



RFD Modem Support FAQs

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1 Basic use/operation

Is it safe to power up the modem without antennas attached?

Yes, the modems are protected against damage during operation without antennas though this can significantly increase the heating of the modems and is not recommended for long periods particularly at high output power settings.

How many antennas do I need to use?

One is the minimum. Two allows for use of diversity and is recommended. Note that the antennas do not have to be the same if using two antennas on the modem.

What antennas can I use?

RF Design sell a variety of antennas on our store that are compatible with the various modem products. If you wish to use a different antenna it should meet the following requirements:

1. It should be designed for the frequency range that you are using.
2. It should be able to handle at least 1W of RF power
3. It should be designed for a 50 Ohm impedance

How do I connect the FTDI cable to the modem?

The black cable of the FTDI (pin 1) should connect to pin 1 on the modem as shown in Figure 1-1.

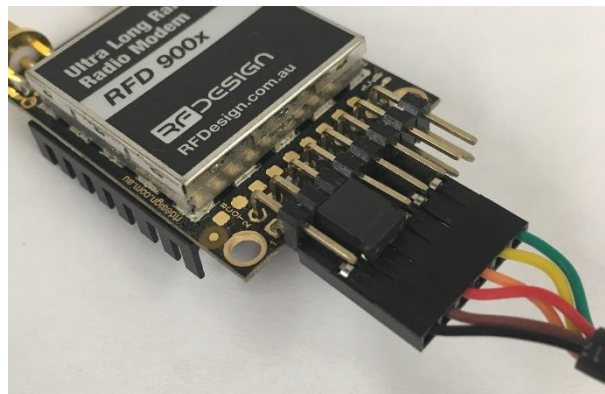


Figure 1- 1: An FTDI cable connected to the RFD900x modem

If using the RFD900u or RFD900ux you will need to align the red wire of the 8-way adapter cables with the red wire of the FTDI (pin 3) and the black cable of the FTDI (pin 1) should connect to pin 1 on 8-way cable as shown in Figure 1-2. They can then be connected using the male-to-male pin bridge that was supplied with the 8-way cable.

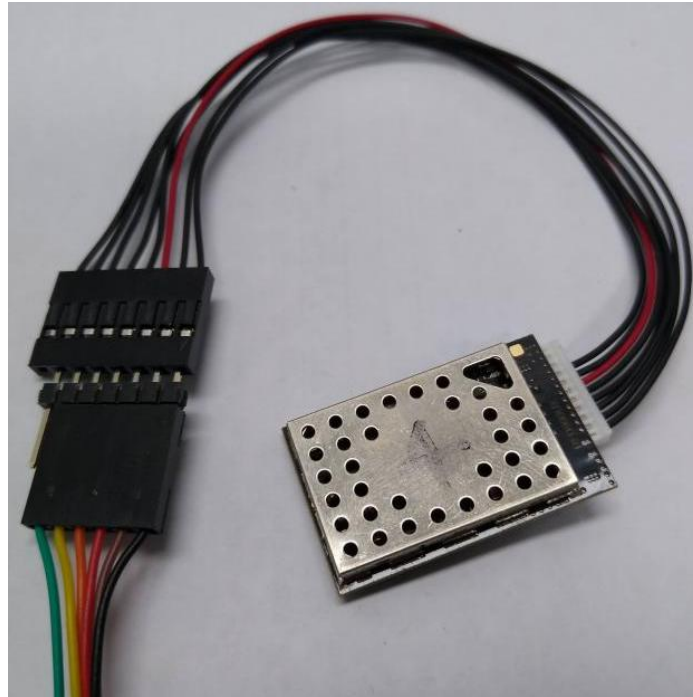


Figure 1- 2: An FTDI cable connected to the RFD900ux modem via 8-way adapter cable

What do I need to upload the firmware or to change the modem configuration?

The best system for changing modem settings or firmware is the RFD900x Modem Tools (see “Useful Links”). After downloading and installing the tools connect the FTDI cable to the modem and to a computer. Open the RFD900x Modem Tools to upload the desired firmware or to change the modem configuration. For full instructions on the modem tools see the RFD900x Modem Tools User Manual in “Useful Links”.

I get no COM ports, or do not know which to use, in Mission Planner/Modem Tools/Serial Terminal?

Make sure the FTDI cable is plugged in to a USB port then open the Device Manager. Check for a Ports (COM & LPT) tab, then expand the tab to look at the list of devices. To identify the COM port of your cable you can disconnect the cable and see which listing disappears or appears when you reconnect the cable. If there are no COM ports listed or are unknown devices listed in the Device Manager you most likely need to install the FTDI chip driver that is available from the FTDI website, see “Useful Links”.

My servos jitter when I turn on my RFD modem?

The RF signal from the modems can interfere with servo operation. To minimise this:

1. Separate the modems, their antennas, and any RF extension coaxial cables, from the servo wires as much as possible.

2. Where RF extension cables and the servo wires must cross do so at right angles wherever possible and minimise the distances of parallel servo cable and RF coaxial cable.
3. Reduce the RF power of the modem, if this does not compromise connection quality at your maximum operating range.
4. Shield the servo wires in conductive tape that is also connected to power ground.

I changed to Multipoint/Asynchronous firmware and the modems don't connect anymore?

The default settings and operations of the alternative firmware are not the same as the SiK, so it is recommended that you consult the relevant firmware manual for detailed operation. Some simple troubleshooting is outlined below.

Multipoint:

1. The default setting for a modem is to have a NODEID set to 1. A network must have a only one master node which NODEID set to 1. Further you must set the network configuration in the master node using the AT&M commands - see the multipoint firmware manual.

Asynchronous:

1. The default setting is for the NODEID set to 1 and the DESTID set to 2. Swap these on one modem to get a two-modem asynchronous link.
2. The LED function is different for this firmware and the LEDs do not light up except when transmitting or receiving data.
3. The default baud rate of the Asynchronous firmware is 115200

2 Performance tips

How can I improve the performance of my R/C signal pass through?

Due to the nature of the RFD modem communications, there may be a noticeable jumpy nature to servo movement and a perceivable latency in the R/C signal.

Depending on the telemetry data requirements you can help to reduce these issues somewhat by reducing the MAX_WINDOW parameter from the default of 131 to as low as 40 depending on the air rate. This can reduce the data throughput somewhat so the user may have to experiment to find the settings that best fit their use case.

How can I get more range?

Providing a dedicated 5V and at least 1A power supply: The modem operating at full power can sometimes exceed the supply capabilities of some flight controllers or the FTDI cable, particularly if connected to a USB extension lead, unpowered hub or a low spec device with power delivery limitations. This can cause issues ranging from limiting amplifier performance to intermittent resets of the modem causing loss of link.

Line of Sight (LOS): The RFD modems are LOS devices with limited ability to get around obstacles, primarily due to the wavelength of operation. To this end operating with minimal obstructions, such as buildings, terrain, trees, etc. obscuring the LOS will improve the quality of the link.

Elevation: The modems are line of sight devices and the elevation of the antennas at both ends affects the radio horizon distance and therefore the line-of-sight range. It can also help mitigate the problems of obstructions in the line of sight and reduce the effects of multipathing. Generally speaking the more antenna elevation the better the performance.

Antenna placement: The placement of the antennas can have a large impact on performance. Antennas placed near to or against metal or carbon fibre can experience distortions to resonant frequency, gain, radiation pattern etc. which can impact performance. Further operating close to metal or carbon fibre can block signal from some directions causing connection issues.

Antenna polarity: The polarity of the antennas can have a large impact on performance. Most antennas have linear polarisation, which should be the same at both ends of the link. If the modem tilt cannot be guaranteed diversity is recommended, with the antennas at 90 degrees to each other, so that the modem can automatically select the antenna which has the best polarisation.

Coaxial Cable: Coaxial cable and adaptors can be a cause of significant losses between antenna and receiver. These losses can be minimised by using cable with an appropriate design frequency, using lower loss variants of cables such as LMR195, avoiding damaged and pinched cables, minimising the number of connector adaptors used as each adaptor will have losses and minimising the overall length of coaxial cable used.

RF Noise: The RFD modems have band filtering to reduce the noise at the radio receiver, despite this noise from other RF devices on the same band, or from electronics such as switching regulators or electronic speed controllers, can reduce the ability of the modem to receive a signal. Therefore, where possible reducing the noise in the area, can improve range. This can be achieved in many ways such as shielding noise sources, considering antenna placement, turning off interfering devices, using directional antennas etc.

Can I operate 2 pairs of modems in proximity?

It is possible to operate 2 pairs of modems in proximity, but there are trade-offs in transmit power, data loss and effective distance between antennas. The effective distance between antennas can be increased by using linearly polarised antennas at 90 degrees.

Firstly, the NetID of the two pairs should be different so that the modem pairs only receive the correct data.

Secondly, try to use non-overlapping frequency bands / RF channels.

The data loss will depend on the modem RSSI (Received Signal Strength Indicator). Typical numbers are:

Configuration	Accepted Loss	Required RSSI
Overlapping channels	<10% data loss	<-30dBm RSSI
Non-overlapping channels	<10% data loss	<-10dBm RSSI
Non-overlapping channels	<1% data loss	<-25dBm RSSI

Typically, two 3dBi antennas 1m apart will have ~26dB attenuation. If one antenna is rotated by 90 degrees, the attenuation will increase to ~36dB.

Antennas with different gain will have a proportional change in attenuation e.g. two 2 dBi antennas would have ~28dB of attenuation while two 6dBi antennas would have ~20dB attenuation and one 6dBi and one 3dBi antenna would have ~23dB of attenuation.

Reducing Tx power by 6dB will halve the distance required between antennas for the same overall attenuation.

Example:

To get <10% data loss with non-overlapping channels (-10dBm RSSI) with antennas 1m apart and the same polarisation, we can set the Tx power to a maximum:

$$-10\text{dBm} + 26\text{dB} = +16\text{dBm}$$

- If we can rotate an antenna by 90 degrees, we can set the Tx power to +26dBm. (-10dBm + 36dB = +26dBm).
- Or if we increase the separation to 2m, we can set the Tx power to +22dBm. (-10dBm + 26dB + 6dB = +26dBm).
- However, if we want <1% data loss (-25dBm RSSI), we should can only set the Tx power to +1dBm. (-25dBm + 26dB = +1dBm)

So, the user should carefully check the intended antenna set-up, the Tx power required to achieve the desired range, and the data loss permissible to use pairs of modems in proximity.

Note that the preceding guide only applies to omnidirectional type antennas. Directional antennas separation requirements will depend radiation patterns and other factors.

3 SiK Troubleshooting

My modems will not connect:

Checklist

1. Confirm that both modems flash a green LED when powered up. This indicates the modem is operating and searching for a link. If the LED is solid green on both modems, then they have connected, and issue may be with connection quality. (See below “My modems drop connection”) If either, or both LEDs are solid red then the modems are in bootloader mode. (See below “My modem has a solid red LED”)
2. Verify that both modems are compatible types. The +, u series and original RFD900 (aka a) series modems will interoperate and can even be connected to the 3dr radios. The x and ux series cannot interoperate with older series due to the new microcontroller causing timing differences. The RFD900x and RFD900ux may interoperate.
3. Check that the same version of firmware is on both modems. This is particularly important with the x series as changes to timings and settings during development can cause issues between firmware versions. The latest version on the RFD website is recommended.
4. Do a factory reset on both modems. Often there is a change to one parameter on a single modem causing issues with the link.

My modems drop connection/take a long time to connect/parameter loading in Mission Planner is slow.

Checklist

1. Follow 1 to 3 of “Modems will not connect”
2. Setup modems approximately 5 metres apart with one vertical antenna on each (preferably dipole antennas) with at least one modem connected to the PC. Wait for modems to connect and run an RSSI test, using AT command ‘AT&T=RSSI’, through a terminal or, by review the RSSI values from the mission planner logs if available. The local and remote (L/R) values should be within 5 points of each other, and both should exceed 200, with the modems set to 20dBm or more output power. If one value is significantly lower than the other (>20 difference in RSSI) then there is likely a fault in the modem receiver filter and the faulty modem will need to be swapped out for a replacement unit.
3. If using the a, + or u series modem ensure that ECC and encryption are disabled. It is known that these features can cause issues with modem operation.
4. Enable RTS/CTS flow control on the modem and force it on at the flight controller. This is particularly helpful for slow parameter loading.
5. If using MAVLink from a PixHawk then ensure that MAVLink is enabled on the modems. Also check that the correct serial speed setting is used on the PixHawk.

Mav2 protocol is only supported on the x series modems and only on version 2.65 or later firmware.

The range of my modems is poor.

Checklist

1. Follow 1 to 3 of “My modems drop connection”
2. Confirm that the modems are being operated as line of sight as this is how the modems are designed to be used.
3. Check the noise figure (noise R/L) from the RSSI test/logs to see if this is high (generally greater than 85). If so, this indicates that there is significant noise on the modem band, that could be interfering with your operation.
4. Increase the modem power to extend the range. (It is the user’s responsibility to know the allowable power settings and frequencies in their area of operations.)
5. It is recommended that at least dipole antennas or RFDflex1s are used, particularly for longer ranges. Monopoles will often perform sub-optimally as correct setup of antenna and ground plane for maximum performance can be time consuming or impractical due to mechanical restrictions.
6. Try to elevate the ground control antenna. This will increase the radio horizon, improve the line-of-sight and lessen the ground interference. At least 2 meters is recommended.
7. Check the specification of the RF extension cable in use as this can have significant loss per metre reducing signal power.
8. If using a long USB cable or USB extension the power drop on the cable may cause the modem to brownout or reset during use at high power. It is recommended to use a separate power supply of 5V and at least 1A of current. (Please note the voltage regulation is critical to avoid damage to the modems as even 5.3V for extended periods have been seen to damage the input regulator on the modem.)

My modem has a solid red LED

Checklist

This indicates that the modem is stuck in bootloader mode.

1. Try to reflash firmware using the RFD modem tools.
2. If the tools cannot establish boot-mode, try to manually force bootloader. This is done by holding a short, on pad one and two on the +, a and u modems, or pad nine and shield for x series modems, as you apply power to the device. The pads are located between the pin header and shield of the modem and are numbered starting from pad one, the left most pad. After the power up, the short can be removed.
3. If, after several attempts at manually forcing bootloader, the issue remains it will be necessary to contact your seller to arrange a modem swap.

4 Useful links

RDF900x/RFD868x modem Firmware

The firmware is the same for both the 868x/900x modems and can be found at.

<http://files.rfdesign.com.au/firmware/>

RFD TOOLS

<http://files.rfdesign.com.au/tools/>

Documentation (including FAQ)

<http://files.rfdesign.com.au/docs/>

Store

<http://store.rfdesign.com.au>

FTDI Cable documentation

http://www.ftdichip.com/Support/Documents/DataSheets/Cables/DS_TTL-232R_CABLES.pdf

5 Document revision history

Version	Date	Changes
1	4/7/18	Release document
1.1	1/4/21	Updated to include more information and reformatting
1.2	24/12/21	Updated to include more information and reformatting