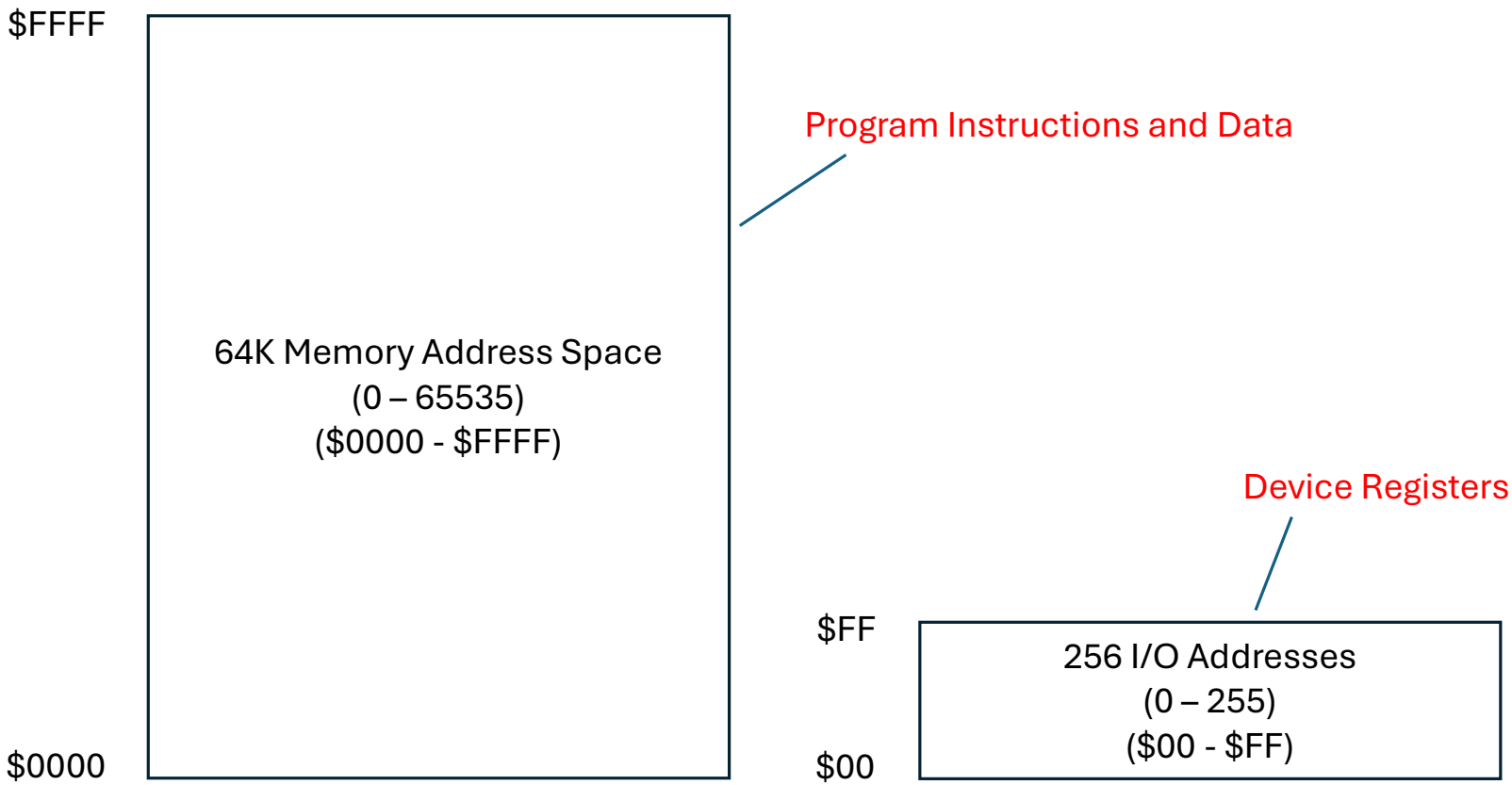

8080 Microcomputer System
POWER
RESET

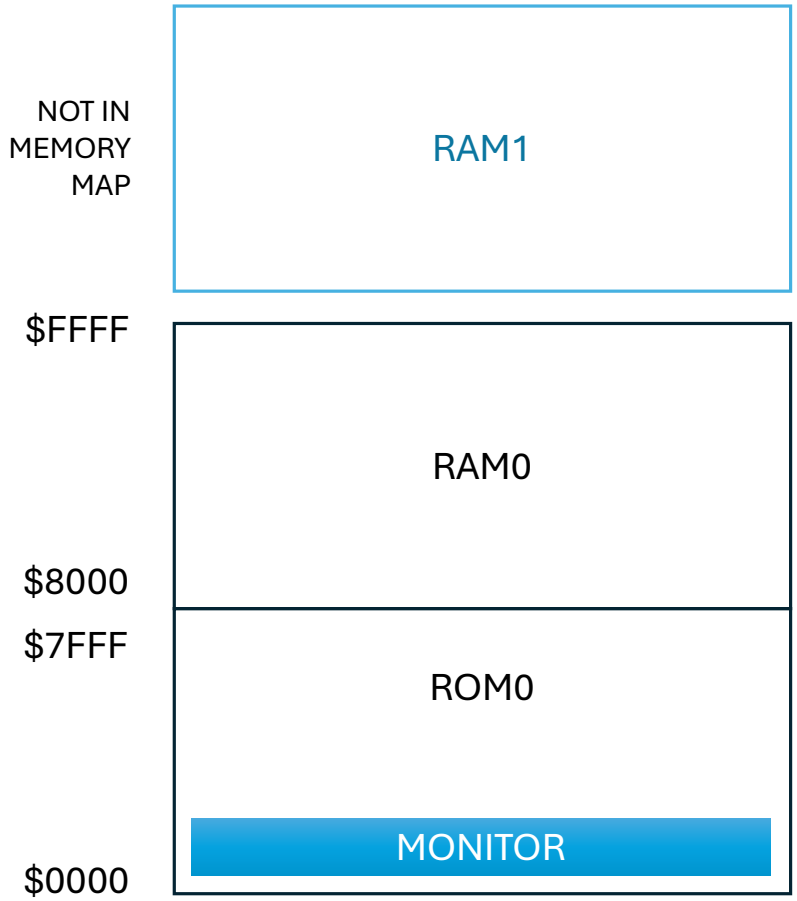
8080 Computer Specifications

Intel 8080 Microprocessor @ 2.2MHz
64KB Static RAM (2x Hitachi HM62256LB-15)
32KB Flash ROM (MicroChip AT28C256-15)
128MB ATA (IDE) Compact Flash Drive
Intel 8250 Serial Port with TTL and RS-232 interface
60W Power Supply (Mean Well 709-PT65A)

8080 Memory and I/O

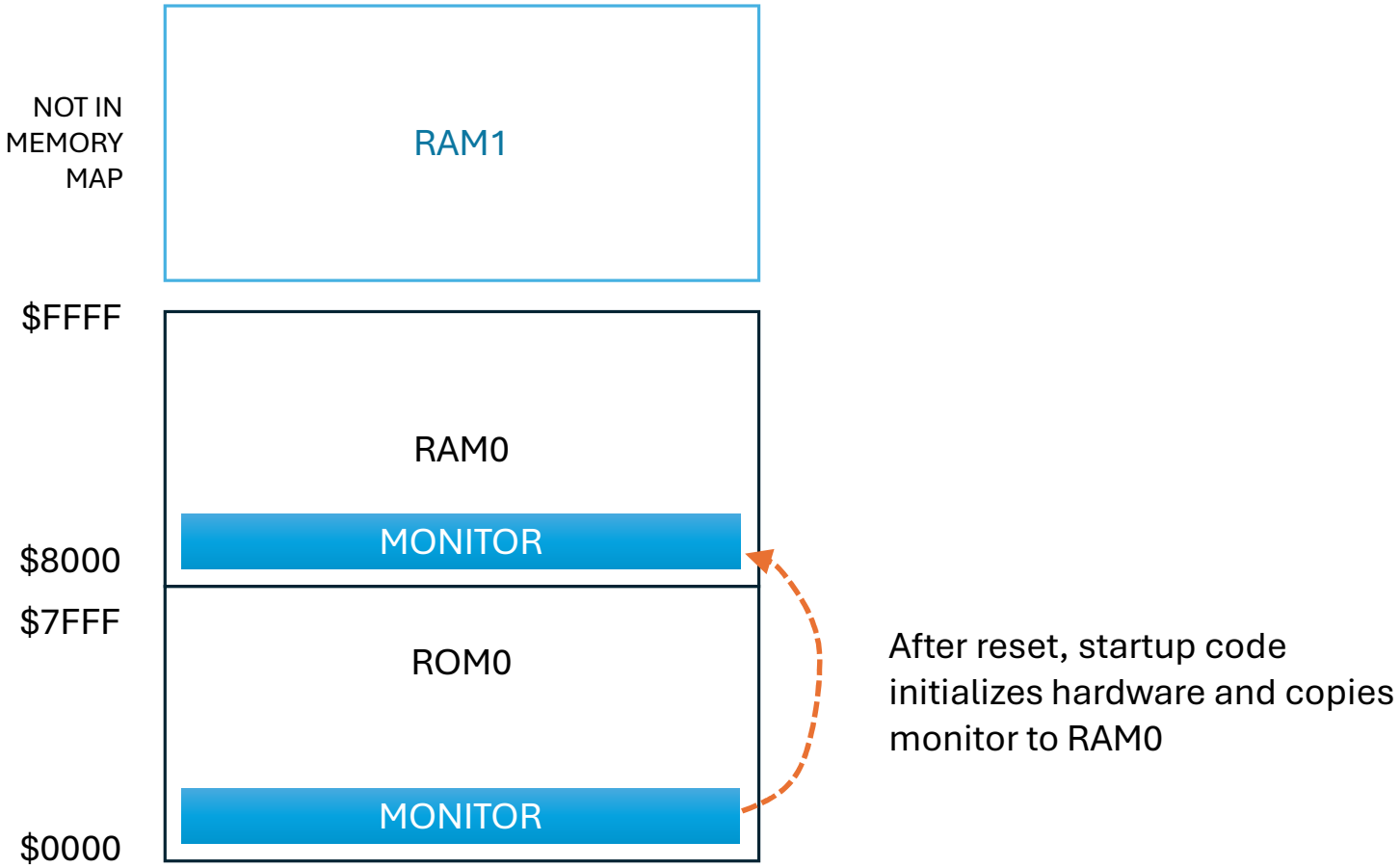


Memory Map After Reset

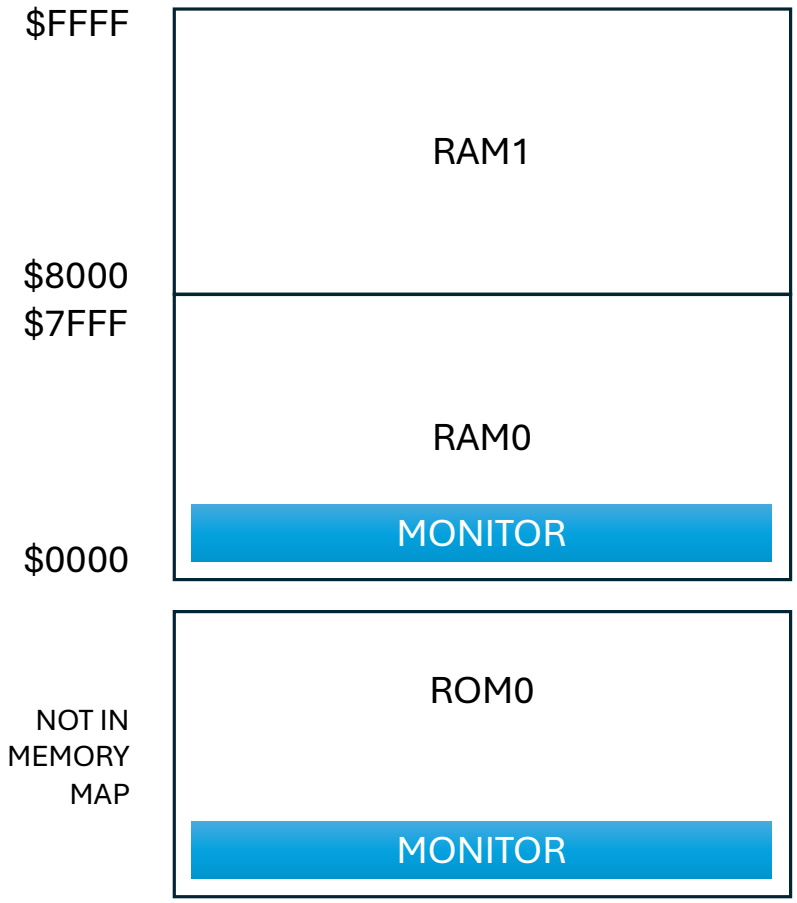


Contains startup and monitor code.

Memory Map After Reset



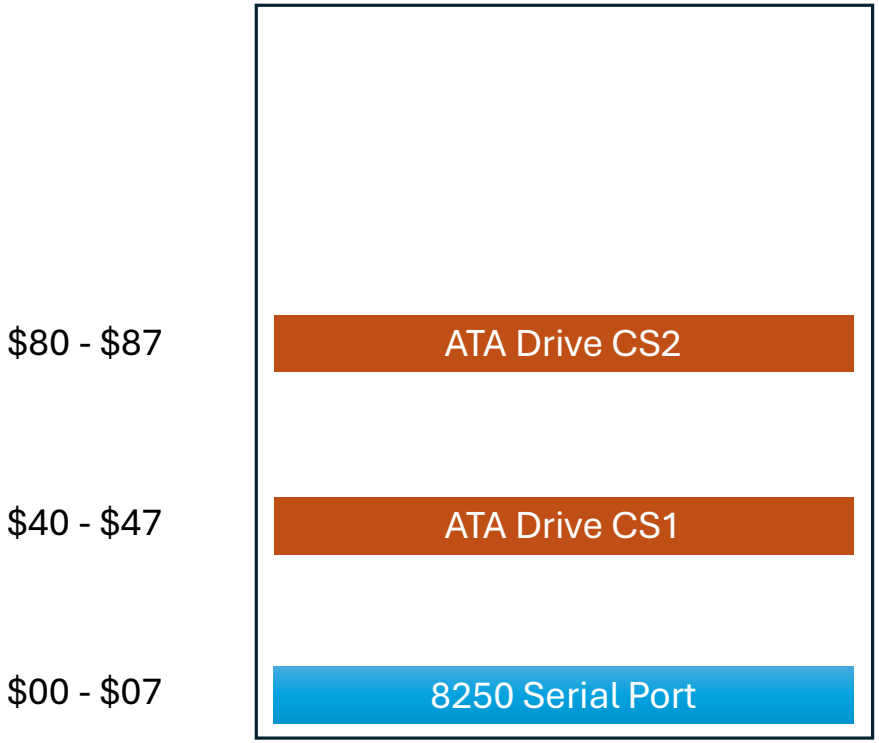
Memory Map Monitor Start



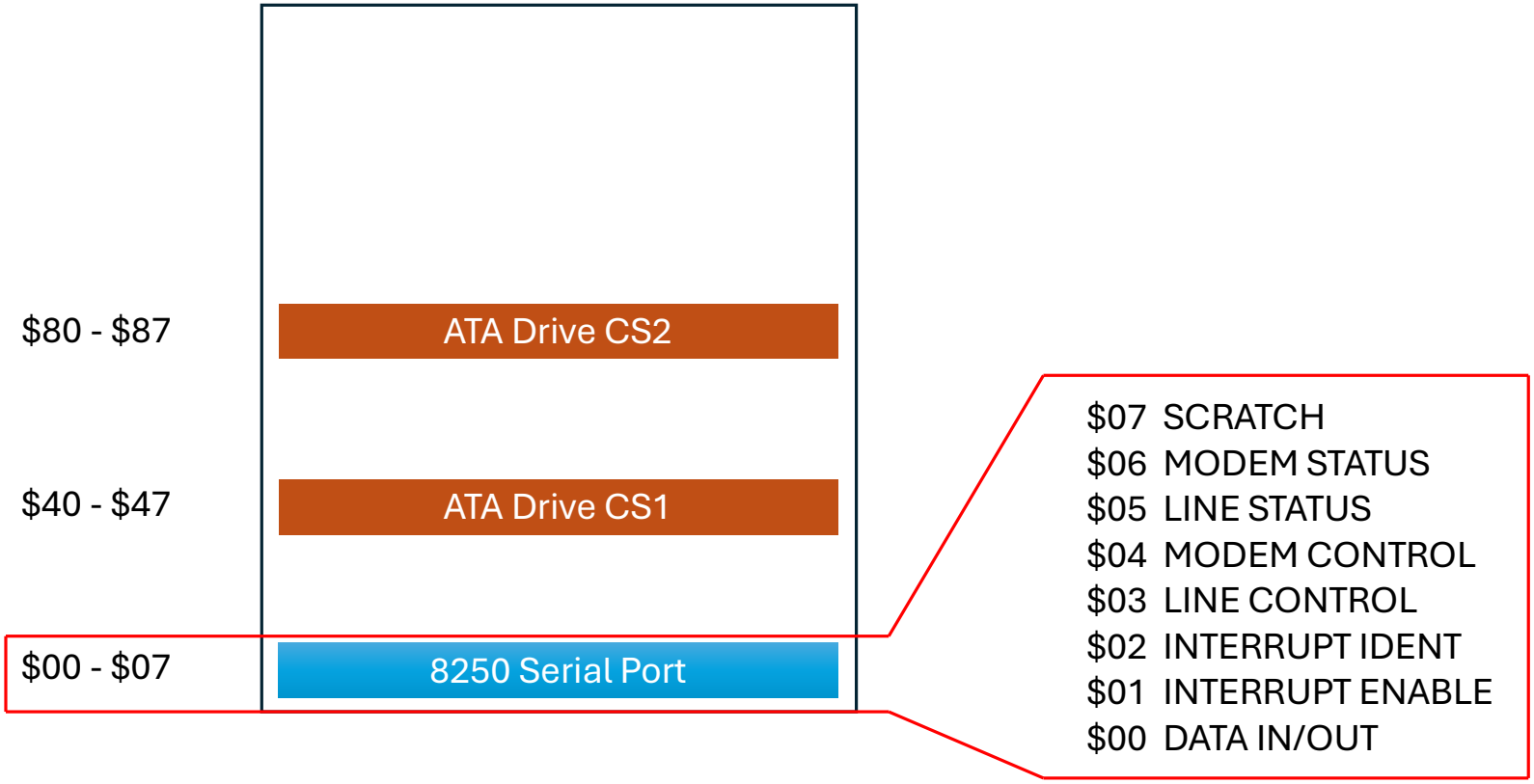
After monitor copy, startup does an IO Write to $00 which changes the memory map to the system run state.

ROM0 is out of the memory map.
RAM0 moved down to ROM0 address at $0000.
RAM1 moved into memory map at address $8000.

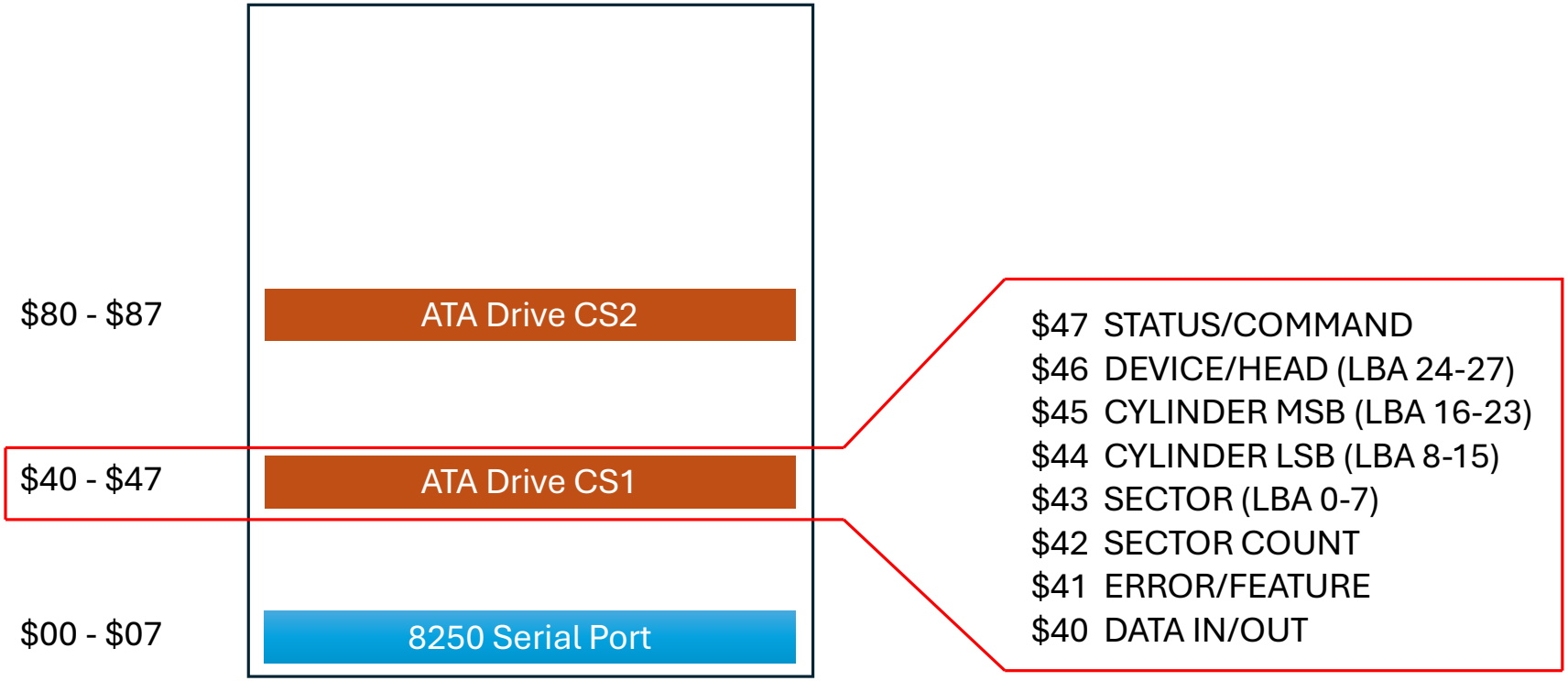
I/O Device Map



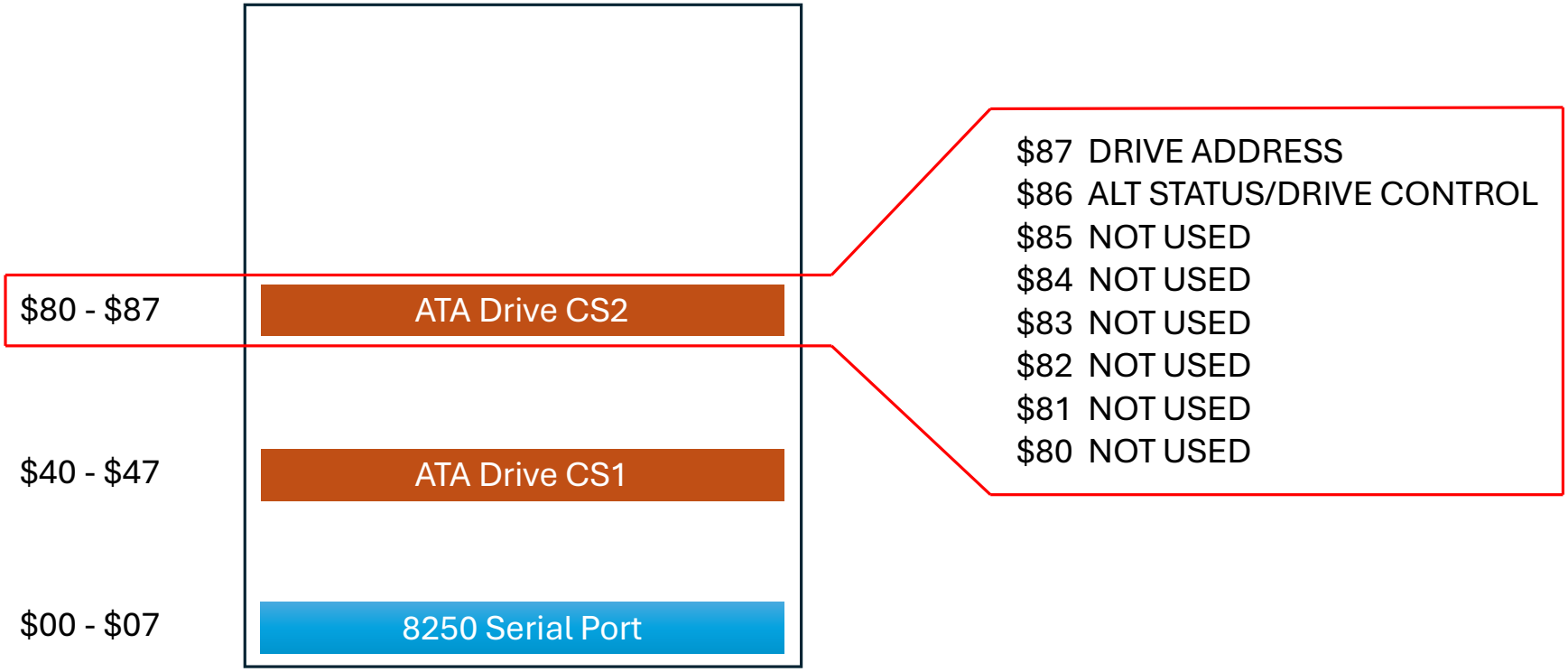
I/O Device Map



I/O Device Map



I/O Device Map



Compact Flash Drive with ATA (IDE) Adapter



Generic 128MB Flash Card
2 for $20.00



StarTech ATA (IDE) to Single CF SSD Adapter
$24.00

Integrating CF Drive with CP/M

```
Flash Drive Information                  CP/M Supported Drive Information
-----------------------------------      ---------------------------------------
Cylinders     : 03D2           (978)     MAX Tracks        : 100          (256)
Heads         : 0008           (  8)
Sectors/Cyl   : 0020           ( 32)     MAX Sectors/Track : 100          (256)
Bytes/Sector  : 200            (512)     Bytes/Sector      : 80           (128)
Total Sectors : 0003D200    (250368)     MAX Sectors/Disk  : 00010000   (65536)
Total Bytes   : 07A40000 (128188416)     MAX Bytes/Disk    : 00800000 (8388608)
```

PROBLEM: FLASH DRIVE CYLINDER/HEAD/SECTOR GEOMETRY NOT A GOOD MATCH FOR CP/M

Integrating CF Drive with CP/M

```
Flash Drive Information                    CP/M Supported Drive Information
-----------------------------------        ----------------------------------------
Cylinders     : 03D2           (978)       MAX Tracks        : 100          (256)
Heads         : 0008           (  8)
Sectors/Cyl   : 0020           ( 32)       MAX Sectors/Track : 100          (256)
Bytes/Sector  : 200            (512)       Bytes/Sector      : 80           (128)
Total Sectors : 0003D200     (250368)      MAX Sectors/Disk  : 00010000   (65536)
Total Bytes   : 07A40000 (128188416)       MAX Bytes/Disk    : 00800000 (8388608)
```

SOLUTION: USE LOGICAL BLOCK ADDRESSING (LBA) MODE

Integrating CF Drive with CP/M

```
Flash Drive Information                  CP/M Supported Drive Information
-----------------------------------      ---------------------------------------
Start Sector  : 00000            (0)     MAX Tracks        : 100          (256)
End Sector    : 3D1FF        (250367)     MAX Sectors/Track : 100          (256)
Bytes/Sector  : 200              (512)     Bytes/Sector      : 80           (128)
Total Sectors : 3D200        (250368)     MAX Sectors/Disk  : 00010000   (65536)
Total Bytes   : 7A40000  (128188416)     MAX Bytes/Disk    : 00800000 (8388608)

Physical Drive Geometry (LBA Mode)
LBA4     LBA3     LBA2     LBA1
xxxx xxxxxx00 00000000 00000000 - First Sector
xxxx xxxxxx11 11010001 11111111 - Last Sector
```

Partitioning Physical CF Drives into CP/M Logical Drives

```
Flash Drive Information                  CP/M Supported Drive Information
-----------------------------------      ---------------------------------------
Start Sector  : 00000            (0)     MAX Tracks        : 100          (256)
End Sector    : 3D1FF       (250367)     MAX Sectors/Track : 100          (256)
Bytes/Sector  : 200             (512)     Bytes/Sector      : 80           (128)
Total Sectors : 3D200         (250368)    MAX Sectors/Disk  : 00010000   (65536)
Total Bytes   : 7A40000   (128188416)     MAX Bytes/Disk    : 00800000 (8388608)

Physical Drive Geometry (LBA Mode)
LBA4     LBA3     LBA2     LBA1
xxxx xxxxxx00 00000000 00000000 - First Sector
xxxx xxxxxx11 11010001 11111111 - Last Sector

Drive Partition Geometry (LBA Mode)
LBA4     LBA3     LBA2     LBA1
           |DSK|| TRK   ||SEC |
xxxx xxxxxx00 00000000 00000000 - CP/M Drive n, track   0, sector  0
xxxx xxxxxx00 00111111 11111111 - CP/M Drive n, track 255, sector 63
```

Partitioning Physical CF Drives into CP/M Logical Drives

```
Flash Drive Information
-----------------------------------
Start Sector  : 00000            (0)
End Sector    : 3D1FF       (250367)
Bytes/Sector  : 200             (512)
Total Sectors : 3D200         (250368)
Total Bytes   : 7A40000   (128188416)
```

```
CP/M Supported Drive Information
---------------------------------------
MAX Tracks        : 100           (256)
MAX Sectors/Track : 100           (256)
Bytes/Sector      : 80            (128)
MAX Sectors/Disk  : 00010000    (65536)
MAX Bytes/Disk    : 00800000  (8388608)
```

BUT... BYTES/SECTOR ARE DIFFERENT!

```
Physical Drive Geometry (LBA Mode)
LBA4     LBA3     LBA2     LBA1
xxxx xxxxxx00 00000000 00000000 - First Sector
xxxx xxxxxx11 11010001 11111111 - Last Sector

Drive Partition Geometry (LBA Mode)
LBA4     LBA3     LBA2     LBA1
           |DSK|| TRK   ||SEC |
xxxx xxxxxx00 00000000 00000000 - CP/M Drive n, track   0, sector  0
xxxx xxxxxx00 00111111 11111111 - CP/M Drive n, track 255, sector 63
```

Partitioning Physical CF Drives into CP/M Logical Drives

```
Flash Drive Information                    CP/M Supported Drive Information
-----------------------------------        ---------------------------------------
Start Sector  : 00000            (0)       MAX Tracks        : 100          (256)
End Sector    : 3D1FF        (250367)       MAX Sectors/Track : 100          (256)
Bytes/Sector  : 200              (512)       Bytes/Sector      : 80           (128)
Total Sectors : 3D200          (250368)      MAX Sectors/Disk  : 00010000   (65536)
Total Bytes   : 7A40000   (128188416)       MAX Bytes/Disk    : 00800000 (8388608)

Physical Drive Geometry (LBA Mode)
LBA4     LBA3     LBA2     LBA1
xxxx xxxxxx00 00000000 00000000 - First Sector
xxxx xxxxxx11 11010001 11111111 - Last Sector

Drive Partition Geometry (LBA Mode)
LBA4     LBA3     LBA2     LBA1
           |DSK|| TRK   ||SEC |
xxxx xxxxxx00 00000000 00000000 - CP/M Drive n, track   0, sector  0 (logical 0-3)
xxxx xxxxxx00 00111111 11111111 - CP/M Drive n, track 255, sector 63 (logical 252-255)
```

SOLUTION: USE IDE 8-BIT TRANSFER MODE AND USE CP/M DEBLOCKING FUNCTIONS!

Partitioning Physical CF Drives into CP/M Logical Drives

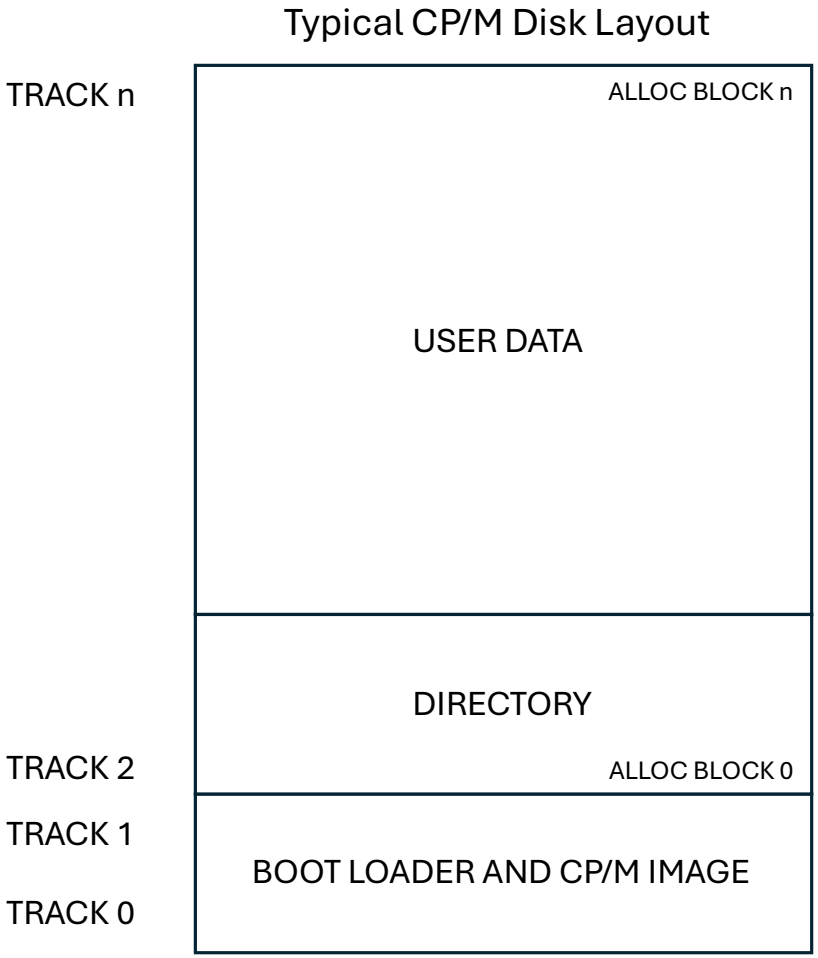
```
Flash Drive Information                  CP/M Supported Drive Information
-----------------------------------      ---------------------------------------
Start Sector  : 00000            (0)     MAX Tracks        : 100          (256)
End Sector    : 3D1FF       (250367)     MAX Sectors/Track : 100          (256)
Bytes/Sector  : 200              (512)   Bytes/Sector      : 80           (128)
Total Sectors : 3D200         (250368)   MAX Sectors/Disk  : 00010000   (65536)
Total Bytes   : 7A40000   (128188416)    MAX Bytes/Disk    : 00800000 (8388608)

Physical Drive Geometry (LBA Mode)
LBA4     LBA3     LBA2     LBA1
xxxx xxxxxx00 00000000 00000000 - First Sector
xxxx xxxxxx11 11010001 11111111 - Last Sector

Drive Partition Geometry (LBA Mode)
LBA4     LBA3     LBA2     LBA1
           |DSK|| TRK   ||SEC |
xxxx xxxxxx00 00000000 00000000 - CP/M Drive n, track   0, sector  0 (logical 0-3)
xxxx xxxxxx00 00111111 11111111 - CP/M Drive n, track 255, sector 63 (logical 252-255)
```

This partitioning scheme allows for 15 logical drives (A through O) with 8MB each.

CP/M Disk Parameters



Partitioning Physical CF Drives into CP/M Logical Drives

```
Drive Partition Physical Geometry

Disks              15
Tracks            256
Sectors/Track      64
Bytes/Sector      512
Total disk    8.388MB

Drive Partition Logical Geometry

Disks              15
Tracks            256
Sectors/Track     256
Bytes/Sector      128
Total disk    8.388MB

One track reserved for CP/M image
```

```
CP/M Disk Parameters

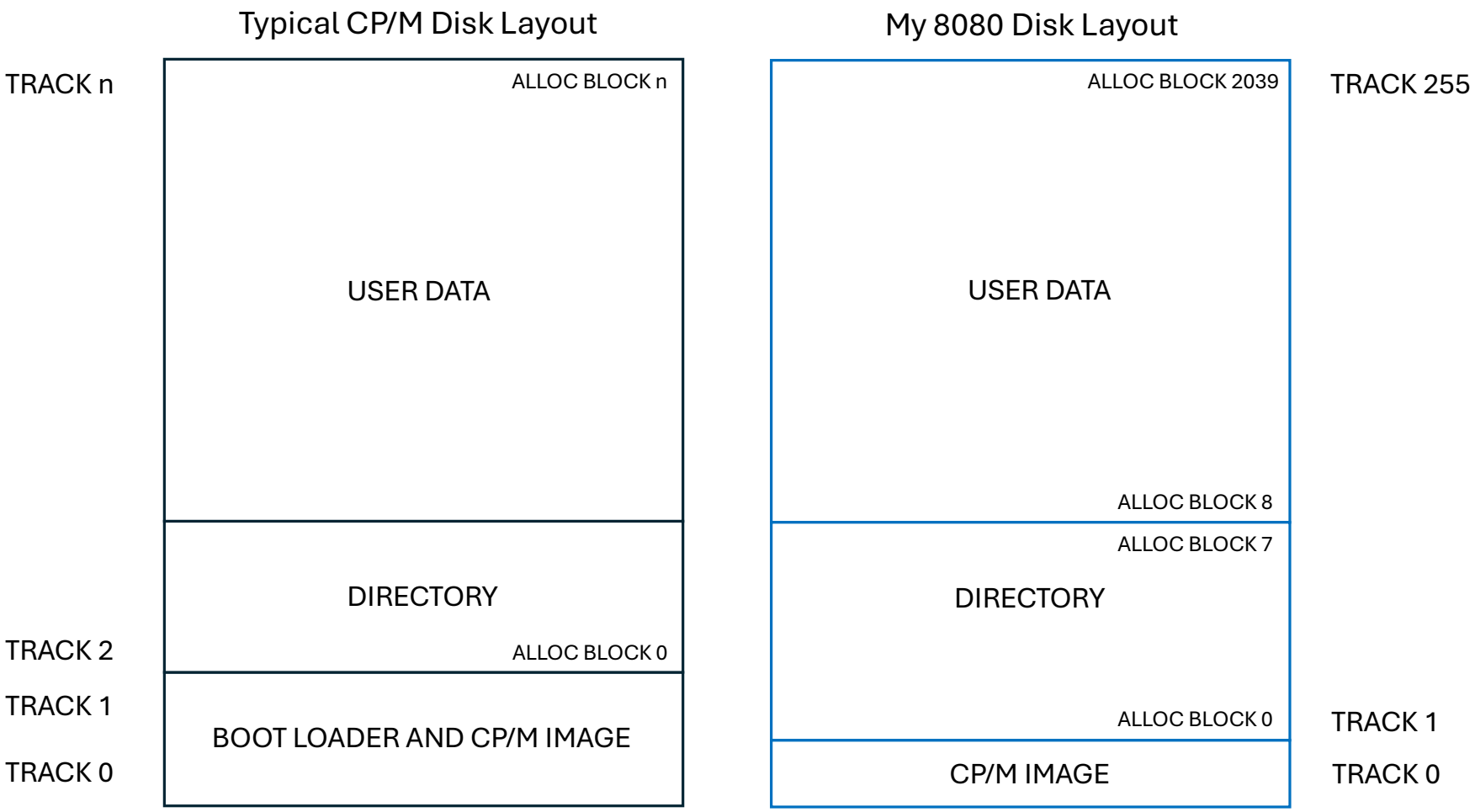
Tracks for files and directory   255
Logical sectors per track        256
Allocation block size           4096 bytes
Total disk blocks               2040
Directory entries per disk      1024

Allocation block size can be:
1024, 2048, 4096, 8192, 16384 bytes

Directory entries can be any value that
when multiplied by 32 fits evenly in an
Allocation Block.

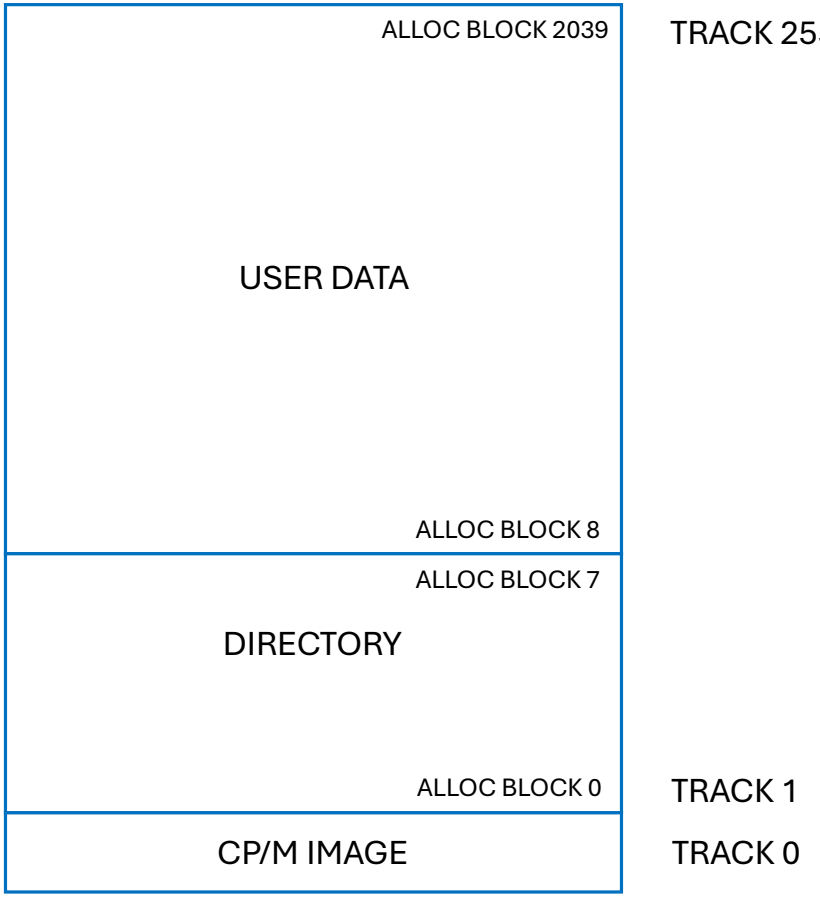
Example:     1024 directory entries
           x   32 bytes per directory entry
            -----
            32768 directory bytes
           ÷ 4096 allocation block size in bytes
            -----
                8 (no remainder)
```

CP/M Disk Parameters



CP/M Disk Parameters

My 8080 Disk Layout



Additional Notes on CP/M Disks

- Track and Sector are always offset 0
  - Most CHS disk controllers are sector offset 1
  - IDE LBA Mode uses sector offset 0
- Sector Translation table resolves interleave and offset
  - Not needed with IDE drives in LBA mode
- Allocation blocks are offset 0
- Track 0 Sector 0 is reserved for the boot loader
  - My 8080 places boot loader in the monitor
- Track 0 and Track 1 are reserved for CP/M
  - My 8080 only needs one track for CP/M

CP/M Disk Parameters

```
CP/M Disk Parameter Block

SPT:  256   Logical sectors per track
BSH:    5   Block shift factor (for 4096 block size)
BLM:   31   Block mask (for 4096 block size)
EXM:    1   Extent mask (1 = total blocks > 256)
DSM: 2039   Logical disk size in blocks -1 ((256sec * 255trk * 128b) / 4096)-1)
DRM: 1023   Directory max entries -1
AL0: 0FFH   Reserved directory blocks (1024*32)/4096 in number of bits = 8)
AL1:    0   Reserved directory blocks
CKS:    0   Check size (set to zero for fixed disk)
OFF:    1   Track offset (defines track where directory begins)
```

CP/M Disk Parameters

```
CP/M Disk Parameter Block

SPT:  256   Logical sectors per track
BSH:    5   Block shift factor (for 4096 block size)
BLM:   31   Block mask (for 4096 block size)
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CP/M Disk Parameters

```
CP/M Disk Parameter Block

SPT:  256   Logical sectors per track
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AL1:    0   Reserved directory blocks
CKS:    0   Check size (set to zero for fixed disk)
OFF:    1   Track offset (defines track where directory begins)
```

Block Size	Shift Factor	Mask
1024	3	7
2048	4	15
4096	5	31
8192	6	63
16384	7	127

CP/M Disk Parameters

```
CP/M Disk Parameter Block

SPT:  256   Logical sectors per track
BSH:    5   Block shift factor (for 4096 block size)
BLM:   31   Block mask (for 4096 block size)
EXM:    1   Extent mask (1 = total blocks > 256)
DSM: 2039   Logical disk size in blocks -1 ((256sec * 255trk * 128b) / 4096)-1)
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AL0: 0FFH   Reserved directory blocks (1024*32)/4096 in number of bits = 8)
AL1:    0   Reserved directory blocks
CKS:    0   Check size (set to zero for fixed disk)
OFF:    1   Track offset (defines track where directory begins)
```

Note: DSM does NOT include reserved tracks for the boot loader and CP/M image

CP/M Disk Parameters

```
CP/M Disk Parameter Block

SPT:  256   Logical sectors per track
BSH:    5   Block shift factor (for 4096 block size)
BLM:   31   Block mask (for 4096 block size)
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DSM: 2039   Logical disk size in blocks -1 ((256sec * 256trk * 128b) / 4096)-1)
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AL0: 0FFH   Reserved directory blocks (1024*32)/4096 in number of bits = 8)
AL1:    0   Reserved directory blocks
CKS:    0   Check size (set to zero for fixed disk)
OFF:    1   Track offset (defines track where directory begins)
```

CP/M Disk Parameters

```
CP/M Disk Parameter Block

SPT:  256   Logical sectors per track
BSH:    5   Block shift factor (for 4096 block size)
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AL0: 0FFH   Reserved directory blocks (1024*32)/4096 in number of bits = 8)
AL1:    0   Reserved directory blocks
CKS:    0   Check size (set to zero for fixed disk)
OFF:    1   Track offset (defines track where directory begins)

Dir Block   0  1  2  3  4  5  6  7
      AL0   1  1  1  1  1  1  1  1  <--- 8 disk blocks reserved for directory

Dir Block   8  9  A  B  C  D  E  F
      AL1   0  0  0  0  0  0  0  0
```

CP/M Disk Parameters

```
CP/M Disk Parameter Block

SPT:  256   Logical sectors per track
BSH:    5   Block shift factor (for 4096 block size)
BLM:   31   Block mask (for 4096 block size)
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DSM: 2039   Logical disk size in blocks -1 ((256sec * 256trk * 128b) / 4096)-1)
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AL0: 0FFH   Reserved directory blocks (1024*32)/4096 in number of bits = 8)
AL1:    0   Reserved directory blocks
CKS:    0   Check size (set to zero for fixed disk)
OFF:    1   Track offset (defines track where directory begins)
```

CP/M Disk Parameters

```
CP/M Disk Parameter Block

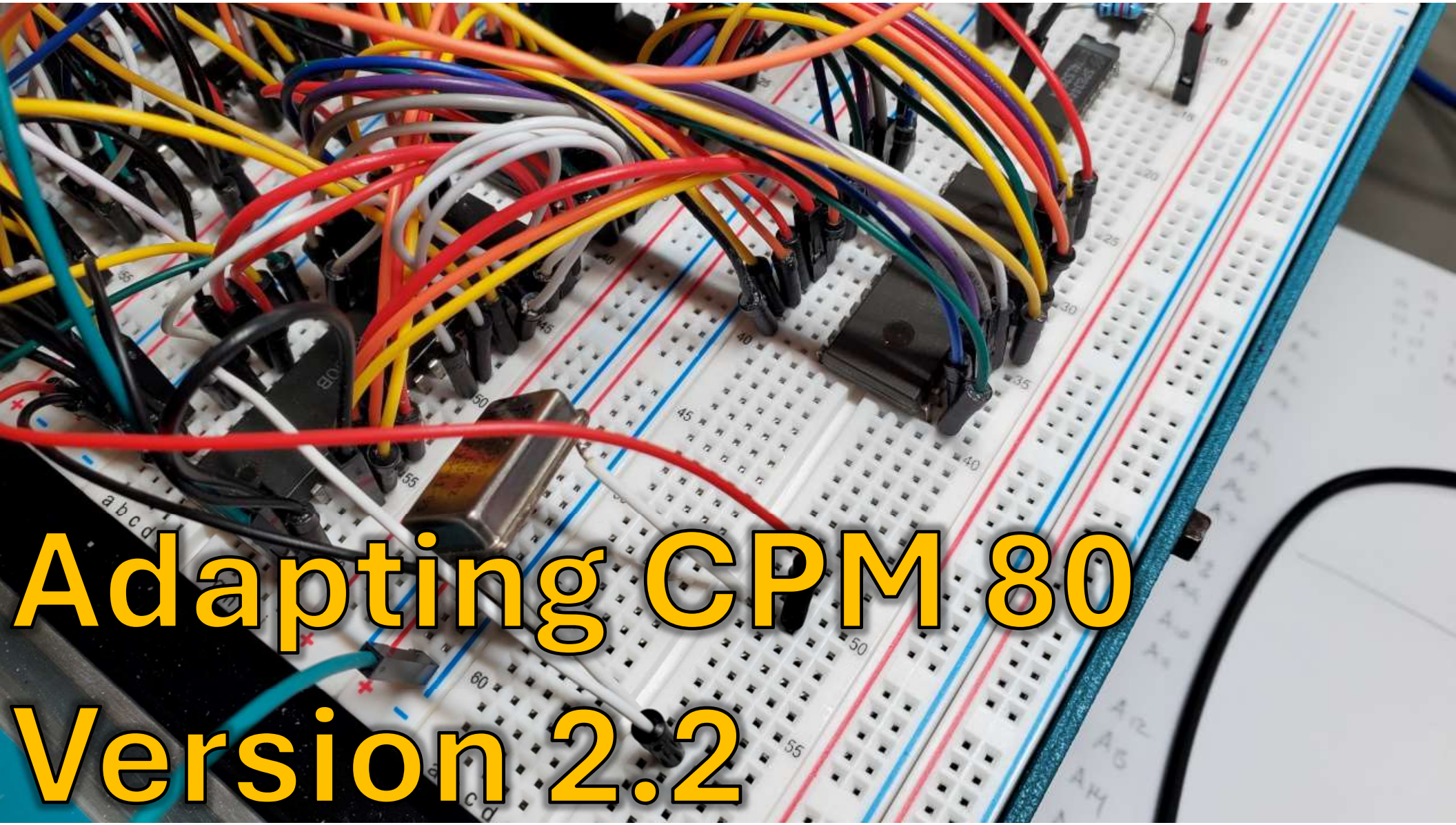
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BSH:    5   Block shift factor (for 4096 block size)
BLM:   31   Block mask (for 4096 block size)
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CKS:    0   Check size (set to zero for fixed disk)
OFF:    1   Track offset (defines track where directory begins)
```

CP/M Disk Driver Development

General Steps for CP/M Disk Driver Development/Testing

1. Review disk controller documentation
2. Define the disk controller in an 8080 assembly file
3. Create and test disk controller initialization for desired operating modes
4. Create and test utility to collect disk parameters from the controller
5. Create and test sector read operation
6. Create and test sector write operation

The above initialization/read/write code will be used for the disk driver portion of the CP/M BIOS


Adapting CPM 80
Version 2.2