Hello Arduino Uno

Getting a “Hello World” with the GNU GCC toolchain

Revision	Author	Date	Description
0.01	D Snider	15/11/05	Initial Outline

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NOTE: WHILE THIS DOCUMENT IS BEING REFINED, META INFORMATION WILL BE IN < BRACKETS > .

1. SW Dev Environment

Google keywords	Description & URLs	tested versions
Cygwin	GNU file utils and make for Windows https://www.cygwin.com/	> make --version GNU Make 4.1
TortoiseGit	Windows based GIT: https://tortoisegit.org/ https://git-for-windows.github.io/	> git --version git version 2.6.2.windows.1
WinAvr	Windows GCC Compiler, Linker and C libraries http://sourceforge.net/projects/winavr/	> avr-gcc --version avr-gcc.exe (WinAVR 20100110) 4.3.3
Atmel Studio	IProgrammer Software which uses the JTAGICE3 debug pod http://www.atmel.com/tools/atmelstudio.aspx	Version 7

2. HW tools

2.1. Atmel JTAGICE3

Google	"Atmel JTAGICE3"
Source	Digikey: http://www.digikey.com/product-detail/en/ATJTAGICE3/ATJTAGICE3-ND/
Support pages	http://www.atmel.com/tools/JTAGICE3.aspx http://www.atmel.com/webdoc/jtagice3/

3. Hello Uno

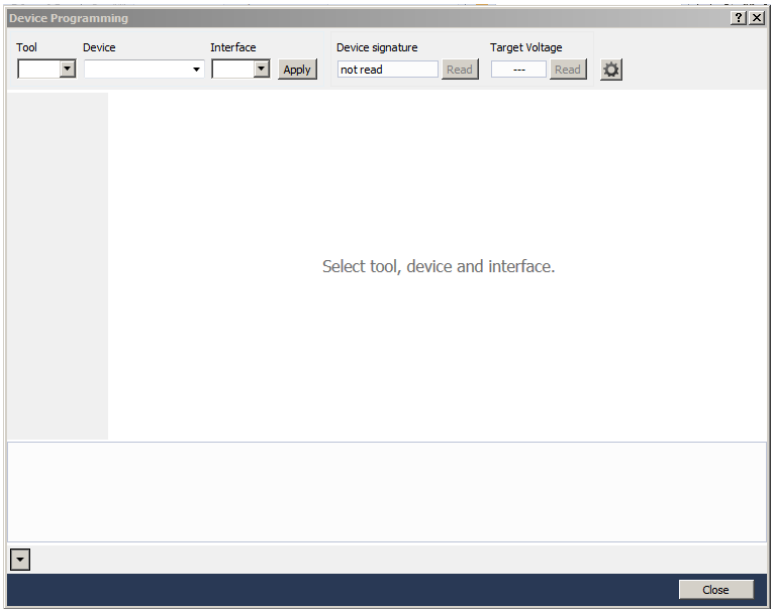
3.1. Build

```
> git clone <github repo>
> cd hello_arduino/uno
> make
...
Linking: hello_uno.elf
...
Creating load file for Flash: hello_uno.hex
…
>  ls hello_uno.hex
hello_uno.hex
```

3.2. Connect ISP pod to Atmel Studio and Uno

Connect to ISP pod

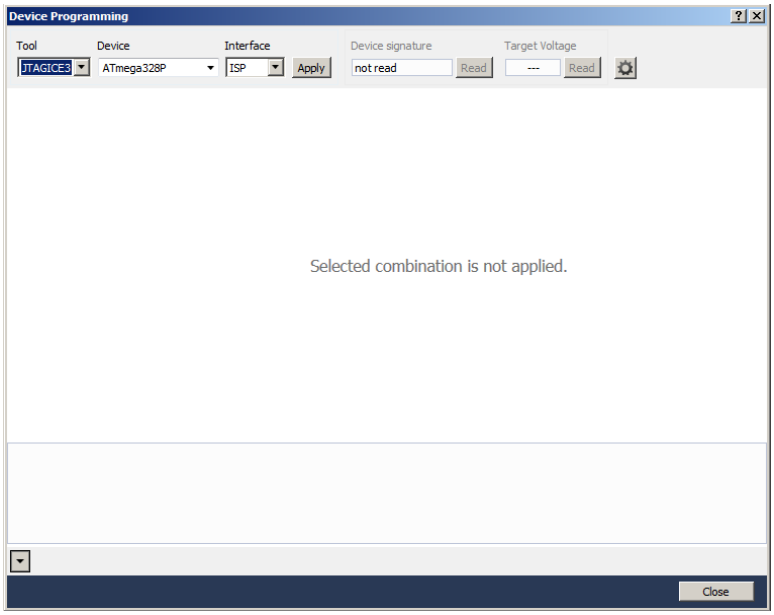
Within Atmel Studio, Select: Tools→ Device Programming



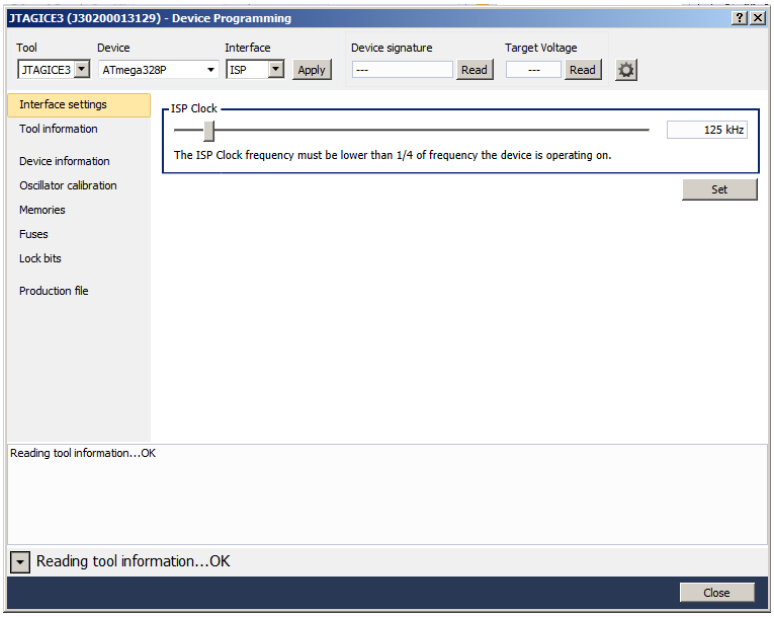
Connect the JTAGICE3 pod to a Windows PC USB port.

Configure:
Tool: JTAGICE3
Device: ATmega328P
Interface: ISP

Select: Apply

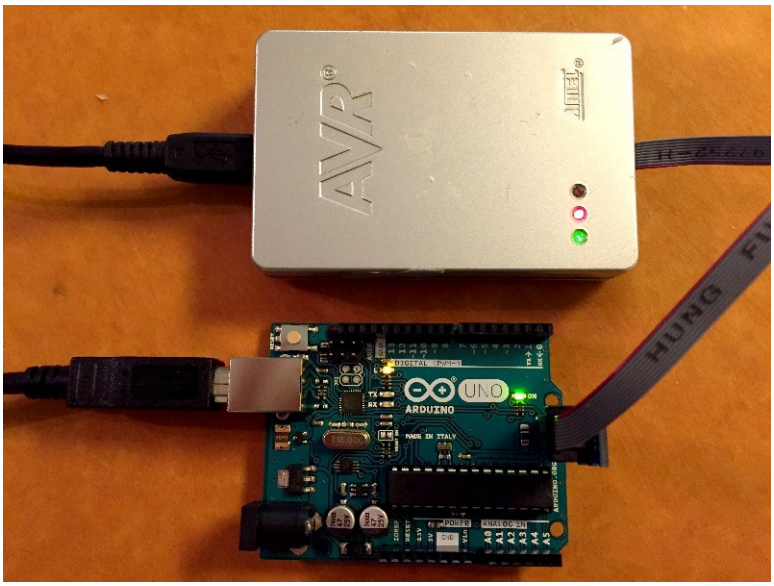


If the pod is found, the following screen should show:



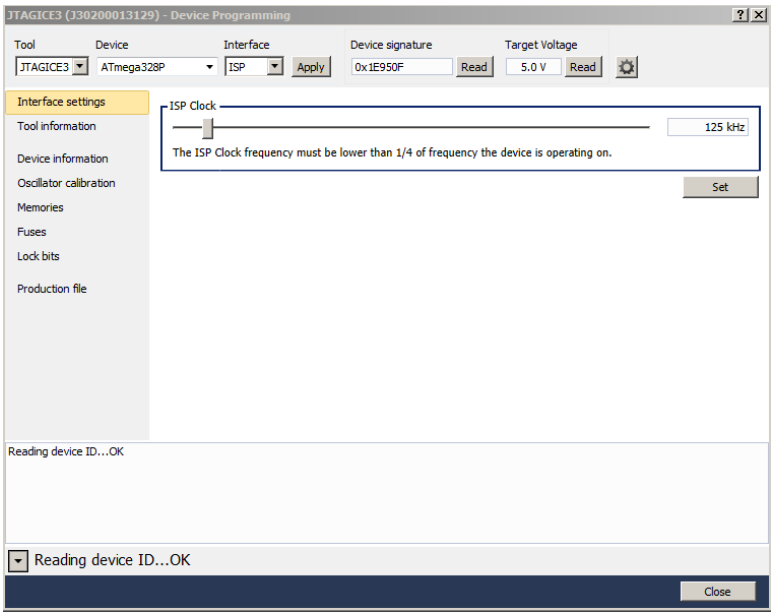
Verify Pod connection to Atmega328p

Connect the Arduino Uno board to a USB cable.
Connect this USB cable to another Windows PC for both power and serial I/O.
Connect the JTAGICE3 6pin ISP header to the UNO header: ICSP.



Select: Target Voltage → Read
It should return 3 to 5V.

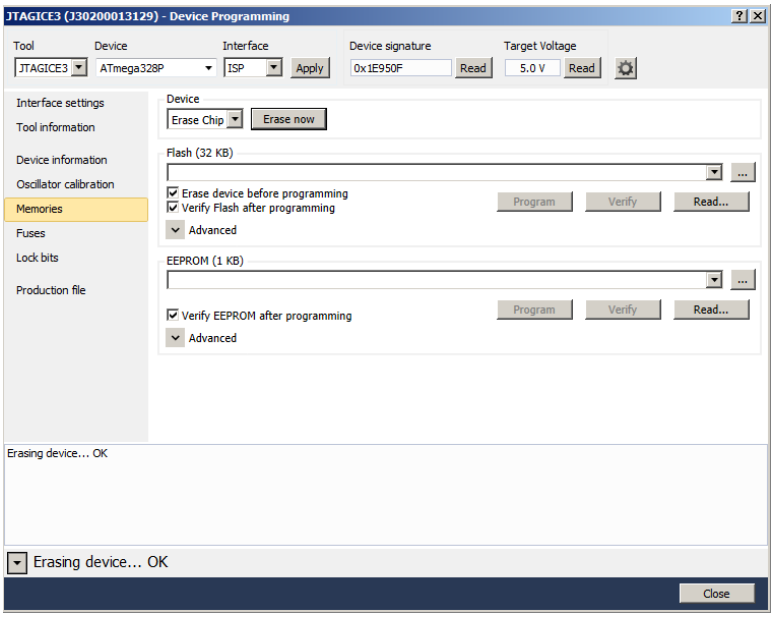
Select: Device signature → Read
There should be no error messages of Device ID mismatch.
For the Atmega328P, the signature should be 0x1E950F.



3.3. Programming Atmega328p

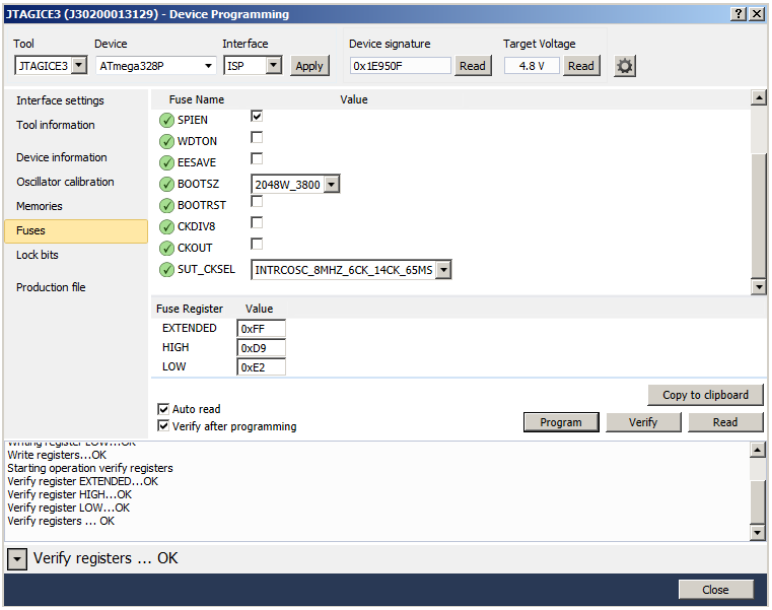
Erase Chip

Select: Memories → Device: Erase Chip → Erase Now



Fuses

Select: Fuses



<Corrected screenshot with LOW updated>

For Arduino Uno - ATmega328p:

EXTENDED: 0xFD

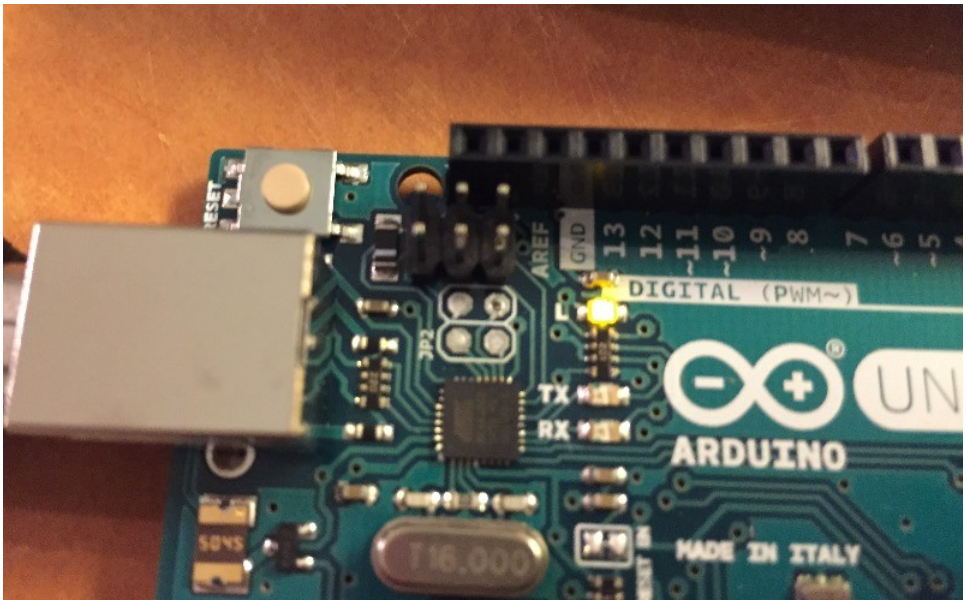
HIGH: 0xD9

LOW: 0xFF

Load hello_uno.hex

```
Select: Memories
Select: Flash: hello_arduino\uno\hello_uno.hex
Select: Program
```

3.4. Verify 1sec LED

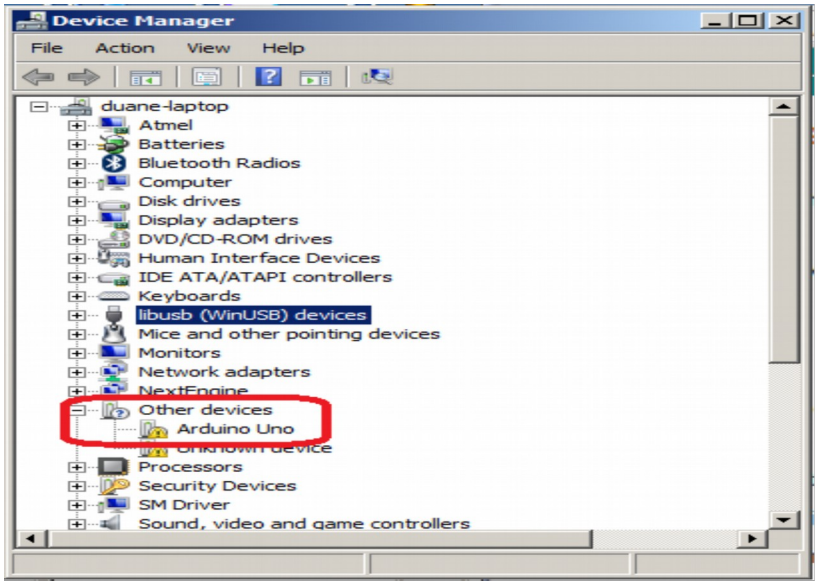


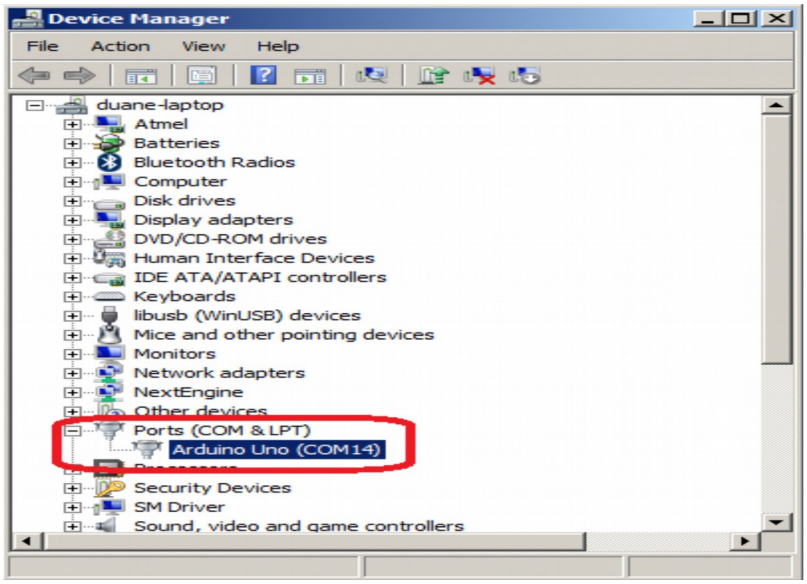
This should precisely transition once a second.

3.5. One-time Windows Driver Install

Within Windows, Open the "Device Manager"
Select: Start, at the prompt enter: devmgmt.msc

Check whether there is a "Ports – COM port" defined,
or an "Other devices/ Arduino Uno" showing?



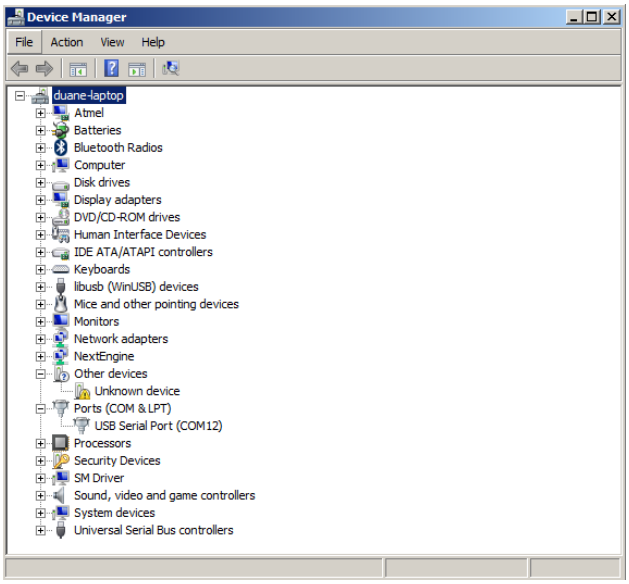


The "Other devices/ Arduino Uno" means a driver needs to be installed:
Right Click "Other Devices / Arduino Uno"
Select Driver Update and point the update to the directory:
'hello_arduino/Uno/doc' directory for the *.inf file

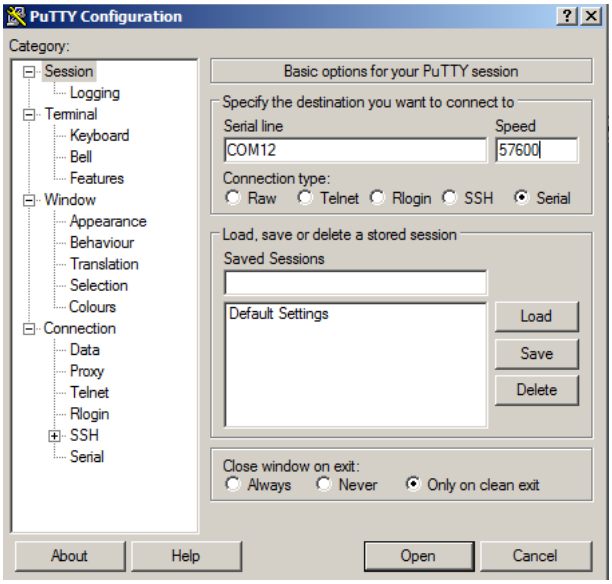
References:
https://www.arduino.cc/en/Main/USBSerial
https://www.arduino.cc/en/Guide/Windows#toc4

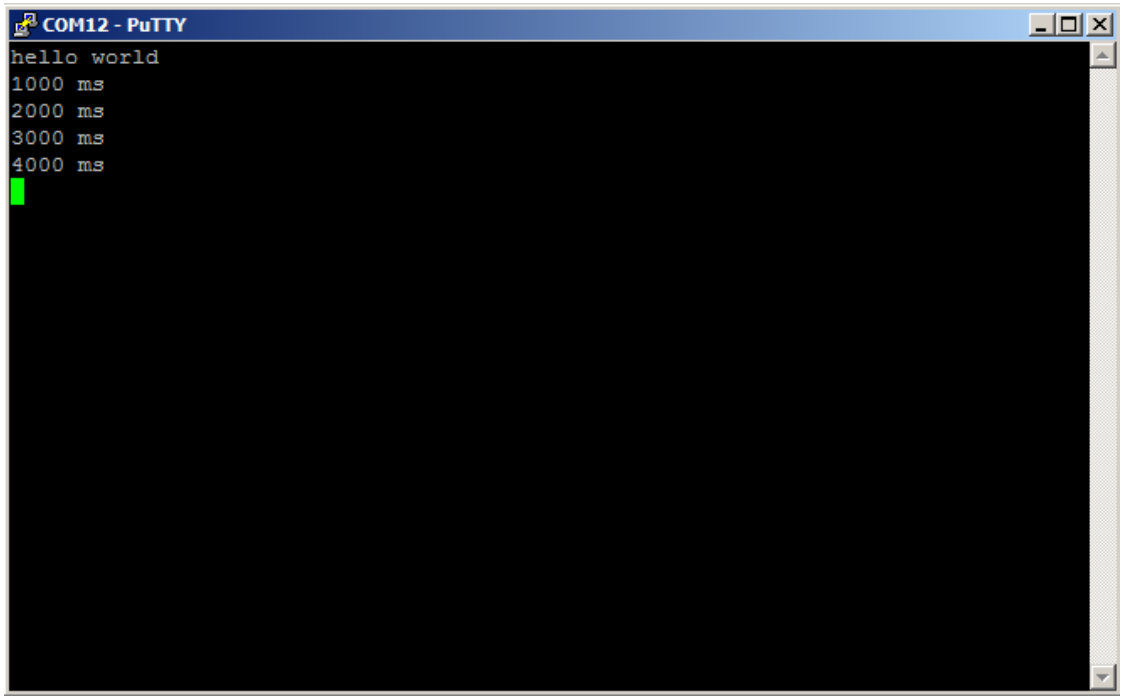
3.6. Verify Serial I/O

Open the Windows “Device Manager”
Within Windows: select Start, at the prompt enter: devmgmt.msc
Search for what COM ports are connected.
This example shows COM12 when the UNO is plugged in.

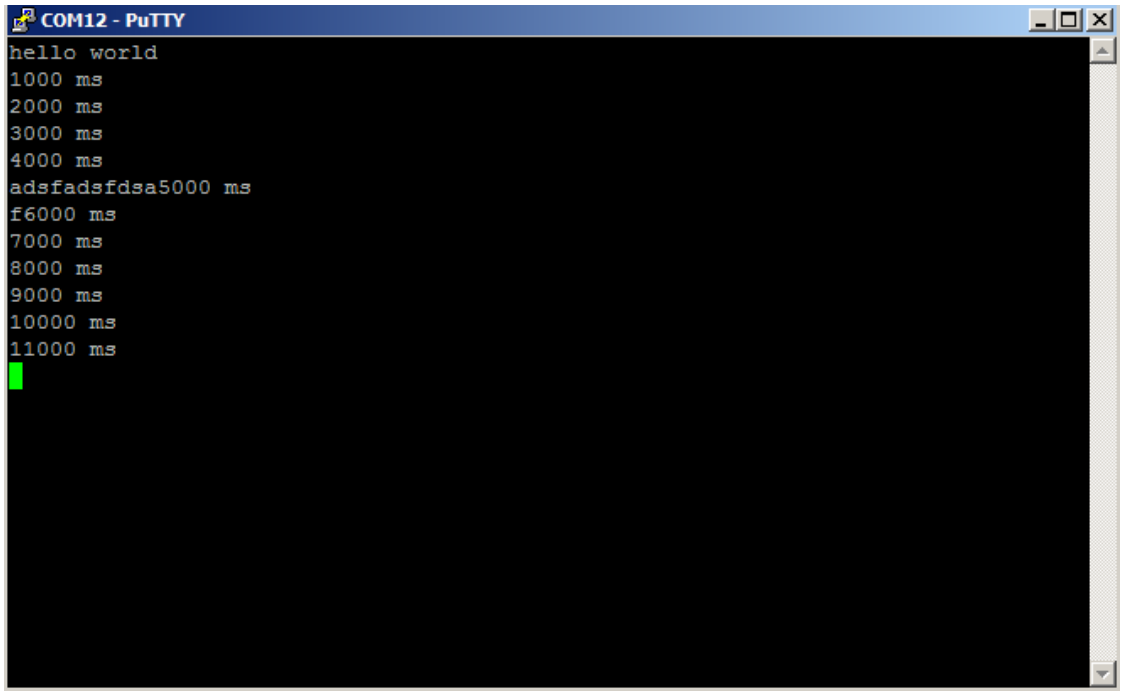


Start up a Putty Window and configure:
   Connection type: serial
   Serial line: COM12
   Speed: 57600
Select: Open





Hit a few keys to verify the Arduino is receiving serial data:



4. Design Notes - Fuses

```
Atmega328P Fuse Notes:

Extended:       //  7  6  5  4  3  2  1  0
                //  1  1  1  1  1  1  1  1   => Atmel factory default: FF
            FD  //  1  1  1  1  1  1  0  1   => Ardyino UNO setting
                                   +--+--+-- BODLVL[2.0]: 111 - Disabled
                                                         100 - 4.3V
                                                         101 - 2.7V

High:           //  7  6  5  4  3  2  1  0
                //
            D9  //  1  1  0  1  1  0  0  1   => Atmel factory default
                //  1  1  0  1  0  1  1  0   => Ardino UNO original setting: D6
                //  1  1  0  1  1  0  0  1
                //  |  |  |  |  |  |  |  + BOOTRST: 1 - no Boot Loader
                //  |  |  |  |  |  +--+--- BOOTSZ[1.0]: 00 - 2K words
                //  |  |  |  |  +---------- EESAVE: 1   - EEPROM not reserved
                //  |  |  |  +------------- WDTON: 1    - Watchdog timer off
                //  |  |  +---------------- SPIE: 0     - SPI programming enabled
                //  |  +------------------- DWEN: 1     - debugWire disabled
                //  +---------------------- RSTDISBL: 1 - External reset enabled


Low:            //  7  6  5  4  3  2  1  0
                //
                //  0  1  1  0  0  0  1  0   => factory default: 62
                //  1  1  1  0  0  0  1  0   => internal 8Mhz RC: E2  → F_CPU =  8000000
            FF  //  1  1  1  1  1  1  1  1   => 8-16Mhz ext crystal   → F_CPU =  xtal = 16000000
                //  |  |  |  |  |  |  |  |
                //  |  |  |  |  +--+--+--+ CLKSEL[3.0]: 0010 - internal 8Mhz
                //  |  |  |  |             |              111x - 8-16Mhz ext crystal
                //  |  |  |  |             |              110x -  3-8Mhz ext crystal
                //  |  |  |  +--+----------+ SUT[1.0],CLKSEL[0]: 11,1 - slowest start up
                //  |  |  +------------------ CKOUT:1   - CLK not out on PB0
                //  +---------------------- CKDIV8: 1 - do not divide clk by 8


UNO     : FD D9 FF
```

5. Resources

Google keywords	Description
Atmega 328p datasheet	*The final word on register settings.* *http://www.atmel.com/devices/atmega328p.aspx* *http://www.atmel.com/images/Atmel-8271-8-bit-AVR-Microcontroller-ATmega48A-48PA-88A-88PA-168A-168PA-328-328P_datasheet_Complete.pdf*
Arduino uno schematic r3	https://www.arduino.cc/en/uploads/Main/Arduino_Uno_Rev3-schematic.pdf
AVR libc	WinAVR library source and documentation http://www.nongnu.org/avr-libc/
AVR freaks	A good online community for most AVR questions http://www.avrfreaks.net/