

Chapter 2

Introduction to 68000

Expected Outcomes

- Point out the feature of 68000 and its architecture
- Recognize the register sets in 68000 programming model
- Interpret the memory map and its addressing ranges

Introduction

- MC68000 is one of the most popular microprocessor as its instruction set is comprehensive and its design is simple for 16 bit system.
- It is capable of supporting multitasking and applicable for high level language
- It uses Von Neumann architecture to produce a simple and flat memory map
- Originally, it is designed for use in household products
- But later, it is used for the design of computers like the Apple Macintosh, Commodore Amiga and Atari ST
- The 68000 eventually obtains its greatest success as a controller such as in HP and Adobe printer
- Its derivatives such as Coldfire have been manufactured for the use of automotive engine controller.

Evolution

- The first microprocessor for Motorola is MC6800 introduced in 1974. This included 6802, 6808, 6809 and 6805
- MACSS introduced MC68000 in 1979 with 16 bit data bus and can be operated with 32 bit (16/32 bits)
- Other upgraded family such as 68020, 8030, 68040 and 68060 – upward compatible
- Also known as 680x0 or 68k
- Motorola ceased production of original NMOS 68000 in 2000 although its derivative such as 68HC00 is still continued in production
- As of 2001, Hitachi and other manufactures continue to manufacture the 68000 under license

68000 Manufacturer

Manufacturer	Description
Apple 68000-8	8 MHz, 64-pin side-brazed ceramic DIP
Hitachi HD68000-8	8 MHz, 64-pin side-brazed ceramic DIP
Mostek MK68000-8B	8 MHz, 64-pin plastic DIP
Motorola XC68000L	64-pin side-brazed ceramic DIP
Rockwell R68000C8	8 MHz, 64-pin side-brazed ceramic DIP
SGS-Thompson TS68000CP10	10 MHz, 64-pin plastic DIP
Signetics SCN68000C4164	4 MHz, 64-pin side-brazed ceramic DIP
Thompson TS68000CFN16	16 MHz, 68 Lead plastic LCC
Toshiba TMP68HC000P-10	10MHz, 64-pin plastic DIP
Motorola MC68HC000LC8	8 MHz, 64-pin side-brazed ceramic DIP
Hitachi HD68000Y10	10 MHz, 68-pin ceramic PGA

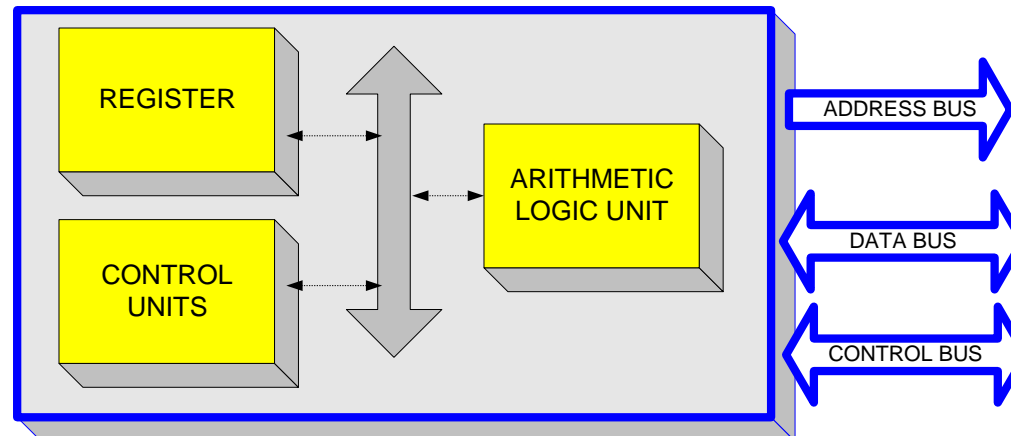
68000 General Specification

- Specifications
- 32-bit Data and Address Registers
- 16-bit Data Bus
- 24-bit Address Bus
- 14 Addressing Modes
- Memory-Mapped Input/Output
- Program Counter
- 56 General Instruction Sets
- 5 Main Data Types
- 7 Interrupt levels
- Synchronous and asynchronous data transfer



68000 Architecture

- 68000 consists of three main modules
 - Registers
 - Arithmetic Logic Unit (ALU)
 - Control Unit



68000 Registers

■ 8 Data Registers (D0 – D7)

- Data storage with 8, 16, and 32 bits operation

■ 8 Address Registers (A0 – A7)

- Address storage with 16 or 32 bits operation

- A7 also known as Stack Pointer

■ Program Counter (PC)

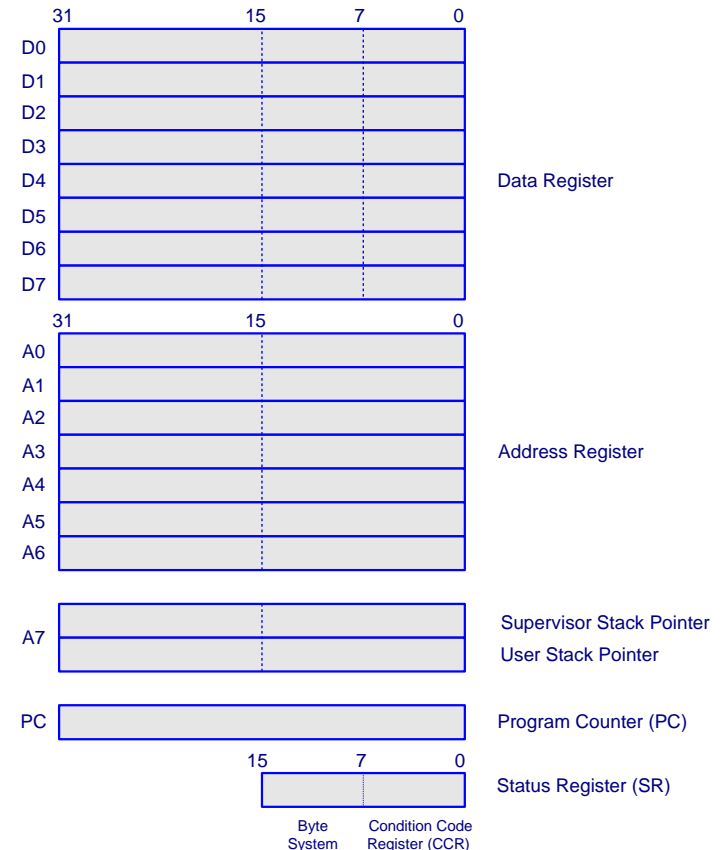
- Represent the next address of instruction

■ Status Register (SR)

- Consists of byte system and Condition code register (CCR)

- Information of result due to execution of instruction

■ Instruction Register (IR)



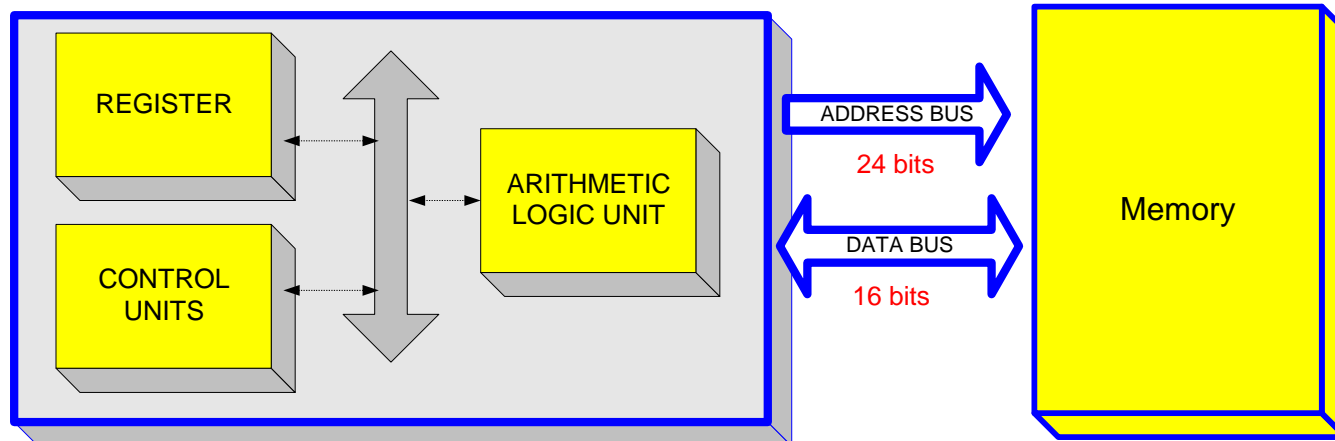
Status Register

Bit	Description
T	Tracing for run-time debugging
S	Supervisor or User mode
I	System responds to interrupts with a level higher than I
X	Retains information from carry bit for multi precision arithmetic
N	Set if the result is MSB is set
Z	Set if the result is zero
V	Set if a signed overflow occur
C	Set if a carry or borrow is generated



68000 & Memory

- Every byte in memory is assigned with an address
- Memory size depends on the size of address bus
- Address range that can be accessed by N bus is 0 to 2^N-1
- 68000 has 24 bits, thus it has 16 777 216 byte location

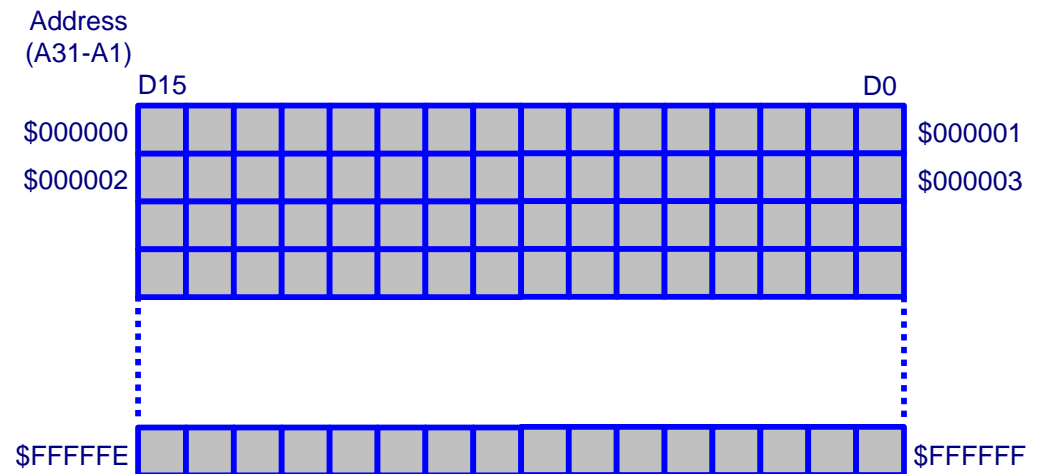
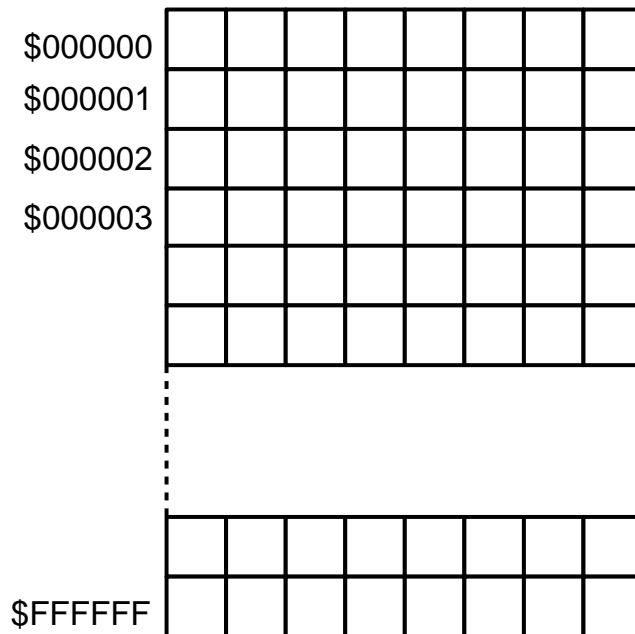


Memory Map

■ 24-bit addresses—16MB memory available

■ Reorganize due to 16-bit data bus

Content of a location



Byte Addressing

- 68000 can read/write data in byte form as the data bus width is 16 bit
- Thus byte can be placed anywhere in memory

\$000000	byte 0	byte 1	\$000001
\$000002	byte 2	byte 3	\$000003
\$000004	byte 4	byte 5	\$000005
\$000006	byte 6	byte 7	\$000007

68000 Family

- MC68000 – 16/32 Bit Microprocessor
- MC68EC000 – 16/32 Bit Embedded Controller
- MC68HC000 – Low Power 16/32 Bit Microprocessor
- MC68008 – 16-Bit Microprocessor with 8-Bit Data Bus
- MC68010 – 16/32 Bit Virtual memory Microprocessor
- MC68020 – 32 Bit Virtual memory Microprocessor
- MC68EC020 – 32 Bit Embedded Controller
- MC68030 – 2nd Generation 32 Bit Microprocessor
- MC68EC030 – 32 Bit Embedded Controller
- MC68040 – 3rd Generation 32 Bit Microprocessor

68000 Family

- MC68LC040 – 3rd Generation 32 Bit Microprocessor
- MC68EC040 – 32 Bit Embedded Controller
- MC68060 – MC68040 with exceptional performance
- MC68LC060 – MC68060 with no FPU (Floating Point Unit)
- MC68330 – Integrated CPU32 Processor
- MC68340 – Integrated Processor with DMA
- MC68881 – Floating Point Processor
- MC68882 – Enhanced Floating Point Processor
- MC68302 – MC68EC00 with internal DRAM, serial/parallel and timer

Self-Test

■ Exercise

Describe the READ operation in computer system

■ Exercise

What is the size of data bus and address bus of MC68000 ?

■ Exercise

If a processor has 8-bit data bus and 16-bit of address bus, what is possible size of the memory ?

■ Exercise

Why the address bus of A0 is not part of MC68000 pin configuration?