

# CLEARCLOCK™ | POWER OPTIMIZED 0.12ps 5x7mm XO



AX7

7.0 x 5.0 x 1.8 mm



RoHS/RoHS II Compliant

MSL = 1



ESD SENSITIVE

## FEATURES

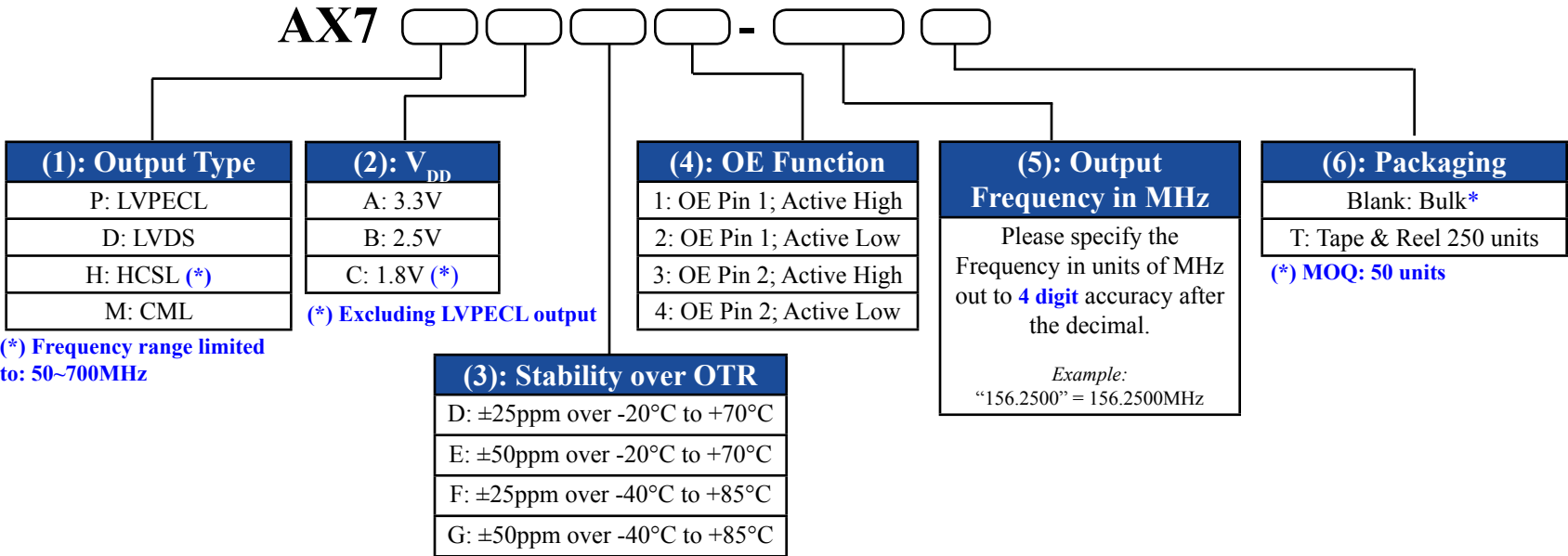
- 0.125ps typ jitter (150fs MAX  $f > 200\text{MHz}$ ,  $25^\circ\text{C}$ )
- Highest in-class frequency range from 50 to 2100MHz
- Excellent spurious suppression
- 70mA MAX  $I_{DD}$  (LVDS, any  $V_{DD}$ )
- Lowest in-class power consumption
- Supports LVPECL, HCSL, LVDS, CML
- Supports  $\pm 50\text{ppm}$  or  $\pm 100\text{ppm}$  all inclusive stability
- $-40^\circ\text{C}$  to  $85^\circ\text{C}$  or  $-20^\circ\text{C}$  to  $70^\circ\text{C}$  operation
- Industry standard 5x7mm footprint

## APPLICATIONS

- Networking and communications
- RF systems, base stations (BTS)
- Test and measurement
- Cloud, server and storage, Fibre Channel
- 100/400GbEthernet
- PCI Express

## OPTIONS AND PART IDENTIFICATION [Note 1]

Note 1: Contact Abracon for part number requests with carrier frequency callouts up to 5 & 6 digit accuracy after the decimal.



Part Number Example:  
**AX7PAF1-644.53125**

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## COMMON KEY ELECTRICAL SPECIFICATIONS

| Parameters                                                                      |                 |                 | Min.                   | Typ.   | Max.                   | Unit | Notes                                                  |
|---------------------------------------------------------------------------------|-----------------|-----------------|------------------------|--------|------------------------|------|--------------------------------------------------------|
| Frequency Range                                                                 | LVPECL          |                 | 50                     |        | 2100                   | MHz  | Option “P”                                             |
|                                                                                 | LVDS            |                 | 50                     |        | 2100                   |      | Option “D”                                             |
|                                                                                 | HCSL            |                 | 50                     |        | 700                    |      | Option “H”                                             |
|                                                                                 | CML             |                 | 50                     |        | 2100                   |      | Option “M”                                             |
| Power Supply Voltage (V <sub>DD</sub> ) <sup>[Note 1]</sup>                     |                 |                 | 2.97                   | 3.3    | 3.63                   | V    | Option “A”                                             |
|                                                                                 |                 |                 | 2.25                   | 2.5    | 2.75                   |      | Option “B”                                             |
|                                                                                 |                 |                 | 1.71                   | 1.8    | 1.89                   |      | Option “C”                                             |
| Current Consumption (I <sub>DD</sub> )                                          | LVPECL          |                 |                        | 87     | 94                     | mA   | @ V <sub>DD</sub> =3.3V                                |
|                                                                                 | LVDS            |                 |                        | 64     | 70                     |      |                                                        |
|                                                                                 | HCSL            |                 |                        | 75     | 80                     |      | @ V <sub>DD</sub> =1.8V                                |
|                                                                                 | CML             |                 |                        | 63     | 68                     |      |                                                        |
| Set Tolerance (as received) @ 25°C ±3°C                                         |                 |                 | -5.00                  | <±3.00 | +5.00                  | ppm  | Relative to carrier                                    |
| Operating Temperature Range (OTR)                                               |                 |                 | -40                    |        | +85                    | °C   | <i>See Options</i>                                     |
| Storage Temperature                                                             |                 |                 | -55                    |        | +155                   | °C   |                                                        |
| Frequency Stability over OTR                                                    |                 |                 | -25                    |        | +25                    | ppm  | Option “D or F”                                        |
|                                                                                 |                 |                 | -50                    |        | +50                    |      | Option “E or G”                                        |
| Aging over 10-Year Product Life <sup>[Note 2]</sup>                             |                 |                 | -15                    |        | +15                    | ppm  |                                                        |
| All Inclusive Frequency Accuracy over 10-Year Product Life <sup>[Note 2]</sup>  |                 |                 | -50                    |        | +50                    | ppm  | Specific to freq. stability option “D” or “F” (±25ppm) |
|                                                                                 |                 |                 | -100                   |        | +100                   |      | Specific to freq. stability option “E” or “G” (±50ppm) |
| Rise (Tr) / Fall Time (Tf)                                                      | LVPECL/LVDS/CML |                 |                        |        | 0.35                   | nS   | 20% ↔ 80% waveform                                     |
|                                                                                 | HCSL            |                 |                        |        | 0.40                   |      |                                                        |
| Duty Cycle                                                                      |                 |                 | 45                     |        | 55                     | %    | @ 50% V <sub>DD</sub>                                  |
| Start-up Time <sup>[Note 2]</sup>                                               |                 |                 |                        | < 5.0  | 10                     | ms   |                                                        |
| Output High Voltage (V <sub>OH</sub> )<br>Output Low Voltage (V <sub>OL</sub> ) | LVPECL          | V <sub>OH</sub> | V <sub>DD</sub> -1.165 |        | V <sub>DD</sub> -0.8   | V    | 50Ω into V <sub>DD</sub> -2.0V or thevenin equivalent  |
|                                                                                 |                 | V <sub>OL</sub> | V <sub>DD</sub> -2.0   |        | V <sub>DD</sub> -1.55  |      |                                                        |
|                                                                                 | LVDS            | V <sub>OH</sub> |                        | 1.4    | 1.6                    |      | 100Ω between OUT and OUTN                              |
|                                                                                 |                 | V <sub>OL</sub> | 0.9                    | 1.1    |                        |      |                                                        |
|                                                                                 | HCSL            | V <sub>OH</sub> | 0.66                   |        | 1.15                   |      | 50Ω to V <sub>DD</sub>                                 |
|                                                                                 |                 | V <sub>OL</sub> | 0.0                    |        | 0.15                   |      |                                                        |
|                                                                                 | CML             | V <sub>OH</sub> | V <sub>DD</sub> -0.085 |        | V <sub>DD</sub> =Max   |      | 50Ω into GND                                           |
|                                                                                 |                 | V <sub>OL</sub> | V <sub>DD</sub> -0.6   |        | V <sub>DD</sub> -0.32  |      |                                                        |
| Output Enable (OE) Control                                                      |                 |                 | 0.8*(V <sub>DD</sub> ) |        |                        | V    |                                                        |
|                                                                                 |                 |                 |                        |        | 0.2*(V <sub>DD</sub> ) |      |                                                        |

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## COMMON KEY ELECTRICAL SPECIFICATIONS

| PARAMETERS                         |        | MIN. | TYP. | MAX. | UNIT | NOTES                   |
|------------------------------------|--------|------|------|------|------|-------------------------|
| Output Enable Time                 |        |      |      | 2.5  | ms   |                         |
| Output Disable Time                |        |      |      | 10   | µs   |                         |
| Output Disable Current Consumption | LVPECL |      | 85   | 86   | mA   | @ V <sub>dd</sub> =3.3V |
|                                    | LVDS   |      | 63   | 65   |      |                         |
|                                    | HCSL   |      | 77   | 78   |      | @ V <sub>dd</sub> =1.8V |
|                                    | CML    |      | 62   | 67   |      |                         |
| RMS Phase Jitter (12kHz -20MHz BW) |        |      |      |      |      |                         |
| 201.000MHz – 2100.000MHz           |        |      | 125  | 150  | fsec | @ V <sub>dd</sub> =3.3V |
| 50.000MHz – 200.000MHz             |        |      | 200  | 300  |      |                         |
| 156.2500MHz                        |        |      | ≤130 | 200  |      |                         |

Note 1: Supply Voltage (Vdd) = 1.8V option not available with LVPECL output

Note 2: Relative to initial measured frequency @ 25°C ±3°C

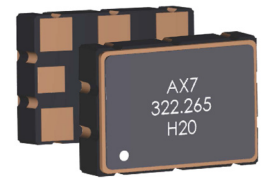
## TYPICAL PHASE NOISE AND JITTER CHARACTERISTICS (@25°C ± 3°C) [Note 2]

| Frequency (MHz)                           |        | 148.35 | 150    | 155.52 | 156.25 | 156.25 | 200    | 212.5 | 312.5 |
|-------------------------------------------|--------|--------|--------|--------|--------|--------|--------|-------|-------|
| RF Output                                 |        | LVDS   | LVPECL | LVPECL | LVPECL | HCSL   | LVPECL | LVDS  | LVDS  |
| RMS Phase Jitter (fsec)<br>12kHz-20MHz BW |        | 125    | 137    | 124    | 123    | 129    | 122    | 127   | 114   |
| Phase Noise (dBc/Hz)                      | 100Hz  | -96    | -98    | -98    | -98    | -99    | -90    | -83   | -94   |
|                                           | 1kHz   | -120   | -120   | -120   | -121   | -121   | -114   | -114  | -115  |
|                                           | 10kHz  | -132   | -132   | -132   | -132   | -132   | -129   | -129  | -126  |
|                                           | 100kHz | -140   | -139   | -141   | -141   | -140   | -138   | -137  | -134  |
|                                           | 1MHz   | -149   | -150   | -151   | -150   | -151   | -148   | -147  | -144  |
|                                           | 10MHz  | -157   | -159   | -159   | -159   | -160   | -159   | -157  | -156  |
|                                           | 20MHz  | -157   | -159   | -159   | -159   | -160   | -159   | -157  | -157  |

| Frequency (MHz)                           |        | 322.265625 |      | 491.52 | 644.53125 | 1000 | 1244.16 | 1500 | 2100   |
|-------------------------------------------|--------|------------|------|--------|-----------|------|---------|------|--------|
| RF Output                                 |        | LVPECL     | HCSL | LVPECL | LVPECL    | LVDS | LVDS    | LVDS | LVPECL |
| RMS Phase Jitter (fsec)<br>12kHz-20MHz BW |        | 121        | 121  | 123    | 127       | 114  | 127     | 112  | 138    |
| Phase Noise (dBc/Hz)                      | 100Hz  | -91        | -92  | -91    | -77       | -76  | -78     | -79  | -77    |
|                                           | 1kHz   | -113       | -114 | -111   | -107      | -102 | -102    | -101 | -98    |
|                                           | 10kHz  | -125       | -125 | -122   | -119      | -115 | -113    | -112 | -108   |
|                                           | 100kHz | -133       | -133 | -131   | -127      | -124 | -122    | -120 | -117   |
|                                           | 1MHz   | -144       | -144 | -138   | -138      | -134 | -131    | -130 | -124   |
|                                           | 10MHz  | -157       | -157 | -154   | -154      | -150 | -149    | -145 | -145   |
|                                           | 20MHz  | -159       | -159 | -154   | -155      | -152 | -150    | -145 | -148   |

Note 2: Refer to following Section for selected Phase Noise Plots

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**Pb** RoHS/RoHS II Compliant

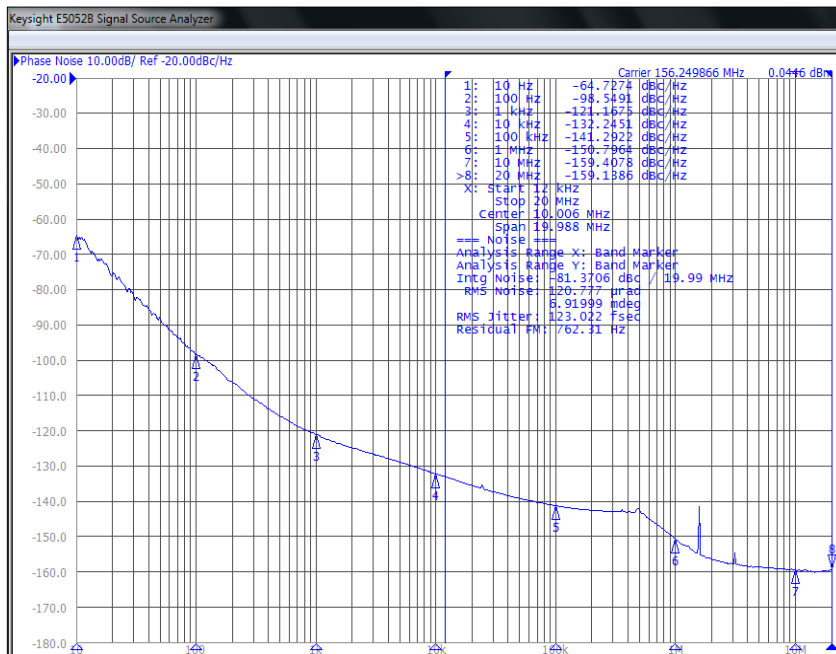
MSL = 1



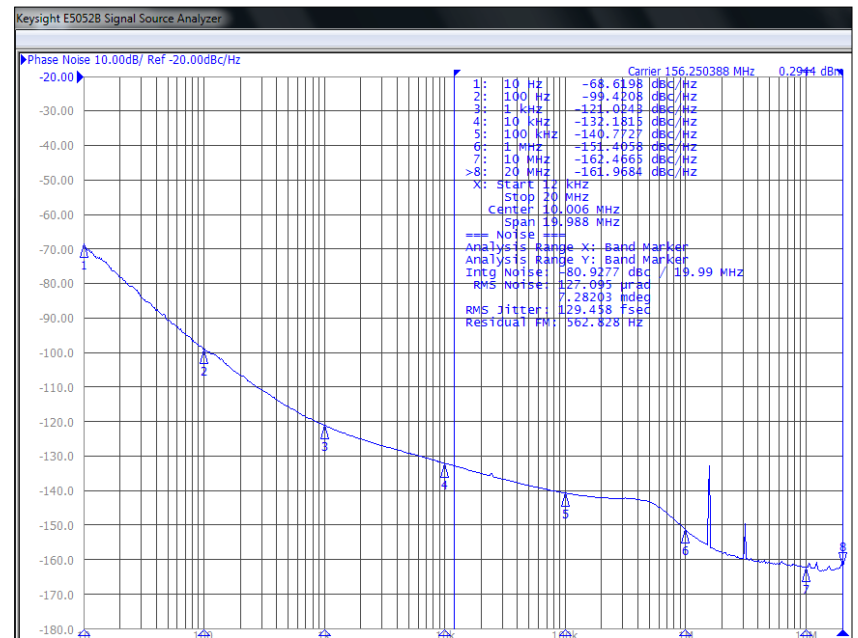
**ESD SENSITIVE**

## SELECTED PHASE NOISE PLOTS (@25°C ± 3°C)

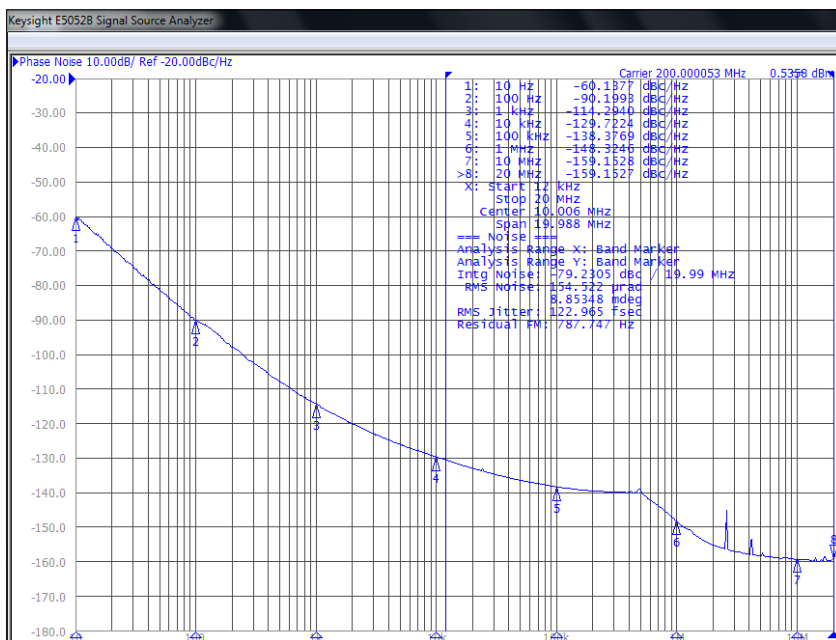
156.25MHz | LVPECL |  $V_{DD}=3.3V$



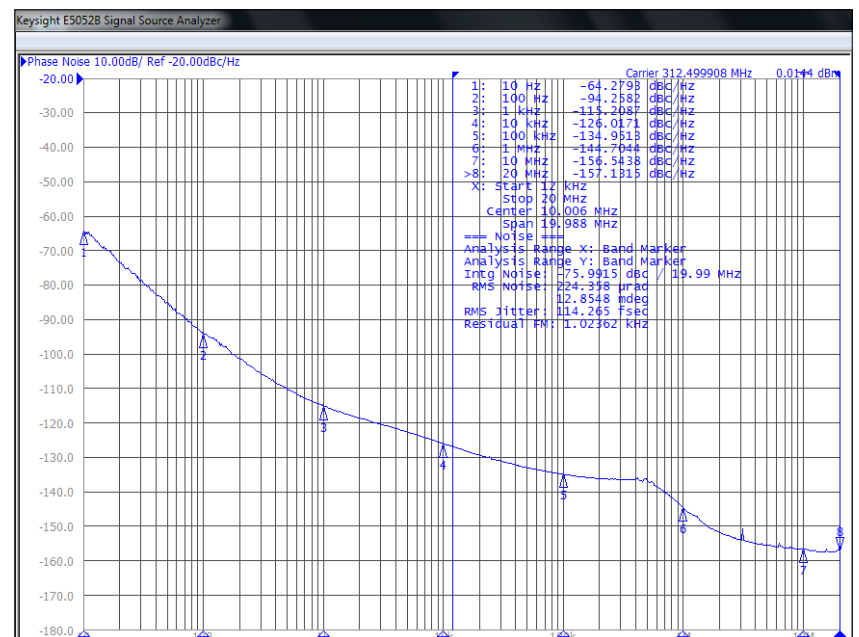
156.25MHz | HCSL |  $V_{DD}=1.8V$



200MHz | LVPECL |  $V_{DD}=3.3V$

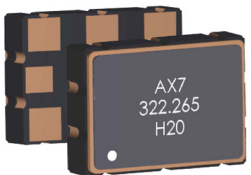


312.5MHz | LVDS |  $V_{DD}=3.3V$



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RoHS/RoHS II Compliant

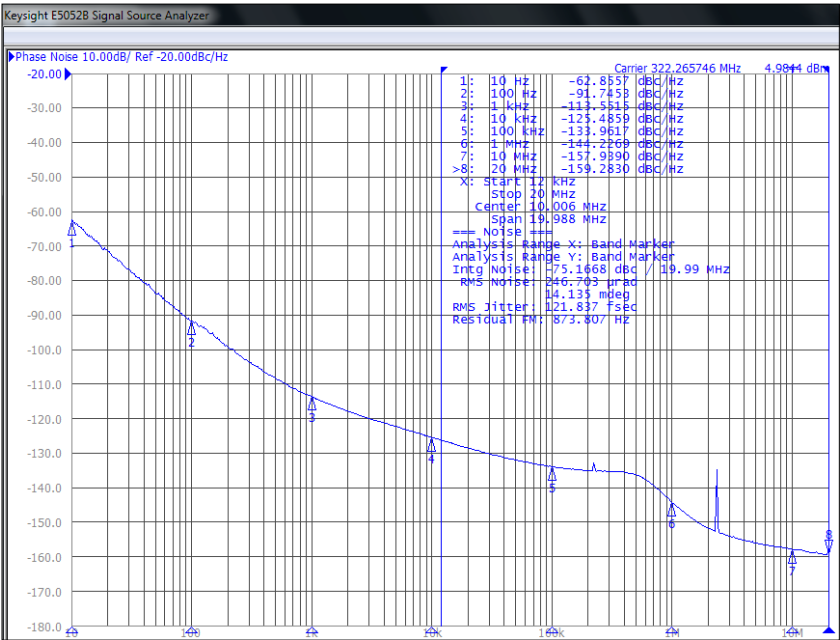
MSL = 1



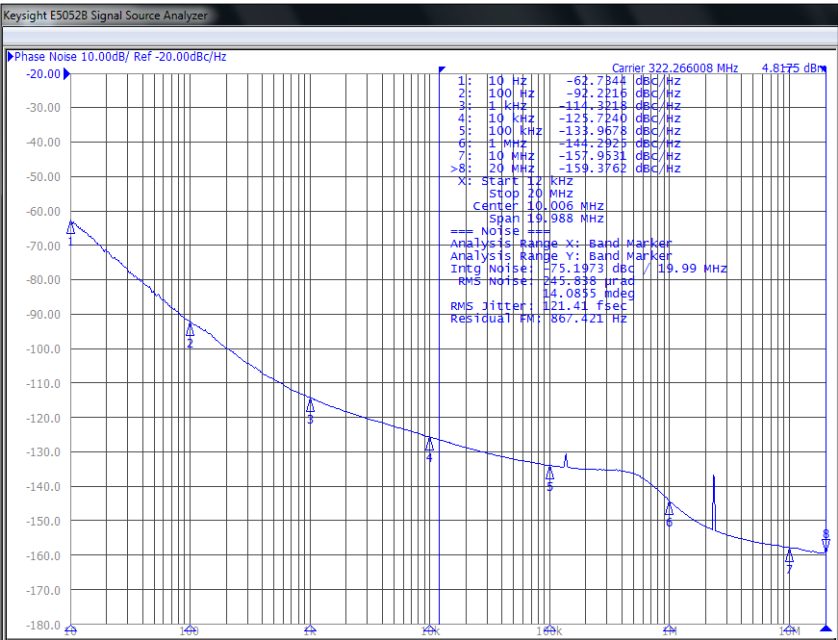
ESD SENSITIVE

## SELECTED PHASE NOISE PLOTS (@25°C ± 3°C)

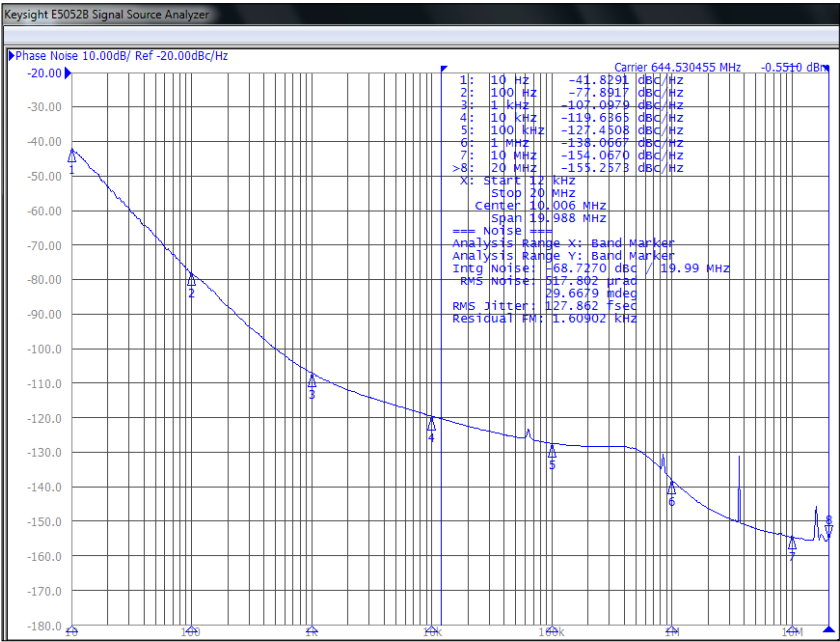
322.265625MHz | LVPECL |  $V_{DD}=3.3V$



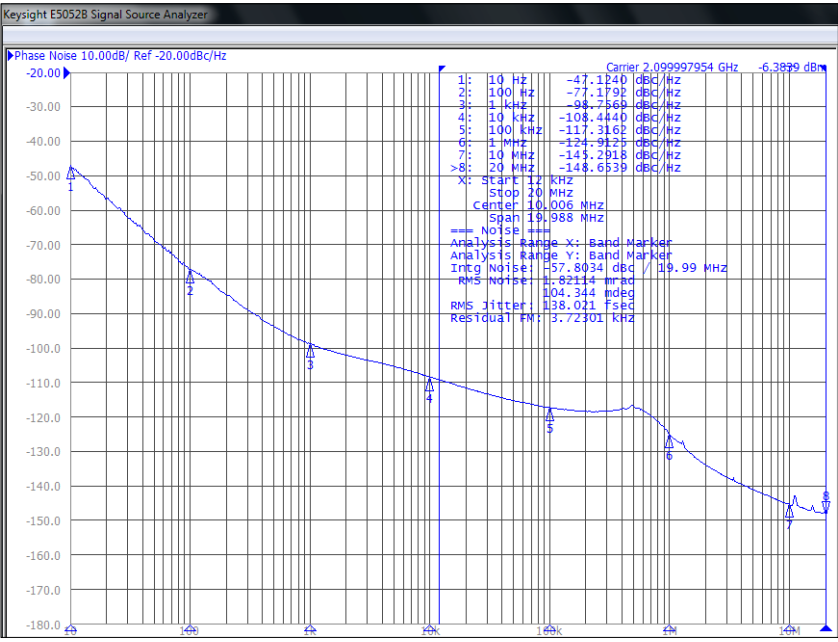
322.265625MHz | HCSL |  $V_{DD}=3.3V$



644.53125MHz | LVPECL |  $V_{DD}=3.3V$



2100MHz | LVPECL |  $V_{DD}=3.3V$



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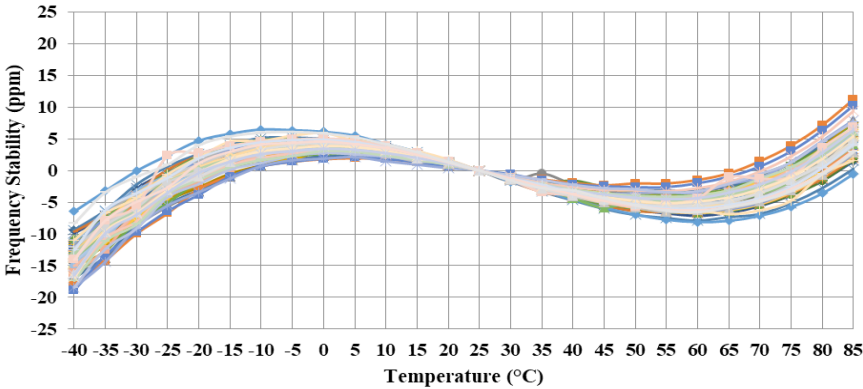
ESD SENSITIVE

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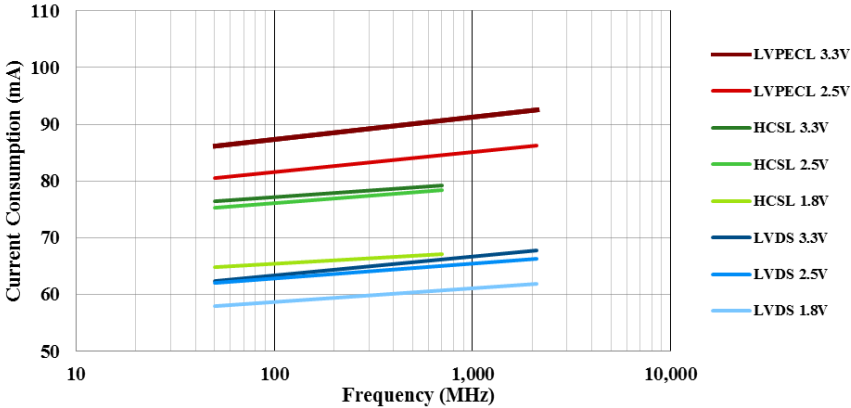
TYPICAL FREQUENCY V<sub>s</sub>. TEMPERATURE CHARACTERISTICS

TYPICAL CURRENT CONSUMPTION (I<sub>DD</sub>) V<sub>s</sub>. FREQUENCY CHARACTERISTICS (@ 25°C ± 3°C)

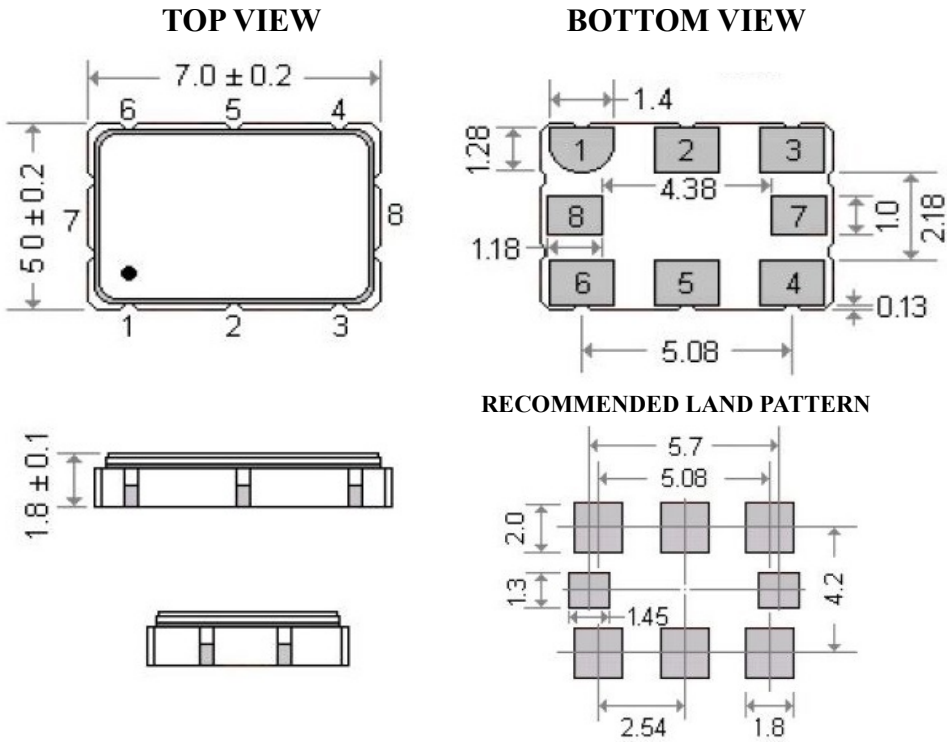
Frequency Stability vs. Temperature  
AX7PAF1-122.8800 (50 units)



Current Consumption (I<sub>DD</sub>) vs. Frequency  
AX7



MECHANICAL DIMENSIONS



| PIN # | FUNCTION                                                                                     |
|-------|----------------------------------------------------------------------------------------------|
| # 1   | <b>Option 1 &amp; 2:</b><br>Output Enable/ Disable<br><b>Option 3 &amp; 4:</b><br>No Connect |
| # 2   | <b>Option 1 &amp; 2:</b><br>No Connect<br><b>Option 3 &amp; 4:</b><br>Output Enable/ Disable |
| # 3   | GND                                                                                          |
| # 4   | Output                                                                                       |
| # 5   | Complementary output                                                                         |
| # 6   | Supply Voltage (V <sub>DD</sub> )                                                            |
| # 7   | No connect                                                                                   |
| # 8   | No connect                                                                                   |

\*Compatible with industry standard 5x7mm footprint. Pin 7 and 8 are no connect solder pads, not required.

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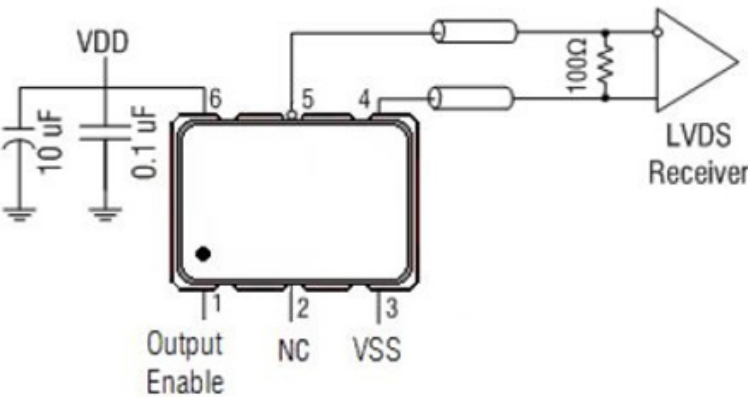
MSL = 1



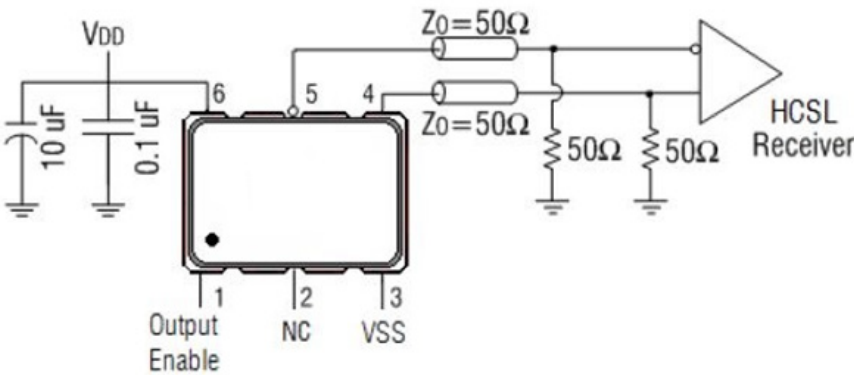
ESD SENSITIVE

## RECOMMENDED TEST CIRCUIT

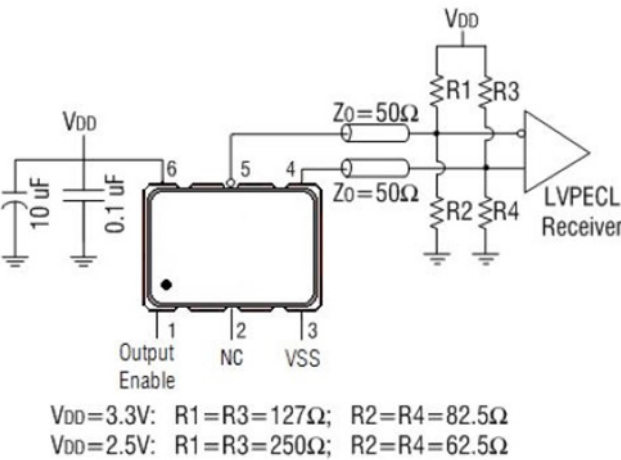
### LVDS



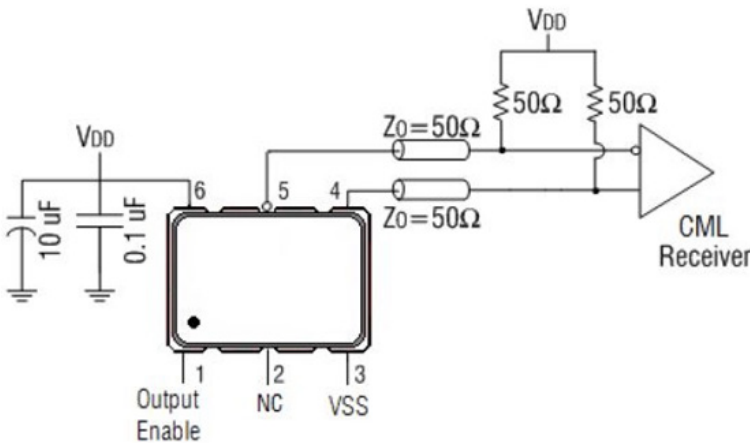
### HCSL



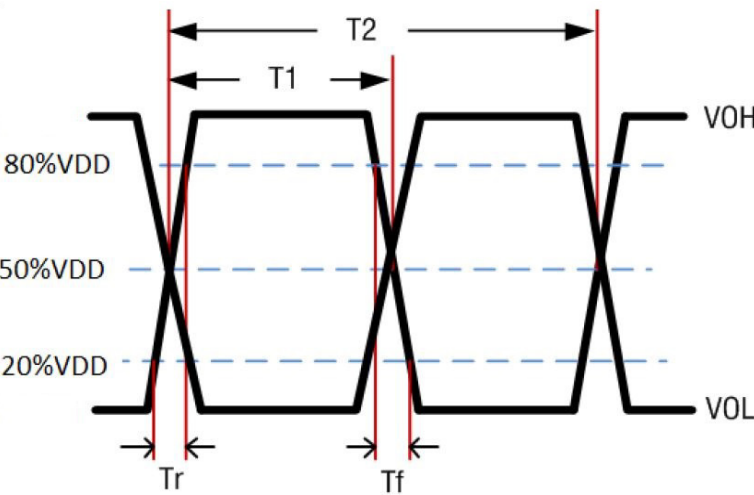
### LVPECL



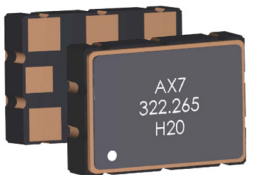
### CML



## DIFFERENTIAL OUTPUT WAVEFORM



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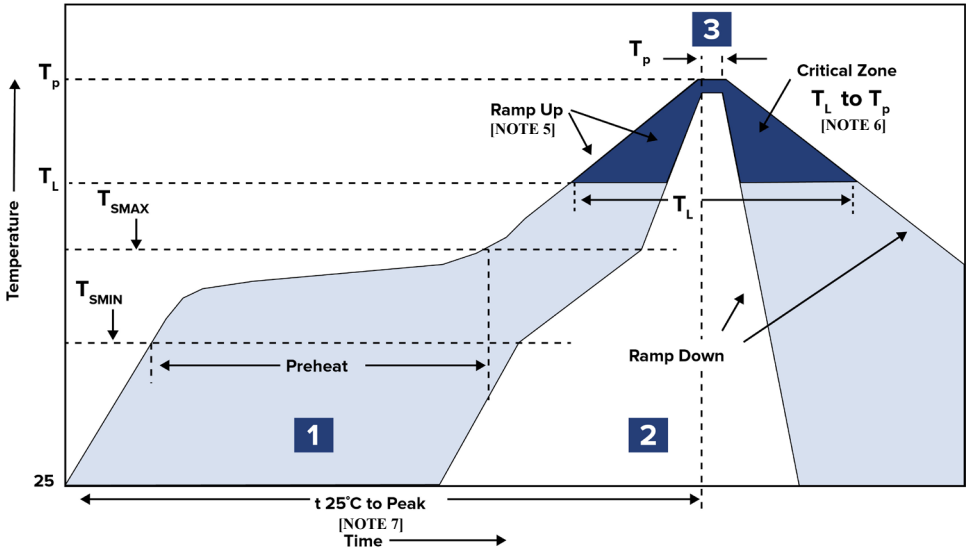
RoHS/RoHS II Compliant

MSL = 1



ESD SENSITIVE

## REFLOW PROFILE



| ZONE | DESCRIPTION    | TEMPERATURE                               | TIME          |
|------|----------------|-------------------------------------------|---------------|
| 1    | Preheat / Soak | $T_{SMIN} \sim T_{SMAX}$<br>150°C ~ 200°C | 60 ~ 180 sec. |
| 2    | Reflow         | $T_L$<br>217°C                            | 60 ~ 150 sec. |
| 3    | Peak heat      | $T_P$<br>260°C±5°C                        | 20 ~ 40 sec.  |

Note 5: Ramp Up Rate ( $T_L \rightarrow T_P$ ) = 3°C / sec. MAX

Note 6: Ramp Down Rate ( $T_P \rightarrow T_L$ ) = 6°C / sec. MAX

Note 7: Time 25°C to Peak Temperature (25°C  $\rightarrow T_P$ ) = 8 minutes MAX

\*Can withstand 2 times reflow

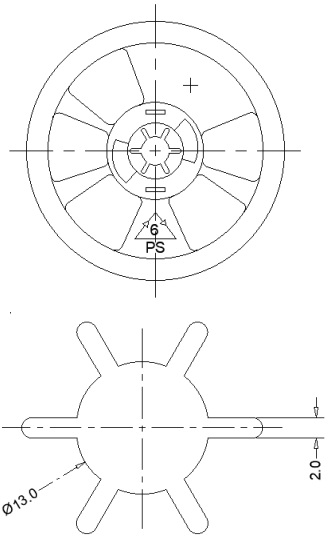
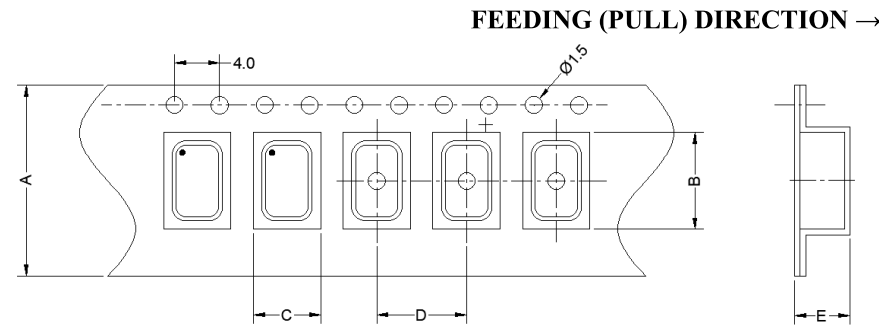
\*All temperatures refer to topside of the package, measured on the package body surface

## PACKAGING

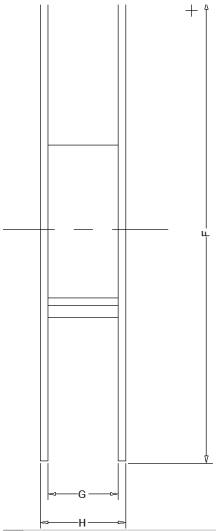
Blank = Bulk\*

T = Tape & Reel 250 units/reel

(\*) MOQ: 50 units



| Tape Dimensions |       |
|-----------------|-------|
| A               | 16.0  |
| B               | 7.2   |
| C               | 5.4   |
| D               | 8.0   |
| E               | 1.8   |
| Reel Dimensions |       |
| F               | 180.0 |
| G               | 16.5  |
| H               | 19.6  |



Dimensions: mm



5101 Hidden Creek Ln Spicewood TX 78669  
Phone: 512-371-6159 | Fax: 512-351-8858  
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[www.abracon.com](http://www.abracon.com)

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