8087 Co Processors and Architechture

Overview
☐Each processor in the 80x86 family has a corresponding coprocessor with which it is compatible.
☐Math Coprocessor is known as NPX,NDP,FUP.
Numeric processor extension (NPX),
Numeric data processor (NDP),
Floating point unit (FUP).

Compatible Processor and Coprocessor

Processors
1. 8086 & 8088
2. 80286
3. 80386DX
4. 80386SX
5. 80486DX
6. 80486SX

Coprocessors
1. 8087
2. 80287,80287XL
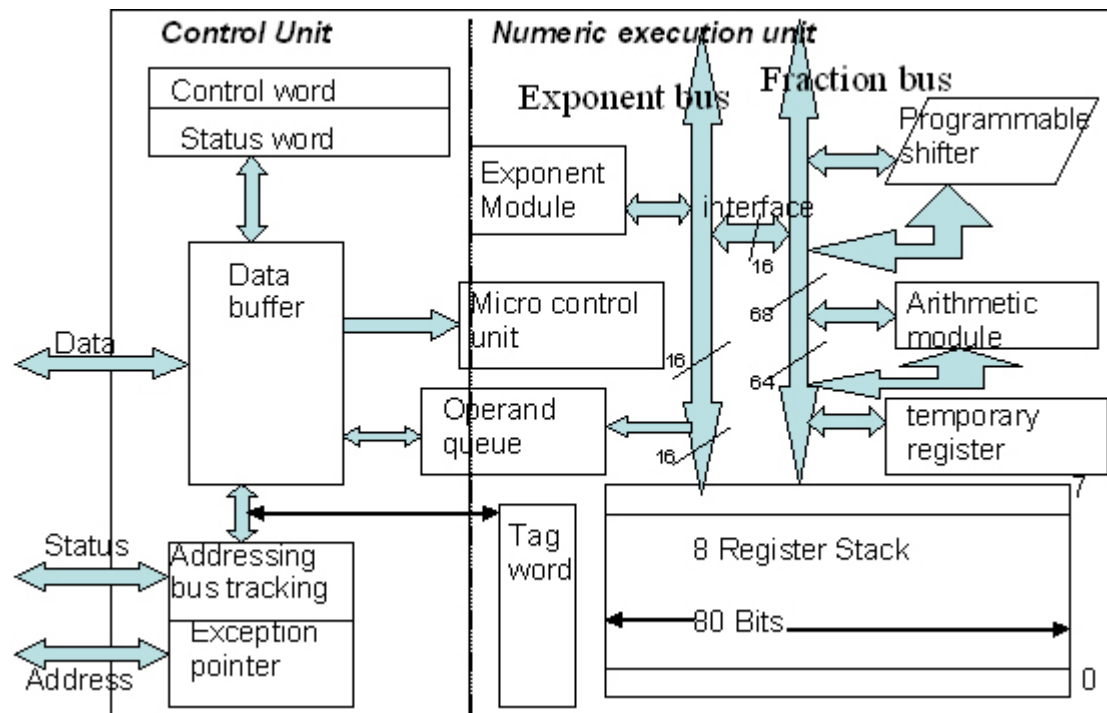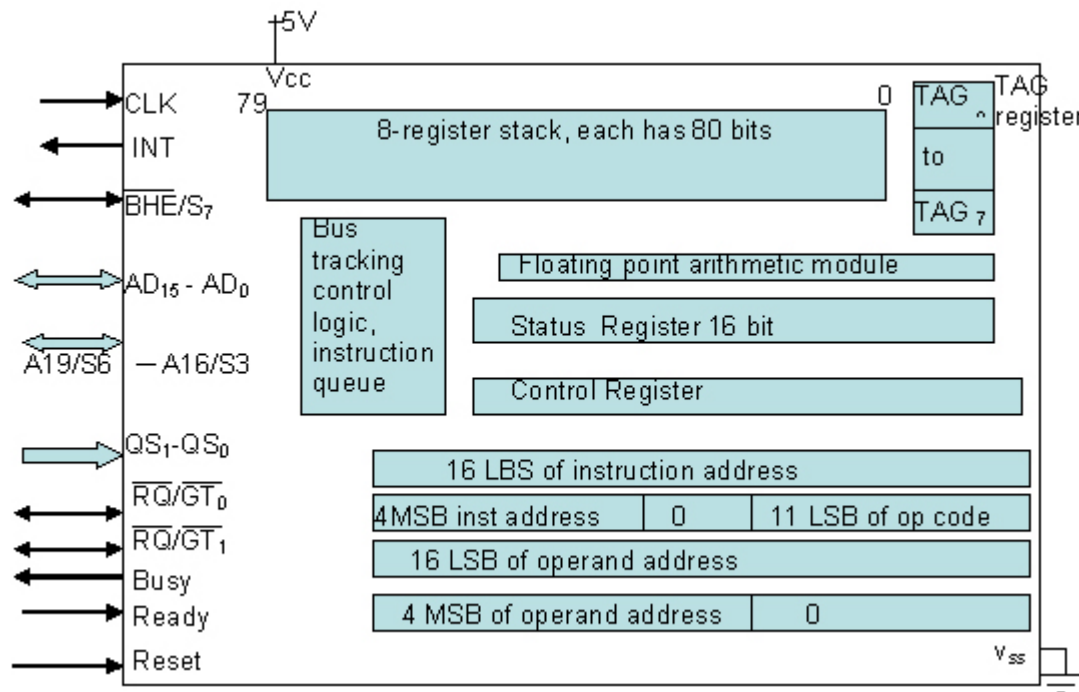3. 80287,80387DX
4. 80387SX
5. It is Inbuilt
6. 80487SX

Architecture of 8087

☐Control Unit
☐Execution Unit

Control Unit

☐Control unit: To synchronize the operation of the coprocessor and the processor.
☐This unit has a Control word and Status word and Data Buffer
☐If instruction is an *ESC*ape (coprocessor) instruction, the coprocessor executes it, if not the microprocessor executes.
☐Status register reflects the over all operation of the coprocessor.

Architecture of 8087

Status Register

15														0
B	C3		ST		C2	C1	C0	ES		PE	UE	OE	ZE	DE	IE

- C3-C0 Condition code bits
- TOP Top-of-stack (ST)
- ES Error summary
- PE Precision error
- UE Under flow error
- OE Overflow error
- ZE Zero error
- DE Denormalized error
- IE Invalid error
- B Busy bit

☐B-Busy bit indicates that coprocessor is busy executing a task. Busy can be tested by examining the status or by using the FWAIT instruction. Newer coprocessor automatically synchronize with the microprocessor, so busy flag need not be tested before performing additional coprocessor tasks.

☐C3-C0 Condition code bits indicates conditions about the coprocessor.

☐TOP- Top of the stack (ST) bit indicates the current register address as the top of the stack.

☐ES-Error summary bit is set if any unmasked error bit (PE, UE, OE, ZE, DE, or IE) is set. In the 8087 the error summary is also caused a coprocessor interrupt.

☐PE- Precision error indicates that the result or operand executes selected precision.

☐UE-Under flow error indicates the result is too large to be represent with the current precision selected by the control word.

☐OE-Over flow error indicates a result that is too large to be represented. If this error is masked, the coprocessor generates infinity for an overflow error.

☐ZE-A Zero error indicates the divisor was zero while the dividend is a non-infinity or non-zero number.

☐DE-Denormalized error indicates at least one of the operand is denormalized.

☐IE-Invalid error indicates a stack overflow or underflow, indeterminate from (0/0,0,-0, etc) or the use of a NAN as an operand. This flag indicates error such as those produced by taking the square root of a negative number.

CONTROL REGISTER

☐Control register selects precision, rounding control, infinity control.

☐It also masks an unmasks the exception bits that correspond to the rightmost Six bits of status register.

☐Instruction FLDCW is used to load the value into the control register.

Control Register

15														0
		IC	R	C	P	C			PM	UM	OM	ZM	DM	IM

•IC Infinity control
•RC Rounding control
•PC Precision control
•PM Precision control
•UM Underflow mask
•OM Overflow mask
•ZM Division by zero mask
•DM Denormalized operand mask
•IM Invalid operand mask
☐IC –Infinity control selects either affine or projective infinity. Affine allows positive and negative infinity, while projective assumes infinity is unsigned.

INFINITY CONTROL

0 = Projective
1 = Affine
☐RC –Rounding control determines the type of rounding.

ROUNDING CONTROL
00=Round to nearest or even
01=Round down towards minus infinity
10=Round up towards plus infinity
11=Chop or truncate towards zero
☐PC- Precision control sets the precision of he result as define in table

PRECISION CONTROL

00=Single precision (short)
01=Reserved
10=Double precision (long)
11=Extended precision (temporary)
☐Exception Masks – It Determines whether the error indicated by the exception affects the error bit in the status register. If a logic1 is placed in one of the exception control bits, corresponding status register bit is masked off.

Numeric Execution Unit

☐This performs all operations that access and manipulate the numeric data in the coprocessor"s registers.
☐Numeric registers in NUE are 80 bits wide.

NUE is able to perform arithmetic, logical and transcendental operations as well as supply a small number of mathematical constants from its on-chip ROM.
Numeric data is routed into two parts ways a 64 bit mantissa bus and a 16 bit sign/exponent bus.