TPMS

Tire Pressure Monitoring Sensor

SP37

Application Note

LF Duty Cycle Measurement

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1 Introduction

Apart from other timing parameters like baud rate the LF-telegram must comply with duty cycle requirements. For a periodic rectangular signal duty cycle is defined as ratio of high-time to signal period. However, the LF telegram is a non periodic, Manchester encoded binary signal. In fact both, the high time and low time, can be half the bit time or full bit time, depending on transmitted bit pattern (see curve A in Figure 1). Therefore for this kind of signal the duty cycle is changed by delaying all rising or all falling edges of the telegram by a constant delay time. As a result the relative change of the short high periods is greater than of the long high periods. Hence the duty cycle is defined as the ratio of the shortest high period and the bit time.

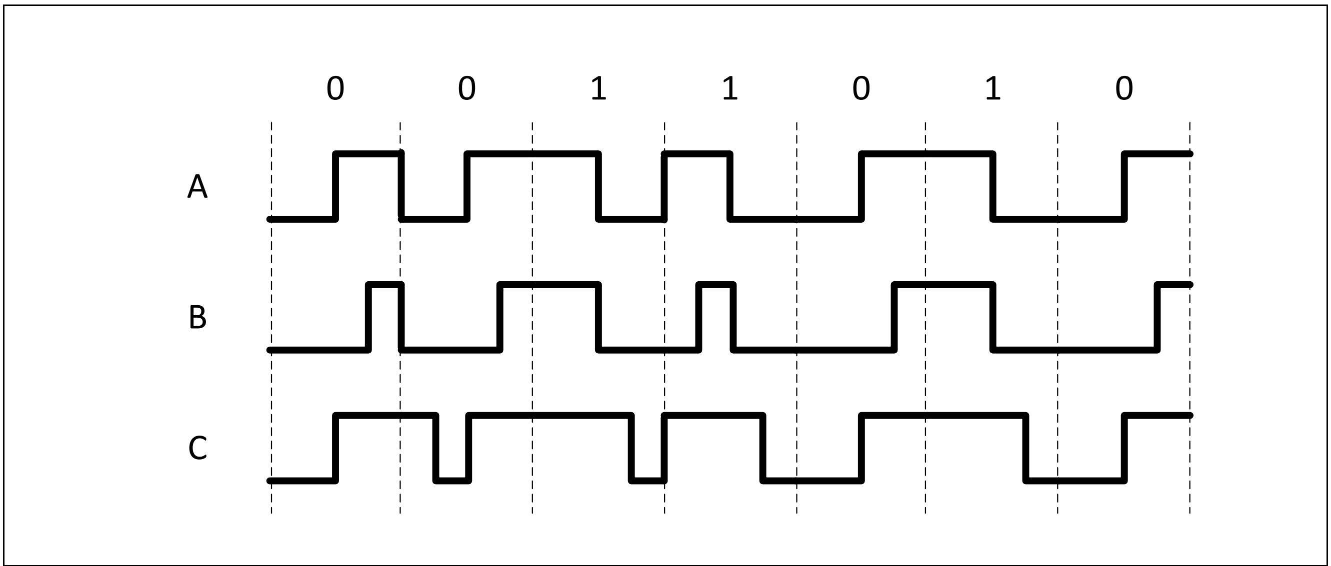

Figure 1 Manchester encoded signal. A: ideal signal, B: decreased duty cycle, C: increased duty cycle

Figure 1 illustrates the definition of duty cycle. Case A is the ideal signal. The shortest high period is half the bit time. Hence the duty cycle is 50%. For case B all rising edges have been delayed by one quarter of the bit time. So the shortest high period is one quarter of the bit time. Therefore the duty cycle is 25%. Finally, in case C all falling edges have been delayed by one quarter of the bit time. The shortest high period is three quarter of a bit time. Hence in case C duty cycle is 75%.

2 Measurement setup

In the test setup the telegrams were generated by PC software. A 125 kHz carrier was modulated with this digital signal using the Agilent 33250A function generator. Since the used software could only provide Manchester encoded telegrams with a 50% duty cycle, a circuit for delaying either the rising edges or the falling edges was built between PC and function generator. Figure 2 shows the measurement setup and Figure 3 the circuit for generating the edge delay.

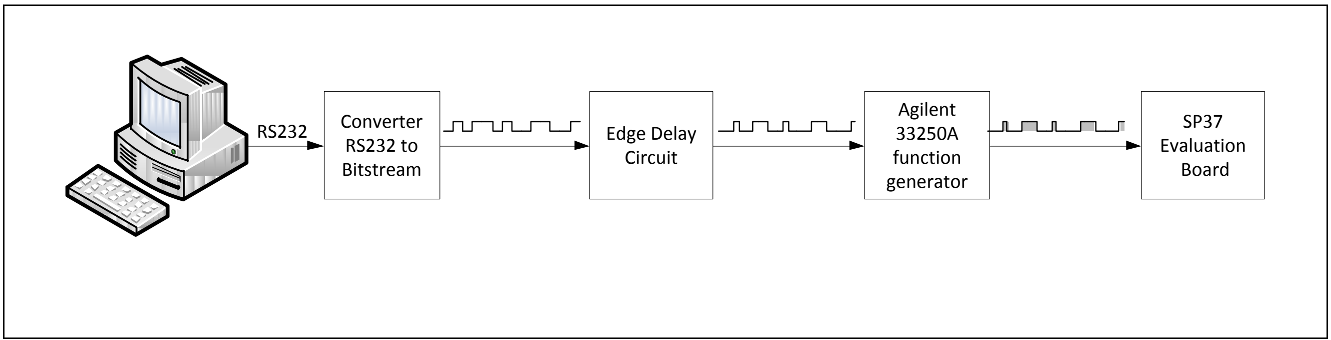

Figure 2 Measurement setup

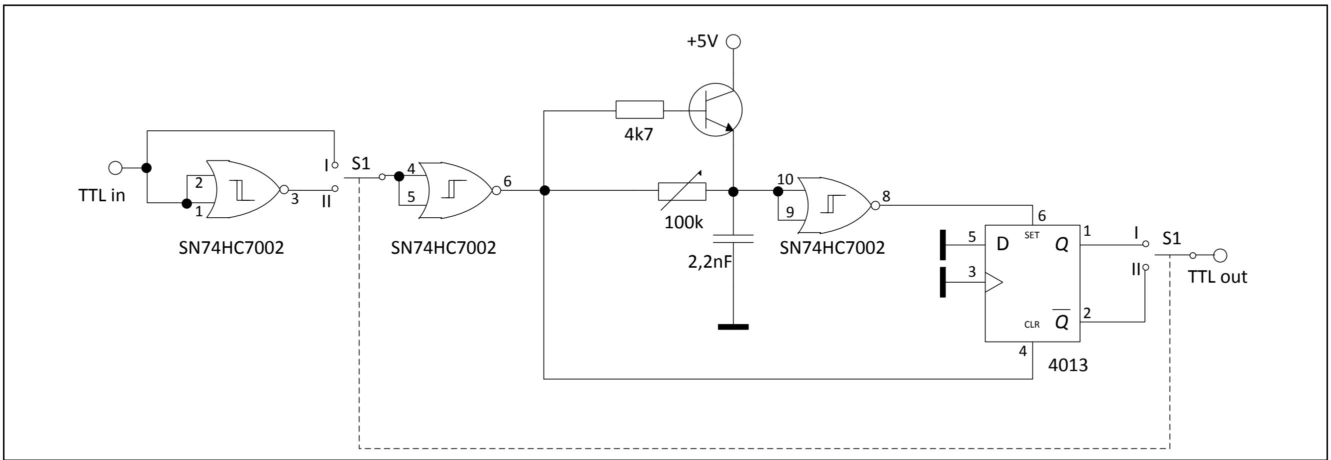

Figure 3 Circuit for generating edge delay. S1 in position I: falling edge delayed, S1 in position II: rising edge delayed.

3 Measurement results

The error rate versus duty cycle was determined by counting the number of detected matching events (matching of sync and P0 pattern) per time when periodically transmitting wakeup telegrams. The result is shown in Figure 4. For safe operation the duty cycle should stay in the interval of 40% to 60%. Anyhow, it is recommended to design the LF transmitter for a duty cycle of 50%.

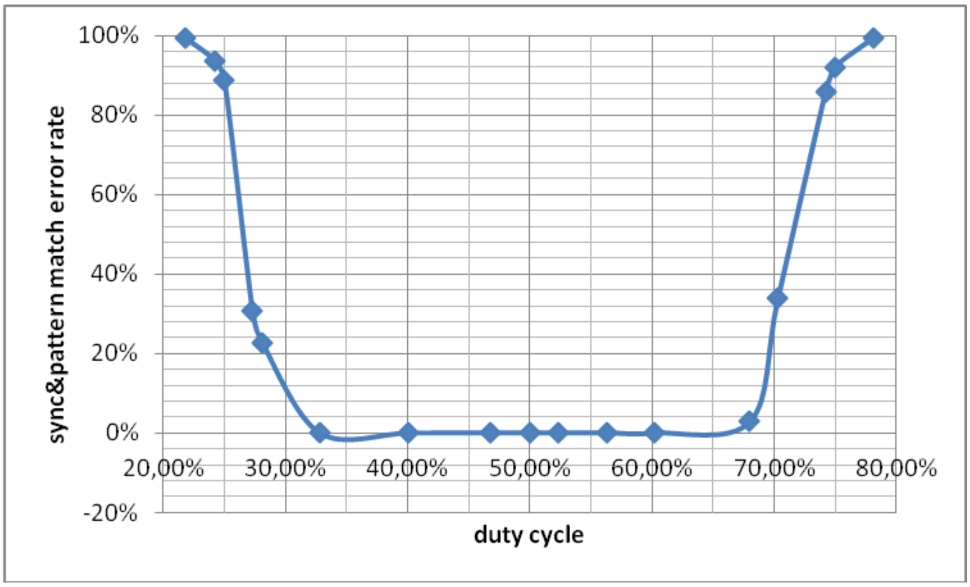

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Figure 4 Error rate versus duty cycle

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