Industrial Automation
Efficient & Robust Semiconductor Solutions

www.infineon.com/automation
Industrial Automation

These days, it’s hard to imagine the production landscape without industrial automation systems. Growing requirements of high product quality, paired with expectations of equally high reliability in high-volume production, mean that the scale of industrial automation will continue to grow. Much of what was previously produced by human hand can no longer be achieved in terms of cost and quality.

Energy efficiency, mobility and security are the main challenges facing modern society. Infineon’s industrial automation products address all of these needs, providing outstanding reliability & robustness, excellent quality and leading-edge innovations. Rich functionality and extensive integration capabilities ensure easy design-in and fast time-to-market.

The industrial automation application is presented in the following diagram:

The automation pyramid illustrates the three main levels as well as the intercommunication between them.

Office Network
(mainly Ethernet based)

Supervisor Level
(e.g., IPC)

Control Level
(e.g., PLC)
Factory Network (Field Bus based)

Field Level
(e.g., Peripheral Module)
Sensor, Actuator Interface (mainly Point-to-Point)

IPC = Industrial Personal Computer
PLC = Programmable Logic Controller
Industrial Automation Overview

**Industrial Power Supply**
- AC/DC
- DC/DC
- UPS

**Supervisor Level**
- Industrial PC/Panel PC
- HMI
- WLAN
- Industrial Ethernet

**Control Level**
- PLC
- HMI
- Field Bus (CAN)
- Safety (SIL)
- Field Bus

**Field Level**
- Micro PLC
- Motor Control
- Sensors
- Actuator Drivers
- Wireless Control

**Security and Protection**
- Software/IP Protection
- Trusted Computing
- Product Authentication
- Access Control

HMI = Human Machine Interface
UPS = Uninterruptible Power Supply
WLAN = Wireless Local Area Network
<table>
<thead>
<tr>
<th>Contents</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Automation Hierarchy and Applications</td>
<td>6</td>
</tr>
<tr>
<td>Supervisor Level</td>
<td>6</td>
</tr>
<tr>
<td>Control Level</td>
<td>10</td>
</tr>
<tr>
<td>Field Level</td>
<td>14</td>
</tr>
<tr>
<td>Industrial Power Supply</td>
<td>19</td>
</tr>
<tr>
<td>Security and Protection</td>
<td>20</td>
</tr>
<tr>
<td><strong>Products and Solutions</strong></td>
<td>21</td>
</tr>
<tr>
<td>Power Supply</td>
<td>21</td>
</tr>
<tr>
<td>Control</td>
<td>27</td>
</tr>
<tr>
<td>Interface</td>
<td>36</td>
</tr>
</tbody>
</table>
Within this level there are mainly PC-based systems used (so-called industrial PC, available as desktop, rack-mounted and panel PCs), equipped with standard OS (e.g., Windows-embedded) and supplier-specific industrial process-control software for process parameterization and visualization. These systems in general intercommunicate within an office network based on a Gbit LAN or higher bandwidth backbone. Also wireless topologies (WLAN) are implemented with industrial enhancement (e.g. protection class of IP65 and higher). There are less real-time requirements on communication since time-critical control processes are usually running on a PLC architecture (see control level).

The supervisory level usually doesn’t contain any control architecture such as PLCs as well as field bus communication devices (e.g. Interbus, Profinbus).

For data-safety reasons (avoiding data loss) there are usually redundant Uninterruptable Power Supplies (UPS) installed, which communicate with the main system (e.g. Ethernet-based) and take over the emergency power supply to avoid data corruption and loss.

Core Applications for Supervisor Level

- Industrial PC
- HMI
- WLAN
Industrial PC

Industrial PCs (IPC) are mainly used for process control (software-based applications) and meshed via standard Ethernet using industrial Ethernet switches. Mobile PC applications in industrial environments are used as programming units or for diagnostic purposes. The main criteria for IPCs are:
- Meet industrial requirements (e.g. protection class, ambient temperature, robustness)
- Customized enclosure (e.g. 19” rack-mountable, boxed PC, panel PC, mobile)
- Compatibility to standard PC architecture (e.g. OS, applications)
- Continuous operation (24 hours/7 days)
- Low power dissipation by CPU and power supply (operation without fan mandatory)
- Hardware access protection (e.g. ID card)
- Industrial field bus interfaces (e.g. RS-485-based, Ethernet-based)

Infineon offers a wide portfolio of energy-efficient power semiconductors (CoolMOS™, OptiMOS™), which meet enhanced low-power design requirements. Also dedicated CPU and memory power supply devices are available (compliant to Intel DrMOS specification).

Due to its market-leading position in the security and identification areas, Infineon also provides tailored solutions for trusted computing (TPM) as well as identification systems (contact-based and contactless chip card ICs). For interface protection there is a wide range of RF and protection devices as well as components for wireless applications available (LNA, RF transistors).

For detailed product information please see the chapter Products and Solutions.

DrMOS = Driver and MOSFET Integrated Module
Human Machine Interface (HMI)

HMI products and systems like Text Displays, Graphic Panels, and Panel PCs are demanding various requirements to core semiconductor products such as microcontrollers, power and interface devices.

The goal of Human-Machine-Interaction engineering is to generate a user interface that makes it easy, efficient, and enjoyable to operate equipment in order to produce optimum results.

The following block diagram shows our best-in-class semiconductor solutions for HMI applications.

For detailed product information please see the chapter Products and Solutions.
WLAN Application

Infineon offers a broad portfolio of RF discrete components like transistors, diodes, MMICs, and switches, as well as ESD protection devices for RF and digital interfaces. With our strong RF product portfolio we address many wireless, consumer, industrial, scientific and medical frequency band requiring best performance.

Our LNA for WLAN applications are the best choice for improving your system sensitivity and extend the range of coverage of your system. In addition to our LNAs, our high-speed ESD low-capacitance protection devices offer the best protection of your RF front-end systems against ESD hazards with no degradation of system performance.

Dual-Band (2.4–6GHz) Wi-Fi Wireless LAN (WLAN, IEEE 802.11a/b/g/n) Front-End

For detailed product information please see the chapter Products and Solutions

ESD = Electro-Static Discharge
LNA = Low-Noise Amplifiers
MMIC = Monolithic Microwave Integrated Circuit
Control Level

This level describes the automation systems (programmable logic controller – PLC) where automation programs are executed. Systems related to this level require high real-time capability (isochronous real-time Ethernet) and are based on a special controller architecture with its own proprietary OS running on it. Since there are high real-time requirements on intercommunication, there are real-time compliant field bus protocols implemented (according IEEE 1588). PLC systems are mainly modular populated to allow customized and automation process-optimized configurations (modular I/O-interface boxes, communication interfaces, function modules, etc.). For enlargement of the operation range there are so-called peripheral controllers installed, which communicate to the (main) PLC via field bus; these systems also take over some pre-processing of I/O data to reduce the working load of the main PLC.

PLC systems are mainly supplied by a 24V DC industrial power-supply network or directly from a mains power line using an industrial power supply (modular or integrated).

Core Applications of Control Level

- PLC
- HMI
- Field Bus (CAN)

CAN = Controller Area Network
Programmable Logic Controller (PLC)

Industrial PLC describe the computing unit of any industrial automation system and therefore need to meet several challenging requirements such as high reliability, environmental noise and influence immunity and also enhanced protection classes (e.g. water-resistant and dust-sealed). Further needs are continuous 24 hours/7 days operation and availability over a wide environmental temperature range as well as real-time operation capability and security and safety enhancements. Due to lengthy experience in several application fields, Infineon products are predestinated to meet several of these challenging requirements. Your PLC application will benefit from these outstanding product features:

- 8/16/32-bit microcontroller portfolio offering enhanced real-time and safety features as well as various communication interfaces
- Best-in-class protected high- and low-side switches with optional isolation and enhanced diagnostics
- Leading experience in security products and brand protection
- Power-supply solutions meeting even automotive requirements
- Comprehensive protection solutions for interfacing units in harsh industrial environments

For detailed product information please see the chapter Products and Solutions.
Human Machine Interface (HMI)

HMI products and systems like Text Displays, Graphic Panels and Panel PCs are demanding various requirements to core semiconductor products such as microcontrollers, power and interface devices.

The goal of Human-Machine-Interaction engineering is to generate a user interface that makes it easy, efficient, and enjoyable to operate equipment in order to produce optimum results.

The following block diagram shows our best-in-class semiconductor solutions for HMI applications.

For detailed product information please see the chapter Products and Solutions.
Field Bus (CAN)

Infineon offers a variety of microcontrollers from low-cost to high-end and transceiver devices featuring CAN as field bus. The portfolio covers a wide range of microcontroller solutions for several automation applications. Our highly energy-efficient transceivers are preparing for the future and are the right fit to our microcontrollers. In addition, we offer a CANopen implementation from one of our partners, which will ease your start to implement CANopen-based applications.

For detailed product information please see the chapter Products and Solutions.

CAN = Controller Area Network
Field Level

The field level describes all terminal equipment such as sensors (optical, magnetic, thermal, etc.) and actuators (magnetic valves, power switches, motor starters, etc.) collaborating with a peripheral PLC or remote I/O system, offering pre-processing of the collected data and communication to the main PLC via field bus. Communication between a peripheral PLC and the end device is usually a point-to-point connection. There are also intelligent communication standards established, which provide, in addition, remote parameterization and diagnostics of the end device. Also wireless solutions (RFID, wireless sensor networks using IEEE 802.15.4 topology) are used for special cases.

Some field-level devices (e.g. vision sensors) still require interfacing with higher bandwidth; for this purpose also fieldbus-based sensors are used.

All items within this level are usually fed by a 24V DC industrial power supply or battery-powered (wireless sensors).

So-called Micro PLCs complete this level mainly used for isolated applications without networked communication channels (e.g. house installation, vendor machine).

Core Applications of Field Level

Micro PLC  |  Motor Control  |  Sensors  |  Actuator Drivers
Micro PLC

There are several aspects to deviate from the standard PLC concept for low-end applications, such as simple house-automation control units or electronic points of sale (ePOS).

In this area, the main requirements are reduction of size, low-cost, ease of use, compactness and even more power efficiency. High availability, networking, integrated isolation, safety and security aspects are secondary required.

Usually these systems are less modular but power dissipation and power loss will become more of an issue. Due to Infineon’s long experience in the OptiMOS™ product family, there are MOSFET solutions with lowest $R_{\text{DS(on)}}$ and best-in-class FOM values available.

The latest Infineon ARM® Cortex™-M4 based 32-bit microcontroller family excellently meets all these requirements, such as enhanced communication channels (Ethernet, USB, UART), interfacing to touch buttons or driving LEDs by integrated high-current ports.

For standard output interfaces, Infineon offers a wide portfolio of low- and high-side switches covering several output-current requirements as well as Constant Current Relay Drivers (CCRD) which enable energy efficient operation of electro-mechanical relays.

For detailed product information please see the chapter Products and Solutions.

FOM = Figure of Merit
Motor Control and Drives

Infineon offers the industry’s most cost-competitive semiconductor system solutions and the highest-quality semiconductor components for motor control and drive applications. Our portfolio covers a wide range of voltage and power classes, supporting a broad application spectrum across the industrial market.

With our power products and microcontrollers you can design efficient, robust, and cost-effective control units for virtually all types of motors, from brushless DC and permanent magnet synchronous motors, through induction and stepper motors, to switched reluctance motors.

Infineon offers Sensor products for reliable and efficient motor operation. The Hall effect latches are widely used for BLDC motor commutation, accurate rotor position sensing with our angle sensors products is used for field oriented motor control. For motor torque control we offer integrated Hall based Current Sensors.

For detailed product information please see the chapter Products and Solutions.

BLDC = BrushLess DC
SiC = Silicon Carbide
Industrial Sensor System

Automation equipment is becoming increasingly powerful and specifications are getting even more complex for industrial and consumer applications. This calls for more intelligent sensors with high accuracy and fast data transfer, e.g. for contactless control systems.

Typical application fields for semiconductor sensors are contactless switching, index counting, current measurement, level metering, and position, pressure or (large-area) motion detection. Thanks to Infineon’s more than 30 years of worldwide electronic experience, we have a rich portfolio of smart sensors.

Today, we supply pressure and magnetic sensors for many automation systems. With our innovative solutions we support the realization of the energy-efficient solutions of our customers.

For detailed product information please see the chapter Products and Solutions.
Actuator Drivers

Industrial PLCs systems finally drive several kind of loads, such as relays, magnetic valves, lamps, and resistive loads, but also more complex devices like motors, which require limitation of on-state current (e.g. contactors).
For this purpose an extensive portfolio of power semiconductors is required to meet all these requirements. Infineon is well fitted to meet all these requirements.
For PWM generation Infineon offers an extensive product portfolio of microcontrollers with enhanced PWM functionality (Capture Compare Unit) but also the driver output stage (half-bridge, bridge motor drivers, discrete MOSFET, IGBTs, and IGBT modules).

For detailed product information please see the chapter Products and Solutions.
PWM = Pulse Width Modulation
Industrial Power Supply

Industrial power supply networks provide a highly available fixed 24V DC supply voltage within specified limits. The output voltage is generated from different supply sources (AC and DC networks, 1-phase and 3-phase supply up to 500V AC); so a wide input voltage range is mandatory to meet these requirements. On the other hand, besides outstanding reliability, high efficiency and marginal power-losses are required as well. Further environmental aspects to be taken into consideration are: a wide operating temperature range, low output voltage noise, and suppression of system perturbation of the supplying superior power grid.

Infineon’s lengthy experience in power-supply solutions offers you a more than adequate product portfolio for your design requirements. There are several power semiconductor products available, ranging from low-voltage MOSFETs (OptiMOS™), with best-in-class R_{DS(on)} and FOM values, to a wide high-voltage MOSFET portfolio (CoolMOS™) as well as discrete and integrated IGBT solutions. For compact power supplies, also highly integrated solutions (CoolSET™) are available, which meet especially low power SMPS requirements.

Besides dedicated power control ICs (PFC/PWM controllers) Infineon also offers a wide portfolio of 8-bit micro-controllers (XC800 family), which contains products well-suited to being used as a supervisorial controller for any system-related functionality (e.g. voltage, temperature monitor, watchdog). These controllers also provide high-current ports, e.g., for direct LED drives.

Additional low-voltage DC/DC Converter-ICs as well as linear voltage regulators, furthermore Current Sensors complete the power supply portfolio downwards to point-of-load power supply applications.

FOM = Figure of Merit
SMPS = Switched Mode Power Supply
PFC = Power Factor Correction

www.infineon.com/smps
Security and Protection

As the leader for hardware-based security with a deep insight into embedded control requirements, Infineon enables customers to build security models based on best-in-class hardware in customized solutions.

Software can be easily analyzed, modified, and copied. As a result, software alone can not protect an entire platform in the same way as an embedded security concept. It does not constitute a Root-of-Trust. Embedded concepts, in contrast, balance security across software and hardware layers.

The embedded approach to security builds a comprehensive Root-of-Trust in a system. This Root-of-Trust can protect an entire platform, including software, system services, functionality, and devices. Hardware-based security at platform level allows simple and cost-effective integration of security-sensitive software code and significantly increases flexibility in development and design. It also allows you to tailor the security ratings of the product or solution to your needs.

In addition Infineon authentication solutions (ORIGA™) will help you to guarantee the use of original equipment and prevent the use of counterfeits, which can cause liabilities and negative impact to the brand of the OEM.
Products and Solutions

Power Supply

High-Voltage MOSFETs

CoolMOS™

The revolutionary CoolMOS™ power family sets new standards in the field of energy efficiency. As technology leader in high-voltage MOSFETs, CoolMOS™ offers a significant reduction of conduction and switching losses and enables high power density and efficiency for superior power-conversion systems.

Especially the latest, state-of-the-art generation of high-voltage power MOSFETs have resulted in the fact that AC/DC power supplies are more efficient, more compact, lighter, and cooler than ever before. This success was achieved by offering the lowest on-state resistance per package outline, the fastest switching speed, and the lowest gate driver requirements of high-voltage MOSFETs commercially available.

Key Features
- Offers a significant reduction of conduction and switching losses
- Enables high power density and efficiency for superior power-conversion systems
- Best-in-class price/performance ratio

Key Benefits
- Easy control of switching behavior
- Outstanding reliability with proven CoolMOS™ quality combined with high body diode ruggedness
- More efficient, more compact, lighter, and cooler

www.infineon.com/coolmos
Low-Voltage MOSFETs

**OptiMOS™**

Power management for telecom and information processing systems faces the challenge of growing power demands, higher efficiency, and lower SMPS cost. At the same time, the available space is constantly shrinking, leading to higher power density requirements.

The solution can be found in the OptiMOS™ low-voltage MOSFET family, demonstrating a combination of industry’s lowest on-state resistance $R_{DS(on)}$ and the best switching performance in the voltage range from 25V up to 250V. Available in leadless SMD packages like CanPAK™, SuperSO8 or S3O8, OptiMOS™ products reduce switching noise, improve EMI for SMPS as well as other industrial applications, and reduce the space consumption with more than 90%.

**Key Features**

- Industry’s lowest on-state resistance and figure of merit in all voltage classes ($R_{DS(on)} \times Q_g$)
- Available in innovative space-saving packages like CanPAK™, S3O8 and SuperSO8, and also in standard packages
- Highest immunity to dynamic turn-on
- RoHS compliant – halogen-free

**Key Benefits**

- Highest efficiency and highest power density
- System cost improvement by reducing need of device paralleling and allowing smaller heatsink
- Environmentally friendly

**Performance of OptiMOS™ Technology**

![Graph showing performance comparison between Infineon and Next Best Competitor](image-url)

www.infineon.com/optimos
AC/DC Integrated Power ICs

CoolSET™
Infineon’s latest 800V CoolSET™ series of products support a power range up to 50W and are offered in both through-holes (DIP type) and surface-mount (DSO type). It is suitable for main-block power supply (Chargers, Adaptors, Blu-ray, DVD players) or standby-block power supply (LED/LCD TV, Home Theatre, Mini-Audio). It’s the ideal solution for low-power design!

Key Features
- Quasi-resonant and fixed-frequency operation
- Active burst mode < 50mW @ no-load condition
- Digital frequency reduction
- Integrated start-up cell
- 800V avalanche rugged CoolMOS™
- Selectable entry and exit burst-mode level
- Adjustable blanking window
- Frequency jitter mode
- Adjustable brownout feature
- Protections features
- Pb-free lead plating; RoHS compliant

Key Benefits
- 800V CoolSET™ in fixed-frequency and quasi-resonant switching for fly-back topology. Both series-integrate 800V CoolMOS™, which comes with start-up cell and avalanche capability for enhanced ruggedness. The series adopts active burst mode for power saving, capable of < 50mW consumption @ no-load.
- 800V CoolSET™ fixed-frequency series introduces selectable active burst-mode levels, integrating brownout protection and internal gate resistor to improve power efficiency during standby, enhance reliability, and ease EMI performance. The Infineon 800V quasi-resonant series uses digital technology implementation.
- The digital frequency reduction allows the quasi-resonant to operate in a stable zero-crossing mode. Thus, the high-efficiency performance is maintained across the entire load range.

www.infineon.com/coolset
DC/DC

DC/DC Converters
Our high-efficiency switching converters help to reduce energy consumption, extending operating time of battery powered systems and by this minimize costs of all kind of systems in operation.

Key Features
- Input voltage up to 60V
- Output currents up to 23A
- Output voltage adjustable respectively fixed to dedicated values
- Shutdown quiescent current down to below 2µA
- Current limitation and overtemperature protection
- Enable feature

Key Benefits
- High efficiency regulation
- Only few external components needed for stable regulation
- Perfectly suited for regulation in pre-/post-regulation power-supply architectures

Block Diagram IFX91041
Voltage Regulator

Voltage Regulator and Trackers
Our linear voltage regulators and trackers help to reduce energy consumption, extending operating time and minimizing operating costs of all kinds of systems. The wide supply-voltage range, low quiescent current, comprehensive protection features, and various packages make our devices to a best fit even in beyond classical automation industries. Our trackers are best suited as additional supplies for off-board loads to increase system reliability.

Key Features
- Input voltage up to 60V
- Output current up to 1.5A
- Output voltage adjustable or fixed to specific values
- Quiescent current down to 20µA
- Overload, overtemperature, short-circuit and reverse-polarity protection
- Low current consumption
- Extended temperature range -40°C ... +125°C

Key Benefits
- Pin-to-pin compatibility with industry standard parts
- Very low dropout voltage
- Trackers for optimized heat distribution and external protection
- Trackers for a maximum of system cost reduction
- Small robust packages

Block Diagram IFX1763
For further products please see the following information:

- **IGBTs**
  www.infineon.com/igbt

- **CoolMOS™**
  www.infineon.com/coolmos

- **High Voltage Gate Driver: EiceDRIVER™**
  http://www.infineon.com/eicedriver

- **Diodes**
  www.infineon.com/discretes

- **LED Backlight Control**
  www.infineon.com/leddriver

- **Magnetic Sensors**
  www.infineon.com/magnetic-sensors
Control

Microcontroller
32-bit – XMC4000 ARM® Cortex™-M4 Family

Key Features
- ARM® Cortex™-M4F core with Floating Point Unit and Memory Protection Unit
- Fully qualified for extended temperature range (125°C ambient temperature)
- Scalable family with flash sizes from 64KB to 2.5MB and packages from QFN-48 to LFBGA-225
- Most advanced PWM, high-resolution PWM, timers and four 12-bit ADC and integrated ΔΣ-Demodulator
- Complete set of industrial standard connectivity peripherals: including Ethernet, USB, SD/MMC, CAN, SPI, UART, I²C
- Software friendly hardware design optimized for component based DAVE™ 3 development toolchain

Key Benefits
- Best in class actuator, timer and mixed signal peripherals for efficient actuator and sensor control
- Easy connection to the automation world with Human Machine Interface, Actuator Control (including Motor Control and ISOFACE™) and Industrial Communication (CAN, Real Time Ethernet) evaluation Kits
- Reduces software development complexity with integrated development toolchain DAVE™ 3
- Designed for harsh industrial requirements

www.infineon.com/microcontroller
**Block Diagram XMC4000**

![Block Diagram XMC4000](image)

**Family Overview XMC4000**

<table>
<thead>
<tr>
<th>CPU Frequency @ 125°C</th>
<th>Flash</th>
<th>SRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td>2.5MB</td>
<td>512KB</td>
</tr>
<tr>
<td>120</td>
<td>1MB</td>
<td>160KB</td>
</tr>
<tr>
<td>120</td>
<td>768KB</td>
<td>160KB</td>
</tr>
<tr>
<td>120</td>
<td>512KB</td>
<td>80KB</td>
</tr>
<tr>
<td>80/120</td>
<td>256KB</td>
<td>40/80KB</td>
</tr>
<tr>
<td>80</td>
<td>128KB</td>
<td>20KB</td>
</tr>
<tr>
<td>80</td>
<td>64KB</td>
<td>20KB</td>
</tr>
</tbody>
</table>

**Memories**

- ARM® Cortex™-M4
- Floating Point Unit

**Communication**

- Ethernet
- USB
- SD/MMC Card I/F
- External Memory I/F
- CAN
- USIC (Serial Communication)

**Timer & Actuator Control**

- CCU4
- CCU8
- High Resolution PWM
- Position Interface
- \(\Delta \Sigma\) Demodulator

**Real Time Clock**

**DMA**

**Data Protection through ECC/Parity**

**Infineon State-of-the-Art**

**Standard**

<table>
<thead>
<tr>
<th>CPU Frequency @ 125°C</th>
<th>Flash</th>
<th>SRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td>2.5MB</td>
<td>512KB</td>
</tr>
<tr>
<td>120</td>
<td>1MB</td>
<td>160KB</td>
</tr>
<tr>
<td>120</td>
<td>768KB</td>
<td>160KB</td>
</tr>
<tr>
<td>120</td>
<td>512KB</td>
<td>80KB</td>
</tr>
<tr>
<td>80/120</td>
<td>256KB</td>
<td>40/80KB</td>
</tr>
<tr>
<td>80</td>
<td>128KB</td>
<td>20KB</td>
</tr>
<tr>
<td>80</td>
<td>64KB</td>
<td>20KB</td>
</tr>
</tbody>
</table>

**Infineon Innovation**

**Infineon State-of-the-Art**

**Standard**

www.infineon.com/microcontroller
32-bit – TriCore™ Family
Leading-edge performance for real-time control.

Key Features
- Superscalar core with integrated MCU-DSP instructions plus FPU
- Clock rate up to 300MHz
- Peripheral Control Processor (PCP) for offloading the main core
- Flash sizes from 1MB to 4MB
- Multiple timers and Capture/Compare Units with ADC trigger for complex control loops
- DMA, memory protection, ECC for SRAM and flash and memory checker
- Multiple communication interfaces including Multi-CAN

Key Benefits
- Highest real-time performance
- Multi-axis control with multiple modulation strategies
- Fast and efficient processing of multiple tasks or control loops
- Designed for harsh industrial requirements
- PRO-SIL™ tests to support SIL

FPU = Floating Point Unit
ADC = Analog Digital Converter
ECC = Error Correction Code

www.infineon.com/microcontroller
16-bit – XE166 Family
With more than 500 million pieces sold C166 has set the standard for 16-bit architectures.

Key Features
- Up to 100 MiPS and integrated MAC unit with complete DSP library
- Flash sizes from 32KB to 1600KB and packages from 38-pin to 176-pin
- Up to 4 independent Capture/Compare Units (CCU6) and ADC with 600ns conversion time
- Memory protection unit, ECC for SRAM and flash and memory checker

Key Benefits
- Real-time performance to support automation requirements
- Fast accessible embedded RAM and flash
- Easy connection to the Automation world with CANopen evaluation kits
- Enhanced peripherals supporting SIL
- Designed for harsh industrial requirements

Block Diagram XE166

MAC = Multiply–Accumulate
8-bit – XC800 Family
Reliable low-cost microcontrollers with real-time control capabilities.

Key Features
- 16-bit co-processor for CORDIC and multiply/divide operations
- Flash sizes from 2KB to 64KB and packages from 16-pin to 64-pin
- Up to 2 independent Capture/Compare Units with ADC trigger for reliable control-loop calculation
- 16-bit timers running at up to 48MHz
- 10-bit ADC with conversion time below 1μs and ±2LSB
- Memory protection, ECC, brown-out detection
- Real-time clock and multiple low-power modes
- MultiCAN (2 nodes and 32 message objects)

Key Benefits
- Low-cost real-time performance
- DAVE™ Bench and DAVE™ Drive: Free tools for programming, loading, and debugging, as well as motor-control code generation
- Reduced CPU load and flash size with enhanced autonomous peripherals and control libraries in ROM
- Designed for harsh industrial requirements – up to 150°C or 130k hours of operation

Block Diagram XC800
CAN Transceivers

Our CAN transceivers provide proven quality, reliable track records, and high robustness electro noise to the communication systems within automation applications. ISO compliance is ensured. For example our IFX1050G has been optimized for high-speed communication whereas the IFX1054G type is suited for fault tolerance at lower data rates, while a separate flag supports diagnostics.

Key Features
- Transmission rates up to 1Mbit/s
- ISO 11898 compliant
- Low power modes
- Support of failure conditions
- Bus wake-up feature

Key Benefits
- Low current consumption
- Thermal protection
- Receive-only mode
- Excellent EMC performance and EMI robustness
- Standby/sleep mode
- Pin-to-Pin replacement for industry standard parts

Block Diagram IFX1050G

CAN = Computer Area Network
EMC = Electro Magnetic Compatibility
EMI = Electro Magnetic Interference

www.infineon.com/can
Authentication – Chip Card

Contact Based Security Controller
The SLC52EIA500 is optimized for embedded security applications offering the I²C interface. It allows very fast design-in and flexible integration. The SLC52EIA500 can therefore be easily integrated as root-of-trust and security server in embedded components. The functionality of the SLC52EIA500 allows secure storing of information, authentication based on strong cryptography, and supports high-end public key systems like RSA and Elliptic Curve DSA.

Key Security Features
- Integrity Guard Security Concept concentrates on digital, mathematically modeled security mechanisms
- Dual CPU implementation for fault detection
- Encryption, masking, and randomization
- Comprehensive error detection over the complete data path
- Active I²-Shield

Key Benefits
- R&D efficiency for application development
- Low effort on SW for security measures
- Short time to market for end-customer products
- Robustness, quality, and long product life spans
- Package to match the application

Block Diagram SLC52EIA500
For further products please see the following information:

Microcontroller
- Microcontroller Companion IC's
- CIC-Family
  www.infineon.com/microcontroller
- Safety Industrial SIL
  www.infineon.com/microcontroller

Security Controller
  www.infineon.com/security

Trusted Platform Module
- Trusted Platform Module
  www.infineon.com/tpm
- Trusted Computing Management
  Server
  www.infineon.com/tpm

Authentication
  www.infineon.com/origa
Interface

Non-Isolated High-Side/Low-Side Driver

Speed TEMPFET™
The speed TEMPFET™ is a family of power MOSFET transistors which are featured with an integrated temperature sensor. The sensor offers a thermal shutdown capability and is available on external pins to enable FAST switching and flexible temperature response control.

Key Features
- N-channel MOSFET with integrated temperature sensor
- Very low $R_{DS(on)}$ down to 6.5mΩ
- Thermal shutdown with latch behavior
- Fast switching up to 1MHz

Key Benefits
- Can be used as high-side, low-side or even in bridge/half-bridge architecture
- Analog driving / linear operation possible (MOSFET like)
- Enable short circuit protection

<table>
<thead>
<tr>
<th>Speed TEMPFET™</th>
<th>D²PAK – 5 Pins 55V Voltage Class</th>
<th>D²PAK – 7 Pins 49V Voltage Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>5–10mΩ</td>
<td>BTS282Z 6.5mΩ</td>
<td></td>
</tr>
<tr>
<td>10–15mΩ</td>
<td>BTS244Z 13mΩ</td>
<td></td>
</tr>
<tr>
<td>15–20mΩ</td>
<td>BTS247Z 18mΩ</td>
<td></td>
</tr>
</tbody>
</table>

www.infineon.com/tempfet
HITFET™

Our well-know and robust HITFET™ portfolio is now extending with new 24V devices and low-ohmic Power HITFET™ devices. We introduced them recently in our Design Link Magazine: 24V HITFET™ and BTS3256D. Our family approach offers high scalability for single- and dual-channel solutions.

Key Features

- Wide range of $R_{DS(on)}$ values (20–550mΩ)
- Logic level input
- Thermal shutdown with auto restart or latch behavior
- Logic level input
- Feedback via increased current at IN pin, for Power HITFET’s also pure digital readout possible
- Current limitation (except BTS3160D)

Key Benefits

- Overload and overvoltage protection
- Protection integrated in MOSFET like package
- Easy design-in
- Perfect fit in $R_{DS(on)}$
- Package to match the application

Block Diagram BTS3256D

![Block Diagram BTS3256D](image-url)
Protected High-Side Switches – PROFET™
Our PROFET™ family offers protection against overload, overvoltages, short-circuits, excess temperature, and ground respectively power-supply loss. For any loads, including resistive, capacitive, and inductive, our PROFET™s are best suited in automation applications for replacing electromechanical relays, fuses, and discrete circuits.

Key Features
- Operating voltage range 4.5 ... 60V
- Typical Load current 0.9 ... 45A
- $I_{Lsc}$ 0.9 ... 200A
- $R_{DSS(on)}$ from 1000mΩ down to 2.5mΩ at room temperature
- Diagnostic feedback
- As single channel or multichannel switches
- 1, 2, 4 and 8 channel

Key Benefits
- Overload and overvoltage protection
- Current limitation
- Short-circuit protection
- Thermal shutdown
- Loss of ground protection
- Loss of ground/$V_{bb}$ protection
- ESD protection

Block Diagram PROFET™
## High-Side Switches for Industrial Applications

<table>
<thead>
<tr>
<th>Resistance Range</th>
<th>1 Channel</th>
<th>2 Channels</th>
<th>4 Channels</th>
<th>8 Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>2–5mΩ</td>
<td>BTS555</td>
<td>BTS550</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 5–10mΩ</td>
<td>BTS50085-1TMA</td>
<td>BTS50085-1TMB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 10–20mΩ</td>
<td>BTS442E2</td>
<td>BTS441TG</td>
<td>BTS6163D</td>
<td></td>
</tr>
<tr>
<td>&gt; 20–50mΩ</td>
<td>BTS432E2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 50–100mΩ</td>
<td>ITS4060S-SJ-N</td>
<td>ITS4100S-SJ-N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 100–200mΩ</td>
<td>ITS4200S-SJ-D</td>
<td>ITS4200S-ME-N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 200mΩ</td>
<td>ITS4300S-SJ-D</td>
<td>ITS41k0S-ME-N</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **No Diagnosis**
- **Digital Status Output**
- **Sense Diagnosis**

- BTS441TG
- BTS441RG
- BTS50085-1TMA
- BTS50085-1TMB
- ITS4060S-SJ-N
- ITS4100S-SJ-N
- ITS4200S-SJ-D
- ITS4200S-ME-N
- ITS4200S-ME-D
- ITS4200S-ME-P
- BTS452T
- ITS4300S-SJ-D
- ITS41k0S-ME-N
- ITS42008-SB-D
- BTS723GW
- BTS724G
ISOFACE™

Galvanically Isolated 8-Channel High-Side Switches and 8-Channel Digital Input ICs

The ISOFACE™ product family provides a robust and intelligent galvanically isolated interface between:

- The microcontroller or bus-ASIC and
- Either load-switches or digital sensor and switch inputs.

The ISOFACE™ product family is designed for industry automation systems such as Programmable Logic Controllers (PLC), Distributed Control Systems, Industrial PCs, General Control Equipment and Sensor Input Modules.

Isolated Switch for Automation
8-Channel Isolated High-Side Switch for Industrial Applications

Key Features
- Up to 1.2 A output current per channel
- 500V isolation (UL508, EN 60664-1)
- Short-circuit protection
- Overload protection

Key Benefits
- Fully integrated system solution for
  - Galvanic isolation between microcontroller and harsh industrial environments
  - Fail Safe
  - No need for opto-coupler
  - No need for external clamping circuitry

Block Diagram ISOFACE™
Digital Input Interface for Automation
8-Channel Isolated and Fully Integrated Digital Input

**Key Features**
- Sensor input characteristic: IEC61131-2 (Type 1/2/3)
- Deglitching filters: software-programmable
- Up to 500kHz sampling frequency
- Comprehensive diagnostics

**Key Benefits**
- Enabling 4x higher integration densities
- Improved EMI robustness through application- and site-specific settings
- High-precision/high-speed applications
- Strong maintenance support helps reducing costly factory-floor down-times

**Product Overview**

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Ordering Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Input ICs</td>
<td></td>
</tr>
<tr>
<td>ISO1181T</td>
<td>SP000876494</td>
</tr>
<tr>
<td>ISO11813T</td>
<td>SP000876504</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Ordering Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Output ICs</td>
<td></td>
</tr>
<tr>
<td>ISO1H801G</td>
<td>SP000722122</td>
</tr>
<tr>
<td>ISO1H802G</td>
<td>SP000726482</td>
</tr>
<tr>
<td>ISO1H811G</td>
<td>SP000413798</td>
</tr>
<tr>
<td>ISO1H812G</td>
<td>SP000413800</td>
</tr>
<tr>
<td>ISO1H815G</td>
<td>SP000555576</td>
</tr>
<tr>
<td>ISO1H816G</td>
<td>SP000555578</td>
</tr>
</tbody>
</table>

**Block Diagram ISO11813T**
Wireless Control

Infineon offers a comprehensive and complementary product portfolio of transmitter, receiver, and transceiver products for the sub 1GHz frequency bands. Make your application wireless by using our standard products for relatively simple application requirements or the SmartLEWIS™ product family members for more complex system or performance requirements.

Standard Products

The standard products comprise the TDA71xx transmitter and TDA72xx receiver and transceiver product variants for ASK and FSK modulation, with a different feature set and frequencies (315, 434, 868, and 915MHz).

Key Features

- Standard Transmitter:
  ASK/FSK Transmitter family for low/high power, temperature range -40 ... +85°C

- Standard Receiver:
  ASK/FSK Receiver family, temperature range -40 ... +105°C, TSSOP and VQFN package

- Standard Transceiver:
  ASK/FSK Transceiver family, single-channel, temperature range -40 ... +85°C, TSSOP and VQFN package

Key Benefits

- Very low current consumption
- Low system costs: only few external components required
- Dedicated product variants for industrial and consumer applications (TDA-7 series) to meet an optimal feature-cost ratio
- Complementary product portfolio (TDA/TK-5 series) for the highest quality standards and harsh environments such as temperature ranges up to 125°C

ASK = Amplitude Shift Keying
FSK = Frequency Shift Keying

ASK = Amplitude Shift Keying
FSK = Frequency Shift Keying
SmartLEWIS™ Family
SmartLEWIS™ stands for Smart Low Energy Wireless Systems and its family members for the next-generation wireless control products, having the highest level of integration and functionality to reduce system complexity and current consumption in an intelligent way.

Key Features
- SmartLEWIS™ TX: ASK/FSK Transmitter, multi-channel, multi-band, multi-power
- SmartLEWIS™ MCU: ASK/FSK Transmitter family with embedded 8051 microcontroller, 125kHz LF receiver and 3-channel ADC, temperature range -40 ... + 125°C
- SmartLEWIS™ RX+: High-Sensitivity Receiver family, single-/multi-channel, digital baseband with autonomous receive functionality and RF channel scanning, temperature range -40 ... +105°C
- SmartLEWIS™ TRX: High-Sensitivity, multi-channel Transceiver with digital baseband processing, up to +14dBm output power, Wireless M-Bus support, temperature range -40 ... +110°C

Key Benefits
- Highest integration and functionality
- Very low current consumption: e.g. the autonomous receive functionality forwards the valid messages to the host microcontroller only, and keep it asleep as long as unwanted messages are received
- Multi-protocol handling
- Low system costs: only few external components required
- Only one device for all major frequency bands (315, 434, 868, 915MHz)
- Dedicated product variants for industrial and consumer applications (PMA-7 series) to meet an optimal feature-cost ratio
- Highest, automotive proven, quality levels

Block Diagram TDA5340

www.infineon.com/wirelesscontrol
Current Sensor

The TLI4970 is a high precision Current Sensor based on Infineon’s well established Hall technology. The coreless concept allows significant miniaturization compared to existing solutions. It is a fully digital solution, easy to use. There is no need for any external calibration and additional parts (such as A/D converters, OP Amps, Reference Voltage) reducing the overall implementation effort, PCB space and cost significantly.

The TLI4970 provides superior accuracy compared to existing open or closed loop systems with magnetic cores. It has additional functionality such as overcurrent detection and programmable filters, but offers a significantly smaller footprint and power consumption.

Key Features
- Galvanic isolated, low resistance measurement principle
- Coreless solution, hysteresis free
- Inherent suppression of stray magnetic field
- 16-bit internal resolution
- Update rate 80k SPS
- Adjustable LP filter (0–10kHz)
- Configurable overcurrent comparator (allows < 5μs quick system shut-off)
- Suitable for industrial and consumer applications
- Plug and play solution – no external calibration needed
- Long-term stability of output signal

Key Benefits
- Fully calibrated digital output
- On-chip temperature and stress compensation
- Programmable low-pass filter for current measurement (0–10kHz)
- Fast and configurable overcurrent detector (> 150kHz)
- Inherent magnetic stray field rejection
- Small package size and weight allows SMD mounting

AC and DC current measurement applications
- AC/DC inverter
- DC/DC converter
- PFC power supplies and drives

Block Diagram TLI4970

www.infineon.com/tli4970

LP = Low Pass
PFC = Power Factor Correction
Hall-Effect Switches

The Hall Switches portfolio of Infineon comprises unipolar and omnipolar switches, bipolar latches and double Hall Switches covering a wide range of applications such as position sensing, index counting, BLDC motor control, etc. Those devices show excellent accuracy and robustness against electrical disturbances and are offered in a variety of packages.

Key Features

- 3V up to 32V operating supply voltage
- Reverse polarity protection (-18V)
- Small current consumption (1.6mA), low power components down to 4µA
- Active error compensation
- High ESD performance up to 7kV HBM
- Small SMD package SOT23
- Leaded package

Key Benefits

- Reduction of system power consumption
- Reduced system size
- Removal of protection devices
- Reliable system operation
- Increased motor efficiency

Hall Switch Types

Latch (Bipolar)

Uni-/Omnipolar Switches

Main application: BLDC Motor Commutation

Proximity Detection

Double Hall Speed-/Direction Switches

Absolute position sensing in power operated systems

BLDC = Brush-Less DC
HBM = Human Body Model

www.infineon.com/hall-switches
Linear Hall Sensors

All products of our linear hall family measure the vertical component of a magnetic field. The output signal is directly proportional to the sensed magnetic field. Based on these principles, our TLE499x family of linear Hall ICs has been designed specifically to meet the requirements of highly accurate angular and linear position measurement, as well as current-measurement applications.

Key Features
- Single supply voltage 4.5 ... 5.5V
- Temperature range -40 ... +150°C
- Linear ratiometric output between -200mT and +200mT within three ranges
- Programmable in sensitivity offset and clamping
- Digital temperature and stress compensation
- High voltage capability and reverse polarity protection
- Low drift of output signal overtemperature and lifetime
- 20-bit digital signal processing
- Analog and digital interfaces

Key Benefits
- Wear-free operation
- Highly accurate contactless position sensing
- In-system calibration
- Flexible system implementation

Block Diagram TLE4998
Speed Sensors

Our differential magnetic speed sensors on Hall basis are specially designed for linear or rotational speed and position measurements for which a ferromagnetic gear tooth or encoder structure is used. The Hall sensors contactless measure with high accuracy the vertical magnetic field component induced by such a ferromagnetic structure. They feature different options of switching algorithms to provide the optimal performance choice for each industrial applications. The sensors offer you further benefits such as integrated capacitors (-C types) for high EMC robustness and provide highest levels of ESD protection as well as high operating temperature ranges. Special versions with additional vibration suppression features are also available to enable precise measurements even in the harshest industrial environments.

To facilitate the magnetic sensor design of your applications, in which a back bias magnet for the magnetic field generation is required (e.g., in gear wheel application or applications using similar ferromagnetic gear tooth structures), we offer an integrated Back Bias (iBB) magnet package option.

Based on Infineon’s leading automotive speed sensor portfolio we offer high quality speed sensors with excellent technical and commercial performance for a board range of industrial applications.

Key Features
- Highly accurate speed measurements over large operating air gaps and broad frequency range
- Use of the common 3-wire voltage or 2-wire current interface
- Broad operating temperature range ($T_A = -40^\circ C \ldots +150^\circ C$)
- Options with high protection against reverse voltage, short circuit and overtemperature
- Option to use the innovative iBB-package solution
- AEC-Q100 qualified

Key Benefits
- Highly robust and cost-effective
- Strong EMC robustness
- Good sensing performance
- High sensitivity

Typical Application of a Magnetic Differential Sensor

www.infineon.com/magnetic-sensors
iAMR Angle Sensors

The TLE5109 combines the low noise characteristics of iAMR with unfiltered signal amplification on one IC.
- The sensor can be directly connected to the analog inputs of a microcontroller
- The output signals are offset and temperature compensated
- Signal amplitudes are independent from supply voltage variations
- 0.1° typ. accuracy

The TLE5109 is based on Infineon’s new automotive qualified integrated Anisotropic Magneto Resistive (iAMR) technology. The iAMR technology combines magneto resistive sensing elements and integrated circuits in one chip. The sensor contains two galvanically separated Wheatstone bridges and includes signal amplifiers. The two bridges provide a \( \sin(2\alpha) \) and \( \cos(2\alpha) \) signal. Where \( \alpha \) is the angle between sensor orientation and the magnetic field direction. From two signals, the absolute orientation of the magnetic field can be easily determined between 0° and 180°. The sensor is available in variants of supply voltage and temperature offset compensation.

Key Features
- Integrated AMR (iAMR) technology
- Differential sine and cosine analog output
- Supply voltage 3.3 or 5.0V
- On chip temperature compensation of amplitude and offset
- Temperature range -40°C ... +150°C
- Automotive qualified
- PG-DSO-8 Package

Key Benefits
- The sensor can be directly connected to the analog inputs of a microcontroller
- Signal amplitudes are independent from supply voltage variations
- 0.9° accuracy

Block Diagram TLE5109
iGMR Angle Sensors

Infineon offers a family of angle sensors based on integrated Giant Magneto Resistance (iGMR) technology. The sensors detect the orientation of an applied magnetic field by measuring sine and cosine angle components with monolithically integrated magneto-resistive elements. Data processing and communication interfaces are integrated on the same silicon chip as the sensing elements, allowing a compact design using small outline packages. The angle sensor family offers a broad variety of communication interfaces, as well as different levels of data processing and self-test capabilities.

**Key Features**
- Integrated magnetic field direction sensing for angle measurement
- Full calibrated 0 ... 360° angle measurement with revolution counter and angle speed measurement
- 15-bit representation of absolute angle value on the output (resolution of 0.01°)
- Temperature range -40 ... +150°C
- High accuracy and short delay times
- Green package with lead-free (Pb-free) plating
- Multiple interface (SPI, PWM, HSM, IIF, SPC)

**Key Benefits**
- Accurate angular position sensing
- Highly efficient motor control
- Wear-free operation
- Easy and variable system implementation

**Block Diagram TLE5012B**
For further products please see the following information:

**ESD Protection**
www.infineon.com/esdprotection

**RF Devices**
www.infineon.com/rf

**Identification – Chip Card**
www.infineon.com/security

**RFID**
www.infineon.com/security

**Sensors**
Manifold Pressure Sensors (MAP/Turbo MAP)
www.infineon.com/pressure

Barometric Air Pressure Sensor (BAP)
www.infineon.com/pressure

**Motor Drive**
Gate and Bridge Driver ICs
www.infineon.com/powermanagements

**MOSFETs**
www.infineon.com/mosfets

**IGBTs**
www.infineon.com/igbt

**Integrated Motor Drivers**
www.infineon.com/motorcontrol

**Power Modules**
www.infineon.com/powermodules

**Linear Current Source**
www.infineon.com/leddriver
Ask Infineon. Get connected with the answers.
Where you need it. When you need it.

Infineon offers its toll-free 0800/4001 service hotline as one central number, available 24/7 in English, Mandarin and German.

Our global connection service goes way beyond standard switchboard services by offering qualified support on the phone. Call us!

- Germany ..................... 0800 951 951 951 (German/English)
- China, mainland .......... 4001 200 951 (Mandarin/English)
- India .......................... 000 800 4402 951 (English)
- USA ............................ 1-866 951 9519 (English/German)
- Other countries .......... 00* 800 951 951 951 (English/German)
- Direct access ............. +49 89 234-0 (interconnection fee, German/English)

* Please note: Some countries may require you to dial a code other than “00” to access this international number, please visit www.infineon.com/service for your country!

Where to Buy
Infineon Distribution Partners and Sales Offices

Please use our location finder to get in contact with your nearest Infineon distributor or sales office.

www.infineon.com/WhereToBuy

Infineon Technologies – innovative semiconductor solutions for energy efficiency, mobility and security.