TSU & TSZ series
Precision Operational Amplifiers

AMS Marketing

Op-Amps & Comparators

The best choice for longevity, accuracy, robustness and power efficiency

Key products

TSZ High Precision Zero Drift Op-Amps
TSU Ultra-low power Op-Amps
TSV Low-voltage (5V), low power and High Speed Op-Amps
TSX 16V low power, precision Op-Amps & Comparators
TSB 36V robust, low power, precision Op-Amps
TSC Current Sense Amplifiers
TS3021, TS3022 5V high-speed Comparators
TS3011 5V Ultra fast Comparator
TS88 5V nano-power Comparators
TS985 5V tiny CSP low power Comparators

The primary link between High Accuracy Analog Sensors and ADCs

- **High precision** for accurate signal conditioning
- **Low power** for battery powered applications
- **Small packages** for space constrained applications

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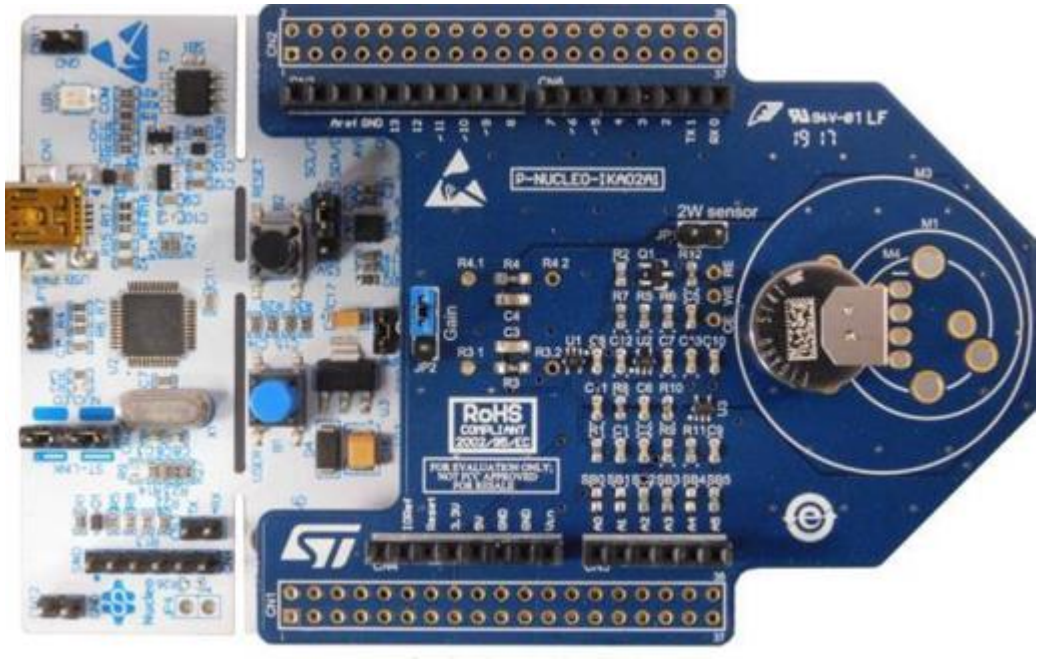
Electrochemical Toxic Gas Sensor

TSU111 High-precision and low-power Zero-Drift Operational Amplifiers



P-NUCLEO-IKA02A1

- Footprint compatible with two-, three- and four-electrode electrochemical sensors (PCD13,5, PCD17, Mini and TGS5141)
- **Signal conditioning based on TSU111 High-precision and low-power Zero-Drift Operational Amplifiers**
- Ultra-low-current precision analog temperature sensor STLM20 for compensation of gas readings
- STM32 Ultra-low-power Arm® Cortex®-M0+ MCU (32 MHz max.) with 64 Kbytes Flash and 8 Kbytes of SRAM
- Figaro TGS5141 Carbon monoxide coin-cell sensor
- Expected lifetime > 10 years

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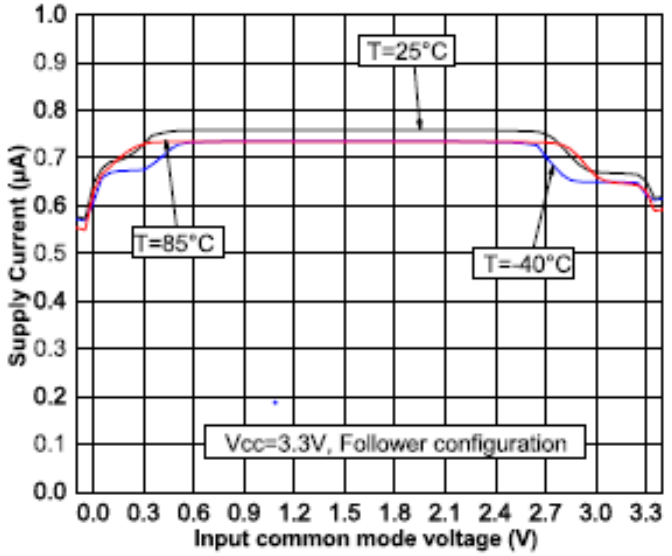
TSU11x Zero-Drift Op-Amps

Nanopower (900 nA) high-accuracy (150 uV) 5V CMOS Op-Amp

- Very high accuracy and stability:
- Offset voltage 150µV max. at 25°C
- 235µV max. over temperature (-40 to 85°C)
- ΔVio/ΔT input offset voltage drift: 1.4µV/°C (-40°C to 85°C)
- **Low input bias current: 10pA max. at 25 °C**
- Rail-to-rail input and output
- **Low supply voltage: 1.5V** to 5.5V (CR2032 compatible)
- Micro power consumption:
- **900nA current consumption typ. at 25°C,**
- 1480nA max over temperature (-40 to 85°C)
- Gain bandwidth product: 11.5KHz typ.
- Single (TSU111), dual (TSU112), quad (TSU114)

Benefits

- Sub-1µA consumption
- High accuracy without calibration



Related products	
See TSU101, TSU102, and TSU104	for further power savings
See TSZ121, TSZ122, TSZ124	for increased accuracy

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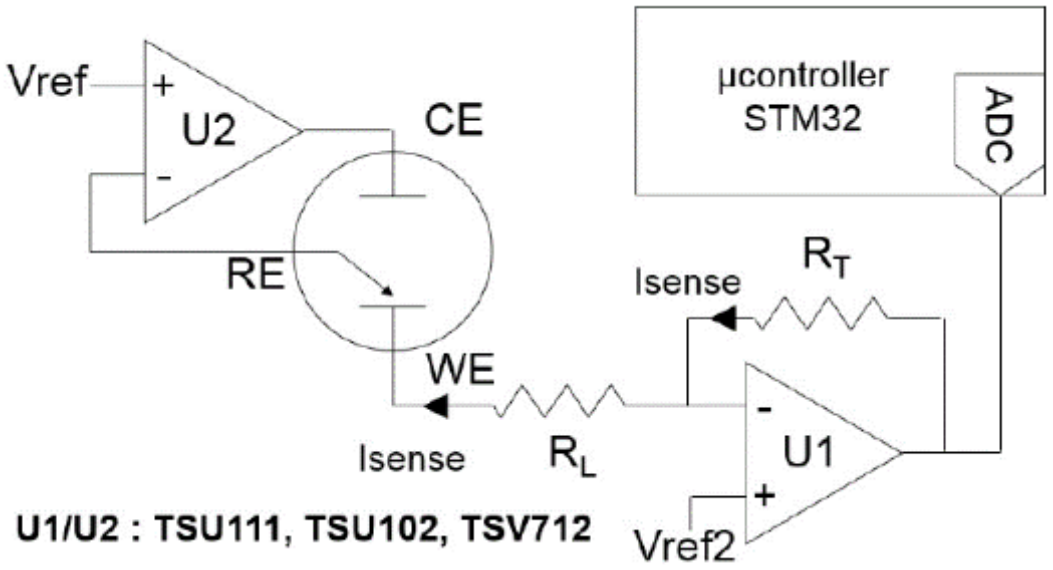
TSU111 as Trans-impedance Amplifier



- A trans-impedance amplifier configuration is used to convert the current generated by the sensor into a voltage that can be read by the ADC of a uC. This electronic design is called a **Potentiostat**.
- To operate correctly, the potentiostat configuration requires that the input bias current (Iib) of the op-amp is low to prevent additional offset caused by RT.
- U1 op-amp converts the current generated by the sensor into a voltage thanks to RT. The output voltage sensed by the ADC is then RT×Isense.
- U2 is used to bias the sensor
- The uC provides the gas concentration from its ADC reading, proportional to Isense.
- TSU111 has 10pA max input bias current, for trans-impedance amplifier configuration

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TSZ Series: Zero-Drift Op-Amps

Zero-Drift Op-Amps do not drift!

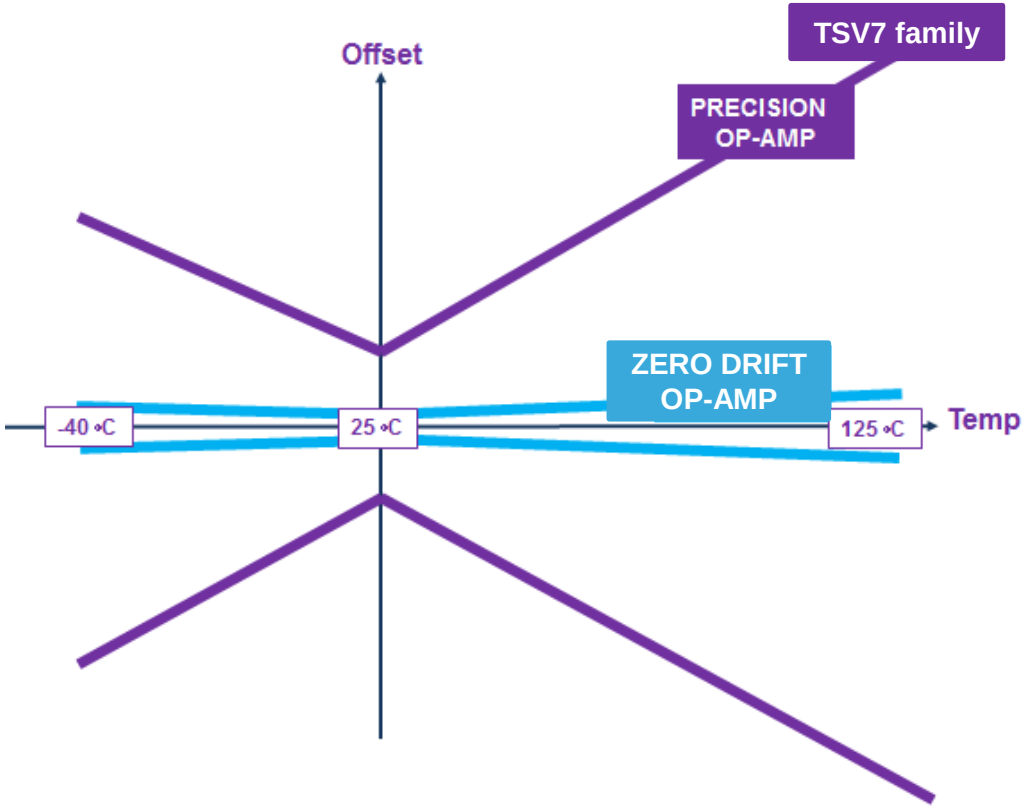
FEATURES

- Offset: (TSZ12x)
  +/- 1 µV typ
  +/- 8 µV worst case
- Offset drift: (TSZ12x)
  10 nV/°C typ
  30 nV/°C max
- 400 kHz GBW (TSZ12x)
- 3 MHz GBW (TSZ18x)
- Operating range: 1.8 to 5.5 V
- Temperature range: -40 to 125 °C
- Rail-to-rail input and output
- ESD: 4kV HBM
- Qualified for automotive applications
- Available in tiny packages:
  - SOT23 and SC70, DFN6 1,2x1,3 for single
  - MiniSO8, SO8, DFN8 2x2 for dual
  - QFN16 3x3, TSSOP14 for quad

APPLICATIONS

- Portable instrumentation
- Battery-powered devices
- Sensor interfaces
- Medical instrumentation
- Electronic scales
- Temperature measurement
- Automotive current mesurement

LONGEVITY 10 YEARS COMMITMENT



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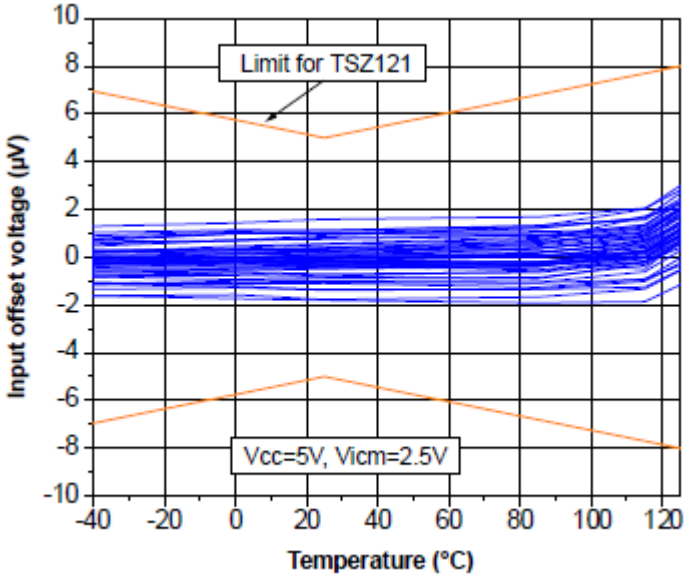
TSZ121

Very high accuracy (5µV) Zero Drift 5V Operational Amplifiers

- Very high accuracy and stability:
  - Offset voltage 5µV max at 25°C
  - **8µV over full temperature range (-40°C to 125°C)**
  - ΔVio/ΔT input offset voltage drift: **30nV/°C** (-40°C to 125°C)
- Rail-to-rail input and output
- Low supply voltage: 1.8V - 5.5V
- Low power consumption: 40µA max. at 5V
- Gain bandwidth product: 400KHz
- Micro-packaging options (**DFN2x2**)

Benefits

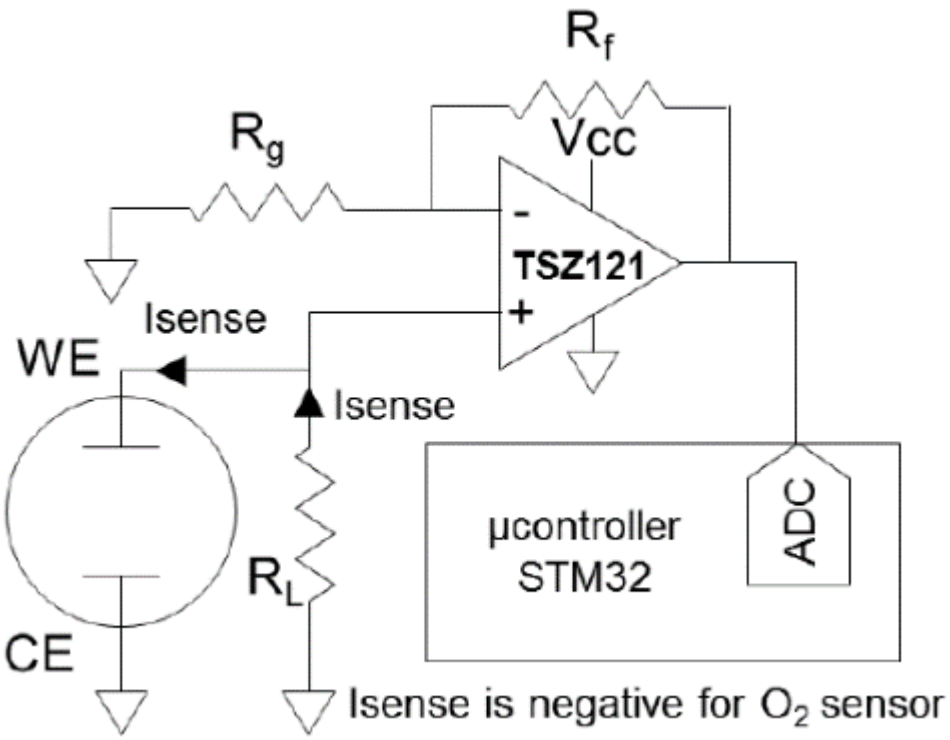
- High accuracy without calibration
- Accuracy virtually unaffected by temperature



TYPICAL APPLICATIONS

- Battery-powered precision applications
- Portable Accuracy measurement and test equipment
- Portable Medical instrumentation
- Analog Sensors signal amplification

TSZ121 in Galvanic Configuration



- An alternative configuration is to use the voltage drop through the load resistor and amplify this voltage with an Op-Amp. The current to voltage conversion is made by RL rather than by the trans-impedance amplifier.
- The scale of the signal to be amplified is RL×Isense, in the range of mV. For this configuration, the op-amp needs a very low Vio and a very low Vio temperature drift.
- The best op-amp for this configuration is the TSZ121 zero-drift op-amp (5µV max Vio). With 0.06µV/°C max Vio drift, a 20°C variation causes a voltage change of just 1.2µV (only 0.01% in a full scale of 10mV).
- The output signal read by the ADC is: - (1 + (Rf/Rg))IsenseRL

Amplifiers / Comparators
From General Purpose to High End

- 40+ years on the market
- High reliability – Industrial/Automotive/Space
- 4 billion units/year sold
- 350 root part numbers

Precision

TSZ121
TSV711
TSV731
TSX711

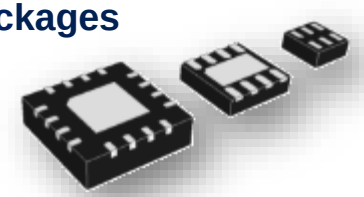
✓ Accurate analog signal measurement

LM324DT
LM358DT
LM2903DT
LM2904DT

✓ Minimize PCB area and application thickness

LM358QT
TSU102IQ2T
TSV632IQ2T
TS985IJT

Tiny Packages

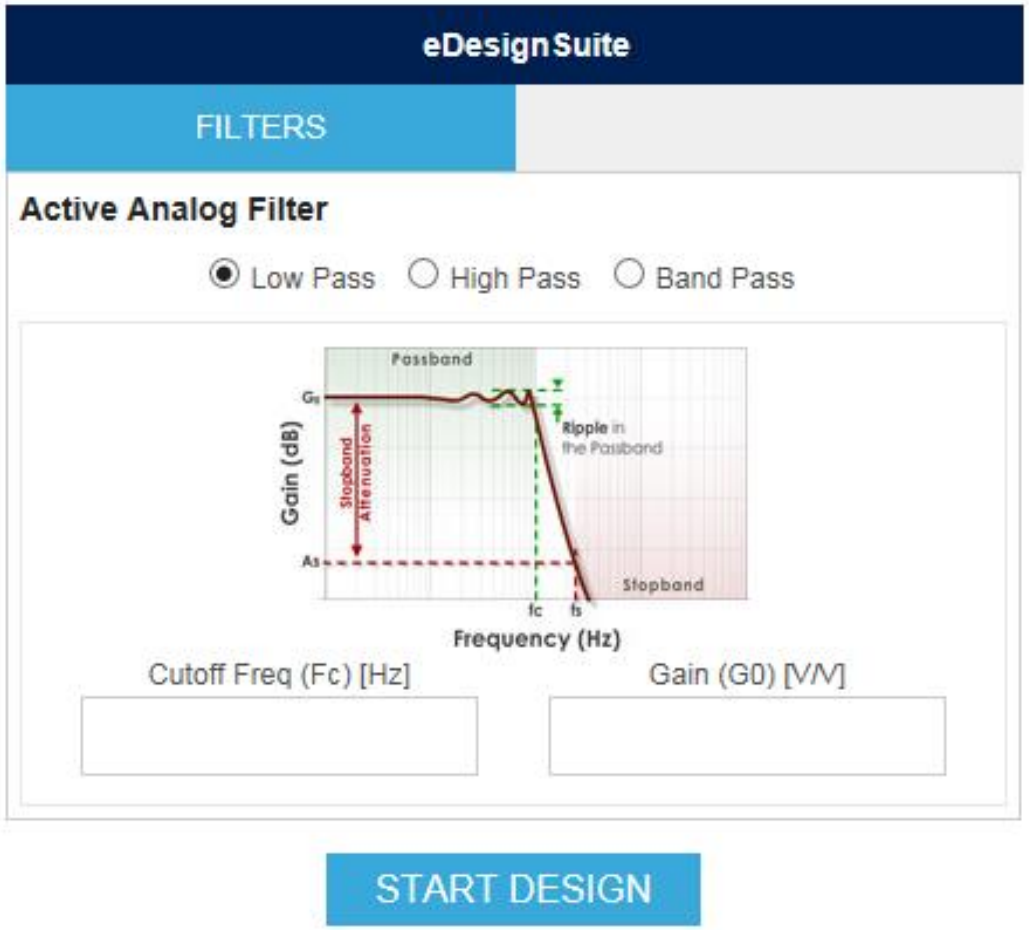


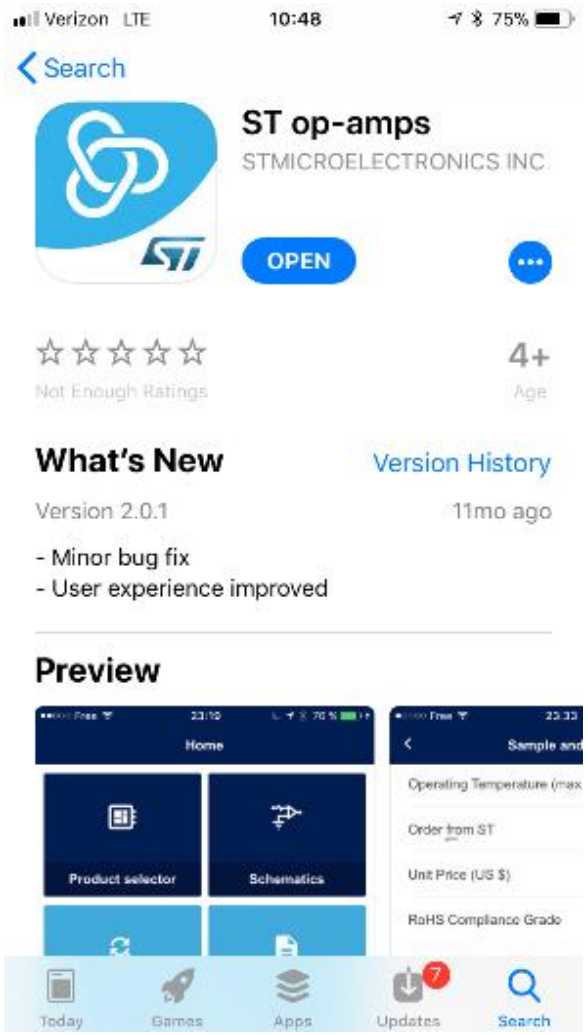
Low Power

TSU101
TSV711
TS881
TSX631

✓ Longer lifetime in battery-operated systems

Mobile App and e-Design Suite





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Electrochemical gas sensor evaluation board

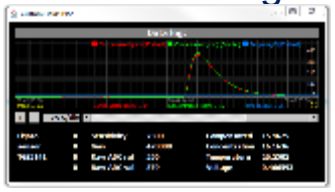
Board

2 x **TSU111** nano-power op amps used for signal conditioning

Ideal for electrochemical sensing thanks to high precision and low power consumption

Getting Started

STM32 Nucleo pack for electrochemical toxic gas sensing



Wireless CO detector demo

Based on **TSU111** Op Amps and **S2-LP** sub-1GHz RF transceiver

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Thank you

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