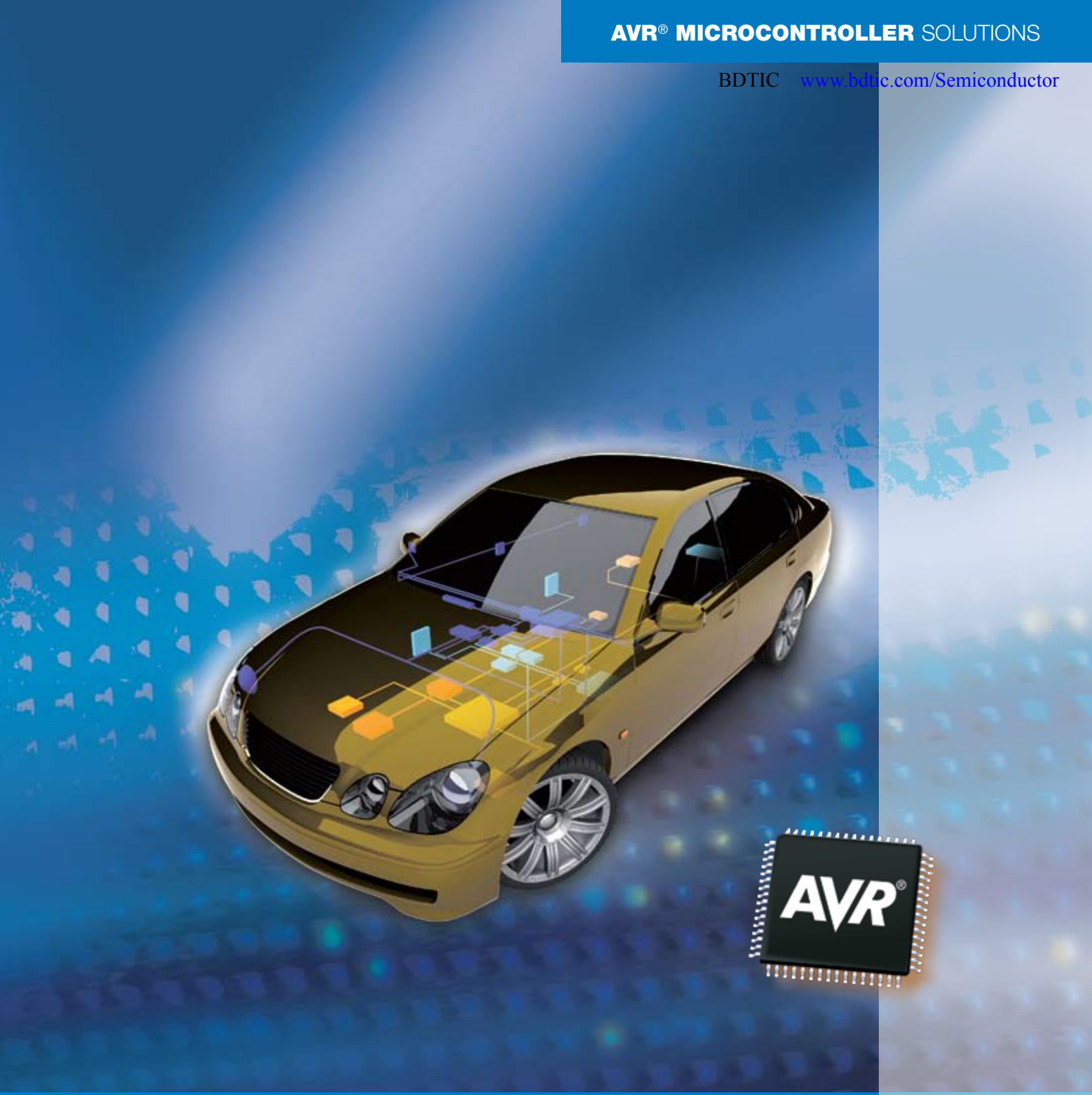


AVR Microcontrollers for Automotive

Scalable Solutions for your Application Needs

ATMEL®

AVR for Automotive Applications
Innovative Microcontroller Solutions

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.

Typical Applications

Infotainment:
Front panel, DVB tuner, Car radio…

Powertrain:
Turbo charger, Fuel pump, Exhaust system, Fan control, BLDC motor control, Battery monitoring, Torque sensor...

Chassis:
Steering column, sensor for stability system, Gyroscope…

Security:
Remote keyless entry, Immobilizer…

Body:
Electronic mirror, Seat control, Window lock, Window and sunroof control with anti-pinch, Capacity touch sensing keypads, CAN & LIN bus interfaces…

AVR Microcontrollers are Qualified to +150°C

Some AVR microcontrollers are qualified for operation up to +150°C ambient temperature (AECQ100 Grade0). Designers can distribute intelligence and control functions directly into or near gearboxes, transfer cases, engine sensors actuators, turbo chargers and exhaust systems.

Automotive AVR available in Grade0 are ATtiny45, ATtiny87/167/327, ATtiny261/461/861, ATmega88/168, ATmega16M1, ATmega32M1, ATmega32C1, ATmega64M1, ATmega64C1.

Atmel automotive AVR microcontrollers are available in four different temperature ranges to serve various applications:

AECQ100 Grade3	T: -40°C to +85°C
AECQ100 Grade2	T1: -40°C to +105°C
AECQ100 Grade1	Z: -40°C to +125°C
AECQ100 Grade0	D, T2: -40°C to +150°C

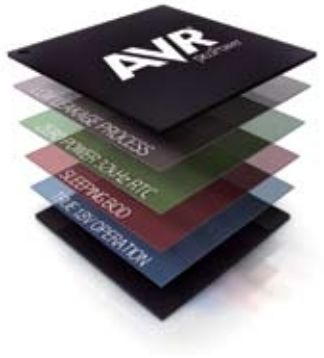
AVR Architecture Benefits

AVR 8-bit RISC Core: High Performance & Low Power Consumption

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.

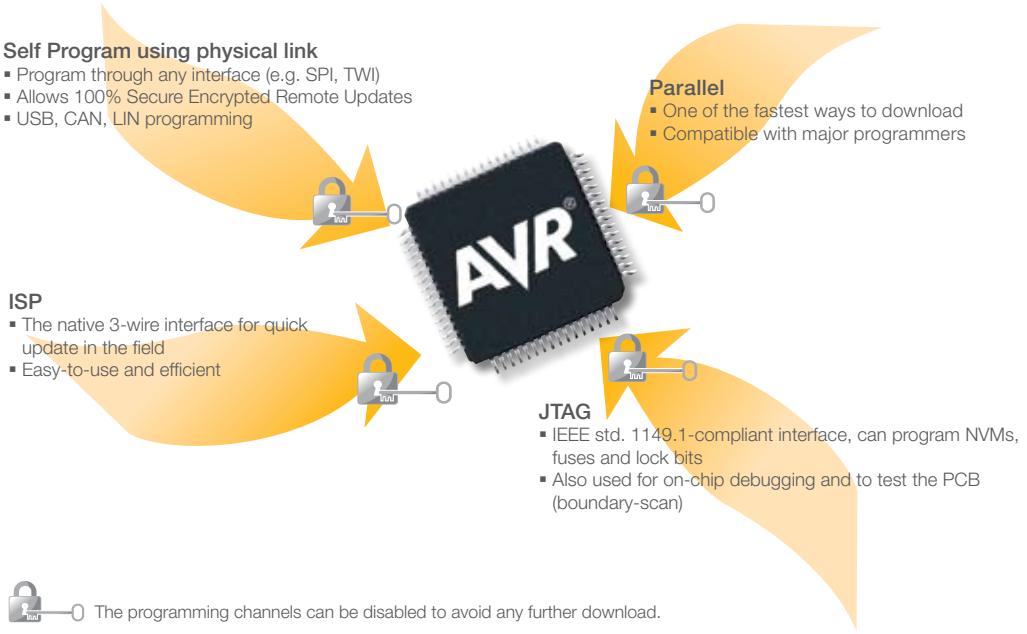
picoPower Family also Automotive Qualified



To meet the low power requirements of modern microcontrollers, Atmel has combined ten years of research and development into the picoPower™ technology for AVR microcontrollers. picoPower enables AVR microcontrollers to achieve the industry's lowest power consumption (100 nA in power-down mode). The picoPower technology incorporates a number of techniques for lower power consumption in sleep and active modes.
Automotive picoPower AVRs are ATmega328P, ATmega164P, ATmega324P, ATmega644P and ATmega169P.

Embedded Flash Technology & Flexible Programming Capabilities

Embedded Flash and EEPROM memories programmed and updated during design, production or maintenance phases eliminate the expensive and time-consuming steps inherent to mask-ROM and OTP microcontrollers. Atmel also offers factory-programmed microcontrollers.



Automotive: A Completely Distributed Architecture

Comfort and safety features are continuously being added to modern vehicles, requiring more embedded computing power. As cost-effective Flash microcontrollers become available, car makers now have the ability to design distributed architectures with scattered and re programmable computing intelligence. This contributes to reduced Electronic Control Unit (ECU) size and cost.

8-bit AVR microcontrollers are perfectly suited for such distributed architectures. They feature on-chip analog interfaces for signal conditioning or programmable I/Os for actuator signaling.
A distributed architecture requires a network to broadcast sensitive information between the ECUs. The most common intelligent networks in a vehicle today are the CAN and LIN In-Vehicle Networks (IVN).

CAN Microcontrollers

Two families of automotive AVR microcontrollers include a CAN controller peripheral: AT90CAN128/64/32 series and ATmega64M1/32M1/16M1, ATmega64C1/32C1 series. They also feature a self programming technology and a comprehensive set of analog and digital peripherals. With 16 Kbytes of Flash to 128 Kbytes of Flash they cover a large range of applications.

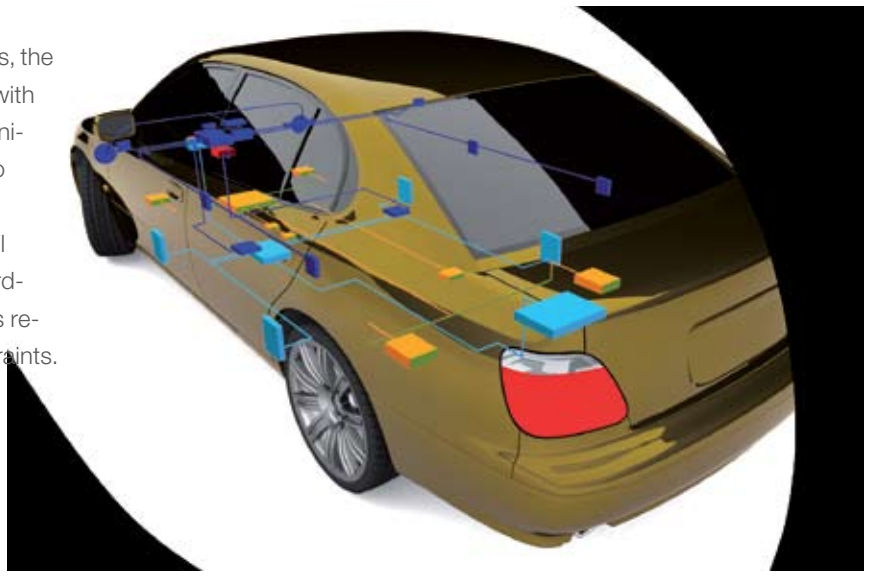
The embedded CAN controller handles the majority of the hardware CAN transport layer tasks. CAN software drivers are available from Vector Informatik® for all AVR CAN Microcontrollers.

LIN Microcontrollers

All automotive mega AVR support a general purpose USART to support LIN master and LIN slave. A stabilized RC oscillator satisfies the LIN slave synchronization requirements. An oscillator with external crystal or resonator is also available for LIN master applications.

LIN2.1 protocol stacks are available from Mentor Graphic® and Vector Informatik for all AVR microcontrollers with general purpose USART or hardware LIN.

For cost sensitive LIN slave applications, the ATtiny327/167/87 family is available with an hardware LIN featuring self synchronization. The same hardware LIN is also available in motor control dedicated AVR ATmega64M1/32M1/16M1 as well as the ATmega64C1/32C1. With hardware LIN the Flash memory footprint is reduced as well as the LIN real time constraints.

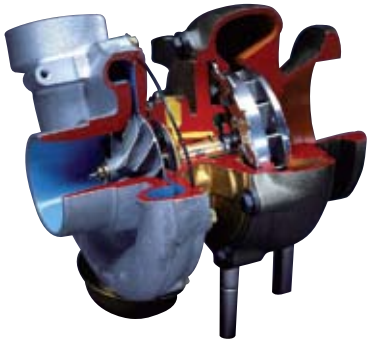


Motor Control Applications

Brushless DC Motor (BLDC) are more and more present in power train, chassis and body applications. Atmel has developed two families of controllers supporting Hall sensor and sensorless applications.

The first family is the ATmega64M1/32M1/16M1 which includes not only a powerful set of analog and digital peripherals optimized for up to six phases BLDC, but also CAN and LIN communication to the ECU.

The second family is the ATtiny861/461/261 including a powerful set of analog and digital peripherals for BLDC. This family supports cost sensitive applications where communication with ECU is done over a simplified I/O system such as PWM command/response.

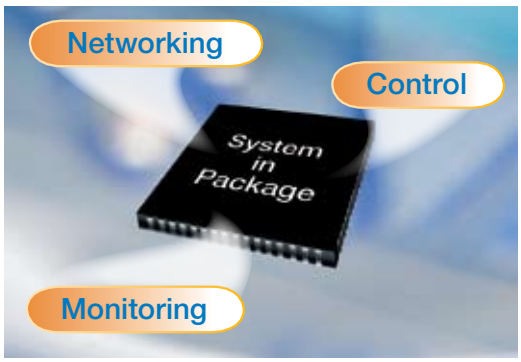


LIN Bus Transceivers

Atmel's modular LIN transceiver family includes simple transceiver ICs (ATA6662) and complex system basis chips (ATA6622/23/24/25/26). All of Atmel's LIN transceivers are compliant with the LIN specification 2.0 and the SAE J2602-2. A combination of voltage regulator and bus transceiver enables the development of simple, yet powerful slave nodes for LIN bus systems. The ATA6622/24/26 also include a window watchdog. The ATA6626, which does not include a time-out feature at the LIN bus, is perfect for systems requiring very slow LIN communication. These devices are designed in Atmel's high-voltage BCD-on-SOI (SMART-I.S®) process. Due to the advantages of the SOI technology, this generation sets new benchmarks for EMI performance. Its ESD protection (8 kV) is best-in-class and helps the design of robust electronic units for the automotive harsh environment. This includes automotive comfort applications, intelligent sensors, or other body electronic applications where low-speed data communication and low costs are a requirement.

LIN & Microcontroller System-in-Package

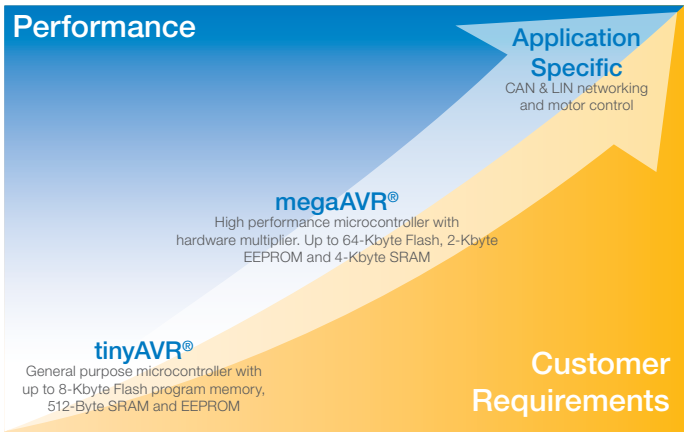
The highest integration level is achieved by Atmel's System-in-Package (SiP) solutions ATA6612/13. With these devices, the die of the ATA6624 LIN system basis chip (SBC) including LIN transceiver, voltage regulator, and watchdog is assembled together with an AVR microcontroller (ATmega88/168) in a single QFN 7 x 7 mm package. With this system-in-package solution, customers can create complete LIN nodes using just one IC. As all pins of the AVR and SBC are bonded out, the full range of AVR tools are available for development.



Automotive Offering

Broad Product Range: Multiplexing & Standard Microcontrollers

The range of devices available to automotive customers covers a variety of needs and will expand rapidly in the future.



CAN & LIN Bus Transceivers

Part Number	Description	Package
LIN Transceivers		
ATA6622	same as ATA6623, with window watchdog	QFN20
ATA6623	LIN system basis chip with LIN transceiver and integrated 3.3V/50 mA voltage regulator	SO8
ATA6624	same as ATA6621, with oustanding EMC performance	QFN20
ATA6625	same as ATA6620, with oustanding EMC performance	SO8
ATA6626	same as ATA6624, with time-out function	QFN20
ATA6662	LIN transceiver with outstanding EMC performance, physical layer conforming to LIN specification 2.0 and SAE J2602-2	SO8
CAN Transceivers		
B10011S	Low-speed CAN Transceiver for high transmission levels, two-wire bus interface, point-to-point interface between trucks and trailers, interface between dashboard and engine, etc.; high reliability, 27V operation, hardware fault recognition	SO16

LIN & Microcontroller System-in-Package (SiP)

SiP combines a LIN Transceiver and a microcontroller in one package.

Part Number	LIN Transceiver	Microcontroller	Package
ATA6612	ATA6624	ATmega88	QFN48
ATA6613	ATA6624	ATmega168	QFN48

Packaging range

AVR Microcontrollers

Product	Flash (KB)	EEPROM (Bytes)	RAM (Bytes)	I/O pins	CAN Mess. Obj.	LIN (b)	UART	USART	USI	SPI	8-bit Timers	12-bit Timers	16-bit Timers	PWM (channel)	10-bits ADC (ch.)	Analog Gain Stage	DebugWIRE/OCD	JTAG/OCD	Vcc Range (V)	Clock Speed (MHz)	Package	Temp. Range (c)
ATtiny24	2	128	128	12					1	1+USI	1		1	4	8	Y	Y		2.7 - 5.5	16	SOIC14, QFN/MLF20	Z
ATtiny25	2	128	128	6					1	1+USI	2			4(d)	4	Y	Y		2.7 - 5.5	16	SOIC8, QFN/MLF20	Z
ATtiny25V	2	128	128	6					1	1+USI	2			4(d)	4	Y	Y		1.8 - 3.6	8	SOIC20, QFN/MLF32 TSSOP20	T
ATtiny261	2	128	128	16					1	1+USI	1		1	5	11	Y	Y		2.7 - 5.5	8	SOIC8, QFN/MLF20	Z, T2
ATtiny44	4	256	256	12					1	1+USI	1		1	4	8	Y	Y		2.7 - 5.5	16	SOIC14, QFN/MLF20	Z
ATtiny44V	4	256	256	12					1	1+USI	1		1	4	8	Y	Y		1.8 - 3.6	16	SOIC14, QFN/MLF20	T
ATtiny45	4	256	256	6					1	1+USI	2			4(d)	4	Y	Y		2.7 - 5.5	16	SOIC8, QFN/MLF20	Z, T2
ATtiny45V	4	256	256	6					1	1+USI	2			4(d)	4	Y	Y		1.8 - 3.6	8	SOIC8	T
ATtiny461	4	256	256	16					1	1+USI	2		1	5	11	Y	Y		2.7 - 5.5	16	SOIC20, QFN/MLF32 TSSOP20	Z, T2
ATtiny84	8	512	512	12					1	1+USI	1		1	4	8	Y	Y		2.7 - 5.5	16	QFN/MLF20	Z
ATtiny85	8	512	512	6					1	1+USI	2			4(d)	4	Y	Y		2.7 - 5.5	16	SOIC8, QFN/MLF20	Z
ATtiny85V	8	512	512	6					1	1+USI	2			4(d)	4	Y	Y		1.8 - 3.6	8	SOIC8	T
ATtiny87	8	512	512	16		H		1	1	1+USI	1		1	4	11	Y	Y		2.7 - 5.5	16	SOIC20, QFN/MLF32 TSSOP20	Z, T2
ATtiny861	8	512	512	16					1	1+USI	1		1	5	11	Y	Y		2.7 - 5.5	16	SOIC20	Z
ATtiny167	16	512	512	16		H		1	1	1+USI	1		1	4	11	Y	Y		2.7 - 5.5	16	SOIC20, QFN/MLF32 TSSOP20	Z, T2
ATtiny327	32	1024	2048	16		H		1	1	1+USI	1		1	4	11	Y	Y		2.7 - 5.5	16	SOIC20, QFN/MLF32 TSSOP20	Z, T2
ATmega48	4	256	512	23		S	1			1+ USART	2		1	6	8		Y		2.7 - 5.5	16	TQFP32, QFN/MLF32	T, T1, Z
ATmega88	8	512	1K	23		S	1			1+ USART	2		1	6	8		Y		2.7 - 5.5	16	TQFP32, QFN/MLF32	T, T1, Z ,T2
ATmega88V	8	512	1K	23		S	1			1+ USART	2		1	6	8		Y		1.8 - 3.6	8	TQFP32, QFN/MLF32	T
ATmega164P	16	512	1K	32		S	2			1+ USART	2		1	6	8	Y		Y	2.7 - 5.5	16	TQFP44, QFN/MLF44	Z
ATmega168	16	512	1K	23		S	1			1+ USART	2		1	6	8		Y		2.7 - 5.5	16	TQFP32, QFN/MLF32	T, T1, Z, D
ATmega169P	16	512	1K	54		S	1		1	1+USI	2		1	4	8			Y	2.7 - 5.5	16	TQFP64, QFN/MLF64	T
ATmega16M1	16	1K	2K	32	6	H		1		1	1	1	1	6+4(d)	11	Y	Y		2.7 - 5.5	16	TQFP32, QFN/MLF32	Z, D
ATmega324P	32	1K	2K	32		S	2			1+ USART	2		1	6	8	Y		Y	2.7 - 5.5	16	TQFP44, QFN/MLF44	Z
ATmega328P	32	1K	2K	32		S	1			1+ USART	2		1	6	8		Y		2.7 - 5.5	16	TQFP44, QFN/MLF44	Z
ATmega32M1	32	2K	2K	32	6	H	1			1	1	1	1	6+4(d)	11	Y	Y		2.7 - 5.5	16	TQFP32, QFN/MLF32	Z, D
ATmega32C1	32	2K	2K	32	6	H	1			1	1		1	4	11	Y	Y		2.7 - 5.5	16	TQFP32, QFN/MLF32	Z, D
ATmega64M1	64	1K	4K	27	6	H		1		1	1	1	1	6+4(d)	11	Y	Y		2.7 - 5.5	16	TQFP32, QFN/MLF32	Z, D
ATmega64C1	64	1K	4K	27	6	H		1		1	1		1	4	11	Y	Y		2.7 - 5.5	16	TQFP32, QFN/MLF32	Z, D
ATmega644P	64	2K	4K	32		S	2			1+ USART	2		1	6	8	Y		Y	2.7 - 5.5	16	TQFP44, QFN/MLF44	Z
AT90CAN32	32	1K	2K	53	15	S	2		1	1	2		2	6+2	8	Y		Y	2.7 - 5.5	16	TQFP64, QFN/MLF64	T, T1, Z
AT90CAN64	64	2K	4K	53	15	S	2		1	1	2		2	6+2	8	Y		Y	2.7 - 5.5	16	TQFP64, QFN/MLF64	T, T1, Z
AT90CAN128	128	4K	4K	53	15	S	2		1	1	2		2	6+2	8	Y		Y	2.7 - 5.5	16	TQFP64, QFN/MLF64	T, T1, Z

a) P: Product in full production, I: Device under introduction
b) S: software ; H: hardware
c) T: -40°C to +85°C, T1: -40°C to +105°C, Z: -40°C to +125°C, T2, D: -40°C to +150°C
d) Two High Frequency, 250kHz, PWM Outputs.

Tool Line Card
Easy & Complete Tool Chain

Integrated Development Environment: AVR Studio®

- Front End for AVR Starter Kits, Programmers and Emulators
- Macro Assembler
- C and Assembly Source Level Debugging
- C-Compiler Interface
- Plug-in for GCC compiler
- AVR Simulator
- Freely available from http://www.atmel.com

Compilers	CodeVision, GCC-AVR, IAR Systems®, ImageCraft®, Rowley
On-chip Debugger	JTAGICE mkII
In-System Programmers	AVRISP mkII, JTAGICE mkII, STK500 + STK501 + STK524
Starter Kits	STK500, STK600
CAN & LIN Driver Libraries	Atmel, OSEK/Vector, Volcano/Mentor, Warwick Control Technologies

Evaluation 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.

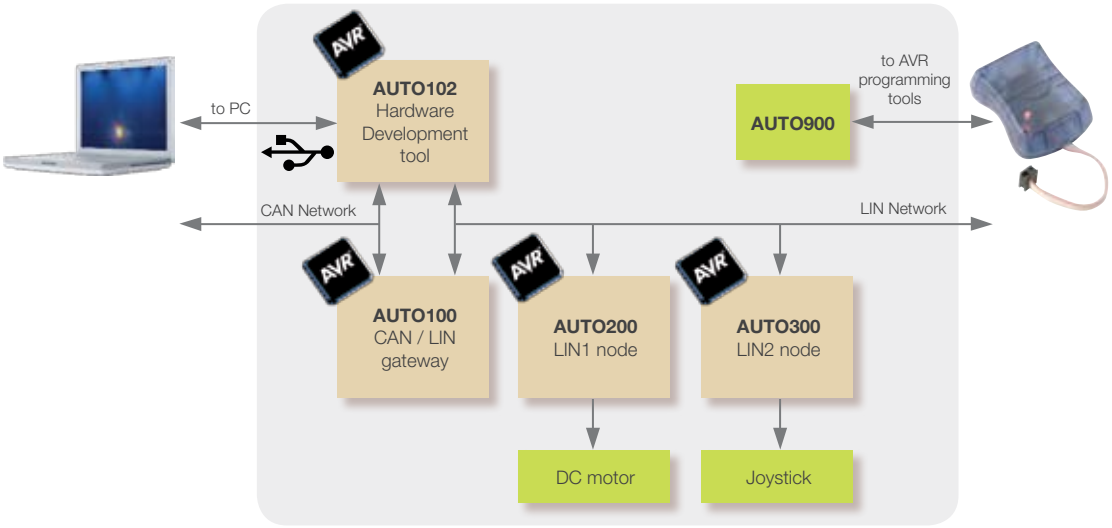
Contents	Description
ATAVRAUTOEK1 evaluation kit	
AUTO102 board	Hardware development tool
AUTO100 board	CAN to LIN gateway without human interface
AUTO200 board	LIN slave node for DC motor control (relay)
AUTO300 board	LIN slave node for joystick control
DC motor	

AUTO100 board

AUTO102 board

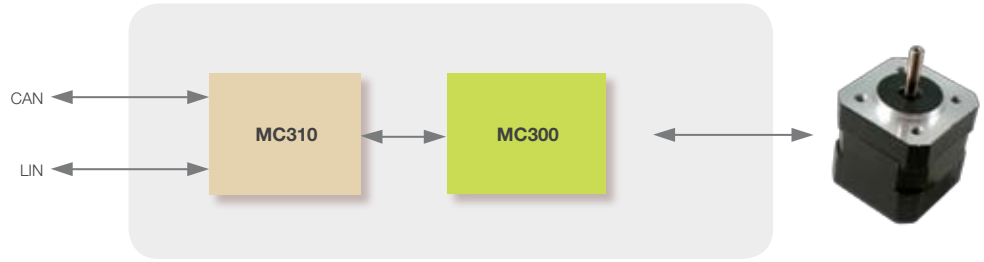
AUTO200 board

AUTO300 board



In association with
Warwick Control Technologies

Contents	Description
MC320 Motor Control Kit for CAN and LIN Applications	
MC300	Power Stage board
MC310	Device Board for ATmega32M1
Motor	BLDC Motor



Hotline avr@atmel.com

Website www.atmel.com/products/avr/auto

Quality : Atmel Fully Committed to Automotive
A historical expertise

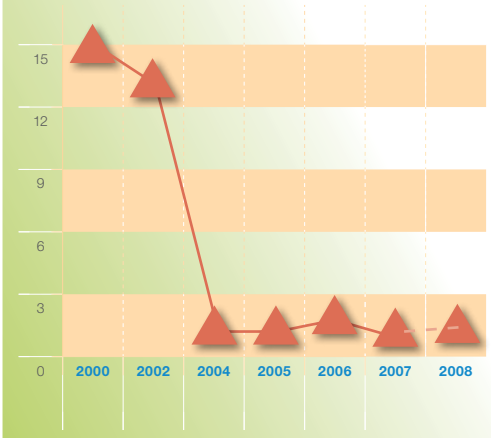
AVR microcontrollers meet the most stringent requirements for ensuring robust functionality in harsh environmental conditions. This is the result of more than 20 years experience in automotive design and a continuous quest for excellence throughout the entire organization. The Quality Management System complies from its inception with the highest level standards, including ISO/TS 16949. As a result, Atmel microcontrollers have been embarked for years worldwide in a variety of vehicle applications, from infotainment to safety functions, as well as multiplexing. This expertise has allowed Atmel to recently introduce a range of "Grade 0" (up to 150°C) microcontrollers capable to withstand the most severe environmental conditions.

Dedicated Resources for Dedicated Methodologies

In the quality domain just like in many others, Automotive is a leader in its field.
Beyond a full product qualification according to AEC-Q100, Atmel has embedded quality in the entire product life cycle from the early design stage until the end of life. This includes usage of particular techniques, tools and methodologies such as identification of Special Characteristics, Failure Modes and Effects Analysis (FMEA), design-to-test techniques, particular screening methodologies such as Part Average Testing (PAT) or Advanced Burn-In (AdBI), process capability optimizing, on-duty support teams and more. These approaches are developed and deployed by a dedicated automotive structure including Marketing, Design, Applications, Product Engineering and Quality and Reliability in-situ facilities.

Step down path to zero PPM

2008 target: 0.5 ppm
(including line + 0 km + field)



Atmel keys for automotive success

- Zero defects is our goal, zero tolerance is our approach
- 100% On-time delivery
- Excellence in development and manufacturing to exceed customer expectations
- Immediate reaction to minimize the impact of any customer issue
- Total commitment by all employees throughout the entire organization

Improving Continuously

The overall Atmel automotive performance is tracked thanks to dedicated automotive metrics, regularly reviewed by the Top Management. This allows an easy identification of opportunities and necessary improvement initiatives.

An Automotive Steering Committee driven by one of the Atmel top executives aims at deploying best automotive practices throughout the company. This has resulted in various improvements likely to develop the Atmel corporate automotive image on the market. Last but not least, Atmel is continuously questioning its qualification and our approache to reach the best reliability performance of its products. This is why Atmel has been playing a key role in some major automotive European funded Programs such as Failure driven Qualification (FdQ) or End of Life Investigation for Automotive System (ELIAS) which are paving the way to future international standards.