Automotive Electronics

Product Information

CF190 – PSI5 Receiver

BOSCH

Invented for life

Customer benefits:

- Fulfillment of the latest PSI5 standard (V1.3)
- Flexible use in 3.3 V and 5 V systems
- Choice between 3 different SPI protocols for easy application
- Various configurations of interface parameters
- Robust design for high ESD requirements

General 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. PSI5 is a flexible, reliable communication standard for automotive sensor and other applications.

The CF190 is intended for use in electronic control units (ECU) for occupant safety systems or other applications. The integrated circuit contains the Manchester decoding for the received sensor data, the sync pulse generation unit for the allocation of a specific time stamp and the automatic generation of the bidirectional protocol according to the last PSI5 specification.

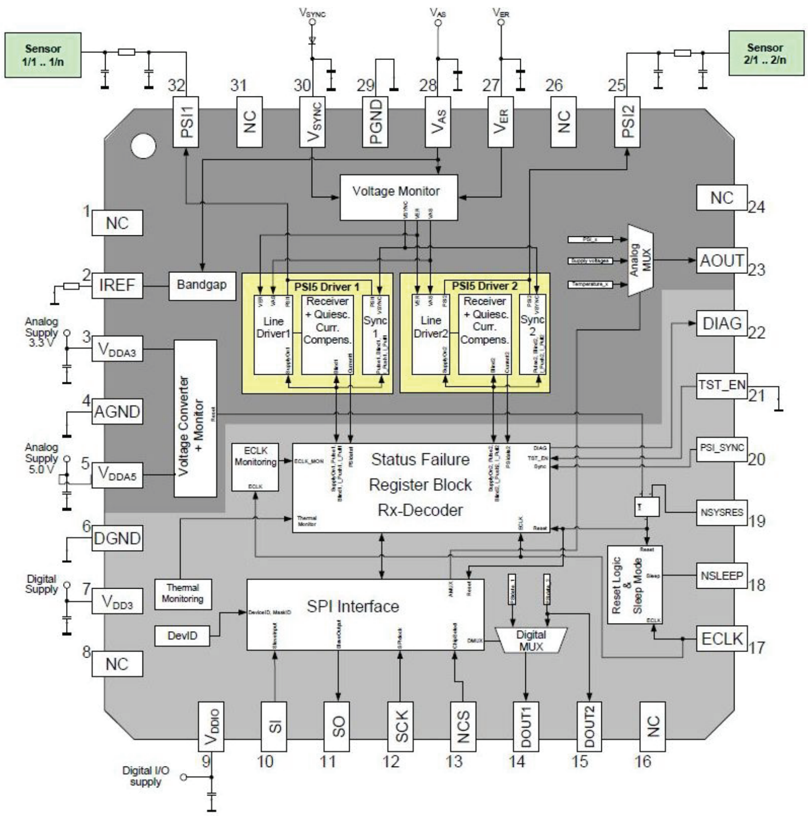
Features

- 2 PSI5 channels
- Bus capability with up to 4 sensors per channel
- 8 and 10 bit data length
- Parallel, universal bus, daisy chain
- Bidirectional communication by µC or with automated sync pulse masking
- Synchronous and asynchronous point to point mode
- sync pulse generation by µC or internally generated
- 3 different SPI protocols integrated, up to 8 MHz
  Open SPI protocol
  Bosch Airbag protocol
  Bosch Engine Management protocol
- IC supply and logic levels with 3.3 V or 5 V
- Sensor supply at the IC pins between 5.6 V and 11 V externally applied (monitoring possible over AOUT)
- Digital output of unfiltered PSI data on a pin possible
- Diagnosis pin for fast failure detection
- Internal voltage and temperature monitoring
- LQFP32 package (low cost)

Functional Description

The CF190 interconnects the external provided sensor supply to the respective PSI interfaces. For sync pulse generation an internal pulse generator was implemented for every channel. The received data are Manchester decoded and available via SPI. The CF190 allows asynchronous communication and synchronous point to point communication as well as parallel bus mode, universal bus mode and daisy chain bus mode. The CF190 provides three different sync pulse generation modes including an automated sync pulse masking for bidirectional communication without the demand of large µC resources.

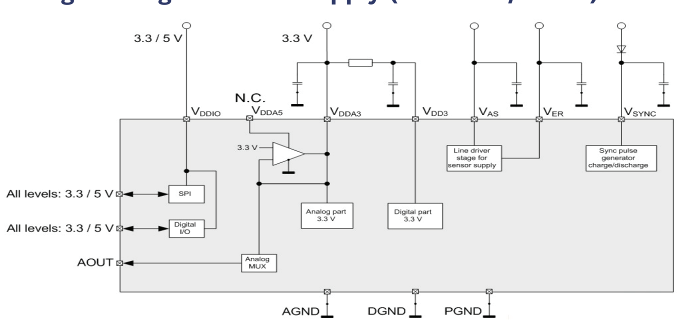
Block Diagram



Power Supply

V_{AS} and V_{SYNC} are the power supply voltages to drive the sensor lines and the sync pulse. V_{ER} is the voltage to drive the gates for the line driver stages. V_{ER} and V_{SYNC} can be connected as one supply in the case of $V_{ER} = V_{AS} + 4.6$ V.

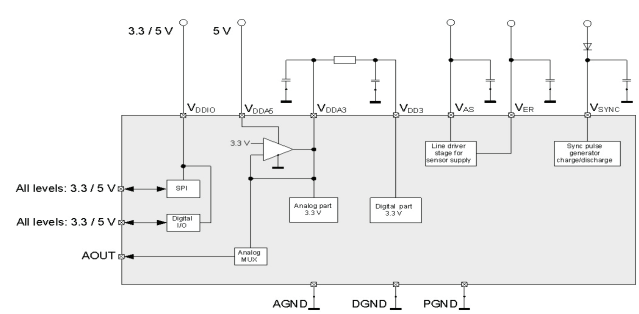
Analog and Digital Power Supply (3.3 V and/or 5 V)



The ASIC operation voltages are V_{DDA3}, V_{DDA5}, V_{DD3}, V_{DDIO}. V_{DDA3} is the 3.3 V power supply for the analog ASIC part and V_{DD3} is the 3.3 V power supply for the digital ASIC part (clock driven). V_{DDIO} is the 3.3 V / 5.0 V power supply for the SPI interface and the digital I/O pins

Power Supply in a pure 5 V System

In system environments were only 5.0 V are available it is possible to derive the internal 3.3 V with an integrated voltage regulator. The voltage regulator is supplied via pin V_{DDA5}. An internal reset is activated if the output voltage of this regulator is out of range. The reset signal is OR combined with the reset signal from pin NSYSRES.

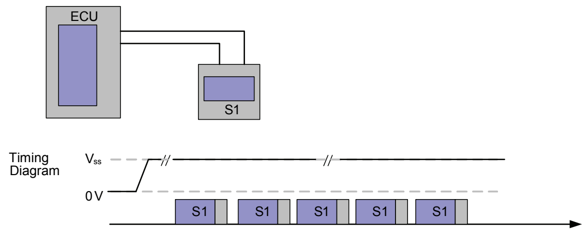


Interface Modes

Asynchronous and Synchronous point-to-point 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.

In asynchronous communication mode all 4 registers (time slot 1 to time slot 4) are used, shifting the data with every new data transmission from time slot 1 up to time slot 4 ("time slot 1" contains the most actual value and "time slot 4" the oldest value).

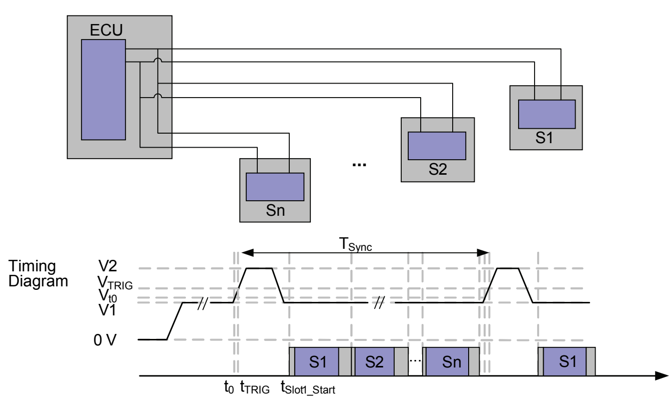


In the synchronous PSI5-S operation, the sensor can transmit a single data word after the sync pulse shifted into time slot 1. Depending on the sensor up to 4 data words can be transmitted using the time slots 1 to 4 according PSI5 specification.

Parallel Bus Topology

PSI5-P describes a bus configuration for synchronous data transmission of one or more sensors. Each sensor is connected to the ECU by a separate pair of wires (star topology).

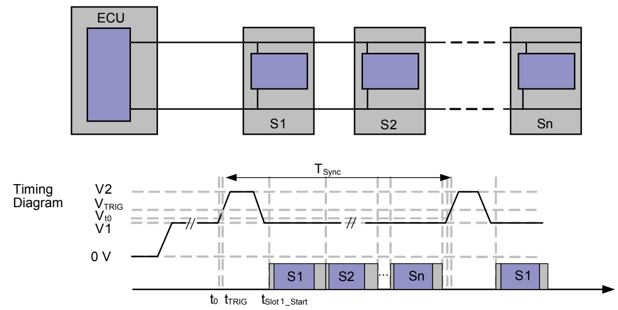
Each data transmission period is initiated by a voltage synchronization signal from the ECU to the sensors. After receiving the synchronization signal, each sensor starts transmitting its data with the corresponding time delay into the assigned time slot. Therefore the parallel bus sensors have to be programmed at the end of line with the appropriate time information.



Universal Bus Topology

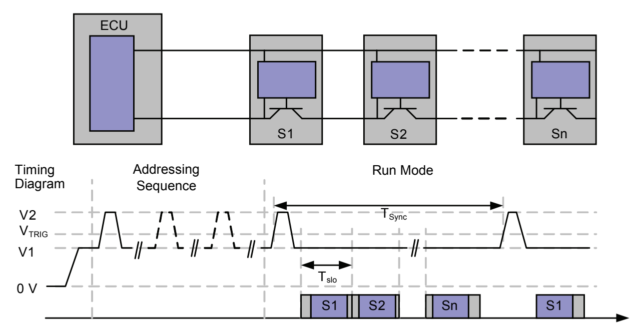
PSI5-U describes a bus configuration for synchronous data transmission of one or more sensors. The sensors are connected to the ECU in different wiring topologies including splices or pass-through configurations.

Each data transmission period is initiated by a voltage synchronization signal from the ECU to the sensors. After receiving the synchronization signal, each sensor starts transmitting its data with the corresponding time delay into the assigned time slot. Therefore the universal bus sensors have to be programmed at the end of line with the appropriate time information.



Daisy Chain Bus Topology

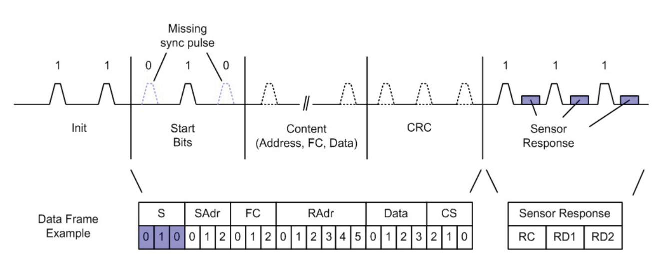
PSI5-D describes a bus configuration for synchronous data transmission of one or more sensors connected in a daisy chain configuration. By default, the sensors have no address and can be connected to each position on the bus. During start-up, each sensor receives an individual address and then passes the supply voltage to the following sensor subsequently. The addressing is realized by bidirectional communication from the ECU to the sensor using a specific sync signal pattern. After having assigned the individual addresses, the sensors start to transmit data in their corresponding time slots in the same way as specified in the parallel bus topology.



Bidirectional Communication

Whereas the sensor to ECU communication is realized by current signals, voltage modulation on the supply lines is used to communicate with the sensors. The PSI5 "sync signal" is used for the sensor synchronization in all synchronous operation modes and also as physical layer for bidirectional communication.

A logical "1" is represented by the presence of a sync signal, a logical "0" by the absence of a sync signal at the expected time window of the sync signal period.



Maximum Ratings

Parameter		Values			Unit
		Min	Typ.	Max.	
Storage Temperature		-55		+150	°C
Ambient temperature	T_{Amb}	-40		+130	°C
Junction temperature	T_J	-40		+150	°C
Main supply voltage V_{AS} (Pin 28)	V_{AS}	-0.3		18	V
Main supply voltage V_{SYNC} (Pin 30)	V_{SYNC}	-0.3		36	V
Main supply voltage V_{ER} (Pin 27)	V_{ER}	-0.3		36	V
Voltage on sensor line PSIx (Pins 25, 32)	V_{PSI}	-0.3		36	V
Digital supply voltage V_{DD3} (Pin 7)	V_{DD3}	-0.3		3.6	V
Logic level supply voltage V_{DDIO} (Pin 9)	V_{DDIO}	-0.3		5.5	V
Analog supply voltage V_{DDA3} (Pin 3)	V_{DDA3}	-0.3		3.6	V
Analog supply voltage V_{DDA5} (Pin 5)	V_{DDA5}	-0.3		5.5	V
Voltage levels on SPI line (Pins 10,11,12,13)		-0.3		5.5	V
µC Port – PSI_SYNC (Pin 20)	V_{SYN}	-0.3		5.5	V
Reset input NSYSRES (Pin 19)	V_{RES}	-0.3		5.5	V
System clock ECLK (Pin 17)	V_{ECLK}	-0.3		5.5	V
Voltage levels on DIAG (Pin 22)	V_{DIAG}	-0.3		5.5	V
Multiplexer DOUT1 (Pin 14)	V_{DOUT1}	-0.3		5.5	V
Output PSI data DOUT2 (Pin 15)	V_{DOUT2}	-0.3		5.5	V
Multiplexer AOUT (Pin 23)	V_{AOUT}	-0.3		3.6	V
Sleep mode input NSLEEP (Pin 18)	V_{NSLEEP}	-0.3		36	V
Operation time		15000			h

Electrical Characteristics

Parameter		Values			Unit
		Min	Typ.	Max	
Digital supply voltage V_{DD3}					
Digital voltage	V_{DD3}	3.0	3.3	3.6	V
Analog supply voltage V_{DDA3}					
Analog voltage	V_{VDDA3}	3.0	3.3	3.6	V
Analog supply voltage V_{DDA5}					
Supply voltage for internal voltage conv.	V_{VDDA5}	4.5	5.0	5.5	V
Digital I/O voltage V_{DDIO}					
Digital I/O voltage in a 3.3 V system	V_{DDIO}	3.0		3.6	V
Digital I/O voltage in a 5.0 V system	V_{DDIO}	4.5		5.5	V
Supply voltage V_{AS}					
Supply voltage V_{AS} @ 65 mA	V_{AS}	6.35		11	V
Supply voltage V_{SYNC}					
Supply voltage V_{SYNC}	V_{SYNC}	V_{AS} +4.6		35	V
Supply voltage V_{ER}					
Supply voltage V_{ER}	V_{ER}	V_{AS} +3.5		35	V

Sensor Lines

Parameter		Values			Unit
		Min	Typ.	Max	
Supply voltage on sensor lines @ I_{PSI} = 65 mA (if no sync pulse active) – standard voltage (dependent on VAS)	$V_{PSI,0}$	5.6		11	V
Upper voltage limitation on sensor line incl. sync pulse	$V_{PSI,max}$			16.5	V
Internal resistance		4		11	Ω
Voltage drop over line driver, where I_{PSI} = 65 mA		260		715	mV
Voltage swing of sync pulse	V_{sync}	3.5			V
Current limitation per sensor line	$I_{limit,line}$	65		130	mA
Current limitation per sensor line	$I_{limit,line,dynamic}$	80			mA

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