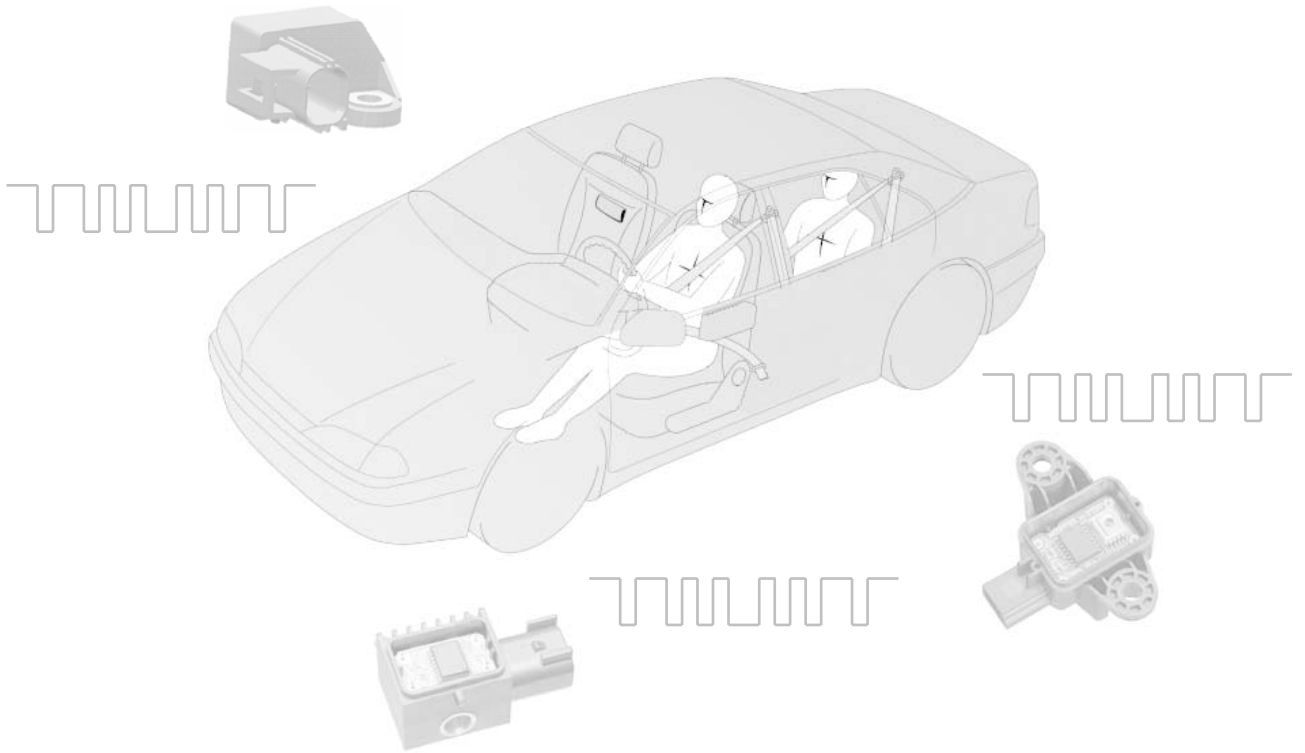


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## Document History and Modifications

Rev.N°	Chapter	Description / Changes	Date
1.0	all	First Edition	15.07.2005
1.1	3, 5,  Appendix C	Correction of CRC-Coding, Update Initialization, Introduction of errors "Time slot violation" and "Sensor ready but unlocked", Definition of $t_{INIT1}$ and $t_{INIT3}$ , Update of the parameters for the alternative synchronization signal for special requirements	30.06.2006

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# Peripheral Sensor Interface for Automotive Applications

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## 1 Introduction

### 1.1 Description

The Peripheral Sensor Interface (PSI5) is an interface for automotive sensor applications. PSI5 is an open standard based on existing sensor interfaces for peripheral airbag sensors, already proven in millions of airbag systems. The technical characteristics, the low implementation overhead as well as the attractive cost make the PSI5 also suitable for many other automotive sensor applications.

Development goal of the PSI5 is a flexible, reliable communication standard for automotive sensor applications that can be used and implemented free of charge.

The PSI5 development and the publication of this technical specification are managed by the “PSI5 Steering Committee”, currently formed by the companies Autoliv, Bosch and Continental Temic.

### 1.2 PSI5 Main features

Main features of the PSI5 are high speed and high reliability data transfer at lowest possible implementation overhead and cost. PSI5 covers the requirements of the low-end segment of digital automotive interfaces and offers a universal and flexible solution for multiple sensor applications.

- Two-wire current interface
- Manchester coded digital data transmission
- High data transmission speed of 125kbps
- High EMC robustness and low emission
- Wide range of sensor supply current
- Variable data word length (8 .. 24 bit)
- Both asynchronous and synchronous operation modes available

### 1.3 Scope

This document describes the interface according to the ISO/OSI reference model and contains the corresponding parameter specifications. PSI5 standardizes the low level communication between peripheral sensors and electronic control units.

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## 1.4 Legal Information

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## 2 System Setup & Operation Modes

### 2.1 System Setup

Figure 1 shows a typical system setup for peripheral sensors connected to an ECU with PSI5.

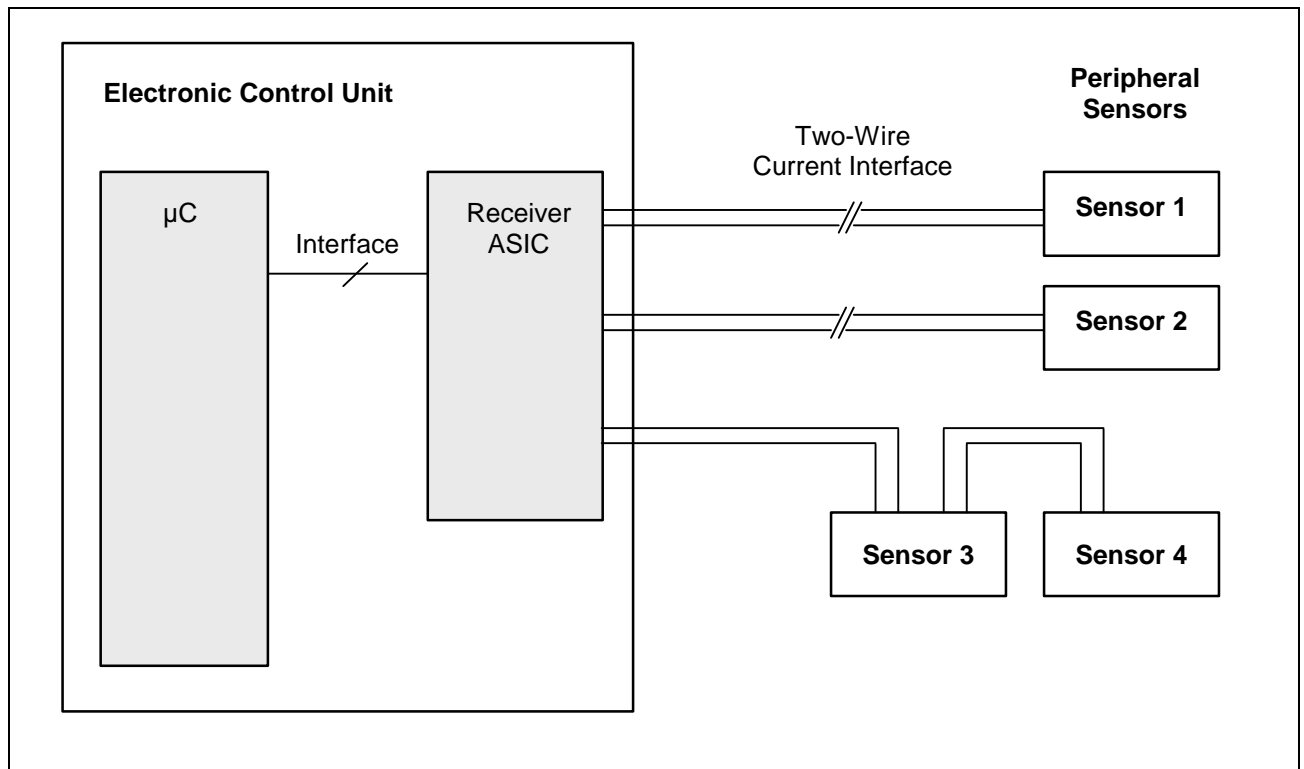


Figure 1 Connection of peripheral sensors to an ECU (Example)

The sensors are connected to the ECU by just two wires, using the same lines for power supply and data transmission. The receiver ASIC provides a pre-regulated voltage to the sensors and reads in the transmitted sensor data. The example above shows a point-to-point connection for sensor 1 and 2 and bus configuration for sensor 3 and 4.

## 2.2 PSI5-A: Asynchronous Operation

PSI5-A describes a point-to-point connection for unidirectional, asynchronous data transmission.

Each sensor is connected to the ECU by two separate wires. After switching on the power supply, the sensor starts transmitting data to the ECU periodically. Timing and repetition rate of the data transmission are controlled by the sensor.

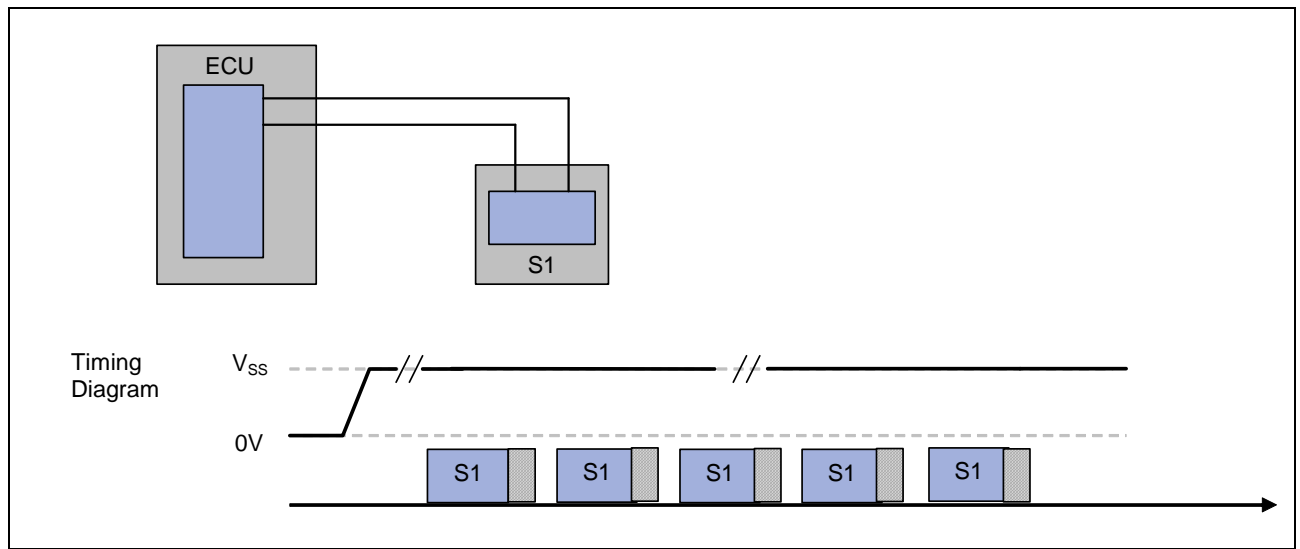


Figure 2 PSI5-A asynchronous point-to-point connection

### 2.3 PSI5-S: Synchronous Operation

The PSI5-S mode allows to transmit sensor data synchronized by the ECU. Synchronization can be optionally used for point-to-point configurations and is mandatory for the bus modes. Timing and access control are realized by two different voltage levels generated by the ECU.

#### 2.3.1 PSI5-S Bus mode, parallel topology

In the PSI5-S parallel bus configuration, sensors are connected to the ECU in parallel.

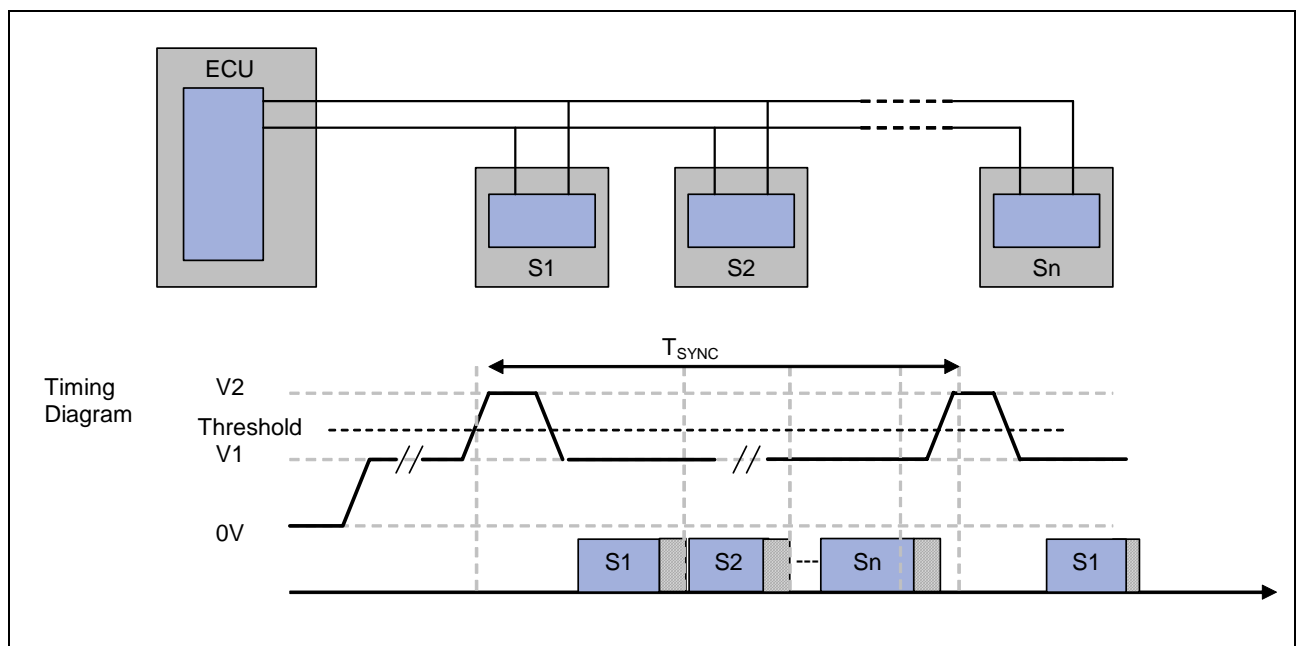


Figure 3 PSI5-S parallel bus topology

Each data transmission period is initiated by a voltage synchronization signal from the ECU to the sensors. After having received the synchronization signal, each sensor starts transmitting its data with the corresponding time shift in the assigned time slot.

Due to the parallel bus configuration, an individual numbering of the sensors is required.

### 2.3.2 PSI5-S Bus mode, serial topology

In PSI5-S serial bus configuration, the sensors are connected to the bus subsequently. Each sensor synchronizes the following sensor by a voltage shift after having completed the transmission of its own data frame.

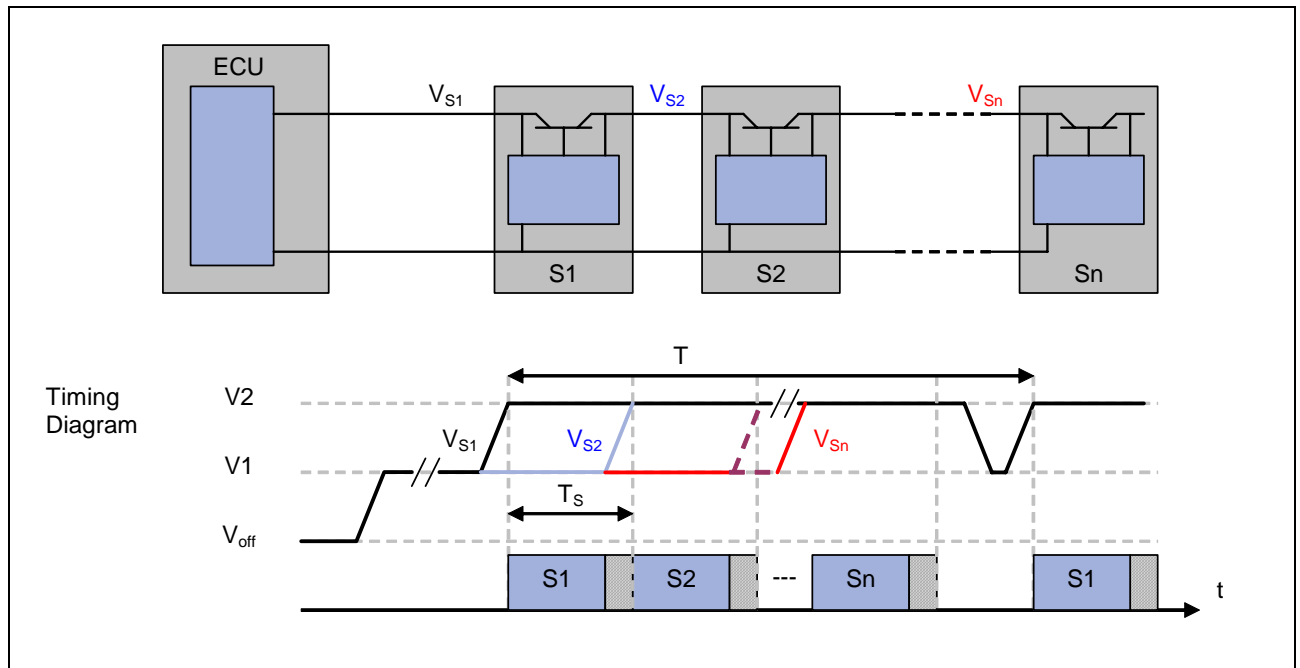


Figure 4 PSI5-S serial bus topology

## 2.4 Sensor Cluster / Multichannel

In a sensor cluster configuration, one physical sensor contains two or more logical channels. Examples could be a two channel acceleration sensor or a combined temperature and pressure sensor.

The data transmission of the different channels can be realized by splitting up the data word of each data frame into two or more blocks or by transmitting the data for the different channels in separate data frames using time multiplex.

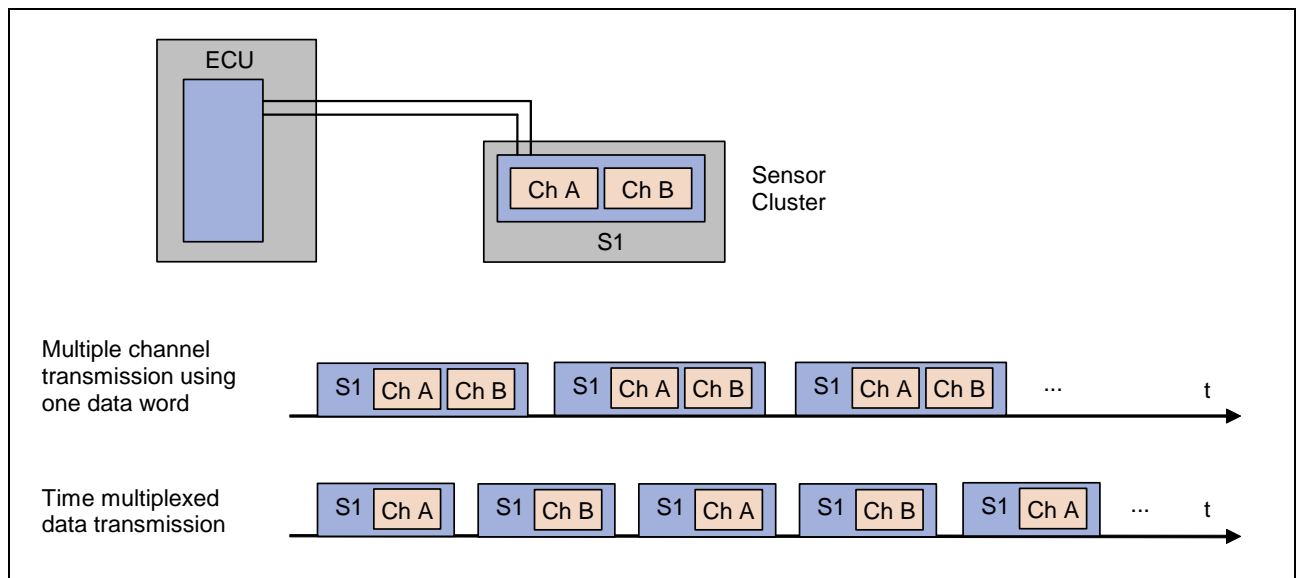


Figure 5 Sensor cluster

Sensor cluster / multichannel operation modes can be combined with both asynchronous and synchronous data transmission and with the different bus configurations.

### 3 Data Transmission

#### 3.1 Physical Layer

PSI5 uses two wires for both power supply to the sensors and data transmission. The ECU provides a pre-regulated voltage to the sensor. Data transmission from the sensor to the ECU is done by current modulation on the power supply lines.

##### 3.1.1 Bit Encoding

A "low" level ( $I_{Low}$ ) is represented by the normal (quiescent) current consumption of the sensor(s). A "high" level ( $I_{High}$ ) is generated by an increased current sink of the sensor ( $I_{Low} + \Delta I$ ). The current modulation is detected within the receiver ASIC.

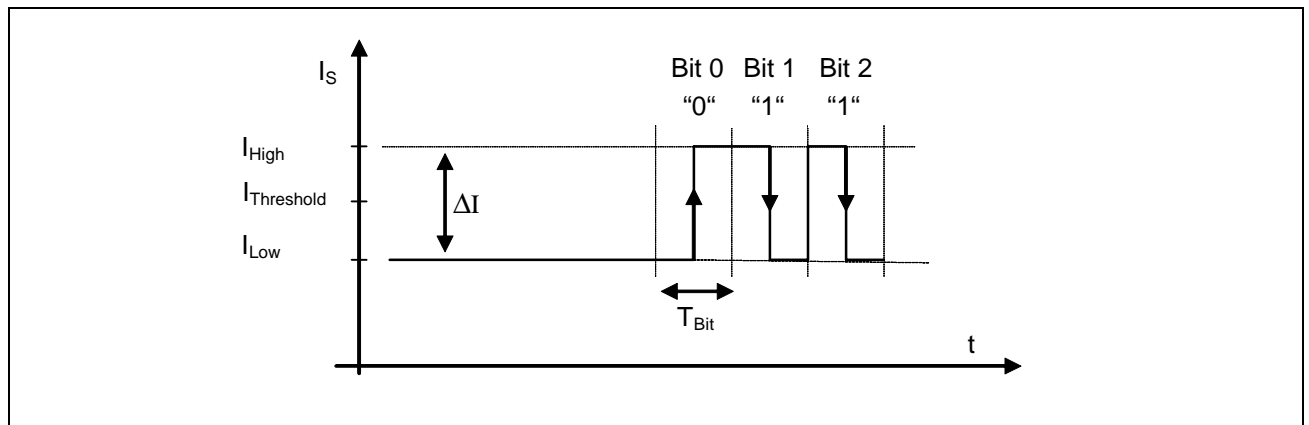


Figure 6 Bit encoding using supply current modulation

Manchester coding is used for data transmission. A logic "0" is represented by a rising slope and a logic "1" by a falling slope of the sending current in the middle of each bit.

##### 3.1.2 Synchronization

For synchronized operation and bus mode, modulation of the supply voltage between the two different voltage levels is applied. The voltage change is detected within the sensors.

### 3.2 Data Link Layer

#### 3.2.1 Data Frames

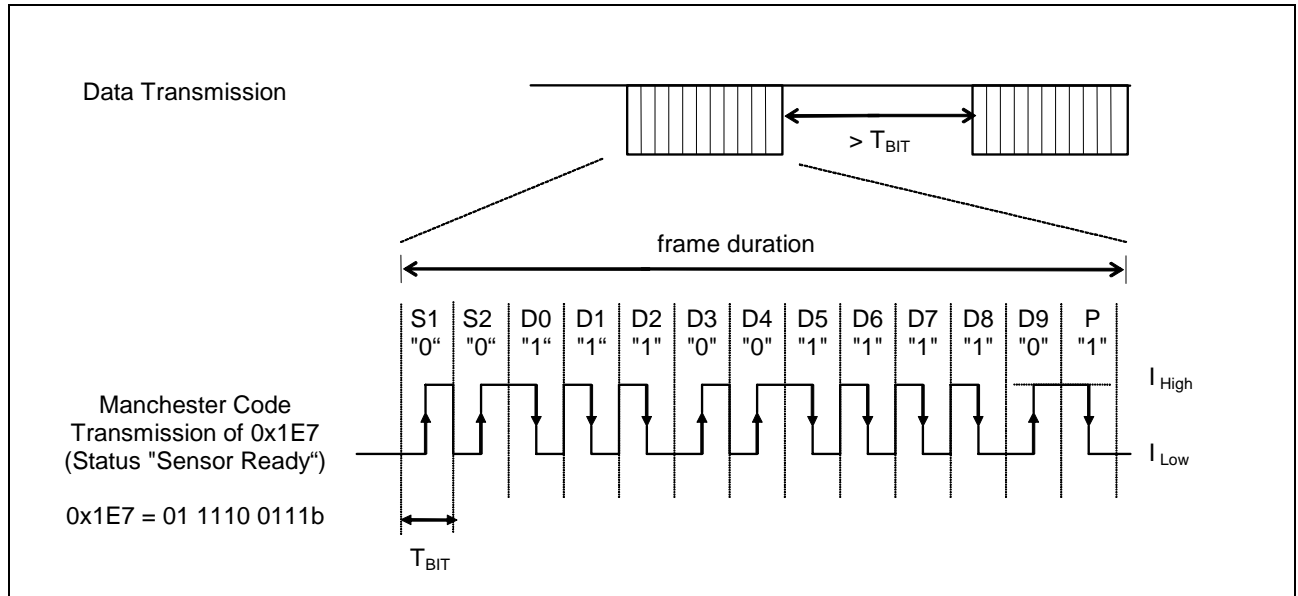


Figure 7 Example of a data frame with 10 data bits (D0-D9), 2 start bits (S1,S2) and one parity bit (P).

Each PSI5 data frame consists of N bits containing two start bits and one parity bit with even parity (or 3 CRC bits) and N-3 (N-5) data bits. Data bits are transmitted LSB first. The data frames are sent periodically from the sensor to the ECU. A minimum gap larger than one bit duration between two data frames is required.

#### 3.2.2 Error control coding

Error control coding is realized by a single bit even parity (recommended for 10 or less bits, see Figure 7) or a three bit CRC (recommended for large data words). The generator polynomial of the CRC is  $g(x)=1+x+x^3$  with a binary CRC initialization value "111". The transmitter extends the data bits by three zeros (as MSBs). This augmented data word shall be fed (LSB first) into the shift registers of the CRC check. Start bits are ignored in this check. When the last zero of the augmentation is pending on the input adder, the shift registers contain the CRC checksum. These three check bits shall be transmitted in reverse order (MSB first: C2, C1, C0).

This CRC error control coding is also applied for the Safe-by-Wire-plus (SbW+) interface the same way like it is applied here.

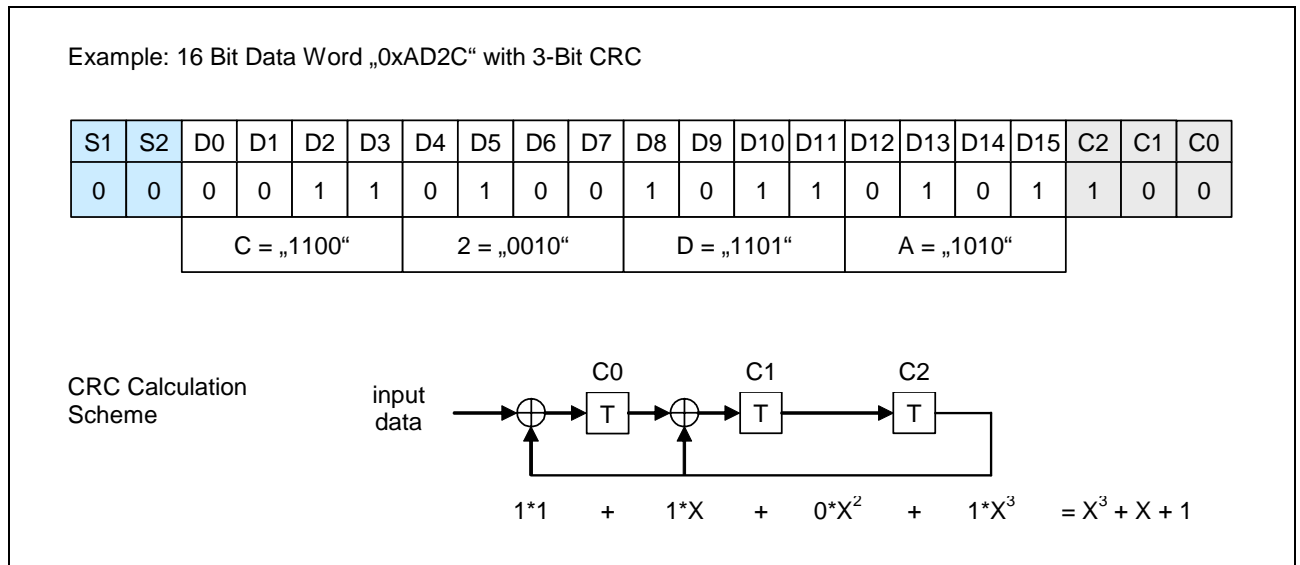


Figure 8 16 Bit Data word example with 3-Bit CRC

### 3.3 Data Range

PSI5 data messages are divided into three ranges:

- Range 1: Data Range
- Range 2: Status and error messages
- Range 3: Block IDs and data for initialization

#### 3.3.1 Data Range (10 Bit)

For 10 bit sensors, the decimal values  $-480$  to  $+480$  are used for the sensor output signal. The range  $-512$  to  $-481$  is reserved for the block and data ID's which are used for transmitting initialization data during startup of the sensor (see chapter 3.4). The range from  $+481$  to  $+511$  is used for status and error messages.

Dec	Hex	Signification	Range	
+511	0x1FF	Reserved	Status & Error Messages	2
+508	0x1FC	Manchester Error Detected by Receiver		
+506	0x1FA	Time slot violation		
+504	0x1F8	Parity Error Detected by Receiver		
+502	0x1F6	Sensor ready but unlocked		
+500	0x1F4	Sensor Defect		
+496	0x1F0	Receive Buffer Empty		
+487	0x1E7	Sensor Ready		
+480	0x1E0	Highest Positive Sensor Signal	Sensor Output Signal	1
:	:	:		
0	0x000	Signal Amplitude "0"		
:	:	:		
-480	0x220	Highest Negative Sensor Signal	Block ID's and Data for Initialization	3
-481	0x21F	Status Data 1111		
:	:	:		
-496	0x210	Status Data 0000		
-497	0x20F	Block ID 16		
:	:	:		
-512	0x200	Block ID 1		

Table 1 Data Range (10 bit data words)

### 3.3.2 Scaling of Data Range

The sensor output signal range scales with the data word length. For sensors with a data word length of more than 10 bit, status and initialization data words of range 2 and 3 are filled up by appending zeros to the LSBs.

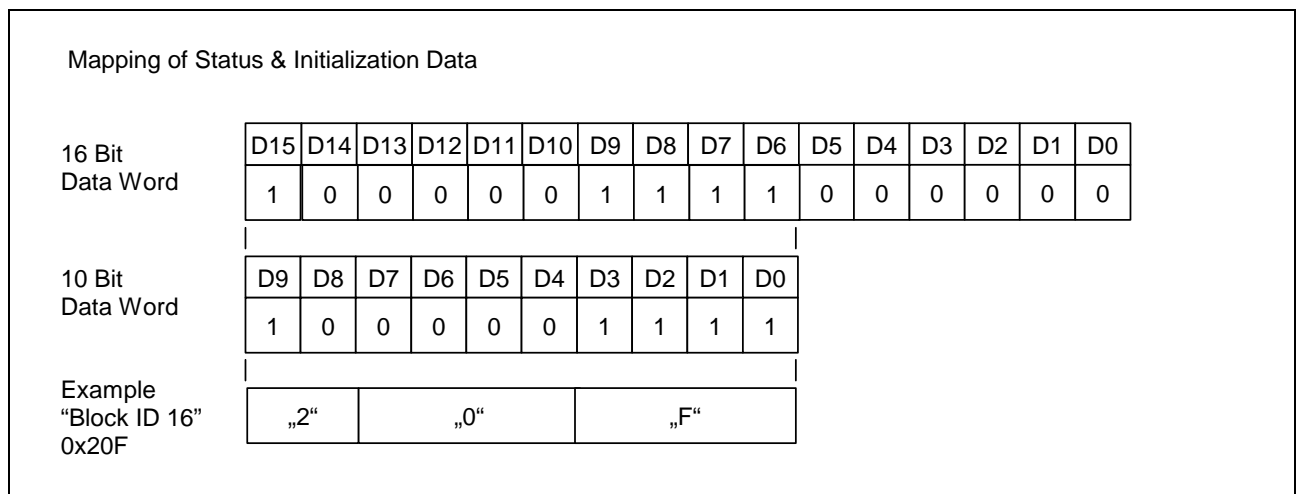


Figure 9 Code word mapping for initialization phase 2

### 3.3.3 Data Range (16 Bit)

Dec	Hex	Signification	Range	
+32704	0x7FC0	Reserved	Status & Error Messages	2
+32512	0x7F00	Manchester Error Detected by Receiver		
+32384	0x7E80	Time slot violation		
+32256	0x7E00	Parity Error Detected by Receiver		
+32128	0x7D80	Sensor ready but unlocked		
+32000	0x7D00	Sensor Defect		
+31744	0x7C00	Receive Buffer Empty		
+31168	0x79C0	Sensor Ready		
+30720	0x7800	Highest Positive Sensor Signal	Sensor Output Signal	1
:	:	:		
0	0x0000	Signal Amplitude "0"		
:	:	:		
-30720	0x8800	Highest Negative Sensor Signal	Block ID's and Data for Initialisation	3
-30784	0x87C0	Status Data 1111		
:	:	:		
-31744	0x8400	Status Data 0000		
-31808	0x83C0	Block ID 16		
:	:	:		
-32768	0x8000	Block ID 1		

Table 2 16 bit data range

### 3.4 Initialization

#### 3.4.1 Sensor Start-Up and Initialization

After each power on or under-voltage reset, the sensor performs an internal initialization which is divided into three phases:

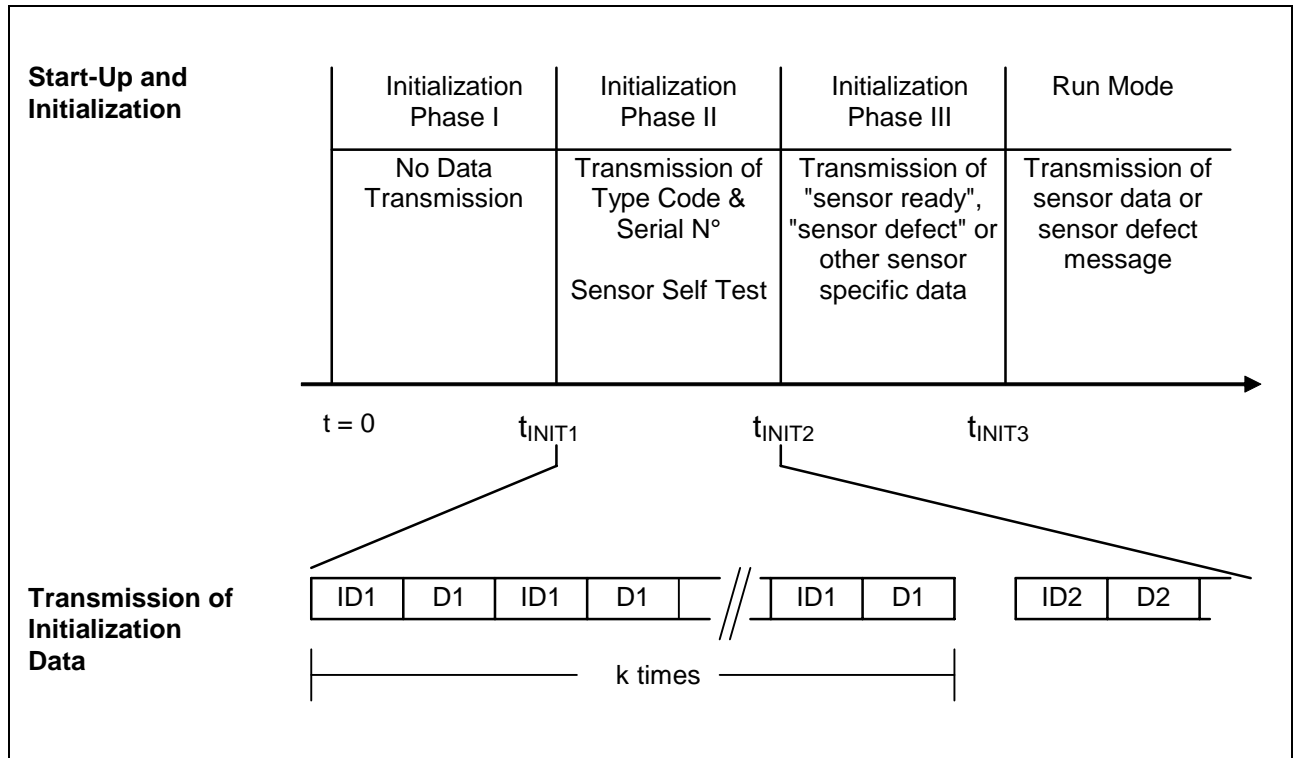


Figure 10 Initialization of the sensor

After any power-on or undervoltage reset, the internal logic starts up with an initialisation program.

	Initialisation Phase I	Initialisation Phase III
Duration of initialization phases	$t = 80 \dots 150$ ms Typical: 100 ms	Minimum: 2 messages Maximum: 200 ms Typical: 10 values

Table 3 Definition of  $t_{INIT1}$  and  $t_{INIT3}$

During the first initialization phase, no data is transmitted and the ECU can perform a connectivity test. During the second initialization phase, the sensor transmits sensor and application specific information to the ECU. During the third initialization phase, the sensor transmits a "sensor ready" or "sensor defect" message as a result of internal tests.

If the sensor is defective, it will continue to send the "sensor defect" messages until it is powered off. The sensor defect message must consist of data words out of data range 2 and 3. Usage of sensor output signal data words out of data range 1 is not allowed during initialization phases II and III.

If the initialization is finished successfully, the sensor goes into run mode and starts transmitting sensor signal data until it is switched off or an internal error is detected.

### 3.4.2 Initialization data format

A special data format and a reserved data range are used during initialization in order to avoid possible mix-up with sensor signal data. “Data Range 3” contains each 16 block identifiers and 4-bit data nibbles (see chapter 3.3).

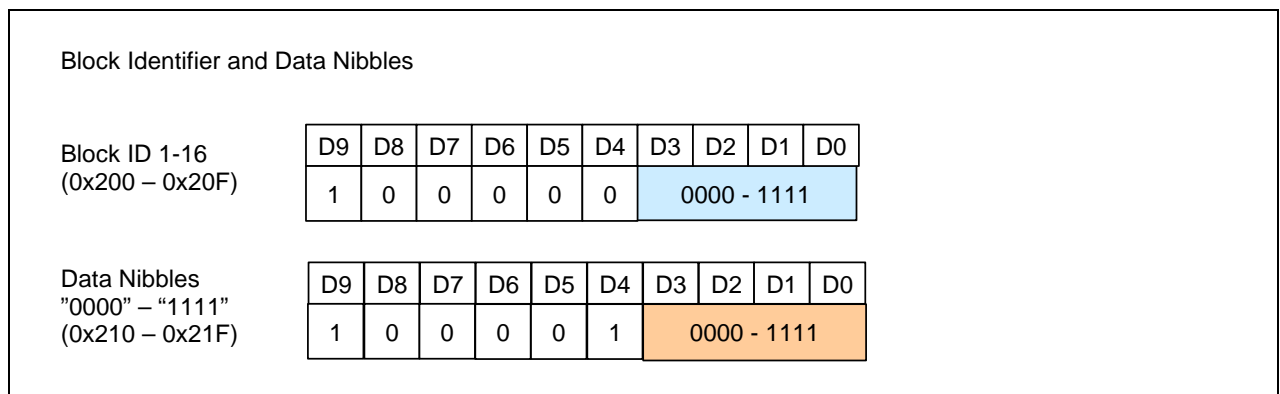


Figure 11 Block ID and Data Nibbles

ID blocks and data blocks are sent in an alternating sequence, “k” times each. The block identifiers are used for a numbering of the following data nibbles.

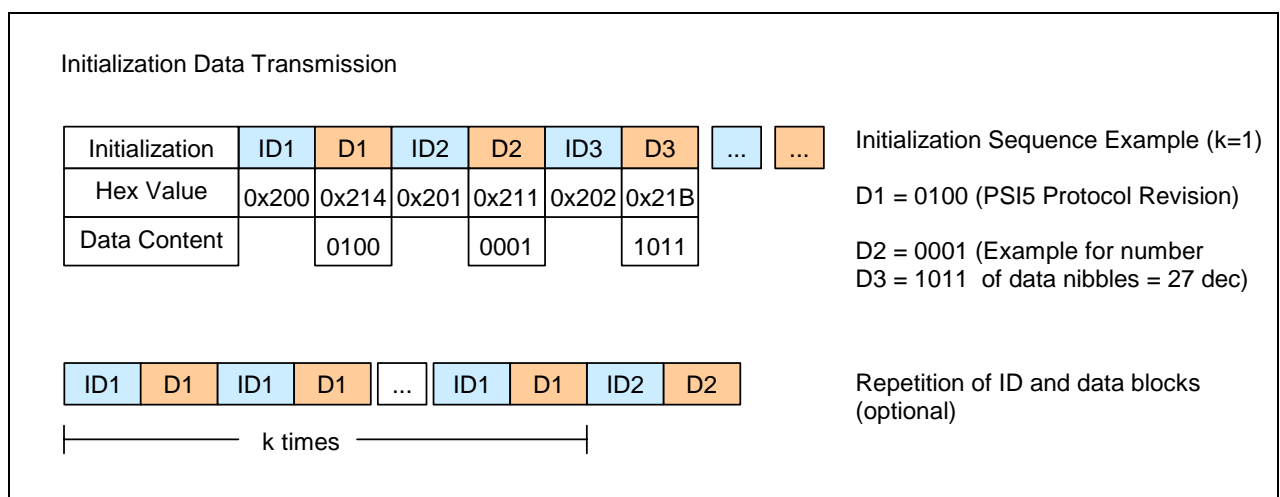


Figure 12 Startup Sequence

If the initialization data exceeds 4x16=64 bit (more than 36 bit of sensor specific information), data can be paged. The ID codes are reused for every 64 bit page of data to be transmitted. Data pages are not numbered. Mapping of the information contained in different data pages has to be derived from the chronology of the startup sequence. It is not mandatory to transmit complete data pages.

The initialization data is based on a 10 bit data word length (see chapter 3.3). Initialization for data frames with less than 10 bit is not specified here. Please refer to PAS3 or equivalent protocols.

#### Initialization data content

The initialization data contains the following information:

- PSI protocol revision
- Total number of data blocks (nibbles) transmitted during initialization
- Manufacturer Code
- Sensor Type
- Sensor and application specific information

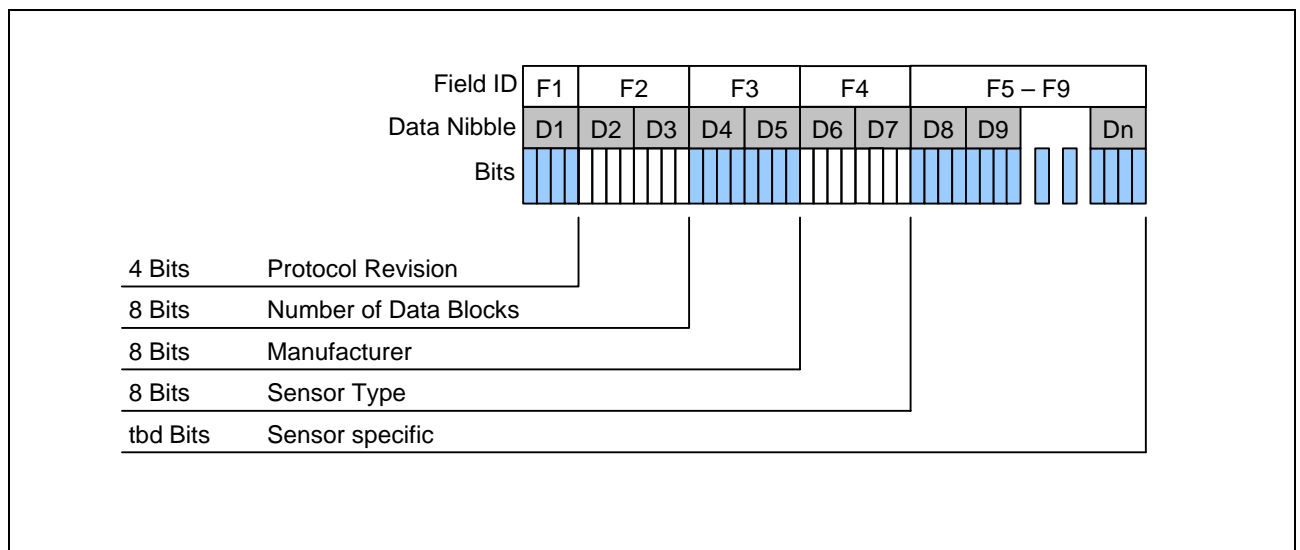


Figure 13 Initialization phase 2: Data Content

Field ID	Name	Bits	Examples	
Mandatory data for all sensors				
A	F1	Protocol revision	4	PSI5 V1.0
	F2	No. of data blocks	8	32 x 4
	F3	Manufacturer code	8	Autoliv, Bosch, Temic,...
	F4	Sensor type	8	Acceleration sensor, 1 channel
Sensor and application specific data				
B	F5	Sensor parameter	8	Bus type 0, X-axis, 100 g
	F6	Sensor code (sensor manufacturer)	8	Housing type 38
	F7	Sensor code (vehicle manufacturer)	12	Q-status "2F"
	F8	Production date	16	2006-06-30
	F9	Line / lot / serial number	56	Lot and serial number

Table 4 Field IDs and the corresponding data

An exemplary data content of the initialization phase 2 for restraint systems can be found in figure 14. This is the recommended version for all kinds of applications:

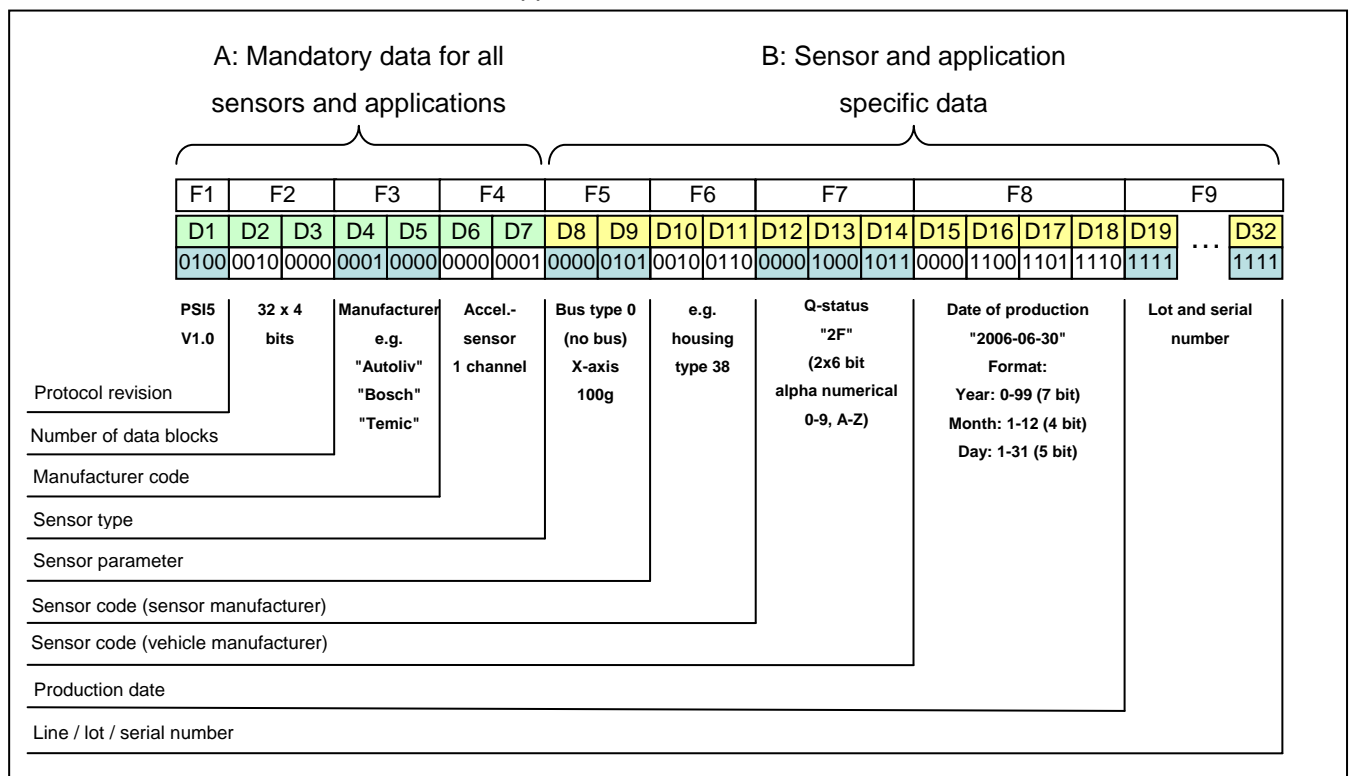


Figure 14 Initialization phase 2: Recommended Data Content

For special applications a deviation from the recommended data content regarding part B (sensor and application specific data) is possible.

## 4 Parameter Specification

### 4.1 General

All voltage and current values are measured at the sensor's connector pins unless otherwise noted.

Values in brackets denote redundant parameters that can be calculated by other specified values and are for illustration purposes only.

### 4.2 Absolute maximum ratings

Parameter	Symbol/Remark	Min	Typ	Max	Unit
Supply voltage *	$V_{SS}$			16.5	V

Table 5 Absolute maximum ratings

\* Higher supply voltages may be specified if required for the application

### 4.3 General Parameters

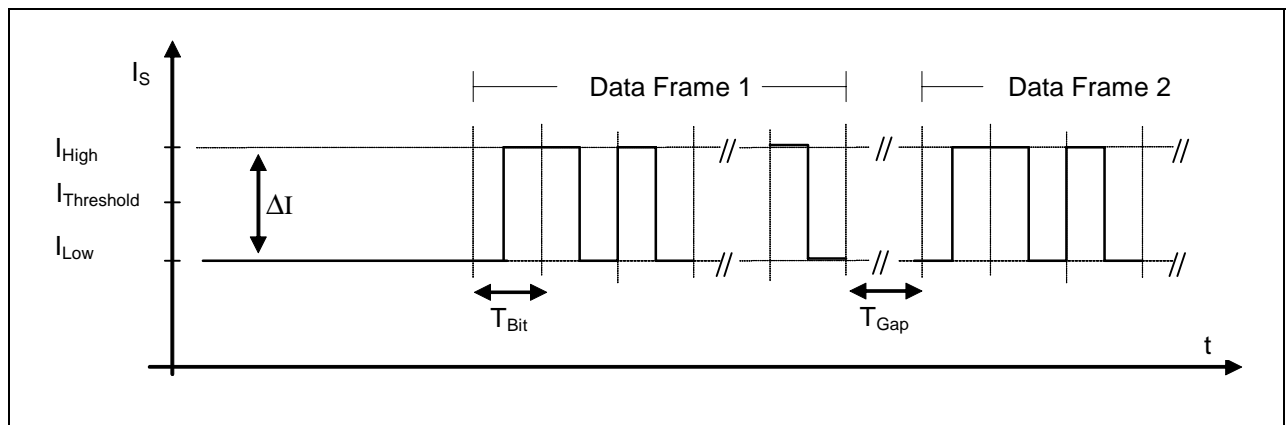


Figure 15 Data frame timing

Parameter	Symbol/Remark	Min	Typ	Max	Unit
Bit time	$T_{\text{Bit}}$	7.6	8.0	8.4	$\mu\text{s}$
Sensor internal clock deviation during data frame *1)				0.1	%
Gap time	$T_{\text{Gap}} > T_{\text{Bit}}$	8.4			$\mu\text{s}$
Sink current $\Delta I$	$\Delta I = I_{\text{High}} - I_{\text{Low}}$	17.0	20.0	30.0	mA
Fall/Rise Time Current Slope *2)	10%..90%	0		1.0	$\mu\text{s}$
Quiescent current consumption *3)	$I_{\text{Low}}$	0		19.0	mA
Tolerance of quiescent current *3)				4.0	mA
Quiescent current, drift rate *3)				1.0	mA/min
Init phase 2 message repetition count	k	1	4	16	times
Maximum temperature gradient				4	K/min

Table 6 General parameters of the PSI5 interface

\*1) Maximum temperature gradient and maximum frame length

\*2) Small rise and fall times lead to increased radiated emission

\*3)  $I_{\text{Low}}$  is the (initial) quiescent current of the sensor. Over lifetime and temperature, the quiescent current may vary by +/- 4.0 mA but must not exceed the limits for  $I_{\text{Low}}$  set to 19 mA. Means for an adaptive current threshold may be required in the receiver in order to cope with varying quiescent currents, especially when connected in bus systems.

#### 4.4 Sensor power on characteristics

To ensure a proper startup of the system, a maximum startup time is specified. During this time, the ECU must provide a minimum current to load capacitances in sensors and wires. After this time, the sensor must sink quiescent current within the specified tolerance band.

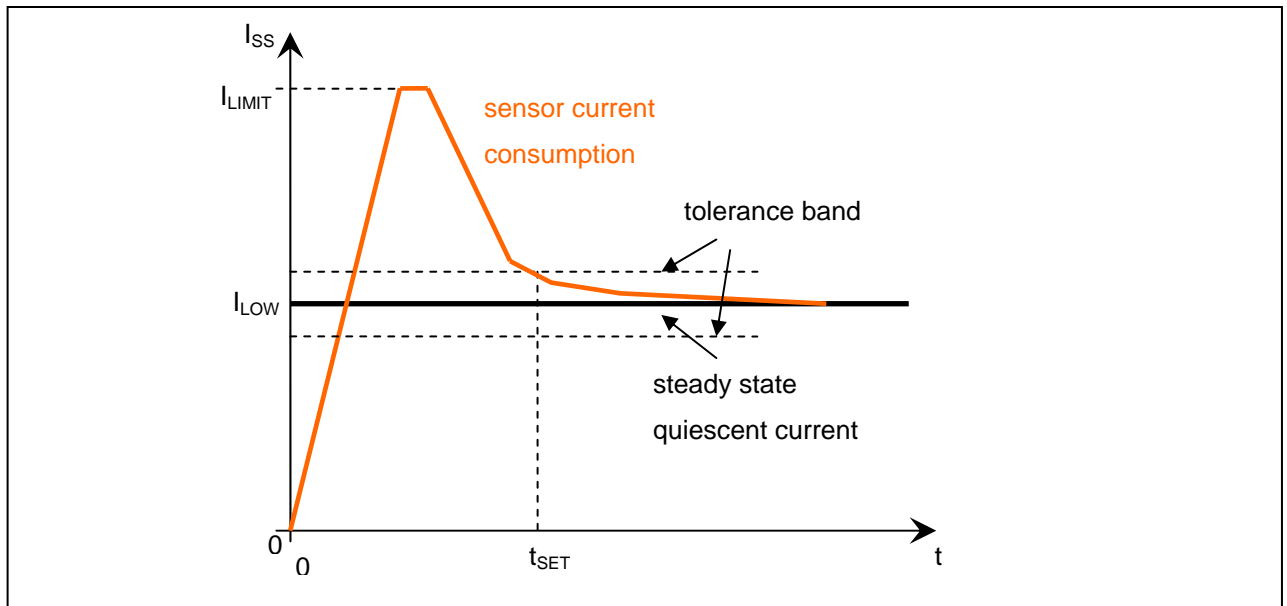


Figure 16 Current consumption during startup

Parameter	Symbol/Remark	Min	Typ	Max	Unit
ECU current limitation	$I_{LIMIT}$	50.0			mA
Set time for quiescent current $I_{LOW}$ *	$t_{SET}$ ( $I_{LIMIT}=50$ mA)			5.0	ms

Table 7 Sensor power on characteristics

\* Quiescent current tolerance applies here (see Table 6)

#### 4.5 Supply line modeling

PSI5 usually uses twisted pair lines which are modeled as shown in Figure 17. Parameter specification is done for the different bus topologies.

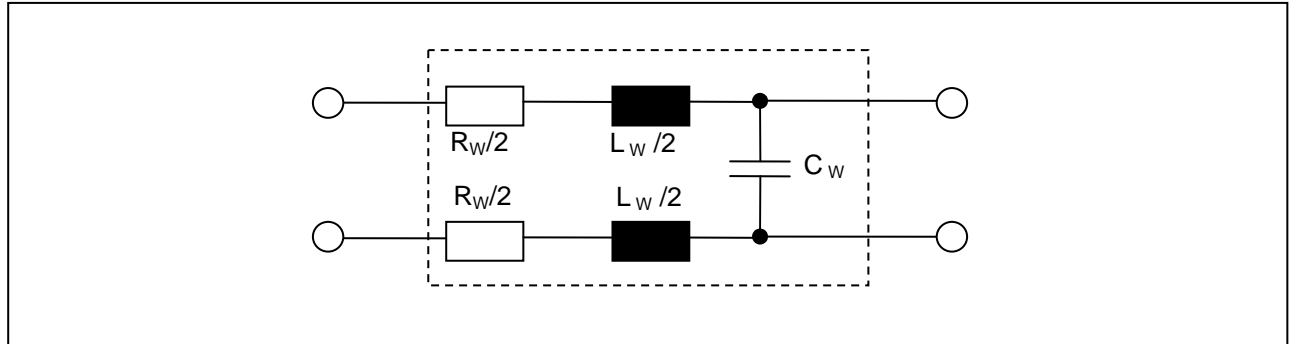


Figure 17 Supply line model for PSI5

#### 4.6 Undervoltage reset and microcut rejection

The sensor must perform an internal reset if the supply voltage drops below a certain threshold for a specified time. By applying such a voltage drop, the ECU is able to initiate a safe reset of all attached sensors.

Microcuts might be caused by loose wires or connectors. Microcuts within the specified limits shall not lead to a malfunction or degraded performance of the sensor.

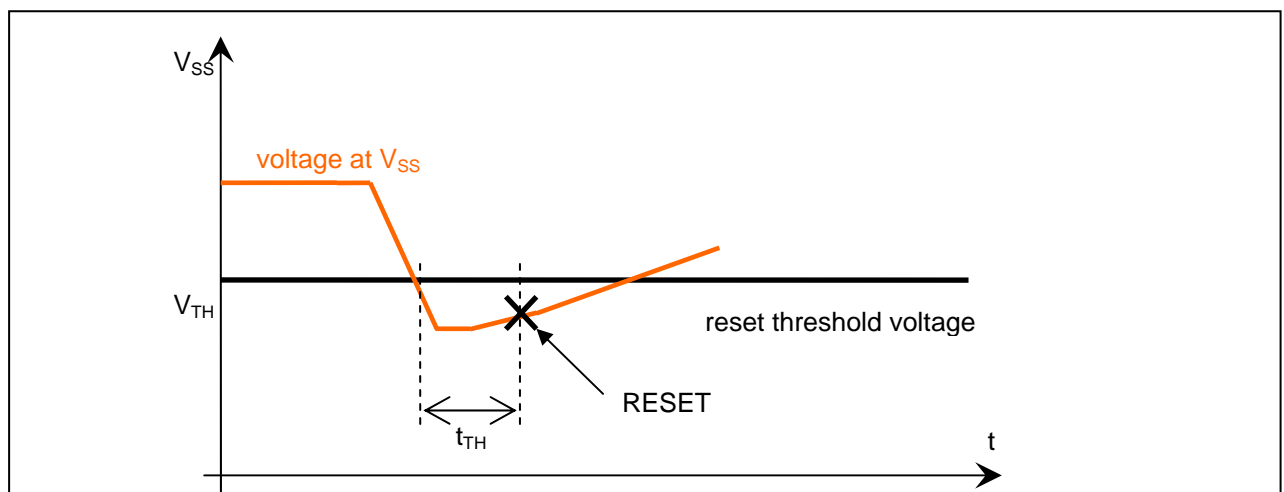


Figure 18 Undervoltage reset behaviour

Parameter	Symbol/Remark	Min	Typ	Max	Unit
Undervoltage reset threshold	$V_{TH}$			3	V
Time below threshold for the sensor to initiate a reset	$t_{TH}$	0.5		200	$\mu s$
Microcut rejection time (no reset)	$I_{SS}=0$	0.5			$\mu s$

Table 8 Reset behaviour parameter specification

#### 4.7 PSI5-A

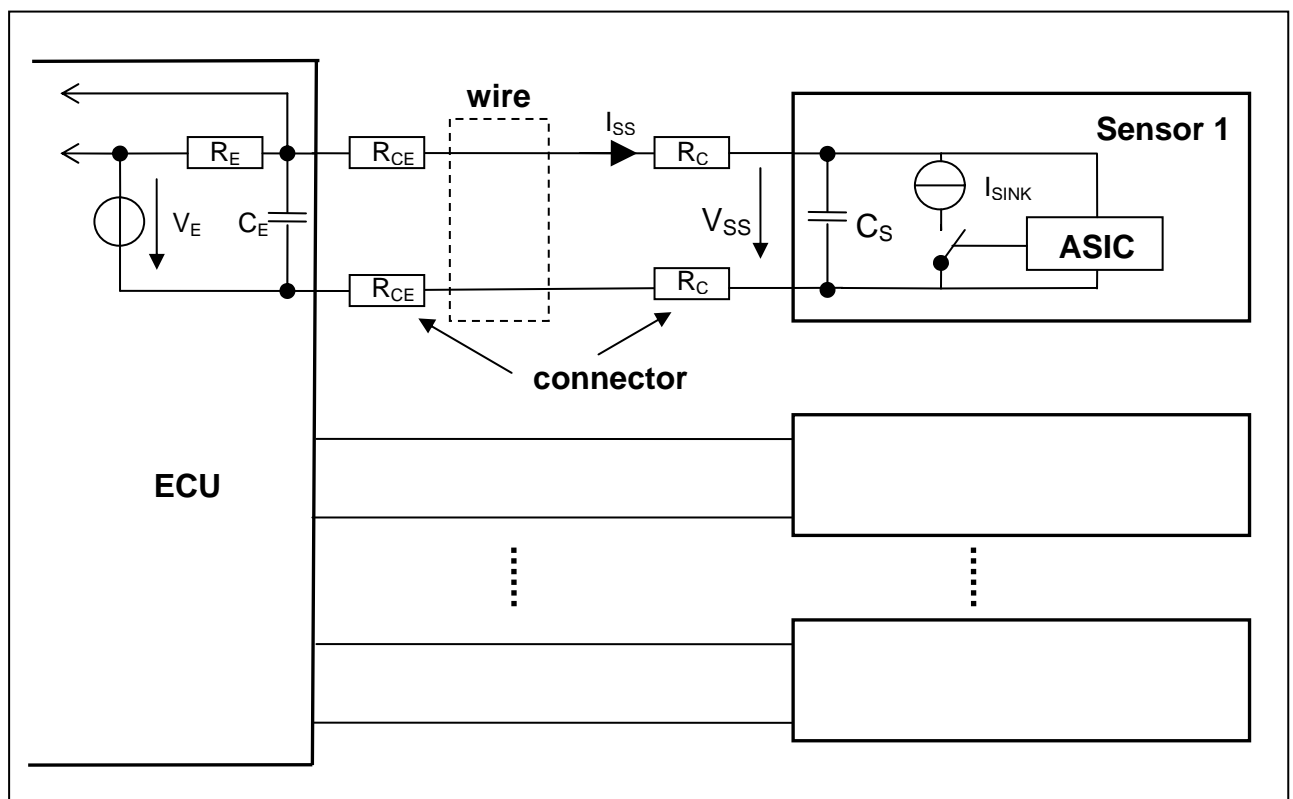


Figure 19 PSI5-A Equivalent circuit

Parameter	Symbol/Remark	Min	Typ	Max	Unit
Supply Voltage	$V_{SS}$	5.0		11.0	V
Capacitive Load	$C_S$			33.0	nF
ECU Connector resistance	$R_{CE}$			0.2	$\Omega$
Sensor Connector resistance	$R_C$			0.2	$\Omega$
Wire resistance	$R_W/2$			0.5	$\Omega$
Wire inductance	$L_W/2$			10	$\mu H$
Wire capacitance	$C_W$			300.0	pF

Table 9 Parameter of PSI5-A

## 4.8 PSI5-S Bus mode

### 4.8.1 Parallel topology

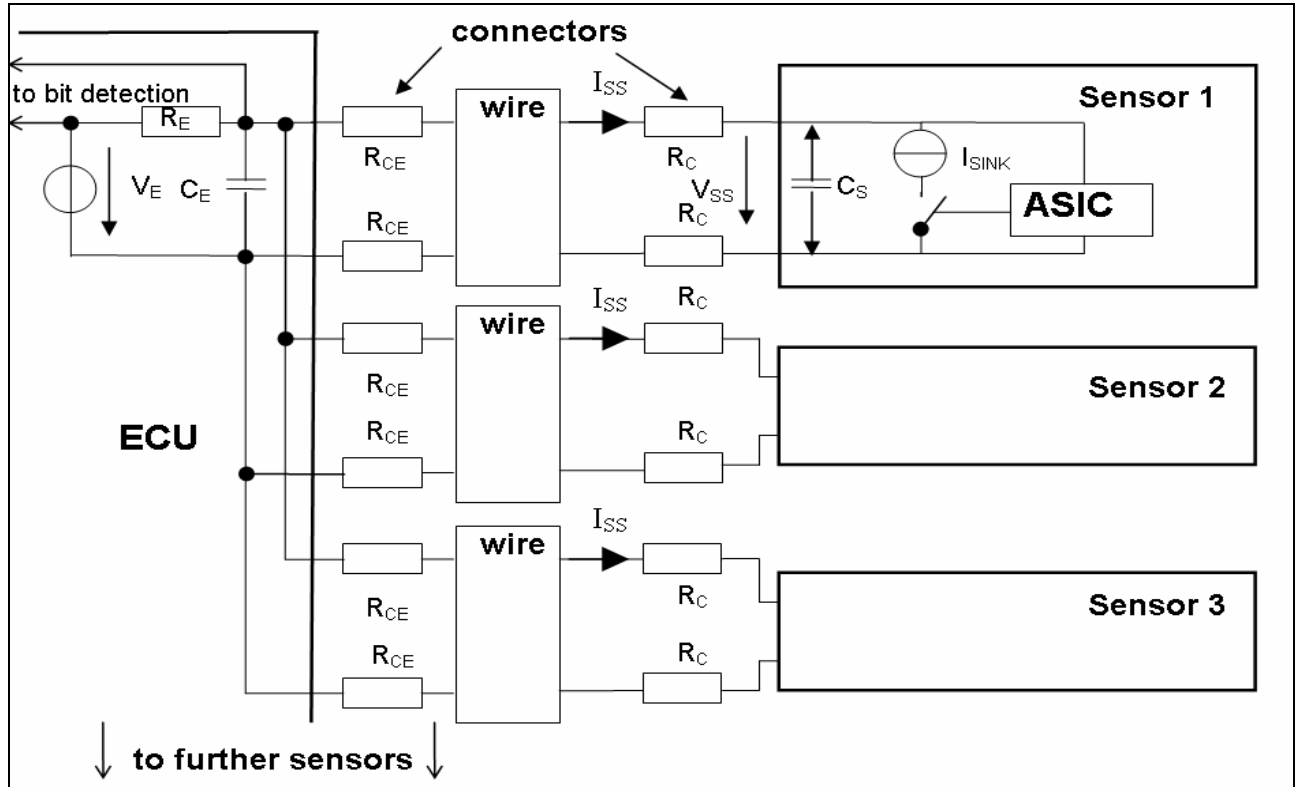


Figure 20 PSI5-S Bus mode

Parameter	Symbol/Remark	Min	Nom.	Max	Unit
Supply Voltage (see Fig. 21)	$V_{SS}$	5.0		11.0	V
Overall Capacitive Bus Load	$C_S$			66.0	nF
ECU Connector resistance	$R_{CE}$			0.2	$\Omega$
Sensor Connector resistance	$R_C$			0.2	$\Omega$
Wire resistance	$R_W/2^*$			0.5	$\Omega$
Wire inductance	$L_W/2^*$			10.0	$\mu H$
Wire capacitance	$C_W^*$			300.0	pF

Table 10 Equivalent circuit parameters

\* Values per sensor connection

#### 4.8.2 Serial topology

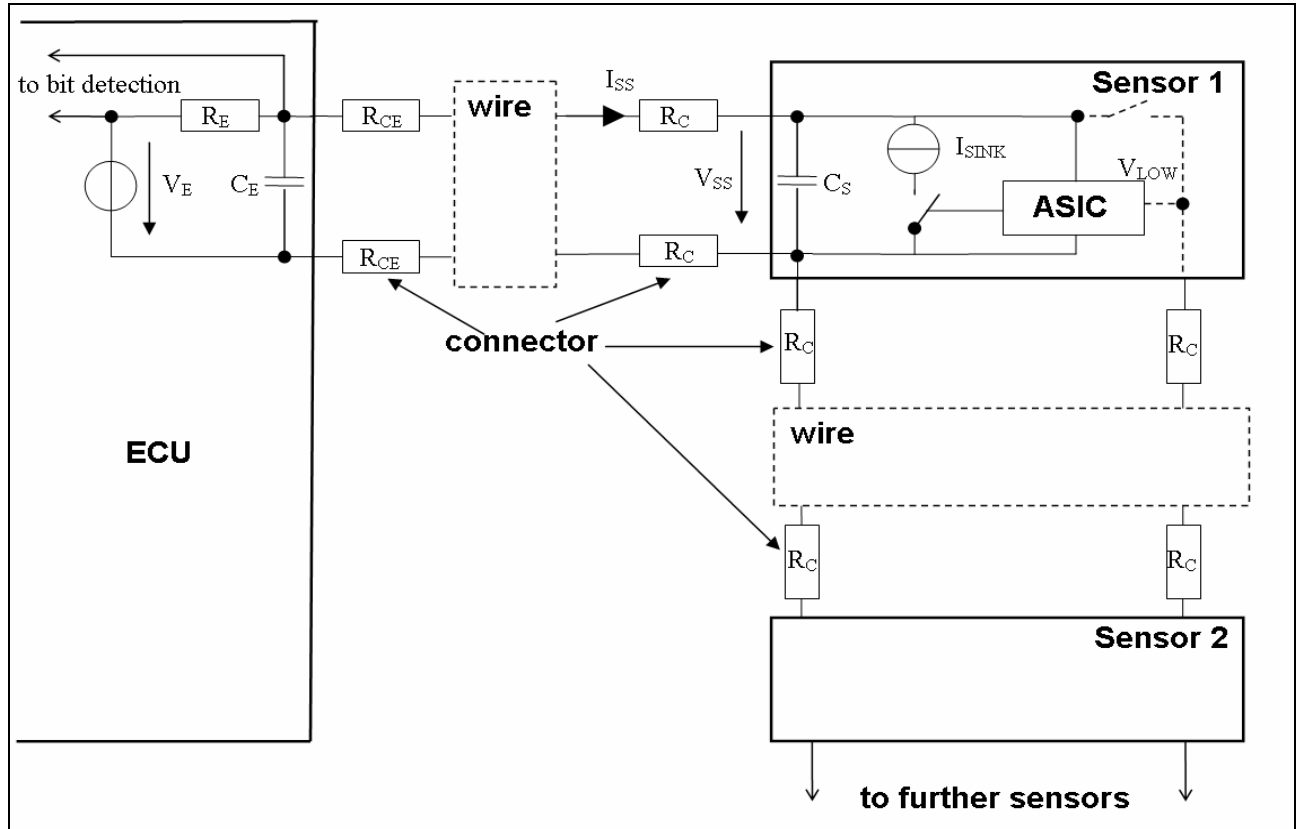


Figure 21 PSI5-S Bus mode, serial equivalent circuit

Parameter	Symbol/Remark	Min	Nom.	Max	Unit
Supply Voltage	$V_{SS}$	5.0		16.5	V
Overall Capacitive Bus Load	$C_S$			66.0	nF
ECU Connector resistance	$R_E$			0.2	$\Omega$
Sensor Connector resistance	$R_C$			0.2	$\Omega$
Wire resistance	$R_W/2^*$			0.5	$\Omega$
Wire inductance	$L_W/2^*$			10.0	$\mu H$
Wire capacitance	$C_W^*$			300.0	pF

Table 11 Equivalent circuit parameters

\* Values from serial connection of all wires (without sensors)

## 4.9 PSI5-S Synchronization signal

### 4.9.1 Parallel bus topology and point-to-point connections

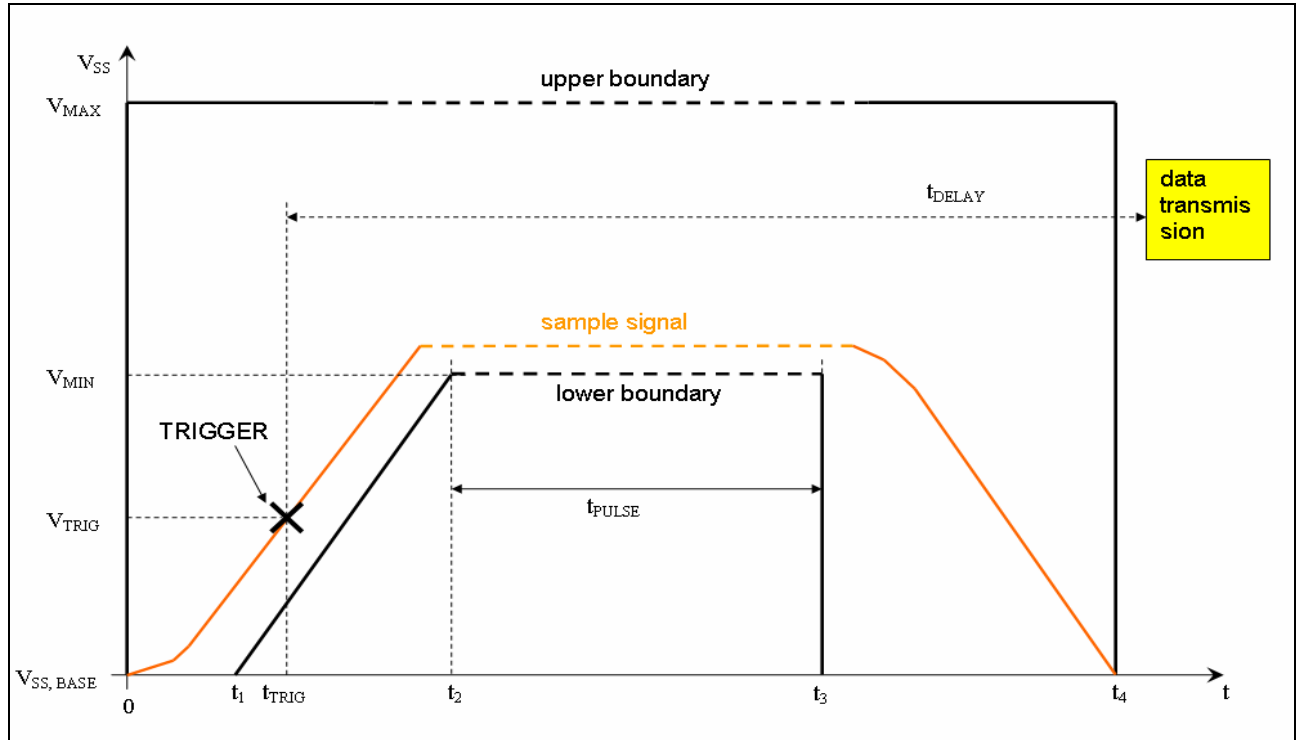


Figure 22 Synchronisation signal for parallel bus and point-to-point connections, voltage at sensor pins  $V_{SS}$

Parameter	Symbol/Remark	Min	Nom.	Max	Unit
Base supply voltage	$V_{SS, BASE}$	5.0			V
Minimum voltage swing	$V_{MIN} - V_{SS, BASE}$	n.a	2.0	n.a	V
Maximum Voltage	$V_{MAX}$		16.5		V
Slew rate *		(0.3)			V/ $\mu$ s
Trigger threshold	$V_{TRIG}$		$(V_{SS, BASE} + V_{MIN})/2$		V
upper start time limit	$t_1$	n.a	4.7	n.a	$\mu$ s
upper pulse start limit	$t_2$	n.a	6.7	n.a	$\mu$ s
lower stop time limit	$t_3$	n.a	16.7	n.a	$\mu$ s
discharge time limit **	$t_4$	n.a	24	n.a	$\mu$ s
maximum remaining discharge current after $t_4$	$I_{SS} - I_{LOW}$			2	mA
Time to start of data transmission (receiver lock time)	$t_{DELAY}$	24			$\mu$ s
sync pulse duration	$t_{PULSE}$	(10.0)			$\mu$ s

Table 12 PSI5-S Synchronization signal for point to point connection and parallel bus systems

\* Small rise and fall times lead to increased radiated emission

\*\* Discharge time to be guaranteed by the ECU's driving circuitry.

#### 4.9.2 Serial bus topology

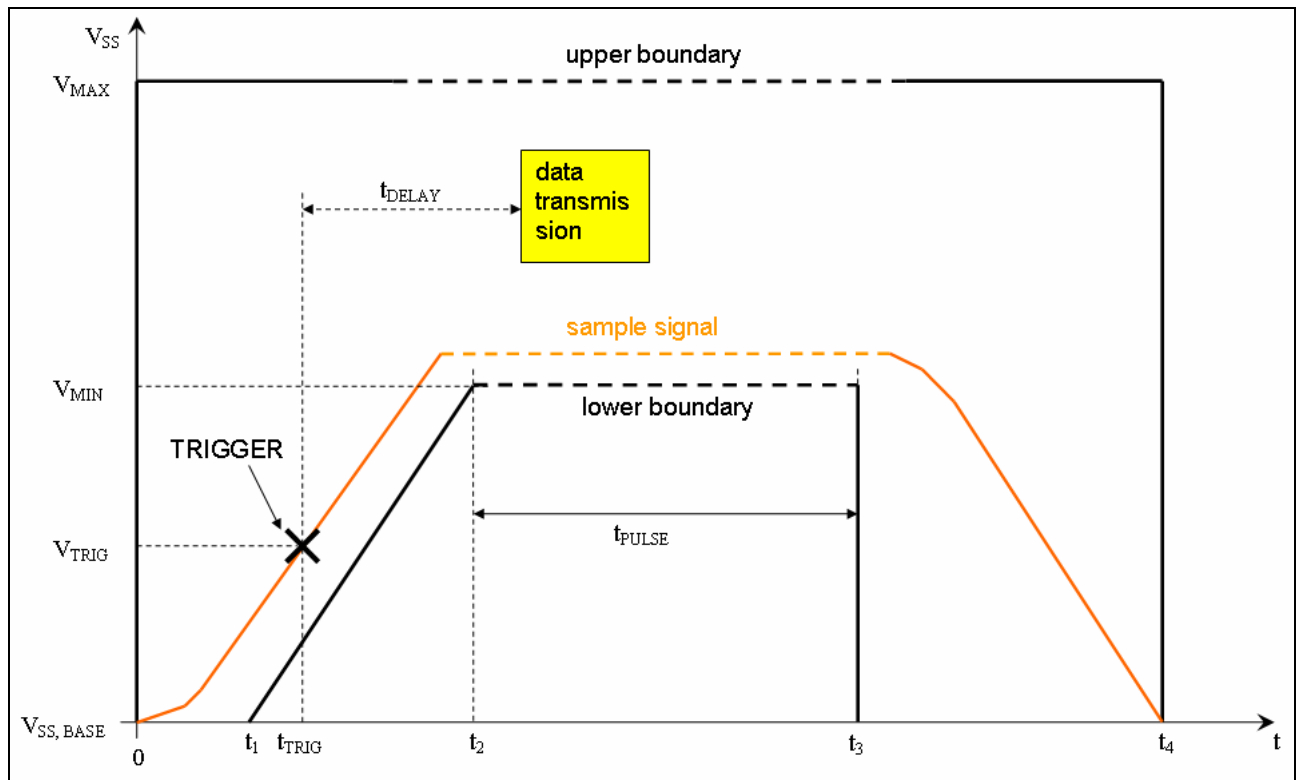


Figure 23 Synchronisation signal for serial bus topology, voltage at sensor pins  $V_{SS}$

Parameter	Symbol/Remark	Min	Nom.	Max	Unit
Base supply voltage	$V_{SS, BASE}$	5.0			V
Minimum voltage swing **	$V_{MIN} - V_{SS, BASE}$	n.a	2.0	n.a	V
Maximum Voltage	$V_{MAX}$	n.a	16.5	n.a	V
Slew rate *		(0.3)			V/ $\mu$ s
Trigger threshold	$V_{TRIG}$		$(V_{SS, BASE} + V_{MIN})/2$		V
upper start time limit	$t_1$	n.a	4.7	n.a	$\mu$ s
upper pulse start limit	$t_2$	n.a	6.7	n.a	$\mu$ s
discharge time limit ***	$t_4 - t_3$	n.a	6.7	n.a	$\mu$ s
maximum remaining discharge current after $t_{DELAY}$	$I_{SS} - I_{LOW}$			2	mA
time to data transmission (receiver lock time)	$t_{DELAY}$	16.7			$\mu$ s

Table 13 PSI5-S Synchronisation signal for serial bus topology

\* Small rise and fall times lead to increased radiated emission

\*\* To be fulfilled even for the last sensor in a row, voltage drop within the sensors to be considered

\*\*\* Discharge time after all sensors have sent their data to be guaranteed by the ECU's driving circuitry

## 5 Appendix A – Status Data Content

The status data content is administrated by the PSI5 steering committee.

### 5.1 Status Data

This specifies the values for transmission of status data in initialization phase 2 shown in Figure 14.

Content	Number of Bits	Example: PAS5	
		Value (binary)	Description
Protocol revision	4	0100	PSI5 V1
Status data block length *	8	0010 0000	32 ID and data blocks (1 page)
Manufacturer	8	0001 0000	Robert Bosch
Sensor type	8	0000 0001	Acceleration sensor
Sensor specific data	tbd	programmed	PAS5 sensor specific

*Table 14 Initialization phase 2: status data*

#### 5.1.1 Manufacturer Codes

Manufacturer	Code (binary)
Autoliv	01000000
Bosch	00010000
Continental Temic	10000000
Siemens VDO	00100000
tbd	tbd

*Table 15 Manufacturer codes*

## 6 Appendix B: Application for automotive restraint systems

### 6.1 Data frame lengths and recommended configurations

The usage of the following data word lengths and sensor configurations is recommended:

data word length	purpose
8	low resolution sensors
10	medium resolution sensors
16	high resolution sensors
20	2 channel multiplex datawords
24	2 channel multiplex datawords

Table 16 Recommended data frame lengths

No.	Sync Mode	No. Sensors	No. Channels	Frames/sync	Sampling rate per channel [kHz]	frame length (data)	parity / CRC	description	example
1	A	1	1	-	4.4	8	P	asynchronous 8 bit trans-mission	MRSA5, PAS3, RSU4,5
2	A	1	1	-	4.4	10	P	asynchronous 10 bit trans-mission	PAS4, RSU5, PPS1, PSAT
3	A	1	1	-	4.4	12, 16 or 20	CRC	asynchronous transmission	
4	S	1	1	1	4.0	8	P	synchronized 8 bit single sensor	RSU4,5
5	S	1	1	2	4.0	8	P	synchronized 8 bit single sensor, 2 frames per sync period	MRSA5
6	S	1	2	4	4.0	8	P	2-channel sensor with 2 frames per sync period for each channel	MRSA5
7	S	1	1	2	4.0	10	P	synchronized 10 bit single sensor, 2 frames per sync period	PAS5
8	S	1	2	2	4.0	20	CRC	dual channel sensor with 2 frames per sync period	PAS5xy
9	S	1	2	2	2.0	12	CRC	2-channel sensor 12 bit	
10	S	2	2	2	2.0	8 or 10	P / CRC	2 sensors 8 or 10 bit, P or CRC	RSU5
11	S	2 or 3	2 or 3	2 or 3	2.0	10	P	2 or 3 10-bit sensors	PAS5

Table 17 Recommended system configurations

## 7 Appendix C: Alternative Synchronization signal for special requirements

The target voltage pulse is specified in chapter 4.9. For special requirements (e.g. harsh EMC environments) a higher voltage pulse may be applied.

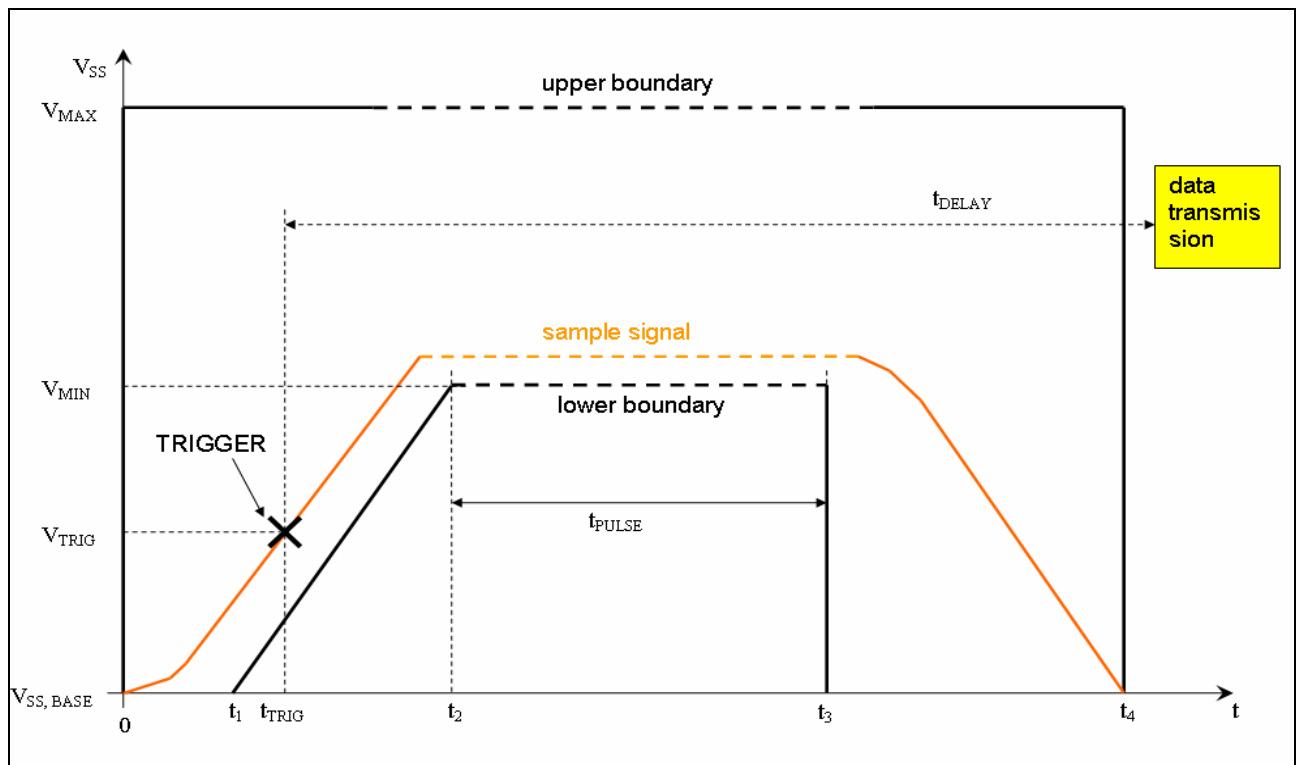


Figure 24 Synchronization signal at sensor pins  $V_{SS}$

Parameter	Symbol/Remark	Min	Nom.	Max	Unit
Base supply voltage	$V_{SS, BASE}$	5.0			V
Minimum voltage swing	$V_{MIN} - V_{SS, BASE}$	n.a	4.5	n.a	V
Maximum Voltage	$V_{MAX}$		14.5		V
Slew rate		(0.37)			V/ $\mu$ s
Trigger threshold	$V_{TRIG}$	$V_{SS, BASE} + 3.0$	$V_{SS, BASE} + 3.25$	$V_{SS, BASE} + 3.5$	V
upper start time limit	$t_1$	n.a	7.7	n.a	$\mu$ s
upper pulse start limit	$t_2$	n.a	12.2	n.a	$\mu$ s
lower stop time limit	$t_3$	n.a	22.2	n.a	$\mu$ s
upper stop time limit (total pulse length)	$t_4$	n.a	35	n.a	$\mu$ s
maximum remaining discharge current after $t_4$	$I_{SS} - I_{LOW}$			2	mA
data transmission delay	$t_{DELAY}$	71			$\mu$ s
sync pulse duration	$t_{PULSE}$	(15.0)			$\mu$ s
receiver blanking time	$t_{BLANK}$			69	$\mu$ s

Table 18 Alternative PSI5-S Synchronization signal for point to point connection and parallel bus systems

\* Small rise and fall times lead to increased radiated emission.