

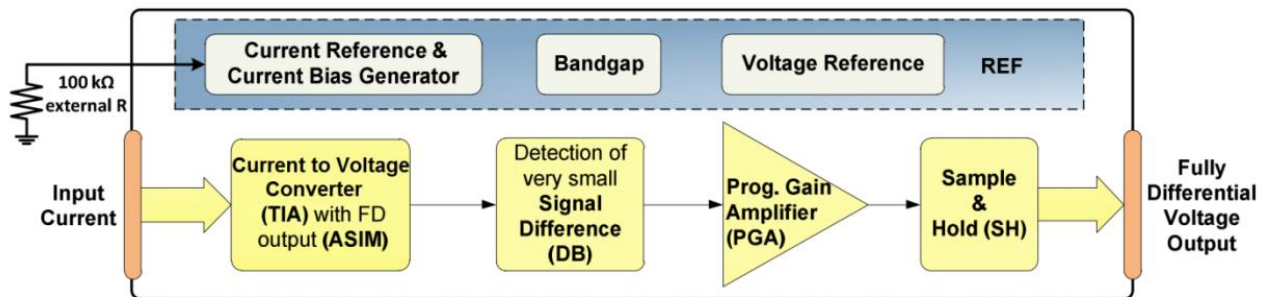
## SC-IC-AFE-180F209

### Current-Input Analogue Front End - Core

*The path from the real world to the digital word*

The **SC-IC-AFE-180F209** chip provides a silicon **IP module** for the programmable analogue front-end (AFE) function, optimized for current-input, low power & high resolution applications. This chip provides a complete signal path between sensor system and suitable analogue-to-digital converter, generating a fully differential output voltage proportional to the input current. It has the same core as SC-I-AFE-180F210 but without digital control and SPI interface because it is usually the part of overall SoC solution.

It is ideally suited for a broad range of devices with the sensor system where the generic information about the phenomenon to be measured - light or other physical or chemical or electrochemical appearance - passes the first electrical conversion to the current. The IP implementation enables easy further System on Chip (SoC) integration of follow up functions.



**SC-IC-AFE-180F209 - Functional block diagram**

#### Key Features

- Detection and measurement of **low input current** from **hundreds of pA to 1 mA [absolute value]**
- Detection of small **input current difference ( $\Delta I$ )** on the level of **hundreds of pA**
- Overall gain up to 1296 (programmable gains 1, 3, 6)
- High linearity: < 0.5 LSB per gain stage for 13-bit resolution ( $\pm 1.3$  V dynamic range)
- Low noise PGA (switched-capacitor architecture)
- Analogue output range:  $\pm 1.3$  Vp-p
- Single supply voltage: 1.6 V to 1.8 V
- Internal band-gap voltage reference: 1.0 V
- Internal voltage and current references
- Power consumption: ~ 4.3 mW
- Operating temperature range:  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$
- Compact IP area: ~ 3.7 mm<sup>2</sup>

#### Technology

- Silicon validated IP module:  
**TSMC 180nm 1P6M mixed signal**

#### Customization Offer

The customization is open to the potential customers on demand. The key emphasis is to meet the system developers' needs in a way to allow quick customization and/or optimization either for the specific sensor system or application.

Flexible re-configurations of the built-in functions are enabled because of the modular design and our original circuit solutions (some features could be changed). Customization of current design or new circuits with additional features, depending on the specific application requirements, are as follows:

- Customisable current ranges on demand, for instance:
  - high current detection up to **10 mA** (for the industrial applications)
- Rearrangement of the PGA gain
- Adjustment of AFE's output to match ADC input from another vendor
- Possibility to detect input voltages instead of input currents, or both
- Ability to upgrade into multi-channel input, etc.

#### Advantages on the Chip Level

Features which make the difference, worthy to be highlighted:

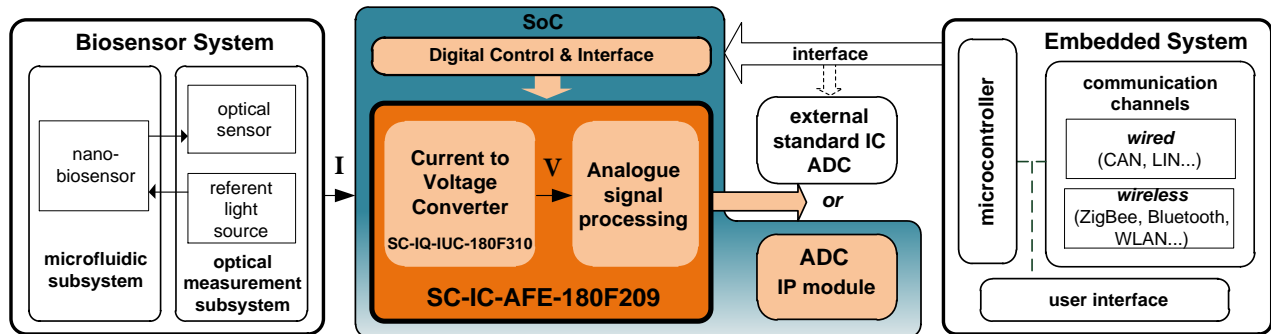
- Direct interface to the sensor system
- Stable internal voltage and current references with only one external component (resistor @ 100 kohms)
- Highly linear current-to-voltage conversion achieved by using Transimpedance Amplifier (TIA) architecture
- Special circuit for current management and biasing of PIN diode in auto-zero mode
- Effective offset cancellation throughout the signal path
- Single-ended current input with fully differential (FD) voltage output for further signal processing
- Low power consumption ideally suited for battery-powered operation; each block has built-in power-down ability that enables effective power management
- Built-in guard rings for the noise isolation
- Carefully done layout, following circuit design, with special emphasis on matching
- Fully functional temperature range: from  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ , under investigation up to  $180^{\circ}\text{C}$

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#### Application Areas

- **Industrial & Consumer:** bio industry - medical, environmental, agriculture, aquaculture, food, ecology (soil, air, water pollution monitoring) / photonics / energy & process control (smart meters & grids) / instrumentation / automotive & security / military equipment & aircrafts / smart phones, gadgets, PCs & notebooks with built-in sensors
- **R&D and scientific projects**, especially in the life science



**Application example: Modern medical diagnostic device based on the achievements in bio-, micro- & nano-technology with the optical sensor as a phenomenon detector**

#### Benefits on the System Level

- Such analogue front-end solution is the crucial part determining system's accuracy and reliability of obtained results
- Detection and measurement of low input current in the range of hundreds of pA, well suited for biosensors, photosensors, LED and PIN diodes
- Top performance is the imperative in the systems built with modern nanobiosensors, MEMS/MOEMS biosensors and microfluidic systems ("lab-on-a-chip")

#### Support on the System Level

Our key goal is that this analogue front-end implementation meets the system level performance of competing dedicated ICs, optimized both in price and performance. With strong technical HW and SW expertise Systemcom Ltd. can provide customers with the following all-around additional technical support (on-demand):

- Additional chip measurements and characterisation
- Service in the evaluation board (PCB) development to be used for device testing, production, after-sales, R&D
- Development of the specific test environment (both SW and HW)
- Support in choosing appropriate ADC, either IP module or external standard IC component
- System level consulting on the customer's specific application requirements
- Support during SoC design
- Participation in the modelling on the system level based on the models like VHDL and MATLAB
- Development of the embedded system including respective microcontroller software

#### Deliverables

- GDSII layout database
- Assembly guidelines and integration support
- Datasheet
- Behavioural VHDL model for SoC simulations
- Layout footprint
- Application notes

#### On demand:

- LVS/SPICE netlist
- MATLAB model for effective system design

#### Contact data

Recommended technical and sales communication through e-mail: [afe@systemcom.hr](mailto:afe@systemcom.hr)

#### About Systemcom Ltd.

Systemcom Ltd, founded in 1993, is a SME design house and reliable semiconductor design partner. We provide best quality IC design services (analogue, digital and mixed signal) and high performance products (IP modules). With long-term expertise in HW and SW development we are dedicated to support customers in achieving shortest time cycle from product concept to revenue shipment. Systemcom strong references are, among others: in analogue and mixed signal design: Robert Bosch GmbH; in digital design: Intel (Itanium), HP and Compaq (Alpha microprocessor).

#### Systemcom AFE Family

- ❖ **SC-I-AFE-180F110** Current-Input AFE with 13-bit ADC
- ❖ **SC-IC-AFE-180F209** Current-Input AFE - Core
- ❖ **SC-I-AFE-180F210** Current-Input AFE
- ❖ **SC-IQ-IUC-180F310** Current-to-Voltage Converter
- ❖ **SC-FD-ADC-180F410** Fully Differential 13-bit ADC

**SC-IC-AFE-180F209** does not contain the block: *Digital Control & Interface* which is usually the part of overall SoC solution.

This block is incorporated in **SC-I-AFE-180F210**.

#### Sale Business Models

- License fee
- Royalties
- Customization / Consulting / Training