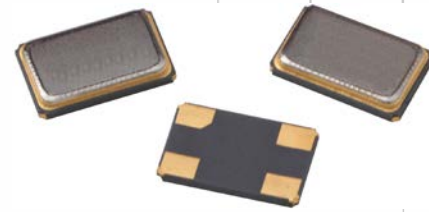




# Model 406

## Surface Mount Quartz Crystal



Part Dimensions:  
6.0 × 3.5 × 1.2mm • 68mg

### Features

- Hermetic Ceramic Surface Mount Package
- Fundamental Crystal Design
- Frequency Range 7.0 – 54MHz
- Frequency Tolerance, ±30ppm Standard
- Frequency Stability, ±50ppm Standard
- Operating Temperature Range to -40°C to +85°C
- Tape and Reel Packaging, EIA-418

Standard Frequencies – see Page 5 for common frequencies.  
\* Check with factory for availability of frequencies not listed.

### Applications

- IoT and IIoT Applications
- Wireless Communications
- FPGA/Microcontrollers
- USB Interfaces
- Computer Peripherals
- Portable Equipment
- Test and Measurement
- M2M Communications
- Broadband Access

### Description

CTS Model 406 incorporates a high Q quartz resonator and is ideal for supporting a wide range of commercial and industrial applications.

### Ordering Information

| Model | Temperature Range | Tolerance @ +25°C | Temperature Stability | Load Capacitance | Frequency [MHz] |
|-------|-------------------|-------------------|-----------------------|------------------|-----------------|
| 406   | C                 | 3                 | 5                     | D                | XXMXXXXX        |

| Code | Temp. Range    |
|------|----------------|
| C    | -20°C to +70°C |
| D    | -30°C to +85°C |
| I    | -40°C to +85°C |

| Code | Stability           |
|------|---------------------|
| 1    | ±10ppm <sup>1</sup> |
| X    | ±15ppm              |
| 2    | ±20ppm              |
| 3    | ±30ppm              |
| 5    | ±50ppm              |

| Code | Tolerance |
|------|-----------|
| 1    | ±10ppm    |
| X    | ±15ppm    |
| 2    | ±20ppm    |
| 3    | ±30ppm    |

| Code | Capacitance | Code | Capacitance | Code | Capacitance |
|------|-------------|------|-------------|------|-------------|
| K    | 8pF         | B    | 13pF        | F    | 24pF        |
| J    | 9pF         | C    | 16pF        | G    | 30pF        |
| A    | 10pF        | D    | 18pF        | H    | 32pF        |
| L    | 12pF        | E    | 20pF        | S    | Series      |

| Code                   | Frequency |
|------------------------|-----------|
| Frequency <sup>2</sup> |           |

Notes:

- 1) Check factory availability when combined with -40°C to +85°C temperature range.
- 2) Frequency is recorded with 2 leading digits before the "M" and 5 significant digits after the "M" [including zeroes].  
(Ex. XXMXXXXX [16M38400], XXMXXXXX [22M11840], XXMXXXXX [14M31818])

**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 | $T_A$     | -          | -20 |     | +70  |      |
|                       |           |            | -30 | +25 | +85  | °C   |
|                       |           |            | -40 |     | +85  |      |
|                       |           |            | -40 |     | +105 |      |
| Storage Temperature   | $T_{STG}$ | -          | -55 | -   | +125 | °C   |

### Frequency Stability

| PARAMETER           | SYMBOL            | CONDITIONS                  | MIN | TYP                      | MAX | UNIT |
|---------------------|-------------------|-----------------------------|-----|--------------------------|-----|------|
| Frequency Range     | $f_o$             | Fundamental Mode            |     | 7 - 54                   |     | MHz  |
| Frequency Tolerance | $\Delta f/f_o$    | @ +25°C                     |     | 10, 15, 20, 25 or 30     |     | ±ppm |
| Frequency Stability | $\Delta f/f_{25}$ | Referenced to +25°C reading |     | 10, 15, 20, 25, 30 or 50 |     | ±ppm |
| Aging               | $\Delta f/f_o$    | Typical per year @ +25°C    | -3  | -                        | 3   | ppm  |

### Crystal Parameters

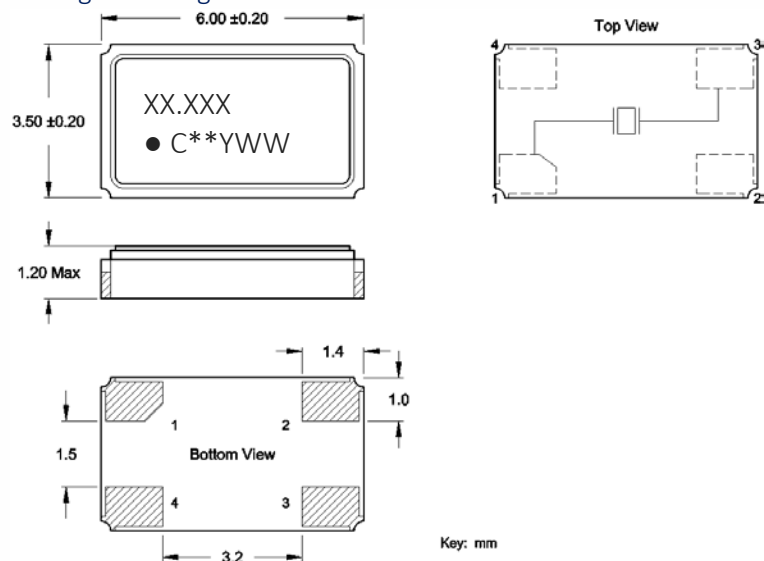
| PARAMETER                | SYMBOL | CONDITIONS     | MIN | TYP                      | MAX | UNIT |
|--------------------------|--------|----------------|-----|--------------------------|-----|------|
| Operating Mode           | -      | -              |     | Fundamental              |     | -    |
| Crystal Cut              | -      | -              |     | AT-Cut Strip             |     | -    |
| Load Capacitance         | $C_L$  | -              |     | See Ordering Information |     | pF   |
| Shunt Capacitance        | $C_o$  | -              | -   | 5.0                      | 7.0 | pF   |
| <b>Series Resistance</b> |        |                |     |                          |     |      |
| Fundamental              | $R_1$  | 7MHz - <12MHz  | -   | -                        | 100 |      |
|                          |        | 12MHz - <14MHz | -   | -                        | 60  | Ω    |
|                          |        | 14MHz - <20MHz | -   | -                        | 50  |      |
|                          |        | 20MHz - 54MHz  | -   | -                        | 40  |      |
| Drive Level              | DL     | -              | -   | 10                       | 300 | μW   |
| Insulation Resistance    | $R_i$  | +100Vdc ±15Vdc | 500 | -                        | -   | MΩ   |

$\Delta f/f_o$  - Frequency deviation referenced to nominal frequency.

$\Delta f/f_{25}$  - Frequency deviation over operating temperature range, referenced to +25°C frequency.

## Mechanical Specifications

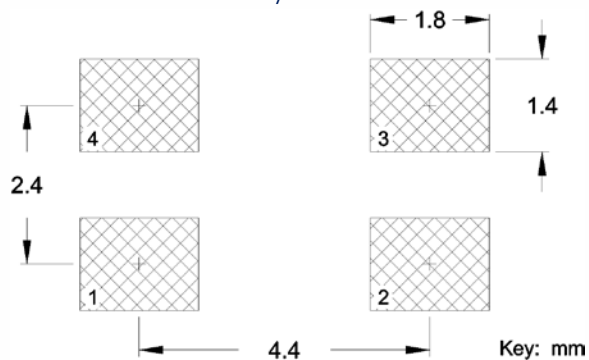
### Package Drawing



### Marking Information

1. XX.XXX – Frequency marked with 3 significant digits after the decimal.
2. C – CTS.
3. \*\* – Manufacturing Site code.
4. YWW – Date Code. Y = 1st Digit of Year, WW = Week.

### Recommended Pad Layout

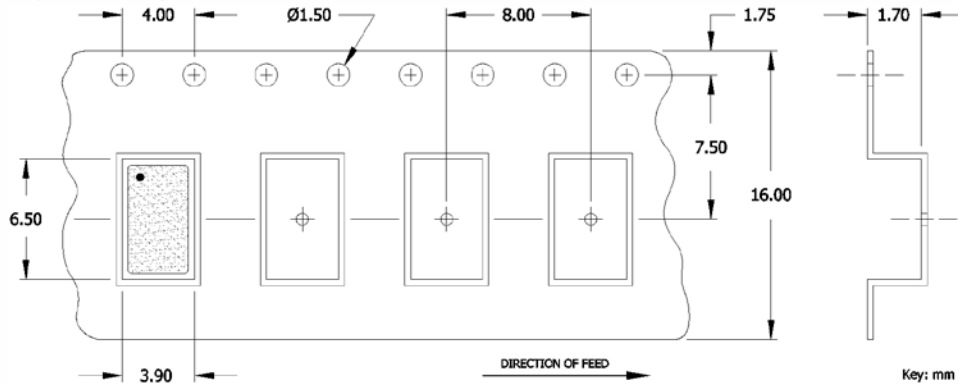


### Notes

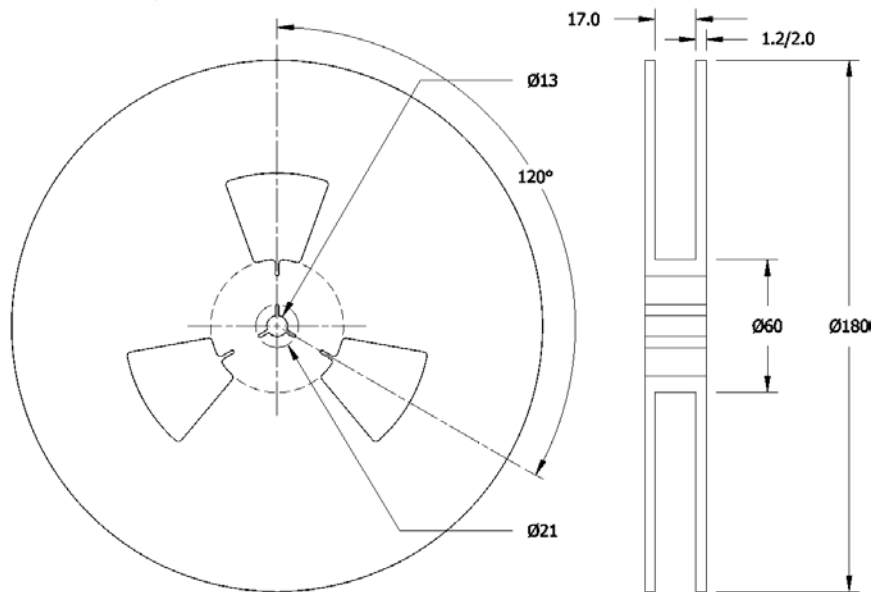
1. JEDEC termination code (e4). Barrier-plating is nickel [Ni] with gold [Au] flash plate.
2. Terminations #2, #4 and the metal lid are connected internally. End user may connect these pins to circuit ground for EMI suppression.
3. Due to package variability, the pad chamfer on the bottom could be located on Pin 1 or 4 in a given lot. Layout orientation should be based on the top view [marking side], as indicated in package drawing. The chamfer location does not affect the electrical performance of the device.
4. Reflow conditions per JEDEC J-STD-020; +260°C maximum, 20 seconds.
5. MSL = 1.

### Packaging – Tape and Reel

Tape Drawing



Reel Drawing



### Notes

1. Device quantity is 1k 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.



## Addendum

### Common Frequencies and Frequency Codes – MHz

| Common Wireless Frequencies |                  |              | Additional Frequencies |                  |              |           |                  |              |
|-----------------------------|------------------|--------------|------------------------|------------------|--------------|-----------|------------------|--------------|
| FREQUENCY                   | PART NUMBER CODE | MARKING CODE | FREQUENCY              | PART NUMBER CODE | MARKING CODE | FREQUENCY | PART NUMBER CODE | MARKING CODE |
| 12.000000                   | 12M00000         | 12.000       | 8.000000               | 08M00000         | 8.000        | 24.553500 | 24M55350         | 24.553       |
| 13.560000                   | 13M56000         | 13.560       | 10.000000              | 10M00000         | 10.000       | 24.576000 | 24M57600         | 24.576       |
| 16.000000                   | 16M00000         | 16.000       | 11.059200              | 11M05920         | 11.059       | 25.000625 | 25M00062         | 25.001       |
| 19.200000                   | 19M20000         | 19.200       | 12.288000              | 12M28800         | 12.288       | 26.041660 | 26M04166         | 26.041       |
| 20.000000                   | 20M00000         | 20.000       | 12.500000              | 12M50000         | 12.500       | 26.800000 | 26M80000         | 26.800       |
| 24.000000                   | 24M00000         | 24.000       | 12.688000              | 12M68800         | 12.688       | 27.000000 | 27M00000         | 27.000       |
| 25.000000                   | 25M00000         | 25.000       | 12.800000              | 12M80000         | 12.800       | 27.600000 | 27M60000         | 27.600       |
| 26.000000                   | 26M00000         | 26.000       | 13.000000              | 13M00000         | 13.000       | 28.224000 | 28M22400         | 28.224       |
| 27.120000                   | 27M12000         | 27.120       | 13.500000              | 13M50000         | 13.500       | 28.322000 | 28M32200         | 28.322       |
| 30.000000                   | 30M00000         | 30.000       | 13.553750              | 13M55375         | 13.553       | 28.375000 | 28M37500         | 28.375       |
| 32.000000                   | 32M00000         | 32.000       | 13.824000              | 13M82400         | 13.824       | 28.636360 | 28M63636         | 28.636       |
| 37.400000                   | 37M40000         | 37.400       | 13.934400              | 13M93440         | 13.934       | 29.491200 | 29M49120         | 29.491       |
| 38.400000                   | 38M40000         | 38.400       | 14.000000              | 14M00000         | 14.000       | 30.400000 | 30M40000         | 30.400       |
| 40.000000                   | 40M00000         | 40.000       | 14.318180              | 14M31818         | 14.318       | 30.720000 | 30M72000         | 30.720       |
| 48.000000                   | 48M00000         | 48.000       | 14.400000              | 14M40000         | 14.400       | 31.250000 | 31M25000         | 31.250       |
| 52.000000                   | 52M00000         | 52.000       | 14.745600              | 14M74560         | 14.745       | 32.768000 | 32M76800         | 32.768       |
|                             |                  |              | 15.360000              | 15M36000         | 15.360       | 33.000000 | 33M00000         | 33.000       |
|                             |                  |              | 16.367600              | 16M36760         | 16.367       | 33.330000 | 33M33000         | 33.330       |
|                             |                  |              | 16.368000              | 16M36800         | 16.368       | 33.333000 | 33M33300         | 33.333       |
|                             |                  |              | 16.384000              | 16M38400         | 16.384       | 33.333300 | 33M33330         | 33.334       |
|                             |                  |              | 16.666700              | 16M66670         | 16.666       | 33.868800 | 33M86880         | 33.868       |
|                             |                  |              | 16.800000              | 16M80000         | 16.800       | 35.328000 | 35M32800         | 35.328       |
|                             |                  |              | 16.934400              | 16M93440         | 16.934       | 36.000000 | 36M00000         | 36.000       |
|                             |                  |              | 18.000000              | 18M00000         | 18.000       | 37.500000 | 37M50000         | 37.500       |
|                             |                  |              | 18.432000              | 18M43200         | 18.432       | 38.000000 | 38M00000         | 38.000       |
|                             |                  |              | 19.440000              | 19M44000         | 19.440       | 38.880000 | 38M88000         | 38.880       |
|                             |                  |              | 19.660800              | 19M66080         | 19.660       | 39.062500 | 39M06250         | 39.062       |
|                             |                  |              | 19.680000              | 19M68000         | 19.680       | 41.600000 | 41M60000         | 41.600       |
|                             |                  |              | 20.480000              | 20M48000         | 20.480       | 44.000000 | 44M00000         | 44.000       |
|                             |                  |              | 20.736000              | 20M73600         | 20.736       | 45.000000 | 45M00000         | 45.000       |
|                             |                  |              | 22.118400              | 22M11840         | 22.118       | 49.152000 | 49M15200         | 49.152       |
|                             |                  |              | 22.579200              | 22M57920         | 22.579       | 50.000000 | 50M00000         | 50.000       |
|                             |                  |              | 24.305000              | 24M30500         | 24.305       | 54.000000 | 54M00000         | 54.000       |
|                             |                  |              | 24.545400              | 24M54540         | 24.545       |           |                  |              |
|                             |                  |              | 24.545454              | 24M54545         | 24.546       |           |                  |              |