

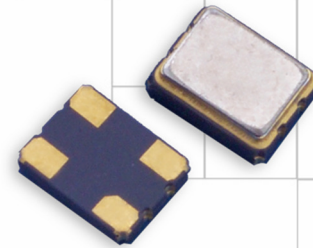


THE DATASHEET OF
525L52025ITR



Model 525

Clipped Sine Wave TCXO/VC-TCXO



Part Dimensions:
3.2 × 2.5 × 1.2mm • 30.8030mg

Features

- Ceramic Surface Mount Package
- Low Phase Jitter Performance
- Fundamental Crystal Design
- Frequency Range 13 – 52MHz *
- +1.8V, +2.5V, +2.8V, +3.0V and +3.3V Operation
- Voltage Control Option for Frequency Tuning [VC-TCXO]
- Tape and Reel Packaging, EIA-481

Standard Frequencies

* See Page 7 for common frequencies.
Check with factory for frequency availability.

Applications

- GPS
- IoT and IIoT
- Wireless Connectivity
- Synchronous Ethernet
- Base Stations/Femto Cells
- Mobile Communication
- WiMax/Wi-Fi/WLAN
- Phase Locked Loop
- Test Equipment

Description

CTS Model 525 is a low cost, small size, high performance Temperature Compensated Crystal Oscillator [TCXO]. Employing analog IC technology that provides a clipped sine wave output, high order temperature compensation engine; coupled with a fundamental quartz crystal M525 has excellent stability and low jitter/phase noise performance.

Ordering Information

| Model | Supply Voltage | Frequency Code [MHz] | Frequency Stability ² | Temperature Range | Frequency Tuning | Packaging | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------|-------------------------------------|-----------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------|---------|----------------|---------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------|----|--------------|----|---------|----|---------|----|---------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------|---|---------------------------|---|----------------------------|--|
| 525 | L | XXX | 10 | D | T | R | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th>Code</th> <th>Voltage</th> </tr> </thead> <tbody> <tr> <td>M</td> <td>+1.8Vdc</td> </tr> <tr> <td>N</td> <td>+2.5Vdc</td> </tr> <tr> <td>T</td> <td>+2.8Vdc</td> </tr> <tr> <td>R</td> <td>+3.0Vdc</td> </tr> <tr> <td>L</td> <td>+3.3Vdc</td> </tr> </tbody> </table> | Code | Voltage | M | +1.8Vdc | N | +2.5Vdc | T | +2.8Vdc | R | +3.0Vdc | L | +3.3Vdc | | <table border="1"> <thead> <tr> <th>Code</th> <th>Stability</th> </tr> </thead> <tbody> <tr> <td>05</td> <td>±0.5ppm [GPS]</td> </tr> <tr> <td>10</td> <td>±1.0ppm</td> </tr> <tr> <td>15</td> <td>±1.5ppm</td> </tr> <tr> <td>20</td> <td>±2.0ppm</td> </tr> <tr> <td>25</td> <td>±2.5ppm</td> </tr> </tbody> </table> | Code | Stability | 05 | ±0.5ppm [GPS] | 10 | ±1.0ppm | 15 | ±1.5ppm | 20 | ±2.0ppm | 25 | ±2.5ppm | | <table border="1"> <thead> <tr> <th>Code</th> <th>Frequency Deviation</th> </tr> </thead> <tbody> <tr> <td>T</td> <td>TCXO [No Voltage Control]</td> </tr> <tr> <td>A</td> <td>±5ppm Minimum³</td> </tr> </tbody> </table> | Code | Frequency Deviation | T | TCXO [No Voltage Control] | A | ±5ppm Minimum ³ | |
| Code | Voltage | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M | +1.8Vdc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| N | +2.5Vdc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| T | +2.8Vdc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R | +3.0Vdc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| L | +3.3Vdc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Code | Stability | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 05 | ±0.5ppm [GPS] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | ±1.0ppm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15 | ±1.5ppm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | ±2.0ppm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25 | ±2.5ppm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Code | Frequency Deviation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| T | TCXO [No Voltage Control] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | ±5ppm Minimum ³ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | <table border="1"> <thead> <tr> <th>Code</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td colspan="2">Product Frequency Code¹</td> </tr> </tbody> </table> | Code | Frequency | Product Frequency Code ¹ | | | <table border="1"> <thead> <tr> <th>Code</th> <th>Temp. Range</th> </tr> </thead> <tbody> <tr> <td>C</td> <td>-20°C to +70°C</td> </tr> <tr> <td>D</td> <td>-30°C to +85°C</td> </tr> <tr> <td>I</td> <td>-40°C to +85°C</td> </tr> </tbody> </table> | Code | Temp. Range | C | -20°C to +70°C | D | -30°C to +85°C | I | -40°C to +85°C | <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 | Frequency | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Product Frequency Code ¹ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Code | Temp. Range | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | -20°C to +70°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | -30°C to +85°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| I | -40°C to +85°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Code | Packing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R | 3k pcs./reel | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Notes:

- 1] Refer to document 016-1454-0, Frequency Code Tables. 3-digits for frequencies <100MHz, 4-digits for frequencies 100MHz or greater.
- 2] Frequency vs. Temperature only.
- 3] See Electrical Characteristics for Voltage Control range per Supply Voltage selected.

**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 |
|-------------------------|------------|----------------------|---------------|-----|--------------|------|
| Maximum Supply Voltage | V_{CC} | - | -0.6 | - | 4.6 | V |
| Maximum Control Voltage | V_C | - | -0.6 | - | $V_{CC}+0.6$ | V |
| Supply Voltage | V_{CC} | $\pm 5\%$ | 1.71 | 1.8 | 1.89 | V |
| | | | 2.38 | 2.5 | 2.63 | |
| | | | 2.66 | 2.8 | 2.94 | |
| | | | 2.85 | 3.0 | 3.15 | |
| | | | 3.14 | 3.3 | 3.47 | |
| Supply Current | I_{CC} | 13.00MHz - <26.00MHz | - | - | 2.0 | mA |
| | | 26.00MHz - 52.00MHz | - | - | 2.5 | |
| Output Load | $R_L//C_L$ | - | 10k Ohm//10pF | | | - |
| Operating Temperature | T_A | | -20 | | +70 | °C |
| | | | -30 | +25 | +85 | |
| | | | -40 | | +85 | |
| Storage Temperature | T_{STG} | - | -40 | - | +85 | °C |

Frequency Stability

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|---------------------|-------------------|------------------------------------------------|-------------------------|---------|-----|-----------|
| Frequency Range | f_0 | - | | 13 - 52 | | MHz |
| Frequency Stability | | | | | | |
| Initial Calibration | $\Delta f/f_0$ | Calibration @ +25°C, After 2 Reflows | -2.0 | - | 2.0 | ppm |
| Temperature Only | | Referenced to +25°C Reading | 0.5, 1.0, 1.5, 2.0, 2.5 | | | \pm ppm |
| Voltage Coefficient | $\Delta f/f_{25}$ | Supply Voltage, $\pm 5\%$ | -0.2 | - | 0.2 | ppm |
| Load Coefficient | | Load, $\pm 10\%$ | -0.2 | - | 0.2 | ppm |
| Aging | $\Delta f/f_{25}$ | First Year @ +25°C, nominal V_{CC} and V_C | -1.0 | - | 1.0 | ppm |
| | | 10 Years @ +25°C, nominal V_{CC} and V_C | -10 | - | 10 | |

Output Parameters

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------------------|--------|-------------------------|-----|--------------|-----|-----------|
| Output Type | - | DC Coupled | | Clipped Sine | | - |
| Output Voltage Levels | V_O | - | 0.8 | - | - | V_{P-P} |
| Start Up Time | T_S | Application of V_{CC} | - | - | 2 | ms |
| Phase Noise | - | See Typical Plots | - | - | - | - |

Control Voltage

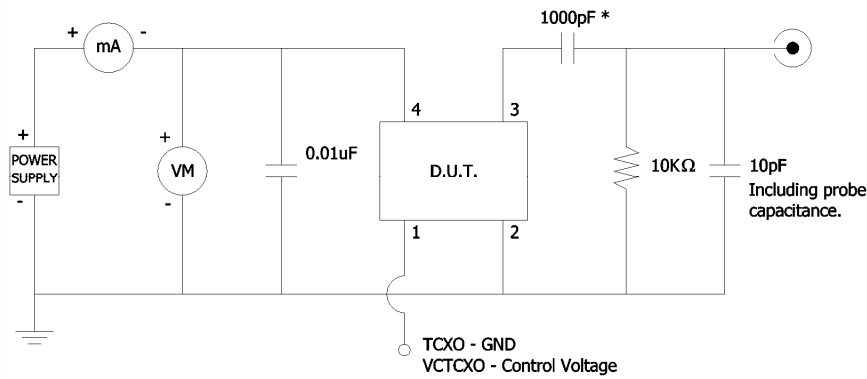
| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------|----------------|------------------------|---------|----------|----------|-------|
| Control Voltage | V_C | 1.8V | 0.30 | 0.90 | 1.50 | V |
| | | 2.5V, 2.8V, 3.0V, 3.3V | 0.40 | 1.40 | 2.40 | |
| Frequency Tuning [VCTCXO Only] | $\Delta f/f_0$ | Specified V_C Range | ± 5 | - | - | ppm |
| Linearity | L | Best Straight Line Fit | - | ± 5 | ± 10 | % |
| Input Impedance | Z_{V_C} | - | 500 | - | - | kOhms |
| Transfer Function | - | - | | Positive | | - |

Electrical Specifications

Test Circuit

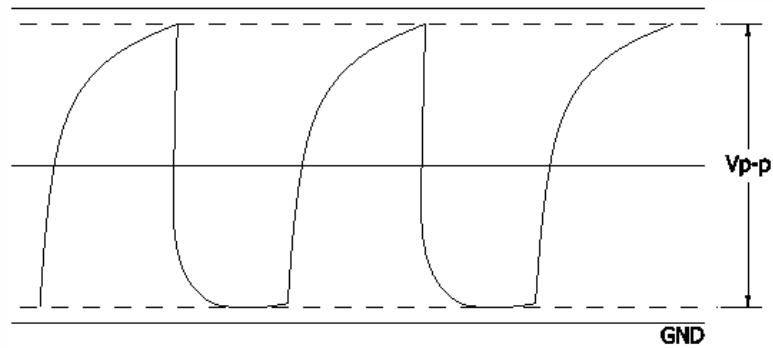
Clipped Sine

* DC-Cut Capacitor: Add 1000pF capacitor between the TCXO output and input of load.



Output Waveform

Clipped Sine

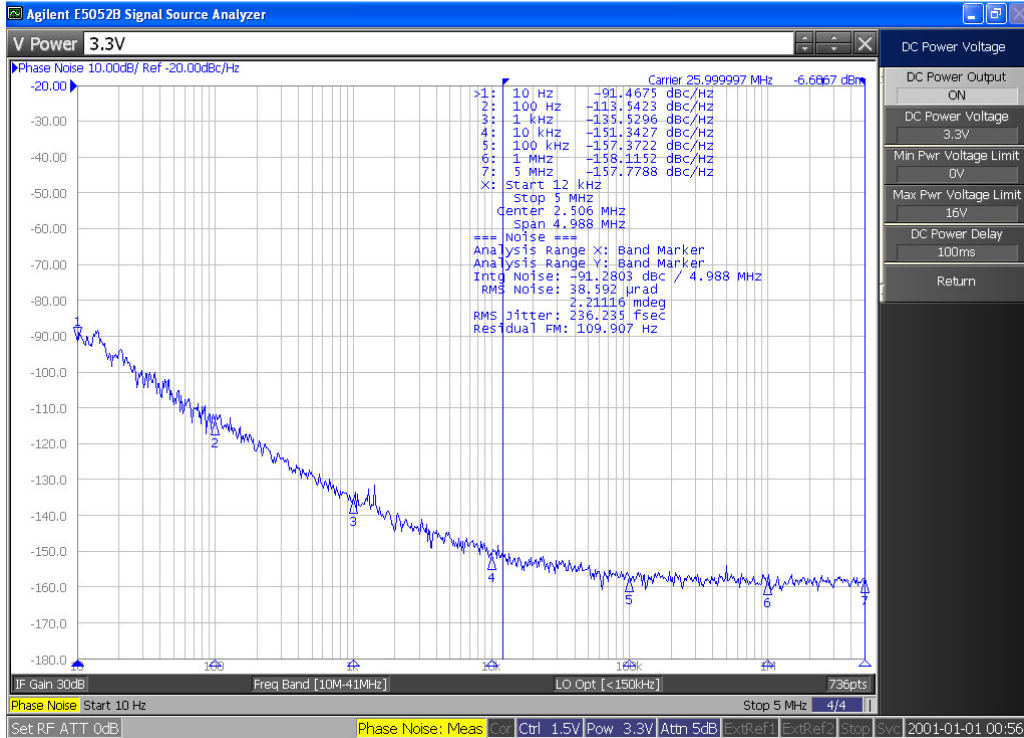


Electrical Specifications

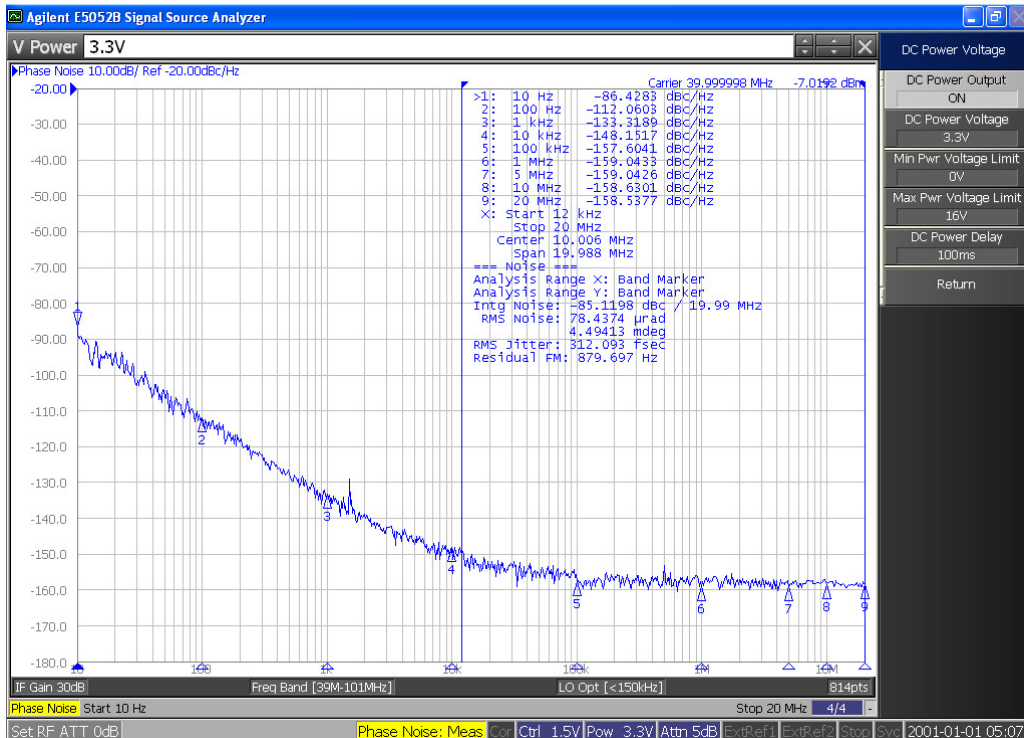
Performance Data

Phase Noise [typical]

26MHz, $V_{CC} = +3.3V$, $V_C = +1.5V$, $T_A = +25^\circ C$

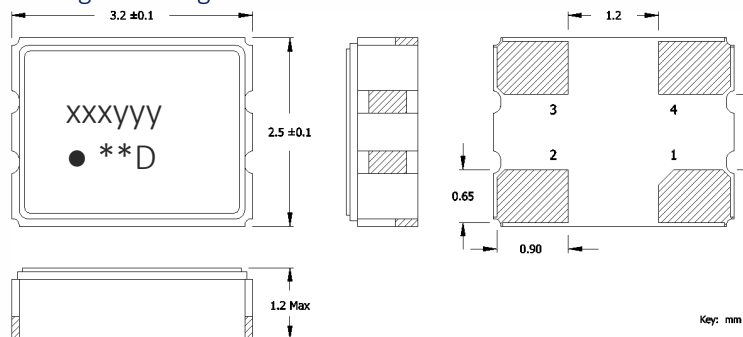


40MHz, $V_{CC} = +3.3V$, $V_C = +1.5V$, $T_A = +25^\circ C$



Mechanical Specifications

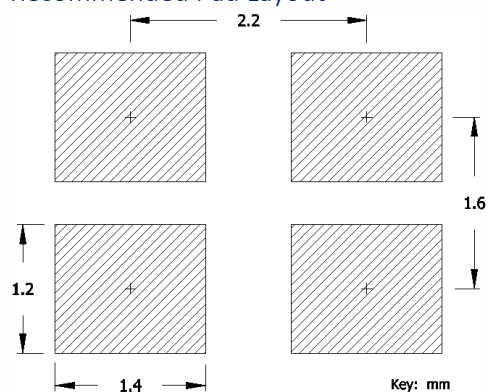
Package Drawing



Marking Information

- xxx – Frequency Code.
3-digits for frequencies <100MHz
[See document 016-1454-0, Frequency Code Tables.]
- yyy – Crystal Lot Code or Date Code [Optional].
- – Pin 1 identifier.
- ** – Manufacturing Site Code.
- D – Date Code. See Table I for codes.

Recommended Pad Layout



Notes

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

Pin Assignments

| Pin | Symbol | Function |
|-----|-----------------|---------------------------|
| 1 | GND | Ground [Note 1] |
| | V _C | Voltage Control [VC-TCXO] |
| 2 | GND | Circuit & Package |
| 3 | Output | RF Output [Note 2] |
| 4 | V _{CC} | Supply Voltage |

Notes

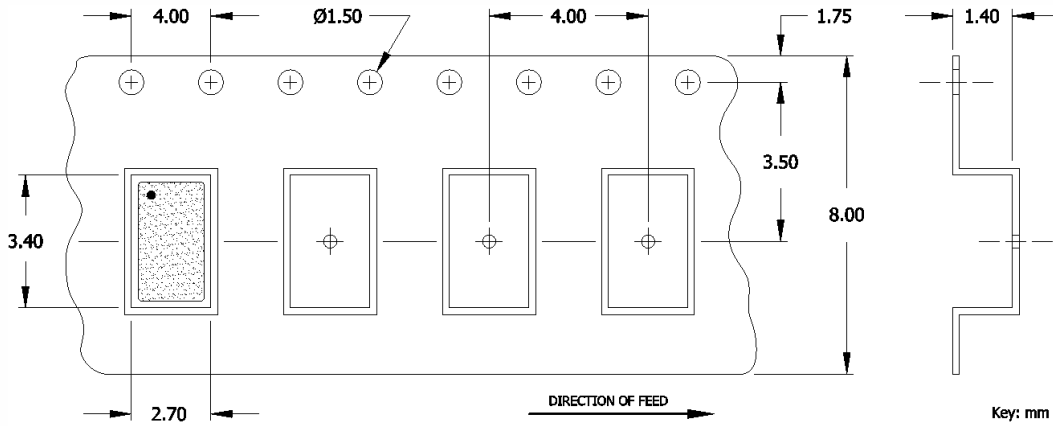
- Connect to ground for TCXO, no frequency tuning. This pin can be left floating.
- DC-Cut Capacitor Required. Add 1000pF capacitor between TCXO output and input of load.

Table I - Date Code, Beginning year 2021

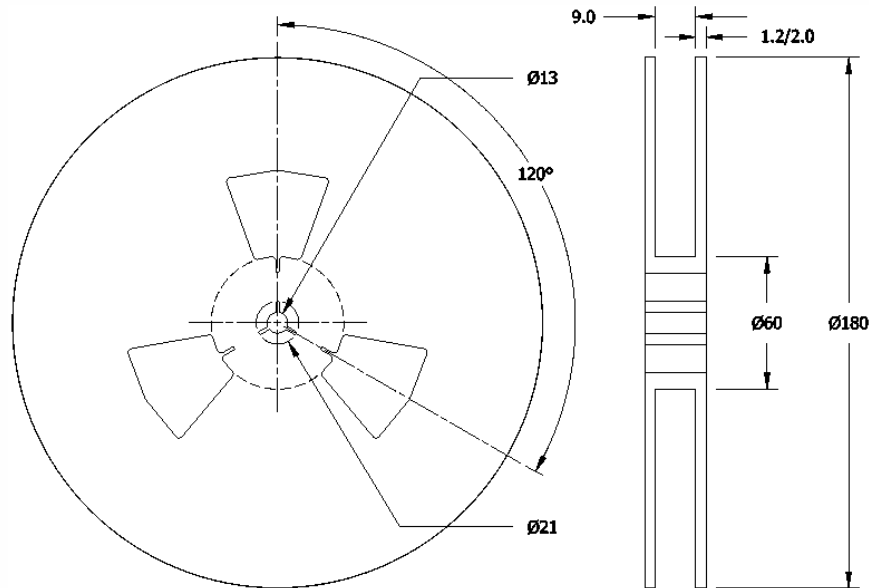
| YEAR | | MONTH | | | | | | | | | | | | | | |
|------|------|-------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | | | |
| 2021 | 2025 | 2029 | 2033 | 2037 | A | B | C | D | E | F | G | H | J | K | L | M |
| 2022 | 2026 | 2030 | 2034 | 2038 | N | P | Q | R | S | T | U | V | W | X | Y | Z |
| 2023 | 2027 | 2031 | 2035 | 2039 | a | b | c | d | e | f | g | h | j | k | l | m |
| 2024 | 2028 | 2032 | 2036 | 2040 | 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 minimum and 3k pieces maximum per 180mm reel.
2. Complete CTS part number, frequency value and date code information must appear on reel and carton labels.



Addendum

Common Frequencies – MHz

| FREQUENCY | ORDERING CODE | FREQUENCY | ORDERING CODE | FREQUENCY | ORDERING CODE | FREQUENCY | ORDERING CODE |
|-----------|---------------|-----------|---------------|-----------|---------------|-----------|---------------|
| 14.400000 | 144 | 27.000000 | 270 | | | | |
| 14.745600 | 147 | 30.720000 | 307 | | | | |
| 16.000000 | 160 | 32.000000 | 320 | | | | |
| 16.384000 | 163 | 38.400000 | 384 | | | | |
| 18.432000 | 184 | 40.000000 | 400 | | | | |
| 19.200000 | 192 | 44.000000 | 440 | | | | |
| 20.000000 | 200 | 48.000000 | 480 | | | | |
| 24.000000 | 240 | 50.000000 | 500 | | | | |
| 25.000000 | 250 | 52.000000 | 520 | | | | |
| 26.000000 | 260 | | | | | | |

Looking for pricing, stock, or lifecycle information?

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-  [CTS-Frequency Controls Information](#)

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