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IBM 3270 Personal Computer Hints and Tips

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PREFACE

The intent of this bulletin is to answer common questions about the 3270-PC. Most of the information it contains is available from other sources, however, I hope that by collecting and indexing the information in a single bulletin, it will be more useful to 3270-PC users.

This bulletin is divided into several sections, each of which is intended to answer the common questions about a single aspect or component of the 3270-PC. The hardware sections are first, followed by the software sections.

The section about API coding contains several suggestions about how to write API programs. Please remember that these are my own ideas and while they work for me, they may not be applicable in your particular environment.

If you have any questions about the 3270-PC that are not covered here, or if you have any hints on how to make better use of the 3270-PC, please send them in on the reader comment form and I will try to include them in the next update.

PLANAR BOARD (MOTHER BOARD) AND POWER SUPPLY

The IBM 3270 Personal Computer (3270-PC) is based on either a standard IBM Personal Computer XT (PC XT) or IBM Personal Computer AT (PC AT). With the exception of the use of a power supply with a very quiet fan in XT-based system units (P/N 6323357, or FRU 6347754.), there are no differences between the 3270-PC and the standard PC XT or PC AT. The accessory cards and the control program provide the 3270-PC functions. The standard PC BIOS is used in the 3270-PC.

Hard disk drives can be added to floppy disk-based system units without requiring a new power supply. If you install a hard disk on the 3270-PC, you should format it with the format routines found on the diagnostic diskette before running FDISK and FORMAT.

On 3270-PC-ATs, it is possible to install extended memory cards to support VDISKs above the 1 Mb (megabyte) address range. These VDISKs can be used for program overlays or data files to speed the execution of applications that run in the PC sessions. If more hard disk space is needed, the AT 30 Mb hard disk works, although it is not officially supported on the original 3270-PC AT models.

There are some quirks in the DOS FDISK command that bear repeating here. If the hard disk that was drive C: is replaced in a system that contains two hard files (C: and D:), and the new drive is formatted before running FDISK, the D: drive will be formatted instead of the new C: drive. This will cause the loss of data on the D: drive.

The solution is to run FDISK before formatting the new disk. Select option 4 which displays the status of the DOS partition. If there is no DOS partition, DOS does not recognize the drive and treats the next drive as C: even thought the user considers it to be D:. If there is no DOS partition on the disk, define one using FDISK option 1, and then format it.

The safest way to avoid this problem is to always run FDISK before formatting a hard disk. If the DOS partition already exists, FDISK will tell you and no further action will be required. If there is is no DOS partition, it can then be easily created.

It is always good practice to run the SHUTDOWN or SHIPDISK programs from the diagnostics disk before turning any 3270-PC with a hard disk off to park the heads. This program can be copied onto the hard disk for greater convenience. Also, the hard disk equipped 3270-PCs should NEVER be moved when powered on.

On XT-based 3270-PCs, there are six long slots and two short slots. Any of the long 3270-PC cards can go in any of the long slots. The only requirement is that the graphics adapters be adjacent to and on either side of the display adapter as they are connected together via top edge connectors.

On 3270-PC-ATs, there is an additional slot restriction. The display adapter, which requires an 8 bit slot, must be in slot 1. As in the XT-based models, the graphics adapters must be in the adjacent slots (2 and 3).

The 3270-PC specific adapter cards all use interrupt level 2.

The math coprocessor is supported in all models with current levels of the control program.

MEMORY ADAPTERS

3270-PC SHORT MEMORY ADAPTER CARD

On standard PCs, it is possible to have a 704K system by using memory in segment A (between 640K and 704K). This will not work on the 3270-PC because the display adapter uses segment A for the hardware screen buffer.

Feature 4505 for XT-based units is a short printer/memory card. This card contains a parallel printer port and 128K of memory. A 256K piggyback card (feature 4500) that plugs into the memory/printer adapter card brings system memory up to 640K without using any long slots.

3270-PC EXPANDED MEMORY (XMA) ADAPTER

The Expanded Memory Adapter (XMA) for the 3270-PC was announced in 1986. The XMA card comes standard with 1 Mb memory and a parallel printer port. An additional 1 Mb of system memory can be added with an optional piggyback card. It requires one long slot and 3270-PC control program version 3. The XMA card differs from previous PC memory cards in several significant areas.

The XMA card contains more than the 640K RAM that can be used by PC DOS. This memory is arranged in logical banks of memory on the XMA card and is managed by version 3 of the 3270-PC control program to run multiple large PC applications. With the XMA card installed, it is possible to have up to six independent PC programs in memory at one time. If all of the programs are well behaved, they can also execute concurrently. The control program will insure that the proper memory bank is available to a PC program when it is executing. Each individual PC program will think that it is running in a system with from 384K to 512K available for its use.

The XMA card is divided into several banks of memory. Each bank addresses the range of 256K to 640K. The first bank of memory is used for control program code. The next six banks are used to hold the program that is running in each of the independent PC sessions. The control program tests for uninstalled memory areas in the 640K to 1024K range and, if any are found, sets a section of the XMA card to those addresses. It then loads a portion of its code into those addresses.

The following figures illustrate how the XMA card functions.

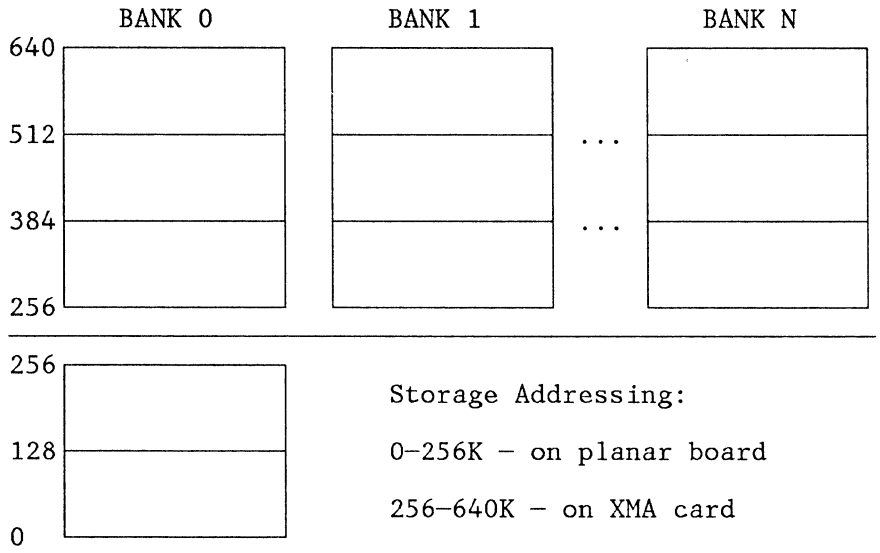

Figure 1. Storage Addressing

In a 3270-PC with the XMA card, the first 256K of memory is on the planar (system) board. The next 384K (256-640K) is on the XMA card. This memory is arranged into logical banks of up to 384K each. The size of each bank is determined when the 3270-PC is customized. Up to six banks, one for each PC session, can be configured. An additional bank of memory on the XMA card is used for control program code.

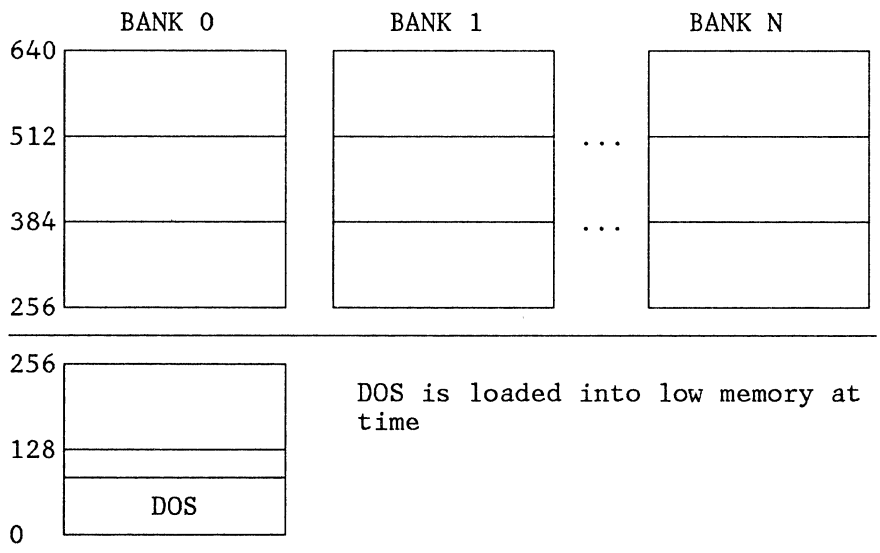

Figure 2. DOS is Loaded into the Lowest Memory Address

When the system is started, DOS is loaded into the low end of system memory on the planar board.

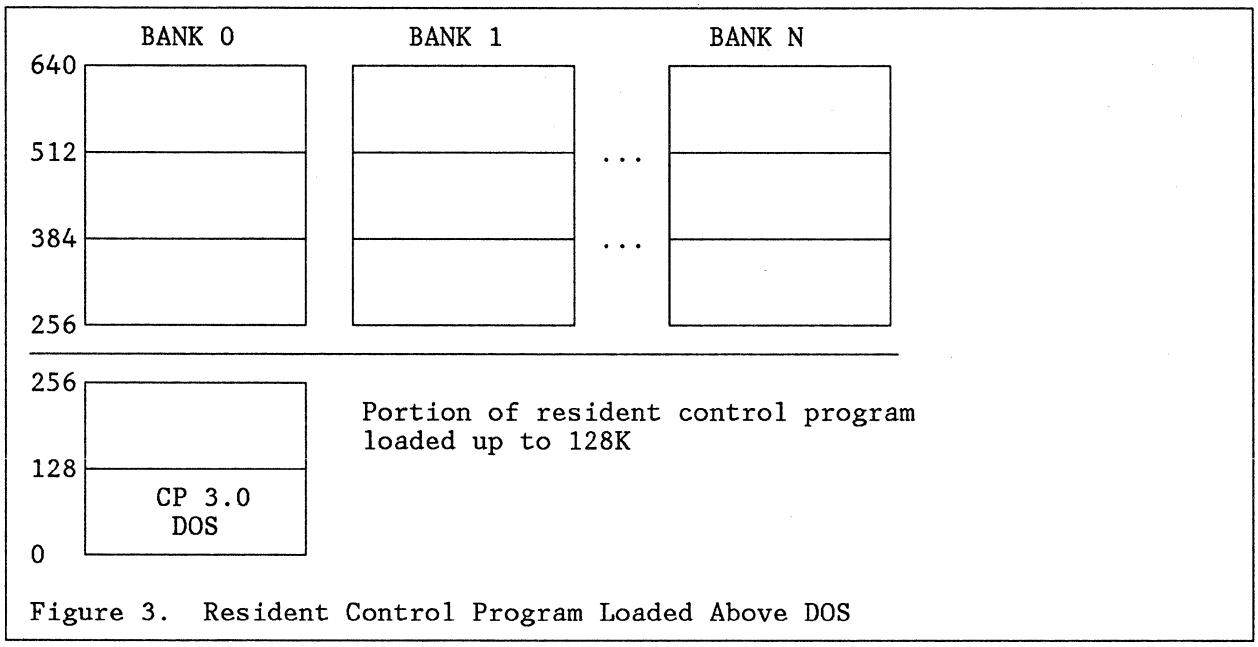

Figure 3. Resident Control Program Loaded Above DOS

The resident portion of the 3270-PC control program version 3.0 is then loaded into the next free memory above DOS.

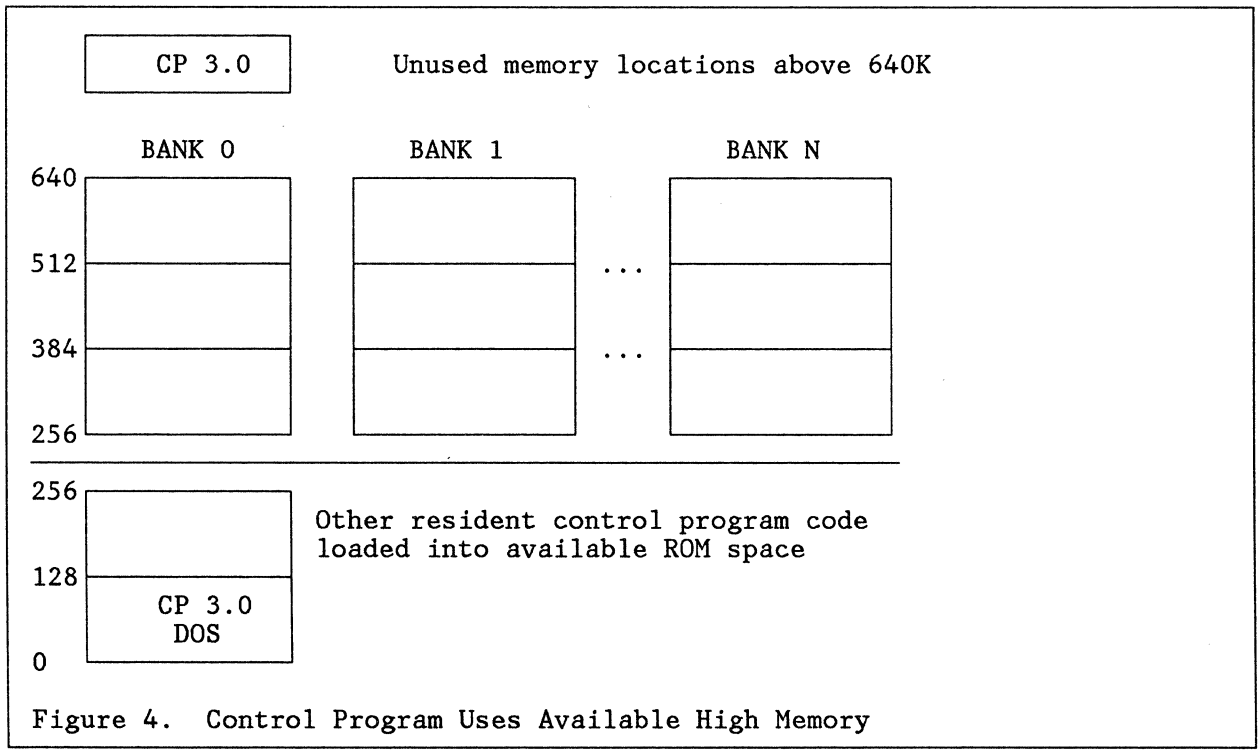

Figure 4. Control Program Uses Available High Memory

While the control program is loading, it looks for unused memory in the range between 640K and 1024K. This is the area of memory used by adapter cards, and system ROM. If the control programs detects a hole, or unused area of memory, in this range, it sets the XMA card to fill the hole and loads a portion of its required resident code into this area.

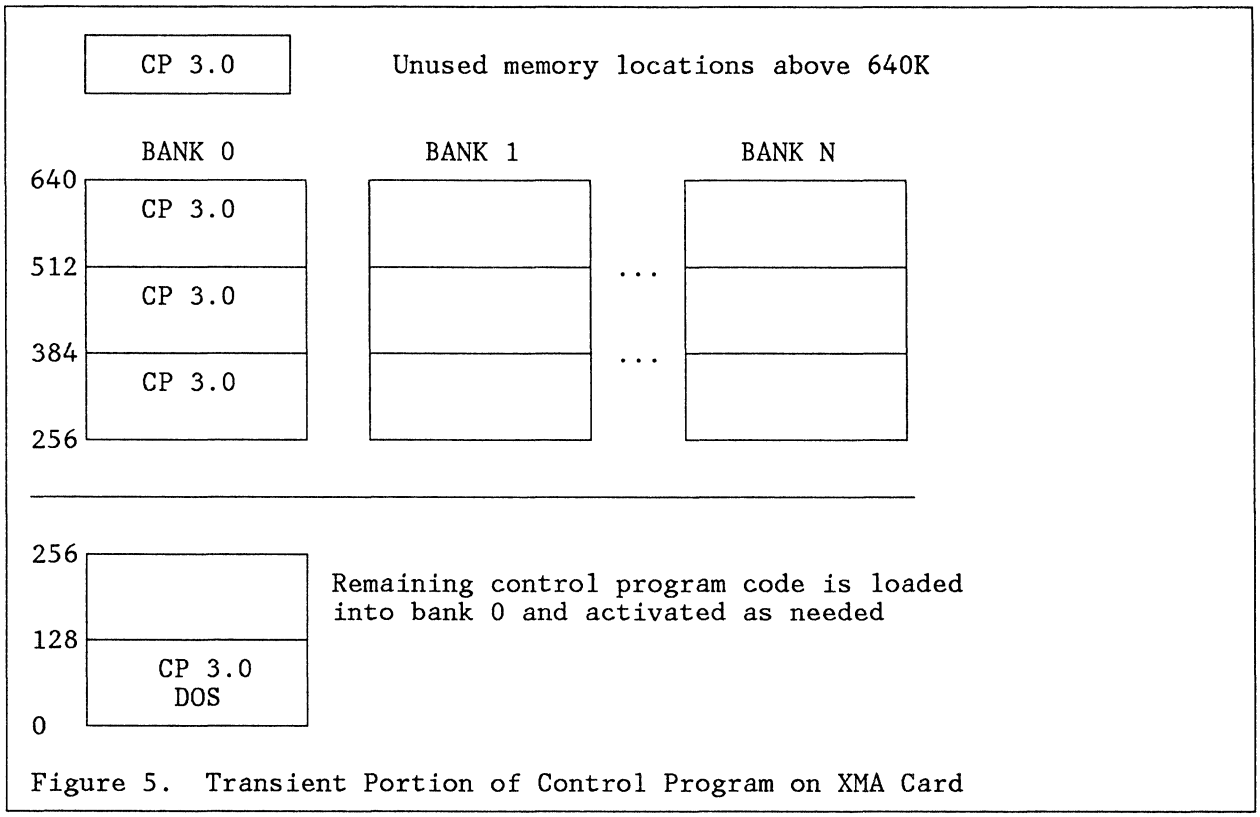

Figure 5. Transient Portion of Control Program on XMA Card

The IPL code also sets up the banks of memory on the XMA card to match the user specification in the configuration file, and loads the transient portion of the control program into its bank on the XMA card.

If no DOS extensions, additional device drivers, or control program system extensions are used, the control program and DOS will not require more than 128K bytes of memory in the 0 to 640K area, leaving 512K available for one PC session. This 512K consists of 128K on the planar board and 384K in its bank on the XMA card.

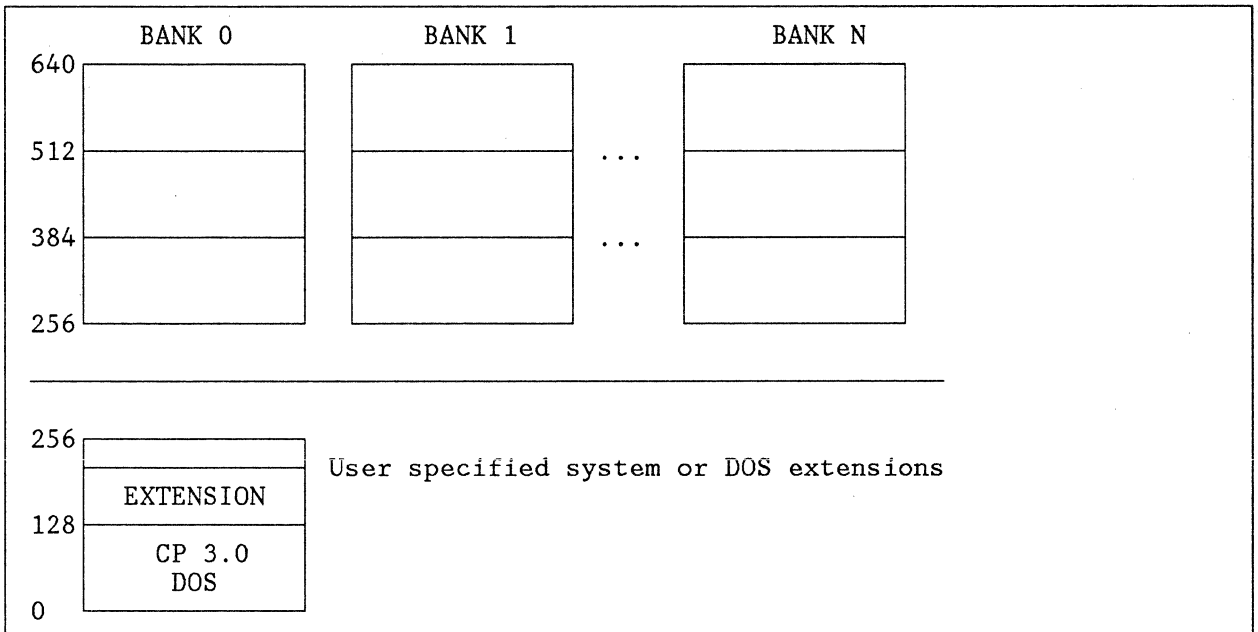

Figure 6. DOS and System Extensions are Installed

If a large DOS device driver, such as a RAM disk or print spooler, is configured, or if a large control program system extension is used, the memory available in the large PC session will be correspondingly reduced.

If the memory required to hold the extra device drivers and system extensions exceeds the 256K on the planar board, it will spill over into the banked memory area and all PC sessions will be reduced in size.

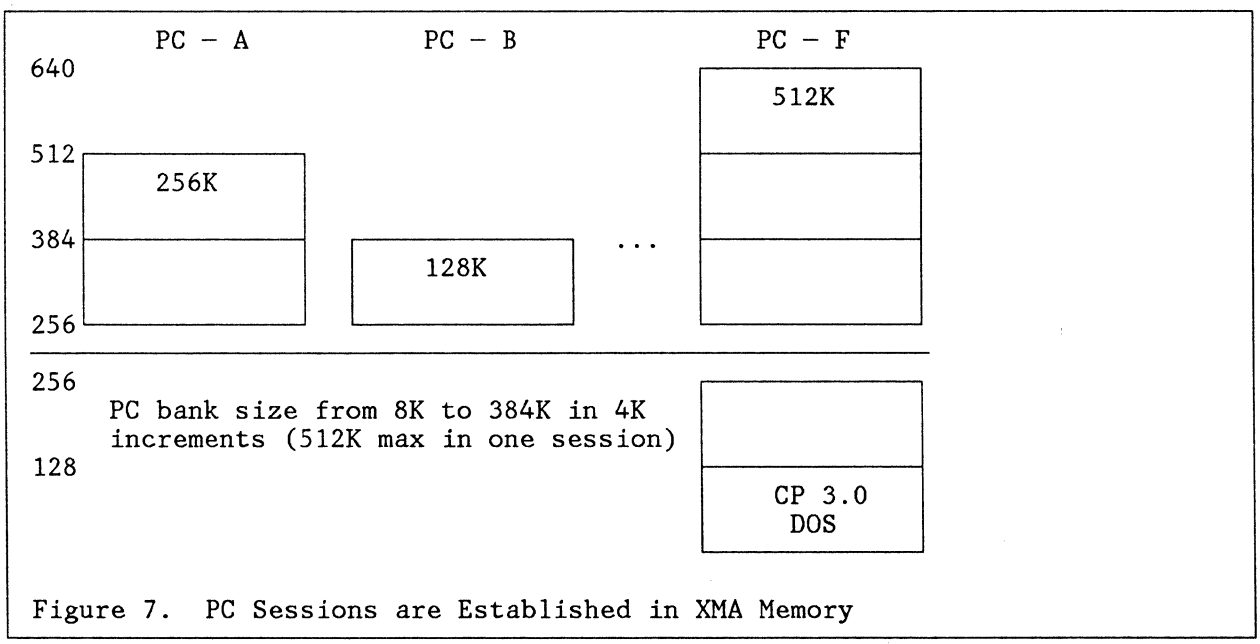

Figure 7. PC Sessions are Established in XMA Memory

The memory allocated to each bank of memory on the XMA card can be specified in 8K increments up to a maximum of 384K. This means that one PC session can have up to 512K by using the 384K banked memory plus the remaining 128K available memory on the planar board. The remaining five sessions can have a maximum of 384K bytes each, up to the amount of memory on the XMA card.

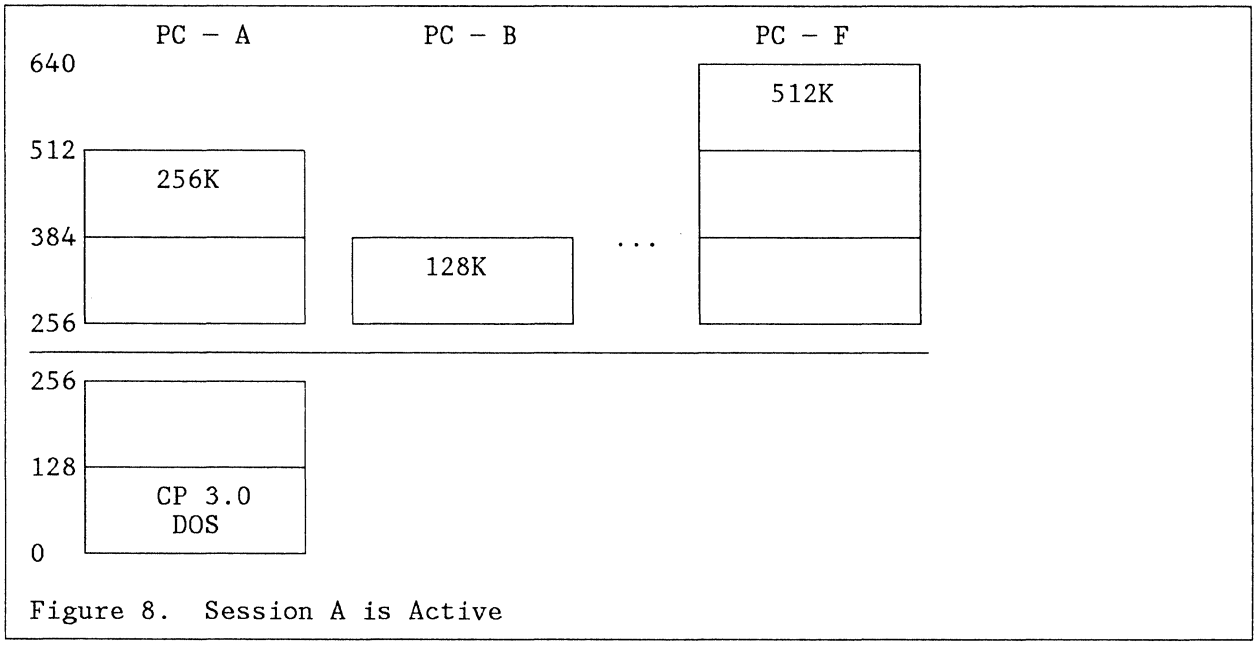

Figure 8. Session A is Active

If PC session A has been customized for 256K, this is the way the system looks to a program running in that window. The program sees a 512K system, with the first 256K used by the control program and DOS. The program is not aware of the other banks of memory on the XMA card.

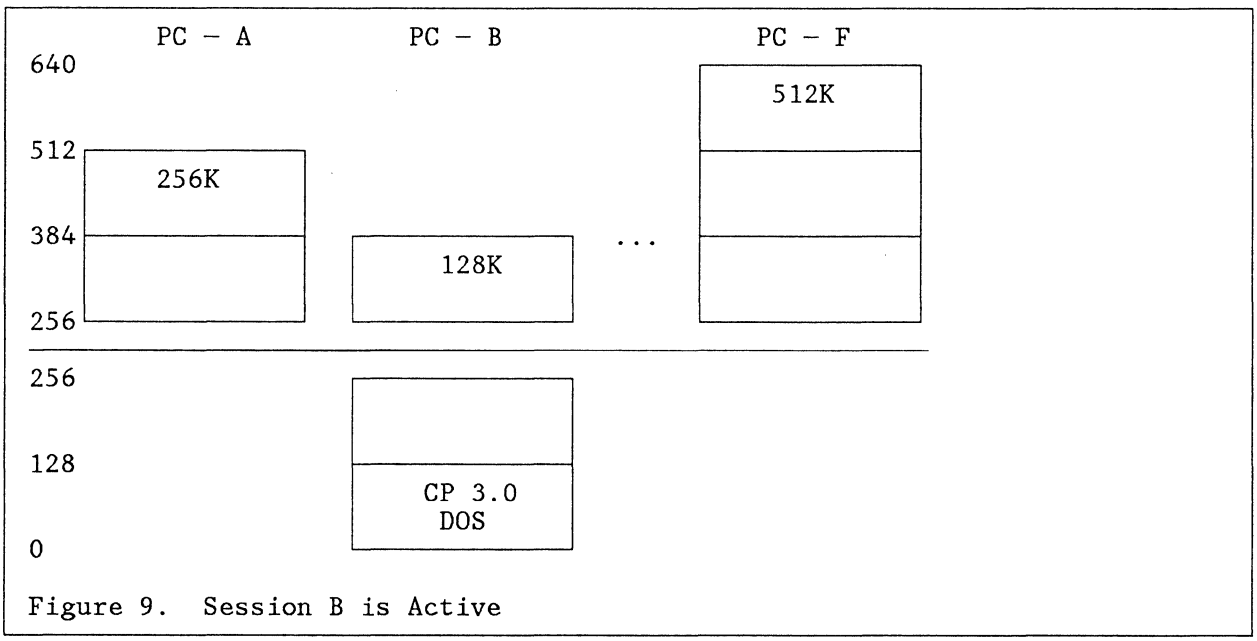

Figure 9. Session B is Active

When the program in session B is dispatched, either automatically by the control program, or by the user hitting the JUMP key, the system appearance is changed to make window B look like a stand-alone PC. The program in window B sees itself running in a 384K system, where the first 256K are used by DOS and the control program.

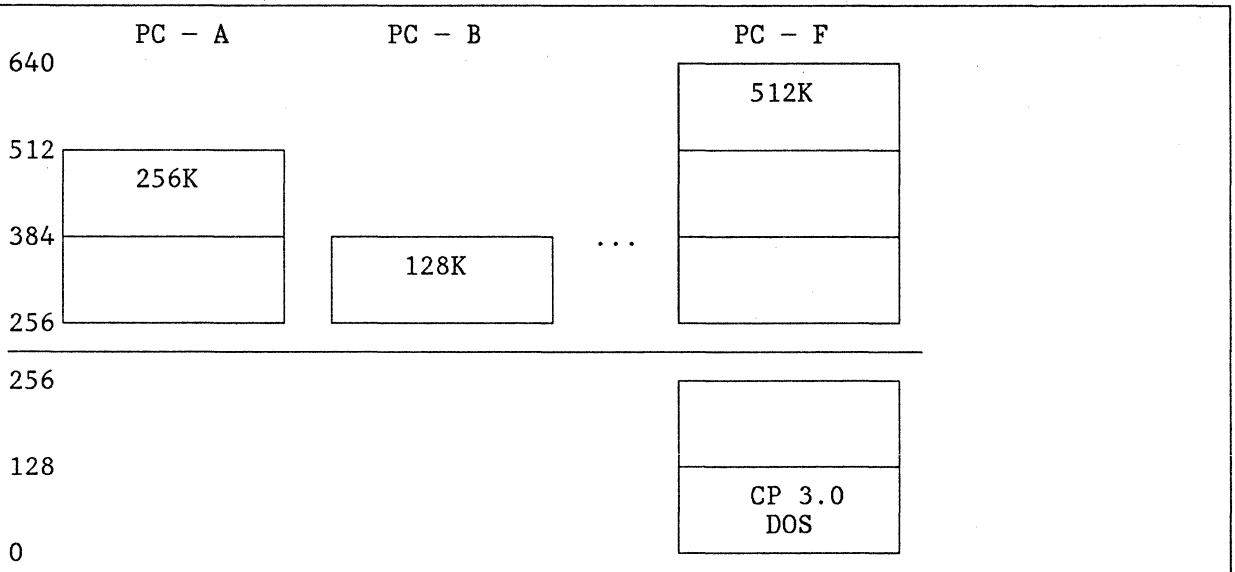

Figure 10. Session F is Active

When the program is session F is dispatched, again either automatically by the control program, or by the user hitting the JUMP key, the system appearance is changed to make window F look like a stand-alone PC. The program in window F sees itself running in a 640K system, where the first 128K are used by DOS and the control program.

There is an important concept that must be remembered when talking about programs running in a multi-DOS system. If the programs in all of the DOS sessions are well behaved, the control program can let them all execute concurrently. However, any program that is not well behaved will not be able to execute when it is not the current session (the window that the operator is is using). Also, when a poorly behaved program is the current session, all programs in the background are stopped. This is described in more detail in the software section of this document and in the 3270-PC Control Program Programming Guide.

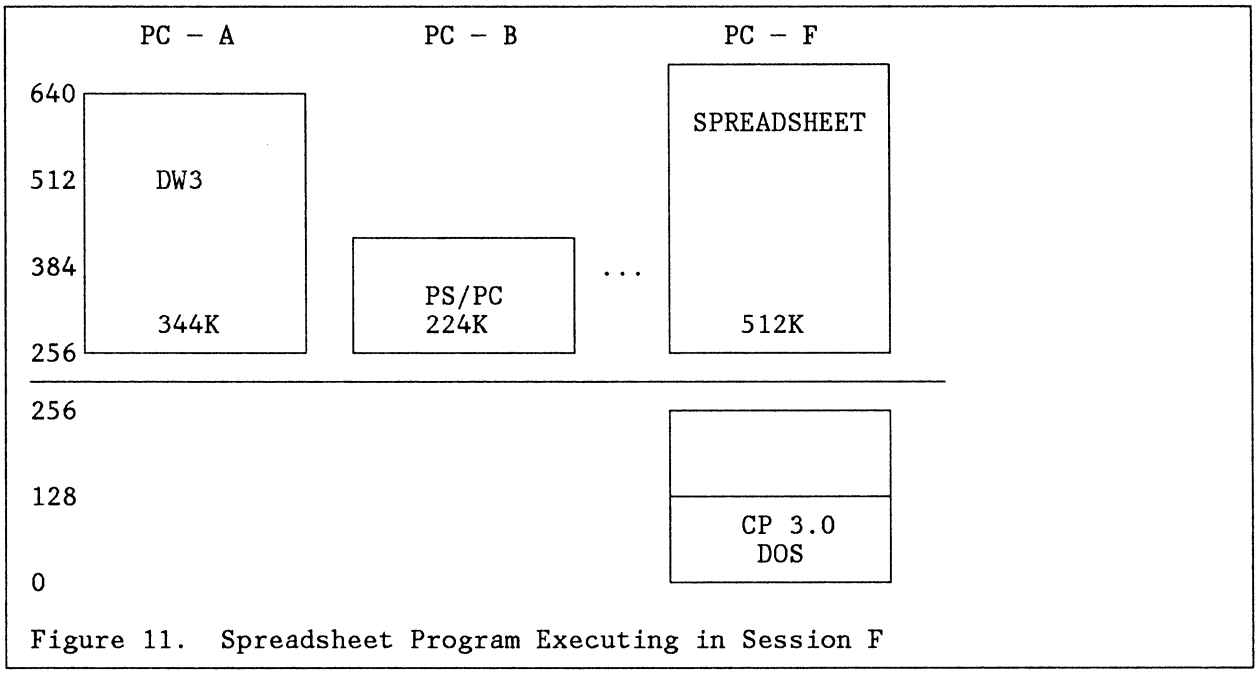

Figure 11. Spreadsheet Program Executing in Session F

This example shows a 3270-PC with three PC sessions customized. They are running DW3, PS/PC, and a spreadsheet. You will note that while all of these programs are loaded into memory at the same time, since they are all poorly behaved, they only execute when the operator uses the JUMP key to activate their session. Unless it is told otherwise, the control program assumes that a PC program is poorly behaved. This is described in more detail in a later section.

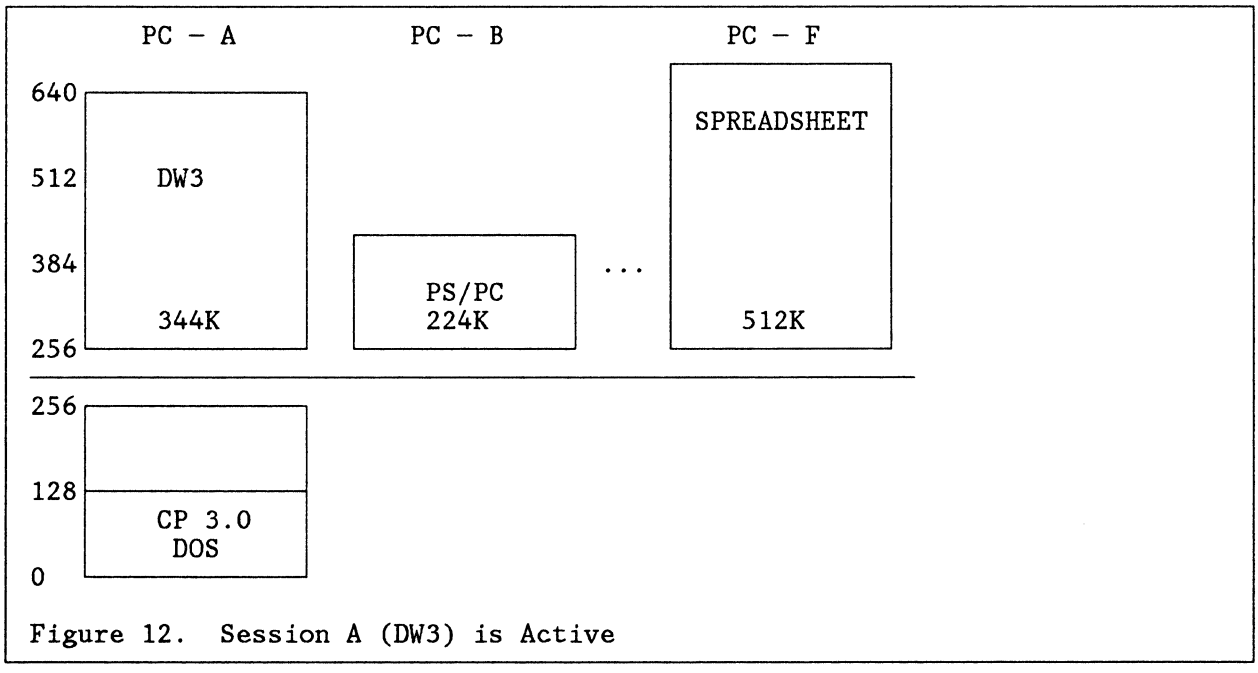

Figure 12. Session A (DW3) is Active

By pressing the JUMP key, the operator makes session A with DW3 active.

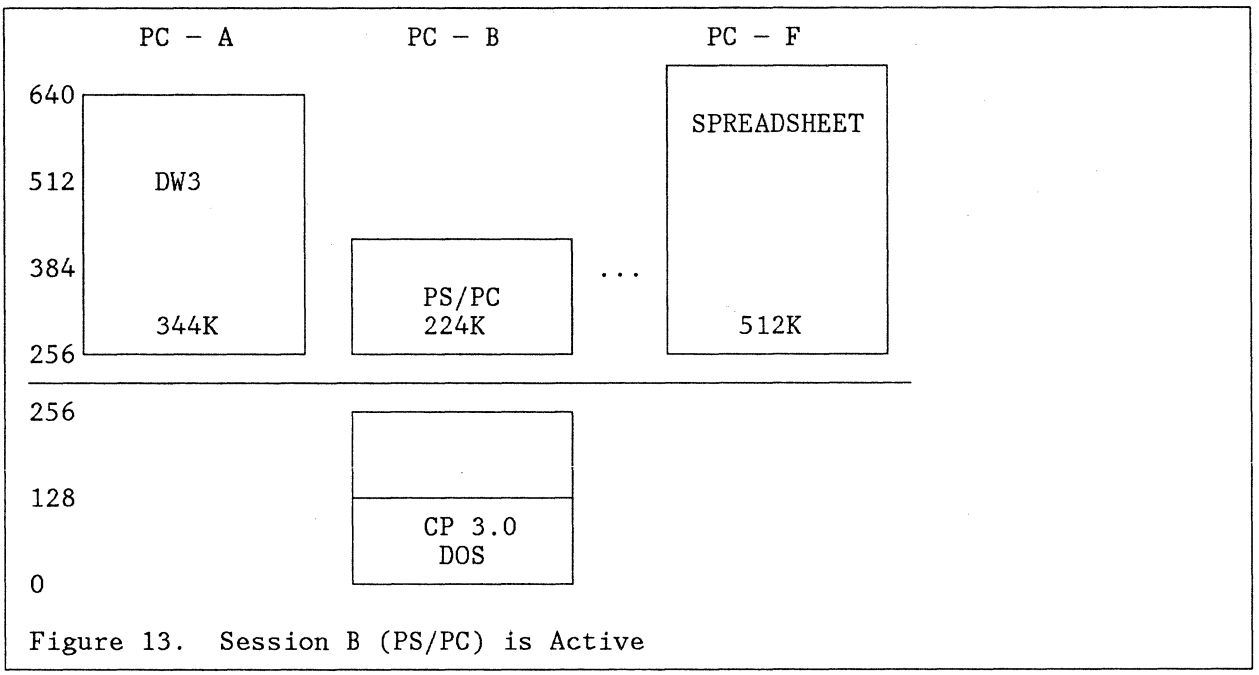

Figure 13. Session B (PS/PC) is Active

Pressing the JUMP key again activates PS/PC, and so on through all of the PC sessions.

The XMA card is capable of supporting up to 16 banks of memory. A translate table on the card is used to map the PC address to the storage address on the card. This mapping is done in blocks of 4 Kb (kilobytes). With this configuration, up to sixteen translate tables can be established, one per address space.

A register on the XMA card determines which translate table is active. The contents of this register plus the first 8 bits of the address point to the proper 4 Kb block on the XMA card. The last 12 bits of the address are used as an offset into this block.

If the translate table entry has the value x'FF', that address is not contained on the XMA card. Since the first 256 Kb of memory are on the system board, the first 64 entries in the table are always x'FF'.

The next 96 entries, for the address range 256K to 640K, may or may not contain an x'FF', depending on whether or not the PC session supported by this bank of memory was customized to include memory in the range covered by the table entry.

The next 96 entries cover the range of addresses from 640K to 1024K. If the entry is for address that contains RAM or ROM, the entry is a x'FF'. If the entry is for a "hole" that is being used to contain control program code, the entry points to the proper location on the XMA card. These "holes" are dynamically located by INDCIPL.

The first 64 and last 96 entries are the same for all banks of memory.

The control program switches to the proper bank of memory by sending a signal to the XMA card via port x'21B6'. This is done when a new task is dispatched, when an interrupt is received, or when a request is made via some API calls.

If additional adapter cards are installed that contain memory in the area between 640K and 1024K, there will be less room for control program code in that area. Since this code is part of the resident control program, is will be moved

to the low memory area, reducing the amount of available memory for the PC session accordingly.

The XMA card is not compatible with the Lotus/Intel/Microsoft EMS specification. This is because the LIM specification uses the holes in the memory area between 640K and 1024K as windows to its expanded memory. The program that is using the LIM expanded memory must be coded to move the desired memory page into the high memory holes or window. With the XMA card, the control program uses the high memory holes for its code, while multiple PC programs, which remain unchanged, can use memory that can extend up to 640K depending on customization options.

If it is necessary to run a very large spreadsheet that requires over 640K memory, a memory card supporting the LIM specification should be selected.

If the objective is to run unchanged PC programs that fit into a 640K system, the XMA card, which allows multiple PC programs to run concurrently, is the logical choice.

After the XMA card is installed, the 3270-PC control program version 3.0 must be recustomized. The customization program asks two questions about the XMA card: does the system contain an XMA card, and if so, how much memory is on the XMA card.

The PC sessions are then defined. Remember that the session must have at least 48K if it is to contain PC DOS.

Finally, the user needs to be sure that the printer address jumper on the card is set properly (LPT1 or LPT2).

The publications for the XMA card include the XMA card installation instructions and the installation instructions for the 1 Mb memory module kit that plugs into the XMA card.

KEYBOARD AND KEYBOARD ADAPTER

There are three different keyboard adapters used in the 3270-PC. The original keyboard adapter was installed on units built before October 25, 1984.

The second keyboard adapter has several changes. The most obvious to the terminal user was the support for the ENTER and black arrow keys when the control program is not loaded. These keys were only active on the original adapter when the control program was active. At all other times, they were inoperative.

On the rear of this keyboard adapter, near the top, there is a non-maskable interrupt (NMI) switch. This is the same switch that is included on an expansion card provided with the Professional Debugging Facility. The switch generates the non-maskable interrupt, INT 2, when pressed. If no program is running to handle this interrupt, it shows up as a parity check 2 on the screen. If the control program is active, it traps this interrupt and takes a system dump if requested to by the user. The system can then be restarted. This eliminates the need for a power off to reactivate a hung system. Other programs, such as the Professional Debug Facility, may also handle this interrupt.

There is a second socket on the rear of this adapter. This is a serial port. The technical data that is available for this port is as follows:

PIN NUMBER	FUNCTION
1	-12v
2	power ground
3	+5v
4	unused
5	unused
6	transmit data
7	signal ground
8	receive data
9	+12v.

Figure 14. Keyboard Adapter Serial Port Data

This port is at I/O addresses 1B8 and 1B9. It could be used with a modem if the pins carrying voltage are left unconnected.

Finally, there is the third type of keyboard adapter. It does not have the NMI switch or serial port, but does support the black arrow and enter keys when the control program is not loaded.

The first style adapter is found on XT-based 3270-PCs built before October 1984. The second type of adapter is found on all AT-based 3270-PCs as well as XT-based units built between October 1984 and early 1986. The third style adapter is found on XT-based 3270-PCs built since early 1986.

The keyboard adapter on the 3270-PC AT is functionally equivalent to the upgraded adapter for XT-based units, but has been designed to run with the higher speed processor. It requires a 16 bit slot.

The keyboard template that is shipped with the 3270-PC contains the appropriate labels for entry assist. Additional keyboard templates are available as P/N 101837469.

DISPLAY

The 3270-PC display is either a standard monochrome display (5150) or a high resolution color display (5272). Both monitors can do PC and host-based graphics, however, only the color display can actually display graphics in color. NOTE: while the 3270-PC supports both the monochrome display and the 5272 color display, only one display can be attached and used at any time. Standard PC display adapters will NOT operate in the 3270-PC, nor will any other PC monitors. If a larger display screen is needed, the 3295 plasma panel can also be attached to XT-based systems running version 1.2.2 of the control program with a special 3295 display adapter. The panel will then be the only display attached to the system.

Neither monitor supports the selection of border colors, 40-column text mode, or high intensity. There is no place to attach a light pen on either display adapter.

The display is attached to the display adapter in the system unit with a nine pin connector. The pin functions are as follows:

PIN	FUNCTION
1	shield - cable (bypass ground)
2	shield - video, red, blue, green
3	reserved
4	ground - signal (tied to pin 2)
5	signal - video, green
6	signal - video, blue
7	signal - video, red
8	signal - horizontal drive
9	signal - vertical drive

Figure 15. Display Adapter Signal Connections

Negative transition (up-level to down-level) initiates horizontal and vertical retrace. Rise and fall times of all signals are less than 20 ns, with video skew within 5 ns.

3270-PC Display Signal Frequencies

Video	21.676 MHZ +- 0.02%
Horizontal deflection	23.612 KHZ +- 0.02%
Vertical deflection	62.967 HZ +- 0.02%

Figure 16. 3270-PC Video Display Characteristics

PC GRAPHICS

To do PC graphics, a special APA (all points addressable) graphics adapter must be installed. While the part numbers differ for XT and AT-based units, and the adapter cards are not interchangeable, they are functionally similar.

PC programs designed to use the color graphics adapter will be able to run unchanged on a 3270-PC equipped with the APA graphics adapter.

There are several differences between the way graphics are handled on a 3270-PC and a standard PC in 720 x 350 high resolution mode. These differences are a result of the higher resolution of the 3270-PC monitor. These differences are documented elsewhere, but will be discussed here briefly for the sake of completeness.

All graphics that are displayed on the screen are broken into a series of dots or pels that are arranged in rows and columns on the screen. A pel is a picture element, or the smallest section of the screen that can be controlled by the PC. The standard PC color graphics adapter has a maximum resolution of 640 by 200 pels.

The following chart compares the various PC color graphics adapter operating modes. Note that neither the 3270-PC nor the standard PC BIOS support the low resolution mode.

	Horizontal Pels	Vertical Pels	Number of Colors	Emulated by 3270-PC
Low resolution	160	100	16	No
Medium resolution	320	200	4	Yes
High Resolution	640	200	2	Yes
3270-PC High resolution	720	350	2	

Figure 17. All Points Addressable Screen Resolution

As the chart shows, the screen of the 3270-PC has a greater resolution than the standard PC. This means that a picture that contains only 200 rows of pels will not fill the screen vertically. The effect of this is that the picture appears compressed vertically. The 200 pels that the program displays actually fill only about 57% of the screen.

This also has the effect of changing the screen's aspect ratio, the ratio of the screen's horizontal and vertical dimensions, which causes circles to appear as ellipses unless the program applies the required correction. Graphics program developers should include an easily changed "aspect ratio" parameter in their programs to provide for easy portability to the 3270-PC or other devices that may be announced in the future with different aspect ratios.

There is another difference in the way the screen is handled in graphics mode. On a standard PC, the display is interlaced. That means that the electron beam that paints the picture on the screen actually has to pass over the screen twice to make a complete picture. On one pass it paints the odd number rows of pels (1, 3, 5, etc.). It is then returned to the top of the screen, indexed to the start of the second row of pels and paints the even numbered rows of pels between the already displayed odd rows. This has the effect of increasing picture stability and reducing flicker. This is the same way that a home television set works.

The 3270-PC does not use this interlace technique to achieve picture stability. Instead, it uses different phosphors and a faster electron beam scan rate to achieve picture stability. This means that on the 3270-PC, the rows of pels are painted in numeric order (1, 2, 3, etc.)

This difference has a significant effect on how graphics programs must be designed. The display buffers must be laid out the same way that the screen is updated. This is because the hardware starts at the beginning of the buffer and displays one pel at a time based on the data in the buffer. On a standard PC, this means that the buffer must contain all of the odd row data ahead of the even row data. On the 3270-PC, the data is laid out in order.

This is the reason that it is not possible to run a small program that puts the 3270-PC display in full screen mode before running a standard graphics program with the expectation that the standard program would then fill the screen. Even if the graphics program did not issue any command that returned the display to standard PC mode, this would not be successful because of the data layout in the buffer. If you ever try this, you see two faded copies of the picture you are attempting to display. At the top of the screen, you will see the part of the picture formed by the odd rows of pels, while the bottom will contain the part of the picture that was contained in the even rows. This is the reason that you can not zap an existing program to run in full screen mode on the 3270-PC.

HOST GRAPHICS

Host-based program symbol graphics, using a program like GDDM, require the installation of the program symbol (PS) adapter card. With this card installed, the 3270-PC looks like a 3279 to the host application.

The following chart compares the screen characteristics of the 3279 and the 3270-PC.

	3279	3270-PC
Horizontal Pels	720	720
Vertical Pels	384 (M3)	350
Horizontal Resolution pels/inch	74.1	76.2
Vertical Resolution pels/inch	55.5	49.8
Character Cell (H x V) pels	9x12	9x14
Presentation space size (Rows x Cols chars)	M2 (24x80) M3 (32x80)	M2 (24x80) M3 (32X80)

Figure 18. 3270-PC and 3279 Screen Characteristics

The cell size is the most significant difference between graphics on the 3279 and the 3270-PC. The cell size of a graphic character on the 3270-PC is 9 by 14 pels, while the cell size of a 3279 is 9 by 12 pels. Before the 3270-PC, other 3270 devices supported by GDDM had cell sizes of either 9 x 12 or 9 x 16. There are two cases where this is important:

1. When GDDM uses one of its standard shading patterns, for example when displaying Interactive Chart Utility output. GDDM does not have a standard shading pattern for a 9 x 14 cell. To correct this problem, APAR PP27623 must be applied to GDDM R3.

2. User defined shading patterns will not be displayed correctly on a 3270-PC. For example, the shading pattern for a 9 x 12 cell will produce a "Venetian Blind" effect consisting of black horizontal bars two pels wide every 12 pels.

There is another extremely significant difference between the 3279 and the 3270-PC. While both devices can operate in model 3 mode with 32 lines, the 3270-PC can only display 24 lines on the screen at one time. The screen must be scrolled by the operator to view the additional eight lines.

With this in mind, what size screen size should be used? My recommendations are as follows:

Always use the 3270-PC in model 2 mode unless:

1. The application must write to a 32 line screen.

2. An application was developed specifically to take advantage of the scrolling capability of the 3270-PC.

3. The migration plan from 3279s to 3270-PCs calls for a period of time during which model 3 host definitions must be used.

When using GDDM's Interactive Chart Utility, always use model 2 mode unless condition 3 above is met.

The PS card has been designed to work with GDDM. Software that bypasses GDDM may work if it allows for the differences in character cell sizes and pel densities.

Graphics can not be copied into a notepad. Only the text portion of a host graphic screen will be copied.

A 3274 attached printer is required to print host graphics unless the 3270-PC has a 3295 display, in which case the PC attached graphics printer can be used to print the monochrome graphic screen image.

DISTRIBUTED FUNCTION COMMUNICATIONS ADAPTER

There are two versions of the coax adapter card in the 3270-PC. The original card, which is the same card as is used in regular PCs for attachment to a 3274 via the 3278/3279 emulation package, requires a long slot.

In the spring of 1986, a short version of this card was announced as a replacement for the long card. It is also used in both the 3270-PC and regular PCs with the emulation program.

INSTALLING A 3295 ON AN EXISTING 3270-PC

It is possible to convert a 3270-PC with a monochrome or color display to use the 3295 plasma panel. The system unit must have the current keyboard adapter card (P/N 2682827). You can check for this by looking for the second socket and the NMI switch on the rear of the keyboard adapter. It is necessary to order the 3295 plasma panel and the appropriate display adapter card, P/N 2683124. Since this display adapter supports both PC APA and host program symbol graphics, the original display and graphics adapters will no be needed.

Remember that only control program version 1.2.2 supports the 3295.

USING THE 3295

The 3295 provides the ability to display multiple large host screens simultaneously. Since the WSCtrl-print screen function can only print 80 characters in a row on the PC printer, each line on the display that is larger than 80 characters will print on two lines. If this is unacceptable, it is necessary to use the 3274 attached printer.

Since the 3295 can display as many as 160 characters on a line, it can be hard to locate data as you look across the screen. To help with this, there 3295 has a rule line that can be displayed. This is a thin line that stretches across the screen on the line where the cursor is located. The rule line can be set to stay on the line where it was turned on or to follow the cursor from line to line. It is controlled with the PF6 key in WSCtrl setup mode.

PRINTER ADAPTER

The printer adapter that is supplied as part of the XT-based system unit can only be used as LPT1. The printer adapter that is provided as part of the AT-based system unit or that is included on the XMA memory card can be switched for use as either LPT1 or LPT2.

PRINTER SUPPORT

Printers attached to the 3270-PC are for local use only. They are not addressable by the host system. The PC printer can print PC text and graphics and host screen images as long as the host screen is text data only. Program symbol graphics in host windows can only be printed on a 3274 attached printer. There is just one exception to this rule: the display adapter for the 3295 plasma panel allows host-based program symbol graphics to be printed on the PC attached graphics printer.

PC PORTS USED BY SYSTEM

In addition to the ports required by the accessory cards installed in the 3270-PC, ports 2D0-2DFH are used by the 3270-PC coax adapter card (distributed function communication adapter).

Port x'21B6' is used by the XMA card.

Ports 1B8-1B9 are use by the serial port on the keyboard adapter card.

OTHER ADAPTER CARDS

The following adapter cards have been tested and found to work in the 3270-PC. Cards marked with an "*" will also work in the expansion box.

1. *async adapter
2. *hard disk adapter
3. *BSC adapter
4. *SDLC adapter
5. *Printer adapter
6. Diskette adapter
7. Keyboard adapter
8. *Distributed function communication (coax) adapter

Adapters that will slow the system down if located in the expansion box due to extra wait states include:

1. Printer memory adapter

2. Memory expansion adapters

3. Display adapter

4. APA Graphics adapter (must be located next to display adapter)

5. PS Graphics adapter (must be located next to display adapter)

SYSTEM ATTACHMENT

If the 3270-PC is attached to the display-printer adapter of a 4331, feature 9843 must be installed on the display-printer adapter for file transfer to function correctly.

The 3270-PC can be attached to the 3274 via a 3299 multiplexer.

The 3270-PC can run in either control unit terminal (CUT) mode or distributed function terminal mode (DFT). In CUT mode, the 3270-PC looks like a standard base model 3278-2. This means that there is no host graphics or extended data stream capability.

In DFT mode, the 3270-PC has full extended data stream capability in up to four host sessions. This includes program symbol (3279 type) graphics in one host session. The 3270-PC can be customized with screen sizes of 24 x 80, 32 x 80, 43 x 80 or 27 x 132 rows and columns. If the 3295 panel is attached, screen sizes up to 62 x 160 are supported. The DFT sessions run independently of each other. If a host response is pending in one host session, the other sessions are still available for sending or receiving messages. In DFT mode, the 3270-PC does all data stream and keystroke processing, offloading this from the 3274.

Entry Assist is supported in CUT mode with control program version 2.0 or later. With 3270-PC control program version 2.1, there is a bug that causes the Word Delete and Typematic Delete function to not work properly. This is corrected in APAR IR66509, which is available from NSD.

Response Time Monitor (RTM) is supported in CUT and DFT mode with control program version 2.0 or later.

File transfer is supported in both CUT and DFT modes. DFT file transfer uses the x'D0' structured field for faster transfer rates than are available in CUT mode.

The 3270-PC does not support data compression. This can have the effect of increasing the amount of data that must be transmitted to the 3270-PC, resulting in increased response time compared to a 3279.

Since the 3270-PC must be operating in DFT mode when used as a host-based graphics terminal, the 3274 will have a smaller load than in a similar configuration of 3279s.

The 3270-PC can be attached to a 3276 when operating in CUT mode. File transfer is supported when attached to the 3276.

3274 LOCAL COPY

Beginning with 3270-PC control program version 2.0, the customization panels include a question about whether or not a form feed before or after a local copy on the 3274 attached printer is needed.

When using DFT mode with control program version 1.2.2, form feed before or after local copy is controlled in a different manner. It is necessary to include feature 9301 (3290 support) on the 3274. The 3290 options in the 3274 customization include question 173, which provides the form feed data for local copy from DFT devices. The 3270-PC will honor this specification if IR63161 is installed. This patch is available from NSD.

MISCELLANEOUS

The standard PC keylock option works on the XT-based 3270-PC.

SYSTEM INITIALIZATION

At initialization time, Control Program Version 1 loads itself into the high end of the DOS address space, sets the BIOS memory pointer to indicate that the system memory has been reduced by the size of the control program, and reboots DOS in the remaining memory.

This can cause a problem if you are using some VDISK programs with an expansion box. Some VDISK programs compare the BIOS system memory value, which has been changed by the control program, with the switch settings on the adapter card for the expansion box. If they do not match, and they will not after the control program has loaded in this manner, VDISK puts out an error message and will not initialize. A patch is available to VDISK for this problem.

Control Program Versions 2 and 3 load into low memory as a DOS extension. After the control program is loaded, the user supplied system extensions are loaded into memory immediately above the control program. On systems with no XMA card, the remaining memory is divided among the PC sessions based upon the user specification at customization time. Systems with the XMA card and 3270-PC control program version 3.0 have the PC sessions established in the XMA banks as described in the memory section of this document.

There is only one copy of DOS in the system. If multi-DOS is customized, there is still just one copy of DOS in memory. There is a copy of the transient portion of COMMAND.COM in each PC session. This requires between 4K and 5K of memory, depending on the version of DOS being used.

It should be noted that the last PC session gets whatever memory is unused when it is created. If the customization menu indicated that the final session should have 128K, but there is only 96K available due to the installation of a print spooler or other resident program for example, the session will have only 96K. On the other hand, if additional memory had been installed in the system, this session would increase in size by the amount of the newly installed memory.

It is possible to gain flexibility in the system configuration by making use of menus and other BAT files at initialization time. If it is necessary to run the system without the control program on some occasions, and to switch between CUT and DFT modes on other occasions, this can be done easily by adding a menu to the AUTOEXEC.BAT file.

The next figure shows an AUTOEXEC.BAT file that puts out a small menu where choice 1 is to run in DFT mode, choice 2 is to run in CUT mode and choice 3 is to run a multi-DOS system with no host sessions. You will note that three other BAT files, 1.BAT, 2.BAT and 3.BAT are needed.

When the control program is initialized, its loader reads three files that are produced during customization: INDCFIG.DAT, INDIBM1.SIF, and INDCFIG.FIL. It is necessary to change the contents of these files to match the requirements of the user for this session. This means that for this example, we must customize the system three times; once for CUT operation, once for DFT operation, and once with no host session. After each customization, it is necessary to save these three files so that they are not overlaid with the output of the next customization. I have chosen to copy them into files beginning with the names CUT, DFT, and NOHOST to make them easy to identify.

The files 1.BAT, 2.BAT, and 3.BAT are used to copy these files back into the files used by the control program loader.

The following AUTOEXEC.BAT file will present a simple menu to the terminal user:

```
ECHO          CONTROL PROGRAM CONFIGURATION MENU
ECHO      ------------------------------------------
ECHO      1.  IPL DFT SYSTEM         TWO HOST SESSIONS
ECHO      2.  IPL CUT SYSTEM         ONE HOST SESSION
ECHO      3.  IPL MULTI-DOS SYSTEM   NO HOST SESSIONS
ECHO      ------------------------------------------
ECHO         ENTER YOUR CHOICE OR ANY DOS COMMAND
```

Figure 19. Sample AUTOEXEC.BAT Menu

Choice 1, which starts a DFT system, would cause the file 1.BAT to be executed. It consists of the following:

```
ECHO  DFT SYSTEM INITIALIZING
COPY  DFT.FIL INDCFIG.FIL
COPY  DFT.SIF INDIBM1.SIF
COPY  DFT.DAT INDCFIG.DAT
INDCIPL /
```

Figure 20. 1.BAT Starts a DFT System

Choice 2 would cause the file 2.BAT to be executed, starting the system in CUT mode. It consists of the following:

```
ECHO  CUT SYSTEM INITIALIZING
COPY  CUT.FIL INDCFIG.FIL
COPY  CUT.SIF INDIBM1.SIF
COPY  CUT.DAT INDCFIG.DAT
INDCIPL /
```

Figure 21. 2.BAT Starts CUT System

Choice 3, for the multi-DOS no host system, would cause the file 3.BAT to be executed. It consists of the following:

```
ECHO  NO HOST SYSTEM INITIALIZATION
COPY  NOHOST.FIL INDCFIG.FIL
COPY  NOHOST.SIF INDIBM1.SIF
COPY  NOHOST.DAT INDCFIG.DAT
INDCIPL /
```

Figure 22. 3.BAT Starts Multi-DOS, No Host System

Entering any other command would simply leave the system in PC mode with no control program loaded.

REBOOTING WITHOUT THE CONTROL PROGRAM

If the user wishes to remove the control program from the system and run as a regular PC, it is just necessary to jump to any non-PC session (host, notepad, or WSCtrl) and hit the Ctrl-Alt-Del key combination. If this key combination is entered while in a PC session, only the single PC session is restarted. The other sessions are not affected.

The default system that is included in the control program update kits for version 2.x is configured for floppy disk-based systems. The system specifies COMMAND.COM on drive A: as the first PC program to run after the control program is started. This means that the system will not work correctly if it is installed on a system with a hard disk.

Book 2, Setting Up and Learning the Control Program, that is included in the control program update kit explains how to copy the control program to a hard disk. Part of this process is to copy the file INDAUTUS.BAT to the hard disk as the file AUTOEXEC.BAT. It then explains how to boot up the system and start the control program. What it does not explain is the need to put a DOS diskette into drive A: on hard disk systems so the PC session will be able to initialize.

```
ECHO OFF
INDCIPL
INDRSTR SCREEN
CLS
ECHO
ECHO
ECHO    IBM 3270-PC Control Program
ECHO
ECHO To go to another window, press Jump
ECHO
ECHO To enlarge a window, press <- ->
ECHO
```

Figure 23. Standard INDAUTUS.BAT

To eliminate this problem, it is necessary to add two lines to either INDAUTUS.BAT before it is copied or to AUTOEXEC.BAT after the copy is complete. These lines are lines 2 and 3 in the next figure. This addition will display a prompt that reminds the terminal operator that there must be a DOS disk in the A: drive before the system can initialize correctly.

```
ECHO OFF

ECHO PLACE A DOS DISKETTE IN DRIVE A: AND PRESS ANY KEY TO CONTINUE
PAUSE

INDCIPL
INDRSTR SCREEN
CLS
ECHO
ECHO
ECHO    IBM 3270-PC Control Program
ECHO
ECHO To go to another window, press Jump
ECHO
ECHO To enlarge a window, press <- ->
ECHO
```

Figure 24. Modified INDAUTUS.BAT

This has been corrected in control program version 3.0.

APPLICATION PROGRAM INTERFACE

A new concept for personal computing was introduced with version 1.2 of the 3270-PC control program. This is the concept of the "programmed operator". This means letting a program executing in a PC session control the communication with the host application connected to one of the host sessions.

To do this, the control program provides an application program interface (API). The native or low level API is an assembler level interface into selected functions of the control program. This low level interface was expanded with version 2 of the control program to include all control program functions.

To make the API easier to use, the High Level Language Application Program Interface (HLLAPI) was also developed. This provides an interface to the low level API from high level languages such as BASIC, COBOL, and PASCAL, making it much easier to code API-based applications. Version 3 of the HLLAPI supports nearly all functions that are available to low level API programs except subtasking and structured field data streams. The following chart includes a column listing each of the calls provided by versions 1 and 2 of the the HLLAPI, followed by the call's name. The next column shows what low level calls must be made in assembler programs to do the same function. The last column shows where the low level call is documented in manual SA23-0221, the 3270-PC Programmers' Reference Manual for 3270-PC control program version 2. This shows that it can be very complicated to write low level API programs.

Function Code No.	High-Level API Function	Low-Level API Function	Comments/ References
1	Connect	-NAME-RES -Q-PARMS -CONN-KEY -Error Routines	Ref pp. 3-5 Ref pp. 4-10 Ref pp. 5-6 User Supplied
2	Disconnect	-DISC-KEY -Error Routines	Ref pp. 5-10 User Supplied
3	Send Key	-Translate -WRIT-KEY -GET-COMP -Error Routines	User Supplied Ref pp. 5-16 Ref pp. 3-7 User Supplied
4	Wait	-Get timer -Set timer -Error Routines	Ref pp. 19-3 Ref pp. 19-5 User Supplied
5	Copy PS	-String Move Routine -Translate Routine -Error Routines	Ref pp.10-2 Ref pp.11-4 User Supplied
6	Search	-String Move Routine -Translate Routine -Search Byte Routine -Error Routines	User Supplied Ref pp.11-4 User Supplied User Supplied
7	Query Cursor	-Query session cursor -Error Routines	Ref pp.4-32 User Supplied
8	Copy String	-String Move Routine -Translate Routine -Error Routines	Ref pp.10-2 Ref pp.11-4 User Supplied
9	Set Session Parameters	-Routines and Flags controlling options on other API functions -Error Routines	User Supplied User Supplied
10	Query Session	-Q-PARMS -Error Routines	Ref pp.4-5 User Supplied
11	Reserve	-Disable input -Error Routines	Ref pp.5-22 User Supplied
12	Release	-Enable input -Error-Routines	Ref pp.5-25 User-Supplied

Figure 25. Version 1 and 2 HLLAPI vs. Low Level Program Coding (Part 1)

Function Code No.	High-Level API Function	Low-Level API Function	Comments/ References
User Supplied	Structured Fields	-CRT-Q	Ref pp. 3-9
		-DEQUE	3-12
		-DEL-ENT	3-15
		-CONN-SF	7-4
		-DEF-BUF	7-11
		-READ-SF	7-15
		-WRITE-SF	7-20
		-DISC-SF	7-11
		-GET-COMP	3-7
		-Error Routines	User Supplied

Figure 26. Version 1 and 2 HLLAPI vs. Low Level Program Coding (Part 2)

The next chart show the calls in HLLAPI version 3. You will note that the HLLAPI now provides the ability to write complex API programs in a high language.

High Level Language Application Program Interface Version 3.0 Function Reference Chart (Part 1 of 4)

NOTE: 2.X implies 3270-PC control program 2.X and above.

SESSION TYPE LEGEND: H - Host
N - Notepad
P - PC
A - Alternate PC Presentation Space
W - Workstation Control

Function Number	Function Name	Difficulty Level	Control Program Compatibility	Session Type Compatibility
**********	OPERATOR SERVICES	**********	**********	**********
20	Query System	Basic	All Levels	All Session Types
10	Query Sessions	Basic	All Levels	HNPA(2.X) HN(1.22)
22	Query Session Status	Basic	All Levels	HNPA(2.X) HN(1.22)
9	Set Session Parameters	Basic	All Levels	All Session Types
3	Send Key	Basic	All Levels	HNPAW(2.X) HNW(1.22)
4	Wait	Advanced	All Levels	HNPA At All Levels
18	Pause	Basic	All Levels	All Session Types
23	Start Host Notification	Advanced	2.X Only	H(2.X)
24	Query Host Update	Advanced	2.X Only	H(2.X)
25	Stop Host Notification	Advanced	2.X Only	H(2.X)
21	Reset System	Basic	All Levels	All Session Types

Figure 27. Part 1 of 4

High Level Language Application Program Interface Version 3.0 Function Reference Chart (Part 2 of 4)

Function Number	Function Name	Difficulty Level	Control Program Compatibility	Session Type Compatibility
**********	PRESENTATION SERVICES	**********	**********	**********
1	Connect Presentation Space	Basic	All Levels	HNPAW(2.X) HNW(1.22)
2	Disconnect	Basic	All Levels	HNPAW(2.X) HNW(1.22)
7	Query Cursor Location	Basic	All Levels	HNPA(2.X) HN(1.22)
14	Query Field Attribute	Advanced	All Levels	HA(2.X) H(1.22)
30	Search Field	Advanced	All Levels	HA(2.X) H(1.22)
31	Find Field Position	Advanced	All Levels	HA(2.X) H(1.22)
32	Find Field Length	Basic	All Levels	HPA(2.X) H(1.22)
34	Copy Field to String	Advanced	2.X Only	HA(2.X)
33	Copy String to Field	Advanced	2.X Only	HA(2.X)
13	Copy OIA	Advanced	2.X Only	HNPA(2.X)
5	Copy Presentation Space	Basic	All Levels	HNPA(2.X) HN(1.22)
8	Copy Presentation Space to String	Basic	All Levels	HNPA(2.X) HNP(1.22)
15	Copy String to Presentation Space	Basic	2.X Only	HNPA(2.X)
6	Search Presentation Space	Basic	All Levels	HNPA(2.X) HN(1.22)

Figure 28. Part 2 of 4

High Level Language Application Program Interface Version 3.0 Function Reference Chart (Part 3 of 4)

Function Number	Function Name	Difficulty Level	Control Program Compatibility	Session Type Compatibility
**********	PRESENTATION SERVICES (Continued)	**********	**********	**********
35	Define Presentation Space	Advanced	2.X Multi-DOS Only	A(2.X Multi-DOS Only)
36	Switch Presentation Space	Advanced	2.X Only	AP(2.X Multi-DOS Only)
37	Display Cursor	Advanced	2.X Only	AP(2.X Multi-DOS Only)
38	Display Presentation Space	Advanced	2.X Only	AP(2.X Multi-DOS Only)
39	Delete Presentation Space	Advanced	2.X Multi-DOS Only	A(2.X Multi-DOS Only)
16	WS Ctrl	Advanced		W(2.X)
**********	DEVICE SERVICES	**********	**********	**********
50	Start Keystroke Intercept	Advanced	2.X Only	HNPA(2.X)
51	Get Key	Advanced	2.X Only	HNPA(2.X)
52	Post Intercept Status	Advanced	2.X Only	HNPA(2.X)
53	Stop Keystroke Intercept	Advanced	2.X Only	HNPA(2.X)
54	Get 3270 AID Key	Advanced	2.X Multi-DOS Only	A(2.X Multi-DOS Only)
11	Reserve	Basic	All Levels	HNP(2.X) HN(1.22)
12	Reserve	Basic	All Levels	HNP(2.X) HN(1.22)

Figure 29. Part 3 of 4

High Level Language Application Program Interface Version 3.0
Function Reference Chart (Part 4 of 4)

Function Number	Function Name	Difficulty Level	Control Program Compatibility	Session Type Compatibility
*********	COMMUNICATION SERVICES	**********	*****************	**************
90	Send File	Advanced	All Levels	n/a (HP is implied)
91	Receive File	Advanced	All Levels	n/a (HP is implied)
*********	SYSTEM SERVICES	**********	*****************	**************
92	Invoke DOS Program	Advanced	All Levels	P
93	DOS Redirect	Advanced	All Levels	P
*********	UTILITY SERVICES	**********	*****************	**************
17	Storage Manager	Advanced	All Levels	XXXXXXXXXXXXX
99	Convert Position or RowCol	Basic	All Levels	HNPA At All Levels

Figure 30. Part 4 of 4

I recommend that even if your application is already coded in assembler, you use the HLLAPI as the interface to the control program and not try to code the low level calls in your program.

If it is not possible to use the HLLAPI, then each each low level API call should be coded as a separate subroutine. These subroutines should be in a common library. If this is done, the subroutines can be thoroughly tested and called by application programs as needed. This allows the application programmer to concentrate on the logic of the application, not on debugging complex low level API calls. The library of subroutines can then be included in the application program during the link edit step. Should a low level API subroutine need to be changed at a later date, it will only be necessary to re-link the application programs that used it.

There has been a new release of the control program approximately every six months since the 3270-PC was announced. There is no reason to assume this will not continue. Therefore, to further isolate your application programs from these changes, I recommend that rather than link your low level API subroutines into the application program, they be assembled into a program that can be run as a DOS extension.

This single program would provide the interface between the high level application program and the low level control program API. If a new release of the control program or DOS provided significant new function, it would only be necessary to change this one assembler program to take advantage of the new function. This would eliminate the need to update, test, debug, and distribute new application programs to possibly thousands of 3270-PCs.

To carry this to the logical conclusion, it might be wise to replace the HLLAPI language interface module (LIM) with your subroutine library. Your program would pass all HLLAPI supported calls to the HLLAPI for execution and would include code for just the calls you need that are not in the HLLAPI. If there were to be another release of the HLLAPI, you could simply modify your own LIM to work with it, again leaving the application programs unchanged.

COMMON API PROBLEMS

When using the High Level Language Application Program Interface (HLLAPI), a common programming error is to exit the application program without issuing a DISCONNECT command to the control program. If this happens, file transfers or other API programs will fail since the control program still has the interfaces marked as being used by the original program.

When intercepting keystrokes with a program running in a PC session and sending them to a different session, such as when using a PC program to control a host session, the PC program will receive three keystrokes for every key the operator presses. The control program sends a signal when the key is pressed, and a signal with a x'F0' scancode followed by another signal when the key is released. To avoid having each keystroke display as multiple keystrokes in the host window, it is necessary to discard all keystrokes with an x'F0' scan code, as well as the break signal before passing the keystrokes to the host.

Versions 2 and 3 of the control program allow host and notepad screens to be copied into PC windows. There is some API coding required for this to be possible however, since PC programs are generally designed to get their data from the keyboard, disk files, modems, etc.

If one were to simply move data to the PC screen from a host screen, the PC program would never know to look in the screen buffer to access the data. To make this function work correctly, it is necessary to write an API program that runs in the selected PC session. This program must connect to the control program as a target for copied data. It should then give the terminal user a message asking that the data be copied to the PC screen, followed by some keystroke sequence that tells the program when the data has been copied and is ready to be processed. This is discussed in chapter 10 of the version 2 and 3 programming manuals.

SYSTEM FILES

The following is a list of files on the two 3270-PC version 2 control program diskettes and their use:

INDCPYRT.DAT.....COPYRIGHT DATA

The following files are used by customization:

INDCFIG.COM.....CUSTOMIZATION PROGRAM

INDSFILS.FIL.....RESIDENT CODE SIZES OF SYSTEM

.....EXTENSIONS IN THE CONTROL PROGRAM

INDSLABS.DAT.....SYSTEM RESOURCE REQUIREMENTS FOR SYS

.....EXT. IN THE CONTROL PROGRAM

The following files used by the default system supplied in the 2.1 release:

INDFAULT.BAT.....COPIES THE DEFAULT SYSTEM TO FORMATTED DISK

INDSAUTO.BAT.....RENAMED AUTOEXEC.BAT FOR THE DEFAULT SYSTEM

INDCFIG.DAT.....DEFAULT SYSTEMS CUSTOMIZATION FILE

INDIBM1.SIF.....DEFAULT SYSTEMS SYSTEM RESOURCE REQUIREMENTS

INDSAVE.REC.....THE NEXT FOUR FILES ARE THE INDSAVE

INDSAVE.AUT.....FILES FOR THE DEFAULT SYSTEM

INDSAVE.SCR

INDSAVE.NOT

The following files are part of the control program for 2.1:

INDCIPL.COM.....IBM LOGO

INDSAOM.COM.....AUTOKEY SYSTEM EXTENSION

INDSCOM.COM.....NUCLEUS COMMON SYSTEM EXTENSION

INDSCPM.COM.....COPY SYSTEM EXTENSION

INDSDCM.COM.....CUT SYSTEM EXTENSION

INDSDOM.COM.....DOS SCHEDULER SYSTEM EXTENSION

INDSEHM.COM.....ERROR HANDLER SYSTEM EXTENSION

INDSFOMB.COM.....DRAW FORMATTER SYSTEM EXTENSION

INDSKSM.COM.....3270 KS EMULATION SYSTEM EXTENSION

INDSNOMB.COM.....NOTEPAD SYSTEM EXTENSION

INDSNUM.COM.....SUPERVISOR SYSTEM EXTENSION

INDSPCM.COM.....PC PRESENTATION SPACE SYSTEM EXTENSION

INDSPRMB.COM.....PRINTER SYSTEM EXTENSION (ALL PRINTERS EXCEPT THE 3852)

INDSPRMI.COM.....3852 PRINTER SYSTEM EXTENSION

INDSROM.COM.....KEYSTROKE ROUTER SYSTEM EXTENSION

INDSSEM.COM.....SESSION MANAGER SYSTEM EXTENSION

INDSWOM.COM.....WSCTRL SYSTEM EXTENSION

INDSXLT.COM.....TRANSLATE SYSTEM EXTENSION

IDELTCAN.EXE.....TCA NON-SNA SYSTEM EXTENSION

IDELTCAS.EXE.....TCA SNA SYSTEM EXTENSION

3270PC.PIF.....CONTAINS INFO ABOUT A SUBSET OF APPLICATIONS

INDIBM2.SIF.....CONTAINS SYSTEM RESOURCE REQUIREMENTS FOR PC SESSIONS

The following files are 3270-PC utilities/applications:

INDDENV.COM.....DISPLAY ENVIRONMENTS (MULTI-DOS ONLY)

INDDISP.COM.....DISPLAY DUMP DATA

INDMERGE.COM.....MERGE PC ENVIRONMENTS (MULTI-DOS ONLY)

INDPATCH.COM.....APPLY A PATCH TO A CONTROL PGM

INDPREP.COM.....PREPARE DUMP DISKETTES

INDQPCH.DAT.....CONTAINS INFO ABOUT PATCHES ON SYSTEM

INDRSTR.COM.....RESTORE A SAVED SYSTEM

INDSAVE.COM.....SAVE A SYSTEM

INDSPIF.COM.....CREATE OR UPDATE PIFS AND SIFS

INDSPLIT.COM.....SPLIT PC ENVIRONMENTS (MULTI-DOS ONLY)

RECEIVE.COM.....RECEIVE FILES FROM HOST TO PC

SEND.COM.....SEND FILES FROM PC TO HOST

TRACE.COM.....TAKE TRACES IN CONTROL PGM

TRANSFER.COM.....DIA FILE TRANSFER

UTILCOPY.BAT.....COPY UTILITIES FROM PID DISKETTE TO A SEPARATE DISKETTE

CUSTOMIZATION HINTS

The serial port definition byte that is requested during customization is the hex value of the byte the control program uses to initialize the serial port if one is present. This determines the port's baud rate, parity, word length and stop bits. The bit values are documented in the XT technical reference manual in the BIOS listing referring to INT 14. At address E721, line 1461, the default byte of 82H is shown to mean 1200 baud, no parity, 1 stop bit, and 7 data bits.

768K OPTION ON XT-BASED UNITS

If you are using the 768K upgrade for version 2.1 of the control program, you should still specify 640K at customization time. This is because a variable amount of memory above the 640K line is used, depending on customization options and system maintenance level.

This upgrade to 3270-PC control program version 2.1 requires that memory be installed in memory segments D and E. (If you are not familiar with the layout of memory in a PC, there is an explanation in any PC technical reference manual.) The standard IBM 64/256K memory expansion card will work correctly in this application. The key requirement is that the card have switches that allow the starting address of the memory on the card to be set by the user. The typical 384K memory card does NOT meet this requirement as they are generally hardwired for addresses beginning at 256K.

The upgrade to the control program includes replacements for the IPL program and several other control program modules, plus a patch. The patch sets a flag in the file INDCFIG.DAT that is produced by the customization process for six other control program files.

When the modified control program is started, it loads approximately 120K of its code (the flagged files and the three other replacement control program modules) into this expanded memory area. The amount of memory required by the control program in the DOS area below 640K is correspondingly reduced.

HOST SESSION POWER-ON RESET

The 3278 and 3279 terminals have a NORMAL/TEST switch that allows the terminal user to send a power-on-reset signal to the host if the application hangs. This same signal is sent from the 3270-PC running version 2 or 3 of the control program with the Ctrl-Clear key combination.

If you are on a system with control program version 1.2.2, the program in appendix A will send the proper signal to the host. When it is assembled, it becomes a small COM file that can be run in one of the PC sessions.

Both the Ctrl-Clear key combination or the program in appendix A will reset all host sessions on a 3270-PC running in DFT mode.

MULTI-DOS CONSIDERATIONS

To understand how multiple PC programs are handled, it is necessary to understand the concept of well behaved and poorly behaved programs.

The control program assumes that all PC programs are poorly behaved unless it is told otherwise. The control program uses a file called a Program Information File (PIF) to determine if a program is well behaved. A PIF is created by the terminal user with the INDSPIF utility program that is provided with the control program. The PIF consists of just twelve bytes: the eight byte program name and four bytes containing flags that indicate whether or not the program does any of the following:

1. Changes interrupt vectors in the range 00 - 7F

2. Writes directly to the display buffer

3. Uses the 8087 math coprocessor

4. Changes the timer or keyboard interrupts

5. Reads the BIOS high memory pointer

6. Uses BASIC (either interpreted or compiled)

A program is well behaved if does none of the items on the list above. A program is moderately well behaved if it does any of the above except swap vectors in the range from 00 to 7F. A program is poorly behaved if it has no PIF or if it swaps vectors in the 00 to 7F range.

When the control program is started, it reads a file named 3270PC.PIF. This is called the consolidated PIF file. It contains information about many commonly used PC programs. The output from the INDSPIF utility can be added to this file, however, the consolidated PIF is resident in memory whenever the control program is active. If a program is not used frequently, it may be better to not always have its PIF data in memory.

If the name of the PC program being started is not found in the consolidated PIF, the directory that contains the program is checked for a file with the same name as the program and the extension PIF. If this file exists, the control program will get the required behavior information from it. If no PIF is found, the program is assumed to be poorly behaved.

The INDSPIF utility lets the user save the behavior information about a PC program in either the consolidated PIF or a separate PIF. While it is not wise to fill memory with a large consolidated PIF file, it is also unwise to load a hard disk with many small PIF files. Although a PIF is only twelve bytes long, it still requires a cluster on disk, which is 8K bytes on a 10 Mb hard disk. A lot of disk space could be required to hold PIF information if there were no consolidated PIF!

A good compromise between memory, disk space and performance is to put the PIF information for well behaved programs that are used frequently in the consolidated PIF to speed their initialization and save disk space. Infrequently used programs should have their PIF information in a separate PIF file.

The following grid shows how the control program determines when multiple PC programs can be allowed to execute concurrently:

Foreground Session	Background Session: Well Behaved	Background Session: Moderately Well Behaved	Background Session: Poorly Behaved
Well Behaved		X	X
Moderately well behaved		X	X
Poorly behaved	X	X	X

Figure 31. Effect of Program Behavior on Other Programs

The foreground task is never suspended. The boxes marked with an 'X' indicate when the background session(s) will be suspended. As the table shows, to have all PC programs executing concurrently, all of the PC programs must be well behaved.

If a poorly behaved program terminates but stays resident as a DOS extension, then all programs that are later run in the same PC session will also be considered to be poorly behaved. For example, if a menu program writes directly to the screen buffer, it is poorly behaved. Any program that it executes as a subtask will therefore be considered poorly behaved also. This can have a negative effect on the performance of the affected program.

When installing a new version of the control program, you will also be installing a new consolidated PIF. It will be necessary to add the entries to the new consolidated PIF that you added to your current PIF. Therefore, you need to keep a list of all the additions you made. It is not wise to just replace the new consolidated PIF with your old one as the IBM defined entries will probably have changed.

MULTI-DOS PERFORMANCE CONSIDERATIONS

Programs performing numerous screen I/Os run faster in a multi-DOS system, even if there is only a single PC session customized. This is because the code that supports the multi-DOS environment includes replacement code for many of the BIOS functions.

Programs that are CPU bound run only slightly slower than in a stand-alone PC, however, programs that do extensive disk I/O may run noticeably slower due to the control program's interception of the DOS calls for I/O. Programs that do I/O with FCBs run slower than programs that use file handles.

OTHER MULTI-DOS CONSIDERATIONS

The control program does not provide any file integrity among concurrently executing PC applications. The user must insure that two PC programs that write to the same disk file do not execute at the same time.

The ANSI.SYS driver does not work in a multi-DOS system; however, VDI drivers that are loaded ahead of the control program do work correctly.

3270-PC control program version 3.0 is the only version of the control program that supports the DOS PRINT command, and only the DOS 3.1 and 3.2 versions of the print command are supported. This means that DOS 3.1 or 3.2 and 3270-PC control program version 3.0 must be installed to use the background print capability of DW2 and DW3.

The CONFIG.SYS file must specify enough files for all of the PC sessions since there is only one copy of DOS in the system. It is suggested that the line FILES=40 be added to the CONFIG.SYS file unless there is already an equal or larger number specified.

In a multi-DOS system, there are a maximum of six drives available for use by PC programs. If any additional drives are specified in the LASTDRIVE statement of the CONFIG.SYS file, they are ignored.

OTHER APPLICATION PROGRAMS

When using either DW2 or DW3, the KQE program must not be used. This program will hang the system.

A print spooler can be used to speed up screen prints or to help with text printing from programs like DisplayWrite. Using a print spooler seems to stop the control program from resetting the printer setup mode when printing screen images using the workstation control print screen function. For example, if your printer is set for compressed type, with no print spooler installed, the printer will be set to 80 character per line mode before the screen is printed.

TRANSFER.COM as provided with control program version 2.1 operates correctly with version 1.2.2. It has not been formally tested with release 1.2.2, therefore, if problems arise that require NSD assistance, it will be necessary to recreate the problem on a version 2.1 system.

The 3270-PC control program version 3 includes support of Final Form Text (FFT) document transfer with Interchange Document Profile (IDP) support.

Lotus 1-2-3[1] works correctly on the 3270-PC. If you are using version 1A, there is a special version from Lotus for the 3270-PC. If you are using version 2, there is support for the 3270-PC in the standard package. Early users of Lotus version 2 reported problems. If file 123.CMP is not 133,848 bytes, Lotus should be contacted for assistance.

VM BOND will NOT run on the 3270-PC.

When installing PS/PC on the 3270-PC, it is necessary to create two PIF files. This process is described in the PS/PC documentation. The step that is not explained clearly is the requirement to create the subdirectory for PS/PC before creating these PIF files. This is because the control program requires that the PIF for any DOS program, like PS/PC, be located in either the consolidated PIF file or in a separate PIF file located in the same directory that contains the program that is to be run, which is PSPC.SYS in the case of PS/PC.

A list of software that has been tested and found to operate properly on the 3270-PC can be found in the INFO library with the keyword PC3270-PC. This list is published in manual GA23-0248 and on reference card GX23- 0386.

TOPVIEW operates under the 3270-PC control program version 2; however, there is one restriction that I have not seen documented: programs that use the display in native full screen (720 x 350) APA graphics mode do not work, but switching to CGA emulation mode (640 x 200) APA mode lets them operate correctly. TOPVIEW is not supported by version 3 of the 3270-PC control program.

File Transfer Express is a program supporting file transfer between a 3270-PC and an 8100 with DPPX or DPCX. APAR IR66321 is required on 3270-PC control program version 2.1 for it to operate correctly.

USING THE 3270-PC AS A SYSTEM CONSOLE

The 3270-PC is not fast enough to be used as the master console for a host system. However, if route codes are used to restrict the number of messages it receives, it is a reasonable choice for a console in a system programmer or help desk area.

---

[1] Lotus 1-2-3 is a trademark of Lotus Development Corporation.

receives, it is a reasonable choice for a console in a system programmer or help desk area.

The use of the 3270-PC API gives the 3270-PC a unique capability if it is used a system console. The API program could watch for specific messages and begin corrective action automatically when the messages are received. The API program could also change the color of the screen to alert the operator when manual intervention is required.

APPENDIX A. WHERE TO GET MORE INFORMATION ABOUT THE 3270-PC

This is a short bibliography about the 3270-PC. I have only included publications that discuss how to use, program, or do problem determination on the 3270-PC here.

GA23-0232 IBM 3270 Personal Computer Control Program Reference (Version 2)

This manual is the main reference for use and customization of the 3270-PC. The first chapters describe how to operate the 3270-PC. Customization and problem determination information is contained in the appendix.

G126-0117 IBM Personal Computer 3270 Supplement to Personal Computer Control Program Reference

This manual is a supplement to the main manual.

SA23-0221 IBM 3270 Personal Computer Control Program Programming Guide

This manual contains the information necessary to write low level API programs. It also contain a description of how the control program works and hints on how to debug PC applications.

SC23-0165 IBM 3270 Personal Computer Control Program Programming Guide

This is the programming guide for control program version 1.2.2.

GA23-0233 3270 Personal Computer Hardware Problem Determination

This is the manual that explains how to do hardware problem determination. It includes a discussion of the switch settings for adapter cards.

GA23-0179 IBM 3270 Personal Computer Introduction and Preinstallation Planning

This manual contains the 3270-PC physical planning information, host software information and 3274 customization information. The file transfer ASCII to EBCDIC translate tables are explained here also.

GA23-0271 IBM 3270 Personal Computer AT Supplement to Introduction and Preinstallation Planning

As its name implies, this is an AT supplement to GA23-0179.

ZZ20-5568 Host to Workstation File Transfer

This Technical Bulletin describes how file transfer operates. It includes an analysis of the data flows involved.

G320-0135 IBM 3270 Personal Computer Planning and Installation Seminar

This scripted presentation contains an excellent description of the 3270-PC and how it is defined to the 3274 and host system.

GA23-0248 IBM 3270 Personal Computer Family Software Guide

This manual lists many programs that have been tested on the 3270-PC family of workstations.

GX23-0386 IBM 3270 Personal Computer Family Software Listing

This is a reference card with a subset of the information in the above manual.

At the time of this writing, there are two issues in the 3270-Personal Computer Technical Journal series.

1. GA23-0291 discusses the API.

2. GA23-0292 discusses how to create a low level API program generator for use by people that don't know how to write assembler programs.

APPENDIX B. SAMPLE POWER-ON RESET PROGRAM

This is a sample program that will send a power-on reset signal to a host CPU from a 3270-PC. It acts like the NORMAL/TEST switch on the 3278 and 3279. By executing this program, a terminal user can eliminate the need to reboot the 3270-PC after connecting it to a different 3274 via a coax switch.

It should be typed into a disk file with an editor exactly as shown. It is then necessary to assemble and link edit the program. Finally, use EXE2BIN to convert it to a COM file.

```
TITLE   PORESET

CSEG    SEGMENT
        ASSUME  DS:CSEG,SS:CSEG,CS:CSEG,ES:CSEG

ORG     100H

BEGIN:  PUSH    DS

POR1:   XOR     AX,AX

        PUSH    AX
        MOV     DX,02D4H
        IN      AL,DX
        AND     AL,2
        JNZ     POR2
        MOV     AL,0
        OUT     DX,AL
        CALL    POR3
        MOV     AL,1
        OUT     DX,AL
        INT     20H

POR2:   MOV     DX,02D5H
        MOV     AL,0CBh
        OUT     DX,AL
        MOV     DX,02D4H
        MOV     AL,0A8H
        OUT     DX,AL
        CALL    POR3
        MOV     DX,02D5H
        MOV     AL,9Dh
        OUT     DX,AL
        MOV     DX,02D4H
        MOV     AL,0A8H
        OUT     DX,AL
        CALL    POR3
        MOV     DX,02D0H
        MOV     AL,0FDh
        OUT     DX,AL
        MOV     DX,02D4H
        MOV     AL,82
        OUT     DX,AL
        CALL    POR3
        MOV     DX,2D0H
        MOV     AL,0FDh
        OUT     DX,AL
        MOV     DX,02D4H
        MOV     AL,2
        OUT     DX,AL
        INT     20H

POR3:   MOV     CX,0064H

POR4:   PUSH    CX
        MOV     CX,0106H
```

```
POR5:   LOOP    POR5
        POP     CX
        LOOP    POR4
        RET

        CSEG    ENDS
        END     BEGIN
```

APPENDIX C. SAMPLE PROGRAM TO ACTIVATE PF13-22 KEYS IN PC SESSION

Since the 3270-PC keyboard has 24 PF keys, many users want to be able to use more than the 10 that are normally available while in a PC session.

Sample program 2 in the 3270-PC control program programming manual for version 2.0 and version 3.0 is designed to disable the WSCtrl key. With just slight modification, this sample program can be made to enable the normally unused PF keys for a PC session.

The code below is designed to change PF keys 13 through 22 to be a shifted PF1-10, which the PC BIOS interprets as PF keys 11-20. This code replaces the very last section of sample program 2 in chapter 26. It begins on page 26-10 in the Version 2 Programming Guide, SA23-0221-0, just before the comment that says **** MAIN BODY****.

This program allows you to label the 3270-PC keyboard template for PF keys 1-10 on the lower line and for PF keys 11-20 on the upper line just above the corresponding key that you would need to strike (along with the shift key) on a regular PC for the same function.

```
; AREA FOR PROGRAM DEFINITIONS
WINDOWA         DB      'A'             ;1ST PC WINDOW
WINDOWB         DB      'B'             ;2ND PC WINDOW
QERNAME         DB      01H             ;OPTION TO GET ID W/NAME

DATASEG ENDS

;
;               MAIN BODY
;

ZCODE   SEGMENT 'CODE'

        ;ESTABLISH ADDRESSABILITY OF CODE
 ASSUME CS:ZCODE

        ;ESTABLISH ADDRESSABILITY OF DATA
START:  MOV     AX,DATASEG
        MOV     DS,AX
        ASSUME  DS:DATASEG
        ; THE CODE THAT WILL CREATE THE TASK WILL FOLLOW THE ACTUAL
        ; DEFINITION OF THE TASK
        JMP     INITTSK

;
;       TASK DEFINITION
;

TASK    PROC    FAR

        CONN$KEY        KEYB,SESSID$1,Q$ID,,INTERCEPT
        ;READ A KEYSTROKE THAT IS DIRECTED TO WINDOW W/ SHORT NAME
READKEYS:
          READ$KEY KEYB,SESSID$1,

        MOV     AL,RKSCANCD
        CMP     AL,56H          ;PF11
        JNE     TK1
        MOV     AL,08H
TK1:
        CMP     AL,5EH          ;pf12
        JNE     TK2
        MOV     AL,10H
TK2:
        CMP     AL,06H          ;CLEAR KEY
        JNE     TK3
        MOV     AL,7DH          ;PAGE UP
TK3:
        CMP     AL,67H          ;PA1
        JNE     TK4
        MOV     AL,7AH          ;PAGE DOWN
TK4:
        CMP     AL,52H          ;ALL WE WANT IS BELOW 60
        JL      TESTKEY
READK2:
        JMP     PASSKEY
```

```
TESTKEY:

        CMP     AL,0F0H         ;FUNNY KEY?
        JNE     READK1
        JMP     FIXF0
READK1:

        push    ax
        AND     AL,07H          ;WE WANT EITHER 8,0 IN LAST BYTE
        pop     ax
        JNZ     PASSKEY
        MOV     TRAN,1          ;FLAG DOING TRANSLATE
        SUB     AL,1            ;MAKE IT INTO THE KEY BELOW IT
        MOV     RKSCANCD,AL     ;STORE IT BACK
FIXF1:
        MOV     AL,RKSHIFST     ;SHIFT STATE
        OR      AL,21H          ;TURN ON RIGHT SHIFT
        MOV     RKSHIFST,AL     ;STORE IT BACK
        JMP     PASSKEY

                ; THE KEY HAS EITHER BEEN TRANSLATED OR NOT, AND IS
                ; READY TO BE WRITTEN TO SESSION.


PASSKEY:
        WRIT$KEY KEYB,SESSID$1,RKSCANCD,RKSHIFST,,,

                ; CONTINUE READING KEYSTROKES
        JMP     READKEYS

FIXF0:
        cmp     tran,1
        MOV     TRAN,0
        JE      FIXF1
        JMP     PASSKEY

TASK    ENDP



;
;               INITIALIZATION CODE
;

        ;REQUEST THE NAME RESOLUTION FOR SESSION MANAGER
INITTSK:        NAME$RES SESSMGR,SMGR

        ;REQUEST THE NAME RESOLUTION FOR THE KEYBOARD
        NAME$RES KEYBOARD, KEYB

        ;GET THE SESSIONID FOR PC WINDOW W/ SHORT NAME = B
        QUERY$ID LENARRAY,QERNAME,WINDOWB,,SMGR,RCODE
```

```
CONT:   ;CREATE A QUEUE IN ORDER TO INTERCEPT KEYS
        CRT$Q   QUE,,LEN$Q,Q$ID

        ;FIND OUT THE TASK ID OF THE INIT CODE. THIS IS THE ID
        ; OF THE TASK THAT IS CONNECTING TO WSCTRL. THIS ID WILL
        ; BE NEEDED LATER TO READ AND WRITE KEYSTROKES
        MOV     AH,9CH          ;QUERY ACTIVE TASK REQUEST
        INT     7AH
        MOV     CONNID,DX       ;SAVE TASK'S ID ON RETURN

        ;CONNECT TO WSCTRL, IN ORDER TO INTERCEPT KEYSTROKES THAT
        ; ARE DIRECTED TO WORKSTATION CONTROL
;       CONN$KEY        KEYB,SESSID$1,Q$ID,,INTERCEPT

        ; CREATE A TASK, NEWLY CREATED TASKS ARE CREATED UNREAD
CONT2:  CRT$TASK TASK,,TASK$STK,NON$PRE,PRIO,KEYB
        MOV     TASK$ID,DX ;SAVE TASK ID

        ;SET THE TASK READY
        SET$RDY TASK$ID,NO$WAIT

        ;EXIT AND STAY RESIDENT
        CALL EXIT$RES

;
;       PROCEDURE DEFINITION
;
;
;       PROCEDURE : EXIT$RES
;       FUNCTION :
;               CALCULATE THE SIZE OF THIS PROGRAM THAT WILL
;               REMAIN RESIDENT, (STACK+SIZE OF TASK+DATA) AND
;               EXIT FROM THIS PROGRAM, BUT STAY RESIDENT
;
;

EXIT$RES        PROC    NEAR
        ; CALCULATE THE LENGTH OF THIS PROGRAM
        MOV     AX,OFFSET DLAST         ;LENGTH OF DATA
        ADD     AX,STAK$SIZ
        ADD     AX,OFFSET INITTSK
        ADD     AX,100H
        MOV     CL,4
        SAR     AX,CL
        INC     AX                      ;ROUND UP

        MOV     DX,AX
        MOV     AH,31H
        INT     21H

EXIT$RES        ENDP
ZCODE   ENDS
        END     START
```

M

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