TO: Microchip Corporation

Report No.	UKY1C-C3-16833-00(43)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	CX3225CA12000D0KPSC1
Specification NO.	--
Crystal unit type	CX3225CA
Frequency	12000 kHz
Frequency tolerance	±30 PPM
Temperature	-40～+85 ℃
Temperature characteristic	±50 PPM
Equivalent series resistance	200 Ω
Load capacitance	8 pF
Drive level	200 uW

Circuit examination history

2016.11.25 First edition UKY1C-C3-16833-00(43)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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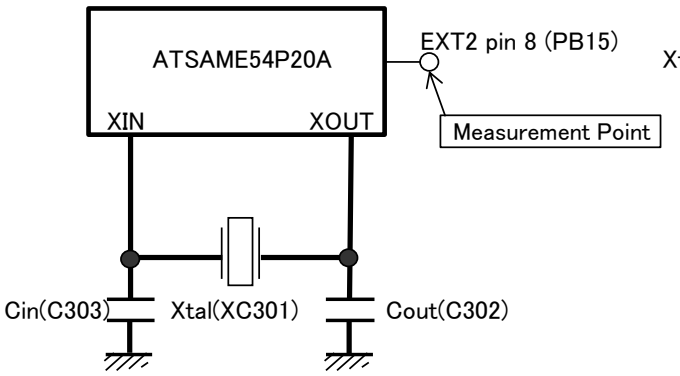
Note:The characteristics of crystal oscillating circuits vary according to a circuit constant, installed condition,etc.
Before use,please conflem matching of the crystal unit with the crystal oscillator circuits.Please also note that the resuits of reviewing the circuits may not meet the characteristics of your product.

○Measurement Circuit Diagram

SAME54 Xplained Pro kit
IC: ATSAME54P20A
Vcc: USB (V)
Xtal(XC301): CX3225CA 12000kHz CL= 8pF



Measurement Item	Instrument
Frequency	Anritsu MS2661C Spectrum Analyzer
Negative Resistance	Anritsu MS2661C Spectrum Analyzer
Drive Level	Tektronix Digital Oscilloscope TDS5052B
	Tektronix AC Current Probe P6022

○Characteristics at Present Constants

CL= 8pF

Circuit Constants		Power Voltage (V)	Automatic Loop Control	Negative Resistance (Ω)	Circuit load Capacitance (pF)	Frequency Deviation (PPM)	Drive Level (μW)	3rd Negative Resistance (Ω)
Cin(C303)	Cout(C302)							
12pF	12pF	USB	Enabled	−3865	10.47	−19.50	7	−410
12pF	12pF	USB	Disabled	−3864	13.02	−32.17	270	−420

・Negative resistance
<Automatic loop control enabled>
The negative resistance for 12000kHz at the present circuit constants is −3865Ω ,
which is enough to assure stable operation of the circuits.
<Automatic loop control disabled>
The negative resistance for 12000kHz at the present circuit constants is −3864Ω ,
which is enough to assure stable operation of the circuits.

・Circuit load capacitance and Frequency tolerance
<Automatic loop control enabled>
The load capacitance of the oscillator circuit is 10.47pF with a frequency deviation of −19.50PPM.
This is based on the fact that this quartz crystal has a frequency deviation of +/−0
by using a load capacitance of 8pF.
<Automatic loop control disabled>
The load capacitance of the oscillator circuit is 13.02pF with a frequency deviation of −32.17PPM.
This is based on the fact that this quartz crystal has a frequency deviation of +/−0
by using a load capacitance of 8pF.

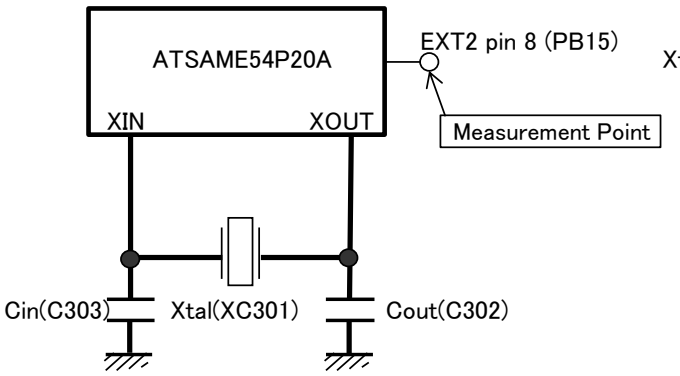
・Drive level
<Automatic loop control enabled>
The drive level of the oscillation circuit is 7μW.
When a quartz crystal unit with 58.76Ω equivalent series resistance and 64.89Ω load resonance resistance is used.
This is a good value without the possibility to cause trouble.
<Automatic loop control disabled>
The drive level of the oscillation circuit is 270μW.
When a quartz crystal unit with 58.76Ω equivalent series resistance and 63.67Ω load resonance resistance is used.
This value is large. This may become the problem.

・3rd Over tone Negative resistance
<Automatic loop control enabled>
The 3rd over tone (= 36000kHz) negative resistance of the oscillation circuit is −410Ω .
The value is guaranteed to stable oscillation in the circuit.
<Automatic loop control disabled>
The 3rd over tone (= 36000kHz) negative resistance of the oscillation circuit is −420Ω .
The value is guaranteed to stable oscillation in the circuit.

・Conclusion
Constant and Load Capacitance change is needed because center frequency is at minus side and drive level with automatic loop control disabled is large.

○Measurement Circuit Diagram

SAME54 Xplained Pro kit
IC: ATSAME54P20A
Vcc: USB (V)
Xtal(XC301): CX3225CA 12000kHz CL= 8pF



Measurement Item	Instrument
Frequency	Anritsu MS2661C Spectrum Analyzer
Negative Resistance	Anritsu MS2661C Spectrum Analyzer
Drive Level	Tektronix Digital Oscilloscope TDS5052B
	Tektronix AC Current Probe P6022

○Characteristics at Recommended Constants

CL= 8pF

Circuit Constants		Power Voltage (V)	Automatic Loop Control	Negative Resistance (Ω)	Circuit load Capacitance (pF)	Frequency Deviation (PPM)	Drive Level (μW)	3rd Negative Resistance (Ω)
Cin(C303)	Cout(C302)							
5pF	5pF	USB	Enabled	−7268	7.16	+9.50	4.4	−920
5pF	5pF	USB	Disabled	−7266	8.90	−8.25	192	−920

・Negative resistance
<Automatic loop control enabled>
The negative resistance for 12000kHz at the present circuit constants is −7268Ω ,
which is enough to assure stable operation of the circuits.
<Automatic loop control disabled>
The negative resistance for 12000kHz at the present circuit constants is −7266Ω ,
which is enough to assure stable operation of the circuits.

・Circuit load capacitance and Frequency tolerance
<Automatic loop control enabled>
The load capacitance of the oscillator circuit is 7.16pF with a frequency deviation of +9.50PPM.
This is based on the fact that this quartz crystal has a frequency deviation of +/−0
by using a load capacitance of 8pF.
<Automatic loop control disabled>
The load capacitance of the oscillator circuit is 8.90pF with a frequency deviation of −8.25PPM.
This is based on the fact that this quartz crystal has a frequency deviation of +/−0
by using a load capacitance of 8pF.

・Drive level
<Automatic loop control enabled>
The drive level of the oscillation circuit is 4.4μW.
When a quartz crystal unit with 58.76Ω equivalent series resistance and 67.84Ω load resonance resistance is used.
This is a good value without the possibility to cause trouble.
<Automatic loop control disabled>
The drive level of the oscillation circuit is 192μW.
When a quartz crystal unit with 58.76Ω equivalent series resistance and 66.01Ω load resonance resistance is used.
This is a good value without the possibility to cause trouble.

・3rd Over tone Negative resistance
<Automatic loop control enabled>
The 3rd over tone (= 36000kHz) negative resistance of the oscillation circuit is −920Ω .
The value is guaranteed to stable oscillation in the circuit.
<Automatic loop control disabled>
The 3rd over tone (= 36000kHz) negative resistance of the oscillation circuit is −920Ω .
The value is guaranteed to stable oscillation in the circuit.

・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 (℃)	Automatic Loop Control	Negative Resistance (Ω)	Drive Level (μW)	3rd Negative Resistance (Ω)
Cin(C303)	Cout(C302)						
5pF	5pF	USB	−40	Enabled	−7268	3	−910
5pF	5pF	USB	−40	Disabled	−7266	198	−910
5pF	5pF	USB	+85	Enabled	−7168	3	−900
5pF	5pF	USB	+85	Disabled	−7166	189	−900

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.