

STAR COOPERATION®

Your Partners in Excellence

FlexGen-M SENT

Manual



Revision History

Version	Date	Description
1.0	2014-08-08	First release
2.1	2015-04-22	New functions for manipulation
2.2	2015-07-30	Two different synchronization options
2.3	2015-10-28	Extension of CAN functionality for remote control
3.1	2017-09-07	Signal multiplexing on SAE J2716 Rev. 04/2016
3.6	2020-01-15	Windows 10 compatibility

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EU-conformity

The manufacturer / distributor / representative

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Hereby declares that the product: FlexGen-M SENT

Corresponds to the fundamental requirements defined in the following guideline(s):

- 2014/30/EU: Electromagnetic tolerability
- 2011/65/EU: Restriction of Hazardous Substances (RoHS)

And therefore, a CE mark is applied to the above named product:



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1.1 INTENDED USE






The FlexGen-M SENT is exclusively intended for use in the laboratory, on test beds or in test vehicles. Any other use without the prior written consent of *STAR COOPERATION* is prohibited.

Only articles described in the chapter “accessories” may be used in connection with the PWM Generator.

The FlexGen-M SENT is **NOT** designed, intended or approved

- as part of a medical system
- with life-sustaining applications
- in aerospace, nuclear or military applications
- in areas where flammable or explosive gas mixtures may occur
- with other applications where a fault or malfunction may result in death, personal injury or serious physical damage.
- The product described in this document is an industrial device. This means that the product has only been developed, intended and approved for professional use and not for home or consumer use. For this reason, use by non-professional users is prohibited.

1.2 PICTOGRAMS USED




	<div style="background-color: #0000FF; color: white; text-align: center; padding: 5px;">NOTE</div> <div style="padding: 5px;">Notes to avoid incorrect operation which can lead to damage to the product.</div>
	<div style="background-color: #FFFF00; text-align: center; padding: 5px;"> CAUTION</div> <div style="padding: 5px;">Indicates a potentially dangerous situation which, if not avoided, could result in minor or moderate injury.</div>
	<div style="background-color: #FFA500; text-align: center; padding: 5px;"> WARNING</div> <div style="padding: 5px;">Indicates potentially dangerous situations which, if not avoided, may result in death or serious injury.</div>

1.3 SAFETY AND HANDLING INSTRUCTIONS

The user guarantees that there is no danger to people or the environment due to malfunction of the device. The user is responsible for compliance with legal regulations when used in public and non-public road traffic. Conformity with legal regulations outside Europe is ensured by the user.

Please read these instructions carefully to protect the device or application from damage or to prevent personal injury. The FlexGen-M SENT must be operated as described here. Changes or adjustments to the PWM Generator are not permitted for reasons of safety and for warranty reasons.

STAR COOPERATION does not accept liability for damage caused by non-observance of this manual.

	<div data-bbox="858 280 1077 331">⚠ WARNING</div> <p>If this product is used in an electronic system with a supply voltage above 42Vac and 50Vdc: Risk of electrocution! To avoid property damage, injury or death: Disconnect the power supply cable before carrying out any work on the electronic system. The function of a networked electronic system can be influenced by this product. Operation may therefore result in property damage or serious injury. The security aspects of the network system and its surroundings must be observed, so that in the case of defects or malfunction of hardware or software the other network electronics are not affected in a way that may result in serious damage or injuries. If transmitted information and data are received by real electronic control units, e. g. in a test vehicle, this information and data can lead to unpredictable functional behaviour or failure of the control units. Check whether the application is safe under laboratory conditions before using this product in the target system! This product may only be used by trained and qualified persons! In safety-critical applications, the product is used at your own risk.</p>
	<div data-bbox="865 801 1070 853">⚠ CAUTION</div> <p>To avoid damage to the device as well as consequential damages and injuries: Do not connect any other signals to the interfaces than those described in the manual. Make sure that all signals are within the specified range. Keep the product away from heaters, stoves, fireplaces and other heat sources. Protect the product from rain and do not use it near water. Do not use the product in areas where there is a risk of explosion. Do not attempt to repair the unit yourself.</p>
	<div data-bbox="896 1115 991 1160">NOTE</div> <p>STAR COOPERATION products without protective housings can be damaged by electrostatic discharges. Appropriate precautions against electrostatic discharges are to be taken to avoid a power loss or drop in functionality!</p>

1.4 USER GROUP

This document is written for technical experts who are familiar with the use of electronic components and systems.

Every person who is involved with the installation, operation, servicing, connection or configuration of the FlexGen-M SENT

- Must be a qualified technician, or electronics technician or engineer
- Must strictly adhere to this manual
- Must have received instructions from an authorized person

2 PRODUCT DESCRIPTION

2.1 OVERVIEW

The FlexGen-M SENT was specially designed for mobile use on test beds. With its two SENT (Single Edge Nibble Transmission) interfaces, the device is able to receive and display sensor signals. At the same time, it is possible to generate its own sensor signals and to simulate any desired sensors.

The interfaces available as SENT-Receiver and as SENT-Transmitter support the standard Norm SAE J2716 04/2016 and are backwards compatible with previous revisions.

The FlexGen-M SENT offers the possibility of realising various functions for signal manipulation via an incident button. The different types of manipulation can be configured by the user. Thus, for example, permanent change of values or the change of values only for a defined number of messages can be implemented. Non-static changes of signals can also be undertaken via ramping procedures.


The FlexGen-M SENT can be operated completely self-sufficiently. All settings of the appliance are undertaken via easy to use dial switches. The set values can be read off at any time via the integrated display.

The FlexGen-M SENT can be configured to different sensors via a USB PC connection. The user can then select between a maximum of 5 preconfigured sensors on the appliance itself.

A synchronisation interface is also available, via which it is possible to cascade several SEN Simulators. Through this, even redundant systems can be simulated for example.

Due to the modular design, many other variants and functions can be realized on request.

The FlexGen-M SENT is a product of the Star Cooperation and was developed and produced entirely in Germany.

	NOTE
	<p>Only use the FlexGen-M SENT for the applications described in chapter 1.1. Intended purposes to ensure fault-free function and warranty validity</p> <p>Accessories other than those listed in chapter 5.3. may only be used with written permission of <i>STAR COOPERATION</i>.</p>

3 TECHNICAL DATA

3.1 ELECTRICAL PROPERTIES

	Characteristics
Supply Voltage	8 - 28V DC, internal polarity reversal protection, short circuit protection
Interfaces	1x SENT Receiver (receiver compliant to SAE J2716) 1x SENT Transmitter (transmitter compliant to SAE J2716) 1x Synchronization (Trigger + CAN compliant to ISO 11898-2) 1x USB 2.0
Display	Display 4x20 Character
Operating Interfaces	1x button 1x dial switch 2x rotary switch (Push/ Push)
Connectors - voltage supply - SENT input - SENT output - Synchronization - USB	Lemo ExJ.1B.302.HLD LEMO EGG.1B.303.CLL LEMO EGJ.1B.303.CLA D-Sub 9-pole connector plug USB socket type B

Table 1: Electrical properties

3.2 PHYSICAL PROPERTIES

	Characteristics
Housing	Aluminium housing with protective caps
Dimensions	200 x 106 x 60 mm
Protection	IP21
Ambient temperature	-20°C bis +60°C

Table 2: Physical properties

4 CONNECTIONS AND CONTROLS

4.1 CONNECTIONS SIDE VIEW BELOW

The interfaces of the SENT Simulator are depicted in the following illustration. The indicated plug designations refer to the device side.

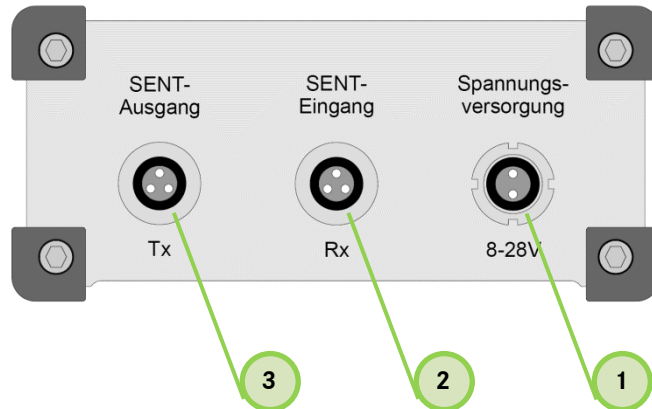


Illustration 1: Power supply and SENT interfaces

1 Power supply

The SENT Simulator can be supplied with a voltage of 8 – 28V via a LEMO-plug. An adapter cable with banana plug is included in the box.

Lemo EXJ.1B.302.HLD

Pin	Signal	Meaning
1	Ubatt+	Supply voltage plus (red connection cable)
2	Ubatt-	Supply voltage minus (black connection cable)

2 SENT Input (Receiver)

The SENT input is designed for the connection of real sensors. A LEMO adaptor cable to banana sockets is included in the scope of delivery.

Lemo EGG.1B.303.CLL

Pin	Signal	Meaning
1	+5V	Voltage output to sensor supply
2	GND	Ground supply to sensor supply
3	SENT	Signal from sensor

3 SENT Output (Transmitter)

The SENT output is designed to connect to a control device. A LEMO adaptor cable to banana sockets is included in the scope of delivery.

Lemo EGJ.1B.303.CLA		
Pin	Signal	Meaning
1	n.c.	Pin not connected
2	GND	Ground input from control device
3	SENT	Signal to control device

4.2 CONNECTIONS SIDE VIEW TOP

The interfaces of the SENT Simulator are depicted in the following illustration. The indicated plug designations refer to the device side.

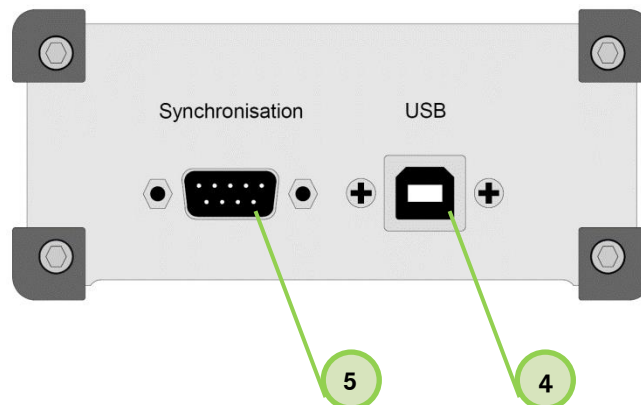


Illustration 2: Top side-view with CAN and USB options(process)

4 USB Interface

A connection to a PC or laptop can be created using the USB, via which individual sensors can be pre-configured. A standard USB cable is included in the scope of delivery.

USB Type B socket		
Pin	Signal	Meaning
1	Vcc	USB 2.0 Standard
2	D-	USB 2.0 Standard
3	D+	USB 2.0 Standard
4	GND	USB 2.0 Standard

5 Synchronisation Interface

Several devices can be cascaded via this interface. An appropriate cable is included in the scope of delivery.

D-Sub 9 pin Pin		
Pin	Signal	Meaning
1	Sync	Synchronisation wire
2	CAN-L	CAN Low
3	GND	Ground
4	<i>Reserved</i>	
5	<i>Reserved</i>	
6	GND	Ground
7	CAN-H	CAN High
8	<i>Reserved</i>	
9	<i>Reserved</i>	

4.3 OPERATING ELEMENTS FRONT VIEW

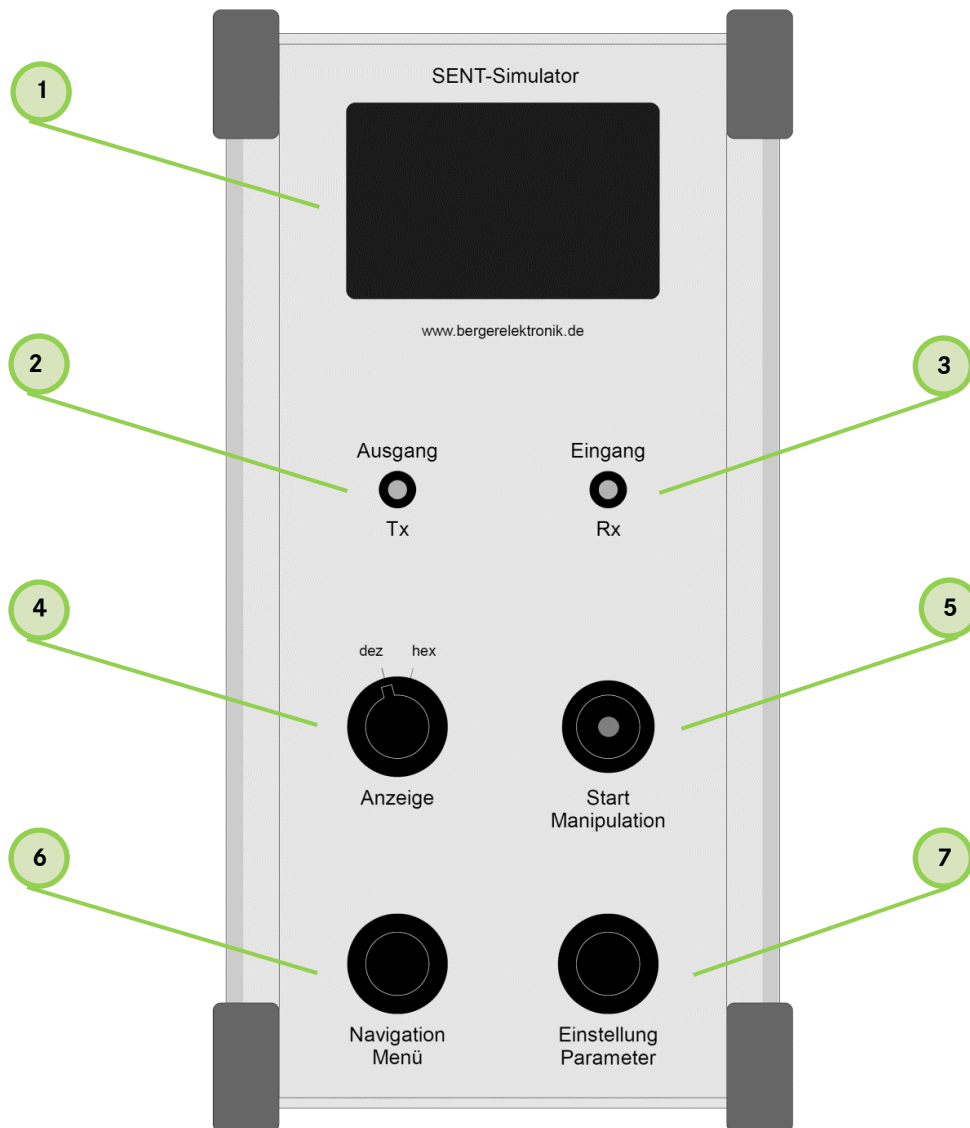


Illustration 3: Front view

1 Display

All relevant parameters and current settings are shown simultaneously in the 4-line display. The values displayed depend on the operation mode.

2 Status output (Transmitter)

The Status LED flashes when there is activity at the SENT output.

3 Status Input (Receiver)

The Status LED flashes when there is activity at the SENT input.

4 Display

Raw values or Identifiers shown in the display can be shown in decimal or hexadecimal form depending on switch position. Hexadecimal values are shown in the display with an 'h' hinter after the value.

5 Start Manipulation

The SENT Simulator has an event button with which the manipulation of signals at the SENT output can be started and stopped. Activation of the button and thus the start of manipulation is shown via an LED integrated into the button.

6 Navigation menu

The rotary switch can be used to navigate through the different menus. Turning anti-clockwise here corresponds to moving upwards and turning clockwise corresponds to moving downwards.

Any sub-menus can be called up by pressing the rotary switch for a short time. Pressing again returns to the main menu. Exact navigation, description and use of the menus is in chapter 5.

7 Settings parameters

Individual values and parameters can be changed with the rotary switch. Turning anti-clockwise here corresponds to reducing values and turning clockwise corresponds to increasing.

The step-size can be varied by quickly pressing the rotary switch to reach the desired target value more quickly.

5 OPERATINGTYPE (MODE)

The SENT-Simulator can basically be used in the 4 different operation types Display, Simulation, Manipulation and Synchronisation. How modes can be changed is described in chapter 7.1.

5.1 DISPLAY

The Display mode is intended to show all available data of a connected sensor on the display. The sensor is connected via the SENT input (Rx). The SENT output (Tx) is in active in this mode.

An entire SENT notification with status field, data nibble and test sum can be displayed as raw values in hexadecimal format. In addition, the individual Fast Channel channels and any cycle counters used can be displayed separately in decimal or hexadecimal format or as converted physical values with unit.

If the connected sensor supports serial communication via the SENT protocol, this information (identifier, data, test sum) can also be displayed. These data can be displayed sorted by identifier or in current sequence of receipt. The online display can be stopped for better legibility and analysis of the data.

5.2 SIMULATION

The Simulation mode is intended to be able to completely emulate a sensor with the SENT-Simulator without it really being available. Communication via the SENT output (Tx) takes place continuously independently of a connected control device. The SENT input (Rx) of the device is not evaluated in this mode.

Similarly to the Display mode, all outgoing data can be shown both for the individual SENT notifications and the serial communication.

Different functions are available to the user to be able to simulate different operational statuses and faults of a sensor, in order to influence the individual signal values in a targeted way or the SENT communication in general.

You can find an extensive description of the functions with their settings possibilities in chapter 7.3.

5.3 MANIPULATION

The Manipulation mode is intended to be able realise a type of gateway between a real existing sensor and a connected control device. The aim of this mode is to falsify, or, for example, freeze individual original values in a focused way.

All the data of a connected sensor are read in via the SENT input (Rx) and are at first fed on to the SENT output (Tx) unchanged. All receipt and transmission data can be shown directly juxtaposed on the integrated display.

It is possible to change specific individual output signals through various functions. You can find an extensive description of the functions with their settings possibilities in chapter 7.3.

5.4 SYNCHRONISATION

The Synchronisation mode is intended to enable several devices to cascade with each other. This can be used for example for redundant systems, to manipulate several channels simultaneously.

For synchronisation, a connection must be created between 2 devices via the synchronisation cable supplied. All participants in synchronisation mode function as slaves, which receive their instructions from a master device. This master-device is the only one that has to be in a different operational mode (display, simulation or manipulation).

There are two kinds of synchronisation. Simple synchronisation is for simultaneous activation of manipulation via the start button. In this type of operation, both master and slave work completely self-sufficiently. Only the start button of the slave device is triggered by the master device.

The second type of operation is the synchronisation of functions. The slave device, which is in "Synchronisation Function" mode, can be used to display SENT data. These devices receive all other settings, functions and specifications automatically from the master. For example, the start of individual functions is also triggered via this master.

6 FUNCTION PROCESS

The user has various functions available in the Simulation and Manipulation types of operation, with which the SENT output data can be changed specifically. These functions can be set via PC configuration software (see chapter 8) or via the Function sub-menu (see chapter 7.3) for the respective application case.

Functions for changing output signals can be activated in the main menu (see chapter 7.1) or in the sub-menus for the display of Fast- Slow-Channel (see chapter 7.4ff).

Activation of functions is via the *Start Manipulation* button. Active functions are ended by activating the button again. An activated function is indicated by the green LED in the button illuminating.

The currently transmitted values of Fast Channel and Slow Channel can also be changed in the Simulation operation mode without an activated function. This can happen in the respective sub-menus (see chapter 7.4 et seq.).

7 MENU AND NAVIGATION

The device starts independently in the main menu when the supply voltage is applied to the SENT Simulator. All sub-menus are reached from this menu using the rotary switch *Navigation*.

7.1 MAIN MENU

The main menu consists of up to 3 pages. Turning the *Navigation* rotary switch navigates between individual lines and pages.

The Illustration 4 shows all lines and pages of the main menu.

The current position is known by an “empty arrow” on the left-hand side. Individual values can be changed by turning the rotary switch *setting*.

If a submenu is present for the current position, this is indicated by a curved bracket on the right-hand side. This is opened by pressing the *Navigation* rotary switch.

	-	-	-	-	-	M	a	i	n		M	e	n	u	-	-	-	-	-
>	L	a	n	g	u	a	g	e	:		E	n	g	l	i	s	h		
	S	e	n	s	o	r	:								0	1		}	
	M	o	d	e	:						D	i	s	p	l	a	y		

	-	-	-	-	-	M	a	i	n		M	e	n	u	-	-	-	-	-
>	F	u	n	c	t	i	o	n	:						0	1		}	
	F	a	s	t		C	h	a	n	n	e	l						}	
	S	l	o	w		C	h	a	n	n	e	l		s	o	r	t	.	

	-	-	-	-	-	M	a	i	n		M	e	n	u	-	-	-	-	-
>	S	l	o	w		C	h		R	x		L	i	s	t			}	
	S	l	o	w		C	h		T	x		L	i	s	t			}	

Illustration 4: Display Main Menu

7.1.1 LANGUAGE

The language for the display text can be selected from German (default) and English using the rotary switch *setting*).

7.1.2 SENSOR

Up to 12 sensor configurations can be stored on the device. The individual configurations can be selected using the *setting* rotary switch. The currently displayed sensor number is immediately loaded and applied as the active configuration.

The *Sensor* sub-menu can be called up by pressing the *Navigation* rotary switch which is described in more detail in chapter 7.2.

The configuration of sensors is done via the software supplied. Only individual configurations can be selected, and their parameters displayed on the device itself.

7.1.3 MODE

The operating style of the SENT-Simulator can be selected on the Mode line. 4 operation types are available for selection:

- Display (receive SENT data and show on Display)
- Simulation (generate SENT data, show on Display and transmit to control device)
- Manipulation (receive and process SENT data, and re-transmit it changed or unchanged)
- Synchronisation (all specifications and settings received from a second SENT-Simulator via the synchronisation interface)

The operation types are described in more detail in chapter 5.

7.1.4 FUNCTION

Depending on the selected mode and set sensor configuration there are up to 13 possibilities for manipulating the output data of the SENT-Transmit interface.

It is possible to switch between the functions using the rotary switch *setting*. The *Function* sub-menu can be called up by pressing the *Navigation* rotary switch which is described in more detail in chapter 7.3.

If a function for manipulation of data is active, this is shown by the green LED in the *Start Manipulation* button and stars around the function number (see Illustration 5)

No function is available in the “Display” mode, as the SENT output is not used. This is shown in the display as ‘-’. Nor is it possible to call up the *Function* sub-menu.

-	-	-	-	-	M	a	i	n	M	e	n	u	-	-	-	-	-
>	F	u	n	c	t	i	o	n	:				*	0	1	*	}
	F	a	s	t		C	h	a	n	n	e	l					}
	S	l	o	w		C	h	a	n	n	e	l	s	o	r	t	.

Illustration 5: Display Main Menu – Function 01 is active

7.1.5 FAST CHANNEL

The sub-menu *Fast Channel*, in which all relevant receipt and transmission data of the SENT Fast Channel are displayed. is called up by pressing the *Navigation* rotary switch. A detailed description can be found in chapter 7.4.

7.1.6 SLOW CHANNEL SORTED

The sub-menu *Slow Channel sorted* in which all relevant receipt and transmission data of the SENT Slow Channel is displayed sorted by the respective ID, is called up by pressing the *Navigation* rotary switch. A detailed description can be found in chapter 7.5.

7.1.7 SLOW CHANNEL RX/TX LIST

The sub-menu *Slow Channel List*, in which all relevant receipt and transmission data of the SENT Slow Channel in the current sequence are displayed is called up by pressing the rotary switch *Navigation*. A detailed description can be found in chapter 7.6.

7.2 SENSOR SUB-MENU

All data relevant to completely describe a sensor is displayed in the Sensor sub-menu. All displayed data can be preconfigured via the PC software supplied and transferred to the device via USB. These settings can only be displayed on the SENT simulator itself.

Pressing the rotary switch *Navigation* takes you from the main menu to sensor menu. By pressing the *Navigation* rotary switch again you leave the sensor menu and go back to the main menu.

The current position in the menu is shown by a “filled” arrow on the left-hand side. Switching between the different parameters is done by turning the Navigation rotary switch.

The current sensor is shown in the first line. Each sensor number (1-5) is assigned an individual name a maximum of 10 characters long. The currently selected sensor can be changed in the entire sub-menu by turning the *setting* rotary switch.

7.2.1 GENERAL SETTINGS

Basic general settings for the SENT interface used are described on the first two pages, such as the SENT-Revision, the Tick time, the number of data nibbles in a SENT message, the optional Pause pulse, the serial protocol for the Slow Channel and the Sensor type according to SAE J2716.

	S	e	n	s	o	r	0	1	:		P	r	e	s	s	T	e	m	p
	R	e	v	i	s	i	o	n	:			0	1	/	2	0	1	0	
	T	i	c	k	t	i	m	e	:						1	2	u	s	
	D	a	t	a	N	i	b	b	l	e	:								6

	S	e	n	s	o	r	0	1	:		P	r	e	s	s	T	e	m	p	
	P	a	u	s	e	P	u	l	s	:		p	p	c	(2	8	2)	
	S	e	r	i	a	l	P	r	o	t	:						e	s	p	
	S	e	n	s	o	r	:								D	.	1	x	x	x

Illustration 6: Sub-menu Sensor – General settings

Sub-menu Sensor – Page 1		
Property	Range	Description
Sensor	01 – 05	Selected active sensor with number (1-5) and maximum 10 place text designation
Revision	04/2007 02/2008 01/2010 04/2016	Applied revision of the SAE J2716 Standard
Ticktime	2.6us - 90us	Tick time for calculation of impulses
Number of data nibbles	0 - 8	Number of data nibbles per message (Fast Channel)

Sub-menu Sensor – Page 2		
Property	Range	Description
Sensor	01 - 12	Selected active sensor with number (1-12) and maximum 10 place text designation
Pause pulse	Npp Pp ppc(0-922)	No pause pulse Use optional pause pulse Pause pulse for constant message length (value in brackets gives the number of Ticks per message)
SerialProt	Nsp Ssp Eso	No serial protocol Short Serial Protocol Enhanced Serial Protocol
Sub-menu Sensor – Page 2		
Property	Range	Description
Sensor	ns	Not specified
	A.1	Dual Throttle Position Sensor
	A.2	Mass Air Flow Sensor
	A.3	Single Secure Sensor
	A.4	Single Sensor
	A.5	Pressure or Pressure/Secure Sensor
	D.1xxx	Other Sensor Class

7.2.2 DEFINITION DATA NIBBLE

Different functions can be assigned to the individual data nibbles of a message. These are displayed on the two following display pages.

S	e	n	s	o	r	0	1	:	P	r	e	s	s	T	e	m	p	
N	i	b	b	l	e	1	:				C	h	1		M	S	N	
N	i	b	b	l	e	2	:				C	h	1		M	i	d	N
N	i	b	b	l	e	3	:				C	h	1		L	S	N	

S	e	n	s	o	r	0	1	:	P	r	e	s	s	T	e	m	p
N	i	b	b	l	e	4	:				C	o	u	n	t	e	r
N	i	b	b	l	e	5	:				C	o	u	n	t	e	r
N	i	b	b	l	e	6	:		I	n	v	C	o	p	y	D	1

Illustration 7: Sub-menu Sensor – Definition data nibble

Sub-menu Sensor – Page 3+4		
Property	Range	Description
Sensor	01 - 12	Selected active sensor with number (1-12) and maximum 10 place text designation
Nibble 1-8	FC Mux DCC Ch1 MSN Ch1 MidN Ch1 LSN Ch2 MSN Ch2 MidN Ch2 LSN Zero Counter Inv copy D1 ---	Fast Channel Multiplexing Data Consistency Counter Fast Channel 1 Most Significant Nibble Fast Channel 1 Middle Nibble Fast Channel 1 Least Significant Nibble Fast Channel 2 Most Significant Nibble Fast Channel 2 Middle Nibble Fast Channel 2 Least Significant Nibble Zero value Life counter Inverted copy of data nibble 1 Data nibble is not used

7.2.3 FAST CHANNEL CONVERSION

The parameters for conversion between raw values and physical quantities for Fast Channel 1 and Fast Channel 2 is displayed on these pages.

S	e	n	s	o	r	0	1	:	P	r	e	s	s	T	e	m	p
F	C	1	M	i	n	-	x	-								1	0
F	C	1	M	a	x	:								4	0	0	0
S	t	a	r	t	V	a	l	u	e	:							0

S	e	n	s	o	r	0	1	:	P	r	e	s	s	T	e	m	p
F	C	1	F	a	c	:			+	0	,	2	0	0	0	0	
F	C	1	O	f	f	:			-	4	0	,	0	0	0	0	
F	C	1	U	n	i	t	:		-	x	-	m	b	a	r		

Illustration 8: Sub-menu Sensor – Conversion Fast Channel

Sub-menu Sensor – Page 5-8		
Property	Range	Description
Sensor	01 - 12	Selected active sensor with number (1-12) and maximum 10 place text designation
FC1-2 Min	0 - 4095 ¹	Minimum raw value for conversion
FC1-2 Max	0 - 4095 ¹	Maximum raw value for conversion
Start value	0 - 4095 ¹	Default value for the simulation of sensor data
FC1-2 Fak		Factor for conversion (floating point number)
FC1-2 Off		Offset for conversion (floating point number)
Unit	4 characters	Physical unit
- X -	0 - F	The multiplexer number if signal multiplexing is used

¹Range of values depends on the number of data nibbles per channel (4095 = 3 Data nibble)

The following formula is used for the conversion of raw values into a physical quantity. Conversion only takes place, if the raw value is between the specified maximum and minimum value.

$$Phy.Value [Unit] = (RawValue * Factor) + Offset$$

7.2.4 MULTIPLEXER SCHEDULE

The Multiplexer Schedule Table is displayed if Fast Channel Multiplexing is used.

S	e	n	s	o	r	0	1	:		P	r	e	s	s	T	e	m	p
M	u	l	t	i	p	l	e	x		S	c	h	e	d	u	l	e	
0	→	1	→	2	→	3	→	5	→	A	→	F						

7.2.5 SLOW CHANNEL IDENTIFIER

The configuration of the Slow Channel IDs is displayed on these pages. Up to 32 Identifiers with their associated start values are defined in this list. Each line is represented as in Illustration 9 and is constructed as follows.

	S	e	n	s	o	r	0	1	:		P	r	e	s	s	T	e	m	p
	0	1	:				0	0	h ⁴				0	0	0	0	h		
	0	2	:		*		0	3	h ⁸				0	0	3	F	h		
	0	3	:		*		1	4	h ⁸				0	0	0	1	h		

Illustration 9: Sub-menu Sensor – Slow Channel Identifier

Sub-menu Sensor – Page 9-20		
Property	Range	Description
Sensor	01 - 12	Selected active sensor with number (1-12) and maximum 10 place text designation
First number	0 - 31	Line index
Star		Marked identifier is used by sensor (activated)
Second number	0 - 255	Identifier
Superscripted number	4 / 8	Identification of 4Bit or 8Bit size of the Identifier follows when using Enhanced Serial Format
Last number	0 - 4095 ²	Default value for the simulation of sensor data

² Range of values depends on serial protocol and size of the identifier

7.2.6 SLOW CHANNEL SCHEDULE LIST

The Schedule Table of the Slow Channel is displayed, which specifies the order in which individual IDs are to be transmitted for a sensor simulation. A Schedule Table can have up to 32 entries according to specification.

	S	e	n	s	o	r	0	1	:	P	r	e	s	s	T	e	m	p	
	0	3	h	⁸	→	0	1	h	⁸	→	0	4	h	⁸	→	0	1	h	⁸
	2	A	h	⁸	→	0	5	h	⁴	→	2	B	h	⁸	→	0	8	h	⁴
	1	F	h	⁸	→	0	F	h	⁴	→	0	3	h	⁴	→	0	1	h	⁴

Illustration 10: Sub-menu Sensor – Slow Channel Schedule Table

The sequence of the Identifiers is marked by arrows, as is seen in Illustration 10. Identification of 4Bit or 8Bit size respectively follows on the identification when the Enhanced Serial Format is used.

7.3 SUB_MENU FUNCTION

The FlexGen-M SENT has implemented 13 different functions with which the output data of the device can be changed in various ways. Settings for all functions can be undertaken in this sub-menu.

The individual setting possibilities can be scrolled through using the *Navigation* rotary switch. The current position is shown by a “filled-up arrow” on the left-hand side. You can leave the sub-menu and return to the main menu by pressing the *Navigation* rotary switch.

The currently selected values can be changed using the *Setting* rotary switch. The step size in setting values can be varied by quickly pressing the rotary switch.

The currently selected function with its associated description text is always shown on the top line of this menu.

Not all the functions are always usable, depending on the sensor settings; these are automatically hidden.

Functions can also be changed conveniently using the PC software supplied. All functions, their usability and setting possibilities are more closely described below.

7.3.1 FUNKTION 01 – FAST CHANNEL 1 STATIC VALUE

Availability: This function is only available if at least one fast channel is provided in the sensor settings.

Functionality: A permanently constant value depending on the number of repetitions is transmitted in Fast Channel 1 with this function.

Funktion 01: Fast-Channel 1 auf festen Wert setzen

Anzahl Wiederholungen: (0 -> unendlich)

Wert Fast-Channel 1: °C

phy_value [°C] = (0,2000 x raw_value) - 40,0000

	0	1	:	F	C	1	S	t	a	t	i	c	V	a	l	u	e		
	R	e	p	e	a	t	:						e	n	d	l	e	s	s
	R	a	w	V	a	l	u	e	:							1	0	0	
	P	h	y	:															

Illustration 11: Function 01 – Screenshot and display output

Function 01		
Property	Range	Description
Repeat	0 - 100,000	Number of repetitions (0 = infinite – cancellation only by button)
Multiplexer	0 - 15	The multiplexer number when using Fast Channel Multiplexing
Raw value	0 - 4095 ³	Raw value to be transmitted
Phy		Converted physical quantity for Fast Channel 1 (raw value shown if outside minimum and maximum values)

³Range of values depends on the number of data nibbles per channel (4095 = 3 Data nibble)

Function 03		
Property	Range	Description
Repeat	0 - 100,000	Number of repetitions (0 = infinite – cancellation only by button)
Multiplexer	0 - 15	The multiplexer number when using Fast Channel Multiplexing
Ramp time	0 - 90,000s	Duration until reaching the new final value
Hold time	0 - 90,000s	Duration for which final value is kept constant
Offset	-4095 - 4095	Raw value (Maximum value dependent on defined number of nibbles for Fast Channel 1)
Phy		Converted physical quantity for Fast Channel 1 (raw value shown if outside minimum and maximum values)
Source		The ramp can be applied to the last value at start of procedure (Start value) or as an offset to the current value (actual value).
End		At the end of the procedure it is possible to jump back to the original value or the last value before the interruption by pressing the button

7.3.4 FUNKTION 04 – FAST CHANNEL 2 STATIC VALUE

Availability: This function is only available if a second fast channel is provided in the sensor settings.

Functionality: The functionality and setting possibilities are identical to Function 01 but relate to Fast Channel 2. For a more detailed description see 7.3.1

7.3.5 FUNKTION 05 – FAST CHANNEL 2 FACTOR/OFFSET ON ACTUAL VALUE

Availability: This function is only available if a second fast channel is provided in the sensor settings.

Functionality: The functionality and setting possibilities are identical to Function 02 but relate to Fast Channel 2. For a more detailed description see 7.3.2

7.3.6 FUNKTION 06 – FAST CHANNEL 2 RAMPING SEQUENCE

Availability: This function is only available if a second fast channel is provided in the sensor settings.

Functionality: The functionality and setting possibilities are identical to Function 03 but relate to Fast Channel 2. For a more detailed description see 0

7.3.7 FUNKTION 07 – FAST CHANNEL RING COUNTER

Availability: This function is only available if a Life counter is provided.

Functionality: The life counter's data nibbles can be frozen at the last value, the increment size of the counter can be increased or a factor/offset applied.

The screenshot shows a software interface for 'Funktion 05: Manipulation des Counter-Feldes'. At the top, there are several tabs: '09 - SC Rampe', '10 - SC Prüfsumme', '11 - SC Ausfall', '12 - Protokoll-Timings', '13 - Tick-Timings', '04 - FC2 Rampe', '05 - Laufender Counter', '06 - FC Prüfsumme', '07 - Status-Bits', and '08 - SC Feste Werte'. The '05 - Laufender Counter' tab is selected. The main area contains three settings: 'Anzahl Wiederholungen' with a value of 1.000 and a note '(0 -> unendlich)', 'Einfrieren' with an unchecked checkbox, and 'Schrittweite' with a value of 16.

0	7	:	F	C	R	i	n	g	C	o	u	n	t	e	r		
R	e	p	e	a	t	:				e	n	d					
M	o	d	e	:						s	t	e	p		s	i	z
s	t	e	p		s	i	z	e	:								5

Illustration 14: Function 07 – Screenshot and display output

Function 07		
Property	Range	Description
Repeat	0 - 100,000	Number of repetitions (0 = infinite - cancellation only by button)
Mode		Send last value unchanged (freeze), constant increment between counter values or Factor/ Offset to the last value
Step size	0 - 255 ⁴	Increase counter before every new message by n steps (value not present if "yes" is selected for freeze).
Factor	-1,000 - +1,000	Factor applied with max. 3 decimal places
Offset	-1,000 - +1,000	Offset applied with max. 3 decimal places

⁴Range of values depends on the number of data nibbles for the counter (255 = 2 data nibbles)

7.3.11 FUNKTION 11 – SLOW CHANNEL STATIC VALUES

Availability: This function is only available if Slow Channel is used in the sensor settings.

Functionality: A permanent constant value can be transmitted for certain identifiers with this function. The identifiers for which this change should be realised can be selected. Each identifier for the change of value can be activated or deactivated by pressing the start button.

1	1	:	S	C		S	t	a	t	i	c	V	a	l	u	e	s
0	1	:		*		0	3	h	⁴				0	0	3	F	h
0	2	:				1	4	h	⁸				0	1	2	3	h
0	3	:		*		2	A	h	⁸				0	0	0	A	h

Illustration 18: Function 11 – Screenshot and display output

Function 11		
Property	Range	Meaning
First number	0 - 31	Line index
Star		Value of highlighted identifier is changed
Second number	0 - 255	serial ID
Superscripted number	4 / 8	Identification of 4Bit or 8Bit size of the Identifier follows when using Enhanced Serial Format
Last number	0 - 4095 ⁵	Fixed value for the change of sensor data

⁵ Range of values depends on serial protocol and size of the identifier

7.3.13 FUNKTION 13 – SLOW CHANNEL CHECKSUM

Availability: This function is only available if Slow Channel is used in the sensor settings.

Functionality: The test sum of an Identifier or of all Identifiers in the Slow Channel can be frozen or set to a fixed value.

1	3	:	S	C	C	h	e	c	k	s	u	m					
R	e	p	e	a	t	:									1	0	x
F	r	e	e	z	e	:										n	o
															-	-	>

1	3	:	S	C	C	h	e	c	k	s	u	m					
S	i	n	g	l	e	I	D	:							y	e	s
I	d	e	n	t	i	f	i	e	r	:					0	3	h ⁴
															-	-	>

1	3	:	S	C	C	h	e	c	k	s	u	m					
V	a	l	u	e	:										0	F	h
<	-	-															

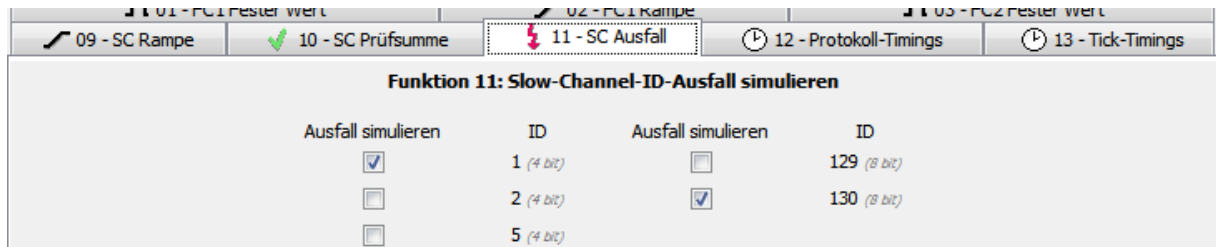
Illustration 20: Function 13 – Screenshot and display output

Function 13		
Property	Range	Description
Repeat	0 - 100,000	Number of repetitions (0 = infinite – cancellation only by button)
Freeze	yes / no	Transmit last value unchanged
individual ID	yes / no	Manipulate test sum for individual ID or all IDs in the Slow Channel
Identifier	0 - 255	Serial ID (value not present if “no” is selected for individual ID)
Fixed value	0 - 15	Transmit set value (value not present if “yes” is selected for freeze).

7.3.14 FUNKTION 14 – SLOW CHANNEL DISABLE IDENTIFIER

Availability: This function is only available if Slow Channel is used in the sensor settings.

Functionality: Transmission of certain identifiers can be prevented.



1	4	:	S	C	I	D	D	i	s	a	b	I	e				
0	3	h	⁴	*		0	F	h	⁸			2	C	h	⁸		
0	4	h	⁴	*		1	A	h	⁸	*		2	D	h	⁸		
0	A	h	⁸			2	B	h	⁸			2	E	h	⁸		

Illustration 21: Function 14 – Screenshot and display output

Function 14		
Property	Range	Description
First number	0 - 255	serial ID
Superscripted number	4 / 8	Identification of 4Bit or 8Bit size of the Identifier for Enhanced Serial Format
Star		Highlighted Identifiers are no longer transmitted.

Availability: This function is always available.

[illegible]

Function 16		
Property	Range	Description
Repeat	0 - 100,000	Number of repetitions (0 = infinite – cancellation only by button)
Ticktime	3 - 1000us	Time for a single tick

Availability: This function is always available.

	1	7	:	I	n	t	e	r	r	u	p	t	i	o	n				
	R	e	p	e	a	t	:										1	0	x
	O	f	F	-	T	i	m	e	:				1	0	0	0	m	s	
	O	n	-	T	i	m	e	:					1	0	0	0	m	s	

Function 17		
Property	Range	Description
Repeat	0 - 100,000	Number of repetitions (0 = infinite – cancellation only by button)
Off time	0 - 90.000s	Duration of communication failure
On time	0 - 90.000s	Duration of communication

7.3.18 FUNKTION 18 – SET DATA NIBBLE INDIVIDUAL

Availability: This function is always available.

Functionality: The number of data nibbles can be varied and individual data nibbles manipulated specifically online. The respective nibble can be activated for the change in value or the original value maintained by pressing the start button.

1	8	:	S	i	n	g	l	e		N	i	b	b	l	e				
R	e	p	e	a	t	:										1	0	x	
D	a	t	a	N	i	b	b	l	e	:							1	0	
																-	-	>	

1	8	:	S	i	n	g	l	e		N	i	b	b	l	e				
N	i	b	b	l	e	0	1	:								0			
N	i	b	b	l	e	0	2	:								0		*	
N	i	b	b	l	e	0	3	:								3		*	

Illustration 25: Function 18

Function 18		
Property	Range of value	Description
Number	0 - 100,000	Number of repetitions (0 = infinite – cancellation only by button)
Data nibble	0 - 10	Number of data nibbles to be transmitted
Nibble01 - Nibble10	0 - 15	Defined nibble value
Star		Maintain original value or manipulate nibble

7.5 SUB_MENU SLOW CHANNEL SORTED

All received and transmitted data from the Slow Channel is shown in this menu. The values are sorted ascendingly by Identifier. Identifiers received but not described by the sensor configuration are marked with a star at the beginning of the line.

The current mode and the activation of individual functions and the number of their repeats is graphically displayed in the top line (see description chapter 7.4).

-	→	-	[-	•	-]	-	→	-		R	x				C	R	C
0	8	:		2	8	8				2	7	7						3	6
0	9	:		3	4	8						0							8
*	1	:		7	8					1	0	2	4					4	2

Illustration 27: Slow Channel actual values sorted by ID

Individual values can be changed directly online in the *Simulation* mode via the *Setting* rotary switch. The respective incremental increase/decrease is indicated by the shown cursor position.

It is possible to scroll between the individual entries by turning the *Navigation* rotary switch. The menu can be exited again by pressing the *Navigation* rotary switch.

7.6 SUB_MENU SLOW CHANNEL RX/TX LIST

Either all received (Rx) or all transmitted data (Tx) from the Slow Channel including their test sums are displayed in this menu. The 50 last received Identifiers are displayed.

The list can be stopped at the last value by pressing the *Setting* rotary switch, in order to read and analyse the data better.

It is possible to scroll between the individual entries by turning the *Navigation* rotary switch. The menu can be exited again by pressing the *Navigation* rotary switch.

8 CONFIGURATION SOFTWARE

Configuration software for PC is available for the SENT simulator with which the settings of the SENT interfaces, the sensor parameters and the manipulation functions can be carried out. This allows the device to be quickly and conveniently preconfigured. All settings can be simultaneously read out from one device and stored on a PC.

The connection between SENT Simulator and PC is made by USB. The following describes the requirements on the PC, the installation of the required drivers and the operation of the software.

8.1 MINIMUM SYSTEM REQUIREMENTS

To guarantee the complete functionality of the configuration software, the following system characteristics are required:

- Operating system Win7 / Win8 / Win10
- USB 2.0 Interface
- Administrative rights to install USB device drivers

8.2 USB DRIVER INSTALLATION

The USB device driver must first be installed at first use of the FlexGen-M SENT on a PC. To do this, follow the instructions given below:

1. Start the tool zadig-2.4.exe
2. Select ,List All Devices' in the ,Options' menu.
3. Select the device ,FlexGen-M SENT' in the dropdown window of the main menu.
4. Select ,libusb-win32 (v1.2.6.0)' as driver and install it.
5. Now data can be exchanged between PC software and the connected device.

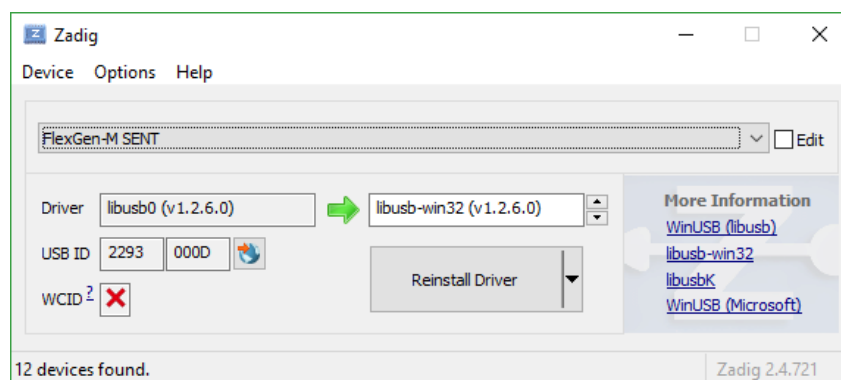


Illustration 28: Select the SENT Simulator and install driver.

8.3 OPERATING INTERFACE

The configuration software is started in German via the file *SENT-Simulator-DE.exe* or in English via the file *SENT-Simulator-EN.exe*. All sensor information stored on the device will be read out automatically and displayed in the operating interface.

The software can also be started without a connected device. In this case however, configurations can only be created which are stored on the PC and can be transferred for example at a later time to a SENT Simulator.

The operating interface is shown in 0. The individual elements are described below

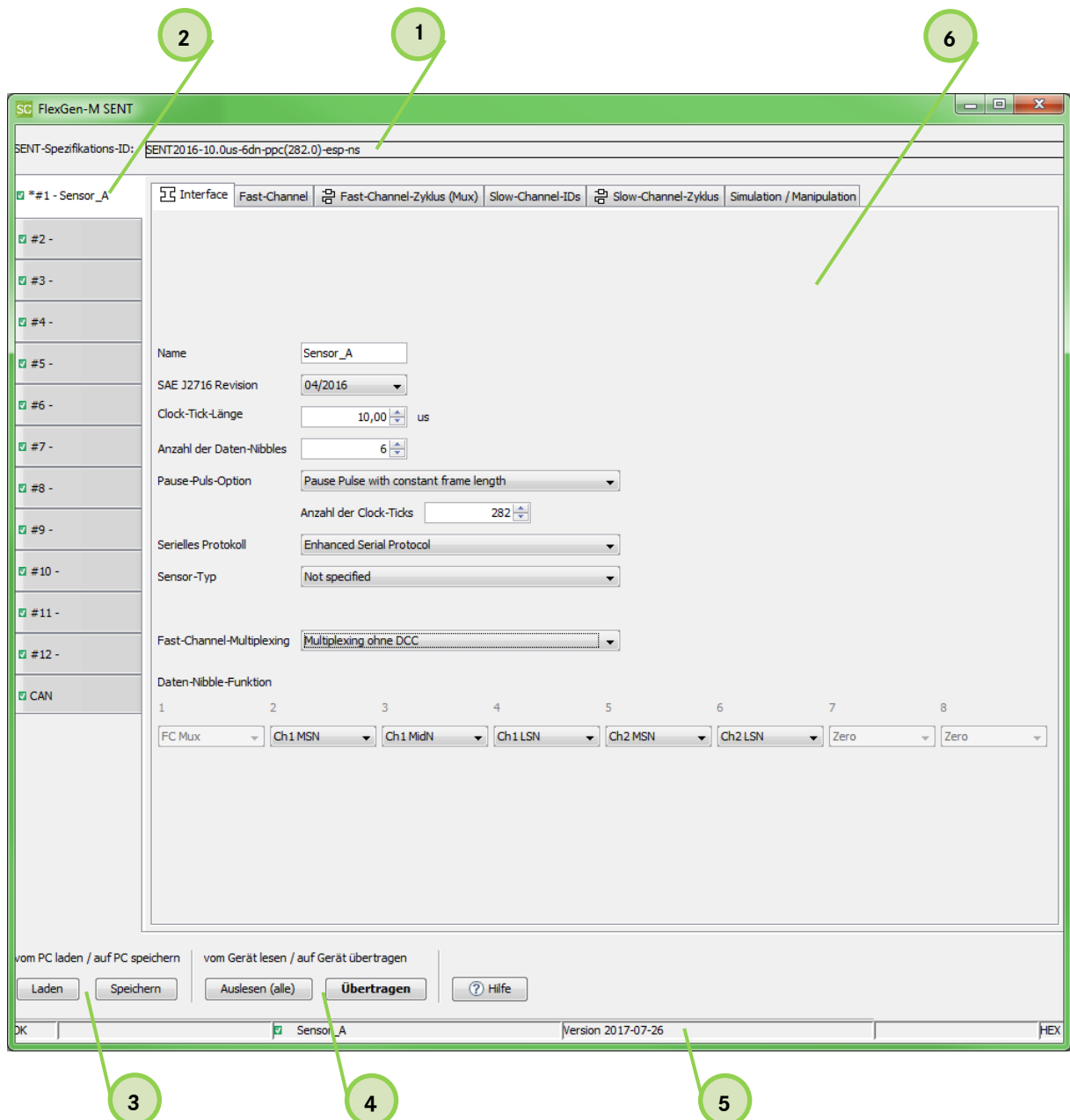


Illustration 29: Configuration Interface

1

SENT-Specification-ID

The short notation of the SENT interface is displayed, as is described in the Norm SAE J2716 after revision 01/2010 in chapter 7 (Configuration Shorthand).

2

Sensor-selection

Up to 5 sensors can be managed simultaneously. In the tab the sensor number and an individual sensor name is displayed for identification. A green tick or a red cross indicate whether a sensor configuration is valid.

3

Load / Save

The settings of all 5 sensors can be stored as a file on the PC and also loaded from this file using the Load and Save buttons.

4

Read / Transfer

If a SENT simulator is connected by USB, the current settings can be read from the device or a single or all sensor settings transferred to the device.

5

Status bar

Transfer instructions or any false configurations are displayed in the bottom status bar. At the same time it is possible to change between decimal and the hexadecimal value displays by clicking on the far right.

6

Setting possibilities

There are many setting possibilities to describe a SENT participant completely. These can be undertaken via the *Interface*, *Fast-Channel*, *Slow-Channel-IDs* and *Slow-Channel cycle* tabs.

The functions for changing the SENT output signal can be configured in the *Simulation/ Manipulation* tab.

8.3.1 INTERFACE

As described in 0, the general and minimum necessary settings for the SENT interface can be undertaken in the *Interface* tab.

SENT Interface (Minimum configuration)	
Designation	Description
Name	max. 10 character individual designation of the sensor used
SAE J2716 Revision	Applied revision of the SAE specification
Clock-Tick-length	Time interval per tick in microseconds
Number of data nibbles	Number of used data nibbles per message
Pause-Pulse-Option	Use of an optional pause pulse between messages optional and Option is only available from revision 01/2010
Number of clock ticks	Number of ticks for calculation of the pause pulse Option is only available from revision 01/2010
Serial protocol	Use of a serial protocol within the status field Enhanced Serial Protocol is only available from revision 01/2010
Sensor-Type	Pre-selection of a sensor as per appendix of SAE standard
Fast Channel Multiplexing	Fast Channel Multiplexing is supported from the revision 2016. This can be activated or deactivated and the DCC (Data Consistency Counter) used
Data nibble function	Assignment of the data nibble to the respective Fast Channel or cycle counter

8.3.2 FAST CHANNEL

Values and units for conversion between the transferred raw values and a physical quantity can be specified in the Fast-Channel tab. A starting value (default value) for the simulation of sensors can be specified at the same time.

Depending on the interface settings, it may be that one or both Fast-Channels are not available. Each multiplexer can have its own conversion specified when using multiplexing.

The screenshot shows the 'Fast-Channel' tab in a software interface. It contains two main sections: 'Fast Channel 1' and 'Fast Channel 2'. 'Fast Channel 1' is active and shows input fields for 'Rohwert' (Raw Value) and 'Phys. Wert' (Physical Value). The 'Rohwert' field has a value of 'p' and the 'Phys. Wert' field has a value of '-40,000 °C'. Below these are fields for 'Maximum' (4095), 'Faktor' (0,2), 'Offset' (-40), and 'Einheit' (°C). A formula is displayed: $phy_value [^{\circ}C] = (0,2000 \times raw_value) - 40,0000$. At the bottom, there are 'Default-Wert' fields with values 200 and 0, and a unit °C. 'Fast Channel 2' is inactive and shows a message: 'nicht verfügbar (siehe Daten-Nibble-Funktion auf der Seite Interface)'.

Illustration 30: physical conversion of FAST Channel

Fast-Channel (physical conversion)	
Designation	Description
Minimum	Smallest raw value used for the conversion (smaller values are not converted into a physical unit)
Maximum	Greatest raw value used for the conversion (greater values are not converted into a physical unit)
Factor	Factor used for the conversion
Offset	Offset used for the conversion
Unit	max. 4 character physical unit for display
Default-value	Start value for the simulation of sensors

8.3.3 FAST CHANNEL CYCLE (MUX)

The multiplex sequence can be defined when using Fast Channel Multiplexing. Up to 16 messages can be specified.

8.3.4 SLOW CHANNEL IDs

If serial communication is supported, all available identifiers can be stored here and provided with a start value for the simulation. Up to 32 identifiers can be activated for communication. When using Enhanced Serial Protocol, a selection can be made between 4Bit and 8Bit identifier.

Illustration 31: Identifiers for serial communication

Slow-Channel-IDs (serial communication)	
Designation	Description
Activated	Use of the identifier for the simulation of sensors and for selection in Schedule Table and function settings
Identifier	4Bit or 8Bit identifier depending on serial protocol
Default-value	Start value for the simulation of sensors

8.3.5 SLOW CHANNEL CYCLE

A cycle table (schedule table) can be stored for the simulation of a sensor via this tab, which specifies the transmitter sequence of the activated identifiers for the serial communication. Such a table can have up to 32 entries. A plus or minus sign appears above each identifier when the mouse is moved, with which an identifier can be added or removed at any desired point.

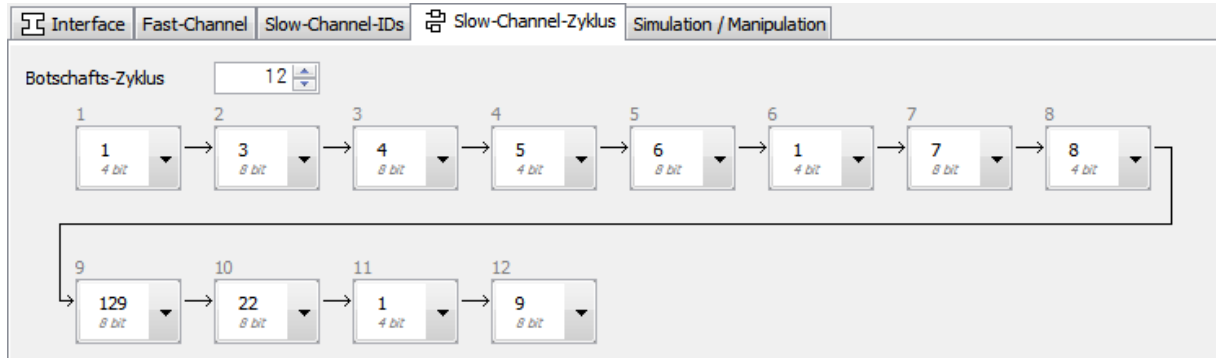


Illustration 32: Schedule table for serial communication

Slow-Channel-Cycle (serial communication)	
Designation	Description
Message cycle	Number of entries in in Schedule Table (maximum 32 entries)
Identifier	Selection possibilities from activated IDs in the Slow-Channel-ID tab(see0)
+	Add additional ID after current entry
-	Remove current entry

8.3.6 SIMULATION / MANIPULATION FUNCTIONS

As described in section 7.3 various functions can be used and individually set on the device to change the output data of the SENT simulator. The configuration software supplied also offers the possibility of adjusting the parameters of these functions. The user can thereby make their own decision between the input convenience of a PC and the fast direct adjustment directly on the device.

Not all functions are usable depending on the sensor and interface settings. The individual functions, their usability and setting possibilities are described in more detail in chapter 7.3.

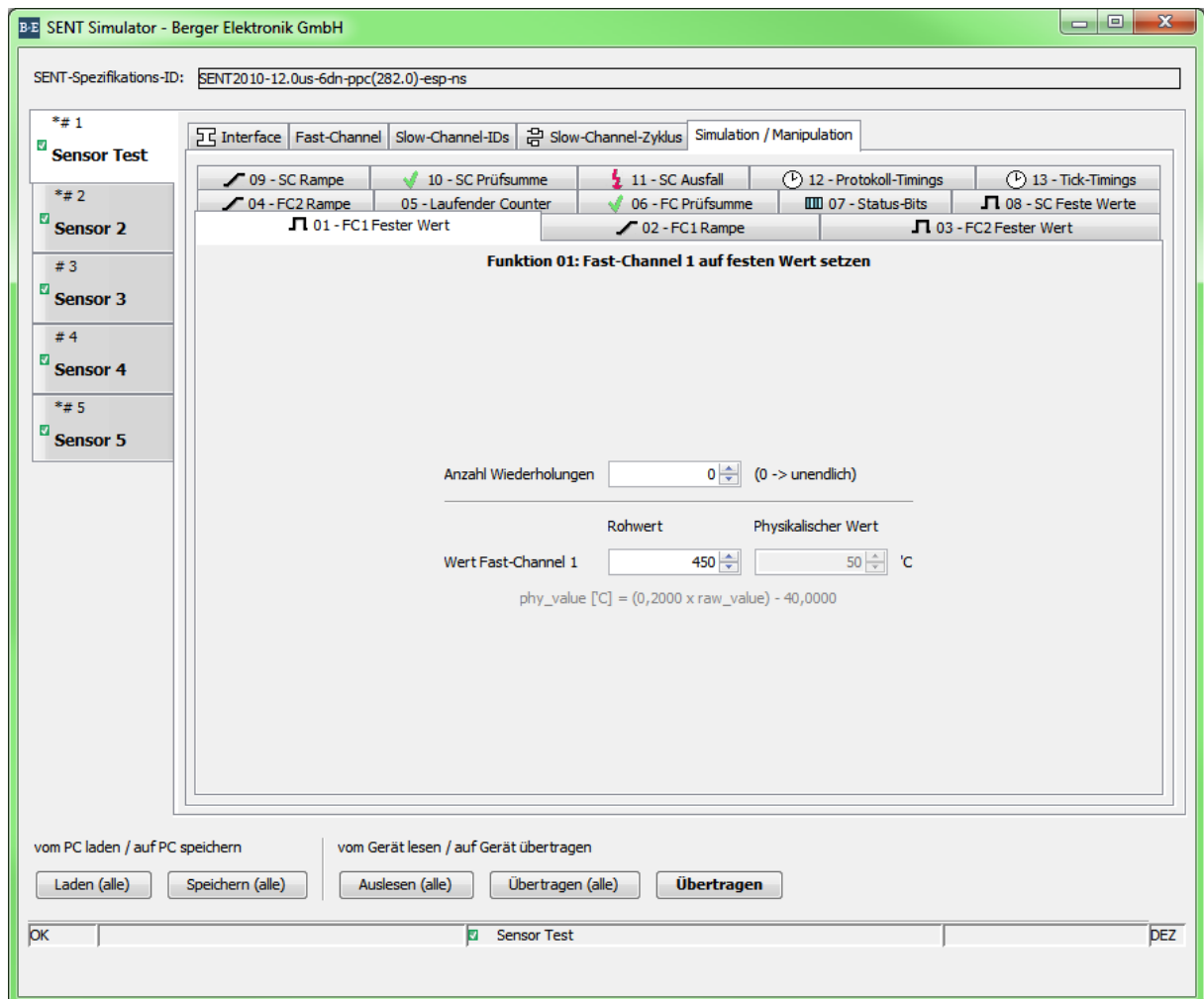


Illustration 33: Simulation/ Manipulation Functions

9 MAINTENANCE, ACCESSORIES AND SHIPPING

The device requires no special maintenance when operated properly. On request, an annual functional test can be carried out with calibration (for example, to maintain the test equipment capability of the user).

9.1 SCOPE OF SUPPLY

The following components are included in the scope of supply:

- FlexGen-M SENT device
- Documentation in German and English
- Cable for power supply on banana plugs, length 2m (BE 5106.003)
- Cable for SENT input signal (receiver) on banana plugs, length 2m (BE 5106.43)
- Cable for SENT output signal (transmitter) on banana plugs, length 2m (BE 5106.44)
- Cable for synchronization to other devices, length 2m (E468 Kabel 3)
- PC configuration software include USB device driver
- USB cable for PC connection

The following components are available as optional accessories which are not included in the standard scope of supply:

- Customer specific cables for individual connection to sensor or ECU

