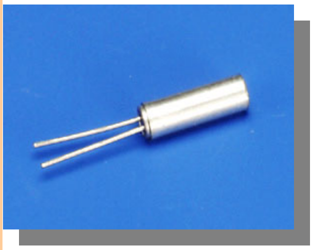
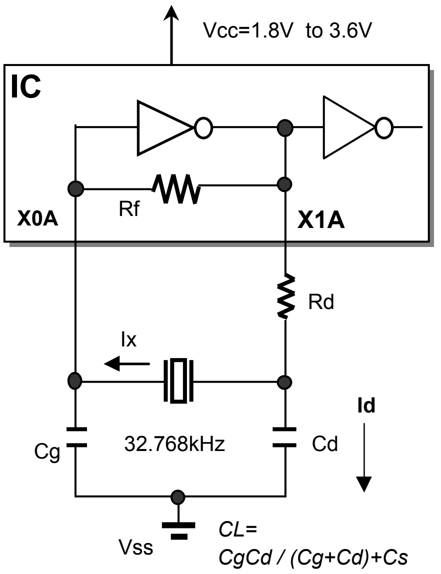
# Evaluation of Low Frequency Clock Oscillation Circuit

**VT-200 6.0pF with MB95107A-64P [LQFP(10x10) 0.50mm pitch]**

Measurement conditions :3.0V , 2.2V



| | |
|---|---|
| Model | :VT-200 |
| Frequency | :Fo=32.768kHz |
| Frequency tolerance | :dF/Fo= +/-20x10$^{6}$ |
| Load capacitance | :CL=6.0pF |
| Equivalent series resistance | :R1=50kohm max |
| Max. drive level | :DL=1x10$^{-6}$W max |
| Level of drive | :DL=0.1x10$^{-6}$W typ |

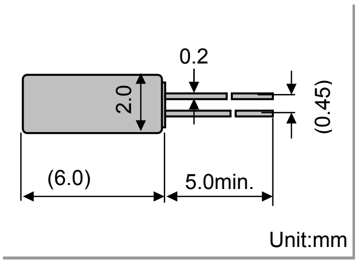



*Remark) Ix : current through crystal*

## FEATURES

1.Compact tubular package
2.Photolithographic process
3.Excellent shock resistance and environmental characteristics.
4.Real time clocks, Timers, Portable applications

## DIMENSIONS(VT-200)




MODEL:VT-200 6.0pF with MB95107A at 25°C

| Key specifications | Vcc=2.2V | Vcc=3.0V | Remarks |
|---|---|---|---|
| Current control resistance : Rd ( k ohm ) | 0 | 0 | Control drive level & secure phase margin |
| Capacitance at gate : Cg ( pF ) | 6 | 6 | Optimal capacitance in response to CL |
| Capacitance at drain : Cd ( pF ) | 6 | 6 | ( CL = Cd // Cg + stray capacitance ) |

| Circuit characteristics ( at 25°C ) | Vcc=2.2V | Vcc=3.0V | Remarks |
|---|---|---|---|
| Matching Accuracy : df / f ( x10$^{-6}$ ) | -2.6 | -0.5 | Frequency offset volume at specified Vcc |
| Voltage Fluctuation : +/-df / V ( x10$^{-6}$ ) | 0.6 | 0.6 | Vcc +/-10% ( Standard operating voltage range ) |
| Drive Level : DL ( x10$^{-6}$W ) | 0.01 | 0.01 | DL=Ix$^{2}$ Re < 1x10$^{-6}$W,Re=R1( 1 + Co / CL )$^{2}$ |
| Negative resistance : \| - RL \| ( kohm ) | 1538 | 1538 | 5 times larger than $R_{1MAX}$ |
| Oscillation allowance : M ( times ) | 31 | 31 | Judgemental standard of oscillation stability |
| consumption current : Id (nA) | 314 | 314 | Cd charge current, Id = ωCd*Vd |
| Voltage of oscillation start : Vstart (V ) | 1.20 | 1.20 | |
| Voltage of oscillation stop : Vstop (V ) | 0.89 | 0.89 | |
| Oscillation start up time : Ts ( sec ) | 0.60 | 0.56 | Time to reach 90% of output level |

| Temperature characteristics of circuit | | Vcc=2.2V | Vcc=3.0V | Remarks |
|---|---|---|---|---|
| at -40°C | Variation : df / T ( x10$^{-6}$ ) | -139 | -139 | Typ.Tp=25°C ( K = -3.5×10$^{-8}$ / °C$^{2}$ ) |
| at +85°C | Variation : df / T ( x10$^{-6}$ ) | -126 | -125 | Typ.Tp=25°C ( K = -3.5×10$^{-8}$ / °C$^{2}$ ) |

The above mentioned value is only for your reference. The value is for the arbitrary samples and does not guarantee the product's characteristics. Please review and check above parameters at customer's end.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MB95100B

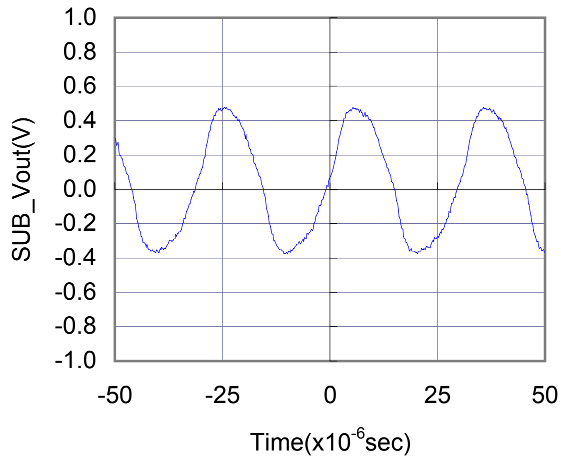
# Evaluation of Low Frequency Clock Oscillation Circuit

**VT-200 6.0pF with MB95107A-64P [LQFP(10x10) 0.50mm pitch]**

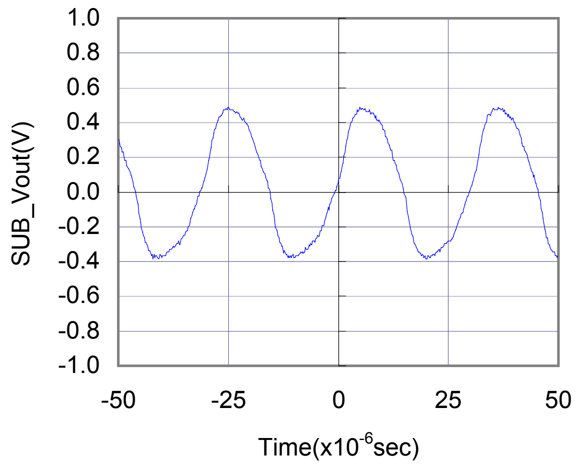
Measurement conditions :3.0V , 2.2V

## Test Data at 25°C

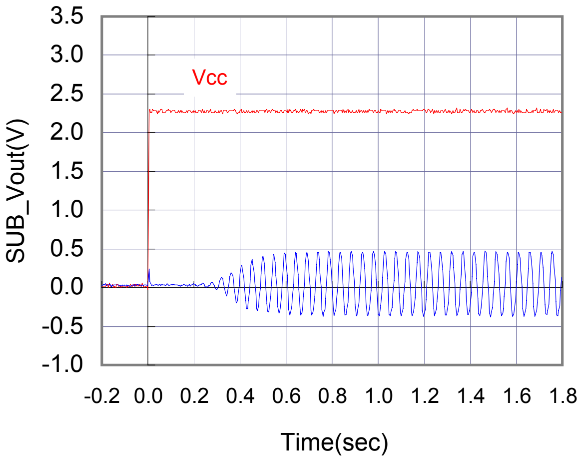
Output signal wave from the oscillator
Vcc=2.2V



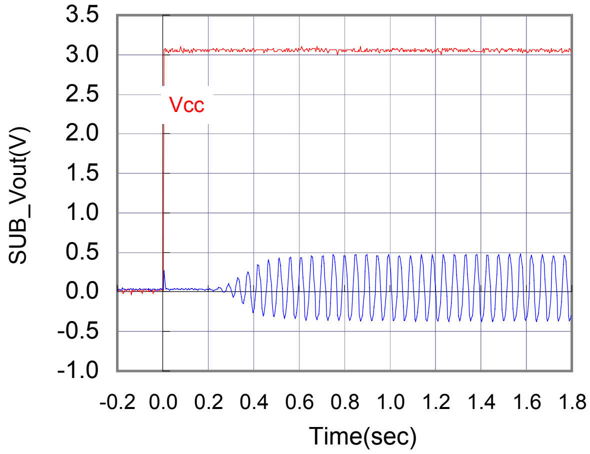

Output signal wave from the oscillator
Vcc=3.0V



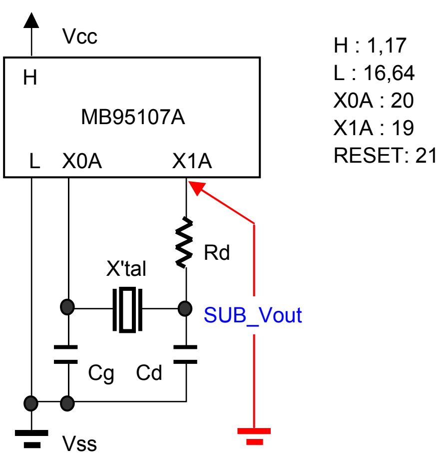

Start up time of SUB_Vout
Vcc=2.2V



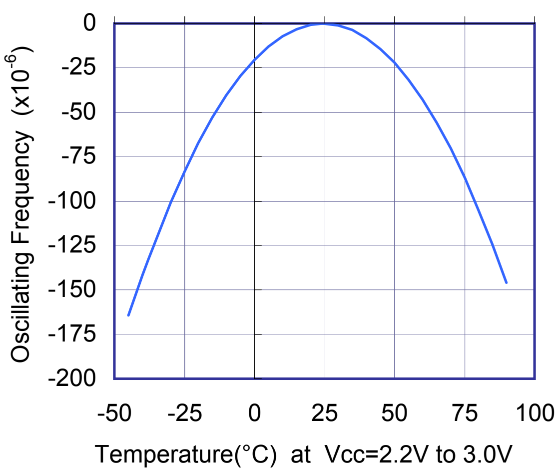

Start up time of SUB_Vout
Vcc=3.0V




Test Circuit




Temperature characteristics of oscillating frequency

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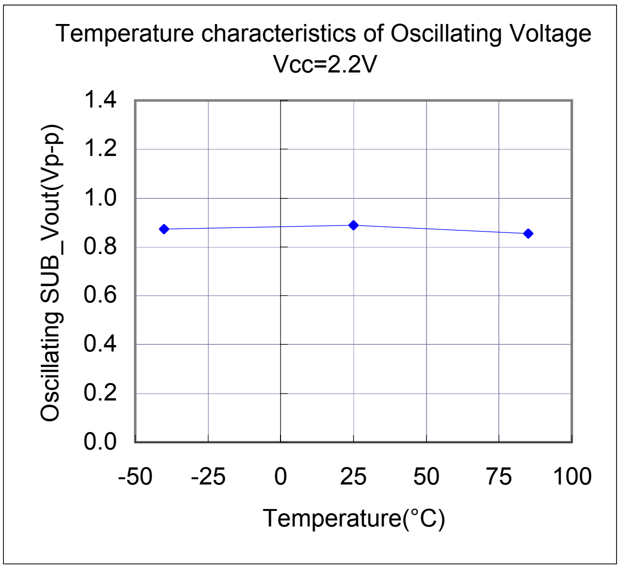
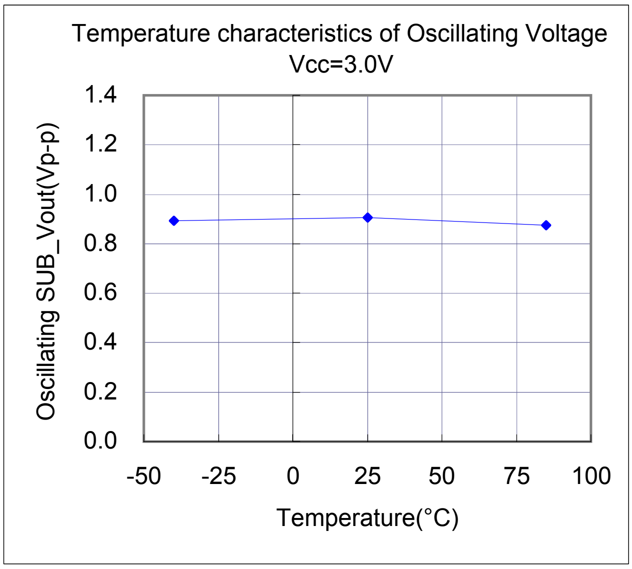
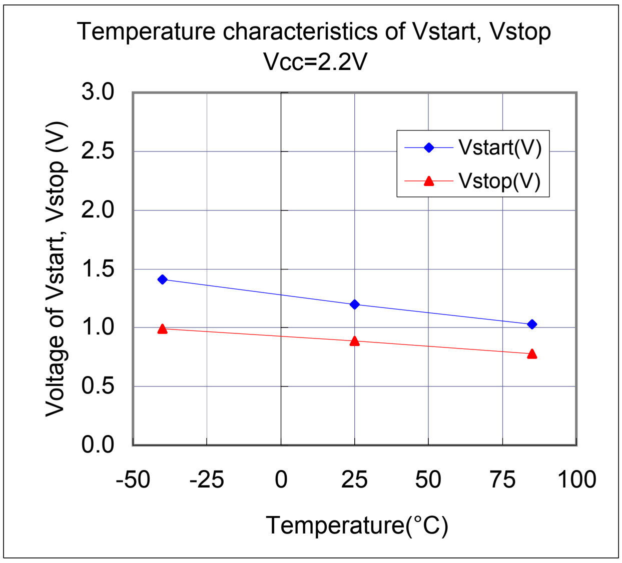
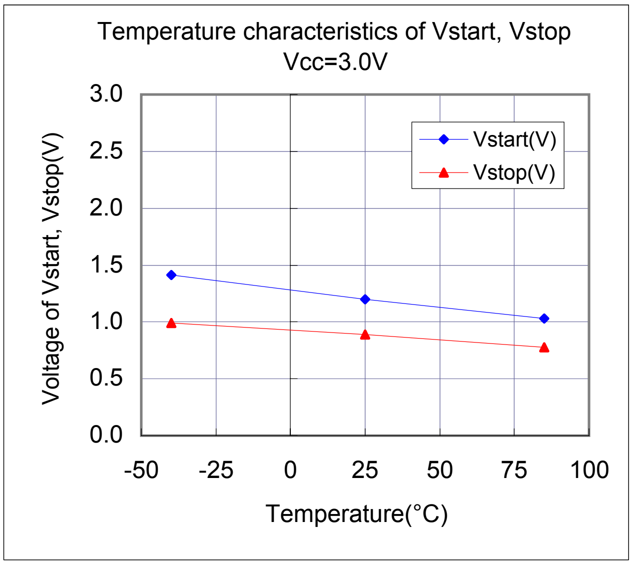
Measurement conditions :3.0V , 2.2V

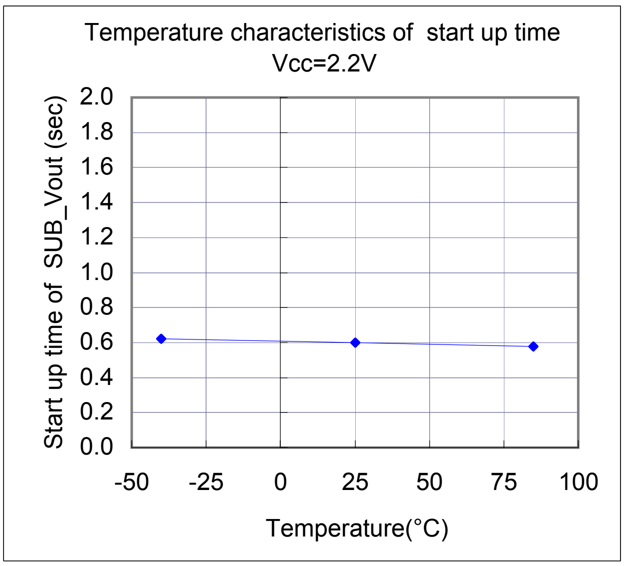
## Test Data : Temperature characteristics

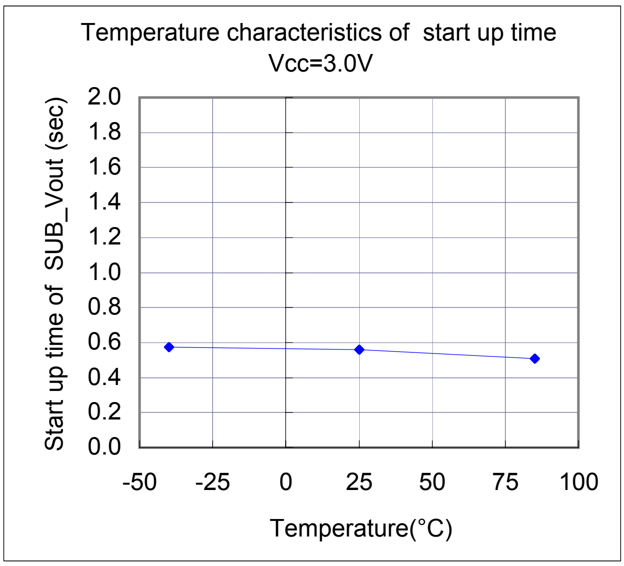


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# Evaluation of Low Frequency Clock Oscillation Circuit

**VT-200 6.0pF with MB95107A-64P [LQFP(10x10) 0.50mm pitch]**

Measurement conditions :3.0V , 2.2V

**Referential components layout(see Figure 1)**

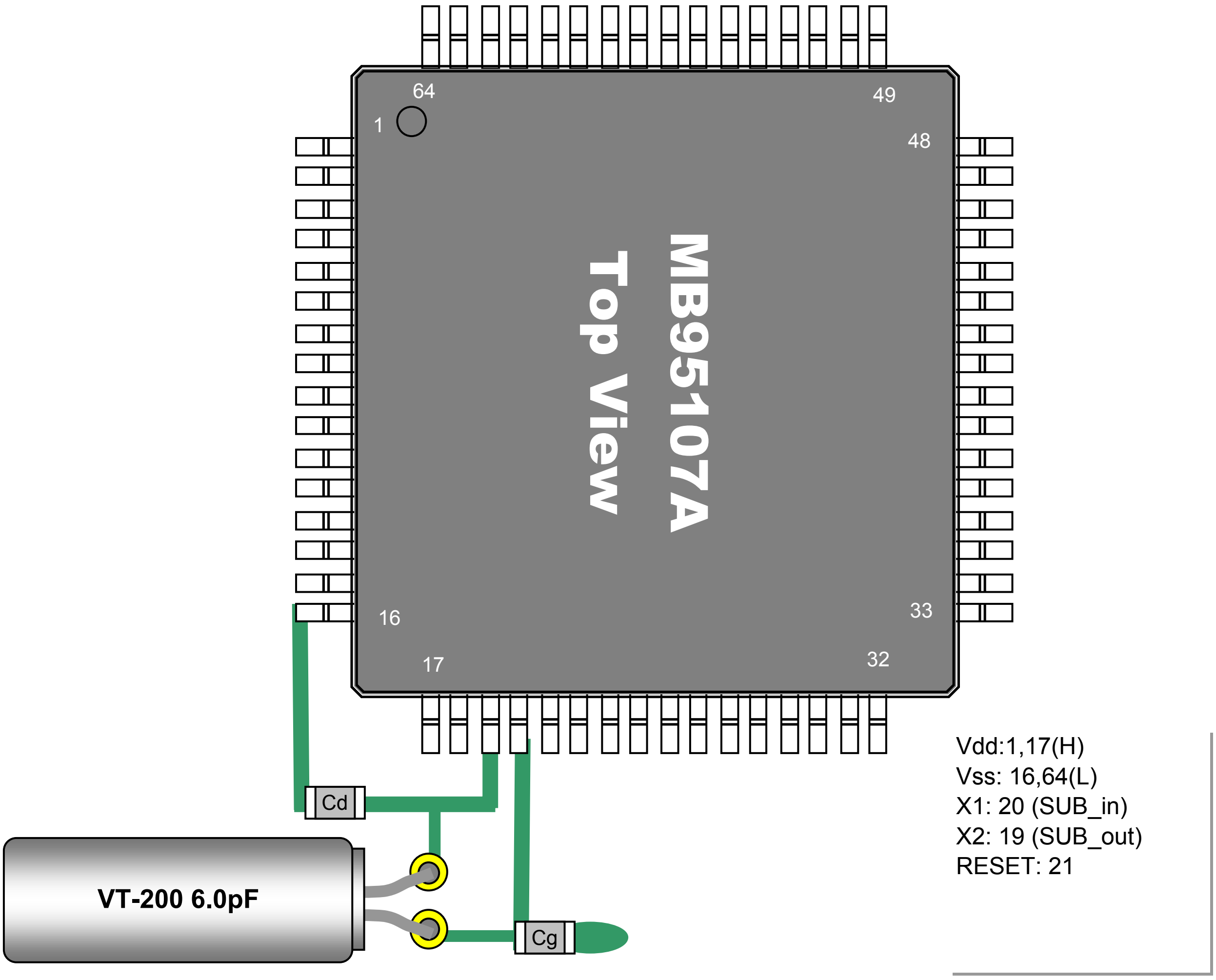


**Figure 1 Referential components layout**

## Notes for Board Design

When using a crystal resonator, place the resonator and its load capacitors as close as possible to SUB_in and SUB_out pins.
Other signal lines should be routed away from the resonator circuit to prevent induction from interfering with correct oscillation (see figure 2).

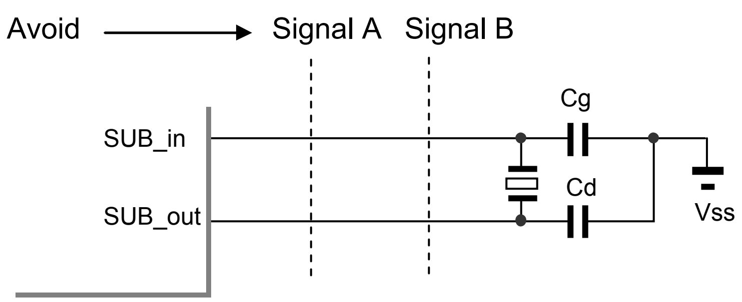


**Figure 2 Example of Incorrect Board Design**

**Remark** When using the subsystem clock, insert resistors Rd in series on the SUB_out side.



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Measurement conditions :3.0V , 2.2V

## [Evaluation Sample at 25°C]

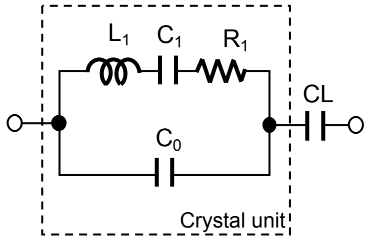
| SAMPLE | No. | CL( pF ) | Fo( Hz ) | fr( Hz ) | R1( kohm ) | Co( pF ) | C1( fF ) | Q( k ) |
|---|---|---|---|---|---|---|---|---|
| VT-200 | 1 | 6 | 32767.90 | 32762.75 | 26.7 | 0.89 | 2.166 | 84.0 |
| | 2 | 6 | 32767.99 | 32762.80 | 27.9 | 0.90 | 2.186 | 79.7 |
| | 3 | 6 | 32767.90 | 32762.79 | 28.8 | 0.88 | 2.148 | 78.6 |

## [IC Test Data : IC samples Rd=0k ohm,Cg=6pF,Cd=6pF at 25°C]

| Vcc(V) | IC sample | Fosc( Hz ) | df / f( x$10^{-6}$ ) | DL(x$10^{-6}$W) | \| -RL \|( kohm ) | Vstart( V ) | Ts(sec) |
|---|---|---|---|---|---|---|---|
| 3.0 | TYP_#1 | 32767.890 | -0.46 | 0.01 | 1538 | 1.20 | 0.56 |
| | TYP_#2 | 32767.910 | 0.15 | 0.01 | 1538 | 1.20 | 0.55 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| 2.2 | TYP_#1 | 32767.820 | -2.59 | 0.01 | 1538 | 1.20 | 0.60 |
| | TYP_#2 | 32767.840 | -1.98 | 0.01 | 1538 | 1.20 | 0.58 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Remark ( see figure 3 )**

Fo = fr ×{ C1/ ( 2×( Co + CL ))+ 1 }  ( Hz )




Fo : Load resonance frequency
fr : Resonance frequency
R1 : Motional resistance
C1 : Motional capacitance
Co : Shunt capacitance
CL : Load Capacitance

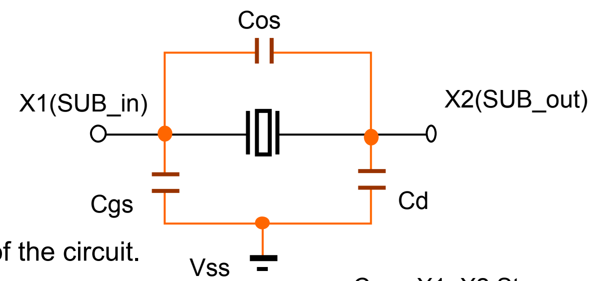
**Figure 3 Equivalent circuit of crystal unit, and CL**

**Remark ( see figure 4)**

Approximate formula of the load capacitance of the circuit CL.

CL = Cg×Cd / (Cg + Cd) + Cs (pF)

Where Cs(=2 to 4pF) Stands for stray capacitance of the circuit.




Cos : X1_X2 Stray capacitance
Cgs : X1_Vss Stray capacitance
Cds : X2_Vss Stray capacitance

**Figure 4 Stray capacitance Cos,Cgs,Cds of the circuit**

Resonator circuit constants will differ depending on the resonator element, stray capacitance in its interconnecting circuit, and other factors. Suitable constants should be determined in consultation with the resonator element manufacturer.

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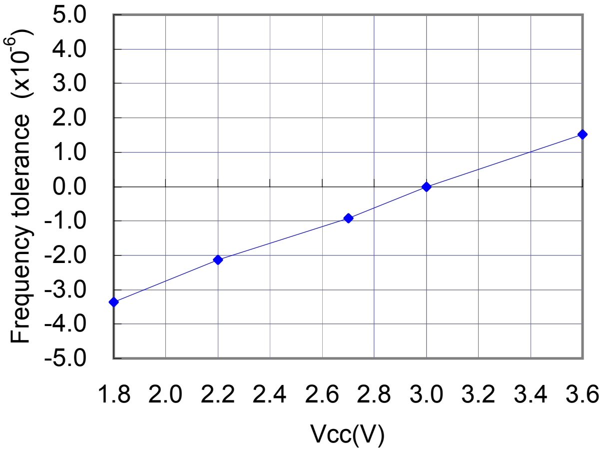
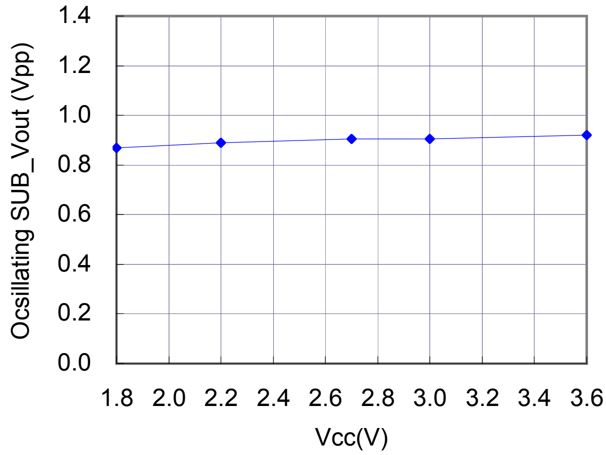
Measurement conditions : Vdd=1.8V to 3.6V at 25°C

## Referential Data : Voltage characteristics

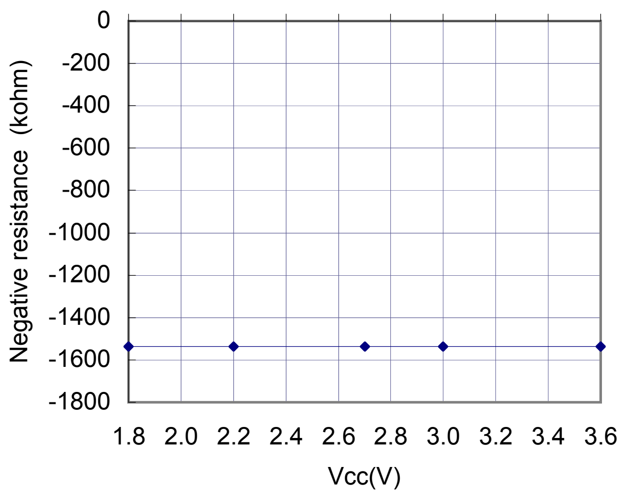
Frequency / voltage coefficient



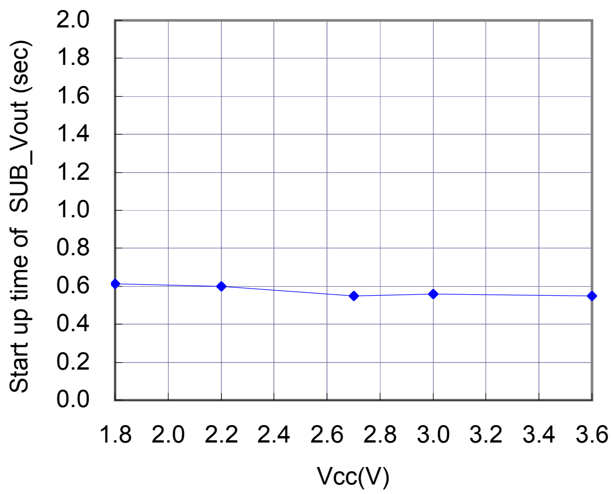

SUB_Vout / voltage coefficient



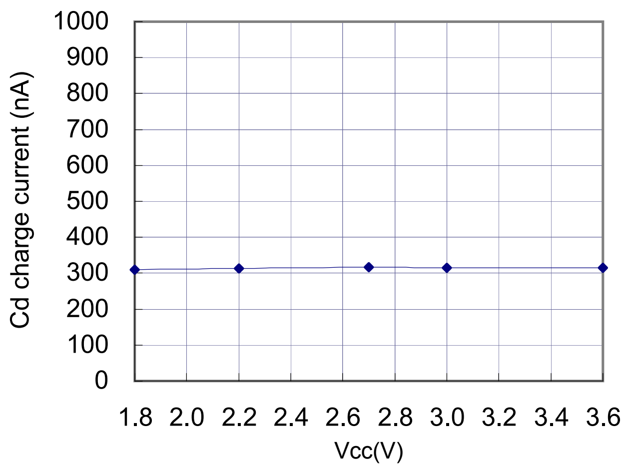

Negative resistance / voltage coefficient



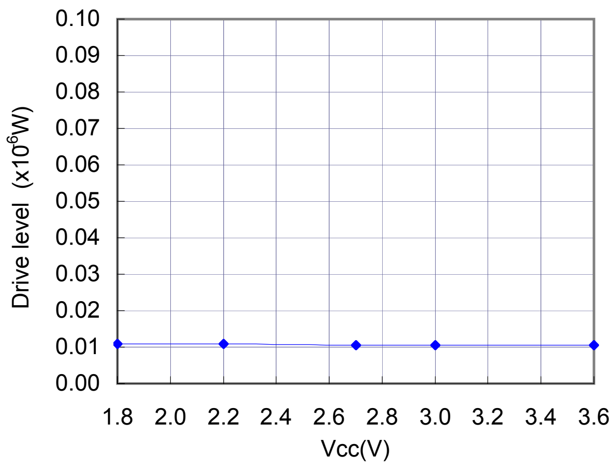

Start up time / voltage coefficient




Cd charge current / voltage coefficient




Drive level / voltage coefficient



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