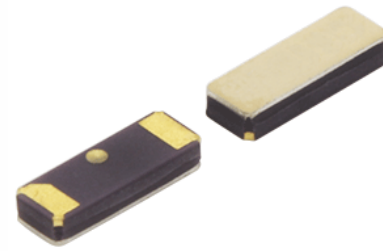


# TF415 Series Tuning Fork Crystal

## Features

- 32.7680kHz Frequency Reference
- Tuning Fork Crystal Design
- Hermetic Ceramic Surface Mount Package
- Ideal for High Density Circuit Boards
- Frequency Tolerance,  $\pm 20$ ppm Standard
- Parabolic Temperature Coefficient
- Tape and Reel Packaging, EIA-418



Part Dimensions:  
4.1 × 1.5 × 0.9mm • 16.3059mg

## Applications

- Real Time Clock Reference
- FPGAs & Microcontrollers
- Wireless Communications
- Consumer Electronics
- Computer Peripherals
- IoT Applications
- Instrumentation
- Industrial Electronics

## Description

CTS TF415 Series is ideal for supporting wide range of electronic designs requiring a Real Time Clock reference. This series will support general commercial and industrial applications.

## Ordering Information

Model	Frequency Tolerance	Load Capacitance	Frequency Code [kHz]	Packaging															
TF 415	2	P	32K7680	R															
<table border="1"> <thead> <tr> <th>Code</th> <th>Package</th> </tr> </thead> <tbody> <tr> <td>415</td> <td>4.1x1.5mm</td> </tr> </tbody> </table>		Code	Package	415	4.1x1.5mm	<table border="1"> <thead> <tr> <th>Code</th> <th>Capacitance</th> </tr> </thead> <tbody> <tr> <td>P</td> <td>12.5pF</td> </tr> <tr> <td>J</td> <td>9pF</td> </tr> </tbody> </table>		Code	Capacitance	P	12.5pF	J	9pF	<table border="1"> <thead> <tr> <th>Code</th> <th>Packing</th> </tr> </thead> <tbody> <tr> <td>R</td> <td>3k pcs./reel</td> </tr> </tbody> </table>		Code	Packing	R	3k pcs./reel
Code	Package																		
415	4.1x1.5mm																		
Code	Capacitance																		
P	12.5pF																		
J	9pF																		
Code	Packing																		
R	3k pcs./reel																		
<table border="1"> <thead> <tr> <th>Code</th> <th>@ +25°C</th> </tr> </thead> <tbody> <tr> <td>2</td> <td><math>\pm 20</math>ppm</td> </tr> <tr> <td>1</td> <td><math>\pm 10</math>ppm<sup>1</sup></td> </tr> </tbody> </table>		Code	@ +25°C	2	$\pm 20$ ppm	1	$\pm 10$ ppm <sup>1</sup>	<table border="1"> <thead> <tr> <th>Code</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td colspan="2">Product Frequency Code<sup>2</sup></td> </tr> </tbody> </table>			Code	Frequency	Product Frequency Code <sup>2</sup>						
Code	@ +25°C																		
2	$\pm 20$ ppm																		
1	$\pm 10$ ppm <sup>1</sup>																		
Code	Frequency																		
Product Frequency Code <sup>2</sup>																			

Notes:

- 1] Check factory for availability.
- 2] Frequency is recorded with two leading digits before the 'K' and 4 significant digits after the 'K' [including zeros].

**Not all performance combinations and frequencies may be available.  
Contact your local CTS Representative or CTS Customer Service for availability.**

This product is specified for use only in standard commercial applications. Supplier disclaims all express and implied warranties and liability in connection with any use of this product in any non-commercial applications or in any application that may expose the product to conditions that are outside of the tolerances provided in its specification.

## Electrical Specifications

### Operating Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Temperature	$T_A$	-	-40	+25	+85	°C
Turnover Temperature	$T_M$	-	+20	+25	+30	°C
Storage Temperature	$T_{STG}$	-	-55	-	+125	°C

### Frequency Stability

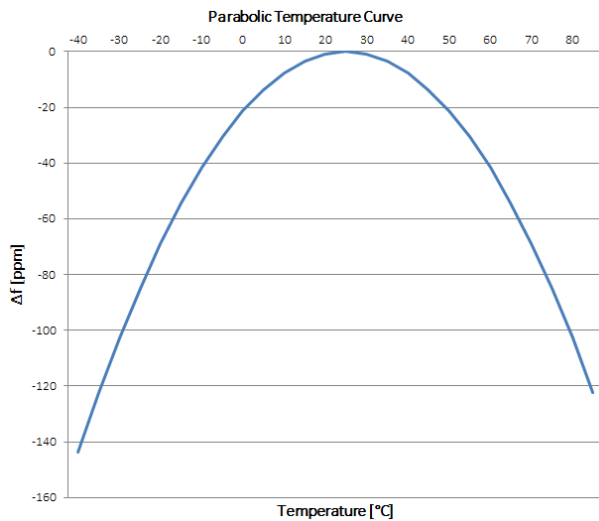
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Frequency	$f_0$	-		32.7680		kHz
Frequency Tolerance [Note 1]	$\Delta f/f_0$	Standard @ +25°C	-20	-	20	ppm
Parabolic Coefficient	$\beta$	See Figure 1		-0.034 ±0.006		ppm/°C <sup>2</sup>
Aging	$\Delta f/f_0$	First Year @ +25°C	-3	-	3	ppm

### Crystal Parameters

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Mode	-	-		Flexural Mode [Tuning Fork]		-
Load Capacitance [Note 1]	$C_L$	Standard	-	12.5	-	pF
Shunt Capacitance	$C_0$	-	-	1.1	-	pF
Motional Capacitance	$C_1$	-	-	3.4	-	fF
Series Resistance	$R_1$	-	-	-	70	kΩ
Drive Level	DL	-	-	0.5	1.0	μW
Insulation Resistance	$R_i$	+100Vdc ±15Vdc	500	-	-	MΩ

1.] See Ordering Information for available options.

Figure 1



Frequency Stability [ $\Delta f$ ] at a given temperature,

$$\Delta f = \beta [T_A - T_M]^2$$

$\beta$  = Parabolic Coefficient  
 $T_A$  = Ambient Temperature  
 $T_M$  = Turnover Temperature

Ex. Find frequency stability at  $T_A = +45^\circ\text{C}$

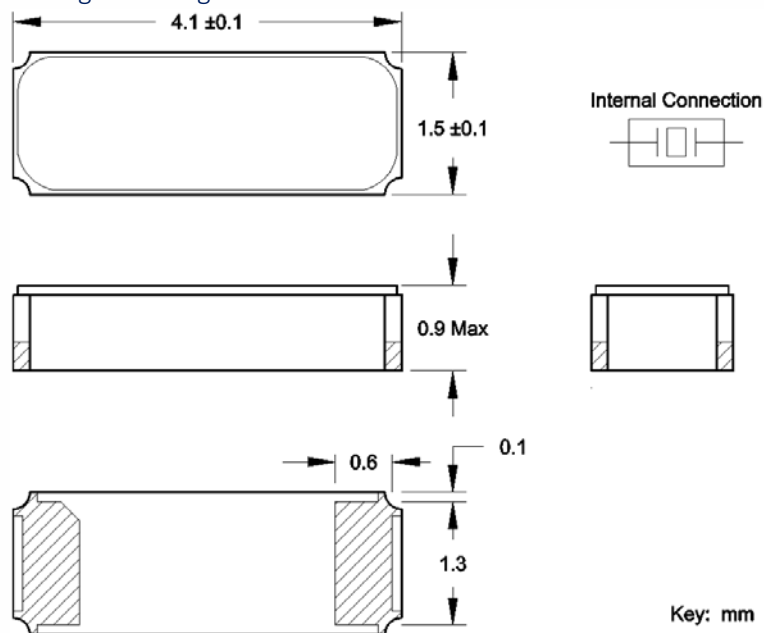
$$\Delta f = -0.034[45-25]^2$$

$$\Delta f = -0.034[20]^2$$

$$\Delta f = -13.6\text{ppm}$$

## Mechanical Specifications

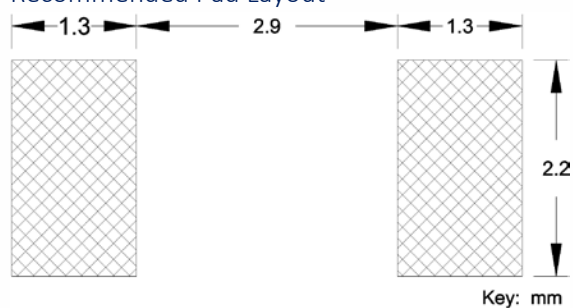
### Package Drawing



### Marking Information

Refer to document 016-0071-0, TF Marking Guide, for marking formats by product family.

### Recommended Pad Layout

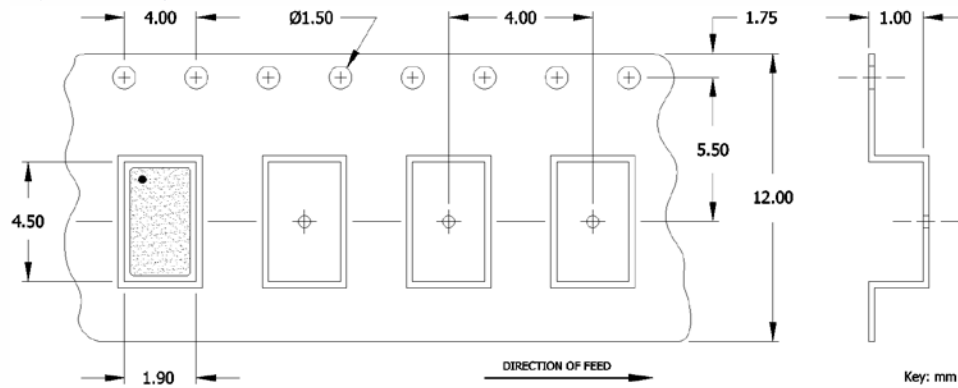


### Notes

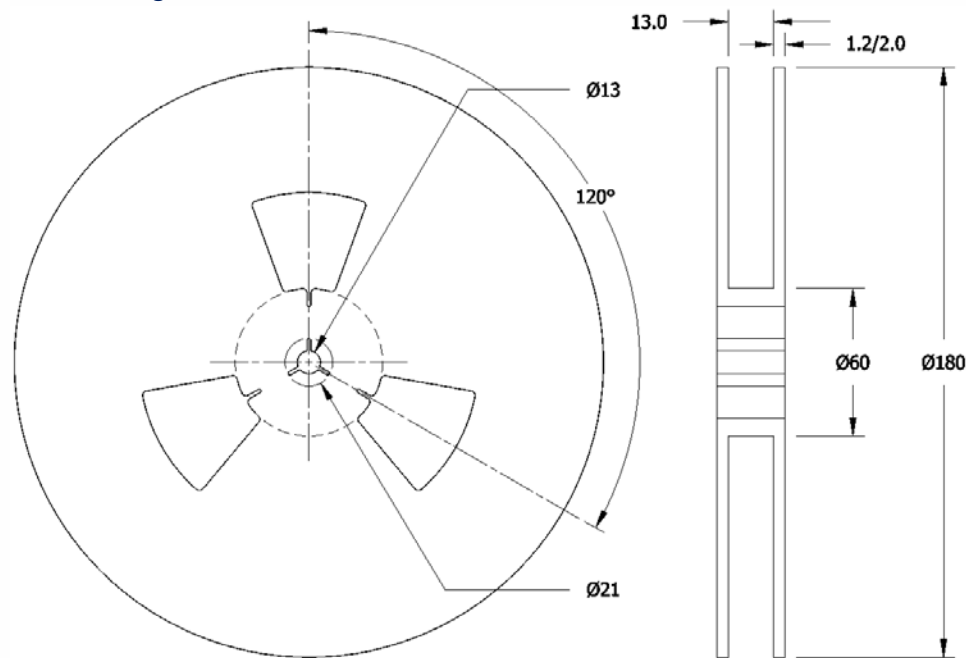
1. JEDEC termination code (e4). Barrier-plating is nickel [Ni] with gold [Au] flash plate.
2. Reflow conditions per JEDEC J-STD-020; +260°C maximum, 20 seconds.
3. MSL = 1.

### Packaging - Tape and Reel

#### Tape Drawing



#### Reel Drawing



#### Notes

1. Device quantity is 3k pieces maximum per 180mm reel.
2. Complete CTS part number, frequency value, date code and manufacturing site code information must appear on reel and carton labels.