3 GLOBETrekker Basics

What is the GLOBETrekker?

The Norsat® GLOBETrekker™ is the industry's leading backpackable broadband satellite system. It features built-in intelligence to enable a user to establish a reliable broadband link (up to 4Mbps) – anywhere in the world especially in remote, harsh and hostile environments.

The Norsat® GLOBETrekker™ represents the next generation of portable satellite systems. It is fully automated with both non-technical and 'power users' in mind. The GLOBETrekker comes equipped with a software application called LinkControl. LinkControl enables a user to configure and operate the terminal through an innovative user interface. The LinkControl software application has been designed such that the more advanced functions, such as commissioning (chapter 8); are performed by a Systems Administrator (such as an IT Manager or Life Cycle/Sustainment Manager). The regular operation of the GLOBETrekker terminal are accessible to all users in field mode.

The Norsat® GLOBETrekker™ is the intelligent choice. Unlike other packages, it is a highly integrated, complete system which includes a segmented carbon fiber antenna, motorized feed assembly, LNB, BUC, motorized azimuth/elevation superstructure, built-in inclinometer, compass, GPS and baseband unit with a modem, spectrum analyzer, SBC, DVB-S receiver, Ethernet switch, DC-DC converter, shock-protected chassis and jacket, and system control software with graphical user interface.

The Norsat® GLOBETrekker™ is a fully functional, ultra-portable satellite system that is airline checkable within the new, more stringent "Free Baggage" allowance requirements.

3 GLOBETrekker Basics

What is the GLOBETrekker Designed to Do?

The Norsat® Ultra-Portable Man-pack able Satellite Terminal, GLOBETrekker™, is designed for two-way IP data communication, from remote locations anywhere in the world, over geostationary satellites.

The Norsat® GLOBETrekker™ was designed from the inside out to be compact, ultra-portable and tough.

The Norsat® GLOBETrekker™ is the industry's first backpackable broadband satellite system setting new standards in portability. This attractive design cleverly addresses the need for a lightweight, rugged and ergonomically friendly system.

The Norsat® GLOBETrekker™ is designed to be transported and operated in even the most challenging environments. It is the only broadbandcapable satellite system which has been designed specifically to be parachute- and helicopter-friendly.

Identifying Basic Elements of the GLOBETrekker

Figure 8 Side View of Assembled GLOBETrekker

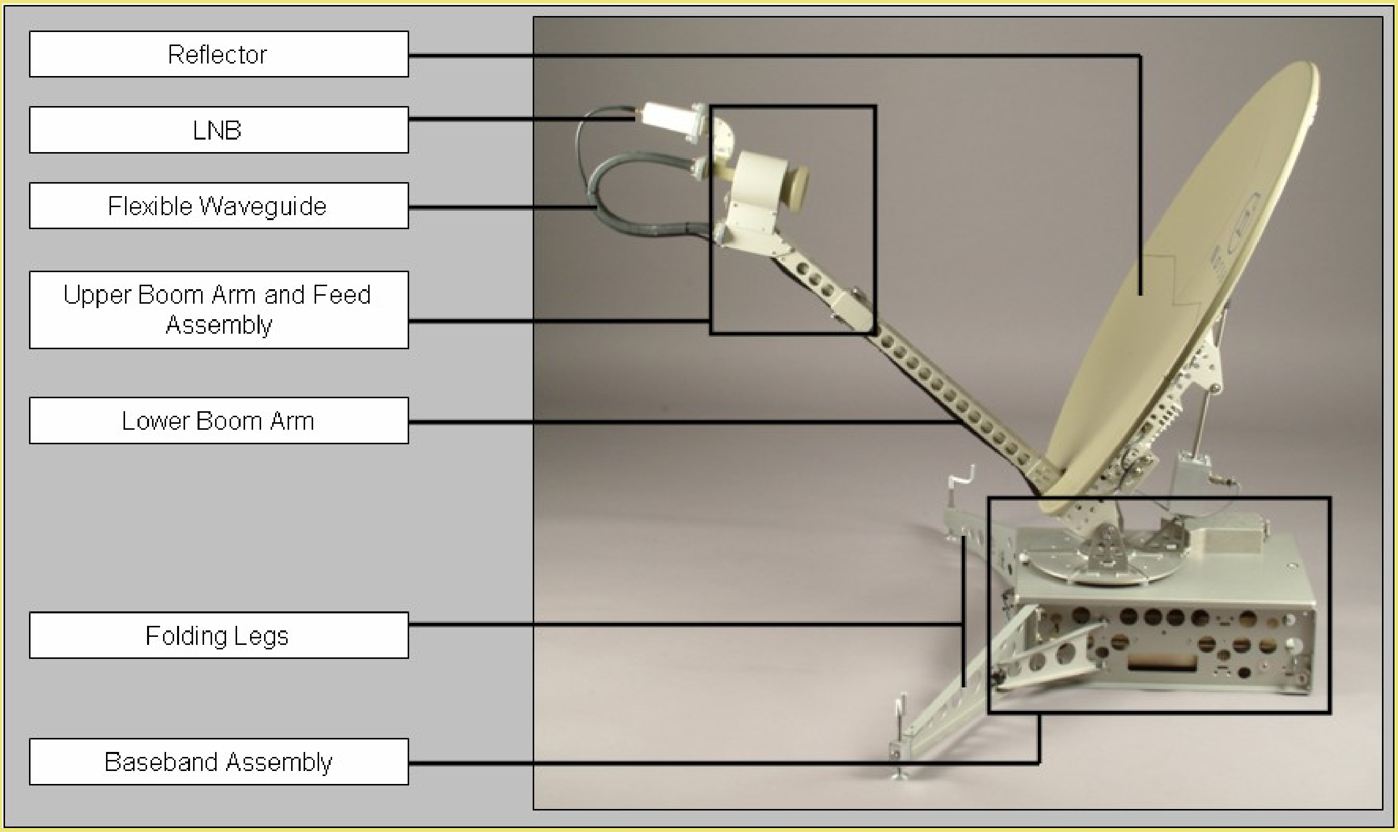


Figure 9 Rear View of Assembled GLOBETrekker Backplate

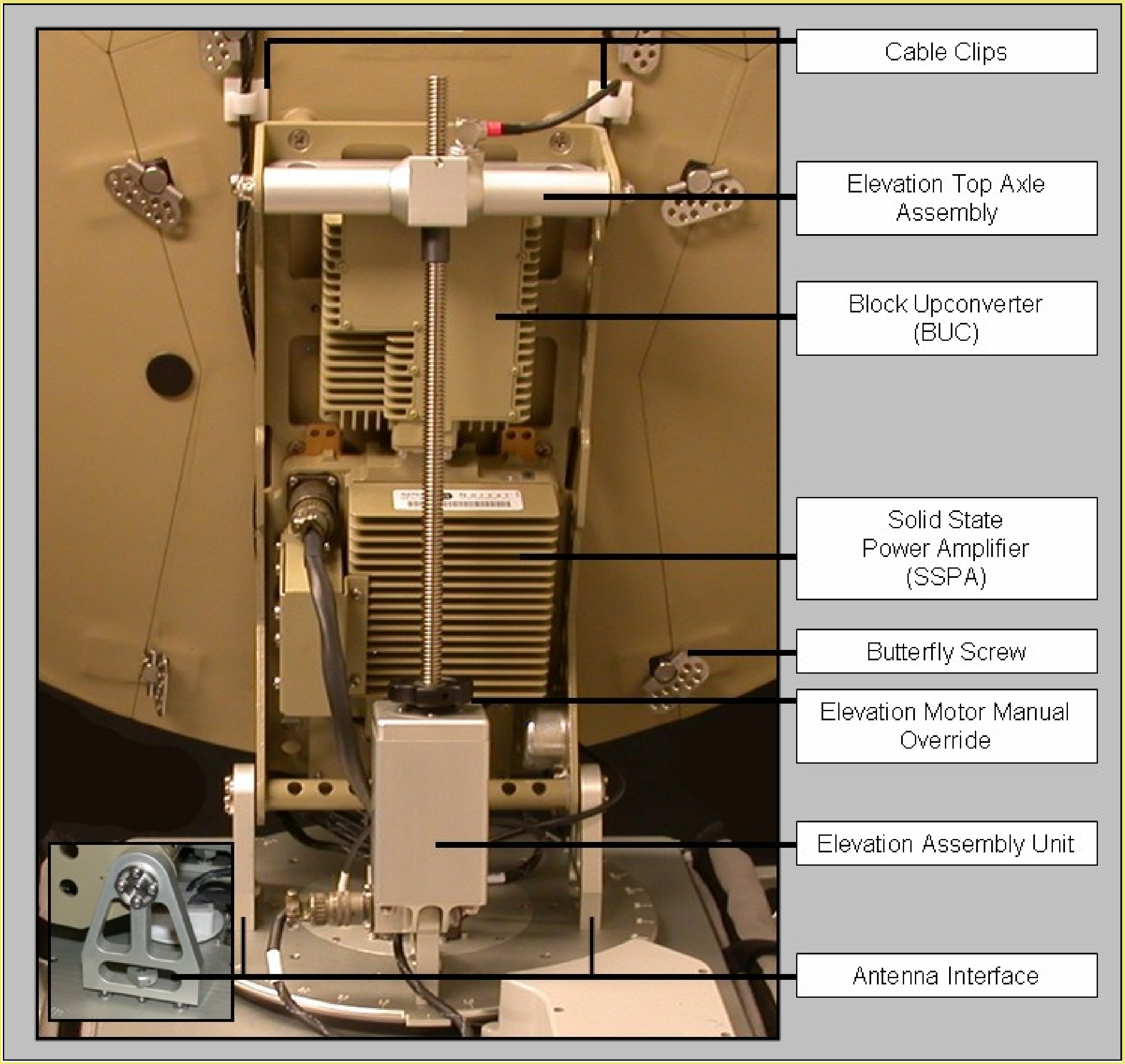
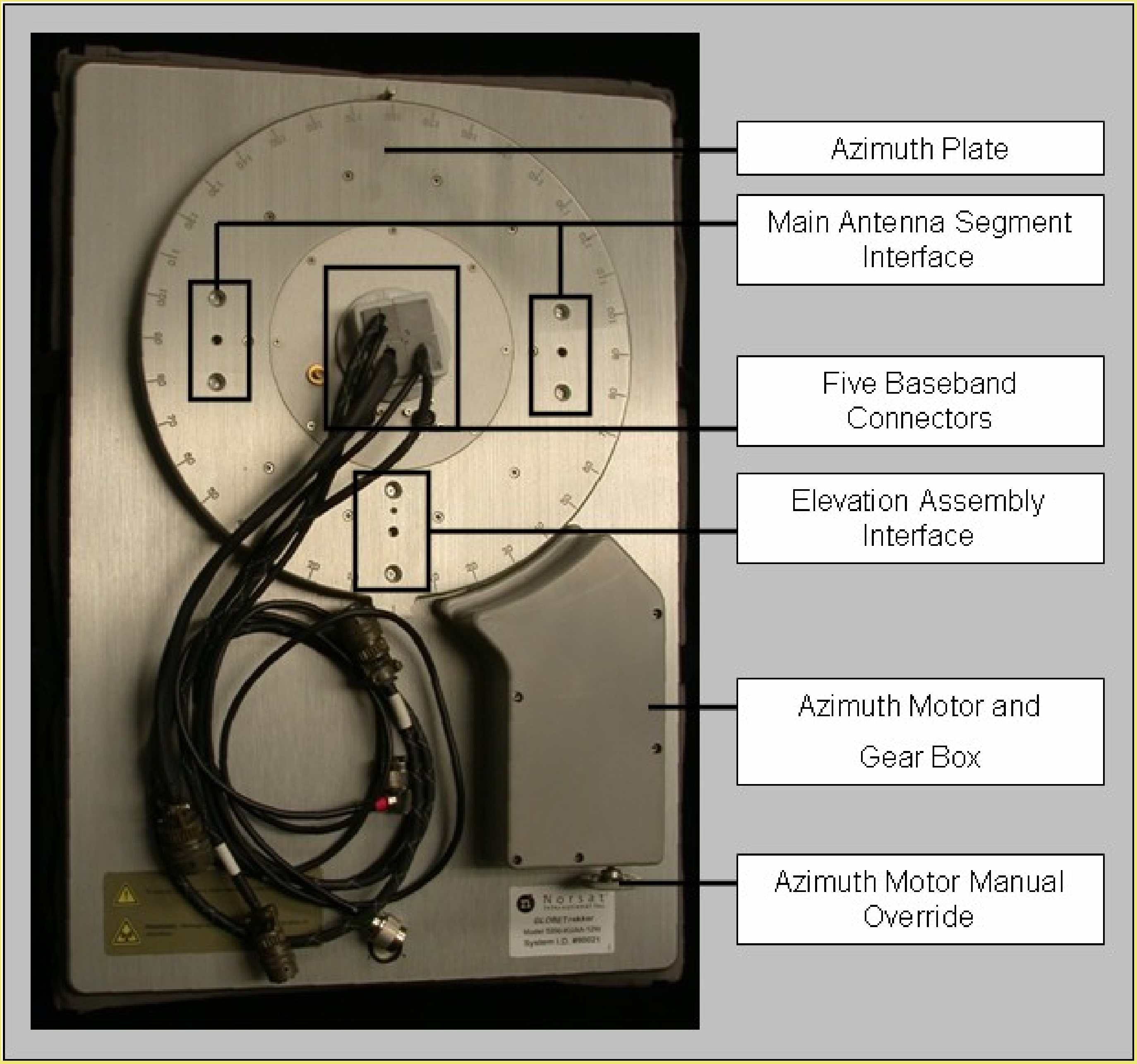


Figure 10 Top View of GLOBETrekker Baseband Unit



GLOBETrekker Basics

How Does the GLOBETrekker Work?

The GLOBETrekker system diagram can be reviewed in **Figure 11 GLOBETrekker Block Diagram**. The GLOBETrekker consists of the Baseband Assembly, Motorized Azimuth/Elevation Assembly, Antenna/RF Assembly, and a AC-DC power supply. Subcomponents of these assemblies are identified below. Details of each of these subcomponents have been included in this chapter under relevant subsections.

Baseband Assembly

The Baseband Assembly combines the following:

- Baseband unit with:
  - iDirect iConnex iNFINITI Modem
  - Single Board Computer [1](900MHz) with Microsoft ® XP Embedded Operating System and Norsat LinkControl application software
  - 5-port Ethernet Switch
  - DVB-S Receiver
  - Spectrum Analyzer
  - DC-DC Converter
  - GPS Receiver
- Custom Frame with Foldable Legs
- Protective Jacket

Motorized Azimuth/Elevation Assembly

The Azimuth/Elevation (Az/El) assembly houses the following components:

- Elevation Azimuth (Az) Unit
- Azimuth Main and Rotational Plate with Feedback Components
- Motor Control Board (inside)
- Azimuth Motor (including gear box)
- Azimuth Motor Manual Override

[1] Single Board Computer = SBC. A single-board computer is a complete computer built on a single circuit board. The design is always centered around a microprocessor.

Antenna/RF Unit

The RF/Antenna unit includes the following components:

- 1m segmented (6) carbon fiber antenna reflector
- Quick-connect BUC/SSPA assembly
- Inclinometer
- Lower boom arm segment (with transmit fixed waveguide and Harmonic filter)
- Upper boom arm and feed assembly (includes Transmit fixed waveguide and Receive Reject filter, and motorized cross-pol compensated feed/OMT/Transmit Reject filter assembly)
- LNB quick-connect assembly set (3)
- Transmit flexible waveguide
- Compass/GPS antenna unit

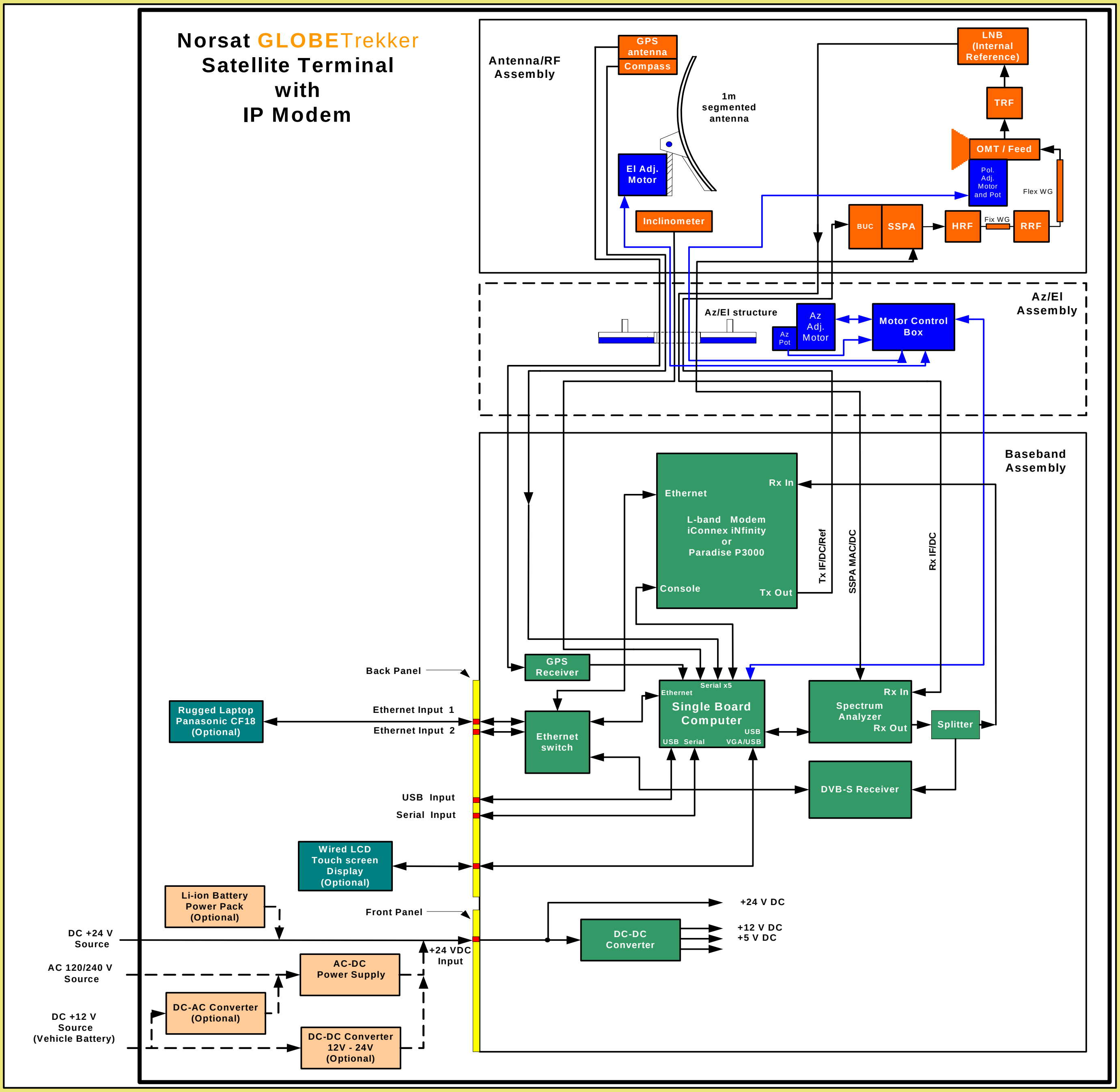
Transmit Path

The transmit side of the uplink chain starts at the Baseband unit with the modem output IF frequency in the L-band range of 950 – 1700 MHz. The exact output frequency is selected by the modem and is a function of the final carrier frequency at the antenna output. The frequency conversion is achieved by the block upconverter (BUC), which shifts the L-band output frequency of the modulator to a desired higher (Ku-band) frequency. The BUC is paired with a Solid State Power Amplifier (SSPA).

All BUC/SSPA options (4W, 8W, 12W, 15W and 20W) are hermetically sealed and are mounted to the back of the reflector. More powerful BUC/SSPA options (25W or 40W) can also be supplied as needed (not integrated).

The output of the BUC/SSPA is fed to the Harmonic (HRF) and Receive Reject Filter (RRF) filters. Harmonic reject filters attenuate all harmonics produced in the BUC/SSPA due to its nonlinearities. Similarly, RRF filters provide attenuation outside the desired transmitter band; specifically receive frequency range from 10.95 GHz to 12.75 GHz, preventing Receive performance degradation due to the injection of noise from the transmit to receive path. Finally, through a flexible waveguide the transmitter signal is applied to the antenna feed through an Orthogonal Mode Transducer (OMT) which isolates the outbound signal from the receive signal. The feed horn feeds energy into the antenna. The directivity of the feed horn is added to that of the antenna resulting in a pattern that is a narrow and concentrated beam.

Figure 11 GLOBETrekker Block Diagram (iDirect or Paradise)



Antenna Parameters

The GLOBETrekker is available in both the regular transmit frequency range of 14.0 to 14.5 GHz and in the extended frequency band of 13.75 GHz to 14.5 GHz.

The transmit gain on the antenna is 41.9 dBi at 14.125 GHz.

On the receive side, the frequency coverage is from 10.95 GHz to 12.75 GHz, segmented into three sections:

- 10.95 GHz to 11.70 GHz
- 11.70 GHz to 12.20 GHz
- 12.25 GHz to 12.75 GHz

The measured gain at the receive Ku-band is 39.5 dBi at 10.95 GHz (worst case scenario).

The G/T of the antenna is:

- 19.4 dB/K at 10.95 GHz
- for an elevation angle of 10 degrees
- an antenna temperature of 43^0 K
- and the LNB noise figure of 0.8 dB

The antenna is linearly polarized where the polarization selection can either be Vertical/Horizontal (V/H) or Horizontal/Vertical (H/V) on the transmit and receive sides.

Complete details of the antenna parameters are shown in **Table 3 Antenna Parameters**.

Table 3 Antenna Parameters	
RF/Antenna	**Ku-band**
Transmit Frequency	13.75 GHz – 14.50 GHz (5200KuAA-#W-E) 14.00 GHz – 14.50 GHz (5200KuAA-#W)
Receive Frequency	10.95 GHz – 11.70 GHz 11.70 GHz – 12.20 GHz 12.25 GHz – 12.75 GHz
RF Power (SSPA Output)	4 W 8 W 12 W 15 W 20W
EIRP (at 1dB compression point)	46.5 dBW (4W) 49.5 dBW (8W) 51.3 dBW (12W) 52.3 dBW (15W) 53.5 dBW (20W)
G/T	19.4 dB/K (10° elevation, antenna temperature 43° K)
LNB Noise Figure	0.8 dB
Antenna	1m carbon fiber, segmented (6)
Antenna Tx Gain at 14.125GHz	41.9 dBi
Antenna Rx Gain at 10.95 GHz	39.5 dBi
Antenna Platform	Motorized El over Az Mounted on support frame
Polarization Configuration	Linear Cross-pol, -90° to +135° Motorized, resolution <0.25°
Elevation Adjustment	10-85°, Motorized, resolution < 0.1°
Azimuth Adjustment	+/- 175°, Motorized, resolution < 0.1°

Receive Path

The isolation between the transmit and receive side is achieved through the use of the OMT (Ortho Mode Transducer) and the TRF (Transmit Reject Filter).

The TRF serves to further isolate the two sides with the receive polarization being orthogonal to the transmit polarization.

The Ku-band receive signal at the output of the transmit reject filer, at the input of the LNB, is at the standard Ku-band frequency (10.95 GHz to 12.75 GHz). A block Down-Converter translates the RF frequency into an L-band output (950 MHz to 1700 MHz) required by the modem. The output of the LNB is also fed to the spectrum analyzer to assist with pointing the antenna and to facilitate system monitoring.

Modem down-converts, demodulates and decodes the incoming signal. The data is then routed to its destination via the integrated 10/100 Mbps auto-negotiating Ethernet switch.

The G/T of the terminal is 19.4 dB/^{0}K at a 10^0 elevation angle.

Modem (iDirect)

The iDirect iConnex iNFINITI modem is capable of operating in Hub-Spoke, Star, and Mesh modes. It can also use the same Hub to support Star, Star/Mesh, and SCPC topologies.

The modem supports multi frequency operation (MF-TDMA) on a burst-by-burst basis. The modem enables outbound signaling from the hub to the spoke terminals in TDM with data rates of up to 17.8 Mbps. Inbound signaling from the spokes to the hub in DMF-TDMA is currently possible at data rates of up to 4.2 Mbps.

Turbo Product Code (TPC) forward error correction is:
- Inbound (spoke to Hub) 0.660 or 0.793
- Outbound (Hub to spoke) 0.793

Table 4 Baseband Parameters shows the details for Baseband unit.

Table 4 Baseband Parameters	
Baseband	**Ku - Band**
RF Interfaces	
Tx out Rx In	950 -1450 (1750) MHz 950 - 1700 MHz
Modem Type	iDirect iConnex iNFINITI
Data Interface	10/100 Base-T Ethernet
Network Topology	Star, Mash or SCPC
Channel Access Scheme	TDM (Downstream) D-TDMA (Upstream)
Modulation	QPSK
Data Rates	128 Kbps - 18MBps (Downstream) 64 Kbps - 4.2 Mbps (Upstream)
Error Control	TPC* Rate 0.793, 0.533, 0.879 (downstream) TPC Rate 0.793, 0.66 and 0.533 (Upstream) *TPC = Turbo Product Coding

The iDirect modem is also a fully functional IP router supporting both static routing and dynamic routing using the RIP (Routing Information Protocol) protocol.

The iDirect modem also provides a TCP-IP routing function supporting the following protocols:

- TCP (Transmission Control Protocol)
- UDP (User Datagram Protocol)
- ICMP (Internet Control Message Protocol)
- IGMP (Internet Group Management Protocol)
- Static Routing
- NAT (Network Address Translation)
- DHCP (Dynamic Host Configuration Protocol)
- DNS (Domain Name System) Caching

Power Configuration Options for the Assemblies

The GLOBETrekker is designed to operate both with DC as prime and AC as an optional power source. The AC/DC power supply has universal, auto-sensing, AC input allowing operation with 110/220 VAC.

The input frequency into the AC/DC power has a range of 47 to 63 Hz. A stable input DC power is generated for terminal electronics when the AC variation is limited on the lower voltage side to 92 volts or over -15% variations at the input.

A DC-to-DC converter translates the 24V DC to +5V and +12V. This is required for different parts of the electronics.

Baseband Connections: Baseband – Antenna/RF Interface

There are five connections originating at the baseband unit. These connections provide the user control over the operation of both receive and transmit functions as well as control of the SSPA and access to the alignment tools via the LinkControl software interface.

Receive IF (Rx) Cable

The Receive IF (Rx) cable is a 50 ohm coaxial cable with a N-type male connector. This connector has been color coded green.

The signals supplied on this interface are:

- Receive IF: the received signal amplified and downconverted by the LNB and supplied to the baseband unit
- 24V DC: supplied to the LNB

This interface does not supply a 10 MHz signal.

Transmit IF (Tx) Cable

The Transmit IF (Tx) cable is a 50 ohm coaxial cable with a N-type male connector. This connector has been color coded red.

The signals supplied on this interface are:

- Transmit IF (950 to 1700 MHz) signal to be upconverted, amplified and transmitted to the satellite. This signal may either be a continuous wave (CW) or modulated signal.
- 10 MHz reference: provides a reference signal for the BUC (Block Upconverter)
- 24 V DC: supplied to the BUC (Block Upconverter)

The transmitter (or BUC), that is located at the base of the antenna, needs the 10MHz signal in order to be unmated and operational.

SSPA Monitoring and Control (M&C) and DC Cable

The SSPA M&C and DC cables consist of a 24 AWG and 16 AWG wire cable with a multi-pin amphenol female connector.

The signals supplied on this interface are:

- SSPA Current: provides indication of the SSPA current consumption. This measurement is displayed in LinkControl Status screen and is used in the power control algorithms.
- SSPA Mute Control: allows the SSPA to be turned OFF/ON via LinkControl.
- SSPA Temperature Sensor Reading: provides an indication of the SSPA temperature. This measurement is displayed in LinkControl Status screen and is used in the power control algorithms.
- SSPA Power Detector Reading: provides an indication of the SSPA transmitted power. This measurement is displayed in LinkControl Status screen and is used in the power control algorithms.
- Received Signal Strength Indication: provides an indication of the received signal strength at frequency specified in LinkControl. The receive signal strength is measured in the Baseband unit and is displayed LinkControl.
- Fan Alarm: provides an indication of the amount of current the fan is consuming.
- Ground: ties the chassis of the Baseband and Antenna/RF units together.
- +24 VDC: provides power to the SSPA.

Alignment Tools Cable

The Alignment Tools connectors originating from the baseband unit include the elevation motor control, polarization motor control, inclinometer, compass and GPS antenna input.

The signals supplied through these interfaces are:

Elevation (El) motor control:	Provides power control to the elevation motor used in antenna alignment and auto-acquire functions.
Polarization motor control:	Provides power control to the polarization motor on the feed assembly and polarization (Pl) angular position feedback to the Baseband unit. The polarization motor is used in polarization alignment and auto-acquire functions.
Inclinometer:	Provides Elevation angular position feedback and used in antenna alignment and auto-acquire functions.
Compass:	Provides Azimuth heading and is used in antenna alignment and auto-acquire functions.
GPS:	Provides location of the terminal. It is used in antenna alignment and auto-acquire functions for initial calculation of the Azimuth (Az), Elevation (El) and Polarization (PL) angles.

4 Transporting the Backpack

Topics Covered:

Norsat GLOBETrekker

Mounting the Backpack

1. Ensure there is sufficient slack in both straps. The strap should be loose enough so that you do not need to bend into the backpack.
2. Stand perpendicular to the backpack at a distance of approximately 6 inches (15 cm). If you are right (left) handed, your right (left) shoulder should be closest to the backpack.
3. Place your feet shoulder-width apart.

4. Kneel on the left (right) knee if you are right (left) handed. Place your right (left) knee at a 90° angle to the floor.

4 Transporting the Backpack

5 Slide your right (left) arm through the right (left) strap. Cup the bottom right (left) hand corner of the backpack with your right (left) hand for support.

6 When the shoulder strap is resting on your shoulder, use your legs to lift the backpack to an upright position. Use your arm to stabilize the backpack during lifting.

Note: Stand straight up. To minimize strain on back, do not swing or jerk the back during lifting.

Transporting the Backpack

7 Once upright, use your arm to slide the backpack across your back.

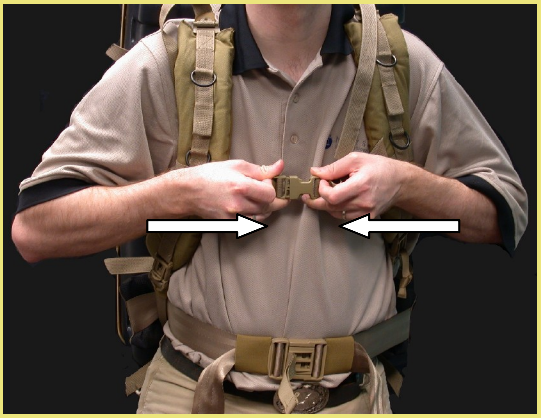
8 Slide the left (right) arm through the left (right) strap.

4 Transporting the Backpack

9 Now pull on the straps to ensure that the backpack fits snugly and lock the waist belt buckle.

10 Draw on the waist belt. The lower lumbar support pad should fit in the small of your back, with the side hip pads sitting comfortably on your hips.

11 Secure the shoulder strap stabilizer across chest.



12 The backpack is now safely mounted on the user's back. Review the backpack Safety Tips in the following section for proper carrying techniques.

Dismounting the Backpack

1 Release the shoulder strap stabilizer buckle.

2 Release the waist belt buckle.

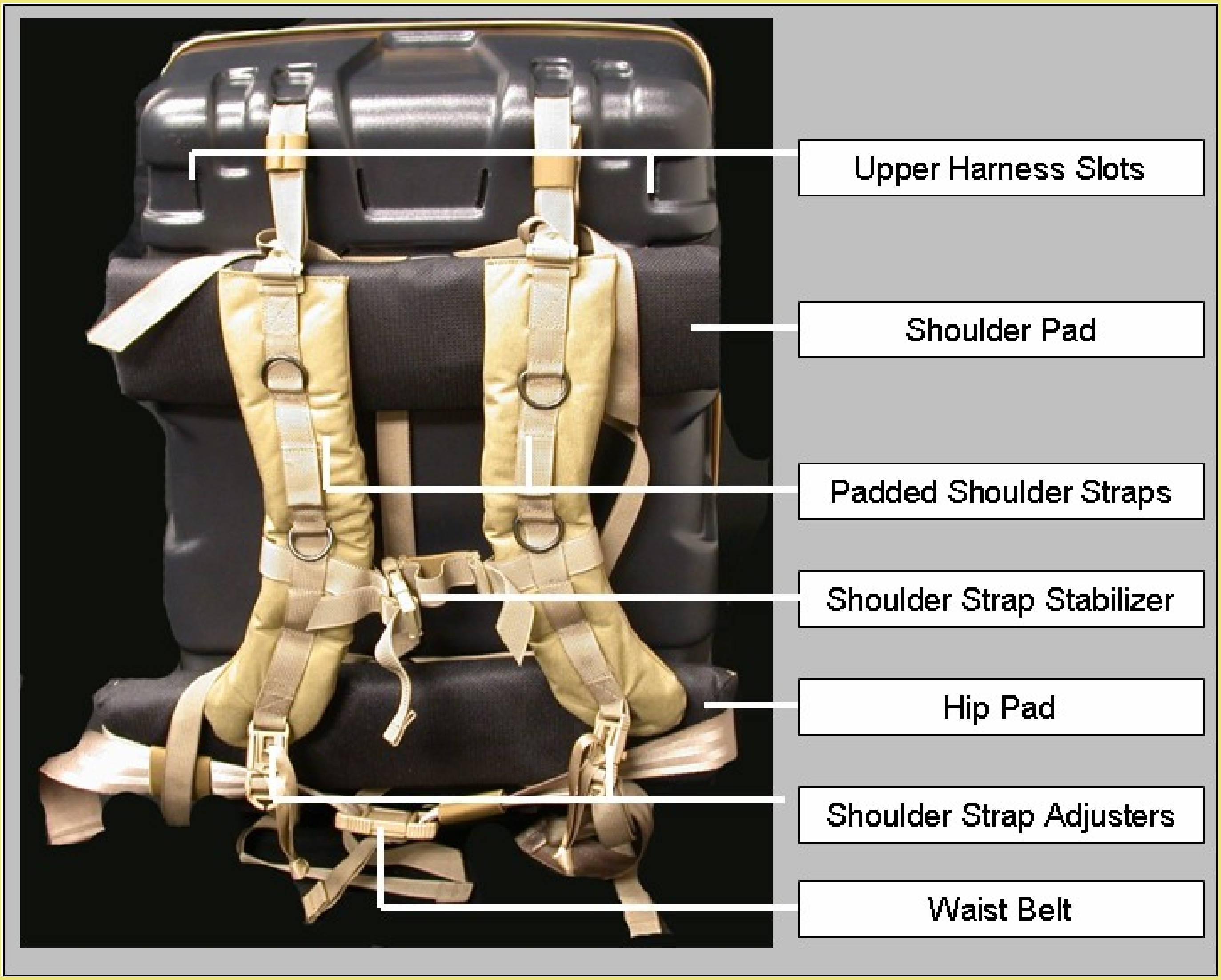
3 Slide off the left (right) shoulder strap.

4 Bend your knees to kneel on your left (right) knee.

5 Place the backpack on the floor perpendicular to you.

6 Remove your right arm from the left (right shoulder strap).

Figure 12 Backpack Components



4 Transporting the Backpack

Safety Tips:

1. Always use both shoulder straps.

2. Do not swing or jerk when mounting the backpack.

3. The bottom of the backpack should not be resting on your buttocks. The distance between your shoulder's straps and hip belt should be roughly equal to the length of your torso – the distance from the base of the neck to the top of the hips. You can tighten the shoulder straps OR thread the straps through higher slot.

4. If you feel a tingling down your arms to the fingers or if your shoulder blades feel that they are being pinched, dismount, loosen the straps and then re-mount the back pack.

5. An ache in the upper back / neck may mean that your center of gravity is too low. Try rethreading the straps through higher upper harness slots.

6. As with all backpacks, you should be careful that you do not slow or stop the blood flow to your shoulders. Take rests if you must carry this load over long distances.

7. If you do not wear the backpack properly or tighten straps too tightly, you may cut under the arm and cause nerve damage.

8. Do not drop the backpack.

9. Do not sit on your backpack.

10. Close your backpack after you have unpacked it.

You should not attempt to wear this backpack if you weigh less than 120 pounds (54.43 kg).

5 Assembling the GLOBETrekker

Topics Covered:

5 Assembling the GLOBETrekker

The chapter explains how to assemble the GLOBETrekker satellite terminal.

Opening the Backpacks

1 Lay the two backpacks flat on the ground.

2 Open the quick release buckles on each backpack by pulling the finger loop away from the backpack (secure the straps so they don't spin while trying to release the buckle).

Deploying the Legs from the Baseband Unit

The baseband unit houses two legs and two rear leg supports.

1 Remove the baseband unit from the backpack using the side-handles attached to the baseband unit.

Hint: Try to place the system in the general direction of the satellite. The photo to the right shows the unit in a top (front) to bottom (back) page view where the top of the page would face south.

Example: If your position is north of the equator, place the unit with the top towards the South.

2 To release the leg from the baseband unit, press the button located at the end of the leg.