ppm from -20°C to +70°C , OE Function , 24.000MHz ]

Ex (3) : 3HJN22 - HT - 32.000 [ 3.3V , HJN seires 2520 type , ±50ppm from -40°C to +105°C , OE Function , 32.000MHz ]

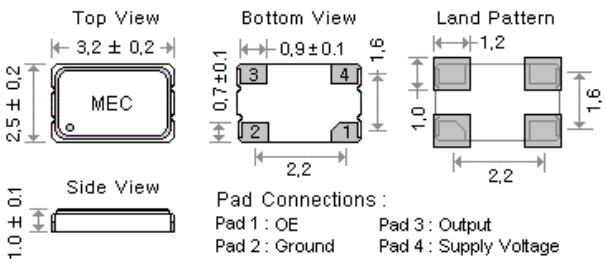
| | | |
|---|---|---|
| [1] | Supply voltage " 18 " for +1.8V ; " 25 " for +2.5V ; " 3 " for +3.3V | |
| [2] | Holder Type | |
| [3] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ;<br>If non-standard please enter the desired stability after " C " , for example " C15 " : represents ±15ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ;<br>If non-standard please enter the desired stability after " F " , for example " F30 " : represents ±30ppm over -40 to +85°C |
| | -40°C ~ 105°C | " G " ± 25ppm ; " H " ± 50ppm ; " J " ± 100ppm ;<br>If non-standard please enter the desired stability after " J " , for example " J40 " : represents ±40ppm over -40 to +105°C |
| [4] | " T " for OE Function , Leave this space blank if no connection on pad 1. | |
| [5] | Frequency in MHz | |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

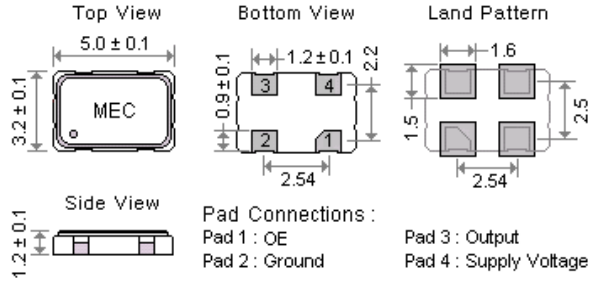
### [ HJN22 ]



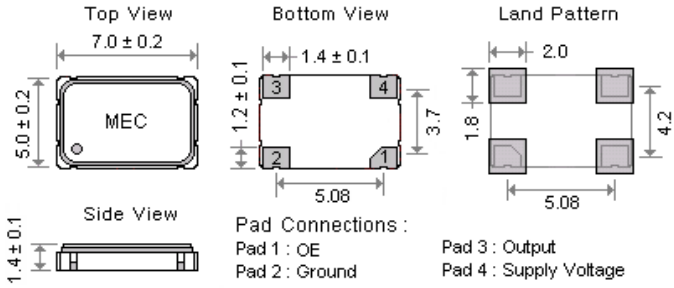

### [ HJN32 ]




### [ HJN53 ]

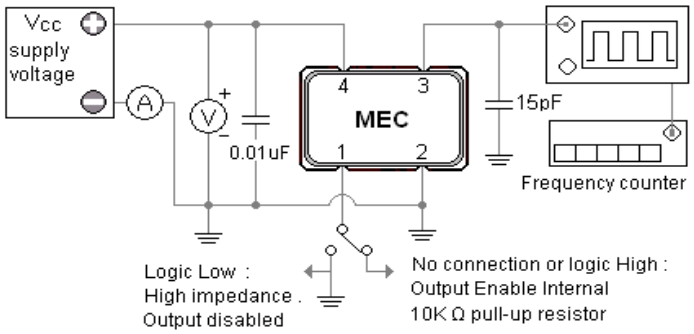



### [ HJN57 ]

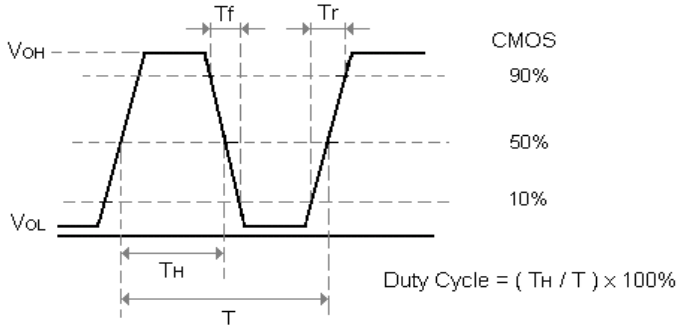



## Test Circuit & Test Waveform

### H ; H_ - series CMOS Test Circuit




### CMOS Output Waveform



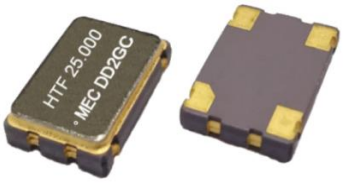
# Crystal Oscillators [ Programmable Quick Turn ]

| HTF _ _ | Quick - Turn Clock Oscillators | SMD | CMOS | 1.8 V | 2.5 V | 3.3 V | Min. 1.0 MHz | Max. 200 MHz |
|---|---|---|---|---|---|---|---|---|

**Features**

**0.9 ps Phase Jitter ( typical )**

- Short lead time. From 1 day to 1 week
- Low jitter , RMS jitter is 0.9 ps typical
- Custom frequencies can easily be configured
- 1.8V, 2.5V or 3.3V supply voltages.




General specifications of all available packages , at Ta=+25°C , CL=15pF

| Model [ Output Logic ] | " HTF " series [ CMOS ] | | | | |
|---|---|---|---|---|---|
| **Type** | **HTF21** | **HTF22** | **HTF32** | **HTF53** | **HTF57** |
| Dimensions | 2.0 * 1.6 * 0.8 mm | 2.5 * 2.0 * 0.8 mm | 3.2 * 2.5 * 1.0 mm | 5.0 * 3.2 * 1.2 mm | 7.0 * 5.0 * 1.3 mm |

| | | | |
|---|---|---|---|
| Supply Voltage ( $V_{DD}$ ) | +1.8 V ± 5% | +2.5 V ± 10% | +3.3 V ± 10% |
| Available Frequency Range | 1.0 ~ 125.0 MHz | 1.0 ~ 200.0 MHz | 1.0 ~ 200.0 MHz |
| Current Consumption | 20 mA ( typ. )<br>30 mA ( max. ) | 28 mA ( typ. )<br>35 mA ( max. ) | 30 mA ( typ. )<br>40 mA ( max. ) |
| Rise Time ( Tr ) / Fall Time ( Tf )<br>10% ⟷ 90% Waveform | 2.0 ns ( typ. )<br>5.0 ns ( max. ) | 1.4 ns ( typ. )<br>3.0 ns ( max. ) | 1.1 ns ( typ. )<br>3.0 ns ( max. ) |

| | | | | | |
|---|---|---|---|---|---|
| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F " represents.<br>For example :<br>" C20 " ± 20 ppm over -20°C to +70°C ;<br>" F30 " ± 30 ppm over -40°C to +85°C |
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Output Logic " High " , " 1 " | $V_{DD}$ - 0.4V ( min. ) | | | | | | | |
| Output Logic " Low " , " 0 " | 0.4V ( max. ) | | | | | | | |
| Duty Cycle | 1 MHz to 150 MHz : 50% ± 5%<br>151 MHz to 200 MHz : 50% ± 10% | | | | | | | |
| Output Load | 15 pF | | | | | | | |
| Start-up Time | 4.5 msec ( typ. ) ; 10 msec ( max. ) | | | | | | | |
| Storage Temperature | -55°C to +150°C | | | | | | | |
| Aging at Ta=+25ºC | ± 3 ppm ( max. ) first year ; ± 2 ppm ( max. ) per year thereafter | | | | | | | |
| SSB Phase Noise | Offset | 10 Hz | 100 Hz | 1 kHz | 10 kHz | 100 kHz | 1 MHz | 10 MHz |
| 125.000 MHz @ 3.3 V | dBc/Hz | -61 | -89 | -110 | -119 | -119 | -142 | -149 |
| RMS Jitter ( 12kHz ~ 20 MHz ) | 0.9 psec ( typ. ) | | | | | | | |

| Output Enable / Disable Function | | |
|---|---|---|
| Output Enable / Disable | | 70% of $V_{DD}$ ( min. ) to Enable. |
| | | 30% of $V_{DD}$ ( max. ) to Disable. |
| Pad 1 Options | Power Down Mode ( code : PD ) | Disable Current : 300 uA ( typ. ) ; 400 uA ( max. ) |
| | | Output Enable Time : 4.5 msec. ( typ. ) ; 10 msec. ( max. ) |
| | OE Mode. High Enable ( code : OE ) | Disable Current : 18 mA ( typ. ) ; 22 mA ( max. ) |
| | | Output Enable Time : 10 nsec. ( max. ) |

# Crystal Oscillators [ Programmable Quick Turn ]

| HTF _ _ | Quick - Turn Clock Oscillators | SMD | CMOS | 1.8 V / 2.5 V / 3.3 V | Min. 1.0 MHz | Max. 200 MHz |
|---|---|---|---|---|---|---|

**0.9 ps Phase Jitter ( typical )**

## Part Number Format and Examples

| | [ 1 ] Supply Voltage | [ 2 ] Holder Type | - | [ 3 ] Frequency Stability | [ 4 ] T | - | [ 5 ] Center Frequency | - | [ 6 ] Disable Options |
|---|---|---|---|---|---|---|---|---|---|
| Examples (1) | 18 | HTF57 | - | B | T | - | 25.000 | - | PD |
| (2) | 25 | HTF53 | - | C30 | T | - | 100.000 | - | OE |
| (3) | 3 | HTF32 | - | E | T | - | 200.000 | - | PD |

Ex (1) : 18HTF57 - BT - 25.000 - PD [ 1.8V , HTF57 type , ±50ppm @ -20°C to +70°C , E/D , 25.000MHz , Power Down Mode ]

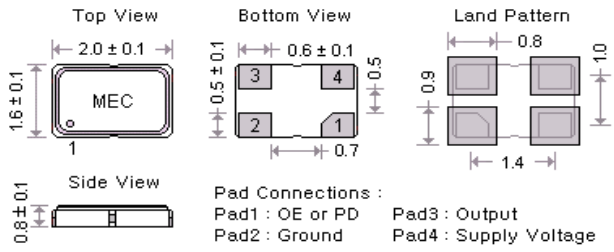
Ex (2) : 25HTF53 - C30T - 100.000 - OE [ 2.5V , HTF53 type , ±30ppm @ -20°C to +70°C , E/D , 100.000MHz , OE Mode ]

Ex (3) : 3HTF32 - ET - 200.000 - PD [ 3.3V , HTF32 type , ±50ppm @ -40°C to +85°C , E/D , 200.000MHz , Power Down Mode ]

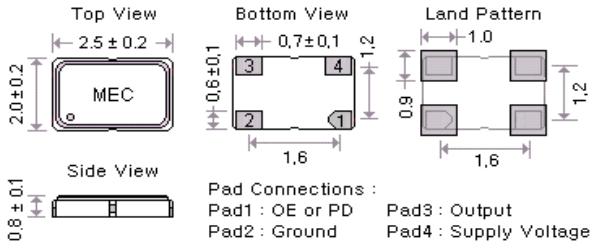
| | | |
|---|---|---|
| [1] | Supply voltage , " 18 " for +1.8V ; " 25 " for +2.5V ; " 3 " for +3.3V | |
| [2] | Holder Type | |
| [3] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " C " ; example " C15 " : represents ±15ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " F " ; example " F30 " : represents ± 30ppm over -40 to +85°C |
| [4] | " T " for Output Enable/Disable Function | |
| [5] | Frequency in MHz | |
| [6] | Pad 1 Options , " PD " Power Down Mode ; " OE " OE Mode. High Enable | |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

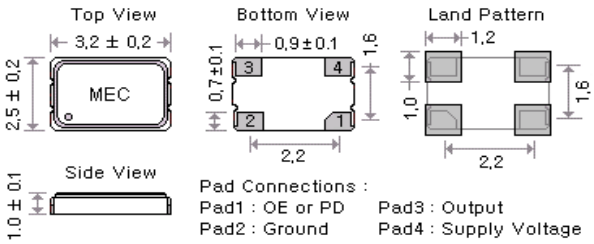
### HTF21



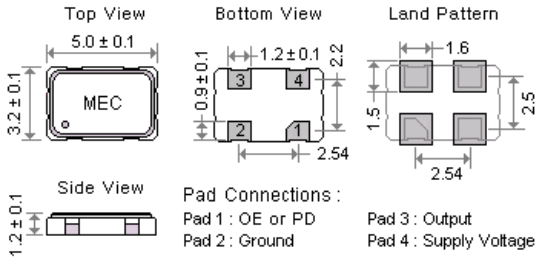

### HTF22



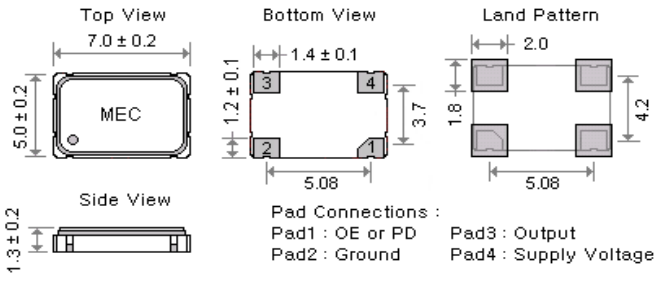

### HTF32




### HTF53




### HTF57



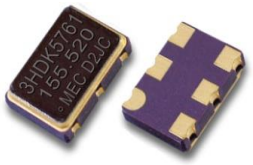
# Differential Crystal Oscillators with No PLL

Differential

| HPK | HDK | HCK | HCLK | SMD | 1.8 V | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|---|
| LVPECL Differential | LVDS Differential | HCSL Differential | LPHCSL Differential | | | | | 13.5 MHz | 220 MHz |

## Features

**Jitter 0.2 pS ( typical )**




- Femtosecond integrated phase jitter ( 200 fs ( typ. ) , 12 KHz to 20 MHz )
- Superior phase noise ( -138 dBc/Hz at 10 KHz and -144 dBc/Hz at 100 KHz offset )

## General specifications , at Ta=+25°C

| Model | HPK | HDK | HCK | HCLK |
|---|---|---|---|---|
| Output Logic | LVPECL | LVDS | HCSL | LPHCSL |
| Package ( dimensions ) unit : mm | HPK2261 ( 2.5 * 2.0 * 1.0 )<br>HPK3261 ( 3.2 * 2.5 * 1.0 )<br>HPK5361 ( 5.0 * 3.2 * 1.2 )<br>HPK5761 ( 7.0 * 5.0 * 1.7 ) | HDK2261 ( 2.5 * 2.0 * 1.0 )<br>HDK3261 ( 3.2 * 2.5 * 1.0 )<br>HDK5361 ( 5.0 * 3.2 * 1.2 )<br>HDK5761 ( 7.0 * 5.0 * 1.7 ) | HCK2261 ( 2.5 * 2.0 * 1.0 )<br>HCK3261 ( 3.2 * 2.5 * 1.0 )<br>HCK5361 ( 5.0 * 3.2 * 1.2 )<br>HCK5761 ( 7.0 * 5.0 * 1.7 ) | HCLK2261 ( 2.5 * 2.0 * 1.0 )<br>HCLK3261 ( 3.2 * 2.5 * 1.0 )<br>HCLK5361 ( 5.0 * 3.2 * 1.2 )<br>HCLK5761 ( 7.0 * 5.0 * 1.7 ) |
| Available Frequency Range | 13.5 MHz ~ 220 MHz | 13.5 MHz ~ 220 MHz | 13.5 MHz ~ 220 MHz | 95 MHz ~ 180.0 MHz |
| Supply Voltage ( $V_{DD}$ ) | -- | +1.8 V ± 5% | +1.8 V ± 5% | +1.8 V ± 5% |
| | +2.5 V ± 5% | +2.5 V ± 5% | +2.5 V ± 5% | +2.5 V ± 5% |
| | +3.3 V ± 10% | +3.3 V ± 10% | +3.3 V ± 10% | +3.3 V ± 10% |
| Current Consumption ( $V_{DD}$ = + 3.3V ) | 30 mA ( typ. )<br>50 mA ( max. ) | 16 mA ( typ. )<br>27 mA ( max. ) | 17 mA ( typ. )<br>30 mA ( max. ) | 11 mA ( typ. )<br>20 mA ( max. ) |
| Output Logic " High " , " 1 " | $V_{DD}$ - 1.03 ( min. )<br>$V_{DD}$ - 0.6 ( max. ) | 1.4 V ( typ. )<br>1.6 V ( max. ) | 550 mV ( min. )<br>850 mV ( max. ) | 550 mV ( min. )<br>900 mV ( max. ) |
| Output Logic " Low " , " 0 " | $V_{DD}$ - 1.85 ( min. )<br>$V_{DD}$ - 1.6 ( max. ) | 0.9 V ( min. )<br>1.1 V ( typ. ) | -150 mV ( min. )<br>150 mV ( max. ) | -150 mV ( min. )<br>150 mV ( max. ) |
| Rise Time / Fall Time ( 20%↔80% of waveform ) | 0.3 nsec. ( typ. )<br>0.6 nsec. ( max. ) | 0.3 nsec. ( typ. )<br>0.5 nsec. ( max. ) | 0.3 nsec. ( typ. )<br>0.6 nsec. ( max. ) | 0.4 nsec. ( typ. )<br>0.7 nsec. ( max. ) |
| Output Voltage Swing | 595 mV ( min. ) ,<br>750 mV ( typ. ) ,<br>930 mV ( max. ) | 250 mV ( min. ) ,<br>350 mV ( typ. ) ,<br>450 mV ( max. ) | 400 mV ( min. ) | 550 mV ( min. ) |
| Output Load | 50 Ω into Vcc - 2V or Thevenin equivalent | 100 Ω between output and complimentary output | 50 Ω to ground on each output | None |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Start-up Time | 5.0 msec. ( typ. ) , 10 msec. ( max. ) | | | | | | |
| Duty Cycle | 50% ± 5% | | | | | | |
| Storage Temperature | -55°C to +150°C | | | | | | |
| Aging at Ta = +25°C | ± 3 ppm ( max. ) first year ; ± 2 ppm ( max. ) per year thereafter | | | | | | |
| RMS Jitter ( 12 KHz to 20 MHz ) | 0.2 psec ( typ. ) ; 0.5 psec ( max. ) [ For 156.250 MHz ] ; 0.18 psec ( typ. ) [ For HCLK ] | | | | | | |
| SSB Phase Noise [ dBc / Hz ( typ.) ] | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz | 1 MHz |
| | 62.5 MHz | -50 | -82 | -116 | -138 | -144 | -149 |
| | 156.250 MHz | -50 | -80 | -115 | -135 | -142 | -147 |

| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F " represents . For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F30 " ± 30 ppm over -40°C to +85°C |
|---|---|---|---|---|---|
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| Output Enable / Disable Function | | |
|---|---|---|
| | Enable | When 70% min. of $V_{DD}$ to Enable Output.<br>Enable time : 10 msec ( max.) |
| | Disable | When 30% max. of $V_{DD}$ to Disable Output.<br>Disable current : 10 uA ( max.)(OE≦0.3V) , Disable time : 0.2 usec. ( max.) |

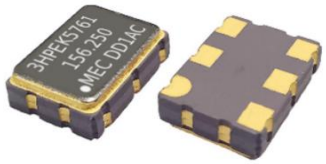
# Superb phase noise differential oscillators

*Differential*

| HPEK | HDEK | HCEK | SMD | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|
| LVPECL | LVDS | HCSL | | | | 13.5 MHz | 220 MHz |

## Features

- Noise improved version for H_EK-series
- Femtosecond integrated phase jitter ( 98 fs typical , 12 KHz to 20 MHz )
- Superior phase noise ( -149 dBc/Hz at 100 KHz and -157 dBc/Hz at 10 MHz offset )



## General specifications , at Ta=+25°C

| Model | HPEK | HDEK | HCEK |
|---|---|---|---|
| Output Logic | LVPECL | LVDS | HCSL |
| Available Frequency Range | 13.5 MHz ~ 60 MHz<br>90 MHz ~ 220 MHz | 13.5 MHz ~ 60 MHz<br>90 MHz ~ 220 MHz | 13.5 MHz ~ 60 MHz<br>90 MHz ~ 220 MHz |
| Supply Voltage ( $V_{DD}$ ) | --- | + 2.5 V ± 10% | + 2.5 V ± 10% |
| | + 3.3 V ± 10% | + 3.3 V ± 10% | + 3.3 V ± 10% |
| Output Load | 50 Ω into $V_{DD}$ - 2.0V<br>or Thevenin equivalent | 100 Ω between output<br>and complimentary output | 50 Ω to ground on each output |
| Rise Time / Fall Time<br>( 20%↔80% of waveform ) | 0.2 nsec ( typ. )<br>0.4 nsec ( max. ) | 0.2 nsec ( typ. )<br>0.4 nsec ( max. ) | 0.5 nsec ( typ. )<br>0.8 nsec ( max. ) |
| Current Consumption | 38 mA ( typ. ) , 60 mA ( max. ) | 15 mA ( typ. ) , 35 mA ( max. ) | 32 mA ( typ. ) , 40 mA ( max. ) |
| Output Logic " High " , " 1 " | $V_{DD}$ - 1.03 ( min. ) , $V_{DD}$ - 0.88 ( max. ) | 1.4 V ( typ. ) , 1.6 V ( max. ) | 0.5 V ( min. ) , 0.9 V ( max. ) |
| Output Logic " Low " , " 0 " | $V_{DD}$ - 1.81 ( min. ) , $V_{DD}$ - 1.62 ( max. ) | 0.9 V ( min. ) , 1.1 V ( typ. ) | - 0.15 V ( min. ) , 0.15 V ( max. ) |
| Output Swing ( single-end ) | 400 mV ( min. ) | 250 mV ( min. ) | 500 mV ( min. ) |

| | | | | | |
|---|---|---|---|---|---|
| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F " represents . For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F30 " ± 30 ppm over -40°C to +85°C |
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Start-up Time | 1.0 msec. ( typ. ) , 5.0 msec ( max. ) | | | | | | |
| Duty Cycle | 50% ± 5% | | | | | | |
| Storage Temperature | -55°C to +150°C | | | | | | |
| Aging at Ta = +25°C | ± 3 ppm ( max. ) first year | | | | | | |
| RMS Jitter<br>( 12 KHz to 20 MHz ) | Freq. output < 100MHz : 350 fsec ( typ. ) , [ 50MHz , 3.3V , LVDS ] | | | | | | |
| | Freq. output > 100MHz : 98 fsec ( typ. ) , [ 156.250MHz , 3.3V , LVDS ] | | | | | | |
| Phase Noise<br>[ dBc / Hz ( typ. ) ] | Offset | 100 Hz | 1 KHz | 10 KHz | 100 KHz | 1 MHz | 10 MHz |
| | 50 MHz | -104 | -134 | -147 | -153 | -152 | -157 |
| | 156.250 MHz | -93 | -123 | -140 | -149 | -152 | -157 |
| Output Enable / Disable Function | Enable | 70% ( min. ) of $V_{DD}$ to enable output.<br>Enable time : 5 msec ( max. ) | | | | | |
| | Disable | 30% ( max. ) of $V_{DD}$ to disable output.<br>Disable current : 10 uA ( max.) [OE≦0.3V] , Disable time : 0.2 usec ( max.) | | | | | |

# Ultra Low Jitter Differential Oscillator

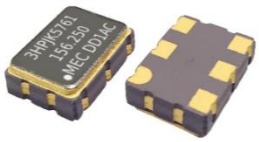
Differential

| HPJK | HDJK | HCJK | SMD | 1.8 V | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| LVPECL Differential | LVDS Differential | HCSL Differential | | | | | 100 MHz | 250 MHz |

## Features

**Jitter 50 fsec ( typical )**

- Femtosecond integrated phase jitter ( 50 fs typical , 12 KHz to 20 MHz )
- Superior phase noise ( -157 dBc/Hz at 100 KHz and -164 dBc/Hz at 10 MHz offset )
- Small size for 2.5 x 2.0 mm package



## General specifications , at Ta=+25°C

| Model | | HPJK | HDJK | HCJK |
|---|---|---|---|---|
| Output Logic | | LVPECL | LVDS | HCSL |
| Available Frequency Range by Voltage ( $V_{DD}$ ) | 1.8 V ± 5% | -- | 100 MHz ~ 175 MHz | 100 MHz ~ 175 MHz |
| | 2.5 V ± 10% | 100 MHz ~ 250 MHz | 100 MHz ~ 250 MHz | 100 MHz ~ 175 MHz |
| | 3.3 V ± 10% | 100 MHz ~ 250 MHz | 100 MHz ~ 250 MHz | 100 MHz ~ 175 MHz |
| | If you have frequency requirements below 100MHz, please contact Mercury. | | | |
| Output Load | | 50 Ω into $V_{DD}$ - 2.0V or Thevenin equivalent | 100 Ω between output and complimentary output | 50 Ω to ground on each output |
| Rise Time / Fall Time ( 20%↔80% of waveform ) | | 0.15 nsec ( typ. ) 0.4 nsec ( max. ) | 0.15 nsec ( typ. ) 0.3 nsec ( max. ) | 0.2 nsec ( typ. ) 0.6 nsec ( max. ) |
| Current Consumption | | 52 mA ( typ. ) , 65 mA ( max. ) | 22 mA ( typ. ) , 30 mA ( max. ) | 38 mA ( typ. ) , 48 mA ( max. ) |
| Output Logic " High " , " 1 " | | $V_{DD}$ - 1.085 ( min. ) , $V_{DD}$ - 0.86 ( max. ) | 1.4 V ( typ. ) , 1.6 V ( max. ) | 0.55 V ( min. ) , 1.0 V ( max. ) |
| Output Logic " Low " , " 0 " | | $V_{DD}$ - 1.81 ( min. ) , $V_{DD}$ - 1.62 ( max. ) | 0.9 V ( min. ) , 1.1 V ( typ. ) | - 0.15 V ( min. ) , 0.15 V ( max. ) |
| Output Swing ( single-end ) | | 400 mV ( min. ) | 200 mV ( min. ) | 450 mV ( min. ) |

| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F " represents . For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F30 " ± 30 ppm over -40°C to +85°C |
|---|---|---|---|---|---|
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Start-up Time | 1.0 msec. ( typ. ) , 5.0 msec. ( max. ) | | | | | | |
| Duty Cycle | 50% ± 5% | | | | | | |
| Storage Temperature | -55°C to +150°C | | | | | | |
| Aging at Ta = +25°C | ± 3 ppm ( max. ) first year ; ± 2 ppm ( max. ) per year thereafter | | | | | | |
| RMS Jitter ( 12 KHz to 20 MHz ) | 50 fsec ( typ. ) , 300 fsec ( max. ) [ For 156.250 MHz , LVDS , 3.3V ] | | | | | | |
| Phase Noise [ dBc / Hz ( typ. ) ] | Offset | 100 Hz | 1 KHz | 10 KHz | 100 KHz | 1 MHz | 10 MHz |
| | 125.0 MHz | -114 | -135 | -147 | -157 | -163 | -164 |
| | 156.250 MHz | -108 | -132 | -141 | -152 | -160 | -161 |
| Output Enable / Disable Function | Enable | 70% ( min.) of $V_{DD}$ to enable output. Enable time : 10 msec ( max. ) | | | | | |
| | Disable | 30% ( max. ) of $V_{DD}$ to disable output. Disable current : 30 uA ( max. ) [ OE = GND ] , Disable time : 0.2 usec ( max. ) | | | | | |

# Crystal Oscillators

HP_ [ LVPECL DIfferential ] | HD_ [ LVDS Differential ] | HC_ [ HCSL Differential ] | HCL_ [ LPHCSL Differential ]

## Part Number Format and Example

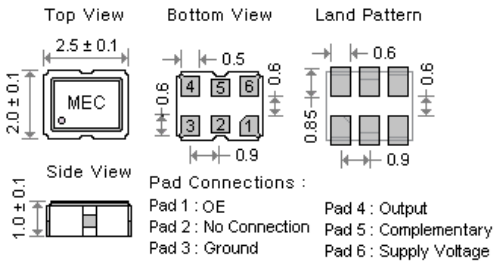
| [ 1 ] | [ 2 ] | [ 3 ] | – | [ 4 ] | – | [ 5 ] |
|---|---|---|---|---|---|---|
| Supply Voltage | Holder Type | 1 or 2 | | Frequency Stability | | Center Frequency |
| Example ( 1 ) | 25 | HCK536 | 1 | – | C15 | – | 125.000 |
| ( 2 ) | 18 | HDJK576 | 2 | – | D | – | 156.250 |

Ex ( 1 ) : 25HCK5361 - C15 - 125.000 [ +2.5V , HCK type , HCSL output , 5.0 x 3.2 mm size , OE on pad 1 , ±15 ppm from -20°C to 70°C , 125.000MHz ]
Ex ( 2 ) : 18HDJK5762 - D - 156.250 [ +1.8V , HDJK type , LVDS output , 7.0 x 5.0 mm size , OE on pad 2 , ±25 ppm from -40°C to 85°C , 156.250MHz ]

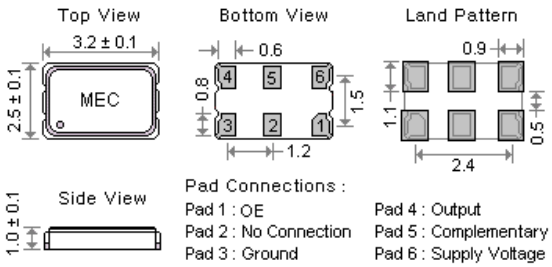
| | | |
|---|---|---|
| [ 1 ] | Supply voltage , " 18 " for +1.8V ; " 25 " for +2.5V ; " 3 " for +3.3V | |
| [ 2 ] | Holder Type | |
| [ 3 ] | " 1 " : OE function on pad # 1 , " 2 " : OE function on pad # 2 | |
| [ 4 ] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ;<br>If non-standard please enter the desired stability after " C " , for example " C15 " : represents ±15ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ;<br>If non-standard please enter the desired stability after " F " , for example " F30 " : represents ± 30ppm over -40 to +85°C |
| [ 5 ] | Frequency in MHz | |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs , Test Circuits

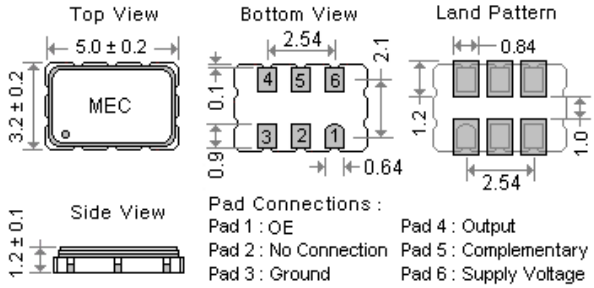
### H__K226



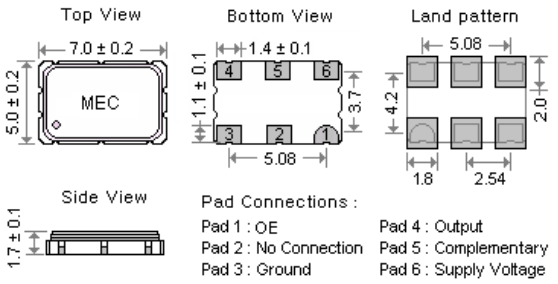

### H__K326



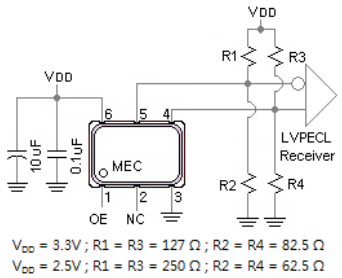

### H__K536




### H__K576

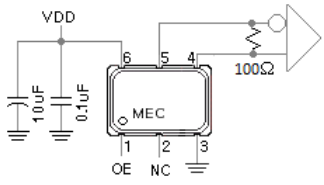



### LVPECL Test Circuit

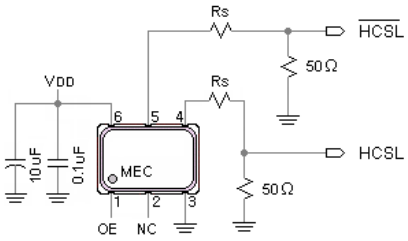



$V_{DD}$ = 3.3V ; R1 = R3 = 127 Ω ; R2 = R4 = 82.5 Ω
$V_{DD}$ = 2.5V ; R1 = R3 = 250 Ω ; R2 = R4 = 62.5 Ω

### LVDS Test Circuit

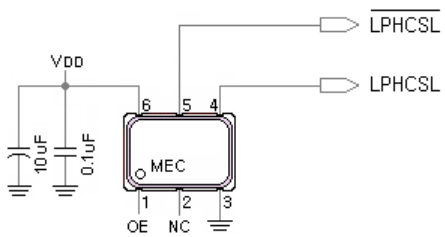



### HCSL Test Circuit




Rs = 0 to 33Ω to minmize ringing in application.

### LPHCSL Test Circuit for HCLK only



# Differential Crystal Oscillators with No PLL

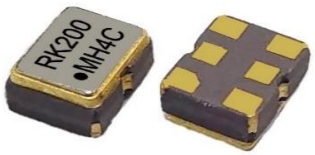
Differential

| HPRK | HDRK | HCRK | SMD | 1.8 V | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| LVPECL Differential | LVDS Differential | HCSL Differential | | | | | 10.0 MHz | 250 MHz |

## Features

**Jitter 0.1 pS ( typical )**

- Femtosecond integrated phase jitter ( 84 fs ( typ.) , 12 KHz to 20 MHz )
- Superior phase noise ( -139 dBc/Hz at 10 KHz and -148 dBc/Hz at 100 KHz offset )
- Package size : 2.5x2.0mm , 3.2x2.5mm , 5.0x3.2mm , 7.0x5.0mm




## General specifications , at Ta=+25°C

| Model | HPRK | HDRK | | HCRK | |
|---|---|---|---|---|---|
| Output Logic | LVPECL | LVDS | | HCSL | |
| Available Frequency Range | 10 MHz ~ 250 MHz | 10 MHz ~ 250 MHz | 10 MHz ~ 160 MHz<br>180 MHz ~ 250 MHz | 20 MHz ~ 50 MHz<br>60 MHz ~ 220 MHz | 100 MHz ~ 160 MHz |
| Supply Voltage ( $V_{DD}$ ) | -- | -- | +1.8 V ± 5% | -- | +1.8 V ± 5% |
| | +2.5 V ± 10% | +2.5 V ± 10% | -- | +2.5 V ± 10% | -- |
| | +3.3 V ± 10% | +3.3 V ± 10% | -- | +3.3 V ± 10% | -- |
| Current Consumption<br>( $V_{DD}$ = + 3.3V ) | 32 mA ( typ. )<br>60 mA ( max. ) | 10 mA ( typ. )<br>25 mA ( max. ) | 8 mA ( typ. )<br>16 mA ( max. ) | 17 mA ( typ. )<br>35 mA ( max. ) | |
| Output Logic " High " , " 1 " | $V_{DD}$ - 1.03 ( min. )<br>$V_{DD}$ - 0.6 ( max. ) | 1.4 V ( typ. )<br>1.6 V ( max. ) | 0.8 V ( typ. )<br>1.0 V ( max. ) | 550 mV ( min. )<br>1.0 V ( max. ) | |
| Output Logic " Low " , " 0 " | $V_{DD}$ - 1.85 ( min. )<br>$V_{DD}$ - 1.6 ( max. ) | 0.9 V ( min. )<br>1.1 V ( typ. ) | 0.3 V ( min. )<br>0.5 V ( typ. ) | -150 mV ( min. )<br>150 mV ( max. ) | |
| Rise Time / Fall Time<br>( 20%↔80% of waveform ) | 0.3 nsec. ( typ. )<br>0.5 nsec. ( max. ) | 0.2 nsec. ( typ. )<br>0.35 nsec. ( max. ) | 0.2 nsec. ( typ. )<br>0.35 nsec. ( max. ) | 0.2 nsec. ( typ. )<br>0.35 nsec. ( max. ) | |
| Output Voltage Swing | 500 mV ( min. )<br>750 mV ( typ. ) | 300 mV ( min. ) ,<br>400 mV ( typ. ) ,<br>480 mV ( max. ) | 200 mV ( min. ) ,<br>300 mV ( typ. ) ,<br>400 mV ( max. ) | 500 mV ( min. ) | |
| Output Load | 50 Ω into Vcc - 2V or<br>Thevenin equivalent | 100 Ω between output and<br>complimentary output | | 50 Ω to ground oneach output | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Start-up Time | 0.75 msec. ( typ. ) , 2.0 msec. ( max. ) | | | | | | |
| Duty Cycle | 50% ± 5% | | | | | | |
| Storage Temperature | -55°C to +150°C | | | | | | |
| Aging at Ta = +25°C | ± 3 ppm ( max. ) first year ; ± 2 ppm ( max. ) per year thereafter | | | | | | |
| RMS Jitter ( 12 KHz to 20 MHz ) | 84 fsec ( typ. ) ; For 156.250 MHz , LVPECL 3.3V | | | | | | |
| SSB Phase Noise [ dBc / Hz ( typ.) ] | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz | 1 MHz |
| | 156.250 MHz | -63 | -97 | -134 | -139 | -148 | -153 |

| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " ; " F " ; " J " represents . For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F30 " ± 30 ppm over -40°C to +85°C ; " J40 " ± 40 ppm over -40°C to +105°C |
|---|---|---|---|---|---|
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |
| | Extended Industrial ( *-40°C to +105°C* ) | *G* | *H* | *J* | |

| Output Enable / Disable Function | | |
|---|---|---|
| | Enable | When 70% min. of $V_{DD}$ to Enable Output.<br>Enable time : 2 msec ( max. ) |
| | Disable | When 30% max. of $V_{DD}$ to Disable Output.<br>Disable current : 30 uA ( max.)(OE≦0.3V) , Disable time : 0.2 usec. ( max.) |

# Differential Crystal Oscillators with No PLL

Differential

HPRK [ LVPECL Differential ] | HDRK [ LVDS Differential ] | HCRK [ HCSL Differential ]

## Part Number Format and Example

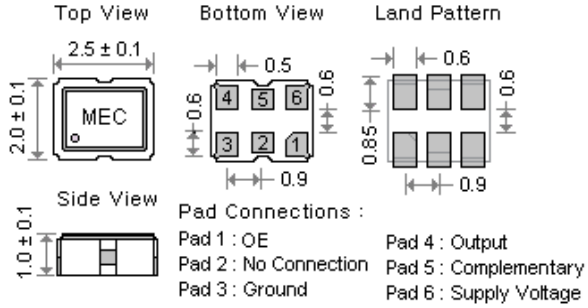
| [ 1 ] | [ 2 ] | [ 3 ] | – | [ 4 ] | – | [ 5 ] |
|---|---|---|---|---|---|---|
| Supply Voltage | Holder Type | 1 or 2 | | Frequency Stability | | Center Frequency |
| Example ( 1 ) | 25V3 | HDRK576 | 1 | – | E | – | 100.000 |
| ( 2 ) | 18 | HPRK326 | 1 | – | D | – | 156.250 |

Ex ( 1 ) : 25V3HDRK5761 - E - 100.000 [ +2.5 ~ +3.3V, HDRK type, LVDS output, 7.0 x 5.0mm size, OE on pad 1, ±50 ppm from -40°C to 85°C, 100.000MHz ]
Ex ( 2 ) : 18HPRK3261 - D - 156.250 [ +1.8V, HPRK type, LVPECL output, 3.2 x 2.5mm size, OE on pad 1, ±25 ppm from -40°C to 85°C, 156.250MHz ]

| | | |
|---|---|---|
| [ 1 ] | Supply Voltage , " 18 " for +1.8V ; " 25 " for +2.5V ; " 3 " for +3.3V ; " 25V3 " for +2.5 ~ +3.3V ±10% | |
| [ 2 ] | Holder Type | |
| [ 3 ] | " 1 " : OE function on pad # 1 , " 2 " : OE function on pad # 2 | |
| [ 4 ] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ;<br>If non-standard please enter the desired stability after " C " , for example " C20 " : represents ±20ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ;<br>If non-standard please enter the desired stability after " F " , for example " F30 " : represents ±30ppm over -40 to +85°C |
| | -40°C ~ 105°C | " G " ± 25ppm ; " H " ± 50ppm ; " J " ± 100ppm ;<br>If non-standard please enter the desired stability after " J " , for example " J40 " : represents ±40ppm over -40 to +105°C |
| [ 5 ] | Frequency in MHz | |

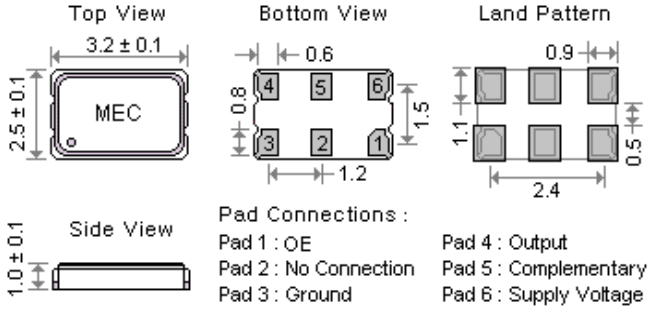
## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs , Test Circuits

### H_RK226



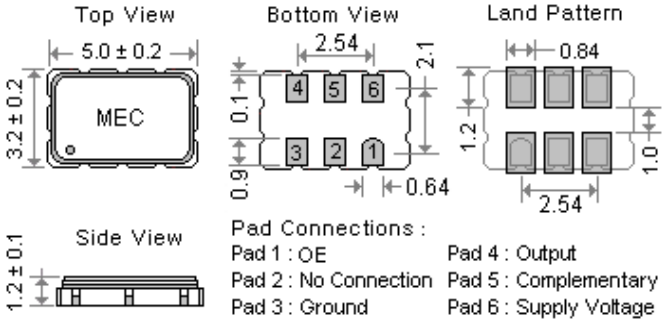

Pad Connections :
Pad 1 : OE
Pad 2 : No Connection
Pad 3 : Ground
Pad 4 : Output
Pad 5 : Complementary
Pad 6 : Supply Voltage

### H_RK326



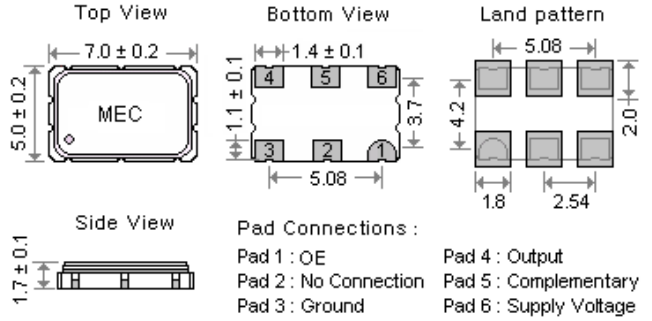

Pad Connections :
Pad 1 : OE
Pad 2 : No Connection
Pad 3 : Ground
Pad 4 : Output
Pad 5 : Complementary
Pad 6 : Supply Voltage

### H_RK536



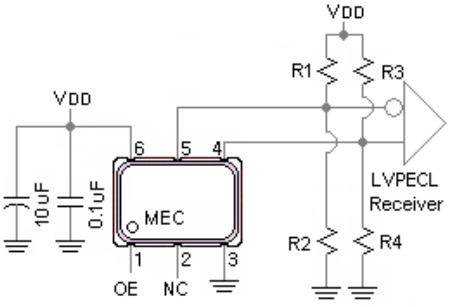

Pad Connections :
Pad 1 : OE
Pad 2 : No Connection
Pad 3 : Ground
Pad 4 : Output
Pad 5 : Complementary
Pad 6 : Supply Voltage

### H_RK576



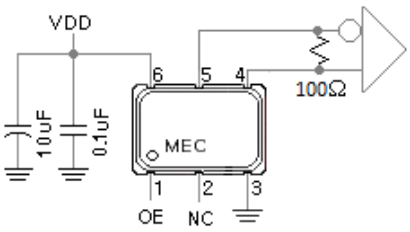

Pad Connections :
Pad 1 : OE
Pad 2 : No Connection
Pad 3 : Ground
Pad 4 : Output
Pad 5 : Complementary
Pad 6 : Supply Voltage

### LVPECL Test Circuit

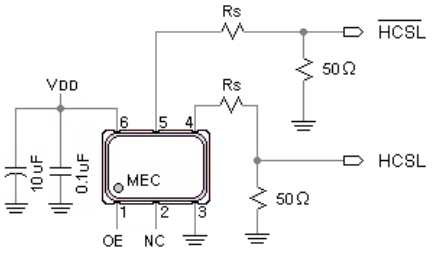



$V_{DD}$ = 3.3V ; R1 = R3 = 127 Ω ; R2 = R4 = 82.5 Ω
$V_{DD}$ = 2.5V ; R1 = R3 = 250 Ω ; R2 = R4 = 62.5 Ω

### LVDS Test Circuit




### HCSL Test Circuit




Rs = 0 to 33Ω to minmize ringing in application.

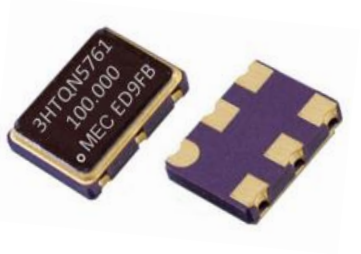
# Low Jitter Crystal Oscillators

| HTQN | HPQN | HDQN | 0.6 ps RMS Jitter | SMD | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| CMOS Waveform | LVPECL Differential | LVDS Differential | | | | | 50 MHz | 1,500 MHz |



## Features

- The HTQN, HPQN and HDQN Series are members of Mercury's Low Jitter Crystal Oscillators
- Output frequency range : 50 MHz to 1,500 MHz
- Low RMS Jitter 0.6 ps typical ( 12kHz to 20MHz )
- Package size : 3.2x2.5mm , 5.0x3.2mm , 7.0x5.0mm




## General specifications , at Ta=+25°C

| Model | HTQN | HPQN | HDQN |
|---|---|---|---|
| Output Logic | CMOS | LVPECL | LVDS |
| Supply Voltage $V_{DD}$ ( code ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) |
| | + 3.3 V ± 10% ( voltage code " 3 " ) | + 3.3 V ± 10% ( voltage code " 3 " ) | + 3.3 V ± 10% ( voltage code " 3 " ) |
| Available Frequency Range | 50 ~ 250 MHz | 50 ~ 1,500 MHz | 50 ~ 1,500 MHz |
| Output Load | 15 pF | 50 Ω into Vcc - 2V or Thevenin equiralent | 100 Ω |
| Output Logic " High " , " 1 " | 90 % $V_{DD}$ | $V_{DD}$ - 1.03 ( min. ) , $V_{DD}$ - 0.6 ( max. ) | 1.4 V ( typ. ) , 1.6 V ( max. ) |
| Output Logic " Low " , " 0 " | 10 % $V_{DD}$ | $V_{DD}$ - 1.85 ( min. ) , $V_{DD}$ - 1.6 ( max. ) | 1.1 V ( typ. ) , 0.9 V ( min. ) |
| Current with Output Disable | 16 mA ( typ. ) | 16 mA ( typ. ) | 16 mA ( typ. ) |
| Current Consumption ( max. ) ( $V_{DD}$ = + 3.3V ) | 50 ~ 100 MHz : 30 mA | 150 ~ 250 MHz : 50 mA | 150 ~ 250 MHz : 30 mA |
| | 101 ~ 150 MHz : 38 mA | 251 ~ 750 MHz : 55 mA | 251 ~ 750 MHz : 34 mA |
| | 151 ~ 200 MHz : 43 mA | 751 ~ 1000 MHz : 57 mA | 751 ~ 1,000 MHz : 38 mA |
| | 201 ~ 250 MHz : 48 mA | 1001 ~ 1500 MHz : 60 mA | 1001 ~ 1,500 MHz : 40 mA |
| Rise Time / Fall Time | 1.5 nsec. ( typ. ) , 3.0 nsec. ( max. ) Tr / Tf : 10% ↔ 90% waveform | 0.2 nsec. ( typ. ) , 0.5 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform | 0.2 nsec. ( Typ. ) , 0.5 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform |
| Start-up Time | 10 msec. ( max. ) | 5.0 msec. ( typ. ) , 10 msec. ( max. ) | 5.0 msec. ( typ. ) , 10 msec. ( max. ) |
| Aging at Ta = +25°C | ± 5 ppm ( max. ) for first year | ± 3 ppm ( max. ) first year ; ± 2 ppm ( max. ) per year thereafter | ± 3 ppm ( max. ) first year ; ± 2 ppm ( max. ) per year thereafter |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Duty Cycle | 50% ± 5% | | | | | | | |
| Storage Temperature | -55°C to +150°C | | | | | | | |
| RMS Jitter ( 12 KHz to 20 MHz ) | 0.6 psec ( typ. ) | | | | | | | |
| SSB Phase Noise [ dBc / Hz ( typ.) ] | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz | 1 MHz | 10 MHz |
| | 156.250 MHz | -55 | - 85 | -109 | -116 | -118 | -139 | -146 |
| | 622.08 MHz | -48 | - 85 | -101 | -102 | -103 | -124 | -133 |

| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F " represents . For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F30 " ± 30 ppm over -40°C to +85°C |
|---|---|---|---|---|---|
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| Output Enable / Disable Function | | |
|---|---|---|
| | Enable | When 70% ( min. ) of $V_{DD}$ to Enable Output. Enable time : 200 nsec. ( max. ) |
| | Disable | When 30% ( max. ) of $V_{DD}$ to Disable Output. Disable current : 16 mA ( max. ) , Disable time : 50 nsec. ( max. ) |

# Crystal Oscillators

| HTQN [ CMOS Waveform ] | HPQN [ LVPECL Differential ] | HDQN [ LVDS Differential ] |
|---|---|---|

## Part Number Format and Example

| | [ 1 ] Supply Voltage | [ 2 ] Holder Type | [ 3 ] 1 or 2 | – | [ 4 ] Frequency Stability | – | [ 5 ] Center Frequency |
|---|---|---|---|---|---|---|---|
| Example | ( 1 ) 25 | HPQN576 | 2 | – | D | – | 622.080 |
| | ( 2 ) 3 | HDQN326 | 1 | – | A | – | 100.000 |

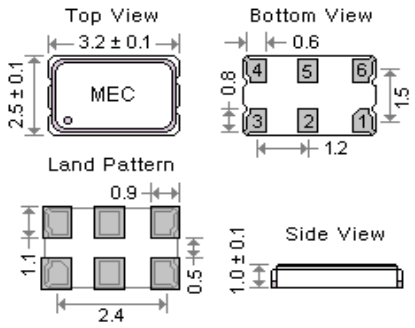
Ex (1) : 25HPQN5762 - D - 622.080 [ +2.5V , H_ _ 576 type , LVPECL output , QN series , OE on pad # 2 , ±25 ppm from -40°C to 85°C , 622.080MHz ]

Ex (2) : 3HDQN3261 - A - 100.000 [ +3.3V , H_ _ 326 type , LVDS output , QN series , OE on pad # 1 , ±25 ppm from -20°C to 70°C , 100.000MHz ]

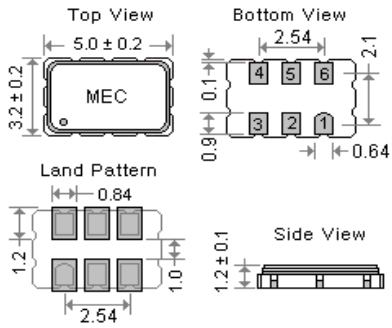
| | | |
|---|---|---|
| [ 1 ] | Supply voltage , " 2.5 " for +2.5V ; " 3 " for +3.3V | |
| [ 2 ] | Holder Type | |
| [ 3 ] | " 1 " : OE function on pad # 1 , " 2 " : OE function on pad # 2 | |
| [ 4 ] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ;<br>If non-standard please enter the desired stability after " C " , for example " C15 " : represents ±15ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ;<br>If non-standard please enter the desired stability after " F " , for example " F30 " : represents ± 30ppm over -40 to +85°C |
| [ 5 ] | Frequency in MHz | |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs ; Test Circuit

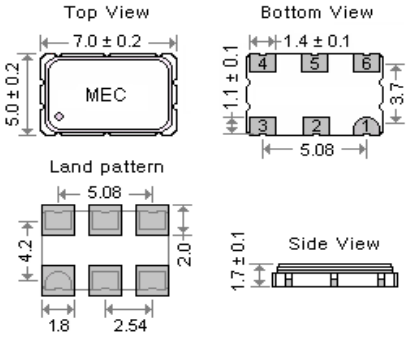
### H_QN326




### H_QN536




### H_QN576




### Pad Connections :

Pad 1 : Output Enable

Pad 2 : No Connection

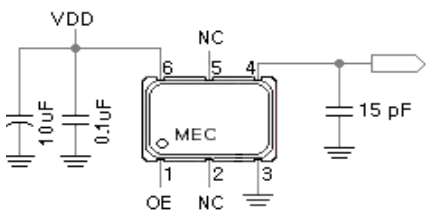
Pad 3 : Ground

Pad 4 : CMOS : Output , Differential : Output

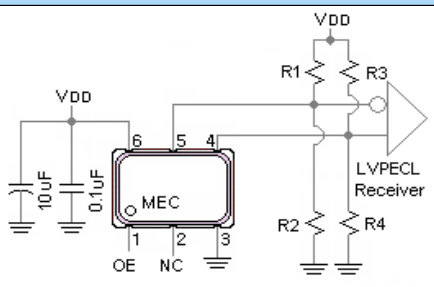
Pad 5 : CMOS : No Connection , Differential : Complementary Output

Pad 6 : Supply Voltage

### CMOS Test Circuit



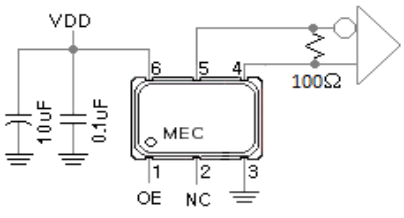

### LVPECL Test Circuit




$V_{DD}$ = 3.3V ; R1 = R3 = 127 Ω ; R2 = R4 = 82.5 Ω

$V_{DD}$ = 2.5V ; R1 = R3 = 250 Ω ; R2 = R4 = 62.5 Ω

### LVDS Test Circuit

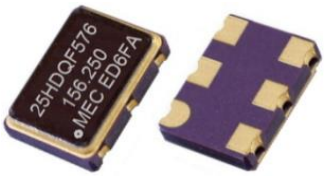


# Crystal Oscillators [ Quick - Turn Clock Oscillators , 10 ~ 1500 MHz ]

| HTQF | HPQF | HDQF | Q family / F series | SMD | 2.5 V / 3.3 V | Min. 10 MHz | Max. 1,500 MHz |
|---|---|---|---|---|---|---|---|
| CMOS Waveform | LVPECL Differential | LVDS Differential | | | | | |

**Features** | **Quick - Turn Clock Oscillators** | **0.8 ps Phase Jitter ( typical )**

- The HTQF, HPQF and HDQF Series are members of Mercury's Q-Family Quick-Turn crystal oscillators
- Output frequency range : 10 MHz to 1,500 MHz
- Package size : 3.2 x 2.5mm , 5.0 x 3.2mm , 7.0 x 5.0mm
- Next-day samples for prototypes




## General specifications , at Ta=+25°C

| Model | HTQF | HPQF | HDQF |
|---|---|---|---|
| Output Logic | **CMOS** | **LVPECL** | **LVDS** |
| Supply Voltage $V_{DD}$ ( code ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) |
| | + 3.3 V ± 10% ( voltage code " 3 " ) | + 3.3 V ± 10% ( voltage code " 3 " ) | + 3.3 V ± 10% ( voltage code " 3 " ) |
| Available Frequency Range | 10 ~ 250 MHz | 10 ~ 1,500 MHz | 10 ~ 1,500 MHz |
| Load | 15 pF | 50 Ω into Vcc - 2V or Thevenin equiralent | 100 Ω |
| Output Logic " High " , " 1 " | 90 % $V_{DD}$ | $V_{DD}$ - 1.03 ( min. ) , $V_{DD}$ - 0.6 ( max. ) | 1.4 V ( typ. ) , 1.6 V ( max. ) |
| Output Logic " Low " , " 0 " | 10 % $V_{DD}$ | $V_{DD}$ - 1.85 ( min. ) , $V_{DD}$ - 1.6 ( max. ) | 1.1 V ( typ. ) , 0.9 V ( min. ) |
| Current with Output Disable | 16 mA ( typ. ) | 16 mA ( typ. ) | 16 mA ( typ. ) |
| Current Consumption ( Max.) ( $V_{DD}$ = + 3.3V ) | 10 ~ 50 MHz : 30 mA | 10 ~ 250 MHz : 50 mA | 10 ~ 250 MHz : 30 mA |
| | 51 ~ 150 MHz : 38 mA | 251 ~ 750 MHz : 55 mA | 251 ~ 750 MHz : 34 mA |
| | 151 ~ 250 MHz : 48 mA | 751 ~ 1,500 MHz : 60 mA | 751 ~ 1,500 MHz : 40 mA |
| Rise Time / Fall Time | 1.5 nsec. ( typ. ) , 3.0 nsec. ( max. ) Tr / Tf : 10% ↔ 90% waveform | 0.2 nsec. ( typ. ) , 0.5 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform | 0.2 nsec. ( typ. ) , 0.4 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform |
| Duty Cycle | 50% ± 5% | | |
| Start-up Time | 10 msec. ( max. ) | | |
| Aging at Ta = +25°C | ± 2 ppm ( max. ) first year ; ± 10 ppm ( max. ) over 10 years | | |
| Storage Temperature | -55°C to +150°C | | |
| RMS Jitter ( 12 KHz to 20 MHz ) | 0.8 psec ( typ. ) | | |

| SSB Phase Noise [ dBc / Hz ( typ.) ] | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz | 1 MHz | 10 MHz |
|---|---|---|---|---|---|---|---|---|
| | 156.250 MHz | -55 | -85 | -109 | -116 | -118 | -139 | -146 |
| | 622.08 MHz | -48 | -85 | -101 | -102 | -103 | -124 | -133 |

| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F " represents . For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F30 " ± 30 ppm over -40°C to +85°C |
|---|---|---|---|---|---|
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| **Output Enable Function** | |
|---|---|
| OE Control on Pad 1 | 70% of $V_{DD}$ ( min. ) to enable output. ( Open connection prohibit. ) |
| | 30% of $V_{DD}$ ( max. ) to disable output. |
| Output Enable Time / Disable Time | 200 nsec. ( max. ) / 50 nsec. ( max. ) |

# Crystal Oscillators [ Quick - Turn Clock Oscillators , 10 ~ 1500 MHz ]

| HTQF [ CMOS Waveform ] | HPQF [ LVPECL Differential ] | HDQF [ LVDS Differential ] |
|---|---|---|

## Part Number Format and Example

| | [ 1 ] | [ 2 ] | [ 3 ] | | [ 4 ] | | [ 5 ] |
|---|---|---|---|---|---|---|---|
| | Supply Voltage | Holder Type | 1 or 2 | – | Frequency Stability | – | Center Frequency |
| Example | (1) 3 | HTQF536 | 2 | – | B | – | 200.000 |
| | (2) 3 | HDQF326 | 1 | – | A | – | 100.000 |

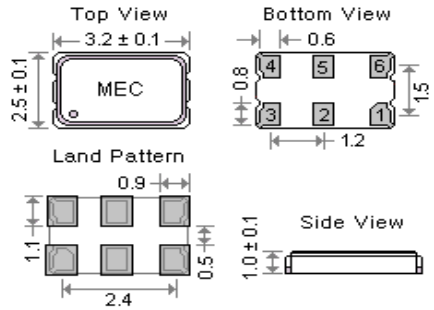
Ex (1) : 3HTQF5362 - B - 200.000 [ +3.3V , H_ _ 536 type , CMOS output , QF series , OE on pad # 2 , ±50 ppm from -20°C to 70°C , 200.000MHz ]

Ex (2) : 3HDQF3261 - A - 100.000 [ +3.3V , H_ _ 326 type , LVDS output , QF series , OE on pad # 1 , ±25 ppm from -20°C to 70°C , 100.000MHz ]

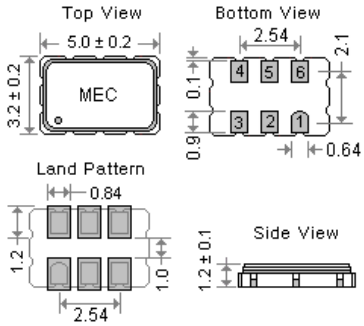
| | | |
|---|---|---|
| [ 1 ] | Supply voltage , " 25 " for +2.5V ; " 3 " for +3.3V | |
| [ 2 ] | Holder Type | |
| [ 3 ] | " 1 " : OE function on pad # 1 ; " 2 " : OE function on pad # 2 | |
| [ 4 ] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ;<br>If non-standard please enter the desired stability after " C " , for example " C15 " : represents ±15ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ;<br>If non-standard please enter the desired stability after " F " , for example " F30 " : represents ± 30ppm over -40 to +85°C |
| [ 5 ] | Frequency in MHz | |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs ; Test Circuit

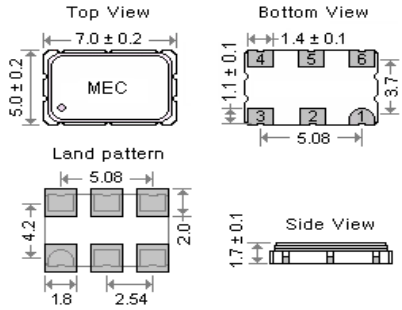
### H_QF326




### H_QF536




### H_QF576




### Pad Connections :

Pad 1 : Output Enable

Pad 2 : No Connection

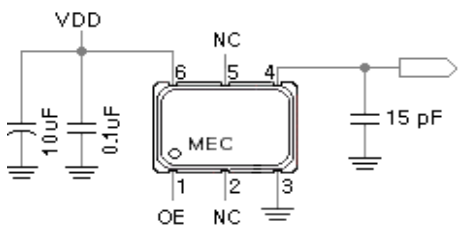
Pad 3 : Ground

Pad 4 : CMOS : Output , Differential : Output

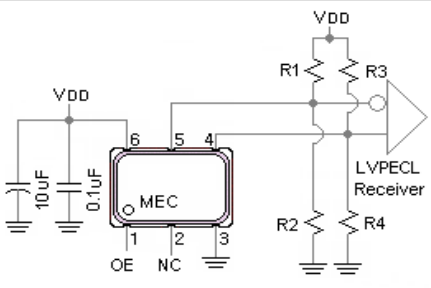
Pad 5 : CMOS : No Connection , Differential : Complementary Output

Pad 6 : Supply Voltage

### CMOS Test Circuit



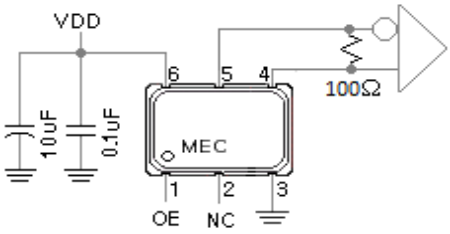

### LVPECL Test Circuit




$V_{DD}$ = 3.3V ; R1 = R3 = 127 Ω ; R2 = R4 = 82.5 Ω

$V_{DD}$ = 2.5V ; R1 = R3 = 250 Ω ; R2 = R4 = 62.5 Ω

### LVDS Test Circuit

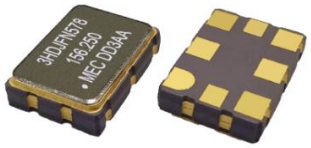


# High Frequency Ultra-low Jitter Crystal Oscillators [ Quick - Turn Oscillators , 50 ~ 2,100 MHz ]

| H_JFN | Quick - Turn Clock Oscillators | 150 fsec RMS Jitter | SMD | 1.8 V | 2.5 V | 3.3 V | Min. 50 MHz | Max. 2,100 MHz |
|---|---|---|---|---|---|---|---|---|
| CMOS / Differential | | | | | | | | |

## Features

- High Frequency Range : 50 ~ 2,100 MHz
- Ultra-low RMS Jitter : 150 fsec ( typ.) @ 3.3V , 156.250 MHz
- Package Size : 3.2 x 2.5mm and 5.0 x 3.2mm and 7.0 x 5.0mm
- Next-Day sample for Prototypes



## General specifications , at Ta = +25°C

| Model | HTJFN | HPJFN | HDJFN | HCJFN | HQJFN |
|---|---|---|---|---|---|
| Output Logic | CMOS (*1) | LVPECL | LVDS | HCSL | CML |
| Supply Voltage ( $V_{DD}$ ) | + 1.8 V ± 5% | -- | + 1.8 V ± 5% (*2) | + 1.8 V ± 5% | + 1.8 V ± 5% |
| | + 2.5 V ± 10% | + 2.5 V ± 10% | + 2.5 V ± 10% | + 2.5 V ± 10% | + 2.5 V ± 10% |
| | + 3.3 V ± 10% | + 3.3 V ± 10% | + 3.3 V ± 10% | + 3.3 V ± 10% | + 3.3 V ± 10% |
| Available Frequency Range | 50 ~ 250 MHz | 50 ~ 2,100 MHz | 50 ~ 2,100 MHz | 50 ~ 700 MHz | 50 ~ 2,100 MHz |
| Output Load | 15 pF ( max. ) | 50 Ω into $V_{DD}$ - 2V or Thevenin equivalent | 100 Ω | 50 Ω to GND | 50 Ω to $V_{DD}$ |
| Output Logic " High " , " 1 " | $V_{DD}$ - 0.4 V ( min. ) | $V_{DD}$ - 1.165 V ( min. )<br>$V_{DD}$ - 0.8 V ( max. ) | $V_{DD}$ : 1.4 V ( typ. )<br>$V_{DD}$ : 1.6 V ( max. ) | $V_{DD}$ : 0.66 V ( min. )<br>$V_{DD}$ : 1.15 V ( max. ) | $V_{DD}$ - 0.085 V ( min. )<br>$V_{DD}$ = ( max. ) |
| Output Logic " Low " , " 0 " | $V_{DD}$ x 0.1 V ( max. )<br>0.3V (max.) for 1.8V only | $V_{DD}$ - 2.0 V ( min. )<br>$V_{DD}$ - 1.55 V ( max. ) | $V_{DD}$ : 1.1 V ( typ. )<br>$V_{DD}$ : 0.9 V ( min. ) | $V_{DD}$ : - 0.15 V ( min. )<br>$V_{DD}$ : 0.15 V ( max. ) | $V_{DD}$ - 0.6 V ( min. )<br>$V_{DD}$ - 0.32 V ( max. ) |
| Output Voltage Swing | --- | 595 mV ( min. )<br>930 mV ( max. ) | 250 mV ( min. )<br>450 mV ( max. ) | 450 mV ( min. )<br>700 mV ( typ. ) | 200 mV ( min. )<br>600 mV ( max. ) |
| Current Consumption ( $V_{DD}$ = + 3.3 V ) | 75 mA ( typ. )<br>90 mA ( max. ) | 100 mA ( typ. )<br>120 mA ( max. ) | 75 mA ( typ. )<br>90 mA ( max. ) | 94 mA ( typ. )<br>115 mA ( max. ) | 70 mA ( typ. )<br>85 mA ( max. ) |
| Disable Current | 62 mA ( typ. ) | 99 mA ( typ. ) | 74 mA ( typ. ) | 93 mA ( typ. ) | 69 mA ( typ. ) |
| Rise Time / Fall Time ( 20% to 80% Waveform ) | 5.0 nsec. ( max. ) ( 10% to 90% ) | 0.4 nsec. ( max. ) | 0.4 nsec. ( max. ) | 0.4 nsec. ( max. ) | 0.4 nsec. ( max. ) |

| | | | | |
|---|---|---|---|---|
| Frequency Stability Codes | Frequency Stability Over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm |
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* |
| | Extended Industrial ( *-40°C to +105°C* ) | --- | *H* | *J* |

| | |
|---|---|
| Duty Cycle | 50% ± 5% |
| Start-up Time | 5 msec ( typ. ) ; 10 msec ( max. ) |
| RMS Jitter ( typ.) ( 12 KHz to 20 MHz ) | 156.250 MHz : 159 fsec ; 491.520 MHz : 155 fsec ; 644.530 MHz : 151 fsec ; 2,000 MHz : 163 fsec |
| Storage Temperature | -55°C to +150°C |
| Aging at Ta = +25°C | ± 3 ppm ( max. ) for first year ; ± 2 ppm ( max. ) per year thereafter |
| Enable / Disable Function on Pad1 | 80% of $V_{DD}$ ( min. ) to enable output. |
| | 20% of $V_{DD}$ ( max. ) to disable output. |
| Enable / Disable Time | 2.5 msec ( max. ) / 10 usec ( max. ) |

Note ＊1 : For CMOS output , only 7.0x5.0mm and 5.0x3.2mm packages are available.
Note ＊2 : This needs AC coupling (100-nF series capacitor). Please check the test circuit.

# High Frequency Ultra-low Jitter Crystal Oscillators [ Quick - Turn Oscillators , 50 ~ 2,100 MHz ]

| H_JFN | Quick - Turn Clock Oscillators | 150 fsec RMS Jitter | SMD | 1.8 V | 2.5 V | 3.3 V | Min. 50 MHz | Max. 2,100 MHz |
|---|---|---|---|---|---|---|---|---|
| CMOS / Differential | | | | | | | | |

## Part Number Format and Example

| | [ 1 ] Supply Voltage | [ 2 ] OSC Type | [ 3 ] Output Waveform | [ 4 ] Series | [ 5 ] Package Size | [ 6 ] OE Function | – | [ 7 ] Frequency Stability | – | [ 8 ] Center Frequency |
|---|---|---|---|---|---|---|---|---|---|---|
| Example (1) | 3 | H | P | JFN | 328 | 1 | – | D | – | 250.000 |
| Example (2) | 3 | H | D | JFN | 578 | 1 | – | E | – | 644.530 |

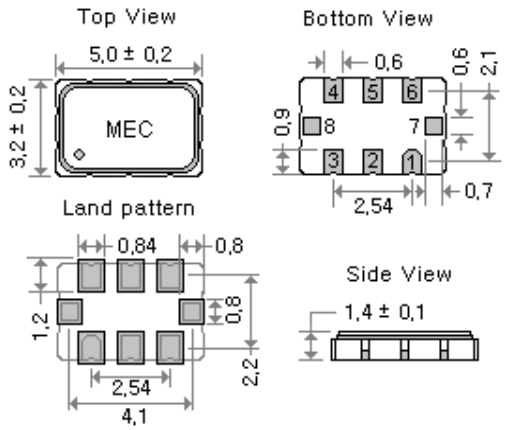
EX (1) : 3HPJFN3281 - D - 250.000 [ +3.3V , HPJFN type , PECL output , 3.2x2.5mm 8pad , OE on pad1 , ±25ppm from -40 to +85°C , 250.000 MHz ]

EX (2) : 3HDJFN5781 - E - 644.530 [ +3.3V , HDJFN type , LVDS output , 7.0x5.0mm 8pad , OE on pad1 , ±50ppm from -40 to +85°C , 644.530 MHz ]

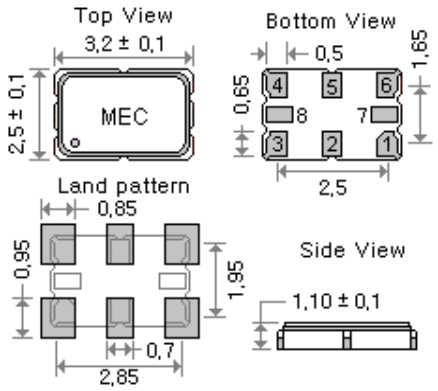
| | | |
|---|---|---|
| [ 1 ] | Supply Voltage , " 18 " for +1.8V ; " 25 " for +2.5V ; " 3 " for +3.3V | |
| [ 2 ] | OSC Type , " H " : XO | |
| [ 3 ] | Output Waveform , " T " : CMOS ; " P " : LVPECL ; " D " : LVDS ; " C " : HCSL ; " Q " : CML | |
| [ 4 ] | JFN Series | |
| [ 5 ] | Package Size , " 328 " : 3.2 x 2.5 mm 8pad ; " 538 " : 5.0 x 3.2 mm 8pad ; " 578 " : 7.0 x 5.0 mm 8pad | |
| [ 6 ] | " 1 " : OE function on pad # 1 | |
| [ 7 ] | -20°C ~ 70 °C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm |
| | -40°C ~ 85 °C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm |
| | -40°C ~ 105 °C | " H " ± 50ppm ; " J " ± 100ppm |
| [ 8 ] | Frequency in MHz | |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

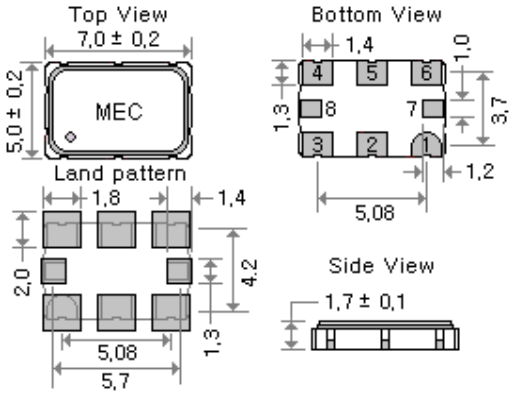
### H_JFN538




### H_JFN328




### H_JFN578




### Pad Connections :

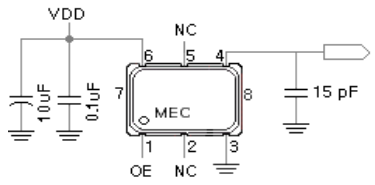
Pad 1 : Output Enable
Pad 2 : No Connection
Pad 3 : Ground
Pad 4 : CMOS : Output , Differential : Output
Pad 5 : CMOS : No Connection , Differential : Complementary Output
Pad 6 : Supply Voltage
Pad 7 : Do Not Connect
Pad 8 : Do Not Connect

# High Frequency Ultra-low Jitter Crystal Oscillators [ Quick - Turn Oscillators , 50 ~ 2,100 MHz ]

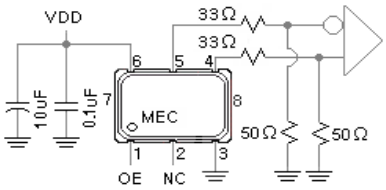
| H_JFN | Quick - Turn Clock Oscillators | 150 fsec RMS Jitter | SMD | 1.8 V | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| CMOS / Differential | | | | | | | 50 MHz | 2,100 MHz |

## Test Circuits

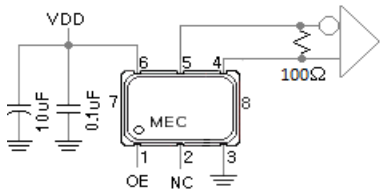
### CMOS



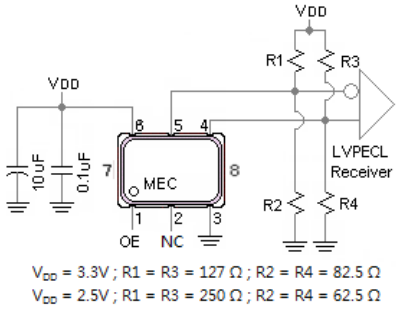

### HCSL




### LVDS Test Circuits for 2.5V and 3.3V

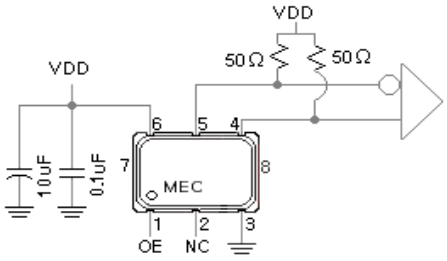



### LVPECL

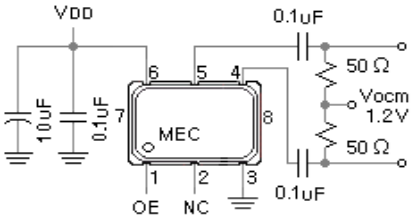



$V_{DD}$ = 3.3V ; R1 = R3 = 127 Ω ; R2 = R4 = 82.5 Ω
$V_{DD}$ = 2.5V ; R1 = R3 = 250 Ω ; R2 = R4 = 62.5 Ω

### CML

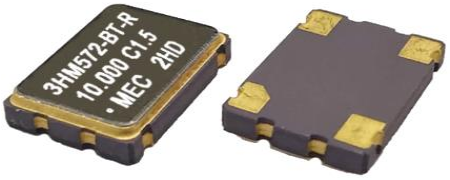



### LVDS Test Circuits for 1.8V only (*2)



# EMI Reduction Spread Spectrum Clock Oscillators

A Drop-in Replacement Solution For Your EMI / EMC Compliance Problem



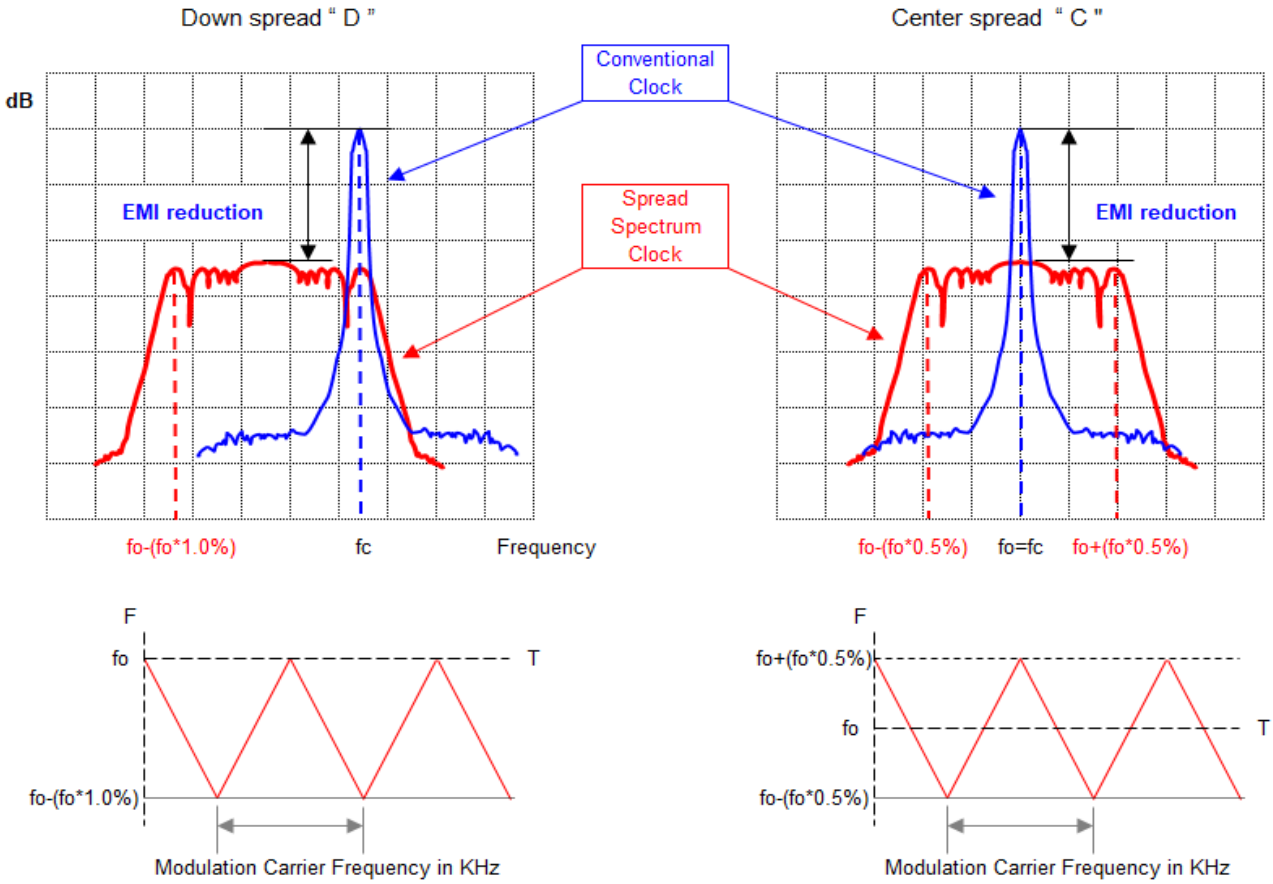

The principle sources of the EMI problems come from the system clocks. Therefore, rather than patching the problem with ferrite beads, EMI filters, ground plane and metal shielding, the most efficient and economical way to reduce the peak radiation energy is to use a spread spectrum clock oscillator .

Compared with conventional clock oscillator , Mercury's HM series spread spectrum (dithered) clock oscillator can reduce EMI as much as 12dB.
The beauty is that it is a drop-in replacement for your existing 7 x 5mm , 5 x 3.2mm clock oscillator.
No need to re-spin the board.

Applications :

- Printers; Multiple function printers (MPCs)
- Digital copiers; PDAs
- Networking; LAN / WAN; Routers
- Storage systems (CD-ROM, VCD, DVD and HDD)
- Scanner; Modems; projectors
- Hand-held ID readers
- Embedded systems; Electrical musical instrument
- Automotive; GPS car navigation systems
- LCD PC monitors / LCD TVs
- ADSL; PCMCIA
- Still Digital cameras (SDCs)

**Modulation Types :** [ Output amplitude (dB) vs frequency span (MHz) ]




Spread Spectrum Clock ( SSC ) :

Unlike a conventional clock, the mode energy of a spread spectrum clock is spread over a wider bandwidth, resulting from the **frequency modulation** technique.

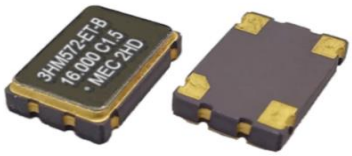
The modulation carrier frequency is in the KHz range which makes the modulation process transparent to the oscillator frequency.

The controlled modulation process can be all on one side of the nominal frequency ( **down spread** ) or 50% higher and 50% lower ( **center spread** ) of the nominal frequency. Down spread is preferred if over-clocking is a problem to the system.

# EMI Reduction Spread Spectrum Clock Oscillators [ Programmable Quick Turn ]

| HM _ B | Quick - Turn Clock Oscillators | B group | SMD | CMOS | 2.5V | 3.3V | Min. 3.0 MHz | Max. 200 MHz |
|---|---|---|---|---|---|---|---|---|

- Reduces electromagnetic Interference ( EMI ) by approx. 12 dB to 18 dB .
- Drop-In Replacement for Conventional Oscillators
- No Need to Re-Spin the Board or Solder Pad Layout
- Operates with a +2.5V or 3.3V Supply Voltage
- 5.0 x 3.2 , 7.0 x 5.0 mm package size




General specifications of all available packages , at Ta=+25°C , CL=15p

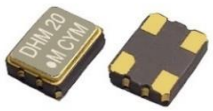
| Group | B group | |
|---|---|---|
| Available Packages | **HM53** ( 5.0 * 3.2 * 1.2 mm ) | **HM572** ( 7.0 * 5.0 * 1.4 mm ) |
| Output Waveform | CMOS ( square wave ) | |
| Supply Voltage ( $V_{DD}$ ) | + 2.5 V ± 10% | + 3.3 V ± 10% |
| Frequency Range | 3.0 MHz ~ 166 MHz | 3.0 MHz ~ 200 MHz |
| Output Logic High " 1 " | 2.25 V ( min.) | 2.97 V ( min.) |
| Output Logic Low " 0 " | 0.25 V ( max.) | 0.33 V ( max.) |

| | | | | |
|---|---|---|---|---|
| Spread Type | Spread Percentage EMI Reduction Rate | | | |
| Center Spread ( " C " ) | ± 0.125 % ( C0.125 ) to ± 2.0 % ( C2.0 ) in ± 0.125 % steps | | | |
| Down Spread ( " D " ) | - 0.25 % ( D0.25 ) to - 4.0 % ( D4.0 ) in 0.25 % steps | | | |
| Frequency Stability Codes ( exclude modulation ) | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm |
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* |
| Modulation Carrier Freq. ( Dither rate ) | 30 KHz ( min. ) ; 40.0 KHz ( max. ) Frequency dependent. Call for details. | | | |
| Current Consumption | 3 MHz ~ 100 MHz : 20 mA ( max. ) | 101 MHz ~ 200 MHz : 30 mA ( max. ) | | |
| Rise Time / Fall Time | 5.0 nsec ( max. ) , 10% ↔ 90% waveform | | | |
| Output Load | 15 pF | | | |
| Start-up Time | 3.0 msec. ( typ. ) ; 5 msec. ( max. ) | | | |
| Duty Cycle | 50% ± 10% | | | |
| Aging at Ta = +25°C | ± 5 ppm per year ( max. ) | | | |
| Storage Temperature | -55°C to + 125°C | | | |
| Output Enable / Disable Function | Enable | 70% ( min. ) of $V_{DD}$ to Enable Output. | | |
| | Disable | 30% ( max. ) of $V_{DD}$ to Disable Output. | | |
| | Output enable / disable time : 100 nsec. ( max. ) | | | |

# EMI Reduction Spread Spectrum Clock Oscillators

| HM _ C | EMI Reduction Spread Spectrum Clock Oscillators<br>C group | SMD | CMOS | 1.8V | 2.5V | 3.3V | Min.<br>16 MHz | Max.<br>40 MHz |
|---|---|---|---|---|---|---|---|---|

- Reduce electromagnetic interference (EMI) by approx. 3 dB to 12 dB
- Operates with +1.8V to +3.3V supply voltage
- 2.5 x 2.0 , 3.2 x 2.5 , 5.0 x 3.2 , 7.0 x 5.0 mm package size



General specifications of all available packages , at Ta=+25°C , CL=15pF

| Group | C Group | | | |
|---|---|---|---|---|
| Type | HM22 | HM32 | HM53 | HM572 |
| Dimemsions | 2.5 * 2.0 * 0.9 mm | 3.2 * 2.5 * 1.0 mm | 5.0 * 3.2 * 1.2 mm | 7.0 * 5.0 * 1.4 mm |

| | | | |
|---|---|---|---|
| Frequency Range | 16 ~ 40 MHz | | |
| Supply Voltage ( $V_{DD}$ ) | 1.8 V ± 10% | 2.5 V ± 10% | 3.3 V ± 10% |
| Output Logic " High ", "1 " | 1.62 V ( min. ) | 2.25 V ( min. ) | 2.97 V ( min. ) |
| Output Logic " Low "," 0 " | 0.18 V ( max. ) | 0.25 V ( max. ) | 0.33 V ( max. ) |
| Rise Time / Fall Time<br>[ 10% $V_{DD}$ ↔ 90% $V_{DD}$ ] | 10 nsec. ( max. ) | 7 nsec. ( max. ) | 7 nsec. ( max. ) |
| Current Consumption | 4 mA ( max. ) | 5 mA ( max. ) | 6 mA ( max. ) |

| | | | |
|---|---|---|---|
| Spread Type | Total% | Down Spread | Center Spread |
| Spread Percentage | 2.0% | -2.0% ( D2.0 ) | ± 1.0% ( C1.0 ) |
| | 1.5% | -1.5% ( D1.5 ) | ± 0.75% ( C0.75 ) |
| | 1.0% | -1.0% ( D1.0 ) | ± 0.5% ( C0.5 ) |

| | | |
|---|---|---|
| EMI Reduction | 3 dB to 12 dB ( typ. ) for the main mode | |
| Modulation Carrier Freq.<br>( Dither rate ) | 20.9 KHz ( min. ) ; 52.4 KHz ( max. )<br>Frequency dependent . Call for details | |
| Duty Cycle | 50% ± 10% | |
| Output Waveform | CMOS | |
| Output Load | 15pF | |
| Start-up Time | 1.0 msec. ( typ. ) ; 5 msec. ( max. ) | |
| Storage Temperature | - 55°C to + 125°C | |
| Aging at Ta = +25°C | ± 5 ppm per year ( max. ) | |
| Output Enable Function | Enable | When 70% ( min. ) of $V_{DD}$ to Enable Output. (Open connection prohibit.) |
| | Disable | When 30% ( max. ) of $V_{DD}$ to Disable Output. |
| | Output Enable Time : 5.0 msec. ( max. ) / Output Disable Time: 100 nsec. ( max. ) | |
| Frequency Stability Code<br>( exclude modulation ) | Freq. Stability over Operating Temperature Range: ± 50 ppm from -40°C to +85°C ( Code is " E " ) | |

# EMI Reduction Spread Spectrum Clock Oscillators

## Part Number Format and Example

| [ 1 ] | [ 2 ] | - | [ 3 ] | [ 4 ] | - | [ 5 ] | [ 6 ] | - | [ 7 ] |
|---|---|---|---|---|---|---|---|---|---|
| Supply Voltage | Holder Type | | Frequency Stability | OE Function | | Center Frequency | Group Type | | Spread type Percentage |

| Examples | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | 25 | HM53 | - | F | T | - | 75.000 | B | - | C2.0 |
| | (2) | 18 | HM32 | - | E | T | - | 25.000 | C | - | D1.0 |

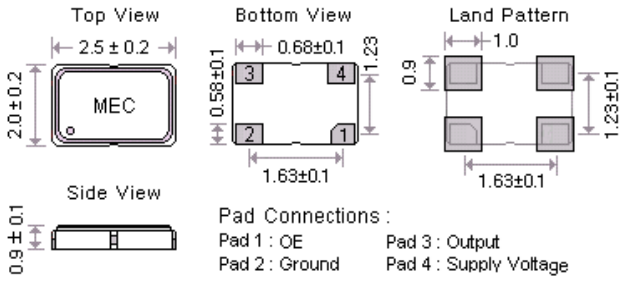
Ex (1) : 25HM53 - FT - 75.000B - C2.0 [ +2.5V, HM-series, HM53 type, ±100ppm from -40°C to +85°C, OE Function, 75.000MHz, B Group, 2.0% center spread ]

Ex (2) : 18HM32 - ET - 25.000C - D1.0 [ +1.8V, HM-series, HM32 type, ±50ppm from -40°C to +85°C, OE Function, 25.000MHz, C Group, 1.0% down spread ]

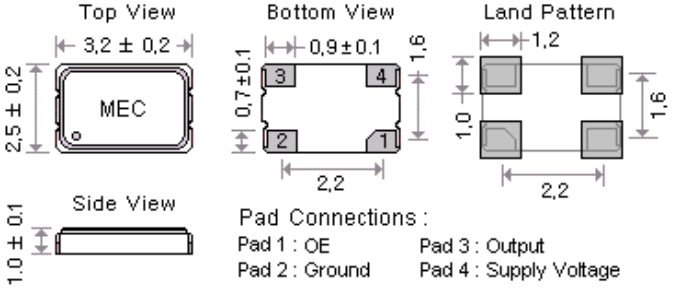
| | | |
|---|---|---|
| [ 1 ] | Supply voltage code : " 18 " for +1.8V , " 25 " for +2.5V , " 3 " for +3.3V | |
| [ 2 ] | Holder Type ( HM53 , HM32 ) | |
| [ 3 ] | -20°C ~ 70 °C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm |
| | -40°C ~ 85 °C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm |
| [ 4 ] | " T " for OE Function | |
| [ 5 ] | Frequency in MHz | |
| [ 6 ] | Group " B " , " C " | |
| [ 7 ] | Spread type & percentage ; " C " for center spread , " D " for down spread | |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

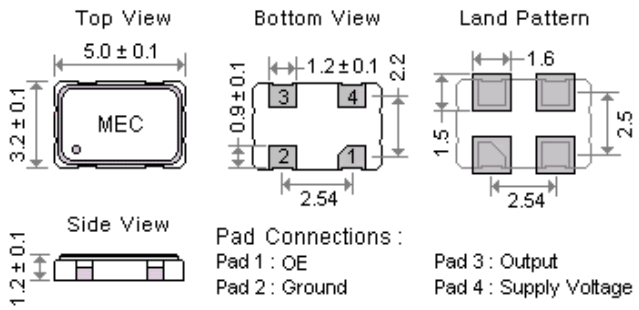
**[ HM22 ]** For group : **C**



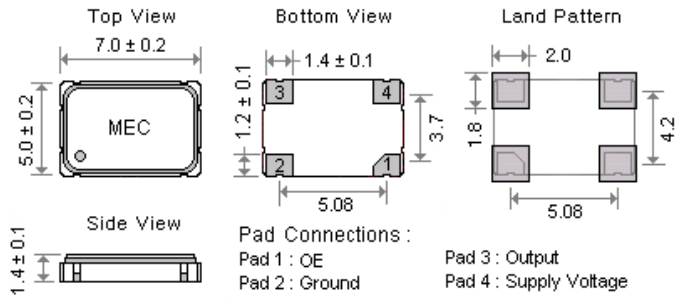

**[ HM32 ]** For group : **C**




**[ HM53 ]** For group : **B** **C**




**[ HM572 ]** For group : **B** **C**

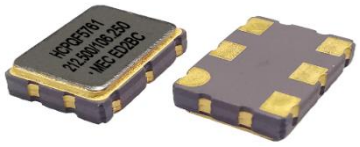


# Frequency Switchable Crystal Oscillators [ 10 ~ 1,500 MHz ]

| HC_QF | Q family | Frequency | Quick - Turn | 1.5 psec | SMD | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|---|
| CMOS / Differential | F series | Switchable | Clock Oscillators | RMS Jitter | | | | 10 MHz | 1,500 MHz |

## Features

- The HCTQF, HCPQF and HCDQF Series are members of Mercury's Q-Family Quick-Turn crystal oscillators
- Output frequency range : 10 MHz to 1,500 MHz
- Package size : 3.2 x 2.5mm , 5.0 x 3.2mm , 7.0 x 5.0mm
- Next-day samples for prototypes



## General specifications , at Ta = + 25°C

| Model | HCTQF | HCPQF | HCDQF |
|---|---|---|---|
| Output Logic | CMOS | LVPECL | LVDS |
| Supply Voltage $V_{DD}$ ( code ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) |
| | + 3.3 V ± 5% ( voltage code " 3 " ) | + 3.3 V ± 5% ( voltage code " 3 " ) | + 3.3 V ± 5% ( voltage code " 3 " ) |
| Available Frequency Range | 10 ~ 250 MHz | 10 ~ 1,500 MHz | 10 ~ 1,500 MHz |
| Output Load | 15 pF | 50 Ω into Vcc - 2V or Thevenin equivalent | 100 Ω |
| Output Logic " High " , " 1 " | 90 % $V_{DD}$ | $V_{DD}$ - 1.03 ( min. ) , $V_{DD}$ - 0.6 ( max. ) | 1.4 V ( typ. ) , 1.6 V ( max. ) |
| Output Logic " Low " , " 0 " | 10 % $V_{DD}$ | $V_{DD}$ - 1.85 ( min. ) , $V_{DD}$ - 1.6 ( max. ) | 1.1 V ( typ. ) , 0.9 V ( min. ) |
| Current Consumption ( $V_{DD}$ = + 2.5 V ) | 10 ~ 150 MHz : 30 mA ( max.) | 10 ~ 750 MHz : 50 mA ( max.) | 10 ~ 750 MHz : 32 mA ( max. ) |
| | 151 ~ 250 MHz : 40 mA ( max.) | 751 ~ 1,500 MHz : 55 mA ( max.) | 751 ~ 1,500 MHz : 35 mA ( max. ) |
| Current with Output Disabie | 18 mA ( typ. ) | 18 mA ( typ. ) | 18 mA ( typ. ) |
| Current Consumption ( $V_{DD}$ = + 3.3 V ) | 10 ~ 150 MHz : 38 mA ( max. ) | 10 ~ 750 MHz : 55 mA ( max. ) | 10 ~ 750 MHz : 34 mA ( max. ) |
| | 151 ~ 250 MHz : 48 mA ( max. ) | 751 ~ 1,500 MHz : 60 mA ( max. ) | 751 ~ 1,500 MHz : 40 mA ( max. ) |
| Rise Time / Fall Time | 10.0 nsec. ( max. )<br>Tr / Tf : 10% ↔ 90% waveform | 0.5 nsec. ( max. )<br>Tr / Tf : 20% ↔ 80% waveform | 0.4 nsec. ( max. )<br>Tr / Tf : 20% ↔ 80% waveform |

| | | | | | |
|---|---|---|---|---|---|
| RMS Jitter [ 12 kHz ~ 20 MHz ] | 1.5 psec. ( typ. ) | | | | |
| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F " represents . For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F30 " ± 30 ppm over -40°C to +85°C |
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |
| Duty Cycle | 50% ± 5% | | | | |
| Start-up Time | 10 msec. ( max. ) | | | | |
| Aging at Ta = +25°C | ± 5 ppm ( max. ) for first year | | | | |
| Storage Temperature | -55°C to +150°C | | | | |
| **Output Enable Function on Pad 1** | | | | | |
| Output Enable / Disable Function | 70% of $V_{DD}$ ( min. ) to enable output. ( Open connection prohibit. ) | | | | |
| | 30% of $V_{DD}$ ( max. ) to disable output | | | | |
| Output Enable Time / Disable Time | 200 nsec. ( max. ) / 50 nsec. ( max. ) | | | | |
| **Frequency Selection Function on Pad 2** | | | | | |
| Frequency Selection ( FSEL ) | When FSEL = 0 ( 0 V or GND ) , Output frequency is Freq.1 ( f 1 )<br>When FSEL = 1 ( $V_{DD}$ ) , Output frequency is Freq.2 ( f 2 ) | | | | Default FSEL pin has internal pull-up resistor |
| FSEL on Pad 2 | 70% of $V_{DD}$ ( min. ) For FSEL = 1 , Output frequency is Freq.2 ( f2 ) | | | | |
| | 30% of $V_{DD}$ ( max.) For FSEL = 0 , Output frequency is Freq.1 ( f1 ) | | | | |
| | Frequency switching time : 60 us ( typ. ) | | | | |

# Frequency Switchable Crystal Oscillators [ 10 ~ 1,500 MHz ]

| HC_QF | Q family / F series | Frequency Switchable | Quick - Turn Clock Oscillators | 1.5 psec RMS Jitter | SMD | 2.5 V | 3.3 V | Min. 10 MHz | Max. 1,500 MHz |
|---|---|---|---|---|---|---|---|---|---|
| CMOS / Differential | | | | | | | | | |

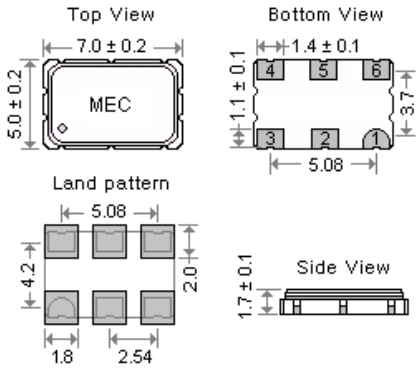
## Part Number Format and Example

Example : 3HCTQF576 - E - 30.000 / 120.000

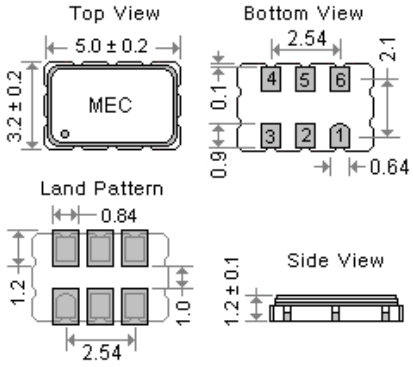
| 3 | HCTQF | 576 | - | E | - | 30.000 | / | 120.000 |
|---|---|---|---|---|---|---|---|---|
| Supply Voltage<br>" **3** " for 3.3V<br>" **25** " for 2.5V | HCTQF : CMOS<br>HCPQF : LVPECL<br>HCDQF : LVDS | Package Size<br>" **576** ": 7 x 5 mm<br>" **536** ": 5 x 3.2 mm<br>" **326** ": 3 x 2.5 mm | - | Frequency Stability Code " **E** ":<br>±50 ppm over -40 to +85°C.<br>Other frequency stabilities are available. | - | Custom Frequency 1<br>FSEL = 0<br>( MHz ) | / | Custom Frequency 2<br>FSEL = 1<br>( MHz ) |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

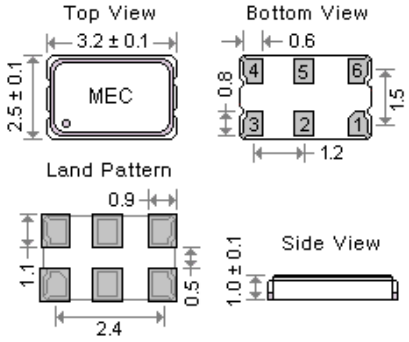
### HC_QF576




### HC_QF536




### HC_QF326




### Pad Connections

Pad 1 : OE

Pad 2 : Frequency Selection [ FSEL = 0 ( f 1 ) , FSEL =1 ( f 2 ) ]

Pad 3 : Ground

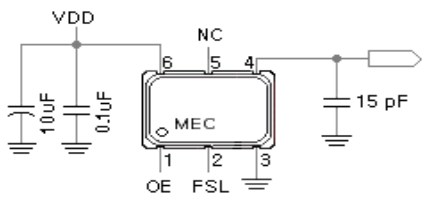
Pad 4 : [ CMOS : Output , LVPECL or LVDS : Differential ]

Pad 5 : [ CMOS : NC , LVPECL or LVDS : Complementary ] Output

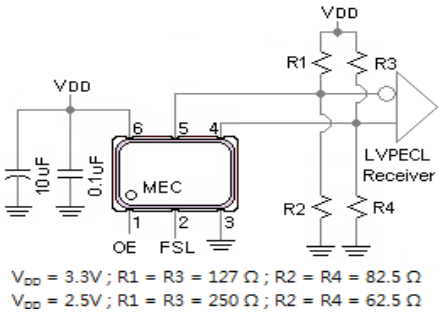
Pad 6 : Supply Voltage

## Test Circuits

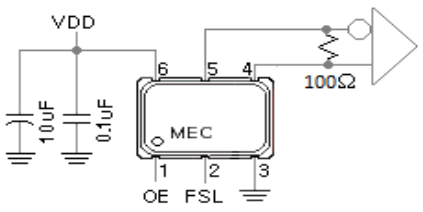
### CMOS




### LVPECL




### LVDS



# 4 Frequencies Switchable Crystal Oscillators [ 15 ~ 2,100 MHz ]

**HC_JFN** — CMOS / Differential

**4 Frequencies Switchable**

**Quick - Turn Clock Oscillators**

**SMD**

**1.8 V** | **2.5 V** | **3.3 V**

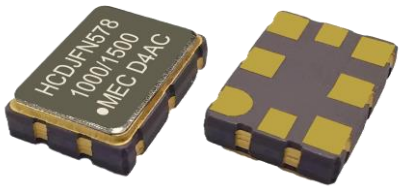
Min. **15 MHz**

Max. **2,100 MHz**

## Features

**150 fs Phase Jitter ( typ. )**

Mercury's 4 Frequencies switchable crystal oscillators that can be delivered in days
An integrated phase jitter performance of 150 fs RMS.
Supports all popular formats: CMOS, LVPECL, LVDS, HCSL and CML
Gaining its precision frequency control market position by providing engineers with next-day samples for prototypes.






## General specifications , at Ta = + 25°C

| Model | HCTJFN | HCPJFN | HCDJFN | HCCJFN | HCQJFN |
|---|---|---|---|---|---|
| Output Logic | **CMOS** | **LVPECL** | **LVDS** | **HCSL** | **CML** |
| Supply Voltage $V_{DD}$ ( code ) | + 1.8 V ± 5% | -- | + 1.8 V ± 5% (*) | + 1.8 V ± 5% | + 1.8 V ± 5% |
| | + 2.5 V ± 10% | + 2.5 V ± 10% | + 2.5 V ± 10% | + 2.5 V ± 10% | + 2.5 V ± 10% |
| | + 3.3 V ± 10% | + 3.3 V ± 10% | + 3.3 V ± 10% | + 3.3 V ± 10% | + 3.3 V ± 10% |
| Available Frequency Range | 15 ~ 250 MHz | 15 ~ 2,100 MHz | 15 ~ 2,100 MHz | 15 ~ 700 MHz | 15 ~ 2,100 MHz |
| Output Load | 15 pF ( max. ) | 50 Ω into $V_{DD}$ - 2V or Thevenin equivalent | 100 Ω between output and complimentary output | 50 Ω to GND | 50 Ω to $V_{DD}$ |
| Output Logic " High " , " 1 " | $V_{DD}$ - 0.4 V ( min. ) | $V_{DD}$ - 1.03 V ( min. )<br>$V_{DD}$ - 0.6 V ( max. ) | 1.4 V ( typ. )<br>1.6 V ( max. ) | $V_{DD}$ : 0.66V ( min. )<br>$V_{DD}$ : 1.15V ( max. ) | $V_{DD}$ - 0.085V ( min. )<br>$V_{DD}$ = ( max. ) |
| Output Logic " Low " , " 0 " | $V_{DD}$ x 0.1 V ( max. )<br>0.3V (max.) for 1.8V only | $V_{DD}$ - 1.85 V ( min. )<br>$V_{DD}$ - 1.6 V ( max. ) | 1.1 V ( typ. )<br>0.9 V ( min. ) | $V_{DD}$ : - 0.15V ( min. )<br>$V_{DD}$ : 0.15V ( max. ) | $V_{DD}$ - 0.6V ( min. )<br>$V_{DD}$ - 0.32V ( max. ) |
| Output Voltage Swing | --- | 595 mV ( min. )<br>930 mV ( max. ) | 250 mV ( min. )<br>450 mV ( max. ) | 450 mV ( min. )<br>700 mV ( typ. ) | 200 mV ( min. )<br>600 mV ( max. ) |
| Current Consumption ( $V_{DD}$ = + 3.3 V ) | 75 mA ( typ. )<br>90 mA ( max. ) | 100 mA ( typ. )<br>120 mA ( max. ) | 75 mA ( typ. )<br>90 mA ( max. ) | 80 mA ( typ. )<br>100 mA ( max. ) | 70 mA ( typ. )<br>85 mA ( max. ) |
| Current with Output Disabie | 62 mA ( typ. ) | 99 mA ( typ. ) | 74 mA ( typ. ) | 79 mA ( typ. ) | 69 mA ( typ. ) |
| Rise Time / Fall Time | 5.0 nsec ( max. )<br>( 10% to 90% Waveform ) | 0.4 nsec ( max. )<br>( 20% to 80% Waveform ) | 0.4 nsec ( max. )<br>( 20% to 80% Waveform ) | 0.4 nsec ( max. )<br>( 20% to 80% Waveform ) | 0.4 nsec ( max. )<br>( 20% to 80% Waveform ) |

| | | | | |
|---|---|---|---|---|
| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm |
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* |
| | Extended Industrial ( *-40°C to +105°C* ) | --- | *H* | *J* |

| | |
|---|---|
| Duty Cycle | 50% ± 5% |
| Start-up Time | 5 msec ( typ. ) ; 10 msec. ( max. ) |
| RMS Jitter [ 12 kHz ~ 20 MHz ] | 156.250 MHz : 148 fsec ( typ. ) ; 312.500 MHz : 147 fsec ( typ. ) ; 644.530 MHz : 141 fsec ( typ. ) ; 2,000 MHz : 155 fsec ( typ. ) |
| Aging at Ta = +25°C | ± 3 ppm ( max.) for first year at 25°C |
| Storage Temperature | -55°C to +150°C |
| **Frequency Selection Function** | |
| FS0 Control on Pad 1 | 70% $V_{DD}$ min. to logic Level " 1 " |
| | 30% $V_{DD}$ max. to logic Level " 0 " |
| FS1 Control on Pad 2 | 70% $V_{DD}$ min. to logic Level " 1 " |
| | 30% $V_{DD}$ max. to logic Level " 0 " |
| Frequency Select Timing ; $t_{FS}$ | 10.0 msec. ( max. ) |
| Frequency Configurations | The frequency output 1 ~ 4 setting is done based on the logic levels in the Table 1. |

Note (＊) : This needs AC coupling (100-nF series capacitor). Please check the test circuit.

# 4 Frequencies Switchable Crystal Oscillators [ 15 ~ 2,100 MHz ]

| HC_JFN | 4 Frequencies Switchable | Quick - Turn Clock Oscillators | SMD | 1.8 V | 2.5 V | 3.3 V | Min. 15 MHz | Max. 2,100 MHz |
|---|---|---|---|---|---|---|---|---|
| CMOS / Differential | | | | | | | | |

**150 fs Phase Jitter ( typ. )**

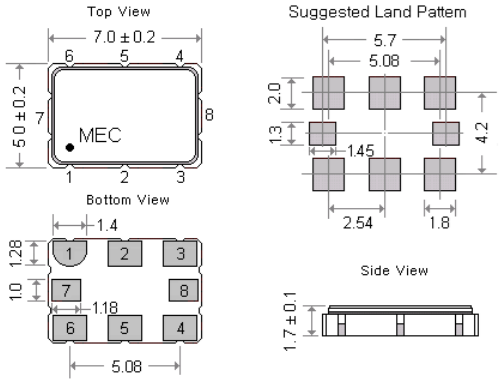
## Part Number Format and Example

Example : 3HCTJFN578 - E - 156 / 250 / 622 / 1024

| 3 | HCTJFN | 578 | - | E | - | 156 | / | 250 | / | 622 | / | 1024 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Supply Voltage<br>" **3** " for 3.3V<br>" **25** " for 2.5V<br>" **18** " for 1.8V | HC**T**JFN : **CMOS**<br>HC**P**JFN : **LVPECL**<br>HC**D**JFN : **LVDS**<br>HC**C**JFN : **HCSL**<br>HC**Q**JFN : **CML** | Package Size<br>" **578** "<br>( 7.0 * 5.0 mm )<br>8pad | - | Freq. Stability Code<br>**E** : ±50 ppm<br>over -40 to +85℃<br>Other temperature stabilities are available. | - | 156.250<br>Freq. 1<br>( MHz ) | / | 250.000<br>Freq. 2<br>( MHz ) | / | 622.080<br>Freq. 3<br>( MHz ) | / | 1024.00<br>Freq. 4<br>( MHz ) |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs , Test Circuits

### HC_JFN578



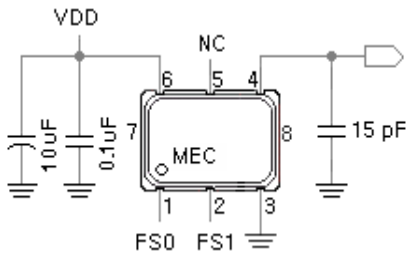

Pad Connection :
Pad 1 : FS0 Control
Pad 2 : FS1 Control
Pad 3 : Ground
Pad 4 : CMOS : Output
Differential : Output
Pad 5 : CMOS : No Used For CMOS
Differential : Complementary Output
Pad 6 : Supply Voltage
Pad 7 : Do Not Connect
Pad 8 : Do Not Connect

Frequency selection configurations

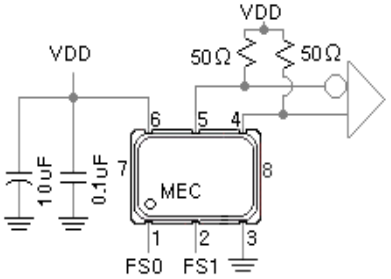
| FS1 | FS0 | Freq. output |
|---|---|---|
| 0 | 0 | Freq. 1 |
| 0 | 1 | Freq. 2 |
| 1 | 0 | Freq. 3 |
| 1 | 1 | Freq. 4 |

Table 1

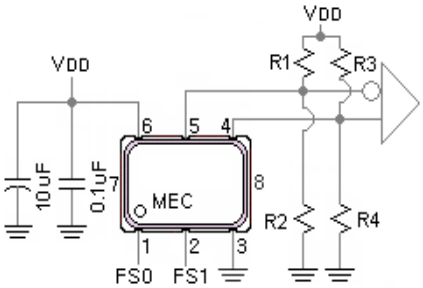
### CMOS Test Circuits




### CML Test Circuits

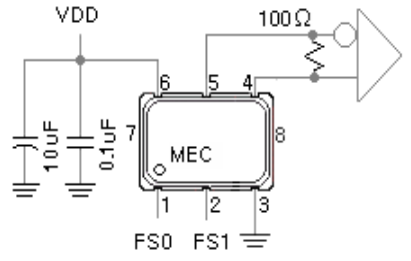



### LVPECL Test Circuits

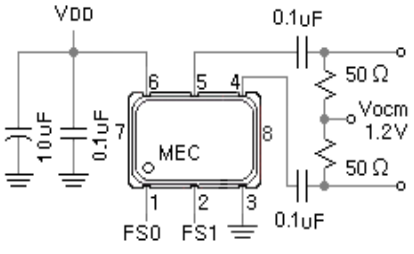



$V_{DD}$ = 3.3 V : R1 = R3 = 127 Ω ; R2 = R4 = 82.5 Ω
$V_{DD}$ = 2.5 V : R1 = R3 = 250 Ω ; R2 = R4 = 62.5 Ω

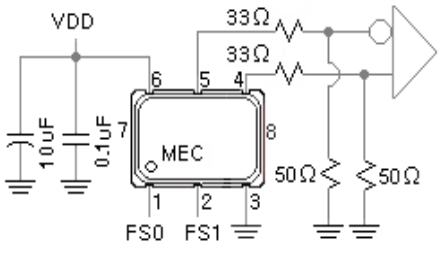
### LVDS Test Circuits for 2.5V and 3.3V



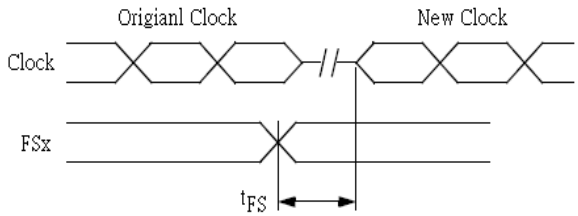

### LVDS Test Circuits for 1.8V only (*)




### HCSL Test Circuits




## Frequency Select Timing



# True Sine Wave Clock Oscillators [ HS series ]

| HS _ _ | True Sine Wave | Thru-Hole | 3.3V | 5.0V | Min. 10 MHz | Max. 160 MHz |
|---|---|---|---|---|---|---|

## Features

- High purity and low total harmonic distortion. Ideal for audio modulation applications.
- For VCXOs with a Sine Wave output, please refer to "GS" series

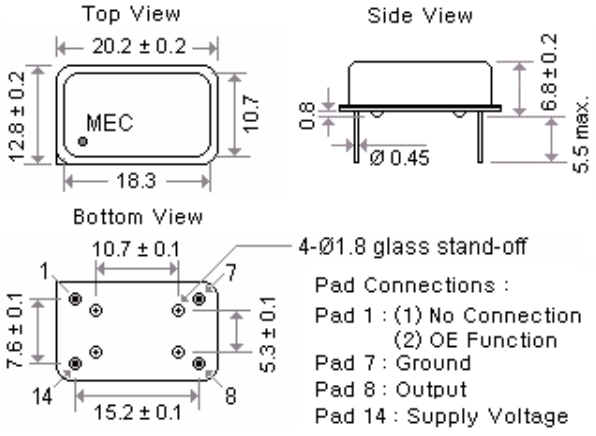
## General specifications of all available packages , at Ta=+25°C

| Model | " HS " series | | | |
|---|---|---|---|---|
| Package Dimensionss , unit : mm | Thru - Hole **HS14** ( 20.2 * 12.8 * 6.8 ) | | | Gull - Wing **HS24** ( 20.2 * 12.8 * 7.8 ) |
| Output Waveform | True Sine Wave | | | |
| Output Load | 50Ω. ( Internally AC coupled ) | | | |
| Supply Voltage ( $V_{DD}$ ) | +3.3V ± 10% | | | +5.0V ± 10% |
| Frequency Range | 10.000 ~ 160.000 MHz | | | 10.000 ~ 156.250 MHz |
| Output Level | Standard: +3.0 dBm ( min. )<br>Tolerance: ± 1 dBm<br>Maximum Power: +7 dBm<br>( User to specify ) | | | Standard: +5.0 dBm ( min. )<br>Tolerance: ± 1 dBm<br>Maximum Power: +13 dBm<br>( User to specify ) |
| Current Consumption | 10 MHz : 9 mA ( typ. ) | | | 10 MHz : 18 mA ( typ. ) |
| | 100 MHz : 18 mA ( typ. ) | | | 100 MHz : 34 mA ( typ. ) |
| | 150 MHz : 19 mA ( typ. ) | | | 150 MHz : 36 mA ( typ. ) |
| Harmonics | < - 30dBc ( frequency dependent ) | | | < - 25dBc ( frequency dependent ) |
| Start-up Time | 5.0 msec. ( max. ) | | | |
| Storage Temperature | -50°C to +125°C | | | |
| Aging at Ta=+25°C | ± 5 ppm per year ( max. ) | | | |
| Pin 1 option | OE Function ; No OE Function option | | | |
| Output Enable / Disable Function ( OE Function ) | 70% of $V_{DD}$ ( min. ) to enable output.<br>30% of $V_{DD}$ ( max. ) to disable output. | | | |
| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm |
| | Commercial *-20°C to +70°C* | *A* | *B* | *C* |
| | Industrial *-40°C to +85°C* | *D* | *E* | *F* |

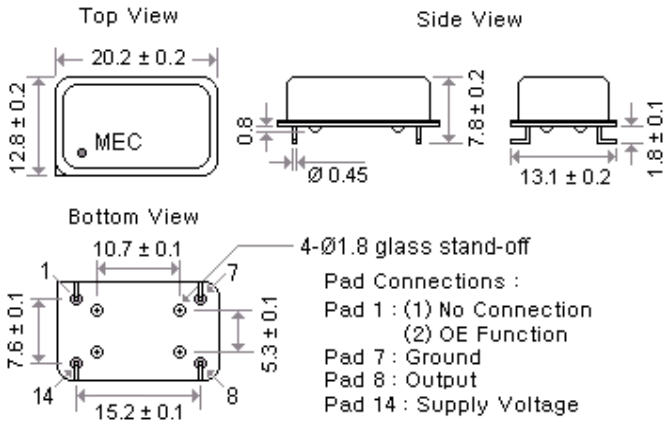
If non-standard please enter the desired stability after the " C " or " F " represents .
For example :
" C20 " : ± 20 ppm over -20°C to +70°C
" F30 " : ± 30 ppm over -40°C to +85°C

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

[ HS14 ]




[ HS24 ]



# True Sine Wave Clock Oscillators [ HS series ]

## Part Number Format and Example

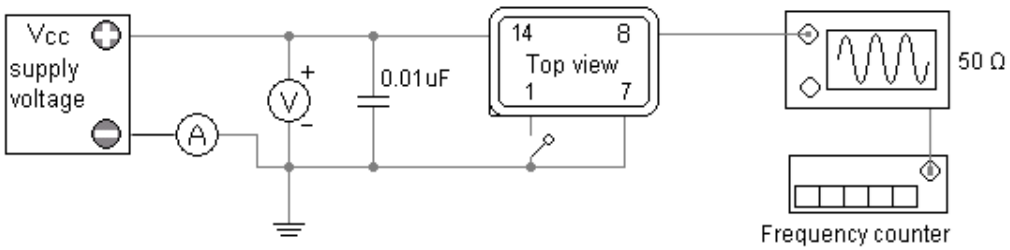
| [ 1 ] | [ 2 ] | | [ 3 ] | [ 4 ] | | [ 5 ] | | [ 6 ] |
|---|---|---|---|---|---|---|---|---|
| Supply Voltage | Holder Type | – | Frequency Stability | Pin 1 option | – | Center Frequency | – | Output Power [ HS series only ] |
| Example 3 | HS14 | – | A | | – | 100.000 | – | 5 |
| 5 | HS24 | – | D | **T** | – | 24.000 | – | 10 |

Ex(1) : 3HS14 - A - 100.000 - 5 [ +3.3V , True Sine wave , ±25ppm from -20°C to 70°C , No OE Function , 100.000MHz , Output power is 5dBm ±1dB ]

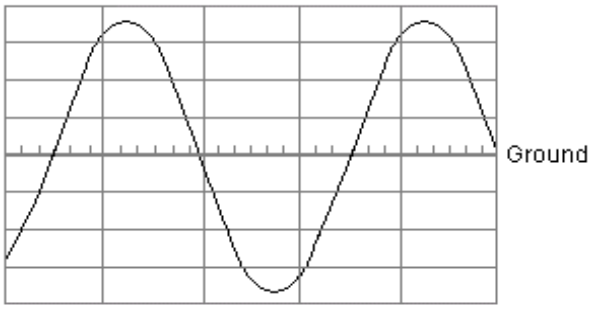
Ex(2) : 5HS24 - DT - 24.000 - 10 [ +5.0V , True Sine wave , ±25ppm from -40°C to 85°C , OE Function , 24.000MHz , Output power is 10dBm ±1dB ]

| | | |
|---|---|---|
| [ 1 ] | Supply voltage , " 3 " for +3.3V ; " 5 " for +5.0V | |
| [ 2 ] | Holder Type | |
| [ 3 ] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ;<br>If non-standard please enter the desired stability after " C " , for example " C15 " : represents ±15ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ;<br>If non-standard please enter the desired stability after " F " , for example " F20 " : represents ±20ppm over -40 to +85°C |
| [ 4 ] | " T " for Pin 1 option , Leave this space blank if no connection on pad 1. | |
| [ 5 ] | Frequency in MHz | |
| [ 6 ] | Output power in dBm | |

## HS - series test circuit




## True Sine Waveform



# Mercury Crystal Oscillator Products Lineup

| General VCXOs Selection Guide [ Square Wave Output ] | | | | |
|---|---|---|---|---|
| Output Wave Output Logic | Product Series | Supply Voltage | Frequency Range | Product Description / Features |
| **CMOS** | G ( SMD ) | 1.8 V / 3.3 V | 1.25 ~ 50 MHz | General purpose VCXOs. |
| | G ( Dip ) | | | |
| | GTQN | 2.5 V / 3.3 V | 10 ~ 250 MHz | 0.6 psec Phase Jitter ( typ. ) |
| | GTQF | 2.5 V / 3.3 V | 10 ~ 250 MHz | 1.2 psec Phase Jitter ( typ. ) |
| | GCTQF | 2.5 V / 3.3 V | 10 ~ 250 MHz | Frequency Switchable , 1.5 psec Phase Jitter ( typ. ) |
| | GTJFN | 1.8 V / 2.5 V / 3.3 V | 15 ~ 250 MHz | 150 fsec Phase Jitter ( typ. ) |
| **LVPECL** | GPQN | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | 0.6 psec Phase Jitter ( typ. ) |
| | GPQF | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | 1.2 psec Phase Jitter ( typ. ) |
| | GCPQF | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | Frequency Switchable , 1.5 psec Phase Jitter ( typ. ) |
| | GPJFN | 2.5 V / 3.3 V | 15 ~ 2,100 MHz | 150 fsec Phase Jitter ( typ. ) |
| **LVDS** | GDQN | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | 0.6 psec Phase Jitter ( typ. ) |
| | GDQF | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | 1.2 psec Phase Jitter ( typ. ) |
| | GCDQF | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | Frequency Switchable , 1.5 psec Phase Jitter ( typ. ) |
| | GDJFN | 1.8 V / 2.5 V / 3.3 V | 15 ~ 2,100 MHz | 150 fsec Phase Jitter ( typ. ) |
| **CML** | GQJFN | 1.8 V / 2.5 V / 3.3 V | 15 ~ 2,100 MHz | 150 fsec Phase Jitter ( typ. ) |
| **HCSL** | GCJFN | 2.5 V / 3.3 V | 15 ~ 700 MHz | 150 fsec Phase Jitter ( typ. ) |

| Frequency Switchable VCXOs [ Select f1 or f2 by Toggling Pin 1 ] [ Square Wave Output ] | | | | |
|---|---|---|---|---|
| Output Wave Output Logic | Product Series | Supply Voltage | Frequency Range | Product Description / Features |
| **CMOS** | GCTQF | 2.5 V / 3.3 V | 10 ~ 250 MHz | Switchable output Oscillators , 1.5 psec Phase Jitter ( typ. ) |
| **LVPECL** | GCPQF | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | Switchable output Oscillators , 1.5 psec Phase Jitter ( typ. ) |
| **LVDS** | GCDQF | 2.5 V / 3.3 V | 10 ~ 1,500 MHz | Switchable output Oscillators , 1.5 psec Phase Jitter ( typ. ) |

# VCXO " G "

| CMOS | Thru-Hole | SMD | 1.8 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|
| | | | | | 1.25 MHz | 50.0 MHz |

Unlike regular clock oscillators that have a fixed output frequency, the output frequency of VCXOs ( also known as " frequency modulators " ) can be tuned ± 50 ~ ± 200ppm up or down from the nominal frequency, by varying the control voltage on the voltage control pin. A varactor and a voltage variable capacitance tuning diode, is used to achieve this function. Applications include ( PLL ) phase lock loop, SONET / ATM, set -top boxes, MPEG, audio -video modulations, video game consoles and HDTV sets, ONET, 10GbE, Fibre Channel, wireless repeaters, transponders, HDTV, FPGAs, data acquisition.


General Specifications of " G " series , [ TA = +25°C , $V_{DD}$= at specified voltage , Load : 15 pF ]

| Model | " G " series | | |
|---|---|---|---|
| Output Waveform | CMOS | | |
| Type | SMD Type | | Thru - Hole Type |
| Pads / Pins | 6 pads | | 4 pins |
| Models ( Dimensions ) , Unit : mm | **G226** ( 2.5 * 2.0 * 1.0 ) | **G576** ( 7.0 * 5.0 * 1.7 ) | **G8** ( 12.8 * 12.8 * 6.3 ) |
| | **G326** ( 3.2 * 2.5 * 1.0 ) | **G536** ( 5.0 * 3.2 * 1.2 ) | **G14** ( 20.2 * 12.8 * 6.8 ) |

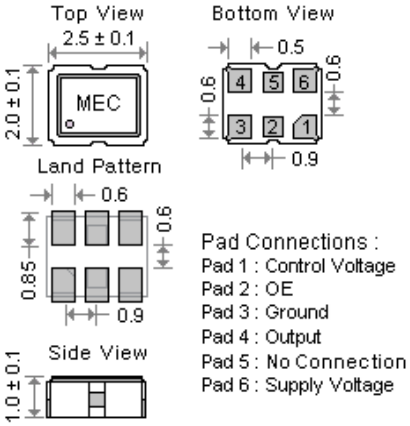
| | | |
|---|---|---|
| Supply Voltage ( $V_{DD}$ ) | +1.8V ± 5% | +3.3V ± 10% |
| Frequency Range | 16.0 MHz ~ 50.0 MHz | 1.25 MHz ~ 50.0 MHz |
| Initial Freq. Accuracy ( at 25 °C ) | with Vc = 0.9V | with Vc = 1.65V |
| Output Logic High " 1 " | 1.62 V ( min. ) | 2.97 V ( min. ) |
| Output Logic Low " 0 " | 0.18 V ( max. ) | 0.33 V ( max. ) |
| Frequency Deviation Range | Standard : ± 80 ppm ( min. ) | Standard : ± 80 ppm ( min. ) |
| Control Voltage Center and Range | 0.9 V ± 0.9 V | 1.65 V ± 1.35 V |

| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard please enter the desired stability after the " C " or " F " |
|---|---|---|---|---|---|
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | For example : " C20 " : ± 20 ppm over -20°C to +70°C ; " F30 " : ± 30 ppm over -40°C to +85°C |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Output Load | | 15 pF | | | | | | |
| Rise Time ( Tr ) / Fall Time ( Tf ) | | 4 nsec.( typ. ) ; 6 nsec.( max. ) Measured between 10% to 90% of waveform | | | | | | |
| Duty Cycle | | 50% ± 10% ( standard ) , 50% ± 5% ( optional, add " ***- S*** " as suffix to part number ) | | | | | | |
| RMS Jitter ( 12 KHz to 20 MHz ) | | 1.0 psec ( max. ) | | | | | | |
| Phase Noise | Offset | 10 Hz | 100 Hz | 1K Hz | 10K Hz | 100K Hz | 1 MHz | |
| [ 27MHz , 3.3V ] | dBc/Hz (typ.) | -40 dBc/Hz | -104 dBc/Hz | -132 dBc/Hz | -147 dBc/Hz | -152 dBc/Hz | -150 dBc/Hz | |
| Start-up Time | | 10 msec. ( max. ) | | | | | | |
| Current Consumption | | 10 ~ 45 mA ( Frequency dependent ). For 27 MHz: 10 mA ( typ. ) at +3.3 $V_{DD}$ | | | | | | |
| Linearity | | 6% ( typ. ) ; 10% ( max. ) | | | | | | |
| Modulation Bandwidth | | 10 KHz ( min. ) Measured at -3 dB | | | | | | |
| Input Impedance | | 5 MΩ ( typ. ) | | | | | | |
| Slope Polarity (Transfer Function) | | Monotonic and Positive : Increasing control voltage always increases output frequency , | | | | | | |
| Storage Temperature | | -55°C to +125°C | | | | | | |
| Aging at Ta = +25℃ | | ± 3 ppm per year ( max. ) | | | | | | |
| Output Enable / Disable Function | | Enable | When 70% ( min. ) of $V_{DD}$ to Enable Output. ; Enable time : 2 msec ( max. ) | | | | | |
| | | Disable | When 30% ( max. ) of $V_{DD}$ to Disable Output. ; Disable time : 100 nsec ( max. ) | | | | | |

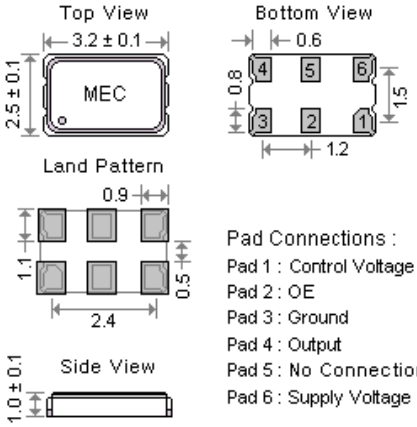
Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

## [ G226 ]



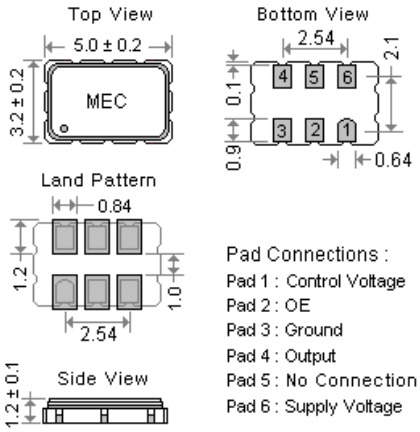

Pad Connections :
Pad 1 : Control Voltage
Pad 2 : OE
Pad 3 : Ground
Pad 4 : Output
Pad 5 : No Connection
Pad 6 : Supply Voltage

## [ G326 ]



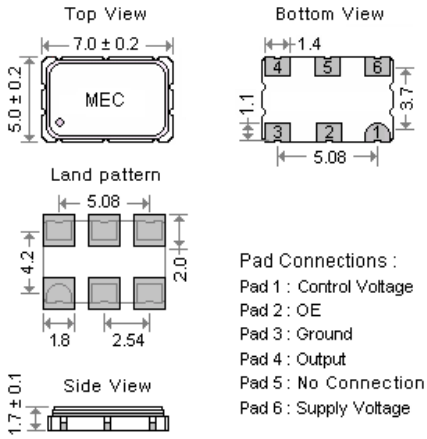

Pad Connections :
Pad 1 : Control Voltage
Pad 2 : OE
Pad 3 : Ground
Pad 4 : Output
Pad 5 : No Connection
Pad 6 : Supply Voltage

## [ G536 ]



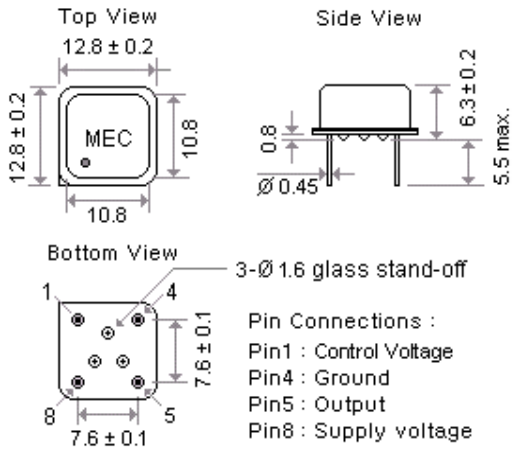

Pad Connections :
Pad 1 : Control Voltage
Pad 2 : OE
Pad 3 : Ground
Pad 4 : Output
Pad 5 : No Connection
Pad 6 : Supply Voltage

## [ G576 ]



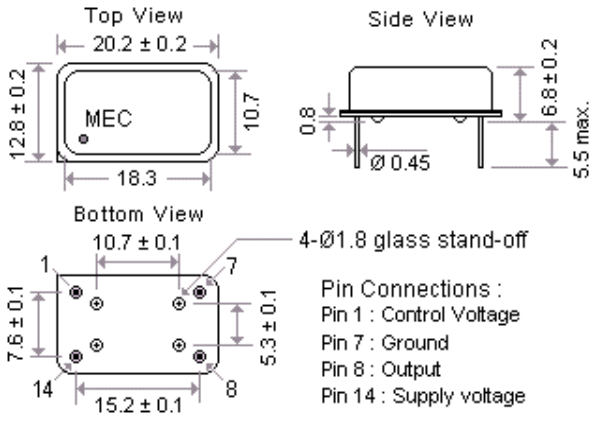

Pad Connections :
Pad 1 : Control Voltage
Pad 2 : OE
Pad 3 : Ground
Pad 4 : Output
Pad 5 : No Connection
Pad 6 : Supply Voltage

## [ G8 ]




Pin Connections :
Pin1 : Control Voltage
Pin4 : Ground
Pin5 : Output
Pin8 : Supply voltage

## [ G14 ]




Pin Connections :
Pin 1 : Control Voltage
Pin 7 : Ground
Pin 8 : Output
Pin 14 : Supply voltage

## Part Number Format and Examples

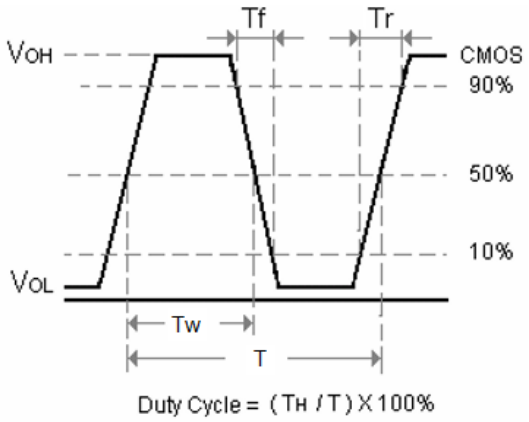
| | [ 1 ] | [ 2 ] | | [ 3 ] | | [ 4 ] | [ 5 ] | | [ 6 ] |
|---|---|---|---|---|---|---|---|---|---|
| | Supply Voltage | Holder Type | – | Frequency Stability | – | Pulling Range | Range Code | – | Center Frequency |
| Examples (1) | 18 | G14 | – | B | – | 100 | N | – | 35.328 |
| Examples (2) | 3 | G576 | – | D | – | 80 | T | – | 27.000 |

Ex (1) : 18G14 - B - 100N - 35.328 [ +1.8V , full size 4 pin Dip type , ±50ppm ( -20°C to 70°C ) , pulling : ±100 ppm ( min. ) , 35.328 MHz ]

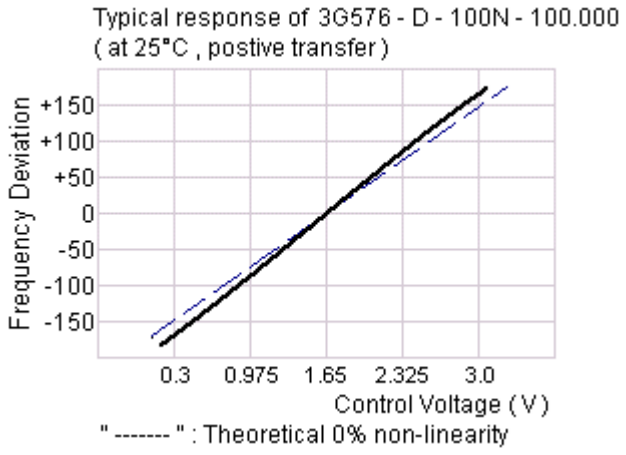
Ex (2) : 3G576 - D - 80T - 27.000 [ +3.3V , G576 type , ±25ppm ( -40°C to 85°C ) , pulling : ±80 ppm ( typ. ) , 27.000 MHz ]

| | | | |
|---|---|---|---|
| [ 1 ] | Supply voltage , " 18 " for +1.8V ; " 3 " for +3.3V | | |
| [ 2 ] | Holder Type | | |
| [ 3 ] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ; | |
| | | If non-standard please enter the desired stability after " C " , for example " C15 ": represents ±15ppm over -20 to +70°C | |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ; | |
| | | If non-standard please enter the desired stability after " F " , for example " F20 ": represents ±20ppm over -40 to +85°C | |
| [ 4 ] | Freqency Pulling Range | 3.3V | From ±30ppm ~ ±150ppm , control Voltage range : 0.3V ~ 3.0 ; control voltage center : ± 1.65 V |
| | | 5.0V | From ±70ppm ~ ±200ppm , control Voltage range : 0.5V ~ 4.5V ; control voltage center : ± 2.5 V |
| [ 5 ] | Pulling Range Code | " M " stands for maximum ; " N " stands for minimum ; " T " stands for typical ( tolerance is ± 20% ) | |
| [ 6 ] | Center Frequency in MHz | | |

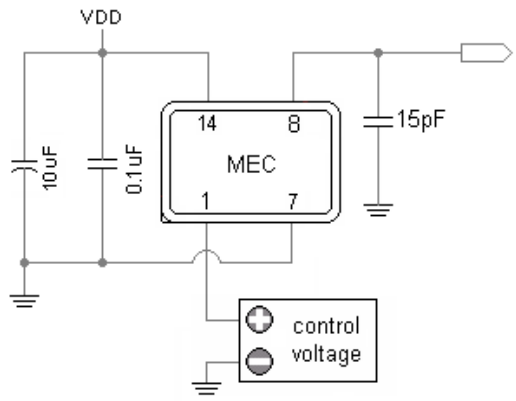
### CMOS Output Waveform



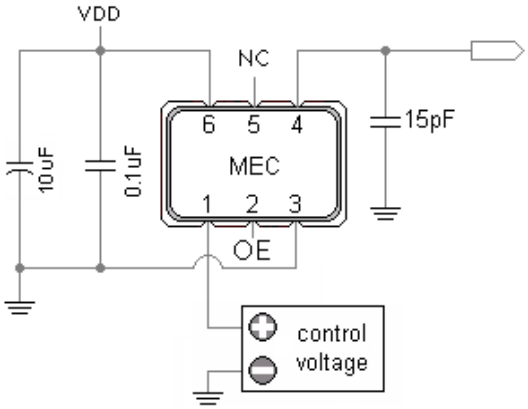

### Transfer Function




### [ Thru - Hole Tpye ] CMOS Square Wave Test Circuit




### [ SMD 6 pads ] CMOS Square Wave Test Circuit

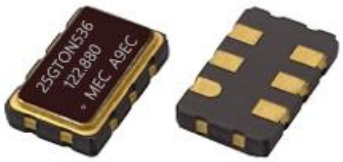


# Low Jitter Voltage Controlled Crystal Oscillators — CMOS Output

| GTQN | GPQN | GDQN | 0.6 ps RMS Jitter | SMD | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| **CMOS** Waveform | **LVPECL** Differential | **LVDS** Differential | | | | | 10 MHz | 1,500 MHz |

## Features

- Output frequency range : 10 MHz to 1500 MHz
- Low RMS Jitter 0.6 ps typical ( 12KHz to 20MHz )
- Package size : 3.2x2.5mm , 5.0x3.2mm , 7.0x5.0mm
- If you need lower rms jitter, please refer to the "G_JFN" series (150 fsec typ. @ 12KHz to 20MHz)



## General specifications , at Ta=+25°C , CL=15pF

| Model | GTQN | GPQN | GDQN |
|---|---|---|---|
| Output Logic | **CMOS** | **LVPECL** | **LVDS** |
| Supply Voltage $V_{DD}$ ( code ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) |
| | + 3.3 V ± 5% ( voltage code " 33 " ) | + 3.3 V ± 5% ( voltage code " 33 " ) | + 3.3 V ± 5% ( voltage code " 33 " ) |
| Available Frequency Range | 10 ~ 250 MHz | 10 ~ 1,500 MHz | 10 ~ 1,500 MHz |
| Output Load | 15 pF | RL = 50 Ω to ($V_{DD}$-2.0V). See test circuit below. | 100 Ω between OUT and OUTN |
| Output Logic " High " , " 1 " | 90 % $V_{DD}$ | $V_{DD}$ - 1.03 ( min. ) , $V_{DD}$ - 0.6 ( max. ) | 1.4 V ( Typ. ) , 1.6 V ( max. ) |
| Output Logic " Low " , " 0 " | 10 % $V_{DD}$ | $V_{DD}$ - 1.85 ( min. ) , $V_{DD}$ - 1.6 ( max. ) | 1.1 V ( Typ. ) , 0.9 V ( min. ) |
| Current with Output Disable | 16 mA ( typ. ) | 16 mA ( typ. ) | 16 mA ( typ. ) |
| Current Consumption ( $V_{DD}$ = + 3.3V ) | 10 ~ 50 MHz : 30 mA | 10 ~ 250 MHz : 50 mA | 10 ~ 250 MHz : 30 mA |
| | 51 ~ 150 MHz : 38 mA | 251 ~ 750 MHz : 55 mA | 251 ~ 750 MHz : 34 mA |
| | 151 ~ 250 MHz : 48 mA | 751 ~ 1,500 MHz : 60 mA | 751 ~ 1,500 MHz : 40 mA |
| Rise Time / Fall Time | 10 nsec. ( max. ) Tr / Tf : 10% ↔ 90% waveform | 0.5 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform | 0.4 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform |
| Duty Cycle | 50% ± 5% | | |
| Start-up Time | 10 msec. ( max. ) | | |
| Aging at Ta = +25°C | ± 5 ppm ( max. ) for first year | | |
| Storage Temperature | -55°C to +150°C | | |

| Frequency Stability Codes | Frequency Stability Over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired Stability after the " C " or " F " represents . For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F20 " ± 20 ppm over -40°C to +85°C |
|---|---|---|---|---|---|
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| RMS Jitter [ 12 KHz ~ 20 MHz ] | 0.6 psec ( typ. ) |
|---|---|

| Phase Noise [ dBc / Hz ( typ. ) ] | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz | 1 MHz | 10 MHz |
|---|---|---|---|---|---|---|---|---|
| | 125 MHz | -63 | -94 | -113 | -122 | -126 | -137 | -156 |
| | 212.5 MHz | -55 | -85 | -108 | -117 | -120 | -132 | -156 |

**Control Voltage Function on Pad 1**

| Supply Voltage | $V_{DD}$ = +2.5 V ; Vcon Center = +1.25V | $V_{DD}$ = +3.3 V ; Vcon Center = +1.65V |
|---|---|---|
| Vcontrol Range | + 0.25V ~ +2.25V | + 0.3V ~ +3.0V |
| Frequency Pulling Range | ± 80 ppm ( min. ) | ± 80 ppm ( min. ) |
| | Up to ± 200 ppm ( min. ) is also available. Please contact Mercury. | |
| Linearity | 5% ( typ. ) ; 10% ( max. ) | |
| Transfer Function | Positive Transfer | |
| Input Impedance | 1 MΩ ( typ. ) | |
| Bandwidth | 10 KHz ( min. ) Measured at -3 dB | |

**Output Enable Function on Pad 2**

| OE Control on Pad 2 | 70% of $V_{DD}$ ( min. ) to enable output. ( Open connection prohibit ) |
|---|---|
| | 30% of $V_{DD}$ ( max. ) to disable output. |
| Output Enable Time / Disable Time | 200 nsec. ( max. ) / 50 nsec. ( max. ) |

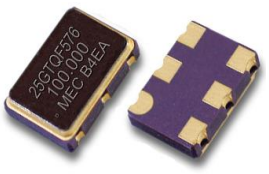
# Voltage Controlled Crystal Oscillators

**GTQF** — CMOS Waveform | **GPQF** — LVPECL Differential | **GDQF** — LVDS Differential | Q family / F series | SMD | 2.5 V / 3.3 V | Min. 10 MHz | Max. 1,500 MHz

## Features

**Quick - Turn Clock Oscillators** | **1.2 pS Phase Jitter ( typical )**

- The GTQF, GPQF and GDQF Series are members of Mercury's Q-Family Quick-Turn crystal oscillators
- Output frequency range : 10 MHz to 1500 MHz
- Low RMS jitter 1.2 ps typical ( 12KHz to 20MHz )
- Package size : 3.2x2.5mm , 5.0x3.2mm , 7.0x5.0mm
- Next-day samples for prototypes




## General specifications , at Ta=+25°C

| Model | GTQF | GPQF | GDQF |
|---|---|---|---|
| Output Logic | **CMOS** | **LVPECL** | **LVDS** |
| Supply Voltage $V_{DD}$ ( code ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) |
| | + 3.3 V ± 5% ( voltage code " 3 " ) | + 3.3 V ± 5% ( voltage code " 3 " ) | + 3.3 V ± 5% ( voltage code " 3 " ) |
| Available Frequency Range | 10 ~ 250 MHz | 10 ~ 1,500 MHz | 10 ~ 1,500 MHz |
| Output Load | 15 pF | 50 Ω into VDD - 2V or Thevenin equivalent | 100 Ω between OUT and OUTN |
| Output Logic " High " , " 1 " | 90 % $V_{DD}$ | $V_{DD}$ - 1.03 ( min. ) , $V_{DD}$ - 0.6 ( max. ) | 1.4 V ( Typ. ) , 1.6 V ( max. ) |
| Output Logic " Low " , " 0 " | 10 % $V_{DD}$ | $V_{DD}$ - 1.85 ( min. ) , $V_{DD}$ - 1.6 ( max. ) | 1.1 V ( Typ. ) , 0.9 V ( min. ) |
| Current with Output Disable | 16 mA ( typ. ) | 16 mA ( typ. ) | 16 mA ( typ. ) |
| Current Consumption ( $V_{DD}$ = + 3.3V ) | 10 ~ 50 MHz : 30 mA | 10 ~ 250 MHz : 50 mA | 10 ~ 250 MHz : 30 mA |
| | 51 ~ 150 MHz : 38 mA | 251 ~ 750 MHz : 55 mA | 251 ~ 750 MHz : 34 mA |
| | 151 ~ 250 MHz : 48 mA | 751 ~ 1,500 MHz : 60 mA | 751 ~ 1,500 MHz : 40 mA |
| Rise Time / Fall Time | 1.5 nsec. ( Typ. ) , 3.0 nsec. ( max. ) Tr / Tf : 10% ↔ 90% waveform | 0.2 nsec. ( Typ. ) , 0.5 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform | 0.2 nsec. ( Typ. ) , 0.4 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Duty Cycle | 50 % ± 5% | | | | | | | |
| Start-up Time | 10 msec. ( max. ) | | | | | | | |
| Aging at Ta = +25°C | ± 2 ppm ( max. ) first year at 25°C ; ± 10 ppm ( max. ) over 10 years | | | | | | | |
| Storage Temperature | -55°C to +150°C | | | | | | | |
| Frequency Stability Codes | Frequency Stability Over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired Stability after the " C " or " F " represents . For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F20 " ± 20 ppm over -40°C to +85°C | | | |
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | | | | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | | | | |
| RMS Jitter [ 12 KHz ~ 20 MHz ] | 1.2 psec ( typ.) | | | | | | | |
| Phase Noise [ dBc / Hz ( typ. ) ] | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz | 1 MHz | 10 MHz |
| | 156.250 MHz | -55 | -85 | -109 | -116 | -118 | -139 | -146 |
| | 491.52 MHz | -61 | -86 | -100 | -105 | -105 | -126 | -137 |

**Control Voltage Function on Pad 1**

| | | |
|---|---|---|
| Supply Voltage | $V_{DD}$ = +2.5 V ; Vcon Center = +1.25V | $V_{DD}$ = +3.3 V ; Vcon Center = +1.65V |
| Vcontrol Range | + 0.25V ~ +2.25V | + 0.3V ~ +3.0V |
| Frequency Pulling Range | ± 80 ppm ( min. ) | ± 80 ppm ( min. ) |
| | Up to ± 200 ppm ( min. ) is also available. Please contact Mercury. | |
| Linearity | 5% ( typ. ) ; 10% ( max. ) | |
| Transfer Function | Positive Transfer | |
| Input Impedance | 1 MΩ ( typ.) | |
| Bandwidth | 10 KHz ( min.) Measured at -3 dB | |

**Output Enable Function on Pad 2**

| | |
|---|---|
| OE Control on Pad 2 | 70% of $V_{DD}$ ( min. ) to enable output. ( Open connection prohibit ) |
| | 30% of $V_{DD}$ ( max. ) to disable output. |
| Output Enable Time / Disable Time | 200 nsec. ( max. ) / 50 nsec.( max. ) |

# Voltage Controlled Crystal Oscillators [ VCXO ]

| GTQN , GTQF [ CMOS Waveform ] | GPQN , GPQF [ LVPECL Differential ] | GDQN , GDQF [ LVDS Differential ] |
|---|---|---|

## Part Number Format and Example

| | [ 1 ] Supply Voltage | [ 2 ] Holder Type | – | [ 3 ] Frequency Stability | – | [ 4 ] Pulling Range | [ 5 ] Range Code | – | [ 6 ] Center Frequency |
|---|---|---|---|---|---|---|---|---|---|
| Examples (1) | 3 | GTQN576 | – | C20 | – | 150 | M | – | 200.000 |
| (2) | 25 | GDQF536 | – | D | – | 100 | N | – | 135.000 |

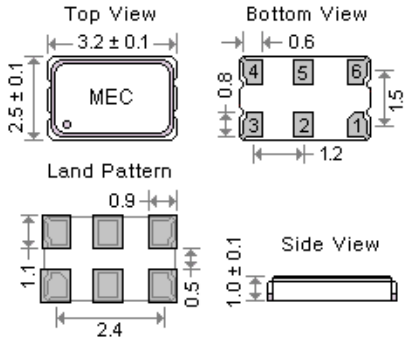
Ex (1) : 3GTQN576 - C20 - 150M - 200.000 [ +3.3V , GTQN576 type , ±20ppm ( -20°C to 70°C ) , Pulling : ±150ppm ( max. ) , 200.000 MHz ]

Ex (2) : 25GDQF536 - D - 100N - 135.000 [ +2.5V , GDQF536 type , ±25ppm ( -40°C to 85°C ) , Pulling : ±100 ppm ( min. ) , 135.000 MHz ]

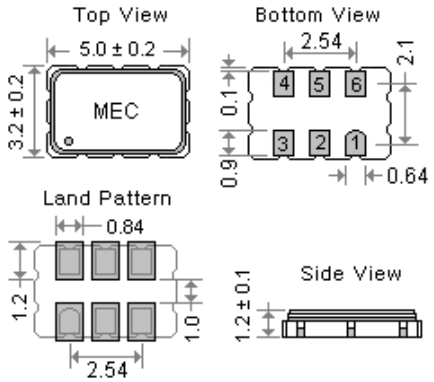
| | | |
|---|---|---|
| [ 1 ] | Supply voltage , " 25 " for +2.5V ; " 3 " for +3.3V | |
| [ 2 ] | Holder Type | |
| [ 3 ] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " C " , for example " C20 " : represents ±20ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " F " , for example " F20 " : represents ±20ppm over -40 to +85°C |
| [ 4 ] | Freqency Pulling Range | |
| [ 5 ] | Pulling Range Code | " M " stands for maximum ; " N " stands for minimum ; " T " stands for typical ( tolerance is ± 20% ) |
| [ 6 ] | Center Frequency in MHz | |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

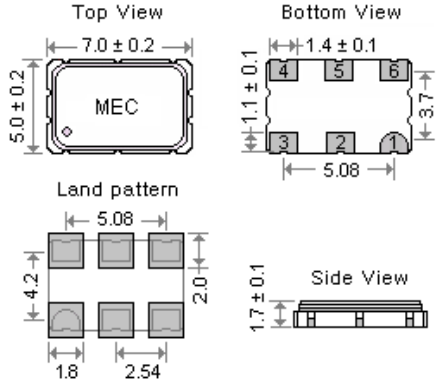
**G_QN326 , G_QF326**




**G_QN536 , G_QF536**




**G_QN576 , G_QF576**

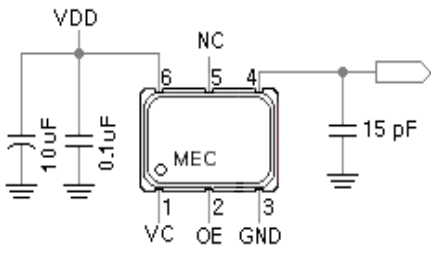



**Pad Connections :**

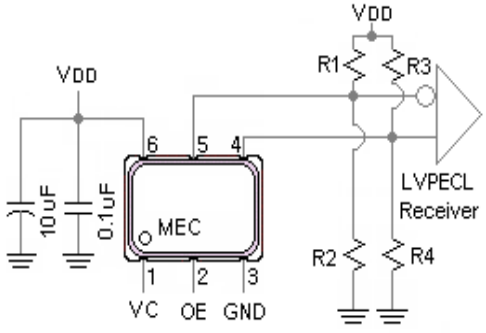
| | | |
|---|---|---|
| **Pad 1** : VCXO | **Pad 2** : OE: High Enable | **Pad 3** : Ground |
| **Pad 4** : [ CMOS : Output , LVPECL or LVDS : Differential ] | **Pad 5** : [ CMOS : NC , LVPECL or LVDS : Complementary ] | **Pad 6** : Supply Voltage |

## Test Circuits and Output Waveforms

**CMOS** Test Circuit



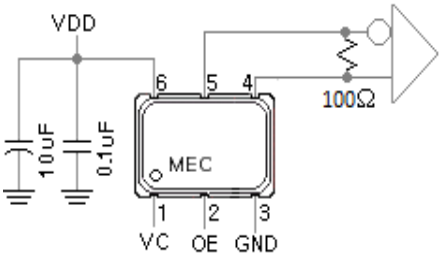

**LVPECL** Test Circuit




$V_{DD}$ = 3.3V ; R1 = R3 = 127 Ω ; R2 = R4 = 82.5 Ω

$V_{DD}$ = 2.5V ; R1 = R3 = 250 Ω ; R2 = R4 = 62.5 Ω

**LVDS** Test Circuit



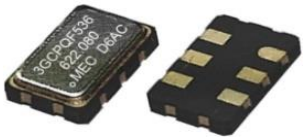
# Switchable Output Crystal Oscillators

| GCTQF | GCPQF | GCDQF | Frequency Switchable | SMD | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| **CMOS** Waveform | **LVPECL** Differential | **LVDS** Differential | | | | | 10 MHz | 1,500 MHz |

## Features

**Quick - Turn Clock Oscillators**

- The GCTQF, GCPQF and GCDQF Series are members of Mercury's Q-Family Quick-Turn crystal oscillators
- Output frequency range : 10 MHz to 1500 MHz
- Package size : 3.2x2.5mm , 5.0x3.2mm , 7.0x5.0mm
- Next-day samples for prototypes




## General specifications , at Ta = + 25°C

| Model | GCTQF | GCPQF | GCDQF |
|---|---|---|---|
| Output Logic | **CMOS** | **LVPECL** | **LVDS** |
| Supply Voltage $V_{DD}$ ( code ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) |
| | + 3.3 V ± 5% ( voltage code " 3 " ) | + 3.3 V ± 5% ( voltage code " 3 " ) | + 3.3 V ± 5% ( voltage code " 3 " ) |
| Available Frequency Range | 10 ~ 250 MHz | 10 ~ 1,500 MHz | 10 ~ 1,500 MHz |
| Output Load | 15 pF | 50 Ω into Vcc - 2V or Thevenin equivalent | 100 Ω between output and complimentary output |
| Output Logic " High " , " 1 " | 90 % $V_{DD}$ | $V_{DD}$ - 1.03 ( min. ) , $V_{DD}$ - 0.6 ( max. ) | 1.4 V ( Typ. ) , 1.6 V ( max. ) |
| Output Logic " Low " , " 0 " | 10 % $V_{DD}$ | $V_{DD}$ - 1.85 ( min. ) , $V_{DD}$ - 1.6 ( max. ) | 1.1 V ( Typ. ) , 0.9 V ( min. ) |
| Current Consumption ( $V_{DD}$ : + 2.5 V ) | 10 ~ 100 MHz : 30 mA ( max. )<br>101 ~ 250 MHz : 40 mA ( max. ) | 10 ~ 600 MHz : 45 mA ( max. )<br>601 ~ 1,500 MHz : 55 mA ( max. ) | 10 ~ 600 MHz : 30 mA ( max. )<br>601 ~ 1,500 MHz : 35 mA ( max. ) |
| Current Consumption ( $V_{DD}$ : + 3.3 V ) | 10 ~ 100 MHz : 35 mA ( max. )<br>101 ~ 250 MHz : 40 mA ( max. ) | 10 ~ 600 MHz : 50 mA ( max. )<br>601 ~ 1,500 MHz : 60 mA ( max. ) | 10 ~ 600 MHz : 35 mA ( max. )<br>601 ~ 1,500 MHz : 40 mA ( max. ) |
| Current with Output Disabie | 18 mA ( Typ. ) | 18 mA ( Typ. ) | 18 mA ( Typ. ) |
| Rise Time / Fall Time | 10.0 nsec. ( max. )<br>Tr / Tf : 10% ↔ 90% waveform | 0.5 nsec. ( max. )<br>Tr / Tf : 20% ↔ 80% waveform | 0.4 nsec. ( max. )<br>Tr / Tf : 20% ↔ 80% waveform |

| | | | | | |
|---|---|---|---|---|---|
| RMS Jitter [ 12 KHz ~ 20 MHz ] | 1.5 psec ( typ. ) | | | | |
| Duty Cycle | 50% ± 5% | | | | |
| Start-up Time | 10 msec. ( max. ) | | | | |
| Aging at Ta = +25°C | ± 2 ppm ( max. ) first year at 25°C ; ± 10 ppm ( max. ) over 10 years | | | | |
| Storage Temperature | -55°C to +150°C | | | | |
| Frequency Stability Codes | Frequency Stability over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm | If non-standard , please enter the desired stability after the " C " or " F " represents . For example : " C20 " ± 20 ppm over -20°C to +70°C ; " F20 " ± 20 ppm over -40°C to +85°C |
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* | |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* | |

| **Control Voltage Function on Pad 1** | | |
|---|---|---|
| Supply Voltage | $V_{DD}$ = +2.5 V ; Vcon Center = +1.25V | $V_{DD}$ = +3.3 V ; Vcon Center = +1.65V |
| Vcontrol Range | + 0.25V ~ +2.25V | + 0.3V ~ +3.0V |
| Frequency Pulling Range | ± 80 ppm ( min. ) | ± 80 ppm ( min. ) |
| | Up to ± 200 ppm ( min. ) is also available. Please contact Mercury. | |
| Linearity | 5% ( typ. ) ; 10% ( max. ) | |
| Transfer Function | Positive Transfer | |
| Input Impedance | 1 MΩ ( typ.) | |
| Bandwidth | 10 KHz ( min. ) Measured at -3 dB | |

| **Frequency Selection Function on Pad 2** | |
|---|---|
| FSEL on pad2 | 70% of $V_{DD}$ ( min. ) For FSEL = 1 , Output frequency is Freq.2 ( f2 ) |
| | 30% of $V_{DD}$ ( max. ) For FSEL = 0 , Output frequency is Freq.1 ( f1 ) |
| | Default FSEL pin has internal pull-up resistor . |
| | Frequency switching time : 60 us ( typ. ) |

# Switchable Output Crystal Oscillators

| GCTQF | GCPQF | GCDQF | Frequency Switchable | SMD | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| CMOS Waveform | LVPECL Differential | LVDS Differential | | | | | 10 MHz | 1,500 MHz |

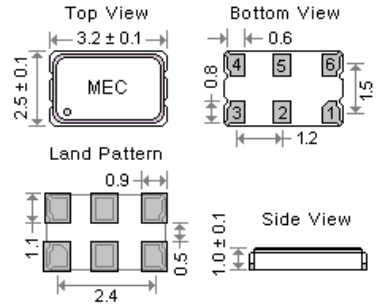
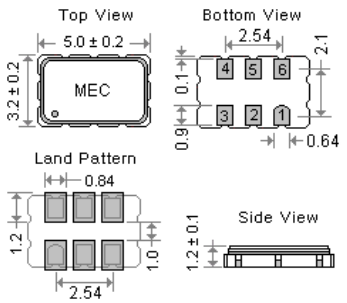
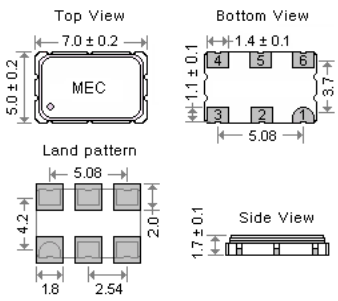
## Part Number Format and Example

**Quick - Turn Clock Oscillators**

Example : 3GCTQF576 - E - 80N - 30.000 / 120.000

| 3 | GCTQN | 576 | - | E | - | 80N | - | 30.000 | / | 120.000 |
|---|---|---|---|---|---|---|---|---|---|---|
| Supply Voltage<br>" **3** " for 3.3V<br>" **25** " for 2.5V | GCTQF : CMOS<br>GCPQF : LVPECL<br>GCDQF : LVDS | Package Size<br>" **576** ": 7 x 5 mm<br>" **536** ": 5 x 3.2 mm<br>" **326** ": 3 x 2.5 mm | - | Frequency Stability Code " **E** ":<br>±50 ppm over -40 to +85°C.<br>Other frequency stabilities are available. | - | ±80 ppm ( min.)<br>frequency pulling range. | - | Custom<br>Frequency 1<br>FSEL = 0<br>( MHz ) | - | Custom<br>Frequency 2<br>FSEL = 1<br>( MHz ) |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

| GC_QF326 | GC_QF536 | GC_QF576 |
|---|---|---|
|  |  |  |

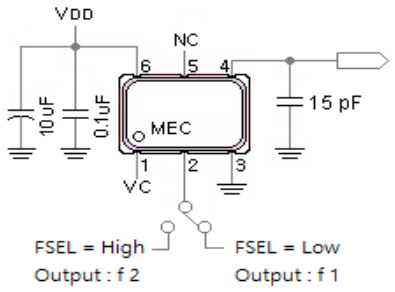
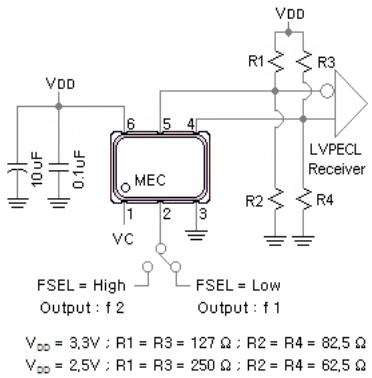
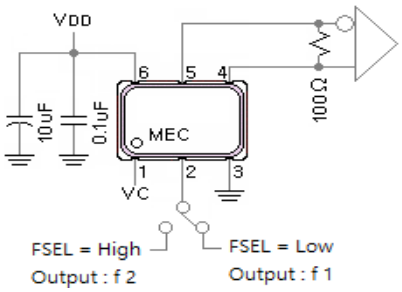


**Pad Connections :**

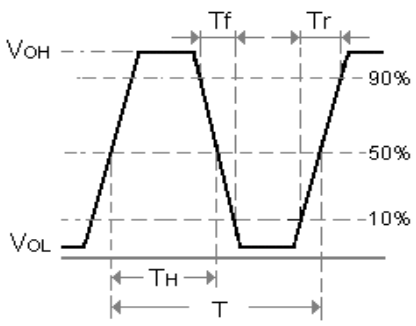
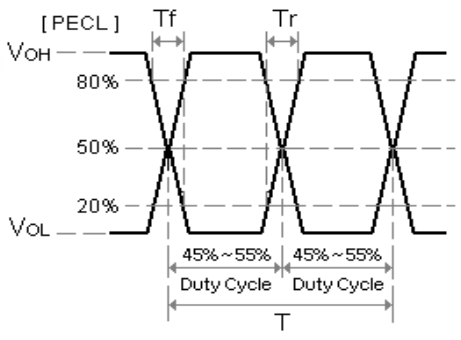
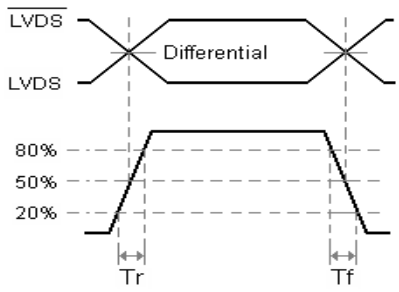
**Pad 1 :** Control Voltage ; **Pad 2 :** Frequency Selection [ FSEL = 0 ( f 1 ) , FSEL =1 ( f 2 ) ] ; **Pad 3 :** Ground

**Pad 4 :** [ CMOS : Output , LVPECL or LVDS : Differential ] ; **Pad 5 :** [ CMOS : NC , LVPECL or LVDS : Complementary ] ; **Pad 6 :** Supply Voltage

## Test Circuits and Output Waveforms

| CMOS Test Circuit | LVPECL Test Circuit | LVDS Test Circuit |
|---|---|---|
|  |  |  |



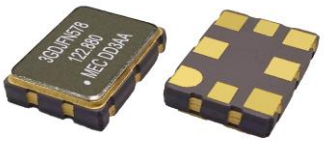
| CMOS Output Waveform | LVPECL Output Waveform | LVDS Output Waveform |
|---|---|---|
|  |  |  |

# High Frequency Ultra-low Jitter Voltage Controlled Crystal Oscillators [ Quick - Turn VCXO , 15 ~ 2,100 MHz ]

| G_JFN | Quick - Turn Clock Oscillators | 150 fsec RMS Jitter | SMD | 1.8 V | 2.5 V | 3.3 V | Min. 15 MHz | Max. 2,100 MHz |
|---|---|---|---|---|---|---|---|---|
| CMOS / Differential | | | | | | | | |

## Features

- High Frequency Range : 15 ~ 2,100 MHz
- Ultra-low RMS Jitter : 150 fsec ( typ. ) @ 3.3V , 156.250 MHz
- Package Size : 5.0 x 3.2mm and 7.0 x 5.0mm
- Next-Day sample for Prototypes



## General specifications , at Ta=+25°C

| Model | GTJFN | GPJFN | GDJFN | GCJFN | GQJFN |
|---|---|---|---|---|---|
| Output Logic | CMOS | LVPECL | LVDS | HCSL | CML |
| Supply Voltage $V_{DD}$ | + 1.8 V ± 5% | --- | + 1.8 V ± 5% (*1) | + 1.8 V ± 5% | + 1.8 V ± 5% |
| | + 2.5 V ± 10% | + 2.5 V ± 10% | + 2.5 V ± 10% | + 2.5 V ± 10% | + 2.5 V ± 10% |
| | + 3.3 V ± 10% | + 3.3 V ± 10% | + 3.3 V ± 10% | + 3.3 V ± 10% | + 3.3 V ± 10% |
| Available Frequency Range | 15 ~ 250 MHz | 15 ~ 2,100 MHz | 15 ~ 2,100 MHz | 15 ~ 700 MHz | 15 ~ 2,100 MHz |
| Output Load | 15pF ( max. ) | 50 Ω into $V_{DD}$ - 2V or Thevenin equivalent | 100 Ω between OUT and OUTN | 50 Ω to GND | 50 Ω to $V_{DD}$ |
| Output Logic " High " , " 1 " | $V_{DD}$ - 0.4 V ( min. ) | $V_{DD}$ - 1.165 V ( min. )<br>$V_{DD}$ - 0.8 V ( max. ) | $V_{DD}$ : 1.4 V ( typ. )<br>$V_{DD}$ : 1.6 V ( max. ) | $V_{DD}$ : 0.66 V ( min. )<br>$V_{DD}$ : 1.15 V ( max. ) | $V_{DD}$ - 0.085 V ( min. )<br>$V_{DD}$ = ( max. ) |
| Output Logic " Low " , " 0 " | $V_{DD}$ x 0.1 V ( max. )<br>0.3V ( max. ) for 1.8V only | $V_{DD}$ - 2.0 V ( min. )<br>$V_{DD}$ - 1.55 V ( max. ) | $V_{DD}$ : 1.1 V ( typ. )<br>$V_{DD}$ : 0.9 V ( min. ) | $V_{DD}$ : - 0.15 V ( min. )<br>$V_{DD}$ : 0.15 V ( max. ) | $V_{DD}$ - 0.6 V ( min. )<br>$V_{DD}$ - 0.32 V ( max. ) |
| Output Voltage Swing | --- | 595 mV ( min. )<br>930 mV ( max. ) | 250 mV ( min. )<br>450 mV ( max. ) | 450 mV ( min. )<br>700 mV ( typ. ) | 200 mV ( min. )<br>600 mV ( max. ) |
| Current Consumption ( $V_{DD}$ = + 3.3 V ) | 75 mA ( typ. )<br>90 mA ( max. ) | 100 mA ( typ. )<br>120 mA ( max. ) | 75 mA ( typ. )<br>90 mA ( max. ) | 80 mA ( typ. )<br>100 mA ( max. ) | 70 mA ( typ. )<br>85 mA ( max. ) |
| Current with Output Disabled | 62 mA ( typ. ) | 99 mA ( typ. ) | 74 mA ( typ. ) | 79 mA ( typ. ) | 69 mA ( typ. ) |
| Rise Time / Fall Time ( 20% to 80% Waveform ) | 5.0 nsec ( max. )<br>( 10% to 90% Waveform ) | 0.4 nsec ( max. ) | 0.4 nsec ( max. ) | 0.4 nsec ( max. ) | 0.4 nsec ( max. ) |

| | | | | |
|---|---|---|---|---|
| RMS Jitter [ 12 KHz ~ 20 MHz ] | 156.250 MHz : 159 fsec ( typ. ) ; 491.520 MHz : 155 fsec ( typ. ) ; 644.530 MHz : 151 fsec ( typ. ) ; 2.000 MHz : 163 fsec ( typ. ) | | | |
| Frequency Stability Codes | Frequency Stability Over Operating Temperature Range | ± 25 ppm | ± 50 ppm | ± 100 ppm |
| | Commercial ( *-20°C to +70°C* ) | *A* | *B* | *C* |
| | Industrial ( *-40°C to +85°C* ) | *D* | *E* | *F* |
| | Extended Industrial ( *-40°C to +105°C* ) | --- | *H* | *J* |
| Duty Cycle | 50 % ± 5% ; 50 % ± 10% for CMOS 1.8V only | | | |
| Start-up Time | 5 msec. ( typ. ) ; 10 msec. ( max. ) | | | |
| Aging at Ta = +25°C | ± 3 ppm ( max. ) for first year ; ± 2 ppm ( max .) per year thereafter | | | |
| Storage Temperature | -55°C to +150°C | | | |
| **Control Voltage Function on Pad 1** | | | | |
| Vcontrol Center | + 0.9 V for $V_{DD}$ = + 1.8 V | + 1.25 V for $V_{DD}$ = + 2.5 V | + 1.65 V for $V_{DD}$ = + 3.3 V | |
| Vcontrol Range | + 0.0 V ~ + 1.8 V | + 0.25 V ~ + 2.25 V | + 0.3 V ~ + 3.0 V | |
| Frequency Pulling Range | ± 100 ppm ( min. )<br>± 200 ppm ( available ) | ± 100 ppm ( min. )<br>± 200 ppm ( available ) | ± 100 ppm ( min. )<br>± 200 ppm ( available ) | |
| Linearity | 1% ( typ. ) ; 10% ( max. ) | | | |
| Transfer Function | Positive Transfer | | | |
| Input Impedance | 5 MΩ ( min. ) | | | |
| Bandwidth | 10 KHz ( typ. ) Measured at -3 dB | | | |
| **Output Enable Function on Pad 2** | | | | |
| Output Enable / Disable Function | 80% of $V_{DD}$ ( min. ) to enable output. | | | |
| | 20% of $V_{DD}$ ( max. ) to disable output. | | | |
| Output Enable Time / Disable Time | 2.5 msec ( max. ) / 10 usec ( max. ) | | | |

Note ∗1 : This needs AC coupling ( 100-nF series capacitor ). Please check the test circuit.

# High Frequency Ultra-low Jitter Voltage Controlled Crystal Oscillators [ Quick - Turn VCXO , 15 ~ 2,100 MHz ]

| G_JFN | Quick - Turn Clock Oscillators | 150 fsec RMS Jitter | SMD | 1.8 V | 2.5 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| CMOS / Differential | | | | | | | 15 MHz | 2,100 MHz |

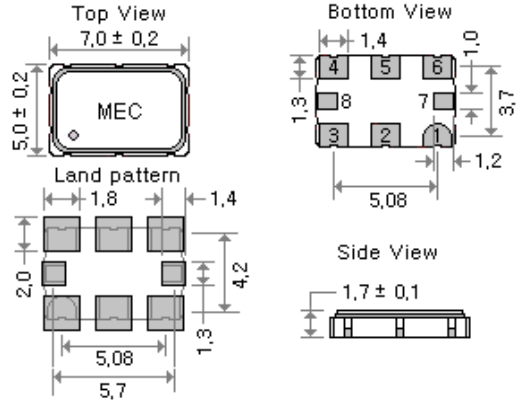
## Part Number Format and Example

Example : 3GPJFN578-E-150N-644.530

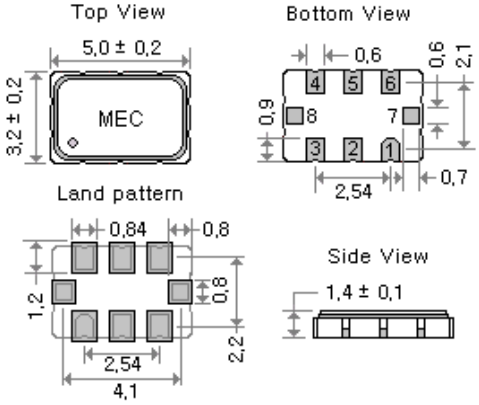
| 3 | G | P | JFN578 | - | E | - | 150N | - | 644.530 |
|---|---|---|---|---|---|---|---|---|---|
| Supply Voltage Code :<br>" **3** " for 3.3V<br>" **25** " for 2.5V<br>" **18** " for 1.8V | " **G** " : for Voltage Controlled Crystal Oscillators | Output Code :<br>" **T** " : COMS<br>" **P** " : LVPECL<br>" **D** " : LVDS<br>" **C** " : HCSL<br>" **Q** " : CML | " **JFN** " : Product Series<br>" **578** " : Package Code 7.0 * 5.0 _ 8 Pad<br>" **538** " : Package Code 5.0 * 3.2 _ 8 Pad | - | Freq. Stability Code :<br>" **E** " : ±50 ppm over -40 to +85 C Other frequency stabilities are available. | - | Freq. Pulling Range :<br>" **150** " : ±150ppm<br>" **M** " : Maximum<br>" **N** " : Minimum<br>" **T** " : Typical | - | Frequency (MHz) |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

### G_JFN578




### G_JFN538

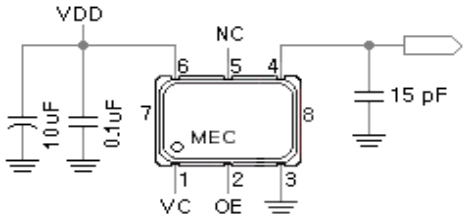



**Pad Connections :**

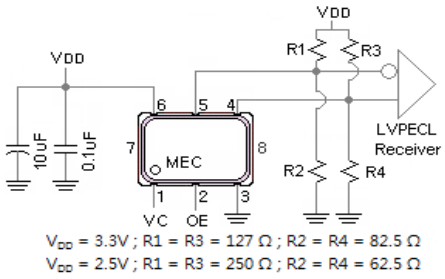
| | | | |
|---|---|---|---|
| **Pad 1** : Control Voltage | **Pad 2** : Output Enable | **Pad 3** : Ground | **Pad 4** : CMOS : Output , Differential : Output |
| **Pad 5** : CMOS : No Connection , Differential : Complementary Output | | **Pad 6** : Supply Voltage | **Pad 7 , Pad 8** : Do Not Connect |

## Test Circuits

### CMOS Test Circuits

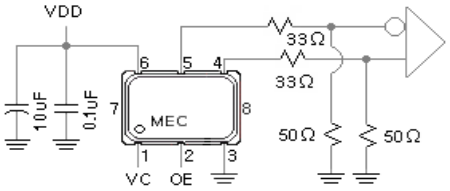



### LVPECL Test Circuits

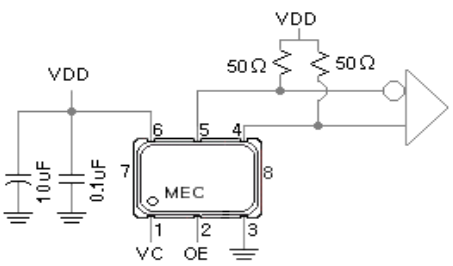



$V_{DD}$ = 3.3V ; R1 = R3 = 127 Ω ; R2 = R4 = 82.5 Ω
$V_{DD}$ = 2.5V ; R1 = R3 = 250 Ω ; R2 = R4 = 62.5 Ω

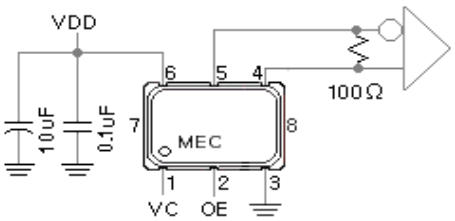
### HCSL Test Circuits



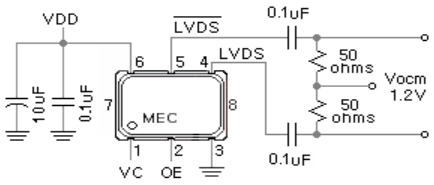

### CML Test Circuits




### LVDS Test Circuits for 2.5V and 3.3V




### LVDS Test Circuits for 1.8V only (*1)



# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

Output Waveform : Clipped Sine Wave " **S** "

Product Summary :

## Product Selection Guide

| TCXO | VCTCXO | Available Freq. Range | RoHS Compliant Equivalent Model | | Package Description | |
|---|---|---|---|---|---|---|
| ● Leadless Surface Mount Types | | | | | | |
| M21S _ | VM21S _ | 10.0 ~ 52.0 MHz | Same | | 4 pad ceramic substrate SMD. ( 2.05 x 1.65 x 0.70 mm ) | |
| M22S _ | VM22S _ | 10.0 ~ 52.0 MHz | Same | | 4 pad ceramic substrate SMD. ( 2.5 x 2.0 x 0.8 mm ) | |
| M32S _ | VM32S _ | 8.192 ~ 52.0 MHz | Same | | 4 pad ceramic substrate SMD. ( 3.2 x 2.5 x 1.2 mm ) | |
| M53S _ | VM53S _ | 6.4 ~ 52.0 MHz | Same | | 4 pad ceramic substrate SMD. ( 5.0 x 3.2 x 1.3 mm ) | |
| M53S _AB | VM53S _AB | 10.0 ~ 52.0 MHz | M53S _AB | VM53S _AB | 4 pad FR4 substrate SMD. ( 5.0 x 3.2 x 1.3 mm ) | |
| M57S _ | VM57S _ | 6.4 ~ 52.0 MHz | Same | | 4 pad ceramic substrate SMD. ( 7.0 x 5.0 x 2.0 mm ) | |
| M57S _AB | VM57S _AB | 6.4 ~ 52.0 MHz | M57S _AB | VM57S _AB | 4 pad FR4 substrate SMD. ( 7.0 x 5.0 x 1.4 mm ) | |
| M572S _ | VM572S _ | 6.4 ~ 52.0 MHz | Same | | 4 pad ceramic substrate SMD. ( 7.0 x 5.0 x 2.3 mm ) | |
| ● Thru - hole Types | | | | | | |
| M39S _ | VM39S _ | 6.4 ~ 52.0 MHz | M39S_ | VM39S_ | Dip Type | 4 pins for VCTCXOs<br>3 pins for TCXOs |
| M14S _ | VM14S _ | 6.4 ~ 52.0 MHz | M14S_ | VM14S_ | Dip Type ( 4 pins ) , Hermetically Sealed | |
| M15S _ | VM15S _ | 6.4 ~ 52.0 MHz | M15S_ | VM15S_ | Dip Type ( 4 pins ) , With Trimmer | |
| M8S _ | VM8S _ | 6.4 ~ 52.0 MHz | M8S_ | VM8S_ | Dip Type ( 4 pins ) , Half size , Hermetically Sealed | |
| M9S _ | VM9S _ | 6.4 ~ 52.0 MHz | M9S_ | VM9S_ | Dip Type ( 4 pins ) , With Trimmer | |

● " _ " is voltage code. Please see the table on next page.

Note: Frequency tuning by the built-in mechanical trimmer is standard for all models except for (V)M57S, (V)M53S and (V)M32S.

Product Options :

● No mechanical trimmer models are available to allow for aqueous washing cycles . To order such option

Note: Non-hermetically sealed (VC)TCXO products are not subject to the washing cycles as the solvent will degrade the trimmer capacitor .

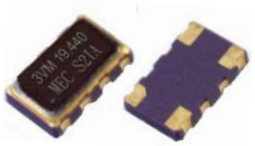
If cleaning is mandatory please choose hermetically sealed packages or no-trimmer option.

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

## Clipped Sine Wave ; Waveform Code " S " [ SMD Type ]

### Features

- Frequency stability as tight as ± 0.5 ppm over -30 °C to 85 °C
- Frequency stability as tight as ± 1.0 ppm over -40 °C to 85 °C



### General Specifications [ TA = +25°C , $V_{DD}$= at specified voltage , Load : 10K ohms//10 pF ]

| Output Waveform | Clipped Sine wave . Waveform code is " S " | | | |
|---|---|---|---|---|
| Suggested package | **M21S , VM21S** | **M22S , VM22S** | **M32S , VM32S** | **M53S , VM53S** |
| Package size | 2.05 x 1.65 x 0.70 mm | 2.5 x 2.0 x 0.8 mm | 3.2 x 2.5 x 1.2 mm | 5.0 x 3.2 x 1.3 mm |
| Supply voltage ( $V_{DD}$ ) [ unit : V ] | 1.8 , 2.5 , 2.8 , 3.0 , 3.3 | 1.8 , 2.5 , 2.8 , 3.0 , 3.3 | 1.8 , 2.5 , 3.0 , 3.3 | 1.8 , 2.5 , 2.8 , 3.0 , 3.3 |
| Frequency Range | 10.0 ~ 52.0 MHz | 10.0 ~ 52.0 MHz | 8.192 ~ 52.0 MHz | 6.4 ~ 52.0 MHz |

| Suggested package | **M57S , VM57S** | **M572S , VM572S** | **M53S-AB , VM53S-AB** | **M57S-AB , VM57S-AB** |
|---|---|---|---|---|
| Package size | 7.0 x 5.0 x 1.9 mm | 7.0 x 5.0 x 2.3 mm | 5.0 x 3.2 x 1.3 mm | 7.0 x 5.0 x 1.4 mm |
| Supply voltage ( $V_{DD}$ ) [ unit : V ] | 2.5 , 3.0 , 3.3 | 1.8 , 2.5 , 2.8 , 3.0 , 3.3 | 1.8 , 2.5 , 2.8 , 3.0 , 3.3 | 1.8 , 2.5 , 2.8 , 3.0 , 3.3 |
| Frequency Range | 6.4 ~ 52.0 MHz | 6.4 ~ 52.0 MHz | 10.0 ~ 52.0 MHz | 10.0 ~ 52.0 MHz |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Standard Frequency ( Partial list ) [ MHz ] | 10.000 | 12.800 | 13.000 | 14.400 | 14.7456 | 15.360 | 16.367667 |
| | 16.384 | 19.200 | 19.440 | 20.000 | 25.000 | 26.000 | 27.000 |
| Initial Calibration Tolerance | < ± 1 ppm. at + 25°C ± 2°C | | | | | | |
| Frequency Stability ( ppm ) | ± 0.5 ppm | ± 1.0 ppm | ± 1.5 ppm | ± 2.0 ppm | ± 2.5 ppm | ± 3.0 ppm | ○ : available ▷ : contact us X : not available |
| Frequency Stability vs Temperature ( examples ) 0°C to 50°C | ○ | ○ | ○ | ○ | ○ | ○ | |
| -10°C to 60°C | △ | ○ | ○ | ○ | ○ | ○ | |
| -20°C to 70°C | △ | ○ | ○ | ○ | ○ | ○ | |
| -30°C to 75°C | △ | ○ | ○ | ○ | ○ | ○ | |
| -30°C to 85°C | △ | ○ | ○ | ○ | ○ | ○ | |
| -40°C to 85°C | △ | △ | ○ | ○ | ○ | ○ | |

| | | |
|---|---|---|
| Frequency Stability | vs Aging at Ta = +25°C | ± 1.0 ppm / year ( max.) |
| | vs Voltage Change | ± 0.2 ppm ( max.) , for a ±5% input voltage change . |
| | vs Load Change | ± 0.2 ppm ( max.) , for a ±10% load condition change . |
| | vs Reflow ( SMD type ) | ± 1.0 ppm ( max.) , 1 reflow and measured 24 hours afterwards . |
| Output Voltage Level ( peak to peak ) | | 0.8 V p-p ( min.) |
| Current Consumption. ( max.) | | 10.0 ~ 15 MHz: 1.5 mA ; 15.1 ~ 26.0 MHz : 2.0 mA ; 26.1 ~ 52.0 MHz : 3.5 mA |

| | | | | |
|---|---|---|---|---|
| Electrical Frequency Tuning ( EFC ) by external Control Voltage | Control Voltage Center | 1.8 V | 2.5 V | 3.0 V / 3.3V |
| | | 0.9 V ± 0.6 V | 1.4 V ± 1.0 V | 1.5 V ± 1.0 V |
| | Frequency Deviation Range | ± 5.0 ppm ( min.) | | |
| | Slope Polarity ( Transfer Function ) | Positive slope. Positive voltage for positive frequency shift. | | |
| | | Input Impedance : 1.0M Ω ( min.) | Modulation Bandwidth : 3 KHz ( min.) | Linearity : ± 10 % ( max.) |
| Start-Up Time | 2.0 msec. ( typ.) , 5.0 msec. ( max.) ( reach 90% amplitude and at +25°C ± 2°C ) | | | |
| Output Load | 10 KΩ // 10 pF ± 10% | | | |
| Output Format | DC block , AC coupled. EX : (V) M53 and (V) M32 model. | | | |

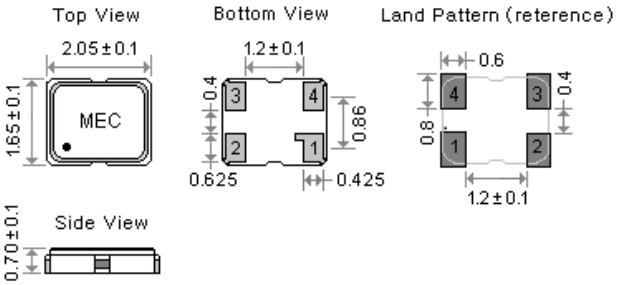
| Phase Noise [ dBc / Hz ; ( typ.) ] | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz |
|---|---|---|---|---|---|---|
| | 13.000 MHz | -80 | -115 | -135 | -148 | -148 |
| Storage Temperature | -40°C to +85°C or -55°C to +125°C ( package dependent ) | | | | | |

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

## Clipped Sine Wave Output Code " S " [ SMD Type ]

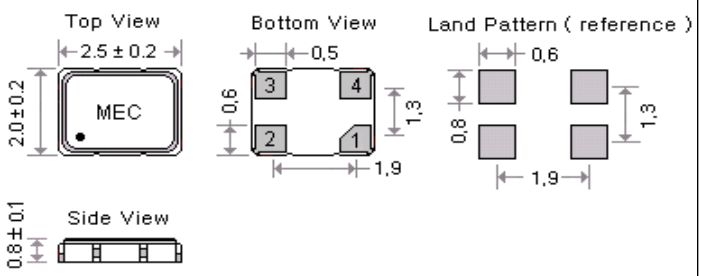
### Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

#### [ M21S _ _ ] ; [ VM21S _ _ ]



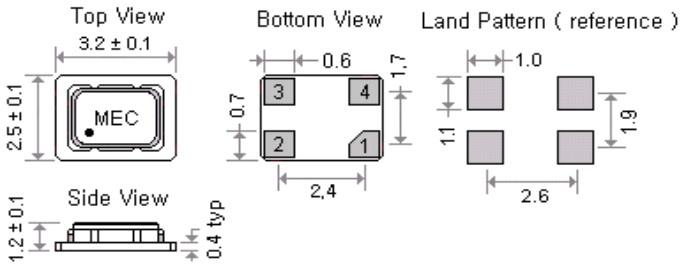

Pad Connections :
Pad 1 : Control voltage for VCTCXO ; Ground for TCXO .
Pad 2 : Ground ; Pad 3 : Output ; Pad 4 : Supply Voltage

#### [ M22S _ _ ] ; [ VM22S _ _ ]



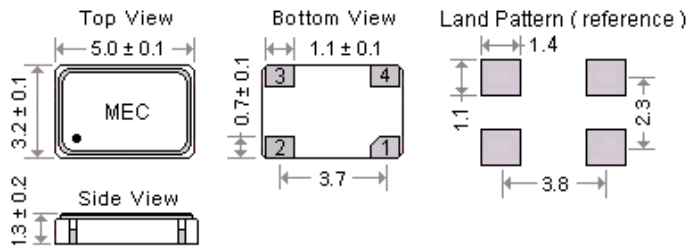

Pad Connections :
Pad 1 : Control voltage for VCTCXO ; Ground for TCXO .
Pad 2 : Ground ; Pad 3 : Output ; Pad 4 : Supply Voltage

#### [ M32S _ _ ] ; [ VM32S _ _ ]



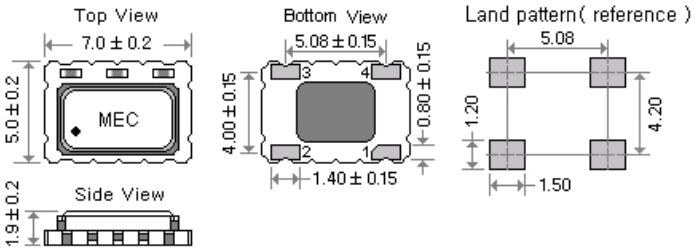

Pad Connections :
Pad 1 : Control voltage for VCTCXO ; Ground for TCXO .
Pad 2 : Ground ; Pad 3 : Output ; Pad 4 : Supply Voltage

#### [ M53S _ _ ] ; [ VM53S _ _ ]



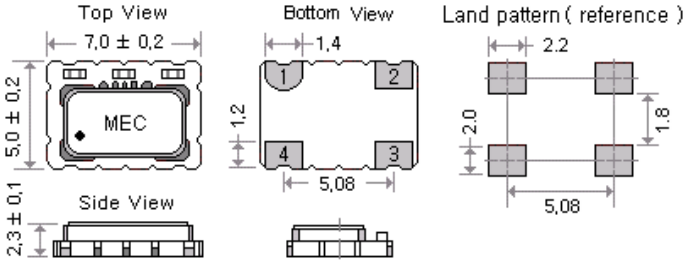

Pad Connections :
Pad 1 : Control voltage for VCTCXO ; Ground for TCXO .
Pad 2 : Ground ; Pad 3 : Output ; Pad 4 : Supply Voltage

#### [ M57S _ _ ] ; [ VM57S _ _ ]




Pad Connections :
Pad 1 : Control voltage for VCTCXO ; Ground for TCXO .
Pad 2 : Ground ; Pad 3 : Output ; Pad 4 : Supply Voltage

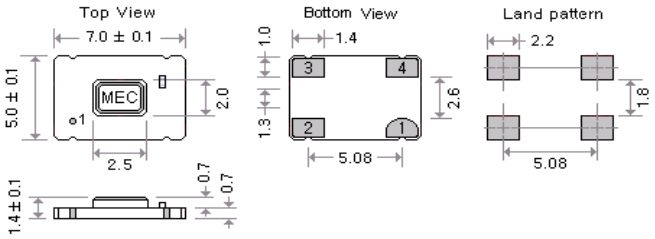
#### [ M572S _ _ ] ; [ VM572S _ _ ]




Pad Connections :
Pad 1 : Control voltage for VCTCXO ; Ground for TCXO .
Pad 2 : Ground ; Pad 3 : Output ; Pad 4 : Supply Voltage

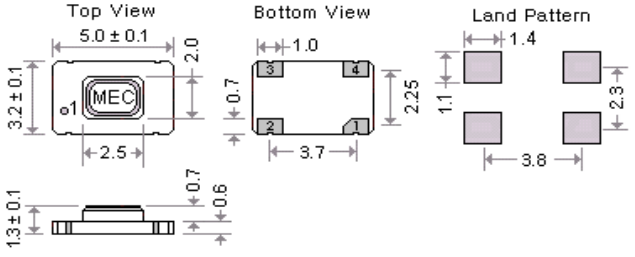
### Outline Dimensions ( Unit : mm ) , Adapter Board Type

#### [ M57S _ _ AB ] ; [ VM57S _ _ AB ]




Pad Connections :
Pad 1 : Control voltage for VCTCXO ; No connection for TCXO
Pad 2 : Ground ; Pad 3 : Output ; Pad 4 : Supply Voltage
White marker is pad1 on PCB

#### [ M53S _ _ AB ] ; [ VM53S _ _ AB ]




Pad Connections :
Pad 1 : Control voltage for VCTCXO ; No connection for TCXO
Pad 2 : Ground ; Pad 3 : Output ; Pad 4 : Supply Voltage
White marker is pad1 on PCB

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

## Clipped Sine Wave ; Waveform Code " **S** " [ Dip Type ]

### Features

- Frequency stability as tight as ± 0.5 ppm over -30 °C to 85 °C
- Frequency stability as tight as ± 1.0 ppm over -40 °C to 85 °C

### General Specifications [ TA = +25°C , $V_{DD}$= at specified voltage , Load : 10K ohms//10 pF ]

| Output Waveform | Clipped Sine Wave . Waveform code is " ***S*** " | | | | |
|---|---|---|---|---|---|
| Suggested package ( Dip type ) | **M8S , VM8S** | **M9S , VM9S** | **M14S , VM14S** | **M15S , VM15S** | **M39S , VM39S** |
| Model with Trimmer | - - - - - | with Trimmer | - - - - - | with Trimmer | with Trimmer |
| Package size ( mm ) | 12.8 x 12.8 x 6.3 | 12.8 x 12.8 x 6.3 | 20.2 x 12.8 x 7.8 | 20.2 x 12.8 x 7.8 | 18.4 x 11.7 x 4.7 |
| Supply voltage ( $V_{DD}$ ) [ unit : V ] | 1.8 , 2.5 , 3.0 , 3.3 | 1.8 , 2.5 , 3.0 , 3.3 | 1.8 , 2.5 , 3.0 , 3.3 | 1.8 , 2.5 , 3.0 , 3.3 | 1.8 , 2.5 , 3.0 , 3.3 |
| Frequency Range | 6.4 ~ 52.0 MHz | 6.4 ~ 52.0 MHz | 6.4 ~ 52.0 MHz | 6.4 ~ 52.0 MHz | 6.4 ~ 52.0 MHz |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Standard Frequency ( Partial list ) [ MHz ] | | 10.000 | 12.800 | 13.000 | 14.400 | 14.7456 | 15.360 | 16.367667 |
| | | 16.384 | 19.200 | 19.440 | 20.000 | 25.000 | 26.000 | 27.000 |
| Initial Calibration Tolerance | | < ± 1 ppm. at + 25°C ± 2°C for model with trimmer | | | | | | |
| | | < ± 2 ppm. at + 25°C ± 2°C for model without trimmer | | | | | | |
| Frequency Stability ( ppm ) | | ± 0.5 ppm | ± 1.0 ppm | ± 1.5 ppm | ± 2.0 ppm | ± 2.5 ppm | ± 3.0 ppm | ○ : available △ : contact us X : not available |
| Frequency Stability vs Temperature ( examples ) | 0°C to 50°C | ○ | ○ | ○ | ○ | ○ | ○ | |
| | -10°C to 60°C | △ | ○ | ○ | ○ | ○ | ○ | |
| | -20°C to 70°C | △ | ○ | ○ | ○ | ○ | ○ | |
| | -30°C to 75°C | △ | ○ | ○ | ○ | ○ | ○ | |
| | -30°C to 85°C | △ | ○ | ○ | ○ | ○ | ○ | |
| | -40°C to 85°C | △ | △ | ○ | ○ | ○ | ○ | |
| Frequency Stability | vs Aging at Ta = +25°C | ± 1.0 ppm / year ( max.) | | | | | | |
| | vs Voltage Change | ± 0.2 ppm ( max.) , for a ±5% input voltage change . | | | | | | |
| | vs Load Change | ± 0.2 ppm ( max.) , for a ±10% load condition change . | | | | | | |
| | vs Reflow ( SMD type ) | ± 1.0 ppm ( max.) , 1 reflow and measured 24 hours afterwards . | | | | | | |
| Output Voltage Level ( peak to peak ) | | 0.8 V p-p ( min.) | | | | | | |
| Current Consumption. ( max.) | | 10.0 ~ 15 MHz: 1.5 mA ; 15.1 ~ 26.0 MHz : 2.0 mA ; 26.1 ~ 52.0 MHz : 3.5 mA | | | | | | |

| | | | | |
|---|---|---|---|---|
| Electrical Frequency Tuning ( EFC ) by external Control Voltage | Control Voltage Center | 1.8 V | 2.5 V | 3.0 V / 3.3V |
| | | 0.9 V ± 0.6 V | 1.4 V ± 1.0 V | 1.5 V ± 1.0 V |
| | Frequency Deviation Range | ± 5.0 ppm ( min.) | | |
| | Slope Polarity ( Transfer Function ) | Positive slope. Positive voltage for positive frequency shift. | | |
| | | Input Impedance : 1.0M Ω min. | Modulation Bandwidth : 3 KHz min. | Linearity : ± 10 % max. |
| Start-Up Time. | 2.0 msec. ( typ.) , 5.0 msec. ( max.) ( reach 90% amplitude and at +25°C ± 2°C ) | | | |
| Output Load | 10 KΩ // 10 pF ± 10% | | | |

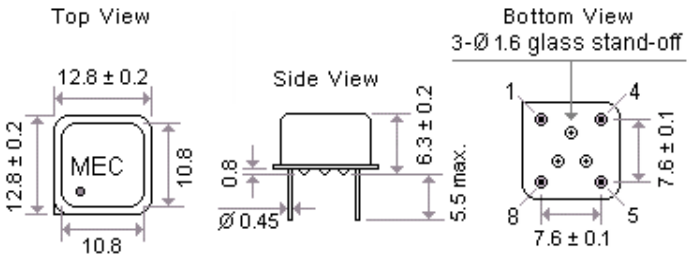
| Phase Noise [ dBc / Hz ; ( typ.) ] | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz |
|---|---|---|---|---|---|---|
| | 13.000 MHz | -80 | -115 | -135 | -148 | -148 |
| Storage Temperature | -40°C to +85°C or -55°C to +125°C ( package dependent ) | | | | | |

# Temperature Compensated Crystal Oscillators [ TCXO " **M** " and VCTCXO " **VM** " ]

Clipped Sine Wave Output Code " **S** " [ Dip Type ]

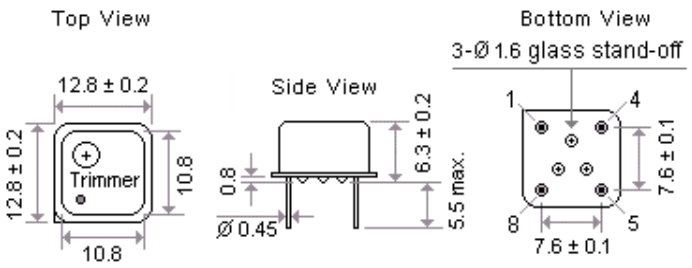
Outline Dimensions ( Unit : mm ) , Suggested pin Layout for SMDs

## [ M8S _ _ ] ; [ VM8S _ _ ]



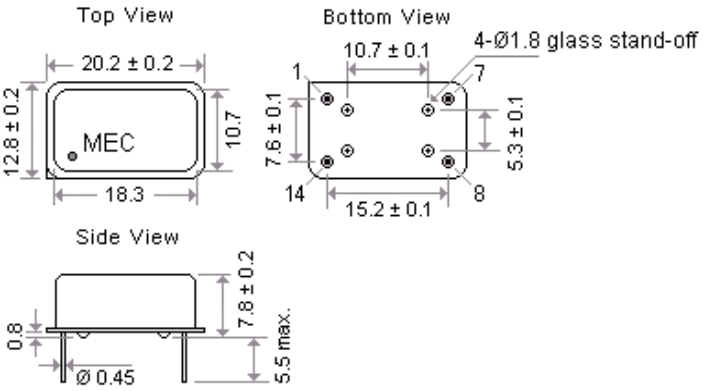

Pin Connections :
Pin 1 : Control voltage for VCTCXO ; No connection for TCXO.
Pin 4 : Ground ; Pin 5 : Output ; Pin 8 : Supply Voltage

## [ M9S _ _ ] ; [ VM9S _ _ ]



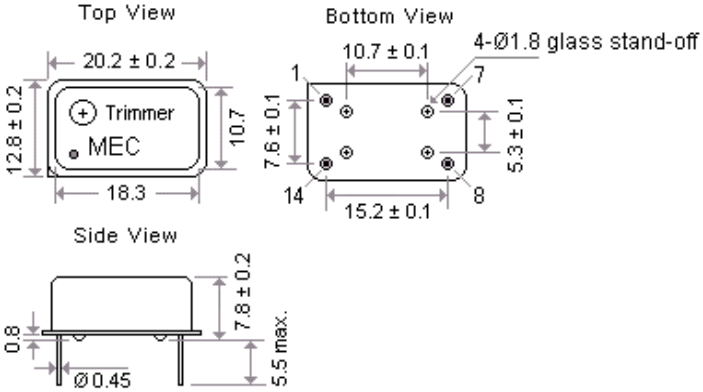

Pin Connections :
Pin 1 : Control voltage for VCTCXO ; No connection for TCXO.
Pin 4 : Ground ; Pin 5 : Output ; Pin 8 : Supply Voltage

## [ M14S _ _ ] ; [ VM14S _ _ ]



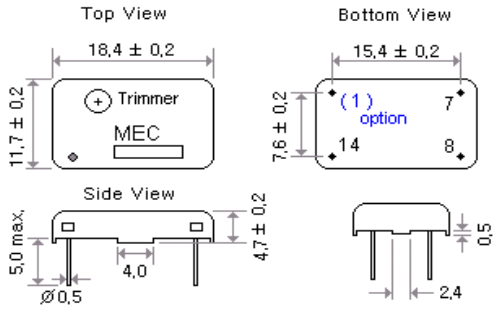

Pin Connections :
Pin 1 : Control voltage for VCTCXO ; No connection for TCXO.
Pin 7 : Ground ; Pin 8 : Output ; Pin 14 : Supply Voltage

## [ M15S _ _ ] ; [ VM15S _ _ ]




Pin Connections :
Pin 1 : Control voltage for VCTCXO ; No connection for TCXO.
Pin 7 : Ground ; Pin 8 : Output ; Pin 14 : Supply Voltage

## [ M39S _ _ ] ; [ VM39S _ _ ]




Pin Connections :
Pin 1 : Control voltage for VCTCXO
[ No physical pin 1 for TCXO. ( 3 pins only ) ]
Pin 7 : Ground ; Pin 8 : Output ; Pin 14 : Supply Voltage

TCXOs

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

## Clipped Sine Wave Output Code " S "

### Part Number Format and Example

| | [ 1 ] Holder Type | [ 2 ] Output Wave | [ 3 ] Supply Voltage | - | [ 4 ] Center Frequency | - | [ 5 ] Frequency Stability | / | [ 6 ] Operating Temp. Range | - | [ 7 ] Adapter Board |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Examples (1) | VM21 | S | 3 | - | 10.000 | - | 1.5 | / | -20+70 | | |
| (2) | M32 | S | 18 | - | 20.000 | - | 2.5 | / | -30+75 | | |
| (3) | VM57 | S | 33 | - | 10.000 | - | 1.0 | / | -20+70 | - | AB |
| (4) | M53 | S | 18 | - | 16.384 | - | 2.5 | / | -40+85 | - | AB |

Ex (1) : VM21S3 - 10.000 - 1.5 / -20+70 [ VCTCXO , VM21 type , Clipped Sine Wave, 3.0V , 10.000MHz , ±1.5ppm from -20°C to 70°C ]

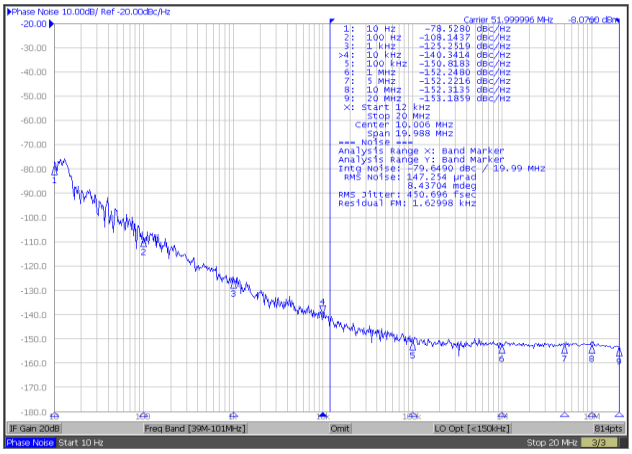
Ex (2) : M32S18 - 20.000 - 2.5 / -30+75 [ TCXO , M32 type , Clipped Sine Wave , 1.8V , 20.000MHz , ±2.5ppm from -30°C to 75°C ]

Ex (3) : VM57S33 - 10.000 - 1.0 / -20+70 - AB [ VCTCXO , VM57 type , Clipped Sine Wave , 3.3V , 10.000MHz , ±1.0ppm from -20°C to 70°C , Adapter Board ]

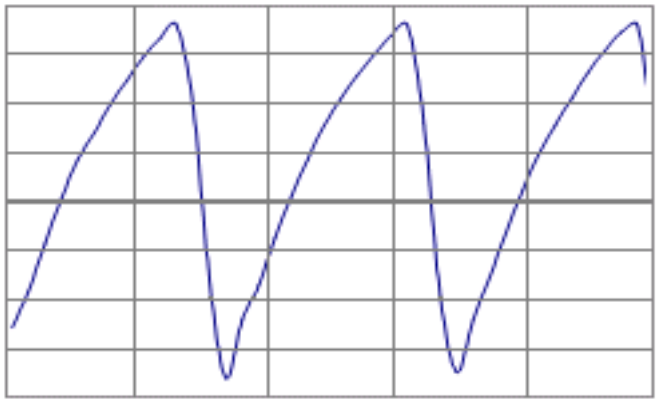
Ex (4) : M53S18 - 16.384 - 2.5 / -40+85 - AB [ TCXO , M53 type , Clipped Sine Wave , 1.8V , 16.384MHz , ±2.5ppm from -40°C to 85°C , Adapter Board ]

| | |
|---|---|
| [ 1 ] | Holder Type |
| | " M " stands for TCXO , " VM " stands for VCTCXO |
| [ 2 ] | " S " stands for Clipped Sine Wave |
| [ 3 ] | Supply voltage , " 18 " stands for +1.8V ; " 25 " stands for +2.5V ; " 28 " stands for +2.8V ; " 3 " stands for +3.0V ; " 33 " stands for +3.3V |
| [ 4 ] | Center Frequency in MHz |
| [ 5 ] | Frequency stability in ± _ ppm ; ex 1 : ± 1.5ppm --- 1.5 , ex 2 : ± 2.5ppm --- 2.5 , ex 3 : ± 1.0ppm --- 1.0 , ex 4 : ± 2.5ppm --- 2.5 |
| [ 6 ] | Operating temperature range in °C |
| | ex 1 : -20 °C to 70°C ----- -20+70 ; ex 2 : -30 °C to 75°C ----- -30+75 ; ex 3 : -20 °C to 70°C ----- -20+70 ; ex 4 : -40 °C to 85°C ----- -40+85 |
| [ 7 ] | Adapter Board Type ----- AB |

### Clipped Sine Wave Typical Phase Noise ( M22S33-52.000 )

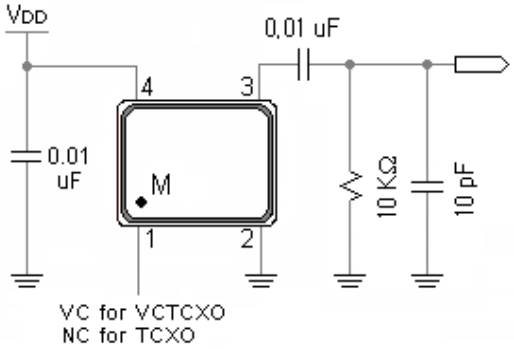


### Clipped Sine Wave , " S " series

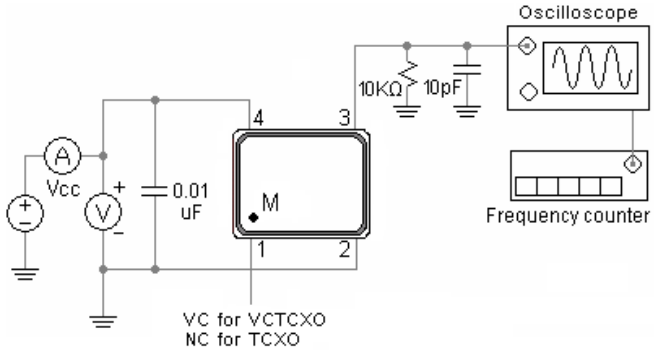


### Test Circuits

#### ( VC )TCXO with clipped sine wave Test Circuits




#### ( VC )TCXO with clipped sine wave Test Circuits For [ (V)M57S ] ; [ (V)M572S ] ; [ (V)M57S _ _ AB ] ; DIP Type



# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

Output Waveform : CMOS " T " , LVPECL " P " , LVDS " D " , HCSL " C " , CML " Q "

Product Summary :

Product Selection Guide

## CMOS output waveform , " T " series

| TCXO | VCTCXO | Available Freq. Range | RoHS Compliant Equivalent Model | | Package Description |
|---|---|---|---|---|---|
| ● Leadless Surface Mount Types | | | | | |
| M211T _ | - - - - - | 10 ~ 52 MHz | Same | | 4 pad ceramic substrate . ( 2.05 x 1.65 x 0.70 mm ) |
| M221T _ | - - - - - | 9.5 ~ 60 MHz | Same | | 4 pad ceramic substrate . ( 2.5 x 2.0 x 0.8 mm ) |
| M32T _ | VM32T _ | 8.192 ~ 40 MHz | Same | | 4 pad ceramic substrate . ( 3.2 x 2.5 x 1.0 mm ) |
| M321T _ | - - - - - | 9.5 ~ 60 MHz | Same | | 4 pad ceramic substrate . ( 3.2 x 2.5 x 1.2 mm ) |
| M531T _AB | - - - - - | 9.5 ~ 60 MHz | Same | | 4 pad FR4 substrate . ( 5.0 x 3.2 x 1.3 mm ) |
| MTF326T _ | VMTF326T _ | 1 ~ 200 MHz | Same | | 6 pad ceramic substrate . ( 3.2 x 2.5 x 1.6 mm ) |
| M53T _ | VM53T _ | 6.4 ~ 40 MHz | Same | | 4 pad ceramic substrate . ( 5.0 x 3.2 x 1.3 mm ) |
| MTF538T _ | VMTF538T _ | 1 ~ 200 MHz | Same | | 8 pad ceramic substrate . ( 5.0 x 3.2 x 1.4 mm ) |
| M571T _AB | - - - - - | 9.5 ~ 60 MHz | Same | | 4 pad FR4 substrate . ( 7.0 x 5.0 x 1.4 mm ) |
| M572T _ | VM572T _ | 32.768 KHz , 1.25 ~ 52 MHz | Same | | 4 pad ceramic substrate . ( 7.0 x 5.0 x 2.3 mm ) |
| ME21T _ | - - - - - | 32.768 KHz | Same | | 4 pad ceramic substrate . ( 2.1 x 1.3 x 1.1 mm ) |
| ME32T _ | - - - - - | 32.768 KHz | Same | | 4 pad ceramic substrate . ( 3.2 x 2.5 x 1.4 mm ) |
| MQN326T _ | VMQN326T _ | 10 ~ 250 MHz | Same | | 6 pad ceramic substrate . ( 3.2 x 2.5 x 1.6 mm ) |
| MQN574T _ | VMQN574T _ | | | | 4 pad ceramic substrate . ( 7.0 x 5.0 x 2.5 mm ) |
| MQF326T _ | VMQF326T _ | 10 ~ 250 MHz | Same | | 6 pad ceramic substrate . ( 3.2 x 2.5 x 1.6 mm ) |
| MQF574T _ | VMQF574T _ | | | | 4 pad ceramic substrate . ( 7.0 x 5.0 x 2.5 mm ) |
| ● Thru - Hold Types | | | | | |
| M39T _ | VM39T _ | 6.4 ~ 52.0 MHz | M39T _ | VM39T _ | 3 pin if TCXO. Package height = 4.7 mm |
| M14T _ | VM14T _ | | M14T _ | VM14T _ | 4 pin if TCXO. Package height = 7.8 mm |
| M15T _ | VM15T _ | | M15T _ | VM15T _ | Dip Type ( 4 pins ) , With Trimmer |
| M8T _ | VM8T _ | | M8T _ | VM8T _ | Dip Type ( 4 pins ) , Half size , Hermetically Sealed |
| M9T _ | VM9T _ | | M9T _ | VM9T _ | Dip Type ( 4 pins ) , With Trimmer |

## Differential output waveform , LVPECL " P " series , LVDS " D " series , HCSL " C " series , CML " Q " series

| | | | | |
|---|---|---|---|---|
| ● Leadless Surface Mount Types | | | | |
| MQN326P _ | VMQN326P _ | 10 ~ 1,500 MHz | Same | 6 pad ceramic substrate . ( 3.2 x 2.5 x 1.6 mm ) |
| MQN576P _ | VMQN576P _ | | | 6 pad ceramic substrate . ( 7.0 x 5.0 x 2.5 mm ) |
| MQF326P _ | VMQF326P _ | 10 ~ 1500 MHz | Same | 6 pad ceramic substrate . ( 3.2 x 2.5 x 1.6 mm ) |
| MQF576P _ | VMQF576P _ | | | 6 pad ceramic substrate . ( 7.0 x 5.0 x 2.5 mm ) |
| MJF326P_ | VMJF326P_ | 15 ~ 2,100 MHz | Same | 6 pad ceramic substrate . ( 3.2 x 2.5 x 1.6 mm ) |
| MJF538P_ | VMJF538P_ | 15 ~ 2,100 MHz | Same | 8 pad ceramic substrate . ( 5.0 x 3.2 x 1.4 mm ) |
| MQN326D _ | VMQN326D _ | 10 ~ 1,500 MHz | Same | 6 pad ceramic substrate . ( 3.2 x 2.5 x 1.6 mm ) |
| MQN576D _ | VMQN576D _ | | | 6 pad ceramic substrate . ( 7.0 x 5.0 x 2.5 mm ) |
| MQF326D _ | VMQF326D _ | 10 ~ 1500 MHz | Same | 6 pad ceramic substrate . ( 3.2 x 2.5 x 1.6 mm ) |
| MQF576D _ | VMQF576D _ | | | 6 pad ceramic substrate . ( 7.0 x 5.0 x 2.5 mm ) |
| MJF326D_ | VMJF326D_ | 15 ~ 2,100 MHz | Same | 6 pad ceramic substrate . ( 3.2 x 2.5 x 1.6 mm ) |
| MJF538D_ | VMJF538D_ | 15 ~ 2,100 MHz | Same | 8 pad ceramic substrate . ( 5.0 x 3.2 x 1.4 mm ) |
| MJF326C_ | VMJF326C_ | 15 ~ 700 MHz | Same | 6 pad ceramic substrate . ( 3.2 x 2.5 x 1.6 mm ) |
| MJF538C_ | VMJF538C_ | 15 ~ 700 MHz | Same | 8 pad ceramic substrate . ( 5.0 x 3.2 x 1.4 mm ) |
| MJF326Q_ | VMJF326Q_ | 15 ~ 2,100 MHz | Same | 6 pad ceramic substrate . ( 3.2 x 2.5 x 1.6 mm ) |
| MJF538Q_ | VMJF538Q_ | 15 ~ 2,100 MHz | Same | 8 pad ceramic substrate . ( 5.0 x 3.2 x 1.4 mm ) |

" _ " is voltage code. Please see the table in next page.

Note: Frequency tuning by built-in mechanical trimmer is standard for all models except for (V)M572T,(V)M572P,(V)M572D .

Note: Non-hermetically sealed (VC)TCXO products are not subject to the washing cycles as the solvent will degrade the trimmer capacitor . If cleaning is mandatory please choose hermetically sealed packages or no-trimmer option.

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ] CMOS Output

| TCXO | VCTCXO | KHz range | CMOS | SMD | 15pF | 3.3V | 32.768 KHz |
|---|---|---|---|---|---|---|---|
| M _ T | VM _ T | | | | | | |

## Features

- Wide frequency range : [ 32.768 KHz ]
- Frequency stability as tight as ± 0.5 ppm over 0 ° C to 50 ° C
- Frequency stability as tight as ± 1.0 ppm over -40°C to 85°C


## General specifications of all available packages , at Ta=+25°C , CL=15pF

| Output Waveform | | Square Wave [ CMOS ] . Waveform Wode is " T " | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Suggested Package ( Size ) | Type | SMD | | | | | | |
| | Demensions | **(V)M572T** ( 7.0 x 5.0 x 2.3 mm ) | | | | | | |
| Frequency Range | | 32.768 KHz [ From KHz with divider. mA current consumption. ] | | | | | | |
| Supply Voltage $V_{DD}$ ( code ) | | +3.3 V ± 5% ( voltage code is " 33 " ) | | | | | | |
| Output Logic Levels | Logic High " 1 " | 2.97 $V_{DD}$ ( min.) | | | | | | |
| | Logic Low " 0 " | 0.33 $V_{DD}$ ( max.) | | | | | | |
| Current Consumption. ( max. ) ( Over operating temperature range . ) | | 8.0 mA ( max.) for 32.768 KHz at +3.3V | | | | | | |
| Initial Calibration Tolerance | | < ± 2.0 ppm at +25°C ± 2°C. | | | | | | |
| Frequency Stability ( ppm ) | | ± 0.5 ppm | ± 1.0 ppm | ± 1.5 ppm | ± 2.0 ppm | ± 2.5 ppm | ± 3.0 ppm | ○ : available △ : contact us X : not available |
| Frequency Stability vs Temperature ( examples ) | 0°C to 50°C | ○ | ○ | ○ | ○ | ○ | ○ | |
| | -10°C to 60°C | △ | ○ | ○ | ○ | ○ | ○ | |
| | -20°C to 70°C | X | ○ | ○ | ○ | ○ | ○ | |
| | -30°C to 75°C | X | ○ | ○ | ○ | ○ | ○ | |
| | -30°C to 85°C | X | ○ | ○ | ○ | ○ | ○ | |
| | -40°C to 85°C | X | △ | ○ | ○ | ○ | ○ | |
| Frequency Stability | vs Aging at Ta = +25°C | ± 1.0 ppm / year ( max.) | | | | | | |
| | vs Voltage Change | ± 0.3 ppm ( max.) , for a ±5% input voltage change . | | | | | | |
| | vs Load Change | ± 0.3 ppm ( max.) , for a ±10% load condition change . | | | | | | |
| | vs Reflow ( SMD type ) | ± 1.0 ppm ( max.) , 1 reflow and measured 24 hours afterwards . | | | | | | |
| Rise and Fall Time | | 10.0 nsec. ( max.) Measured at 20% ↔ 80% of the waveform | | | | | | |
| Electrical Frequency Tuning ( EFC ) by external Control Voltage | Control Voltage Center | 1.5 V ± 1.0 V ( 3.3V ) | | | | | | |
| | Frequency Deviation Range | ± 5.0 ppm ( min.) | | | | | | |
| | Slope Polarity ( Transfer Function | Positive slope. Positive voltage for positive frequency shift. | | | | | | |
| | | Input Impedance : 1.0M Ω ( min.) | Modulation Bandwidth : 3 KHz ( min.) | Linearity : ± 10 % ( max.) | | | | |
| Start-Up Time. | | 5.0 msec. ( typ.) , 10.0 msec. ( max.) ( reach 90% amplitude and at+25°C±2°C) | | | | | | |
| Duty Cycle | | 50 % ± 5% | | | | | | |
| Output Load | | 15 pF | | | | | | |
| Storage Temperature | | -40°C to +85°C or -55°C to +125°C ( package dependent ) | | | | | | |

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

## CMOS Wave Output Code " T "

### Part Number Format and Example

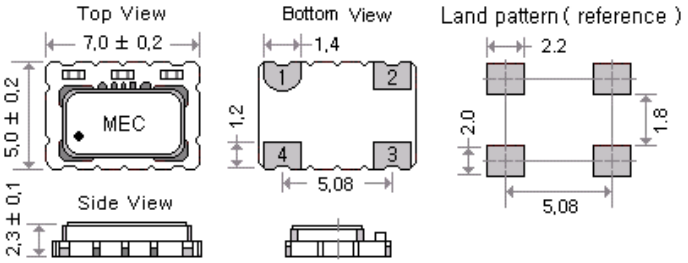
| [ 1 ] | [ 2 ] | [ 3 ] | - | [ 4 ] | - | [ 5 ] | / | [ 6 ] |
|---|---|---|---|---|---|---|---|---|
| Holder Type | Output Wave | Supply Voltage | | Center Frequency | | Frequency Stability | | Operating Temp. Range |
| Examples | M572 | T | 33 | - | 32.768K | - | 1.5 | / | -30+85 |

Ex : M572T33 - 32.768K - 1.5 / -30+85 [ TCXO , M572 type , CMOS output , 3.3V , 32.768KHz , ±1.5ppm from -30°C to 85°C ]

| | |
|---|---|
| [ 1 ] | Holder Type |
| | " M " stands for TCXO , " VM " stands for VCTCXO |
| [ 2 ] | " T " stands for Square Wave |
| | ex : M572T --- TCXO , M572 pcakage , CMOS output |
| [ 3 ] | Supply voltage , " 33 " stands for +3.3V |
| [ 4 ] | Center Frequency in KHz |
| [ 5 ] | Frequency stability in ± _ ppm ; ex : ± 1.5ppm --- 1.5 |
| [ 6 ] | Operating temperature range in °C |
| | ex : -30 °C to 85°C ----- -30+85 |

### Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

#### [ (V) M572T_ _ ]

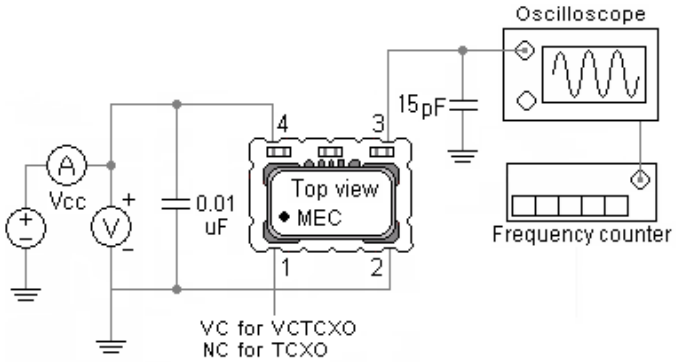



Pad Connections :

Pad 1 : NC - - - TCXO ; Vcon - - - VCTCXO

Pad 2 : Ground ; Pad 3 : Output , Pad 4 : Supply Voltage

#### ( VC )TCXO with CMOS output wave test Circuit




TCXOs

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ] CMOS Output

| TCXO | VCTCXO | MHz range | CMOS | SMD | 15pF | 1.8 V | 2.5 V | 3.0 V | 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M _ T | VM _ T | | | | | | | | | 6.4 MHz | 52.0 MHz |

## Features

- Wide frequency range : [ 6.4 MHz ~ 52.0 MHz ]
- Frequency stability as tight as ± 0.5 ppm over 0°C to 50°C
- Frequency stability as tight as ± 1.0 ppm over -40°C to 85°C

## General specifications of all available packages , at Ta=+25°C , CL=15pF

| Output Waveform | Square wave [ CMOS ] . Waveform code is " T " | | |
|---|---|---|---|
| Type | M32T , VM32T | M53T , VM53T | M572T , VM572T |
| Package size ( mm ) | 3.2 x 2.5 x 1.0 | 5.0 x 3.2 x 1.3 | 7.0 x 5.0 x 2.3 |
| Frequency Range | 8.192 ~ 40.0 MHz | 6.4 ~ 40.0 MHz | 6.4 ~ 52.0 MHz |

| | | | | | | |
|---|---|---|---|---|---|---|
| Supply Voltage $V_{DD}$ ( code ) | | | +1.8 V ± 5% ( code is " 18 " ) | +2.5 V ± 5% ( code is " 25 " ) | +3.0 V ± 5% ( code is " 3 " ) | +3.3 V ± 5% ( code is " 33 " ) |
| Current Consumption. ( max.) ( Over operating temperature range . ) | Package | M32T | 6 mA | 6 mA | 6 mA | 6 mA |
| | | M53T | 6 mA | 6 mA | 6 mA | 6 mA |
| | | M572T | 10 mA | 10 mA | 13 mA | 13 mA |
| Output Logic Levels | Logic High " 1 " ( min.) | | 1.62 V | 2.25 V | 2.7 V | 2.97 V |
| | Logic Low " 0 " ( max.) | | 0.25 V | 0.25 V | 0.3 V | 0.33 V |

| | | | | | | |
|---|---|---|---|---|---|---|
| Standard Frequency ( Partial list ) [ MHz ] | 10.000 | 12.800 | 13.000 | 14.7456 | 16.000 | 16.384 |
| | 19.200 | 19.440 | 19.680 | 20.000 | 25.000 | 27.000 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Initial Calibration Tolerance | Models with mechanical trimmer : < ± 1.0 ppm. +25°C ± 2°C. Models without mechanical trimmer : < ± 2.0 ppm at +25°C ± 2°C. | | | | | | | |
| Frequency Stability ( ppm ) | | ± 0.5 ppm | ± 1.0 ppm | ± 1.5 ppm | ± 2.0 ppm | ± 2.5 ppm | ± 3.0 ppm | ○ : available △ : contact us X : not available |
| Frequency Stability vs Temperature ( examples ) | 0°C to 50°C | ○ | ○ | ○ | ○ | ○ | ○ | |
| | -10°C to 60°C | △ | ○ | ○ | ○ | ○ | ○ | |
| | -20°C to 70°C | X | ○ | ○ | ○ | ○ | ○ | |
| | -30°C to 75°C | X | ○ | ○ | ○ | ○ | ○ | |
| | -30°C to 85°C | X | ○ | ○ | ○ | ○ | ○ | |
| | -40°C to 85°C | X | △ | △ | △ | ○ | ○ | |

| | | | | |
|---|---|---|---|---|
| Frequency Stability | vs Aging at Ta = +25°C | ± 1.0 ppm / year ( max.) | | |
| | vs Voltage Change | ± 0.3 ppm ( max.) , for a ±5% input voltage change . | | |
| | vs Load Change | ± 0.3 ppm ( max.) , for a ±10% load condition change . | | |
| | vs Reflow ( SMD type ) | ± 1.0 ppm ( max.) , 1 reflow and measured 24 hours afterwards . | | |
| Electrical Frequency Tuning ( EFC ) by external Control Voltage | Control Voltage Center | 0.9 V ± 0.6 V ( 1.8 V ) ; 1.4 V ± 1.0 V ( 2.5V ) ; 1.5 V ± 1.0 V ( 3.0V / 3.3V ) | | |
| | Frequency Deviation Range | ± 5.0 ppm ( min.) | | |
| | Slope Polarity ( Transfer Function ) | Positive slope. Positive voltage for positive frequency shift. | | |
| | | Input Impedance : 1.0M Ω ( min.) | Modulation Bandwidth : 20 KHz ( min.) | Linearity : ± 10 % ( max.) |

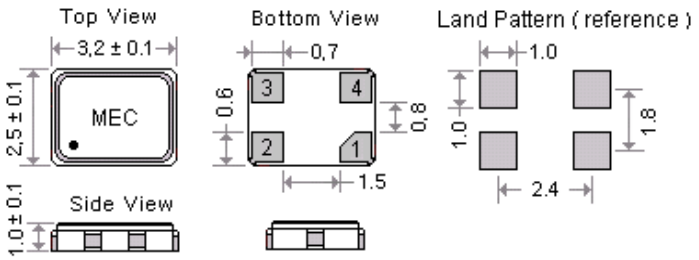
| | | | | | | |
|---|---|---|---|---|---|---|
| Output Load | 15 pF | | | | | |
| Duty Cycle | Standard: 50 % ± 10 % ; Option: 50 % ± 5 % | | | | | |
| Storage Temperature | -40°C to +85°C or -55°C to +125°C ( package dependent ) | | | | | |
| Phase Noise [ dBc / Hz ( typ. ) ] | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz |
| | M572T33 - 10.000 | -96 dBc / Hz | -122 dBc / Hz | -138 dBc / Hz | -145 dBc / Hz | -150 dBc / Hz |

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

CMOS Wave Output Code " T "

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

### [ (V) M32T_ _ ]

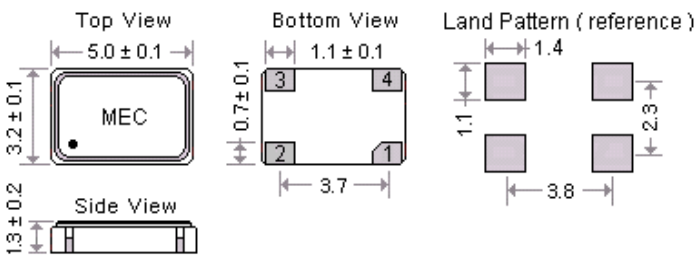



Pad Connections :

Pad 1 : Control voltage for VCTCXO ; Ground for TCXO .

Pad 2 : Ground ; Pin 3 : Output , Pin 4 : Supply Voltage

### [ (V) M53T_ _ ]

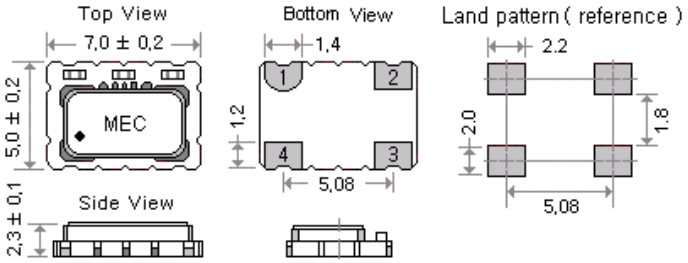



Pad Connections :

Pad 1 : Control voltage for VCTCXO ; Ground for TCXO .

Pad 2 : Ground ; Pad 3 : Output , Pad 4 : Supply Voltage

### [ (V) M572T_ _ ]




Pad Connections :

Pad 1 : NC - - - TCXO ; Vcon - - - VCTCXO

Pad 2 : Ground ; Pad 3 : Output , Pad 4 : Supply Voltage

TCXOs

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

CMOS Output

| TCXO | VCTCXO | MHz range | CMOS | DIP | 15pF | 1.8 V / 2.5 V / 3.0 V / 3.3 V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| M _ T | VM _ T | | | | | | 6.4 MHz | 52.0 MHz |

## Features

- Wide frequency range : [ 6.4 ~ 52.0 MHz ]
- Frequency stability as tight as ± 0.5 ppm over 0°C to 50°C
- Frequency stability as tight as ± 1.0 ppm over -40°C to 85°C

## General specifications of all available packages , at Ta=+25°C , CL=15pF

| Output Waveform | Square wave [ CMOS ] . Waveform code is " T " | | | | |
|---|---|---|---|---|---|
| Suggested package ( Dip type ) | M8T , VM8T | M9T , VM9T | M14T , VM14T | M15T , VM15T | M39T , VM39T |
| Model with Trimmer | - - - - - | with Trimmer | - - - - - | with Trimmer | with Trimmer |
| Package size ( mm ) | 12.8 x 12.8 x 6.3 | 12.8 x 12.8 x 6.3 | 20.2 x 12.8 x 7.8 | 20.2 x 12.8 x 7.8 | 18.4 x 11.7 x 4.7 |
| Supply voltage ( $V_{DD}$ ) [ unit : V ] | 1.8 , 2.5 , 3.0 , 3.3 | 1.8 , 2.5 , 3.0 , 3.3 | 1.8 , 2.5 , 3.0 , 3.3 | 1.8 , 2.5 , 3.0 , 3.3 | 1.8 , 2.5 , 3.0 , 3.3 |
| Frequency Range | 6.4 ~ 52.0 MHz | 6.4 ~ 52.0 MHz | 6.4 ~ 52.0 MHz | 6.4 ~ 52.0 MHz | 6.4 ~ 52.0 MHz |

| | | | | | | |
|---|---|---|---|---|---|---|
| Supply Voltage $V_{DD}$ ( code ) | | +1.8 V ± 5% ( code is " 18 " ) | +2.5 V ± 5% ( code is " 25 " ) | +3.0 V ± 5% ( code is " 3 " ) | +3.3 V ± 5% ( code is " 33 " ) | |
| Current Consumption. ( max.) ( Over operating temperature range . ) | Package M8T | 5 mA | 7 mA | - - - - - | 10 mA | |
| | Package M9T | 6 mA | 6 mA | 6 mA | 6 mA | |
| | Package M14T | 10 mA | 10 mA | 13 mA | 13 mA | |
| | Package M15T | 10 mA | 10 mA | 13 mA | 13 mA | |
| | Package M39T | - - - - - | 10 mA | 13 mA | 13 mA | |
| Output Logic Levels | Logic High " 1 " ( min.) | 1.62 V | 2.25 V | 2.7 V | 2.97 V | |
| | Logic Low " 0 " ( max.) | 0.25 V | 0.25 V | 0.3 V | 0.33 V | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Standard Frequency ( Partial list ) [ MHz ] | 10.000 | 12.800 | 13.000 | 14.7456 | 16.000 | 16.384 |
| | 19.200 | 19.440 | 19.680 | 20.000 | 25.000 | 27.000 |
| Initial Calibration Tolerance | Models with mechanical trimmer : < ± 1.0 ppm. +25°C ± 2°C. Models without mechanical trimmer : < ± 2.0 ppm at +25°C ± 2°C. | | | | | |

| Frequency Stability ( ppm ) | | ± 0.5 ppm | ± 1.0 ppm | ± 1.5 ppm | ± 2.0 ppm | ± 2.5 ppm | ± 3.0 ppm |
|---|---|---|---|---|---|---|---|
| Frequency Stability vs Temperature ( examples ) | 0°C to 50°C | ○ | ○ | ○ | ○ | ○ | ○ |
| | -10°C to 60°C | △ | ○ | ○ | ○ | ○ | ○ |
| | -20°C to 70°C | X | ○ | ○ | ○ | ○ | ○ |
| | -30°C to 75°C | X | ○ | ○ | ○ | ○ | ○ |
| | -30°C to 85°C | X | ○ | ○ | ○ | ○ | ○ |
| | -40°C to 85°C | X | △ | △ | △ | ○ | ○ |

○ : available △ : contact us X : not available

| | | | | |
|---|---|---|---|---|
| Frequency Stability | vs Aging at Ta = +25°C | ± 1.0 ppm / year ( max.) | | |
| | vs Voltage Change | ± 0.3 ppm ( max.) , for a ±5% input voltage change . | | |
| | vs Load Change | ± 0.3 ppm ( max.) , for a ±10% load condition change . | | |
| | vs Reflow ( SMD type ) | ± 1.0 ppm ( max.) , 1 reflow and measured 24 hours afterwards . | | |
| Electrical Frequency Tuning ( EFC ) by external Control Voltage | Control Voltage Center | 0.9 V ± 0.6 V ( 1.8 V ) ; 1.4 V ± 1.0 V ( 2.5V ) ; 1.5 V ± 1.0 V ( 3.0V / 3.3V ) | | |
| | Frequency Deviation Range | ± 5.0 ppm ( min.) | | |
| | Slope Polarity ( Transfer Function ) | Positive slope. Positive voltage for positive frequency shift. | | |
| | | Input Impedance : 1.0M Ω ( min.) | Modulation Bandwidth : 20 KHz ( min.) | Linearity : ± 10 % ( max.) |

| | |
|---|---|
| Output Load | 15 pF |
| Rise and Fall Time | 10.0 nsec. ( max.) Measured at 20% ↔ 80% of the waveform |
| Start-Up Time. | 5.0 msec. ( typ.) , 10.0 msec. ( max.) ( reach 90% amplitude and at+25°C±2°C) |
| Duty Cycle | Standard: 50 % ± 10 % ; Option: 50 % ± 5 % |
| Storage Temperature | -40°C to +85°C or -55°C to +125°C ( package dependent ) |

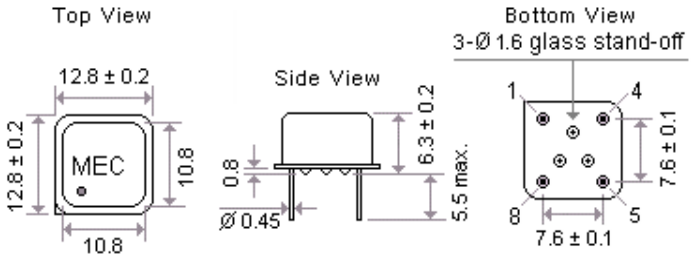
| Phase Noise [ dBc / Hz ( typ. ) ] | Offset | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz |
|---|---|---|---|---|---|---|
| | M572T33 - 10.000 | -96 dBc / Hz | -122 dBc / Hz | -138 dBc / Hz | -145 dBc / Hz | -150 dBc / Hz |

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

CMOS Wave Output Code " T "

## Outline Dimensions ( Unit : mm ) , Suggested pin Layout

### [ (V) M_8T_ _ ] - - - Gull - wing SMD is also available .

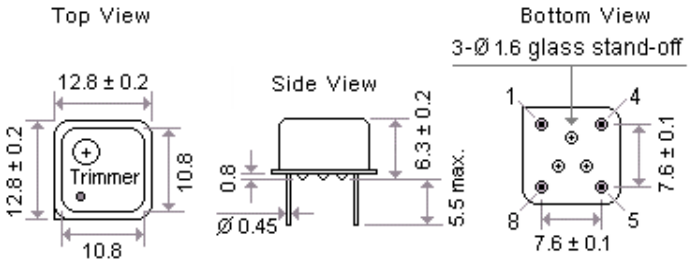



Pad Connections :

Pin 1 : Control voltage for VCTCXO ; No connection for TCXO.

Pin 4 : Ground ; Pin 5 : Output ; Pin 8 : Supply Voltage

### [ (V) M_9T_ _ ] - - - with mechanical trimmer

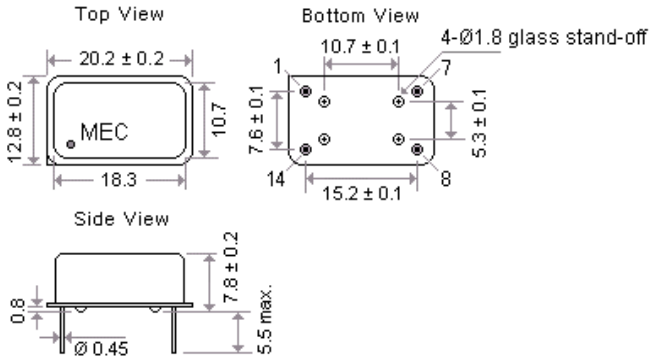



Pad Connections :

Pin 1 : Control voltage for VCTCXO ; No connection for TCXO.

Pin 4 : Ground ; Pin 5 : Output ; Pin 8 : Supply Voltage

### [ (V) M_14T_ _ ] - - - Gull - wing SMD is also available .

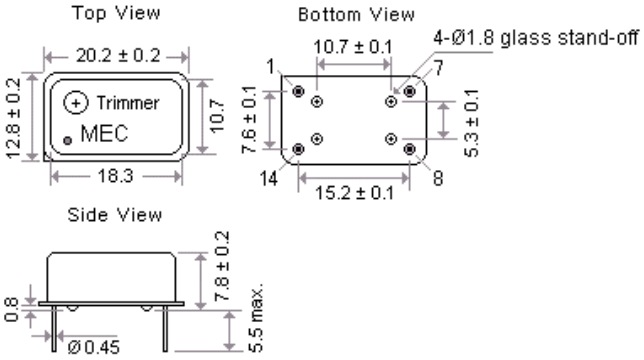



Pad Connections :

Pin 1 : Control voltage for VCTCXO ; No connection for TCXO.

Pin 7 : Ground ; Pin 8 : Output ; Pin 14 : Supply Voltage

### [ (V) M_15T_ _ ] - - - with mechanical trimmer

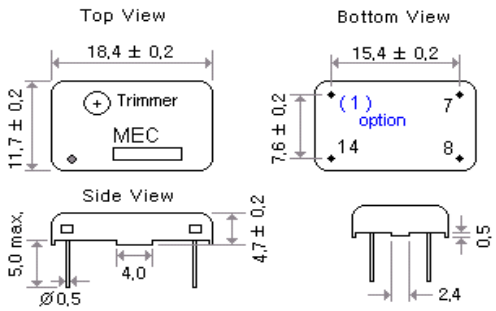



Pad Connections :

Pin 1 : Control voltage for VCTCXO ; No connection for TCXO.

Pin 7 : Ground ; Pin 8 : Output ; Pin 14 : Supply Voltage

### [ (V) M_39T_ _ ]




Pad Connections :

Pin 1 : Control voltage for VCTCXO

[ No physical pin 1 for TCXO. ( 3 pins only ) ]

Pin 7 : Ground ; Pin 8 : Output ; Pin 14 : Supply Voltage

TCXOs

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

## CMOS Wave Output Code " T "

### Part Number Format and Example

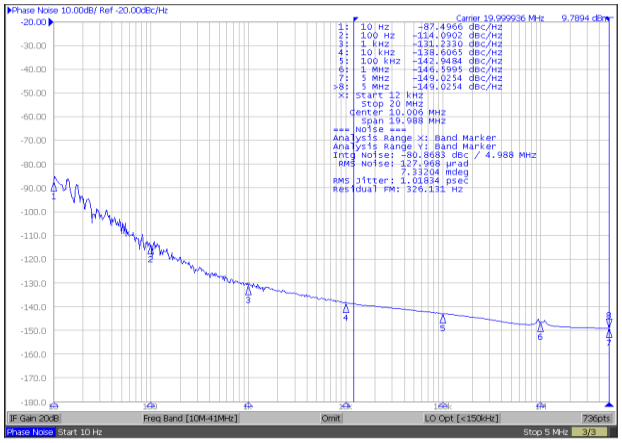
| | [ 1 ] Holder Type | [ 2 ] Output Wave | [ 3 ] Supply Voltage | - | [ 4 ] Center Frequency | - | [ 5 ] Frequency Stability | / | [ 6 ] Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|
| Examples (1) | VM32 | T | 3 | - | 10.000 | - | 1.5 | / | -20+70 |
| (2) | M572 | T | 3 | - | 20.000 | - | 2.5 | / | -30+85 |

Ex (1) : VM32T3 - 10.000 - 1.5 / -20+70 [ VCTCXO , VM32 type , CMOS output , 3.0V , 10.000MHz , ±1.5ppm from -20°C to 70°C ]

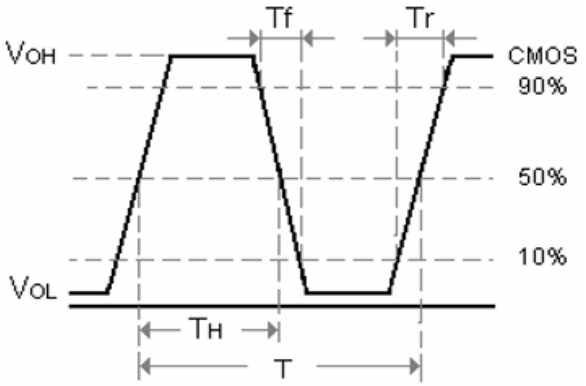
Ex (2) : M572T3 - 20.000 - 2.5 / -30+85 [ TCXO , M572 type , CMOS output , 3.0V , 20.000MHz , ±2.5ppm from -30°C to 85°C ]

| | |
|---|---|
| [ 1 ] | Holder Type |
| | " M " stands for TCXO , " VM " stands for VCTCXO |
| [ 2 ] | " T " stands for Square Wave |
| | ex 1 : VM32T --- VCTCXO , VM32 pcakage , CMOS Output ; ex 2 : M572T --- TCXO , M572 pcakage , CMOS Output |
| [ 3 ] | Supply voltage , " 18 " stands for +1.8V ; " 25 " stands for +2.5V ; " 3 " stands for +3.0V ; " 33 " stands for +3.3V |
| [ 4 ] | Center Frequency in MHz |
| [ 5 ] | Frequency stability in ± _ ppm ; ex 1 : ± 1.5ppm --- 1.5 , ex 2 : ± 2.5ppm --- 2.5 |
| [ 6 ] | Operating temperature range in °C |
| | ex 1 : -20 °C to 70°C ----- -20+70 ; ex 2 : -30 °C to 85°C ----- -30+85 |

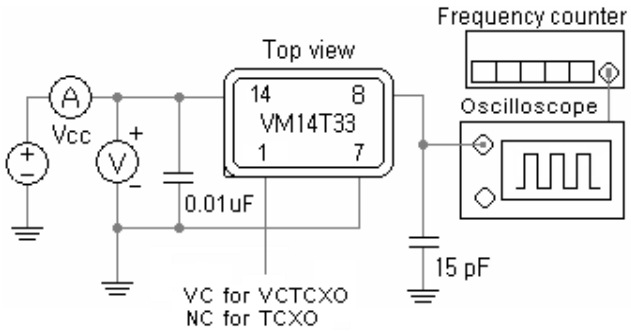
### CMOS Typical Phase Noise ( M572T33-20.000 )



### CMOS Output Wave , " T " series




### ( VC )TCXO with CMOS square wave: Ex. VM14T33



# Temperature Compensated Crystal Oscillators [ TCXO " M " ]

CMOS Output

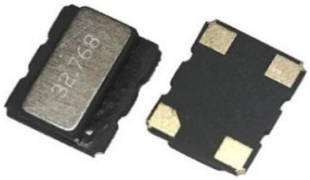
| TCXO | uA Current | ± 8 ppm | CMOS | SMD | 15 pF | 1.8V | 2.5V |
|---|---|---|---|---|---|---|---|
| ME _ T | 32.768 KHz | -40 to +105 °C | | | | 3.0V | 3.3V |

## Features

- CMOS 32.768 KHz TCXO with a maximum frequency stability of ± 5 ppm
  ( ± 2.62 minutes / year ) over -40 to +85°C, providing a much better timekeeping accuracy than the competition
- A proprietary temp. compensation technique is applied to the built-in 32.768 KHz tuning fork crystal & temp. sensor
- A 1.5 µA typical current consumption makes it ideal for battery-operated devices
- Small ceramic SMD package, ideal for new miniaturizing applications

Applications:

- Frequency reference for real time clocks ( RTCs )
- Portable instruments
- Timing synchronization for networks, servers, hubs, routers and switches
- Smart metering, data loggers
- GPS receivers. Telematics.




## General specifications of all available packages , at Ta=+25°C , CL=15pF

| Output Waveform | | Square wave [ CMOS ] , Waveform code is " **T** " | |
|---|---|---|---|
| Model | | **ME21T** | **ME32T** |
| Package size | | 2.1 x 1.3 x 1.0 mm | 3.2 x 2.5 x 1.3 mm |
| Standard Supply Voltages | | 1.8V , 2.5V , 3.0V , 3.3V | |
| Start-up Time | | 1.0 sec ( max.) | |
| Nominal Frequency | | 32.768 KHz | |
| Initial Calibration Tolerance ( at +25°C ± 3°C ) | | ± 2.5 ppm ( max.) | |
| Current Consumption ( With No Load ) | | 1.0 uA ( typ.) , 2.0 uA ( max.) | |
| Frequency Stability over Temperature ( max. ) | | ± 5.0 ppm ( -40°C to +85°C ) | |
| | | ± 8.0 ppm ( -40°C to +105°C ) | |
| Timing error over time [ ± 5 ppm ( -40°C to +85°C ) ] | | ± 0.432 sec/day ; ± 12.960 sec / month ; ± 2.628 minutes / year , w.r.t fo at +25°C. | |
| Frequency Stability | vs Aging | ± 3.0 ppm / year ( max.) first year at +25°C | |
| | vs Load Change | ± 0.2 ppm ( max.) for a ± 10% loading condition change | |
| | vs Supply Voltage Delta Freq / V | ± 1.0 ppm / V ( max.) | |
| Output Load | | 15 pF | |
| Output Voltage Level | $V_{OH}$ | 90% $V_{DD}$ ( min.) | |
| | $V_{OL}$ | 10% $V_{DD}$ ( max.) | |
| Rise Time and Fall Time | | 100 ns ( max.) Measured at 20% ⟷ 80% of the waveform | |
| Duty Cycle | | 50% ± 10% | |
| Output Enable / Disable Function ( Open connection is prohibited ) | | $V_{DD}$ of 80% ( min.) to enable output | |
| | | $V_{DD}$ of 20% ( max.) to disable output | |

# Temperature Compensated Crystal Oscillators [ TCXO " M " ] | CMOS Output

## Part Number Format and Example

| [ 1 ] | [ 2 ] | [ 3 ] | | [ 4 ] | | [ 5 ] | | [ 6 ] |
|---|---|---|---|---|---|---|---|---|
| Holder Type | Waveform Code | Supply Voltage | - | Nominal Frequency | - | Frequency Stability | / | Operating Temp. Range |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Examples | (1) | ME32 | T | 33 | - | 32.768 K | - | 8.0 | ／ | -40+105 |
| | (2) | ME21 | T | 18 | - | 32.768 K | - | 5.0 | ／ | -40+85 |

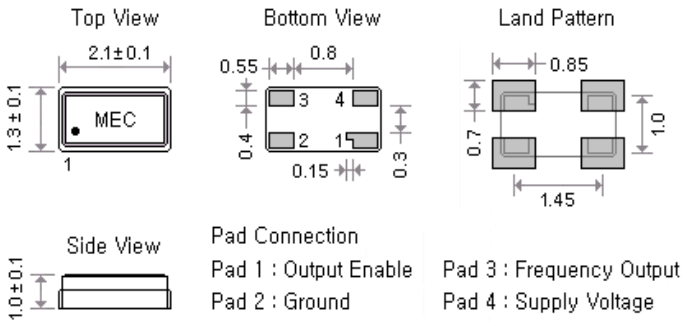
Ex (1) : ME32T33 - 32.768K - 8.0 / -40+105 [ ME series 3225 type , CMOS , 3.3V , 32.768 KHz , ± 8.0 ppm from -40°C to +105°C ]

Ex (2) : ME21T18 - 32.768K - 5.0 / -40+85 [ ME series 2113 type , CMOS , 1.8V , 32.768 KHz , ± 5.0 ppm from -40°C to +85°C ]

| | |
|---|---|
| [ 1 ] | Holder Type |
| | " ME32 " stands for TCXO 3225 type ; " ME21 " stands for TCXO 2113 type |
| [ 2 ] | " T " stands for CMOS waveform |
| [ 3 ] | Supply voltage , " 18 " stands for +1.8V ; " 25 " stands for +2.5V ; " 3 " stands for +3.0V ; " 33 " stands for +3.3V |
| [ 4 ] | Nominal Frequency , " K " stands for KHz |
| [ 5 ] | Frequency stability in ± _ ppm ; ex 1 : ± 8.0ppm --- 8.0 , ex 2 : ± 5.0ppm --- 5.0 |
| [ 6 ] | Operating temperature range in °C |
| | ex 1 : -40 °C to +105°C ----- -40+105 ; ex 2 : -40 °C to +85°C ----- -40+85 |

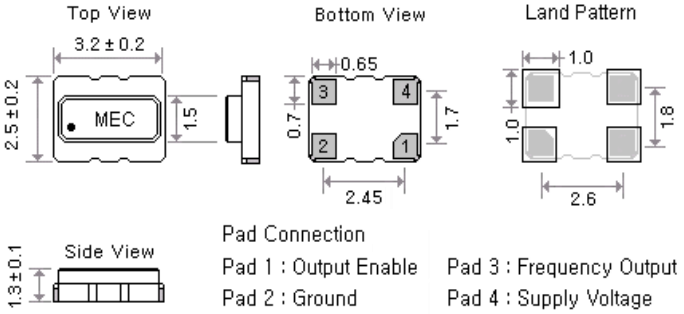
## Package Dimensions ( Unit : mm )

### [ ME21T ]




Pad Connection
Pad 1 : Output Enable
Pad 2 : Ground
Pad 3 : Frequency Output
Pad 4 : Supply Voltage

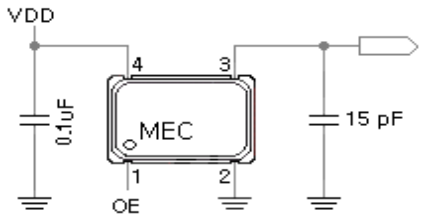
### [ ME32T ]



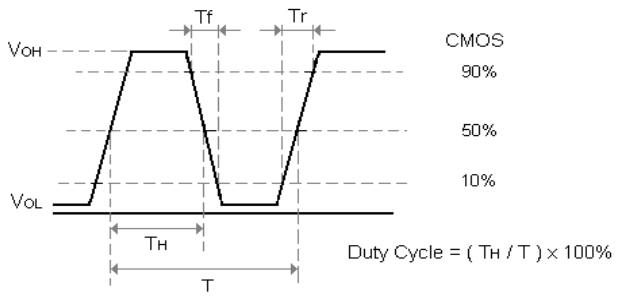

Pad Connection
Pad 1 : Output Enable
Pad 2 : Ground
Pad 3 : Frequency Output
Pad 4 : Supply Voltage

## Test Circuit and Output Waveform

### Test Circuit




### CMOS Output Waveform




TCXOs

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

| TCXO | | | VCTCXO | | | N | SMD | 2.5V | 3.3V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MQN _ T | MQN _ P | MQN _ D | VMQN _ T | VMQN _ P | VMQN _ D | series | | | | 10 MHz | 1,500 MHz |
| CMOS | LVPECL | LVDS | CMOS | LVPECL | LVDS | | | | | | |

## Features

**0.8 pS Phase Jitter ( typical )**

- Wide frequency range : 10 ~ 1500 MHz
- RMS Jitter (12 kHz ~ 20MHz) : 0.8 ps typ. ( at 156.250 MHz)
- Package size : 3.2 x 2.5 x 1.6mm and 7.0 x 5.0 x 2.5mm
- Single end output : CMOS , Differential output : LVPECL or LVDS

## General specifications , at Ta=+25°C

| Model | (V)MQN326T , (V)MQN574T | (V)MQN326P , (V)MQN576P | (V)MQN326D , (V)MQN576D |
|---|---|---|---|
| **Output Logic** | **CMOS** | **LVPECL** | **LVDS** |
| Supply Voltage $V_{DD}$ ( code ) | + 2.5 $V_{DD}$ ± 5% ( voltage code " 25 " ) | + 2.5 $V_{DD}$ ± 5% ( voltage code " 25 " ) | + 2.5 $V_{DD}$ ± 5% ( voltage code " 25 " ) |
| | + 3.3 $V_{DD}$ ± 5% ( voltage code " 33 " ) | + 3.3 $V_{DD}$ ± 5% ( voltage code " 33 " ) | + 3.3 $V_{DD}$ ± 5% ( voltage code " 33 " ) |
| Available Frequency Range | 10 ~ 250 MHz | 10 ~ 1,500 MHz | 10 ~ 1,500 MHz |
| Output Load | 15 pF | 50 Ω into Vcc - 2V or Thevenin equiralent | 100 Ω |
| Output Logic " High " , " 1 " | 90 % $V_{DD}$ | $V_{DD}$ - 1.03 ( min.) , $V_{DD}$ - 0.6 ( max.) | 1.4 V ( typ.) , 1.6 V ( max.) |
| Output Logic " Low " , " 0 " | 10 % $V_{DD}$ | $V_{DD}$ - 1.85 ( min.) , $V_{DD}$ - 1.6 ( max.) | 1.1 V ( typ.) , 0.9 V ( min.) |
| ( $V_{DD}$ = + 2.5V ) Current Consumption ( max.) | 50 MHz : 34 mA | 156 MHz : 46 mA | 156 MHz : 32 mA |
| | 125 MHz : 38 mA | 600 MHz : 50 mA | 800 MHz : 40 mA |
| | 200 MHz : 40 mA | 1,000 MHz : 60 mA | 1,000 MHz : 44 mA |
| ( $V_{DD}$ = + 3.3V ) Current Consumption ( max.) | 50 MHz : 36 mA | 156 MHz : 50 mA | 156 MHz : 35 mA |
| | 125 MHz : 40mA | 600 MHz : 55 mA | 800 MHz : 40 mA |
| | 200 MHz : 44 mA | 1,000 MHz : 62 mA | 1,000 MHz : 44 mA |
| Current with Output Disabled | 18 mA ( typ.) | 18 mA ( typ.) | 18 mA ( typ.) |
| Rise Time / Fall Time | 1.5 nsec. ( typ.) , 3.0 nsec. ( max. ) Tr / Tf : 10% ↔ 90% waveform | 0.2 nsec. ( typ.) , 0.5 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform | 0.2 nsec. ( typ.) , 0.4 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Initial Calibration Tolerance | ± 1.0 ppm. ( max.) at +25°C±2°C. ( upon shipment ) for Package Size ( 3.2 * 2.5 mm ) | | | | | | | |
| | ± 2.0 ppm. ( max.) at +25°C±2°C. ( upon shipment ) for Package Size ( 5.0 * 7.0 mm ) | | | | | | | |
| Frequency Stability Codes | Temperature (ref to +25°C) | ± 2.0 ppm over -40°C to +85°C ( default ) | | | | | | |
| | | ± 1.0 ppm over -40°C to +85°C ( available ) | | | | | | |
| | Aging at Ta = +25°C | ± 1.0 ppm max . , per year at 25°C | | | | | | |
| | Voltage Change | ± 0.2 ppm max . , for a ±5% input voltage change. | | | | | | |
| | Load Change | ± 0.2 ppm max . , for a ±10% load condition change. | | | | | | |
| | Reflow | ± 1.0 ppm max . , 1 reflow and measured 24 hours afterwards. | | | | | | |
| Duty Cycle | 50 % ± 5% | | | | | | | |
| Start-up Time | 5.0 msec. ( max.) | | | | | | | |
| RMS Jitter [ 12 kHz ~ 20 MHz ] | 0.8 psec ( typ.) | | | | | | | |
| Phase Noise [ dBc / Hz ( typ.) ] | Offset | 10 Hz | 100 Hz | 1K Hz | 10K Hz | 100K Hz | 1M Hz | 10M Hz |
| | 125 MHz | -51 | -93 | -111 | -123 | -125 | -135 | -155 |
| | 212.5 MHz | -42 | -87 | -105 | -115 | -118 | -130 | -151 |
| Storage Temperature | -55°C to + 125°C | | | | | | | |

| Control Voltage Function on Pad 1 | | Output Enable Function on pad 2 | |
|---|---|---|---|
| Control Voltage Center and Range | +1.5V ± 1.0V for both $V_{DD}$ = 2.5V and 3.3V | OE Control on Pad 2 | 70% of $V_{DD}$ ( min.) to enable output. (Open connection prohibit.) |
| Frequency Pulling Range | ± 8 ppm ( min.) | | 30% of $V_{DD}$ (max.) to disable output (high impedance). |
| Linearity | 1% ( typ.) ; 10% ( max.) | | |
| Transfer Function | Positive Transfer | | |
| Absolute Voltage | 4.0 V ( max.) | Ouput Enable Time / Disable Time | 200 nsec. ( max.) / 50 nsec. ( max.) |
| Input Impedance | 770 KΩ ( typ.) | | |

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

| TCXO | | | VCTCXO | | | F series | SMD | 2.5V | 3.3V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MQF _ T | MQF _ P | MQF _ D | VMQF _ T | VMQF _ P | VMQF _ D | | | | | 10 MHz | 1,500 MHz |
| CMOS | LVPECL | LVDS | CMOS | LVPECL | LVDS | | | | | | |

**Features**

**Quick - Turn Clock Oscillators**

**1.0 pS Phase Jitter ( typical )**

- Wide frequency range : 10 ~ 1500 MHz
- RMS Jitter ( 12 KHz ~ 20MHz ) : 1.0 ps typ. ( at 156.250 MHz )
- Package size : 3.2 x 2.5 x 1.6mm and 7.0 x 5.0 x 2.5mm
- Next-Day sample for prototypes

**General specifications , at Ta=+25°C**

| Model | (V)MQF326T , (V)MQF574T | (V)MQF326P , (V)MQF576P | (V)MQF326D , (V)MQF576D |
|---|---|---|---|
| **Output Logic** | **CMOS** | **LVPECL** | **LVDS** |
| Supply Voltage $V_{DD}$ ( code ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) | + 2.5 V ± 5% ( voltage code " 25 " ) |
| | + 3.3 V ± 5% ( voltage code " 33 " ) | + 3.3 V ± 5% ( voltage code " 33 " ) | + 3.3 V ± 5% ( voltage code " 33 " ) |
| Available Frequency Range | 10 ~ 250 MHz | 10 ~ 1,500 MHz | 10 ~ 1,500 MHz |
| Output Load | 15 pF | 50 Ω into Vcc - 2V or Thevenin equiralent | 100 Ω |
| Output Logic " High " , " 1 " | 90 % $V_{DD}$ | $V_{DD}$ - 1.03 ( min. ) , $V_{DD}$ - 0.6 ( max. ) | 1.4 V ( Typ. ) , 1.6 V ( max. ) |
| Output Logic " Low " , " 0 " | 10 % $V_{DD}$ | $V_{DD}$ - 1.85 ( min. ) , $V_{DD}$ - 1.6 ( max. ) | 1.1 V ( Typ. ) , 0.9 V ( min. ) |
| ( $V_{DD}$ = + 2.5V ) Current Consumption ( max.) | 50 MHz : 34 mA | 156 MHz : 46 mA | 156 MHz : 32 mA |
| | 125 MHz : 38 mA | 600 MHz : 50 mA | 600 MHz : 38 mA |
| | 200 MHz : 40 mA | 1,000 MHz : 60 mA | 1,000 MHz : 44 mA |
| ( $V_{DD}$ = + 3.3V ) Current Consumption ( max.) | 50 MHz : 36 mA | 156 MHz : 50 mA | 156 MHz : 35 mA |
| | 125 MHz : 40mA | 600 MHz : 55 mA | 600 MHz : 40 mA |
| | 200 MHz : 44 mA | 1,000 MHz : 62 mA | 1,000 MHz : 46 mA |
| Current with Output Disabled | 18 mA ( Typ.) | 18 mA ( Typ.) | 18 mA ( Typ.) |
| Rise Time / Fall Time | 1.5 nsec. ( Typ. ) , 3.0 nsec. ( max. ) Tr / Tf : 10% ↔ 90% waveform | 0.2 nsec. ( Typ. ) , 0.5 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform | 0.2 nsec. ( Typ. ) , 0.4 nsec. ( max. ) Tr / Tf : 20% ↔ 80% waveform |

| | | |
|---|---|---|
| Initial Calibration Tolerance | ± 1.0 ppm ( max. ) at +25°C±2°C ( at the shipment ) for Package Size ( 3.2 * 2.5 mm ) | |
| | ± 2.0 ppm ( max. ) at +25°C±2°C ( at the shipment ) for Package Size ( 5.0 * 7.0 mm ) | |
| Frequency Stability Codes | Temperature ( refer to +25°C) | ± 2.0 ppm over -40°C to +85°C ( default for Quick - Turn ) |
| | | ± 1.0 ppm over -40°C to +85°C ( available ) |
| | Aging at Ta = +25°C | ± 1.0 ppm ( max. ) first year |
| | Voltage Change | ± 0.2 ppm ( max. ) , for a ±5% input voltage change. |
| | Load Change | ± 0.2 ppm ( max. ) , for a ±10% load condition change. |
| | Reflow | ± 1.0 ppm ( max. ) , 1 reflow and measured 24 hours afterwards. |
| Duty Cycle | 50 % ± 5% | |
| Start-up Time | 5 msec ( max. ) | |
| Storage Temperature | -55°C to +125°C | |
| RMS Jitter [ 12 KHz ~ 20 MHz ] | 1.0 psec ( typ. ) | |

| Phase Noise [ dBc / Hz ( typ.) ] | Offset | 10 Hz | 100 Hz | 1K Hz | 10K Hz | 100K Hz | 1M Hz | 10M Hz |
|---|---|---|---|---|---|---|---|---|
| | 156.250 MHz | -65 | -92 | -108 | -114 | -117 | -139 | -147 |
| | 212.500 MHz | -61 | -90 | -106 | -110 | -112 | -133 | -142 |
| | 312.500 MHz | -51 | -79 | -97 | -102 | -103 | -125 | -134 |

| Control Voltage Function on Pad 1 | | Output Enable Function on pad 2 | |
|---|---|---|---|
| Control Voltage Center and Range | +1.5V ± 1.0V for both $V_{DD}$ = 2.5V and 3.3V | OE Control on Pad 2 | 70% of $V_{DD}$ ( min. ) to enable output. ( Open connection prohibit. ) |
| Frequency Pulling Range | ± 8 ppm ( min. ) | | 30% of $V_{DD}$ ( max. ) to disable output. |
| Linearity | 1% ( typ. ) ; 10% ( max. ) | | |
| Transfer Function | Positive Transfer | | |
| Absolute Voltage | 4.0 V ( max. ) | Output Enable Time / Disable Time | 200 nsec. ( max. ) / 50 nsec. ( max. ) |
| Input Impedance | 770 KΩ ( typ.) | | |

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

## Part Number Format and Example

| [ 1 ] | [ 2 ] | [ 3 ] | [ 4 ] | - | [ 5 ] | - | [ 6 ] | / | [ 7 ] |
|---|---|---|---|---|---|---|---|---|---|
| Holder Type | Package Code | Waveform Code | Supply Voltage | | Center Frequency | | Frequency Stability | | Operating Temp. Range |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Examples | (1) | MQN | 326 | D | 25 | - | 622.080 | - | 1.0 | ／ -40+85 |
| | (2) | VMQF | 576 | P | 33 | - | 120.000 | - | 2.0 | ／ -40+85 |

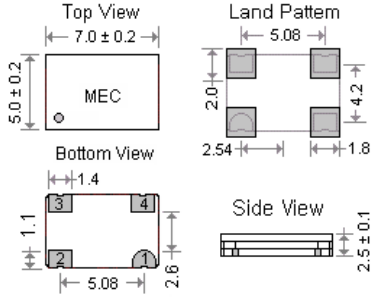
Ex (1) : MQN326D25 - 622.080 - 1.0 / -40+85 [ TCXO , MQN326 type , LVDS , +2.5V , 622.080MHz , ±1.0ppm from -40°C to 85°C ]

Ex (2) : VMQF576P33 - 120.000 - 2.0 / -40+85 [ VCTCXO , VMQF576 type , LVPECL , +3.3V , 120.000MHz , ±2.0ppm from -40°C to 85°C ]

| | |
|---|---|
| [ 1 ] | Holder Type : " MQN " , " MQF " stands for TCXO ; " VMQN " , " VMQF " stands for VCTCXO |
| [ 2 ] | Package Code : " 326 " stands for 3.2 x 2.5 x 1.6 mm 6pad ; " 576 " stands for 5.0 x 7.0 x 2.5 mm 6pad |
| [ 3 ] | Output Waveform Code : " T " stands for CMOS ; " P " stands for PECL ; " D " stands for LVDS |
| [ 4 ] | Supply Voltage : " 25 " stands for +2.5V ; " 33 " stands for +3.3V |
| [ 5 ] | Center Frequency in MHz |
| [ 6 ] | Frequency Stability in ± _ ppm ; ex 1 : ± 1.0ppm --- 1.0 , ex 2 : ± 2.0ppm --- 2.0 |
| [ 7 ] | Operating Temperature Range in °C<br>ex : -40 °C to 85°C ----- -40+85 |

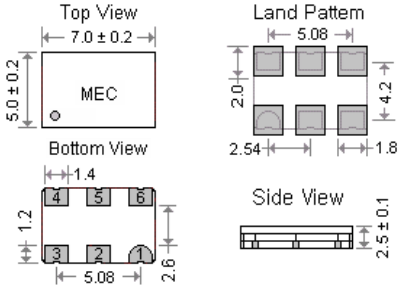
## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

### [ (V)MQ _ 574T ]



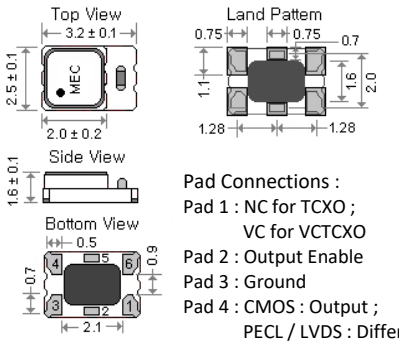

Pad Connections :
Pad 1 : NC for TCXO ;
VC for VCTCXO
Pad 2 : Ground
Pad 3 : Output
Pad 4 : Supply Voltage

### [ (V)MQ _ 576P ] , [ (V)MQ _ 576D ]




Pad Connections :
Pad 1 : NC for TCXO ;
VC for VCTCXO
Pad 2 : Output Enable
Pad 3 : Ground
Pad 4 : Output
Pad 5 : Complementary
Pad 6 : Supply Voltage

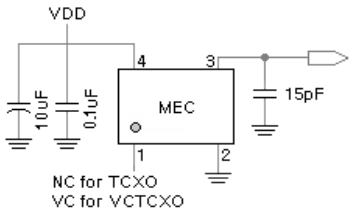
### [ (V)MQ _ 326T ] , [ (V)MQ _ 326P ] , [ (V)MQ _ 326D ]



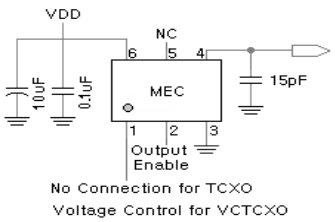

Pad Connections :
Pad 1 : NC for TCXO ;
VC for VCTCXO
Pad 2 : Output Enable
Pad 3 : Ground
Pad 4 : CMOS : Output ;
PECL / LVDS : Differential
Pad 5 : CMOS : No Connection ;
PECL / LVDS : Complementary
Pad 6 : Supply Voltage

## Test Circuits and Output Waveforms

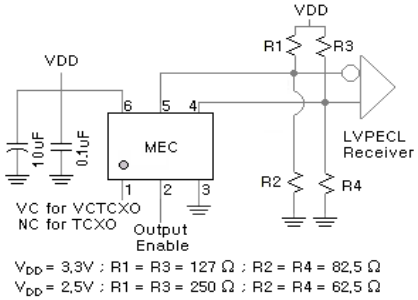
### CMOS for 4pad package



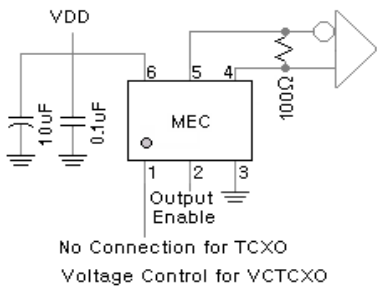

### CMOS for 6pad package




### LVPECL




### LVDS



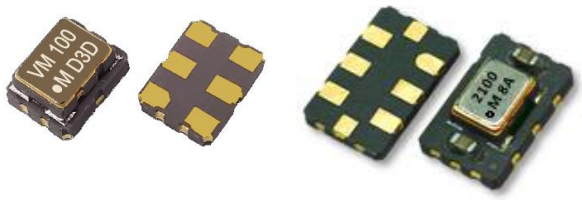

TCXOs

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

| TCXO | VCTCXO | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| MJF_ | VMJF_ | Quick - Turn Clock Oscillators | 250 fsec RMS Jitter | SMD | 1.8 V | 2.5 V | 3.3 V | Min. 15 MHz | Max. 2,100 MHz |

## Features

- Wide frequency range : 15 ~ 2100 MHz
- RMS jitter (12KHz ~ 20MHz ) : 250 fsec typ. ( at 156.250MHz , 3.3V )
- Next-Day sample for Prototypes
- package size : 5.0 x 3.2mm and 3.2 x 2.5mm




## General specifications , at Ta = + 25°C

| Model | (V)MJF326P , (V)MJF538P | (V)MJF326D , (V)MJF538D | (V)MJF326C , (V)MJF538C | (V)MJF326Q , (V)MJF538Q |
|---|---|---|---|---|
| Output Logic | LVPECL | LVDS | HCSL | CML |
| Supply Voltage $V_{DD}$ | -- | + 1.8 V ± 5% (*) | + 1.8 V ± 5% | + 1.8 V ± 5% |
| | + 2.5 V ± 5% | + 2.5 V ± 5% | + 2.5 V ± 5% | + 2.5 V ± 5% |
| | + 3.3 V ± 5% | + 3.3 V ± 5% | + 3.3 V ± 5% | + 3.3 V ± 5% |
| Available Frequency Range | 15 ~ 2,100 MHz | 15 ~ 2,100 MHz | 15 ~ 700 MHz | 15 ~ 2,100 MHz |
| Output Load | 50 Ω into $V_{DD}$ - 2V or Thevenin equivalent | 100 Ω between output and complimentary output | 50 Ω to GND | 50 Ω to $V_{DD}$ |
| Output Logic " High " , " 1 " | $V_{DD}$ - 1.03 V ( min.)<br>$V_{DD}$ - 0.6 V ( max.) | 1.4 V ( Typ.)<br>1.6 V ( max.) | $V_{DD}$ : 0.66 V ( min.)<br>$V_{DD}$ : 1.15 V ( max.) | $V_{DD}$ - 0.085 V ( min.)<br>$V_{DD}$ = ( max.) |
| Output Logic " Low " , " 0 " | $V_{DD}$ - 1.85 V ( min.)<br>$V_{DD}$ - 1.6 V ( max.) | 1.1 V ( Typ.)<br>0.9 V ( min.) | $V_{DD}$ : - 0.15 V ( min.)<br>$V_{DD}$ : 0.15 V ( max.) | $V_{DD}$ - 0.6 V ( min.)<br>$V_{DD}$ - 0.32 V ( max.) |
| Output Voltage Swing | 595 mV ( min.)<br>930 mV ( max.) | 250 mV ( min.)<br>450 mV ( max.) | 620 mV ( min.)<br>700 mV ( typ.) | 200 mV ( min.)<br>600 mV ( typ.) |
| Current Consumption ( $V_{DD}$ = + 3.3 V ) | 100 mA ( typ.)<br>120 mA ( max.) | 75 mA ( typ.)<br>90 mA ( max.) | 80 mA ( typ.)<br>100 mA ( max.) | 70 mA ( typ.)<br>85 mA ( max.) |
| Current with Output Disabie | 99 mA ( typ.) | 74 mA ( typ.) | 79 mA ( typ.) | 69 mA ( typ.) |
| Rise Time / Fall Time ( 20% to 80% Waveform ) | 0.4 nsec. ( max.) | 0.4 nsec. ( max.) | 0.4 nsec.( max.) | 0.4 nsec. ( max.) |

| | | |
|---|---|---|
| Initial Calibration Tolerance | ± 1.0 ppm ( max.) at +25°C ± 2°C. | |
| Frequency Stability | Temperature (ref to +25°C) | ± 1.5 ppm over -40°C to +85°C ( default ) |
| | | ± 1.0 ppm over -40°C to +85°C ( available ) |
| | Aging at Ta = +25°C | ± 1.0 ppm ( max. ) , per year |
| | Voltage Change | ± 0.2 ppm ( max. ) , for a ± 5% input voltage change. |
| | Load Change | ± 0.2 ppm ( max. ) , for a ± 10% load condition change. |
| | Reflow | ± 1.0 ppm ( max. ) , 1 reflow and measured 24 hours afterwards. |
| Duty Cycle | 50 % ± 5% | |
| Start-up Time | 5 msec ( typ. ) ; 10 msec ( max. ) | |
| Storage Temperature | -55°C to +150°C | |
| RMS Jitter ( typ.) ( 12 KHz to 20 MHz ) | 15 MHz ~ 50 MHz : 500 fsec ( typ. ) , 51MHz ~ 1,200 MHz : 250 fsec ( typ. ) | |

| Control Voltage Function on Pad 1 | | Output Enable Function on pad 2 | |
|---|---|---|---|
| Control Voltage Center and Range | + 1.5V ± 1.0V for both $V_{DD}$ = 2.5V and 3.3V | Output Enable / Disable Function | 70% of $V_{DD}$ ( min. ) to enable output. |
| | + 0.9V ± 0.6V for both $V_{DD}$ = 1.8V | | 30% of $V_{DD}$ ( max. ) to disable output |
| Frequency Pulling Range | ± 8 ppm ( min.) | Output Enable Time | 2.5 msec ( max. ) |
| Linearity | 1% ( typ. ) ; 10% ( max. ) | | |
| Transfer Function | Positive Transfer | Output Disable Time | 10 usec ( max. ) |
| Input Impedance | 5 MΩ ( typ. ) | | |

Note * : This needs AC coupling ( 100-nF series capacitor ). Please check the test circuit.

# Temperature Compensated Crystal Oscillators [ TCXO " M " and VCTCXO " VM " ]

| TCXO | VCTCXO | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| MJF_ | VMJF_ | Quick - Turn Clock Oscillators | 250 fsec RMS Jitter | SMD | 1.8 V | 2.5 V | 3.3 V | Min. 15 MHz | Max. 2,100 MHz |

## Part Number Format and Example

| [ 1 ] Holder Type | [ 2 ] Package Code | [ 3 ] Waveform Code | [ 4 ] Supply Voltage | - | [ 5 ] Center Frequency | - | [ 6 ] Frequency Stability | / | [ 7 ] Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|
| Examples (1) | MJF | 326 | D | 33 | - | 156.250 | - | 1.0 | / | -20+70 |
| (2) | VMJF | 538 | C | 18 | - | 100.000 | - | 1.5 | / | -40+85 |

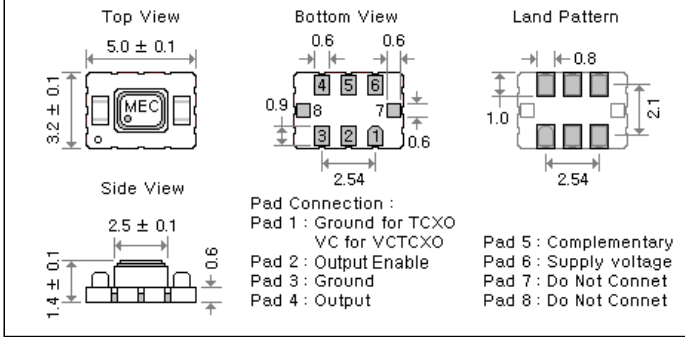
Ex (1) : MJF326D33 - 156.250 - 1.0 / -20+70 [ TCXO , MJF326 type , LVDS , +3.3V , 156.250MHz , ±1.0ppm from -20°C to 70°C ]

Ex (2) : VMJF538C18 - 100.000 - 1.5 / -40+85 [ VCTCXO , VMJF538 type , HCSL , +1.8V , 100.000MHz , pulling：±8ppm min. , ±1.5ppm from -40°C to 85°C ]

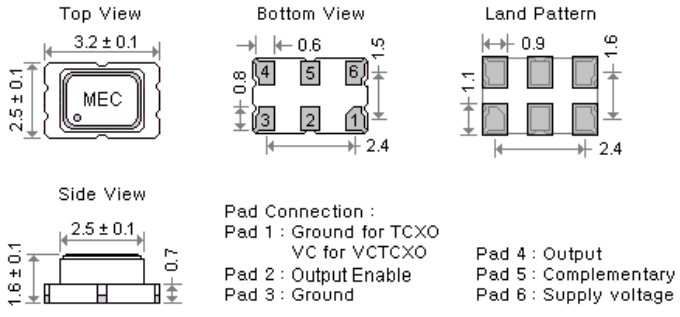
| | |
|---|---|
| [ 1 ] | Holder Type : " MJF " stands for TCXO ; " VMJF " stands for VCTCXO |
| [ 2 ] | Package Code : " 326 " stands for 3.2 x 2.5 x 1.6 mm 6pad ; " 538 " stands for 5.0 x 3.2 x 1.4 mm 8pad |
| [ 3 ] | Output Waveform Code : " P " stands for LVPECL ; " D " stands for LVDS ; " C " stands for HCSL ; " Q " stands for CML |
| [ 4 ] | Supply Voltage : " 18 " stands for +1.8V ; " 25 " stands for +2.5V ; " 33 " stands for +3.3V |
| [ 5 ] | Center Frequency in MHz |
| [ 6 ] | Frequency Stability in ± _ ppm ; ex 1 : ± 1.0ppm --- 1.0 , ex 2 : ± 1.5ppm --- 1.5 |
| [ 7 ] | Operating Temperature Range in °C<br>ex 1 : -20 °C to 70°C ----- -20+70 ; ex 2 : -40 °C to 85°C ----- -40+85 |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

### MJF538_ , VMJF538_

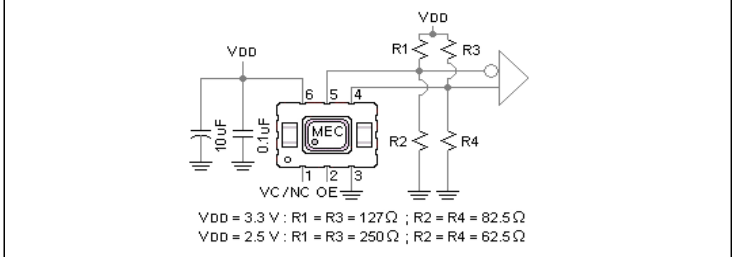



### MJF326_ , VMJF326_

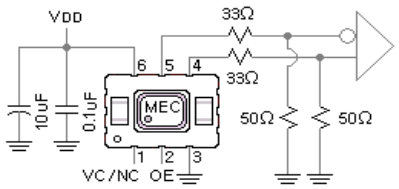



## Test Circuits

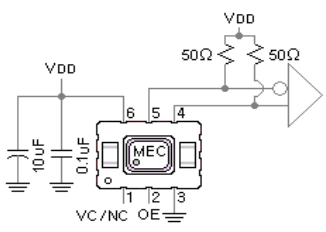
### LVPECL Test Circuit



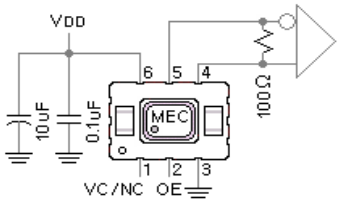

### HCSL Test Circuit



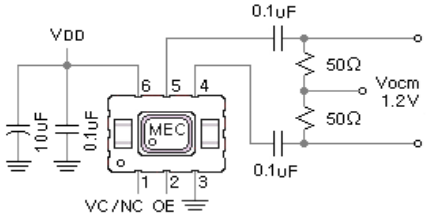

### CML Test Circuit




### LVDS Test Circuit for 2.5V and 3.3V




### LVDS Test Circuits for 1.8V only (*)




Note * : The 50-ohm termination resistors along with the bias voltage (Vocm) is required to be set at the destination circuit as shown in the figure.

# Temperature Compensated Crystal Oscillators [ TCXO " M " ]

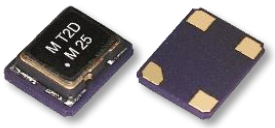
CMOS Output

CMOS Wave Output Code " T " [ SMD Type ]

| TCXO | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| M _1T | Output Enable / Disable | -40 to +85 ℃ | CMOS | SMD | 15pF | 1.8 V | 2.5 V | 3.3 V | Min. 9.5 MHz | Max. 60 MHz |

## Features

- Wide frequency range : [ 9.5 MHz ~ 60.0 MHz ]
- Frequency stability as tight as ± 2.5 ppm over -40°C to 85°C
- Frequency stability as tight as ± 5.0 ppm over -40°C to 105°C ( available )



## General specifications of all available packages , at Ta=+25°C , CL=15pF

| Output Waveform | Square wave [ CMOS ] . Waveform code is " T " | | |
|---|---|---|---|
| Type | **M211T** | **M221T** | **M321T** |
| Package ( Size ) | 2.05 x 1.65 x 0.70 mm | 2.5 x 2.0 x 0.8 mm | 3.2 x 2.5 x 1.2 mm |
| Frequency Range | 10.0 ~ 52.0 MHz | 9.5 ~ 60.0 MHz | 9.5 ~ 60.0 MHz |

| Output Waveform | Adapter Board Type | |
|---|---|---|
| Type | **M531T-AB** | **M571T-AB** |
| Package ( Size ) | 5.0 x 3.2 x 1.3 mm | 7.0 x 5.0 x 1.4 mm |
| Frequency Range | 9.5 ~ 60.0 MHz | 9.5 ~ 60.0 MHz |

| | | | | | |
|---|---|---|---|---|---|
| Supply Voltage Range | | + 1.8 V ( code is " 18 " ) | + 2.5 V ( code is " 25 " ) | + 3.3 V ( code is " 33 " ) | |
| Current Consumption | | 6 mA ( max.) | 7 mA ( max.) | 8 mA ( max.) | |
| Standard Frequency [ MHz ] | | 12.000 , 20.000 , 24.000 , 25.000 , 26.000 , 40.000 , 50.000 , 60.000 | | | |
| Initial Calibration Tolerance | | ± 2.0 ppm ( max.) at +25°C ± 2°C. after reflow | | | |
| Frequency Stability | | ± 2.5 ppm | ± 5.0 ppm | ± 10.0 ppm | X : not available |
| Frequency Stability vs Temperature | - 40°C to + 85°C | ○ | ○ | ○ | △ : please contact us |
| | - 40°C to + 105°C | △ | △ | ○ | ○ : available |
| Frequency Stability | vs Aging at Ta= + 25°C | ± 1.0 ppm ( max.) , per year | | | |
| | vs Voltage Change | ± 0.3 ppm ( max.) , for a ± 5% input voltage change . | | | |
| | vs Load Change | ± 0.3 ppm ( max.) , for a ± 10% load condition change . | | | |
| Output Logic High " 1 " | | $V_{DD}$ of 80% ( min.) | | | |
| Output Logic Low " 0 " | | $V_{DD}$ of 20% ( max.) | | | |
| Rise Time and fall time | | 10.0 nsec. ( max.) ; 10% ↔ 90% of the waveform | | | |
| Duty Cycle | | 50 % ± 5 % | | | |
| Start-Up Time. | | 5.0 msec. ( max.) | | | |
| Output Load | | 15 pF | | | |
| Output Enable / Disable Function on Pad1 ( Don't use in the OPEN condition ) | | $V_{DD}$ of 80% ( min.) to enable output | | | |
| | | $V_{DD}$ of 20% ( max.) to disable output | | | |
| RMS Jitter ( 12KHz ~ 20MHz ) | | 0.3 psec ( typ.) , 1.0 psec ( max.) | | | |
| Phase Noise Offset / dBc / Hz [ typ. ] | 50MHz as example | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz |
| | | -85 dBc / Hz | -111 dBc / Hz | -133 dBc / Hz | -149 dBc / Hz | -154 dBc / Hz |
| Storage Temperature | | -55°C to +125°C | | | | |

# Temperature Compensated Crystal Oscillators [ TCXO " M " ]

## CMOS Wave Output Code " T " [ SMD Type ]

### Part Number Format and Exmple

| | [ 1 ] | [ 2 ] | [ 3 ] | [ 4 ] | - | [ 5 ] | - | [ 6 ] | / | [ 7 ] | - | [ 8 ] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Holder Type | Enable/Disable Function | Output Wave | Supply Voltage | | Center Frequency | | Frequency Stability | | Operating Temp. Range | | Adapter Board |
| Examples | (1) | M32 | 1 | T | 33 | - | 40.000 | - | 5.0 | / | -40+105 | |
| | (2) | M57 | 1 | T | 33 | - | 10.000 | - | 2.5 | / | -40+85 | - AB |

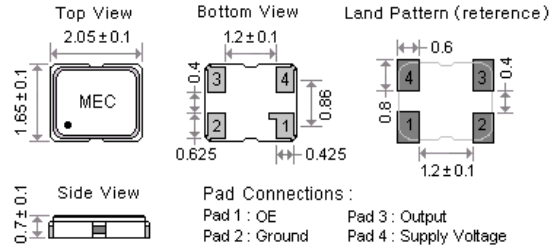
Ex (1) : M321T33 - 40.000 - 5.0 / -40+105 [ TCXO , 3225 SMD package , OE on pad1 , CMOS output , 3.3V , 40.000MHz , ±5.0ppm from -40°C to 105°C ]

Ex (2) : M571T33 - 10.000 - 2.5 / -40+85 - AB [ TCXO , 7050 SMD package , OE on pad1 , CMOS output , 3.3V , 10.000MHz , ±2.5ppm from -40°C to 85°C , Adapter Board ]

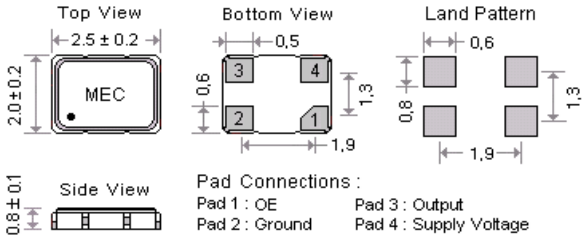
| | |
|---|---|
| [ 1 ] | Holder Type |
| | " M " stands for TCXO |
| [ 2 ] | Enable / Disable Function on pad1 , ex M321 --- OE on pad1 |
| [ 3 ] | " T " stands for Square Wave |
| | ex : M321T --- TCXO , 3225 SMD pcakage , CMOS output |
| [ 4 ] | Supply voltage , " 18 " stands for +1.8V ; " 25 " stands for +2.5V ; " 33 " stands for +3.3V |
| [ 5 ] | Center Frequency in MHz |
| [ 6 ] | Frequency stability in ± _ ppm ; ex 1 : ± 2.5ppm --- 2.5 , ex 2 : ± 5.0ppm --- 5.0 |
| [ 7 ] | Operating temperature range in °C |
| | ex 1 : -40 °C to 105°C ----- -40+105 ; ex 2 : -40 °C to 85°C ----- -40+85 |
| [ 8 ] | Adapter Board Type ----- AB |

### Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

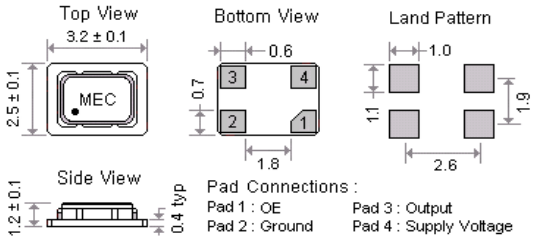
[ M211T ]




[ M221T ]

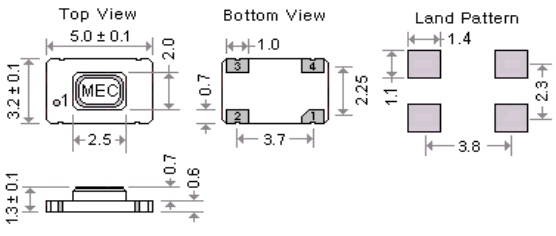



[ M321T ]

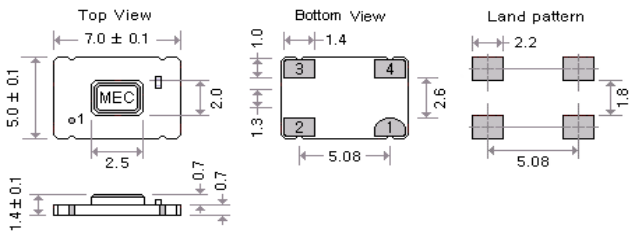



### Outline Dimensions ( Unit : mm ) , Adapter Board Type

[ M531T _ _ AB ]




[ M571T _ _ AB ]



# Temperature Compensated Crystal Oscillators [ TCXO " M " ]

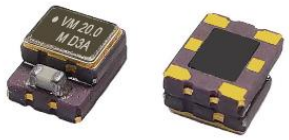
CMOS Output

| TCXO | VCTCXO | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| MTF_T | VMTF_T | Quick - Turn Clock Oscillators | CMOS | 1.8 V | 2.5 V | 3.3 V | Min. 1 MHz | Max. 200 MHz |

## Features

**1.2 pS Phase Jitter ( typical )**

- Programmable low cost CMOS TCXO
- High frequency range : [ 1 MHz ~ 200 MHz ]
- Frequency stability as tight as ± 2.0 ppm over -40°C to 85°C



## General specifications of all available packages , at Ta=+25°C , CL=15pF

| Output Waveform | Square wave [ CMOS ] . Waveform code is " T " | |
|---|---|---|
| Type | **MTF326 , VMTF326** | **MTF538 , VMTF538** |
| Package Size | 3.2 x 2.5 x 1.6 mm | 5.0 x 3.2 x 1.4 mm |

| | | | | |
|---|---|---|---|---|
| Supply Voltage ( $V_{DD}$ ) | | + 1.8 V ( code is " 18 " ) | + 2.5 V ( code is " 25 " ) | + 3.3 V ( code is " 33 " ) |
| Available Frequency Range | | 1 ~ 125 MHz | 1 ~ 200 MHz | 1 ~ 200 MHz |
| Current Consumption | | 30 mA ( max. ) | 35 mA ( max. ) | 40 mA ( max. ) |
| Initial Calibration Tolerance | | ± 2.0 ppm at +25°C ± 2°C. ( Default for Quick - Turn ) | | |
| Frequency Stability | vs Temperature | ± 2.0 ppm ( max.) at -40°C to 85°C ( Default for Quick - Turn ) | | |
| | vs Aging at Ta= + 25 °C | ± 1.0 ppm ( max.) , per year | | |
| | vs Voltage Change | ± 0.3 ppm ( max.) , for a ± 5% input voltage change . | | |
| | vs Load Change | ± 0.3 ppm ( max.) , for a ± 10% load condition change . | | |
| | vs Reflow | ± 1.0 ppm ( max.) , 1 reflow and measured 24 hours afterwards . | | |
| Output Logic High " 1 " | | $V_{DD}$ - 0.4 V ( min.) | | |
| Output Logic Low " 0 " | | 0.4 V ( max.) | | |
| Rise Time and Fall Time | | 10.0 nsec ( max.) ; 10% ↔ 90% of the waveform | | |
| Duty Cycle | | 1 ~ 150MHz : 50 % ± 5 % | | |
| | | 150 ~ 200MHz : 50 % ± 10 % | | |
| Start-Up Time | | 5.0 msec. ( typ.) , 10.0 msec. ( max.) | | |
| Output Load | | 15 pF | | |
| Electrical Frequency Tuning ( EFC ) by external Control Voltage | Control Voltage Center | 1.8 V | 2.5 V | 3.3 V |
| | | 0.9 V ± 0.6 V | 1.4 V ± 1.0 V | 1.5 V ± 1.0 V |
| | Frequency Deviation Range | ± 5.0 ppm ( min.) | | |
| | Slope Polarity ( Transfer Function ) | Positive slope. Positive voltage for positive frequency shift. | | |
| | | Input Impedance : 1.0M Ω ( min.) | Modulation Bandwidth : 3 KHz ( min.) | Linearity : ± 10 % ( max.) |
| Output Enable / Disable Function | | 70% of $V_{DD}$ ( min.) to enable. | | |
| | | 30% of $V_{DD}$ ( max.) to disable. | | |
| | | Disable Current : 0.2 mA ( typ.) , 1.0 mA ( max.) | | |
| RMS Jitter ( 12KHz ~ 20MHz ) | 100MHz as example | 1.2 psec ( typ. ) | | |

| Phase Noise Offset / dBc / Hz ( typ.) | 10 Hz | 100 Hz | 1 KHz | 10 KHz | 100 KHz |
|---|---|---|---|---|---|
| 100MHz as example | -72 dBc / Hz | -101 dBc / Hz | -115 dBc / Hz | -121 dBc / Hz | -119 dBc / Hz |

| | |
|---|---|
| Storage Temperature | -55°C to +150°C |

# Temperature Compensated Crystal Oscillators [ TCXO " M " ]

CMOS Wave Output Code " T "

## Part Number Format and Exmple

| | [ 1 ] Holder Type | [ 2 ] Output Wave | [ 3 ] Supply Voltage | _ | [ 4 ] Center Frequency | _ | [ 5 ] Frequency Stability | / | [ 6 ] Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|
| Examples | (1) MTF538 | T | 33 | - | 133.330 | - | 1.0 | / | -40+85 |
| | (2) VMTF326 | T | 18 | - | 100.000 | - | 2.0 | / | -10+60 |

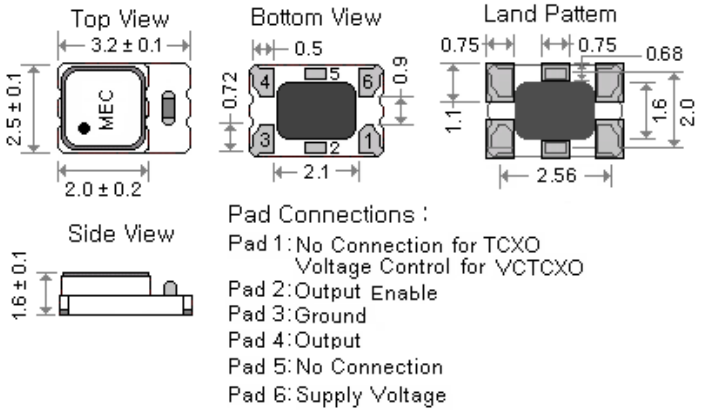
Ex (1) : MTF538T33 - 133.330 - 1.0 / -40+85 [ TCXO , 5032 SMD package , CMOS , 3.3V , 133.330MHz , ±1.0ppm from -40°C to 85°C ]

Ex (2) : VMTF326T18 - 100.000 - 2.0 / -10+60 [ VCTCXO , 3225 SMD package , CMOS , 1.8V , 100.000 MHz , ±2.0ppm from -10°C to 60°C ]

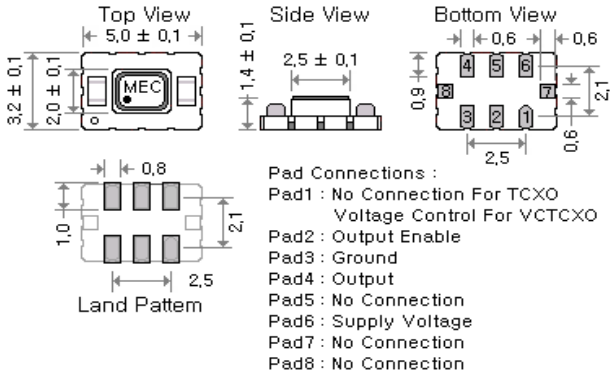
| | |
|---|---|
| [ 1 ] | Holder Type |
| | " MTF " stands for TCXO ; " VMTF " stands for VCTCXO |
| [ 2 ] | " T " stands for Square Wave |
| [ 3 ] | Supply voltage : " 18 " stands for +1.8V ; " 25 " stands for +2.5V ; " 33 " stands for +3.3V |
| [ 4 ] | Center Frequency in MHz |
| [ 5 ] | Frequency stability in ± _ ppm ; ex 1 : ± 1.0ppm --- 1.0 , ex 2 : ± 2.0ppm --- 2.0 |
| [ 6 ] | Operating temperature range in °C |
| | ex 1 : -40 °C to 85°C ----- -40+85 ; ex 2 : -10 °C to 60°C ----- -10+60 |

## Outline Dimensions ( Unit : mm ) , Suggested pad Layout for SMDs

### [ (V) MTF326T ]




### [ (V) MTF538T ]




TCXOs

# " OCXO " [ Oven Controlled Crystal Oscillators ]

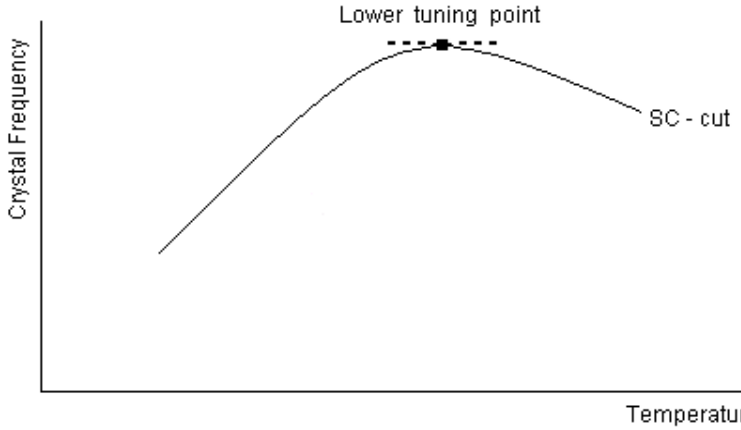
| " OC_ _ E " series ( True Sine Wave ) | " OC_ _ S " series ( Clipped Sine Wave ) | " OC_ _ T " series ( Square Wave ) |
|---|---|---|

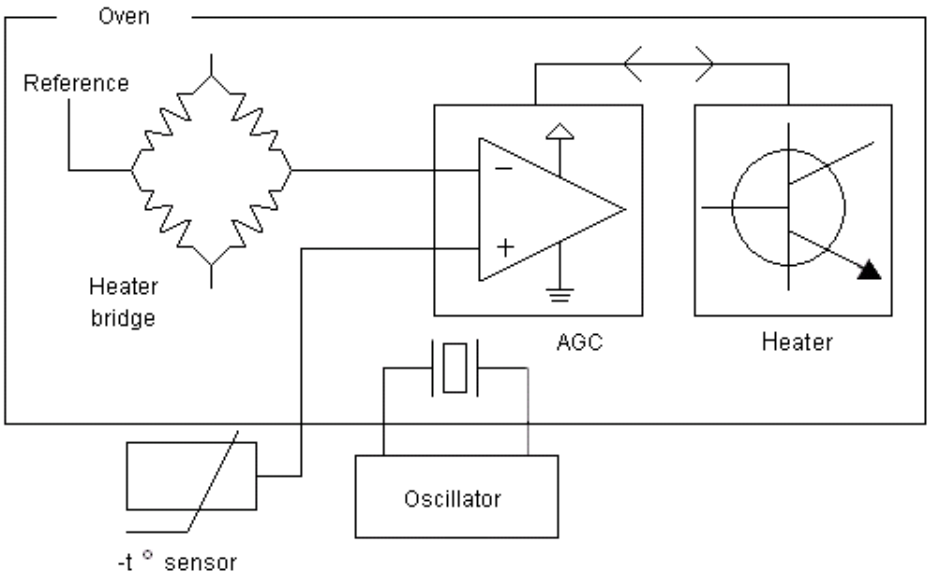
## What is an OCXO ?

Relatively speaking , an OCXO perform in the ± 0.01 ~ ± 0.1ppm range , a TCXO performs in the ± 1.0 ~ ± 5.0ppm range while a non - compensated clock oscillator performs in the ±25 with ±50ppm range .

A TCXO relies upon on a resistor / capacitor compensation network to counter the crystal's temperature - dependent frequency behavior . An OCXO has a crystal that is " ovenized " . This means the crystal " sees " a constant temperature regardless of the ambient temperature condition . The oven consists of a proportional heater ( power transistor ) and an automatic gain control ( AGC ) circuit . Also , a thermister monitors the oven temperature and sends an offset signal to the AGC which then turns the power transistor on and off accordingly . Thermal gradient and heat loss are carefully controlled to minimize the set point fluctuation of the oven . The oven temperature is normally set near the upper tuning point ( UPT ) of the crystal's freq. - temp. curve . At the UPT , the slope is zero and ideally there is no frequency change if the crystal " sees " a constant temperature .

Applications for OCXOs include satellite radio beacons , Stratum 3 systems , PCS / GMS base stations , SONET clocks , frequency synthesizers and instrumentation .



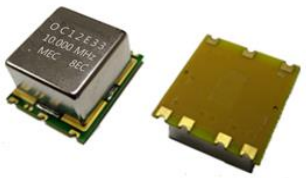



# " OCXO " [ Oven Controlled Crystal Oscillators ]

| OC12T | OC12E | Best stability | Standard OCXO Series | SMD | 3.3V | 5.0V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| Square Wave | True Sine Wave | ± 10 ppb | | | | | 5 MHz | 40 MHz |

## Applications

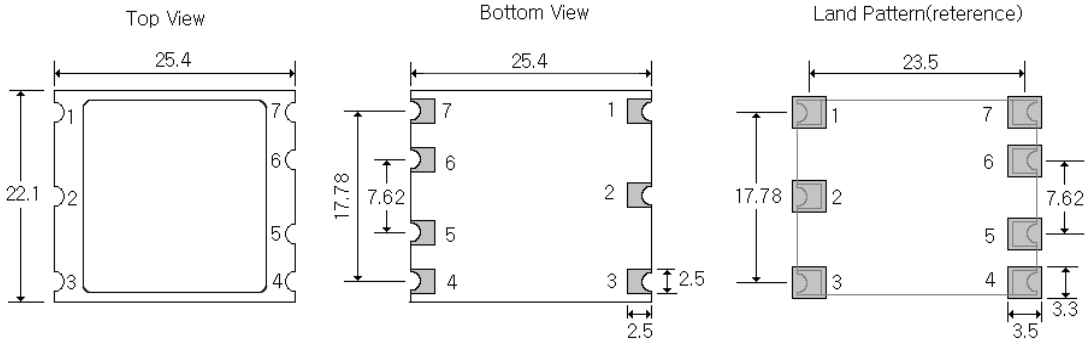
- OC12_ ( 25.4 * 22.1 * 11.0 mm )
- +3.3V , +5.0V Supply Voltages
- Voltage control ( Electronic Frequency Tuning ) is standard .

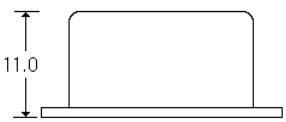


## General Specifications ( at+25°C and specified input voltage )

| Output Waveform | | Square wave. Waveform code is " T " | | True Sine Wave. Waveform code is " E " | |
|---|---|---|---|---|---|
| Supply Voltage | | +3.3 V | +5.0 V | +3.3 V | +5.0 V |
| Supply Voltage range , " Voltage code " | | +3.3V ± 5% , " 3 " | +5.0V ± 5% , " 5 " | +3.3V ± 5% , " 3 " | +5.0V ± 5% , " 5 " |
| Frequency Range | | 5 ~ 40.0 MHz | | 5 ~ 40.0 MHz | |
| Initial Calibration Tolerance | | ± 200 ppb ( max.) | ± 200 ppb ( max.) | ± 200 ppb ( max.) | ± 200 ppb ( max.) |
| | | Vcon = +1.65 V | Vcon = +2.5 V | Vcon = +1.65 V | Vcon = +2.5 V |
| Type of Crystal Cut Used | | " SC - cut " crystal or " IT - cut " crystal | | | |
| Frequency Stability | vs Temperature ( refer to +25°C ) | ± 5 ppb ( max.) over 0°C to +70°C | | | |
| | | ± 10 ppb ( max.) over -30°C to +70°C | | | |
| | | ± 10 ppb ( max.) over -40°C to +85°C | | | |
| | vs Voltage Change | ± 0.5 ppb ( max.) , for a ± 5% input voltage change . | | | |
| | vs Warm-up time (+25°C) | 10 minute ( max.) Within ± 10 ppb of its reference frequency. | | | |
| | vs Aging | ± 0.5 ppb ( max.) / after 30 days ; ± 50 ppb( max.) / first year ; ± 400 ppb ( max.) over 10 years. | | | |
| Voltage Control On pin 1 (EFC) ( Electronic Freq. Tuning ) | Freq. Deviation Range | ± 0.5 ppm ( min.) , ±5 ppm ( max.) Reference to fo at +25°C and over operating temperature range. | | | |
| | Control Voltage Range | +1.65V ± 1.65V | +2.5V ± 2.5V | +1.65V ± 1.65V | +2.5V ± 2.5V |
| | Transfer Function | Positive : Increasing control voltage increases output frequency . | | | |
| | Input Impedance | 50 K ohms ( min.) | | | |
| | EFC Linearity | ± 10 % ( max.) | | | |
| Power | Power Dissipation ( at +25°C ) | 1.2 Watts (max.) at steady-state; 1000 mA ( max.) at turn-on. | | | |
| Output | Output Level ( for True Sine ) | --- | --- | +8 dBm ( typ.) , +10 dBm ( max.) | |
| | Harmonic ( for True Sine ) | --- | --- | -30 dBc ( max.) | |
| | Spurious ( for True Sine ) | --- | --- | -60 dBc ( max.) | |
| | Load | 15pF | | 50 Ω | |
| | Output Logic High ( $V_{OH}$ ) | +2.4 V ( min.) | +2.4 V ( min.) | --- | --- |
| | Output Logic Low ( $V_{OL}$ ) | + 0.4 V ( max.) | + 0.4 V ( max.) | --- | --- |
| | Duty Cycle ( $V_{DD}$ ) | 50 % ± 5% @ +1.4V | | | |
| | Rise and Fall Time | 7 nsec. ( max.) ( 20% → 80% of waveform ) | | | |
| | Phase Noise Offset [ 10.0 MHz ] ( typ.) | 1 Hz | 10 Hz | 1 KHz | 10 KHz |
| | | -98 dBc | -126 dBc | -145 dBc | -152 dBc |

## Outline Dimensions ( Unit : ±0.2 mm )




Pin Connections :

Pin 1 : Voltage Control
Pin 2 : No Connected
Pin 3 : $V_{DD}$
Pin 4 : Output
Pin 5 : No Connected
Pin 6 : No Connected
Pin 7 : Ground

OCXOs

# " OCXO " [ Oven Controlled Crystal Oscillators ]

| OC13T | OC13E | Best stability | Standard OCXO Series | DIP | 3.3V | 5.0V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| Square Wave | True Sine Wave | ± 5.0 ppb | | | | | 5 MHz | 40 MHz |

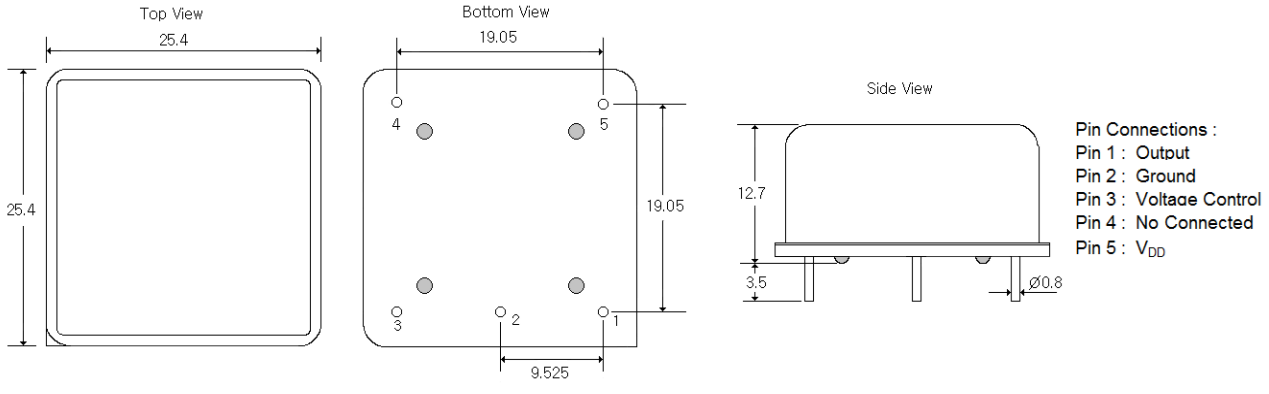
## Applications

- OC13_ ( 25.4 * 25.4 * 12.7 mm)
- Full Size 5 pin dip full metal package
- +3.3V , +5.0V Supply Voltages
- Voltage control ( Electronic Frequency Tuning ) is standard .


## General Specifications ( at+25°C and specified input voltage )

| Output Waveform | | Square wave. Waveform code is " T " | | True Sine Wave. Waveform code is " E " | |
|---|---|---|---|---|---|
| Supply Voltage | | +3.3 V | +5.0 V | +3.3 V | +5.0 V |
| Supply Voltage range , " Voltage code " | | +3.3V ± 5% , " 3 " | +5.0V ± 5% , " 5 " | +3.3V ± 5% , " 3 " | +5.0V ± 5% , " 5 " |
| Frequency Range | | 5 ~ 40.0 MHz | | 5 ~ 40.0 MHz | |
| Initial Calibration Tolerance | | ± 100 ppb ( max.) | ± 100 ppb ( max.) | ± 100 ppb ( max.) | ± 100 ppb ( max.) |
| | | Vcon = +1.65 V | Vcon = +2.5 V | Vcon = +1.65 V | Vcon = +2.5 V |
| Type of Crystal Cut Used | | " SC - cut " crystal or " IT - cut " crystal | | | |
| Frequency Stability | vs Temperature ( refer to +25°C ) | ± 3 ppb ( max.) over 0°C to +70°C | | | |
| | | ± 5.0 ppb ( max.) over -30°C to +70°C | | | |
| | | ± 5.0 ppb ( max.) over -40°C to +85°C | | | |
| | vs Voltage Change | ± 1.0ppb ( max.) , for a ± 5% input voltage change . | | | |
| | vs Warm-up time (+25°C) | 10 minute ( max.) Within ± 10 ppb of its reference frequency. | | | |
| | vs Aging | ± 0.5 ppb ( max.) / after 30 days ; ± 50 ppb ( max.) / first year ; ± 300 ppb ( max.) over 10 years. | | | |
| Voltage Control On pin 1 (EFC) ( Electronic Freq. Tuning ) | Freq. Deviation Range | ± 0.5 ppm ( min.) , ± 5 ppm ( max.) Reference to fo at +25°C and over operating temperature range. | | | |
| | Control Voltage Range | +1.65V ± 1.65V | +2.5V ± 2.5V | +1.65V ± 1.65V | +2.5V ± 2.5V |
| | Transfer Function | Positive : Increasing control voltage increases output frequency . | | | |
| | Input Impedance | 50 K ohms ( min.) | | | |
| | EFC Linearity | ± 10 % ( max.) | | | |
| Power | Power Dissipation ( at +25°C ) | 1.3 Watts ( max.) at steady-state; 1000 mA ( max.) at turn-on. | | | |
| Output | Output Level ( for True Sine ) | --- | --- | +8 dBm ( typ.) , +10 dBm ( max.) into 50Ω load . | |
| | Harmonic ( for True Sine ) | --- | --- | -30 dBc ( min.) | |
| | Spurious ( for True Sine ) | --- | --- | -60 dBc ( min.) | |
| | Load | 15pF | | 50 Ω | |
| | Output Logic High ( $V_{OH}$ ) | +2.4 V ( min.) | +2.4 V ( min.) | --- | --- |
| | Output Logic Low ( $V_{OL}$ ) | + 0.4 V ( max.) | + 0.4 V ( max.) | --- | --- |
| | Duty Cycle ( $V_{DD}$ ) | 50 % ± 5% @ +1.4V | | --- | --- |
| | Rise and Fall Time | 7 nsec. ( max.) ( 20% → 80% of waveform ) | | --- | --- |
| | Phase Noise Offset [ 10.0 MHz ] ( typ.) | 10 Hz | 100 Hz | 1 KHz | 10 KHz |
| | | -120 dBc | -135 dBc | -145 dBc | -150 dBc |

## Outline Dimensions ( Unit : ±0.2 mm )



# " OCXO " [ Oven Controlled Crystal Oscillators ]

| OC14T | Best stability | Voltage Control | DIP | 3.3V | 5.0V | Min. | Max. |
|---|---|---|---|---|---|---|---|
| Square Wave | ± 30 ppb | | | | | 5 MHz | 40 MHz |

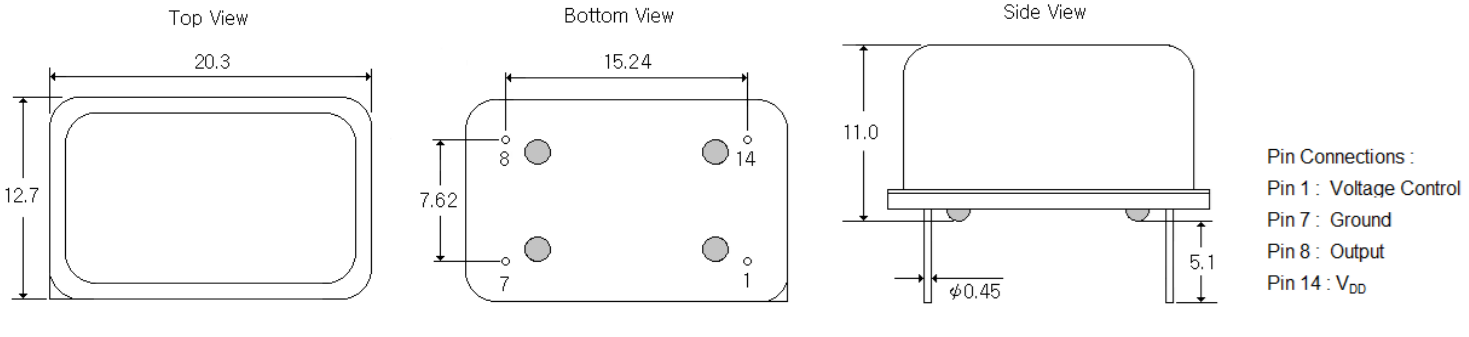
## Applications


- OC14_ ( 20.3 * 12.7 * 11.0 mm)
- +3.3V , +5.0V Supply Voltages
- Voltage control ( Electronic Frequency Tuning ) is standard .

## General Specifications ( at+25°C and specified input voltage )

| Output Waveform | | Square wave . Waveform code is " T " | | | |
|---|---|---|---|---|---|
| Supply Voltage | | +3.3 V | | +5.0 V | |
| Supply Voltage range , " Voltage code " | | +3.3V ± 5% , " 3 " | | +5.0V ± 5% , " 5 " | |
| Frequency Range | | 5 ~ 40.0 MHz<br>Standard Frequency : 10.0 MHz | | 5 ~ 40.0 MHz<br>Standard Frequency : 10.0 MHz | |
| Initial Calibration Tolerance | | ± 500 ppb ( max.)<br>Vcon = +1.65 V | | ± 500 ppb ( max.)<br>Vcon = +2.5 V | |
| Type of Crystal Cut Used | | " SC - cut " crystal or " IT - cut " crystal | | | |
| Frequency Stability | vs Temperature ( refer to +25°C ) | ± 50 ppb ( max.) over 0°C to +70°C | | | |
| | | ± 100 ppb ( max.) over -30°C to +70°C | | | |
| | | ± 100 ppb ( max.) over -40°C to +85°C | | | |
| | vs Voltage Change | ± 50ppb ( max.) , for a ± 5% input voltage change . | | | |
| | vs Warm-up time (+25°C) | 10 minute max. Within ± 100 ppb of its reference frequency. | | | |
| | vs Aging | ± 5 ppb max./after 30 days ; ± 500 ppb max./first year ; ± 3 ppm max.over 10 years. | | | |
| Voltage Control On pin 1 (EFC) ( Electronic Freq. Tuning ) | Freq. Deviation Range | > ± 5 ppm Reference to fo at +25°C and over operating temperature range. | | | |
| | Control Voltage Range | +1.65V ± 1.65V | | +2.5V ± 2.5V | |
| | Transfer Function | Positive : Increasing control voltage increases output frequency . | | | |
| | Input Impedance | 50 K ohms min. | | | |
| | EFC Linearity | ± 10 % ( max.) | | | |
| Power | Power Dissipation ( at +25°C ) | 0.8 Watts max. at steady-state; 600 mA max. at turn-on. | | | |
| Output | Output Logic High ( $V_{OH}$ ) | +2.4 V ( min.) | | +2.4 V ( min.) | |
| | Output Logic Low ( $V_{OL}$ ) | + 0.5 V ( max.) | | + 0.5 V ( max.) | |
| | Duty Cycle ( $V_{DD}$ ) | 50 % ± 5% @ + 2.0V | | | |
| | Output Load | 15pF | | | |
| | Rise and Fall Time | 7 nS ( max.) ( 20% → 80% of waveform ) | | | |
| | Phase Noise Offset [ 10.0 MHz ] ( typical ) | 1 Hz | 10 Hz | 1 KHz | 10 KHz |
| | | -70 dBc | -108 dBc | -140 dBc | -150 dBc |

## Outline Dimensions ( Unit : ±0.2 mm )




OCXOs

# " OCXO " [ Oven Controlled Crystal Oscillators ]

| OC18T | OC19T | Best stability | Standard OCXO Series | DIP | 3.3V | 5.0V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| Square Wave | Square Wave | ± 10 ppb | | | | | 5 MHz | 40 MHz |

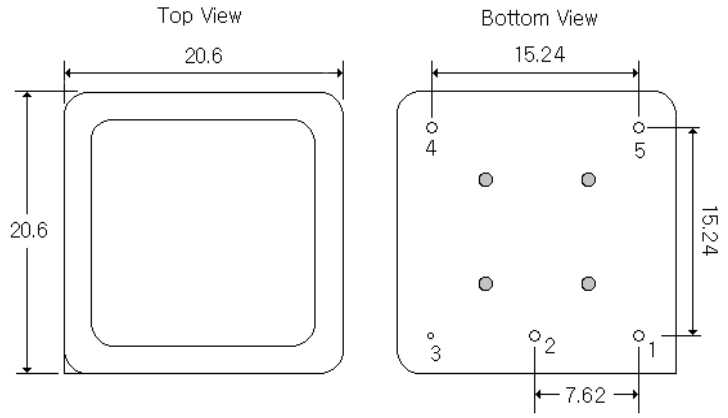
## Applications

- OC18 / OC19 _ ( 20.6 * 20.6 * 11.0 mm ) typical
- Full Size 5 pin dip full metal package
- +3.3V , +5.0V Supply Voltages
- Voltage control ( Electronic Frequency Tuning ) is standard

## General Specifications ( at+25°C and specified input voltage )

| Output Waveform | | Square wave . Waveform code is " T " | | | |
|---|---|---|---|---|---|
| Supply Voltage | | +3.3 V | +5.0 V | | |
| Supply Voltage range , " Voltage code " | | +3.3V ± 5% , " 3 " | +5.0V ± 5% , " 5 " | | |
| Frequency Range | | 5 ~ 40.0 MHz<br>Standard Frequency : 10.0 MHz | 5 ~ 40.0 MHz<br>Standard Frequency : 10.0 MHz | | |
| Initial Calibration Tolerance | | ± 500 ppb ( max.) | ± 500 ppb ( max.) | | |
| | | Vcon = +1.65 V | Vcon = +2.5 V | | |
| Type of Crystal Cut Used | | " SC - cut " crystal or " IT - cut " crystal | | | |
| Frequency Stability | vs Temperature ( refer to +25°C ) | ± 5 ppb ( max.) over 0°C to +70°C | | | |
| | | ± 10 ppb ( max.) over -30°C to +70°C | | | |
| | | ± 10 ppb ( max.) over -40°C to +85°C | | | |
| | vs Voltage Change | ± 0.5ppb ( max.) , for a ± 5% input voltage change . | | | |
| | vs Warm-up time (+25°C) | 3 minute max. Within ± 50 ppb of its reference frequency. | | | |
| | vs Aging | ± 0.5 ppb max./after 30 days ; ± 50 ppb max./first year ; ± 300 ppb max. over 10 years. | | | |
| Voltage Control On pin 1 (EFC) ( Electronic Freq. Tuning ) | Freq. Deviation Range | ± 0.5 ppm min, ± 2 ppm max. Reference to fo at +25°C and over operating temperature range. | | | |
| | Control Voltage Range | +1.65V ± 1.65V | +2.5V ± 2.5V | | |
| | Transfer Function | Positive : Increasing control voltage increases output frequency . | | | |
| | Input Impedance | 100 K ohms min. | | | |
| | EFC Linearity | ± 10 % ( max.) | | | |
| Power | Power Dissipation ( at +25°C ) | 1.3 Watts max. at steady-state; 800 mA max. at turn-on. | | | |
| Output | Output Logic High ( $V_{OH}$ ) | +2.4 V ( min.) | +3.5 V ( min.) | | |
| | Output Logic Low ( $V_{OL}$ ) | + 0.5 V ( max.) | + 0.5 V ( max.) | | |
| | Duty Cycle ( $V_{DD}$ ) | 50 % ± 5% @ 2.0V | | | |
| | Load | 15pF | | | |
| | Rise and Fall Time | 7 nS ( max.) ( 20% → 80% of waveform ) | | | |
| | Phase Noise Offset [ 20.0 MHz ] ( typical ) | 10 Hz | 100 Hz | 1 KHz | 10 KHz |
| | | -115 dBc | -135 dBc | -145 dBc | -150 dBc |

## Outline Dimensions ( Unit : ±0.2 mm )




| OC18 | |
|---|---|
| Pin Connections : | |
| Pin 1 : Voltage Control | |
| Pin 2 : No Connected | |
| Pin 3 : Ground | |
| Pin 4 : Output | |
| Pin 5 : $V_{DD}$ | |

| OC19 | |
|---|---|
| Pin Connections : | |
| Pin 1 : $V_{DD}$ | |
| Pin 2 : Output | |
| Pin 3 : Ground | |
| Pin 4 : Voltage Control | |
| Pin 5 : No Connected | |

# " OCXO " [ Oven Controlled Crystal Oscillators ]

| OC32T | OC32E | Best stability | Standard OCXO Series | DIP | 3.3V | 5.0V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| Square Wave | True Sine Wave | ± 5.0 ppb | | | | | 5 MHz | 40 MHz |

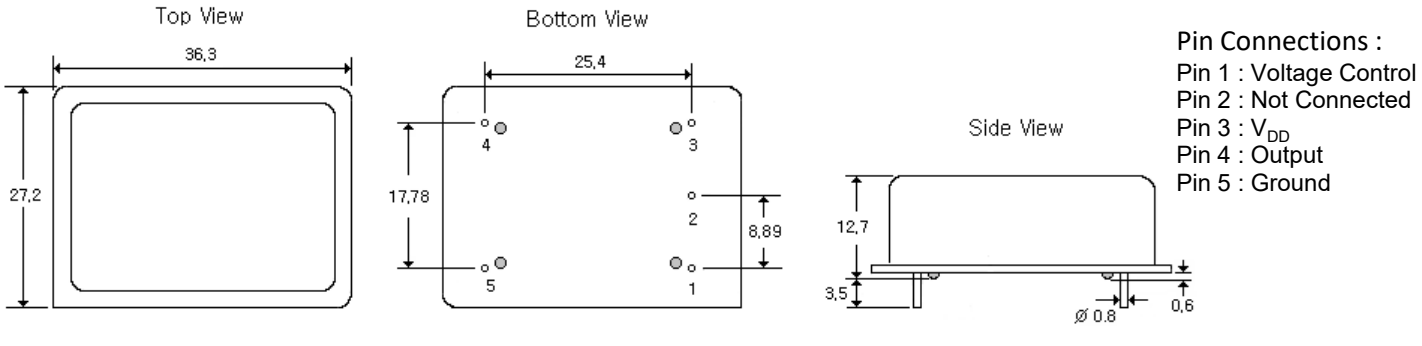
## Applications

- OC32_ ( 36.3 * 27.2 * 12.7 mm)
- Full Size 5 pin dip full metal package
- +3.3V , +5.0V Supply Voltages
- Voltage control ( Electronic Frequency Tuning ) is standard .

## General Specifications ( at+25°C and specified input voltage )

| Output Waveform | | Square wave. Waveform code is " T " | | True Sine Wave. Waveform code is " E " | |
|---|---|---|---|---|---|
| Supply Voltage | | +3.3 V | +5.0 V | +3.3 V | +5.0 V |
| Supply Voltage range , " Voltage code " | | +3.3V ± 5% , " 3 " | +5.0V ± 5% , " 5 " | +3.3V ± 5% , " 3 " | +5.0V ± 5% , " 5 " |
| Frequency Range | | 5 ~ 40.0 MHz<br>Standard Frequency : 10.0 MHz | | 5 ~ 40.0 MHz<br>Standard Frequency : 10.0 MHz | |
| Initial Calibration Tolerance | | ± 100 ppb ( max.) | ± 100 ppb ( max.) | ± 100 ppb ( max.) | ± 100 ppb ( max.) |
| | | Vcon = +1.65 V | Vcon = +2.5 V | Vcon = +1.65 V | Vcon = +2.5 V |
| Type of Crystal Cut Used | | " SC - cut " crystal or " IT - cut " crystal | | | |
| Frequency Stability | vs Temperature ( refer to +25°C ) | ± 3 ppb ( max.) over 0°C to +70°C | | | |
| | | ± 5.0 ppb ( max.) over -30°C to +70°C | | | |
| | | ± 10 ppb ( max.) over -40°C to +85°C | | | |
| | vs Voltage Change | ± 0.5ppb ( max.) , for a ± 5% input voltage change . | | | |
| | vs Warm-up time (+25°C) | 10 minute max. Within ± 10 ppb of its reference frequency. | | | |
| | vs Aging | ± 0.5 ppb max./after 30 days ; ± 50 ppb max./first year ; ± 300 ppb max.over 10 years. | | | |
| Voltage Control On pin 1 (EFC) ( Electronic Freq. Tuning ) | Freq. Deviation Range | ± 0.5 ppm min, ± 2 ppm max. Reference to fo at +25°C and over operating temperature range. | | | |
| | Control Voltage Range | +1.65V ± 1.65V | | +2.5V ± 2.5V | |
| | Transfer Function | Positive : Increasing control voltage increases output frequency . | | | |
| | Input Impedance | 50 K ohms min. | | | |
| | EFC Linearity | ± 10 % ( max.) | | | |
| Power | Power Dissipation ( at +25°C ) | 1.3 Watts max. at steady-state; 850 mA max. at turn-on. | | | |
| Output | Output Level ( for True Sine ) | --- | --- | +8 dBm ( typ.) , +10 dBm ( max.) | |
| | Harmonic ( for True Sine ) | --- | --- | -30 dBc ( min.) | |
| | Spurious ( for True Sine ) | --- | --- | -60 dBc ( min.) | |
| | Load | 15pF | | 50 Ω | |
| | Output Logic High ( $V_{OH}$ ) | +2.4 V ( min.) | +2.4 V ( min.) | --- | --- |
| | Output Logic Low ( $V_{OL}$ ) | + 0.4 V ( max.) | + 0.4 V ( max.) | --- | --- |
| | Duty Cycle ( $V_{DD}$ ) | 50 % ± 5% @ +1.4V | | | |
| | Rise and Fall Time | 7 nsec. ( max.) ( 20% → 80% of waveform ) | | | |
| | Phase Noise Offset [ 10.0 MHz ] ( typical ) | 10 Hz | 100 Hz | 1 KHz | 10 KHz |
| | | -120 dBc | -135 dBc | -145 dBc | -150 dBc |

## Outline Dimensions ( Unit : ±0.2 mm )




Pin Connections :
Pin 1 : Voltage Control
Pin 2 : Not Connected
Pin 3 : $V_{DD}$
Pin 4 : Output
Pin 5 : Ground

# " OCXO " [ Oven Controlled Crystal Oscillators ]

| OC41T | Best stability | Standard OCXO Series | SMD | 3.3V | Min. | Max. |
|---|---|---|---|---|---|---|
| Square Wave | ± 30 ppb | | | | 5 MHz | 40 MHz |

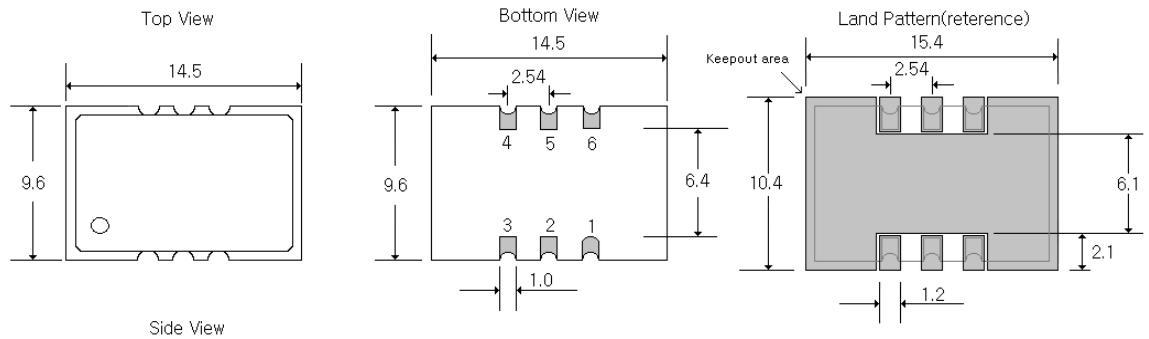
## Applications

- OC41_ ( 14.5 * 9.6 * 6.5 mm)
- 6 pin SMD package
- +3.3V Supply Voltages
- Voltage control ( Electronic Frequency Tuning ) is standard .

## General Specifications ( at+25°C and specified input voltage )

| Output Waveform | | Square wave . Waveform code is " T " | | | |
|---|---|---|---|---|---|
| Supply Voltage | | +3.3 V | | | |
| Supply Voltage range , " Voltage code " | | +3.3V ± 5% , " 3 " | | | |
| Frequency Range | | 5 ~ 40.0 MHz | | | |
| Initial Calibration Tolerance | | Vcon = +1.65 V ; ± 500 ppb ( max.) typ. , ± 200 ppb ( max.) available | | | |
| Type of Crystal Cut Used | | " IT - cut " crystal | | | |
| Frequency Stability | vs Temperature ( refer to +25°C ) | ± 20 ppb ( max.) over -20°C to +70°C | | | |
| | | ± 30 ppb ( max.) over -40°C to +85°C | | | |
| | vs Voltage Change | ± 10 ppb ( max.) , for a ± 5% input voltage change . | | | |
| | vs Warm-up time (+25°C) | 5 minute max. Within ± 100 ppb of its reference frequency. | | | |
| | vs Aging | ± 3.0 ppb max./after 30 days ; ± 400 ppb max./first year ; ± 2 ppm max. over 10 years. | | | |
| | vs Load Change | ≦ ± 10 ppb , for ±10 % load condition change . | | | |
| | vs Reflow | ± 1.0 ppm max . , 1 reflow and measured 24 hours afterwards. | | | |
| Voltage Control On pin 1 (EFC) ( Electronic Freq. Tuning ) | Freq. Deviation Range | > ± 5 ppm Reference to fo at +25°C and over operating temperature range. | | | |
| | Control Voltage Range | +1.65V ± 1.65V | | | |
| | Transfer Function | Positive : Increasing control voltage increases output frequency . | | | |
| | Input Impedance | 50 K ohms min. | | | |
| | EFC Linearity | ± 10 % ( max.) | | | |
| Power | Power Dissipation ( at +25°C ) | 0.6 Watts max. at steady-state; 600 mA max. at turn-on. | | | |
| Output | Output Logic High ( $V_{OH}$ ) | + 2.4 V ( min.) | | | |
| | Output Logic Low ( $V_{OL}$ ) | +0.4 V ( max.) | | | |
| | Duty Cycle ( $V_{DD}$ ) | 50 % ± 5% @ 1.65V | | | |
| | Load | 15pF | | | |
| | Rise and Fall Time | 7 nS ( max.) ( 20% → 80% of waveform ) | | | |
| | Phase Noise Offset [ 20.0 MHz ] ( typical ) | 10 Hz | 100 Hz | 1 KHz | 10 KHz |
| | | -98 dBc | -126 dBc | -145 dBc | -152 dBc |

## Outline Dimensions ( Unit : ±0.2 mm )




Pin Connections :

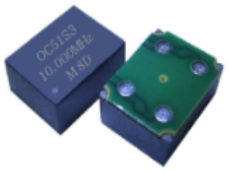
Pin 1 : Voltage Control
Pin 2 : No Connected
Pin 3 : Ground
Pin 4 : Output
Pin 5 : No Connected
Pin 6 : $V_{DD}$

# " OCXO " [ Oven Controlled Crystal Oscillators ]

| OC51T | OC51S | Best stability | Standard OCXO Series | SMD | 3.3V | 5.0V | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| Square Wave | Clipped Sine Wave | ± 20 ppb | | | | | 10 MHz | 40 MHz |

## Applications

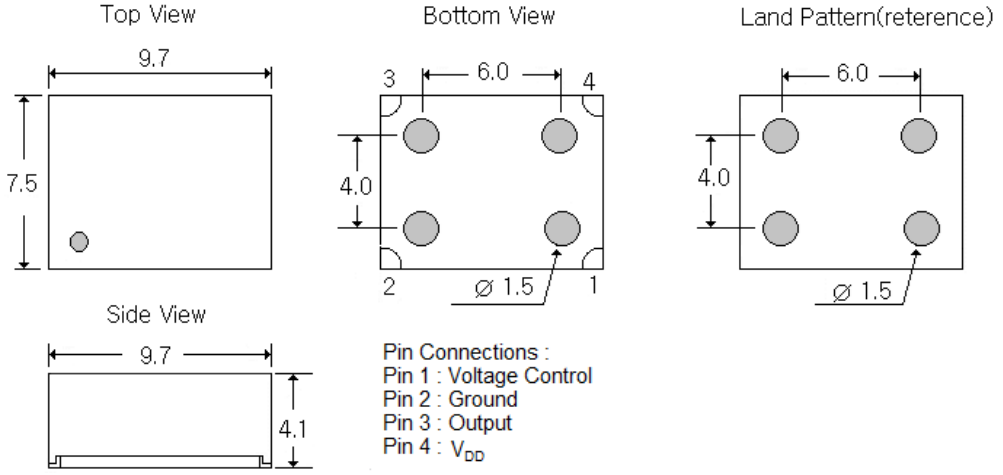
- OC51_ ( 9.7 x 7.5 x 4.1 mm) Miniaturized 4-Pad SMD package
- +3.3V , +5.0V Supply Voltages
- Voltage control ( Electronic Frequency Tuning ) is standard .



## General Specifications ( at+25°C and specified input voltage )

| Output Waveform | | Square wave. Waveform code is " T " | | Clipped Sine Wave. Waveform code is " S " | |
|---|---|---|---|---|---|
| Supply Voltage | | +3.3 V | +5.0 V | +3.3 V | +5.0 V |
| Supply Voltage range , " Voltage code " | | +3.3V ± 5% , " 3 " | +5.0V ± 5% , " 5 " | +3.3V ± 5% , " 3 " | +5.0V ± 5% , " 5 " |
| Frequency Range | | 10 ~ 40.0 MHz | | 10 ~ 40.0 MHz | |
| Initial Calibration Tolerance | | ± 500 ppb ( max.) | | ± 500 ppb ( max.) | |
| | | Vcon = +1.65 V | Vcon = +2.5 V | Vcon = +1.65 V | Vcon = +2.5 V |
| Type of Crystal Cut Used | | " IT - cut " crystal | | | |
| Frequency Stability | vs Temperature ( refer to +25°C ) | ± 10 ppb ( max.) over -30°C to +70°C | | | |
| | | ± 20 ppb ( max.) over -40°C to +85°C | | | |
| | vs Voltage Change | ± 10ppb ( max.), for a ± 5% input voltage change . | | | |
| | vs Warm-up time (+25°C) | 5 minute max. Within ± 0.1 ppm of its reference frequency. | | | |
| | vs Aging | ± 3.0 ppb max./after 30 days ; ± 600 ppb max./first year ; ± 3 ppm max. over 10 years. | | | |
| | vs Reflow | ± 1.0 ppm max . , 1 reflow and measured 24 hours afterwards. | | | |
| Voltage Control On pin 1 (EFC) ( Electronic Freq. Tuning ) | Freq. Deviation Range | > ± 5 ppm Reference to fo at +25°C and over operating temperature range. | | | |
| | Control Voltage Range | +1.65V ± 1.65V | | +2.5V ± 2.5V | |
| | Transfer Function | Positive : Increasing control voltage increases output frequency . | | | |
| | Input Impedance | 100 K ohms min. | | | |
| | EFC Linearity | ± 10 % ( max.) | | | |
| Power | Power Dissipation ( at +25°C ) | 0.4 Watts max. at steady-state; 350 mA max. at turn-on. | | | |
| Output | Output Logic High ( $V_{OH}$ ) | +2.4 V ( min.) | +4.5 V ( min.) | _ | _ |
| | Output Logic Low ( $V_{OL}$ ) | + 0.4 V ( max.) | + 0.4 V ( max.) | _ | _ |
| | Duty Cycle ( $V_{DD}$ ) | 50 % ± 5% @ 1.65V | | _ | |
| | Load | 15pF | | 10 KΩ // 10 pF ± 10% | |
| | Output Voltage Level ( peak to peak ) | _ | _ | 0.8 V p-p ( min.) | |
| | Rise and Fall Time | 7 nS ( max.) ( 20% → 80% of waveform ) | | | |
| | Phase Noise Offset [ 20.0 MHz ] ( typical ) | 10 Hz | 100 Hz | 1 KHz | 10 KHz |
| | | -98 dBc | -126 dBc | -145 dBc | -152 dBc |

## Outline Dimensions ( Unit : ±0.2 mm )




OCXOs

# " OCXO " [ Oven Controlled Crystal Oscillators ]

| Square Wave " OC _ T " | Clipped Sine Wave " OC _ S " | True Sine Wave " OC _ E " |
|---|---|---|

## Part Number Format and Example

| | [ 1 ] Holder Type | [ 2 ] Output Wave | [ 3 ] Supply Voltage | - | [ 4 ] Center Frequency | - | [ 5 ] Frequency Stability | / | [ 6 ] Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|
| Examples | (1) OC14 | T | 5 | - | 5.000 | - | 10 | / | -40+85 |
| | (2) OC18 | E | 5 | - | 100.000 | - | 100 | / | -30+70 |
| | (3) OC51 | S | 3 | - | 10.000 | - | 30 | / | -20+70 |
| | (4) OC12 | E | 3 | - | 10.000 | - | 200 | / | 0+70 |

Ex (1) : OC14T5 - 5.000 - 10 / -40+85 [ OC14 type , Square Wave , 5.0V , 5.000MHz , ± 10ppb from -40°C to 85°C ]

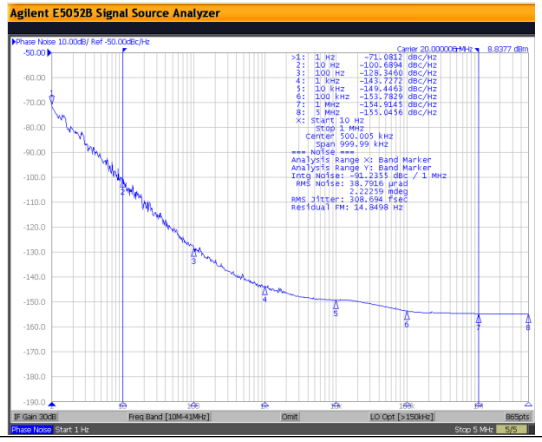
Ex (2) : OC18E5 - 100.000 - 100 / -30+70 [ OC18 type , True Sine Wave , 5.0V , 100.000MHz , ± 100ppb from -30°C to 70°C ]

Ex (3) : OC51S3 - 10.000 - 30 / -20+70 [ OC51 type , Clipped Sine Wave , 3.3V , 10.000MHz , ± 30ppb from -20°C to 70°C ]

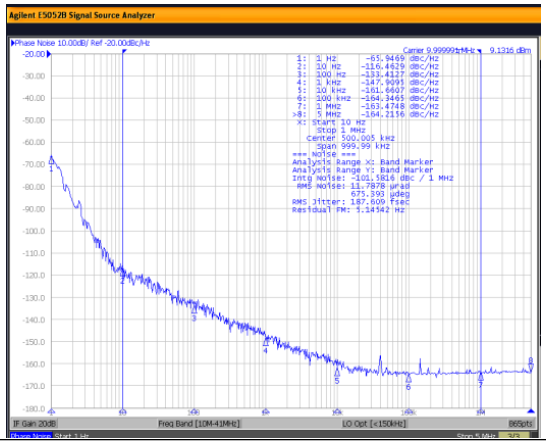
Ex (4) : OC12E3 - 10.000 - 200 / 0+70 [ OC12 type , True Sine Wave , 3.3V , 10.000MHz , ± 200ppb from 0°C to 70°C ]

| | |
|---|---|
| [ 1 ] | Holder Type |
| | " OC_ _ " stands for OCXO , |
| [ 2 ] | " T " stands for Square Wave , " E " stands for True Sine Wave , " S " stands for Clipped Sine Wave |
| | ex 1 : OC14T , OC14 package , Square Wave ; ex 2 : OC18E , OC18 package , True Sine Wave ; |
| | ex 3 : OC51S , OC51 package , Clipped Sine Wave ; ex 4 : OC12E , OC12 package , True Sine Wave |
| [ 3 ] | Supply voltage , " 5 " for 5.0V D.C , " 3 " for 3.3V D.C |
| [ 4 ] | Center Frequency in MHz |
| [ 5 ] | Frequency stability in ± _ ppb ; ex 1 : ± 10ppb ---10 , ex 2 : ± 100ppb ---100 , ex 3 : ± 30ppb ---30 , ex 4 : ± 200ppb ---200 |
| [ 6 ] | Operating temperature range in °C |
| | ex 1 : -40 °C to 85°C ----- -40+85 ; ex 2 : -30 °C to 70°C ----- -30+70 ; ex 3 : -20 °C to 70°C ----- -20+70 ; ex 4 : 0 °C to 70°C ----- 0+70 |

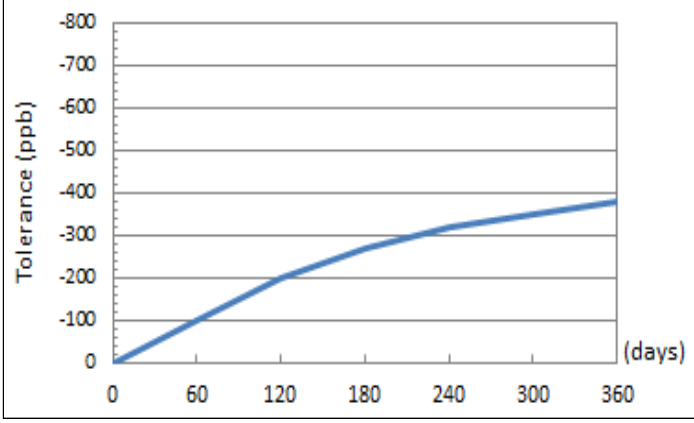
SSB Phase Noise : Clipped Sine Wave(OC51S-20.000)



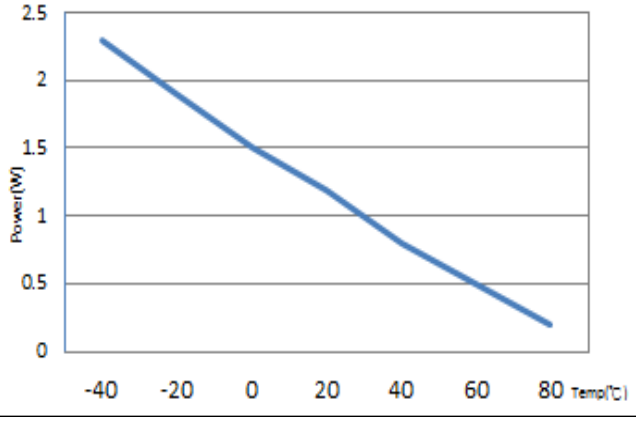

SSB Phase Noise : Square Wave(OC13T-10.000)




Aging : OC51S-20.000




Power Consumption vs Temperature (OC13T5-10.000)

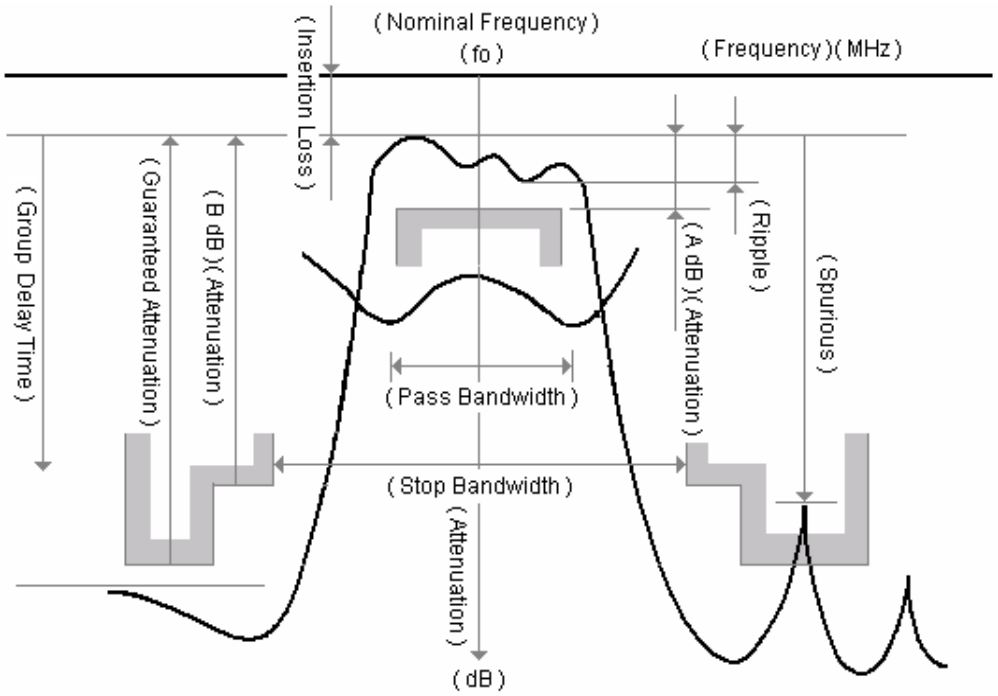



OCXOs

# M. C. F. [ Monolithic Crystal Filters ]

M.C.F. ( Monolithic Crystal Filters ) features high quality quartz resonators with sharp cutoff characteristics, low loss , good inter-modulation and a high stability over a wide temperature range .
Consider applying band pass filters to communication systems .

## Characteristic diagram and terms of crystal filters



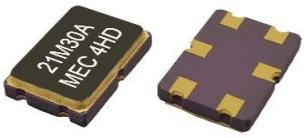

| | |
|---|---|
| ● Nominal Frequency : | This is the nominal value of the center frequency (fo) and is used as the reference frequency of related standards. |
| ● Pass Bandwidth : | This is the frequency interval in which the relative attenuation (the attenuation from the minimum insertion loss) is equal to the specified value "A dB" (Usually 3dB). |
| ● Insertion Loss : | This is the difference of attenuation when a filter is and isn't inserted. The minimum insertion loss is the minimum value of insertion loss and becomes as the reference level of attenuati characteristics specification. The constant loss is the insertion loss at the nominal frequency. |
| ● Ripple : | This is the maximum value of the difference between the peak value of attenuation in the pass band and the minimum insertion loss. |
| ● Stop Bandwidth : | This is the frequency interval in which the relative attenuation is equal to the specified value "B dB". |
| ● Guaranteed Attenuation : | This is the relative attenuation guaranteed in the specified range within attenuation band scope. |
| ● Spurious Response : | This is the value of relative attenuation generated by the secondary vibration in the specified range within attenuation band scope. |
| ● Group Delay Time : | This is the difference between the maximum and the minimum value of the group delay in the specified range of the pass band. |
| ● Terminating Impedance : | This is the impedance value terminated to the input and the output side of filter and is indicated by the resistance portion and the parallel capacity portion including the floating capacity. |

# M. C. F. [ Monolithic Crystal Filters ]

| MQ | Surface Mount | Fund. | 21.4 MHz | 21.7 MHz | 45.0 MHz | 50.85 MHz | 2 poles |
|---|---|---|---|---|---|---|---|
| 7.0 * 5.0 * 1.3 mm | 4 poles in one package | | | | | | 4 poles |

## Features

● Specifically designed for mobile, wireless communications pagers, cellular and cordless phones.




## Surface Mount Type [ MQ series ( 21.400 , 21.700 , 45.000 , 50.850 MHz ) ]

| Frequency ( MHz ) | Model | No. of poles | Pass Bandwidth | | Stop Bandwidth | | Ripple | Insertion Loss | Guaranteed Attenuation | | Terminating Impedance | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | dB | KHz (min.) | dB | KHz (max.) | dB (max.) | dB (max.) | dB | KHz | ohms // pF | Cc ( pF ) |
| 21.400 | **21MQ7.5A** | 2 | 3 | ± 3.75 | 20 | ± 18 | 1.0 | 2.0 | 70 | -910 | 850 // 6.0 | |
| | **21MQ15A** | 2 | 3 | ± 7.5 | 18 | ± 25 | 0.5 | 1.5 | 70 | -910 | 1500 // 2.5 | |
| | **21MQ15B** | 4 | 3 | ± 7.5 | 40 | ± 25 | 1.0 | 3.0 | 70 | -910 | 1800 // 0.35 | 5.0 |
| | **21MQ30A** | 2 | 3 | ± 15 | 15 | ± 50 | 1.5 | 2.0 | 60 | -910 | 2500 // 0 | |
| 21.700 | **21.7MQ15A** | 2 | 3 | ± 7.5 | 18 | ± 28 | 1.0 | 2.0 | 70 | -910 | 1500 // 2.5 | |
| 45.000 | **45MQ7.5A** | 2 | 3 | ± 3.75 | 15 | ± 18 | 1.0 | 2.0 | 70 | -910 | 350 // 6.0 | |
| | **45MQ7.5B** | 4 | 3 | ± 3.75 | 40 | ± 15 | 1.0 | 4.0 | 80 | -910 | 300 // 5.0 | 16.0 |
| | **45MQ15A** | 2 | 3 | ± 7.5 | 15 | ± 25 | 1.0 | 2.0 | 70 | -910 | 560 // 6.0 | |
| | **45MQ15B** | 4 | 3 | ± 7.5 | 30 | ± 25 | 1.0 | 3.0 | 80 | -910 | 800 // 1.7 | 8.0 |
| 50.850 | **50.85MQ15B** | 4 | 3 | ± 7.5 | 35 | ± 25 | 1.0 | 3.0 | 80 | -910 | 620 // 0.5 | 5.0 |

( Operating Temperature Range : -20°C to +70°C ; Storage Temperature Range : -40°C to +85°C )

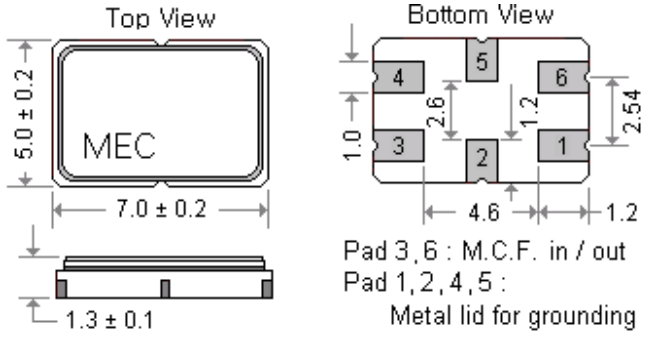
## Part Number Format and Example

| [1] | [2] | [3] | [4] |
|---|---|---|---|
| Center Freq. Code | Package | Pass band width | Poles code |

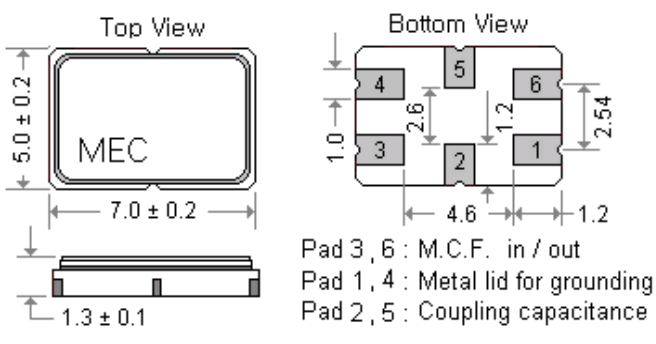
Ex (1) : 45MQ15B [ 45.000 MHz , SMD Type package , Pass band width ± 7.5KHz , 4 poles ]

| | |
|---|---|
| [1] | Center freq. code : " 21 " for 21.400MHz , " 21.7 " for 21.700MHz , " 45 " for 45.000MHz , " 50.85 " for 50.850MHz |
| [2] | " MQ " series for ( 7.0 * 5.0 * 1.3mm ) SMD Type package |
| [3] | Pass band width ( 3dB ) ( min. ) [ " 7.5 " for ± 3.75 KHz , " 15 " for ± 7.5 KHz , " 30 " for ± 15 KHz ] |
| [4] | Poles code [ " A " for 2 poles ] [ " B " for 4 poles ] |

### 2 poles Outline Dimensions ( Unit : mm )




### 4 poles Outline Dimensions ( Unit : mm )




M.C.F.

# M. C. F. [ Monolithic Crystal Filters ]

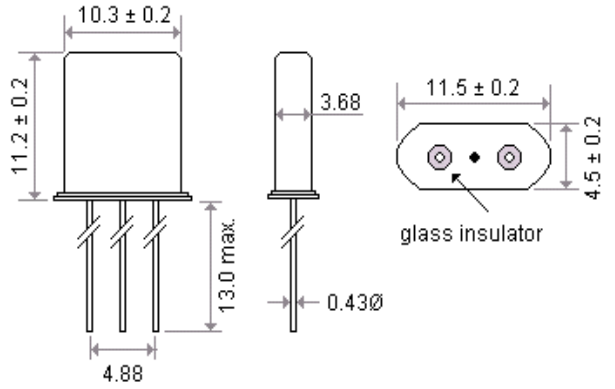
| 49T | Dip Type | Fundumental | 10.7 MHz | 2 poles | 4 poles | 6 poles | 8 poles |
|---|---|---|---|---|---|---|---|
| [ 11.5 * 4.5 * 11.2 mm ] | | | | | | | |

## Thru - Hole Type ( standard frequency 10.700 MHz )

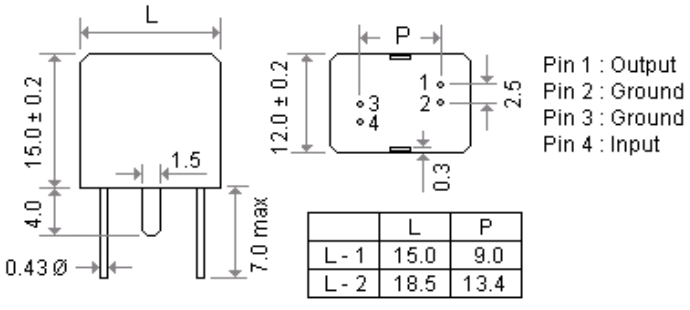
| Channel Spacing ( KHz ) | Model | No. of poles | Pass Bandwidth | | Stop Bandwidth | | Ripple | Insertion Loss | Guaranteed Attenuation | | Terminating Impedance | Package | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | dB | KHz (min.) | dB | KHz (max.) | dB (max.) | dB (max.) | dB | KHz | ohms // pF | Tandem set | One package |
| 12.5 | **10M7.5A** | 2 | 3 | ± 3.75 | 20 | ± 18 | 0.5 | 1.5 | 35 | ±300 ~ ±1000 | 1.8K // 5.0 | 49T | |
| | **10M7.5B** | 4 | 3 | ± 3.75 | 40 | ± 14 | 1.0 | 2.5 | 65 | ±300 ~ ±1000 | 1.8K // 4.5 | 49T a pair | |
| | **10M7.5C** | 6 | 3 | ± 3.75 | 45 | ± 8.75 | 2.0 | 3.5 | 65 | ±12.5 ~ ±300 | 1.8K // 3.5 | 49T 3 pcs | L1 |
| | **10M7.5D** | 8 | 3 | ± 3.75 | 65 | ± 8.75 | 2.0 | 4.0 | 90 | ±12.5 ~ ±300 | 1.8K // 3.5 | 49T 4 pcs | L2 |
| 20.0 | **10M12A** | 2 | 3 | ± 6.0 | 18 | ± 25 | 0.5 | 2.0 | 35 | ±300 ~ ±1000 | 2.5K // 2.5 | 49T | |
| | **10M12B** | 4 | 3 | ± 6.0 | 40 | ± 20 | 1.0 | 2.5 | 65 | ±300 ~ ±1000 | 2.5K // 1.5 | 49T a pair | |
| | **10M12C** | 6 | 3 | ± 6.0 | 45 | ± 15 | 2.0 | 4.0 | 65 | ±20 ~ ±300 | 2.5K // 1.5 | 49T 3 pcs | L1 |
| | **10M12D** | 8 | 3 | ± 6.0 | 65 | ± 15 | 2.0 | 2.0 | 90 | ±20 ~ ±300 | 2.5K // 1.5 | 49T 4 pcs | L2 |
| 25.0 | **10M15A** | 2 | 3 | ± 7.5 | 18 | ± 25 | 0.5 | 1.5 | 35 | ±300 ~ ±1000 | 3.0K // 2.0 | 49T | |
| | **10M15B** | 4 | 3 | ± 7.5 | 40 | ± 25 | 1.0 | 2.5 | 55 | ±300 ~ ±1000 | 3.0K // 1.5 | 49T a pair | |
| | **10M15C** | 6 | 3 | ± 7.5 | 45 | ± 18 | 2.0 | 3.0 | 65 | ±25 ~ ±300 | 3.3K // 1.5 | 49T 3 pcs | L1 |
| | **10M15D** | 8 | 3 | ± 7.5 | 65 | ± 18 | 2.0 | 4.0 | 90 | ±25 ~ ±300 | 3.3K // 1.5 | 49T 4 pcs | L2 |
| 50.0 | **10M30A** | 2 | 3 | ± 15 | 15 | ± 50 | 0.5 | 1.5 | 30 | ±300 ~ ±1000 | 5.0K // 0 | 49T | |
| | **10M30B** | 4 | 3 | ± 15 | 30 | ± 40 | 1.0 | 2.5 | 30 | ±300 ~ ±1000 | 5.5K // -1.0 | 49T a pair | |
| | **10M30C** | 6 | 3 | ± 15 | 60 | ± 45 | 2.0 | 3.0 | 65 | ±45 ~ ±300 | 5.5K // -1.0 | 49T 3 pcs | L1 |
| | **10M30D** | 8 | 3 | ± 15 | 60 | ± 30 | 2.0 | 3.5 | 90 | ±50 ~ ±300 | 5.5K // -1.0 | 49T 4 pcs | L2 |

## Part Number Format and Example

### 49T

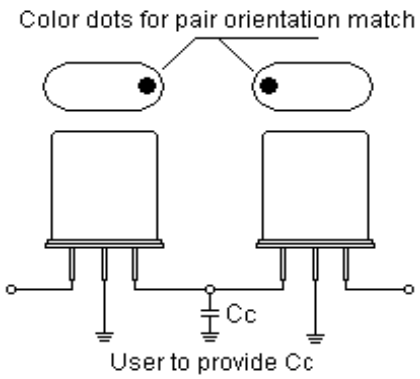



### ( L - 1 ) , ( L - 2 ) - - - One Package Type




| | L | P |
|---|---|---|
| L - 1 | 15.0 | 9.0 |
| L - 2 | 18.5 | 13.4 |

### 4 pole M.C.F. ( Paired packages , Tandem set )




M.C.F.

# M. C. F. [ Monolithic Crystal Filters ]

| U1 [ 7.8 * 3.1 * 8.0 mm ] | U5 [ 7.8 * 3.1 * 6.0 mm ] | Dip Type | Fund. | 21.4 MHz | 45.0 MHz | 2 poles | 4 poles | 6 poles | 8 poles |
|---|---|---|---|---|---|---|---|---|---|

## Thru - Hole Type ( standard frequency 21.400 MHz )

| Channel Spacing ( KHz ) | Model | No. of poles | Pass Bandwidth | | Stop Bandwidth | | Ripple | Insertion Loss | Guaranteed Attenuation | | Terminating Impedance | Package | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | dB | KHz (min.) | dB | KHz (max.) | dB (max.) | dB (max.) | dB | KHz | ohms // pF | Tandem set | One package |
| 12.5 | **21M7.5A** | 2 | 3 | ± 3.75 | 20 | ± 18 | 0.5 | 1.5 | 35 | ±300 ~ ±1000 | 850 // 6.0 | U-1 , U-5 | |
| | **21M7.5B** | 4 | 3 | ± 3.75 | 40 | ± 15 | 1.0 | 2.5 | 65 | ±300 ~ ±1000 | 850 // 5.0 | a pair ( U -1,U-5 ) | |
| | **21M7.5C** | 6 | 3 | ± 3.75 | 45 | ± 8.75 | 2.0 | 3.0 | 65 | ±12.5 ~ ±300 | 850 // 5.0 | 3 pcs | S1 |
| | **21M7.5D** | 8 | 3 | ± 3.75 | 65 | ± 8.75 | 2.0 | 4.0 | 90 | ±12.5 ~ ±300 | 850 // 5.0 | 4 pcs | S2 |
| 20.0 | **21M12A** | 2 | 3 | ± 6.0 | 20 | ± 25 | 0.5 | 1.5 | 35 | ±300 ~ ±1000 | 1.2K // 3.0 | U-1 , U-5 | |
| | **21M12B** | 4 | 3 | ± 6.0 | 40 | ± 20 | 1.0 | 2.5 | 65 | ±300 ~ ±1000 | 1.2K // 2.5 | a pair ( U -1,U-5 ) | |
| | **21M12C** | 6 | 3 | ± 6.0 | 45 | ± 15 | 2.0 | 3.0 | 65 | ±20 ~ ±300 | 1.2K // 2.5 | 3 pcs | S1 |
| | **21M12D** | 8 | 3 | ± 6.0 | 65 | ± 15 | 2.0 | 4.0 | 90 | ±20 ~ ±300 | 1.2K // 2.5 | 4 pcs | S2 |
| 25.0 | **21M15A** | 2 | 3 | ± 7.5 | 18 | ± 25 | 0.5 | 1.5 | 35 | ±300 ~ ±1000 | 1.5K // 2.0 | U-1 , U-5 | |
| | **21M15B** | 4 | 3 | ± 7.5 | 40 | ± 25 | 1.0 | 2.5 | 65 | ±300 ~ ±1000 | 1.5K // 2.0 | a pair ( U -1,U-5 ) | |
| | **21M15C** | 6 | 3 | ± 7.5 | 45 | ± 18 | 2.0 | 3.0 | 65 | ±25 ~ ±300 | 1.5K // 2.0 | 3 pcs | S1 |
| | **21M15D** | 8 | 3 | ± 7.5 | 65 | ± 18 | 2.0 | 4.0 | 90 | ±25 ~ ±300 | 1.5K // 2.0 | 4 pcs | S2 |
| 50.0 | **21M30A** | 2 | 3 | ± 15 | 15 | ± 45 | 0.5 | 1.5 | 35 | ±300 ~ ±1000 | 1.5K // 1.0 | U-1 , U-5 | |
| | **21M30B** | 4 | 3 | ± 15 | 40 | ± 50 | 1.0 | 2.5 | 65 | ±300 ~ ±1000 | 2.2K // 0.5 | a pair ( U -1,U-5 ) | |
| | **21M30C** | 6 | 3 | ± 15 | 45 | ± 35 | 2.0 | 3.0 | 65 | ±45 ~ ±300 | 2.2K // 0.5 | 3 pcs | S1 |
| | **21M30D** | 8 | 3 | ± 15 | 65 | ± 35 | 2.0 | 4.0 | 90 | ±50 ~ ±300 | 2.2K // 0.5 | 4 pcs | S2 |

## Thru - Hole Type [ standard frequency 45.000 MHz( Fundamental mode ) ] ; available frequency range ( 45.000 ~ 45.100 MHz )

| Channel Spacing ( KHz ) | Model | No. of poles | Pass Bandwidth | | Stop Bandwidth | | Ripple | Insertion Loss | Guaranteed Attenuation | | Terminating Impedance | Package Type | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | dB | KHz (min.) | dB | KHz (max.) | dB (max.) | dB (max.) | dB | KHz | ohms // pF | | |
| 12.5 | **45M7.5A** | 2 | 3 | ± 3.75 | 10 | ± 12.5 | 1.0 | 2.0 | 65 | ±300 ~ ±1000 | 200 // 4.0 | U5 | U1 |
| | **45M7.5B** | 4 | 3 | ± 3.75 | 30 | ± 12.5 | 1.0 | 4.0 | 80 | ±300 ~ ±1000 | 350 // 6.5 | U5 a pair | U1 a pair |
| 25.0 | **45M15A** | 2 | 3 | ± 7.5 | 15 | ± 25 | 1.0 | 2.0 | 35 | ±300 ~ ±1000 | 650 // 3.0 | U5 | U1 |
| | **45M15B** | 4 | 3 | ± 7.5 | 30 | ± 25 | 1.0 | 3.0 | 80 | ±300 ~ ±1000 | 650 // 3.0 | U5 a pair | U1 a pair |
| 50.0 | **45M30A** | 2 | 3 | ± 15 | 15 | ± 60 | 1.5 | 2.5 | 35 | ±300 ~ ±1000 | 1.2K // 0 | U5 | U1 |
| | **45M30B** | 4 | 3 | ± 15 | 30 | ± 50 | 1.0 | 3.0 | 80 | ±300 ~ ±1000 | 1.2K // 0.7 | U5 a pair | U1 a pair |

# M. C. F. [ Monolithic Crystal Filters ]

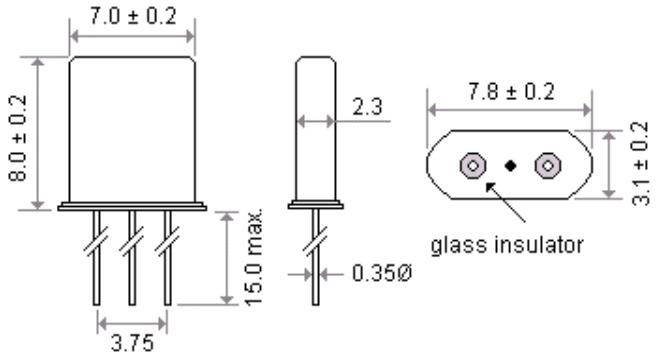
## Part Number Format and Example

| Dip Type Part Number Format | | | | |
|---|---|---|---|---|
| [ 1 ] | [ 2 ] | [ 3 ] | [ 4 ] | [ 5 ] |
| Frequency Code | M | Width Code | Poles Code | Holder Type |
| Examples | 21 | M | 15 | D | U5 |

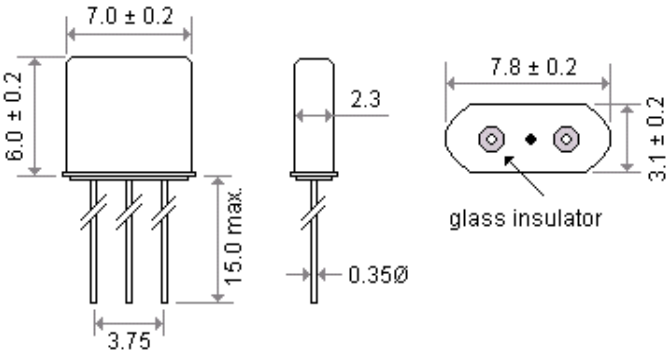
| | |
|---|---|
| [ 1 ] | Freq. code : " 10 " for 10.700MHz , " 21 " for 21.400MHz , " 45 " for 45.000MHz , " 50.85 " for 50.850MHz |
| | Freq. code : If none standard freq. please show freqency with one decimal point . |
| [ 2 ] | " M " Dip Type series , |
| [ 3 ] | Pass band width ( 3dB ) (min.) |
| | " 7.5 " for ± 3.75KHz , " 12 " for ± 6.0KHz , " 15 " for ± 7.5KHz , " 30 " for ± 15KHz , |
| [ 4 ] | No. of poles |
| | " A " for 2 poles , " B " for 4 poles , " C " for 6 poles , " D " for 8 poles |
| [ 5 ] | Dip type holder type |
| [ 6 ] | Standard operating temperature range is -20°C to 70°C , |
| | If non-standard please enter the desired temp. range after " / " , for example " / -30+70 " : -30°C to 70°C |

## Package Dimensions ( unit : mm )

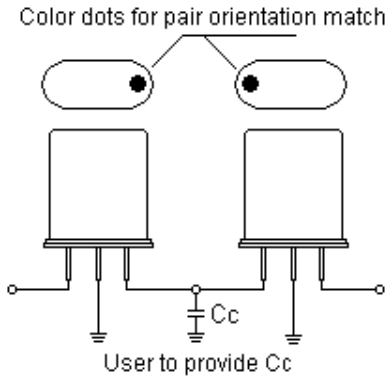
### [ U 1 ]



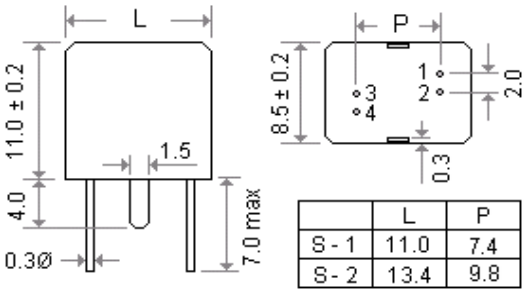

### [ U 5 ]




### 4 pole M.C.F. ( Paired packages , Tandem set )




### [ S - 1 ] , [ S - 2 ]




| | L | P |
|---|---|---|
| S - 1 | 11.0 | 7.4 |
| S - 2 | 13.4 | 9.8 |

# Part Number Formats and Product Marking Rules

## Quartz Crystals

### Holder Type

SMD type : X11 | X21 | X22 | X32 | MJ | MQ | M49 | ML49 | MP5 | MP4 | MP25 | MP24 | X2012 | X3215

Dip type : H49 | HUS | HUSL | U1 | U5 | T38 | T26

### Part Number Format and Example

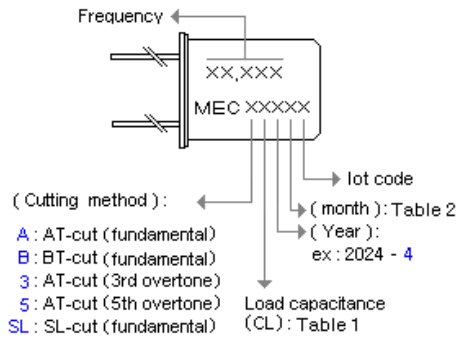
| | [ 1 ] Holder Type | - | [ 2 ] Center Freq. | - | [ 3 ] CL | - | [ 4 ] Freq . Tolerance | / | [ 5 ] Freq. Stability | [ 6 ] Operating Temp. Range Code | / | [ 7 ] Special ESR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example (1) | H49 | - | 40.000A3 | - | 12 | - | 30 | / | 30 | X | | |
| Example (2) | X32 | - | 26.000 | - | 16 | - | 30 | / | 30 | X | / | 20R |
| Example (3) | MJ | - | 12.000 | - | 20 | - | 10 | / | 10 | W | | |
| Example (4) | M49 | - | 24.000 | - | 18 | - | 20 | / | 30 | H | / | 15R |

Ex (1) : H49 - 40.000A3 - 12 - 30 / 30 X [ 49/U type , 40.000MHz , AT-cut 3rd overtone , 12pF , ±30ppm ( 25°C ) , ±30ppm ( -10°C to 60°C) ]
Ex (2) : X32 - 26.000 - 16 - 30 / 30 X / 20R [ X32 type , 26.000MHz , 16pF , ±30ppm ( 25°C ) , ±30ppm ( -10°C to 60°C) , 20 Ω ]
Ex (3) : MJ - 12.000 - 20 - 10 / 10 W [ MJ type , 12.000MHz , 20pF , ±10ppm ( 25°C ) , ±10ppm ( 0°C to 50°C ) ]
Ex (4) : M49 - 24.000 - 18 - 20 / 30 H / 15R [ M49 type , 24.000MHz , 18pF , ±20ppm ( 25°C ) , ±30ppm ( -30°C to 85°C ) , 15 Ω ]

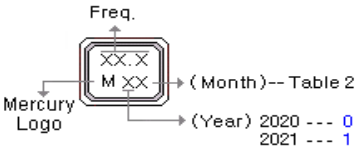
| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [ 1 ] | Holder Type | | | | | | | | | | | | |
| [ 2 ] | Center frequency . Please add " A3 , A5 or B " after the " Freq. in MHz " for the quartz cut other options . | | | | | | | | | | | | |
| | Blank : AT-cut fund. mode ; A3 : AT-cut 3rd overtone ; A5 : AT-cut 5th overtone ; B : BT-cut fund. mode ; SL : SL-cut fund. mode | | | | | | | | | | | | |
| [ 3 ] | Load Capacitance ( CL ) : series ( spec. code is " S " ) or | | | | | | | | | | | | |
| | Parallel ( If parallel , please specify CL value , typical CL ranges from 8 to 32 pF ) | | | | | | | | | | | | |
| | Available Options " V " = Vinyl sleeve around holder , " K " = 3rd lead at bottom center , " R " = On reel | | | | | | | | | | | | |
| | " G " = 3rd lead at top center , " I " = Teflon insulator at bottom | | | | | | | | | | | | |
| [ 4 ] | Calibration tolerance value : freq. tolerance value ( at 25°C ) , industrial temp. range | | | | | | | | | | | | |
| [ 5 ] | Frequency Stability , industrial temp. range | | | | | | | | | | | | |
| [ 6 ] | Temp. Range Options | W | 0°C ~ +50°C | X | -10°C ~ +60°C | Y | -20°C ~ +70°C | F | -30°C ~ +70°C | G | -10°C ~ +80°C | | |
| | | H | -30°C ~ +85°C | I | -40°C ~ +85°C | J | -40°C ~ +90°C | K | -40°C ~ +105°C | M | -55°C ~ +105°C | | |
| | | N | -55°C ~ +125°C | | | | | | | | | | |
| | Temp. Range is -10°C to 60°C , for example " X " | | | | | | | | | | | | |
| [ 7 ] | If non-standard please enter the desired Temp. Range after " / " , for example " -20 + 60 " : -20°C to 60°C | | | | | | | | | | | | |
| | If non-standard please enter the desired ESR ( Equivalent Series Resistance ) after " / " , for example " 20R " : 20Ω | | | | | | | | | | | | |

### Production Marking Rules

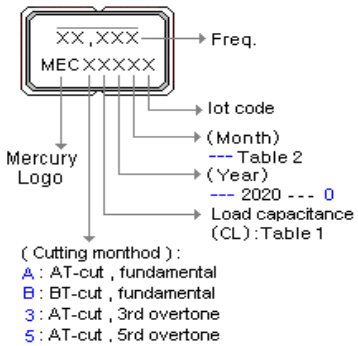
#### General X'tal package type marking rules



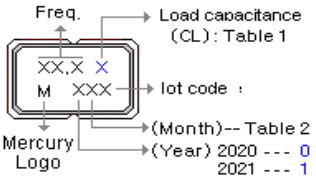

#### X11 marking rules



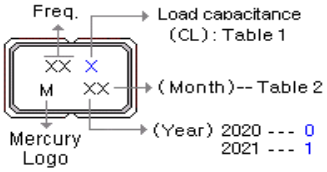

#### MQ , MJ marking rules




#### X22 , X32 marking rules




#### X21 marking rules




| Table 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CL | < 10 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | >34 | Series |
| Code | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | a | b |

| Table 2 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
| Code | A | B | C | D | E | F | G | H | I | J | K | L |

# Part Number Formats and Product Marking Rules

## Crystal Oscillators

### Holder Type

| Output Wave / Output Logic | Supply Voltage | Product Series | SMD types |
|---|---|---|---|
| Square Wave LVPECL | 2.5 / 3.3 | HPK x x x | x x x = 576 , 536 , 326 , 226 |
| | 3.3 | HPEK x x x | x x x = 576 , 536 , 326 , 226 |
| | 2.5 / 3.3 | HPJK x x x | x x x = 576 , 536 , 326 , 226 |
| | 2.5 / 3.3 | HPQN x x x | x x x = 576 , 536 , 326 |
| | 2.5 / 3.3 | HPQF x x x | x x x = 576 , 536 , 326 |
| | 2.5 / 3.3 | HPRK x x x | x x x = 576 , 536 , 326 , 226 |
| | 2.5 / 3.3 | HPJFN x x x | x x x = 578 , 538 , 328 |
| | 2.5 / 3.3 | HCPQF x x x | x x x = 576 , 536 , 326 |
| | 2.5 / 3.3 | HCPJFN x x x | x x x = 578 |
| Square Wave LVDS | 1.8 / 2.5 / 3.3 | HDK x x x | x x x = 576 , 536 , 326 , 226 |
| | 2.5 / 3.3 | HDEK x x x | x x x = 576 , 536 , 326 , 226 |
| | 1.8 / 2.5 / 3.3 | HDJK x x x | x x x = 576 , 536 , 326 , 226 |
| | 2.5 / 3.3 | HDQN x x x | x x x = 576 , 536 , 326 |
| | 2.5 / 3.3 | HDQF x x x | x x x = 576 , 536 , 326 |
| | 1.8 / 2.5 / 3.3 | HDRK x x x | x x x = 576 , 536 , 326 , 226 |
| | 1.8 / 2.5 / 3.3 | HDJFN x x x | x x x = 578 , 538 , 328 |
| | 2.5 / 3.3 | HCDQF x x x | x x x = 576 , 536 , 326 |
| | 1.8 / 2.5 / 3.3 | HCDJFN x x x | x x x = 578 |
| Square Wave HCSL | 1.8 / 2.5 / 3.3 | HCK x x x | x x x = 576 , 536 , 326 , 226 |
| | 2.5 / 3.3 | HCEK x x x | x x x = 576 , 536 , 326 , 226 |
| | 1.8 / 2.5 / 3.3 | HCJK x x x | x x x = 576 , 536 , 326 , 226 |
| | 2.5 / 3.3 | HCRK x x x | x x x = 576 , 536 , 326 , 226 |
| | 1.8 / 2.5 / 3.3 | HCJFN x x x | x x x = 578 , 538 , 328 |
| | 1.8 / 2.5 / 3.3 | HCCJFN x x x | x x x = 578 |
| Square Wave CML | 1.8 / 2.5 / 3.3 | HQJFN x x x | x x x = 578 , 538 , 328 |
| | 1.8 / 2.5 / 3.3 | HCQJFN x x x | x x x = 578 |
| Square Wave LPHCSL | 1.8 / 2.5 / 3.3 | HCLK x x x | x x x = 576 , 536 , 326 , 226 |

| Output Wave / Output Logic | Supply Voltage | Product Series | SMD types | Thru-Hole types |
|---|---|---|---|---|
| Square Wave CMOS | 1.8 / 2.5 / 3.3 / 5.0 | SWO | SWO | - - - - - |
| | 1.8 / 2.5 / 3.3 / 5.0 | H x x | x x = 53 , 32 , 22 , 21 | x x = 8,14 |
| | 1.8 / 2.5 / 3.3 / 5.0 | HG x x | - - - - - | |
| | 1.8 / 2.5 / 3.3 / 5.0 | HA x x | x x = 57 , 53 , 32 , 22 | |
| | 1.8 / 2.5 / 3.3 | HEA x x | x x = 57 , 53 , 32 , 22 | |
| | 1.8 / 2.5 / 3.3 | HJN x x | x x = 57 , 53 , 32 , 22 | |
| | 1.8 / 2.5 / 3.3 | HY x x | x x = 57 , 53 , 32 , 22 | |
| | 1.0 / 1.2 | HU x x | x x = 57 , 53 , 32 , 22 | |
| | 1.8 / 2.5 / 3.3 | HTF x x | x x = 57 , 53 , 32 , 22 , 21 | - - - - - |
| | 2.5 / 3.3 | HTQN x x x | x x x = 576 , 536 , 326 | |
| | 2.5 / 3.3 | HTQF x x x | x x x = 576 , 536 , 326 | |
| | 1.8 / 2.5 / 3.3 | HTJFN x x x | x x x = 578 , 538 | |
| | 2.5 / 3.3 | HCTQF x x x | x x x = 576 , 536 , 326 | |
| | 1.8 / 2.5 / 3.3 | HCTJFN x x x | x x x = 578 | |
| Square Wave True Sine | 3.3 / 5.0 | HS x x | - - - - - | x x = 14 |
| | 3.3 / 5.0 | HS x x | - - - - - | x x = 24 |

" x x x " = package code

### Part Number Format and Example

| | [ 1 ] Supply Voltage | [ 2 ] Holder Type | | [ 3 ] Frequency Stability | [ 4 ] OE Function | | [ 5 ] Center Frequency |
|---|---|---|---|---|---|---|---|
| EX. (1) | 25 | H32 | - | C20 | T | - | 100.000 |
| (2) | 3 | HDQN5761 | - | E | | - | 156.250 |

Ex (1) : 25H32 - C20T - 100.000 [ 2.5V , H32 type , OE on pin 1 , ±20ppm from -20°C to 70°C , 100.000MHz ]

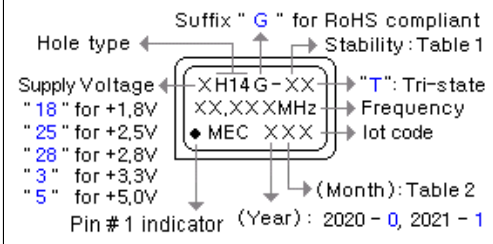
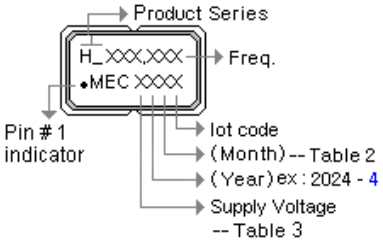
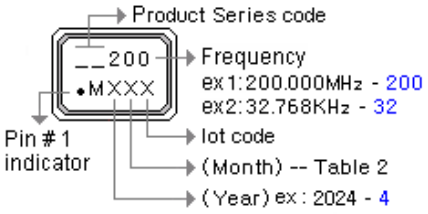
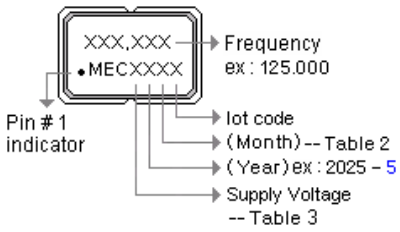
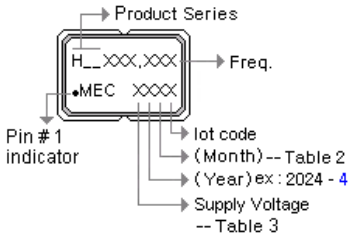
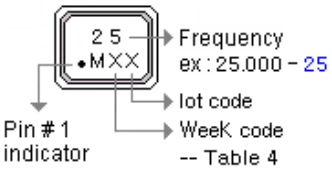
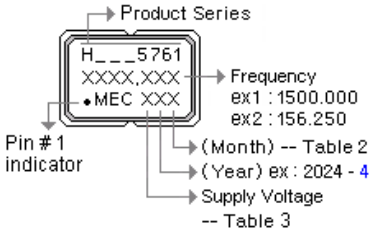
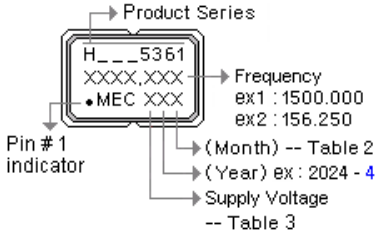
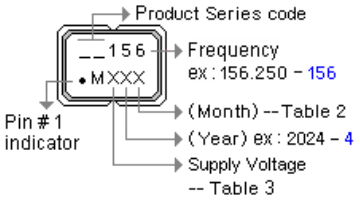
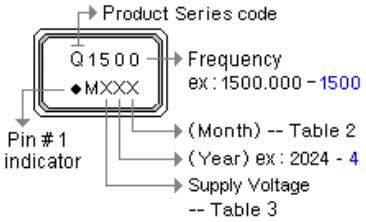
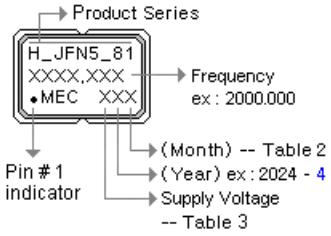
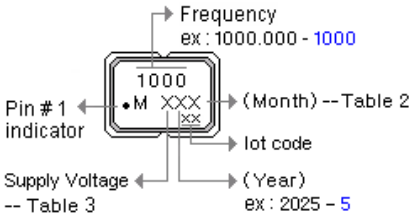
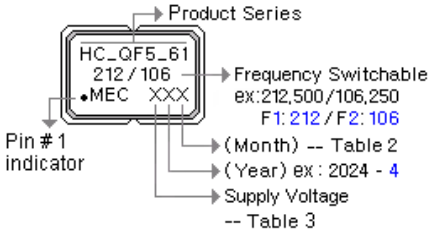
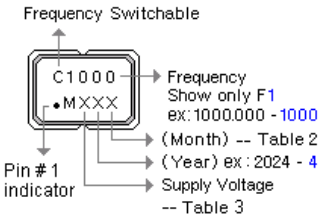
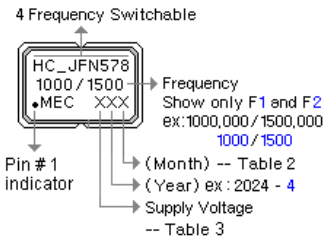
Ex (2) : 3HDQN5761 - E - 156.250 [ 3.3V , HDQN5761 type , OE on pin 1 , ±50ppm from -40°C to 85°C , 156.250MHz ]

| | | |
|---|---|---|
| [ 1 ] | Supply voltage , " 10 " for +1.0V ; " 12 " for +1.2V ; " 18 " for +1.8V ; " 25 " for +2.5V ; " 28 " for +2.8V ; " 3 " for +3.3V ; " 5 " for +5.0V | |
| [ 2 ] | Holder Type | |
| [ 3 ] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " C " , for example " C20 " : represents ±20ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " F " , for example " F30 " : represents ±30ppm over -40 to +85°C |
| | -40°C ~ 105°C | " G " ± 25ppm ; " H " ± 50ppm ; " J " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " J " , for example " J40 " : represents ±40ppm over -40 to +105°C |
| [ 4 ] | " T " for OE Function , Leave this space blank if no connection on pad 1. | |
| [ 5 ] | Frequency in MHz | |

# Part Number Formats and Product Marking Rules

## Crystal Oscillators

### Production Marking Rules

| H14 , H8 | H ( A , Y , U ) 57<br>H ( A , Y , U ) 53 | H ( A , Y , U , EA , JN , TF ) 32<br>H ( A , Y , U , EA , JN , TF ) 22 |
|---|---|---|
|  |  |  |
| SWO , H53 | H ( EA , JN , TF ) 57 , 53 | H21 , HTF21 |
|  |  |  |
| ( H_K , H_JK , H_EK , H_RK ) 5761<br>( H_QN , H_QF ) 5761 | ( H_K , H_JK , H_EK , H_RK ) 5361<br>( H_QN , H_QF ) 5361 | ( H_K , H_JK , H_EK , H_RK ) 3261<br>( H_K , H_JK , H_EK , H_RK ) 2261 |
|  |  |  |
| H_QN3261 , H_QF3261 | H_JFN5781 , H_JFN5381 | H_JFN3281 |
|  |  |  |
| HC__QF5761 , HC__QF5361 | HC__QF3261 | HC__JFN578 |
|  |  |  |

| | | |
|---|---|---|
| Table 1 | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " C " , for example " C20 " : represents ±20ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " F " , for example " F30 " : represents ±30ppm over -40 to +85°C |
| | -40°C ~ 105°C | " G " ± 25ppm ; " H " ± 50ppm ; " J " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " J " , for example " J40 " : represents ±40ppm over -40 to +105°C |

| Table 2 | Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Code | A | B | C | D | E | F | G | H | I | J | K | L |

| Table 3 | Supply Voltage | 5.0 V | 3.3 V | 3.0 V | 2.8 V | 2.5 V | 1.8 V | 1.5 V | 1.2 V | 1.0 V | 2.5~3.3 V |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | B | D | E | F | H | J | L | N | P | W |

# Part Number Formats and Product Marking Rules

## Spread Spectrum Low EMI Clock Oscillators

### Holder Type

| Type | SMD types | Waveform |
|---|---|---|
| HM x x | x x = 22 , 32 , 53 , 572 | square wave |

x x = package code

### Part Number Format and Example

| [ 1 ] | [ 2 ] | - | [ 3 ] | [ 4 ] | - | [ 5 ] | [ 6 ] | - | [ 7 ] |
|---|---|---|---|---|---|---|---|---|---|
| Supply Voltage | Holder Type | | Frequency Stability | OE Function | | Center Frequency | Group Type | | Spread type Percentage |
| Examples (1) 3 | HM572 | - | B | T | - | 10.000 | B | - | C1.5 |
| (2) 25 | HM53 | - | F | T | - | 75.000 | B | - | C2.0 |
| (3) 18 | HM32 | - | E | T | - | 25.000 | C | - | D1.0 |

Ex (1) : 3HM572 - BT - 10.000B - C1.5 [ 3.3V , HM572 type , ±50ppm from -20°C to 70°C , OE Function , 10.000MHz , B group , Center Spread 1.5% ]

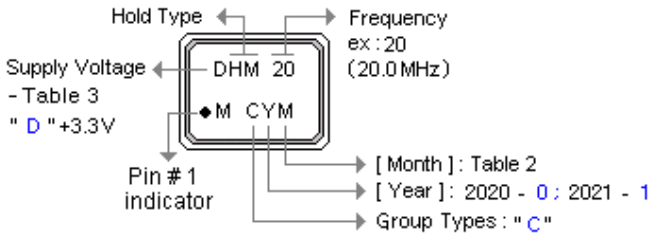
Ex (2) : 25HM53 - FT - 75.000B - C2.0 [ 2.5V , HM53 type , ±100ppm from -40°C to 85°C , OE Function , 75.000MHz , B group , Center Spread 2.0% ]

Ex (3) : 18HM32 - ET - 25.000C - D1.0 [ 1.8V , HM32 type , ±50ppm from -40°C to 85°C , OE Function , 25.000MHz , C group , Down Spread 1.0% ]

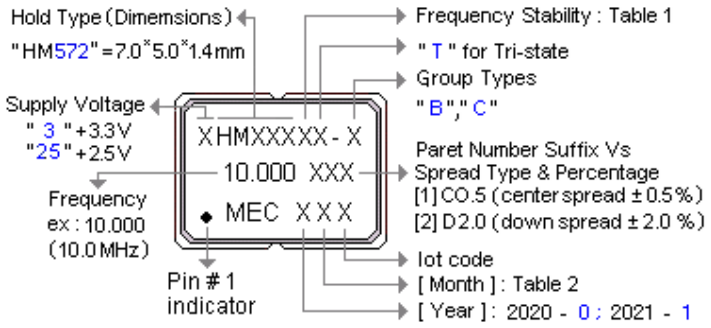
| | | |
|---|---|---|
| [ 1 ] | Supply Voltage , " 18 " for +1.8V ; " 25 " for +2.5V ; " 3 " for +3.3V | |
| [ 2 ] | Holder Type ( HM572 , HM53 , HM32 ) | |
| [ 3 ] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ; |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ; |
| [ 4 ] | " T " for OE Function | |
| [ 5 ] | Frequency in MHz | |
| [ 6 ] | Group " B " , " C " | |
| [ 7 ] | Spread type & percentage ; " C " for Center Spread , " D " for Down Spread | |

### Production Marking Rules

#### HM22 , HM32




#### HM572 , HM53




| | | |
|---|---|---|
| Table 1 | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ; |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ; |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Table 2 | Month | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
| | Code | A | B | C | D | E | F | G | H | I | J | K | L |

| | | | | |
|---|---|---|---|---|
| Table 3 | Supply Voltage | 3.3 V | 2.5 V | 1.8 V |
| | | D | H | J |

# Part Number Formats and Product Marking Rules

## [ VCXO ] Voltage Controlled Crystal Oscillators

### Holder Type

| Output Wave / Output Logic | Supply Voltage | Product Series | SMD types |
|---|---|---|---|
| Square Wave LVPECL | 2.5 / 3.3 | GPQN x x x | x x x = 576 , 536 , 326 |
| | 2.5 / 3.3 | GPQF x x x | x x x = 576 , 536 , 326 |
| | 2.5 / 3.3 | GCPQF x x x | x x x = 576 , 536 , 326 |
| | 2.5 / 3.3 | GPJFN x x x | x x x = 578 , 538 |
| Square Wave LVDS | 2.5 / 3.3 | GDQN x x x | x x x = 576 , 536 , 326 |
| | 2.5 / 3.3 | GDQF x x x | x x x = 576 , 536 , 326 |
| | 2.5 / 3.3 | GCDQF x x x | x x x = 576 , 536 , 326 |
| | 1.8 / 2.5 / 3.3 | GDJFN x x x | x x x = 578 , 538 |
| Square Wave HCSL | 1.8 / 2.5 / 3.3 | GCJFN x x x | x x x = 578 , 538 |
| Square Wave CML | 1.8 / 2.5 / 3.3 | GQJFN x x x | x x x = 578 , 538 |

| Output Wave / Output Logic | Supply Voltage | Product Series | SMD types | Thru-Hole types |
|---|---|---|---|---|
| Square Wave CMOS | 1.8 / 3.3 | G x x | - - - - - | x x = 8,14 |
| | 1.8 / 3.3 | G x x x | x x x = 576 , 536 , 326 , 226 | |
| | 2.5 / 3.3 | GTQN x x x | x x x = 576 , 536 , 326 | |
| | 2.5 / 3.3 | GTQF x x x | x x x = 576 , 536 , 326 | - - - - - |
| | 1.8 / 2.5 / 3.3 | GTJFN x x x | x x x = 578 , 538 | |
| | 2.5 / 3.3 | GCTQF x x x | x x x = 576 , 536 , 326 | |

" x x x " = package code

### Part Number Format and Example

| | [ 1 ] Supply Voltage | [ 2 ] Holder Type | - | [ 3 ] Frequency Stability | - | [ 4 ] Pulling Range | [ 5 ] Range Code | - | [ 6 ] Center Frequency |
|---|---|---|---|---|---|---|---|---|---|
| Ex. (1) | 18 | G14 | - | B | - | 80 | N | - | 35.328 |
| Ex. (2) | 3 | GTQF576 | - | C20 | - | 150 | M | - | 200.000 |

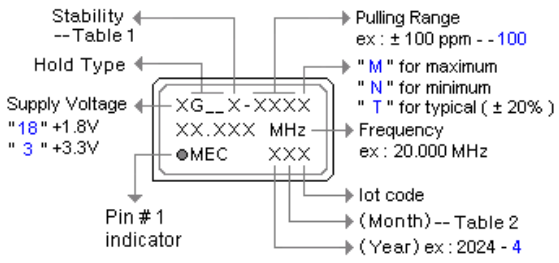
Ex (1) : 18G14 - B - 80N - 35.328 [ 1.8V , G14 type , ±50ppm from -20°C to 70°C , Pulling : ±80ppm ( min. ) , 35.328MHz ]

Ex (2) : 3GTQF576 - C20 - 150M - 200.000 [ 3.3V , GTQF576 type , ±20ppm from -20°C to 70°C , Pulling : ±150ppm ( max. ) , 200.000MHz ]

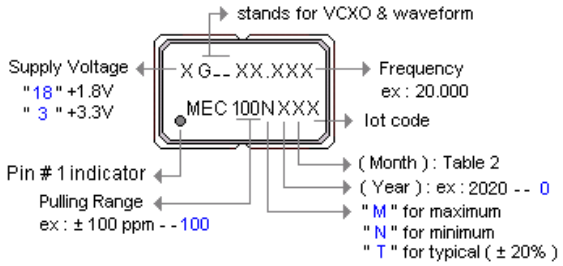
| | | |
|---|---|---|
| [ 1 ] | Supply voltage , " 18 " for +1.8V ; " 25 " for +2.5V ; " 3 " for +3.3V | |
| [ 2 ] | Holder Type | |
| [ 3 ] | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " C " , for example " C15 " : represents ±15ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ; |
| | | If non-standard please enter the desired stability after " F " , for example " F20 " : represents ±20ppm over -40 to +85°C |
| [ 4 ] | Freqency Pulling Range | |
| [ 5 ] | Pulling Range Code | " M " stands for maximum ; " N " stands for minimum ; " T " stands for typical ( tolerance is ± 20% ) |
| [ 6 ] | Center Frequency in MHz | |

### Production Marking Rules

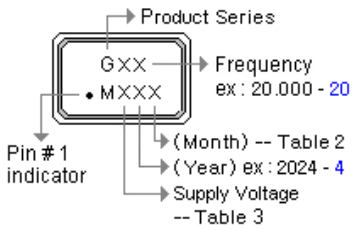
G_8 , G_14




G536 , G576




G_226 , G_326

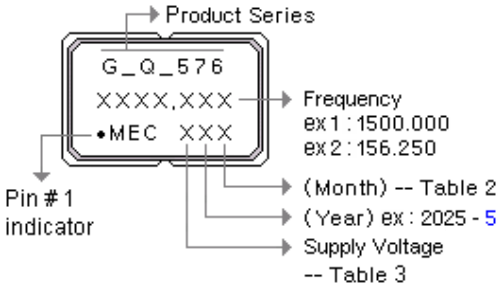


# Part Number Formats and Product Marking Rules

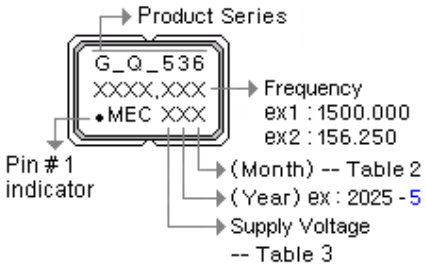
## [ VCXO ] Voltage Controlled Crystal Oscillators

### Production Marking Rules

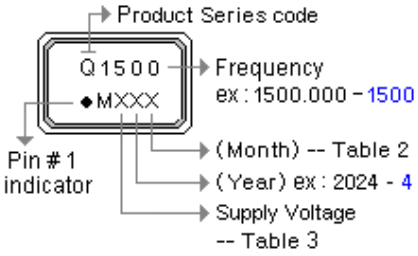
#### G_QF576 , G_QN576



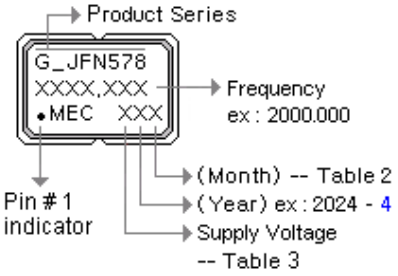

#### G_QF536 , G_QN536



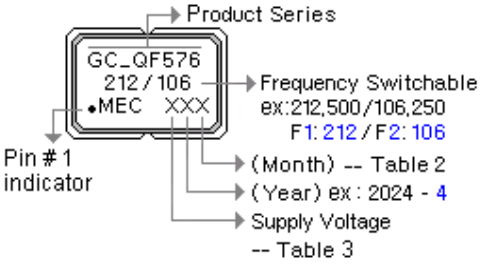

#### G_QF326 , G_QN326



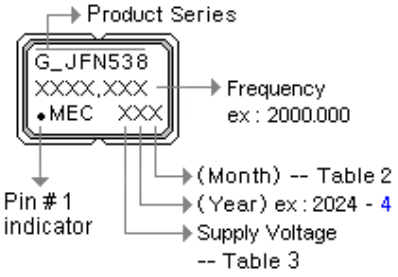

#### G_JFN578



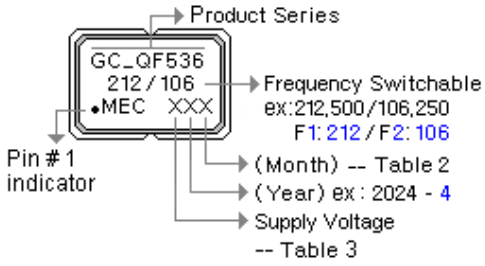

#### GC_QF576



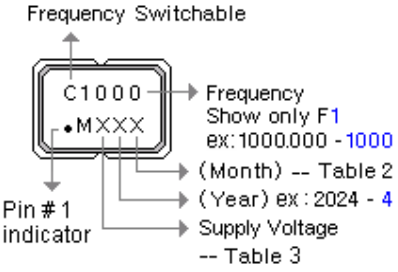

#### G_JFN538




#### GC_QF536




#### GC_QF326




| | | |
|---|---|---|
| Table 1 | -20°C ~ 70°C | " A " ± 25ppm ; " B " ± 50ppm ; " C " ± 100ppm ;<br>If non-standard please enter the desired stability after " C " , Ex : " C15 " : represents ±15ppm over -20 to +70°C |
| | -40°C ~ 85°C | " D " ± 25ppm ; " E " ± 50ppm ; " F " ± 100ppm ;<br>If non-standard please enter the desired stability after " F " , Ex : " F20 " : represents ±20ppm over -40 to +85°C |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Table 2 | Month | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
| | Code | A | B | C | D | E | F | G | H | I | J | K | L |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Table 3 | Supply Voltage | 5.0 V | 3.3 V | 3.0 V | 2.8 V | 2.5 V | 1.8 V | 1.5 V | 1.2 V | 1.0 V |
| | | B | D | E | F | H | J | L | N | P |

# Part Number Formats and Product Marking Rules

## [ TCXO vs VCTCXO ] Temperature Compensated Crystal Oscillators

### Holder Type

| Waveform | TCXO | VCTCXO | SMD types | Thru-Hole types |
|---|---|---|---|---|
| Clipped Sine Wave | M x x S | VM x x S | x x = 21 , 22 , 32 , 53 , 57 , 572 | x x = 8 , 9 , 14 , 15 , 39 |
| CMOS output | M x x T | VM x x T | x x = 32 , 53 , 572 | |
| | M x x 1 T | - - - - - | x x = 21 , 22 , 32 | - - - - - |
| | ME x x T | - - - - - | x x = 21 , 32 | |
| | MTF x x x T | VMTF x x x T | x x x = 326 , 538 | |
| | MQN x x x T | VMQN x x x T | x x x = 326 , 574 | |
| | MQF x x x T | VMQF x x x T | x x x = 326 , 574 | |
| LVPECL output | MJF x x x P | VMJF x x x P | x x x = 326 , 538 | |
| | MQN x x x P | VMQN x x x P | x x x = 326 , 576 | |
| | MQF x x x P | VMQF x x x P | x x x = 326 , 576 | - - - - - |
| LVDS output | MJF x x x D | VMJF x x x D | x x x = 326 , 538 | |
| | MQN x x x D | VMQN x x x D | x x x = 326 , 576 | |
| | MQF x x x D | VMQF x x x D | x x x = 326 , 576 | |
| HCSL output | MJF x x x C | VMJF x x x C | x x x = 326 , 538 | |
| CML output | MJF x x x Q | VMJF x x x Q | x x x = 326 , 538 | |

" x x x " = package code

### Part Number Format and Example

| | [ 1 ] Holder Type | [ 2 ] Output Wave | [ 3 ] Supply Voltage | - | [ 4 ] Center Frequency | - | [ 5 ] Frequency Stability | / | [ 6 ] Operating Temp. Range |
|---|---|---|---|---|---|---|---|---|---|
| Examples | (1) VM32 | T | 33 | - | 10.000 | - | 1.5 | / | -20+70 |
| | (2) M53 | S | 3 | - | 20.000 | - | 2.5 | / | -30+75 |
| | (3) MQN576 | P | 33 | - | 155.520 | - | 1.0 | / | 0+50 |

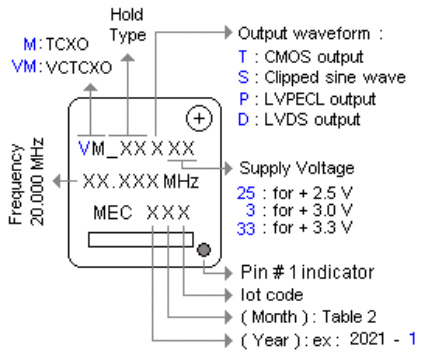
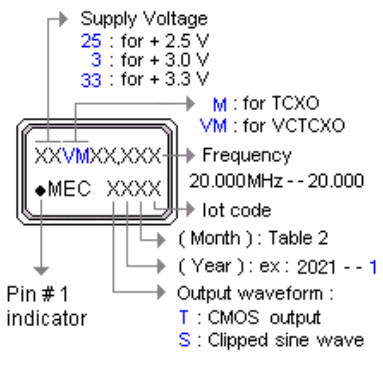
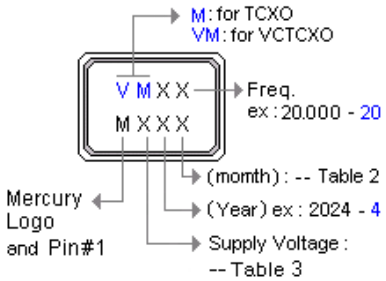
Ex (1) : VM32T33 - 10.000 - 1.5 / -20+70 [ VCTCXO , VM32 type , CMOS output , 3.3V , 10.000MHz , ±1.5ppm from -20°C to 70°C ]

Ex (2) : M53S3 - 20.000 - 2.5 / -30+75 [ TCXO , M53 type , Clipped Sine Wave , 3.0V , 20.000MHz , ±2.5ppm from -30°C to 75°C ]

Ex (3) : MQN576P33 - 155.520 -1.0 / 0+50 [ TCXO , MQN576 type , LVPECL differential , 3.3V , 155.520MHz , ±1.0ppm from 0°C to 50°C ]

| | |
|---|---|
| [ 1 ] | Holder Type |
| | " M " stands for TCXO , " VM " stands for VCTCXO |
| [ 2 ] | " S " stands for Clipped Sine Wave ; " T " stands for CMOS output ; " D " stands for LVDS differential ; " P " stands for LVPECL differential ; " C " stands for HCSL output ; " Q " stands for CML output |
| | ex 1 : VM32T --- TCXO , VM32 pcakage , CMOS output |
| [ 3 ] | Supply Voltage , " 18 " stands for +1.8V ; " 25 " stands for +2.5V ; " 3 " stands for +3.0V ; " 33 " stands for +3.3V |
| [ 4 ] | Center Frequency in MHz |
| [ 5 ] | Frequency stability in ± _ ppm ; ex 1 : ± 1.5ppm --- 1.5 , ex 2 : ± 2.5ppm --- 2.5 , ex 3 : ± 1.0ppm --- 1.0 |
| [ 6 ] | Operating temperature range in °C |
| | ex 1 : -20 °C to 70 °C ----- -20+70 ; ex 2 : -30 °C to 75 °C ----- -30+75 ; ex 3 : 0 °C to 50 °C ----- 0+50 |

### Production Marking Rules

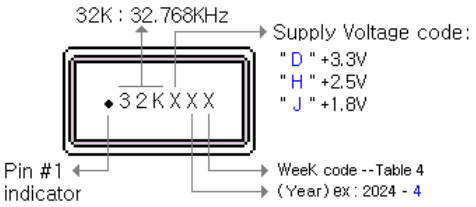
| General ( VC )TCXO pcakage types marking rules | ( V )M572_ | ( V )M32_ , ( V )M22_ , ( V )M21_ |
|---|---|---|
|  |  |  |

# Part Number Formats and Product Marking Rules

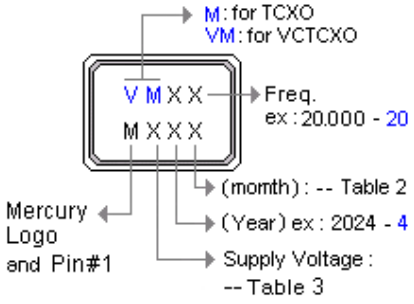
## [ TCXO vs VCTCXO ] Temperature Compensated Crystal Oscillators

### Production Marking Rules

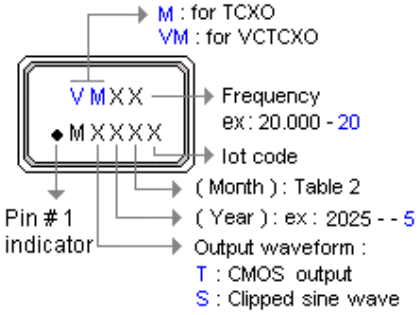
#### ME32 , ME21



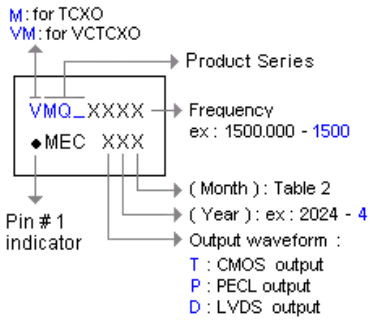

#### M321T , M211T , M221T



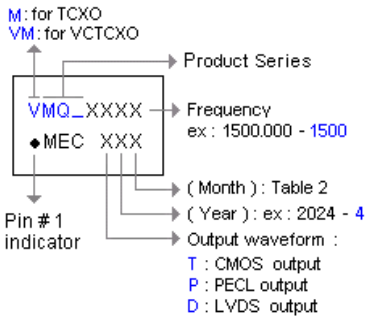

#### ( V )M57_ , ( V )M53_



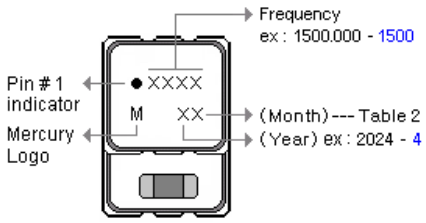

#### (V)MQN574_ , (V)MQF574_



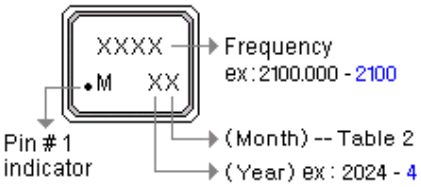

#### (V)MQN576_ , (V)MQF576_



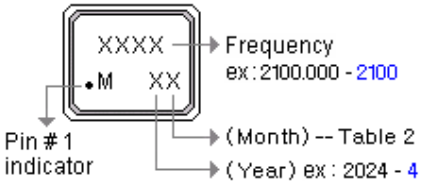

#### (V)MQF326_ , (V)MQN326_ , (V)MTF326_




#### (V)MJF538_ , (V)MTF538_




#### (V)MJF326_




| Table 2 | Month | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Code | A | B | C | D | E | F | G | H | I | J | K | L |

| Table 3 | Supply | 5.0 V | 3.3 V | 3.0 V | 2.8 V | 2.5 V | 1.8 V | 1.5 V | 1.2 V | 1.0 V |
|---|---|---|---|---|---|---|---|---|---|---|
| | Voltage | B | D | E | F | H | J | L | N | P |

| Table 4 Week Code | Week | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Code | A | B | C | D | E | F | G | H | I | J | K | L | M |
| | Week | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| | Code | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
| | Week | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| | Code | a | b | c | d | e | f | g | h | i | j | k | l | m |
| | Week | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 |
| | Code | n | o | p | q | r | s | t | u | v | w | x | y | z |

# Part Number Formats and Product Marking Rules

## [ OCXO ] Oven Controlled Crystal Oscillators

### Holder Type

| Type | Thru-Hole types | SMD types | Waveform |
|---|---|---|---|
| OC x x | x x = 13 , 14 , 18 , 19 , 32 | x x = 12 , 41 , 51 | Square Wave ; True Sine Wave ; Clipped Sine Wave |

### Part Number Format and Example

| [ 1 ] | [ 2 ] | [ 3 ] | | [ 4 ] | | [ 5 ] | | [ 6 ] |
|---|---|---|---|---|---|---|---|---|
| Holder Type | Output Wave | Supply Voltage | - | Center Frequency | - | Frequency Stability | / | Operating Temp. Range |

| Examples | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (1) | OC14 | T | 5 | - | 5.000 | - | 10 | / | -40+85 |
| (2) | OC18 | E | 5 | - | 100.000 | - | 100 | / | -30+70 |
| (3) | OC51 | S | 3 | - | 10.000 | - | 30 | / | -20+70 |
| (4) | OC12 | E | 3 | - | 10.000 | - | 200 | / | 0+70 |

Ex (1) : OC14T5 - 5.000 - 10 / -40+85 [ OC14 type , Square Wave , 5.0V , 5.000MHz , ± 10ppb from -40°C to 85°C ]

Ex (2) : OC18E5 - 100.000 - 100 / -30+70 [ OC18 type , True Sine Wave , 5.0V , 100.000MHz , ± 100ppb from -30°C to 70°C ]

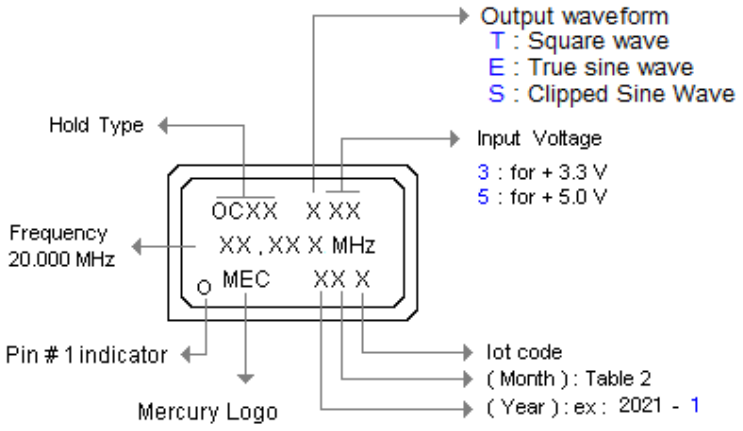
Ex (3) : OC51S3 - 10.000 - 30 / -20+70 [ OC51 type , Clipped Sine Wave , 3.3V , 10.000MHz , ± 30ppb from -20°C to 70°C ]

Ex (4) : OC12E3 - 10.000 - 200 / 0+70 [ OC12 type , True Sine Wave , 3.3V , 10.000MHz , ± 200ppb from 0°C to 70°C ]

| | |
|---|---|
| [ 1 ] | Holder Type |
| | " OC_ _ " stands for OCXO , |
| [ 2 ] | " T " stands for Square Wave , " E " stands for True Sine Wave , " S " stands for Clipped Sine Wave |
| | ex 1 : OC14T , OC14 package , Square Wave ; ex 2 : OC18E , OC18 package , True Sine Wave ; |
| | ex 3 : OC51S , OC51 package , Clipped Sine Wave ; ex 4 : OC12E , OC12 package , True Sine Wave |
| [ 3 ] | Supply voltage , " 5 " for 5.0V D.C , " 3 " for 3.3V D.C |
| [ 4 ] | Center Frequency in MHz |
| [ 5 ] | Frequency stability in ± _ ppb ; ex 1 : ±10ppb --- 10 , ex 2 : ± 100ppb --- 100 , ex 3 : ± 30ppb --- 30 , ex 4 : ± 200ppb --- 200 |
| [ 6 ] | Operating temperature range in °C |
| | ex 1 : -40 °C to 85°C ----- -40+85 ; ex 2 : -30 °C to 70°C ----- -30+70 ; ex 3 : -20 °C to 70°C ----- -20+70 ; ex 4 : 0 °C to 70°C ----- 0+70 |

### Production Marking Rules

#### General OCXO package types marking rules




| Table 2 | Month | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Code | A | B | C | D | E | F | G | H | I | J | K | L |

# Part Number Formats and Product Marking Rules

## [ M. C. F. ] Monolithic Crystal Filters

### Holder Type

SMD Types : MQ

Dip Types : 49T | U1 | U5 | S1 | S2 | L1 | L2

### SMD Type ( 7.0 * 5.0 * 1.3 mm ) Part Number Format and Example

| | [ 1 ] | [ 2 ] | [ 3 ] | [ 4 ] |
|---|---|---|---|---|
| | Frequency Code | MQ | Width Code | Poles Code |
| Examples | 45 | MQ | 15 | B |

Ex : 45MQ15B [ 45.000MHz , SMD type MQ , Passband : ±7.5KHz , 4poles ]

### Dip Type Part Number Format and Example

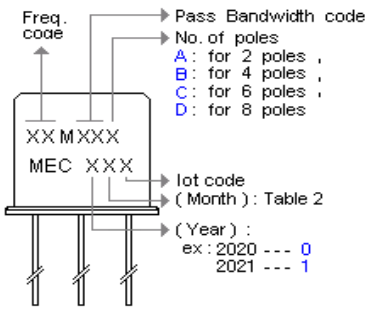
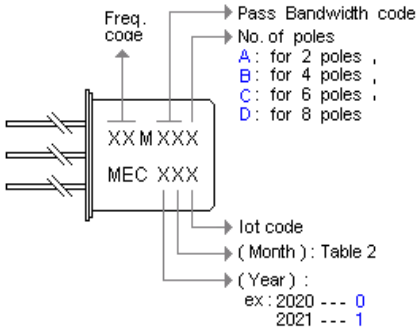
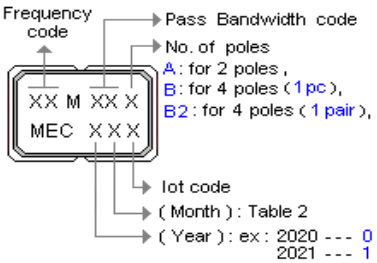
| | [ 1 ] | [ 2 ] | [ 3 ] | [ 4 ] | [ 5 ] | [ 6 ] |
|---|---|---|---|---|---|---|
| | Frequency Code | M | Width Code | Poles Code | Holder Type | Temperature range |
| Examples | 21 | M | 15 | B | U5 | |

Ex : 21M15BU5 [ 21.400MHz , Dip Type , Passband : ±7.5KHz , 4poles , RoHS compliant , U5 Dip type ]

| | |
|---|---|
| [ 1 ] | Freq. code : " 10 " for 10.700MHz , " 21 " for 21.400MHz , " 21.7 " for 21.700MHz , " 45 " for 45.000MHz , " 50.85 " for 50.850MHz |
| | Freq. code : If none standard freq. please show freqency with one decimal point . |
| [ 2 ] | " M " Dip Type , " MQ " SMD Type |
| [ 3 ] | Pass band width ( 3dB ) (min.) |
| | " 7.5 " for ± 3.75KHz , " 15 " for ± 7.5KHz , " 20 " for ± 10KHz , " 30 " for ± 15KHz , |
| [ 4 ] | No. of poles |
| | " A " for 2 poles , " B " for 4 poles , " C " for 6 poles , " D " for 8 poles |
| [ 5 ] | Dip type holder type |
| [ 6 ] | Standard operating temperature range is -20°C to 70°C , |
| | If non-standard please enter the desired temp. range after " / " , for example " / -30+70 " : -30°C to 70°C |

### Production Marking Rules

General MCF package types marking rules

| U5 series | U1 , 49T series | MQ series |
|---|---|---|
|  |  |  |

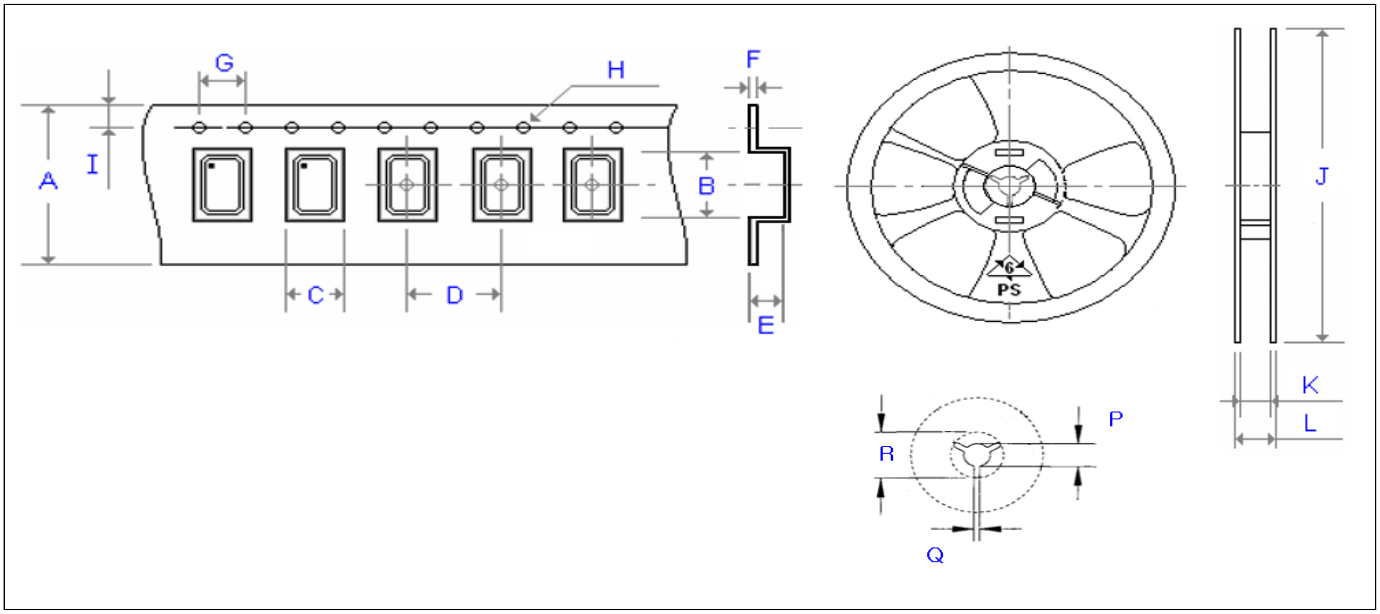




| Table 2 | Month | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Code | A | B | C | D | E | F | G | H | I | J | K | L |

# Emboss Taping and Reel Specifications

| [ Crystal Units ] | [ M . C . F . Units ] |
|---|---|




## Carrier Type Dimensions ( unit : mm ) ±0.3mm

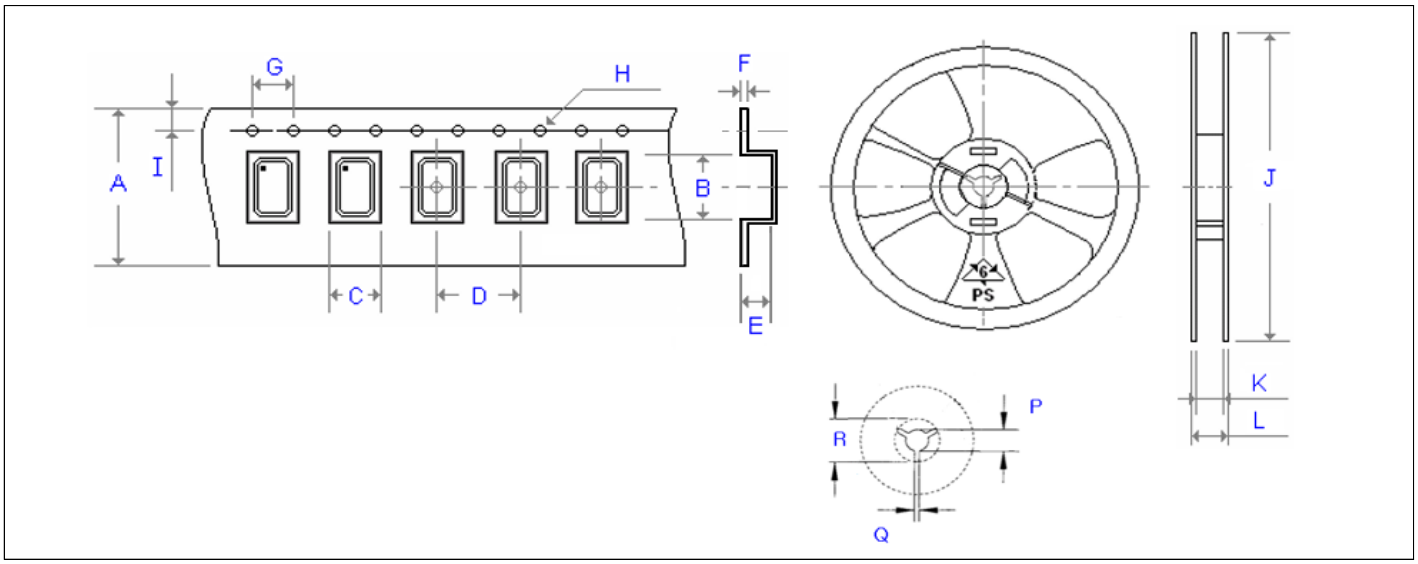
| | A | B | C | D | E | F | G | H | I | pcs / reel |
|---|---|---|---|---|---|---|---|---|---|---|
| X11 | 8.00 | 1.79 | 1.39 | 4.00 | 0.45 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| X21 | 8.00 | 2.30 | 1.90 | 4.00 | 0.60 | 0.20 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| X22 | 8.00 | 2.80 | 2.25 | 4.00 | 1.10 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| X32 | 8.00 | 3.40 | 2.70 | 4.00 | 1.40 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| X2012 | 8.00 | 2.25 | 1.45 | 4.00 | 0.75 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| X3215 | 12.00 | 3.40 | 1.70 | 4.00 | 1.00 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| MJ | 12.00 | 5.30 | 3.60 | 8.00 | 1.40 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| MQ | 16.00 | 7.20 | 5.40 | 8.00 | 1.80 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| M49 | 24.00 | 15.00 | 5.00 | 12.00 | 4.25 | 0.40 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| ML49 | 24.00 | 14.80 | 5.00 | 12.00 | 3.50 | 0.40 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| MP4 ( 24 ) | 24.00 | 13.30 | 5.10 | 12.00 | 4.20 | 0.40 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| MP5 ( 25 ) | 24.00 | 13.40 | 5.10 | 12.00 | 5.20 | 0.40 | 4.00 | Ø 1.50 | 1.75 | 1000 |

## Reel Dimensions ( unit : mm ) +2.0 / -0.0mm

| | J | K | L | P | Q | R | pcs / reel |
|---|---|---|---|---|---|---|---|
| X11 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| X21 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| X22 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| X32 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| X2012 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| X3215 | 180.00 | 13.00 | 16.00 | 13.20 | 2.50 | - | 3000 |
| MJ | 180.00 | 13.00 | 16.00 | 13.20 | 2.50 | - | 1000 |
| MQ | 180.00 | 17.20 | 19.30 | 13.30 | 2.20 | 22.00 | 1000 |
| M49 | 330.00 | 24.50 | 29.10 | 13.00 | 2.20 | 17.30 | 1000 |
| ML49 | 330.00 | 24.50 | 29.10 | 13.00 | 2.20 | 17.30 | 1000 |
| MP4 ( 24 ) | 330.00 | 24.50 | 29.10 | 13.00 | 2.20 | 17.30 | 1000 |
| MP5 ( 25 ) | 330.00 | 24.50 | 29.10 | 13.00 | 2.20 | 17.30 | 1000 |

# Emboss Taping and Reel Specifications

## [ Crystal Oscillator Units ]




### Carrier Type Dimensions ( unit : mm ) ±0.3mm

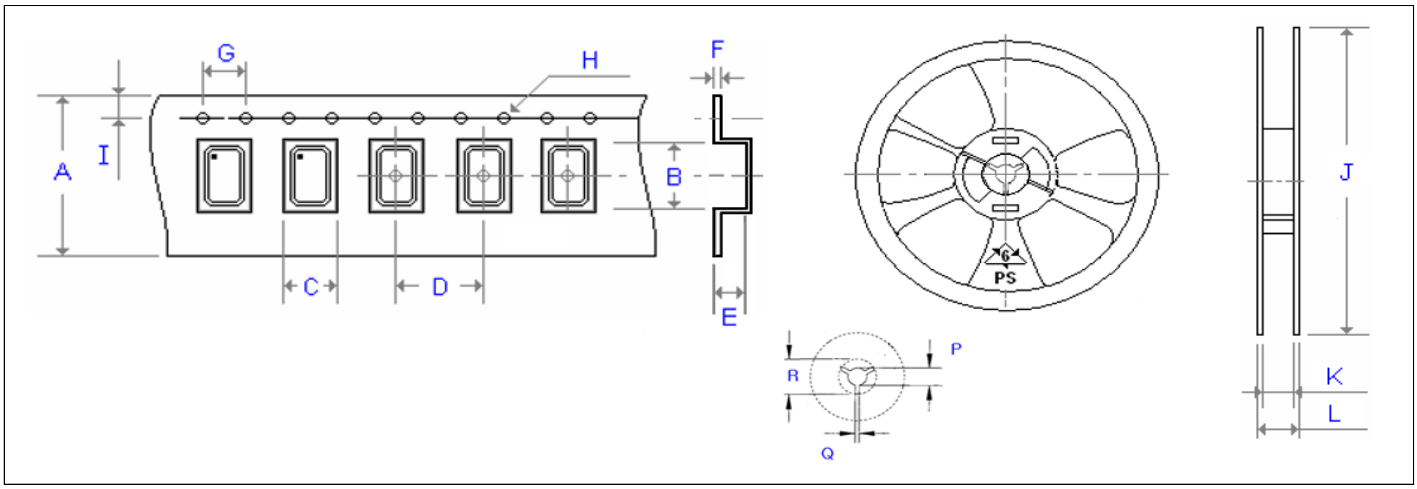
| | A | B | C | D | E | F | G | H | I | pcs / reel |
|---|---|---|---|---|---|---|---|---|---|---|
| H21 | 8.00 | 2.30 | 1.90 | 4.00 | 0.90 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| H_22 | 8.00 | 2.80 | 2.25 | 4.00 | 1.10 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| H_32 | 8.00 | 3.40 | 2.70 | 4.00 | 1.40 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| H_53 | 12.00 | 5.30 | 3.60 | 8.00 | 1.40 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| H_57 | 16.00 | 7.30 | 5.30 | 8.00 | 1.90 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| SWO | 16.00 | 7.20 | 5.40 | 8.00 | 1.80 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| H _ 216 | 8.00 | 2.30 | 1.90 | 4.00 | 0.90 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| H _ 226 | 8.00 | 2.80 | 2.25 | 4.00 | 1.10 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| H _ 326 | 8.00 | 3.40 | 2.70 | 4.00 | 1.40 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| H _ 536 | 12.00 | 5.30 | 3.60 | 8.00 | 1.40 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| H _ 576 | 16.00 | 7.30 | 5.30 | 8.00 | 1.90 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| H _ 328 | 8.00 | 3.40 | 2.70 | 4.00 | 1.40 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| H _ 538 | 12.00 | 5.40 | 3.60 | 8.00 | 1.70 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| H _ 578 | 16.00 | 7.30 | 5.30 | 8.00 | 1.90 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| H_43 | 24.00 | 11.80 | 10.00 | 16.00 | 5.00 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 500 |

### Reel Dimensions ( unit : mm ) +2.0 / -0.0mm

| | J | K | L | P | Q | R | pcs / reel |
|---|---|---|---|---|---|---|---|
| H21 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| H_22 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| H_32 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| H_53 | 180.00 | 13.00 | 16.00 | 13.20 | 2.50 | - | 1000 |
| H_57 | 180.00 | 17.20 | 19.30 | 13.30 | 2.20 | 22.00 | 1000 |
| SWO | 180.00 | 17.20 | 19.30 | 13.30 | 2.20 | 22.00 | 1000 |
| H _ 216 | 178.00 | 8.40 | 11.40 | 13.30 | 2.50 | 20.50 | 3000 |
| H _ 226 | 180.00 | 8.40 | 11.40 | 13.20 | 2.10 | - | 3000 |
| H _ 326 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| H _ 536 | 180.00 | 13.00 | 16.00 | 13.20 | 2.50 | - | 1000 |
| H _ 576 | 180.00 | 17.20 | 19.30 | 13.30 | 2.20 | 22.00 | 1000 |
| H _ 328 | 180.00 | 8.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| H _ 538 | 180.00 | 13.00 | 16.00 | 13.20 | 2.50 | - | 1000 |
| H _ 578 | 180.00 | 17.20 | 19.30 | 13.30 | 2.20 | 22.00 | 1000 |
| H_43 | 330.00 | 24.50 | 29.10 | 13.00 | 2.20 | 17.30 | 500 |

# Emboss Taping and Reel Specifications

| [ VCXO ] | [ ( VC )TCXO ] |
|---|---|




## Carrier Type Dimensions ( unit : mm ) ±0.3mm

| | A | B | C | D | E | F | G | H | I | pcs / reel |
|---|---|---|---|---|---|---|---|---|---|---|
| G_226 | 8.00 | 2.80 | 2.25 | 4.00 | 1.10 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| G_326 | 8.00 | 3.40 | 2.70 | 4.00 | 1.40 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| G_536 | 12.00 | 5.30 | 3.60 | 8.00 | 1.40 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| G_576 | 16.00 | 7.30 | 5.30 | 8.00 | 1.90 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| G_538 | 12.00 | 5.40 | 3.60 | 8.00 | 1.70 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| G_578 | 16.00 | 7.30 | 5.30 | 8.00 | 1.90 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| (V)M21 | 8.00 | 2.30 | 1.90 | 4.00 | 0.90 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| ME21 | 8.00 | 2.30 | 1.50 | 4.00 | 1.35 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| (V)M22 | 8.00 | 2.80 | 2.25 | 4.00 | 1.10 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| (V)M_32 | 8.00 | 3.71 | 2.80 | 4.00 | 1.75 | 0.25 | 4.00 | Ø 1.50 | 1.75 | 3000 |
| (V)M_326 | 12.00 | 3.60 | 2.90 | 4.00 | 1.70 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| (V)M_53 | 12.00 | 5.30 | 3.60 | 8.00 | 1.40 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| (V)M_538 | 12.00 | 5.40 | 3.60 | 8.00 | 1.70 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 1000 |
| (V)M_57(2) | 16.00 | 7.40 | 5.50 | 8.00 | 2.80 | 0.35 | 4.00 | Ø 1.50 | 1.75 | 500 |
| (V)M_43 (63) | 24.00 | 11.80 | 10.00 | 16.00 | 5.00 | 0.30 | 4.00 | Ø 1.50 | 1.75 | 500 |

## Reel Dimensions ( unit : mm ) +2.0 / -0.0mm

| | J | K | L | P | Q | R | pcs / reel |
|---|---|---|---|---|---|---|---|
| G_226 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| G_326 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| G_536 | 180.00 | 13.00 | 16.00 | 13.20 | 2.50 | - | 1000 |
| G_576 | 180.00 | 17.20 | 19.30 | 13.30 | 2.20 | 22.00 | 1000 |
| G_538 | 180.00 | 13.00 | 16.00 | 13.20 | 2.50 | - | 1000 |
| G_578 | 180.00 | 17.20 | 19.30 | 13.30 | 2.20 | 22.00 | 1000 |
| (V)M21 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| ME21 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| (V)M22 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| (V)M_32 | 180.00 | 9.00 | 12.00 | 13.20 | 2.10 | - | 3000 |
| (V)M_326 | 180.00 | 13.00 | 16.00 | 13.20 | 2.50 | - | 1000 |
| (V)M_53 | 180.00 | 13.00 | 16.00 | 13.20 | 2.50 | - | 1000 |
| (V)M_538 | 180.00 | 13.00 | 16.00 | 13.20 | 2.50 | - | 1000 |
| (V)M_57(2) | 180.00 | 17.20 | 19.30 | 13.30 | 2.20 | 22.00 | 500 |
| (V)M_43 (63) | 330.00 | 24.50 | 29.10 | 13.00 | 2.20 | 17.30 | 500 |

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