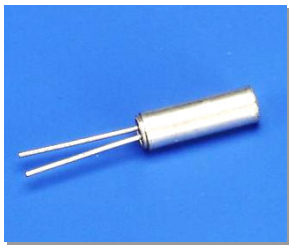
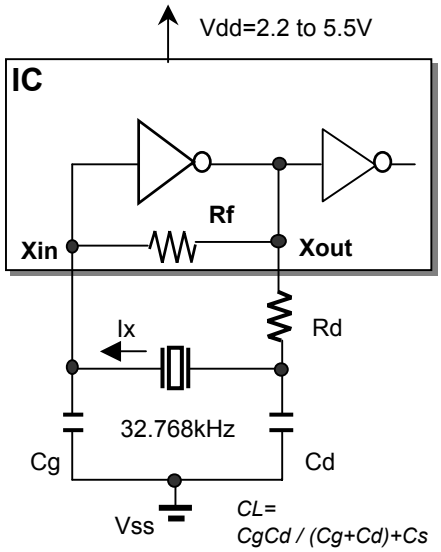
Evaluation of Subsystem Clock Oscillation Circuit

[uPD78F0148HGC-8BT] QFP(14x14) 0.65mm pitch

Measurement conditions : 5.0V , 3.3V



Model	:VT-200
Frequency	:Fo=32.768kHz
Frequency tolerance	:dF/Fo= +/-20x10^{-6}
Load capacitance	:CL=6.0pF
Equivalent series resistance	:R1=50kohm max
Max. Drive level	:DL=x10^{-6}W max
Recommended drive level	:DL=0.1x10^{-6}W typ

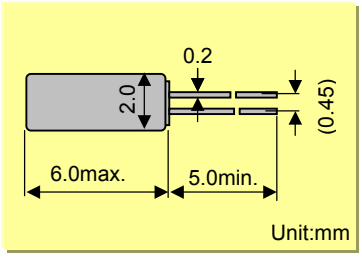


Remark) Ix : current through crystal

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 6.0pF with uPD78F0148HGC at 25°C

Key specifications	Vdd=3.3V	Vdd=5.0V	Remarks
Current control resistance : Rd (k ohm)	220	220	Control drive level & secure phase margin
Capacitance at gate : Cg (pF)	6	8	Optimal capacity in response to CL
Capacitance at drain : Cd (pF)	6	8	(CL = Cd // Cg + stray capacitance)

Circuit characteristics (at 25°C)	Vdd=3.3V	Vdd=5.0V	Remarks
Matching Accuracy : df / f (x10^{-6})	-0.3	0.2	Frequency offset volume at specified Vdd
Voltage Fluctuation : +/-df / V (x10^{-6})	6.6	6.7	Vdd +/-10% (Standard operating voltage range)
Drive Level : DL (x10^{-6}W)	0.03	0.05	DL=Ix^2 Re < 1x10^{-6}W,Re=R1(1 + Co / CL)^2
Negative resistance : | - RL | (kohm)	599	549	5 times larger than R_{1MAX}
Oscillation allowance : M (times)	12.0	11.0	Judgemental standard of oscillation stability
Oscillation start up time : Ts (sec)	0.80	0.80	Time to reach 90% of output level

Temperature characteristics of circuit		Vdd=3.3V	Vdd=5.0V	Remarks
at -40°C	Variation : df / T (x10^{-6})	-135	-134	Typ.Tp=25°C (K = -3.5×10^{-8} / °C^2)
at +85°C	Variation : df / T (x10^{-6})	-136	-136	Typ.Tp=25°C (K = -3.5×10^{-8} / °C^2)

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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78K0/KF1+

Evaluation of Subsystem Clock Oscillation Circuit

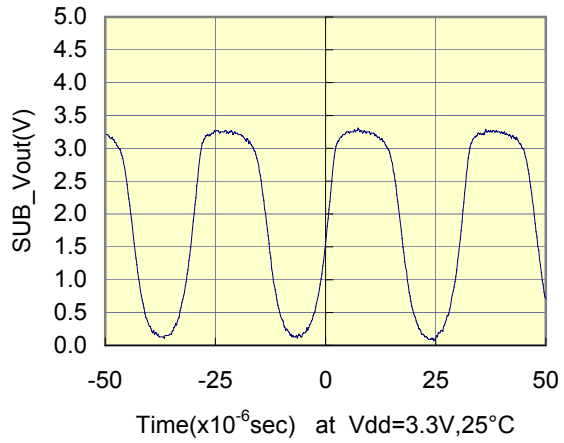
[uPD78F0148HGC-8BT] QFP(14x14) 0.65mm pitch

Measurement conditions : 5.0V , 3.3V

Test Data

Output signal wave from the oscillator

MODEL : VT-200 6.0pF with uPD78F0148HGC



Output signal wave from the oscillator

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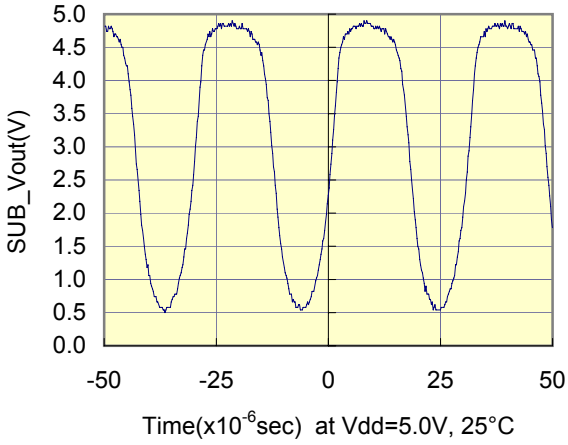
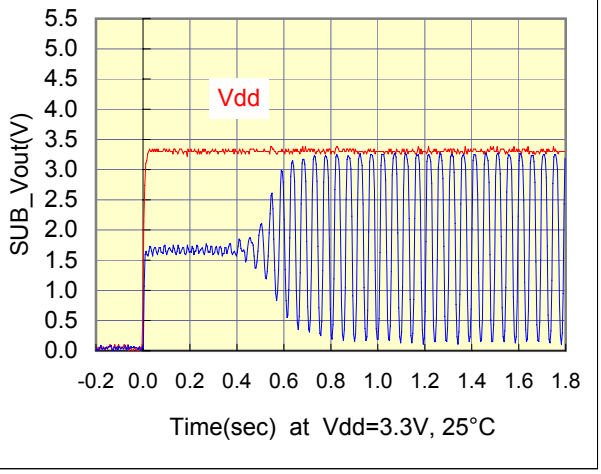


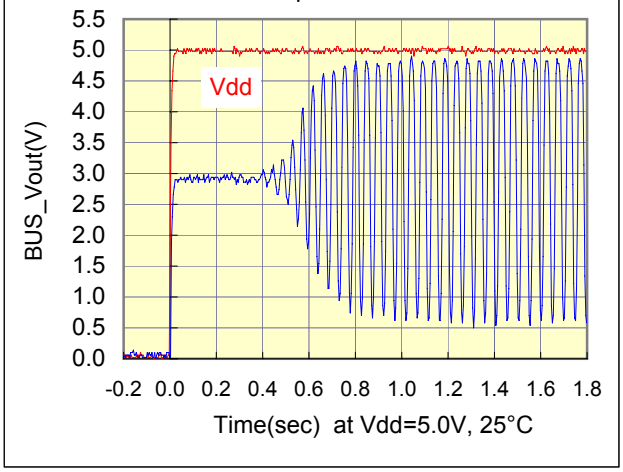
Start up time of SUB_Vout

MODEL : VT-200 6.0pF with uPD78F0148HGC



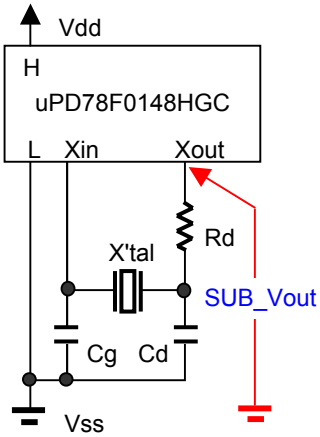
Start up time of SUB_Vout

MODEL : VT-200 6.0pF with uPD78F0148HGC



Test Circuit

MODEL : VT-200 12.5pF with uPD78F0148HGC

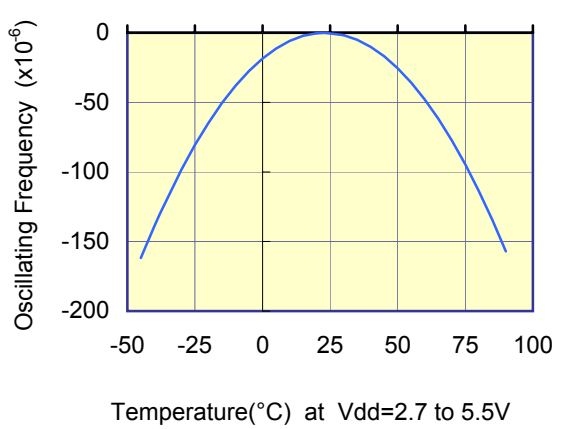


H : 1,9,31
L : 2,8,11,30
Xin : 15
Xout :16

Recommended Values
X'tal :
VT-200 +/-20/6.0pF
Vdd=3.3V and 5.0V
Rd=220 kohm
Cg= 6 to 8pF typ
Cd= 6 to 8pF typ
Ta=-40 to 85°C

Temperature characteristics of oscillating frequency

MODEL : VT-200 6.0pF with uPD78F0148HGC



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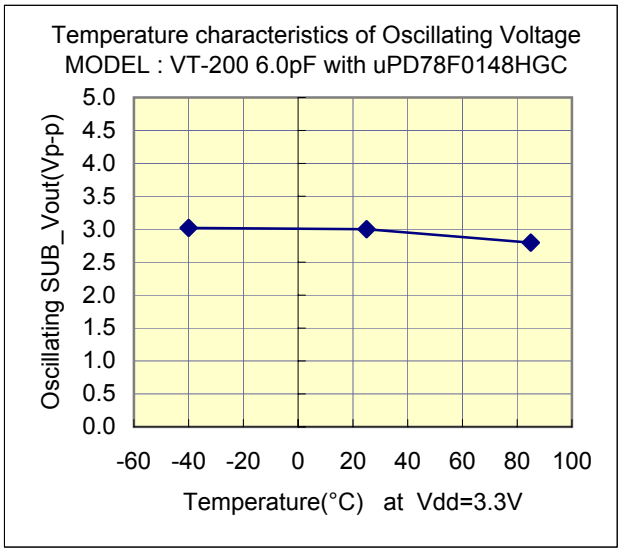
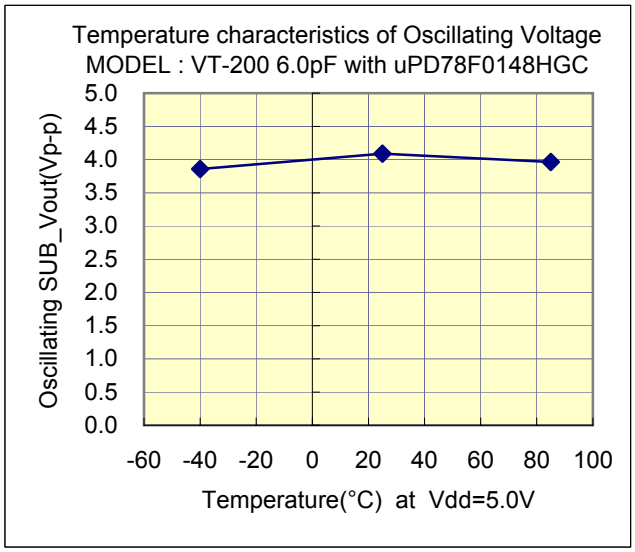
Evaluation of Subsystem Clock Oscillation Circuit

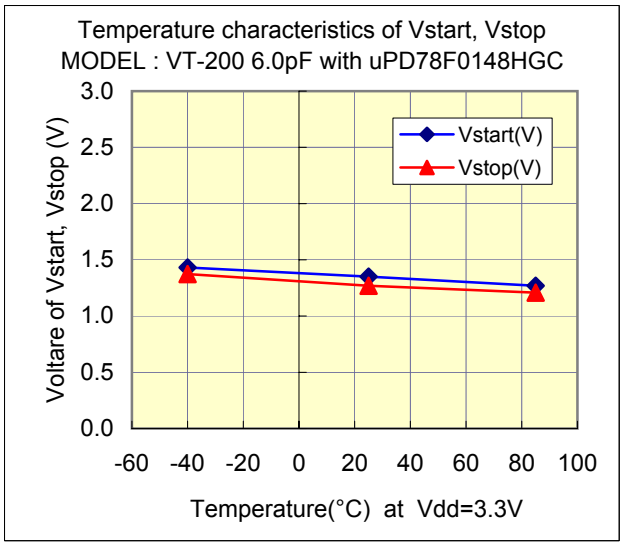
[uPD78F0148HGC-8BT] QFP(14x14) 0.65mm pitch

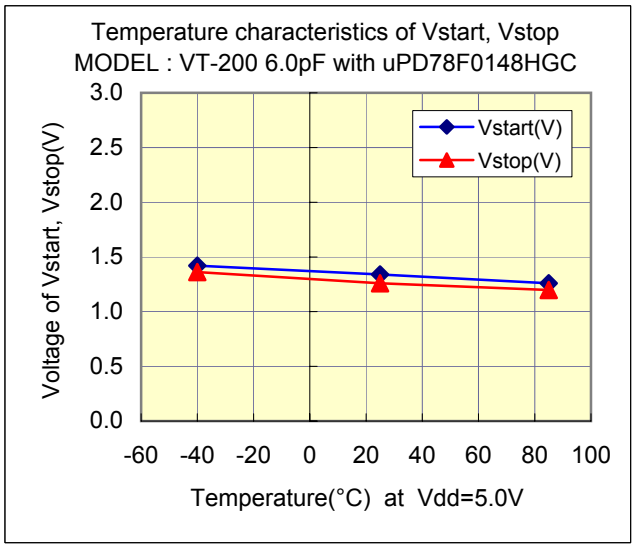
Measurement conditions : 5.0V , 3.3V

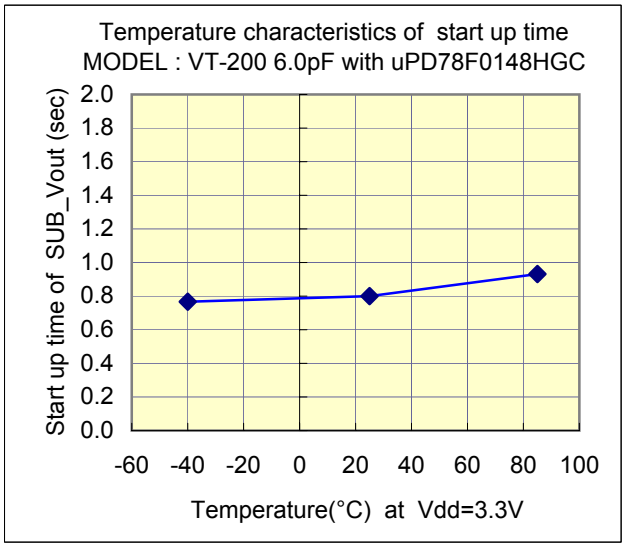
Test Data : Temperature characteristics

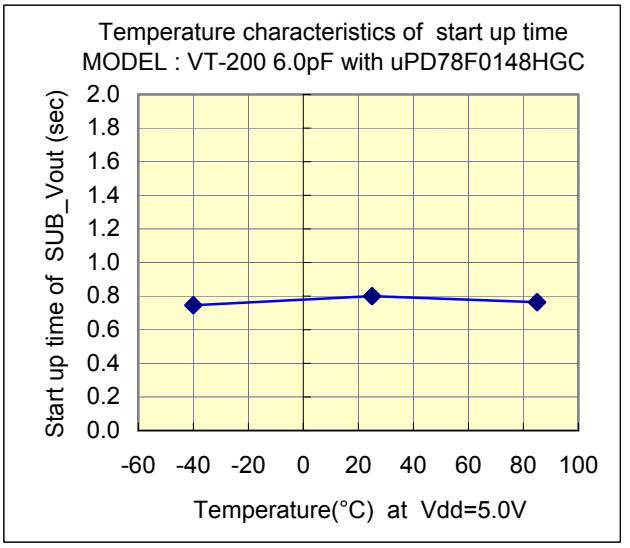












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Evaluation of Subsystem Clock Oscillation Circuit

[uPD78F0148HGC-8BT] QFP(14x14) 0.65mm pitch
Measurement conditions : 5.0V , 3.3V

Referenicial components layout(see Figure 1)

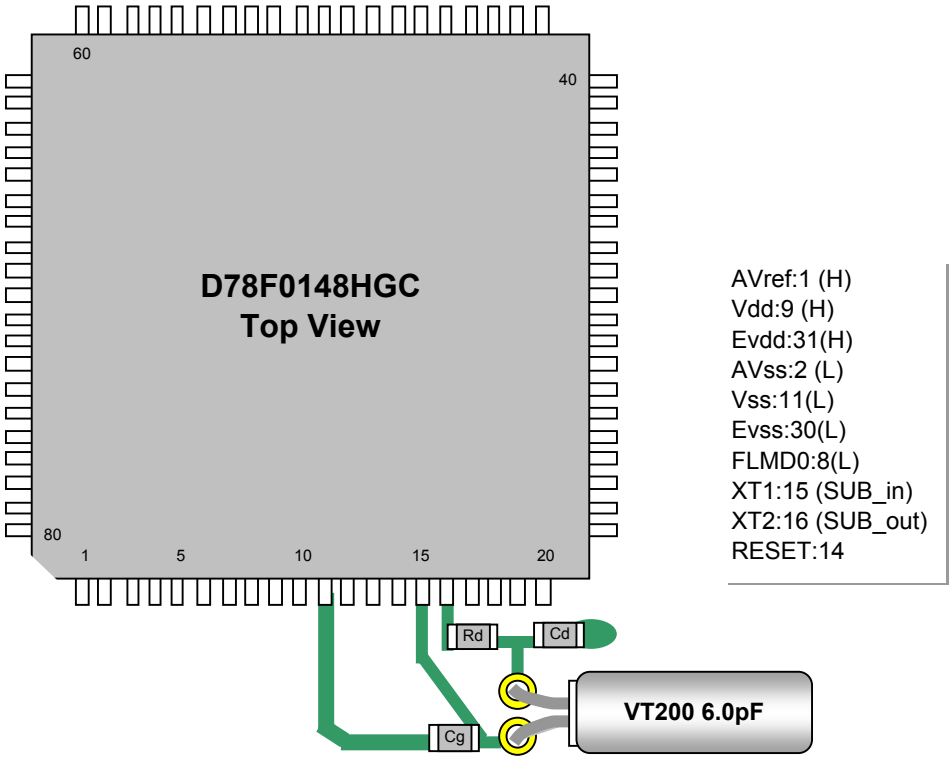

Figure 1 Referenicial components layout

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).

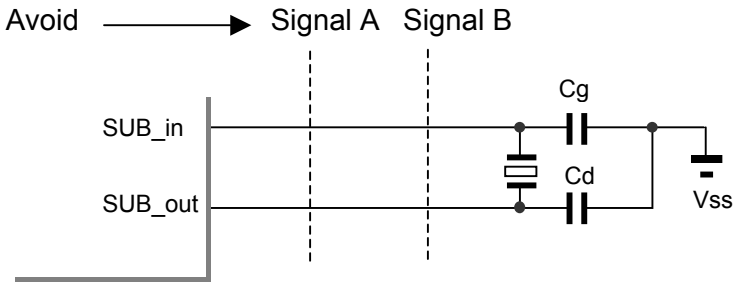

Figure 2 Example of Incorrect Board Design

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

Evaluation of Subsystem Clock Oscillation Circuit

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Measurement conditions : 5.0V , 3.3V

[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	32768.18	32762.98	28.7	0.91	2.193	77.2
	2	6	32768.18	32763.04	27.8	0.89	2.161	80.9
	3	6	32768.19	32763.00	27.2	0.90	2.187	81.7

[IC Test Data : IC Sampl Rd=220 ohm,Cg=8pF,Cd=8pF at 25°C]

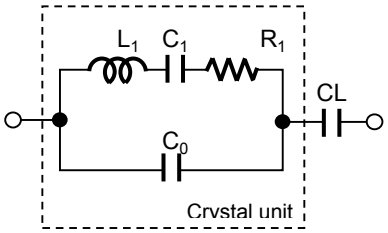
Vcc(V)	IC Sampl	Fosc(Hz)	df / f(x10^{-6})	DL(x10^{-6}W)	| -RL |(kohm)	Vstart(V)	Ts(sec)
5.0	HHH500	32768.19	0.15	0.05	549	1.34	0.80
	LLL500	32768.18	0.00	0.03	549	1.09	0.80

[IC Test Data : IC Sampl Rd=220 ohm,Cg=6pF,Cd=6pF at 25°C]

Vcc(V)	IC Sampl	Fosc(Hz)	df / f(x10^{-6})	DL(x10^{-6}W)	| -RL |(kohm)	Vstart(V)	Ts(sec)
3.3	HHH500	32768.17	-0.31	0.03	599	1.35	0.80
	LLL500	32768.24	1.83	0.02	599	1.11	0.80

Remak (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

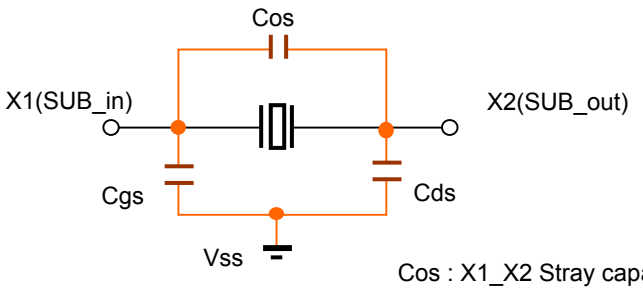
Figure 3 Equivalent circuit of crystal unit, and CL

Remak (see figure 4)

Approximate formula of the load capacitance of the circuit CL.

CL = Cg×Cd / (Cg + Cd) + Cs (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.

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