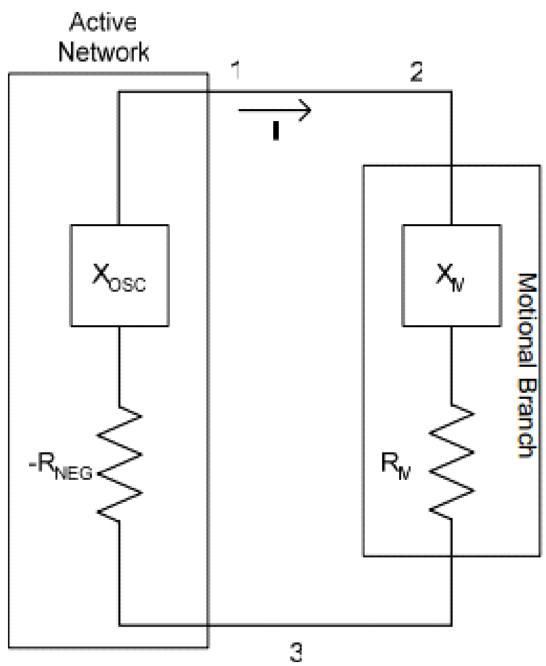
Crystal - Measuring Oscillator Negative Resistance

Introduction

Negative resistance models the required gain needed from the active network to sustain stable oscillations. The negative resistance model is shown in Figure 1. The crystal is represented by a reactance term Xm and a motional resistance term Rm. The active network is represented by the reactance term Xosc and the Resistance term -Rneg where Rneg is the negative resistance of the inverter amplifier.

One process used as a means to easily evaluate the negative resistance characteristics and oscillation allowance of an oscillator circuits is the method of adding a resistor to the hot terminal of the crystal unit and observing whether it can oscillate (examining the negative resistance). The oscillator circuit capacity can be examined by changing the value of the added resistance.

Figure 1. Negative Resistance Model



Measuring Negative Resistance of the Active Network

The steps for measuring the negative resistance of the active network are as follows:

1) Compute crystal parameters Co, Cs, Ls, Rs and CL using a Network Analyzer such as 250B/C by Saunders and Associated Inc.

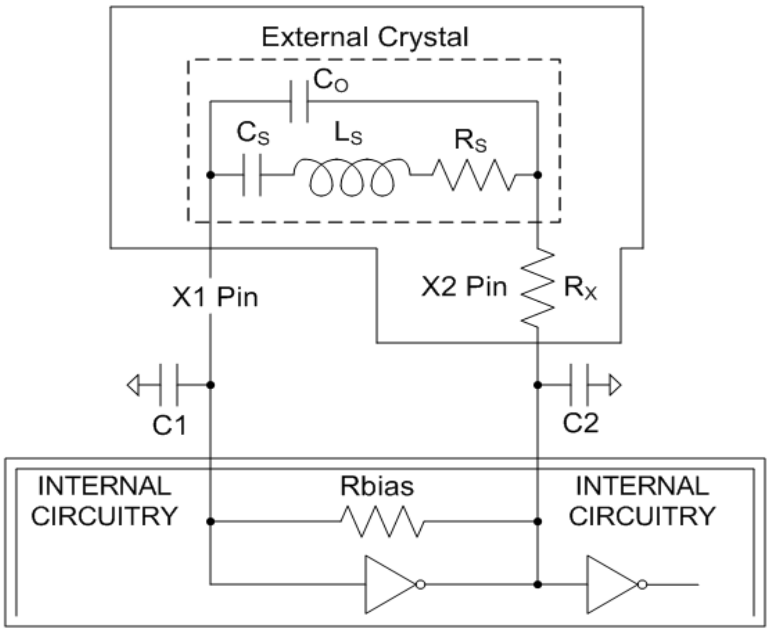
2) Solder crystal on X1 and X2 pins of the IDT clock IC and mount the crystal load capacitors next to the device pins (as shown in Figure 2).

3) Adjust the load capacitance to get the output frequency error to nearly 0ppm (account for contribution due to stray capacitance on the PCB board).

4) Connect a series resistor Rx (as shown in Figure 2) and keep increasing its value until oscillations stop occurring on powering up the device.

5) The negative resistance of the active network is then equal to Rx + Rs.

Figure 2. Active Network



www.IDT.com

Corporate Headquarters
6024 Silver Creek Valley Road
San Jose, CA 95138 USA

Sales
1-800-345-7015 or
408-284-8200
Fax: 408-284-2775
www.IDT.com

Tech Support
email: clocks@idt.com
480-763-2056