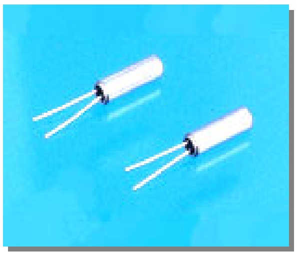
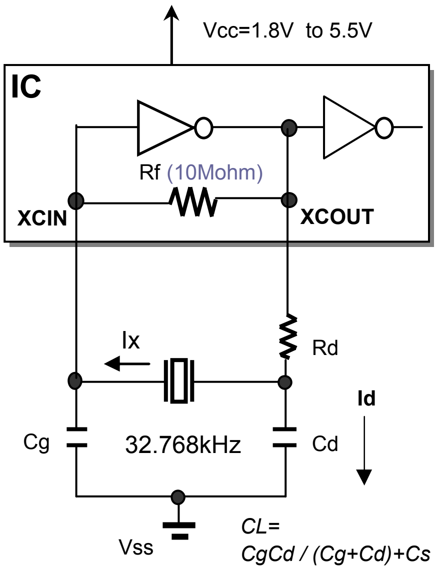
Evaluation of Subsystem Clock Oscillation Circuit

[M34559G6FP-52P] LQFP(10x10) 0.65mm pitch

Measurement conditions :5.0V,3.0V



Model	:VT-200
Frequency	:Fo=32.768kHz
Frequency tolerance	:dF/Fo= +/-20x10^{6}
Load capacitance	:CL=12.5pF
Equivalent series resistance	:R1=50kohm max
Max. drive level	:DL=1x10^{-6}W max
Level of drive	:DL=0.1x10^{-6}W typ

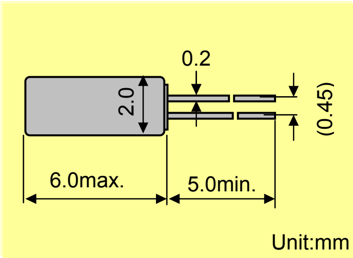


Remark) Ix : current through crystal

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 12.5pF with M34559G6FP at 25°C

Key specifications	Vcc=3.0V	Vcc=5.0V	Remarks
Current control resistance : Rd (k ohm)	100	100	Control drive level & secure phase margin
Capacitance at gate : Cg (pF)	22	22	Optimal capacitance in response to CL
Capacitance at drain : Cd (pF)	22	22	(CL = Cd // Cg + stray capacitance)

Circuit characteristics (at 25°C)	Vcc=3.0V	Vcc=5.0V	Remarks
Matching Accuracy : df / f (x10^{-6})	3.1	3.1	Frequency offset volume at specified Vcc
Voltage Fluctuation : +/-df / V (x10^{-6})	0.3	0.3	Vcc +/-10% (Standard operating voltage range)
Drive Level : DL (x10^{-6}W)	0.26	0.23	DL=Ix^2 Re < 1x10^{-6}W,Re=R1(1 + Co / CL $)^2$
Negative resistance : | - RL | (kohm)	1134	504	5 times larger than R_{1MAX}
Oscillation allowance : M (times)	22.7	10.1	Judgemental standard of oscillation stability
consumption current : Id (nA)	2,048	2,082	Cd charge current, Id = ωCd*Vd
Voltage of oscillation start : Vstrat (V)	1.17	1.17	
Voltage of oscillation stop : Vstop (V)	0.95	0.95	
Oscillation start up time : Ts (sec)	0.35	0.40	Time to reach 90% of output level

Temperature characteristics of circuit		Vcc=3.0V	Vcc=5.0V	Remarks
at -20°C	Variation : df / T (x10^{-6})	-69	-69	Typ.Tp=25°C (K = -3.5×10^{-8} / °C^2)
at +85°C	Variation : df / T (x10^{-6})	-131	-131	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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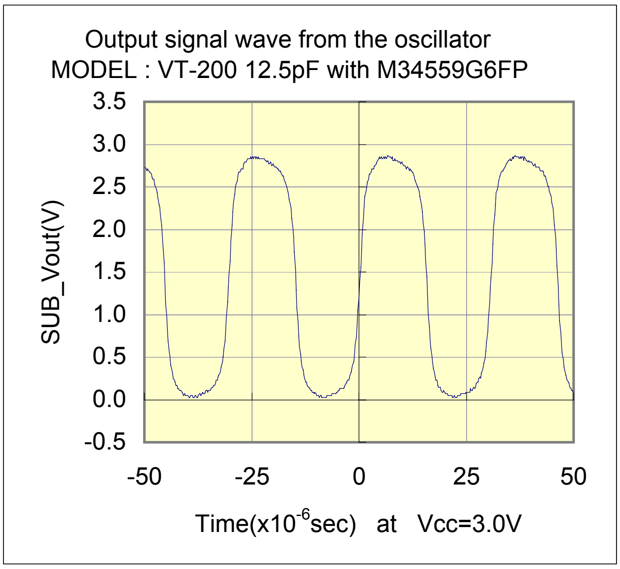
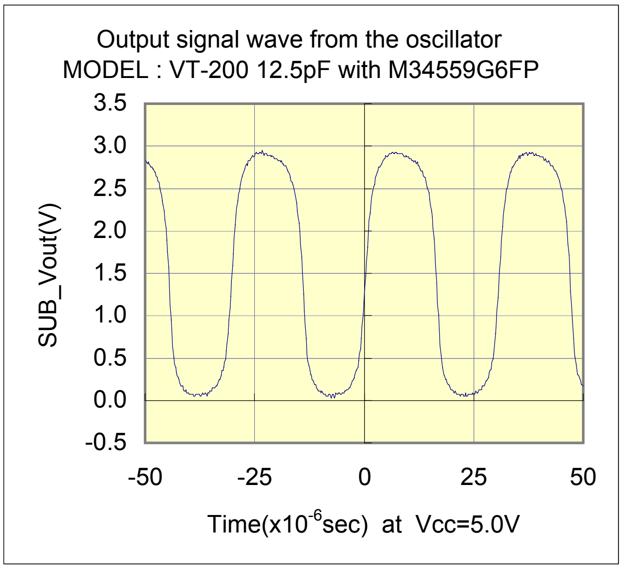
Evaluation of Subsystem Clock Oscillation Circuit

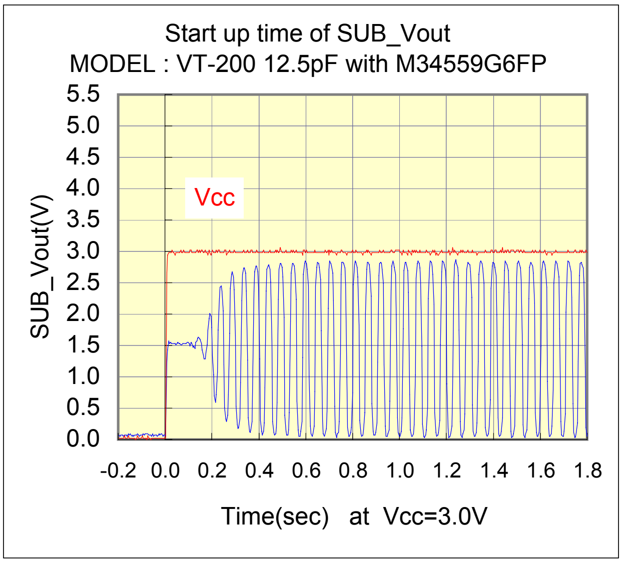
[M34559G6FP-52P] LQFP(10x10) 0.65mm pitch

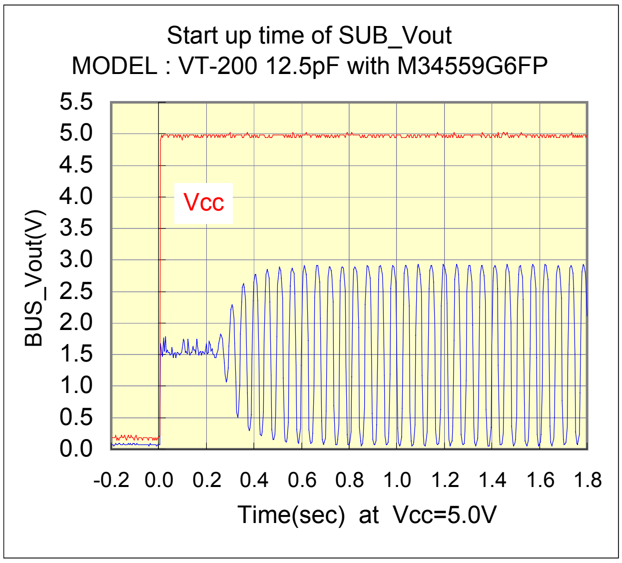
Measurement conditions :5.0V,3.0V

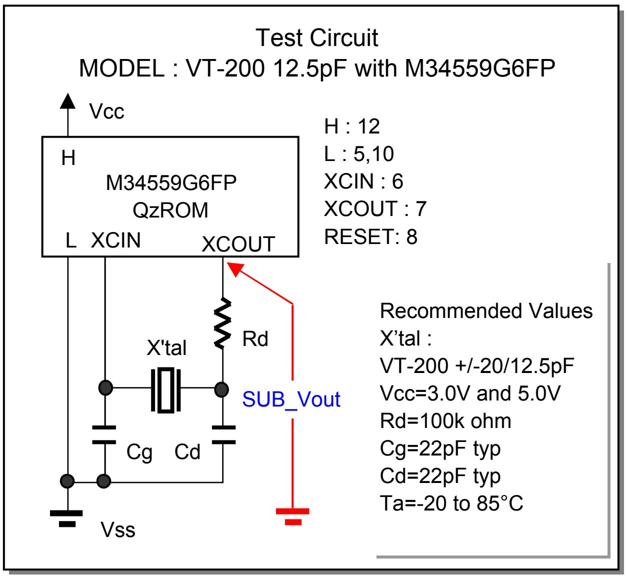
Test Data at 25°C

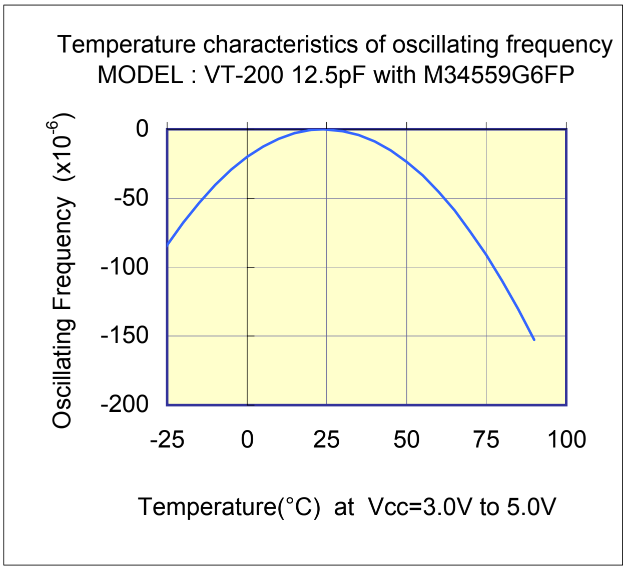












We value the "takumi" spirit.

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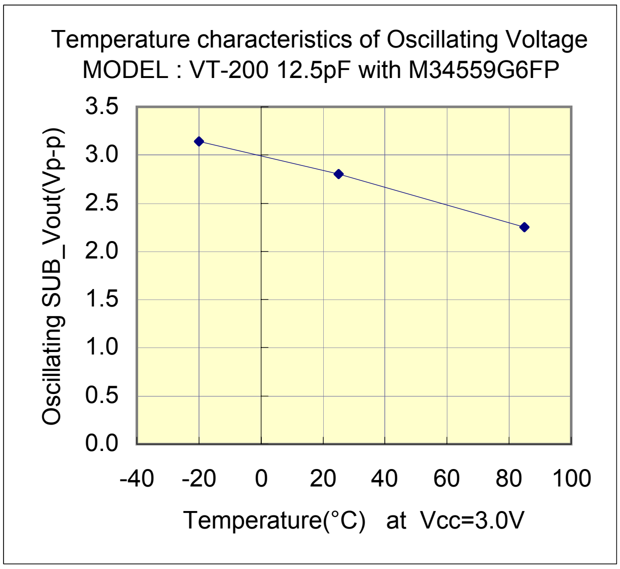
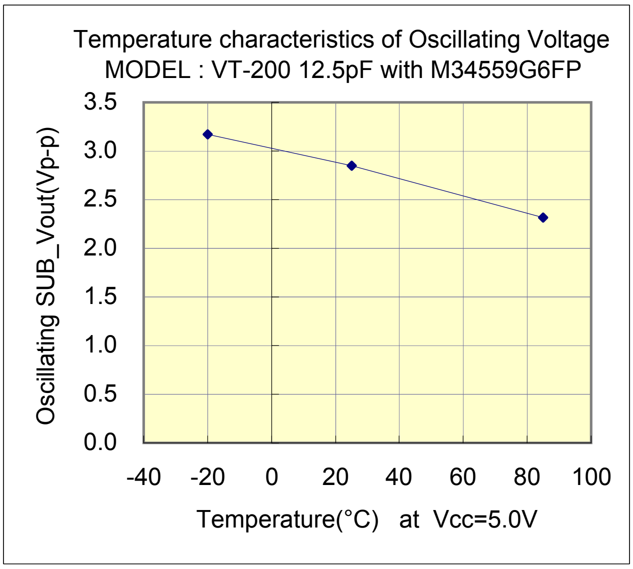
Evaluation of Subsystem Clock Oscillation Circuit

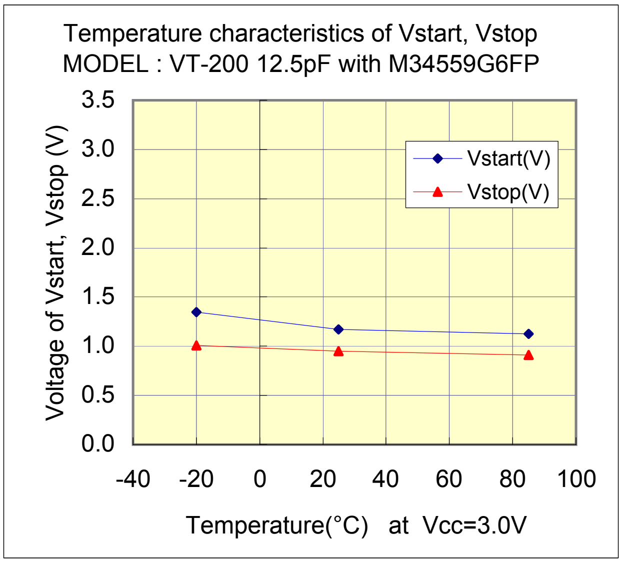
[M34559G6FP-52P] LQFP(10x10) 0.65mm pitch

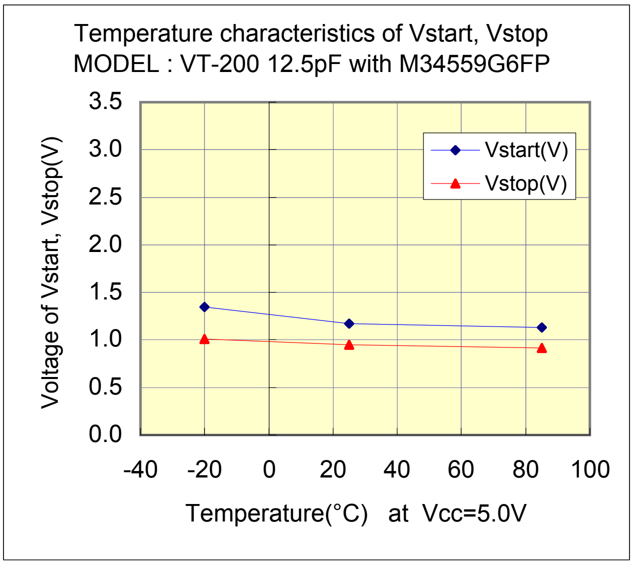
Measurement conditions :5.0V,3.0V

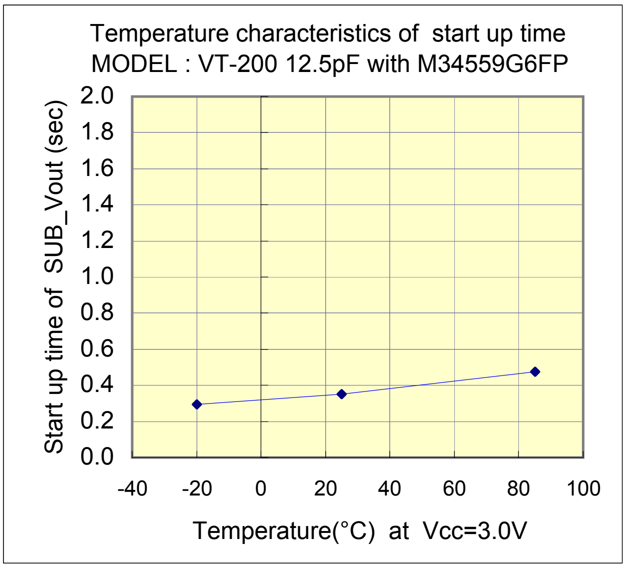
Test Data : Temperature characteristics

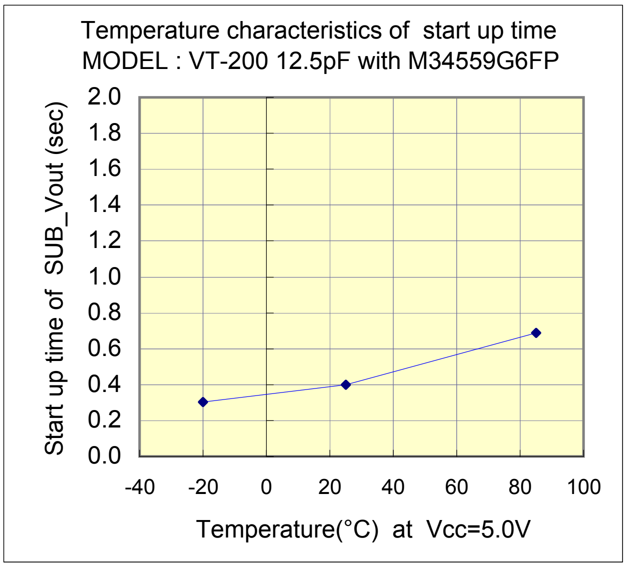












Evaluation of Subsystem Clock Oscillation Circuit

[M34559G6FP-52P] LQFP(10x10) 0.65mm pitch

Measurement conditions :5.0V,3.0V

Referential components layout(see Figure 1)

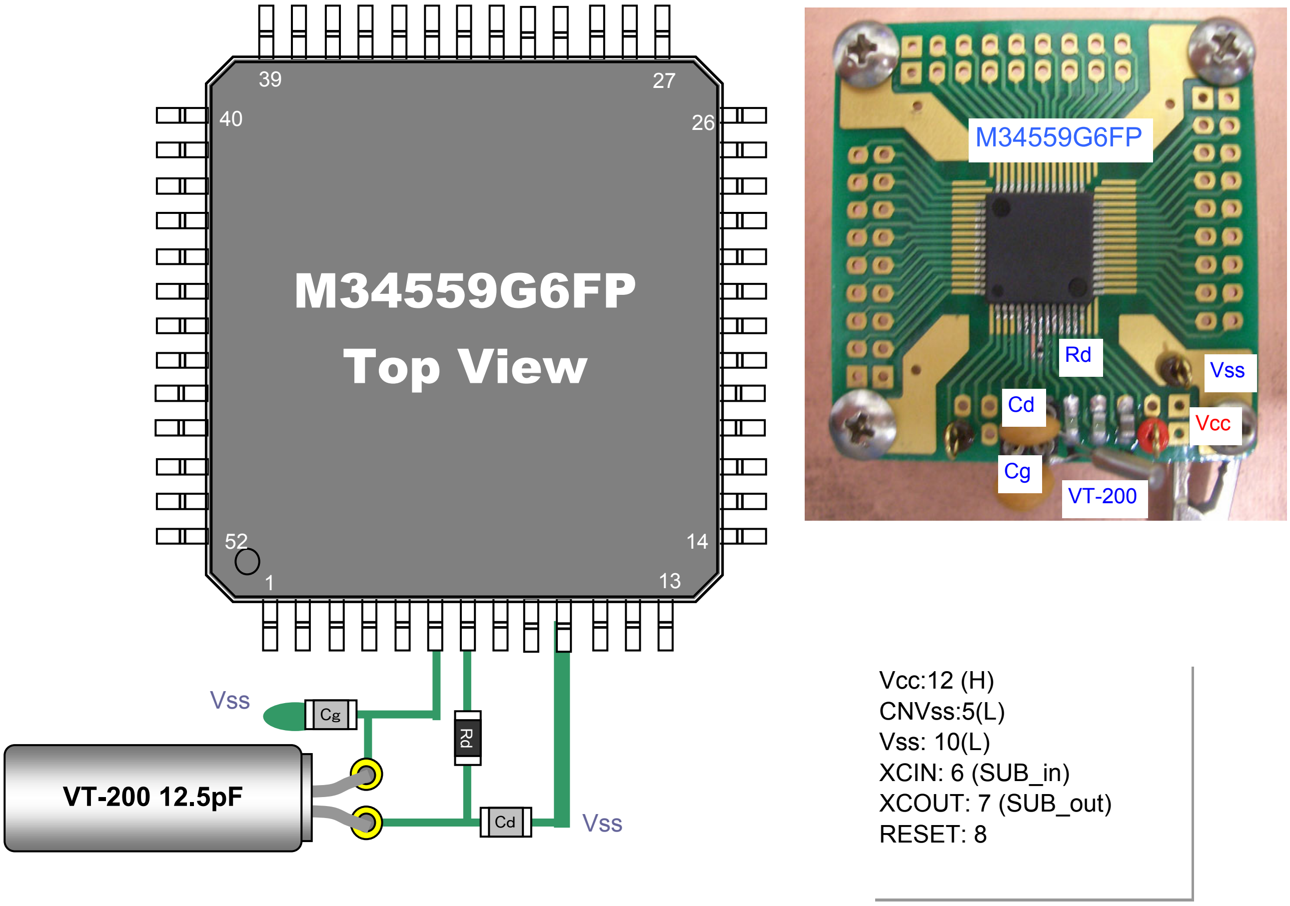


Figure 1 Referential components layout

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).

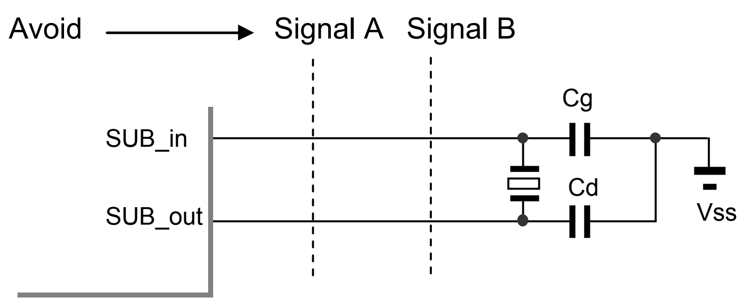


Figure 2 Example of Incorrect Board Design

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

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Evaluation of Subsystem Clock Oscillation Circuit

[M34559G6FP-52P] LQFP(10x10) 0.65mm pitch

Measurement conditions :5.0V,3.0V

SII

[Evaluation Sample : VT-200 12.5pF at 25°C]

SAMPLE	No.	CL(pF)	Fo(Hz)	fr(Hz)	R1(kohm)	Co(pF)	C1(fF)	Q(k)
VT-200 12.5pF	1	12.5	32768.11	32765.28	27.4	0.91	2.319	76.5
	2	12.5	32768.09	32765.24	26.9	0.89	2.333	77.4
	3	12.5	32768.34	32765.45	29.9	0.93	2.368	68.6

[IC Test Data : IC sample Rd=100k ohm,Cg=22pF,Cd=22pF at 25°C]

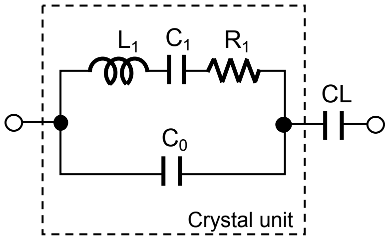
Vcc(V)	IC sample	Fosc(Hz)	df / f($x10^{-6}$)	DL($x10^{-6}$W)	| -RL |(kohm	Vstart(V)	Ts(sec)
5.0	TYP	32768.440	3.08	0.23	504	1.17	0.40
	HH	32768.470	3.99	0.29	544	1.29	0.36
	LL	32768.370	0.94	0.18	334	0.86	1.00

[IC Test Data : IC sample Rd=100k ohm,Cg=22pF,Cd=22pF at 25°C]

Vcc(V)	IC sample	Fosc(Hz)	df / f($x10^{-6}$)	DL($x10^{-6}$W)	| -RL |(kohm	Vstart(V)	Ts(sec)
3.0	TYP	32768.440	3.08	0.26	1134	1.17	0.35
	HH	32768.320	-0.59	0.35	1134	1.29	0.38
	LL	32768.460	3.69	0.18	544	0.86	0.55

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

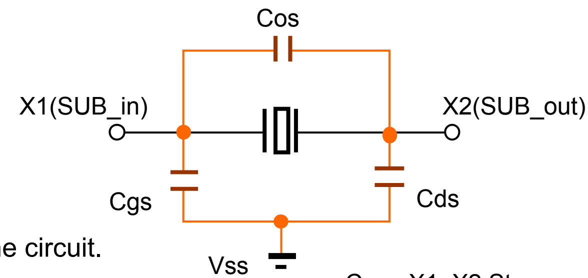
Figure 3 Equivalent circuit of crystal unit, and CL

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.

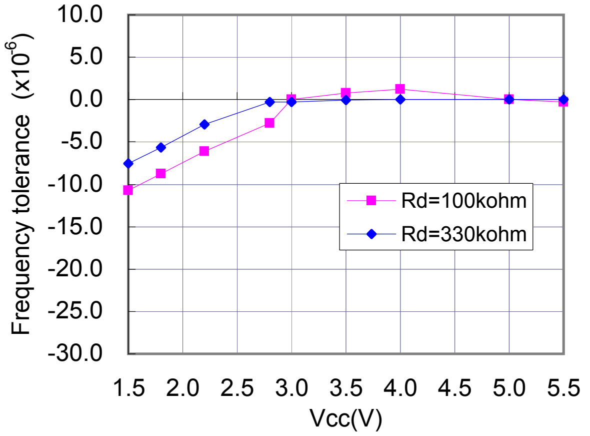
Evaluation of Subsystem Clock Oscillation Circuit

[M34559G6FP-52P] LQFP(10x10) 0.65mm pitch

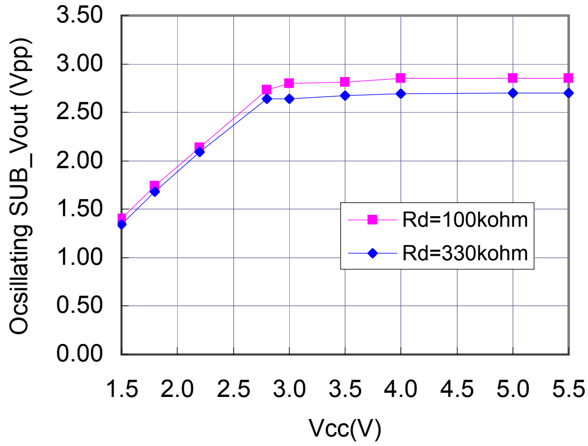
Measurement conditions : Vdd=(1.5)V to 5.5V at 25°C

Referential Data : Voltage characteristics

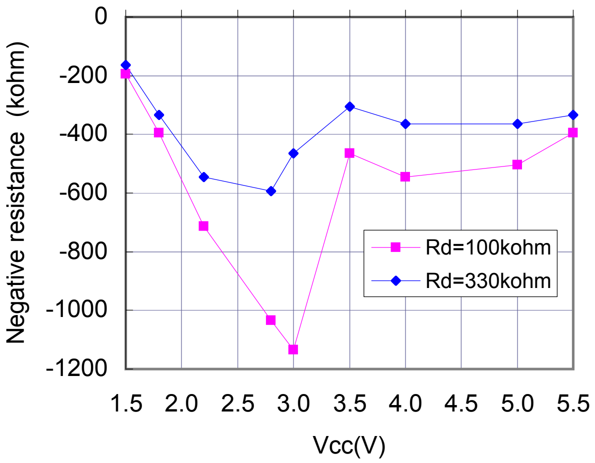
Frequency / voltage coefficient
MODEL : VT-200 12.5pF with M34559G6FP



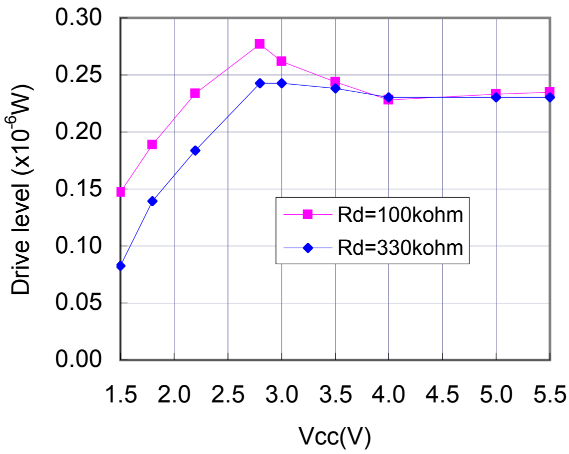
SUB_Vout / voltage coefficient
MODEL : VT-200 12.5pF with M34559G6FP



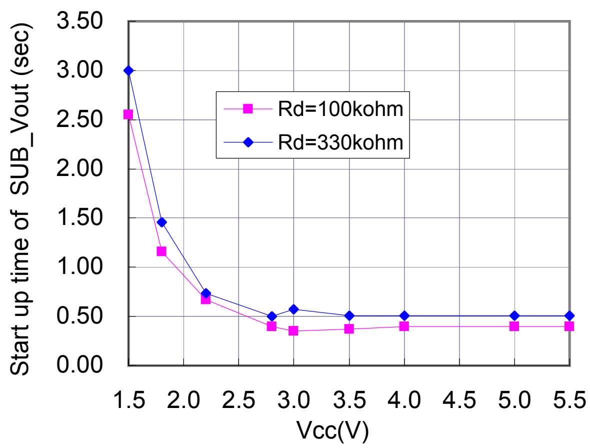
Negative resistance / voltage coefficient
MODEL : VT-200 12.5pF with M34559G6FP



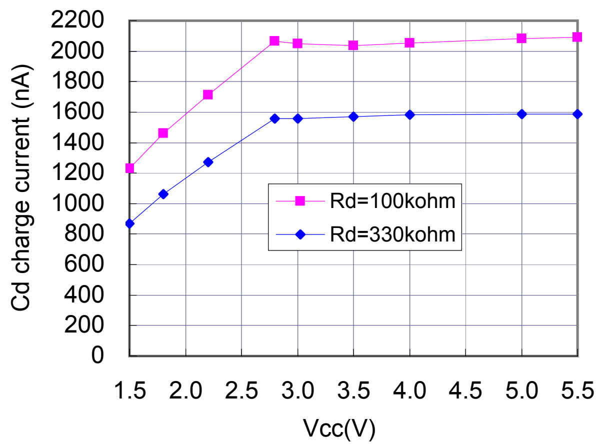
Drive level / voltage coefficient
MODEL : VT-200 12.5pF with M34559G6FP



Start up time / voltage coefficient
MODEL : VT-200 12.5F with M34559G6FP



Cd charge current / voltage coefficient
MODEL : VT-200 12.5pF with M34559G6FP



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