TO: Microchip Corporation

Report No.	UKY1C-C3-16838-00(99)N 1/4
Date Issued	25-Nov-16

Crystal oscillation circuits report

Dear Sirs,
We are pleased to submit a report on the above subject as follows:

Yours faithfully

Board name	SAME54 Xplained Pro kit	
IC name	ATSAME54P20A	
Specification	ST3215SB32768E0HPWBB	
Specification NO.	--	
Crystal unit type	ST3215SB	
Frequency	32.768	kHz
Frequency tolerance	±20	PPM （25±3℃）
Temperature	-40～+85	℃
Secondary Temp Coefficent	-0.04Max	PPM/℃2
Equivalent series resistance	70	kΩ Max
Load capacitance	9	pF
Drive level	0.5	uW

Circuit examination history

2016.11.25 First edition UKY1C-C3-16838-00(99)N

Crystal Units design section		Crystal oscillation circuit evaluation section		
Approved by	Checked by	Approved by	Checked by	Prepared
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The reference about the above
KYOCERA Crystal Device Corporation Marketing Division
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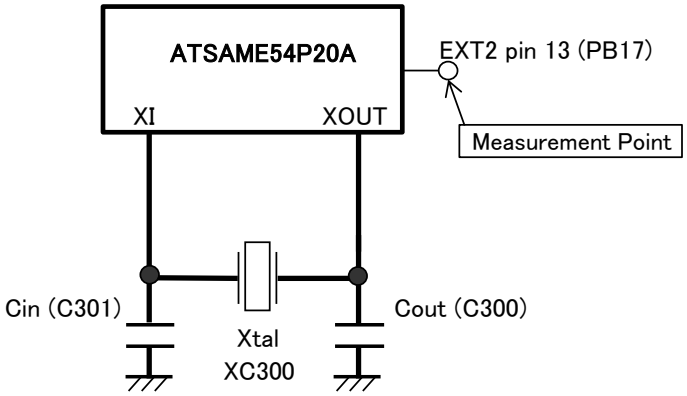
Note:The characteristics of crystal oscillating circuits vary according to a circuit constant, installed condition,etc.
Before use,please conflem matching of the crystal unit with the crystal oscillator circuits.Please also note that the resuits of reviewing the circuits may not meet the characteristics of your product.

○Measurement Circuit Diagram

SAME54 Xplained Pro kit
IC: ATSAME54P20A
Vcc: USB (V)
Xtal: ST3215SB 32.768kHz CL= 9pF



Measurement Item	Instrument
Frequency	Agilent Universal Counter 53132A
Negative Resistance	Agilent Spectrum Analyzer E4402B
Current	Agilent Multimeter 34401A
Drive Level	Tektronix Digital Oscilloscope TDS5052B
	Tektronix AC Current Probe P6022
	Agilent Arbitrary Waveform Generator 33120A

○Characteristics at Present Constants

CL= 9pF

Circuit Constants		Power Voltage (V)	Drive Mode	Negative Resistance (kΩ)	Circuit load Capacitance (pF)	Frequency Deviation (PPM)	Drive Level (μ W)
Cin (C301)	Cout (C300)						
12pF	12pF	USB	Standard	−495	7.05	+36.71	0.046
12pF	12pF	USB	High	−646	7.02	+37.32	0.065

・Negative resistance

<Standard>

The negative resistance for 32.768kHz at the present circuit constants is −495kΩ , which is enough to assure stable operation of the circuits.

<High>

The negative resistance for 32.768kHz at the present circuit constants is −646kΩ , which is enough to assure stable operation of the circuits.

・Circuit load capacitance and Frequency tolerance

<Standard>

The load capacitance of the oscillator circuit is 7.05pF with a frequency deviation of +36.71PPM.
This is based on the fact that this quartz crystal has a frequency deviation of +/−0 by using a load capacitance of 9pF.

<High>

The load capacitance of the oscillator circuit is 7.02pF with a frequency deviation of +37.32PPM.
This is based on the fact that this quartz crystal has a frequency deviation of +/−0 by using a load capacitance of 9pF.

・Drive level

<Standard>

The drive level of the oscillation circuit is 0.046μ W, when a quartz crystal unit with 43.27kΩ equivalent series resistance and 54.67kΩ load resonance resistance is used.
This is a good value without the possibility to cause trouble.

<High>

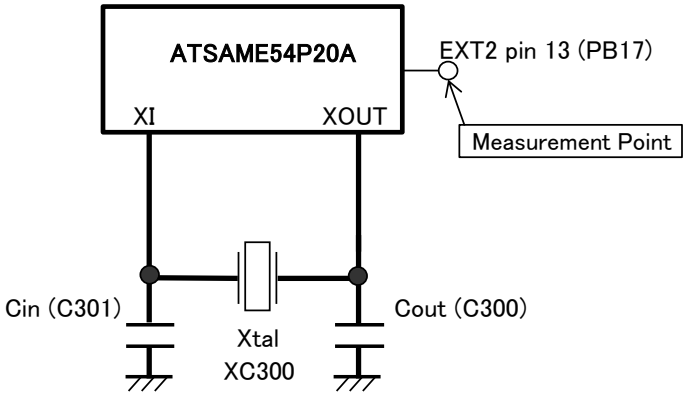
The drive level of the oscillation circuit is 0.065μ W, when a quartz crystal unit with 43.27kΩ equivalent series resistance and 54.67kΩ load resonance resistance is used.
This is a good value without the possibility to cause trouble.

・Conclusion

Constant and Load Capacitance change is needed because center frequency is at plus side.

○Measurement Circuit Diagram

SAME54 Xplained Pro kit
IC: ATSAME54P20A
Vcc: USB (V)
Xtal: ST3215SB 32.768kHz CL= 9pF



Measurement Item	Instrument
Frequency	Agilent Universal Counter 53132A
Negative Resistance	Agilent Spectrum Analyzer E4402B
Current	Agilent Multimeter 34401A
Drive Level	Tektronix Digital Oscilloscope TDS5052B
	Tektronix AC Current Probe P6022
	Agilent Arbitrary Waveform Generator 33120A

○Characteristics at Recommended Constants

CL= 9pF

Circuit Constants		Power Voltage (V)	Drive Mode	Negative Resistance (kΩ)	Circuit load Capacitance (pF)	Frequency Deviation (PPM)	Drive Level (μ W)
Cin (C301)	Cout (C300)						
15pF	15pF	USB	Standard	−363	8.79	+3.30	0.062
15pF	15pF	USB	High	−463	8.78	+3.54	0.085

・Negative resistance

〈Standard〉

The negative resistance for 32.768kHz at the present circuit constants is −363kΩ , which is enough to assure stable operation of the circuits.

〈High〉

The negative resistance for 32.768kHz at the present circuit constants is −463kΩ , which is enough to assure stable operation of the circuits.

・Circuit load capacitance and Frequency tolerance

〈Standard〉

The load capacitance of the oscillator circuit is 8.79pF with a frequency deviation of +3.30PPM.
This is based on the fact that this quartz crystal has a frequency deviation of +/−0 by using a load capacitance of 9pF.

〈High〉

The load capacitance of the oscillator circuit is 8.78pF with a frequency deviation of +3.54PPM.
This is based on the fact that this quartz crystal has a frequency deviation of +/−0 by using a load capacitance of 9pF.

・Drive level

〈Standard〉

The drive level of the oscillation circuit is 0.062μ W, when a quartz crystal unit with 43.27kΩ equivalent series resistance and 54.67kΩ load resonance resistance is used.
This is a good value without the possibility to cause trouble.

〈High〉

The drive level of the oscillation circuit is 0.085μ W, when a quartz crystal unit with 43.27kΩ equivalent series resistance and 54.67kΩ load resonance resistance is used.
This is a good value without the possibility to cause trouble.

・Conclusion

We recommend use of the product at the present constants.
However, please check whether it is satisfactory enough in your company.

○Temperature Characteristics at Recommended Constants

Circuit Constants		Power Voltage (V)	Temperature (℃)	Drive Mode	Negative Resistance (kΩ)	Drive Level (μ W)
Cin (C301)	Cout (C300)					
15pF	15pF	USB	−40	Standard	−373	0.066
15pF	15pF	USB	+85	Standard	−363	0.068

The results of testing the mounted board we borrowed from you this time are as described above.
Please also check and review them on your side before use.