Serial Bus Simulator

Data Stream Generator for Serial Bus Protocols

User Manual

PEAK System

Products taken into account

Product Name	Model	Item Number
Serial Bus Simulator	1.1	IPEH-003050

PEAK-System Technik GmbH
Otto-Roehm-Strasse 69
64293 Darmstadt
Germany

Phone: +49 (0)6151 8173-20
Fax: +49 (0)6151 8173-29

www.peak-system.com
info@peak-system.com

Issued 2009-02-27

Contents

1 Introduction

The Serial Bus Simulator (SBS) generates data streams for several serial bus types. The data streams can be used e.g. for demonstrations and validations of measuring systems.

1.1 Properties at a Glance

- Generates data streams for the following serial bus systems:
  - CAN
  - LIN
  - V.24 (RS-232)
  - I^2C
  - SPI
- 2 different transfer rates for each bus system
- Disengageable transmission of data frames
- Specific generation of defect data frames
- Pin assignment of D-Sub CAN connector according to CiA 102 DS
- Generation of an analog voltage for testing (e.g. trigger)
- Pickoffs for oscilloscope probes
- Desk-type casing
- Power supply via USB connection

1.2 Prerequisites for the Operation

The following prerequisites must be given, so that the SBS can be used properly:

- Vacant USB port on an external device (e.g. measuring instrument, computer, power supply unit) for the power supply of the SBS (about 125 mA current consumption)

1.3 Scope of Supply

The scope of supply normally consists of the following parts:

- Serial Bus Simulator (desk-type casing) with USB connection cable
- CD with user manual in PDF format

2 Connectors

This chapter describes the pin assignment of each connector on the rear and on the control panel of the Serial Bus Simulator (SBS).

2.1 USB Cable for Power Supply

The USB cable is used for the simplified connection of the power supply (5 V). The USB data lines are unused.

Plug the USB connector into any USB port of an external device (e.g. measuring instrument, computer, power supply unit).

The **green LED** at the rear of the casing is on, when the 5-Volt supply is present.

The current consumption of the SBS is about 125 mA.

2.2 GND Socket

In order to establish a ground connection between the SBS and a measuring set-up a 4-mm socket is available at the rear of the casing. A cable with banana plug can be used here (not included).

2.3 CAN/LIN D-Sub Connector

The 9-pin D-Sub male connector on the rear of the casing includes the differential CAN signal (ISO 11898-2) and the LIN signal as well as a ground line. These signals are also available at the pickoffs on the control panel of the SBS.

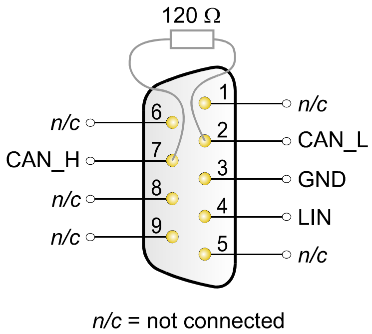

Figure 1: Pin assignment of the D-Sub male connector for CAN and LIN

The CAN bus is terminated internally between the two signal lines CAN_L and CAN_H with 120 Ω.

The SBS is configured as LIN master and the LIN bus is terminated with 1 kΩ accordingly.

2.4 Pickoffs for Measuring

At the front of the control panel 17 pickoffs are available for measuring purposes.

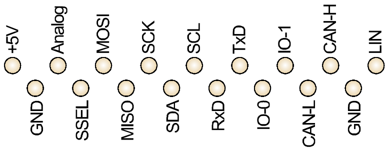

Figure 2: Pin assignment of the pickoffs on the control panel (description in the following table)

Label	Function	Remark
+5V	Power supply 5 V	Via 100 Ω, not intended to drive electrical loads
GND	Ground	
Analog	Analog voltage 0 - 3.3 V from potentiometer	Via 100 Ω, not intended to drive electrical loads
SSEL	SPI: Slave Select	
MOSI	SPI: Master Out – Slave In	
MISO	SPI: Master In – Slave Out	Reserved for future applications
SCK	SPI: Serial Clock	
SDA	I^2C: Serial Data	
SCL	I^2C: Serial Clock	
RxD	V.24/RS-232: Receive Data	Reserved for future applications
TxD	V.24/RS-232: Transmit Data	
IO-0	GPIO-0	Reserved for future applications
IO-1	GPIO-1	Reserved for future applications
CAN_L	CAN: Low signal	
CAN_H	CAN: High signal	
GND	Ground	
LIN	LIN signal	

3 Control Elements and LEDs

This chapter describes the function of the control elements and LEDs on the Serial Bus Simulator (SBS).

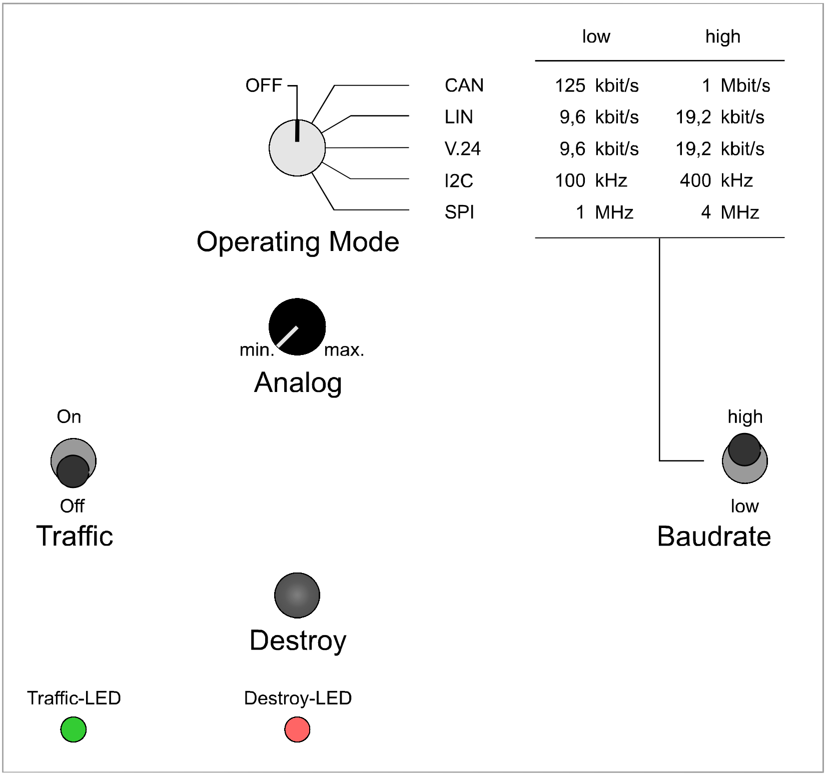

Figure 3: Layout of the control elements and LEDs

3.1 Operating Mode (Rotary Switch)

The rotary switch activates one out of five sources for serial data:

- **CAN** (Controller Area Network)
- **LIN** (Local Interconnect Network)
- **V.24** (standard for data remote transfer, related to RS-232)
- **I²C** (Inter-Integrated Circuit)
- **SPI** (Serial Peripheral Interface)

In position **OFF** no serial data is generated. However, the SBS is still alive. Analog functions, like the 3.3 Volts at the potentiometer and the 5-Volt output, are active.

The output of each data source is described in chapter 4 on page 12.

3.2 Analog (Potentiometer)

The potentiometer has several functions:

- When generating data errors (Destroy push button), the position of the error within the data frame can be adjusted.
- The variable data byte within the data frames can be varied from 0x00 to 0xFF.
- A voltage from 0 to 3.3 Volts is provided at the pickoff **Analog** for measuring purposes.

Note: The voltage at the pickoff **Analog** is not intended to drive electrical loads.

3.3 Baudrate (Selector Switch)

The selector switch determines the transfer rate for each data source. The transfer rates are defined as follows:

Data source	Transfer rate	
	low	**high**
CAN	125 kbit/s	1 Mbit/s
LIN	9600 Baud	19200 Baud
V.24	9600 Baud	19200 Baud
I^2C	100 kHz	400 kHz
SPI	1 MHz	4 MHz

3.4 Traffic (Selector Switch/LED)

When switched to **On**, additional data load is activated for the selected data source. Usually three frames are transmitted cyclically in turn every 50 ms.

The green LED flashes in the rhythm of the additional frames being transmitted.

3.5 Destroy (Push Button/LED)

By pressing this push button an additional frame with a protocol violation is generated. This frame should be recognized as erroneous at measurements (except for SPI).

The red LED flashes, when an erroneous frame is transmitted (pressed push button).

4 Transmission Behavior of the Data Sources

This chapter describes which data is transmitted by the data sources depending on the settings on the control panel.

You'll find the information for CAN, LIN, V.24, I^2C and SPI on the following pages.

4.1 CAN

CAN data frames are generated, when the rotary switch **Operating Mode** is turned to the position **CAN**. The ACK bit (Acknowledge) is generated by the SBS itself, thus a listen-only operation is possible.

The selector switch **Baudrate** changes the transfer rate to the value given on the control panel (125 kbit/s or 1 Mbit/s).

When pressing the **Destroy** push button, the data source generates a correct CAN frame superimposed by a long dominant gap to force an error.

The position of the dominant gap within the CAN frame can be adjusted with the **Analog** potentiometer. The gap length depends on the selected transfer rate. So, different types of errors are generated, e.g. CRC or Stuff errors.

The transmitted CAN frame (without error) would be:

CAN ID	Length	Data (hex)
0x00000666 (29 bit)	8	01 23 45 67 89 AB CD EF

If the **Traffic** selector switch is in position **On**, three additional CAN frames are transmitted cyclically in turn every 50 ms:

CAN ID	Length	Data	Data (hex)
0x00000200 (29 bit)	4	"C" "A" "N" [Analog]	43 41 4E [00 … FF]
0x300 (11 bit)	6	"L" "e" "C" "r" "o" "y"	4C 65 43 72 6F 79
0x00000400 (29 bit)	4	"P" "E" "A" "K"	50 45 41 4B

The value [Analog] is determined by the position of the **Analog** potentiometer.

4.2 LIN

LIN data frames are generated, when the rotary switch **Operating Mode** is turned to the position **LIN**.

The selector switch **Baudrate** changes the transfer rate to the value given on the control panel (9600 bit/s or 19200 bit/s).

When pressing the **Destroy** push button, the data source generates a LIN frame with illegal header parity. The error is generated with the following composition: header parity XOR 0x40

The transmitted LIN frame (without error) would be:

LIN ID	Length	Data (hex)
0x0F (15 dec)	4	00 55 AA FF

If the **Traffic** selector switch is in position **On**, three additional LIN frames are transmitted cyclically in turn every 50 ms:

LIN ID	Length	Data	Data (hex)
0x1E (30 dec)	4	"L" "I" "N" [Analog]	4C 49 4E [00 … FF]
0x2D (45 dec)	6	"L" "e" "C" "r" "o" "y"	4C 65 43 72 6F 79
0x3C (60 dec)	4	"P" "E" "A" "K"	50 45 41 4B

The value [Analog] is determined by the position of the **Analog** potentiometer.

4.3 V.24

V.24/RS-232 data frames are generated, when the rotary switch **Operating Mode** is turned to the position **V.24**. The data format is:

8 data bits, no parity bit, 1 stop bit (8N1)

The selector switch **Baudrate** changes the transfer rate to the value given on the control panel (9600 bit/s or 19200 bit/s).

When pressing the **Destroy** push button, the data source generates a 5 byte long frame with illegal stop bit in the third frame (“c”).

The position of the **Analog** potentiometer doesn't have any influence on the generation of the errors.

The transmitted V.24 frame (without error) would be:

Length	Data	Data (hex)
5	“a” “b” “c” “d” CR	61 62 63 64 0D

If the **Traffic** selector switch is in position **On**, three additional V.24 frames are transmitted cyclically in turn every 50 ms:

Length	Data	Data (hex)
5	“V” “2” “4” [Analog] CR	56 32 34 [00 … FF] 0D
7	“L” “e” “C” “r” “o” “y” CR	4C 65 43 72 6F 79 0D
5	“P” “E” “A” “K” CR	50 45 41 4B 0D

The value [Analog] is determined by the position of the **Analog** potentiometer.

4.4 I²C

I²C data frames are generated, when the rotary switch **Operating Mode** is turned to the position **I2C**.

The selector switch **Baudrate** changes the transfer rate to the value given on the control panel (100 kHz or 400 kHz).

When pressing the **Destroy** push button, the data source generates an 8 byte long frame with missing ACK bits at the characters “o” and “c”.

The position of the **Analog** potentiometer doesn't have any influence on the generation of the errors.

The transmitted I²C frame (without error) would be:

Data	Data (hex)
0xA0 0x00 0x00 “n” “o” “a” “c” “k”	A0 00 00 6E 6F 61 63 6B

The first three bytes represent the command “EEPROM write to address 0x0000”.

If the **Traffic** selector switch is in position **On**, three additional I²C frames are transmitted cyclically in turn every 50 ms:

Data	Data (hex)
0xA0 0x01 0x00 “I” “2” “C” [Analog]	A0 01 00 49 32 43 [00 … FF]
0xA0 0x01 0x80 “L” “e” “C” “r” “o” “y”	A0 01 80 4C 65 43 72 6F 79
0xA0 0x02 0x00 “P” “E” “A” “K”	A0 02 00 50 45 41 4B

The value [Analog] is determined by the position of the **Analog** potentiometer.

4.5 SPI

SPI data frames are generated, when the rotary switch **Operating Mode** is turned to the position **SPI**. Data is transmitted via the pin MasterOut-SlaveIn (MOSI). The pin MasterIn-SlaveOut (MISO) is not used by this application.

The selector switch **Baudrate** changes the transfer rate to the value given on the control panel (1 MHz or 4 MHz).

When pressing the **Destroy** push button, the data source generates a 4 byte long frame. Since the SPI bus doesn't have a stringent protocol, a frame cannot be destroyed and is therefore always decoded as correct. It can be used for trigger purposes.

The transmitted SPI frame (always correct) is:

Data	Data (hex)
0x00 0x05 0x0A 0x0F	00 05 0A 0F

If the **Traffic** selector switch is in position **On**, three additional SPI frames are transmitted cyclically in turn every 50 ms:

Data	Data (hex)
“S” “P” “I” [Analog]	53 50 49 [00 … FF]
“L” “e” “C” “r” “o” “y”	4C 65 43 72 6F 79
“P” “E” “A” “K”	50 45 41 4B

The value [Analog] is determined by the position of the **Analog** potentiometer.

5 Technical Specifications

Serial busses	
Simulated bus types	CAN, LIN, V.24 (RS-232), I^2C, SPI

Supply	
Supply voltage	+5 V DC ±5 % (via USB port)
Current consumption	about 125 mA

Measures	
Size	120 x 45 x 155 mm (4 3/4 x 1 3/4 x 6 1/8 inches) (W x H x D)
Weight	340 g (12 oz.)

Environment	
Operating temperature	0 - +70 °C (32 - 158 °F)
Temperature for storage and transport	-25 - +85 °C (-13 - +185 °F)
Relative humidity	15 – 90 %, not condensing