

ACCURATE 2A

High-Precision ASIC for Ultra-Low Current Measurements spanning from -1 fA to $-20\text{ }\mu\text{A}$

Highlights

Wide Dynamic Range

Measures currents from -1 fA to $-20\text{ }\mu\text{A}$ with a resolution of 0.2 fA , without band switching.

Advanced Features

Low leakage of 4 fA for bare die version. Asynchronous operation with acquisition time proportional to input current.

High Accuracy

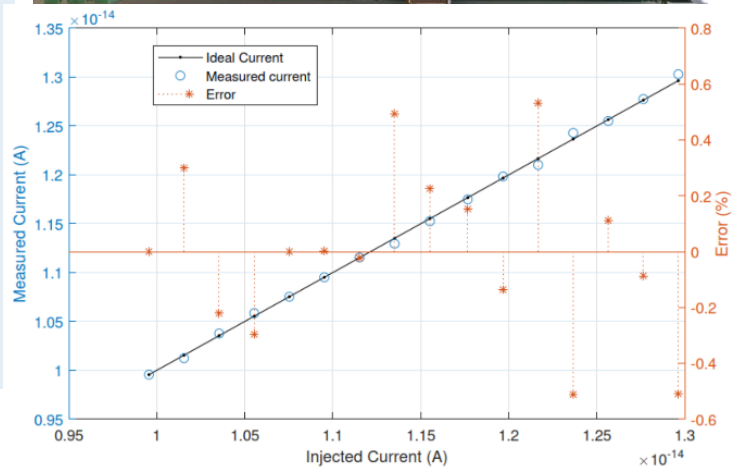
Maintains a global error smaller than $\pm 2\%$ at 25°C across its full measurement range.

Proven Performance

Extensively tested at research facilities and medical institutions.

Keywords

Ultra-low current, ASIC, current measurement, radiation monitoring, high resolution, precision instrumentation.



Description

The ACCURATE 2A ASIC is a specialized ultra-low current measurement device, designed for detailed electrical measurements ranging from -1 femtoamperes to -20 microamperes . This ASIC is primarily deployed as a front-end sensor interface in ionization chambers for radiation monitoring and is applicable in other sensitive measurement environments such as photodiode signal processing and current/charge-output sensor systems. Designed using a 130 nm process technology, the device features a compact die area of 1.95 mm^2 and includes 26 input/output pads that enable flexible connectivity configurations.

The device employs a current-to-frequency conversion technique alongside a direct slope current measurement method to achieve a minimum resolution of 0.2 fA . It operates efficiently with a power consumption of 3 mW from a 3.3 V supply. The integrated circuit includes OTA, comparators, charge pumps, and a clock generator that collectively contribute to its high performance and measurement precision. The acquisition time depends on input current. In the default configuration 10 fA measurement needs 1000 seconds, 100 fA needs 100s, etc. However, this is configurable, and the measurement could be made faster by trading off the higher end of measurement.



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Advantages

Technical Precision

The ASIC distinguishes itself by maintaining a consistent accuracy across a broad dynamic range without the need for band switching. The demonstrated global accuracy of $\pm 2\%$ at $25\text{ }^\circ\text{C}$, sets a new benchmark in ultra-low current measurement.

Validated in rigorous environments

The ASIC's design and functionality have been thoroughly validated under rigorous conditions at leading research facilities and medical centers. The testing confirms its robustness and suitability for integration into high-stakes environments where precise current measurement is critical.

Integration Versatility

Designed with multiple operational modes, the ACCURATE 2A offers exceptional adaptability for technical integrations, making it suitable for a wide range of electronic assemblies requiring ultra-low current measurement.

Configurability

Current is calculated using the relation $I_{meas} = Q_{ref}/T_w$, where Q_{ref} is reference charge and T_w is measurement window. Both the parameters are tunable and hence the chip could be tuned to desired operation regime for optimal speed and dynamic range.

For further information and licensing requests, please reach out to the CERN Venture Connect Program Manager.

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Applications

High Precision Instrumentation in:

- Scientific Research Equipment
- Environmental Sensing Devices
- Process Control in Manufacturing
- Energy Systems Monitoring
- Biosensing & Molecular Diagnostics

The applications listed above are examples of where ACCURATE 2A could be utilized. The versatility of the technology encourages further exploration.

The chip available as bare die or packaged using hermetically sealed 28 pin CLCC. An evaluation board with the chip connected to an FPGA and Microcontroller and standard serial interfaces is also available

Publications

Mohanan, S. K. (2021). An Accurate Ultra-low Current Measurement ASIC for Ionization Chamber Readout. Doctoral dissertation, CERN. [Link](#)

Mohanan, S. K. et al. (2021). Comparative Analysis of Ultra-Low Current Measurement Topologies With Implementation in 130 nm Technology. IEEE Access, 9, 63855–63864. [Link](#)

Mohanan, S. K. et al. (2022). An Ultra Low Current Measurement Mixed-Signal ASIC for Radiation Monitoring Using Ionisation Chambers. IEEE Sensors Journal, 22(3), 2142–2150. [Link](#)