

Application Manual

OM-7604-C7

Low Power Clock Oscillator 32.768 kHz

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OM-7604-C7

Low Power Clock Oscillator 32.768 kHz

1. OVERVIEW

- Oscillator with built-in “Tuning Fork” crystal oscillating at 32.768 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. 300 nA
- Standard operating temperature range T_A : -40 to +85°C
- Extended operating temperature range T_B : -40 to +125°C
- Synchronized output after Enable/Disable
- Low aging rate
- Miniature ceramic SMT package with metal lid, RoHS-compliant and 100% lead-free: 3.2 x 1.5 x 0.70 mm
- Automotive qualification according to AEC-Q200 available

1.1. GENERAL DESCRIPTION

The OM-7604-C7 combines an advanced very low power CMOS oscillator circuitry together with a 32.768 kHz “tuning-fork” crystal in a miniaturized 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 synchronous 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 tied to Low State.

The OM-7604-C7 is also available in extended temperature range version (-40°C to +125°C).

1.2. APPLICATIONS

The OM-7604-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 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

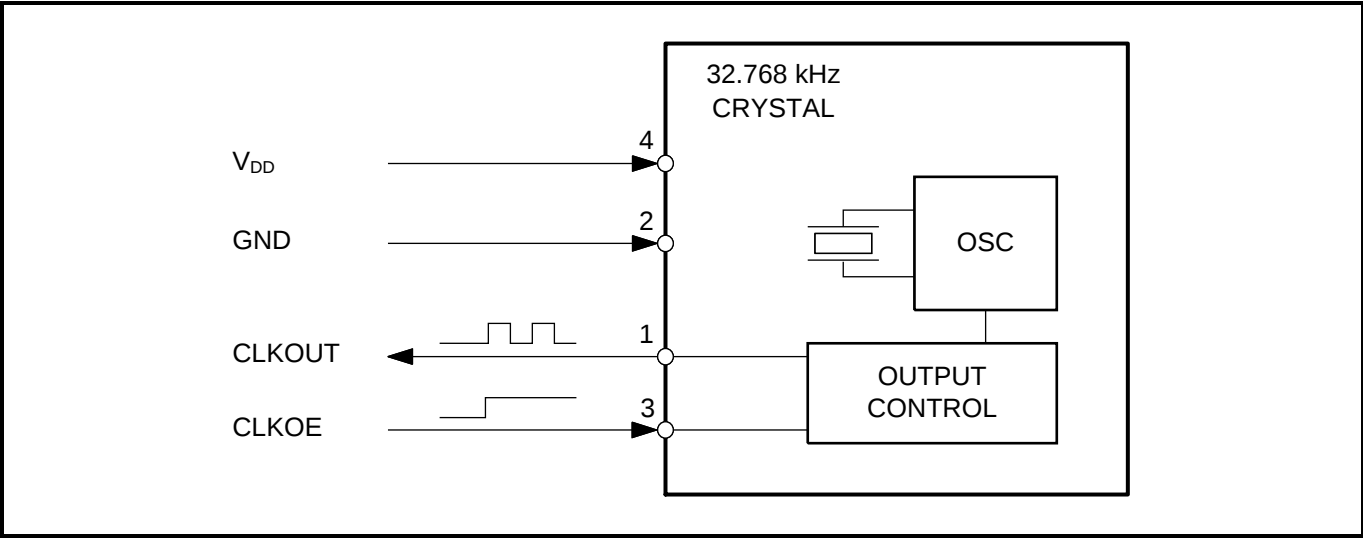
1.3. ORDERING INFORMATION

Example: OM-7604-C7 -20/+20ppm TA QC

Code	Operating temperature range
TA (Standard)	-40 to +85°C
TB	-40 to +125°C

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

2. BLOCK DIAGRAM



2.1. PINOUT

C7 Package: (top view)

#4

#3

#1

#2

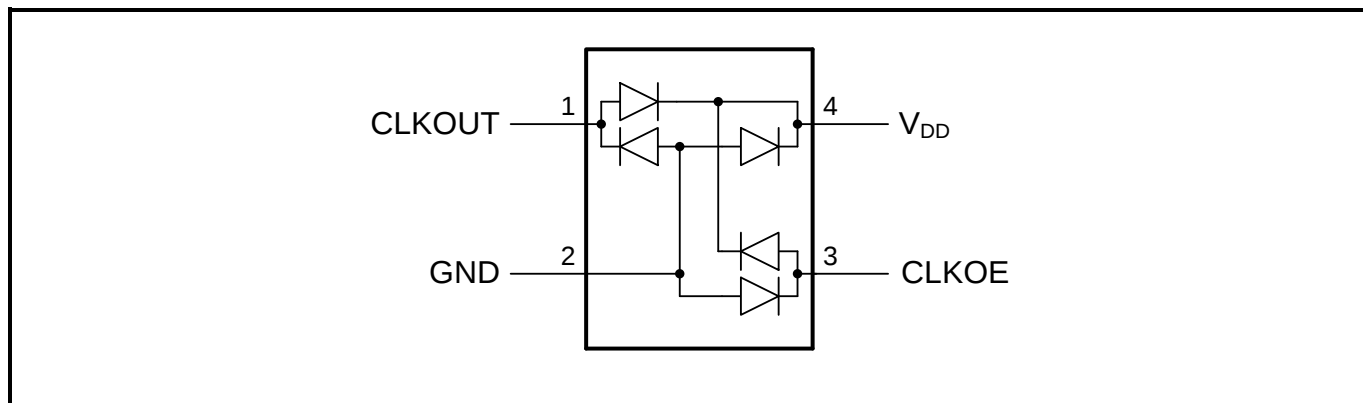
7604

#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 32.768 kHz. When CLKOE is tied to Ground, the CLKOUT pin is LOW.
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 LOW.
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		-0.3	6.0	V
V_I	Input voltage		-0.3	6.0	V
V_O	Output voltage		-0.3	6.0	V
P_{TOT}	Total power dissipation			300	mW
V_{ESD}	Electrostatic discharge Voltage	HBM (1)		±2000	V
I_{LU}	Latch-up current	(2)		±100	mA
T_{OPRA}	Standard operating temperature T_A		-40	85	°C
T_{OPRB}	Extended operating temperature T_B		-40	125	°C
T_{STO}	Storage temperature	Stored as bare product	-55	125	°C
T_{PEAK}	Maximum reflow condition	JEDEC J-STD-020C		265	°C

(1) HBM: Human Body Model, according to JESD22-A114.

(2) Latch-up testing, according to JESD78., Class I (room temperature), level A (100 mA).

3.2. OPERATING PARAMETERS

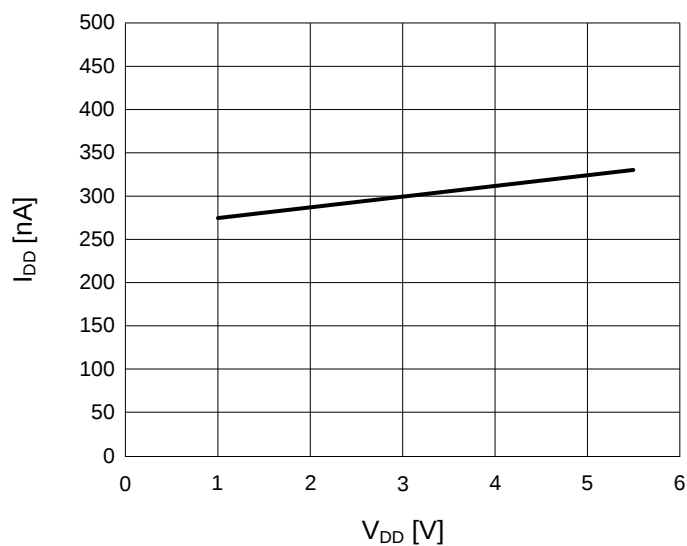
For this Table, $V_{DD} = 3.0$ V; $GND = 0$ V; $T_A = 25$ °C; unless otherwise indicated.

Operating Parameters:

Operating Parameters:						
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Supply						
V _{DD}	Power supply voltage	T _A = -30 to 125°C	1.2		5.5	V
		T _A = -40 to -30°C	1.3		5.5	
V _{DDSR}	V _{DD} slew rate				±0.5	V/ms
I _{DD}	V _{DD} Supply Current. CLKOUT disabled. (1)	V _{DD} = 3.0 V		300	500	nA
		V _{DD} = 5.0 V		320	550	
		V _{DD} = 3.0 V, T _A = -40 to 85°C			1000	
		V _{DD} = 5.0 V, T _A = -40 to 85°C			1100	
		V _{DD} = 3.0 V, T _A = -40 to 125°C			1500	
		V _{DD} = 5.0 V, T _A = -40 to 125°C			1650	
Input CLKOE						
V _I	Input voltage		GND -0.3		V _{DD} +0.3	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} = -1.0 mA	V _{DD} – 0.4			V
V _{OL}	LOW level output voltage	I _{OL} = 1.0 mA			GND +0.4	V
C _L	Output load capacitance	CMOS			15	pF
t _r	Output rise time	C _L = 10 pF, 10% to 90% V _{DD}		70	100	ns
t _f	Output fall time	C _L = 10 pF, 10% to 90% V _{DD}		70	100	ns
t _{CKH}	Synchronized CLKOUT enable time (see following diagram)		15.3		45.8	µs
t _{CKL}	Synchronized CLKOUT disable time (see following diagram)		0		15.3	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 x V _{DD} x f _{OUT} e.g. ΔI _{DD} = 10 pF x 3.0 V x 32'768 Hz = 980 nA						

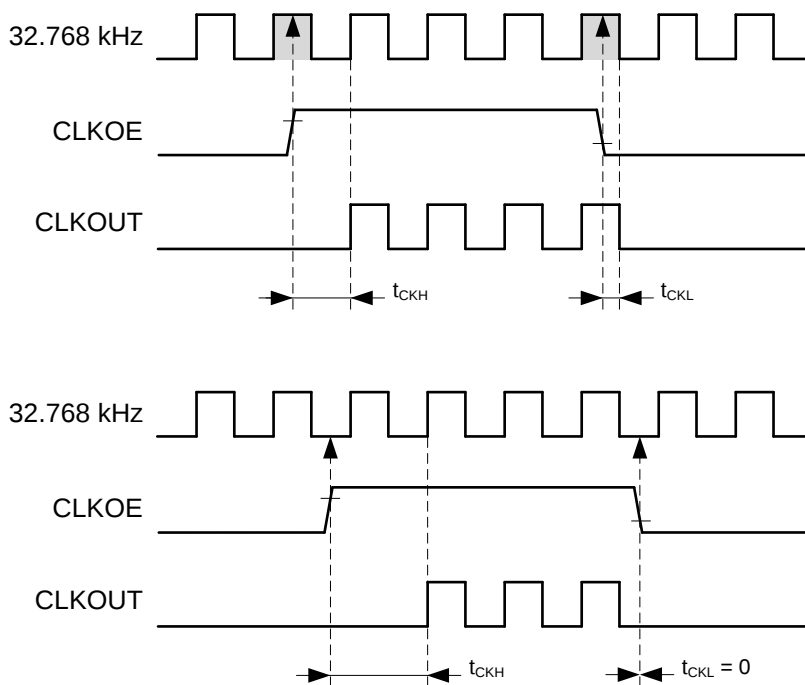
3.3. TYPICAL CHARACTERISTICS

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



3.4. TIMING WAVEFORMS

Synchronized CLKOUT enable/disable time:



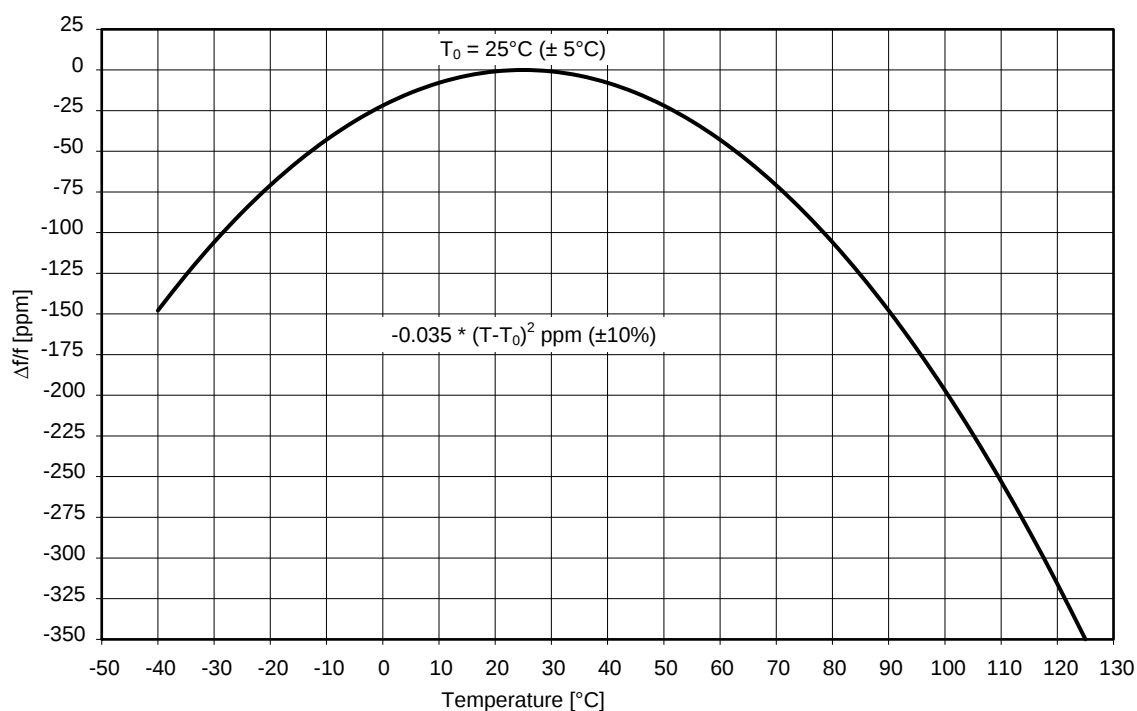
3.5. OSCILLATOR PARAMETERS

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

Oscillator Parameters:

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Xtal General						
f	Crystal Frequency			32.768		kHz
t _{START}	Oscillator start-up time			0.4	0.8	s
$\bar{D}_{CLKOUT}$	CLKOUT duty cycle	$T_A = -30\text{ to }125^{\circ}\text{C}$ $V_{DD} = 1.2\text{ to }5.5\text{ V}$ $T_A = -40\text{ to }-30^{\circ}\text{C}$ $V_{DD} = 1.3\text{ to }5.5\text{ V}$	40		60	%
Xtal Frequency Characteristics						
$\Delta f/f$	Frequency accuracy			± 10	± 20	ppm
$\Delta f/V$	Frequency vs. voltage characteristics	$1.5\text{ V} \leq V_{DD} \leq 5.5\text{ V}$			± 1.5	ppm/V
$\Delta f/f_{TOPR}$	Frequency vs. temperature characteristics	$T_{OPR} = -40^{\circ}\text{C to }+125^{\circ}\text{C}$ $V_{DD} = 3.0\text{ V}$	$-0.035^{\text{ppm}}/^{\circ}\text{C}^2 (T_{OPR}-T_0)^2 \pm 10\%$			ppm
T ₀	Turnover temperature		20		30	$^{\circ}\text{C}$
$\Delta f/f$	Aging first year max.				± 3	ppm

3.5.1.XTAL FREQUENCY VS. TEMPERATURE CHARACTERISTICS

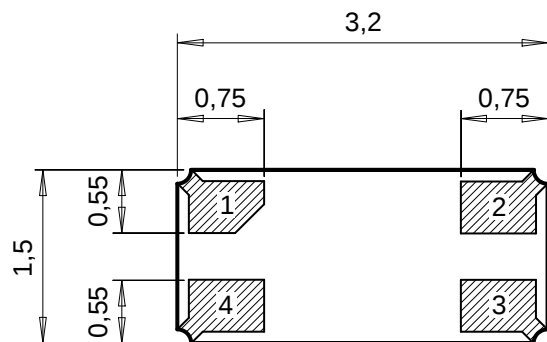


4. PACKAGE

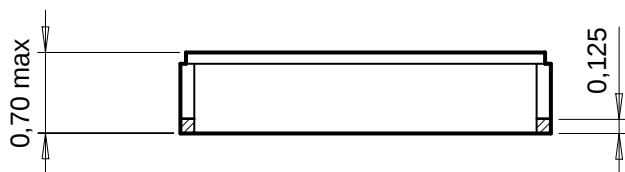
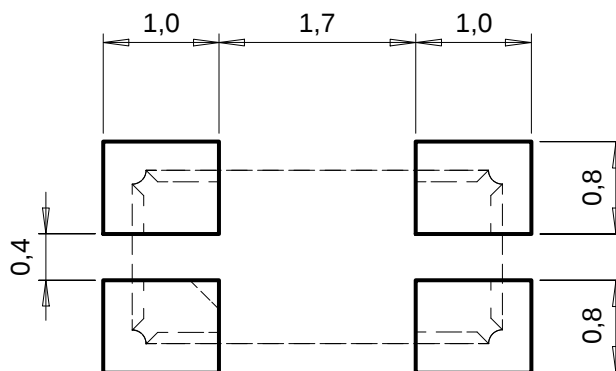
4.1. DIMENSIONS AND SOLDER PAD LAYOUT

OM-C7 Package:

Package dimensions (bottom view):



Recommended solder pad layout:



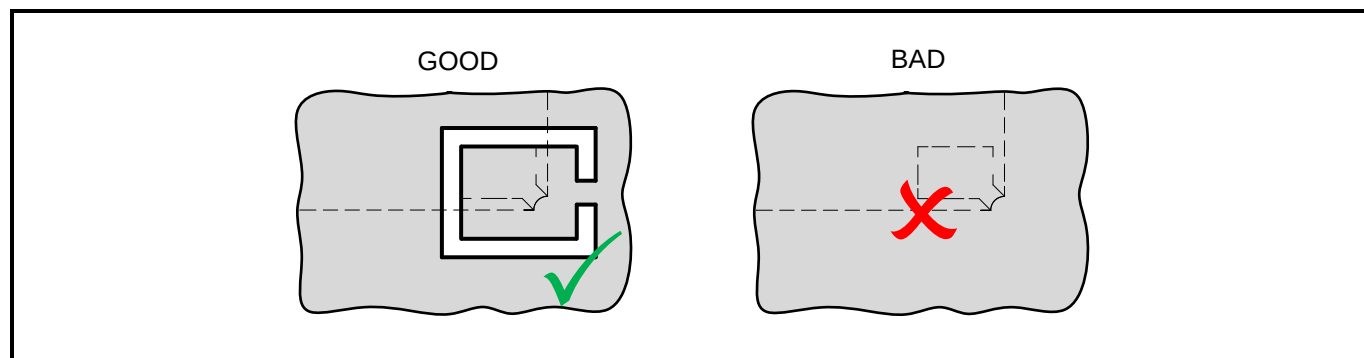
Metal lid is not connected

Tolerances: unless otherwise specified $\pm 0.1\text{mm}$
 Drawing: OM-7604-C7_Pack-drw_20170214

All dimensions in mm typical.

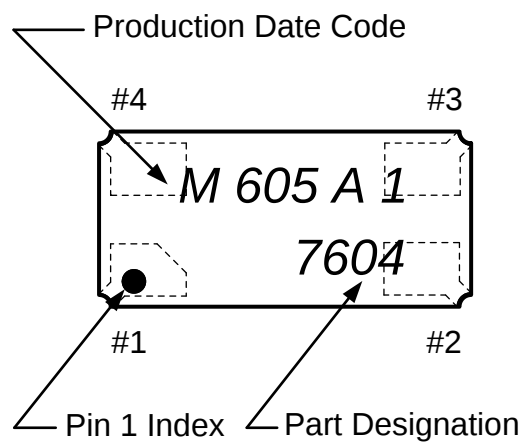
4.1.1. RECOMMENDED THERMAL RELIEF

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



4.2. MARKING AND PIN #1 INDEX

Laser marking OM-7604-C7 Package: (top view)

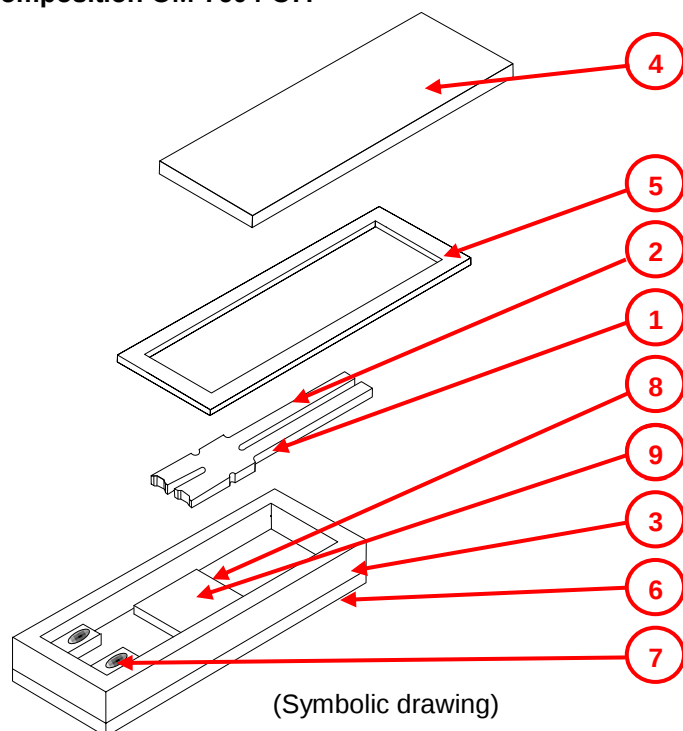


5. MATERIAL COMPOSITION DECLARATION & ENVIRONMENTAL INFORMATION

5.1. HOMOGENOUS MATERIAL COMPOSITION DECLARATION

Homogenous material information according to IPC-1752 standard

Material Composition OM-7604-C7:



No.	Item Component Name	Sub Item Material Name	Material Weight (mg) (%)		Substance Element	CAS Number	Comment
1	Resonator	Quartz Crystal	0.27	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	6.30	100%	Al ₂ O ₃	1344-28-1	
4	Metal Lid	Kovar Lid	2.67	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	0.54	80%	Au80 / Sn20	Au: 7440-57-5	
				20%		Sn: 7440-31-5	
6	Terminations	Internal and extrenal 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 Silicone glue	0.09	88%	Ag	Ag: 7440-22-4	
				12%	Siloxanes and silicones	68083-19-2	di-Me, vinyl group-terminated
				0%	Distillates, petroleum hydrotreated	64742-47-8	Does not appear in finished product
8	CMOS IC	Silicon Die pad plating	0.34	94%	Si	Si: 7440-21-3	
				6%	Au	Au: 7440-57-5	
9	Die attach	Gold bumps	0.025	100%	Au	Au: 7440-57-5	
Unit weight			10.57				

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	Conductive adhesive	Silver filled Silicone glue	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 10.6 mg.

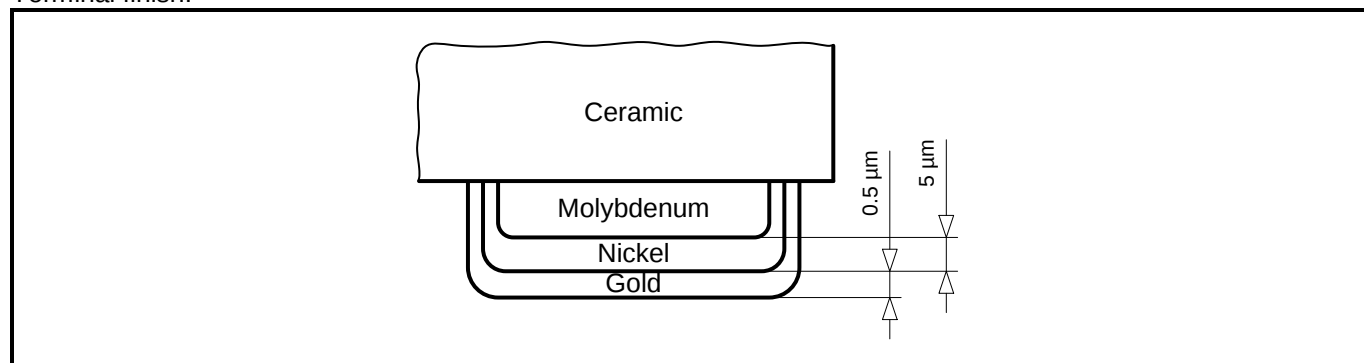
Item Material Name	No.	Item Component Name	Material Weight (mg) (%)		Substance Element	CAS Number	Comment
Quartz Crystal	1	Resonator	0.27	2.58	SiO ₂	14808-60-7	
Chromium	2	Electrodes	0.0003	0.003	Cr	Cr: 7440-47-3	
Ceramic	3	Housing	6.30	59.59	Al ₂ O ₃	1344-28-1	
Gold	2 4 5 6 8 9	Electrodes Metal Lid Seal Terminations CMOS IC Die attach	0.53	4.97	Au	Au: 7440-57-5	
Tin	5	Seal	0.11	1.02	Sn	Sn: 7440-31-5	
Nickel	4 6	Metal Lid Terminations	0.29	2.74	Ni	Ni: 7440-02-0	
Molybdenum	6	Terminations	0.26	2.50	Mo	Mo: 7439-98-7	
Kovar	4	Metal Lid	2.40	22.73	Fe53Ni29Co18	Fe: 7439-89-6 Ni: 7440-02-0 Co: 7440-48-4	
Silver	7a	Conductive adhesive	0.079	0.75	Ag	Ag: 7440-22-4	
Siloxanes and silicones	7b	Conductive adhesive	0.011	0.10	Siloxanes and silicones	68083-19-2	di-Me, vinyl group-terminated
Distillates	7c	Conductive adhesive	0	0	Distillates	64742-47-8	hydrotreated petroleum, does not appear in finished products
Silicon	8	CMOS IC	0.32	3.02	Si	Si: 7440-21-3	
Unit weight (total)			10.6	100			

5.4. ENVIRONMENTAL PROPERTIES & ABSOLUTE MAXIMUM RATINGS

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

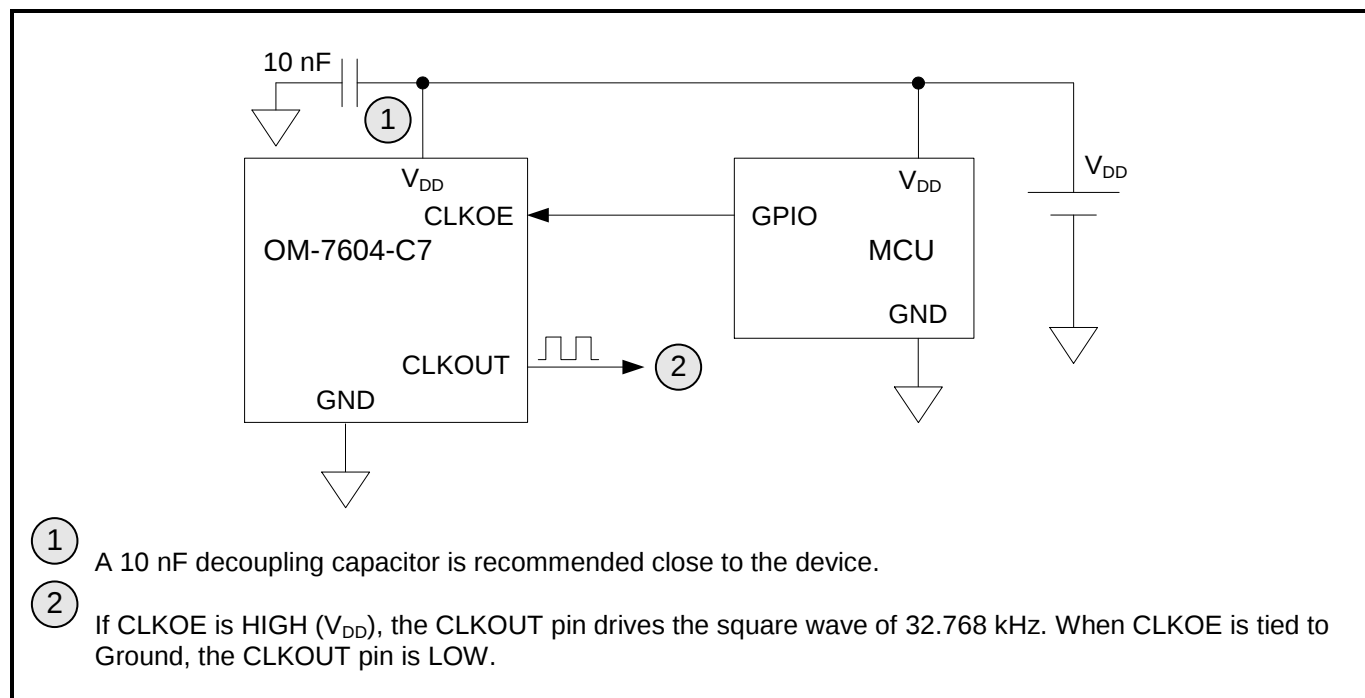
Parameter	Directive	Conditions	Value
Product weight (total)			10.6 mg
Storage temperature		Store as bare product	-55 to +125°C
Moisture sensitivity level (MSL)	IPC/JEDEC J-STD-020D		MSL1
FIT / MTBF			available on request

Terminal finish:



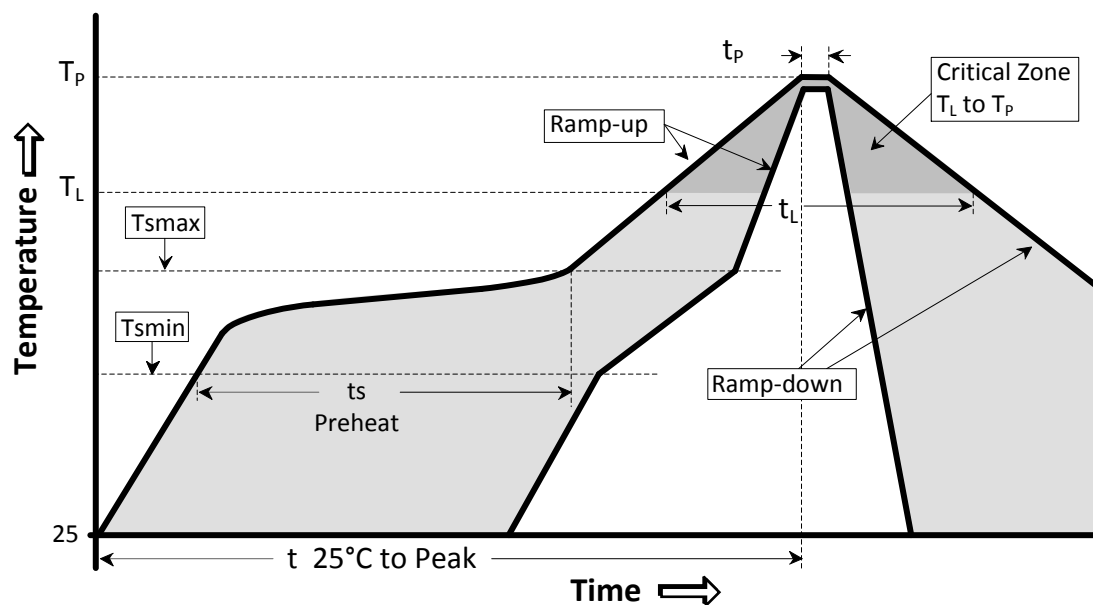
6. APPLICATION INFORMATION

6.1. OPERATING OM-7604-C7



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	(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}	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	T _p	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 32.768 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 crystals due to mechanical resonance of the crystal blank.

Overheating, rework high temperature exposure:

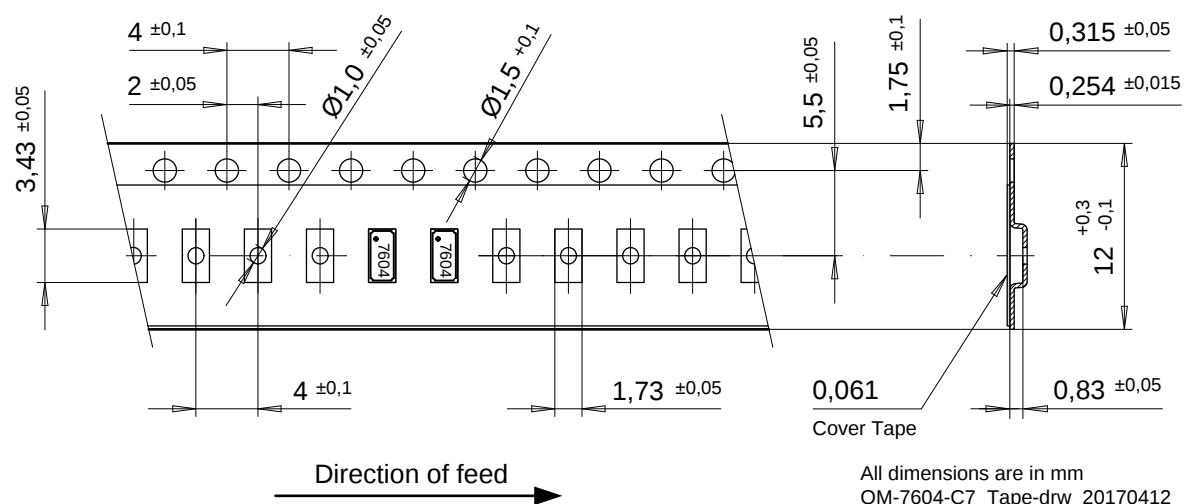
Avoid overheating the package. The package is sealed with a seal ring consisting of 80% Gold and 20% Tin. The eutectic melting temperature of this alloy is at 280°C. Heating the seal ring up to >280°C will cause melting of the metal seal which then, due to the vacuum, is sucked into the cavity forming 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.

Technical drawing of a circular product label. The top view shows a circle with a diameter of $\varnothing 13$. The label features a central circular hole and six triangular segments arranged radially. The segments are separated by gaps, with a 60° angle indicated between the segments. A dimension of 1.8 is shown for the width of the segments. A label is attached to the top left, reading "Product Label 32-7680Hz". A side view on the right shows the label's profile, with a minimum thickness of $\text{min. } 12.4$ and a maximum height of $\text{max. } 17$. The side view also shows the internal structure, including a central hole with a diameter of $\varnothing 61.5$ and a total height of $\varnothing 178$.

Tape Leader and Trailer: Minimum length 300 mm



Thickness: 0.061 mm

Medial section removal, both lateral stripes remain on carrier

8. COMPLIANCE INFORMATION

Micro Crystal confirms that the standard product Low Power Clock Oscillator OM-7604-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
August 2017	1.0	First release
June 2019	1.1	Complemented Operating Parameters, 3.2. Specified Oscillator Parameters up to +125°C, 3.5. Added metal lid is not connected, 4.1.

Information furnished is believed to be accurate and reliable. However, Micro Crystal assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. In accordance with our policy of continuous development and improvement, Micro Crystal reserves the right to modify specifications mentioned in this publication without prior notice. This product is not authorized for use as critical component in life support devices or systems.



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