Unit 2

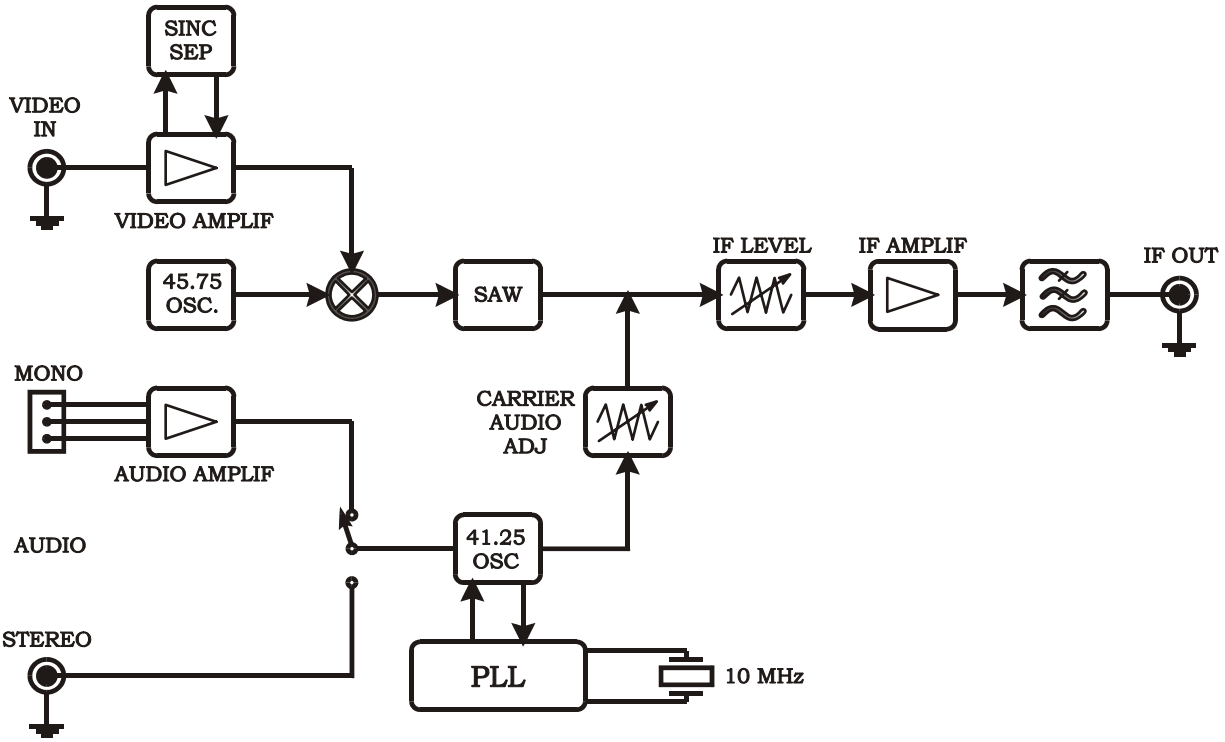
IF Modulator

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 syntonized 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, invertes 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.

2. Technical Characteristics:

2.1. General Characteristics:

Operation Temperature: _____ 0 to 45°C
AC Power Supply: _____ 220Vca / +36Vcc (optional)
Maximum consuption: _____15W
Dimensions: _____ Height = 44mm; Width = 482.6mm; Depth = 197mm
Weight: _____ 3.45 Kg

2.2. Video Input:

Impedance: _____ 75 Ohms
Return Loss:_____ > 30 dB (100 KHz to 4.2 MHz)
Level: _____ 1 Vpp (adjustable)
Clamping _____ in the blanking

2.3. Audio input:

Mono:
Impedance: _____ 600 Ohms balanced
Level: _____ 0 dBm (Adjustable)
Bandwidth: _____ 15 KHz

Stereo:
Impedance: _____ 75 Ohms unbalanced
Level: _____ 0 dBm (Adjustable)
Bandwidth: _____ 100 KHz

2.4. IF Output:

Impedance: _____ 50 Ohms
Return loss: _____ > 23 dB
Level: _____ 0 dBm maximum. (Adjustable)
Audio/Video carrier ratio: _____ -10 dB (Adjustable)
Harmonics: _____ < -60 dB

2.5. Video Carrier:

Frequency: _____ 45.75 MHz
Modulation: _____ 87.5 % (Adjustable)
Frequency response: _____ according to Mask. 1
Differential gain: _____ < +/- 3 %
Differential phase:_____ < +/- 2°
Signal to noise ratio: _____ > 60 dB (4.2 MHz BW)
K factor pulse 2 T: _____ < +/- 3 % (vide Mask. 2)
Line tilt: _____ < +/- 2 %
Frame tilt: _____ < +/- 3 %
Chr/Lum. delay: _____ < +/- 25 ns (vide Mask. 3)
Chrom./Luminance Gain: _____ < +/- 2 %
Synchronizing Pulse Amplitude:_____ < +/- 2 %
Burst Amplitude: _____ < +/- 5 %
ICPM: _____ < +/- 2 ° (pre-correction)

2.6. Audio Carrier:

Frequency: _____ 41.25 MHz
Frequency Stability: _____ 2x 10^{-6} (Thermal Chamber)
Deviation:_____ +/- 25 KHz (Adjustable)

Mono:

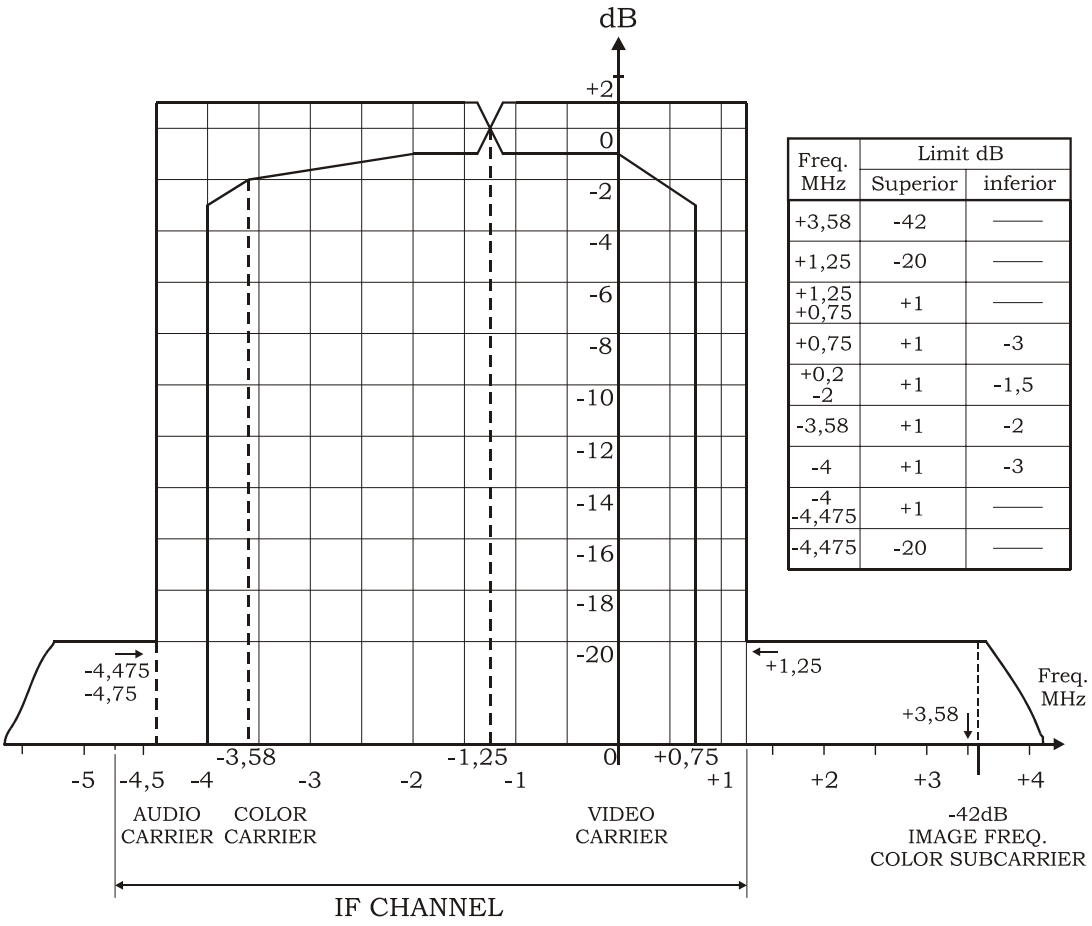
Pre-emphasis: _____ 75 µs (according to mask 4)
Freq. response: _____ +/- 0.5 dB (50 Hz to 15 KHz)
Distortion: _____ < 1 % (50 Hz to 15 KHz)
Signal to Noise Ratio:_____ > 60 dB (1 KHz signal)

Stereo:

Pre-emphasis:_____ turned off
Freq. response:_____ +/- 0.5 dB (50 Hz to 100 KHz)
Distortion: _____ < 1 % (50 Hz to 100 KHz)
Signal to Noise Ratio: _____ > 60 dB (signal 1 KHz)

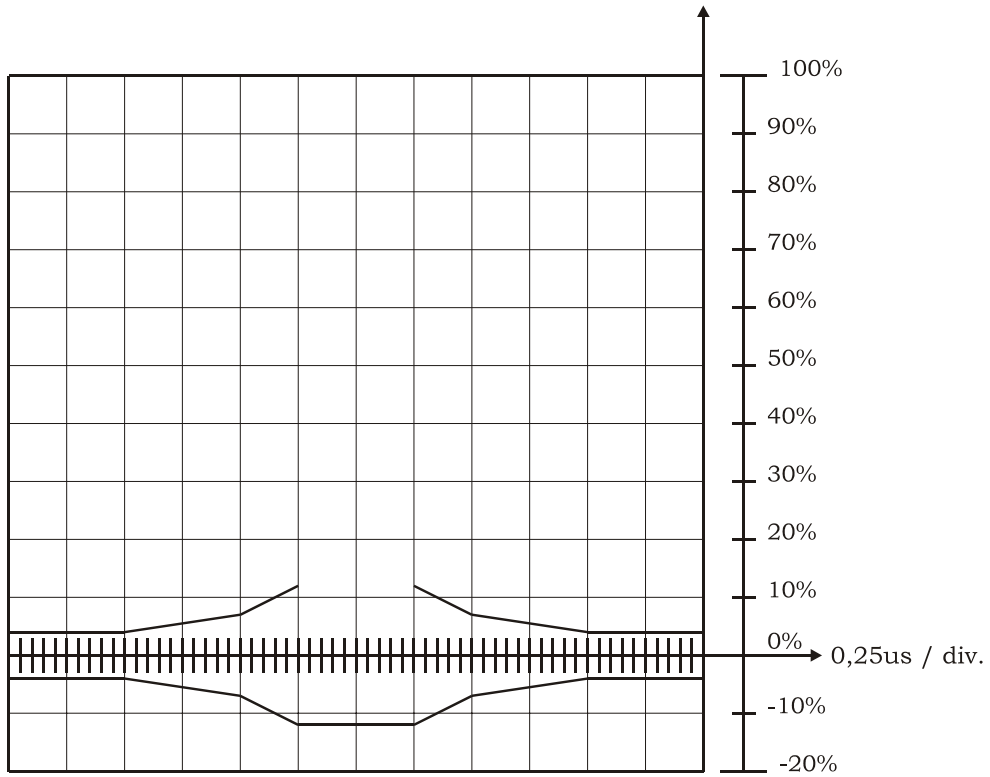
3. Reference Mask:

3.1. Frequency Response Mask 1:

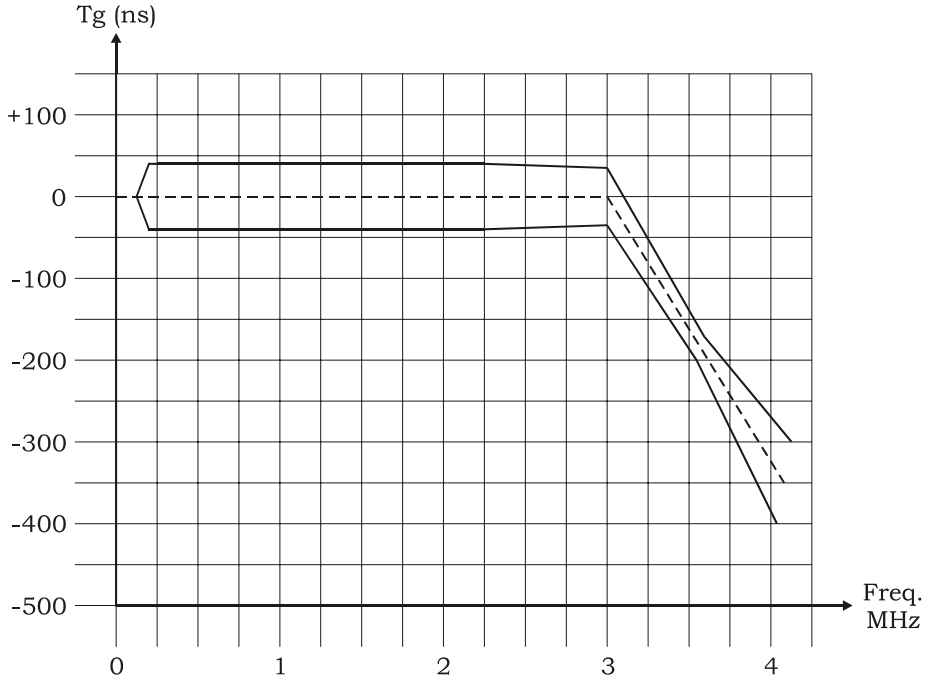


Freq. MHz	Limit dB	
	Superior	inferior
+3,58	-42	——
+1,25	-20	——
+1,25 +0,75	+1	——
+0,75	+1	-3
+0,2 -2	+1	-1,5
-3,58	+1	-2
-4	+1	-3
-4 -4,475	+1	——
-4,475	-20	——

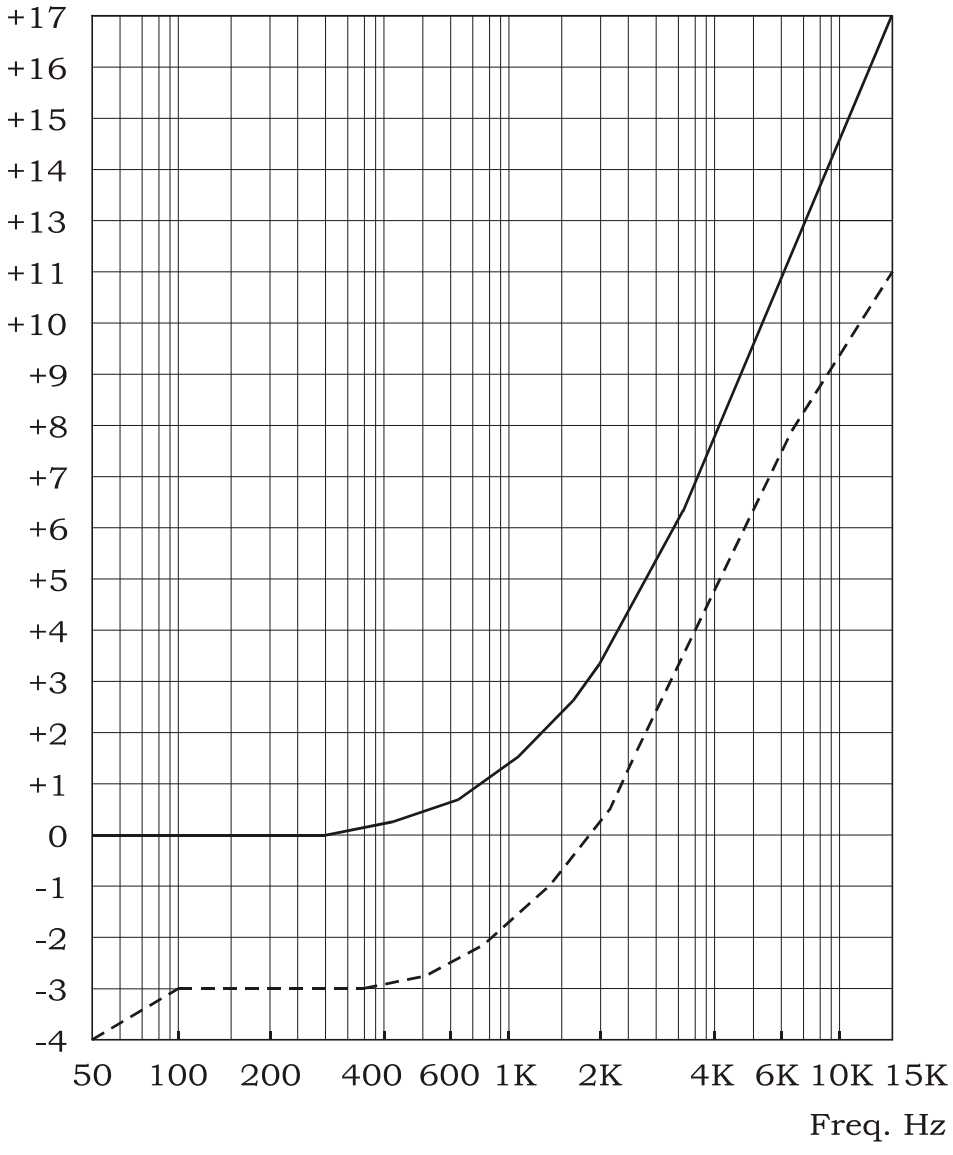
3.2 K Factor = 3% Mask 2:



3.3. Video Pre-Corrector Mask 3:

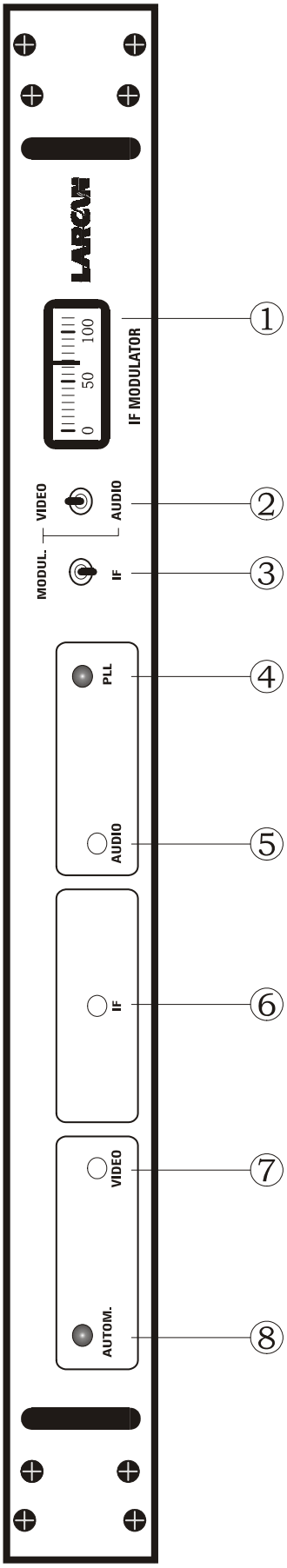


3.4. 75µs Pre-Emphasis Audio Response Mask 4:



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 swicth. 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.

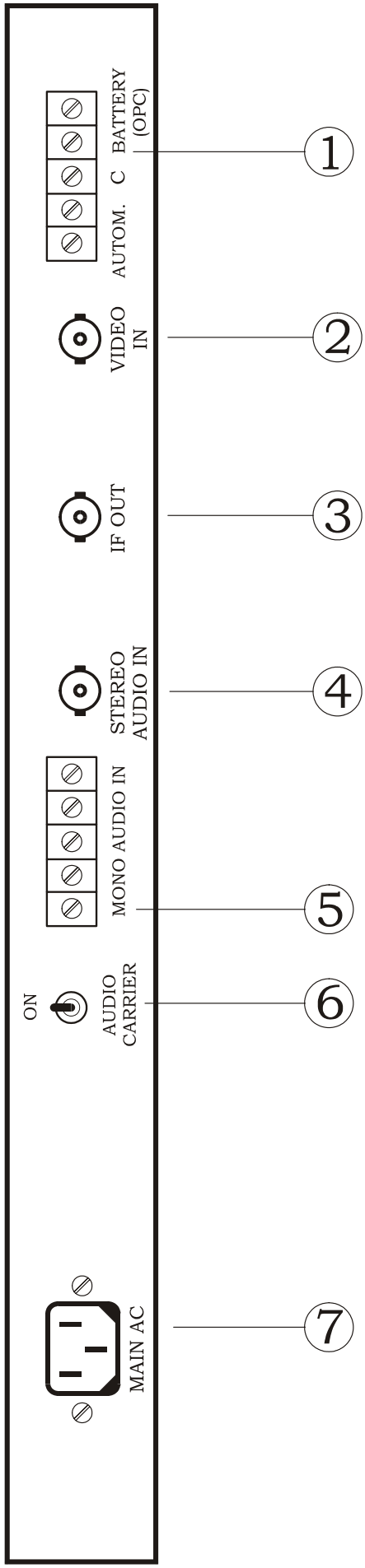
5. Audio: Audio level adjustment through trimpot R92.

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.