

OX-249

Space Qualified Oven Controlled Crystal Oscillator (OCXO)



Description

The OX-249 provides exceptionally low phase noise and outstanding ADEV performance in a popular enclosure over a wide range of environmental conditions. This Space OCXO platform bridges the performance gap between lower power consumption EMXOs and higher SWaP (Size, Weight, and Power) OCXOs housed in connectorized enclosures. The OX-249 series becomes the most popular choice where there is a need for exceptional spectral purity, stability, and accuracy. The OX-249 offers exceptional MIL-PRF-55310 Class 2 hybrid reliability and quality assurance.

Features

- 100 krad (Si) TID Tolerant
- Wide Temperature Range
- CMOS/Sine/LVDS Outputs
- Fast Warm-up Time
- Very Tight Stability
- Very Low Phase Noise
- Low Mass: <14 grams
- Rugged Construction
- Frequencies: 10 MHz to 200 MHz



Applications

- Defense Satellites
- Weather Satellites
- Communication Satellites
- Manned Space Vehicles
- Spaceborne Telescopes
- Missiles and Interceptors
- Deep Space Exploration
- Planetary Rovers
- Launch Vehicles
- ICBM Silos

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1. Electrical Specifications

Table 1-1. Common Characteristics [All Frequencies and Options]

Parameter	Min.	Typ.	Max.	Units	Condition ⁴
Supply voltage (Vcc)	4.75	5.0	5.25	VDC	—
Power consumption (in air)	—	—	3.8	Watts	Peak warm-up power
	—	—	1.5	Watts	Steady state @ +25°C
	—	—	2.8	Watts	Steady state @ -40°C
Frequency vs. Temperature (reference to +25°C)	-50	—	+50	ppb	-10°C to +60°C
	-75	—	+75	ppb	-20°C to +70°C
	-100	—	+100	ppb	-40°C to +85°C
Warm-up time @ +25°C	—	—	75	seconds	to ±100 ppb of frequency at 1 hour after turn-on
Warm-up time @ -40°C	—	—	150	seconds	to ±100 ppb of frequency at 1 hour after turn-on
Frequency vs. supply voltage change ± 5%	-30	—	+30	ppb	—
Frequency vs. load change ± 10% ¹	-20	—	+20	ppb	—
ADEV	—	8x10 ⁻¹²	1x10 ⁻¹¹	—	τ=1 second
G-Sensitivity (total gamma) ¹	—	0.5	1	ppb/g	0.008g ² /Hz, 20 Hz to 2 kHz
Mass ¹	—	13.4	14	grams	—

Table 1-2. Sinewave Output Parameters [40 MHz to 100 MHz]

Parameter	Min.	Typ.	Max.	Units	Condition ⁴
Load	—	50	—	Ω	—
Output Power	+5	+7.5	+10	dBm	50Ω load
Output VSWR ¹	—	—	2:1	—	Across F _{nom} ±500 kHz, referenced to 50Ω
Harmonics	—	—	-35	dBc	—
Subharmonics	—	—	none	dBc	—
Spurious	—	—	-80	dBc	—

Table 1-3. AC MOS Output Parameters [10 MHz to 100 MHz]

Parameter	Min.	Typ.	Max.	Units	Condition ⁴
Load	—	15	50	pF	AC MOS (load in parallel with 10 kΩ)
Low Output Level (Vol)	—	—	0.1 Vcc	V	—
High Output Level (Voh)	0.9 Vcc	—	—	V	—
Rise/Fall Time	—	—	5	ns	(10-90%)
Duty Cycle	40	—	60	%	(Voh-Vol)/2

Table 1-4. LVDS Output Parameters [40 MHz to 200 MHz]

Parameter	Min.	Typ.	Max.	Units	Condition ⁴
Differential Output Voltage (VOD)	250	—	450	mV	RL = 100Ω
Offset Voltage (VOS)	1.125	—	1.450	V	
Duty Cycle	40	50	60	%	Measured at 50% amplitude
Subharmonics	—	—	-30	dBc	>100 MHz
Spurious	—	—	-65	dBc	>100 MHz

Table 1-5. Frequency Tuning (EFC) [when present]

Parameter	Min.	Typ.	Max.	Units	Condition ⁴
Tuning Voltage	0	—	4	V	—
Tuning Range	Sufficient to tune to nominal frequency for 15 years				Positive slope
EFC Input DC Resistance	100	—	—	kΩ	—

Table 1-6. Additional Parameters [≤ 50MHz]

Parameter	Min.	Typ.	Max.	Units	Condition ⁴
Initial tolerance for fixed frequency	-200	—	+200	ppb	at time of shipment, without EFC.
Initial tolerance, EFC = 2.00 volts	-400	—	+400	ppb	at time of shipment, with EFC.
vs. aging /1 day	-2	—	+2	ppb	after 30 days of operation, constant ambient conditions and supply voltage.
vs. aging /1st year	-200	—	+200	ppb	
vs. aging /15 years	-1000	—	+1000	ppb	
Typical Phase Noise @ 50 MHz (Sine Output). Maximum performance is Sinewave only. For AC MOS or LVDS performance, contact factory.	—	-78	-72	dBc/Hz	1 Hz
	—	-108	-103	dBc/Hz	10 Hz
	—	-135	-130	dBc/Hz	100 Hz
	—	-153	-148	dBc/Hz	1 kHz
	—	-162	-157	dBc/Hz	10 kHz
	—	-163	-160	dBc/Hz	100 kHz
	—	-163	-160	dBc/Hz	1 MHz

Table 1-7. Additional Parameters [> 50 MHz to ≤ 80 MHz] [> 100 MHz to ≤ 160 MHz, LVDS only]

Parameter	Min.	Typ.	Max.	Units	Condition ⁴
Initial tolerance for fixed frequency	-300	—	+300	ppb	at time of shipment, without EFC.
Initial tolerance, EFC = 2.00 volts	-500	—	+500	ppb	at time of shipment, with EFC.
vs. aging /1 day	-3	—	+3	ppb	after 30 days of operation, constant ambient conditions and supply voltage.
vs. aging /1st year	-400	—	+400	ppb	
vs. aging /15 years	-1500	—	+1500	ppb	
Typical Phase Noise @ 80 MHz (Sine Output). Maximum performance is Sinewave and does not apply to AC MOS or LVDS outputs.	—	-74	-68	dBc/Hz	1 Hz
	—	-105	-100	dBc/Hz	10 Hz
	—	-132	-127	dBc/Hz	100 Hz
	—	-152	-147	dBc/Hz	1 kHz
	—	-162	-157	dBc/Hz	10 kHz
	—	-163	-160	dBc/Hz	100 kHz
	—	-163	-160	dBc/Hz	1 MHz

Table 1-8. Additional Parameters [> 80 MHz to ≤ 100 MHz] [> 160 MHz to ≤ 200 MHz, LVDS only]

Parameter	Min.	Typ.	Max.	Units	Condition ⁴
Initial tolerance for fixed frequency	-500	—	+500	ppb	at time of shipment, without EFC.
Initial tolerance, EFC = 2.00 volts	-600	—	+600	ppb	at time of shipment, with EFC.
vs. aging /1 day	-4	—	+4	ppb	after 30 days of operation, constant
vs. aging /1st year	-500	—	+500	ppb	ambient conditions and supply voltage.
vs. aging /15 years	-2000	—	+2000	ppb	
Typical Phase Noise @ 100 MHz (Sine Output). Maximum performance is Sinewave only and does not apply to AC MOS or LVDS outputs.	—	-70	-65	dBc/Hz	1 Hz
	—	-100	-95	dBc/Hz	10 Hz
	—	-130	-125	dBc/Hz	100 Hz
	—	-151	-147	dBc/Hz	1 kHz
	—	-160	-157	dBc/Hz	10 kHz
	—	-163	-160	dBc/Hz	100 kHz
	—	-163	-160	seconds	1 MHz

Table 1-9. Absolute Maximum Ratings

Absolute Maximum Ratings ²	Min.	Max.	Units	Condition ⁴
Supply Voltage ³	—	+7	V	Peak value of DC+AC.
EFC Voltage	-0.3	+12	V	When EFC input is present.
Storage Temperature	-65	+150	°C	No voltage applied to any connection.
Terminal Solder Temperature	—	260	°C	15 seconds maximum.
ESD rating	1000 volts HBM/CDM		—	—

Notes:

1. Met by design. Not tested.
2. Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Extended exposure to Absolute Maximum conditions may impact device reliability adversely.
3. Not used.
4. Unless stated otherwise, all parameter limits refer to typical conditions for supply voltage, EFC and load at +25°C.
5. Met during qualification.

Other Notes

- The maximum deliverable quantity with a single lot date code is 50 units. Order quantities that exceed 50 units will be delivered in multiple lot date codes with deliveries separated by 4 weeks. Each production lot, with the exception of engineering units (Screening Option E), will be kitted with homogeneous material which is then allocated across multiple lot date code builds to satisfy the deliverable order quantity.
- OX-249 platform meets the derating guidelines set forth by EEE-INST-002 Level 1.
- Contact the factory for improved performance or additional performance parameters.
- Phase noise degrades with increasing output frequency.
- Fixed frequency models will generally exhibit better phase noise, aging rate, and temperature stability than models with EFC.
- Data sheet subject to technical modification.
- For technical support regarding this data sheet, please contact VOP-Support@microchip.com.

2. Environmental Conditions

Table 2-1. Environmental Conditions

Radiation Tolerant (operating)	Active devices are selected from product families that are radiation tolerant to 100 krad (Si) Total Ionizing Dose. When available, wafer lot specific RLAT data for non-SMD active devices will be provided as part of the data book that ships with flight units. Platform passed 300 krad (Si) Total Ionizing Dose (50-300 rad/s) during qualification. Test report is available upon request.
Mechanical Shock (non operating)*	MIL-STD-202, Test Method 213, Condition E (1000g, 0.5 msec)
Vibration Random (non operating)*	MIL-STD-202, Test Method 214, Condition I-J (37.8 grms, 3 minutes/axis)
Vibration Sine (non operating)*	MIL-STD-204, Test Method 204, Condition D (20 Gpk, 20 minutes/axis)
Storage Temperature*	-65°C minimum and +150°C maximum
Note: *Met during qualification.	

3. EEE Component Pedigree and Device Screening Options

Table 3-1. EEE Component Pedigree and Device Screening Options

Ordering Code	S	F	E
Element Evaluation	MIL-PRF-38534, Class K, Rev. K	MIL-PRF-38534, Class K, Rev. K	COTS
Screening Level	Class S IAW MIL-PRF-55310, Rev. E	Class S IAW MIL-PRF-55310, Rev. F	Electrical Verification (EM)
Nondestructive Bond Pull	MIL-STD-883, Method 2023	MIL-STD-883, Method 2023	N/A
Internal Visual	IAW MIL-PRF-55310	IAW MIL-PRF-55310	N/A
Stabilization Bake	MIL-STD-883, Method 1008, Cond. C +150°C for 48 hrs	MIL-STD-883, Method 1008, Cond. C +150°C for 48 hrs	MIL-STD-883, Method 1008, Cond. C +150°C for 48 hrs
Random Vibration	N/A	MIL-STD-883, Method 2026, Cond. I-B	N/A
Thermal Shock	MIL-STD-883, Method 1011, Cond. A	MIL-STD-883, Method 1011, Cond. A	N/A
Temperature Cycling	MIL-STD-883, Method 1010, Cond. B	MIL-STD-883, Method 1010, Cond. C	N/A
Constant Acceleration	MIL-STD-883, Method 2001, Cond. A 5000g, Y1 only	MIL-STD-883, Method 2001, Cond. A 5000g, Y1 only	N/A
Seal (Fine and Gross Leak)	Fine: M202, Method 112, Cond. C Gross: M202, Method 112, Cond. D	Fine: M883, Method 1014, Cond. B1 Gross: M883, Method 1014, Cond. B2	Fine: M202, Method 112, Cond. C Gross: M202, Method 112, Cond. D
PIND	MIL-STD-883, Method 2020, Cond. B	MIL-STD-883, Method 2020, Cond. A	N/A
Pre-Burn-in Electrical Test	IAW MIL-PRF-55310	IAW MIL-PRF-55310	IAW MIL-PRF-55310
Powered Burn-in	MIL-STD-883, Method 1015, Cond. B, +125°C for 240 hrs	MIL-STD-883, Method 1015, Cond. B, +125°C for 240 hrs	N/A
Post-Burn-in Electrical Test	IAW MIL-PRF-55310	IAW MIL-PRF-55310	N/A
Radiographic	MIL-STD-883, Method 2012	MIL-STD-883, Method 2012	N/A
External Visual and Mechanical	MIL-STD-883, Method 2009	MIL-STD-883, Method 2009	MIL-STD-883, Method 2009

4. Quality Conformance Inspections (QCI)

Group A Inspection (included 100% with screening options S and F)

Group A Inspection is performed in accordance with Table V of MIL-PRF-55310.

- Subgroup 1: Electricals
- Subgroup 2: Solderability

Group B Inspection (included 100% with screening options S and F)

Group B Inspection consists of frequency aging testing in accordance with MIL-PRF-55310 with the exception of using logarithmic aging projection.

Group C Inspection (optional, destruct specimens required)

Group C Inspection is optional and must be included on the customer's purchase order when required. By default, Group C Inspection is quoted and performed in accordance with Table VII of the same MIL-PRF-55310 revision level as the applicable screening level. However, Table C-Xc (Condition PI) of MIL-PRF-38534, Rev L can be performed by request. MIL-PRF-55310 Group C Inspection will not include Salt Atmosphere. As permitted by MIL-PRF-55310, we will substitute MIL-PRF-38534 Group D (package evaluation) for Salt Atmosphere and will include all resultant LAT data as part of the data book that is included with the flight units.

5. Deliverable Data

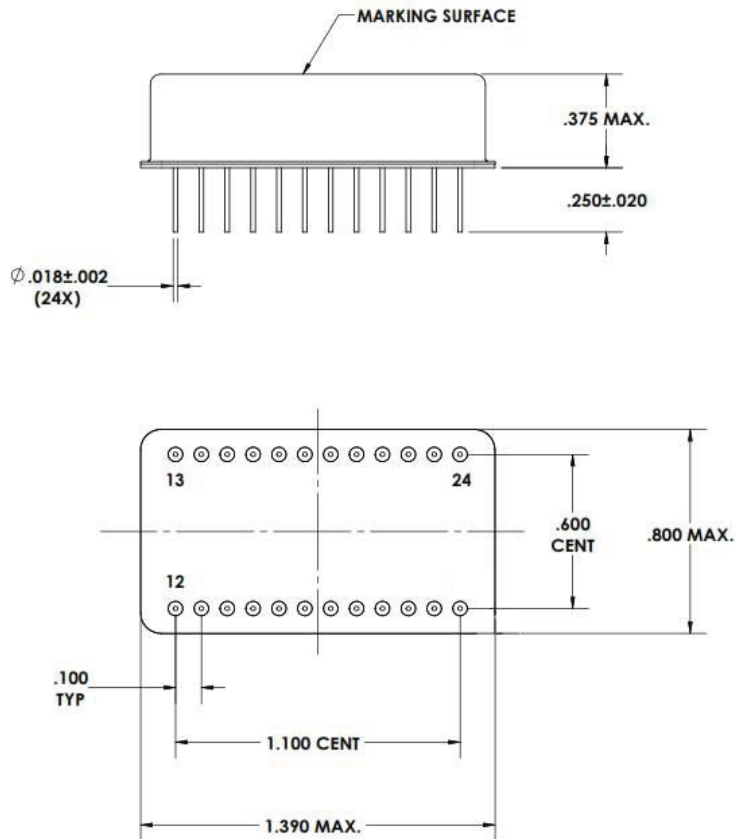
The manufacturer supplies the following data, as a minimum, with each lot of devices:

- a. As applicable to the Screening Option chosen, completed assembly and screening lot travelers, screening data, including radiographic images, and rework history.
- b. Electrical test variables data, identified by unique serial number.
- c. Special items when required by purchase order such as Group C, DPA, and RGA data. Unless otherwise specified on purchase order, all destruct specimens will be shipped. As delivered, all destruct specimens will be identified by subgroup (if applicable) and packaged separately from flight units.
- d. For units with Option S and F Screening, traceability, component LAT, enclosure LAT, and wafer lot specific RLAT data for non-SMD active devices (if applicable).
- e. Certificate of Conformance.

6. Package Information

6.1. Package Drawing

Figure 6-1. Outline Drawing/Enclosure



Pin Connections (Sinewave/CMOS)	
Pin	Function
1	EFC Input or N/C
6, 7, 12, 14	Ground (Case)
13	RF Output
24	Vcc
Pin numbers are for reference only and not marked on parts.	

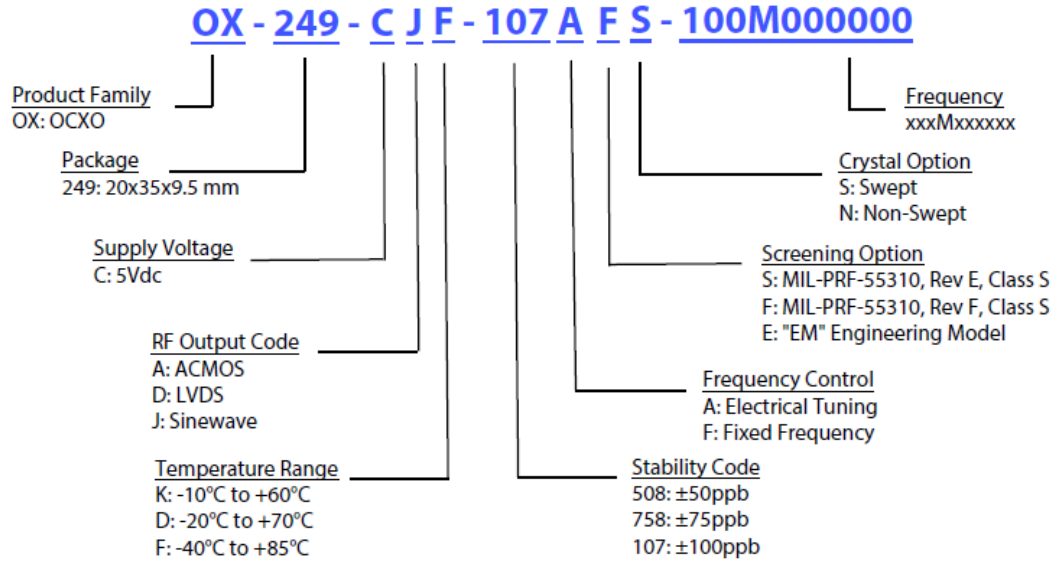
Pin Connections (LVDS ≤ 100 MHz)	
Pin	Function
1	EFC Input or N/C
6, 7, 12, 15	Ground (Case)
13	LVDS Out -
14	LVDS Out +
24	Vcc
Pin numbers are for reference only and not marked on parts.	

Pin Connections (LVDS > 100 MHz)	
Pin	Function
1	EFC Input or N/C
6, 7, 12, 14	Ground (Case)
10	LVDS Out +
11	LVDS Out -
24	Vcc
Pin numbers are for reference only and not marked on parts.	

Note: We recommend all "N/C" pins be externally tied to ground. Lid is internally tied to case ground.

7. Ordering Information

Figure 7-1. OX-249 Ordering Information



Temperature Range and Stability Options Table			
Stability/Temperature	F: -40°C to +85°C	D: -20°C to +70°C	K: -10°C to +60°C
508 (± 50 ppb)	Not Available	Not Available	Available
758 (± 75 ppb)	Not Available	Available	Not Available
107 (± 100 ppb)	Available	Not Available	Not Available

8. Revision History

Revision	Date	Description
B	01/2026	The following changes were made: - In Table 1-4. LVDS Output Parameters [40 MHz to 200 MHz], the maximum value for the parameter Offset Voltage (VOS) has been changed to 1.450 and the following parameters have been removed: - Output Voltage High (VOH) - Output Voltage Low (VOL) - Differential Output Voltage Error (ΔVOD) - Offset Voltage Error (ΔVOS) - Added section Deliverable Data. - In section 6.1. Package Drawing, the following note has been added: "We recommend all "N/C" pins be externally tied to ground. Lid is internally tied to case ground."
A	09/2024	Converted to Microchip branding.

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