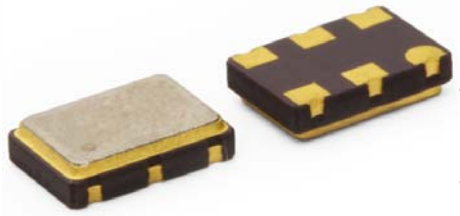
# Model 377

## 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:
7.0 × 5.0 × 2.0mm • 178.462mg

Standard Frequencies

| | |
|---|---|
| - 100.00MHz | - 156.25MHz |
| - 122.88MHz | - 166.00MHz |
| - 125.00MHz | - 200.00MHz |
| - 153.60MHz | - 204.08MHz |
| - 155.52MHz | - 245.76MHz |

* Check with factory for availability.

### Applications

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

### Description

CTS Model 377 is a low cost, small size, high performance VCXO. Employing the latest IC technology, coupled with a high frequency fundamental crystal, M377 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 |
|---|---|---|---|---|---|---|
| 377 | L | B | 3 | I | XXX or XXXX | T |

| Code | Voltage |
|---|---|
| L | +3.3V ±5% |
| N | +2.5V ±5% |

| Code | Stability |
|---|---|
| 3 | ±50ppm |
| 5 | ±25ppm |
| 6 | ±20ppm [1] |

| Code | Frequency |
|---|---|
| | Product Frequency Code [2] |

| Code | APR |
|---|---|
| B | ±50ppm [3] |

| 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.**



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# 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 | $V_{CC}$ | ±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 | °C |
| Storage Temperature | $T_{STG}$ | - | -40 | - | +100 | °C |

## Frequency Stability

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Frequency Range | $f_O$ | - | | 100 - 250 | | MHz |
| Frequency Stability [Note 1] | $\Delta f/f_O$ | ±20ppm stability, -20°C to +70°C only | | 20, 25 or 50 | | ±ppm |
| Absolute Pull Range [Note 2] | APR | Frequencies ≥200MHz, APR is ±30ppm | 50 | - | - | ±ppm |
| Aging | $\Delta f/f_{25}$ | First Year @ +25°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 $f_O$ 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 Ohms | 247 | 350 | 454 | mV |
| Offset Voltage | $V_{OS}$ | $R_L$ = 100 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 | 0.7$V_{CC}$ | - | - | V |
| Disable Input Voltage | $V_{IL}$ | Pin 2 Logic '0', Output Disabled | - | - | 0.3$V_{CC}$ | V |
| Standby Current | $I_{STB}$ | Pin 2 Logic '0', Output Standby | - | - | 10 | µA |
| Enable Time | $T_{PLZ}$ | Pin 2 Logic '1' | - | - | 20 | µs |
| Phase Jitter, RMS | tjrms | Bandwidth 12 kHz - 20 MHz | - | 70 | 500 | fs |
| Phase Noise | - | See Typical Plots | - | - | - | - |



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# Electrical Specifications

## Enable Truth Table

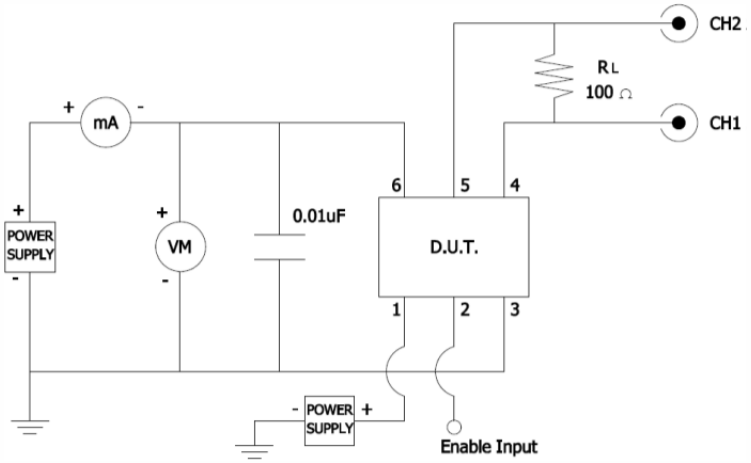
| Pin 2 | Pin 4 & 5 | Pin 2 | Pin 4 & 5 | Pin 2 | Pin 4 & 5 |
|---|---|---|---|---|---|
| Logic '1' | Output | Open | Output | Logic '0' | High Imp. |

## Control Voltage

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Control Voltage | $V_C$ | - | 0.30 | 1.65 | 3.00 | V |
| Frequency Deviation | $\Delta f/f_O$ | $V_C$ = 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 | $Z_{Vc}$ | - | 10 | - | - | MOhms |
| Modulation Roll-off | - | @ -3dB | 20 | - | - | kHz |
| Transfer Function | - | - | | Positive | | - |

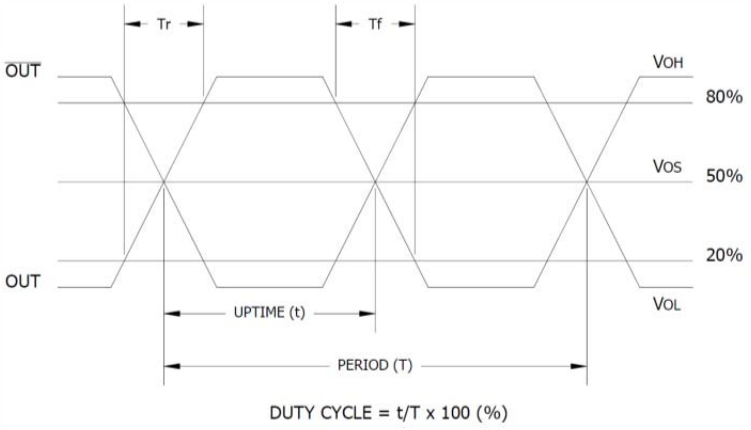
## Test Circuit

LVDS




## Output Waveform

LVDS



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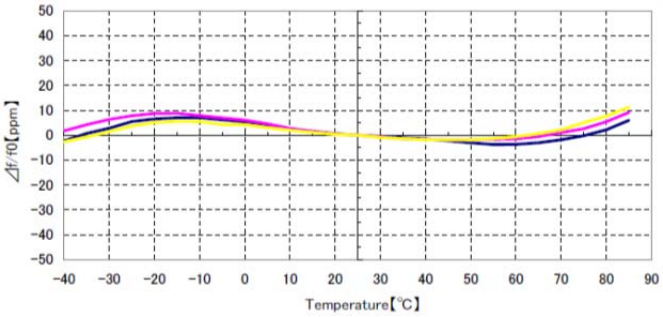
# Electrical Specifications

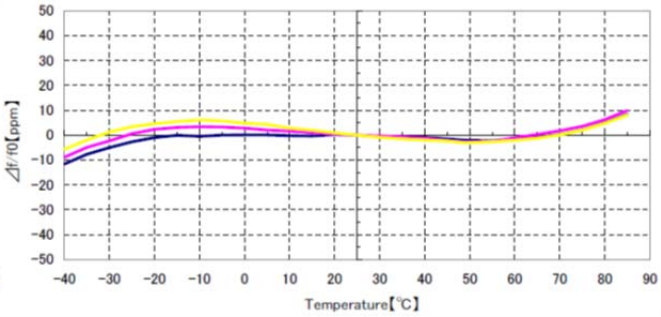
## Performance Data

### Frequency Deviation – Over Temperature [typical]

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

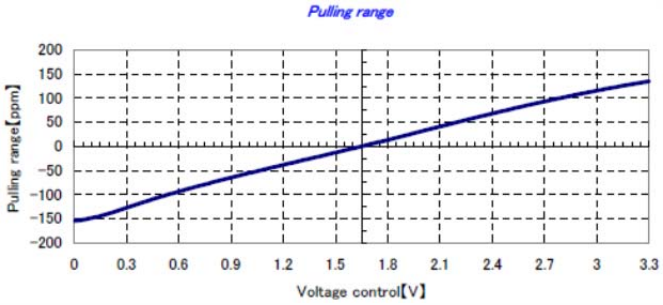



156.25MHz, $V_{CC}$ = 3.3V, $V_C$ = 1.65V

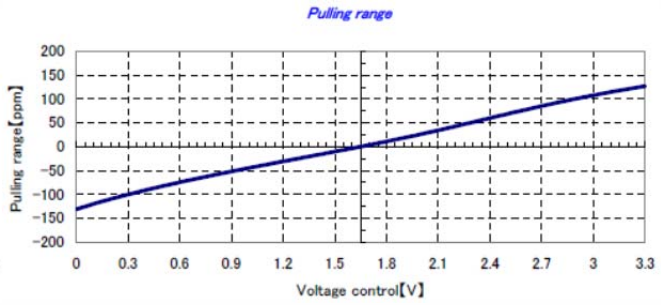



### Frequency Deviation – Pulling Range [typical]

122.88MHz, $V_{CC}$ = 3.3V, $T_A$ = +25°V

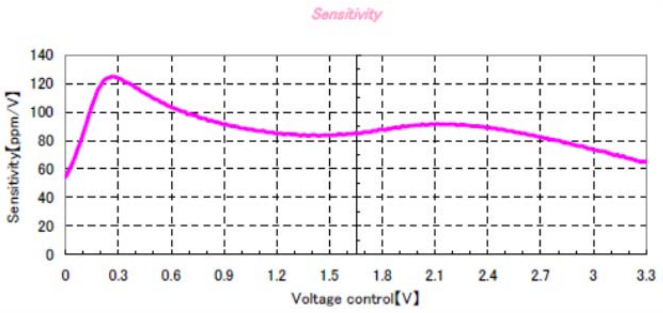



156.25MHz, $V_{CC}$ = 3.3V, $T_A$ = +25°V

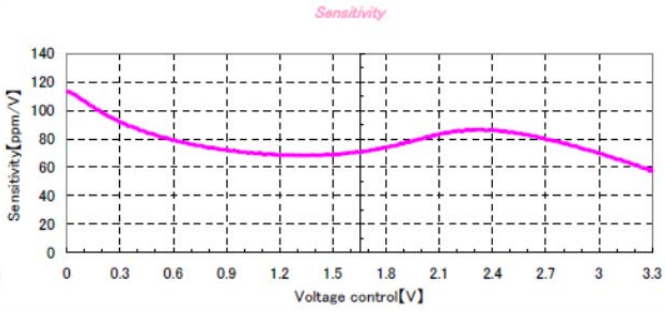



### Frequency Deviation – Gain Transfer [typical]

122.88MHz, $V_{CC}$ = 3.3V, $T_A$ = +25°V




156.25MHz, $V_{CC}$ = 3.3V, $T_A$ = +25°V



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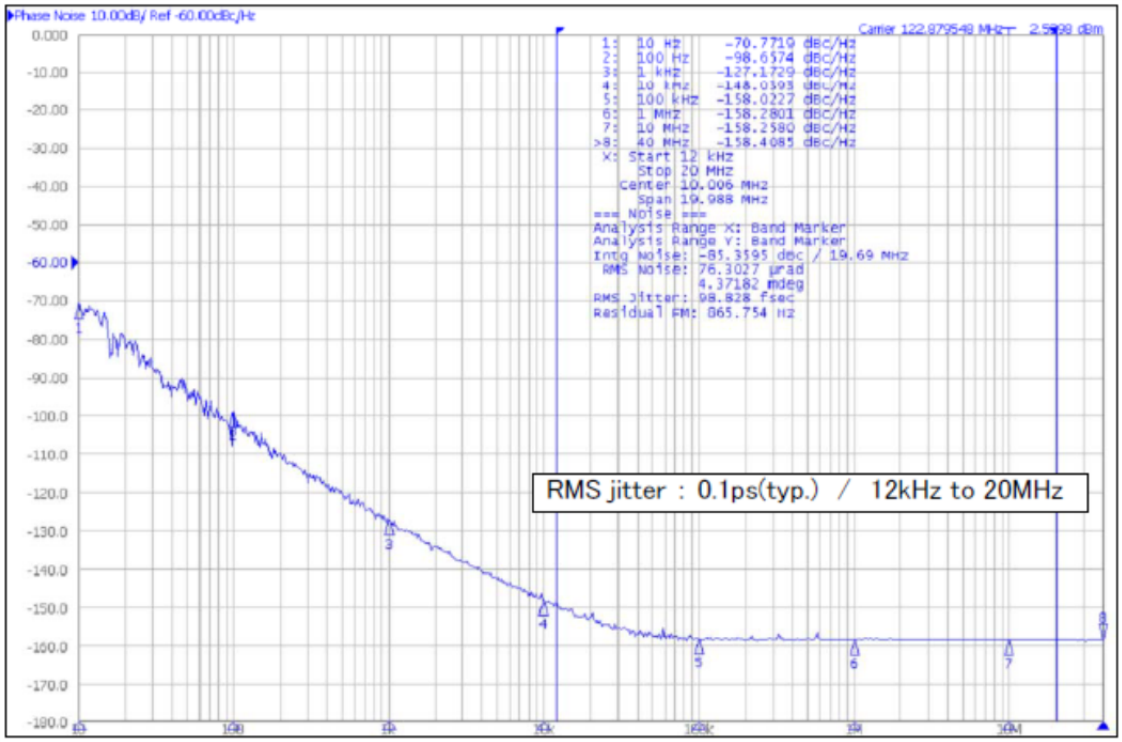
# Electrical Specifications

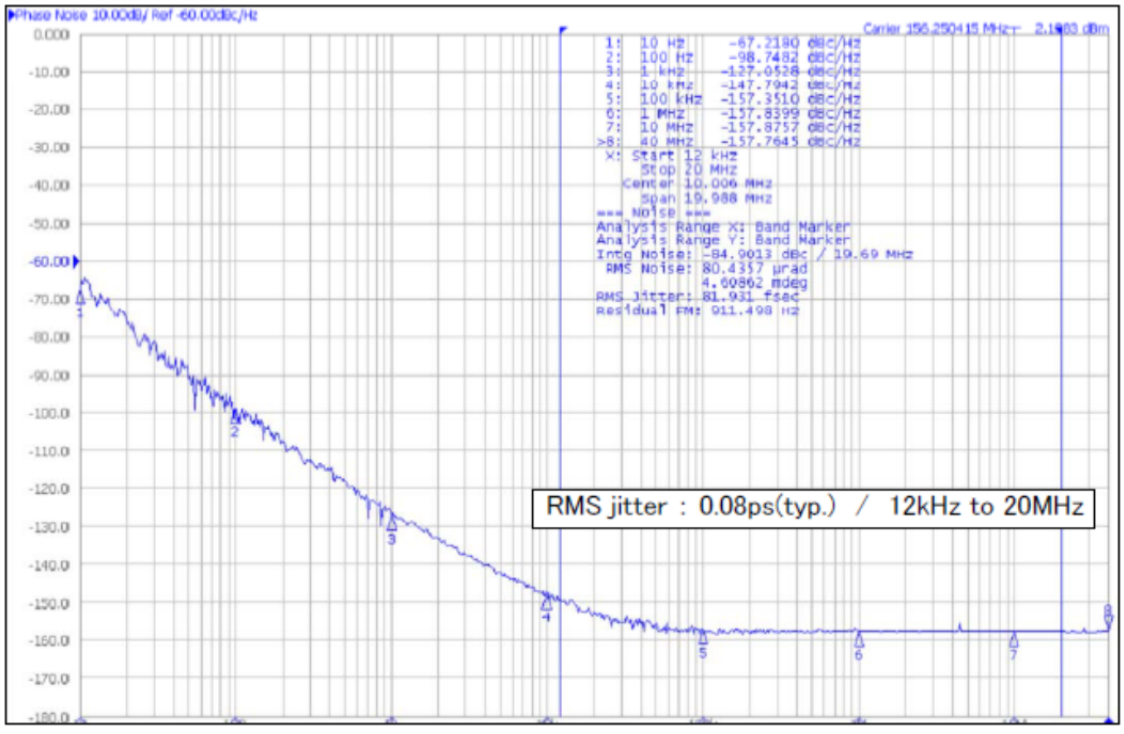
## Performance Data

### Phase Noise [typical]

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




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



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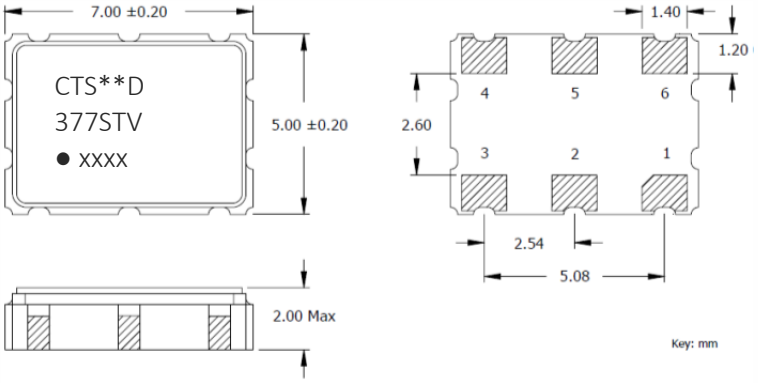
# Mechanical Specifications

## Package Drawing

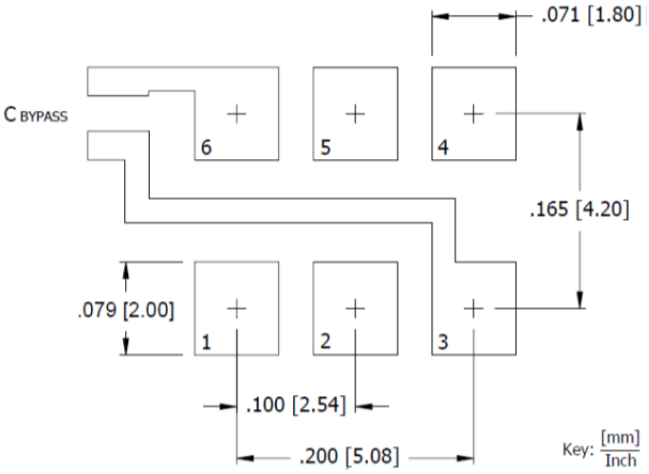



## Marking Information

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 | $V_C$ | Control Voltage |
| 2 | EOH | Enable |
| 3 | GND | Circuit & Package |
| 4 | Output | RF Output |
| 5 | $\overline{\text{Output}}$ | RF Output, Complementary |
| 6 | $V_{CC}$ | Supply Voltage |

## Table I - Date Code

| MONTH / YEAR | | | | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |



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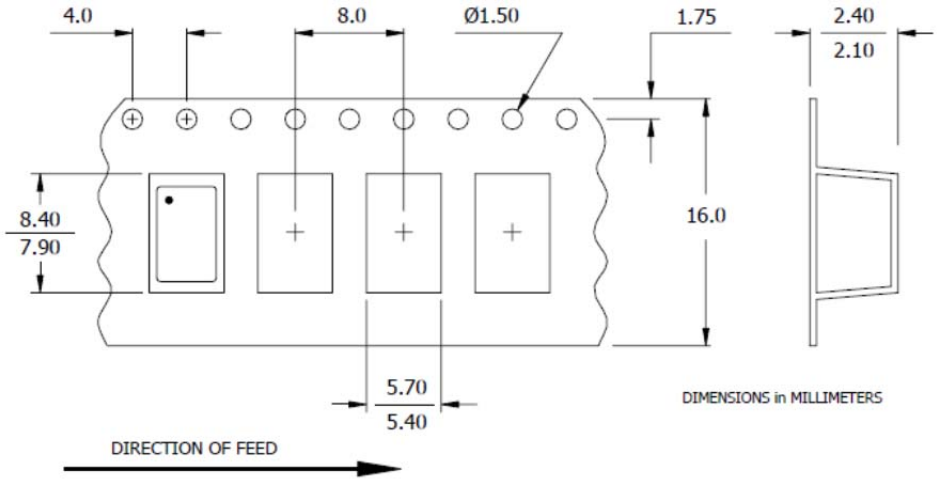
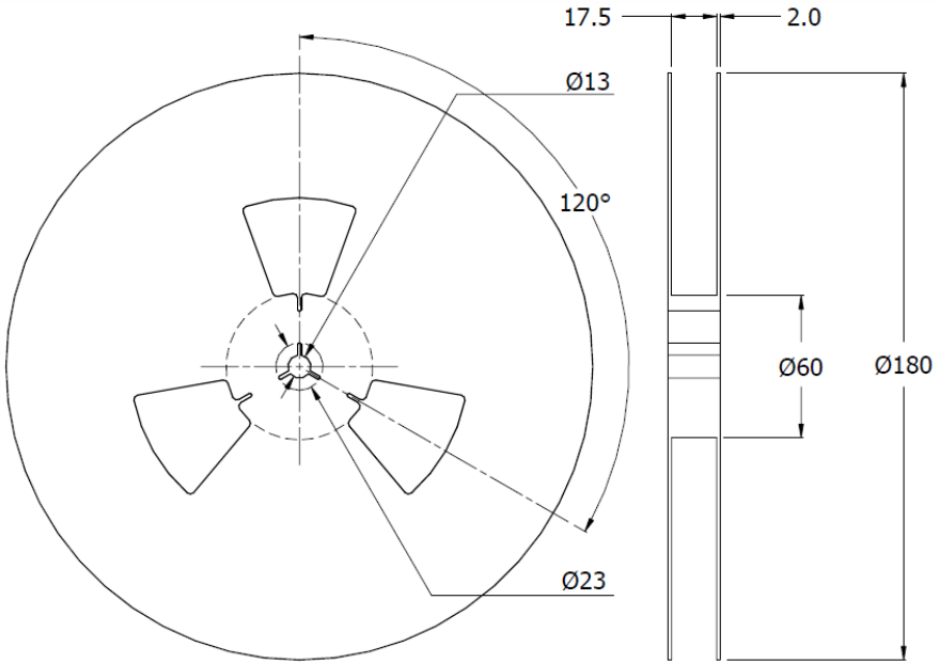
## Packaging - Tape and Reel

### Tape Drawing




### Reel Drawing




Dimensions in Millimeters

### 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.



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