

EX-219

Space Evacuated Miniature Crystal Oscillator (EMXO)



Description

The EX-219 provides exceptionally low power consumption and tight temperature stabilities in a small package over a wide range of environmental conditions. This Space EMXO platform bridges the performance gap between higher power consumption OCXOs and lower power consumption TCXOs. The EX-219 series becomes the most popular choice where there is a need for spectral purity, short-term stability, and long-term accuracy all in a low Size, Weight, and Power (SWaP) design.

Features

- 100 krad (Si) TID Tolerant
- Low Power Consumption
- Fast Warm-up Time
- Tight Stability
- Low Phase Noise
- Small Form Factor
- Low Mass: <9 grams
- Rugged Construction
- Frequency Range: 10 MHz to 130 MHz
- Previous Models: EX-209, EX-245, C4540



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. Frequency Stabilities [10 MHz to 20 MHz]

Parameter	Min.	Typ.	Max.	Units	Condition
vs. operating temperature range (reference to +25°C)	-50	—	+50	ppb	-10 to +60°C
	-75	—	+75	ppb	-20 to +70°C
	-100	—	+100	ppb	-40 to +85°C
Initial tolerance for fixed frequency	-1	—	+1	ppm	at time of shipment
vs. supply voltage change	-10	—	+10	ppb	$V_S \pm 5\%$
vs. load change	-10	—	+10	ppb	Load $\pm 5\%$
vs. aging /1 day	-2	—	+2	ppb	after 7 days of operation
vs. aging /1st year	-200	—	+200	ppb	—
vs. aging /10 year	-1000	—	+1000	ppb	10 MHz to <12 MHz
vs. aging /10 year	-1500	—	+1500	ppb	12 MHz to <16 MHz
vs. aging /10 year	-2000	—	+2000	ppb	16 MHz to 20 MHz
Warm-up time @ +25°C	—	—	180	seconds	to ± 100 ppb of frequency at 1 hour after turn-on
Warm-up time @ -40°C	—	—	240	seconds	

Table 1-2. Frequency Stabilities [>20 MHz to 120 MHz]

Parameter	Min.	Typ.	Max.	Units	Condition
vs. operating temperature range (reference to +25°C)	-75	—	+75	ppb	-10 to +60°C
	-100	—	+100	ppb	-20 to +70°C
	-150	—	+150	ppb	-40 to +85°C
Initial tolerance for fixed frequency	-1.5	—	+1.5	ppm	at time of shipment
vs. supply voltage change	-15	—	+15	ppb	3.3 $\pm 5\%$
	-25	—	+25	ppb	5.0 $\pm 5\%$
vs. load change	-15	—	+15	ppb	Load $\pm 5\%$
vs. aging /1 day	-3	—	+3	ppb	after 7 days of operation
vs. aging /1st year	-300	—	+300	ppb	—
vs. aging /10 year	-3000	—	+3000	ppb	—
Warm-up time @ +25°C	—	—	180	seconds	to ± 100 ppb of frequency at 1 hour after turn-on
Warm-up time @ -40°C	—	—	240	seconds	

Table 1-3. Frequency Stabilities [>120 MHz to 130 MHz]

Parameter	Min.	Typ.	Max.	Units	Condition
vs. operating temperature range (reference to +25°C)	-75	—	+75	ppb	-10 to +60°C
	-100	—	+100	ppb	-20 to +70°C
	-150	—	+150	ppb	-40 to +85°C
Initial tolerance for fixed frequency	-1.5	—	+1.5	ppm	at time of shipment
vs. supply voltage change	-25	—	+25	ppb	3.3 $\pm 5\%$
	-25	—	+25	ppb	5.0 $\pm 5\%$
vs. load change	-25	—	+25	ppb	Load $\pm 5\%$
vs. aging /1 day	-3	—	+3	ppb	after 7 days of operation
vs. aging /1st year	-300	—	+300	ppb	—
vs. aging /10 year	-3000	—	+3000	ppb	—
Warm-up time @ +25°C	—	—	180	seconds	to ± 100 ppb of frequency at 1 hour after turn-on
Warm-up time @ -40°C	—	—	240	seconds	

Table 1-4. Single Supply Voltage (V_s) Option

Parameter	Min.	Typ.	Max.	Units	Condition
Supply voltage	3.13	3.3	3.47	VDC	—
	4.75	5.0	5.25	VDC	—
Power consumption	—	—	2.2	Watts	during warm-up
	—	—	0.7	Watts	steady state @ +25°C
	—	—	1.2	Watts	steady state @ -40°C

Table 1-5. Dual Supply Voltage Option

Parameter	Min.	Typ.	Max.	Units	Condition
Oscillator Supply Voltage (V_{osc})	3.13	3.3	3.47	VDC	—
	4.75	5.0	5.25	VDC	—
Oscillator Supply Current (I_{osc})	—	—	60	mA	—
Oven Supply Voltage (V_{oven})	3.13	3.3	3.47	VDC	—
	4.75	5.0	5.25	VDC	—
Oven Power Consumption (I_{oven})	—	—	2.0	Watts	during warm-up
	—	—	0.6	Watts	steady state @ +25°C
	—	—	1.1	Watts	steady state @ -40°C

Table 1-6. RF Output

Parameter	Min.	Typ.	Max.	Units	Condition
Signal	HCMOS				for frequency from 10 MHz to 120 MHz
Load	—	15	—	pF	—
Signal Level (Vol)	—	—	0.1	V_s	—
Signal Level (Voh)	0.9	—	—	V_s	—
Rise/Fall Time	—	—	7	ns	10%-90% for frequency from 10 MHz to 55 MHz
	—	—	4	ns	10%-90% for frequency from >55 MHz to 120 MHz
Duty Cycle	40	—	60	%	(Voh-Vol)/2
Subharmonics (>55 MHz)	—	—	-40	dBc	>55 MHz to 120 MHz
Spurious	—	—	-80	dBc	met during qualification (not tested)
Signal	Sinewave				—
Load	—	50	—	Ω	—
Output Power (0 dBm)	+0	+2	+4	dBm	50 Ω load
Output Power (+3 dBm)	+3	+5	+7	dBm	50 Ω load
Output Power (+5 dBm)	+5	+7	+9	dBm	50 Ω load
Harmonics	—	—	-30	dBc	10 MHz to 120 MHz
Harmonics	—	—	-20	dBc	>120 MHz to 130 MHz
Subharmonics (>55 MHz)	—	—	-30	dBc	>120 MHz to 130 MHz
Subharmonics (>55 MHz)	—	—	-40	dBc	>55 MHz to 120 MHz
Spurious	—	—	-80	dBc	met during qualification (not tested)

Table 1-7. Frequency Tuning (EFC)

Parameter	Min.	Typ.	Max.	Units	Condition
Tuning Range	Sufficient to tune to nominal frequency over operating temperature range, supply voltage variation, load variation, and 10 years aging				EFC (0V to Vref)
EFC Input DC Resistance	100	—	200	kΩ	—
Vref	+2.4	+2.5	+2.6	VDC	source current 1 mA maximum

Table 1-8. Additional Parameters [10 MHz to 20 MHz]

Parameter	Min.	Typ.	Max.	Units	Condition
Phase Noise (typical performance @ 10 MHz)	—	-90	-80	dBc/Hz	1 Hz
	—	-120	-110	dBc/Hz	10 Hz
	—	-145	-135	dBc/Hz	100 Hz
	—	-150	-145	dBc/Hz	1 kHz
	—	-155	-150	dBc/Hz	10 kHz
	—	-155	-150	dBc/Hz	100 kHz
ADEV	—	—	2x10 ⁻¹¹	—	τ = 1 sec
G-Sensitivity (total gamma)	—	—	1	ppb/g	Test at 10g sine vibration at 100 Hz

Table 1-9. Additional Parameters [>20 MHz to 55 MHz]

Parameter	Min.	Typ.	Max.	Units	Condition
Phase Noise (typical performance @ 40 MHz)	—	-100	-90	dBc/Hz	10 Hz
	—	-130	-120	dBc/Hz	100 Hz
	—	-145	-140	dBc/Hz	1 kHz
	—	-150	-145	dBc/Hz	10 kHz
	—	-150	-145	dBc/Hz	100 kHz
ADEV	—	—	5x10 ⁻¹¹	—	τ = 1 sec
G-Sensitivity (total gamma)	—	—	1	ppb/g	Test at 10g sine vibration at 100 Hz

Table 1-10. Additional Parameters [>55 MHz to 130 MHz]

Parameter	Min.	Typ.	Max.	Units	Condition
Phase Noise (typical performance @ 100 MHz)	—	-90	-85	dBc/Hz	10 Hz
	—	-125	-115	dBc/Hz	100 Hz
	—	-135	-130	dBc/Hz	1 kHz
	—	-145	-140	dBc/Hz	10 kHz
	—	-145	-140	dBc/Hz	100 kHz
ADEV	—	—	5x10 ⁻¹¹	—	τ = 1 sec
G-Sensitivity (total gamma)	—	—	1	ppb/g	Test at 10g sine vibration at 100 Hz

2. Environmental Conditions

Table 2-1. Environmental Conditions (Qualified to)

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.
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-H (30 grms, 3 minutes/axis)
Vibration Sine (non operating)*	MIL-STD-202, Test Method 204, Condition D (20 Gpk, 20 minutes/axis)
Storage Temperature*	-55°C minimum and +85°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	B	E
Element Evaluation	MIL-PRF-38534, Class K, Rev. K	MIL-PRF-38534, Class K, Rev. K	COTS
Screening Level	S-Level Screening	B-Level Screening	Electrical Verification (EM)
Nondestructive Bond Pull	MIL-STD-883, Method 2023	N/A	N/A
Internal Visual	IAW MIL-PRF-55310	IAW MIL-PRF-55310	IAW MIL-PRF-55310
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
Thermal Shock	MIL-STD-883, Method 1011, Cond. A 0°C to 100°C for 15 cycles	N/A	N/A
Temperature Cycling ¹	MIL-STD-883, Method 1010, Cond. A -55°C to 85°C for 10 cycles ²	MIL-STD-883, Method 1010, Cond. A -55°C to 85°C for 10 cycles ²	N/A
Constant Acceleration ¹	MIL-STD-883, Method 2001 1000g Y1 only ³	MIL-STD-883, Method 2001 1000g Y1 only ³	N/A
Seal (Fine and Gross Leak) ¹	N/A (Vacuum Seal)	N/A (Vacuum Seal)	N/A (Vacuum Seal)
PIND	MIL-STD-883, Method 2020, Cond. B 10g peak at 60 Hz minimum	N/A	N/A
Pre-Burn-in Electrical Test	IAW MIL-PRF-55310	IAW MIL-PRF-55310	IAW MIL-PRF-55310
Powered Burn-in ¹	85°C for 240 hrs ²	85°C for 240 hrs ²	N/A
Post-Burn-in Electrical Test	IAW MIL-PRF-55310	IAW MIL-PRF-55310	N/A
Radiographic	MIL-STD-883, Method 2012	N/A	N/A
External Visual and Mechanical	MIL-STD-883, Method 2009	MIL-STD-883, Method 2009	MIL-STD-883, Method 2009

Notes:

1. These test inspections deviate from the screening requirements for Class 2 oscillators listed in MIL-PRF-55310.
2. The maximum operating and storage temperature of the EX-219 is +85°C. The EX-219 shall not be exposed to temperature higher than +85°C for an indefinite period of time. However, the EX-219 can tolerate manufacturing process temperatures up to +100°C maximum for 168 hours total accumulative time.
3. The design and construction of the EX-219 can withstand up to 1000g constant acceleration.

4. Quality Conformance Inspections (QCI)

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

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 B)

Group B Inspection consists of frequency aging testing in accordance with MIL-PRF-55310 with the exception of using a third-order log fit for the first-year aging projection (See [Aging Projection](#) for detailed information).

Group C Inspection (optional, eight destruct specimens required)

Group C Inspection is optional and shall be requested on the customer's purchase order. Group C Inspection will be performed in accordance with MIL-PRF-55310, Revision F, Table VII with modifications and exceptions as defined by [Table 4-1](#). If Group C Inspection in accordance with MIL-PRF-38534, Table C-Xc is required, please state this clearly in your RFQ and we will provide a quote with our requirements for handling the exception.

Table 4-1. Modified Group C Inspection for EX-219 IAW MIL-PRF-55310, Rev F With Exceptions

Group C Inspection MIL-PRF-55310, Rev F, S-Level					
Sub group	Test	Specification	Method, Condition	Quantity (Accept)	EX-219 Notes and Exceptions
1	Sine Vibration	MIL-STD-202	Method 204, Test Condition D	8(0)	Non-operating
	Random Vibration	MIL-STD-202	Method 214, Test Condition I-F		Non-operating
	Shock	MIL-STD-202	Method 213, Test Condition E		Note 2
	Conducted Interference (when specified)	MIL-PRF-55310	Para. 4.8.37		Not Performed
	Acoustic Noise (when specified)	MIL-PRF-55310	Para. 4.8.40		Not Performed
	Acceleration (when specified)	MIL-PRF-55310	Para. 4.8.32		Not Performed
	Explosion (when specified)	MIL-PRF-55310	Para. 4.8.43		Not Performed
	End-point electrical	—	—		—
2	Thermal Shock	MIL-STD-202	Method 107, Test Condition B	2(0)	Method 107, Test Condition A (Note 1)
	Ambient Pressure	MIL-PRF-55310	Para. 4.8.46.1		Non-operating
	Storage Temperature	MIL-PRF-55310	Para 4.8.47 at -55°C and +85°C		Note 2
	Magnetic Field (when specified)	—	—		Not Performed
	Radiation Hardness (when specified)	—	—		Not Performed
	End-point electrical	—	—		—
3	Resistance to Soldering Heat	MIL-STD-202	Method 210, Test Condition C	2(0)	Note 2
	Moisture Resistance	MIL-STD-202	Method 106, Test Condition B		—
	Salt Atmosphere	—	—		Not Performed
	End-point electrical	—	—		—
4	Terminal Strength	MIL-STD-202	Method 211	2(0)	Note 2
	Resistance to Solvents	MIL-STD-202	Method 215		Not Performed
	Fungus (when specified)	—	—		Not Performed
	End-point electrical	—	—		—
5	Life Test	MIL-STD-883	Method 1005 for 1,000 hours at +125°C	2(0)	1,000 hours at +85°C (Note 1)
	End-point electrical	—	—		—

Notes:

1. Maximum operating temperature and storage temperature of EX-219 is +85°C. The EX-219 shall not be exposed to temperature higher than +85°C for any length of time. The EX-219 is an Oven Controlled Crystal Oscillator (OCXO). When it sees a temperature higher than the maximum operating temperature, the internal oven will shut down.
2. The package of EX-219 is evacuated and sealed using cold weld technology. The vacuum inside the package induces a negative differential pressure relative to the fine leak detector chamber. Hence, steady state current testing is performed instead of leak testing. See the Vectron® EMXO white paper referenced in [Leak Test](#).

Other Notes

1. Contact the factory for improved stabilities or additional product options. Not all options and codes are available at all frequencies.
2. Unless stated otherwise, all values are valid after warm-up time and refer to typical conditions for supply voltage, frequency control voltage, load and temperature (25°C).
3. Phase noise degrades with increasing output frequency.
4. Subject to technical modification.
5. Contact factory for availability.
6. Option for micro-jumps screening. See [Micro-Frequency Jumps](#).
7. RGA (by itself or as part of DPA) does not apply to this evacuated platform and will not be performed.
8. The maximum deliverable quantity with a single lot date code is 75 units. Order quantities that exceed 75 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.
9. For technical support regarding this data sheet, please contact VOP-Support@microchip.com.

5. Deliverable Data

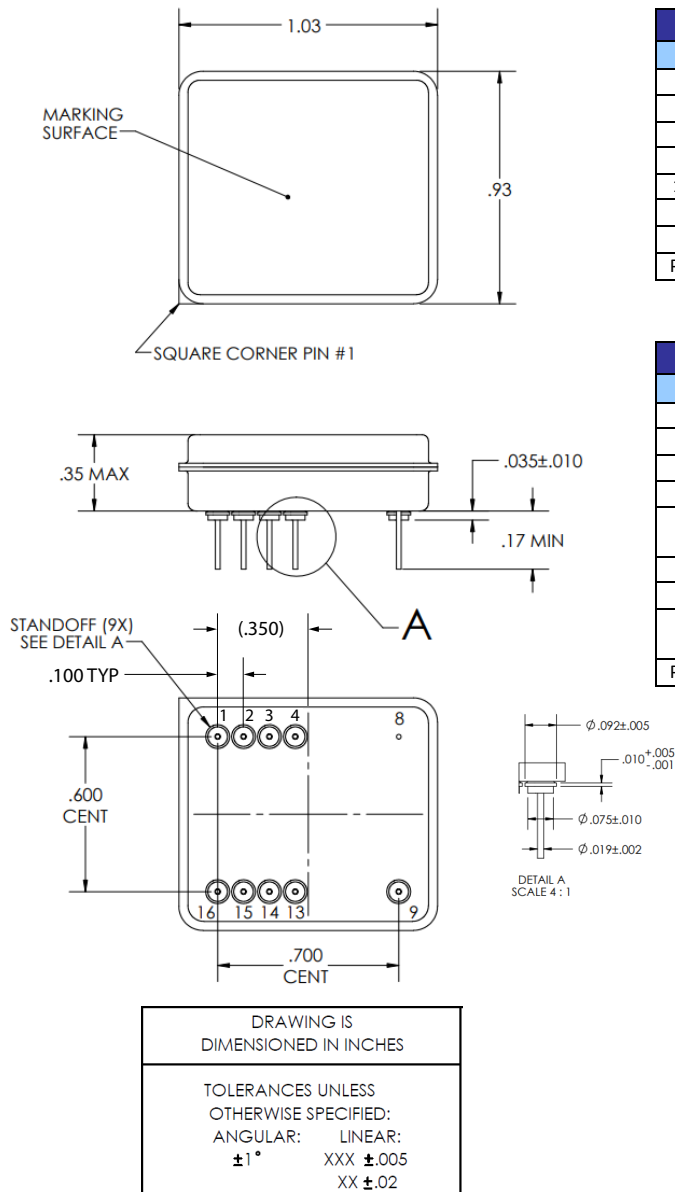
The manufacturer supplies the following data, as a minimum, with each lot of devices:

- 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 B 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 for Single Supply Option		
Pin	With EFC	Fixed Frequency
1	EFC Input	No Connection
2-4	No Connection	No Connection
8	Ground (Case)	Ground (Case)
9	RF Output	RF Output
13-14	No Connection	No Connection
15	Vref	No Connection
16	Supply Voltage Input (Vs)	Supply Voltage Input (Vs)

Pin numbers are for reference only and not marked on parts.

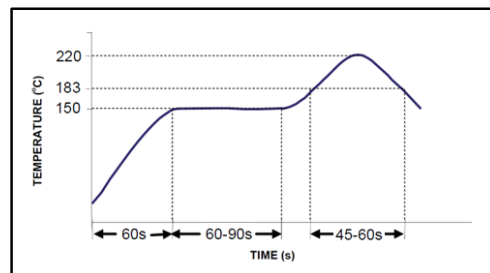
Pin Connections for Dual Supply Option		
Pin	With EFC	Fixed Frequency
1	EFC Input	No Connection
2-4	No Connection	No Connection
8	Ground (Case)	Ground (Case)
9	RF Output	RF Output
13	Oven Supply Voltage Input (Voven)	Oven Supply Voltage Input (Voven)
14	No Connection	No Connection
15	Vref	No Connection
16	Oscillator Supply Voltage Input (Vosc)	Oscillator Supply Voltage Input (Vosc)

Pin numbers are for reference only and not marked on parts.

Notes: All "No Connection" pins are NOT electrically connected internally and are recommended to be connected to GND externally.

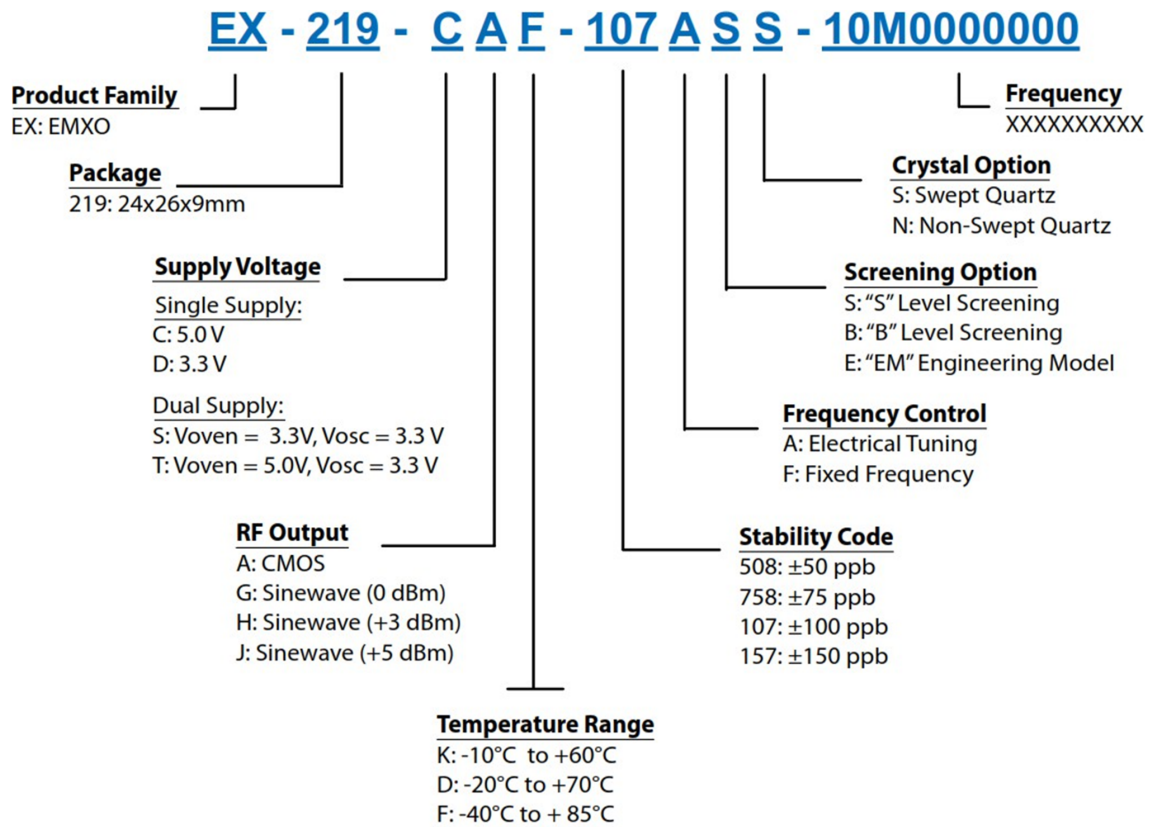
Devices with Screening Option "E" possess 63/37 or 60/40 Sn/Pb tinned leads; all other devices are tinned by the factory in 63/37 Sn/Pb prior to shipment.

Recommended Solder Reflow
Maximum temperature is 230°C for 10 second



7. Ordering Information

Figure 7-1. EX-219 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	10–20 MHz
758 (± 75 ppb)	Not Available	10–20 MHz	>20–130 MHz
107 (± 100 ppb)	10–20 MHz	>20–130 MHz	Not Available
157 (± 150 ppb)	>20–130 MHz	Not Available	Not Available

8. Application Notes

All data and notes are for reference only.

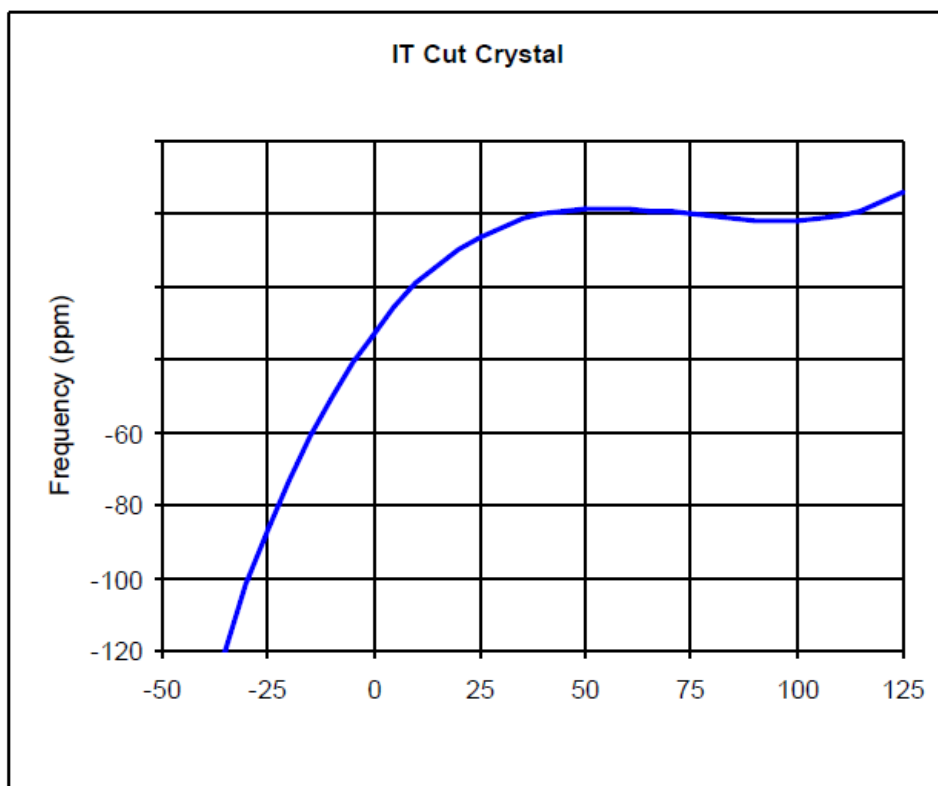
8.1. EMXO Technology

The EMXO is an Oven Controlled Crystal Oscillator (OCXO) hermetically sealed in an evacuated package. It is comprised of a heated substrate (oven) and an output substrate. The oven is mounted on a thermally insulated structure that maintains a nearly constant temperature at about +95°C over the operating temperature range whereas the output substrate is mounted directly on the case. Unlike a conventional OCXO, the EMXO is sealed in an evacuated package using high internal vacuum as the insulation medium to achieve lower power consumption and faster warm-up time.

8.2. Crystal Resonator

A doubly rotated crystal (IT-Cut), which is stress compensated, is used to obtain good phase noise, better aging rate and lower g-sensitivity. The crystal has a 4-point mounting structure for robustness and low g-sensitivity. Synthetic swept quartz is used for the flight model (FM) to achieve higher radiation tolerance. The Temperature Characteristic (TC) of an IT cut crystal in a third order polynomial function has an inflection temperature at IT Cut Crystal +75°C and an Upper Turn Point (UTP) of +95°C. To obtain the advantage of minimal frequency sensitivity, the oven temperature is set at or around the UTP of the crystal. The following figure shows typical Temperature Characteristic (TC) of an IT cut crystal.

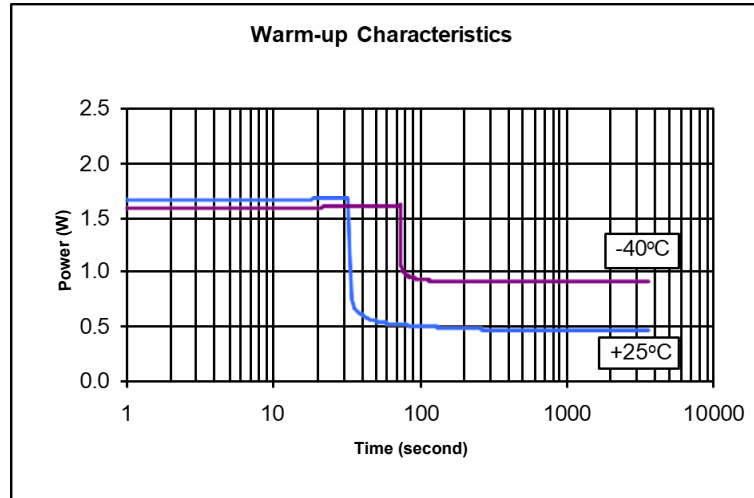
Figure 8-1. Typical Temperature Characteristic (TC) IT Cut Crystal



8.3. Warm-up Characteristic

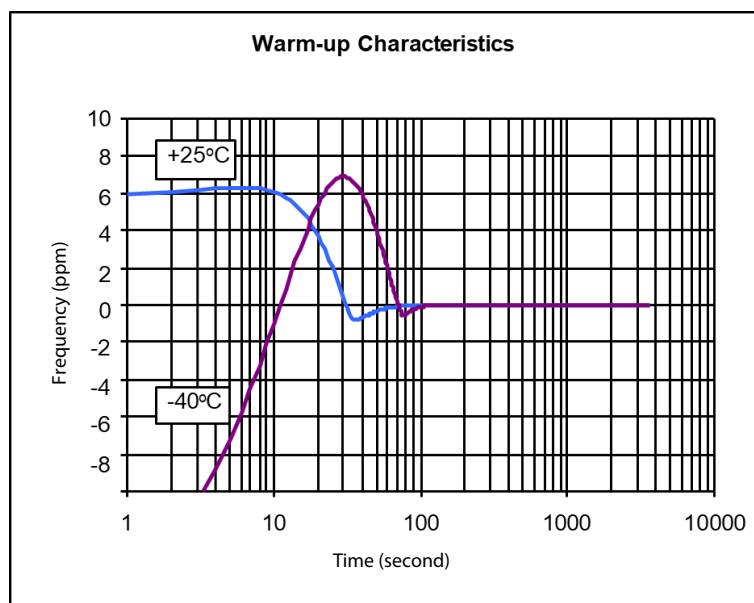
At cold turn-on, the oven is fully powered and the oven temperature rises to the preset temperature which is about 95°C. When the set temperature has been reached, the oven power consumption is cut back to the steady state condition. At steady state, the oven is proportionally controlled and maintains a nearly constant oven temperature. The turn-on power consumption must be higher than the steady state power to prevent power starving, especially at the cold end of the operating temperature. The warm-up time is inversely proportional to the case temperature. Since the EMXO is evacuated and has much less thermal mass than a conventional OCXO, its warm-up time is much faster. The following figure shows the typical warm-up power characteristic at -40°C and +25°C.

Figure 8-2. Typical Warm-up Power Characteristics



During warm-up, the output frequency follows the TC of the crystal frequency until the oven power has cut back to the steady state condition. After oven cut back, the frequency still slowly changes until the oven temperature reaches equilibrium state. The following figure shows the warm-up frequency characteristic at -40°C and +25°C.

Figure 8-3. Warm-up Frequency Characteristics



8.4. Operating Temperature Characteristic

The operating temperature specified herein is the device case temperature. Since the oven is proportionally controlled, its power consumption is inversely proportional to the case temperature. [Figure 8-4](#) shows the steady state power versus case temperature. If the case temperature rises above the maximum operating temperature, the oven will shut off. Thus, the output frequency is no longer stable and follows the TC for the crystal. [Figure 8-5](#) shows frequency versus case temperature. Although the maximum operating temperature is +85°C, the case temperature can increase up to +95°C without causing any permanent damage. However, the maximum temperature shall not exceed +95°C for an indefinite period of time and, during the manufacturing process, shall not exceed +100°C for more than 168 hrs total accumulative time. If a part has been exposed to a temperature above +95°C for a longer duration, it might possibly accelerate internal outgassing. In turn, it will degrade the internal vacuum pressure causing an increase in power consumption.

Figure 8-4. Steadystate Power Versus Case Temperature

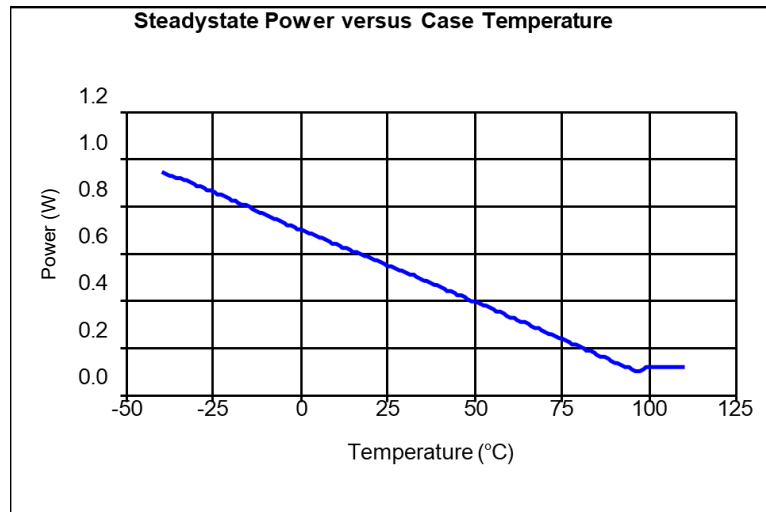
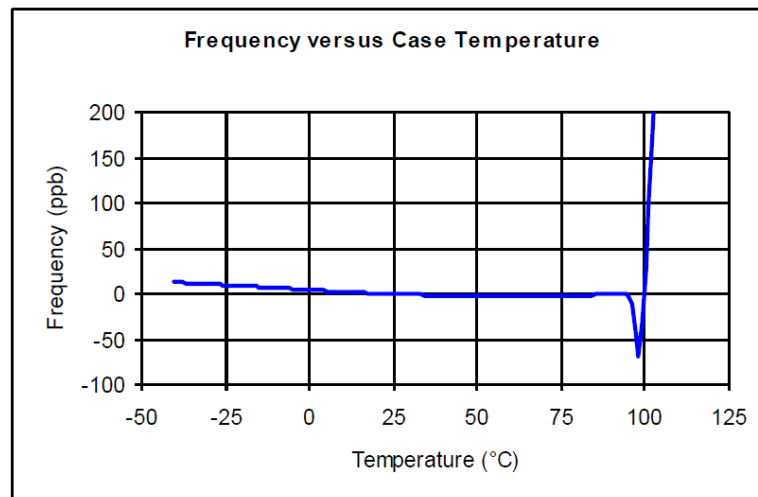


Figure 8-5. Frequency Versus Case Temperature



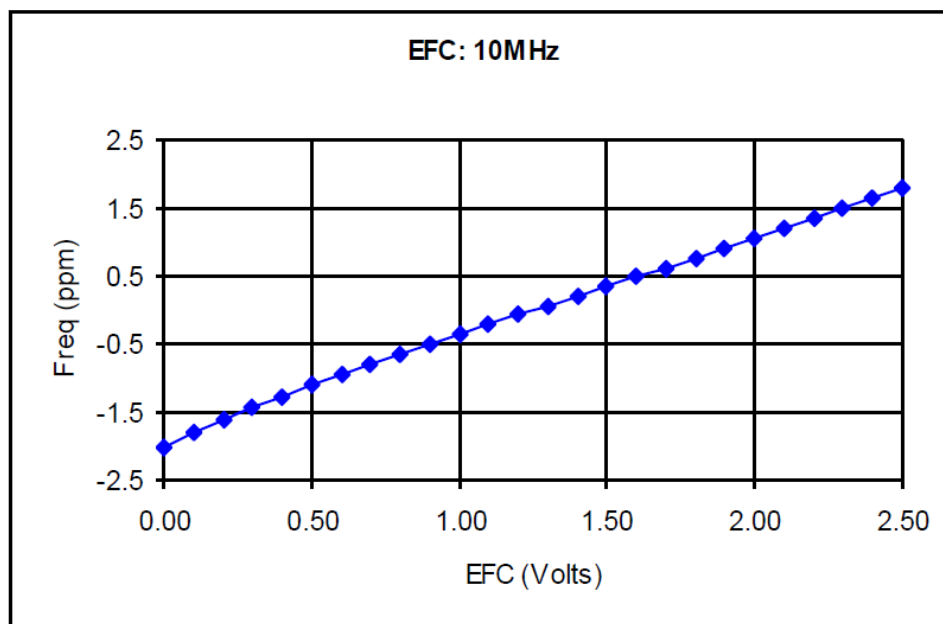
8.5. Initial Frequency Accuracy

There are two options for defining initial frequency accuracy.

a. Fixed Frequency: This option does not have an output frequency adjustment. The output frequency will be set to the specified limit at time of shipment.

b. Electronic Frequency Control (EFC): This option offers frequency adjustment with input voltage at pin #1. The EFC is positive and monotonic as shown in the following figure. This option will allow the end user to adjust the output frequency closer to the nominal frequency or to correct for long-term aging. A low-noise internal voltage reference (Vref) is offered with this option for biasing a voltage divider resistor network or DAC to control the EFC input. Using a noisy voltage reference to control the EFC input can degrade phase noise or ADEV performance. Initial frequency accuracy is not specified for the EFC option. The EFC pull range is sufficient to correct the effects of frequency aging over a 10-year to 15-year product life.

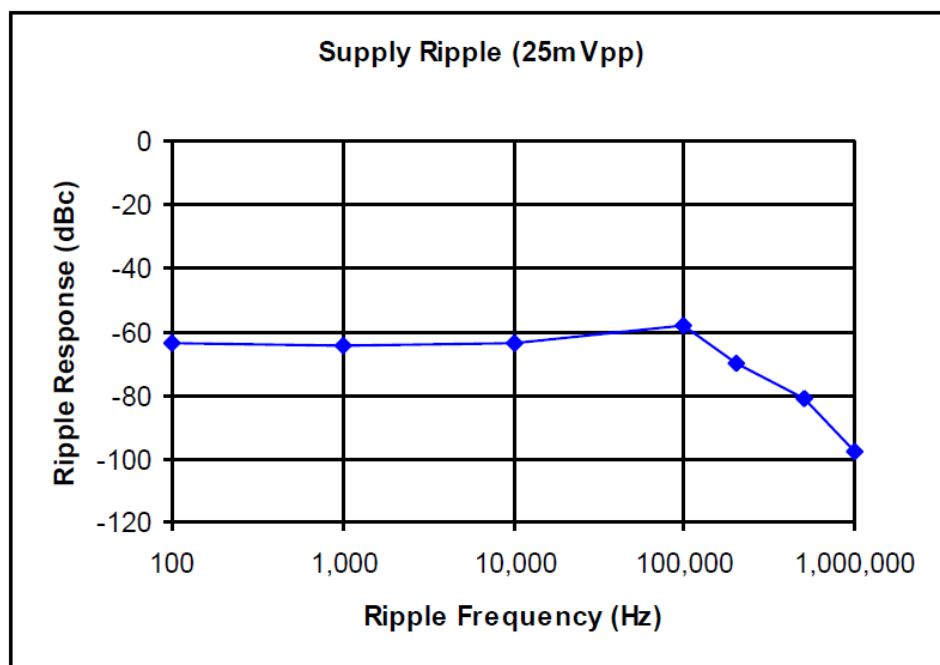
Figure 8-6. Electronic Frequency Control (EFC)



8.6. Supply Ripple of Single Supply Option

Most applications require a single supply input voltage for both the oscillator and oven circuitries. Although a voltage reference is used to regulate the supply voltage to the oscillator stage, the output buffer still uses the external supply voltage directly. Thus, the supply ripple can have a direct influence on the output signal. The following figure shows the typical ripple response.

Figure 8-7. Supply Ripple



An external LC filter can be used in the supply line to suppress the ripple amplitude. The current rating of the inductor used in the filter shall be capable of handling high input current especially during warm-up.

8.7. Dual Supply Option

The EX-219 offers a dual supply option for independent operation of oscillator (Vosc) and oven (Voven) supply lines. The advantages of using the dual supply option are described below.

1. Supply Ripple: With this option, an external LC filter with a low current rating can be used in the Vosc line to suppress supply ripple.
2. 3.3V LVCMOS Output: If 3.3V LVCMOS output wave form is required and the 3.3Vdc supply does not have sufficient power to operate the 3.3Vdc single supply option, then a dual supply option with 5.0Vdc (Voven) and 3.3Vdc (Vosc) can be used.

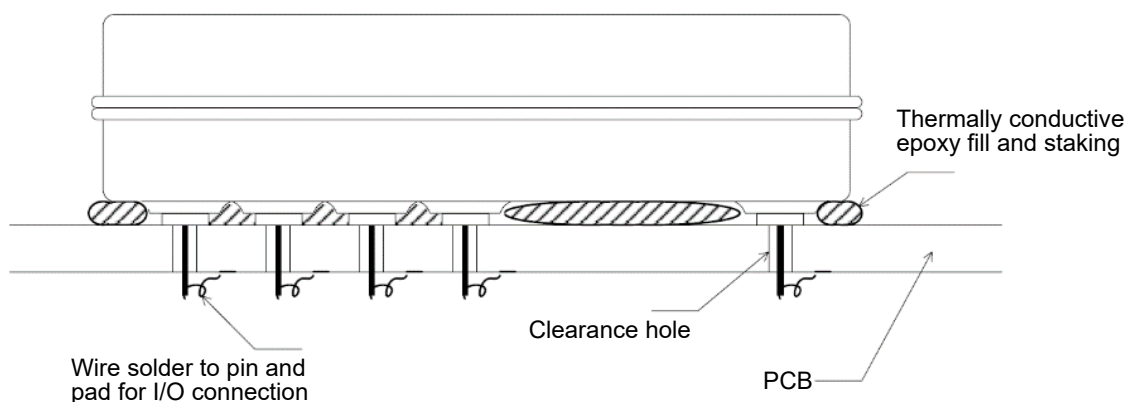
8.8. Thermal Considerations

The thermal resistance from the case of the EX-219 to the mounting plate should be considered when the part is mounted. Heat rise on the case is proportional to the steady state power consumption shown in [Figure 8-4](#). Since the oven is a servo controlled system, the heat rise on the case will eventually reach an equilibrium point depending on the thermal resistance from the case to the mounting plate. If the thermal resistance from the case to the mounting plate is too high, the heat rise on the case will cause the oven to shut off sooner. In the event of oven shut off due to the case temperature exceeding the oven set temperature, there is still remaining self-heating power dissipated by the other components in the oscillator circuitry. This self-heating power is 150 mW typical. The EX-219 is a 16 pin doublewide dual in-line package (DDIP). It consists of nine glass to metal seal feed-through pins and one case/GND pin. In space applications, sinking heat through mounting pins is not recommended because the nine feed-through pins have poor thermally conductive properties. Sinking heat directly from the case of the part to the mounting plate is recommended.

8.9. Part Installation

Stress relief mounting is highly recommended for the EX-219. Thermally conductive adhesive can be used to mechanically bond the bottom surface of the case to the mounting plate with all ten pins protruding through the clearance holes to the opposite side of the PCB. Then, wires can be used to make connections from the pins to the I/O pads on the PCB as shown in the following figure.

Figure 8-8. Part Installation



8.10. Aging Projection

MIL-PRF-55310 specifies measurement of frequency aging for 30 days or longer. The measurements obtained shall be fit using the method of least squares to the function as follows:

$$f(t) = A(\ln(Bt + 1)) + f_0$$

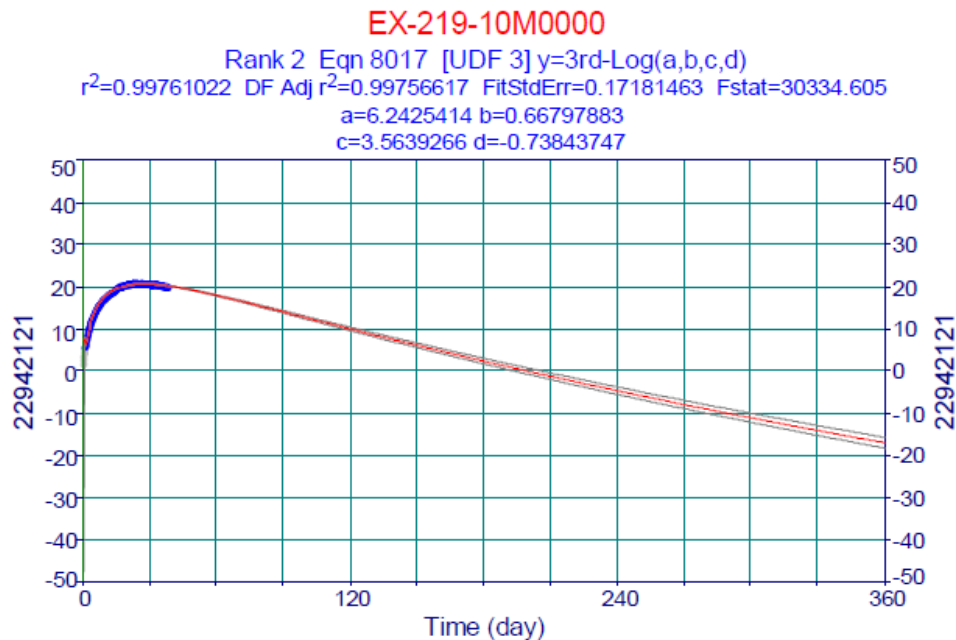
If the aging trend is not monotonic, the measurement period shall be extended to 40 days or longer after the extremum in the aging trend, and the measurements from 12 days after the extremum is reached to the end of the aging measurement period shall be fit to the above function. Thus, Group B Aging can extend beyond 60 days.

To maintain Group B Aging to 30 days, the EX-219 uses a third order log function as follows for non-monotonic aging trends.

$$f(t) = A + B\ln(t) + C\ln(t)^2 + D\ln(t)^3 + f_0$$

The following figure shows that 40 days of aging data fit well to the third order log function with R² greater than 99%. The fit function was then used to project for one-year aging.

Figure 8-9. Aging Projection



8.11. Micro-Frequency Jumps

Micro-frequency jumps, commonly known as micro-jumps, are transient or permanent single burst frequency variations. These events are almost always caused by the crystal resonator, and occur randomly and with unpredictable magnitudes. Within the same oscillator manufacturing lot, certain oscillators will exhibit a greater degree of micro-jumps than others. A paper given at the 1998 IEEE Frequency Control Symposium reported that the predominant factor affecting micro-jump performance is crystal resonator surface preparation. Although crystal resonator fabrication process control has significantly improved over time, surface imperfection related micro-jumps continue to plague our industry.

The typical oscillator specification does not address micro-jumps since they are relatively small and well within the overall stability of most oscillators. Their magnitudes range from a few parts per 10^{10} to a few parts per 10^9 which has been acceptable for most applications. However, as Phase Lock Loop (PLL) designs have advanced and integrated into loop filter constrained FPGA or ASIC platforms, micro-jumps may result in PLL dropout.

Screening micro-jumps is not a simple task, and can be very costly and time consuming for oscillator manufacturers who lack the proper equipment. A multi-channel Zero Dead-Time (ZDT) frequency measurement system is required with accuracy down to parts per 10^{12} or better while continuously monitoring the oscillator output to detect micro-jumps up to five days in duration. Additionally, RF isolation between channels is very critical for achieving such high levels of accuracy. Using the advantage of having many years of experience in the frequency control industry, Microchip has designed and built a production scale ZDT test system for micro-jump screening. To take advantage of 100% screening for micro-jumps, please include the request in your RFQ. Unless otherwise agreed to, the micro-jump limit will be tested to ± 0.2 ppb. Devices that exceed the limit will not be considered failures and will be shipped with the order. Microchip will provide serialized data on all tested units.

Figure 8-10. Typical Delta Frequency Without Micro-Jump

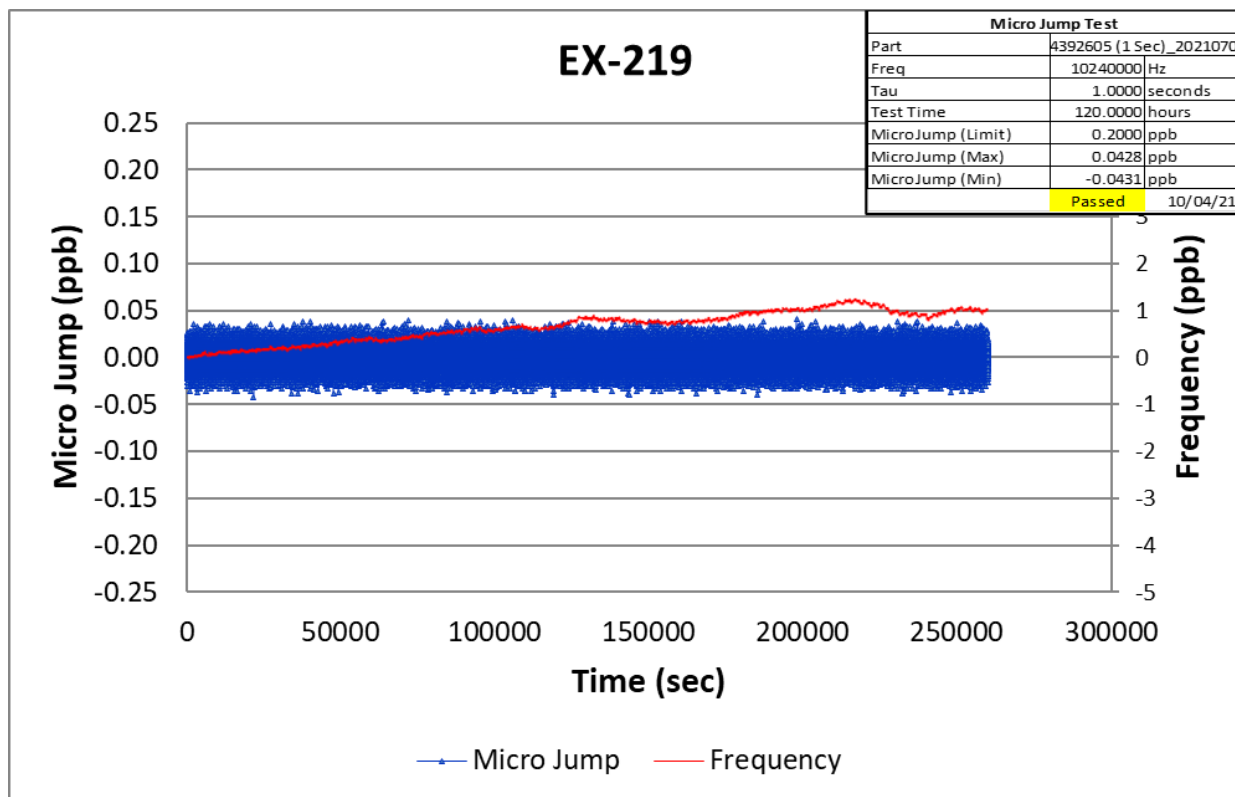


Figure 8-11. Delta Frequency with Micro-Jump

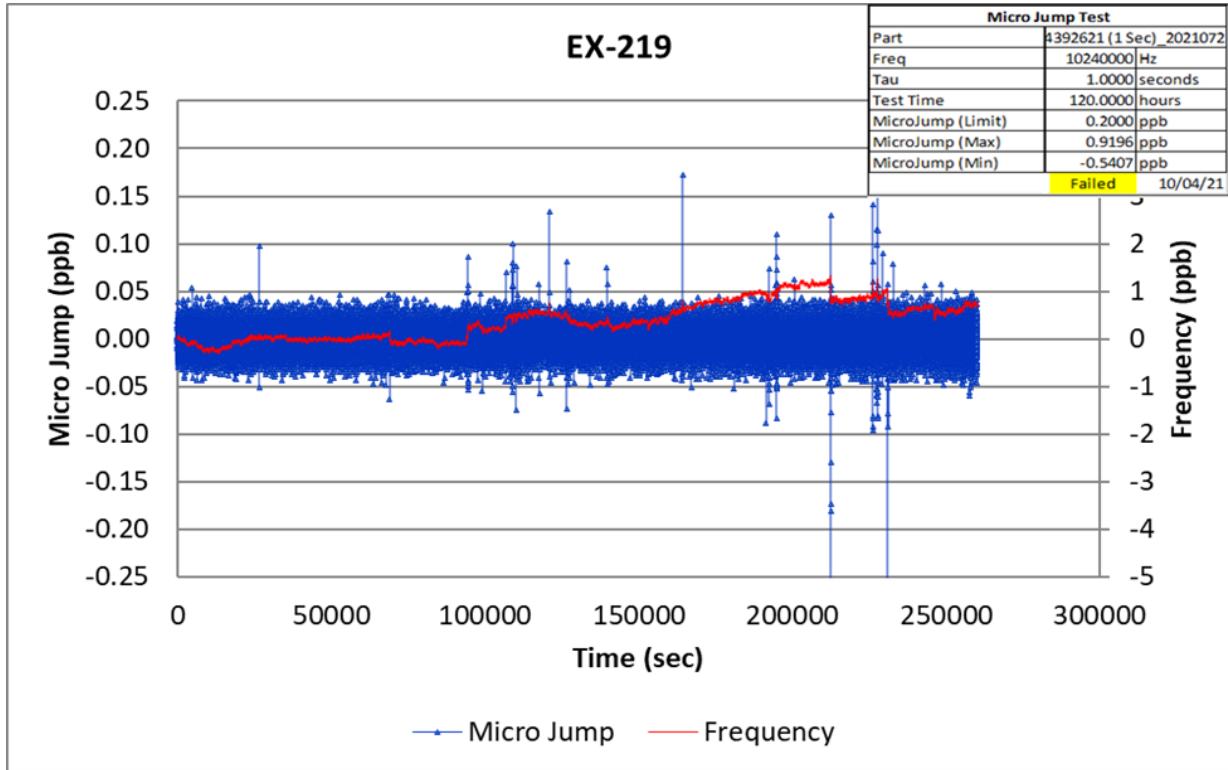
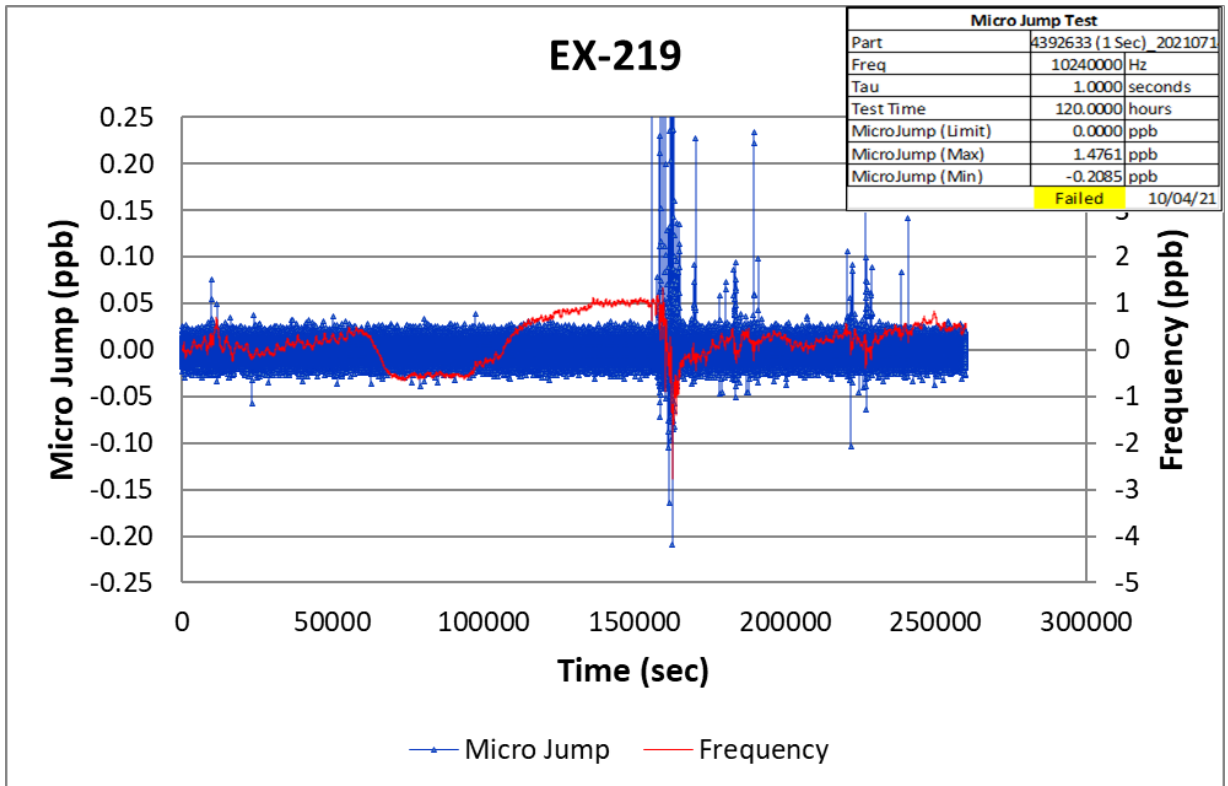


Figure 8-12. Delta Frequency with Burst Jumps



8.12. Leak Test

Most hermetically sealed packages are back filled with a gas or gasses mixed with some low percentage of detective gas such as He at around 1atm pressure and then are sealed using resistance weld or seam weld methods. Packages sealed in this manner have a typical leak rate of 1×10^{-10} to 1×10^{-9} atm cc/sec. Therefore, a leak detector having 1×10^{-8} atm cc/sec resolution and accuracy will be sufficient to perform the leak test.

On the other hand, the EMXO package is hermetically sealed using a cold-weld process and evacuated under hard vacuum during welding. The cold-weld package is typically used for crystals and achieves a leak rate better than 1×10^{-12} atm cc/sec He. The internal vacuum level at seal is better than 1×10^{-5} torr. To maintain performance over a mission life of 15 years, the EX-219 package leak rate should achieve 1×10^{-11} atm cc/sec He or better. To perform a leak test at this level presents a challenging task. A Krypton-85 leak detector can test leak rates down to this level but the bomb duration is very long and may not be practical for manufacturing.

Contrary to most electronic devices, the EMXO has a proportionally controlled oven whereby power consumption is inversely proportional to thermal resistance from the oven to the case. In this case, the EMXOs vacuum is utilized for thermal insulation. If the vacuum degrades as a result of a leak, the power consumption will be much higher. Hence, electrical parameters such as power consumption and frequency aging can determine package hermeticity. Please request the Vectron® EMXO white paper for additional detailed information on package hermeticity.

8.13. Internal Gas Analysis (IGA)

IGA is not applicable to the Space EMXO. After pre-seal vacuum baking, EMXO is hermetically sealed under hard vacuum. At time of seal, the vacuum level is at 1×10^{-6} torr or better. At this level of vacuum pressure, the moisture and any other gasses are insignificant relative to the limit specified in MIL-STD-883, TM 1018. Although IGA can probably be performed on the evacuated package, the result will be grossly obscured and inaccurate due to the hard vacuum.

8.14. Other Typical Parameters

Figure 8-13. Phase Noise (10 MHz)

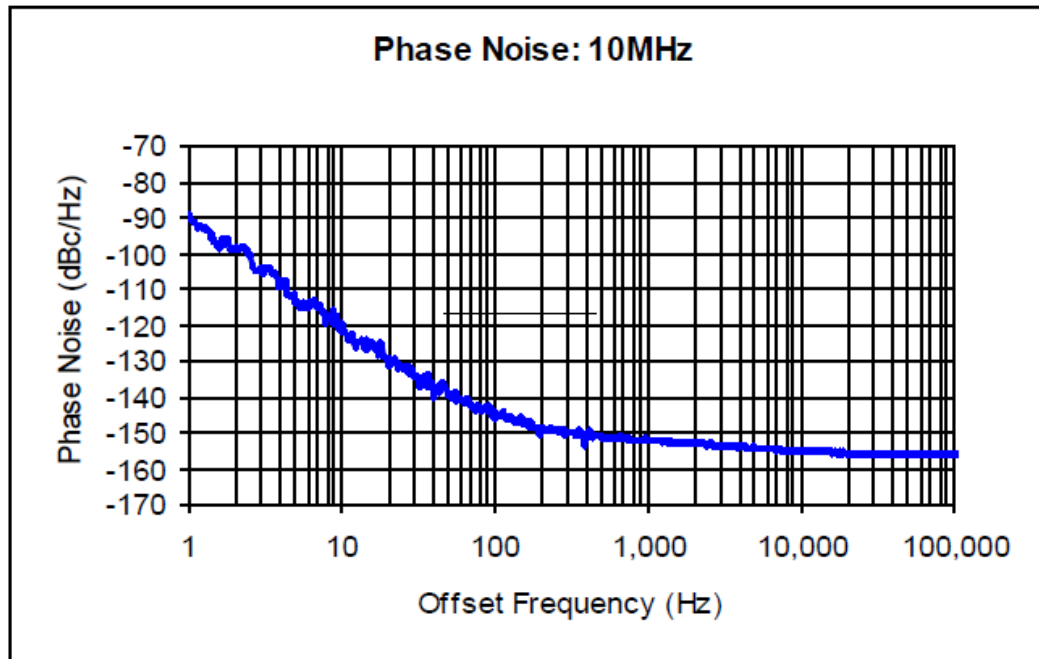
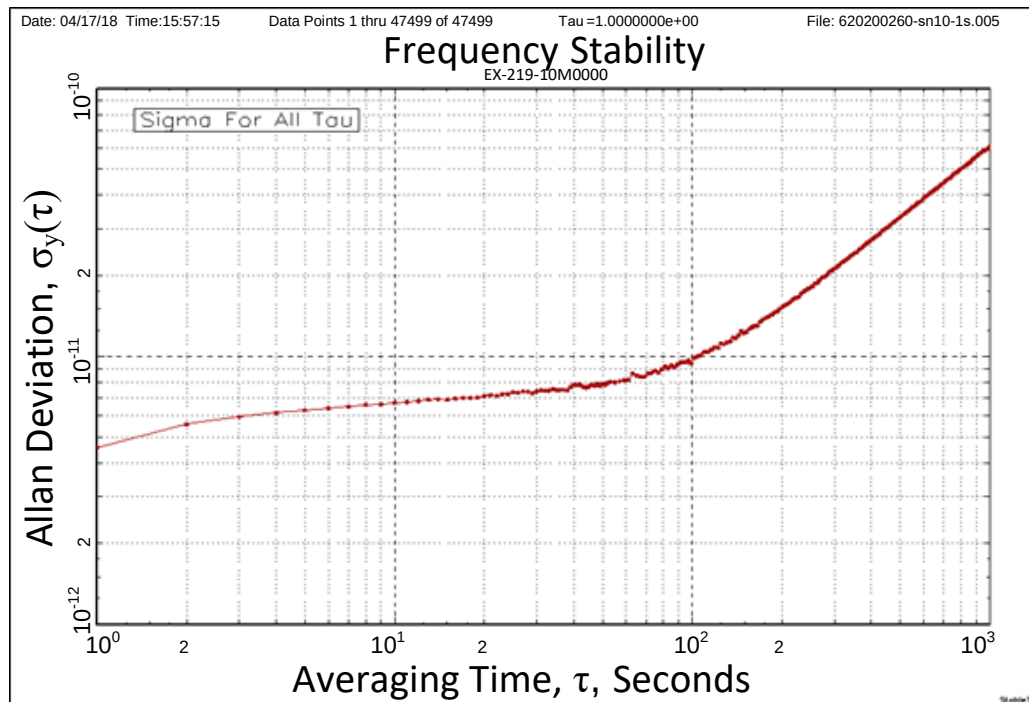


Figure 8-14. Allan Deviation (10 MHz)



9. Revision History

Revision	Date	Description
C	02/2026	The following changes were made: • In Table 1-10. Additional Parameters [>55 MHz to 130 MHz], the typical and maximum values have been changed to -135 and -130 for the 1 kHz condition. • In section 4. Quality Conformance Inspections (QCI), under Other Notes, point 6 now includes a link to Micro-Frequency Jumps and added note 9 with email address for technical support. • Added section Deliverable Data. • Added second note in Package Drawing.
B	09/2024	Updated Tuning Range description in Frequency Tuning (EFC) table.
A	08/2024	Converted to Microchip branding.

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