ClearClock™ | Ultra-Low Jitter & Power Optimized 3.2 x 2.5 mm XO



AX3

ESD Sensitive

3.2 x 2.5 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

Features

- Exceptionally Low RMS Jitter: < 80fs Typ (150fs Max @ 156.25MHz)
- Available in industry standard frequencies between 100MHz and 212.5MHz
- Lowest power consumption in its class (16mA Typ LVDS @ 156.25MHz)
- ±25ppm stability over industrial operating temperature (-40 to +85ºC)
- 3.3V, 2.5V, 1.8V supply voltage options
- LVPECL, LVDS, HCSL differential outputs
- Industry standard 3.2 x 2.5 x 1.0 mm footprint
- Available in Abracon's Global Distribution Network

Applications

- PCI Express
- 10G/40G/100G optical Ethernet
- Networking & communication
- RF systems, base stations (BTS)
- Data center
- Test & measurement

Options and Part Identification [Note 1]

AX3 ▢ ▢ ▢ ▢ — ▢ ▢

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

(2): V_{dd}
- A: 3.3V
- B: 2.5V
- C: 1.8V (*)

(*) Excluding LVPECL

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

(***) MOQ: 250 units

Part Number Example:

AX3PAF1-156.2500
AX3PAF1-156.2500T
AX3PAF1-156.2500T3

Note 1: Contact Abracon for non-standard configurations and/or requests with carrier frequency callouts up to 5 & 6 digit accuracy after the decimal.

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MSL = 1

Electrical Characteristics

Parameters		Min.	Typ.	Max.	Unit	Notes
Frequency Range		100		212.500	MHz	
Standard Available Frequencies		100, 114.285, 122.88, 125, 148.5, 150, 155.52, 156.25, 200, 212.500			MHz	Contact Abracon for availability of frequenices not listed
Supply Voltage (V_{dd}) [Note 2]		2.97	3.3	3.63	V	Option "A"
		2.37	2.5	2.62		Option "B"
		1.71	1.8	1.89		Option "C"
Supply Current (I_{dd})	LVPECL		30	50	mA	@ 200MHz; @ V_{dd} = 3.3V
	LVDS		16	27		@ 200MHz; @ V_{dd} = 3.3V
	HCSL		17	30		@ 200MHz; @ V_{dd} = 3.3V
Operating Temperature Range		-20		+70	°C	Option "D"
		-40		+85		Option "F" or "Q"
Storage Temperature		-55		+150	°C	
Frequency Accuracy (Initial Set-Tolerance) at time of shipment (Pre-Reflow) @ +25°C		-10	< ±5	+10	ppm	Relative to carrier frequency
Frequency Stability over [Note 3,4] Operating Temperature Range		-15		+15	ppm	Option "D" (-20°C to +70°C)
		-20		+20		Option "Q" (-40°C to +85°C)
		-25		+25		Option "F" (-40°C to +85°C)
Aging over 20 Year Product Life [Note 5]		-15		+15	ppm	
All-Inclusive Frequency Accuracy (Total Stability) over 20 Year Product Life [Note 5, 6]		-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 20% to 80% $V_{peak\ to\ peak}$	LVPECL		0.2	0.4	ns	@ V_{dd}=3.3V, R_L=50Ω
			0.3	0.6		@ V_{dd}=2.5V, R_L=50Ω
	LVDS		0.15	0.4		@ V_{dd}=3.3V, R_L=100Ω
			0.15	0.4		@ V_{dd}=2.5V, R_L=100Ω
			0.3	0.5		@ V_{dd}=1.8V, R_L=100Ω
	HCSL		0.3	0.5		@ V_{dd}=3.3V, R_L=50Ω to GND
			0.3	0.5		@ V_{dd}=2.5V, R_L=50Ω to GND
			0.3	0.6		@ V_{dd}=1.8V, R_L=50Ω to GND
Duty Cycle		45		55	%	
Start-up Time [Note 3]			< 2	5.0	ms	

Note 2: Supply Voltage (V_{dd}) = 1.8V option not available with LVPECL output
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: Relative to post-reflow frequency
Note 6: Includes temperature stability, initial frequency accuracy, load pulling, power supply variation, and 20-year aging

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AX3

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MSL = 1

Electrical Characteristics Cont.

Parameters			Min.	Typ.	Max.	Unit	Notes
Differential Output High Voltage (V_{OH}) Output Low Voltage (V_{OL})	LVPECL	V_{OH}	V_{dd}-1.03		V_{dd}-0.88	V	R_L=50Ω to V_{dd}–2.0V
		V_{OL}	V_{dd}-1.85		V_{dd}-1.60		
	LVDS	V_{OH}		1.40	1.60		R_L=100Ω between both outputs
		V_{OL}	0.90	1.10			
	HCSL	V_{OH}	0.40	0.74	0.85		R_L=50Ω to ground on each output
		V_{OL}	-0.15	0.00	0.15		
Output Voltage Swing			0.595	0.75	0.93	V	LVPECL
			0.25	0.35	0.45		LVDS
			0.620	0.70	0.78		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 -20MHz BW) | V_{dd} = 3.3V [Note 7, 8, 9]

Frequency (MHz)	Output	RMS Jitter	
		Typ. (fs)	Max (fs)
100	HCSL	153	200
	LVPECL	211	300
	LVDS	304	500
114.285	LVPECL	264	500
	LVDS	239	500
122.88	HCSL	122	200
	LVPECL	228	300
	LVDS	198	300
125	HCSL	138	200
	LVPECL	91	150
	LVDS	186	300
148.5	LVPECL	154	200
	LVDS	158	200
150	LVPECL	154	200
	LVDS	153	200
155.52	LVPECL	121	150
156.25	HCSL	113	150
	LVPECL	75	150
	LVDS	115	150
200	LVDS	70	150
	LVPECL	140	200
	HCSL	140	200
212.5	LVDS	60	150
	LVPECL	130	200
	HCSL	130	200

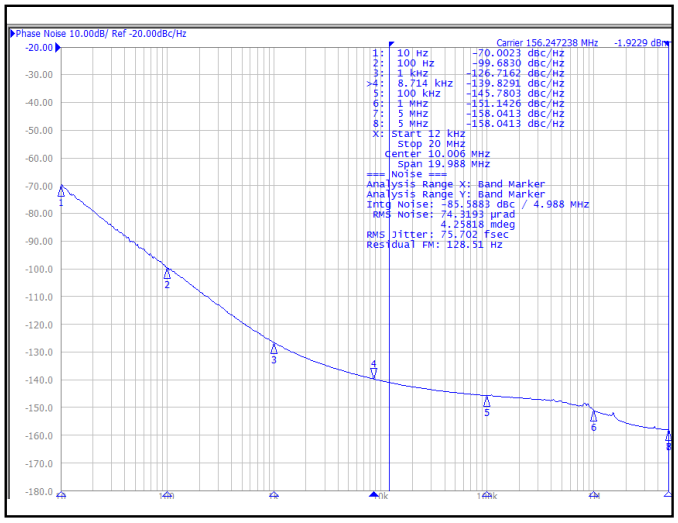
Note 7: Guaranteed by characterization; RMS Phase Jitter specifications are inclusive of any spurs
Note 8: Phase jitter measured with Keysight E5052B Signal Source Analyzer
Note 9: Refer to the next section for phase noise test setup and representative phase noise plots

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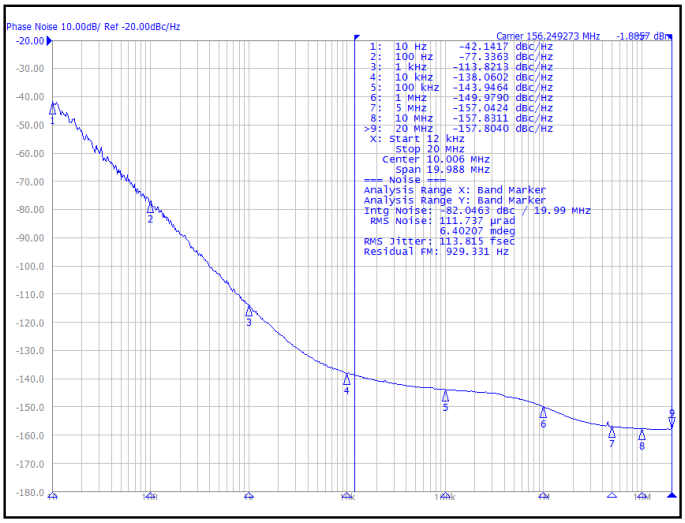
Phase Noise Test Setup [Note 10]

- Keysight E5052B Signal Source Analyzer
- Integration Bandwidth = 12kHz to 20MHz
- Spurious Activity (entire plot trace) = Not Omitted (Normalized in dBc/Hz)
- Specifed Spur Omission Function = Not Enabled
- IF Gain = 20dB
- Correlation = 5
- Average = 3

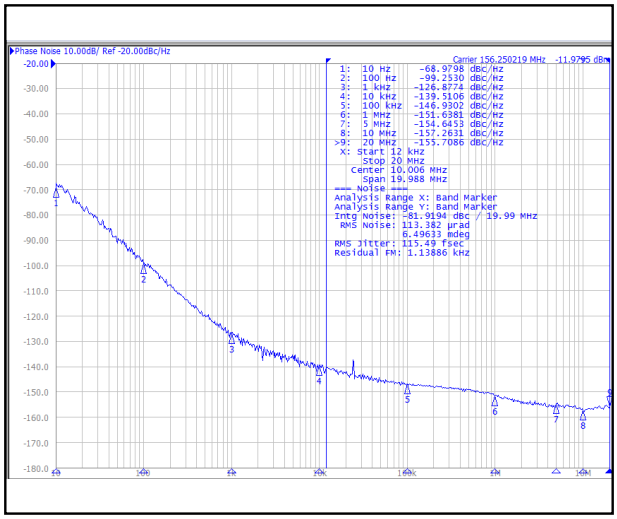
F=156.2500MHz | V_{dd}=3.3V | LVPECL
RMS Phase Jitter = 75 fs



F=156.2500MHz | V_{dd}=3.3V | HCSL
RMS Phase Jitter = 113 fs



F= 156.2500MHz | V_{dd}=3.3V | LVDS
RMS Phase Jitter = 115 fs



Note 10: Contact Abracon for phase noise plots at any desired combination of V_{dd}, differential output format, and carrier frequency within the available range

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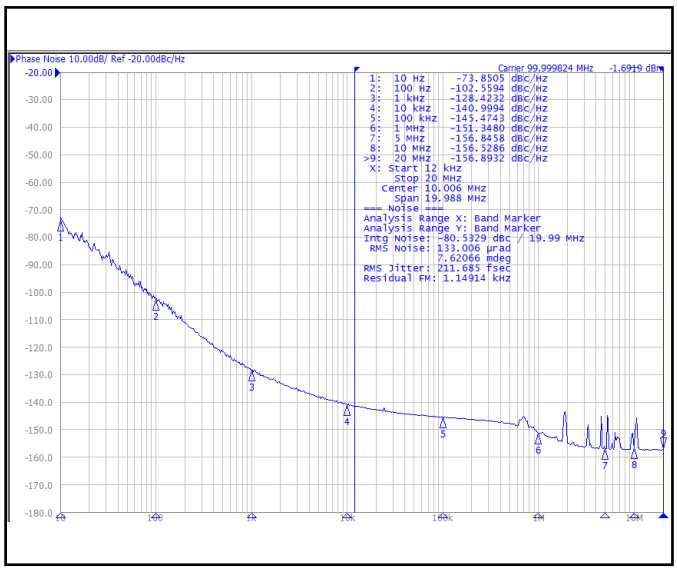
ESD Sensitive

Pb

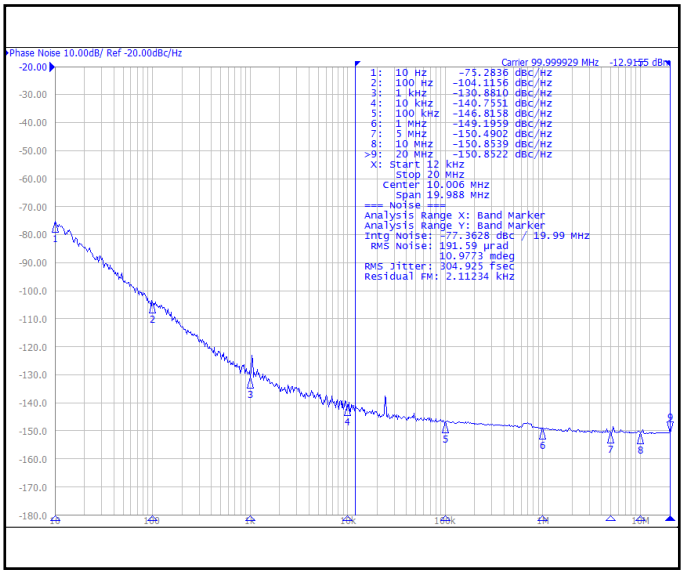
3.2 x 2.5 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

Representative Phase Noise Plots Cont. [Note 10]

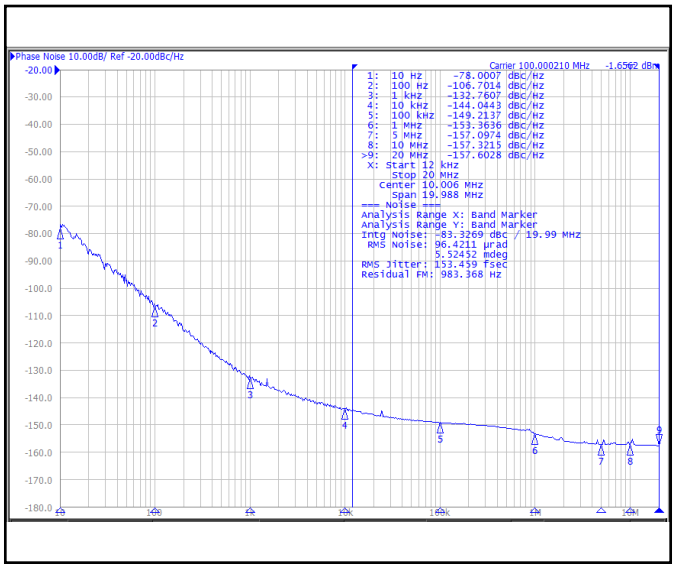
F=100.0000MHz | V_{dd}=3.3V | LVPECL
RMS Phase Jitter = 211 fs



F= 100.0000MHz | V_{dd}=3.3V | LVDS
RMS Phase Jitter = 304 fs



F= 100.0000MHz | V_{dd}=3.3V | HCSL
RMS Phase Jitter = 153 fs



Note 10: Contact Abracon for phase noise plots at any desired combination of V_{dd}, differential output format, and carrier frequency within the available range

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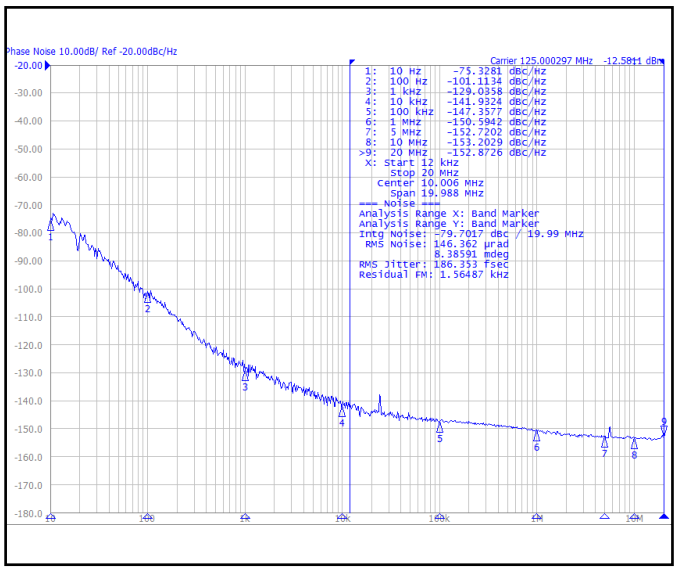
ESD Sensitive

Pb

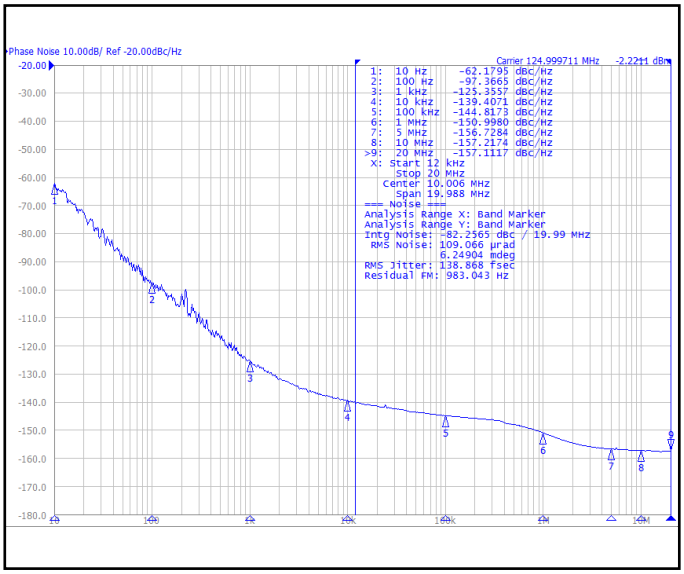
3.2 x 2.5 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

Representative Phase Noise Plots Cont. [Note 10]

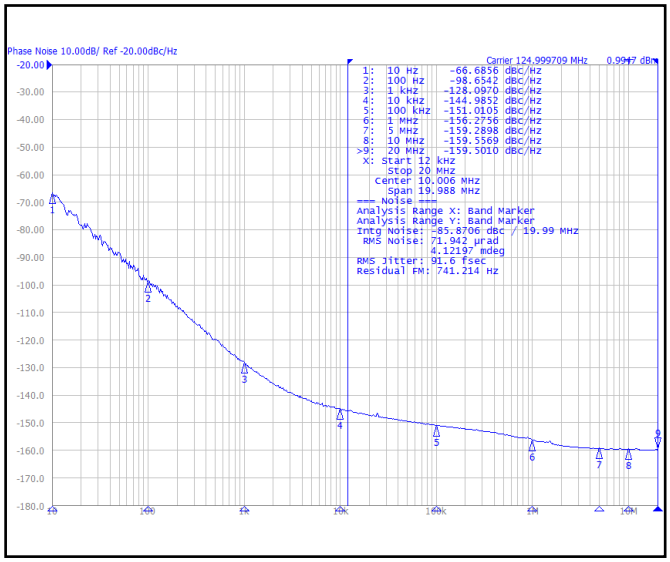
F=125.0000MHz | V_{dd}=3.3V | LVDS
RMS Phase Jitter = 186 fs



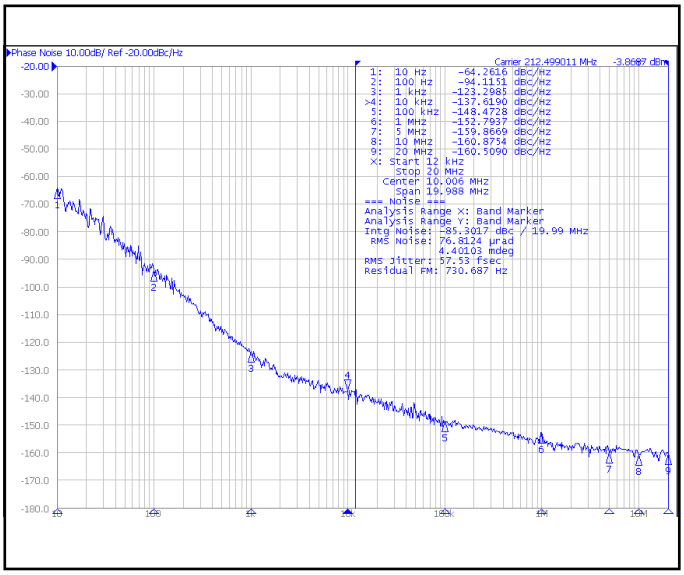
F= 125.0000MHz | V_{dd}=3.3V | HCSL
RMS Phase Jitter = 138 fs



F= 125.0000MHz | V_{dd}=3.3V | LVPECL
RMS Phase Jitter = 91 fs



F= 212.5000MHz | V_{dd}=3.3V | LVDS
RMS Phase Jitter = 57 fs



Note 10: Contact Abracon for phase noise plots at any desired combination of V_{dd}, differential output format, and carrier frequency within the available range

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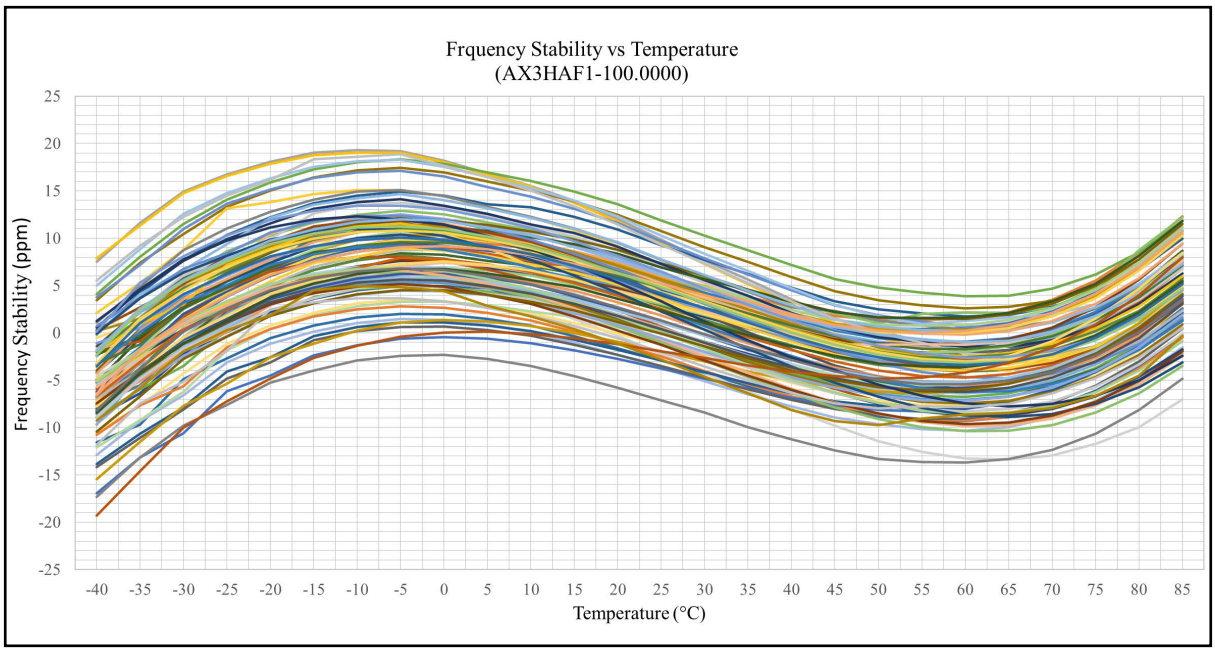
AX3

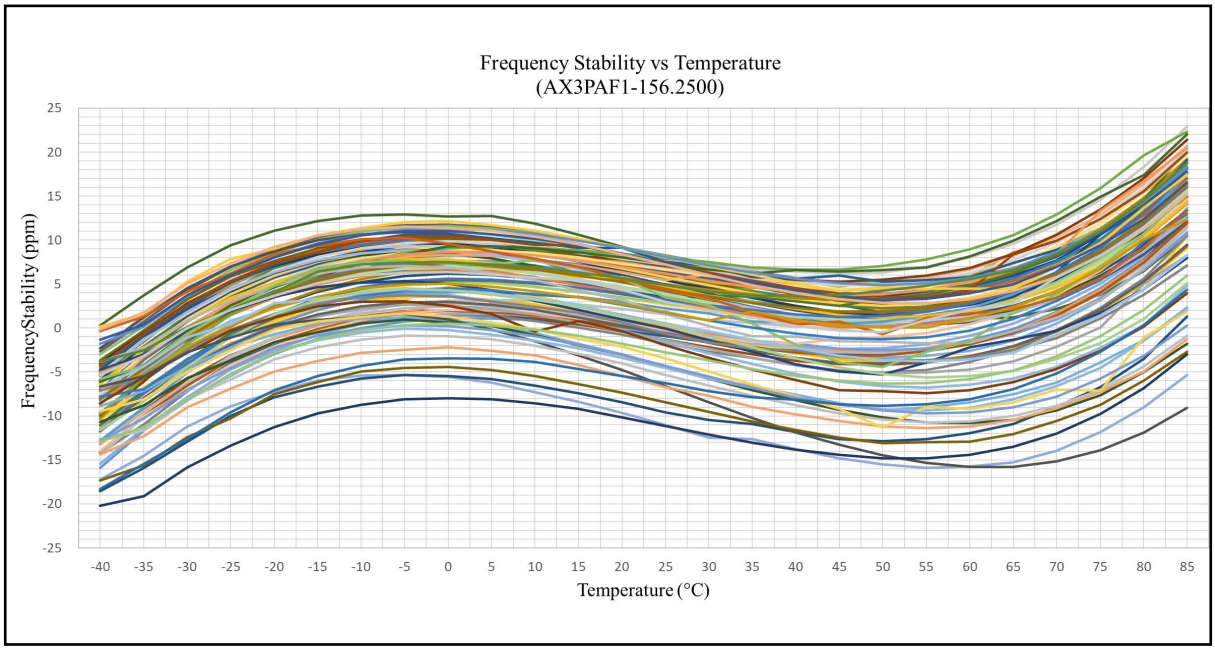
ESD Sensitive

Pb

3.2 x 2.5 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

Typical Frequency vs. Temperature Characteristics





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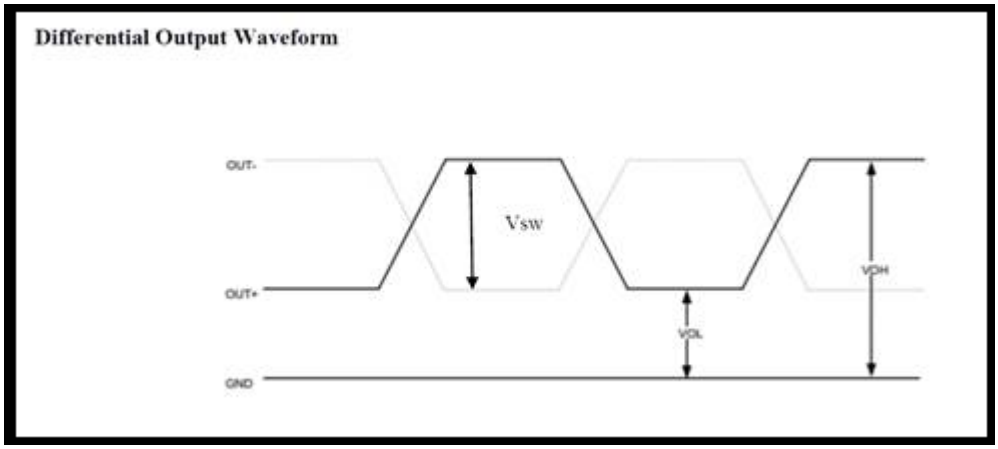


AX3

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3.2 x 2.5 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

Differential Output Waveform



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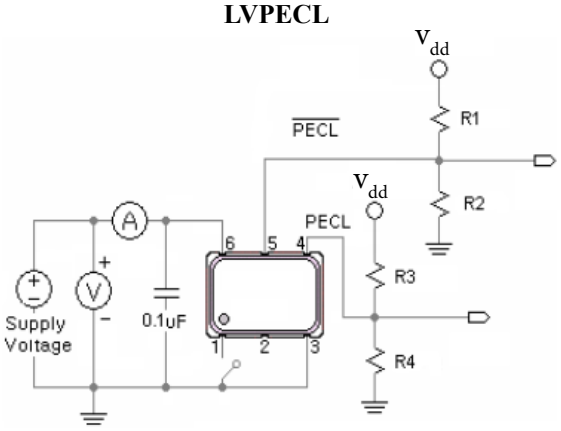
ESD Sensitive

Pb

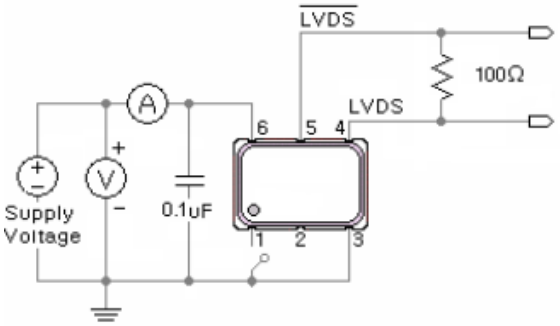
3.2 x 2.5 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

Recommended Test Circuit [Note 11]

LVPECL

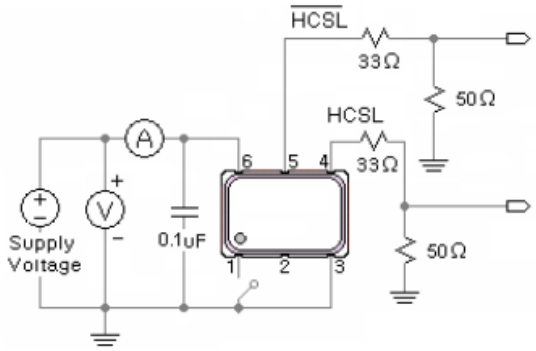


LVDS



V_{dd}=3.3V: R1=R3=127Ω; R2=R4=82.5 Ω
V_{dd}=2.5V: R1=R3=250Ω; R2=R4=62.5 Ω

HCSL



Note 11: Recommended test circuit images display OE Functions Option 1 & Option 2 where 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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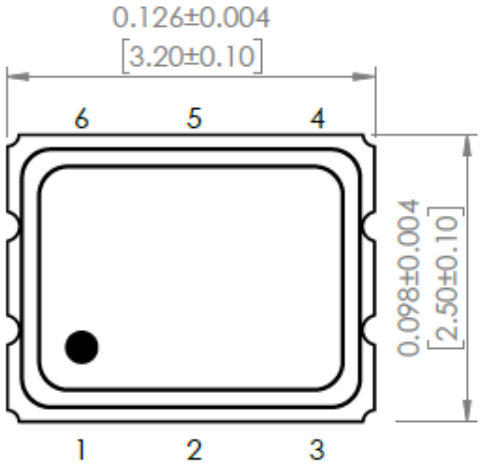


AX3

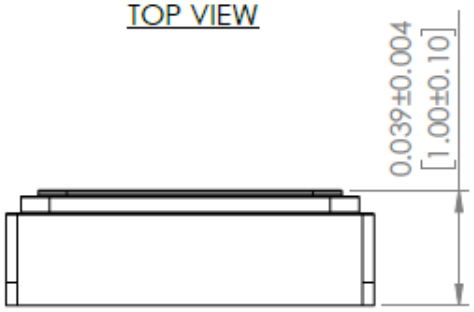
ESD Sensitive

3.2 x 2.5 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

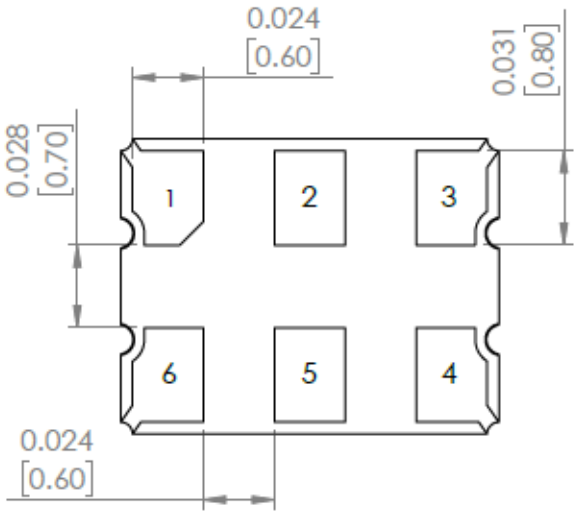
Mechanical Dimensions



TOP VIEW

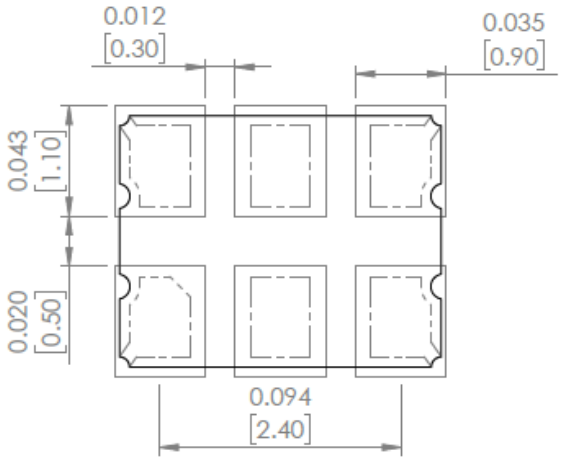


SIDE VIEW



BOTTOM VIEW

Recommended Land Pattern



Case 1 Pin #1=Output Enable/Disable Function *where* OE is Active HIGH		Case 2 Pin #2=Output Enable/Disable Function *where* OE is Active HIGH	
Pin	**Description**	**Pin**	**Description**
# 1	Output Enable = Logic High, "1", V_{dd}	**# 1**	No Connect
	Output Disable = Logic Low, "0", GND	**# 2**	Output Enable = Logic High, "1", V_{dd}
# 2	No Connect		Output Disable = Logic Low, "0", GND
# 3	GND	**# 3**	GND
# 4	Output	**# 4**	Output
# 5	Complementary output	**# 5**	Complementary output
# 6	Supply Voltage (V_{dd})	**# 6**	Supply Voltage (V_{dd})

Dimensions: inches [mm]

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Recommended Reflow Profile

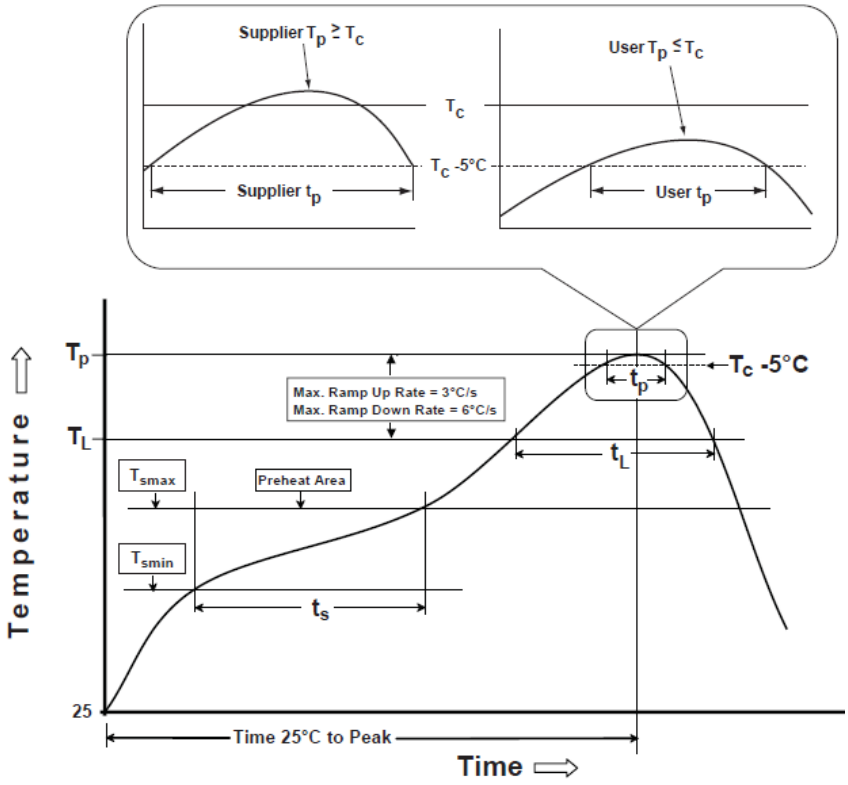


Table 1

SnPb Eutectic Process Classification Temperatures (Tc)		
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 (Tc)			
Package Thickness	**Volume mm³ <350**	**Volume mm³ >350**	**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
*Tolerance for peak profile temperature (TP) is defined as a supplier minimum and a user maximum.		
**Tolerance for time at peak profile temperature (tp) is defined as supplier minimum and a user maximum.		

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AX3

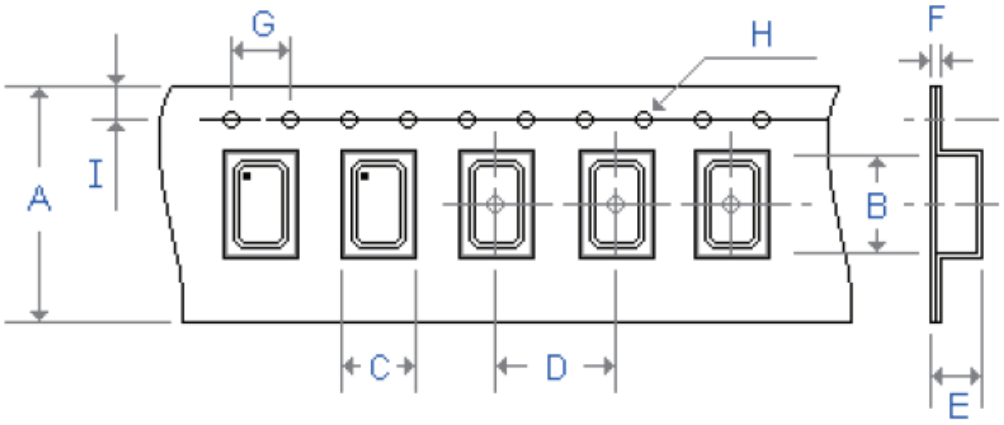
ESD Sensitive

3.2 x 2.5 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

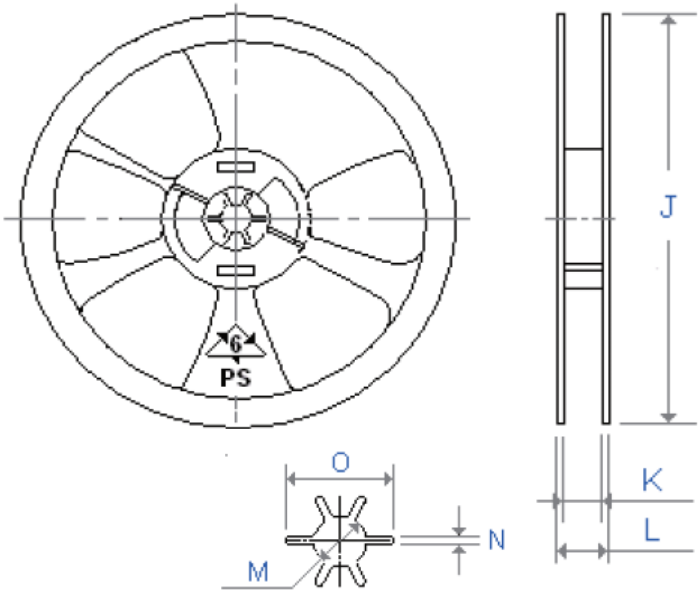
Packaging

Blank = Bulk (MOQ = 250 units)
T = Tape & Reel 1,000 units/reel
T3 = Tape & Reel 3,000 units/reel

Feeding (PULL) Direction →



Tape Dimensions	
A	8.00
B	3.40
C	2.70
D	4.00
E	1.40
F	0.30
G	4.00
H	Ø1.55
I	1.75
Reel Dimensions	
J	180.00
K	10.90
L	11.40
M	13.20
N	2.20
O	22.00



Dimensions: mm

ATTENTION: Abracon LLC's products are COTS – Commercial-Off-The-Shelf products; suitable for Commercial, Industrial and, where designated, Automotive Applications. Abracon's products are not specifically designed for Military, Aviation, Aerospace, Life-dependent Medical applications or any application requiring high reliability where component failure could result in loss of life and/or property. For applications requiring high reliability and/or presenting an extreme operating environment, written consent and authorization from Abracon LLC is required. Please contact Abracon LLC for more information.

ABRACON

5101 Hidden Creek Ln Spicewood TX 78669
Phone: 512-371-6159 | Fax: 512-351-8858
For terms and conditions of sales, please visit:
www.abracon.com

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深圳市满度科技有限公司
Web:www.manduic.com
Tel:150-1290-5940
Email:sales@manduic.com