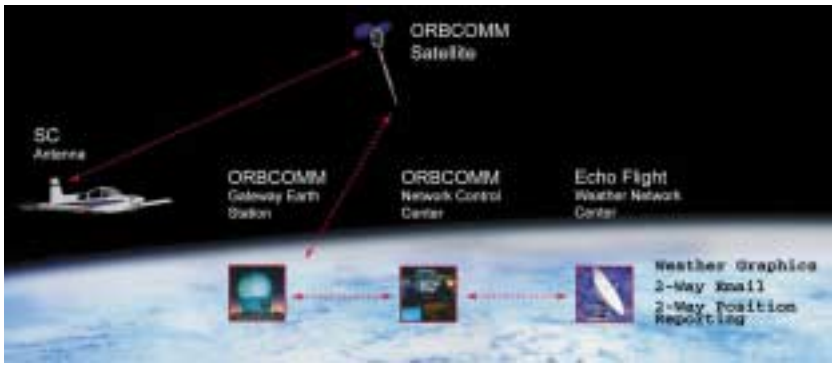
Installation Manual For Q2000 Satellite Transceiver



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ORBCOMM
GLOBAL DATA & MESSAGING

Version 11/10/2003

Please Read ! As with any Satellite transceiver proper installation procedures are important to maximize performance. The ORBCOMM satellite transceiver can be sensitive to excess aircraft RFI noise. For optimal performance please carefully review this manual.

The Q 2000 Transceiver is primarily meant to be used as portable equipment and is not STC'd . Permanently mounting it in the aircraft requires a form 337.

One-Year Limited Warranty

Echo Flight, manufactures its hardware products from parts and components that are new or equivalent to new in accordance with industry-standard practices. Echo Flight warrants that the hardware products it manufactures will be free from defects in materials and workmanship. The warranty term is one year beginning on the date of invoice, as further described below.

Damage due to shipping the products to you is covered under this warranty. Otherwise, this warranty does not cover damage due to external causes, including accident, abuse, misuse, problems with electrical power, servicing not authorized by Echo Flight, usage not in accordance with product instructions, failure to perform required preventive maintenance, and problems caused by use of parts and components not supplied by Echo Flight.

This warranty does not cover any items that are in one or more of the following categories: software; external devices; accessories or parts added to an Echo Flight system after the system is shipped from Echo Flight; or accessories or parts that are not installed at the Echo Flight factory. Keyboards, and mice that are included on Echo Flight's standard price list are covered under this warranty; all other monitors, keyboards, and mice are not covered.

Echo Flight will repair or replace products returned to Echo Flight's facility. To request warranty service, you must call Echo Flight within the warranty period. Refer to your User's Guide to find the appropriate telephone number for obtaining customer assistance. If warranty service is required, Echo Flight will issue a Return Material Authorization Number. You must ship the products back to Echo Flight in their original or equivalent packaging, prepay shipping charges, and insure the shipment or accept the risk of loss or damage during shipment. Echo Flight will ship the repaired or replacement products to you freight prepaid if you use an address in the U.S. (excluding Puerto Rico and U.S. possessions). Shipments to other locations will be made freight collect.

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1. GENERAL INSTALLATION CONSIDERATIONS

These general installation considerations are important to optimize the performance of the Q 2000 satellite transceiver for weather reception and 2 way personal messaging.

1.1 Place antenna on top of aircraft.

The antenna must be placed on top of the aircraft to maximize the sky view. The ORBCOMM satellite constellation operates with 35 satellites circling overhead. Typically at any one time there are 2 and ½ satellites in view, although at times there can be several minutes between satellites. For successful two way communications only one satellite is required.

The two recommended antennas are the Comant CI-248-10 (above serial number 3102581) and CI-177-4. These antennas are specifically tuned to the ORBCOMM frequency and have a center pin ground to effectively reduced P-static. Use of other antennas may not perform as well as the antennas listed above.

1.2 Place antenna towards the aft of the aircraft.

Whenever possible the antenna should be located to the aft of the aircraft to reduce the effects of P-Static from the slip stream. Ideally it should be as far back as possible without being shadowed by the stabilizer which would reduce sky view. It may be necessary to move one of the com antennas to the belly of the aircraft to allow for standard antenna spacing. Please leave at least 3 ft. separation from other antennas to prevent the reradiating though other antennas.

1.3 Avoid placement in areas likely to experience skin current.

It is important to avoid placing the antenna in the ground return path of current between the battery or alternator at the firewall and any high current equipment at the aft of the aircraft such as a battery. The current on the skin can cause interference with the antenna reducing connectivity time with the satellites. Always install the antenna aft of such equipment when ever possible.

1.4 Static wicks.

Make sure static wicks are installed and in good working condition on the tail of the aircraft. Check for poorly bonded aircraft control surfaces or other antennas as well. A Dayton Granger high-voltage test set can be used to verify static wicks are in good operating condition.

1.5 Isolate transceiver chassis from ground.

The Q2000 chassis should be isolated from ground so as to not cause a problem with ground loop noise. Make sure to isolate the transceiver through the use of rubber grommets where it comes into direct contact with the airframe. Measure resistance between the chassis and mounting surface (without antenna and data cables attached) to be sure. Not performing this will result in the satellite transceiver becoming far more susceptible to noise.

1.6 Use double shielded cable.

RG-400U or 142 cable should be used to connect the Comant antenna to the Satellite transceiver. Make sure that the cable is at least 2 feet from other cabling. Using double shielded cable.

- Cable routing should be as direct as possible to minimize length. Any excess length should be cut and not coiled.
- If cabling needs to be routed through a bulkhead fastener make sure that it is not shared with any

other conductor. Always avoid bundling with other potentially noisy cables.

1.7 Avoid installation close to these areas of potential RFI interference.

Please avoid antenna installation close to these areas of potential interference. Non shielded wiring, noisy alternators, strobes, beacons, inverters and other noisy avionics can contribute to reduced connection time.

During installation take care to:

- Choose the location for the antenna, maintaining a at least 3 feet if possible or **six to seven feet** between any other previously installed transmitting antennas. This may require you to move an existing VHF antenna to the bottom of the aircraft. If you are forced to find a “happy medium” locate no closer than ½ wavelength (3.5 ft.) from other transmitting antennas
- Maintain about **3 feet** from heater ignition, autopilot and other control surface actuators and motors.
- Maintain about **5 feet** from fluorescent lamps, air conditioners, blowers, strobe lights and power supplies.
- Maintain at least **2 feet** from any current carrying or antenna cables.
- Antenna and data cables can not be routed parallel or along side power cables or carriers (such as beacons, autopilot servos or communication radios) that operate near the ORBCOMM frequency bands (137-138 MHZ and 148-150MHz).
- Power inverters should be mounted as far from the satellite transceiver as possible.

1.8 Alternator Noise.

Alternator noise can be reduced by the use of Lone Star aviation filters. Resistive field switches should be checked by looking for a few ohms of resistance. Lone Star aviation can be reached at 1-817-548-7768.

1.9 Verify installation with diagnostic software.

Much as with lightning detection systems and the use of the skin mapper to assure proper operation, isolating and reducing the source of noise is also necessary for normal operation of the satellite transceiver. This is performed with the satellite transceiver diagnostic software and discussed in chapter four.

Although the satellite transceiver specs allow for ample signal to noise ratio to receive weather data irregardless of the satellite's position in the sky. In noisy aircraft this will be compromised and will be noticeable when satellites are low on the horizon. Typically what will happen is the customer will receive inconsistent weather delivery results.

The satellite transceiver diagnostic software can be downloaded at:
http://www.echoflight.com/support/downloads/scdiag.asp

1.10 Assure antenna is this properly grounded and sealed from outside elements.

As with any antenna properly grounding and maintaining that ground is essential. Improper grounding of the antenna can be a major cause of reduced ability to link with ORBCOMM constellation. The antenna must be bonded directly to the metal skin of the aircraft (gaskets are not to be used). A good electrical connection needs to exist between all antenna fasteners and the metallic

frame on the skin. Once installed, applying a bead of silicon around the outside of the antenna base will seal it from the outside elements.

Please leave a ground plane of at least **2 Feet** of continuous metal around the antenna free of any access panels or baggage doors

Note: Any poorly bonded antenna as well as aircraft control surfaces will generate static discharge and flight. This can be checked for with Dayton Granger high-voltage test set.

2. HARDWARE

2.1 Antenna

There are two recommended antennas, the **Comant CI-248-10** (above serial number 3102581)

MODEL	CI 248-10 Data Link / WX Antenna
Electrical	
Frequency	137 - 150.5 MHz
VSWR	2.5:1 Maximum
Polarization	Vertical
Radiation Pattern	Omnidirectional
Impedance	50 Ohms
Power	25 Watts
Mechanical	
Weight	0.52 lb. Maximum
Height	17 in. Maximum
Material	Molded Radome
Finish	Polyurethane Enamel
Connector	BNC
Environmental	
Temperature	-55°C to +85°C
Altitude	50,000 ft.
Air Speed	350 Knots TAS @ 25,000 ft.
Federal Specifications	
RTCA Environmental	DO-160D
Environmental Category	[F2X]ACB[S(L)U(F,F1)T(C,C1,R)] XRFDXSXXXXX[XX]X[XXXX]XAX
FAA TSO	C37d, C38d
RTCA MOPS	DO-186A
ORDER OPTIONS	
Connector	
BNC	Standard
Color	
White	Standard

Comant CI-177-4

MODEL	CI 177-4 Data Link / WX Antenna
Electrical	
Frequency	137 - 150 MHz
VSWR	1.5:1 Maximum
Polarization	Vertical
Radiation Pattern	Omnidirectional
Impedance RF	50 Ohms
Power RF	50 Watts
Mechanical	
Weight	0.4 lb. Maximum
Height	16.25 in. Maximum
Material	Valox housing / Fiberglass whip
Finish	Polyurethane Enamel
Connector	BNC
Environmental	
Temperature	-55°C to +85°C
Altitude	50,000 ft.
Air Speed	250 Knots TAS at 25,000 ft.
Federal Specifications	
RTCA Environmental	DO-160D
Environmental Category	[D2]-ACB[(C,C1,R)(F,F1,U)] XRFDXSX[X]XXX[XXX]X[XXXX]XCX
FAA TSO	C37d, C38d
RTCA MOPS	DO-186A
ORDER OPTIONS	
Connector	
BNC	Standard
Color	
White	Standard

2.2 Q 2000 Satellite Transceiver

Specifications
- Operating Temperature: -40°C to +85°C
- Storage Temperature: -50°C to +85°C
- FCC, ETSI, SAE J1455

Communications
- Transmit Frequencies: 148.000 to 150.000 MHz
- Receive Frequencies: 137.000 to 138.000 MHz
- Transmit Power: 5W min.
- Data Rates: 2400 bps Uplink, 4800 bps Downlink

Data Interfaces
- 4 Digital Output Switches
- 8 Digital Inputs
- 2 RS-232 Serial Ports or 1 J1708/CAN, and 1 RS-232 Serial
- 4 Analog Inputs (0-5V)

Physical Specifications
- Size: 8.4” x 4.9” x 0.97” (213mm x 124 mm x 25 mm)
- Weight: Less than 1.0 pound (425 grams)

Power
- Input Voltage: 9-36 VDC

Communications
- Transmit Frequencies: 148.000 to 150.000 MHz
- Receive Frequencies: 137.000 to 138.000 MHz
- Transmit Power: 5W min

3. INSTALLATION

1. Choose the location for the antenna, maintaining at least 3 feet and if possible **six to seven feet** between any other previously installed antenna. This may require you to move an existing VHF antenna to the bottom of the aircraft. If you are forced to find a "happy medium" locate no closer than ½ wavelength (3.5 ft.) from other antennas. Locating the antenna too close to obstructions such as the vertical stabilizer will limit the radiation pattern of the transmission, causing nulls and reducing the effective viewing area for satellite connection.
   Note: As with any antenna installation, location of non-communication antennas too close to the VHF whip antenna may not only degrade the transmission through reflection, but may also absorb and re-radiate the transmission causing a condition similar to having two Communications antennas located in close proximity to each other.
2. Line up the antenna base template and mark the center of the appropriate mounting and BNC plug clearance holes.
3. Drill appropriate mounting and BNC plug clearance holes.
   Note: Before drilling check the front and back of the mounting area for hidden obstructions.
4. Determine the size of bonding area. Outline the area of the fuselage to be bonded, staying 1/16 of an inch within the dimensions of the base of the antenna.
   Note: A good electrical connection must exist between all fasteners and metallic frame on the skin
5. Remove all paint and primer, exposing bare metal on ALL mating surfaces.
6. Install doublers and nutplates if they are necessary for application.
7. The structure of the aircraft must be considered to determine the need for a backing plate. Backing plates should tie into existing structure, or at the very least, spread the stress out far enough that the stress

points are dissipated gradually into the surrounding airframe skin. Aviation grade mounting screws of a proper length for the application must be used. Torque should be evenly applied across all mounting screws to avoid deformation of the mounting point.

8. Place a BNC connector on a length of RG-400U or 142 cable, taking care that the shielding integrity is maintained.

9. Pull the end of the coaxial cable with the attached BNC connector from the inside of the aircraft, out through the BNC clearance hole.

10. Attach the BNC connector to the antenna.
    Note It is important to have good conductivity between the coaxial shield and the ground plane. Any ground plane installed must be well bonded electrically to the metal frame of the aircraft to prevent electrical noise to the receiver.

11. Treat the bare metal with Aluma prep 33 an anti-corrosion solution.
    Note: The key to making the bonding procedure successful is the careful cleaning, Alodine application, immediate fastening, and sealing of the antenna to the mounting surface.

12. Prepare the antenna, being careful to apply the bonding process to the entire base surface.

13. After one to two minutes, rinse by sponging (not wiping) the Alodine.

14. Tighten all screws mounting screws with even pressure, to ensure that the antenna lays flat on the mounting surface.

15. Using an air or manually-pressured sealer gun, apply a 1/8 inch bead of RTV Sealant (or equal) around the outer periphery edge of the base of the antenna and around the cut-out for the BNC connector.

16. The area above each mounting screw should be filled with RTV Sealer after the screw is tightened. On pressurized hulls, the connector coupling nut and backshell should be coated after assembly, as should the feed through hole.

17. Clean off any sealer that has squeezed out, being cautious not to leave any voids or gaps at the base of the antenna. If necessary, add additional sealer.

18. Using your finger dampened with soapy mixture, feather the sealer by pulling it around the base.

19. Place the satellite transceiver in the aft of the aircraft (do not place up by the instrument panel). Run the power cable back to the satellite transceiver making sure the cables are not routed parallel or along side power cables. Verify their is no metallic patch between the communicator case and the mounting point. A rubber/nylon shoulder washer where the screw enters the mounting hole is recommended with another rubber/nylon shoulder washer on the bottom or exiting hole. To isolate it from the case.

20. Carefully route the free end of the coaxial cable to the satellite transceiver. The antenna connections are made with the BNC connector. The cable should be fastened to the aircraft structure to reduce flexing and secured to eliminate failure due to vibration fatigue.
    Note: Do not route cabling near components which may cause electrical noise such as magneto and generator wiring. Leave a small amount of slack in the cable to allow for movement due to load changes and vibration. Do not forget, DC – DC converters.

21. Be certain that the coax connector is properly assembled without a short circuit.

22. Cut the coaxial cable to length and install the BNC connector, taking care that the shielding integrity is maintained. The BNC connector is now ready to connect with the Satellite transceiver.

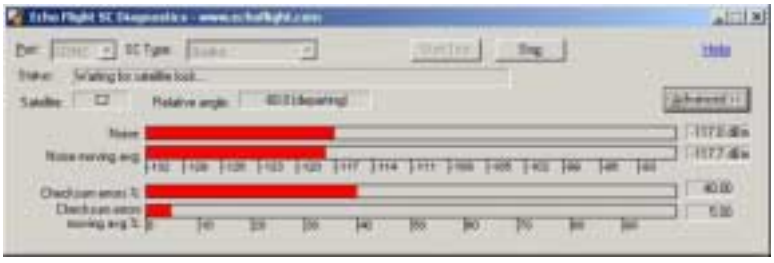
4. TESTING INSTALLATION

4.1 Echo Flight SC Diagnostics Software

The Echo Flight SC Diagnostics software is used to maximize the performance of satellite transceivers used with the ORBCOMM satellite network. As with any satellite-based data link system, performance can be impaired by problems with antenna installation or RF emissions onboard the aircraft. This software is to be used as a tool to assist you in isolating and reducing these types of problems.

It is generally recommended that you install noise reduction filters first if you suspect there may be noise issues with the aircraft before performing any tests. Two filters, manufactured by Lonestar Aviation **(1-817-548-7768)** are recommended. The first filter is called the "Eliminator" (part #122253-10A). It is to be installed inline with the transceiver and power. The second filter (*if additional noise suppression is needed*) is for use on the aircraft alternator and is designated as part # (LS0301004). These filters can also be found online at LonestarAviation.com.

There are two types of transceivers in use with the Echo Flight system. These devices are manufactured either by Panasonic or Quake Global. There are minor differences in the diagnostic utility due to differences in these two units (*see below*).



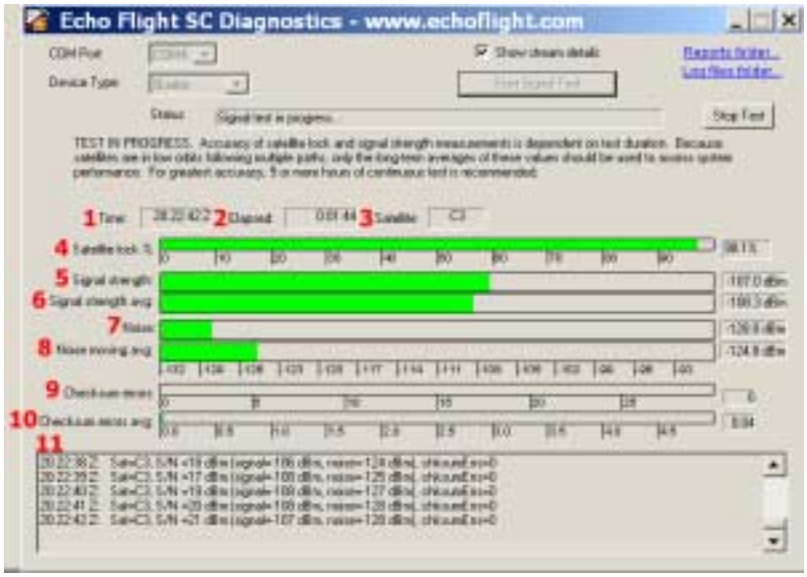
(If your SC is manufactured by Panasonic, instead of the "Start Test" button, you will find two buttons marked "Noise Test" and "Error Test". These tests are executed separately on a Panasonic SC, but they are executed simultaneously with a Quake SC.)

- Port: This is the serial port on the laptop or PC used to connect to the SC.
- SC Type: There are 4 possible device types. Most units currently in use have a Panasonic SC. Garmin owners will have a GDL 49, while owners of Echo Flight Flight Cheetah or other hardware will not.
- Start Test, Noise Test, Errors Test: These buttons are used to start test sequences.
- Stop: Ends a test sequence in progress.
- Status: Shows status of currently executing test.
- Satellite: Shows the 2-character identifier of the satellite currently locked.
- Relative angle: Shows the relative angle of the satellite to the antenna. As each satellite approaches, this value is positive *(starting with a theoretical minimum of 0).* When the satellite is at its minimum distance, this reaches 90 degrees. As the satellite departs, this value will be negative, dropping until the SC is no longer able to lock on --or until the SC chooses a different satellite. Because the satellites often do not pass directly overhead, it is best to perform checksum error tests during a pass in which the relative angle starts with a low (< 40 degrees) positive angle of approach. This ensures that the satellite pass will carry it fairly close to your location.
- Noise: Shows the value of most recent RF noise measurement in dBm. A typical use of this indicator is to note the relative change in noise level as different pieces of avionics equipment are powered on or off.
- Noise moving avg: Shows the moving average of the noise measurement.
- Checksum errs: Shows the most recent percentage of data which was corrupted during transmission to/from the satellite. This value is only available when the SC is locked on to a satellite.
- Checksum errors moving avg: Shows the moving average of the checksum error rate. Ideally, this rate should not exceed a few percentage points for most of a satellite pass. Each corrupted packet must be re-transmitted, and this retransmission process slows down the delivery of data. The more packets are corrupted, the less likely it is that performance of the system will be acceptable.

4.2 Advanced Diagnostic page.

This advanced diagnostic page is only for use when recommended by Echo Flight customer service.

Advanced Diagnostic Measurements



There are a number of parameters that are measured by the diagnostics software. Normally you need only monitor a few of these measurements.

1. **Time in UTC**. General information
2. **Elapsed Time since test was started.** Used to verify test has been performed long enough to be valid.
3. **Specific Satellite identification.** General information.
4. **Percentage of satellite lock.** This generally is not used as the same information is sent out to the Echo Flight server while the aircraft is in flight.

5. **Signal strength.** This measures the level of the signal strength in db of the ORBCOMM satellite connection. It is normal to see this fluctuate up and down to reflect the constantly changing positions of the satellites.
6. *** Signal Strength avg.** This is the average signal strength as measured during the entire test period and is to be used to compute signal to noise ratio.
7. **Noise.** This measures the noise generated in the 136-150 Mhz band which will have a direct effect on reception of the ORBCOMM satellites.
8. *** Noise Moving Average.** This is the average noise generated in this band as measured during the entire test.
9. *** Checksum errors.** This measures actual interference with the ORBCOMM satellite communicator in real time, particularly useful when testing for the effects of other equipment that sends out interference in pulses, such as strobe lights.
10. **Checksum avg.** This measures the cumulative percentage of interfering noise since the test began. 1.5% or less is considered normal
11. **Frame Update.** The frame update provides 1 second updates of time, satellite identification, Signal to noise, satellite strength, noise and checksum errors.

4.3 Test

Caution !

When the engine is running please have another person handle all aircraft control as well as looking out the window while you perform the test with the diagnostic software.

1. Once you have loaded the diagnostics software. Plug the cable from your transceiver into the serial port of your laptop.
2. Bring the aircraft out on the ramp in a location that maximizes sky view.
3. Pull all other circuit breakers in the aircraft aside from your transceiver breaker.
4. Record test results on the attached sheet.

5. **TEST 1**. Using only the aircraft's battery power turn on the transceiver and start the signal test. The test should run about 30 minutes. At the end of that time period you should of averaged between 60-90% Satellite Lock **(4)** and a signal to noise ratio of at least 12 db. Signal to noise ratio is the difference between Noise Moving avg. **(8)** and Signal Strength avg. **(6)** . If you do not have a minimum of 12 db signal to noise ratio at this point contact Echo Flight at 888-739-7161.
6. **TEST 2.** Repeat the test with the aircraft in flight if possible with all equipment on for at least 30 minutes. If these test results indicate either an overall reduction in the signal to noise ratio or an or increase in the Checksum average this will most likely be due to excessive interfering noise.
7. Noise Moving avg. **(8)** (constant noise level) most effectively measures the continuous noise floor generated in the aircraft, Checksum errors **(9)** measures in near real time (few second lag) any pulsing interference. It is important that you check both measurements as constant noise very often will not show up in the Checksum errors measurement and pulsing noise will not show up in the Noise Moving avg.
8. To isolate the cause of noise, pull one circuit breaker at a time and wait about 1 minute when checking the Noise Moving avg. When observing the Checksum errors measurement 10 seconds should suffice. If in doubt a particular system is generating noise it is useful to repeat the test to verify.
9. If the signal to noise ratio is less than 12db and or the Checksum error average is greater than 1.5% and you have not installed both filters yet please do so.
10. If the filters have been installed additional noise reduction may be necessary. Please also review the installation manual to verify all other installation requirements have been complied with. If you seek additional support please do not hesitate to call Echo Flight at 888-739-7161