PATRIOT

ANTENNA SYSTEMS

1.2M MVSAT Antenna

INSTALLATION & ASSEMBLY INSTRUCTIONS

PATRIOT®

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Claimants under this Warranty shall present their claims along with the defective equipment to PATRIOT ANTENNA immediately upon failure. Non-compliance with any part of this claim procedure may invalidate this warranty in whole or in part.

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PATRIOT ANTENNA has the right to void the warranty when the antenna is installed by someone other then a certified installer.

Product Serial Number- _____

Date Purchased- _____

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SECTION 1- OVERVIEW

1.1 TECHNICAL DESCRIPTION

The 1.2M VSAT Antenna System is an elevation over azimuth positioner featuring the simple, rugged Roto-Lok drive system for the azimuth which produces very low backlash, high stiffness and high reliability and driven by a low backlash, gear box with a DC motor. The elevation system features a highly reliable linear actuator to control elevation. All drive components are high strength steel, housed in lubricated for life housings which results in the most reliable, no maintenance system with the minimum of weight. The reflector is a offset, prime focus, aluminum illuminated by a corrugated horn. The RF power amplifier may be installed on the feed boom, or inside the truck. A Handcrank across AZ axis is included allowing easy antenna positioning if the controller malfunction and elevation actuator my be driven with a battery charger or other 12 volt system. The basic 2-port antenna system weighs only 150 pounds.

RF SYSTEMS

The offset reflector/feed system produces co-polarization patterns that easily meet the 29-25 log theta requirement. The .8 f/d optics reduces off axis cross-pol in the asymmetrical plane. The RF power amplifier may be installed on the feed boom, or inside the truck. Waveguide that run to power amp across each axis can be via twist-flex or rotary joints. The system can be configured for either 2-port or 4-port

ROTO-LOK DRIVE SYSTEM

The patented Roto-Lok drive system utilizes highly reliable aircraft control cables in a redundant configuration to achieve a zero backlash, light weight, very stiff drive system. It achieves this high tech performance using low tech components by simply wrapping the cable around the driver capstan several times before wrapping the larger driven drum. The method used to wrap the capstan results a minimum free length of cable. The load in the cable on the main drum is exponentially reduced as it is wrapped around the drum. Therefore the total elongation of the cable when under load is minimized. The Roto-Lok system results in stiffness of up to 10 times that of comparable gear or harmonic drive systems. The cables are pretensioned and spring loaded at the main drum attachment point which eliminates backlash at installation and from any unexpected cable stretch in the future.

SECONDARY DRIVE SYSTEM

The Az Roto-Lok drive system is driven by a low backlash worm gear set with a 40:1 ratio. The factory low back lash of the worm gear set is reduced further by the Roto-Lok drive ratio resulting in a lash equivalent to only .06 dB as seen by the RF system. The gear sets are housed in a sealed housing which allows the gear set to be continuously lubricated in synthetic oil which maximizes gear efficiency and minimizes wear.

MOTOR DRIVES

Light weight, reliable, servo quality DC motor with integral gear box is used for the Az drive. This motor was selected because it provides the best torque to weight ratio as well as allowing dual speed operation for slewing and peaking. These motors produce constant torque over the speed range with no cogging at low speeds which ensures smooth operation when peaking the antenna. The 24V DC design provides current limiting torque control and will allow vehicle battery operation if necessary. A linear actuator is used in the elevation drive, a low cost alternative to a typical roto-lok system. This system offers dependable and continuous constant torque over the full travel motion of the elevation axis.

CONTROLS

The system will interface with a jog controller which allows remote control of the system. Each axis position is displayed as well as limit indications. The unit will also interface with a full function controller with features such as automatic stow, GPS/flux-gate input and automatic satellite pointing and tracking.

CONSTRUCTION

Except for the drive components and bearings, the AZ/EL base plate, AZ/EL casting, feedboom and backing structure and covers will be all aluminum. The fabrication of parts and assembly will be of world wide quality standards.

SECTION 2- INSTALLATION AND SET-UP

2.1 GENERAL

The 1.2M VSAT positioner has been fully tested with the controller prior to shipment. All position feedback, limit sensing, limit switches (except elevation stow) and motor speeds have been calibrated or set. The positioner should be secured to the vehicle, connecting wave guide or boom mounted HPA cables, connecting coax, connecting control cables to controller and connecting auxiliary control cable to wave guide switch if applicable.

The vehicle roof should be reinforced with a substructure capable of carrying the wind loads as specified on the interface drawing to the vehicle frame. The structure should be stiff enough to prevent no more than a 0.5 dB of TX gain loss in a 30mph gusting to 45mph wind. (850 IN/LB moment @ .25º)

A 3-inch diameter hole should be in the mounting surface. The mounting surface must be flat within .005 inch to prevent binding the azimuth bearing after torquing the mounting bolts. No obstruction should be above the interface surface in a 17-inch diameter envelope. Any other roof-mounted equipment such as air conditioners should be more than 64 inches from center of interface bolt pattern. A hard flat surface is required for the feed bumpers as shown on the interface drawing.

2.2 INSTALLATION TO VEHICLE

Remove the top of the shipping crate. Remove the narrow end at the azimuth platform end of the crate. Connect controller cable to controller and raise the antenna in elevation until the backing structure is vertical. (See attached figure.)

Adjust the forks on the forklift to just straddle the pallet . **Place cardboard pieces between the pallet and the forks.**

Carefully raise positioner out of the crate watching control cables. Safety strap positioner to forklift truck. Maneuver over to rear of truck. Raise positioner to clear vehicle roof by about two feet. Lower control cables into center of mounting hole and place riser tubes in place and install the screws (provided) into holes in pallet. Use these as guides to position pallet directly over bolt pattern. **Note: Positioner must be installed with azimuth cable termination housing aligned on centerline of vehicle.**

Remove and replace set screws with mounting bolts provided. APPLY LOCKTITE 242 OR EQUIVALENT TO BOLTS.

TORQUE ALL BOLTS TO 9-10 FT. LBS.

2.3 CONTROLLER INSTALLATION

Install controller into electronics rack. Connect cables to rear making sure P1 and P2 are connected to correct sockets. (P1 to J1 AND P2 to J2) **Confirm controller voltage and fuse are correct**, if not, convert to correct voltage by following instructions in the controller manual Section 2.2.1. Connect AC power cable to controller.

2.4 CONTROLLER/POSITIONER VERIFICATION TEST

Turn power on. Wait for self-check to complete. Hit mode button once to reach display/function mode. Press deploy button to Deploy. Antenna will drive until:

ELEVATION	20.0º	(approx.)
AZIMUTH	0.0º	
POLARIZATION	0.0º	

Press speed button to change speed to FAST

HAVE SOMEONE OUTSIDE AND ELEVATED SO ANTENNA MOVEMENT CAN BE OBSERVED DURING TEST!
Push El UP button. Antenna elevation reading should increase. Move until elevation reads 20 degrees. Place inclinometer on feed boom tubes. Inclinometer should indicate that feed boom tubes are 20º above horizontal. (Note: The feed boom tubes are indicated on the interface drawing and are parallel to the antenna bore sight.) If not, refer to the controller manual for elevation zero voltage setting.

Press AZ CW and AZ display should increase, and AZ should rotate CW as viewed from above the antenna.

Press AZ CCW and AZ display should decrease.

Press Pol CW and Pol display should increase.
Press Pol CCW and Pol display should decrease, and the feed AZ should rotate CW as viewed from behind the reflector.

2.5 ELEVATION STOW POSITION SETTING

HAVE SOMEONE OUTSIDE AND ELEVATED SO ANTENNA MOVEMENT MAY BE OBSERVED DURING TEST!

Press mode key to change screens and Select STOW.

2.5 CONTROLLER/POSITIONER VERIFICATION TEST CONT.

Watch reflector surface approach feed horn.

Press **STOP** when reflector is within 2" of feed horn.

Jog down until reflector presses on rubber padding on feed housing.

Adjust stow limit switch if necessary by bending lever. Stow switch is on east side with long lever. (East is the left side as viewed from behind the reflector)

2.6 FINAL CALIBRATION OF SYSTEM

Check AZ ZERO position on roof. If azimuth controller will stow at AZ = 0.0 degrees you may adjust AZ zero voltage +/- 2º to bias stow position. Adjust zero voltage per Section 4.1.1 of controller manual.

SECTION 3- AZIMUTH POSITIONING SYSTEM

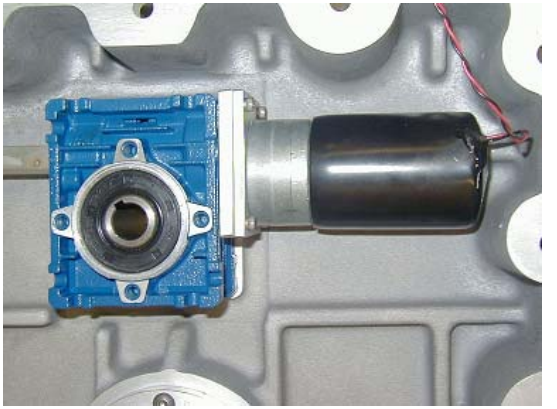
3.1 AZIMUTH BEARING

The azimuth bearings are precision ground sealed bearings with a dynamic and static moment capacity of over four times the worst-case wind load specification. They are located on the AZ/EL casting top and bottom. The bearing is packed with synthetic grease during assembly and no further greasing is required.
Because of the excess capacity, low rpm, and low number of cycles, no maintenance is required.

3.2 AZIMUTH GEARBOX

The azimuth gearbox is a low backlash worm gear box. The worm gear drive isolates any backlash in the motor drive from the system. In addition, since it is a 40:1 ratio it will not back drive, eliminating any need for a brake on the drive train. (See Fig.)

The motor drives the input worm via a quill/female hole and square key. The worm shaft is extended with a hex shape installed for the hand crank. The azimuth capstan is secured to the output shaft with a square key knurl plus permanent locktite to eliminate any backlash between the capstan and gearbox.



The low backlash is achieved by selective fit of the worm and worm gear. The nominal backlash for the gearbox is 30' which is reduced by the Roto-Lok drive to less than 4'of the beam of the antenna. The gearbox contains synthetic oil filled half way to the level plugs. Because of the design capacity of the gearbox, low rpm and limited cycles experienced by an SNG system, no maintenance is required.

3.3 AZIMUTH MOTOR

The azimuth drive motor is a 24 DC motor with integral 30:1 spur gear train. (See fig on pg.6) The motor armature rotates at up to 3000 rpm causing a high frequency noise that will vary depending of the loading condition of the motor.
The maximum output speed is 100 rpm. The output shaft is “D” shaped with a special adapter with a slot for a square key.
Since the low backlash worm gear drive isolates the backlash from the motor, any backlash between the shaft adapter, square key or motor gear train will not be seen by the reflector bore sight. The motor is mounted to an adapter plate that is bolted to the gearbox with (4) screws.
No maintenance of the azimuth motor is required.

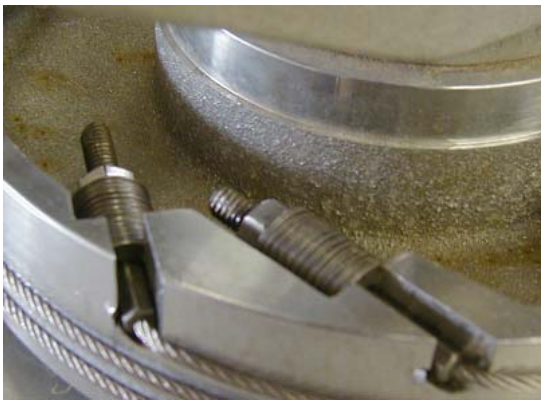
3.4 AZIMUTH ROTO-LOK CABLE DRIVE

The patented azimuth Roto-Lok drive produces a zero backlash; high stiffness, no wear, no lubrication, and maximum reliability drive system. The system consists of two 1/16, 7x19 stainless steel aircraft control cables reverse wrapped twice around the grooved capstan and once around the drum, with solid connections on one end and high force Belleville springs on the other end (Fig. Below). One cable has the capacity to withstand a 75mph wind load. The additional cable is used to provided increased stiffness and drive redundancy. **If a cable becomes damaged during usage, cut off cable and continue to use positioner. Replace cable when time permits at your maintenance facility.**

The cables are sized to last the life of the positioner. The springs will automatically compensate for any elongation of the cable.

Cable position should be checked as per the periodic maintenance schedule in Section 6. If cables have drifted, manually move cables using blunt instrument on the azimuth drum until the correct position is obtained.

At installation the Belleville springs are collapsed until no “air” is seen between the springs. You should check this condition yearly to account for the slow settling of the cable strands. Use pliers to hold stud and 1/4 box end wrench to tighten nut. **Be sure not to over tighten. Tighten until springs are <u>almost</u> fully collapsed. (Fig below)**



3.5 AZIMUTH POSITION FEEDBACK

The azimuth position feedback is produced by a 10 turn, 1K-ohm potentiometer driven by a gear located on kingpin post . (Fig. Below) Since the Roto-Lok drive has no backlash, the position feedback is as accurate (1%) as the resolution (.3°) and accuracy of the potentiometer and the backlash between the potentiometer and the azimuth capstan. The potentiometer is sealed and rated for IP 65 environment - wind, rain, dust, etc.

The potentiometer is mounted on AZ/EL casting. The azimuth potentiometer is slotted and driven by a belt and a small sprocket located on the AZ king pin and the small gear on the potentiometer. The potentiometer is mechanically centered at the travel position (5 turns from either end) when AZ platform is in the AZ stow position. This is accomplished by removing the belt from the potentiometer gear. The potentiometer may also be electrically zeroed by the controller. See pertaining section of the controller manual.

3.6 AZIMUTH STOW AND LIMIT SWITCHES

The controller uses the AZ potentiometer voltage to determine limits. Therefore, the positioner is equipped with only an azimuth stow position switch.
The azimuth stow limit switch is mounted on the AZ/EL casting, on a boss next to azimuth drive sprocket. (Fig. Below) The switch is fixed relative to the mounting surface and is actuated by a small shoulder bolt located on the azimuth potentiometer drive sprocket. The stow switch actuation occurs at slightly different positions depending if you approach the stow position from CW or CCW. Therefore, the azimuth stow position will vary approximately 1º from stowing from CW or CCW.

Since the controller drives to 0° AZ after sensing the stow switch, the AZ stow position can be varied by either changing the zero position of the AZ potentiometer or zero voltage of the controller.

3.6 AZIMUTH STOW AND LIMIT SWITCHES CONT.

Rotation Direction Convention: + is clockwise (CW) viewed from above the mount

\- is counter clockwise (CCW) viewed from above the mount

NOMINAL AZMUITH LIMITS'

Model	Limits
1200MVSAT (With 400° AZ)	+200° / -200°
120MVSAT (With 360° AZ)	(4 Overlapping +/- 95° Sectors)

Notes:

1) The Limits should be set after the potentiometer has been centered as described above. If the potentiometer is moved from this position, the limits should be reset.

2) The AZ angle displayed by the controller is affected by several parameters in the controller. (These include AZ Scale Factor, AZ Reference Position).

3) While setting the limits, watch the AZ capstan to make sure it does not run into the end of the cables.

4) The angles at the limits in the chart shown above are for nominal values of these parameters, and the values actually displayed by the controller at the limits may vary.

SECTION 4- ELEVATION POSITIONING SYSTEM

4.1 ELEVATION PIVOT ASSEMBLY

The elevation pivot assembly consists of a linear actuator assembly that pivots between the two blades on the AZ/EL casting at the motor end and pinned at backing plate clevis. The backing structure tubes pivot at az/el base pivot blocks. All moving or pivoting points pivot in bronze bushings or High tech polymer bushings. (See fig.) No maintenance is required. If squeaking noise is heard, spray silicone lubricant with "straw" nozzle down between the two pivot points.

4.2 ELEVATION LINEAR ACTUATOR

The elevation actuator is a ball screw mechanism driven by a 12 volt motor and integrated gearbox attached at the bottom of the actuator. The ball screw offers high resolution and accurate repeatability, is designed to isolate backlash in the drive from the system.

Because of the design capacity of the actuator, lifetime lubrication and limited cycles experienced by an MVSAT system, no maintenance is required. (See fig.)

4.3 ELEVATION POSITION FEEDBACK

The elevation position feedback is produced by an electronic inclinometer located in the feed box. (See fig below) No adjustment or maintenance is required. The inclinometer is electronically zeroed in the controller. See Section 2.3 in the controller Manual.

4.4 ELEVATION STOW AND LIMIT SWITCHES

The elevation stow switch is mounted in the Pol cover. The limit switches are mounted in the elevation actuator gearbox.

The elevation up and stow switch do not require adjustment.

SECTION 5- FEED AND POLARIZATION POSITIONING SYSTEM

5.1 GENERAL

The Feed assembly consists of feed boom, upper and lower feed brackets, feed housing, RF components and polarization drive housing. The feed boom is pivoted about the elevation axis to eliminate additional flex-guide required if pivoted at edge of reflector. The pivot connection at the end of the feed arms in the upper feed bracket is with brass bushings. A piece of 18" flex waveguide is used at the end of the waveguide tube to the OMT. The feed/OMT is rotated by chain drive assembly and 12 VDC motor. Position feedback is from a 10 turn potentiometer.

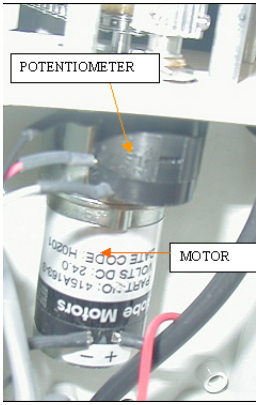
5.2 FEED

The feed assembly consists of an inclinometer, feed horn and OMT with male pivot bushings. The male bushings pivot in delrin female bushings at each end of the OMT. The Bushings are mounted to a mounting plate. The pol drive sprocket attaches to the OMT and the waveguide attaches to the other end with M6 screws at the rear flange of the OMT. The feed/polarization drive is mounted underneath the pol mounting plate in the feed box with the gear on the outside and the driving pol sprocket to rotate feed.

5.3 POLARIZATION DRIVE

The feed/polarization drive is mounted underneath the pol mounting plate in the pol drive box with a drive sprocket mating to the motor shaft, which extends through the feed drive box. The polarization drive motor (See fig on page 11) is a 12 VDC gear motor. Small gear is attached to the end of motor shaft which drives the small gear to drive the position potentiometer. The controller travel limits are +/- 90 degrees for a 2-port. (See RCI 3050 Controller Manual section 3.3).

Since the low backlash chain drive isolates the feed from the motor, no brake is required. No maintenance of the Polarization motor/assembly is required. The polarization drive can be replaced only by a complete unit including the motor, motor sprocket /gear, chain, elevation inclinometer, potentiometer and gear, and drive sprocket.



5.4 POLARIZATION POSITION POTENIOMETER

The polarization feedback is produced by a 10 turn, 1K-ohm potentiometer driven by the motor gear, and mounted in the feed box and shaft extends outside the box. The resolution and accuracy is 0.3 degrees. The potentiometer is rated for IP 65 environment, Wind, Rain, and Dust etc… The potentiometer is mechanically set at the one-half travel position, (5 turns from either end) and will read approximately 500 ohms at 0 degrees pol (stow). The potentiometer may be set using the controller. The voltage reading at pol stow will read 2.5V at 0 degrees. See RCI controller manual Sec. 3.3

5.5 POLARIZATION LIMITS

The controller uses the polarization potentiometer voltage to determine limits. The controller drives to 0 degrees pol when it stows. The positioner has the mechanical capability of +/- 90 degrees per section 3.3 of the controller manual. If the controller fails to terminate power to the motor and the system is driven to a hard limit stop, the DC motor will stall. To correct, reset pol jam error in the controller.

5.6 FEED ASSEMBLY

The feed assembly consists of the feed, the polarization drive and the polarization potentiometer. The feed assembly is installed as a complete unit and secured to lower feed bracket. The feed horn is mechanically positioned with a template within 1/8” of the theoretical focal point of the reflector. This positioning assures the RF System the gain and FCC compliance as stated in the specifications. Minor RF improvement can be realized by optimizing the feed positioning using transmit or receive patterns. Inclinometer is mounted on the inside of feed box.

SECTION 6 - MAINTENANCE

6.1 GENERAL

The 1.2 meter Mobile VSAT is designed such that any wear should never degrade performance below specifications and essentially no maintenance will ever be required. However, since it is impossible to ascertain or test for all possible environments, the following check up is recommended each year. If any problems are observed, refer to the appropriate section.

6.2 ANNUAL INSPECTION

AZIMUTH

1. Hand crank in azimuth, the unit should hand crank easily.
2. Check for unusual noise in azimuth bearing and azimuth gearbox.
3. Run in azimuth and check for unusual noise in azimuth motor.
4. Check position of azimuth drive cables on capstan at 0 deg. AZ. Refer to (Fig. 3.3) for proper position and spacing.
5. Check drive cables for damage.
6. Have someone run to both AZ limits and observe cable tracking.
7. Inspect cable terminations, and tighten springs if more than .010 gap exists between spring sets. Tighten with an open-end 1/4" wrench and using Visegrips pliers holding stud.
8. Inspect AZ stow switch.
9. Inspect and confirm AZ potentiometer is seated properly and not damaged.
10. Check AZ bearing screws, AZ gearbox bolts, AZ pot bracket, etc are tight.

ELEVATION

1. Check for unusual noise in elevation pivot bearings.
2. Run in elevation and check for unusual noise in elevation motor. (Run to Limits) unit should travel easily. Inspect elevation limit switches.

POLARIZATION

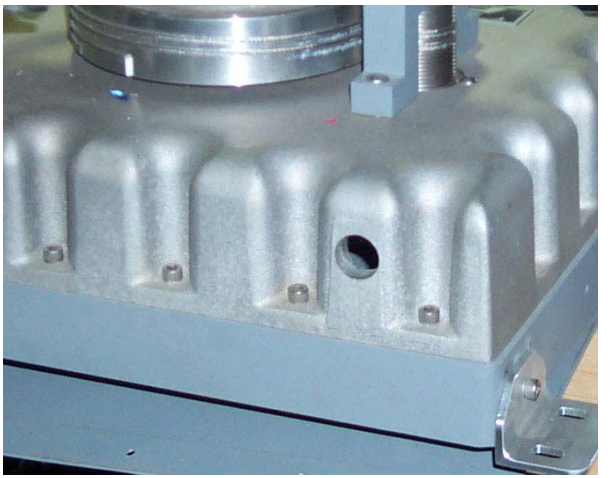
1. Remove feed cover.
2. Run in polarization and check for unusual noise in polarization gearing or motor.
3. Inspect polarization potentiometer.
4. Inspect wave-guide for any damage, dents, or cracks.

6.3 SPARE/REPLACEMENT PARTS

Since no maintenace is required, only electrical parts are recommended as spares. These parts will not fail from activity, but may fail from environmental exposure.

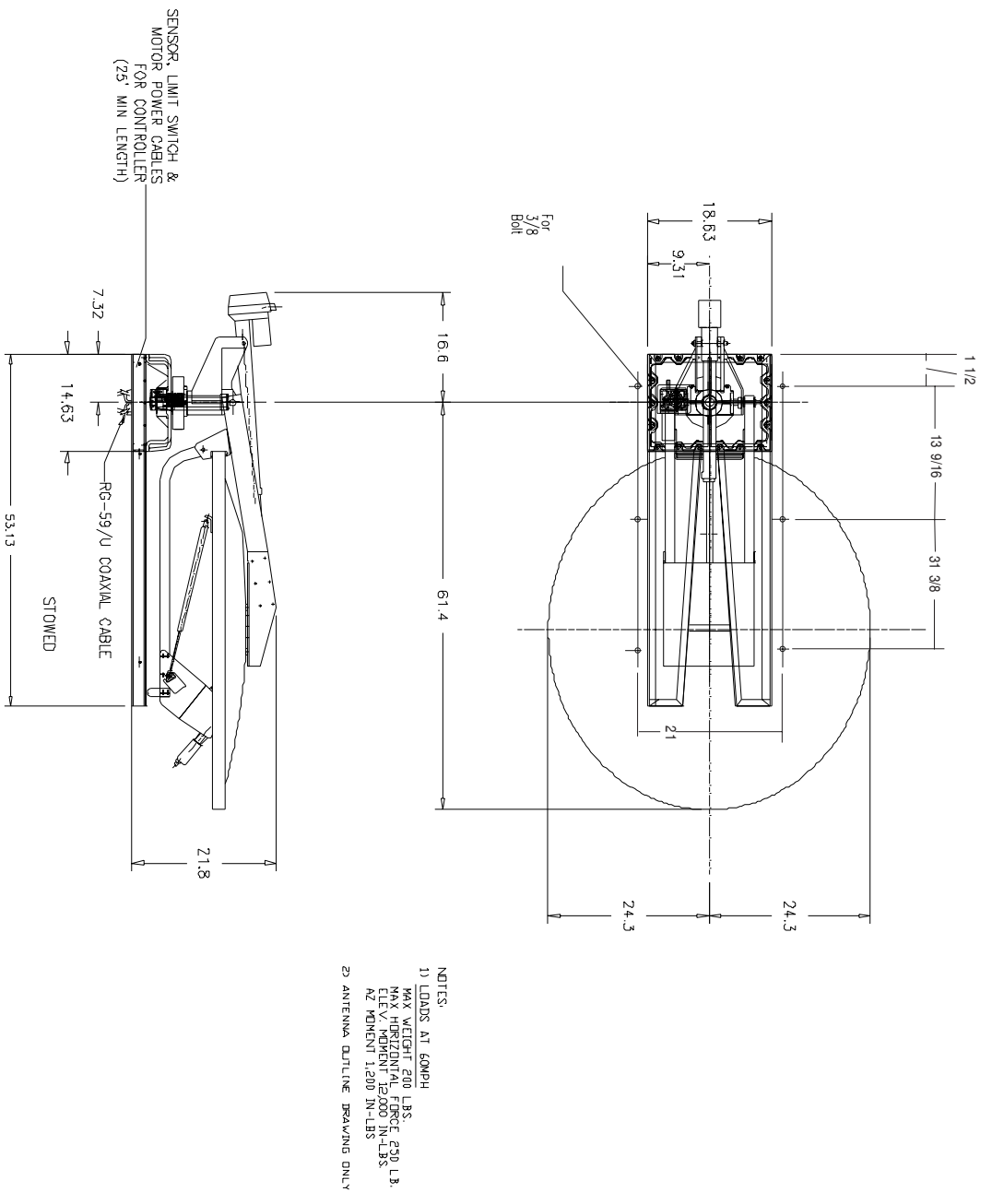
MANUAL AZIMUTH

The 1.2MVSAT comes with a manual drive on the azimuth if needed. The manual drive is located on the lower right back of casted mount underneath cover plates (See attached figure.)



Use a 1/2” socket with extension (See attached figure.)

SECTION 7- Interface Drawing



SECTION 8- Specifications

ELECTRICAL	Receive	Trasmit
Frequency	11.7-12.2 GHz	14.0-14.5 GHz
Gain (Midband)		
R/T	42.0 dBi	43.5 dBi
VSWR	1.30:1	1.30:1
Beamwidth (degrees)		
-3 dB	1.5	1.2
-10 dB	2.6	2.1
First Sidelobe Level (+/- 2 dB)	-20 dB	-20 dB
Radiation Pattern Spacing	Meets Current FCC requirements for	2 deg.
Antenna Noise Temp @ 30 deg Elev.	30degK	
Polarization	Linear	
Power Handling Capability		0.5KW per port
Cross Pol-Isolation		
On-Axis	35 dB	35 dB
Off-Axis (within .5 dB BW)	32 dB	32 dB
Off-Axis (within 1 dB BW)	30 dB	30 dB
Feed Port Isolation		
RX/RX	30 dB	
TX/RX	60 dB	60 dB

MECHANICAL	
Reflector	1.2M Prime Focus Offset
Mount Geometry	Elevation over Azimuth
Polarization	Rotation of Feed
Travel	
Azimuth	400 degrees
Elevation	
Operational	0-70 degrees of reflector boresight
(Standard)	
	0-90(optional)
Total	0-160 degrees
Polarization	+/- 95 degrees for 2-Port
	+/- 50 degrees for Electronic H/V Switching or 4-Port
Speed	
Slewing/Deploying	2 degrees/second
Peaking	0.2 degrees/second
Motors	24V DC Variable Speed, Constant
Torque	
RF Interface	
HPA Stowage	Feed Boom, Rear of Reflector, or Inside Truck
Axis Transistion	Twist-Flex or Rotary Joints
Waveguide	WR 75 Cover Flangl at Interface Point
Coax	RG59 run from feed to base plus 8 ft.
Electrical Interface	25 ft. Cable with connectors for Controller
Optional Manual Drive	1/2" Hex Socket Wrench
Weight	110 to 150 lbs. depending on options selected

ENVIRONMENTAL	
(Wind) Survival	
Deployed	75 mph
Stowed	100 mph
Operational Tracking	45 mph (at 60 deg. F Min. Temperature)
Temperature	
Operational	-20degF to 125degF
Survival	-40degF to 140degF

CONTROLLER	
Type	Jog or Full Function Controller
Manual Mode Input	Front Panel Keypad for Jog/Run/Run
To/Stow	
Automatic Mode Input	GPS, Flux-Gate Compass and Antenna
LNB	
Size	Two or Three rack units high
Input Power	110V AC 1 ph 60 Hz 15 amp or 220V AC 1 ph 60 Hz 7.5 amp

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