

ECE 477 Digital Systems Senior Design Project

Module 1 General Guidelines

Outline

- Lab Notebook Guidelines
- On-Line Documentation Guidelines
- Patent Liability Guidelines
- Microcontroller Selection Guidelines
 - Memory Requirements / Types
 - Development Environment
 - Interfacing / Bus Expansion
- Motherboard Selections Guidelines
- Prerequisite Review Guidelines

Lab Notebooks – *Individual*

- Used to keep track of all observations, modifications, “buggy behavior”, etc., for a product under development
- All observations, modifications, redesigns, comments, notes to yourself, etc., should be documented as they occur, NOT “after the fact”
- Each individual will be required to maintain an on-line lab notebook on their team’s project webpage
- This is NOT a BLOG !!!!

Individual Lab Notebook Entries

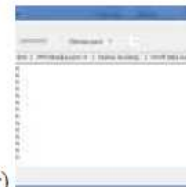
Entries will be done in HTML, but may include scanned sheets and digital pictures as well as links to hardware or software source files - most important thing is to keep it current!

October 24, 2013, 2 hours:

The I2C fuel gauge (MAX17043) was connected to the STM32F4 discovery board and tested. After a few attempts, battery voltage and state-of-charge (SOC) data was retrieved from the Maxim chip. Tests with the Agilent volt meter confirmed that the voltage reading was well within the datasheet's tolerance of 5 mV (0.005 V), but further testing is required to verify that the SOC estimate is correct. Charging and discharging of the battery will need to be performed while the fuel gauge is connected and powered.



(larger)



(larger)

During development of the fuel gauge code, overflow errors occurred on the ITM print return line (SWO) that dropped data after about ten characters set. It was determined that the buffer on the STM32F1 chip inside the ST-LINK v2 programmer was being filled too quickly. After online research, writing a divider value to a poorly-documented asynchronous clock speed register successfully allowed all characters to be sent, so printf() now works over the SWO bus reliably. Further work to get breakpoints working consistently without lock ups is still required.

October 26, 2013, 3 hours:

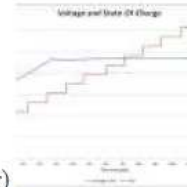
Continued work to exercise the fuel gauge was performed, with the battery charged using a lithium-ion compatible charger at 1 A with the fuel gauge chip continuously monitoring the charge, along with the voltmeter for comparison. Once again, the voltage reading was well within the stated 5 mV tolerance of the actual voltage, a difference likely also influenced by voltage drops across cables. The test setup is shown below:



(larger)



(larger)



(larger)

The chart shown above, a subset of the charging graph (the complete charge sequence with this charger and a 6000 mAh battery about 50% full would take over 4 hours), shows that the chip is magically capable of sensing a slowly increasing state of charge (the state of charge is reported to the nearest percentage point, thus the step on the graph) even though the voltage is essentially constant and no current sense resistor is used. This phenomenon demonstrates that our project can successfully monitor the estimated battery state of charge.

Lab Notebook Evaluation Form

Evaluation:

Component/Criterion	Score	MPY	Points
Level of technical detail – enough detail should be included for others to reproduce your work, and not simply a “blog” (i.e., not be a log of time spent in class or what you ate at a meeting, etc.)	0 1 2 3 4 5	X 3	
Pictures, drawings and diagrams – should be included where appropriate, very large images should be linked (to thumbnails of those images)	0 1 2 3 4 5	X 1	
Update record – daily entries should be made <i>as work is done</i> (not days “after the fact”), and should reflect steady, consistent progress	0 1 2 3 4 5	X 2	
Weekly summaries – weekly summaries should be a concise summary of the major accomplishments for the preceding Sunday – Saturday period	0 1 2 3 4 5	X 1	
Technical Writing Style and Clarity – writing style should be professional and concise as well as employ good grammar, sentence structure, etc. – what you wrote should be readily understandable to one “skilled in the art”	0 1 2 3 4 5	X 3	
		TOTAL	/ 50

Scoring:

5	<i>Excellent – among the very best notebooks completed this semester</i>
4	<i>Good – all requirements were amply satisfied</i>
3	<i>Average – some areas for improvement, but all basic requirements were satisfied</i>
2	<i>Below average – some basic requirements were not satisfied</i>
1	<i>Poor – very few of the requirements were satisfied</i>
0	<i>Unacceptable</i>

Lab Notebook Evaluation

- Level of technical detail
 - Can we reproduce what you did from what is written in your notebook?
 - No “blogs”
- Appropriateness
 - Is the content directly related to the project?
 - No “personal remarks” (what you ate, etc.)
- Pictures, diagrams, etc.
 - Need to aid in understanding work done
 - **Thumbnail** large images to reduce inline image size (generally do not need high-res images for most lab notebook entries)

Lab Notebook Evaluation

- Update Record
 - must be within 2-3 days of actual work
- Weekly summaries
 - 2-3 sentences highlighting main points of week's work
- Technical writing style
 - use 3rd person
 - future employers may see your notebook

On-Line Documentation Guidelines

- In addition to individual lab notebooks, each group should maintain on-line **hardware** and **software** documentation
 - data sheets
 - application notes
 - schematics
 - code listings
- Use a **version control system** (your choice) to manage updates and track changes

Hardware Documentation

- Include text describing changes made to each revision of the schematic
- Include information about test setups and prototyping breadboards
- Include any “debugging notes” or general observations useful to the hardware portion of the team
- Update schematic as you prototype and *prototype as much as possible of your schematic*

Software Documentation

- Include diagnostic routines developed
 - note which SW version they work with
- As part of header of each software module, include complete history of modifications

; Title: *(a descriptive title of this program)*
; Version: *m.n (version number, following specified guidelines)*
; Filename: *(name of file)*
; Author(s): *(person who has written code)*
; Purpose/Function of Program: *(a brief paragraph describing the overall function performed)*
; How Program is Run on Target System: *(include starting address, etc.)*
; Date Started: *(when you first started to write this program)*
; Update History: *(list of changes made since first written, date of each change)*

Patent Liability Guidelines

- **Primary purpose of patent is to protect intellectual property:**

Congress shall have the power . . . to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.

U.S. Constitution - Article 1, Section 8

Patent Liability Guidelines

- **Patent = Right to Exclude**
 - Prevent others from making, using or selling your invention
 - Right to exclude \neq Right to make
 - May not own all required components
 - Need for licensing
 - Patent is *not* needed to manufacture a product
 - Duration = **20 years** from **filing date**

Patent Liability Guidelines

- **Patent requirements:**

- Useful
- Novel
- Non-Obvious

- **Patent contains:**

- Written description
- Drawings/schematics
- Claims

Patent Liability Guidelines

- Applying for a patent requires
 - extensive search of **prior art**
 - protracted negotiation with assigned patent officer
 - patent lawyer
- Many on-line patent search engines are available – see www.freepatentsonline.com or google.com/patents
- The official web site of the U.S. Patent Office is – www.uspto.gov (printed copies of “old” patents available for a small fee)

Patent Liability Guidelines

- Best time to search for possible patent infringement is at **product conception** stage
- If the possibility of infringement exists, either:
 - eliminate **infringing function** from your design
 - modify your design so that the **infringing function** is performed in a “**substantially different way**”
- Types of infringement
 - literal
 - doctrine of equivalents

Literal Infringement

- **Exactly** same function performed **exactly** the same way
- Should be “obvious”
- Either eliminate this function from your design **-or-** obtain license/pay royalty fee to use this function
- Note that “**simply adding additional features**” does **not** eliminate infringement

Doctrine of Equivalents

- **Substantially** same function performed **substantially** the same way
- Hypothetical examples
 - for fastening pieces of wood together, does a **screw** perform “substantially the same function” in “substantially the same way” as a **nail**?
 - for reproducing recorded music, does a **vinyl LP** perform “substantially the same function” in “substantially the same way” as a **CD**?
 - for the purpose of recognizing an access code (PIN) , does **software running on a microcontroller** perform “substantially the same function” in “substantially the same way” as a **state machine realized with discrete flip-flops and gates**?

Doctrine of Equivalents

- Need a clear understanding of mechanism (“way”) – the mechanism is the *function* of interest in analyzing infringement liability under the doctrine of equivalents
 - hypothetical #1: “fastening” is not what is “patented”; rather, the fastening mechanism (ribbing on nail vs. threads on screw)
 - hypothetical #2: “music reproduction” is not what is “patented”; rather, the music reproduction mechanism (needle vibration following molded groove vs. optically reading digital data from pits molded into plastic disc)
 - hypothetical #3: “recognizing an access code” is not what is “patented”; rather, the access code recognition mechanism (software running on a generic embedded microcontroller vs. discrete custom hardware realizing a state machine)

Doctrine of Equivalents

- Stated another way, is the “software” implementation of any function the **equivalent** of a (digital) hardware implementation of that function under the **doctrine of equivalents**?
- Answer: “hard to say” – this is why there are patent lawyers!
- No case to date where software ruled the equivalent of hardware **per se** – but have been cases where functions (“algorithms”) of hardware and software devices ruled as performed in “substantially the same way”

Avoiding Infringement

- **Designing around**
- **Licensing**
 - **Straight license**
 - **Cross-license**
- **Acquiring subject patent**
- **Declaratory judgment action**
- **Ceasing manufacturing**

Microcontroller Selection Guidelines

- Memory requirements/types
 - Beware of hidden liabilities
 - Data acquisition (ADC) buffers
 - Large file storage (mp3)
 - Library routines (floating point emulation, printf)
 - Nonvolatile memory
 - Flash (code, static data)
 - in-circuit programmable?
 - programming “dongle” availability?
 - programming connector requirements?
 - EEPROM (storage of calibration or configuration parameters, history data, control panel settings)
 - granularity of erase/write?
 - software driver availability?

Microcontroller Selection Guidelines

- Volatile memory (SRAM)
 - stack
 - heap
 - I/O buffers
 - run-time variables
 - (generally no executable code except for “specialty functions” like erasing and reprogramming a sector in Flash)
 - note initialization requirements when system boots

Microcontroller Selection Guidelines

- Interfacing/Bus Expansion
 - Number of general purpose I/O pins
 - programmable data direction?
 - programmable pull device?
 - Bus expansion capability
 - multiplexed or simplex external bus?
 - “glue logic” requirements?
- Number/types of integrated peripherals
- **Golden Microcontroller Selection Rule:**
“match” project requirements to μ C capabilities as closely as practicable

Microcontroller Selection Guidelines

- Development environment
 - Useful to have an asynchronous serial port dedicated to debugging
 - Useful to have spare I/O pins dedicated to debugging (e.g., “heartbeat” LED)
 - In-circuit programmable Flash available for quickly downloading and testing code revs (but typically require a “programming dongle” so *be sure to include a header/connector on your PCB*)
 - BDM (background debug mode) *VERY helpful be sure to include a 6-pin BDM header on your PCB if using a Freescale microcontroller*
 - Assembler/Compiler/Linker/Loader/(Simulator)?

Microcontroller Selection Guidelines

- Carefully note **package options** available
 - QFP, SOIC, and SSOP types generally preferable
 - QFN type “doable” (but avoid if possible)
 - watch out for “tabs” on bottom of chip
 - DIP types OK (good for prototyping) but compromise PCB density
 - avoid PGA and BGA
- Price/availability
 - get **at least two more** than you need of every IC
 - now (sooner rather than later)

Package Options (Sample)

**PLASTIC QUAD FLATPACK
(QFP)**



**44-Lead MQFP
"PQ"**

**PLASTIC SHRINK SMALL
OUTLINE (SSOP)**



**20-Lead SSOP
"SS"**



**28-Lead SSOP
"SS"**

**PLASTIC THIN QUAD
FLATPACK (TQFP)**



**44-Lead TQFP
"PT"**



**64-Lead TQFP
"PT"**



**80-Lead TQFP
"PT"**

**PLASTIC THIN SHRINK
SMALL OUTLINE (TSSOP)**



**8-Lead TSSOP
(4.4mm) "ST"**



**14-Lead TSSOP
(4.4mm) "ST"**



**20-Lead TSSOP
(4.4mm) "ST"**

**PLASTIC SMALL OUTLINE
(SOIC)**



**8-Lead SOIC (EIAJ)
(.208") "SM"**



**8-Lead SOIC
(.150") "SN"**



**14-Lead SOIC
(.150") "SL"**



**16-Lead SOIC
(.150") "SL"**



**18-Lead SOIC
"SO"**



**28-Lead SOIC
"SO"**



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Architecture: 8 16 32

Max Speed (MHz): 1 5 10 20 40 80+

Flash (KB): 1 2 4 8 16 32 64 128 256 512

RAM (KB): 0 64 128 256 512 1024+

EEPROM (Bytes): 6 8 14 20 28 44 64 80 100+

Package Pins: 3.0 to 3.6

App. Voltage (V):

Low Power: Low Sleep Fast Wake Active Control XLP

SPI: 1+ 2+ 3+ 4+

I2C: 1+ 2+ 3+ 4+

UART: 1+ 2+ 3+ 4+

Other Comms: USB LIN CAN PSP Ethernet

8 Bit Timers: 1+ 2+ 3+ 4+

16 Bit Timers: 1+ 2+ 3+ 4+

32 Bit Timers: 1+ 2+ 3+ 4+

Real Time Clock: Timer H/W RTCC

PWM Channels: 1+ 2+ 3+ 4+

PWM Resolution (bits): 8+ 10+ 16+

Input Captures: 1+ 2+ 3+ 4+

ADC Channels: 0 4 8 12 16+

ADC Resolutions (bits): 8+ 10+ 12+

Comparators: 1+ 2+ 3+ 4+

Touch Channels: 0 4 8 12 16+

LCD Segments: 0 60 90 120 150 180+

Total Products: 532 To sort, click on the column header

Product Family	Architecture	5K \$ Pricing	Flash (KB)	EEPROM (Bytes)	RAM (KB)	CPU Speed (MHz, MIPS)	LowPower	Comparators	ADC Channels	ADC Bits	Total UART	SPI	I2C	USB	Ethernet	LIN	CAN	Total Timers	Input Capture	PWM Channels	Parallel Port	Segment LCD	Supply Voltage
PIC10F200	8	0.30	0.37	0	0.01	[4,1]	Yes	0	0		0	0	0					1	0	0	0	0	2 to 5.5
PIC10F204	8	0.33	0.37	0	0.01	[4,1]	Yes	1	0		0	0	0					1	0	0	0	0	2 to 5.5
PIC10F202	8	0.33	0.75	0	0.02	[4,1]	Yes	0	0		0	0						1	0	0	0	0	2 to 5.5
PIC10F220	8	0.36	0.37	0	0.01	[8,2]	Yes	2	8		0	0						1	0	0	0	0	2 to 5.5
PIC10F206	8	0.36	0.75	0	0.02	[4,1]	Yes	1	0		0	0						1	0	0	0	0	2 to 5.5
PIC16F54	8	0.39	0.75	0	0.02	[20,5]	Yes	0	0		0	0						1	0	0	0	0	2 to 5.5
PIC10F222	8	0.39	0.75	0	0.02	[8,2]	Yes	2	8		0	0						1	0	0	0	0	2 to 5.5
PIC12F508	8	0.41	0.75	0	0.02	[4,1]	Yes	0	0		0	0						1	0	0	0	0	2 to 5.5
PIC12F509	8	0.45	1.5	0	0.04	[4,1]	Yes	0	0		0	0						1	0	0	0	0	2 to 5.5
PIC16F505	8	0.48	1.5	0	0.07	[20,5]	Yes	0	0		0	0						1	0	0	0	0	2 to 5.5
PIC12F519	8	0.49	1.5	64	0.04	[8,2]	Yes	0	0		0	0						1	0	0	0	0	2 to 5.5
PIC12F510	8	0.49	1.5	0	0.03	[8,2]	Yes	1	3	8	0	0						1	0	0	0	0	2 to 5.5
PIC16F506	8	0.52	1.5	0	0.06	[20,5]	Yes	2	3	8	0	0						1	0	0	0	0	2 to 5.5
PIC12F609	8	0.52	1.75	0	0.06	[20,5]	Yes	1	0		0	0						2	0	0	0	0	2 to 15
PIC16F57	8	0.52	3	0	0.07	[20,5]	Yes	0	0		0	0						1	0	0	0	0	2 to 5.5
PIC12F615	8	0.55	1.75	0	0.06	[20,5]	Yes	1	4	10	0	0						3	1	1	0	0	2 to 15
PIC16F526	8	0.55	1.5	64	0.06	[20,5]	Yes	2	3	8	0	0						1	0	0	0	0	2 to 5.5
PIC12F617	8	0.59	3.5	0	0.13	[20,5]	Yes	1	4	10	0	0						3	1	1	0	0	2 to 5.5
PIC16F610	8	0.59	1.75	0	0.06	[20,5]	Yes	2	0		0	0						2	0	0	0	0	2 to 15
PIC16F616	8	0.69	3.5	0	0.13	[20,5]	Yes	2	8	10	0	0						3	1	1	0	0	2 to 15
PIC12F629	8	0.70	1.75	128	0.06	[20,5]	Yes	1	0		0	0						2	0	0	0	0	2 to 5.5

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Comparators: 1+ 2+ 3+ 4+

Touch Channels: 0 4 8 12 16+

LCD Segments: 0 60 90 120 150 180+

Total Products: 22 To sort, click on the column header

Product Family	Architecture	SK \$ Pricing	Flash (KB)	EEPROM (Bytes)	RAM (KB)	CPU Speed (MHz, MIPS)	LowPower	Comparators	ADC Channels	ADC Bits	Total UART	SPI	I2C	USB	Ethernet	LIN	CAN	Total Timers	Input Capture	PWM Channels	Parallel Port	Segment LCD	Supply Voltage
PIC24FJ64GB1	16	3.57	64	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ128GB	16	3.81	128	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ64GB1	16	3.84	64	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ192GB	16	4.02	192	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ64GB1	16	4.05	64	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ128GB	16	4.07	128	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ256GB	16	4.23	256	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ128GB	16	4.28	128	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ192GB	16	4.28	192	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ128GB	16	4.30	128	0	96.0	[32,16]		3	16	10	4	3	3	Devi	Yes			5	18	18	EPMP	0	2.2 to 3.6
PIC24FJ128DA	16	4.34	128	0	24.0	[32,16]		3	16	10	4	3	3	Devi	Yes			5	18	18		0	2.2 to 3.6
PIC24FJ192GB	16	4.49	192	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ256GB	16	4.49	256	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ256GB	16	4.65	256	0	96.0	[32,16]		3	16	10	4	3	3	Devi	Yes			5	17	17	EPMP	0	2.2 to 3.6
PIC24FJ256DA	16	4.69	256	0	24.0	[32,16]		3	16	10	4	3	3	Devi	Yes			5	18	18		0	2.2 to 3.6
PIC24FJ256GB	16	4.70	256	0	16.0	[32,16]	Yes	3	16	10	4	3	3	Devi	Yes			5	18	18	PMP	0	2 to 3.6
PIC24FJ128GB	16	4.79	128	0	96.0	[32,16]		3	24	10	4	3	3	Devi	Yes			5	18	18	EPMP	0	2.2 to 3.6
PIC24FJ128DA	16	4.83	128	0	24.0	[32,16]		3	24	10	4	3	3	Devi	Yes			5	18	18	EPMP	0	2.2 to 3.6
PIC24FJ256DA	16	5.11	256	0	96.0	[32,16]		3	16	10	4	3	3	Devi	Yes			5	18	18		0	2.2 to 3.6
PIC24FJ256GB	16	5.14	256	0	96.0	[32,16]		3	24	10	4	3	3	Devi	Yes			5	18	18	EPMP	0	2.2 to 3.6
PIC24FJ256DA	16	5.18	256	0	24.0	[32,16]		3	24	10	4	3	3	Devi	Yes			5	18	18	EPMP	0	2.2 to 3.6

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AVR 8-, 32-bit ARM-based Wireless 8051

8- and 32-bit low power, high performance MCU



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AVR

Atmel® offers both 8-bit and 32-bit AVR flash microcontrollers.

AVR combines the most code-efficient architecture for C and assembly programming with the ability to tune system parameters throughout the entire life cycle of your key products. No other microcontrollers deliver more computing performance at a lower power consumption. Combined with industry leading development tools and design support, you get to market faster. And once there, you can easily and cost-effectively refine and improve your product offering.

It's simple: AVR works across the entire range of applications you're working on, or want to work on.

32-bit AVR UC3

The 32-bit AVR UC3 product family is built on the high-performance 32-bit AVR architecture and optimized for highly integrated applications. The 32-bit AVR UC3 microcontrollers deliver high computational throughput, deterministic real-time control, low power consumption, low system cost, high reliability and ease of use. The 32-bit AVR CPU includes cutting-edge features such as integer and fixed point DSP arithmetic, single-cycle multiply and accumulate instructions, and single-cycle SRAM access. The peripheral DMA controller and multi-layer high-speed bus architecture make the UC3 core ideal for high throughput applications. UC3 devices are perfectly suited for portable and battery-powered applications due to their outstanding low power properties. UC3 will be offering a new series of devices with Floating Point Unit (FPU) which improves processing performance by allowing the MCU to perform arithmetic calculations on decimal numbers in fewer clock cycles with higher precision and wider dynamic range. [Read more.](#)



8/16-bit AVR XMEGA

The AVR XMEGA delivers a leading combination of system performance and low-power features. With a Peripheral DMA controller, an innovative Peripheral Event System, crypto engine, and high-speed ADC and DAC, AVR XMEGA pushes the boundaries for high-performance 8/16-bit MCUs.

All AVR XMEGA devices are compatible with tinyAVR and megaAVR devices. Within the XMEGA family, devices are 100% code compatible across all devices from the smallest to the largest. This makes it possible to develop with any XMEGA device, and switch to any other XMEGA device later without having to change any code. This allows multi-project development teams to keep and maintain only one code base and use and re-use this across multiple projects. The result is much faster development and prototyping cycles. [Read more.](#)



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AVR Solutions

32-bit AVR UC3

Automotive AVR

Battery Management AVR

megaAVR

tinyAVR

XMEGA

32-bit AVR UC3

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Devices	AVR Core	Hardware Multiplier	DSP Instructions	FPU MPU/Flash Vault	HW Touch Support	Flash (Kbytes)	Boot Code (Bytes)	ISP	Self Program Memory	SRAM (Bytes)	Debug	RTC w/Osc.	16-bit Timers	Input Capture Block/Channels	Max QTouch/QMatrix Channels	PWM Channels	Enhanced PWM	Ethernet MAC 10/100	USB	Sync Serial Controller (125)	SPI	TWI	USART	I2C Support/ISO7816	LIN	10-bit A/D Single-Ended Channels	12-bit A/D Single-Ended Channels	Analog Comparator	12-bit D/A Channels or 16-bit Audio DAC	Temp. Sensor	D Sensor Cha	
AT32UC3A0128	32-bit	Yes	yes	no	yes/no	no	128	included	Yes	yes	32K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	1	LS/FS device + OTG	yes	2 + 4	USART 1	4	Yes/Yes	0	8	0	0	2x 16-bit	no	1
AT32UC3A0256	32-bit	Yes	yes	no	yes/no	no	256	included	Yes	yes	64K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	1	LS/FS device + OTG	yes	2 + 4	USART 1	4	Yes/Yes	0	8	0	0	2x 16-bit	no	1
AT32UC3A0512	32-bit	Yes	yes	no	yes/no	no	512	included	Yes	yes	64K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	1	LS/FS device + OTG	yes	2 + 4	USART 1	4	Yes/Yes	0	8	0	0	2x 16-bit	no	1
AT32UC3A1128	32-bit	Yes	yes	no	yes/no	no	128	included	Yes	yes	32K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	1	LS/FS device + OTG	yes	2 + 4	USART 1	4	Yes/Yes	0	8	0	0	2x 16-bit	no	1
AT32UC3A1256	32-bit	Yes	yes	no	yes/no	no	256	included	Yes	yes	64K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	1	LS/FS device + OTG	yes	2 + 4	USART 1	4	Yes/Yes	0	8	0	0	2x 16-bit	no	1
AT32UC3A1512	32-bit	Yes	yes	no	yes/no	no	512	included	Yes	yes	64K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	1	LS/FS device + OTG	yes	2 + 4	USART 1	4	Yes/Yes	0	8	0	0	2x 16-bit	no	1
AT32UC3A3128	32-bit	Yes	yes	no	yes/no	no	128	included	Yes	yes	128K	JTAG/Nexus	yes	6	12/12	32/-	12	no	no	Hi-Speed device + OTG	yes	2 + 4	USART 2	4	Yes/Yes 4 (UART)	8	0	0	0	2x 16-bit	no	1
AT32UC3A3256	32-bit	Yes	yes	no	yes/no	no	256	included	Yes	yes	128K	JTAG/Nexus	yes	6	12/12	32/-	12	no	no	Hi-Speed device + OTG	yes	2 + 4	USART 2	4	Yes/Yes 4 (UART)	8	0	0	0	2x 16-bit	no	1
AT32UC3A3256S	32-bit	Yes	yes	no	yes/no	no	256	included	Yes	yes	128K	JTAG/Nexus	yes	6	12/12	32/-	12	no	no	Hi-Speed device + OTG	yes	2 + 4	USART 2	4	Yes/Yes 4 (UART)	8	0	0	0	2x 16-bit	no	1
AT32UC3A364	32-bit	Yes	yes	no	yes/no	no	64	included	Yes	yes	128K	JTAG/Nexus	yes	6	12/12	32/-	12	no	no	Hi-Speed device + OTG	yes	2 + 4	USART 2	4	Yes/Yes 4 (UART)	8	0	0	0	2x 16-bit	no	1
AT32UC3A364S	32-bit	Yes	yes	no	yes/no	no	64	included	Yes	yes	128K	JTAG/Nexus	yes	6	12/12	32/-	12	no	no	Hi-Speed device + OTG	yes	2 + 4	USART 2	4	Yes/Yes 4 (UART)	8	0	0	0	2x 16-bit	no	1
AT32UC3B0128	32-bit	Yes	yes	no	yes/no	no	128	included	Yes	yes	32K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	no	LS/FS device + OTG	yes	1 + 3	USART 1	3	Yes/Yes	0	8	0	0	0	no	
AT32UC3B0256	32-bit	Yes	yes	no	yes/no	no	256	included	Yes	yes	32K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	no	LS/FS device + OTG	yes	1 + 3	USART 1	3	Yes/Yes	0	8	0	0	0	no	
AT32UC3B0512	32-bit	Yes	yes	no	yes/no	no	512	included	Yes	yes	96K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	no	LS/FS device + OTG	yes	1 + 3	USART 1	3	Yes/Yes	0	8	0	0	2x 16-bit	no	
AT32UC3B064	32-bit	Yes	yes	no	yes/no	no	64	included	Yes	yes	16K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	no	LS/FS device + OTG	yes	1 + 3	USART 1	3	Yes/Yes	0	8	0	0	0	no	
AT32UC3B1128	32-bit	Yes	yes	no	yes/no	no	128	included	Yes	yes	32K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	no	LS/FS device	no	1 + 2	USART 1	2	Yes/Yes	0	6	0	0	0	no	
AT32UC3B1256	32-bit	Yes	yes	no	yes/no	no	256	included	Yes	yes	32K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	no	LS/FS device	no	1 + 2	USART 1	2	Yes/Yes	0	6	0	0	0	no	
AT32UC3B1512	32-bit	Yes	yes	no	yes/no	no	512	included	Yes	yes	96K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	no	LS/FS device	no	1 + 2	USART 1	2	Yes/Yes	0	6	0	0	2x 16-bit	no	
AT32UC3B164	32-bit	Yes	yes	no	yes/no	no	64	included	Yes	yes	16K	JTAG/Nexus	yes	10	6/6	32/-	13	yes	no	LS/FS device	no	1 + 2	USART 1	2	Yes/Yes	0	6	0	0	0	no	
AT32UC3C0128C	32-bit	yes	yes	yes	yes/yes	no	128	included	yes	yes	36K	JTAG/Nexus/AwI2C	yes, AST	6	12/12	-/-	16	yes	1	FS device + LS/FS OTG	yes	2 + 5	USART 3	5	yes/yes 5 (UART)	0	16	4	4x 12-bit	no	1	
AT32UC3C0256C	32-bit	yes	yes	yes	yes/yes	no	256	included	yes	yes	68K	JTAG/Nexus/AwI2C	yes, AST	6	12/12	-/-	16	yes	1	FS device + LS/FS OTG	yes	2 + 5	USART 3	5	yes/yes 5 (UART)	0	16	4	4x 12-bit	no	1	
AT32UC3C0512C	32-bit	yes	yes	yes	yes/yes	no	512	included	yes	yes	68K	JTAG/Nexus/AwI2C	yes, AST	6	12/12	-/-	16	yes	1	FS device + LS/FS OTG	yes	2 + 5	USART 3	5	yes/yes 5 (UART)	0	16	4	4x 12-bit	no	1	
AT32UC3C064C	32-bit	yes	yes	yes	yes/yes	no	64	included	yes	yes	20K	JTAG/Nexus/AwI2C	yes, AST	6	12/12	-/-	16	yes	1	FS device + LS/FS OTG	yes	2 + 5	USART 3	5	yes/yes 5 (UART)	0	16	4	4x 12-bit	no	1	
AT32UC3C1128C	32-bit	yes	yes	yes	yes/yes	no	128	included	yes	yes	36K	JTAG/Nexus/AwI2C	yes, AST	6	12/12	-/-	16	yes	1	FS device + LS/FS OTG	yes	2 + 5	USART 3	5	yes/yes 5 (UART)	0	16	4	4x 12-bit	no	1	
AT32UC3C1256C	32-bit	yes	yes	yes	yes/yes	no	256	included	yes	yes	68K	JTAG/Nexus/AwI2C	yes, AST	6	12/12	-/-	16	yes	1	FS device + LS/FS OTG	yes	2 + 5	USART 3	5	yes/yes 5 (UART)	0	16	4	4x 12-bit	no	1	
AT32UC3C1512C	32-bit	yes	yes	yes	yes/yes	no	512	included	yes	yes	68K	JTAG/Nexus/AwI2C	yes, AST	6	12/12	-/-	16	yes	1	FS device + LS/FS OTG	yes	2 + 5	USART 3	5	yes/yes 5 (UART)	0	16	4	4x 12-bit	no	1	
AT32UC3C164C	32-bit	yes	yes	yes	yes/yes	no	64	included	yes	yes	20K	JTAG/Nexus/AwI2C	yes, AST	6	12/12	-/-	16	yes	1	FS device + LS/FS OTG	yes	2 + 5	USART 3	5	yes/yes 5 (UART)	0	16	4	4x 12-bit	no	1	
AT32UC3C2126C	32-bit	yes	yes	yes	yes/yes	no	128	included	yes	yes	36K	JTAG/Nexus/AwI2C	yes, AST	3	6/6	-/-	10	yes	1	FS device + LS/FS OTG	yes	1 + 4	USART 2	4	yes/yes 4 (UART)	0	11	2	2x 12-bit	no	1	
AT32UC3C2256C	32-bit	yes	yes	yes	yes/yes	no	256	included	yes	yes	68K	JTAG/Nexus/AwI2C	yes, AST	3	6/6	-/-	10	yes	1	FS device + LS/FS OTG	yes	1 + 4	USART 2	4	yes/yes 4 (UART)	0	11	2	2x 12-bit	no	1	
AT32UC3C2512C	32-bit	yes	yes	yes	yes/yes	no	512	included	yes	yes	68K	JTAG/Nexus/AwI2C	yes, AST	3	6/6	-/-	10	yes	1	FS device + LS/FS OTG	yes	1 + 4	USART 2	4	yes/yes 4 (UART)	0	11	2	2x 12-bit	no	1	
AT32UC3C264C	32-bit	yes	yes	yes	yes/yes	no	64	included	yes	yes	20K	JTAG/Nexus/AwI2C	yes, AST	3	6/6	-/-	10	yes	1	FS device + LS/FS OTG	yes	1 + 4	USART 2	4	yes/yes 4 (UART)	0	11	2	2x 12-bit	no	1	
AT32UC3C016	32-bit	Yes	yes	no	yes/yes	yes	16	included	Yes	yes	8K	JTAG/Nexus/AwI2C	yes, AST	6	12/12	17/136	35	no	no	0	no	1 + 4	USART 2	4	no/no 4 (UART)	0	8	8	0	yes	1	
AT32UC3C032	32-bit	Yes	yes	no	yes/yes	yes	32	included	Yes	yes	16K	JTAG/Nexus/AwI2C	yes, AST	6	12/12	17/136	35	no	no	0	no	1 + 4	USART 2	4	no/no 4 (UART)	0	8	8	0	yes	1	
AT32UC3C064	32-bit	Yes	yes	no	yes/yes	yes	64	included	Yes	yes	16K	JTAG/Nexus/AwI2C	yes, AST	6	12/12	17/136	35	no	no	0	no	1 + 4	USART 2	4	no/no 4 (UART)	0	8	8	0	yes	1	

Automotive AVR

Click on Down/Up arrows to sort. Download to Excel.

Devices	AVR Core	Hardware Multiplier	Flash (Kbytes)	Boot Code (Bytes)	ISP	Self Program Memory	EEPROM (Bytes)	SRAM (Bytes)	Debug	RTC w/Osc.	8-bit Timers	16-bit Timers	Input Capture Block/Channels	Max QTouch/QMatrix Channels	PWM Channels	Enhanced PWM	SPI	TWI	USART	CAN LIN	10-bit A/D Single-Ended Channels	Analog Comparator	
AT90CAN128 Automotive	8-bit	yes	128	included	yes	yes	4K	4K	JTAG	yes	2	2	2/3	16/64	7	no	1	1	2	1	0	8	1

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Battery Management AVR

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Devices	AVR Core	Hardware Multiplier	Flash (Kbytes)	Boot Code (Bytes)	ISP Self Program Memory (Bytes)	EEPROM (Bytes)	SRAM (Bytes)	Debug	RTC w/Osc.	8-bit Timers	16-bit Timers	Input Capture Block/Channels	Max QTouch/QMatrix Channels	PWM Channels	Enhanced PWM	USB	SPI	TWI	USART	CAN LIN	10-bit A/D Single-Ended Channels	Analog Comparator	10-bit D/A Channels	Temp Sensor
ATmega406	8-bit	yes	40	included	yes	yes	512	2K	JTAG	yes	1	1	0/0	8/-	2	0	1	10 + CC	yes	23				
ATmega16HVA	8-bit	yes	16	included	yes	yes	256	512	DebugWire	no	no	2	2/4	3/-	0	1	0	5 + CC	yes	21				
ATmega8HVA	8-bit	yes	8	included	yes	yes	256	512	DebugWire	no	no	2	2/4	3/-	0	yes	0	5 + CC	yes	21				
ATmega16HVB	8-bit	yes	16	included	yes	yes	512	1K	DebugWire	no	no	2	2/4	8/-	0	1	1	7 + CC	yes	29				
ATmega32HVB	8-bit	yes	32	included	Yes	Yes	1K	2K	DebugWire	no	no	2	2/4	8/-	0	1	1	7 + CC	yes	29				

megaAVR

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Devices	AVR Core	Hardware Multiplier	Flash (Kbytes)	Boot Code (Bytes)	ISP Self Program Memory (Bytes)	EEPROM (Bytes)	SRAM (Bytes)	Debug	RTC w/Osc.	8-bit Timers	16-bit Timers	Input Capture Block/Channels	Max QTouch/QMatrix Channels	PWM Channels	Enhanced PWM	USB	SPI	TWI	USART	CAN LIN	10-bit A/D Single-Ended Channels	Analog Comparator	10-bit D/A Channels	Temp Sensor		
ATmega8	8-bit	Yes	8	included	Yes	Yes	512	1K	no	Yes	2	1	1/2	12/-	3	no	0	1	1	0	0	8	1	0	no	
ATmega8515	8-bit	Yes	8	included	Yes	Yes	512	512	no	no	1	1	1/2	16/-	3	no	0	1	0	1	0	0	0	0	no	
ATmega8535	8-bit	Yes	8	included	Yes	Yes	512	512	no	Yes	2	1	1/2	16/16	3	no	0	1	1	1	0	0	8	1	0	no
ATmega16	8-bit	Yes	16	included	Yes	Yes	512	1K	JTAG	Yes	2	1	1/2	16/32	4	no	0	1	1	1	0	0	8	1	0	no
ATmega32	8-bit	Yes	32	included	Yes	Yes	1K	2K	JTAG	Yes	2	1	1/2	16/-	4	no	0	1	1	1	0	0	8	1	0	no
ATmega64	8-bit	Yes	64	included	Yes	Yes	2K	4K	JTAG	Yes	2	2	1/2	16/-	7	no	0	1	1	2	0	0	8	1	0	no
ATmega128	8-bit	Yes	128	included	Yes	Yes	4K	4K	JTAG	Yes	2	2	1/2	16/-	7	no	0	1	1	2	0	0	8	1	0	no
ATmega162	8-bit	Yes	16	included	Yes	Yes	512	1K	JTAG	Yes	2	2	1/2	16/-	6	no	0	1	0	2	0	0	0	1	0	no
ATmega48	8-bit	Yes	4	no	Yes	no	256	512	DebugWire	Yes	2	1	1/2	12/16	6	no	0	1+1 USART master	1	1	0	0	8	1	0	yes
ATmega88	8-bit	Yes	8	included	Yes	Yes	512	1K	DebugWire	Yes	2	1	1/2	12/32	6	no	0	1+1 USART master	1	1	0	0	8	1	0	Yes
ATmega168	8-bit	Yes	16	included	Yes	Yes	512	1K	DebugWire	Yes	2	1	1/2	16/64	6	no	0	1+1 USART master	1	1	0	0	8	1	0	Yes
AT90CAN128	8-bit	Yes	128	included	Yes	Yes	4K	4K	JTAG	Yes	2	2	2/3	16/64	7	no	0	1	1	2	1	0	8	1	0	no
ATmega325	8-bit	Yes	32	included	Yes	Yes	1K	2K	JTAG	Yes	2	1	1/2	16/64	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega3250	8-bit	Yes	32	included	Yes	Yes	1K	2K	JTAG	Yes	2	1	1/2	16/-	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega6450	8-bit	Yes	64	included	Yes	Yes	2K	4K	JTAG	Yes	2	1	1/2	-/-	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega645	8-bit	Yes	64	included	Yes	Yes	2K	4K	JTAG	Yes	2	1	1/2	16/64	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega329	8-bit	Yes	32	included	Yes	Yes	1K	2K	JTAG	Yes	2	1	1/2	16/-	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega3290	8-bit	Yes	32	included	Yes	Yes	1K	2K	JTAG	Yes	2	1	1/2	16/-	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega649	8-bit	Yes	64	included	Yes	Yes	2K	4K	JTAG	Yes	2	1	1/2	16/-	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega6490	8-bit	Yes	64	included	Yes	Yes	2K	4K	JTAG	Yes	2	1	1/2	16/-	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega640	8-bit	Yes	64	included	Yes	Yes	4K	8K	JTAG	Yes	2	4	4/5	16/-	15	no	0	1+4 USART master	1	4	0	0	16	1	0	no
ATmega1281	8-bit	Yes	128	included	Yes	Yes	4K	8K	JTAG	Yes	2	4	2/3	16/64	8	no	0	1+2 USART master	1	2	0	0	8	1	0	no
ATmega2561	8-bit	Yes	256	included	Yes	Yes	4K	8K	JTAG	Yes	2	4	2/3	-/-	8	no	0	1+2 USART master	1	2	0	0	8	1	0	no
ATmega2560	8-bit	Yes	256	included	Yes	Yes	4K	8K	JTAG	Yes	2	4	4/5	-/-	15	no	0	1+4 USART master	1	4	0	0	16	1	0	no
ATmega1280	8-bit	Yes	128	included	Yes	Yes	4K	8K	JTAG	Yes	2	4	4/5	16/64	15	no	0	1+4 USART master	1	4	0	0	16	1	0	no
ATmega644	8-bit	Yes	64	included	Yes	Yes	2K	4K	JTAG	Yes	2	1	1/2	16/64	6	no	0	1+2 USART master	1	2	0	0	8	1	0	no
AT90CAN32	8-bit	Yes	32	included	Yes	Yes	1K	2K	JTAG	Yes	2	2	2/3	16/64	7	no	0	1	1	2	1	0	8	1	0	no
AT90CAN64	8-bit	Yes	64	included	Yes	Yes	2K	4K	JTAG	Yes	2	2	2/3	16/64	7	no	0	1	1	2	1	0	8	1	0	no
AT90US1286	8-bit	Yes	128	included	Yes	Yes	4K	8K	JTAG	Yes	2	2	1/2	16/64	9	no	LS/FS device	1+1 USART master	1	1	0	0	8	1	0	no
AT90US1267	8-bit	Yes	128	included	Yes	Yes	4K	8K	JTAG	Yes	2	2	1/2	16/64	9	no	LS/FS device + OTG	1+1 USART master	1	1	0	0	8	1	0	no
AT90US8647	8-bit	Yes	64	included	Yes	Yes	2K	4K	JTAG	Yes	2	2	1/2	16/64	9	no	LS/FS device + OTG	1+1 USART master	1	1	0	0	8	1	0	no
AT90US8646	8-bit	Yes	64	included	Yes	Yes	2K	4K	JTAG	Yes	2	2	1/2	16/64	9	no	LS/FS device	1+1 USART master	1	1	0	0	8	1	0	no
ATmega164P	8-bit	Yes	16	included	Yes	Yes	512	1K	JTAG	Yes	2	1	1/2	16/64	6	no	0	1+2 USART master	1	2	0	0	8	1	0	no
ATmega324P	8-bit	Yes	32	included	Yes	Yes	1K	2K	JTAG	Yes	2	1	1/2	16/64	6	no	0	1+2 USART master	1	2	0	0	8	1	0	no
ATmega165P	8-bit	Yes	16	included	Yes	Yes	512	1K	JTAG	Yes	2	1	1/2	16/64	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega169P	8-bit	Yes	16	included	Yes	Yes	512	1K	JTAG	Yes	2	1	1/2	16/-	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega644P	8-bit	Yes	64	included	Yes	Yes	2K	4K	JTAG	Yes	2	1	1/2	16/64	6	no	0	1+2 USART master	1	2	0	0	8	1	0	no
AT90PWM1	8-bit	Yes	8	included	Yes	Yes	512	512	DebugWire	no	1	1+PSC	1/2	8/-	7	Yes	0	1	0	0	0	8	2	0	no	
ATmega329P	8-bit	Yes	32	included	Yes	Yes	1K	2K	JTAG	Yes	2	1	1/2	16/-	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega3290P	8-bit	Yes	32	included	Yes	Yes	1K	2K	JTAG	Yes	2	1	1/2	16/-	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega325P	8-bit	Yes	32	included	Yes	Yes	1K	2K	JTAG	Yes	2	1	1/2	16/64	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
ATmega3250P	8-bit	Yes	32	included	Yes	Yes	1K	2K	JTAG	Yes	2	1	1/2	16/-	4	no	0	1+1 USI	1 USI	1	0	0	8	1	0	no
AT90US82	8-bit	no	8	included	Yes	Yes	512	512	DebugWire	no	1	1	1/2	12/8	4	no	FS device	1+1 USART master	0	1	0	0	0	1	0	no
AT90US8162	8-bit	no	16	included	Yes	Yes	512	512	DebugWire	no	1	1	1/2	-/8	4	no	FS device	1+1 USART master	0	1	0	0	0	1	0	no

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Internal Flash (kByte)	Internal RAM (kByte)	EEPROM (kByte)	Serial Interface Type	A/D Converter Bits	I/O Pins	Ambient Operating Temperature Min-Max (°C)	Additional Features
16	1	1	CAN	8	From: To: <= > 120	-40 TO 105	COP
32	2	2	ETHERNET	10	120 > 120	-40 TO 125	EXTERNAL MEMORY
48	3	4	I2C	12	>= 30	-40 TO 85	INTERNAL CLOCK
64	4	8	J1939	16	30 32	0 TO 70	INTERNAL VOLTAGE

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Product (# of Parts)	Datasheet/Part Data	Order	Description	Device Type	Core Type	Core Operating Frequency Max (MHz)	Internal Flash (kByte)	Internal RAM (kByte)	EEPROM (kByte)	Serial Interface Type	CAN	A/D Converter Channels	A/D Converter Bits
S12HV (26) *		Buy Direct Sample	Family Scalable Value Line Cluster Solutions with CAN	MCU	HCS12 HCS12	32 32	48 64 32	4 2	4	CAN SCI SPI I2C	MSCAN12 CAN 2.0 A/B	-	
			16-bit		HCS12	50	128	6	4	SCI SPI CAN I2C			

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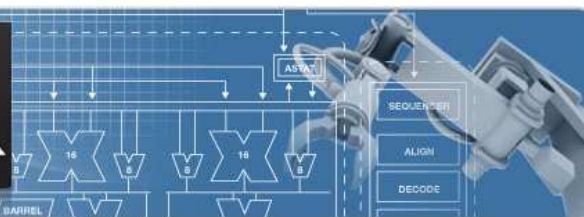
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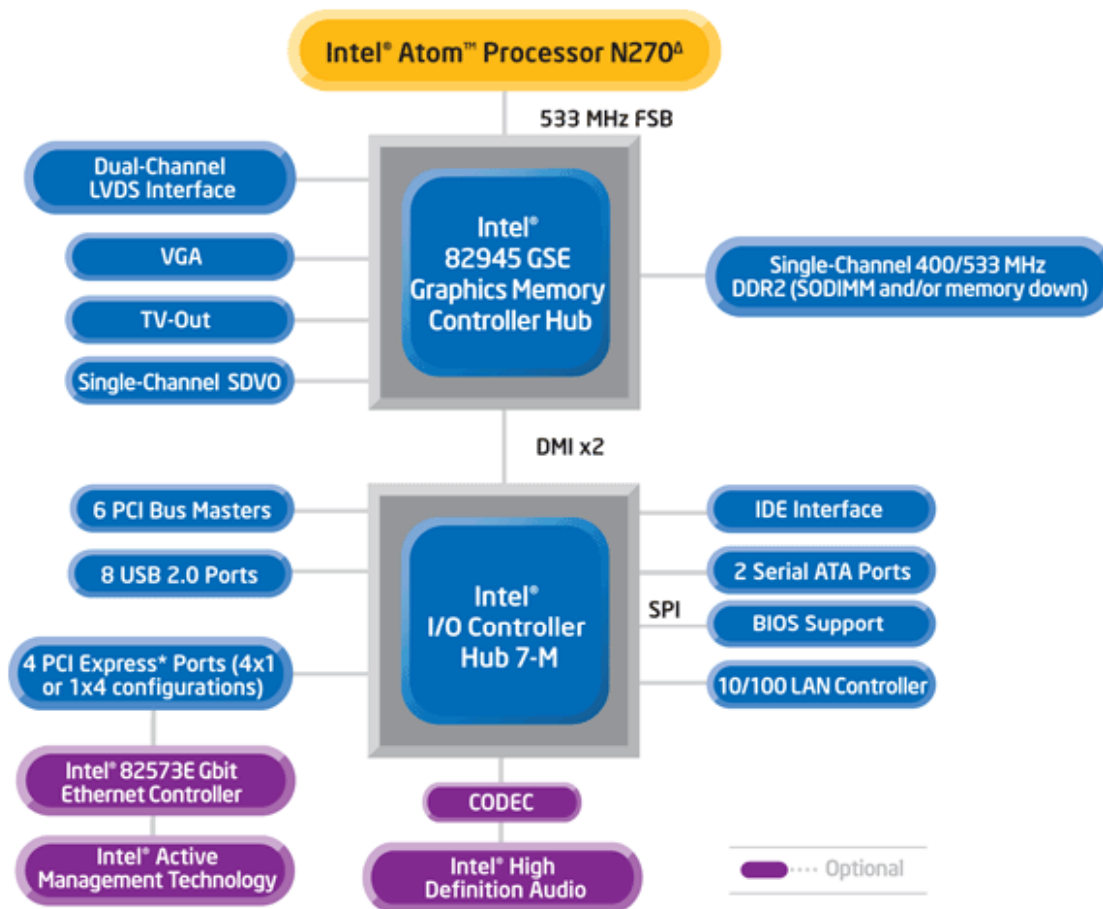
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- Contact Technical Support
- Third Party Developers



Board Peripheral Features

- VGA port and DVI-D
- Two (2) SATA ports
- One (1) parallel ATA port (44-pin mobile header)
- Eight (8) USB 2.0 ports (four back-panel, two front-panel, one internal, one PCIe mini-card)
- One (1) PCIe x1 port
- One (1) PCIe mini-card connector for wireless adapter
- Realtek ALC268* High Definition Audio codec
- Front-panel headphone and mic-in support
- 10/100/1000 Realtek RTL8111* Ethernet Controller
- Legacy I/O:
 - PS/2
 - Serial
- 12 VDC input



<http://www.intel.com/products/processor/atom/index.htm>

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http://www.keil.com/arm/mcb2300/mcb2370.asp

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MCB2370 Evaluation Board

The Keil MCB2370 Evaluation Board introduces you to the NXP LPC2378 microcontroller. It allows you to create and test working programs for this advanced architecture.



Components Included

The MCB2370 Evaluation Board includes the following:

- [MCB2300 Evaluation Board](#) populated with an LPC2378,
- [RealView MDK-ARM Evaluation Tools](#).
- [MCB2300 Quick Start Guide](#).

System Requirements

- PC with one available USB port,
- Windows 2000, XP and Vista,
- One CD-ROM drive,
- [ULINK family USB-JTAG Adapter](#) for high-performance Debug/Download (optional).

Evaluation Software

The MCB2370 Evaluation Board includes [RealView MDK-ARM Evaluation Tools](#). These tools help you get started writing programs and testing the microcontroller and its capabilities. Sample applications which run on the MCB2370 are included.

<http://www.keil.com/mcb2300/mcb2370.asp>

Prerequisite Review Guidelines

- Topics from ECE 270 (Module 1) you should review include:
 - How to read/interpret data sheets
 - Logic levels and noise margins
 - Interfacing different families of CMOS logic
 - Electrostatic discharge
 - Sourcing and sinking currents
 - Propagation delay and transition time
 - Effects of capacitive and resistive loads
 - Power dissipation as a function of supply voltage and switching frequency
 - Current spikes and decoupling
 - Three-state and open-drain outputs

Prerequisite Review Guidelines

- Topics from ECE 362 you should review include:
 - Embedded application software organization
 - SCI and SPI applications
 - ATD applications and analog signal conditioning
 - TIM applications
 - PWM applications and interfaces
 - Switching D.C. loads
 - Optical isolation of inputs and outputs
 - Keypad (switch matrix) and contact closure de-bouncing
 - Rotary pulse generators (RPG)
 - Position control, stepper motors, (hobbyist) servos
 - LCD interface
 - I/O expansion using shift registers
 - Bus timing analysis