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.

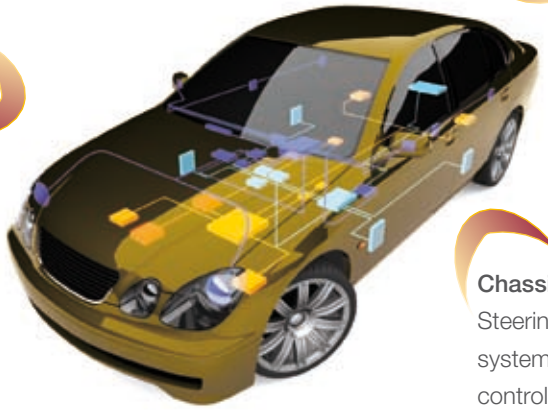
Taking advantage of its unsurpassed experience in embedded Flash memory microcontrollers, with a large number of AVR® devices, Atmel® brings innovative solutions, whether for sensor or actuator control or more-sophisticated networking applications.

These microcontrollers are fully-engineered to fulfill OEMs' quality requirements towards zero defects.

Typical Applications

Infotainment:
Front panel, DVB tuner, Car radio…

Powertrain:
Fuel injection, Turbo compressor for diesel motor, Injection pump, Torque sensor, central Engine Control Unit board, Fan control, BLDC motor control, Battery monitoring, Fuel system…



Chassis:
Steering column sensor for the system stability, Laser distance controller, Digital camera, Gyroscope…

Security:
Remote keyless entry, Immobilizer…

Body:
Keypads, Electronic mirror, Seat controller, CAN & LIN bus interfaces, Window control with anti-pinch, Sensor control…

AVR Microcontrollers are Qualified to +150°C

The ATmega88 and ATtiny45 are the first AVR microcontrollers to be qualified for operation up to +150°C (AECQ100 Grade 0). They withstand automotive temperature extremes, thus allowing designers to distribute intelligence and control functions directly into gearboxes, engine sensors and actuators, transfer cases, turbochargers, while simplify the wiring network.

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

Grade 3	T: -40°C to +85°C
Grade 2	T1: -40°C to +105°C
Grade 1	Z: -40°C to +125°C
Grade 0	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:

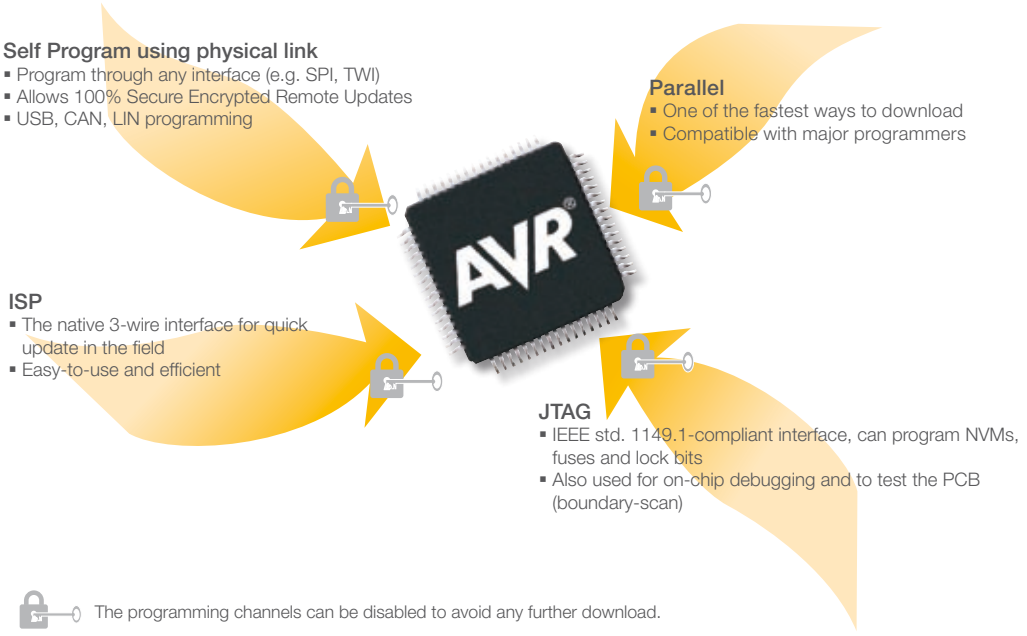
- Highest system integration with a large number of analog and digital peripherals
- Highest 8-bit CPU performance executing powerful instructions in a single clock cycle
- Highest code density with high-level C-language optimization
- Self-programming memory
- Product compatibility for both code and 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.

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 reprogrammable computing intelligence. This contributes to reduced Electronic Control Unit (ECU) size and cost. Features are implemented with an array of sensors and actuators, controlled by one microcontroller, resulting in physical mechatronic elements.

8-bit AVR microcontrollers are perfectly suited for such distributed architectures, because 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).

As network complexity increases, new combinations are possible: various CAN networks interconnect through main ECUs, sub-LIN networks with master and multi-slave configurations (especially in the body domain), or low-level equipment connecting to the high-level CAN networks through gateways.

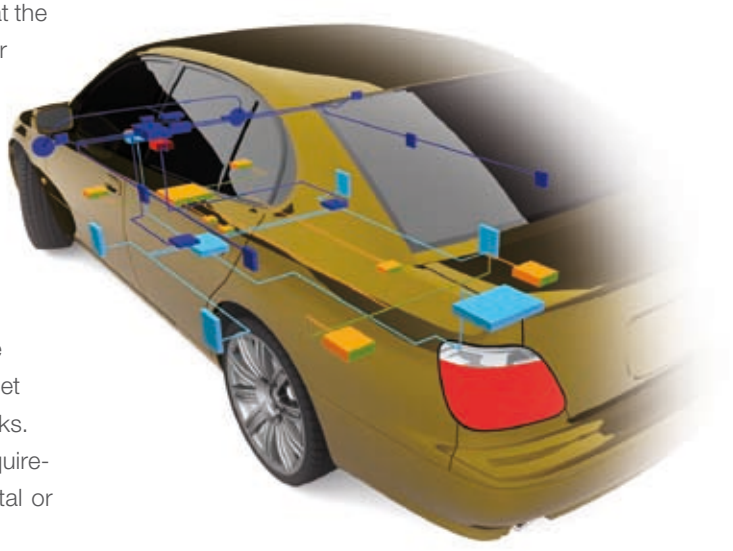
CAN & LIN Microcontrollers

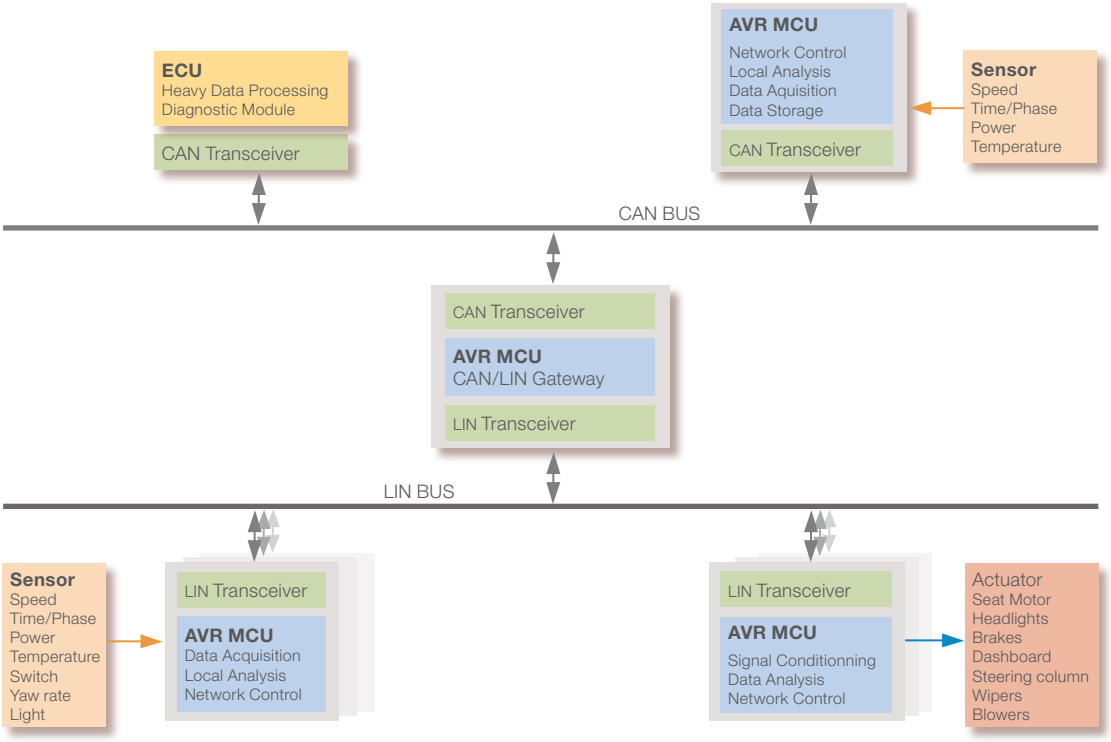
Atmel Automotive AVR microcontrollers support high-speed and low-speed CAN and 1.3 or 2.1 Master/Slave LIN.

The AT90CAN devices feature a self-programming technology with up to 128 Kbytes Flash memory, a comprehensive set of analog and digital peripherals, and a CAN controller which handles the majority of the hardware CAN transport layer tasks, thus reducing the resources needed at the processor level. This leaves computing power available for other applications tasks, and drops the overall system cost.

LIN applications can be developed using the LIN/USART, USART or USI peripherals in all standard Atmel automotive microcontrollers. Chose a tinyAVR® for simple function or megaAVR® for more complex nodes – all are supported by a set of various Atmel or third party software stacks. An internal RC oscillator satisfies the LIN requirements for slave node without external crystal or resonator.

Both CAN and LIN developments are supported by proprietary free of charge hardware and software tools, and also a large series of stacks from OSEK™/Vector, Volcano™/Mentor® or Warwick Control Technologies.



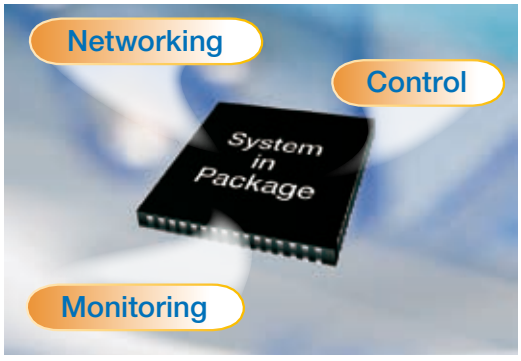


LIN Bus Transceivers

Atmel offers a new LIN transceiver generation, starting with the stand-alone LIN transceiver ATA6662 and the higher integrated LIN system basis chips (SBCs) ATA6623/25, which include a LIN2.0-compliant LIN transceiver and a 3.3V/5V voltage regulator. The extended version ATA6622/24 includes, in addition, an integrated window watchdog. These devices are designed in Atmel's high-voltage BCD-on-SOI (SMARTIS™) 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

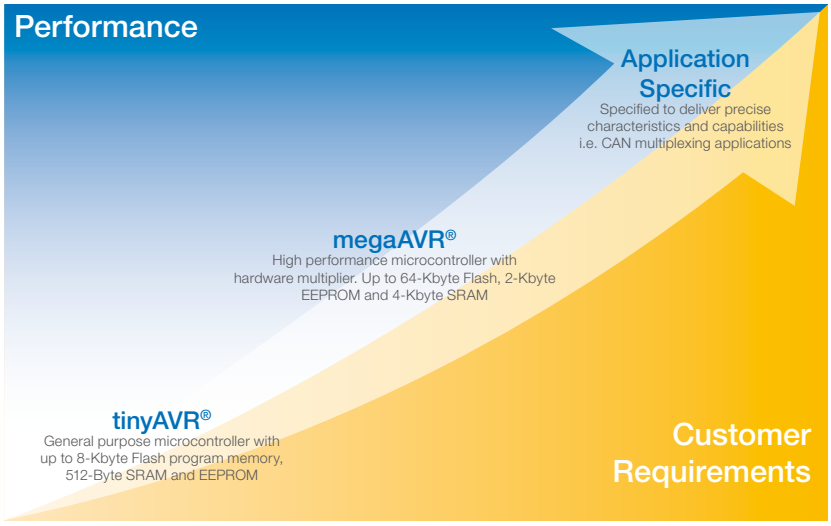
The highest integration level is achieved by System-in-Package (SiP) devices, where the ATA6621/ATA6624's LIN SBC (System Basis Chip) die is assembled together with an AVR microcontroller in a single QFN package. Using these SiP devices, customers can create complete LIN node solutions using only one IC and minimum board space. This reduces not only time-to-market but also total system costs. In addition, customers can use standard AVR development tools for their SiP solutions.



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. Most of them are able to design LIN master or slave applications by using a USART with the addition of a LIN stack.



AVR Microcontrollers

Product	Status a)	Flash (KB)	EEPROM (Bytes)	RAM (Bytes)	I/O pins	CAN Mess. Obj.	LIN (Software)	UART/USART	SPI/TWI by USI	SPI	8-bit Timers	16-bit Timers	PWM (channel)	10-bits ADC	Analog Gain Stage	DebugWIRE/OCD	JTAG/OCD	Vcc Range (V)	Clock Speed (MHz)	Package	Temp. Range b)
tinyAVR																					
ATtiny24	P	2	128	128	12		Y		1	1	1	1	4	8	Y	Y		2.7 - 5.5	16	SOIC14, QFN20	T, T1, Z
ATtiny25	P	2	128	128	6		Y		1	1	2		4	4	Y	Y		2.7 - 5.5	16	SOIC8, QFN20	T, T1, Z
ATtiny25V	P	2	128	128	6		Y		1	1	2		4	4	Y	Y		1.8 - 3.6	8	SOIC8, QFN20	T
ATtiny44	P	4	256	256	12		Y		1	1	1	1	4	8	Y	Y		2.7 - 5.5	16	SOIC14, QFN20	T, T1, Z
ATtiny45	P	4	256	256	6		Y		1	1	2		4	4	Y	Y		2.7 - 5.5	16	SOIC8, QFN20	T, T1, Z, T2
ATtiny45V	P	4	256	256	6		Y		1	1	2		4	4	Y	Y		1.8 - 3.6	8	SOIC8	T
ATtiny84	I	8	512	512	12		Y		1	1	1	1	4	8	Y	Y		2.7 - 5.5	16	QFN20	T, T1, Z
ATtiny85	P	8	512	512	6		Y		1	1	2		4	4	Y	Y		2.7 - 5.5	16	SOIC8	T, T1, Z
megaAVR																					
ATmega48	P	4	256	512	23		Y	1	1	1	2	1	6	8		Y		2.7 - 5.5	16	TQFP32, QFN32	T, T1, Z
ATmega88	P	8	512	1K	23		Y	1	1	1	2	1	6	8		Y		2.7 - 5.5	16	TQFP32, QFN32	T, T1, Z, T2
ATmega88V	P	8	512	1K	23		Y	1	1	1	2	1	6	8		Y		1.8 - 3.6	8	TQFP32, QFN32	T
ATmega168	P	16	512	1K	23		Y	1	1	1	2	1	6	8		Y		2.7 - 5.5	16	TQFP32, QFN32	T, T1, Z
picoPower																					
ATmega164P	P	16	512	1K	32		Y	2		1	2	1	6	8	Y		Y	2.7 - 5.5	16	TQFP44, QFN44	T, T1, Z
ATmega324P	P	32	1K	2K	32		Y	2		1	2	1	6	8	Y		Y	2.7 - 5.5	16	TQFP44, QFN44	T, T1, Z
ATmega644P	P	64	2K	4K	32		Y	1		1	2	1	6	8	Y		Y	2.7 - 5.5	16	TQFP44, QFN44	T, T1, Z
Application specific AVR																					
AT90CAN32	P	32	1K	2K	53	15	Y	2	1	1	2	2	6+2	8	Y		Y	2.7 - 5.5	16	TQFP64, QFN64	T, T1, Z
AT90CAN64	P	64	2K	4K	53	15	Y	2	1	1	2	2	6+2	8	Y		Y	2.7 - 5.5	16	TQFP64, QFN64	T, T1, Z
AT90CAN128	P	128	4K	4K	53	15	Y	2	1	1	2	2	6+2	8	Y		Y	2.7 - 5.5	16	TQFP64, QFN64	T, T1, Z

a) P: Product in full production, I: Device under introduction
b) T: -40°C to +85°C, T1: -40°C to +105°C, Z: -40°C to +125°C, T2: -40°C to +150°C

CAN & LIN Bus Transceivers

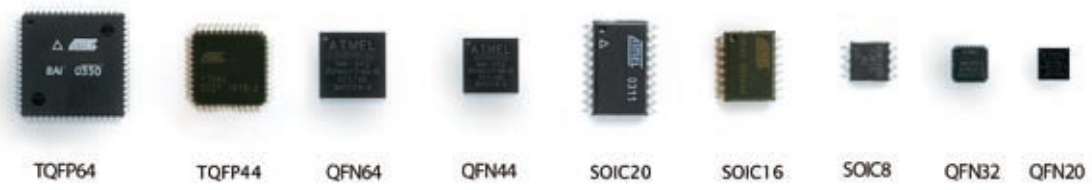
Part Number	Description	Package
LIN Transceivers		
ATA6620	LIN system basis chip with LIN transceiver and integrated 5V/50 mA voltage regulator	SO8
ATA6621	same as ATA6620, with window watchdog	QFN20
ATA6622	same as ATA6623, with window watchdog	QFN20
ATA6623	LIN system basis chip with LIN transceiver 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
ATA6661	LIN transceiver, physical layer conforming to LIN specification 2.0	SO8
ATA6662	LIN transceiver with outstanding EMC performance, physical layer conforming to LIN specification 2.0 and SAE J2602-2	SO8
ATA6663	same as ATA6662, ability to switch-off the master resistor	SO8
ATA6664	same as ATA6663, no time-out function	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
ATA6602	ATA6621	ATmega88	QFN48
ATA6603	ATA6621	ATmega168	QFN48
ATA6612	ATA6624	ATmega88	QFN48
ATA6613	ATA6624	ATmega168	QFN48

Packaging range



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

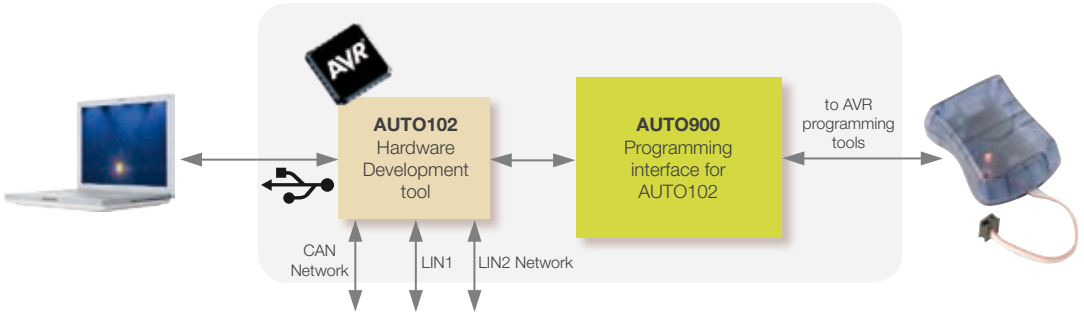
Compilers	CodeVision, GCC-AVR, IAR Systems®, ImageCraft®, Rowley
On-chip Debugger	JTAGICE mkII
In-System Programmers	AVRISP mkII, JTAGICE mkII, STK500 + STK501
Starter Kits	STK500 series, CAN transceiver with ADAPTCAN01, ATDVK90CAN1
CAN & LIN Driver Libraries	Atmel, OSEK/Vector, Volcano/Mentor, Warwick Control Technologies
Configuration Tools & Autocoders	Vector, Mentor, Warwick Control Technologies

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.

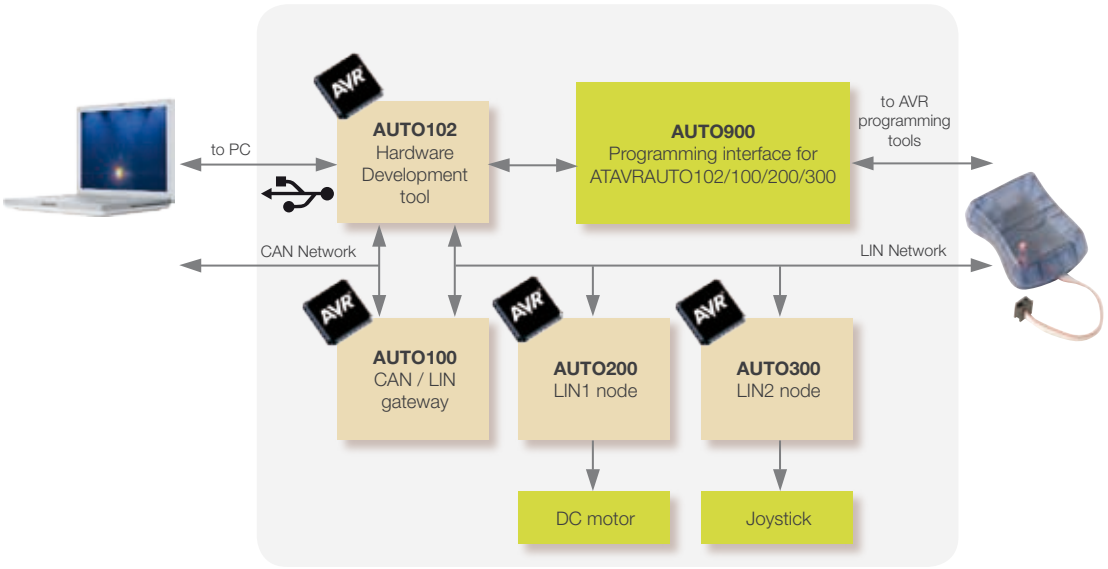
Debugger Kit

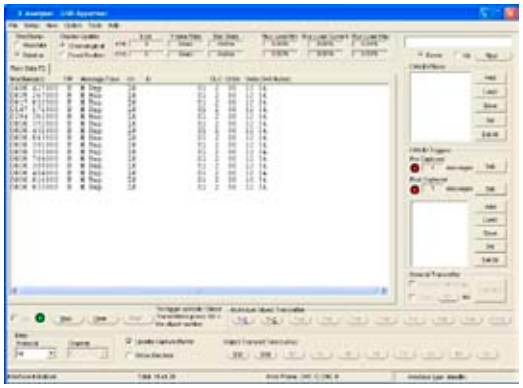
Contents	Description
ATAVRAUTO102 debugger kit	
AUTO102 board	Hardware development tool
AUTO900 board	Programming interface for standard AVR programming tools. This board is a simple adaptor to use standard AVR programming tools as JTAGICEmk II or AVRISP



Evaluation Kit

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
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
DC motor	





In association with
Warwick Control Technologies

Hotline avr@atmel.com

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

Quality : Atmel Fully Committed to Automotive
A historical expertise

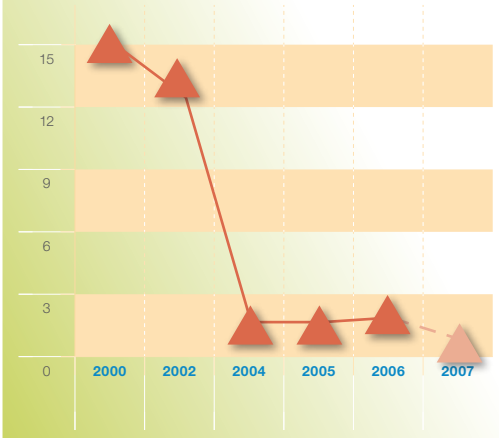
AVR microcontrollers meet the most stringent requirements for ensuring robust functionality in harsh environmental conditions. This is the result of more than 20 years experience in automotive design and a continuous quest for excellence throughout the entire organization. The Quality Management System 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" 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, Failure Analysis & Reliability in-situ facilities and Quality.

Step down path to zero PPM

Goal 2007: 1 ppm
(including line + 0 km + field)



Atmel keys for automotive success

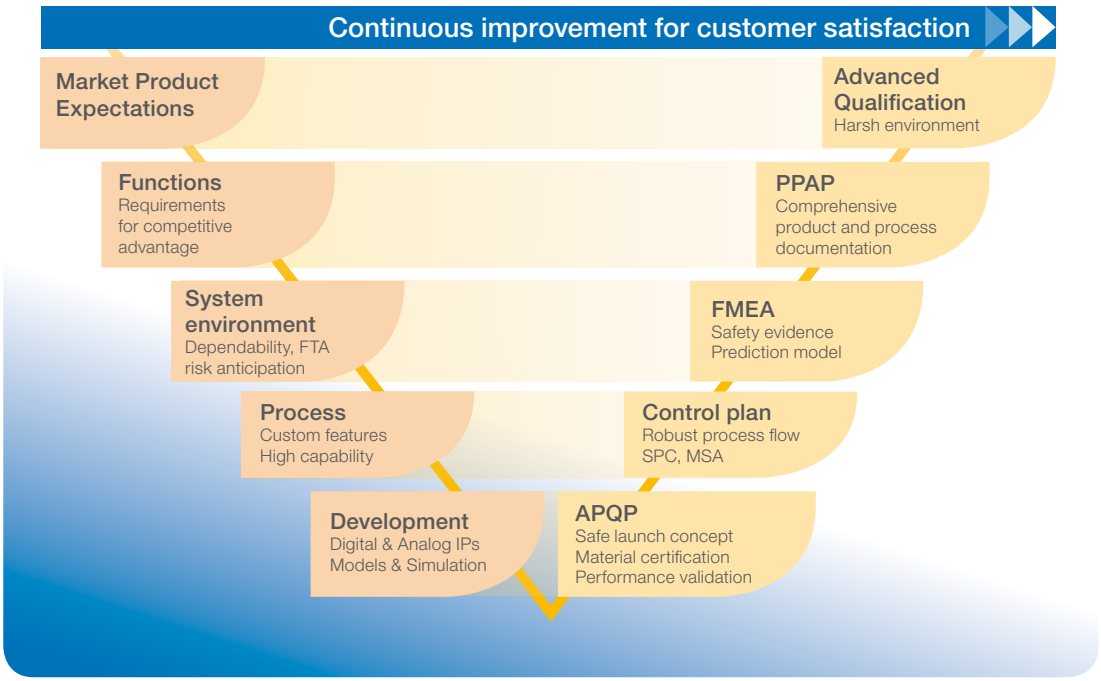
- Zero defects is our goal, zero tolerance is our approach
- 100% On-time delivery
- Excellence in development and manufacturing to exceed customer expectations
- Immediate reaction to minimize the impact of any customer issue
- Total commitment by all employees throughout the entire organization

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 approaches for reaching 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.

New Product Introduction (NPI)



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