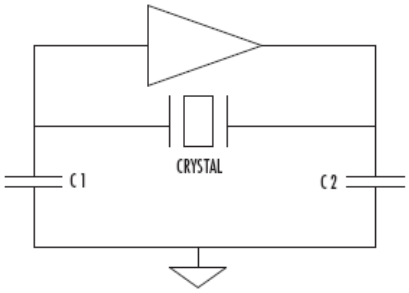
APPLICATION NOTE 6
CRYSTAL LOAD CAPACITANCE

The most frequent error in specifying load capacitance is mistaking that the value of the capacitors are the same as the crystal load capacitance, which is not accurate.

The capacitors placed on either side of the crystal and connected to ground provide the proper phase shift around the closed loop network. This issues that the gate input is in phase with the gate output. A condition necessary for sustained oscillation.

The difficulty lies in that the value of C stray is dependent on the application. Other significant factors are the circuit trace layout, the pin-to- pin capacitance of the microprocessor (or other digital device), and the distance between the oscillator input pins and the crystal. The PCB material and crystal grounding also should be a consideration. Measuring stray capacitance is also extremely difficult, as measuring devices tend to swamp out these small capacitance values. Generally speaking it is much easier to ask the customer to try a crystal with a standard Cl, and then adjust the value to correct the frequency.

C stray usually ranges from 2pF to 8pF. If the customer is not sure what load capacitance to specify, the equation below can be solved using the values of C1, C2 and assuming a C stray of 5pF. Therefore, if the customer is using a couple of 29pF capacitors, the following calculation may be made referencing the circuit below:



$$Cl = \frac{C_1 \times C_2}{C_1 + C_2} + C_{stray}$$

$$Cl = \frac{29 \times 29}{29 + 29} + 5 \qquad Cl = \frac{841}{58} + 5 \qquad Cl = 14.5 + 5 = 19.5pF$$

For this example, the recommended load capacitance would be 20pF.