ATMega

Development Board

Manual

V1.0

Introduction

Development boards allow a quick implementation of a prototype design and successive downloads of the program directly in circuit without the need to remove the microcontroller and place it in a programmer. This enables the design to be tested quickly and necessary modifications made easily, improving the project and product development times considerably. This board can also be used in a more fixed application, as a base or CPU board for a more complex system. Connections are provided to each of the microcontroller pins, and these connections can then be run to a auxiliary board, where all the other IC's are mounted to interface to the outside application. This allows easy swapping of the boards, if necessary and also the auxiliary board to be changed easily without affecting the main board. This board is also ideal as a training board, allowing a number of test circuits to be built on attached breadboards or prototyping boards. These can be connected by headers to the ATMega Development Board, allowing easy testing and replacing as each lesson or tutorial is completed.

The ATMega Development Board uses the ATMEga163 as a base microcontroller. This IC is one of the new Mega range of Atmel AVR microcontrollers, offering much larger program space. The ATMega163 includes a large 16kb of program flash memory, which will be more than adequate for most applications. Program code can also be developed on this board for smaller ATMega microcontrollers, by limiting the number of pins used and first testing the code on this development board and then making the necessary changes for the target microcontroller, prior to porting the code to the smaller device. The AVR range of microcontrollers utilise a reduced instruction set over the previous 8051 series, also a number of more powerful instructions have been added to allow complex decision making and mathematical calculations to be performed easily.

The ATMega163 also includes a number of peripheral features which reduce the need for special auxiliary IC's. A total of 8 channels of Analog to Digital converters are provided, providing 10 bit accuracy for each. This is ideal for an analogue system, where a large number of sensors are used, analog comparators are also included allowing alarms to be initiated when certain set points are reached. Similarly a UART is provided for connecting to a PC, allowing information transfer between the PC and development board. Computer programs can be written easily in Visual Basic or Delphi to communicate with the board and display the necessary information on the computer. A SPI connection is provided on the board, for easy interface to a SPI bus or other SPI devices. This will allow easy transfer of information on a standard bus or between devices.

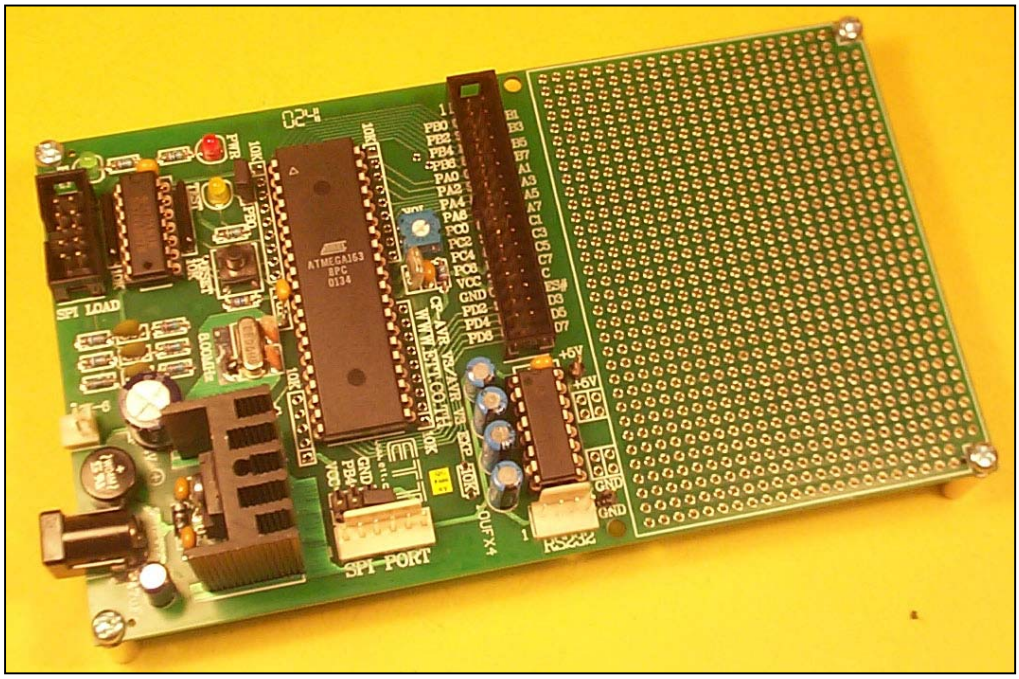

Figure 1: ATMega Development Board

1.0 Specifications

1.1 Board Specifications

Summary of board specifications and features

- ATMega163 on-board with 8MHz Crystal
  - 16Kbytes of Flash Memory
  - 1024 bytes of RAM Memory
  - 512 bytes of EEPROM Memory
  - 32 I/O pins
  - 3 Timers
  - Real Time Clock
  - 8 channels ADC with 10-bit accuracy
  - SPI Serial Interface
- In circuit programming via computer download cable (provided)
- 5V regulator on-board with necessary power supply components
- 34 Pin I/O connector for access to microcontroller port pins
- Separate SPI Port Connection
- Adjustable Analogue Reference Trimpot
- RS232 Communication with on-board MAX232 or equivalent
- Test LED to RA0 pin
- Power-On LED
- Programming LED
- Reset pushbutton provided

1.2 Microcontroller Specifications

The new ATMega163 includes a lot of new exciting features, beyond that of the previous AT90S series. These include,

High Performance Low Power AVR CPU:

- 130 Powerful Instructions
- 32 x 8 General Purpose Working Registers
- Up to 8 MIPs Throughput at 8Mhz
- On-chip 2-cycle Multiplier
- Nonvolatile Program and Data Memories

Self-programming In-System Programmable Flash Memory:

- 16K Bytes with Optional Boot Block (256 – 2K Bytes)
  Endurance – 1,000 Write / Erase Cycles
- Boot Section Allows Reprogramming of Program Code without External Programmer
- Optional Boot Code Section with Independent Lock Bits
- 512 Bytes EEPROM
  Endurance – 100,000 Write / Erase Cycles
- 1024 Bytes Internal SRAM
- Programming Lock for Software Security

Peripheral Features:

- Two 8-bit Timer/Counters with Separate Prescalar and Compare Mode
- One 16-bit Timer/Counter with Separate Prescalar, Compare Mode, and Capture Mode
- Real Time Clock with Separate Oscillator and Counter Mode
- Three PWM Channels
- 8-channel, 10-bit ADC
- Byte-oriented 2 wire Serial Interface
- Programmable Serial UART
- Master/Slave SPI Serial Interface
- Programmable Watchdog Timer with Separate On-chip Oscillator
- Analog Comparator

Special Microcontroller Features:

- Power-on Reset and Programmable Brown-out Detection
- Internal Calibrated RC Oscillator
- External and Internal Interrupt Sources
- Four Sleep Modes: Idle, ADC Noise Reduction, Power Save and Power-Down

Power Consumption at 4MHz, 3.0V and 25oC:

- Active 5.0mA
- Idle Mode 1.9mA
- Power-down Mode <1 μA

I/O:

- 32 Programmable I/O Lines

1.3 AVR Technology

The AVR technology was first released by Atmel in 1997, and has since grown substantially in products offered and popularity. It's main benefits include a RISC core and a large bank of working registers. These working registers are connected to the ALU, allowing many instructions to be executed in one clock cycle. In other microcontrollers these instructions can take many clock cycles. Hence the AVR is much more code efficient and can achieve a much faster throughput than other microcontrollers. In the case of the ATMega163 the throughput approaches 1MIPS per MHz.

The instructions available with the AVR range, have also been optimised, allowing compares and bit manipulation to be done easily. This reduces a the program code size required and also improves the speed.

This structure and improved instructions also allows the AVR devices to be efficient in code, when writing programs with the C language.

2.0 Set-Up and Programming The Development Board

2.1 Setting Up

Firstly connect the ATMega Development Board to a suitable DC power supply. This should be between 13-16Vdc and capable of at least 500mA. The jack can be either positive-negative or negative-positive. Once the power supply is connected the red Vcc LED will illuminate.

Next connect the computer cable (ET-PSPI), that is included with the development board. The 25 pin DB 25 connector is connected to the computer parallel port.

Figure 2: PSPI Program Download cable

The 10 pin polarized connector, is connected to the development board, at the black socket (SPI Load) on the left hand side of the board. This connector will only go in, in a single direction, the locking piece needs to match the gap in the shrouded male header, as seen below.

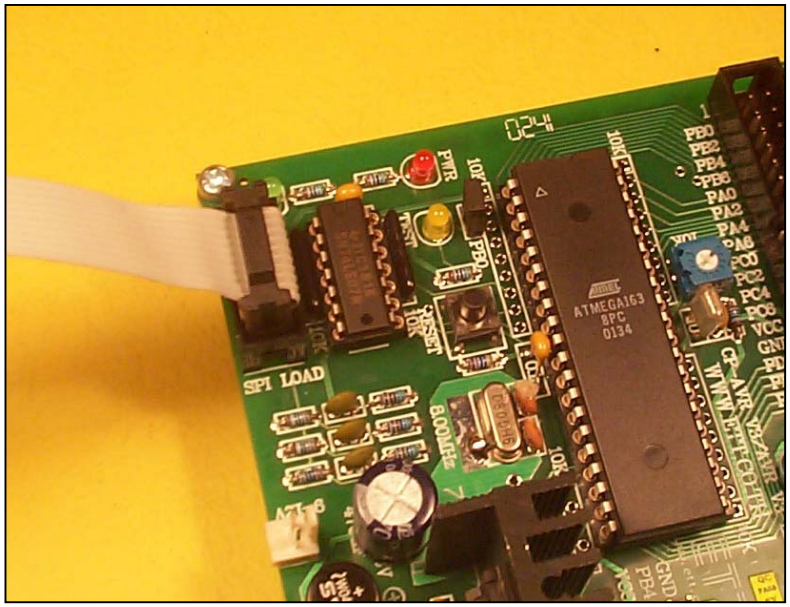

Figure 3: Download Cable Connection

The board is now ready to program.

2.2 Preparing Software

To download a program to the ATMega board, it will be necessary to prepare and compile a suitable program, by using any of the many development tools that are available for this microcontroller. The compiled program needs to be in *.hex format prior to downloading.

The most common program development tool used by AVR developers. Is the AVR Studio IDE (integrated development environment) from Atmel. This is available free from Atmel and can be downloaded from their website at www.Atmel.com . This includes an editor for preparing the program, a debugger and simulator for stepping through the program and identifying errors. Most importantly it also includes a compiler for preparing the final *.hex file for loading into the microcontroller.

2.3 Downloading to the Board

To down-load the compiled software to the board.

1. Firstly open the download program (w95mega163v1.exe), which is included in the accompanying CD. This can be done by clicking on the file in Windows explorer, or by copying the file to the computer hard-drive and running it from the command line.
2. Once the program is running, click on the “Open Hex File” button and select the program to be down-loaded to the board. Once this is in ready, the progress bar at the bottom will display “Load Hex File Ok”.
3. Now select the correct LPT port for the connection to the development board. In most cases this will be LPT1.
4. To program the device, this can be done by either pressing the “Auto” button. In which case the program will check if the chip is blank, if necessary then erase the chip, followed by programming and verifying the code. Alternatively, the “Erase”, “Blank”, “Program” and “Verify” buttons can be pressed in this sequence to program the device. Whilst the board is being programmed the green “PGRM” led will flash.
5. Once the device has been programmed, the code will start to run automatically and it is not necessary to reset the board.

Note: In regard to the Lock and Write Fuses, it is not recommended to use these until you are fully conversant with their function. As inadvertent programming of these bits within the microcontroller, can prevent the microcontroller from being reprogrammed.

2.4 Using the Software

Operation of the software is quit straightforward. To program a device, the first step is to

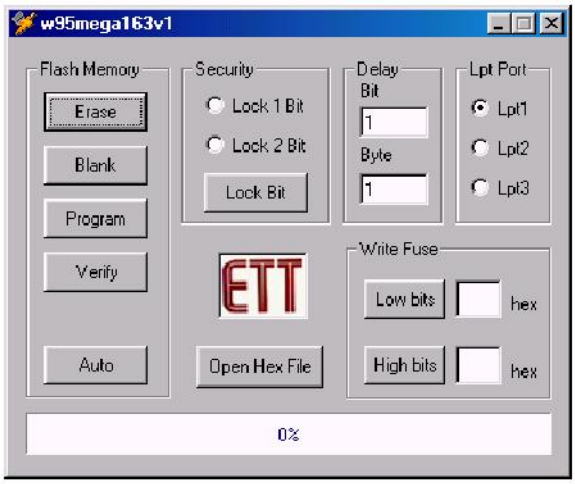

Figure 4: Download Software Screen Shot

"Open Hex File". Then press "Auto" if a complete download operation is required. This will then automatically Erase, Program and Verify the code. Or alternatively, these steps can be done manually.

For the Security, Delay and Write Fuses portion, it is recommended these only be used if you have a thorough understanding of the ATMega device. More information on these features can be found in the ATMega datasheet. Essentially these can lock or prevent access to the microcontroller, and if programmed require special programmers to un-lock or re-enable the device.

2.5 Running My First Program – Led.hex

A number of programs are included with the accompanying CD, that will demonstrate the features of the board, and provide a number of ready to run solutions to test various parts of the board. In this section we will load and run the Led program, to flash the test LED at port position PB0. This is the yellow LED, that is located just to the left of the ATMega163.

Firstly connect the board to the computer and power supply as indicated previously. Also ensure the jumper is in place next to this LED, which connects the LED to port pin PB0. Then open the download software (w95mega163v1.exe) on the accompanying CD. This can be run directly from the CD or loaded into the computer. Now follow the steps as below,

1. Press "Open Hex File" on the program.
2. Now in the explorer window, go to your CD drive and find the folder examples, then find LED.hex, and click on this file. Press Open and this file will be loaded into the download program.
3. Now ensure the Lpt port selection in the program is correct. This is the group of selection buttons at the top right of the program. Most parallel ports are LPT1, so this normally will not need to be changed.
4. Now press the "Auto" button on the program and program will be downloaded to the microcontroller.
5. Once this is complete, the words "Program Flash Ok", will appear in the progress bar of the download program.
6. The program will now run automatically and the yellow LED should start to flash.

3.6 Troubleshooting

<u>Program Downloads But Will Not Run</u>

1. Verify your code, has been downloaded correctly, by pressing the Verify button.
2. Check your code or use a compiled program that is known to work.

<u>Program Will Not Download</u>

1. Check cable connections and power supply.
2. Check port selection on the programming software, is correct according to the parallel port being used.
3. If you are using Windows 2000 or Windows XP, you will need to install the Userport program, available on the accompanying CD. This will enable the computer parallel port to be used with the Windows 95 software provided. The userport program needs to be running prior to running the download software.

3.0 Power Supply

4.1 Power Supply Connection

The power supply circuit on the Development Board has been designed for heavy duty, and will maintain a 5V supply to the circuit under quite high load conditions. A standard plugpack can be used to supply power to the board, the plugpack pin and shield can be either polarity as a full wave rectifier is used in the circuit.

The power supply can be connected to either the poarized header or the plugpack connection, as shown in the photo below. The DC input voltage can be between 9 and 12 V, and should be capable of supplying at least 500mA.

The red LED will come on to indicate the supply is okay.

Output voltage of 5Vdc is available at several points around the board.

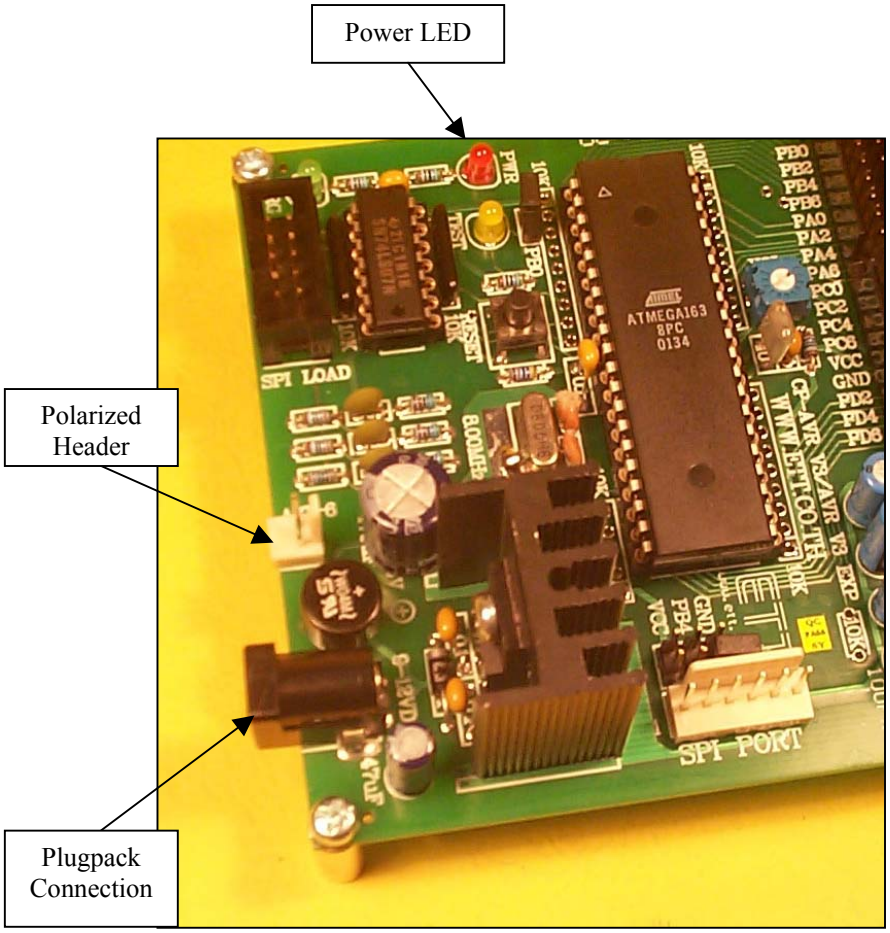

Figure 5: Power Supply Connections