**Freescale Semiconductor**
Application Note

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# Using the FXTH87 Family of LF Receivers for TPMS Application

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## 1 Introduction

The aim of this document is to present best practices when using the FXTH87 family of LF receivers for Tire Pressure Monitoring Systems (TPMS) application.

### 1.1 Keywords

LF Receiver, Q factor, Dequeuing

**Contents**





freescale Xtrinsic

## 1.2 Application and block diagrams

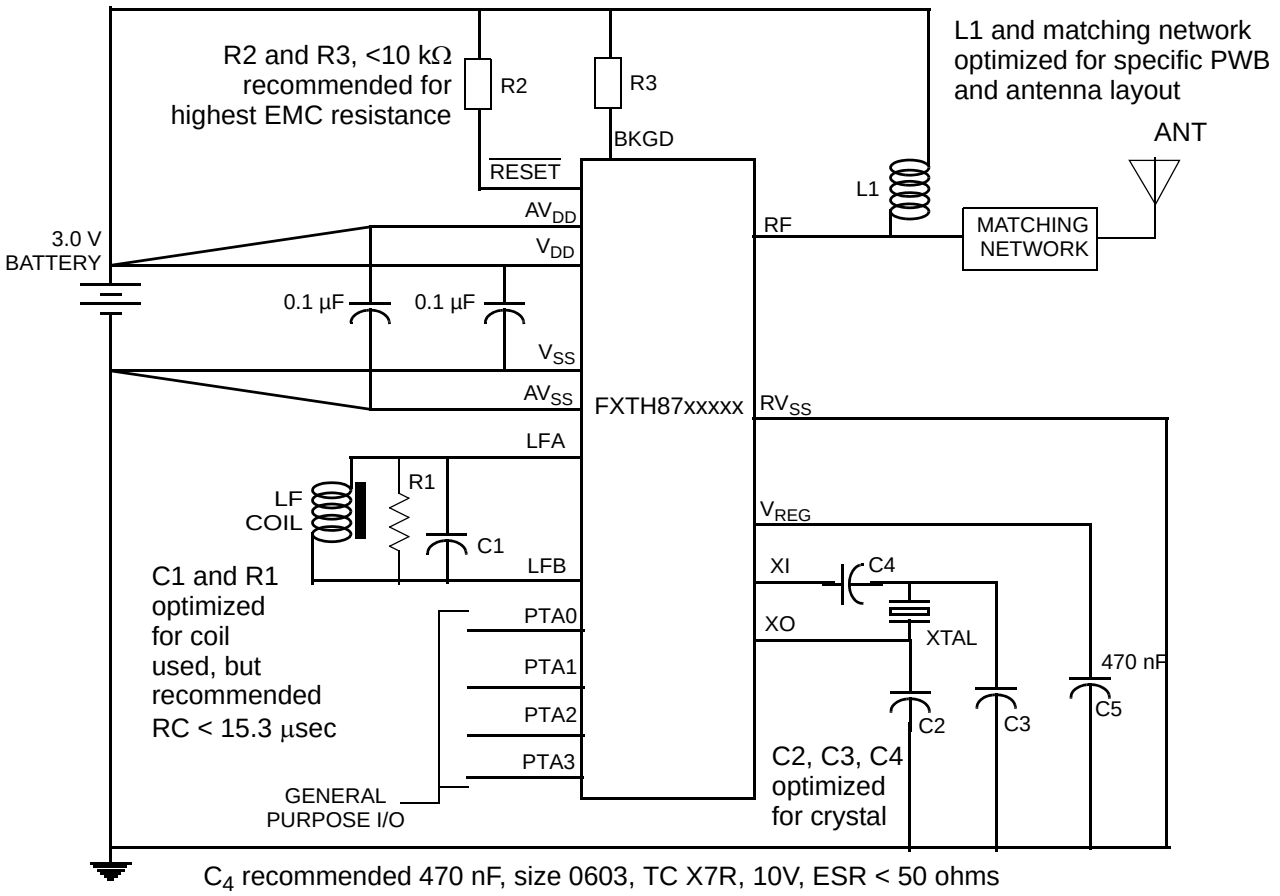


**Figure 1. Application diagram**

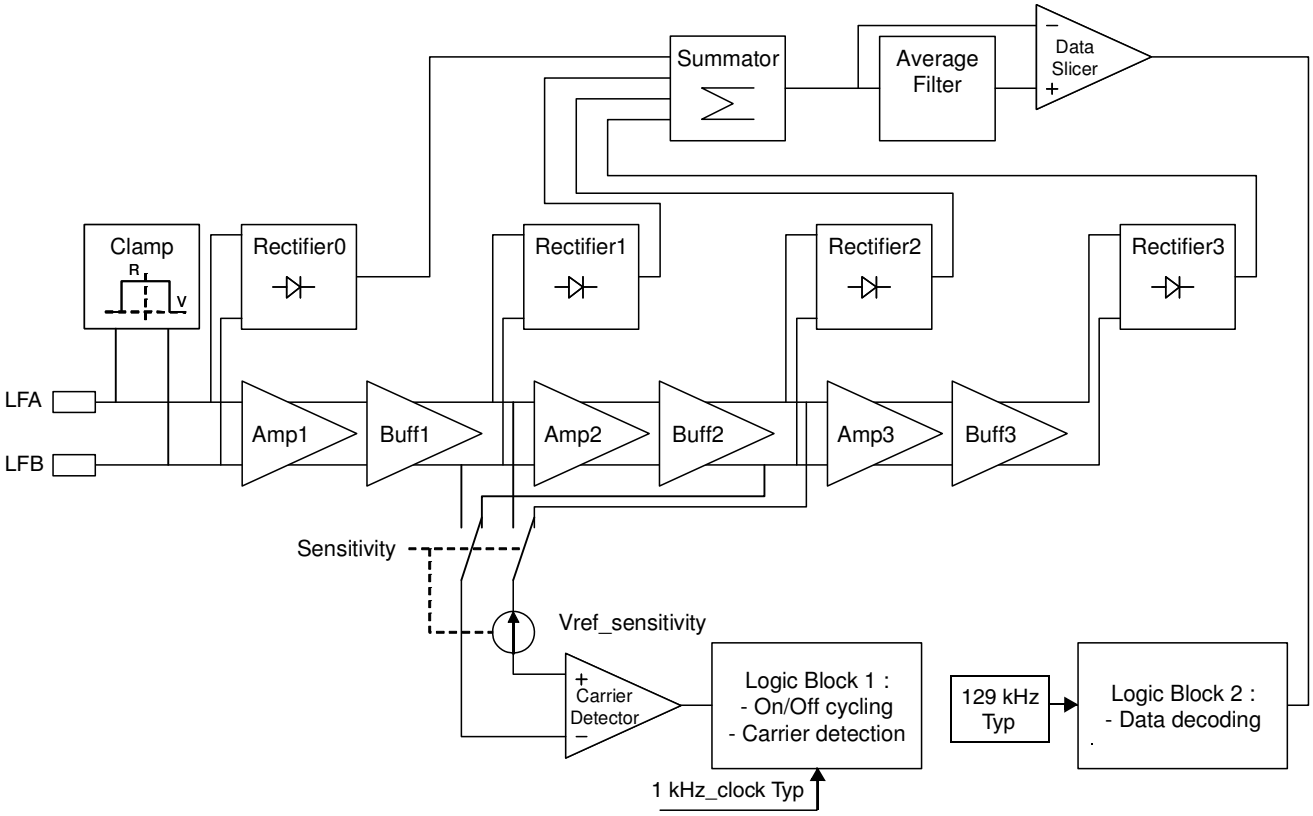


**Figure 2. Internal LF block diagram**

# 2 Q factor

## 2.1 Q factor characteristics

When using an R, L, C network at LFR inputs, LF data envelope is impacted as depicted in Figure 3 and Figure 4.

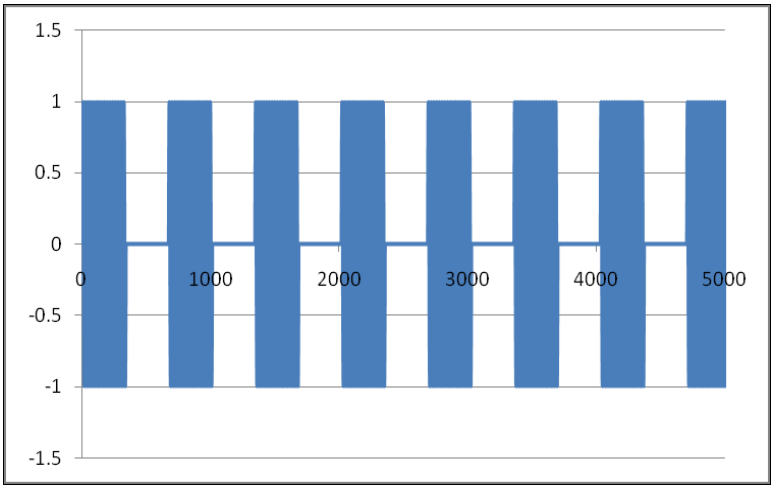


**Figure 3. Q = 0**

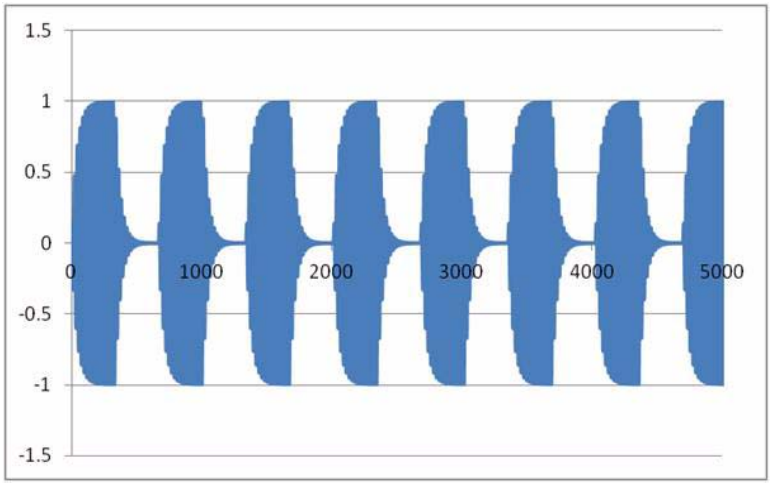


**Figure 4. Q = 6**

## 2.2 Freescale recommendations

To link to the internal LFR architecture, it is recommended to use the FXTH87xxxxx IC with an overall Q factor (for the whole system transmitter and receiver) of six maximum to guarantee the full functionality.

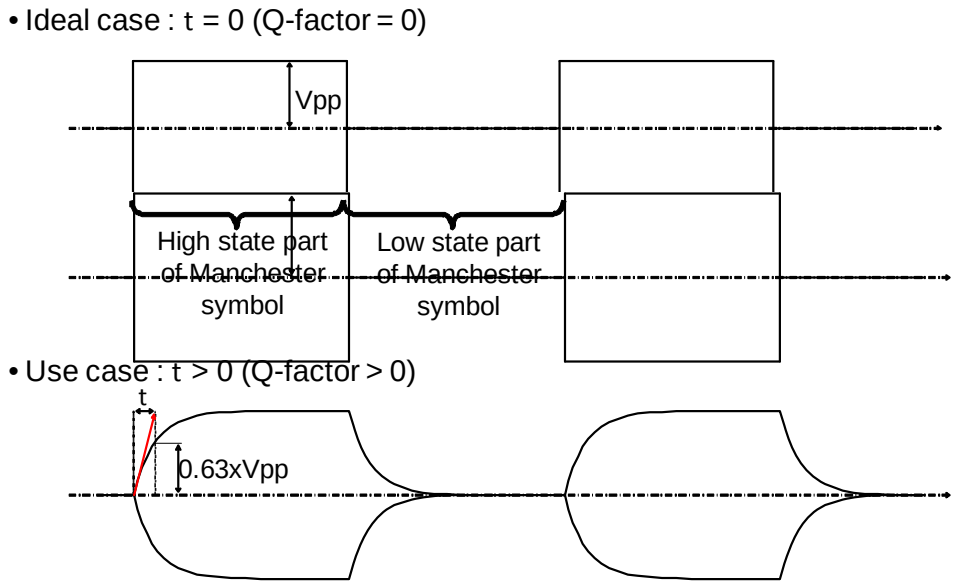


**Figure 5. Recommended τ < 15.3 µs**

In the case of an asymmetrical Q factor, as represented in Figure 6, Q factor limit, which can be used for the overall system, can be extended to 14 for the rising edge if the Q factor falling edge is 1.

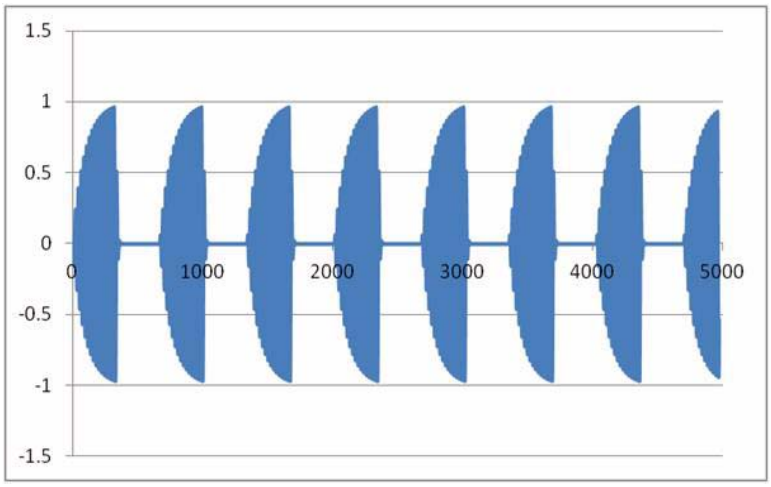


**Figure 6. Q-rising edge = 14, Q-falling edge = 1**
**Recommended τ on rising edge < 35.6 µs**
**Recommended τ on failing edge < 2.5 µs**

# 3 Dequeuing function

## 3.1 Description

When DEQEN bit (LFCTRLC register) is set, the dequeuing function is activated. This function is used to reduce the Q factor by switching an additional resistor, selected with LOWQ bits in LFCTRLC register.

This aims at reducing the LF level at LFR inputs when using a high-power transmitter.

This additional resistor is switched ON instantaneously when LF inputs level is detected as being higher than 100 mVpp.

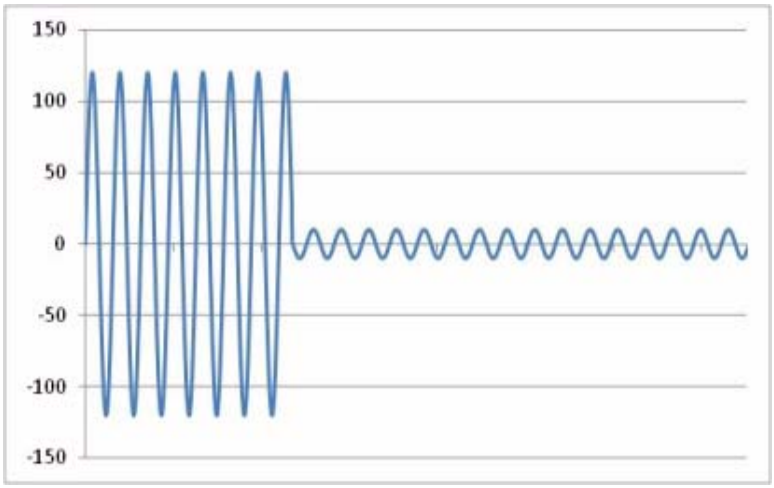


**Figure 7. LF waveform; before and after DEQEN enabled**

The resistor is switched ON until the next LFR off time. That is to say in following cases:

- An error/EOM is detected by the data decoding state machine.
- No SYNC pattern has been found and timeout has occurred.
- A LFEN disabled has been written to LFR registers.

If dequeuing activation occurs somewhere during effective data receive, the demodulation chain will not be able to follow the input amplitude variation and the frame might be lost.

If the input amplitude is much lower than the activation threshold, the dequeuing is not activated during the frame decoding. The frame will be received correctly.

If the input amplitude is much higher than the activation threshold, the dequeuing will be activated during the preamble. The frame will be received correctly.

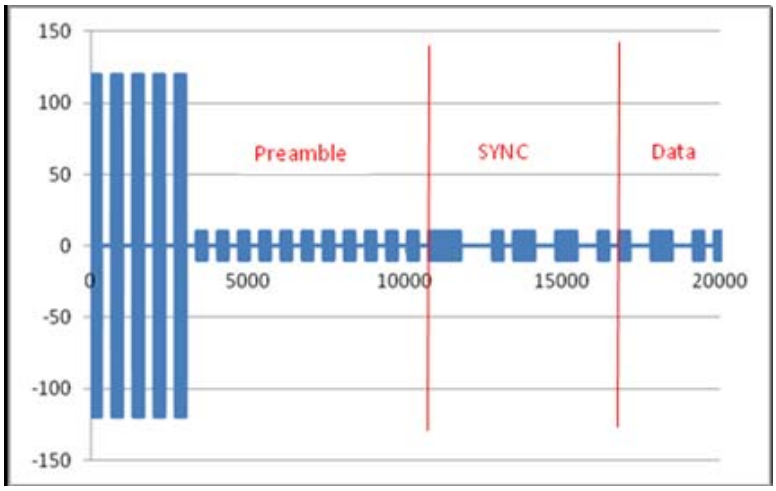


**Figure 8. LF frame; before and after DEQEN enabled**

If the input amplitude is slightly below the activation threshold, any noise or small amplitude increase will activate the dequeuing whatever the current position in the frame. When this occurs outside or at the end of the preamble, an error might be generated inside the decoder (during data frame) or the SYNC pattern could be not recognized. The LFR will be turned off and then restarts. The frame will be lost.

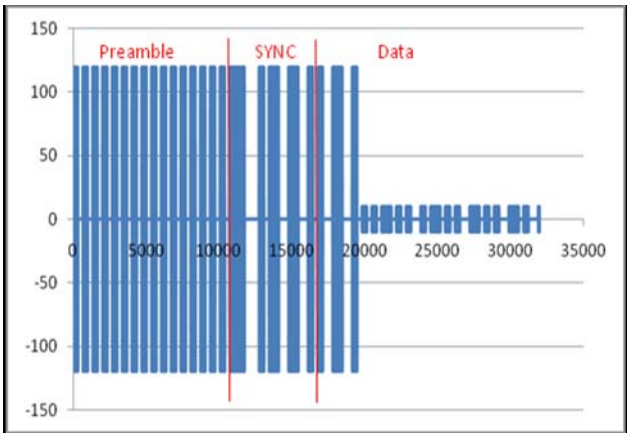


**Figure 9. LF frame; possible cause of error condition**

## 3.2 FSL recommendations

FSL recommendations to avoid losing frames around dequeuing activation threshold are:

- Use a long CW preamble in order to ensure that dequeuing function will be activated during preamble if needed and not during data frame.
- Use dequeuing function only in application with LF input levels much higher or really lower than 100 mVpp. If used in those conditions, frames cannot be lost due to the unexpected activation of the dequeuing function.
- Do not use dequeuing function if your application does not need more than 66 dB range, which correspond to an LF input signal maximum with 70% modulation depth around 1.2 Vpp.

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