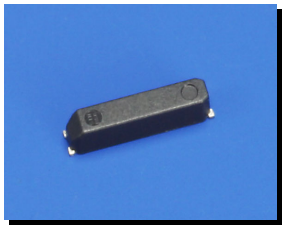
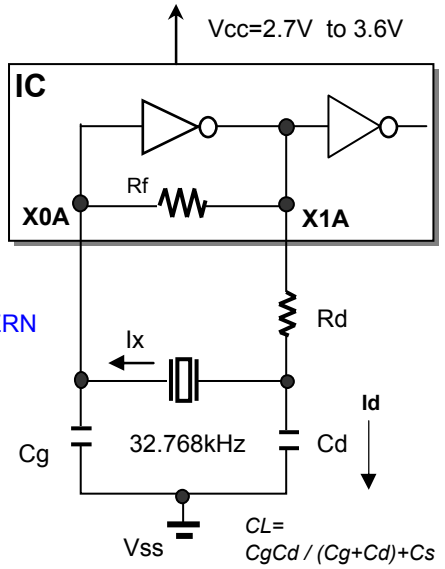
Evaluation of Subsystem Clock Oscillation Circuit

[MB91F647-176P] LQFP(24x24) 0.50mm pitch

Measurement conditions :3.3V , (2.2V)reference



Model	:SSP-T7
Frequency	:Fo=32.768kHz
Frequency tolerance	:dF/Fo= +/-20x10^{6}
Load capacitance	:CL=7.0pF
Equivalent series resistance	:R1=65kohm max
Max. drive level	:DL=1x10^{-6}W max
Level of drive	:DL=0.1x10^{-6}W typ

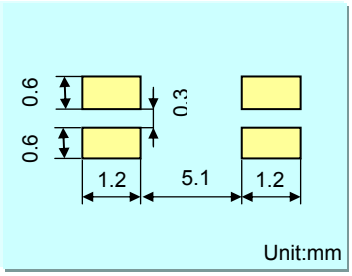


Remark) Ix : current through crystal

FEATURES

1.Ultra thin type with 1.4mm Max.
2.SMD type suitable for automatic & high density surface mounting.
3.Plastic mold package containing highly reliable tubular type quartz crystal.
4.Excellent shock and heat resistance.
5.Cellular phones,PDA,Radio communication equipment, Portable applications etc.

RECOMMENDED SOLDERING PATTERN



MODEL:SSP-T7 7.0pF with MB91F647 at 25°C

Key specifications	Vcc=(2.2V)	Vcc=3.3V	Remarks
Current control resistance : Rd (k ohm)	330	330	Control drive level & secure phase margin
Capacitance at gate : Cg (pF)	9	9	Optimal capacitance in response to CL
Capacitance at drain : Cd (pF)	8	8	(CL = Cd // Cg + stray capacitance)

Circuit characteristics (at 25°C)	Vcc=(2.2V)	Vcc=3.3V	Remarks
Matching Accuracy : df / f (x10^{-6})	-11.4	0.4	Frequency offset volume at specified Vcc
Voltage Fluctuation : +/-df / V (x10^{-6})	3.0	2.0	Vcc +/-10% (Standard operating voltage range)
Drive Level : DL (x10^{-6}W)	0.06	0.05	DL=Ix^{2} Re < 1x10^{-6}W,Re=R1(1 + Co / CL)^{2}
Negative resistance : | - RL | (kohm)	870	960	5 times larger than R_{1MAX}
Oscillation allowance : M (times)	13	15	Judgemental standard of oscillation stability
Consumption current : Id (nA)	856	1,246	Cd charge current, Id = ωCd*Vd
Voltage of oscillation start : Vstart (V)	1.46	1.46	
Voltage of oscillation stop : Vstop (V)	1.23	1.23	
Oscillation start up time : Ts (sec)	0.50	0.54	Time to reach 90% of output level

Temperature characteristics of circuit		Vcc=(2.2V)	Vcc=3.3V	Remarks
at -40°C	Variation : df / T (x10^{-6})	-135	-135	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.

Seiko Instruments USA Inc.
2990,West Lomita Blvd., Torrance, CA 90505, U.S.A
Telephone :+1 310-517-7771 Facsimile :+1 310-517-7792
Email :info@siu-la.com

Seiko Instruments GmbH
Siemensstrasse 9,D-63263 Neu-Isenburg,Germany
Telephone :+49-6102-297-0 Facsimile :+49-6102-297-320
Email :info@seiko-instruments.de

Seiko Instruments Inc.
1-8,Nakase,Mihama-ku,Chiba-shi,Chiba 261-8507,Japan
Facsimile :+81-43-211-8030
E-mail :component@sii.co.jp

MB91645

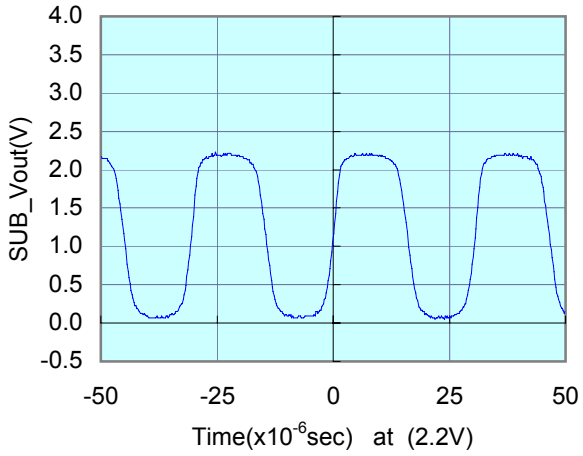
Evaluation of Subsystem Clock Oscillation Circuit

[MB91F647-176P] LQFP(24x24) 0.50mm pitch

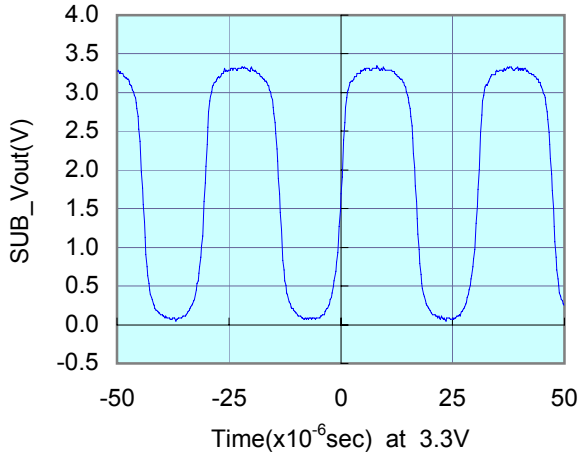
Measurement conditions :3.3V , (2.2V)reference

Test Data at 25°C

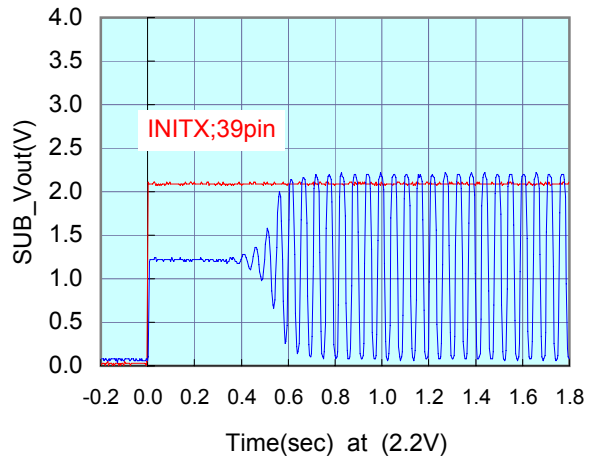
Output signal wave from the oscillator
MODEL : SSP-T7 7.0pF with MB91F647



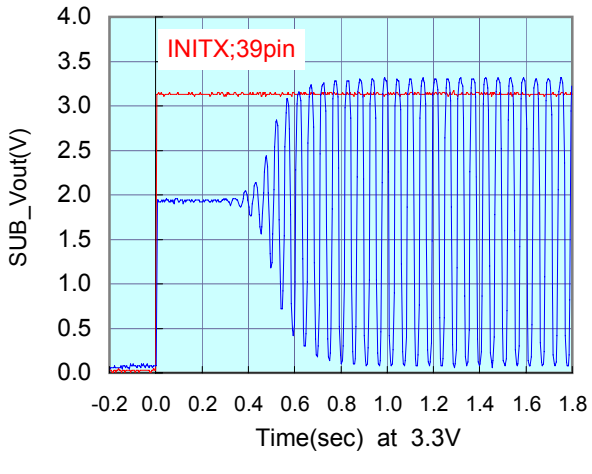
Output signal wave from the oscillator
MODEL : SSP-T7 7.0pF with MB91F647



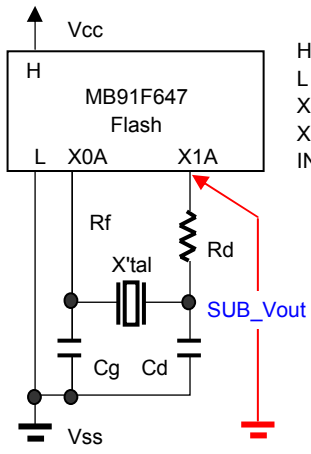
Start up time of SUB_Vout
MODEL : SSP-T7 7.0pF with MB91F647



Start up time of SUB_Vout
MODEL : SSP-T7 7.0pF with MB91F647



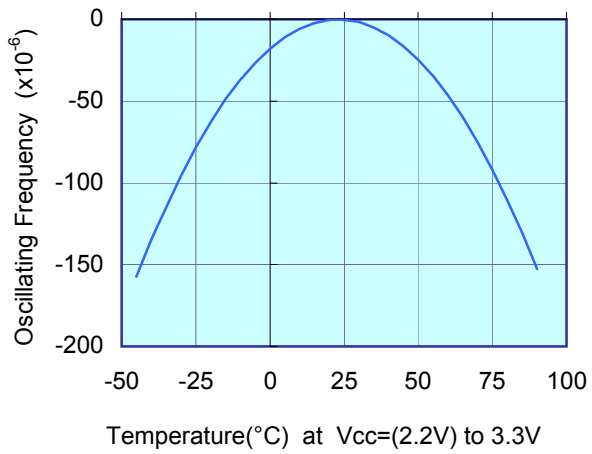
Test Circuit
MODEL : SSP-T7 7.0pF with MB91F647



H : 34,64,89,133,176
L : 1,33,44,66,88,132,148
X0A : 46
X1A : 45
INITX(Reset): 39

Recommended Values
X'tal :
SSP-T7 +/-20/7.0pF
Vcc=(2.2V) and 3.3V
Rd=330 kohm
Cg= 9pF typ
Cd= 8pF typ
Ta=-40 to 85°C

Temperature characteristics of oscillating frequency
MODEL : SSP-T7 7.0pF with MB91F647



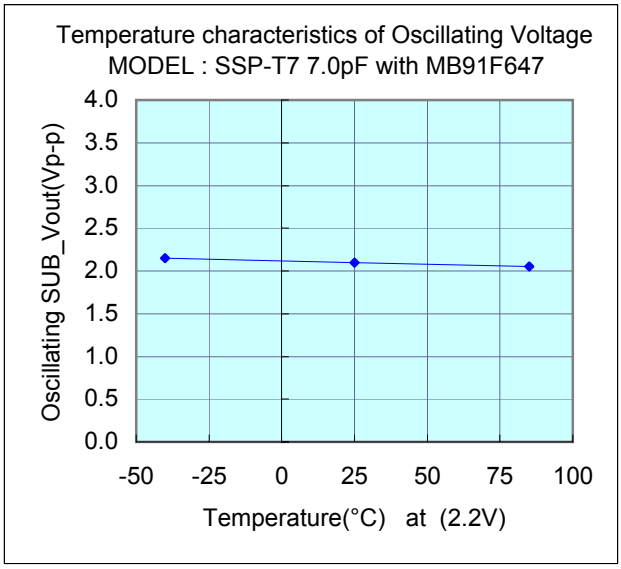
Seiko Instruments Inc.
Phone:+81-43-211-1207(Direct)

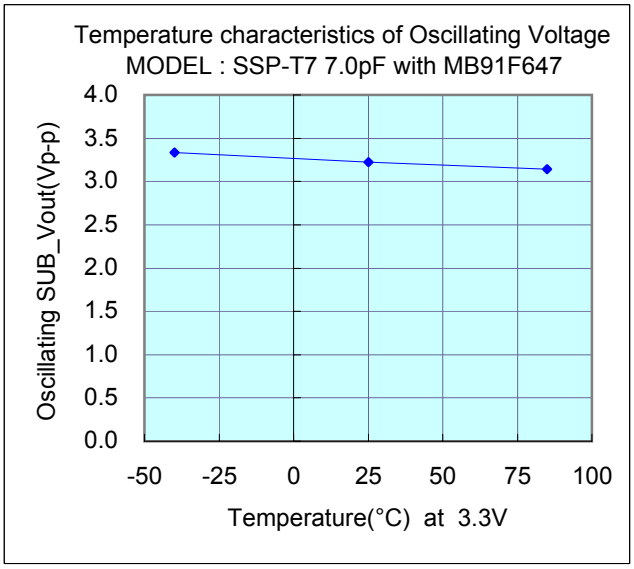
Evaluation of Subsystem Clock Oscillation Circuit

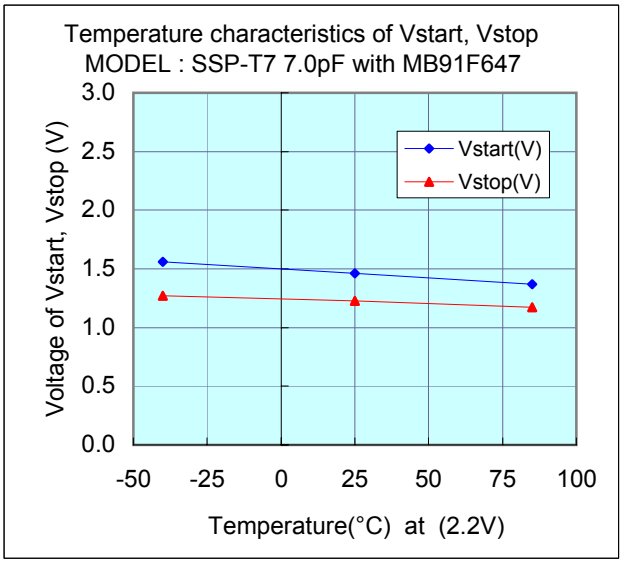
[MB91F647-176P] LQFP(24x24) 0.50mm pitch

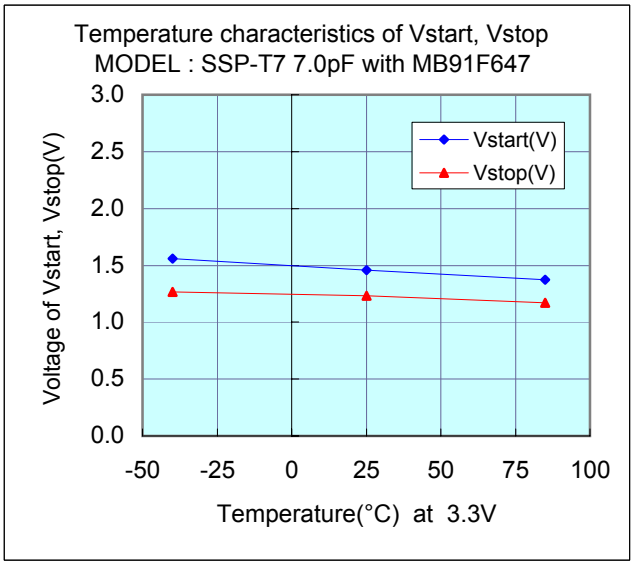
Measurement conditions :3.3V , (2.2V)reference

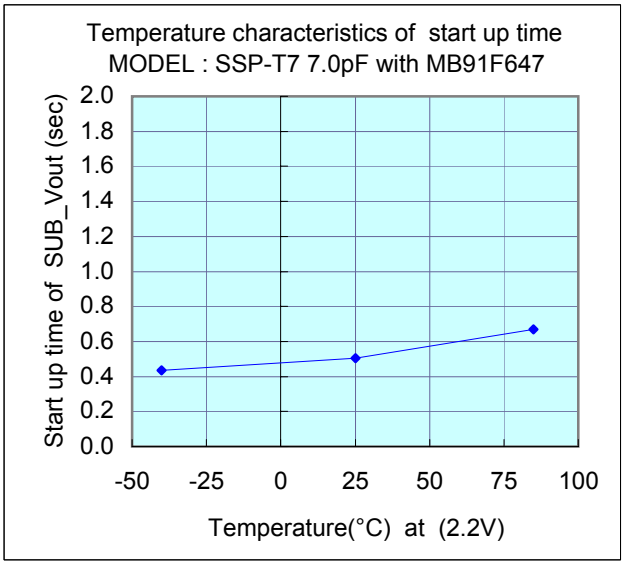
Test Data : Temperature characteristics

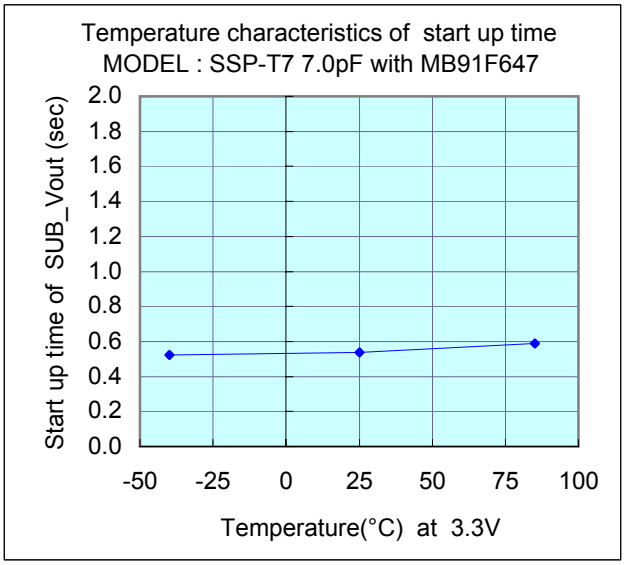












Seiko Instruments Inc.
Phone:+81-43-211-1207(Direct)

Evaluation of Subsystem Clock Oscillation Circuit

[MB91F647-176P] LQFP(24x24) 0.50mm pitch

Measurement conditions :3.3V , (2.2V)reference

Referential components layout(see Figure 1)

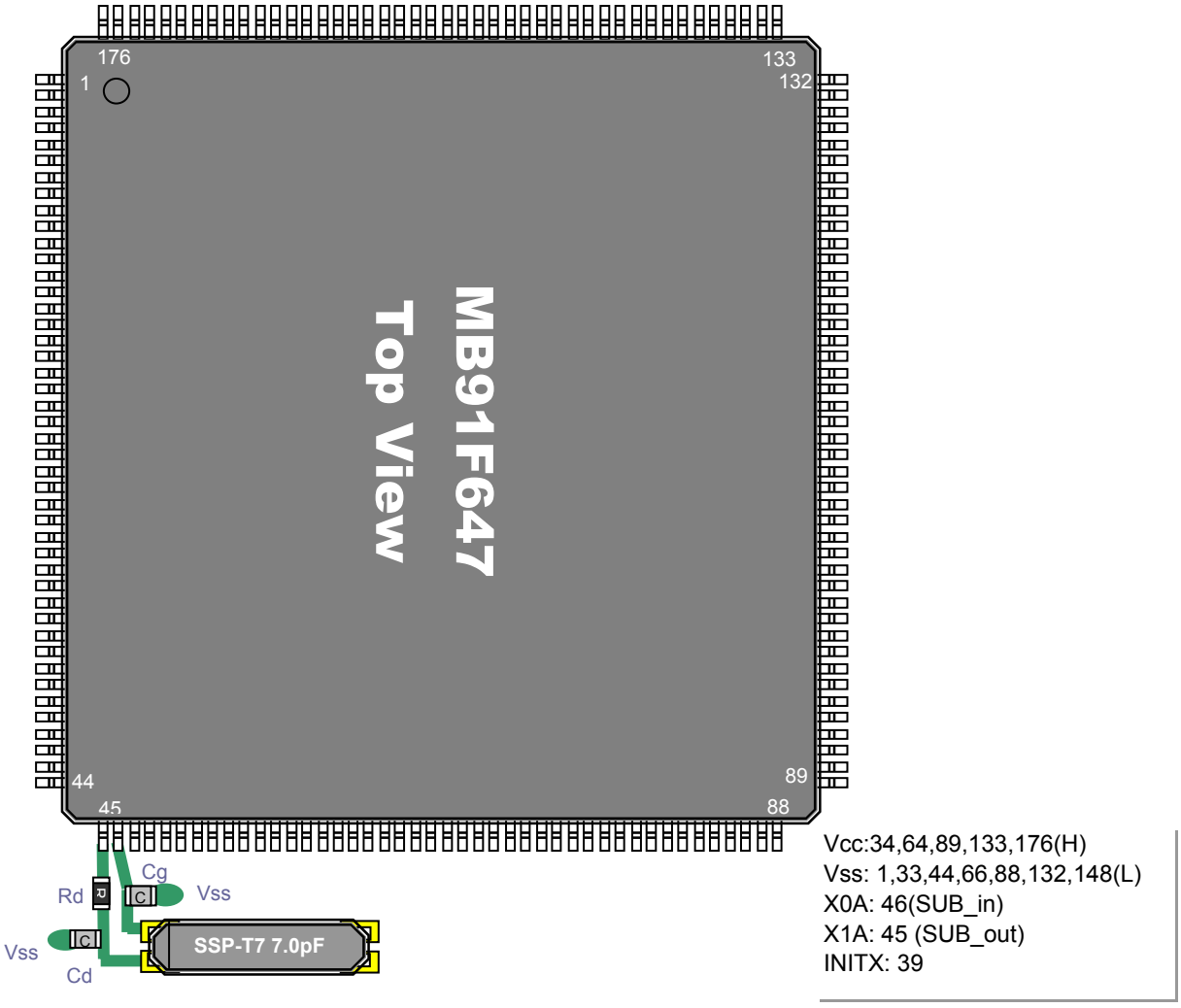


Figure 1 Referential components layout

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).

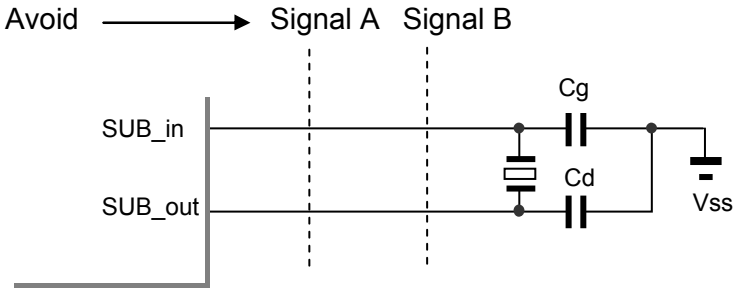


Figure 2 Example of Incorrect Board Design

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

Evaluation of Subsystem Clock Oscillation Circuit

[MB91F647-176P] LQFP(24x24) 0.50mm pitch

Measurement conditions :3.3V , (2.2V)reference

[Evaluation Sample : SSP-T7 7.0pF at 25°C]

SAMPLE	No.	CL(pF)	Fo(Hz)	fr(Hz)	R1(kohm)	Co(pF)	C1(fF)	Q(k)
SSP-T7 7.0pF	1	7	32768.10	32763.95	40.0	0.84	1.986	61.2
	2	7	32767.88	32763.63	39.2	0.85	2.037	60.9
	3	7	32767.83	32763.68	40.3	0.83	1.983	60.8

[IC Test Data : IC sample Rd=330k ohm,Cg=9pF,Cd=8pF at 25°C]

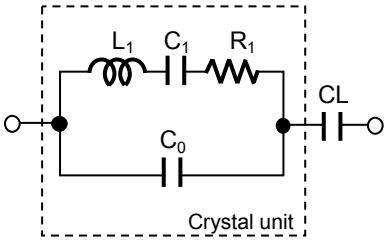
Vcc(V)	IC sample	Fosc(Hz)	df / f(x10^{-6})	DL(x10^{-6}W)	| -RL |(kohm)	Vstart(V)	Ts(sec)
3.3	TYP_#1	32768.114	0.43	0.05	962	1.46	0.54
	TYP_#2	32768.120	0.61	0.05	962	1.45	0.55
	TYP_#3	32768.110	0.31	0.05	962	1.46	0.53

[IC Test Data : IC sample Rd=330k ohm,Cg=(9pF),Cd=(8pF) at 25°C]

Vcc(V)	IC sample	Fosc(Hz)	df / f(x10-6)	DL(x10-6W)	| -RL |(kohm)	Vstart(V)	Ts(sec)
(2.2)	TYP_#1	32767.725	-11.44	0.05	872	1.46	0.50
	TYP_#2	32767.730	-11.29	0.05	872	1.45	0.50
	TYP_#3	32767.726	-11.41	0.05	872	1.46	0.48

Remark (see figure 3)

$$Fo = fr \times \{ C1/ (2\times(Co + CL))+ 1 \} \quad (Hz)$$



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

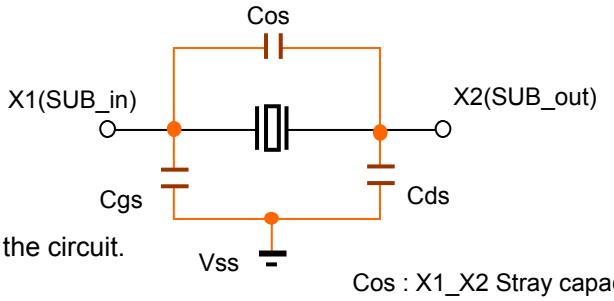
Figure 3 Equivalent circuit of crystal unit, and CL

Remark (see figure 4)

Approximate formula of the load capacitance of the circuit CL.

$$CL = Cg\times Cd / (Cg + Cd) + Cs \quad (pF)$$

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.

Seiko Instruments Inc.
Phone:+81-43-211-1207(Direct)

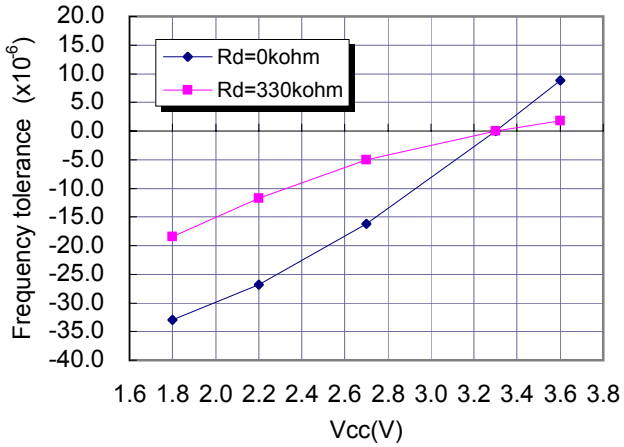
Evaluation of Subsystem Clock Oscillation Circuit

[MB91F647-176P] LQFP(24x24) 0.50mm pitch

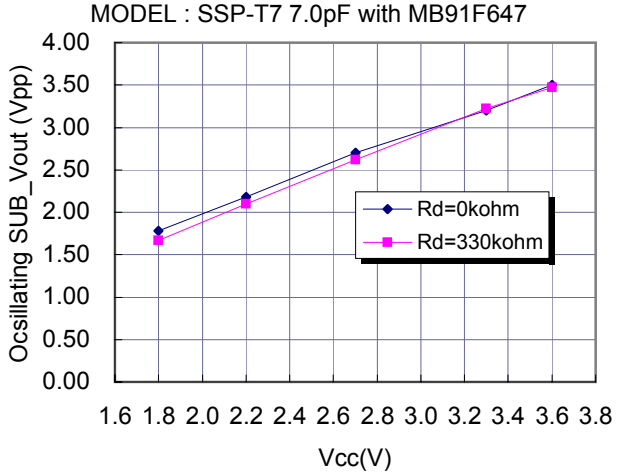
Measurement conditions : Vcc=(1.8V) to 3.6V at 25°C

Referential Data : Voltage characteristics

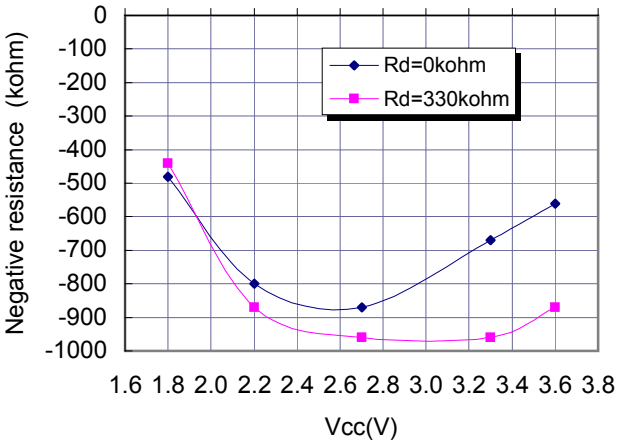
Frequency / voltage coefficient
MODEL : SSP-T7 7.0pF with MB91F647



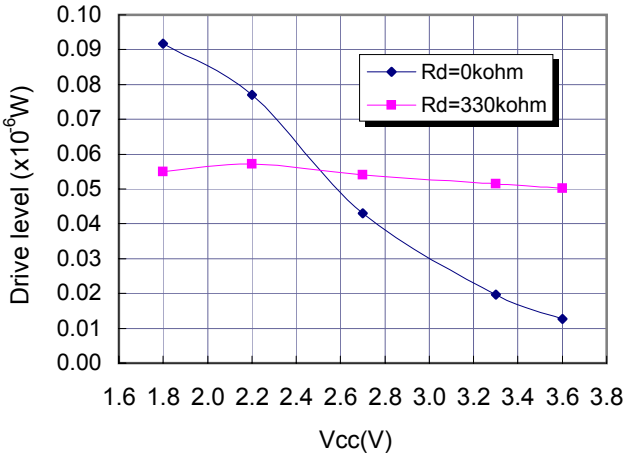
SUB_Vout / voltage coefficient
MODEL : SSP-T7 7.0pF with MB91F647



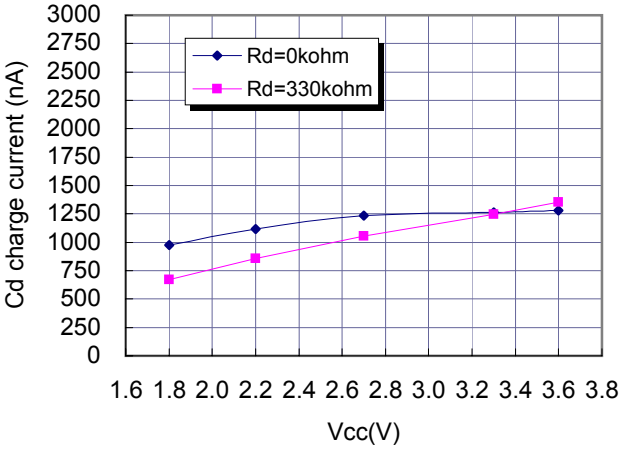
Negative resistance / voltage coefficient
MODEL : SSP-T7 7.0pF with MB91F647



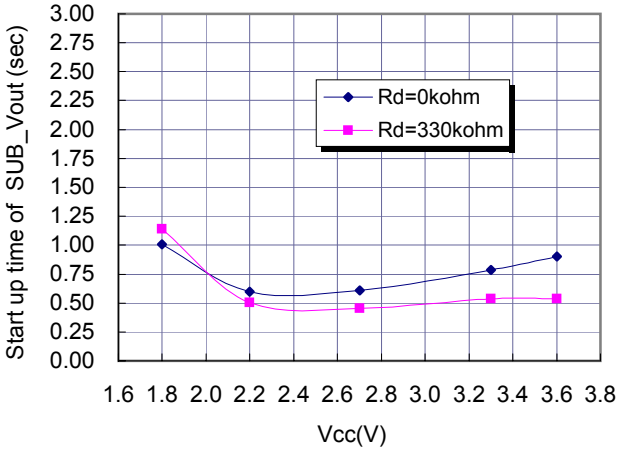
Drive level / voltage coefficient
MODEL : SSP-T7 7.0pF with MB91F647



Cd charge current / voltage coefficient
MODEL :SSP-T7 7.0pF with MB91F647



Start up time / voltage coefficient
MODEL : SSP-T7 7.0F with MB91F647



Seiko Instruments Inc.
Phone:+81-43-211-1207(Direct)