

TQC9120

Standard Frequency Differential Oscillator

TOKYO QUARTZ CO.,LTD

Features

- 31 standard frequencies from 25 MHz to 212.5 MHz
- LVPECL and LVDS output signaling types
- 0.6 ps RMS phase jitter (random) over 12 kHz to 20 MHz bandwidth
- Frequency stability as low as ± 10 ppm
- Industrial and extended commercial temperature ranges
- Industry-standard packages: 3.2x2.5, 5.0x3.2 and 7.0x5.0 mmxmm
- For any other frequencies between 1 to 625 MHz, refer to TQC9121 and TQC9122 datasheet

Applications

- 10GB Ethernet, SONET, SATA, SAS, Fibre Channel, PCI-Express
- Telecom, networking, instrumentation, storage, server



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Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
LVPECL and LVDS, Common Electrical Characteristics						
Supply Voltage	V _{dd}	2.97	3.3	3.63	V	
		2.25	2.5	2.75	V	
		2.25	–	3.63	V	Termination schemes in Figures 1 and 2 - XX ordering code
Output Frequency Range	f	25	–	212.5	MHz	See last page for list of standard frequencies
Frequency Stability	F _{stab}	-10	–	+10	ppm	Inclusive of initial tolerance, operating temperature, rated power supply voltage, and load variations
		-20	–	+20	ppm	
		-25	–	+25	ppm	
		-50	–	+50	ppm	
First Year Aging	F _{aging1}	-2	–	+2	ppm	25°C
10-year Aging	F _{aging10}	-5	–	+5	ppm	25°C
Operating Temperature Range	T _{use}	-40	–	+85	°C	Industrial
		-20	–	+70	°C	Extended Commercial
Input Voltage High	V _{IH}	70%	–	–	V _{dd}	Pin 1, OE or \overline{ST}
Input Voltage Low	V _{IL}	–	–	30%	V _{dd}	Pin 1, OE or \overline{ST}
Input Pull-up Impedance	Z _{in}	–	100	250	k Ω	Pin 1, OE logic high or logic low, or \overline{ST} logic high
		2	–	–	M Ω	Pin 1, \overline{ST} logic low
Start-up Time	T _{start}	–	6	10	ms	Measured from the time V _{dd} reaches its rated minimum value.
Resume Time	T _{resume}	–	6	10	ms	In Standby mode, measured from the time \overline{ST} pin crosses 50% threshold.
Duty Cycle	DC	45	–	55	%	Contact TQC for tighter duty cycle
LVPECL, DC and AC Characteristics						
Current Consumption	I _{dd}	–	61	69	mA	Excluding Load Termination Current, V _{dd} = 3.3V or 2.5V
OE Disable Supply Current	I _{OE}	–	–	35	mA	OE = Low
Output Disable Leakage Current	I _{leak}	–	–	1	μ A	OE = Low
Standby Current	I _{std}	–	–	100	μ A	\overline{ST} = Low, for all V _{dds}
Maximum Output Current	I _{driver}	–	–	30	mA	Maximum average current drawn from OUT+ or OUT-
Output High Voltage	V _{OH}	V _{dd} -1.1	–	V _{dd} -0.7	V	See Figure 1(a)
Output Low Voltage	V _{OL}	V _{dd} -1.9	–	V _{dd} -1.5	V	See Figure 1(a)
Output Differential Voltage Swing	V _{Swing}	1.2	1.6	2.0	V	See Figure 1(b)
Rise/Fall Time	T _r , T _f	–	300	500	ps	20% to 80%, see Figure 1(a)
OE Enable/Disable Time	T _{oe}	–	–	115	ns	f = 212.5 MHz - For other frequencies, T _{oe} = 100ns + 3 period
RMS Period Jitter	T _{jitt}	–	1.2	1.7	ps	f = 100 MHz, V _{DD} = 3.3V or 2.5V
		–	1.2	1.7	ps	f = 156.25 MHz, V _{DD} = 3.3V or 2.5V
		–	1.2	1.7	ps	f = 212.5 MHz, V _{DD} = 3.3V or 2.5V
RMS Phase Jitter (random)	T _{phj}	–	0.6	0.85	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dds}
LVDS, DC and AC Characteristics						
Current Consumption	I _{dd}	–	47	55	mA	Excluding Load Termination Current, V _{dd} = 3.3V or 2.5V
OE Disable Supply Current	I _{OE}	–	–	35	mA	OE = Low
Differential Output Voltage	V _{OD}	250	350	450	mV	See Figure 2

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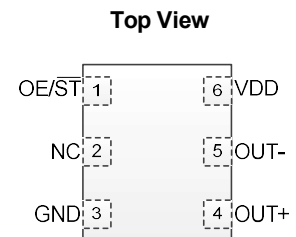
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Electrical Characteristics(continued)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
LVDS, DC and AC Characteristics (continued)						
Output Disable Leakage Current	I _{leak}	–	–	1	μA	OE = Low
Standby Current	I _{std}	–	–	100	μA	\overline{ST} = Low, for all V _{dds}
VOD Magnitude Change	ΔVOD	–	–	50	mV	See Figure 2
Offset Voltage	VOS	1.125	1.2	1.375	V	See Figure 2
VOS Magnitude Change	ΔVOS	–	–	50	mV	See Figure 2
Rise/Fall Time	T _r , T _f	–	495	600	ps	20% to 80%, see Figure 2
OE Enable/Disable Time	T _{oe}	–	–	115	ns	f = 212.5 MHz - For other frequencies, T _{oe} = 100ns + 3 period
RMS Period Jitter	T _{jitt}	–	1.2	1.7	ps	f = 100 MHz, VDD = 3.3V or 2.5V
		–	1.2	1.7	ps	f = 156.25 MHz, VDD = 3.3V or 2.5V
		–	1.2	1.7	ps	f = 212.5 MHz, VDD = 3.3V or 2.5V
RMS Phase Jitter (random)	T _{phj}	–	0.6	0.85	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all V _{dds}

Pin Description

Pin	Map		Functionality
1	OE	Input	H or Open: specified frequency output L: output is high impedance
	\overline{ST}	Input	H or Open: specified frequency output L: Device goes to sleep mode. Supply current reduces to I _{std} .
2	NC	NA	No Connect; Leave it floating or connect to GND for better heat dissipation
3	GND	Power	VDD Power Supply Ground
4	OUT+	Output	Oscillator output
5	OUT-	Output	Complementary oscillator output
6	VDD	Power	Power supply voltage



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Absolute Maximum

Attempted operation outside the absolute maximum ratings of the part may cause permanent damage to the part. Actual performance of the IC is only guaranteed within the operational specifications, not at absolute maximum ratings.

Parameter	Min.	Max.	Unit
Storage Temperature	-65	150	°C
VDD	-0.5	4	V
Electrostatic Discharge (HBM)	–	2000	V
Soldering Temperature (follow standard Pb free soldering guidelines)	–	260	°C

Thermal Consideration^[1]

Package	θ_{JA} , 4 Layer Board (°C/W)	θ_{JC} , Bottom (°C/W)
7050, 6-pin	142	27
5032, 6-pin	97	20
3225, 6-pin	109	20

Note:

1. Refer to JESD51 for θ_{JA} and θ_{JC} definitions, and reference layout used to determine the θ_{JA} and θ_{JC} values in the above table.

Maximum Operating Junction Temperature^[2]

Max Operating Temperature (ambient)	Maximum Operating Junction Temperature
70°C	90°C
85°C	105°C

Note:

2. Datasheet specifications are not guaranteed if junction temperature exceeds the maximum operating junction temperature.

Environmental Compliance

Parameter	Condition/Test Method
Mechanical Shock	MIL-STD-883F, Method2002
Mechanical Vibration	MIL-STD-883F, Method2007
Temperature Cycle	JESD22, Method A104
Solderability	MIL-STD-883F, Method2003
Moisture Sensitivity Level	MSL1 @ 260°C

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Waveform Diagrams

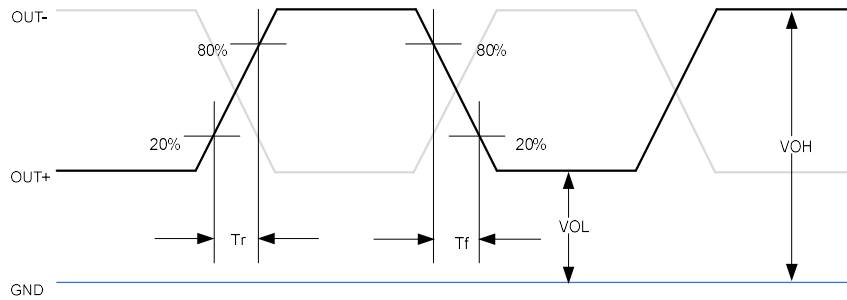


Figure 1(a). LVPECL Voltage Levels per Differential Pin (OUT+/OUT-)

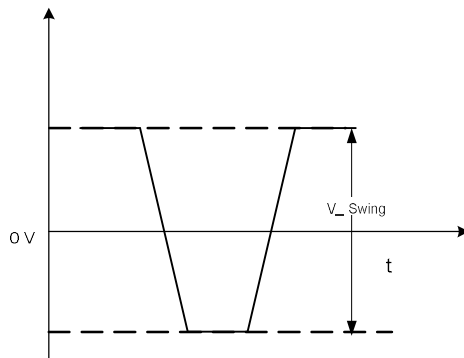


Figure 1(b). LVPECL Voltage Levels Across Differential Pair

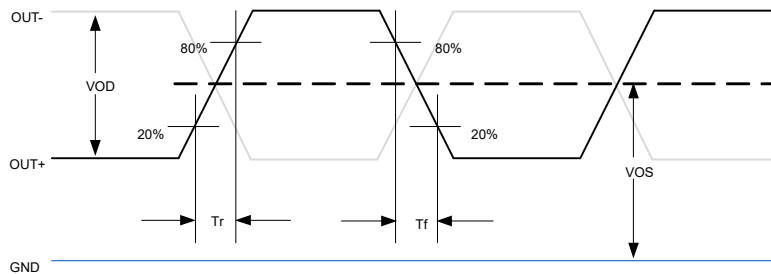


Figure 2. LVDS Voltage Levels per Differential Pin (OUT+/OUT-)

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Termination Diagrams

LVPECL:

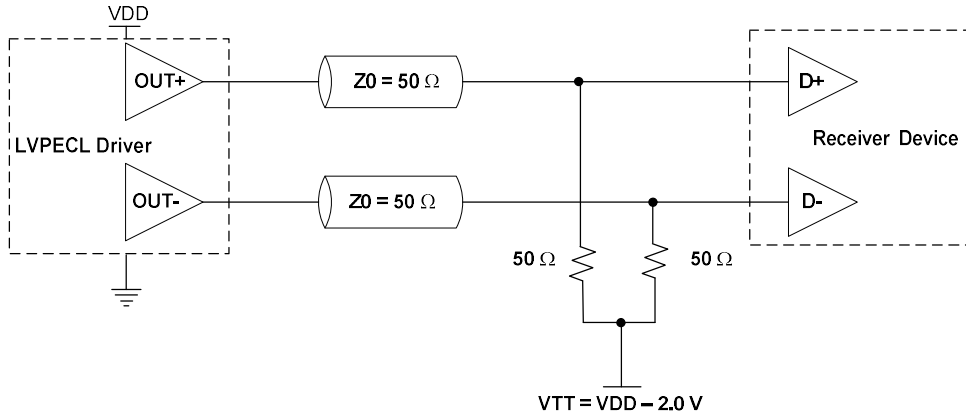


Figure 3. LVPECL Typical Termination

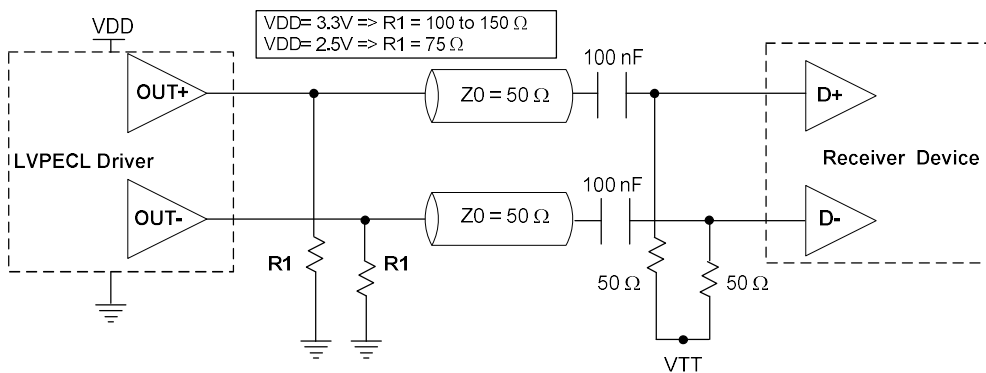


Figure 4. LVPECL AC Coupled Termination

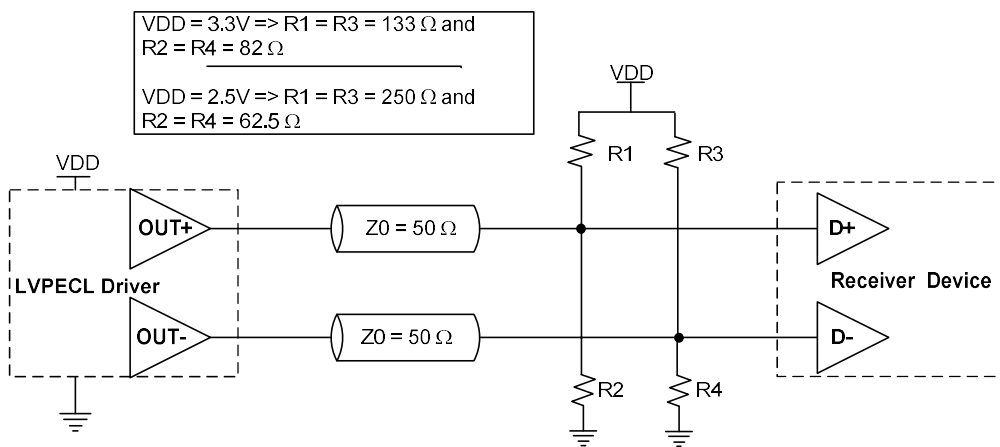


Figure 5. LVPECL with Thevenin Typical Termination

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LVDS:

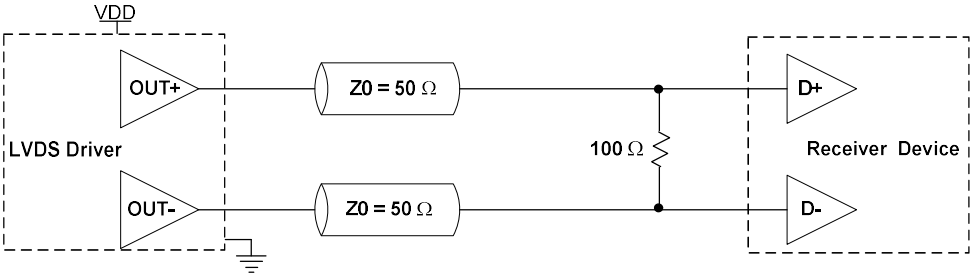


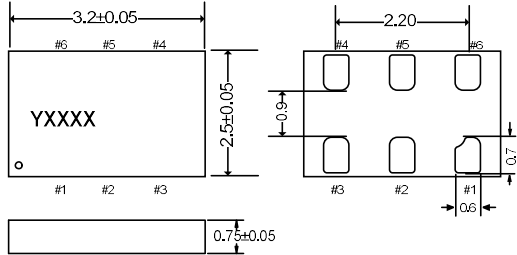
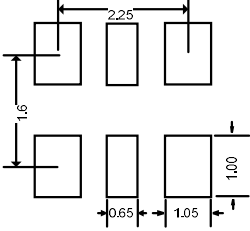
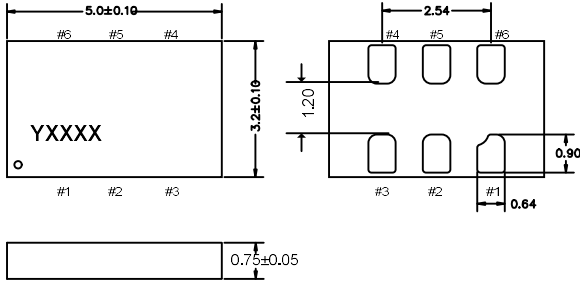
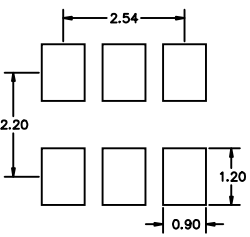
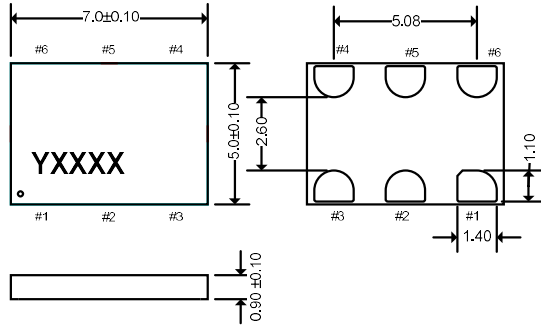
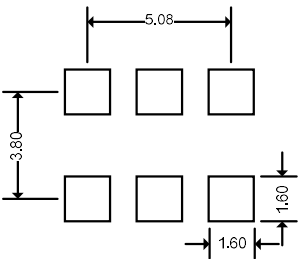
Figure 6. LVDS Single Termination (Load Terminated)

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Dimensions and Patterns

Package Size – Dimensions (Unit: mm) ^[3]	Recommended Land Pattern (Unit: mm) ^[4]
<p>3.2 x 2.5x 0.75 mm</p> 	
<p>5.0 x 3.2 x 0.75 mm</p> 	
<p>7.0 x 5.0x 0.90 mm</p> 	

Notes:

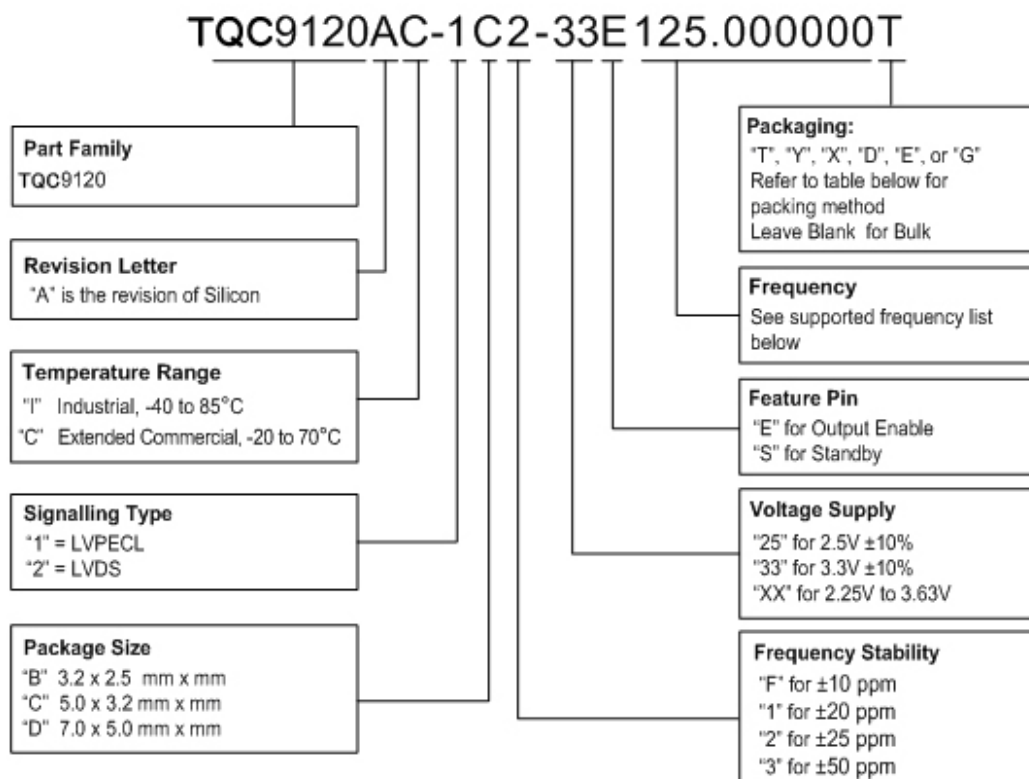
- 3. Top Marking: Y denotes manufacturing origin and XXXX denotes manufacturing lot number. The value of "Y" will depend on the assembly location of the device.
- 4. A capacitor of value 0.1 μ F between Vdd and GND is recommended.

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Ordering Information



Supported Frequencies

25.000000 MHz	50.000000 MHz	74.175824 MHz	74.250000 MHz	75.000000 MHz	98.304000 MHz	100.000000 MHz	106.250000 MHz
125.000000 MHz	133.000000 MHz	133.300000 MHz	133.330000 MHz	133.333000 MHz	133.333300 MHz	133.333330 MHz	133.333333 MHz
148.351648 MHz	148.500000 MHz	150.000000 MHz	155.520000 MHz	156.250000 MHz	161.132800 MHz	166.000000 MHz	166.600000 MHz
166.660000 MHz	166.666000 MHz	166.666600 MHz	166.666660 MHz	166.666666 MHz	200.000000 MHz	212.500000 MHz	

Ordering Codes for Supported Tape & Reel Packing Method

Device Size	8 mm T&R (3ku)	8 mm T&R (1ku)	8 mm T&R (250u)	12 mm T&R (3ku)	12 mm T&R (1ku)	12 mm T&R (250u)	16 mm T&R (3ku)	16 mm T&R (1ku)	16 mm T&R (250u)
7.0 x 5.0 mm	-	-	-	-	-	-	T	Y	X
5.0 x 3.2 mm	-	-	-	T	Y	X	-	-	-
3.2 x 2.5 mm	D	E	G	T	Y	X	-	-	-

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Revision History

Revisions	Release Date	Change Summary
1.01	2/20/13	Original
1.02	11/23/13	Added input specifications, LVPECL/LVDS waveforms, packaging T&R options
1.03	2/6/14	Added 8mm T&R option
1.04	3/3/14	Added ± 10 ppm
1.05	7/23/14	Include Thermal Consideration Table
1.06	10/3/14	Modified Thermal Consideration values
1.07	3/15/16	<ul style="list-style-type: none">• Included Maximum Operating Junction Temperature Table• Added Thermal Consideration Notes to Table

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Silicon MEMS Outperforms Quartz

Best Reliability

Silicon is inherently more reliable than quartz. Figure 1 shows a comparison with quartz technology.

Why is EpiSeal™ MEMS Best in Class:

- EpiSeal MEMS resonators are hermetically vacuum-sealed during wafer processing, which eliminates foreign particles and improves long term aging and reliability
- MEMS resonator is paired with advanced analog IC

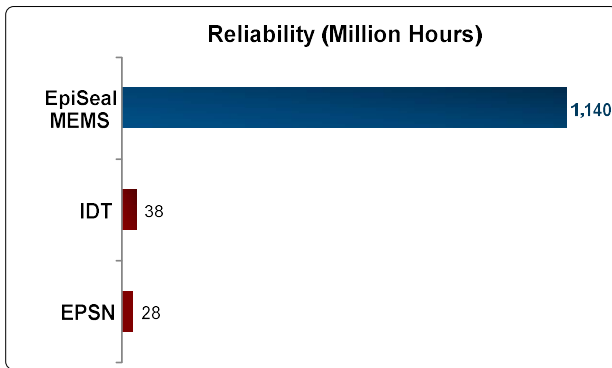


Figure 1. Reliability Comparison^[1]

Best Aging

Unlike quartz, EpiSeal MEMS oscillators have excellent long-term aging performance which is why every new EpiSeal MEMS product specifies 10-year aging.

Why is EpiSeal MEMS Best in Class:

- EpiSeal MEMS resonators are hermetically vacuum-sealed during wafer processing, which eliminates foreign particles and improves long term aging and reliability
- Inherently better immunity of electrostatically driven MEMS resonator

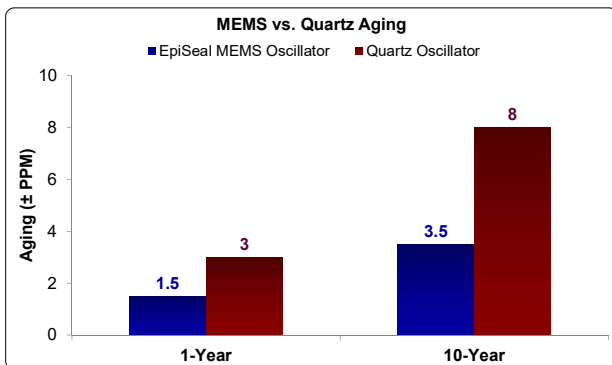


Figure 2. Aging Comparison^[2]

Best Electro Magnetic Susceptibility (EMS)

EpiSeal MEMS oscillators in plastic packages are up to 54 times more immune to external electromagnetic fields than quartz oscillators as shown in Figure 3.

Why is EpiSeal MEMS Best in Class:

- Internal differential architecture for best common mode noise rejection
- Electrostatically driven MEMS resonator is more immune to EMS

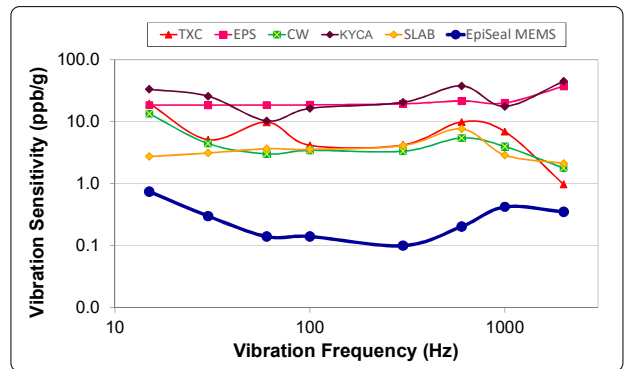


Figure 3. Electro Magnetic Susceptibility (EMS)^[3]

Best Power Supply Noise Rejection

EpiSeal MEMS oscillators are more resilient against noise on the power supply. A comparison is shown in Figure 4.

Why is EpiSeal MEMS Best in Class:

- On-chip regulators and internal differential architecture for common mode noise rejection
- MEMS resonator is paired with advanced analog CMOS IC

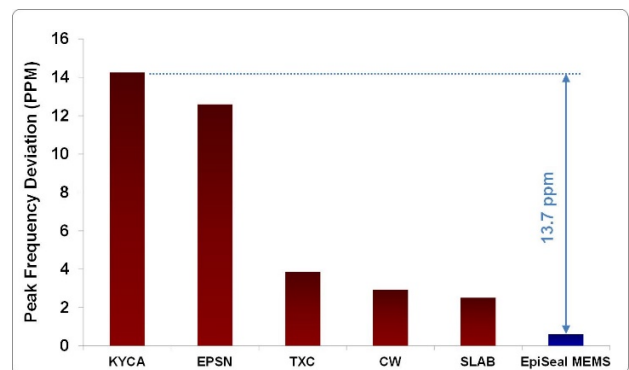


Figure 4. Power Supply Noise Rejection^[4]

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Best Vibration Robustness

High-vibration environments are all around us. All electronics, from handheld devices to enterprise servers and storage systems are subject to vibration. Figure 5 shows a comparison of vibration robustness.

Why is EpiSeal MEMS Best in Class:

- The moving mass of MEMS resonators is up to 3000 times smaller than quartz
- Center-anchored MEMS resonator is the most robust design

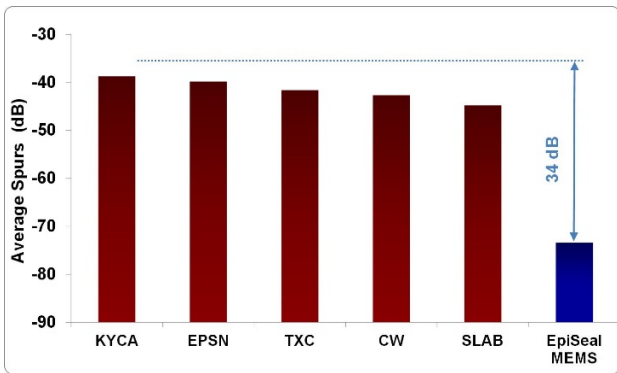


Figure 5. Vibration Robustness^[5]

Best Shock Robustness

EpiSeal MEMS oscillators can withstand at least 50,000g shock. They maintain their electrical performance in operation during shock events. A comparison with quartz devices is shown in Figure 6.

Why is EpiSeal MEMS Best in Class:

- The moving mass of MEMS resonators is up to 3000 times smaller than quartz
- Center-anchored MEMS resonator is the most robust design

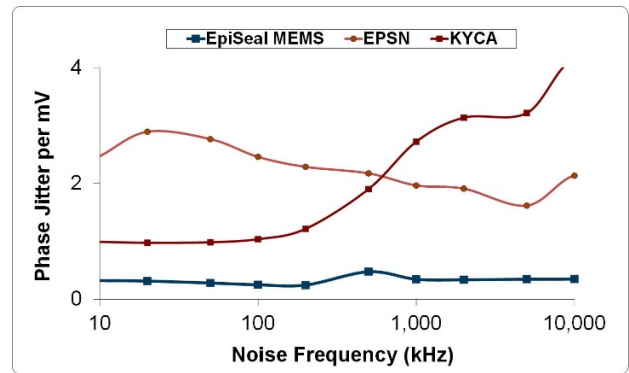


Figure 6. Shock Robustness^[6]

Figure labels:

- TXC = TXC
- Epson = EPSN
- Connor Winfield = CW
- Kyocera = KYCA
- SiLabs = SLAB
- TQC = EpiSeal MEMS

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Notes:

1. Data source: Reliability documents of named companies.
2. Data source: TQC and quartz oscillator devices datasheets.
3. Test conditions for Electro Magnetic Susceptibility (EMS):
 - According to IEC EN61000-4.3 (Electromagnetic compatibility standard)
 - Field strength: 3V/m
 - Radiated signal modulation: AM 1 kHz at 80% depth
 - Carrier frequency scan: 80 MHz – 1 GHz in 1% steps
 - Antenna polarization: Vertical
 - DUT position: Center aligned to antenna

Devices used in this test:

Label	Manufacturer	Part Number	Technology
EpiSeal MEMS	TQC	TQC9120AC-1D2-33E156.250000	MEMS + PLL
EPSN	Epson	EG-2102CA156.2500M-PHPAL3	Quartz, SAW
TXC	TXC	BB-156.250MBE-T	Quartz, 3 rd Overtone
CW	Conner Winfield	P123-156.25M	Quartz, 3 rd Overtone
KYCA	AVX Kyocera	KC7050T156.250P30E00	Quartz, SAW
SLAB	SiLab	590AB-BDG	Quartz, 3 rd Overtone + PLL

4. 50 mV pk-pk Sinusoidal voltage.

Devices used in this test:

Label	Manufacturer	Part Number	Technology
EpiSeal MEMS	TQC	TQC8208AI-33-33E-25.000000	MEMS + PLL
NDK	NDK	NZ2523SB-25.6M	Quartz
KYCA	AVX Kyocera	KC2016B25M0C1GE00	Quartz
EPSN	Epson	SG-310SCF-25M0-MB3	Quartz

5. Devices used in this test:

same as EMS test stated in Note 3.

6. Test conditions for shock test:

- MIL-STD-883F Method 2002
- Condition A: half sine wave shock pulse, 500-g, 1ms
- Continuous frequency measurement in 100 μ s gate time for 10 seconds

Devices used in this test:

same as EMS test stated in Note 3.

7. Additional data, including setup and detailed results, is available upon request to qualified customer.