Latest Developments in Sensor Signal Conditioning, Position Sensors and In-Car Wireless Power

Tech Taipei, Automotive and Electric Vehicles
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Agenda

• Sensor Signal Conditioners
• Position Sensors
• In-Car Wireless Power
Automotive & Industrial Division
Automotive & Industrial Focus Products

**Actuator & MC Energy Mgmt.**
- Intelligent battery sensor
- Arc fault detection
- Integrated Mirror Control ICs

**Position Sensing**
- Inductive Position Sensors
- Magneto-Resistive SSC
- EPS Systems

**Sensor Solutions**
- Optical Sensors
- Gas Sensors
- Humidity Sensors
- Low Pressure

**Power Solutions**
- IVI PMIC / DPU
- FuSa PMIC / DPU

**ASIC / ASSP**
- Sensor Signal Conditioning
- Customer Specific Products
Sensor Signal Conditioning Basics

Pressure Sensor Module (Sensor Element + SSC-IC)

Signal of Sensor Element

OUT Signal:
- Analog: ratiometric (10 ... 90)%Vs
- Digital: SENT, LIN, PWM, PSI5, I2C, SPI, OWI, ...
- temperature compensated
- linearized
- typical error <= 1%FSO over Temp.

OUT-Signal of SSC-IC after Calibration
Sensor IC Solutions for Exhaust Gas Sensors

- ZSSC416x for Differential Pressure Sensor
- ZSSC417x for High Temperature Sensors
- Various Standard Products and ASICs for Urea Tank Pressure and Temp Sensor (depending on IF requirements: AOUT, LIN, SENT, PWM etc.)
- Ultrasonic Sensor IC for Tank Level Sensor (ASIC Only)
- Concept for NOx/Lambda Sensor IC and Particle Sensor
A Modular Approach: ZSSC416X Base Platform

High-Accuracy Amplification, 16-Bit Precision and SENT 3.0 Output supporting ASIL B Applications

• IDT’s first “base platform” sensor signal conditioner product
• Modular design concept with building blocks for each segment.
• Two full bridges
• SENT output and an I²C interface
• A direct result of hundreds of man-hours obtain customer feedback. This is essentially what the market is asking for!
Resistive Sensing: Pressure, High Temperature

Physical Characteristics
• Supply voltage: 4.75V to 5.25V
• Input span: 1 to 800 mV/V
• ADC resolution: 12 to 18 bit
• Output resolution: 12-bit via SENT interface;
• OR up to 15-bit plus a sign bit for OWI or I\(^2\)C™ interface
• Package: 4 x 4 mm 24-QFN

Features
• Differential sensor bridge inputs and internal or external temperature sensors
• Digital compensation of offset, gain, and higher order non-linearity
• Operating temperature range: -40°C to 150°C
• Accuracy: ±0.25% FSO @ -40°C to 125°C
• Safety Functionality, ASIL B:
First Next Gen. Platform Derivative SSC

**ZSSC415x - Automotive Single Bridge with Analog Out**

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**ZSSC4150**
- Single Bridge
- Internal or External Diode for Temperature
- Support for RTD Temperature Sensors
- Type PTC & NTC Supported
- Bridge Used As Temperature Sensor
- Analog Output
- One Wire Interface for Calibration (OWI)
- I²C™ Interface for Industrial Applications
- Overvoltage/Reverse Battery to ±40V

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**Key USPs**
- Overvoltage reverse battery protection of ±40V, the ZSSC415X is truly one of the most robust sensor signal conditioners available in the market today
- Large sensor offset correction using digital zooming with 16 to 18 bit resolution.
- Extended diagnostics beyond traditional input and output diagnostics to allow for ASIL B.
Product Family

Automotive
5V with High Voltage Protection
−40°C to 150°C

ZSSC4151
Single Bridge Analog Output
5V±10%
OVRB ±40v
Status: Production

ZSSC416x Family of SSC’s Resistive Bridge with SENT 3.0, ASIL
5V±5% OVRB ±18v
Status: Production

ZSSC4161
Single Bridge, SENT, I2C, Basic Temp

ZSSC4162
Single Bridge, SENT, I2C, Ext Temp

ZSSC4165
DualBridge, SENT, I2C, ExtTemp

ZSSC417x Family of SSC’s Thermocouple w/SENT 3.0, HTS, ASIL
5V±5% OVRB ±18v
Status: Production

ZSSC4171
Single Thermocouple SENT, I2C
Status: Production

ZSSC4175
Dual Thermocouple SENT, I2C
Status: Production
ZSSC415x/6x/7x Configuration Flow

- HTS
- P
- Dual P
- Dual HTS
- HTS / P
- PSt
- PP
- PT
- PPt
- MAF
...
Technology References for IDT SSCs

ASIC for Motor Oil Pressure and Temperature Sensor with SENT

ASIC for Ear Thermometer: Thermopile signal processing

Two ZMDI SSCs (ZSC31014,31015) create a Product Line of Sensors for White Goods

System-on-Chip ASIC for Ultrasonics Oil Level Measurement

ASIC for magneto resistive angle sensor used in throttle flaps

ASIC for “Flex Fuel” Ethanol content Measurement System

Platform ASIC for Inductive Position Sensing Applications

Capacitive Bridge Sensor ASIC for Humidity Sensing

Oil Level Measurement
Automotive & Industrial Focus Products

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- Intelligent battery sensor
- Arc fault detection
- Integrated Mirror Control ICs

Position Sensing
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- Magneto-Resistive SSC
- EPS Systems

Sensor Solutions
- Optical Sensors
- Gas Sensors
- Humidity Sensors
- Low Pressure

Power Solutions
- IVI PMIC / DPU
- FuSa PMIC / DPU

ASIC / ASSP
- Sensor Signal Conditioning
- Customer Specific Products
Position Sensors Ubiquitous in EPS Systems

- Enable Automobile OEMs to meet improved steering safety and fuel efficiency requirements
- Hand-wheel position to know direction to turn power steering motor
- Torque sensing to measure how much effort the driver needs to turn steering wheel
- Motor position for providing motor control, particularly in BLDC motors for power steering assistance
Position Sensors Technologies

**Magneto-Resistive**
- Highest accuracy down to 0.1°
- <180° angle range
- Products available (ASIC, ASSP)

**Inductive**
- No magnet required, rotary & linear
- Can handle complex motion
- Product available (ASIC)

**Hall**
- Cost effective, small, 360° angle range
- Best solution for high speed side shaft
- AMR+Hall combo for high accuracy 360°
IDT Inductive Position Sensors

- Ultra-thin solution - Small form factor, no magnet required
- Total stray field immunity - ISO 11452-8 compliant
- No external sensor needed - the sensor is a PCB coil
- Compliant to auto standards - AECQ-100, ESD, EMC, ISO26262
- Suitable for high temperature
- On and off-axis capability and alignment

Metallic target (Al, Cu,..)
Simple coil design on 2-sided PCB
Chip

Sensor modules including PCB available
ZMID520X - Inductive Position Sensor

Features

- Fully automotive qualified to AECQ-100
- 5V supply
- Overvoltage, reverse polarity, short circuit protected
- Analog output, 1024 steps: ZMID5201
- PWM output, 1024 steps: ZMID5202
- SENT output, 4096 steps: ZMID5203
- High precision: ± 0.2% accuracy

Benefits

- Ultra-thin
  - small form factor
- No magnet needed
  - moving target = copper or aluminum foil
  - low BOM
- Ratiometric measurement
  - tolerant against misalignment of target
Position Sensors
Typical Inductive Applications

- **Linear motion**
- **Torque**
- **2D (XY) motion**
- **Arc motion**
- **Hollow shaft 360° off-axis rotation**
- **End of shaft 360° on-axis rotation**
- **End of shaft 180° on-axis rotation**
Advantages over Competitors

IDT inductive position sensor products allow customers to save cost, increase performance or build on their own core competency

<table>
<thead>
<tr>
<th>Feature</th>
<th>Advantage over Competitors</th>
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<tr>
<td>No magnet needed</td>
<td>Cost saving, wide temperature range, higher reliability</td>
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<tr>
<td>Wide range of applications</td>
<td>Adaptable mechanical design: rotational end-of-shaft (on-axis), side-shaft (off-axis), torque, linear motion, XY or arc motion</td>
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<td>Ultra-thin solution (PCB + metal foil)</td>
<td>Typ 2-3mm total height, saving space and costs</td>
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<td>Always at full resolution</td>
<td>Up to 4096 steps for any given coil design, e.g. 4096 steps over 360°, 4096 steps over 30°, 4096 steps over 25mm, 50mm,..etc….</td>
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<td>Wide temperature range</td>
<td>Chip: -40 to +150°C (160° on request), coil &lt;-40°C or &gt;+160°C</td>
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<td>Meeting elevated magnetic stray field immunity specification ISO11452-8</td>
<td>Particularly suitable for electrical vehicles and hybrids</td>
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<td>ASIL-A to –D (diversity, duplication, diagnosis) according to ISO26262</td>
<td>Suitable for safety critical applications (steering, brake, e-gas,..)</td>
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<td>IDT provides complete turnkey solutions</td>
<td>Any entry point for the customer up to complete sensor module including PCB, coil and target</td>
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Leader in Wireless Power
In-Vehicle Smart Phone Wireless Charging

Product Preview

• Supports up to 15W Wireless Power Charging
• WPC Qi 1.2.3
• AEC-Q100, grade 2
• EMI/EMC performance meets CISPR-25
• Highly integrated solution

Automotive Demo Kit at CES and MWC, 2017

(example application – for illustrative purposes only)
Thank You

Questions?
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