Registers

Most of the registers contain data/instruction offsets within 64 KB memory segment. There are four different 64 KB segments for instructions, stack, data and extra data. To specify where in 1 MB of processor memory these 4 segments are located the processor uses four segment registers:

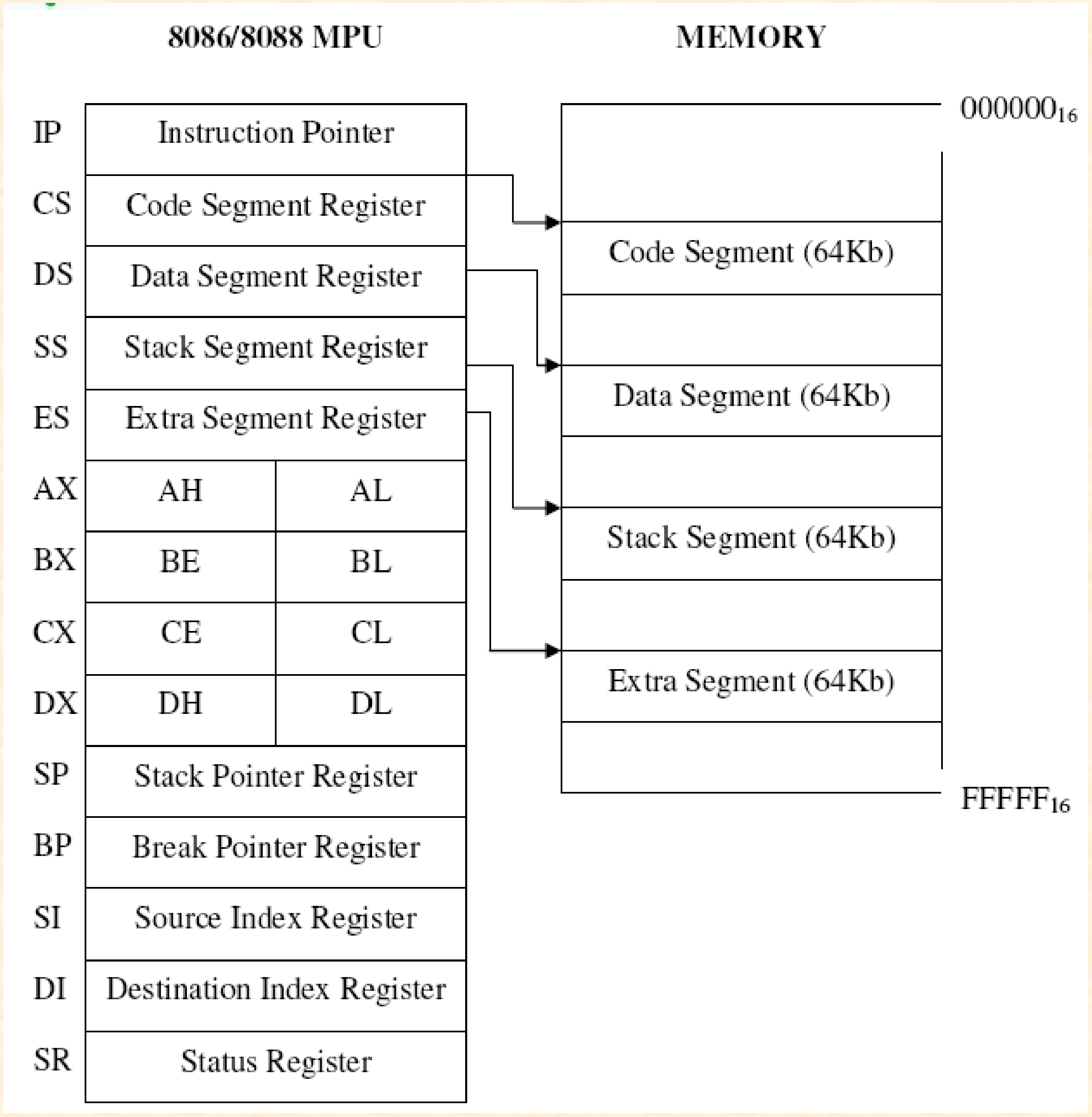
Code segment (CS) is a 16-bit register containing address of 64 KB segment with processor instructions. The processor uses CS segment for all accesses to instructions referenced by instruction pointer (IP) register. CS register cannot be changed directly. The CS register is automatically updated during far jump, far call and far return instructions.

Stack segment (SS) is a 16-bit register containing address of 64KB segment with program stack. By default, the processor assumes that all data referenced by the stack pointer (SP) and base pointer (BP) registers is located in the stack segment. SS register can be changed directly using POP instruction.

Segment Register

Data Register

Pointer & index Register



Data segment (DS) is a 16-bit register containing address of 64KB segment with program data. By default, the processor assumes that all data referenced by general registers (AX, BX, CX, DX) and index register (SI, DI) is located in the data segment. DS register can be changed directly using POP and LDS instructions.

Extra segment (ES) is a 16-bit register containing address of 64KB segment, usually with program data. By default, the processor assumes that the DI register references the ES segment in string manipulation instructions. ES register can be changed directly using POP and LES instructions.

It is possible to change default segments used by general and index registers by prefixing instructions with a CS, SS, DS or ES prefix.

All general registers of the 8086 microprocessor can be used for arithmetic and logic operations. The general registers are:

Accumulator register consists of 2 8-bit registers AL and AH, which can be combined together and used as a 16-bit register AX. AL in this case contains the low-order byte of the word, and AH contains the high-order byte. Accumulator can be used for I/O operations and string manipulation.

Base register consists of 2 8-bit registers BL and BH, which can be combined together and used as a 16-bit register BX. BL in this case contains the low-order byte of the word, and BH contains the high-order byte. BX register usually contains a data pointer used for based, based indexed or register indirect addressing.

Count register consists of 2 8-bit registers CL and CH, which can be combined together and used as a 16-bit register CX. When combined, CL register contains the low-order byte of the word, and CH contains the high-order byte. Count register can be used as a counter in string manipulation and shift/rotate instructions.

Data register consists of 2 8-bit registers DL and DH, which can be combined together and used as a 16-bit register DX. When combined, DL register contains the low-order byte of the word, and DH contains the high-order byte. Data register can be used as a port number in I/O operations. In integer 32-bit multiply and divide instruction the DX register contains high-order word of the initial or resulting number.

The following registers are both general and index registers:
Stack Pointer (SP) is a 16-bit register pointing to program stack.
Base Pointer (BP) is a 16-bit register pointing to data in stack segment. BP register is usually used for based, based indexed or register indirect addressing.
Source Index (SI) is a 16-bit register. SI is used for indexed, based indexed and register indirect addressing, as well as a source data address in string manipulation instructions.
Destination Index (DI) is a 16-bit register. DI is used for indexed, based indexed and register indirect addressing, as well as a destination data address in string manipulation instructions.

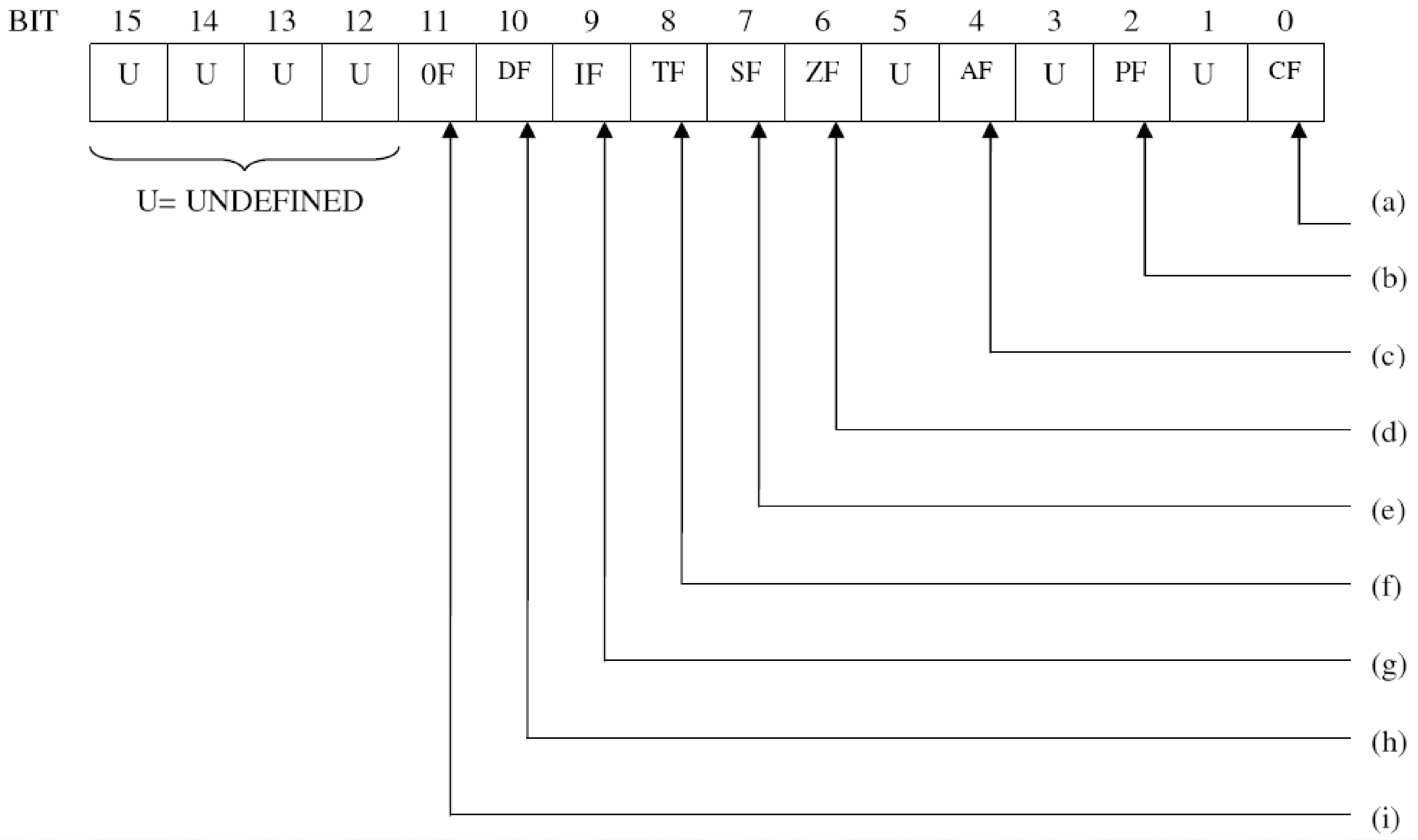
Other registers:

Instruction Pointer (IP) is a 16-bit register.

Flags is a 16-bit register containing 9 1-bit flags:

- •Overflow Flag (OF) - set if the result is too large positive number, or is too small negative number to fit into destination operand.
- •Direction Flag (DF) - if set then string manipulation instructions will auto-decrement index registers. If cleared then the index registers will be auto-incremented.
- •Interrupt-enable Flag (IF) - setting this bit enables maskable interrupts.
- •Single-step Flag (TF) - if set then single-step interrupt will occur after the next instruction.
- •Sign Flag (SF) - set if the most significant bit of the result is set.
- •Zero Flag (ZF) - set if the result is zero.
- •Auxiliary carry Flag (AF) - set if there was a carry from or borrow to bits 0-3 in the AL register.
- •Parity Flag (PF) - set if parity (the number of "1" bits) in the low-order byte of the result is even.
- •Carry Flag (CF) - set if there was a carry from or borrow to the most significant bit during last result calculation.

8086 flag register format


BIT
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
U
U
U
U
0F
DF
IF
TF
SF
ZF
U
AF
U
PF
U
CF
U= UNDEFINED
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
(i)