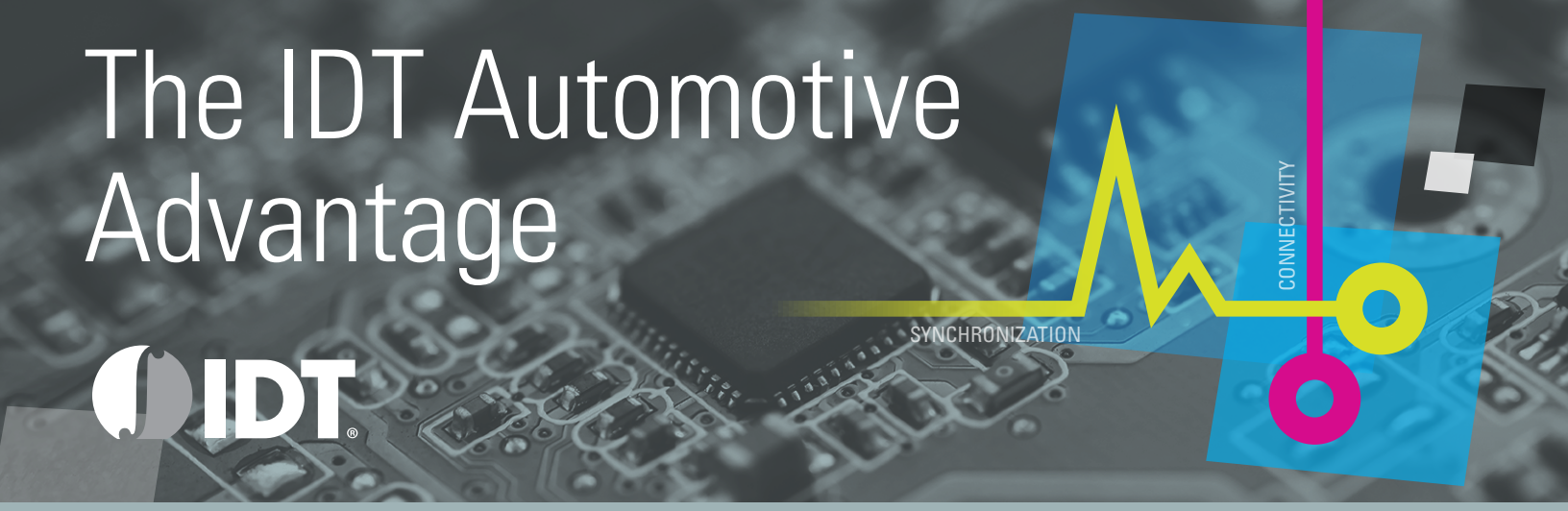
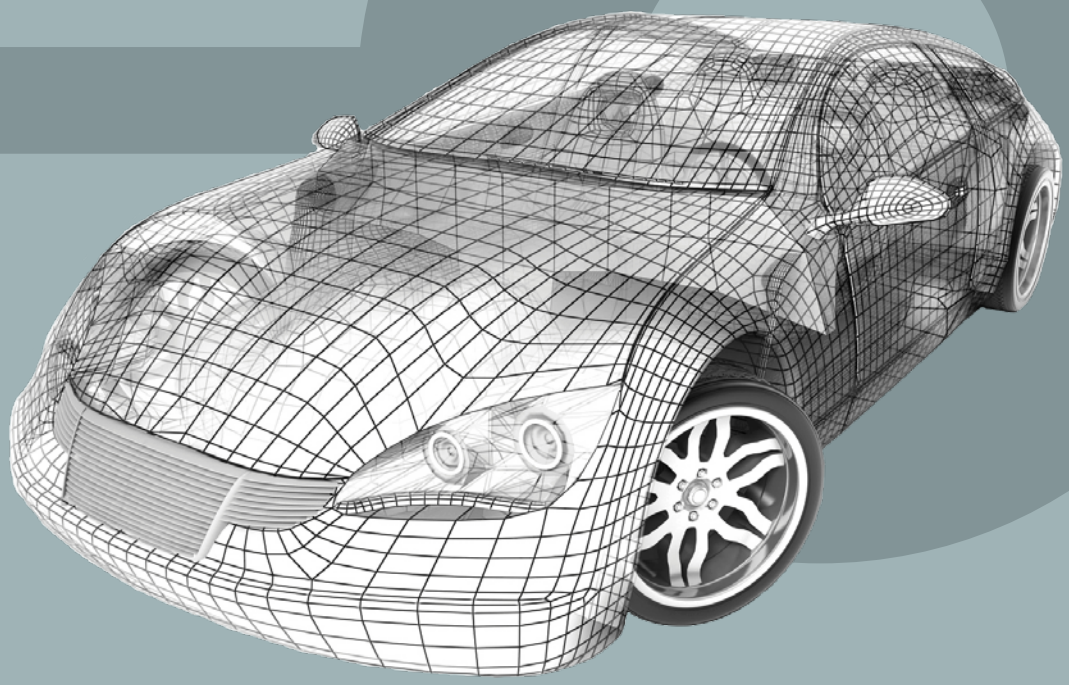
The IDT Automotive Advantage



POWERTRAIN
ENERGY MANAGEMENT
SAFETY
INFOTAINMENT
BODY
CHASSIS



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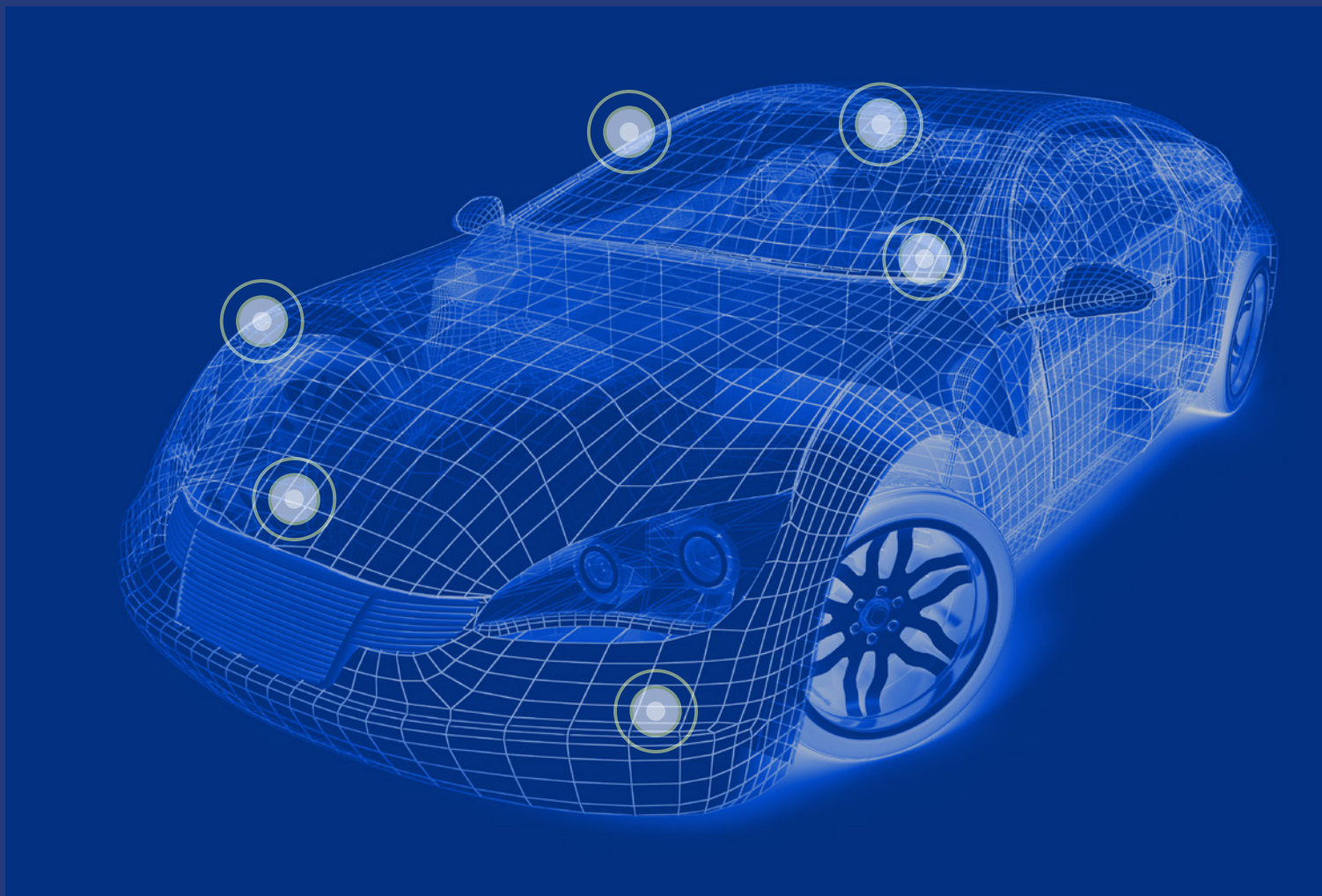


Who We Are

Integrated Device Technology, Inc. develops system-level solutions that optimize its customers' applications. IDT's market-leading products in RF, timing, wireless power transfer, serial switching, interfaces and sensing solutions are among the company's broad array of complete mixed-signal solutions for the communications, computing, consumer, automotive and industrial segments. These products are used for development in areas such as 4G infrastructure, network communications, cloud datacenters and power management for computing and mobile devices.

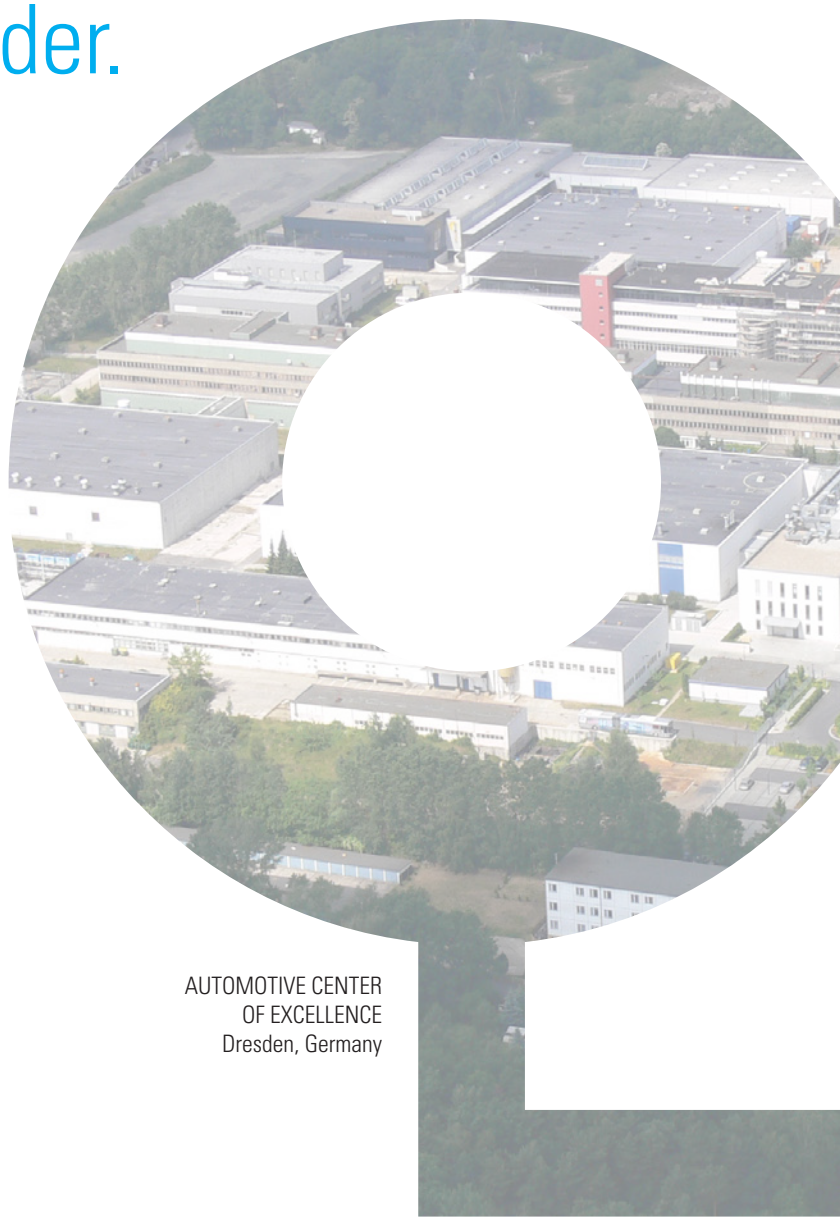
The IDT Automotive Advantage

Following the acquisition of the German based semi-conductor company ZMDI in 2015, IDT became well placed as a supplier to the automotive industry. ZMDI's products in sensing and power management have been designed into automotive applications for decades and the synergy of sensing combined with the world class products of IDT now provide the industry with a multi-platform solution provider.

In 2016 IDT formally renamed the ZMDI headquarters in Dresden Germany the **Automotive Center of Excellence**.

This center houses a dedicated and world class engineering and automotive certified test facility specializing in leading edge automotive solutions.

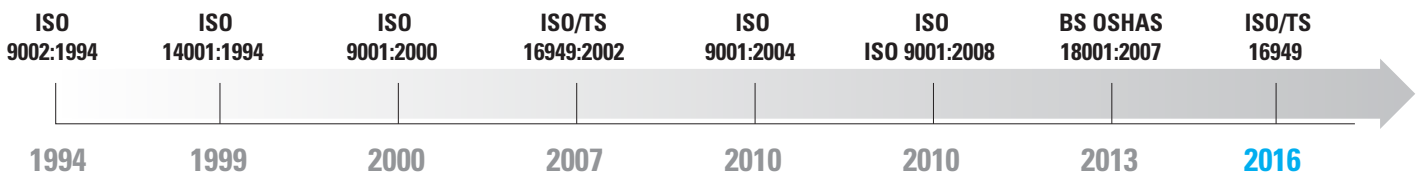
The synergy of sensing combined with the world class products of IDT now provide the industry with a multi-platform solution provider.



AUTOMOTIVE CENTER
OF EXCELLENCE
Dresden, Germany

IDT is a Fully Certified Automotive Supplier

IDT expanded its automotive capabilities in 2016 through the TS 16949 certification of a second test and production facility. The company's longstanding production facility in Penang, Malaysia has passed the two-stage certification process for automotive back-end manufacturing under the requirements of TS 16949, the International Standard for Automotive Quality Management Systems. IDT now can offer a dual-source automotive capability that will help the company meet the requirements of its global high-volume customers, delivering security of supply through different locations.



TS 16949
International Standard for Automotive Quality Management Systems

The new Penang automotive back-end production floor joins the IDT Automotive Center of Excellence in Dresden, Germany, which has been successfully certified since 2004 as ZMDI, a company IDT acquired in December 2015. Both facilities offer wafer test class 100 and final test class 1.000 capabilities.

IDT AUTOMOTIVE QUALITY POLICY

- Top Management driven Automotive Quality Mind Set
- Voice-of-Customer Focus
- Built-in Quality (BIQ) in all Automotive Processes
- Voice-of-Supply Partner Feedback
- Quality Policy Sharing with Automotive Supply Partners
- VDA6.3 Supply Partner Management
- Long-term Automotive Security of Supply by Contracts
- Lean 6-Sigma for Continuous Improvement
- Zero Incidents Quality Products & Services
- TS16949 Certification for Automotive Development & Manufacturing
- ISO26262 Functional Safety Regime
- Quarterly TS16949 Management Review

AUTOMOTIVE CENTER OF EXCELLENCE

- IDT Europe GmbH is IDT's Corporate Automotive Center of Excellence
- More then 20 years of automotive experience in development and supply
- Automotive Management, Development Teams and Global Automotive Quality Management
- TS16949 certified for "Design and Manufacturing of Automotive Integrated Products"
- ISO14001 Environmental Certification
- Automotive Business Process Management (BPM) Organization
- Dedicated Functional Safety Management (ISO26262) with Certified Project Management
- Automotive Test Competence Center (ATCC) for Automotive Safe-Launch
- TS16949 Certified Automotive Dual Source Backend Manufacturing Site with IDT Malaysia (Penang)
- Automotive Design Sites in IDT Europe HQ Dresden, Stuttgart, Munich and Bulgaria in Varna & Sofia
- Dedicated Automotive Centers for Failure Analysis - Product Qualification - Complaint Handling
- Automotive Technology Reliability Monitoring

IDT AUTOMOTIVE SOLUTIONS

IDT is now a real player in automotive design. The addition of the ZMDI automotive portfolio of products has enabled IDT to now serve the automotive electronic design segment with not only the decades of proven support in sensor signal conditioner products, but also new opportunities in timing, RF, power management, and switches.

IDT's Dresden, Germany facility has passed the two-stage certification process for automotive backend manufacturing under the requirements of TS 16949. With our Penang, Malaysia facility, we now offer a dual-source automotive capability that meets the requirements of global high-volume customers, delivering security of supply through different locations.

POWERTRAIN

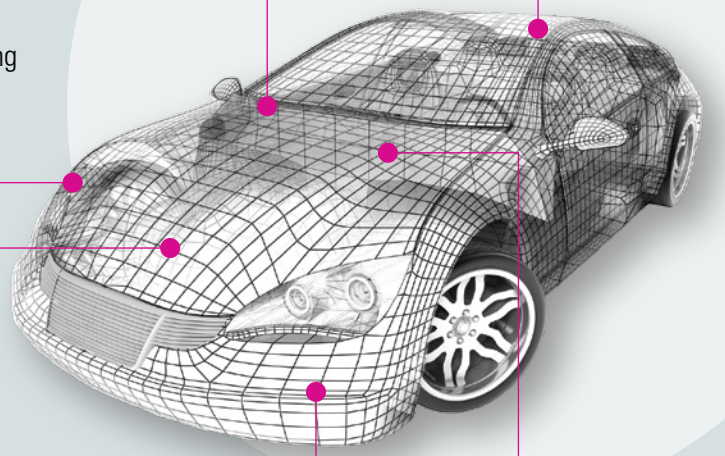
- Oil (Level, Temperature, Pressure, Quality)
- In-Cylinder Pressure
- UREA Pressure
- Mass Air Flow Sensor
- Soot Pressure Sensor Transmission
- Throttle Control
- Manifold Pressure/Temperature
- High Temperature Sensing (HTS)
- Flex Fuel
- E-Gas
- Diesel Heating

BODY

- HVAC
- Interior Lighting
- Power Seat
- Rain Sensor
- Sun Sensor
- Humidity Sensor
- Mirror Control

INFOTAINMENT

- Timing Solutions
- Power Management
- Wireless Power
- Sensor Products
- RF Products
- RapidIO



ENERGY MANAGEMENT

- Battery Management

CHASSIS

- Electric Power Steering
- ABS/ ESP

SAFETY

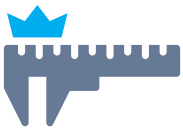
- Seat Occupant Detection
- Hands-Off Detection

AUTOMOTIVE QUALIFIED SENSOR SIGNAL CONDITIONER SOLUTIONS

Along with automotive products that are specific to certain areas of the automobile, IDT provides high precision, reliable, and robust sensor signal conditioners (SSCs) that span automotive applications from bumper to bumper and can operate in harsh automotive conditions with long-term stability. Our highly efficient, high-value application-specific and standard product SSCs are compatible with virtually any type of resistive or capacitive sensor; e.g., pressure, humidity, temperature, force, torque, flow, strain, angle, position, altitude, and rotational speed. They include diagnostic functions often required for automotive sensor modules to support the maintenance-on-demand policy of many automotive OEMs as well as special failure-mode operations required for safety-critical sensor applications such as brake pressure sensing.

Robust Product Offering

Robust Product Offering



Best-in-Class and Unique Calibration Techniques

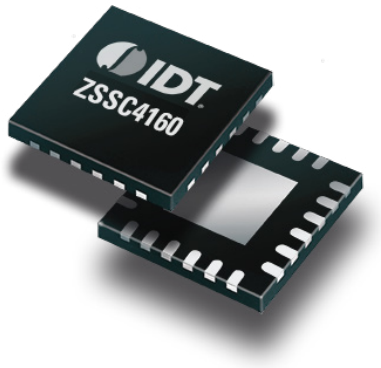
- Allows for lowest total system cost
- One fewer calibration temperature point than leading competitors
- More accurate calibration results with only one pass

Support Beyond the Sale

- Direct engineering interface from evaluation to production
- Software, board layout, calibration, testing, EMC/EMI expertise

IDT AUTOMOTIVE SOLUTIONS

Powertrain Applications



Electronic control technology in powertrain applications requires information from the myriad of systems that comprise an automobile's Powertrain.

As a result, automobiles today are filled with sensors that measure a variety of conditions such as:

- Transmission & Throttle Control
- Manifold Pressure/ Temperature
- Oil (Level, Temperature, Pressure, Quality)
- In-Cylinder Pressure
- UREA Pressure
- Mass Air Flow
- Diesel Heating
- Emissions Sensors

IDT's sensor signal conditioners are ideal companions for the resistive and capacitive sensors that populate the Powertrain. These products assist in providing the information needed to meet government regulations and address the growing concern about carbon emissions.

Powertrain Sensor Signal Conditioner Summary

Functions
Resistive SSC

Temperature Ranges
-40 to 125°C, -40 to 150°C

Input Types
Single-bridge, Dual-bridge, Dual-thermocouple

Interface Types
I²C, Ratiometric Voltage, Absolute Voltage, ZACwire™, Analog LIN, PWM, SENT 3

Adjustable Analog Gains
1 to 420

Resolutions (bits)
12 to 18

Sample Rates (kHz)
0.2 to 7.8

Package Types
SSOP, VFQFPN, WAFER

ZSSC416X/417X Next Generation Sensor Signal Conditioner Family

Full SENT 3.0 compliance: optimized for ASIL B applications

Bridge inputs configurable for single, dual, or differential measurements

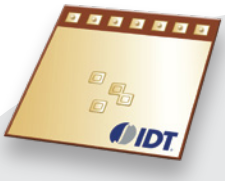
Internal and external temperature sensing; support for thermocouple

APPLICATION	ZSSC416	ZSSC417
Transmission and Throttle Control	●	
Manifold Pressure/Temperature	●	
Oil (Level, Temperature, Pressure, Quality)	●	
In-Cylinder Pressure	●	
UREA Pressure	●	
Mass Air Flow	●	
Diesel Heating	●	
Emissions		●

IDT AUTOMOTIVE SOLUTIONS

Body and Cabin Applications

Body and cabin electronics systems cover a variety of applications that include comfort as well as features that enhance driver safety and security. IDT provides products that are suitable for a variety of cabin features.

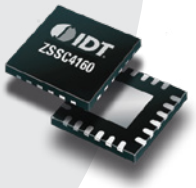


IDT's optical sensor portfolio consists of UVA and UVB light sensors, ambient light sensors, RGB color sensors, and proximity sensors. These products can enable standard applications such as rear view mirror and display adjustment as well as more exotic applications such as smart windshield polarization and intelligent sun roof control.

Industry leading gas sensor technology from IDT can enable use cases such as air quality monitoring to improve passenger comfort.

The ZAMC4100 is an intelligent Actuator and Motor Control IC featuring the industry's smallest footprint. It is ideal for exterior mirror control applications that with space restrictions.

- 9 x 9 mm 64-PQFN
- Smallest industry footprint
- ARM® Cortex™- M0 architecture
- Wide operating voltage range: 6 to 18 V, 40V transient condition
- AEC-Q100-qualified



IDT's sensor signal conditioners provide compelling features that are ideal for cabin heating, ventilation, and air conditioning systems (HVAC).

IDT AUTOMOTIVE SOLUTIONS

Chassis and Safety

MAGNETORESISTIVE SENSOR SIGNAL CONDITIONER

ZSSC5101

- Accepts sensor bridge arrangements for both rotational as well as linear movement
- Full-scale travel range of up to 360 mechanical degrees
- Ratiometric analog output

Function: Magnetoresistive SSC
Automotive Qualification: Yes
Temperature Range: -40 to 160°C
Supply Voltage: 4.5 - 5.5
Input Type: Dual-bridge
Interface: Ratiometric Voltage

Throttle position sensor

Safety and Efficiency

Modern automobile chassis and safety systems consist of a multitude of electronic systems that interact with everything from steering to braking to tire pressure monitoring. Like the Powertrain, sensors play a big role in providing information to the various systems. Some of the chassis and safety elements that require sensors include:

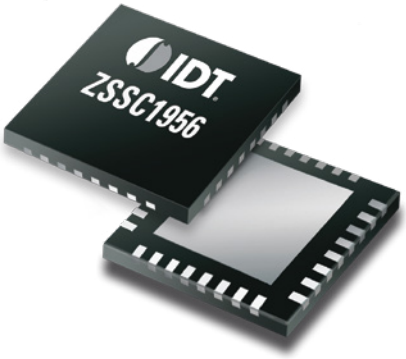
- Electric Power Steering
- Electronic Stability Control
- Automatic Braking Systems
- Pneumatic Brake Control
- Throttle Control
- Throttle Position Measurement
- Pedal Position Measurement
- Steering Wheel Position Measurement
- Tire Pressure Monitoring
- Seat Occupancy

Enabling these systems are sensor signal conditioners for resistive and magneto-resistive sensors that are part of the various chassis and safety systems in the modern automobile.

IDT also offers environmental sensors to enable modern safety features. For example, our thermopile sensors that can be used in applications like seat occupancy detection based on detection of body temperature. Also, IDT's gas sensor technology can be used for a variety of safety features such as **carbon monoxide detection** and even **breathalyzer** applications.

IDT AUTOMOTIVE SOLUTIONS

Battery Management



INTELLIGENT BATTERY SENSOR IC

ZSSC1956 Intelligent Data Acquisition SoC

- Winner of the 2012 and 2013 Frost & Sullivan Product Innovation Award
- Embedded ARM® Cortex®-M0 microcontroller
- 96kB flash memory, 8kB SRAM
- Dual channel, high-precision measurement front-end
- LIN 2.2-compliant interface to host controller
- Automotive AEC-Q100 qualified

Managing Energy Improves Efficiency

Due to the urgent global need to reduce environmental pollution and to meet governmental regulations limiting maximum harmful emission from vehicles, automotive companies are increasing their efforts to introduce features aimed towards reducing fuel consumption. One of these highly effective fuel saving features is the start-stop system, which automatically shuts down and restarts the engine as needed to reduce the amount of time the engine spends idling, thereby reducing fuel consumption and emissions by as much as 5 to 10 percent. In order to ensure a safe re-start of the engine once it has been turned off, precise information on the charge condition of the starter battery is essential.

Measuring charge and discharge currents is particularly challenging as the battery monitoring IC must be capable of precisely measuring milliampere currents when the engine is turned off and up to more than one thousand amperes when the engine is started. Modern automobile systems are increasingly reliant on consistent battery power, even when that power is supplied by mature lead acid battery technology. In battery management solutions for lead acid batteries, an intelligent sensor can bring decision making to the sensing solution by combining accurate measurement with processor capability. This can serve to optimize both battery life and reliability.

IDT's sensor signal conditioning technology combined with intelligence in the form of a microcontroller provides an ideal solution for battery sensing and management in automotive applications. IDT's battery sensor ICs accurately determine the charge condition of the battery based on inputs including charge and discharge currents, battery voltage, temperature, and aging. Both voltage and current are measured with two highly linear, synchronous 24-bit analog-to-digital converters.

IDT AUTOMOTIVE SOLUTIONS

Infotainment

TIMING SOLUTIONS
- Programmable clock generators
- Crystal oscillators
- PCI Express clock generators and buffers
- Custom clocks to meet specific requirements

SENSOR PRODUCTS
- Optical sensors for display brightness and contextual awareness

WIRELESS POWER
- Wireless Power Transmitters for in-vehicle phone charging

POWER MANAGEMENT FOR CABIN AND NETWORK APPLICATIONS
- Highly integrated, intelligent PMICs
- Distributed power units for power scalability
- Digital PWM controllers

RF PRODUCTS
- RF Switches
- RF Mixers
- Digital Step Attenuators
- Variable Gain Amplifiers

RapidIO® SWITCHES
- Advanced interconnect for high performance computing and wireless infrastructure applications

MEMORY INTERFACE PRODUCTS
- Enabling faster and more efficient advanced memory modules

Solutions in Infotainment

Portable consumer electronic devices have come to increasingly influence the automotive market. Consumers no longer want to be isolated simply because they are in an automobile. Instead, they look to the automobile to be an extension of their mobile devices and the complexity of infotainment systems is increasing dramatically as a result. Reduced design cycles and time to market have come to be expected in order to keep up with advances in technology.

Additionally, changes in the wireless networks are enabling new applications that will influence the future of infotainment. Central to the new 5G network are advanced computing systems used to analyze data at the network edge rather than the core.

IDT offers several products that address many of the technical requirements of complex infotainment systems as well as edge computing while offering a variety of product types to assist in limiting the number of suppliers required by manufacturers.

IDT AUTOMOTIVE SOLUTIONS

Infotainment

Wireless Power Transmitters

- Proven 5 to 15 W Wireless Power Transmitters
- Wireless Power Consortium Qi-compliant
- Highly integrated for low BOM cost and ease of design

PowerShare
By Integrated Device Technology

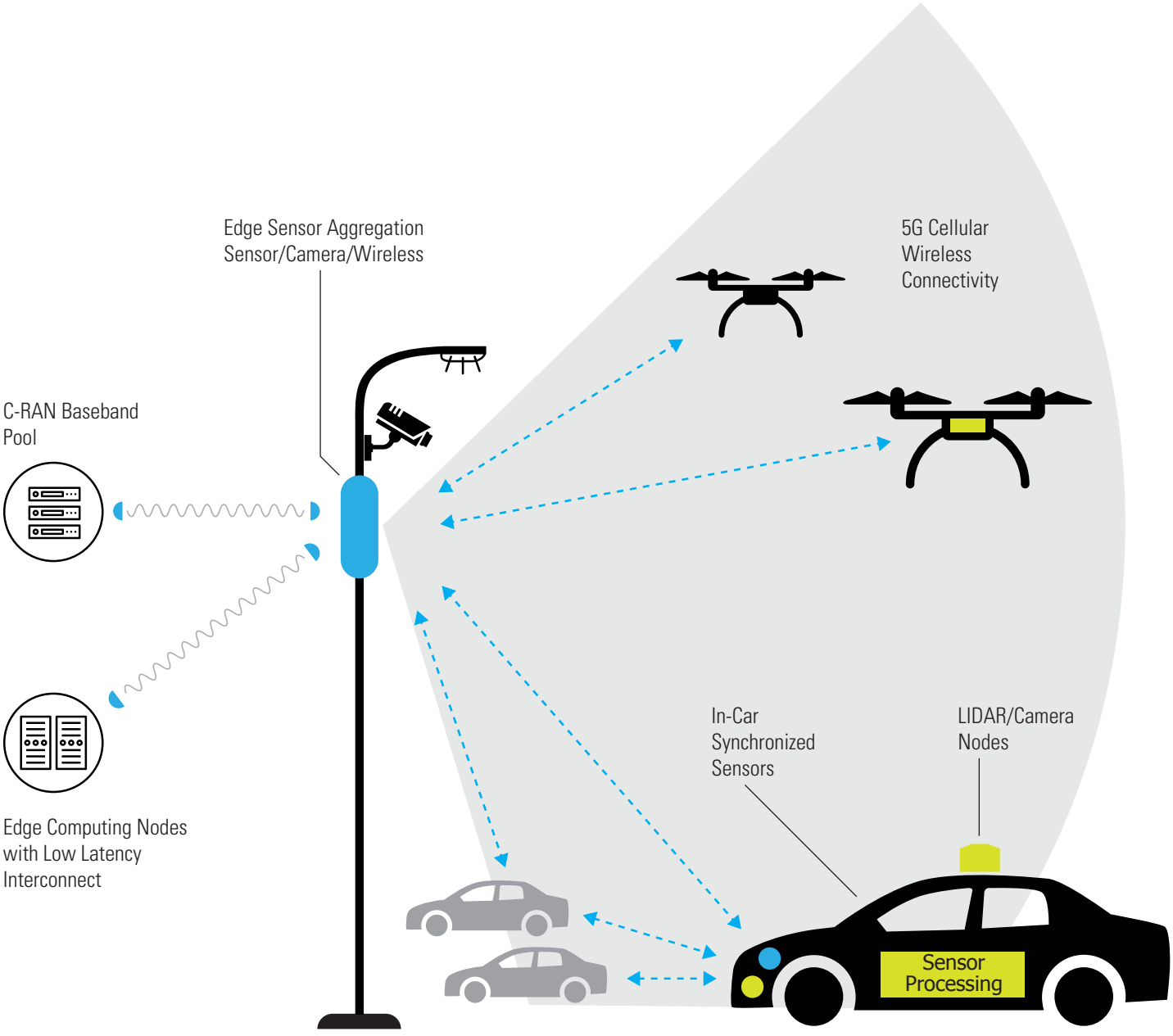
VersaClock® 3S Programmable Clock Generator

- Best-in-Class performance for power sensitive designs
- 5 to 8 output clocks to replace multiple timing devices
- Ultra-low power 32.768KHz Real Time Clock
- One time programmable memory for configuration storage
- Innovative power saving features
- Small packages down to 3 x 3 mm

IDT AUTOMOTIVE SOLUTIONS

Infotainment

5G NETWORK WILL EXTEND TO NEW APPLICATIONS



IDT AUTOMOTIVE SOLUTIONS

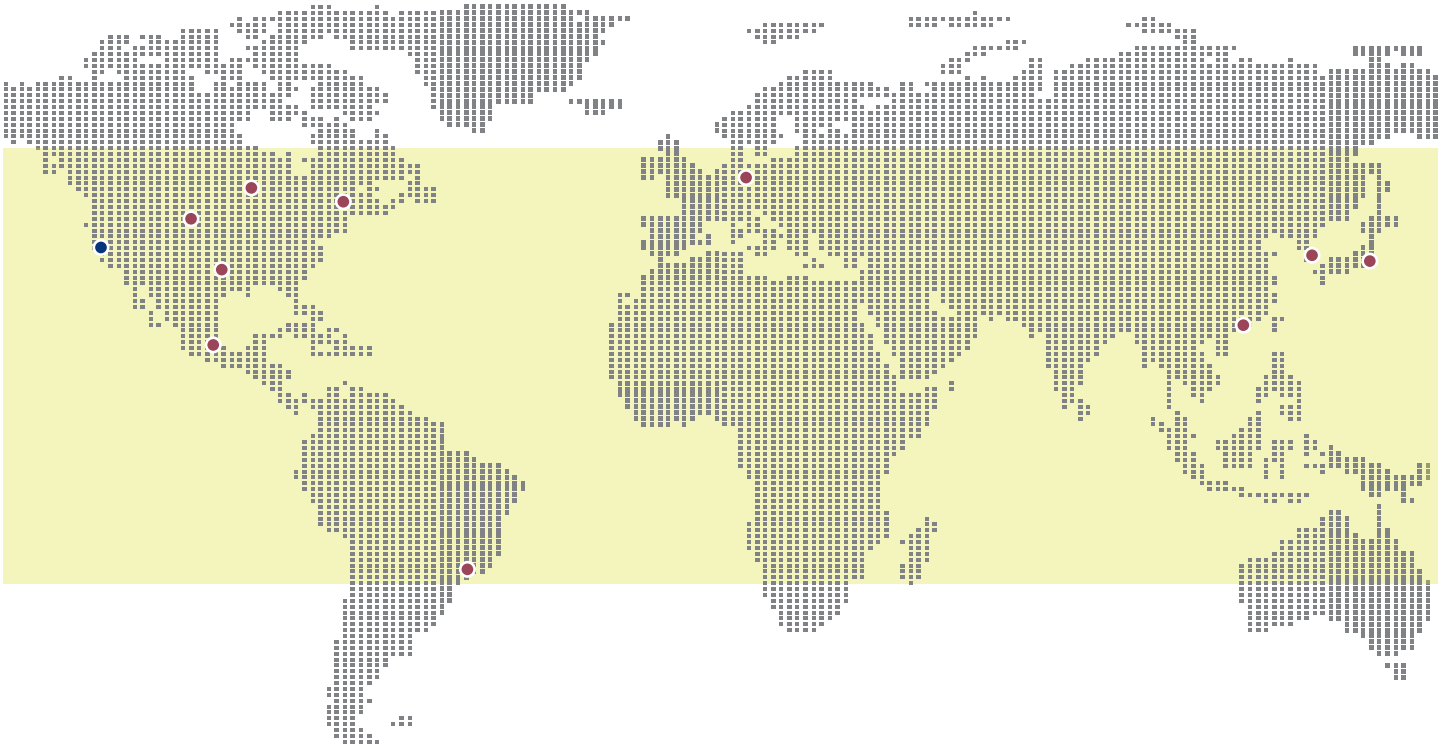
Infotainment

EXAMPLE OF A VERY INTELLIGENT NETWORK **EDGE**

- Edge Computing Cluster with RapidIO 10xN (50Gbps) ToR switching and IBM Power8 servers

- Up to 40 sockets per rack with any to any interconnect
- Set up at 5G Lab Germany
- Edge offload for remote robotics and vehicle offload

Global Direct and Distribution Network



IDT Has the Keys to Next-Generation Automotive Designs

IDT is driving the future of the connected vehicle, with a host of products and technologies geared for a new generation of electronics-rich automobiles. In addition to decades of proven success in the automotive industry with sensing solutions, IDT now offers other automotive platform solutions in timing, RF, and power and battery management that all play a role in advanced electronics systems for the vehicles of tomorrow. And with its low-latency RapidIO interconnect switches; IDT is deeply involved in building the 5G network essential for the move toward autonomous vehicles. IDT stands apart with technical expertise combined with the experience, commitment and a proven portfolio of products to address the technological design requirements of today and tomorrows connected car.

idt.com

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IDT
Integrated Device Technology