



# Model 375

## HFF LVDS VCXO

### Features

- Ceramic Surface Mount Package
- Ultra-Low Phase Jitter Performance
- High Frequency Fundamental Crystal Design
- Frequency Range 100 – 250MHz \*
- +2.5V or +3.3V Operation
- Output Enable Standard
- Tape and Reel Packaging, EIA-418



Part Dimensions:  
5.0 × 3.2 × 1.2mm • 62.28mg

### Applications

- Small Cells
- Wireless Communication
- Broadband Access
- SONET/SDH/DWDM
- Base Stations
- Ethernet/GbE/SyncE
- Digital Video
- Test and Measurement

#### Standard Frequencies

- |             |             |
|-------------|-------------|
| - 100.00MHz | - 156.25MHz |
| - 122.88MHz | - 166.00MHz |
| - 125.00MHz | - 200.00MHz |
| - 153.60MHz | - 204.80MHz |
| - 155.52MHz | - 245.76MHz |

\* Check with factory for availability.

### Description

CTS Model 375 is a low cost, small size, high performance VCXO. Employing the latest IC technology, coupled with a high frequency fundamental crystal, M375 has excellent stability and low jitter/phase noise performance.

### Ordering Information

| Model                               | Supply Voltage                                                                                                                  | Absolute Pull Range                                                                             | Frequency Stability | Temperature Range | Frequency Code [MHz] | Packaging           |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------|-------------------|----------------------|---------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------|----------------|--------|----------------|--------|-----------------------------------------------------------------------------------------------|---------------------|---------|-------------------------------------------------------------------------------------------------------------------------|--------------|-----------|-------------------------------------|--|--|
| 375                                 | L                                                                                                                               | B                                                                                               | 3                   | I                 | XXX or XXXX          | T                   |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
|                                     | <table><tr><th>Code</th><th>Voltage</th></tr><tr><td>L</td><td>+3.3V ±5%</td></tr><tr><td>N</td><td>+2.5V ±5%</td></tr></table> | Code                                                                                            | Voltage             | L                 | +3.3V ±5%            | N                   | +2.5V ±5% |                                                                                                                                               | <table><tr><th>Code</th><th>Stability</th></tr><tr><td>3</td><td>±50ppm</td></tr><tr><td>5</td><td>±25ppm</td></tr><tr><td>6</td><td>±20ppm<sup>1</sup></td></tr></table> | Code        | Stability | 3              | ±50ppm | 5              | ±25ppm | 6                                                                                             | ±20ppm <sup>1</sup> |         | <table><tr><th>Code</th><th>Frequency</th></tr><tr><td colspan="2">Product Frequency Code<sup>2</sup></td></tr></table> | Code         | Frequency | Product Frequency Code <sup>2</sup> |  |  |
| Code                                | Voltage                                                                                                                         |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| L                                   | +3.3V ±5%                                                                                                                       |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| N                                   | +2.5V ±5%                                                                                                                       |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| Code                                | Stability                                                                                                                       |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| 3                                   | ±50ppm                                                                                                                          |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| 5                                   | ±25ppm                                                                                                                          |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| 6                                   | ±20ppm <sup>1</sup>                                                                                                             |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| Code                                | Frequency                                                                                                                       |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| Product Frequency Code <sup>2</sup> |                                                                                                                                 |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
|                                     |                                                                                                                                 | <table><tr><th>Code</th><th>APR</th></tr><tr><td>B</td><td>±50ppm<sup>3</sup></td></tr></table> | Code                | APR               | B                    | ±50ppm <sup>3</sup> |           | <table><tr><th>Code</th><th>Temp. Range</th></tr><tr><td>C</td><td>-20°C to +70°C</td></tr><tr><td>I</td><td>-40°C to +85°C</td></tr></table> | Code                                                                                                                                                                      | Temp. Range | C         | -20°C to +70°C | I      | -40°C to +85°C |        | <table><tr><th>Code</th><th>Packing</th></tr><tr><td>T</td><td>1k pcs./reel</td></tr></table> | Code                | Packing | T                                                                                                                       | 1k pcs./reel |           |                                     |  |  |
| Code                                | APR                                                                                                                             |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| B                                   | ±50ppm <sup>3</sup>                                                                                                             |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| Code                                | Temp. Range                                                                                                                     |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| C                                   | -20°C to +70°C                                                                                                                  |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| I                                   | -40°C to +85°C                                                                                                                  |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| Code                                | Packing                                                                                                                         |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |
| T                                   | 1k pcs./reel                                                                                                                    |                                                                                                 |                     |                   |                      |                     |           |                                                                                                                                               |                                                                                                                                                                           |             |           |                |        |                |        |                                                                                               |                     |         |                                                                                                                         |              |           |                                     |  |  |

#### Notes:

- 1] Only available with "C" temperature range.
- 2] Refer to document 016-1454-0, Frequency Code Tables.  
3-digits for frequencies <100MHz, 4-digits for frequencies 100MHz or greater.
- 3] Frequencies ≥200MHz, APR is ±30ppm.

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

## Electrical Specifications

### Operating Conditions

| PARAMETER               | SYMBOL    | CONDITIONS      | MIN          | TYP        | MAX          | UNIT               |
|-------------------------|-----------|-----------------|--------------|------------|--------------|--------------------|
| Maximum Supply Voltage  | $V_{CC}$  | -               | -0.3         | -          | 5.0          | V                  |
| Maximum Control Voltage | $V_C$     | -               | -0.5         | -          | $V_{CC}$     | V                  |
| Supply Voltage          | $V_{CC}$  | $\pm 5\%$       | 3.14<br>2.38 | 3.3<br>2.5 | 3.47<br>2.63 | V                  |
| Supply Current          | $I_{CC}$  | LVDS Load       | -            | 20         | 55           | mA                 |
| Output Load             | $R_L$     | Between Outputs | -            | 100        | -            | Ohms               |
| Operating Temperature   | $T_A$     | -               | -20<br>-40   | +25        | +70<br>+85   | $^{\circ}\text{C}$ |
| Storage Temperature     | $T_{STG}$ | -               | -40          | -          | +100         | $^{\circ}\text{C}$ |

### Frequency Stability

| PARAMETER                       | SYMBOL            | CONDITIONS                                                                        | MIN | TYP          | MAX | UNIT            |
|---------------------------------|-------------------|-----------------------------------------------------------------------------------|-----|--------------|-----|-----------------|
| Frequency Range                 | $f_0$             | -                                                                                 |     | 100 - 250    |     | MHz             |
| Frequency Stability<br>[Note 1] | $\Delta f/f_0$    | $\pm 20\text{ppm}$ stability, $-20^{\circ}\text{C}$ to $+70^{\circ}\text{C}$ only |     | 20, 25 or 50 |     | $\pm\text{ppm}$ |
| Absolute Pull Range<br>[Note 2] | APR               | Frequencies $\geq 200\text{MHz}$ , APR is $\pm 30\text{ppm}$                      | 50  | -            | -   | $\pm\text{ppm}$ |
| Aging                           | $\Delta f/f_{25}$ | First Year @ $+25^{\circ}\text{C}$ , nominal $V_{CC}$ and $V_C$                   | -3  | -            | 3   | ppm             |

1.] Inclusive of initial tolerance at time of shipment, changes in supply voltage, load, temperature and 1st year aging.

2.] Minimum guaranteed frequency shift from  $f_0$  over variations in temperature, aging, power supply and load.

### Output Parameters

| PARAMETER                   | SYMBOL               | CONDITIONS                       | MIN         | TYP          | MAX         | UNIT          |
|-----------------------------|----------------------|----------------------------------|-------------|--------------|-------------|---------------|
| Output Type                 | -                    | -                                |             | LVDS         |             | -             |
| Output Voltage Levels       | $V_{OH}$<br>$V_{OL}$ | LVDS Load<br>LVDS Load           | -<br>0.90   | 1.43<br>1.10 | 1.60<br>-   | V             |
| Differential Output Voltage | $V_{OD}$             | $R_L = 100\text{ Ohms}$          | 247         | 350          | 454         | mV            |
| Offset Voltage              | $V_{OS}$             | $R_L = 100\text{ Ohms}$          | 1.125       | 1.25         | 1.375       | V             |
| Output Duty Cycle           | SYM                  | @ 1.25V                          | 45          | -            | 55          | %             |
| Rise and Fall Time          | $T_R, T_F$           | @ 20%/80% Levels                 | -           | 0.4          | 1.0         | ns            |
| Start Up Time               | $T_S$                | Application of $V_{CC}$          | -           | 5            | 10          | ms            |
| Enable Function             |                      |                                  |             |              |             |               |
| Enable Input Voltage        | $V_{IH}$             | Pin 2 Logic '1', Output Enabled  | $0.7V_{CC}$ | -            | -           | V             |
| Disable Input Voltage       | $V_{IL}$             | Pin 2 Logic '0', Output Disabled | -           | -            | $0.3V_{CC}$ | V             |
| Standby Current             | $I_{STB}$            | Pin 2 Logic '0', Output Standby  | -           | -            | 10          | $\mu\text{A}$ |
| Enable Time                 | $T_{PLZ}$            | Pin 2 Logic '1'                  | -           | -            | 20          | $\mu\text{s}$ |
| Phase Jitter, RMS           | $t_{jrms}$           | Bandwidth 12 kHz - 20 MHz        | -           | 70           | 500         | fs            |
| Phase Noise                 | -                    | See Typical Plots                | -           | -            | -           | -             |

## Electrical Specifications

### Enable Truth Table

| Pin 2     | Pin 4 & 5 | Pin 2 | Pin 4 & 5 | Pin 2     | Pin 4 & 5 |
|-----------|-----------|-------|-----------|-----------|-----------|
| Logic '1' | Output    | Open  | Output    | Logic '0' | High Imp. |

### Control Voltage

| PARAMETER           | SYMBOL         | CONDITIONS                        | MIN  | TYP                      | MAX  | UNIT  |
|---------------------|----------------|-----------------------------------|------|--------------------------|------|-------|
| Control Voltage     | $V_C$          | -                                 | 0.30 | 1.65                     | 3.00 | V     |
| Frequency Deviation | $\Delta f/f_0$ | $V_C = 0.0V$<br>$V_C = 3.3V$      |      | -155 to -75<br>75 to 155 |      | ppm   |
| Linearity           | L              | Best Straight Line Fit            | -    | 5                        | 10   | %     |
| Gain Transfer       | $K_V$          | Pull Sensitivity; @ +1.65V, +25°C | -    | 75                       | -    | ppm/V |
| Input Impedance     | $Z_{V_C}$      | -                                 | 10   | -                        | -    | MOhms |
| Modulation Roll-off | -              | @ -3dB                            | 20   | -                        | -    | kHz   |
| Transfer Function   | -              | -                                 |      | Positive                 |      | -     |

### Test Circuit

LVDS



### Output Waveform

LVDS



## Electrical Specifications

### Performance Data

#### Frequency Deviation – Over Temperature [typical]

122.88MHz,  $V_{CC} = 3.3V$ ,  $V_C = 1.65V$



156.25MHz,  $V_{CC} = 3.3V$ ,  $V_C = 1.65V$



#### Frequency Deviation – Pulling Range [typical]

122.88MHz,  $V_{CC} = 3.3V$ ,  $T_A = +25^{\circ}C$

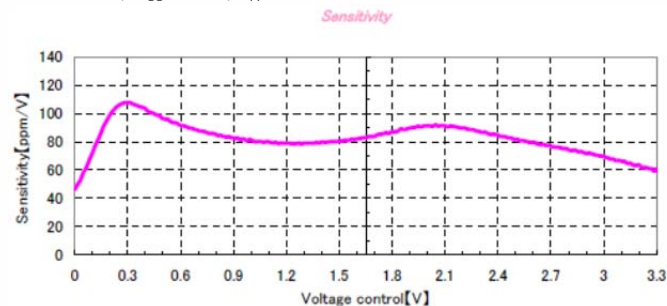


156.25MHz,  $V_{CC} = 3.3V$ ,  $T_A = +25^{\circ}C$

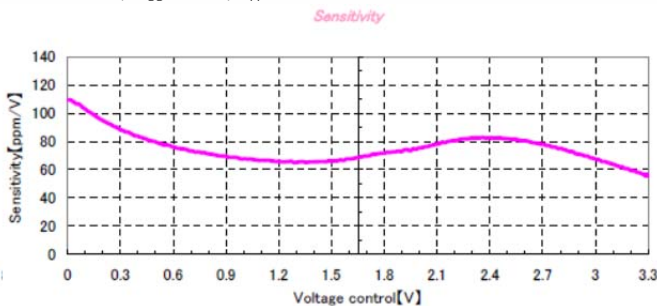


#### Frequency Deviation – Gain Transfer [typical]

122.88MHz,  $V_{CC} = 3.3V$ ,  $T_A = +25^{\circ}C$



156.25MHz,  $V_{CC} = 3.3V$ ,  $T_A = +25^{\circ}C$

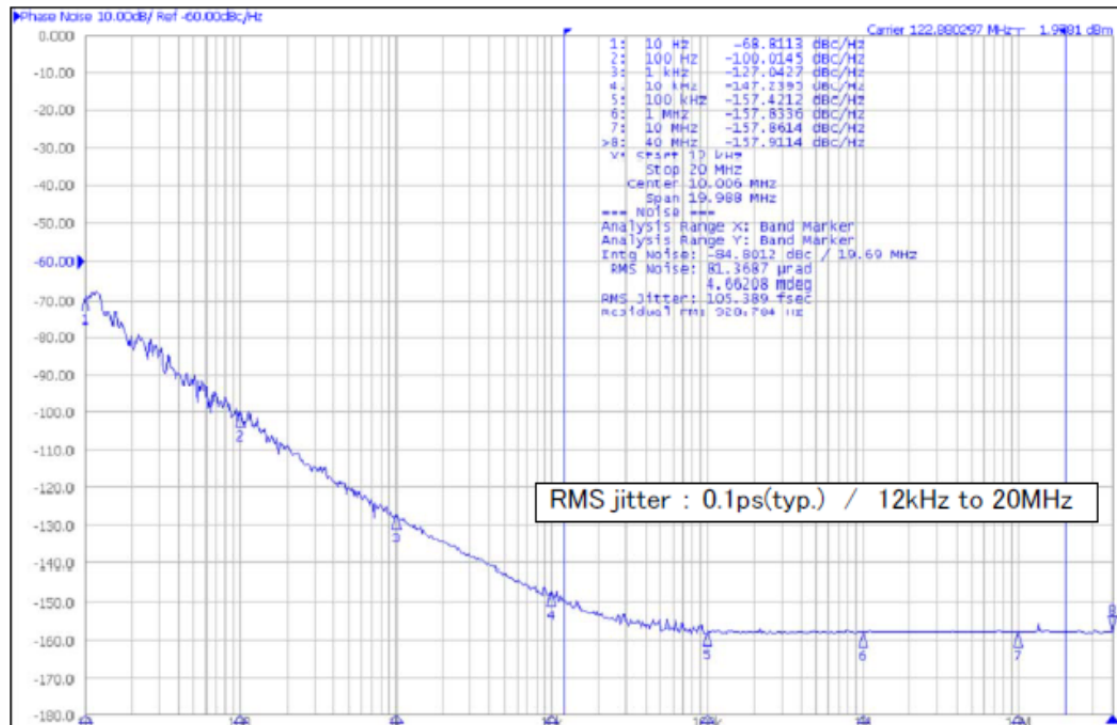


## Electrical Specifications

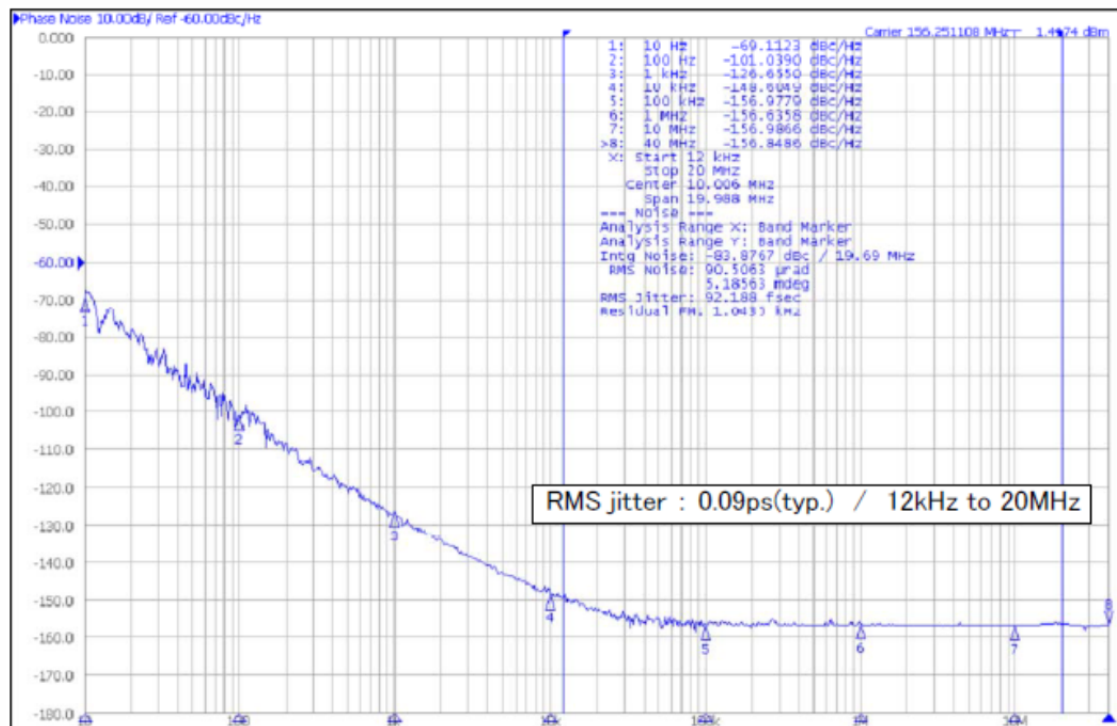
### Performance Data

#### Phase Noise [typical]

122.88MHz,  $V_{CC} = 3.3V$ ,  $V_C = 1.65V$ ,  $T_A = +25^\circ C$



156.25MHz,  $V_{CC} = 3.3V$ ,  $V_C = 1.65V$ ,  $T_A = +25^\circ C$



## Mechanical Specifications

### Package Drawing



### Marking Information

1. \*\* - Manufacturing Site Code.
  2. D - Date Code. See Table I for codes.
  3. ST - Frequency Stability/Temperature Code. [Refer to Ordering Information]
  4. V - Voltage Code. L = 3.3V, N = 2.5V
  5. xxxx - Frequency Code. 4-digits required for frequencies 100MHz and above.
- [See document 016-1454-0, Frequency Code Tables.]

### Recommended Pad Layout



### Notes

1. Termination pads (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.

### Pin Assignments

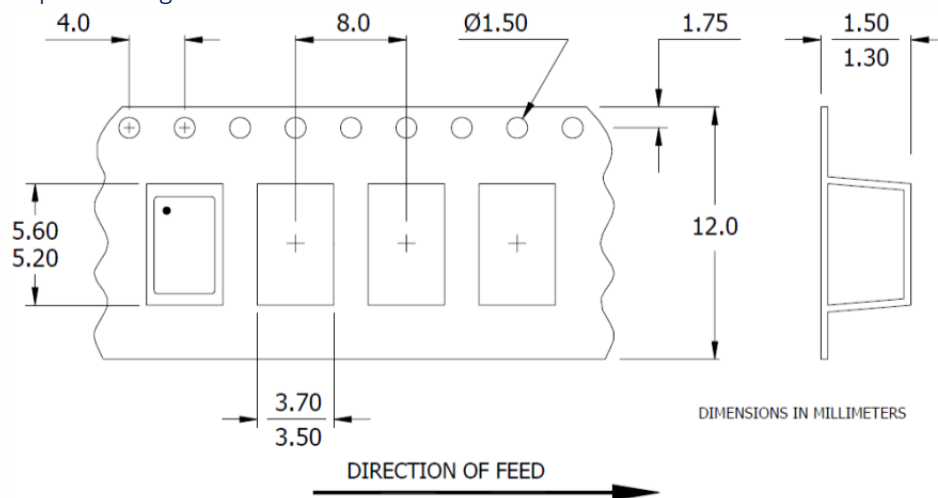
| Pin | Symbol          | Function                 |
|-----|-----------------|--------------------------|
| 1   | V <sub>C</sub>  | Control Voltage          |
| 2   | EOH             | Enable                   |
| 3   | GND             | Circuit & Package        |
| 4   | Output          | RF Output                |
| 5   | Output          | RF Output, Complementary |
| 6   | V <sub>CC</sub> | Supply Voltage           |

Table I - Date Code

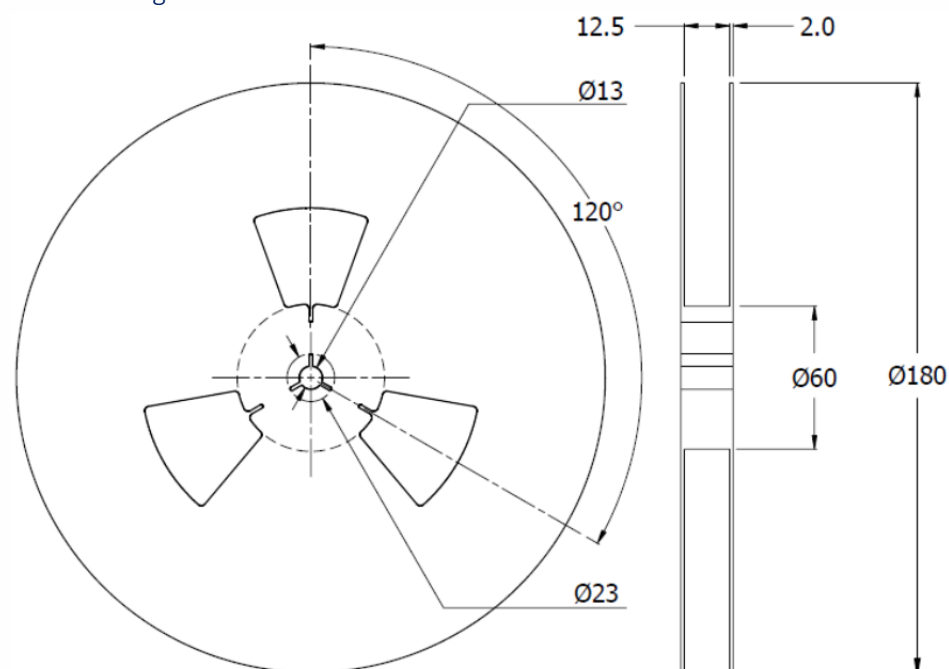
| MONTH |      |      |      |      | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|-------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| YEAR  |      |      |      |      |     |     |     |     |     |     |     |     |     |     |     |     |
| 2001  | 2005 | 2009 | 2013 | 2017 | A   | B   | C   | D   | E   | F   | G   | H   | J   | K   | L   | M   |
| 2002  | 2006 | 2010 | 2014 | 2018 | N   | P   | Q   | R   | S   | T   | U   | V   | W   | X   | Y   | Z   |
| 2003  | 2007 | 2011 | 2015 | 2019 | a   | b   | c   | d   | e   | f   | g   | h   | j   | k   | l   | m   |
| 2004  | 2008 | 2012 | 2016 | 2020 | n   | p   | q   | r   | s   | t   | u   | v   | w   | x   | y   | z   |

## 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 and date code information must appear on reel and carton labels.