Lab 5 Memories and Index Registers

Submit lab5.asm at the end of your lab, not your project.

I. AVR ATmega2560 Memories

Program storage: Flash memory (.cseg directive)

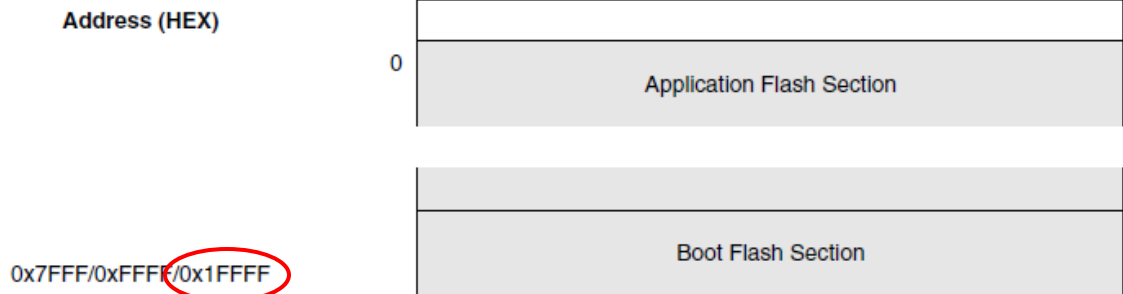Data storage: SRAM and EEPRROM (.dseg and .eseg directives)

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
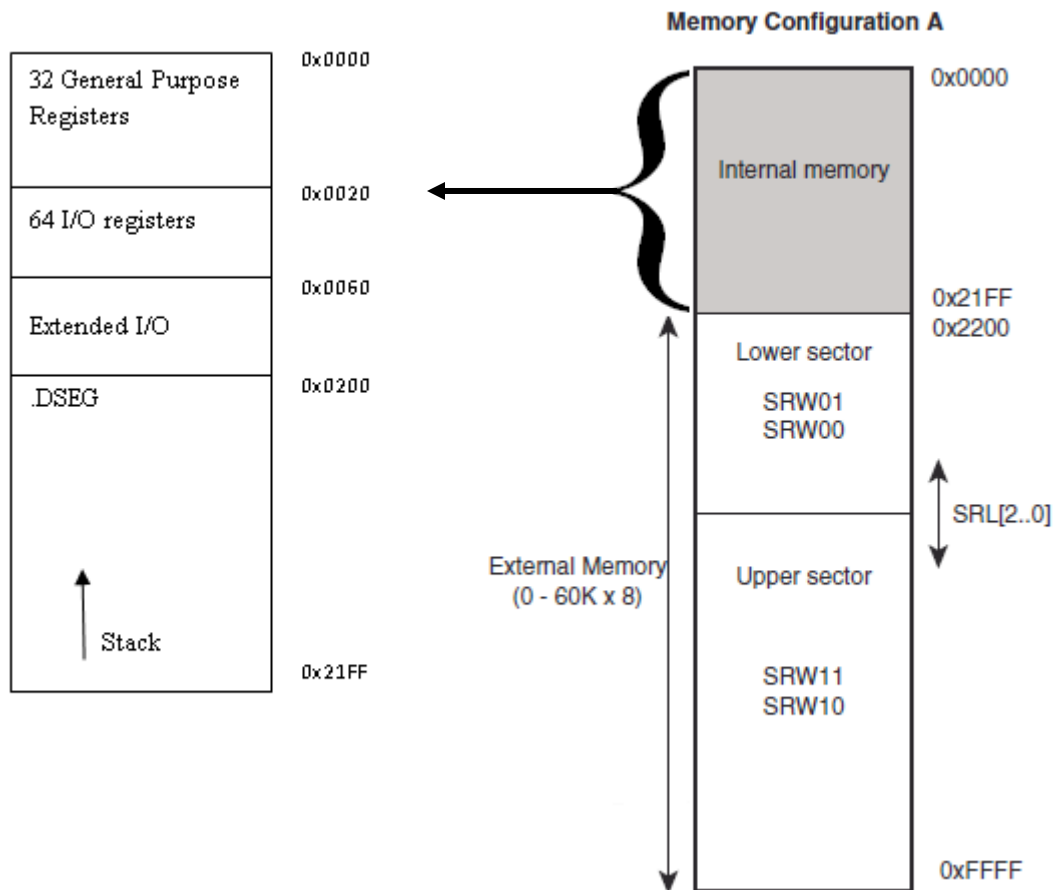
What is the largest flash memory address of ATmega2560?

Based on the above table, 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+

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).
1. Write a short program to calculate the length of the string
2. Expand the above program to copy the string from the program memory (flash) to the data memory (SRAM).

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This lab is derived from Chapters 5 and 12 of your textbook (Some Assembly Required by Timothy S. Margush) and the datasheet of ATMEGA 2560 available in AVR Resources folder on conneX.

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