Application Hint 32

Receiver Crystal Selection

Introduction

All timing and tuning operations are derived from the internal Colpitts reference oscillator. Timing and tuning is controlled through the REFOSC pin in one of three ways:

- connect a ceramic resonator,
- connect a crystal, or
- drive this pin with an external timing signal.

The third approach is attractive for lowering system cost further if an accurate reference signal exists elsewhere in the system; for example, a reference clock from a crystal- or ceramic-resonator-controlled microprocessor. This method also provides some noise immunity by synchronizing the microprocessor clock with the Micrel receiver. The microprocessor clock, whether or not used as the receiver clock, should not have fast transitions (for example, sawtooth waveshapes are more likely to have problems than sinusoidal). An externally applied signal should be ac-coupled and resistively-divided down, or otherwise limited, to approximately 0.5Vpp. The specific reference frequency required is related to the system transmit frequency and to the operating mode of the receiver as set by the SWEN pin.

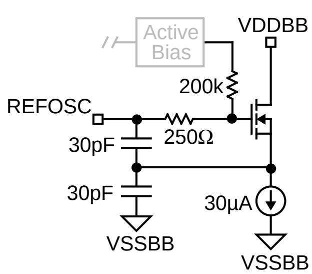

Figure 1. Internal Oscillator

Reference Oscillator

The on-board oscillator, together with an externally connected resonator or clock signal, establishes the operating frequency of the Micrel receiver. When using a resonator (ceramic resonator or crystal), its series resistance should be minimized to ensure oscillation. In cases where the resonator series resistance is too great, the oscillator may oscillate at a diminished peak-to-peak level, or may fail to oscillate entirely. Micrel recommends that series resistances for ceramic resonators and crystals do not exceed 50Ω and 100Ω respectively.

Typical Crystal Specification

For customers who prefer to use crystals for the resonating element (such as in fixed-mode operation), Micrel suggests the following crystal specification as a general starting point:

- Parallel-resonant mode with 20pF load capacitance
- Crystal series resistance ≤100Ω
- ±50ppm initial tolerance
- ±100ppm from –40°C to +85°C
- ≤10ppm/year aging
- ≥1mW drive level
- Q = 110,000

These are suggested specifications only and may differ depending on the specific application. However, crystal series resistance is important and should be carefully considered. As a rule of thumb, series resistance decreases as crystal package size increases (for example, HC6 vs. HC49) and crystal frequency increases.

Designs using the MICRF001 use crystal values from 2.2959MHz to 3.3674MHz. For customers who cannot meet the series resistance target and Q values within these frequency values, an external discrete oscillator is suggested. This oscillator (see Figure 2) provides much higher gain than the circuit within the MICRF001 and will oscillate with crystals having series resistance up to 400Ω. This oscillator is quite small and inexpensive, requiring no critical components. The oscillator output would simply be connected to the REFOSC pin of the MICRF001 instead of connecting a crystal directly.

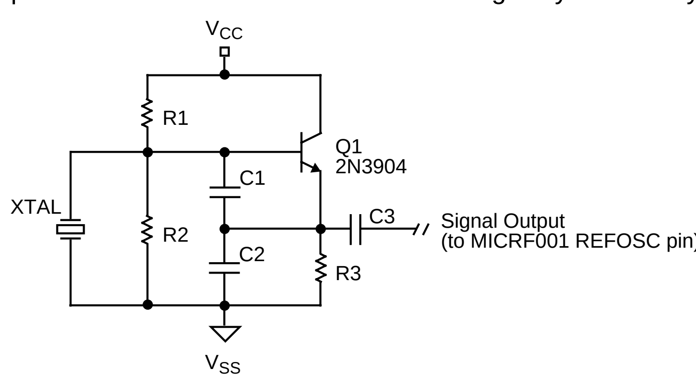

Figure 2. External Oscillator

External Crystal Oscillator Example Circuit

Choose R1, R2 large (several 100kΩ)

Choose C1, C2 small (10pF to 50pF)

Choose R3 for 50µA to 200µA transistor bias current

C3 is dc blocking cap, value not critical

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The MICRF011/RF022/RF002/RF003 second generation receivers have reference oscillator values of approximately 2 times that of the MICRF001. Higher frequency values are easier to manufacture and operate with the Micrel receiver.

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