POWER UP AND HANDLING – ORDER OF OPERATIONS FOR ALL RFS SYSTEMS

Not following these instructions can be determined by RFS personnel and improper handling will void warranty. Follow these simple steps to ensure proper operation and years of service from your system(s).

- ESD and Transient Protection
    - The GPS1/GPS2 bare circuit boards are electrostatic discharge (ESD) sensitive devices and ESD precautions must be observed when handling the boards. Installations must be protected from electrical transients on the power supply and RF I/O lines. This is especially important in outdoor installations, and/or where connections are made to sensors with long leads. Inadequate transient protection can result in damage to the modules or RF circuitry and/or create a fire and safety hazard.
- NEVER POWER UP EITHER GPS-1/GPS-2 or BASESTATION-1 WITHOUT AN ANTENNA ATTACHED
    - Once powered, an antenna acts like any electrical conductor and radiates an EM field.
    - The RF circuitry configured for high-power will damage the modem when operating with 30dbM of output power and no antenna is attached.
    - An RF eye diagram test will show this problem and the warranty will be void (although the modems can be replaced).
- NEVER USED CUT, KINKED OR SUSPECT CABLES
    - Coaxial RF cables which have holes in the outer insulation, severe bends or kinks, nicks, pinches or cuts should be replaced as they will cause performance problems. Kinks can change the impedance and usually also indicate strain on the crimp connector. Treat your coax with care.
- ALWAYS MAKE SURE GPS-1/GPS-2 ARE SECURELY MOUNTED
    - Use ¾” Aluminum stand-offs with felt pads so as not to short any of the mounting hardware or the PCB. None of the RF components (sockets/plugs) should touch it.
    - Use no material which would short the antenna or RF components
    - Verify your workbench and work-area has not metal components touching the system boards.
- MOUNT THE GPS ANTENNA TOWARDS THE SKY
    - Optimal performance will also achieved with the antenna securely mounted
    - Generally below the RF Antenna by an inch or two works fine
- MOUNT THE GPS ANTENNA AT LEAST 12” FROM THE RF ANTENNA
    - The further away they are from each other, the better.
- GPS1/GPS2 POWER UP TEST
    - On power-up, the SD-Card should be inserted and with the GPS jumper enabled, the Red SDIO LED will blink and the green system LED will blink. Only after 4 satellite GPS lock will the Blue LED come on.
- ALWAYS CHECK YOUR SD-MEDIA CARD
    - Power up the system and confirm that the RED SDIO led is blinking and the SD Media is valid.
    - If the board gets VERY hot, remove the SD-Card – your SD-Card is damaged and should be replaced.
- USE THE RIGHT ENCLOSURE
    - Make sure all enclosures are made of fiberglass, plastic, or other materials with low RF attenuation to avoid compromising antenna performance where antennas are internal to the enclosure. Carbon fiber or Metal enclosures are not suitable for use with internal antennas as they will block antenna radiation and reception.

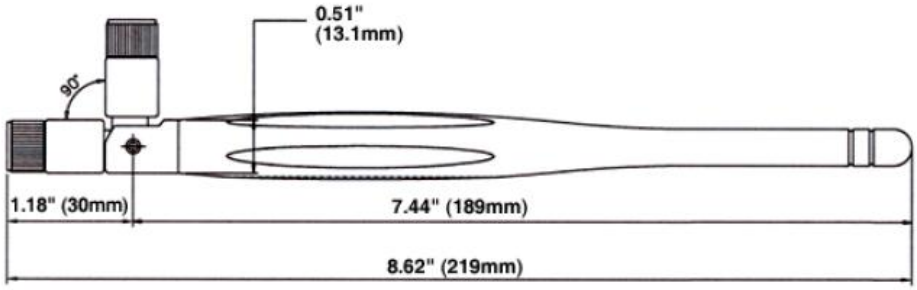
    - Outdoor enclosures must be water tight, such as a NEMA 4X enclosure.
- STORE EXCESS COAXIAL CABLE CORRECTLY
    - Excess coax between your radio and antenna mount should never be wound into a circular coil of less than 12" in diameter. Doing so can cause system problems. Your best option for handling excess coax is to serpentine the cable into a 12 to 18 inch yarn-like skein. Secure the skein in the center with a wire tie and tuck it away.
- MAKE SURE ALL RF CONNECTIONS ARE SECURE
    - Double check uFL connection to Modem if that is used, the top should be firmly seated.
    - Make sure SMA/RPSMA connections are screwed on tight using needle nose pliers
- MOUNT ANTENNA BASE TO VEHICLE
    - This is the Coax plug itself. It needs to be physical screwed down to the vehicle with the nut which came with it. Remember, all transmitting antennas need ground plane (counterpoise). The Antenna is not load bearing and should not be used to secure the cable end – use the nut on the end of the RF cable to secure the Jack. Screw the antenna into the jack fully.

VEHİCLE ANTENNA

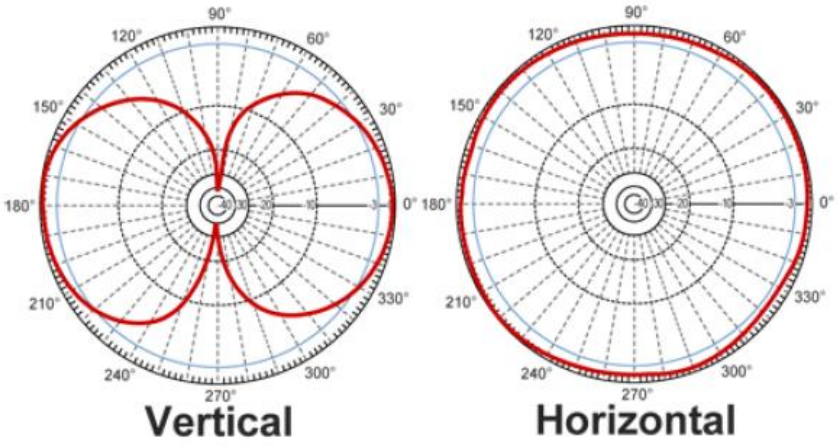
0dBi Omnidirectional

BASESTATİON WHİP ANTENNA

Frequency	860-960 MHz
Gain	3 dBi
Horizontal Beam Width	360°
Impedance	50 Ohm
Max. Power	50W
VSWR	< 2.0
Lightning Protection	DC Ground

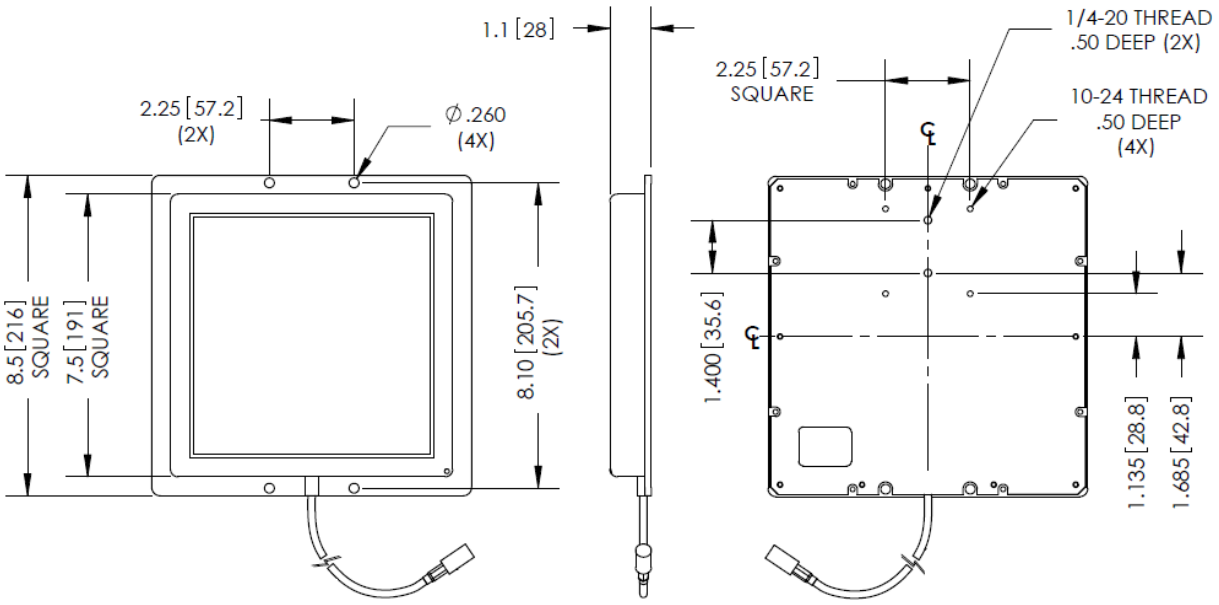


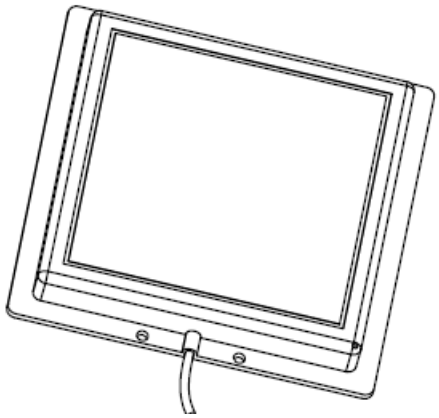
RF Antenna Patterns



Version: 1.01

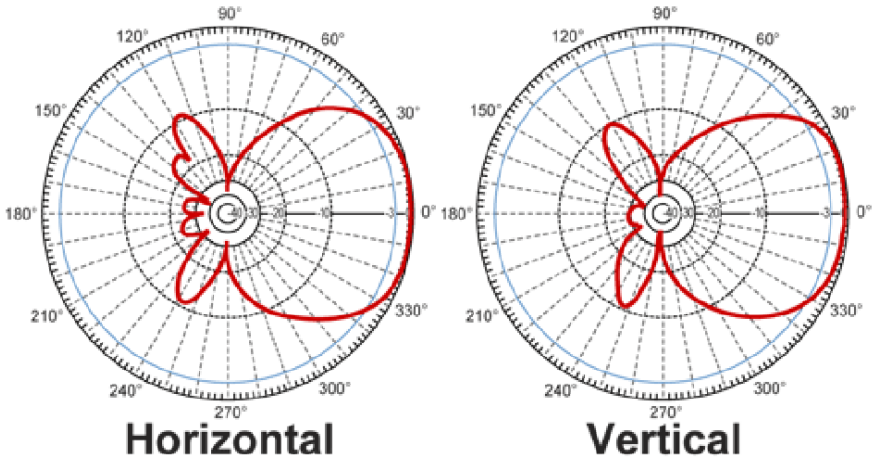
BASESTATION PATCH ANTENNA





Frequency	902-928 MHz
Gain	8 dBi
Horizontal Beam Width	75 degrees
Vertical Beam Width	65 degrees
Impedance	50 Ohm
VSWR	< 1.5:1 avg.

RF Antenna Gain Patterns



FLIGHT DYNAMICS

Note that using a higher gain antenna will provide for more directional reception. Your transmitter puts out a fixed amount of power and the antenna does not change that -- it is only distributing that power so we only get gain by listening to a smaller area.

The antenna on your vehicle should ALWAYS be a low dBi (0-1 dBi) omnidirectional antenna since the vehicle may be moving or tumbling around in all directions (e.g. a booster or nosecone or moving in different directions).

If you plan on flying at lower altitudes then a 3dBi omni-directional (duck/whip) antenna is the best choice. For lower altitude flights or always catching the horizon after apogee, use the whip antenna. The whip antenna may exhibit a null or loss at apogee for higher altitude flights, and then recover later.

With the patch antenna facing the vehicle at a 45-90 degree angle during lift-off boost, or tilting so as to cover the launch area, the entire flight will be made available with the patch antenna (so long as the vehicle does not fly behind the antenna).

On the receiver the patch antenna is the best choice if you want to fly to higher altitudes however, take note of the fact that under extreme cicumstances, unless you manually track the vehicle as it is flying, you may lose horizon coverage.

Polarization on base-station antennas is important since we can have 6-8 dBi polarization fades as the airframe rotates (since it likely has a vertically polarized tumbling antenna). An 8 dBi has a 60 degree FOV - good for sky coverage and will still do well at the launch pad but highly resistant to the tumbling fades of a rotating airframe antenna.

The ultimate configuration is a dual base-station setup with a 3dBi whip antenna on one receiver and the 8dBi patch antenna on the other for horizon coverage. This provides for “whole-sky” coverage. The alternate configuration uses one base-station but a splitter, pre-amp and two antennas for the same functionality. Contact sales for more information and pricing on these systems.

See also: RFM-configuration