Commodore WiFi Modem

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About the C64 MicroView and Wi-Fi Modem

The Commodore Wi-Fi modem is a multipurpose board that allows for experimentation with the Commodore 64 (or other Commodore computer with a compatible User Port like the C128 or VIC20), the MicroView Arduino-compatible device with OLED display, and a serial-based Wi-Fi Module such as the Microchip / Roving Networks RN-XV Module or the XBee® Wi-Fi Module, in a variety of configurations. The Wi-Fi modem ships with an RN171.

All I/O pins on the MicroView are broken out along the top of the board to allow for interfacing to external devices. Refer to the MicroView documentation and **Table 1** for details.

Current-limiting resistors are recommended between all user port lines and the board. A socket is provided for this purpose at U1, these can be either individual 100-330 Ohm resistors, or a resistor network DIP such as the Bourns Inc. 4116R-1-101LF (provided) can be used. The Commodore SX-64 requires 100 Ohm resisters while most other models will work with 330 Ohm.

A separate VIN connector is provided for powering the board for standalone use, this is <u>not</u> required when the board is connected to a computer.

Reset buttons are provided for resetting each of the C64, MicroView, and Wi-Fi Module.

All parts are through-hole for ease of soldering.

Configurations

Default Configuration

The **default configuration** allows the MicroView to arbitrate between the C64 and the RN-XV, acting like a simple virtual modem, assuming a sketch is loaded into the MicroView to perform this function.

1. TX and RX of the C64 User Port connected to pins D6 and D5 of the MicroView (Software Serial RX/TX #1).

2. TX and RX of the Wi-Fi Module connected to pins D1 and D0 of the MicroView (Hardware Serial)

3. No jumpers are installed on the "TX" and "RX" jumpers.

4. Power is supplied to the MicroView and RN-XV from the C64 User Port.

5. All RS-232 signal lines are connected between the C64 and MicroView for enhanced modem emulation, through current-limiting resistors provided in the resistor network DIP at U1.

Firmware

Two firmware options are available:

Menu (WiFiModem-Menu-*.hex):

Simple menu driven which allows you to connect to:

1. Connect to remote hosts
2. Dial from a phone book and configure an auto-connect entry
3. Accept incoming calls
4. Configure WiFi settings

WiFiModem-Hayes-*.hex

Hayes emulation. Should work with most terminal programs. See the Hayes Command section for supported AT commands.

Baud rate selection

Immediately after bootup, 'Baud Detection' will be displayed on the MicroView. Pressing a key on the keyboard within three seconds will detect the baud rate and store it in flash for future bootups. Some keys such as space may cause an incorrect baud rate to be detected. The most reliable key to press is the letter u.

C64 Directly Connected to Wi-Fi Module

This configuration connects the TX and RX from the User Port directly to the Wi-Fi Module's RX and TX pins. Ensure the Wi-Fi Module's serial port is configured to match the baud rate of the C64.   Refer to the Wi-Fi Module's documentation for configuration and command set details.

1. Remove the MicroView from the board.

2. Place jumpers on the jumper pins marked "TX" and "RX".

Standalone

This configuration allows the board to be used standalone, without being connected to a computer.

1. Remove the cartridge from the User Port.

2. Supply +3.3V to +16V to the board on the VIN connector. The connector is a standard 2.1 mm barrel connector, center-pin positive.   This connects to the MicroView's VIN pin which regulates the input voltage. The board requires about 200 mA @ 5V.

Note: Do <u>not</u> connect the external VIN when the board is connected to the User Port!

MicroView as an Interface Device to the C64

This configuration allows the MicroView's GPIO (including analog input, PWM output, digitial I/O and even I²C) to be used to interface to the outside world, with data exchanged to the C64 via serial port. A sketch is required inside the MicroView to perform this function.

1. Remove the Wi-Fi Module from the board.

2. Note that some of the MicroView pins are shared with the User Port pins – see **Table 1**. Therefore it is recommended to remove the resistor network and provide standalone resistors only between TxD and RxD at U1.   This frees up the Analog GPIO A0 to A5.

MicroView Pinout

At the heart of the C64 Wifi Modem is a "Microview", an a Arduino Uno-compatible device with built-in OLED display. The pinout is as follows:

				Arduino Code PIN
				MicroView Physical PIN
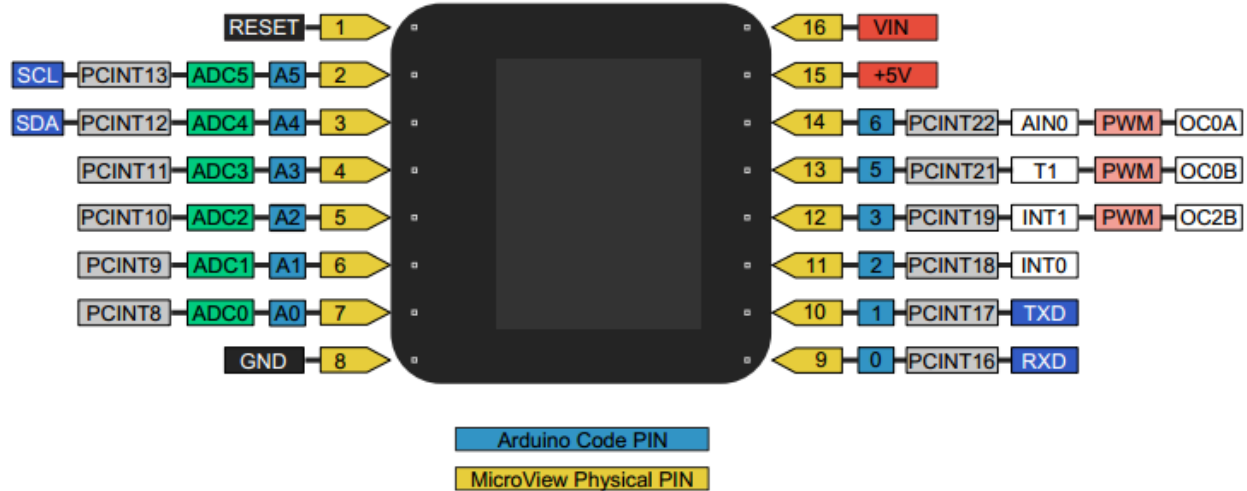
All the MicroView pins are broken out along the top of the cart, to allow interfacing to the outside world.   Note that some pins are connected to the C64 User Port, as per **Table 1** below.

Table 1 – MicroView Pinout

Pin#	MicroView	C64 User Port	Wi-Fi	Notes
1	RESET	-	-	-
2	A5 SCL	Pin D (RTS)	-	For extended RS-232 support
3	A4 SDA	Pin E (DTR)	-	For extended RS-232 support
4	A3	Pin F (RI)	-	For extended RS-232 support
5	A2	Pin H (DCD)	-	For extended RS-232 support
6	A1	Pin K (CTS)	-	For extended RS-232 support
7	A0	Pin L (DSR) Pin 6 (CNT2)*	-	For extended RS-232 support (*Connected to Pin 6 for UP9600 mode when jumper is in place)
8	GND	Pins 1,12,A,N (GND)	Pin 10 (GND)	Ground
9	D0 RxD	-	Pin 2 (TxD)	Hardware Serial RxD.
10	D1 TxD	-	Pin 3 (RxD)	Hardware Serial TxD.
11	D2	-	Pin 12 (RTS)	Serial RTS from Wi-Fi
12	D3	-	Pin 16 (CTS)	Serial CTS to Wi-Fi
13	D5	Pin M (TxD) Pin 5 (SP1)	-	Software Serial RxD (Pin 5 is for UP9600 mode)
14	D6	Pins B,C (RxD) Pin 7 (SP2)	Pins B,C (RxD) Pin 7 (SP2)	Software Serial TxD (Pin 7 is for UP9600 mode)
15	+5V (from C64)	Pin 2 (+5V to MicroView)	Pin 2 (+5V to MicroView)	+5V Power from C64 to MicroView In standalone mode, +5V available here
16	VIN	-	-	External VIN **for standalone use** +3.3V to +16V

Schematic

Software Support

UP9600 Support

The UP9600 driver for 9600 baud support in Novaterm 9.6 is supported. Add the jumper marked UP9600 Enable to enable it. Note that this prevents Pin L (DSR) from being used.

The UP9600 driver is also supported in Striketerm 2014 (based on Novaterm 9.6), but a workaround is required: The driver must be selected and the configuration saved with the Wi-Fi Modem unplugged. Plug in the modem (with the C64 power off) and restart Striketerm and it will then work normally.

CommodoreServer Support

www.commodoreserver.com is supported at 2400 baud (Modem and Hayes) and 38400 baud (Hayes only). The recommended way to connect is to configure the WiFi modem to auto-connect to the commodoreserver server. To configure, follow these steps:

2400 baud

1. Make sure the modem is set for 2400 baud. During power-up, the MicroView will display the baud rate. If it is not set to 2400 baud, set the baud rate using a terminal program such as NovaTerm. See the section for Baud Rate Selection.
2. Configure auto-connect to connect to www.commodoreserver.com:1541 at power-up
   a. Menu firmware:
      i. Set one of the phone book entries to www.commodoreserver.com:1541
      ii. Configure auto-connect for the phone book entry.
   b. Hayes firmware:
      i. Set one of the phone book entries to www.commodoreserver.com:1541 using at&pb*x*=www.commodoreserver.com:1541 where x is a phone book entry from 1-9.
      ii. Configure auto-connect using at&pbauto=*x* where x matches the phone book entry above.
3. Reboot the computer and WiFi modem
4. load "v-1541",8,1
5. sys 49152
6. new
7. Wait for the modem to show 'CONNECT'
8. Log in to CommodoreServer
   a. load ">login username,pin",2
9. Get a directory
   a. Load "$",2
10. V-1541 and documentation can be found at http://www.commodoreserver.com/Downloads.asp

38400 baud

38400 baud only works with the Hayes firmware.

1. Configure auto-connect to connect to **CS38** at power-up
   a. Set one of the phone book entries to CS38 using at&pb*x*=cs38 where x is a phone book entry from 1-9.
   b. Configure auto-connect using at&pbauto=*x* where x matches the phone book entry above.
2. Reboot the computer and WiFi modem
3. load "v-1541.38k",8,1
4. sys 49152
5. new
6. Wait for the modem to show 'CONNECT'
7. Log in to CommodoreServer
   a. load ">login username,pin",2
8. Get a directory
   a. Load "$",2
9. V-1541 and documentation can be found at http://www.commodoreserver.com/Downloads.asp

When the modem detects CS38 being dialed, it will automatically switch to 38400 baud and connect to www.commodoreserver.com:1541.

QuantumLink Rebooted / Reloaded

Q-Link Rebooted and Q-Link Reloaded are currently supported at 1200 baud with firmware 0.08 or higher.

1200 baud support requires that the WiFly modem is configured with 'set comm time 20'. If you purchased your modem before December 28th, 2015 you will have to configure this setting. See Appendix A for instructions.

To access Q-Link, follow these steps:

For the Hayes firmware:

1. Using a terminal program, boot the modem up at 1200 baud (press u or <return> when 'Baud Detection' is displayed) and set the following settings:
   a. ate1q0v1&c1&k0s0=0&w
2. Download a fresh Q-Link disk from one of the following sites:
   a. http://www.lyonlabs.org/commodore/qlink/QuantumLink.d64
   b. http://orrtech.us/qlink/files/QuantumLink.d64
3. load "change access",8,1
4. Select 'Change access information'
5. Change the modem type to 'Hayes or Hayes-compatible'
6. Change the modem speed to 1200 baud
7. Change the phone type to Tone
8. Change the access number to one of the following:
   a. QLink Rebooted: +5551212
   b. QLink Reloaded: +5551213
   c. Note: The + is required
9. Select SIGN ON TO Q-LINK
10. Q-Link should now launch and log you in.
11. The next time you want to connect, repeat step 1 and then boot the disk using
    a. load "*",8,1

For the Menu firmware:

1. Using a terminal program, boot the modem up at 1200 baud (press u or <return> when 'Baud Detection' is displayed) and set the following settings using the Configuration menu:
    a. Disable flow control (menu item should say 'Enable flow control')
    b. Disable DCD always on (menu item should say 'Enable DCD always on')
2. Download a fresh Q-Link disk from one of the following sites:
    a. http://www.lyonlabs.org/commodore/qlink/QuantumLink.d64
    b. http://orrtech.us/qlink/files/QuantumLink.d64
3. load "change access",8,1
4. Select 'Change access information'
5. Change the modem type to 'Other command driven modems'
6. Change the modem speed to 1200 baud
7. Change the phone type to Tone
8. Change the access number to one of the following:
    a. QLink Rebooted: +5551212
    b. QLink Reloaded: +5551213
    c. Note: The + is required. The number is not actually used when using the Menu firmware, but a number must be entered.
9. Select SIGN ON TO Q-LINK
10. Press <return> to bring up the modem menu. Note: The Q-Link terminal program requires a <return> after each line which causes an extra <return> to be sent to the modem.
11. Select 1. Telnet to host or BBS
12. If an X is displayed, press the DEL key and enter the phone number and press <return>
    a. QLink Rebooted: 5551212
    b. QLink Reloaded: 5551213
13. Press <return> and the port prompt as it will be automatically changed to the correct port.
14. When it says 'Connected to qlink.lyonlabs.org' or 'Connected to q-link.org', press F1
15. Q-Link should now launch and log you in.
16. The next time you want to connect, repeat step 1, boot the disk using the command below and then repeat steps 9-15.
    a. load "*",8,1

BBSs

Overview

To allow incoming connections, you must configure the TCP port to listen on. Use a terminal program to configure the remote port using 'at &port=xxxx' where xxxx is the TCP port and then reboot both modules. Example: at&port=2000. If you want users outside of your home network to connect, configure TCP port forwarding on your Internet router.

If the BBS uses ath1 to put the modem off-hook, you should consider using a static IP address. The ath1 command puts the WiFly module to sleep which could result in a new IP address when it wakes up. See Appendix B.

You should turn off remote configuration of the WiFly module otherwise remote users can reconfigure your WiFly by sending $$$ to enter command mode. WiFly firmware 4.75 and higher has removed this feature as it's considered a security risk. See Apendix A.

Unlike some PC based solutions, there is no 'front end' that answers the call so if someone is already connected to the modem or the modem is off-hook (ath1), they will not be able to create the connection.

Use at*m= to define a custom message that is sent to users after connecting. The message will appear after the 'CONNECTING…' message.

The modem will only print one RING, even if auto-answer is disabled (ats1=0).

When a remote user connects, they will see 'CONNECTING TO SYSTEM'. At this point they are connected.

Ivory 3.3

Basic functionality has been tested with v0.9. More testing is required.

- Set modem to 1200 baud using a terminal program
- Configure the listening port. Default is 2000
- Configure modem with ATE0Q0V0&C0X1&K1S0=1S2=43&w
- Configure BBS with '1200 Hayes Compatible'
- Connect using CGTerm and press enter after connecting and the BBS should detect a new connection

Known issues:

- BBS sends +++ to hang up but doesn't send ATH. It may be going back to 300 baud to send the ATH command which is not supported by the modem.
- Does not work at 2400 baud.
- BBS tries to init modem at 300 baud, sending atm0e0v0x1s0=1 but this isn't really an issue.

The BBS should be hacked to issue all commands at 1200/2400 baud.

Hayes Commands

Defaults in **bold**.

Hayes Basic Command Set

Command	Description	Comments
at&port=	Set TCP listening port for answering calls	If set to 0, incoming calls will be disabled. Modifying the port requires a reboot of the WiFly. At 2400 baud, the reboot will be handled by the MicroView but at other baud rates the end-user must reboot both the MicroView and the WiFly module. Port settings is saved immediately. at&w is not required.
at&pb?	List phone book entries	
at&pbclear	Clear all phone book entries and add factory defaults	Also pre-populates phone book entry numbers 8 and 9 with bbs.jammingsignal.com:23 and www.commodoreserver.com:1541 Phone book settings are saved immediately. at&w is not required.
at&pbclear2	Clear all phone book entries	Phone book settings are saved immediately. at&w is not required.
at&pb#=*address*	Modify a phone book entry	Example: at&pb1=bbs.jammingsignal.com:23 Phone book settings are saved immediately. at&w is not required.
at&pbauto=	Set phone book entry for auto-connect at bootup	Set to 0 to disable. Phone book settings are saved immediately. at&w is not required.
ati	Display modem configuration information	Displays MAC address, IP address, SSID, Firmware version, listen port and AT init string.
ata	Answer incoming call	If an inbound connection has been created by the WiFly, RING will be sent to the computer. ata will answer the call.
atd *address* atdt *address* atdp *address*	Connect to a remote host. Format is hostname:port	Defaults to port 23. Examples: atd bbs.jammingsignal.com:23 atdp bbs.jammingsignal.com atdtbbs.jammingsignal.com
atd# atdt# atdp#	Connect to a remote host from the phone book.	Example: atd#1 atdp#4 atdt#9
ate / ate0	Disable echo	
ate1	**Enable echo**	

ath / ath0	Force modem on-hook (hang-up)	+++ during inbound and outbound calls will drop to command mode which will then allow you to use ath / ath0 to drop the call.
ath1	Force modem off-hook (pick-up)	WiFly module is put to sleep and can we waken up by ath, ath0, atz or at&f.
atm0	Does nothing	Does nothing. Added to satisfy init strings for some BBSs.
atm1	Does nothing	Does nothing. Added to satisfy init strings for some BBSs.
atm2	Does nothing	Does nothing. Added to satisfy init strings for some BBSs.
atq0	Display AT command results	
atq1	Suppress AT command results	
atv0	Display numeric result codes	
atv1	**Display textual result codes**	
| atx0 | Return results codes 0-4 | ```
0 - OK
1 - CONNECT
2 - RING
3 - NO CARRIER
4 - ERROR
5 - CONNECT 1200
6 - NO DIALTONE (DNS failure)
7 - BUSY        (Connection failure)
8 - NO ANSWER (not implemented)
10 - CONNECT 2400
11 - CONNECT 4800
.
etc..
``` |
atx1	Return results codes 0-5, 10+	See X0
atx2	Return results codes 0-6, 10+	See X0
atx3	Return results codes 0-5, 7, 10+	See X0
atx4	Return results codes 0-7, 10+	See X0
atz	Load saved settings from EEPROM.	
at&c0	**Force data carrier detect (DCD) on at all times**	
at&c1	Data carrier detect (DCD) follows remote carrier / connection	DCD will turn on when an outbound or inbound connection is made
at&f	Load modem factory defaults	
at&k0	**Disable RTS/CTS (RTR/CTS) flow control**	
at&k1	Enable RTS/CTS (RTR/CTS) flow control	
at&w	Save settings to flash	
at&r	Enter RAW terminal mode which allows you to communicate directly with the WiFly module	
at*k= (at&key= in v0.08 or older)	Set WiFi key, if required	

at*m=	Set message to display after a remote user connects (incoming connection). A ^ in the message sends a new line (\r\n). Max 75 characters. Message can be cleared by not specifying a message (at*m=).	Example: at*m=^Welcome to my BBS.^^Press <enter> a few times to connect.^
at*p= (at&pass= in v0.08 or older)	Set WiFi passphrase, if required	Example: at*p=Commodore64
at*s= (at&ssid= in v0.08 or older)	Set WiFi SSID	Configures SSID and attemps to connect. Configure pass or key before ssid.

Hayes S Registers

Command	Description	Comments
ats0=0	**Disable auto-answer**	
ats0=1	Enable auto-answer	
ats2=*num*	Set +++ escape code. Decimal number from 1 to 254	Defaults to 043 (+)
ats99=0	**Invalid AT commands produce an ERROR result.**	
asts99=1	Invalid AT commands produce an OK result.	Should only be used when running a program that uses AT commands that are not supported by the modem and does not allow for the AT initialization string to be changed. Can be used to fool the BBS into believing the command was successful.

Appendix A: Setup after Factory Reset

Overview

After a factory reset, the settings below are recommended for normal. Note: The default baud rate of the WiFly module after a factory reset is 9600.

The manual for the WiFly module (Microchip RN171) can be downloaded from: http://www.microchip.com/wwwproducts/Devices.aspx?product=RN171

Procedure

1. Switch to VT102 mode in your terminal. If using the menu firmware, press delete at the menu to switch the modem to ASCII mode.
2. Enable echo in your terminal. Novaterm is C=E.
3. Menu mode: Choose option 4 - Configuration and then choose option 5 - Direct Terminal Mode (Debug)
4. Hayes mode: Type at&r to enter Direct Terminal Mode (Debug)
5. You will see '*** Terminal Mode (Debug) ***'
6. Type three $ signs ($$$) and you should see: cmd
7. Type a command and press <return>. It should say AOK.
   a. Example: Enter 'set comm time 20' without the quotes and press <return>
8. Type: 'save' without the quotes and press <return>. It should say Storing in Config.
9. Reboot the MicroView and WiFly

If pressing <return> gives no results, try a different ASCII terminal mode. VT102 Novaterm works but ANSI does not.

Settings

set wlan join 1	*(Auto- associate with access point)*
set ip dhcp 1	*(Turn on DHCP client)*
set uart baud 2400	*(Default baud rate)*
set uart flow 1	*(Turn on hardware flow control, needed for UP9600 mode)*
set ip tcp-mode 0x10	*(Turn off remote configuration via $$$)*

Plus the SSID and key/passphrase need to be set. This can be done through the Arduino interface, or manually as follows:

set wlan key <key>	(for WEP)
-or-	
set wlan passphrase <phrase>	(for WPA)
set wlan ssid <ssid>	*(Set the SSID)*
set comm time 20	(Default is 5. Setting this to 20 fixes 1200 baud issues)
set ip protocol 2	(Enable TCP client/server mode)
set ip flags 23	(Enable DNS caching, TCP retry, TCP_NODELAY, TCP connection status)

Then **save** and **reboot** to make the changes permanent.

Settings that can be pasted:

set wlan join 1
set ip dhcp 1
set uart baud 2400
set uart flow 1
set ip tcp-mode 0x10
set comm time 20
set ip protocol 2
set ip flags 23
save

Appendix B: DCHP / Static IP address configuration

Overview

The default IP configuration uses DHCP to assign an IP address, subnet mask, default gateway and DNS server. The following explains how to switch between DHCP and static IP addressing.

DHCP IP address

1. Switch to VT102 mode in your terminal. If using the menu firmware, press delete at the menu to switch the modem to ASCII mode.
2. Enable echo in your terminal. Novaterm is C=E.
3. Menu mode: Choose option 4 - Configuration and then choose option 5 - Direct Terminal Mode (Debug)
4. Hayes mode: Type at&r to enter Direct Terminal Mode (Debug)
5. You will see '*** Terminal Mode (Debug) ***'
6. Type three $ signs ($$$) and you should see: cmd
7. Enter the command. Note: the command 'get ip' and 'get dns' will show the current settings.
         set ip dhcp 1
8. Type: 'save' without the quotes and press <return>. It should say Storing in Config.
9. Reboot the MicroView and WiFly

Static IP address

1. Switch to VT102 mode in your terminal. If using the menu firmware, press delete at the menu to switch the modem to ASCII mode.
2. Enable echo in your terminal. Novaterm is C=E.
3. Menu mode: Choose option 4 - Configuration and then choose option 5 - Direct Terminal Mode (Debug)
4. Hayes mode: Type at&r to enter Direct Terminal Mode (Debug)
5. You will see '*** Terminal Mode (Debug) ***'
6. Type three $ signs ($$$) and you should see: cmd
7. Enter the following commands, modifying the values as required. Note: the command 'get ip' and 'get dns' will show the current settings.
         set ip dhcp 0
         set ip address 192.168.1.10
         set ip net 255.255.255.0
         set ip gateway 192.168.1.1
         set dns address 8.8.8.8
8. Type: 'save' without the quotes and press <return>. It should say Storing in Config.
9. Reboot the MicroView and WiFly