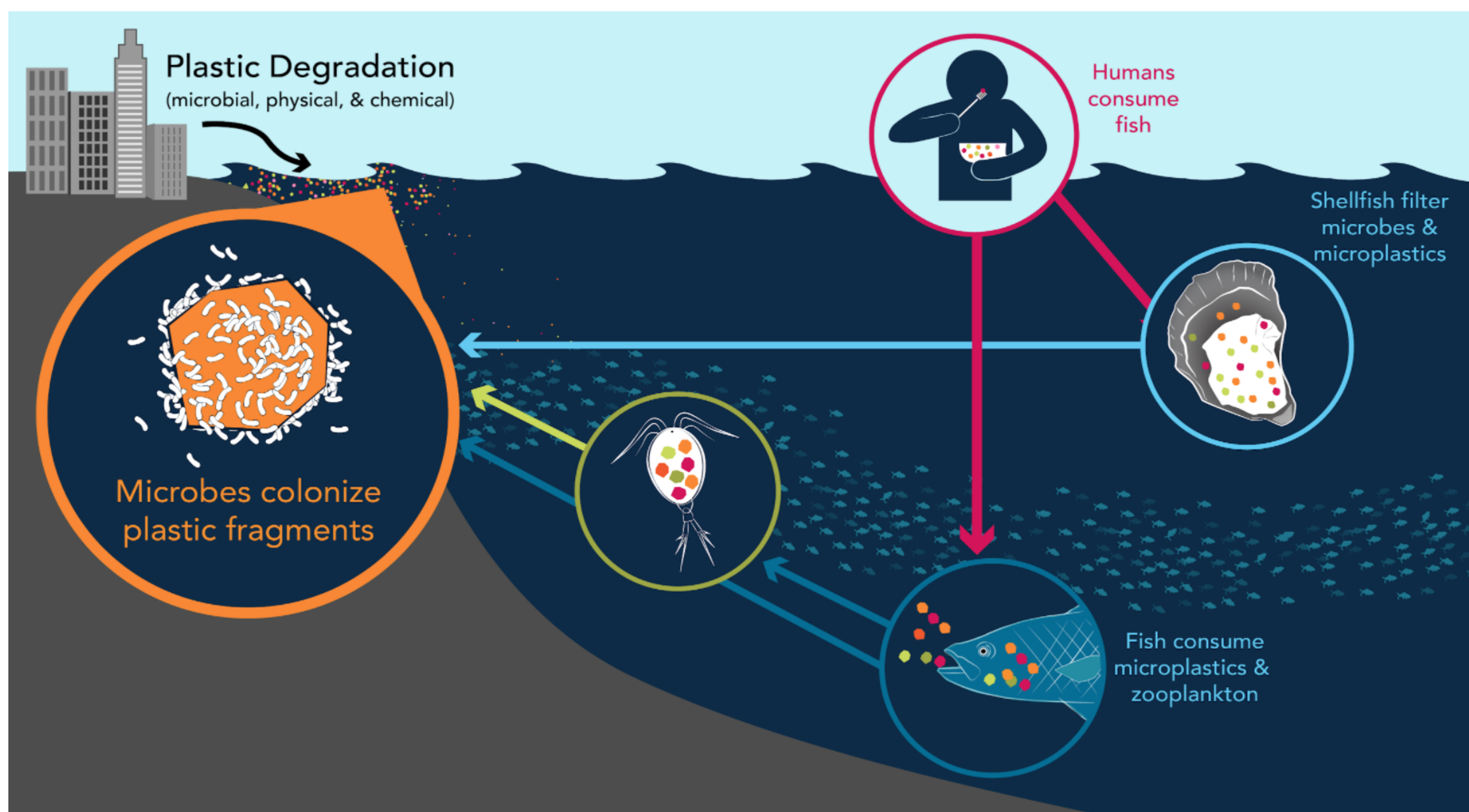




A Sensor Readout IC Architecture for Microplastic Detection

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Motivation



- Microplastics cause damage to human health
- Currently, it is often detected in the feces of infants
microplastics have also been detected in the blood of healthy people
- ➔ **Need to readout IC for microplastic detection**

Problems of Prior Architecture

❖ Conventional Analysis Process



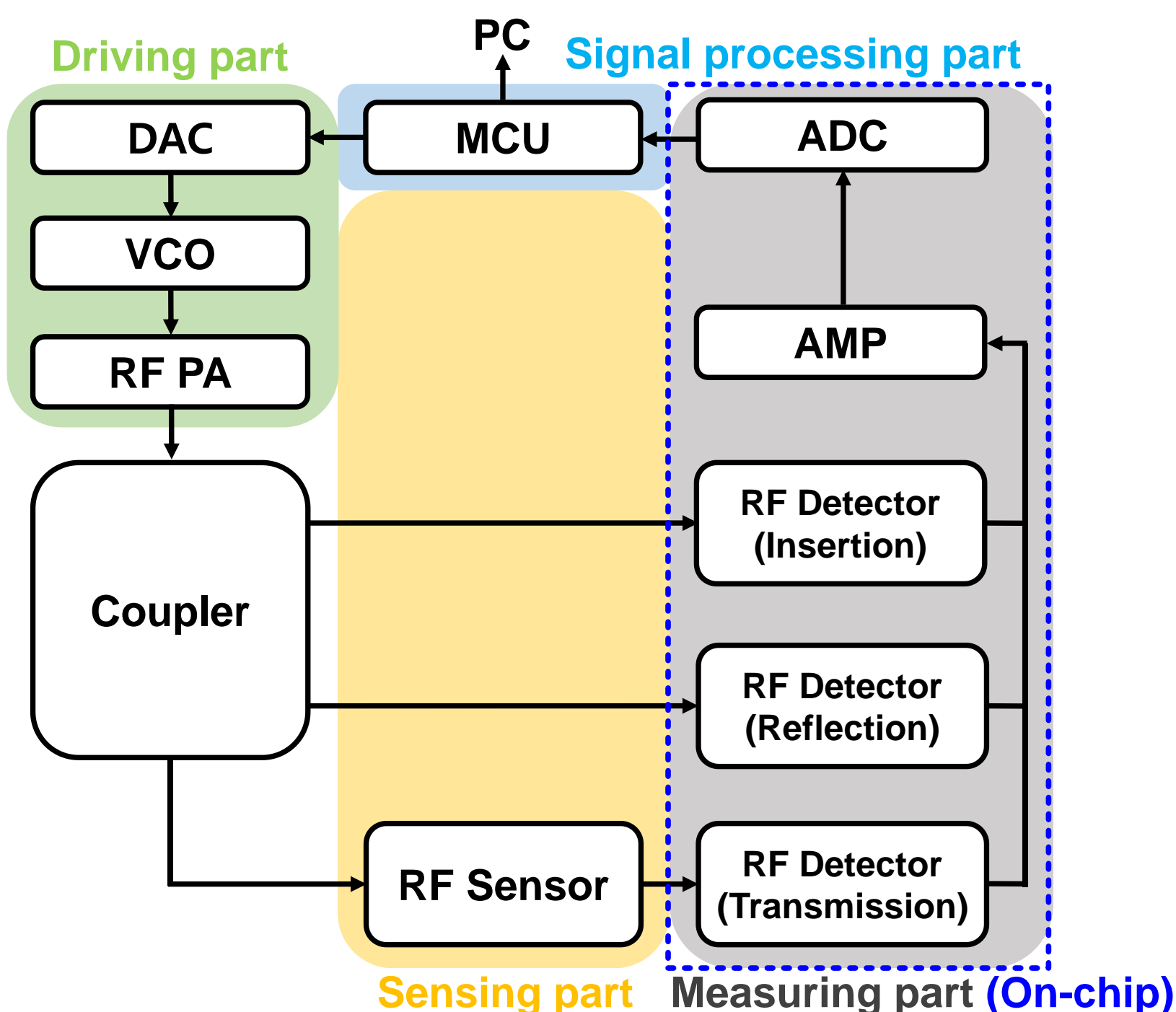
- ➔ TGA-FR-IR
- ➔ Pyrolysis GC-MS
- ➔ TED-GC-MS

❖ Problems using Analysis Equipments (TGA-FR-IR, Pyrolysis GC-MS, TED-GC-MS)

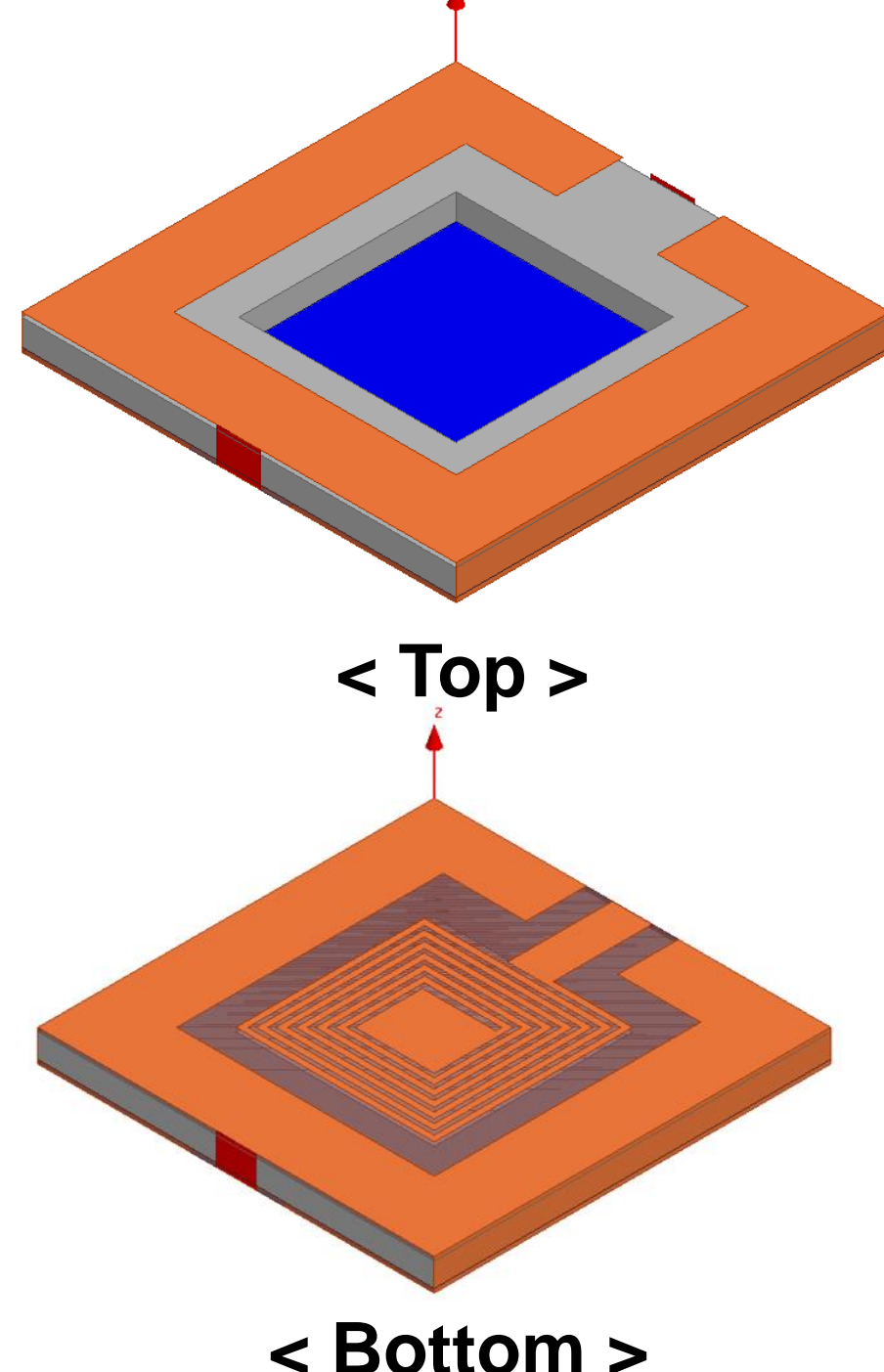
- ➔ Expensive ☹️
- ➔ One-time concentration analysis ☹️
- ➔ Lack of standardized application process ☹️
- ➔ Long pre-processing time and cost burden ☹️

Architecture of Proposed System

❖ Overall System Diagram



❖ RF Sensor

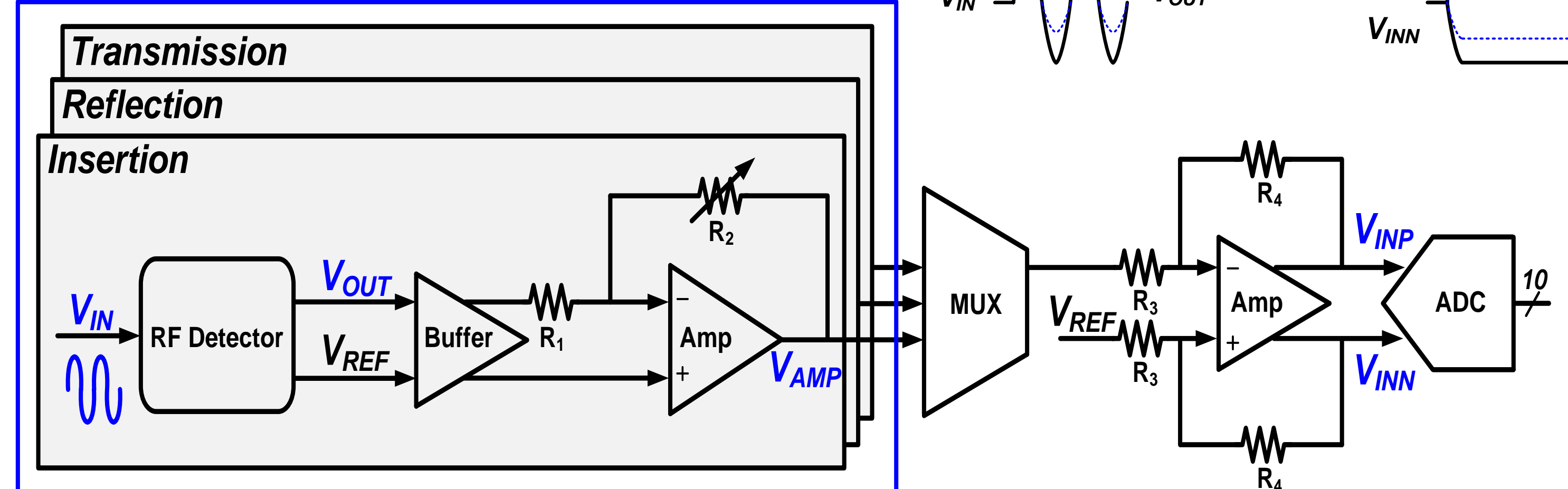


- Overall system consists of sensing, measuring, and driving part
- ➔ Using PDMS-based RF resonant sensor, S11 of the RF Sensor varies depending on the amount of microplastic

Concept of Proposed Idea

❖ Proposed Readout IC

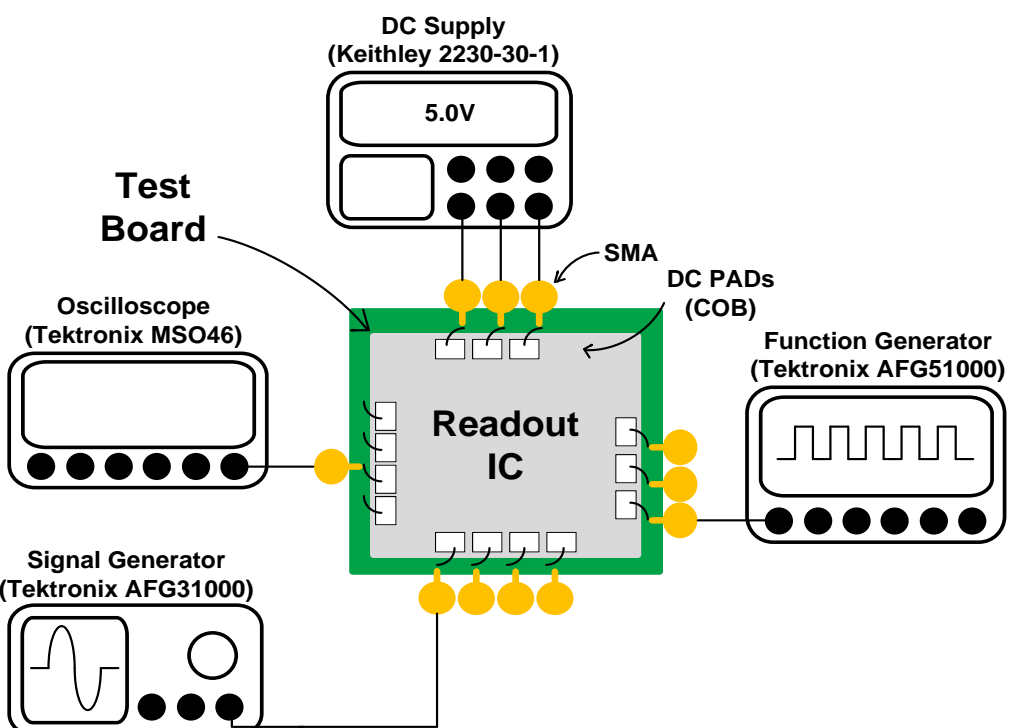
ROIC 3-Channel



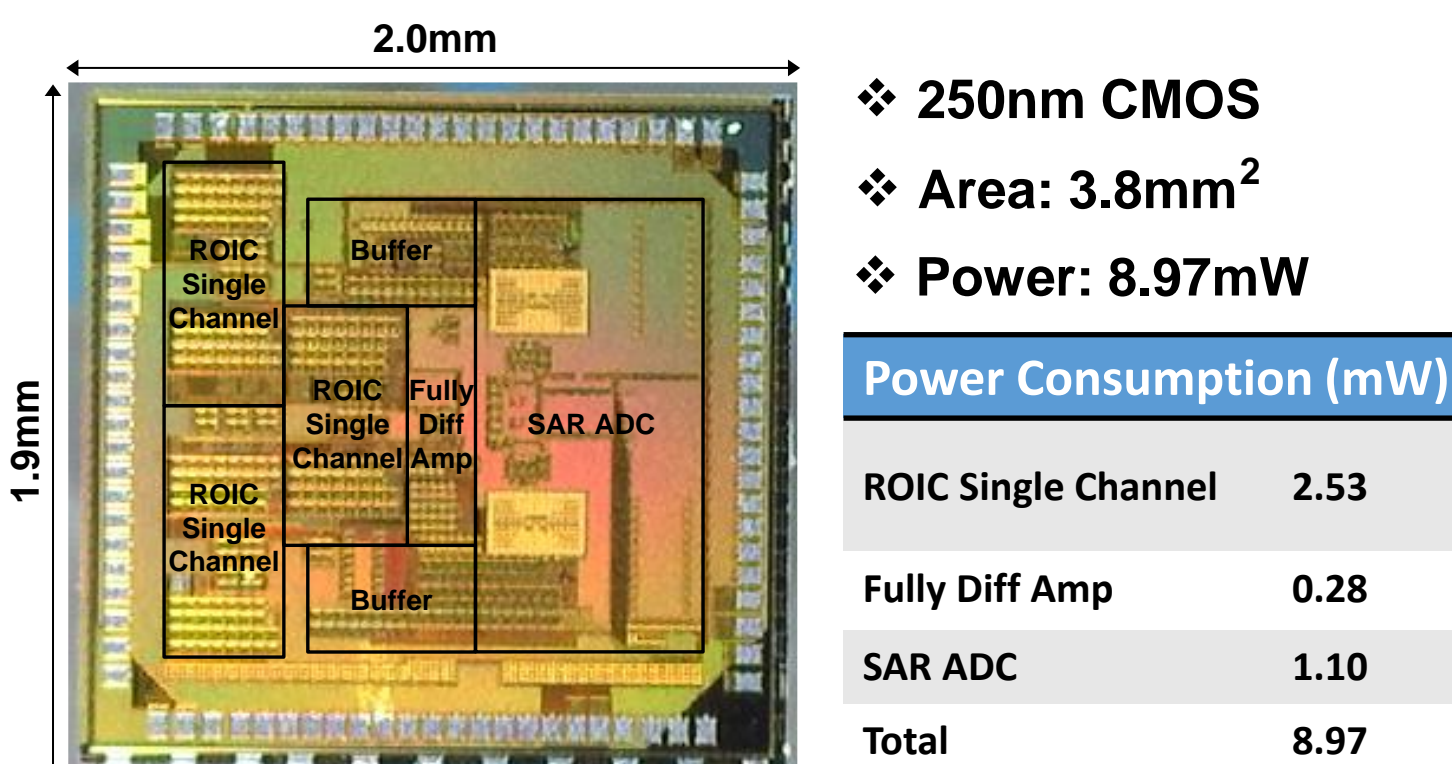
- Proposed Readout IC consists of RF Detector, Amplifier, ADC
- Using RF Detector, the signal applied from the RF sensor is converted to a DC signal
- Given the appropriate sampling rate and resolution, SAR ADC is ideal candidate
- ➔ Sampling rate = 10.4kS/s, Resolution = 10bit

Measurement Results

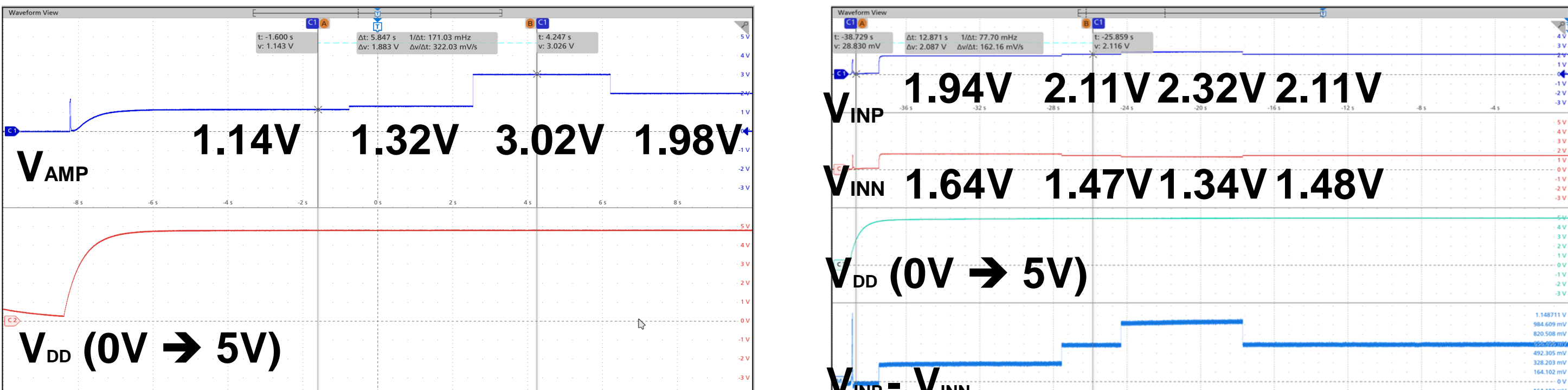
❖ Measurement setting



❖ Die photograph



❖ Measurement transient response



- Feedback Gain Control = 1/2/12/6

Performance Summary & Conclusion

❖ Technology and Specifications

Parameter	Value
Technology	250nm CMOS
Area	3.8mm ²
Supply Voltage	5V
RF Input Voltage Range	±177m~700mV
Amplifier Voltage Gain	2~12
ADC Sampling Rate	10.4kS/s
ADC Resolution	10-bit
Power Consumption	8.97mW

❖ Conclusion

- The difference between insertion and reflection indicates the presence or absence of microplastic
- It is expected to contribute to human health and the preservation of the earth's environment 😊

Acknowledgement

The chip fabrication and EDA tool were supported by the IC Design Education Center (IDEC), Korea.
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