

Application Manual

VCXO2H

VCXO Clock Oscillator 5 MHz – 170 MHz

TABLE OF CONTENTS

1. OVERVIEW	3
1.1. GENERAL DESCRIPTION	3
1.2. APPLICATIONS	3
1.3. ORDERING INFORMATION	4
2. BLOCK DIAGRAM	5
2.1. PINOUT	5
2.2. PIN DESCRIPTION	5
3. ELECTRICAL SPECIFICATIONS	6
3.1. ABSOLUTE MAXIMUM RATINGS	6
3.2. OPERATING PARAMETERS	7
3.3. TYPICAL CHARACTERISTICS	7
3.4. OSCILLATOR PARAMETERS	8
3.4.1. FREQUENCY VS. TEMPERATURE CHARACTERISTICS	8
4. PACKAGE	9
4.1. DIMENSIONS AND SOLDER PAD LAYOUT	9
4.2. MARKING AND PIN #1 INDEX	10
5. MATERIAL COMPOSITION DECLARATION & ENVIRONMENTAL INFORMATION	11
5.1. HOMOGENOUS MATERIAL COMPOSITION DECLARATION	11
5.2. RECYCLING MATERIAL INFORMATION	12
5.3. ENVIRONMENTAL PROPERTIES & ABSOLUTE MAXIMUM RATINGS	13
6. APPLICATION INFORMATION	14
6.1. TEST CIRCUIT	14
6.2. OUTPUT WAVEFORM	15
6.3. SOLDERING INFORMATION	16
6.4. HANDLING PRECAUTIONS FOR MODULES WITH EMBEDDED CRYSTALS	17
7. COMPLIANCE INFORMATION	18
8. DOCUMENT REVISION HISTORY	18

VCXO2H

VCXO Clock Oscillator 5 MHz – 170 MHz

1. OVERVIEW

- Voltage Controlled Oscillator with built-in AT-cut crystal (VCXO), operating in fundamental mode
- Minimum Absolute Pull Range APR for temperature range:
 - ± 130 ppm for B = -40 to +85°C
 - ± 110 ppm for C = -55 to +125°C
- Very fast start-up: typ.1 ms at 25°C
- Output signal HCMOS compatible
- High shock and vibration resistance
- Operating voltage: 3.3 V
- Power consumption:
 - < 10 mA, F \leq 40 MHz
 - < 20 mA, F \leq 100 MHz
 - < 25 mA, F \leq 130 MHz
- Operating temperature range:
 - B = -40 to +85°C
 - C = -55 to +125°C
 - X = Custom
- Low aging rate
- Ceramic SMD package (5.0 x 3.2 mm), RoHS-compliant and 100% lead-free

1.1. GENERAL DESCRIPTION

The VCXO2H combines a Voltage Controlled High Frequency HCMOS oscillator circuitry together with an AT-cut quartz crystal in a hermetically sealed ceramic package with ceramic lid. No external components are required. The frequency output 5 MHz – 170 MHz on F_{OUT} pin is always enabled. The frequency can be adjusted by varying the control voltage applied to the Control Voltage Input pin V_c.

1.2. APPLICATIONS

The VCXO2H voltage controlled clock oscillator module combines outstanding performance and robustness in a standard ceramic package:

- VCXO oscillator module (embedded XTAL) in a standard 5.0 x 3.2 mm lead-free ceramic package
- High shock and vibration resistant

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

- Avionics / Aerospace: Airborne Equipment / Engine Control / Actuator Controller / Temperature Controller / Instrumentation / Navigation and Guidance Systems
- Instrumentation: Field Test Instrument / Automotive Test Equipment
- Communication: Optical Network / Wireless Communication System
- Security / Safety: Survival and Protection System / Railway Security System / Fire Fighter Equipment
- Industrial: Telemetry / A/C Controller / Hydraulic Sensor

1.3. ORDERING INFORMATION

Example: VCXO2H V – C 100.000 MHz T3 XXX

Code	Package Size
VCXO2H	5.0 x 3.2 mm

Code	Supply voltage
V	$V_{DD} = 3.3 \text{ V}$

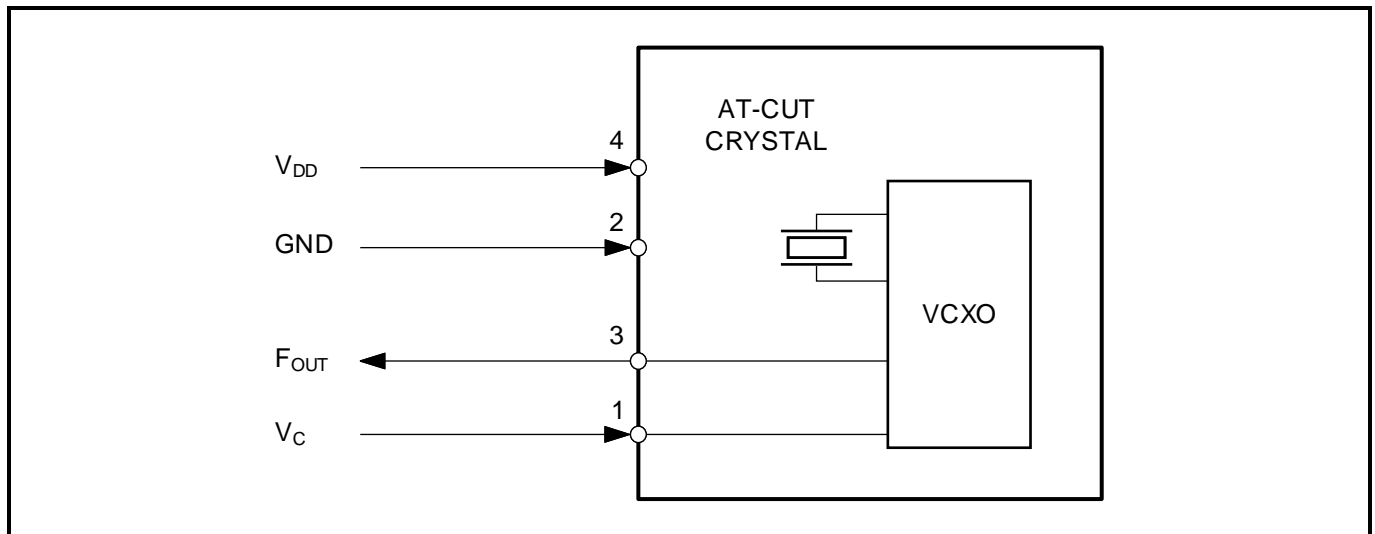
Code	Temperature range
B	-40 to +85°C
C	-55 to +125°C
X	Custom

Code	Frequency
100.000 MHz	100.000 MHz

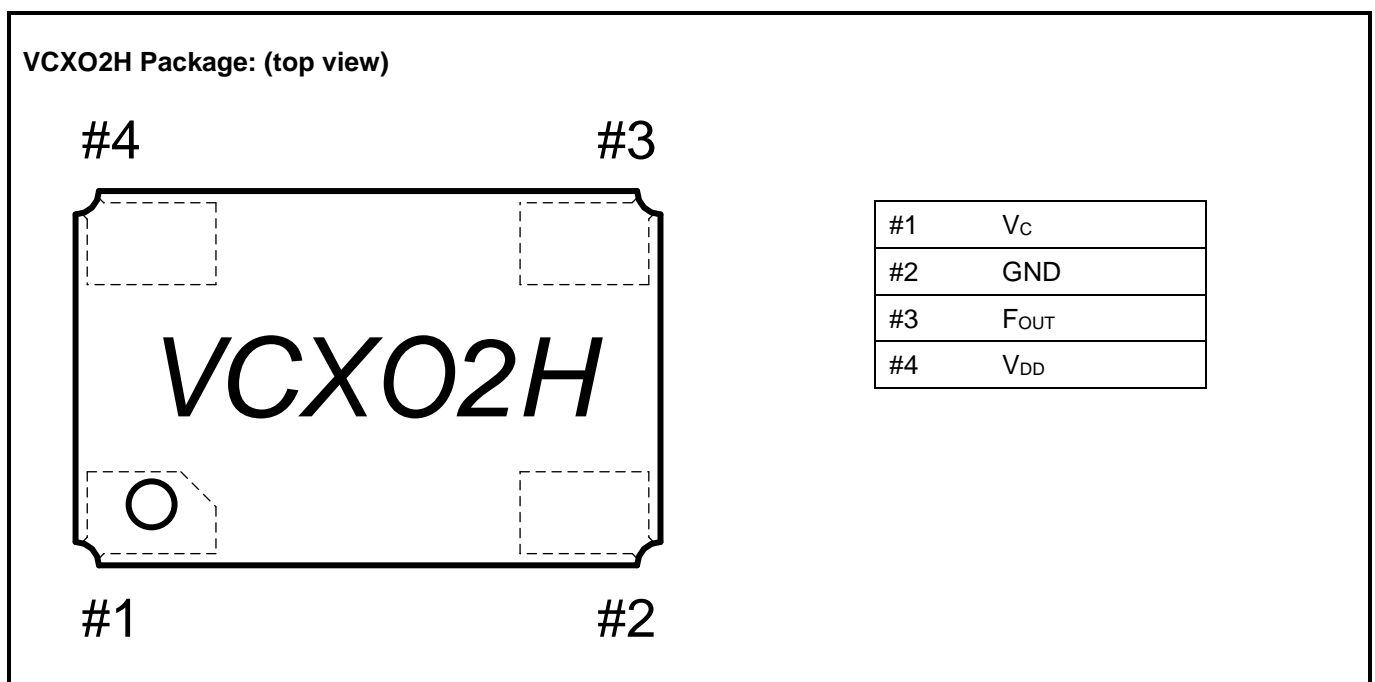
Code	Option 2
T3	SnAgCu solder dipped pads
Blank	Au flashed pads

Code	Customer specification N°
XXX	XXX

2. BLOCK DIAGRAM



2.1. PINOUT



2.2. PIN DESCRIPTION

Symbol	Pin #	Description
V_C	1	Control Voltage Input. The frequency on F_{OUT} pin can be adjusted by varying the voltage applied to V_C . The slope polarity is positive (increasing voltage increases output frequency).
GND	2	Ground.
F_{OUT}	3	Clock Output; always enabled. F_{OUT} pin drives the square wave of the frequency. The frequency can be adjusted by varying the control voltage applied to the V_C pin.
V_{DD}	4	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} = 3.3 V	-0.3	3.8	V
V _I	Input voltage		-0.3	V _{DD}	V
V _O	Output voltage		-0.3	V _{DD}	V
V _{ESD}	ESD voltage	HBM (1)		±2000	V
		MM (2)		±200	
T _B	Operating temperature range B		-40	85	°C
T _C	Operating temperature range C		-55	125	°C
T _{STO}	Storage temperature	Stored as bare product	-65	125	°C
T _{PEAK}	Maximum reflow condition	JEDEC J-STD-020C		265	°C

(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; $GND = 0\text{ V}$; $T_A = 25\text{ }^\circ\text{C}$; unless otherwise indicated.

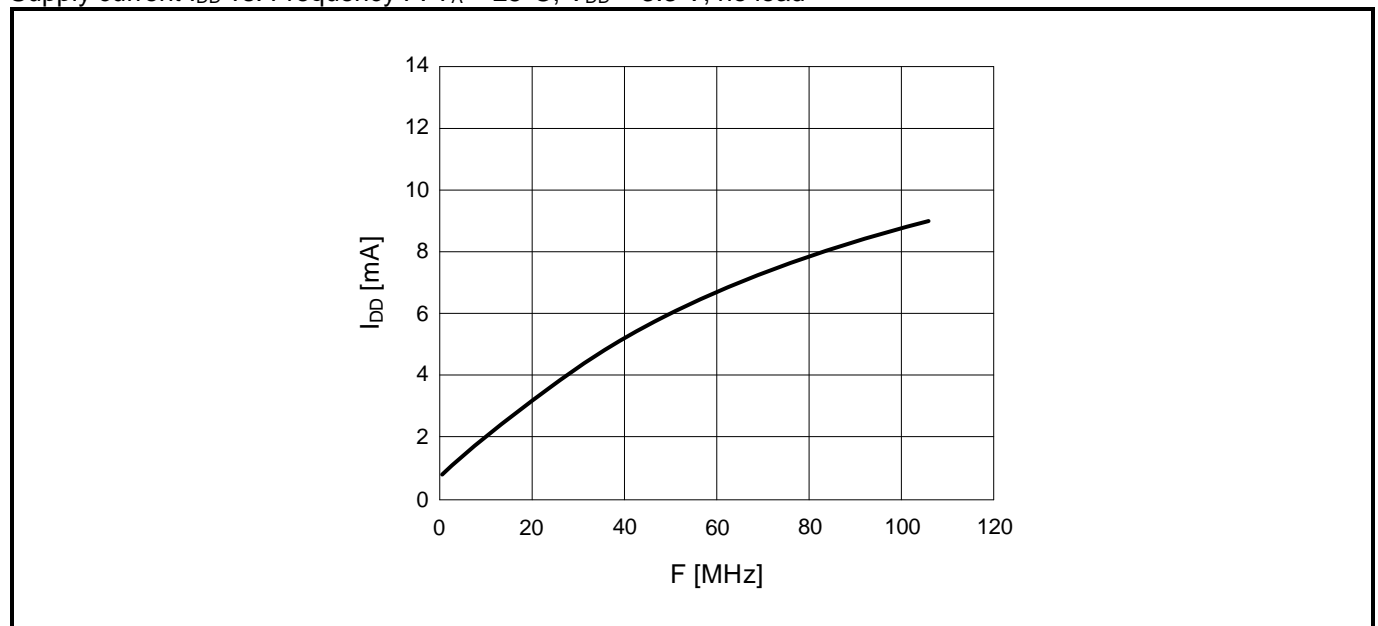
Operating Parameters:

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Supply						
V_{DD}	Power supply voltage ⁽¹⁾	Nominal $V_{DD} = 3.3\text{ V}$	3.135		3.465	V
I_{DD}	Input current. $V_{DD} = 3.3\text{ V}$ F_{OUT} enabled, no load	$5\text{ MHz} \leq F \leq 40\text{ MHz}$			10	mA
		$40\text{ MHz} < F \leq 100\text{ MHz}$			20	
		$100\text{ MHz} < F \leq 130\text{ MHz}$			25	
Input V_C						
V_C	Control voltage range		0		3.3	V
	Slope polarity		positive			
V_{CBW}	Control voltage bandwidth	@ -3 dB	10			kHz
Z_{VC}	V_C input impedance		100			k Ω
Output F_{OUT} (HCMOS compatible)						
V_{OH}	HIGH level output voltage		$V_{DD} - 0.5$			V
V_{OL}	LOW level output voltage				0.4	V
C_L	Output load capacitance	HCMOS	3	15	47	pF
t_r / t_f	Rise & fall time	$C_L = 15\text{ pF}$, 20% to 80% V_{DD}			2	ns

(1) A 47 nF decoupling capacitor has to be connected between V_{DD} and GND.

3.3. TYPICAL CHARACTERISTICS

Supply current I_{DD} vs. Frequency F : $T_A = 25\text{ }^\circ\text{C}$, $V_{DD} = 3.3\text{ V}$, no load



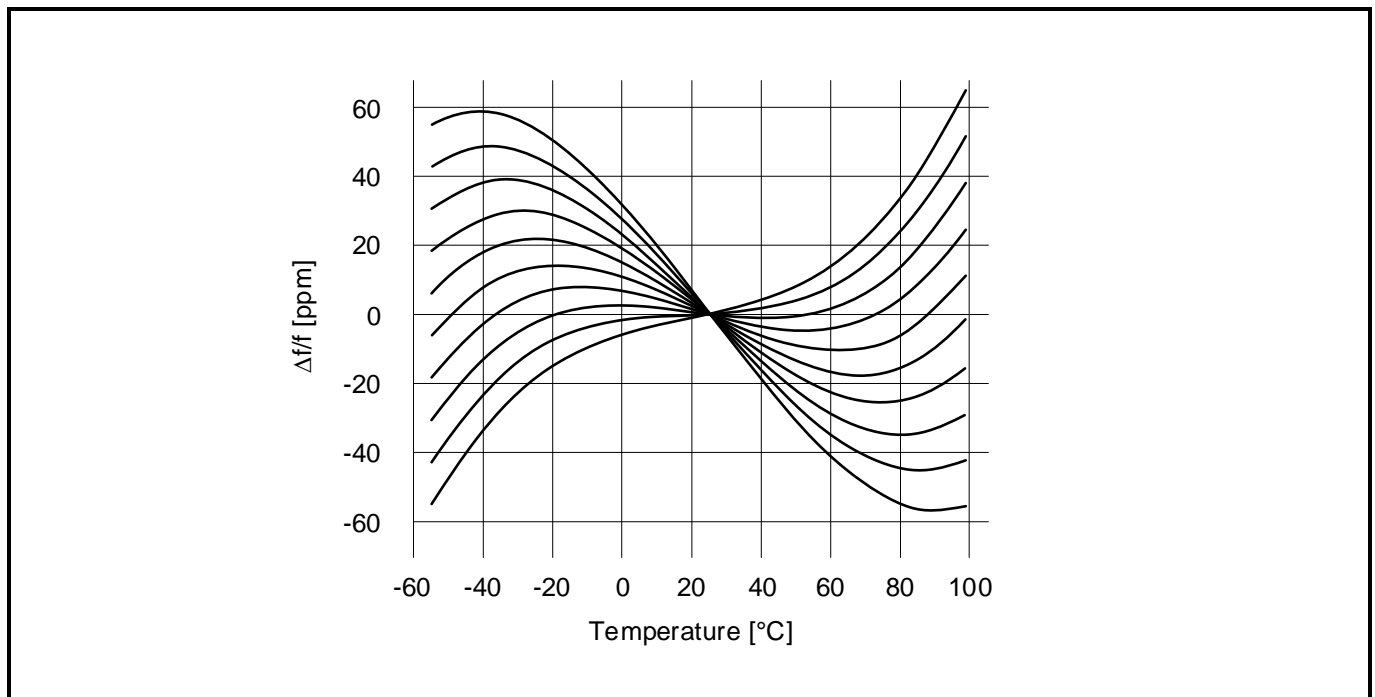
3.4. OSCILLATOR PARAMETERS

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

Oscillator Parameters:

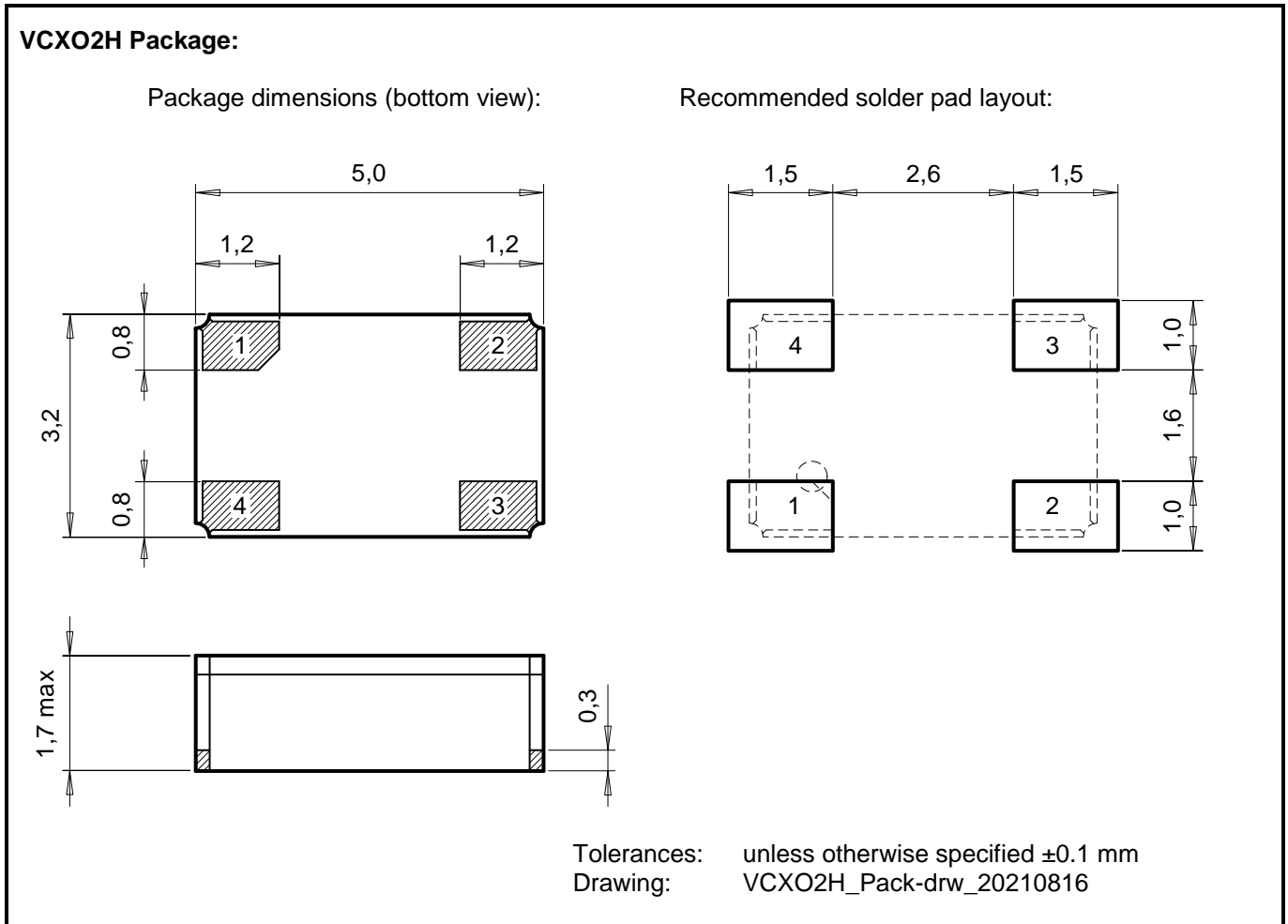
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
General						
F	Frequency range		5		170	MHz
t_{START}	Oscillator start-up time			1	5	ms
δ_{FOUT}	F_{OUT} duty cycle @ $V_{DD}/2$		40		60	%
Frequency Performance						
$\Delta F/F$	Minimum Absolute Pull Range APR (see ORDERING INFORMATION)	Including adjustment at +25°C, long term aging 1 year, V_{DD} variations $\pm 5\%$, C_L variations min. to max. and frequency stability over temperature range. For temperature range B = -40 to +85°C C = -55 to +125°C	± 130 ± 110			ppm

3.4.1. FREQUENCY VS. TEMPERATURE CHARACTERISTICS



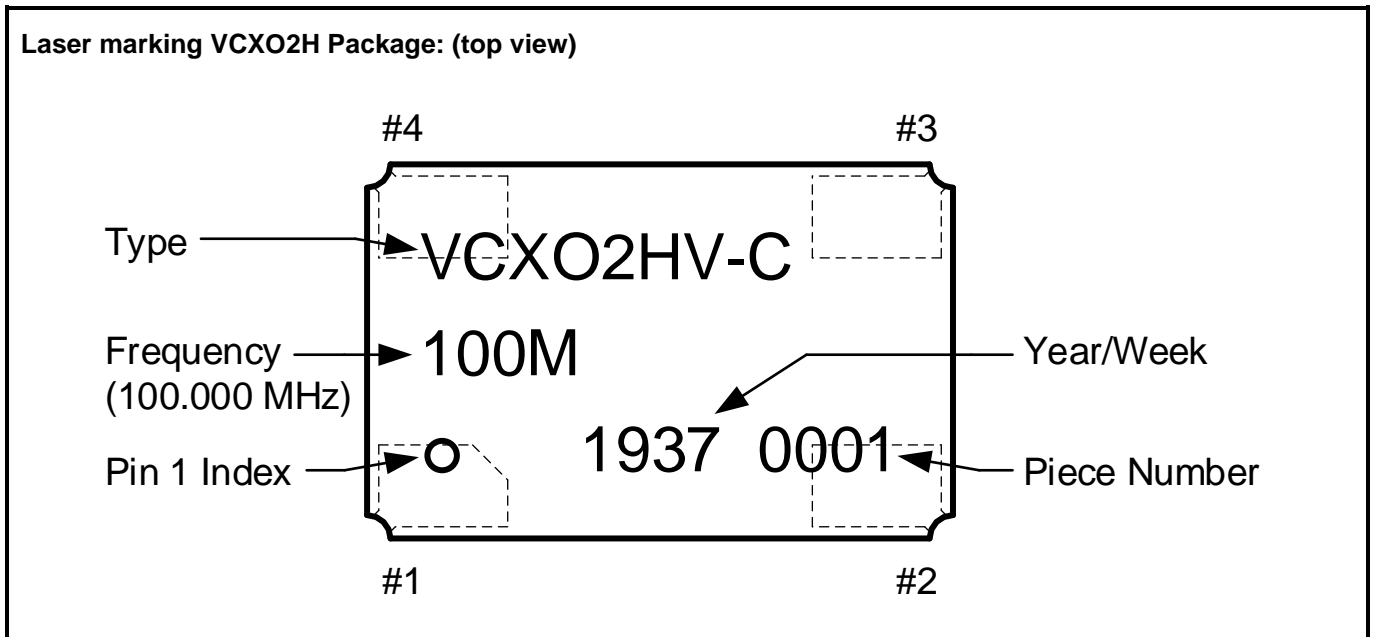
4. PACKAGE

4.1. DIMENSIONS AND SOLDER PAD LAYOUT



All dimensions in mm typical.

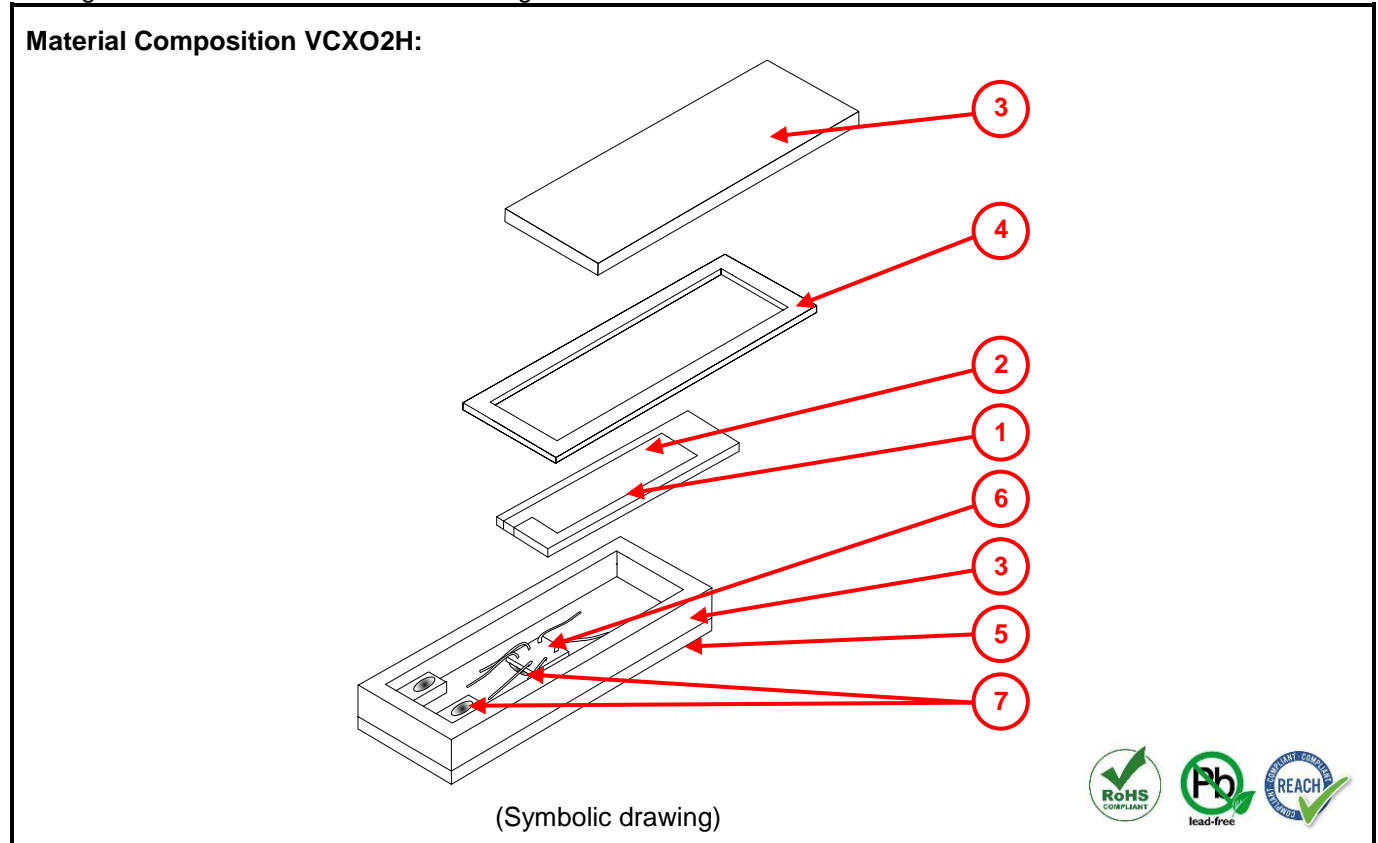
4.2. MARKING AND PIN #1 INDEX



5. MATERIAL COMPOSITION DECLARATION & ENVIRONMENTAL INFORMATION

5.1. HOMOGENOUS MATERIAL COMPOSITION DECLARATION

Homogenous material information according to IPC-1752 standard



No.	Item Component Name	Sub Item Material Name	Material Weight		Substance Element	CAS Number	Comment
			(mg)	(%)			
1	Resonator	Quartz Crystal	3.7	100%	SiO ₂	14808-60-7	
2	Electrodes	Cr+Au	0.2	5%	Cr	Cr: 7440-47-3	
				95%	Au	Au: 7440-57-5	
3	Housing	Ceramic	63.1	100%	Al ₂ O ₃	1344-28-1	
4	Seal	Solder Preform	3.6	80%	Au80 / Sn20	Au: 7440-57-5	
				20%		Sn: 7440-31-5	
5	Terminations	Internal and external terminals	5.1	80%	W	W: 7440-33-7	Tungsten
				15%	Ni	Ni: 7440-02-0	Nickel plating
				5%	Au 0.3 micron	Au: 7440-57-5	Gold plating
6	HCMOS IC	Silicon	1.0	95%	Si	Si: 7440-21-3	
		Die pad plating		1%	Al	Al: 7429-90-5	
		Bonding wires		4%	Al	Al: 7429-90-5	
7	Conductive adhesive	Silver filled Epoxy	1.3	70%	Ag	Ag: 7440-22-4	
				30%	EP	129915-35-1	
		Unit weight typ. ±10%	78				

5.2. RECYCLING MATERIAL INFORMATION

Recycling material information according to IPC-1752 standard.

Element weight is accumulated and referenced to the unit weight of 78 mg.

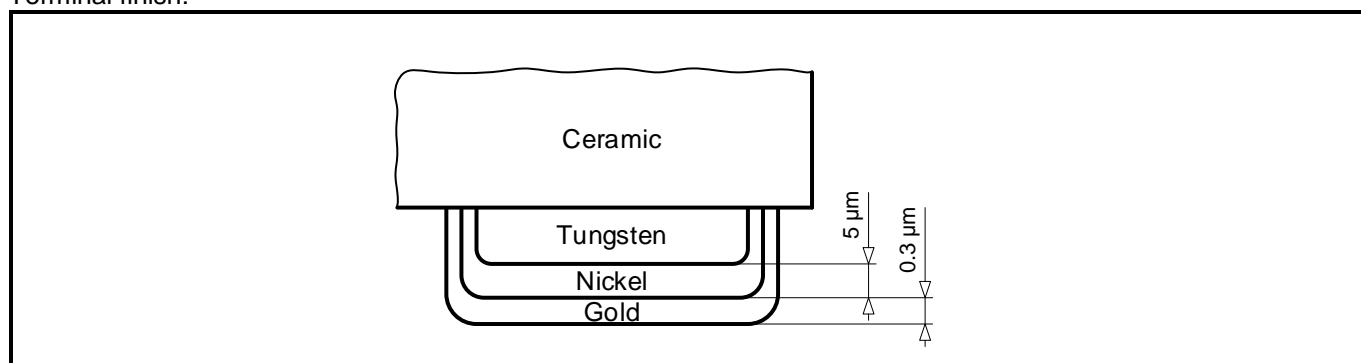
Item Material Name	No.	Item Component Name	Material Weight		Substance Element	CAS Number	Comment
			(mg)	(%)			
Quartz Crystal	1	Resonator	3.7	4.74	SiO ₂	14808-60-7	
Chromium	2	Electrodes	0.01	0.013	Cr	Cr: 7440-47-3	
Ceramic	3	Housing	63.1	80.9	Al ₂ O ₃	1344-28-1	
Gold	2	Electrodes	3.32	4.26	Au	Au: 7440-57-5	
	4	Seal					
	5	Terminations					
Tin	4	Seal	0.72	0.92	Sn	Sn: 7440-31-5	
Nickel	5	Terminations	0.77	0.98	Ni	Ni: 7440-02-0	
Tungsten	5	Terminations	4.08	5.23	W	W: 7440-33-7	
Silicon	6a	HCMOS IC	0.95	1.22	Si	Si: 7440-21-3	
Aluminum	6b	HCMOS IC	0.05	0.06	Al	Al: 7429-90-5	
	6c	HCMOS IC					
Silver	7a	Conductive adhesive	0.91	1.17	Ag	Ag: 7440-22-4	
Epoxy	7b	Conductive adhesive	0.39	0.50	EP	129915-35-1	
Unit weight (total) typ. ±10%			78	100			

5.3. ENVIRONMENTAL PROPERTIES & ABSOLUTE MAXIMUM RATINGS

Package	Description
DFN-4 ceramic package	Dual Flat No Leads (DFN), hermetically sealed ceramic package with ceramic lid.

Parameter	Directive	Conditions	Value
Product weight (total)			78 mg
Storage temperature		Store as bare product	-65 to +125°C
Moisture sensitivity level (MSL)	IPC/JEDEC J-STD-020D		MSL1
MTTF			> 100 years

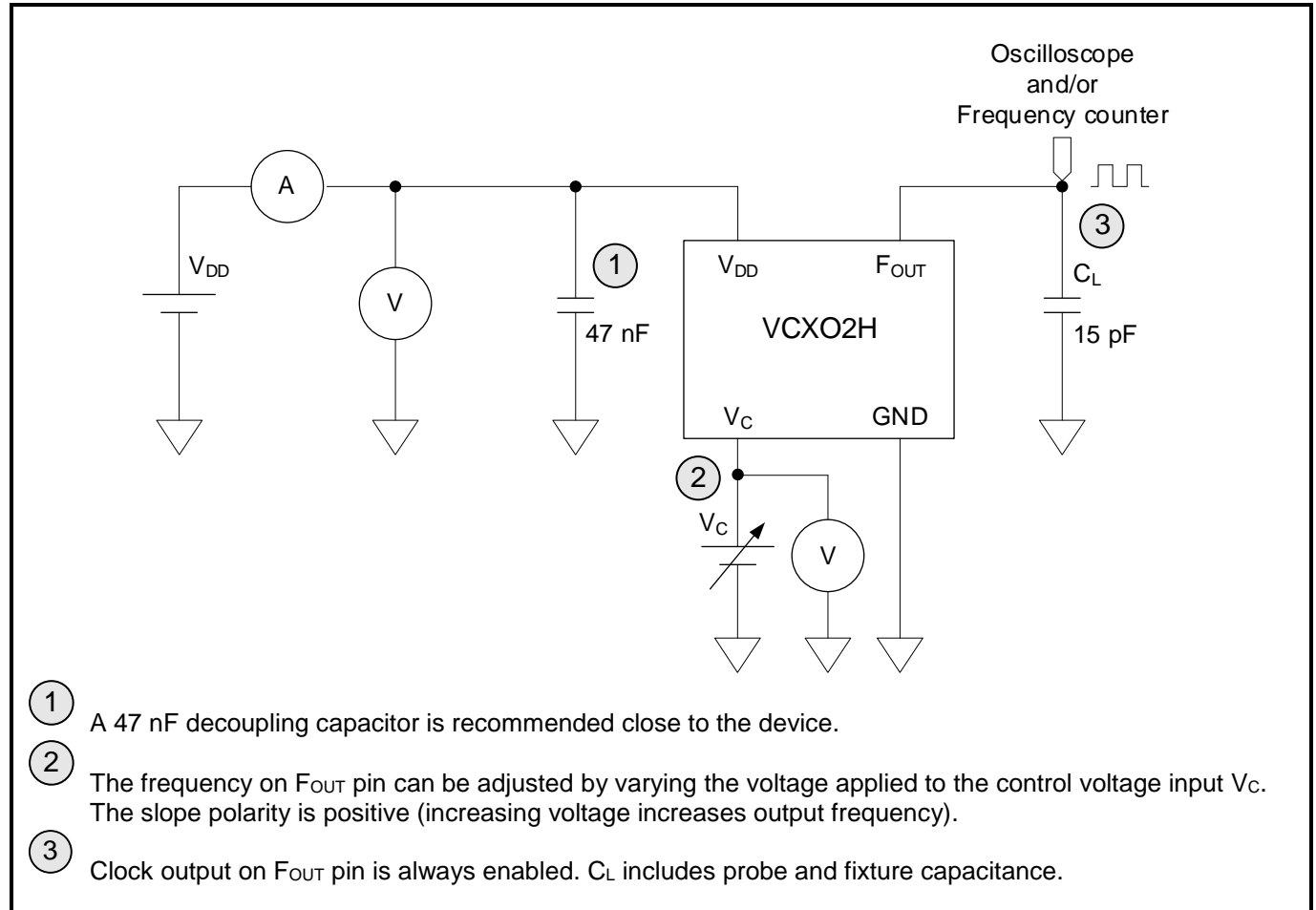
Terminal finish:



6. APPLICATION INFORMATION

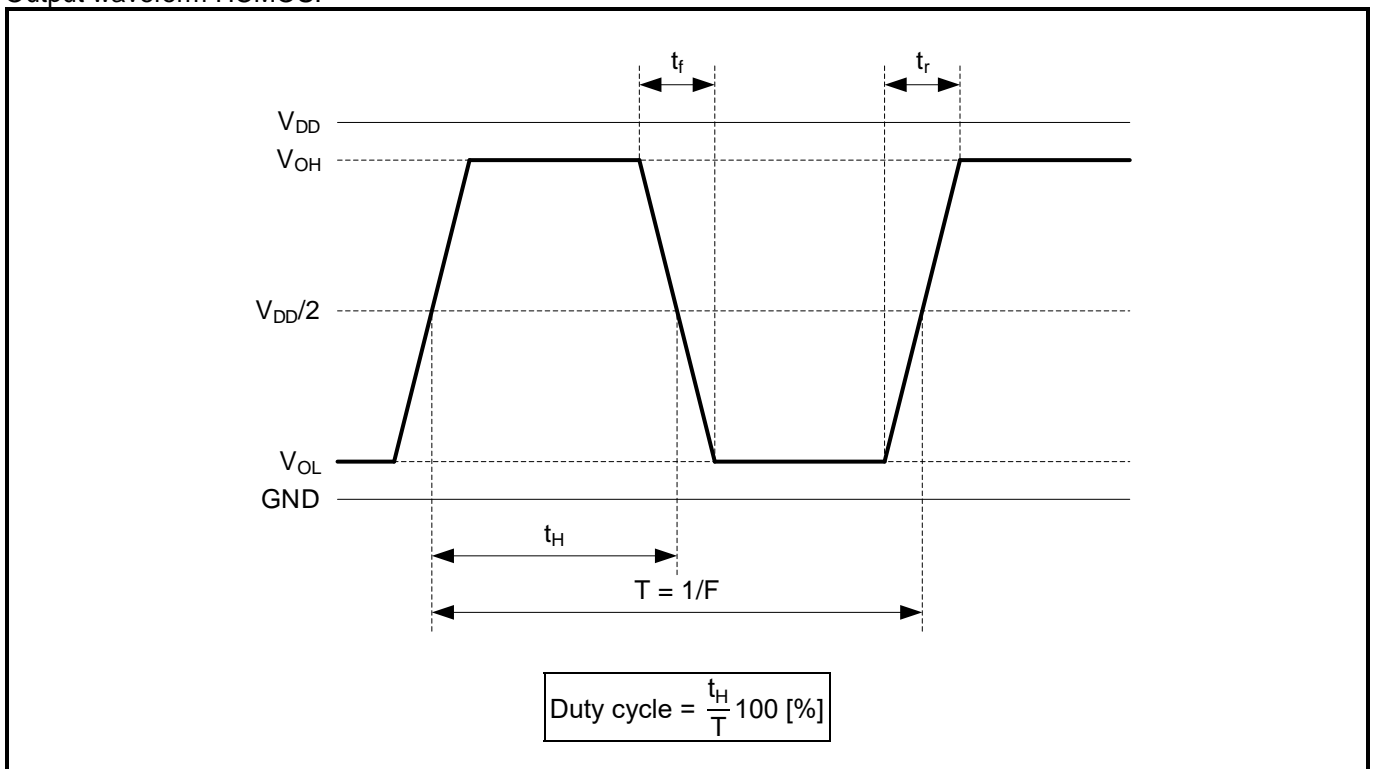
6.1. TEST CIRCUIT

Test circuit HCMOS:

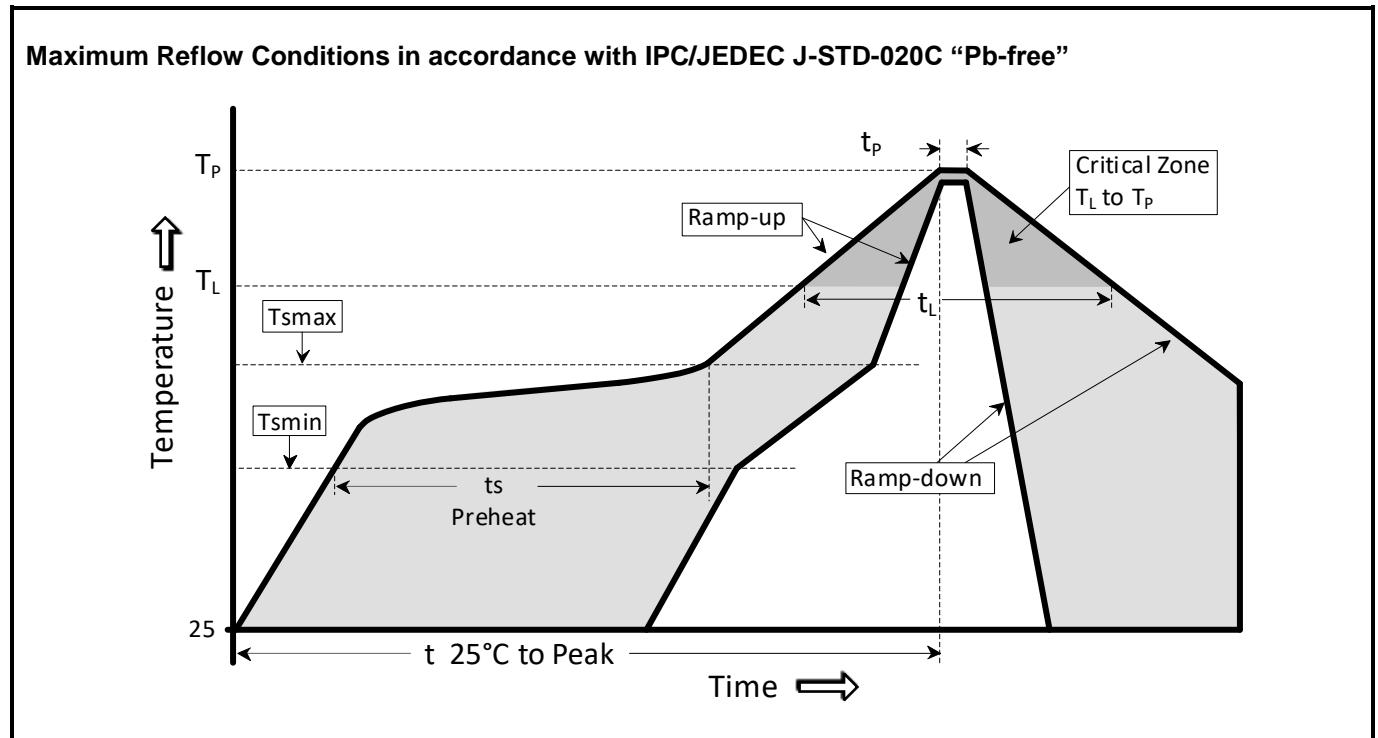


6.2. OUTPUT WAVEFORM

Output waveform HCMOS:



6.3. SOLDERING INFORMATION



Temperature Profile	Symbol	Condition	Unit
Average ramp-up rate	(T_{Smax} to T_P)	3°C / second max	°C / s
Ramp down Rate	T_{cool}	6°C / second max	°C / s
Time 25°C to Peak Temperature	$T_{to-peak}$	8 minutes max	min
Preheat			
Temperature min	T_{Smin}	150	°C
Temperature max	T_{Smax}	200	°C
Time T_{Smin} to T_{Smax}	t_s	60 – 180	sec
Soldering above liquidus			
Temperature liquidus	T_L	217	°C
Time above liquidus	t_L	60 – 150	sec
Peak temperature			
Peak Temperature	T_p	260	°C
Time within 5°C of peak temperature	t_p	20 – 40	sec

6.4. HANDLING PRECAUTIONS FOR MODULES WITH EMBEDDED CRYSTALS

The built-in AT-cut crystal consists of pure Silicon Dioxide in crystalline form. The cavity inside the 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 5000 g / 0.3 ms.

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 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.

Use the following methods for rework:

- Use a hot-air-gun set at 270°C.
- Use 2 temperature controlled soldering irons, set at 270°C, with special-tips to contact all solder-joints from both sides of the package at the same time, remove part with tweezers when pad solder is liquid.

7. COMPLIANCE INFORMATION

Micro Crystal confirms that the standard product VCXO Clock Oscillator VCXO2H 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 MCSO-Series.pdf](#) (contains VCXO2)

8. DOCUMENT REVISION HISTORY

Date	Revision #	Revision Details
August 2016	3.0	Initial version
August 2021	4.0	New extended version

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