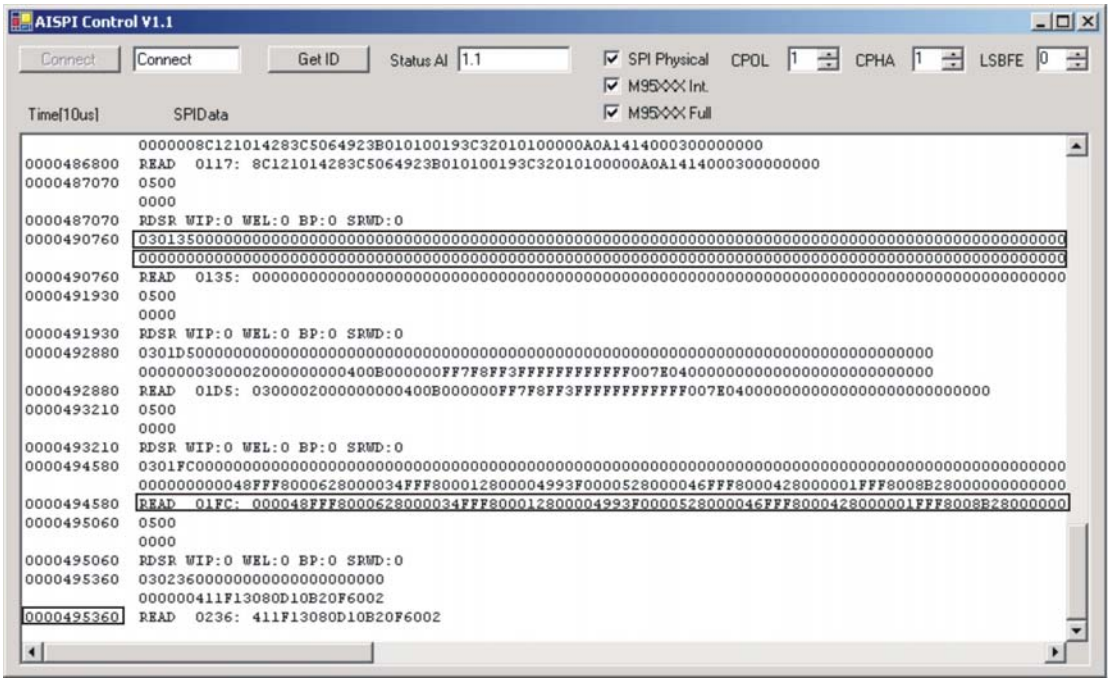
SPIControl

AI3 Application

SPI Communication Monitor & Analyzer



Date: 08.10.2004
Version: 1.2
Filename: AI SPI Documentation (eng).doc

Author: C. Jungkind

KOPF GmbH
Kapbachstraße 6
76829 Landau
Tel.: 06341/91767-0
Mail: info@kopfweb.de

Change History

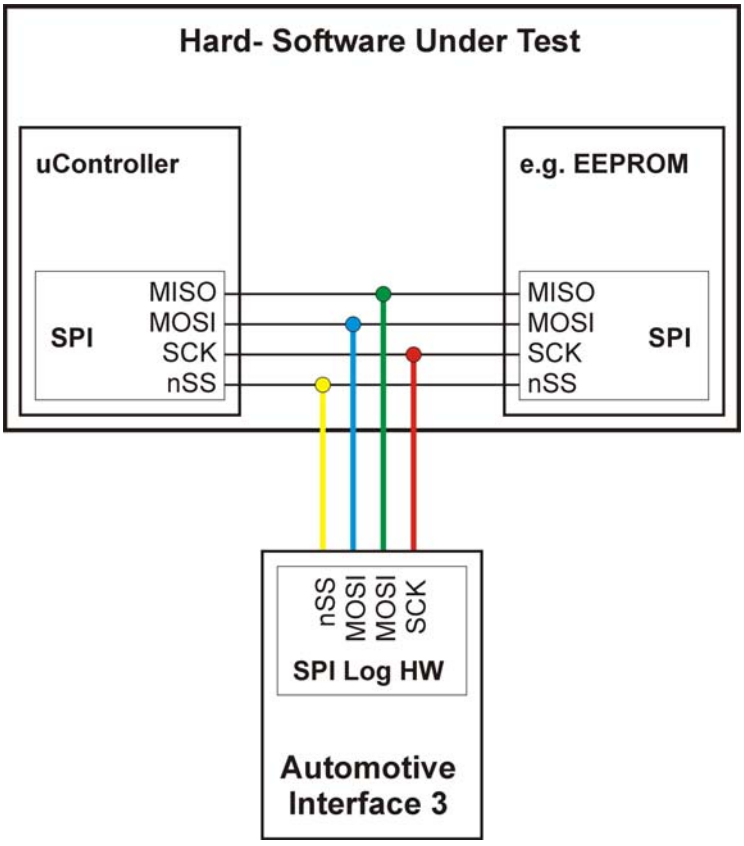
Version	Datum	Bearbeiter	Änderungen
1.0	12.01.04	C.J.	First draft
1.1	09.02.04	M.S.	M95XXX Interpreter add-on
	11.02.04	A.K.	Formatting
1.11	11.05.04	M.S.	Fast-Startup add-on
1.2	08.10.04	C.J.	Translation to English

Table of Contents

1 Functional Overview

Regarding the application „SPIControl“, the Automotive Interface 3 (AI3) is used as two-channel SPI-Slave. Therefore it can be used to trace bi-directional 8/16-bit communication[1] between any SPI master and slave device.
A 16-bit timestamp (resolution: 10us) is added to each monitored SPI-Frame and this data package is transferred in real-time over USB to PC. On the PC, the data package is displayed and written to a logfile.

Example of use



MISO: Master In Slave Out
MOSI: Master Out Slave In
SCK: Serial Clock
/SS: Slave Select

LED1: SPI Overflow
LED2: General function indicator(0.5 Hz frequency), additionally toggled in case of USB communication

Logfiles: Program directory, extension: .log (Ascii-format)

[1] By uC-Hardware, only 8-bit SPI communication is supported.

2 Setup

The following items shortly describe how to set-up the AI3 for the application „SPIControl“. Each step will be described in the following chapters in detail.

- Connect the AI3 to your PC USB-Interface
- Install the FTDI USB driver
- If necessary, install the .NET-Framework
- Install AISPI Control Application
- Connect the measuring lines to your SPI-devices to be monitored
- Start the AISPI Control Application
- Press „Connect“ button
- Choose monitor-mode (physical and/or interpreted)
- Choose SPI communication parameters (CPOL, ...)

3 Technical data Automotive Interface 3

Supply Voltage	Powered by USB
CAN-Interface	2x TJA1050 (82C251), 1x TJA1054
LIN-Interface	1x TJA1020 (no internal pullup)
RS232-Interface	1x HIN202 (PC, SPS)
USB-Interface	1x FTDI245
Dimensions (WxDxH)	60x122x36 mm
Weight	0,2 kg
Temperature range	-40°C – 85 °C (0°C-50°C USB)
Microcontroller	MC9S12DP256/25 MHz
Memory	256 kB Flash-EPROM (firmware update by PC possible) 12 kB RAM

4 SPI data rate limitations

In order to monitor an unlimited amount of SPI data, the data has to be transferred from AI3 to PC in real-time. Therefore, the max. SPI data rate is limited by USB 1.1 data rate, which is strongly dependent on PC processor load.
The max. data rate of the HCS12-SPI-Ports, which is 12,5 Mbit/s, can therefore not be utilized completely.
Taking into account the protocol overhead when transferring data between AI3 and PC, the following data rates can be achieved:

- when transferring only 1 Byte in each SPI-Frame[2], the max. SPI data rate is 1 Mbit/s
- when transferring several bytes each SPI-Frame (>25), the max. SPI data rate can be up to 8 Mbit/s

Lost data bytes (data bytes, that are transferred from SPI master to slave device, but which are not monitored by AI3) caused by receive buffer overflow in the AI3 are signalised by LED1.

5 SPIControl parameter description

5.1 Interpreter options

SPI Physical: all monitored SPI data is shown in raw format (hex-values)
M95XXX Int.: Interpreter output of the SPI-commands of M95XXX EEPROMs
M95XXX Full: Output of all M95XXX commands or of read/write-commands only

5.2 SPI parameter CPOL – clock polarity

The clock polarity of the AI3 SPI interface can be controlled by SPIControl PC Application. This parameter has to be chosen according to the setting in the slave and master device under test.
CPOL = 0: clock signal is normal low, clock pulses are high
CPOL = 1: inverse

5.3 SPI parameter CPHA – clock phase

The clock phase of the AI3 SPI interface can be controlled by SPIControl PC Application. This parameter has to be chosen according to the setting in the slave and master device under test.
CPHA = 0: valid data is sampled with the rear clock edge
CPHA = 1: valid data is sampled with the front clock edge

5.4 SPI parameter LSBFE – bit order

The bit order of the AI3 SPI interface can be controlled by SPIControl PC Application. This parameter has to be chosen according to the setting in the slave and master device under test.
LSBFE = 0: MSB first
LSBFE = 1: LSB first

[2] A data frame is characterized by /SS=0

6 Software installation and AI3 firmware update

6.1 System requirements

Operating system:	Win98, Win2000 or XP, .NET-Framework has to be installed
Hard disk space:	30 MB (without framework)

6.2 Installation of USB driver

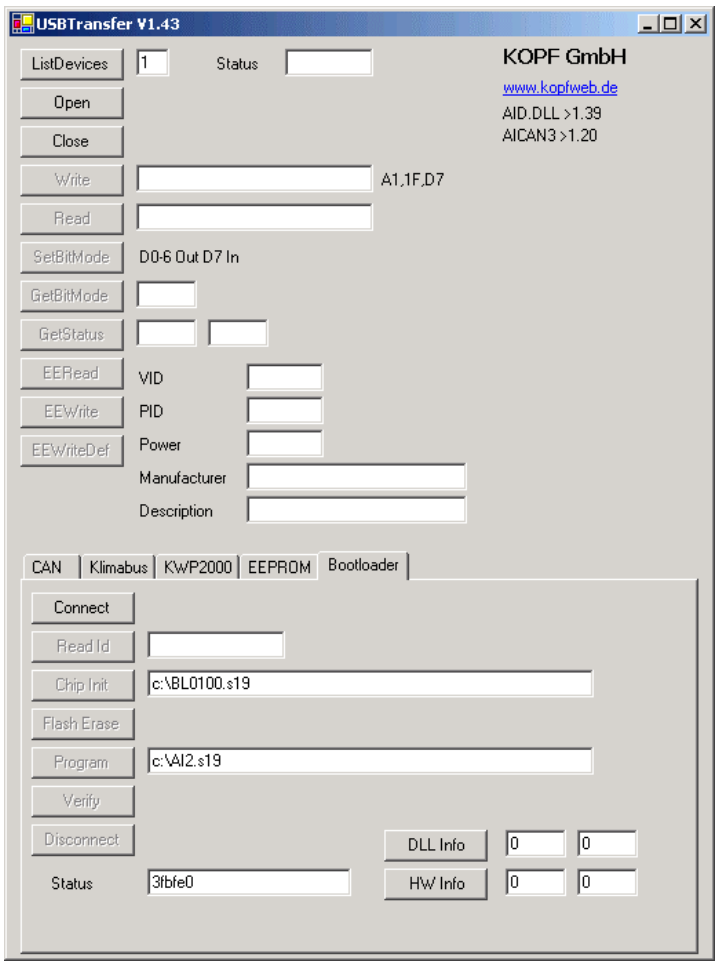
- Connect AI3 to a free PC USB-port
- Insert driver disk and install USB driver from directory *USBDriver*

6.3 Installation of AISPI Control

- Insert driver disk and run *Setup.exe* in directory *AISPI Control V1.0*

6.4 Firmware update

By running a flash bootloader on the AI3, the application firmware can be updated over USB. To update the AI3 firmware, the PC Application *USBTransfer* is required:



Firmware-Update procedure:

1. Install *USBTransfer*: insert driver disk and run *Setup.exe* in directory *USBTransfer V1.xx*
2. Connect AI3 to PC, potentially disconnect all BDM-debuggers
3. Close any running AI3 Application
4. Run *USBTransfer*
5. Press button *ListDevices*: adjacent window needs to show 1 (if 0 is shown, the USB driver is possibly not properly installed)
6. Select tab *Bootloader*
7. Press button *Connect*: LED1 starts to flash on high frequency
8. Press button *Read ID*
9. By doubleclicking the text box right of button *Chip Init*, a file open dialogue is displayed: select the file *BL0100.s19* which is provided on the driver disk
10. Press button *Chip Init*
11. Press button *Flash Erase*, wait 10s before proceeding
12. By doubleclicking the text box right of button *Program*, a file open dialogue is displayed: select the file *AI.s19* file containing the firmware to be programmed
13. Press button *Program*
14. Press button *Verify*: *No Error* needs to be displayed
15. Press button *Disconnect*

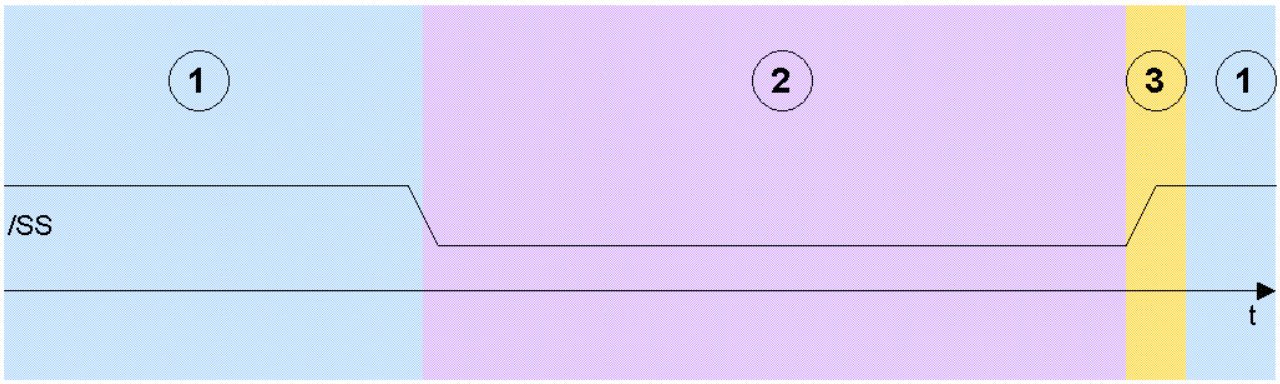
7 Detailled application description

7.1 Hardware setup

The AI3 needs to be connected to the SPI-system of interest in the same way as shown in picture “Example of use” in chapter 1. The AI3 inputs MOSI1 and MOSI2 can be assigned to the wires between master and slave arbitrarily. A wiring proposal is shown in the appendix.
It is necessary to know that only 8/16-bit SPI transfers can be monitored.

7.2 AI-Firmware

After connecting the AI3 to the PC over USB, the firmware is blocking until the button *Connect* is pressed.
After connecting to the PC, the firmware behaviour is dependent on the /SS-timing:



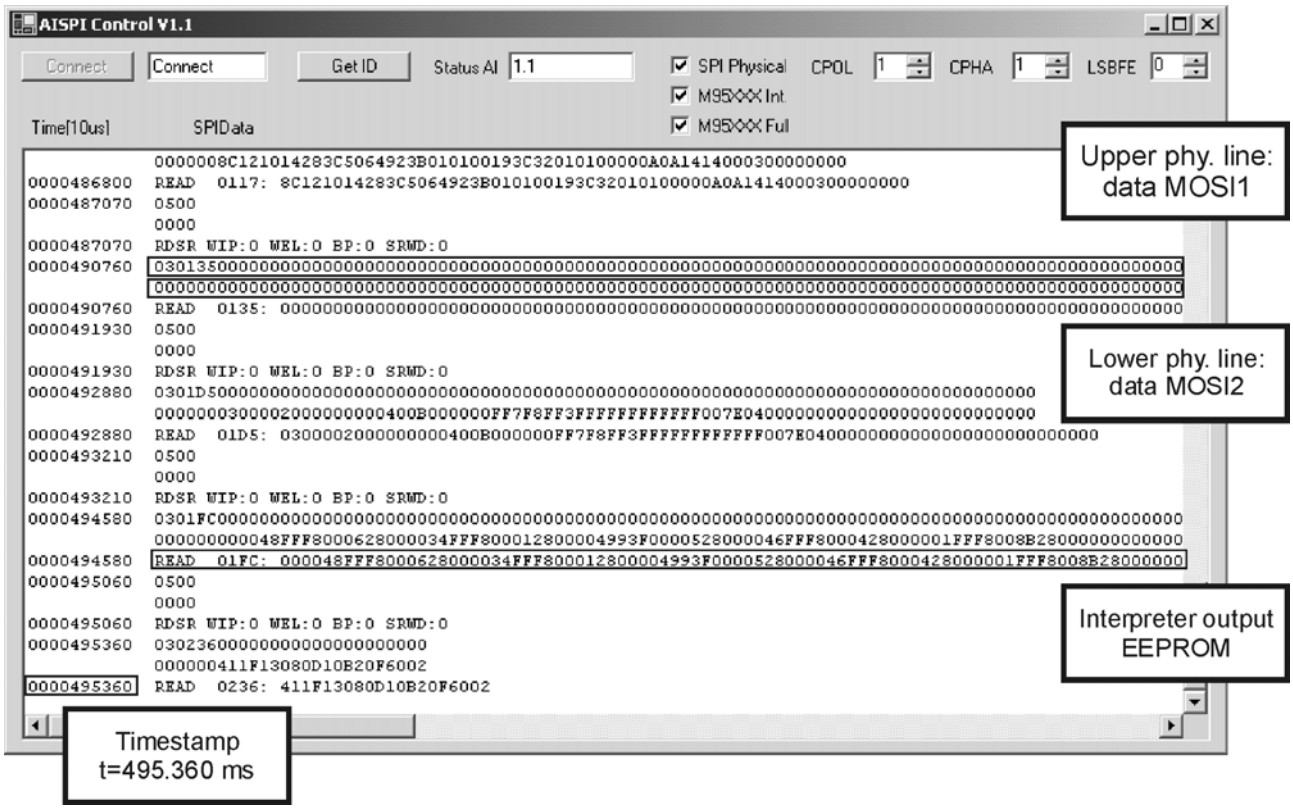
Stage 1) The firmware is waiting for /SS falling edge.
Stage 2) The data on MOSI1 (SPI1) and MOSI2 (SPI2) is monitored and sent sequentially to the PC. The data is not yet displayed on the PC; the data is displayed when receiving the timestamp-information which is generated with /SS rising edge.
Stage 3) With /SS rising edge, a timestamp is generated on the AI3 and transferred to the PC. On the PC, the data stored in stage 2 is displayed together with the timestamp information. A timestamp rollover happens every 650ms.

7.3 PC-Software AISPI Control

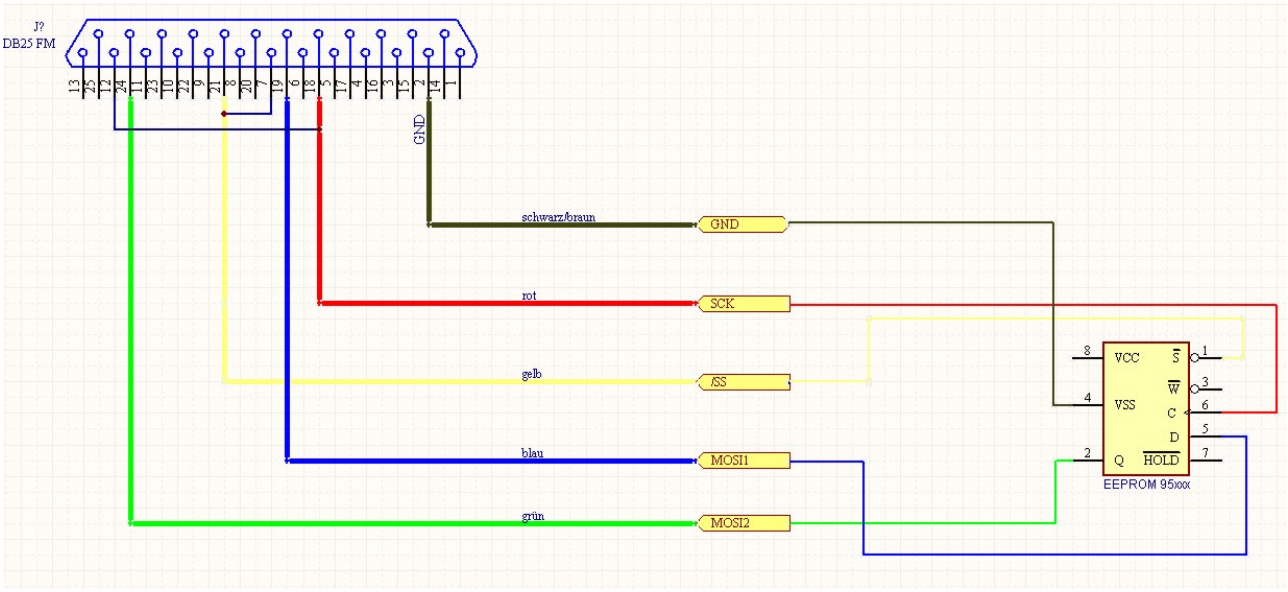
The PC application *AISPI Control* includes the following functionality:

- By pressing button *Connect*, the *AI3*-firmware is enabled. The SPI monitoring starts, the SPI data is displayed in the AISPI Control main window. Additionally, the logfiles are created by default in the application directory (attention: the old logfile is always overwritten).
- After connecting to the AI3, the setting of the SPI interface can be controlled by the boxes CPOL, CPHA and LSBFE. The last setting is stored inside the AI3 and automatically reloaded.

The picture below shows AISPI Control running:



8 Appendix


J?
DB25 FM
GND
schwarz/braun
GND
rot
SCK
gelb
/SS
blau
MOSI1
grün
MOSI2
VCC
VSS
Q
HOLD
EEPROM 95xxx