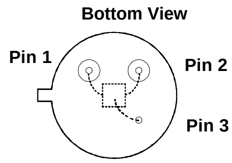
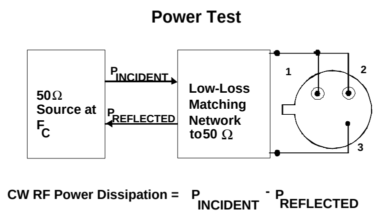
## Electrical Connections

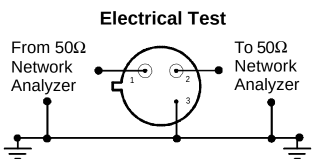
This two-port, three-terminal SAW resonator is bidirectional. However, impedances and circuit board parasitics may not be symmetrical, requiring slightly different oscillator component-matching values.

| Pin | Connection |
|---|---|
| 1 | Input or Output |
| 2 | Output or Input |
| 3 | Case Ground |




## Typical Test Circuit

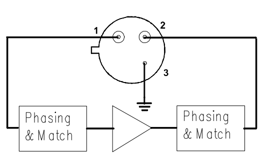


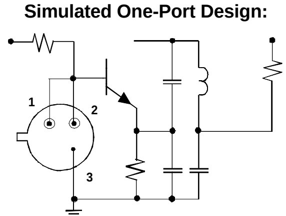

## Typical Application Circuits

This SAW resonator can be used in oscillator or transmitter designs that require 180° phase shift at resonance in a two-port configuration. One-port resonators can be simulated, as shown, by connecting pins 1 and 2 together. However, for most low-cost consumer products, this is only recommended for retrofit applications and not for new designs.

**Conventional Two-Port Design:**

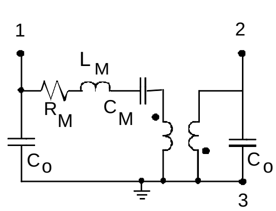



**Simulated One-Port Design:**



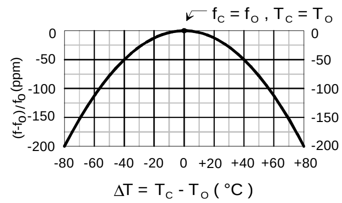

## Equivalent LC Model

The following equivalent LC model is valid near resonance:



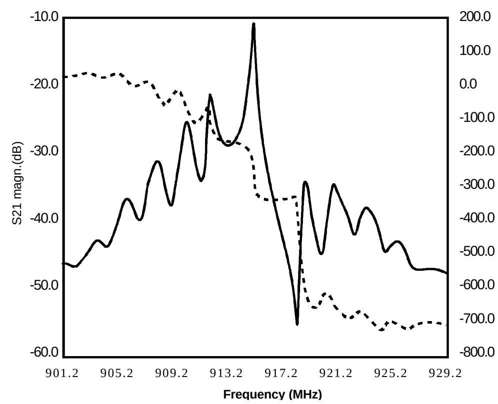

## Temperature Characteristics

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

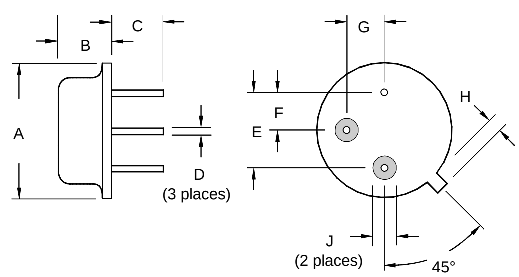



## Typical Frequency Response

The plot shown below is a typical frequency response for the RP series of two-port resonators. The plot is for RP1094.




## Case Design




| Dimensions | Millimeters | | Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | | 9.30 | | 0.366 |
| 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 | |

# RP Series SM-4A Two-Port SAW Resonators

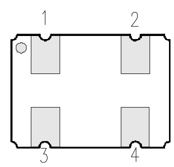
## Absolute Maximum Ratings

| Rating | Value | Units |
|---|---|---|
| CW RF Power Dissipation (See: Typical Test Circuit) | +0 | dBm |
| DC Voltage Between Any Two Pins (Observe ESD Precautions) | ±30 | VDC |
| Case Temperature | -40 to +85 | °C |

## Electrical Connections

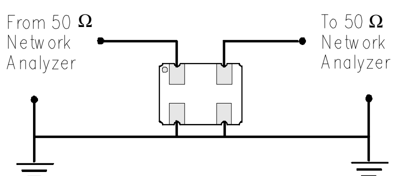
This two-port, three-terminal SAW resonator is bidirectional. However, impedances and circuit board parasitics may not be symmetrical, requiring slightly different oscillator component-matching values.

| Pin | Connection |
|---|---|
| 1 | Input or Output |
| 2 | Output or Input |
| 3 | Case Ground |
| 4 | Case Ground |

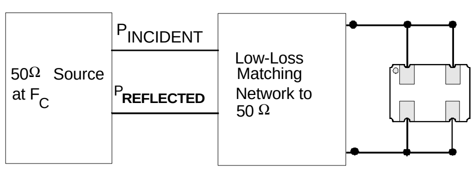



## Typical Test Circuit

**Electrical Test:**



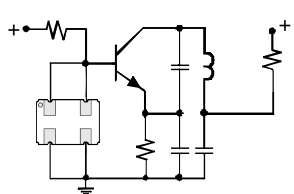

**Power Test:**



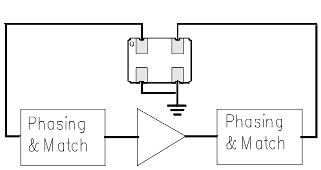

CW RF Power Dissipation = $P_{INCIDENT}$ - $P_{REFLECTED}$

## Typical Application Circuits

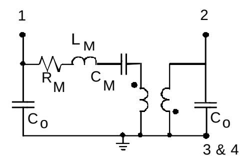
**Simulated One-Port Design:**




**Conventional Two-Port Design:**

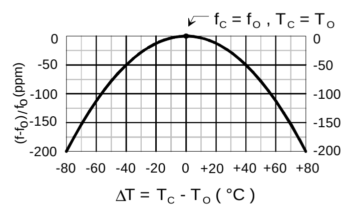



## Equivalent LC Model



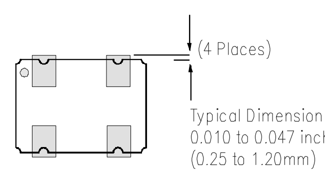

## Temperature Characteristics

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

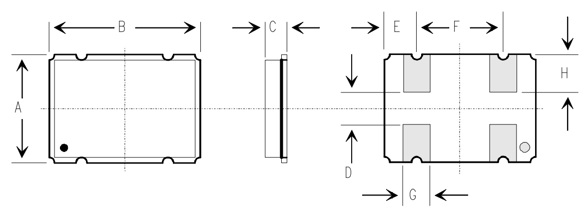



## Typical Circuit Board Land Pattern

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.




## Case Design SM-4A




| Dimensions SM-4A | Inches | Millimeters |
|---|---|---|
| | Nominal | Nominal |
| A | 0.205 | 5.21 |
| B | 0.265 | 6.73 |
| C | 0.078 | 1.98 |
| D | 0.071 | 1.80 |
| E | 0.057 | 1.45 |
| F | 0.150 | 3.81 |
| G | 0.050 | 1.27 |
| H | 0.075 | 1.91 |

## RP Two-Port 180° SAW Resonators

(All parameters measured in 50Ω system)

| Part Number | Resonant Freq. at 25°C | | Insertion Loss (dB) | | Quality Factor | | Ratings | Temperature Stability | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Absolute $F_c$ (MHz) | Tolerance $\Delta F_c$(kHz) | Typ. | Max | Unloaded Q | 50 W Loaded Q | CW RF Power Dissipa-tion (dBm) | Turnover Temp. $T_O$ (°C) | | | Turnover Freq. $F_O$ (kHz) |
| | | | | | | | Value | Min. | Typ. | Max. | Typ. |
| Notes | 2, 3, 4, 5 | | 2, 5, 6 | | 5, 6, 7 | | | 6, 7, 8 | | | |
| RP1234 | 293.075 | ±100 | 13.1 | 18.0 | 12,000 | 9,400 | +5 | 38 | 53 | 68 | $f_c$+8.5 |
| RP1098 | 307.3 | ±100 | 11.0 | 18.0 | 13,000 | 9,600 | +5 | 33 | 48 | 63 | $f_c$+6 |
| RP1053 | 310.0 | ±250 | 14 | 18 | 4,000 | 3,200 | 0 | 47 | 62 | 77 | $f_c$ |
| RP1239 | 315.0 | ±75 | 5.3 | 8.5 | 18,000 | 8,100 | 0 | 37 | 52 | 67 | $f_c$+8.5 |
| RP1238 | 407.3 | ±100 | 5.4 | 8.0 | 13,700 | 6,300 | 0 | 43 | 58 | 73 | $f_c$+16 |
| RP1237 | 418.0 | ±75 | 5.7 | 8.0 | 13,600 | 6,500 | 0 | 47 | 62 | 77 | $f_c$+21 |
| RP1237-1 | 418.05 | ±75 | 5.7 | 8.0 | 13,600 | 6,500 | 0 | 47 | 62 | 77 | $f_c$+21 |
| RP1298 | 423.22 | ±100 | 5.2 | 8.0 | 15,200 | 6,900 | 0 | 24 | 39 | 54 | $f_c$+2.6 |
| RP1207-5 | 433.92 | ±75 | 8.2 | 10.0 | 12,700 | 7,800 | +5 | 40 | 55 | 70 | $f_c$+14 |
| RP1308 | 433.92 | ±75 | 6.3 | 8.0 | 12,000 | 6,300 | 0 | 36 | 51 | 66 | $f_c$+11 |
| RP1102 | 905.5 | ±250 | 9.5 | 15.0 | 6,000 | 3,500 | +5 | 44 | 59 | 74 | $f_c$+39 |
| RP1286 | 906.0 | ±100 | 7.1 | 10.0 | 6,600 | 3,700 | +5 | 16 | 31 | 46 | $f_c$+1 |
| RP1261 | 913.612 | ±212 | 8.2 | 10.0 | 6,500 | 4,000 | +5 | 23 | 38 | 53 | $f_c$+5.7 |
| RP1094 | 915.0 | ±150 | 8.5 | 15.0 | 6,100 | 3,700 | +5 | 53 | 68 | 83 | $f_c$+63 |
| RP1285 | 916.55 | ±150 | 7.5 | 10.0 | 6,500 | 3,800 | +5 | 23 | 38 | 53 | $f_c$+5 |
| RP1103 | 924.5 | ±250 | 11.1 | 15.0 | 6,000 | 3,800 | +5 | 34 | 49 | 64 | $f_c$+6 |

### RO and RP Series 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 frequency $f_C$ is the frequency of minimum IL with the resonator in the specified test fixture in a 50 Ω test system with VSWR ≤ 1.2:1. Typically, $f_{OSCILLATOR}$ or $f_{TRANSMITTER}$ is less than the resonator $f_C$. $|F_A|$ is typically ±10 ppm/year.
3) One or more of the following United States patents apply: 4,454,488; 4,616,197, and others pending.
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± 5°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° less than the specified *resonator* $T_O$.

9a) This equivalent RLC model approximates RO surface mount resonator performance near the resonant frequency and is

## RP Two-Port 180° SAW Resonators

(All parameters measured in 50Ω system)

| Part Number (Cont.) | RF Equivalent RLC Model | | | | | | | Packaging | Lid Symbol | Application - For Reference Only | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Motional Res. $R_m$ (Ω) | | Motional Cap. $C_m$ (fF) | Motional Ind. $L_m$ (µH) | Shunt Static Cap. $C_O$ (pF) | | | Case Style | | Typ. Circuit and Freq. (MHz) | Nom. Radio Freq. (MHz) |
| | Typ. | Max | Typ. | Typ. | Min. | Typ. | Max. | | | | |
| Notes | 5, 6, 7, 9 | | | | | | | | | | |
| RP1234 | 352 | 695 | 0.127215 | 2.31659 | 1.0 | 1.3 | 1.6 | TO39 | P1234 | 293.125 LO | 303.825 |
| RP1098 | 256 | 695 | 0.134251 | 1.99801 | 1.0 | 1.3 | 1.6 | TO39 | P1098 | 307.25 LO | 318 |
| RP1053 | 352 | 695 | 0.125 | 2100 | 1.0 | 1.3 | 1.6 | TO39 | 334-A025 | 310.0TX | 310.0 |
| RP1239 | 84 | 167 | 0.336771 | 758.027 | 1.9 | 2.2 | 2.5 | TO39 | P1239 | 315.00 TX | 315.00 |
| RP1238 | 86 | 152 | 0.330391 | 462.150 | 2.1 | 2.4 | 2.7 | TO39 | P1238 | 407.30 LO | 418.00 |
| RP1237 | 93 | 152 | 0.303334 | 477.932 | 2.0 | 2.3 | 2.6 | TO39 | P1237 | 418.00TX | 418.00 |
| RP1237-1 | 93 | 152 | 0.305206 | 474.887 | 2.0 | 2.3 | 2.6 | TO39 | 1237-1 | 418.00 TX | 418.00 |
| RP1298 | 82 | 152 | 0.297547 | 475.283 | 2.2 | 2.5 | 2.8 | TO39 | P1298 | 423.22 LO | 433.92 |
| RP1207-5 | 157 | 216 | 0.183245 | 734.159 | 1.4 | 1.7 | 2.0 | TO39 | 1207-5 | 433.92 TX | 433.92 |
| RP1308 | 107 | 152 | 0.279470 | 481.378 | 1.4 | 1.7 | 2.0 | TO39 | P1308 | 433.92 TX | 433.92 |
| RP1102 | 198 | 463 | 0.106865 | 289.086 | 1.0 | 1.3 | 1.6 | TO39 | P1102 | 905.5 TX | 905.5 |
| RP1286 | 126 | 216 | 0.208528 | 147.985 | 1.6 | 1.9 | 2.2 | TO39 | P1286 | 905.80 LO | 916.50 |
| RP1261 | 157 | 217 | 0.171332 | 177.124 | 1.4 | 1.7 | 2.0 | TO39 | P1261 | 913.50 TX | 913.50 |
| RP1094 | 166 | 463 | 0.158119 | 191.3434 | 1.1 | 1.4 | 1.7 | TO39 | P1094 | 914.95 TX | 915 |
| RP1285 | 137 | 217 | 0.194528 | 155.005 | 1.7 | 2.0 | 2.3 | TO39 | P1285 | 916.50 TX | 916.50 |
| RP1103 | 259 | 463 | 0.118860 | 249.340 | 1.1 | 1.4 | 1.7 | TO39 | P1103 | 924.5 TX | 924.5 |

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 be calculated as: $C_P \approx C_O$ - 0.05 pF.

9b) This equivalent RLC model approximates RO TO39 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 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 $C_O$.

9c) This equivalent RLC model approximates RP TO39 resonator performance near the resonant frequency and is provided for reference only. The capacitance $C_O$ is the measured static (nonmotional) capacitance between either pin 1 and ground or pin 2 and ground. The measurement includes case parasitic capacitance.

10) The typical FTC for TO-39 resonators is 0.037 ppm/°$C^2$ and the typical FTC for SMRs is 0.032 ppm/°$C^2$.

11) The DC insulation resistance between any two pins is a minimum of 1 MΩ.

12) The DC voltage between any two pins (observe ESD precautions) is ±30 VDC.

13) The case temperature is rated between -40° to +85°C.

14) Soldering temperature is +250°C.

15) Maximum nominal insertion phase shift at resonance is 180° for the RP series.