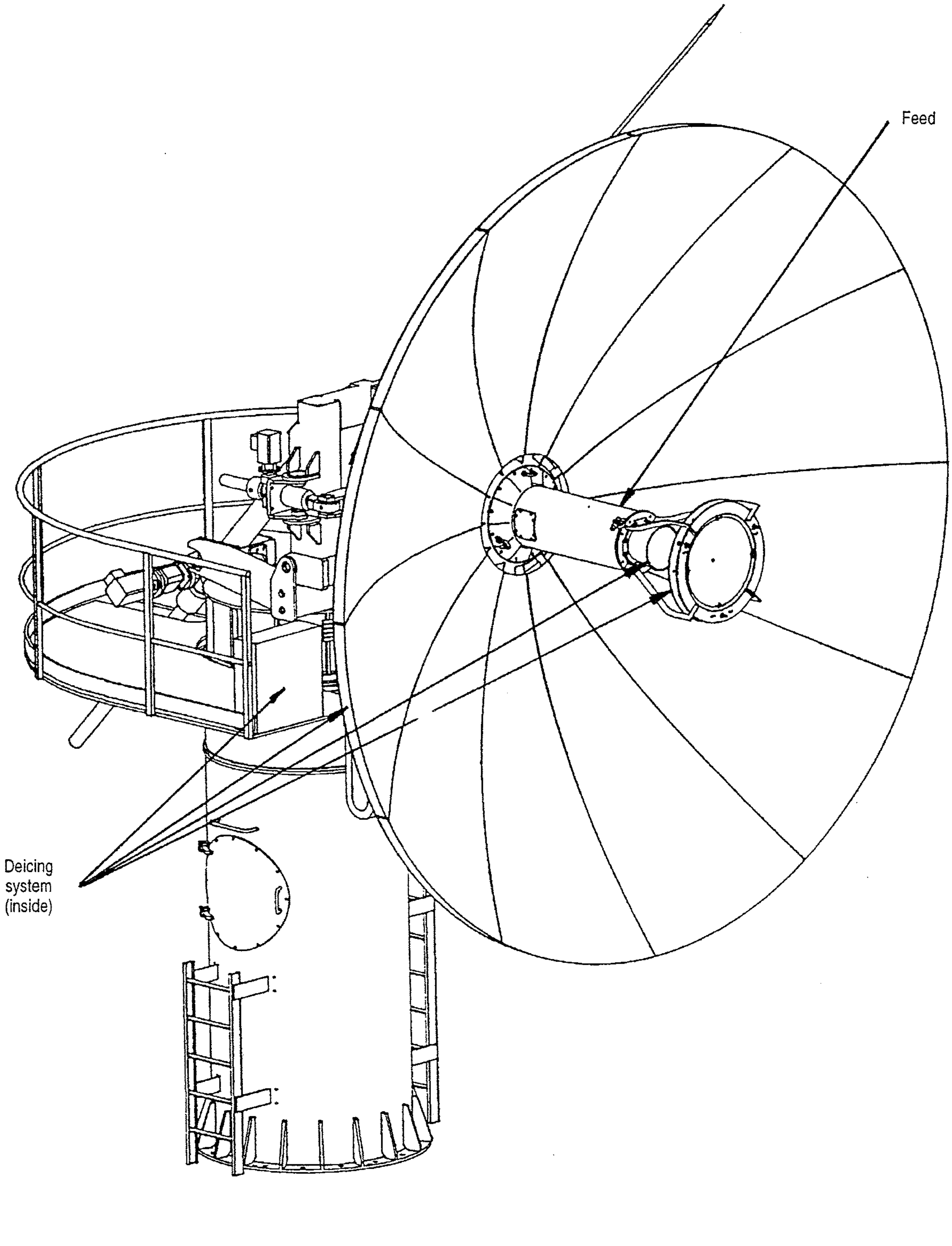


Figure 8 – Antenna – Front view

ALCATEL

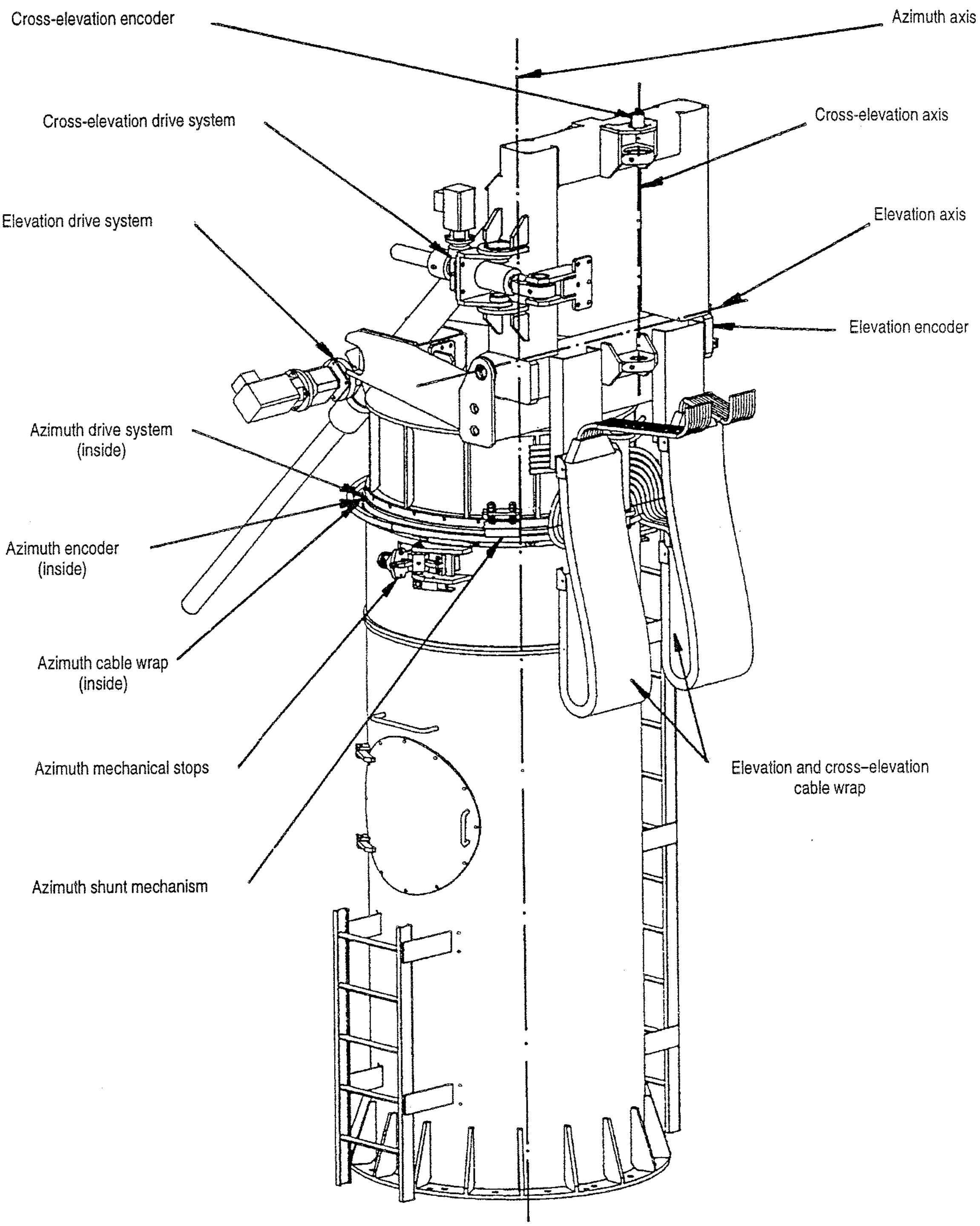


Figure 9 – General view of mounting

MOVEMENT SYSTEMS

The azimuth rotation system (Figure 10) comprises a large circular crown wheel driven by two pinions that are in turn driven by two brushless motors linked to reducers. Two safety disk brakes, electrically controlled, are coupled directly to the motors. this system is located inside the main pedestal tube, near the azimuth rotation bearings.

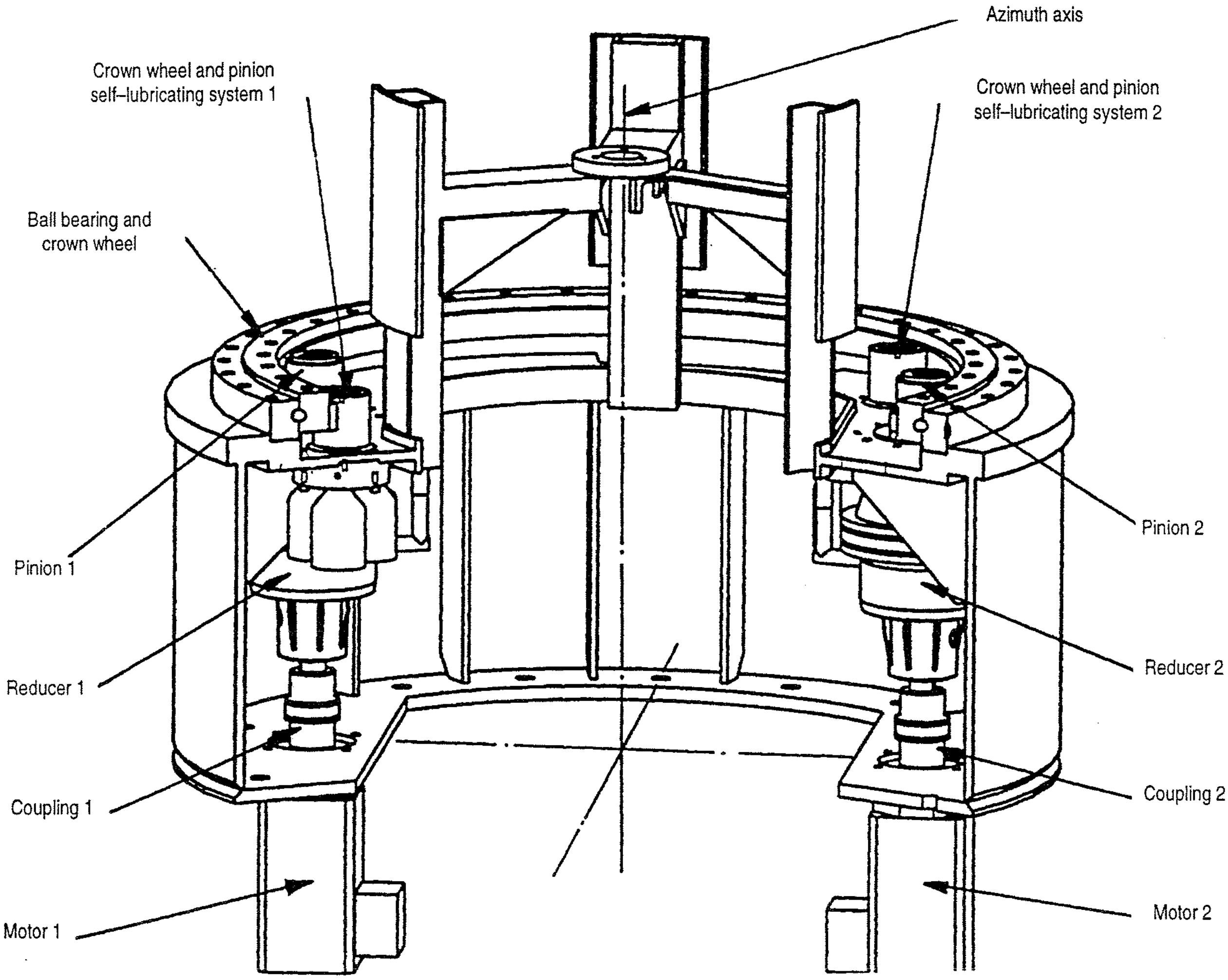


Figure 10 – Antenna – azimuth rotation system

The elevation rotation system comprises a jack driven by a brushless motor linked to a coaxial reducer. A safety disk brake, electrically controlled, is coupled directly to the motor.

The cross–elevation rotation system comprises a jack driven by a brushless motor.

ENCODERS

Three 17–bit optical encoders (one on each axis) tell the ACU how the antenna is positioned.

TRAVEL LIMIT SWITCHES

Antenna movements in all three axes are limited by travel limit switches (two on each axis, controlling the minimum and maximum values).

AZIMUTH AXIS LIMIT SWITCHES AND ZONE INDICATORS

Limit switches and zone indicators are used, on the azimuth axis, to avoid mechanical damage to antenna in case of malfunction.

There are thre types of limit switches on the azimuth axis :

- software limit switches,
- electrical limit switches,
- mechanical limit switches.

There are two limit switches for each type : one in the CCW direction and one in the CW direction.

There are two zone indicators on the azimuth axis : a CW zone indicator and a CCW zone indicator.

Figures 11 and 13 respectively show the positions of the various components and how these safety features work.

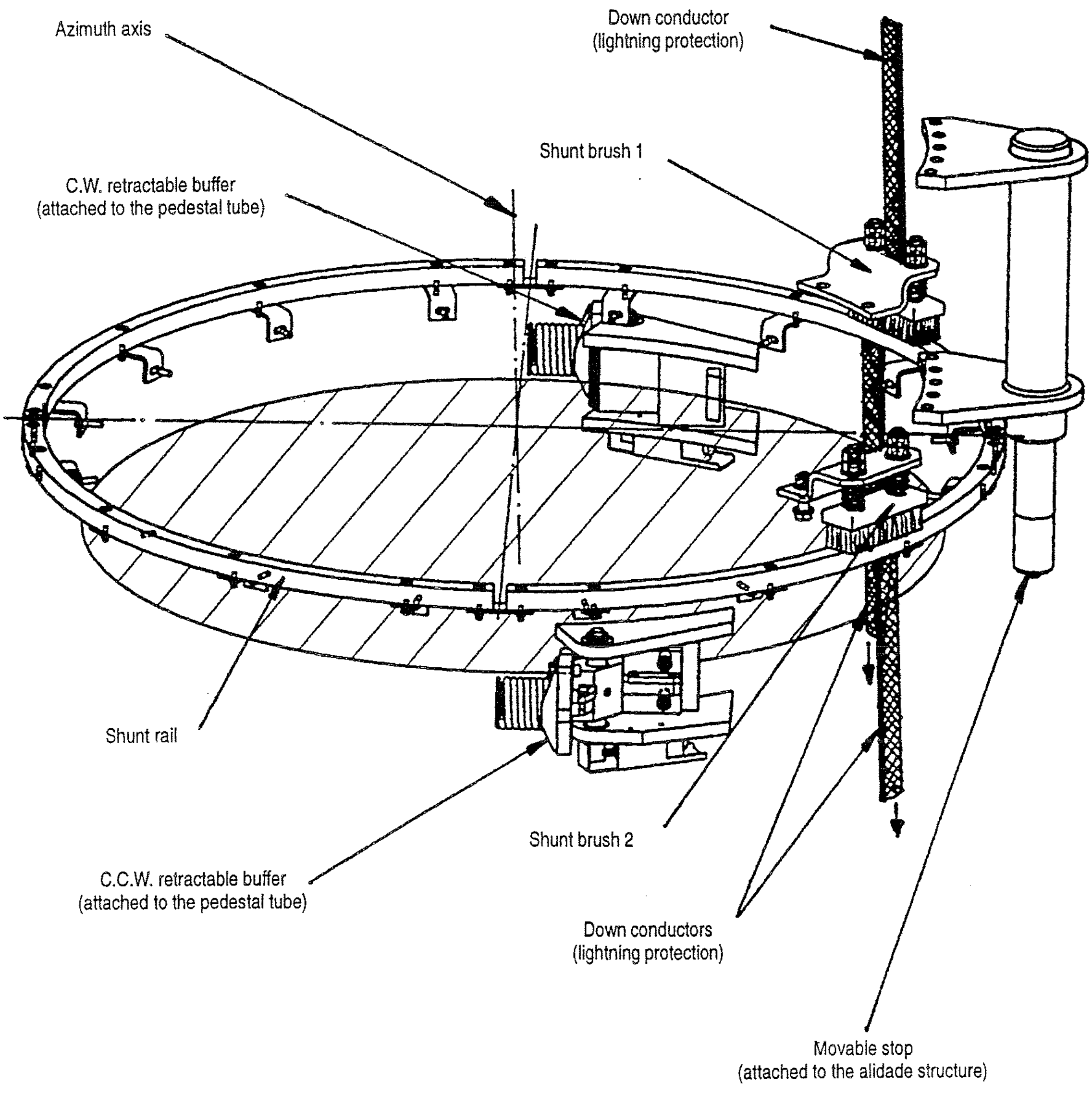


Figure 11 – Antenna – positions of azimuth travel stops

Software limit switches

The software limit switches are parameters keyed into the Antenna Control Unit and stored in a non-volatile memory. During antenna mouvement, the ACU constantly checks that antenna position is within software limits and it stops the antenna if either CW or CCW limit is reached.

These software limit switches are non operating when the antenna is moved with the hand held antenna control.

The software limit switches are adjusted to allow coverage of ± 270 degrees.

Electrical limit switches

The electrical limit switches are push-button switches, inside the pedestal tube, that are mechanically activated when either CW or CCW limit is reached and antenna movement is automatically halted.

The electrical limit switches are adjusted +300 millidegrees beyond the software limit switches. If properly adjusted, the electrical switch limit should never be activated, because the software limit switch will stop antenna movement before (excepted when operation with hand held antenna control.

Mechanical limit switches

The mechanical limit switches are buffers that block antenna movement if ever both the software and electrical limit switches fail.

The mechanical limit switches are adjusted approximately +500 millidegrees beyond the electrical limit switches.

Zone indicators

The zone indicators are activated by the antenna as it moves in and out of the CW or the CCW zones. The CW zone is active when antenna goes beyond 80° in the CW directionl; the CCW zone is active when antenna goes beyond 280° in the CCW direction. The ACU monitors the zone indicators to check that they indicate a zone that is consistent with antenna position. The ACU stops the antenna movement if any incoherence is detected.

The zone indicators induce a 5 to 10 degrees hysteresis between entering a zone and exiting the zone.

Principles of operation

Figure 12 depicts the angles in the azimuth axis' mechanical reference that define CW and CCW zones as well as the electrical limits.

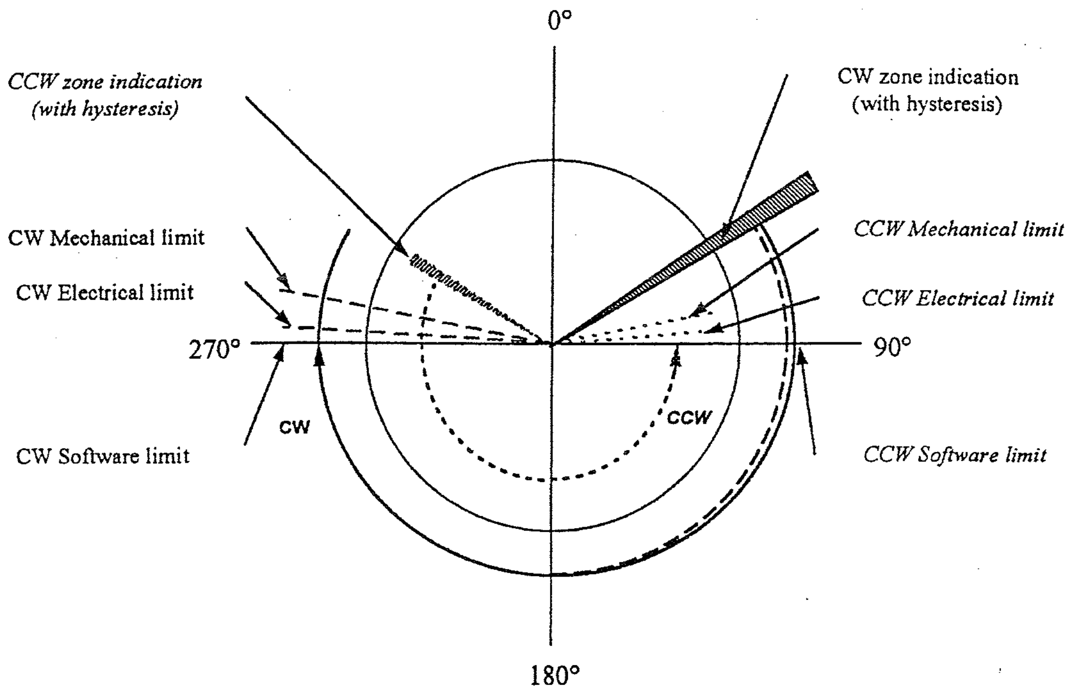
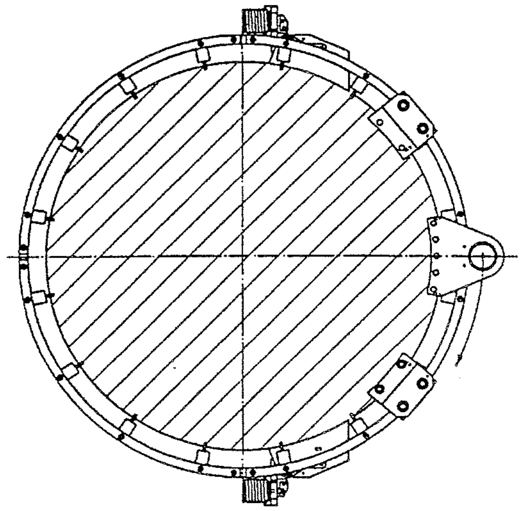
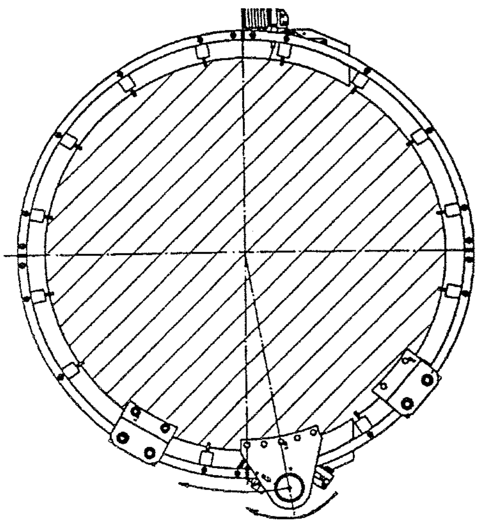


Figure 12 – Azimuth axis mechanical and electrical references

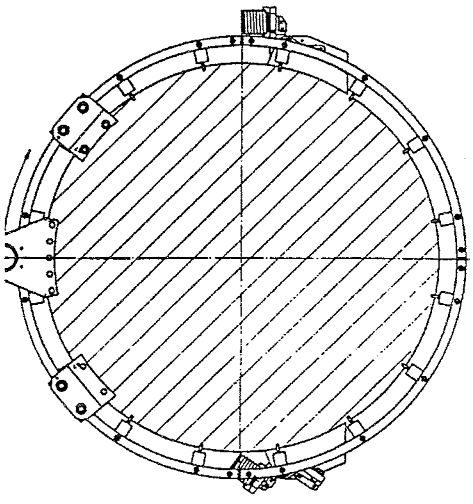
Figure 13 shows the principle of operation of the mechanical limit switches and zone indicators for an antenna movement in the CW direction. Figure 14 is a diagram which explains operation of the mechanical limit switches, zone indicators and electrical limit switches.



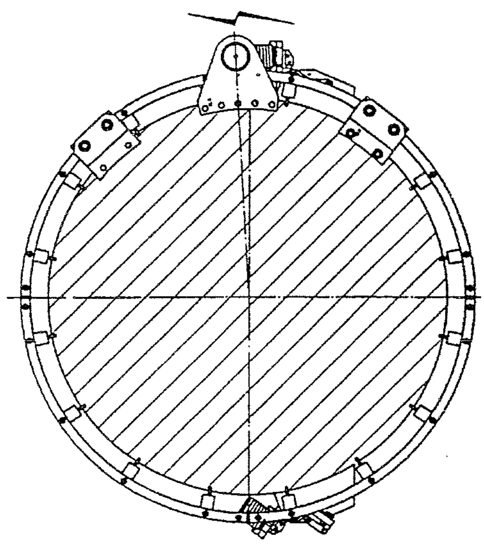
Phase 1 : 0° ≤ Az < +90°
(C.C.W. buffer : ON – C.W. buffer : ON)



Phase 2 : Az = +90°
(C.C.W. buffer : inhibition – C.W. buffer : ON)



Phase 3 : +90° < Az < +270°
(C.C.W. buffer : OFF – C.W. buffer : ON)



Phase 4 : Az = +270°
(C.C.W. buffer : OFF – C.W. buffer : impact)

Same principle for the other direction

C.W. : Clock Wise   C.C.W. : Counter Clock Wise

Figure 13 – Antenna – Theory of operation of the azimuth travel buffers

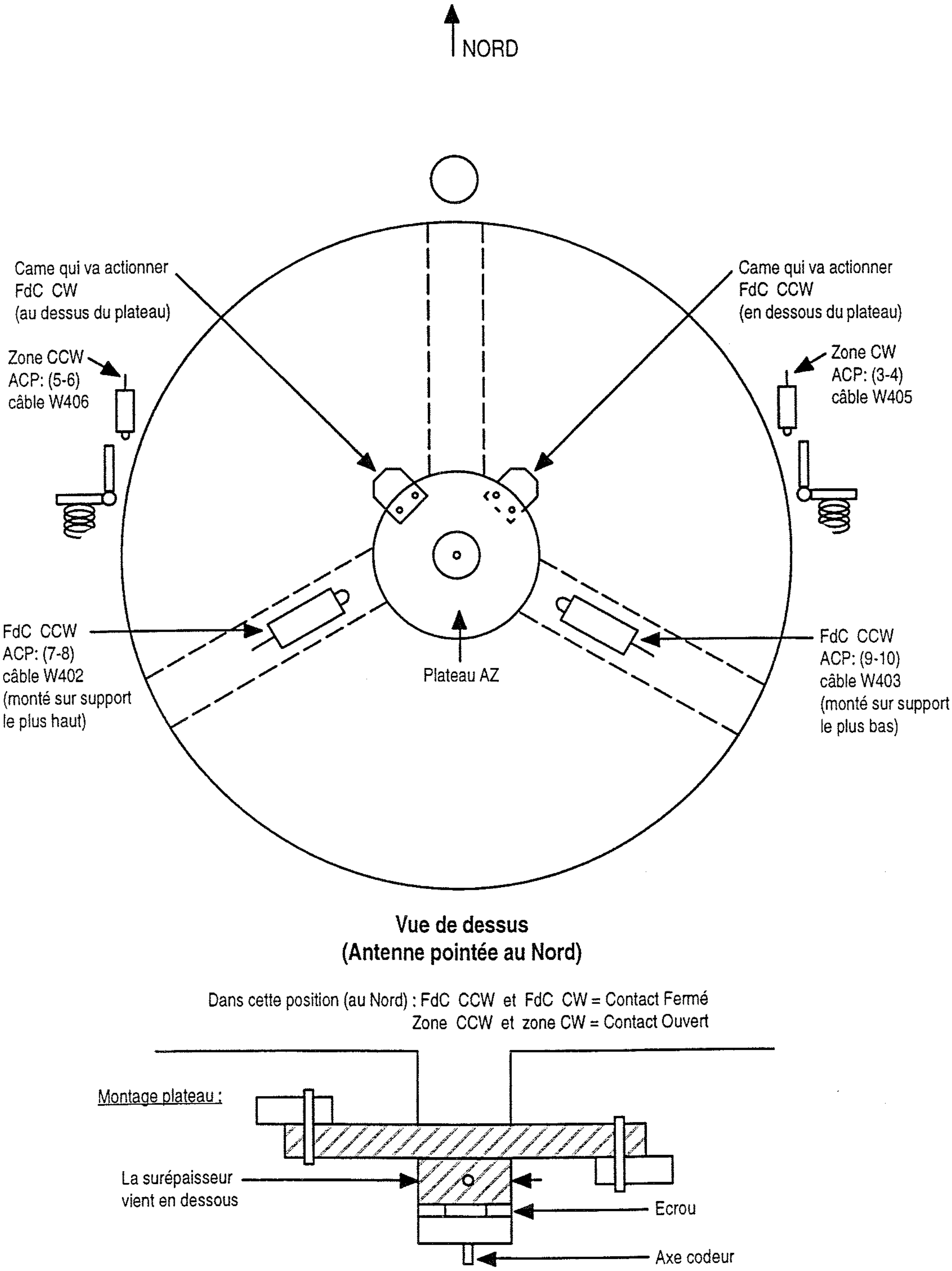


Figure 14 – Sécurités mécaniques et électriques de rotation en azimut

Movement in CW direction from mechanical reference 0

- when antenna is at 0°, both zone indicator loops are inactive (dry loops opened).
- as antenna moves in CW direction, it first trips CW zone indicator (dry loop closed) at 82° (–2° incertainty). At the same time, CCW electrical limit switch is inhibited.
- antenna persues its movement to CW software limit switch, adjusted at 270°. If for any reason (incorrect value keyed in for example), antenna continues to move in CW direction, CW electrical limit switch will be activated (dry loop opened) at 271°.3 (–1° incertainty).
- when moving back out of CW zone, the antenna will trip the CW zone indicator (dry loop opened) at up to 72° (–2° uncertainty).

Movement in CCW direction from mechanical reference 0

- when antenna is at 0°, both zone indicator loops are inactive (dry loops opened).
- as antenna moves in CCW direction, it first trips CCW zone indicator (dry loop closed) at 278° (+2° incertainty). At the same time, CW electrical limit switch is inhibited.
- antenna persues its movement to CCW software limit switch, adjusted at 90°. If for any reason (incorrect value keyed in for example), antenna continues to move in CCW direction, CCW electrical limit switch will be activated (dry loop opened) at 88.7° (+1° incertainty).
- when moving back out of CW zone, the antenna will trip the CCW zone indicator (dry loop opened) at up to 288° (+2° uncertainty).

ELEVATION AND CROSS-ELEVATION LIMIT SWITCHES

On each of these axes, two buffers (minimum and maximum) positioned on the jacks limit the range of movement.

CABLE CHAINS

The cable chains provide protected cable transitions between the fixed and moving parts of the antenna.

The azimuth cable chains (Figure 15) are located in the alidade structure. This provides an entry for the cables and winds them as the antenna rotates around its azimuth axis.

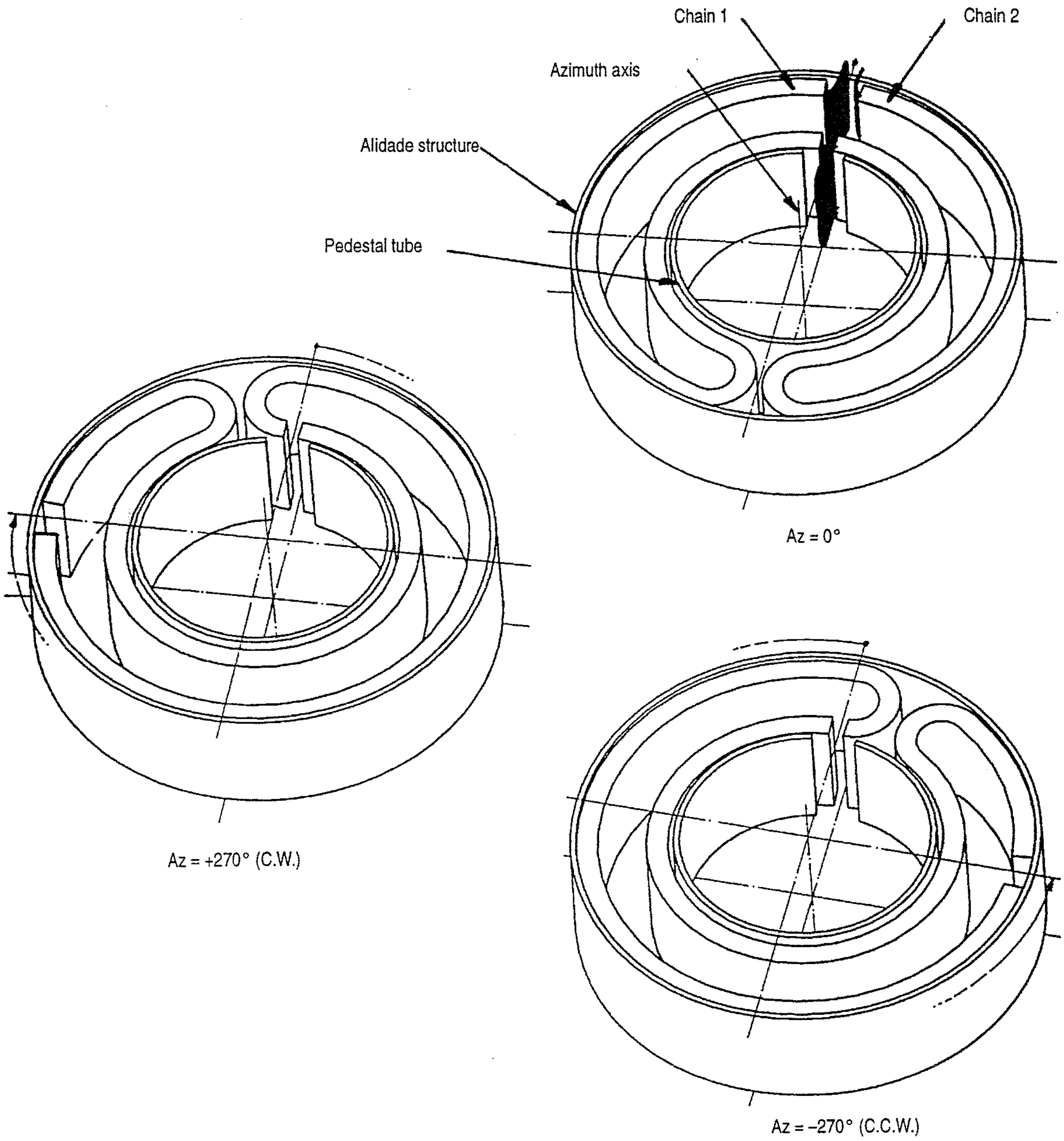


Figure 15 – Azimuth cable chains

The elevation and cross-elevation axis cable chains (Figure 16) are located between the alidade structure and the antenna hub. They provide an entry for the cables and wind them when the antenna is rotating.

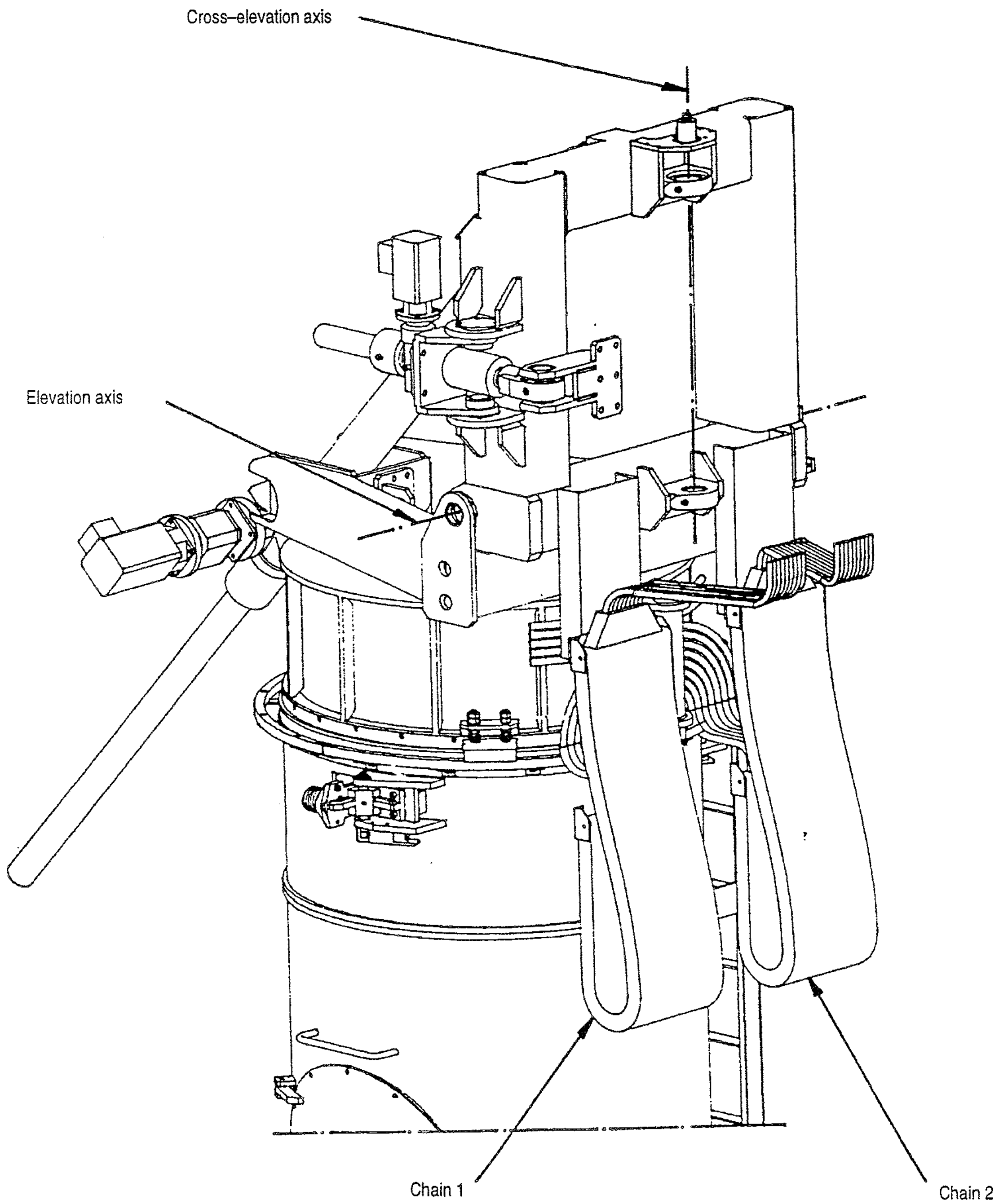


Figure 16 – Antenna – Elevation and cross–elevation cable chains

SELF–LUBRICATING SYSTEMS

The mechanical components such as the ballbearings, crown wheel, pinions, jacks and reducers, need to be lubricated to maintain performance and reliability.

The self-lubricating devices reduce maintenance operations.

The roller bearings and jacks are fitted with a number of oil cartridge lubricators.
The crown wheel and pinions are fitted with two self–lubricating pinions linked to oil cartridge lubricators (Figure 10).

The minimum life of the lubricators is approximately six months.

2.5.1.2 – Reflector

The reflector (Figure 17) comprises:

- 12 panels,
- 12 support braces,
- 1 hub.

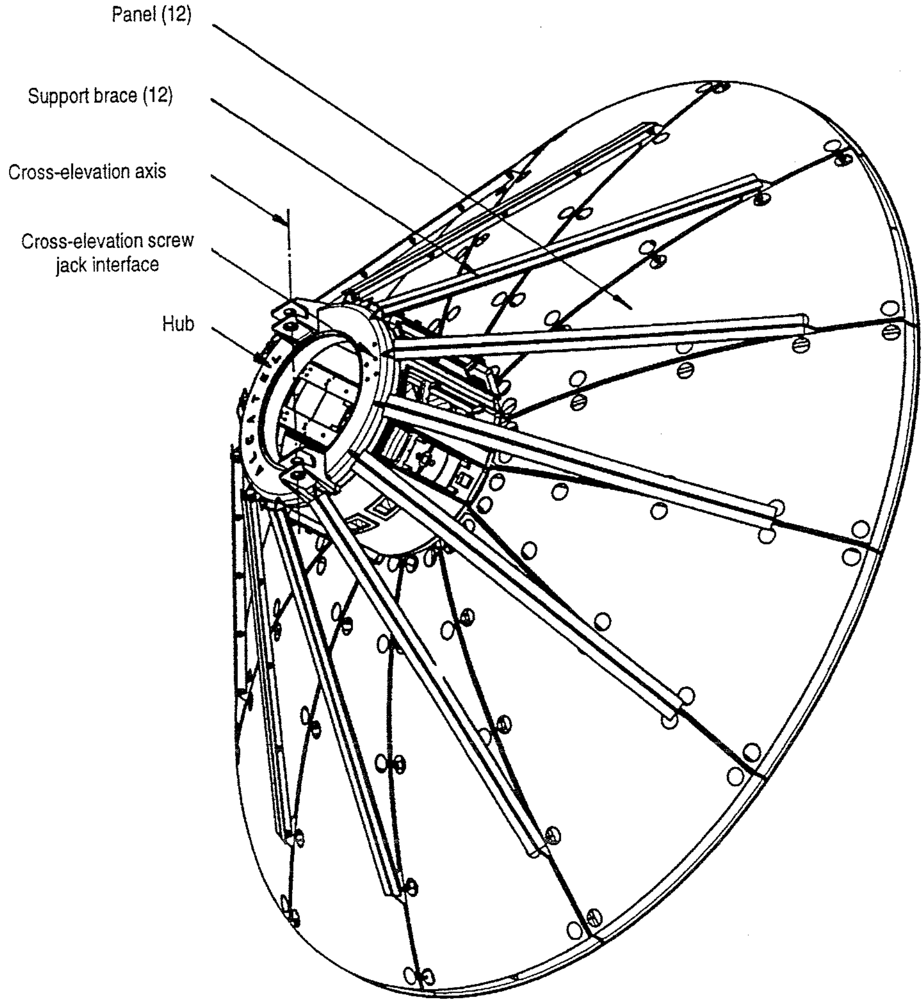


Figure 17 – Rear view of the reflector

The 12 panels are bolted, not just to the support braces, but also to the adjacent panels to provide a continuous structure. Their precision manufacture is such that:

- no mechanical adjustments are required on assembly, apart from pairing the panels together,
- replacement panels can always be fitted with no need for adjustment.

A blanking plate is provided to seal the rear opening of the hub.

2.5.1.3 – FEED

The feed (Figures 19 and 18) comprises the following components:

- a four-port multiplexer,
- a polarizer,
- a circular waveguide component and a tracking coupler (optional),
- a corrugated horn,
- a subreflector.

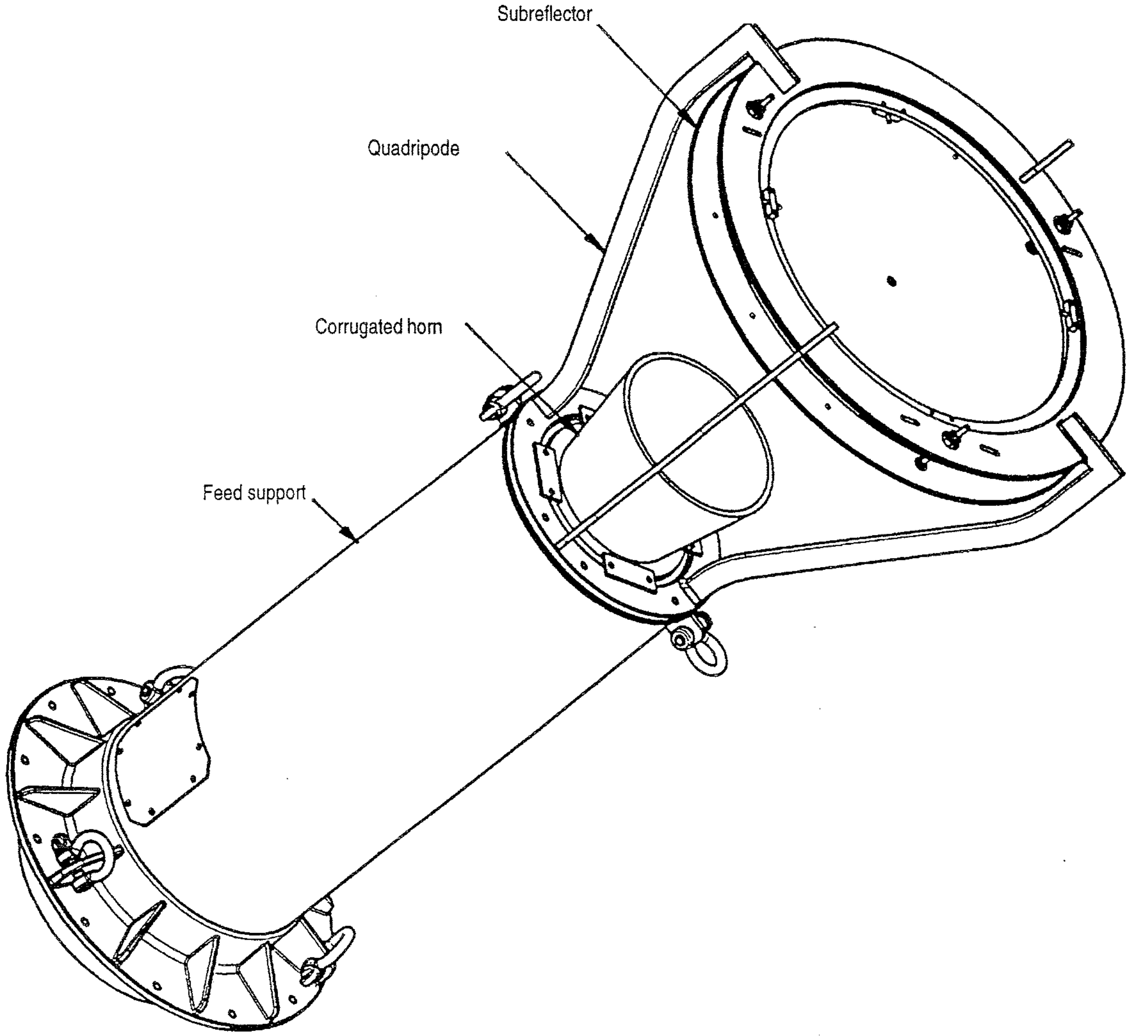


Figure 18 – Feed – Assembly

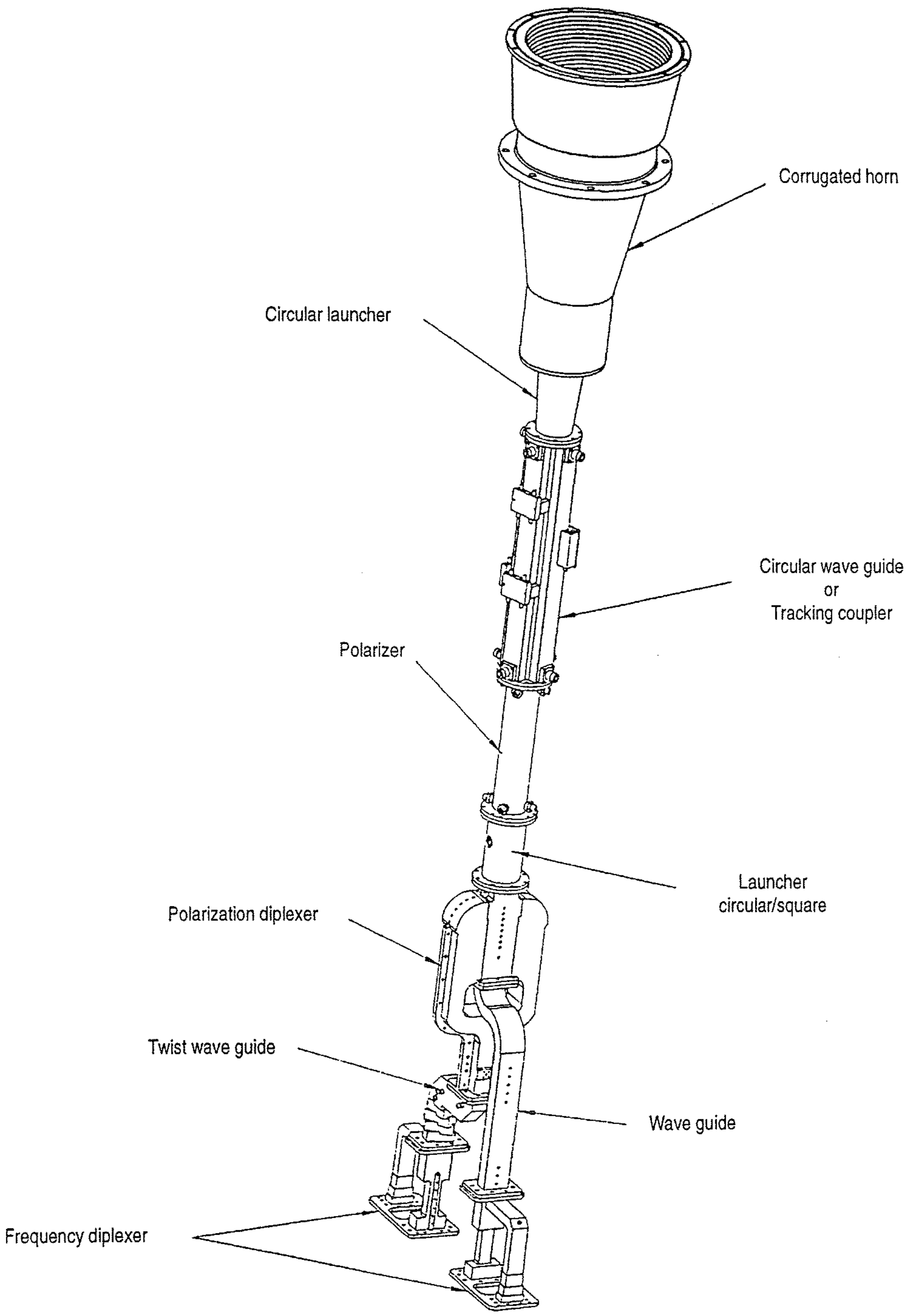


Figure 19 – Feed – Overall view

The corrugated horn and the circular waveguide (or optional tracking coupler) are mounted within a feed support assembly.

The subreflector is mounted directly on the feed by a quadripode structure.

The four-port multiplexer and the polarizer are connected to the RF equipment located inside the antenna hub.

The feed and hub are assembled together by bolts, and require no adjustments. Two hatches in the feed support provide access to the bolts.

2.5.1.4 – Access components

The interior of the pedestal tube includes a floor providing access to the azimuth mechanisms. A ladder and trapdoor allow access. Lighting and a safety switch are also provided.

A platform provides access to the RF equipment installed in the antenna hub, and to the elevation and cross-elevation drive systems. Mounted on the alidade structure, this is fitted with a ladder, a hatch, a rail and a safety switch.

When an engineer goes into the pedestal tube or onto the platform on the alidade structure, the safety interlock switches cut the power supply to the motors and switch on the lighting.

The internal floor or the platform will accommodate two engineers, standing or kneeling.

2.5.1.5 – De–icing

The de-icing system prevents the build up of snow or ice on the reflector, the subreflector and the corrugated horn.

The reflector and the subreflector are protected by flexible radiators on the rear surface, secured by adhesive mountings and covered by a protective sheet.

A silicon coated heating material is fixed to the horn.

DE-ICING SYSTEM CONTROL

The de–icing system control feeds the de–icing circuits as and when required by atmospheric conditions. It comprises a unit containing differential circuit breakers, relays, LEDs, connector strips and two temperature sensors. The electrical circuit diagram of this unit is given in the wiring specification, section 1.3.3.

Sensor 1 activates the power supply circuit when the ambient temperature falls below +5° and deactivates it when it rises above this temperature.

Sensor 2 deactivates the power supply circuit when the ambient temperature falls below –15° and reactivates it when it rises above this same temperature.

DE-ICING POWER

The power needed to de-ice the reflector and the subreflector is approximately 500 W/m^2. For the horn, the figure is approximately 650 W. The total power needed by the de-icing system is around 14 kW.

2.5.1.6 – Lightning protection

Lightning protection (Figure 20) is provided by a lightning conductor secured to the top brace of the reflector and linked to the system earth by two uninsulated drop cables. Jumper cables (elevation and cross-elevation axes) and a special shunt (azimuth axis) are provided for continuity of connection and to protect the bearings against lightning strikes.

2.5.1.7 – UPS/CPS box

UPS/CPS box is mounted on top side of the hub. The electrical diagram of this box is given in appendix 1 (Figure 175).

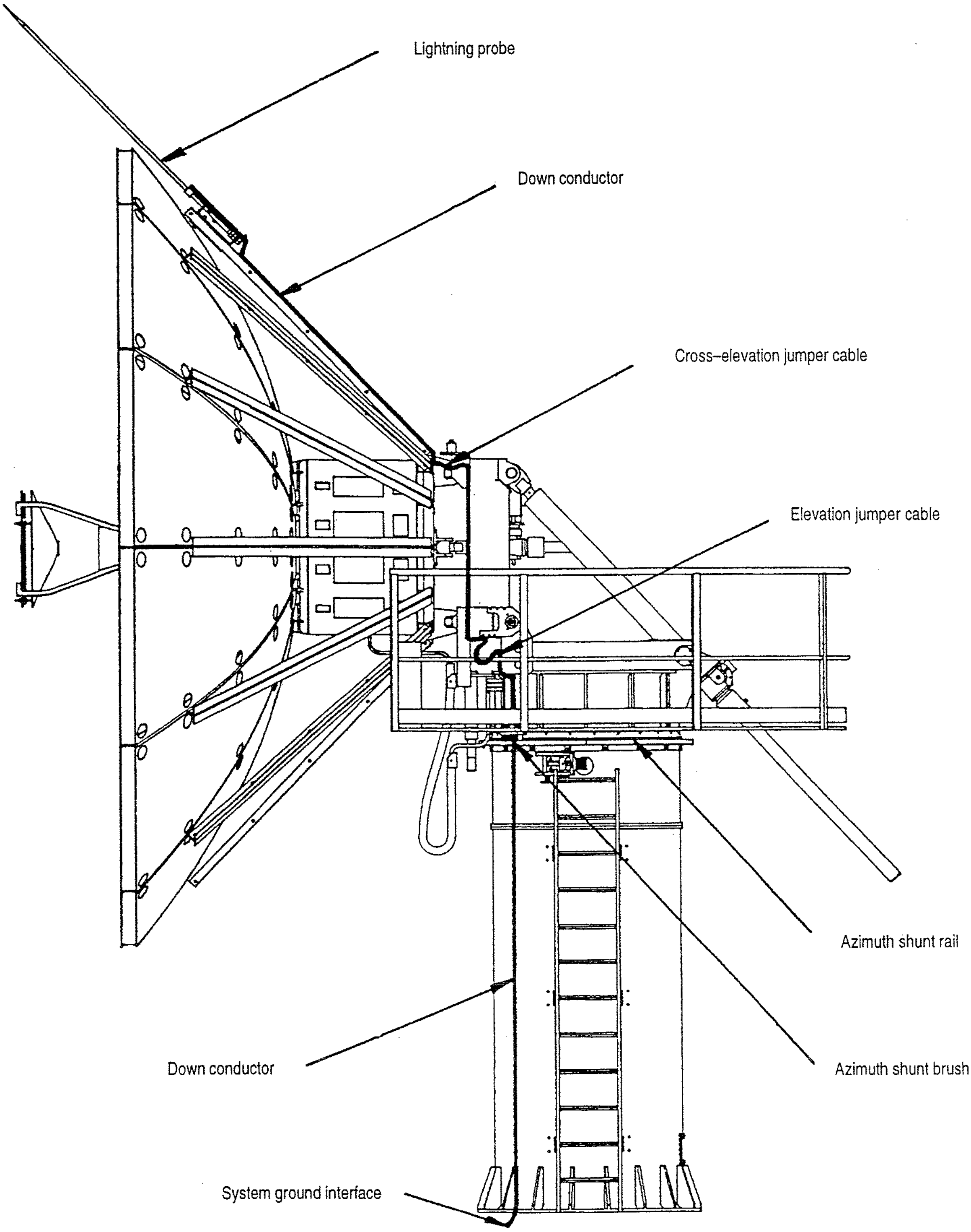


Figure 20 – Lightning protection system

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2.5.2 – Pre-equipped hub

The pre-equipped hub of the antenna contains the RF equipment. The equipment is divided into two half hubs, each connected to one polarization. These two half-hubs are identical, apart from a thermostatically controlled unit which contains:

- the TCU/CDMA filters and probes in the LHCP half-hub,
- the EIRP measurement sensor in the RHCP half-hub.

When the hub is mounted on the antenna, access to the equipment in it is obtained by unscrewing the protective plate from the rear with the antenna in the vertical position (0° elevation).

Figure 21 shows a pre-equipped half-hub. This photo corresponds to a prototype version, used to show equipment layout. Figures 22 and 23 give back views of the complete hub.

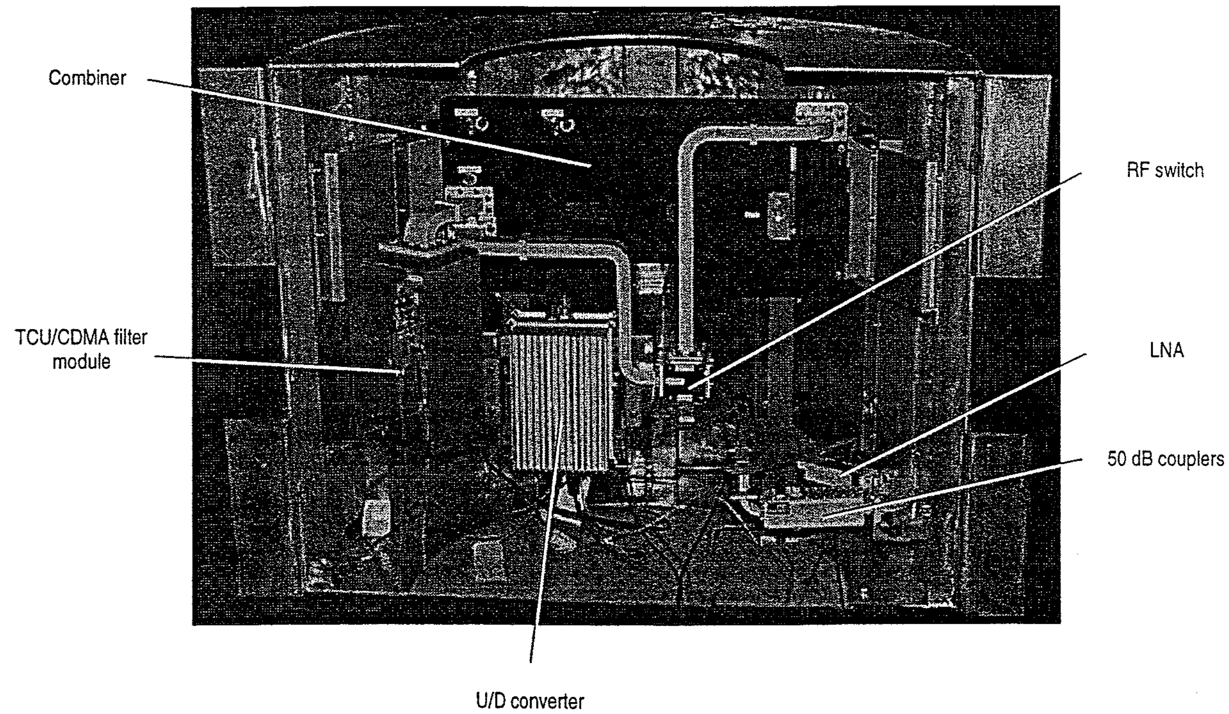

Figure 21 – Internal view of a pre–equipped LHCP half–hub

A half-hub includes the following equipment:

- four GSG 301 power amplifiers, arranged around the outside and each protected by a ventilation cover for cooling the internal part of the hub and the amplifier,
- a combiner,
- a GSG 401 up and down-converter,
- a thermostatically-controlled TCU/CDMA filter (LHCP) or EIRP measurement probe (RHCP) unit,
- an electrically controlled waveguide RF switch,
- a receive filter,
- a low noise amplifier,
- a set of waveguides required to interconnect the various units,

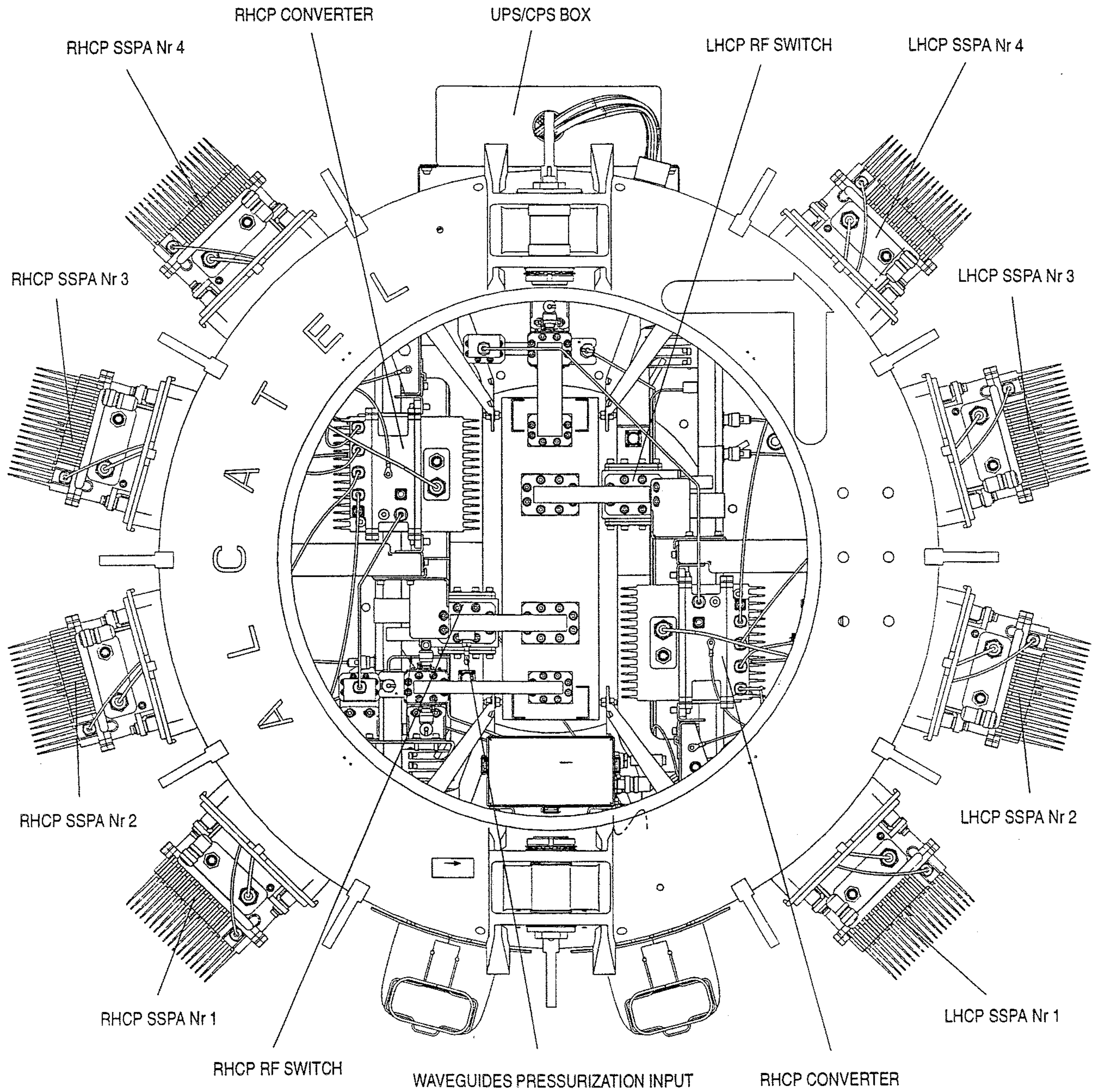

Figure 22 – Back view of the fitted hub (Access door removed)

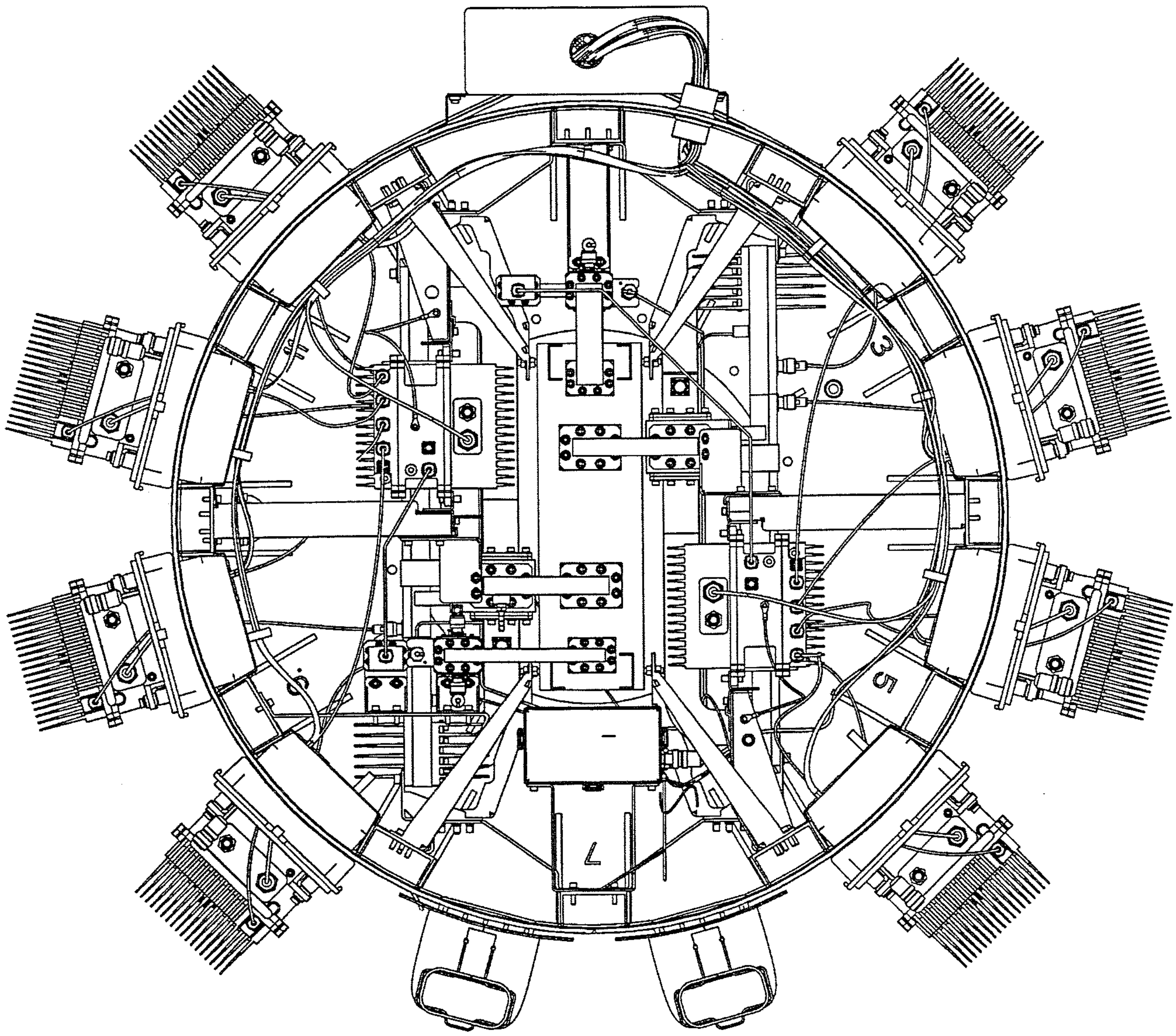

Figure 23 – Cut back view of the fitted hub

– various cables.

This equipment, apart from the sets of waveguides, cables and the RF switch are described in detail later in this manual.

All the RF equipment is sealed. The antenna feeds and waveguides are pressurized.

2.5.2.1 – Operation

The functional block diagrams of the units incorporated in the LHCP and RHCP half-hubs of the antenna are given respectively in figures 24 and 25.

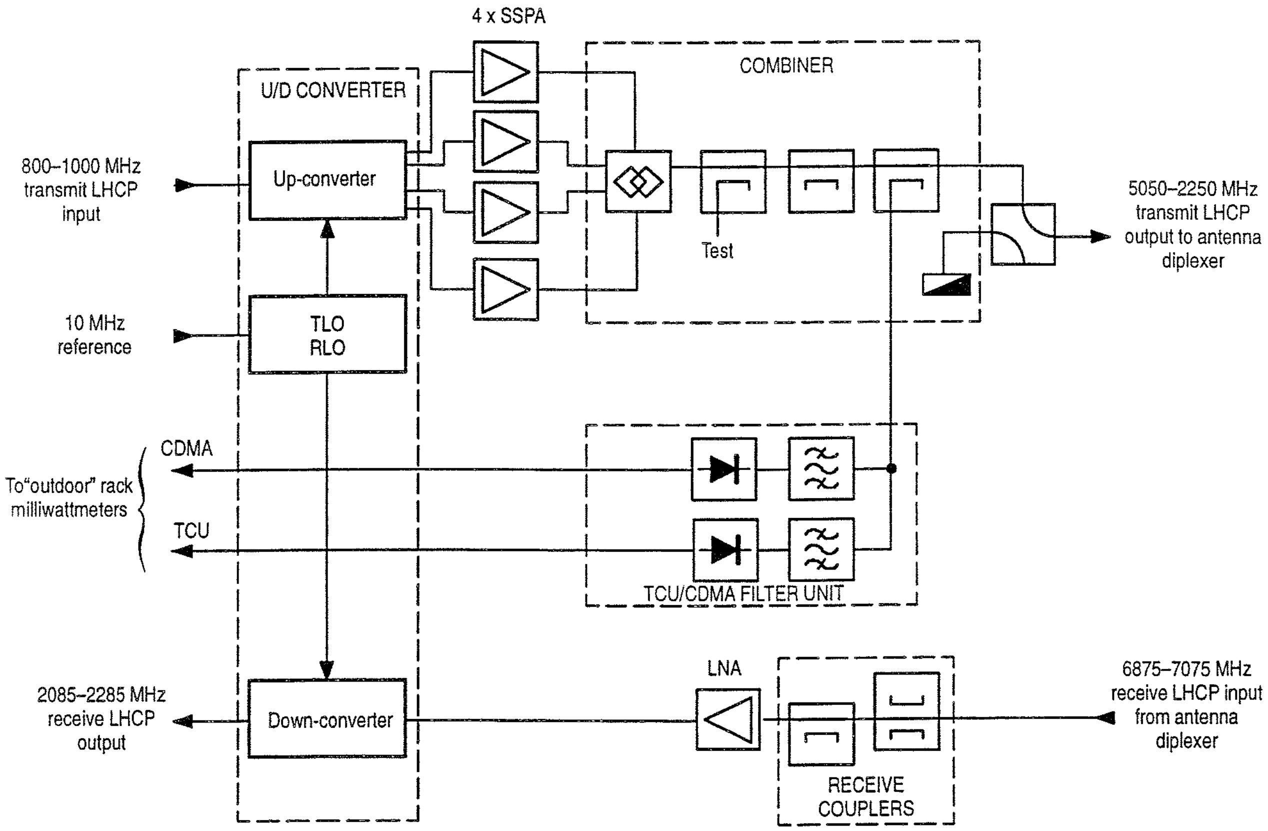

Figure 24 – Functional block diagram of the LHCP half-hub of the antenna

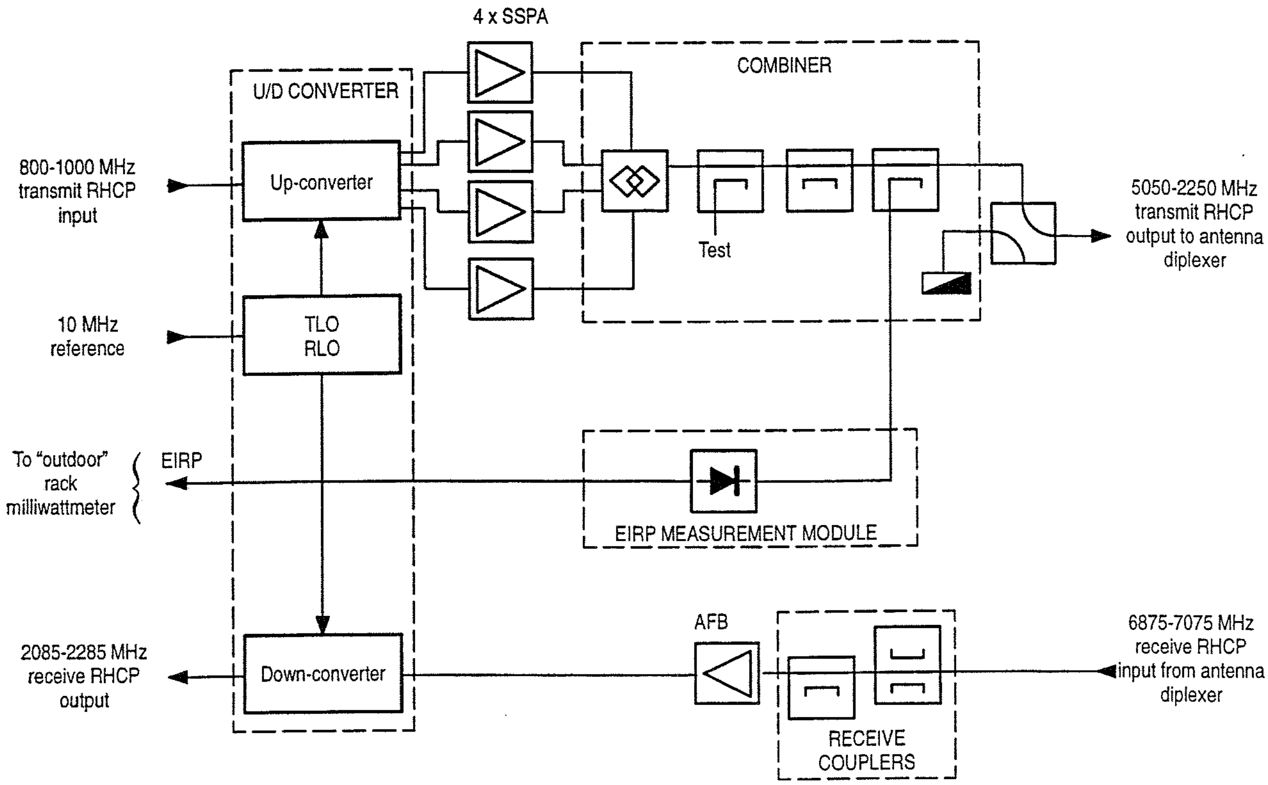

Figure 25 – Functional block diagram of the RHCP half–hub of the antenna

The functions handled by the antenna hub equipment are described in section 2.1.2.3.

2.5.2.2 – Configuration

Not applicable.

2.5.2.3 – Access

UP AND DOWN CONVERTER

Refer to section 2.5.4.3.

POWER AMPLIFIERS

Refer to section 2.5.3.3.

COMBINER

Refer to section 2.5.5.3.

ANTENNA/LOAD SWITCH

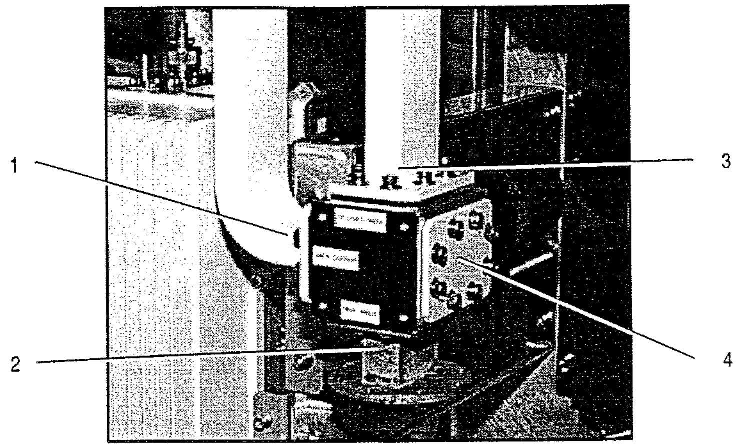

Figure 26 – Antenna/load RF switch

ITEM (Fig. 26)	COMPONENT	DESCRIPTION
1	CPRF flange (6 x 6 mm diameter fixing holes)	RF input (from combiner)
2	CPRF flange (6 x 6 mm diameter fixing holes)	RF output (antenna)
3	CPRF flange (6 x 6 mm diameter fixing holes)	RF output (to combiner power load)
4	CPRF flange (6 x 6 mm diameter fixing holes)	Second input (to low power load for adaptation)
RSWITCH (RHCP) or LSWITCH (LHCP)	TB	Remote monitoring port

LOW NOISE AMPLIFIER

ITEM (Fig. 27)	COMPONENT	DESCRIPTION
1	CPR 112G flange	RF input (from antenna diplexer)
2	Female N coaxial connector	RF output (to down-converter) and power feed voltage input (from down-converter)

RECEIVE COUPLERS

This subsystem is fitted with two 50 dB injection couplers for applying a signal to the LNA input.

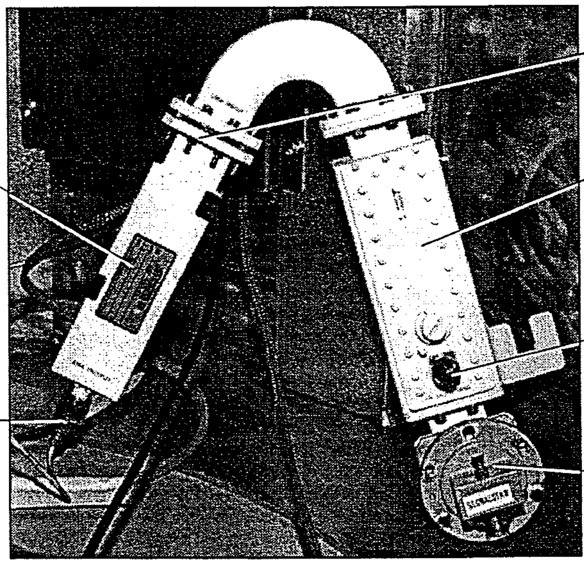

Figure 27 – LNA and receive couplers

ITEM	COMPONENT	DESCRIPTION
See figure 27	Female N coaxial connector	Test signal injection

2.5.2.4 – Connections

UP AND DOWN-CONVERTER

Refer to section 2.5.4.4.

POWER AMPLIFIERS

Refer to section 2.5.3.4.

ANTENNA/LOAD SWITCH

PIN	SIGNAL	MEANING
A	–	Position 1 command (antenna)?
B	–	Command common
C	–	Position 2 command (load)?
D	–	Position 1 information (D/E loop closed)?
E	–	Position information common
F	–	Position 2 information (F/E loop closed)?

2.5.2.5 – Specifications

UP AND DOWN-CONVERTER

Refer to subsection 2.5.4.5.

POWER AMPLIFIERS

Refer to section 2.5.3.5.

COMBINER

Refer to section 2.5.5.4.

ANTENNA/LOAD SWITCH

Frequency band	3900 to 5850 MHz
SWR	⩽ 1.05
Insertion loss	⩽ 0.02 dB
Decoupling between ports	⩾ 80 dB
Switching time	⩽ 80 ms
Control voltage	42 to 54 V

LOW NOISE AMPLIFIER

Frequency band	6850 to 7100 MHz
Gain	52.5 to 55.5 dB
Gain variation • in band • in a 40 MHz band	 ± 0.5 dB ± 0.2 dB
Gain variation slope (typical)	2 dB/MHz
Gain stability (at constant temperature) • short term (10 minutes) • medium term (24 hours) • long term (one month)	 ± 0.1 dB ± 0.2 dB ± 0.5 dB
Gain stability versus temperature	± 0.05 dB/°C
SWR • input • output	 ⩽ 1.25 ⩽ 1.3
Noise temperature at 23°C	⩽ 60 K (typical : 55 K)
Output power at 1 dB compression	⩾ +15 dBm (typical : +27 dBm)
third order intercept point	⩾ +25 dBm (typical : +27 dBm)
TPG mode response in a 40 MHz band • Linear • Parabolic • Ripple	Typical values : 0.01 ns/MHz 0.001 ns/MHz^2 0.1 ns peak-to-peak
AM/PM conversion (output level = –5 dBm)	5°/dB (typical)
Power supply • voltage • current	 12 to 24 V (nominal : 15 V) ⩽ 300 mA (nominal : 120 mA)
Temperature range	–40 to +70°C

RECEIVE COUPLERS

Coupling value (at 6975 MHz)	50 dB ± 0.1 dB
In-band coupling variation	± 0.2 dB
SWR at waveguide ports	⩽ 1.1
SWR at coaxial ports	⩽ 1.2

2.5.2.6 – Cooling and heating

There are two possible service configurations:

- Normal service,
- Low temperature startup.

NORMAL SERVICE

In normal service:

- the SSPA are cooled individually by fans,
- each fan draws air into the hub and then expels it (the hub air inlets are fitted with dust filters),
- the other equipment is cooled by the flow of air resulting from the intake,
- the SSPA and their power supplies never need heating in normal service, even with low outside temperatures,
- to guarantee normal service from the up and down-converter in cases of low outside temperatures, their casings are fitted with temperature sensors and radiators.

LOW TEMPERATURE STARTUP

When starting up with low outside temperatures:

- the RF equipment of the hub and the SSPA power supplies are heated by radiators installed in the hub and controlled by temperature sensors,
- when the normal service temperature is reached, the equipment is powered down,
- if necessary, the up and down-converter internal radiators can be powered to enable this equipment to be started up in a few minutes.

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2.5.3 – 80 W power amplifier – GSG 301

The 80 W power amplifier comprises two blocks:

- the power amplifier block (solid state power amplifier, SSPA),
- the power supply block.

In normal service, this is covered by a housing, secured to the antenna hub and contains a fan powered from the 220 V AC mains supply. The fan draws air into the hub, circulates it around the amplifier and expels it through the ventilation holes provided in the top part of the housing.

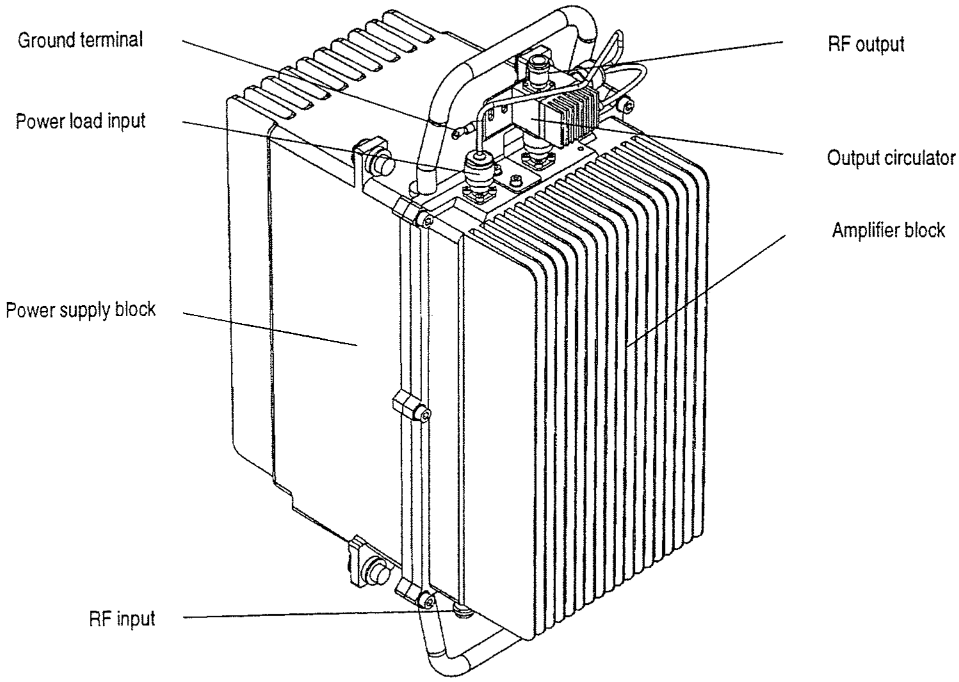


Figure 28 – Overall view of the power amplifier

2.5.3.1 – Operation

Figure 29 is a functional block diagram of the amplifier system.

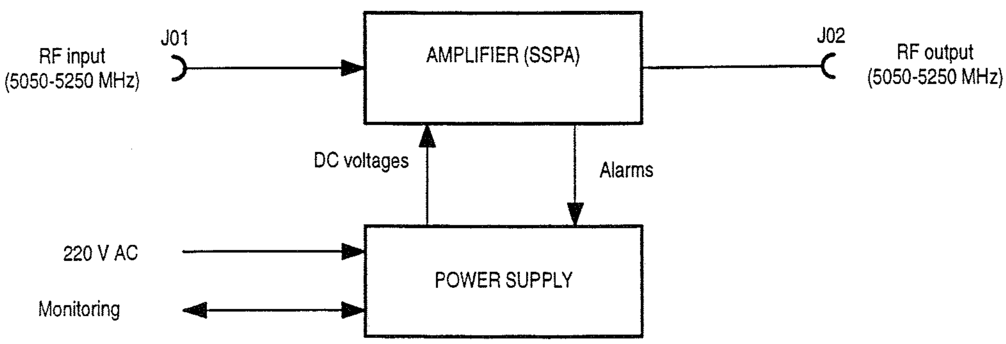


Figure 29 – Functional block diagram of the power amplifier system

POWER AMPLIFIER BLOCK

This block comprises a cast module with cooling fins, containing a printed circuit board supporting:

- the RF amplification circuits, based on power FET transistors,
- FET bias circuits,
- Alarm detection circuits.

Figure 30 is a block diagram of the amplifier.

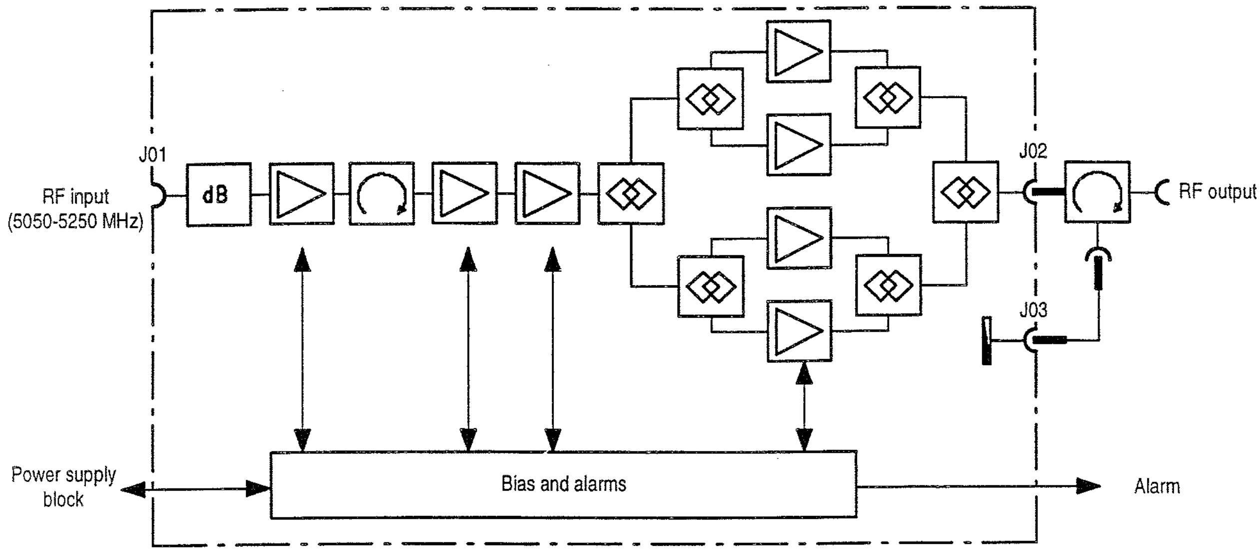


Figure 30 – Block diagram of the amplifier block

The amplifier is made up of four 25 W power transistors mounted in parallel, driven by three FET amplifiers connected in series. 3 dB couplers distribute the signal to the four transistors and then combine the signals at the output.

An output circulator external to the amplifier block is connected to the output. Fitted with a power load integrated in the module, this protects the amplifier against reflected power (on switching, for example). A semi–rigid coaxial cable connected to the output of this circulator provides the link to the load. The link with the port of the combiner corresponding to the amplifier is via a coaxial cable.

A general alarm is transmitted externally via an isolated loop. This marshalls the following alarms:

- DC current consumption of the power FET transistors,
- abnormal temperature detection (monitoring cooling system operation),
- power voltage monitoring (+10.7 V and –8 V).

The RF power can be disconnected or reconnected by a remote control signal received via the remote monitoring connector.

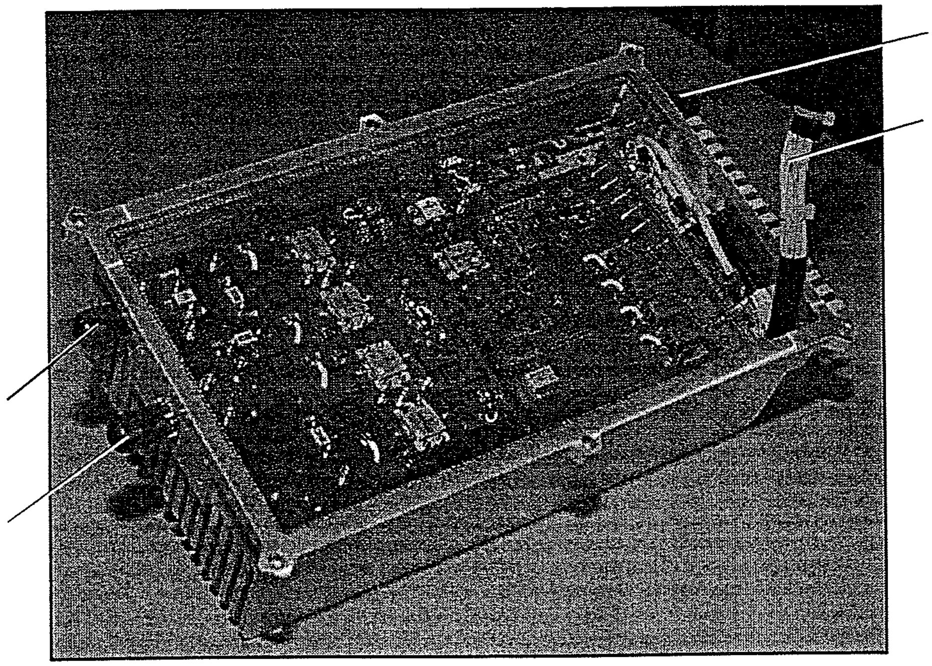


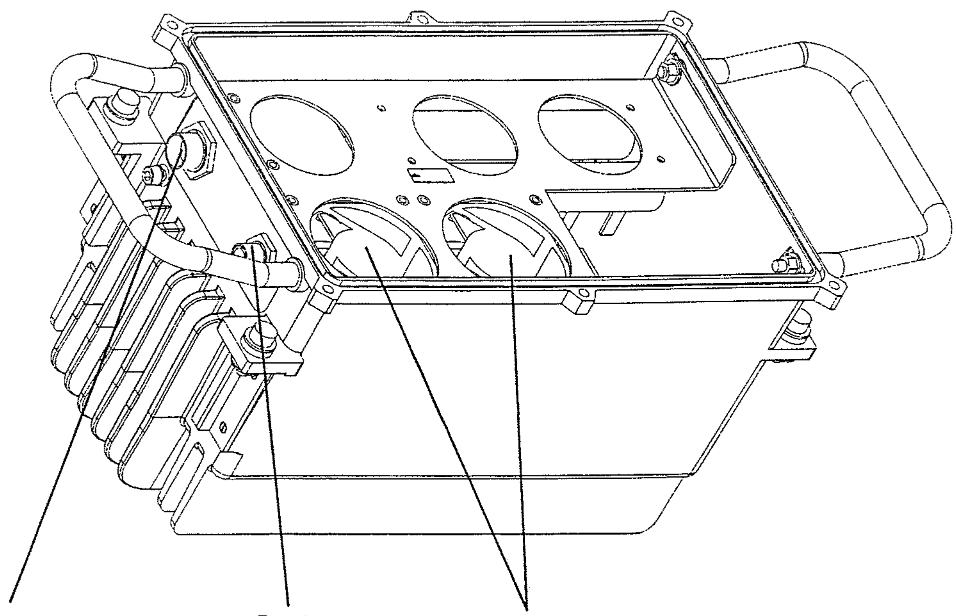
Figure 31 – Internal view of the SSPA

POWER SUPPLY

This power supply receives 220 V mains voltage and outputs the regulated 10.7 and –8 V DC voltages required to operate the amplifier.

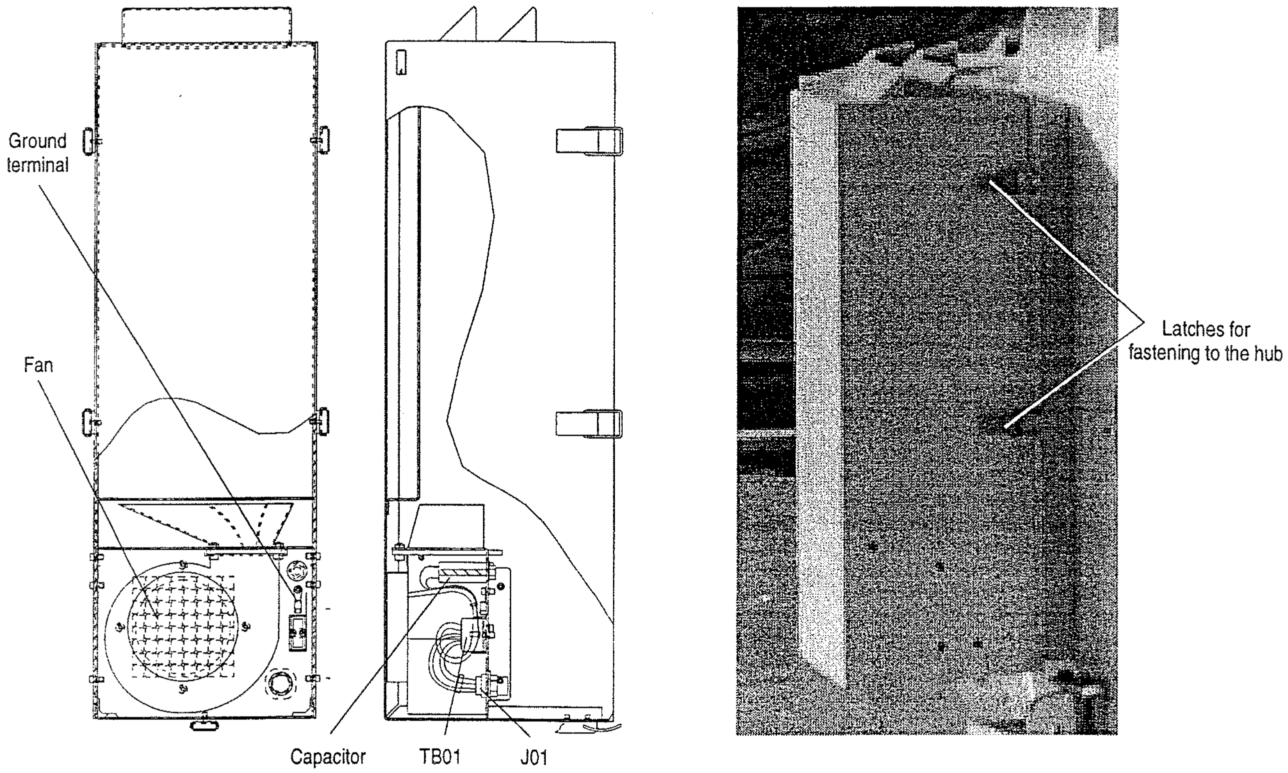
Alarms from the amplifier and the RF power disconnect command also pass through this block.

Figure 32 shows a view of this power supply and its port connectors.



COOLING CASING

The casing is shown in figure 33.



Cut views

Housing mounted on hub

Figure 33 – Cooling housing

Wiring of the cooling housing is given by figure 34.

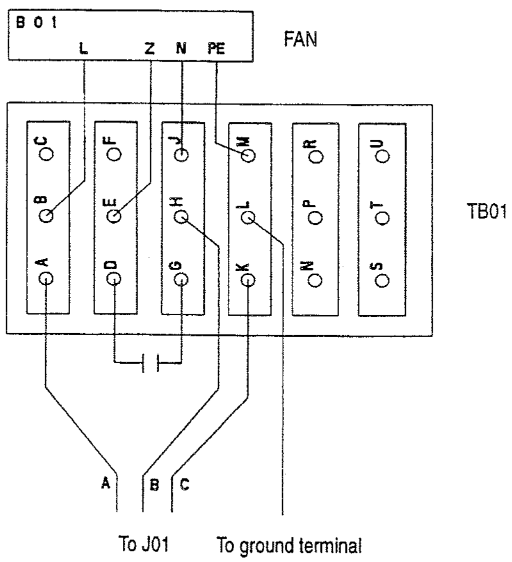


Figure 34 – Cooling housing wiring

2.5.3.2 – Configuration

Not applicable.

2.5.3.3 – Access

AMPLIFIER BLOCK

ITEM	COMPONENT	DESCRIPTION
J01	50 Ω sealed coaxial connector	RF input
J02	50 Ω sealed coaxial connector	RF output
J03	50 Ω sealed coaxial connector	Power load input

POWER SUPPLY BLOCK

ITEM	COMPONENT	DESCRIPTION
J01	Female six–way HE301 socket	Remote monitoring
J02	Male three–way HE301 socket	Mains power supply

2.5.3.4 – Connections

MAINS POWER SUPPLY CONNECTOR

PIN	SIGNAL	DESCRIPTION
A	–	Phase
B	–	Neutral
C	–	Earth

REMOTE MONITORING CONNECTOR

PIN	SIGNAL	DESCRIPTION
A	–	Alarm relay common contact
B	–	Alarm relay make contact
C	–	Power control
D	–	Power control common
E	–	Amplifier normal service LED control (to interface board)
F	–	

2.5.3.5 – Specifications

Service frequency band	5050-5250 MHz
Gain in linear service (25°C)	27 to 28 dB
Output power at 1 dB compression • Minimum • typical	 48 dBm (63 W) 49 dBm (79 W)
Third order intermodulation	C/I > 28 dBc (Pscl = 42.3 dBm)
Phase imbalance	< ± 10°
Output power at saturation	≃ 50 dBm (100 W)
Total dissipated power (typical)	570 W

2.5.4 – Up and down converter – GSG 401

The up and down converter assembly comprises three blocks:

- an up converter block,
- a down converter block + local oscillators common to both converters,
- a power supply block.

These three are bolted together to form a single assembly, sealed by gaskets. the casings of the up converter and power supply blocks are finned to provide heat sink capability.

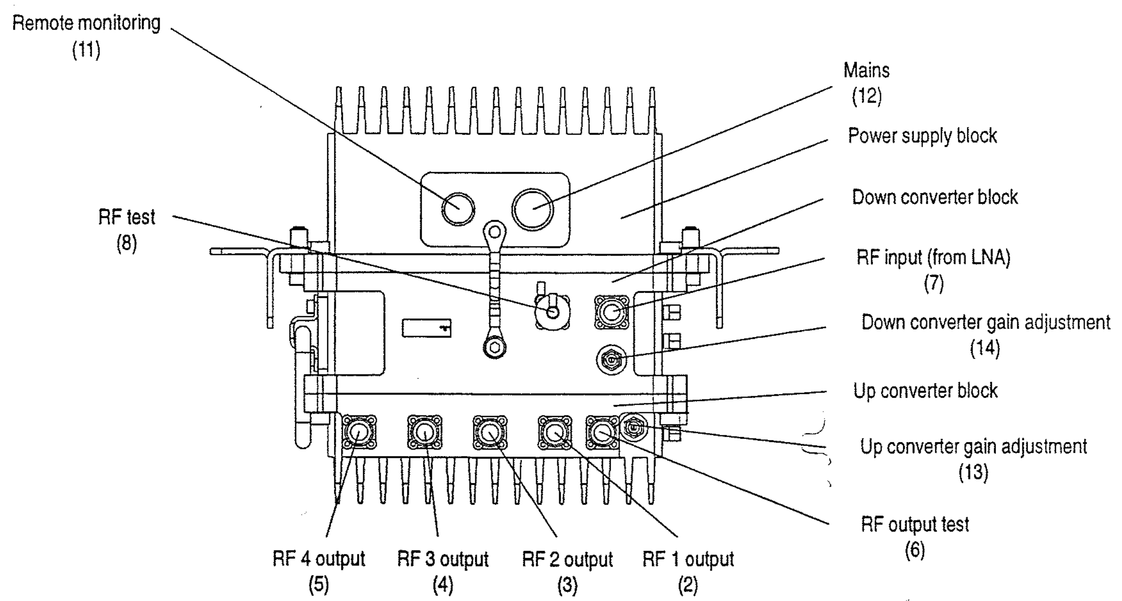


Figure 35 – Up and down converter assembly – RF, mains and monitoring ports

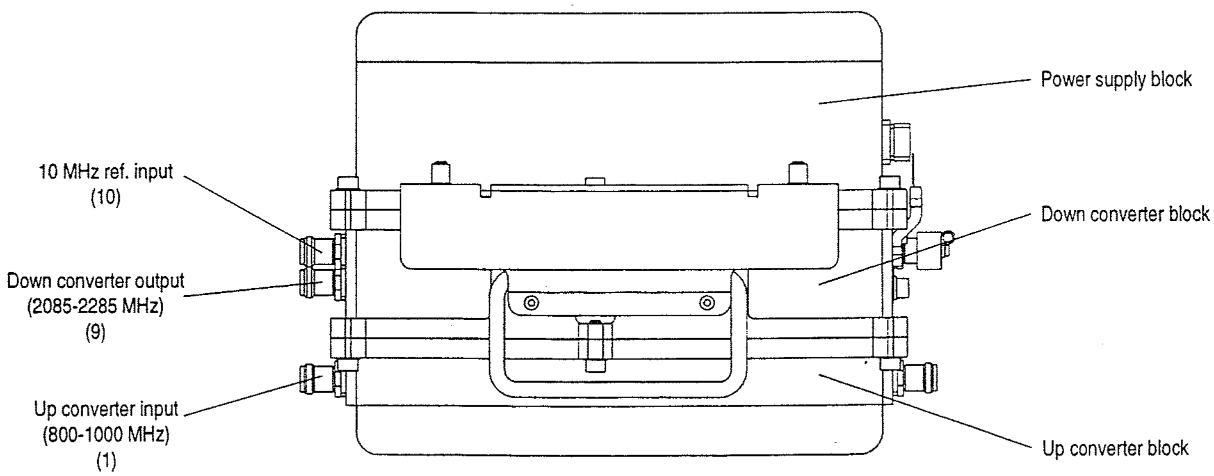


Figure 36 – Up and down converter assembly – IF ports

ALCATEL

2.5.4.1 – Operation

The operational description of the up and down converter assembly is based on the block diagram in figure 40.

UP CONVERTER

The up converter block is fitted with a single printed circuit board. The input signal (800 to 1000 MHz) is applied to a processing subsystem made up of amplifiers and temperature variable attenuators to maintain a constant transmit subsystem gain (compensating for SSPA gain variations and variations in the gain of the other components of the subsystem). An overload detection circuit at the input protects the active components of the equipment by adjusting the attenuation of the second attenuator.

A mixer receives the amplified signal and the signal from the transmit local oscillator (4250 MHz) and translates the amplified signal into the transmission band (5050-5250 MHz). The mixer is followed by:

- a bandpass filter for rejecting spurious signals and image frequencies (3250-3450 MHz),
- three amplifier stages,
- a one input/four output divider for distributing the signal to the four power amplifiers for each polarization circuit.

An RF test output is available.

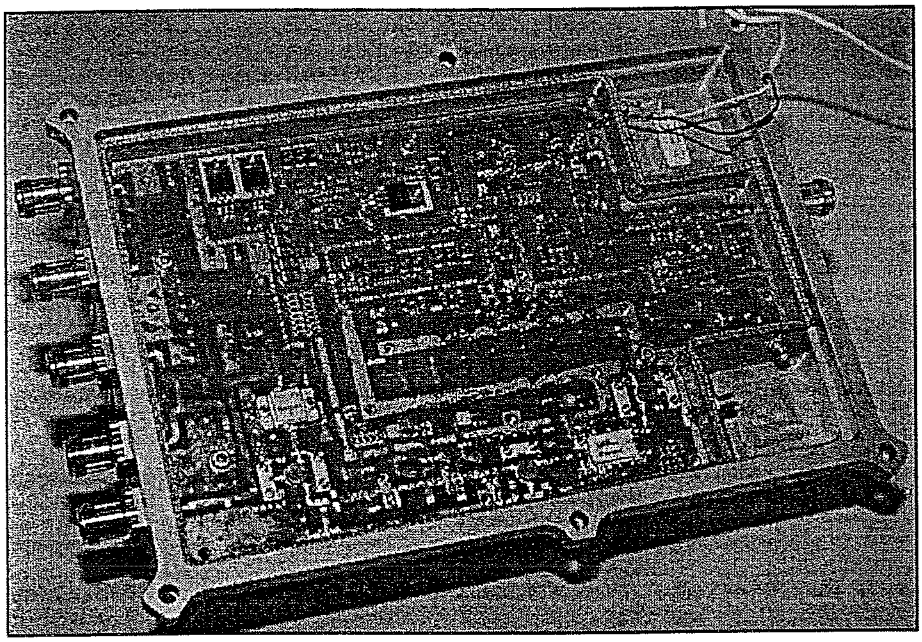


Figure 37 – Up converter block, shown open

DOWN CONVERTER BLOCK AND LOCAL OSCILLATORS

The down converter block is fitted with two printed circuit boards, one supporting the RF and conversion circuits, the second supporting the transmit and receive local oscillators. This block comprises:

- an LNA power supply, transmitted via the LNA–down converter coaxial cable. The power supply features an alarm circuit detecting excessive current consumption (> 450 mA) or consumption that is too low (< 100 mA) from the LNA, and outputting an isolated loop, open in an alarm condition.
- an RF subsystem comprising a bandpass filter, a mixer receiving the signal from the antenna and the signal from the receive local oscillator (9160 MHz),
- a subsystem amplifying the signal output from the mixing stage (2085–2285 MHz). The gain of the amplifier can be adjusted in the factory to establish the transposition stage's conversion gain value.

An RF port, at the input of the down converter block, can be used to inject a test signal.

Each of the local oscillators – transmit and receive – is based on a dielectric resonator oscillator (DRO), frequency stabilized by a phase locked loop. To reduce the comparison frequency, the frequency from the DRO is mixed with an auxiliary frequency which differs from it by 10 MHz (the comparison frequency value). This auxiliary frequency is made up of a harmonic of the 90 MHz reference frequency generated locally. The reference used for the comparison is a 10 MHz frequency created from the 90 MHz reference.

The 90 MHz reference oscillator is based on a VCXO that is slaved, via a phase locked loop, on the external 10 MHz reference frequency. this frequency is distributed to both up and down converter blocks. The same applies for the 10 MHz frequency, obtained by dividing the 90 MHz frequency by nine.

Each local oscillator, and the 90 MHz reference oscillator, has an alarm circuit detecting any drift in its phase locked loop. This circuit opens an isolated loop to signal an alarm condition.

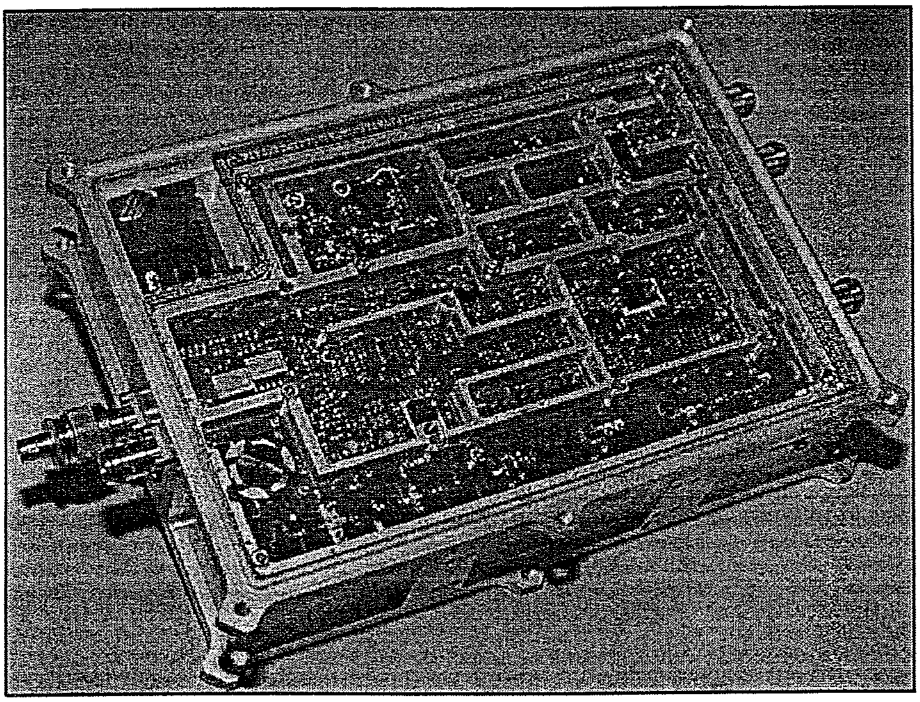


Figure 38 – Down converter block shown open (Converter)

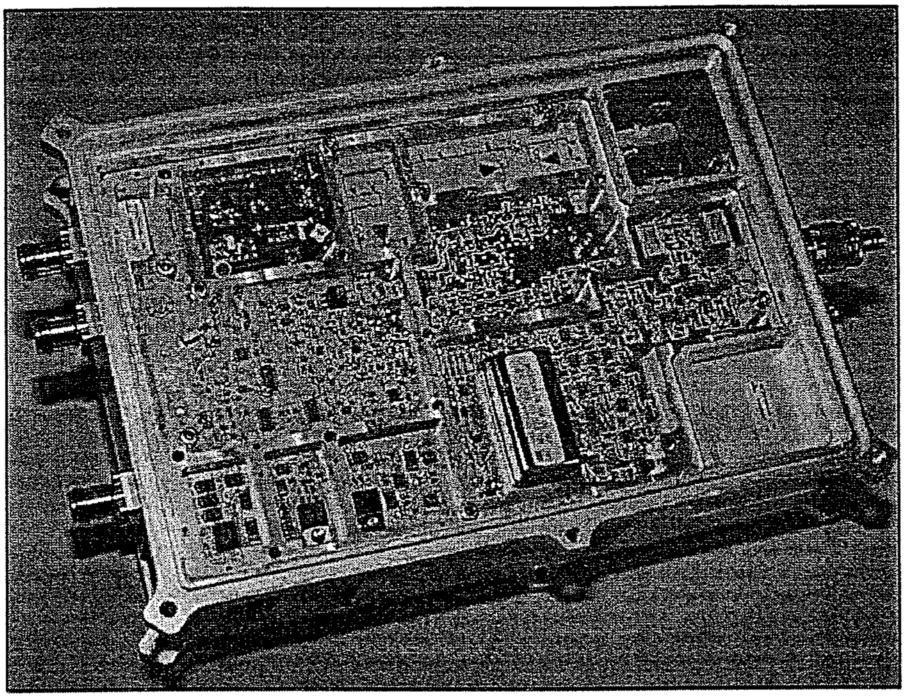


Figure 39 – Down converter block, shown open (LO)

POWER SUPPLY

The power supply module receives mains voltage and, from this, generates the regulated 12 V DC voltage required by the transposition blocks.

It also receives the alarm loops from the local oscillators and the LNA power supply, which it sends to the remote management connector (loops open in alarm condition).

A thermal contact enables heater plates in the transposition units when the internal temperature is between approximately –10° and +5°C.

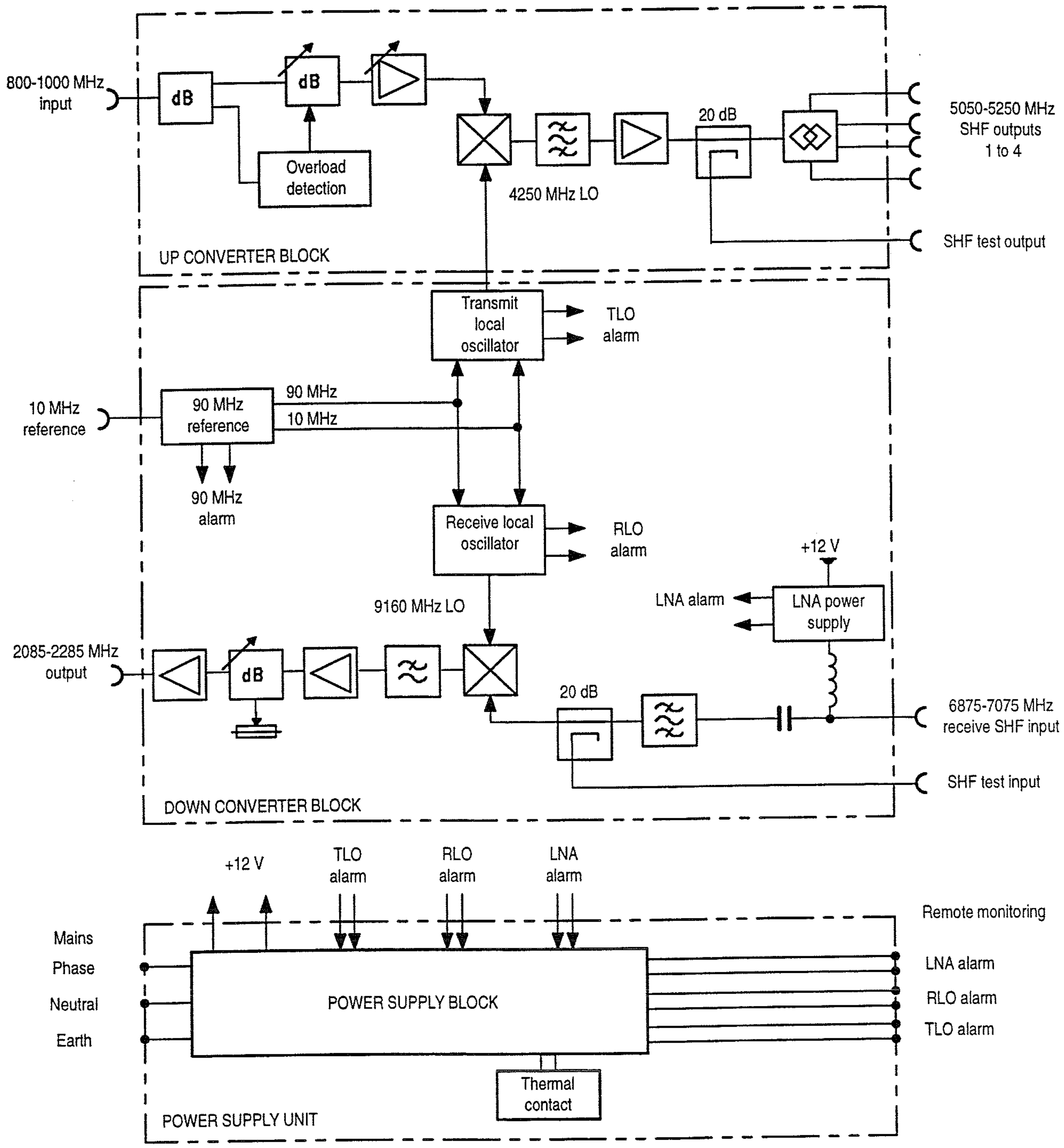


Figure 40 – Functional block diagram

2.5.4.2 – Configuration

Not applicable.

2.5.4.3 – Ports and controls

ITEM (Fig. 35 & 36)	COMPONENT	DESCRIPTION
1	Female N connector	Up converter input (800-1000 MHz)
2	Female N connector	Up converter RF output (1)
3	Female N connector	Up converter RF ouptut (2)
4	Female N connector	Up converter RF output (3)
5	Female N connector	Up converter RF output (4)
6	Female N connector	Up converter RF test output
7	Female N connector	Down converter RF input
8	Female N connector	RF test input (at the down converter input)
9	Female N connector	Down converter output (2085-2285 MHz)
10	Female N connector	10 MHz reference input
11	Female 6–way HE301 connector	Remote monitoring (isolated alarm loop output)
12	Male 3–way HE301 connector	Mains input
13	Potentiometer	Up converter gain adjustment
14	Potentiometer	Down converter gain adjustment

2.5.4.4 – Connections

MAINS POWER CONNECTOR

PIN	SIGNAL	DESCRIPTION
A	–	Phase
B	–	Neutral
C	–	Earth

REMOTE INDICATION CONNECTOR

PIN	SIGNAL	DESCRIPTION
A	–	LNA alarm relay common contact
B	–	LNa alarm relay make contact
C	–	Down converter alarm relay common contact

PIN	SIGNAL	DESCRIPTION
D	–	Down converter alarm relay make contact
E	–	Up converter alarm relay common contact
F	–	Up converter alarm relay make contact

2.5.4.5 – Specifications

UP CONVERTER

Input frequency	800 to 1000 MHz
Output frequency	5050 to 5250 MHz
Conversion gain (at 25°C)	36.5 dB (adjustable according to the gradients due to the coaxial cables)
Point at 1 dB compression • at 25°C • in the temperature range	 > 30.5 dBm > 29.5 dBm
Third order intercept point	> 37 dBm in the temperature range
Phase balance	< ± 2° on the four outputs
Amplitude balance	< ± 0.5 dB on the four outputs

DOWN CONVERTER

Input frequency	6075 to 7075 MHz
Output frequency	2085 to 2285 MHz
Conversion gain (at 25°C)	15.5 dB (adjustable)
Point at 1 dB compression	> 25 dBm
Third order intercept point	> 34 dBm
Image frequency rejection	> 50 dB

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2.5.5 – Combiner – GSG 501

The combiner incorporates:

- the couplers needed to combine the output signals from the four power amplifiers of each polarization,
- the measurement couplers needed for the various measurements taken at the power amplifier output,
- the power load for receiving output power from the amplifier when unconnected to the antenna.

As figure 41 shows, it is associated with:

- a set of waveguides for linking:
  - the combiner and the antenna/load switch,
  - the power load and the antenna/load switch,
  - the antenna/load switch and the antenna multiplexer,
- a waveguide form antenna/load switch, electrically controlled.

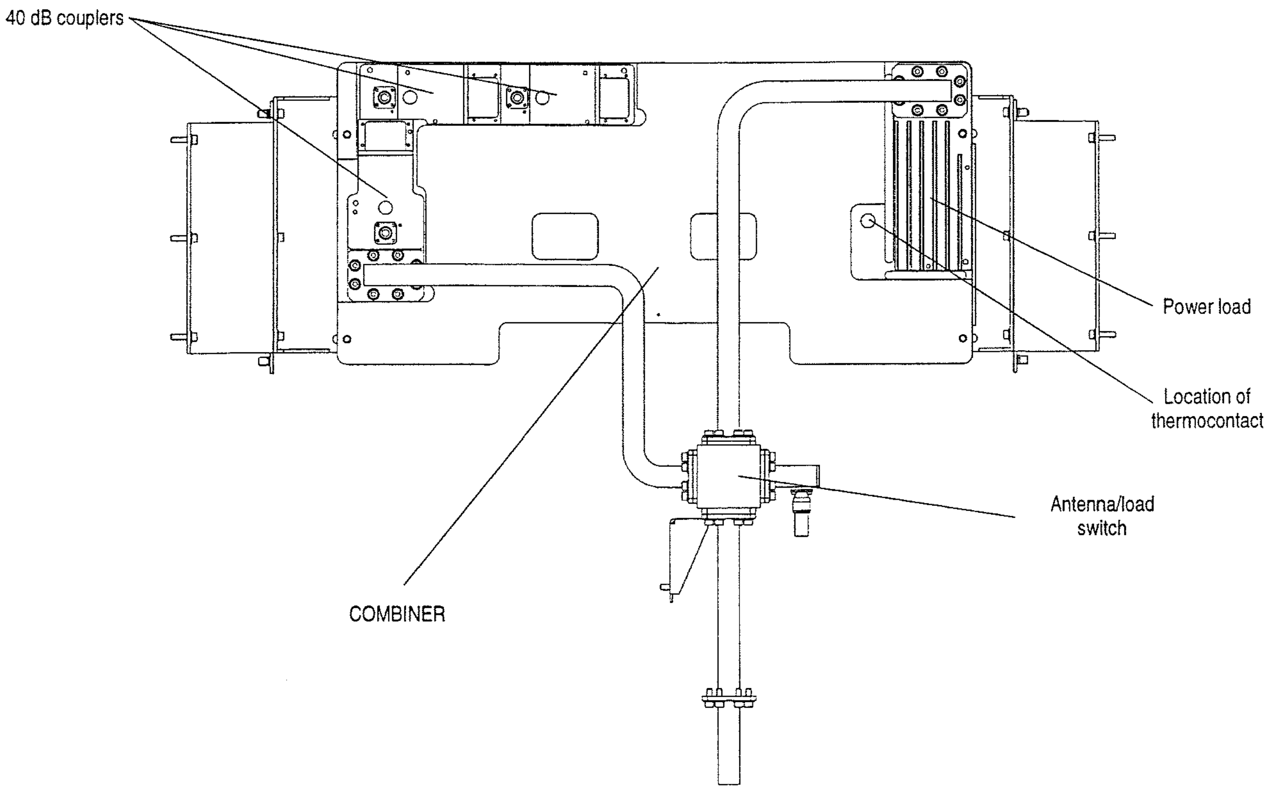


Figure 41 – Combiner and associated equipment

2.5.5.1 – Operation

The operation of the combiner can be worked out from the functional block diagram in figure 42.

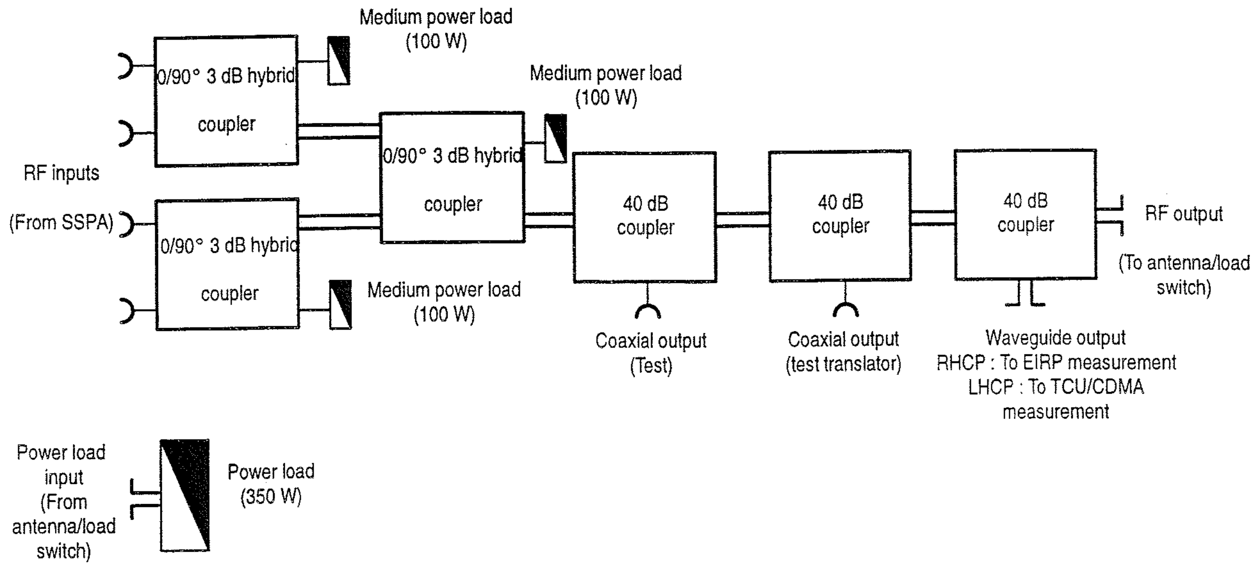


Figure 42 – Functional block diagram of the combiner

The signals from the SSPAs are combined by two hybrid 3 dB couplers, one output of which is linked to a medium power decoupling load (100 W).

Three 40 dB couplers, fitted with waveguide/coaxial adapters are located at the output of the combiner to provide three measurement ports. The combiner output is by waveguide.

The power load is also fitted with a waveguide input.

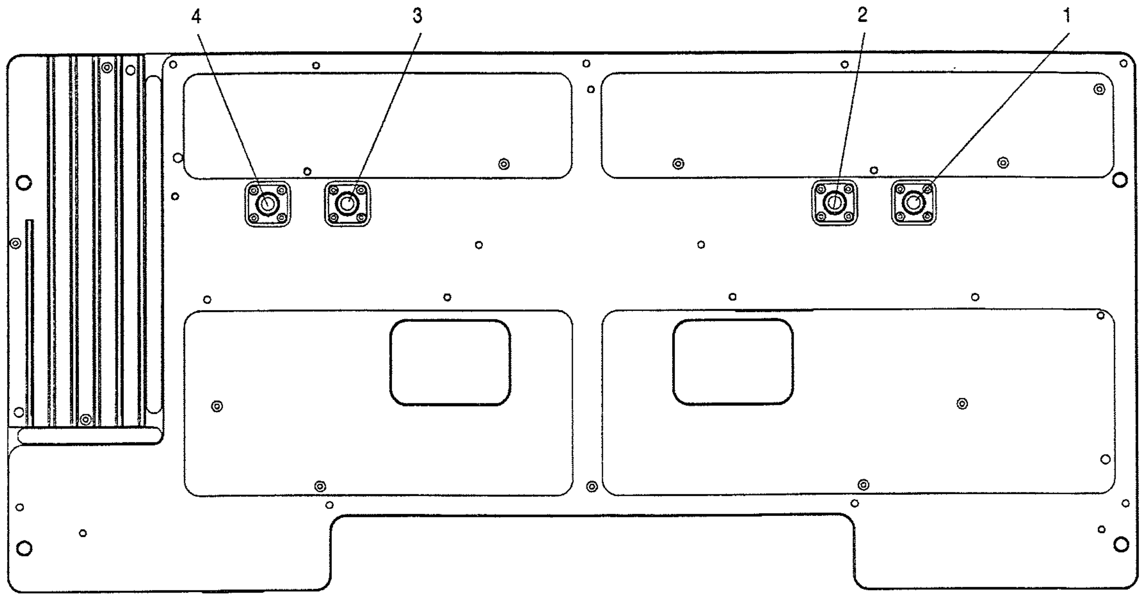
An alarm generated by a thermal contact that operates at approximately 145° protects the load against abnormally high temperatures.

All these components are incorporated in a black sealed housing.

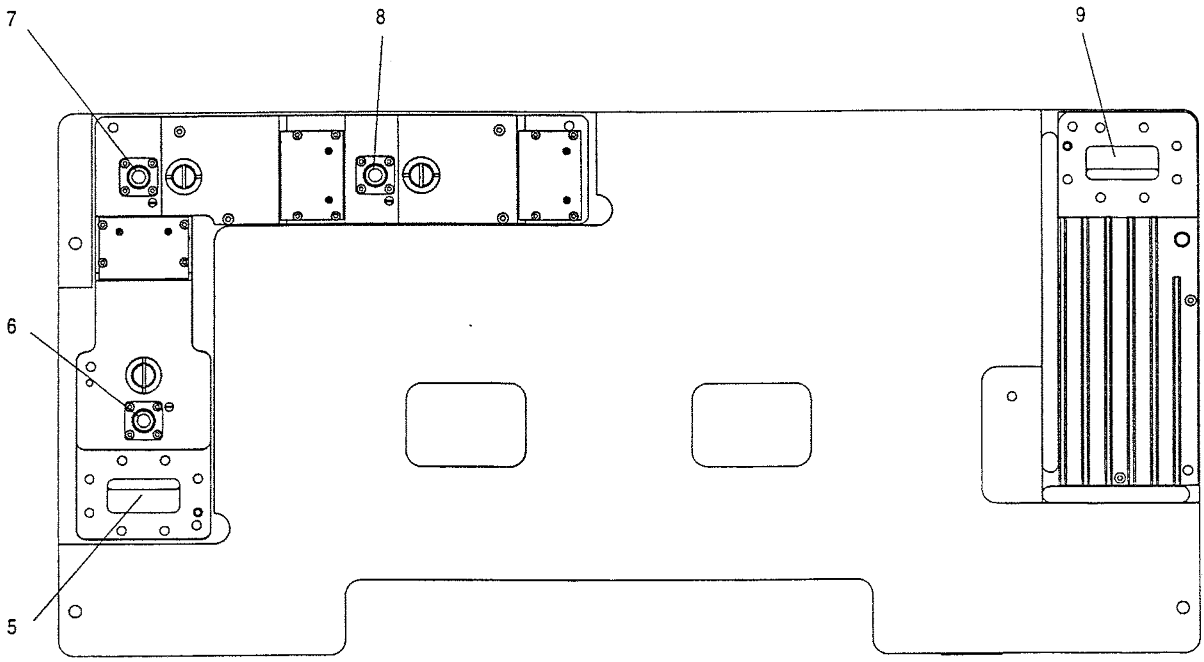
2.5.5.2 – Configuration

Not applicable.

2.5.5.3 – Ports



Rear view (without power load)



Front view

Figure 43 – Combiner

In the table below, the reference for the SSPA position is given from the combiner front view (the side supporting the RF output and power load input ports).

ITEM (Fig. 43)	COMPONENT	DESCRIPTION
1	Female N coaxial connector	Lefthand external SSPA RF input
2	Female N coaxial connector	Lefthand internal SSPA RF input
3	Female N coaxial connector	Righthand internal SSPA RF input
4	Female N coaxial connector	Righthand internal SSPA RF input
5	CPR 187 flange	Combiner output (to antenna/load switch)
6	Female N coaxial connector	40 dB coupler output to TCU/CDMA filter (LHCP) or EIRP measurement filters (RHCP)
7	Female N coaxial connector	40 dB coupler output to test translator (Not used)
8	Female N coaxial connector	40 dB coupler output (test)
9	CPR 187 flange	Power load input (from antenna/load switch)

2.5.5.4 – Specifications

COMBINER

Frequency band	5050-5250 MHz
SWR	< 1.2 (20.8 dB) (Exemption accepted if <1.3 (17 dB) for one of the four ports)
Coupling losses	–6.25 dB ± 0.4 dB
Decoupling between ports	> 20 dB
Phase difference (0, –90 and –180°)	± 2°

POWER LOAD

Frequency band	5050-5250 MHz
SWR	< 1.2 (20.8 dB) (Exemption accepted if <1.3 (17 dB))
Power accepted	350 W

TRANSMIT TEST COUPLERS

SWR at the waveguide ports	< 1.2 (20.8 dB)
SWR at the coaxial ports	< 1.2 (20.8 dB)
Coupling value at 5150 MHz	40 dB ± 0.1 dB
Coupling variation	± 0.2 dB

2.5.6 – TCU/CDMA filter unit

The TCU/CDMA filter unit comprises an enclosure with a heater plate maintaining a temperature of 50°C ± 10°C, limiting frequency drift to ± 0.2 MHz. This unit contains:

- a set of two filters made up of invar cavities, the couplings and transmission bands of which can be adjusted by mechanical components,
- three milliwattmeter probes (TCU and CDMA LHCP, EIRP RHCP).

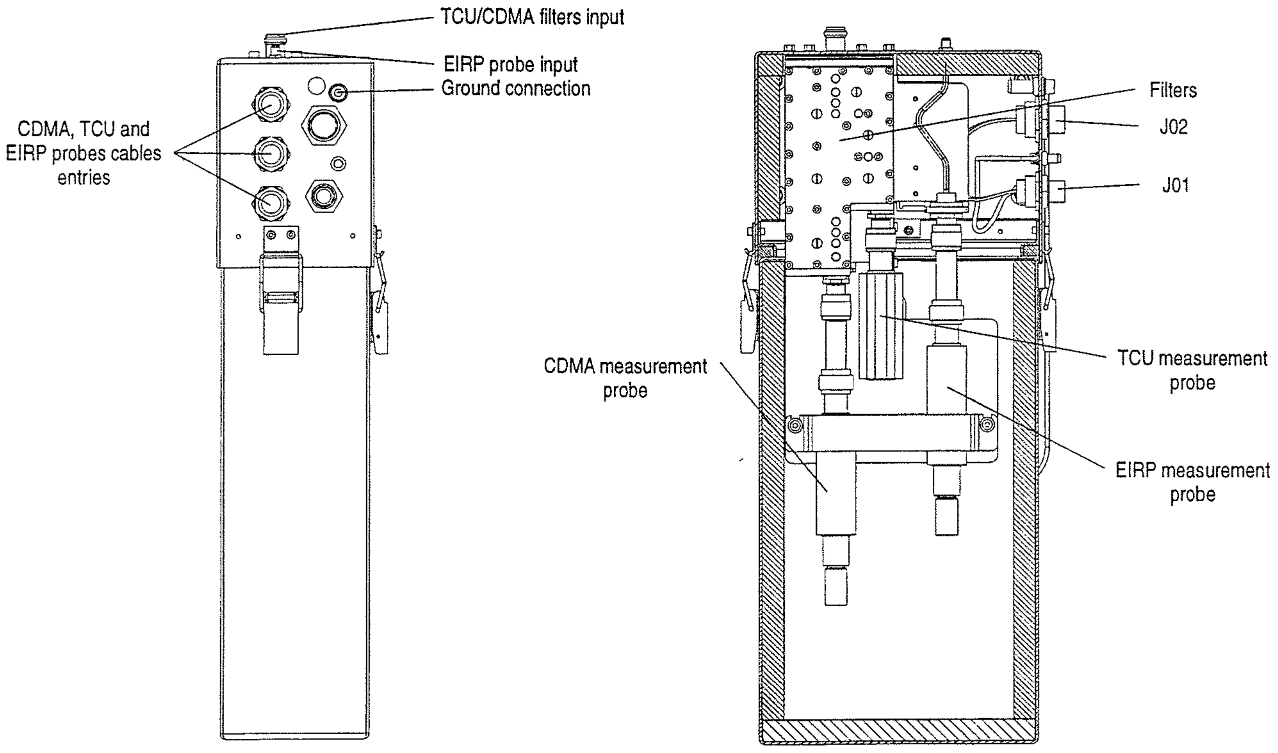


Figure 44 – TCU/CDMA filter unit

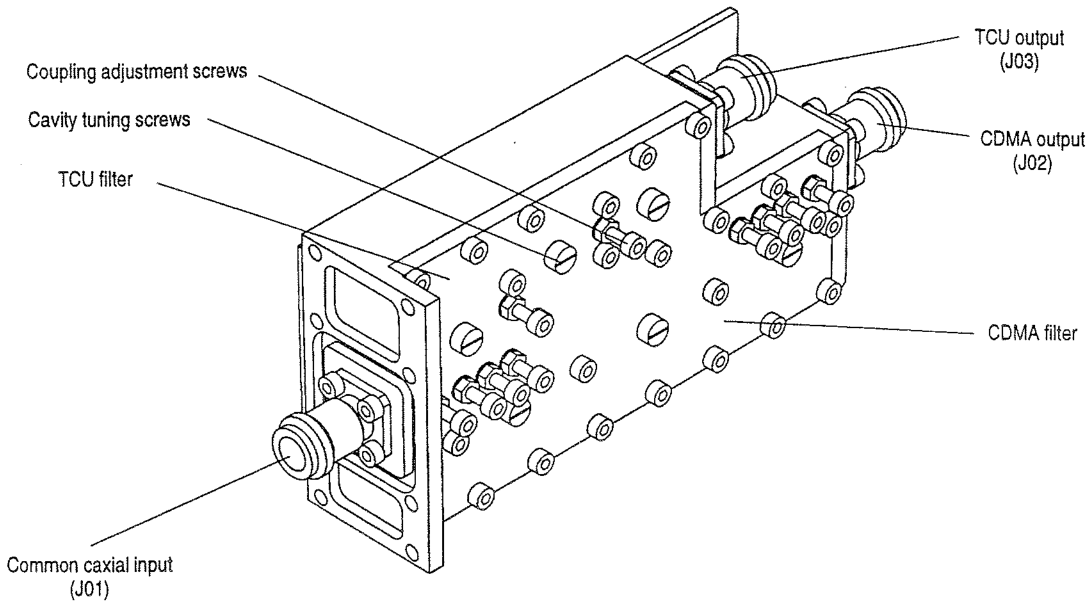


Figure 45 – CDMA and TCU filters

Figure 46 is a diagram of the temperature regulation system.

The heater plate is powered via J02 (pins A and B) while contact S01 is closed, in other words between 40 and 60°C.

An alarm is generated at J01 (loop J01–A/B open) when the internal temperature of the unit is below 30°C or above 70°C.

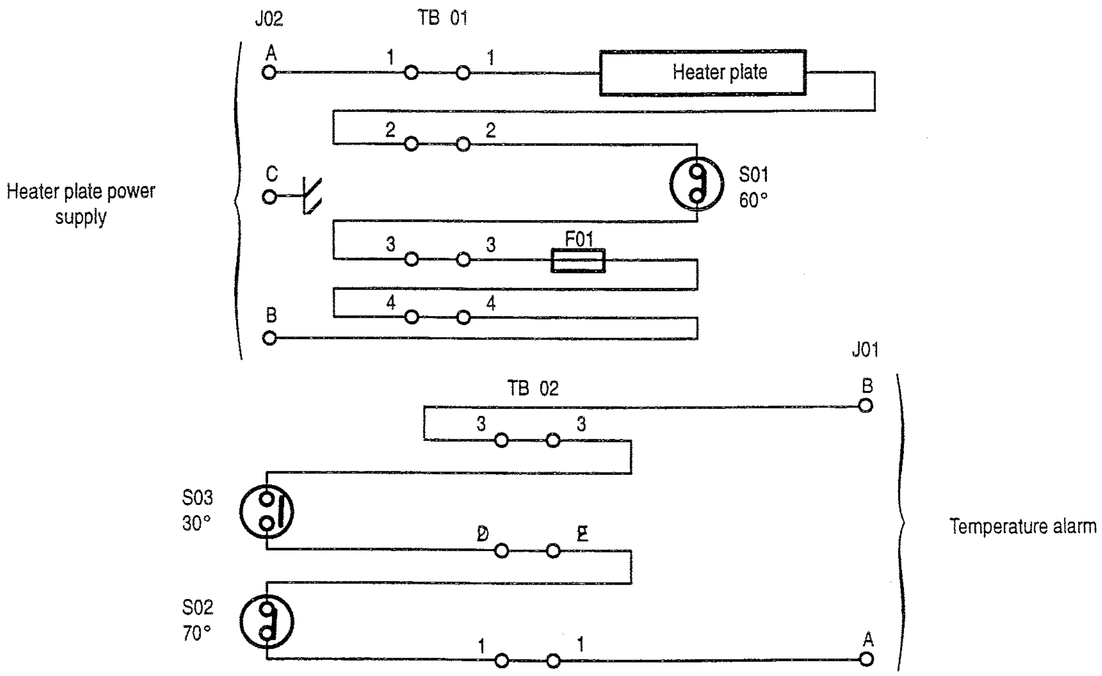


Figure 46 – Temperature regulation

The positions of the TBs and thermal contacts are given in figure 47 :

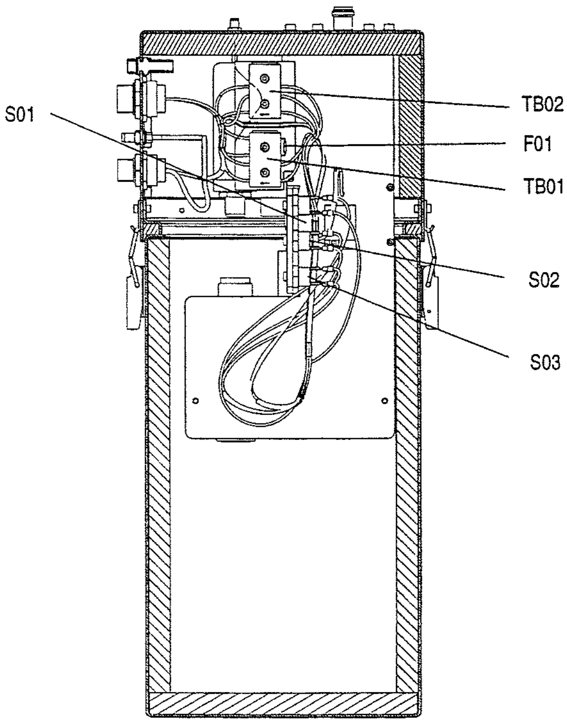


Figure 47 – Positioning of TBs and thermal contacts

2.5.6.1 – Configuration

Not applicable.

2.5.6.2 – Ports

ITEM	COMPONENT	DESCRIPTION
J01 (filter)	Female N connector	Input common to both filters
J01 (box)	Male six–way HE301 circular connector	Unit temperature alarm loop
J02 (box)	Female three–way HE301 circular connector	Unit heater plate power supply

2.5.6.3 – Connections

CONNECTOR J01

PIN	SIGNAL	DESCRIPTION
A	–	Isolated loop, open in alarm condition
B	–	
C to F	–	–

CONNECTOR J02

PIN	SIGNAL	DESCRIPTION
A	–	Phase
B	–	Neutral
C	–	Earth

2.5.6.4 – Specifications

CDMA FILTER

Frequency band	5097 to 5250 MHz (153 MHz)
Number of poles	6
Zero	1.065/B/2 MHz
Mid–band insertion loss	0.2 dB approx
Insertion loss at f_0	$\leqslant$ 0.5 dB
SWR	$\leqslant$ 1.2
5091-5092 MHz band rejection	$\geqslant$ 25 dB

TCU FILTER

Frequency band	5091 to 5092 MHz (3 MHz)
Number of poles	3
Bandwidth	3 MHz
Mid–band insertion loss	3 dB approx
Insertion loss at f_0	$\leqslant$ 2.5 dB
SWR	$\leqslant$ 1.2
5104-5241 MHz band rejection	$\geqslant$ 25 dB

2.5.7 – "Outdoor" rack

The "outdoor" rack (Figure 48) contains the local management equipment and other equipment. This sealed rack is made of weatherproof materials. It stands 26 U high and is wide enough to accommodate two 19" subracks side by side. It features a heating system and a redundant cooling system, comprising two air coolers. Two doors at the front and two at the rear (these two support the air coolers) provide ready access to the wiring and other equipment. Rack safety is covered by:

– an optical smoke detector, located inside the rack, in the top part.

– an electromagnetic switch on each door, generating an alarm when any door is opened.

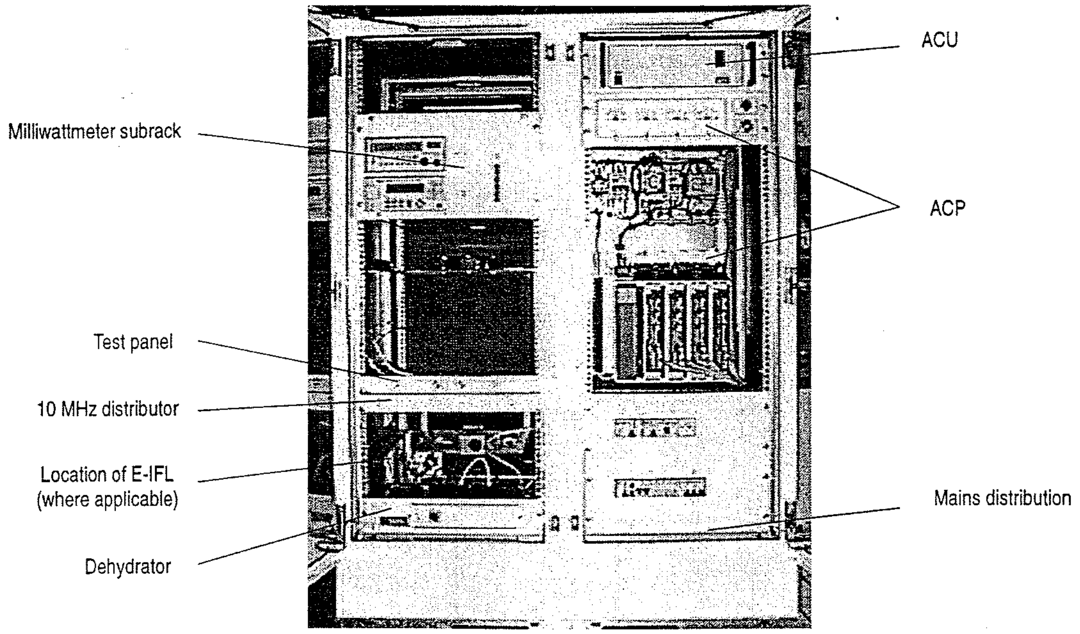


Figure 48 – "Outdoor" rack

2.5.7.1 – Operation

The equipment of the "outdoor" rack, apart from the cooling system, is all described in detail in this manual.

The two coolers operate in "MAIN/AUXILIARY" mode. This mode of operation is managed by the ACU via isolated loops. Every 48 hours, the mode of operation is inverted (main becomes auxiliary and vice versa).

A thermostat inside the rack ensures operation within the conditions specified in the table below:

INTERNAL TEMPERATURE	MAIN COOLER	AUXILIARY COOLER
$T < 25°C$	Off	Off
$25°C \leqslant T < 34°C$	Evaporator fan in service	Off

INTERNAL TEMPERATURE	MAIN COOLER	AUXILIARY COOLER
34°C ≤ T < 36°C	Evaporator fan, compressor and concensation fan in service	Off
T ≥ 36°C	Evaporator fan, compressor and condensation fan in service	Evaporator fan, compressor and condensation fan in service

If the main cooler fails, the backup cooler is automatically placed in service. In this case, the internal temperature of the rack will be 47°C in worst case environment conditions (external temperature = 55°C).

Both coolers are stopped automatically when any door of the rack is opened.

A test switch inside the rack can be used to force the two coolers to operate by short circuiting the door opening detectors.

Figure 49 is a functional block diagram of the cooling management system.

Each cooler has an isolated loop which opens in an alarm condition. This alarm, processed by the ACU, is the result of the summing of two alarms:

- opening of the cooler circuit breaker following an electrical fault,
- detection of a high temperature at the cooler output.

If on power up the temperature inside the "outdoor" rack is above the maximum threshold, the alarm is generated and remains until the temperature falls below the threshold.

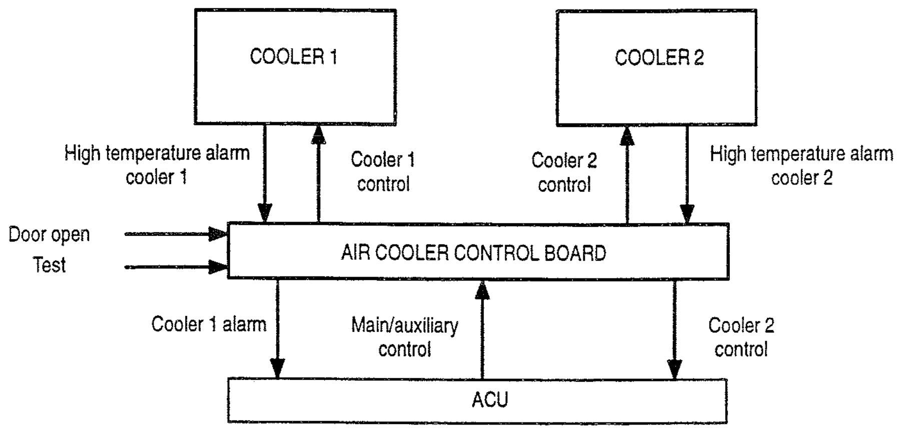


Figure 49 – Functional block diagram of the cooling system management function

The two coolers start immediately on power up but, after cut-off and restarting, the two coolers restart after a different delay (protection against short-cycles)

2.5.7.2 – Configuration

Not applicable.

2.5.7.3 – Ports

Refer to sections relative to sub-assemblies of the rack.

2.5.7.4 – Connections

Refer to sections relative to sub-assemblies of the rack.

2.5.7.5 – Specifications

Not applicable.

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2.5.8 – Outdoor cabinet mains distribution

This unit is located in the bottom right part of the cabinet. It includes all thermal breakers, contactors and fuses necessary for cabinet protection. It includes also a socket to supply an external equipment (measuring equipment for instance). The terminal board X1 is used for interconnections with equipment external to the unit.

A front view and a back view of this equipment are given on figures 50 and 51.

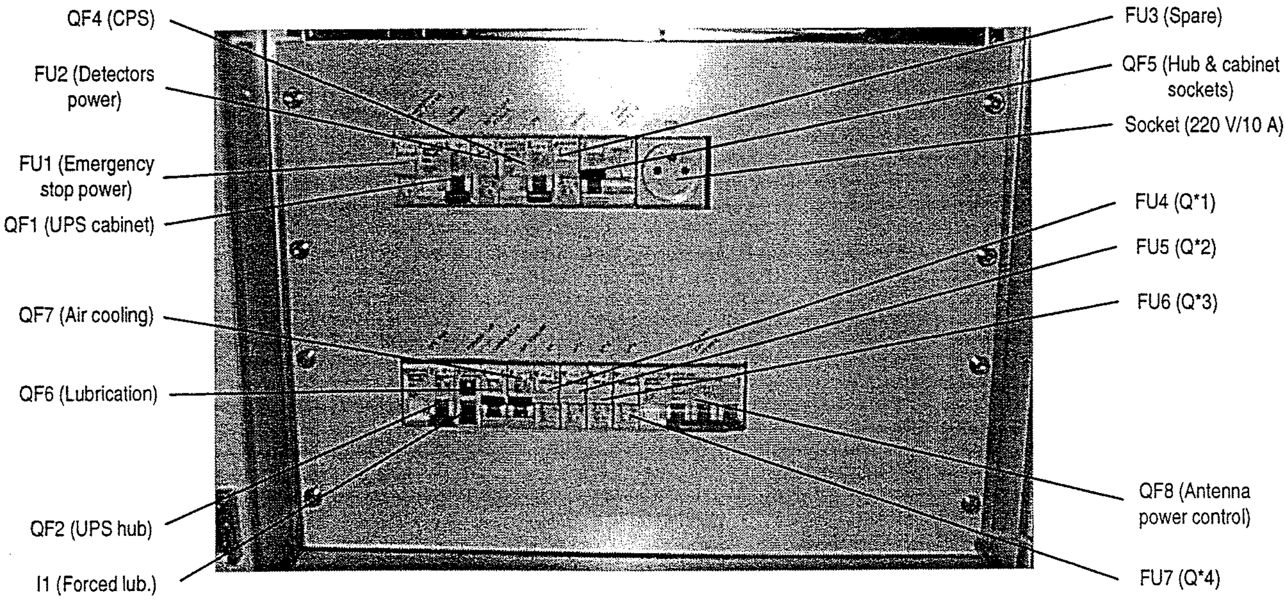

Figure 50 – Mains distribution – Front view

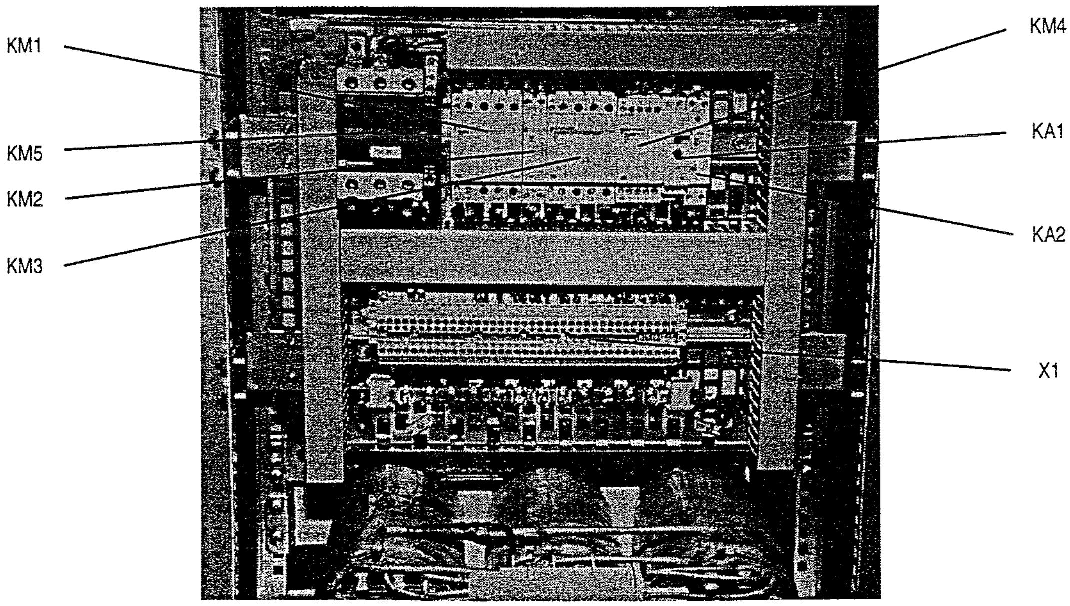

Figure 51 – Mains distribution – Rear view

The fuctions of the breakers, fuses and switches of the front panel are given by the following table :

ITEM	FUNCTION
FU1	Emergency stop power
FU2	Detectors power
FU3	Spare
FU4	Heating 1
FU5	Heating 2
FU6	Heating 3
FU7	Heating 4
I1	Azimuth crown-wheel lubrication forcing
QF1	UPS for outdoor rack
QF2	UPS for hub
QF4	CPS for outdoor rack
QF5	Hub and outdoor rack sockets
QF6	Lubrication
QF7	Air cooling
QF8	Antenna control power

2.5.8.1 – Operation

Figure 52 gives the general diagram of this unit, in its environment.

The switch I1 enables manual forcing of lubrication of the azimuth crown-wheel, necessary at commissionning of the antenna (see section 3.4.2).

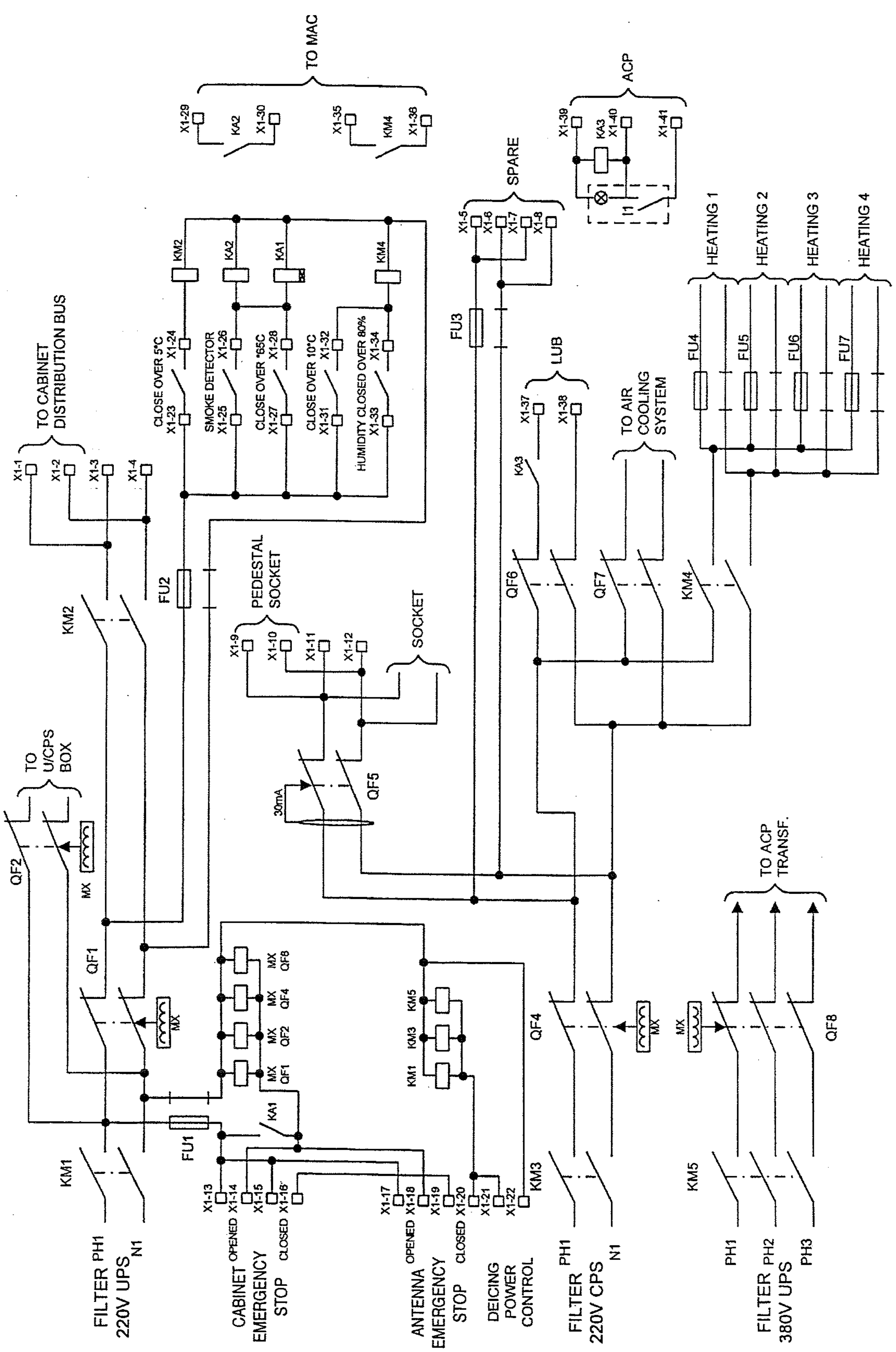

Figure 52 – Mains distribution general diagram

The outdoor rack is fitted with the following safety devices (Figure 53) :

- devices ensuring the electronic systems function in an optimal environment,
- fire detection,
- emergency shutdown system.

Equipment safety devices

When the rack is started up at temperatures of –40° C, the internal heating system is started up by the 10° C temperature sensor which closes to energize the coil of relay KM4.

When the temperature inside the rack reaches 5° C, the 5° C detector closes, enabling relay KM2 to supply power to the rack's electronic systems.

When the temperature inside the rack reaches 10° C, the 10° C sensor opens so that relay KM4 is no longer energized and the heater system is shut down.

In normal operation, if the door of the outdoor rack is opened and the relative humidity inside the rack rises above 80%, the humidity sensor closes and the heater is started up again until the relative humidity level falls below 80%.

Operation of the heater system is reported via an information loop to the MAC (Monitoring, Alarms and Control) system.

Fire detection

The outdoor rack is fitted with a fire detection system including:

- a smoke detector,
- a high temperature sensor (65° C).

If either of these problems occurs, the corresponding sensor energizes relays KA1 and KA2. Relay KA1 is subject to a time delay (which can be set manually to between 1 and 10 minutes), and feeds the remote isolating modules (MX) of breakers QF1, QF2, QF4 and QF8, tripping them out.

Service is restored by manually resetting each circuit breaker.

Emergency shutdown

The emergency shutdown system comprises two "emergency stop" switches:

- one on the antenna platform,
- one on the right side of the outdoor rack.

Both have the same effect on the system.

Each emergency stop switch is fitted with two contacts, one is normally open and the other is closed.

The normally open contacts of the two emergency stop switches are connected in series with the three coils of relays KM1 (220 V UPS), KM3 (220 V CPS) and KM5 (380 V UPS).

The normally open contacts are connected in parallel with the relay KA1 contact.

When either of the emergency stop switches is operated:

- the contact that closes trips out breakers QF1, QF2, QF4 and QF6.
- the contact that opens isolates the power supply to the coils of relays KM1, KM3 and KM5 all of which drop out.

To restore service:

- **check that breakers QF1, QF2, QF4 and QF6 are indeed tripped out. If they are not, trip the breakers concerned manually.**
- **return the emergency stop switch to the normal operating position then reset each circuit breaker.**

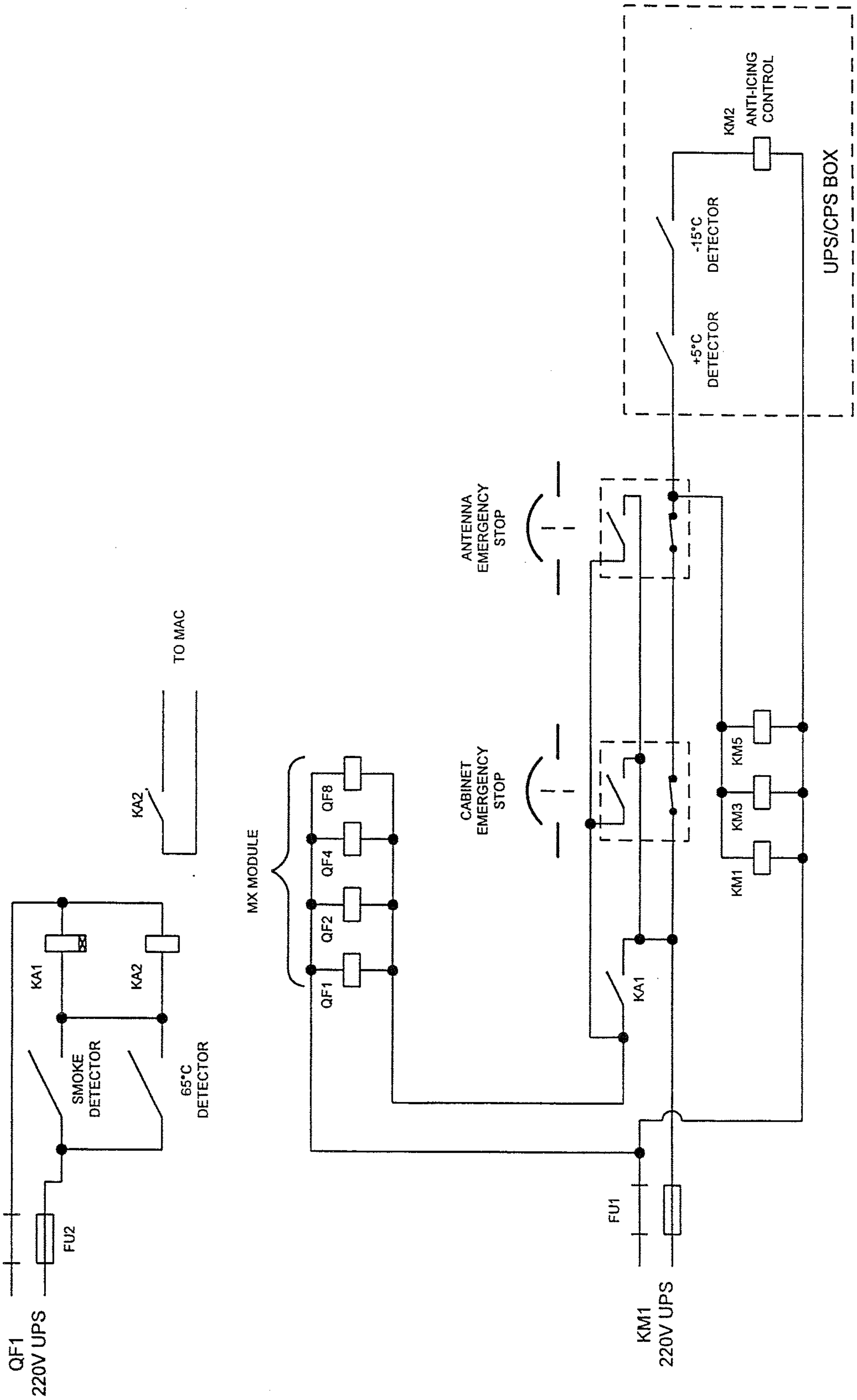

Figure 53 – Safety device diagram

2.5.8.2 – Setup

Not applicable.

2.5.8.3 – Connectors

NAME	ITEM	FUNCTION
X1	Terminal board	Links of the unit with external equipment

2.5.8.4 – Connections

TERMINAL BOARD X1

PIN	SIGNAL
1 to 4	220 V UPS to cabinet distribution bus
5–6 7–8	Spare
9–10	To pedestal socket
11–12	Spare
13–14	From cabinet emergency stop
15–16	From cabinet emergency stop
17–18	From antenna emergency stop
19–20	From antenna emergency stop
21–22	Deicing power control
23–24	From cabinet thermal contact closed over 5° C
25–26	From cabinet smoke detector
27–28	From cabinet thermal contact closed over 65° C
29–30	To monitoring & control
31–32	From cabinet thermal contact closed over 10° C
33–34	From cabinet contact closed over 80% humidity
35–36	To monitoring & control
37–38	To azimuth crown-wheel lubrication
39–40–41	To ACP (Lubrication forcing)