

Zimodem 4.0 (C)2016-2024 Bo Zimmerman  
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Audio dial capability developed by Scott Swazey. <http://www.tattlersolutions.com>

#### Intro:

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This firmware code provides an api for communication between a serial terminal and the ESP8266 or ESP32. It simulates the old-style Hayes "AT" commands, so that the ESP8266 appears to the terminal as if it were a Hayes modem. These "AT" commands may then be issued to the ESP8266 in order to force it to connect to a wireless access point, and from there to make one or more manageable connections to the internet. It also includes a streaming serial "telnet" mode, and server/port listener capabilities.

The default baud rate that the firmware establishes is 9600. Be sure to use the commands below to set this to the proper baud rate for your terminal/host computer. If you plan on using the Commodore 8-bit utilities, keep the firmware baud rate saved at 9600.

#### Building:

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To build this firmware for the ESP-01 or ESP-12, I used the Arduino IDE rev1.8.10 with the 2.7.4 Arduino ESP8266 libraries using the Generic ESP8266 Module. Versions newer than 2.7.4 may not work. Install the libraries from the Boards Manager using [http://arduino.esp8266.com/stable/package\\_esp8266com\\_index.json](http://arduino.esp8266.com/stable/package_esp8266com_index.json). Both versions of the firmware are built with SPIFFS enabled. On the ESP8266, I used settings of 1M/160k, but you may want to alter that depending on your hardware and needs.

To build this firmware for the ESP-32, I also used the Arduino IDE rev 1.8.10 with the Arduino ESP32 Dev Module installed from the board manager \* , with the following settings: QIO, 8MB, 80MHZ, 921600, NONE, Avrisp Mk II \*.\* , and 3MB App space. Currently on library version 2.07.

#### Using:

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Upon initialization, or any time the ESP module is reset, the modem will display its version, and some information about the host hardware, and then read a configuration file from the internal SPIFFS to re-establish the previously set baud rate, and to attempt to re-connect to the previously connected wireless router. The first time it is run, the firmware will set a baud rate of 9600 and display INITIALIZED to let you know that no previous wifi configuration was found. Once the serial terminal displays READY, it is ready to receive commands.

**AT+CONFIG:** The first command you'll probably want to enter is used to connect to a wireless router, and set your flow control and other command mode settings.

**Linefeeds:** If you plan to use this primarily from a computer that doesn't need linefeeds, such as the C64, you'll want to enter ATR0 to go into carriage-return only mode, and then at&w to save this setting as well.

**Baud Rate:** If you want to operate at a higher baud, you'll want to enter AT19200 (or whatever baud rate you want to try), and then reconnect your terminal program to the modem at that new baud rate. If everything looks good, and you want to keep the new baud rate across restarts, save the new baud rate with AT&W. Warning though: Most of the example C64 programs assume the modem defaults to 9600 baud.

AT+PRINT: If you want to try printing to a CUPS/IPP-printer, enter AT+PRINT?:<host>:<port>/<path>, followed by your data. Where ? is A)scii, P)etscii, or R)aw. A 5 second pause in incoming data completes the document and returns to command mode. Example: AT+PRINTR:192.168.1.10:631/ipp/printer -- followed by ENTER and then the data to print, without any pause longer than 5 seconds. Subsequent to doing this, using AT+PRINT will repeat the previous URL.

AT+IRC: If you want to chat on IRC, enter AT+IRC, enter a nickname and a irc host as a phone number entry, then /join channels, chat, or /quit.

AT+SHELL: ESP32 Modem users with SD-cards can enter AT+SHELL to get a shell command prompt. Enter ? to get a list of shell commands.

AT+PING: To check if your wifi is connected and DNS resolution is working, try AT+PING"google.com". An OK means a response was received.

AT+COMET64: For modems with SD-cards, this puts the modem into 2400 bps, CSIP protocol mode for reading/writing directly to the card (for V-1541). +++ to exit.

AT+HOSTCM: For modems with SD-cards, this puts the modem into HOSTCM protocol mode for reading/writing directly to the card (for Commodore SupetPET SP9000). +++ to exit.

AT+1650, 1660, 1670: Puts the modem into a emulation mode for Commodore 1650, 1660, and 1670. Changes baud rates accordingly. Use AT&L or AT&F to clear emulation settings.

Telnet Dialing: If you want to connect to a remote telnet server, eg coffeemud.net, port 23, you'll want to enter **AT&S62=1DT"coffeemud.net:23"**. Don't forget to set your terminal program to the proper translation mode (ANSI, ASCII, or whatever).

Normal Dialing: If you are using a Commodore Graphics terminal program and want to connect to a Commodore BBS, or a standard ASCII terminal program for a non-Commodore BBS, you'll want to enter e.g. **ATD"cottonwoodbbs.dyndns.org:6502"**. The "T" in "ATDT" is optional if register 62 is 0 (default).

Q-Link Setup: If you want to use Q-Link, you need to add a phone number alias first. To do this, enter **ATP"5551212=q-link.net:5190"** or enter it from the config menu **AT+CONFIG**. From the C64 Q-Link client, select "Hayes compatible" 9600 baud modem when prompted.

BBS/Port Listeners: If you want to run a Commodore BBS program using the modem, you'll want to configure the BBS program to the same idle baud rate that your modem is using (9600 baud by default), configure it for a Hayes style modem (or the C=1670), and either create a persistant listener using AT+CONFIG, or use an initialization string of "ATR0E0S0=1S41=1A6400" plus any other recommended settings from the BBS program. This creates a listener at port 6400 that switches directly to stream mode on the first ring, with no linefeed carriage returns, and no keystroke echo. Your BBS program may require you add certain other settings, such as V0 or X1.. which you should also do.

Command Set:

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The command set is as follows (not case sensitive):

**ATZ** : closes all open socket connections (preserving the Access Point connection), stops all listeners, and resets the state of the Command processor to the saved configuration, preserving the current baud rate and wifi connection.

**A/** : Repeats the previous command

**ATI** : re-shows the startup message, including wifi connection information.

**ATI0** : same as **ATI**

**ATI1** : Shows the current common variable settings, common 'S' registers.

**ATI2** : Shows the modem's current IP address

**ATI3** : Shows the modem's current Wireless Router connection

**ATI4** : Shows only the firmware current version

**ATI5** : Shows all the current variable settings, all 'S' registers.

**ATI6** : Shows the current mac address.

**ATI7** : Shows the current formatted time (see **AT&T**).

**ATI8** : Shows the firmware build date/time

**ATI9** : Same as **I3**, but also includes any static settings, same order as **ATW**

**ATI10**: Shows the last printer url used.

**ATA** : If a server listener has generated a RING, then **ATA** will switch the last rung connection to Stream mode (see **ATD**).

**ATAn** : Causes the modem to create a server listening on port n. When a connection is received, the terminal will generate 1 or more RINGS according to the **ATS0** register, followed by a normal CONNECT response. At this point, all other commands related to connections may be used normally, unless **ATS41** is > 0, in which case incoming connections are automatically sent to Stream mode as per **ATD** or **ATA**. Listeners are listed along with other connections using **ATC0**.

**ATAPn** : Adding a P modifier causes all incoming connection input to be translated to PETSCII

**ATATn** : Adding a T modifier causes connection streaming input to be translated per TELNET when the changed to Stream mode

**ATAEn** : Adding a E modifier causes connection terminal echo to be enabled when the changed to Stream mode

**ATAXn** : Adding a X modifier causes connection XON/XOFF flow control to be enabled when the changed to Stream mode.

**ATM0** : Speaker always off

**ATM1** : Speaker on until carrier detected

**ATM2** : Speaker always on

**ATM3** : Speaker on only after dialing

**ATN0** : Shuts down all listeners, leaving client connections open

**ATNn** : if n > 0 then closes a Server (**ATA**) listener with the given id; does not close any connections received from that listener.

**ATE0** : Turns serial terminal echo off for command mode.

**ATE1** : Turns serial terminal echo on for command mode.

**ATV0** : Turns off verbose responses mode (Uses Terse Numeric response mode)

**ATV1** : Turns on verbose responses mode (Uses Word response mode)

**ATX0** : Turns off extended response codes (1/CONNECT instead of 5/CONNECT 2, etc..)

**ATX1** : Turns on extended response codes (5/CONNECT 2 instead of 1/CONNECT, etc..)

**ATF0** : Turns on rts/cts flow control.  
**ATF1** : Turns on xon/xoff flow control.  
**ATF2** : Turns on xon/xoff flow control, sets XON mode (if necessary), and, in command mode, will immediately go to XOFF when a single connection packet is received. This is very useful when the client wants to ensure it only receives one packet to process. You can think of this as an alternative way to use xon/xoff by having XOFF automatic between packets.  
**ATF3** : Similar to ATF2 except that the default is XOFF, and, in command mode, a XON code from the user will immediately trigger either an empty packet response [ 0 0 0 ], or a real packet if one is available. After this, as in **ATF2**, XOFF is automatically set.  
**ATF4** : Turns off flow control for command mode  
\* : in AT+1670 mode, **ATF0** will instead turn on stream mode echo, and ATF1 will turn it off.

**ATQ0** : Turns off quiet mode (Sends response codes)  
**ATQ1** : Turns on quiet mode (Stops sending response codes)

**ATR0** : Suppresses linefeed (\n \$0a) in end of lines. Will only send carriage return (\r \$0d).  
**ATR1** : Sends \r\n (\$0d0a) as end of line string.  
**ATR2** : Sends \n\r (\$0a0d) as end of line string.  
**ATR3** : Suppresses carriage return (\r \$0d) in end of lines. Will only send linefeed (\n \$0a).

**ATBn** : Sets a new serial Baud Rate. Takes effect immediately.  
**ATB"n,xYz"** : Sets baud rate n, bits x, parity (E,O,M, or N) for Y, and stop bits z.

**ATW** : List all wireless network access points scanned within range. The response for each entry is the SSID, following by the RSSI, followed by an \* character is the connection is encrypted.  
**ATWn** : Where n > 0, this lists up to n wireless network access points scanned within range. The response for each entry is the SSID, following by the RSSI, followed by an \* character is the connection is encrypted.  
**ATW"[SSI],[PASSWORD]"** : Connects to the wireless access point with the given SSI, using the given password.  
**ATW"[SSI],[PASSWORD],[IP],[DNS],[GATEWAY],[SUBNET]"** : as **ATW**, but with more options  
**ATWP** : Adding a P modifier is the same as all forms of **ATW**, with both arguments and results presented in PETSCII.

**ATD** : Start a streaming connection between the current opened connection. Use "+ + +" to exit back to Command mode.  
**ATDn** : Where n > 0, this will start a streaming connection between the previously opened connection with an id the same as n. Use "+ + + +" to exit back to Command mode.  
**ATD"[HOSTNAME]:[PORT]"** : This opens a streaming connection between the terminal and the given host/port. Use "+ + + +" to disconnect and exit back to command mode.  
**ATDP"[HOSTNAME]:[PORT]"** : Adding a P modifier causes connection input to be translated to PETSCII during the streaming session.  
**ATDT"[HOSTNAME]:[PORT]"** : Adding a T modifier allows connection input to be translated per TELNET during the streaming session (see **S62**).  
**ATDE"[HOSTNAME]:[PORT]"** : Adding a E modifier causes terminal echo to be enabled that streaming session.  
**ATDX"[HOSTNAME]:[PORT]"** : Adding a X modifier causes XON/XOFF flow control to be enabled that streaming session.  
**ATDS"[NAME]:[PASS]@[HOSTNAME]:[PORT]"** : Adding a S modifier, along with username and password, causes an SSH shell connection to be made.

**ATDnnnnnnn** : Where n=0-9, if the digits exist in the phonebook (see **ATP**), it will try connect to that host, with those modifiers, from the phonebook.

**ATC** : Shows information about the current network connection in the following format "[CONNECTION STATE] [CONNECTION ID] [CONNECTED TO HOST]:[CONNECTED TO PORT]"

**ATC0** : Lists information about all of the network connections in the following format "[CONNECTION STATE] [CONNECTION ID] [CONNECTED TO HOST]:[CONNECTED TO PORT]", including any Server (**ATA**) listeners.

**ATCn** : Where n > 0, this changes the Current connection to the one with the given ID. If no connection exists with the given id, ERROR is returned.

**ATC"[HOSTNAME]:[PORT]"** : Creates a new connection to the given host and port, assigning a new id if the connection is successful, and making this connection the new Current connection. The quotes and colon are required.

**ATCP"[HOSTNAME]:[PORT]"** : Adding a P modifier causes all connection input to be translated to PETSCII

**ATCT"[HOSTNAME]:[PORT]"** : Adding a T modifier causes streaming input to be translated per TELNET when the changed to Stream mode

**ATCE"[HOSTNAME]:[PORT]"** : Adding a E modifier causes terminal echo to be enabled when the changed to Stream mode

**ATCX"[HOSTNAME]:[PORT]"** : Adding a X modifier causes XON/XOFF flow control to be enabled when the changed to Stream mode

**ATH** : Hangs up (disconnects and deletes) all open connections. Does not close Server listeners.

**ATH0** : Hangs up (disconnects and deletes) the current opened connection.

**ATH1** : If no client connection with id 1 is open, this will put server listeners into 'busy' mode.

**ATHn** : Hangs up (disconnects and deletes) the open client connection with the given id.

**ATO** : Re-enters a Streaming session (see **ATD**) under the previous settings, with the current (previous) connection.

**ATP** : Lists all existing phonebook entries, with the format phone number followed by **ATD** modifiers, followed by the host and port. Add ? to also get notes.

**ATP"[NUMBER]=[HOSTNAME]:[PORT],[NOTES]"** : Adds or Modifies an entry to the phonebook with the given 7 digit number, host, port, and notes. Use **ATDnnnnn..** to connect.

**ATPP"[NUMBER]=[HOSTNAME]:[PORT],[NOTES]"** : Adding a P modifier causes connection input to be translated to PETSCII when connected to that entry.

**ATPT"[NUMBER]=[HOSTNAME]:[PORT],[NOTES]"** : Adding a T modifier causes connection input to be translated per TELNET when connected to that entry.

**ATPE"[NUMBER]=[HOSTNAME]:[PORT],[NOTES]"** : Adding a E modifier causes terminal echo to be enabled when connected to that entry.

**ATPX"[NUMBER]=[HOSTNAME]:[PORT],[NOTES]"** : Adding a X modifier causes XON/XOFF flow control to be enabled when connected to that entry.

**ATP"[NUMBER]=DELETE"** : Removes the phonebook entry with the given number.

**ATS0=n** : Changes the number of RING messages received before a CONNECT response is sent, on incoming Server listeners.

**ATS1=n** : Unimplemented, always returns OK

**ATS2=n** : Change the escape character (n = 0-255), Defaults to ASCII decimal 43 ("+")

**ATS3=n** : Change the Carriage Return Character (n = 0-127), Defaults to ASCII decimal 13 (Carriage Return)

**ATS4=n** : Change the Line Feed Character (0-127), Defaults ASCII decimal 10 (Line Feed)

**ATS5=n** : Change the Backspace Character (0-32), ASCII decimal 8 (Backspace)

**ATS6=n** : Unimplemented, always returns OK

**ATS40**=n : Change the size of the connection packets (n > 0), Defaults to 127 bytes  
**ATS41**=n : When n > 0, all incoming Server listener connections are immediately sent to Stream mode. If n=0, connections remain in normal command mode (default).  
**ATS42**=n : Set the CRC8 for an attached Transmit command. e.g.  
**ATS42**=123T"[MESSAGE]" returns error unless 123 is CRC8 of "[MESSAGE]".  
**ATS43**=n : Sets a standby baud rate n for the next incoming or outgoing connection only. ATZ clears.  
**ATS44**=n : Sets an automatic delay of n milliseconds after most bytes written to the Serial port. This is for computers that support a baud rate, but can't really keep up, and you don't want to use flow control.  
**ATS45**=n : Changes how packet and at&g data is delivered. 0 is normal binary with normal headers, 1 is 78 char HEX digit streams followed by EOLN with hex digit headers, 2 is decimal digits followed by EOLN, with decimal digit headers, 3 is normal without SUM header. Add 4 to add packet numbers.  
**ATS46**=n : Changes DCD status. n=0 is default DCD=HIGH=online. n=1 is DCD=LOW=online. n=2 always HIGH. n=3 always LOW.  
**ATS47**=n : Changes DCD pin number, n=2 is default  
**ATS48**=n : Changes CTS status. n=0 is default CTS=HIGH=active. n=1 is CTS=LOW=active. n=2 always HIGH. n=3 always LOW.  
**ATS49**=n : Changes CTS pin number, n=0 is default on ESP01, and default is 5 otherwise  
**ATS50**=n : Changes RTS status. n=0 is default RTS=HIGH=active. n=1 is RTS=LOW=active. n=2 always HIGH. n=3 always LOW.  
**ATS51**=n : Changes RTS pin number, n=4 is default  
**ATS52**=n : Changes RI status. n=0 is default RI=HIGH=active. n=1 is RI=LOW=active. n=2 always HIGH. n=3 always LOW.  
**ATS53**=n : Changes RI pin number, n=14 is default  
**ATS54**=n : Changes DTR status. n=0 is default DTR=HIGH=active. n=1 is DTR=LOW=active. n=2 always HIGH. n=3 always LOW.  
**ATS55**=n : Changes DTR pin number, n=12 is default  
**ATS56**=n : Changes DSR status. n=0 is default DSR=HIGH=active. n=1 is DSR=LOW=active. n=2 always HIGH. n=3 always LOW.  
**ATS57**=n : Changes DSR pin number, n=13 is default  
**ATS60**=n : When n > 0, immediately saves existing listeners and automatically restores them later. n=0 to clear.  
**ATS61**=n : When n > 0, sets the number of seconds to timeout a print job stream (AT+PRINT). Default is 5 seconds  
**ATS62**=n : When n > 0, enables/disables telnet support in the **ATD** (Dial) command. Default is 0 (disabled).  
**ATS63**=n : When n > 0, enables/disables +++ (n=1), DTR (n=2), or OTH/PDP (n=3) hangup while in stream mode  
**ATSn?** : Where n >=0 will show the current value of status register n

+++ : With a 1 second pause with no other characters afterwards, this will disconnect the current opened connection.

**ATT**"[MESSAGE]" : Transmit the given text string, with \r\n at the end, on the current connection.

**ATTn** : Where n > 0, this starts a transmit of exactly n bytes to the current connection. The \n from entering this command must be followed by the n bytes to transmit.

**ATTP**"[MESSAGE]" : Transmit the given text string, translating petSCII to ASCII, with \r\n at the end, on the current connection.

**ATTPn** : Where n > 0, this starts a transmit of exactly n bytes to the current connection, translating petSCII to ASCII. The \n from entering this command must be followed by the n bytes to transmit.

**ATT+**"[MESSAGE]" : A + argument may be used to force the 'T' command to return the CRC8 of the message instead of OK, when successful.

**ATL0** : Re-sends the most recently sent data packet again  
**ATLn** : Re-sends the most recently sent data packet for connection id n. Prefix n with 0 for earlier packet.

**AT&H** : Shows a help file from the web, or brief help otherwise. Use &H6502 to reinforce web download.

**AT&L** : Reloads the saved configuration.

**AT&W** : Saves the current configuration: WiFi settings(**ATW**), baud rate (**ATB**), end of line (**ATR**) settings, flow control (**ATF**), echo mode (**ATE**), extended responses (**ATX**), verbose responses (**ATV**), quiet responses (**ATQ**), PETSII mode (**AT&P1**), pin statuses (**ATS46 - S58**), Rings (**ATS0**), Listener Stream-mode (**ATS41**), and Listener restore (**ATS60**), printer spec (**AT+PRINT**), the busy message, telnet (**S62**), hangup mode (**S63**), and operating mode (**AT+16xx**).

**AT&F** : Restores the modem to factory default settings. Use &F86 to reformat the SPIFFS.

**AT&On** : n is 1 to turn on internal serial-reception log, n is 0 to turn off or view a previously turned-on log, n is 88 to turn on ESP32 debug port.

**AT&U** : Checks the firmware home page to see if a new version is available.

**AT&U2600** : Will update the firmware from the home page on the web.

**AT&U=x**: Will update the firmware from the web to custom version x.

**AT&Kn** : Flow Control, similar to **ATF<sub>n</sub>**, n=0,1,2: disable, n=3,6: rts/cts, n=4,5: Xon/Xoff

**AT&Pn** : Where n > 0, all command mode input and output will be translated to/from PETSII before internal processing. This will not affect received packet data, or the stream mode.

**AT&Nx** : Shows the status of ESP module I/O pin x

**AT&Mn** : Adds the byte denoted by n to a list of mask-out bytes. These are bytes that are not transmitted to the serial port in command mode incoming packets. If this command is followed by a C, N, or A command on the SAME LINE, then the setting will apply ONLY to that connection or listener.

**AT&M** : Resets the mask-out bytes list. No bytes will be masked-out. If this command is followed by a C, N, or A command on the SAME LINE, then the setting will apply ONLY to that connection or listener.

**AT&Dn** : Adds the byte denoted by n to a list of delimiter bytes. These are bytes that will compose the last byte in a command-mode incoming packet that is still shorter than the limit set by **ATS40**. This is useful for CR-LF formatted data. If this command is followed by a C, N, or A command on the SAME LINE, then the setting will apply ONLY to that connection or listener.

**AT&D** : Resets the delimiter bytes list. No bytes will be delimited, and packets will contain as many bytes as are received and allowed by **ATS40**. If this command is followed by a C, N, or A command on the SAME LINE, then the setting will apply ONLY to that connection or listener.

**AT&S"40=[HOSTNAME]"** : Change the modem hostname

**AT&S"41=[TERMTYPE]"** : Change the telnet 'termtype' response string

**AT&S"42=[BUSYMSG]"** : Change the stream connection 'busy message'

**AT&T"[TIMEZONE],[TIME FORMAT],[NTP URL]"** : set up the NTP clock. DISABLE to disable. Format is like Java SimpleDateFormat, but with % escapes. Each argument is optional.

**AT&G"[HOSTNAME]:[PORT]/[FILENAME]"** : Streams a file from an HTTP/FTP/GOPHER source on the internet. The header contains channel 0, file length, and an 8-bit sum of all the bytes in the forthcoming file, followed by the bytes of the file, all formatted as a normal packet. An ASCII 3 (CNTRL-C) received during the transfer will abort. The S44 register can be used to create artificial delays in this output. XON/XOFF Flow control also remains in effect with, on a byte-by-byte basis for the auto and manual flow control systems. Requires flash space for caching, or S45=3 to eliminate the SUM header.

**AT&Y** : Resets the state machine string. No state machine will be executed.

**AT&Yn** : Change the current state (for command mode AND current connection) to state n, where n is a decimal number.

**AT&Y"[CODED STATE MACHINE]"** : Adds the coded format string to a state machine. If this command is followed by a C, N, or A command on the SAME LINE, then the setting will apply ONLY to that connection or listener. State Machine Format: MMCCNN ... States are numbered by their order in the list starting with 00. Non-matches automatically go to the next state until a match is made. 'MM' is hex byte to match (or 00 to match all). 'c' is one of these commands :e=eat byte, p=push byte to que, d=send byte, q=send all queued, x=flush queue, r=replace with byte represented by hex CC. 'C' is either '-', one of the command letters above, or a hex byte value if the first command was 'r'. 'NN' is the next state to go to, with 00 being the first state.