IBM Personal System/2™
Seminar Proceedings

**The Publication for Independent Developers
of Products
for IBM Personal System/2**

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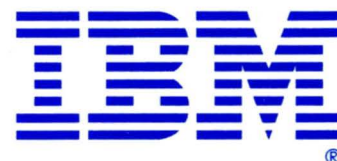
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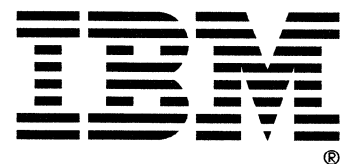
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Contents

Foreword

IBM Personal System/2™ Seminars and Proceedings provide information about new product announcements and enhancements to existing products, and are intended to assist independent developers in their hardware and software development efforts.

Over the past several years, the success of the IBM Personal Computer family was due in part to the efforts of independent developers, whose hardware and software products have become widely used. For its part, IBM helped these vendors by holding relevant technical seminars and publishing the proceedings of those seminars. The result was a mutually beneficial partnership and transfer of technical knowledge.

With the advent of the Personal System/2 family, IBM's seminar program will continue. Through these seminars and the corresponding Proceedings, IBM will address the independent developers' need for technical information about the latest IBM products. In these and future Proceedings, you will find technical information about subjects such as:

- IBM computer design and architecture

- IBM computer components and their interaction

- Memory capacities, speeds, transfer rates

- Input/output device capacities, speeds, access methods and rates

- Graphics and display technologies, programming considerations

- Printing technologies, programming considerations

- Operating system high level interfaces

- Development tools: capabilities, languages, program verification aids

- Compatibility considerations

- Communications: capabilities, offerings, statistics

- Enhancements to existing IBM hardware and software products

- Hints, tips and techniques to enhance your productivity

Through these seminars and Proceedings, IBM intends to maintain its partnership with independent developers and assist them in successfully producing hardware and software products for the IBM Personal System/2 Family.

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IBM Personal System/2 Model 30 Architecture

System Unit

The IBM Personal System/2 Model 30 system board is a highly integrated system board that forms the heart of the IBM Personal System/2 Model 30 system. The major functional components on the system board are:

- 8086-2 Microprocessor and support logic

- Optional 8087-2 Numeric Data Coprocessor

- PC-compatible system resources (timer, interrupt and DMA)

- 64 KB ROM

- 640 KB RAM with parity

- Keyboard and pointing device interfaces

- Real-time clock with battery back-up

- Video subsystem

- Hardfile interface

- Diskette interface

- Serial interface

- Parallel interface

- Expansion I/O channel connector to support 3 expansion slots.

Processor

The IBM Personal System/2 Model 30 CPU is an 8086-2 operating at 8 MHz. Four clock cycles (0 wait states) are required per bus cycle to transfer a word or a byte between the processor and the system RAM or ROM (500 nsec). Transfers between the processor and I/O devices or memory devices on the I/O Channel will be byte wide and take 8 clock cycles (4 wait states), resulting in a 1000 nsec bus cycle. If a 16-bit read or write is performed to a device on the 8-bit data bus, 12 wait states will be inserted and the system board logic will simulate two 8-bit transfers. This results in a total of 16 clocks cycles (2000 nsec) for a word transfer over the 8-bit data bus. Additional wait states may be inserted by using the I/O Channel Ready signal. The following figure shows the system data flow:
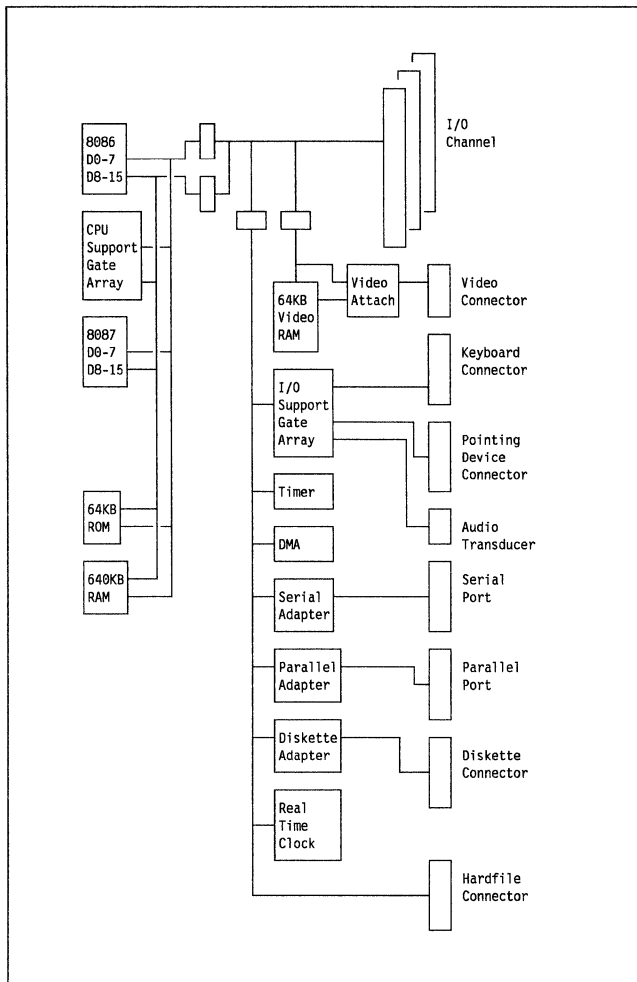
Figure 1. System Data Flow

Memory Address Map

The 8086 CPU supports one megabyte of address space (00000-FFFFF). A 16-bit wide data bus is provided to system board RAM and ROM. An 8-bit wide data bus is provided to the rest of memory.

HEX RANGE	FUNCTION
00000-3FFFF	SYSTEM BOARD RAM
40000-9FFFF	SYSTEM BOARD or I/O CHANNEL RAM
A0000-AFFFF	VIDEO BUFFER(System board or I/O channel)
B0000-B7FFF	I/O CHANNEL VIDEO BUFFER
B8000-BFFFF	VIDEO BUFFER(System board or I/O channel)
C0000-EFFFF	I/O CHANNEL MEMORY
F0000-FFFFF	SYSTEM ROM

ROM

The system board supports 64 KB of ROM containing POST, BIOS and a BASIC interpreter. The ROM consists of two 32K x 8 chips and they are plugged into two 28-pin DIP sockets on the system board.

RAM

The system board supports 640 KB of RAM. System board RAM in the address range of 40000H to 9FFFFH may be replaced in 64 KB increments by RAM in the I/O channel. This address range is searched during the power-on self test. If RAM is found in the I/O channel in this range, the corresponding block of RAM on the system board will be disabled and the I/O channel RAM will be used.

Timer

The system design contains the three individually programmable timers of the 8253/4 timer/counter chip. Channels 0 and 2 are used in a manner compatible with the IBM PC and the IBM PC XT.

Channel 0 **System Timer Interrupt**
    GATE 0 - Tied high
    CLK IN - 1.19 MHz
    CLK OUT - Interrupt request 0

Channel 1 **Reserved for Diagnostics**

Channel 2 **System Tone Generator**
    GATE 0 - Port 61 bit-0
    CLK IN - 1.19 MHz
    CLK OUT - Speaker data

Audio Controller and Speaker

The audio interface is compatible with the IBM PC and the IBM PC XT. Sound may be generated three ways:

1. A direct program control register bit may be toggled to generate a pulse train.

2. The output from Channel 2 of the timer may be programmed to generate a waveform to the speaker.

3. The clock input to the timer can be modulated with a program-controlled I/O register bit.

An audio transducer mounted on the system board is used instead of the speaker used in the IBM PC and the IBM PC XT.

Real-Time Clock

The IBM Personal System/2 Model 30 uses a National Semiconductor® 58167A real-time clock chip. This chip maintains a time count from milliseconds through months in a 24-hour format. The chip also provides fifty-six bits of RAM. BIOS uses three bytes of this memory to support the alarm function (hours, minutes, and seconds). BIOS uses additional RAM to store a year and month count, a century indicator, and a checksum for the RAM. A 3-volt lithium battery on the bus card provides power to the real-time clock when the system unit is off.

Interrupt Controller

The interrupt controller has a command set that is compatible with the Intel® 8259 Programmable Interrupt Controller except that rotating priorities are not supported. The power-on routines set the controller to edge-triggered mode with the interrupt vectors assigned to processor vectors 8 through 15. Each interrupt requires an end-of-interrupt command to reset the interrupt service.

The system provides eight levels of interrupt in addition to the 8086 NMI. Levels 2-7 are available on the system I/O channel. Interrupt level 1 is shared by the keyboard port, the mouse port and the real-time clock. Interrupt level 1 will always be a level-sensitive interrupt regardless of how bit 3 of ICW1 (port 20) is programmed. Level 1 is also unique in that the TYPE byte programmed into ICW2 (port 21) is ignored when level 1 is acknowledged. The interrupt controller substitutes a type byte of 70H when acknowledging an Interrupt 1. The pointer to the Interrupt 1 service routine is at location 1C4H (4*71H).

Interrupt Assignments

LEVEL	SYSTEM BOARD	I/O CHANNEL
NMI	PARITY CHECK AND COPROCESSOR	I/O CHANNEL CHECK
IRQ0	TIMER CHANNEL 0	NOT AVAILABLE
IRQ1(2)	KEYBOARD - POINTING DEVICE - REAL-TIME CLOCK	NOT AVAILABLE
IRQ2	VIDEO(NO BIOS SUPPORT)	AVAILABLE
IRQ3	NOT USED	AVAILABLE
IRQ4	SERIAL PORT	AVAILABLE(1)
IRQ5	FIXED DISK	AVAILABLE(1)
IRQ6	DISKETTE DRIVE	AVAILABLE(1)
IRQ7	PARALLEL PORT(NO BIOS SUPPORT)	AVAILABLE

Figure 2. Interrupt Assignments

Notes:

1. Interrupts are available to the I/O channel if they are not enabled by the system board function normally assigned to that interrupt.

2. Interrupt 1 is a shared interrupt for system board I/O. It generates a TYPE byte of 70H regardless of the value programmed in ICW2. A BIOS routine pointed to by Interrupt 71H will read port A0H, determine the highest priority device requesting service, and redirect control to the appropriate BIOS routine.

8086 INT	DESCRIPTION
71H	SHARED PLANAR INTERRUPT
Keyboard will be redirected to INT 9H.	
Real-Time Clock will be redirected to INT 70H.	
Pointing Device will be redirected to INT 73H.	

Figure 3. Interrupt 1

Note:

The keyboard interrupt will be redirected to INT 9H if the TYPE byte programmed in the Interrupt Controller is 08H. If the TYPE byte is modified by an application, BIOS will redirect it to the appropriate location.

DMA

The IBM Personal System/2 Model 30 DMA controller is an Intel 8237A-5 operating at 4MHz. The CPU support gate array inserts one wait state in all DMA operations.

LEVEL	SYSTEM BOARD	I/O CHANNEL
DRQ1	NOT USED	AVAILABLE
DRQ2	DISKETTE	AVAILABLE
DRQ3	HARDFILE	AVAILABLE

Figure 4. DMA Assignments

Note: DMA channels are available to the I/O channel if they are not enabled by the system board function normally assigned to that DMA channel.

Onboard I/O Subsystems

I/O support logic is used to generate chip-select for the following system I/O devices:

- Video controller
- Parallel interface
- Serial interface
- Diskette controller
- Hardfile interface
- Real-time clock.

Each individual select line, except for the Real-Time Clock, can be disabled by programming the planar control register (Port 65h). When one of the internal devices is selected, the command signals to the I/O expansion slots are disabled. However, if the internal device select is disabled, the command signals to the I/O expansion slots will be enabled.

Keyboard/Pointing Device Interface

The system board includes the keyboard and pointing device interface logic. The keyboard interface is identical to the pointing device interface. The logic prcvides hardware serialize/de-serialize support along with parity generation and checking.

A BIOS INT 71H handler accepts the keyboard interrupt, stores the keyboard data in a register at I/O address 60h, and passes control to the keyboard BIOS in a manner compatible with the IBM PC and the IBM PC XT.

Hardfile Interface

The IBM Personal System/2 Model 30 fixed disk hardware is composed of a 20 MB fixed disk drive with integrated controller circuitry. The integration of the controller onto the disk drive eliminates the need for a separate adapter.

The controller interface is a new design that utilizes a highly integrated chip set. This interface is not compatible with the IBM Personal Computer AT or IBM PC XT fixed disk adapter at the hardware level. ROM BIOS has been written to account for any differences, so compatibility is maintained at the BIOS interface level. The command interface is register-oriented and byte-parallel with an 8-bit data path into the on-board dual 512-byte sector buffer. The sector buffer access is designed to run at the rate of 1.25 MB per second. This high speed data transfer allows the fixed disk interleave in the IBM Personal System/2 Model 30 to be three to one.

The hardware interface is composed of a set of five registers from 320H to 324H. These registers are decoded to provide command/status information, error indication and a data path into the sector buffer. All registers are 8-bits wide. The fixed disk function signals task completion using hardware interrupt level 5. All sector buffer data transfers are performed through DMA. DMA channel 3 is used by the fixed disk. The fixed disk does not require the use of a setup program as in the IBM Personal Computer AT. A drive-type byte is passed from the drive to the system. The system identifies the appropriate drive parameters (such as number of heads and number of cylinders) in the BIOS drive table. The controller automatically increments the head and/or steps the fixed disk drive read/write heads for multi-sector operations that cross track and/or cylinder boundaries. Any failing read/write operations are retried up to 15 times by the controller.

Data integrity is maintained on the fixed disk by a six-byte Error Correcting Code (ECC) field appended to each sector as it is written. This allows the controller to detect and correct an error of up to 16 bits in length. An on-card microprocessor performs the error correction based on input from the ECC generation hardware.

The 20 MB fixed disk drive in the IBM Personal System/2 has four read/write heads and 612 data cylinders. The read/write heads are controlled by a quasi-closed loop servo system that yields higher track densities. The microprocessor provides correction information for the access mechanism based on an imbedded servo burst, prior to index, on each track. The time to seek 1/3 of the surface of the disk is 80 ms. The area beyond the last data cylinder serves as a dedicated landing zone.

Diskette Interface

The IBM Personal System/2 Model 30 diskette drive supports 3.5" (90-millimeter) double-sided, double-density diskettes with a formatted capacity of 720K bytes.

The diskette drive uses modified frequency modulation (MFM) to read and write digital data, with a track-to-track access time of 6 milliseconds.

When the drive is selected, the servo-controlled DC drive motor starts and drives the hub at a constant speed of 300 revolutions per minute (RPM). The head positioning system, which consists of a stepper motor and its associated electronics, moves the magnetic head to the desired track of the diskette. The stepper

motor assembly uses one step-pulse to cause a one-track linear movement of the magnetic head. During a write operation, a 0.115 millimeter (0.0045 in.) data track is recorded with a 0.1875 millimeter (0.0073 in.) spacing (center-to-center) between the tracks. This allows 135 tracks per inch (TPI).

Data is read from the diskette by the data-recovery circuitry, which consists of a low-level read amplifier, differentiator, zero-crossing detector and digitizing circuits. All data decoding is done by the diskette controller.

The diskette drive also has the following sensor systems:

- A track 00 sensor that detects when the head/carriage assembly is at track 00

- The write-protect sensor that senses the position of the write-protect tab

- The diskette-changed sensor that detects when a diskette has been removed from the drive

- The index sensor that detects the index marker.

The diskette controller consists of custom logic and a NEC® μPD765 Floppy Disk Controller (or equivalent) that resides on the system board. The diskette controller attaches to the diskette drives using a short cable. The timings and signal sequences are similar to the industry standard 133.4 millimeter (5.25 in.) diskette drive specification.

The diskette controller supports a rate of 250K bits/second, double-density, modified frequency modulation (MFM)-coded diskette drives and uses write precompensation with an analog phase-lock loop for clock and data recovery. The diskette drive parameters are programmable. In addition, the controller supports the diskette drive's write-protect feature. The controller uses direct memory access (DMA) for record data transfers. Interrupt level 6 is used to indicate when an operation is complete and that a status condition requires processor attention.

Serial Interface

The IBM Personal System/2 Model 30 serial port is IBM PC and IBM PC XT compatible. It uses a National Semiconductor 8250A Serial Controller in the I/O address range of 03FBH to 03FFH. The serial controller interrupt output generates an Interrupt 4. A 25-pin D shell (male) connector is used. The default device name is COM1:.

Parallel Interface

The IBM Personal System/2 Model 30 printer port is IBM PC and IBM PC XT compatible. Its I/O address range is 0378H - 037FH. The ACK signal from the printer can generate an Interrupt 7, but this interrupt is not supported by BIOS. A 25-pin D Shell (female) connector is used. Bit 7 of port 65h can disable the output drivers of port 378H. This allows data to be read into port 378H. The default device name is LPT1:.

IBM Personal System/2 Model 30 Video Subsystem

The video subsystem resides on the system board. The video logic is composed of a memory controller gate array, a video formatter gate array, 64K of multiport dynamic memory, an 8K static RAM character generator, and a 256 x 18 color palette with three 6-bit digital-to-analog converters (DAC).

All IBM Color/Graphics Adapter (CGA) video modes are supported. All CGA graphics modes are double scanned from 200 to 400 lines. This architecture is not a bit plane design, so the Enhanced Graphics Adapter modes are not supported as part of the base planar video support. The light pen is not supported.

The IBM Personal System/2 Model 30 video uses Interrupt 10H at the BIOS level to maintain compatibility with the IBM Color/Graphics Adapter.

In addition to the modes compatible with the IBM Color/Graphics Adapter, two new modes were added. The additional modes are 320 by 200 (double scanned to 400 lines) graphics (256 colors of 256K colors available) and 640 x 480 graphics (2 of 256K colors available).

Display Support

The video subsystem supports four new analog displays:

- IBM Personal System/2 Monochrome Display 8503

- IBM Personal System/2 Color Display 8512

- IBM Personal System/2 Color Display 8513

- IBM Personal System/2 Color Display 8514.

All displays can support operation at a scan frequency of 31.5 kHz in a non-interlaced format. The polarity of the two synchronization signals output to the display determines the number of horizontal scans.

The IBM Personal System/2 automatically configures the video to support the display attached. When the system senses the presence of an analog monochrome display, BIOS sums the R, G, and B colors and outputs the video signal to pin 2 (green).

The 8503 Monochrome Display has a 12-inch diagonal tube with a medium persistence paper-white phosphor. This monitor helps provide a useful tool for document processing and gray shade imaging. When an application written for the color modes is run on the monochrome display, BIOS sums the colors into 64 monochrome gray shades without requiring any change to the application software.

The 8512 Color Display has a 14-inch diagonal tube with a .41 millimeter stripe pitch format and short persistence phosphors. The 8513 Color Display has a 12-inch diagonal tube with a .28 millimeter dot pitch format and short persistence phosphors. Both monitors provide a useful tool for displaying text and graphics information as well as high quality color images.

The 8514 Color Display has a 16-inch diagonal tube with a 0.309 (diagonal) dot matrix pitch. It uses medium persistence phosphors.

Each display connects to a 15-pin, subminiature, D-shell connector at the rear of the system. The monitor cable is six feet in length.

A BIOS call (AH = 1AH) has been added to read the type of display attached.

Text Modes

In text modes, the character box is an 8 x 16 box. The character font table is loaded into the character generator. All 16 scan lines are able to be programmed into the character generator.

Graphics Modes

In the graphics modes, the character font table in BIOS is used to create the character pels. For most graphic modes, the character box is an 8 x 8 character box that is double scanned to create an 8 x 16 character box and, therefore, not all 16 lines are programmable.

The 640 x 480 mode is not double scanned. Thirty character rows are displayed in this mode. This mode provides a square pel representation when used with displays that provide a 4 x 3 aspect ratio.

Video Mode Summary

The following is a summary of video modes supported in BIOS.

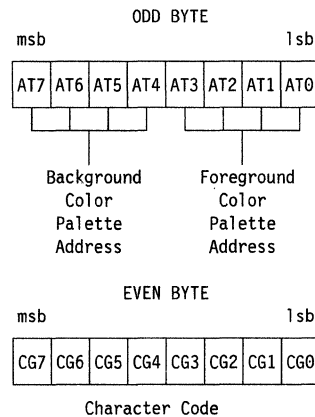| BIOS Mode	Type	Colors	Alpha Format	Buffer Start	Char Box Size	Screen Pages	Resolution	Refresh Rate
0, 1	A/N	16/256K	40x25	B8000	8x16	8	320x400	70Hz
2, 3	A/N	16/256K	80x25	B8000	8x16	8	640x400	70Hz
4, 5	APA	4/256K	40x25	B8000	8x8	1	320x200	70Hz
6	APA	2/256K	80x25	B8000	8x8	1	640x200	70Hz
11	APA	2/256K	80x30	A0000	8x16	1	640x480	60Hz
13	APA	256/256K	40x25	A0000	8x8	1	320x200	70Hz

When a 31.5 kHz analog monochrome monitor is connected to the IBM Personal System/2 Model 30, the maximum number of colors in the table above will be replaced with a value of 64 gray shades.

Video Buffer Organization

The following shows the memory mapping of the display buffer used by BIOS in text modes 0 to 3:

```
A0000        Character
             Generator
             Self Load
A7FFF        Storage
        ┌─────────────────┐
        │    Not Used     │
B8000   ├─────────────────┤
        │ Character Code  │
B8001   ├─────────────────┤
        │ Attribute Code  │
        ├─────────────────┤
        │ Character Code  │
        ├─────────────────┤
        │ Attribute Code  │
        ├─────────────────┤
        │        •        │
        │        •        │
BFFFE   ├─────────────────┤
        │ Character Code  │
BFFFF   ├─────────────────┤
        │ Attribute Code  │
        └─────────────────┘
```

Two bytes define each character on the display screen. The character code in the even byte can reference up to 256 characters held in the character generator. The odd byte defines the attribute information which is divided into two 4-bit addresses for the background and foreground colors. Sixteen colors are available for the foreground and sixteen colors are available for the background. However, when character blinking is enabled, the most significant bit of the attribute byte, AT7, is reserved for turning on or off the blink for that character, and thus leaves only 8 colors available for a background color. Likewise, when using 512 characters out of the character generator, AT3, is used to select between the low or high order 256 characters in the character generator. In this case, there are only 8 colors available for the foreground color. Bit 4 of the Character Generator Interface and Sync Polarity Register, 3D4h, Index 12h, enables 512 character selection. Blink is enabled by bit 5 in the CGA Mode Control Register, 3D8h. The format for the two bytes is as follows:

```
                    ODD BYTE
   msb                                    lsb
 ┌─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┐
 │ AT7 │ AT6 │ AT5 │ AT4 │ AT3 │ AT2 │ AT1 │ AT0 │
 └─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┘
      └──────┬──────┘      └──────┬──────┘
         Background           Foreground
           Color                Color
          Palette              Palette
          Address              Address

                   EVEN BYTE
   msb                                    lsb
 ┌─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┐
 │ CG7 │ CG6 │ CG5 │ CG4 │ CG3 │ CG2 │ CG1 │ CG0 │
 └─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┘
                  Character Code
```

CGA Graphics Modes

The following shows the memory mapping for the graphics modes 4 through 6:

```
B8000  | Pixel Byte |     ┐  First Pixels Displayed
       |            |     ├─ Upper Lefthand Corner
B8001  | Pixel Byte |     ┘  Odd Scan Lines (1,3,5,...)
       |            |
       |     .      |
       |     .      |
BA000  | Pixel Byte |     ┐  First Pixels Displayed
       |            |     ├─ Upper Lefthand Corner
B8001  | Pixel Byte |     ┘  Even Scan Lines (2,4,6,...)
       |            |
       |     .      |
       |     .      |
BFFFF  | Pixel Byte |
```
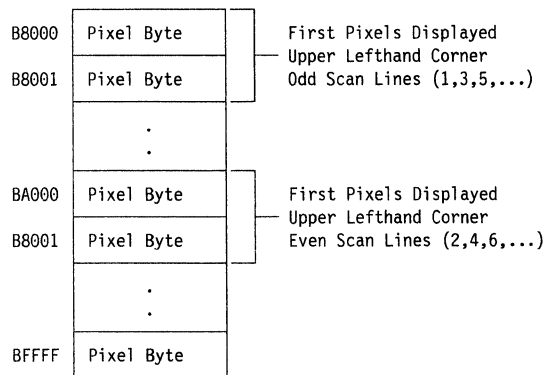
Even and odd scan lines are separated by 8K bytes and are compatible with the IBM Color/Graphics Adapter.

When in graphics modes 4, 5, and 6, the first addressable scan line is fetched starting at address B8000H. This data is then double scanned or automatically duplicated on the second physical scan line on the screen. The second addressable scan line is fetched at address BA000H and is double scanned also. Conceptually, double scanning simply involves double dotting the pixels in the vertical direction.
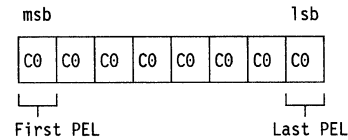
The format for the pixel byte in modes 4 and 5 is as follows:

```
msb                          lsb
| C1 | C0 | C1 | C0 | C1 | C0 | C1 | C0 |
  └──┬──┘               └──┬──┘
  First PEL             Last PEL
```
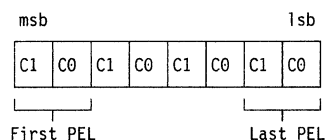
In modes 4 and 5, the bit pair C1 and C0 select one of four colors for each pel from one of two color sets. The colors are selected through the CGA Border Control Register (BCR), 3D9h. When bit 5 of the Border Control Register is set to 1, color set 1 is chosen. When bit 4 of this register is set to 1, an intensified color set 0 or color set 1 is selected--whichever was chosen with bit 5. Bits 4 and 5 set to a 1 is the default. Bit 4 of the BCR, C1 and C0 of the pixel byte and bit 5 of the BCR become

the palette address. Bits 3 through 0 of the BCR select the background color, which is selected when C1 and C0 are 00. The default palette in this mode is the CGA-compatible palette.

The format for the pixel byte in mode 6 is as follows:

```
msb                          lsb
| C0 | C0 | C0 | C0 | C0 | C0 | C0 | C0 |
  └──┬──┘               └──┬──┘
  First PEL             Last PEL
```

In this mode, one bit defines each pel. If bit 2 in the CGA Mode Control Register, 3D8h, is 1, the foreground color comes from palette address, 7h. If this bit is 0, the foreground color comes from the palette address specified in the CGA Border Control Register, bits 3-0. The background color always maps to palette address 00h. The default color 0 is black and the default color 7 is white.

New Graphics Modes

The following shows the memory mapping for modes 11h and 13h:

```
A0000  | Pixel Byte |  ┐  First Pixel(s)
       |            |  ┘     Displayed
A0001  | Pixel Byte |
       |     .      |
       |     .      |
       |     .      |
       | Pixel Byte |
AFFFF  | Pixel Byte |
```
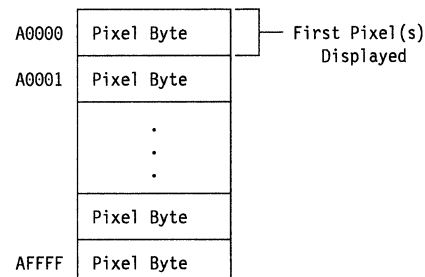
The video buffer for the 320 x 200 x 256 color and 640 x 480 x 2 color graphics mode is addressed linearly.

```
msb                          lsb
| C7 | C6 | C5 | C4 | C3 | C2 | C1 | C0 |
```
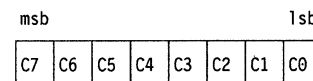
In mode 11h, the pixel definition is the same as in mode 6. In mode 13h, one byte of data is used to define one pixel on the display screen. A pixel is defined by the C7-C0 bits in the memory byte.

Palette Interface

The color palette has 256, 18-bit read/write data registers, an 8-bit write address register and an 8-bit read address register. Each data register is divided into three 6-bit data areas, one for each color (R, G, B). Loading each data register takes three CPU I/O writes in the sequence of red, then green, then blue.

Note: Bits 6 and 7 are unused in these palette writes and should be set to 0.

The palette supports both a single register write operation and a burst load operation.

To maintain software compatibility, programmers should use the BIOS interface when loading the color palette. BIOS supports two calls for setting and two calls for reading the color registers. The calls are through interrupt 10H with (AH) = 10H. The value in the AL register determines the specific operation:

10H - Set individual color register

12H - Set block of color registers

15H - Read individual color register

17H - Read block of color registers

1BH - Sum color values to gray shades.

For an individual register load, the address for the specific color register (0 - 255) is loaded into the BX register. The DH, CH, and CL registers contain the red, green and blue values, respectively.

The second call supports setting a block of color registers. Using this call, one to 256 color values can be set or read with a single BIOS call. The BX register contains the address for the first register to be set, and CX contains the number of registers to set. The value contained in ES:DX points to a table of color values, where each table entry contains the red, green and blue values for a color.

To sum the color values to gray shades, BIOS calculates a weighted sum (30% red, 59% green, and 11% blue), and then writes the sum into the red, green, and blue components of the color register. The original data for these color registers is not retained.

RAM-Loadable Character Generator

The character generator is RAM loadable. Four 8x16 character fonts of 256 characters each may be stored in the video buffer at A0000H. Two of these fonts may be loaded into and displayed from the character generator at any one time. A BIOS call (AH = 11H) is provided to load the character generator.

Hardware Features/Options And Products Supported

The hardware features/options and products available for the IBM Personal System/2 Model 30 are listed below:

Part Number	Description
- 6450213	PC Network Adapter
- 6450215	Serial/Parallel Adapter
- 6450217	Serial Adapter Cable
- 6450230	PC Network Base Expander
- 6450231	PC Network Short Distance Kit
- 6450232	PC Network Medium Distance Kit
- 6450233	PC Network Long Distance Kit
- 6450234	PC Network 25-Foot Cabling Segment
- 6450235	PC Network 50-Foot Cabling Segment
- 6450236	PC Network 100-Foot Cabling Segment
- 6450237	PC Network 200-Foot Cabling Segment
- 6450238	PC Network Transformer Unit
- 6450242	Serial Adapter Connector
- 1501204	Binary Synchronous Communications (BSC) Adapter
- 1501205	SDLC Communications Adapter
- 1501220	PC Network Adapter II
- 1501221	PC Network Baseband Adapter
- 1501300	Game Control Adapter
- 6451502	Data Acquisition and Control Adapter
- 6451503	General Purpose Interface Bus Adapter
- 6451504	Data Acquisition and Control Adapter Distribution Panel
- 1502067	Communications Adapter Cable
- 74X8403	Enhanced 5250 Display Station Emulation Convenience Kit, V2.12
- 74X8425	Enhanced 5250 Display Station Emulation Adapter Kit, V2.12
- 6339098	IBM Token-Ring Network PC Adapter Cable
- 6339100	IBM Token-Ring Network PC Adapter
- 2685193	IBM 2MB Expanded Memory Adapter
- 1887744	IBM Personal System/2 Display Adapter
- 59X4146	IBM 6157 Streaming Tape Drive Adapter
- 4234548	5364 Driver Card
- 65X2016	High Speed Adapter (HSA)
- 65X2017	3117 Scanner Adapter
- 1501217	IBM Personal System/2 8087 Math Co-Processor
- 1501216	IBM Personal System/2 Speech Adapter
- 1501224	IBM Personal System/2 Data Migration Facility
- 63X4882	General Purpose Interface Bus Adapter Cable
- 67X0438	IBM Token-Ring Network PC Adapter II
- 6134339	PC Network Baseband Extender
- 56X2412	InfoWindow Enhanced Graphics Adapter
- 83X9670	3278/3279 Emulation Adapter
- 81X8630	IBM PC Music Feature
- 67X0410	IBM Token-Ring Network PC Adapter Diskette
- 83X8851	IBM Token-Ring Network PC Adapter HM & S Addendum
- 6236069	IBM 4700 Finance Communication System Security Option
- 85X2710	Realtime Interface Co-Processor (128KB)
- 85X2706	Realtime Interface Co-Processor (512KB)
- 8575146	Enhanced Graphics Adapter Jumper Card
- 6450244	IBM Personal System/2 5.25 Inch External Diskette Drive Adapter
- 6450350	IBM Personal System/2 Mouse

Peripherals

- 3117	Scanner
- 3118	Scanner
- 3363-A01	IBM 3363 Optical Disk Drive
- 3363-B01	IBM 3363 Optical Disk Drive
- 3812	Page Printer (Serial Interface)
- 3852-002	Color Inkjet Printer
- 4201-001	Proprinter - EMC (PRHS)
- 4201-002	Proprinter
- 4202	Proprinter XL
- 46900 (RP244)	ROLMphone 244PC (Available from ROLM only)

- 4869-001	IBM Personal System/2 5.25 Inch External Diskette Drive	- 6184	IBM 6184 Color Plotter
- 5152	Graphics Printer	- 6186	IBM 6186 Color Plotter
- 5178	PC Network Translator Unit	- 7372	IBM 7372 Color Plotter
- 5182	Color Printer	- 8228-001	IBM Token-Ring Network Multistation Access Unit
- 5201-001	IBM Quietwriter (Reg.)	- 8503-001	IBM Personal System/2 Monochrome Display 8503
- 5201-002	IBM Quietwriter (Reg.)		
- 5202	IBM Quietwriter (Reg.) III	- 8512-001	IBM Personal System/2 Color Display 8512
- 5216	Wheelprinter (Parallel Interface)		
- 5223	Wheelprinter E	- 8513-001	IBM Personal System/2 Color Display 8513
- 5841	IBM PC 1200 Baud Model (External)		
- 5842	IBM PC 2400 Baud Modem (External)	- 8514-001	IBM Personal System/2 Color Display 8514
- 6157-001	IBM 6157 Streaming Tape Drive		
- 6180	IBM 6180 Color Plotter		

ROM BIOS Compatibility

Introduction

The ROM BIOS for the IBM Personal System/2 Model 30 is not identical to previous levels of BIOS, although it has the same programming interfaces. Application programs should not reference locations within the ROM, as data tables and code entry points may be at different addresses. Instead, programs should always use documented DOS or BIOS interfaces. Failure to do this may result in programs that do not work properly on various members of the IBM PC family.

The BIOS interfaces of the IBM Personal System/2 Model 30 are an evolution of the BIOS interfaces provided on the IBM Personal Computer, IBM Personal Computer XT, and IBM Personal Computer AT and, therefore, ensure a high degree of software compatibility. Extensions have been made where required to support some of the IBM Personal System/2 Model 30's new features.

The IBM Personal System/2 Model 30 is based on an 8086 microprocessor. This processor has an instruction set identical to the 8088 of the IBM PC and IBM PC XT, but executes instructions faster. The following sections compare the BIOS in the IBM Personal System/2 Model 30 with the BIOS in the IBM Personal Computer (8088), IBM Personal Computer XT (8088), and, in some cases, the IBM Personal Computer AT (80286).

Interrupt 5H - Print Screen

The Interrupt (Int) 5H routine serves the same function and is used the same way as the print screen interrupt on previous systems. It has been expanded to work with two new video modes.

Interrupt 9H - Keyboard Hardware

Application programs that replace Interrupt 9H are compatible (through the keyboard data port at address 60h). However, they may have to make allowances for the expanded set of scan codes that can be returned by the IBM Enhanced Keyboard (first announced with the IBM PC AT Model 339).

User keyboard interrupt handlers must depend on port 60h as an input only port (i.e., READ only). I/O to the keyboard is conducted by BIOS through other port addresses based on the connector to which the keyboard is actually attached. The hardware interrupt generated by each keystroke is redirected through Int 71H. Because this interrupt level is shared by the keyboard, mouse port, and real time clock, BIOS code at Int 71H must determine which port the keyboard is attached to and move the scan codes arriving at that port to PORT 60h, which is where the Int 9H handler expects to find them. Applications programs should not change Int 71H.

The IBM Personal System/2 Model 30 does not use an 8042 microcontroller to process keystrokes like the IBM Personal Computer AT does. Therefore, changing the typematic rate of the keyboard and other such functions can be done only through the Int 16H function calls provided by BIOS.

Interrupt 10H - Video

The video subsystem of the IBM Personal System/2 Model 30 is highly compatible with the IBM Color Graphics Adapter (CGA) and also provides new functions, such as the ability to load character fonts and program the color registers. In addition, two new video modes are available.

One of the new modes (13H) sets up a 320 x 200 picture element (pel) screen buffer and allows 256 simultaneous colors, from a programmable palette of 262,144 colors. Using this mode, it is possible to display high quality, digitized pictures and other graphic information.

The other new mode (11H) sets up a 640 x 480 pel screen buffer and allows any two colors from the 262,144 color palette to be used. With this mode, it is possible to display 30 rows of 80-column text.

The video interface also enables you to change the color registers in the CGA-compatible modes so that those modes can also take advantage of the large, programmable color palette.

CGA video modes that provide 200 pel high APA graphics (4, 5, and 6) automatically are double scanned by the hardware to provide the 400 scan lines required by the 31.5 kHz monitors.

The IBM Personal System/2 Model 30 displays the character fonts from a read/write memory. Video BIOS (Int 10H) provides mechanisms that enable you

to load up to 4-8 x 16 fonts of 256 characters each. The fonts can be used individually or combined in groups of two to create a 512-character set. The application's four character fonts are loaded into a 16K byte portion of video memory and the two being displayed are copied to an 8K static memory in the video circuitry by issuing a SET BLOCK SPECIFIER (AH = 11H, AL = 3H) call. Programs that load their own character font must make a SET BLOCK SPECIFIER function call before the character font will show up on the display. This is slightly different than the IBM Enhanced Graphics Adapter, where changing the character font in RAM resulted in instantaneous changes on the display. Making the SET BLOCK SPECIFIER call results in programs that run correctly on both EGA and the IBM Personal System/2 Model 30. The video BIOS interface also provides an easy method of switching back to the original 8 x 16 character font that is provided in the BIOS ROM.

Three new interfaces provide the capability to sum the color register information into gray scales, to switch displays, and to query the state and functional capabilities of the video subsystem.

A summing algorithm converts the color register data to a monochrome gray scale as they are loaded into the hardware. The set of 262,144 palette colors map to 64 shades of gray on all monitors. This BIOS function is always performed when you have an analog monochrome monitor. If you have an analog color display, you can enable it by using a BIOS call. This enables you to preview how an application looks on an analog monochrome display even if you do not have one available.

The display switching capability enables application programs to switch easily back and forth between the system board video circuitry and another video adapter in the I/O channel when the two require the same BIOS data areas and I/O port addresses.

The functionality and video state information request returns a table of information that lets applications and system level software know which video modes are supported, how much video RAM is available, and a number of other useful video parameters.

Applications that access the video RAM buffer directly do not need to synchronize the access with the horizontal and vertical sync signals.

Interrupt 12H - Memory Size Determination

IBM Personal System/2 Model 30 now supports an Extended BIOS Data Area (EBDA) that is reserved at the high end of RAM during the power-on self test. The size of this area initially is 1K but can be enlarged as more space is required. Applications making the BIOS memory size request will receive a response that is the total amount of memory in the machine MINUS the size of the EBDA. For example, in a 640K system, Int 12H will report 639K of memory available. Applications that measure the size of RAM themselves and assume that all memory at higher addresses is available will experience problems; applications that request DOS to allocate memory to them will not.

Interrupt 13H - Diskette and Fixed Disk

The IBM Personal System/2 Model 30 uses 3.5" diskette drives rather than 5.25" drives. The differences between these drives are transparent to most programs that use the documented BIOS and DOS interfaces.

Programs should assure that the parameters passed in DL (drive number) and AL (sector count) are valid. (The IBM PC and IBM PC XT specifically stated that AL was not used for format operations; AL is used for format operations on the IBM Personal System/2 Model 30.) If a reset operation (AH = 0) is done without specifying DL, then the returned status in AH may be incorrect.

Before formatting a diskette, programs should issue a SET MEDIA TYPE FOR FORMAT (AH = 18H) call. Calling READ DRIVE PARAMETERS (AH = 8H) will obtain the correct parameters to use for the drive.

The diskette change line associated with the 3.5" diskette drives will indicate when the media in a drive is changed. This signal reduces the risk of erroneous I/O to a diskette that has just been inserted. This may also improve performance by allowing buffers such as DOS's directory and file allocation table to remain in memory as long as the diskette is not changed.

Applications should use diskette BIOS function AH = 15H (READ DASD TYPE) to determine if the diskette drives support the diskette change line. If the drive does not support the change line, then the application never receives an error code of 06H (media has been changed) from BIOS. Likewise, any calls made to diskette BIOS function AH = 16H (DISK

CHANGE LINE STATUS) return AH = 0H (disk change line not active).

The fixed disk BIOS now supports a park heads function (AH = 19H) that can be called by any application to prepare the system for shutdown before moving.

Because the fixed disk controller is now integrated with the drive, a RESET also recalibrates the drive. This takes longer than just resetting the fixed disk controller. Programs should avoid unnecessary resets. (One reset should be issued to a drive after a BIOS read or write operation reports an error.)

The diskette and fixed disk use DMA for data transfers and therefore support overlapped I/O with other devices.

Interrupt 14H - Asynchronous Communications

The Asynchronous BIOS interface now supports setting parameters such as "sticky" parity.

Interrupt 15H - System Services

BIOS functions exist to obtain system parameters such as machine model and sub-model, BIOS revision level, DMA and real time clock information, etc. System services also supports all of the functions required to enable and use the mouse port. It returns a pointer to the location of the extended BIOS data area.

Because of the 8086 processor, functions to support memory above the 1M memory address space (i.e., protected mode) are not supported. Cassette I/O functions also are not supported.

Interrupt 16H - Keyboard

Keyboard Interrupt 16H is fully compatible with the previous keyboard BIOS interfaces and provides the expanded functions introduced on the IBM Personal Computer AT Model 339 for the IBM Enhanced Keyboard.

Interrupt 1AH - System and Real-Time Clock

The Daylight Savings Time option is not supported.

Power-On Self Test

The power-on self test (POST) of the IBM Personal System/2 Model 30 contains a number of enhancements.

The IBM Personal System/2 Model 30 contains no configuration switches or jumpers (except on certain option cards) and does not require a configuration program. POST automatically determines configuration information.

If POST detects that a card in the I/O channel conflicts with the addressing of the memory, serial port, parallel port , or video circuitry on the system board, it disables the system board circuitry and enables the I/O channel hardware. (Diagnostics will inform you of your error if you insert a serial or parallel adapter with the address jumpers set incorrectly.)

The amount of POST testing in the areas of serial, parallel, diskette, and video has been increased.

The first 128K of memory in the system is soldered onto the system board; the remaining 512K is on two SIP packages that mount in sockets on the system board. If POST detects a memory failure in the first 128K of RAM, it displays error code 205. It then re-maps the memory address space, exchanging the address order of the soldered and socketed memory. This enables you to continue using the system with 512K of memory until you can have the system serviced.

Copy-Protected Programs

Copy protection may work differently on the IBM Personal System/2 Model 30 for the following reasons:

- Track density for the 3.5" diskette drive is 135 tracks/inch.

- Track-to-track access time and head settle time parameters are overridden by BIOS if minimum drive requirements are not met.

- BIOS insures that the drive motor has 500 milliseconds for startup on both read and write operations.

- If diskette BIOS is bypassed, the diskette change signal will not work properly and may cause loss of data.

Programs that use special diskette formats should use the SET MEDIA TYPE FOR FORMAT function call of diskette BIOS to assure that BIOS does not provide defaults that are incorrect for what the application is trying to accomplish. It is also important to indicate in AL the number of sectors used in a format operation.

Machine Identification

A machine model byte is stored in ROM at location 0F000:0FFFE. The meaning of the byte is:

```
0FFh - IBM Personal Computer
0FEh - IBM Personal Computer XT
       IBM Portable Personal Computer
0FDh - IBM PCjr
0FCh - IBM Personal Computer AT
0F9h - IBM PC Convertible
0FAh - IBM Personal System/2 Model 30
```

The model byte also can be obtained through a system services BIOS function on the IBM Personal System/2 Model 30.

Software Compatibility

One of the goals of properly designed software is to have the capability of being ported among the various models of a product family and being run with no problems. Software that uses the architected interfaces has the highest probability of running successfully on all of the models in the family.

The following sections contain recommendations that will increase compatibility among members of the IBM PC family. Also included are techniques that should be avoided.

- Use high-level languages whenever possible.

- Use only documented interfaces to the operating system (DOS and BIOS).

- Don't keep interrupts turned off any longer than necessary.

- Avoid time critical routines.

- Always provide a stack that is large enough to handle your own program's needs and the requirements of the rest of the system as it handles interrupts, BIOS calls, and DOS calls. At a minimum 256 bytes (in addition to the application's requirements) should be provided.

- All systems will not be configured the same. Avoid writing programs which "hard code" such things as asynchronous and parallel port addresses and diskette drive identifiers.

- Do not assume that all memory at higher addresses is owned by your application.

  Remember that there is now an Extended BIOS data area in high memory. The best approach is to request DOS to allocate memory to your application.

- Because of the minimal loading on the IBM Personal System/2 Model 30 I/O channel, data written to nonexistent I/O addresses may read back from the same address (even after a delay) if no other I/O activity intervenes. Programs that use techniques such as this to determine the presence of hardware options should assure that other I/O bus activity takes place between writes and reads. A technique that works well is to read the interrupt mask register between writing and reading a port.

- Programs should not use self-modifying code. Because of the 8086 family's pipelined architecture, an instruction may have already been "fetched" at the time the program tries to modify it. Because the length of the pipeline and the amount of interrupt activity may vary from one system in the family to another, programs that modify themselves can appear to work properly on one system but fail on another.

- The IBM Personal System/2 Model 30 automatically determines configuration information during POST and does not use switches or configuration data stored in CMOS memory. Configuration information is available to applications through a number of BIOS function calls. Programs should avoid reading locations that were switches or CMOS memory on previous machines.

IBM Personal Computer Disk Operating System (DOS) Version 3.30

Introduction

The IBM Personal Computer Disk Operating System (DOS) Version 3.30 provides all of the functions contained in the prior version of DOS (3.20), plus enhancements for support of the IBM Personal System/2 family. DOS 3.30 also includes enhancements to the national language support provided by DOS 3.20 as well as a new feature called code page switching.

The purpose of this section is to provide an overview and pertinent technical information regarding DOS 3.30. If further information is required, please refer to the DOS documentation listed at the end of this section. The specific relationship of DOS 3.30 to DOS 3.20 and prior releases of DOS is also described in this section.

Highlights

DOS 3.30 provides the same application support that previous versions of DOS have provided as well as the following additional functions. IBM PC DOS 3.30 supports the IBM Personal System/2. This support includes the following additions:

- 1.44MB 3.5" diskette drives.

- Partitioned large disks.

- Up to four Async ports, at up to 19,200 Baud each.

- TIME and DATE set the CMOS clock.

- STACKS support can be disabled.

- Enhanced National Language Support. DOS 3.30 is translated into eleven languages, provides country information for nineteen countries and supports seventeen different national keyboards.

- Code page switching between the existing national code pages and a new multilingual code page.

- Enhancements to the batch file processor.

- Enhancements to several existing DOS commands for improved ease of use and error recovery.

Note:

> The Model 30 does not support 1.44 Mb 3.5" diskette drives.

> The Model 30 supports two async ports, at up to 9600 baud each.

Code Page Switching

Many countries require accented characters to support their languages. The standard IBM PC character set does not include all of the required characters, and, therefore, some countries made up their own character sets to allow the use of these accented characters. Since the IBM PC can only display 256 characters at a time, some of the characters in the standard set were replaced to add the accented characters. This replacement causes problems if files created in one country (which contain accented characters) are displayed in different countries. The different characters sets are referred to as code pages.[1]

To solve this problem, IBM has developed a new character set that has all the required accented characters. (This was done by deleting some of the block graphic and Greek symbol characters from the standard set.) With this new character set, data can be interchanged without problems.

Since existing files use the old character set, there should be a way to look at files in the old character set as well as files in the new character set. This dual code page environment is what code page switching provides.

---

[1] A Code Page is a particular mapping of a character set to numeric values. By changing either the character set or the numeric values, a different code page can be created. Thus, a code page is an abstract concept without a real representation. A Font is the appearance of a code page. Thus, it is the font that makes a code page real. A code page can have many fonts. DOS 3.30 only provides one font per code page.

Code page switching is achieved by defining multiple character sets to font down loadable devices. Once defined, the user can switch between these prepared code pages as needed. DOS 3.30 provides display, printer and country dependent information support for the following code pages:

- 437 - IBM PC standard

- 850 - New multilingual

- 860 - Portuguese national

- 863 - French-speaking Canadian national

- 865 - Nordic countries national.

New and Changed Commands

There are several new commands with DOS 3.30. Also several existing commands have been enhanced significantly.

APPEND Command

The APPEND command is a terminate and stay resident enhancement to DOS 3.30, which provides a data path function. APPEND's function is based on the APPEND command provided with the IBM PC Network Program and IBM PC LAN Program products. APPEND defines a new class of DOS command. It is an external command the first time it is run. Thereafter it is an internal command.

APPEND searches for files in alternate directories if they are not found in the directory asked for by an application. Several alternate directories can be defined. APPEND processes the following DOS functions:

- 0FH - FCB OPEN

- 23H - FCB FILE SIZE

- 3DH - ASCIIZ OPEN.

If instructed to by the user, APPEND also processes the following additional DOS functions:

- 11H - FCB SEARCH FIRST

- 4BH - ASCIIZ EXEC PROGRAM

- 4EH - ASCIIZ FIND FIRST.

APPEND holds the alternate directory list or places it in the current DOS environment.

ATTRIB Command

The ATTRIB command has been enhanced to enable the 'Read-Only' and 'Archive' attributes to be set or reset for all files at or below a certain directory level. With this enhancement, a single ATTRIB command could reset the 'Archive' attribute for all files on a disk.

ATTRIB can also be used as a WHEREIS command. For example, to find all occurrences of the *xyz.dat* file, type:

```
ATTRIB \XYZ.DAT /S
```

BACKUP Command

The BACKUP command has been enhanced in several ways. It uses a new structure for the backup diskette. A single file contains all the data for all files backed up to that disk. This change results in higher performance and more dense file storage. BACKUP also will format the backup diskettes if they are not formatted already. BACKUP produces an optional log file on the backup source indicating the status of all backed up files and which disk they were backed up on.

CALL Command

The CALL command is a new batch file command. It enables a batch file to call another batch file without re-invoking COMMAND. CALL nesting is limited only by available memory. CALL can be used wherever a single command can be used. File redirection (<, > and > >) and piping are not supported on the CALL command line to call batch files.

CHCP Command

The CHCP command is a new internal command that enables the user to select a code page for the active country-dependent information and all devices that support code page switching. CHCP can also be used to determine the currently active code page.

DATE and TIME Commands

The DATE and TIME commands now set the CMOS clock each time they are used, providing that CMOS memory has already been initialized. This change only occurs on PC types that have CMOS clocks.

FASTOPEN Command

The FASTOPEN command is a terminate and stay resident enhancement to DOS 3.30 that can improve greatly the performance of directory access functions. FASTOPEN provides a directory entry cache that is managed on a least-recently-used basis for each defined drive. FASTOPEN support is only provided for non-removable drives selected by the user.

FASTOPEN works by building up in memory a fraction (the most active entries) of a disk's directory structure. This includes directory entries for both files and subdirectories. Any DOS function call that references a file name (example: OPEN, RENAME, FIND) will first search the FASTOPEN cache. If the entry is found in the cache no disk I/O is performed. If it is not found in the cache, DOS locates the entry on the disk and adds it to the cache (possibly removing another entry if the cache is full).

FASTOPEN keeps the directory entries for closed files. If a file is re-opened within a short time from the close, DOS 3.30 finds the file's directory entry in the cache. This enables the file to be opened without any disk I/O. This can be helpful for programs with a lot of overlays and for programs that deal with large numbers of files (such as database programs).

GRAFTABL Command

GRAFTABL has been enhanced to support the national code pages. GRAFTABL can load the upper 128 CGA graphic mode character definitions for one of four different code pages. It also provides status indicating the currently selected code page.

KEYB Command

The KEYB command is a terminate and stay resident enhancement to DOS 3.30 that provides support for different national keyboard layouts. KEYB replaces the KEYBxx commands provided in prior DOS versions. KEYB supports eleven keyboard layouts with support for different dead key and shifting rules for each keyboard.

Support for eleven keyboards made it impractical to extend the KEYBxx approach. A single table driven command (KEYB) is used instead. The tables used by KEYB are contained in a file provided with DOS

3.30 called KEYBOARD.SYS. In this file there are keyboard definitions for the eleven layouts in two code pages.

MODE Command

The MODE command has been enhanced to support up to four COMx devices on the IBM Personal System/2 Models 50, 60 and 80. MODE also allows the Baud rate to be set to 19,200 on these COMx devices.

MODE also provides additional options to support code page switching. This support includes the ability to download code page images (designate or prepare), select a code page (invoke or select), and check the currently selected code page as well as the list of possible code pages (query or status).

MODE code page support works on a device by device level. This is in contrast to the support provided by CHCP, which works system wide.

NLSFUNC Command

The NLSFUNC command is a terminate and stay resident enhancement to DOS 3.30 that provides support for enhanced country-dependent information and code page switching. NLSFUNC provides support for the existing 'get' or 'set' country-dependent information (AH = 38H) DOS function as well as support for the new 'get' extended country-dependent information (AH = 65H) DOS function. NLSFUNC also provides support for the global code page (AH = 66H) DOS function.

RESTORE Command

The RESTORE command has been changed to support the new format backup diskette produced by BACKUP. RESTORE continues to support the pre-DOS 3.30 backup diskette. RESTORE also supports greater selectivity as to which files should be restored.

SELECT Command

The SELECT command has been enhanced to generate the new form of the KEYB command and COUNTRY statement. There has been no change to the user options for SELECT.

CONFIG.SYS Changes

For DOS 3.30, the COUNTRY statement has been enhanced and two new device drivers have been provided. These additions are part of the extended national language and code page switching support.

COUNTRY Statement

The COUNTRY statement has been enhanced to enable the user to specify a code page for the country information. Since the DOS country-dependent information contains character strings, the information can be code page dependent. IBM PC DOS 3.30 provides two sets of country information (i.e. two code pages) for all eighteen countries.

The country information is no longer built into DOS. It is contained in a file called COUNTRY.SYS. DOS 3.30 stores the information for a single country in a single code page in memory. To access information for other countries or code pages, DOS must access the COUNTRY.SYS file. This is done using support provided by the NLSFUNC command.

Both the COUNTRY statement and the NLSFUNC command can specify the location of the COUNTRY.SYS file. If not specified, the path COUNTRY.SYS is used.

Because the system stores only one country's information, the DOS 'get' or 'set' country-dependent information function may fail if the NLSFUNC is not installed, the COUNTRY.SYS file is not found or there is an I/O error reading the COUNTRY.SYS file. This is not the case with older versions of DOS.

DEVICE Statement

DOS 3.30 provides two new device drivers for code page switching support. Code page switching is provided for displays and printers that support font definition.

Video support:

- Enhanced Graphics Adapter compatible adapters and displays

- PC Convertible LCD display

- IBM Personal System/2 family displays.

Printer support:

- The IBM 4201 Proprinter (with character download feature)

- The IBM 5202 Quietwriter 3 (with multi-code page cartridges).

DISPLAY.SYS Device Driver

The DISPLAY.SYS device driver provides code page switching support for the CON device. This support includes:

- Download (designation) of up to twelve code page images

- Selection (invoke) of one the code page images

- Status (query) of the actively displayed code page and the list of possible code pages.

With DISPLAY.SYS loaded and code page switching set up the GRAFTABL command is not needed to define the upper 128 CGA graphics characters.

PRINTER.SYS Device Driver

The PRINTER.SYS device driver provides code page switching support for the LPT1 (or PRN), LPT2 and LPT3 devices. This support includes:
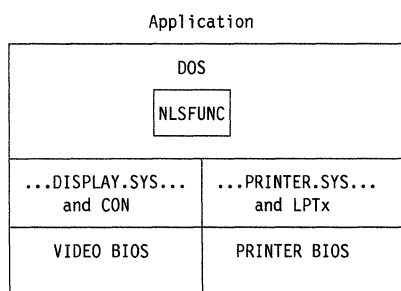
- Download (designation) of up to twelve code page images

- Selection (invoke) of one the code page images

- Status (query) of the actively displayed code page and the list of possible code pages.

```
                    Application
         ┌──────────────────────────────┐
         │             DOS              │
         │         ┌────────┐           │
         │         │NLSFUNC │           │
         │         └────────┘           │
         ├───────────────┬──────────────┤
         │ ...DISPLAY.SYS...│...PRINTER.SYS...│
         │    and CON    │   and LPTx   │
         ├───────────────┼──────────────┤
         │   VIDEO BIOS  │  PRINTER BIOS│
         └───────────────┴──────────────┘
```
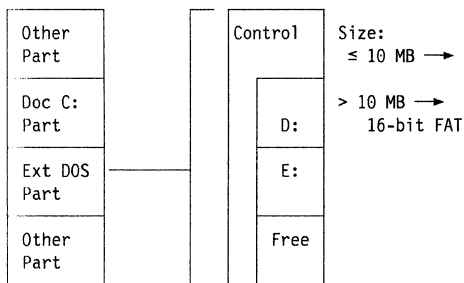
STACKS Statement

The STACKS statement has been modified to enable the user to to suppress the STACKS support added in DOS 3.20. When suppressed, DOS 3.30 returns to IBM PC DOS 3.10 mode where no stacks are provided. IBM continues to recommend that STACKS support be used to prevent undetected failures due to processor stack overflows.

Partitioned Disk Support

IBM PC DOS, since Version 2.0, has provided the ability to subdivide a single disk in up to four partitions. With DOS 3.30 one of those partitions (called the extended DOS partition) can be divided again into more partitions. These additional partitions are assigned drive letters and can be used as if they are separate disk drives. This support enables DOS to access media with a total size exceeding the current 32M disk size limit. For example, a 64M disk could be accessed as two 32M disks.

The new drive letters are created automatically by the built-in DOS Disk Device Driver when the system boots up. On machines with a " D:" drive, any extended partitions on the "C:" drive are given letters starting with "E:". Otherwise, the letters start with "D:". Other devices, such as VDISKs, are given drive letters after the extended partition drive letters.

```
 ┌─────────┐   ┌──┐  ┌─────────┐ ┌──────────────────┐
 │ Other   │   │  │  │ Control │ │ Size:            │
 │ Part    │   │  │  │         │ │ ≤ 10 MB ──►       │
 ├─────────┤   │  │  ├─────────┤ ├──────────────────┤
 │ Doc C:  │   │  │  │         │ │ > 10 MB ──►       │
 │ Part    │   │  │  │ D:      │ │   16-bit FAT      │
 ├─────────┤───┤  │  ├─────────┤ └──────────────────┘
 │ Ext DOS │   │  │  │ E:      │
 │ Part    │   │  │  ├─────────┤
 ├─────────┤   │  │  │ Free    │
 │ Other   │   │  │  │         │
 │ Part    │   │  │  │         │
 └─────────┘   └──┘  └─────────┘
```

FDISK Utility

The DOS 3.30 FDISK Utility has been enhanced to enable the user to create and delete the extended DOS partition and drives within it. FDISK also provides status information on the current disk partition structure. The drives created by FDISK can be from one cylinder up to 32M.

Batch File Changes

Two changes have been made to batch file processing. They are:

- ECHO suppression

    Any echo of a batch file line can be suppressed by starting the line with an @. This enables a batch file to suppress the echo of ECHO OFF. To run an external command with a name that starts with @, add a drive letter to the command's name (i.e.; @C:@PGM ...).

- DOS environment variables can be referenced within a batch file. To refer to a variable, enclose it's name in percent signs (%) (example: %PATH%).

Interrupt 21H Enhancements

Several new Interrupt 21H DOS functions have been defined. The functions support extended country information, code page switching and performance.

65H - Get or Set Extended Country Information

This Interrupt 21H enables an application to request extended country information for any country in any code page. This function requires NLSFUNC to be loaded to access information for other than the current country /code page combination. For DOS 3.30 this call returns the following information:

- Country-dependent information (like prior DOS versions)
- Character collating table
- Character uppercasing table
- File name character uppercasing table.

66H - Get or Set Global Code Page

This Interrupt 21H enables an application to set the code page for the 'get' or 'set' country-dependent information DOS function. It also switches all code page switching capable devices to the selected code page. These functions require NLSFUNC to be loaded. 'Get' does not require NLSFUNC.

67H - Set Handle Count

This Interrupt 21H allows an application to request more than twenty (20) (the IBM PC DOS 3.20 limit) files per process. This enables programs that use a large number of files, such as database programs, to open up to 255 files.

68H - Commit File

This Interrupt 21H enables an application to commit all modified file information to disk. This includes flushing all modified data buffers and updating the file's directory entry. This function works like CLOSE, but the file remains open.

Relationship to Prior Versions

DOS 3.30 is an upwardly compatible enhancement to DOS 3.20. It requires a minimum of 46KB of user memory (compared with 44KB for DOS 3.20), and DOS 3.30 offers functions not available in previous versions of DOS while maintaining standard functions and interfaces. Where standard programming practices are employed, most programs continue to run under DOS 3.30 without change.

DOS 3.30 uses slightly more memory than previous DOS versions which may increase the memory requirements of some programs. In this case, the program may be divided into smaller segments or more memory may be added to the system. The DOS extensions NLSFUNC, FASTOPEN, DISPLAY.SYS and PRINTER.SYS use more memory if they are installed.

The following areas are changed from DOS 3.20:

- BASIC and BASICA are now the same program. The old BASIC interpreter is no longer supported. Internally, BASIC runs or loads BASICA using an exec.

- Only a single country's country-dependent information is kept within DOS.

- Existing AUTOEXEC.BAT files containing KEYBxx commands must be modified to use the new KEYBxx format.

- BACKUP can no longer create pre-DOS 3.30 format backup diskettes. RESTORE continues to process the old-style backup diskettes.

- DATE and TIME now set the CMOS clock.

- The DEBUG, LINK and EXE2BIN commands now come with the DOS Technical Reference.

Installation and Operations

DOS 3.30 is installed by the same process used with DOS 3.20 unless page switching is selected. Normally, a first time user uses the SELECT command to install DOS. SELECT EXECs FORMAT and XCOPY to install DOS. Current users should use the REPLACE and SYS commands to install DOS.

To install code page switching, the user modifies the CONFIG.SYS and AUTOEXEC.BAT files created by the above steps. The user must add the DISPLAY.SYS and PRINTER.SYS DEVICE statements to CONFIG.SYS. The user also must add the NLSFUNC and several MODE commands to AUTOEXEC.BAT. The DOS reference provides instructions for the user to follow to accomplish these steps.

Packaging

The IBM Personal Computer DOS Version 3.30 is available in a single multi-diskette package. DOS is shipped on 5.25" and 3.5" diskettes. The DOS product package consist of two 5.25" diskettes and one 3.5" diskette. In addition, the package includes a "Read This First" card and the following listed publications.

The DOS 3.30 Technical Reference package now contains one 5.25" and one 3.5" diskette. In addition, the package includes the publications listed below.

Publications

DOS 3.30 is described in the following publications that are part of the IBM PC DOS 3.30 package:

- IBM Personal Computer Disk Operating System Users Guide (Level 3.30)

- IBM Personal Computer Disk Operating System Reference (Level 3.30)

- IBM Personal Computer Disk Operating System Quick Reference. Card (Level 3.30)

A DOS Technical Reference, intended for application programmers, is also available for separate purchase.

The DOS 3.30 Technical Reference package provides the following publications:

- IBM Personal Computer Disk Operating System Technical Reference (Level 3.30)

- IBM Personal Computer Disk Operating System Technical Quick Reference Card (Level 3.30).

Media Migration

Introduction

Media migration refers to the process of transferring software resources from the currently available 5.25" media to the newer 3.5" media. IBM offers four products to accomplish this task:

1. The IBM Personal Computer 3.5" - 720 KB Diskette Drive Option.

   This internal diskette drive is used in some models of the IBM PC XT and IBM Personal Computer AT.

2. The IBM Personal Computer 3.5" External Diskette Drive Option.

   There are two models of the IBM Personal Computer 3.5" External Diskette Drive. One model is for use with the IBM Personal Computer, IBM Personal Computer XT, and the IBM Portable Personal Computer. The other model is for use with the IBM Personal Computer AT and the IBM XT Model 286. Both models provide the capability to exchange information between the system with which they are used and the IBM Personal System/2.

3. The IBM Personal System/2 5.25" External Diskette Drive Option.

   This external 5.25" drive provides a method for the new 3.5" floppy-equipped system to use and transfer data and programs from 5.25" media. This drive replaces drive "B:" and operates in the same fashion as a normal system "B:" drive. The option includes the external drive, an option card with 8 KB ROM and a cable.

4. The IBM Personal System/2 Data Migration Facility

   The Data Migration Facility is a hardware/software package that provides an inexpensive method of uni-directional file transfer to a Personal System/2 from any IBM PC system equipped with a parallel interface.

   The Data Migration Facility uses a new feature in the Personal System/2 that enables bi-directional data transfer on the system board's parallel interface. Files cannot be transferred into any other IBM parallel interface.

Description

The hardware component of the Data Migration Facility package is a passive adapter that contains the wiring necessary to implement the software protocol. It is attached to the printer end of the IBM PC Printer Cable. The cable and adapter then are plugged into the parallel connectors on the sending and receiving machines. The connection is external, and the device requires no power. The user does not need to remove any covers or perform any special setup other than plugging it in prior to use.

The Data Migration Facility software consists of complementary send and receive programs. The send program is shipped on a 5.25" diskette, and the receive program comes on a 3.5" diskette. They are DOS-loadable COM files, and are invoked like DOS commands. The receive program takes over the receiving system and polls the parallel port for incoming data whenever it is not actively receiving files. After the receive program is installed, the send program is executed on the sending system-once for each file or group of files on a given drive and/or directory. The send program emulates the syntax and function of the DOS COPY command, with some limitations. The software transmission protocol uses 6-part handshaking with retries for each byte, and cyclical redundancy checking is performed at both ends to detect data errors.

Performance

The only limitations to the speed of data transmission are the time required for the propagation of signals and the individual performance characteristics of the sending and receiving systems. For the purpose of estimating total net transfer time, the average is about 2,000 bytes per second.

Performance comparison

OPERATION: *	TIME TO COMPLETION: Configuration I: PC/XT connected to Pers. Syst./2 Mod 30 via Data Migration Facility	Configuration II: PC/AT with external 3.5" diskette drive
Copy 362, 496 bytes from 5.25" 360 Kb diskette to 3.5" 720 Kb diskette.	3 minutes, 31 sec. (13,744 bits/sec.) (1715 bytes/sec.)	3 minutes, 18 sec.

Note: * Operation is exclusive of hardware installation and set up.

Summary

The IBM Personal System/2 Model 30 opens up a
wide range of opportunities for the independent
developer. Improvements in performance, video, I/O
subsystems and BIOS highlight the ways in which the
opportunity of the independent developer is
enhanced. These seminar proceedings have been
presented to assist you in your development efforts
by providing relevant information about the Model 30
and a direction for development as well.

Notes

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