

TO: Microchip Corporation

Report No.	UKY1C-C3-16740-00 (99) N 1/3
Date Issued	5 October 2016

## Crystal oscillation circuits report

Dear Sirs,

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

Yours faithfully,

IC Specification	ATtiny817
Specification	ST2012SB32768E0HPWBB
Specification No.	USY1N-H1-16348-00
Crystal unit type	ST2012SB
Frequency	32.768kHz
Frequency tolerance	$\pm 20\text{PPM}$ ( $+25^{\circ}\text{C} \pm 3^{\circ}\text{C}$ )
Secondary temperature Coefficient	$-0.04\text{MAX.} \times 10^{-6} / ^{\circ}\text{C}^2$
Equivalent series resistance	80K $\Omega$
Load capacitance	9.0pF
Drive level	0.5 $\mu\text{W}$ Max.

Circuit examination history	5 October 2016 UKY1C-C3-16740-00 (99) N First edition
ATtiny817-MNRES / ATtiny817-MNR / ATtiny817-MFR	

Crystal oscillation circuit evaluation section	Crystal Units design section	Crystal Units Division		Design center Division		
		Approved by	Checked by	Approved by	Checked by	Prepared
Design center Division	Crystal Units Division	A. Muraoka	Y. Yasuda	A.Hisako	F.Horie	Y.Yuki

The reference about the above

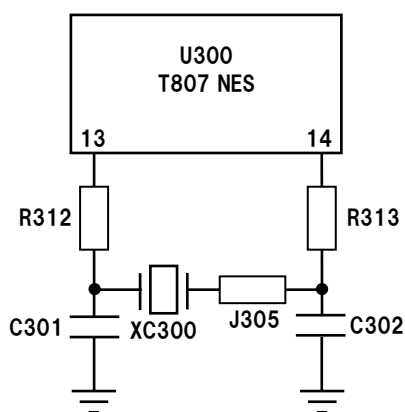
KYOCERA Crystal Device Corporation      Design center Division

5850 Higashine-koh, Higashine-shi, Yamagata 999-3701

Tel:+81-237-43-5747      Fax:+81-237-43-5651

**Note:** The characteristics of crystal oscillating circuits vary according to a circuit constant, installed condition, etc. Before use, please confirm matching of the crystal unit with the crystal oscillator circuits. Please also note that the results of reviewing the circuits may not meet the characteristics of your product.

## MEASUREMENT CIRCUIT DIAGRAM (PCB:No.ATMEL ATTINY817 XPLAINED PRO (A08-2506) )



XC300: ST2012SB  
32.768 kHz CL=9.0 pF

Power Supply Voltage = USB

Measurement Item	Instrument
Frequency	Universal C HP53132A
Negative resistance	Agilent Spectrum Analyzer E4402B
Drive level	Tektronix Current Probe P6022
	Waveform Generator HP33120A
	Tektronix Oscilloscope TD5052B

### CHARACTERISTICS AT PRESENT CONSTANTS

Circuit Constants	Temperature (°C)	Negative Resistance (kΩ)	Circuit load capacitance (pF)	Frequency Deviation (PPM)	Drive Level (μW)
R312=0Ω R313=0Ω J305=N.M. C301=10pF C302=10pF	+25	-620	6.77	+73.1	0.0006

#### •Negative resistance

The negative resistance for 32.768kHz at the present circuit constants is -620kΩ, which is enough to assure stable operation of the circuits.

#### •Circuit load capacitance and Frequency tolerance

The load capacitance of the oscillator circuit is 6.77pF with a frequency deviation of +73.1PPM. This is based on the fact that this quartz crystal has a frequency deviation of  $\pm 0$  by using a load capacitance of 9.0pF.

#### •Drive level

The drive level of the oscillation circuit is 0.0006 μW, when a quartz crystal unit with 56.5kΩ equivalent series resistance and 80.0kΩ load resonance resistance is used. This is a good value without the possibility to cause trouble.

#### •Problem

There is a gap of +73.1PPM for the frequency deviation of the present constant. Before using the product, please change the present constant to the recommended constant.

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# CHARACTERISTICS AT RECOMMENDED CONSTANTS

Recommended Constants	Temperature (°C)	Negative Resistance (kΩ)	Circuit load capacitance (pF)	Frequency Deviation (PPM)	Drive Level (μW)
R312=0Ω R313=0Ω J305=N.M. C301=13pF C302=13pF	-40	-455	-	-	0.0006
	+25	-455	8.36	+17.8	0.0008
	+85	-415	-	-	0.0010

## •Negative resistance

The negative resistance for 32.768kHz at the present circuit constants is -415kΩ to -455kΩ, which is enough to assure stable operation of the circuits.

## •Circuit load capacitance and Frequency tolerance

The load capacitance of the oscillator circuit is 8.36pF with a frequency deviation of +17.8PPM. This is based on the fact that this quartz crystal has a frequency deviation of ±0 by using a load capacitance of 9.0pF.

## •Drive level

The drive level of the oscillation circuit is 0.0006 μW to 0.0010 μW, when a quartz crystal unit with 56.5kΩ equivalent series resistance and 75.3kΩ 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 Recommend constants.  
However, please check whether it is satisfactory enough in your company.

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