RT-CK450

User Manual

Cana SatCom Inc.

Table of Content

Introduction

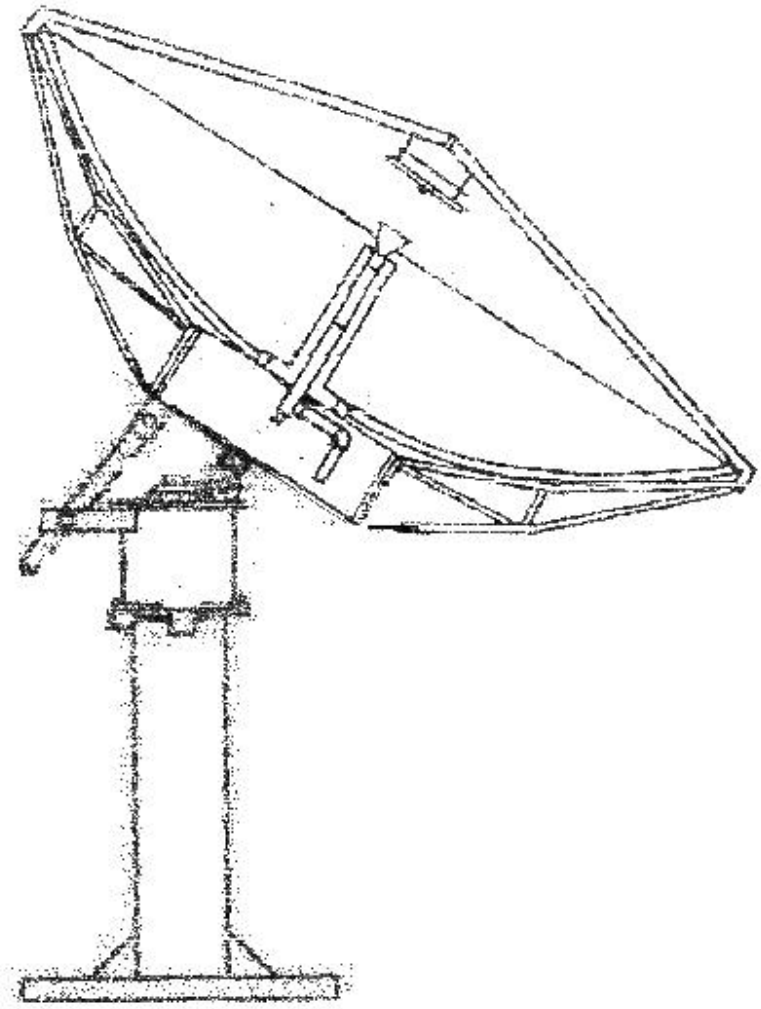

Figure 1. Side View of RT-CK450

Cana SatCom's RT-CK450 4.5M earth station antenna features a dual reflector, an exclusively designed 2 or 4-port ring focus, beam-shaping feed and ground plane configuration with high efficiency, low side lobe, low VSWR, and wide bandwidth. It is mainly used for high-density data, voice, communications networks and broadcast applications,

This versatile antenna can be configured in transmit and receive or receive only; either linear or circular polarized; C-Band, Ku-Band, or hybrid C/Ku receive only. The pedestal mount is made manual or motorizable.

Features:

- Three year warranty on all structural components;
- High gain;
- Easy assembly.

Technical Specifications

Antenna and Feed System Specifications

Table 1 RT-CK450 Antenna and Feed System Specifications

Antenna Specifications - RT-CK450					
Parameters		C-band		Ku-band	
		Receive	Transmit	Receive	Transmit
Frequency (GHz)		3.7 - 4.2	5.925 - 6.425	10.95 - 12.75	14.0 - 14.5
Gain (dB)		43.8	47.2	53.0	54.5
V.S.W.R.		1.25:1	1.25:1	1.25:1	1.25:1
-3dB bean width		1.14°	0.72°	0.37°	0.31°
-15dB bean width		2.40°	1.42°	0.57°	0.63°
Noise Temperature	Elevation 10°	36°K		60°K	
	Elevation 20°	27°K		50°K	
	Elevation 40°	24°K		44°K	
Tx Power Capacity			5 Kw/port		1 Kw/port
Feed Interface		GPR-229F	GPR-159G/137G	WR-75	WR-75
Insertion Loss		0.2 dB	0.20 dB	0.25 dB	0.25 dB
R/T Isolation		85 dB		85 dB	
Cross Polar Isolation		35 dB	35 dB	35 dB	35 dB
Axial Ratio		1.8 dB	1.8 dB		
Side Lobe	First	-14dB		-14dB	
	Far End	CCIR Rep-580			

Mechanical Specifications

Table 2 RT-CK450 Mechanical Specifications

Mechanical Parameters		
Optics Type		Ring focus
Reflector Material		Precision formed aluminum
Main Reflector Segments		12
Mount Type		Pedestal mount
Main Reflector Size in Diameter		4500 mm
Sub-reflector Size in Diameter		495 mm
Steering		Manual
Azimuth Range		±65°
Elevation Range		0° - 90°
Surface Tolerance	Main reflector	≤ 0.50 mm (r.m.s.)
	Sub-reflector	≤ 0.25 mm (r.m.s.)
Paint Color		White
Typical Shipping Volume		6.2M^3
Typical Shipping Weight		1370 kg
Shipping Container		Qty 1 per standard 20 ft land/sea container. Qty 3 per standard 40 ft land/sea container

Environmental Conditions

Table 3 Environmental Conditions for RT-CK450

Environmental Conditions		
Wind Loading	Operational	20 m/s
	Survival	55 m/s
Operating Temperature		-45℃ - +60℃
Humidity		10% - 98%
Seismic	Vertical	0.15 g/s
	Horizontal	0.30 g/s
Paint Color		White

How the Antenna Works

In signal receiving, the satellite antenna works as a device to marshal and concentrate the Hertzian wave energy permeated in the air through its paraboloid reflectors. In signal transmitting, is works in an opposite way of receiving to project the Hertzian wave beam onto the satellite that it is communicating with. There is a device called feed positioned at the focus point of the paraboloid to collect in or transmit out the signals. Please refer to the conceptual diagram shown in Figure 2 for the processes.

The simplest and earliest antenna is the so-called front feeding parabolic antenna. Later it developed into the Cassegrain and Gregorian dual reflector antennas. The ring focus antenna, which is the main product from our company, is the further development in the antenna design, which greatly improved the performance, especially for the medium or small sized antennas.

Because the wavelength in microwave band is very small, such as for the satellite communications, in C-band, 4–6 GHz, it is less than 50mm and in Ku-band, 12–14 GHz, it is only about 20mm, the characters of the Hertzian wave is quite similar to the optical wave. Based on this we adopt the theory of the geometrical optics in design the parabolic reflector for our antenna products.

The main reflector of the ring-focus antenna is a circumrotating paraboloid and the sub-reflector is a circumrotating ellipsoid. In signal transmitting, the Hertzian wave emitted from the feed and projected to the apex of the sub-reflector, is reflected to the edge of the main reflector, whereas the wave projected to the edge of the sub-reflector is reflected to the center of the main reflector. In terms of the geometrical optics, by going through this reflecting process, the Hertzian wave forms a strong beam parallel to the central axes of the antenna, just like a light beam from a flashlight, which points to the communicating satellite. Please refer to the Figure 2.

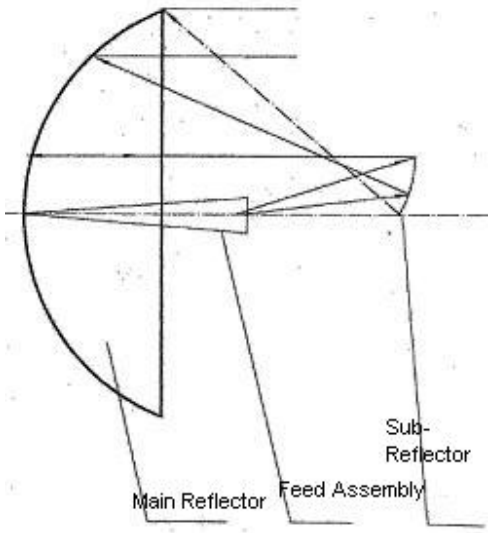

Figure 2. How the Antenna Works

Major Components of RT-CK450 Antenna System

Major Components

The antenna system is composed of two major portions, Antenna Dish and Base.

Dish Assembly includes:

- Main reflector
- Sub-reflector
- Sub-reflector support poles
- Feed sleeve
- Pivot body
- Radiate girders
- Circular girder-pull rod

- Feed
- Waveguide
- Polarization adjuster, etc.

The antenna base is composed of:

- Pedestal
- Tripod
- Azimuth adjusting bar
- Elevation adjusting bar, etc.

Main Reflector

The main reflector is composed of 12 precision-formed aluminum sectors, Z-shaped tendons, conjunction boards, and other conjunction hardware. The main reflector features both high accuracy and rigidity.

Antenna Frame

The antenna frame is composed of the pivot body, 12 radiate girders and 24 circular girders.

The pivot body is the key point in the antenna assembly, which is a cylinder with 1200 mm in diameter and 450 mm in height, built with a top and a bottom flange and tendons. It is formed as the base for installation and calibration of the main reflector sectors, radiate girders, feed assembly and sub-reflector. It is also the conjunction of the dish assembly and the pedestal base. All loadings of the antenna, including gravity, wind, ice, seismic loading, etc. are supported by the pivot body and through it impressed upon the pedestal base. So, the pivot body is structurally important in the whole antenna system for its accuracy and rigidity.

The radiate girders support the reflector sectors and keep the mechanical accuracy, passing the loading of the reflector sectors onto the pivot body.. The reflector sectors, pivot body and radiate girders are connected and fixed with taper pins to ensure the accuracy in reinstallation.

Sub-Reflector Assembly

The sub-reflector assembly includes the sub-reflector, support poles and temper screws. The sub-reflector is

a rotating camber with the diameter of 495 mm, which is made by CNC lathe with high precision and rigidity. The sub-reflector is controllable and adjustable in 3 dimensions through 4 adjusting screw bolts. 4 metal poles secured on the radiate girders support the sub-reflector, forming a decussation with 45° in degree.

Support Base Assembly

The antenna base consists of the pedestal, tripod, and azimuth and elevation actuators to control the 3-dimension movement of the antenna. There are 6 boltholes on the bottom of the pedestal, used for fastening the antenna system onto the pre-installed bolts on the concrete foundation. The tripod connects and secures the pivot body and pedestal. The elevation actuator, located right above the pivot body, is connected with the tripod and pivot body by taper pins. The azimuth actuator is located between the pedestal and the tripod. The azimuth and elevation of the antenna is controlled and adjusted by the two actuators easily and precisely.

Antenna Installation

Considerations for Foundation Preparation

The foundation design based upon this document is suitable for plain areas where the basic wind pressure remains within 80kg/m^2. Areas that do not conform to this condition should be dealt with appropriately, for example, by increasing the thickness of the foundation to 1.5m, incorporating bar-mat reinforcement within the concrete cubic, etc.

1. The foundation should be built on plains usually with a ground endurance of 8000kg/m^2. It should be 100mm high above the ground with minimum embedment depth of 1000mm.
2. The foundation made of 300m^3 concrete can be molded by a single casting. The construction should comply with the corresponding construction specifications and test standards.
3. The anchor bolts should be embedded in strict accordance with the marked size. The absolute value of positive and negative errors should not be more than 1.0mm. The 6 anchor bolts adopt Q235 steel.
4. The antenna should be installed with reliable lighting protection facilities.
5. The foundation should be installed firmly with a pull resistance of no less than 16 ton/m^2, and a horizontal force resistance of no less than 8 ton/m^2.
6. If the foundation is built on the top of a building, the anchor bolts should be welded firmly with the reinforcing steel bar of the building beam. The thickness of the foundation in this case can be 400 - 500mm.
7. In the areas frequently visited by hurricane or typhoon, the depth of the foundation can be up to 1500mm and it should be reinforced with bar-mat and welded firmly with the anchor bolts.
8. The foundation can be molded into a whole body. If a split one required, mold it according to the size

as shown in the diagram.

Preparation for the Antenna Installation

Unpack all the parts and accessories shipped with the antenna. Follow the Packing List to identify and classify them at the scene of the installation for the antenna. Clean the surface of each piece of parts and put the antirust grease to all copulate interfaces and screw holes. Clean the dust with cotton yarn from all painted surfaces.

Make sure all necessary tools and accessory materials are well prepared at the installation field. We have included a list in this manual for recommended installation tools for your convenience.

Antenna Installation

Installing Pedestal

1. First, check the built foundation to make sure its azimuth approximates the azimuth of the satellite to be pointed to, so that the adjustment of the azimuth will be easier.
2. Install the pedestal onto the foundation by putting it vertically on the foundation with preinstalled bolts going through the corresponding holes at the bottom and fastening the nuts. Make sure the pedestal is perpendicular to the ground. Refer to Figure 3 and Figure 4 for this procedure.
3. Install the azimuth actuator. Please note the azimuth adjusting screw has been preinstalled on the pedestal.
4. Install the elevation adjusting screw for the elevation actuator.

Installing Reflectors

There are two ways to install the reflectors depending on the installation conditions. The first one is to assemble the reflectors at the field, then hoist it onto the pedestal with a crane. The second one is to directly install on the pedestal piece by piece.

Installing Pivot Body.

If installing at the field, first find a flat ground of about 5m by 5m. Raise the pivot body from the bottom with three wooden or concrete pads with the same height of more than 300mm.

If installing directly onto the pedestal, connect and secure the joints on the elevation actuator and the joints on the tripod, fastening with the taper pins; then install the elevation and azimuth actuators properly.

Installing Radial Girders

Put each numbered radial girder into the corresponding position with the same number on the pivot body. Insert the taper pin to secure each girder and fasten it with the bolt, gasket and nut.

Refer to Figure 3 for this step.

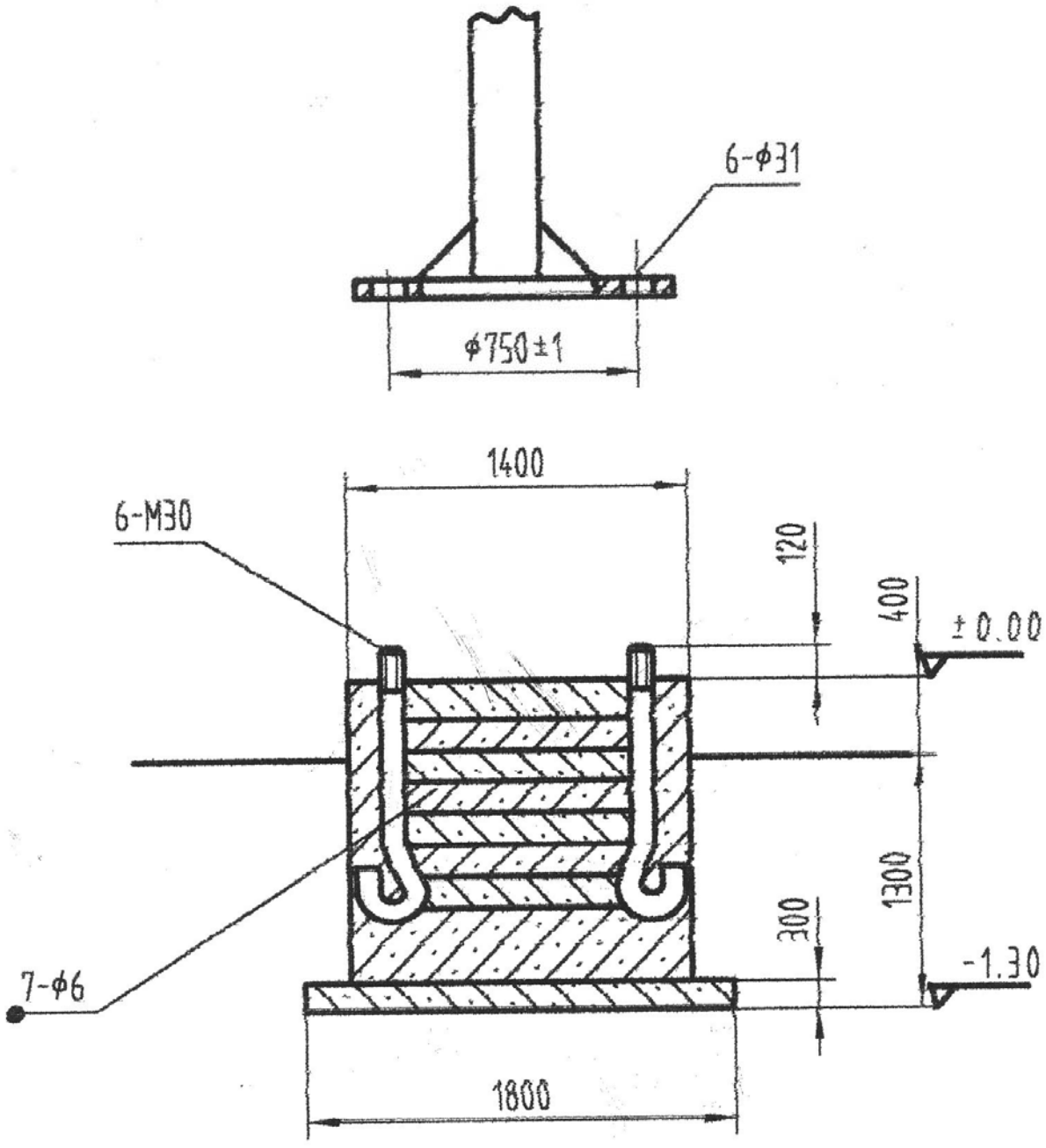

Figure 3. Side View of Pedestal and Foundation

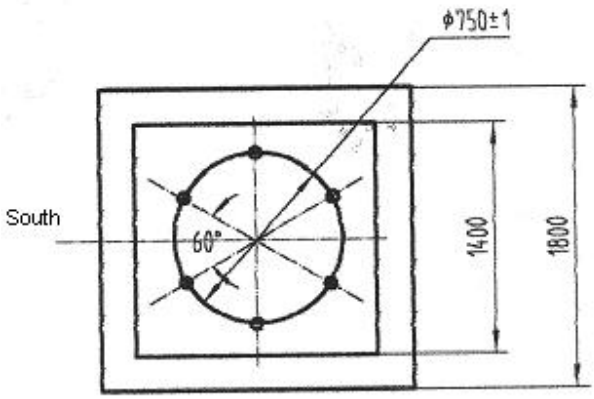

Figure 4. Top View of Pedestal and Foundation

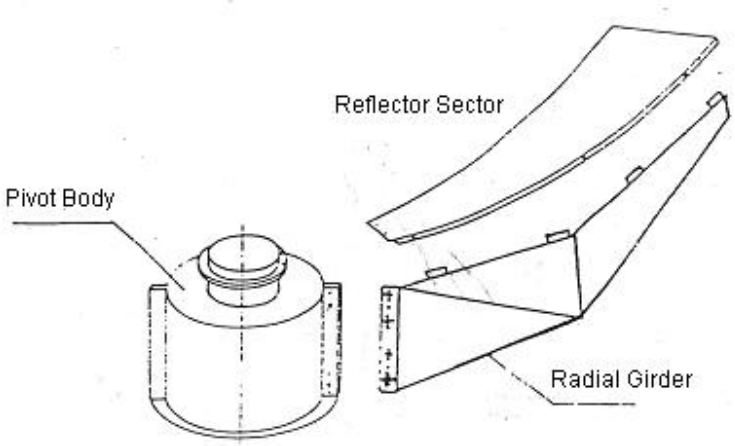

Figure 5. Installing the pivot body, radial girders and reflector sectors

Installing Reflector Segments

Put each numbered reflector sector to the corresponding position on the radial girder with the same number. Insert the taper pin on the sector into the corresponding hole on the girder. Put the screw on the joint board and adjust the gap and position between sectors to make sure the gaps are equal and the sectors are at the same height. Fasten the nuts onto the bolts. Repeat the above steps until all 12 sectors are all installed properly.

Installing Circular Girder-Pull Rods

Fasten the 12 inner circular/ring rods and 12 outer circular/ring rods with the bolts, gaskets and nuts, as shown in Figure 5

Installing Sub-Reflector and Support Struts.

As shown in Figure 6, install the sub-reflector and the support struts onto the corresponding

position. Secure them by fastening the bolts.

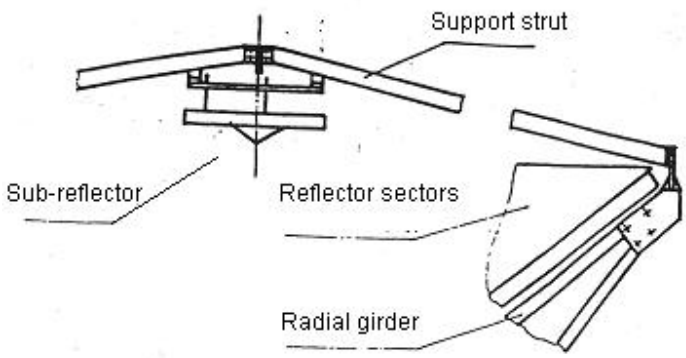

Figure 6. Installing sub-reflector and support poles

Installing Feed and Feed Sleeve

On the flat ground, connect the feed and waveguide together. Put and secure them into the feed sleeve. Hoist the assembly into the pivot body and fasten it in place. Please see Figure 7 for this step.

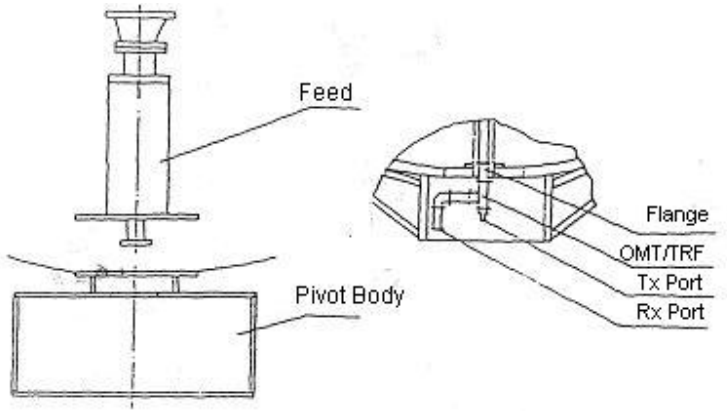

Figure 7. Installing Feed and Feed Glove

Adjusting Sub-reflector

Use the appropriate tools to adjust the installed sub-reflector to make it positioned on the designed location. Please refer to Figure 8 for this step.

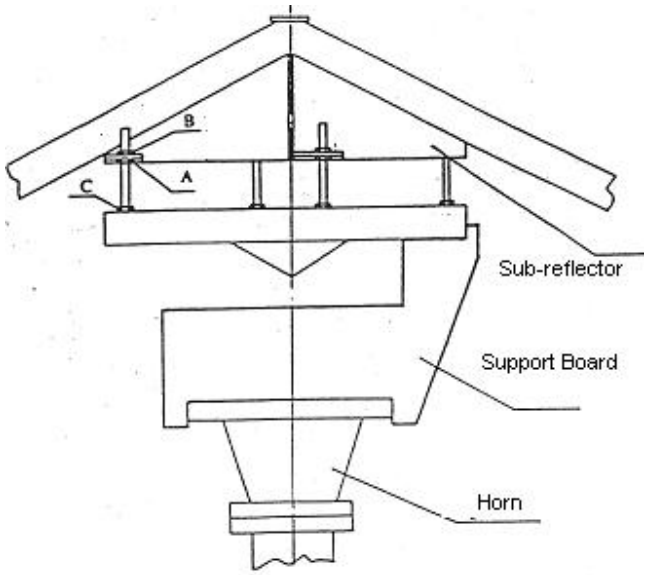

Figure 8. Adjusting Sub-reflector

Hoisting and Installing Reflector Assembly

Use two wire ropes, making a circle on one end and tightening another end on the crane hook. Put two wire rope circles through the pivot body. Insert two V-shaped steel bar (#7) or pipe (φ70) with length of 1300mm into the circle of two wire ropes under the bottom of the pivot body. Use another 4 steel wires to hold the crane hook and the edge of antenna, with the mouth of the paraboloid upward, to make the hoisting stable. Hoist the reflector assembly onto the pedestal and secure it in place.

Installing OMT

Match the OMT flange to the flange of the waveguide tube and put the seal ring in between. Fasten the bolts at the last.

Adjusting Antenna Stance

Check all over the installation process. Make sure all screws and bolts are fastened. Adjust the azimuth and elevation by tuning the both actuators to make the antenna pointing to the designated satellite. Finally, fasten all backup nuts.

At this step, all installation work is finished and ready for tuning up.

Tuning up Polarization Device

The new polarization unit adopted by RT-CK450 is our patent proprietary device, which features easy tuning up and larger range of adjustment.

Identifying Polarizing Direction

The rectangular waveguide tube is the interface between the antenna feed and the receiving device. The waveguide tube determines the polarizing direction for receiving or transmitting Hertzian waves.

In the rectangular waveguide tube, the electric field direction of the dominant mode transmitting is perpendicular to the wide side of the tube, as shown in Figure 9. The polarizing of the antenna is determined by the electric field direction in the waveguide tube. So, the polarizing direction can be tuned by adjusting the waveguide tube.

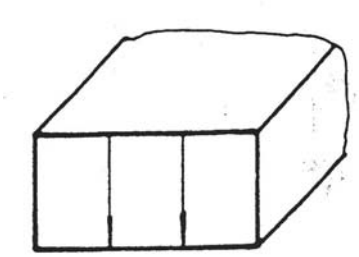

Figure 9. Electric Field Direction

As shown in Figure 10, it is called vertical polarization if the electric field direction is perpendicular to the ground and horizontal polarization if the electric field direction is parallel to the ground.

Figure 10. Vertical and Horizontal Polarization

Structure of Rotating Polarization Device

The structure of the rotating polarization device is shown in Figure 11

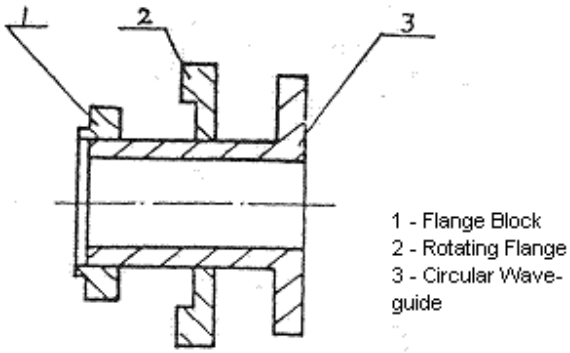

Figure 11. Polarizing Device

Adjusting Polarization

1. Embed the flange block in the rotating polarization device into the notch of the connected circular waveguide.
2. Connect and Secure the two flanges together by inserting the bolts and fasten the nuts, as shown in Figure 12.

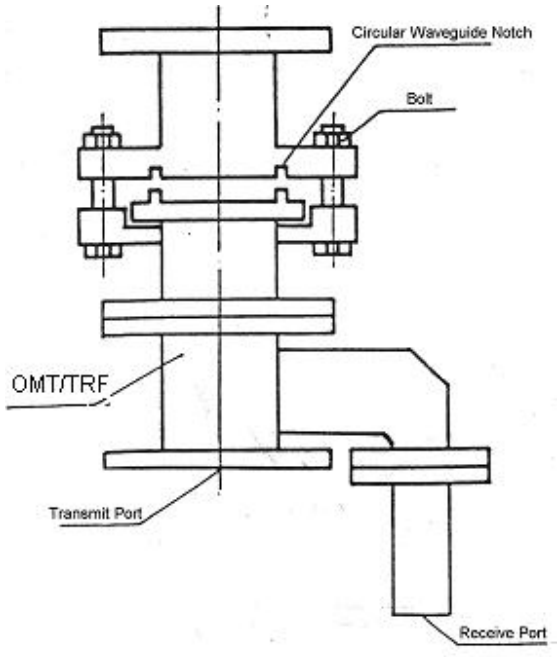

Figure 12. Adjusting Polarization

Pointing Satellite

After setting up the antenna system, the last step is to point the antenna right to the satellite to be communicated with.

1. Adjust the azimuth of the antenna. The azimuth is adjusted by rotating the hand-wheel on the axis of the azimuth actuator. It should be operated slowly and carefully.
2. Adjust the elevation of the antenna. The elevation is adjusted by rotating the handle on the axis of the elevation actuator. It should be operated slowly and carefully.
3. Determine the azimuth, elevation and polarization. They are determined by the following formula, respectively.

Elavation:

$$E = arctg\left(\frac{\cos\theta * \cos(\Phi_s - \Phi_0) - R/(R+H)}{\sqrt{1-(\cos\theta * (\cos\Phi_s - \Phi_0))}}\right)$$

Azimuth:

$$A = 180^{\circ} + arctg\left(\frac{tg(\Phi_s - \Phi_0)}{\sin\theta}\right)$$

Polarization Degree:

$$P = \pm\left\{90^{\circ} - arctg\left[\frac{tg\theta}{\sin(\Phi_s - \Phi_0)}\right]\right\},$$

where: if $\Phi_s - \Phi_0 < 0$, P is negative;

if $\Phi_s - \Phi_0 > 0$, P is positive.

In the above formulas:

R = Radius of the earth, 6370 km;

H = Height of the satellite, 35786 km;

Φ_s = Longitude of the earth station (East);

Antenna Maintenance

The satellite antenna should be maintained in good work conditions with a regular maintenance plan, usually once a year. It is not necessary to reposition the azimuth and elevation during the maintenance work. The following are the regular maintenance jobs.

1. Regularly check the fastening hardware for any loosening. Loosened nuts, bolts, etc. will affect the performance of the antenna and more seriously, expose the antenna system to the risk of causing accidents or injuries in the earth station.
2. Regularly check if the film on the horn mouth is broken or worn out. If necessary, replace the film in time.
3. Regularly clean the surface and remove rust from the all hardware, then repaint them. If the galvanized hardware is seriously rusted, replace with the new one.
4. Pay close attention to the local weather report everyday. If there is the possibility of strong wind of greater then 10 degrees, position the antenna vertically towards the sky to reduce the chance of damaging.
5. Set up a full range of the lightning protection system in the earth station or where the antenna is installed to prevent it from being hit by thunder storms.
6. When it is snowing, clear out the snow in time on the surface of the reflectors to keep the antenna working in the normal status.

Recommended Tools for Installation

The following tools are recommended for the installation and maintenance of the antenna.

1. 375mm wrench, 200mm wrench, 12’ and 8’ nut runners.
2. Cross-shaped and slot-shaped screwdrivers.
3. Steel hammer and wooden hammer.
4. Crowbar.
5. Pincers and tongs
6. Tape measure (5m)
7. Tools specific for opening shipping crates and cases.

RT-CK450 Lists of System Parts

Packing List

Table 4 Packing List

Seq. #	Part Name	Packing	No.	Content
1	Reflector Segments	Wooden crate	1	12 sectors
2	Sub-Reflector	Wooden crate	1	Sub-reflector and support boards
3	Feed Kit	Wooden crate	1	Feed, Waveguide, OMT, etc.
4	Pivot Body	Gunnysack	1	Pivot Body
5	Radial Girder	Gunnysack	4	12 Radial girders
6	Circular Girder-Pull Rod	Gunnysack	1	24 Rods
7	Sub-reflector Strut	Gunnysack	1	4 Struts
8	Feed Sleeve	Gunnysack	1	Feed Sleeve
9	Pedestal	Gunnysack	1	Pedestal
10	Embedded Parts	Gunnysack	1	6 Anchor Bolts
11	Molding Board	Gunnysack	1	1 Foundation moulding board
12	Fastening Hardware	Wooden crate	1	All fastening nuts, bolts, screws and small accessories

Antenna System Parts

Table 5 List of Antenna System Parts

Sequential #	Part Name	Quantity	Notes
1	Reflector Segments	12	
2	Pedestal	1	
3	Degree Dial	1	

4	Radial Girders	12	
5	Pivot Body	1	
6	Feed Pole	4	
7	Lang Pull-rods	12	
8	Short Pull-rods	12	
9	Feed	1 set	5 pieces plus 2 block boards
10	Feed Base	1	
11	Sub-reflector	1	
12	Elevation Adjusting Pole	1	
13	Azimuth Adjusting Pole	1	
14	Fastening Hardware	1 set	Refer to Table 6
15	Adjusting Poles	2	
16	User Manual	1	

Fastening Hardware List

Table 6 Fastening Hardware List

Seq. #	Part Name	Spec	Quantity	Notes
1	Bolts	M5×15	24	Countersunk head
2	Bolts	M6×16	8	Countersunk head
3	Bolts	M5×20	56	
4	Bolts	M6×20	8	
5	Nuts	M6×20	18	
6	Nuts	M8×35	8	
7	Nuts	M10×25	48	
8	Nuts	M10×35	8	
9	Nuts	M12×30	48	

10	Nuts	M16×60	8	
11	Nuts	M16×65	16	
12	Nuts	M5	56	
13	Nuts	M6	8	
14	Nuts	M8	16	
15	Nuts	M10	56	
16	Nuts	M12	4	
17	Nuts	M16	16	
18	Nuts	M30	7	
19	Flat Washer	Φ5	56	
20	Flat Washer	Φ6	26	
21	Flat Washer	Φ8	16	
22	Flat Washer	Φ10	56	
23	Flat Washer	Φ12	52	
24	Flat Washer	Φ16	24	
25	Flat Washer	Φ30	7	
26	Spring Washer	Φ5	56	
27	Spring Washer	Φ6	26	
28	Spring Washer	Φ8	16	
29	Spring Washer	Φ10	56	
30	Spring Washer	Φ12	52	
31	Spring Washer	Φ16	24	
32	Spring Washer	Φ30	7	
33	Taper Pin	27×95	1	
34	Taper Pin	35×95	2	
35	Cotter Pin	4×50	8	
36	Cotter Pin	4×55	7	
37	Cotter Pin	5×70	1	