

Wireless Howto

Rev 9

The Overdrive System can use radio modems to communicate between the Control Computer ("CC") and the Embedded Computer ("EC"). The modem manufacturer is Cirronet (GA, USA). The model used at both the CC base and the EC remote is "WIT2410".

These are 100mW Spread Spectrum modems, which means they continuously change frequency ("frequency hopping") within the 2.4GHz band, in order to avoid continuous interference.

Power and Cabling

The modems draw 90-100mA peak. Power into the modem should be in the range 4-10V. Cirronet claims that 12V will overheat an internal regulator.

There are solderable pads on the transceiver board "1A" for the following:

Power, labeled "PWR": pin1 (square pad) GND, Pin 2 ("+") +Volts
Serial, labeled "SER": Receive "R", Transmit "T", and GND "G".
Carrier "CAR" : LED cathode pin1 (square), anode pin2 "+" (no resistor required)

Transceiver board "2A" has slightly different labels on its pads. Contact tech support for details.

Antennas

The base uses either a 6dBi "patch antenna" or a 9dBi Yagi antenna. The remotes use a 2dB whip antenna. Cirronet has antenna cables with right-angle connectors to the modem. The connectors and cables are standardized and available commercially from various vendors. The small connector on the modem is called "MMCX", and the one on the whip connector is called "SMA".

Cirronet part numbers :

4" whip antenna : RWA249S

12" cable from modem to whip antenna: CBLRF12S

Right-angle MMCX connector antenna cables are also available, the antenna connector gender is opposite the whip antenna above.

Directional antennas can also be used on the control station modem for improved signal strength in noisy environments.

9Db 60 degree Yagi, Hyperlink Technologies part # : HG2409-Y
Obtain both of these cables to interface with the Yagi antenna above.
Cirronet cables : CBLRF6MT-9 (MMCX to TNC fem), CBLRF60N
Cirronet also has directional antennas of their own, like the
"CORNER249" 65 degree.

If you are mounting the base modem in an enclosure. A typical way is to use a "TNC" bulkhead connector as above.

Smaller diameter (higher loss) cables suitable for interfacing with an amplifier.

Cables from Hyperlink Technologies :
WBC195R TNC Male to N-male (2ft)
WBC195R N-Male to N-male (5ft)

Noise

Unlike Fiber communications, RF is prone to noise. RF noise interferes with the transmission from CC to EC. Interference is caused by RF of the same frequency in the vicinity, or the modem's own RF waves bouncing off of objects and canceling each other. The 2.4 GHZ band in which the modems communicate is also used by wireless ethernet equipment, telephones, etc.

The EC software checks the incoming streaming data, and discards corrupted data, so unwanted movement should never get to actuators under EC control.

If RF interference is such that the modems cannot contact each other after several tries (about 36ms), the carrier light on the remote will go off.

The modems themselves detect data errors, and try to re-send data, but Overdrive streams data at such a high frequency and quantity that it fills much of the available bandwidth . so time for re-transmits is limited. As a result, individual pieces ("packets") of the stream occasionally get dropped. The EC software re-creates missing data, an attempts to recover from partial packets, but may drop data or even disconnect if there are too many problems in a row.

If RF interference is bad, you will see reported EC warnings on the Log page. If warnings are of a fairly high frequency, like every 3 minutes, it is best to relocate the Base antenna to a better location.

Look closely at the time the error was logged. A single EC warning in the log is harmless, and should not affect actuator motion, multiple warnings within the same second will affect movement, causing servos to pause momentarily.

The RF signal passes through materials, but may not go through walls as well as open air, try to obtain direct line of sight between base and remote. Use of a directional antenna, like a 9Db, 60 degree Yagi, is preferred in noisy environments. It should help to put the CC Base antenna closer to the Remote. The base modem can be operated at the end of a run of fiber to achieve this. Use of a 500 Milliwatt amplifier on the base modem will improve the signal to noise ratio, but FCC approval for your product must be obtained if used in the USA.

Overdrive Software Settings

It is necessary to set “Optimize Communications for Radio” on the System page. This will make the software adjust the streaming data so as to use less of the available bandwidth, reducing the chance of broken packets, and leaving more time for error correction. Also, the EC will ack less frequently, and a disconnection timeout will take 5 seconds to show up, instead of the usual 1 second timeout.

Buffering is an optimization which occurs when “Optimize Communications for Radio” is used. The EC software corrects several types of over-air data errors. This process requires that the motion data be delayed four 60Hz frames, so motion will occur 66.6msec later than usual.

Reduced Framerate Interpolation is an optimization which occurs when “Optimize Communications for Radio” is used. The CC switches to a lower framerate (30 instead of 60 Hz, currently) and in-between data is calculated on the fly. Servos still see 60 frames of position data per second, but every second position is mathematically generated.

It is advisable to set “Suppress EC Popups” (on the EC page) when using radio modems. This sends warning messages to the log, and prevents numerous popup messages from cluttering the screen when there are communications warnings. Critical messages (like EC connection or disconnection) will still pop up.

It is also advisable to set “Comm Auto-Reconnect” (on the EC page) when using modems, so if communications are lost, the EC re-establishes communications with the CC without having to be

restarted.

The WIT2410 modems are programmable, and completely interchangeable, but only with the proper settings. A "Base" must be connected to the CC, a "Remote" connected to the EC. On the overdrive computer the modems can be reprogrammed with "minicom", On a PC, the modems can be reprogrammed with COM24.EXE, a utility from cirronet. The details are in the manufacturers "Integration Guide" in this documentation. Most settings are optimized for Overdrive, but you may want to change a modem to act as a base versus a remote, or change its frequency range for different countries.

Interface

The modems require an interface circuit in order to be plugged into a computer/EC. This circuit converts the modem's 3.3Volt logic to RS-232 levels. This PCB can be purchased from Concept Overdrive, normally it comes with a modem.

The red LED indicates power. The green LED on the Remote modem indicates that there is a good carrier between the base and remote (The base modem green LED is always on). An external carrier LED can be connected to the "CAR" pads of the board. Use wires long enough to locate the LED somewhere visible. A current-limiting resistor is already on the PCB for the carrier LED, an external resistor is not necessary.

Programming Cirronet Radio Modems

The Cirronet modems can be reprogrammed to work in a different frequency band, etc.

If you need to do this, follow these steps :

1. save your profile and show, as motion control "mocon" must be shut off to use the serial port to program the modem.
2. Click the Contol Panel buttons: Serial -> Program Radio Modems.
3. This gets you into a modem communications terminal. Once in minicom,
type: Alt-W
to turn "line-Wrap" on
type: Alt-A
to turn "Add line-feed" on

Alternately, you can use Ctl-Alt-F1 to get to a text terminal, log in as ctlsys, type: minicom , and follow the steps above. When you're done with text mode, Ctl-Alt-F7 to gets you back to graphics mode.

4. For systems with the high speed communications option (PCI card), plug the modem into the fourth serial port "S3". For systems with normal speed communications, plug the modem into the EC serial port "S1".

Power on the modem.

5. Press the F3 key to send the command string , or type :

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:wit2400
```

You will see a ">" prompt if command mode started correctly. This means you are now talking to the modem.

You can optionally enter :

```
m!
```

and the modem will print out most of its current parameters.

The full set of modem commands is in the Cirronet "integration guide" in this documentation.

Note that the command above only works if it is the first thing sent to the modem after power-up. If you fail to send this first, you must cycle the power to the modem to try it again.

6. Programming Example:

If you are changing the frequency range to the Japan band, type:

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pe3 [enter]
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m> [enter]
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pe? [enter]
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The first command sets to frequency range 3, the second stores the setting in memory, the third queries the modem about the current range, it should respond with "03".

Frequency range codes : 0 = US/Europe, 1 = France, 2 = Spain, 3 = Japan, 4 = Canada. See Cirronet data sheet.

Turn the radio off. The next time you power it up, it will continue to operate in the new frequency range or other settings you have changed. Repeat this process with the other modem.

The modems come preconfigured for use with Overdrive. If a modem is purchased directly from the manufacturer and needs configuration, the standard Overdrive settings are as follows.

Cirronet WIT2410 modem:

Overdrive versions 1.0 - 1.3 :

sd01 , sp00 , wp01 , wu01, ph40 , pw1A , pk05 , pr02 , px00 , zb00

Overdrive versions 1.4 and above :

sd00 , sp00 , wpo1 , wu01 , ph3A , pw15 , pk05 , pr07 , px00 , zb00

A base unit will have: wb01

A remote unit will have: wb00

Note that if you enter an "sd" command, the bps rate will change immediately, so you must change the minicom bps rate too, in order to store your settings with m>

To get to the bps rate settings :

Alt-O -> Serial port setup -> E

Press <Esc> to get out of these config pages.

In systems with high speed serial, the serial card itself is normally set up to double any requested bps rate. Thus, you can communicate with a 115K modem by setting minicom to 57K. Likewise, you can communicate with a 230K modem by setting minicom to 115K.