

## Quick Reference Guide

Version 1.0.0

### The High Nibble



For the more significant bits

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# 1. Introduction

The VT132 terminal module is an RC2014 compliant module which makes it possible to use a RC2014 as a stand-alone computer as it provides keyboard input and VGA display output.

It also provides WiFi modem emulation which enables the use of a terminal program (like Kermit or QTerm on CP/M) for transferring data, controlling a remote computer or logging into a BBS.

This Quick Reference Guide lists the options and commands needed for everyday use of the VT132.






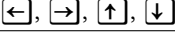
For a more in-depth look into details, please consult the VT132 website provided by TheHighNibble:

<https://thehighnibble.com/vt132/>

## 1.1. Key symbols

The following key symbols are used that may need explanation:

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|   |             |
|---|-------------|
|  | Tab         |
|  | Enter       |
|  | Space       |
|  | Backspace   |
|  | Shift       |
|  | Cursor keys |

---



## 2. The Terminal

The main function of the VT132 is the terminal. It functions as a VT100 terminal but is also capable of ANSI color sequences and can also display DOS ANSI . SYS compatible sequences.

Alternative personalities like ADM-3A or VT-52 are also available.

### 2.1. Keys in Terminal Mode

| Key                     | Function   |
|-------------------------|--|
| <b>Alt</b> + SysRq      | Open Setup Screen  |
| <b>Alt</b> + <b>Esc</b> | Open Quick Settings Menu (left <b>Alt</b> only)                          |
| <b>Ctrl</b> + <b>J</b>  | Send LINEFEED key  |
| ScrollLock              | NO SCROLL function, like <b>Ctrl</b> + <b>S</b> / <b>Ctrl</b> + <b>Q</b> |

### 2.2. The Quick Settings Menu

Use these keys to navigate inside this menu:

| Key  | Function                                 |
|--|--|
| <b>Esc</b>                                   | Close Quick Settings Menu (at top level) |
| <input type="text"/><br><b>↵</b><br><b>→</b> | Make selection, enter menu               |
| <b>Esc</b><br><b>←</b><br><b>←</b>           | Go back one level                        |

## 2. The Terminal

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- Selecting an action (ie. not a menu or checkbox/radio button) will execute this action and close the menu.
- You can press the underlined key to select an option.

The following **menu options** are available:

- Actions:
  - Clear display
  - Soft reset
  - Reset terminal: The same as 0 in Set-Up menus, resets the terminal to a defined state.
  - Reboot: Reboots the microcontroller of the VT132
  - Clean NVR: *factory reset* the VT132 by deleting all terminal and modem settings
- Terminal Type:
  - Emulation Mode: change personality
  - 7-bit NRCS characters: enable/disable NRCS<sup>1</sup> mode
- ASCII emulation:
  - Select a pre-defined emulation *profile*
  - White/Green/Amber/Blue screen all sets: DEC Codepage, Bold = Bright + Thick, ANSI color palette (except Amber: VGA palette), 80x24 screen
  - Ansi.sys sets: Codepage 437, Home on Clear, VGA color palette, 80x25 screen
- Keyboard: Select the keyboard layout (US/UK/German/Italian)
- Modem: Enable modem locally
  - When enabling this setting, the modem part cannot be accessed via the serial connection
  - Instead, when switching from ONLINE to LOCAL mode, you can talk directly to the modem (bypassing the connected computer)
- On-Line: switch between ONLINE and LOCAL mode (for using the modem, see above)

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<sup>1</sup>National Replacement Character Set: When enabled, some characters are replaced with language specific characters, eg. Umlauts in German



# 3. Set-Up Mode

## 3.1. Keys in Set-Up Mode

| Key          | Function  |
|--------------|---|
| <b>F1</b>    | Show/hide help  |
| <b>5</b>     | Advance to the next screen                                |
| <b>←→</b>    | Move cursor to the next tab stop                          |
| <b>←</b>     | Move cursor to the beginning of the line                  |
| <b>⇧ + C</b> | On Set-Up B: reset NVRAM to factory defaults on next boot |
| <b>⇧ + S</b> | Save the settings to NVS                                  |
| <b>⇧ + R</b> | Recall settings from NVS                                  |

## 3.2. The Set-Up Screens

The Set-Up screens imitate the same functions on a real DEC VT100 terminal.

### 3.2.1. Set-Up A

This page shows the tab stops at the bottom of the screen.

| Key   | Function                                |
|-------|---|
| ⏏ + T | Reset all tab stop to default           |
| 2     | Set / clear tab stop at cursor position |
| 3     | Clear all tab stops                     |
| 4     | Toggle online / local mode              |
| 9     | Toggle 80 / 132 columns per line        |

- In **online mode**, the terminal is connected to the computer via the serial port.
- In **local mode**, the terminal can be used to connect directly to the modem using the *Quick Settings menu* (see 2.2 on page 7).

### 3.2.2. Set-Up B

On this page, various configuration *bits* can be set. Use the cursor to navigate above the bit and press **[6]** to toggle it. Use **[←]** and **[→]** to move quicker.

These bits are available:

| Bit                     | Function   |
|-------------------------|--|
| Scroll                  | Use smooth scrolling                                       |
| Auto Repeat             | Press longer on a key and the input will be repeated       |
| Screen Inv.             | Invert the screen colors (to eg. black on white)           |
| Cursor                  | Change cursor shape (block / line)                         |
| Margin Bell             | Ring the bell when cursor is on right margin               |
| Keyclick                | Every keypress will make a clicking sound                  |
| Ansi/VT52               | If disabled, VT52 personality is used                      |
| Auto Xon/off            | Use Xon/Xoff as flow control                               |
| US/UK                   | Switch between US and UK keyboard layout                   |
| Wrap Around             | Characters will flow to the next line at the end of a line |
| New Line                | Pressing <b>[↵]</b> sends CR + LF instead of only CR       |
| Interlace               | Enable a <i>scanline effect</i>                            |
| Parity Odd/Even         | Not used   |
| Parity                  | Not used   |
| Bits 7/8                | Not used   |
| Backspace DEL/BS        | Send DEL or BS when pressing Backspace                     |
| Bold is Bright          | If bold text is displayed bright                           |
| Bold is Thick           | If bold text is displayed <b>thick</b>                     |
| Set ANSI.SYS Compliance | The terminal will be more compatible to DOS ANSI . SYS     |
| Set NumLock on Reset    | Enable NumLock on bootup                                   |

**Please note:**

- Use keys `[7]` and `[8]` to set the baudrate used on the terminal serial port, it is shown in the lower right.
- US/UK switch will replace # with £
- The Ansi/VT52 bit is for VT100 compatibility, as it reacts to `ESC[?21` (start VT52 mode) and `ESC<` (return to ANSI mode, ie. ANSI/VT100 personality). Changing the personality to VT52 disables this bit, all other will enable it.
- The bits for **bold** text are applied to text with the attribute `ESC[1m`.
- *ANSI.SYS Compliance* makes the cursor go home (`ESC[H`) on a clear screen request (`ESC[2J`), and makes some of the lower ASCII characters (between 0x00-0x1F) visible.

### 3.2.3. Set-Up C

This screen is a VT132 enhancement over the VT100 functionality.

You can also see the version number and the memory utilization (with help disabled).

You can change the following settings:

| Key      | Function                               |
|----------|--|
| <b>2</b> | Select codepage (DEC or Codepage 437)  |
| <b>3</b> | Select lines per screen (24, 25 or 30) |
| <b>6</b> | Toggle ANSI or VGA color palette       |
| <b>7</b> | Set default foreground color           |
| <b>8</b> | Set default background color           |

**Please note:**

- Codepage 437 is not available in 132 column mode.
- When switching to 30 line mode, WiFi cannot be started due to memory constraints. Also, if WiFi is already started, 30 line mode is not available (the option toggles between 24 and 25 lines then).
- To set the colors, move the cursor above the desired color on the bottom left of the screen.
- The current default foreground/background color is displayed on the last line of the screen by the word `Default`.
- The current screen size is displayed on the last line of the screen.

### 3.2.4. Set-Up D

This screen is a VT132 enhancement over the VT100 functionality.

| Key | Function                |
|-----|-------------------------|
| 6   | Set the keyboard layout |
| 7   | Toggle MCS/NRCS         |
| ↑   | Change Personality      |
| ↓   |                         |






**Please note:**

- To change the keyboard layout, move the cursor above the desired label and press 6.
- When enabling NRCS, certain characters in the lower 127 characters are replaced with country-specific characters according to the selected keyboard layout.
- The current keyboard layout and personality is shown in the last line of the screen.
- Selecting *WordStar/VT100* will enable WordStar cursor movement sequences for the cursor keys instead of standard ANSI cursor sequences (*ANSI/VT100*).



# 4. The Modem



## 4.1. Background

The VT132 modem part is designed to provide a modified Hayes AT compatible command set for connecting over WiFi via TCP/IP sockets with an optional Telnet protocol layer.

- The original AT command set was strictly in upper case. This is because the bit sequence of the ASCII values for A and T have a specific property that enables autobaud detection of the connection to the data terminal equipment (DTE).
- **The modem only responds to AT commands in upper case.**
- Commands are terminated by <sup>1</sup> usually generated by the  (Enter or Return) key on your keyboard.
- Commands can be edited, before pressing , using <sup>2</sup> to erase the previous character entered. You may need to configure the terminal to generate <BS> when you press the  (backspace) key on your keyboard.
- The AT command processor is based on a finite state machine (FSM). If you type anything that is not recognized by the rules of the FSM you will immediately see an **ERROR** message.

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<sup>1</sup>carriage return, +, 0x0D, decimal 13

<sup>2</sup>backspace, +, 0x08, decimal 8

## 4.2. Communication

### 4.2.1. Baudrate

To set the baudrate of the modem, press the **Prog** button on the VT132 module. After each press of this button, the modem outputs its new baud rate to the serial port – so you can press this button repeatedly until you can read your baud rate.

### 4.2.2. Serial Port

To communicate with the VT132 modem, you can use either the pins of the RC2014 extended bus (Rx2, Tx2) or the 6 pin header labelled *Modem Port B*.

See section A.2 on page 25 (*Jumper settings and headers*) for details.



## 4.3. Modem commands

### 4.3.1. Standard commands

All commands (except AT by itself, A/ and +++) need to have (uppercase) AT prefixed.

| Command               | Function  |
|-----------------------|---|
| AT                    | Test, answers OK  |
| A/                    | Repeat last command (immediate)                           |
| \$                    | Show Help   |
| I or I0               | Show modem model string                                   |
| I1                    | Show firmware version string                              |
| I2                    | Show firmware build chain version string                  |
| Z                     | Modem soft reset  |
| &F                    | Restore factory defaults (does not store to NVRAM)        |
| &W                    | Write settings to NVRAM                                   |
| D <i>host:port</i>    | Open connection to <i>host:port</i> , port defaults to 23 |
| +++                   | Escape from data mode to command mode                     |
| O                     | Return to data mode                                       |
| H                     | Hangup  |
| &A                    | Enable Answer mode  |
| A                     | Answer an incoming call                                   |
| S <i>n</i>            | Select register <i>n</i> as current register              |
| ?                     | Query current register                                    |
| = <i>r</i>            | Set value of register to <i>r</i>                         |
| S <i>n</i> = <i>r</i> | Set value of register <i>n</i> to <i>r</i> , eg. S15=1    |
| &K or &K0             | Disable RTS/CTS flow control                              |
| &K1                   | Enable RTS/CTS flow control                               |

### 4.3.2. WiFi commands

| Command            | Function   |
|--------------------|--|
| +W?                | Show WiFi status   |
| +W= <i>sss,ppp</i> | Connect to WiFi SSID <i>sss</i> using password <i>ppp</i>                        |
| +W\$               | Show WiFi IP address   |
| +W#                | Show Wi-Fi MAC address   |
| +W+                | (Re)connect to WiFi  |
| +W-                | Disconnect from WiFi   |
| +B?                | Query Baud Rate used on serial port  |
| +B= <i>n</i>       | Set Baud Rate on serial port<br>(4800, 9600, 14400, 19200, 38400, 57600, 115200) |
| +T?                | Query Telnet TERM environment variable   |
| +T= <i>ttt</i>     | Set Telnet TERM environment variable   |

### 4.3.3. OTA update commands

| Command        | Function   |
|----------------|--|
| +U= <i>url</i> | Set custom URL to fetch image from                         |
| +U?            | Query for new version online and show status               |
| +U^            | Upgrade to queried version if it is newer                  |
| +U!            | Force upgrade even if queried version is the same or older |
| +U\$           | Show OTA partition status                                  |

### 4.3.4. Enable Telnet mode

Use `ATS15=1` to enable Telnet mode.

## 4.4. S Registers

The modem has a total of 51 S registers, S0 to S50.

Most of them are undefined and unused. The following table lists all defined registers that are used by the VT132 modem part.

| Register | Default | Function  |
|----------|---------|---|
| S0       | 0       | Number of rings before Auto-Answer (0-255, 0 = never) |
| S1       | 0       | Ring Counter (0-255 rings)                            |
| S14      | 23      | TCP/IP Port for Answer Mode (0-65535)                 |
| S15      | 0       | Telnet Protocol for Data Mode (0/1)                   |
| S16      | 3       | Negotiate Telnet SGA (0/1/2/3)                        |
| S17      | 3       | Negotiate Telnet ECHO (0/1/2/3)                       |
| S18      | 0       | Negotiate Telnet BIN (0/1/2/3)                        |
| S19      | 3       | Negotiate Telnet NAWS (0/1/2/3)                       |
| S20      | 80      | NAWS Negotiate Columns (0-255)                        |
| S21      | 24      | NAWS Negotiate Rows (0-255)                           |
| S22      | 3       | Negotiate Telnet TERMINAL-TYPE (0/1/2/3)              |
| S39      | 0       | RTS/CTS Flow Control (0/1, set by AT&K)               |

0/1: 0 - disabled, 1 - enabled

0/1/2/3: 0 - Won't/Don't, 1 - Will, 2 - Do, 3 - Will/Do

## 4.5. Messages

### 4.5.1. Dial response messages

The following table shows the responses to the dial command `ATDhost:port`

| Response        | Reason   |
|-----------------|--|
| NO DIALTONE     | no Wi-Fi connection has been established with an AP                            |
| ALREADY IN CALL | a connection is already established ('Dialed' or 'Answered') with another host |
| ERROR           | no hostname is provided  |
| NO ANSWER       | no socket can be opened to the remote <i>hostname:port</i>                     |
| CONNECT         | a socket connection is opened with <i>hostname:port</i>                        |
| CONNECT TELNET  | a Telnet connection is opened with <i>hostname:port</i>                        |

### 4.5.2. Query Wi-Fi status messages

The following table shows the responses to the **Query WiFi status** command `AT+W?`

| Response             | Reason   |
|----------------------|--|
| WIFI NOT STARTED     | no Wi-Fi connection has been attempted since power-on or hardware reset  |
| WIFI IDLE            | Wi-Fi status is queried during a connection attempt  |
| WIFI NO SSID         | no AP with the given SSID/password is found following the <code>AT+W+</code> or <code>AT+W=...</code> commands |
| WIFI CONNECTED       | connection successful to an AP with the <code>AT+W+</code> or <code>AT+W=...</code> commands                   |
| WIFI CONNECT FAILED  | tba  |
| WIFI CONNECTION LOST | lost connection with the AP  |
| WIFI DISCONNECTED    | unsuccessful connection attempt, or a successful disconnection with the <code>AT+W-</code> command             |

## 4.6. Telnet

### 4.6.1. Telnet options

The VT132 supports the following Telnet options:

- SGA (Suppress Go Ahead)
- ECHO
- BIN (Binary Transmission)
- NAWS (Negotiate About Window Size)
- TERMINAL-TYPE

Each Telnet Option is negotiated via a request/response exchange described as *Do/Don't* (request) and *Will/Won't* (response). Trying to understand how these work for each Option usually requires reading the RFC and extreme patience and experimentation.

Usually you either want an Option completely **On** (Do/Will) or **Off** (Don't/Won't).

Setting the supported Options and their default values are defined via specific S Registers 4.4 on page 19.

In summary the defaults are:

| Option        | Default     | Description  |
|---------------|-------------|--|
| SGA           | Do/Will     | Required for the NVT to work character by character and not in linemode  |
| ECHO          | Do/Will     | tba  |
| BIN           | Don't/Won't | To operate as an NVT, binary mode is not required. File transfer protocols like KERMIT and XMODEM do their own binary encoding |
| NAWS          | Do/Will     | The remote host can learn your terminal windows size in characters, the default is 80 x 24 set in S20 and S21 respectively     |
| TERMINAL-TYPE | Do/Will     | The remote host can learn your terminal type, the default is vt100   |

The `TERMINAL-TYPE` must be known by the remote system to be recognised.

When connecting to `telnetd` on MacOS I use `vt100+` from the `terminfo` database which provides support for color over and above the standard `vt100` terminal type, making text applications like `htop` work as expected and in color.

### 4.6.2. Enabling Telnet Protocol

Telnet protocol is **not** enabled by default. To enable it, set the S Register S15 to 1 manually:

- Enable Telnet using: `ATS15=1`
- Disable Telnet using: `ATS15=0`

The Telnet protocol is applied to both **outgoing** connections 'Dialed' with ATD and **incoming** connections 'Answered' with ATA or Auto-answer.

## 4.7. Answer Mode

Listening for incoming TCP/IP socket connections is **not enabled** by default.

- To **enable** listening for incoming TCP/IP socket connections you must manually enter AT&A to *Enable Answer Mode*.
- Answer Mode will remain enabled, and can only disabled by an ATZ (Soft Reset), hardware reset or power-cycle.
- Incoming TCP/IP socket connections will cause the modem to respond with RING, repeated every three (3) seconds.
- As each RING occurs the Ring Counter in S1 is incremented by one (1).
- The user can *Answer* the incoming call at any time with ATA and the modem will accept the TCP/IP socket connection and enter **Data Mode**.
- If the **Number of rings before Auto-Answer** is set in S0 to a number greater than zero (0 = never) and S1 is greater-than-or-equal to S0 the modem will *Auto-answer*: accept the TCP/IP socket connection and enter **Data Mode**.
- If Telnet protocol is enabled by ATS15=1 then the Telnet Protocol will be negotiated with the remote host after the modem enters **Data Mode**.
- The user can *Hangup* an incoming call by sending the Escape Sequence +++ (with guard times) to return to **Command Mode** and then sending ATH to *Hangup*.
- A Hangup ATH will reset the Ring Counter in S1 to zero (0).





# A. Hardware

## A.1. Installation

To install the VT132 in an RC2014 or a compatible system, place it in a standard or extended bus socket.

If your backplane does not offer an extended bus, the modem cannot be used via bus pins, instead the modem 6 pin header has to be used. The extended bus pins are not used for other purposes.

**On a new VT132, the NVR (Non-volatile RAM) is not initialized.**

At power-on or reset, following the **Wait** message, a new VT132 will display **Error** along with a series of bells. This is expected because the NVR has not been initialized. Once you write settings to the NVR, this error should not persist.

## A.2. Jumper settings and headers

The board features the following jumpers:

| Jumper             | Function                                 |
|--------------------|--|
| JP1 RxA<br>JP2 TxA | Connect terminal to port A on bus pins   |
| JP3 RxB<br>JP4 RxB | Connect modem to port B on ext. bus pins |
| JP5 Pwr FTDI       | Connect Power to FTDI +5V pin            |
| JP6 Pwr Modem      | Connect Power to modem header +5V pin    |

Enabling JP1 and JP2 is highly advised, as the VT100 terminal serial connection is not available on a 6 pin header.

If you want to provide power to, or take power from either of the 6 pin headers then JP5 and JP6 will provide power or isolate the VCC pin in the FTDI Program and Modem Port B 6 pin headers respectively.

**Warning:** You should normally only connect one power source to the system at a time.

| FTDI Program |               | Modem Port B |           |
|--------------|---------------|--------------|-----------|
| Pin          | Function      | Pin          | Function  |
| 1            | GND           | 1            | GND       |
| 2            | not connected | 2            | CTS       |
| 3            | Vcc (+5V)     | 3            | Vcc (+5V) |
| 4            | Tx            | 4            | Tx        |
| 5            | Rx            | 5            | Rx        |
| 6            | not connected | 6            | RTS       |

If your RC2014 serial module uses the RTS/CTS pins, you can disable JP3+4 and use jumper wires to connect the **Modem Port B** of the VT132 to your serial module, as no bus pins are assigned to RTS/CTS.

The **FTDI Program** header outputs debug messages from the ESP32 microcontroller. You can connect another terminal (or a PC) to watch the debug output. The output uses 115200 baud, 8 data bits, no parity, 1 stop bit (8-N-1).

It is also possible to flash the ESP32 via this header. To enable the *programming mode*, press and hold **Reset**, press and hold **Prog**, release **Reset** and release **Reset**. Another firmware can now be uploaded, eg. via `esptool`.

## A.3. Buttons

The VT132 module offers two buttons:

- Reset
- Prog

The hardware **Reset** button on the PCB reboots the ESP32 (EN line reset). This will cause both the VT100 terminal and the modem to reset. Any unsaved settings (terminal and/or modem settings) will be lost.

*Note:* The computer connected to the VT132 will not be reset, so after the reset, you will be in the same program as before.

The hardware **Prog** button is used to switch the baud rate of the modem. After each press of this button, the modem outputs its new baud rate to the serial port - so you can press this button repeatedly until you can read your baud rate.



## B. Escape-Sequences

The following Escape-Sequences are supported by the VT132 Terminal.

The VT132 in VT100 mode supports sequences from the real DEC VT100, but also some sequences from later models like VT102, VT220, VT510 or VT520.

Also, sequences from VT52 are available in VT52 mode of the VT100 personality (and using the VT52 personality); these are shown at the end.

Furthermore, some sequences that are used by ANSISYS (from DOS) are available.

Sequences from other personalities are not shown in this Guide.

## B.1. VT100(+) sequences

| Sequence                           | Function                                   |
|------------------------------------|--|
| Cursor Movement:                   |  |
| ESC [ <i>row</i> ; <i>column</i> H | Move cursor to position                    |
| ESC [ <i>row</i> ; <i>column</i> f | Move cursor to position                    |
| ESC [ <i>n</i> D                   | Cursor Backwards                           |
| ESC [ <i>n</i> B                   | Cursor Down                                |
| ESC [ <i>n</i> C                   | Cursor Forward                             |
| ESC [ <i>n</i> A                   | Cursor Up                                  |
| ESC [ <i>n</i> d                   | Move cursor to the indicated row           |
| ESC [ <i>n</i> G                   | Move cursor to the indicated column        |
| ESC 7                              | Save Cursor position and attributes        |
| ESC 8                              | Restore Cursor position attributes         |
| ESC D                              | Index (move cursor down or scroll)         |
| ESC E                              | Move cursor to start of next line          |
| ESC M                              | Reverse Index                              |
| Text insertion / deletion:         |  |
| ESC [ J                            | Erase screen from cursor down              |
| ESC [ 0 J                          | Erase screen from cursor down              |
| ESC [ 1 J                          | Erase screen from cursor up                |
| ESC [ 2 J                          | Erase entire screen                        |
| ESC [ J                            | Erase line from cursor right               |
| ESC [ 0 J                          | Erase line from cursor right               |
| ESC [ 1 J                          | Erase line from cursor left                |
| ESC [ 2 J                          | Erase entire line                          |
| ESC [ <i>n</i> P                   | Delete <i>n</i> Characters on Current Line |
| ESC [ <i>n</i> X                   | Erase <i>n</i> Characters on Current Line  |
| ESC [ <i>n</i> @                   | Insert <i>n</i> Characters (Spaces)        |
| ESC [ <i>n</i> L                   | Insert <i>n</i> Lines                      |
| ESC [ <i>n</i> M                   | Delete <i>n</i> Lines                      |

| <b>Sequence</b>             | <b>Function</b>                          |
|-----------------------------|--|
| Scrolling:                  |  |
| ESC [ <i>n</i> ; <i>n</i> r | Set Top and Bottom line of scroll region |
| ESC [ <i>n</i> S            | Scroll Up <i>n</i> Lines                 |
| ESC [ <i>n</i> T            | Scroll Down <i>n</i> Lines               |
| Tab stops:                  |  |
| ESC H                       | Set tab stop at cursor                   |
| ESC [ <i>g</i>              | Clear tab stop at cursor                 |
| ESC [ 0 <i>g</i>            | Clear tab stop at cursor                 |
| ESC [ 3 <i>g</i>            | Clear all tab stops                      |
| Text Attributes:            |  |
| ESC # 3                     | Double Height Line - Top Half            |
| ESC # 4                     | Double Height Line - Bottom Half         |
| ESC # 5                     | Single Width / Single Height Line        |
| ESC # 6                     | Double Width / Single Height Line        |
| ESC [ 0 m                   | Attributes Off                           |
| ESC [ 1 m                   | Bold or Increased Intensity              |
| ESC [ 2 m                   | Dim (Decreased Intensity)                |
| ESC [ 22 m                  | Disable Bold and Dim                     |
| ESC [ 3 m                   | Italic                                   |
| ESC [ 23 m                  | Disable Italic                           |
| ESC [ 4 m                   | Underscore                               |
| ESC [ 24 m                  | Disable Underline                        |
| ESC [ 5 m                   | Blink                                    |
| ESC [ 25 m                  | Disable Blink                            |
| ESC [ 7 m                   | Inverse                                  |
| ESC [ 27 m                  | Disable Inverse                          |
| ESC [ 8 m                   | Blank (Invisible)                        |
| ESC [ 28 m                  | Disable Blank                            |

## B. Escape-Sequences

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| <b>Sequence</b>  | <b>Function</b>   |
|------------------|---|
| Color:           |   |
| ESC [ <i>n</i> m | Set Foreground Color ( <i>n</i> = 30...37)  |
| ESC [ 39 m       | Set Current Foreground Color as Default   |
| ESC [ <i>n</i> M | Set Background Color ( <i>n</i> = 40...47)  |
| ESC [ 49 m       | Set Background Color as Default   |
| ESC [ <i>n</i> m | Set Bright Foreground Color ( <i>n</i> = 90...97)   |
| ESC [ <i>n</i> M | Set Bright Background Color ( <i>n</i> = 100...107)   |
| Color numbers:   |   |
| 0                | Black   |
| 1                | Red   |
| 2                | Green   |
| 3                | Yellow (Brown)  |
| 4                | Blue  |
| 5                | Magenta   |
| 6                | Cyan  |
| 7                | White   |
| Selective Erase: |   |
| ESC [ 1 " q      | Protect from Selective Erase  |
| ESC [ 0 " q      | Unprotect from Selective Erase  |
| ESC [ 2 " q      | Unprotect Selective Erase   |
| ESC [ ? s J      | Selective Erase on Screen (like ESC[J]<br>s: 0: to end of screen, 1: to top of screen,<br>2: whole screen |
| ESC [ ? s K      | Selective Erase in Line (like ESC[K above)<br>s: 0: to left, 1: to right, 2: whole line                   |



| <b>Sequence</b>                            | <b>Function</b>                     |
|--|-------------------------------------|
| Switches, $x = h / l$ to enable / disable: |                                     |
| ESC [ 4 $x$                                | Insert Mode                         |
| ESC [ 20 $x$                               | Line Feed/New Line Mode             |
| ESC [ ? 1 $x$                              | Cursor Keys Mode                    |
| ESC [ ? 2 1                                | Start VT52 mode (ESC < returns)     |
| ESC [ ? 3 $x$                              | Column Mode                         |
| ESC [ ? 4 $x$                              | Scrolling Mode                      |
| ESC [ ? 5 $x$                              | Screen Mode                         |
| ESC [ ? 6 $x$                              | Origin Mode                         |
| ESC [ ? 7 $x$                              | Autowrap Mode                       |
| ESC [ ? 8 $x$                              | Auto Repeat Mode                    |
| ESC [ ? 9 $x$                              | Interlace Mode                      |
| ESC [ ? 12 $x$                             | Set Blinking Cursor                 |
| ESC [ ? 25 $x$                             | Set Cursor Visible                  |
| ESC [ ? 40 $x$                             | Allow switching 80/132 Mode         |
| ESC [ ? 42 $x$                             | NRCS Mode                           |
| ESC [ ? 45 $x$                             | Reverse-wraparound Mode             |
| ESC [ ? 47 $x$                             | Use Alternate Screen Buffer         |
| ESC [ ? 67 $x$                             | Backarrow Key Mode                  |
| ESC [ ? 1047 $x$                           | Use Alternate Screen Buffer         |
| ESC [ ? 1048 $x$                           | Save/Restore Cursor                 |
| ESC [ ? 1049 $x$                           | S/R Cursor and Use Alternate Screen |
| ESC =                                      | Keypad Application Mode             |
| ESC >                                      | Keypad Numeric Mode                 |

## B. Escape-Sequences

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| <b>Sequence</b>                      | <b>Function</b>  |
|--------------------------------------|--|
| Set Cursor Style ( _ = Space, 0x32): |  |
| ESC [ 0 _ q                          | Blinking Block   |
| ESC [ 1 _ q                          | Blinking Block (default)                               |
| ESC [ 2 _ q                          | Steady Block   |
| ESC [ 3 _ q                          | Blinking Underline                                     |
| ESC [ 4 _ q                          | Steady Underline                                       |
| ESC [ 5 _ q                          | Blinking Bar   |
| ESC [ 6 _ q                          | Steady Bar   |
| ESC c                                | Reset (like Power Cycle)                               |
| ESC [ !                              | Soft Terminal Reset                                    |
| ESC # 8                              | Screen Alignment Display (fill screen with <i>Es</i> ) |
| Select Character Set:                |  |
| ESC ( A                              | G0 - United Kingdom Set                                |
| ESC ( B                              | G0 - ASCII Set   |
| ESC ( 0                              | G0 - Special Graphics                                  |
| ESC ( 1                              | G0 - Alt Standard Character Set                        |
| ESC ( 2                              | G0 - Alt Special Graphics                              |
| ESC ) A                              | G1 - United Kingdom Set                                |
| ESC ) B                              | G1 - ASCII Set   |
| ESC ) 0                              | G1 - Special Graphics                                  |
| ESC ) 1                              | G1 - Alt Standard Character Set                        |
| ESC ) 2                              | G1 - Alt Special Graphics                              |
| ESC * <i>n</i>                       | Select Character Set G2 ( <i>n</i> = A,B,0,1,2)        |
| ESC + <i>n</i>                       | Select Character Set G3 ( <i>n</i> = A,B,0,1,2)        |

| <b>Sequence</b>           | <b>Function</b>  |
|---------------------------|--|
| Terminal Query Sequences: |  |
| ESC [ 6 n                 | Request Cursor Position  |
| ESC [ row ; column R      | <i>To Host:</i> Cursor Position Report   |
| ESC [ 5 n                 | Request Operating Status   |
| ESC [ 0 n                 | <i>To Host:</i> Terminal in good operating condition   |
| ESC [ 3 n                 | <i>To Host:</i> Terminal has a malfunction   |
| ESC Z                     | Identify Terminal  |
| ESC [ c                   | Query Device Attributes  |
| ESC [ 0 c                 | Query Device Attributes  |
| ESC [ ? 1 ; n c           | <i>To Host:</i> Device Attributes<br>VT132 will reply: ESC [ ? 64 ; 1 ; 6 ; 22 c<br><i>64 = class 4 device, 1 = 132 columns,</i><br><i>6 = Selective Erase, 22 = ?</i> |

## B.2. VT52 sequences

These VT52 sequences are available in VT100 mode:

| <b>Sequence</b>         | <b>Function</b>             |
|-------------------------|-----------------------------|
| ESC A                   | Cursor Up                   |
| ESC B                   | Cursor Down                 |
| ESC C                   | Cursor Right                |
| ESC D                   | Cursor Left                 |
| ESC F                   | Enter Graphics Mode         |
| ESC G                   | Exit Graphics Mode          |
| ESC H                   | Cursor to Home              |
| ESC I                   | Reverse Line Feed           |
| ESC J                   | Erase to End of Screen      |
| ESC K                   | Erase to End of Line        |
| ESC Y <i>row column</i> | Move cursor to position     |
| ESC Z                   | Identify                    |
| ESC / Z                 | <i>To host:</i> response    |
| ESC =                   | Enter Alternate Keypad Mode |
| ESC >                   | Exit Alternate Keypad Mode  |
| ESC <                   | Enter ANSI Mode             |

## B.3. ANSI.SYS sequences

| <b>Sequence</b> | <b>Function</b>                                |
|-----------------|--|
| ESC [ s         | save cursor state (position and attributes)    |
| ESC [ u         | restore cursor state (position and attributes) |