RFM®

RO2138A

## 407.300 MHz SAW Resonator

- *Ideal for European 418.0 MHz Superhet Receiver LOs*
- *Very Low Series Resistance*
- *Quartz Stability*
- *Surface-Mount, Ceramic Case with 21 mm^2 Footprint*
- *Complies with Directive 2002/95/EC (RoHS)*

The RO2138A is a true one-port, surface-acoustic-wave (SAW) resonator in a surface-mount, ceramic case. It provides reliable, fundamental-mode, quartz frequency stabilization of local oscillators operating at approximately 407.3 MHz. This SAW was designed for 418.0 MHz superhet receivers with 10.7 MHz IF. Applications include remote-control and wireless security receivers operating in the United Kingdom under DTI MPT 1340 and in the USA under FCC Part 15 regulations.

SM-2 Case

Absolute Maximum Ratings

Rating	Value	Units
CW RF Power Dissipation (See Typical Test Circuit)	+0	dBm
DC Voltage Between Terminals (Observe ESD Precautions)	±30	VDC
Case Temperature	-40 to +85	°C
Soldering Temperature (10 seconds / 5 cycles max.)	260	°C
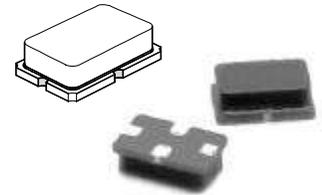
Electrical Characteristics

| Characteristic		Sym	Notes	Minimum	Typical	Maximum	Units
Frequency (+25 °C)	Nominal Frequency	f_C	2, 3, 4, 5	407.225		407.375	MHz
	Tolerance from 407.300 MHz	Δf_C				±75	kHz
Insertion Loss		IL	2, 5, 6		1.2	1.7	dB
Quality Factor	Unloaded Q	Q_U	5, 6, 7		14,800		
	50 Ω Loaded Q	Q_L			1,700		
Temperature Stability	Turnover Temperature	T_O	6, 7, 8	10	25	40	°C
	Turnover Frequency	f_O			f_C		
	Frequency Temperature Coefficient	FTC			0.032		ppm/°C^2
Frequency Aging	Absolute Value during the First Year	$|f_A|$	1		≤10		ppm/yr
DC Insulation Resistance between Any Two Terminals			5	1.0			MΩ
RF Equivalent RLC Model	Motional Resistance	R_M	5, 7, 9, 6		14	26	Ω
	Motional Inductance	L_M			78.4820		µH
	Motional Capacitance	C_M			1.95000		fF
	Transducer Static Capacitance	C_O	5, 6, 9	1.8	2.1	2.4	pF
Test Fixture Shunt Inductance		L_{TEST}	2, 7		74		nH
Lid Symbolization				144			

CAUTION: Electrostatic Sensitive Device. Observe precautions for handling.

Notes:

1. Frequency aging is the change in f_C with time and is specified at +65°C or less. Aging may exceed the specification for prolonged temperatures above +65°C. Typically, aging is greatest the first year after manufacture, decreasing in subsequent years.
2. The center frequency, f_C, is measured at the minimum insertion loss point, IL_{MIN}, with the resonator in the 50 Ω test system (VSWR ≤ 1.2:1). The shunt inductance, L_{TEST}, is tuned for parallel resonance with C_O at f_C. Typically, $f_{OSCILLATOR}$ or $f_{TRANSMITTER}$ is approximately equal to the resonator f_C.
3. One or more of the following United States patents apply: 4,454,488 and 4,616,197.
4. Typically, equipment utilizing this device requires emissions testing and government approval, which is the responsibility of the equipment manufacturer.
5. Unless noted otherwise, case temperature T_C = +25°C±2°C.
6. The design, manufacturing process, and specifications of this device are subject to change without notice.
7. Derived mathematically from one or more of the following directly measured parameters: f_C, IL, 3 dB bandwidth, f_C versus T_C, and C_O.

8. Turnover temperature, T_O, is the temperature of maximum (or turnover) frequency, f_O. The nominal frequency at any case temperature, T_C, may be calculated from: $f = f_O [1 - FTC (T_O - T_C)^2]$. Typically *oscillator* T_O is approximately equal to the specified *resonator* T_O.
9. This equivalent RLC model approximates resonator performance near the resonant frequency and is provided for reference only. The capacitance C_O is the static (nonmotional) capacitance between the two terminals measured at low frequency (10 MHz) with a capacitance meter. The measurement includes parasitic capacitance with "NC" pads unconnected. Case parasitic capacitance is approximately 0.05 pF. Transducer parallel capacitance can by calculated as: $C_P \approx C_O - 0.05$ pF.

407.300 MHz   *SAW Resonator*

Electrical Connections

The SAW resonator is bidirectional and may be installed with either orientation. The two terminals are interchangeable and unnumbered. The callout NC indicates no internal connection. The NC pads assist with mechanical positioning and stability. External grounding of the NC pads is recommended to help reduce parasitic capacitance in the circuit.
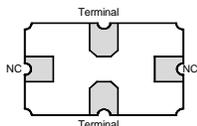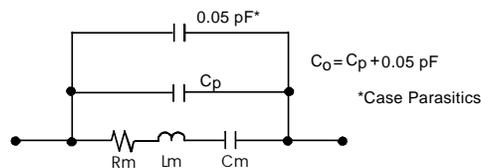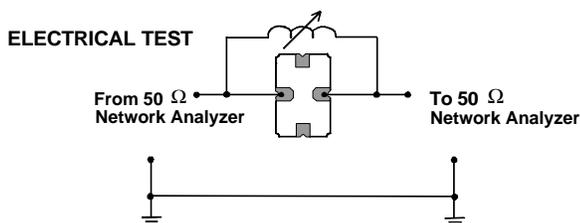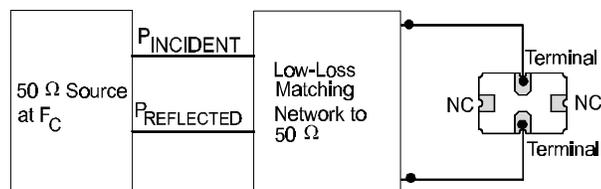

Typical Test Circuit

The test circuit inductor, L_{TEST}, is tuned to resonate with the static capacitance, C_O, at F_C.

ELECTRICAL TEST

From 50 Ω
Network Analyzer

To 50 Ω
Network Analyzer

POWER TEST

50 Ω Source at F_C

$P_{INCIDENT}$

$P_{REFLECTED}$

Low-Loss Matching Network to 50 Ω

Terminal

NC   NC

Terminal
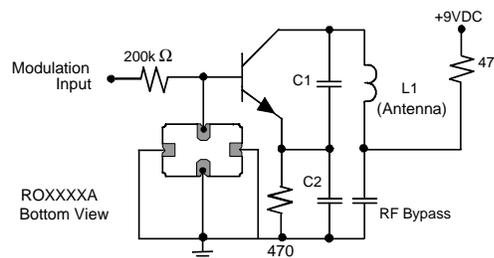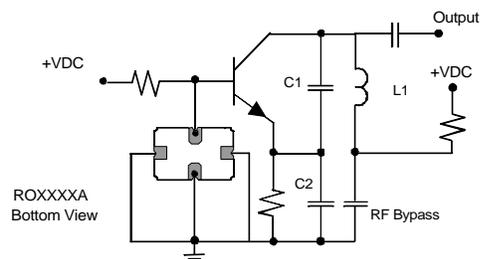
CW RF Power Dissipation = $P_{INCIDENT}$ - $P_{REFLECTED}$

Typical Application Circuits

Typical Low-Power Transmitter Application

Modulation Input
200k Ω
C1
+9VDC
47
L1 (Antenna)
C2
RF Bypass
470
ROXXXXA Bottom View

Typical Local Oscillator Application

+VDC
C1
L1
+VDC
Output
C2
RF Bypass
ROXXXXA Bottom View

Equivalent LC Model

0.05 pF*

Cp

$C_O = C_p + 0.05$ pF

*Case Parasitics

Rm   Lm   Cm

Temperature Characteristics

The curve shown on the right accounts for resonator contribution only and does not include LC component temperature contributions.

$f_C = f_O$, $T_C = T_O$

$\Delta T = T_C - T_O$ (°C)
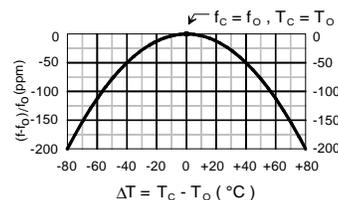
Typical Circuit Board Land Pattern

The circuit board land pattern shown below is one possible design. The optimum land pattern is dependent on the circuit board assembly process which varies by manufacturer. The distance between adjacent land edges should be at a maximum to minimize parasitic capacitance. Trace lengths from terminal lands to other components should be short and wide to minimize parasitic series inductances.

(4 Places)

Typical Dimension: 0.010 to 0.047 inch (0.25 to 1.20 mm)
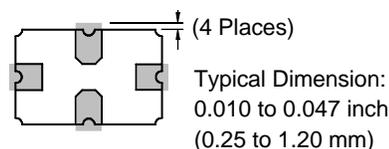
Case Design

The case material is black alumina with contrasting symbolization. All pads are nominally centered with respect to the base and consist of 40 to 70 microinches electroless gold on 60-350 micorinches electroless nickel.
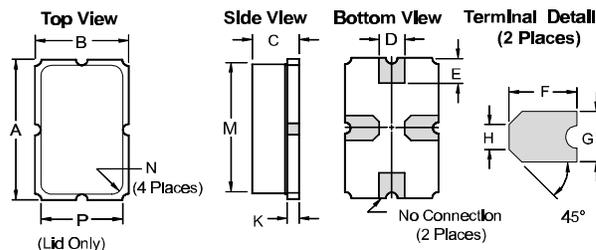
Dimensions	Millimeters		Inches	
	Min	Max	Min	Max
A	5.74	5.99	0.226	0.236
B	3.73	3.99	0.147	0.157
C	1.70	2.29	0.067	0.090
D	0.94	1.10	0.037	0.043
E	0.83	1.20	0.033	0.047
F	1.16	1.53	0.046	0.060
G	0.94	1.10	0.037	0.043
H	0.43	0.59	0.017	0.023
K	0.43	0.59	0.017	0.023
M	5.08	5.33	0.200	0.210
N	0.38	0.64	0.015	0.025
P	3.05	3.30	0.120	0.130