

# Evaluation of Subsystem Clock Oscillation Circuit

[HD64N3687GFP-64E] LQFP(10×10) 0.5mm pitch

Measurement conditions : 5.0V (in use of regulator), 3.3V (non use of regulator)

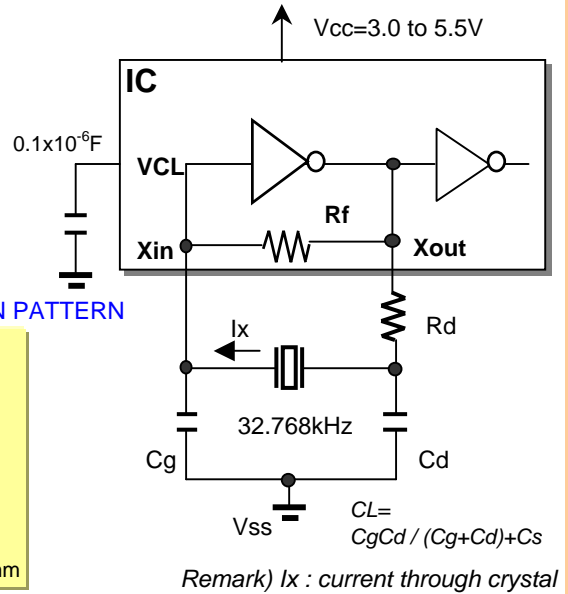
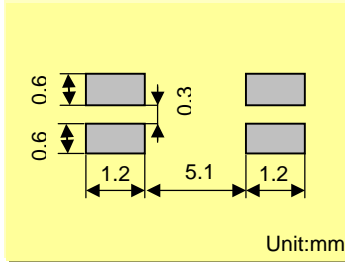


Model :SSP-T7  
 Frequency :Fo=32.768kHz  
 Frequency tolerance :dF/Fo= +/-20x10<sup>-6</sup>  
 Load capacitance :CL=7.0pF  
 Equivalent series resistance :R1=65kohm max  
 Max. Drive level :DL=x10<sup>-6</sup>W max  
 Recommended drive level :DL=0.1x10<sup>-6</sup>W typ

### 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 SOLDERIN PATTERN



When the internal power supply Step-Down circuit is not used, please connect the external power supply to the VCL pin and Vcc pin.

The permissible range for the power supply voltage is 3.0V to 3.6V.

MODEL:SSP-T7 7.0pF with HD64N3687GFP at 25°C

Key specifications	Vcc=3.3V	Vcc=5.0V	Remarks
Current control resistance : Rd ( k ohm )	0	0	Control drive level & secure phase margin
Capacitance at gate : Cg ( pF )	9	9	Optimal capacity in response to CL
Capacitance at drain : Cd ( pF )	8	8	( CL = Cd // Cg + stray capacitance )

Circuit characteristics ( at 25°C )	Vcc=3.3V	Vcc=5.0V	Remarks
Matching Accuracy : df / f ( x10 <sup>-6</sup> )	-0.9	0.3	Frequency offset volume at specified Vdd
Voltage Fluctuation : +/-df / V ( x10 <sup>-6</sup> )	1.5	0.0	Vdd +/-10% ( Standard operating voltage range )
Drive Level : DL ( x10 <sup>-6</sup> W )	0.10	0.10	DL=Ix <sup>2</sup> Re < 1x10 <sup>-6</sup> W, Re=R1( 1 + Co / CL ) <sup>2</sup>
Negative resistance :   - RL   ( kohm )	1347	1347	5 times larger than R <sub>1MAX</sub>
Oscillation allowance : M ( times )	20.7	20.7	Judgemental standard of oscillation stability
Oscillation start up time : Ts ( sec )	0.44	0.45	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 <sup>-6</sup> )	-132	-132	Typ.Tp=25°C ( K = -3.5x10 <sup>-8</sup> / °C <sup>2</sup> )
at +85°C Variation : df / T ( x10 <sup>-6</sup> )	-133	-134	Typ.Tp=25°C ( K = -3.5x10 <sup>-8</sup> / °C <sup>2</sup> )

The mention 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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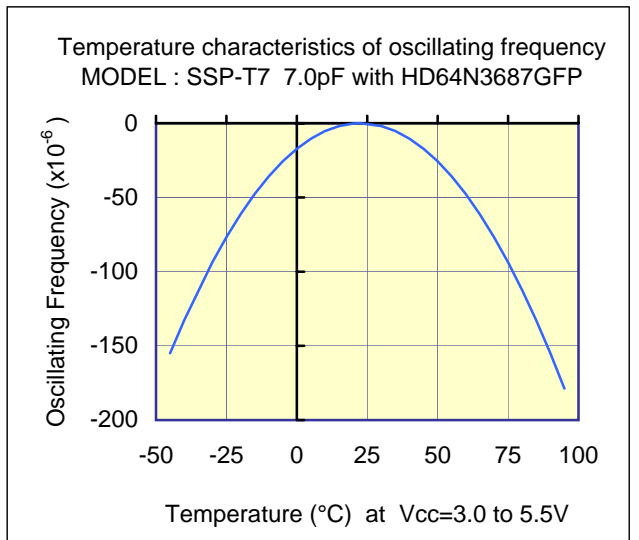
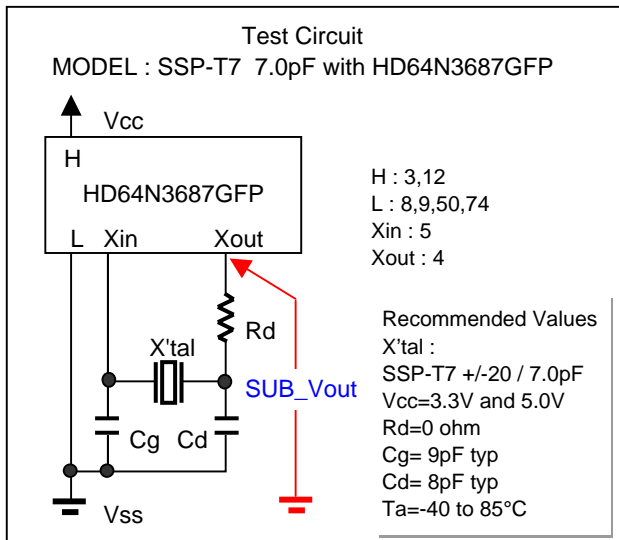
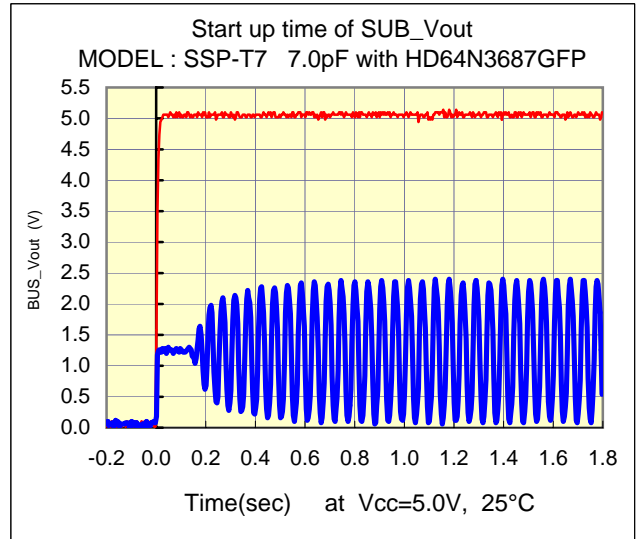
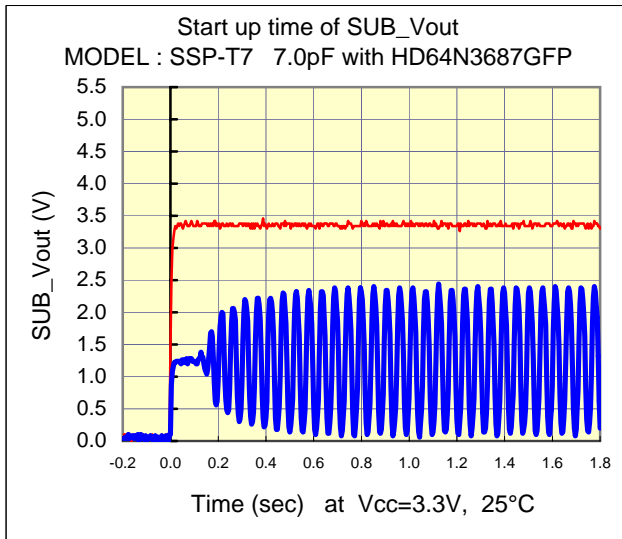
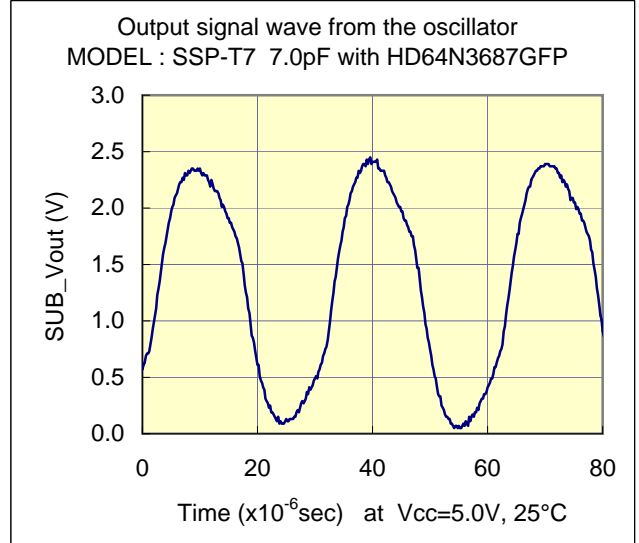
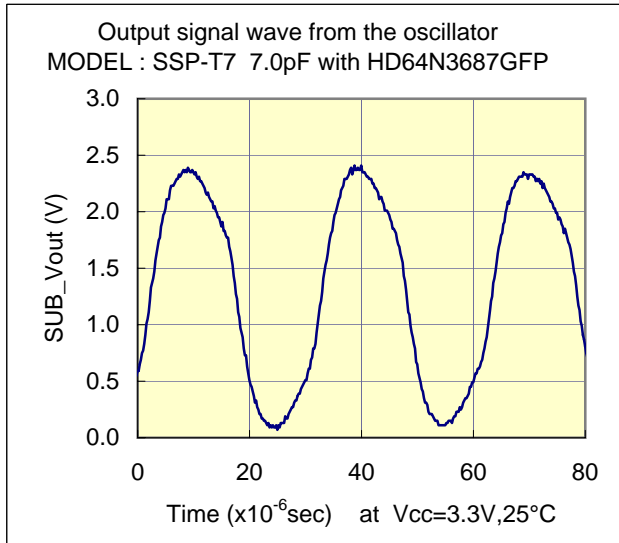
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## Test Data



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## Referencial components layout (see Figure 1 )

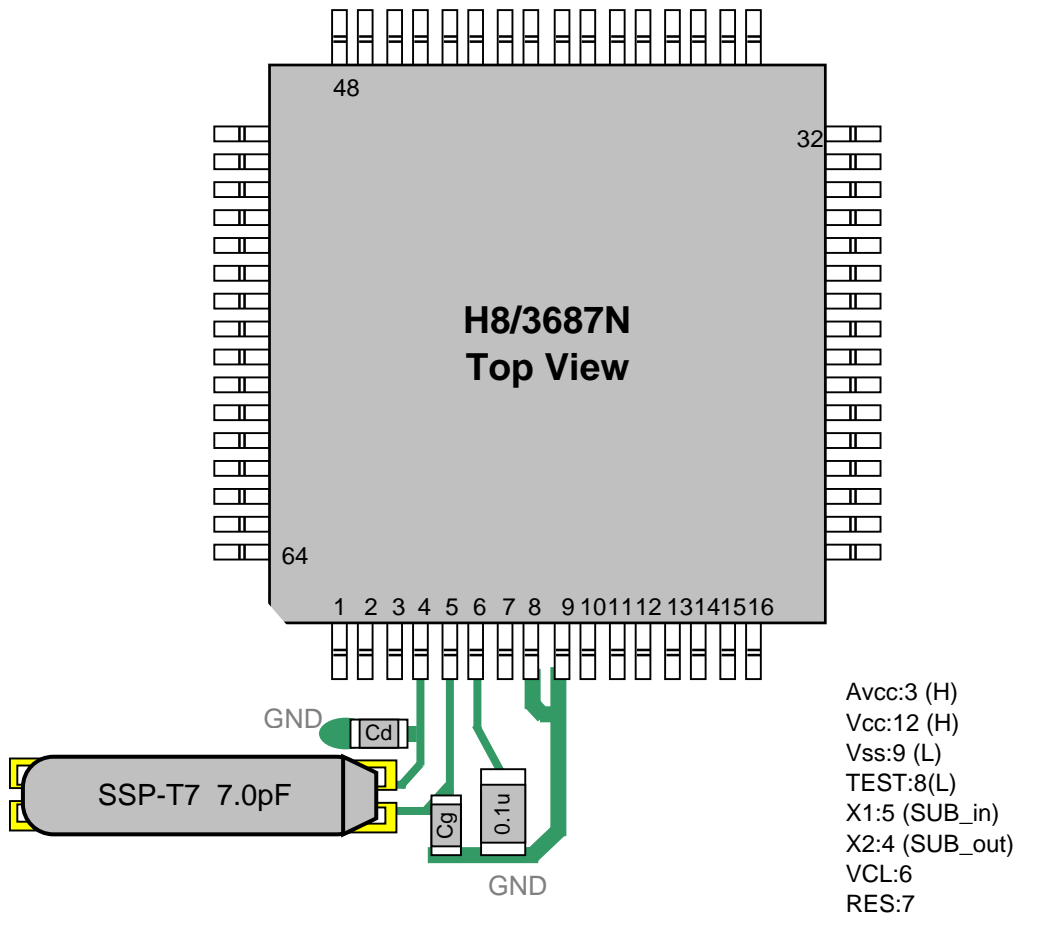


Figure 1 Referencial components layout

## Notes 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).

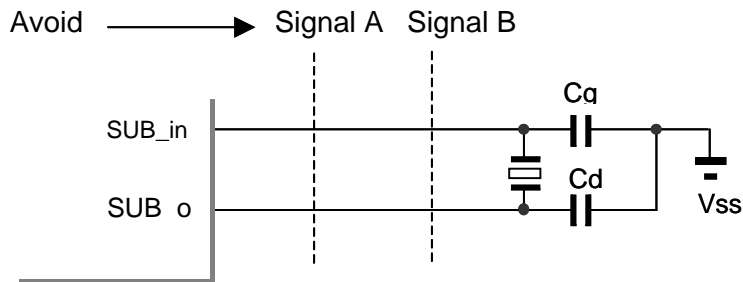


Figure 2 Example of Incorrect Board Design

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

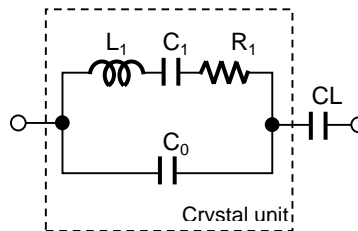
SAMPLE	No.	CL( pF )	Fo( Hz )	fr( Hz )	R1( kohm )	Co( pF )	C1( fF )	Q( k )
SSP-T7 7.0pF	1	7	32768.40	32764.24	37.8	0.83	1.987	64.7
	2	7	32767.88	32763.63	39.2	0.85	2.037	60.9
	3	7	32767.83	32763.68	40.3	0.83	1.983	60.8

## [IC Test Data : IC typ Rd=0 ohm,Cg=9pF,Cd=8pF at 25°C]

Vcc( V )	IC typ	Fosc( Hz )	df / f( x10 <sup>-6</sup> )	DL(x10 <sup>-6</sup> W)	-RL  (kohm)	Vstart( V )	Ts(sec)
3.3	1	32767.85	-0.8	0.10	1347	1.45	0.49
	2	32767.85	-0.9	0.10	1347	1.46	0.48
	3	32767.85	-0.9	0.10	1347	1.46	0.48
5.0	1	32767.88	-0.1	0.10	1347	1.46	0.49
	2	32767.89	0.3	0.10	1347	1.46	0.49
	3	32767.89	0.2	0.10	1347	1.45	0.48

**Remak ( see figure 3 )**

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



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

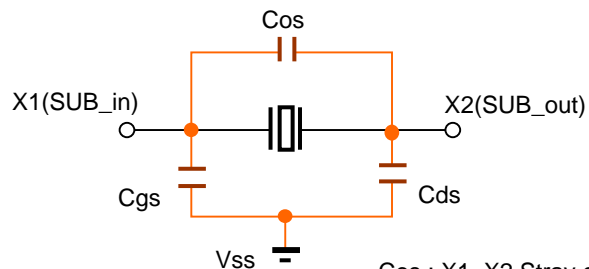
**Figure 3 Equivalent circuit of crystal unit, and CL**

**Remak ( see figure 4 )**

Approximate formula of the load capacitance of the circuit CL.

$$CL = Cg \times Cd / ( Cg + Cd ) + Cs \text{ ( pF )}$$

Where Cs Stands for stray capacity 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.