

# ClearClock™ Oscillator Family | Low-Power HCSL| 2.0x1.6mm XO

## Description

Abracon's AK1LP offers the latest low power HCSL technology that allows for a simplified termination method compared to traditional HCSL, reduces overall power consumption, and a decreased bill of materials. The Abracon AK1LP is available with a compact 2.0 x 1.6 mm package capable of with a frequency stability of  $\pm 25$  ppm over an operating temperature range of  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ . Additional advantages include a various power supply options ranging from 1.8V, 2.5V, 3.3V and a continuous voltage range of 1.71V to 3.63V.



## Features

- Available in industry standard frequencies between 100MHz & 156.25MHz
- $\pm 25$ ppm stability over industrial operating temperature ( $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ )
- 1.8V, 2.5V, 3.3V, 1.71V to 3.63V Continuous supply voltage options
- Industry standard 2.0 x 1.6 x .83 mm footprint
- Available in Abracon's global distribution network

## Typical Applications

- Optical Transceivers and Modules
- Data Centers, Storage, and Servers
- Networking switches and gateways
- 100G/200G/400G/800G Ethernet
- Fibre Channel/SONET/SDH/PCIE
- Industrial and FPGA applications
- Test & measurement

## Electrical Specifications

| Parameters                                                                    |      | Min.             | Typ.  | Max.   | Unit | Notes                                                      |
|-------------------------------------------------------------------------------|------|------------------|-------|--------|------|------------------------------------------------------------|
| Frequency Range                                                               |      | 100              |       | 156.25 | MHz  |                                                            |
| Standard Available Frequencies                                                |      | 100.000, 156.250 |       |        | MHz  | Contact Abracon for availability of frequencies not listed |
| Supply Voltage (Vdd)                                                          |      | 2.97             | 3.3   | 3.63   | V    | Option “A”                                                 |
|                                                                               |      | 2.375            | 2.5   | 2.625  |      | Option “B”                                                 |
|                                                                               |      | 1.71             | 1.8   | 1.89   |      | Option “C”                                                 |
|                                                                               |      | 1.71             |       | 3.63   |      | Option “E”                                                 |
| Supply Current (Idd)                                                          | HCSL |                  | 10    | 15     | mA   | @ 100MHz, Vdd=3.3V                                         |
|                                                                               |      |                  | 15    | 20     |      | @ 156.25MHz, Vdd=3.3V                                      |
| Operating Temperature Range                                                   |      | -20              |       | 70     | °C   | Option “D”                                                 |
|                                                                               |      | -40              |       | 85     |      | Option “F” or “Q”                                          |
| Storage Temperature                                                           |      | -55              |       | 150    | °C   |                                                            |
| Frequency Tolerance <sup>[Note 1]</sup>                                       |      | -10              | < ±5  | 10     | ppm  |                                                            |
| Frequency Stability over <sup>[Note 2,3]</sup><br>Operating Temperature Range |      | -15              | < ±10 | 15     | ppm  | Option “D” (-20°C to +70°C)                                |
|                                                                               |      | -20              | < ±15 | 20     |      | Option “Q” (-40°C to +85°C)                                |
|                                                                               |      | -25              | < ±20 | 25     |      | Option “F” (-40°C to +85°C)                                |
| First Year Aging                                                              |      | -3               |       | 3      | ppm  | At 25°C                                                    |
| All-Inclusive Frequency Accuracy<br>(Total Stability) <sup>[Note 4]</sup>     |      | -40              |       | 40     | ppm  | Option “D” (-20°C to +70°C)                                |
|                                                                               |      | -45              |       | 45     |      | Option “Q” (-40°C to +85°C)                                |
|                                                                               |      | -50              |       | 50     |      | Option “F” (-40°C to +85°C)                                |
| Rise (Tr) / Fall (Tf) Time <sup>[Note 5]</sup>                                |      |                  | 0.45  | 0.7    | ns   | RL=No Load                                                 |
| Duty Cycle                                                                    |      | 45               |       | 55     | %    |                                                            |
| Start-up Time <sup>[Note 2]</sup>                                             |      |                  | < 2   | 5      | ms   |                                                            |

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## Electrical Specifications Cont.

| Parameters                                                            |      |                 | Min.                   | Typ. | Max.                   | Unit | Notes                                                               |
|-----------------------------------------------------------------------|------|-----------------|------------------------|------|------------------------|------|---------------------------------------------------------------------|
| Differential<br>Output High Voltage (VOH)<br>Output Low Voltage (VOL) | HCSL | V <sub>OH</sub> | 0.550                  |      | 0.900                  | V    | R <sub>L</sub> = No Load                                            |
|                                                                       |      | V <sub>OL</sub> | -0.15                  | 0.00 | 0.15                   |      |                                                                     |
| Output Voltage Swing (V <sub>opp</sub> )                              |      |                 | 0.550                  |      |                        | V    |                                                                     |
| Output Enable & Disable Control                                       |      |                 | 0.7*(V <sub>dd</sub> ) |      |                        | V    | Output Enable or No Connect                                         |
|                                                                       |      |                 |                        |      | 0.3*(V <sub>dd</sub> ) |      | Output Disable (High Impedance)                                     |
| Output Enable Time                                                    |      |                 |                        | < 1  | 2.0                    | ms   |                                                                     |
| Output Disable Time                                                   |      |                 |                        |      | 0.2                    | μs   |                                                                     |
| Output Disable Current Consumption                                    |      |                 |                        |      | 10                     | μA   | OE ≤ 0.3V                                                           |
| RMS Phase Jitter<br>(12kHz to 20MHz from Carrier)                     |      |                 | See Table 1 below      |      |                        |      | V <sub>dd</sub> , output logic type and Carrier frequency dependent |

Note 1: Frequency Accuracy (Initial Set-Tolerance), at time of shipment (pre-reflow), relative to carrier frequency, @ +25°C

Note 2: Relative to initial measured frequency @ +25°C

Note 3: Option Q only available in select frequencies. Please contact Abracon for availability

Note 4: Includes post reflow frequency accuracy, temperature stability, load pulling, power supply variation, and 10-year aging

Note 5: Measured over 20% to 80% of waveform

**Table 1**  
**RMS Phase Jitter 12kHz – 20MHz BW** [Note 6,7]

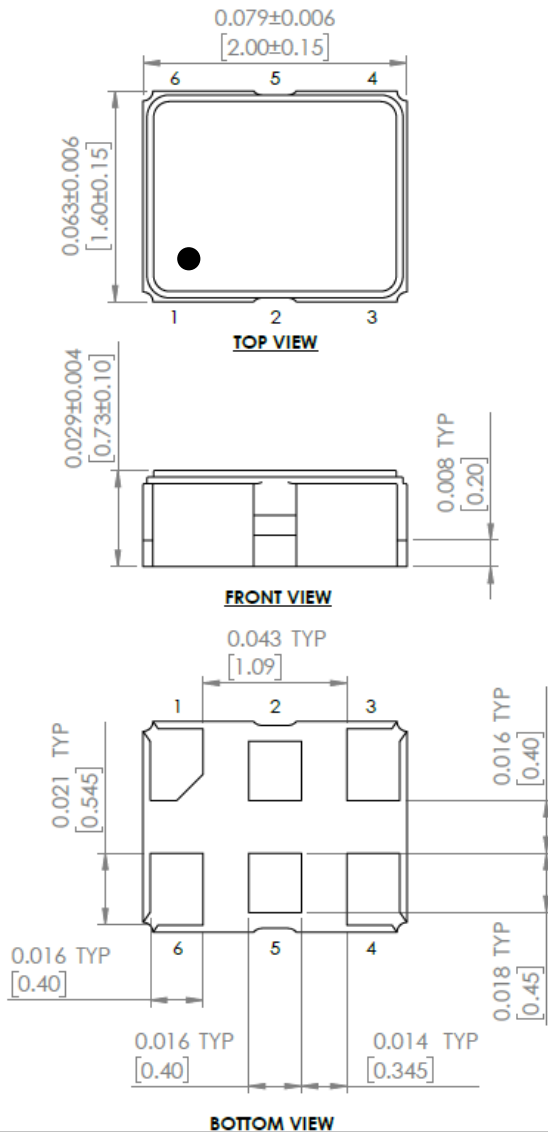
| Frequency (MHz) | V <sub>dd</sub> (V) | RMS Jitter |          |
|-----------------|---------------------|------------|----------|
|                 |                     | Typ. (fs)  | Max (fs) |
| 100             | 1.8                 | 122        | 180      |
|                 | 2.5                 | 120        | 180      |
|                 | 3.3                 | 118        | 180      |
| 156.25          | 1.8                 | 100        | 150      |
|                 | 2.5                 | 100        | 150      |
|                 | 3.3                 | 100        | 150      |

Note 6: Guaranteed by characterization; RMS Phase Jitter specifications are inclusive of any spurs

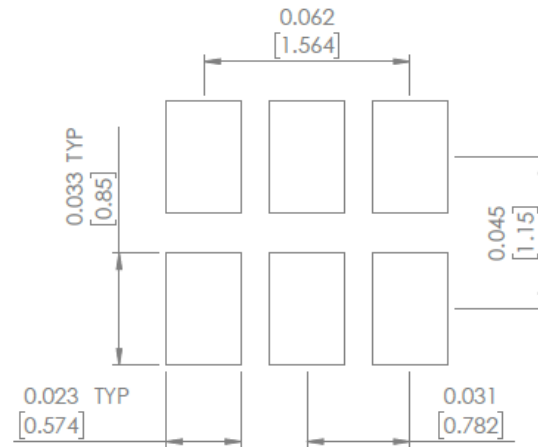
Note 7: Phase jitter measured with Keysight E5052B Signal Source Analyzer

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## Mechanical Dimensions



### RECOMMENDED LAND PATTERN



### Case 1

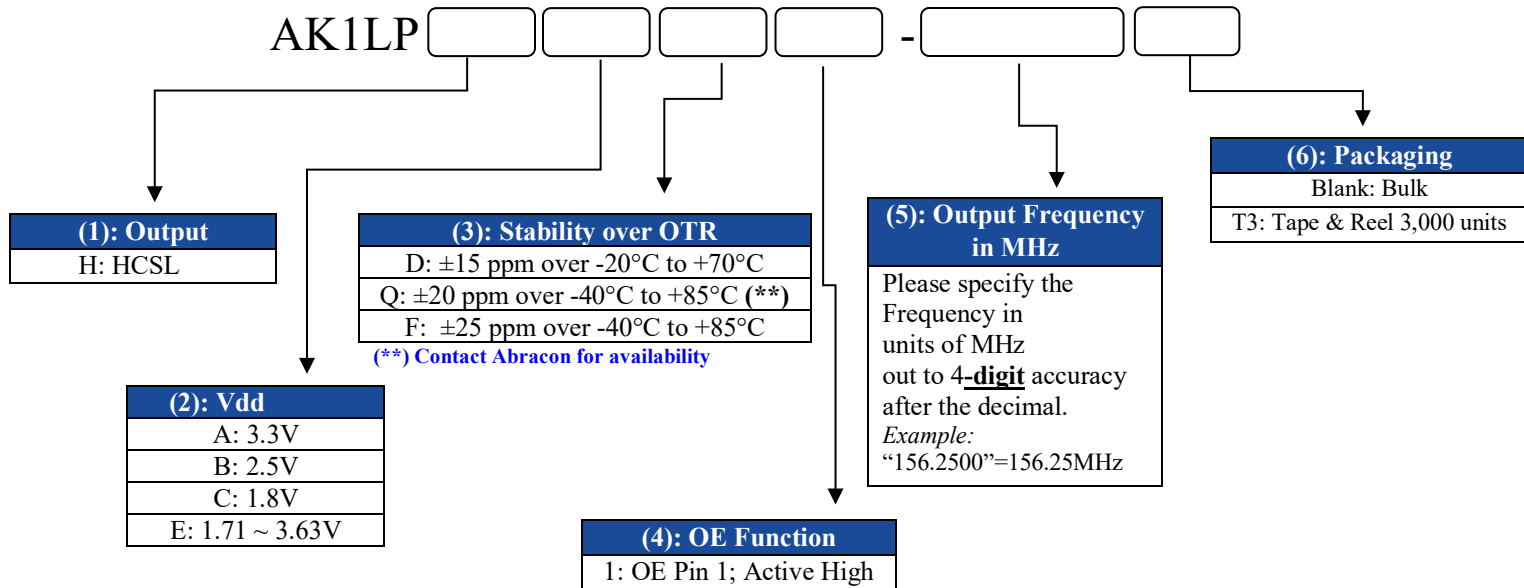
Pin #1=Output  
Enable/Disable Function  
where OE is Active HIGH

| Pin | Description                                                                  |
|-----|------------------------------------------------------------------------------|
| # 1 | Output Enable = Logic High, "1", Vdd<br>Output Disable = Logic Low, "0", GND |
| # 2 | No Connect                                                                   |
| # 3 | GND                                                                          |
| # 4 | Output                                                                       |
| # 5 | Complementary output                                                         |
| # 6 | Supply Voltage (Vdd)                                                         |

Dimensions: Inches [mm]

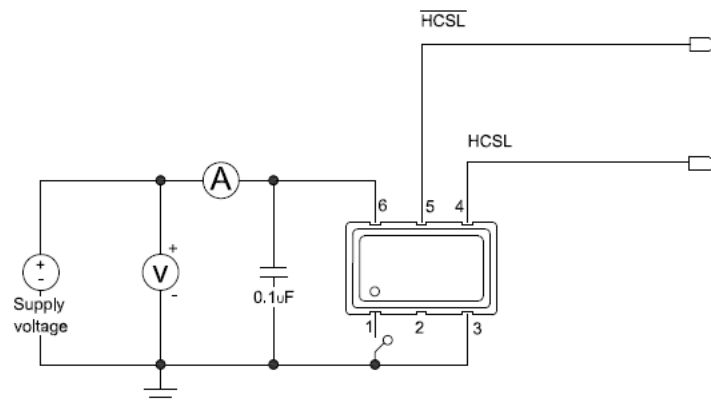
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## Part Identification



## Recommended Test Circuit

### LP-HCSL



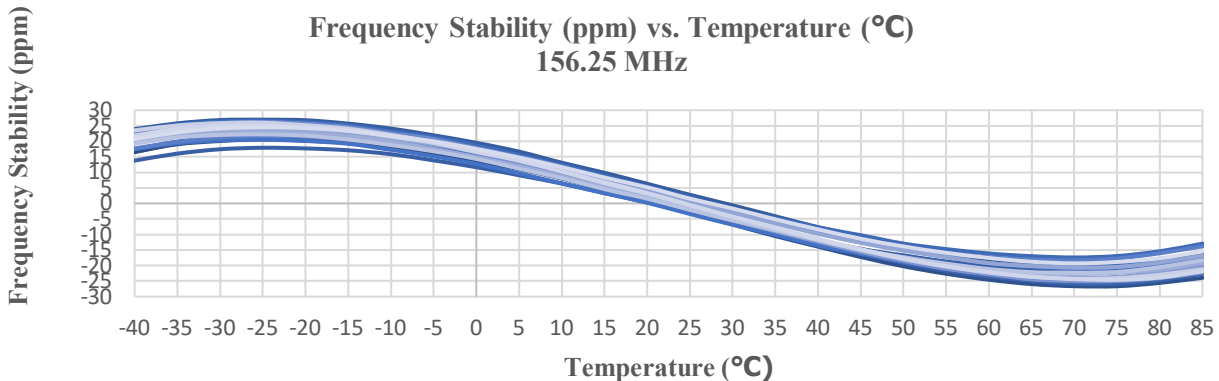
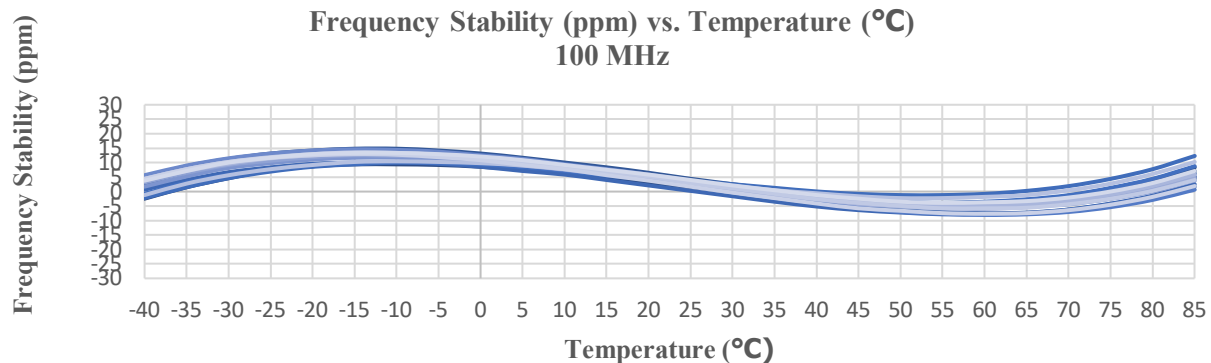
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## Absolute Maximum Ratings <sup>[Note 8]</sup>

| Parameters                             | Min.                      | Typ. | Max.         | Unit | Notes               |
|----------------------------------------|---------------------------|------|--------------|------|---------------------|
| Supply Voltage                         | $V_{SS}-0.5$              |      | 4.5          | V    |                     |
| Input Voltage                          | $V_{SS}-0.5$              |      | $V_{DD}+0.5$ | V    |                     |
| Output Voltage                         | $V_{SS}-0.5$              |      | $V_{DD}+0.5$ | V    |                     |
| Maximum Junction Operating Temperature |                           |      | 150          | °C   |                     |
| Ambient Operating Temperature Range    | -40                       |      | 85           | °C   | Industrial          |
| Ambient Operating Temperature Range    | -20                       |      | 70           | °C   | Extended Commercial |
| Reflow Temperature                     |                           |      | 260          | °C   | See Reflow Profile  |
| ESD Protection                         | 4kV HBM, 300V MM, 2kV CDM |      |              |      |                     |

Note 8: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability. The data sheet limits are not guaranteed if the device is operated beyond the recommended operating conditions.

## Typical Frequency vs Temperature Characteristics



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## Reflow Profile [JEDEC J-STD-020]

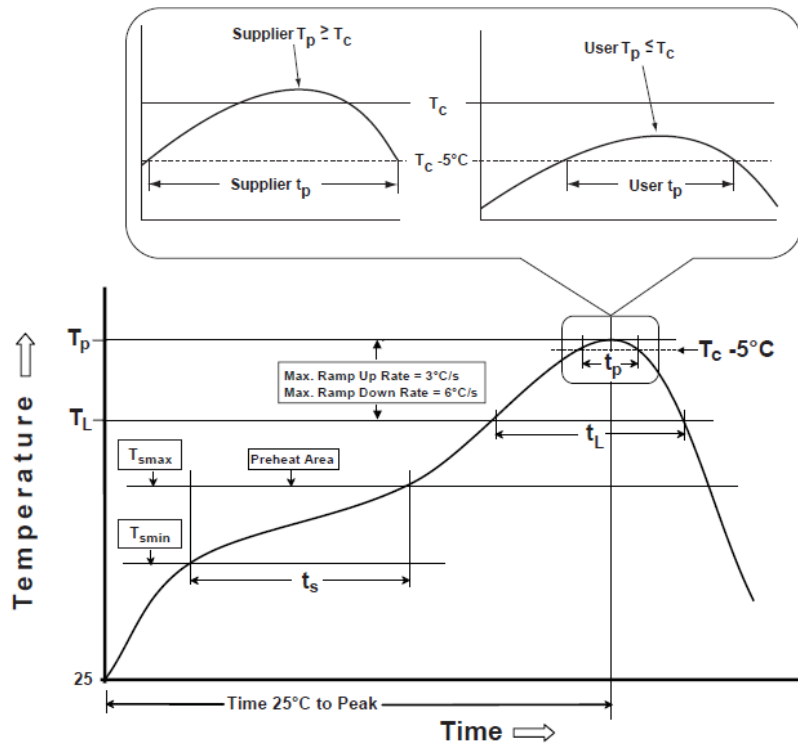


Table 1

| SnPb Eutectic Process<br>Classification Temperatures ( $T_c$ ) |                             |                             |
|----------------------------------------------------------------|-----------------------------|-----------------------------|
| Package Thickness                                              | Volume mm <sup>3</sup> <350 | Volume mm <sup>3</sup> ≥350 |
| <2.5 mm                                                        | 235 °C                      | 220 °C                      |
| ≥2.5 mm                                                        | 220 °C                      | 220 °C                      |

Table 2

| Pb-Free Process<br>Classification Temperatures ( $T_c$ ) |                             |                                 |                              |
|----------------------------------------------------------|-----------------------------|---------------------------------|------------------------------|
| Package Thickness                                        | Volume mm <sup>3</sup> <350 | Volume mm <sup>3</sup> 350-2000 | Volume mm <sup>3</sup> >2000 |
| <1.6 mm                                                  | 260 °C                      | 260 °C                          | 260 °C                       |
| 1.6 mm - 2.5 mm                                          | 260 °C                      | 250 °C                          | 245 °C                       |
| >2.5 mm                                                  | 250 °C                      | 245 °C                          | 245 °C                       |

| Profile Feature                                                                   | Sn-Pb Eutectic Assembly | Pb-Free Assembly |
|-----------------------------------------------------------------------------------|-------------------------|------------------|
| Preheat / soak                                                                    |                         |                  |
| Temperature minimum ( $T_{smin}$ )                                                | 100°C                   | 150°C            |
| Temperature maximum ( $T_{smax}$ )                                                | 150°C                   | 200°C            |
| Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )                                       | 60 - 120 sec.           | 60 - 120 sec.    |
| Average ramp-up rate ( $T_{smax}$ to $T_p$ )                                      | 3°C/sec. max            | 3°C/sec. max     |
| Liquidous $T_L$                                                                   | 183°C                   | 217°C            |
| Time at li                                                                        | 60 - 150 sec.           | 60 - 150 sec.    |
| Peak package body temperature ( $T_p$ )*                                          | see Table 1             | see Table 2      |
| Time ( $t_p$ )** within 5°C of the specified classification temperature ( $T_c$ ) | 20 sec.                 | 30 sec.          |
| Ramp-down rate ( $T_p$ to $T_{smax}$ )                                            | 6°C/sec. max            | 6°C/sec. max     |
| Time 25°C to peak temperature                                                     | 6 min. max              | 8 min. max       |
| Reflow cycles                                                                     | 2 max                   | 2 max            |

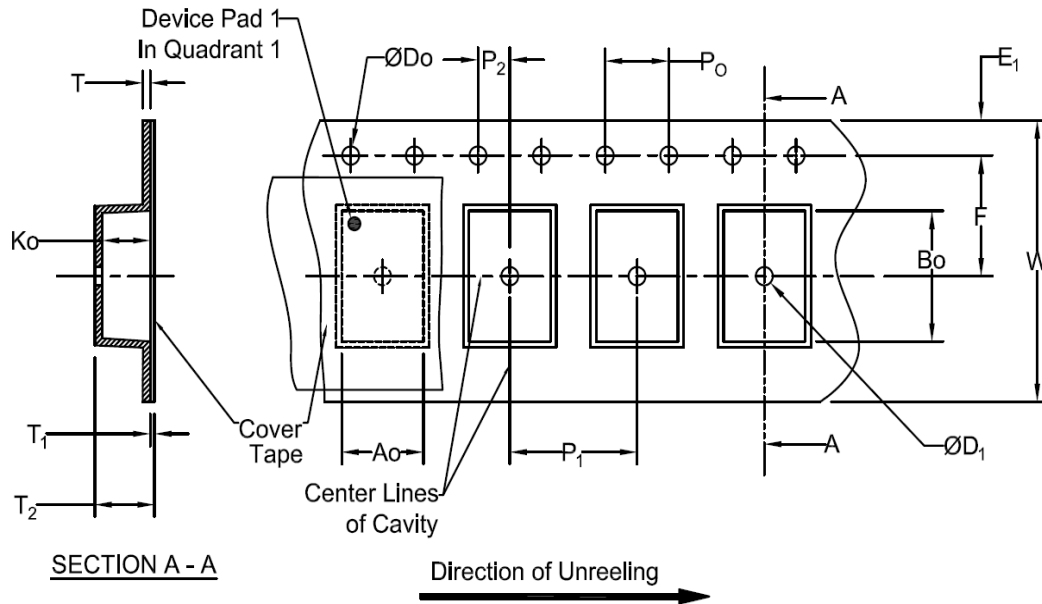
\*Tolerance for peak profile temperature ( $T_p$ ) is defined as a supplier minimum and a user maximum.

\*\*Tolerance for time at peak profile temperature ( $t_p$ ) is defined as supplier minimum and a user maximum.

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## Packaging

T3: 3,000pcs/reel

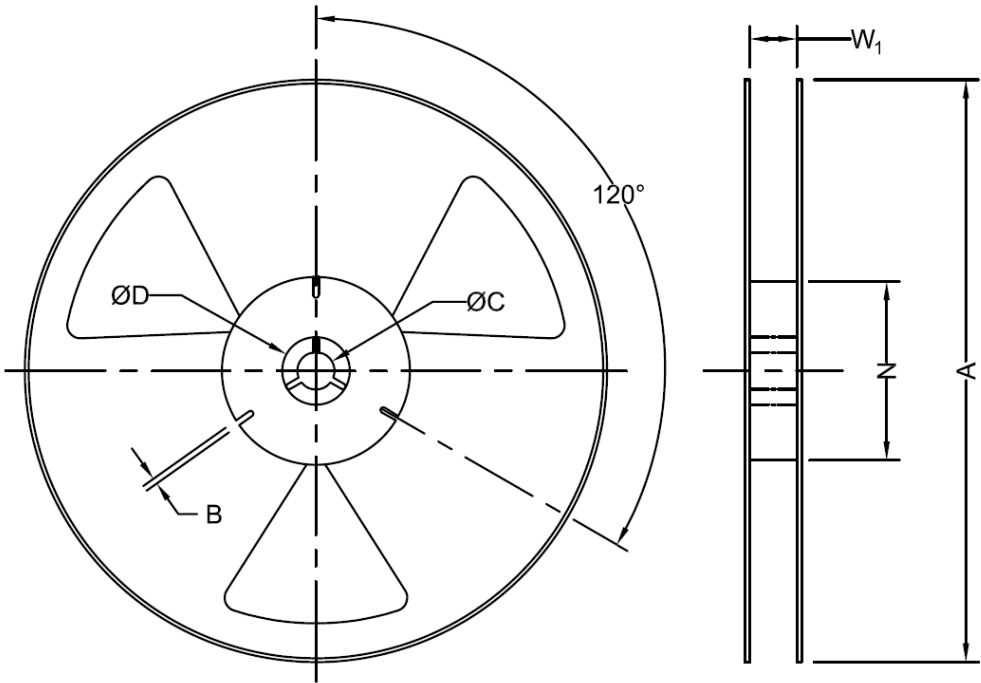


| Tape Specifications (mm) |                |                |                |                      |                      |                      |         |
|--------------------------|----------------|----------------|----------------|----------------------|----------------------|----------------------|---------|
| Width                    | Ao             | Bo             | Do             | D <sub>1</sub> (Min) | E <sub>1</sub>       | F                    | Ko      |
| 8mm                      | *              | *              | 1.5+0.1/-0.0   | 1.0                  | 1.75±0.1             | 3.5±0.05             | *       |
| Width                    | P <sub>1</sub> | P <sub>2</sub> | P <sub>0</sub> | T (Max)              | T <sub>1</sub> (Max) | T <sub>2</sub> (Max) | W (Max) |
| 8mm                      | 4.0±0.1        | 2.0±0.05       | 4.0±0.1        | 0.6                  | 0.1                  | 2.5                  | 8.3     |

**\*Note: Compliant to EIA-481**

Dimensions: mm

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| Reel Specifications (mm) |          |         |         |               |         |         |                 |
|--------------------------|----------|---------|---------|---------------|---------|---------|-----------------|
| Width                    | Qty/Reel | A (Nom) | B (Min) | C (Min)       | D (Min) | N (Min) | *W <sub>1</sub> |
| 8mm                      | 3000     | 178     | 1.5     | 13.0+0.5/-0.2 | 20.2    | 50      | 8.4+1.5/-0.0    |

**\*Note: Measured at Hub**

Dimensions: mm

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