ALCATEL

Alcatel 9775

GLOBALSTAR
Gateway RF subsystem

USER'S AND MAINTENANCE MANUAL

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1 – Foreword

1.1 – Warranty

See the terms of the contract of sale.

1.2 – Compliance with European rules

The CE marking: CE printed on the product denote compliance with the following norms:

1.2.1 – Safety

- 73/23/EEC amended by the 93/68/EEC
  Compliance with the norm is acknowledged when the equipment conforms to the requirements specified by the following norms:
  - IEC 950 (1991) + A_1 + A_2 + A_3,
  - IEC 215 (1987) + A_1,
  - EN 41003 (1993).
- Equipment category:.....(Class.....)

1.2.2 – Electromagnetic Compatibility (EMC)

- 89/336/EEC of may 3rd 1989, amended by:
  - 92/31/EEC norm issued on April 28th 1992,
  - 93/68/EEC norm issued on July 22nd 1993.

The product is in compliance with the electromagnetic compatibility specifications of ETS 300385 norm. The environments considered in the ETS 300385 norm are defined as environments for telecommunication centres in accordance with the definition reported in the ETS 300386–1 norms.
For the grounding distribution the ETS 300254 norm is applied.

Equipment category:.....(Class.....)

1.3 – Safety instructions

1.3.1 – General rules

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere

in this manual violates safety standards of design, manufacture, and intended use of the product. ALCATEL assumes no liability for the customer's failure to comply with these requirements.

Ground the equipment: For Safety Class 1 equipment (equipment having a protective earth terminal), an uninterruptible safety earth ground must be provided from the mains power source to the product input wiring terminals or power cable.

DO NOT operate the product in an explosive atmosphere or in presence of flammable gases or fumes.

For continued protection against fire: replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type. DO NOT use repaired fuses or short-circuited fuse holders.

Keep away from live circuits: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers or shields are for use by service-trained personnel only. under certain conditions, dangerous voltages may exist even with equipment switched off. To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.

DO NOT operate an equipment which may be damaged: Whenever it is possible that the safety protection features built into this product have been impaired, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to Alcatel Service Office for service and repair to ensure that safety features are maintained.

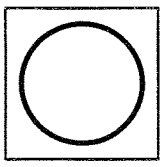
DO NOT service or adjust alone: Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT substitute parts or modify equipment: Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to Alcatel Service Office for service and repair to ensure that safety features are maintained.

1.3.2 – Labels on the equipment indicating danger

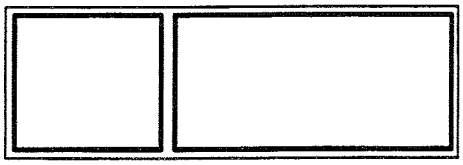
When subassemblies and modules are fitted with warning labels, it is essential that you heed the warnings.

These labels are produced to international standard IEC 417. The symbols or labels are in geometric shapes:



CONTAINS A **SYMBOL** OR **TEXT** INDICATING:
–A **PROHIBITION**
(WHITE BACKGROUND AND RED BORDER WITH BLACK SYMBOL OR TEXT)
–AN **OBLIGATION**
(BLUE BACKGROUND WITH WHITE SYMBOL OR TEXT).

CONTAINS A **SYMBOL** REPRESENTS:
–A **WARNING** OR A **DANGER**
(YELLOW BACKGROUND WITH BLACK SYMBOL AND BORDER).



CONTAINS **TEXT** GIVING:
–**INFORMATION** OR AN **INSTRUCTION** THAT MAY BE ASSOCIATED WITH A WARNING SYMBOL
(BLACK TEXT AND BORDER ON YELLOW BACKGROUND).

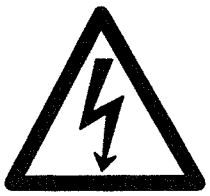
These labels are designed to indicate dangerous situations; they may contain any standard symbol or any label considered necessary to protect users and employees and equipment.

The most frequent danger situations and symbols are:

Danger or general warning

Dangerous electrical voltages

Close to dangerous voltages (> 42.4 V peak, 60 V DC; power level ≥ 240 VA) you will find the following warning label:



Danger, high temperatures

The presence of heat-radiating mechanicals parts is indicated by the following label in compliance with IEC 417 NORM, fig. 5041:

Risk of explosion

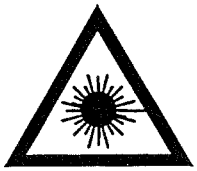
Batteries/risk of explosion, the following label is affixed with the following warning:

CAUTION
There is danger of explosion if the battery is incorrectly replaced. Replace only with a battery of the same type or an equivalent type recommended by the manufacturer. Dispose of the old batteries in accordance with the manufacturer's instructions.

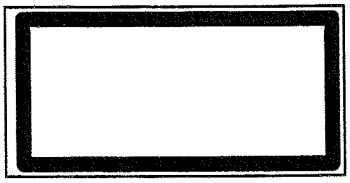
Sensitivity to electrostatic discharges

Harmful optical signals

If the assembly or unit is fitted with a laser, the labels most comply with the IEC 825–1–1993 International Norms:



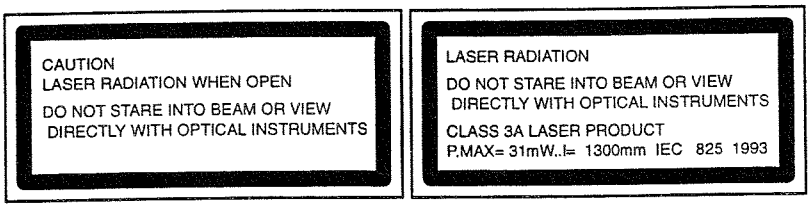
The symbol indicates the presence of a laser beam. Danger level is stated within rectangular label:



If the laser is a class 1 product, the label depicting the symbol within a triangle is not compulsory.

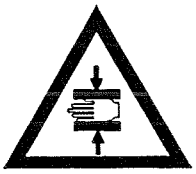
The rectangular shapes label describes all the information needed, i.e.:

- Laser class,
- Power emitted,
- Wave length,
- Ref. norm.,
- Precautionary measures taken depend on Laser class,
- Indications given on openings panels and safety interlocks.



Moving mechanical parts

The following warning label is affixed next to fans or other moving mechanical parts:



Before carrying out any maintenance operation see that all the moving mechanical parts have been stopped.

1.3.3 – Earth symbols

Terminal for connecting the protective earth conductor in power supply wiring

Other earth terminal

1.3.4 – Danger symbols used in documentation

These symbols alert the reader to possible risks. They indicate:

- the cause and type of danger,
- the possible consequences,
- the preventive action.

warning

- **protection of personnel**
- warning of a **possible dangerous situation**
- danger of serious injury

attention

- **protection of equipment,**
- warning to a procedure, practice, or condition that **could be dangerous** for equipment or its environment,
- danger for equipment or environment damage; permanent loss data possibility.

1.4 — Electromagnetic compatibility (EMC)

The EMC performance of the equipment depends largely on installation (cables, earth connections, etc.) and operation (equipment, configuration, shielding, etc.).

General specifications – Installation

- For all links consisting of shielded cables, use only cables and connectors of the types indicated or having a lower transfer impedance (Zt).
  If a maximum cable length is specified, do not exceed that length.
- Adhere strictly to the procedures specified for assembling the shielded cables.
- Connect the cable shielding to earth as instructed.
- Install any filters external to the equipment in the positions and using the method specified.
- Earth the equipment using a cable of the specified cross section and impedance.
- Fit any shielding that has to be installed during installation; clean and remove the grease from all parts before assembly.
- Before inserting shielded modules, clean and remove the grease from all contact surfaces (contact springs, abutting surfaces, etc.).
- Follow the additional instructions for correct installation of the equipment for EMC.

General specifications – Commissioning and startup

- Perform the operations necessary for the electrical modules to ensure EMC performance.
- Check operation of the equipment when all shielding is correctly in place (front shielding, electrostatic discharge protection for connectors, etc.).
- Follow any additional instructions concerning the proper use of the equipment for EMC.

General specifications – Maintenance

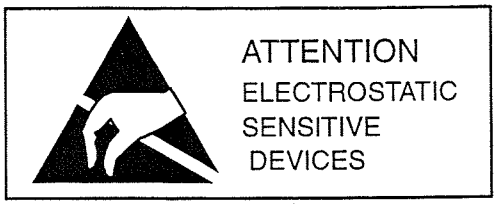
- Before inserting shielded replacement modules in place of failed modules or when changing the equipment configuration, clean and remove the grease from the contact surfaces (contact springs, abutting surfaces, etc.).
- In the event of replacement, also clean the shielding.

The EMC rules are distinguished in the handbook by a symbol and statement, see § 1.3.4.

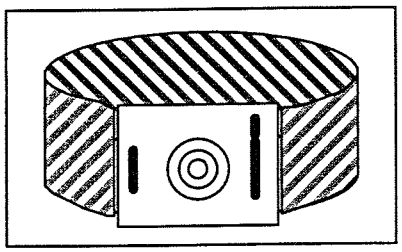
1.5 — Electrostatic discharge (ESD)

Before removing any ESD protection on the monitors, connectors, etc., follow the advice below. Always replace the ESD protection when the routine maintenance or other procedure is finished.

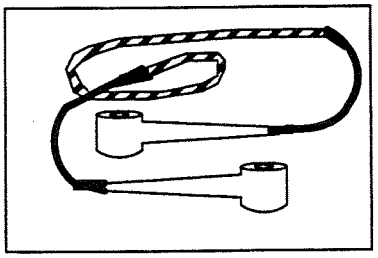
Many electrical devices are sensitive to electrostatic discharge; these have the following warning labels:



If you need to work on these electronic devices during installation/maintenance, be particularly vigilant. You must be earthed by the elastic wrist strap and associated spiral cable:



ELASTIC STRAP



SPIRAL CABLE

- The elastic strap must be attached to your wrist.
- The spiral cable must be attached to the elastic strap and to the earth terminal on the equipment frame.

1.6 – Using the manual

This manual is **designed for the user** of the equipment. With it you should be able to commission and operate the equipment to a basic level.

You should always read this manual in conjunction with the attached revision document so that you are aware of the latest equipment upgrades.

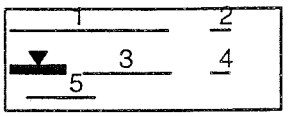
Manual revision

- This edition of the manual gives information on the version of the equipment in which the subsystem revision indices are at least as shown below.

Subsystem reference	Item Nº	Revision index	Subsystem reference	Item Nº	Revision index

1.7 – Subsystem identification

The subsystems are identified by labels of the type shown below.



The numbers indicate the following areas:

- **1** – Item number, example: 3BT 03840 AAAA,
- **2** – Revision index,
- **3** – Serial number; example: C9605234,
- **4** – Index number,
- 5 – Factory identifier; example: GBA 231.

1.8 – Abbreviations

A

ACP	Antenna Control Power
ACU	Antenna Control Unit
AZ	Azimuth

C

CCITT	International Telegraph and Telephone Consultative Committee
CDMA	Code Division Multiple Access
CPS	Customer Power Supply

E

EIRP	Effective Isotropic Radiated Power
EL	Elevation
EMC	Electromagnetic Compatibility
ESP	Even Seconds Pulses
ESTP	Even Seconds Timing Pulses

F

FET	Field Effect Transistor

G

GPS	Global Positioning System
GRS	Gateway RF Subsystem
GTS	Gateway Transceiver Subsystem

I

IF	Intermediate Frequency
IFL	Inter-Facility Link
IP3	Third order Intercept Point

L

LHCP	Left Hand Circular Polarization
LNA	Low Noise Amplifier

M

MAC	Monitoring And Control

P

PLL	Phase Lock Loop

R

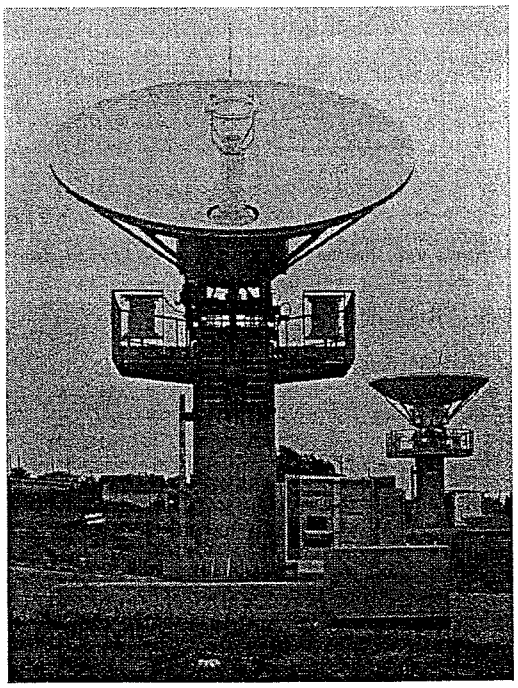
RF	Radio Frequency
RFT	RF Terminal
RHCP	Right Hand Circular Polarization
Rx	Receive

S	
SHF	Super High Frequency
SSPA	Solid State Power Amplifier
T	
TBD	To Be Determined
TCU	Telemetry and Command Unit
Tx	Transmit
U	
UPS	Uninterruptible Power Supply
X	
XEL	Cross elevation

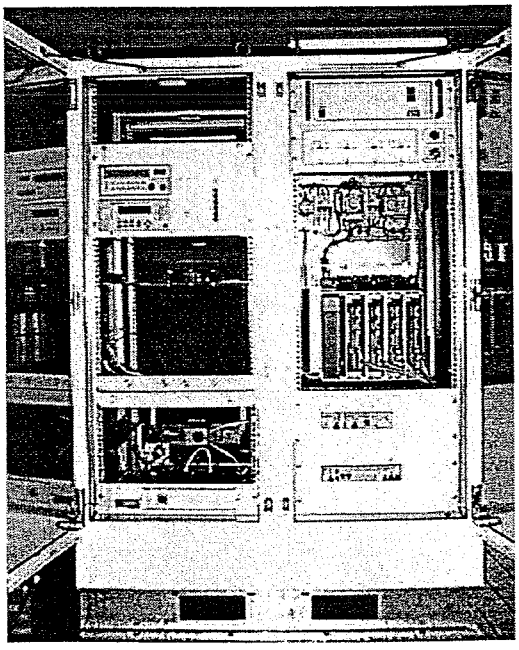
2 – Overview

2.1 — Introduction

ANTENNA



"OUTDOOR" RACK



GATEWAY BUILDING EQUIPMENT

This equipment consist in subracks integrated in a rack suppied by the custommer.

2.1.1 – General

The Earth stations for accessing the GLOBALSTAR satellite network comprise four 5.5 m diameter antennas, with hubs that incorporate the RF equipment. Each antenna is linked to an "Outdoor" rack and all of the antennas are linked to an "indoor" rack. Figure 1 is a functional block diagram of the antenna and "Indoor" rack equipment.

Each antenna comprises:

- a three-axis mounting: azimuth (vertical axis), elevation (horizontal axis) and cross-elevation (axis at right angles to the first two),
- a reflector (or radiator),
- a feed,
- ancillary equipment.

The RF equipment incorporated in the hub concerns the transmit and receive subsystems. It includes, for each of the two polarizations:

- for the transmit subsystem (TX LHCP or TX RHCP):
  - an up-converter,
  - a 300W power amplifier obtained by coupling four 80W amplifiers,
  - an integrated combiner for coupling the amplifiers,
  - a switch for connecting the power amplifier to the antenna or to a load (power load incorporated in the combiner),
  - various couplers, incorporated in the combiner, with filters for measuring EIRP and test purposes;
- for the receive subsystem (RX LHCP or RX RHCP):
  - a receive filter incorporated in the multiplexer,

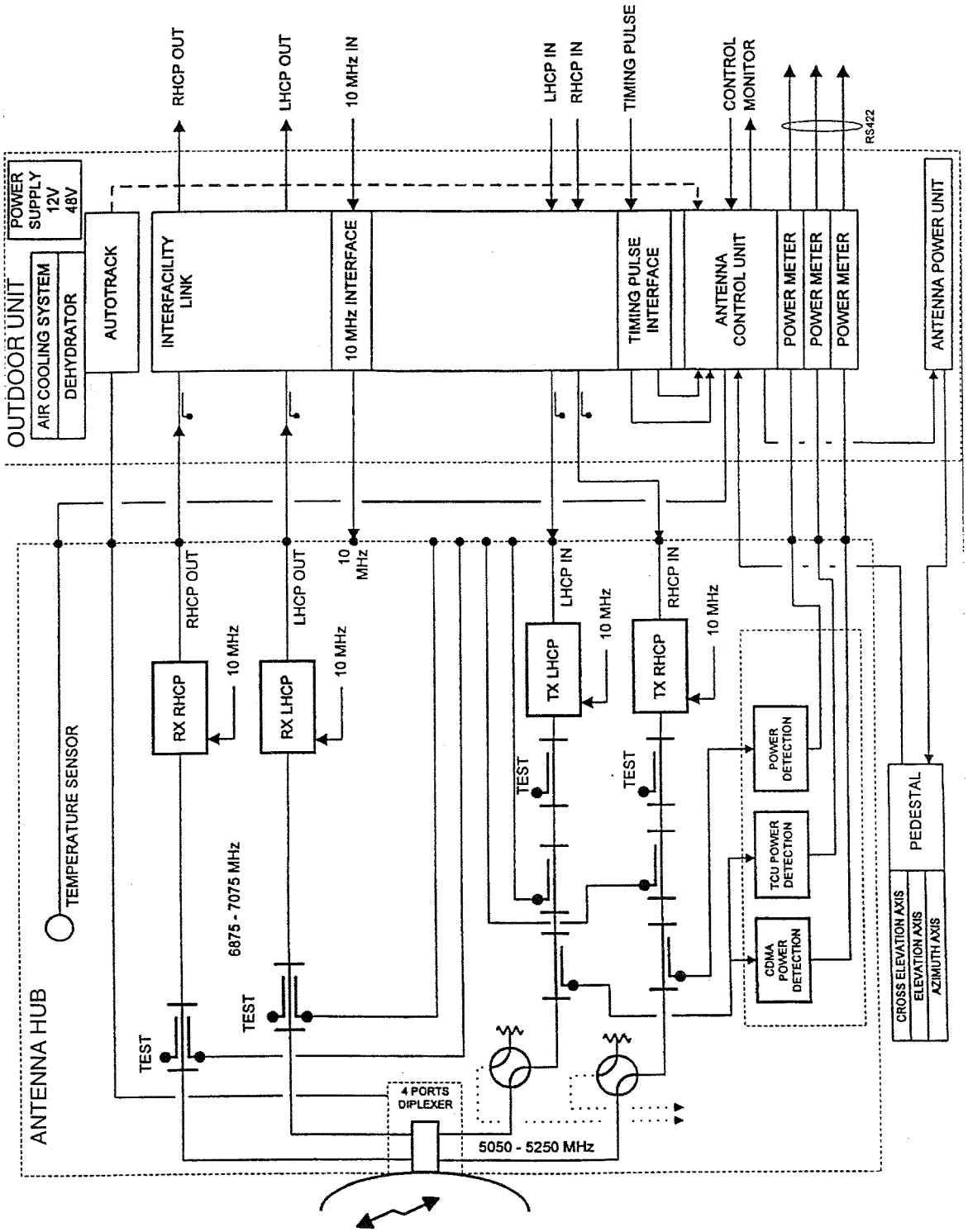


Figure 1 – General block diagram

- test couplers,
- a 60 K low noise amplifier (LNA),
- a down-converter.

The "outdoor" rack (figure 2) comprises:

- the antenna control unit (ACU) which also handles management functions,
- the power equipment for controlling the antenna positioning motors,
- two milliwattmeters for measuring and sending the access station building information concerning the output power of the various channels,
- a compressor for pressurizing and drying the waveguides and feed,
- an optional tracking receiver for autotrack mode operation,
- miscellaneous equipment (10 MHz dividers, test couplers, cable interfaces, air conditioning control commands, circuit breakers, LEDs and so on),
- interconnections with the Earth station building via a coaxial cable or optical fibre interfacility link (IFL or E-IFL).

The "indoor" rack contains the following equipment:

- an ICC interface subrack, containing four interface modules, one for each RF terminal (RFT) and two redundant PSUs providing power to the interface modules.
- four IFL or E-IFL subracks.

2.1.2 – Main functions

The main functions of the equipment are set out below (Figures 2 and 3).

2.1.2.1 – "Indoor" rack equipment

- formatting of four 10 MHz frequency reference signals for transmission to the hub of each antenna.

2.1.2.2 – "Outdoor" rack equipment

- distributing the 10 MHz reference signal to the tracking receiver and the antenna hub,
- transmission of LHCP (lefthand circular polarization) and RHCP (righthand circular polarization) transmission signals to the antenna hub (800–1000 MHz band),
- reception of LHCP and RHCP signals from the hub (2085–2285 MHz band) and transmission of them to the "indoor" equipment,
- reception, from the antenna base, of information concerning the positioning of the antenna, processed by the ACU,
- measurement and digitizing, for transmission to the "indoor" equipment over one RS422 link, of the three analogue signals from the power sensors located at the output of the hub measurement couplers,
- distribution to the ACU of the timing pulse reference from the "indoor" equipment,
- transmission of control signals to the antenna power units,
- transmission to the various antenna motors, of the supply currents generated by the antenna power unit,

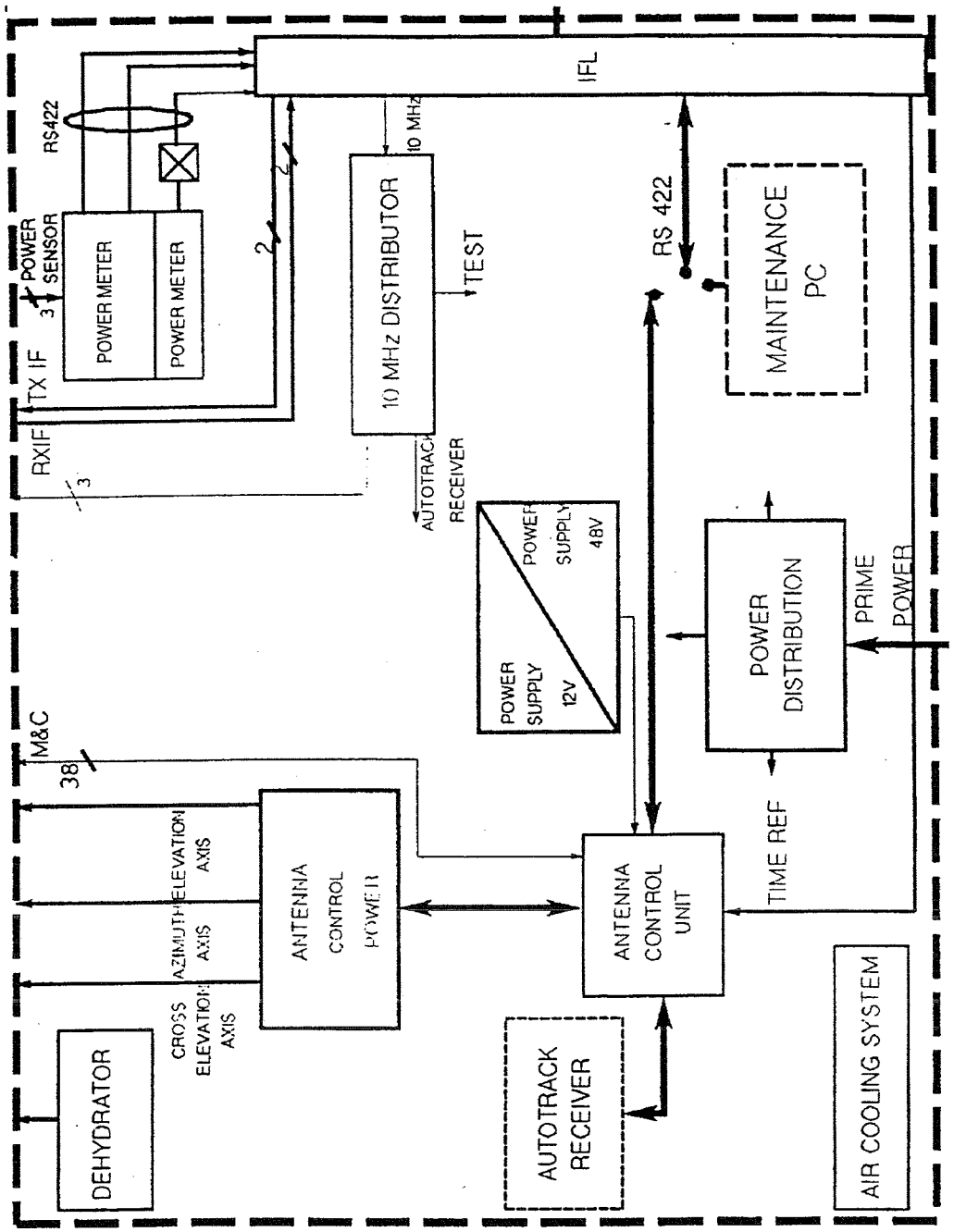


Figure 2 – Functional block diagram of the "outdoor" rack

- reception of commands from the "indoor" equipment by the ACU and transmission by the ACU of remote indication signals,
- translation in the receive band of these signals and transmission to the couplers at the input of the hub's LHCP and RHCP receive subsystems,
- integration of the optional autotrack system, linked to the ACU,
- integration of the waveguide and antenna feed pressurizing compressor and of the rack cooling system (two air-air exchangers).

2.1.2.3 – Antenna hub

- conversion, within the 5050–5250 MHz band, of the RHCP and LHCP IF signals (800–1000 MHz band) from the "outdoor" equipment, via two up-conversion stages,
- for each polarization:
  - distribution of the signals from the up-converter to four 80W power amplifiers with their outputs coupled,
  - routing of the signals from the power amplifier stage through three series-connected couplers (test, sampling of the signal to the test translator, power measurement),
  - routing via a switch for directing the signal to the antenna feed (optional operation) or to a power load (testing or shutting down carrier transmission),
- reception of the LHCP and RHCP signals from the two feed receive ports, within the 6875–7075 MHz band,
- for each polarization:
  - routing via a coupler including an input for injecting a test signal and an input for injecting the signal taken from the test translator,
  - amplification of the SHF signal via a 60K low noise amplifier,
  - conversion, via a down-converter, of the signal in the 2085–2285 MHz band, prior to transmission to the "outdoor" equipment,
- transmission to the "outdoor" equipment of the signal from a temperature probe inside the hub.

2.1.2.4 – Antenna

- Reflector:
  - secondary radiator for focussing signals from the satellite to the subreflector and combining the transmission signals reflected by the subreflector in a parallel beam,
  - subreflector reflecting the signals received from the satellite to the feed and the signals received from the feed to the reflector.
- Feed:
  - reception of the LHCP and RHCP SHF signals from the power and transmission amplifier to a satellite, after bandpass filtering,
  - reception, from the satellite, of the RHCP and LHCP SHF signals, bandpass filtering and transmission to the low noise amplifier,
  - optional tracking coupler for autotrack mode operation.
- Mounting:
  - azimuth axis rotation by means of a crown wheel, located at the top of the pedestal tube, and two motors,

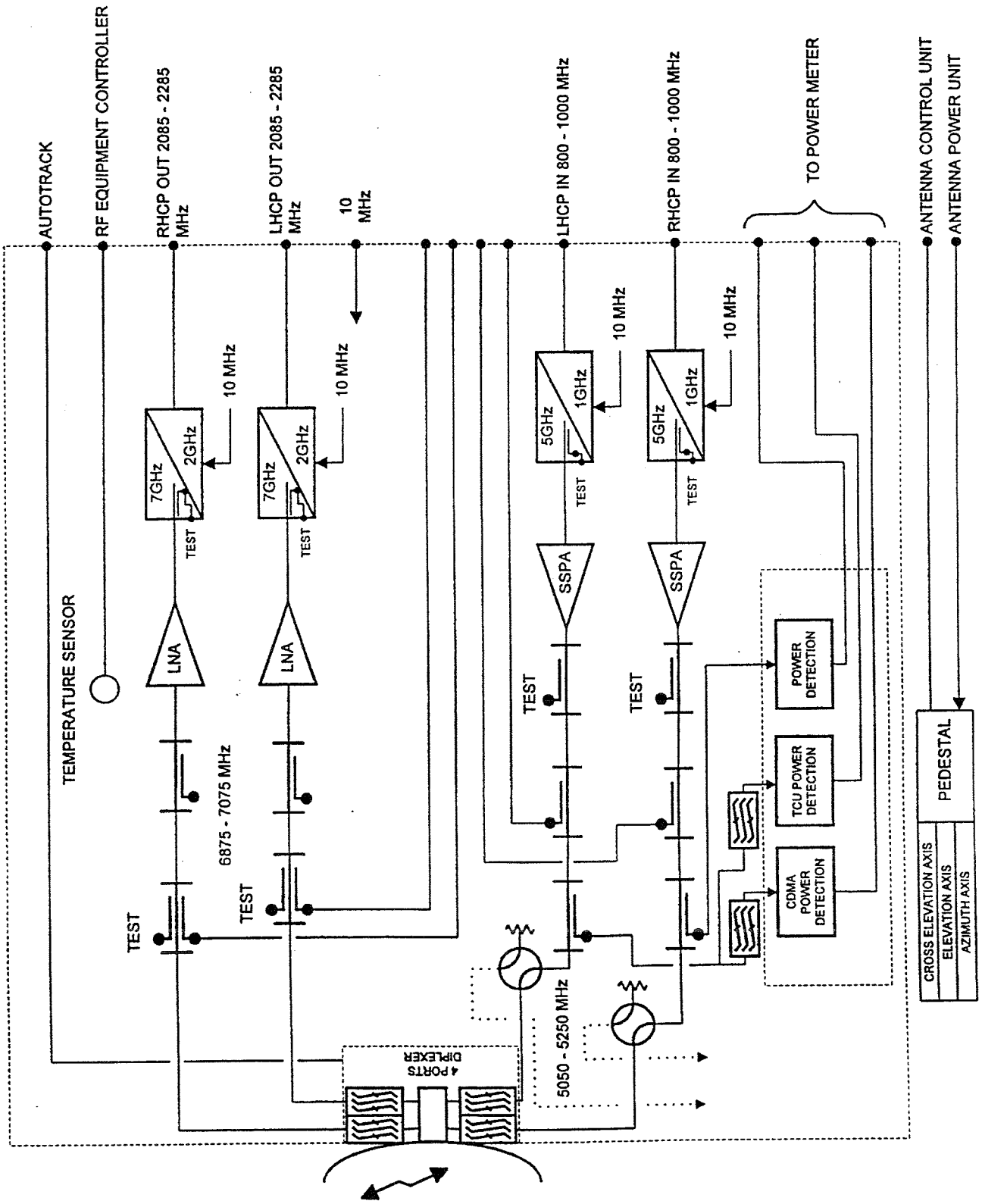


Figure 3 – Functional block diagram of the antenna

- elevation and cross-elevation axis rotation by means of jacks driven by a motor/reducer assembly set,
- positioning information on each axis generated by a 17-bit optical encoder.

– Related equipment:
- de-icing system for preventing the build-up of ice and snow on the reflector,
- hub heater to maintain an operational temperature within the hub when the outside temperature is low,
- waveguide and feed pressurization to protect against condensation and damp,
- platform and ladder for maintenance access.

2.2 – Specifications

2.2.1 – Electrical specifications

2.2.1.1 – Antenna system

TRANSMISSION

Frequency band	5.05 – 5.25 GHz
SWR	⩽ 1.20
Polarizations	righthand circular and lefthand circular
Gain	⩾ 47.6 dB at 5.05 GHz
Maximum power	1000 W
Feed interfaces	WR 187
Decoupling • Between transmit and receive ports • between transmit ports	 > 80 dB > 25 dB
Axial ratio	⩽ 1 dB

RECEPTION

Frequency band	6.875 –7.075 GHz
SWR	⩽ 1.20
Polarizations	Righthand circular and lefthand circular
Gain	⩾ 50.2 dB to 6.875 GHz
Noise temperature • Elevation = 5° • Elevation = 10° • Elevation = 20° • Elevation = 30°	 ⩽ 72 K ⩽ 50 K ⩽ 38 K ⩽ 35 K

Feed interfaces	WR 137
Decoupling • Between transmit and receive ports • Between receive ports	 > 50 dB > 25 dB
Axial ratio	≤ 1 dB

TRACKING

Frequency band	6.875 –7.075 GHz
SWR	≤ 2
Polarizations	Circular
Feed interfaces	Coaxial
Decoupling • Between transmit and tracking ports • Between receive and tracking ports • Between transmit or receive ports and tracking coupler loads	 > 110 dB > 40 dB > 27 dB

2.2.1.2 – Transmit system

Frequency band	5.05 – 5.25 GHz
Bandwidth at 1 dB	≥ 200 MHz
EIRP (without autotrack option)	≥ 68 dBW
EIRP (with autotrack option)	≥ 67 dBW
C/N operational	≥ 16 dB
Transmit polarizations	Both simultaneously
Broadband noise in the GPS band (1575.42 ± 2 MHz), at a distance of 8.5 m from the antenna	≤ –50 dBW/m^2/MHz
Spurious in the GPS band, at a distance of 8.5 m from the antenna	≤ –60 dBW/m^2
In-band radiated spurious noise, within a 4 kHz band	≤ –60 dBc

2.2.1.3 – Transmit RF equipment

The transmit RF equipment comprises:

- IFL,
- up-converter,
- power amplifier.

INPUT INTERFACES

Values defined at the IFL transmit signal inputs

Input SWR (50 ohms system)	≤ 1.4
Input signal level, operating (delivering EIRP at specified NPR)	–4 to +4 dBm
Input level, overdrive with no damage	+20 dBm
Input dynamic range (IFL input level = 0 dBm)	≥ 40 dB
Frequency input	800 to 1000 MHz

OUTPUT INTERFACES

Frequency band	5.05 – 5.25 GHz
In-band integrated phase error	≤ 0.001 rad^2
In-band spurious noise (in a 4 kHz band)	≤ –60 dBc
Harmonics in output	≤ –60 dBc
Noise figure	≤ 50 dB
Passband output power deviation (200 MHz band)	≤ 4 dB peak-to-peak
Channel output power ripple (1.2 MHz band)	≤ 0.25 dB peak-to-peak
Output power swept frequency response ΔP	≤ 0.25 dB peak-to-peak

TRANSFER CHARACTERISTICS

Translation frequency (LO)	4250 MHz
Phase loop locking band	9 999 980 Hz to 10 000 020 Hz
LO phase noise • 100 Hz • 1 kHz • 10 kHz • 100 kHz • 1 MHz	 ≤ – 60 dBc/Hz ≤ – 70 dBc/Hz ≤ – 85 dBc/Hz ≤ –110 dBc/Hz ≤ –130 dBc/Hz

2.2.1.4 – Coupled outputs

Three coupled outputs are available at the output side of each power amplifier, for:

- the test translator,
- a test output,
- power detectors:
  - CDMA and TCU for lefthand circular polarization,
  - EIRP for righthand circular polarization.

The three outputs all have the same characteristics:

Coupling value	–35 to –50 dB ± 0.5 dB
In-band coupling variation	≤ ±0.2 dB

2.2.1.5 – Power detectors

Each antenna subsystem has three power detectors:

- CDMA level,
- TCU level,
- EIRP level on righthand circular polarization.

CDMA POWER DETECTOR

Detection band	5096.96 to 5249.12 MHz
Rejected band	5091 to 5092 MHz
Rejection	⩾ 25 dB
Measurement accuracy • 58 dBW < EIRP ⩽ 68 dBW • 38 dBW < EIRP ⩽ 58 dBW • EIRP ⩽ 38 dBW	 ⩽ ±0.5 dB ⩽ ±1.0 dB ⩽ ±2.0 dB
Dynamic range	⩾ 40 dB
Measurement rate	⩾ 50 ms

TCU POWER DETECTOR

Detection band	5091 to 5092 MHz
Rejected band	5096.96 to 5249.12 MHz
Rejection	⩾ 25 dB
Measurement accuracy • EIRP from 47 dBW to 58 dBW • EIRP > 58 dBW	 ⩽ ±0.5 dB ⩽ ±1.0 dB
Dynamic range	⩾ 25 dB
Measurement rate	⩾ 100 ms

RHCP POWER DETECTOR

Detection band	5096.96 to 5249.12 MHz
Rejection	⩾ 25 dB
Dynamic range	⩾ 40 dB
Measurement accuracy • 58 dBW < EIRP ⩽ 68 dBW • 38 dBW < EIRP ⩽ 58 dBW • EIRP ⩽ 38 dBW	 ⩽ ±0.5 dB ⩽ ±1.0 dB ⩽ ±2.0 dB
Measurement rate	⩾ 50 ms

2.2.1.6 – Thermal probe

A temperature sensor accurate to within ± 2°C is installed in the hub.

2.2.1.7 – Receive system

Frequency band	6875 to 7075 MHz
Bandwidth at 1 dB	⩾ 200 MHz
G/T (without autotrack option)	⩾ 27.5 dB/K
G/T (with autotrack option)	⩾ 26.5 dB/K
System temperature	⩽ 200 K
Receive polarizations	Both simultaneously
Communication flow density	⩽ –110.8 dBW/m^2
Telemetry flow density	–157.4 dBW/m^2 to –144 dBW/m^2

The G/T values are given subject to the following conditions:

- 10° angle of elevation,
- Clear sky conditions,
- RHCP and LHCP transmitters operating simultaneously in their respective service conditions,
- At any random moment in the life of the system,
- At the antenna position determined by data from the astronomical tables.

The calculation is based on a value of 68 dBK for the transceiver system temperature.

2.2.1.8 – Receive RF equipment

The receive RF equipment comprises:

- low noise amplifier,
- down-converter,
- IFL.

INPUT INTERFACES

Frequency band	6875 to 7075 MHz
Noise figure	⩽ 1.5 dB
Maximum input level	⩽ 0 dBm

OUTPUT INTERFACES

Values defined at the IFL receive signal outputs.

Frequency band	2085 to 2285 MHz
Impedance	50 ohms
Image frequency rejection	⩾ 50 dB
Point at 1 dB of compression	⩾ +10 dBm

IP3 output	⩾ +20 dBm
IFL output level at maximum communication flow density at the antenna input	–14 to –8 dBm
Minimum signal level at the IFL output	To Be Specified
Noise signal power	⩽ –30 dBc
SWR	⩽ 1.4

TRANSFER CHARACTERISTICS

Number of frequency changes	1
Translation frequency (LO)	9160 MHz
Phase loop locking band	9 999 980 Hz to 10 000 020 Hz
LO phase noise • 100 Hz • 1 kHz • 10 kHz • 100 kHz • 1 MHz	 ⩽ – 60 dBc/Hz ⩽ – 70 dBc/Hz ⩽ – 85 dBc/Hz ⩽ –105 dBc/Hz ⩽ –120 dBc/Hz
Receive subsystem gain stability	Better than ± 0.5 dB/24 hours

2.2.1.9 – Receive couplers

The receive system is fitted with two couplers on each polarization:

- a directional coupler for injecting test signals at the input of each low noise amplifier,
- a coupler located at the output of the down-converter, for:
  - testing the signal from the down-converter,
  - injecting a test signal at the input of the IFL receive part.

LNA INPUT INJECTION COUPLER

Coupling value at 6975 MHz	50 dB ± 0.1 dB
Tolerance on in-band coupling	⩽ ± 0.2 dB

DOWN-CONVERTER OUTPUT COUPLER

Coupling ratio	–25 to –15 dB ????
Tolerance on coupling ratio	–0.5 to +0.5 dB

2.2.2 – Mechanical specifications

ANTENNA

Reflector diameter	5.50 m
Antenna weight	5000 kg approx.

"OUTDOOR" RACK

Dimensions (L x H x D)	1200 x 1650 (1700 including hooks)x 1200 mm
Weight	300 kg approx.

2.2.3 – Antenna kinematic specifications

Range of movement • Azimuth • Elevation • Cross-elevation	 ± 270° 0° to 90° ± 8°
Tracking speed • Azimuth • Elevation • Cross-elevation	 2.5°/s max. 0.5°/s max. 0.5°/s max.
Hunting speed • Azimuth • Elevation • Cross-elevation	 12°/s 3°/s 1°/s
Tracking acceleration • Azimuth • Elevation • Cross-elevation	 0.05°/s^2 0.05°/s^2 0.05°/s^2
Hunting acceleration • Azimuth • Elevation • Cross-elevation	 2.5°/s^2 1°/s^2 0.2°/s^2
Angle of elevation corresponding to the two axis/three axis changeover	65°

2.2.4 – Environmental specifications

2.2.4.1 – Climatic

EXTERNAL EQUIPMENT – SERVICE CONDITIONS

Temperature	– 40 to +55° C
Relative humidity	5 to 100%
Rain	≤ 20 cm/h
Altitude	≤ 3000 m
Average wind speed	≤ 70 km/h
Gusts	≤ 90 km/h
Solar radiation	≤ 1.1 mW/mm^2
Tropical conditions	According to ATSM G21

Salt atmosphere	⩽ 41 ‰
Dust and sand	Particles ⩽ 0.01 mm at 25 km/h
Snow and ice	Snow thickness ⩽ 5 cm (2 inches)
Snowfall intensity	⩽ 10 cm/h
Vibration and shock	According to NEBS–TR–NWT–63 – Fig. 6.1

The antenna should be set to the survival position (Zenith position) immediately the wind speed exceeds 125 km/h.

EXTERNAL EQUIPMENT – NON–SERVICE CONDITIONS

Temperature	– 40 to +85° C
Relative humidity	5 to 100%
Rain	⩽ 30 cm/h
Altitude	⩽ 10000 m (air transportation)
Average wind speed	⩽ 200 km/h
Gusts	⩽ 250 km/h
Solar radiation	⩽ 1.5 mW/mm^2
Tropical conditions	According to ATSM G21
Salt atmosphere	⩽ 41 ‰
Dust and sand	Particles ⩽ 0.01 mm to 25 km/h
Snow and ice	Snow thickness ⩽ 5 cm (2 inches)
Snowfall intensity	⩽ 10 cm/h
Vibration and shock	Packaged for transportation by land, air or sea

"INDOOR" EQUIPMENT

Temperature • Operating conditions • Non-operating conditions	 + 5 to +55° C –40 to +55° C
Relative humidity • Operating conditions • Non-operating conditions	 50% ± 30%, non condensing 5% to 95%, non condensing
Altitude • Operating conditions • Non-operating conditions	 ⩽ 3000 m ⩽ 10000 m

2.2.4.2 – Power supply specifications (antenna, "hub" and "outdoor" rack equipment)

GENERAL

Single–phase supply with backup • Voltage • Frequency • Power consumption	 220 V ± 10 % 50/60 Hz ± 5 % 8 kVA
Three–phase mains supply with backup • Voltage • Frequency • Power consumption	 380 V ± 10% 50/60 Hz ± 5 % 10 kVA
Single–phase mains supply, without backup • Voltage • Frequency • Power consumption	 220 V ± ? % 50/60 Hz ± 5 % 22.5 kVA

ANTENNA HUB

220 V single–phase, with backup	2 x 3 kVA
220 V single–phase, without backup	4 x 4.5 kVA

"OUTDOOR" RACK

220 V single–phase, with backup	2 kVA
380 V three–phase, with backup	10 kVA
220 V single–phase, without backup	4.5 kVA

2.2.5 – Levels diagrams

Levels diagrams concerning stations without or with optical fiber are given respectively by figures 4 and 5.

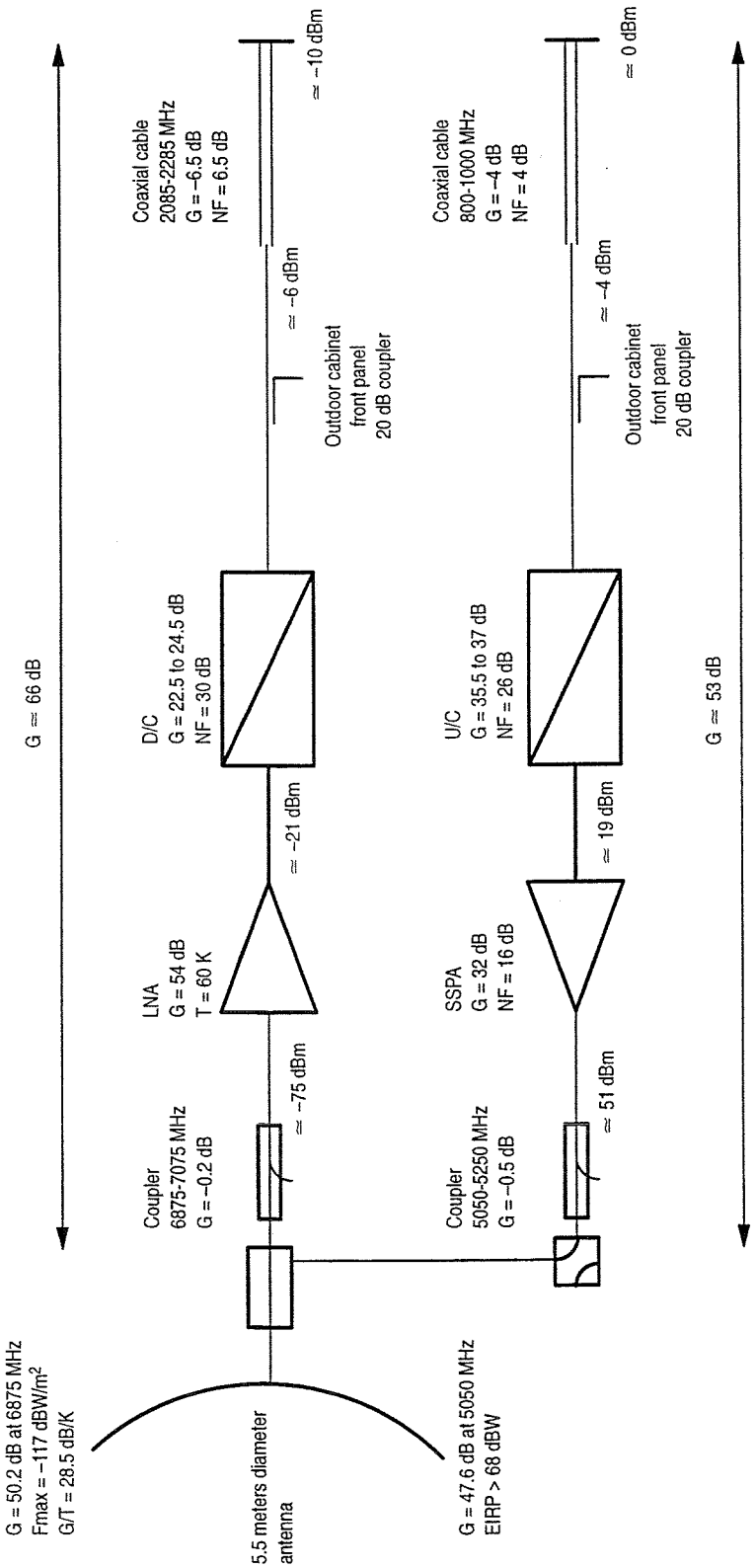


Figure 4 – Station diagram level at 23° C (without optical fiber)

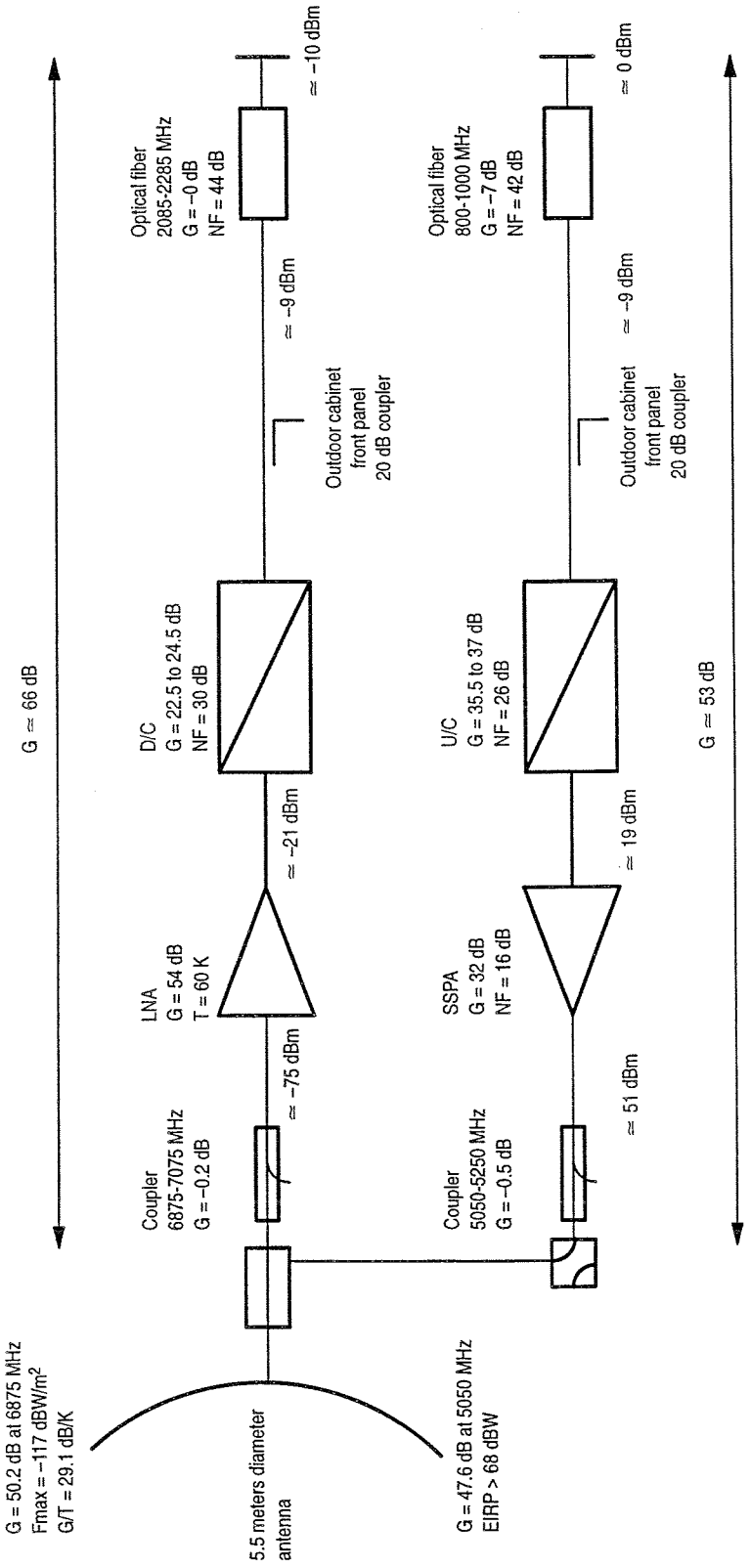


Figure 5 – Station diagram level at 23° C (with optical fiber)

2.3 – Composition

The quantities indicated in the tables below are for a single antenna. Equipment shown in boldface type is further broken down in the tables that follow.

2.3.1 – Antenna sub-system

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Antenna	–	**3BT 08559 AAAA**	**1**
Pre-equipped hub	–	**3BT 08345 AAAA**	**1**
Set of active units for hub	–	**3BT 08684 AAAA**	**1**

2.3.1.1 – Antenna

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Anchoring kit	–	3BT 08561 AAAA	1
Ground azimuth Pedestal	–	3BT 08562 AAAA	1
Azimuth frame	–	3BT 08563 AAAA	1
Footbridge	–	3BT 08564 AAAA	1
Hub	–	3BT 08565 AAAA	1
Reflector framework	–	3BT 08566 AAAA	1
Reflector panels set with deicing	–	3BT 08567 AAAA	1
Azimuth motorization	–	3BT 08568 AAAA	1
Elevation motorization	–	3BT 08569 AAAA	1
Cross-elevation motorization	–	3BT 08570 AAAA	1
Elevation jack	–	3BT 09481 AAAA	1
Cross-elevation jack	–	3BT 09482 AAAA	1
Azimuth coder	–	3BT 08571 AAAA	1
Elevation coder	–	3BT 08572 AAAA	1
Cross-elevation coder	–	3BT 08573 AAAA	1
Lightning protection	–	3BT 08574 AAAA	1
Azimuth stroke stop	–	3BT 08576 AAAA	1
Elevation stroke stop	–	3BT 08577 AAAA	1
Cross elevation stroke stop	–	3BT 08578 AAAA	1
Security stops	–	3BT 08579 AAAA	1

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Elevation chains	–	3BT 08581 AAAA	1
Feed system • without autotrack • with autotrack	 – –	 3BT 08583 AAAA 3BT 08582 AAAA	 1 1

2.3.1.2 – Pre-equipped hub (3BT 08345 ABAA)

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Fitted hub	–	3BT 08565 AAAA	1
Fitted door	–	3BT 09949 AAAA	1
50 dB Rx coupler	GSK 501	3BT 08303 AAAA	2
Squares and supports kit	–	3BT 09178 ABAA	1
CDMA/TCU equipped case	–	3BT 11316 AAAA	1
Equipped combiner	–	3BT 10680 AAAA	2
Waveguide equipped with guide/TGC coaxial adapter (for switch)	–	3BT 09574 AAAA	2
Gaskets kit	–	3BT 09368 ABAA	1
Nuts and bolts kit	–	3BT 09369 ABAA	1
Cables kit	–	3BT 09709 AAAA	1
Power cables kit	–	3BT 11553 AAAA	1

2.3.1.3 – Hub tracking kit (3BT 10498 AAAA)

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Up/Down converters autotrack	–	3BT 09963 AAAA	1
Coaxial link (autotrack – LNA)	–	3BT 10009 AAAA	1
Autotrack equipped case		3BT 11557 AAAA	1
Coaxial link		3BT 11575 AAAA	1
Coaxial link		3BT 11576 AAAA	1
Coaxial link		3BT 11577 AAAA	1

2.3.1.4 – Set of active units for hub (3BT 08684 AAAA)

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
80 W amplifier	GSG 301	3BT 08413 AAAA	8
Up/down converter	GSG 401	3BT 08346 AAAA	2
Blower box assembly	–	3BT 09360 AAAA	8

2.3.2 – "Outdoor" cabinet equipment

2.3.2.1 – "Outdoor" cabinet (3BT 08674 ABAA)

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Cabinet	–	3BT 08681 ABAA	1
Power meters and interfaces tray	–	3BT 11953 AAAA	1
10 MHz divider subrack	–	3BT 08678 AAAA	1
Test tray	–	3BT 09289 AAAA	1

2.3.2.2 – Equipment for "Outdoor" cabinet

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Antenna Control Unit	–	–	1
Antenna Control Power	–	–	1
Pressurization	–	–	1

2.3.2.3 – Outdoor cabinet tracking kit (3BT 10633 AAAA)

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Cables kit	–	3BT 10061 AAAA	1
Tracking receiver	–	–	1

2.3.2.4 – Outdoor cabinet IFL kit (3BT 11585 AAAA)

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Outdoor cabinet IFL kit	–	3BT 11585 AAAA	1

2.3.2.5 – Outdoor cabinet E-IFL kit (3BT 11521 AAAA)

This kit includes no sub-assembly.

2.3.3 – Gateway building equipment

2.3.3.1 – ICC subrack

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
ICC subrack	–	3BT 09589 AAAA	1
ICC module	–	3BT 09582 AAAA	1
ICC power supply module	–	3BT 09583 AAAA	1
Wire	–	3CC 00786 AAAA	1

2.3.3.2 – Line amplifier module option (3BT 10634 AAAA)

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Line amplifier module	–	3BT 10635 AAAA	1
Coaxial link	–	3BT 11094 AAAA	9
Coaxial link	–	3BT 11094 ABAA	2
Coaxial link	–	3BT 11094 ACAA	3
Coaxial link	–	3BT 11094 ADAA	2
Fitted cable	–	3BT 11004 AAAA	8
Fitted cable	–	3BT 11004 ABAA	8

2.3.3.3 – Gateway building IFL kit (3BT 11662 AAAA)

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Fitted cable	–	3BT 11624 AAAA	4

2.3.3.4 – Gateway building E-IFL kit (3BT 11663 AAAA)

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Fitted cable	–	3BT 11625 ACAA	4
Fitted cable	–	3BT 11627 AAAA	1
Fitted cable	–	3BT 11670 AAAA	1
Fitted cable	–	3BT 11004 ACAA	4

2.3.4 – Gateway building-Outdoor rack IFL link (3BT 12139 AAAA)

This kit includes no sub-assembly.

2.3.5 – Outdoor rack-Antenna links

2.3.5.1 – Fitted cables kit (3BT 10670 ABAA)

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Azimuth cable chain N° 1	–	3BT 10673 ABAA	1
Azimuth cable chain N° 2	–	3BT 09985 ABAA	1
Set of cables not integrated in the chains	–	3BT 11379 ABAA	1

2.3.5.2 – AZ-EL autotrack cables kit (3BT 11690 AAAA)

DESIGNATION	REFERENCE	PARTS LIST N°	QTY
Fitted cable	–	3BT 11677 AAAA	1
Fitted cable	–	3BT 11678 AAAA	1

2.4 – Operation

Figure 6 shows the interfaces between the various subsystems that make up a GLOBALSTAR satellite system access station. Of the four antennas that make up the station, one is fitted with the Autotrack option. The single "Indoor" rack is linked to the "Outdoor" racks, one of which is linked to each antenna. The description of operation is also based on the functional block diagrams in figures 1 to 3.

2.4.1 – Transmission circuits

In transmission, the eight transmit IF lines (LHCP and RHCP of the four antennas) are received on the "Indoor" rack. This sends them in pairs to each "Outdoor" rack, via the IFL or E-IFL depending on the distance separating the building from the antenna.

The LHCP and RHCP signals (800 to 1000 MHz) for each antenna are received by the "Outdoor" rack, which sends them to the antenna hub equipment. Among this equipment, two up-converters (each associated with one polarization) translate the LHCP and RHCP IF signals into the 5050–5250 MHz transmit SHF band.

On each polarization, the SHF signals are then applied to a power amplifier made up of four FET amplifiers linked in parallel. This technique improves station availability

- through the use of solid state amplifiers, and
- by maintaining operation (in degraded mode) if one of the amplifiers fails.

The signals from the four amplifiers are then combined and applied to the RHCP or LHCP antenna port, as required, via a waveguide switch for directing them, if necessary, to a power load (for test purposes or for cutting off transmission to the satellite).

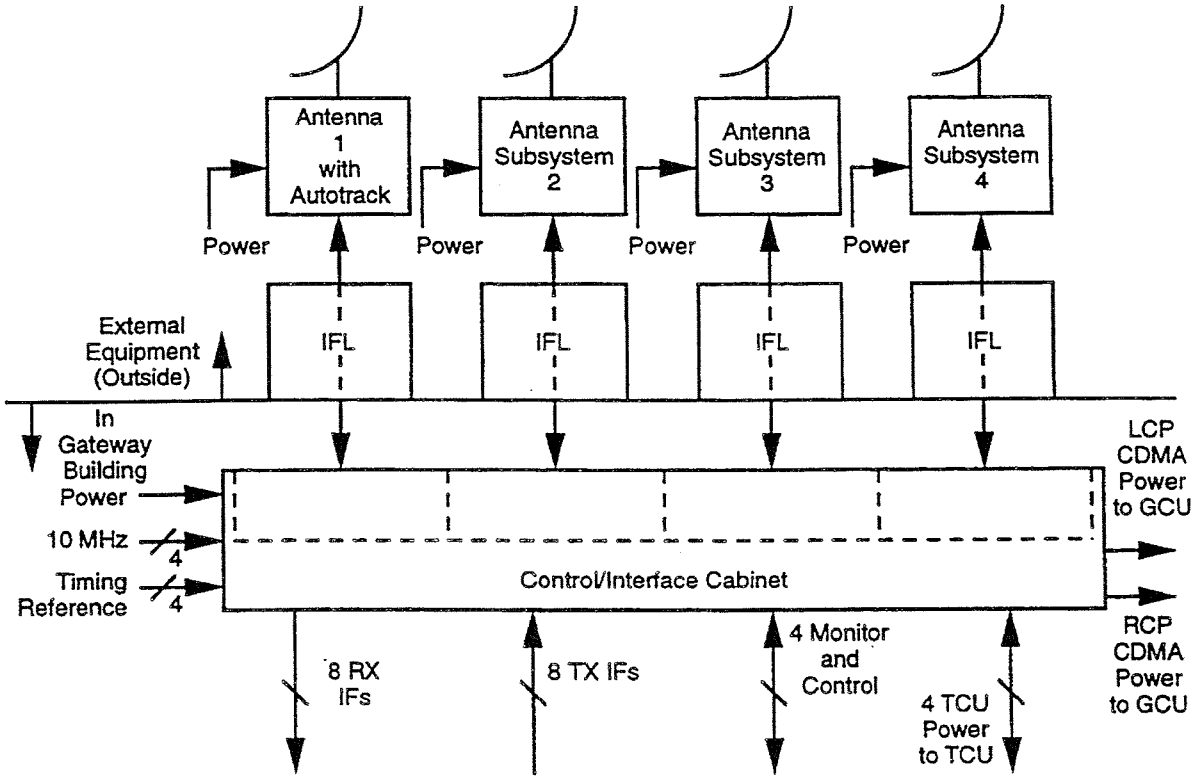


Figure 6 – RF subsystem external interfaces

2.4.2 – Receive circuits

In receive mode, the SHF signals of each polarization are received in the 6875–7075 MHz band. They are processed in the same way for each polarization, as follows:

- amplification by an FET type low noise amplifier,
- conversion in the 2085-2285 MHz band.

The resulting IF signals are sent to the "Outdoor" rack linked to the antenna, which sends them in turn to the "Indoor" rack that is shared by all four antennas.

2.4.3 – Test equipment

Test circuits and equipment are provided for system operation and maintenance purposes.

2.4.3.1 – "Outdoor" rack test panel

This panel comprises four 20 dB couplers:

- two at the transmit IF output of the "Outdoor" rack (one on each polarization),
- two at the receive IF input of the "Outdoor" rack (one on each polarization).

The coupled output of each of these couplers is linked to a front panel test point, used to monitor the transmit and receive LHCP and RHCP IF signals at the interface between the "Outdoor" rack and the antenna hub equipment.

2.4.3.2 – Power measurements

A 40 dB coupler, installed at the output of the LHCP power amplifier, transmits a fraction of the output power to the filters separating the CDMA and TCU signal frequency bands. The corresponding power levels for each of these signals are measured by milliwattmeters which convert them into digital values in IEEE 488 format.

A 40 dB coupler at the output of the RHCP power amplifier measures the total EIRP transmitted to the antenna on this polarization. This power is measured by a milliwattmeter which converts it into digital values in IEEE 488 format.

The information from the three milliwattmeters is applied to converters where it is converted for transmission over RS422 serial links.

The couplers required for these measurements are incorporated in the combiners of the antenna hub. The milliwattmeter filters and probes are integrated in a thermostatically controlled unit which is also located in the antenna hub. The milliwattmeters and the IEEE 488/RS422 converters are installed in the "Outdoor" rack. The signals available on the RS422 links are then transmitted to the "Indoor" rack.

2.4.3.3 – Transmission test couplers

The output combiner of each power amplifier is also fitted with a 40 dB coupler with a test point for directly measuring the EIRP or checking the transmitted spectrum.

2.4.3.4 – Receive test couplers

The input of each low noise amplifier has a subsystem fitted with a double 50 dB injection coupler for testing the low noise amplifier.

2.4.3.5 – Conversion test

The converters are fitted with test points for:

- checking the signals output of the up-converters (20 dB coupler at the output),
- injecting a test signal at the down-converter input (20 dB coupler at the input).

2.4.4 – Antennas

The feed of each of the four antennas has a four-port diplexer (two inputs and two outputs) for transmitting and receiving on two polarizations. The feed of one of the four antennas is also fitted with a tracking coupler generating the signal for the autotrack system (down-converter plus tracking receiver).

The reflector of each antenna comprises twelve panels held in place by twelve support braces fixed to a hub.

The antenna mounting is fitted with encoders generating digital information indicating the position of the antenna on each of its three axes.

The "Outdoor" rack has an antenna control unit (ACU) and a module containing the antenna control power (ACP) equipment. Depending on the astronomical tables stored in the ACU, and the information received on the antenna position, this sends commands to the ACP which generates the currents to drive the motors controlling azimuth, elevation and cross-elevation positioning.

2.4.5 – Station monitoring

The ACU for each antenna helps with station management, transmitting all the commands from the gateway building and sending it status and alarm information from the antenna hub equipment and the "Outdoor" rack.

2.4.6 – Auxiliary equipment

2.4.6.1 – Interfacility link (IFL)

The IFL comprises all the equipment and cables (optical fibre, where appropriate) needed to interconnect the external equipment (antenna and "Outdoor" rack) and internal equipment ("Indoor" rack).

The standard IFL version (coaxial cables) is used for distances from 5 to 100 meters.

The Extended IFL version (E-IFL) is used for distances from 100 meters to 5 kilometers.

2.4.6.2 – 10 MHz distributor

A 10 MHz reference frequency is supplied to the "Outdoor" rack which sends it to a 10 MHz distribution module in the "Outdoor" rack. This module distributes the frequency:

- to the up and down-converters, where it is used as a reference to maintain the stability of the local oscillators,
- to the down-converter and the tracking receiver in the "Outdoor" rack associated with the antenna equipped with the autotrack option.

2.4.6.3 – Compressor

A compressor is incorporated in the "Outdoor" rack for pressurizing the waveguides and the feed to protect against damp.

2.4.6.4 – Air conditioning

Air conditioning is obtained by means of two units integrated in the back doors of the "Outdoor" rack. These units are controlled by a rack cooling control unit located at the back of the ACP. Access to this unit is via the left back door of the rack.

2.5 – Description of the modules

2.5.1 – Antenna

The antenna comprises the following components:

- mounting,
- reflector,
- feed,
- access components,
- de-icing system,
- lightning protection,
- UPS and CPS boxes.

These are supplemented by the hub which contains the RF equipment described in section 2.5.

Overall views of the antenna are given in figures 7 and 8.

2.5.1.1 – Mounting

The mounting is a three-axis mounting for selecting the zenithal position on:

- a vertical axis: azimuth,
- a horizontal axis: elevation,
- an axis at right angles to the previous two: cross–elevation.

The mounting (Figure 9) comprises:

- structures,
- the movement drive system,
- encoders,
- travel limit switches,
- mechanical stops,
- cable wraps,
- self-lubricating systems.

STRUCTURES

The structures include a main pedestal tube with a large diameter roller bearing for rotating the reflector around the azimuth axis. This supports an "alidade" construction azimuth structure.

Two bearings on this structure are for rotating the reflector around the elevation axis. This mechanism supports the elevation structure.

Two bearings secured to the elevation structure, rotate the reflector around the cross-elevation axis.

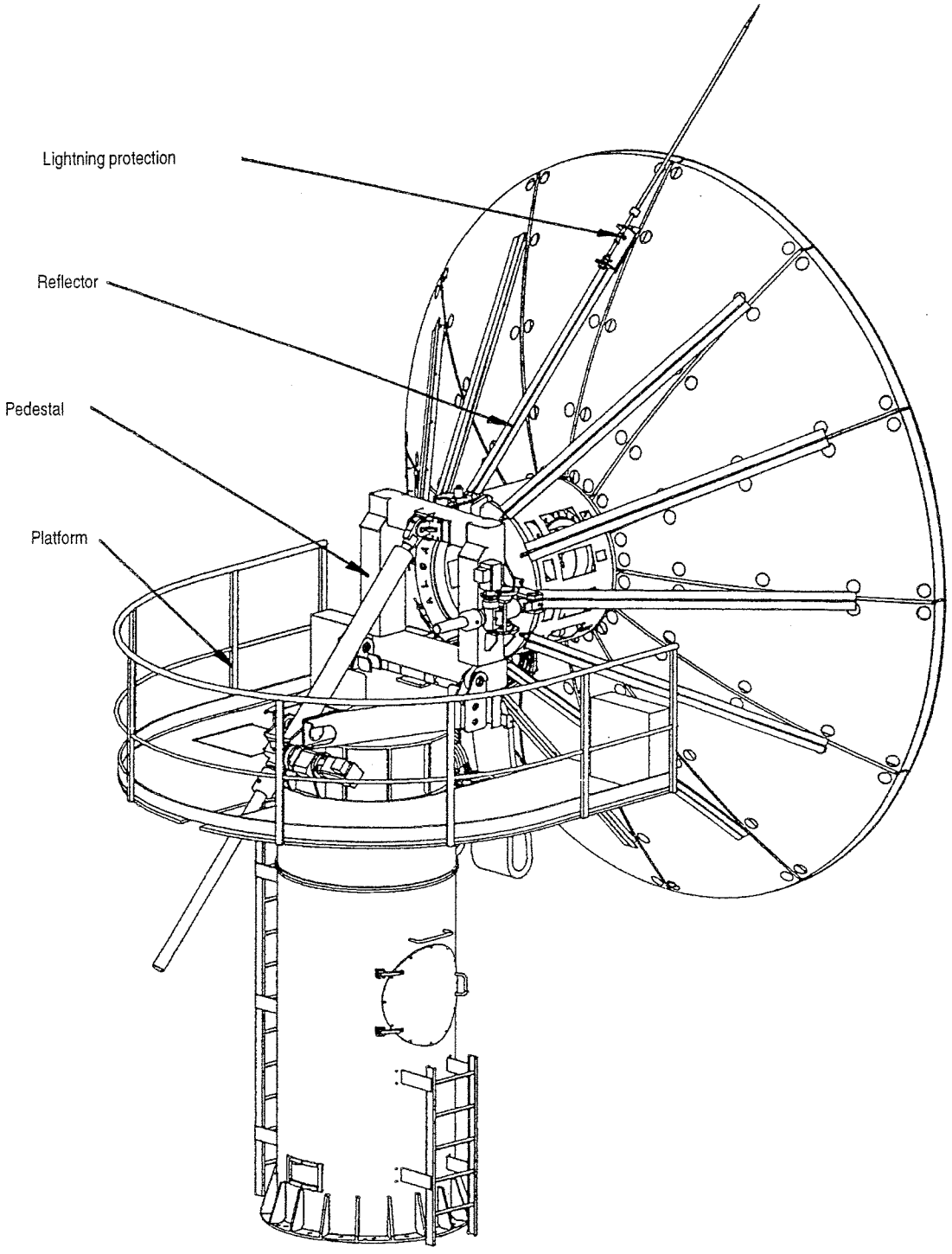


Figure 7 – Antenna – Rear view