ST Analog Products

for Automotive applications

General Purpose Analog and RF

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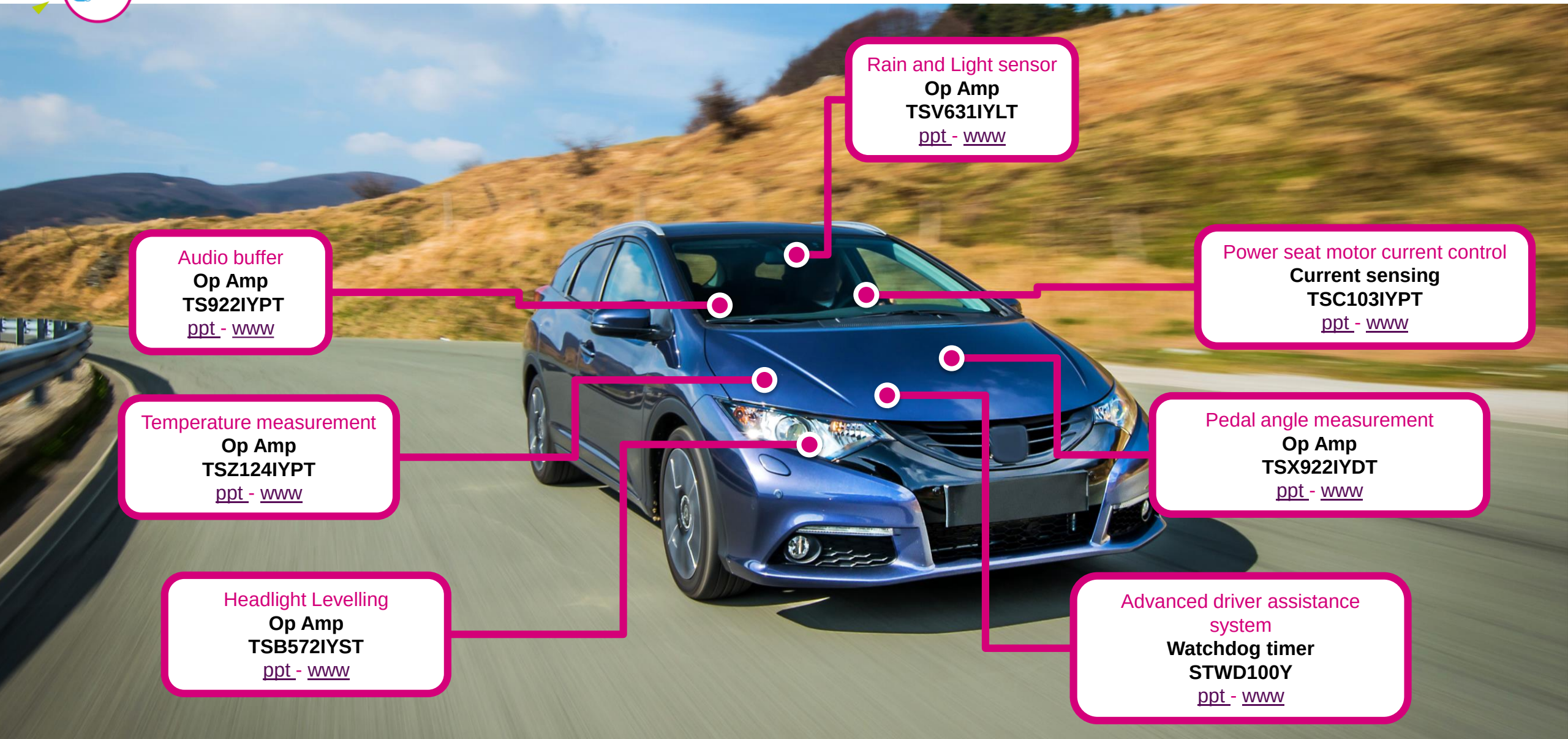
Added value for **SMART DRIVING**



Rain and Light sensor
Op Amp
TSV631IYLT
ppt - www

Audio buffer
Op Amp
TS922IYPT
ppt - www

Power seat motor current control
Current sensing
TSC103IYPT
ppt - www

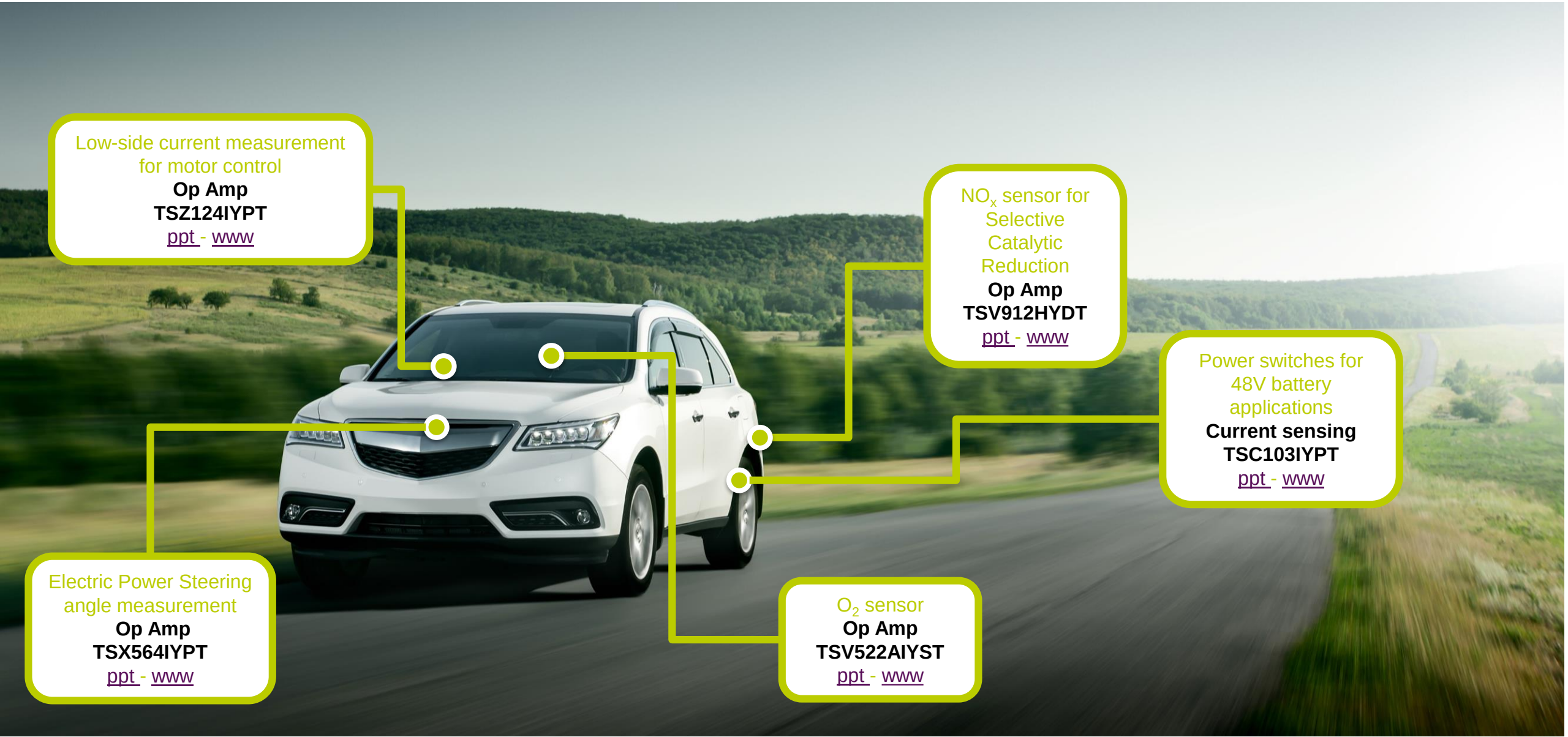
Temperature measurement
Op Amp
TSZ124IYPT
ppt - www

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

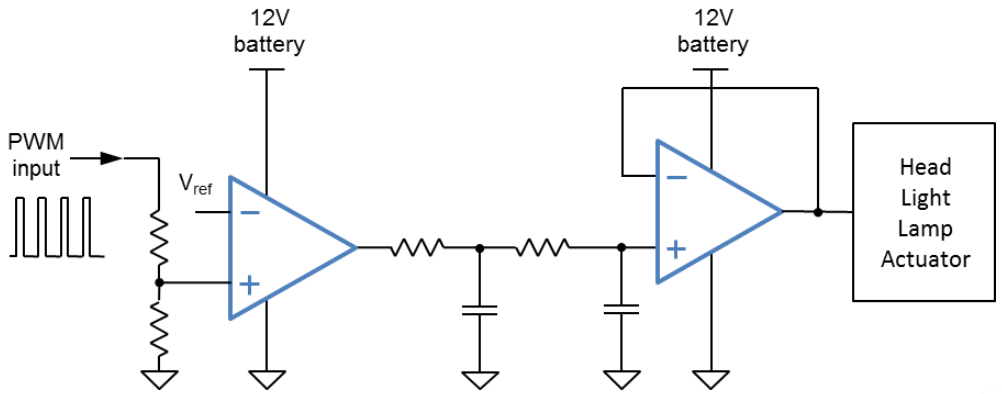
O_2 sensor
Op Amp
TSV522AIYST
ppt - www

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	Benefit
Supply voltage 36 V operating	Capability to provide control voltage proportional to battery
Supply voltage 40 V AMR	Reduces need of load dump clamping
Rail-to-rail input / output stage	No need for charge pump circuitry

Op Amp – 36V

TSB572IYST

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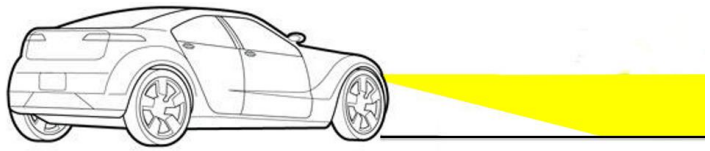
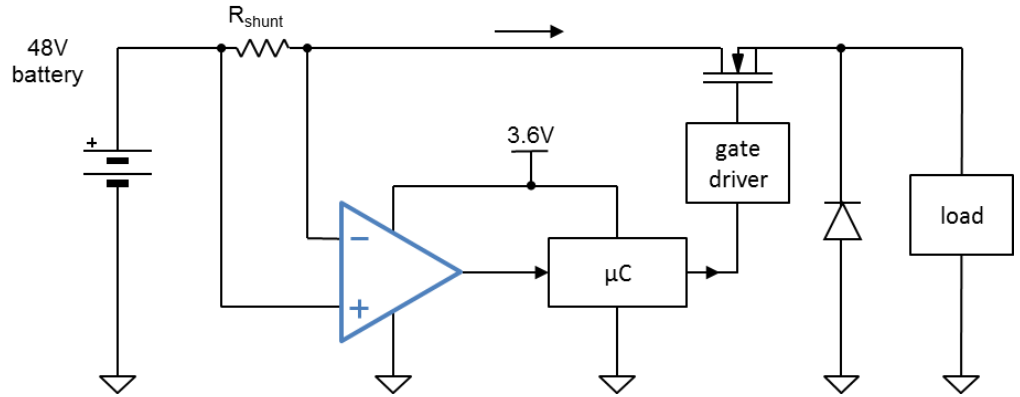


Power switches for 48 V battery applications

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	Benefit
Input pins sustain: -16 to 75 V ESD 2.5 kV	No protection needed for: Load dump, reversed battery, ESD surges
Output voltage accuracy: ±2.5% @ 25 °C ±4% from -40 to 125 °C	Minimizes shunt value and cost

Current sense amplifier

TSC103IYPT

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AN4909: Intelligent power switches for 48 V battery applications

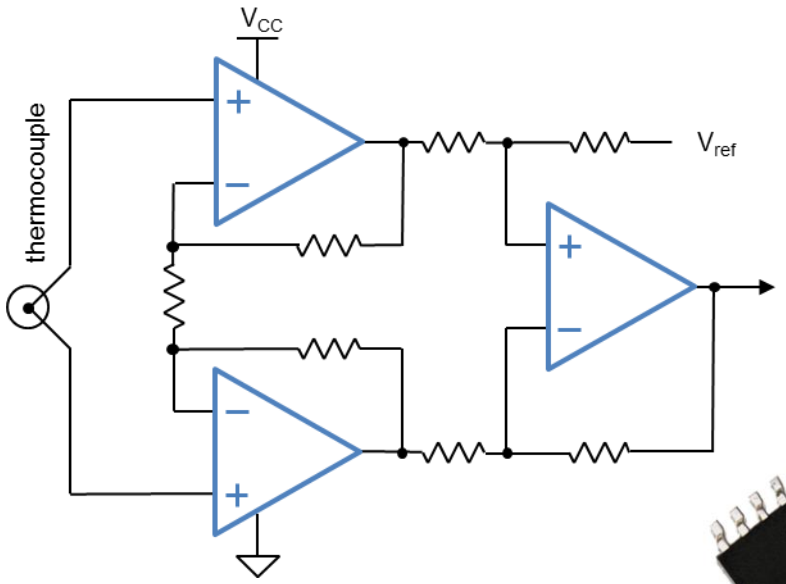
Temperature measurement

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.



ST Offer

Feature	Benefit
Input offset voltage V_{IO} < 5 µV @ 25°C V_{IO} < 8 µV -40 to 125 °C	Excellent measurement without trimming
Input offset voltage drift ΔVio/ΔT 30 nV/°C (max.)	Stability of measurement versus temperature change
Input bias current I_{IB} < 200 pA	Compatible with high impedance sensor

Op Amp – Zero Drift

TSZ124IYPT

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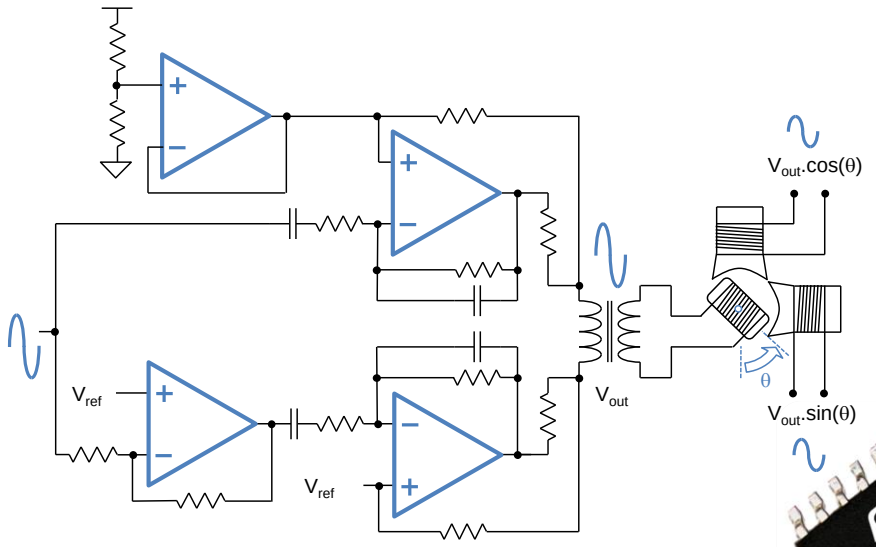
Electric Power Steering angle measurement

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	Benefit
High output current I_{OUT} = 90 mA (typ.)	Capability to drive coils
Slew rate 1.1 V/µs (typ.)	Enables high sampling frequency
Supply voltage range 3 to 16 V	High-voltage biasing of the magnetic coil

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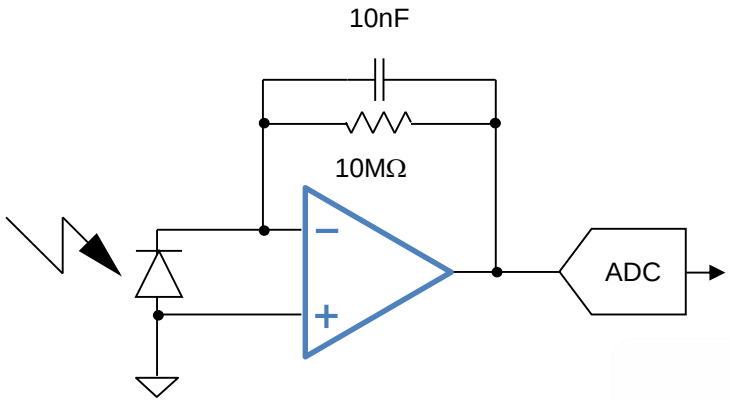
Rain and light sensors

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	Benefit
Input bias current I_{IB} < 10 pA @ 25 °C I_{IB} < 100 pA @ 125 °C	Maintains excellent accuracy by not affecting diode current
Supply voltage range 1.5 to 5.5 V	Compatible with wide choice of supplies
SOT23-5	Micro package enhances sensor form factor

Op Amp – Low Power

TSV631IYLT

AN4451: Signal conditioning for a UV sensor

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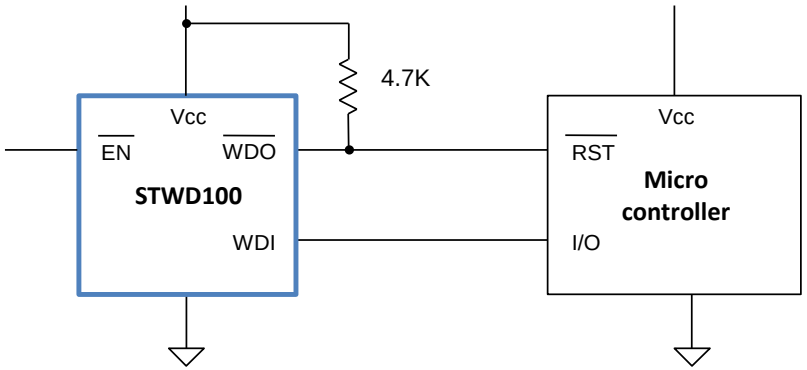
Advanced Driving Assistance System

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

Watchdog timer

STWD100Y

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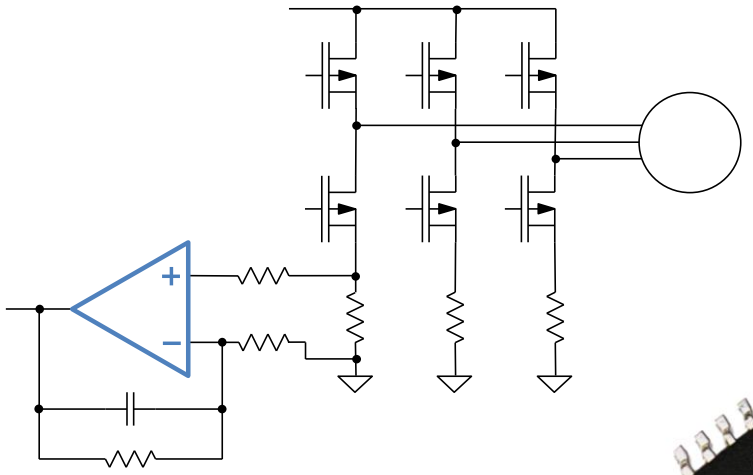
Low-side current measurement for motors

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	Benefit
Input offset voltage V_{IO} < 5 µV @ 25 °C V_{IO} < 8 µV (-40 to 125°C)	Minimizes shunt resistor value and cost
TSSOP14	Facilitates integration

Op Amp – Zero Drift

TSZ124IYPT

UM1737: How to use the product evaluation board (STEVAL-ISQ014V1) for low-side current sensing with the TSZ121 operational amplifier

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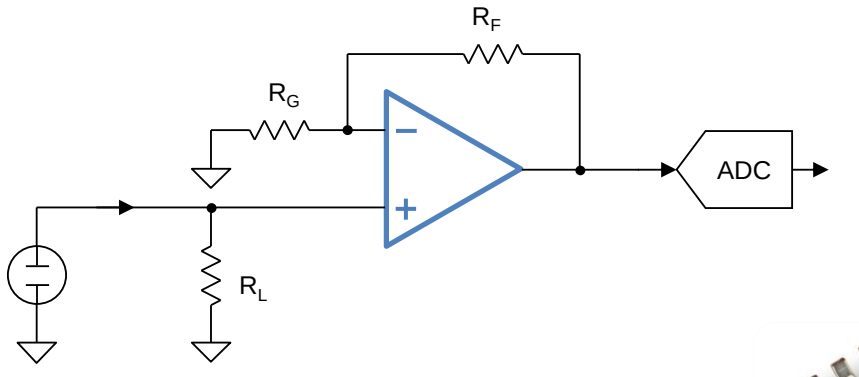
O_2 sensors

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 O_2 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	Benefit
Input offset voltage V_{IO} < 800 µV	Excellent measurement without trimming
Input bias current I_{IB} < 10 pA	Compatible with high impedance sensor
MiniSO8	Micro package enhances sensor form factor

Op Amp – Low Power

TSV522AIYST

AN4348: Signal conditioning for electrochemical sensors

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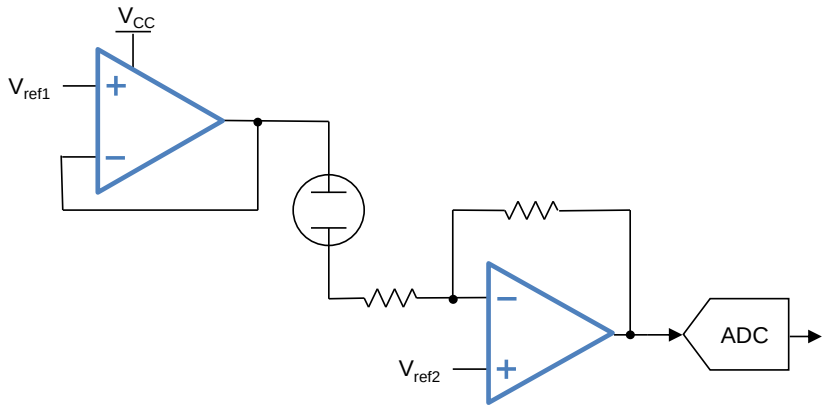
NO_X sensors for SCR

Context

Vehicles must comply with environmental regulations that require a dramatic reduction of Nitrogen Dioxide emissions (NO_x and NO_2). 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 N_2 and water.



ST Offer

Feature	Benefit
Low input bias current I_{IB} < 10 pA	Maintains sensor accuracy
Operating temperature -40 to 150 °C	Compatible with extreme working conditions
ESD HBM 5 kV	Increased reliability in assembly line and during lifetime

Op Amp

TSV912HYDT

AN4348: Signal conditioning for electrochemical sensors

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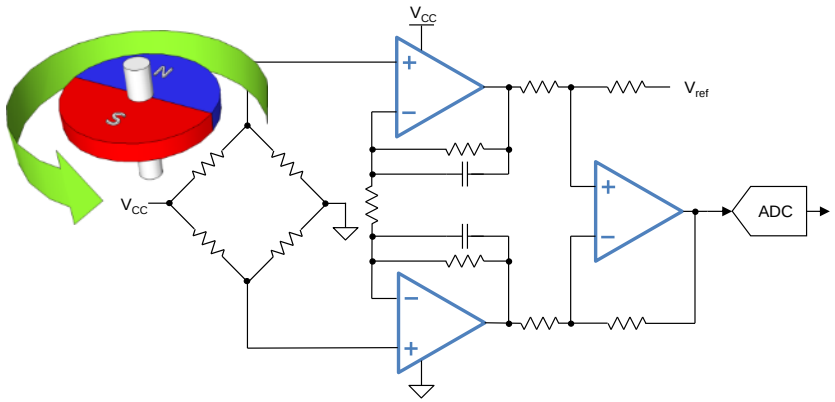
Pedal angle measurement

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	Benefit
High gain bandwidth Product: 10 MHz	Minimum phase shift between sensor and ADC
Supply voltage range 4 to 16 V	Compatible with high voltage sensor

Op Amp – 16V CMOS

TSX922IYDT

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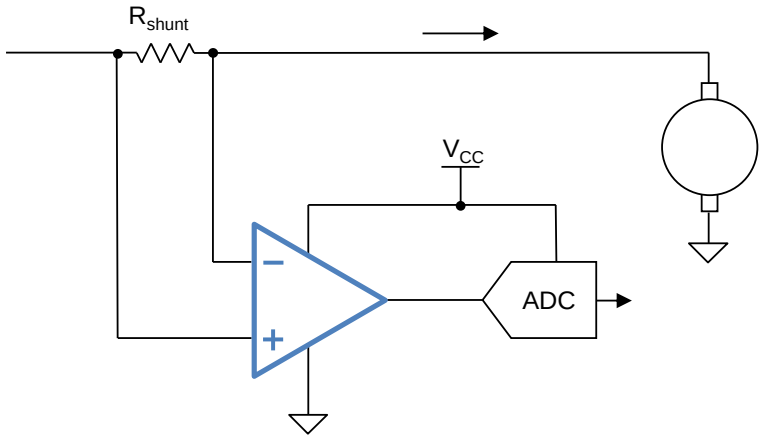
Power seat current control

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	Benefit
Input pins sustain: -16 to 75 V ESD 2.5 kV	No protection needed for: Load dump, reversed battery, ESD surges
Output voltage accuracy: ±2.5% @ 25 °C ±4% from -40 to 125 °C	Minimizes shunt value and cost

Current sense amplifier

TSC103IYPT

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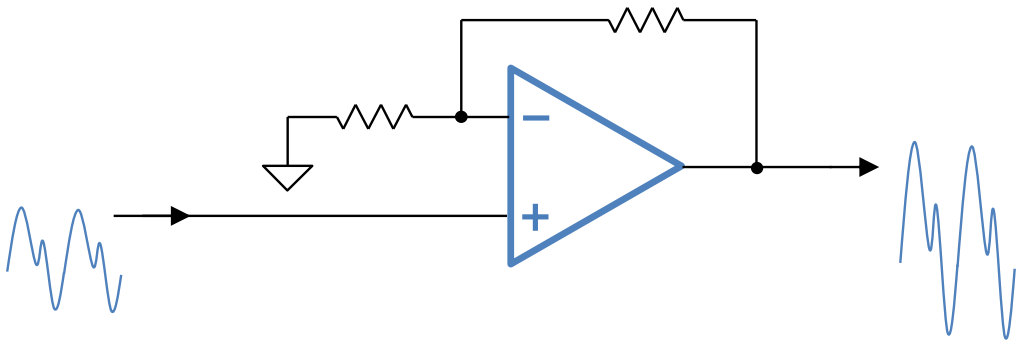
AN4304: How to filter the input of a high-side current sensing
AN4366: Compensate the input offset of a high-side current sensing
AN4369: Adjustable gain with a current sensing

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	Benefit
Low noise: 9 nV/√ Hz	Maintain audio quality
High output current: 80 mA	Ability to drive 32 Ω loads
Supply voltage range 2.7 to 12 V	High level of signal ensures disturbance rejection

Op Amp

TS922IYPT

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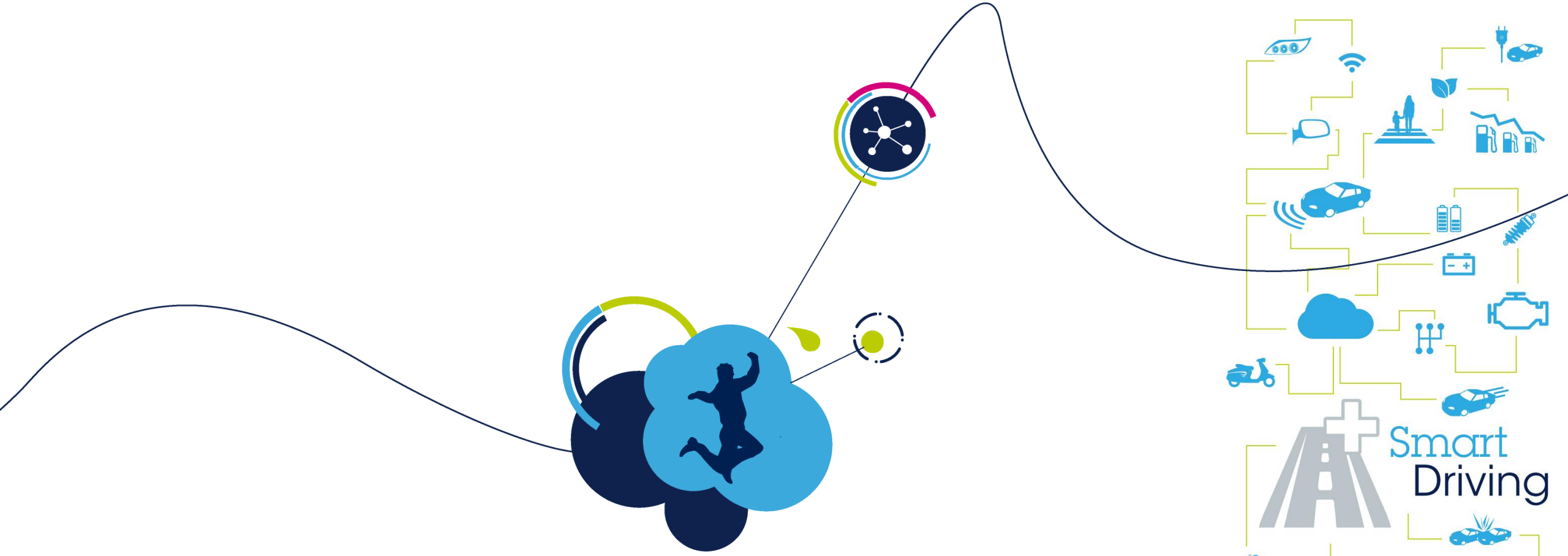

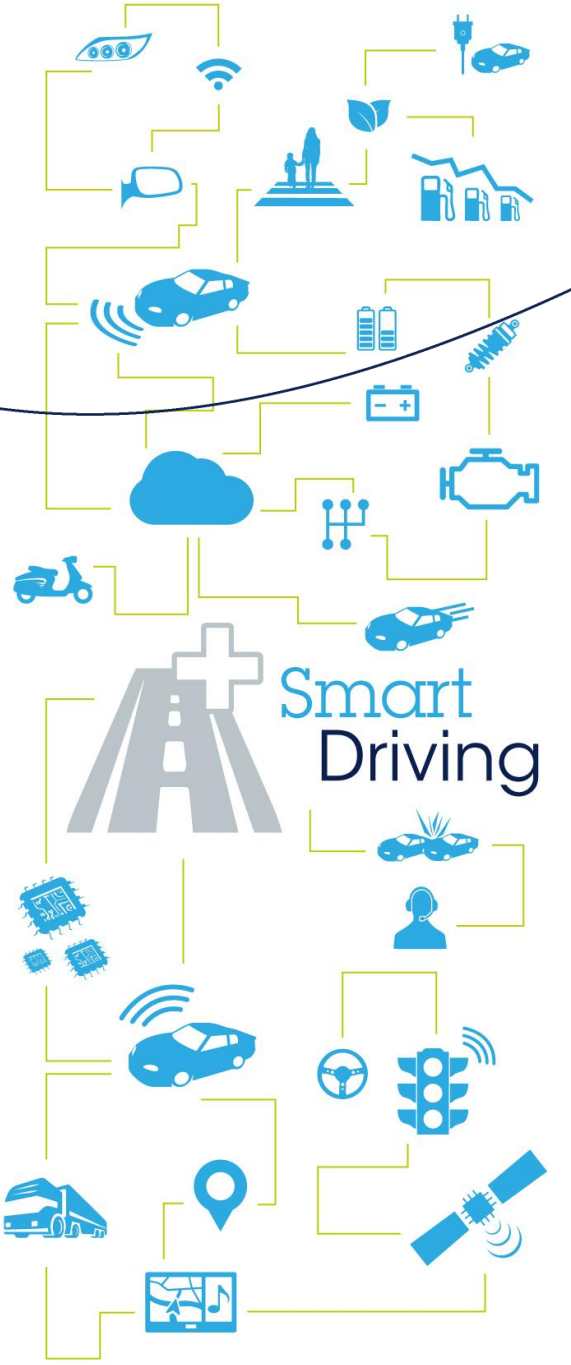

Support tools

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Automotive op amps sample kit 2017

Order information

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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