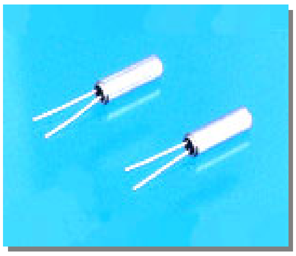
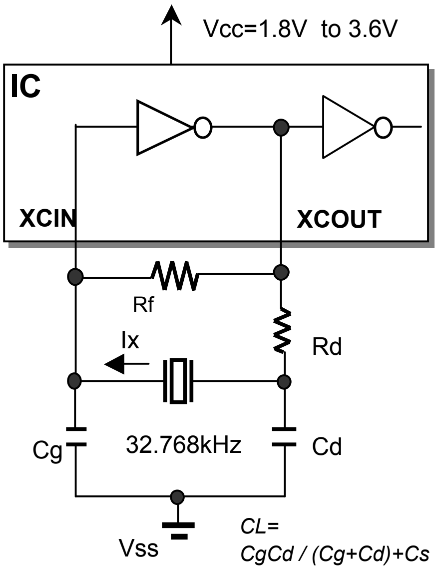
Evaluation of Subsystem Clock Oscillation Circuit

[HD64338602R-32P] LQFP(6x5) 0.5mm pitch

Measurement conditions :3.0V



Model	:VT-200
Frequency	:Fo=32.768kHz
Frequency tolerance	:dF/Fo= +/-20x10^{6}
Load capacitance	:CL=12.5pF
Equivalent series resistance	:R1=50kohm max
Max. drive level	:DL=1x10^{6}W max
Level of drivel	:DL=0.1x10^{6}W typ

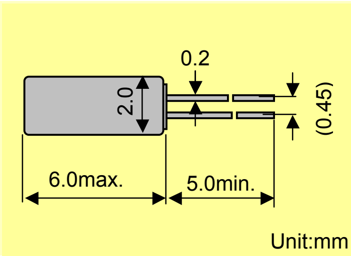


Remark) Ix : current through crystal

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)



The gain of H8/38602R subclock oscillation circuit is different when the circuit is in reset status and in reset-off status.
In this report, H8/38068R is evaluated by method1(in reset status: L) and method2(in reset-off status: H).

Method2(in reset-off status:H) NG

MODEL:VT-200 12.5pF with HD64338602R at 25°C

Key specifications	RESET_H	RESET_L	Remarks
Negative feedback resistance : Rf (M ohm)	open	open	
Current control resistance : Rd (k ohm)	0	0	Control drive level & secure phase margin
Capacitance at gate : Cg (pF)	15	20	Optimal capacity in response to CL
Capacitance at drain : Cd (pF)	15	18	(CL = Cd // Cg + stray capacitance)

Circuit characteristics (at 25°C)	RESET_H	RESET_L	Remarks
Matching Accuracy : df / f (x10^{-6})	-1.2	0.3	Frequency offset volume at specified Vdd
Voltage Fluctuation : +/-df / V (x10^{-6})	0.6	1.8	Vdd +/-10% (Standard operating voltage range)
Drive Level : DL (x10^{-6}W)	0.28	0.33	DL=Ix^{2} Re < 1x10^{-6}W,Re=R1(1 + Co / CL)^{2}
Negative resistance : | - RL | (kohm)	**109**	784	5 times larger than R_{1MAX}
Oscillation allowance : M (times)	**2.2**	15.7	Judgemental standard of oscillation stability
Voltage of oscillation start : Vstrat (V)	1.78	1.66	
Voltage of oscillation stop : Vstop (V)	1.64	1.24	
Oscillation start up time : Ts (sec)	1.16	0.62	Time to reach 90% of output level

Temperature characteristics of circuit		RESET_H	RESET_L	Remarks
at -40°C	Variation : df / T (x10^{-6})	-144	-143	Typ.Tp=25°C (K = -3.5×10^{-8} / °C^{2})
at +85°C	Variation : df / T (x10^{-6})	-132	-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.

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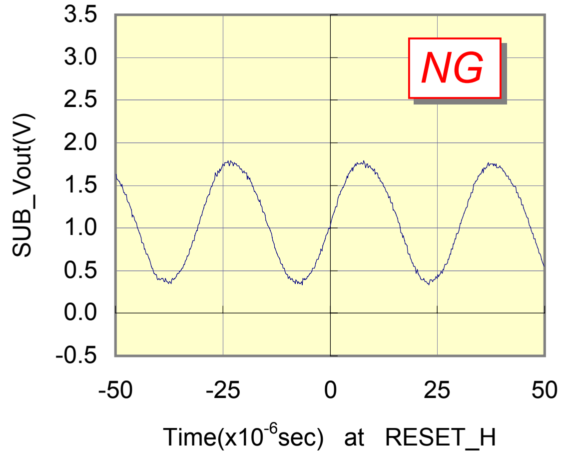
Test Data at 25°C

Output signal wave from the oscillator
MODEL : VT-200 12.5pF with HD64338602R



Output signal wave from the oscillator
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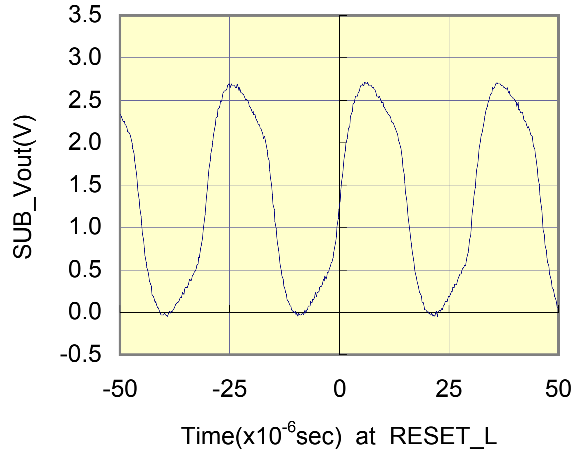
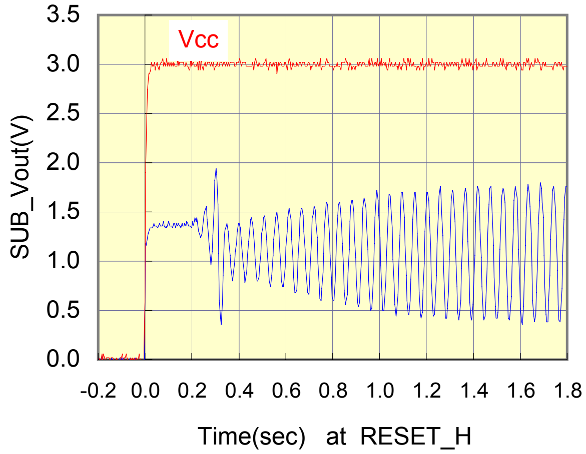


Start up time of SUB_Vout
MODEL : VT-200 12.5pF with HD64338602R



Start up time of SUB_Vout
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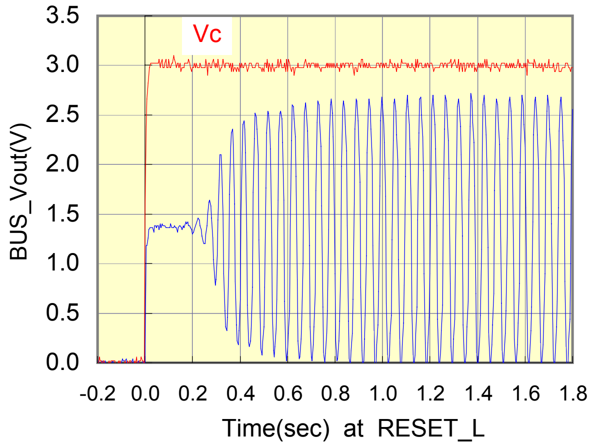
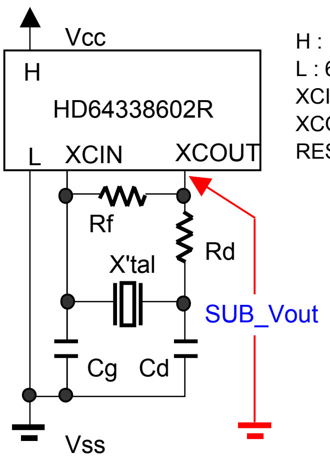


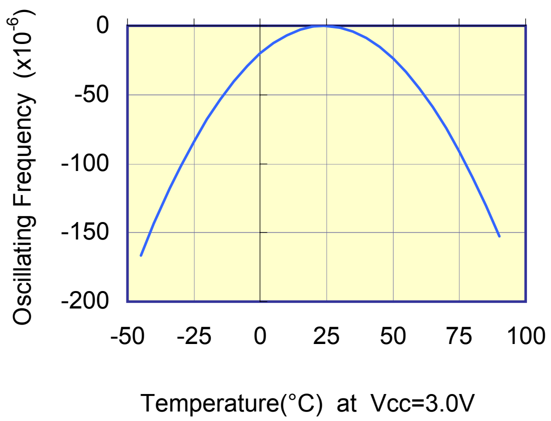
Test Circuit
MODEL : VT-200 12.5pF with HD64338602R



H : 1,8
L : 6
XCIN : 2
XCOUT : 3
RESET: 4

Recommended Values
X'tal :
VT-200 +/-20/12.5pF
Vcc= 3.0V
Rf=open
Rd=0 ohm
Cg=15 to 20pF typ
Cd=15 to 18pF typ
Ta=-40 to 85°C

Temperature characteristics of oscillating frequency
MODEL : VT-200 12.5pF with HD64338602R



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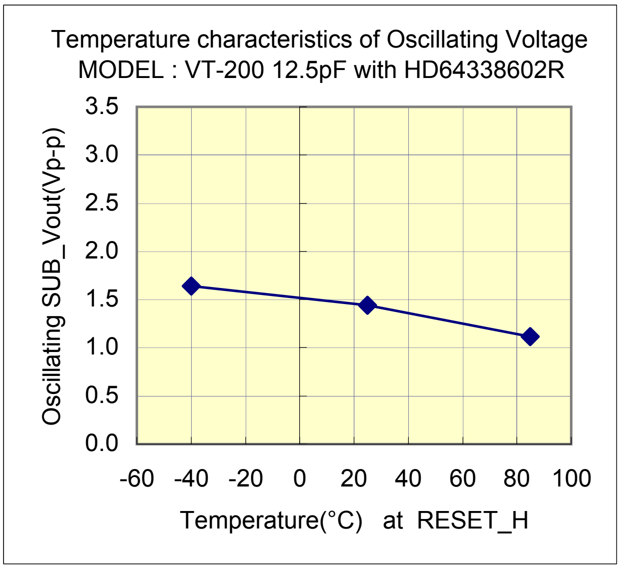
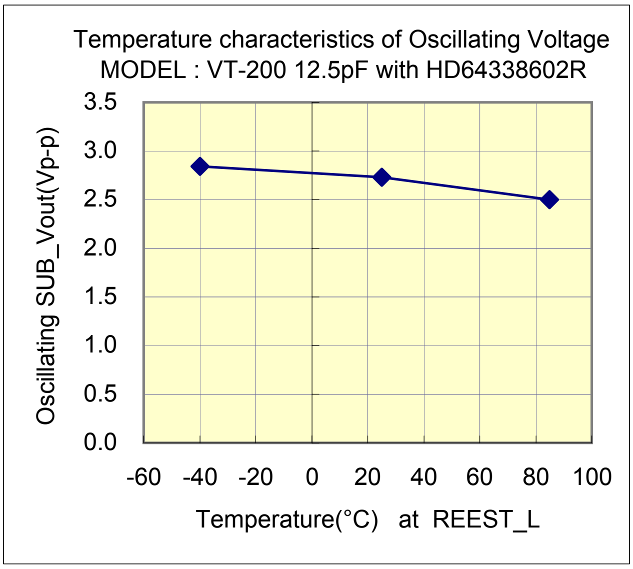
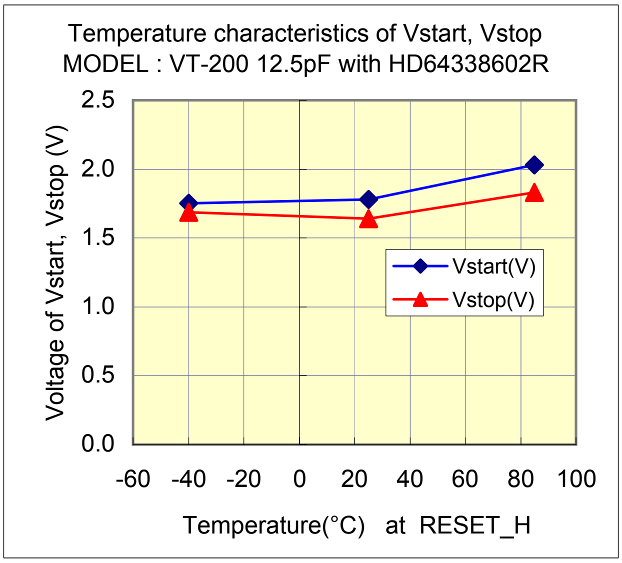
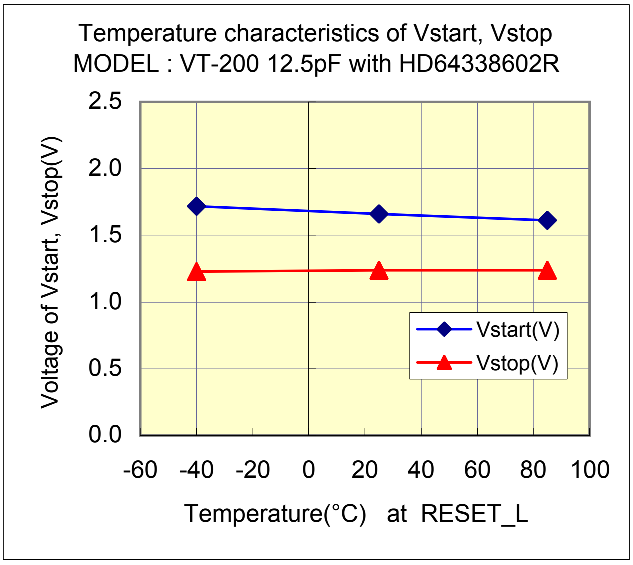
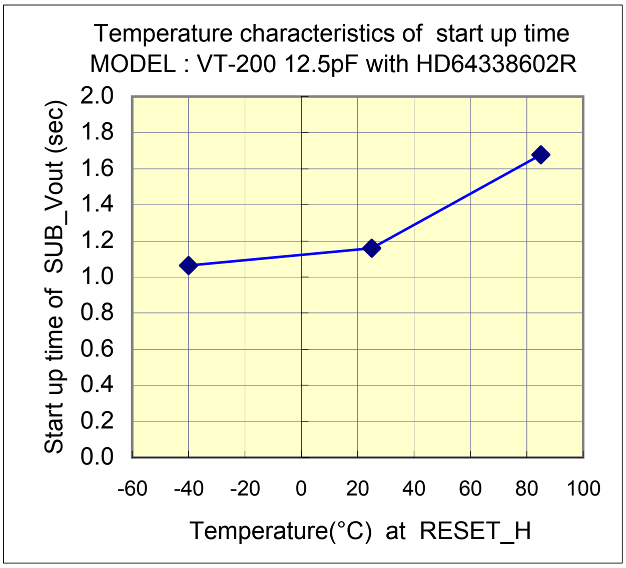
Test Data : Temperature characteristics

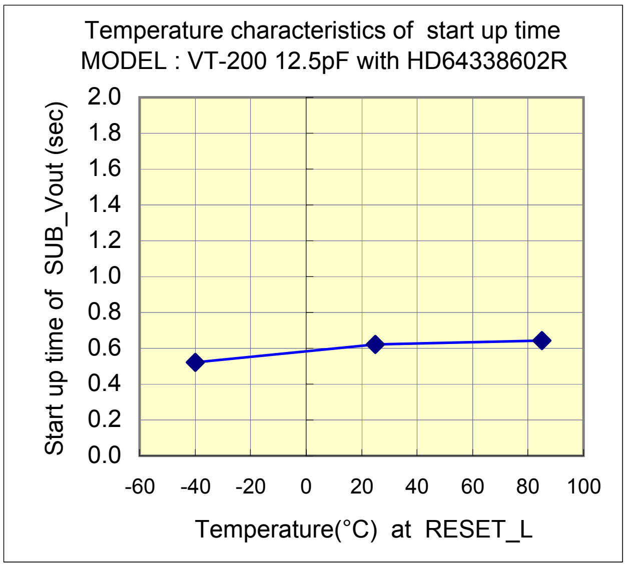












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Referential components layout(see Figure 1)

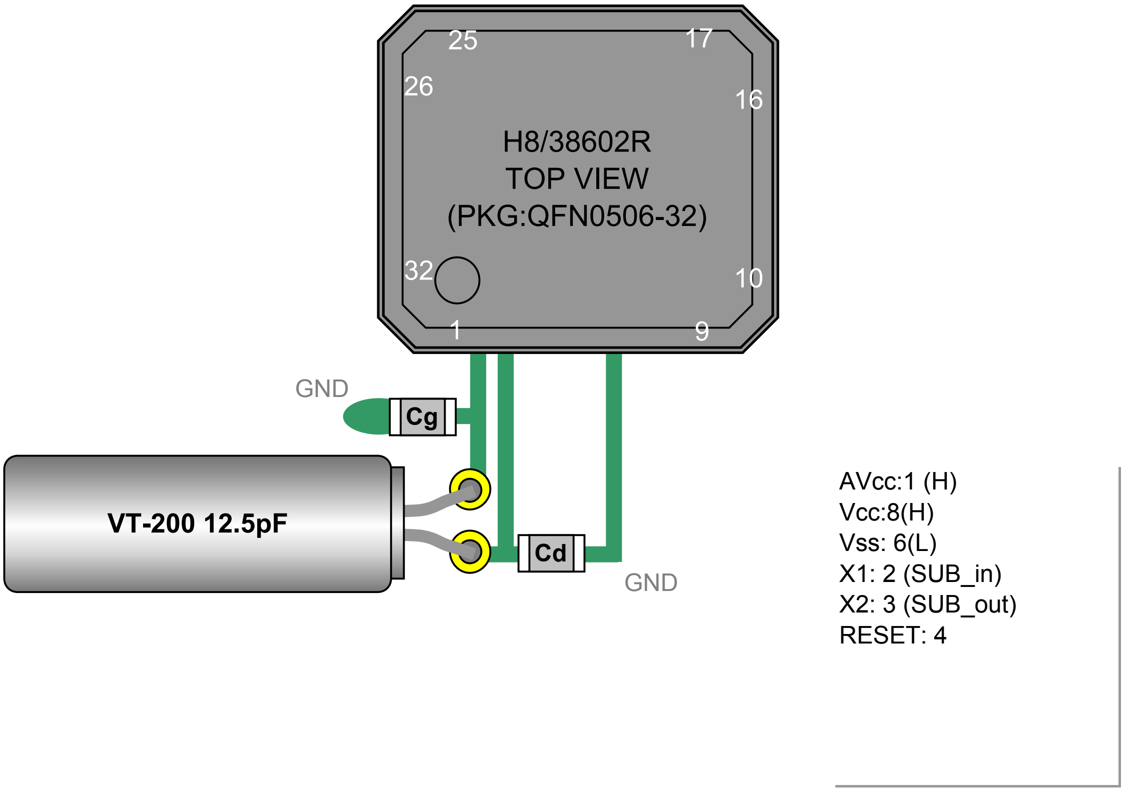

Figure 1 Referential components layout

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).

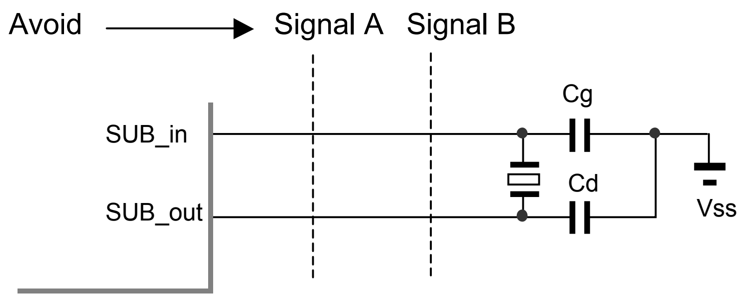

Figure 2 Example of Incorrect Board Design

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Measurement conditions :3.0V

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[Evaluation Sample : VT-200 12.5pF at 25°C]

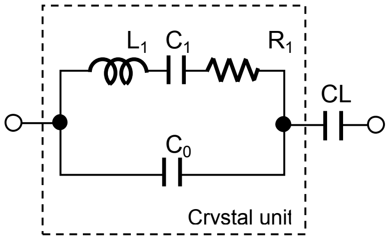
SAMPLE	No.	CL(pF)	Fo(Hz)	fr(Hz)	R1(kohm)	Co(pF)	C1(fF)	Q(k)
VT-200 12.5pF	1	12.5	32768.11	32765.28	27.4	0.91	2.319	76.5
	2	12.5	32768.09	32765.24	26.9	0.89	2.333	77.4
	3	12.5	32768.34	32765.45	29.9	0.93	2.368	68.6

[IC Test Data : IC samples Rd=0 ohm,Cg=15 to 20pF,Cd=15 to 18pF at 25°C]

RESET	IC samples	Fosc(Hz)	df / f($x10^{-6}$)	DL($x10^{-6}$W)	| -RL |(kohm	Vstart(V)	Ts(sec)
RESET_L	TYP	32768.350	0.33	0.33	784	1.66	0.62
	HH	32768.390	1.55	0.30	854	1.52	0.56
	HL	32768.380	1.25	0.30	784	1.59	0.58
	LH	32768.414	2.28	0.29	854	1.48	0.60
	LL	32768.390	1.55	0.30	784	1.54	0.61
RESET_H	TYP	32768.300	-1.20	0.28	109	1.78	1.16
	HH	32768.336	-0.10	0.28	109	1.73	0.98
	HL	32768.320	-0.59	0.27	109	1.68	1.10
	LH	32768.340	0.03	0.26	109	1.68	1.04
	LL	32768.330	-0.28	0.28	109	1.66	1.00

Remark (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

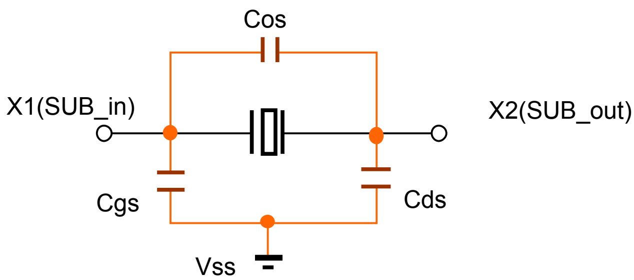
Figure 3 Equivalent circuit of crystal unit, and CL

Remark (see figure 4)

Approximate formula of the load capacitance of the circuit CL.

CL = Cg×Cd / (Cg + Cd) + Cs (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.