



## Quick Reference Guide

Version 1.0.0

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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/>



# 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
Alt-SysRq	Open Setup Screen
Alt-Esc	Open Quick Settings Menu
Ctrl-J	Send LINEFEED key
ScrollLock	NO SCROLL function, like Ctrl-S / Ctrl-Q

## 2.2. The Quick Settings Menu

Use these keys to navigate inside this menu:

Key	Function
Esc	Close Quick Settings Menu (at top level)
Space Enter →	Make selection, enter menu
Esc Backspace ←	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
  - 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 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
- 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)

## 3. Set-Up Mode

### 3.1. Keys in Set-Up Mode

Key	Function
F1	Show/hide help
5	Advance to the next screen
Shift-T	Reset tab stops to default
Tab	Move cursor to the next tab stop
Enter	Move cursor to the beginning of the line
Shift-C	On Set-Up B: reset NVRAM to factory defaults on next boot

### 3.2. The Set-Up Screens

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

Use F1 to toggle the help display which shows all keys.

Use 5 to advance to the next screen.

#### 3.2.1. Set-Up A

This page shows the tab stops and offers to toggle **80/132 columns** text display and also switching between **online** and **local mode**.

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. Set-Up Mode

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Use **Shift-S** (capital S) to save and **Shift-R** (capital R) to recall the settings from NVS.

#### 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 **Tab** and **Enter** 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	...
Auto Xon/off	Use Xon/Xoff as flow control
US/UK	Switch between US and UK keyboard layout
Wrap Around	...
New Line	...
Interlace	Enable a 'scanline effect'
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>
Home on Erase	Should the cursor go to upper left on clear screen
NumLock on Reset	Should NumLock be enabled 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.
- The bits for **bold** text are applied to text with the attribute ESC [ 1m.
- *Home on Erase* makes the cursor go home (ESC [ H) on a clear screen request (ESC [ 2J), just as MS-DOS ANSI . SYS works.

### 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
2	Select codepage (DEC or Codepage 437)
3	Select lines per screen (24, 25 or 30)
6	Toggle ANSI or VGA color palette
7	Set default foreground color
8	Set default background color

**Please note:**

- Codepage 437 is not available in 132 column mode.
- When switching to 30 line mode, the modem part of VT132 is not available due to memory constraints.
- 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 by the word `Default` on the last line of the screen.
- 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

Unlike the VT100 terminal, the modem does not try to faithfully emulate any particular original device.

Instead it is designed to provide an MVP (minimum viable product) providing a modified Hayes 'AT' compatible command set for connecting over Wi-Fi 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 <CR> (carriage return, <ctrl>-m, 0x0D, decimal 13) usually generated by the Enter or Return key on your keyboard.
- Commands can be edited, before pressing <CR>, using <BS> (backspace, <ctrl>-H, 0x08, decimal 8) to erase the previous character entered. You may need to configure the terminal to generate <BS> when you press the Backspace or <- 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.

## 4.2. Modem commands

### 4.2.1. 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

### 4.2.2. 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 (4800, 9600, 14400, 19200, 38400, 57600, 115200)
+T?	Query Telnet TERM environment variable
+T= <i>ttt</i>	Set Telnet TERM environment variable

### 4.2.3. 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

### 4.2.4. Enable Telnet mode

Use `ATS15=1` to enable Telnet mode.

### 4.2.5. 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

## 4.3. WiFi Messages

### 4.3.1. 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>

### 4.3.2. 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

## 4.4. Telnet

### 4.4.1. 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 in 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 4.2.5 on page 16.

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.

### 4.4.2. Enabling Telnet Protocol

Telnet protocol is **not** enabled by default.

- To enable the Telnet protocol you must manually set 'S' Register S15 to 1 with `ATS15=1`
- To disable the Telnet protocol you must manually set 'S' Register S15 to 0 with `ATS15=0`

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

### 4.5. 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 FTDI 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 JP2 TxA	Connect terminal to port A on bus pins
JP3 RxB 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 FTDI +5V pin

Enabling JP1 and JP2 is highly advised, as the VT100 terminal serial connection is not available on a FTDI 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 115.200 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.