

# Evaluation of Subsystem Clock Oscillation Circuit

[MB95F108BW-64P] LQFP(10x10) 0.50mm pitch

Measurement conditions :3.0V , 2.2V

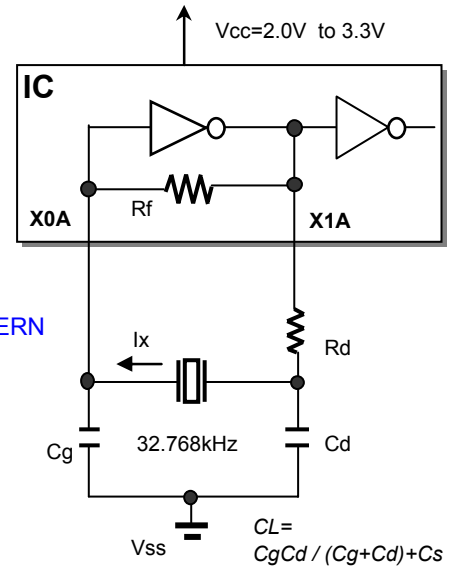
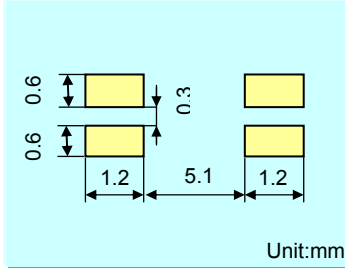


Model :SSP-T7  
 Frequency :Fo=32.768kHz  
 Frequency tolerance :dF/Fo= +/-20x10<sup>6</sup>  
 Load capacitance :CL=7.0pF  
 Equivalent series resistance :R1=65kohm max  
 Max. drive level :DL=1x10<sup>6</sup>W max  
 Level of drive :DL=0.1x10<sup>6</sup>W typ

## 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



Remark) Ix : current through crystal

MODEL:SSP-T7 7.0pF with MB95F108BW at 25°C

Key specifications	Vcc=2.2V	Vcc=3.0V	Remarks
Negative feedback resistance : Rf ( M ohm )	Built-in	Built-in	
Current control resistance : Rd ( k ohm )	0	0	Control drive level & secure phase margin
Capacitance at gate : Cg ( pF )	8	8	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=3.0V	Remarks
Matching Accuracy : df / f ( x10 <sup>-6</sup> )	-1.7	-0.3	Frequency offset volume at specified Vcc
Voltage Fluctuation : +/-df / V ( x10 <sup>-6</sup> )	0.4	0.5	Vcc +/-10% ( Standard operating voltage range )
Drive Level : DL ( x10 <sup>-6</sup> W )	0.03	0.03	DL=Ix <sup>2</sup> Re < 1x10 <sup>6</sup> W, Re=R1( 1 + Co / CL ) <sup>2</sup>
Negative resistance :   - RL   ( kohm )	1557	1657	5 times larger than R <sub>1MAX</sub>
Oscillation allowance : M ( times )	24.0	25.5	Judgemental standard of oscillation stability
Voltage of oscillation start : Vstart ( V )	1.34	1.34	
Voltage of oscillation stop : Vstop ( V )	0.98	0.98	
Oscillation start up time : Ts ( sec )	0.80	0.80	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 <sup>-6</sup> )	-137	-137	Typ.Tp=25°C ( K = -3.5x10 <sup>-8</sup> / °C <sup>2</sup> )
at +85°C	Variation : df / T ( x10 <sup>-6</sup> )	-125	-125	Typ.Tp=25°C ( K = -3.5x10 <sup>-8</sup> / °C <sup>2</sup> )

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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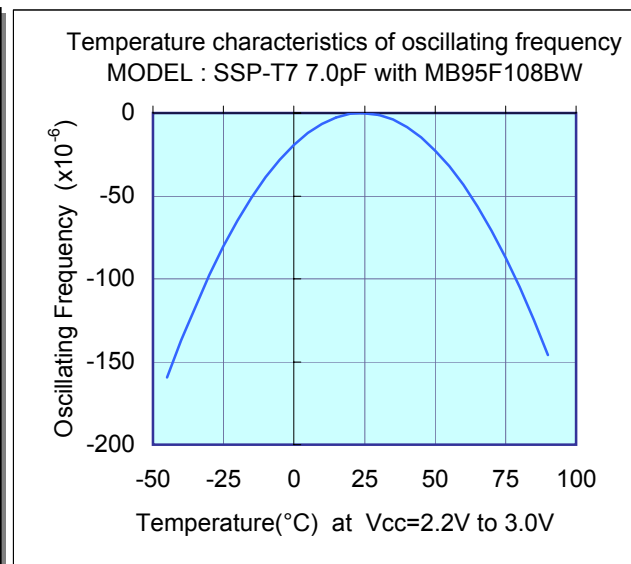
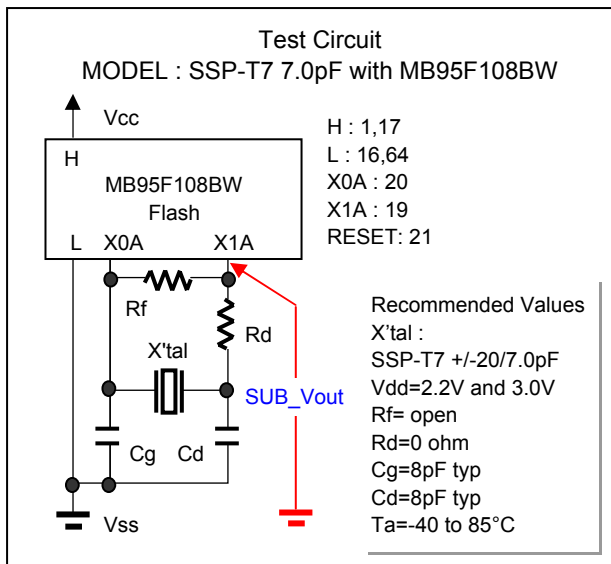
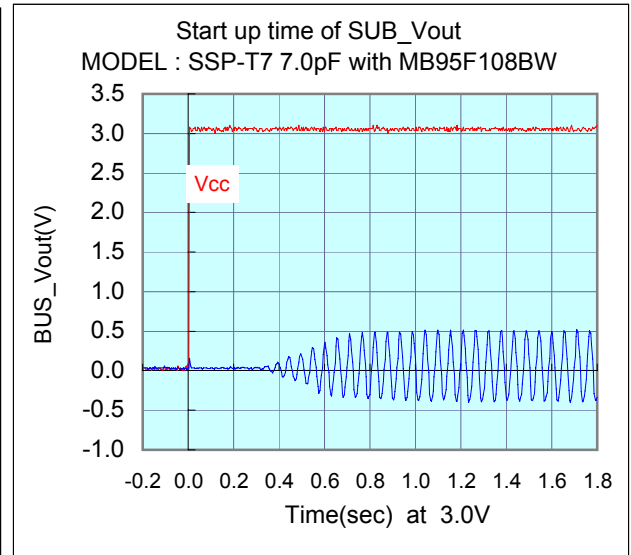
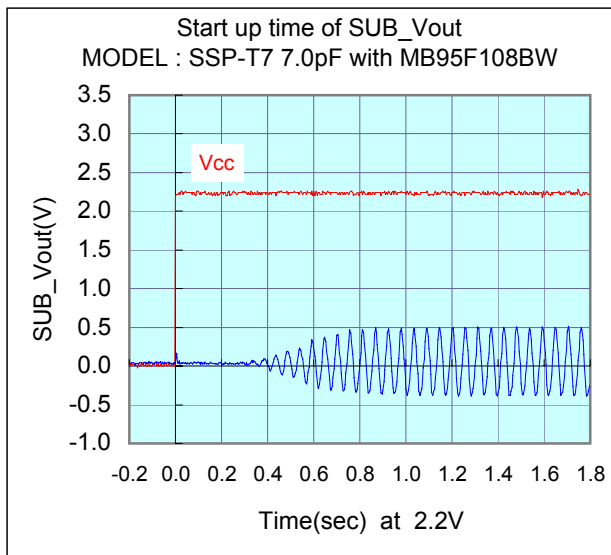
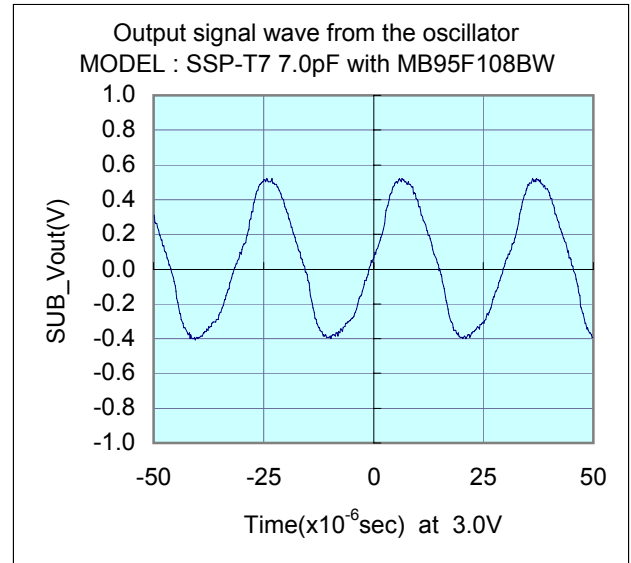
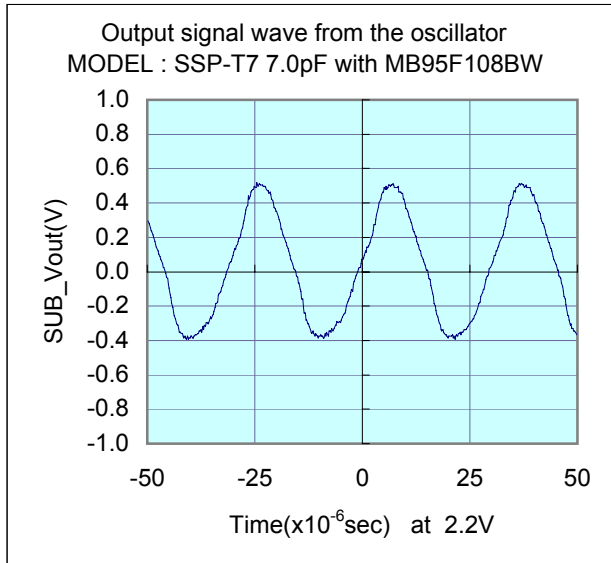
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## Test Data at 25°C



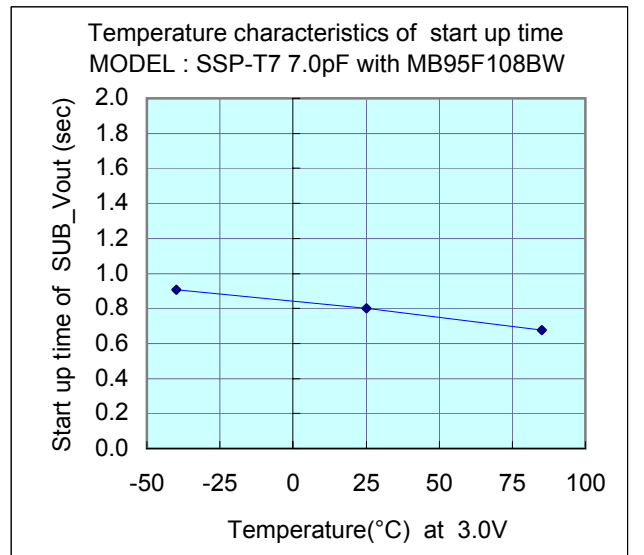
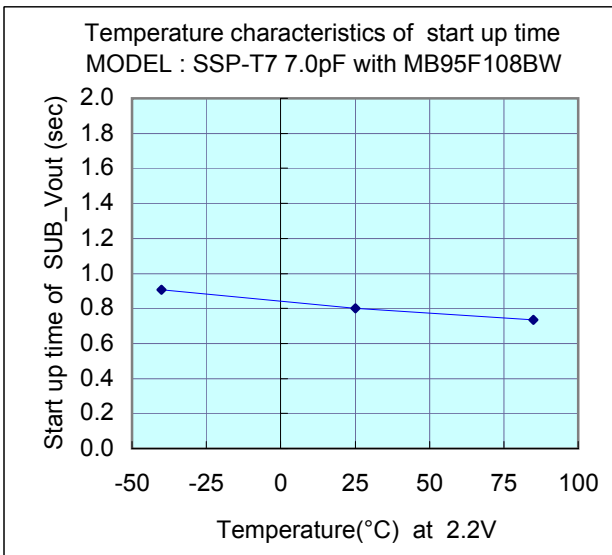
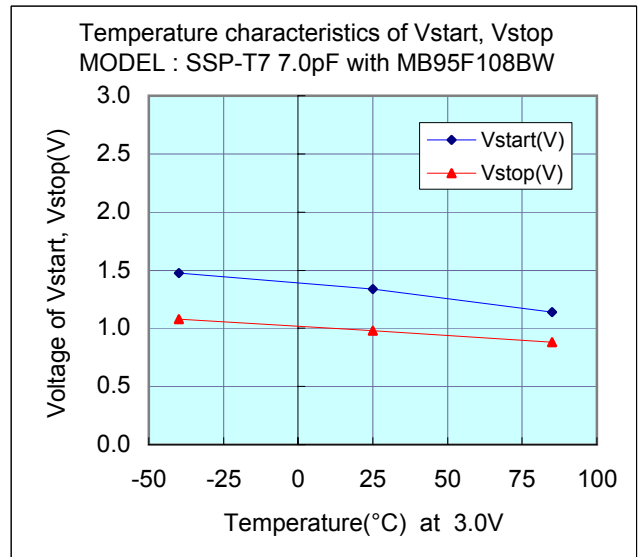
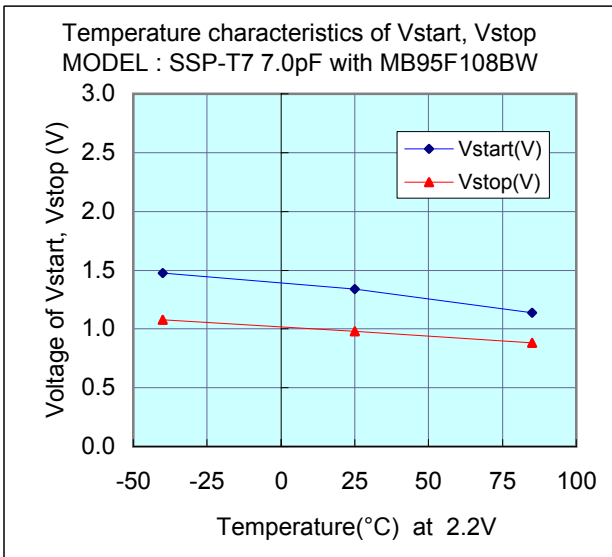
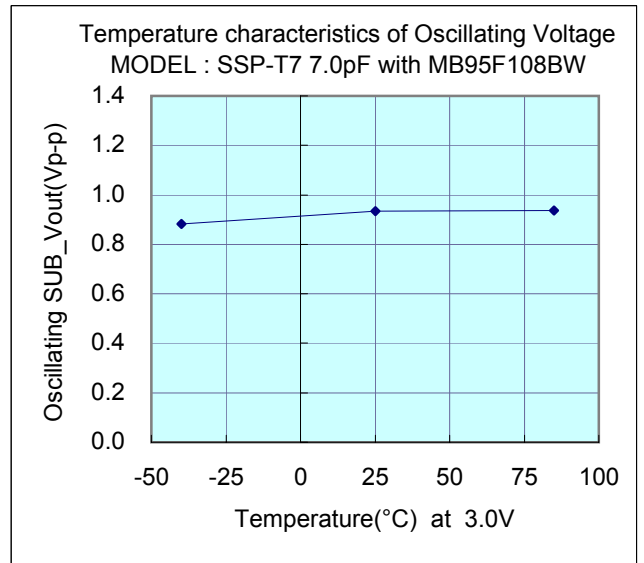
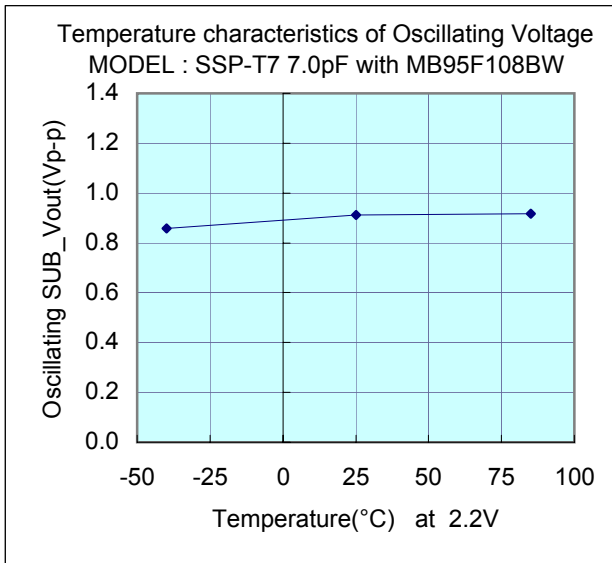
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[MB95F108BW-64P] LQFP(10x10) 0.50mm pitch

Measurement conditions :3.0V , 2.2V



## Test Data : Temperature characteristics



# Evaluation of Subsystem Clock Oscillation Circuit

[MB95F108BW-64P] LQFP(10x10) 0.50mm pitch

Measurement conditions :3.0V , 2.2V



## Referential components layout(see Figure 1)

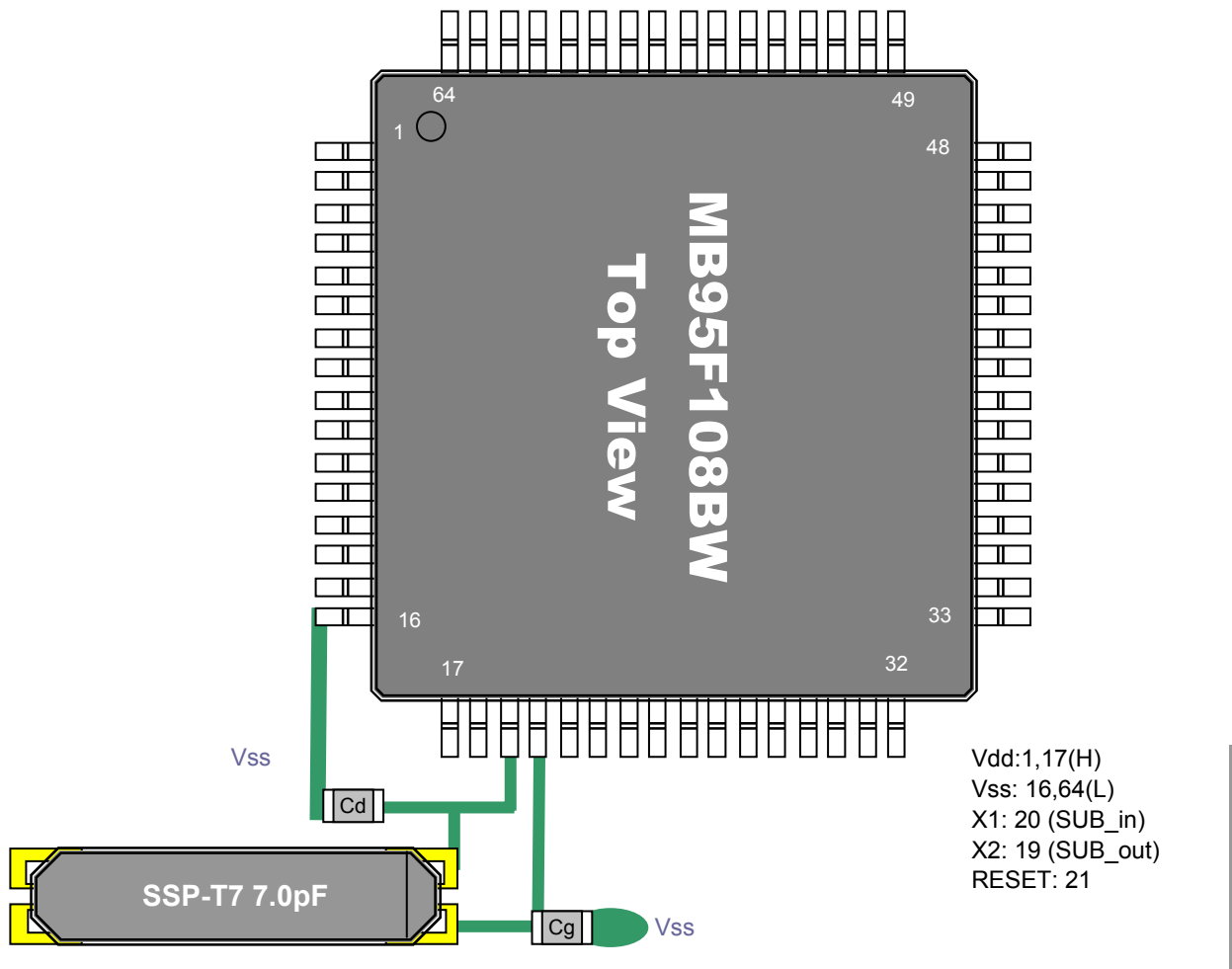


Figure 1 Referential components layout

### 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).

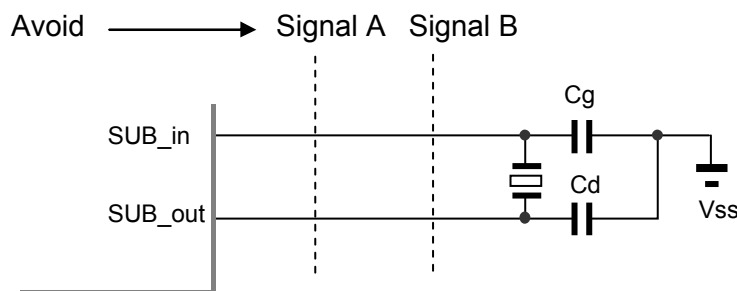


Figure 2 Example of Incorrect Board Design

**Remark** When using the subsystem clock, insert resistors  $R_d$  in series on the SUB\_out side.

# Evaluation of Subsystem Clock Oscillation Circuit

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Measurement conditions :3.0V , 2.2V



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

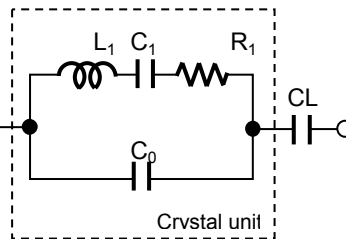
SAMPLE	No.	CL( pF )	Fo( Hz )	fr( Hz )	R1( kohm )	Co( pF )	C1( fF )	Q( k )
SSP-T7 7.0pF	1	7	32767.98	32763.81	45.1	0.86	2.000	53.9
	2	7	32767.88	32763.63	39.2	0.85	2.037	60.9
	3	7	32767.83	32763.68	40.3	0.83	1.983	60.8

## [IC Test Data : IC samples Rd=0k ohm,Cg=8pF,Cd=8pF at 25°C]

Vcc(V)	IC samples	Fosc( Hz )	df / f( x10 <sup>-6</sup> )	DL(x10 <sup>-6</sup> W)	-RL  ( kohm )	Vstart( V )	Ts(sec)
3.0	TYP_#1	32767.970	-0.31	0.03	1657	1.34	0.80
	TYP_#2	32767.980	0.00	0.02	1657	1.30	0.60
2.2	TYP_#1	32767.924	-1.71	0.03	1557	1.34	0.80
	TYP_#2	32767.933	-1.43	0.02	1557	1.30	0.60

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

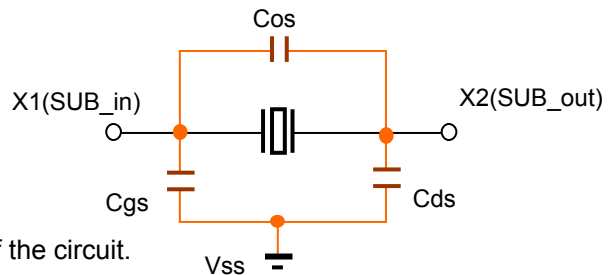
Figure 3 Equivalent circuit of crystal unit, and CL

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=(1.8V) to (3.6V) at 25°C

## Referential Data : Voltage characteristics

