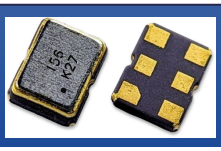
ClearClock™ | Ultra-Low Jitter, Fixed-Frequency Miniature Clock Oscillator



AK2

ESD Sensitive

2.5 x 2.0 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

Product Description

Abracon's latest addition to the ClearClock™ family of ultra-low rms jitter oscillators is now available in a miniature 2.5 x 2.0 x 1.0 mm package. The AK2 family is based on 3rd overtone quartz crystal technology and is ideally suited for optical transceivers, networking and server systems. AK2 family is available with bias voltages of 3.3V and 2.5V for LVDS & LVPECL output configuration; and 3.3V, 2.5V & 1.8V for HCSL differential output. Production-ready frequencies include 100, 125, 148.5, 156.25 and 200MHz with better than ±30 ppm frequency stability over -40°C to +85°C operating temperature range.

The AK2 family offers best-in-class rms phase jitter of <110 fs typical at 156.25MHz carrier @ V_{dd} = +2.5V with LVDS output, and is guaranteed to exhibit <200fs rms jitter @ 156.25MHz carrier with any bias voltage and RF output configuration.

Features

- Based on 3rd Overtone, Quartz Crystal Technology
- Ultra-low rms jitter; < 120fs typical @ 156.25MHz
- Lowest in-class power consumption (15mA max with LVDS)
- ±25ppm max & ±30ppm max stability over -20°C to +70°C and -40°C to +85°C respectively
- 3.3V, 2.5V & 1.8V supply voltage options
- LVPECL, LVDS and HCSL differential output options
- Output enabled (Active High standard default)

Applications

- Optical Transceivers
- Optical Modules
- Networking and communications
- Gigabit Ethernet
- Fibre Channel
- SONET/SDH
- RF systems, base stations (BTS)
- Datacenter
- PCI Express
- Test & measurement
- Active cables
- Compact HD-SDI cameras

Options and Part Identification [Note 1]

AK2 ☐ ☐ ☐ ☐ — ☐ ☐

(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: ±25ppm over -20°C to +70°C
- F: ±30 ppm over -40°C to +85°C

(4): OE Function
- 1: OE Pin 1; Active High
- 2: 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: 100 units

Part Number Example:

AK2PAF1-156.2500	**[(100) units in Bulk]**
AK2PAF1-156.2500T	**[(1k) units on Tape & Reel]**
AK2PAF1-156.2500T3	**[(3k) units on Tape & Reel]**

Note 1: 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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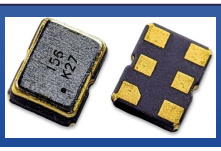

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MSL = 1

Electrical Characteristics

Parameters		Min.	Typ.	Max.	Unit	Notes
Frequency Range		100		200	MHz	
Standard Available Frequencies		100, 125, 148.5, 156.25, 200			MHz	Contact Abracon for availability of frequencies 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		10	15		@ 200MHz; @ V_{dd} = 3.3V
	HCSL		22	30		@ 200MHz; @ V_{dd} = 3.3V
Operating Temperature Range		-20		+70	°C	Option "D"
		-40		+85		Option "F"
Storage Temperature		-55		+150	°C	
Frequency Accuracy (Initial Set-Tolerance, as received stand-alone measured frequency) [Note 3] at time of shipment (Pre-Reflow) @ +25°C		-10	< ±5	+10	ppm	Relative to carrier frequency
Frequency Shift through Reflow		-2		+2	ppm	Relative to as received frequency
Frequency Stability over Operating Temperature Range		-25		+25	ppm	Option "D" (-20°C to +70°C)
		-30		+30		Option "F" (-40°C to +85°C)
First Year Aging		-3		3	ppm	Maximum first year aging ±2.00 ppm max. per year thereafter
Aging over 20 Year Product Life [Note 4]		-15		+15	ppm	
All-Inclusive Frequency Accuracy (Total Stability) over 20 Year Product Life [Note 5]		-52		+52	ppm	Option "D" (-20°C to +70°C)
		-57		+57		Option "F" (-40°C to +85°C)
Rise (Tr) / Fall (Tf) Time 20% to 80% $V_{peak\ to\ peak}$	LVPECL		0.3	0.6	ns	@ V_{dd}=3.3V, R_L=50Ω
	LVDS		0.3	0.5		@ V_{dd}=3.3V, R_L=100Ω
	HCSL		0.3	0.6		@ V_{dd}=3.3V, R_L=50Ω to GND
Duty Cycle		45		55	%	
Start-up Time			< 2	5.0	ms	

Note 2: Supply voltage (Vdd) = 1.8V option not available with LVPECL output
Note 3: Relative to initial measured frequency @ +25°C, pre-reflow
Note 4: Relative to post-reflow frequency
Note 5: Includes post reflow frequency accuracy, temperature stability, load pulling, power supply variation, and 20-year aging

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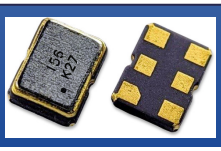

AK2

ESD Sensitive

2.5 x 2.0 x 1.0 mm
RoHS/RoHS II Compliant
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			0.50			V	LVPECL
			0.25	0.35	0.45		LVDS
			0.50				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				< 2.00	5.00	ms	
Output Disable Time					0.2	µs	
Output Disable Current Consumption					< 10	µA	OE ≤ 0.3V
RMS Phase Jitter (12kHz to 20MHz from Carrier)				< 200	500	fsec	Vdd, RF output type and Carrier frequency dependent
				< 150	200		@ 156.25MHz

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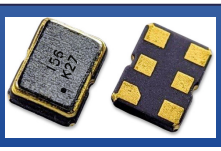

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RoHS/RoHS II Compliant
MSL = 1

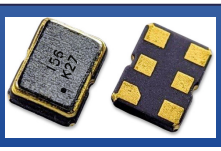
Phase Noise Test Setup

- 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

Typical Values measured at 25ºC ± 3ºC

Frequency (MHz)		100.00MHz								156.25MHz	
VDD		1.8V		2.5V			3.3V			1.8V	2.5V
RF Output		LVDS	HCSL	LVDS	HCSL	LVPECL	LVDS	HCSL	LVPECL	LVDS	
rms Phase Jitter (fsec) 12kHz-20MHz		385.27	147.12	207.96	117.86	131.63	255.13	195.68	123.73	139.49	107.18
Phase Noise (dBc/Hz)	100Hz	-104.49	-86.91	-80.88	-75.50	-99.17	-87.89	-105.15	-102.40	-93.43	-93.21
	1kHz	-125.64	-120.54	-115.99	-115.89	-129.38	-120.80	-132.38	-132.55	-123.45	-125.31
	10kHz	-134.97	-144.63	-140.15	-147.34	-145.94	-143.61	-144.58	-146.61	-136.98	-139.61
	100kHz	-140.45	-152.42	-149.52	-457.05	-153.02	-146.87	-150.96	-152.79	-140.93	-149.12
	1MHz	-147.69	-155.94	-153.49	-153.53	-156.87	-148.30	-150.70	-156.98	-150.53	-154.70
	10MHz	-149.67	-157.06	-153.53	-159.42	-157.87	-153.04	-154.78	-158.59	-155.31	-156.40

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 at 25ºC±3ºC



AK2

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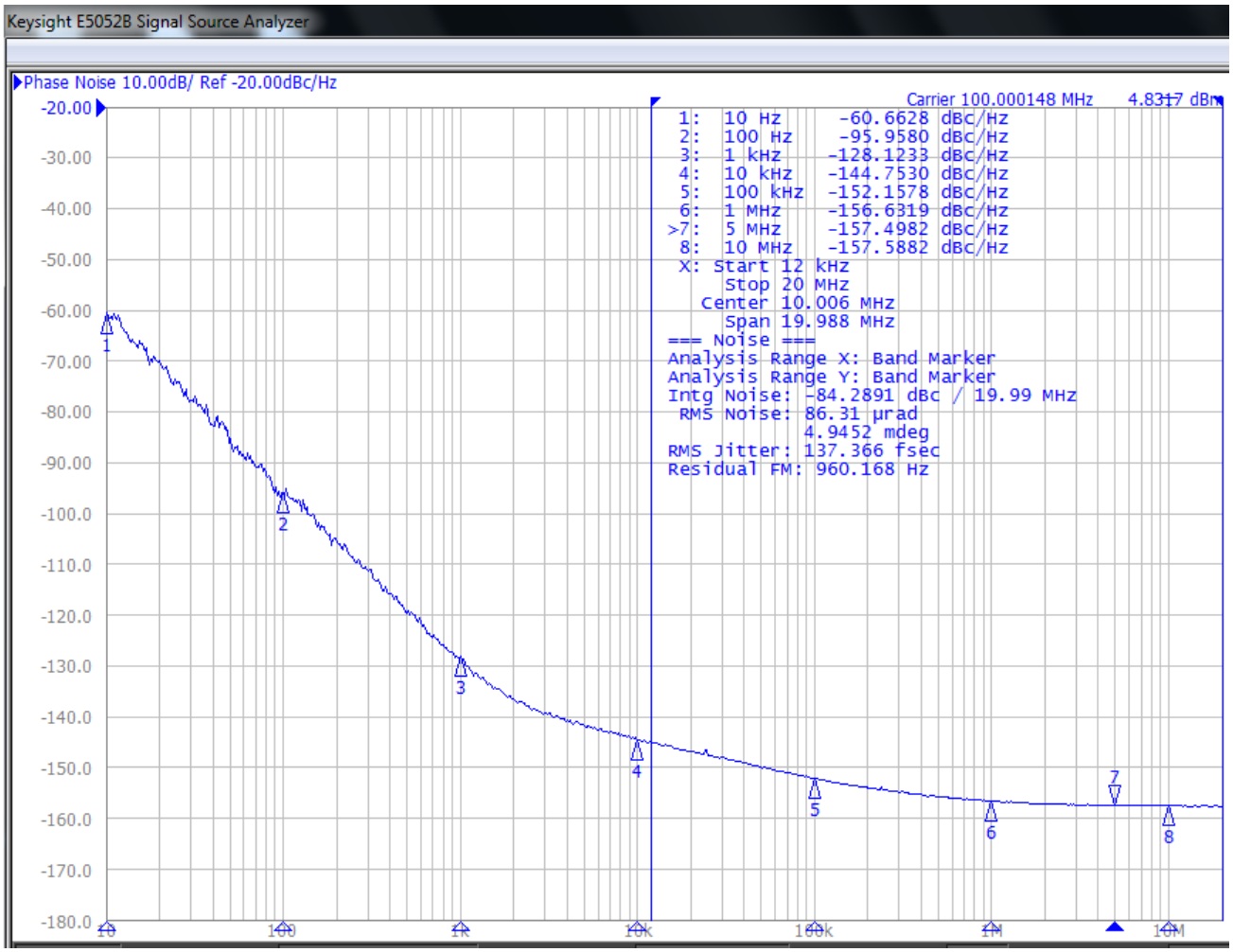
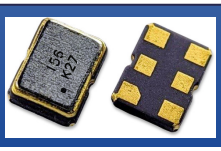
2.5 x 2.0 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

Representative Phase Noise Plots @ +25°C [Note 8]

F= 100.00MHz | V_{dd}=2.50V | LVPECL
RMS Phase Jitter = 137 fsec



Note 8: Contact Abracon for phase noise plots at alternative supply voltage (Vdd) & differential output formats



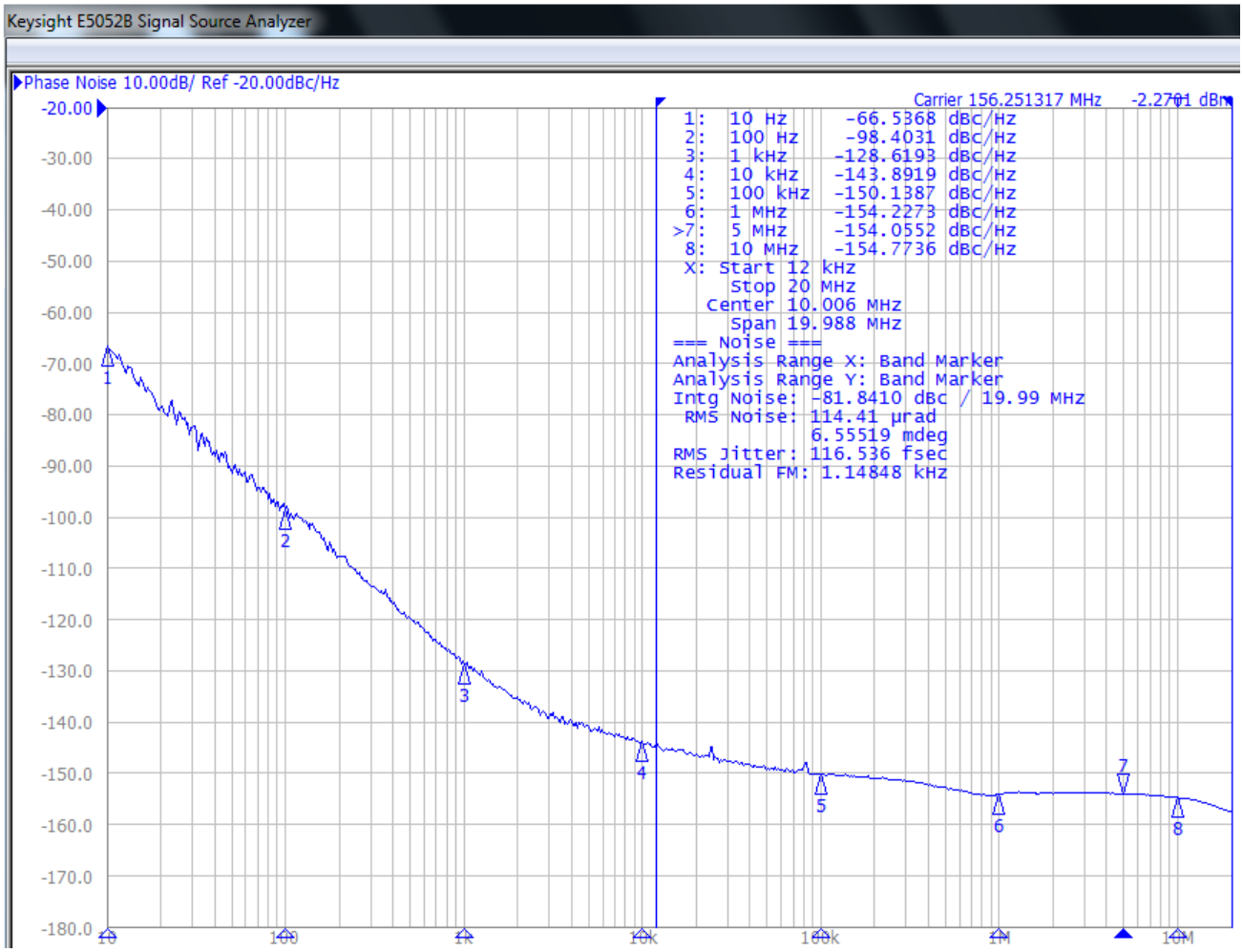
AK2

ESD Sensitive

2.5 x 2.0 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

Representative Phase Noise Plots @ +25°C [Note 8]

F= 156.2500MHz | V_{dd}=2.50V | LVDS
RMS Phase Jitter = 117 fsec



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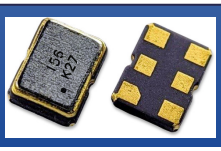

AK2

ESD Sensitive

Pb

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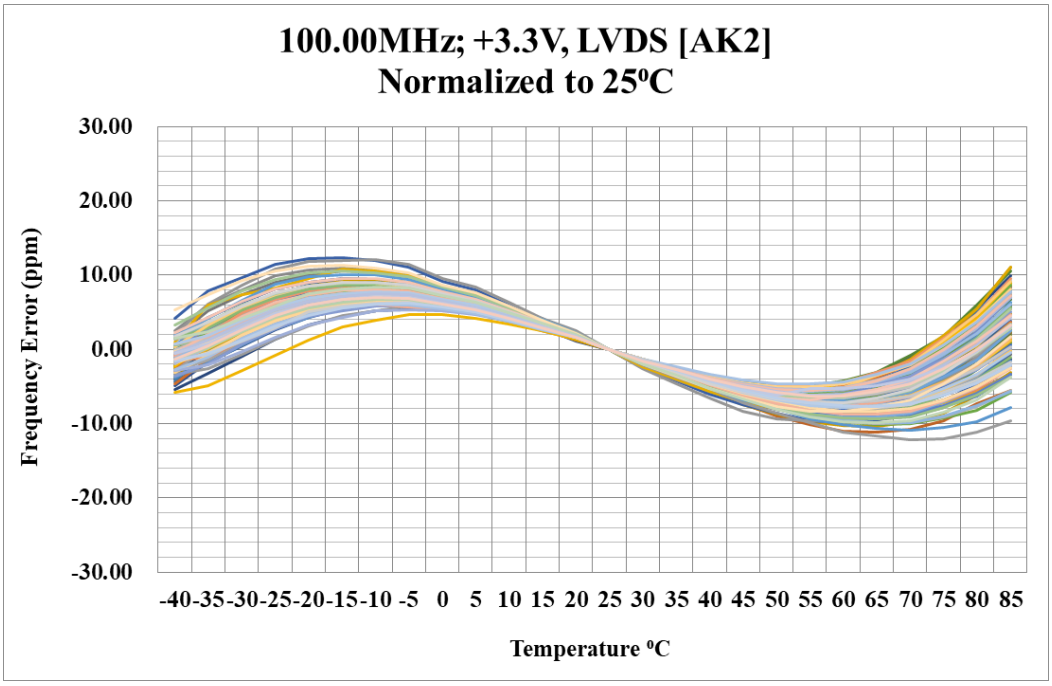
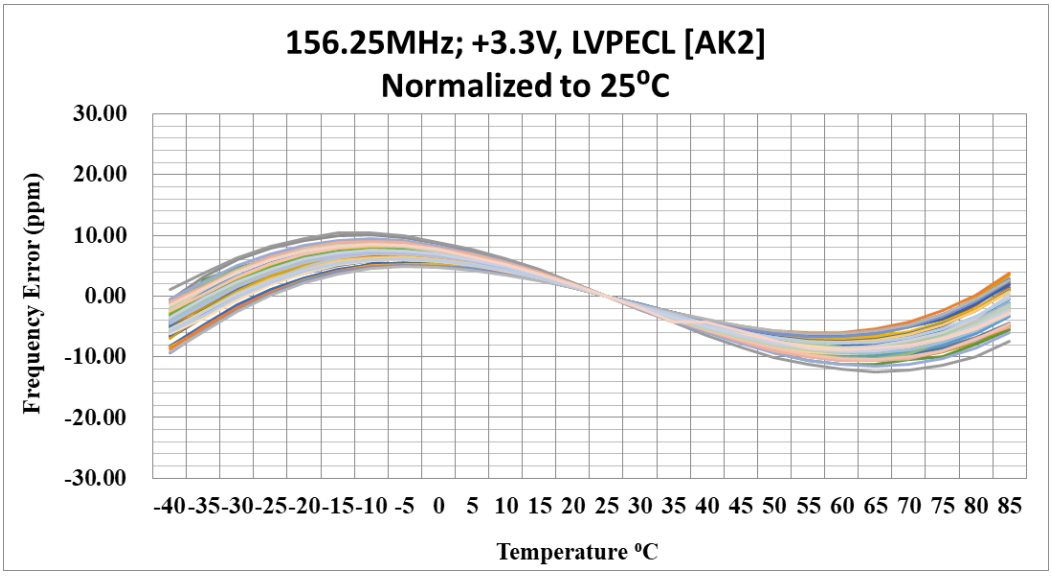
MSL = 1

Typical Frequency vs. Temperature Characteristics





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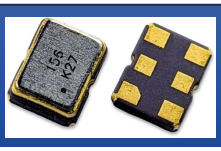

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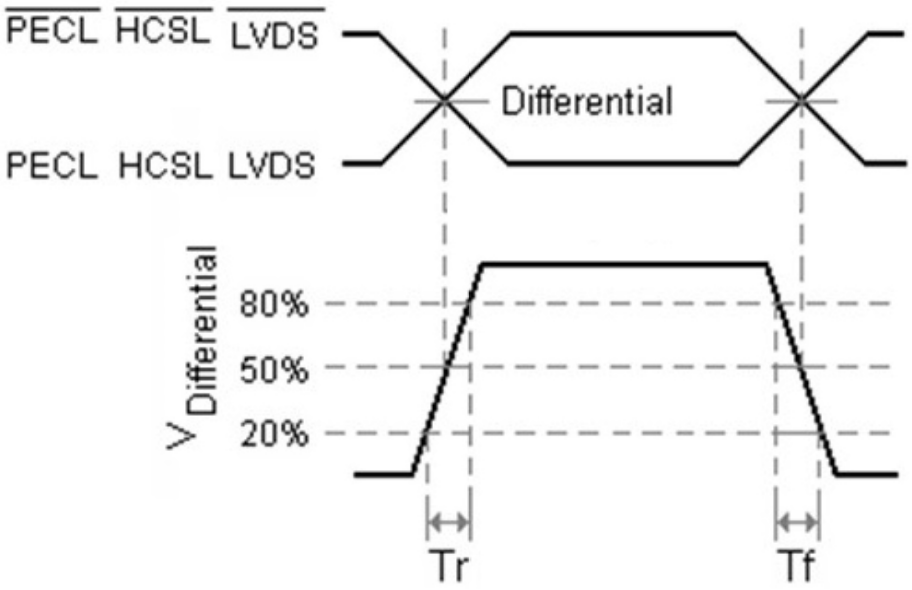
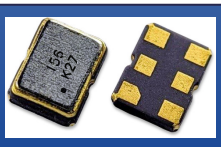
Differential Output Waveform

LVPECL, LVDS and HCSL Output Waveforms





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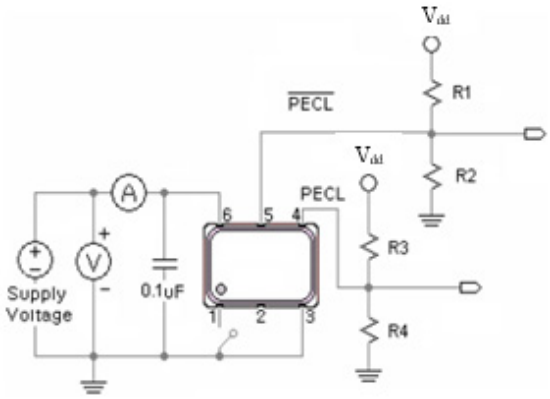
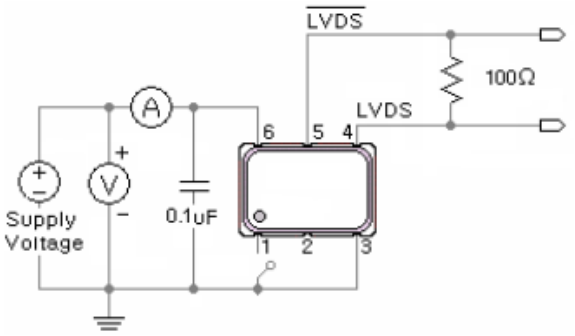
Recommended Test Circuit [Note 9]

LVPECL

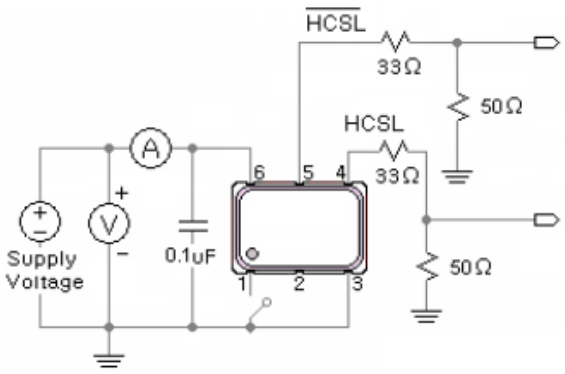


Vdd= 3.3V: R1=R3=127Ω; R2=R4=82.5Ω
Vdd= 2.5V: R1=R3=250Ω; R2=R4=62.5Ω

LVDS



HCSL



Note 9: 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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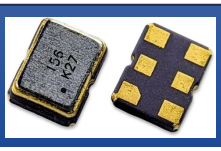

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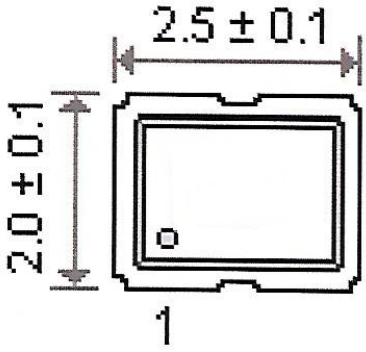
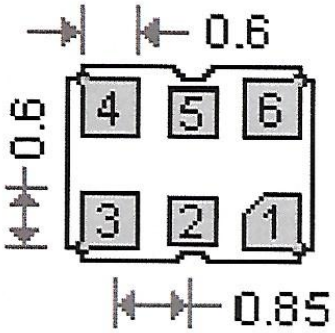
Mechanical Dimensions

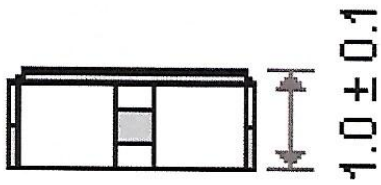
Top View



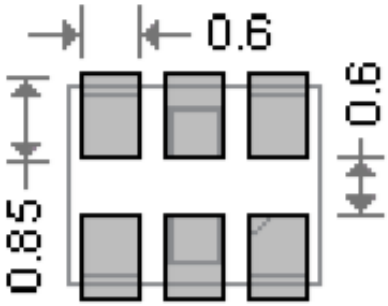
Bottom View



Side View



Recommended Land Pattern



Case 1 Pin #1= Enable/Disable Function where OE is Active HIGH		Case 2 Pin #2= 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 Enable = 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: [mm]

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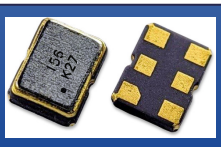

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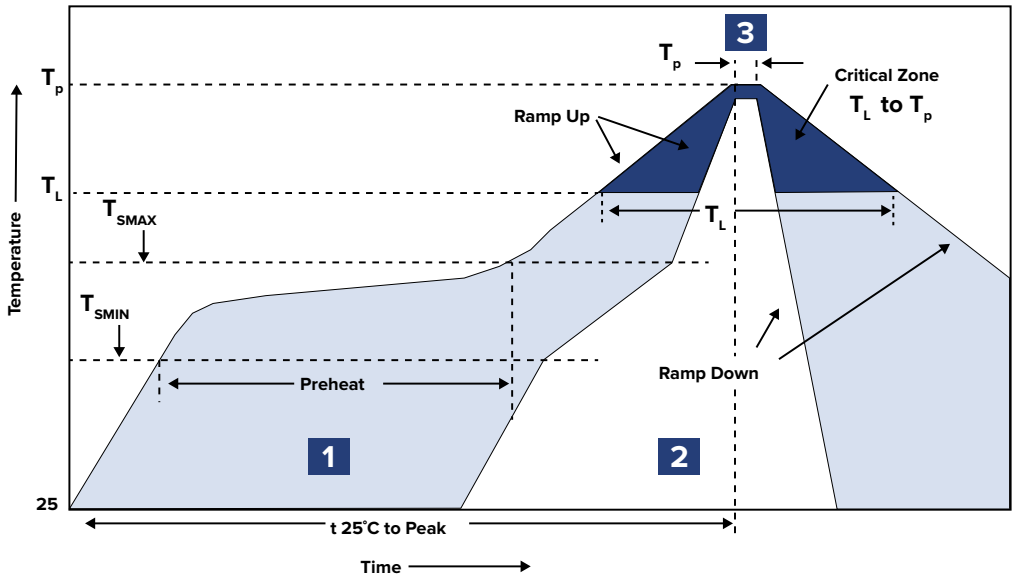
Recommended Reflow Profile



Zone	Description	Temperature	Time
1	Preheat / Soak	T_{SMIN} ~ T_{SMAX} 150°C ~ 220°C	80 ~ 140 sec.
2	Reflow	T_L 220°C	60 sec.
3	Peak heat	T_P 260°C±5°C	~10 sec.

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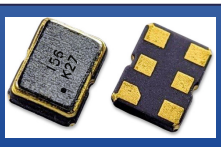

AK2

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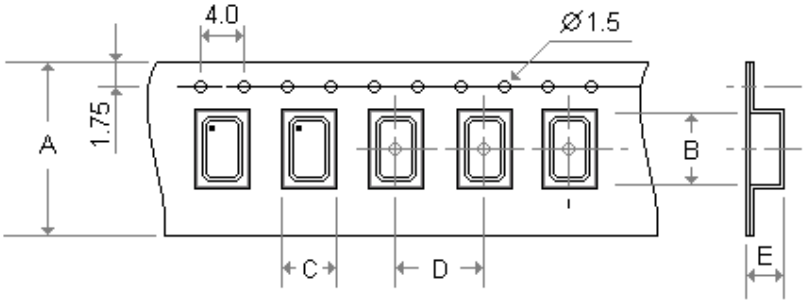
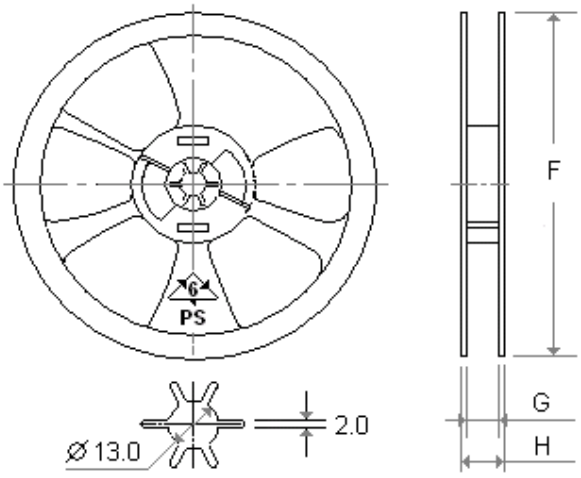
2.5 x 2.0 x 1.0 mm
RoHS/RoHS II Compliant
MSL = 1

Packaging

Blank = Bulk (MOQ=100 units)
T = Tape & Reel 1,000 units/reel
T3 = Tape & Reel 3,000 units/reel

Feeding (PULL) Direction →





Dimensions : (Unit : mm)

A	B	C	D	E
8.0	2.7	2.2	4.0	1.2

F	G	H
180.0	9.0	12.0

- (10) sprocket hold pitch cumulative tolerance is ±0.10 mm
- "E" measured from a place on the inside bottom of the pocket to the top surface of the carrier

Dimensions: mm

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