
**Troll Systems Corporation
Microwave Systems**

6.5 GHz RF Linkbox for Tracking Antenna

User Manual



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6.5 GHz RF Linkbox for Tracking Antenna

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ABOUT THIS MANUAL

This manual details connectivity and operation of the Troll Systems Corp 6.4 to 6.5 GHz airborne linkbox and transmitter and is intended for use by qualified operators, installers, and service personnel. Users of this manual should already be familiar with basic concepts of radio, video, and audio. For information about terms in this manual, see Glossary of Terms, Abbreviations and Acronyms. It is also very important to pay special attention to Warnings, Caution and Notes.

Glossary of Terms, Abbreviations and Acronyms

Abbreviations, acronyms, and terms used throughout this manual are defined in the following list.

Term	Definition
AC	Alternating Current
ALT	Altitude
ANT	Antenna
AUX	Auxiliary
Az	Azimuth
BAS	Broadcast Auxiliary Service
CAL	Calibrate
CAM	Camera
Ch	Channel
COMM	Communication
COTS	Commercial-Off-The-Shelf
CPU	Central Processing Unit
dB	Decibel
DC	Direct Current
DMM	Digital Multimeter
e.g.	Latin: <i>exempli gratia</i> , meaning “for example”
EMI	Electro-Magnetic Interference
ENG	Electronic News Gathering
ESD	Electro-Static Discharge
et al	Latin: <i>et alia</i> , meaning “and others”
FM	Frequency Modulation

Term	Definition
GPS	Global Positioning System
GUI	Graphic User Interface
HD	High Definition
Hz	Hertz
H/W	Hardware
INS	Inertial Navigation System
I/O	Input/Output
i.e.	Latin: id est, meaning “that is”
LAT	Latitude
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LNA	Low-Noise Amplifier
LNG	Longitude
MICOWV	Microwave
MUX	Multiplexer
NEMA	National Electrical Manufacturing Association
NIC	Network Interface Card
nm (NM)	Nautical Mile (note: 1 nautical mile equals 1.150782 miles)
NTSC	National Television System Committee
NV	NavTrack
PC	Personal Computer
PED	Pedestal
POL	Polarization
PRSETS	Presets
RAM	Random Access Memory
RF	Radio Frequency
RFI	Radio Frequency Interference
ROM	Read Only Memory
RPC	Remote Procedure Call
RX	Receiver/Receive
S/W	Software

Term	Definition
SDI	Serial Digital Interface
SV	System Variable
TX	Transmitter/Transmit
V	Volt
VAC	Volts Alternating Current
VDC	Volts Direct Current
W	Watt

Warnings, Cautions and Notes

Warnings

Warnings are included to alert the user that possible hazards are associated with the processes/procedures described. These may cause death or injury in any form, if the instructions in the operational or procedural task are not followed precisely. Warnings describe the potential hazards and possible impact that could occur if the warnings are not observed.



WARNING: This format is used for general warnings.



WARNING: This format is used for electrical warnings.



WARNING: This format is used for mechanical warnings.



WARNING: This format is used for warnings which include the risk of fire.

Cautions

Cautions are included to alert the user that damage to the equipment (e.g., HD Controller) is possible if the instructions in the operational or procedural task are not followed precisely. Cautions describe the hazards and possible impact that could occur if the cautions are not observed.



CAUTION: This format is used for all cautions.

Notes

Notes are included to provide the user with supplemental information, which is helpful but does not necessarily belong in the core text. Many operational and procedural tasks are easier with the addition of notes.



NOTE: This format is used for all notes.

Warranty

Troll Systems Corp warrants, to the original customer only, that the product is free from defects in material and workmanship and conforms to the specification, if any. If no specification is listed, the items are warranted to conform to our currently published specification for the product. The warranty period is for a period of one year from the date of shipment. Troll will repair or replace (at its option) any such device which is returned to the Troll factory office, with transportation charges prepaid and within the warranty period. The liability of Troll shall be limited to the repair or replacement of the device and shall not include installation, or any other charge or expense incurred. This warranty shall not apply to any unit or part thereof which, in the opinion of Troll, has been installed or used improperly; damaged by accident, corrosion, misused, or negligence; or altered or repaired in such a manner as to impair performance. Troll must receive written notice of the defect within the warranty period. Customer must pay packing, crating and transportation costs to and from the factory. At the Customer's request, Troll will make reasonable efforts to provide warranty service at the Customer's premises, provided that Customer pays Troll's then current rates for field service and the associated travel and living expenses. If a fault has been caused by improper installation, maintenance or use, or by abnormal conditions of operation, those repairs will be billed at normal rates. Troll shall have the right of final determination as to the existence and cause of any such defect. The user is urged to exercise caution against making any modifications to this system without the expressed consent of Troll Systems Corp. or the user risks voiding their authority to operate this system per the terms of this system's FCC license. Contact Troll Systems customer service at 1-661-702-8900.

1. OVERVIEW

1.1 INTRODUCTION

Troll System's Linkbox is an airborne communications and data link that operates SkyLink Antenna systems and related equipment. Available in standard ATR units it features a built-in touchscreen monitor and a graphical user interface (GUI) that enables the user to configure and control the aircraft's entire microwave transmission system including transmitting radios, tracking antennas, stabilized cameras, sensor payloads, Ethernet routing, power distribution, mapping and control settings.

2. SAFETY

The following safety considerations are intended as a guide for safe usage of this system per FCC guidelines and the manufacturer. Review the following information for safe usage of this product.

2.1 GENERAL SAFETY PRECAUTIONS

The following safety requirements, as well as local site requirements and regulations, must be observed by personnel operating and maintaining the equipment described in this manual to ensure awareness of potential hazards. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with this manual as well as federal and state regulatory requirements, it may cause harmful interference to radio communications.

It is the responsibility of the owner or operator of this equipment to ensure proper and safe usage of this equipment in accordance to the state and federal regulatory requirements. Troll Systems Corp cannot be held responsible for any harm or injury resulting from the use of this equipment. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

The following general safety precautions are not related to any specific procedures and therefore do not appear elsewhere in this publication. They are, however, precautions that personnel need to understand and apply when operating or repairing equipment. Installation, operation, and maintenance should be performed only by qualified personnel.

2.1.1 Know and Comply with Local, State, and Federal Safety Requirements

All personnel handling and using this equipment should be familiar with all local, state, and federal safety requirements applicable to the equipment, processes, and materials you use during maintenance. Before using any substances or materials marked toxic or hazardous, always refer to the Material Safety Data Sheets (MSDS) for that substance/material for any special protective equipment, handling, and/or disposal requirements.



CAUTION: Any modifications made to the LinkBox not approved by Troll Systems Corporation will void the user's authority to operate this equipment.

2.1.2 Do Not Service or Adjust Alone

Do not start a maintenance or adjustment procedure if that procedure requires more than one technician to be safely performed. It is particularly important that such work not be performed in a remote area away from other qualified personnel who may be needed to render assistance. When a maintenance task requires two or more personnel to be safely accomplished, delay the task until qualified personnel are available to assist you.

2.2 RF SAFETY CONSIDERATIONS AND PRECAUTIONS

The guidelines for safe operation herein are derived from OET bulletin 65, August 1997, as recommended by the Federal Communications Commission (FCC).



WARNING: High levels of RF power are present in the unit. Exposure to RF or microwave power can cause burns and may be harmful to health. Remove power from the unit prior to disconnecting any RF cables and before inspecting damaged cables and/or antennas. Avoid standing in front of high gain antennas (such as a dish antenna) and never look into the open end of a waveguide or cable where RF power may be present.

When this system is operated without an antenna, it will not create RF energy exceeding 1.0 mW/cm^2 , which is the FCC limit for exposure. Connecting an antenna to the unit greatly increases the potential for harmful exposure to microwave radiation and all personnel must maintain a minimum distance from the radiator per the amount of radiation emanating from the transmitter and the antenna.

2.2.1 Applicable Safe Distances to Active RF

The Maximum Permissible Exposure (MPE) safe distances from the antenna with a gain of 12 dBi is as follows:

- The safe distance measured in centimeters (cm) is: 109.748 cm
- The safe distance measured in inches (in) is: 43.208 in



NOTE: Hazardous RF radiation limits and recommended distances may vary by country. Observe all applicable state and federal regulations when using this transmitter.

To calculate safe distances in situations where [paragraph 2.2.1](#) is not applicable, use the following formula suggested by OET65. The calculations provided are for common antennas often used in the mobile microwave environment.

2.2.1.1 Calculating MPE

- $EIRP = P * (10^{(G/10)}) = (\text{antilog of } G/10) * P$
 - P= RF power delivered to the antenna in mW
 - G= Power gain of the antenna in the direction of interest relative to an isotropic radiator
 - R= distance to the center of radiation of the antenna in centimeters
 - S= MPE in mW/cm² (milliwatts per square centimeter)
- Conversions
 - dBi to numeric gain = Antilog (dBi/10)
 - Feet to centimeters = Feet * 30.48
 - Centimeters to Feet = cm * .0328
 - $4\pi = 12.57$
- User Input
 - RF power delivered to the antenna = Watts
 - Antenna gain (referenced to isotropic antenna) = dBi
 - Distance from the center of radiation = Feet

- Calculations Steps
 1. [P] RF power input. Watts to milliwatts = Watts * 1000
 2. [G] Antenna gain dBi. Numeric gain = Antilog (dBi/10)
 3. [EIRP] Multiply P * G

2.3 ELECTRICAL POWER / SHOCK HAZARDS

Always verify that electrical power is disconnected and that applicable safety procedures have been followed before doing maintenance on any electrical/electronic equipment. High voltage electrical energy is stored in some electrical equipment (electrolytic capacitors, UPS batteries, etc.) even after the source of primary external power has been disconnected. Always remove external power, deactivate equipment, or discharge the potential to ground (when applicable) before working on the equipment.

If a high-potential insulation test is required, follow the procedures and precautions outlined in the appropriate National Electrical Manufacturing Association (NEMA) standards. Check with the area supervisor if unfamiliar with these standards, specific equipment, or procedures.

When troubleshooting a system with electrical power applied, first verify that all personnel in the hazard area are advised, that the equipment is tagged, and/or that an assistant is posted at the point of power control.



WARNING: Potentially lethal voltage/current is present throughout many electrical installations. Maintenance personnel shall employ positive power lockout devices and post all required warning tags/signs when applicable to ensure that no unauthorized application of power can occur during maintenance. Failure to heed this warning could result in serious injury or death by electrocution.

2.3.1 Electrostatic Discharge Sensitive (ESDS) Components

Computers, microprocessors, and other solid state components (circuit cards, I/O boards, etc.) which are not clearly marked with the ESDS symbol will be handled as ESD sensitive components until determined otherwise. Retain protective ESDS packing and shipping bags, containers, non-conductive foam pads, etc. (see [Figure 2-1](#)) for use in the return of repairable components.



CAUTION: Beware of electrostatic buildup. Delicate solid-state Integrated Circuits (ICs) can be damaged by improper handling procedures. Use proper electrostatic safeguards when installing/removing circuit cards and handling ESD sensitive assemblies. As required, wear a grounded wrist strap, use anti-static floor and table mats, and minimize the handling of sensitive solid-state devices. Keep all ESD sensitive components in their original containers until ready for use. Always discharge personal static before handling ESD sensitive components and do not slide solid state devices over any surface. Handle plug-in card assemblies only by their non-conductive edges.

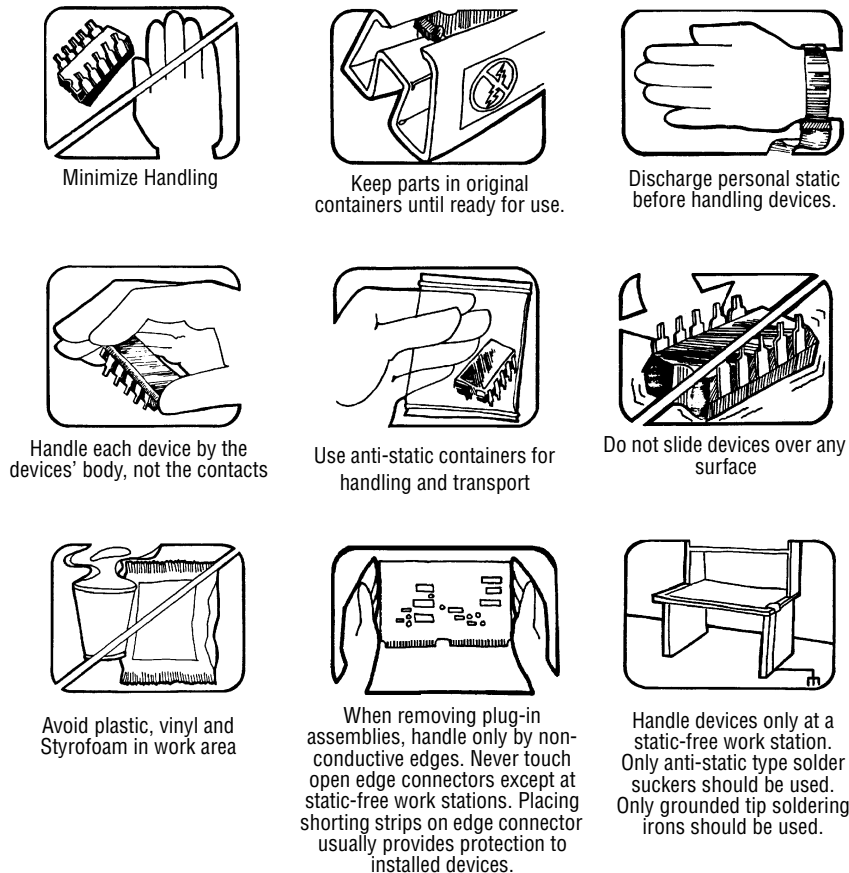


Figure 2-1. Electrostatic Discharge Precautions

3. SPECIFICATIONS

3.1 LINKBOX PHYSICAL CHARACTERISTICS

- Size (physical dimensions):
 - Height: 7.75 inches (19.5 cm)
 - Depth: 13.94 inches (35 cm)
 - Width: 4.94 inches (12.5 cm)
- Weight: 10 pounds
- Input Voltage: 18-32 VDC
- Input Current: 1 A nominal, 24 A max with external loads
- Output Voltage:
 - 4 X 28 VDC (up to 7 A each or 20 A total)
 - 3 X 12 VDC (9 A total)

3.2 LINKBOX TECHNICAL CHARACTERISTICS

- Band: C
- Frequency Range: 6400 - 6500 MHz
- Power: 8W linear
- Video Inputs:
 - SDI
 - Composite
 - HDMI
 - Ethernet
- Power Outputs:
 - Two (2) 28 VDC Switches
 - Three (3) 12 VDC Switches
 - 100 Watt max power
- Eight (8) external Ethernet ports
- Operating System: Linux
- Data Ports:
 - 1 Ethernet 10/100
 - 2 USB

4. LINKBOX ORIENTATION

4.1 LINKBOX DESCRIPTION

Troll's Linkbox is a comprehensive RF system controller distilled into a 1/3 ATR, touchscreen control system. It can be used to operate and manage:

- Microwave radios
- Antenna monitoring and control
- Power monitoring
- Video control and monitoring
- Audio control and monitoring
- Multi-port Ethernet switching and routing
- Mapping control with interfaces for Aero and Churchill
- Waypoint creation and selection
- Multi-port inputs and outputs including HDMI
- Encoding, decoding and encryption
- FTCA certification DO-160

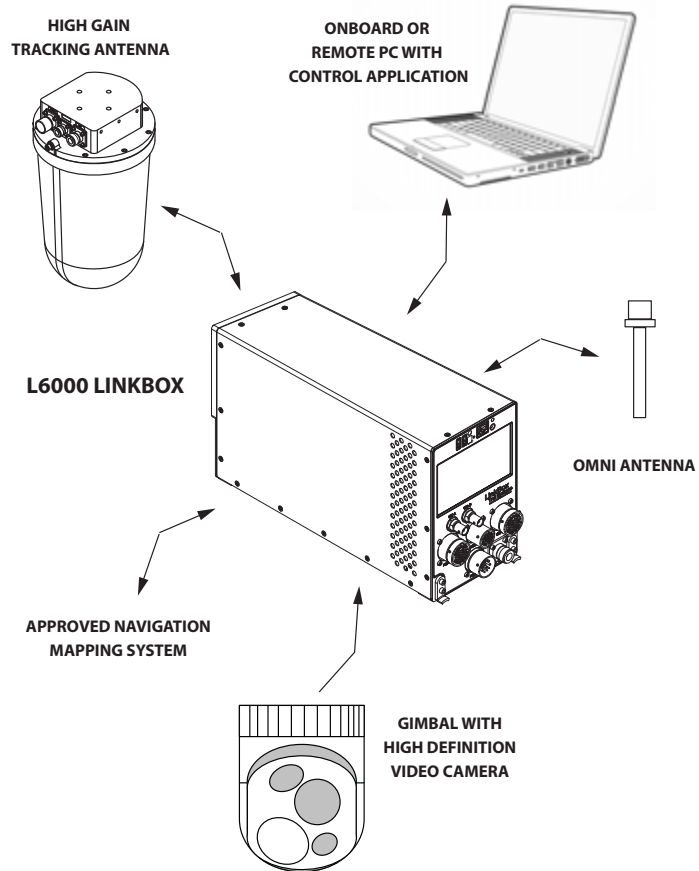


Figure 4–1. Linkbox Typical Usage Configuration

4.2 LINKBOX INSTALLATION

Refer to the following content for linkbox installation information.



CAUTION: Any modifications made to the LinkBox not approved by Troll Systems Corporation will void the user's authority to operate this equipment.

4.2.1 Linkbox Installation - Mounting

The Linkbox is mounted onto an ATR Mounting Tray using the two spring-loaded mounting fasteners on the rear and two locking adjustable fasteners on the front panel all of which are part of the plate's configuration (refer to [Figure 4-2](#)).

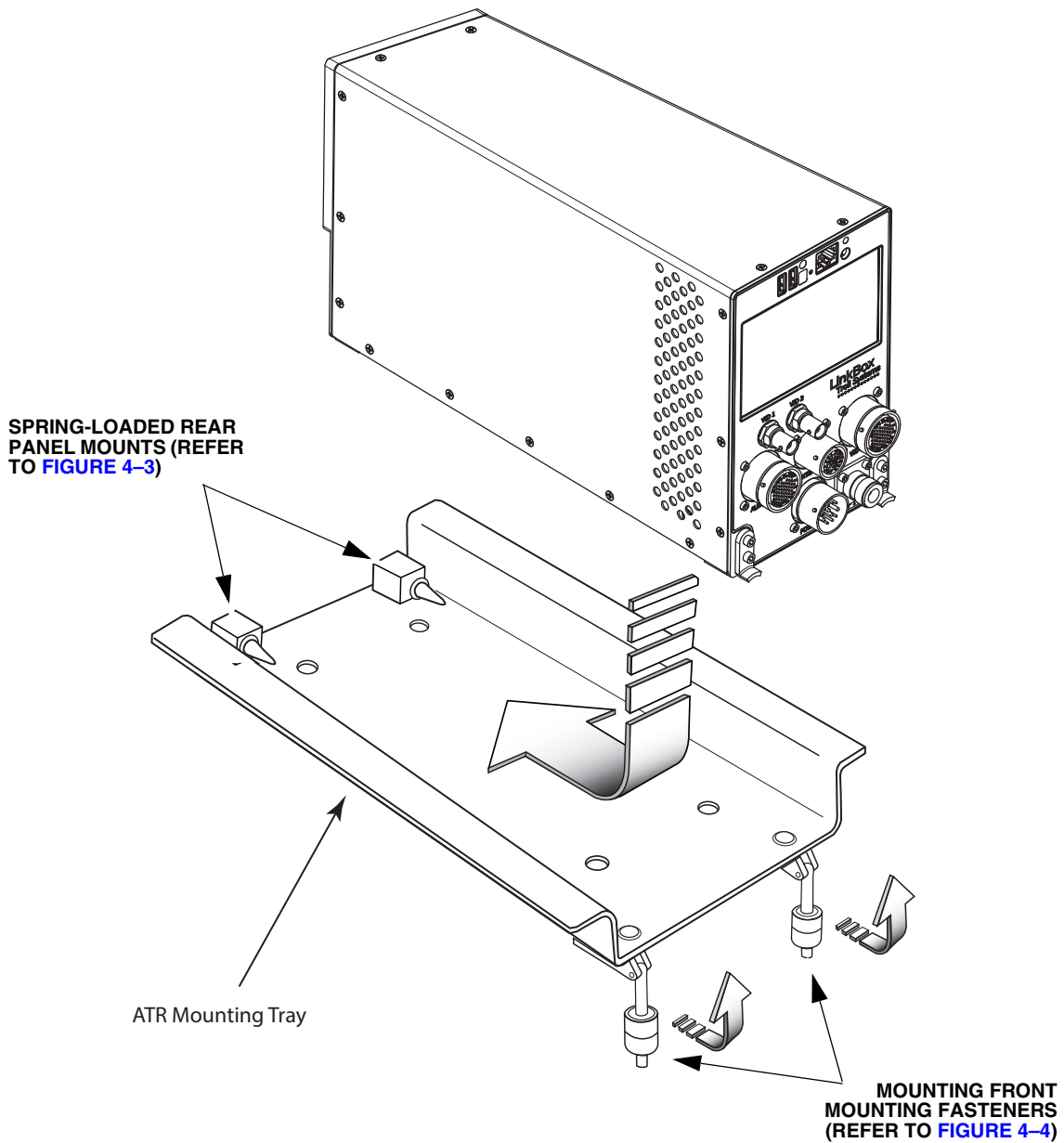


Figure 4-2. Linkbox Mounting Procedure

Carefully place the linkbox onto the already installed mounting plate and slide it backwards towards the back of the plate ensuring that both of the ATR mounting tray's spring-loaded mounting fixtures are inserted into the linkbox's rear panel mounting receptacles (refer to [Figure 4-3](#)).

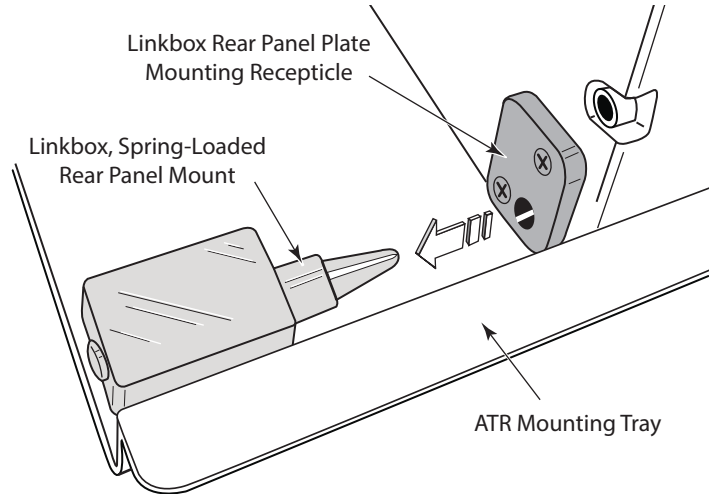


Figure 4-3. Linkbox Rear Panel Mounting Configuration

Slide the linkbox backward as far as the rear, mounting fixtures will allow. Once the linkbox is secured by the rear fixtures of the mounting tray, the front mounting fasteners are used to secure the linkbox mount (refer to [Figure 4-2](#) and [Figure 4-4](#)).

1. Swing each free-hanging, spring-loaded front fastener (located on the mounting plate) up completely (refer to [Figure 4-2](#)).

2. Slide the fastening cylinder along the center axis towards the linkbox, inserting the plate's contoured mounting brackets into the cylinder.

3. Twist the fasteners in

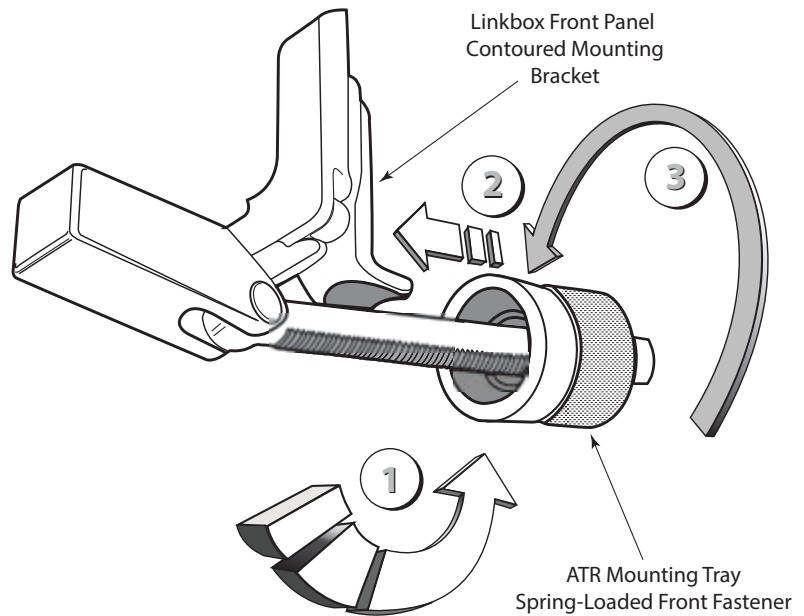


Figure 4-4. Linkbox Front Panel Mounting Configuration

4.2.2 Linkbox Installation - Connectivity

The linkbox typically requires connectivity to in-flight transmitting antennas as well as onboard video capturing equipment (e.g. gimbal) and 28 VDC power connections.

4.2.2.1 Linkbox Front Panel Connections

The linkbox's front panel includes all of the connection ports required for full operation. These port connections include (refer to [Figure 4-5](#)):

- Video In 1 (HD-SDI)- BNC connector
- Video In 2 (Composite) - BNC connector
- Antenna Control
- Video Input/Output
- Auxiliary Input/Output
- Power
- RF 1

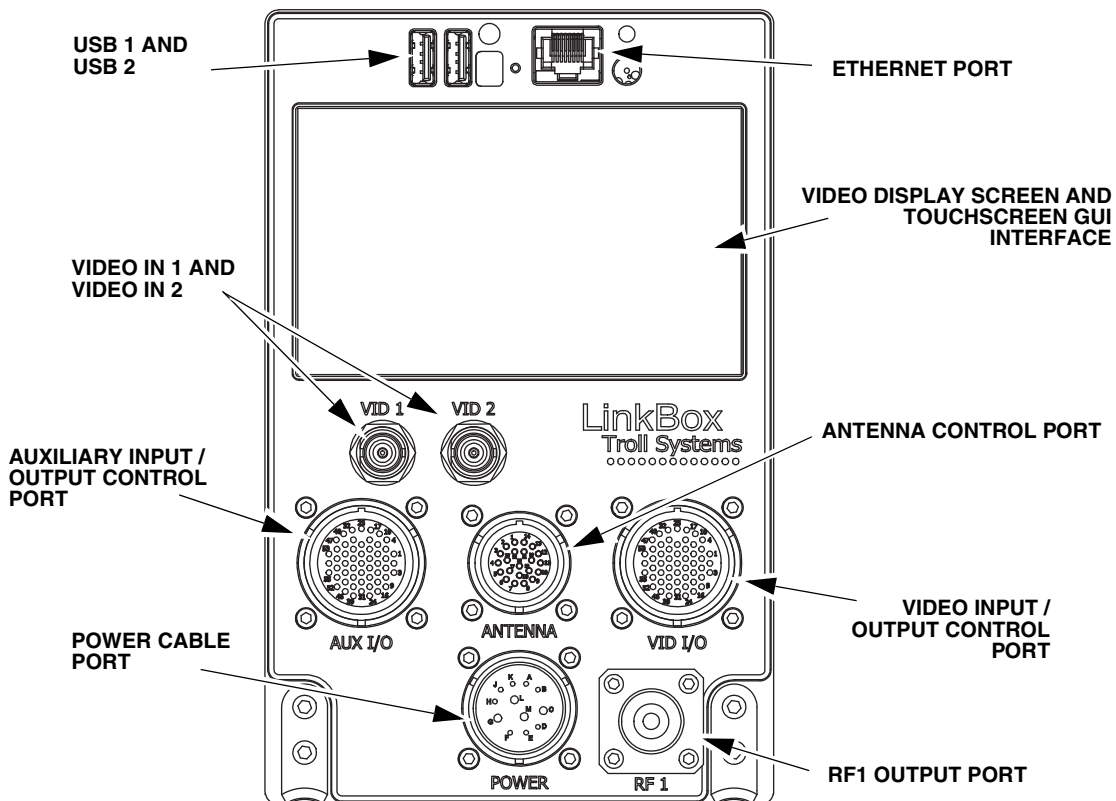


Figure 4-5. Linkbox Front Panel Orientation

Additional port connections located above the GUI / Video screen include two USB-B ports and an Ethernet port.

4.2.2.2 System Connectivity - Cables

The system connectivity requirements illustrated in this document includes three Troll Systems primary cables. These cables are:

- E-409-0001-00 Cable, Aircraft Power, LB6000
- E-409-0000-00 Cable, Mini Pod Control Cable, LB6000
- E-409-0002-00 Cable, Linkbox, AUX I/O Harness

There is typically additional cabling including CAT5 (or higher) Ethernet cable with RJ 45 connectors as well as shielded RF and coaxial cable with BNC or TNC connectors.

4.2.2.3 System Connectivity - Power

The linkbox’s power connection requirements utilizes Troll Systems power cable E-409-0001-00 with connector MS27467T15F97SA which connects to the linkbox’s POWER port on the front panel (refer to [Figure 4-6](#)).

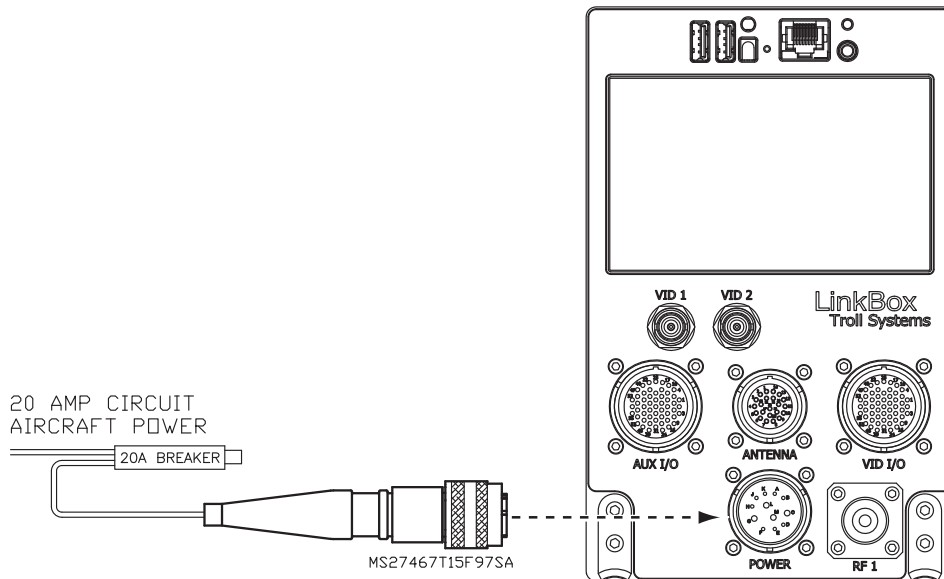


Figure 4-6. Linkbox Power Connection Requirement

4.2.2.4 System Connectivity - Mini Pod Tracking Antenna

Connectivity between a tracking, transmitting antenna system such as the Troll Systems Skylink Mini Pod II requires a control and power cable (in this example the Troll Systems E-409-000-00 cable) connecting the linkbox ANTENNA port (requiring connector C-061-0395-000, MS27467T13F35PN-UTHST2) to the mini pod CONTROL port (requiring connector C-061-0323-00, D38999/26MB35SN-UTHST1), refer to [Figure 4-7](#).

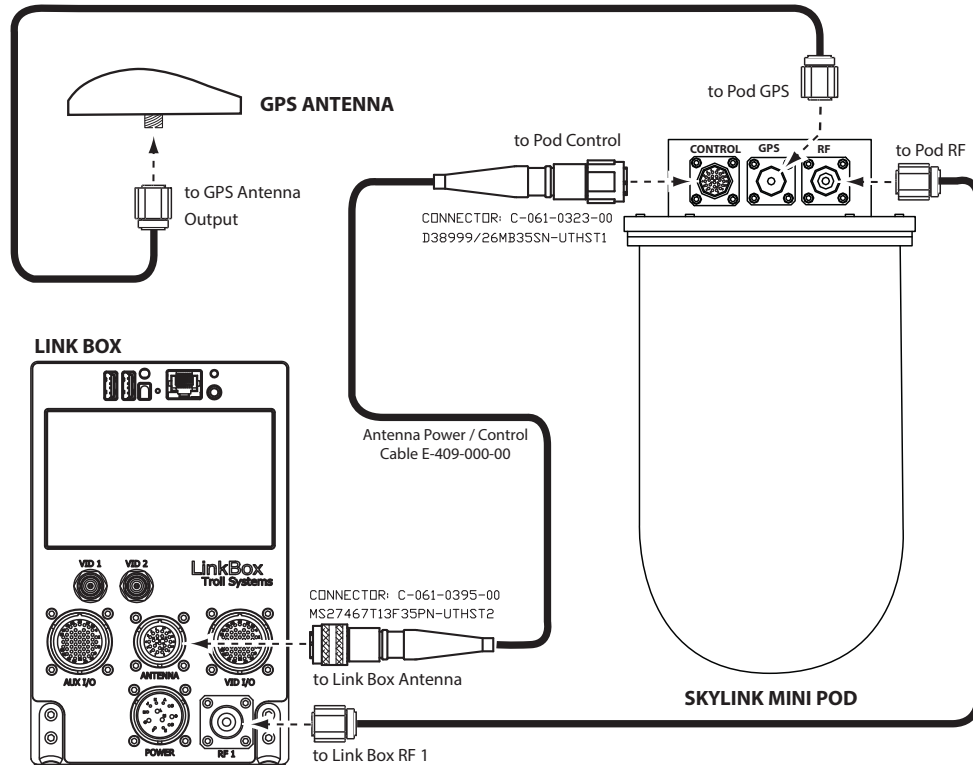


Figure 4-7. Typical Linkbox and Skylink Mini Pod II Connectivity

The linkbox RF1 should be connected to the antenna's RF input connection using shielded RF cable with TNC connectors.

4.2.2.5 System Connectivity - System Auxiliary Input / Output

Figure 4–8 shows an example of system-wide communications auxiliary connectivity using an octopus style cable which may include several different cable and connectors for various connections (e.g. RJ45 for comms and Ethernet, USB, TNC, BNC DS 9-pin, etc.) for multiple system communications requirements such as power, network and control.

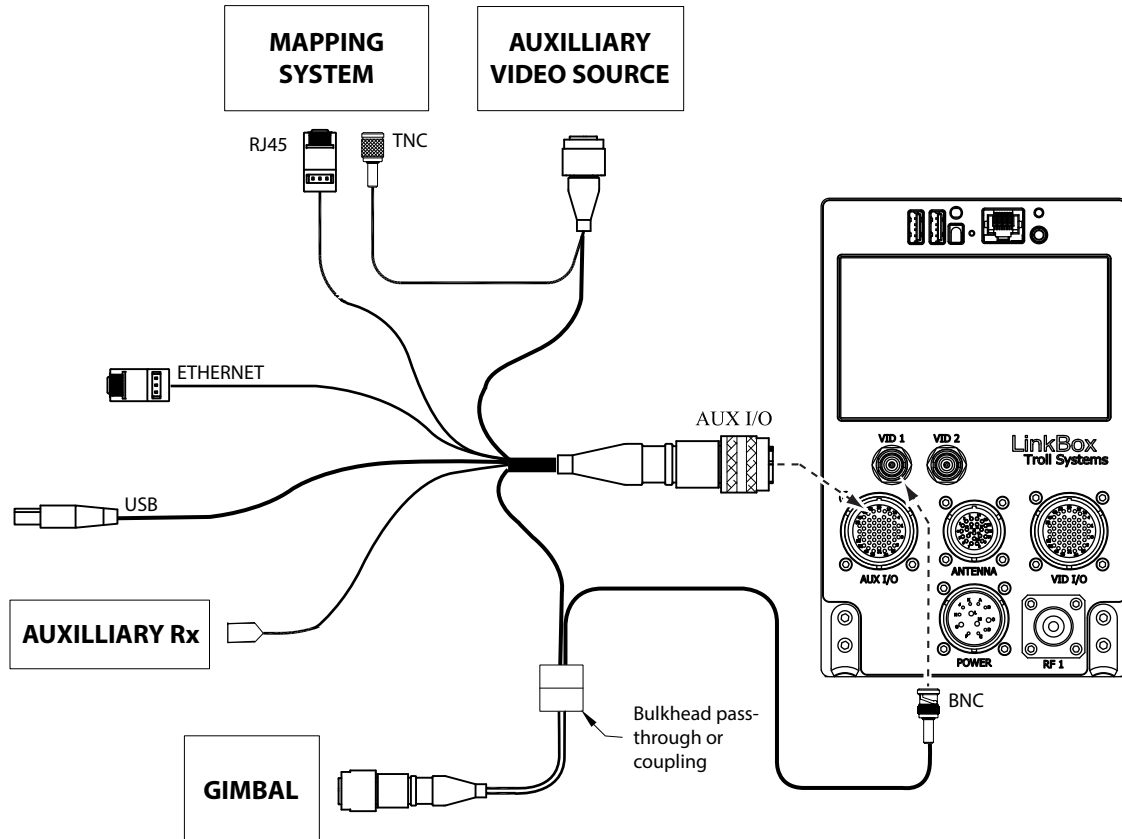


Figure 4–8. System Input / Output Connectivity with Multi-Purpose Cable

5. OPERATION

The linkbox powers up automatically when the aircraft’s circuit panel is powered ON. Linkbox operation is also autonomous but may need changes to various system settings for operations specific to the users requirements. For this the linkbox includes a touchscreen graphical user interface (GUI) located on the linkbox’s video playback display on the front panel (see Figure 4–5) for the user to access and make changes to the system settings.

5.1 USER INTERFACE (GUI)

The graphical user interface (GUI) is an overlay that will appear, when prompted, onscreen over the video feed of the linkbox front panel video display, or an HD monitor display when an external monitor is connected to the system (see [Figure 5-1](#)).

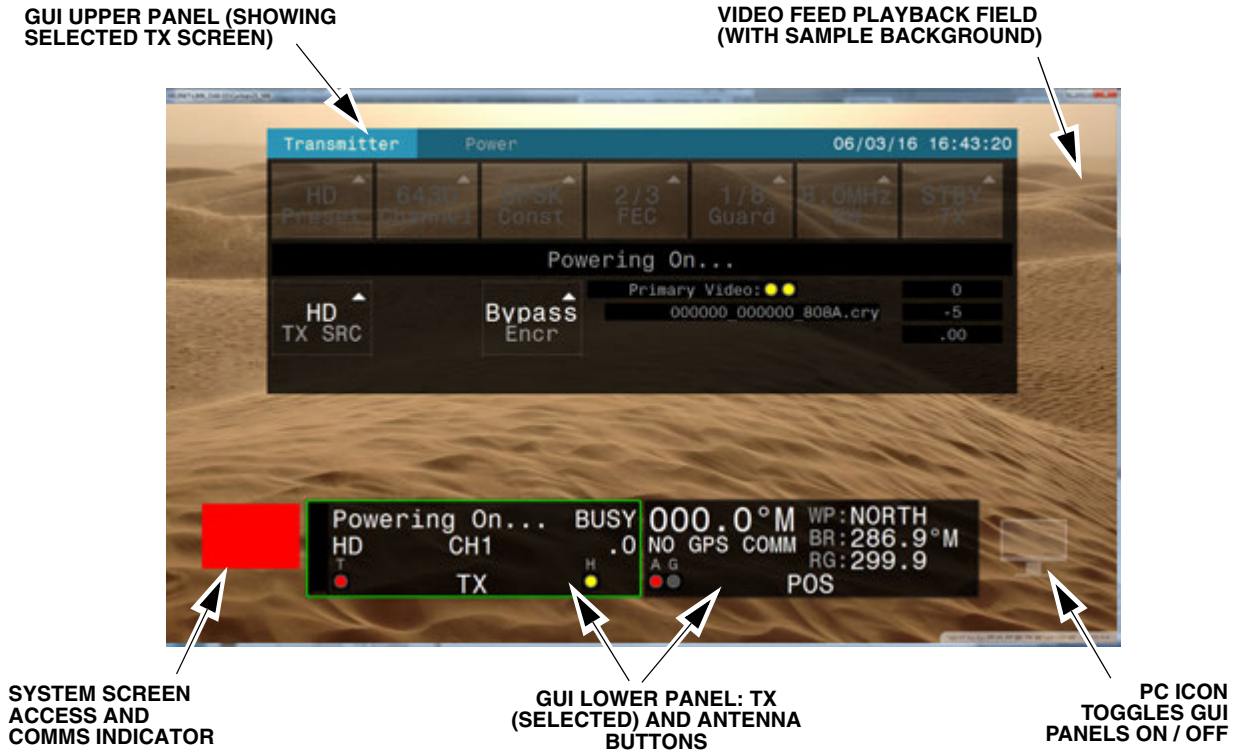


Figure 5-1. Video Display Feed with GUI Overlay

The video playback screen may only show the video feed. Pressing anywhere on the screen will bring up the GUI's lower panel (see [Figure 5-2](#)).

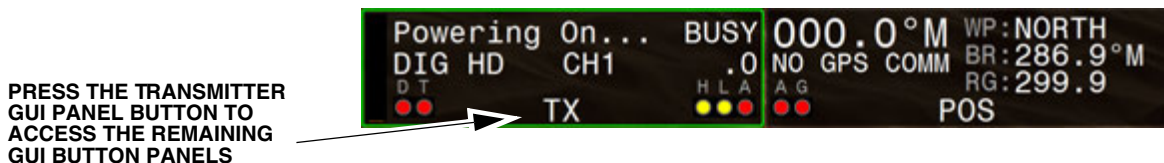


Figure 5-2. Lower GUI Button Panel

5.1.1 Lower Panel Buttons

The lower panel is divided into two large virtual buttons displaying elements of critical operational data. The left button is the Transmitter (TX) button and the right button is the Antenna (POS) button. The elements displayed in each button are as follows:

5.1.1.1 TX (Transmitter) Button Elements

Refer to [Figure 5-3](#) for the Transmitter button elements.

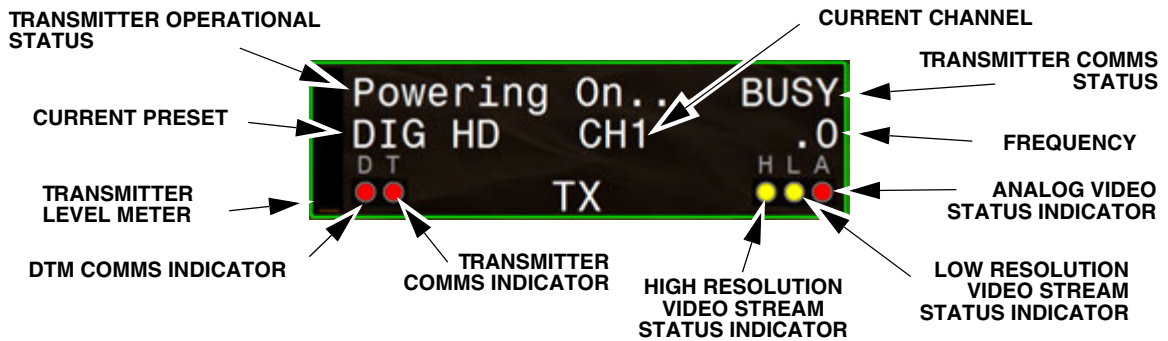


Figure 5-3. Transmitter Button Elements

5.1.1.2 POS (Antenna) Button Elements

Refer to [Figure 5-4](#) for the Antenna button elements.

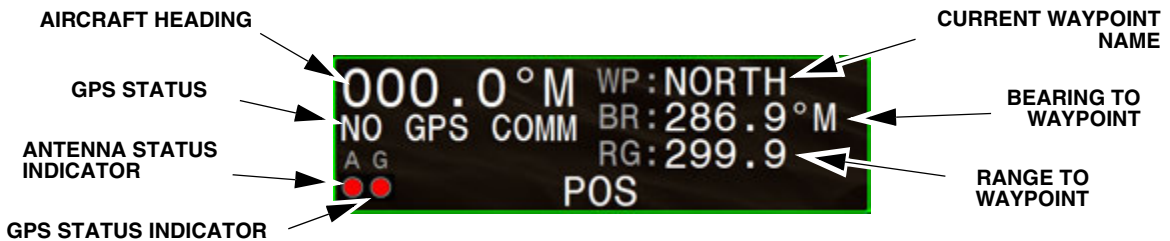


Figure 5-4. Antenna Button Elements

5.1.2 TX Screen Transmitter Tab Page Panels

Pressing the TX button will open the upper GUI button panel, providing access to the functions and settings on those panels (refer to [Figure 5-5](#) and [Table 5-1](#)).

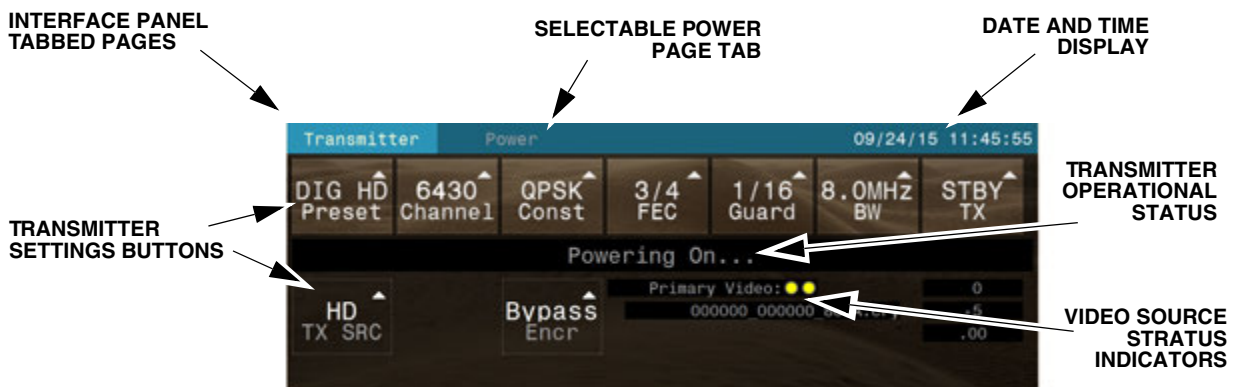


Figure 5-5. Graphical User Interface Overlay Panels

5.1.2.1 Upper Transmitter Panel - Transmitter Tab

The upper panel TX screen, transmitter tab provides access to the linkbox transmitter settings (accessible via the GUI buttons) including (see [Table 5-1](#)).

Table 5-1. GUI Control Button Elements


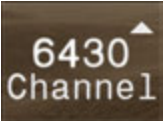



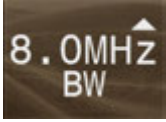

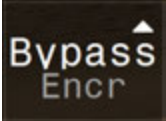
Button	Name / Function	Settings / Description
	Preset	<p>Accesses the available transmitter preset selections (may vary per system):</p> <ul style="list-style-type: none"> • HR CLEAN - High Resolution Clean (without overlay) • HR OVL - High Resolution Overlay (with overlay) • ANALOG - Analog
	Channel Selection	<p>Accesses the available transmitter channel / frequency selections:</p> <ul style="list-style-type: none"> • 6430 • 6438 • 6446 • 6455 • 6463 • 6471 • 6480 • 6488 • 6496 • 6505 • 6513 • 6521
	Transmitter Modulation Scheme	<p>Transmitter Modulation Scheme selections:</p> <ul style="list-style-type: none"> • QPSK • 16QAM • 64QAM
	FEC (forward error correction) Button	<p>Forward Error Correction setting selections:</p> <ul style="list-style-type: none"> • 1/2 • 3/4 • 7/8

Table 5–1. GUI Control Button Elements

Button	Name / Function	Settings / Description
	Guard Button	Guard selection settings: <ul style="list-style-type: none"> • 1/32 • 1/16 • 1/8 • 1/4
	BW (bandwidth) Button	Bandwidth selection settings: <ul style="list-style-type: none"> • 6 MHz • 7 MHz • 8 MHz
	Transmitter Source Button	Transmitter source video output selection (may vary per system): <ul style="list-style-type: none"> • Off • High Resolution (with overlay) • High Resolution Clean • Low Resolution (with overlay) • Analog
	Encryption Mode Selection	Accesses the Encryption Mode selections: <ul style="list-style-type: none"> • Bypass • Alpha • Bravo • Charlie • Delta

5.1.2.2 DVBT System Modulation Bit-rates at 6 GHz

Refer to [Table 5-2](#) for the system modulation bit-rates.

Table 5-2. Bitrates for 6 MHz DVB-T System

Modulation	Coding Rate*	Guard Interval**			
		1/4	1/8	1/16	1/32
QPSK	1/2	3.732	4.147	4.391	4.524
	2/3	4.976	5.529	5.855	6.032
	3/4	5.599	6.221	6.587	6.786
	5/6	6.221	6.912	7.318	7.540
	7/8	6.532	7.257	7.684	7.917
16-QAM	1/2	7.465	8.294	8.782	9.048
	2/3	9.932	11.059	11.709	12.064
	3/4	11.197	12.441	13.173	13.572
	5/6	12.441	13.824	14.637	15.080
	7/8	13.063	14.515	15.369	15.834
64-QAM	1/2	11.197	12.441	13.173	13.572
	2/3	14.929	16.588	17.564	18.096
	3/4	16.796	18.662	19.760	20.358
	5/6	18.662	20.735	21.955	22.620
	7/8	19.595	21.772	23.053	23.751

5.1.2.3 DVBT System Modulation Bit-rates at 7 GHz

Refer to [Table 5-3](#) for the system modulation bit-rates

Table 5-3. Bitrates for 7 MHz DVB-T System

Modulation	Coding Rate*	Guard Interval**			
		1/4	1/8	1/16	1/32
QPSK	1/2	4.354	4.838	5.123	5.278
	2/3	5.806	6.451	6.830	7.037
	3/4	6.532	7.257	7.684	7.917
	5/6	7.257	8.064	8.538	8.797
	7/8	7.620	8.467	8.965	9.237
16-QAM	1/2	8.709	9.676	10.246	10.556
	2/3	11.612	12.902	13.661	14.075
	3/4	13.063	14.515	15.369	15.834
	5/6	14.515	16.127	17.076	17.594
	7/8	15.240	16.934	17.930	18.473

Table 5–3. Bitrates for 7 MHz DVB-T System

Modulation	Coding Rate*	Guard Interval**			
		1/4	1/8	1/16	1/32
64-QAM	1/2	13.063	14.515	15.369	15.834
	2/3	17.418	19.353	20.491	21.112
	3/4	19.595	21.772	23.053	23.751
	5/6	21.772	24.191	25.614	26.390
	7/8	22.861	25.401	26.895	27.710

5.1.2.4 DVBT System Modulation Bit-rates at 8 GHz

Refer to [Table 5–4](#) for the system modulation bit-rates

Table 5–4. Bitrates for 8 MHz DVB-T System

Modulation	Coding Rate*	Guard Interval**			
		1/4	1/8	1/16	1/32
QPSK	1/2	4.976	5.529	5.855	6.032
	2/3	6.635	7.373	7.806	8.043
	3/4	7.465	8.294	8.782	9.048
	5/6	8.294	9.216	9.758	10.053
	7/8	8.709	9.676	10.246	10.556
16-QAM	1/2	9.953	11.059	11.709	12.064
	2/3	13.271	14.745	15.612	16.086
	3/4	14.929	16.588	17.564	18.096
	5/6	16.588	18.431	19.516	20.107
	7/8	17.418	19.353	20.491	21.112
64-QAM	1/2	14.929	16.588	17.564	18.096
	2/3	19.906	22.118	19.516	24.128
	3/4	22.394	24.882	26.346	27.144
	5/6	24.882	27.647	29.273	30.160
	7/8	26.126	29.029	30.737	31.668

*** Coding Rate Setting:**

The coding rate setting determines how much forward error correction is used to reduce the video data loss while in use on moving vehicles, particularly aircraft. If the coding rate is set to 1/2, then half of the available data rate is being used for error correction and the remaining available data for video.

NOTE: a code rate of 1/2 consumes most of the bandwidth for error correction, but also provides the highest degree of protection against video interference.

**** Guard Interval:**

The guard interval provides resistance to multipath and co-channel interference. Longer guard intervals are used in areas where high levels of multipath are found such as dense metro areas. A guard interval of 1/4 is the longest while, conversely, a guard interval 1/32 is the shortest

5.1.2.5 Upper Transmitter Panel - Power Tab

The upper panel Transmitter screen, Power page includes the power toggles for the linkbox including all four twenty-eight volt (28 VDC) buttons for the linkbox power, the power amplifier, the transmitter power and all twelve volt (12 VDC) power buttons (see [Figure 5-6](#)).

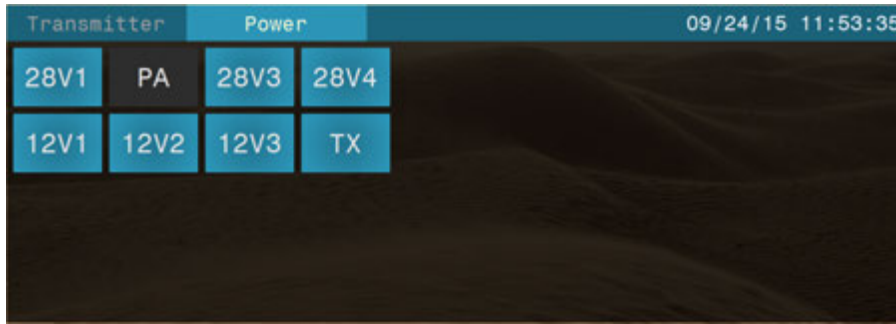


Figure 5-6. Transmitter Panel Power Page

5.1.3 POS Screen Antenna Tab Page Panels

Pressing the POS button on the lower panel accesses the upper panel Antenna screen (refer to [Figure 5-4](#) and [Figure 5-7](#)).

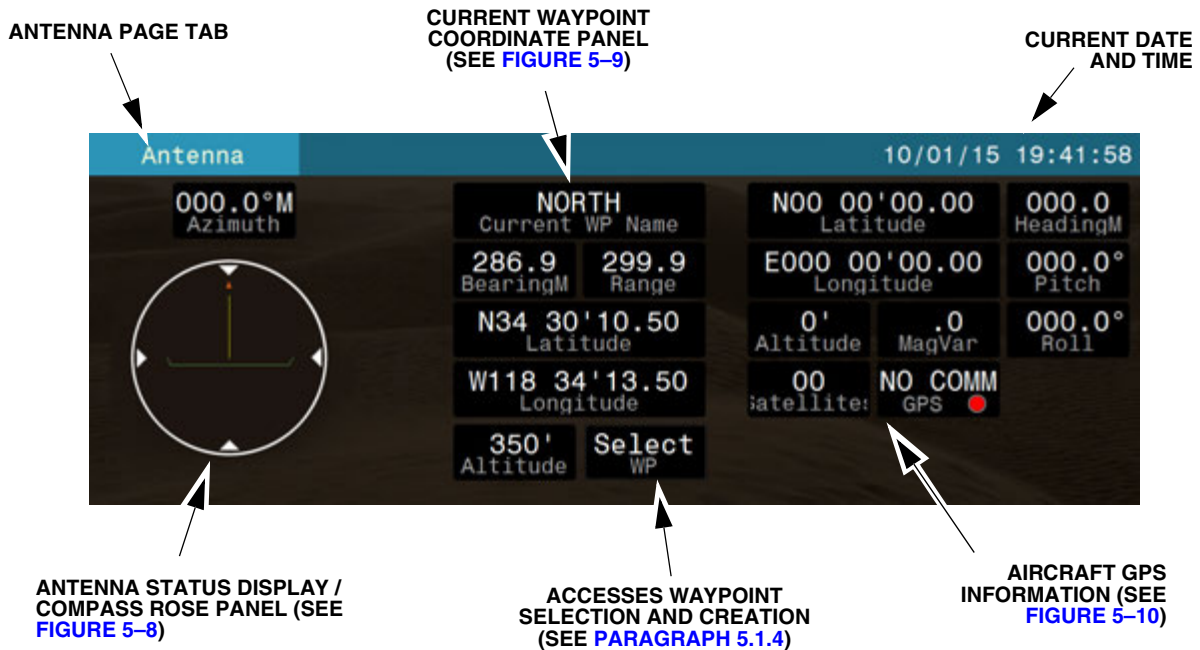


Figure 5-7. Antenna Screen Panels

5.1.3.1 Antenna Screen - Compass Rose Panel

The Compass Rose panel includes a graph indicating the position of the antenna's high-gain feed's actual control position as well as the command (pending) position (refer to [Figure 5-8](#)).

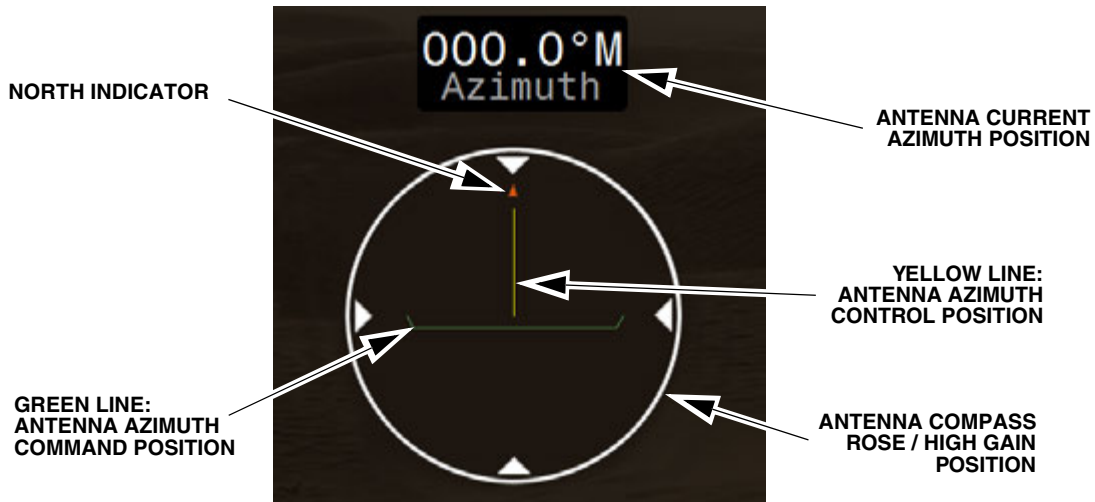


Figure 5-8. Compass Rose and Receiver Status Meters

5.1.3.2 Antenna Screen - Waypoint Status Panel

The Waypoint status panel provides information regarding the selected Waypoint location, bearing and range as well as the geographical status (see [Figure 5-9](#)).

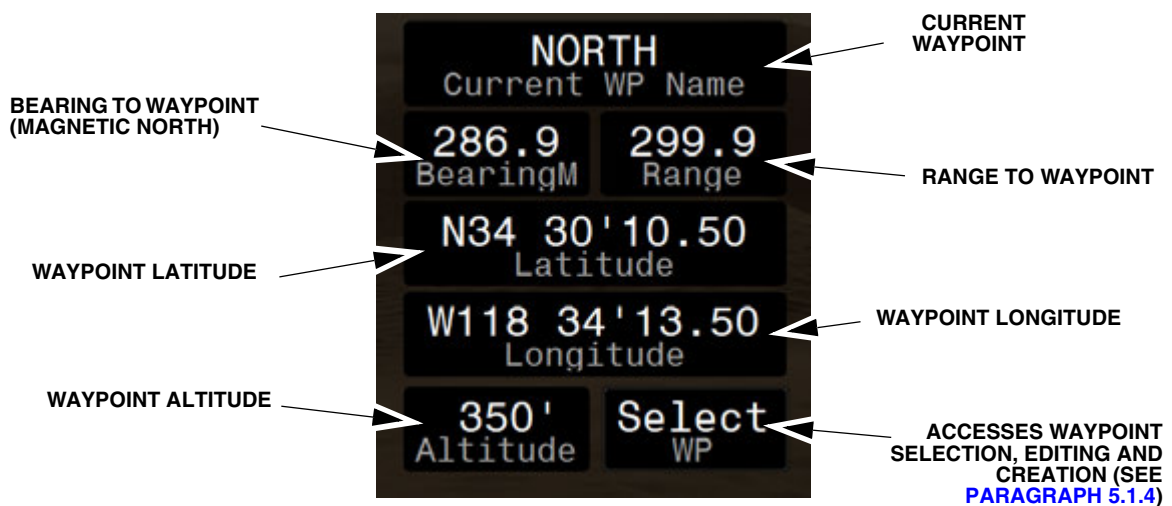


Figure 5-9. Aircraft to Waypoint Status Panel

5.1.3.3 Antenna Screen - Aircraft Panel

The Antenna screen aircraft panel provides aircraft status information including latitude, longitude and altitude as well as the GPS operational status (see [Figure 5-10](#)).

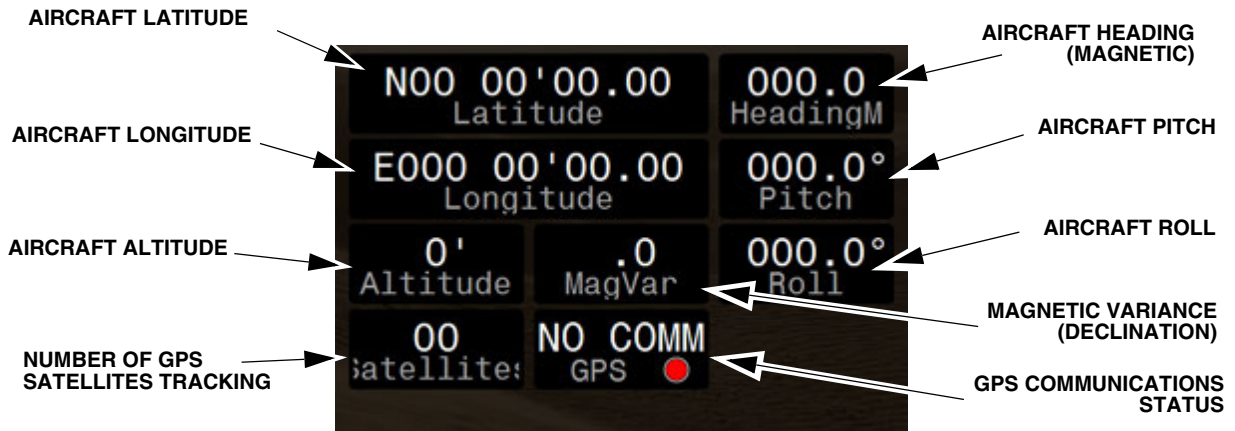


Figure 5-10. Antenna Screen Aircraft Panel

5.1.4 Waypoints

Waypoints are pre-programmed locations by which the signal tracking, the IMU and the GPS combine to provide navigation and targeting related functionality and data.

Press the WP button located at the bottom of the Waypoints status panel on the Antenna screen to access the Waypoints tool (see [Figure 5-11](#)).

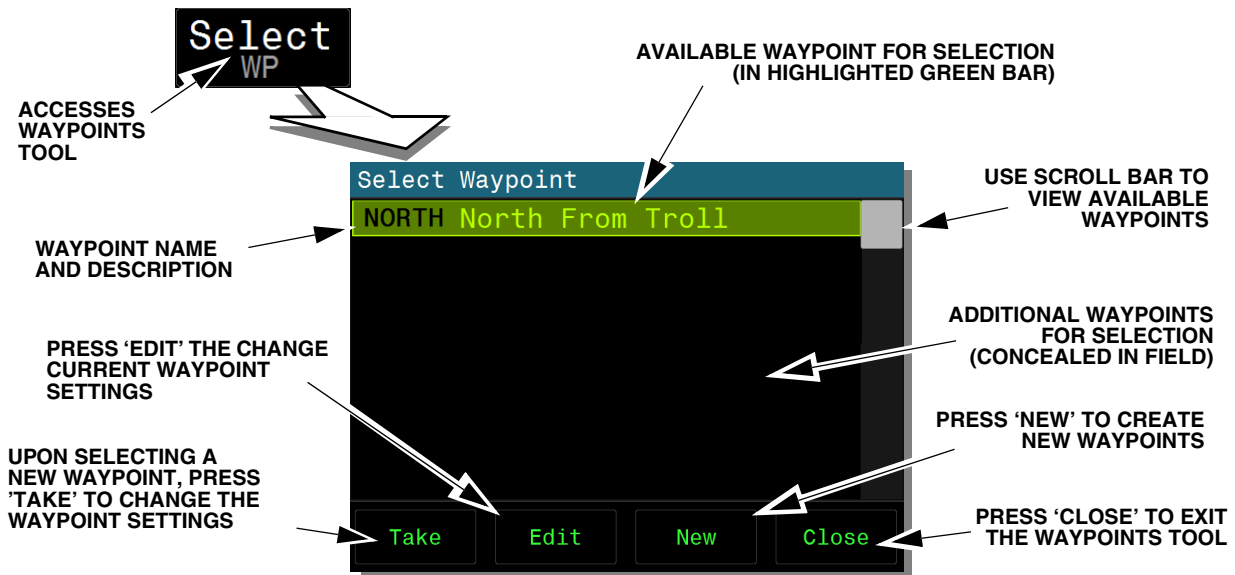


Figure 5-11. Accessing Waypoints

5.1.4.1 Selecting Waypoints

To select a new Waypoint, scroll down through the Waypoint selection menu using the scroll bar (refer to [Figure 5-11](#)), select the required new Waypoint on the GUI screen then press the TAKE button at the bottom of the menu.

5.1.4.2 Creating a New Waypoint

To create a new Waypoint, press the “New” button on the Waypoint panel (refer to [Figure 5-11](#) and [Figure 5-12](#)). Doing so will access the Waypoint creation tool.

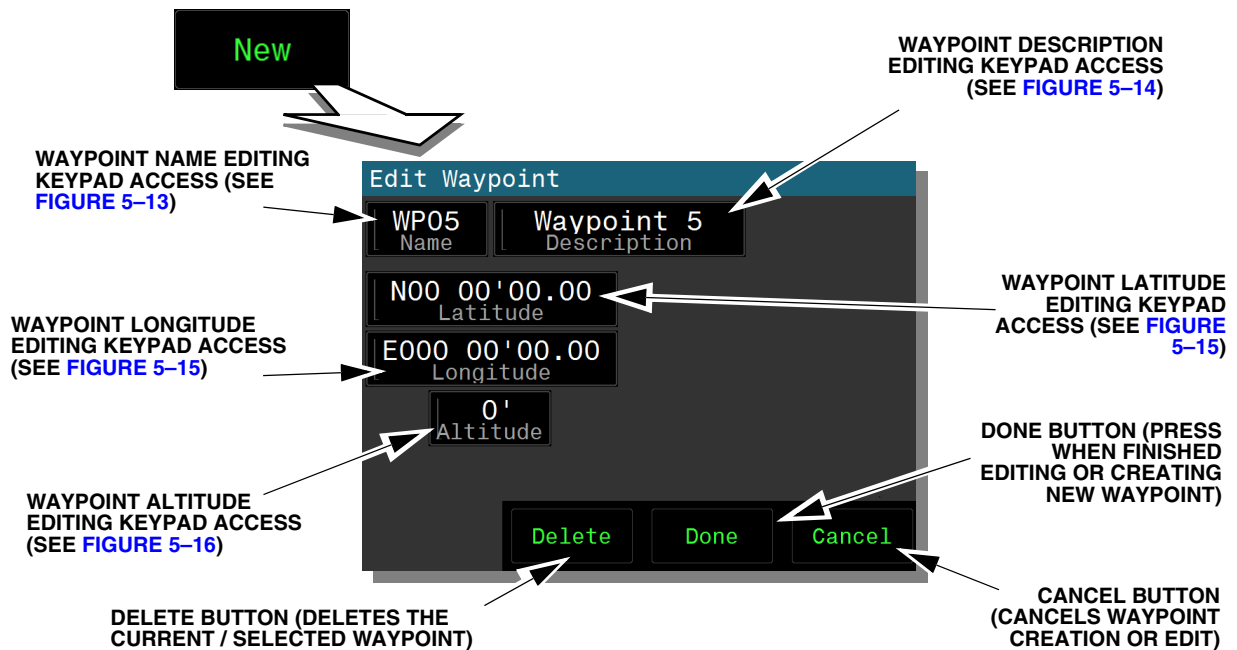


Figure 5-12. “New” Waypoint Editing Tool

The Waypoint creation tool provides several options for creating the new Waypoint including:

- Name (refer to [Figure 5-13](#))
- Description (refer to [Figure 5-14](#))
- Latitude (refer to [Figure 5-15](#))
- Longitude (refer to [Figure 5-15](#))
- Altitude (refer to [Figure 5-16](#))

5.1.4.3 Waypoint Name and Description

Upon selecting to create a new Waypoint, the system will automatically provide a default name in a numerical order (e.g. WP01, WP02 etc) and also provide a default description (Waypoint 1, Waypoint 2, etc.). The default name and description will remain unless the user chooses to edit the default name and description.

To provide a name for the new Waypoint, press the Name button located in the top, left corner of the Waypoint creation tool (see [Figure 5–12](#)). Upon pressing the button, a virtual "Qwerty" keyboard will open on the screen (see [Figure 5–13](#)), providing a tool to immediately edit the name.

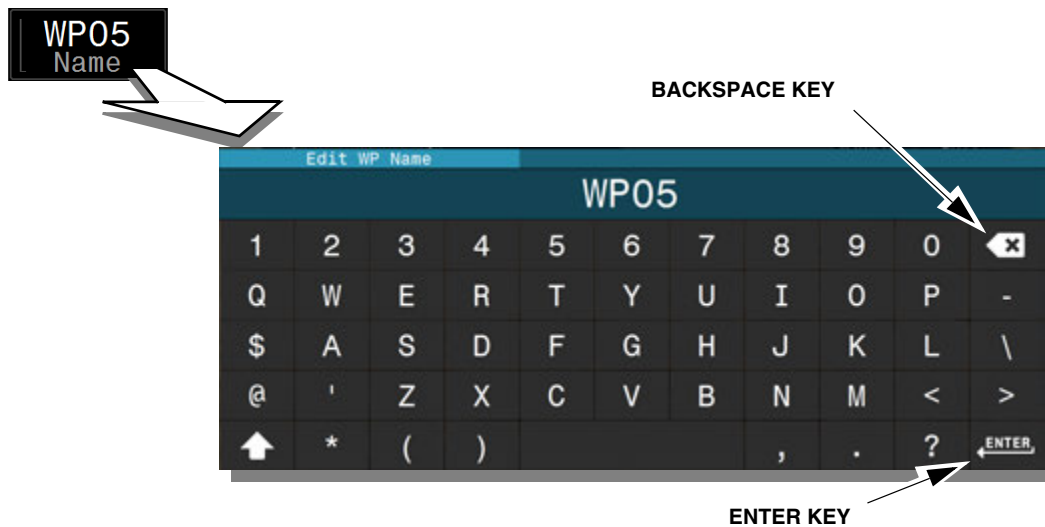


Figure 5–13. Waypoint Name Editing Keyboard

To edit the default name, press the backspace key to delete the default name characters, from right to left, and then type in the replacement characters. Press Enter when finished.

Likewise, upon pressing the Description button, the Description editing keyboard will become accessible. Delete the default description characters and then type in the replacement description (refer to [Figure 5–14](#)).

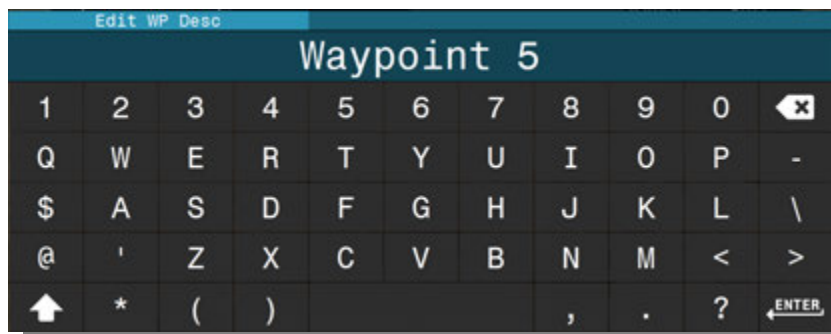


Figure 5–14. Waypoint Description Editing Keyboard

5.1.4.4 Waypoint Latitude and Longitude

Pressing the Latitude and Longitude buttons accesses a virtual keypad for the settings of the corresponding geographical coordinates (refer to [Figure 5–15](#)). The Waypoint coordinates are in DMS (Degrees, Minutes, Seconds format) and are entered in a linear manner similar to the Waypoint Name and Description. The default for Latitude is N00 00' 00.00 and the Longitude default is E000 00' 00.00.

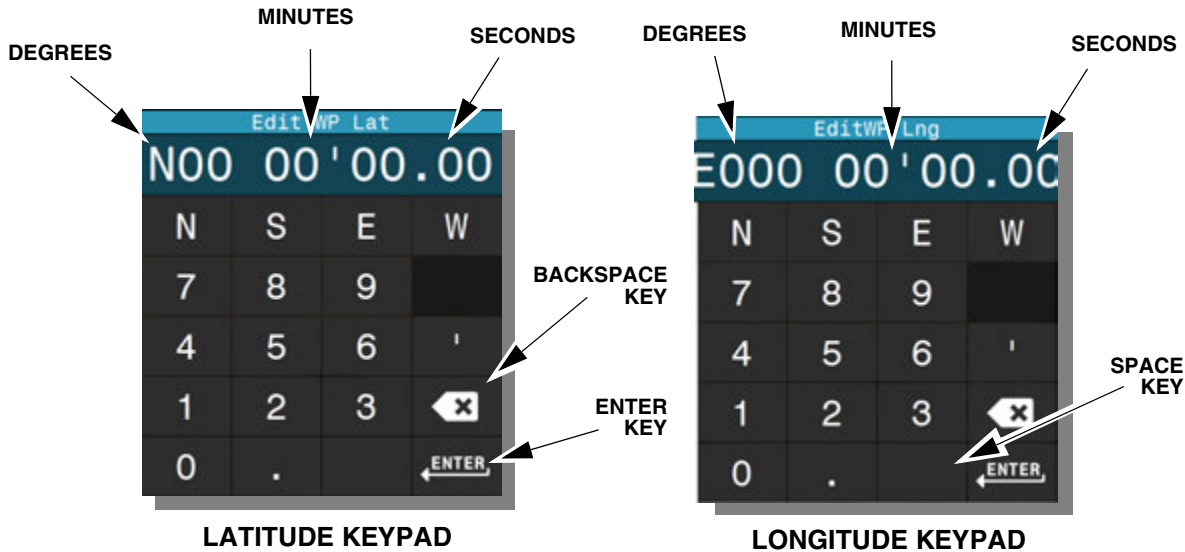


Figure 5–15. Latitude and Longitude Edit Keypads

To edit the coordinate to the required Latitude and Longitude, press the Backspace key, which will delete the characters from right to left. Enter the required coordinates from left to right, starting with the Degrees, then the Minutes and finally the seconds. For example, if the required Longitude is 122° 36' 52.5" W, then enter W followed by 122 for the Degrees. Enter the space key followed by 36' for the Minutes and finally enter 52.5 for the seconds, followed by the “Enter” key to confirm the entire entry.

5.1.4.5 Waypoint Altitude

Press the Altitude button to access the altitude editing tool (see [Figure 5–16](#)).

Pressing backspace clears the current or default entry allowing entry of the required Waypoint altitude in feet. Pressing the Minus key enters an altitude that is below sea level. When the required characters are entered, Press “Enter” to confirm the entry.

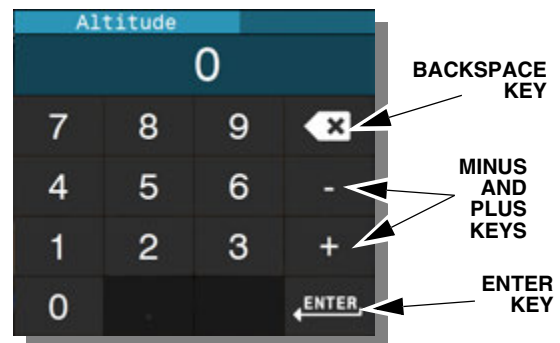


Figure 5–16. Altitude Edit Keypad

5.1.5 System Screens

The bright, button sized indicator on the left end of the lower panel is, in fact a button that accesses the system screens (see [Figure 5-17](#)).

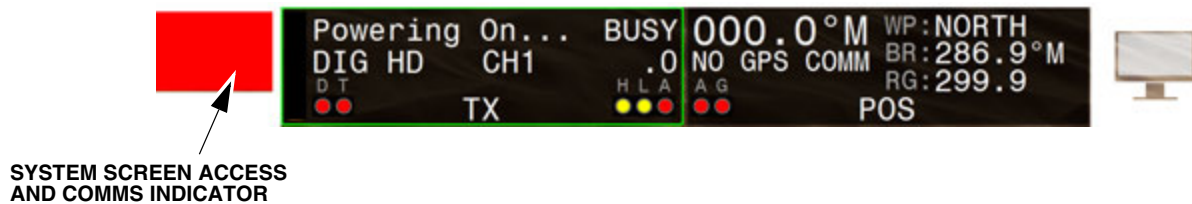


Figure 5-17. System Screen Access Button

5.1.5.1 System Status Page

Upon pressing the button the system screens will open (refer to [Figure 5-18](#)). The default System screen is the Status page tab showing in the upper panel with system status displays and indicators. The System Status lower panel is a message panel which displays messages alerting the user of errors or faults to the software application's functionality. Touching the lower panel will cycle through the messages, eventually clearing all of the messages.

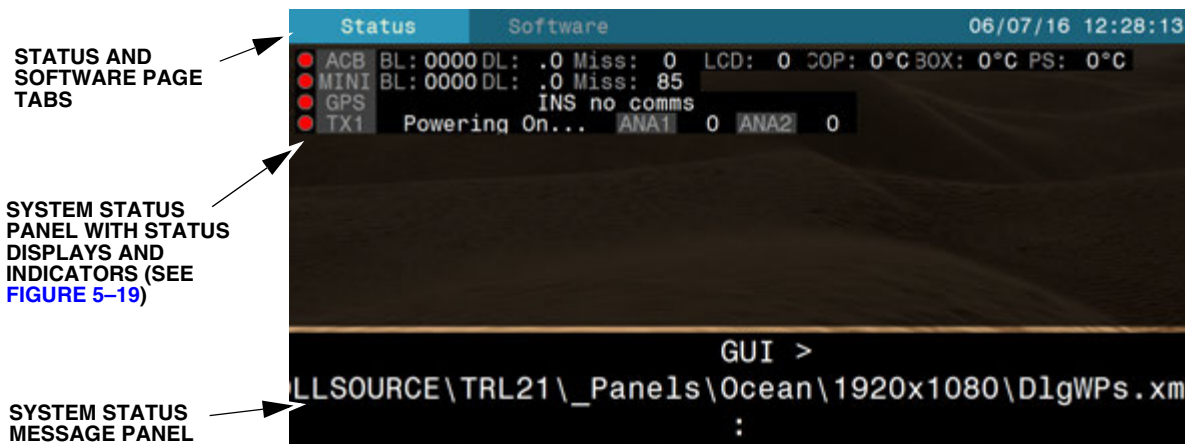


Figure 5-18. System Screen Status Panels



NOTE: If the user has questions or concerns regarding the messages and the software application's functionality, contact Troll Systems customer service at 661-702-8900

The status indicators panel shows the communications and operational status of several system functions including antenna comms, GPS, the DTM module, the transmitter and the Altitude Heading Reference System, or AHRS (see [Figure 5-19](#)).

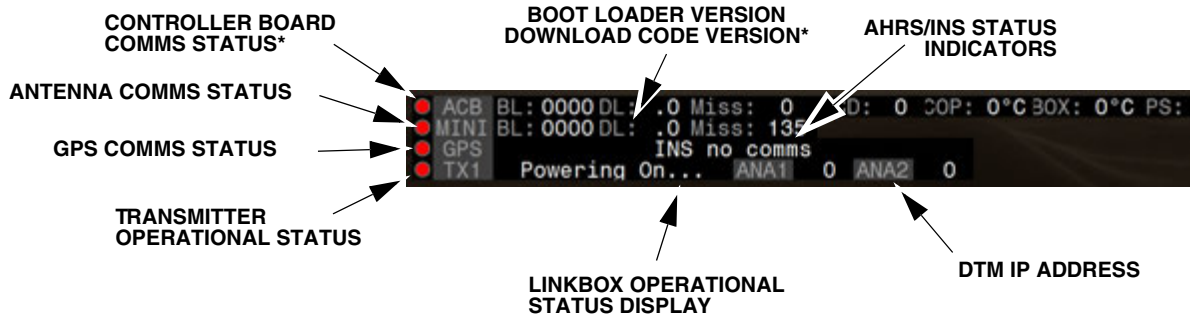


Figure 5-19. System Screen Status Indicator Panel

5.1.5.2 System Software Page

Pressing the software tab accesses the system software page which display the software information including software version, build, MAC address and the IP address (see [Figure 5-20](#)).

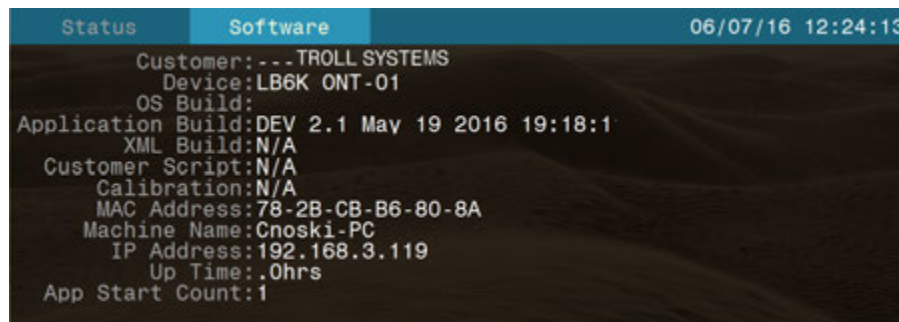


Figure 5-20. System Software Information Page

6. MAINTENANCE AND TROUBLESHOOTING

This section includes system maintenance requirements as well as troubleshooting suggestions to aid in any system operational issues. In the event of a malfunction, this section contains information and procedures for the maintenance and troubleshooting of issues that could occur that may effect the proper operation of the system. Refer to the following sections herein to address these potential issues and the suggested procedures to correct them. In the event that the issue is not addressed in the Troubleshooting section, or the suggested action does not correct the problem, contact the manufacturer at the contact information listed within the manual herein.

6.1 MAINTENANCE

The linkbox does not have any maintenance requirements.

6.2 TROUBLESHOOTING

If a malfunction or operational anomaly occurs during usage of the airborne system, refer to the following Troubleshooting table to identify and possibly correct the problem.

Refer to [Table 6–1](#) for troubleshooting suggestions:

Table 6–1. Troubleshooting the Controller

Symptom	Probable Cause	Suggested Action
The Linkbox screen is blank, front panel indicators are not illuminated.	1. Power is not being supplied to the Linkbox.	1. Check 20 Amp aircraft circuit breaker. Reset if necessary. 2. The Linkbox is not turned ON.
Linkbox is not controlling the transmitter (not responding).	1. Transmitter is not Online (i.e., Online indicator on TX Page is red). 2. Transmitter is not properly configured on the Linkbox.	1. Verify that the transmitter is powered ON. Turn the transmitter ON via the TX Page (if powered OFF). 2. Check transmitter configuration. Correct configuration issues as necessary.

Table 6–1. Troubleshooting the Controller

Symptom	Probable Cause	Suggested Action
<p>The linkbox is not controlling the antenna.</p>	<ol style="list-style-type: none"> 1. Tracking antenna INS or AHRS requires calibration 2. Bad connection between Linkbox and antenna. 	<ol style="list-style-type: none"> 1. Open the System, Test VN200 page and confirm that the Linkbox reports the INS module is aligned. Re-calibrate if necessary. 2. Perform the following test to confirm that the linkbox is communicating with the antenna system: <ol style="list-style-type: none"> a. Activate the Antenna (ANT) Panel. b. Set the antenna to Manual (MAN) control. c. Configure the antenna for Slew (SLW) operation by pushing softkey 3 (below MAN on the Action Bar) for approximately one (1) second. d. Confirm that SLW operation is active. e. Rotate the selection knob on the front panel in either direction to manually move the antenna. f. If manual control of the antenna was accomplished, then the problem exists with the INS module itself or the connections between it and the Linkbox. Check all connections. Restart Linkbox if possible and re-calibrate. g. Power cycle the Linkbox (i.e., turn the unit OFF and then back ON again).

Table 6–1. Troubleshooting the Controller

Symptom	Probable Cause	Suggested Action
The antenna is not pointing in the right direction.	<ol style="list-style-type: none"> 1. Azimuth not properly calibrated. 2. Magnetic interference near gyro. 3. An offset may be programmed and producing adverse effects. 	<ol style="list-style-type: none"> 1. Re-calibrate azimuth setting. 2. Remove/relocate item(s) causing magnetic interference. 3. Check all programmed offsets and adjust as necessary.
Unable to control the antenna.	<ol style="list-style-type: none"> 1. VN200 is not online. 2. Antenna set to Manual (MAN). 	<ol style="list-style-type: none"> 1. Check the ANT status button. If the antenna is set for manual operation (MA). 2. Return antenna control to NavTrack (NV).
Unable to “quick switch” Waypoint when the Antenna Panel (status button) is active.	<ol style="list-style-type: none"> 1. Antenna (ANT) set to Manual (MAN). 	<ol style="list-style-type: none"> 1. Set antenna to NavTrack (NAV).