CML Semiconductor Products

Application Information

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Xtal Oscillator Circuits

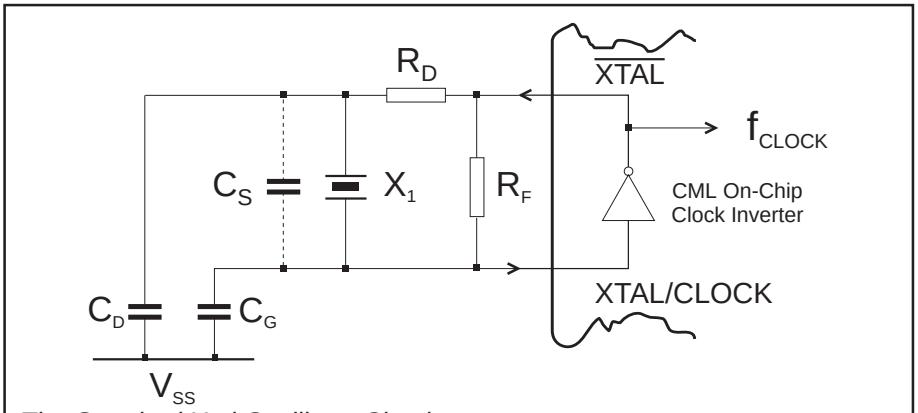
This Application Note discusses a general Xtal oscillator circuit applicable to most individual CML microcircuits.

The figure below shows the standard Xtal oscillator circuit from which most recommended Data Sheet circuits are derived.

The standard on-chip CML CMOS oscillator circuit will function correctly with the majority of Xtals, however the use of this circuit with a few Xtal types may cause the following problems:

1. Excessive drive level to the Xtal.
2. Excessive over-voltage, outside the device maximum ratings, at the oscillator input pin. This over-voltage may show itself as degraded microcircuit performance.
3. Failure to start oscillation can be caused by the use of a Xtal with a very high ESR.

Note: Operation of any CML microcircuit without a Xtal or clock input may cause device damage.



The Standard Xtal Oscillator Circuit

Standard Xtal Oscillator Components

R_F Feedback Resistor

To set the bias point of the internal amplifier. Low values of R_F will reduce loop-gain and disturb the phase of the feedback network. Typical value = 1.0MΩ ± 20% in a range of 1.0MΩ to 20MΩ. Refer to the relevant data sheet for the recommended value, as this component is sometimes integrated on chip.

R_D Drive Resistor

Used to limit the Xtal drive level by forming a voltage-divider between R_D and C_D. R_D also stabilizes the oscillator against changes in the output impedance of the inverter. To verify that the maximum operating supply voltage does not overdrive the Xtal, observe the output frequency at the buffered output. Under proper operating conditions the frequency should increase slightly (a few ppm) as the supply voltage increases. If the Xtal is being overdriven, an increase in supply will normally cause a decrease in frequency or instability. If the latter is the case (i.e. Xtal being overdriven), increase the value of R_D *(refer to the Xtal manufacturers' recommendations).*

X_1 Xtal

A parallel resonant Xtal to the value recommended in the relevant Data Sheet.

C_D Drain Capacitor

To provide phase shift and reduce Xtal drive. Large values of C_D tend to stabilize the oscillator against variations in power supply voltage but also reduce the tuning capability of the oscillator and overtone activity. Refer to the relevant data sheet for the recommended value.

C_G Gate Capacitor

To provide phase shift and input voltage for the amplifier. In some oscillator circuits C_G is used to adjust the oscillator frequency although this generally may not be required. Large values of C_G reduce loop-gain and increase stability. C_G may be used to reduce over-voltage at the inverter input. However, the reduction in loop-gain may cause oscillator start-up problems. Refer to the relevant data sheet for the recommended value.

C_S Stray Capacitance

Due to the low motional capacitance of small Xtals and the high inverter input impedance, the designer should be concerned with circuit board layout. For best oscillator performance C_S should be less than 1.0pF. An allowance (of 5pF, typically) should be made for stray capacitance when calculating values for C_D and C_G.