Automotive Electronics

Product Information

CF190 – PSI5 Receiver

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)

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.

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.
voltage regulator. The voltage regulator is supplied via pin VDDA5. 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.

Power Supply

VAS and VSYNC are the power supply voltages to drive the sensor lines and the sync pulse. VER is the voltage to drive the gates for the line driver stages. VER and VSYNC can be connected as one supply in the case of VER = VAS + 4.6 V.

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

The ASIC operation voltages are VDDA3, VDDA5, VDD3, VDDIO. VDDA3 is the 3.3 V power supply for the analog ASIC part and VDD3 is the 3.3 V power supply for the digital ASIC part (clock driven). VDDIO 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 VDDA5. 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 syn-
chronous 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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Temperature</td>
<td>-55</td>
<td>+150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-40</td>
<td>+130</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Junction temperature</td>
<td>-40</td>
<td>+150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Main supply voltage</td>
<td>-0.3</td>
<td>18</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Voltage on sensor line</td>
<td>-0.3</td>
<td>36</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Voltage on sensor line</td>
<td>-0.3</td>
<td>36</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Voltage on sensor line</td>
<td>-0.3</td>
<td>36</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

### Electrical Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Digital supply voltage</td>
<td>3.0</td>
<td>3.3</td>
<td>3.6</td>
<td>V</td>
</tr>
<tr>
<td>Analog supply voltage</td>
<td>3.0</td>
<td>3.3</td>
<td>3.6</td>
<td>V</td>
</tr>
<tr>
<td>Supply voltage for internal</td>
<td>4.5</td>
<td>5.0</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>Digital I/O voltage</td>
<td>3.0</td>
<td>3.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Supply voltage VAS</td>
<td>6.35</td>
<td>11</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Supply voltage VSYNC</td>
<td>VSYNC+4.6</td>
<td>35</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Supply voltage VER</td>
<td>VERS+3.5</td>
<td>35</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

### Sensor Lines

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Supply voltage on sensor</td>
<td>5.6</td>
<td>11</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>lines @ IPSI = 65 mA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(if no sync pulse active)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(dependent on VAS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper voltage limitation</td>
<td>16.5</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>on sensor line incl. sync</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pulse</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal resistance</td>
<td>4</td>
<td>11</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>Voltage drop over line</td>
<td>260</td>
<td>715</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>driver, where IPSI = 65 mA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage swing of sync pulse</td>
<td>3.5</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current limitation per sensor line</td>
<td>65</td>
<td>130</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Current limitation per sensor line</td>
<td>80</td>
<td>130</td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>