The CLONE

IBM PC Compatibility Support

for the NCR Decision Mate V

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o Execution Parameters:

   − ON/OFF Switch

   − Function/Directional Keys Assignment

   − Keyboard Layout

   − Usage Message

o Interrupt Support for:

   − Print Screen   INT 05h

   − Video Services   INT 10h

   − Equipment−List   INT 11h

   − Cassette (inop return)   INT 15h

   − Keyboard Services (with scan codes)   INT 16h

   − Printer Services − Parallel & Serial   INT 17h

o DOS/BASIC level PC key assignments

o Print Screen Key

o Only 3K Memory Resident Program

The CLONE provides a subset level of compatibility with an IBM & Compatible PC's (PC) ROM BIOS services relating to Video, Keyboard, Printer I/O and other functions.

The Video Services are implemented via Interrupt 10 hex and are performed using the NEC 7220 Graphic Chip within the Decision Mate V (DMV). Not all service functions have been implemented; refer to the VIDEO SERVICES for specific details.

The Keyboard Services of the DMV, via Interrupt 16 hex, are enhanced to support PC scan code return values. A revised keyboard mapping, optionally installed by the CLONE, provides full Functional/Directional keys simulation at the DOS/BASIC levels. In addition, a PrtSc key that provides a CRT Screen dump to the printer is simulated at both the Keyboard Service and DOS level using the Shift '*' key on the numeric key pad. Not all PC keys are available; specifically, the Alt alpha/numeric keys are not emulated.

The Printer Services are implemented via Interrupt 17 hex and support the K210 Centronics-Interface and the K212/K801 Serial-Interface Modules. The normal PC implementation supports only a Parallel interface as LPTx; the CLONE simulates the parallel interface for the K212/K801, thereby needing no changes to programs requiring parallel printer usage.

The functions of Equipment Check (Interrupt 11 hex) and Cassette (Interrupt 15 hex) are implemented to return simulated status values.

The PrtSc key is implemented via the addition of Interrupt 05 hex, Print Screen Service.

o Set Video Mode   AH = 00

  — Perform Clear Screen only

o Set Cursor Size   AH = 01l

  — Support Cursor display ON/OFF

  — Sizes for raster lines 0 — 7

o Set Cursor Position   AH = 02l

  — Within Page 0 only

o Read Cursor Position   AH = 03l

o Scroll Window UP   AH = 06l

o Scroll Window DOWN   AH = 07h

o Read Character and Attribute   AH = 08h

o Write Character and Attribute   AH = 09h

o Write Character   AH = 0Ah

o Write Character as TTY   AH = 0Eh

o Read Video Mode   AH = 0Fh

    80x25 black and white text; value 02

      —or—

    80x25 Color text; value 03

The others services and video paging have yet to be implemented.

o WORDPERFECT 4.1 & 4.2; SSI Software, Inc.

o WORDSTAR — Release 4; MicroPro Int. Corp.

(except WORD FINDER; Microlytics, Inc.)

o NORTON UTILITIES 3.10; Peter Norton Computing, Inc.
— NU, TS, etc.

o SIDEWAYS 2.0 & 3.0; Funk Software, Inc.

o XTREE 2.00; Executive System, Inc.

o PRINT MASTER; Unison World, Inc.

(non—graphic mode only)

o CED — DOS Command Editor 1.0; C. J. Dunford

The general compatibility of a program written for the PC and its successful execution under the CLONE is affected greatly by the use and/or access of data via direct port level I/O. The various adapter boards and support circuits of the PC may be addressed via direct port I/O. This practice is normally used for status verification and/or special PC feature implementation. The assignment of the port addresses varies even between the PC models and are much different and/or non—existent in the DMV.

The conflict of address assignments and usage between the DMV and the PC cause different failure indications, depending on the DMV hardware interface configuration. Known conflicts are the DMV and the PC differences in programs using sound and interrupt controller programming. These types of programs may cause the printer to slew continuously or to hang the machine. The most common symptom is the latter.

For programs which allow configuration options, try turning off sound. For video options, try specifying ones that have snow or flicker and, if available, use a ROM BIOS interface.

Programs which use only ROM BIOS Video Services, Interrupt 10 hex, for output to the CRT and which do not use Graphic Mode operations are functional under the CLONE.

Programs wishing to obtain maximum performance on a PC have gone to using direct movement of display data to the video RAM. The video RAM on the DMV is not directly accessible, so there is no simulation. Programs that use this technique to avoid 'flicker' or 'snow' on the CRT directly access the video controller status port. A check is made for the presence of bit 0 or 3 to be on, which indicates that access to video RAM at that time will not cause interference.

The following is the assembler code normally used for this test:

the dx register will be loaded with 03DA hex

```
st_ck:   in    al, dx        EC       ;hex object
         test  al, 01h       A8 01
         jnz   st_ck         75 FB
```

As you can see from the above code example, it is an endless loop waiting for bit 0 to come on. When this type of code is executed on the DMV, the system will be hung and the only recourse is the reset the machine.

Using the DEBUG command, a search can be made of the test program looking for the above binary code sequence. The above specific example has been found to present in several programs.

An example DEBUG search would be:

s 0 xxxx EC A8 01   xxxx = program size

The PC to DMV key mapping is the same with the exception of:

o   Alternate F01 — F10 mapped to Shift F11 — F20

o   Special Keys

  — Shift TAB   — F15

  — END   — F16   Cntl END — Cntl F1·

  — INS   — F17

  — PgDn   — F18   Cntl PgDn — Cntl F1·

  — PgUp   — F19   Cntl PgUp — Cntl F1!

  — BREAK   — F20

  — DEL   — CLR key

o   Numeric Pad

  — PrtSc   — Shift '*'

  — Shift/Cntl Numbers equate to PC Directional Keys

o   DOS Command Line Edit Support

  — Copy 1 char   — F11

  — Copy to   — F12

  — Dup   — F13

  — Skip to   — F14

Programs written for the PC normally use ROM BIOS Keyboard Services, Interrupt 16 hex, for access to the keyboard. The two service functions of reading characters, AH = 00 – read character; AH = 01 – Character ready, return in the AH register (auxiliary byte) the assigned scan code for the specific key depressed and in the AL register (main byte) is its actual assigned ASCII code hex value. The group of special keys on the PC have a fixed ASCII code hex value of zero (00) and the scan code (auxiliary byte) is used to identify which specific special key was depressed.

When using DOS/BASIC level keyboard access routines, the return values are somewhat different. These routines return a single character equal to the ASCII code hex value for the key. For the special keys, a return of zero (00) indicates a second character is available to identify the specific key depressed.

The CLONE support both of the above access methods. The optional activate parameter of 'F' will install the DOS/BASIC level key code values using the DMV keyboard programming escape sequences. The Interrupt 16 keyboard return values are unaffected by this parameter and always return appropriate AH/AL values.

Normal first-time execution of the CLONE need not specify DOS/BASIC level activate parameter. A subsequent reactivation of the CLONE with the 'F' parameter option will reprogram the DMV keyboard. The state of all DMV programmable keys will be saved before the CLONE starts keyboard re-programming. Upon de-activation of the CLONE a restore the original keys values will be made. Not all programmable keys are affected, refer to the keyboard layout screen for the specific keys.

For DOS Command Line Edit support four DMV function keys are optionally programmed ('F' parameter option) for your convenience:

1. Copy 1   F11
2. Copy to   F12
3. Copy   F13
4. Skip to   F14

1. First-time Usage message, CLONE execution w/no parameters.

```
 _____
| CLONE - Ver R.XX - (C) Copyright 1986 by D.A.Rogers; ALL RIGHTS RESERVED |
|  _____  |
| |                                                    | |
| |  Status: The CLONE is NOT Resident!                | |
| |_____| |
|Printer = ?          Licensed to: xxxxxxxxxxxxxxxxxx   DOS 2.77|
|                                                        |
|           Execution CLONE (+ [ F ]) or (-)             |
|                                                        |
|   "+" or "-" )  Activate (if followed by:)             |
|                    "F" =  Install Function/Directional Keys |
|                    "l" =  List Keyboard Layout         |
|                                                        |
|   "-" or "/" )  De-Activate                            |
|                                                        |
|                          *letters may be either case   |
|_____|
```

R.XX   - CLONE Version and Point Release number.
Printer = ? - Printer type: P for Parallel, S for Serial.
xxxxxx's   - Name of Licensee and Serial Number.
DOS 2.77   - DOS Version number of 00 or 11.

o Execution Parameters:

CLONE { + [F L] } or (-)

Activate: '+' or '='

Optional: 'F' for Install Function/Directional Keys
                 'L' for List of Keyboard Layout Display

De-Activate: '-' or '/'

        Letters may be either case.

o PrtSc Key:

- Shift Numeric Pad '*' is the PrtSc Key

    If the printer is inoperative, a flashing "P"
    will appear in the upper right corner of screen.

o First time usage type "CLONE +FL", New Line;
    then depress the PrtSc Key to capture keyboard layout.

1. Normal initialization/installation message.

```
┌──────────────────────────────────────────────────────────────┐
│ ┌────────────────────────────────────────────────────────────┐ │
│ │ CLONE - Ver R.XX - (C) Copyright 1986 by D.A.Roger; ALL RIGHTS RESERVED │ │
│ └────────────────────────────────────────────────────────────┘ │
│ ┌────────────────────────────────────────────────────────────┐ │
│ │                                                            │ │
│ │   Status:  The CLONE is fully initialized;  and is Active. │ │
│ │                                                            │ │
│ └────────────────────────────────────────────────────────────┘ │
│ Printer = ?          Licensed to: xxxxxxxxxxxxxxxxxx     DOS 2.?? │
└──────────────────────────────────────────────────────────────┘
```
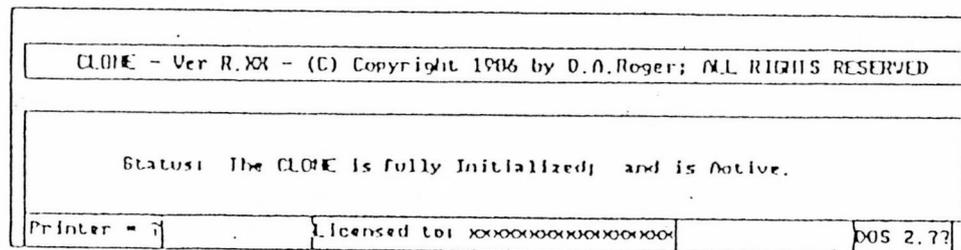
2. Momentary message while defining DOS Level Keyboard.
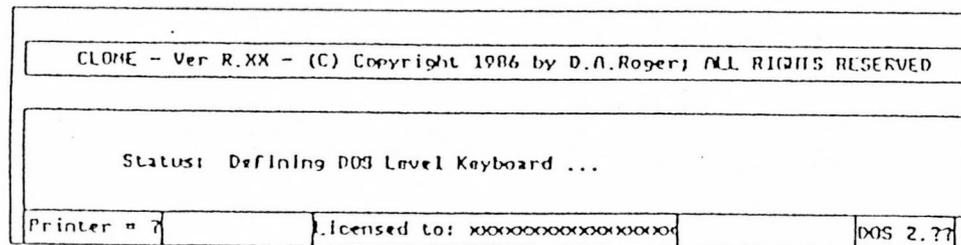
```
┌──────────────────────────────────────────────────────────────┐
│ ┌────────────────────────────────────────────────────────────┐ │
│ │ CLONE - Ver R.XX - (C) Copyright 1986 by D.A.Roger; ALL RIGHTS RESERVED │ │
│ └────────────────────────────────────────────────────────────┘ │
│ ┌────────────────────────────────────────────────────────────┐ │
│ │                                                            │ │
│ │   Status:  Defining DOS Level Keyboard ...                 │ │
│ │                                                            │ │
│ └────────────────────────────────────────────────────────────┘ │
│ Printer = ?          Licensed to: xxxxxxxxxxxxxxxxxx     DOS 2.?? │
└──────────────────────────────────────────────────────────────┘
```

R.XX   - CLONE Version and Point Release number.
Printer = ? - Printer type; P for Parallel, S for Serial.
xxxxxx's   - Name of Licensee and Serial Number.
DOS 2.??   - DOS Version number of 00 or 11.

1. CLONE – Active.

```
┌─────────────────────────────────────────────────────────────┐
│ ┌───────────────────────────────────────────────────────┐   │
│ │ CLONE – Ver R.XX – (C) Copyright 1986 by D.A.Roger; ALL RIGHTS RESERVED │
│ └───────────────────────────────────────────────────────┘   │
│ ┌───────────────────────────────────────────────────────┐   │
│ │                                                         │   │
│ │    Status:  The CLONE is fully Initialized;  and is Active!  │
│ │                                                         │   │
│ └───────────────────────────────────────────────────────┘   │
│ Printer = ?          Licensed to: xxxxxxxxxxxxxxxxx    DOS 2.7? │
└─────────────────────────────────────────────────────────────┘
```

2. CLONE – NOT Active.

```
┌─────────────────────────────────────────────────────────────┐
│ ┌───────────────────────────────────────────────────────┐   │
│ │ CLONE – Ver R.XX – (C) Copyright 1986 by D.A.Roger; ALL RIGHTS RESERVED │
│ └───────────────────────────────────────────────────────┘   │
│ ┌───────────────────────────────────────────────────────┐   │
│ │                                                         │   │
│ │   Status:  The CLONE is fully Initialized;  but is NOT Active!  │
│ │                                                         │   │
│ └───────────────────────────────────────────────────────┘   │
│ Printer = ?          Licensed to: xxxxxxxxxxxxxxxxx    DOS 2.7? │
└─────────────────────────────────────────────────────────────┘
```

R.XX   – CLONE Version and Point Release number.
Printer = ? – Printer type; P for Parallel, S for Serial.
xxxxx's   – Name of Licensee and Serial Number.
DOS 2.7?   – DOS Version number of 00 or 11.

3. CLONE Re–Activated complete.

```
┌─────────────────────────────────────────────────────────────┐
│ ┌───────────────────────────────────────────────────────┐   │
│ │ CLONE – Ver R.XX – (C) Copyright 1986 by D.A.Roger; ALL RIGHTS RESERVED │
│ └───────────────────────────────────────────────────────┘   │
│ ┌───────────────────────────────────────────────────────┐   │
│ │                                                         │   │
│ │    Status:   The CLONE has been Re-Activated.           │
│ │                                                         │   │
│ └───────────────────────────────────────────────────────┘   │
│ Printer = ?          Licensed to: xxxxxxxxxxxxxxxxx    DOS 2.7? │
└─────────────────────────────────────────────────────────────┘
```

4. CLONE De–Activation complete.

```
┌─────────────────────────────────────────────────────────────┐
│ ┌───────────────────────────────────────────────────────┐   │
│ │ CLONE – Ver R.XX – (C) Copyright 1986 by D.A.Roger; ALL RIGHTS RESERVED │
│ └───────────────────────────────────────────────────────┘   │
│ ┌───────────────────────────────────────────────────────┐   │
│ │                                                         │   │
│ │    Status:   The CLONE has been De-Activated.           │
│ │                                                         │   │
│ └───────────────────────────────────────────────────────┘   │
│ Printer = ?          Licensed to: xxxxxxxxxxxxxxxxx    DOS 2.7? │
└─────────────────────────────────────────────────────────────┘
```

R.XX   – CLONE Version and Point Release number.
Printer = ? – Printer type; P for Parallel, S for Serial.
xxxxx's   – Name of Licensee and Serial Number.
DOS 2.7?   – DOS Version number of 00 or 11.

2. Keyboard Layout – DOS 2.11

```
+------------------------------------------------------------------+
| CLONE - Ver R.XX - (C) Copyright 1986 by D.A.Roger; ALL RIGHTS RESERVED |
|                 Licensed to:  xxxxxxxxxxxxxxxxx                   |
+------------------------------------------------------------------+
      *** All DMV Keys are the same with the exception of: ***
      +------+------+------+------+  +------+------+------+------+------+
|Cntl  |      |      |      |      |  |^END  |      |^PgDn |^PgUp |SysRst|
|Shft|Alt-F1|Alt-F2|Alt-F3|Alt-F4|Alt-F5| |Alt-F6|Alt-F7|Alt-F8|Alt-F9|Alt-F10|
|   |Cpy 1 |Cpy to| Dup  |Skp to|SftTab|  | END  | INS  | PgDn | PgUp |Break |
|Key| F11  | F12  | F13  | F14  | F15  |  | F16  | F17  | F18  | F19  | F20  |
      +------+------+------+------+  +------+------+------+------+------+

                              | TAB  |  | Home | LtArw| DnArw | UpArw | RtArw|
>>> F11-14 DOS Edit Keys <<<  +------+  +------+------+------+------+------+

>>All Decision Mate V Keys      Shft    | Home | UpArw | PgUp |        |
  are  expanded  to  include     |-DEL-|  7   |  8   |  9   |  /   |
  their scancode when  input    +------+------+------+------+------+
  through Interrupt 16h. For      ^CLR^  | LtArw|        | RtArw|PrtScn|
  DOS access of Function and     Note:   |  4   |  5   |  6   |  *   |
  Directional keys; execute      Control key   +------+------+------+
  CLONE  with  "f"  option.<<   definition     | END  | DnArw | PgDn |
                                supported.      |  1   |  2   |  3   | NL  |
                                               +------+------+------+------+
                                                                   |DOS 2.11|
```

Errors

1. Attempt made to activate an already active CLONE.

```
+------------------------------------------------------------------+
| CLONE - Ver R.XX - (C) Copyright 1986 by D.A.Roger; ALL RIGHTS RESERVED |
+------------------------------------------------------------------+
|                                                                  |
|          Status:  The CLONE is already Active!                   |
|                                                                  |
+------------------------------------------------------------------+
| Printer = ?        | Licensed to: xxxxxxxxxxxxxxxxxx |  DOS 2.?? |
+------------------------------------------------------------------+
```

2. Attemp made to deactivate an already deactivated CLONE.

```
+------------------------------------------------------------------+
| CLONE - Ver R.XX - (C) Copyright 1986 by D.A.Roger; ALL RIGHTS RESERVED |
+------------------------------------------------------------------+
|                                                                  |
|          Status:  The CLONE is already De-Activated!             |
|                                                                  |
+------------------------------------------------------------------+
| Printer = ?        | Licensed to: xxxxxxxxxxxxxxxxxx |  DOS 2.?? |
+------------------------------------------------------------------+
```

R.XX   – CLONE Version and Point Release number.
Printer = ? – Printer type: P for Parallel, S for Serial.
xxxxxx's   – Name of Licensee and Serial Number.
DOS 2.??   – DOS Version number of 00 or 11.

R.XX   – CLONE Version and Point Release number.
Printer = ? – Printer type: P for Parallel, S for Serial.
xxxxxx's   – Name of Licensee and Serial Number.
DOS 2.??   – DOS Version number of 00 or 11.

3. CLONE execution with invalid parameters.

```
┌─────────────────────────────────────────────────────────────┐
│  ┌───────────────────────────────────────────────────────┐  │
│  │ CLONE - Ver R.XX - (C) Copyright 1906 by D.A.Roger;    │  │
│  │                    ALL RIGHTS RESERVED                  │  │
│  └───────────────────────────────────────────────────────┘  │
│  ┌───────────────────────────────────────────────────────┐  │
│  │                                                         │  │
│  │   Status:  Parameter Error - The CLONE's status is      │  │
│  │            NOT affected!                                │  │
│  ├──────────────┬──────────────────────────────┬─────────┤  │
│  │ Printer = ?  │ Licensed to: xxxxxxxxxxxxxxxxx │ DOS 2.?? │  │
│  └──────────────┴──────────────────────────────┴─────────┘  │
│                                                              │
│        Execution: CLONE (+ [ f l ]) or (-)                   │
│                                                              │
│   "+" or "*" )  Activate (if followed by:)                   │
│                 "f" =  Install Function/Directional Keys     │
│                 "l" =  List Keyboard Layout                  │
│                                                              │
│   "-" or "/" )  De-Activate                                  │
│                            *letters may be either case       │
└─────────────────────────────────────────────────────────────┘
```

4. Initialization Error — incorrect DOS memory values.

```
┌─────────────────────────────────────────────────────────────┐
│  ┌───────────────────────────────────────────────────────┐  │
│  │ CLONE - Ver R.XX - (C) Copyright 1906 by D.A.Roger;    │  │
│  │                    ALL RIGHTS RESERVED                  │  │
│  └───────────────────────────────────────────────────────┘  │
│  ┌───────────────────────────────────────────────────────┐  │
│  │                                                         │  │
│  │   Status:  Initialization Error - The CLONE has NOT     │  │
│  │            been Installed!                              │  │
│  ├──────────────┬──────────────────────────────┬─────────┤  │
│  │ Printer = ?  │ Licensed to: xxxxxxxxxxxxxxxxx │ DOS 2.?? │  │
│  └──────────────┴──────────────────────────────┴─────────┘  │
└─────────────────────────────────────────────────────────────┘
```

5. Non-supported DOS version error.

System prompt display:

The CLONE requires DOS 2.00 or 2.11

R.XX   — CLONE Version and Point Release number.
Printer = ? — Printer type; P for Parallel, S for Serial.
xxxxxx's   — Name of Licensee and Serial Number.
DOS 2.??   — DOS Version number of 00 or 11.

R.XX   — CLONE Version and Point Release number.
Printer = ? — Printer type; P for Parallel, S for Serial.
xxxxxx's   — Name of Licensee and Serial Number.
DOS 2.??   — DOS Version number of 00 or 11.

The CLONE
IBM PC Compatibility Support
for the NCR Decision Mate V

PROGRAMMERS
Reference Guide

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(619) 746-0698

Print Screen	Interrupt 05h
Video Services:	Interrupt 10h
Set Video Mode	AH = 00h
Set Cursor Size	AH = 01h
Set Cursor Position	AH = 02h
Read Cursor Position	AH = 03h
Scroll Window UP	AH = 06h
Scroll Window DOWN	AH = 07h
Read Character and Attribute	AH = 08h
Write Character and Attribute	AH = 09h
Write Character	AH = 0Ah
Write Character via TTY	AH = 0Eh
Read Video Mode	AH = 0Fh
Equipment — List Service	Interrupt 11h
Cassette Tape Service	Interrupt 15h
Keyboard Services:	Interrupt 16h
Read Character	AH = 00h
Read Character	AH = 01h
Shift/Cntl/Alt Status	AH = 02h
Printer Services:	Interrupt 17h
Send byte to printer	K210 AH = 00h
Send byte to printer	K212/K801 AH = 00h
Initialize printer	AH = 01h
Get printer status	AH = 02h
Character Set/Translation Charts	

Print Screen		none

Input Registers:

Return Registers:

This service is used to print the video screen (text mode) to the printer. It can be use with programs for output of the current display screen by coding of the assembler 'INT' command with an operand of 05 hex.

The CLONE simulated PrtSc key, numeric pad shift '*', invokes this service.

Set Video Mode	AH = 00

Input Registers:

AL =   video mode settings in hex:

    02 — 80x25 black/white text
    03 — 80x25 color text

Return Registers:

This service is normally used to set the various video display modes. A by-product of this service is the clearing of the screen when changing modes.

Under the CLONE's control only a clearing of the screen will occur. The above AL register values are shown only as a reminder of the supported modes available on the DMV. The specific mode is determined by a flag set by the operating system software at boot time on the DMV. This flag reflects only a Color or a Monochrome type CRT installed and has nor relationship to PC modes.

Set Cursor Size

Input Registers:

23

    CH =   start raster line number
    CL =   ending raster line number

    Bit 5 of the CH register determines:
        one = cursor is not displayed, turned off
        zero = cursor is displayed, turned on

Return Registers:

This service is used to control the cursor display. The CH/CL registers specify the raster line values ranging from 0 (zero), being the top most line number, to 7 (seven), being the bottom line number. The range reflects the 8x8 character matrix of the IBM PC. Normal value setting are CH = 06, CL = 07; resulting in a double line cursor display.

The state of bit 5 in the CH register is used to control the overall display of the cursor. If the bit is on, value 1, the display of the cursor will be turned OFF. If the bit is off, value 0, the display of the cursor will be turned ON.

Set Cursor Position

Input Registers:

24

    BH =   video page value
    DH =   Row value
    DL =   Column value

Return Registers:

This service is used to position the cursor within the video display page. The video page or text screen has a matrix of 25 Rows by 80 Columns. The upper left corner is assigned Row 0, Column 0. DH/DL registers specify the point of placement of the cursor within the screen matrix.

The BH register value on a compatible selects a specific target page, but the CLONE currently supports page ZERO only.

17

| Read Cursor Position | AH = 03 |

Input Registers:

BH = video page value

Return Registers:

CH = start raster line number
CL = ending raster line number
DH = Row value
DL = Column value

This service is used to obtain the current position of the cursor within the video display page. The video page or text screen has a matrix of 25 Rows by 80 Columns. The upper left corner is assigned Row 0, Column 0.

The CH/CL registers return values specify the cursor size information, they are currently preset to a return with values of 07 hex each. The DH/DL registers return values specify the current position of the cursor within the screen matrix.

The BH register value on a compatible selects a specific target page, but the CLONE currently supports page ZERO only.

| Scroll Window UP | AH = 06 |

Input Registers:

AL = number of lines to scroll up
BH = attribute to fill blank line
CH = top Row value   y
CL = left Column value   x
DH = bottom Row value   y
DL = right Column value   x

Return Registers:

None

This service is used to scroll a window from bottom to top in an upward direction as specified by the top/left corner and bottom/right matrix coordinate combinations: CH/CL − DH/DL.

The AL register value specifies the number of blank lines to scroll within the window. If the AL register value is ZERO or greater than the window size the entire window is cleared using the fill attribute.

The BH register value specifies the fill color attribute for blank lines.

Scroll Window DOWN

AH = 07

Input Registers:

27

```
AL  =   number of lines to scroll up
BH  =   attribute to fill blank line
CH  =   top Row value
CL  =   left Column value
DH  =   bottom Row value
DL  =   right Column value
```

Return Registers:

None

This service is used to scroll a window from top to bottom in an downward direction as specified by the top/left corner and bottom/right matrix coordinate combinations: CH/CL — DH/DL.

The AL register value specifies the number of blank lines to scroll within the window. If the AL register value is ZERO or greater than the window size the entire window is cleared using the fill attribute.

The BH register value specifies the fill color attribute for blank lines.

Read Character and Attribute

AH = 08

Input Registers:

28

```
BH  =   video page value.
```

Return Registers:

```
AH  =   character
AL  =   display attribute
```

This service is used to read the current character and its video display attribute at the current cursor position.

The AH register return value will be the actual DMV CRT display character from video memory. This character may be a result of a conversion to a DMV displayable character and not the original PC display character. The AL register return value, display attribute, will be the converted PC equivalent of the characters' DMV attribute value.

The BH register value on a compatible selects a specific target page, but the CLONE currently supports page ZERO only. dn

Write Character and Attribute		AH = 09

29

Input Registers:

    AL =   display character
    BH =   video page
    BL =   attribute .
    CX =   repeat counter

Return Registers:

    None

This service is used to write a character with a video display attribute at the current cursor position.

The AL register value, display character, will be translated to an available DMV displayable character. The BL register value will be converted to an equivalent display attribute appropriate to the DMV.

The BH register value on a compatible selects one of 4 color pages, but the CLONE currently only supports page ZERO.

The CX register value specifies the number of repeats of the chararter with its attribute to be displayed. Line wrap will occur.

The current cursor position is not incremented by the service.

Write Character		AH = 0A

30

Input Registers:

    AL =   display character
    BH =   video page
    CX =   repeat counter

Return Registers:

    None

This service is used to write a character using the last specified video display attribute at the current cursor position.

The AL register value, display character, will be translated to an available DMV displayable character.

The BH register value on a compatible selects one of 4 color pages, but the CLONE currently only supports page ZERO.

The CX register value specifies the number of repeats of the chararter to be displayed. Line wrap will occur.

The current cursor position is not incremented by the service.

20

Write Character via TTY	AH = 0E

31

Input Registers:

AL = display character
BH = video page

Return Registers:

None

Read Video Mode	AH = 0F

32

Input Registers:

None

Return Registers:

AH = display width (fixed – 80 charcters)
AL = video mode return settings for:

Monochrome CRT: 02 – 80x25 black and white text display
Color CRT: 03 – 80x25 color text display

This service is used to write a character using the TTY as the output device. The effect of this service is that the character can be redirected and the cursor position is incremented.

The AL register value, display character, will be converted to a displayable character available on the DMV.

The BH register value on a Compatible selects a specific target page, but the CLONE currently supports page ZERO only.

This service is normally used to read the current setting of the video mode.

The CLONE return only two values matching the configuration of the DMV for a Color CRT or Monochrome CRT.

22

Equipment – List

none

33

Input Registers:

Return Registers:

$AX =$ equipment flags:

bits	desciption	set to	
15,14	# of Printers	01	
13	Serial Printer?	0	(1=serial)
12	Game Adapter	0	(1=installed)
11,10,9	# of RS–232c Ports	001	(1 port)
8	DMA Chip installed	0	(0=installed)
7,6	# of 5 1/4" Drives	01	(+1=number)
5,4	Initial video mode	10	(80x25 Color)
		or 11	(80x25 Monochrome)
3,2	System board RAM	11	(64k normal)
1	Math coprocessor	0	(not necessary)
0	IPL from diskette	1	(drives exist)

This service is used to obtain an equipment list status of the PC. The CLONE returns a preset value varying only in the initial mode setting which is dependent on the type of CRT monitor in the MV, see above.

Cassette Tape Access

none

34

Input Registers:

Return Registers:

$AH = 86$

Cflag set on at return

This service is used to access the Cassette tape unit. The CLONE always returns with the AH register having an error status of 86 and the Cflag set on.

21

| Read Character | AH = 00 |

35

Input Registers:

Return Registers:

AH = scan code (auxiliary byte)
AL = ASCII character (main byte)

This service is used to read a character from the keyboard. The character is removed from keyboard buffer an its contents count is decrimented by one. The return registers AH/AL identify the actual key depressed (entered). The auxiliary byte (scan code) will identify the special key values when the main byte (ASCII character) is zero. Refer to Keyboard Code Chart for scan code and special key assignments.

23

| Character ready | AH = 01 |

36

Input Registers:

Return Registers:

AH = scan code (auxiliary byte)
AL = ASCII character (main byte)

ZF flag settings:

off (0) = character ready
on (1) = character not present

This service is used to determine if a character has been entered at the keyboard. The character, if present, is not removed from the keyboard buffer and its contents counter is not decrimented by one. The return registers AH/AL identify the actual key if entered. The auxiliary byte (scan code) will identify the special key values when the main byte (ASCII character) is zero. Refer to Keyboard Code Chart for scan code and special key assignments.

The state of the ZF flag indicates if a key was entered. If off (0) a key is present and is in the keyboard buffer. Note that the ZF flag has a reverse meaning, another way of looking at it is:

NZ = character ready
ZR = character not ready

26

| Get shift status | AH = 02 |

Input Registers:

  none

Return Registers:

  AL =   shift status bits:

        0 — right shift depressed
        1 — left shift depressed
        2 — Ctrl depressed
        3 — Alt depressed
        4 — Scroll Lock active
        5 — Num Lock active
        6 — Caps Lock active
        7 — Insert state active

This service is normally used to obtain the status of the keyboard control keys.

The DMV keyboard hardware has no equivalent function, so the CLONE returns a fixed value of zero, all states off.

| Send byte to the printer | AH = 00 |

Input Registers:

  AL =   character

Return Registers:

  AH = . output status:

    Because of the Serial interface only the following status values can be returned:

      90 hex — operational printer
      60 hex — inoperative printer

This service is used to output a character to the printer.

The K212/K801 Serial interface modules can not return but operative and inoperative status values.

Send byte to the printer	AH = 00

Input Registers:

39

AL =   character

Return Registers:

AH =   output status:

bit	desciption
7	not busy
6	acknowledge
5	out—paper
4	selected
3	I/O error
2	not used
1	not used
0	time—out

This service is used to output a character to the printer.   The return I/O status, AH register bits, reflect an on state (1).

The K210 Centronics Parallel interface module can return the above status setting. The normal return value for an operational printer is 90 hex.

24

Initialize printer	AH = 01

Input Registers:

Return Registers:

40

AH =   output status:

Refer to specific interface type Service 00 for status return values.

This service is used to initialize the printer by sending it the following two hex characters: 08, 0C.

Get printer status

AH = 02

41

Input Registers:

Return Registers:

AH = output status:

Refer to specific interface type Service 00
for status return values.

This service is used to obtain the current status of the printer.

	00	10	20	30	40	50	60	70	80	90	A0	B0	C0	D0	E0	F0
0	Ä	ä	¨	0	@	P	`	p								
1	Æ	æ	!	1	A	Q	a	q								
2	Å	å	"	2	B	R	b	r								
3	ß	¤	#	3	C	S	c	s								
4	É	é	$	4	D	T	d	t								
5	Ñ	ñ	%	5	E	U	e	u								
6	Ö	ö	&	6	F	V	f	v								
7	ß	æ	'	7	G	H	g	w								
8	Ç	b	(	8	H	X	h	x								
9	Ü	ü	)	9	I	Y	i	y								
A	à	ù	*	:	J	Z	j	z								
B	è	ł	+	;	K	[	k	{								
C	´	§	,	<	L	\	l	|								
D	°	ł	-	=	M	]	m	}								
E	↑	n	.	>	N	^	n	~								
F	¨	ł	/	?	O	_	o	█								

Characters 80 — FF duplicte 00 — 7F, with high bit off.

27

25

44

463

	00	10	20	30	40	50	60	70	80	90	A0	B0	C0	D0	E0	F0

28

	00	10	20	30	40	50	60	70	80	90	A0	B0	C0	D0	E0	F0
0		⟩		0	@	P	`	p	ç	É	a	▨	†	▨	a	=
1	o	⟨	!	1	A	Q	a	q	ü	æ	i	▨	†	▨	b	+
2	o	¡	"	2	B	R	b	r	é	Æ	o	▨	†	▨	G	⟩
3	o	¨	▪	3	C	S	c	s	a	o	u	│	†	▨	P	⟨
4	o	¨	$	4	D	T	d	t	ä	ö	ñ	+	−	▨	S	?
5	o	§	%	5	E	U	e	u	à	ò	Ñ	▨	†	▨	s	?
6	o	↑	&	6	F	V	f	v	å	ù	a	▨	▨	▨	m	/
7	o	↑	'	7	G	W	g	w	ç	ú	o	▨	▨	▨	t	~
8	o	↑	(	8	H	X	h	x	ê	ÿ	¿	▨	▨	▨	P	o
9	o	∨	)	9	I	Y	i	y	o	Ü	†	▨	▨	†	T	o
A	o	⟩	*	:	J	Z	j	z	è	Ü	†	▨	▨	†	O	o
B	o	⟨	+	;	K	[	k	{	ï	¢	/	▨	▨	▨	d	/
C	o	?	,	<	L	\	l	|	ì	£	/	▨	▨	▨	?	n
D	o	?	−	=	M	]	m	}	ì	¥	↓	▨	▨	▨	ñ	2
E	↑	↑	.	>	N	^	n	~	Ä	P	⟨	▨	▨	▨	B	a
F	▨	∨	/	?	O	_	o			Å	f	⟩	▨	▨	▨	H	

Keys Layout

| F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | F11 | F12 | F13 | F14 | F15 | | F16 | F17 | F18 | F19 | F20 |

| ESC | ! 1 | @ 2 | # 3 | $ 4 | % 5 | ^ 6 | & 7 | * 8 | (9 |) 0 | _ − | + = | |←| | TAB | | ↖ | ← | ↓ | ↑ | → |

| CNTL | Q | W | E | R | T | Y | U | I | O | P | { [| }] | CNTL | | CLR | 7 | 8 | 9 | / |

| CAPS | A | S | D | F | G | H | J | K | L | : ; | " ' | NEW LINE | | − | 4 | 5 | 6 | * |

| ⇧ | \ | Z | X | C | V | B | N | M | < , | > . | ? / | ⇧ | | ↑ | 1 | 2 | 3 | NEW LINE |

| (space) | | 0 | 00 | . |

Location Assignments

| F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | F11 | F12 | F13 | F14 | | F50 | F51 | F52 | F53 | F54 |

| E1 | E2 | E3 | E4 | E5 | E6 | E7 | E8 | E9 | E10 | E11 | E12 | E13 | E14 | | E50 | E51 | E52 | E53 | E54 |

| D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 | D11 | D12 | D13 | | D50 | D51 | D52 | D53 | D54 |

| C0 | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | | C50 | C51 | C52 | C53 | C54 |

| B0 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 | B11 | | | | B50 | B51 | B52 | B53 | B54 |

| A5 | | | | | | | | | | | | | | | A50 | A52 | A53 |

Main Keyboard — Row 1 Locations: F0 — F14

	Unshifted Char	Hex	AH AL	Shifted Char	Hex	AH AL	Control Char	Hex	AH AL
F0	F1	E0	3B 00	F1	C0	54 00	F1	A0	5E 00
F1	F2	E1	3C 00	F2	C1	55 00	F2	A1	5F 00
F2	F3	E2	3D 00	F3	C2	56 00	F3	A2	60 00
F3	F4	E3	3E 00	F4	C3	57 00	F4	A3	61 00
F4	F5	E4	3F 00	F5	C4	58 00	F5	A4	62 00
F5	F6	E5	40 00	F6	C5	59 00	F6	A5	63 00
F6	F7	E6	41 00	F7	C6	5A 00	F7	A6	64 00
F7	F8	E7	42 00	F8	C7	5B 00	F8	A7	65 00
F8	F9	E8	43 00	F9	C8	5C 00	F9	A8	66 00
F9	F10	E9	44 00	F10	C9	5D 00	F10	A9	67 00
F10	F11	EA	00 EA	AltF1	CA	08 29	F11	AA	00 AA
F11	F12	EB	00 EB	AltF2	CB	0C 5F	F12	AB	00 AB
F12	F13	EC	00 EC	AltF3	CC	0D 2B	F13	AC	00 AC
F13	F14	ED	00 ED	AltF4	CD	0E 08	F14	AD	00 AD
F14	sTAB	EE	8F 00	AltF5	CE	0F 09	F15	AE	00 AE

Main Keyboard — Row 2 Locations: E0 — E14

	Unshifted Char	Hex	AH AL	Shifted Char	Hex	AH AL	Control Char	Hex	AH AL
E0	ESC	1B	01 1B	ESC	1B	01 1B	ESC	1B	01 1B
E1	1	31	02 31	!	21	02 21			
E2	2	32	03 32	@	40	03 40			
E3	3	33	04 33	#	23	04 23			
E4	4	34	05 34	$	24	05 24			
E5	5	35	06 35	%	25	06 25			
E6	6	36	07 36	^	5E	07 5E			
E7	7	37	08 38	&	26	08 26			
E8	8	38	09 38	*	2A	09 2A			
E9	9	39	0A 39	(	28	0A 28			
E10	0	30	0B 30	)	29	0B 29			
E11	-	2D	0C 2D	_	5F	0C 5F	^_	1F	0C 1F
E12	=	3D	0D 3D	+	2B	0D 2B			
E13	BkSp	8B	0E 08	BkSp	8B	0E 08	^BkSp	9B	0E 7F
E14	TAB	09	0F 09	TAB	09	0F 09	TAB	09	0F 09

29

	Unshifted			Shifted			Control		
	Char	Hex	AH AL	Char	Hex	AH AL	Char	Hex	AH AL
D0	Cntl			Cntl			Cntl		
D1	q	71	10 71	Q	51	10 51	^Q	11	10 11
D2	w	77	11 77	W	57	11 57	^W	17	11 17
D3	e	65	12 65	E	45	12 45	^E	05	12 04
D4	r	72	13 72	R	52	13 52	^R	12	13 12
D5	t	74	14 74	T	54	14 54	^T	14	14 14
D6	y	79	15 79	Y	59	15 59	^Y	19	15 19
D7	u	75	16 75	U	55	16 55	^U	15	16 15
D8	i	69	17 69	I	49	17 49	^I	09	0E 09
D9	o	6F	18 6F	O	4F	18 4F	^O	0F	18 0F
D10	p	70	19 70	P	50	19 50	^P	10	19 10
D11	[	5B	1A 5B	{	7B	1A 7B	^[	1B	01 1B
D12	]	5D	1B 5D	}	7D	1B 7D	^]	1D	1B 1D
D13	Cntl			Cntl			Cntl		

	Unshifted			Shifted			Control		
	Char	Hex	AH AL	Char	Hex	AH AL	Char	Hex	AH AL
C0	CpLk			CpLk			CpLk		
C1	a	61	1E 61	A	41	1E 41	^A	01	1E 01
C2	s	73	1F 73	S	53	1F 53	^S	11	1F 13
C3	d	64	20 64	D	44	20 44	^D	04	20 04
C4	f	66	21 66	F	46	21 46	^F	06	21 06
C5	g	67	22 67	G	47	22 47	^G	07	22 07
C6	h	68	23 68	H	48	23 48	^H	08	23 08
C7	j	6A	1C 6A	J	4A	1C 4A	^J	0A	1C 0A
C8	k	6B	25 6B	K	4B	25 4B	^K	0B	25 0B
C9	l	6C	26 6C	L	4C	26 6C	^L	0C	26 0C
C10	;	3B	27 3B	:	3A	27 3A			
C11	'	27	28 27	"	22	28 22	^~	00	00 00
C12	`	60	29 60	~	7E	29 7E	^"	1E	07 1E
C13	N/L	88	1C 0D	N/L	88	1C 0D	^N/L	98	1C 0A

Numeric Pad — Rows 1 — 3   Locations: F50/54, E50/54, D50/54

Main Keyboard — Rows 5 & 6   Locations: B99, B0 — B11, A5

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	Unshifted			Shifted			Control		
	Char	Hex	AH AL	Char	Hex	AH AL	Char	Hex	AH AL
B99	Shft			Shft			Shft		
B0	\	5C	2B 5C	|	7C	2B 7C	^|	1C	2B 1C
B1	z	7A	2C 7A	Z	5A	2C 5A	^Z	1A	2C 1A
B2	x	78	2D 78	X	58	2D 58	^X	18	2D 18
B3	c	63	2E 63	C	43	2E 43	^C	03	2E 03
B4	v	76	2F 76	V	56	2F 56	^V	16	2F 16
B5	b	62	30 62	B	42	30 42	^B	02	30 02
B6	n	6E	31 6E	N	4E	31 4E	^N	0E	31 0E
B7	m	6D	32 6D	M	4D	32 4D	^M	0D	32 0D
B8	,	2C	33 2C	<	3C	33 3C			
B9	.	2E	34 2E	>	3E	34 3E			
B10	/	2F	35 2F	?	3F	35 3F			
B11	Shft			Shft			Shft		
A5	Sp	20	39 20	Sp	20	39 20	Sp	20	39 20

	Unshifted			Shifted			Control		
	Char	Hex	AH AL	Char	Hex	AH AL	Char	Hex	AH AL
F50	END	EF	4F 00	AltF6	CF	6D 00	^END	AF	75 00
F51	INS	F0	52 00	AltF7	D0	6E 00		00	00 00
F52	PgDn	F1	51 00	AltF8	D1	6F 00	^PgDn	B1	76 00
F53	PgUp	F2	49 00	AltF9	D2	70 00	^PgUp	B2	84 00
F54	Brk	F4	2E 03	AltF10	D3	71 00	Reset	B3	
E50	↖	81	47 00	↖	81	47 00	^↖	91	77 00
E51	←	82	4B 00	←	82	4B 00	^←	92	73 00
E52	↓	83	50 00	↓	83	50 00	↓	93	4E 2B
E53	↑	84	48 00	↑	84	48 00	−	94	4A 2D
E54	→	85	4D 00	→	85	4D 00	→	95	74 00
D50	DEL	86	53 00	CLR	7F	00 7F	^CLR	96	00 96
D51	7	37	08 37	Home	D7	47 00	^Home	B7	77 00
D52	8	38	09 38	↑	D8	48 00	8	B8	60 38
D53	9	39	0A 39	PgUp	D9	49 00	9	B9	84 00
D54	/	2F	35 2F	/	DF	37 2F	/	BF	37 2F

31

Numeric Pad — Rows 4 — 6   Locations: C50/54, B50/54, A50/53

Unshifted

	Char	Hex	AH	AL
C50	–	2D	0C	2D
C51	4	34	05	34
C52	5	35	06	35
C53	6	36	07	36
C54	*	2A	09	2A
B50	+	2B	0D	2B
B51	1	31	02	31
B52	2	32	03	32
B53	3	33	04	33
B54	N/L	88	1C	80
A50	0	30	0B	30
A52	00	30	0B	30
A53	.	2E	34	2E

Shifted

	Char	Hex	AH	AL
C50	–.	F4	6B	2D
C51	LtAw	D4	4D	00
C52	5	D5	06	35
C53	RtAw	D6	4D	00
C54	PrtSc	DA		
B50	+	DB	6C	2B
B51	END	DC	4F	00
B52	DnAw	DD	50	00
B53	PgDn	DE	51	00
B54	N/L	88	1C	80
A50	0	30	0B	30
A52	00	30	0B	30
A53	.	2E	34	2E

Control

	Char	Hex	AH	AL
C50	–	F5	6B	2D
C51	^LtAw	B4	73	00
C52	5	B5	61	35
C53	^RtAw	B6	74	00
C54	^PtSc	BA	72	00
B50	+	BB	6C	2B
B51	^END	BC	75	00
B52	2	BD	62	32
B53	^PgDn	BE	76	00
B54	N/L	98	1C	0A
A50	0	30	0B	30
A52	00	30	0B	30
A53				

The use of the CLONE In a commercial environment is subject to the following conditions and mutual agreements:

1. Payment of the site license fee is payable to D.A.Roger. The fee is based on the number of Decision Mate V systems available for use (inventory) at your specific commercial location or within your span of organizational control. Reference SITE LICENSE PRICE SCHEDULE.

2. You are authorized to make copies of the executable program and/or install them on multiple CPUs, in its original, unmodified form, up to the limit specified in the site license.

3. It is your responsibility to make the additional copies from the original distribution disk for installation on the systems to use the CLONE. Installation may be to a hard disk or network file server.

4. You may make copies of the program documentation, in both its printed form and machine readable form, without restriction.

5. You will be notified of future versions of the CLONE. Their use is granted as part of this license at no additional fee. A small service charge will be required covering new documentation, media and mailing costs.

I, the under signed as an authorized agent of my company, enter into and agree to abide by the terms and conditions of this license.

_____   _____
Signature   Date

_____   _____
Name (please print or type)   DMV System Cat.

_____
Title

_____   _____
Site/Organization Name   Company

ORDER FORM

Please check the appropriate license you wish to purchase:

( ) Non—commercial single user/cpu license of the CLONE.

( ) Commercial multi—user/cpu site license for:

DMV's available (inventory) _____.

Payment of $_____ is enclosed, per Price Schedule, plus $5.00 for Postage & Handling.

Form of payment is check or money order payable to D.A.Roger.

_____

Name

_____

Company

_____

Address

_____   _____   _____

City   State   Zip

_____

Send to: David A. Roger
                        1840 Donalor Dr.
                        Escondido, CA 92027

For orders outside of the U.S., please add an additional $5.00, and enclose an International money order payable in U.S. currency.

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```
##########################################################################################
#     CLONE - Ver 3.02 - (C) Copyright 1986 by D.A.Roger; ALL RIGHTS RESERVED     #
##########################Licensed to: D.A. Roger   *0000##################################
#       *** All DMV Keys are the same with the exception of: ***                          #
#   +--------+--------+--------+--------+--------+  +--------+--------+--------+--------+   #
#Ctrlö        ö        ö        ö        ö ö^END ö         ö^PgDn ö^PgUp öSysRstö #
#ShftöAlt-F1öAlt-F2öAlt-F3öAlt-F4öAlt-F5ö öAlt-F6öAlt-F7öAlt-F8öAlt-F9öAltF10ö #
#     öCpy 1 öCpy toö Dup  öSkp toöSftTABö ö END  ö INS  ö PgDn ö PgUp öBreak ö #
#   +--------+--------+--------+--------+--------+  +--------+--------+--------+--------+   #
# Keyö F11  ö F12  ö F13  ö F14  ö F15  ö ö F16  ö F17  ö F18  ö F19  ö F20   ö #
#   +--------+--------+--------+--------+--------+  +--------+--------+--------+--------+   #
#                                         ö TAB  ö ö Home*ö LtAw*ö DnAw ö UpAw ö RtAw*ö #
# >>> F11-14 DOS Edit Keys <<<            +--------+  +--------+--------+--------+--------+   #
#                                         Shftö      ö Home*ö UpAw ö PgUp*ö        ö #
# >>All Decision  Mate V  Keys            ö"DEL" ö 7  ö 8  ö 9  ö /   ö #
#   are  expanden  to  include            +--------+  +--------+--------+--------+--------+   #
#   their scancode when  input            ^CLR^  ö LtAw*ö        ö RtAw*öPrtSc*ö #
#   through Interrupt 16h. For    *Note:          ö 4  ö 5  ö 6  ö *   ö #
#   DOS access of Function and    Control key     +--------+--------+--------+--------+   #
#   Directional keys;   execute   definition      ö END* ö DnAw ö PgDn*ö        ö #
#   CLONE  with  "+f"  option.<<  supported.      ö 1  ö 2  ö 3  ö NL  ö #
#                                                 +--------+--------+--------+--------+   #
######################################################################################DOS 2.11##
A:ö>
```