

Attracting Tomorrow



TDK-Micronas

Most Preferred Partner for Sensing and Control

TDK-Micronas GmbH
Sensor Systems Business Company
Embedded World 2020

TDK Corporation

At a glance

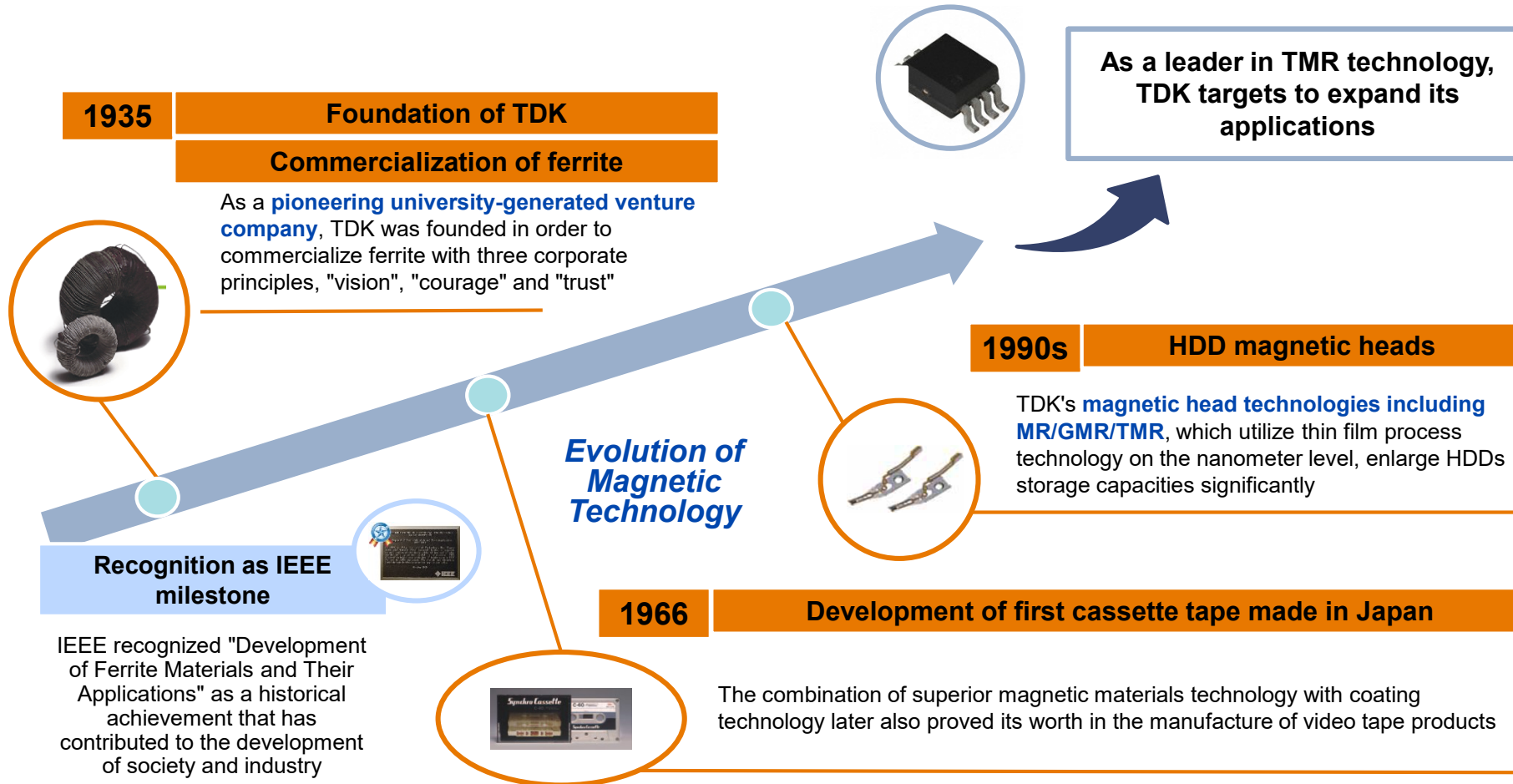
TDK Corporation is a leading electronics company. Our focus is on information and communication technology, automotive, industrial and consumer electronics markets. TDK's comprehensive portfolio features passive components such as ceramic, aluminum electrolytic and film capacitors, magnetics, high-frequency, and piezo & protection devices. Our product spectrum also includes sensors and sensor systems such

as temperature and pressure, magnetic and MEMS sensors. In addition, TDK provides power supplies and energy devices, magnetic heads, and more. The portfolio is marketed under the product brands TDK, EPCOS, InvenSense, Micronas, Tronics and TDK-Lambda. The company has a network of design and manufacturing locations and sales offices in Asia, Europe, North and South America.

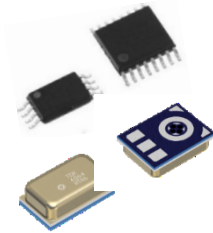
Key info (fiscal year 2019, ending March 31)		Major milestones	
Business	<ul style="list-style-type: none"> ● Passive components ● Sensor application products ● Magnetic application products ● Film application products ● Others 	1935	TDK (<i>Tokyo Denki Kagaku Kogyo</i> = <i>Tokyo Electric & Chemical Industries</i>) established in Japan to manufacture and commercialize ferrites
		1986	SAE Magnetics acquired
		2005	Amperex Technology Limited (ATL) acquired
		2005	Lambda Power Group acquired
Headquarters	Tokyo, Japan	2007	Recording Media business sold
Sales	JPY 1,382 billion	2008	EPCOS AG acquired
Sites	More than 200 factories, R&D & sales offices in more than 30 countries	2016	Micronas Semiconductor Holding AG acquired
		2017	TDK-Qualcomm HF joint venture RF360 started; cooperation with Qualcomm enhanced InvenSense, Inc. acquired
Employees	105,000	2018	Chirp Microsystems, Inc. acquired

TDK's Magnetic Products with 80 Years History

» Since the first commercialization of ferrite in 1935, magnetic technologies / solutions have been and will continue to be the core of TDK «



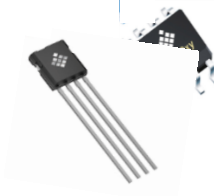
TDK's Sensor Product Portfolio



**TMR Angle
Sensors &
MEMS Microphones**



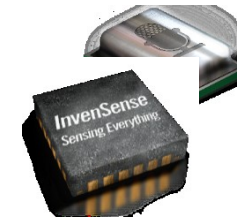
**Temperature
& Pressure
Sensors**



**Hall Sensors
& Embedded
Controllers**



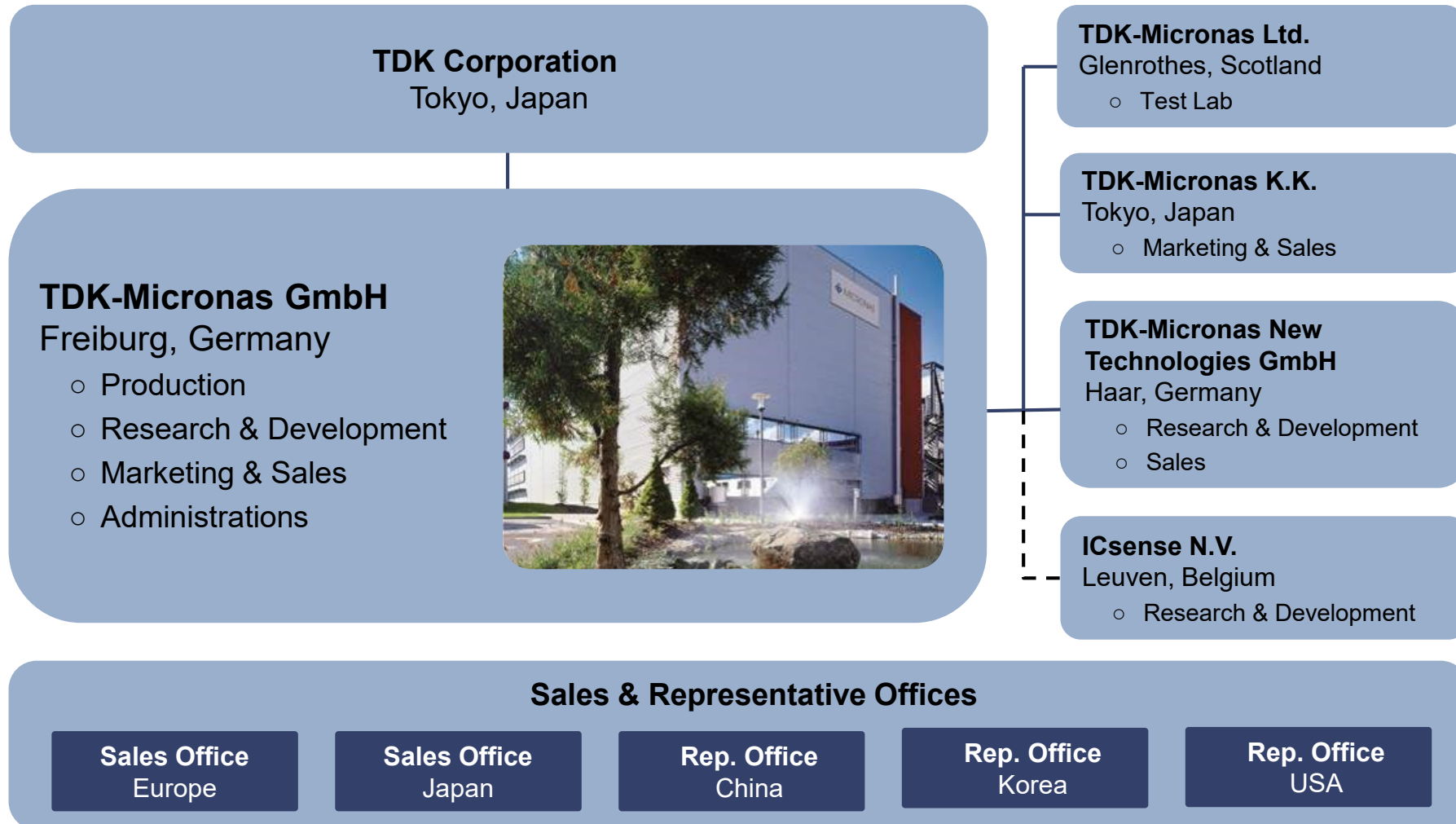
**MEMS Inertial
Sensors &
Gyroscope**



**MEMS Gyro/Accel
Microphones
Pressure Sensors**

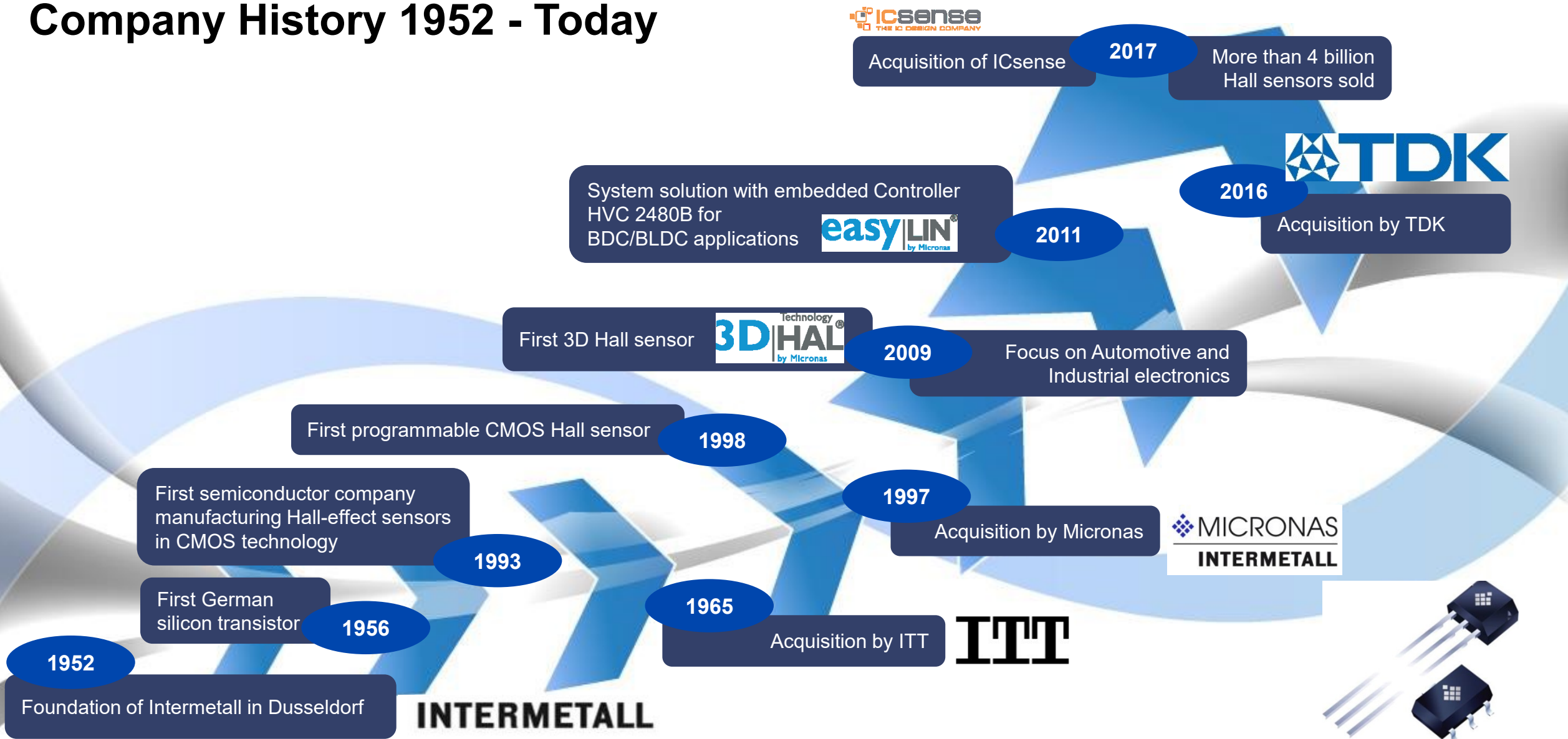
SSBC Vision: "Be a World No. 1 Sensor Solution Provider."

TDK-Micronas Group Structure and Locations



TDK-Micronas Company History 1952 - Today

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TDK-Micronas Technology Milestones

 MICRONAS
4 Billion
Sensors shipped



First ISO 26262 compliant Hall switch family for stringent functional safety requirements



First vertical integration of Hall-plates in a sensor enables multidimensional magnetic field measurement



In-house package development for gas sensors with integrated Teflon® particle filter



Microcontroller with integrated LIN interface



Hall Sensor with integrated microcontroller for flexible sensor output (SENT, LIN, PWM)



First semiconductor company manufacturing Hall-effect sensors in CMOS technology



TO92UA
SOT89B

SOIC8

Leadless
QFN

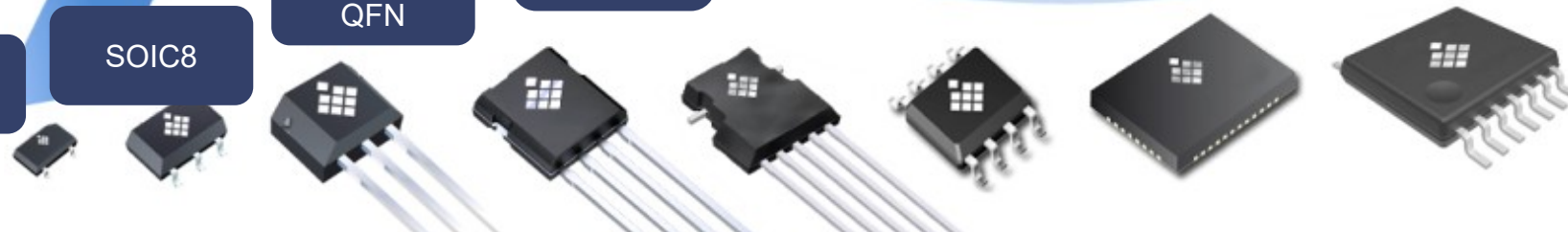
Open
Cavity
QFN

TO92UP
4-pin
leaded

SOT23

TSSOP14
dual die

TO92UF
int.caps



Products

TDK-Micronas Product Portfolio

Magnetic Field Sensors



- Major automotive trends for CO₂ reduction and car electrification are asking for tighter controls, thus increasing the demand for magnetic field sensors.
- TDK-Micronas has the broadest portfolio for automotive and industrial applications covering switches, linear, direct angle and current sensors.

Embedded Motor Controllers



- Up to 100 electric motors per vehicle.
- Fully integrated controllers for BLDC, stepper and BDC motors.
- All-inclusive single-chip control solution provides higher system efficiency to reduce motor size and weight.

Applications

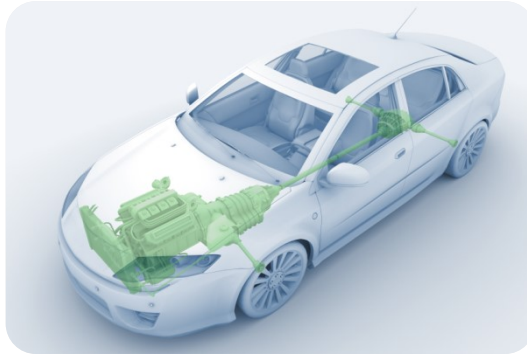
Magnetic Field Sensors & Embedded Motor Controllers

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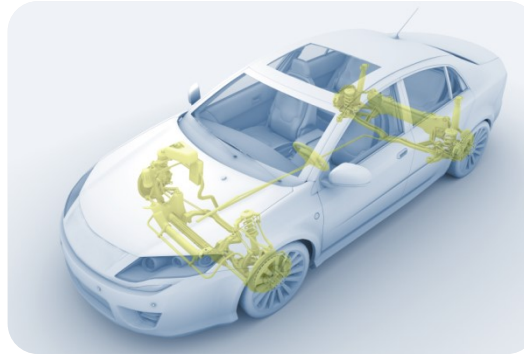
Automotive

Powertrain



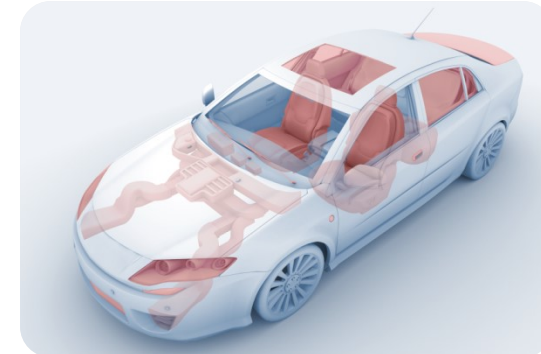
- Active Pedal
- Powertrain Valves
- Battery Management
- Gear Position
- Water/Oil Pumps
- Shift Lever Position
- Turbo Charger
- Liquid Level

Chassis & Safety



- Steering Torque
- Steering Angle
- Steering Motor Position
- Chassis Position Sensor
- Braking Pedal

Body & Security



- Window Lift / Sun Roof
- AGM – Grille Shutter
- LED Fans
- Door Lock
- Buckle Switch
- Adaptive Headlights
- HVAC Blower & Flap Control
- Seat Position / Climate

Applications

Magnetic Field Sensors & Embedded Motor Controllers

Industrial



Building, Home & Office Automation

- HVAC
- Rolling Shutters / Blind



Home Appliance & White Goods

- Washing Machine / Dishwasher
- Coffee Maker / Water Flow



Mobility & Robotics

- E-Bike
- Robots



Factory & Process Automation

- Production Equipment
- Solar Energy



Garden & Power Tools

- Mower
- Cordless Drill



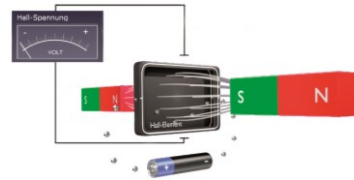
Agricultural & Heavy Machinery

- Harvester
- Excavator

Magnetic Field Sensors Technology

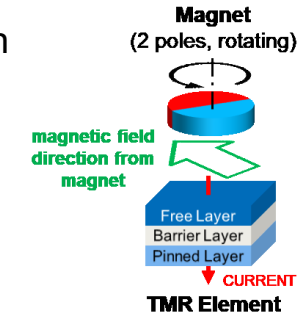
Hall Effect Principle

- Hall plate voltage is proportional to the intensity of the perpendicular magnetic field
- Field direction can be obtained by combining several Hall plates



TMR Principle

- Free Layer magnetization direction follows external magnetic field
- The resistance of TMR element is proportional to the relative angle between Free and Pin Layer



Hall Benefits

- Hall plate can be integrated directly into CMOS process
- Monolithic integration of signal processing ASIC and Hall plates is possible
- Cost effective implementation to perfectly fit to a wide range of applications

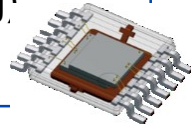
TMR Benefits

- Much larger signal / noise ratio in comparison to other magnetic sensing technologies (HALL / AMR / GMR)
- Offers best accuracy and/or lowest consumption capability
- TDK technology is very robust with stable performance over temperature and lifetime

Magnetic Field Sensors Trends

Redundancy

Two silicon dies are integrated into a single package to respond efficiently to redundancy requirements for most critical applications (pedal, throttle, steering)



Performance

Higher sensor performance helps reducing system costs thanks to cheaper magnet use and relaxed system tolerance.

Digital Interfaces

Requirements for higher diagnosis information and higher bandwidth are inducing a transition trend from analog output towards digital output.

Robustness

Lifetime robustness, EMC/ESD immunity and immunity against disturbing magnetic stray fields caused by the increased car electrification (HEV/EV).

Integration

Capacitors are integrated into the sensor package in order to fulfill stringent EMC/ESD requirements and to reduce overall system cost



Safety

New product developments and documentations are meeting the requirements of ISO26262, the de-facto standard for automotive functional safety.

ASIL | ready

Magnetic Field Sensors Products

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TDK-Micronas offers the broadest portfolio of magnetic field sensors for automotive and industrial applications

Hall Switches

- Position detection
- Replacement of micro switches

Roller shutter



Buckle switch



3D Hall Sensors

- Magnetic field direction measurement
- Precise linear measurement up to 40 mm and angle up to 360°

3D|HAL[®]
by Micronas



EGR valve



Clutch pedal

1D Hall Sensors

- Magnetic field amplitude measurement
- Replacement of conventional potentiometer



Steering torque



Pedal position

TMR Sensors

- Direct measurement of magnetic field angle
- Highest accuracy and response time

Motor position



Speed Sensing

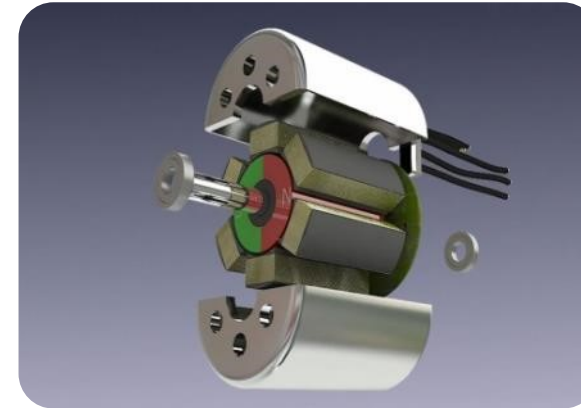


Embedded Motor-Controllers Technology

TDK-Micronas is focusing on fully integrated embedded motor-control solutions, providing high efficiency and flexibility for driving electric motors

Technology

- High integration level in HV CMOS technology
 - 32-bit ARM®-CORTEX-M3 CPU core
 - Digital peripheral
 - Memory
 - MOSFET HV drive
 - Analog converters, 12 V voltage regulators
 - LIN bus transceiver
- Automotive certified firmware package
- Small form factor QFN package
- Automotive range $T_J = -40\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$



Embedded Motor-Controllers Trends

Transition to BLDC

Brushless DC-motors enables weight, space and noise reduction for smart actuator solutions. With higher volume, delta cost compared to Brush DC-motor is reducing and largely compensated with other benefits.



Performance

Smaller motors must reach higher torque and longer lifetime requirements. More performant and adaptable driving schemes are required.

Miniaturization

Electronic drive must adapt to smaller form factor motors with minimized footprint and optimized number of external components.

Cost reduction through SW re-use

Software development costs are increasing and customers want to use already validated IP with high re-use for several motor platforms.

Embedded Motor-Controllers Products

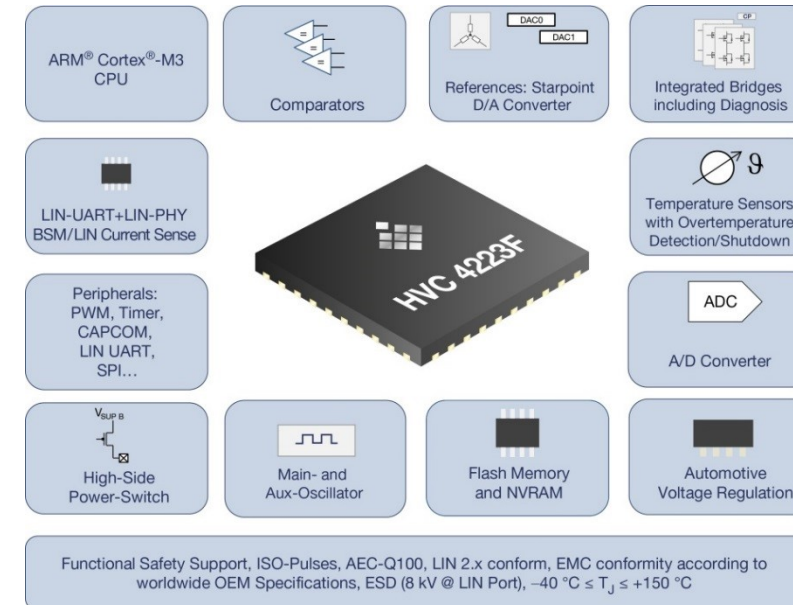
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Fully integrated single-chip motor-control solution with optimized system efficiency to reduce motor size and weight and improved re-usability and flexibility

Products

- Flexibility for direct stepper/brushless DC-motor control (sensored/sensorless)
- High-performance to enable sophisticated control schemes
- Minimized number of external components
- Supporting automotive OEM diagnosis routines
- Short development time
 - Easy-to-use development tools and app notes
 - Complete working demos
 - Professional automotive certified firmware package
 - Easy configuration and re-use between different applications

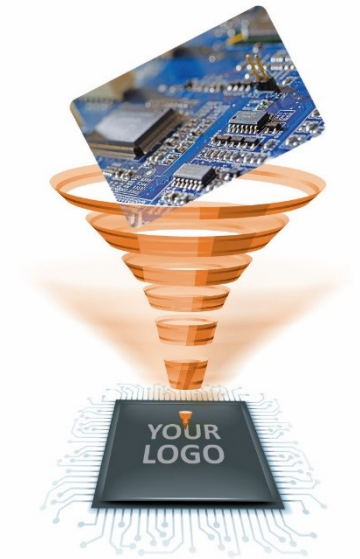


ICsense – Reduce Cost and Space with ASICs (Application Specific ICs)

ICsense, a wholly-owned subsidiary of TDK-Micronas, is Europe's premier IC design company. ICsense's core business is ASIC development and supply, and custom IC design services. ICsense has the largest fab-independent European design group with worldclass expertise in analog, digital, mixed-signal and high-voltage IC design. The company develops and supplies customer-exclusive ASIC solutions for the automotive, medical, industrial and consumer market compliant with ISO9001, ISO13485, and IEC61508-ISO26262.

Why integrate your existing electronic circuits into a single ASIC ?

- Reduce BOM (Bill-of-Material) costs
- Reduce size and weight
- Reduce power consumption
- Increase reliability and performance
- Reduce test and assembly costs
- Protect your IP



Main Expertise Areas



Sensor / MEMS



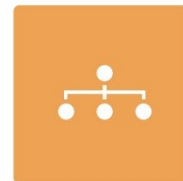
High-Voltage



Power / Battery



Low-Power



Communication

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www.micronas.com