SEMTECH

SX1261/SX1262

WIRELESS & SENSING PRODUCTS

Application Note:

Crystal Oscillator Trimming

AN1200.33
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Table of Contents

List of Figures

1 Introduction

The purpose of this document is to describe how to trim the internal foot capacitors on the crystal supplying the 32 MHz clock in order to reach a smaller frequency error.

Within the SX1261 and SX1262 chips, the load capacitors for the crystal oscillator (XOSC) are internal, and can be trimmed on-the-fly, so as to minimize the frequency error between a transmitter and a receiver.

Trimming allows the user to correct the frequency error between two devices. It is also useful as drift compensation due to temperature, or to synchronize a local mesh network against a LoRaWAN™ gateway whose accuracy is guaranteed at ±10 ppm.

2 Trimming Procedure

The SX1261 and SX1262 contain two capacitors which can be trimmed independently thanks to the registers "XTA trim" & "XTB trim" in order to set them as balanced or unbalanced. Their value can be set from 11.3 pF to 33.4 pF (0x00 to 0x2f) by steps of 0.47 pF.

```
// Set the chip in "Standby oscillator" mode
Radio.SetStandby( STDBY_XOSC );
// Write XTA & XTB registers
Radio.WriteReg( REG_XTA_TRIM, 0x05 );
Radio.WriteReg( REG_XTB_TRIM, 0x05 );
```

Note:

Each time the SX1261/SX1262 starts the oscillator, the default register value of 0x12 (16 pF) is written, this make frequency trimming unusable in RxDutyCycle mode[1].

[1] For more information about RxDutyCycle mode, see the Semtech Application Note AN1200.35.

3 Trimming Results

The following graphs were recorded in "Tx continuous wave" mode, in other words a continuous tone at a given frequency is generated then recorded on a digital signal analyzer.

The measurements are typical values done on one representative SX1261 chip, with a 32 MHz NDK crystal (ref EXS00A-CS06465).

3.1 Temperature

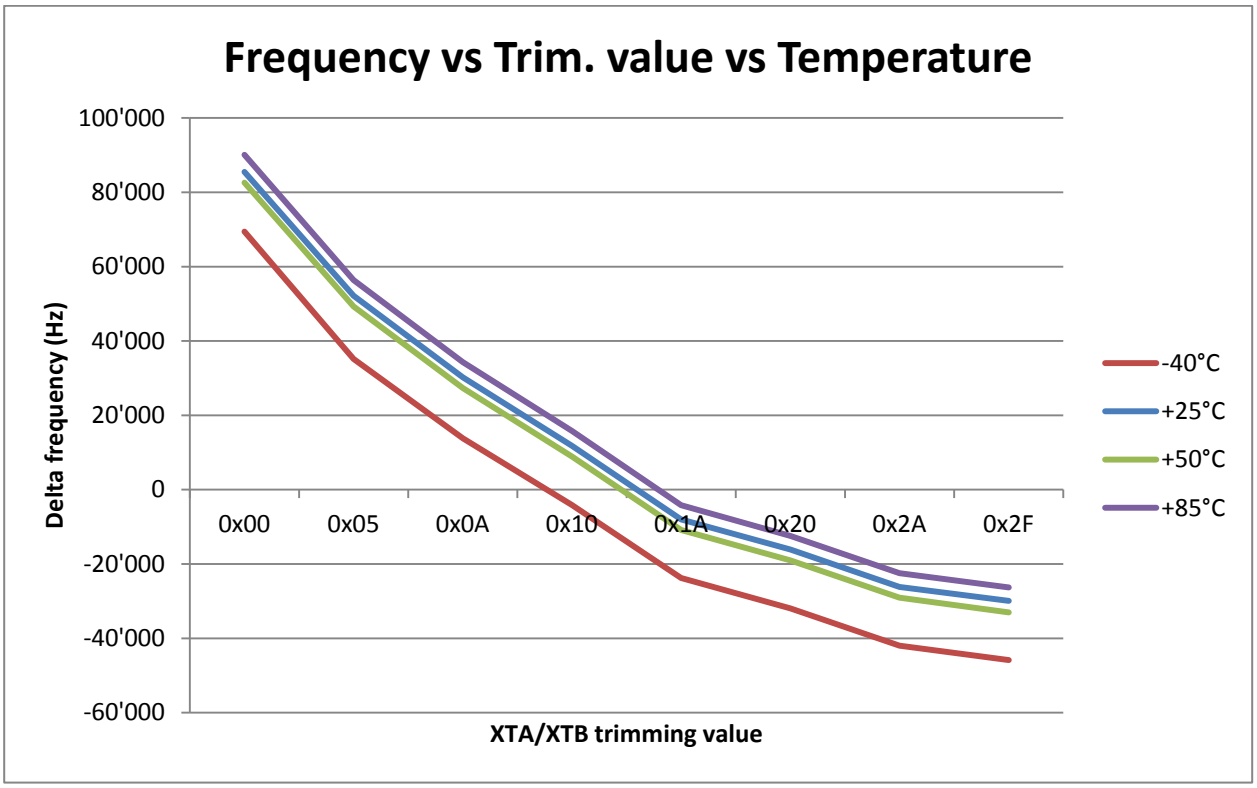

Figure 1: Trimming versus Temperature

All curves are relatively parallel so it can be concluded that the temperature has very few effects on trimming values.

Note:

The values presented in this graph were recorded with a base frequency of 868 MHz.

3.2 RF Frequency

The chip has been tested at the following frequencies: 433 MHz, 868 MHz and 915 MHz over typical, minimum and maximum temperatures.

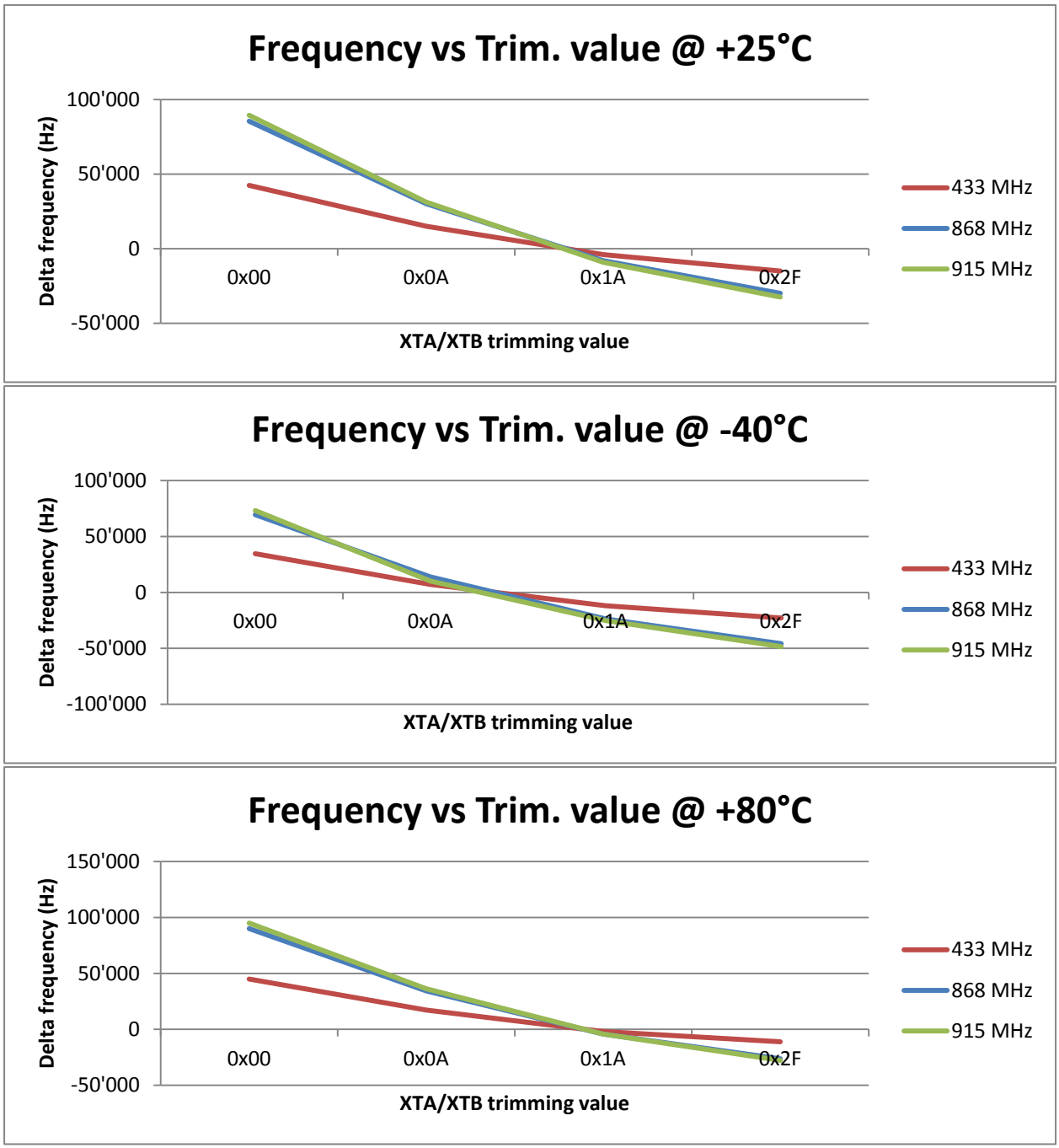

Figure 2: Trimming versus Frequency

As expected the trimming deviation at 868 MHz is almost twice the effect at 433 MHz. Moreover, as observed in *Section 3.1*, the values are shifted in frequency due to the temperature but have a consistent behavior over frequency and temperature.

4 Conclusion

A large frequency correction can be made by using the oscillator trimming feature. The frequency pullability (expressed in ppm/pF) of a crystal depends on how it is designed, therefore the actual pulling range offered by the SX1261 and SX1262 on the application should be verified.

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