# RO2101

# 433.92 MHz SAW Resonator

- ***Ideal for 433.92 MHz Transmitters***
- ***Very Low Series Resistance***
- ***Quartz Stability***
- ***Rugged, Hermetic, Low-Profile TO39 Case***
- ***Complies with Directive 2002/95/EC (RoHS)***

The RO2101 is a true one-port, surface-acoustic-wave (SAW) resonator in a low-profile TO39 case. It provides reliable, fundamental-mode, quartz frequency stabilization of fixed-frequency transmitters operating at 433.92 MHz. The RO2101 is designed specifically for remote-control and wireless security transmitters operating in Europe under ETSI I-ETS 300 220 and in Germany under FTZ 17 TR 2100.



**TO39-3 Case**

### Absolute Maximum Ratings

| Rating | Value | Units |
|---|---|---|
| CW RF Power Dissipation | +0 | dBm |
| DC Voltage Between Any Two Pins | ±30 | VDC |
| Case Temperature | -40 to +85 | °C |

### Electrical Characteristics

| Characteristic | | Sym | Notes | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|---|---|
| Center Frequency (+25 °C) | Absolute Frequency | $f_C$ | 2, 3, 4, 5 | 433.845 | | 433.995 | MHz |
| | Tolerance from 433.920 MHz | $\Delta f_C$ | | | | ±75 | kHz |
| Insertion Loss | | IL | 2, 5, 6 | | 1.5 | 2.0 | dB |
| Quality Factor | Unloaded Q | $Q_U$ | 5, 6, 7 | | 12,800 | | |
| | 50 Ω Loaded Q | $Q_L$ | | | 2,000 | | |
| Temperature Stability | Turnover Temperature | $T_O$ | 6, 7, 8 | 24 | 39 | 54 | °C |
| | Turnover Frequency | $f_O$ | | | $f_c$ + 2.7 | | kHz |
| | Frequency Temperature Coefficient | FTC | | | 0.037 | | ppm/°C$^2$ |
| Frequency Aging | Absolute Value during the First Year | $\|f_A\|$ | 1 | | ≤10 | | ppm/yr |
| DC Insulation Resistance between Any Two Pins | | | 5 | 1.0 | | | MΩ |
| RF Equivalent RLC Model | Motional Resistance | $R_M$ | 5, 7, 9 | | 18 | 26 | Ω |
| | Motional Inductance | $L_M$ | | | 86.0075 | | µH |
| | Motional Capacitance | $C_M$ | | | 1.56417 | | fF |
| | Pin 1 to Pin 2 Static Capacitance | $C_O$ | 5, 6, 9 | 1.7 | 2.0 | 2.3 | pF |
| | Transducer Static Capacitance | $C_P$ | 5, 6, 7, 9 | | 1.7 | | pF |
| Test Fixture Shunt Inductance | | $L_{TEST}$ | 2, 7 | | 78 | | nH |
| Lid Symbolization (in Addition to Lot and/or Date Codes) | | RFM RO2101 | | | | | |

**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 significantly 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 less than the resonator $f_C$.
3. One or more of the following United States patents apply: 4,454,488 and 4,616,197 and others pending.
4. Typically, equipment designs utilizing this device require 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 20°C less than 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 pin1 and pin 2 measured at low frequency (10 MHz) with a capacitance meter. The measurement includes case parasitic capacitance with a floating case. For usual grounded case applications (with ground connected to either pin 1 or pin 2 and to the case), add approximately 0.25 pF to $C_O$.

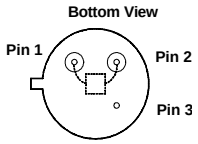
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## Electrical Connections

This one-port, two-terminal SAW resonator is bidirectional. The terminals are interchangeable with the exception of circuit board layout.

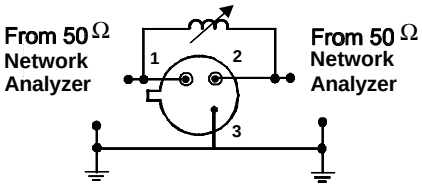
| Pin | Connection |
|---|---|
| 1 | Terminal 1 |
| 2 | Terminal 2 |
| 3 | Case Ground |



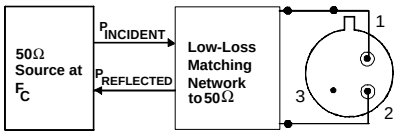

## Typical Test Circuit

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

**Electrical Test:**



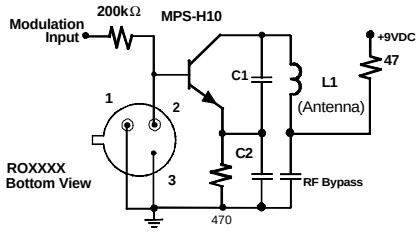

**Power Test:**



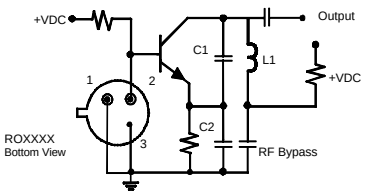

CW RF Power Dissipation = $P_{INCIDENT} - P_{REFLECTED}$

## Typical Application Circuits

**Typical Low-Power Transmitter Application:**

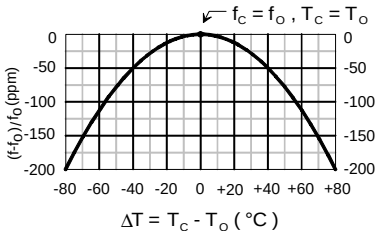



**Typical Local Oscillator Application:**



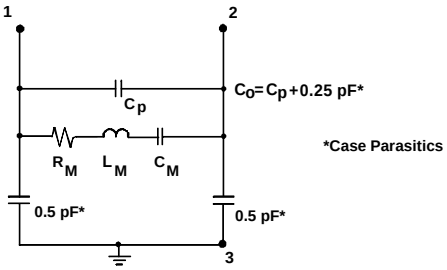

## Temperature Characteristics

The curve shown on the right accounts for resonator contribution only and does not include oscillator temperature characteristics.

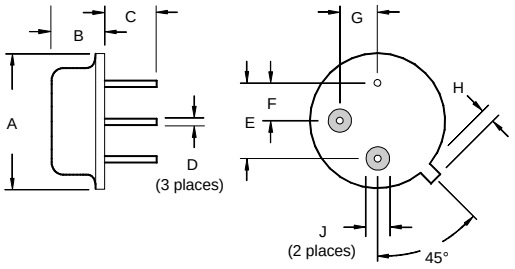



## Equivalent LC Model

The following equivalent LC model is valid near resonance:




## Case Design




| Dimensions | Millimeters | | Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | | 9.40 | | 0.370 |
| B | | 3.18 | | 0.125 |
| C | 2.50 | 3.50 | 0.098 | 0.138 |
| D | 0.46 Nominal | | 0.018 Nominal | |
| E | 5.08 Nominal | | 0.200 Nominal | |
| F | 2.54 Nominal | | 0.100 Nominal | |
| G | 2.54 Nominal | | 0.100 Nominal | |
| H | | 1.02 | | 0.040 |
| J | 1.40 | | 0.055 | |


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