novotechnik
Siedle Gruppe

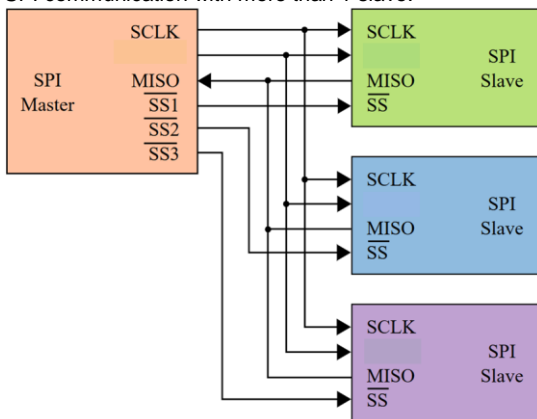# Content

1. SPI Protocol

This document reflects the Novotechnik sensor protocol implementation of the standard SPI protocol.
A basic knowledge of the SPI Bus is required for a proper understanding of this document.

1.1 Bus Topology

SPI communication with only 1 slave:
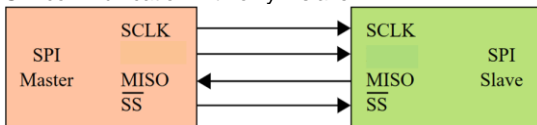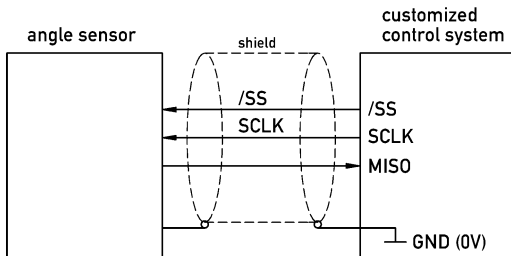

SPI communication with more than 1 slave:

1.2 Electrical Characteristics

The serial protocol of Novotechnik Multi turn sensors is a three wires protocol (/SS, SCLK, MISO).
The rotary sensor is considered as a slave mode:
- /SS pin is a 3.3 V (5V tolerant) digital input
- SCLK pin is a 3.3 V (5V tolerant) digital input
- MISO pin is a 5V digital output

1.3 SPI Mode

Clock phase   CPHA = 1   even clock changes are used to sample the data
Clock polarity   CPOL = 0   active high clock
The positive going edge shifts a bit to the slave´s output stage and the negative going edge samples the bit at the master´s input stage.

1.4 MISO (Master In, Slave Out)

The MISO of the slave is a tri state output.

1.5 /SS Slave Select

The /SS pin enables a frame transfer (if CPHA = 1). It allows a re-synchronisation between slave and master in case of communication error.

1.6 Master Start-up

/SS, SCLK, MISO can be undefined during the master start-up as long as the slave is re-synchronized before the first frame transfer.

1.7 Slave Start-up

The slave start-up (after power-up or an internal failure) takes 15 ms. Within this time /SS and SCLK is ignored by the slave. The first frame can therefore be sent after 15 ms.
MISO is high-impedant until the slave is selected by its /SS input.

1.8 Timing

To synchronize communication, the master deactivates /SS high for at least 1 μs.
In this case, the slave will be ready to receive a new frame.

The master can re-synchronize at any time, even in the middle of a byte transfer.

1.9 Slave Reset

In case of internal failures the slave shows 0 for all bits.
Power off / on is necessary for a slave reset.

1.10 Data Frame Structure

A data frame consists of 2 data bytes (Data 16 – most significant byte first).

1.11 Data Structure

Data 16: Angle A [15:0] with (Angle Span) $/2^{16}$

Most Significant Byte								Less Significant Byte							
MSB							LSB	MSB							LSB
A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0

Data 16: Error

In case of internal failures the slave shows 0 for all bits

Most Significant Byte								Less Significant Byte							
MSB							LSB	MSB							LSB
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1.12 Angle Calculation

All communication timing is independent (asynchronous) of the angle data processing.
The angle is calculated continuously by the slave every 1 ms.
The last angle calculated is hold to be read by the master at any time.

1.13 Document Changes

Revision	Changes	Date	Who
V_00	First edition	23.04.19	VM/mm