↗ **Atmel LIN Solutions**

ATMEL®
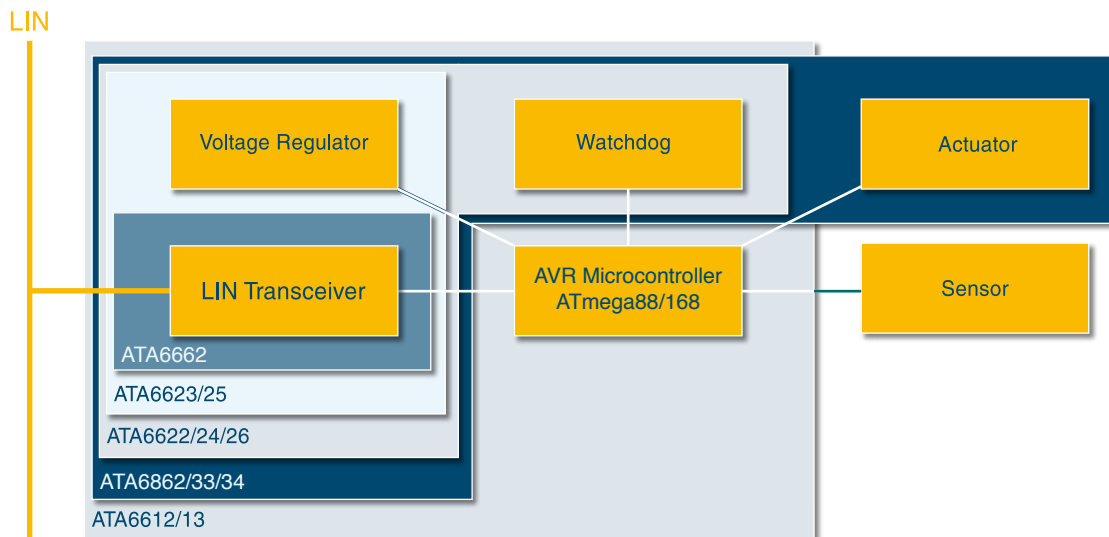
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Atmel's LIN Family

Atmel®'s modular LIN family includes a simple transceiver IC (ATA6662), complex system basis chips (ATA6622/23/24/25/26), and system-in-package solutions (ATA6612/13) with complete system integration including Atmel's famous AVR® microcontrollers ATmega88/168. In addition, Atmel provides a family of LIN motor driver system basis chips for H-Bridge and BLDC motor applications (ATA6823/33/34), which are suitable for both standard temperature and high temperature applications. All parts are based on Atmel's 2nd Generation LIN IP with excellent EMI and ESD performance. Atmel's innovative mixed-signal BCD-on-SOI technology (SMART-I.S®), which is used for many body electronics and powertrain devices, enables maximum integration, extended EMC performance, and high-temperature capability.

LIN

| Voltage Regulator | Watchdog | Actuator |

| LIN Transceiver | AVR Microcontroller ATmega88/168 | Sensor |

ATA6662
ATA6623/25
ATA6622/24/26
ATA6862/33/34
ATA6612/13

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Atmel's Automotive AEC-Q100

Atmel, a globally operating manufacturer of innovative integrated circuits, has more than 25 years of automotive electronics design expertise and is a market leader in various automotive areas.

With a broad scope of automotive-dedicated technologies such as BCDMOS, BCD-on-SOI and non-volatile CMOS, and automotive-qualified fabs (ISO 9001:2000, ISO TS 16949:2002, ISO 14001:2004), Atmel is able to provide high-end products that meet the strict automotive quality demands and that make vehicles more safe, economical and convenient. Design-ins are supported by our application engineers, demonstration and evaluation kits, reference boards, software, and detailed documentation.
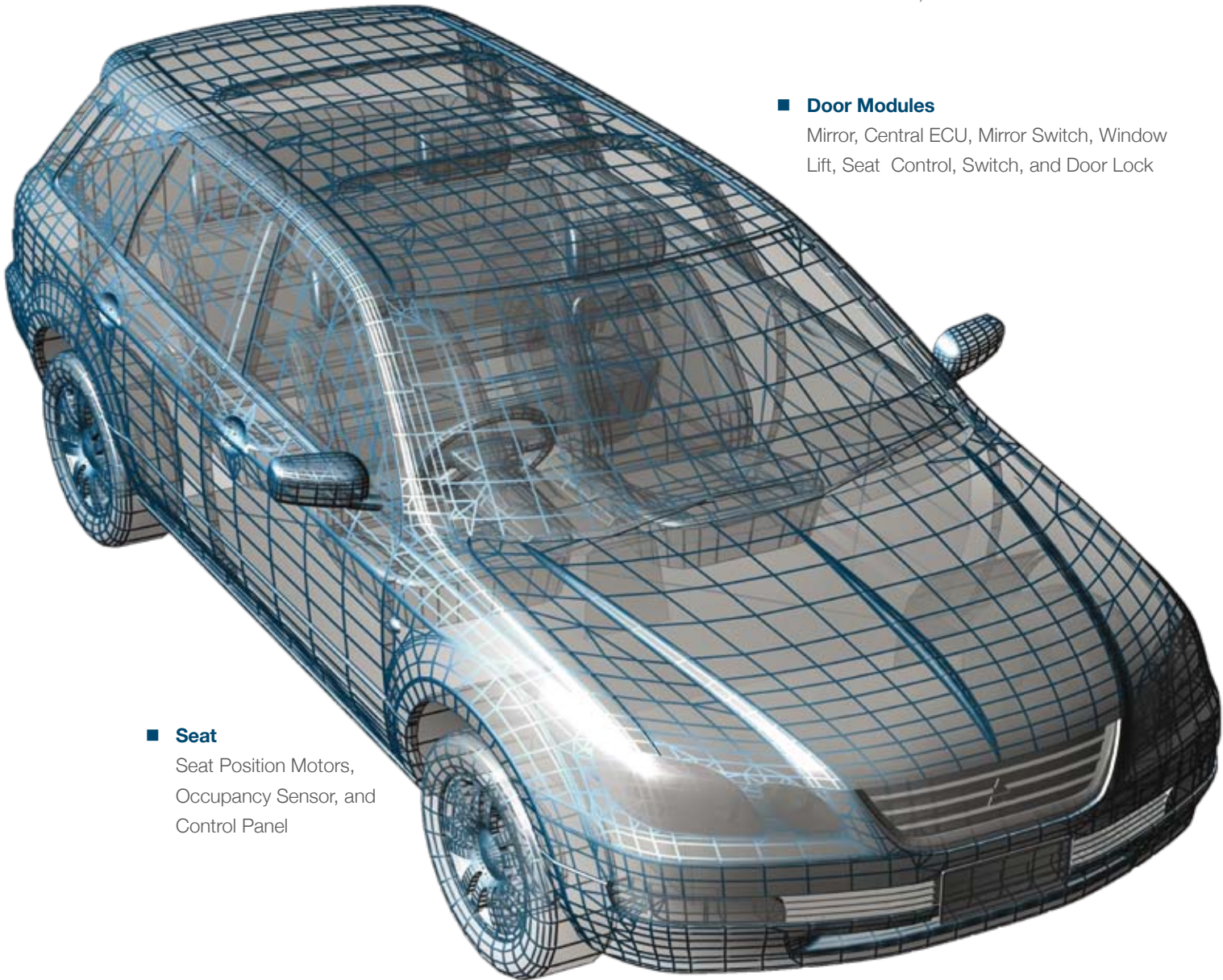
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LIN Applications

■ **Roof**
Rain Sensor, Light Sensor, Light Control, and Sunroof

■ **Climate Control**
Small Motors, Control Panel

■ **Door Modules**
Mirror, Central ECU, Mirror Switch, Window Lift, Seat Control, Switch, and Door Lock

■ **Seat**
Seat Position Motors, Occupancy Sensor, and Control Panel

■ **Steering Wheel**
Cruise Control, Wiper, and Flashers

■ **Engine**
Sensors, Small Motors

ATMEL®

BCD-on-SOI Technology

Atmel's innovative mixed-signal BCD-on-SOI technology (SMART-I.S.), which is used for many body electronics and powertrain devices, enables maximum integration, extended EMC performance, and high-temperature capability.

SMART-I.S. Features

- Fully Dielectric Isolated Twin Well, 4 Metal Layers, Operating Temperatures up to 200°C
- High-density 5V NMOS and PMOS Transistors
- DMOS Family for 25V, 45V, 65V, and 80V
- Bipolar PNP and NPN Transistors
- Patented DMOS Method for Optimized Trade-off between $V_{breakdown}$ and R_{dson}
- Zener Diodes, Resistors, Capacitors, OTP

SMART-I.S. Benefits

- High-temperature and High-voltage Capability
- Small Size (Gate Density Equivalent to 0.5 µm CMOS)
- Excellent Radiation Hardness
- Reduced R_{dson} Due to SOI
- Lower Parasitics for Simpler Design
- Higher Switching Frequencies for Power Devices

- Reduced Switching Losses
- Improved Latch-up Immunity
- Low Leakage Currents
- Reduced Electromagnetic Susceptibility
- Improved Efficiency, e.g., Power Converters
- New and Easy-to-realize Design Concepts
- Reusability of IPs
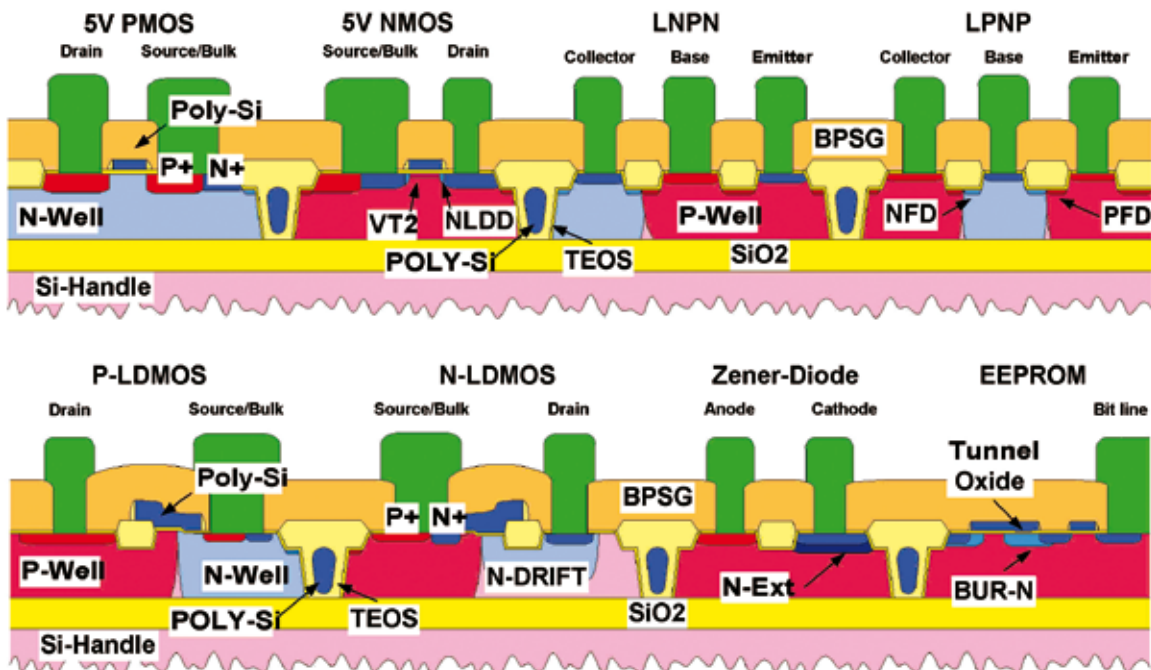

SMART-I.S. Cross Section (Through First Metal Layer)

EMC Performance

The EMC requirements for LIN nodes have continuously increased over the last few years. In particular the requirements for radiation-resistance and ESD resistance have increased.

With the 2nd generation of LIN components, Atmel's SMART-I.S. silicon-on-insulator technology separates the individual elements with oxide-isolation rather than standard PN-junctions. With standard technology due to electromagnetic interferences, an RF signal is added to the bus signal. Thus, the resulting voltage can be a negative voltage compared to ground potential. As a result, parasitic transistors, located at these pins are activated and cause interferences in other parts of the IC. The graphic below illustrates a parasitic NPN-transistor activated as result of negative voltage at an IC pin. SOI technology does not exhibit this behavior as there are no parasitic transistors between the neighboring wells due to the oxide isolation. DPI tests (Direct Power Injection) whereby the undesired HF radiation is simulated on LIN pins effectively verify this.
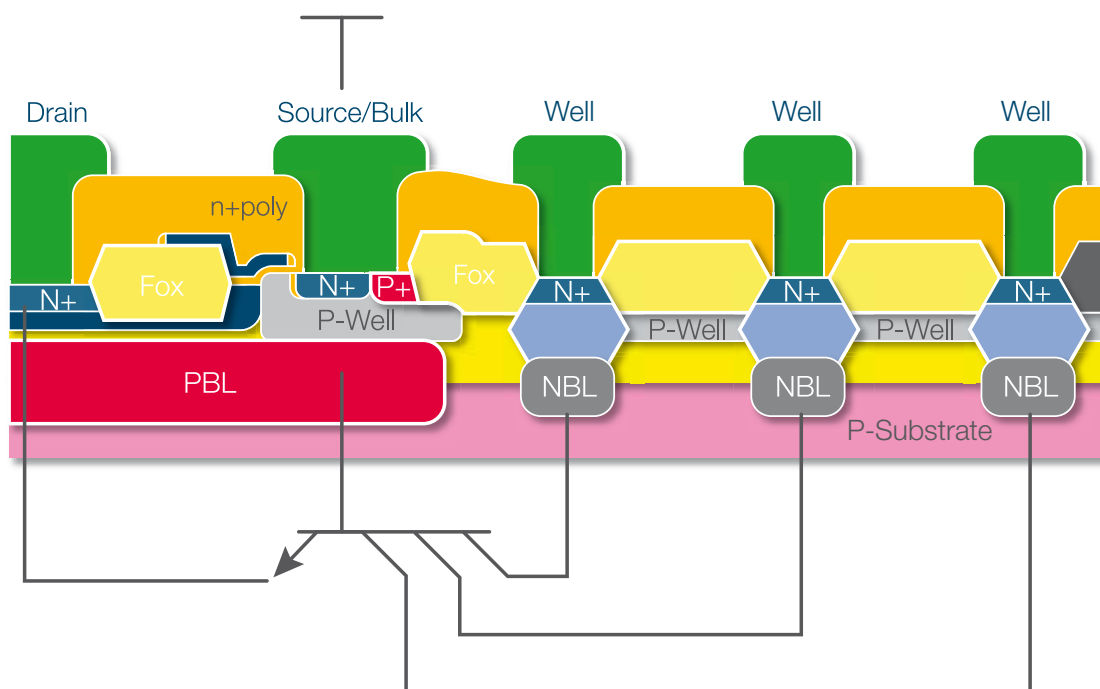
Example of a Parasytic Transistor in Standard Bulk Technology

Atmel's LIN transceivers, fabricated with SOI tech-nology, when measured to a test limit of 34 dBm demonstrate no evidence of this weakness, in contrast to transceivers developed in conventional technologies. (The figure on the right shows a comparison of DPI test fault limits between bulk and SOI technologies.)

In addition, SOI technology offers distinct advan-tages in the development of suitable ESD pro-tection for LIN transceivers. This is particularly important for the LIN pin, which must be suitable for voltages in the range of +40V to –27V without the use of external protective circuits. The LIN pin's inbuilt ESD protection can only be active at volt-ages lower than –27V to guarantee the stipulated inverse polarity protection of this pin.

Junction isolation drastically limits the construction of ESD protection in conventional BCD technolo-gies. ESD protection structures must be placed in extra isolation wells, which substantially increase
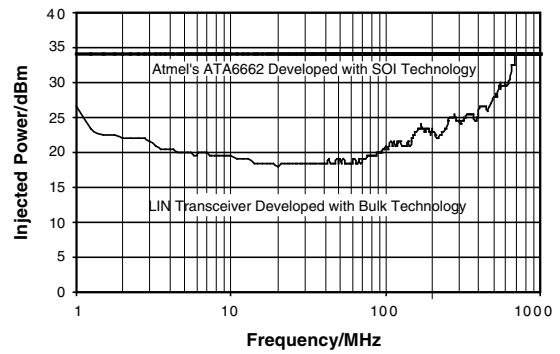
the latch-up in this area of the circuit. With SOI technology, as all components are completely iso-lated with an oxide, standard ESD structures can be used in voltage ranges that are more negative than ground.

Independent test institutes measuring in accor-dance with IEC 6100-4-2 have measured ESD resistance values of up to 11 kV for Atmel's LIN transceivers.

LIN Transceiver – ATA6662

The ATA6662 is a fully integrated LIN transceiver complying with the LIN specification 2.0 and the SAE J2602-2. It interfaces the LIN protocol handler and the physical layer in automotive applications. The device is designed to handle data communication for in-vehicle sub-networks with baud rates up to 20 kBd. Due to the advantages of SOI technology (SOI = Silicon-on-Insulator), the ATA6662 sets new benchmarks in EMI performance. The ATA6662 also provides outstanding ESD performance with an ESD protection of greater than 6 kV and compliance with the IEC 61000-4-2 standard.

Features

- Best-in-class Electromagnetic Compatibility (EMC) Performance Verified by Independent Test Houses
- Extended ESD Level at LIN, Wake, and Supply (VS) Pins

- Temperature Range from –40°C to 150°C
- Operating Voltage Range from 5V to 27V (40V)
- Low Electromagnetic Emission (EME)
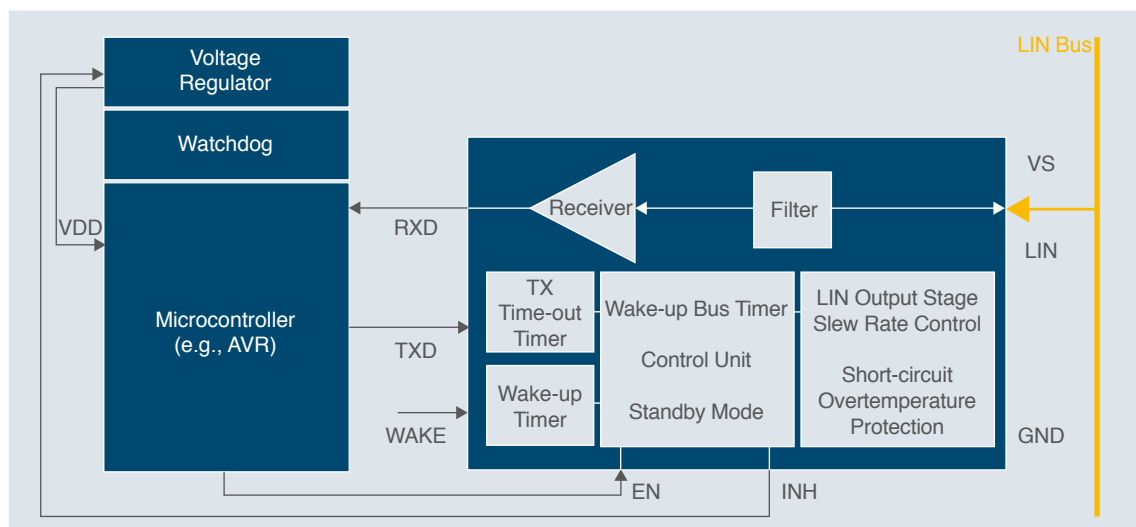- ATA6661 Pin Compatibility

Benefits

- Less Qualification Efforts Due to Near Global OEM Approval
- Less External Components Due to Excellent Electromagnetic Compatibility

Applications

- Automotive: Body, Safety, Powertrain
- Industrial

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LIN System Basis Chips ATA6622/23/24/25/26

Atmel's LIN System Basis Chips are fully integrated LIN transceivers with voltages regulators. The ATA6622/24/26 also includes a window watchdog. All Atmel's LIN SBCs are in compliance with both the LIN specification 2.0 and SAE J2602-2. The combination of voltage regulator and bus transceiver enables the development of simple, yet powerful slave nodes for LIN bus systems.

The ATA6622/23/24/25/26 devices are designed to handle data communication for in-vehicle sub-networks with baud rates of up to 20 kBd. For systems requiring very slow LIN communication, the ATA6626 (a derivative of the ATA6624) has no time-out feature implemented at the LIN bus.

Due to the advantages of Atmel' Silicon-on-Insulator technology, these devices have set new benchmarks in EMI performance. The ATA6622/23/24/25/26 also provide outstanding ESD performance with an ESD protection of greater than 6 kV and compliance with the IEC 61000-4-2 standard.
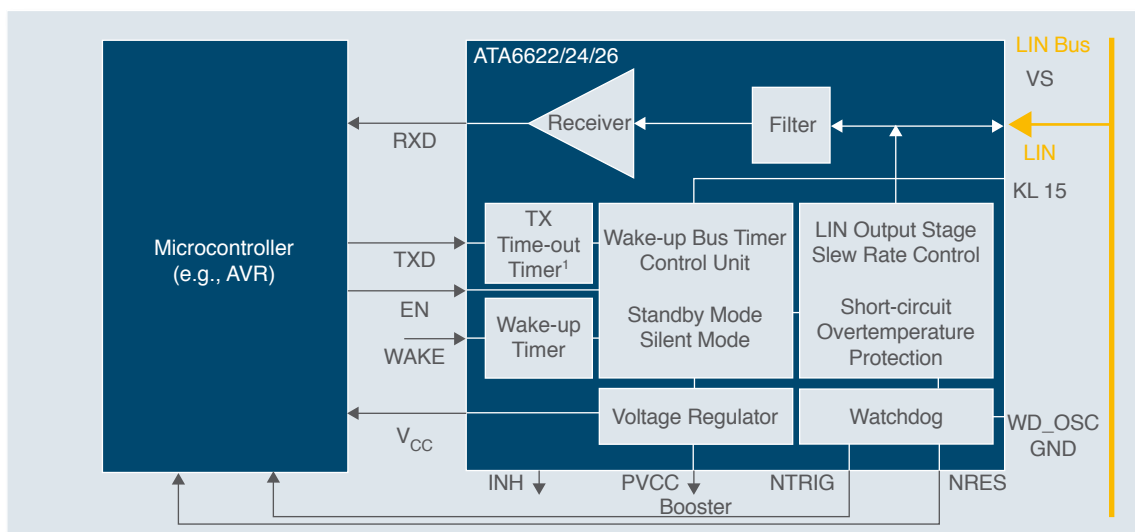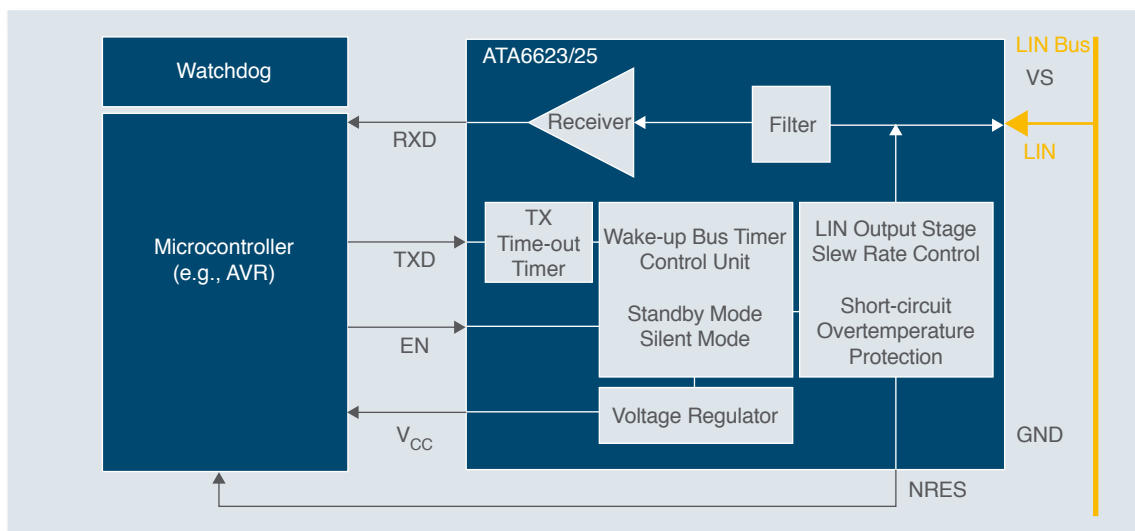
[1] Time-out timer not included in the ATA6626

Features

- Best-in-class Electromagnetic Compatibility (EMC) Performance Verified by Independent Tests Houses
- Extended ESD Level at LIN and Supply (VS) Pins (also at WAKE pin for ATA6622/24/26)
- Operating Voltage Range from 5V to 27V (40V)
- Linear Low-drop Voltage Regulator:
  ATA6622/23: 3.3V ± 2%/50 mA
  ATA6624/25/26: 5V ± 2%/50 mA

- Low Electromagnetic Emission (EME)
- Temperature Range from –40°C to 150°C
- Backwards Compatibility with ATA6620 (ATA6622/24/26) and with ATA6621 (ATA662/25)
- Window Watchdog (ATA6622/24/26)
- Wake-up Capabilities via LIN, Wake, and KL15 Pins (ATA6622/24/26)
- Boosting of Voltage Regulator Output Current Possible with an External NPN Transistor

Benefits

- Less Qualification Efforts Due to Near Global OEM Approval
- Less External Components Due to Excellent Electromagnetic Compatibility

Comparison Chart

Part No.	LIN Transceiver	Voltage Regulator	Watchdog	LIN Time-out-timer	Package
ATA6622	•	3.3V	•	•	QFN20 5 mm x 5 mm
ATA6623	•	3.3V		•	SO8
ATA6624	•	5V	•	•	QFN20 5 mm x 5 mm
ATA6625	•	5V		•	SO8
ATA6626	•	5V	•		QFN20 5 mm x 5 mm

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H-Bridge Gate Driver with LIN Transceiver – ATA6823

The ATA6823 combining system basis functionality with the capability of predriver stages is designed to control a DC motor in an external H-bridge. Together with a microcontroller, the ATA6823 forms a small system, which can work in the low speed in-vehicle-networking thanks to the LIN transceiver. With a PWM input and direction input from the microcontroller, ATA6823 independently handles the control of the external NMOS transistor.

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Features

- Speed and Direction Control of a DC Motor via 4 Externally-powered NMOS Transistors
- Diagnostic and Protection Functions Including Thermal Prewarning
- Integrated Window Watchdog
- Integrated Pin-programmable 5V/3.3V Regulator
- Integrated LIN Transceiver LIN 2.1 Compliant
- Very Low Current Consumption in Sleep Mode
- Shoot-through Protection with an Adjustable Cross-conduction Timer
- Small, Robust QFN32 7 mm x 7 mm Package

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Benefits

- Complete DC Motor Control System with only a Few Components
- Atmel's LIN Transceiver as Integrated Design Block
- Integrated Watchdog Enables Use in Safety-critical Applications
- Predriver Stages Designed to Control Broad Range of External NMOS Transistors up to 100A and More Current Capability
- Fully Populated and Programmed Design Boards Available for Easy Application Design
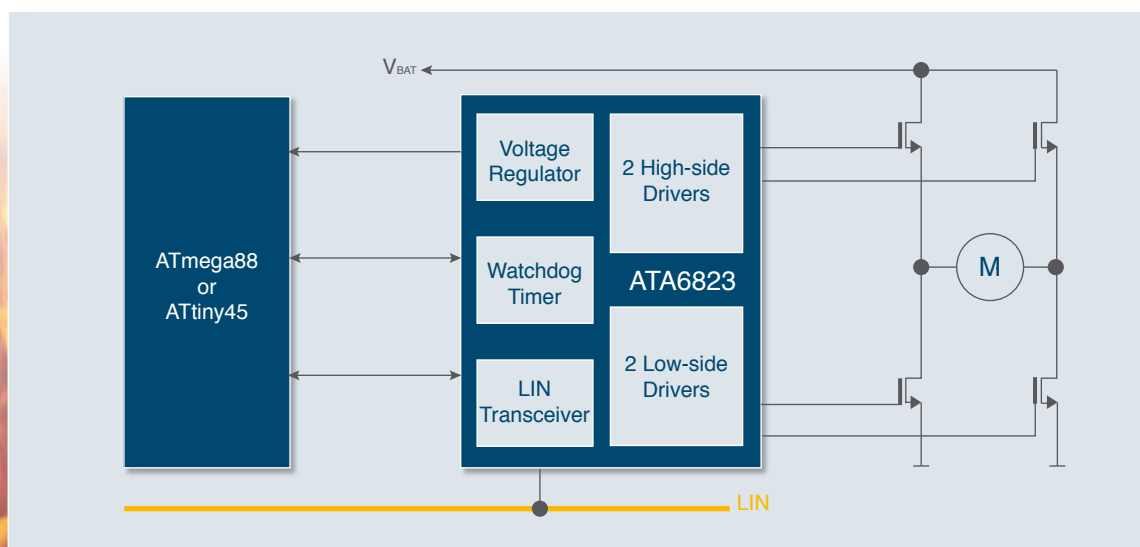
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BLDC Motor Driver and LIN System Basis Chip – ATA6833/34

The outstanding features of brushless DC motors are used more and more in automotive applications. The ATA6833/34 is designed to control a 3- phase BLDC motor via six external NMOS transistors in conjunction with a separate microcontroller. Convenience electronics as well as safety critical high-temperature applications in the powertrain can benefit from its high functionality, which comprises voltage regulator, watchdog, LIN transceiver, and pre-driver stages. The ATA6833 works up to 150°C junction temperature, which is sufficient for ambient temperatures up to 125°C, whereas ATA6834 is specially equipped to work up to 200°C junction temperature, which qualifies this IC for high-temperature under-the-hood applications with 150°C ambient temperature.

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Features

- 3 Push-pull Stages Control 6 Externally Powered NMOS Transistors
- PWM Frequency up to 50 kHz
- Various Diagnostic and Protection Functions Including Thermal Prewarning
- Integrated Window Watchdog
- Integrated LIN 2.1-compliant LIN Transceiver
- Shoot-through Protection by Adjustable Cross-conduction Timer
- Small and Robust QFN48 7 mm x 7 mm Package
- Very Low Current Consumption in Sleep Mode

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Benefits

- Low Additional Component Requirement for Complete BLDC Motor Control Systems
- Reuse of Atmel's Renowned LIN Transceiver
- Suitable for Safety Critical Applications due to an Internal Watchdog
- Predriver Stages Designed to Control a Variety of External NMOS Transistors up to 100A Current Capability
- BLDC Motor Drives without Hall Sensors can be Used as Signal Conditioning Carried out by the Microcontroller
- Fully Populated and Programmable Design Boards Available

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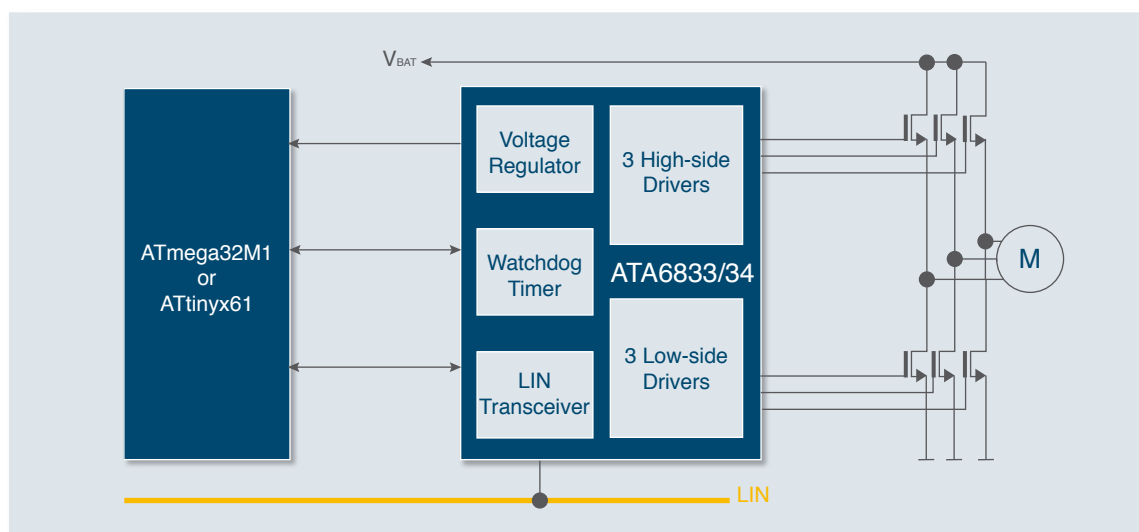
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LIN System-in-Package ATA6612/13

The ATA6612/13 is a system-in-package (SiP) solution, where the die of the ATA6624 LIN system basis chip (SBC) including LIN transceiver, voltage regulator, and watchdog is assembled together with an AVR microcontroller (ATmega88/168) in a single QFN 7 mm x 7 mm package. With this system-in-package solution, customers can cre-

ate complete LIN nodes using just one IC. The board real-estate is reduced to a minimum. All of the pins of the LIN system basis chip and the microcontroller are bonded out providing custom-ers the same flexibility and performance for their applications as they have when using discrete parts.
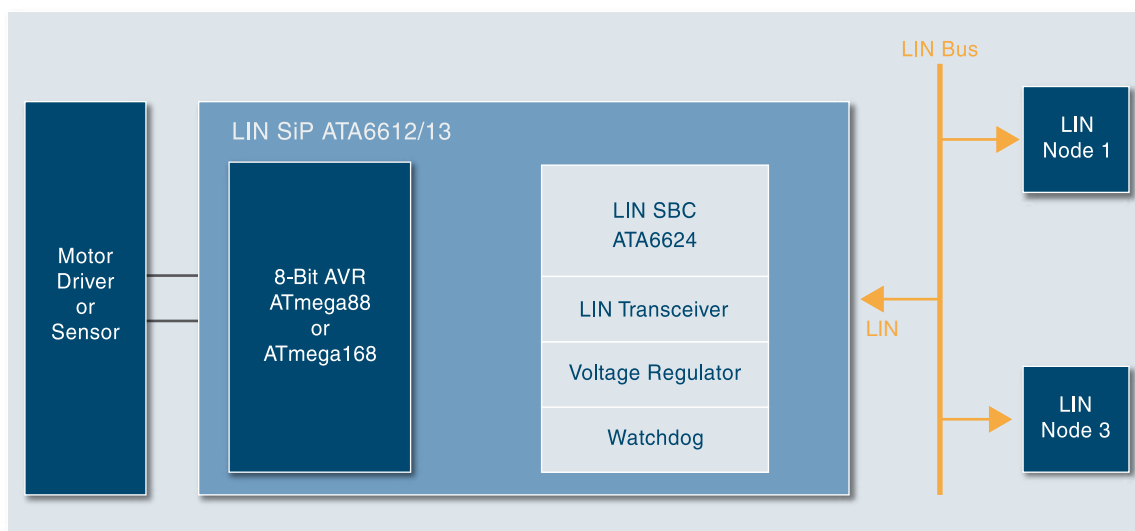
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Features LIN SBC

- LIN Transceiver Best-in-class Electromagnetic Compatibility (EMC)
- Extended ESD Level at LIN, Wake, and Supply (Vs) Pins
- Linear Low-drop Voltage Regulator
- Window Watchdog
- LIN 2.0 and SAE J2602-2

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Features AVR Microcontroller

- Advanced RISC Architecture
- 8/16 Kbyte Flash Memory
- LIN-capable UART
- 8-channel 10-bit ADC
- 512-byte Real E2PROM
- 1-Kbyte RAM

AVR Automotive Microcontrollers

The automotive market for electronics is growing rapidly as the demand for comfort, safety and reduced fuel consumption increases. All of these new functions require local intelligence and control, which can be optimized by the use of small, powerful microcontrollers.

Taking advantage of its unsurpassed experience in embedded Flash memory microcontrollers, with a large number of AVR devices, Atmel brings innovative solutions, whether for sensor or actuator control or more-sophisticated networking applications. These microcontrollers are fully-engineered to fulfill OEMs' quality requirements towards zero defects.

AVR Architecture Benefits

The AVR 8-bit architecture has reached a high level of acceptance in many market segments for its:

- Highest System Integration with a Large Number of Analog and Digital Peripherals
- Highest 8-bit CPU Performance Executing Powerful Instructions in a Single Clock Cycle
- Highest Code Density with High-level C-language Optimization

- Self-programming Memory
- Product Compatibility for both Code and Features
- Complete and Low-cost Tool Set Including Open-source C-compiler
- Brown-out Detection and Flash Corruption Security

AVR Microcontroller Evaluation and Debugger Kits

These automotive kits are particularly suited for rapid development of CAN and LIN nodes including gateways between the two protocols as encountered in modern vehicle architectures.

| ATAVRAUTO102 Debugger Kit	
Content	Description
AUTO102 Board	Hardware Development Tool
AUTO900 Board	Programming Interface for Standard AVR Programming Tools
ATAVRAUTOEK1 Evaluation Kit	
Content	Description
AUTO102 Board	Hardware Development Tool
AUTO100 Board	CAN to LIN Gateway without Human Interface
AUTO200 Board	LIN Slave Node for DC Motor Control (Relay)
AUTO300 Board	LIN Slave Node for Joystick Control
AUTO900 Board	Programming Interface for Standard AVR Programming Tools. This Board is a Simple Adaptor to Use Standard AVR Programming Tools as JTAGICEmkII or AVRISP

Multiplexing and Standard Microcontrollers

tinyAVR®		
Part Number	**Description**	**Package**
ATtiny25	AVR Microcontroller with 2-Kbyte Flash MCU, 128-byte RAM, 128-byte EEPROM, 10-bit ADC, up to 16 MIPS, Internal Calibrated Oscillator	SOIC8
ATtiny45	AVR Microcontroller with 4-Kbyte Flash MCU, 256-byte RAM, 256-byte EEPROM, 10-bit ADC, up to 16 MIPS, LIN-capable USI, Internal Calibrated Oscillator	SOIC8
ATtiny85	AVR Microcontroller with 8-Kbyte Flash MCU, 512-byte RAM, 512-byte EEPROM, 10-bit ADC, up to 16 MIPS, LIN-capable USI, Internal Calibrated Oscillator	SOIC8
ATtiny24	AVR Microcontroller with 2-Kbyte Flash MCU, 128-byte RAM, 128-byte EEPROM, 10-bit ADC, up to 16 MIPS, Internal Calibrated Oscillator	SOIC14, QFN28
ATtiny44	AVR Microcontroller with 4-Kbyte Flash MCU, 256-byte RAM, 256-byte EEPROM, 10-bit ADC, up to 16 MIPS, LIN-capable USI, Internal Calibrated Oscillator	SOIC14, QFN28
ATtiny84	AVR Microcontroller with 8-Kbyte Flash MCU, 512-byte RAM, 512-byte EEPROM, 10-bit ADC, up to 16 MIPS, LIN-capable USI, Internal Calibrated Oscillator	SOIC14, QFN28
ATtiny167	AVR Microcontroller with 16-Kbyte Flash MCU, 512-byte RAM, 512-byte EEPROM, 10-bit ADC, up to 16 MIPS, LIN-capable USI, Internal Calibrated Oscillator	SOIC20 VQFN32 (Sawn)
megaAVR®		
Part Number	**Description**	**Package**
ATmega48	AVR Microcontroller with 4-Kbyte Flash MCU, 512-byte RAM, 256-byte EEPROM, 10-bit ADC, up to 16 MIPS, LIN-capable UART, Internal Calibrated Oscillator	TQFP32, QFN32
ATmega88	AVR Microcontroller with 8-Kbyte Flash MCU, 1-Kbyte RAM, 512-byte EEPROM, 10-bit ADC, up to 16 MIPS, LIN-capable UART, Internal Calibrated Oscillator	TQFP32, QFN32
ATmega168	AVR Microcontroller with 16-Kbyte Flash MCU, 1-Kbyte RAM, 512-byte EEPROM, 10-bit ADC, up to 16 MIPS, LIN-capable USI, Internal Calibrated Oscillator	TQFP32, QFN32
ATmega164P	AVR Microcontroller with 16-Kbyte Flash MCU, 1-Kbyte RAM, 512-byte EEPROM, 10-bit ADC, up to 16 MIPS, LIN-capable USI, Internal Calibrated Oscillator	TQFP44, QFN44
ATmega324P	AVR Microcontroller with 32-Kbyte Flash MCU, 2-Kbyte RAM, 1-Kbyte EEPROM, 10-bit ADC, up to 16 MIPS, LIN-capable USI, Internal Calibrated Oscillator	TQFP44, QFN44
ATmega644P	AVR Microcontroller with 64-Kbyte Flash MCU, 4-Kbyte RAM, 2-Kbyte EEPROM, 10-bit ADC, up to 16 MIPS, LIN-capable USI, Internal Calibrated Oscillator	TQFP44, QFN44
Application-specific Microcontroller		
Part Number	**Description**	**Package**
AT90CAN32	AVR Microcontroller with 32-Kbyte Flash MCU, 15 Message Objects CAN Controller, 2-Kbyte RAM, 1-Kbyte EEPROM, 10-bit ADC, TWI, up to 16 MIPS, LIN-capable UART	TQFP64, QFN64
AT90CAN64	AVR Microcontroller with 64-Kbyte Flash MCU, 15 Message Objects CAN Controller, 4-Kbyte RAM, 2-Kbyte EEPROM, 10-bit ADC, TWI, up to 16 MIPS, LIN-capable UART	TQFP64, QFN64
AT90CAN128	AVR Microcontroller with 128-Kbyte Flash MCU, 15 Message Objects CAN Controller, 4-Kbyte RAM, 4-Kbyte EEPROM, 10-bit ADC, 2-Wire Interface (TWI), up to 16 MIPS, LIN-capable UART	TQFP64, QFN64
ATmega32M1	AVR Microcontroller with 32-Kbyte Flash MCU, 2-Kbyte RAM, 1-Kbyte EEPROM, 6 Message Objects CAN Controller, LIN Controller, 10-bit ADC, 10-bit DAC, PSC high performance waveform controller, 64 MHz PLL for fast PWM, up to 16 MIPS	TQFP32, QFN32
ATmega32C1	AVR Microcontroller with 32-Kbyte Flash MCU, 2-Kbyte RAM, 1-Kbyte EEPROM, 6 Message Objects CAN Controller, LIN Controller, 10-bit ADC, 10-bit DAC, 64 MHz PLL for fast PWM, up to 16 MIPS	TQFP32, QFN32

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LIN Tools

Atmel provides various cost-effective support tools to assist in the development of LIN networks. The development boards have been designed to give designers a quick start with the IC and to enable prototyping and testing of new designs. There are a number of placeholders on the board, which offer the designer the chance to modify various parameters. With the SiP development boards, all pins of the AVR and SBC are bonded out, therefore the full range of AVR tools including AVR Studio® and front-end assembler are available for development and debugging. Certified LIN 2.0 and 2.1 protocol stacks from leading suppliers are available for the ATA6612/ATA6613.
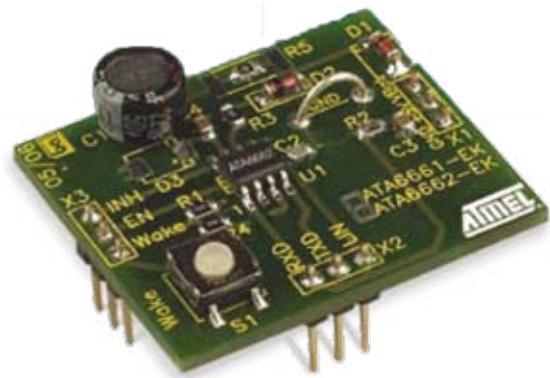
Furthermore, a LIN ANSI C software library is available for LIN slave nodes. ActiveX® components, also provided by Atmel, can be used to create a simple PC-program to emulate the LIN master node. Creating and testing LIN networks is both easy and inexpensive with Atmel's hardware and software tools. The software tools can be downloaded online at http://www.atmel.com/dyn/products/app_notes. asp?family_id=607.

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Ordering Information

Extended Part Number	Package	Remarks
ATA6662-TAQY	SO8	4K, Tape & Reel, Pb-free
ATA6662-EK	—	Development Board
ATA6612P-PLQW	QFN48, 7 mm x 7 mm	8 kB Flash Memory
ATA6612-EK	—	Development Board
ATA6613P-PLQW	QFN48, 7 mm x 7 mm	16 kB Flash Memory
ATA6613-EK	—	Development Board
ATA6622-PGQW	QFN20	3.3V LIN SBC, Pb-free, 6k, Tape & Reel
ATA6622-EK	—	Development Board
ATA6623-TAQY	SO8	3.3V LIN SBC, Pb-free, 4k, Tape & Reel
ATA6623-EK	—	Development Board
ATA6624-PGQW	QFN20	5V LIN SBC, Pb-free, 6k, Tape & Reel
ATA6624-EK	—	Development Board
ATA6625-TAQY	SO8	5V LIN SBC, Pb-free, 4k, Tape & Reel
ATA6625-EK	—	Development Board
ATA6626-PGQW	QFN20	5V LIN SBC without Time-out Timer, Pb-free, 6k, Tape & Reel
ATA6626-EK	—	Development Board

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