Application Note

AS393x

Non-univocal Pattern Detection

Content Guide

1 General Description

The AS393X LF-Wake-up receiver Product Family has an embedded correlator that compares the received data stream to the stored data pattern and issues a wake-up interrupt on the pin WAKE in case of positive correlation.

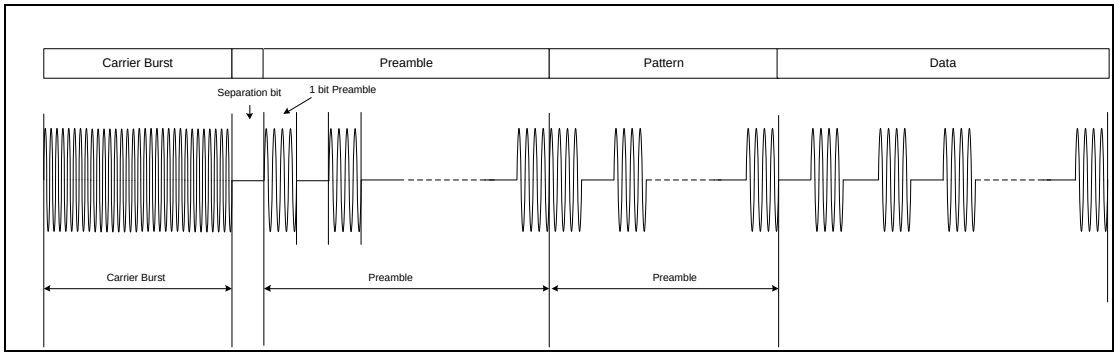
Due to the fact that the AS393X products cannot distinguish between the preamble and the pattern, multiple different received patterns can result in the AS393X issuing a wake-up interrupt even though the AS393X is programmed to detect just one wakeup pattern.

This document explains this issue and proposes a change in the protocol that solves this problem.

2 AS393X: Wake-up Protocol

The AS393X wake-up protocol consists of a carrier burst, a separation bit, a preamble and a wake-up pattern, as shown in Figure 1.

Figure 1: AS393X Wake-up Protocol



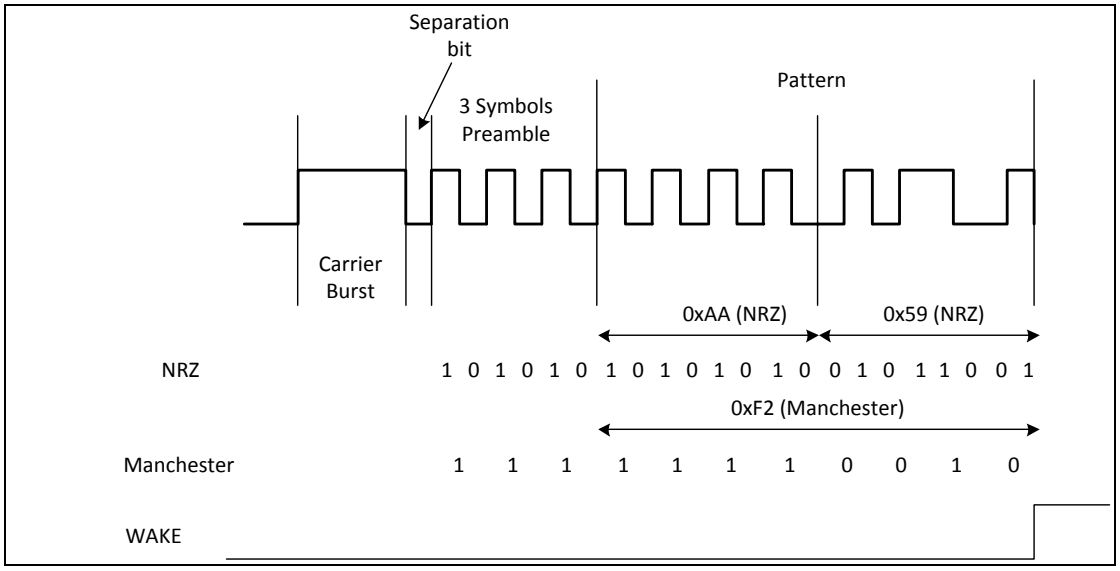
3 AS393X: Non-univocal Pattern Detection

As described in the introduction, in the Wake-up Protocol there is no separation between the preamble and the pattern; this means that the AS393X doesn't have any chance to distinguish between the preamble and the pattern. The consequence is that different wakeup patterns can trigger the AS393X to issue a wakeup interrupt despite it being programmed and intended to recognize just one wakeup pattern.

3.1 Example

Assuming that the transmitted pattern consists of a carrier burst, a separation bit, three symbols preamble and a (F2)hex Manchester pattern. If the AS393X pattern is programmed as (F2)hex Manchester (R5=0x59, R6=0xAA) the wakeup interrupt is set to high concurrently with the last bit of the received pattern, as shown in Figure 2.

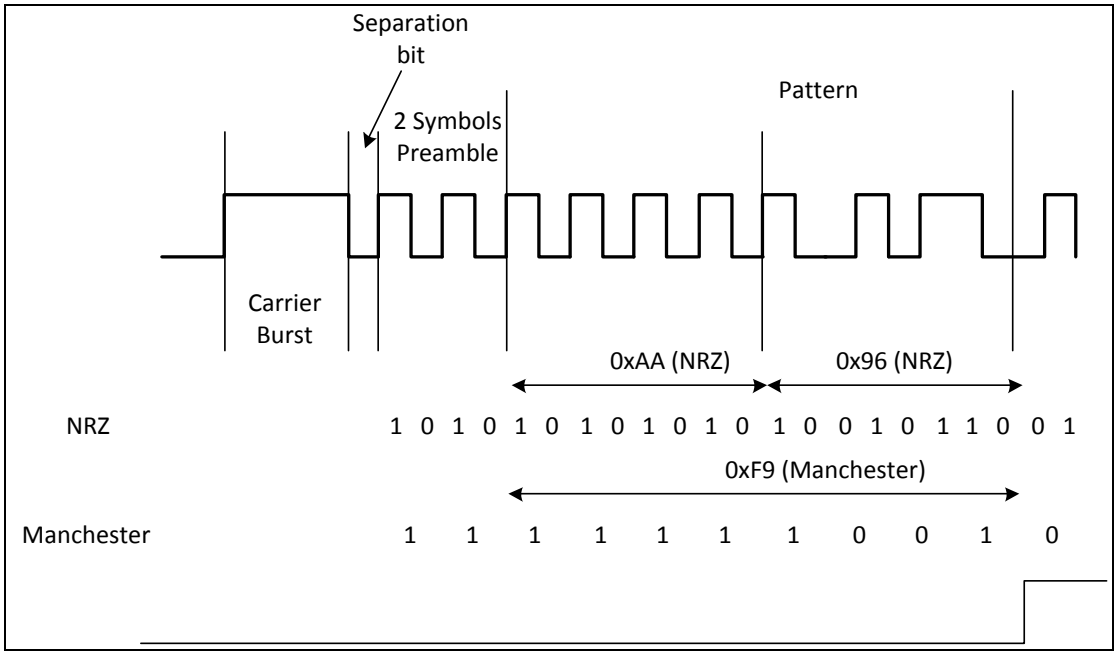
Figure 2: Wake-up with pattern 0xF2



In all figures a high signal represents the presence of the carrier (“1” NRZ), while a low signal represents a no-carrier (“0” NRZ).

It is possible to observe that the AS393X issues also a wake-up interrupt if the programmed pattern is 0xF9 (R6=0xAA, R5=0x96) in correspondence of the second last Manchester symbol, as shown in Figure 3. The reason can be explained with the fact that the AS393X cannot distinguish between the preamble and the pattern and, in this case, the last bit of the preamble is “swallowed” by the pattern.

Figure 3: Wake-up with pattern 0xF9

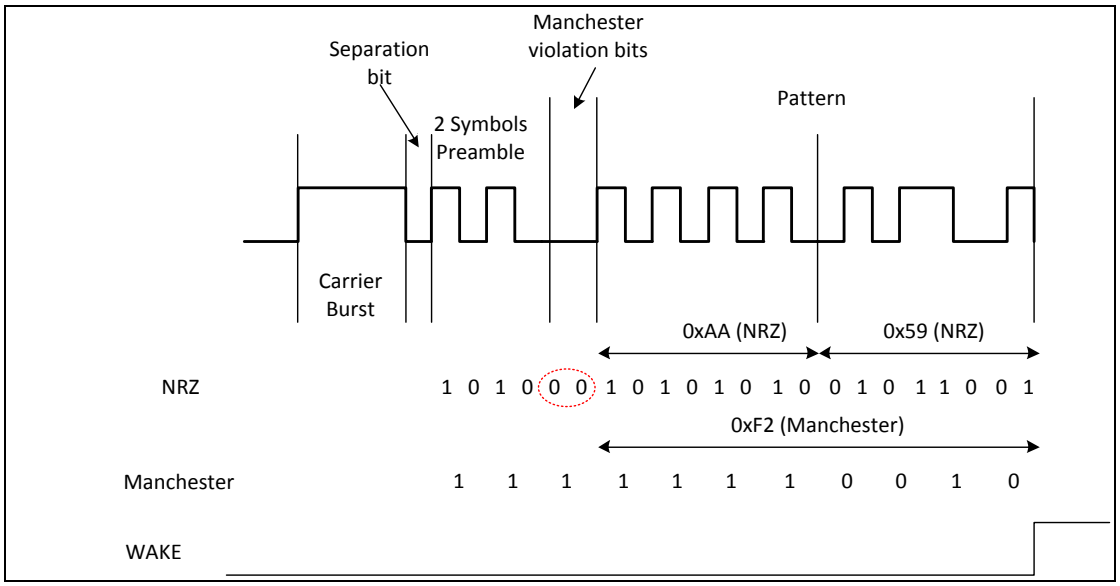


The same would happen if the AS393X is programmed with 0xFC (R6=0xAA, R5=0xA5); in this case the wake-up would be displayed on the third last bit.

4 AS393X: Proposed Solution

It is possible to solve this non-univocal pattern detection introducing a Manchester violation between the end of the preamble and the first bit of the pattern, as shown in Figure 4. A Manchester violation can consist of a sequence of two zero bits consecutively. Two zeros are not allowed in the Manchester encoding technique, therefore represent a Manchester violation.

Figure 4: Manchester violation in between preamble and pattern

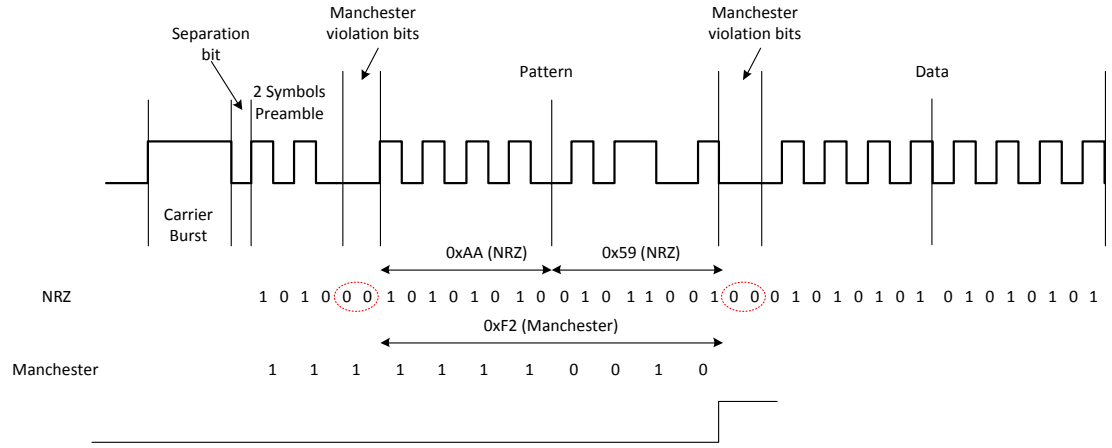


This violation can avoid that the bits right before the pattern are considered as part of the pattern. With this new transmitted pattern the AS393X will wake-up and issue an interrupt only and only if the programmed pattern is 0xF2 Manchester (R6=0xAA, R5=0x59).

5 AS393X: Separation between Pattern and Data

Since there is also no separation bit between the pattern and the data, the correlator might take one symbol from the data and valuate it as part of the pattern. The consequence is again that with the same transmitted wakeup pattern the AS393X can wake up with more than one stored wake-up pattern. The proposed solution is to introduce another Manchester violation bit between the pattern and the data as shown in Figure 5.

Figure 5: Manchester violations before and after the pattern



This violation can avoid that the bits left after the pattern (parts of the data) are considered as part of the pattern. With this new transmitted pattern the AS393X will wake up and issue an interrupt only and only if the programmed pattern is 0xF2 Manchester (R6=0xAA, R5=0x59).

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8 Revision Information

Changes from 1-00 (2012-Apr-12) to current revision 1-04 (2016-Nov-25)		Page
1-01	Update to ams corporate format (2014-Jan-16)	
1-02	Update to corporate format	1-7
1-03	Changed all AS3933 to AS393x	
1-04	Description changed	3

Note: Page numbers for the previous version may differ from page numbers in the current revision.
Correction of typographical errors is not explicitly mentioned.