Application Note

SL900A

SPI Interface

Content Guide

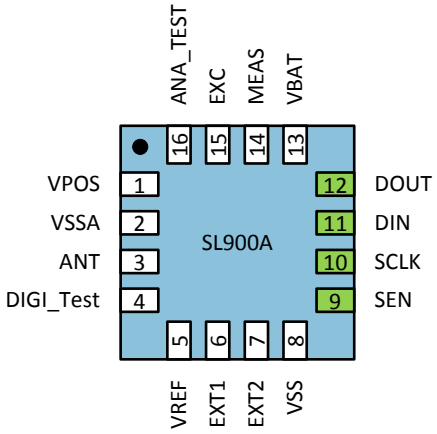
1 General Description

This document provides a detailed description of the SPI interface of the smart label device SL900A. For a complete description

The pins that are required for SPI communication are:

- SCLK: Serial clock signal, generated by the microcontroller,
- SEN: Slave enable signal, generated by the microcontroller,
- DIN: Data input signal, generated by the microcontroller,
- DOUT: Data output signal, generated by SL900A.

Figure 1: SL900A Pinout – SPI Interface Pins highligh



2 SPI Basic Information

The maximum serial clock (SCLK) frequency is 5MHz with a 3V supply and 1MHz with a 1.5V supply. The SPI communication is active when the serial enable (SEN) signal is HIGH. The data is shifted out on the rising edge of the SCLK signal and sampled on the falling edge of the SCLK signal.

Figure 2: SPI Signal Timing Diagram

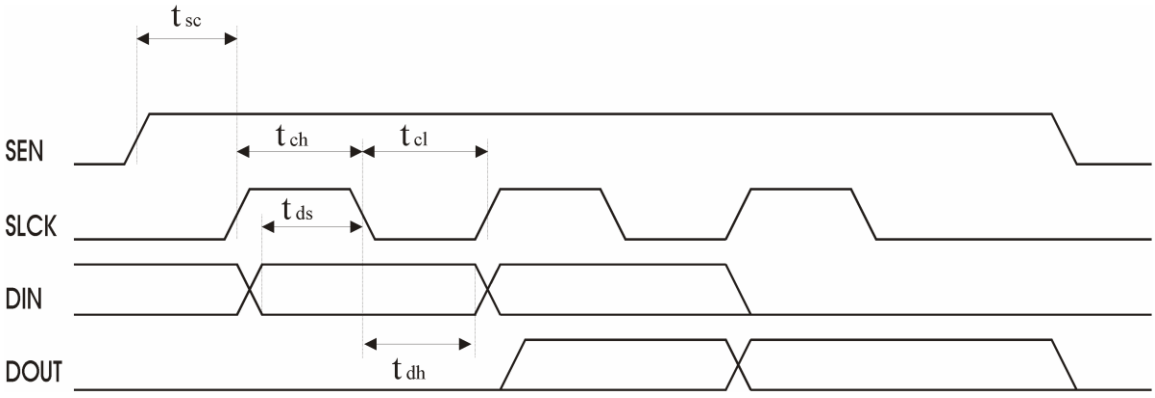


Figure 1: SPI timing for 3V supply voltage

Symbol	Min	Max	Description
t_{sc}	150µs	-	SEN to first SCLK rising edge setup time
t_{ch}	100ns	-	SCLK high period
t_{cl}	100ns	-	SCLK low period
t_{ds}	50ns	-	Data setup time
t_{dh}	50ns	-	Data hold time

Figure 2: SPI timing for 1.5V supply voltage

Symbol	Min	Max	Description
t_{sc}	150µs	-	SEN to first SCLK rising edge setup time
t_{ch}	500ns	-	SCLK high period
t_{cl}	500ns	-	SCLK low period
t_{ds}	50ns	-	Data setup time
t_{dh}	50ns	-	Data hold time

3 SPI Commands

All SPI commands are byte-oriented. The first 2 bits in the first byte define the type of the SPI command:

Figure 3: SPI Commands

Command Code	Command Type	Command Description
[0, 0]	Write Command	Writes data to the internal EEPROM. Single byte, or page write is possible.
[0, 1]	Read Command	Read data from the internal EEPROM. Continuous read is possible.
[1, 0]	RFU	Reserved for future use
[1, 1]	Direct Command	Sends a direct command to the device.

3.1 Write Command

The start of the write operation occurs with the rising edge of the DIN signal and is carried out after 8 data bits are sent to the SL900A. The write operation duration is approximately 7.2ms and depends on the frequency of the internal oscillator. The SPI interface ignores all new commands for the entire duration of the write operation.

Figure 4: SPI Write Operation

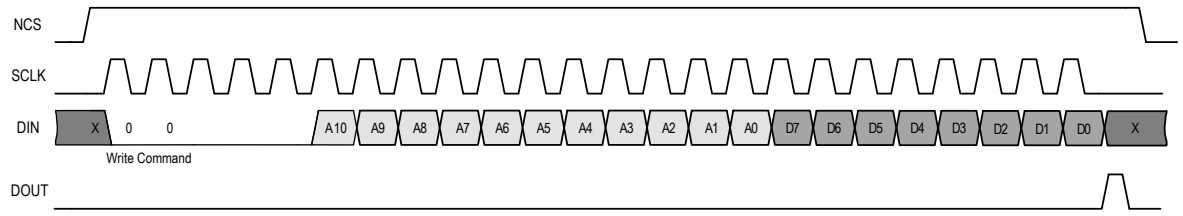


Figure 5: SPI Write Operation - Single Byte

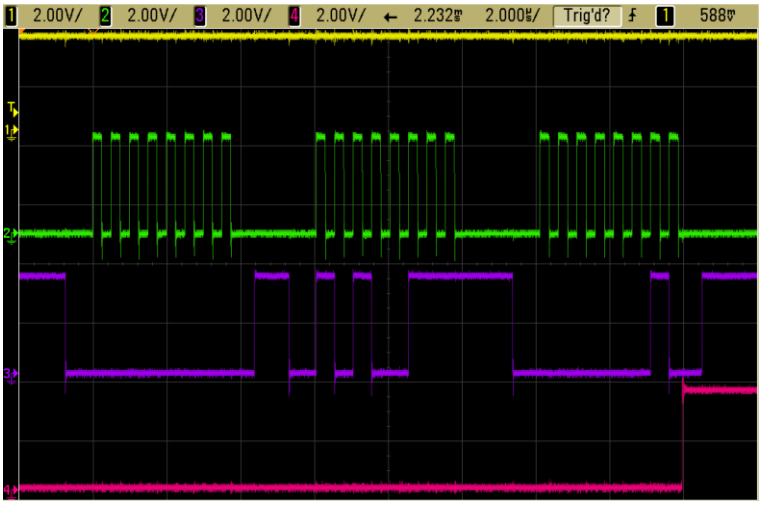


Figure 6: SPI Write Command - Page Mode

Trace 1 (yellow): SEN

Trace 2 (green): SCLK

Trace 3 (purple): DIN

Trace 4 (magenta): DOUT

In page write mode it is possible to write a maximum of 16 bytes in a single write operation and at least 2 bytes which takes approximately 7.2ms. The write operation is started immediately after the SEN signal falls to low, or after the internal address pointer hits the page boundary.

3.2 Read Command

Figure 7: Read Operation

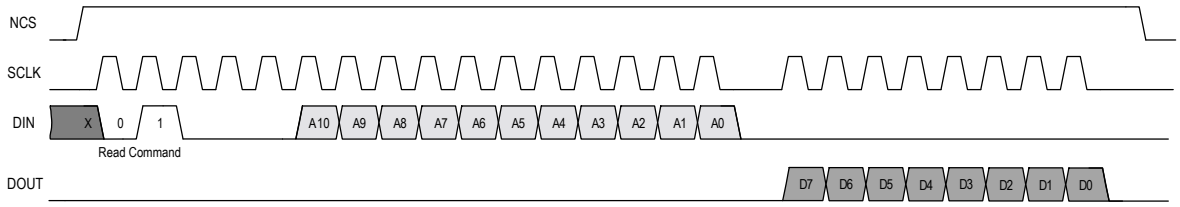


Figure 8: SPI Read Command (Command Type and Adress Part)

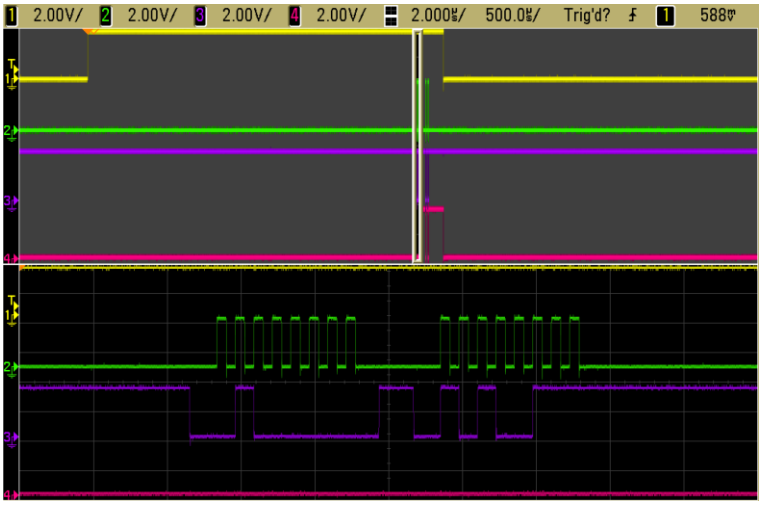
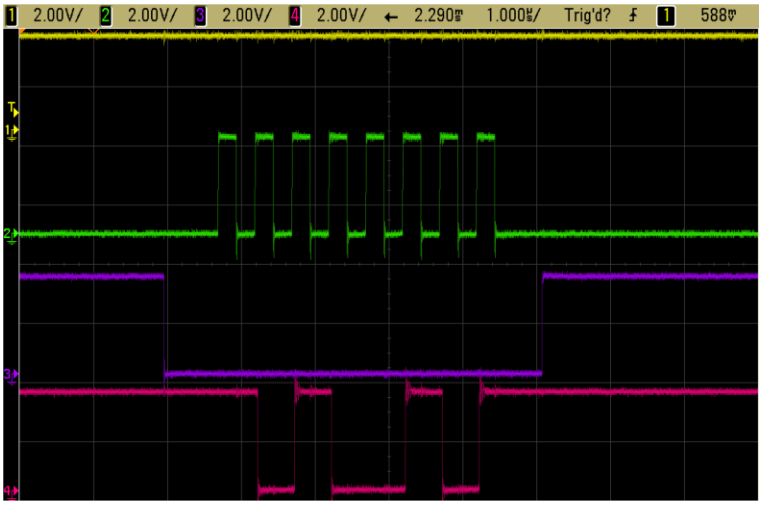


Figure 9: SPI Read Command (Data Part)



Trace 1 (yellow): SEN
Trace 2 (green): SCLK
Trace 3 (purple): DIN
Trace 4 (magenta): DOUT

The read operation is started immediately after the read command is written in. The SL900A signalizes that the data from the EEPROM is ready with the rising edge of the DOUT signal. After the rising edge of the DOUT signal, the microcontroller can read out the data. The SEN signal should be high for the entire duration of the read operation. The falling edge of the SEN signal terminates the read operation. Data can be read out in continuous mode as the address used is the starting address and is incremented automatically after each 8 SCLK periods.

3.3 Direct Command

Figure 10: Direct Command - Get External Sensor X, Read FIFO, Read Shelf Life

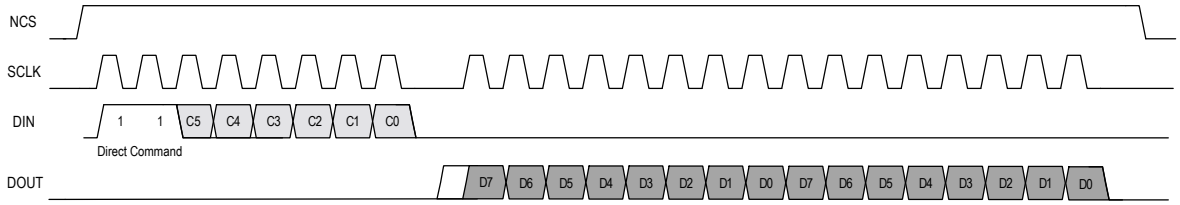


Figure 11: Direct Command - Write FIFO

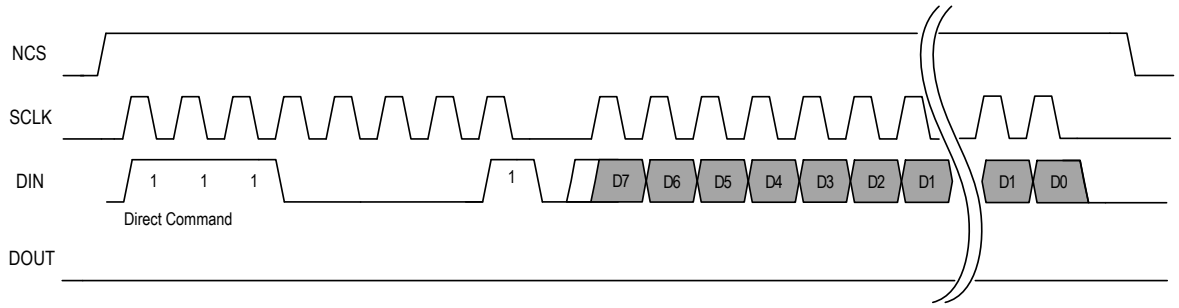
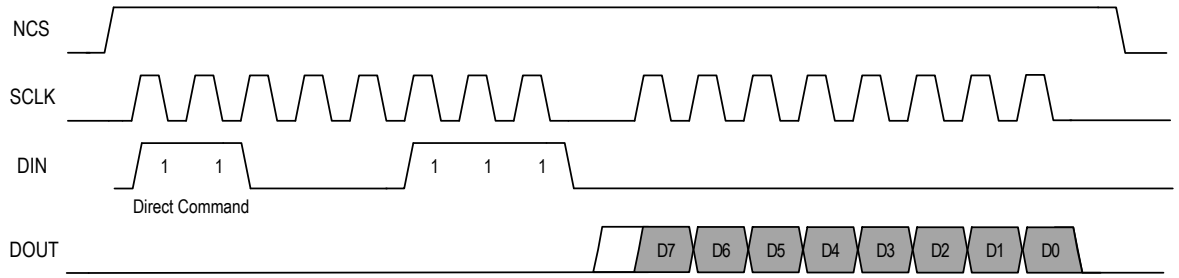


Figure 12: Direct Command - Read FIFO Status



3.3.1 Direct Command Codes

Figure 13: SPI Direct Commands

Command Code 0b11C_5-C_0	Command	Description
0b11**00 0000**	Reset	All calibration registers are refreshed from the EEPROM. Same function as POR.
0b11**00 0001**	Get Temperature	After the DOUT signal goes high 16 additional clock pulses should be sent to read out temperature data.
0b11**00 0010**	Get Battery Level	After the DOUT signal goes high 16 additional clock pulses should be sent to read out battery level data.
0b11**00 0011**	Get External Sensor 1	After the DOUT signal goes high 16 additional clock pulses should be sent to read out the sensor 1 data.
0b11**00 0100**	Get External Sensor 2	After the DOUT signal goes high 16 additional clock pulses should be sent to read out the sensor 2 data.
0b11**00 0101**	Start Log	Starts the timer or IRQ mode – first the start time needs to be written using the SPI Write mode.
0b11**00 0110**	End Log	Stops the timer or IRQ
0b11**00 0111**	Read FIFO Status	Returns the FIFO status (8-bit)
0b11**00 1000**	Read Shelf Life	Returns the remaining shelf life (24-bit)
0b11**10 0000**	Read FIFO	Reads up to 8 bytes from the FIFO
0b11**10 0001**	Write FIFO	Writes up to 8 bytes to the FIFO

Figure 14: Direct Command Example: Get Temperature (Command Part)

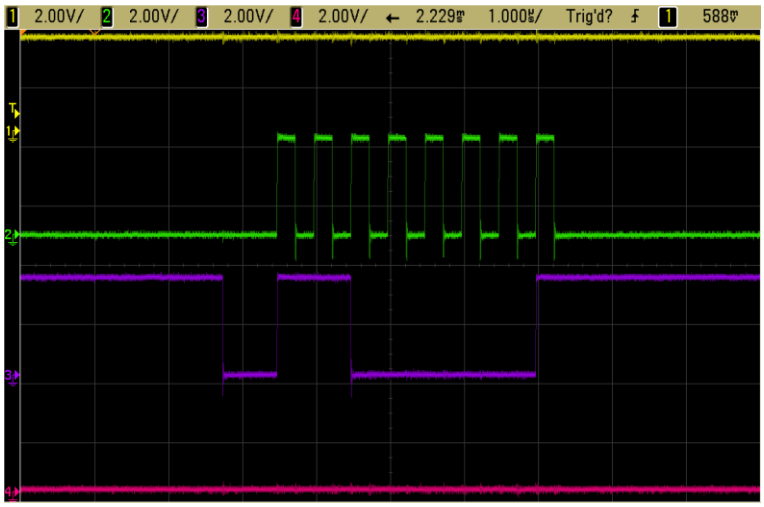


Figure 15: Direct Command Example: Get Temperature (Data read-out)

Trace 1 (yellow): SEN
Trace 2 (green): SCLK
Trace 3 (purple): DIN
Trace 4 (magenta): DOUT

The direct command is initialized immediately after the 8-bit command code is shifted in. The above figures show a Get Temperature direct command. This operation starts the AD conversion on the integrated temperature sensor. The end of conversion is signalized with the rising edge on DIN signal. The 16-bit data can be read out after the rising edge of the DOUT signal. The SEN signal has to be high for the complete duration of the direct command.

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6 Revision Information

Changes from 1-00 (2013-Apr-19) to current revision 1-01 (2014-Jul-22)	Page
Update to corporate format	1-11

Note: Page numbers for the previous version may differ from page numbers in the current revision.