

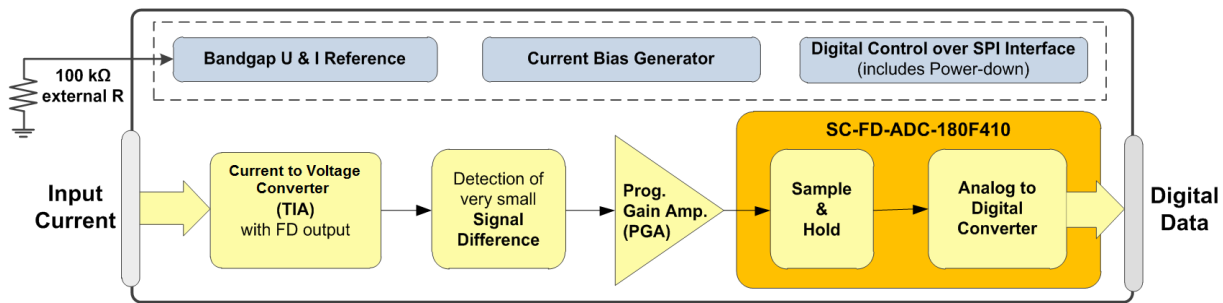
## SC-I-AFE-180F110

### Current-Input Analogue Front End with 13-bit ADC

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

The **SC-I-AFE-180F110** chip provides a silicon **IP module** and/or **ASIC** solution for the analogue front-end (**AFE**) function with ADC, optimized for current-input, low power & high resolution applications. This chip provides a complete signal path between sensor system and microcontroller, generating digital word proportional to the input current.

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-I-AFE-180F110 - Functional block diagram**

#### Key Targeted Features

- Detection and measurement of **low input current** from **hundreds of pA to 1 mA [absolute value]**
- Detection and measurement 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)
- 13-bit ADC with built-in self-calibration and offset cancellation
- ADC's INL < 0.7 LSB (13-bit resolution)
- Built in FIFO for fast consecutive measurements (depth 8, 16 bit)
- Single supply voltage: 1.6 V to 1.8 V
- Internal band-gap voltage reference: 1.0 V
- Internal voltage and current references
- User control over standard SPI interface
- Programmable clocking for PGA and S&H
- Power consumption: ~ 6.1 mW
- Operating temperature range: -40°C to 125°C
- Compact IP area: ~ 5.8 mm<sup>2</sup>

#### 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
- Digital control for battery-saving low-power modes
- Strict consumption (power-down) control
- Possibility to detect input voltages instead of input currents, or both
- Ability to upgrade into multi-channel input, etc.

#### Technology

- **TSMC 180nm 1P6M mixed signal**

#### Advantages on the Chip Level

Features which make the difference, worthy to be highlighted:

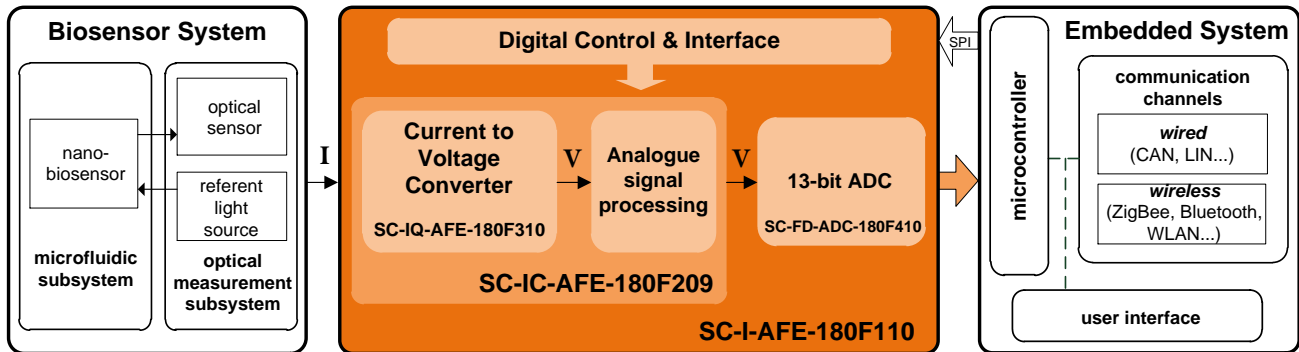
- Direct interface to the sensor system
- Stable internal voltage and current references with only one external component (resistor @ 100 kohms)
- Highly linear current-to-voltage conversion achieved by using Transimpedance Amplifier (TIA) architecture
- Special circuit for current management and biasing of PiN diode in auto-zero mode
- Effective offset cancellation throughout the signal path
- 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°C to 125°C, under investigation up to 180°C

## SC-I-AFE-180F110

### Current-Input Analogue Front End with 13-bit ADC

#### 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")
- Easy external post-processing, either by DSP, microcontroller, microprocessor, FPGA, etc.

#### 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)
- 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
- VHDL code for synthesis

#### 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-time 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: Bosch; in digital design: Intel, HP & 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* - it 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