INSTALLATION & OPERATION MANUAL FOR THE MODEL PRB-1900-xx "PROPAGATOR" INDOOR PCS BAND REPEATERS

Contents:

1.0 Regulatory & Safety Information

1.1 FCC Warning Statement

<u>WARNING:</u> This device complies with CFR 47, Part 24 of the FCC rules. Any modification not expressly approved by the manufacturer could invalidate the user's authority to operate the device.

1.2 Safety Information

<u>CAUTION:</u> In order to comply with FCC rules for Radio Frequency Exposure, the following must be observed:

The PROPAGATOR must be installed such that a minimum separation distance of 1.25" (3 cm.) is maintained between each antenna face (the large white plastic 15" X 15" surfaces on each side of the chassis) and any persons.

2.0 Equipment Description

1.2 Physical Configuration

Figure 1 is an illustration of the PCS-1900-xx "Propagator" Repeater (hereafter referred to as the SSR) indicating important features. As shown in the illustration there is a main electronics housing (chassis) that has a square shape with rounded corners. The chassis is attached to a mounting base that incorporates an azimuth rotation feature with detents. The approximate size of the chassis is 15" X 15" X 4"; the corners have a 3" radius. The mounting bracket has a base that is approximately 9" X 3.75" X 0.75" that positions the chassis approximately 3.25" away from its mounting surface. The unit weighs approximately 8.75 pounds without the power supply. A separate, AC wall outlet mounted, DC power source is provided. This unit is approximately 3.75" X 2" X 1.25" in size and weighs approximately 0.8 lbs. A white plastic radome covers each 15" X 15" face of the chassis; these surfaces are electrically active and must be kept free of contaminating materials. Also, take special note that each face of the SSR has a unique electrical function and must properly oriented in operation (see section 2.0). The radome with the Andrew flash indicates which side should be facing the handset (mobile unit).

1.3 Electronic Description & Block Diagram

The 1900 series PCS repeaters operate in the 1900 MHz PCS band. They were developed to provide more reliable coverage and/or range extension of PCS systems within sheltered structures. Three models cover all US PCS sub-bands (AD, BE, & FC). Pre-aligned antennas on each side of the repeaters make them easy to install and simple to operate. Designed for indoor environments, they only require a standard US 110VAC outlet for operating power. The design employs high linearity amplifiers that work well with all popular signal formats (TDMA, CDMA, GSM, etc.).

Figure 2 is an electronic block diagram of SSR internal and external circuitry. A full band internal antenna on the base station face of the SSR (donor antenna) feeds a highly selective diplexer functions to separate and isolate the uplink (Tx) and downlink (Rx) signal paths. A different internal full band antenna and diplexer on the mobile face of the SSR function in a complementary manner to separate and isolate the uplink (Rx) and downlink (Tx) signal paths. The signal from each diplexer's Rx filter feeds an amplifier with an AGC loop that limits maximum output power to approximately 4 milliwatts. The amplifier RF outputs feed the complementary TX band pass filter in each diplexer which functions to limit spurious amplifier output signals and further isolate the complementary band's signal. Both amplifiers include Received Signal Strength Indicator (RSSI) circuitry and over-current protection circuitry.

1.4 Operational Environment

The SSR has been designed to operate properly in a temperature and humidity controlled indoor environment. Operation in environments where the ambient temperature is outside the 30^{o}-105^{o} F range or the relative humidity is greater than 50% may result in unsatisfactory performance. Exposure to temperatures outside the 10^{o}-120^{o} F range or relative humidity greater than 90% may result in permanent damage to the unit.

2.0 Installation Guide Lines

2.1 Location

Proper operation of the SSR cannot be achieved if the following installation location guide lines are not followed.

The prevention of signal feedback from the transmit antenna on one side of the SSR to the same path's receive antenna on the opposite side of the SSR is paramount to proper operation of the SSR. Any matter in the surrounding environment of the SSR will produce undesirable feedback signals. Any object with any physical dimension that is greater than 2 inches may cause undesirable signal reflections and/or refractions severe enough to cause unstable operation of the SSR. Metal objects normally cause worse reflections and/or refraction than non-metallic objects. The level of undesired reflected and/or refracted signals is directly proportional to the size of the object and inversely proportional to the distance between the SSR and the reflecting/refracting object. Obviously, a perfect "free space" environment for the SSR is the ideal location, but not practical. However, a major goal of the operating location selection process is to find a place that approximates a "free space" environment as closely as possible.

A location that provides a "clear" communication link with a suitable base station when using a typical handset is also required for proper operation of the SSR. Base station signal level at various candidate locations should be measured using the RSSI on a handset or more precise instrumentation. Experience indicates that a location with the highest base station signal level that is free of any object within a hemisphere of 15-20 foot radius centered on one side of the SSR should provide suitable SSR operation.

Figures 3 thru 5 show typical installation locations that have been found to provide a stable operating environment for the SSR.

Figure 3 is the preferred installation location: on or very near an exterior window. Extensive testing has show that when mounted directly on the surface of the window glass of an exterior window well above the floor (8' minimum) the SSR operates in a stable fashion for both gain settings if the area outside the window is free of signal reflecting objects within a 40 foot radius. If mounted near but not on the surface of

the glass the 73 dB system (50 dB active) gain setting is recommended for maximum stability margin.

Figure 4 is the next best installation location: mounted on an interior wall surface of typical gypsum wallboard (drywall) construction about 7 or 8 feet off the floor but not too close to the ceiling. Be careful to position the SSR between metal studs in the wall if present. Extensive stability testing has shown this mounting location to provide stable operation for both gain settings of the SSR.

Figure 5 show a third acceptable installation location: mounted on the ceiling or on extension poles of 1' or 2' lengths. The 73 dB system (50 dB active) gain setting has been show to provide stable operation for all ceiling mount configurations. The 83 dB system (60 dB active) gain setting is only recommended for the 2' extension pole configuration. When using the extension pole configurations the SSR must be keep well above floor level (at least 8').

When mounted to a ceiling it may be desirable to point the Propagator in a different direction. The mounting base has a built-in detent rotation feature that allows the main electronics chassis to be rotated ± 47 degrees about its vertical axis. Simply pull down on the mounted Propagator and rotate to a new detent position.

Table 1 summarizes the stability rating verses mounting location with gain setting as a parameter.

2.2 Mounting Considerations

Mounting should be accomplished with due consideration of the minimization of undesirable feedback signal discussed in section 2.1. The mounting base along with its companion mounting plate provide for a wide variety of structural attachment methods when installing the SSR. The polarization of the base station facing antennas in the SSR strongly favors attachment of the mounting base to a horizontal surface above or below the SSR. Standard fastening techniques can be used to attach the aluminum mounting plate shown in Figure 6 to the desired horizontal surface. Once the mounting plate is securely attached to the mounting surface the SSR is attached to the threaded studs on the mounting plate using the provided nylon thumbnuts (see Figure 7).

2.3 Power Supply Location & Connections

The power supply furnished with the SSR requires a standard US 110 VAC outlet. It connects to the SSR via a permanently attached two-conductor cable. The location of the power supply also requires special attention to the minimization of undesirable feedback signals. The recommended location is as near the plane that bisects the SSR around the finned edge as possible and as far away from the SSR as possible.

3.0 Operation Guide Lines

3.1 Status Indicating Light Emitting Diodes (LEDs)

Four small status indicating LEDs are visible on the Mobile unit facing side of the SSR; they provide the following information (see Figure 1):

Green LED nearest the mounting base.	On state indicates that SSR is receiving power from the power supply and the internal circuitry has not exceeded the maximum safe current demand.
	Off state (concurrent with an off state for the adjacent Red LED) indicates that the SSR is not receiving power from the power supply.
Red LED adjacent to Green Power LED described above.	On state indicates an internal over current event has occurred. Power to the SSR must be interrupted for 10 or more seconds to reset this "circuit breaker" function. Repeated resets (more than 3 times in 30 minutes) may cause permanent damage to SSR.
	Off state (with concurrent on state of power LED) indicates normal SSR operation
Green LED adjacent to red LED described above.	RSSI for the down link (signal received from the base station and re-transmitted to the handset). On state indicates reception of a useable signal from the base station.
Green LED near the edge of the SSR opposite the green Power described above.	RSSI for the up link (signal received from the handset and re-transmitted to the base station). On state indicates reception of a useable signal from the handset.

3.2 Stability

After mounting the SSR in a location selected using the guidelines of section 2.0 and connecting the power supply stable operation must be confirmed. If stable operation in the selected location cannot be achieved, either another stable location must be found. If the subject SSR is set at the 60 dB active gain level (83 dB system gain) it may be possible to achieve stable operation by setting the gain of the SSR to the 50 dB active gain (73 dB system gain) state per the procedure described in Appendix C.

A good way to confirm stable operation is by use of a spectrum analyzer and a suitable pick-up antenna. Locate the spectrum analyzer and pick-up antenna outside the 15-20 feet clear field hemisphere of the SSR, adjust the analyzer controls to display signals in a 150 MHz band centered on the operating band of the SSR (see appendix A), and set the analyzer bandwidth, attenuation, and sweep parameters to provide –90 to –100 dBm measurement sensitivity. Turn off the SSR by removing its' power cable. While viewing the analyzer display, turn the SSR back on and watch for spurious signals that change amplitude and frequency in a random manner. The presence of such randomly changing signals is a strong indication of an unstable SSR. With a normally operating SSR you should be able to see the base station down link signal and this signal should increase in amplitude when the SSR is turned on (See Figure 7).

If a spectrum analyzer is not available, a less certain but useful way to confirm satisfactory operation is to make a phone call using a hand set that operates in the same band as the SSR. The audio quality is usually badly garbled and distorted when the SSR is operating in an unstable manner.

TABLE 1. Stability Rating Matrix

Mounting Configuration	Reference Figure	Proximity of Base Station Radome Surface to Adjacent Vertical Surface	Stability Rating	
			50 dB Active Gain	60 dB Active Gain
Top Window Sill	3a	On Glass Surface	5	5
	3b	More than ¼" Off Glass Surface	5	2
Center of Window	3c	On Glass Surface	5	5
Wall Mounting	4a	On Wall Surface	5	5
	4b	More than ½" Off Wall Surface	5	3
		Extension Pole Used		
Ceiling Mounting	5a	None	5	3
	5b	1 foot	5	4
	5c	2 foot	5	5

Rating Scale:

Stable for 100% of All Installations Tested = 5
Stable for 80% of All Installations Tested = 4
Stable for 60% of All Installations Tested = 3
Stable for 40% 0f All Installations Tested = 2

Figure 1. Propagator PCS-1900 Repeater

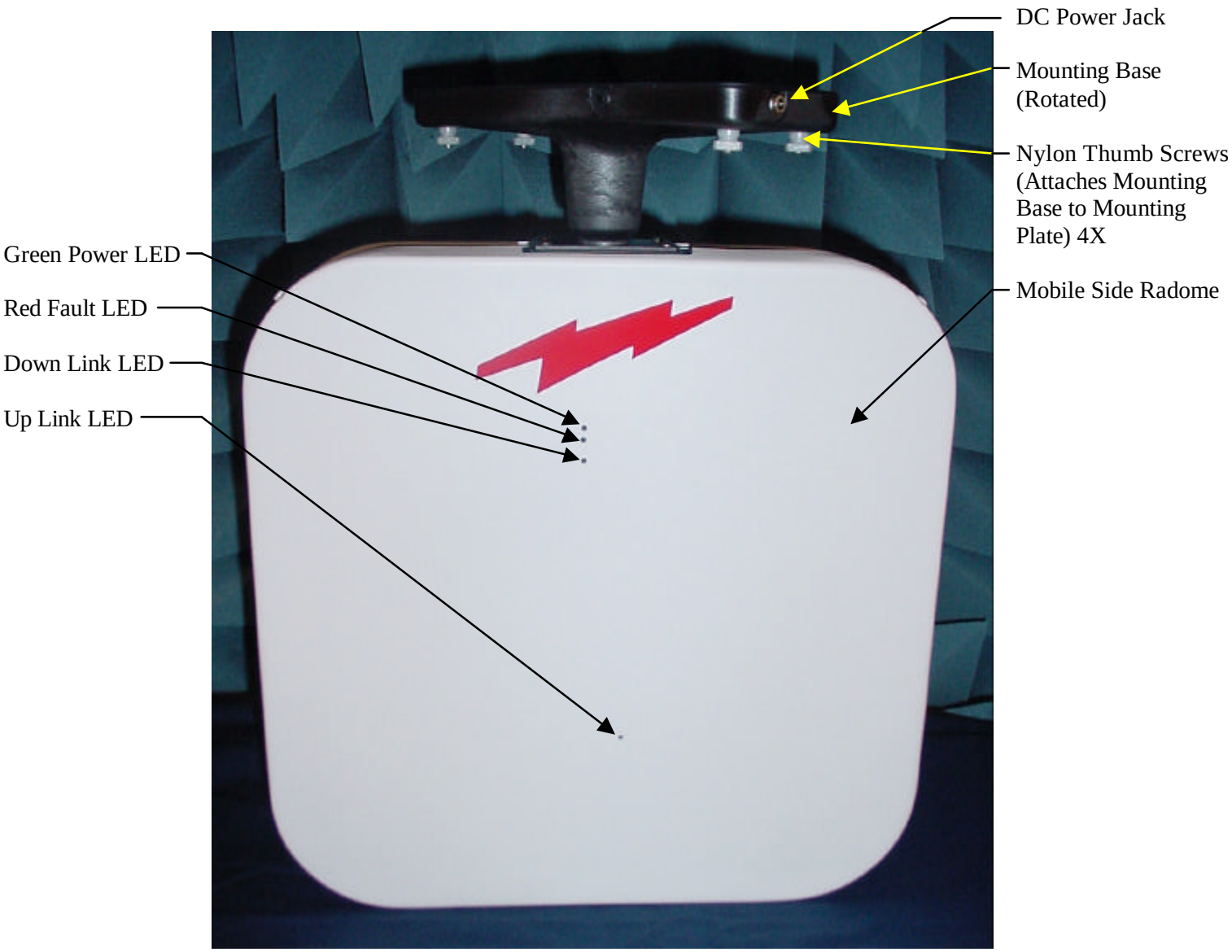


Figure 2. Propagator Repeater Block Diagram

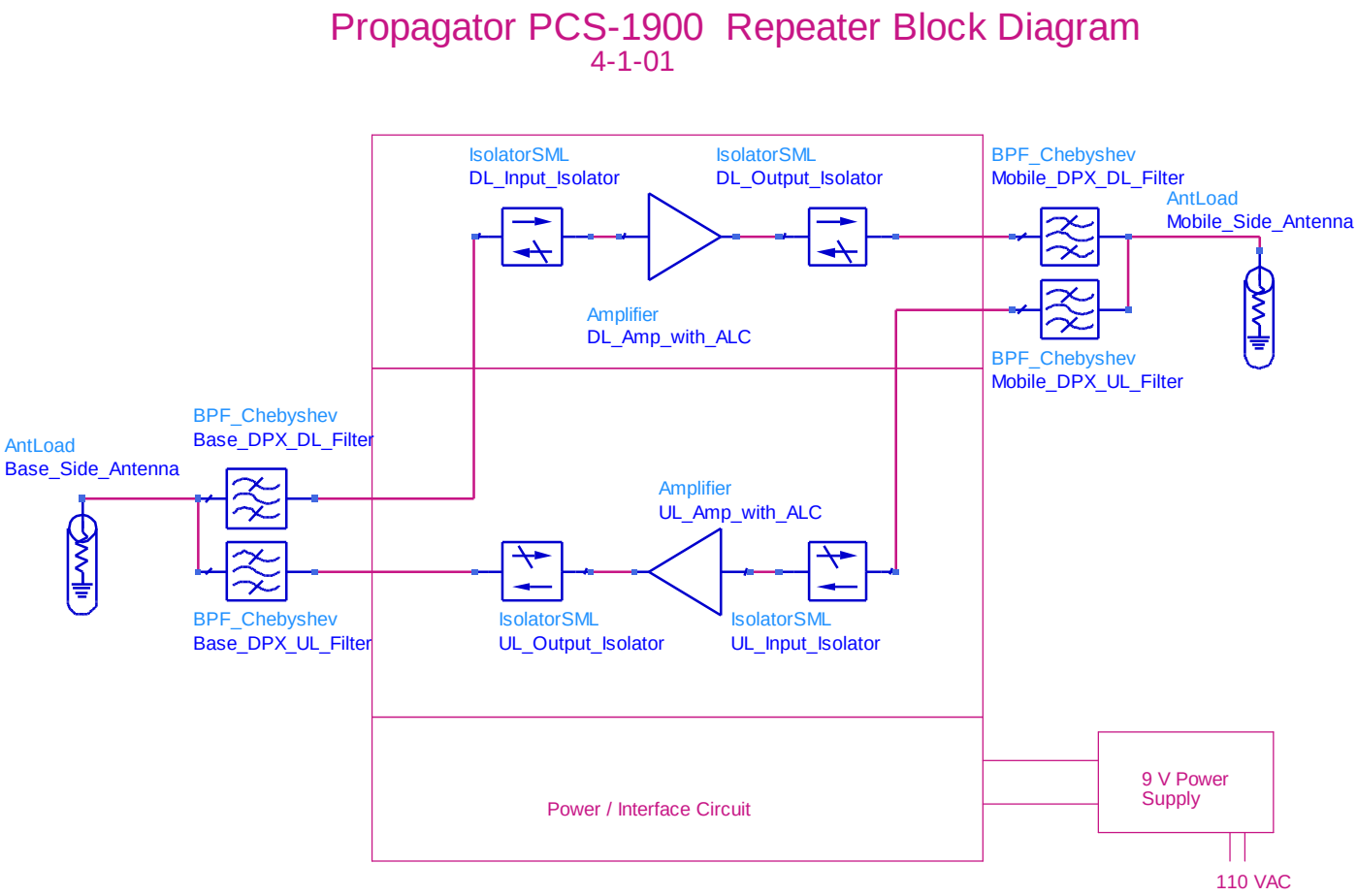


Figure 3. Preferred Window Mounting

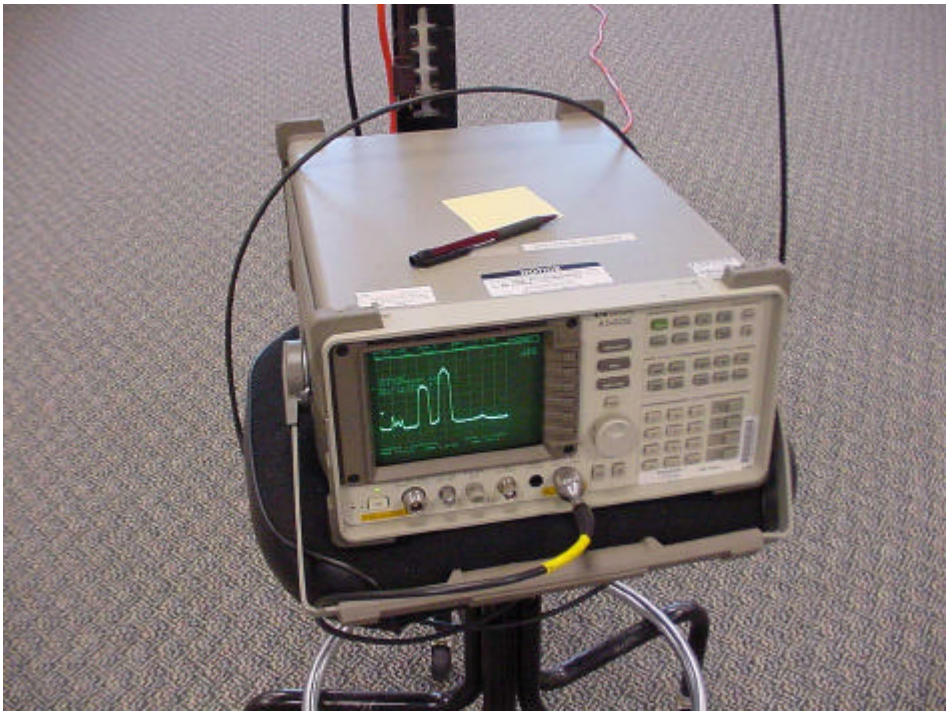
Figure 4. Wall Mounted Configuration

Figure 5. Ceiling Mounted Repeaters

Figure 6. Propagator Mounting Plate

Figure 7. Propagator Mounting Base Attached to Mounting Plate

Figure 8. Example of Spectrum Analyzer Display of Base Station Signals for Stable Operation of the SSR



APPENDIX A. PCS Frequency Band and Blocks

Band/Block	Channel Numbers	Mobil Station Transmit Frequency (MHz)	Base Station Transmit Frequency (MHz)
A	0-299	1850-1865	1930-1945
D	300-399	1865-1870	1945-1950
B	400-699	1870-1885	1950-1965
E	700-799	1885-1890	1965-1970
F	800-899	1890-1895	1970-1975
C	900-1199	1895-1910	1975-1990

APPENDIX B: Specifications

Model PRB-1900-xx	**-AD**	**-BE**	**-FC**
Rx Freq (MHz)	1850-1870	1870-1890	1890-1910
Rx NF	5 dB Max		
Tx Freq (MHz)	1930-1950	1950-1970	1970-1990
Maximum Tx Power at Antenna Port	+11 dBm typical; +14 dBm Max		
ACPR (IS-95)	-48 dB Min @ ±885 kHz		
Power @110VAC	20 watts Max		
Temp Range	30 to 95 ^{o}F		
Total System Gain	73 or 83 dB Typical		
Rx/Tx Active Gain	50 or 60 dB selectable		
Size	15" X 15" X 4" less Power Supply		
Weight	8¾ lbs less Power Supply		

APPENDIX C: Gain Adjustment

The standard factory active gain setting for the Propagator is 50dB. Some installation locations provide a very low multi-path feedback environment and can support a stable active gain of 60dB. Factory trained service personnel can easily set the gain of the Propagator to either gain setting using the following procedure:

1) Remove the white plastic radome on the mobile side of the Propagator. This is accomplished by using a dull pocket knife to first remove the plastic staking pins in the plastic rivets around the edge of the radome (see Figure C-1). After the staking pins are removed, the plastic expansion sleeves are easily extracted using the same dull pocket knife (see Figure C-2).
2) Remove the 4 nylon screws attaching the mobile side antenna circuit board to the nylon stand-offs on the electronics housing (see Figure C-3).
3) Carefully remove (unplug) the antenna circuit board using the large holes thru the circuit board adjacent to the RF connector on the bottom side of the circuit board. It may be necessary to rock the circuit board around after the RF connection is unplugged to get the circuit board past the 4 plastic LED lenses.
4) The gain setting jumpers are accessible thru two slot openings in the electronics housing cover (see Figure C-4). The jumpers should be covering both circuit pins for 50dB active gain (see Figure C-5). The jumpers should only be covering one pin for 60dB active gain (see Figure C-6). Set the jumpers for the desired gain in each channel; the downlink gain set jumper is nearest the mounting base of the Propagator (see Figure C-7).
5) Reverse steps 1-3 above to re-install the antenna circuit board and the radome.

DO NOT DISTURB THE BRASS DIPLEXER TUNING SCREWS !!!

Figure C-1. Plastic Rivet Staking Pin Removal

Figure C-2. Plastic Rivet Expansion Sleeve Removal

Figure C-3. Nylon Antenna Circuit Board Attachment Screws and LED Lenses

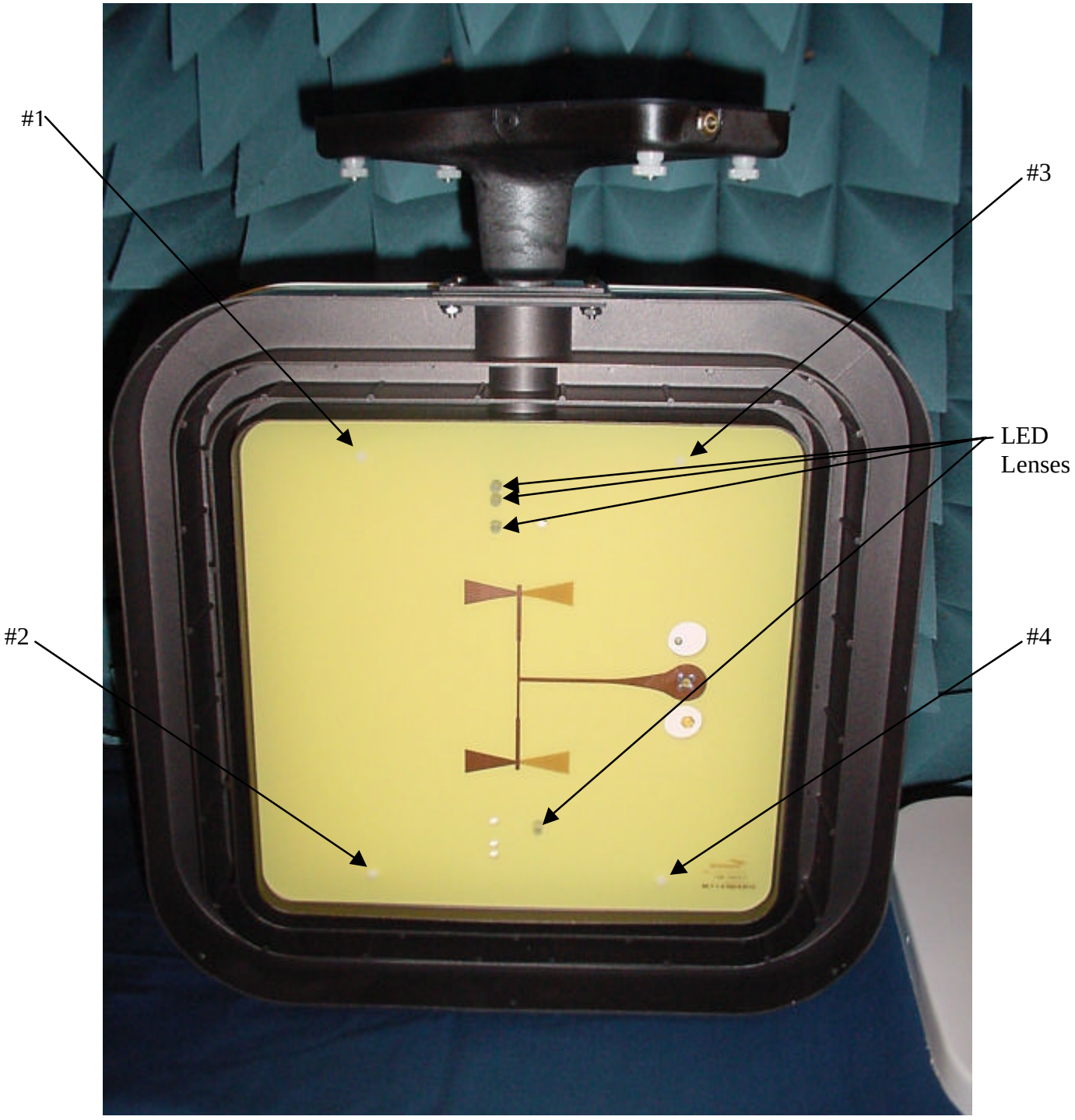


Figure C-4. Gain Setting Jumper Slots

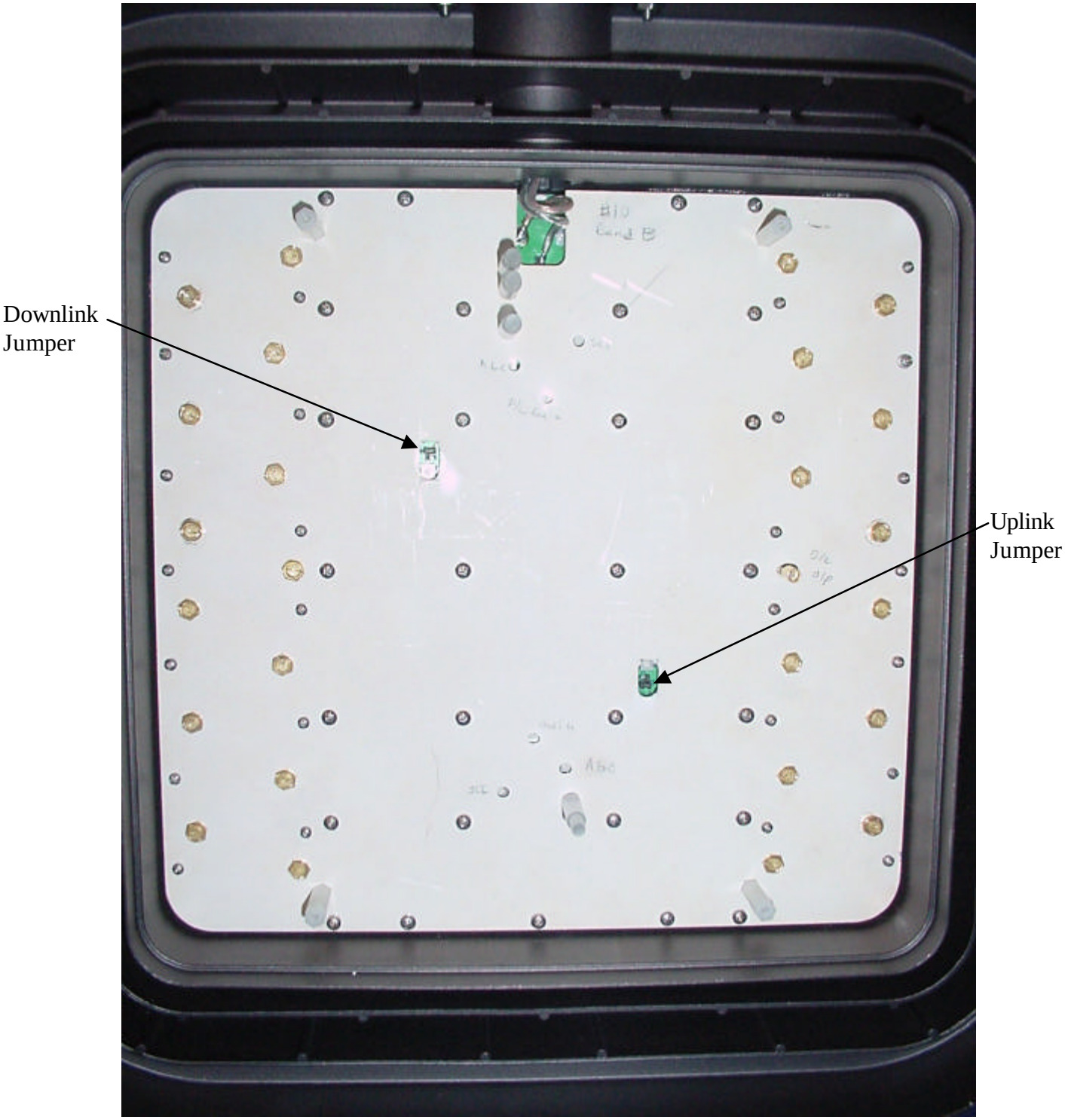


Figure C-5. 50 dB Gain Jumper Orientation (Uplink Slot)

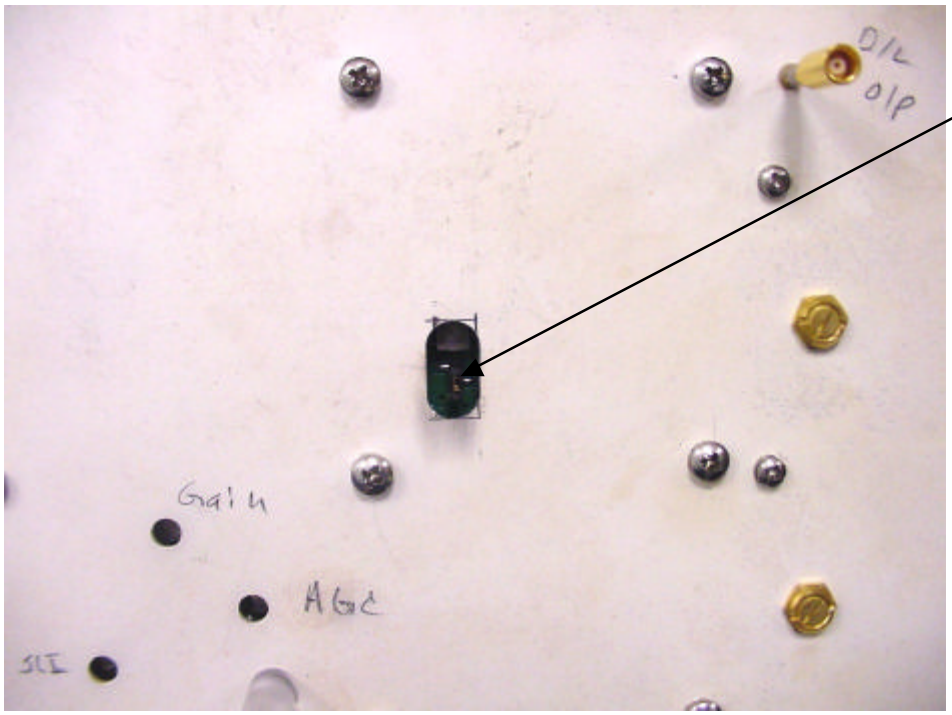


Figure C-6. 60 dB Gain Jumper Orientation (Uplink Slot)