

Application Manual

OV-0100-C7

Low Power Clock Oscillator
100.000 kHz

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OV-0100-C7

Low Power Clock Oscillator 100.000 kHz

1. OVERVIEW

- Oscillator with built-in “Tuning Fork” crystal oscillating at 100.000 kHz
- Very tight frequency tolerance: ± 20 ppm
- Excellent oscillator stability: < 1.5 ppm/V
- High shock and vibration resistance
- Wide operating voltage range: 1.2 V to 5.5 V
- Very low power consumption: typ. 650 nA
- Standard operating temperature range T_A : -40 to +85°C
- CLKOUT enable/disable
- Low aging rate
- Miniature ceramic SMD package, RoHS-compliant and 100% lead-free: 3.2 x 1.5 x 1.0 mm
- Automotive qualification according to AEC-Q200 available

1.1. GENERAL DESCRIPTION

The OV-0100-C7 combines an advanced very low power CMOS oscillator circuitry together with a 100.000 kHz “tuning-fork” crystal in a miniaturized ceramic package. No external components are required. The very low power consumption over a wide supply voltage and temperature range is the key feature of this product.

The frequency output on CLKOUT pin can be enabled/disabled by the CLKOE pin. The CLKOUT frequency is enabled when CLKOE pin is connected to V_{DD} . When the CLKOE pin is tied to GND the frequency is disabled and the CLKOUT pin is high impedance (Hi-Z).

1.2. APPLICATIONS

The OV-0100-C7 oscillator module combines very low power consumption with a very small ceramic package:

- Smallest oscillator module (embedded XTAL) in a very small 3.2 x 1.5 x 1.0 mm lead-free ceramic package
- Price competitive

The unique size and the competitive pricing make this product perfectly suitable for many applications:

- Communication: IoT / Wearables / Wireless Sensors and Tags / Handsets
- Automotive: M2M / Navigation & Tracking Systems / Dashboard / Tachometers / Engine Controller
Car Audio & Entertainment Systems
- Metering: E-Meter / Heating Counter / Smart Meters / PV Converter / Utility metering
- Outdoor: ATM & POS systems / Surveillance & Safety systems / Ticketing Systems
- Medical: Glucose Meter / Health Monitoring Systems
- Safety: Security & Camera Systems / Door Lock & Access Control
- Consumer: Gambling Machines / TV & Set Top Boxes / White Goods
- Automation: PLC / Data Logger / Home & Factory Automation / Industrial and Consumer Electronics

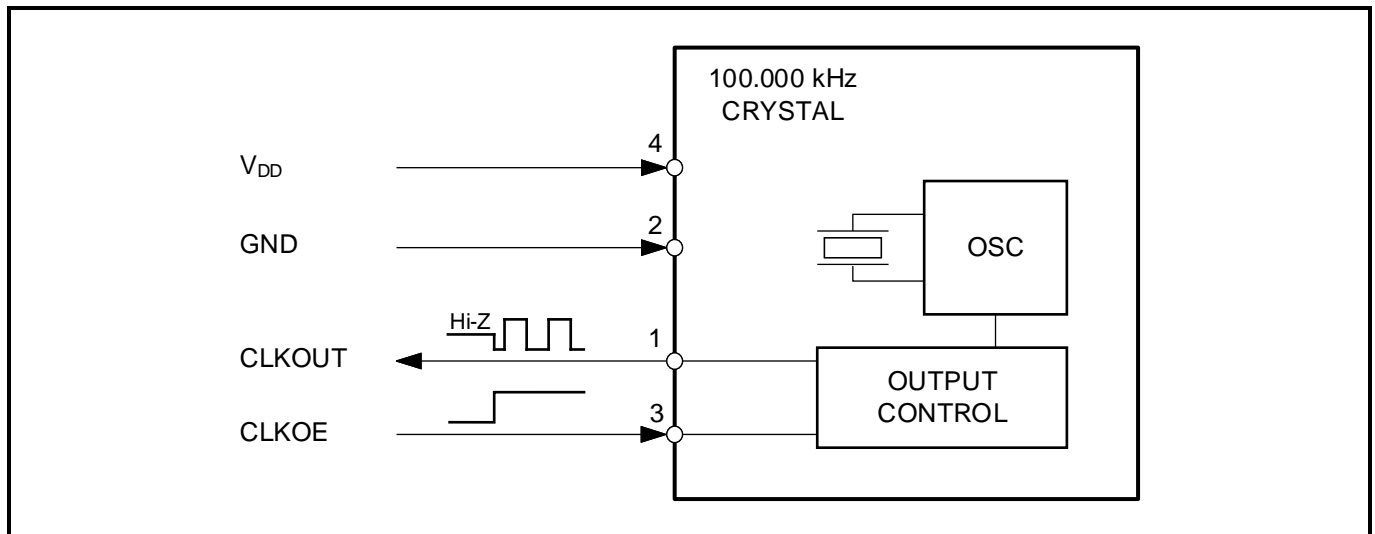
1.3. ORDERING INFORMATION

Example: OV-0100-C7 -20/+20ppm TA QC

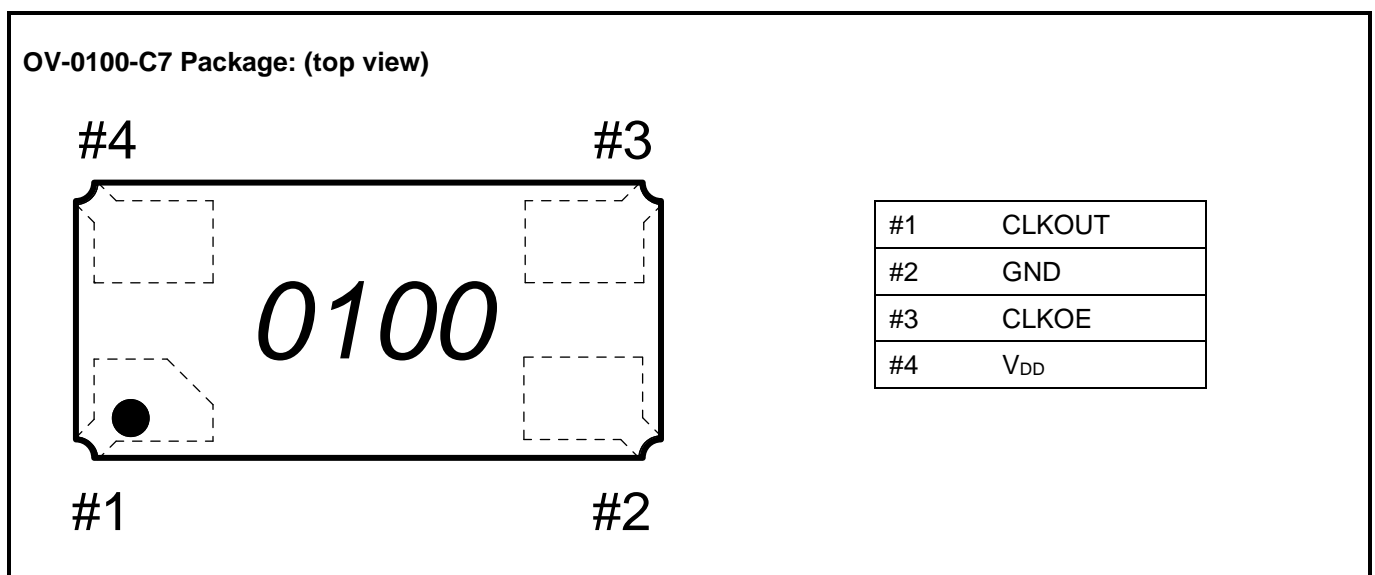
Code	Operating temperature range
TA (Standard)	-40 to +85°C

Code	Qualification
QC (Standard)	Commercial Grade
QA	Automotive Grade AEC-Q200
QM	Medical Grade

2. BLOCK DIAGRAM



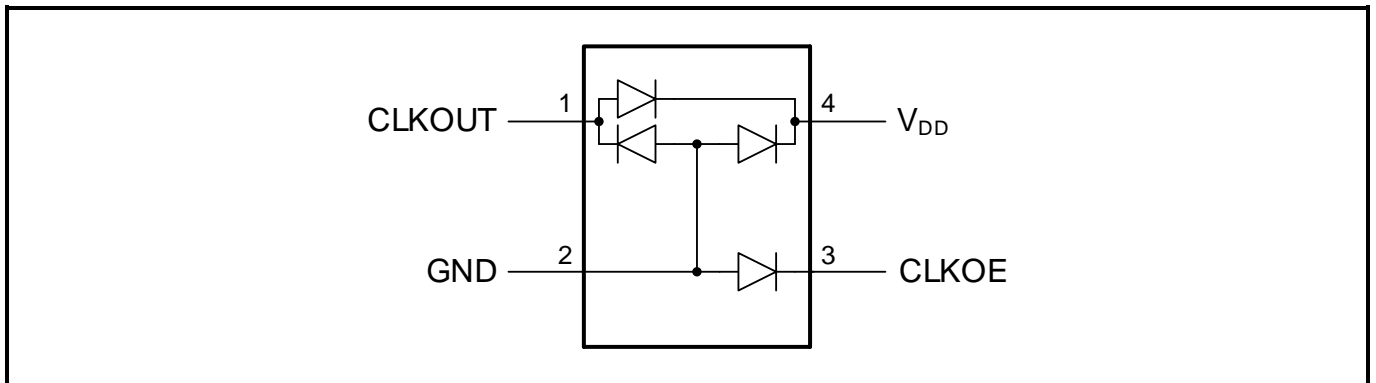
2.1. PINOUT



2.2. PIN DESCRIPTION

Symbol	Pin #	Description
CLKOUT	1	Clock Output; push-pull; controlled by CLKOE. If CLKOE is HIGH (V _{DD}), the CLKOUT pin drives the square wave of 100.000 kHz. When CLKOE is tied to Ground, the CLKOUT pin is high impedance (Hi-Z).
GND	2	Ground.
CLKOE	3	Input to enable the CLKOUT pin. If CLKOE is HIGH, the CLKOUT pin is in output mode. When CLKOE is tied to Ground, the CLKOUT pin is high impedance (Hi-Z).
V _{DD}	4	Power Supply Voltage.

2.3. DEVICE PROTECTION DIAGRAM



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		-0.5	6.0	V
V _I	Input voltage		-0.5	6.0	V
V _O	Output voltage		-0.5	V _{DD} +0.5	V
T _{OPRA}	Standard operating temperature T _A		-40	85	°C
T _{STO}	Storage temperature	Stored as bare product	-55	125	°C
T _{PEAK}	Maximum reflow condition	JEDEC J-STD-020C		265	°C

3.2. OPERATING PARAMETERS

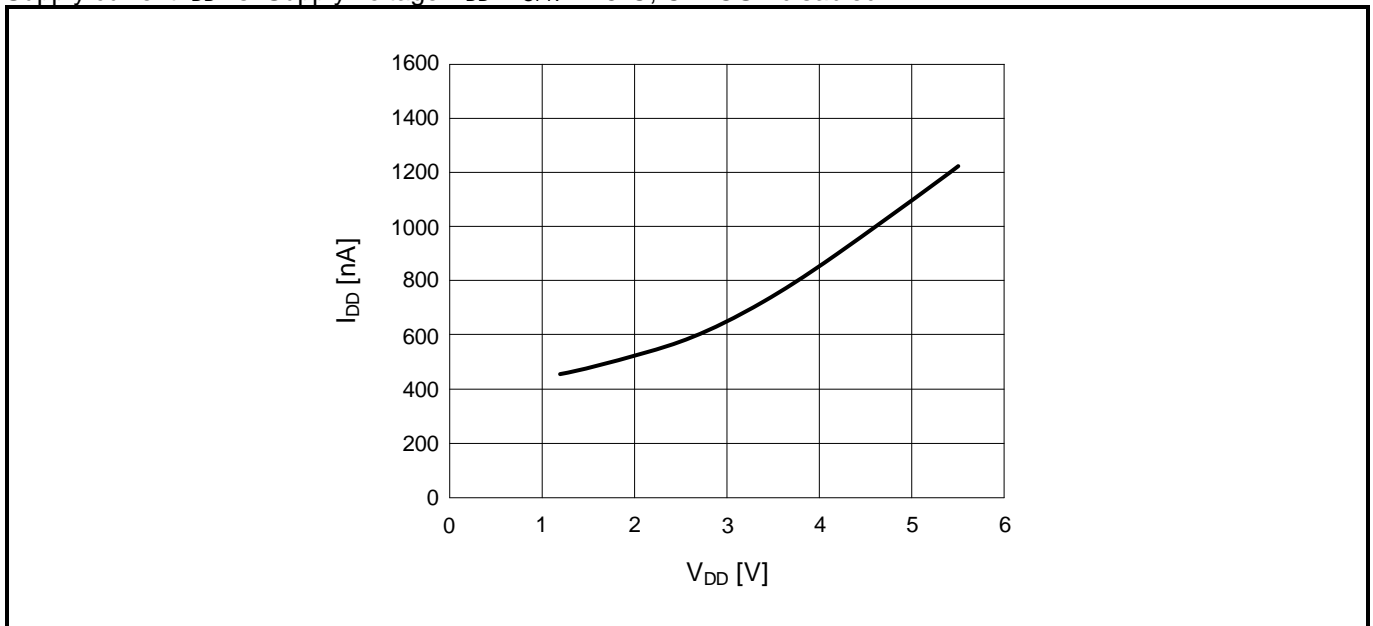
For this Table, V_{DD} = 1.2 to 5.5 V; GND = 0 V; T_A = -40°C to +85°C; TYP values at 25°C and 3.0 V; unless otherwise indicated.

Operating Parameters:

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Supply						
V _{DD}	Power supply voltage		1.2		5.5	V
V _{DDSR}	V _{DD} slew rate				±0.5	V/ms
I _{DD}	V _{DD} Supply Current. CLKOUT disabled. ⁽¹⁾	V _{DD} = 3.0 V, T _{OPR} = 25°C		650	850	nA
		V _{DD} = 5.0 V, T _{OPR} = 25°C		1100	1700	
		V _{DD} = 3.0 V, T _A = -40 to 85°C			1700	
		V _{DD} = 5.0 V, T _A = -40 to 85°C			3400	
Input CLKOE						
V _I	Input voltage		GND -0.5		V _{DD} +0.5	V
V _{IL}	LOW level input voltage		GND		0.2 V _{DD}	V
V _{IH}	HIGH level input voltage		0.8 V _{DD}		V _{DD}	V
Output CLKOUT						
V _{OH}	HIGH level output voltage	I _{OH} = -400 µA, V _{DD} = 1.5 to 5.5 V	V _{DD} -0.4			V
V _{OL}	LOW level output voltage	I _{OL} = 400 µA, V _{DD} = 1.5 to 5.5 V			GND +0.4	V
C _L	Output load capacitance	CMOS			15	pF
t _r / t _f	Rise time / Fall time	C _L = 10 pF, V _{DD} = 1.2 to 1.5 V			150	ns
		C _L = 10 pF, V _{DD} = 1.5 to 5.5 V			100	ns
t _{CKH}	CLKOUT enable time (see following diagram)				0	µs
t _{CKL}	CLKOUT disable time (see following diagram)		0		5	µs
⁽¹⁾ When CLKOUT is enabled (CLKOE is HIGH) the additional V _{DD} supply current ΔI _{DD} can be calculated as follows: ΔI _{DD} = C _L × V _{DD} × f _{OUT} e.g. ΔI _{DD} = 10 pF × 3.0 V × 100'000 Hz = 3 µA						

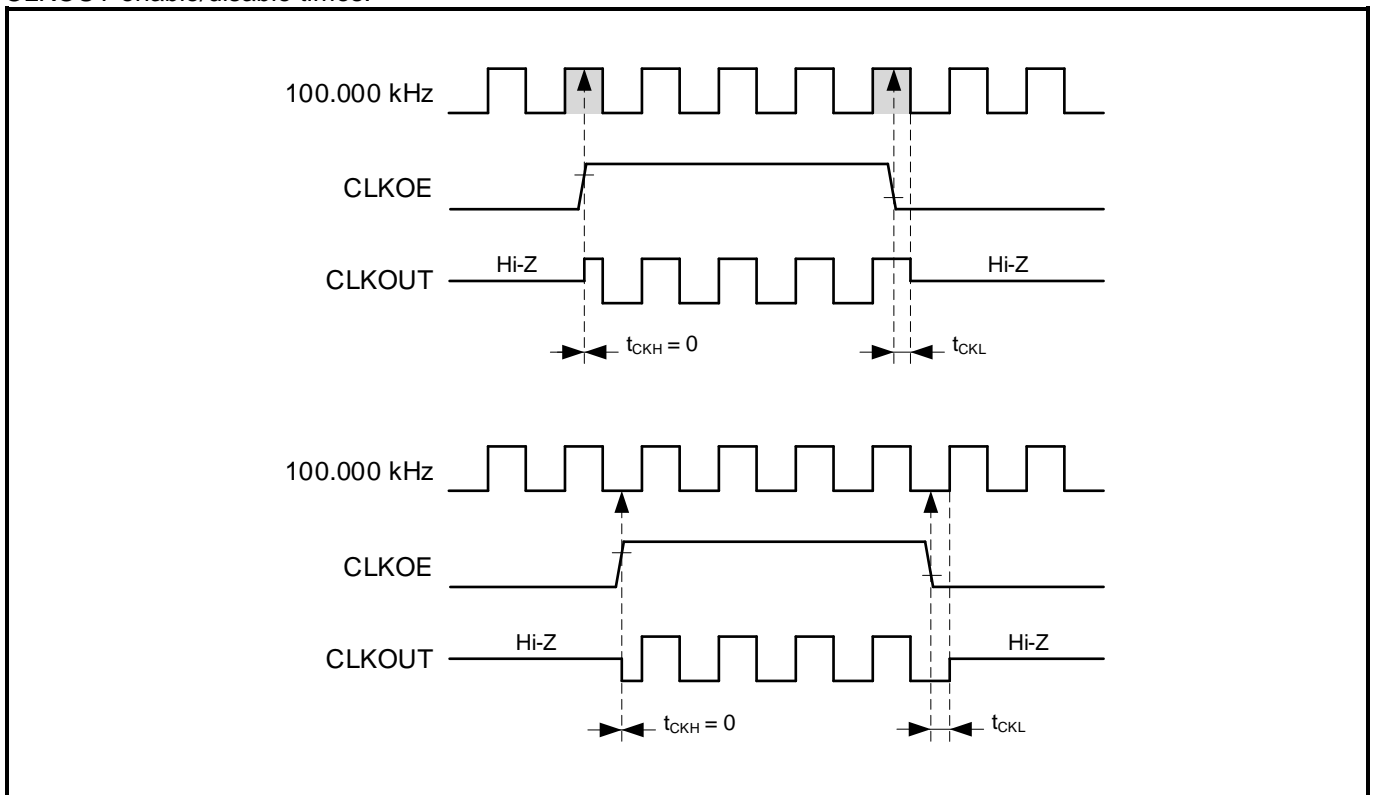
3.3. TYPICAL CHARACTERISTICS

Supply current I_{DD} vs. Supply voltage V_{DD} : $T_{OPR} = 25^{\circ}\text{C}$, CLKOUT disabled



3.4. TIMING WAVEFORMS

CLKOUT enable/disable times:



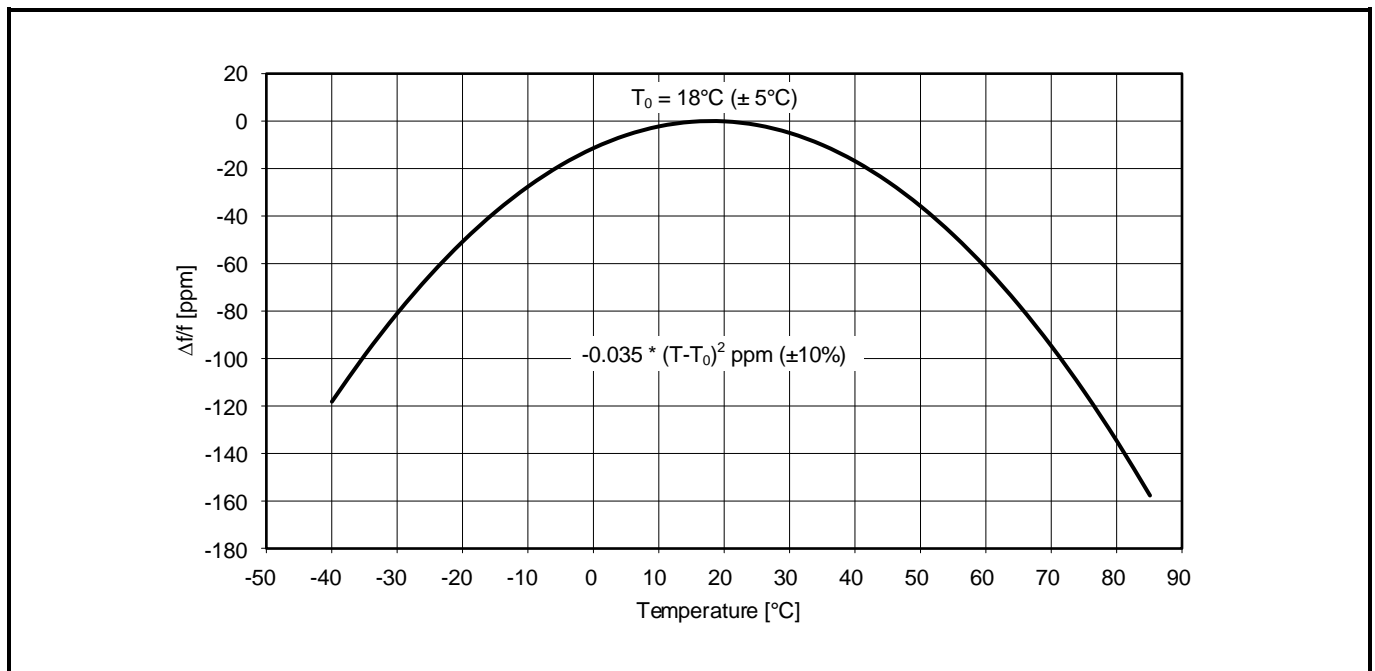
3.5. OSCILLATOR PARAMETERS

For this Table, $V_{DD} = 3.0\text{ V}$; $GND = 0\text{ V}$; $T_{OPR} = 25^\circ\text{C}$; unless otherwise indicated.

Oscillator Parameters:

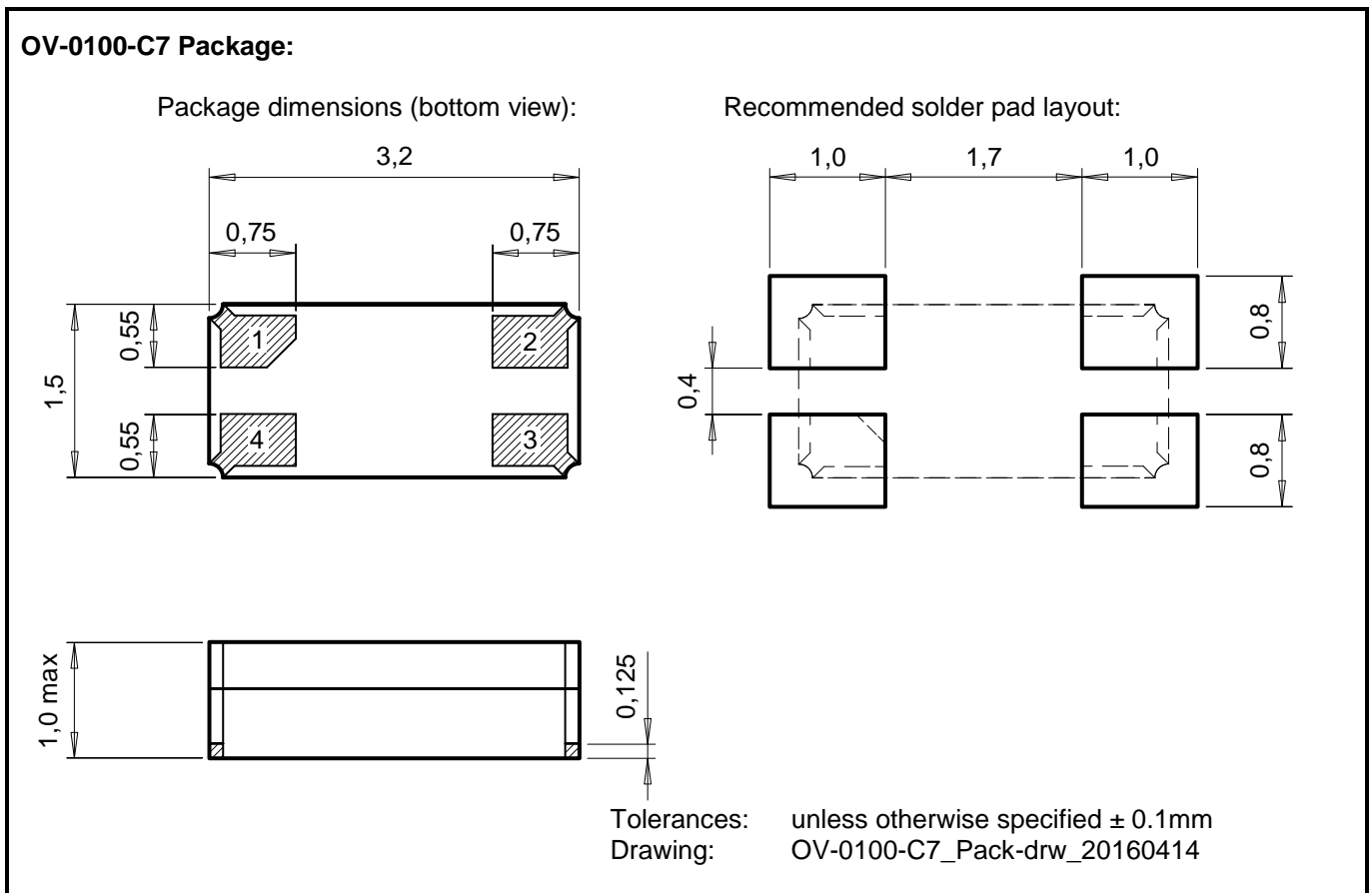
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Xtal General						
f	Crystal Frequency			100.000		kHz
t _{START}	Oscillator start-up time			150	500	ms
\bar{d}_{CLKOUT}	CLKOUT duty cycle		40		60	%
Xtal Frequency Characteristics						
$\Delta f/f$	Frequency accuracy			± 10	± 20	ppm
$\Delta f/V$	Frequency vs. voltage characteristics	$1.2\text{ V} \leq V_{DD} \leq 5.5\text{ V}$			± 1.5	ppm/V
$\Delta f/f_{TOPR}$	Frequency vs. temperature characteristics	$T_{OPR} = -40^\circ\text{C}$ to $+85^\circ\text{C}$ $V_{DD} = 3.0\text{ V}$				$-0.035\text{ ppm}/^\circ\text{C}^2 (T_{OPR}-T_0)^2 \pm 10\%$
T ₀	Turnover temperature		13	18	23	°C
$\Delta f/f$	Aging first year max.				± 3	ppm

3.5.1.XTAL FREQUENCY VS. TEMPERATURE CHARACTERISTICS



4. PACKAGE

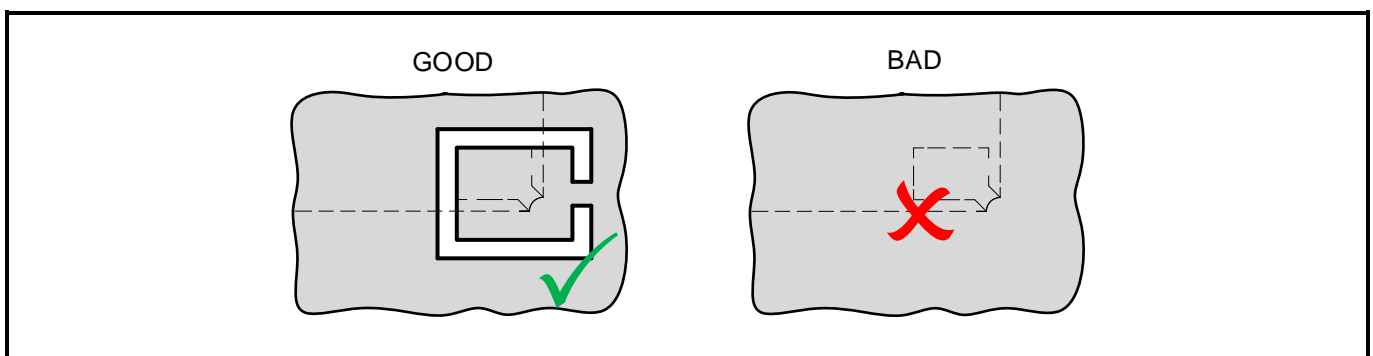
4.1. DIMENSIONS AND SOLDER PAD LAYOUT



All dimensions in mm typical.

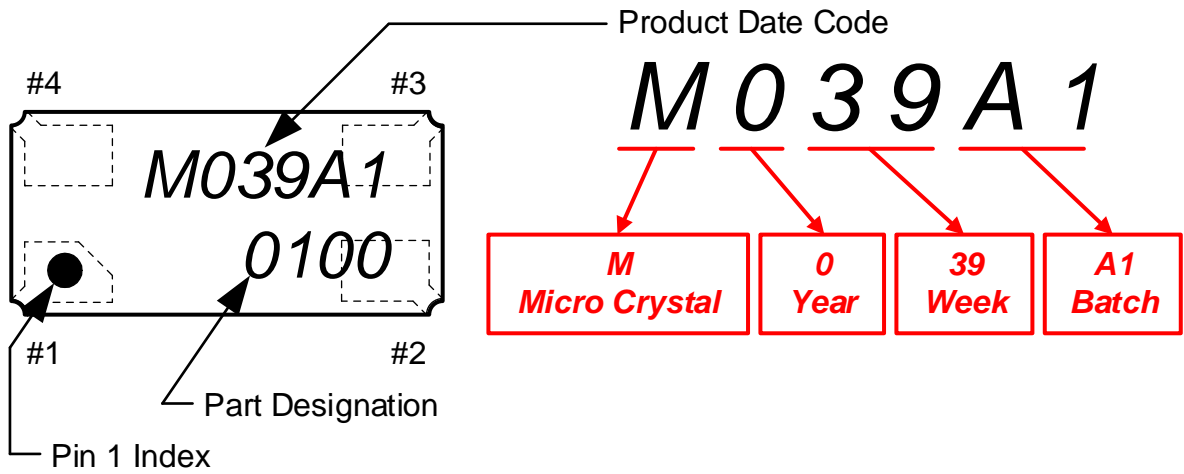
4.1.1. RECOMMENDED THERMAL RELIEF

When connecting a pad to a copper plane, thermal relief is recommended.



4.2. MARKING AND PIN #1 INDEX

Laser marking OV-0100-C7 Package: (top view)

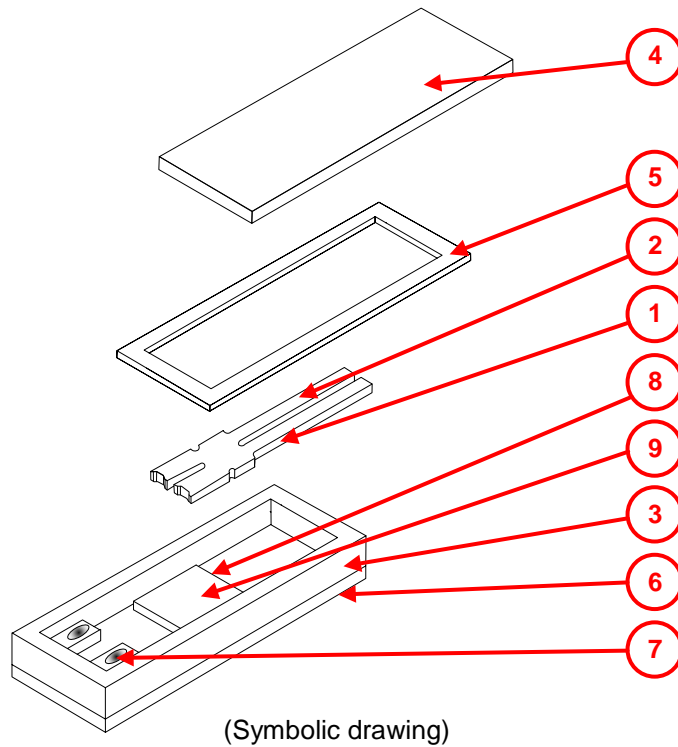


5. MATERIAL COMPOSITION DECLARATION & ENVIRONMENTAL INFORMATION

5.1. HOMOGENOUS MATERIAL COMPOSITION DECLARATION

Homogenous material information according to IPC-1752 standard

Material Composition OV-0100-C7:



No.	Item Component Name	Sub Item Material Name	Material Weight		Substance Element	CAS Number	Comment
			(mg)	(%)			
1	Resonator	Quartz Crystal	0.40	100%	SiO ₂	14808-60-7	
2	Electrodes	Cr+Au	0.007	5%	Cr	Cr: 7440-47-3	
				95%	Au	Au: 7440-57-5	
3	Housing	Ceramic	6.30	100%	Al ₂ O ₃	1344-28-1	
4	Lid	Ceramic	4.65	98.5%	Al ₂ O ₃	1344-28-1	Ceramic Lid
				1.0%	Ni	Ni: 7440-02-0	Nickel plating
				0.5%	Au	Au: 7440-57-5	Gold plating
5	Seal	Solder Preform	0.38	80%	Au80 / Sn20	Au: 7440-57-5	
				20%		Sn: 7440-31-5	
6	Terminations	Internal and external terminals	0.33	80%	Mo	Mo: 7439-98-7	Molybdenum
				15%	Ni	Ni: 7440-02-0	Nickel plating
				5%	Au 0.5 micron	Au: 7440-57-5	Gold plating
7	Conductive adhesive	Silver filled Epoxy	0.15	70%	Ag	Ag: 7440-22-4	
				30%	EP	129915-35-1	
8	CMOS IC	Silicon	0.18	99%	Si	Si: 7440-21-3	
				1%	Al	Al: 7429-90-5	
9	Die attach	Gold bumps	0.018	100%	Au	Au: 7440-57-5	
Unit weight			12.4				

5.2. MATERIAL ANALYSIS & TEST RESULTS

Homogenous material information according to IPC-1752 standard

No.	Item Component Name	Sub Item Material Name	RoHS						Halogen				Phthalates				
			Pb	Cd	Hg	Cr+6	PBB	PBDE	F	Cl	Br	-	BBP	DBP	DEHP	DINP	
1	Resonator	Quartz Crystal	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2	Electrodes	Cr+Au	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3	Housing	Ceramic	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4	Lid	Ceramic Lid & Plating	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
5	Seal	Solder Preform	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
6	Terminations	Int. & ext. terminals	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
7	Conductive adhesive	Silver filled Epoxy	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
8	CMOS IC	Silicon & Die pad plating	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
9	Die attach	Gold bumps	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	MDL	Measurement Detection Limit	2 ppm				5 ppm		50 ppm				0.003%		0.01%		

nd = not detectable

Test methods:

RoHS Test method with reference to IEC 62321-5: 2013
Halogen Test method with reference to BS EN 14582:2007
Phthalates Test method with reference to EN 14372

MDL: 2 ppm (PBB / PBDE: 5 ppm)
 MDL: 50 ppm
 MDL: 0.003 % (DINP 0.01%)

5.3. RECYCLING MATERIAL INFORMATION

Recycling material information according to IPC-1752 standard.

Element weight is accumulated and referenced to the unit weight of 12.4 mg.

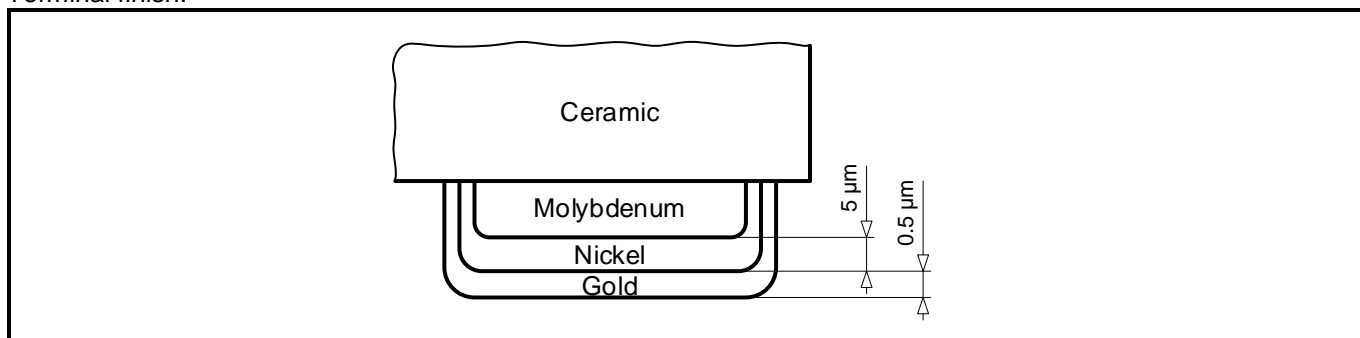
Item Material Name	No.	Item Component Name	Material Weight		Substance Element	CAS Number	Comment
			(mg)	(%)			
Quartz Crystal	1	Resonator	0.40	3.20	SiO ₂	14808-60-7	
Chromium	2	Electrodes	0.0004	0.003	Cr	Cr: 7440-47-3	
Ceramic	3	Housing	10.88	87.64	Al ₂ O ₃	1344-28-1	
	4	Lid					
Gold	2	Electrodes	0.37	2.97	Au	Au: 7440-57-5	
	4	Lid					
	5	Seal					
	6	Terminations					
Tin	5	Seal	0.076	0.61	Sn	Sn: 7440-31-5	
Nickel	4	Lid	0.096	0.77	Ni	Ni: 7440-02-0	
	6	Terminations					
Molybdenum	6	Terminations	0.26	2.13	Mo	Mo: 7439-98-7	
Silver	7a	Conductive adhesive	0.105	0.85	Ag	Ag: 7440-22-4	
Epoxy	7b	Conductive adhesive	0.045	0.36	EP	129915-35-1	
Silicon	8a	CMOS IC	0.18	1.46	Si	Si: 7440-21-3	
Aluminum	8b	CMOS IC	0.0018	0.015	Al	Al: 7429-90-5	
Unit weight (total)			12.4	100			

5.4. ENVIRONMENTAL PROPERTIES & ABSOLUTE MAXIMUM RATINGS

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

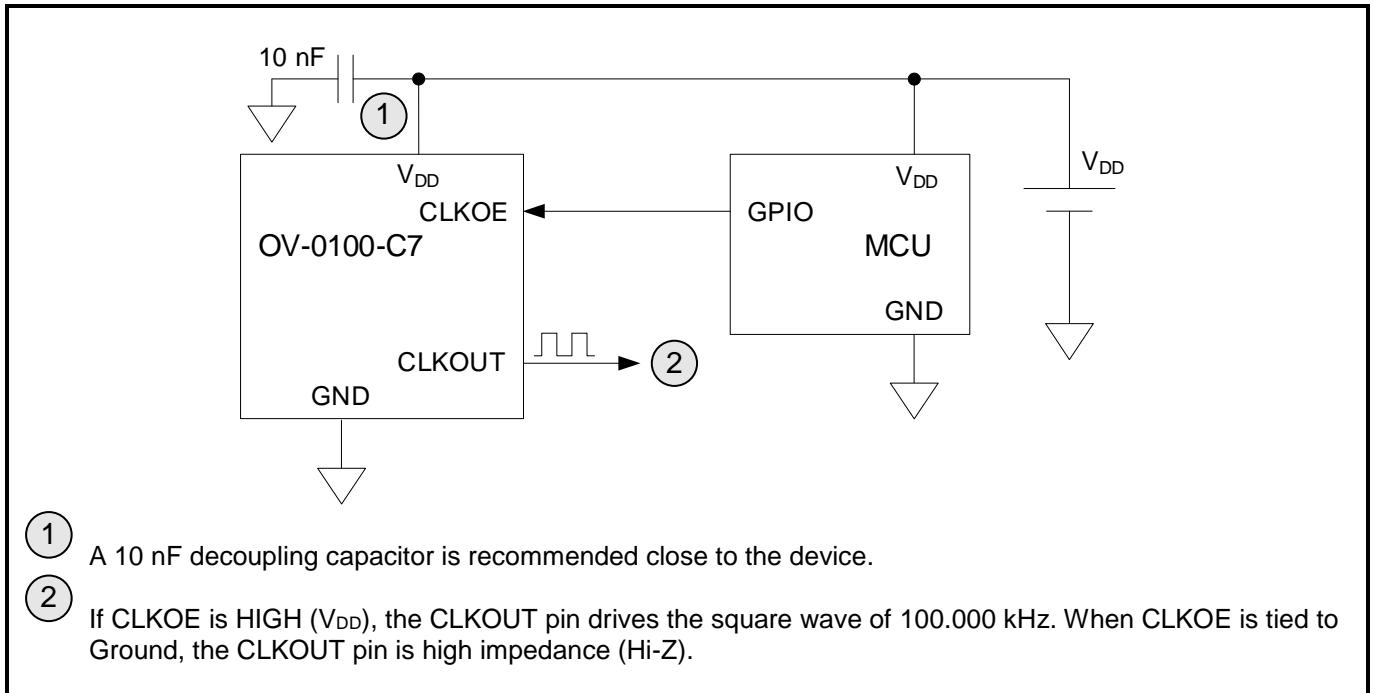
Parameter	Directive	Conditions	Value
Product weight (total)			12.4 mg
Storage temperature		Store as bare product	-55 to +125°C
Moisture sensitivity level (MSL)	IPC/JEDEC J-STD-020D		MSL1
FIT / MTBF			available on request

Terminal finish:

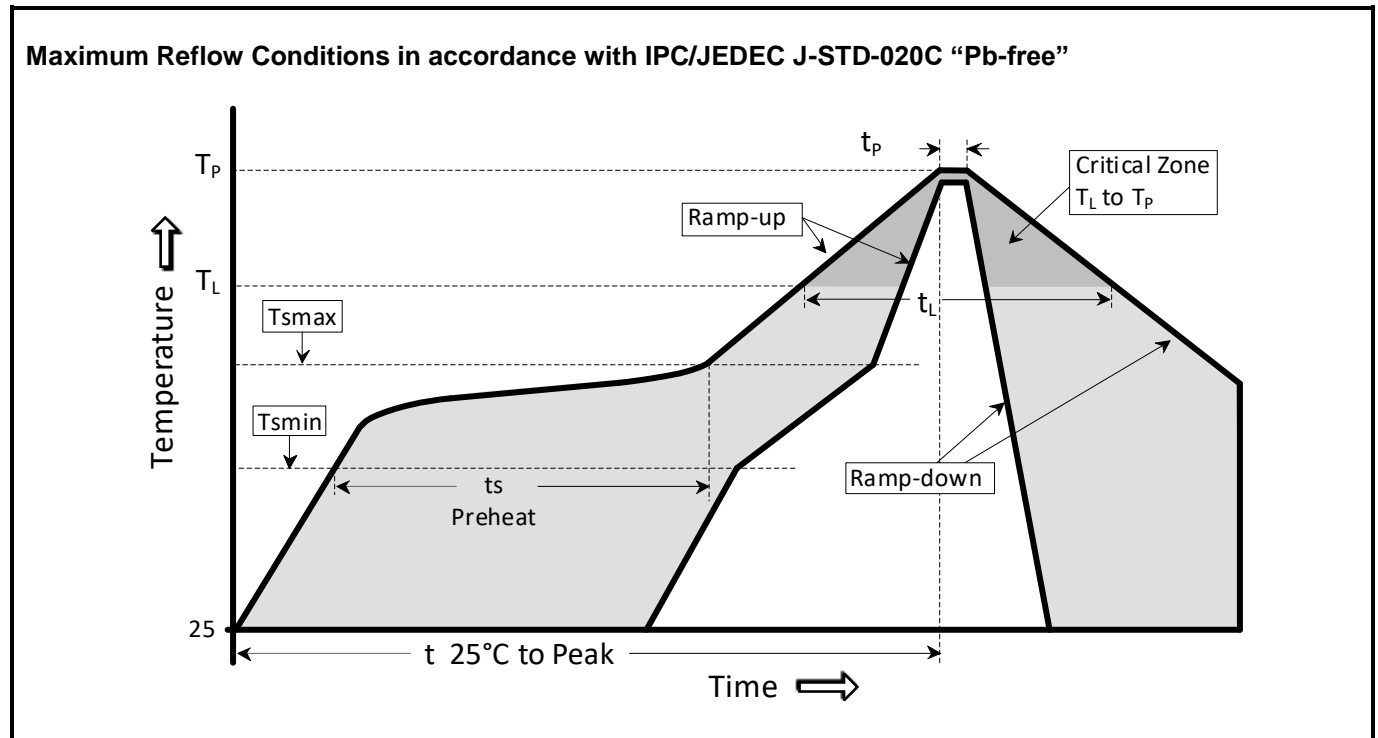


6. APPLICATION INFORMATION

6.1. OPERATING OV-0100-C7



6.2. 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

6.3. HANDLING PRECAUTIONS FOR MODULES WITH EMBEDDED CRYSTALS

The built-in tuning-fork 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 100.000 kHz. 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:

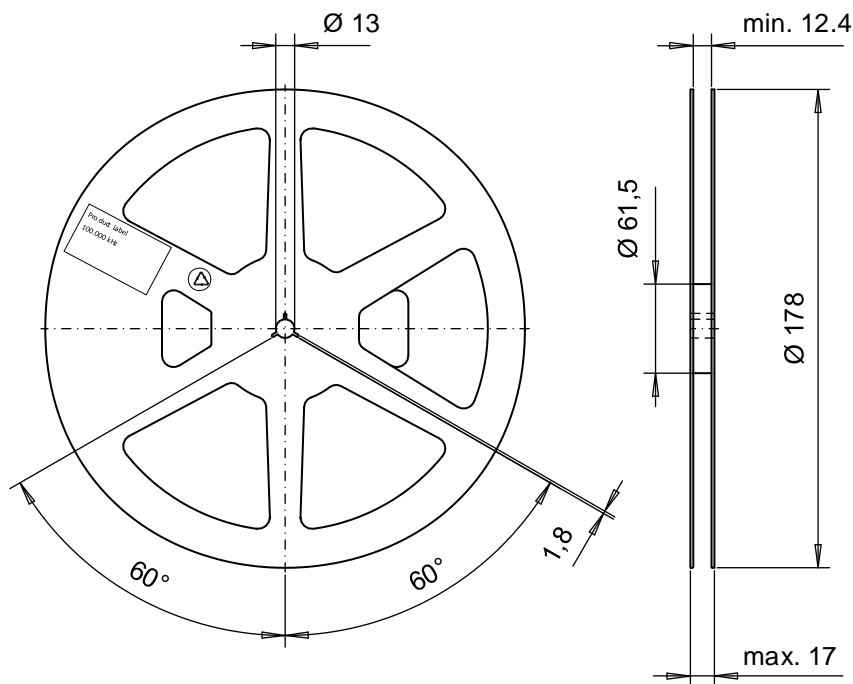
Avoid overheating the package. The package is sealed with a seal ring consisting of 80% Gold and 20% Tin. The eutectic melting temperature of this alloy is at 280°C. Heating the seal ring up to >280°C will cause melting of the metal seal which then, due to the vacuum, is sucked into the cavity forming an air duct. This happens when using hot-air-gun set at temperatures >300°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.

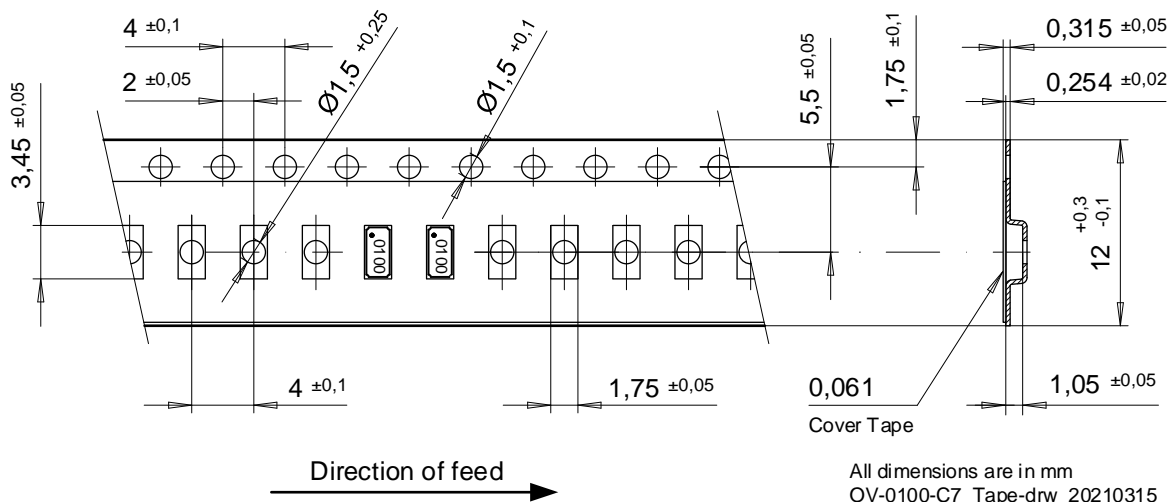
7. PACKING & SHIPPING INFORMATION

Reel: 7" = 178 mm



Carrier Tape:

Material: Polycarbonate, conductive
 Width: 12 mm
 Tape Leader and Trailer: Minimum length 300 mm



All dimensions are in mm
 OV-0100-C7_Tape-drw_20210315

Cover Tape:

Tape: Polypropylene, 3M™ Universal Cover Tape (UCT)
 Adhesive Type: Pressure sensitive, Synthetic Polymer
 Thickness: 0.061 mm

Peel Method:

Medial section removal, both lateral stripes remain on carrier

8. COMPLIANCE INFORMATION

Micro Crystal confirms that the standard product Low Power Clock Oscillator OV-0100-C7 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 OV_OM-Series.pdf](#)

9. DOCUMENT REVISION HISTORY

Date	Revision #	Revision Details
June 2017	1.0	First release
June 2019	1.1	Changed Output load capacitance C_L Max. from 10 pF to 15 pF, 3.2.
March 2021	1.2	Removed Medical Implantable, 1. Applied more precise term: T_{OPR} , 3. Added Product Date Code definition, 4.2. Changed package designation from SON-4 to DFN-4, 5.4. Corrected tape drawing, 7. Added new disclaimer

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