# ClearClock™ Oscillator Family | Ultra-Low Jitter | 3.2x2.5mm XO

## AK3AAIG

Request Samples | Check Inventory

ESD Sensitive | Pb

**3.2 x 2.5 x 1.0 mm**
**RoHS/RoHS II Compliant**
**MSL Level = N/A**

## Features

- AEC-Q200 Qualified
- Automotive Grade 1: -40°C to +125°C Available
- TS16949 Production Line Certified, PPAP Available Upon Request
- Exceptionally Low RMS Jitter: 83fs Typ (LVDS @ 156.25MHz)
- Based on 3rd overtone, quartz crystal technology
- Available in industry standard frequencies between 100MHz and 200MHz
- 2.5V, 3.3V, 2.25V to 3.63V Continuous supply voltage options
- LVPECL, LVDS, HCSL differential output logic
-

## 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

## Key Electrical Specifications

| Parameters | | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|---|
| Frequency Range | | 100 | | 200 | MHz | |
| Standard Available Frequencies | | 100.000, 114.285, 122.880. 125.000, 148.500, 150.000, 155.520, 156.250 & 200.000 | | | MHz | Contact Abracon for availability of frequencies not listed |
| Supply Voltage (Vdd) [Note 1] | | 2.97 | 3.3 | 3.63 | V | Option "A" |
| | | 2.375 | 2.5 | 2.625 | | Option "B" |
| | | 2.375 | | 3.63 | | Option "D" |
| Supply Current (Idd) | LVPECL | | 40 | 60 | mA | @ 200MHz; @ Vdd=3.3V |
| | LVDS | | 17 | 35 | | @ 200MHz; @ Vdd=3.3V |
| | HCSL | | 27 | 40 | | @ 200MHz; @ Vdd=3.3V |
| Operating Temperature Range | | -20 | | 70 | °C | Option "D" |
| | | -40 | | 85 | | Option "F" or "Q" |
| | | -40 | | 105 | | Option "X" |
| | | -40 | | 125 | | Option "A" |
| Storage Temperature | | -55 | | 125 | °C | |
| Frequency Tolerance [Note 2] | | -10 | < ±5 | 10 | ppm | |
| Frequency Stability over [Note 3,4] 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) |
| | | -50 | < ±45 | 50 | | Option "X" (-40°C to +105°C) |
| | | -50 | < ±45 | 50 | | Option "A" (-40°C to +125°C) |
| First Year Aging | | -3 | | 3 | ppm | At 25°C |
| All-Inclusive Frequency Accuracy (Total Stability) [Notes 5] | | -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) |
| | | -100 | | 100 | | Option "X" (-40°C to +105°C) |
| | | -100 | | 100 | | Option "A" (-40°C to +125°C) |

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**3.2 x 2.5 x 1.0 mm**
**RoHS/RoHS II Compliant**
**MSL Level = N/A**

## Key Electrical Specifications Cont.

| | | | | | | |
|---|---|---|---|---|---|---|
| Rise (Tr) / Fall (Tf) Time [Notes 6] | LVPECL | | 0.2 | 0.4 | ns | @ Vdd=3.3V, $R_L$=50Ω |
| | LVDS | | 0.2 | 0.4 | | @ Vdd=3.3V, $R_L$=100Ω |
| | | | 0.2 | 0.4 | | @ Vdd=2.5V, $R_L$=100Ω |
| | HCSL | | 0.5 | 0.8 | | @ Vdd=3.3V, $R_L$=50Ω to GND |
| | | | 0.5 | 0.8 | | @ Vdd=2.5V, $R_L$=50Ω to GND |
| Duty Cycle | | 45 | | 55 | % | |
| Start-up Time [Note 3] | | | < 2 | 5 | ms | |

Note 1: Supply voltage (Vdd) = 2.5V and 2.375~3.63V options not available with LVPECL output
Note 2: Frequency Accuracy (Initial Set-Tolerance), at time of shipment (pre-reflow), relative to carrier frequency, @ +25°C
Note 3: Relative to initial measured frequency @ +25°C
Note 4: Option Q only available in select frequencies. Please contact Abracon for availability
Note 5: Includes post reflow frequency accuracy, temperature stability, load pulling, power supply variation, and 10-year aging
Note 6: Measured over 20% to 80% of waveform

| Parameters | | | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|---|---|
| Differential Output High Voltage (VOH) Output Low Voltage (VOL) | LVPECL | $V_{OH}$ | $V_{dd}$-1.025 | $V_{dd}$-0.95 | $V_{dd}$-0.88 | V | $R_L$=50Ω to $V_{dd}$–2.0V |
| | | $V_{OL}$ | $V_{dd}$-1.81 | $V_{dd}$-1.7 | $V_{dd}$-1.62 | | |
| | LVDS | $V_{OH}$ | | 1.43 | 1.60 | | $R_L$=100Ω between both outputs |
| | | $V_{OL}$ | 0.90 | 1.10 | | | |
| | HCSL | $V_{OH}$ | 0.50 | 0.74 | 0.85 | | $R_L$=50Ω to ground on each output |
| | | $V_{OL}$ | -0.15 | 0.00 | 0.15 | | |
| Output Voltage Swing (Vopp) | | | 0.400 | | | V | LVPECL |
| | | | 0.250 | 0.350 | 0.450 | | LVDS |
| | | | 0.500 | 0.700 | 0.850 | | HCSL |
| Output Enable & Disable Control | | | 0.7*($V_{dd}$) | | | V | Output Enable or No Connect |
| | | | | | 0.3*($V_{dd}$) | | Output Disable (High Impedance) |
| Output Enable Time | | | | < 1 | 5.0 | ms | |
| Output Disable Time | | | | | 0.2 | µs | |
| Output Disable Current Consumption | | | | | 10 | µA | OE ≤ 0.3V |
| RMS Phase Jitter (12kHz to 20MHz from Carrier) | | | See Table 1 below | | | | Vdd, output logic type and Carrier frequency dependent |

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**RoHS/RoHS II Compliant**
**MSL Level = N/A**

## Key Electrical Specifications Cont.

**Table 1**
**RMS Phase Jitter 12kHz – 20MHz BW, Vdd=3.3V** [Note 7, 8, 9]

| Frequency (MHz) | Output | RMS Jitter | |
|---|---|---|---|
| | | Typ. (fs) | Max (fs) |
| 100 | LVDS | 184 | 200 |
| | LVPECL | 166 | 200 |
| | HCSL | 152 | 175 |
| 125 | LVDS | 118 | 150 |
| | LVPECL | 94 | 125 |
| | HCSL | 90 | 115 |
| 156.25 | LVDS | 83 | 125 |
| | LVPECL | 64 | 100 |
| | HCSL | 71 | 100 |
| 200 | LVDS | 55 | 100 |
| | LVPECL | 75 | 100 |
| | HCSL | 70 | 100 |

Note 7: Guaranteed by characterization; RMS Phase Jitter specifications are inclusive of any spurs
Note 8: Phase jitter measured with Keysight E5052B Signal Source Analyzer
Note 9: Refer to the next section for phase noise test setup and representative phase noise plots

## Absolute Maximum Ratings [Note 10]

| Parameters | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| Supply Voltage | Vss-0.5 | | 5 | V | |
| Input Voltage | Vdd-0.5 | | $V_{DD}$+0.5 | V | |
| Output Voltage | Vdd-0.5 | | $V_{DD}$+0.5 | V | |
| Maximum Junction Operating Temperature | | | 150 | ºC | |
| Ambient Operating Temperature Range | -40 | | 125 | ºC | Automotive |
| Ambient Operating Temperature Range | -20 | | 70 | ºC | Extended Commercial |
| Reflow Temperature | | | 260 | °C | See Reflow Profile |
| ESD Protection | 4kV HBM, 300V MM, 2kV CDM | | | | |

Note 10: 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.

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## Options and Part Identification [Note 11]

AK3AAIG [ ] [ ] [ ] [ ] - [ ] [ ]

| (1): Output |
|---|
| P: LVPECL |
| D: LVDS |
| H: HCSL |

| (2): Vdd |
|---|
| A: 3.3V |
| B: 2.5V (*) |
| D: 2.375 ~ 3.63V (*) |

(*) Excluding LVPECL

| (3): Stability over OTR |
|---|
| D: ±15 ppm over -20°C to +70°C |
| Q: ±20 ppm over -40°C to +85°C (**) |
| F: ±25 ppm over -40°C to +85°C |
| X: ±50 ppm over -40°C to +105°C |
| A: ±50 ppm over -40°C to +125°C |

(**) Contact Abracon for availability

| (4): OE Function |
|---|
| 1: OE Pin 1; Active High |
| 3: OE Pin 2; Active High |

| (5): Output Frequency in MHz |
|---|
| Please specify the Frequency in units of MHz out to 4-**digit** accuracy after the decimal. *Example:* "156.2500"=156.25MHz |

| (6): Packaging |
|---|
| Blank: Bulk |
| T: Tape & Reel 1,000 units |
| T3: Tape & Reel 3,000 units |

## ***Part Number Example:***

AK3AAIGPAF1-156.2500
AK3AAIGPAF1-156.2500T
AK3AAIGPAF1-156.2500T3

Note 11: Contact Abracon for non-standard part number configurations and/or requests with carrier frequency callouts up to 5 & 6 digit accuracy after the decimal

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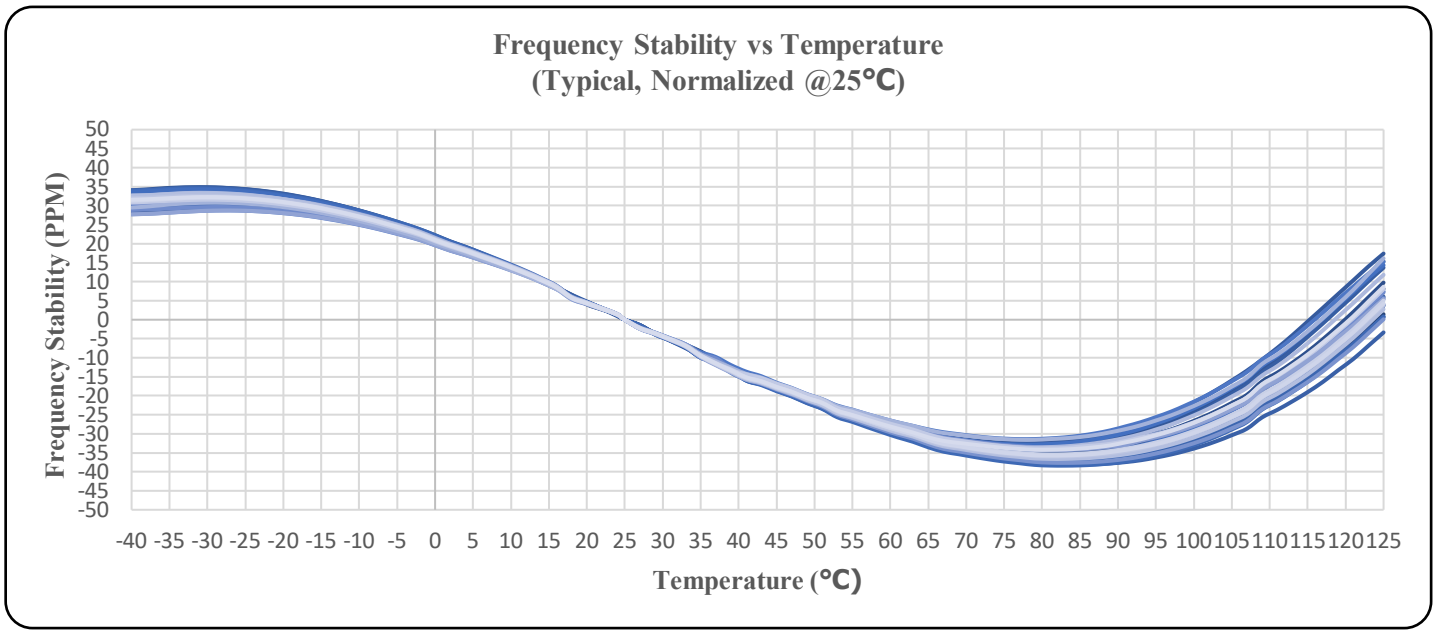
## Typical Frequency vs. Temperature Characteristics





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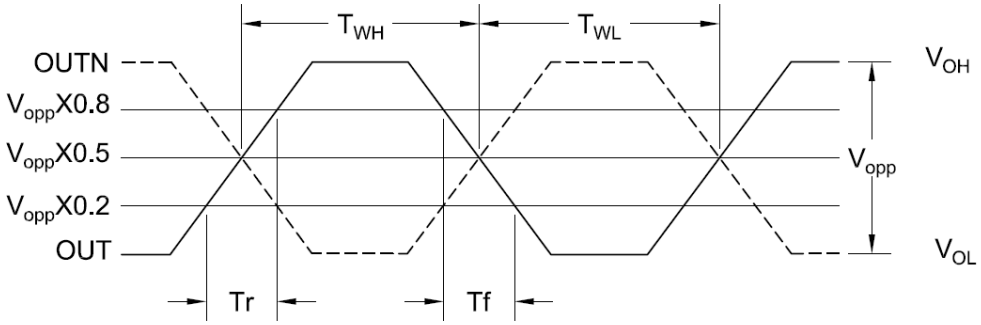
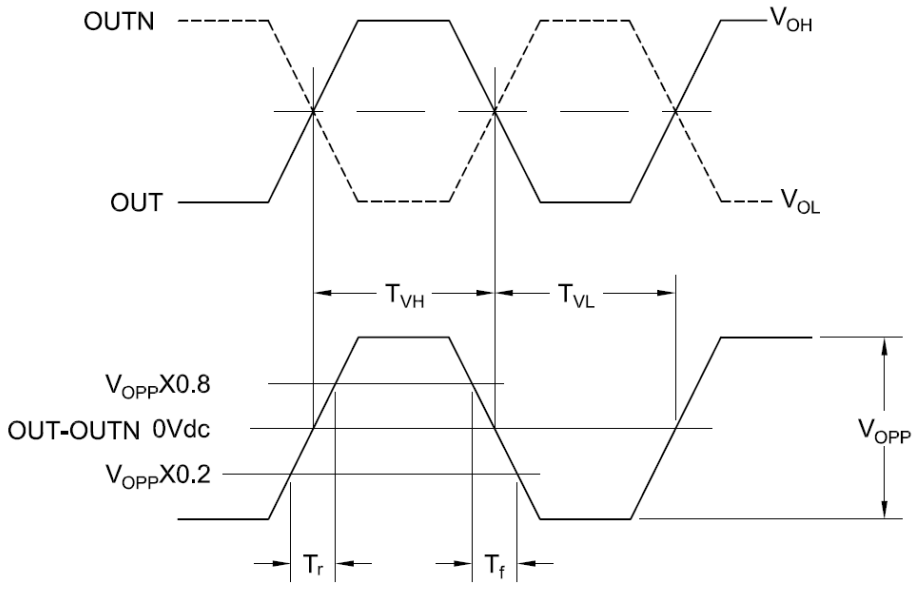
## Differential Output Waveform

LVPECL: Output Wave Form (Duty, Tr, Tf)




$$\text{Duty Cycle} = \frac{T_{WH}}{T_{WH}+T_{WL}} \times 100\%$$

LVDS: Output Wave Form (Duty, Tr, Tf, VOH, VOL, VOpp )




$$\text{Duty} = \frac{T_{VH}}{T_{VH}+T_{VL}} \times 100\%$$

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**3.2 x 2.5 x 1.0 mm**
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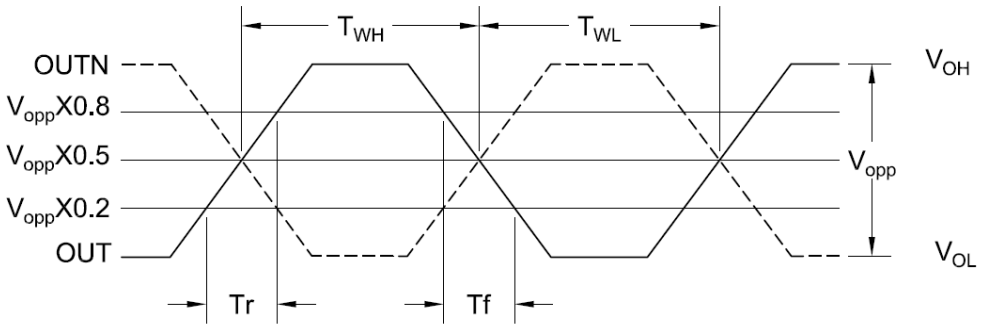
**MSL Level = N/A**

HCSL: Output Wave Form (Duty, Tr, Tf, VOH, VOL, VOpp )




$$\text{Duty Cycle} = \frac{T_{WH}}{T_{WH}+T_{WL}} \times 100\%$$

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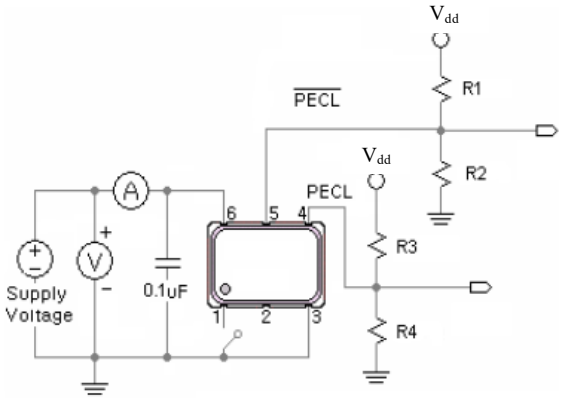
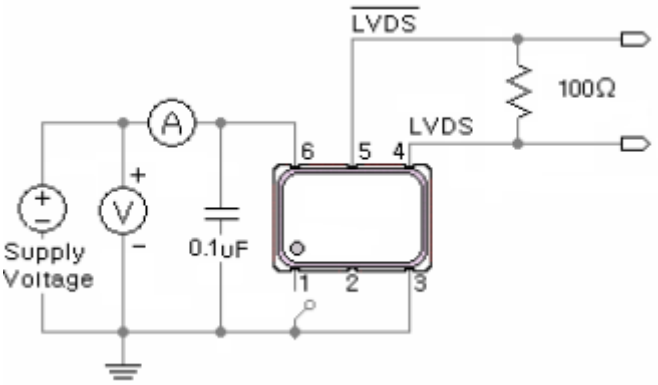
## Recommended Test Circuit [Note 12]

### LVPECL

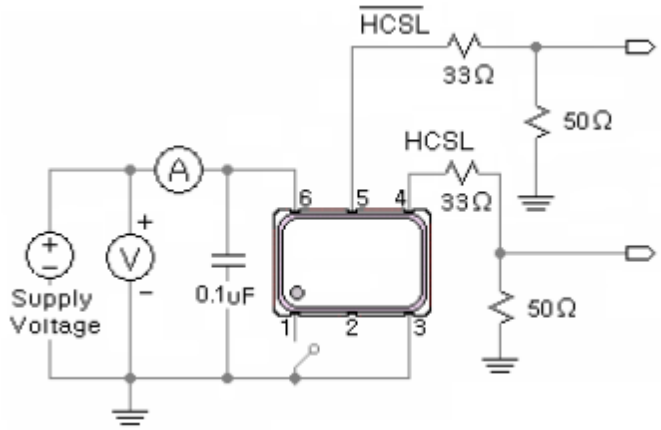



### LVDS




Vdd= 3.3V: R1=R3=127Ω; R2=R4=82.5Ω

### HCSL




Note 12: Recommended test circuit images are representative of when the OE Function is located on Pin 1; when the OE Function is located on Pin 2, then Pin 1=No Connect & Pin 2=OE or No Connect.

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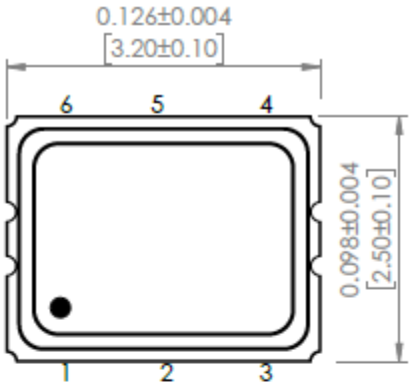
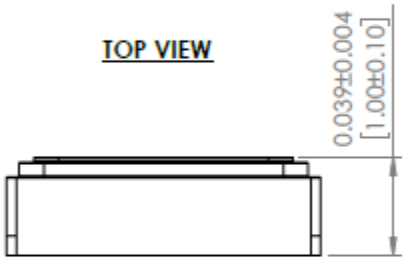
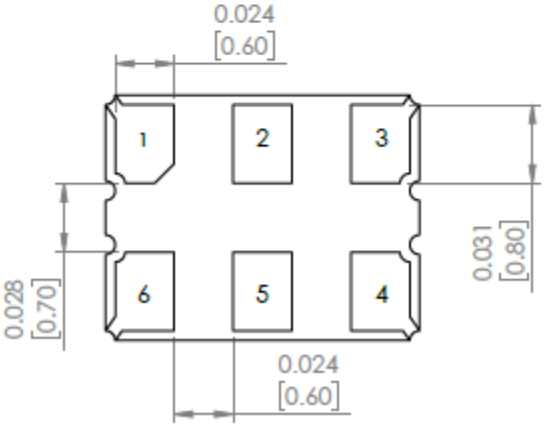
## Mechanical Dimensions



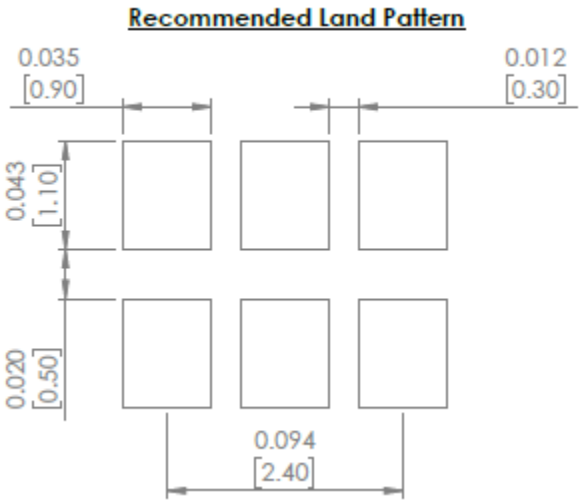

TOP VIEW




SIDE VIEW




BOTTOM VIEW




| Case 1<br>Pin #1=Output<br>Enable/Disable Function<br>*where* OE is Active HIGH | | Case 2<br>Pin #2=Output<br>Enable/Disable Function<br>*where* OE is Active HIGH | |
|---|---|---|---|
| **Pin** | **Description** | **Pin** | **Description** |
| **# 1** | Output Enable = Logic High, "1", Vdd | **# 1** | No Connect |
| | Output Disable = Logic Low, "0", GND | **# 2** | Output Enable = Logic High, "1", Vdd |
| **# 2** | No Connect | | Output Enable = Logic Low, "0", GND |
| **# 3** | GND | **# 3** | GND |
| **# 4** | Output | **# 4** | Output |
| **# 5** | Complementary output | **# 5** | Complementary output |
| **# 6** | Supply Voltage (Vdd) | **# 6** | Supply Voltage (Vdd) |

**Dimensions: inches [mm]**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## Reflow Profile [JEDEC J-STD-020]

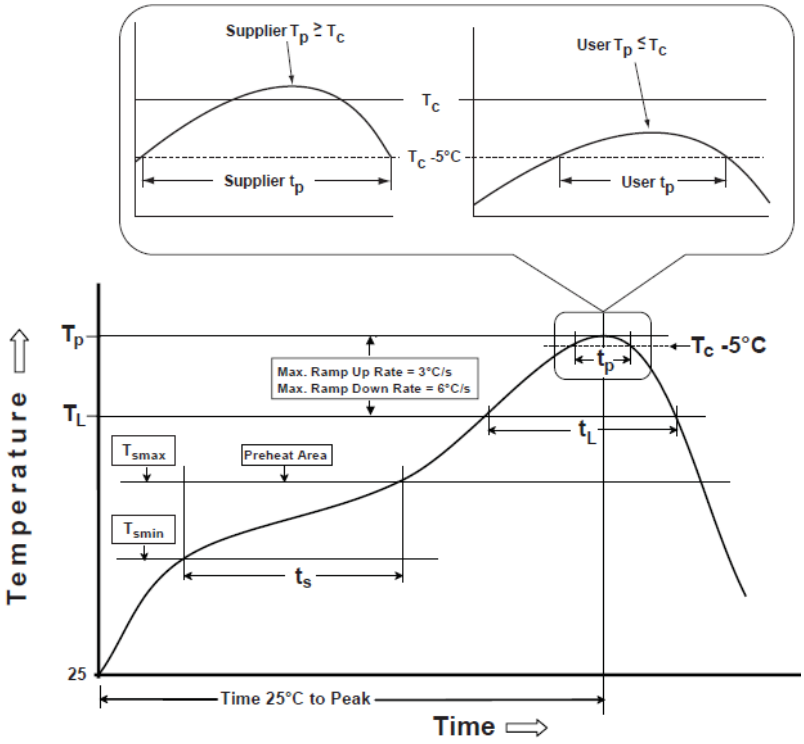


**Table 1**

| SnPb Eutectic Process Classification Temperatures ($T_c$) | | |
|---|---|---|
| Package Thickness | Volume mm³ <350 | Volume mm³ ≥350 |
| <2.5 mm | 235 °C | 220 °C |
| ≥2.5 mm | 220 °C | 220 °C |

**Table 2**

| Pb-Free Process Classification Temperatures ($T_c$) | | | |
|---|---|---|---|
| Package Thickness | Volume mm³ <350 | Volume mm³ 350-2000 | Volume mm³ >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 temperature ($T_L$) | 183°C | 217°C |
| Time at liquidous ($t_L$) | 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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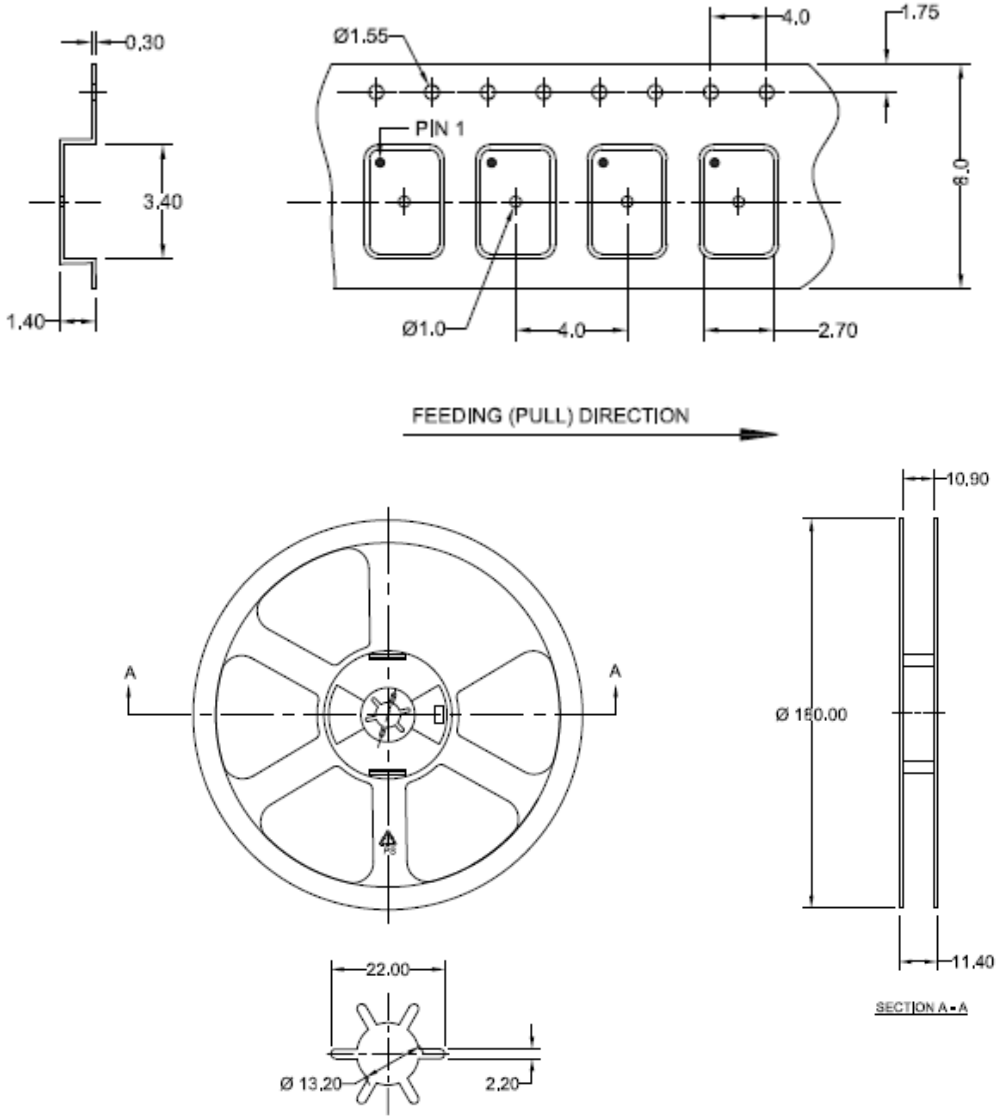
## Packaging

**Blank = Bulk**
**T = Tape & Reel 1,000 units/reel**
**T3= Tape & Reel 3,000 units/reel**




**Dimensions: mm**



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AK3AAIGPDF1-200.0000T AK3AAIGDDF1-156.2500T AK3AAIGHDF1-156.2500T AK3AAIGPDF1-100.0000T
AK3AAIGHDF1-100.0000T AK3AAIGPDF1-156.2500T AK3AAIGHDF1-125.0000T AK3AAIGPDF1-125.0000T