Application Note 3:SL13A-SPI Temperature Measurement

SPI Temperature Measurement with SL13A

Table of Contents

Revision History

Revision	Date	Owner	Description
1.0	11.04.2013	bhi	Initial Document

1 General Information

The temperature reading with the SPI interface was originally designed as a test function during wafer sort. However it can also be used in an application if the following guidelines are followed. This document is valid for v2.0 silicon and for v2.2 silicon.

2 Test Frame & Command Byte

In order to read out the temperature, the test bit (B2) in the Command byte of the Test frame should be set. The length of the frame is 49 clock pulses (6 bytes + 1 execute pulse). The first byte in the Test frame is the Command byte. The second byte is the Address byte, which should be set to 0x00 when operating in the Test mode. The last 4 bytes are a 32-bit test number used in the test mode. The execute clock pulse activates selected test mode. The structure of the Command byte is shown in the table 2 below:

Table 1 - Test Frame

Command Byte	Address Byte	Test Mode Number Bytes
B7:B0	B7:B0	B31:B0

Table 2 – Structure of the Command byte

Bit Number	Description
B7	EEPROM Write
B6	EEPROM Read
B5	EEPROM Erase
B4	EEPROM Write Block
B3	EEPROM Erase Block
B2	Test
B1	RFU
B0	0: System EEPROM 1: User/Measurement EEPROM

3 Clearing the Test Mode

Note: Before sending a Test frame for test mode activation the test mode has to be cleared first, even if this is the first frame in the communication sequence. The test mode is cleared with the bit B0 of the 32-bit test mode number to high (see Figure below):

Figure 1 - Test Frame - Clearing the test mode by setting B0 to high (see arrow)

Trace 1 – CE

Trace 2 – Dout

Trace 3 – Din

Trace 4 – CLK

4 Setting the Test Mode for Temperature Readout

For the temperature readout the test mode #9 should be used. This mode is selected by setting bit B9 of the 32-bit test mode number to high (see Figure below):

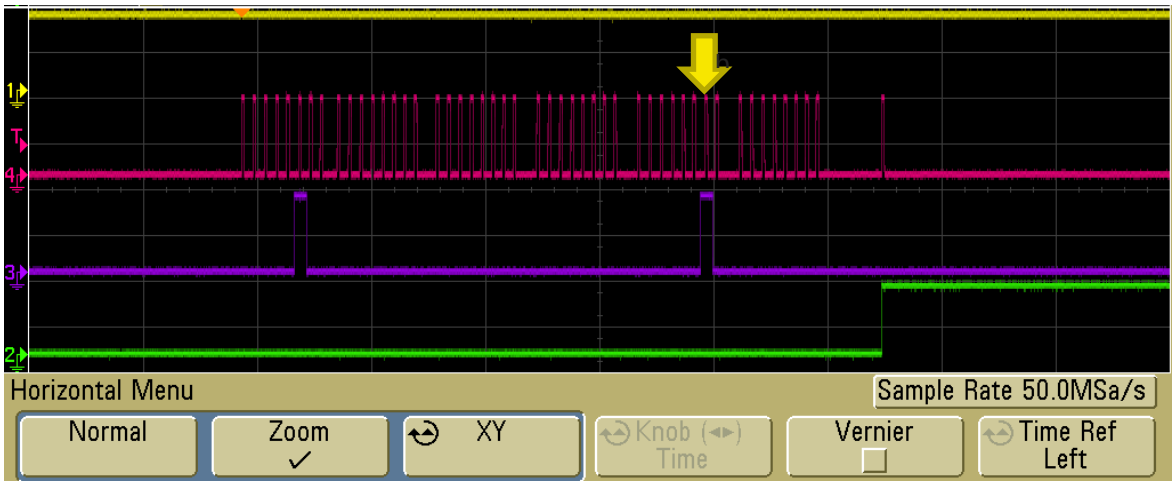

Figure 2 – Test Frame showing the temperature test mode activation with B9 (see arrow)

Trace 1 – CE

Trace 2 – Dout

Trace 3 – Din

Trace 4 – CLK

The temperature data output is automatic and serial. It starts approx. 3.5ms after the execute clock pulse, as shown in the figure below. The initial delay is a function of the supply voltage.

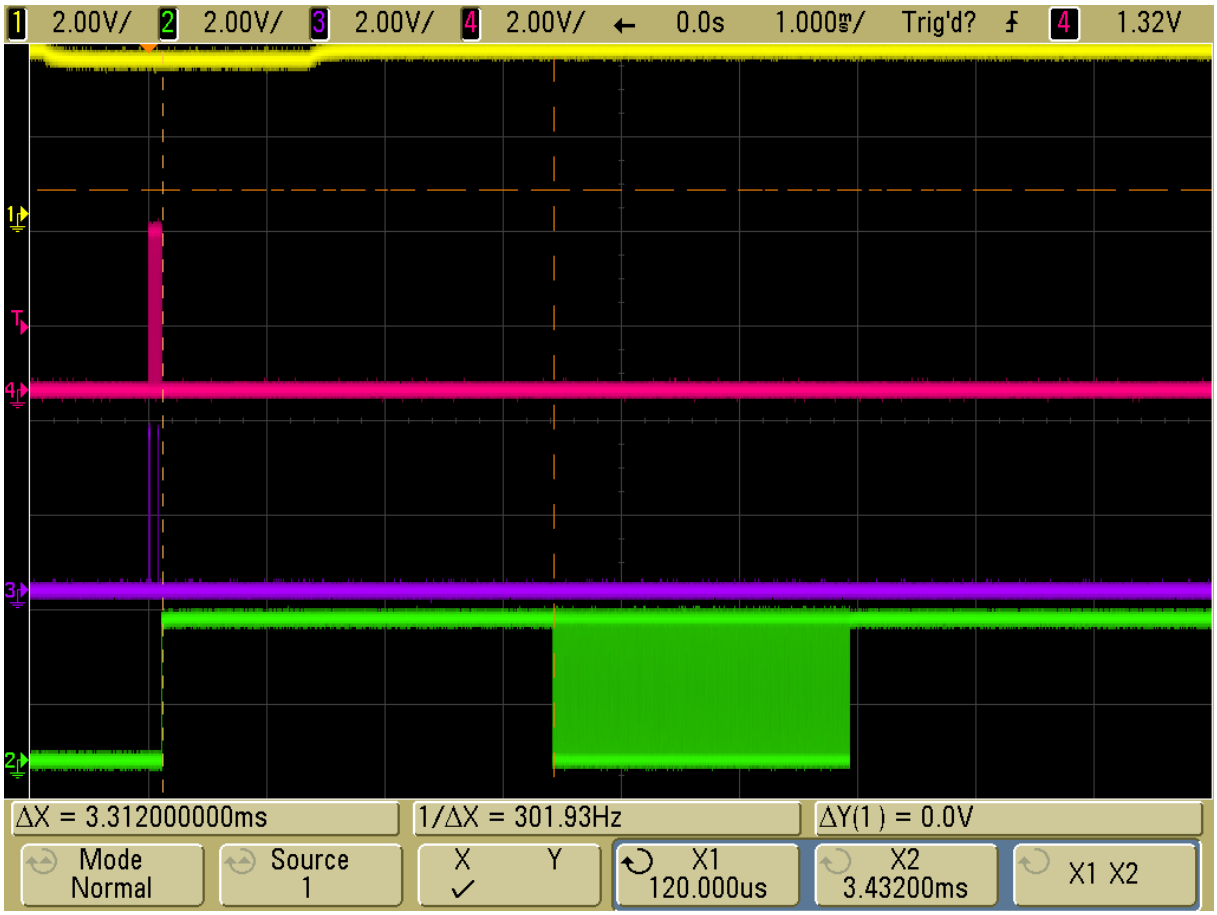

Figure 3 - Serial temperature value output

Trace 1 – CE

Trace 2 – Dout

Trace 3 – Din

Trace 4 – CLK

The number of clock pulses on the Dout pin is a function of the temperature. The minimum number of clock pulses is 512, the maximum is 1024. The frequency of the clock pulses is ~350 kHz as shown in the next Figure:

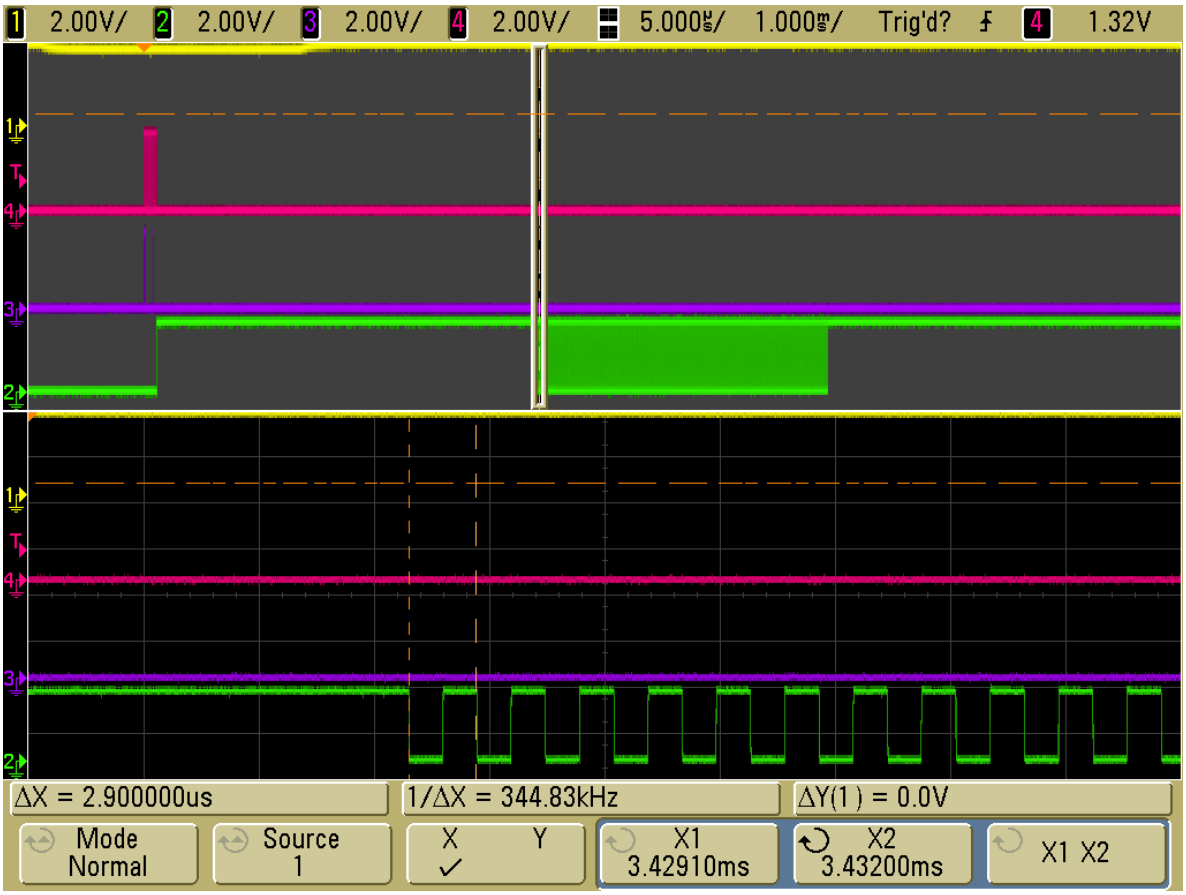

Figure 4 - Pulses on Dout

Trace 1 – CE

Trace 2 – Dout

Trace 3 – Din

Trace 4 – CLK

5 Temperature Calculation

The temperature is calculated as follows:

$$T[°C] = code * 0.169 - 90.5 - 5.4 + offset$$

while

$$code = (\#\ of\ pulses - 512) * 2$$

and

$$offset = 6\ bit\ value\ of\ the\ system\ EEPROM, address\ 0x05, bits\ 31 - 26$$

The offset is not automatically calculated by the chip operating in the test mode 9. Therefore this needs to be done by the MCU of the application

6 Proposed Procedure for SPI Temperature Readout

1. Set CE signal HIGH,
2. Read the bits 31-26 in the address 0x05 of the System EEPROM for offset calculation,
3. Clear the test mode – test mode #0,
4. Read the temperature – test mode #9.

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