Application Manual

OCXOVT-SAR

Cospas-Sarsat OCXO with Sine Wave Output – up to 40 MHz

TABLE OF CONTENTS

OCXOVT-SAR

Cospas-Sarsat OCXO with Sine Wave Output – up to 40 MHz

1. OVERVIEW

- Oven Controlled Oscillator with built-in oven and AT-cut crystal (OCXO), operating in fundamental mode
- Frequency versus temperature: < ±3 ppb / 50 s at -40 to +55°C
- Frequency long term aging: < ±4.5 ppm including calibration and 10 years aging
- Frequency internally calibrated (pin 1 to GND): ≤ ±1 ppm
- Very fast start-up: typ.1 ms at 25°C
- Fast warm-up. Warm-up time within ±0.1 ppm at +25°C: ≤ 60 s
- Output signal sine wave (typ. load = 10 pF)
- High shock and vibration resistance
- Operating voltage: 5.0 V
- Power consumption:
  - ≤ 40 mA at +25°C
  - ≤ 70 mA at -20°C
- Operating temperature range: -40 to +55°C
- Low aging rate
- DIL-14 metal package (20.2 x 12.6 mm), RoHS-compliant

1.1. GENERAL DESCRIPTION

The OCXOVT-SAR combines an Oven Controlled Sine Wave Output oscillator circuitry together with an AT-cut quartz crystal in a hermetically sealed DIL-14 / 4 pins metal package. No external components are required.
The frequency output – up to 40 MHz on F_{OUT} pin is always enabled. The frequency is calibrated internally with an accuracy of ≤ ±1 ppm (pin 1 to GND).

1.2. APPLICATIONS

The OCXOVT-SAR oven controlled clock oscillator module combines outstanding performance and robustness in a standard metal package:

- OCXOVT-SAR oscillator module (embedded XTAL) in a standard 20.2 x 12.6 mm DIL-14 / 4 pins metal package
- High shock and vibration resistant

The robust construction and high performances make this product perfectly suitable for many high reliability applications:

- Cospas-Sarsat

1.3. ORDERING INFORMATION

Example: OCXO V T – SAR 10.150700 MHz D2 XXX

Code	Package Size
OCXO	20.2 x 12.6 mm

Code	Supply voltage
V	V_{DD} = 5.0 V

Code	Frequency stability
T	High stability

Code	Applications
SAR	Cospas-Sarsat *

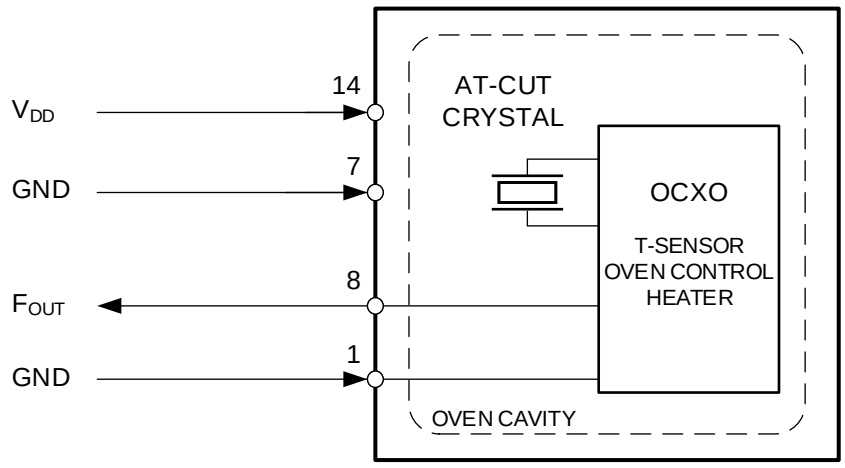
Code	Frequency
10.150700 MHz	10.150700 MHz

Code	Option 1
D2	SMD (formed leads)
Blank	THD (Standard)

Code	Customer specification N°
XXX	XXX

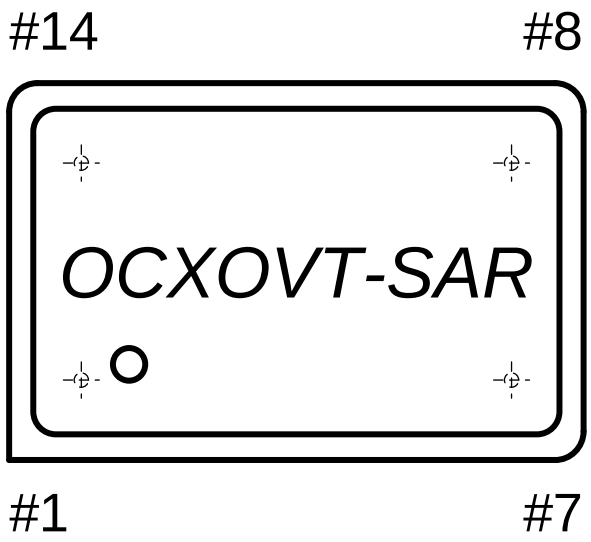
* (Sine Wave Output)
(-40 to +55°C)

2. BLOCK DIAGRAM



2.1. PINOUT

OCXOVT-SAR Package: (top view)



#1	GND
#7	GND
#8	F_{OUT}
#14	V_{DD}

2.2. PIN DESCRIPTION

Symbol	Pin #	Description
GND	1	Ground. No frequency control. Pin 1 has to be connected to GND.
GND	7	Ground.
F_{OUT}	8	Clock Output; always enabled. F_{OUT} pin drives the sine wave of the frequency. No frequency control. Pin 1 has to be connected to GND. The frequency is calibrated internally with an accuracy of ≤ ±1 ppm.
V_{DD}	14	Power Supply Voltage.

3. ELECTRICAL SPECIFICATIONS

3.1. ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings according to IEC 60134:

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
V_{DD}	Power supply voltage	Nominal V_{DD} = 5.0 V	-0.3	5.5	V
V_O	Output voltage		-0.3	V_{DD}	V
V_{ESD}	ESD voltage	HBM (1)		±2000	V
		MM (2)		±200	
T	Operating temperature range		-40	55	°C
T_{STO}	Storage temperature	Stored as bare product	-55	125	°C
T_{PEAK}	Maximum pins soldering temperature	10 seconds maximum		235	°C
		5 seconds maximum		260	

(1) HBM: Human Body Model, according to JESD22-A114.
(2) MM: Machine Model, according to JESD22-A115.

3.2. OPERATING PARAMETERS

For this Table, V_{DD} = nominal voltage; GND = 0 V; T_A = +25°C; unless otherwise indicated.

Operating Parameters:

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Supply						
V_{DD}	Power supply voltage (1)		4.8		5.2	V
I_{DD}	Input current. T_A = +25 °C, C_L = 10 pF				40	mA
	Input current. T_A = -20 °C, C_L = 10 pF				70	
	Input current at start-up. T_A = -40 °C, C_L = 10 pF	Duration = 10 seconds			350	
Pin 1 GND						
	No frequency control		Pin 1 has to be connected to GND			
Output F_{OUT} (Sine Wave)						
C_L	Output load capacitance		5	10	15	pF
V_{OS}	Output signal level		>1			V_{PP}

(1) A 3.3 µF buffer and a 47 nF decoupling capacitor have to be connected between V_{DD} and GND close to the device.

3.3. OSCILLATOR PARAMETERS

For this Table, V_{DD} = nominal voltage; GND = 0 V; T_A = +25°C; unless otherwise indicated.

Oscillator Parameters:

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
General						
F	Frequency range		5		40	MHz
t_{START}	Oscillator start-up time			1	5	ms
Frequency Characteristics						
ΔF/F	**Frequency versus temperature**	-40 to +55°C 15 minutes after turn-on and a change rate of 5°C/h			< ±3 ppb / 50 s	
ΔF/F	**Frequency long term aging**	Including calibration and 10 years aging			< ±4.5	ppm
ΔF/F	Frequency calibration accuracy (pin 1 to GND)	Internally calibrated			±1	ppm
ΔF/F	Frequency stability versus load change of ±10%				±10	ppb
t	Warm-up time within ±0.1 ppm at +25°C				60	s
ΔF/F	Stability versus V_{DD}				< ±0.1	ppm
σ	Short term stability (Allan deviation) at T = 0.1 to 30 s				< 0.5	ppb
	Typical short term stability (Allan deviation) at T = 1 s			0.05		
L	Phase noise	Typical at 10 MHz: Static conditions, BW = 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz		 -100 -130 -140 -145 -145		dBc/Hz

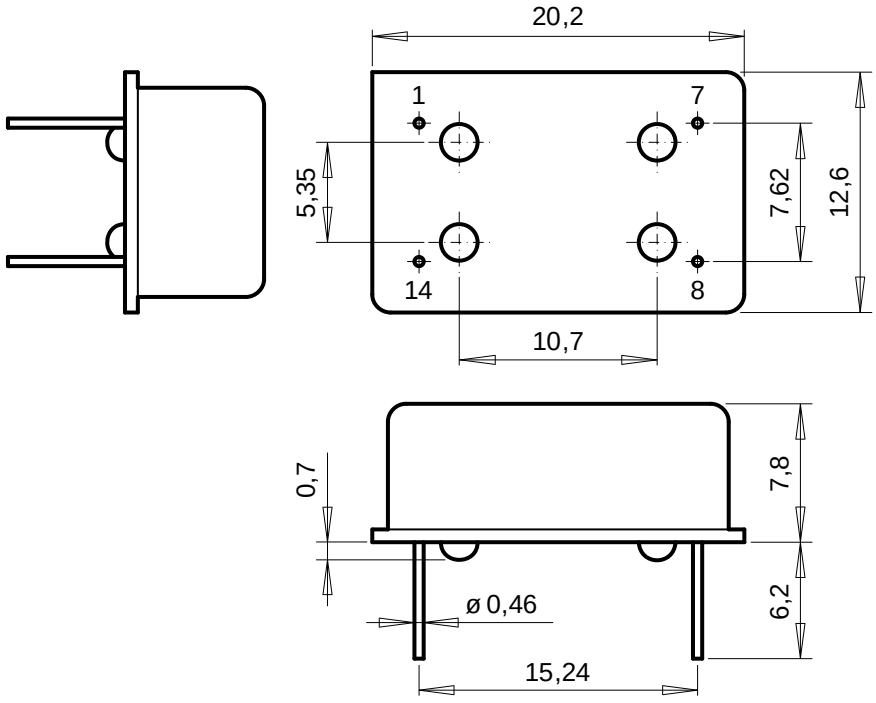
4. PACKAGE

4.1. DIMENSIONS

4.1.1.THD PACKAGE (STANDARD)

OCXOVT-SAR THD standard package (Option 1 = Blank):

Package dimensions (bottom view):



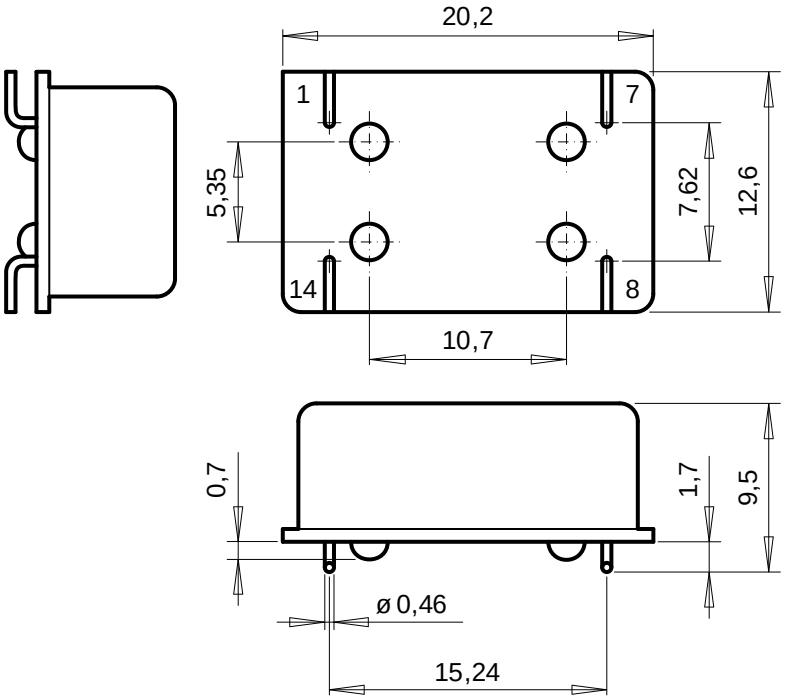
Case is connected to GND (pin 7)

Dimensions: in mm
Tolerances: unless otherwise specified ±0.1 mm
Drawing: OCXOVT-SAR_THD_Pack-drw_20211015

4.1.2.SMD PACKAGE

OCXOVT-SAR SMD formed leads package (Option 1 = D2):

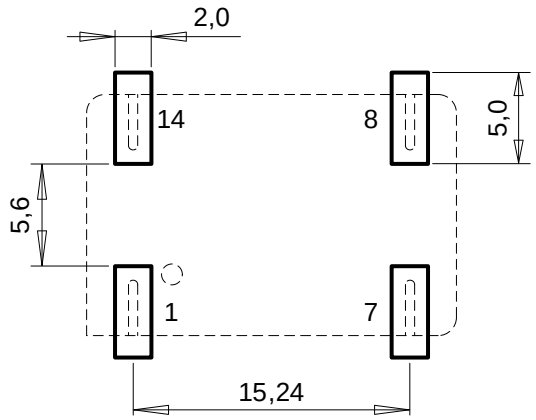
Package dimensions (bottom view):



Case is connected to GND (pin 7)

Dimensions: in mm
Tolerances: unless otherwise specified ±0.1 mm
Drawing: OCXOVT-SAR_SMD_Pack-drw_20211015

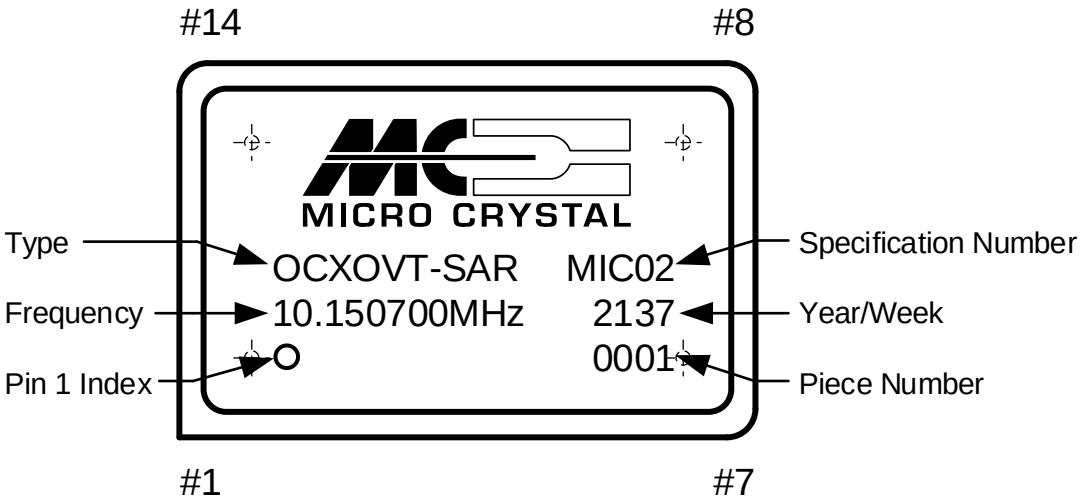
4.1.3.RECOMMENDED SOLDER PAD LAYOUT FOR SMD PACKAGE



Dimensions: in mm

4.2. MARKING AND PIN #1 INDEX

Laser marking OCXOVT-SAR Package: (top view)



5. MATERIAL COMPOSITION DECLARATION & ENVIRONMENTAL INFORMATION

5.1. HOMOGENOUS MATERIAL COMPOSITION DECLARATION

Homogenous material information according to IPC-1752 standard

Material Composition OCXOVT-SAR:

No.	Item Component Name	Sub Item Material Name	Material Weight (mg)	(%)	Substance Element	CAS Number	Comment
1	Resonator	Quartz Crystal	9	100%	SiO_2	14808-60-7	
2	Electrodes	Cr+Au	1	5%	Cr	Cr: 7440-47-3	
				95%	Au	Au: 7440-57-5	
3	Resonator Housing	Ceramic	125	90%	Al_2O_3	1344-28-1	
		Terminations		7%	W	W: 7440-33-7	Tungsten
				2%	Ni	Ni: 7440-02-0	Nickel plating
				1%	Au	Au: 7440-57-5	Gold plating
4	Resonator Lid	Kovar Lid	65	90%	Fe53Ni29Co18	Fe: 7439-89-6 Ni: 7440-02-0 Co: 7440-48-4	Metal Lid (Kovar)
		Ni-plating		9%	Ni	Ni: 7440-02-0	Nickel plating
		Au-plating		1%	Au	Au: 7440-57-5	Gold plating
5	Resonator Seal	Solder Preform	10	80%	Au80 / Sn20	Au: 7440-57-5	
				20%		Sn: 7440-31-5	
6	Resistors	Ceramic body	60	90%	Al_2O_3	1344-28-1	
		Terminations		1%	Cu	Cu: 7440-50-8	
				1%	Ni	Ni: 7440-02-0	
				8%	Sn	Sn: 7440-31-5	
7	Solder connections	Solder	50	100%	Sn97Ag2Cu1	Sn: 7440-31-5 Ag: 7440-22-4 Cu: 7440-50-8	
8	PCB	Substrate	780	80%	Fiberglass Epoxy		
		Plating		14%	Cu	Cu: 7440-50-8	
				3%	Ni	Ni: 7440-02-0	
				3%	Au	Au: 7440-57-5	
9	Custom IC	Silicon	120	90%	Si	Si: 7440-21-3	
		Die pad plating		1%	Al	Al: 7429-90-5	
		Bonding wires		9%	Au	Au: 7440-57-5	
10	Base	CRS1010 Steel	2350	94%	Fe	Fe: 7439-89-6	
		Kovar Pins		3%	Fe53Ni29Co18	Fe: 7439-89-6 Ni: 7440-02-0 Co: 7440-48-4	Metal Pins (Kovar)
		Glass		3%		65997-17-3	
11	Cap	SPCD Steel	1250	100%	Fe	Fe: 7439-89-6	
12	Capacitors	Ceramic body	120	90%	Al_2O_3	1344-28-1	
		Terminations		1%	Cu	Cu: 7440-50-8	
				1%	Ni	Ni: 7440-02-0	
				8%	Sn	Sn: 7440-31-5	
13	Conductive adhesive	Silver filled Epoxy	60	70%	Ag	Ag: 7440-22-4	
				30%	EP	129915-35-1	
		Unit weight typ. ±20%	5000				

5.2. RECYCLING MATERIAL INFORMATION

Recycling material information according to IPC-1752 standard.
Element weight is accumulated and referenced to the unit weight of 5000 mg.

Item Material Name	No.	Item Component Name	Material Weight (mg)	Material Weight (%)	Substance Element	CAS Number	Comment
Quartz Crystal	1	Resonator	9.0	0.18	SiO_2	14808-60-7	
Chromium	2	Electrodes	0.05	0.001	Cr	Cr: 7440-47-3	
Ceramic	3a 6a 12a	Resonator Housing Resistors Capacitors	274.5	5.49	Al_2O_3	1344-28-1	
Gold	2 3d 4c 5 8d 9c	Electrodes Resonator Housing Resonator Lid Resonator Seal PCB Custom IC	45.0	0.90	Au	Au: 7440-57-5	
Tin	5 6d 12d	Resonator Seal Resistors Capacitors	16.4	0.33	Sn	Sn: 7440-31-5	
Nickel	3c 4b 6c 8c 12c	Resonator Housing Resonator Lid Resistors PCB Capacitors	33.6	0.67	Ni	Ni: 7440-02-0	
Tungsten	3b	Resonator Housing	8.75	0.175	W	W: 7440-33-7	
Kovar	4a 10b	Resonator Lid Base	129.0	2.58	Fe53Ni29Co18	Fe: 7439-89-6 Ni: 7440-02-0 Co: 7440-48-4	
Iron	10a 11	Base Cap	3459.0	69.18	Fe	Fe: 7439-89-6	
Glass	10c	Base	70.5	1.41		65997-17-3	
Copper	6b 8b 12b	Resistors PCB Capacitors	111.0	2.22	Cu	Cu: 7440-50-8	
Silicon	9a	Custom IC	108.0	2.16	Si	Si: 7440-21-3	
Aluminum	9b	Custom IC	1.2	0.024	Al	Al: 7429-90-5	
Silver	13	Conductive adhesive	42.0	0.84	Ag	Ag: 7440-22-4	
Epoxy	13	Conductive adhesive	18.0	0.36	EP	129915-35-1	
Substrate	8a	PCB	624.0	12.48	Fiberglass Epoxy		
Solder	7	Solder connections	50.0	1.0	Sn97Ag2Cu1	Sn: 7440-31-5 Ag: 7440-22-4 Cu: 7440-50-8	
	Unit weight (total) typ. ±20%		5000	100			

5.3. ENVIRONMENTAL PROPERTIES & ABSOLUTE MAXIMUM RATINGS

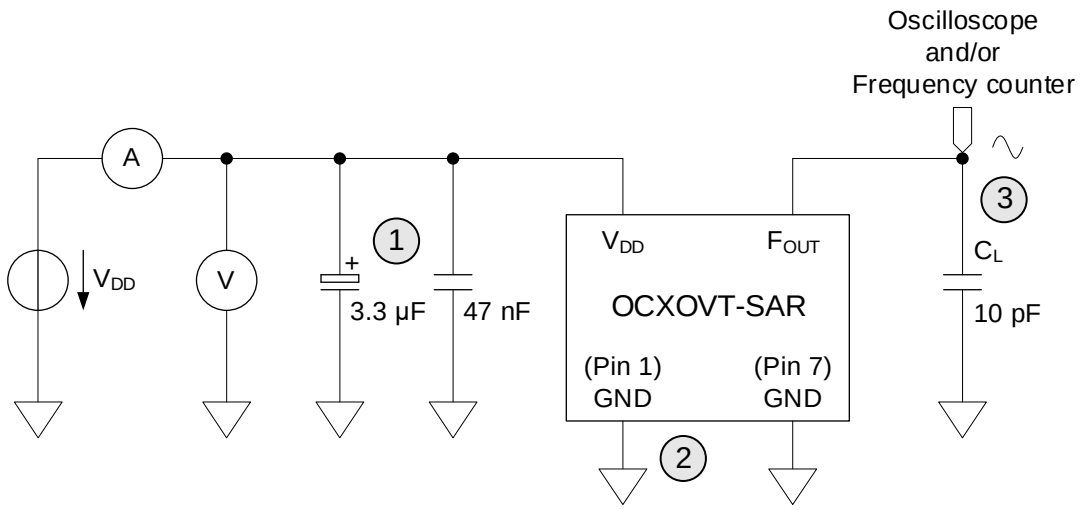
Package	Description
DIL-14 / 4 pins metal package	Dual In-Line (DIL), hermetically sealed metal package.

Parameter	Directive	Conditions	Value
Product weight (total)			5000 mg
Storage temperature		Store as bare product	-55 to +125°C
Moisture sensitivity level (MSL)	IPC/JEDEC J-STD-020D		MSL1

6. APPLICATION INFORMATION

6.1. TEST CIRCUIT

Test circuit sine wave:



1. A 3.3 µF buffer and a 47 nF decoupling capacitor have to be connected between V_{DD} and GND close to the device.
2. No frequency control. Pin 1 has to be connected to GND.
3. Clock output on F_{OUT} pin is always enabled. C_L includes probe and fixture capacitance.

6.2. SOLDERING INFORMATION

Hand solder only – not reflow compatible. See ABSOLUTE MAXIMUM RATINGS.

6.3. HANDLING PRECAUTIONS FOR MODULES WITH EMBEDDED CRYSTALS

The built-in AT-cut crystal consists of pure Silicon Dioxide in crystalline form. The cavity in the built-in crystal package is evacuated and hermetically sealed in order for the crystal blank to function undisturbed from air molecules, humidity and other influences.

Shock and vibration:

Keep the crystal / module from being exposed to **excessive mechanical shock and vibration**. Micro Crystal guarantees that the crystal / module will bear a mechanical shock of 500 g / 4 ms / 6 directions, or 100 g / 23 ms / 6 directions.

The following special situations may generate either shock or vibration:

Multiple PCB panels - Usually at the end of the pick & place process the single PCBs are cut out with a router. These machines sometimes generate vibrations on the PCB that have a fundamental or harmonic frequency close to the resonance frequency of the crystal unit. This might cause breakage of crystal blanks due to resonance. Router speed should be adjusted to avoid resonant vibration.

Ultrasonic cleaning - Avoid cleaning processes using ultrasonic energy. These processes can damage the crystals due to the mechanical resonance frequencies of the crystal blank.

Overheating, rework high temperature exposure:

Avoid overheating the package. The built-in crystal package is sealed with a seal ring consisting of 80% Gold and 20% Tin. The eutectic melting temperature of this alloy is at 280°C. Heating the seal ring up to >280°C will cause melting of the metal seal which then, due to the vacuum, is sucked into the cavity forming an air duct. This happens when using hot-air-gun set at temperatures >280°C.

7. COMPLIANCE INFORMATION

Micro Crystal confirms that the standard product Oven Controlled Oscillator OCXOVT-SAR is compliant with "EU RoHS Directive" and "EU REACh Directives".
Please find the actual Certificate of Conformance for Environmental Regulations on our website:
CoC_Environment_OCXO-Series.pdf

8. DOCUMENT REVISION HISTORY

Date	Revision #	Revision Details
November 2012	9.0	Initial version
February 2022	10.0	New extended version

MICRO CRYSTAL SWITZERLAND
A COMPANY OF THE SWATCH GROUP

Micro Crystal AG
Muehlestrasse 14
CH-2540 Grenchen
Switzerland

Phone +41 32 655 82 82
sales@microcrystal.com
www.microcrystal.com