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SAW Resonators

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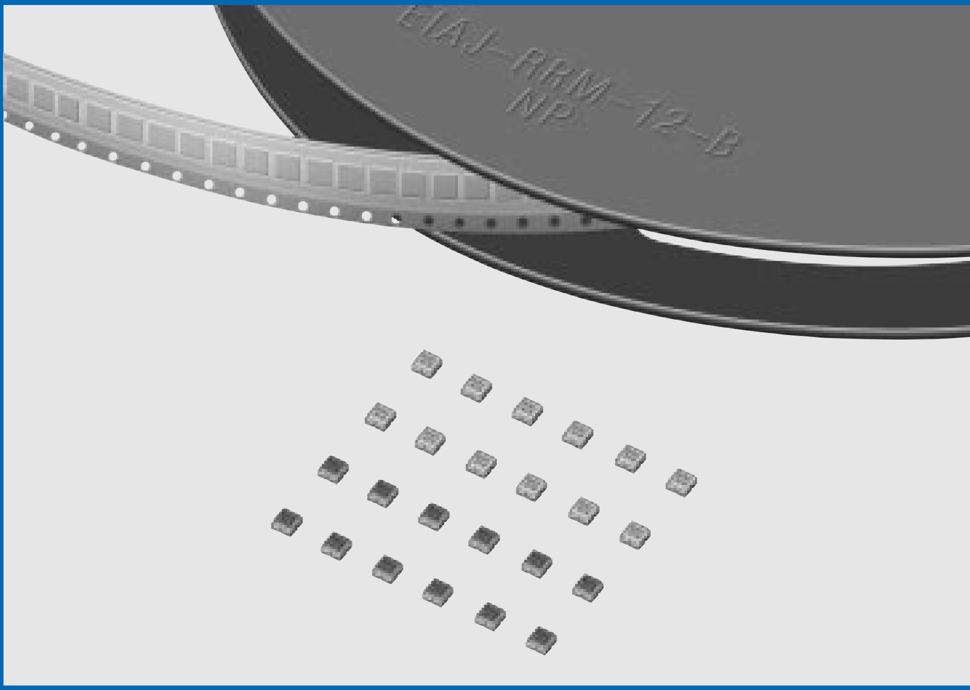
SURFACE ACOUSTIC WAVE RESONATORS



GLOBAL PART NUMBERS
JUNE 2001

Innovator in Electronics

Murata
Manufacturing Co., Ltd.

www.DataSheet4U.com

Cat.No.P36E

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● Part Numbering (The structure of the "Global Part Numbers" that have been adopted since June 2001 and the meaning of each code are described herein. If you have any questions about details, inquire at your usual Murata sales office or distributor.)

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SAW Resonators

(Global Part Number) **SA** ❶ **R** ❷ **CC** ❸ **433M92** ❹ **B** ❺ **X** ❻ **M** ❼ **0** ❽ **R05** ❾

❶Product ID

Product ID	
SA	SAW

❷Function

Code	Function
R	Resonator

❸Structure/Size

Code	Structure/Size
CC	Package (SC33 package)

❹Resonant Frequency

Expressed by six-digit alphanumerics. The unit is in hertz (Hz). A decimal point is expressed by the capital letter "**M**".

❺Design

Code	Design
B	1 port

❻Board

Code	Board
X	Crystal

❼Resonant Frequency Tolerance

Code	Resonant Frequency Tolerance
L	±50kHz
M	±75kHz
P	±100kHz

❽Customer Code

Expressed by a figure.

❾Packaging

Code	Packaging
R12	2000pcs. /ø178mm Reel
R05	5000pcs. /ø330mm Reel

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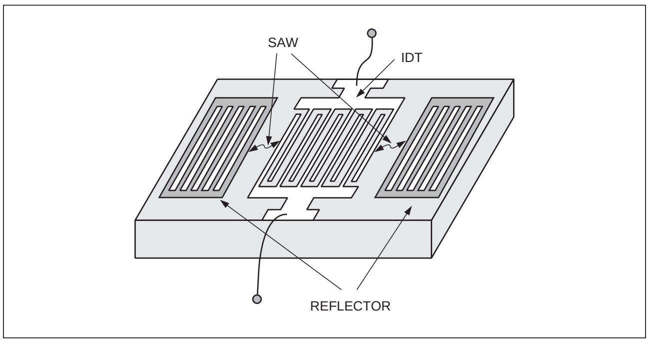
Applications and Data of SAW Resonator

■ Application

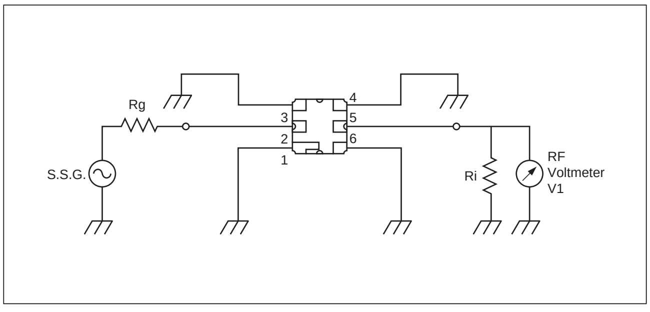
SAW RESONATER has generally 2 types of 1-port type and 2-port type.
1-port SAW RESONATOR is basically a 2 terminal device and its application is similar to that of quartz bulk wave resonator or ceramic resonator. Most of the application circuit is Colpitts or similar type that can be made with low cost. 1-port SAW RESONATOR is also applicable to VCO (Voltage Controlled Oscillator) application.
2-port SAW RESONATOR is a kind of very narrow, low loss band-pass filter. Oscillation circuit is mostly like a RF amplifier with feedback loop.
SARCC series is 1-port SAW RESONATOR. Later application data is oscillation circuit by 1-port SAW RESONATOR.

■ Basic structure of 1-port SAW RESONATOR

1-port SAW RESONATOR has one IDT (Inter Digital Transducer), which generates and receives SAW, and two grating reflectors, which reflect SAW and generate a standing wave between the two reflectors. IDT and reflectors are fabricated on quartz crystal substrate by photolithographic process. Cut angle of the substrate shall be selected carefully. SAW RESONATOR chip is encapsuled in a ceramic package.

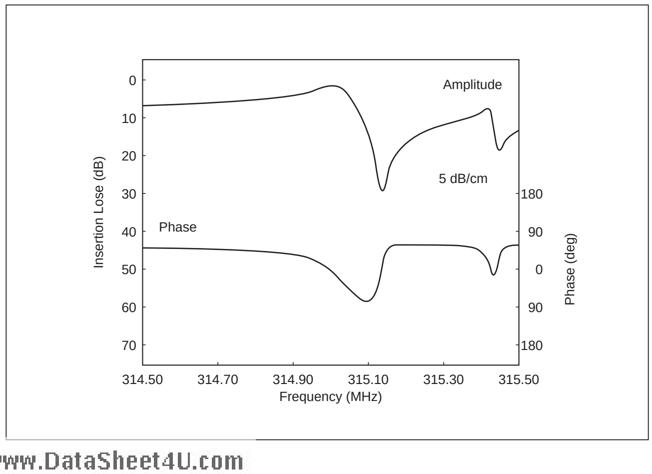


■ Test Circuit

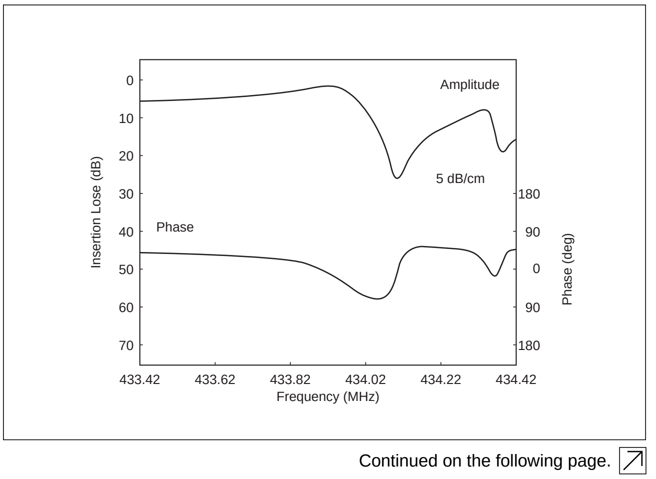


■ Transmission Characteristics of 1-port SAW RESONATOR

SARCC315M00BXM0



SARCC433M92BXM0



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Applications and Data of SAW Resonator

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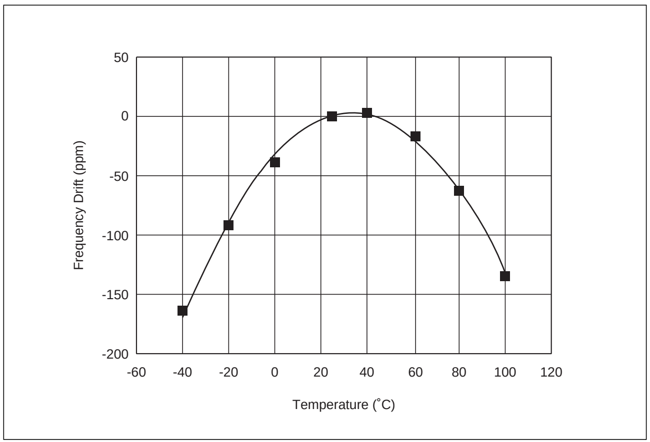
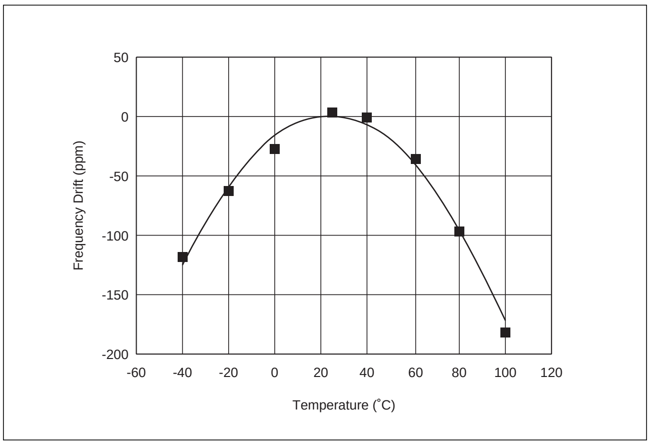
■ Temperature Characteristics of 1-port SAW RESONATOR

SARCC315M00BXM0



SARCC433M92BXM0



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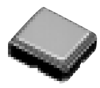
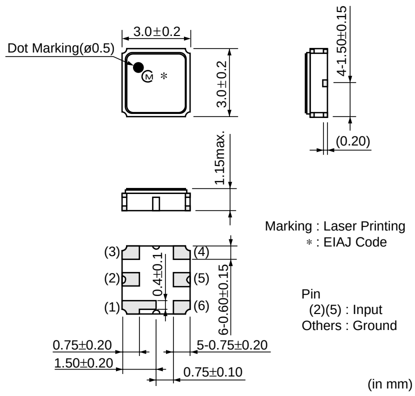
SAW Resonators

SARCC Series





SAW Resonator utilizes Surface acoustic Wave, and is able to be applied to high frequency circuit where conventional crystal, ceramic resonators are not available, as SAW Resonator oscillates stably with its fundamental mode over frequency range from 50 MHz to around 1 GHz.
Murata SAW Resonator - SARCC series - has high stability, good temperature characteristics provided by quartz crystal substrate and is developed with SAW technology accumulated for SAW filters through Murata's long experience.
SAW Resonator can be applied to many types of high frequency devices including RF remote controls, CATV FSK demodulators and CATV 2nd local oscillators.

■ Features

1. High Oscillation Frequency Stability
   Both initial tolerance and temperature coefficient of oscillating frequency of SAW Resonator are between quartz bulk resonator's and LC's / RC's.
   Temperature coefficient of oscillating frequency for quartz crystal :
   10**-6/degree C, LC : 10**-3-10**-4/dgree C,
   while SAW Resonator : 5x10**-6/dgree C.
   (The number following ** means multiplier.)
2. Adjustment Free
   As SAW Resonator utilizes mechanical vibration of piezoelectric material, while LC/RC utilizes electrical resonance, oscillator using SAW Resonator is stable against peripheral circuit or supply voltage fluctuation, and is basically free from adjustment.
3. Simple/Low Cost Circuit by Fundamental Oscillation
   Multiplying circuit necessary for quartz bulk wave resonator is not required as SAW Resonator oscillates with its fundamental mode over the frequency range of 50 MHz to 1 GHz. Therefore, oscillation circuit is simple and low cost.
4. Quartz Crystal Substrate
   SARCC series realizes better temperature characteristics, higher stability against peripheral circuit, by utilizing quartz crystal substrate, compared to SAW Resonators with other materials.
5. Small Size Package
   SARCC series use small size ceramic package with 3.0x3.0x1.15mm. This is good for high density mount.
6. They can be applied Corpitts Oscillator circuit.
7. Components do not contain lead.

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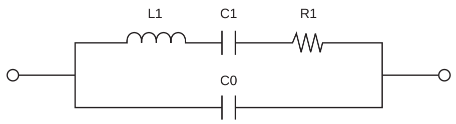
Part Number	Resonant Loss (dB)	Resonant Frequency (MHz)	Parallel Capacitance (at 1MHz) (pF)
SARCC304M30BXL0	2.2 max.	304.300	2.4
SARCC304M30BXM0	2.2 max.	304.300	2.4
SARCC304M30BXP0	2.2 max.	304.300	2.4
SARCC315M00BXL0	2.2 max.	315.000	2.4
SARCC315M00BXM0	2.2 max.	315.000	2.4
SARCC315M00BXP0	2.2 max.	315.000	2.4
SARCC423M22BXL0	2.5 max.	423.220	2.1
SARCC423M22BXM0	2.5 max.	423.220	2.1
SARCC423M22BXP0	2.5 max.	423.220	2.1
SARCC433M87BXL0	2.5 max.	433.870	2.1
SARCC433M87BXM0	2.5 max.	433.870	2.1
SARCC433M87BXP0	2.5 max.	433.870	2.1
SARCC433M92BXL0	2.5 max.	433.920	2.1
SARCC433M92BXM0	2.5 max.	433.920	2.1
SARCC433M92BXP0	2.5 max.	433.920	2.1
SARCC434M15BXL0	2.5 max.	434.150	2.1
SARCC434M15BXM0	2.5 max.	434.150	2.1
SARCC434M15BXP0	2.5 max.	434.150	2.1

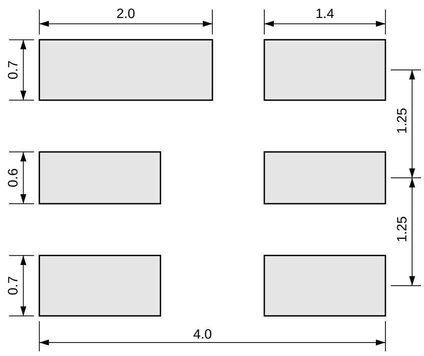
Operating Temperature Range: -40 to +85 dgree C, Storage Temperature Range: -40 to +85 dgree C.

■ Equivalent Circuit



Part Number	L1 (μH)	C1 (pF)	R1 (Ω)	C0 (pF)
SARCC304M30BX_0	164.495	0.001663	22.0	2.37
SARCC315M00BX_0	159.331	0.001602	22.0	2.25
SARCC423M22BX_0	110.088	0.001284	22.2	2.00
SARCC433M87BX_0	92.747	0.001451	20.2	2.00
SARCC433M92BX_0	96.529	0.001394	22.1	2.112
SARCC434M15BX_0	95.288	0.00141	20.0	1.97

■ Recommended Land Pattern



(in mm)

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Oscillation Circuit

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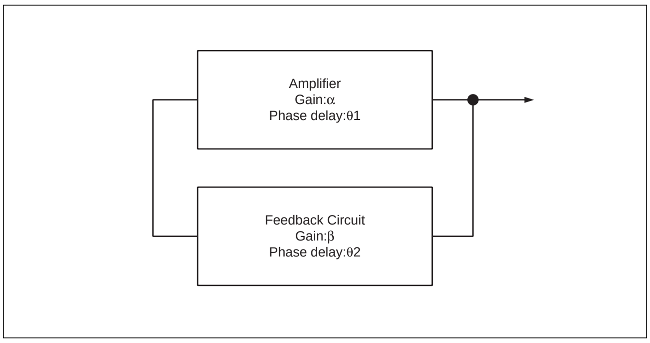
■ Theory of Oscillation Circuit

Oscillation circuits using LC or quartz crystal are called 'Feedback Oscillators'. Feedback oscillator consists of an amplifier and a feedback circuit.
The circuit oscillates, with no input signal applied from outside of the oscillator, when feedback signal from the output of the amplifier has the same amplitude and phase to the input signal. The conditions required to the feedback to enable oscillation are as follows;

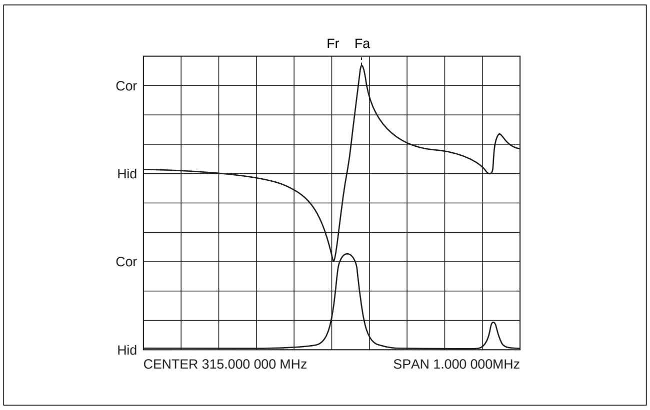
Amplitude : $G = \alpha + \beta \geqq 0$ [dB]
Phase : $\theta = \theta 1 + \theta 2 = 360 \times n$ [degree]
(n: Natural number)



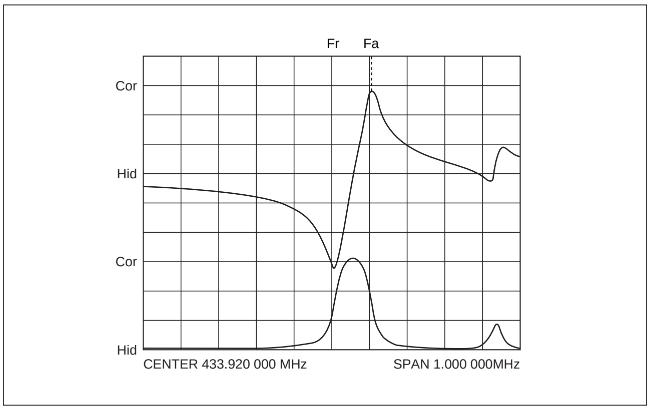
1-port SAW RESONATOR is a kind of two terminal resonant device utilizing piezoelectricity, like quartz crystal bulk wave resonator or ceramic resonator. The equivalent circuit of 1-port SAW RESONATOR is same to that of quartz or ceramic resonator, and therefore, impedance characteristics of SAW RESONATOR is as shown in Fig.1.

1. Fig. 1 Impedance Characteristics of 1-port SAW RESONATOR

SARCC315M00BXM0



SARCC433M92BXM0

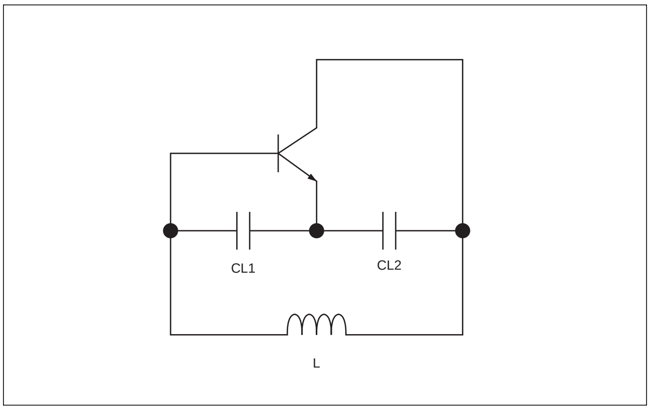


2. Basic Structure of Corpitts Oscillator

Colpitts is one of the popular oscillation circuits. Basic structure of Colpitts oscillator is as shown in Fig.2. The oscillating frequency is approximately same to resonant frequency of L, CL1 and CL2.

$$fosc = 1 / (2\pi (L \times CL1 \times CL2 / (CL1 + CL2))^{1/2})$$

Fig. 2. Corpitts Oscillator Circuit.



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Oscillation Circuit

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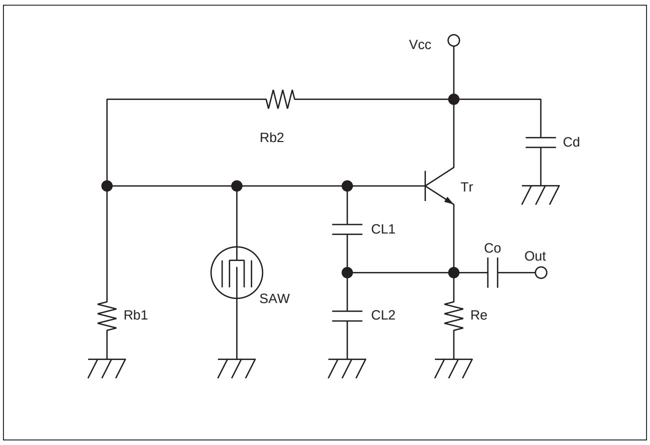
3. Example of 1-port SAW Oscillator

In the case of an oscillation circuit using piezo resonator, the inductor in Fig.2 can be replaced by the resonator because its impedance is inductive between fr (impedance minimum) and fa (impedance maximum) as shown in Fig.1.
Fig.3 shows an example of oscillation circuit using 1-port SAW RESONATOR. Rb1 and Rb2 are for DC bias. Re is a load impedance. Cd is for power line de-coupling. CL1 and CL2 are load capacitance to satisfy oscillation conditions. Values of CL1 and CL2 must be evaluated to get desired oscillating frequency.
Transistor shall be a high frequency type - fT a few GHz or more.
SMT type transistor, resistor, capacitor are recommended for application more than 100 MHz due to the inductance of the lead terminals.

Fig. 3. 1-port SAW Oscillator Circuit



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Actual measurments of SAW Oscillator

■ 315 MHz 1-port SAW Oscillator

Fig.4 shows an example of oscillator with 1-port SAW RESONATOR. Here, transistor is 2SC4228(NEC), SAW RESONATOR is SARCC315M00BXL0 (315.00 MHz resonator).
Supply voltage (Vcc) characteristics and temperature characteristics are shown in Fig.6. CL1, CL2, Co and Re characteristics are shown in Fig. 7 ti Fig. 10.

Tr: 2SC4228
SAW: SARCC315M00BXL0
Rb1=Rb2=2kΩ
Re=160Ω
CL1=12pF GRM18821CH120JA01B
CL2=8pF GRM1882C2D8RDV01B
Co=2pF GRM1884C1H2R0CZ01B

Fig. 4 Oscilltor Circuit

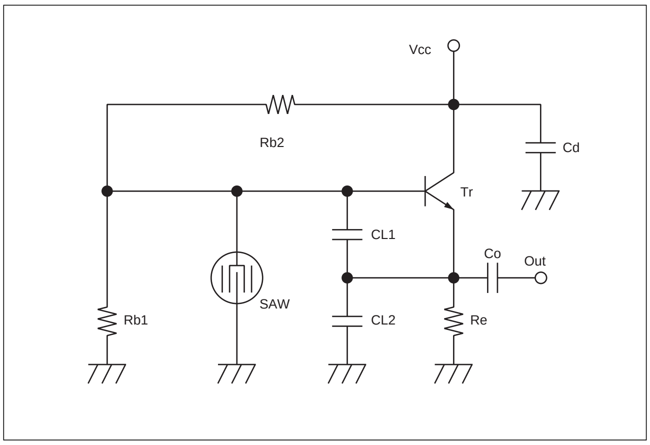
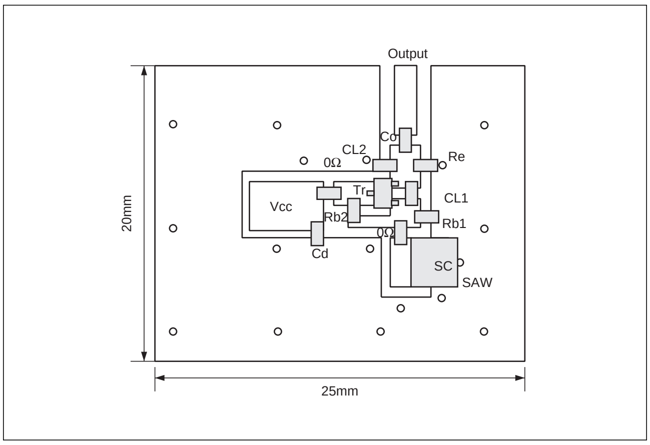
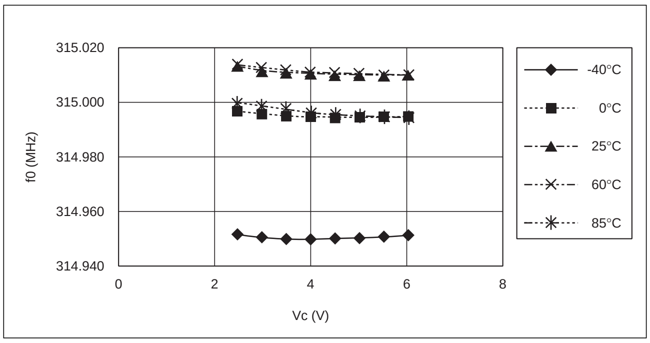


Fig. 5 Land Pattern

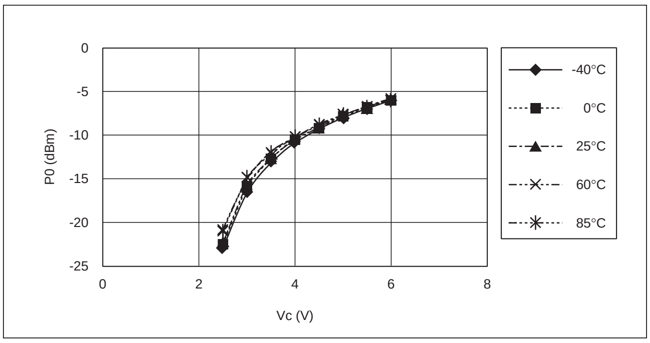


1. Fig. 6 Vcc Characteristics

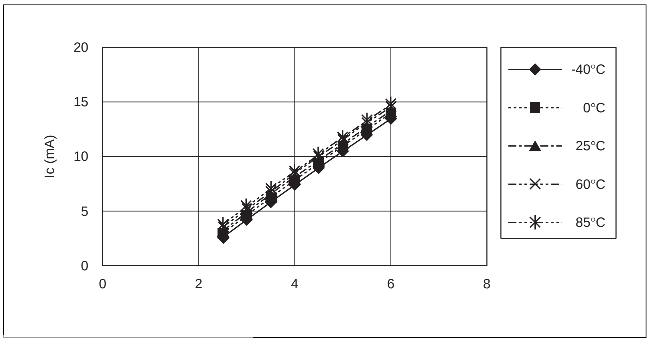
Frequency



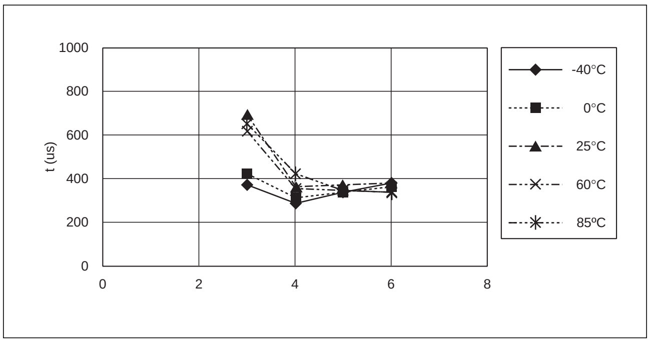
Output Power



Current Consumption



Rise Time



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Actual measurments of SAW Oscillator

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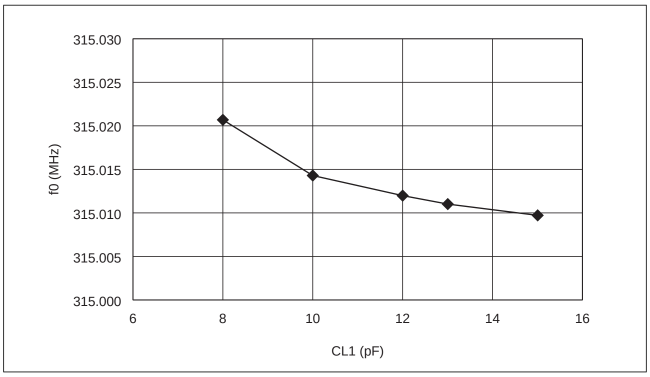
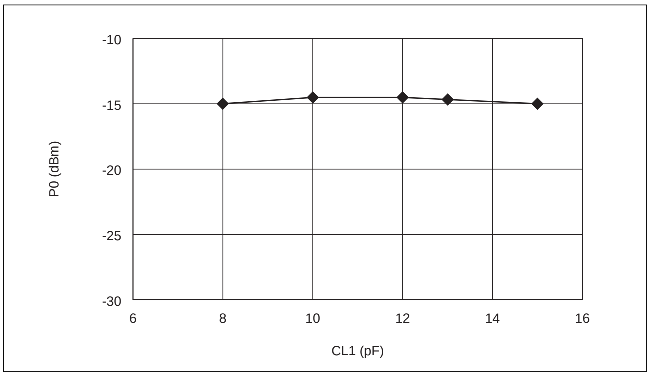
2. Fig. 7 CL1 Characteristics

Frequency



Output Power



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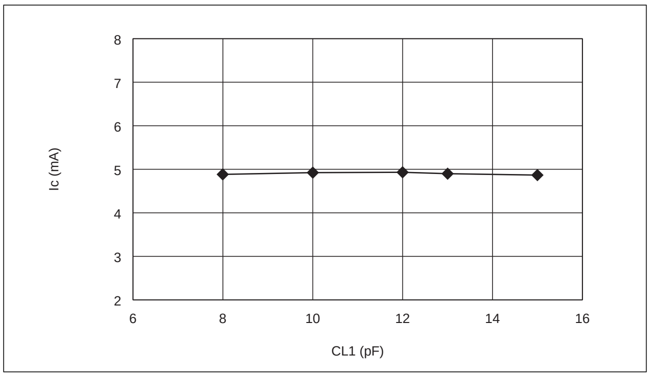
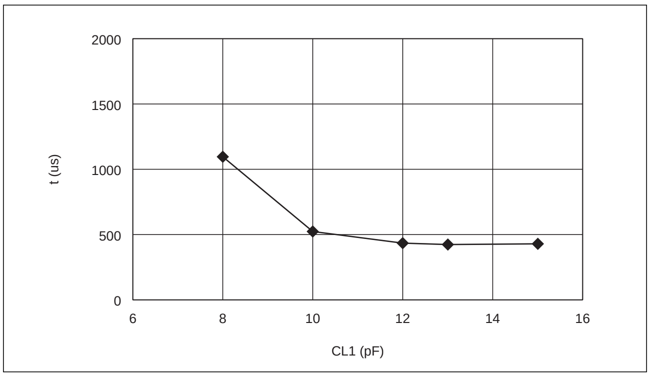
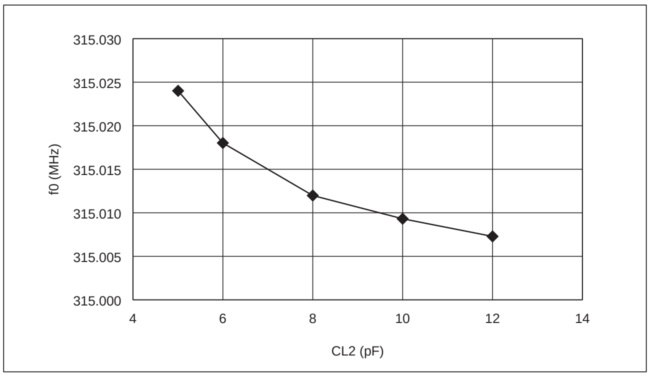


Rise Time

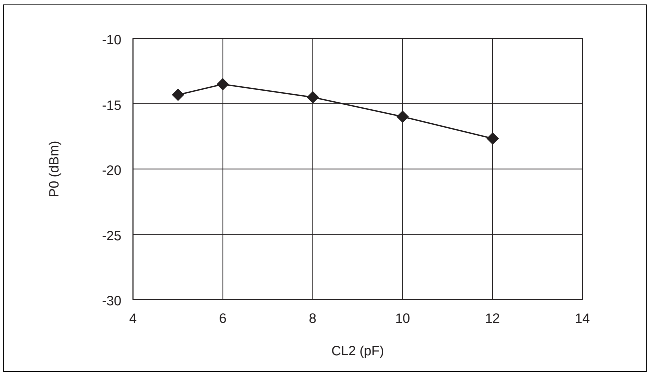


3. Fig. 8 CL2 Characteristics

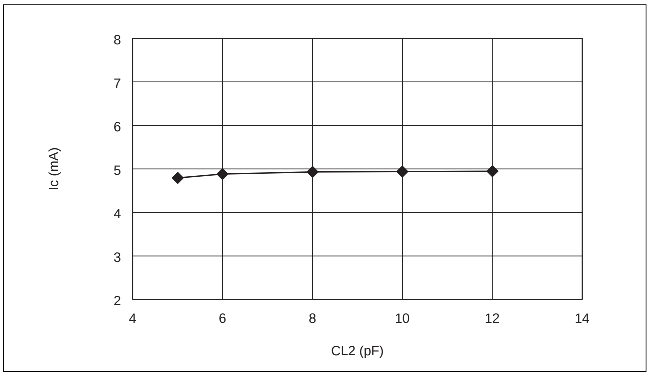
Frequency



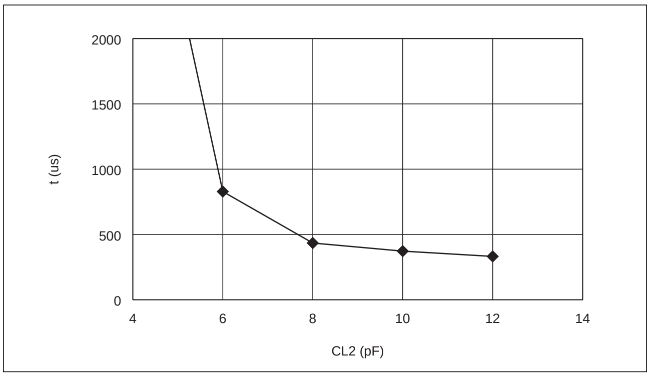
Output Power



Current Consumption



Rise Time



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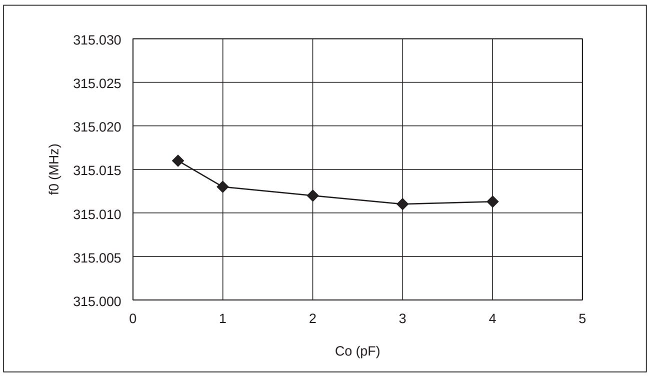
Actual measurments of SAW Oscillator

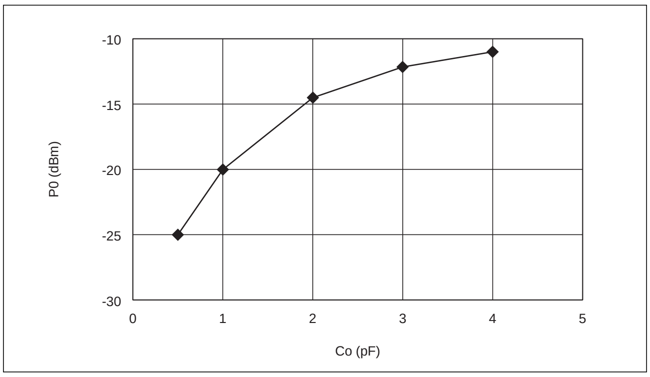
Continued from the preceding page.

4. Fig. 9 Co Characteristics

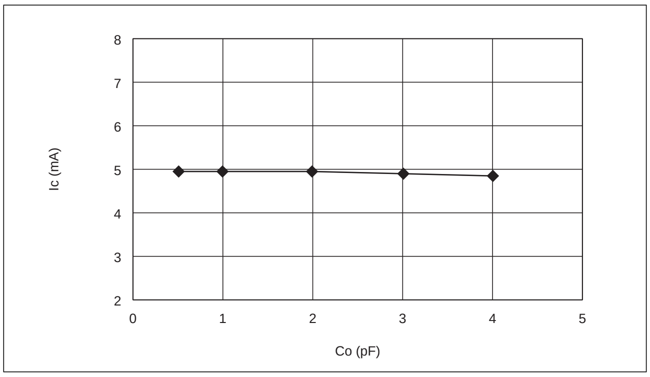
Frequency



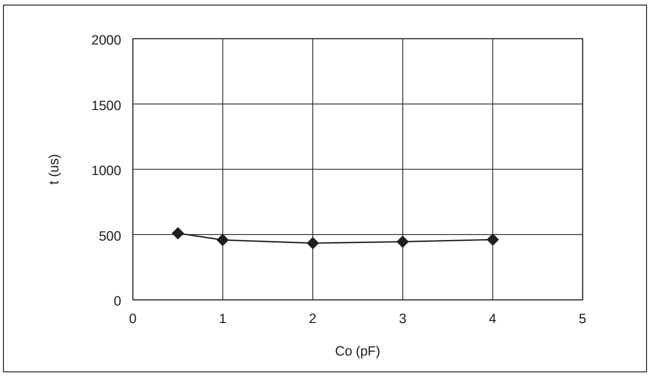
Output Power



Current Consumption

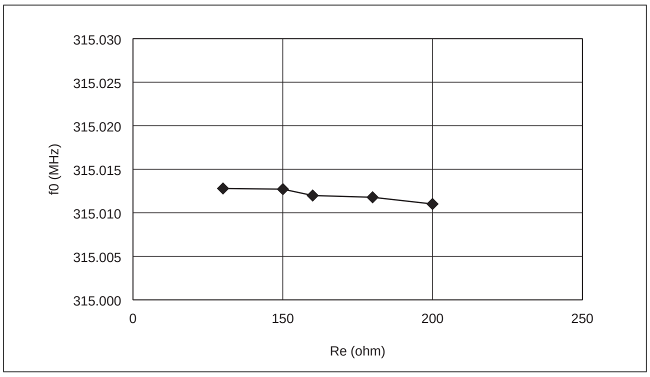


Rise Time

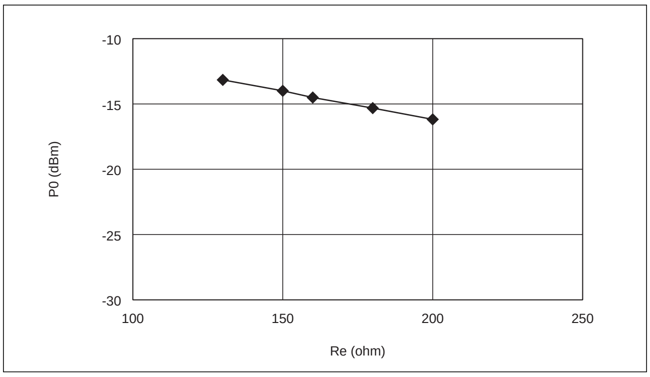


5. Fig. 10 Re Characteristics

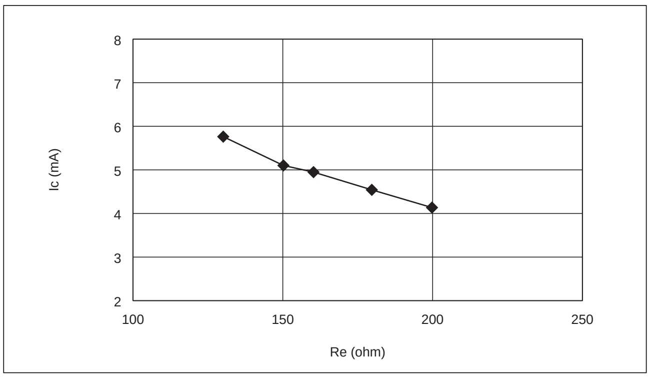
Frequency



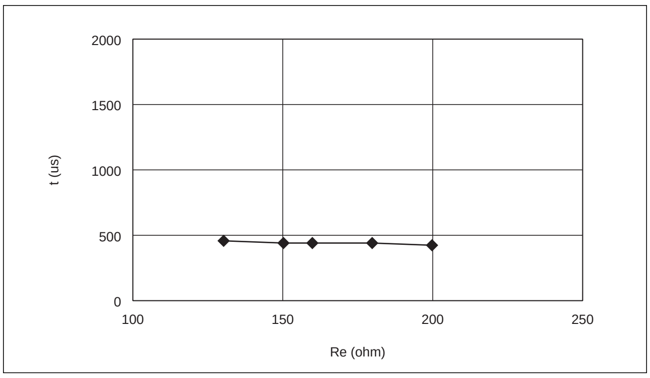
Output Power



Current Consumption



Rise Time



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Actual measurments of SAW Oscillator

Continued from the preceding page.

■ 433.92 MHz 1-port SAW Oscillator

Fig. 11 shows an example of oscillator with 1-port SAW RESONATOR. Here, transistor is 2SC4228(NEC), SAW RESONATOR is SARCC433M92BXM0 (433.92 MHz resonator).

Supply voltage (Vcc) characteristics and temperature characteristics are shown in Fig. 13.

Tr: 2SC4228
SAW: SARCC433M92BXM0
Rb1=Rb2=2kΩ
Re=160Ω
CL1=10pF GRM1882C1H100JA01B
CL2=8pF GRM1882C1H8RD201B
Co=2pF GRM1884C1H2R0CZ01B

Fig. 11 Oscillator Circuit

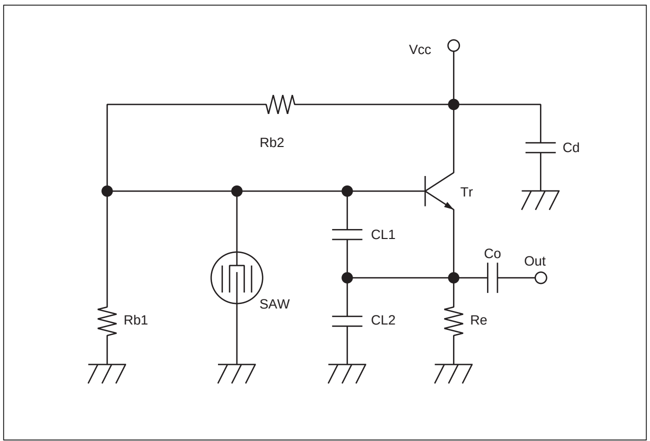
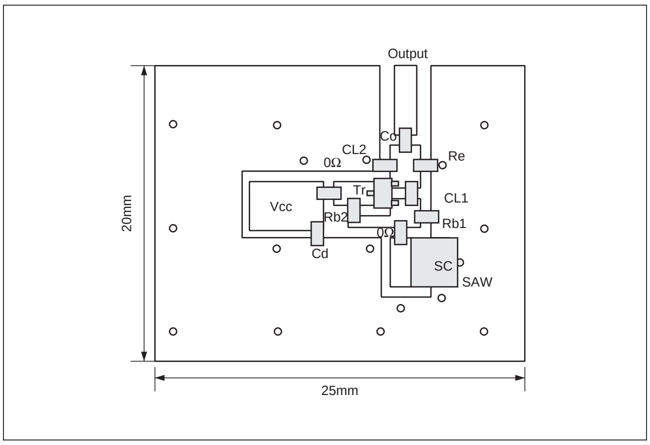
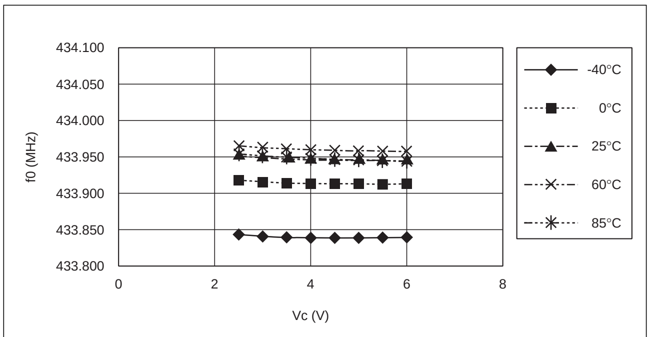


Fig. 12 Land Pattern

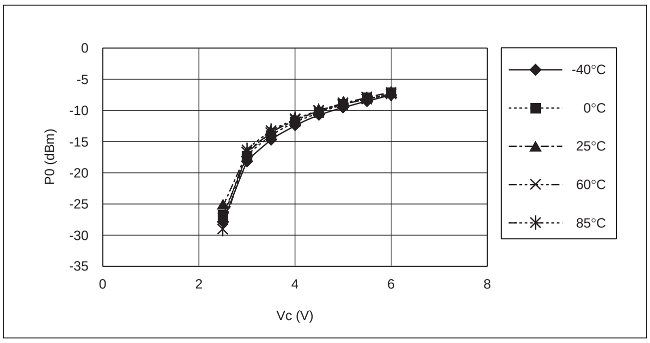


1. Fig. 13 Vcc Characteristics

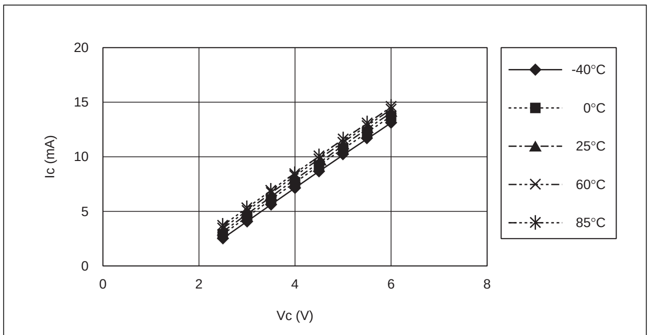
Frequency



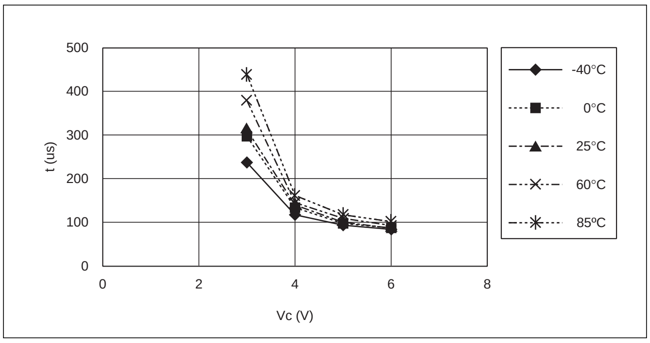
Output Power



Current Consumption



Rise Time



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Actual measurments of SAW Oscillator

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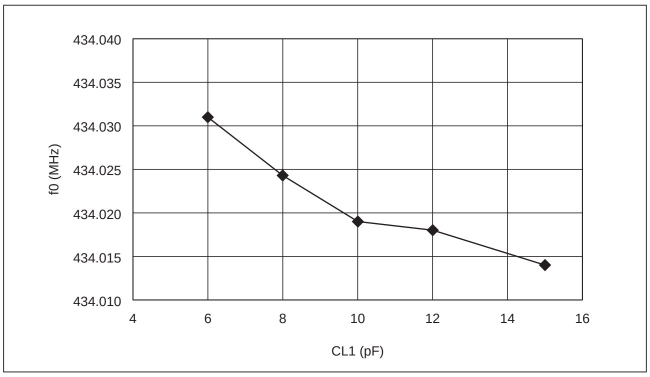
2. Fig. 14 CL1 Characteristics

Frequency



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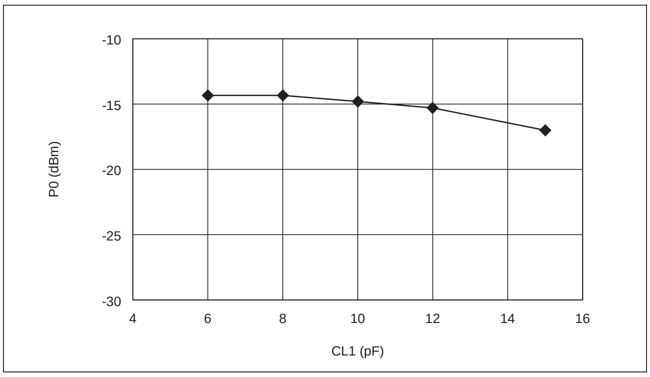
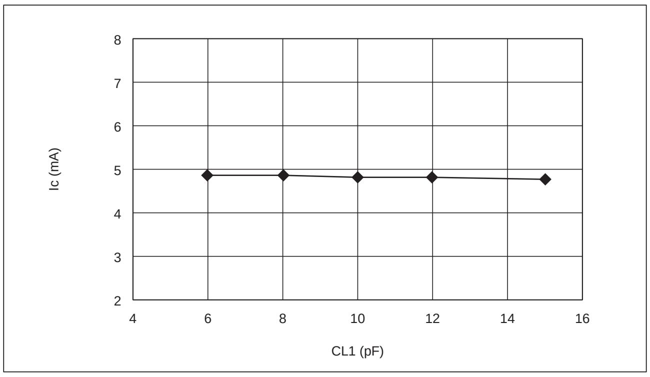
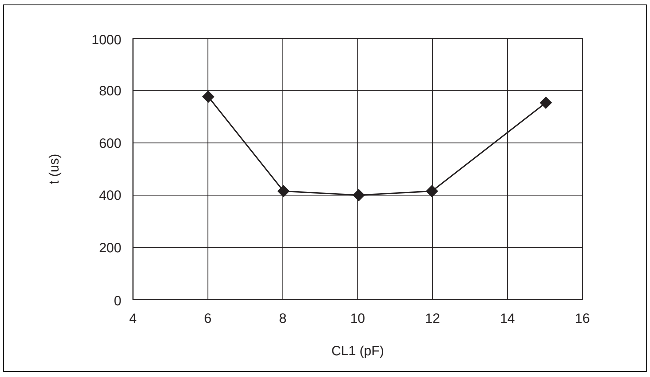


Current Consumption

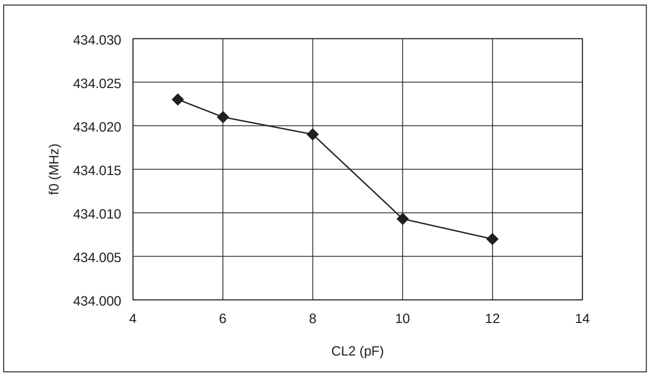


Rise Time

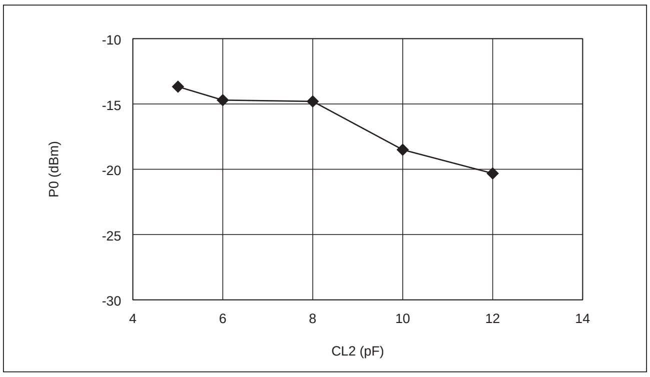


3. Fig. 15 CL2 Characteristics

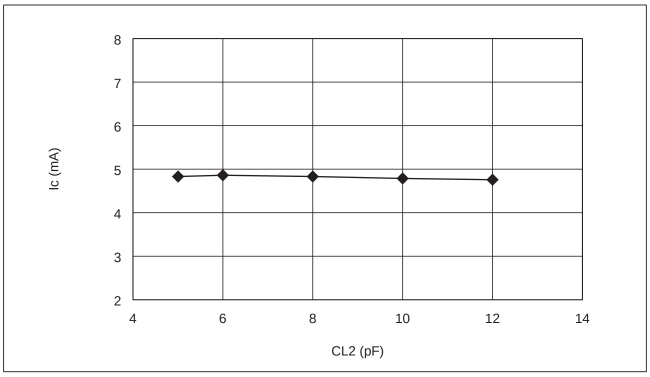
Frequency



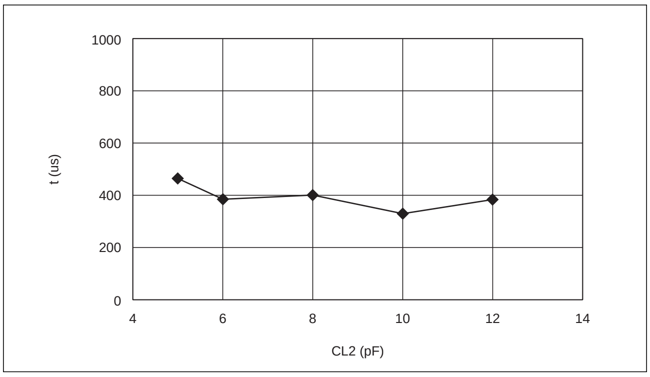
Output Power



Current Consumption



Rise Time



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Actual measurments of SAW Oscillator

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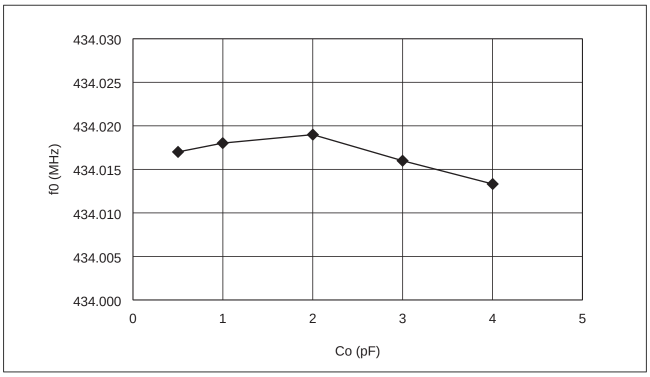
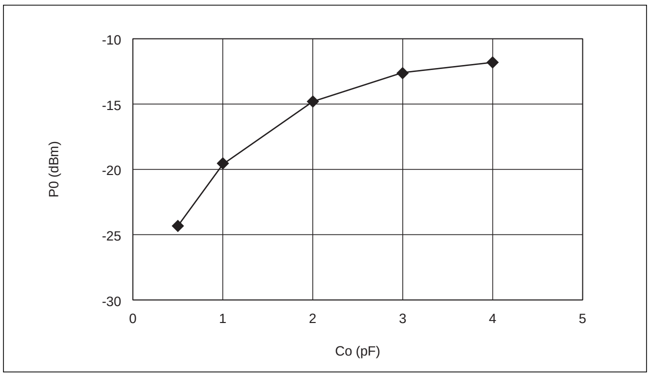
4. Fig. 16 Co Characteristics

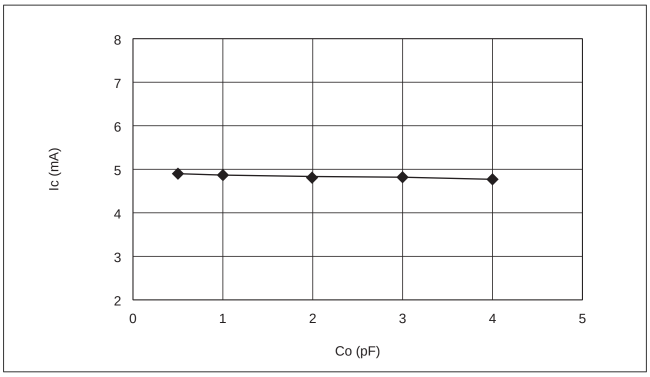
Frequency



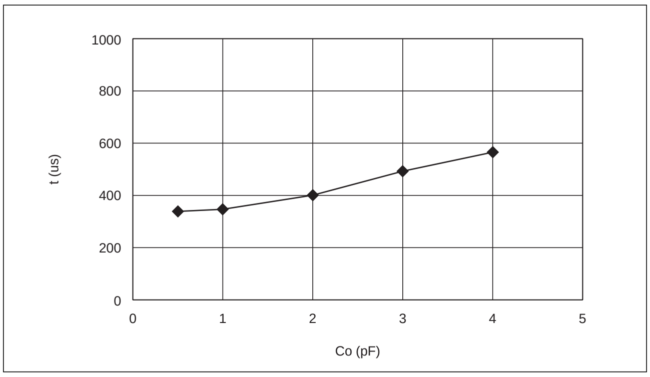
Output Power



Current Consumption

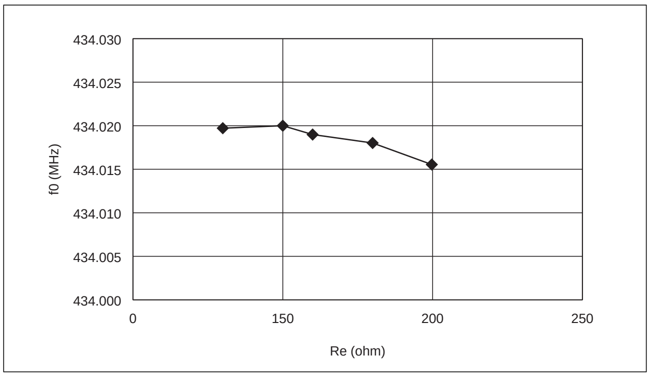


Rise Time

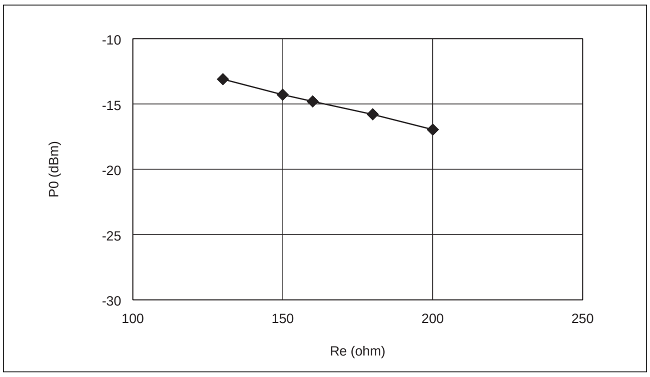


5. Fig. 17 Re Characteristics

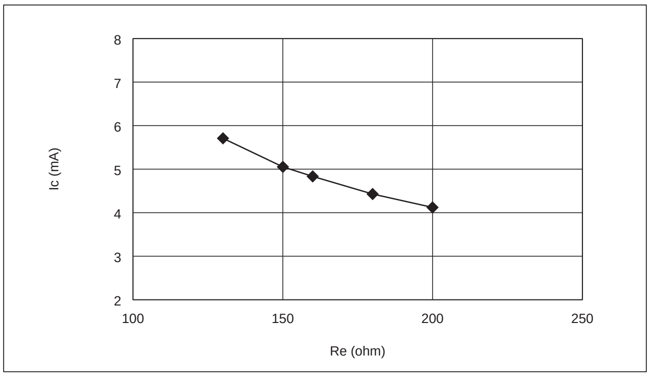
Frequency



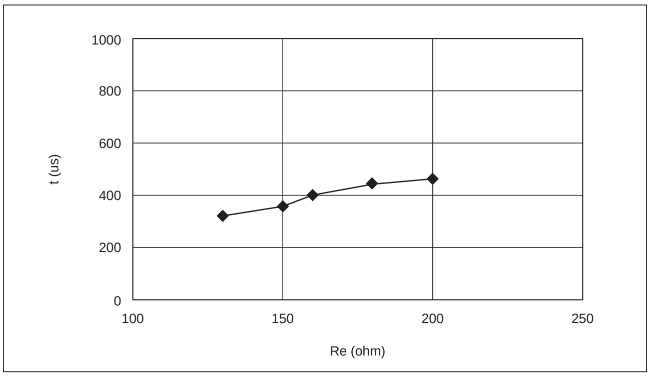
Output Power



Current Consumption



Rise Time



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Keyless Entry System

RF remote control transmitter and reciver for automotive security device is getting popular. MURATA SARCC series are suitable for this application due to the advantage of adjustment-free (or easy adjustment) and high stability. Example of application circuit is shown in Fig.18 and Fig.19.

Fig. 18 Transmitter Circuit

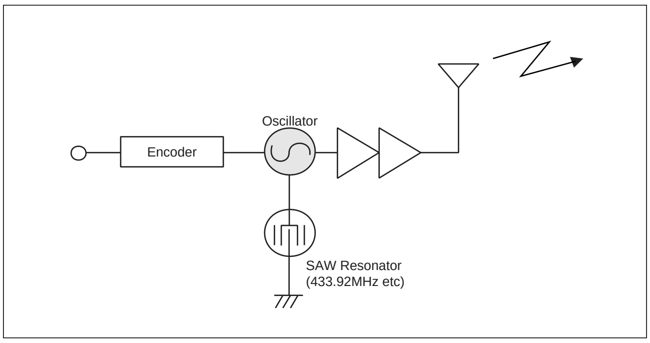
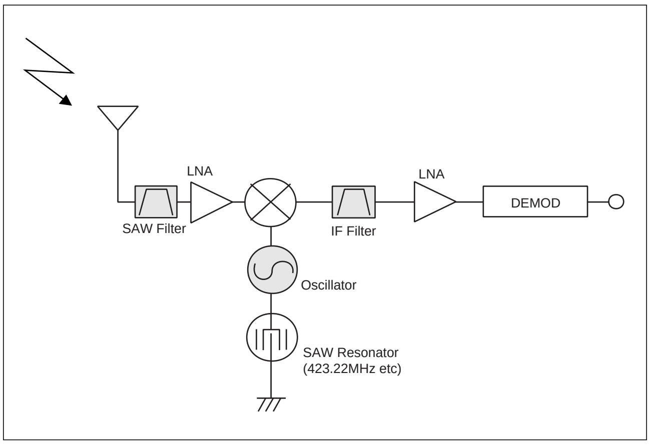


Fig. 19 Receiver Circuit



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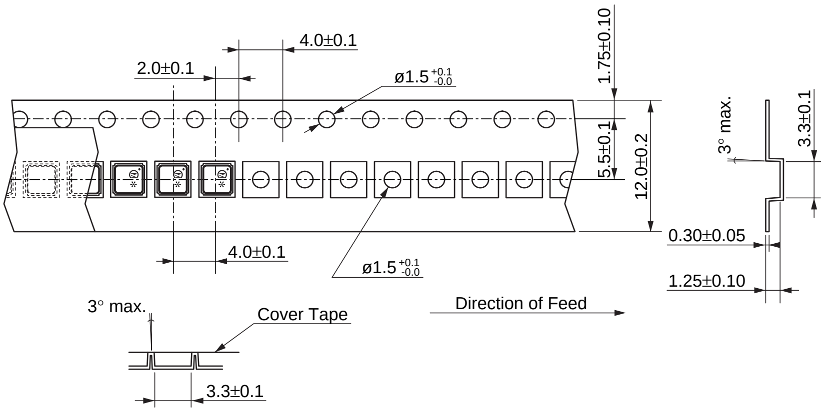
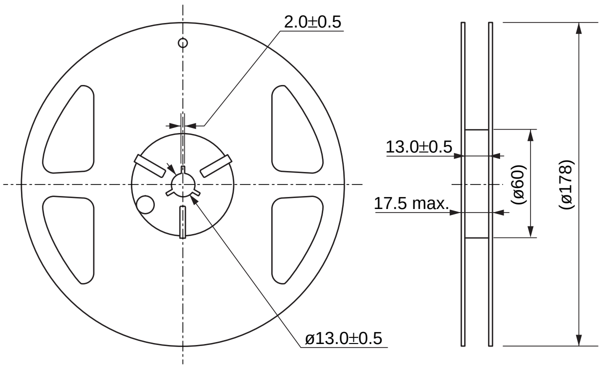
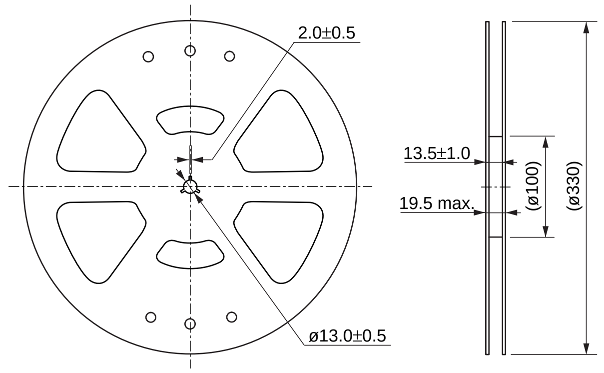


(in mm)



ø178 Reel Dimension

(in mm)



ø330 Reel Dimension

(in mm)

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1. Mount this component at the position so that stress by warp or bend of the PCB may not apply to it.
2. It might be a cause of destruction to apply excessive shock on mounting this component on PCB when positioning claw, pick-up nozzle, etc of component placement machine are abraded. Keep regular maintenance which is instructed on each machine to prevent from these kinds of troubles.
3. Mount all terminals, or terminal strength might be degraded.
4. Face this component to PCB.

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Head Office
1-10-1, Higashi Kotari, Nagaokakyo-shi, Kyoto 617-8555, Japan Phone: 81-75-951-9111

International Division
3-29-12, Shibuya, Shibuya-ku, Tokyo 150-0002, Japan
Phone: 81-3-5469-6123 Fax: 81-3-5469-6155 E-mail: intl@murata.co.jp

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