Norsat International Inc.

USER MANUAL

WAYFARER 0.8M KA-BAND
MANUAL FLY-AWAY ANTENNA

TABLE OF CONTENTS

Acronyms

ACU	Antenna Control Unit
AZ	Azimuth
BUC	Block Upconverter
CCW	Counter clockwise
CW	Clockwise
EL	Elevation
IFL	Interfacility Link
LNB	Low-noise Block Downconverter
OMT	Orthomode Transducer
POL	Polarization

Safety

Caution 	**Grounding the Terminal** Ground the system with a grounding conductor in accordance to national and local electrical codes.
Danger 	**FCC Radio Frequency Exposure Information for Mobile Transmitting Devices** When the power is on, do not stand within the line of sight of the terminal to the satellite and maintain an off-axis clearance distance of a full reflector diameter length from the centre of the beam.
Danger 	**Electrical Hazards in Wet and Windy Conditions** While the terminal is designed for outdoor use (e.g. optional waterproof power supply), observe the following safety precautions during windy and wet weather conditions. Some steps may not apply depending on the BUC configuration. 1. Check cable connectors and power cords for damage or tears. Replace cables and cords as needed. 2. Disconnect the terminal from its power source before you move it. 3. Disconnect the terminal from its power source if you suspect a power malfunction
Warning 	**Hot Surfaces** When transmitting, do not touch the BUC as it may result in burns or injury.
Danger 	**Hazards of Microwave Radiation in Electromagnetic Fields** When the power is on, the area directly in front of the antenna is an Area of Restricted Occupancy. Observe the following safety precautions: 1. Limit human exposure time to the area directly in front of the main antenna assembly. 2. Never place any part of your body between the antenna and the Feed Horn assembly. 3. Never place any part of your body in line with the direction of the antenna transmission path. 4. Locate the terminal as far as possible from ungrounded metal.

Danger 	**Dielectric Heating** Dielectric heating is the heating of an insulating material caused by placing it in a high frequency electric field. When a human enters a Radio Frequency (RF) field, the body acts as dielectric. If the power in the RF field exceeds 10 milliwatts per centimetre, the individual will have a noticeable rise in body temperature. The severity of burns may vary from minor to major. Burns or other damage may result in long term injury or even death. The vital organs of the body are highly susceptible to dielectric heating. The eyes are also highly susceptible to dielectric heating. Do not look directly into devices radiating RF energy. You must not stand directly in the path of RF radiating devices
Warning 	**Unintentional Radio Interference** This equipment generates, uses, and radiates radio frequency energy. If you install and use the device according to the instruction manual, the device will not cause harmful interference to radio communications. If you operate the device in a residential area, it is likely to cause harmful interference to radio communications; you will correct the interference at your own expense.
Warning 	**Changes or Modifications to Equipment** Changes or modifications to this equipment, not expressly approved by the manufacturer could void the user's authority to operate the equipment. **Accessories and Devices** Use of non-approved accessories or devices may lead to a degradation in performance, damage to equipment, or potential hazards **Servicing the Equipment** Do not service the equipment alone unless another person is present to administer first-aid

List of Contents

COMPONENTS	QUANTITY
Leg Assembly	1
Pedestal Assembly (Optionally integrated with BUC and LNB)	1
Reflector Hub	1
Reflector Petals	6
Feed Horn	1
Mounting Pegs	3
Modem (Optional)	1
IFL Cable (Optional)	1

1. Product Overview

The Norsat WAYFARER is an industrial strength transportable satellite communication system built strong for the most demanding users working with the most challenging applications and environments. The WAYFARER is fully automated, integrated, and versatile enough for deployment virtually anywhere, including mobile field offices, field vehicles, or directly on the ground. A complete satellite solution, the WAYFARER includes everything to meet your communication needs.

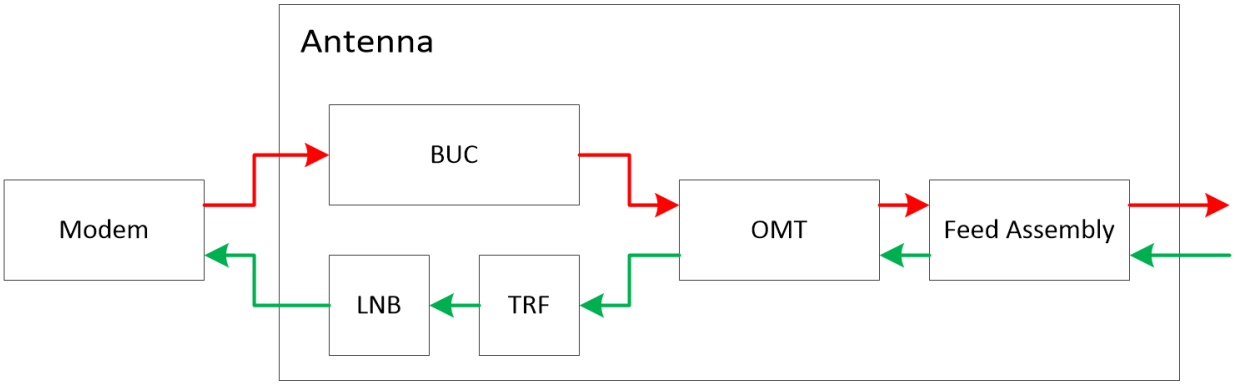
2. System Overview

The system consists of the terminal, BUC and LNB. The antenna is equipped with two dials and an inclinometer to read its azimuth and elevation position.

On the transmit side, the terminal contains a BUC or SSPA to convert the L-Band Tx signals from the modem to Ku-Band RF signals and amplify them to the specified power levels. The amplified signals are passed through the output waveguide to the OMT before entering the feed. The feed projects the RF energy on to the parabolic reflector up to a satellite.

On the receive side, the receive RF energy is gathered by the reflector and focused on the feed, which directs the energy to the OMT. The OMT is connected between two waveguide rotary joints to enable adjustment of the polarization. The OMT then splits the receive signal and passes it to the TRF and then the LNB, which outputs L-Band Rx signals to the modem.

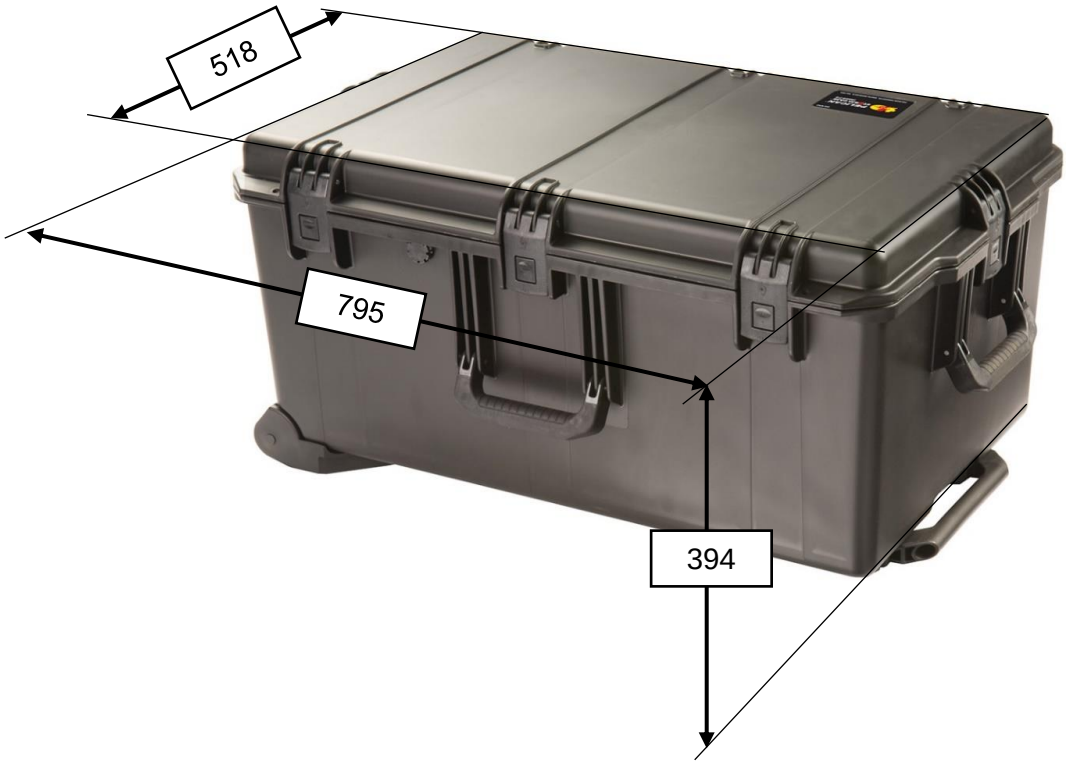
Refer to the figure below for the system block diagram and the RF chain of the antenna when connected to a modem.



3. Hardware

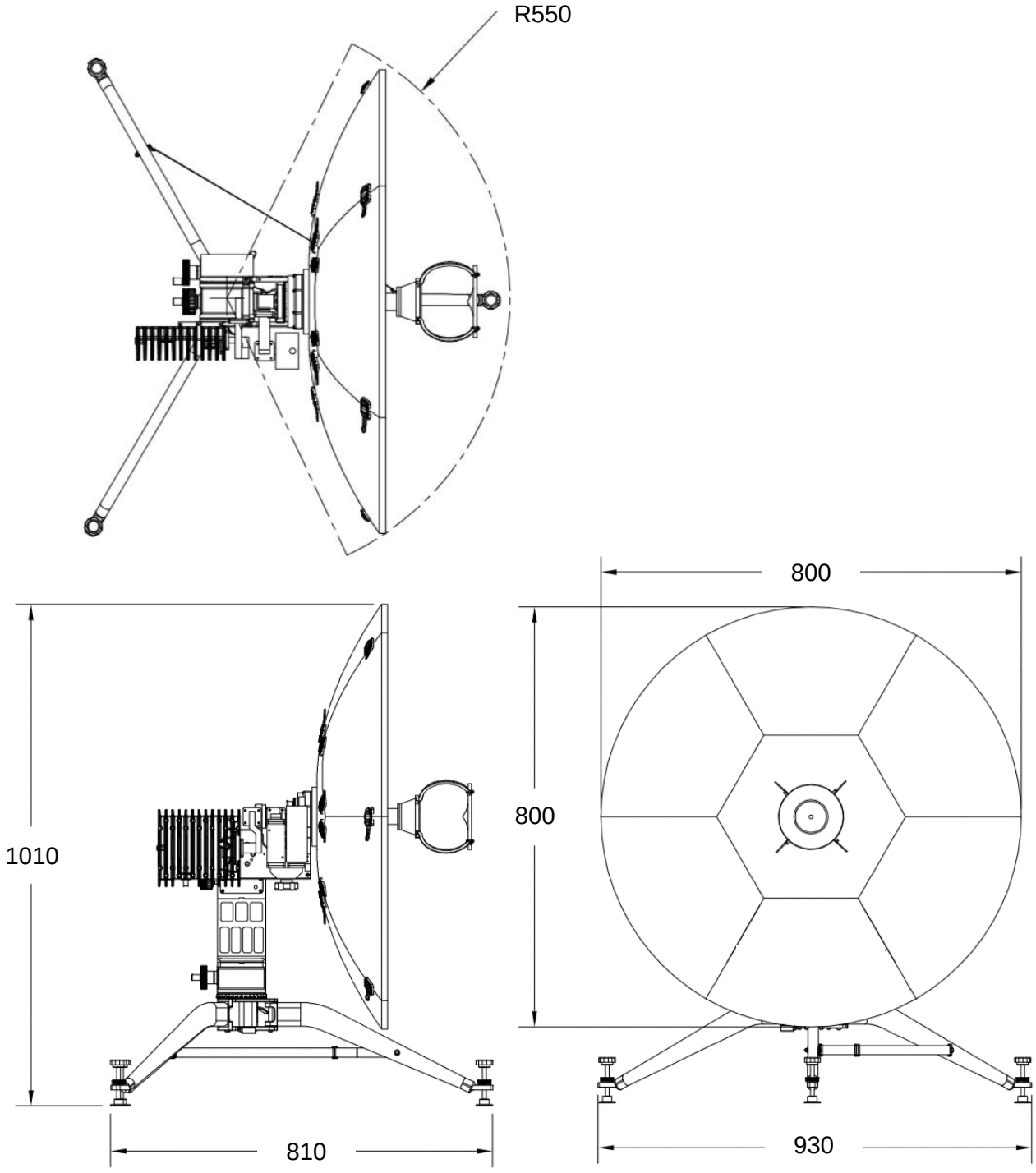
3.1 Case Dimensions

All dimensions are in millimeters.



3.2 Antenna Dimensions

All dimensions are in millimeters.



4. System Components

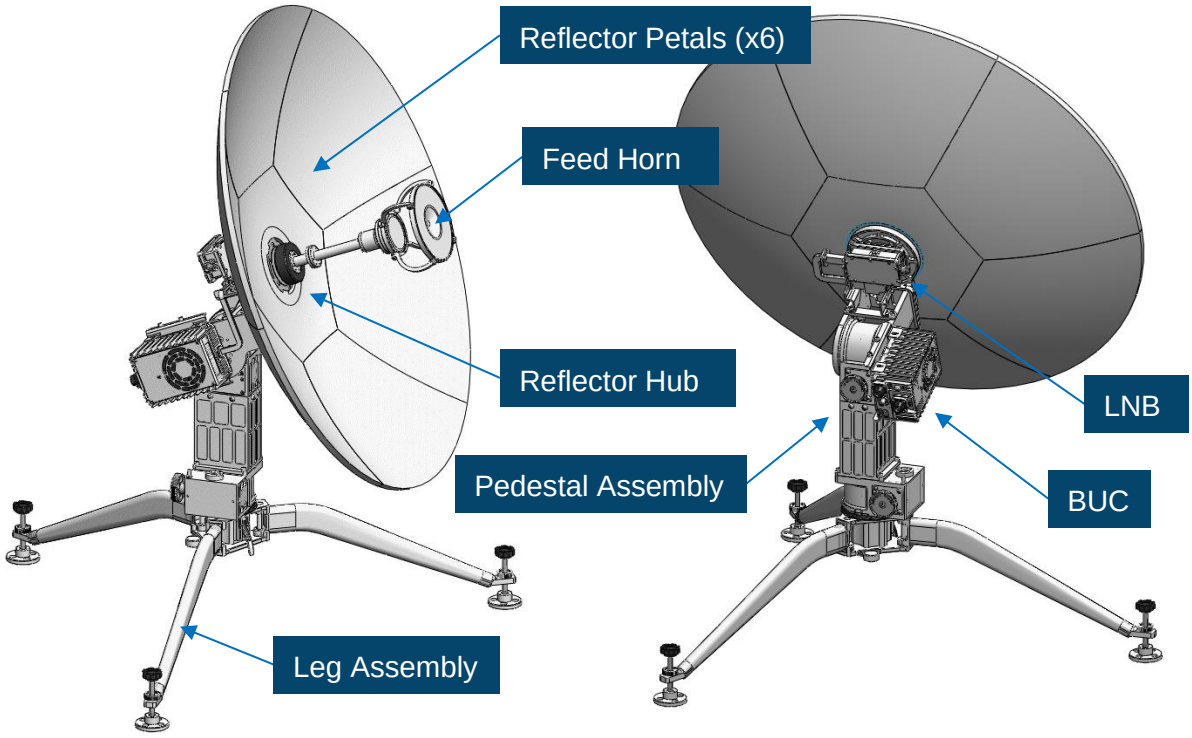
The azimuth module consists of the azimuth handwheel, planetary gearbox, worm gearbox, internal gear, and azimuth base. Meanwhile, the elevation module consists of the elevation handwheel, elevation gearbox and elevation base. Both modules are mechanically self-locking and can be manually controlled through their own respective handwheels on the pedestal.

The polarization module consists of the LNB and TRF attached to the OMT. Its main functionality is to isolate the Tx and Rx signals.

In addition, the Feed, Reflector Assembly, and BUC mount onto the Pedestal Assembly. The Reflector Assembly is segmented into six (6) outer petals and the central reflector hub for compact storage.

The Pedestal Assembly mounts onto the Leg Assembly, which allows for leveling and angle compensation on uneven and inclined surfaces.

Refer to the image below for the location of the system components.



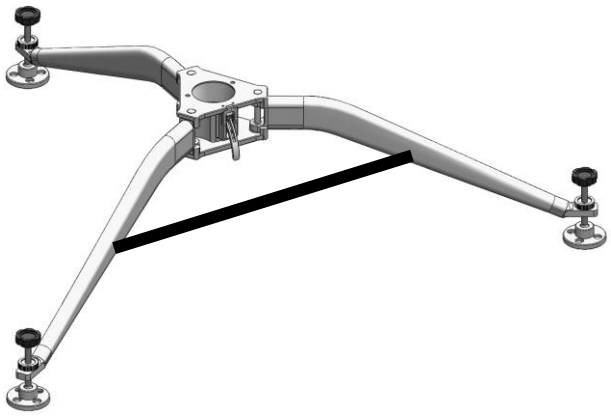
5. Assembly

5.1 Site Selection

1. Find a clear level area. The terminal can handle up to 2.5° offset.
2. Ensure that there is line of sight towards the target satellite.
3. Ensure that you can provide a safe clearance area or prevent people from walking in the way of transmission.

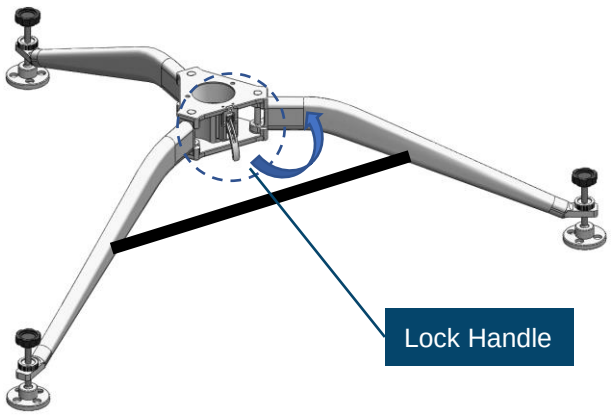
5.2 Antenna Assembly

1. Pull out the tripod.
2. Unfold the legs to limit and buckle up the strap so that the legs are sturdy.



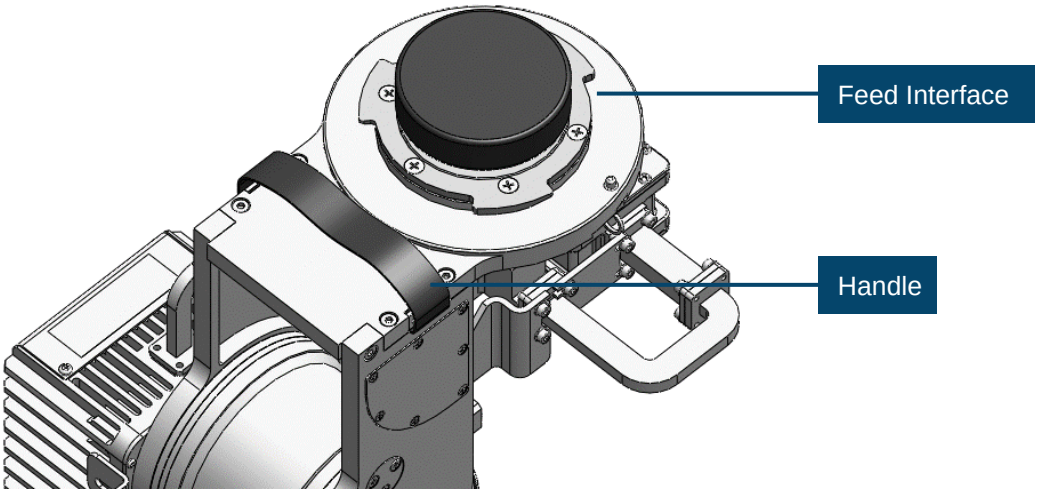
3. Pull up the metal latch on the side of the tripod.

   Note: Ensure the latch remains pulled up until the pedestal is inserted into the tripod.

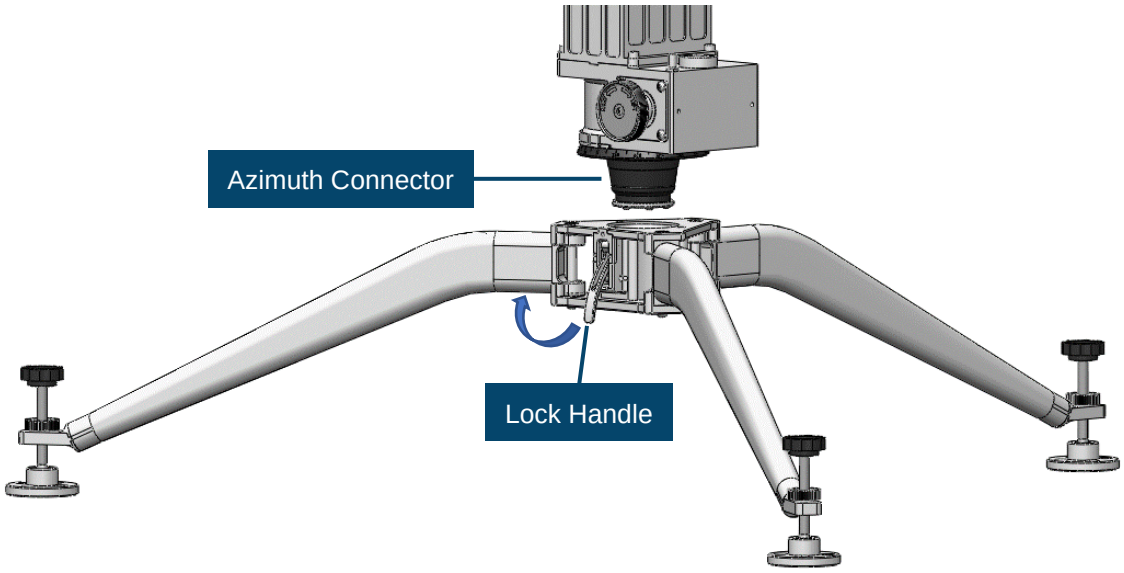


4. If this is a high wind condition, stake down or add ballast weight to the tripod legs.

5. Take out the pedestal.
6. Orientate the pedestal so its feed interface and handle face upwards while the azimuth connector faces downwards.



7. Carry the pedestal by the handle at the top of the pedestal.
8. Insert the azimuth connector into the tripod while the lock handle is pulled upwards.



9. Ensure the pedestal sits flat onto the tripod.
10. Adjust the orientation so that front points to the satellite belt.
11. Push down the latch on the tripod to lock the pedestal into place.

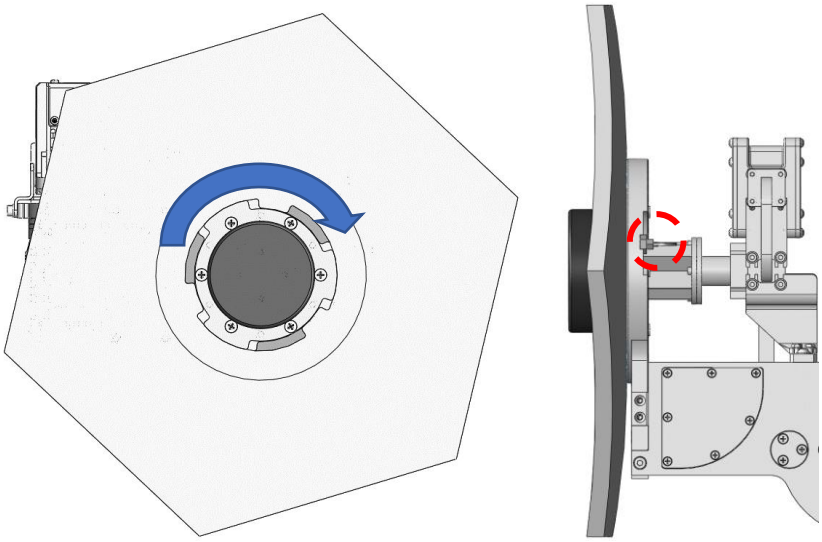
12. Adjust the elevation angle to 10 degrees for ease of assembly for the first petal segments.

    Note: Refer to Section 6.3.2 for elevation adjustment instructions.

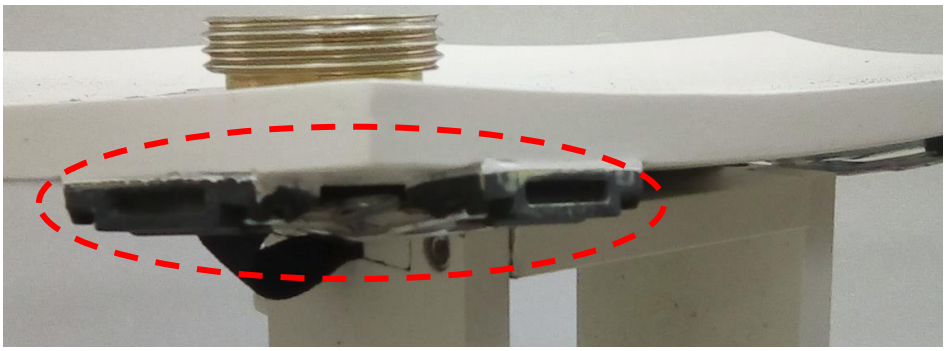
13. Insert the reflector hub onto the feed interface on the pedestal by aligning the mating central hub petals.

14. Rotate the reflector hub clockwise until the locking pin engages.

    Note: When removing the reflector hub, the pin needs to be extended to allow the reflector hub to rotate.



Note: If the reflector hub is stuck when disassembling, check if the latches are causing interference with the pedestal.



15. Take out the petals from Case 1.

    Note: Each petal is labeled with a matching number to indicated where it is installed on the Reflector Hub.

16. While performing the steps below to attach petals 1 and 2, ensure to carefully support both petal segments until the latches between the two segments are engaged.

    Note: A petal segment is not fully secured onto the reflector hub until it is also latched onto at least one adjacent petal.

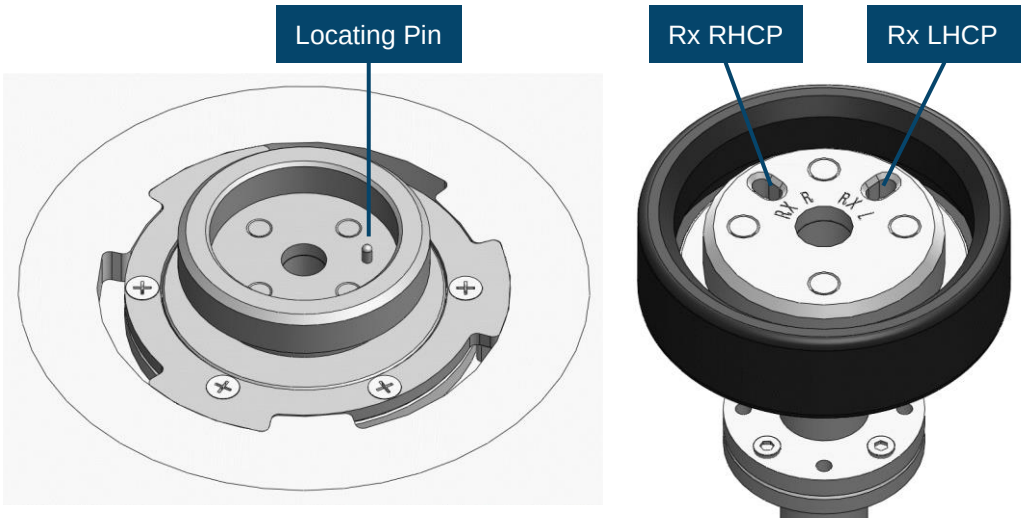
    a. Insert the locating stubs on petal 1 into the reflector hub.
    b. Engage the latches on the hub to petal 1.
    c. Insert the locating stubs on petal 2 into the reflector hub.
    d. Engage the latches on the hub to petal 2.
    e. Engage the latches between petals 1 and 2.

17. Continue to install the remaining petal segments in ascending order by following the steps below:

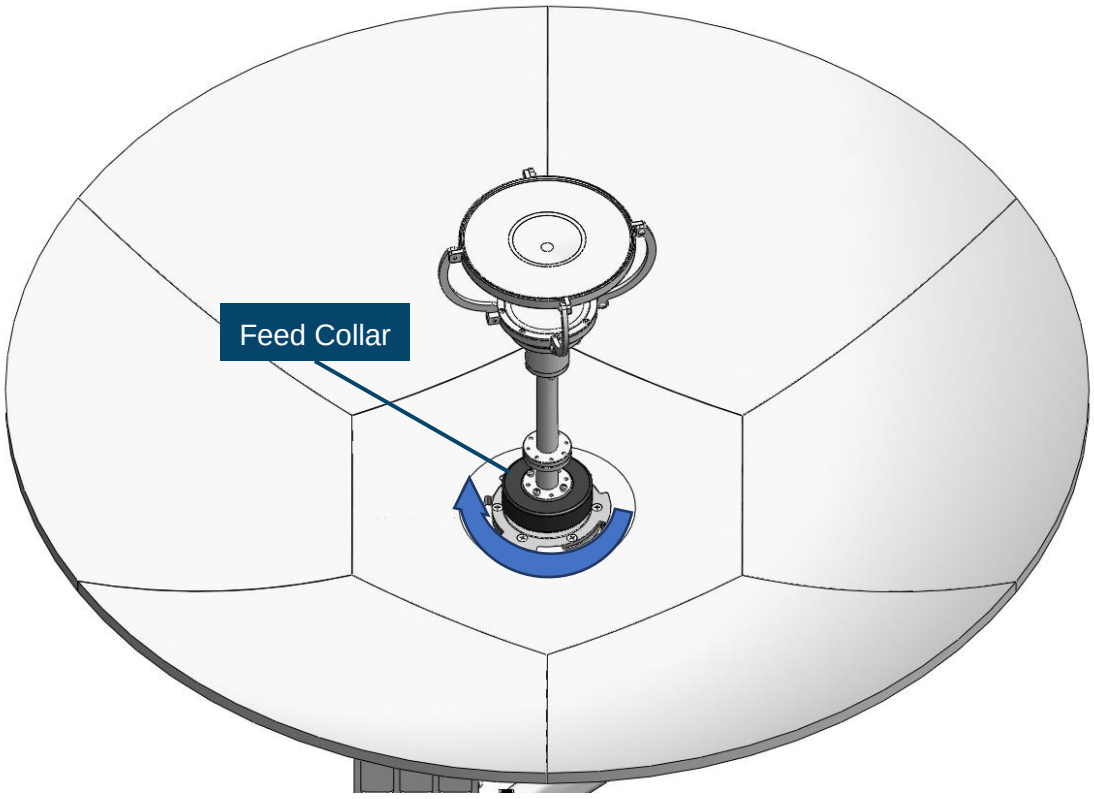
    a. Adjust the polarization assembly position and elevation angle as needed to install the reflector petal segments. Refer to Section 6.3 for instructions.
    b. Insert the locating stubs on petal into the reflector hub.
    c. Engage the latches on the hub to petal.
    d. Engage the latches between any adjacent petals.

18. Take out the feed assembly and align the slot corresponding with the desired Rx polarization onto the locating pin on the pedestal.

    Note: The feed assembly includes two slots for LHCP and RHCP Rx polarization.



19. Assemble feed to feed mount by tightening the feed collar clockwise.

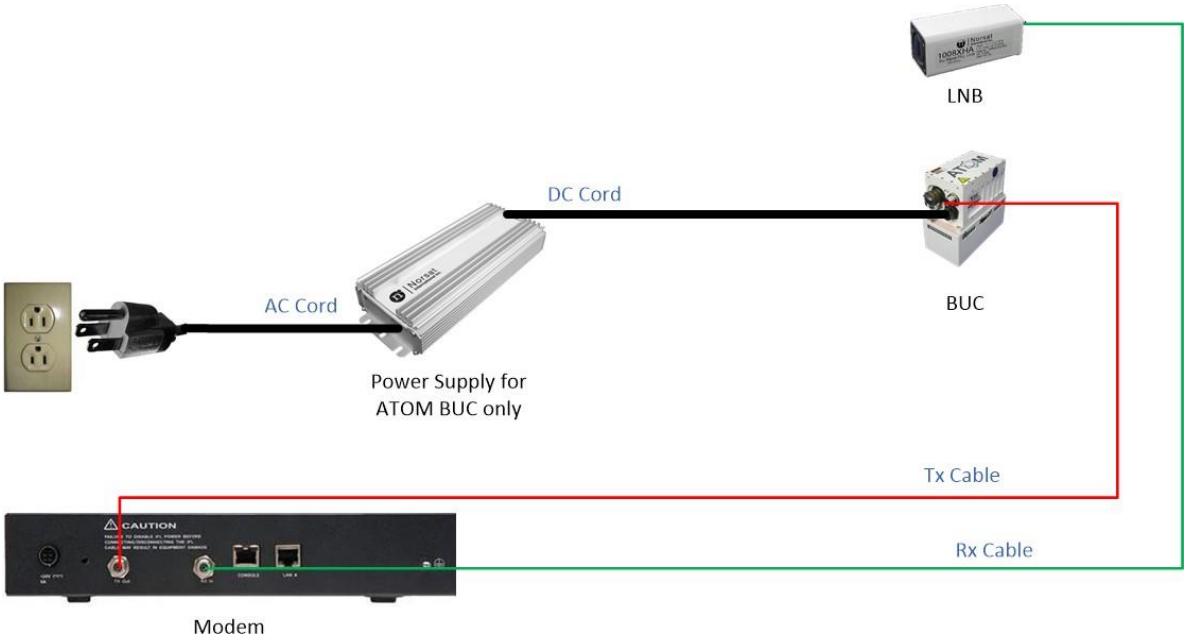


20. Assembly is now complete.

5.3 Cable Connection

Connect cables according to the table below. Ensure to connect the antenna and BUC power supplies to the AC outlet last.

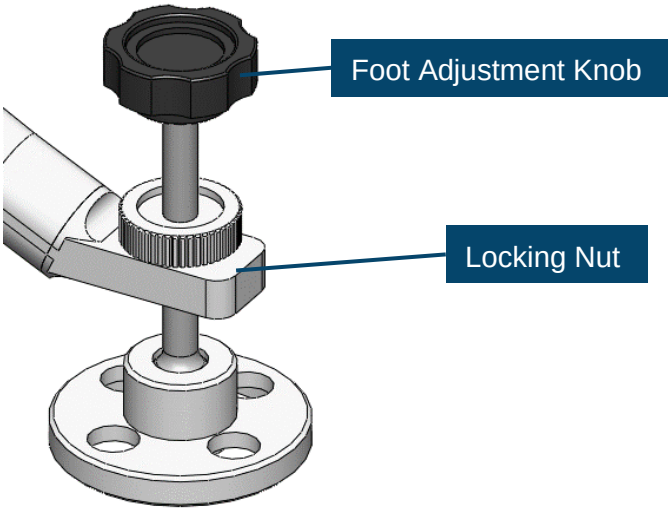
SIGNAL	FROM	TO	CABLE
Tx Signal	Modem Tx Port	BUC RF In	Tx Cable (Red End)
Rx Signal	LNB	Modem Rx Port	Rx Cable (Green End)
DC Power (Optional)	Power Supply for ATOM BUC	BUC DC In	DC Cord
AC Power (Optional)	AC Outlet	Power Supply for ATOM BUC	AC Cord



6. Operational

6.1 Levelling

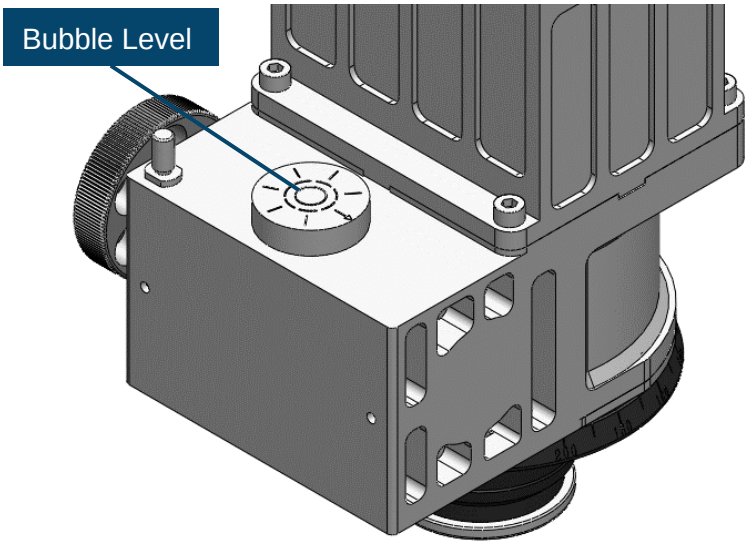
1. Loosen the locking nut on the foot to be adjusted.



2. Examine the location of the bubble in the Bubble Level on the Pedestal.

3. Decrease the height of the footpad(s) closest to the bubble and/or increase the height of the footpad(s) farthest to center the bubble.

   Turn the foot adjustment screw CW or CCW to elevate or lower the foot respectively.

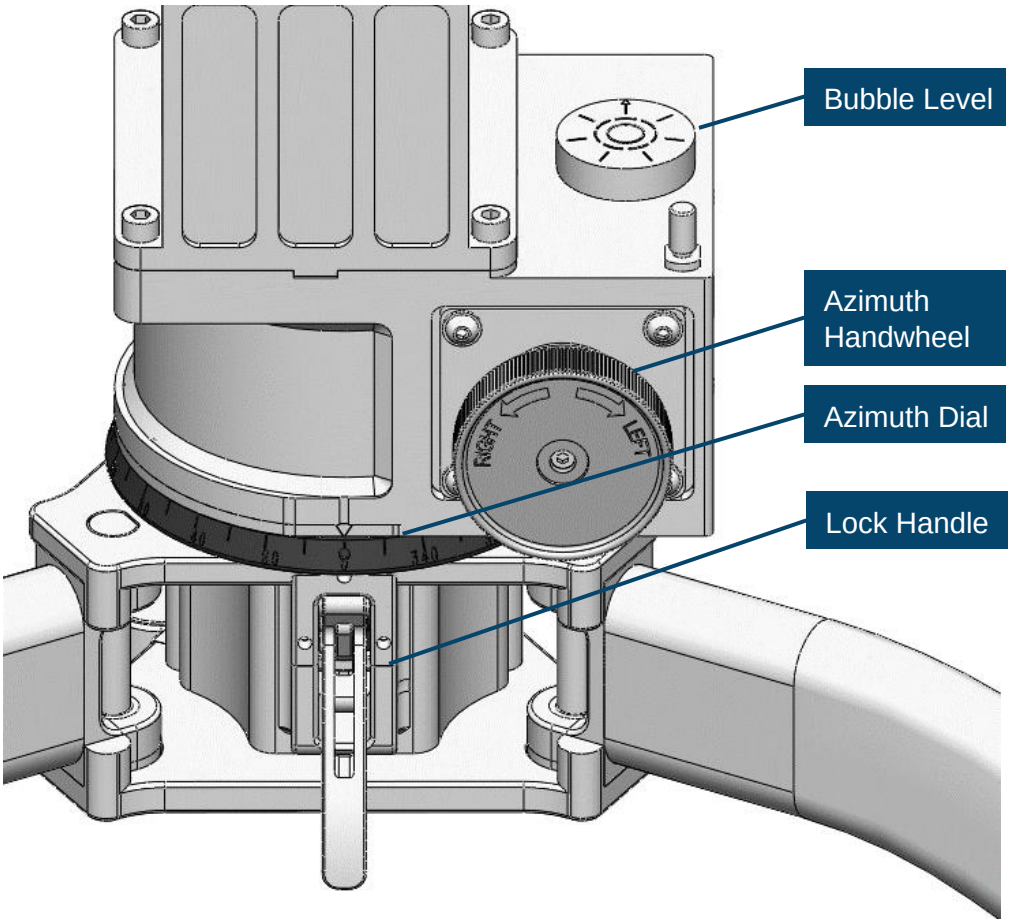


4. Continue adjusting the footpad heights until the bubble in the Bubble Level is centered.

5. Once the system is leveled, ensure the locking nuts are tightened on all feet.

6.2 Zeroing the Azimuth Dial

1. Turn the Azimuth Handwheel so the Azimuth Dial reads 0 degrees.
2. Unlock the Lock Handle of the Leg Assembly
3. Rotate the Pedestal Assembly so the arrow on the bubble level points towards the equator.
4. Re-engage the Lock Handle of the Leg Assembly.



6.3 Adjusting Antenna Position

6.3.1 Azimuth Adjustment

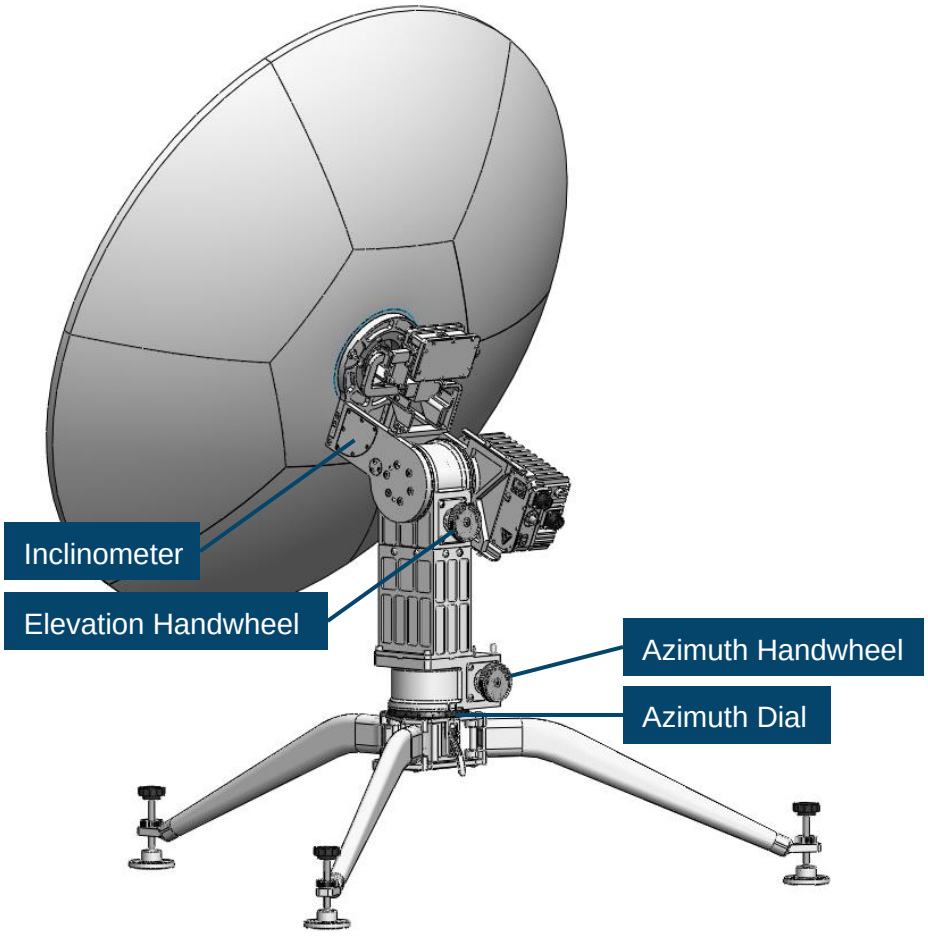
1. Use the lower handwheel to control the azimuth position of the terminal.
    a. Rotate the handwheel CW to move the azimuth to the left.
    b. Rotate the handwheel CCW to move the azimuth to the right.

2. Use the azimuth dial on the bottom of the pedestal to read the current azimuth position.

6.3.2 Elevation Adjustment

1. Use the upper handwheel to control the elevation position of the terminal.
    a. Rotate the handwheel CW to move the elevation to the down.
    b. Rotate the handwheel CCW to move the elevation to the up.

2. Use the inclinometer on the side of the pedestal to read the current elevation position.



6.4 Manual Acquisition Procedure

6.4.1 Preparation

1. Attach a spectrum analyzer of equivalent pointing tool to the LNB output.
2. Configure the feed horn to the correct Rx polarization.
3. Determine the target azimuth and elevation position of the satellite.
4. Adjust the antenna to point towards the target azimuth and elevation position.
5. Sweep the azimuth 20 degrees east and west.
6. Does the spectrum analyzer detect a signal at the target frequency? If so, skip to Section 6.4.3. Otherwise, continue to the next section.

6.4.2 Antenna Sweeping

1. Adjust the elevation 2 degrees upwards from its current position.
2. Re-sweep the azimuth 20 degrees east and west from the target azimuth position.
3. Does the spectrum analyzer detect a signal at the target frequency? If so, skip to Section 6.4.3, otherwise, continue to the next step.
4. Move the elevation the same amount that was just moved but add another 2 degrees and change the direction.
5. Return to Step 2 of this section.

6.4.3 Azimuth Optimization

1. Gradually move the azimuth eastward.
2. If the signal strength increases, continue to move eastward. Otherwise, change directions and gradually move westward.
3. Once the signal strength starts to decrease, move backwards until peak signal strength reading is achieved.

6.4.4 Elevation Optimization

1. Gradually move the elevation upwards.
2. If the signal strength increases, continue to move upwards. Otherwise, change directions and gradually move downwards.
3. Once the signal strength starts to decrease, move backwards until peak signal strength reading is achieved.
4. Is the signal sufficiently strong? If not, then the antenna might be pointed to a sidelobe of the target satellite. In this case, restart from Section 6.4.1. Otherwise, the antenna has successfully pointed to the target satellite.

7. System Troubleshooting

PROBLEM	TROUBLESHOOTING STEPS
No or weak signal	1. Test reception with a different cable. 2. Verify there are no obstructions in the look angle. 3. Verify all other interfacing components, such as the modem and LNB, are functioning properly. 4. If the problem is not corrected in the above steps, contact the terminal manufacturer.
Unable to transmit	1. Check condition of Tx cable. 2. Verify the flexible waveguide is installed tightly. 3. Verify there are no obstructions in the look angle. 4. Verify all other interfacing components, such as the modem and BUC, are functioning properly. 5. If the problem is not corrected in the above steps, contact the terminal manufacturer.
Azimuth has difficulties moving	1. Verify the azimuth base is not jammed. 2. Perform a full azimuth sweep and observe if there is any resistance. 3. Contact the terminal manufacturer.
Elevation has difficulties moving	1. Verify the target angle is not beyond the elevation range. 2. Verify the elevation gearbox is not jammed. 3. Perform a full elevation sweep and observe if there is any resistance. 4. Contact the terminal manufacturer.
Petals do not assemble onto the Pedestal	1. Verify the Petals are installed onto the location matching their number on the Reflector Hub. 2. Contact the terminal manufacturer.

8. System Maintenance

Regular maintenance is recommended per the schedule below:

NO.	DESCRIPTION	FREQUENCY
1	Inspect and clean integrity of feed horn window, replace when damaged.	Once per month
2	Inspect OMT and waveguide sealing, if there is a leakage, dry out the components and seal with silicon fusion tape or replace damaged parts.	Once per month
3	Inspect screws and nuts, tighten, or replace screws upon loosening or rusting.	Once per month
4	Inspect system for any noise during operation. Clean up the transmission and lubricate if any noise.	Once per month
5	Inspect paint integrity of the antenna, touch up when required.	Once per month
6	Lubricate gears and transmissions.	Once per year
7	Clean the petal surface.	Every 3 months or required when exposed to extreme conditions

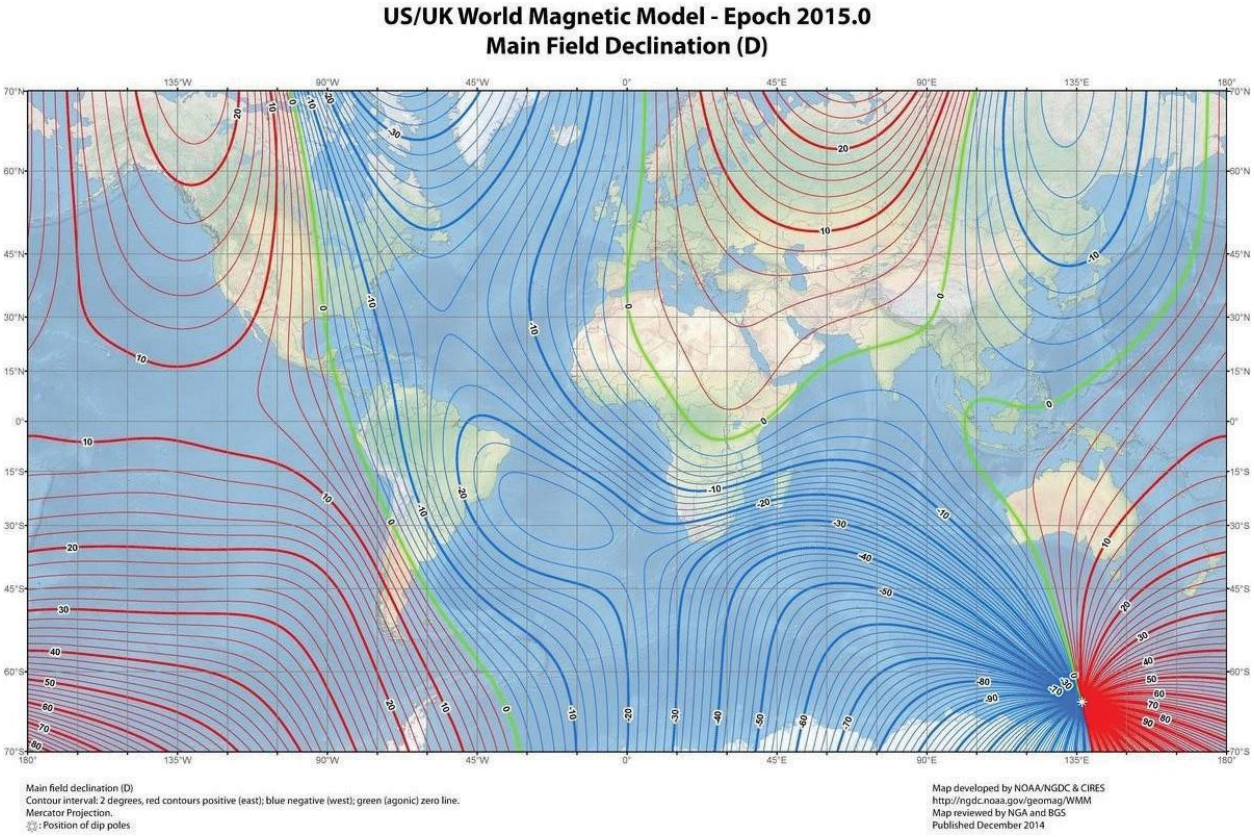
9. Technical Specification

ELECTRICAL	
Reflector Aperture	0.8m
Reflector Material	Carbon Fibre
Feed Configuration	Centre
Tx Frequency	29.0 to 30.0 GHz
Rx Frequency	19.2 to 20.2 GHz
Tx Gain	45.0+20lg(f/30) dBi
Rx Gain	41.4+20lg(f/20) dBi
Polarization	Circular
Tx/Rx Isolation (Port Isolation)	85 dB
Sidelobe	≤-14 dB (First Sidelobe)
Azimuth Range	0° to 360° (Continuous)
Elevation Range	0° to 90°
Tx Feed Interface	WR28
Rx Feed Interface	WR42

MECHANICAL	
Case Size	85.6cm (L) x 72.5cm (W) x 41.6cm (H)
Case Weight	≤ 22kg (Antenna and Case Only)

ENVIRONMENTAL	
Operational Wind Load	40 km/h
Survival Wind Load	65 km/h
Temperature	-40°C to +60°C
Humidity	0 to 95%

Appendix A – Magnetic Declination Map



US/UK World Magnetic Model - Epoch 2015.0 Main Field Declination. (2014, December).

Retrieved from http://ngdc.noaa.gov/geomag/WMM

Norsat International Inc.

ABOUT NORSAT

Norsat International Inc., founded in 1977, is a leading provider of innovative communication solutions that enable the transmission of data, audio and video for remote and challenging applications. Norsat's products and services include customizable satellite components, portable satellite terminals, maritime solutions and satellite networks. The company's products and services are used extensively by telecommunications services providers, emergency services and homeland security agencies, military organizations, health care providers and Fortune 1000 companies.

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