HARRIS

# CDP68EM05C4
# CDP68EM05C4N

## CMOS High Performance Silicon Gate 8-Bit Microcontroller Emulator

January 1991



### Features

- **CDP68HC05C4/C8 Microcontroller Emulation**
  - **All CDP68HC05C4/C8 Hardware and Softwear Features, Except as Noted in this Data Sheet**
- **Full 8K Byte Address Space Available (7984 Bytes Available Externally)**
- **176 Bytes of On-Chip RAM, No ROM**
- **Also Can be Used for CDP68HC05C8 Emulation**
- **Un-Multiplexed External Address and Data Lines**
- **Available in Two Package Types:**
  - **CDP68EM05C4 - 40 Lead Piggyback Package with 2764 EPROM Socket Capability**
  - **CDP68EM05C4N - 68 Lead Plastic Chip Carrier (PLCC)**

### Description

The CDP68EM05C4 and CDP68EM05C4N Emulator devices are functionally equivalent to the CDP68HC05C4 microcomputer, and are designed to permit prototype development and preproduction of systems for mask programmed applications. Data bus, address bus and control signals are externally available to provide off chip address capability.

In addition to this feature, the Emulator devices differ from the CDP68HC05C4 microcomputer as follows: 1) Memory locations which are occupied as ROM on the CDP68HC05C4 are accessed as external locations with the Emulators. 2) Mask-programmable options available on the microcomputer (i.e., CPU oscillator type and external interrupt sense) are fixed in hardware in the Emulator devices, and are available as separate Emulator types identified with suffix letters EC, ELC, ER or ELR. The corresponding option for each suffix letter is shown below:

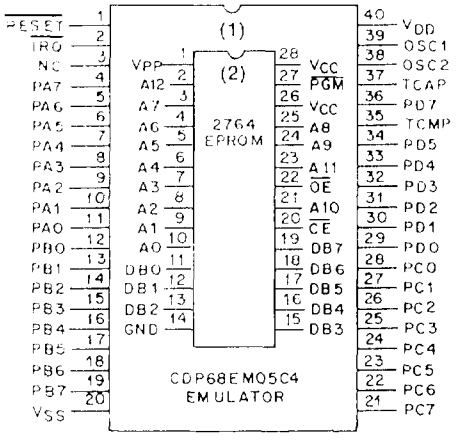
a) CPU oscillator type: C = crystal/ceramic resonator; R = resistor.

b) External interrupt sense: EL = negative edge and level sensitive; E = edge only sensitive.

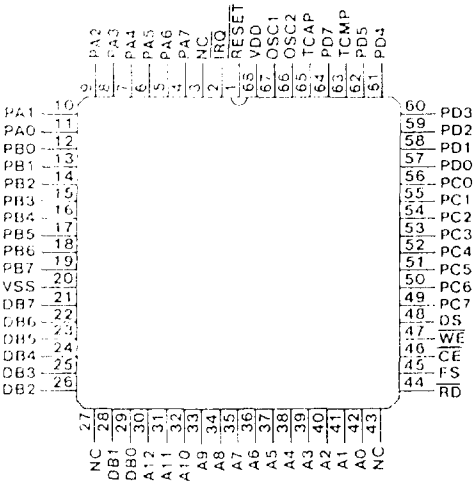
The CDP68EM05C4 and CDP68EM05C4N represent two package types. The CDP68EM05C4 is available in a piggyback package having the footprint of the 40 lead dual-in-line package of the CDP68HC05C4 microcomputer. The top of the piggyback package has socket capability for a 28 lead EPROM. The CDP68EM05C4N is available in a 68 lead Plastic Chip Carrier (PLCC).

### Pinouts

CDP68EM05C4
40 LEAD PIGGYBACK PACKAGE
TOP VIEW




CDP68EM05C4N
68 LEAD PLASTIC CHIP CARRIER
TOP VIEW

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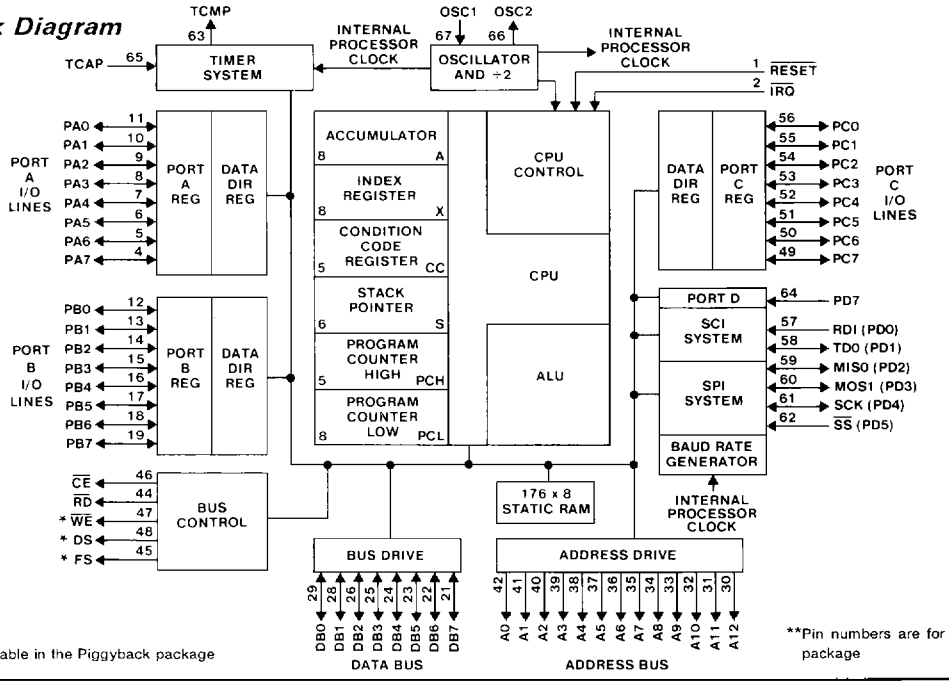
File Number **2754**

## Block Diagram




*Not available in the Piggyback package

**Pin numbers are for PLCC package

## Memory

The CDP68EM05C4 and CDP68EM05C4N Emulators each have a total address space of 8192 bytes. The Emulators have implemented 208 bytes of the address locations for I/O and internal RAM. The remainder is available for external memory. The first 256 bytes of memory (page zero) are comprised of the I/O port locations, timer locations, 48 bytes of external address space and 176 bytes of RAM. The next 7936 bytes are available to address external memory. The address map is shown in Figure 1. A description of the remaining internal addressable functions can be found in the CDP68HC05C4 data sheet, File No. 2748, see Section 2 of this Data Book.

## Signal Descriptions

The following list includes only those additional signals that are not available on the CDP68HC05C4 microcomputer. See the CDP68HC05C4 data sheet for a description of the remaining signals which are common to the Emulators and the CDP68HC05C4 microcomputer.

A0-A12 - Address lines 0 through 12.

DB0-DB7 - Bidirectional 8-bit non-multiplexed data bus with TTL inputs.

$\overline{CE}$, ($\overline{OE}$*) - Chip Enable: An output signal used for selecting external memory or I/O. A low level indicates when external RAM or I/O is being accessed. The Chip Enable signal will not go true, however, when addressing the 7 unused locations in the 32 bytes of I/O space even though the address lines will be valid.

$\overline{RD}$, ($\overline{CE}$*) - Read: A status output which indicates direction of data flow with respect to external or internal memory (a low level indicates a read from memory space). A read from internal memory or I/O will place data on the external data bus.

$\overline{WE}$** - Write Enable: An active low strobe pulse output for use in writing data to external RAM memory. A low level indicates valid data on the data bus.

DS** - Data Strobe: An output signal for use as a strobe pulse when address and data are valid. This output is used to transfer data to or from a peripheral or memory and occurs any time the Emulator reads or writes. DS is a continuous signal at fosc ÷ 2 when the Emulator is not in the WAIT or STOP mode.

FS** - Fetch Status: An output which indicates an op code fetch cycle

* $\overline{CE}$ and $\overline{RD}$ are used as $\overline{OE}$ (Output Enable) and $\overline{CE}$ (Chip Enable) signals, respectively in the Piggyback package.

** Not available in the Piggyback package.

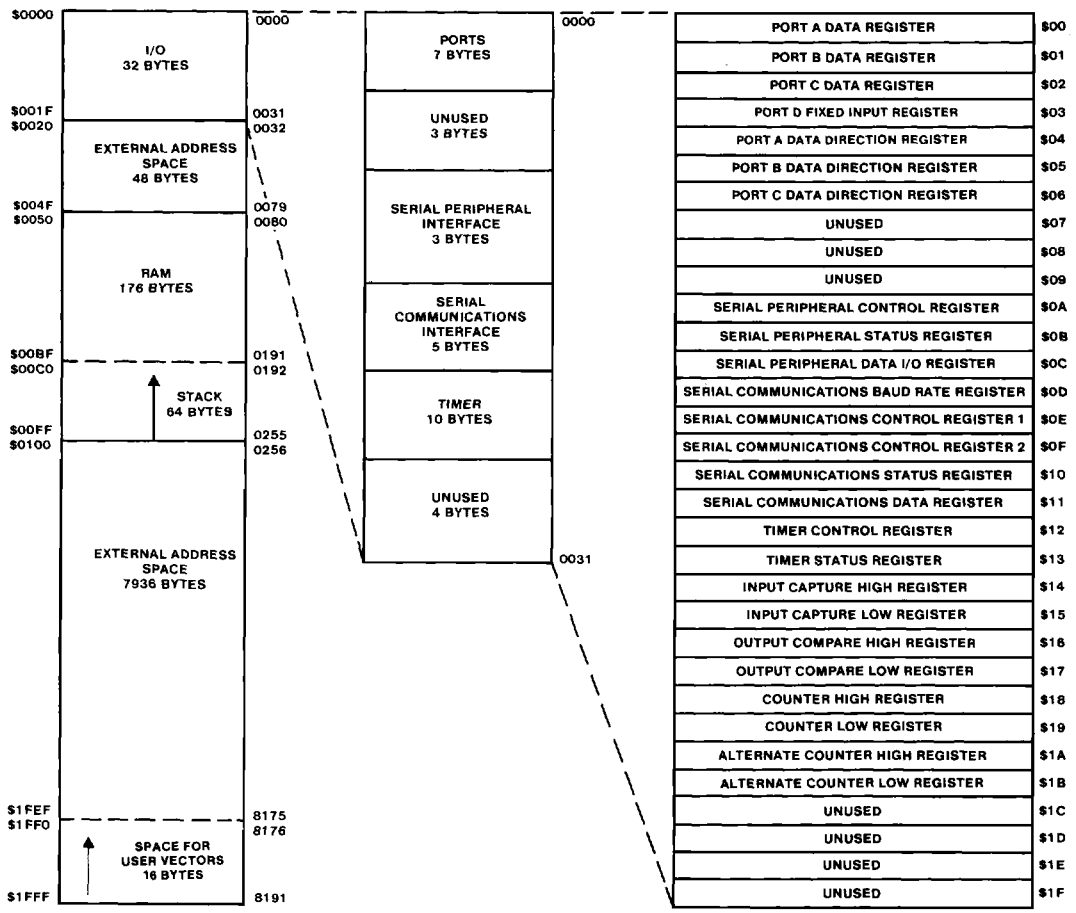



FIGURE 1. ADDRESS MAP.

## $\overline{IRQ}$ (Maskable Interrupt Request)

Interrupt input trigger sensitivity is available as either 1) negative edge-sensitive only, or 2) both negative edge-sensitive and level-sensitive triggering. In the latter case, either type of input to the $\overline{IRQ}$ pin will produce the interrupt. The Emulator completes the current instruction before it responds to the interrupt request. When the $\overline{IRQ}$ pin goes low for at least one tILIH as defined in the CDP68HC05C4 data sheet, a logic one is latched internally to signify that an interrupt has been requested. When the Emulator completes it's current instruction, the interrupt latch is tested. If the interrupt latch contains a logic one, and the interrupt mask bit (I bit) in the condition code register is clear, the Emulator then begins the interrupt sequence. The $\overline{IRQ}$ input requires an external resistor to VDD for "wire-OR" operation.

## OSC1, OSC2

Oscillator ($f_{OSC}$) connections. Depending on the Emulator CPU oscillator type, which is fixed in hardware, the pins can be configured for either a crystal or ceramic resonator oscillator, or for an RC oscillator. Alternatively, with either CPU oscillator type*, an external clock may be used by applying the external clock signal to the OSC1 input with the OSC2 pin not connected. The internal clocks are derived by a divide-by-2 of the oscillator frequency ($f_{OSC}$).

* The crystal/ceramic resonator CPU oscillator type is recommended to reduce loading on the external clock source.

**READ CYCLE TIMING CDP68EM05C4** (Piggyback Emulator)
VDD = 5.0V ± 10%, VSS = 0V, $T_A = 25^oC$

| PARAMETER | | LIMITS | | UNITS |
|---|---|---|---|---|
| | | MIN | MAX | |
| External Input Oscillator Pulse Width, Low or High | TCPL, TCPH | 90 | — | ns |
| Read Cycle | TRC | 476 | — | ns |
| Address Before $\overline{OE}$ | TOA | 50 | — | ns |
| Access Time From $\overline{OE}$ | TAO | — | 200 | ns |
| Access Time From Stable Address | TAA | — | 350 | ns |
| Access Time From $\overline{CE}$ | TAA | — | 350 | ns |
| Data Bus Driven From $\overline{OE}$ | TEX | 0 | — | ns |
| Address Hold Time After $\overline{OE}$ | TAH | 0 | — | ns |
| Data Hold Time After Address | TOH | 0 | — | ns |
| Data Hold Time After $\overline{OE}$ | TDH | 0 | — | ns |
| $\overline{OE}$ High to Data Bus not Driven | THZ | 0 | 60 | ns |

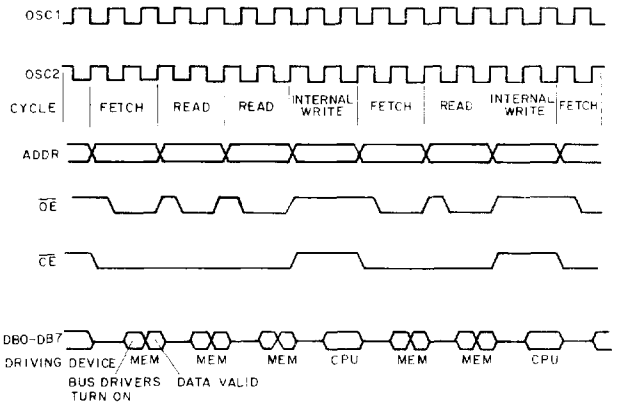



**FIGURE 2. TYPICAL CYCLE TIMING FOR THE CDP68EM05C4 EMULATOR.**

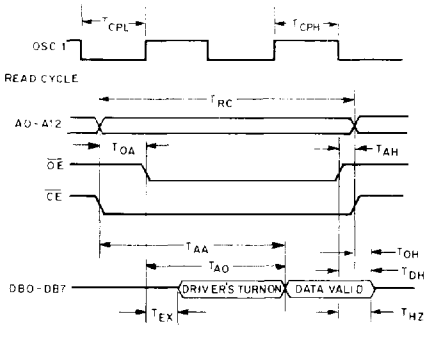



**FIGURE 3. CONTROL TIMING DIAGRAM FOR THE CDP68EM05C4 EMULATOR.**

**READ CYCLE TIMING CDP68EM05C4N** (PLCC Emulator)
VDD = 5.0V ± 10%, VSS = 0V, TA = 25°C

| PARAMETER | | LIMITS | | UNITS |
|---|---|---|---|---|
| | | MIN | MAX | |
| External Input Oscillator Pulse Width, Low or High | TCPL, TCPH | 90 | — | ns |
| Read Cycle | TRC | 476 | — | ns |
| Address Before Chip Enable | TCA | 50 | — | ns |
| Access Time From Chip Enable | TAC | — | 200 | ns |
| Access Time From Address | TAA | — | 350 | ns |
| Access Time From $\overline{RD}$ | TAA | — | 350 | ns |
| Data Bus Driven From $\overline{CE}$ | TEX | 0 | — | ns |
| Address Hold Time After $\overline{CE}$ | TAH | 0 | — | ns |
| Data Hold Time After Address | TOH | 0 | — | ns |
| Data Hold Time After $\overline{CE}$ | TDH | 0 | — | ns |
| $\overline{CE}$ High to Data Bus Not Driven | THZ | 0 | 60 | ns |

**WRITE CYCLE TIMING CDP68EM05C4N** (PLCC Emulator)
VDD = 5.0V ± 10%, VSS = 0V, TA = 25°C

| PARAMETER | | LIMITS | | UNITS |
|---|---|---|---|---|
| | | MIN | MAX | |
| External Input Oscillator Pulse Width, Low or High | TCPL, TCPH | 90 | — | ns |
| Write Cycle | TWC | 476 | — | ns |
| Address Before $\overline{CE}$, $\overline{WE}$ | TAS | 50 | — | ns |
| DS, $\overline{WE}$ Pulse Width | TDSP, TWP | 200 | — | ns |
| $\overline{WE}$ = L to CPU Driving Bus | TWHZ | 0 | — | ns |
| Data Set-Up Time | TDS | 150 | — | ns |
| Data Hold Time After $\overline{WE}$ | TDH | 50 | — | ns |
| Address Valid After $\overline{WE}$ | TWR | 50 | — | ns |
| $\overline{WE}$ High to Bus Not Driven | TDOZ | 50 | — | ns |

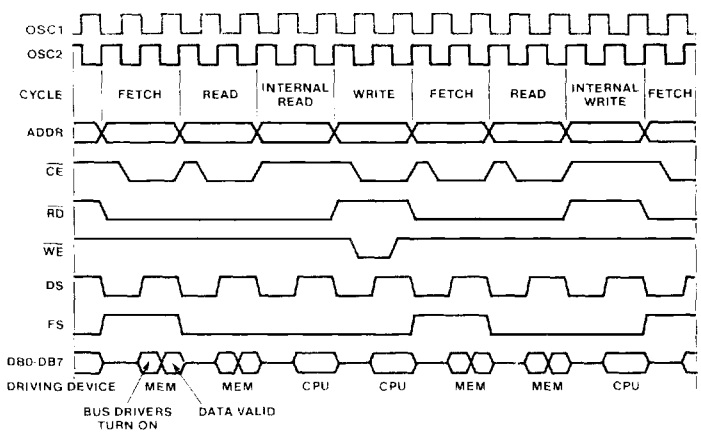



FIGURE 4. CDP68EM05C4N EMULATOR TYPICAL CYCLE TIMING

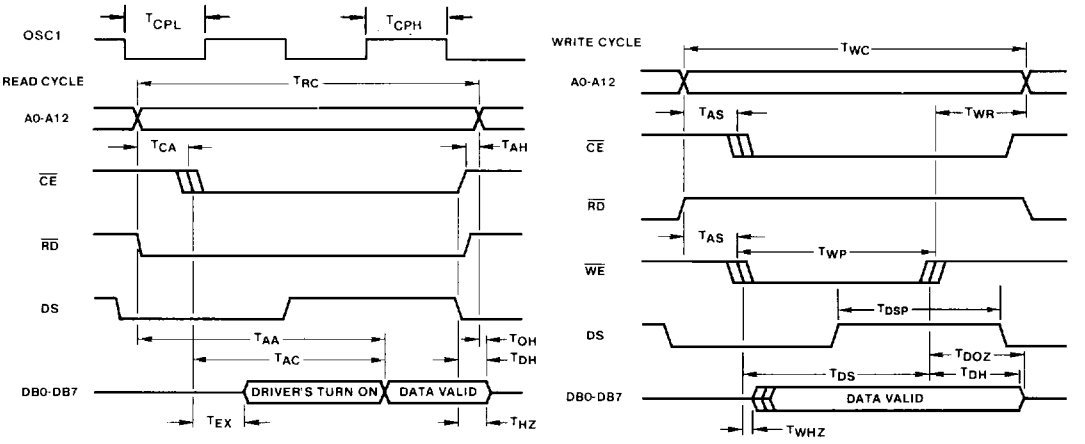



FIGURE 5. CDP68EM05C4N EMULATOR CONTROL TIMING DIAGRAMS.

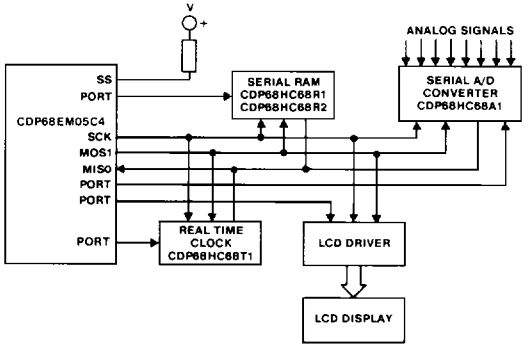



FIGURE 6. SERIAL PERIPHERAL INTERFACE (SPI) BUS SYSTEM.

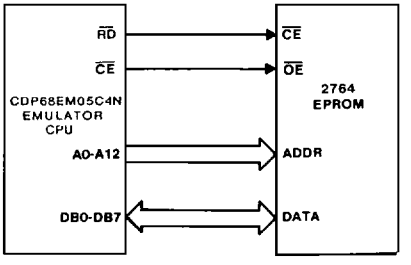



FIGURE 7. CDP68EM05C4N EMULATOR INTERFACED WITH 2764 EPROM.

## *Customer Ordering Information*

The four available variations should be ordered by the following part number designations:

CDP68EM05C4EC - CDP68EM05C4NEC — Edge only sensitive interrupts with crystal or ceramic resonator oscillator network.

CDP68EM05C4ELC - CDP68EM05C4NELC — Edge and level sensitive interrupts with crystal or ceramic resonator oscillator network.

CDP68EM05C4ER - CDP68EM05C4NER — Edge only sensitive interrupts, resistor oscillator network.

CDP68EM05C4ELR - CDP68EM05C4NELR — Edge and level sensitive interrupts, resistor oscillator network.