Application Manual

OM-0100-C8

Low Power Clock Oscillator
100.000 kHz

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OM-0100-C8

Low Power Clock Oscillator 100.000 kHz

1. OVERVIEW

- Oscillator with built-in “Tuning Fork” crystal oscillating at 100.000 kHz
- Frequency tolerance: ±100 ppm
- Excellent oscillator stability: < 3 ppm/V
- High shock and vibration resistance
- Wide operating voltage range: 1.6 V to 5.5 V
- Very low power consumption: typ. 550 nA
- Standard operating temperature range T_A: -40 to +85°C
- CLKOUT enable/disable
- Low aging rate
- Ultra-miniature ceramic SMT package with metal lid, RoHS-compliant and 100% lead-free: 2.0 x 1.2 x 0.70 mm
- Automotive qualification according to AEC-Q200 available

1.1. GENERAL DESCRIPTION

The OM-0100-C8 combines an advanced very low power CMOS oscillator circuitry together with a 100.000 kHz “tuning-fork” crystal in an ultra-miniature ceramic package with metal lid. 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 OM-0100-C8 oscillator module combines very low power consumption with a ultra-small ceramic package:

- Smallest oscillator module (embedded XTAL) in a ultra-small 2.0 x 1.2 x 0.70 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

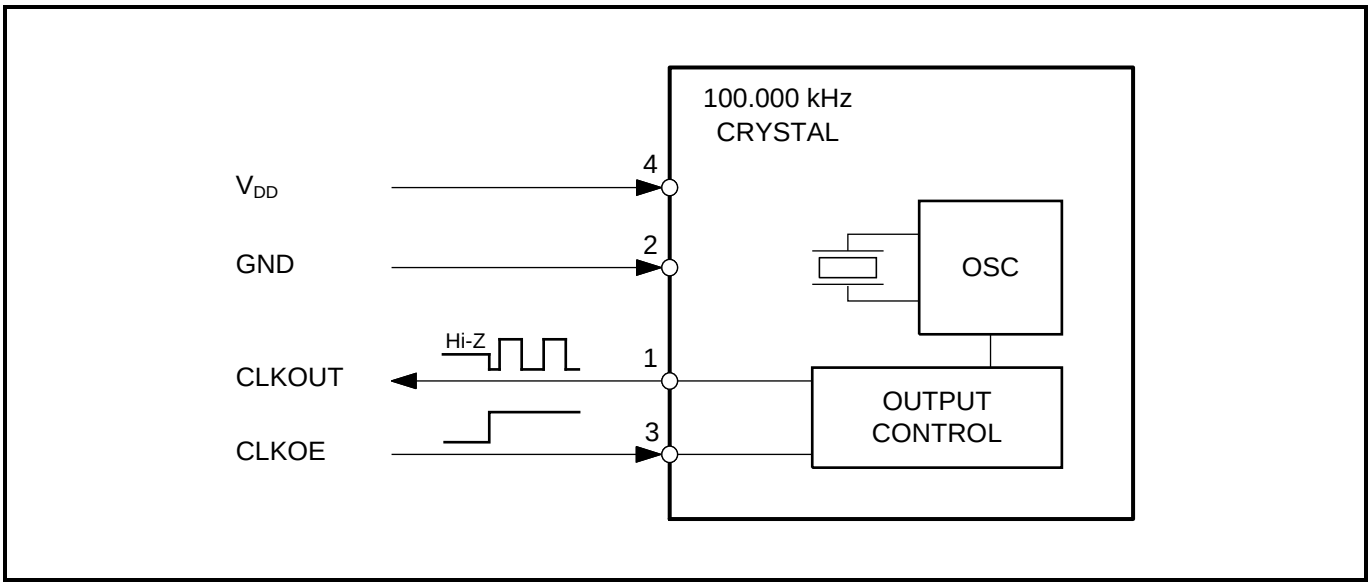
1.3. ORDERING INFORMATION

Example: OM-0100-C8 -20/+20ppm TA QC

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

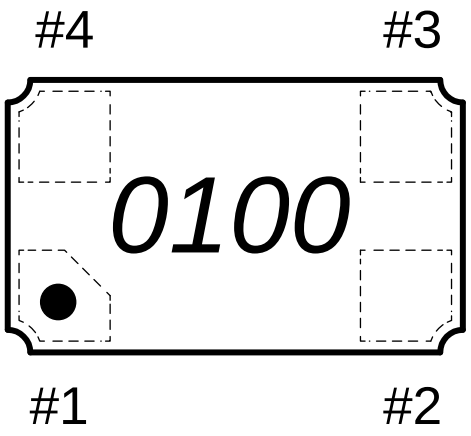
Code	Qualification
QC (Standard)	Commercial Grade
QA	Automotive Grade AEC-Q200

2. BLOCK DIAGRAM



2.1. PINOUT

OM-C8 Package: (top view)

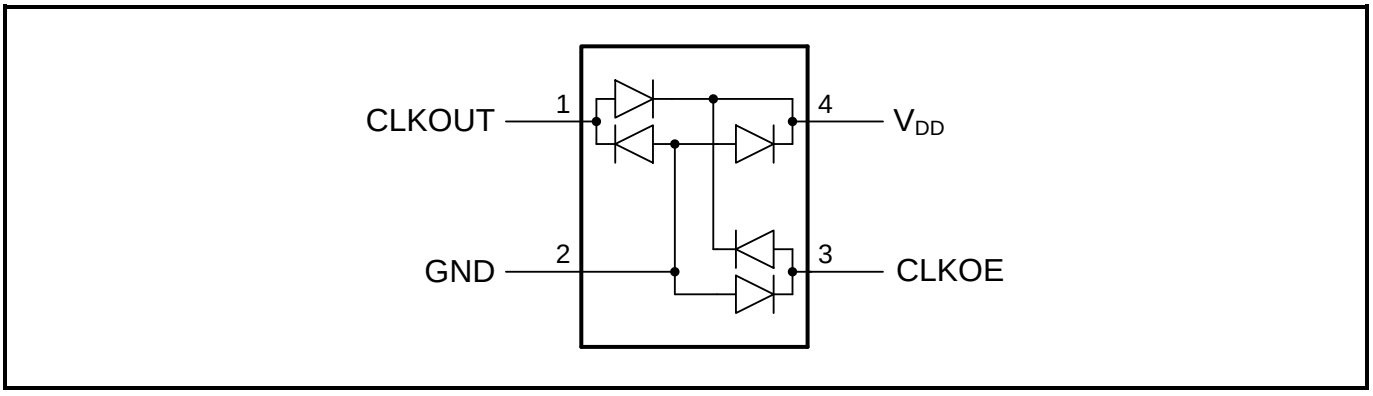


#1	CLKOUT
#2	GND
#3	CLKOE
#4	V_{DD}

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	6.0	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} = 3.0 V; GND = 0 V; T_A = 25 °C; unless otherwise indicated.

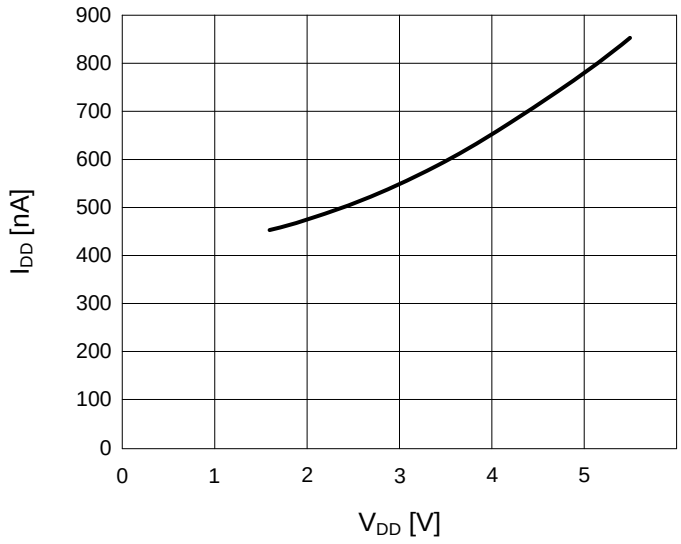
Operating Parameters:

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Supply						
V_{DD}	Power supply voltage		1.6		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_A = 25°C		550	750	nA
		V_{DD} = 5.0 V, T_A = 25°C		780	1000	
		V_{DD} = 3.0 V, T_A = -40 to 85°C			1500	
		V_{DD} = 5.0 V, T_A = -40 to 85°C			2000	
Input CLKOE						
V_I	Input voltage		GND -0.5		V_{DD} +0.5	V
V_{IL}	LOW level input voltage		GND		0.3 V_{DD}	V
V_{IH}	HIGH level input voltage		0.7 V_{DD}		V_{DD}	V
Output CLKOUT						
V_{OH}	HIGH level output voltage	I_{OH} = -400 µA, V_{DD} = 1.6 to 5.5 V	V_{DD} – 0.4			V
V_{OL}	LOW level output voltage	I_{OL} = 400 µA, V_{DD} = 1.6 to 5.5 V			GND +0.4	V
I_{OZ}	Hi-Z leakage current	CLKOE = GND, CLKOUT = V_{DD} or GND			±100	nA
t_r	Output rise time	C_L = 10 pF, 10% to 90% V_{DD}		30	70	ns
t_f	Output fall time	C_L = 10 pF, 10% to 90% V_{DD}		30	70	ns
t_{CKH}	CLKOUT enable time (see following diagram)		0		0.5	µs
t_{CKL}	CLKOUT disable time (see following diagram)				0	µs

(1) When CLKOUT is enabled (CLKOE is HIGH) the additional V_{DD} supply current ΔI_{DD} can be calculated as follows: $\Delta I_{DD} = C_L \times V_{DD} \times f_{OUT}$
e.g. ΔI_{DD} = 10 pF x 3.0 V x 100'000 Hz = 3 µA

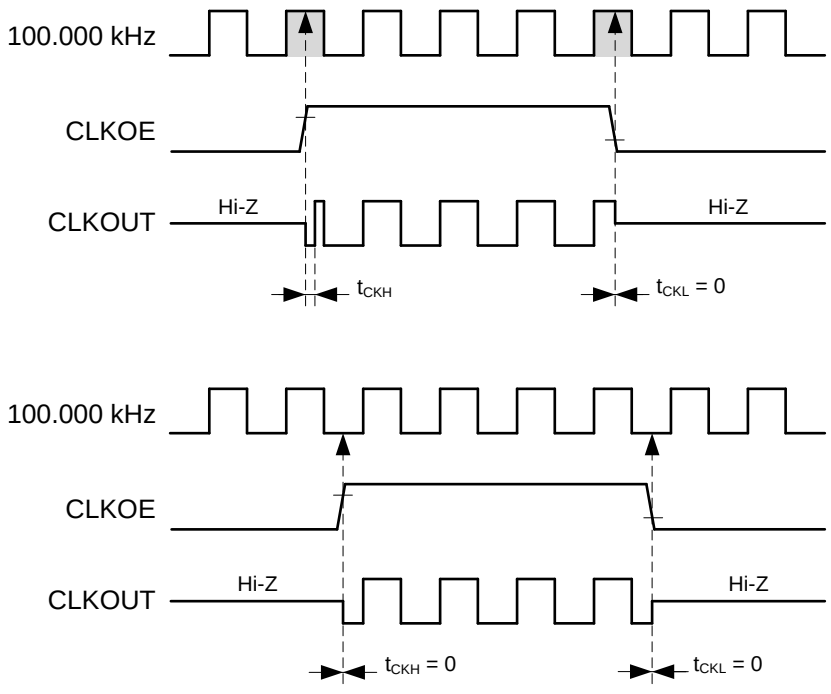
3.3. TYPICAL CHARACTERISTICS

Supply current I_{DD} vs. Supply voltage V_{DD}: T_A = 25°C, CLKOUT disabled



3.4. TIMING WAVEFORMS

CLKOUT enable/disable time:



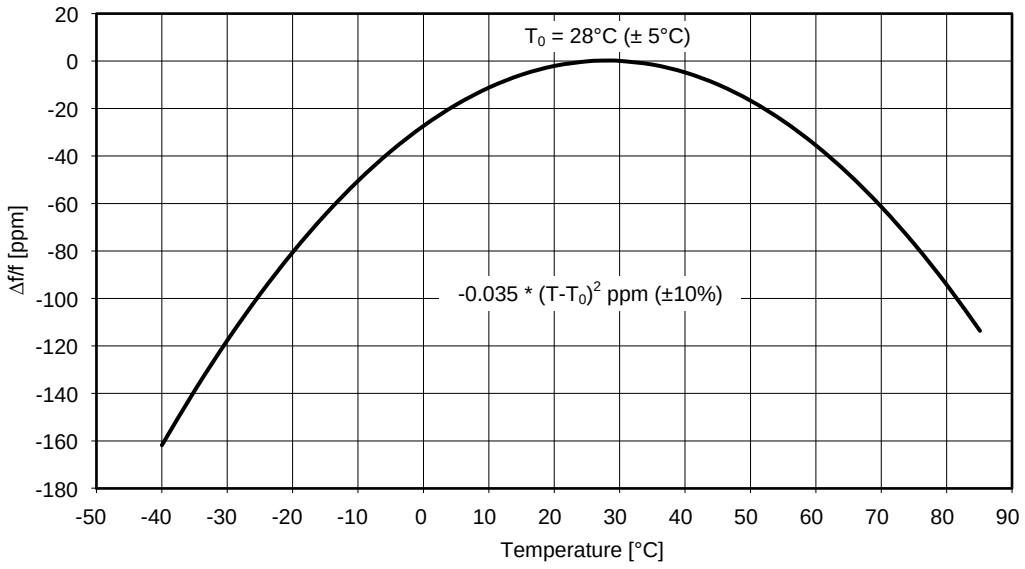
3.5. OSCILLATOR PARAMETERS

For this Table, V_{DD} = 3.0 V; GND = 0 V; T_A = 25 °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			50	500	ms
δ_{CLKOUT}	CLKOUT duty cycle		40		60	%
Xtal Frequency Characteristics						
Δf/f	Frequency accuracy			±50	±100	ppm
Δf/V	Frequency vs. voltage characteristics	1.6 V ≤ V_{DD} ≤ 5.5 V			±3	ppm/V
$\Delta f/f_{TOPR}$	Frequency vs. temperature characteristics	T_{OPR} = -40°C to +85°C V_{DD} = 3.0 V		$-0.035^{ppm}/_{°C^2}$ $(T_{OPR}-T_0)^2$ ±10%		ppm
T_0	Turnover temperature		23	28	33	°C
Δf/f	Aging first year max.				±3	ppm

3.5.1.XTAL FREQUENCY VS. TEMPERATURE CHARACTERISTICS

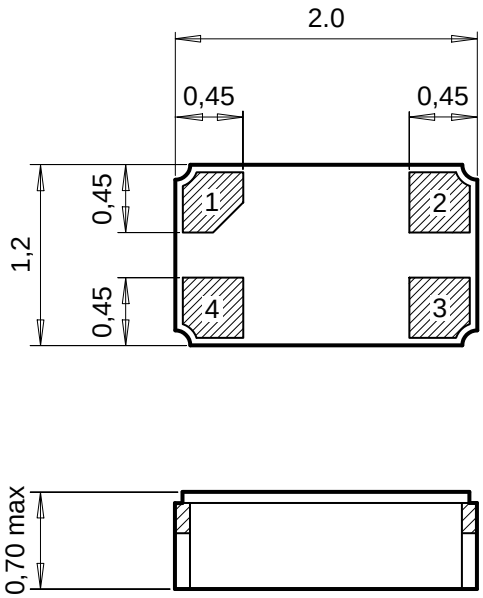


4. PACKAGE

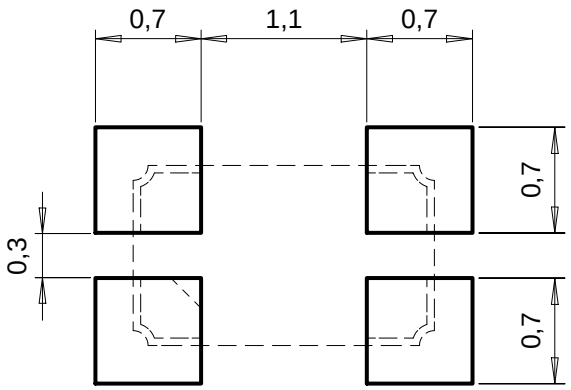
4.1. DIMENSIONS AND SOLDER PAD LAYOUT

OM-C8 Package:

Package dimensions (bottom view):



Recommended solder pad layout:

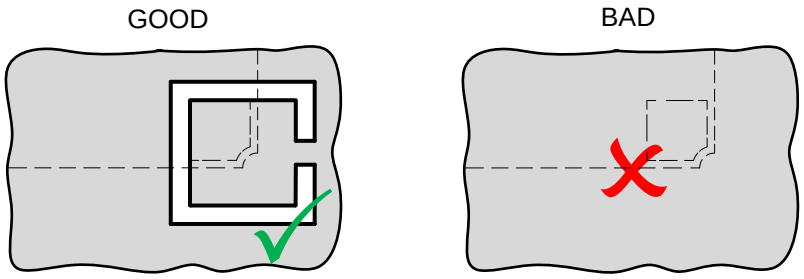


Tolerances: unless otherwise specified ± 0.1mm
Drawing: OM-0100-C8_Pack-drw_20170329

All dimensions in mm typical.

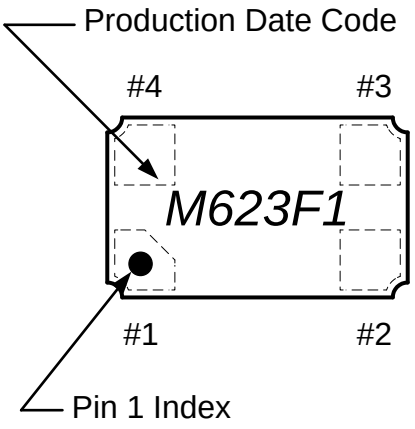
4.1.1.RECOMMENDED THERMAL RELIEF

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



4.2. MARKING AND PIN #1 INDEX

Laser marking OM-0100-C8 Package: (top view)

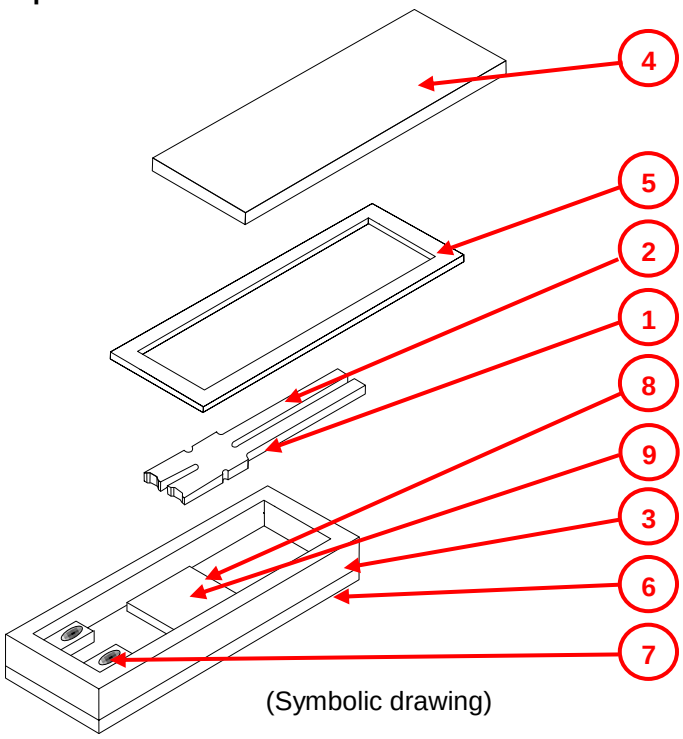


5. MATERIAL COMPOSITION DECLARATION & ENVIRONMENTAL INFORMATION

5.1. HOMOGENOUS MATERIAL COMPOSITION DECLARATION

Homogenous material information according to IPC-1752 standard

Material Composition OM-0100-C8:



(Symbolic drawing)

No.	Item Component Name	Sub Item Material Name	Material Weight (mg)	(%)	Substance Element	CAS Number	Comment
1	Resonator	Quartz Crystal	0.22	100%	SiO_2	14808-60-7	
2	Electrodes	Cr+Au	0.005	6%	Cr	Cr: 7440-47-3	
				94%	Au	Au: 7440-57-5	
3	Housing	Ceramic	3.24	100%	Al_2O_3	1344-28-1	
4	Metal Lid	Kovar Lid	1.05	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	Seal	Solder Preform	0.18	80%	Au80 / Sn20	Au: 7440-57-5	Premelted on Metal Lid
				20%		Sn: 7440-31-5	
6	Terminations	Internal and extrenal terminals	0.32	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	Resonator attach	Gold bumps	0.012	100%	Au	7440-57-5	
8	CMOS IC	Silicon	0.088	98%	Si	Si: 7440-21-3	
		Die pad plating		2%	Al	Al: 7429-90-5	
9	Die attach	Gold bumps	0.018	100%	Au	Au: 7440-57-5	
		Unit weight	5.13				

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	I	BBP	DBP	DEHP	DINP
1	Resonator	Quartz Crystal	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
3	Housing	Ceramic	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4	Metal Lid	Kovar Lid & Plating	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
6	Terminations	Int. & ext. terminals	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
7	Resonator attach	Gold bumps	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
9	Die attach	Gold bumps	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	MDL:	2 ppm (PBB / PBDE: 5 ppm)
Halogen	Test method with reference to BS EN 14582:2007	MDL:	50 ppm
Phthalates	Test method with reference to EN 14372	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 5.13 mg.

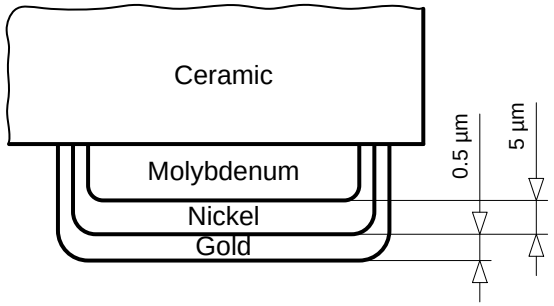
Item Material Name	No.	Item Component Name	Material Weight (mg)	Material Weight (%)	Substance Element	CAS Number	Comment
Quartz Crystal	1	Resonator	0.22	4.31	SiO_2	14808-60-7	
Chromium	2	Electrodes	0.0003	0.006	Cr	Cr: 7440-47-3	
Ceramic	3	Housing	3.24	63.08	Al_2O_3	1344-28-1	
Gold	2 4 5 6 7 9	Electrodes Metal Lid Seal Terminations Resonator attach Die attach	0.21	4.00	Au	Au: 7440-57-5	
Tin	5	Seal	0.036	0.70	Sn	Sn: 7440-31-5	
Nickel	4 6	Metal Lid Terminations	0.14	2.78	Ni	Ni: 7440-02-0	
Molybdenum	6	Terminations	0.26	4.99	Mo	Mo: 7439-98-7	
Kovar	4	Metal Lid	0.94	18.42	Fe53Ni29Co18	Fe: 7439-89-6 Ni: 7440-02-0 Co: 7440-48-4	
Silicon	8a	CMOS IC	0.086	1.68	Si	Si: 7440-21-3	
Aluminum	8b	CMOS IC	0.0018	0.034	Al	Al: 7429-90-5	
	Unit weight (total)		5.13	100			

5.4. ENVIRONMENTAL PROPERTIES & ABSOLUTE MAXIMUM RATINGS

Package	Description
SON-4	Small Outline Non-leaded (SON), ceramic package with metal lid

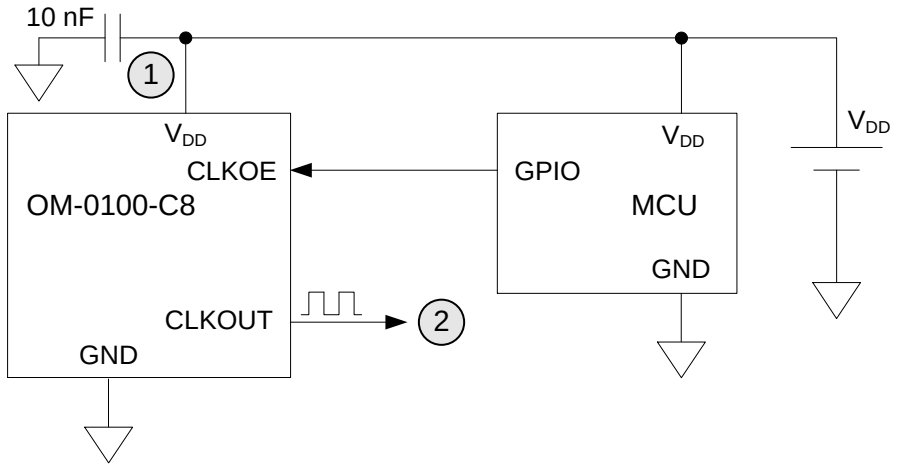
Parameter	Directive	Conditions	Value
Product weight (total)			5.13 mg
Storage temperature		Store as bare product	-55 to +125°C
Moisture sensitivity level (MSL)	IPC/JEDEC J-STD-020D		MSL1
FIT / MTBF			available on request

Terminal finish:



6. APPLICATION INFORMATION

6.1. OPERATING OM-0100-C8

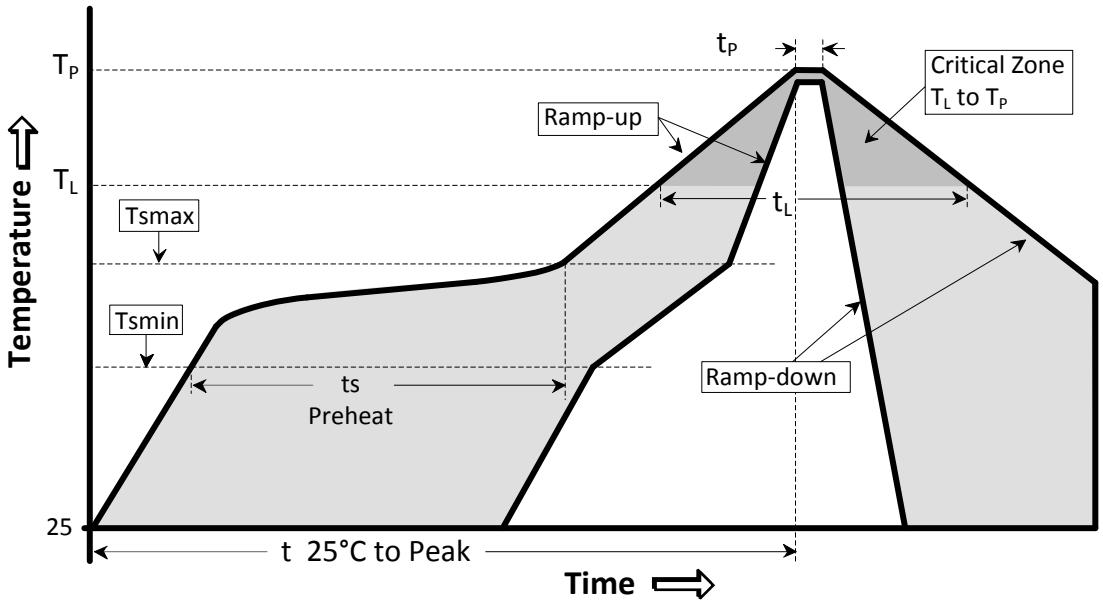


1 A 10 nF decoupling capacitor is recommended close to the device.

2 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).

6.2. SOLDERING INFORMATION

Maximum Reflow Conditions in accordance with IPC/JEDEC J-STD-020C "Pb-free"



Temperature Profile	Symbol	Condition	Unit
Average ramp-up rate	(Ts_{max} 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	$T_{to\text{-}peak}$	8 minutes max	min
Preheat			
Temperature min	Ts_{min}	150	°C
Temperature max	Ts_{max}	200	°C
Time Ts_{min} to Ts_{max}	ts	60 – 180	sec
Soldering above liquidus			
Temperature liquidus	T_L	217	°C
Time above liquidus	t_L	60 – 150	sec
Peak temperature			
Peak Temperature	Tp	260	°C
Time within 5°C of peak temperature	tp	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 damages crystals due to mechanical resonance of the crystal blank.

Overheating, rework high temperature exposure:

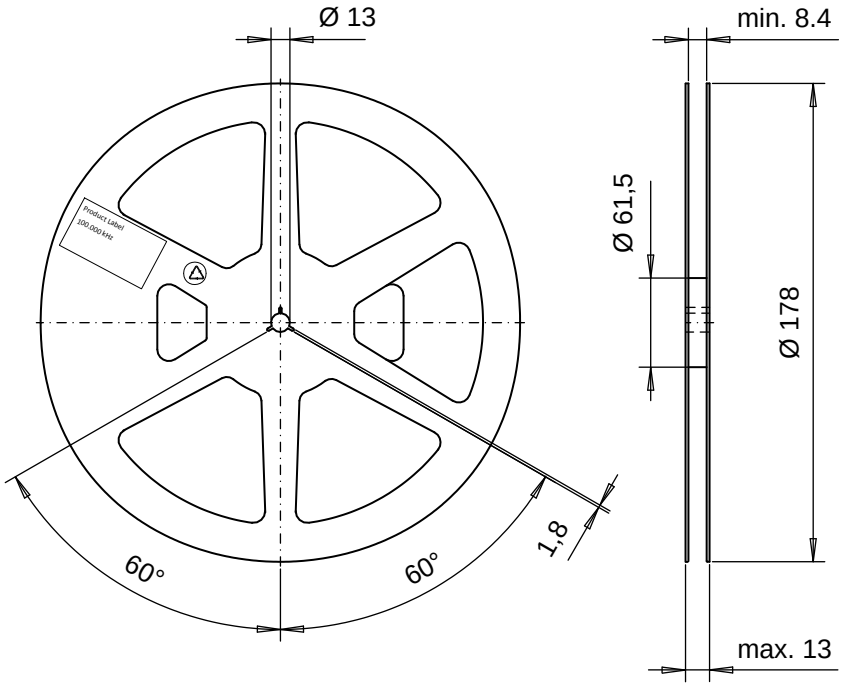
Avoid overheating the package. The package is sealed with a seal ring consisting of 80% Gold and 20% Tin. The eutectic melting temperature of this alloy is at 280°C. Heating the seal ring up to >280°C will cause melting of the metal seal which then, due to the vacuum, is sucked into the cavity forming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

Use the following methods for rework:

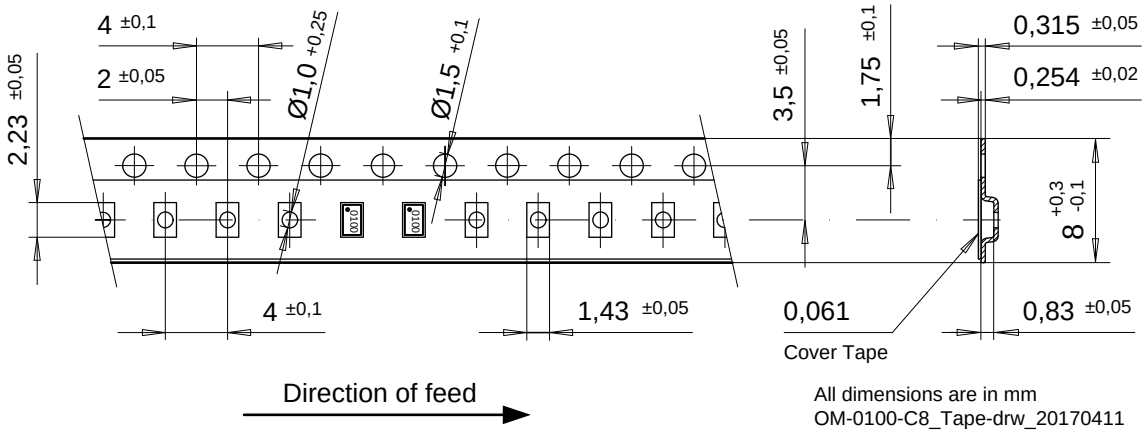
- Use a hot-air- gun set at 270°C.
- Use 2 temperature controlled soldering irons, set at 270°C, with special-tips to contact all solder-joints from both sides of the package at the same time, remove part with tweezers when pad solder is liquid.

7. PACKING & SHIPPING INFORMATION

Reel: 7” = 178 mm



Carrier Tape:
Material: Polycarbonate
Width: 8 mm
Tape Leader and Trailer: Minimum length 300 mm



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 OM-0100-C8 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

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