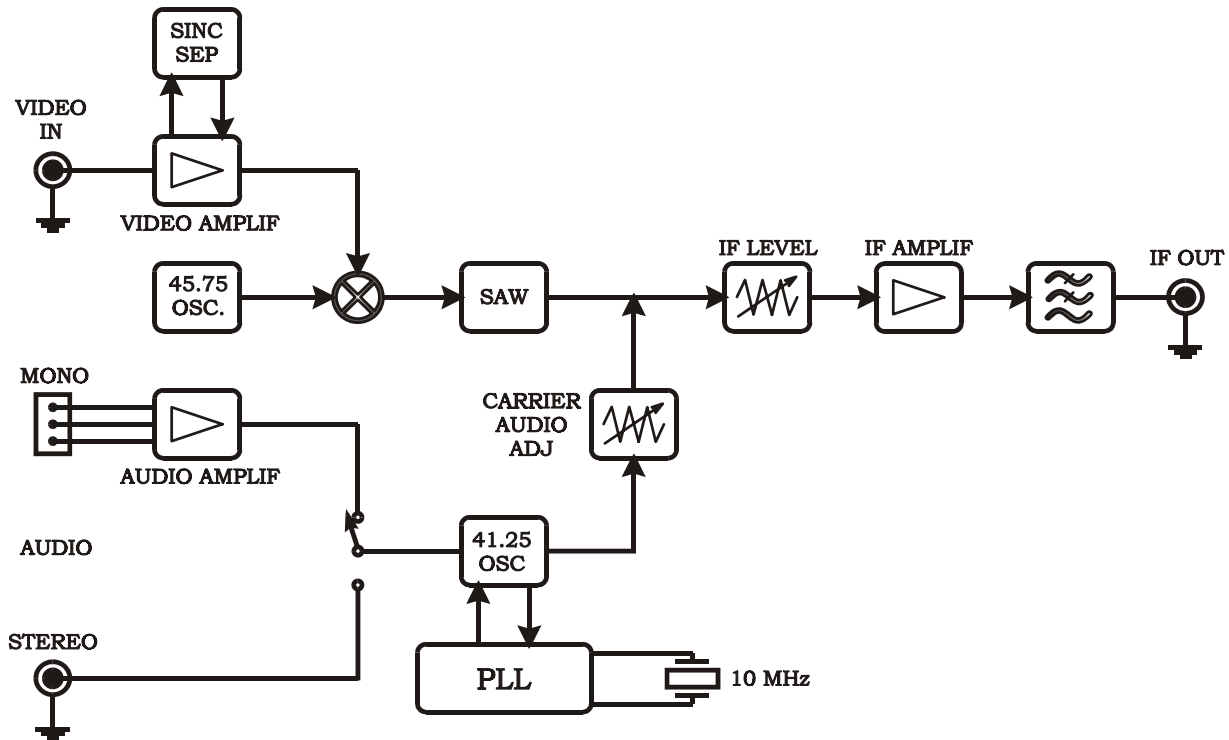


## 1. Audio and Video Modulator:

### 1.1. Function:

This module function is to generate two carriers: one in 45.75 MHz and the other in 41.25 MHz. The first is modulated in AM-VSB by a video signal and the other one is modulated in frequency by an audio signal.

### 1.2. Block Diagram:



### 1.3. Technical Description:

#### 1.3.1. Video Modulator:

The transistor Q1 oscillates in the crystal frequency (45.75 MHz - IF video), and the transistor Q2, with high input impedance, guarantees the isolation to the oscillator Q1 output. The frequency accuracy is adjusted in the variable inductor L1. The input video signal, with adjustable level in R27 (front panel), is applied to the high impedance input push-pull amplifier formed by transistors Q6 and Q9. The amplifier output signal modulates in amplitude, in the mixer M1, the video carrier.

The integrated circuits IC18 to IC21 form a group delay predistortion circuit. The synchronized cells, at the video bandwidth, cause an advancement of 170 ns at 3.58MHz. This video pre-distortion is inserted in the circuit through jump's JP5 and JP6. The adjustable attenuator R146 allows equalizing the video level when the pre-corrector circuit is turned off.

The transistor Q12 receives the video signal, inverts its phase and applies it to the IC7 amplifier. This amplifier causes a non-linear enlargement to the video signal emphasizing the synchronizing pulses. This signal is clamped in 0.7V by the D5 and is compared to 0.3V (due to diode D4) in the comparator circuit IC6. In this manner, at the IC6 output, there will be only synchronizing pulses. These pulses are applied to the IC5 (mono-stable) in the negative transition to generate clamping pulses. The clamping pulses commute the transistor Q10 that switches the video signal clamping it to the blanking level through R45. This adjustment allows choosing the point of modulation in the mixer for a better linearity. If there is lack of clamping pulses, the Q11 transistor commutes, allowing adjusting through R44 the level of the video carrier without modulation.

The integrated circuit IC9B receives the clamping signal detected through D7, changes its state and commutes the transistor Q13. It allows switching the external circuits connected to the Automatic output. The led in the panel shows this operation, when it is green it indicates video on. This circuit presents about 60 seconds delay time approximately.

The video signal peak is detected through IC8 and through IC9 and it is differentiated with the level adjusted through R45, in order to extract the dc component.

The IC9A output has a dc level related to the video signal not taking into account the synchronizing pulses. The 100% video measurement is adjusted through R72 in the meter with a video signal with 100% APL. The C118 e L18 components form an ICPM corrector circuit that allows correcting a non-desirable phase-shift at the video carrier caused by the modulating signal.

The modulated video carrier is amplified by IC1 and the SAW filter FL1 filters this signal giving the final characteristics of the desired modulation, i.e., AM\_VSB (amplitude modulation with vestigial side band). The amplifiers IC2, IC3 and IC4 produce the necessary gain to signal, in order to compensate the losses in SAW filter and deliver a 0 dBm output level. The output signal level is adjustable by R12 (front panel), which controls the PIN diode conduction (D1). The trimpot R13 limits the maximum IF output level and the circuit formed by transistor Q19 and capacitor C120 increases slowly the output level to eliminate high frequency peaks when the equipment is turned on.

The IF signal, after amplification, passes through a low-pass filter, formed by L6, L7, C21, C22 and C23 to eliminate harmonic signals. Part of this signal is sent to the detector circuit formed by transistors Q3 and Q4 to measure the IF signal in the panel. The trimpot R24 allows adjusting the reading level through the meter.

### 1.3.2. Audio Modulator:

The transistor Q14 and associated components generate the audio carrier. The applied voltage to the varicap diode D10 controls its frequency. The amplifiers IC12 and IC13 increase the signal level and through the trimpot R108 is applied to the IF amplifier to be delivered at the output. A sample of this signal is delivered to the “prescaler” IC14 through R108. It divides the signal into 64 and delivers it to PLL (integrated IC15). The PLL divides again this signal, now into 66, and compares it with a reference signal in phase, resulting a voltage proportional to the difference of the phase between the signals; this voltage is filtered and applied to diode D10 to correct the frequency. The reference frequency for PLL is generated at the integrated circuit itself that oscillates at 10 MHz and divides it into 1024. The oscillator crystal is found in a thermal chamber, which is controlled by Q15 and by thermistor NT1, for better frequency stability. The trimmer C90 allows the fine adjustment of this carrier frequency (41.25 MHz). If the circuit cannot correct the frequency, the transistors Q17 and Q18 are commuted to turn on the frequency error red led.

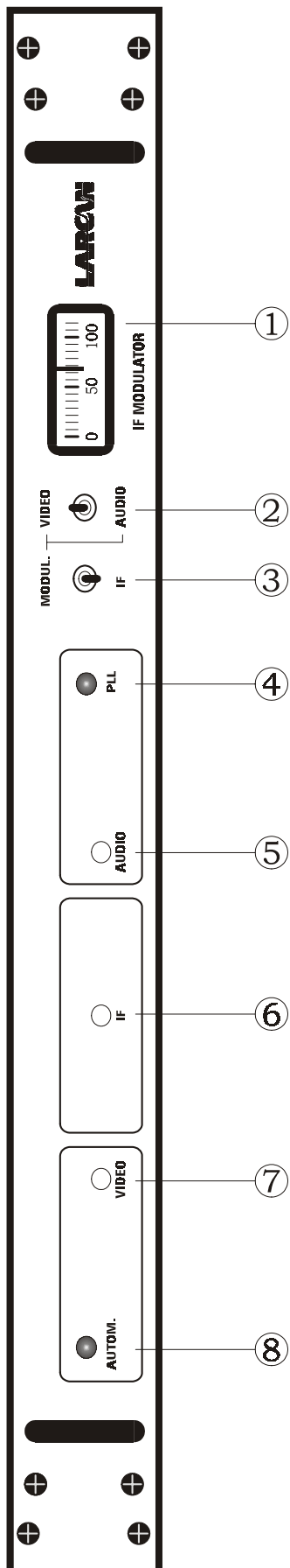
The audio signal that will cause the modulation in frequency in this carrier may come from the mono audio input or stereo audio input. It is possible to select it through jump JP3.

The mono audio input circuit has an unbalanced amplifier IC10 and pre-emphasis circuit. It is possible to turn off the pre-emphasis through jump JP2. The trimpot R92 (front panel) adjusts the audio level that will cause the correct modulation index. The integrated circuit IC17 and associated components form a peak detector of audio signal and a trimpot R117 allows adjusting 100% at the meter for the correct deviation. The battery input (+36V) through D16 and fuse F1 connects through connector CN2 the power supply FTE017 (optional).

**Obs:** The circuit diagram is divided into four parts.

## 4. Frontal and Back Panel:

### 4.1. Frontal Panel:



Each element in the panel has the following function:

**1. Meter:** For video, audio and IF measurements. For a video signal with 100% APL the meter will indicate 100%. In the audio position, the measurement of 100% in the meter will indicate the correct deviation. In the IF position, the measurement of 100% corresponds to 0 dBm level in the output.

**2. Video/Audio:** Measurement selector switch. This switch selects the video or audio modulation index when the switch (IF/modul.) is in the position (modul.).

**3. Modul/IF:** Measurement selector switch. It selects between the modulation index or the IF level.

**4. PLL:** Bicolour led, when it is red indicates that the Audio carrier is out of frequency.

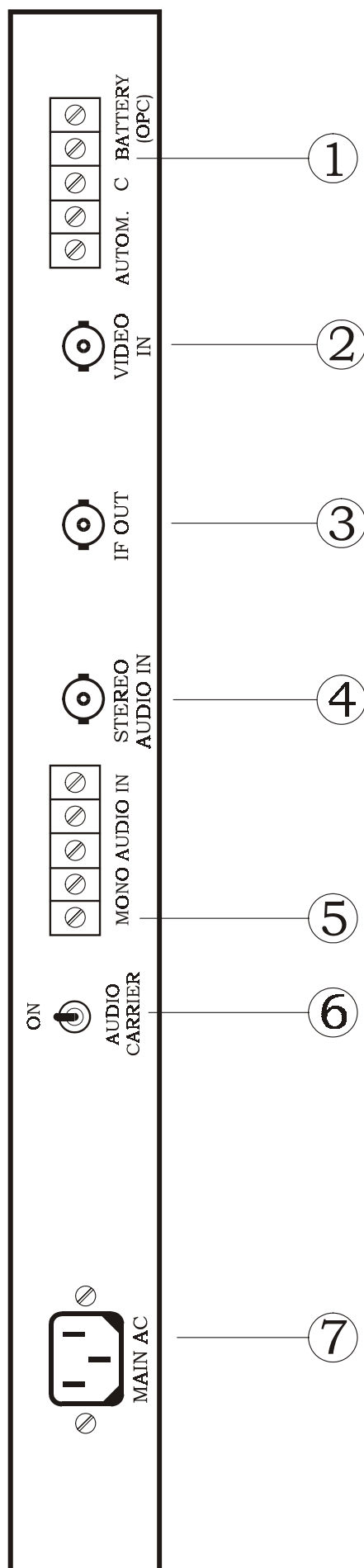
**5. Audio:** Audio level adjustment through trimpot R92.

**6. IF:** IF level adjustment through trimpot R12.

**7. Video:** Video level adjustment through trimpot R27.

**8. Autom:** Bicolour Led, when it is red it indicates video off, when it is green indicates video on. It takes about 60 seconds delay time to change from green to red one.

## 4.2. Back Panel:



Each element in the panel has the following function:

### 1. AUTOM, C AND BATTERY (OPC):

- AUTOM: output to external command. When the video is on, this output is short circuit to the ground (50mA maximum current).

- C: EXTERNAL CONTROL: Lower output IF level by ground contact.

- BATTERY (OPC): Battery input +36V (optional).

**2. VIDEO IN:** Video input 75 Ohms impedance (unbalanced) and 1 Vpp level.

**3. IF OUT:** IF output with 50 Ohms impedance (unbalanced) and adjustable level. 0dBm Nominal.

**4. STEREO AUDIO:** Stereo audio input, 75 Ohms impedance (unbalanced), 0dBm level.

**5. MONO AUDIO IN:** Mono audio input, 600 Ohms impedance (balanced) and 0 dBm/400 Hz level.

**6. AUDIO CARRIER:** Turn on/off the audio carrier.

**7. MAIN AC:** Power supply input 220V.

## 8. Power Supply:

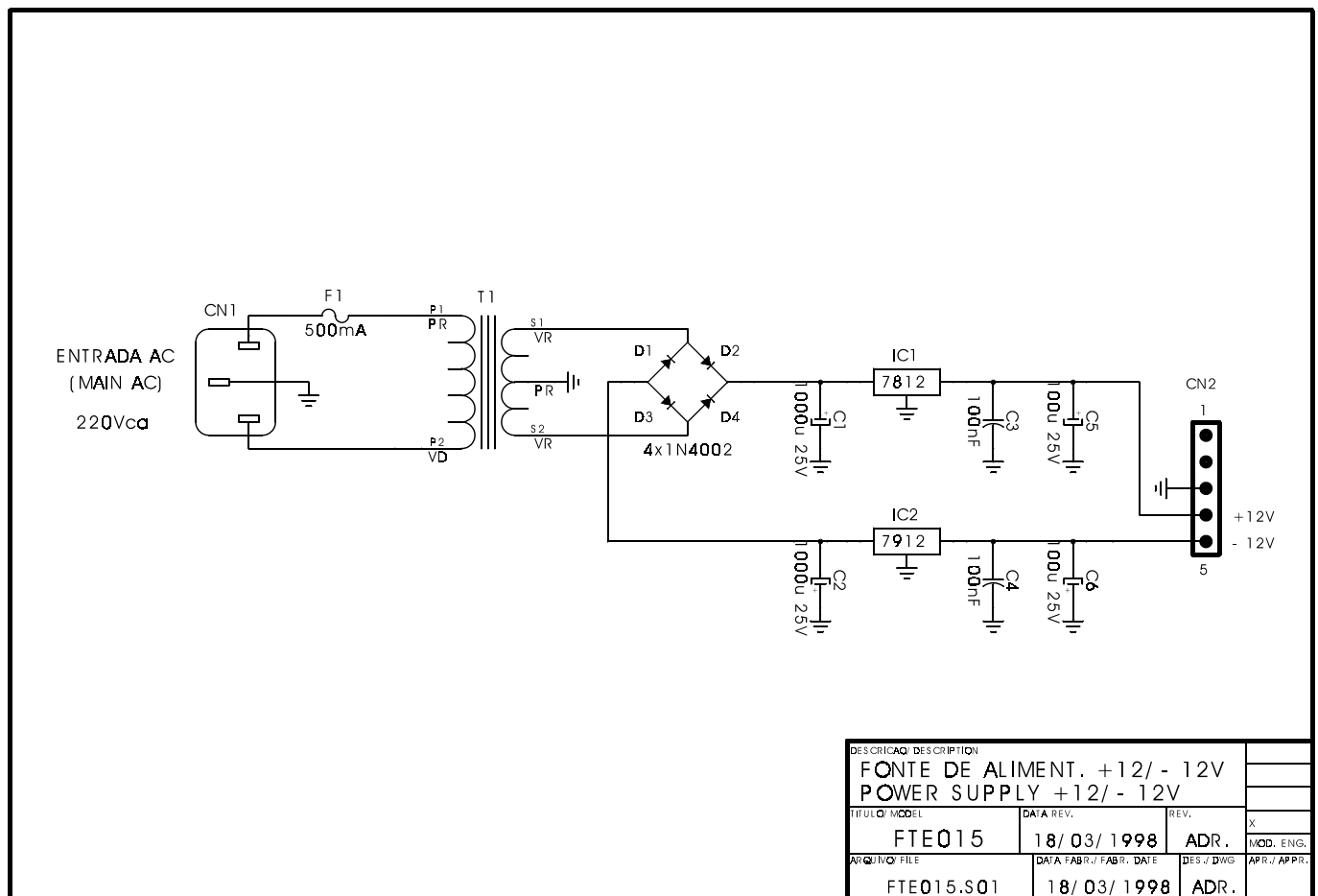
### 8.1. Function:

The power supply function is to generate +12V and -12V voltage suitable to supply the modulator.

### 8.2. Technical Description:

The transformer T1 reduces the input voltage for the rectifiers D1 to D4. The positive and negative voltage obtained after the rectification and filtering through C1 and C2 are regulated through IC1 and IC2 to obtain +12V and -12V voltage to supply the Modulator.

### 8.3. Circuit Diagram FTE015:



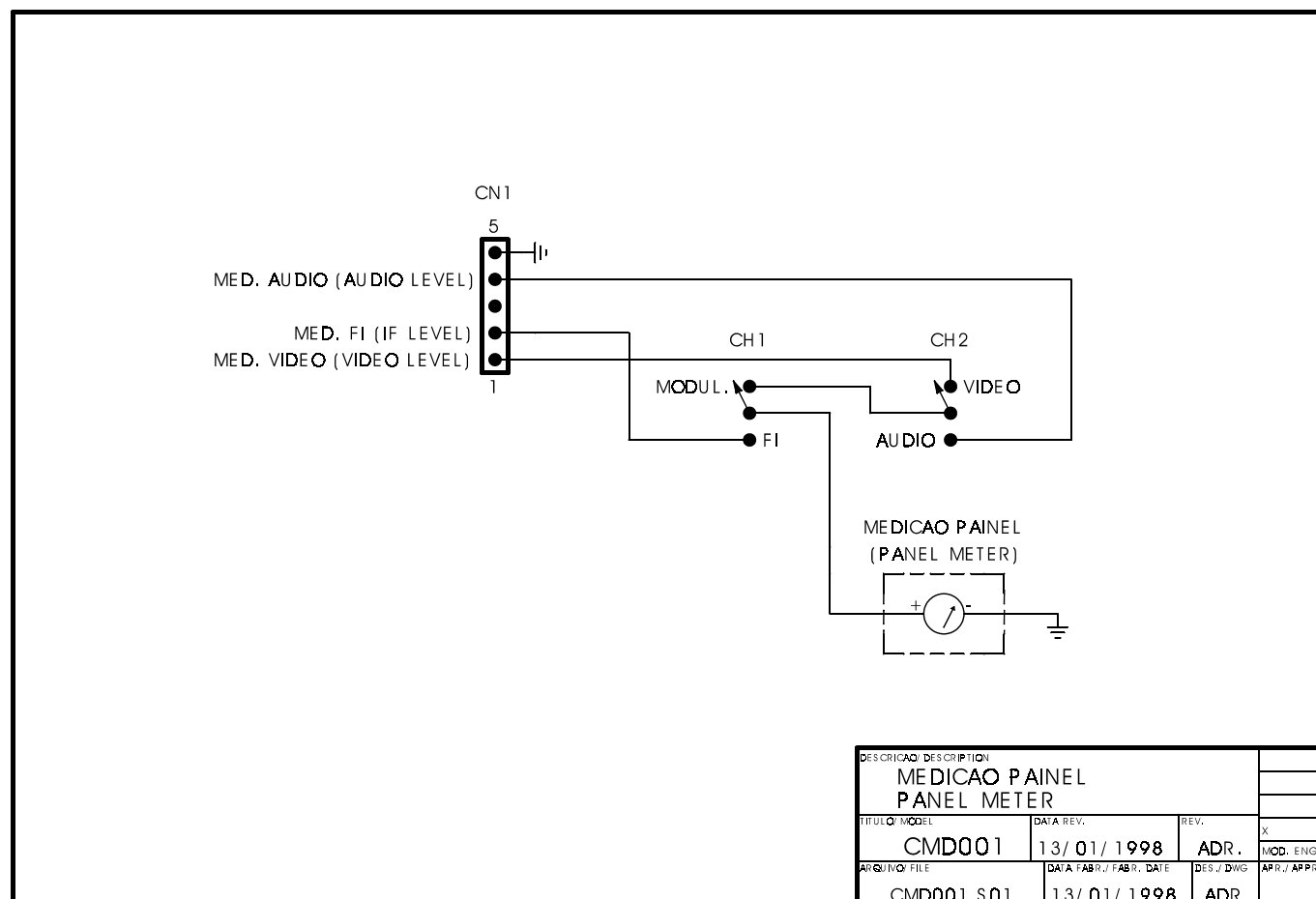


## 10. Meter Circuit:

### 10.1. Function:

The meter circuit allows, through the selector switches and meter, the measurements of the video modulation, audio modulation and the IF level.

### 10.2. Circuit diagram CMD001:



## **1. Channel UP converter:**

### **1.1. Introduction:**

This module converts an IF signal, into “a” UHF band channel, maintaining its characteristics and the same bandwidth.

### **1.2. IF filter and amplifier AGC (for transposer):**

The filter and IF amplifier establish the necessary bandwidth to the input signal and supply a gain in it, maintaining a constant level, through an AGC loop. It is used only in the transposer equipments.

### **1.3. IF pre-distortion:**

The IF module pre-distortion corrects the intermodulation, the differential gain, the differential phase and the synchronism compression. This correction is done by pre-distortion on IF level (41-47 MHz). This module is placed after the audio and video modulator and before the channel converter module.

### **1.4. Automatic Level Control (ALC):**

This module maintains the output peak power at its nominal value, even if there is gain variation due to the temperature and power supply variations.

It allows a maximum correction of  $\pm 1\text{dB}$ .

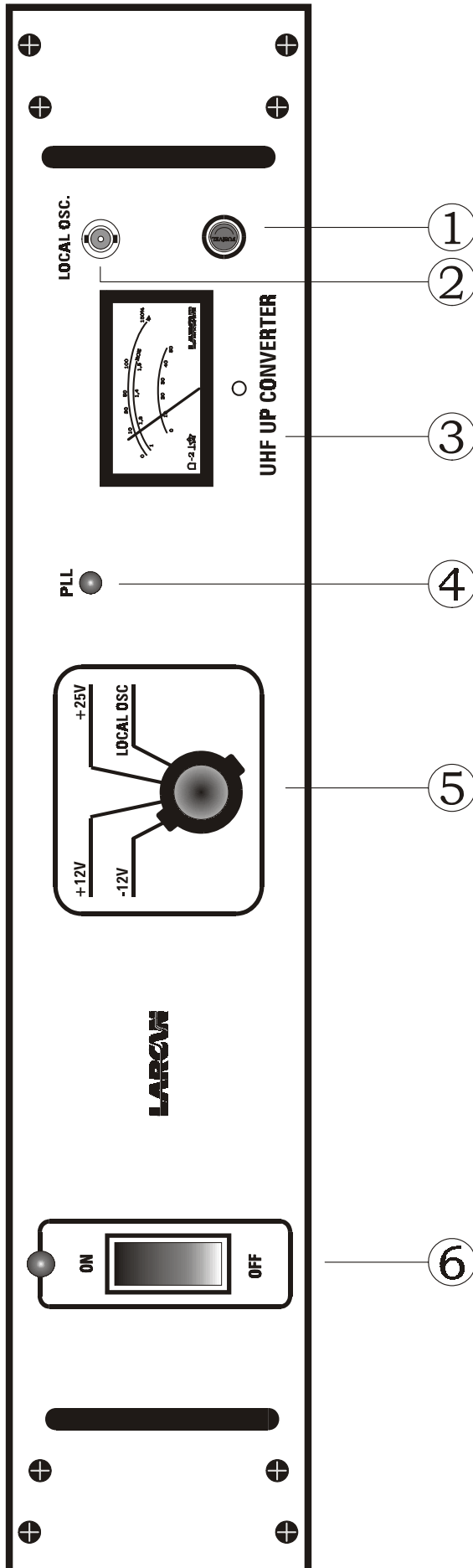
### **1.5. Channel converter:**

The UHF channel UP converter has an oscillator that is controlled by PLL, whose frequency operation is selected by DIP switch from the Local Oscillator control board, according to the channel programming chart.

### **1.6. Protections/signals:**

The channel UP converter has in its front panel a PLL (Phase Locked Loop) alarm led that shows if the converter is out of the operation frequency.

## 2.2. UP Converter Frontal Panel (for transmitter):



Each element in the panel has the following function:

**1.** FUSE: 2 A fuse.

**2.** LOCAL OSC: BNC connector used to monitor the local oscillator by spectrum analyzer.

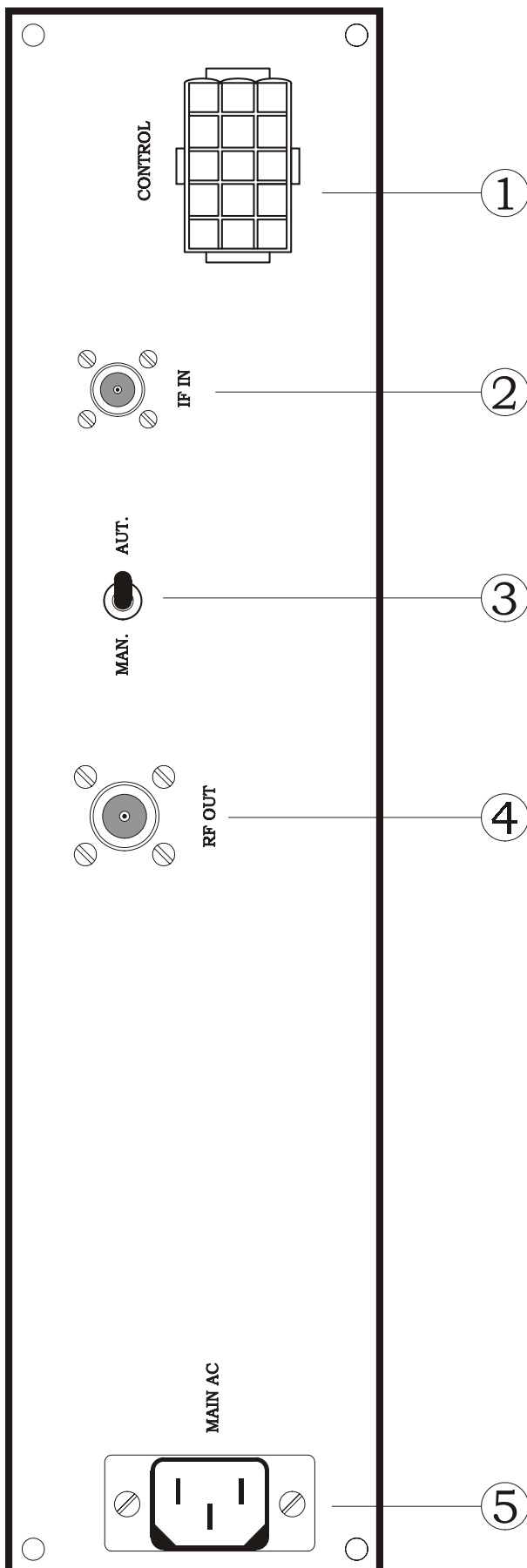
**3.** METER: Allows measurements of +12V, -12V, +25V and Local Oscillator.

**4.** PLL Led alarm: When the led lights, it indicates that the local oscillator is out of frequency.

**5.** SELECTOR SWITCH: According to the switch position, the values are indicated in the meter.

**6.** ON/OFF SWITCH: this switch allows turn on and off the UP converter.

### 2.3. UP Converter Back Panel (for transposer and transmitter):



Each element in the panel has the following function:

**1. CONNECTOR 15P:** main power supply, commands and measurements.

**2. IF IN:** IF input connector type BNC.

**3. Automatic/Manual selector switch:** Automatic: the equipment operation depends on the Video or IF signal. Manual: its operation does not depend on the Video or IF signal.

**4. RF OUT:** RF output connector type N.

**5. MAIN AC:** Main AC input 220V.

### 3. IF filter amplifier:

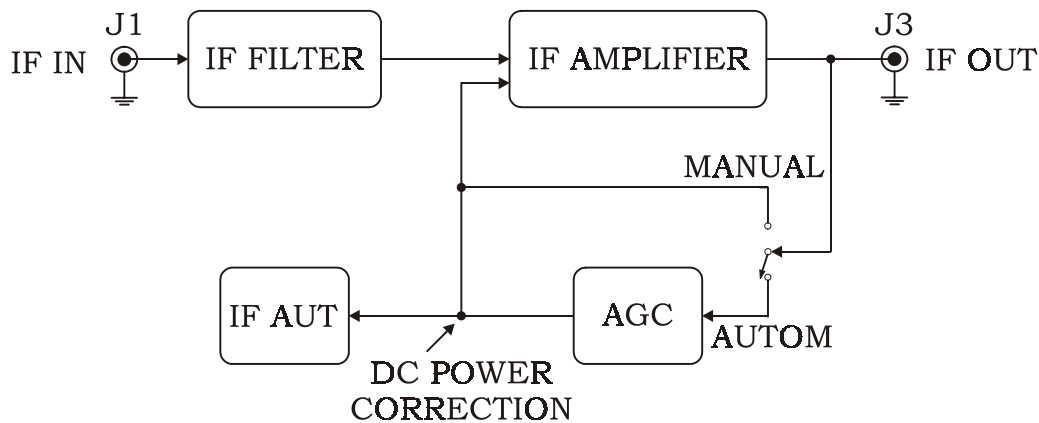
#### 3.1. Function:

The IF filter establishes the adequate bandwidth to the input signal and the IF amplifier supplies the gain for this signal, maintaining a constant level, through AGC loop.

#### 3.2. Technical Characteristics:

|                            |                               |
|----------------------------|-------------------------------|
| Central Frequency          | 44 MHz                        |
| Bandwidth                  | 6 MHz                         |
| Input and Output impedance | 50 Ohms                       |
| Maximum output level       | +3 dBm                        |
| Linearity                  | + or – 0.25 dB in $\pm 3$ MHz |
| Maximum gain               | 60 dB                         |
| AGC band                   | 50 dB                         |
| Supply                     | +12V at 250mA                 |

#### 3.3. Block Diagram:



#### 3.4. Technical description:

##### 3.4.1. IF Filter:

The input signal is applied by J1. The integrated circuit IC1 amplifies the applied signal to the IF filter.

The function of the circuit that is formed by C7, L3, C8, C9, L4, C10, C11, L5, C12, C13, C14 and C16 is to determine the IF amplifier operation bandwidth. This filter is adjusted to obtain a 6MHz bandwidth.

##### 3.4.2. IF amplifier:

The IF signal received from IF filter is, through C17, connected to the adjustable attenuating loop, that is formed by diodes D2, R9, D4 and D3. After the attenuating loop, the signal is amplified by the integrated circuit MAR-7 (IC2).

The amplified signal passes through another attenuating loop, formed by diodes and resistors D5, R14, D7 and D6, and it is connected by the capacitor C28 to the integrated circuit MAR-6 (IC3), and finally, through capacitor C29, reaches the integrated circuit MAR-7 (IC4).

A sample signal from the output signal is taken from the resistor R45; after, it is amplified by transistor Q4 and detected by the diodes D10 and D11. The detected signal by the diode D11 is supplied, by the emitter follower Q3, to check the IF level in the panel.

The integrated circuit IC5-B supplies in its output a dc level, that is the function of the received signal J1. The diode D1 and L9 act respectively in the polarization of the attenuating loops, altering the final gain of the IF amplifier. When JP2 is in the AUT position, this dc level is proportional due to the detected signal by the diode D10, maintaining the IF level constant in the output J3.

The IC5-A output level is the result of input levels voltage comparison between pins 3 and 2. This way we can determine the operation point of the IF command adjusting R21. Through CN3-1 the

following circuits are enabled.

## 4. IF Pre-distortion linearity:

### 4.1. Function:

It corrects the non-linearity and/or intermodulation that are generated at the final stage of the transmitter amplification.

### 4.2. Technical characteristics:

Frequency band: \_\_\_\_\_ 41 to 47 MHz  
 Input level: \_\_\_\_\_ -4.0 dBm  $\pm$  1.0 dBm  
 Output level (adj): \_\_\_\_\_ + 3.0 dBm (max)  
 Input/Output Impedance: \_\_\_\_\_ 50 ohm  
 Supply: \_\_\_\_\_ +25V

### 4.3. Technical Description:

IF signal applied to the input J1 is amplified by Q1, and in Q2 is divided in order to supply two circuits, a linear one and a non-linear one.

The linear circuit has about a 40 ns delay line to compensate the delay caused in the non-linear circuit. After the delay line, the signal is inserted through trimpot R13 in the adder circuit that is formed by Q4 and Q5.

The non-linear circuit causes a distortion in the signal through D3 and D4 that have its conduction region determined by trimpots R11 and R29. This signal, distorted and amplified by Q7 and Q8, is put in phase by equalizer circuit formed for L11, C29, R40 and R41, again amplified for Q9, via trimpot R50 and transistor Q10 and finally is added to the linear signal.

The composed IF signal passes by the attenuator circuit, and its level is adjusted by R44, and amplified by IC1 when it is delivered to output J2.

### 4.4. Adjustment Procedure:

The signal should be constantly checked by the spectrum analyzer using the red pattern modulated signal.

**1)** Insert the circuit in the system when the IF level is about -3.0 dBm in the input and all the trimpots are in the minimum.

**2)** Adjust trimpot R44 to 80% of its course approximately, then increase the level in R13 until the nominal power is reached.

**3)** Adjust trimpots R11 and R29 in order to cause the needed distortion to cancel the distortion that comes from the amplifying final stage, adjusting the level of this signal in the trimpot R50 and compensating the power variation in the trimpot R13, in order to maintain it as a nominal one. Adjust the inductor L11 to obtain the distorted signal phase inversion that will be inserted in the system.

## 5. Automatic Level Control (ALC):

### 5.1. Function:

The Automatic Level Control corrects the transmitter output peak sync power due to the variation gain of the amplifiers.

### 5.2. Technical Description:

This circuit has a total attenuation of 1dB, allowing controlling the power to positive and negative variation of 0.5dB.

The command occurs through the obtained voltage from the TV monitor through wire identified by the CAP cord. If the Turn on/turn off switch in the panel is OFF, it allows adjusting the output power, as it fixes the CP input in 3.7V. We can observe in the circuit the variable attenuator by the diodes PIN formed by diodes D1, D2 and D3, and capacitors C10, C11 to C14 and resistors R14 and R15.

The Pin diodes current occurs through the integrated circuit IC1A, by shock CH1. The TV monitor CAP command voltage supplies the IC1A inverter gate through R1. The integrate circuit IC1A amplifies this voltage increasing its range from -0.5 to -10V.

The integrated circuit IC1B receives this voltage of -0.5 to -10V by R10, adding it to a pre-fixed value R7, R8 and R9. This causes the IC1B output variation from -1.5 to -8V approximately, causing the circuit attenuation to PIN diode, which does not exceed a total variation of 1dB.

The divisor formed by R18, R19 and R20, allows obtaining the reference voltage (REF) to calibrate the transmitter power in the ALC OFF situation.

### 5.3. Adjustment Procedure:

- a) Turn the switch to OFF position (in the panel).
- b) Adjust R19 to a 3.7V reading in a digital multimeter in the output REF pin.
- c) Adjust the sweep generator, the detector and the oscilloscope to 0dBm IF frequency, inserting the circuit.
- d) Through CN1 turn on R1 to ground.
- e) Verify if the attenuation is inferior to 1dB in the oscilloscope and memorize the response.
- f) Through CN1, turn on R1 to -12V.
- g) Through R9 adjust the attenuation to 1dB in the oscilloscope.
- h) Turn off CN1 and adjust R5 to half of the range in the oscilloscope.
- i) Insert the circuit between the modulator and the channel converter.
- j) The IF level is adjusted to nominal power when the switch is in OFF position.
- k) Change to the ON position, verifying the output power.

## 6. Channel UP Converter:

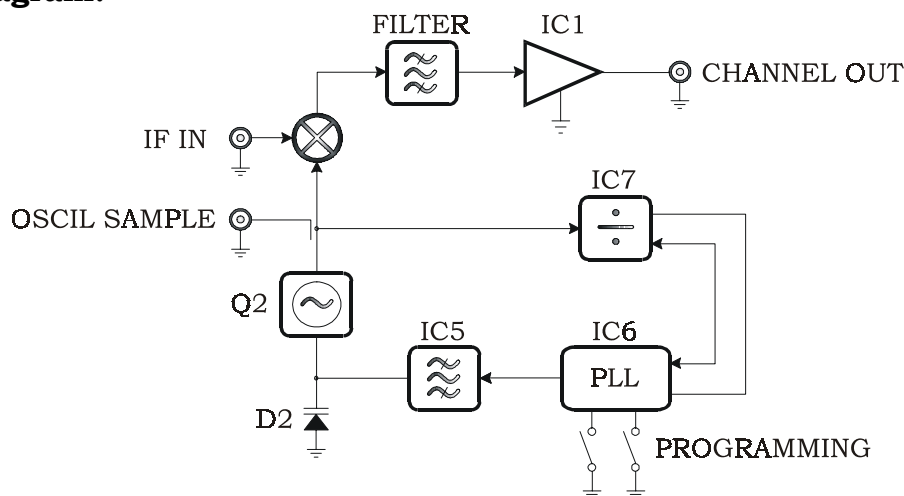
### 6.1. Function:

The channel UP converter function is to convert the IF frequency (41 to 47 MHz) to a determined channel in UHF.

### 6.2. Technical Characteristics:

Input frequency band: \_\_\_\_\_ 41 to 47 MHz  
 Output frequency band: \_\_\_\_\_ 470 to 890 MHz  
 Gain: \_\_\_\_\_ 0 dB  
 Input/Output Impedance: \_\_\_\_\_ 50 Ohms  
 Channel bandwidth: \_\_\_\_\_ 6 MHz  
 Consume: \_\_\_\_\_ +12V at 150mA

### 6.3. Block Diagram:



### 6.4. Technical Description:

The oscillator, transistor Q2, generates a low noise signal in the used frequency band. Its frequency is determined by the control voltage applied to diode varicap D2. The amplifier IC3 receives the oscillator signal and provides load isolation and, the amplifier IC2 delivers to the mixer a +17 dBm level. A sample from the oscillator signal is, through R25, delivered to IC7 prescaler, that divides the signal into 64 and 65, according to the control that comes from PLL, integrated circuit IC8. PLL receives the prescaler signal and divides it according to the external programming (1 to 8), and compares it in phase to a reference signal controlled by crystal generated by the own integrated circuit.

In the integrated circuit output results a proportional voltage that is the phase difference among the signals. This voltage is filtered by IC5 and applied to diode D2 for the frequency correction

The mixer MX1 receives IF signals and the local oscillator, and generates through the signal beating the desired channel. The conversion loss in the mixer is approximately 8dB at most. The signal after the mixer passes through the channel filter that rejects the local oscillator and the undesirable product in the conversion. The amplifier IC1 compensates the mixer and the channel filter losses.

### 6.5. System alignment:

1. Program the oscillator according to the given channel chart and with a multimeter in PT2, adjust trimmer C21 to a 4.5V reading. The led helps the adjustment, when it is turned off it indicates that the oscillator is in the desired frequency. In the point meas. at oscillator shows 0.5V level indicating the RF presence that comes from the local oscillator.

2. Put the sweep generator in the IF band in 41 to 47 MHz, and apply to the IF input, in JP1. Adjust the channel filter to the maximum gain and a better linearity, with the detector in the channel output.

## 7. PLL protection:

### 7.1. Function:

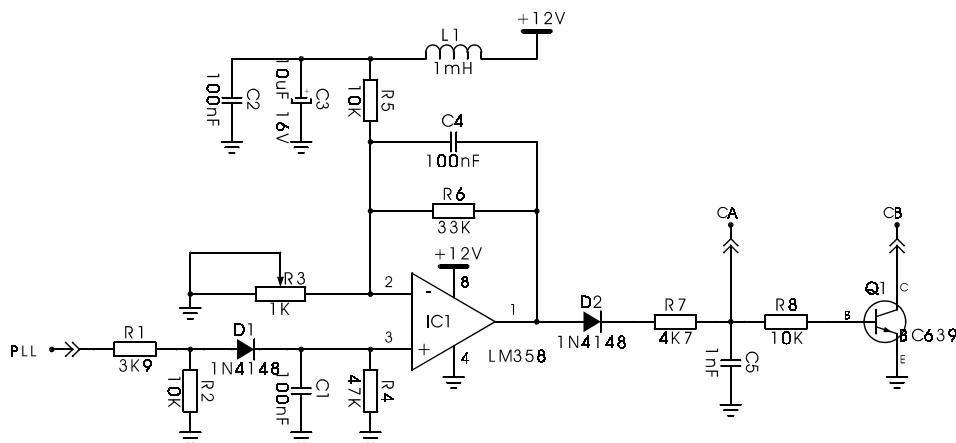
This circuit function is to turn off the transmitter.

### 7.2. Technical Description:

The DC voltage that comes from the channel converter, more precisely from the channel converter Led diode, is applied to the comparator through diode D1 by resistor R1 and reaches circuit integrated IC1 pin 3.

Through the adjustment in the trimpot R3, we can act in the integrated circuit comparison, moving pin 1 to high level (operational gain X comparing voltage). Then, through diode D2 this voltage is applied to CA output (High level) or CB (Low level), by the transistor Q1 collector saturation.

### 7.3. Circuit diagram PRT007:



| DESCRIÇÃO / DESCRIPTION        |                         |            |              |
|--------------------------------|-------------------------|------------|--------------|
| PROTEÇÃO PLL<br>PLL PROTECTION |                         |            |              |
| TÍTULO / MODEL                 | DATA REV.               | REV.       |              |
| PRT007                         | 06/04/1999              | ADR.       | X            |
| ARQUIVO / FILE                 | DATA FABR. / FABR. DATE | DES. / DWG | APR. / APPR. |
| PRT007.S01                     | 06/04/1999              | ADR.       |              |

## **8. UP Converter supply -12, +12 and +24V:**

### **8.1. Function:**

The power supply function is to generate -12V, +12V and +24V voltage suitable to supply the UP Converter.

### **8.2. Technical Description:**

The main AC input voltage is reduced by the transformer T1.

T1 has two secondary winds, one for the +24V and the second for the +12V and -12V supplies.

D1, D2, D3 and D4 rectifiers the secondary voltage that is filtered by the capacitor C1. IC1 is a linear regulator that feeds +24V at the output.

D5 and D6 are the rectifier diodes for the positive voltage filtered by C4.

IC2 is a linear regulator for the +12V output supply.

In the same manner there are a rectifier and a linear regulator for the negative voltage -12V.