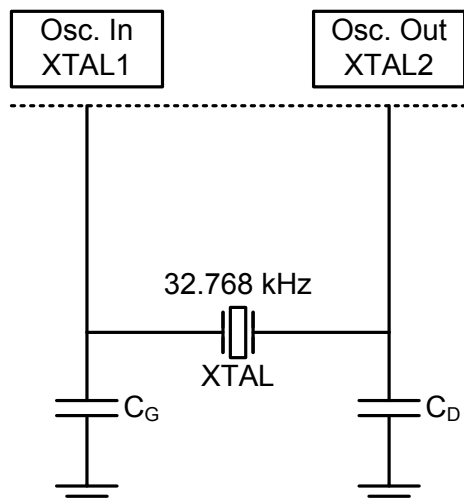


Pierce Oscillator

Design and Crystal
Recommendations

Atmel
ATmega169

ATmega169



Oscillator Design Check

Test Conditions			
Power Supply Voltage V_{DD}	2.7	5.5	V
Load Capacitors C_D / C_G	12 / 12		pF
Results			
Effective Load Capacitance	12.8	11.6	pF
Oscillation Allowance	>500	>500	k Ω
Oscillator Output Voltage AC	660	695	mV _{RMS}
Drive Level	0.445	0.385	μ W
Startup Time	250	200	ms
Overtone Mode Suppression	Safe		----

Recommendation

Crystal		
Crystal Type	MS3V-T1R / CC7V-T1A	
Frequency	32.768	kHz
Load Capacitance C_L	12.5	pF
Tolerance	+/-20	ppm
Oscillator Design		
C_D	12	pF
C_G	12	pF

Remarks

The ATmega169 consists of a self limiting Pierce Oscillator.

Placing $C_D = 12$ pF and $C_G = 12$ pF load capacitors on each side of the crystal results in an effective load capacitance of 12.8 pF at $V_{DD} = 2.7$ V and 11.6 pF at $V_{DD} = 5.5$ V (including board stray capacitances) which are good matches for a crystal specified for $C_L = 12.5$ pF.

The oscillator circuit provides an oscillation allowance greater than 500 k Ω ; this allows the safe use of smallest SMD quartz crystals ($ESR \leq 100$ k Ω).

Date: October 2010

Revision N°: 1.0

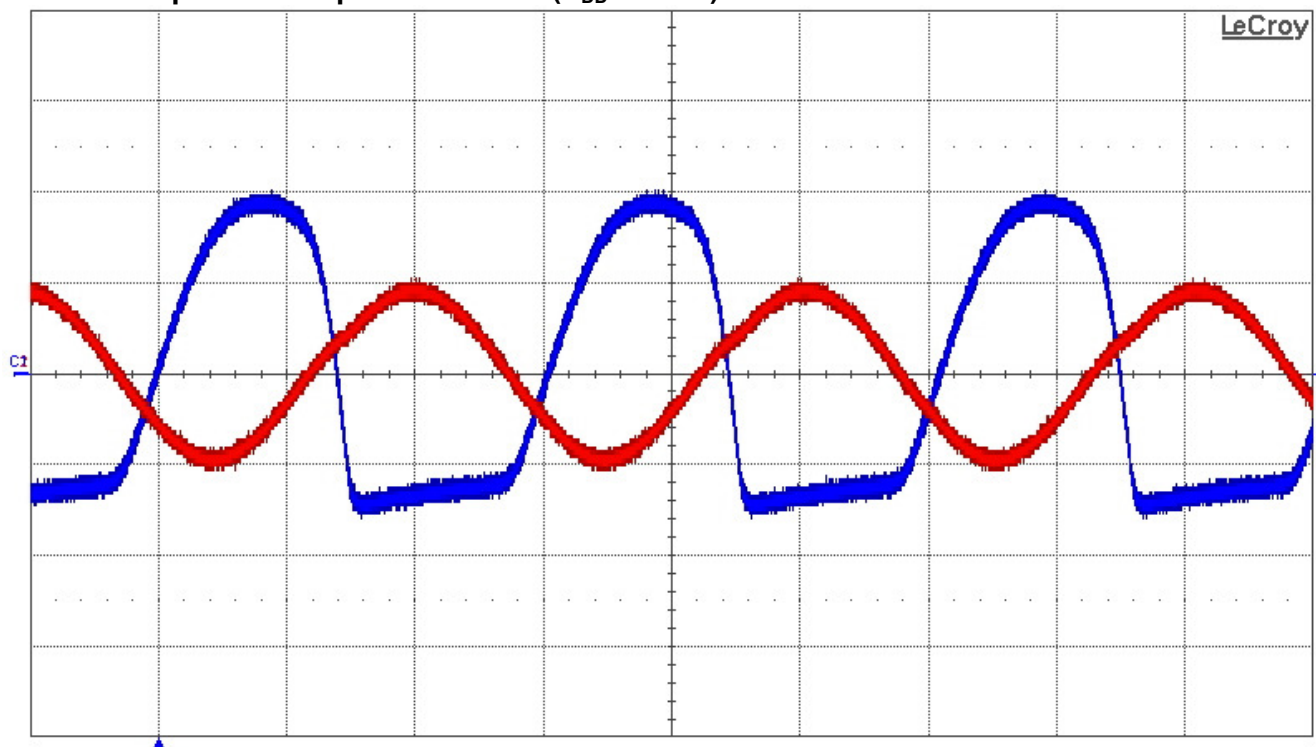
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In accordance with our policy of continuous development and improvement,
Micro Crystal reserves the right to modify specifications or design-recommendations without prior notice.
The recommendations stated above are based on measured-results, respecting the "oscillator design rules".
Micro Crystal makes no representation or warranty for information in this "Design and Crystal Recommendations".

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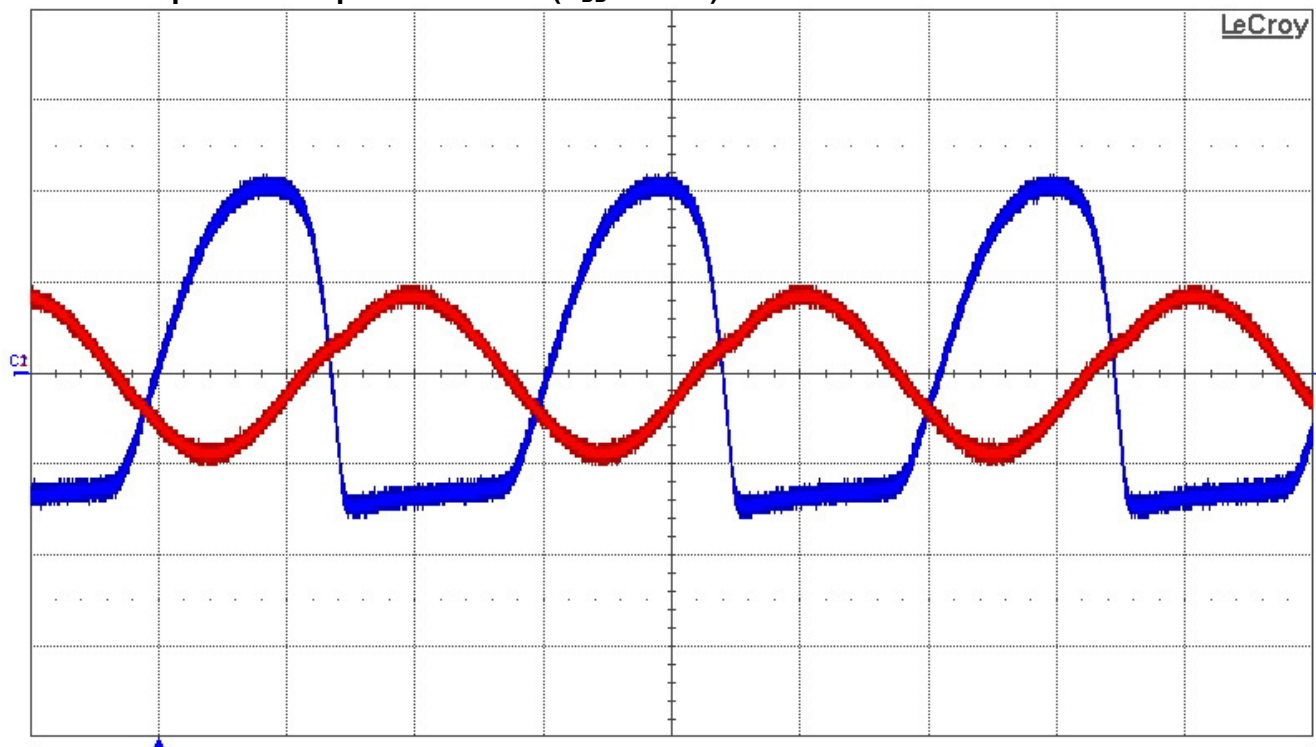
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Oscillator Input and Output waveforms ($V_{DD} = 2.7\text{ V}$):



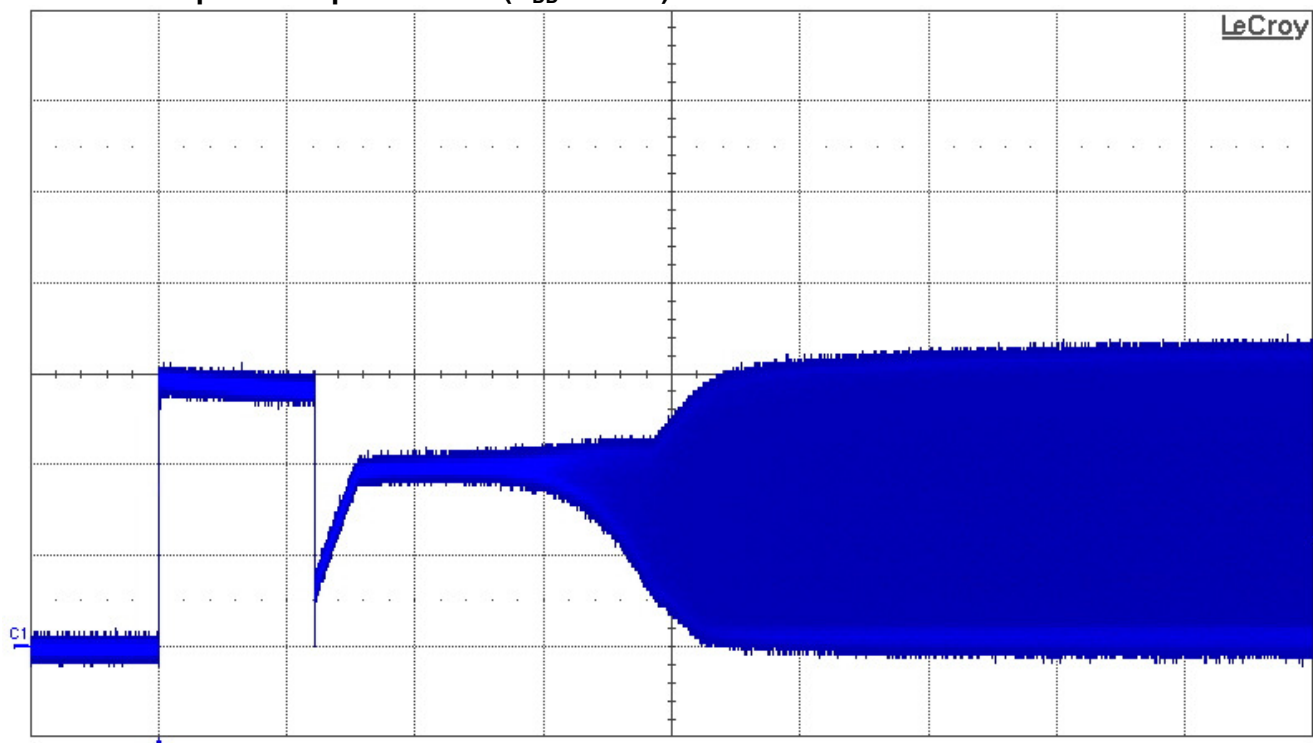
■ C1: Osc. Out (500 mV/div - AC) ■ C2: Osc. In (500 mV/div - AC) Time base: 10 $\mu\text{s}/\text{div}$

Oscillator Input and Output waveforms ($V_{DD} = 5.5\text{ V}$):



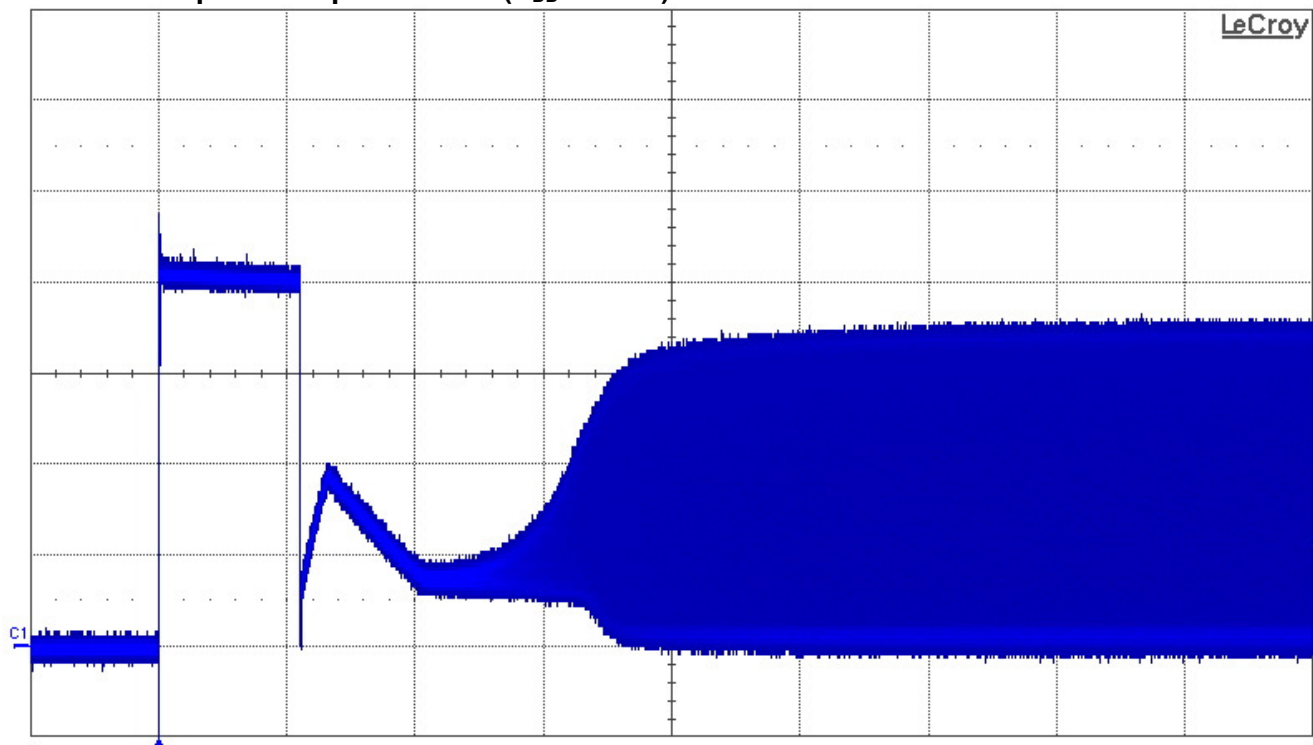
■ C1: Osc. Out (500 mV/div - AC) ■ C2: Osc. In (500 mV/div - AC) Time base: 10 $\mu\text{s}/\text{div}$

Oscillator Output startup waveform ($V_{DD} = 2.7\text{ V}$):



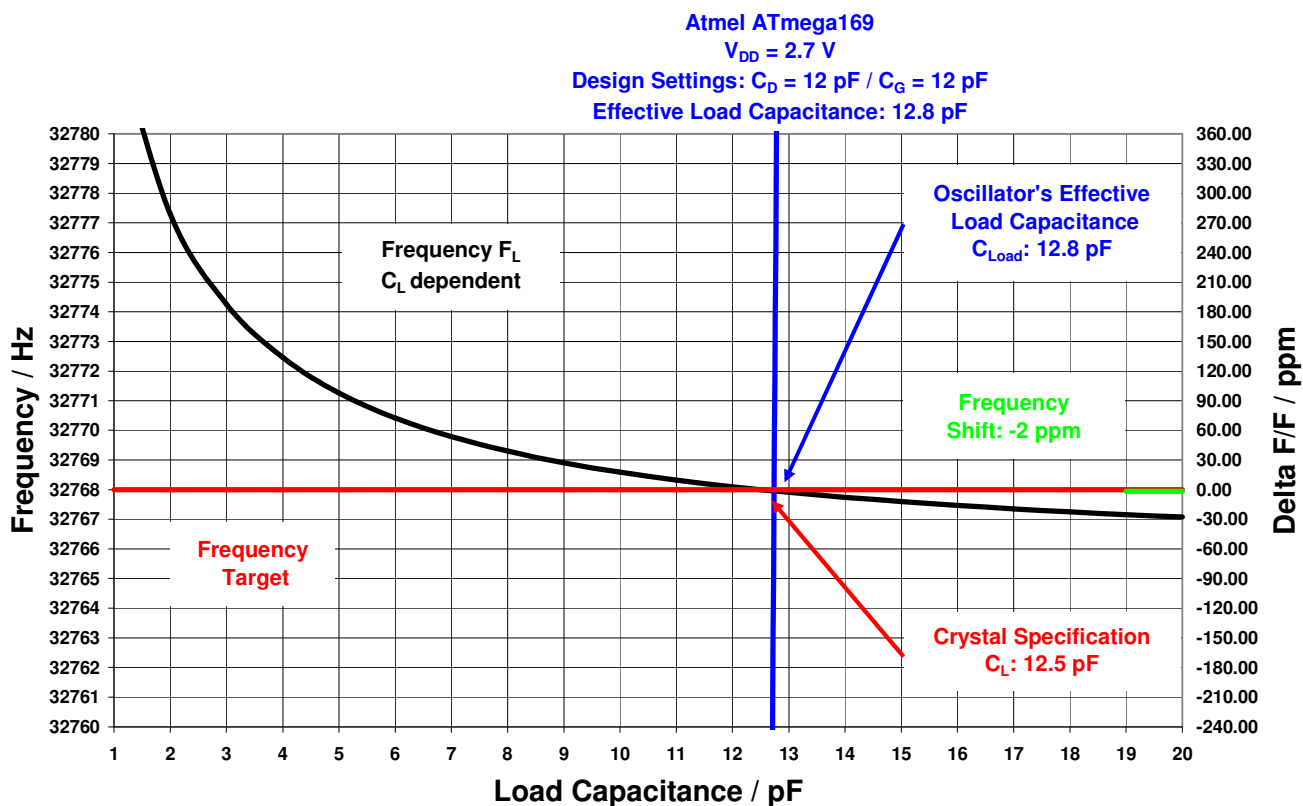
■ C1: Osc. Out (500 mV/div - DC) Time base: 50 ms/div

Oscillator Output startup waveform ($V_{DD} = 5.5\text{ V}$):



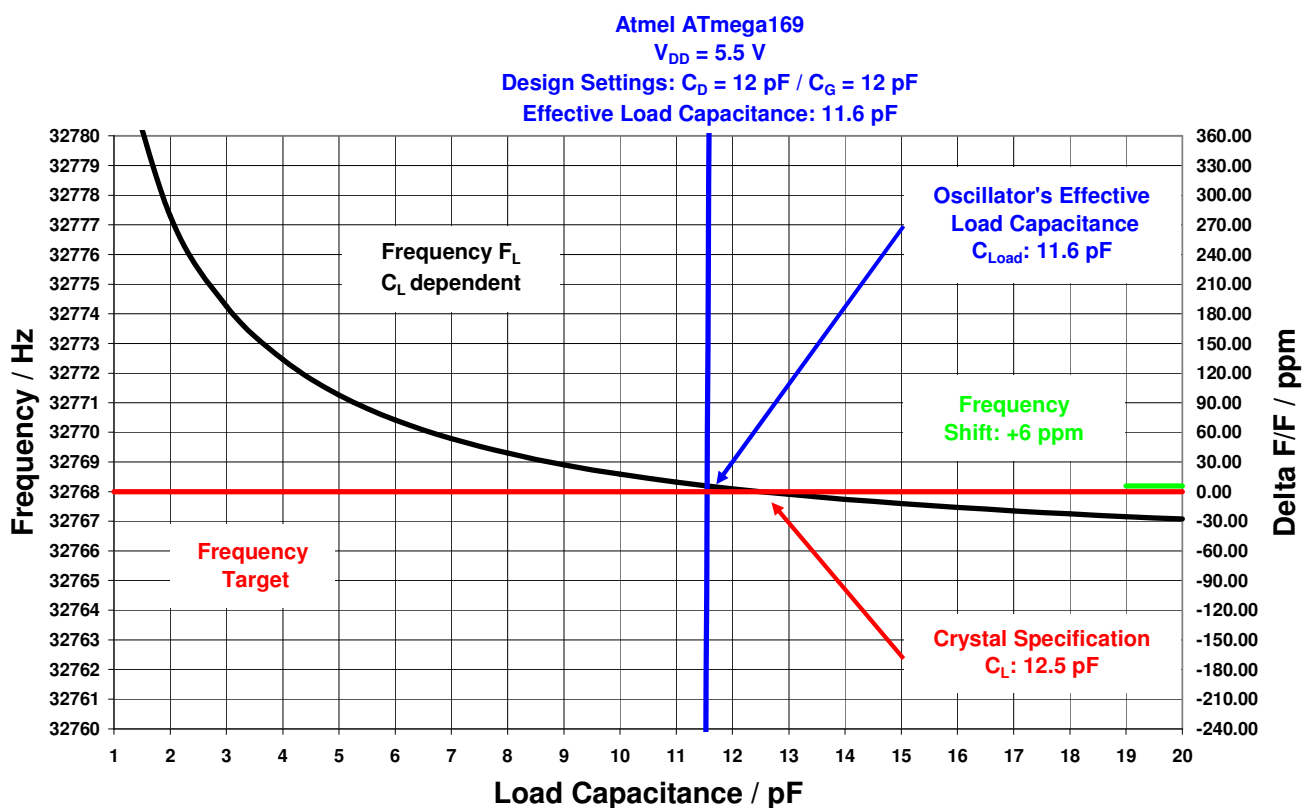
■ C1: Osc. Out (500 mV/div - DC) Time base: 50 ms/div

Crystal matching chart ($V_{DD} = 2.7\text{ V}$):



As shown in the chart above, an effective load capacitance of 12.8 pF results in a frequency offset of -2 ppm using a MS3V-T1R crystal specified for $C_L = 12.5\text{ pF}$.

Crystal matching chart ($V_{DD} = 5.5\text{ V}$):



As shown in the chart above, an effective load capacitance of 11.6 pF results in a frequency offset of +6 ppm using a MS3V-T1R crystal specified for $C_L = 12.5\text{ pF}$.