Microprocessors and Peripheral Devices

Presented By:-

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8085 MICROPROCESSOR ARCHITECTURE

8085 is pronounced as "eighty-eighty-five" microprocessor. It is an 8-bit microprocessor designed by Intel in 1977 using NMOS technology.

It has the following configuration −

- 8-bit data bus
- 16-bit address bus, which can address upto 64KB
- A 16-bit program counter
- A 16-bit stack pointer
- Six 8-bit registers arranged in pairs: BC, DE, HL
- Requires +5V supply to operate at 3.2 MH_z single phase clock

It is used in washing machines, microwave ovens, mobile phones, etc.

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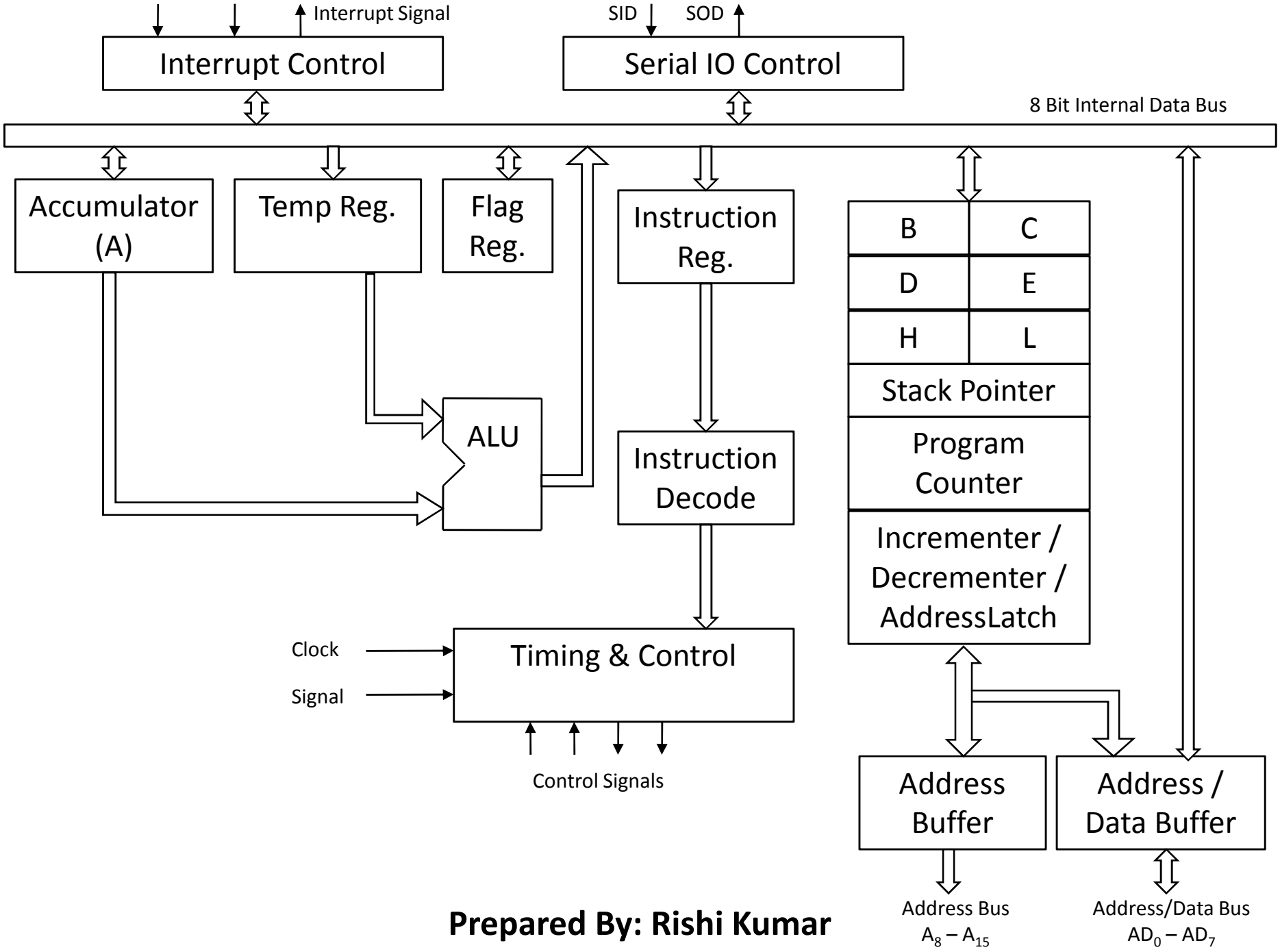

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8085 MICROPROCESSOR – FUNCTIONAL UNITS

- **Accumulator:-**It is an 8-bit register used to perform arithmetic, logical, I/O & LOAD/STORE operations. It is connected to internal data bus & ALU.
- **Arithmetic and logic unit:-** As the name suggests, it performs arithmetic and logical operations like Addition, Subtraction, AND, OR, etc. on 8-bit data.
- **General purpose register:-**There are 6 general purpose registers in 8085 processor, i.e. B, C, D, E, H & L. Each register can hold 8-bit data.

  These registers can work in pair to hold 16-bit data and their pairing combination is like B-C, D-E & H-L.

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8085 MICROPROCESSOR – FUNCTIONAL UNITS

- **Program counter:-**It is a 16-bit register used to store the memory address location of the next instruction to be executed. Microprocessor increments the program whenever an instruction is being executed, so that the program counter points to the memory address of the next instruction that is going to be executed.
- **Stack pointer:-**It is also a 16-bit register works like stack, which is always incremented/decremented by 2 during push & pop operations.
- **Temporary register:-**It is an 8-bit register, which holds the temporary data of arithmetic and logical operations.

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8085 MICROPROCESSOR – FUNCTIONAL UNITS

- **Flag register :-** It is an 8-bit register having five 1-bit flip-flops, which holds either 0 or 1 depending upon the result stored in the accumulator.

  These are the set of 5 flip-flops −

  - Sign (S)
  - Zero (Z)
  - Auxiliary Carry (AC)
  - Parity (P)
  - Carry (C)

  Its bit position is shown in the following table −

D7	D6	D5	D4	D3	D2	D1	D0
S	Z		AC		P		CY

8085 MICROPROCESSOR – FUNCTIONAL UNITS

Flags:-

1.Sign Flag (S):- After execution of any arithmetic and logical operation, if D7 of the result is 1, the sign flag is set. Otherwise it is reset. D7 is reserved for indicating the sign; the remaining is the magnitude of number. If D7 is 1, the number will be viewed as negative number. If D7 is 0, the number will be viewed as positive number.

2.Zero Flag (z):- If the result of arithmetic and logical operation is zero, then zero flag is set otherwise it is reset.

3.Auxiliary Carry Flag (AC):If D3 generates any carry when doing any arithmetic and logical operation, this flag is set. Otherwise it is reset.

4.Parity Flag (P):- If the result of arithmetic and logical operation contains even number of 1's then this flag will be set and if it is odd number of 1's it will be reset.

5.Carry Flag (CY):- If any arithmetic and logical operation result any carry then carry flag is set otherwise it is reset.

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8085 MICROPROCESSOR – FUNCTIONAL UNITS

- **Instruction register and decoder:-**It is an 8-bit register. When an instruction is fetched from memory then it is stored in the Instruction register. Instruction decoder decodes the information present in the Instruction register.
- **Timing and control unit:-**It provides timing and control signal to the microprocessor to perform operations. Following are the timing and control signals, which control external and internal circuits −
  - Control Signals: READY, RD', WR', ALE
  - Status Signals: S0, S1, IO/M'
  - DMA Signals: HOLD, HLDA
  - RESET Signals: RESET IN, RESET OUT

8085 MICROPROCESSOR – FUNCTIONAL UNITS

- **Interrupt control:-**As the name suggests it controls the interrupts during a process. When a microprocessor is executing a main program and whenever an interrupt occurs, the microprocessor shifts the control from the main program to process the incoming request. After the request is completed, the control goes back to the main program.

  There are 5 interrupt signals in 8085 microprocessor: INTR, RST 7.5, RST 6.5, RST 5.5, TRAP.

- **Serial Input/output control:-**It controls the serial data communication by using these two instructions: SID (Serial input data) and SOD (Serial output data).

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8085 MICROPROCESSOR – FUNCTIONAL UNITS

- **Address buffer and address-data buffer:-**The content stored in the stack pointer and program counter is loaded into the address buffer and address-data buffer to communicate with the CPU. The memory and I/O chips are connected to these buses; the CPU can exchange the desired data with the memory and I/O chips.
- **Address bus and data bus:-**Data bus carries the data to be stored. It is bidirectional, whereas address bus carries the location to where it should be stored and it is unidirectional. It is used to transfer the data & Address I/O devices.

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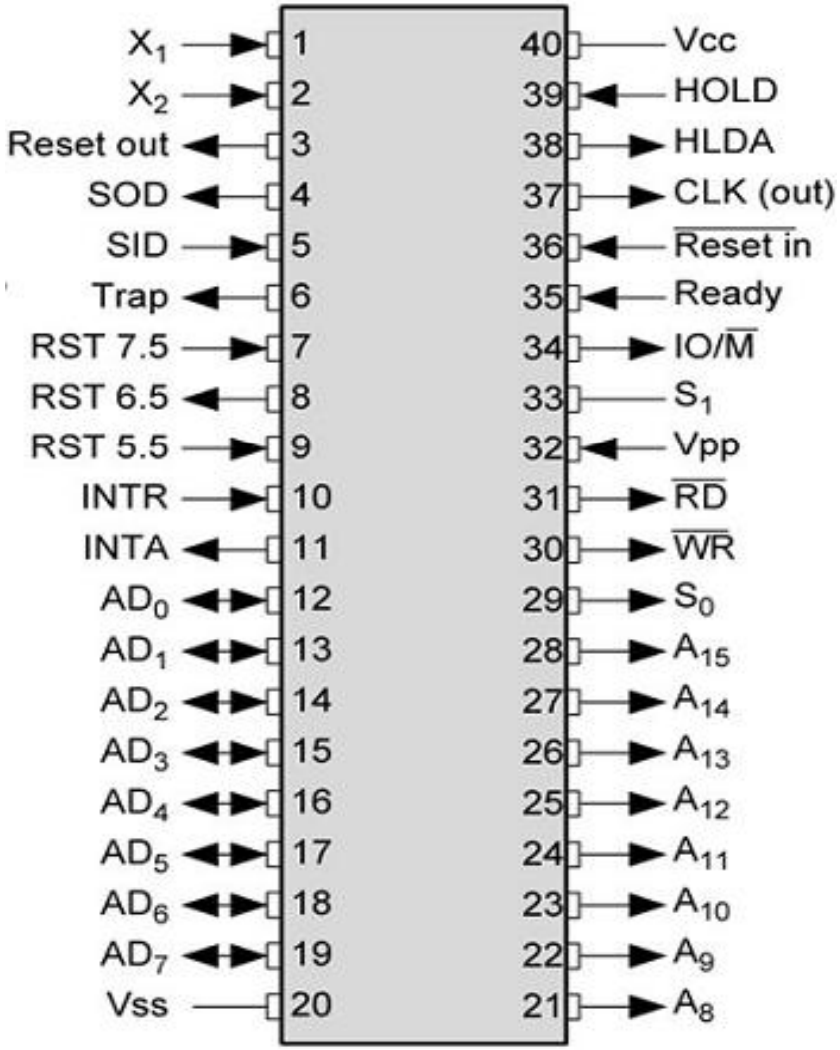
PIN CONFIGURATION OF 8085 MICROPROCESSOR:-



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PIN CONFIGURATION OF 8085 MICROPROCESSOR:-

- **Address bus:-**A15-A8, it carries the most significant 8-bits of memory/IO address.
- **Data bus:-**AD7-AD0, it carries the least significant 8-bit address & data bus.
- **Control signals:-**These signals are used to identify the nature of operation. There are 3 control signal and 3 status signals.

  Three control signals are RD, WR & ALE.

  RD – This signal indicates that the selected IO or memory device is to be read and is ready for accepting data available on the data bus.

  WR – This signal indicates that the data on the data bus is to be written into a selected memory or IO location.

  ALE – It is a positive going pulse generated when a new operation is started by the microprocessor. When the pulse goes high, it indicates address. When the pulse goes down it indicates data.

PIN CONFIGURATION OF 8085 MICROPROCESSOR:-

- **Status Signals:-**Three status signals are IO/M, S0 & S1.

  IO/M:-This signal is used to differentiate between IO and Memory operations, i.e. when it is high indicates IO operation and when it is low then it indicates memory operation.

  S1 & S0:-These signals are used to identify the type of current operation.

- **Power supply:-**There are 2 power supply signals – VCC & VSS. VCC indicates +5v power supply and VSS indicates ground signal.

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PIN CONFIGURATION OF 8085 MICROPROCESSOR:-

- **Clock signals:-**There are 3 clock signals, i.e. X1, X2, CLK OUT.

  X1, X2 – A crystal (RC, LC N/W) is connected at these two pins and is used to set frequency of the internal clock generator. This frequency is internally divided by 2.

  CLK OUT – This signal is used as the system clock for devices connected with the microprocessor.

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PIN CONFIGURATION OF 8085 MICROPROCESSOR:-

- **Interrupts & externally initiated signals:-**
  Interrupts are the signals generated by external devices to request the microprocessor to perform a task. There are 5 interrupt signals, i.e. TRAP, RST 7.5, RST 6.5, RST 5.5, and INTR. We will discuss interrupts in detail in interrupts section.

  INTA – It is an interrupt acknowledgment signal.

  RESET IN – This signal is used to reset the microprocessor by setting the program counter to zero.

  RESET OUT – This signal is used to reset all the connected devices when the microprocessor is reset.

  READY – This signal indicates that the device is ready to send or receive data. If READY is low, then the CPU has to wait for READY to go high.

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PIN CONFIGURATION OF 8085 MICROPROCESSOR:-

- **Interrupts & externally initiated signals:-**

  HOLD – This signal indicates that another master is requesting the use of the address and data buses.

  HLDA (HOLD Acknowledge) – It indicates that the CPU has received the HOLD request and it will relinquish the bus in the next clock cycle. HLDA is set to low after the HOLD signal is removed.

PIN CONFIGURATION OF 8085 MICROPROCESSOR:-

- **Serial I/O signals:-**There are 2 serial signals, i.e. SID and SOD and these signals are used for serial communication.

  SOD (Serial output data line) − The output SOD is set/reset as specified by the SIM instruction.

  SID (Serial input data line) − The data on this line is loaded into accumulator whenever a RIM instruction is executed.

ADDRESSING MODES IN 8085

Addressing Modes are the instructions used to transfer the data from one register to another register, from the memory to the register, and from the register to the memory without any alteration in the content. Addressing modes in 8085 is classified into 5 groups −

1. **Immediate addressing mode:-**In this mode, the 8/16-bit data is specified in the instruction itself as one of its operand. It may be 2bytes or 3 bytes long.

For example:

MVI	D, 20H	20H is copied into register D.
		(2 bytes instruction)
LXI	B, 2050H	Load 2050H in register pair B-C.
		(3 bytes instruction)

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ADDRESSING MODES IN 8085

2. Register addressing mode:- In this mode, the data is copied from one register to another.

For example:

MOV A, B data in register B is copied to register

3. Direct addressing mode:- In this mode, the data is directly copied from the given address to the register.

For example:

STA 2400H data at address 2400H is copied to register A.

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ADDRESSING MODES IN 8085

4. **Indirect addressing mode:-**In this mode, the data is transferred from one register to another by using the address pointed by the register.

For example:

LADX 06H	Move the contents of memory location, whose address is the contents of BC register pair, to A.

5. **Implied addressing mode:-**This mode doesn't require any operand; the data is specified by the opcode itself.

For example:

CMP	Content of the accumulator are complemented.

INTEL 8085 INSTRUCTION

An instruction is a command issued to the microprocessor to perform a given task on some specified data. It is a binary pattern designed inside a microprocessor to perform the specific task. Instruction can be classified into five functional group:-

1. **Data Transfer Group:-** This group of instruction transfer (copies) data from a location to another location. Data transfer instructions are:

```
MOV     B,C
MOV     B, M
MVI     B, 58H
LXI     B, 2500H
STA     2000H
```

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INTEL 8085 INSTRUCTION

2. **Arithmetic Group:-** This group of instruction perform Arithmetic operations like addition, subtraction, increment, decrement etc. Some of Arithmetic instructions are:

ADD	B
ADC	H
SBB	M
INR	C
SBI	52H
DCR	M
INX	H

INTEL 8085 INSTRUCTION

3. **Logical Group:-** This group of instruction perform Logical operations like AND, OR, EX-OR, Complement etc. Some of Logical instructions are:

ANA	B
ANI	65H
ORA	M
CMA	
CMC	
STC	
RAL	

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INTEL 8085 INSTRUCTION

4. **Branch Group:-** This group of instruction change sequence of program. Some of Branch instructions are:

JMP	2050H
JNC	2050H
JPE	2050H
JM	2000H
CALL	2100H
CPE	2200H
RPO	2300H

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INTEL 8085 INSTRUCTION

4. **Machine Control Group:-** Machine control instructions are:

HLT	Halt and enter into wait state.
EI	Enable Interrupts
DI	Disable Interrupts
SIM	Set Interrupt mask
RIM	Read Interrupt Mask
NOP	No operation.

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INTERRUPTS IN 8085

Interrupts are the signals generated by the external devices to request the microprocessor to perform a task. There are 5 interrupt signals, i.e. TRAP, RST 7.5, RST 6.5, RST 5.5, and INTR.

Interrupt are classified into following groups based on their parameter −

- **Vector interrupt** − In this type of interrupt, the interrupt address is known to the processor.

  For example: RST7.5, RST6.5, RST5.5, TRAP.

- **Non-Vector interrupt** − In this type of interrupt, the interrupt address is not known to the processor so, the interrupt address needs to be sent externally by the device to perform interrupts.

  For example: INTR.

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INTERRUPTS IN 8085

- **Maskable interrupt** – In this type of interrupt, we can disable the interrupt by writing some instructions into the program.

  For example:RST7.5, RST6.5, RST5.5.

- **Non-Maskable interrupt** – In this type of interrupt, we cannot disable the interrupt by writing some instructions into the program.

  For example: TRAP.

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INTERRUPTS IN 8085

- **Software interrupt** – In this type of interrupt, the programmer has to add the instructions into the program to execute the interrupt. There are 8 software interrupts in 8085, i.e. RST0, RST1, RST2, RST3, RST4, RST5, RST6, and RST7.

- **Hardware interrupt** – There are 5 interrupt pins in 8085 used as hardware interrupts, i.e. TRAP, RST7.5, RST6.5, RST5.5, INTA.

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