

ADCs - connecting the real world with the virtual world

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- **founded in 1997 in Herrenberg (Stuttgart)**
- **focus on**
 - fabless IC-Design
 - IC supply chain management
- **establishment of the IC-Design Center Dresden in 2005**
 - Expanding the service to analog/mixed signal IC-Design
 - Focus on smart power, smart RFID and sensor applications
- **Acquisition of PE by the French company “Group Serma” in Juli 2013**

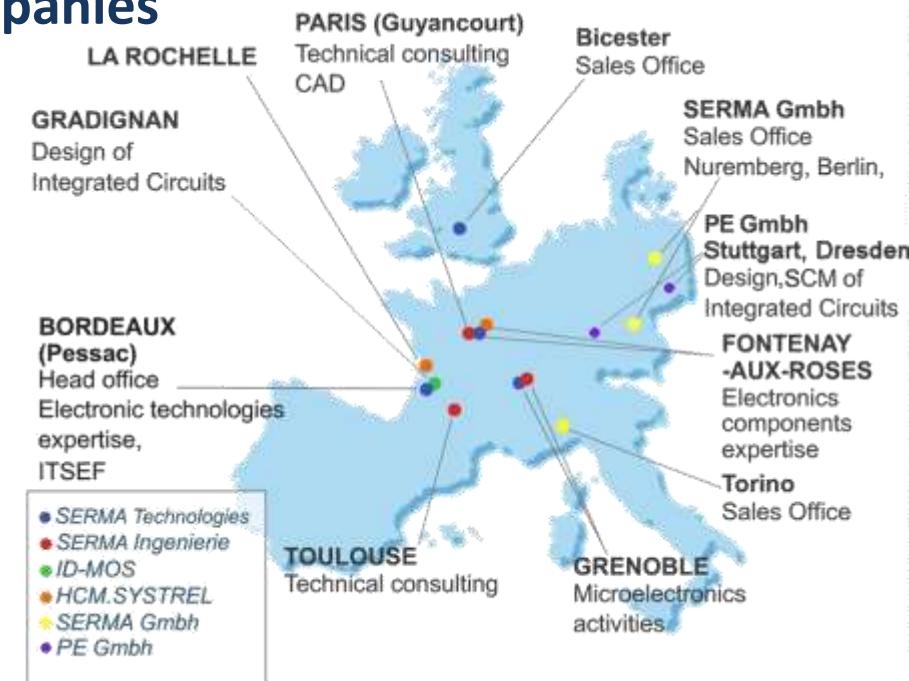


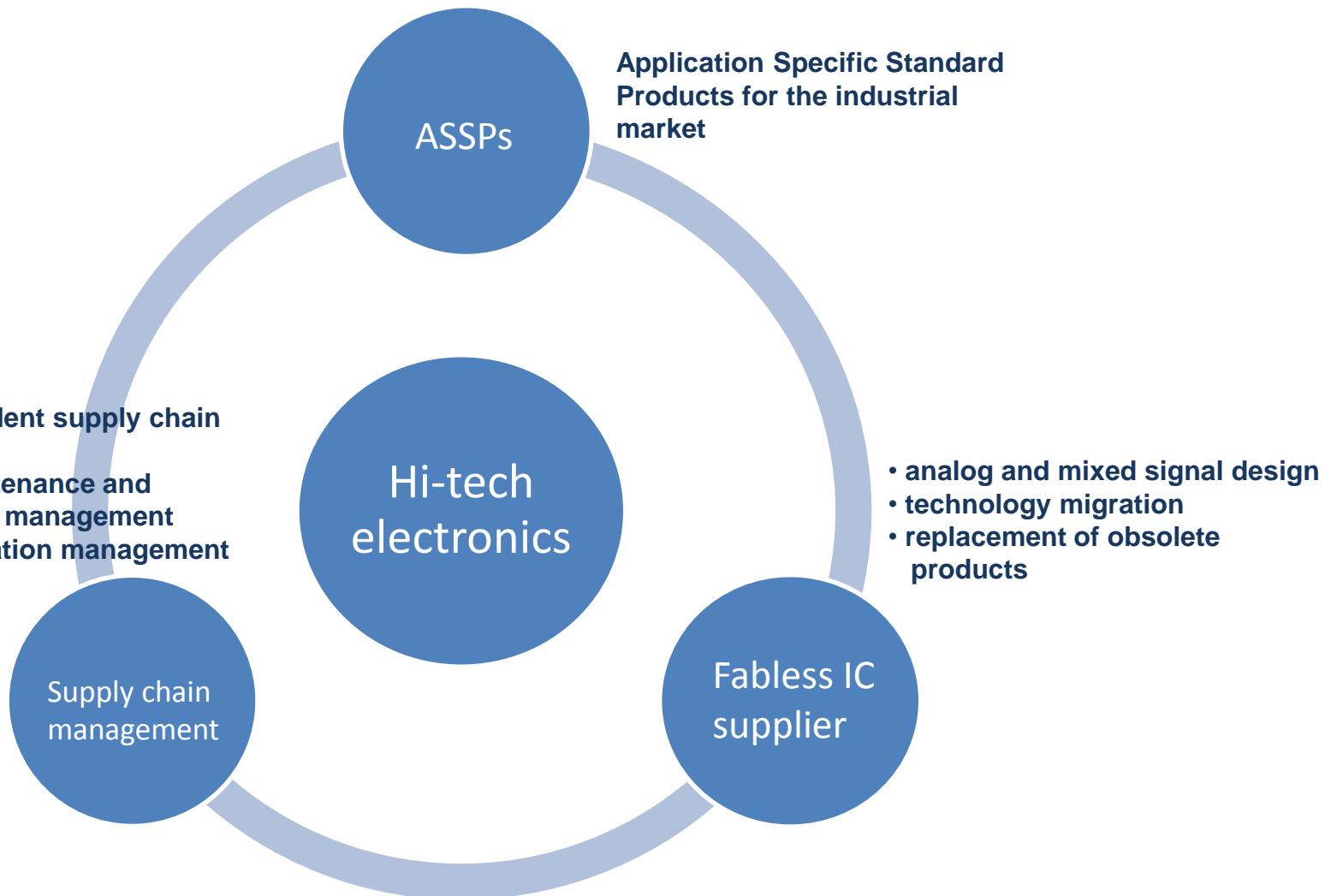
Overview of Serma

SERMA TECHNOLOGIES

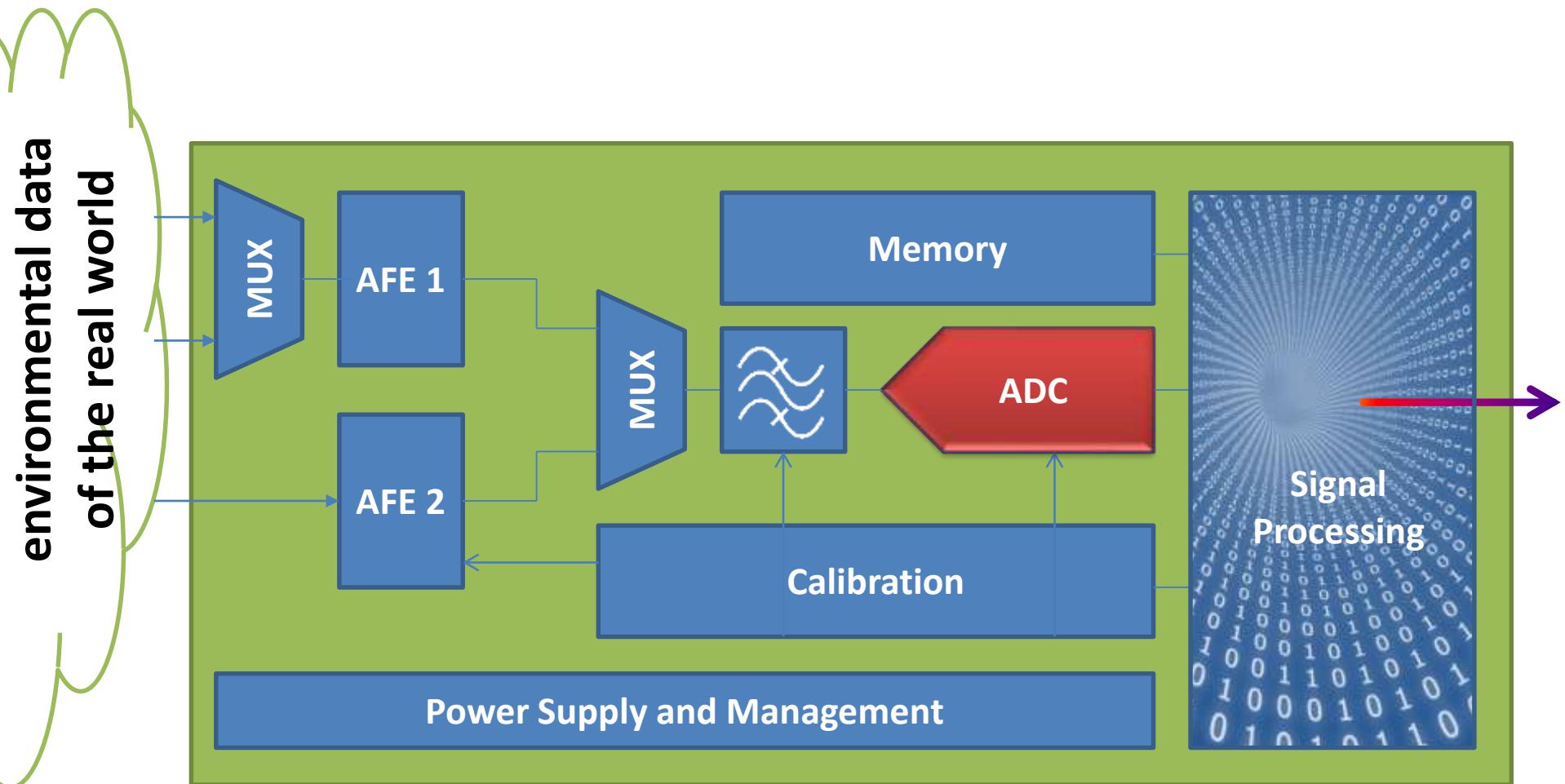


- founded in 1994
- legally and financially independent privately owned company
- Group Serma is composed of 6 companies
 - Serma Technologies
 - Serma Ingénierie
 - IDMOS
 - Productivity Engineering GmbH
 - HCM.Systrel
 - Serma GmbH





ADC types and principles



Flash

Dual Slope

Successive Approximation

Single Slope

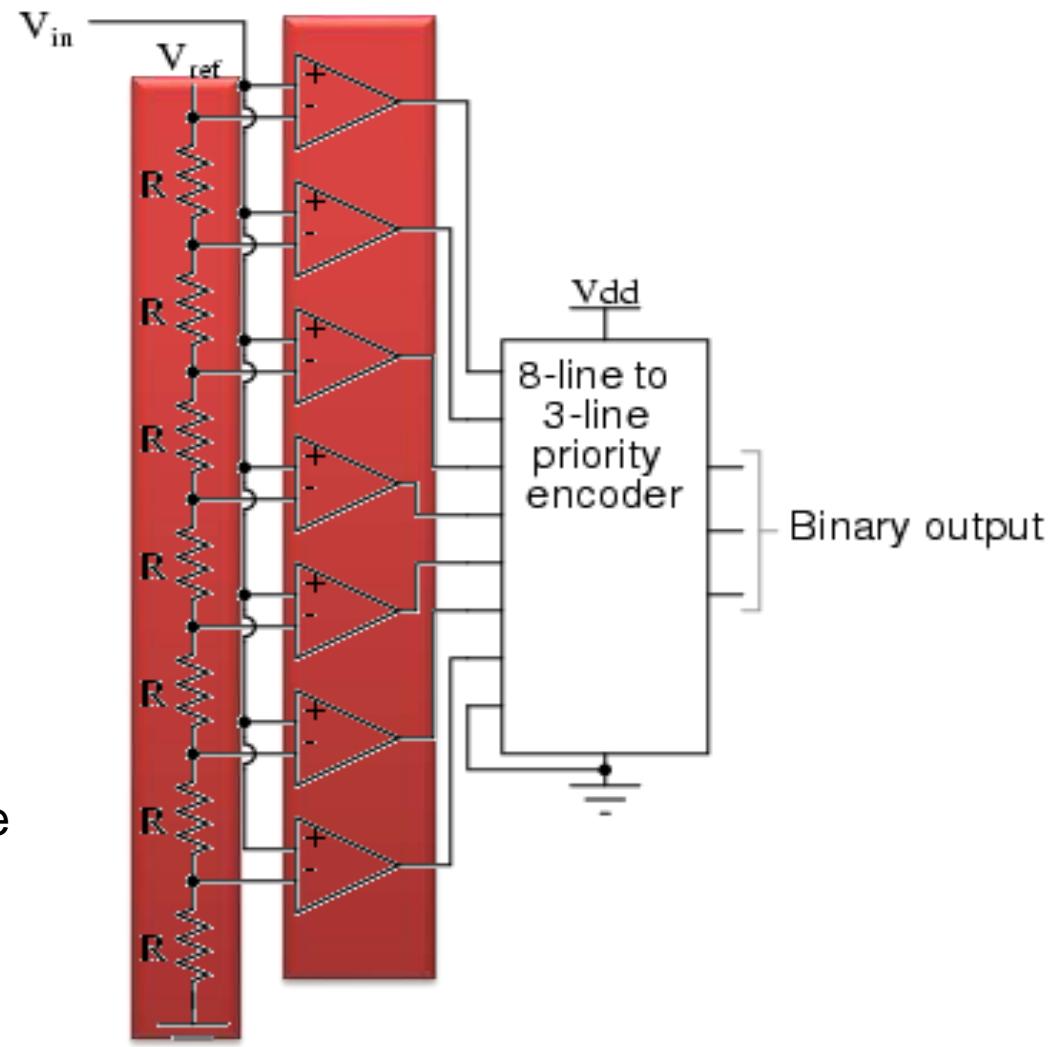
Pipeline

Sigma Delta

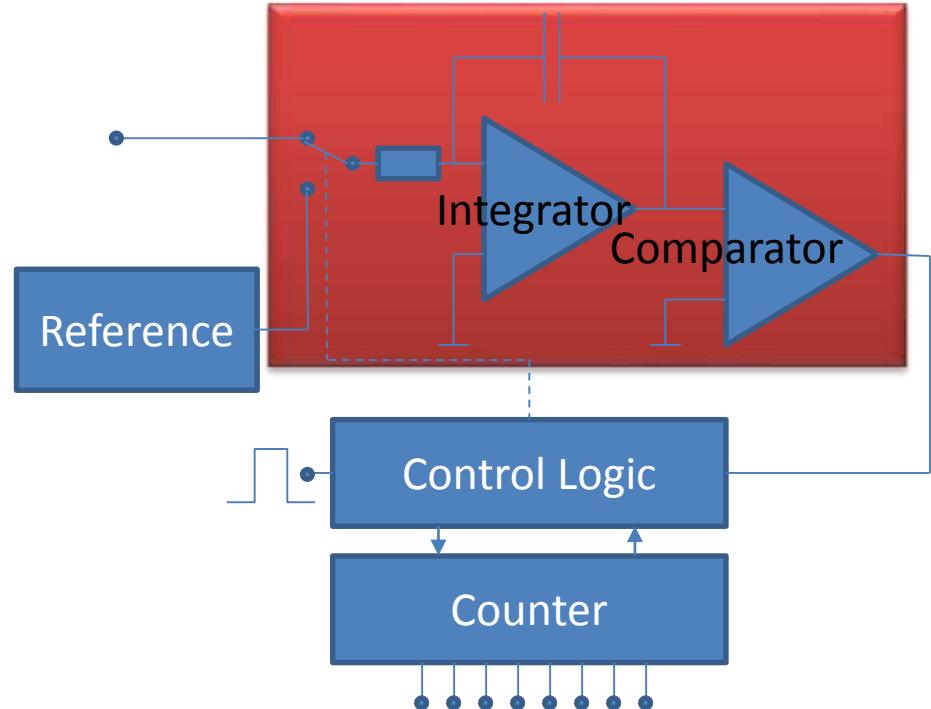
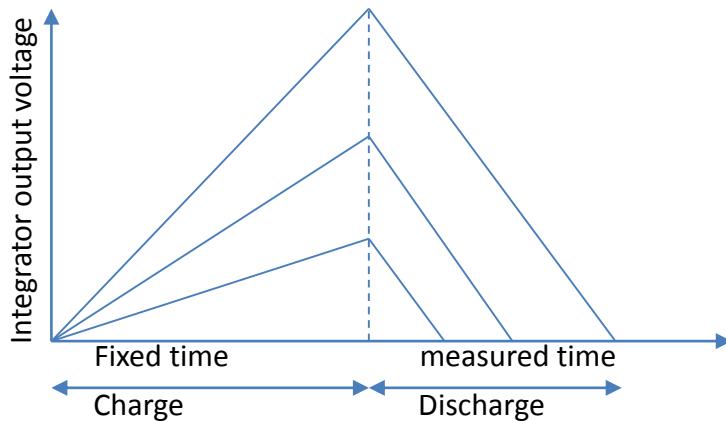
Charge Balancing

and mixtures

A Flash converter requires $2^n - 1$ comparators for an n -bit conversion \rightarrow impractical for more than 8bit = 255 comparators

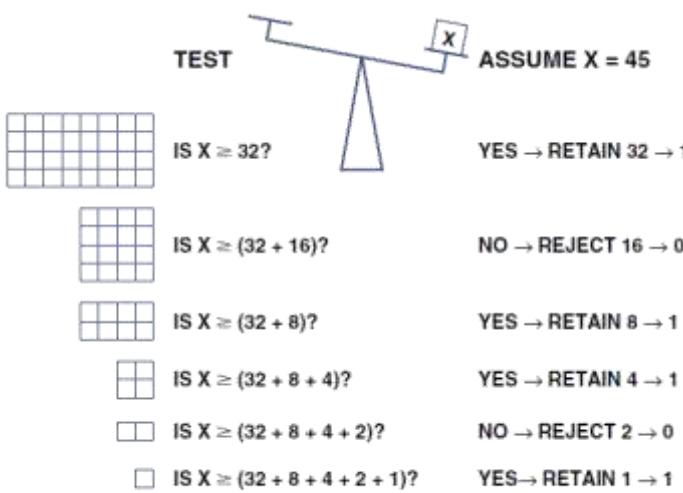


Flash
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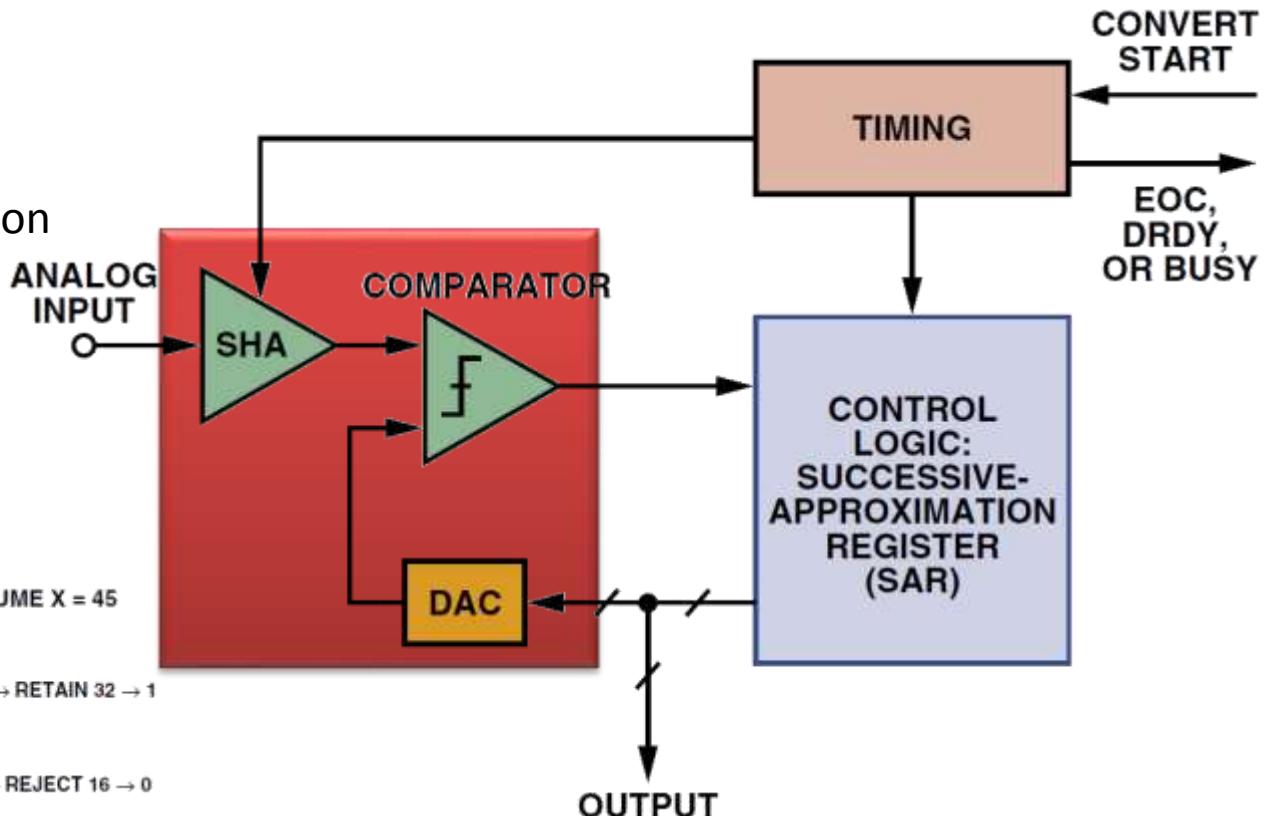


1. charge fixed time with input voltage
2. Discharge with reference voltage
3. Count time until discharged

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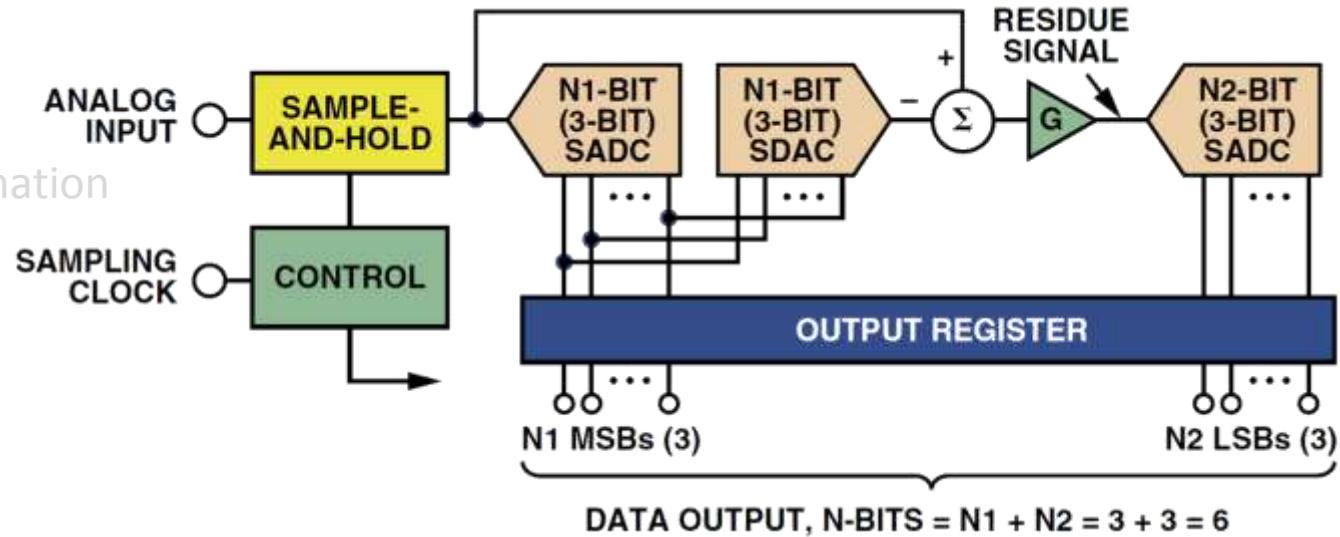


$$\text{TOTALS: } X = 32 + 8 + 4 + 1 = 45^{10} = 1011012$$



Source: Analog Devices

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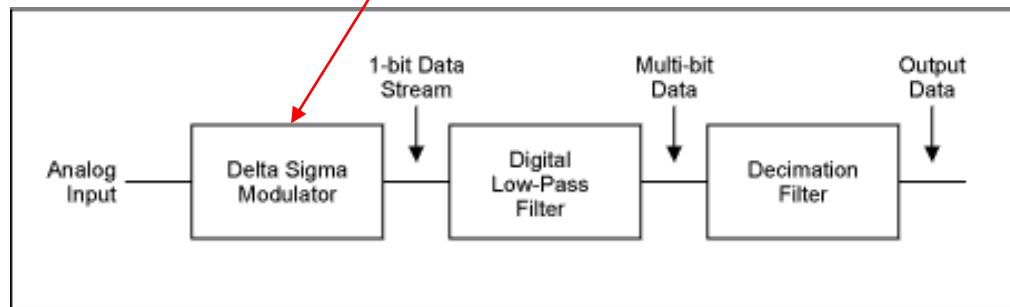
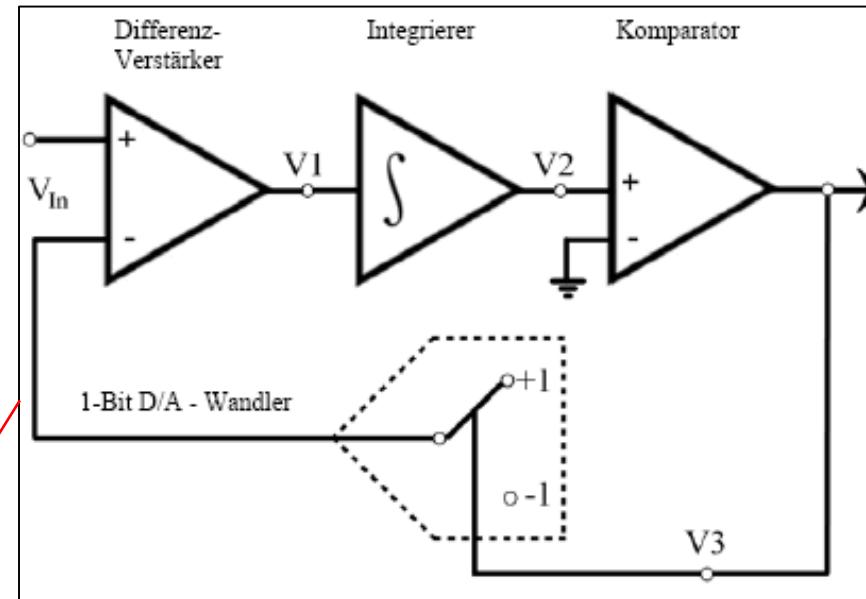


1. Convert 3Bit (MSB) analog to digital
2. Convert result back to analog
3. Subtract result from input value
4. Convert residue in next stage after amplification (LSB)
5. Sum up result from both stages

Source: Analog Devices

- Flash
- Dual Slope
- Successive Approximation
- Single Slope
- Pipeline
- Sigma Delta**
- Charge Balancing and mixtures

1st order Sigma-Delta Modulator



Physical measured values (examples)

Pressure=> Capacity (MEMS)=> current => **Voltage**,

Temperature => Resistor (PT100) => **Voltage**

Humidity => Resistor => **Voltage**, Capacity => current => **Voltage**

Radiation(Pyro/Thermophile) => **Voltage**

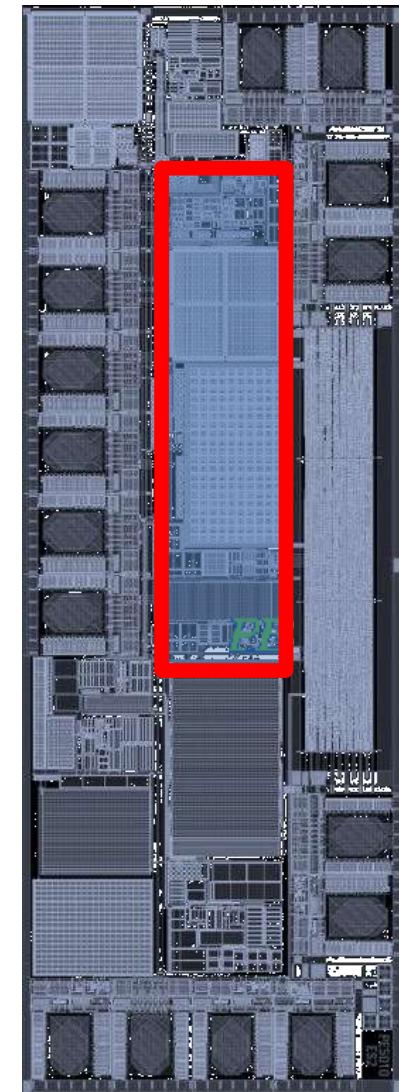
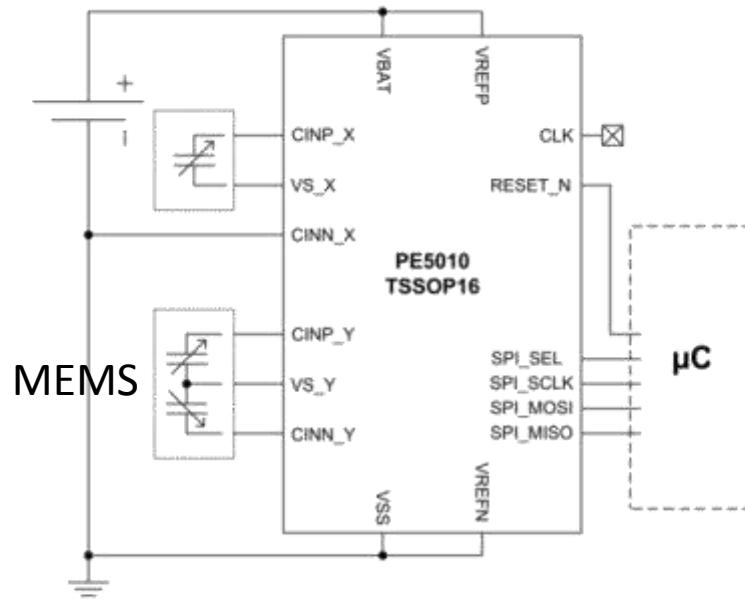
Light (solar cell) => current => **Voltage**

Resistor (DMS)=> **Voltage**

...

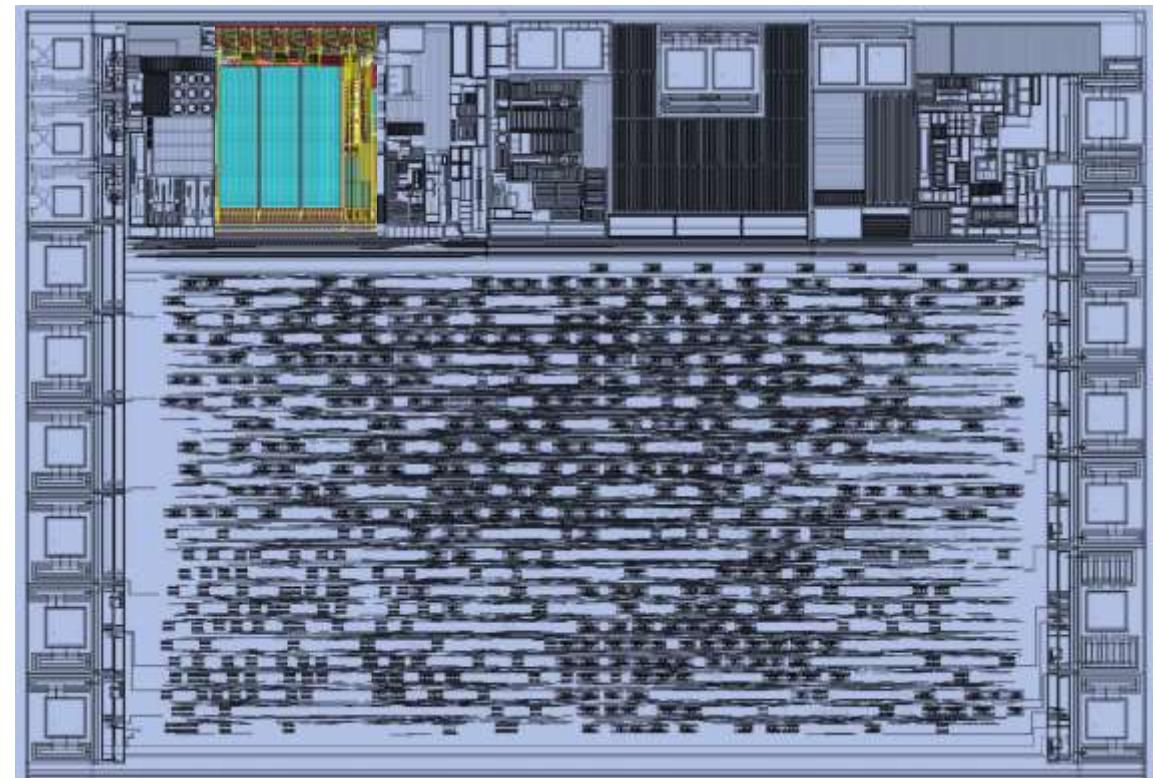
ASIC design examples with ADCs

- 2 single ended/differential Sensors
- capacitive sensing chip
- 12 bit Sigma-Delta converter

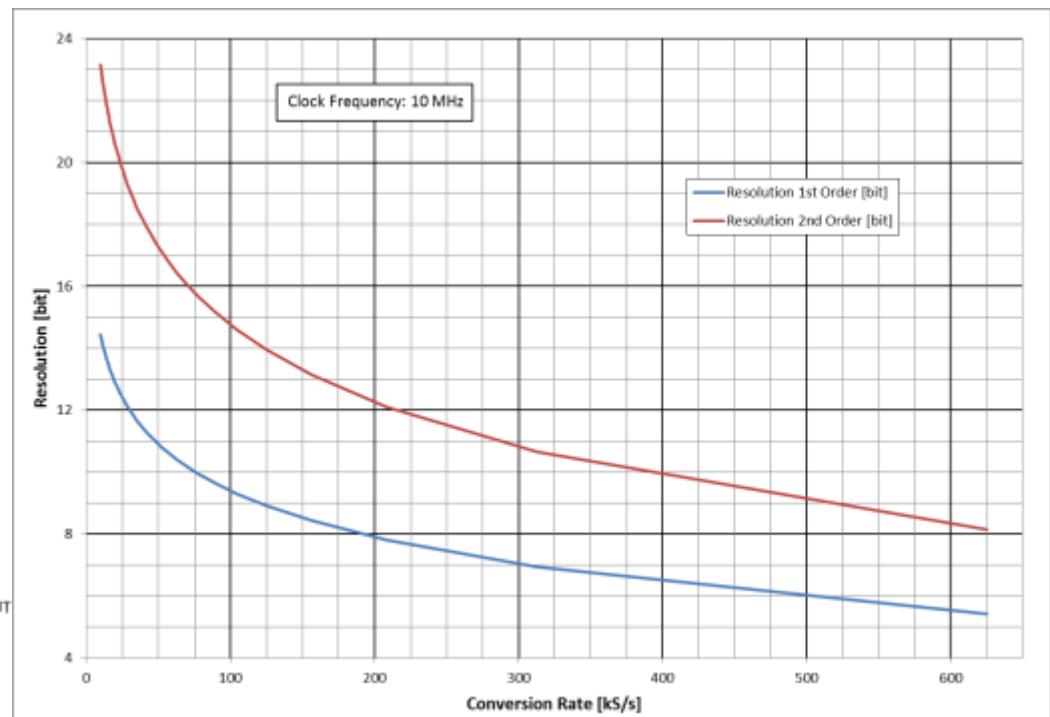
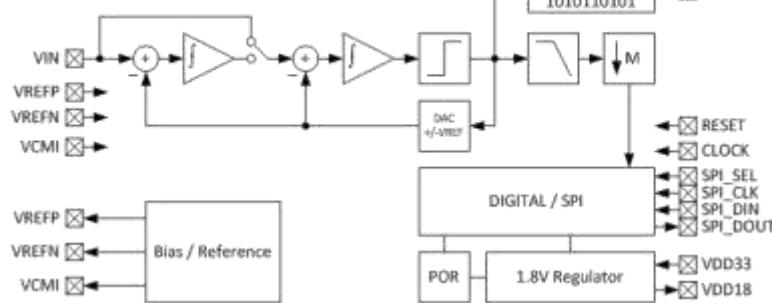
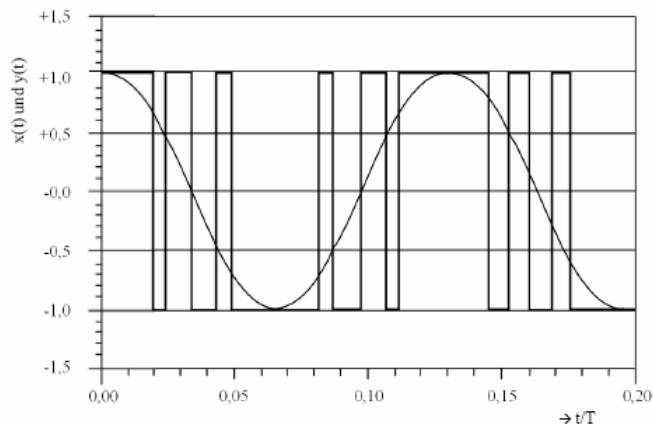
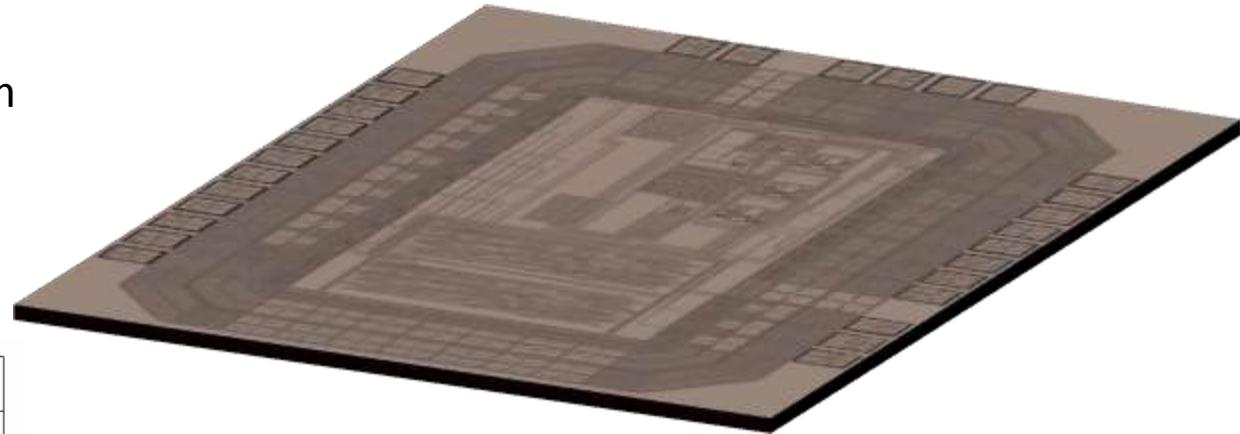


Application in smart metering, digital SMPS and power control

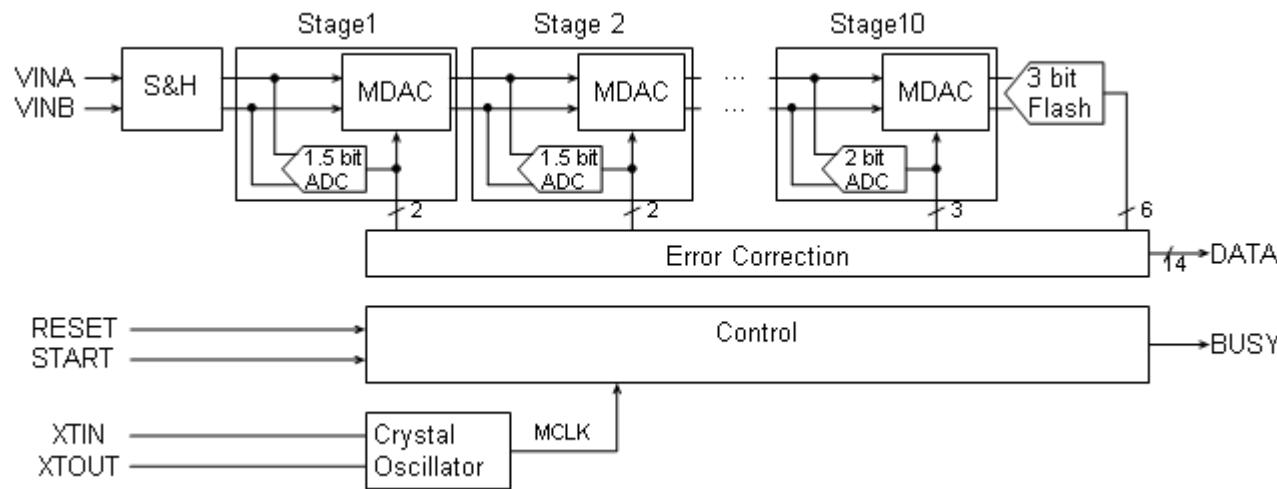
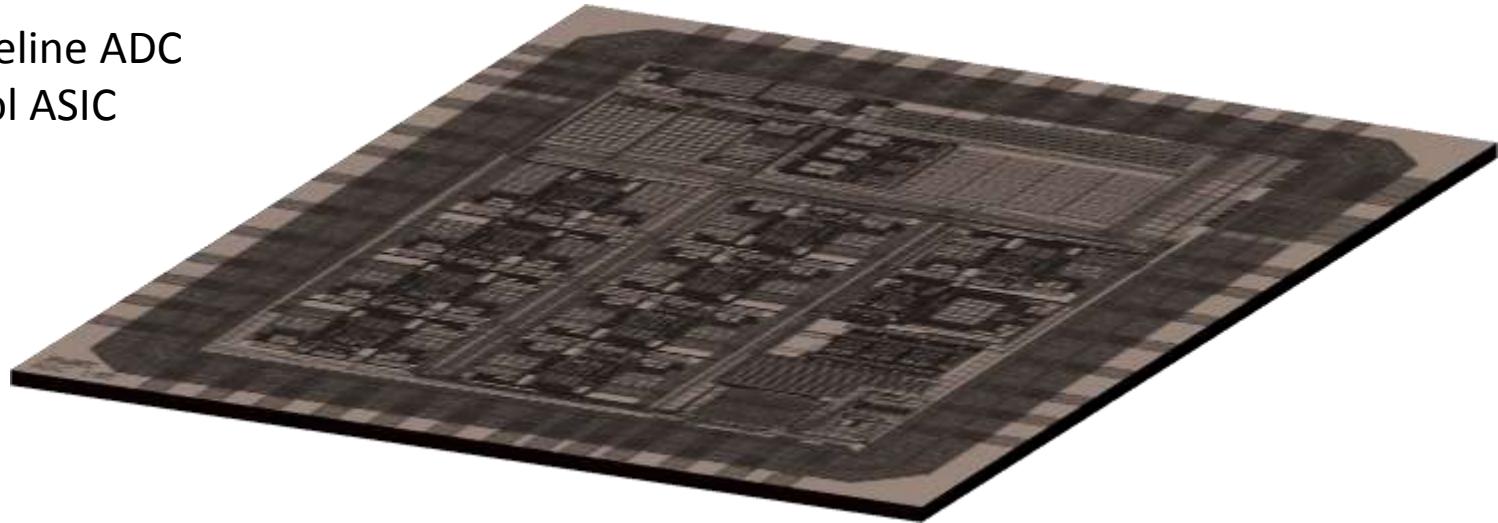
3 x 8bit
successive approximation
2MS/s



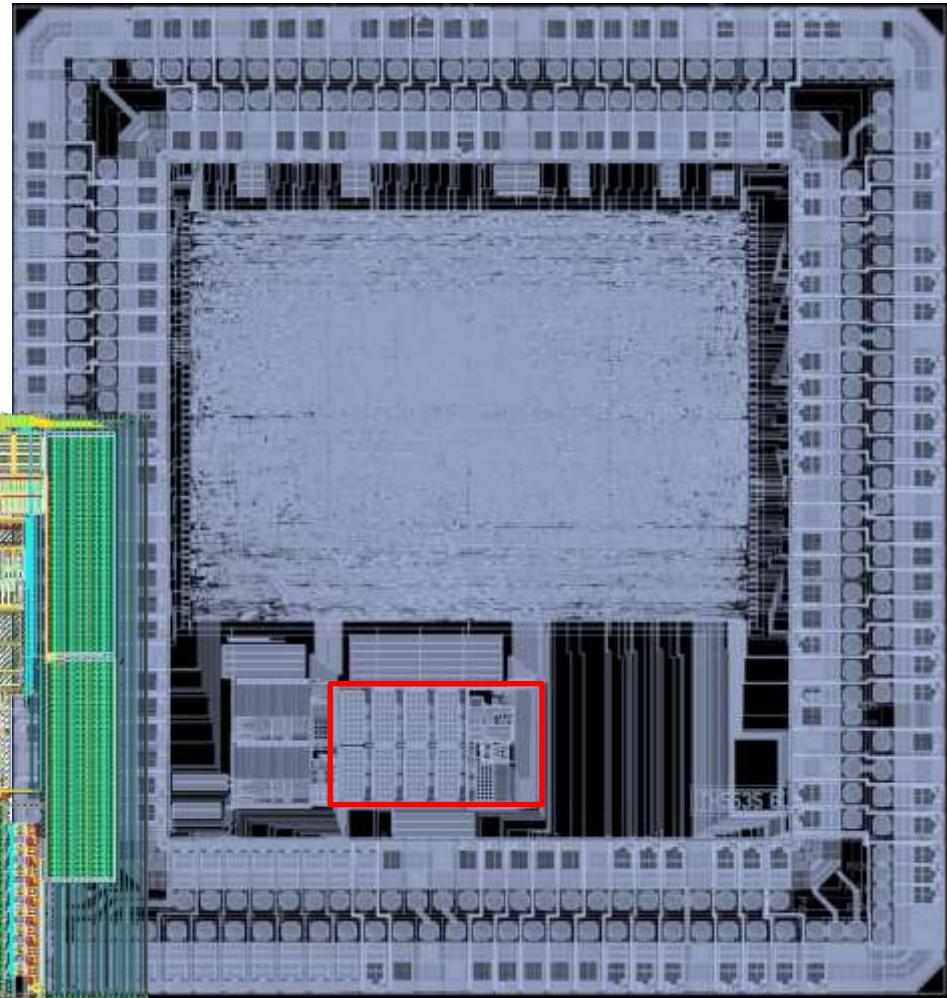
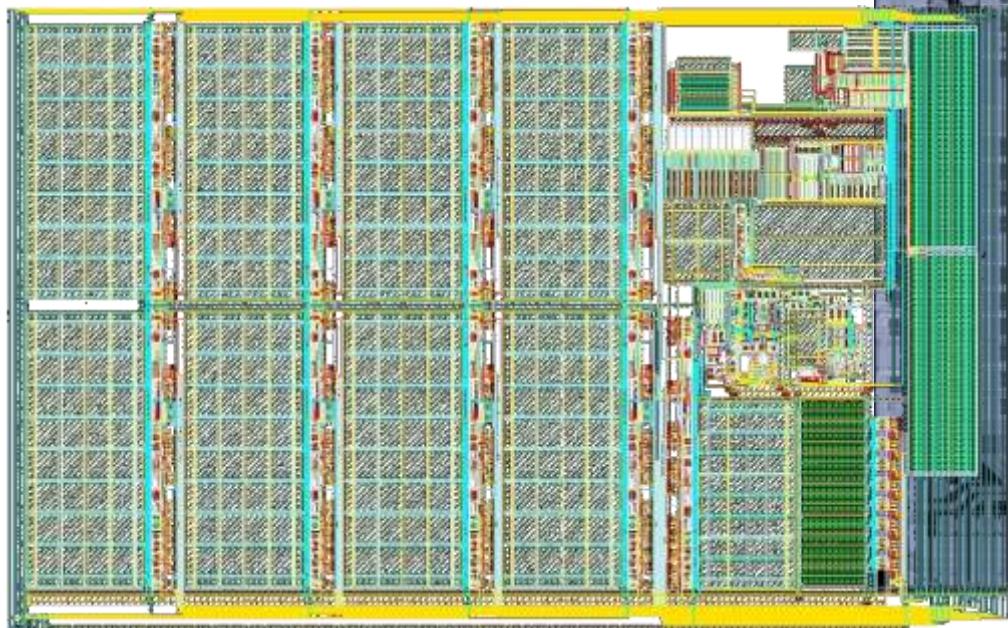
16 bit Delta-Sigma ADC 0,18 μ m
20MS/s
Slow conversion speed but
high resolution applications



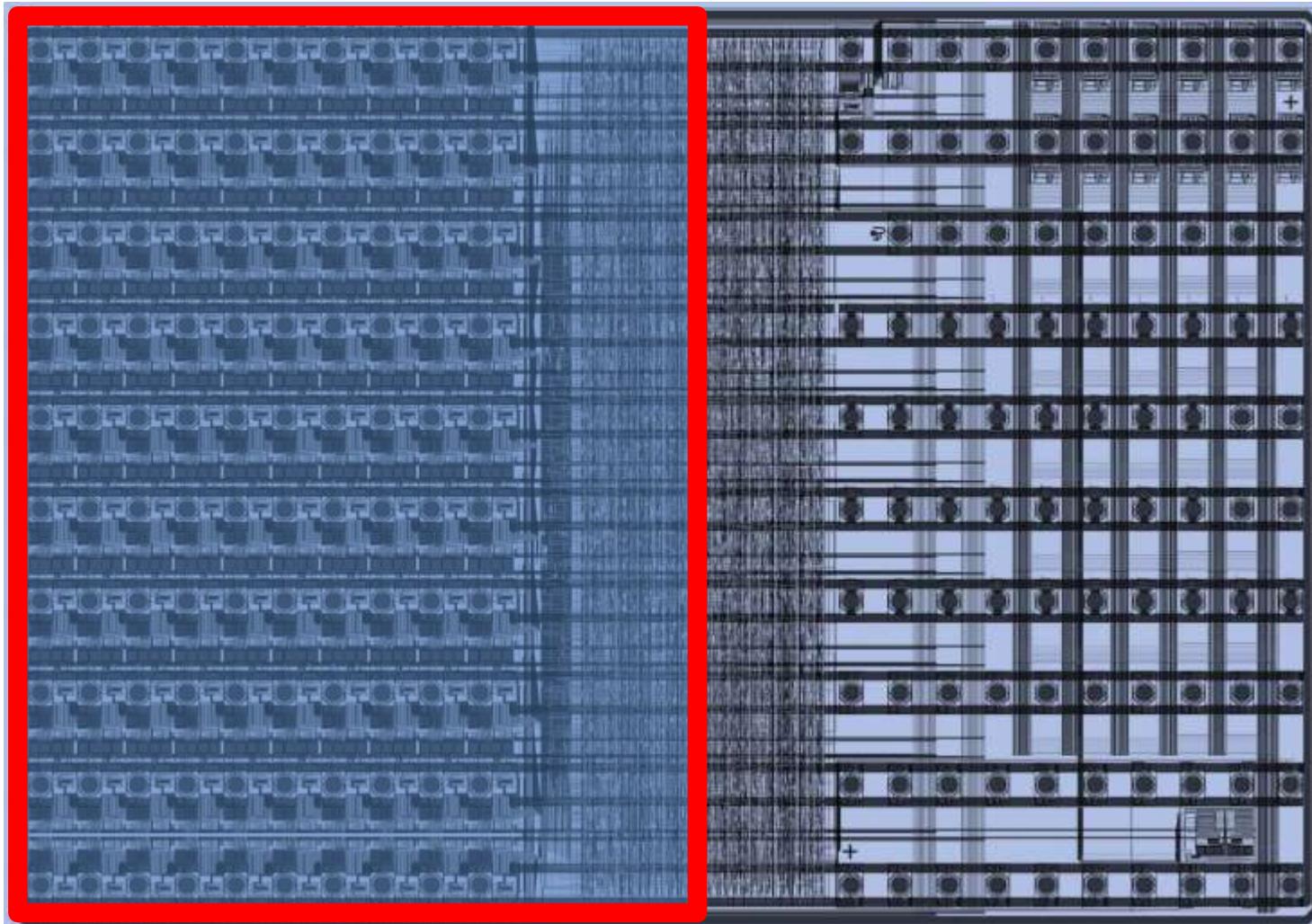
14bit 5MS/s pipeline ADC
Industrial control ASIC



10 bit successive approximation converter with 8 multiplexed inputs each having it's own S&H circuit.
Conversion speed is >125kS/s.



100 x 10bit counter ADCs, charge measurement

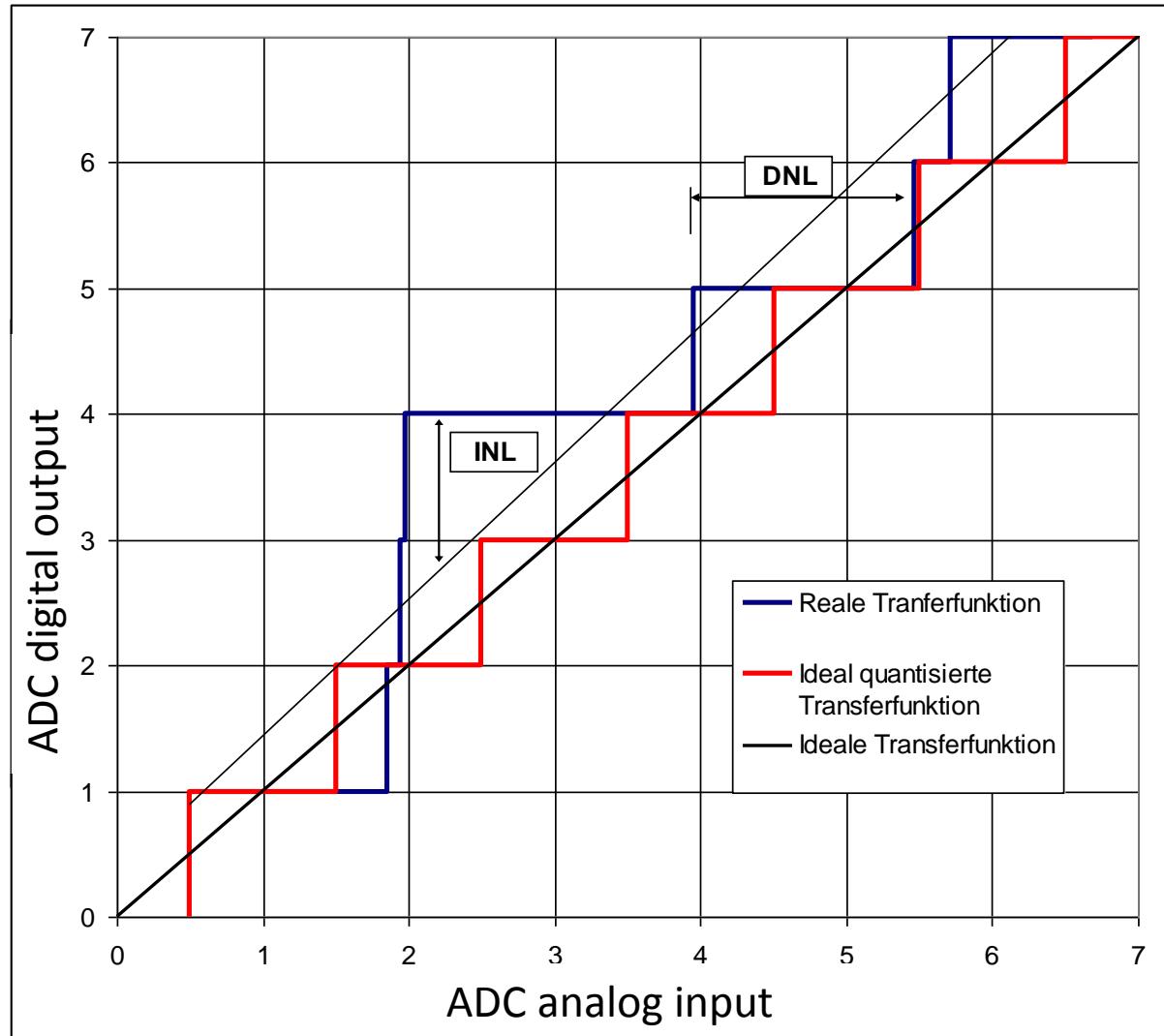


Measurement of ADCs in ASIC



Im Beispiel wurde zum Test des ADCs
ein genauer DAC mit hoher Auflösung
(>16 Bit) und geringen Nichtlinearitäten
(max. 15 ppm) als Referenz verwendet.

Some key parameters

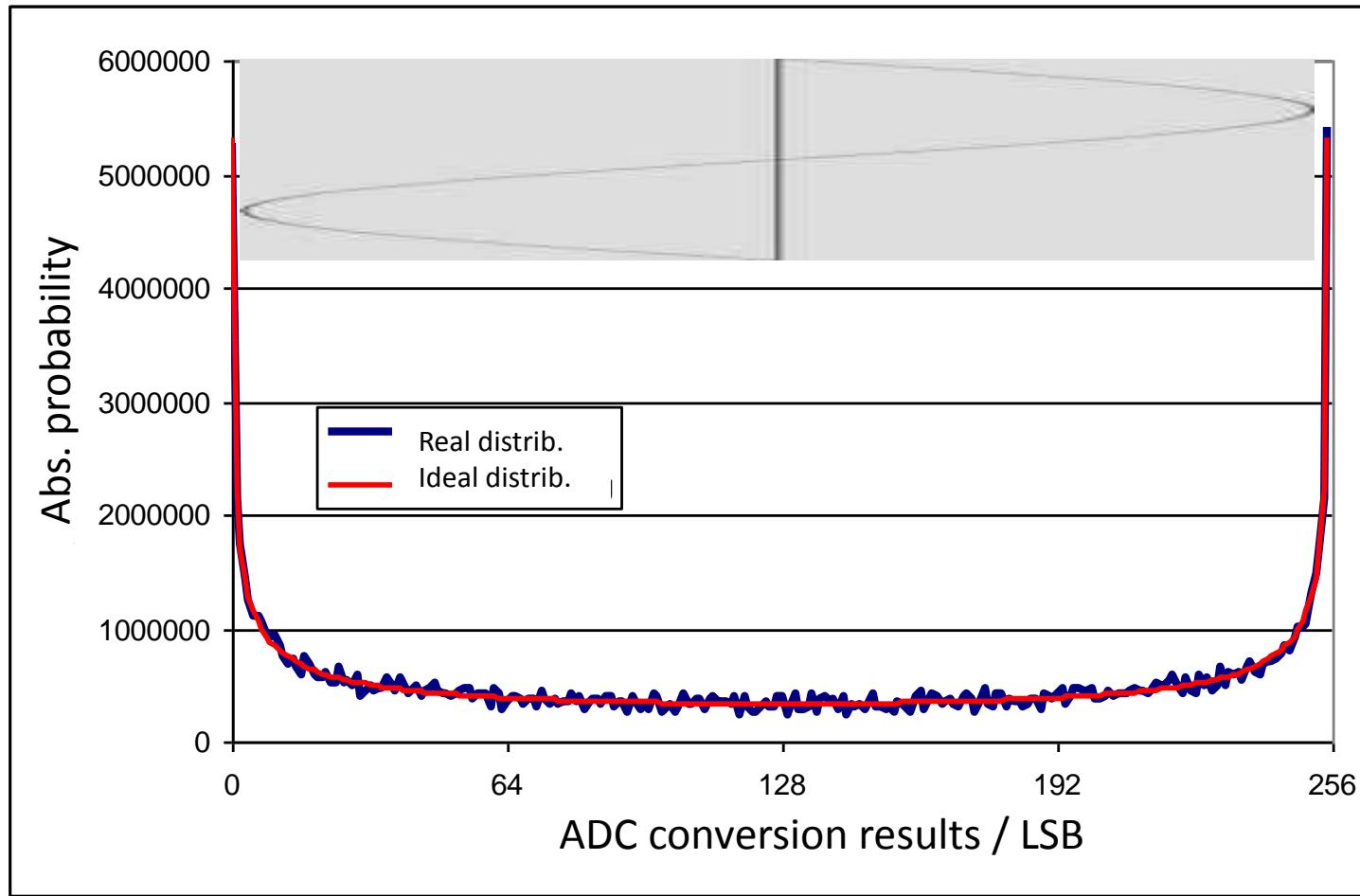


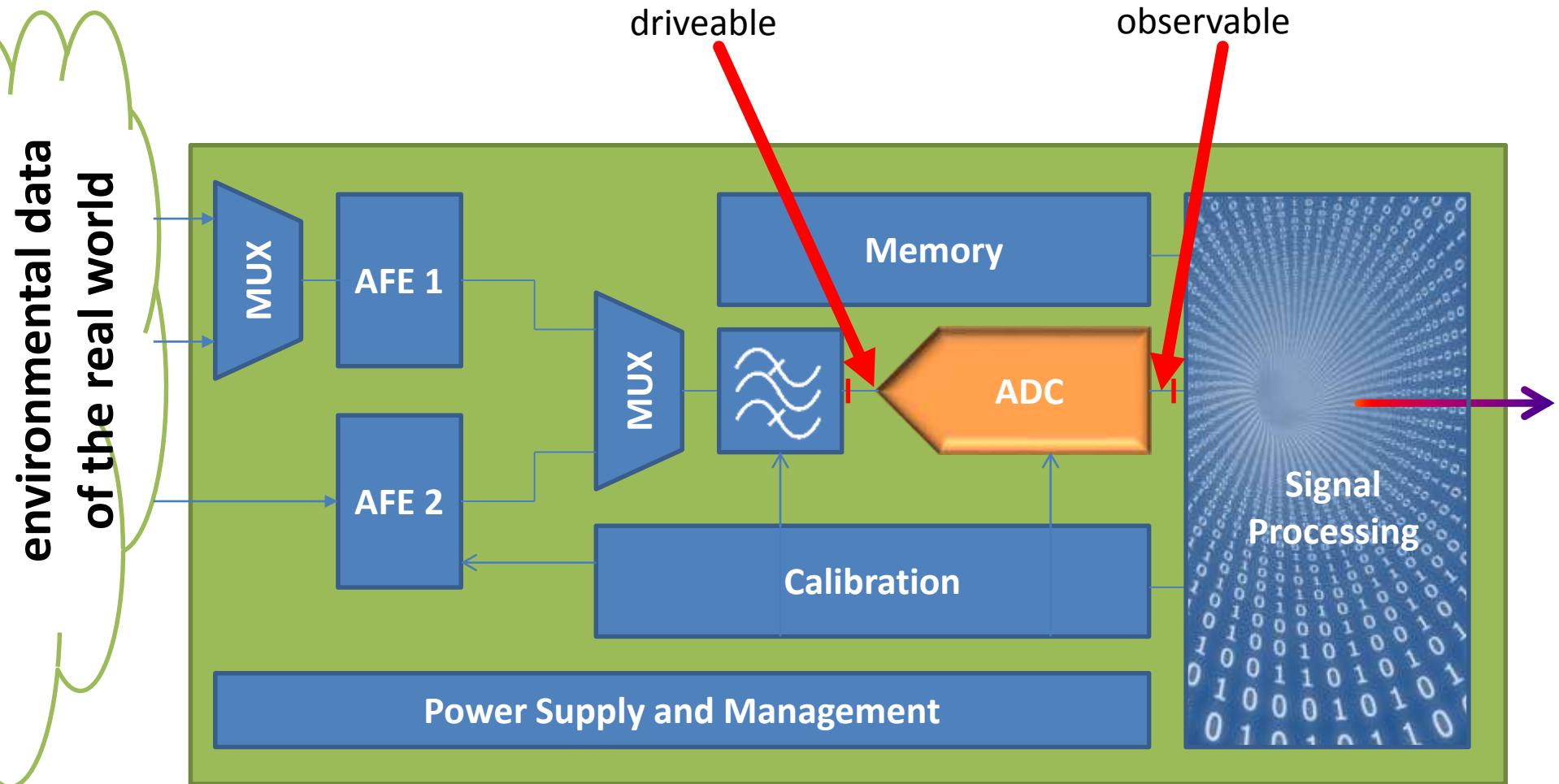
Issues come up with:

- Offset of amplifiers
- Gain errors
- Cross coupling
- Parasitics
- noise

and others.

Input stimulation with clean sinusoidal voltage – bath tub curve





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