**Dragonchip**

# Application Note 006

Oscillator circuit design guide for DC6688 device family

Document Revision 1.51 April, 2012

# Table of Content

# 1 Overview

This document provides information on how to use the on-chip oscillator circuit to create a working oscillator for clock generation on the DC6688 family of microcontroller.

## 1.1 Oscillator Circuit

The DC6688's on-chip oscillator is composed of an inverted amplifier and a parallel feedback resistor. The XIN and XOUT pins are correspondingly the input and the output of the amplifier, which with off-chip components form a positive reactance oscillator.

The basic principle of the oscillator circuit is that the on-chip amplifier provides a negative feedback to the off-chip circuit, where it has a resonating element that will be excited and resonate at its design frequency by the negative feedback.

Our on-chip oscillator is designed to be used with crystal or ceramic resonator as the resonating element and with minimal amount of additional components. In general, the complete off-chip circuit comprises only the resonating element with 2 loading capacitors, where these capacitors may often built-in to the resonating element itself.

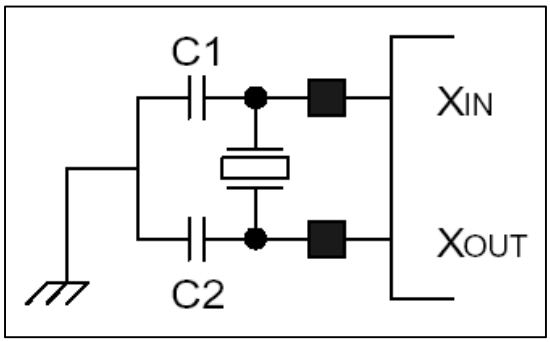


Figure 1-1: Typical off-chip circuit

# 2 PCB Layout Consideration

The oscillator circuit is very sensitive to noise and stray capacitance, therefore several precautions must be taken when designing the PCB layout.

1) Avoid long parallel pattern or cross pattern of XIN and XOUT.
2) The layout for the oscillator circuit should be arranged as short as possible (<15mm). The stray capacitance between circuits and ground patterns would be reduced.
3) The ground for the loading capacitor should be connected to the IC's VSS pin with trace as short as possible. This reduces the chances of interference from noise.
4) Crossing of oscillator circuit patterns over other circuit patterns should be avoided.
5) We recommend a guard ring form by a GND line around oscillator circuit, as well as a GND layer underneath the oscillator circuit if possible, thus making a shield against external noise.
6) An aluminum (220uF/16V) capacitor and a ceramic (0.1u) capacitor should be added across VDD and VSS as decoupling function. The ceramic capacitor should be placed as close to the chip as possible.
7) The Power and Ground line should be as thick as possible.

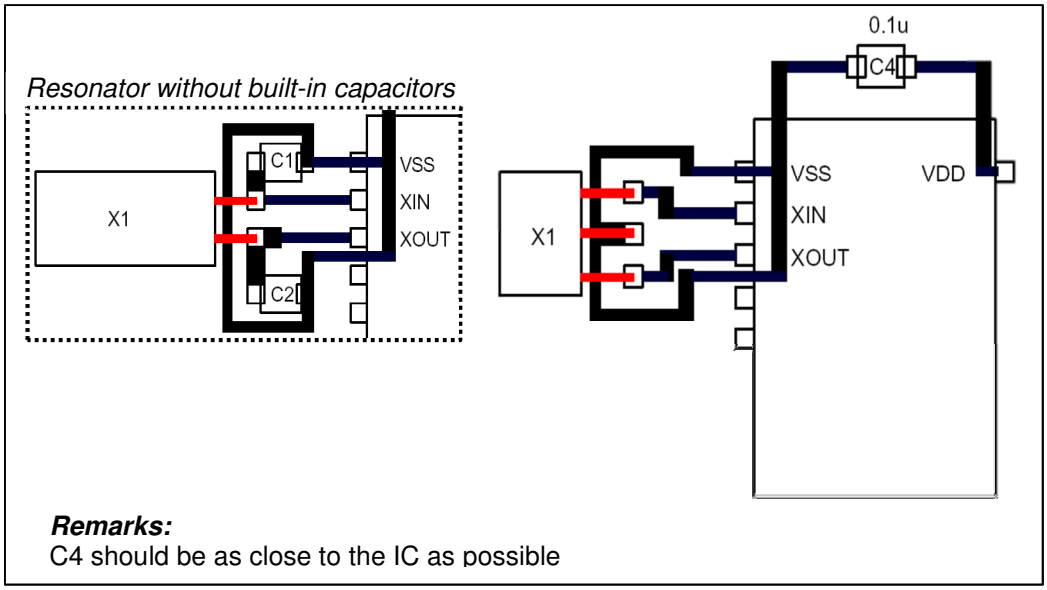


Figure 2-1: Recommended PCB Layout design for connecting the resonator with(without) built-in capacitor

# 3 Off-chip Circuit Adjustment

Since there are many crystal and ceramic resonator available on the market these days, our on-chip circuit cannot be catered for all without making some minor adjustment to the off-chip circuit. A common adjustment made would be the addition of an external feedback resistor and a damping resistor in the off-chip circuit.

It is recommended that both external feedback resistor and damping resistor should only be added if there are proven to be necessary, usually by the resonating element's manufacturer. As most of the time poor PCB layout is the cause of the oscillator circuit failure. Thus adding these components are not without their drawbacks and may even cripple the circuit.

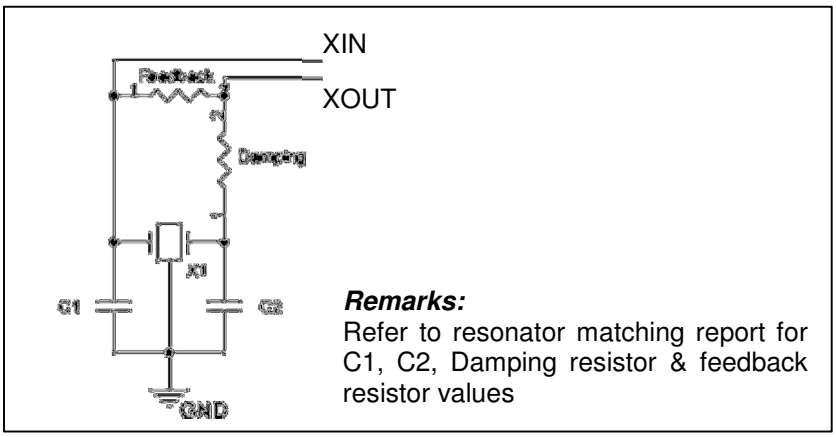


Figure 3-1: Oscillator circuit with damping & feedback resistor

## 3.1 External Feedback Resistor

The external feedback resistor would reduce the resistance of the feedback path, hence adjust the DC offset of the amplifier. This is needed when no oscillation is generated or the generated waveform is unstable with the default circuit.

A side-effect of the external feedback resistor is that it increases the current consume by the circuit and pro-long the startup time of the circuit.

## 3.2 Damping Resistor

The damping resistor works with the loading capacitors to suppress the higher harmonic frequencies generated by the resonating element. This is used mostly on ceramic resonator which has built-in loading capacitors but the capacitance is too small to filter out the higher harmonics.

A side-effect of adding the damping resistor is that it shifts the resonate frequency of the resonating element, and it reduces the voltage swing of the generated oscillation.

# 4 Revision History

| Document Rev No. | Issued Date | Section | Page | Description | Edited by | Reviewed by |
|---|---|---|---|---|---|---|
| 1.0 | Mar 2005 | | | Preliminary | | |
| 1.1 | Jul 2005 | | | Add DC6688FSA/DC6688FS Family | | |
| 1.2 | Jun 2006 | | | Add DC6688FL32 | | |
| 1.3 | Jul 2006 | | | Add DC6688F05S | | |
| 1.4 | Apr 2008 | | | Updated Target Device | | |
| 1.5 | Mar 2012 | | | Updated basic information and cover all DC66888 Device family | Patrick Li | Danny Ho |
| 1.51 | Apr 2012 | | | Correction | Patrick Li | |

## Copyright Notice



## Disclaimer

Dragonchip Ltd. assumes no responsibility for any errors contained herein.


**Dragonchip Ltd.**
**TEL: (852) 2776-0111**
**FAX: (852) 2776-0996**
**http://www.dragonchip.com**