

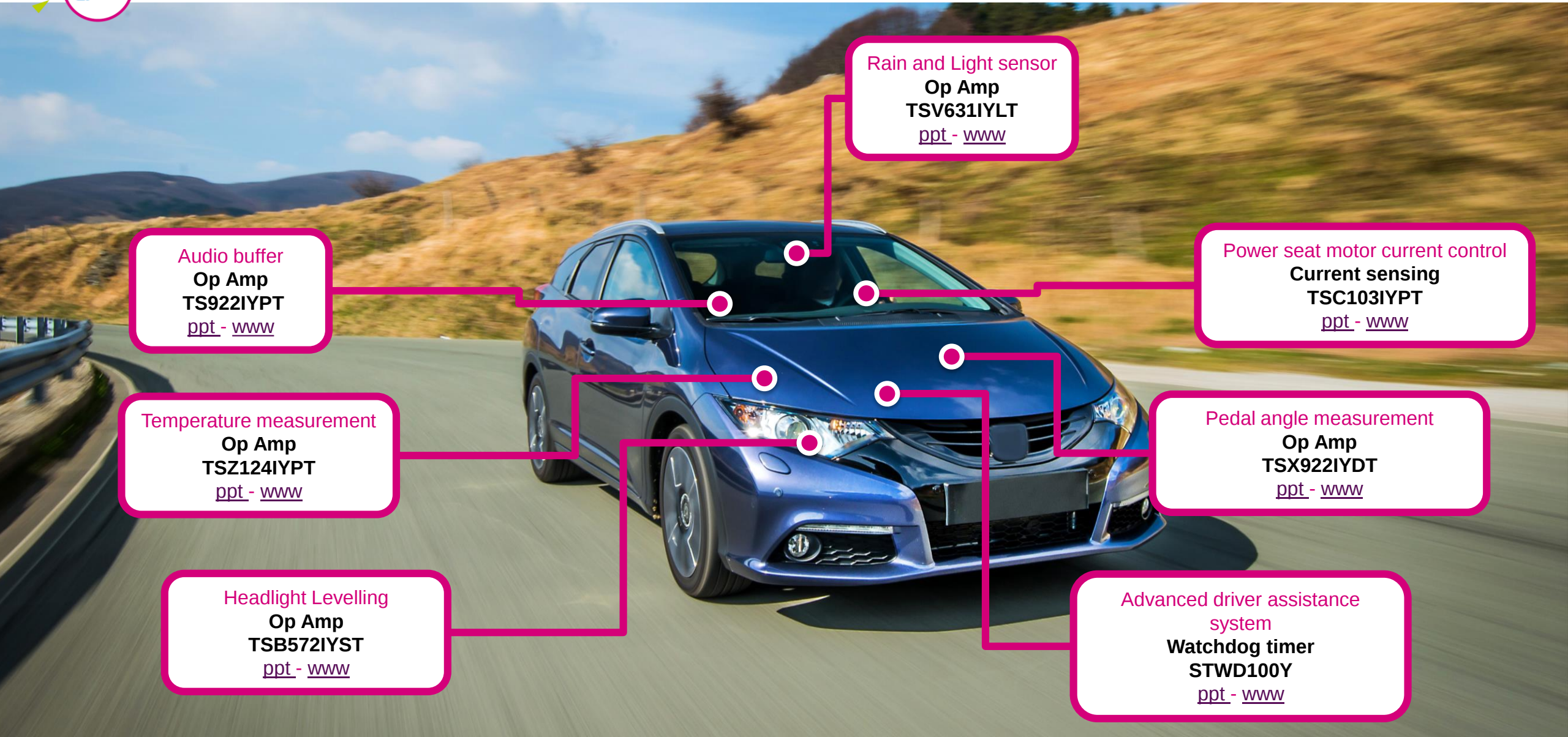
ST Analog Products for Automotive applications

General Purpose Analog and RF





Added value for SMART DRIVING



Audio buffer
Op Amp
TS922IYPT
[ppt](#) - [www](#)

Rain and Light sensor
Op Amp
TSV631IYLT
[ppt](#) - [www](#)

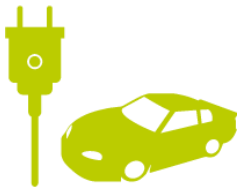
Power seat motor current control
Current sensing
TSC103IYPT
[ppt](#) - [www](#)

Temperature measurement
Op Amp
TSZ124IYPT
[ppt](#) - [www](#)

Pedal angle measurement
Op Amp
TSX922IYDT
[ppt](#) - [www](#)

Headlight Levelling
Op Amp
TSB572IYST
[ppt](#) - [www](#)

Advanced driver assistance
system
Watchdog timer
STWD100Y
[ppt](#) - [www](#)



Added value for GREENER DRIVING

Low-side current measurement
for motor control

Op Amp
TSZ124IYPT

[ppt](#) - [www](#)

NO_x sensor for
Selective
Catalytic
Reduction

Op Amp
TSV912HYDT

[ppt](#) - [www](#)

Power switches for
48V battery
applications

Current sensing
TSC103IYPT

[ppt](#) - [www](#)

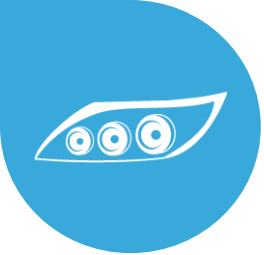
Electric Power Steering
angle measurement

Op Amp
TSX564IYPT

[ppt](#) - [www](#)

O₂ sensor
Op Amp
TSV522AIYST

[ppt](#) - [www](#)

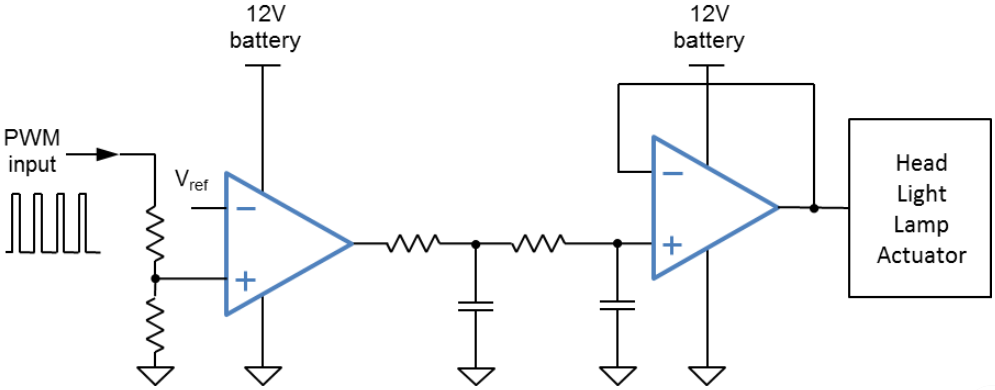


Headlight Levelling

Context

The headlight angle adjustment helps to compensate the car pitch angle, whatever the car loading or road conditions. The levelling becomes more and more critical as the headlight power increases, to prevent other drivers from being dazzled.

Principle of operation



The ECU provides a PWM signal proportional to the desired headlight angle. The first op amp acts as a level shifter, and the second as a low-pass filter in order to provide a voltage proportional to the battery voltage to the actuator.



ST Offer

Feature

Supply voltage
36 V operating

Supply voltage
40 V AMR

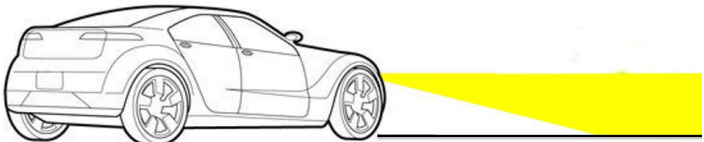
Rail-to-rail input / output
stage

Capability to provide control
voltage proportional to
battery

Reduces need of load dump
clamping

No need for charge pump
circuitry

Benefit



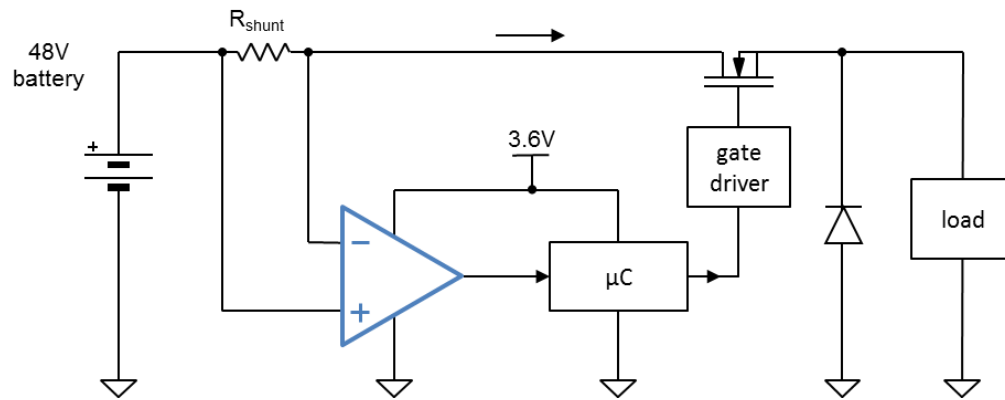


Power switches for 48 V battery applications

Context

The automotive industry is committed to meet future emission regulations, and the implementation of an intermediate battery voltage of 48 V appears to be a very promising solution.

Principle of operation



The current sense amplifier measures the current through a shunt resistor. If the current exceeds the programmed threshold, the microcontroller inhibits the gate drive.

ST Offer

Feature

Input pins sustain:
-16 to 75 V
ESD 2.5 kV

Output voltage accuracy:
±2.5% @ 25 °C
±4% from -40 to 125 °C

Benefit

No protection needed for:
Load dump, reversed
battery, ESD surges

Minimizes shunt value and
cost



Current sense amplifier
TSC103IYPT



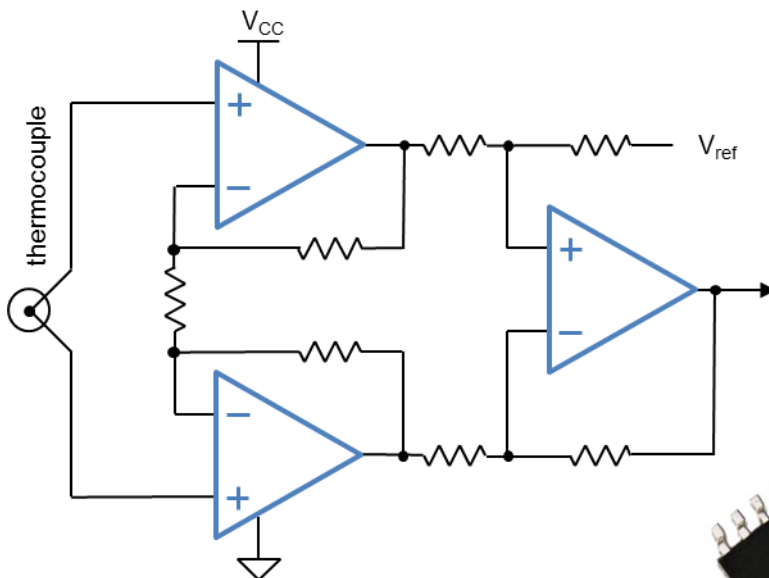
Temperature measurement

Context

Temperature is measured to guarantee safe operation of motors, converters and electronic control units. In hybrid and electric vehicles, temperature measurement helps to monitor and maximize battery efficiency.

Principle of operation

The thermocouple probe creates a reference voltage proportional to temperature, amplified by a high-accuracy op amp in a differential amplifier configuration.



Op Amp – Zero Drift
TSZ124IYPT

ST Offer

Feature

Input offset voltage
 $V_{IO} < 5 \mu\text{V} @ 25^\circ\text{C}$
 $V_{IO} < 8 \mu\text{V} -40 \text{ to } 125^\circ\text{C}$

Input offset voltage drift
 $\Delta V_{IO}/\Delta T$
 $30 \text{ nV}/^\circ\text{C} (\text{max.})$

Input bias current
 $I_{IB} < 200 \text{ pA}$

Benefit

Excellent measurement
without trimming

Stability of measurement
versus temperature change

Compatible with high
impedance sensor



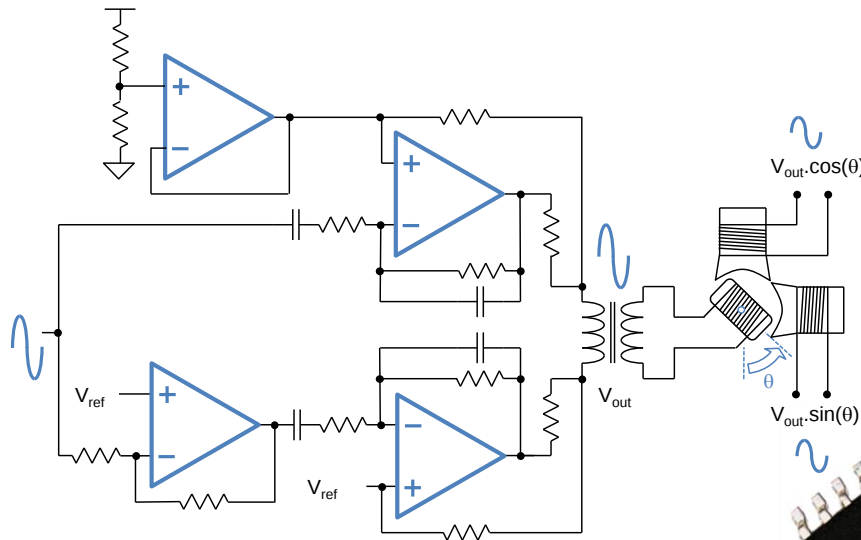
Electric Power Steering angle measurement

Context

Electric Power Steering systems are replacing hydraulic systems in order to tailor steering-gear responses to driving conditions. In addition, EPS is a major contributor to fuel-saving efforts.

Principle of operation

The angle is measured by a resolver. The sine wave is amplified to the primary winding of a rotary transformer. The secondary side signal is modified by the angle.



Op Amp – 16V CMOS
TSX564IYPT

ST Offer

Feature

High output current
 $I_{OUT} = 90 \text{ mA (typ.)}$

Slew rate
 $1.1 \text{ V}/\mu\text{s (typ.)}$

Supply voltage range
3 to 16 V

Benefit

Capability to drive coils

Enables high sampling frequency

High-voltage biasing of the magnetic coil



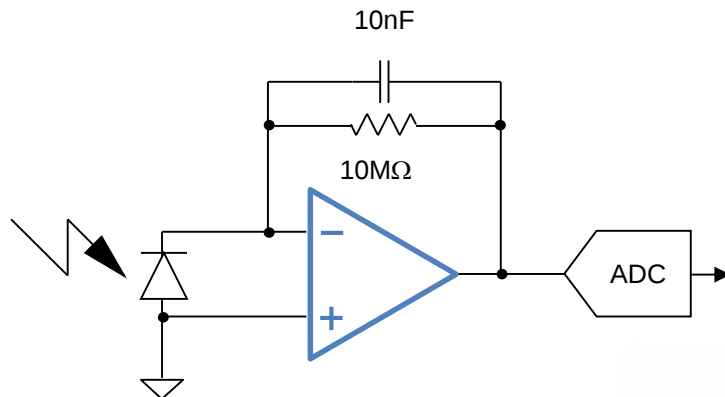
Rain and light sensors

Context

Rain and light sensors are widely used for the automatic mode of windscreen wipers and lights. Further applications can include the automatic closing of electric roof and windows or adjustment of dashboard backlight.

Principle of operation

The photodiode generates a reverse current proportional to the amount of light. This current is converted into voltage and amplified by an op amp.



ST Offer

Feature

Input bias current
 $I_{IB} < 10 \text{ pA @ } 25^\circ\text{C}$
 $I_{IB} < 100 \text{ pA @ } 125^\circ\text{C}$

Supply voltage range
1.5 to 5.5 V

SOT23-5

Maintains excellent accuracy
by not affecting diode current

Compatible with wide choice
of supplies

Micro package enhances
sensor form factor

Benefit



Op Amp – Low Power
TSV631YLT





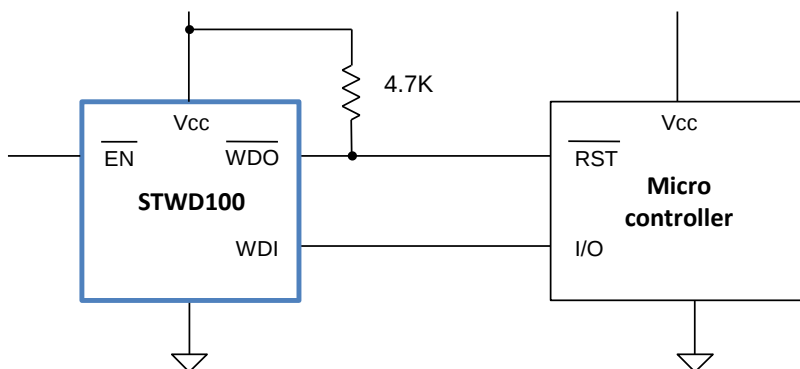
Advanced Driving Assistance System

Context

Watchdog ICs improve system reliability by monitoring the system for software code execution errors and hardware failures. This is specially critical for Advanced Driving Assistance Systems paving the way to autonomous vehicles.

Principle of operation

When operating correctly, a vehicle's systems regularly reset the STWD100 watchdog timer. If the timer exceeds the specified timeout period, an alert is triggered.

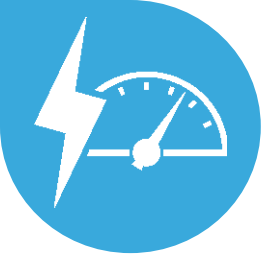


ST Offer

Feature	Variety of available watchdog timeout periods	Benefit
	Simple, robust and reliable implementation	
	Supply voltage range 2.7 to 5.5 V	
SOT23-5	Compatible with wide choice of supplies	Micro package enhances sensor form factor



Watchdog timer
STWD100Y



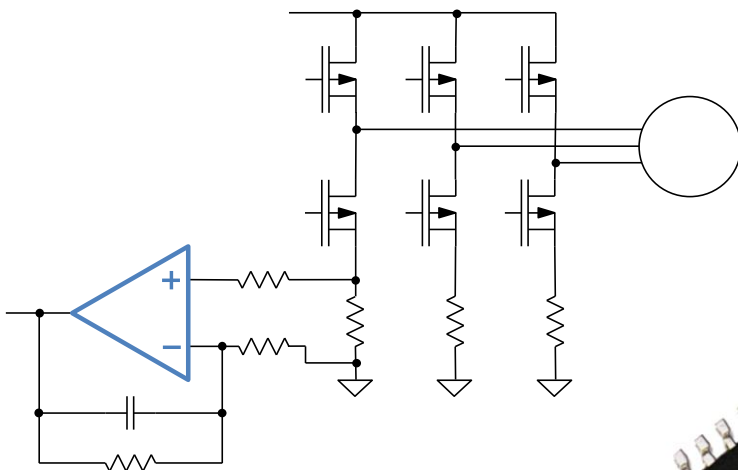
Low-side current measurement for motors

Context

The pervasion of brushless DC motors in automotive leads to removal of energy-wasting belts for the transmission of power to sub-systems.

Principle of operation

The current is measured in each branch of the 3-phase MOSFET bridge. The shunt resistor voltage drop is amplified by a high-accuracy op amp.



ST Offer

Feature

Input offset voltage
 $V_{IO} < 5 \mu\text{V} @ 25^\circ\text{C}$
 $V_{IO} < 8 \mu\text{V} (-40 \text{ to } 125^\circ\text{C})$

Benefit

Minimizes shunt resistor value and cost

TSSOP14

Facilitates integration





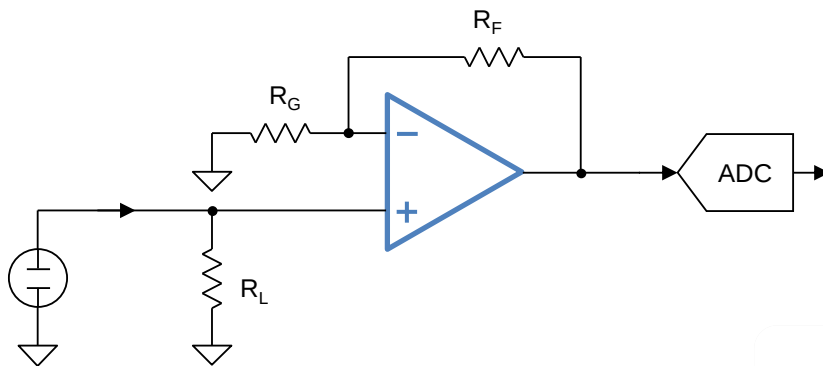
O₂ sensors

Context

Measurement of exhaust or inlet gas concentration of oxygen enables emission control by adjustment of combustion. Other applications include measurement of the partial pressure of oxygen in air breathed by passengers.

Principle of operation

The O₂ level is translated into current by the electrochemical sensor. The current is converted into voltage and amplified by the op amp in a trans-impedance configuration.



ST Offer

Feature

Input offset voltage
 $V_{IO} < 800 \mu V$

Input bias current
 $I_{IB} < 10 \text{ pA}$

MiniSO8

Excellent measurement
without trimming

Compatible with high
impedance sensor

Micro package enhances
sensor form factor

Benefit



Op Amp – Low Power
TSV522AIYST



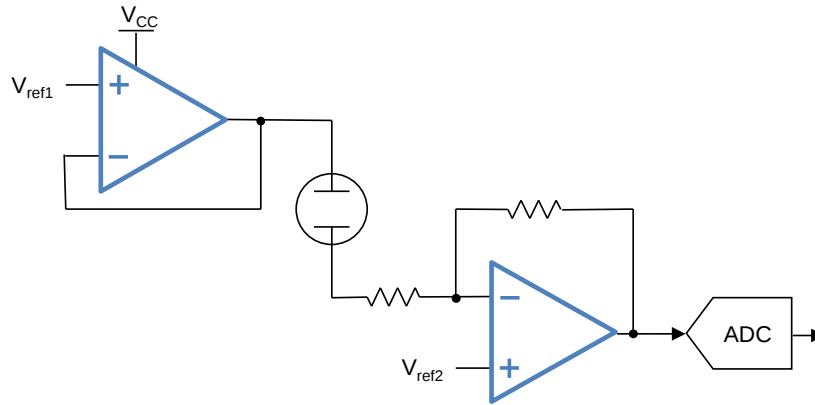
NO_x sensors for SCR

Context

Vehicles must comply with environmental regulations that require a dramatic reduction of Nitrogen Dioxide emissions (NO_x and NO₂). This pressure implies new technologies such as real-time measurement of NO_x and selective catalytic reduction (SCR).

Principle of operation

NO_x is measured in the exhaust gas using an amperometric or potentiometric method. Aqueous ammonia (also named urea) is injected in the catalyst in order to transform NO_x into N₂ and water.



ST Offer

Feature

Low input bias current
 $I_{IB} < 10 \text{ pA}$

Operating temperature
 $-40 \text{ to } 150 \text{ }^{\circ}\text{C}$

ESD HBM
5 kV

Maintains sensor accuracy

Compatible with extreme
working conditions

Increased reliability in
assembly line and during
lifetime

Benefit



Op Amp
TSV912HYDT

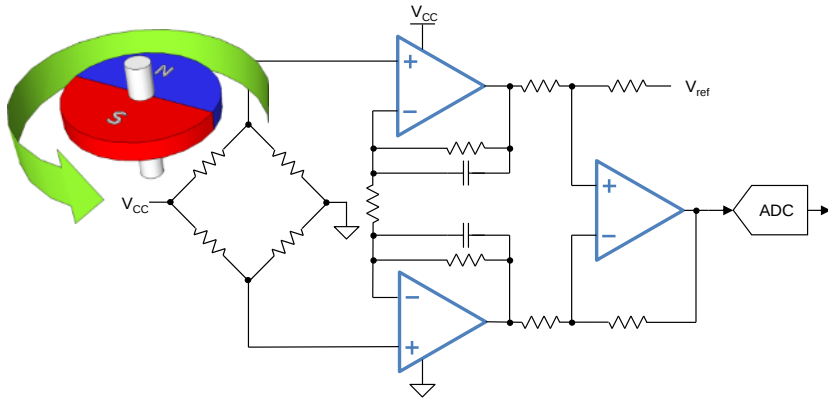


Pedal angle measurement

Context

Measurement of pedal position is mandatory for drive-by-wire systems, enabling new features such as adaptive cruise control. Other applications include throttle valve angle measurement and windscreen wiper control.

Principle of operation



The magnetic field created by a permanent magnet is measured by an Anisotropic Magneto Resistor included in a Wheatstone bridge. The electrical signal is amplified by the op amp in a difference amplifier configuration.

ST Offer

Feature

High gain bandwidth
Product: 10 MHz

Supply voltage range
4 to 16 V

Benefit

Minimum phase shift
between sensor and ADC

Compatible with high voltage
sensor



Op Amp – 16V CMOS
TSX922IYDT



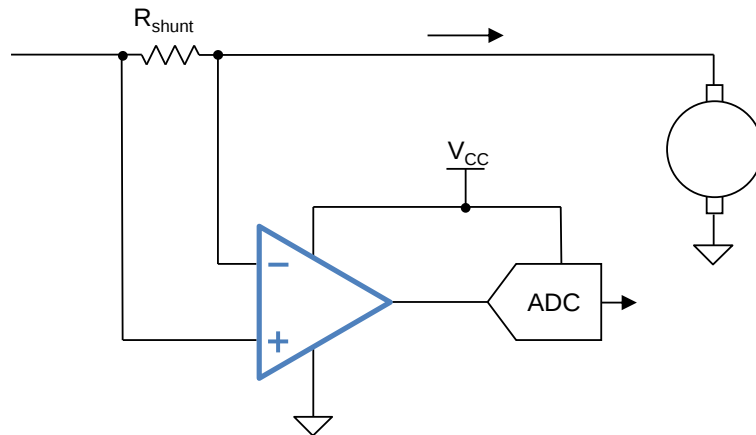
Power seat current control

Context

Power seat controls allow the user to fine-tune the seat position using a joystick. Advanced features can include automatic recall of user-customized settings. Modern cars can use 3 to 6 motors per seat for position adjustment.



Principle of operation



The current flowing to the motor is measured through a shunt resistor. The current sense amplifier is directly connected to the shunt, and thanks to the internal gain, the output pin feedbacks current.

ST Offer

Feature

Input pins sustain:
-16 to 75 V
ESD 2.5 kV

Output voltage accuracy:
 $\pm 2.5\%$ @ 25 °C
 $\pm 4\%$ from -40 to 125 °C

Benefit

No protection needed for:
Load dump, reversed
battery, ESD surges

Minimizes shunt value and
cost



Current sense amplifier
TSC103IYPT



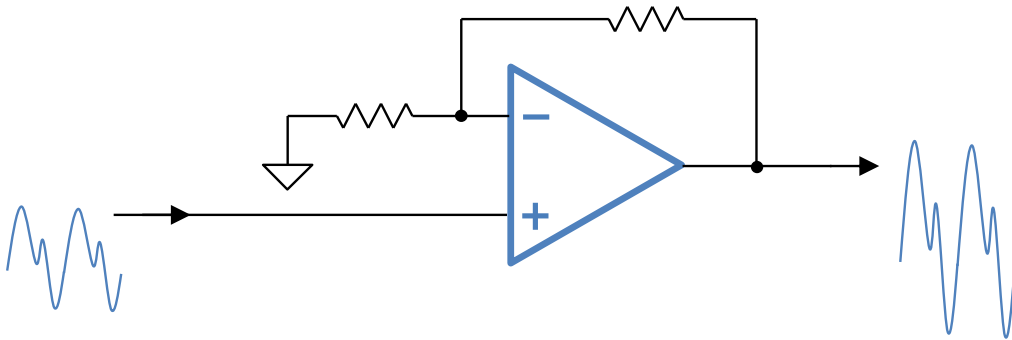


Audio buffer

Context

Audio quality has direct impact on the end-user perception of the vehicle's quality. Audio is now required not only for music, but also for navigation and user vocal interface.

Principle of operation



The amplifier is used to buffer and amplify the audio signal. Amplifiers with good audio performance are required.

ST Offer

Feature

Low noise: $9 \text{ nV}/\sqrt{\text{Hz}}$

High output current: 80 mA

Supply voltage range
2.7 to 12 V

Maintain audio quality

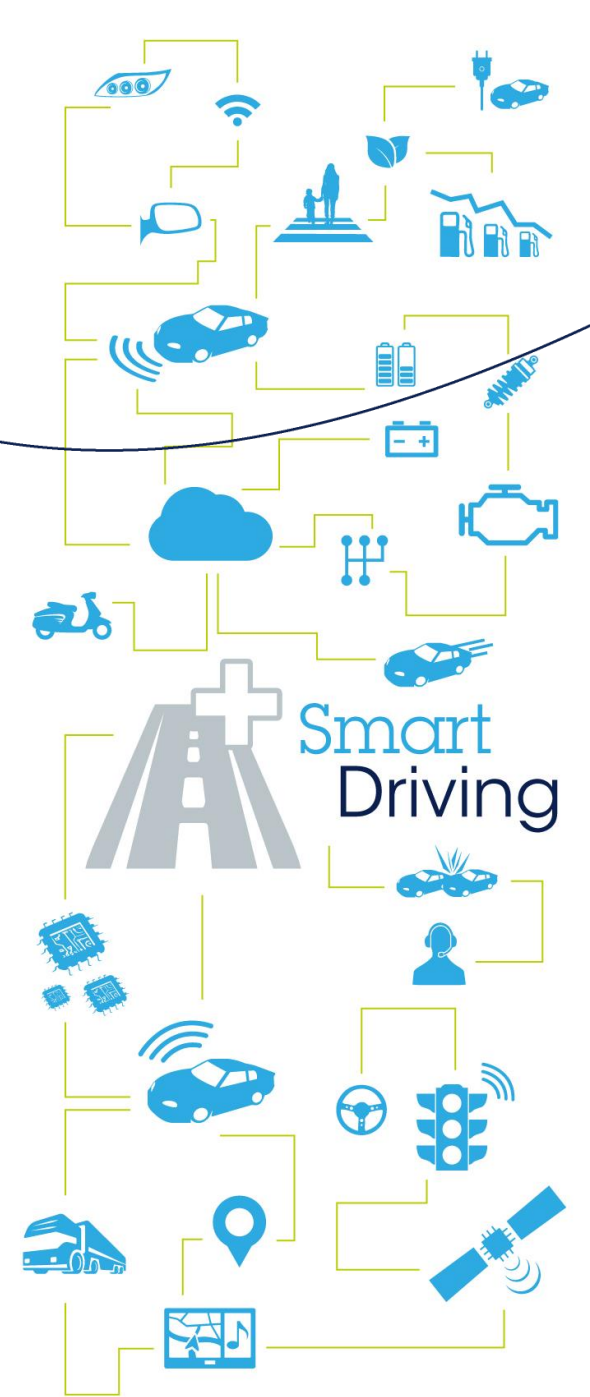
Ability to drive 32Ω loads

High level of signal ensures
disturbance rejection

Benefit



Op Amp
TS922YPT



Smart
Driving

Automotive op amps sample kit 2017



Order information



Automotive Op amps sample kit

Operational amplifiers and comparators enhance the analog signal chain

Order code: KITAUTOPAMP02

Order by multiples of 20

Featured products

Product	Description	Package
Up to 70 V		
TSC101AIYLT	High-side current sense amplifier	SOT23-5
TSC1031IYPT	High-voltage high-side current sense amplifier	TSSOP8
Up to 36 V		
LM2904WHYDT	32 V, low-power dual bipolar high temperature (150 °C) op amp	SO8
LM2903HYDT	36 V, low-power dual bipolar high temperature (150 °C) comparator	SO8
TSB572IYQ2T	36 V, low-power dual rail-to-rail BiCMOS op amp	DFN8
Up to 16 V		
TS972IYDT	10 V, very low-noise dual rail-to-rail Output CMOS op amp	SO8
TSX921IYLT	16 V, wide bandwidth 10 MHz single rail-to-rail I/O CMOS op amp	SOT23-5
TSX9291IYLT	16 V, wide bandwidth 20 MHz single rail-to-rail I/O CMOS op amp	SOT23-5
TSX712IYDT	16 V, precision dual rail-to-rail I/O CMOS op amp	SO8
TSX7192IYDT	16 V, low-power precision dual rail-to-rail I/O CMOS op amp	SO8
TSX339IYPT	16 V, micropower dual CMOS open drain comparator	TSSOP14
TSX3702IYDT	16 V, micropower dual CMOS push-pull comparator	SO8
Up to 5.5 V		
TSV631IYLT	5.5V, low-voltage, micropower single rail-to-rail I/O CMOS op amp	SOT23-5
TSV912AIYST	5V, wide bandwidth dual rail-to-rail I/O CMOS op amp	MiniSO8
TSZ121IYLT	5V, 400 KHz, very high accuracy (5μV) zero drift rail-to-rail I/O CMOS op amp	SOT23-5
TSZ182IYST	5V, 3 MHz, very high accuracy (25μV) zero drift rail-to-rail I/O CMOS op amp	MiniSO8

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