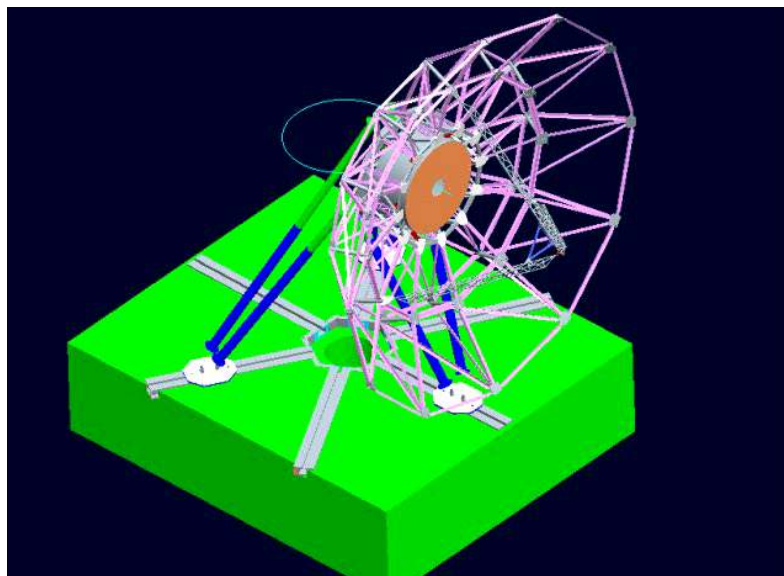


PROPOSAL FOR THE PROVISION OF A HEXAPODE BASED ANTENNA ASSEMBLY


RX AND RX/TX STATIONS



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DOCUMENT CHANGE LOG

ISSUE	DATE	CHANGES	NOTES
A	10/06/05	ALL PAGES	-

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1 Environmental Requirements

1.1 Operational

The operational environmental requirements for the X-band Remote Sensing Receiving Station are listed in Table 1.

Table 1 - Operational Environmental Requirements

Characteristics	Values
Temperature range operating	-25° to +55° C
Relative humidity	up to 100% non condensing
Wind operational	100 km/h

1.1.1 Survival

The survival environmental requirements for the X-band Remote Sensing Receiving Station are listed in Table 2.

Table 2 - Survival Environmental Requirements

Characteristics	Values
Temperature range survival	-30° to +60° C
Wind survival	200 km/h

2 Antenna Characteristics

2.1 General Description:

Main Hexapod features (see antenna structure in Figure 1) are:

- NO singular points (i.e. no axes)
- UNLIMITED azimuth travel (no cable wrap, no rotary joints)
- High stiffness
- Isostatic mount (no internal stresses due to thermal dilatations or pedestal drift)
- Simple mechanical structure
- Easy access to mechanical parts
- Easy access to front-end equipment
- Suitable for harsh environment
- Simplified maintenance



Figure 1 - Hexapod Antenna Structure

Characteristics & Performances:

Optics:	Shaped Cassegrain
Reflector:	from 4 to 7m diameter, shaped parabolic reflector F/D=0.3
Subreflector:	shaped hyperboloid (12% of the main dish) supported by 3 steel frameworks.
Feed	Corrugated horn or exponential horn
Frequency band	available from S band to Ka band
G/T (5 m diameter)	28 dB/K @ 5° El and 8200 MHz
3 dB Beamwidth (5m)	0.45° @ 8200MHz
Mount type:	Hexapod
Pointing Coverage:	upper hemisphere for elevation above 0.5°.
Angular speed:	normally 2.5°/sec, up to 6°/sec
Gain:	no less than 49dB at 7.9 GHz for a typical 5m dish
Polarization:	Circular (RHCP or LHCP)
Off axis side lobes:	according to the CCIR masks: 29-25log(θ) for θ<7° and 32-25log(θ) for θ> 9.2°.
Noise Temperature:	(at 5° elevation, only antenna, clear sky) 60° K
Cable Wrap:	Flexible cables with no torsion even for continuous, endless Azimuth rotation
Centre-Hub:	About 1 cubic meter of available space for all RF equipments plus up ad down converters, easily accessible. Optionally thermally controlled.

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Pedestal

6 servo jacks	
Angular Speed	2.5° /s (6° /s) in any direction
Acceleration:	10° /s ² in any direction
Elevation travel:	0.5° to 179.5°
Azimuth travel:	unlimited

External Dimensions (for a typical 5m dish)

Pedestal	
Jack minimal length	2.5m
Jack stroke	1.8m
Jack ball screw diameter	60mm
HEXAPOD station	
Height in working position	3.0m
Stow Position	90° El at minimum height (2.5m)
Base diameter	1.3m

Pointing errors:

Static	0.05° (including backlash)
Dynamic @ 10° /s ² and 2.5° /s	0.06°
Wind loading @ 25m/s	0.08°
Total (RMS)	0.12°
Maximal operating jack force	42000 N
Maximal jack static strength	100000 N
Maximal jack speed	31 mm/s
Maximal jack power	1300W

Primary power requirements

Voltage	380Vac 50Hz 3phase
Consumption pedestal	5kVA
Nominal power	2500W

Environmental

<u>Temperature range</u>	
Operating	-25° to +45° C
Survival	-30° to +60° C
<u>Relative humidity</u>	up to 100% non condensing
<u>Wind operational</u>	100 km/h

Wind survival 200 km/h

2.1.1 Waveguide pressurisation and de-icing

Waveguide pressurization

Waveguide pressurized for to avoid the humidity entering the waveguides both the feed aperture and the waveguides and sealed to allow a small overpressure (20mm hg) of a dehydrated air provided by a dehydrator-pressurizer.

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2.1.2 De-icing (optional)

De-icing consist of a 400Wm² heater of the main reflector surface. A thermostat automatically commands the de-icing operation when the temperature falls below settable values (typically 0°).

2.1.3 Steerability

All upper hemisphere without singular points (like the zenith for the Azimuth/Elevation mount or the horizon for the XY mount). The actual reflector angular speed is identical to the satellite angular speed without need of cosecant correction.

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2.2 RF Receive subsystem

2.2.1 General

The RF Receive Subsystem depends from the customer requirements.

3 M&C subsystem

The Monitoring & Controls subsystem consists of a graphical interface showing the status of the satellite station. It appears like a synoptic panel, with the equipment, signal, etc. The operator can view the status or setup the remote equipments.

The faults of equipments are monitored on this interface.

This feature is implemented in the shelter subsystem but it can be realized far away from the satellite station.

4 Shelter subsystem

There are 2 alternatives for the installation of the antenna:

- In the first alternative the antenna is installed on the roof of a small building with the equipment room under the antenna;
- In the second alternative the equipment room is realized inside a commercial conditioned shelter.

Both alternatives are shown in Figure 2.

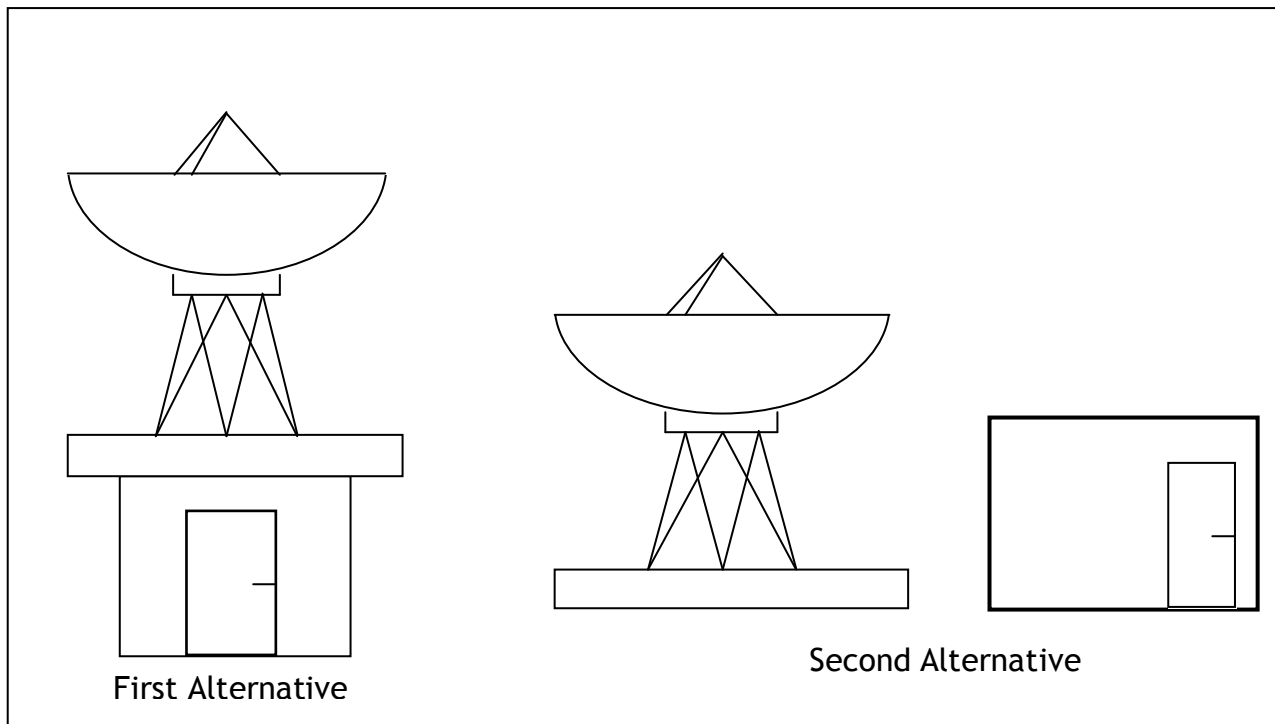
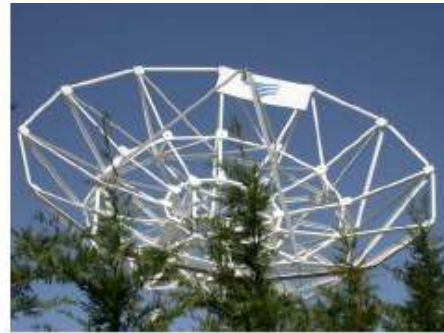
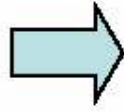
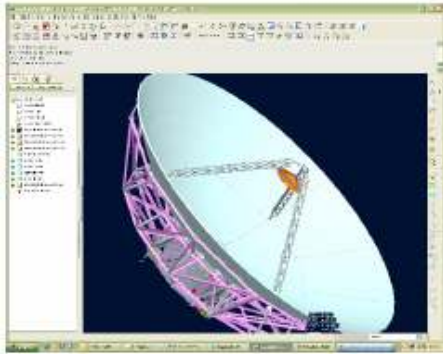


Figure 2 Installation alternatives

In the first alternative the equipments room is under the antenna floor. Signalling and Power Cabling between antenna and equipment room does not require long cable runs. This solution requires that the customer realizes the equipment building.

Even though the first alternative is the preferred one, this proposal includes the provision of a conditioned mini shelter close to the antenna. MCU (Motion Control Unit), M&C (Monitor and Control) and Multimission HDR Demodulator subsystems are installed inside the mini shelter.

The mini shelter includes also the auxiliary equipments like UPS, NB/SB Power Board and De-icing controller.



Designed for operation with LEO and Remote Sensing satellites.

The advantage of the hexapod structure consists in fast motion, light weight, easy transporation.

In the full operational range no singularity exists.



Figure 3 - Hexapod mount views

Characteristics:

Velocity:	2.5°/s in any direction
Acceleration:	10°/s ² in any direction
Elevation travel:	0 to 90°
Azimuth travel:	unlimited
Pointing errors:	
static	0.05°(inc. backlash)
dynamic @ 10°/s ² and 2.5°/s	0.06°
wind loading @ 25m/s	0.08°
total (RMS)	0.12°
Maximal operating jack force	42000 N
Maximal jack static strength	100000 N
Maximal jack speed	31 mm/s
Maximal jack power	1300W

Feed	Corrugated horn
Frequency band	8000 to 8400 MHz
G/T @ 5° el, f= 8200 MHz	28 dB/K
Beamwidth @ -3dB, f= 8200MHz	0.45°
Side lobes	-18 dB

Dimensions:

Antenna	
Reflector diameter	5m
Antenna interface diameter	0.7m
Pedestal	
Jack minimal length	2.5m
Jack stroke	1.8m
Jack ball screw diameter	40mm
HEXAPOD station	
Height in working position	3.0m
in survival position	2.5m
Base diameter	1.3m

Simple operator graphic interface

operating modes:	stand-by manual position azimuth slew program tracking preset ephemeris tracking stow
operating temperature:	+0° to +50°C
storage temperature:	-20° to +60°C
humidity:	up to 95%RH

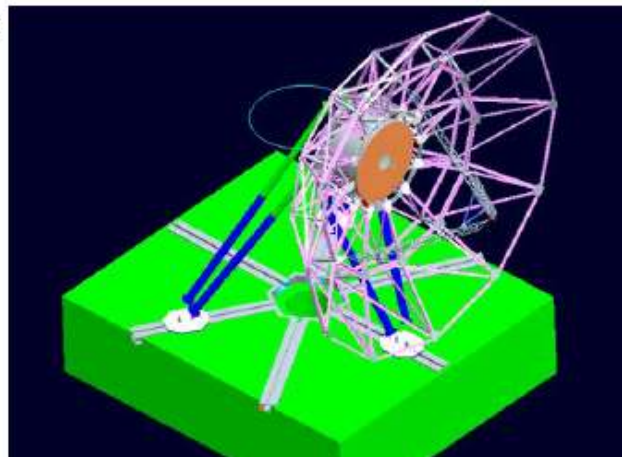


Figure 4 - STANDARD Hexapod Antenna Main Characteristics

5 Antenna De-icing Subsystem

5.1 Operation Characteristics

The operation of the de-icing system is executed by the auxiliary de-icing control. The system scans two conditions, rain and ice, through a control unit (ASE model DS-4):

- **First condition: "Rain"** - In presence of rain it will be turned on the blower and the heater system for the horn, with a hot air flow towards the horn.
- **Second condition: "Ice"** - In presence of ice it will be turned on, besides the blower and heater system for the horn, the heater air system for the reflector and the heater system for the sub-reflector. The three heater air will be turned on in sequence with a delay of 5 seconds each one. The system is on until the temperature is below the set one (the setting is performed in the control unit for temperature TC-4800 - Tempatron). The turning off occurs when the temperature is reached or when there is no ice condition.

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5.1.1 Protections and Signalling

The status of the antenna is 100% monitored from a dedicated electronic system (actual pointing, actual speed, motor currents, limit detectors, safety devices).

The operation of the antenna is controlled by integrated safety logics to prevent any potentially dangerous situation.

In case of potentially dangerous situation or malfunction, the antenna is stopped, and the malfunction is reported on the screen.

In addition limits switches or equivalent hardware overrides the electronic controls to stop the antenna.

Panic button is available in strategic points for safety.

Lightning rods and copper flex connections are distributed around the structure to protect the equipments.

6 Antenna Tracking Subsystem

Available Tracking modes:

- ✓ **Program Track**
- ✓ **Conical Scan**
- ✓ **Monopulse**

Tracking accuracy:

static	0.05° (including backlash)
dynamic @ 10° /s ² and 2.5° /s	0.06°
wind loading @ 25m/s	0.08°
total (RMS)	0.12°
Maximal operating jack force	42000 N
Maximal jack static strength	100000 N
Maximal jack speed	31 mm/s
Maximal jack power	1300W

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6.1.1 ACU Operational Modes

Industrial PC based architecture with Real Time OS and Linux based for GUI, Extensive use of digital signal processing and predictive servo-control techniques for enhanced performance:

Simple operator graphic interface

Operating modes:

- stand-by
- manual position
- azimuth slew
- Tracking
- preset
- ephemeris tracking
- stow
- bore sight

MCU interface: CAN bus, RS232,
 Brakes control: 24V

9.6 Monitor and Control Subsystem

The status of the overall station can be fully monitored on a screen. The singular parts to be monitored are selected by a click on a proper icon.

The status of the antenna shows all the status and control variables (pointing, speeds, currents, etc. plus the commands stored to be executed etc.)

Commands are given by a keyboard and a mouse.

The status of the station shows the signal path, switch status, active equipments, etc.

In case of malfunction the screen shows the origin of the alarms and warnings, and a selection of the action to be taken.