OPERATIONAL DESCRIPTION

FLO Repeater

CGU-20-50-100 Wrms

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1. INTELLIGENT HIGH GAIN ON-CHANNEL REPEATER (HGOCR-I)

1.1. INTRODUCTION

Intelligent High Gain On-Channel Repeaters (hereinafter HGOCR-I) are the new solution for SFN repeaters designed and manufactured by MIER COMUNICACIONES.

Traditional on-channel repeaters require to know or estimate fundamental parameters such as reception level and isolation between antennas before their installation.

The advantage of HGOCR-I is that it incorporates a global gain control that allows to install the equipment without requiring this information, therefore it offers a maximum flexibility for network planning, minimizes its incertitude and simplifies the equipment installation and commissioning.

When the HGOCR-I starts up, it automatically adapts to the environment changing conditions, therefore there is no longer need to do previous “in-field” measurements, allowing a faster and easier deployment.

The new global gain control compensates slow environment variations, whereas the new generation echo canceller takes care of fast variations, both together guarantee HGOCR-I in long term stability.

HGOCR-I offers a high immunity to medium/long term variations. As the new global gain control avoids the risk of oscillation, the output power hardly ever needs to be shut down.

1.2. OCR, HGOCR & HGOCR-I

Traditionally, before installing a conventional On-Channel Repeater (OCR) or a High Gain On-Channel Repeater (HGOCR) in a site, it is required to estimate two fundamental parameters:

- Estimated reception level (Pin), and
- Available isolation between transmission and reception antennas (I).

Once this parameters are known, system stability can be warranted by limiting the OCR / HGOCR output power as shown in the following equations:

$P_{out}(dBm) < P_{in}(dBm) + I(dB) - 10dB$, for OCR

$P_{out}(dBm) < P_{in}(dBm) + I(dB) + 10dB$, for HGOCR

Having to know these two parameters before installing the On-Channel Repeater implies a difficulty in network planning based On-Channel Repeaters. Whereas the reception level is easy to estimate using specific software for network planning, the isolation between antennas is much harder to estimate, because it depends on several factors, such like physical placement of the two antennas, distance and relative angle between antennas, site environment, weather conditions, etc. As a result, some uncertainty may arise.

A possible solution is to measure on-site this two parameters once the antennas have been installed, but this is an expensive and low efficient approach. Moreover, it requires very specific instruments to measure the isolation between antennas.

Intelligent HGOCR (hereinafter HGOCR-I) allows to overcome this obstacle, offering the following advantages:

- It provides maximum flexibility during network planning phase,
- It simplifies equipment turning-gon,
- It makes the HGOCR-I independent from changing reception level and/or isolation conditions, guarantying its long term stability.

This is achieved combining the new generation active echo canceller system and a smart control system that adapts overall gain to reception level and isolation between antennas conditions.

1.3. HGOCR-I PHILOSOPHY

HGOCR-I is continuously performing a real-time monitoring of the operating gain margin (GM). Therefore HGOCR-I can increase or reduce its gain at any time that the echo power level exceeds the previously defined thresholds (these thresholds are user-programmable settings).

So, HGOCR-I provides a global gain control system, depending on the existing echo power level.

This global gain control system (that depends on the echo power level) is slow enough to let the fast Gain Margin variations be absorbed by the active echo canceller system, whereas the long-term slow variations, are compensated by the HGOCR-I itself.

When the HGOCR-I is started up, an initial minimum gain condition is loaded, so minimum output power level is obtained. The available output power level is gradually increased until it reaches on of the two following conditions:

1) Gain Margin limit specified by the user has been reached, or:
2) Maximum output power level specified by the user has been reached (usually equal to HGOCR-I nominal power)

The HGOCR-I avoids the need to do previous isolation measurement, simplifying the installation and turning-on process.

User configurable parameters, regarding the gain control system, are:

- **P max:** Maximum output power level (usually equal to nominal power)
- **P min:** Minimum output power level
- **GM min:** Minimum admissible Gain (Maximum admissible echo power level)
- **Hysth-DN:** lower hystheresis threshold
- **Hysth-UP:** upper hystheresis threshold

Intelligent gain control will start working as soon as the gain margin exceeds any of the specified limits:

- If ($GM < GM_{min} – Hysth_{DN}$) and ($P_{out} > P_{min}$) $\rightarrow$ Gain will be decreased
- If ($GM > GM_{min} + Hysth_{UP}$) and ($P_{out} < P_{max}$) $\rightarrow$ Gain will be increased

HGOCR-I advantages vs. HGOCR:

- It eases network planning and minimize its incertitude
- It simplifies the On-channel repeater start up
- It improves immunity towards the medium-term and long-term variations of Gain Margin conditions (i.e. reception level or isolation between antennas variations) → Minimizes service shutdowns, then improving system availability.

1.4. OPERATING EXAMPLES

Figure 1 shows a simulation of a 50W (47dBm) HGOCR behaviour when reception level and/or isolation between antennas conditions are changing along time.

As shown in the Gain Margin figure, the limit GM=-10dB (echo power level 10dB higher that received signal power level) is highlighted, since when GM exceeds this value the system stability is not guaranteed and shutdowns of the transmitted signal may occur. It can be seen that under these conditions, service is interrupted approximately a 10% of the time.

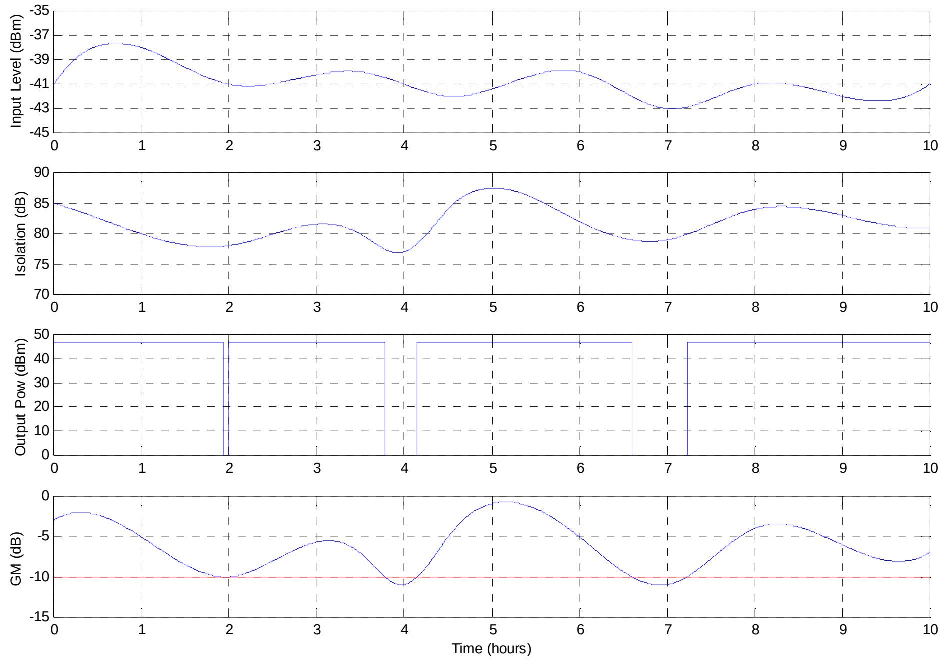

Figure 1 – HGOCR simulation

Figure 2 shows a simulation of HGOCR-I behaviour in the same changing conditions of reception level and isolation between antennas.

The parameters used in this simulation are:

P_{max} = 47dBm
P_{min} = 37dBm
GM_{min} = -8dB
Hysth-DN = 1dB
Hysth-UP = 1dB

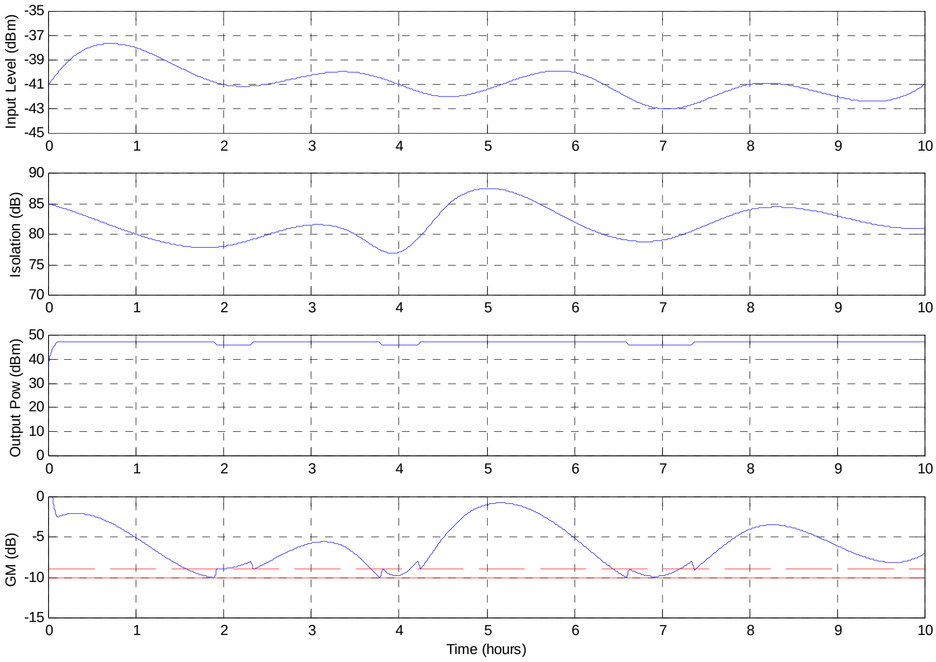

Figure 2 - HGOCR-I simulation

Notice that, in this case, HGOCR-I gain (and therefore output power level) adapts to reception level conditions and isolation between antennas conditions to keep the average value of gain margin at –8dB (specified value for the simulation). As a result, the continuity of service is guaranteed for a 100% of the time.

The following figures show the same simulation for a HGOCR (Figure 3) and a HGOCR-I (Figure 4), but in this case the isolation presents instantaneous variations added to long term variations. These instantaneous variations should appear in some specific environments (i.e. an urban environment with a multitude of vehicles circulating in the site proximity).

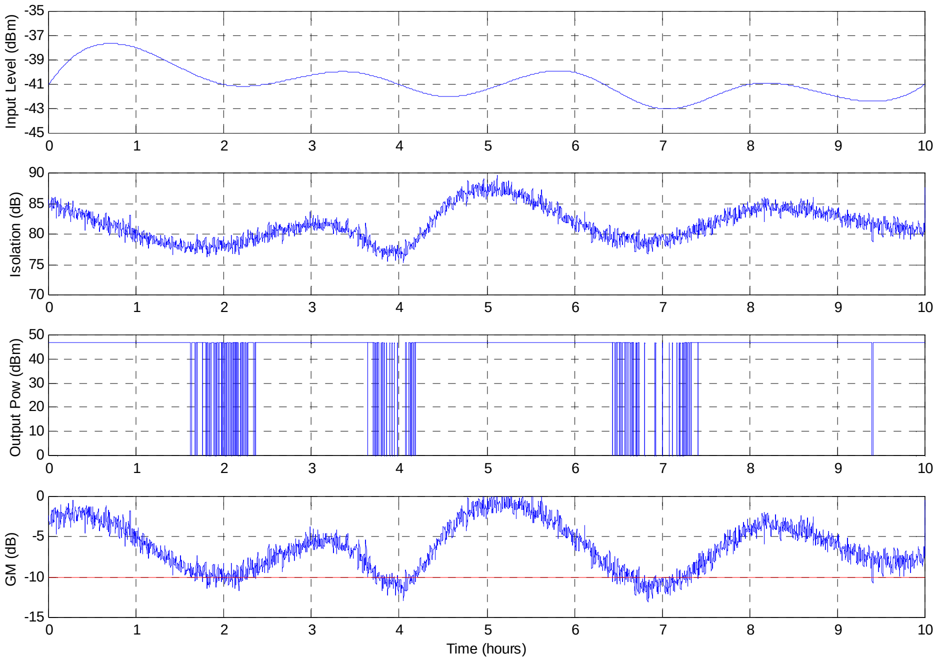

Figure 3 –HGOCR simulation, isolation presents instantaneous variations

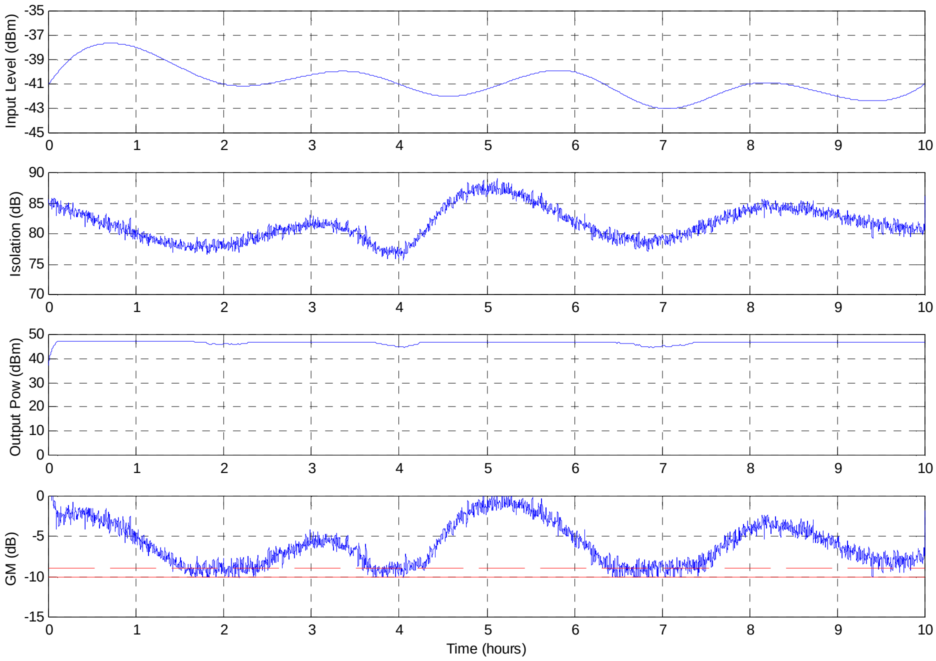

Figure 4 - HGOCR-I simulation, isolation presents instantaneous variations

HGOCR-I features fast isolation variations absorption by the echo canceller, whereas slow variations are absorbed by the HGOCR-I intelligent gain control.

1.5. HGOCR-I CONFIGURABLE PARAMETERS THROUGH THE FRONT PANEL

The following menu levels have been added inside the "Service Menu":

Service Menu
└── HGOCR Control
  ├── Smart AGC (Section 1.5.1)
  ├── IF Stages (Section 1.5.2)
  └── Echo Canceller (Section 1.5.3)

1.5.1. "SMART AGC" MENU:

Parameter	Values	Default setting	Description
Active	{Off, On}	On	When the Smart AGC is activated, the HGOCR-I will continually adapt its output power in order to keep the Gain Margin within the specified working range
Pmax	[0 to –20] dB, 1dB step	0dB	Maximum output power (Offset, referred to the equipment's nominal output power)
Pmin	[0 to –20] dB, 1dB step	-10dB	Minimum output power (Offset, referred to the equipment's nominal output power)
GM min	[-3 to –8] dB, 1dB step	-8dB	Minimum operating Gain Margin
Hysth-UP	[1 to 3] dB, 1dB step	1 dB	Hystheresis above GM min (threshold for the HGOCR-I to increase its output power)
Hysth-DN	[1 to 3] dB, 1dB step	2 dB	Hystheresis below GM min (threshold for the HGOCR-I to decrease its output power)

Note:

- Although Pmax and Pmin are prepared to accept values as low as –20dB, the current HGOCR-I hardware might not work properly for values lower than –12dB. We do not recommend to exceed the –12dB limit with the current HGOCR-I.

1.5.2. ”IF STAGES” MENU:

Parameter	**Values**	**Default setting**	**Description**
Bandwidth	{5, 5, 7, 8} MHz	5.55 MHz	Operating bandwidth
Coarse delay	[0 ... 511Δ] Δ steps	0 ns	Added input-output delay (coarse steps)
Fine delay	[0 ... Δ - 6.9] ns, 6.9ns steps	0 ns	Added input-output delay (fine steps)

being:

Δ = 124.5ns, 7MHz & 8MHz BW modes

Δ = 166ns, 5MHz & 6MHz BW modes

Note:

- The overall added delay will be the sum of both the coarse and fine delay values that have been set

1.5.3. *"ECHO CANCELLER" MENU:*

Parameter	Values	Default setting	Description
Active	{Yes, No}	Yes	Enables or disables the echo canceller
Temp. window	[MinΔ ... MaxΔ] ns	MaxΔ	Echo canceller's temporal window length
Antenna delay	[0 ... LimitΔ] Δ steps	0 ns	Input and output cable delay compensation. Compensates the delay caused by the cables, filters, etc. inserted in the path between the HGOCR and both the receiving and transmitting antennas
Tracking	{Slow, Standard, Fast, Very fast, Maximum}	Standard	Tracking speed for the Echo Canceller's algorithm.
Split pos.	{None, [MinΔ ... MaxΔ]}, Δ steps	None	Splitting position for the temporal window
Split delay	[0 ... LimitΔ] Δ steps	0 ns	Added delay at the splitting position (such delay is the temporal gap between the two cancellation window segments)

being:

Δ = 124.5ns, 7MHz & 8MHz BW modes

Δ = 166ns, 5MHz & 6MHz BW modes

2. GENERAL DESCRIPTION

The CGU20-50-100/HG FLO gap-filler unit is described in this manual. This unit is included in the COMPACT series of Mier Comunicaciones, S.A. The main characteristics of the COMPACT series are:

- Compact size.
- Valid for analogue as well as digital television. Migration through a minimal number of changes.
- Admits great number of configurations within the same electromechanical base.
- Possibility of frequency agility.
- Class AB driver and class AB output power amplifier, solid state and wide band. BIV/V output frequency range with no need of amplifiers adjustment when changing channel.
- Excellent performance qualities and long term reliability due to the technology used, SMD fitting and the control system.
- Control system based on a microprocessor which allows self-diagnosis and local, as well as remote, decision taking. It allows remote and local control and monitoring through “LCD” and RS232 interface or Ethernet.
- High modularity, easy maintenance.
- IF filtering through “SAW” technology.
- Synthesised local oscillator with very low phase noise. Easy channel switching. High stability options.
- IF “AGC” and output “ RF AGC”.
- Equipment self-protection against over temperature and reflections.
- “EMC” standards compliance.

The gap-filler units contained in the COMPACT series have also the following specific characteristics:

- 4 poles input filter inside the unit.
- Single local oscillator that allows completely coherent frequency conversion for perfect synchronisation in SFN networks.
- Adaptative echo cancellation performed by digital signal processing in the High Gain models (CGU20-50-100/HG FLO) which increases the Gain Margin in 15dB.
- IF, pre-amplification, post-amplification, LO, 10Mhz samples accessible in back and front panel.
- Possibility of external 10Mhz reference locking system that allows to lock the external frequency and have the internal oscillator phase-noise mask.

3. UNIT COMPOSITION

The Table 1 below shows the modules and the boards belonging to the CGU20-50-100/HG FLO equipment described in this manual. In grey optional elements.

ASSEMBLY ELEMENT	CGU20-50-100/HG FLO
Reference oscillator:	84A0270-11
Down converter: *Converter board*	80A0843 *80S0843*
Up converter: *Converter board* *DDS Synthesizer* *Display*	80A0780-10 *80S0662-14* *80A0554-13* *80S0668-10*
Amplifiers: Driver Amplifier Power Amplifier (100W) Power Amplifier (20W-50W)	 84A0518/D10 84A0507 84A0519
I/R detector:	84S0508
Clamp module	84S0501
Linearity corrector:	84A0393-10
Measurements and control board: *Control board* *CPU board*	80A0715-12 *80S0656-12* *80S0657-12*
Echo canceller:	80A0779/FLO
Interconnection board:	80S0783-10
Power supply:	84N0506
Mains input:	34N0118 33N0006 X 2 33N0023 17N0005 X 3
Input filter:	84A0180-10/D
Fan units:	31N0007 31N0018
Mechanics Box:	83S0109

Table 1.- Modules and boards list for the CGU20-50-100W HG FLO.

4. MECHANICAL DESCRIPTION

All the equipment are built up in the same mechanical drawer, ready to be placed in a standard 19” cabinet or also as an independent desktop equipment. The fixing of the equipment to the 19” cabinet can be made through fully removable sliding guides, fixed slides or also through a steady system by using the appropriate fixing kit.

The dimensions of the Unit are 19”x4Ux600mm (483mm x177mm x 600mm). The maximum depth of the equipment with all the options and connectors is 602mm. Notice that the front panel has two handles that stand out 40mm. The maximum weight is 35 kg with all the options.

The equipment is completely closed. This way, an excellent radio-frequency shield as well as completely user safety are achieved. The internal servicing of the equipment (to be performed by skilled personnel) can be made by removing the upper lids.

The equipment is divided in four external parts:

1. Front panel, 19” 4U. Air inlet must be left free. This front panel also includes four safety screws which allow the attachment of the equipment to the cabinet if necessary.
2. Back panel. Air cooling exits must be left free.
3. Sides. Allow the fixation of the equipment by means of sliding guides.
4. Upper lids. Allow access to the interior of the equipment.

The interior of the equipment is divided in four areas. Each one of them is made of an independent and closed metallic cavity. This way the required shielding between them is achieved:

1. Input and power supply area. Located in the back left side of the equipment by the back panel and the left panel. It is closed through an independent upper lid. It includes an extracting fan attached to the back panel which allows incoming air from the front panel through specially designed slots located in this cavity. When required the input channel filter is placed here.
2. RF area. Located by the previous described area, next to the back panel. It is formed by three metallic cavities (named slots) in which up to the three RF processing cards can be inserted. These cavities are closed through an independent lid so that they remain completely shielded. This lid has several holes, necessary to allow the adjustment of the inserted cards. When the equipment is working it is essential that the lid is on and correctly screwed. DC supply and control signal connections are performed through an interconnection card located in the bottom of the cavities. The access to this interconnection card is made by means of a peephole in the lower part of the equipment.
3. Power amplification area. Located on the right side of the equipment, from the front panel to the back panel. It is built up with a big dimensions heat sink with high heat evacuation capacity to which the power amplifiers are attached. Given that all the RF modules placed in this cavity are shielded there is no other lid

different to the general one. During the servicing tasks, the upper lid can be removed. However, it is essential that when the equipment is functioning the amplifier shield is in place. The heat sink has a fan that takes the air from the front of the equipment. Air is forced to pass through the heat sink wings and finally goes out through the back panel. In order to have access to this fan it is necessary to remove the front panel.

4. Control area. Located in the front left side. It has the control board fixed to the front and the linearity corrector module fixed to the wall by the RF zone. This area has additional space to place other modules, for instance, a reference oscillator.

This multiple cavities system separates each one of the functions of the equipment and ensures a high isolation between them. The high shielding avoids radio frequency and therefore instability phenomena. Radiation and susceptibility are very much reduced. Notice that, for maintenance, the equipment can work without having the upper and lower lids on; but that, in these conditions, there might not be possible to guarantee a fulfilment of the radiations and susceptibility established specifications. The equipment must not be switched on with the power amplifier shield nor the ones in the RF area removed.

4.1. FRONT PANEL

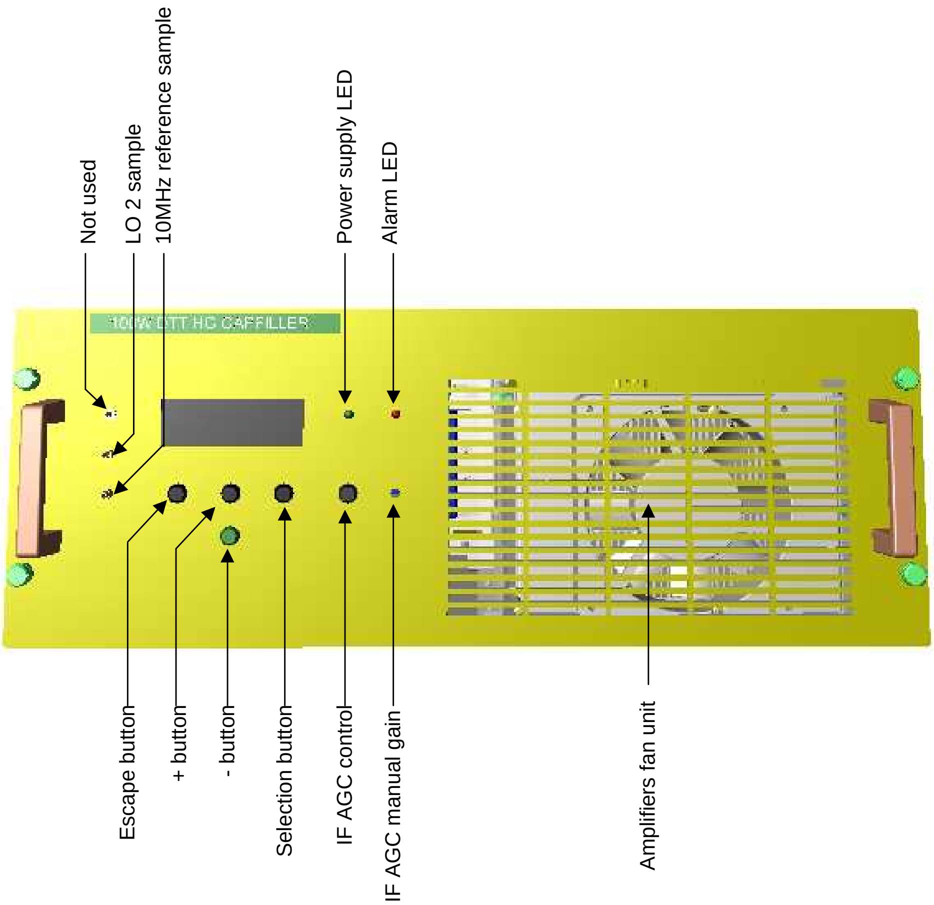

Figure 1.- Front panel elements.

Front panel description:

- Power supply LED: Green LED lighted when gap-filler unit is switched on.
- Alarm LED: Red LED lighted when an alarm is present.
- Control display: State, alarms and measurements presentation. Control of gap-filler unit behaviour (See section **¡Error! No se encuentra el origen de la referencia.**).
- Control display buttons (See section **¡Error! No se encuentra el origen de la referencia.**).:

  SEL: Menu selection button.
  + : Up menu button.
  – : Down menu button.
  ESC: Escape menu button.
- 10Mhz reference sample: +9dBm sample of reference oscillator.

- LO reference sample: -20dBm sample of Local Oscillator used in Gap-filler unit down and up-conversion.
- IF AGC control: Control of input AGC:

  AGC button pushed: Input AGC switched to automatic. Down-converter gain is automatically adjusted to obtain a constant IF level.

  AGC button un-pushed: Input AGC switched off. IF level is controlled by means of IF AGC gain potentiometer.
- IF AGC gain: Control Gain of down converter

As shown in Figure 2 access to interconnection board is situated at bottom of gap-filler unit.

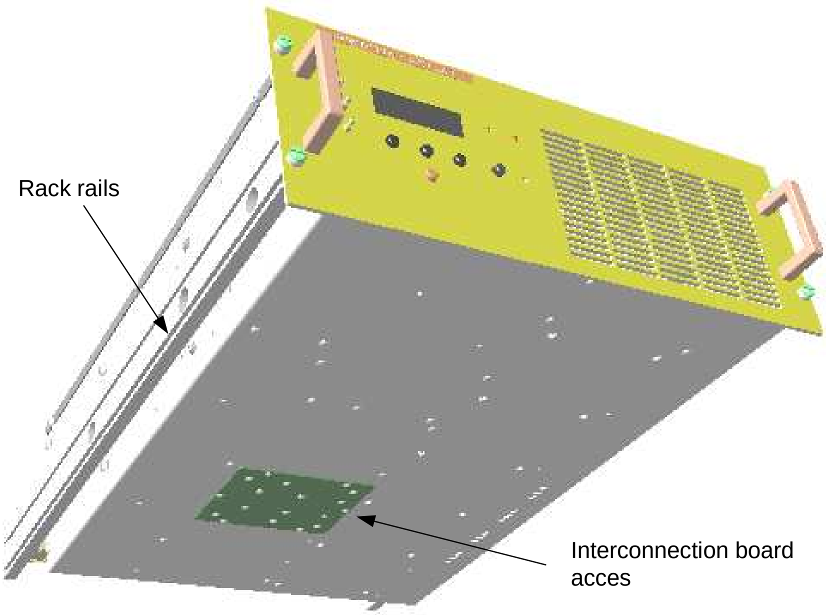

Figure 2.- Front view. Downside.

Unit rails can be unfixed from rack rails by pressing the lever situated in the central part of the rails. This action is sketched at Figure 9.

4.2. BACK PANEL

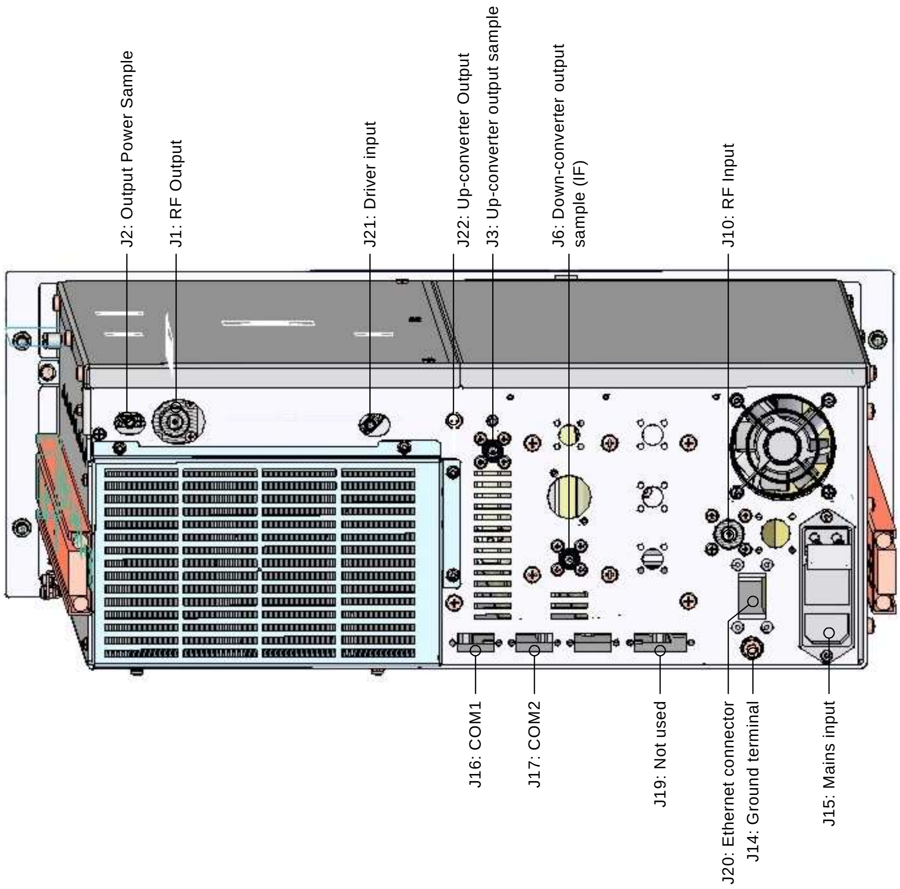

Figure 3. Back panel configuration

Back panel connectors description:

- J1. RF output. N female 50Ω.
- J2. RF output sample. BNC female 50Ω.
- J3. RF output sample, up-converter (Slot S3). BNC female 50Ω. For testing and troubleshooting purposes, signal level is labelled during production adjustment and test.
- J6. IF sample, down-converter (Slot S2). BNC female 50Ω. For testing and troubleshooting purposes, signal level is labelled during production adjustment and test.
- J10. RF input. N female 50Ω.
- J14. Ground terminal.
- J15. Mains input, IEC male, includes “on” switching button and two phase fuses.
- J16. COM1. DB9 female. NOT USED.
- J17. COM2. DB9 female. NOT USED.
- J20. Ethernet connector. RJ45 female.

4.3. INTERNAL PARTS SITUATION

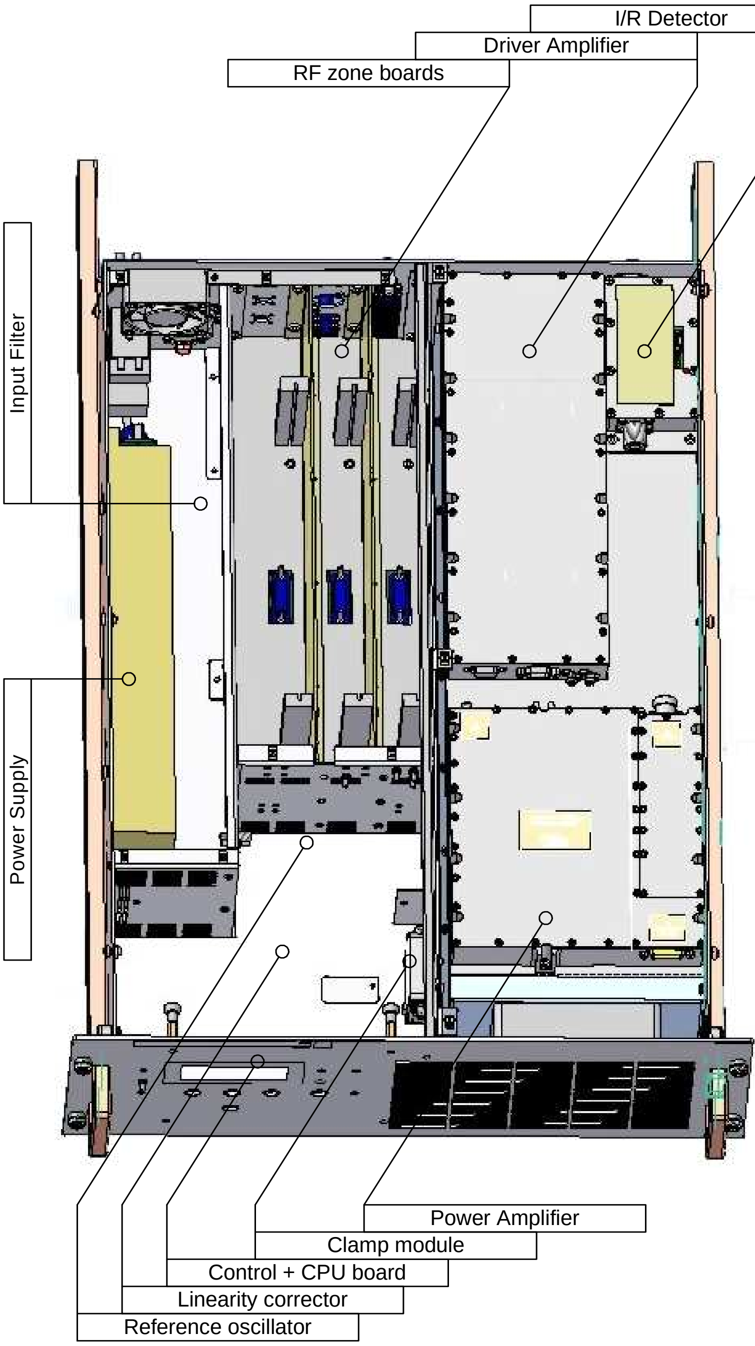

Figure 4.- Internal parts situation.

4.4. RF ZONE BOARDS SITUATION

For CGU100/HG the position of the signal processing boards inside the unit is as follows:

- SLOT 1 (S1): Echo-canceller.
- SLOT 2 (S2): Down-converter.
- SLOT 3 (S3): Up converter.

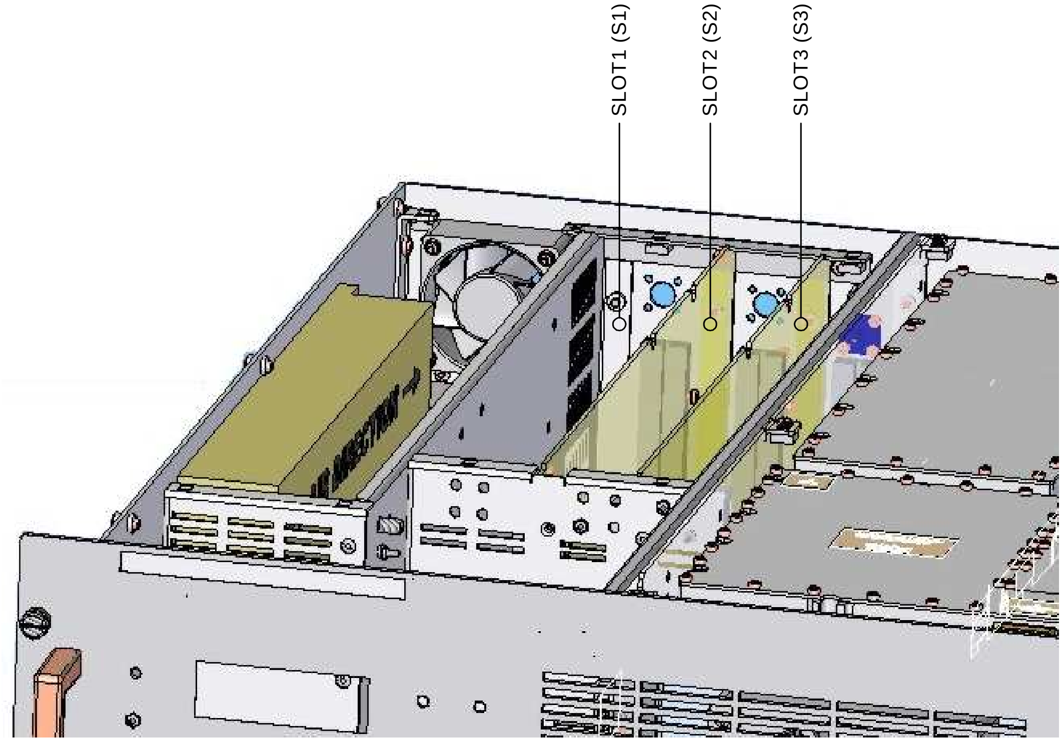

Figure 5.- RF slots nomenclature.

4.4.1. TEMPERATURE PROBES SITUATION

Four temperature measurements are shown in the control display. These measurements are obtained from the positions shown in Figure 6.

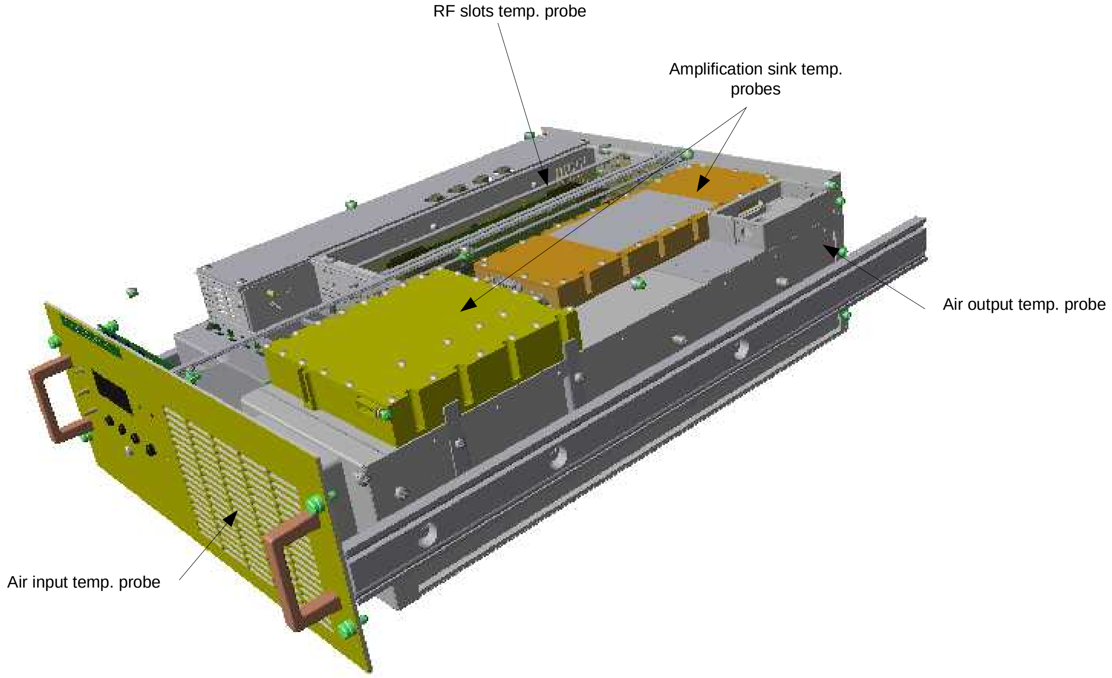

Figure 6.- Temperature probes situation.

4.5. INTERNAL LIDS

Inside the equipment there is an interconnection panel. This allows the RF and IF connection between the cards inserted into the three slots, the input channel filters, the linearity corrector, the reference oscillator and the front panel, depending on the different available versions. This panel has the connectors as shown in the last figure and two more on the side of the power supply cavity and input area. The notation input/output is made in regard of the slots. These connections are described as follow:

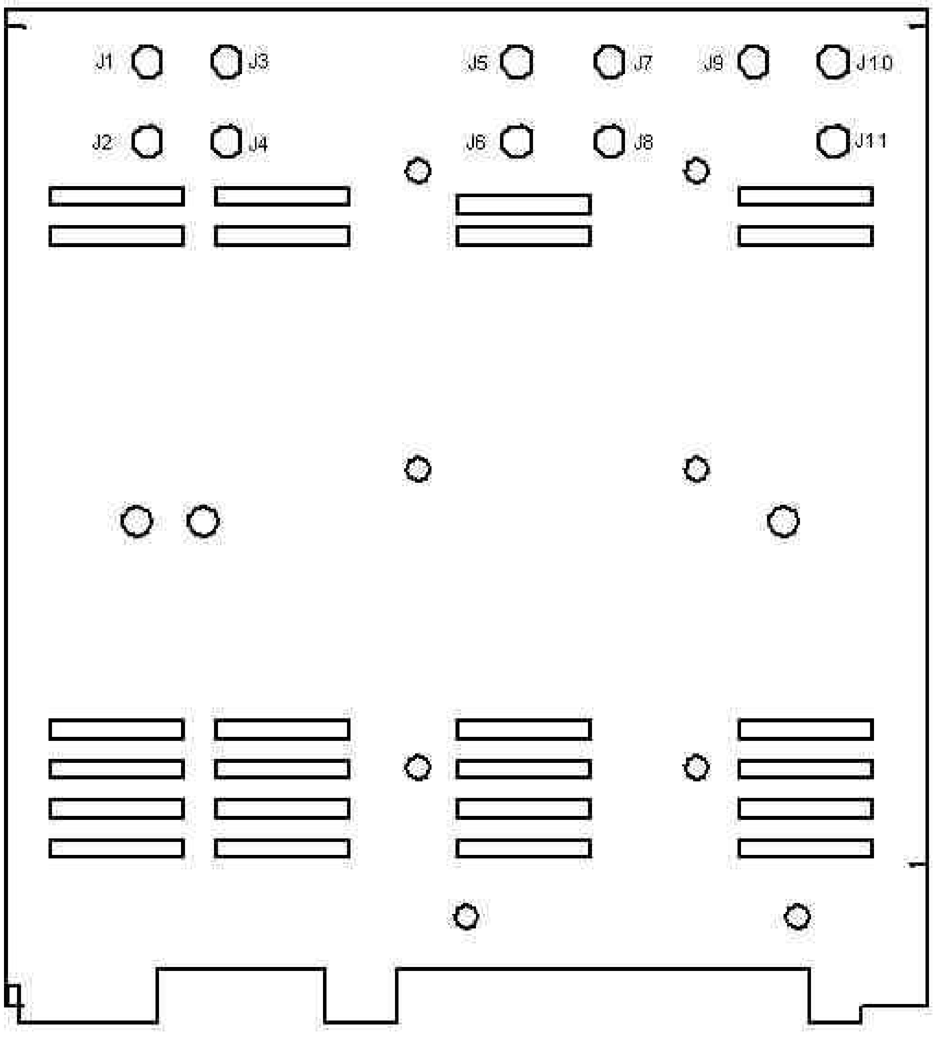

Figure 7.- RF interconnection internal panel.

- Slot S1 (Echo canceller).
  - J1. Free.
  - J2. Free.
  - J3. Free.
  - J4. Free.
- Slot S2 (Down-converter).
  - J5. RF input. From input filter.
  - J6. Free.
  - J7. IF output. To linearity corrector.
  - J8. Free.
- Slot S3 (Up-converter).
  - J9. IF input. From clamp module.
  - J10. 10Mhz input. From reference oscillator.
  - J11. Up converter local oscillator output sample. To frontal pannel.

The RF slots have a cover to ensure its shielding. Through this covers it is possible to make the required adjustments. The cover has a silkscreen print that represents each one of the three slots where the RF cards are inserted. It also has the required holes to access the adjustment points and switches that can be handled in each one of the boards. The silkscreen printed indicates the names of these adjustments and the matching type of the board, because the first and the second slots admit two types of different cards depending on the type of implemented equipment.

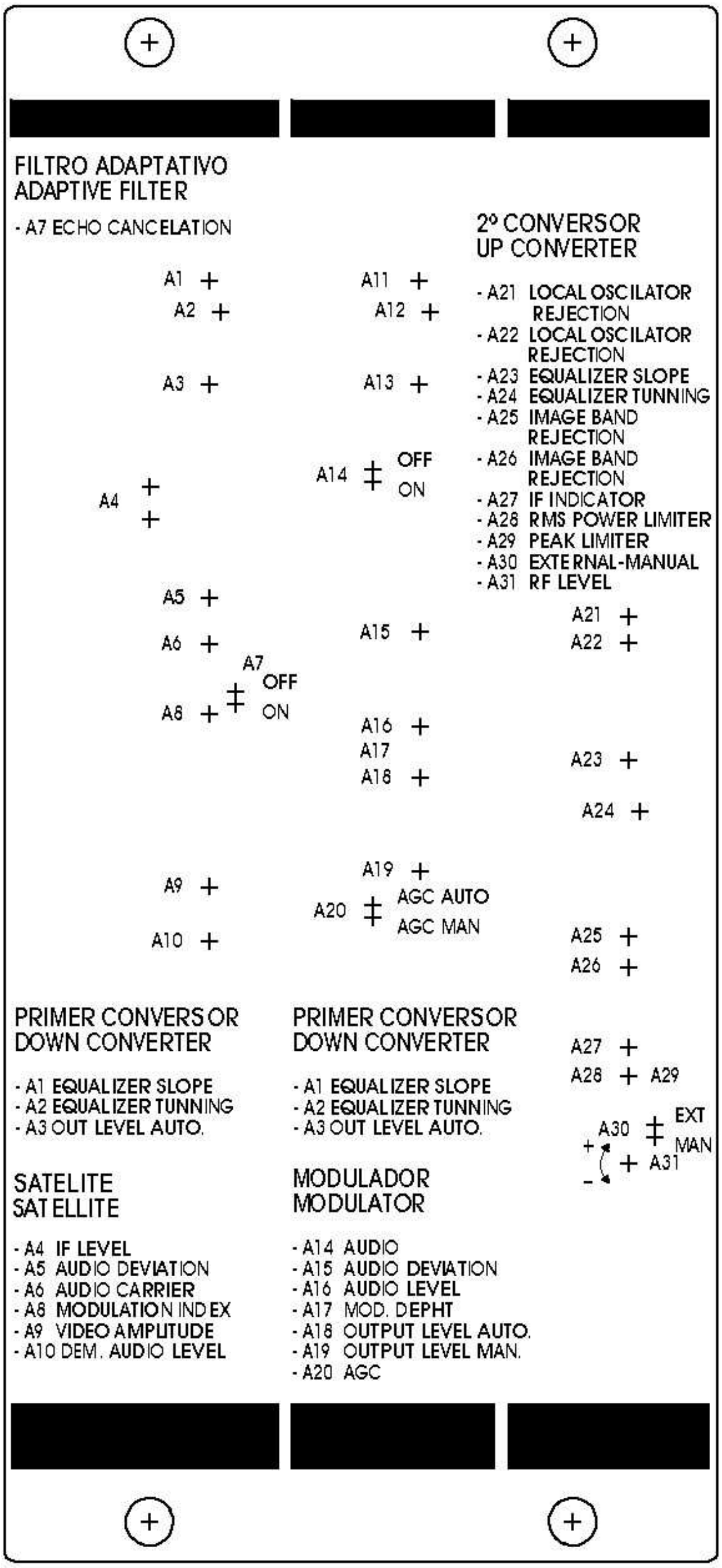

Figure 8.- RF Area lid.

4.6. UNIT RAILS

When the unit is inserted into the rack, the rails (drawer runners) fix the unit to avoid take it out by chance. To extract the Unit it must be unfixed. Next figure shows how two little levers allow to unfix the rails:

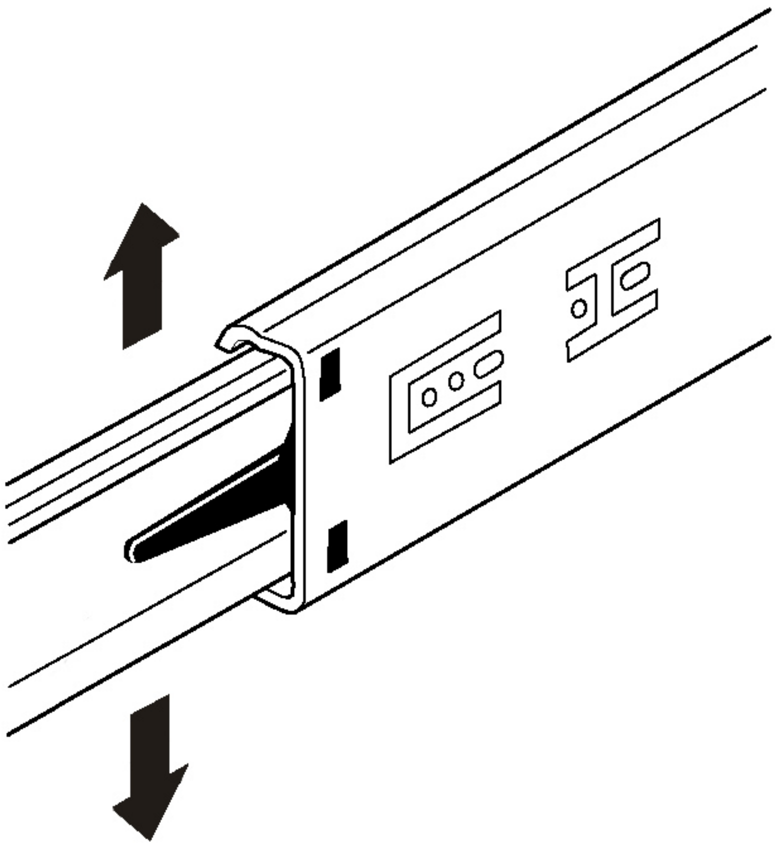

Figure 9.- Extraction of gap-filler unit from rack rails.

5. ELECTRONIC DESCRIPTION

The block diagram of the Gap-filler unit is detailed in this section.

Four block diagrams are included:

- **Complete block diagram:** The elements and connections between them of the whole system are sketched in Figure 10. This schematic does not contain information about the signals transmitted between elements (modules and boards) of the unit. This schematic contains all the input and output connectors of the unit. For clarity purposes, the information of the signals has been divided in three diagrams: RF signals, power supply signals and measurements and control signals.
- **RF Signal block diagram:** The path through the modules of the modulated signal containing the broadcasted information is shown individually in this scheme. Frequency and levels are indicated at each point. In case of sample paths, the value of coupling is also noted. The signal levels presented in this scheme are a reference value that must not be taken as an exact value since they are generic values for a Gap-filler unit. When precision adjusting for a signal level is required, the value in the diagram has a tolerance value.
- **Measurement and control block diagram:** All the connections between modules and boards containing control and indication information is shown in this block diagram. Also the output/input control Ethernet connector is shown.
- **Power supply block diagram:** In this diagram we can see the power supply distribution with the voltage values of each module and board. The voltage indication is presented as a nominal value. For exact value adjusting consult the measurements menu at the front panel control display.

These block diagrams are described in the following sections.

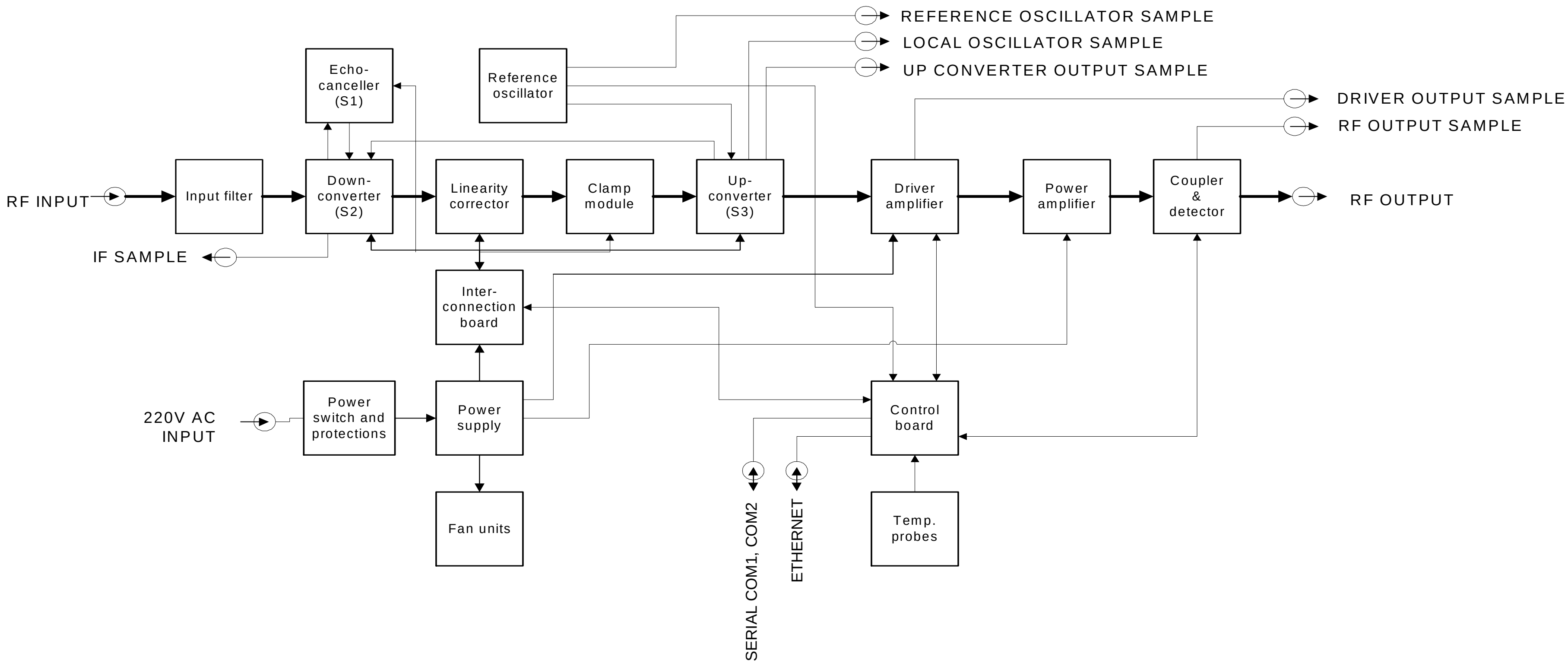

Figure 10.- Complete Gap-filler unit block diagram

5.1. SIGNAL PATH DESCRIPTION

RF input: RF input signals must be connected to the input connector. The input signal is filtered by means of a 4 pole passive filter in order to prepare the down-conversion input signal. *Down-converter* move the input signal to IF (the IF signal is inverted since it uses a LO with a higher frequency than the input signal).

IF processing: *Down-converter* also performs SAW filtering of IF signal. IF frequency equalization can be adjusted. *Echo-cancellation board* processing is situated inside the signal path of the down converter. In order to perform a good A/D conversion, the input level of *echo-canceller* board must be adjusted accurately to –15dBm. At the output of *down-converter* a coupler is used to obtain a IF signal sample at the back panel connector. The output of down-converter is connected to *linearity corrector* module that performs the pre-distortion of the IF signal to obtain a linear behavior of the whole signal path (including the amplification stages.). At the *up-converter* input, before moving to RF, IF level detection is performed. High level and low level detection is performed. IF frequency equalization can be adjusted at this point.

RF conversion: IQ modulator performs agile mixing of the IF signal. With the same LO of the *down-conversion* the signal is converted to RF frequency again. High rejection of IQ modulator spurious (LO rejection and image band rejection) can be adjusted. After conversion, an electronic attenuator is used to control the output level of the up-converter and, in consequence, the output power of the gap-filler unit. Following stages have fixed gain. This gain can be controlled internally by means a potentiometer or externally by means of I2C communication with the control board. In normal operation the gain is controlled by the control board. A sample of the *up-converter* output is connected to the back panel of the unit. Notice that this sample is still a pre-distortionated signal. Quality measurements can not be measured in this point. For CGU-50/HG, after *up-converter* module a *pre-amplification filter* is added in order to protect the power amplifier.

Amplification stages: The gain of final stages is divided in two amplifiers modules. A high gain *driver amplifier* is used first. For trouble-shooting purposes a sample is present at the output of this module. This sample is not wired to the back panel and the signal is still not linear. *Power amplifier* module obtains the desired output power.

Output power processing: After amplification stages a coupler is used in order to obtain an output sample at the back panel of the unit. At the same time have a forward and reversed power detectors obtain a voltage indication of both signals.

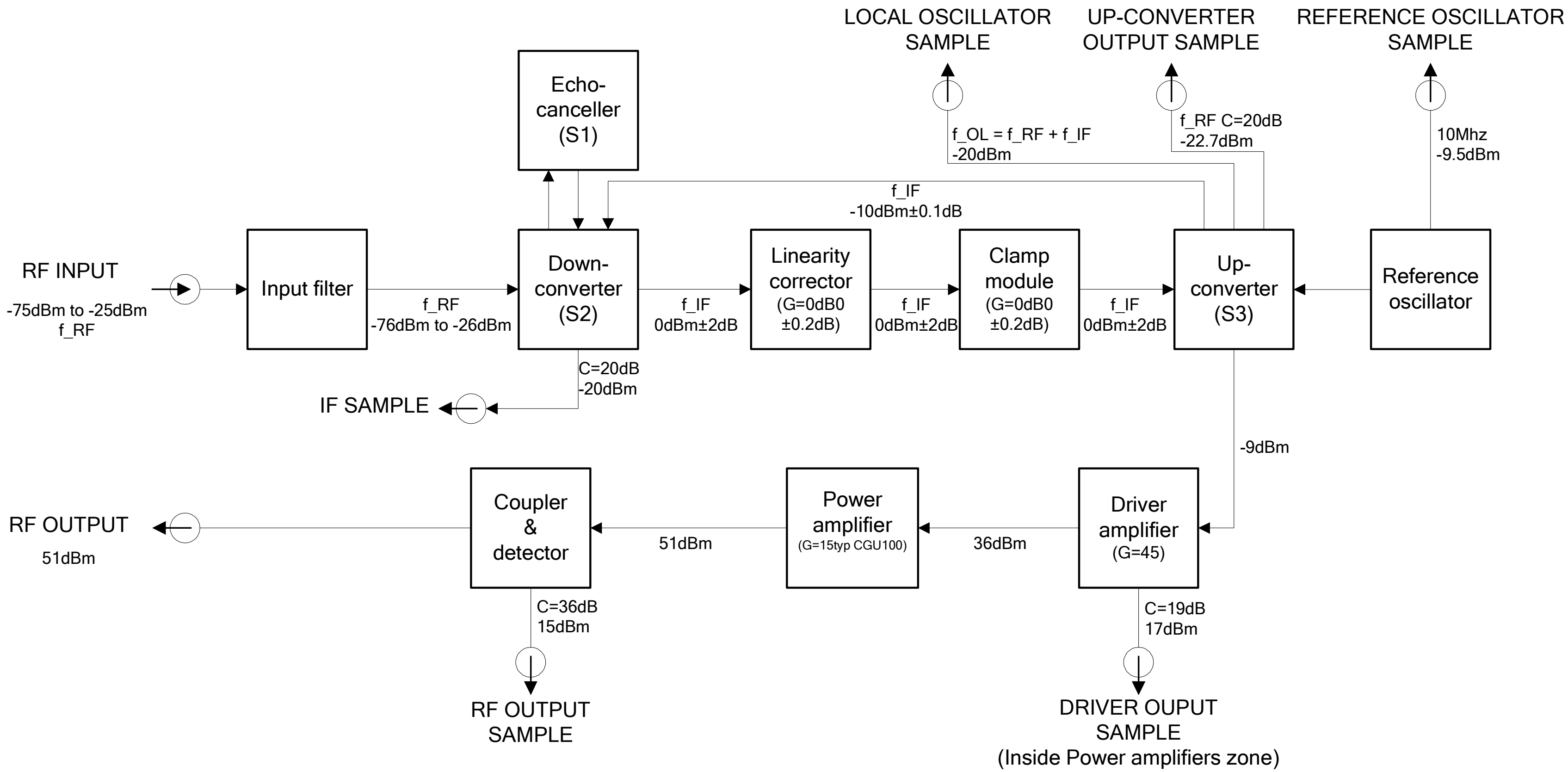

Figure 11.- RF Signal block diagram.

5.2. POWER SUPPLY DISTRIBUTION

Input AC connector provides protection in front over-currents and over-voltages. Three varistors and two fuses are used. The *power supply* module performs the AC-DC conversion. Two outputs are generated, power amplifier power supply voltage and 25.5V for the other boards and modules. *Power amplifier* supply voltage is 30V for CGU100/HG gap-filler unit. *Driver* amplifier module and fan units are supplied directly by means of 25.5V output. *Interconnection board* generates 12V for the *clamp module* and 24V from where all the remaining boards and modules (except of *coupler and detector module*) are supplied. *Coupler and detector* module uses +12V generated by *control and measurements* board. Consumption of all slot boards are sensed in *interconnection board*.

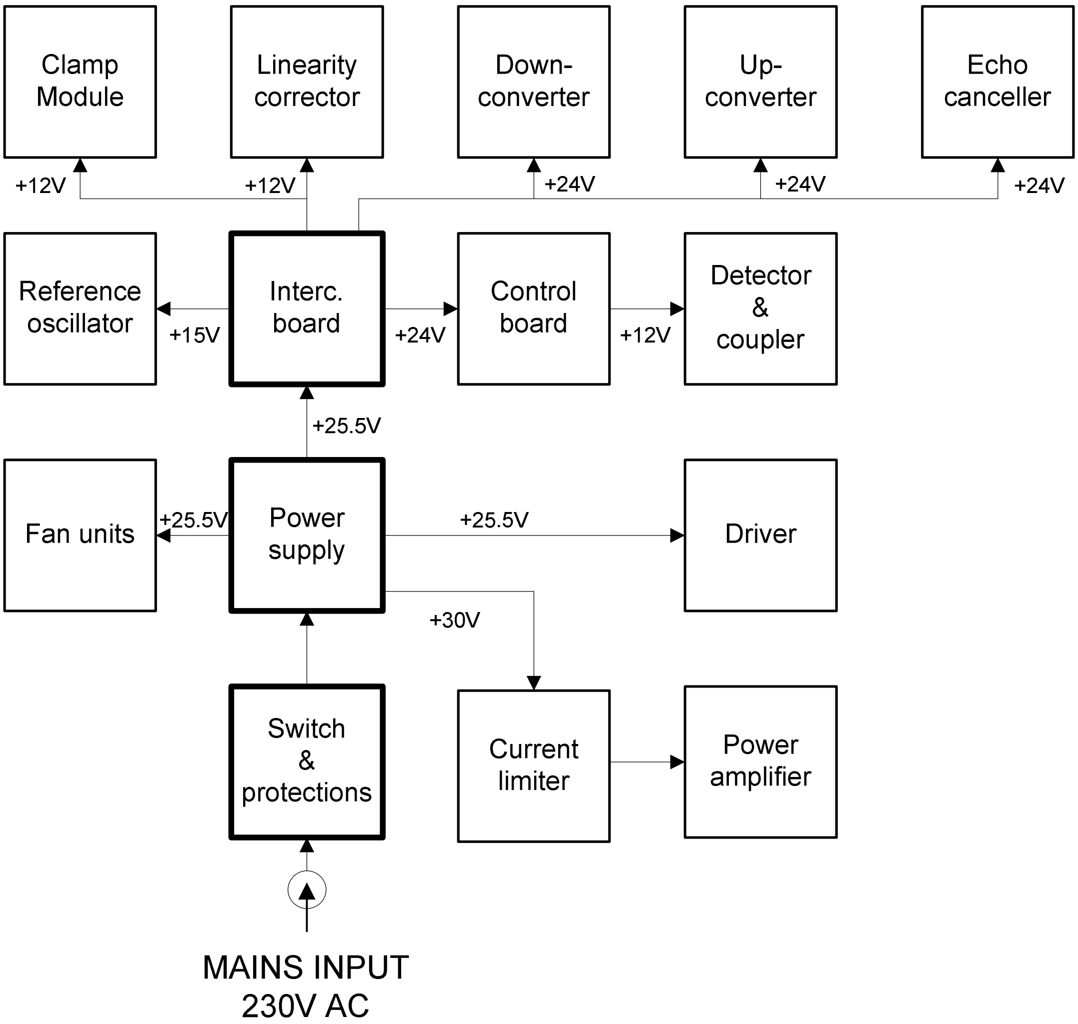

Figure 12.- Power supply distribution diagram.

5.3. CONTROL AND MEASUREMENTS

The functional behaviour of the gap-filler unit is controlled by the control and measurement boards. The functional connections between this board and the rest of modules and boards are described in Table 2.

Element	**Relation description**
Interconnection board	– All the control and measurement signals coming from slot boards pass through this board. – Slot boards current and voltage sensing is sent to control board.
Echo canceller	– Indication of alarms is sent to the control board. – Echo canceller switch OFF is displayed as an alarm in control menu
Down-converter	– IF AGC control voltage and MAN/AUTOMATIC selection is performed in control board. Manual gain of IF AGC is moved to control board.
Up-converter	– Local oscillator state (PLL locked or unlocked) is sent to control board. – IF presence indication is sent to control board. – I2C communication which allows up-converter gain adjustment is used between up-converter and control boards. SCL and SDA are connected.
Driver amplifier	– Driver amplifier consumption – Output forward signal detected voltage. – Reflected signal detected voltage.
Power amplifier	– No relation
Current limiter	– Voltage and current sensing of power amplifier is sent to control board
Reference oscillator	– Input signal locking state is sent to control board (Gap-filler units does not use this signal).
Temperature probes	– Temperature variable resistors terminals are connected to control board in order to calculate temperatures in different points of equipment.

Table 2.- Control and measurements signals brief.

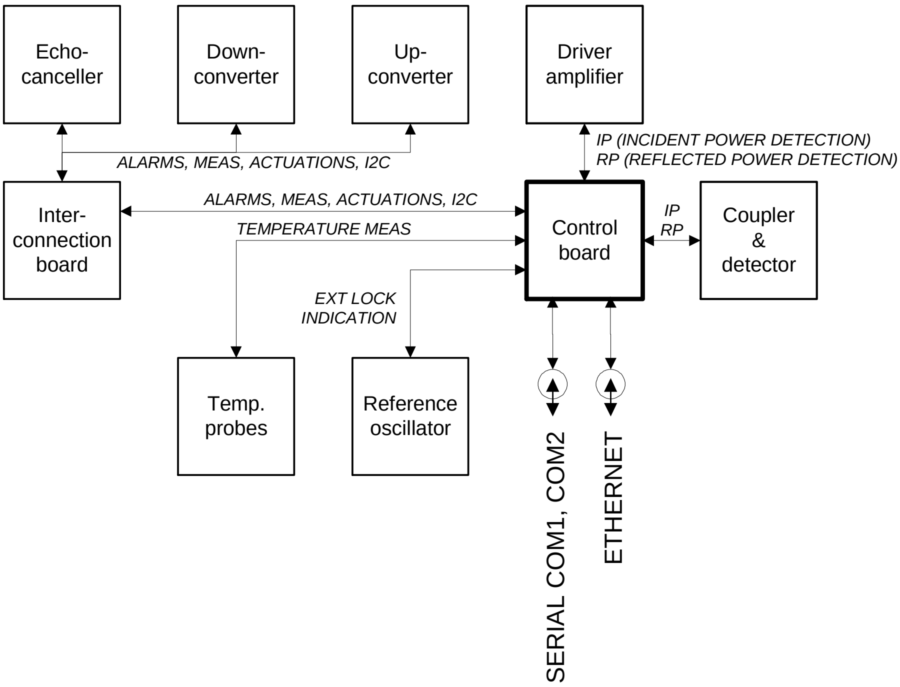

Figure 13.- Control and measurement block diagram.

The microprocessor based control system has the following characteristics:

1. Guaranteed operation of the equipment in case of microprocessor failure.
2. Local as well as remote continuous monitoring of the main equipment parameters with alarm indication.
3. Voltage measurements of the equipment.
4. Consumption measurements.
5. Temperature measurements in the most relevant points of the equipment.
6. Protection against over-temperature.
7. Forward and reflected power measurement.
8. Protection against output reflected power.
9. Output power automatic control. Protection against overdrive.
10. Detection of the input signal presence/absence.
11. Working hours indication.