

Evaluation of Subsystem Clock Oscillation Circuit

[MB89F538-64P] LQFP(12x12) 0.65mm pitch
 Measurement conditions :5.0V , 3.3V(reference)

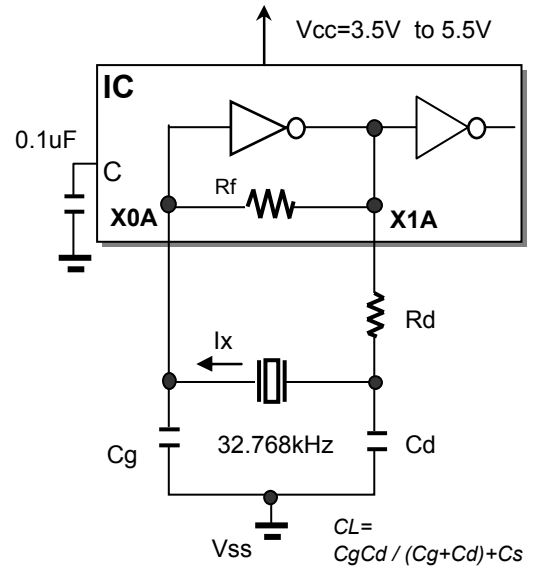
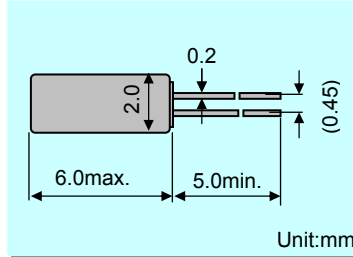


Model :VT-200
 Frequency :Fo=32.768kHz
 Frequency tolerance :dF/Fo= +/-20x10⁶
 Load capacitance :CL=6.0pF
 Equivalent series resistance :R1=50kohm max
 Max. drive level :DL=1x10⁶W max
 Level of drive :DL=0.1x10⁶W typ

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)



Remark) I_x : current through crystal

MODEL:VT-200 6.0pF with MB89F538 at 25°C

Key specifications	Vcc=(3.3V)	Vcc=5.0V	Remarks
Negative feedback resistance : R _f (M ohm)	Built-in	Built-in	
Current control resistance : R _d (k ohm)	470	470	Control drive level & secure phase margin
Capacitance at gate : C _g (pF)	8	10	Optimal capacitance in response to CL
Capacitance at drain : C _d (pF)	8	9	(CL = C _d // C _g + stray capacitance)

Circuit characteristics (at 25°C)	Vcc=(3.3V)	Vcc=5.0V	Remarks
Matching Accuracy : df / f (x10 ⁻⁶)	-0.8	3.8	Frequency offset volume at specified V _{dd}
Voltage Fluctuation : +/-df / V (x10 ⁻⁶)	4.0	5.5	V _{dd} +/-10% (Standard operating voltage range)
Drive Level : DL (x10 ⁻⁶ W)	0.07	0.13	DL=I _x ² Re < 1x10 ⁻⁶ W, Re=R1(1 + Co / CL) ²
Negative resistance : - RL (kohm)	858	1538	5 times larger than R _{1MAX}
Oscillation allowance : M (times)	17.2	30.8	Judgemental standard of oscillation stability
Voltage of oscillation start : V _{start} (V)	2.07	2.06	
Voltage of oscillation stop : V _{stop} (V)	1.66	1.66	
Oscillation start up time : T _s (sec)	0.63	0.36	Time to reach 90% of output level

Temperature characteristics of circuit		Vcc=(3.3V)	Vcc=5.0V	Remarks
at -40°C	Variation : df / T (x10 ⁻⁶)	-132	-132	Typ.Tp=25°C (K = -3.5x10 ⁻⁸ / °C ²)
at +85°C	Variation : df / T (x10 ⁻⁶)	-139	-138	Typ.Tp=25°C (K = -3.5x10 ⁻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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We value the "takumi" spirit.

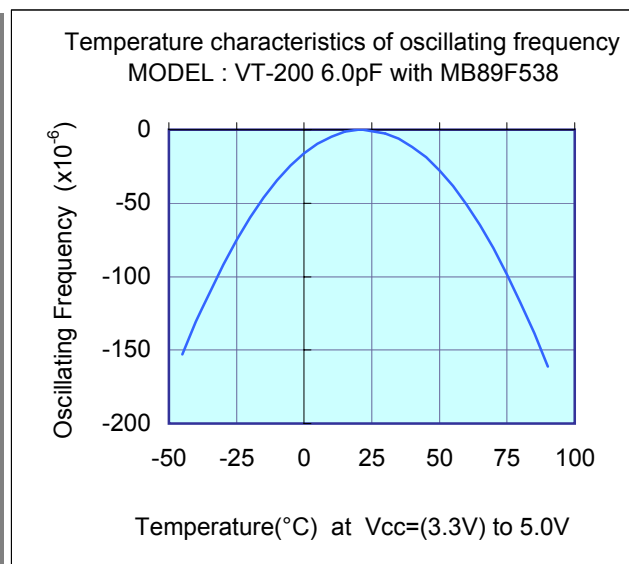
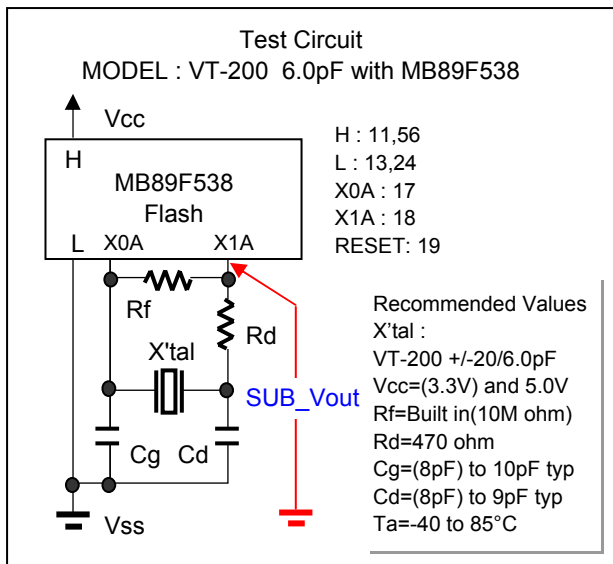
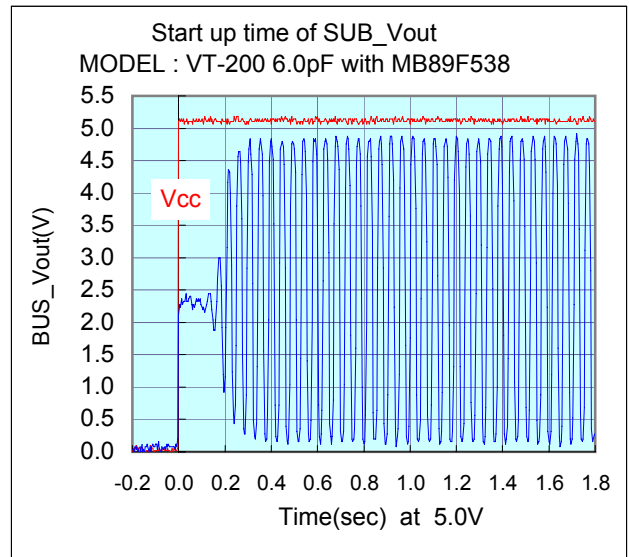
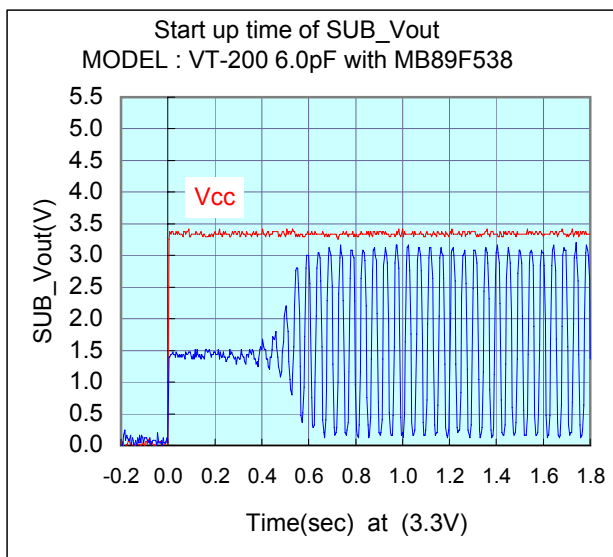
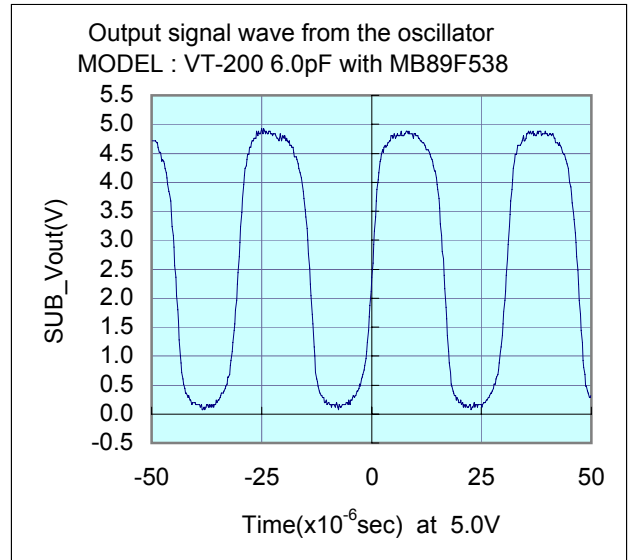
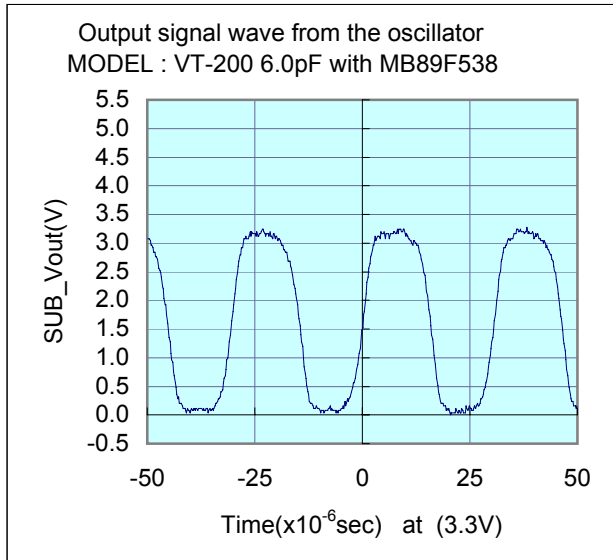
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Test Data at 25°C



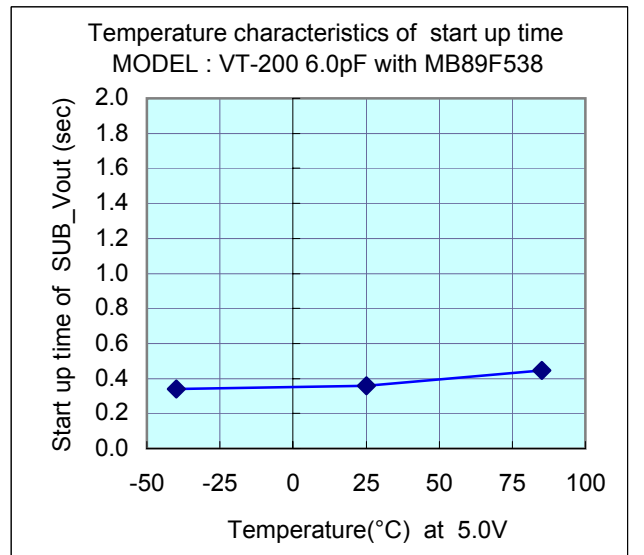
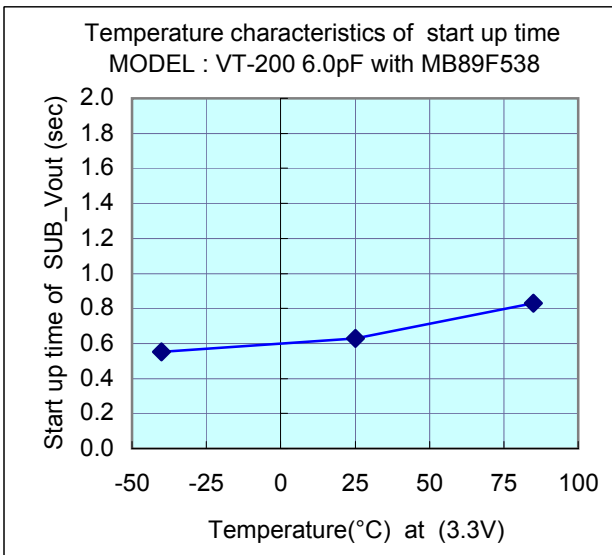
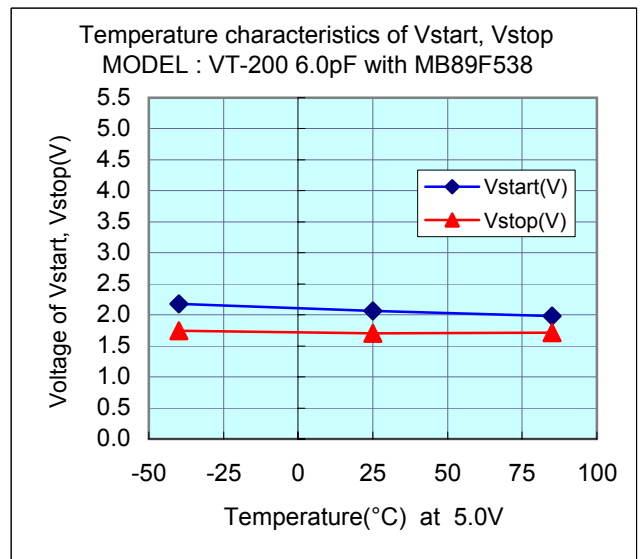
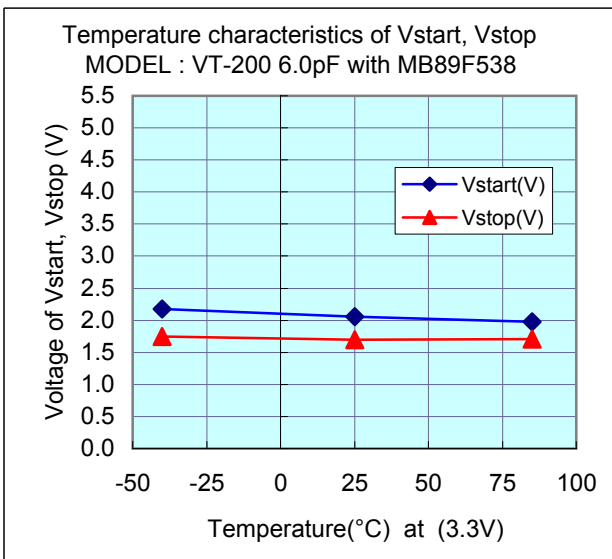
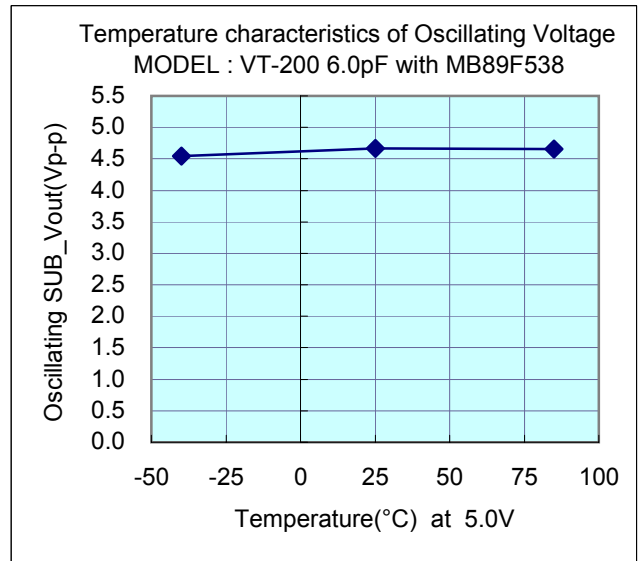
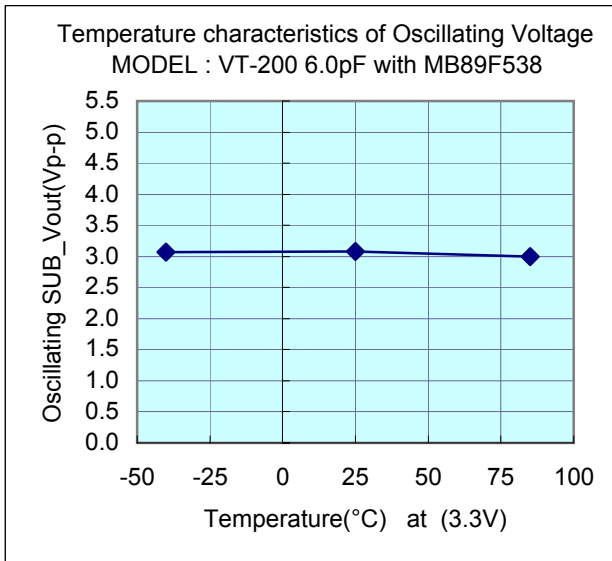
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Measurement conditions :5.0V , 3.3V(reference)



Test Data : Temperature characteristics



Evaluation of Subsystem Clock Oscillation Circuit

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 Measurement conditions :5.0V , 3.3V(reference)



Referential components layout(see Figure 1)

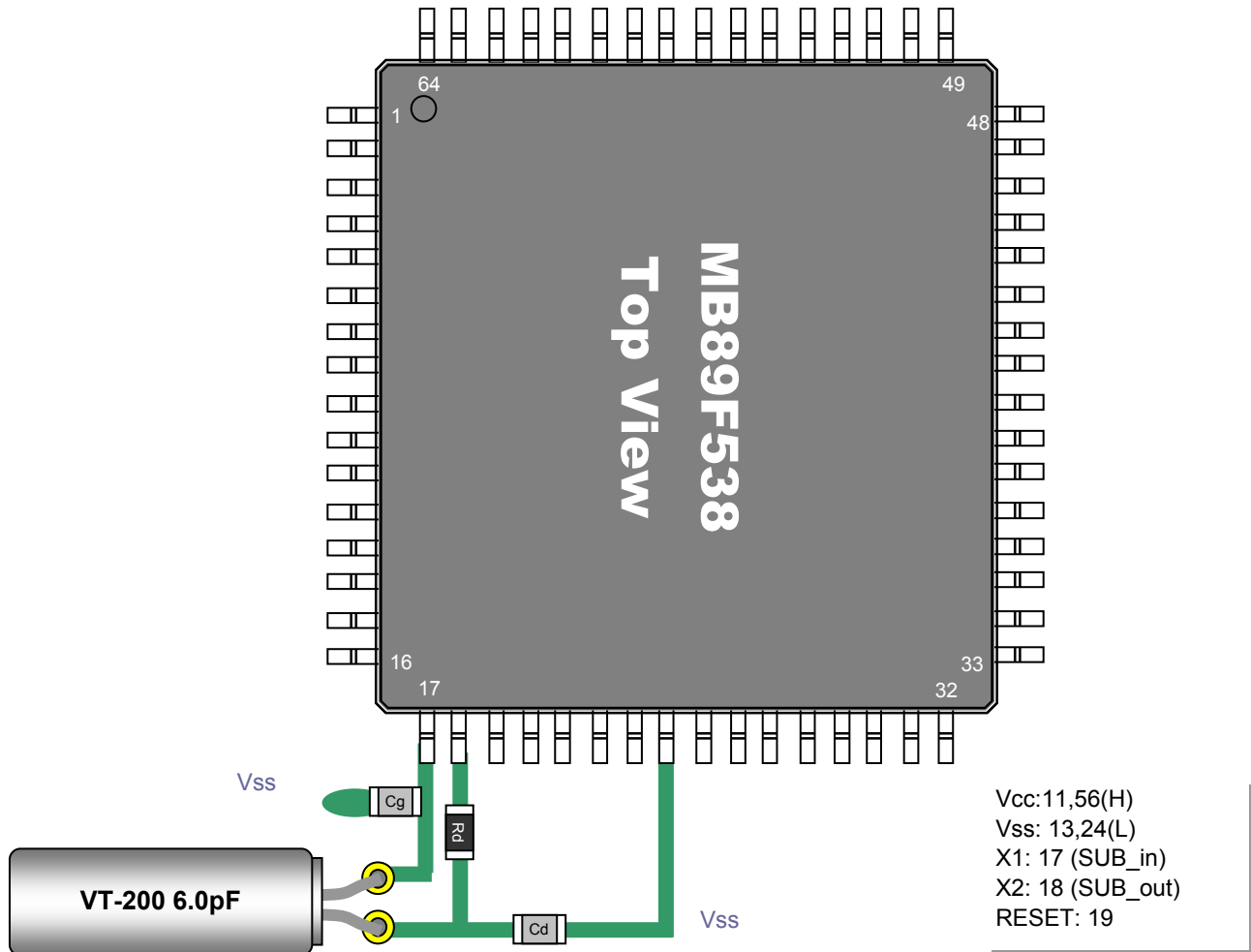


Figure 1 Referential components layout

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).

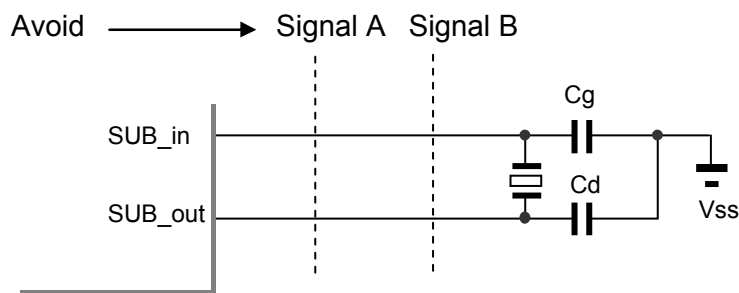


Figure 2 Example of Incorrect Board Design

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

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 Measurement conditions :5.0V , 3.3V(reference)



[Evaluation Sample : VT-200 6.0pF at 25°C]

SAMPLE	No.	CL(pF)	Fo(Hz)	fr(Hz)	R1(kohm)	Co(pF)	C1(fF)	Q(k)
VT-200 6.0pF	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=470k ohm,Cg=10pF,Cd=9pF at 25°C]

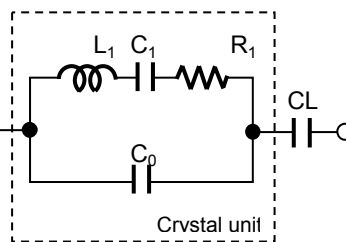
Vcc(V)	IC samples	Fosc(Hz)	df / f(x10 ⁻⁶)	DL(x10 ⁻⁶ W)	-RL (kohm)	Vstart(V)	Ts(sec)
5.0	TYP_#1	32768.030	3.82	0.13	1538	2.06	0.36
	TYP_#2	32768.000	2.90	0.12	1538	2.05	0.40
	TYP_#3	---	---	---	---	---	---

[IC Test Data : IC samples Rd=470k ohm,Cg=(8pF),Cd=(8pF) at 25°C]

Vcc(V)	IC samples	Fosc(Hz)	df / f(x10 ⁻⁶)	DL(x10 ⁻⁶ W)	-RL (kohm)	Vstart(V)	Ts(sec)
(3.3)	TYP_#1	32767.880	-0.76	0.07	858	2.07	0.63
	TYP_#2	32767.850	-1.68	0.07	120	2.08	0.65
	TYP_#3	---	---	---	---	---	---

Remark (see figure 3)

$$F_o = f_r \times \{ C_1 / (2 \times (C_o + C_L)) + 1 \} \text{ (Hz)}$$



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

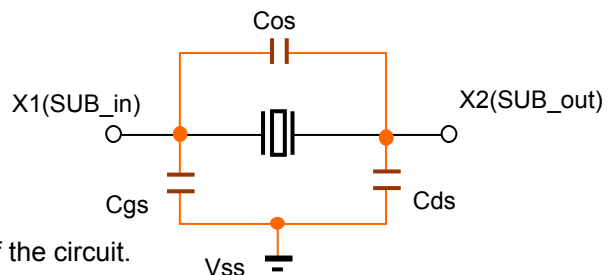
Figure 3 Equivalent circuit of crystal unit, and CL

Remark (see figure 4)

Approximate formula of the load capacitance of the circuit CL.

$$CL = C_g \times C_d / (C_g + C_d) + C_s \text{ (pF)}$$

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=(2.7V) to 5.5V at 25°C

Referential Data : Voltage characteristics

