Lab 5 Memories and Index Registers

I. AVR ATmega2560 Memories

Program storage: Flash memory (.cseg directive)
Data storage: SRAM and EEPRROM (.dseg and .eseg directives)

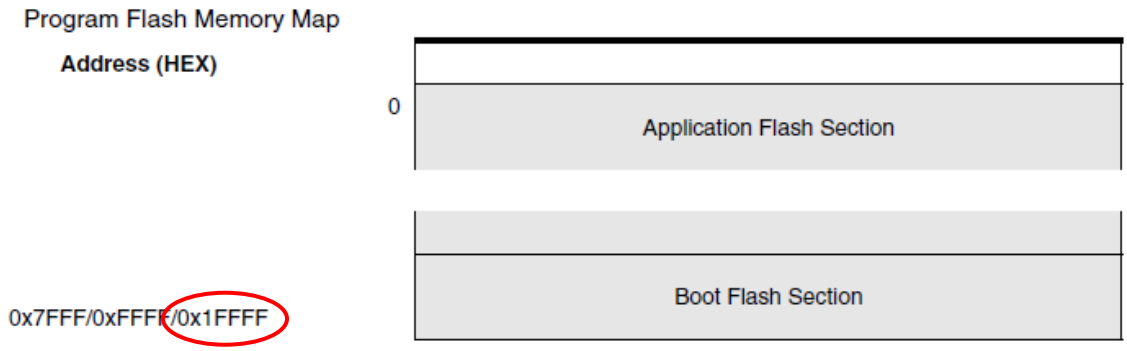
The Configuration Summary of ATmega2560:[1]

Table 2-1. Configuration Summary

Device	Flash	EEPROM	RAM	General Purpose I/O pins	16 bits resolution PWM channels	Serial USARTs	ADC Channels
ATmega2560	256KB	4KB	8KB	86	12	4	16

The diagram of the program flash memory[1]:

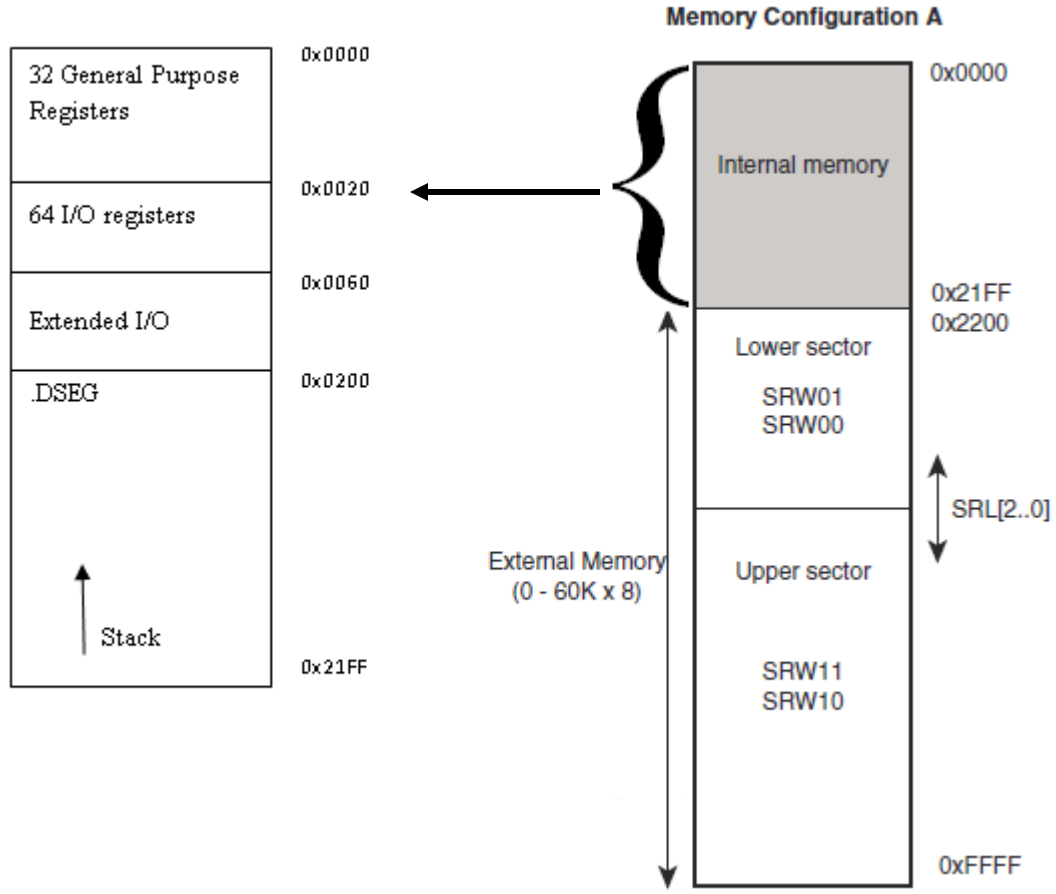
Figure 8-1. Program Flash Memory Map



What is the largest flash memory address of ATmega2560?
Based on Table 2-1, the memory size is 256KB -> 2^{18}Bytes ->2^{17}words, the largest word address is 0x1FFFF(17bits).

The diagram of the SRAM[1]:

Figure 9-1. External Memory with Sector Select



II. Index Registers

Data Direct Addressing:

We practiced the following instruction in the previous labs:

lds R0, msg
sts msg, R0

In general, the instruction takes the form of "lds Rd, (k)", where the value of k is a 16-bit unsigned integer representing memory address of the SRAM (data memory). The content (1 byte) stored in memory address k is loaded to register Rd.

Data Indirect Addressing:

The AVR processor has three register pairs that can be used for data indirect addressing. The three register pairs (also called index registers) are:

X -> R27:R26 or XH :XL
Y -> R29:R28 or YH :YL
Z -> R31:R30 or ZH :ZL

The address to be accessed must be preloaded into either X, Y, or Z register. What do the following statements do?

```
LD Rd, X
ST X, Rr
LPM R23, Z+
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Indirect addressing is especially suited for accessing arrays, tables, and Stack Pointer.

III. Download lab5.asm and finish the program.

A C-style string (C string) is stored in the program memory (flash memory). Write a short program to calculate the length of the string and copy the string from the program memory (flash) to the data memory (SRAM).

This lab is derived from Chapters 5 and 12 of the book (Some Assembly Required by Timothy S. Margush) and the datasheet of ATMEGA 2560 (See the course website: Resources -> avr_resiyrces -> Atmel_ATmega2560_datasheet.pdf, page 27)

1. The diagrams are copied and modified from the datasheet mentioned above.