ADVANCED TV LINE

Model AT7120

120W ATSC UHF Transmitter

OWNERS MANUAL

Linear Industries Incorporation

www.linear-tv.com
Made in USA

AT7120

120W UHF 8VSB-ATSC TRANSMITTER

ADVANCED TV LINE
Owner Manual

Table of Contents

User Notices and WARNINGS

USER NOTICES

IT IS VERY IMPORTANT TO READ THE FOLLOWING MANUAL SECTIONS PRIOR TO OPERATION OF THIS TRANSMITTER!

Notice 1

The transmitter main operating voltage setting is marked on the rear of the chassis.

Notice 2

The transmitter operating frequency is set from the factory.

Notice 3

For adjusting the RF output power setting a qualified technician should always employ the use of an RF Wattmeter and a calibrated dummy load.

Notice 4

Should accident or injury occur to the personnel engaged in the installation, operation, or service of the equipment should seek proper medical attention. It is advisable that such personnel have familiarity with first-aid practices.

Notice 5

To call our technical support center or for other customer service issues at Linear Inc, refer to the following number: 847 428-5793, or e-mail to broadcast@linear-tv.com

Notice 6

If you experience some specific difficulty and the technical information available in this manual is not enough to help you, do not hesitate to call LINEAR technical support center.

Notice 7

WARNING!

THE VOLTAGES AND CURRENTS IN THIS EQUIPMENT COULD BE DANGEROUS. PERSONEL MUST, AT ALL TIMES, OBSERVE SAFETY WARNINGS, INSTRUCTIONS, AND ANY REGULATIONS.

THIS OWNER'S MANUAL IS INTENDED AS A GENERAL GUIDE FOR TRAINED AND QUALIFIED PERSONNEL WHO ARE AWARE OF THE DANGERS THAT ARE INHERENT IN THE HANDLING AND OPERATION OF POTENTIALLY HAZARDOUS ELECTRICAL AND ELECTRONIC CIRCUITS. IT IS NOT THE INTENT OF THIS MANUAL TO PROVIDE A COMPLETE SET OF SAFETY INSTRUCTIONS OR PRECAUTIONS THAT SHOULD ALREADY BE UNDERSTOOD BY TRAINED OR EXPERIENCED PERSONNEL IN USING THIS OR OTHER TYPES OF ELECTRONIC EQUIPMENT.

THE INSTALLATION, OPERATION, AND MAINTENANCE OF THIS EQUIPMENT INVOLVE RISKS TO PERSONNEL AND ALSO TO THE EQUIPMENT. LINEAR, INC. SHALL NOT BE RESPONSIBLE FOR INJURY OR DAMAGE THAT IS THE RESULT OF IMPROPER PROCEDURES OR USE BY PERSONS IMPROPERLY TRAINED OR LACKING THE KNOWLEDGE TO PERFORM ASSOCIATED TASKS.

ALL LOCAL CODES FOR BUILDING, SAFETY, FIRE, OR RELATED STANDARDS MUST BE OBSERVED. CONSULT LOCAL AUTHORITIES FOR THE STANDARDS FOR THE AREA OR REGION WHERE THE EQUIPMENT WILL BE INSTALLED AND PUT IN USE.

WARNING!

AT ALL TIMES DISCONNECT AC/MAINS POWER BEFORE OPENING COVERS, DOORS, ENCLOSURES, PANELS, OR PROTECTIVE SHIELDS THAT EXPOSE LIVE CIRCUITS. NEVER PERFORM MAINTENANCE, MAKE ADJUSTMENTS, OR SERVICE THE EQUIPMENT WHEN ALONE OR FATIGUED.

***WARNING*!**

IF ELECTROLYTIC OR OIL FILLED CAPACITORS ARE UTILIZED IN THE EQUIPMENT AND THE COMPONENT APPEARS LEAKY, OR IS BULGING, OR IF THE CASE OR COVERING OF THE COMPONENT APPEARS DAMAGED OR DISTRESSED ALLOW SUFFICIENT TIME FOR THE UNIT TO COOL and FULLY DISCHARGE BEFORE SERVICING. SERVICING HOT OR LEAKY CAPACITORS CAN CAUSE A RUPTURE OF THE CASE AND POSSIBLE INJURY.

Returns and Exchanges

Equipment (Damaged or undamaged) should not be returned without written approval and a Merchandise Return Authorization (MRA Number) from your Linear Sales representative or Linear Customer Service. Special shipping instruction will be provided which will assure proper handling. The circumstances and reasons for the return must be included in the request for return. Equipment that is special or "custom" ordered may not be returnable. In situations where return or exchange is at the request of the customer a restocking fee may be charged. All returns must be sent freight prepaid and

properly insured by customer. When communicating with Linear please refer to your Order or Invoice Number.

Unpacking

Use care when unpacking the equipment. First perform a visual inspection of the item(s) to determine if any damage occurred during shipment. Be sure to retain all the shipping materials (crates and boxes or cartons) until such time that it has been determined that the received equipment arrived undamaged. Find all PACKING LISTS and keep them to assist in locating and identifying any components or assemblies that may have been removed for safe. Make sure that all shipping straps, supports and packing materials are completely removed from the equipment prior to initialization and use.

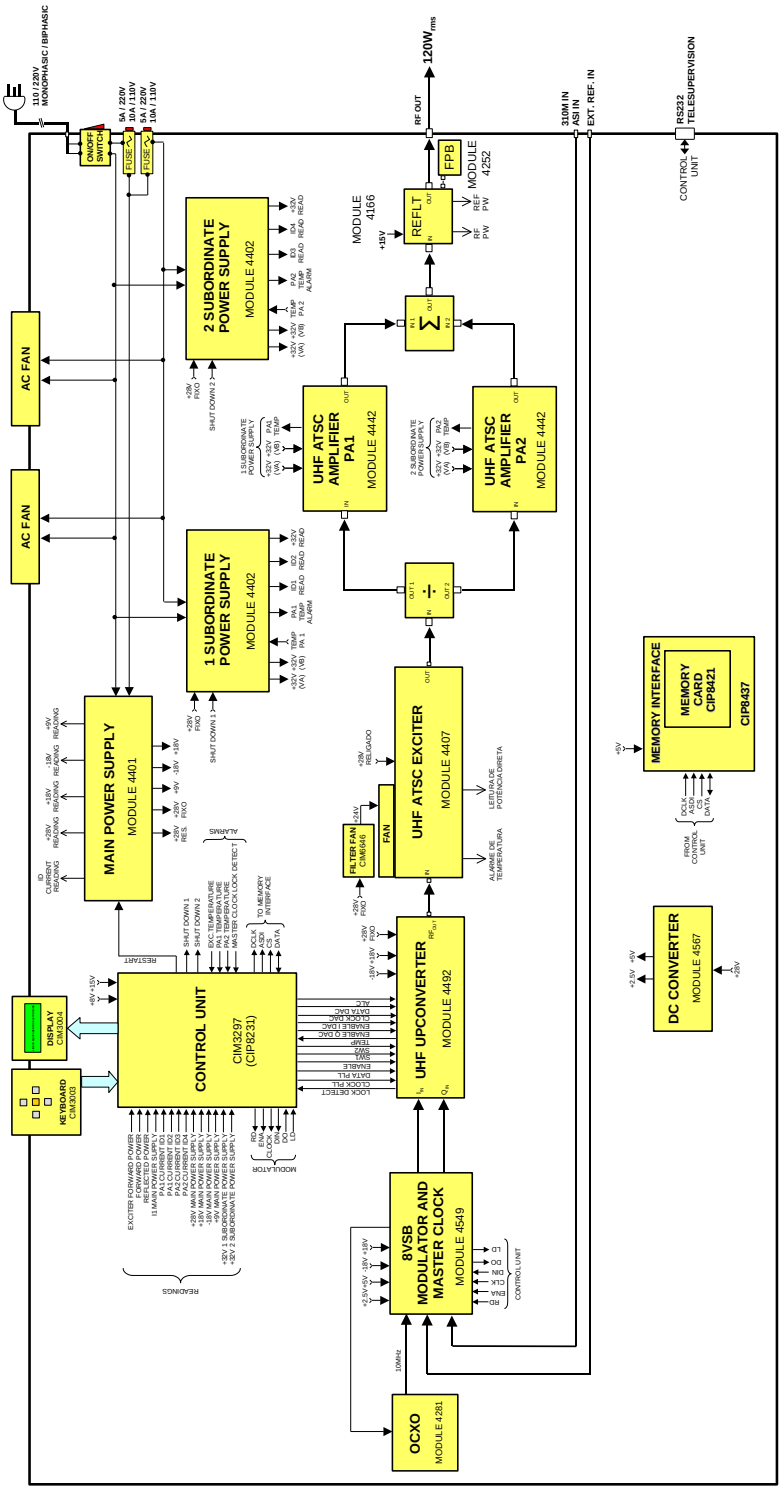
Section 1 – AT7120 General Description

The ATSC DTV transmitter model AT7120 is part of the ADVANCED TV line, having modular construction meeting EIA 19”rack standards, and is composed for the following modules:

- 01 Main Control unit - CIM3297
- 01 Keypad - CIM3003
- 01 Display LCD 20 columns x 02 lines - CIM3004
- 01 Memory interface - CIP8421
- 01 1Mbits memory card – CIP8421
- 01 UHF ATSC Exciter- Module 4407
- 01 up-Digital Converter - Module 4492
- 01 Power Supply - Module 4401 (versions M110/M220/B220)
- 01 8VSB Modulator and Master Clock Generator - Module 4549
- 01 DC/DC Converter (+2.5V and +5V) – Module 4567
- 02 UHF ATSC Amplifier – Module 4442
- 01 OCXO – Module 4292

When AT7120 is a TRANSMITTER that can be installed with or without a 6 pole elliptical filter on its RF output. In this application, the overall performance of the unit will meet or exceed the FCC requirements for out of channel spurious emission. Please refer to Annex C.

AT7120 Block Diagram



Module 4549

8VSB Modulator

The 8VSB modulator automatically recognizes the incoming transport stream as either SMPTE310M or ASI. The transport stream input utilizes the BNC connector located on the rear panel of the unit. The modulated output signal of this module is composed by two IF orthogonal carriers termed; signals (I) and (Q). The central frequency of the 8VSB modulated IF signal is 18.83339MHz. The signal processing and modulation performed on this module follows the ATSC recommendation A/53 E.

This module also performs the non-linear corrections that might be necessary to enhance the equipment efficiency to meet FCC spurious emissions requirements. In this case, an RF output filter is required. The recommended linear equalization is also automatically performed in this module.

Master Clock

The master clock unit generates signals utilizing a Voltage Controlled Oscillator and Phase Locked Loop at 172.16MHz. The PLL is locked at 10MHz reference, externally or internally generated. This signal provides the time base for the 8VSB modulator.

Module 4492

IF to UHF up-Converter

The IF carries the orthogonal (I) and (Q) signals generated in module 4549, (8VSB Modulator), which is then routed to the up-converter module. The output signal of this module is set on the FCC/UHF operational 6MHz channel of the transmitter AT7120.

Inside the converter the modulated IF band is mixed with the continuous wave local oscillator LO. As a result of this mixing, the IF translation to the UHF band is performed. The LO is a free oscillator, that has its frequency locked via PLL. The LO/PLL is generated by a 10MHz OCXO (oven controlled crystal oscillator), or provided by an external reference signal.

Module 4281

10MHz reference automatic switching

Both circuits; the 8VSB modulator and the up-converter, share the same reference signal source. The use of the same reference signal creates perfect synchronization and stability during the DTV transmission process. The internal 10MHz signal is obtained from an OCXO oscillator with a stability of 0.3ppm. An external 10MHz signal can be used as the reference signal; a GPS signal for instance. The external reference input is a BNC connector located on the rear panel of the unit. In the absence of this external source, the unit automatically utilizes the internal 10MHz source generated by the OCXO.

Module 4407

60W UHF band multistage amplifier

The IF modulated signal (previously converted into UHF) is amplified by a 60W UHF amplifier. This amplifier uses transistors built with LDMOS technology operating in a class AB configuration, which provides excellent efficiency and linearity. The RF OUT connector of the unit provides the high power RF output.

RF Output monitoring

Module 4407 detects the direct and reverse RF power present on the RF OUT connector of the unit. The detected information is then converted to correspondent DC levels before being routed to the master control unit, where it is processed and displayed at the front panel LCD screen in watts.

Module 4442

AT7120 transmitter has two Modules 4442 connected in parallel, which work as digital TV end amplifiers in all UHF band. The amplifier is made of the following components:

Input Coupler

The input RF coupler equally divides the UHF signal present in the input connector for the two amplification cells, maintaining 50Ω impedance.

Cell A – 35W Amplifier

The amplification cell A is obtained by a Push-Pull 35W amplifier, class AB. Transistor T1 is in this cell. The polarization circuit of cell A is made of a VGS timer circuit with temperature compensation, differential amplifier and gate impedance reducer.

Cell B – 35W Amplifier

Just as cell A, cell B's amplification is obtained by a Push-Pull 35W amplifier, class AB. Transistor T2 is in this cell. The polarization circuit in cell B also is made of a VGS timer circuit with temperature compensation, differential amplifier and gate impedance reducer.

Output Coupler

It is a hybrid coupler built with a special semi-rigid coaxial cable, better known as "wireline". This type of cable has 2 internal conductors interlinked; this set has the characteristics of a hybrid coupler. As the input coupler, this coupler also has four gates (input/output; isolated, -3dB 0˚, -3 dB 90˚).

Temperature Alarm

Module 4442 has a protection circuit that disarms the module in case the temperature rises above 65˚ C. This circuit is basically made of thermal sensor S1, DC amplifier and voltage comparator CI-1.

CIM3297

Control unit card

The digital management of the DTV AT7120 transmitter is done by the control unit card, CIM3297. This control unit uses an A128 microcontroller programmed in assembler language. The unit process data regarding the following operational parameters:

- Warns of signal lock failure of the PLL in the up-converter.
- Warns of excessive temperature of the 60W amplifier.
- Monitors and displays the RF direct and reflected powers of the 60W amplifier, muting the transmission in case of extreme levels.
- Displays DC current levels of the main power supply module.
- Process and displays power supply voltage(s).
- Sets in the operational channel of the Up-converter unit and transmits power levels via ALC. Sets and monitors the operational channel frequency in the up-converter unit as well as the transmit power levels which is controlled by the automatic level control circuits.

The control unit is directly connected to a keypad and LCD screen, both located on the front panel of the transmitter AT7120. Numerous parameters can be set via the keypad and monitored by the LCD screen. The same functions can be performed via RS232 HyperTerminal connection.

Module 4401

Power Supply

The power supply module is a switching power supply type, utilizing a half-bridge topology. A control unit monitors the power supply output and adjusts to varying load to maintain a nominal +32 VDC. The voltage and current data is provided to the control unit card for display on the LCD screen.

AT7120 External Interfaces

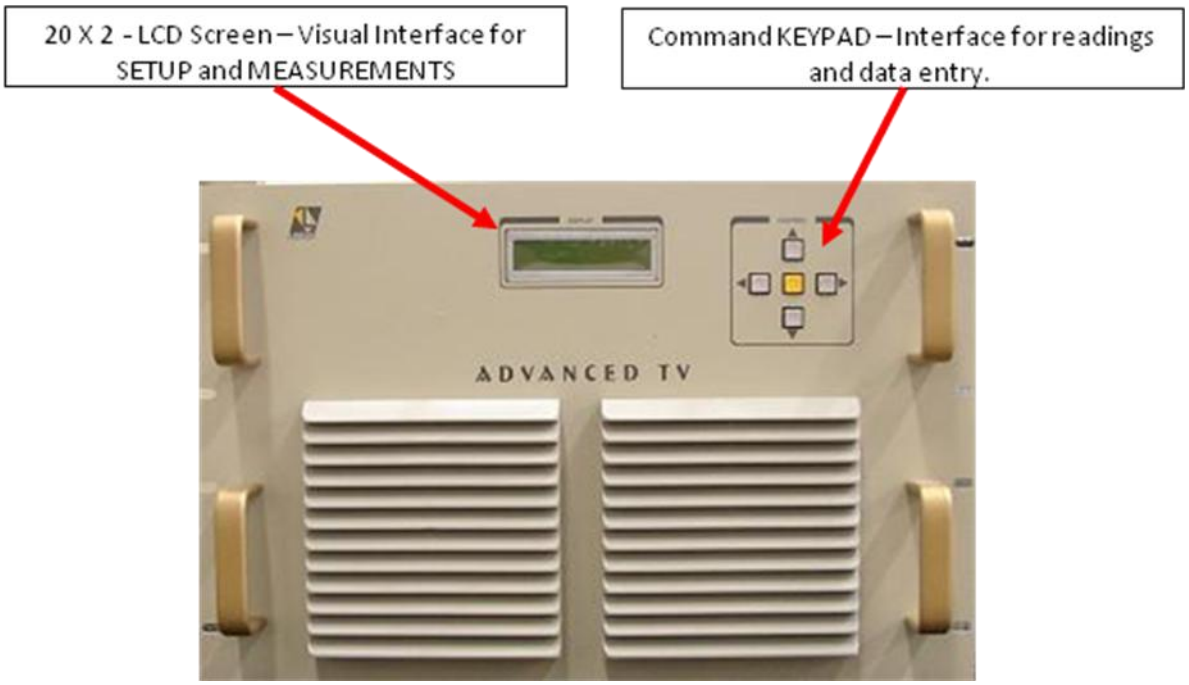


Fig.1.2: AT7120 Front View

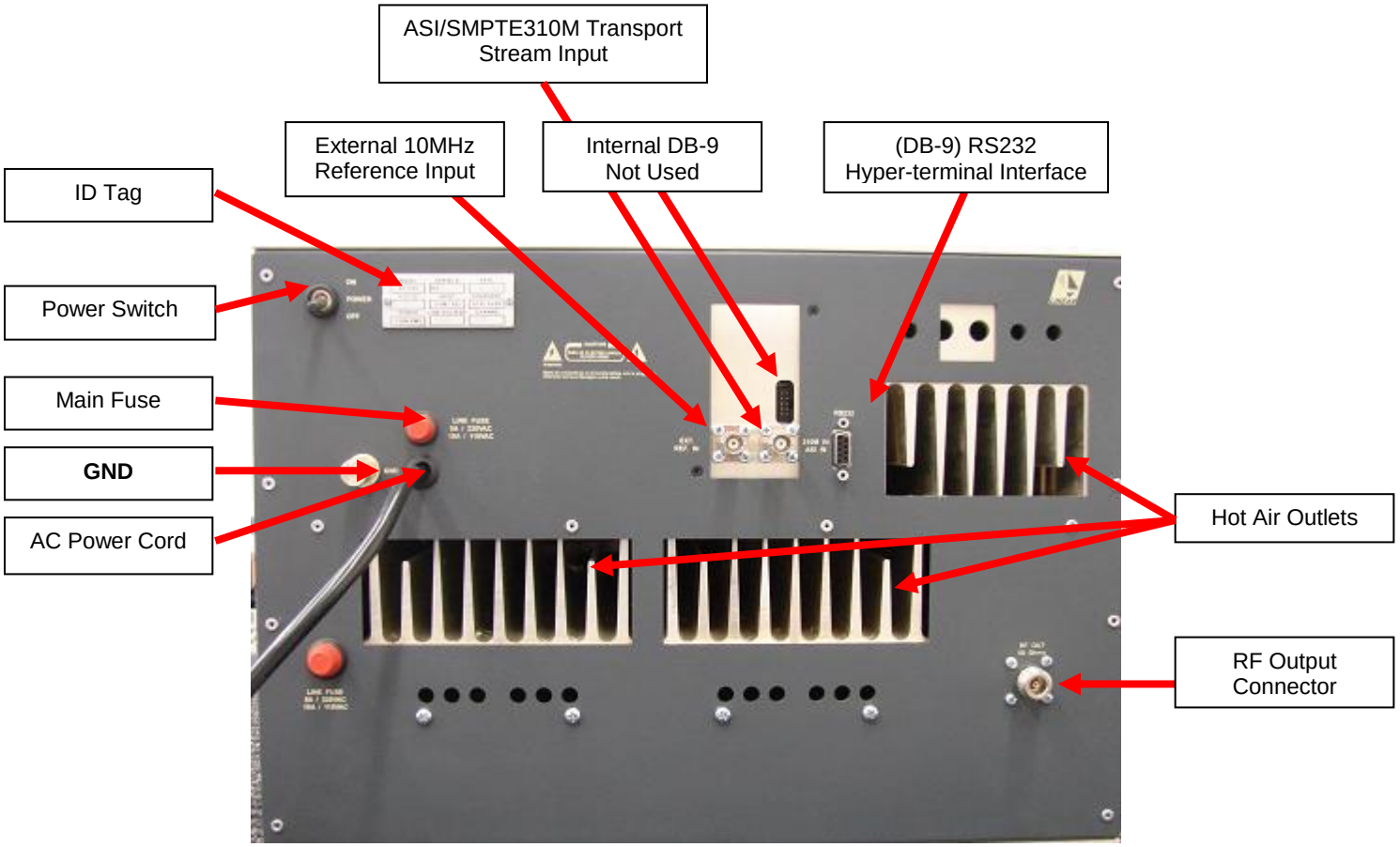


Fig.1.3: AT7120 Rear Panel View

AT7120 - Modules and Parts Displacement

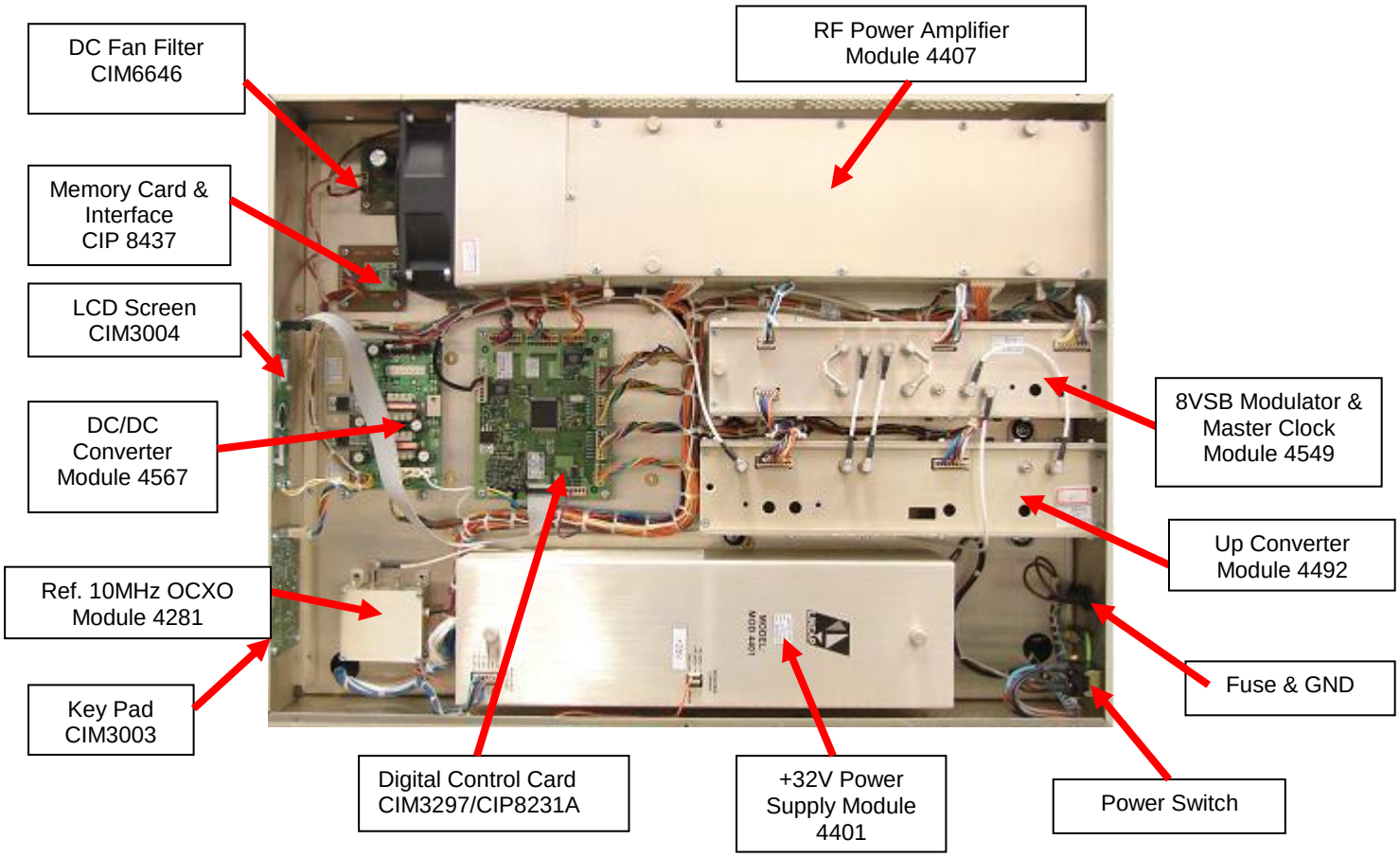


Fig.1.4: AT7120 Modules and Parts displacement

AT7120 - 120W ATSC UHF Transmitter - Technical Specifications

Table XX: AT7120 Technical specifications

Electrical	
Main	220 VAC, bi phase, 50-60 Hz. standard
Consumption	400W @ 120W RMS/RF
Power Factor Correction, FPC.	Included
Signal Input	
Transport Stream Input	ATSC/MPEG2, compliant to SMPTE310M
Input Data Rate	19.39 Mbps
External Reference Signal	10MHz. (0 to +10 dBm).
Input Connector	75Ω (BNC),
Reference Input Connector	50Ω (BNC),
RF	
Modulation Mode	8VSB.
IF	18.833916 MHz.
Channel Bandwidth	6MHz.
Test Signal	PRBS
Frequency Range	UHF. C14 to Ch53, (3 bands).
Frequency Step	1 Hz. ± 220kHz
Symbol Rate	10.76 MSymbol/sec.
Digital/Analog Converter	16 bit
Linearization Pre-Correction	Included
Pilot frequency stability overall	± 4.6 ppm.
Initial tolerance	± 1.0 ppm.
Vs. temperature in operating temperature range (steady state)	± 10 ppb.
Holdover 24 hours, full temp. range	± 12 ppb.
24 hours drift (after 30 days)	± 1.0 ppb.
Long term stability over 15 years	± 3.5 ppm.
Peak to peak frequency response	0.15 dB.
Peak to peak group delay response	10 ns.
Phase noise	≤ -104 dBc/Hz @ 20kHz offset.
Conducted spurious and harmonics	< -60 dBc, FCC 47 Part 74.
Radiated spourious and harmonics	< -80 dBc, FCC 47 Part 74.
MER (Modulation Error Rate)	≥ 29 dB (transmitter output) typical.
RF output connector	N
Communication	
Hyper-terminal	RS232 (DB-9)
External Command – ON/OFF	(DB-9)
Mechanical	
Air speed over drawers	50 ft/minute.
Dimensions	5UR (H), 19”(W), 26”(D)
Weight	Gross: 110 lb.

Section 2 – Control Set

Functional Description

The digital control is responsible for all management of AT7120 transmitter.

This unit Monitors and assures the system is operating within acceptable parameters and provides user control access via key pad located on the front panel, or via RS232 hyper-terminal.

Its main attributions are:

- Warns of signal lock failure of the PLL in the up-converter.
- Warns of excessive temperature of the 60W amplifier.
- Monitors and displays the RF direct and reflected powers of the 60W amplifier, muting the transmission in case of extreme levels.
- Displays DC current levels of the main power supply module (I1).
- Process and displays power supply voltage(s).
- Sets in the operational channel of the Up-converter unit and transmits power levels via ALC. Sets and monitors the operational channel frequency in the up-converter unit as well as the transmit power levels which is controlled by the automatic level control circuits.

The control unit is directly connected to a keypad and LCD screen, both located on the front panel of the transmitter AT7120. Numerous parameters can be set via the keypad and monitored by the LCD screen. The same functions can be performed via RS232 HyperTerminal connection.

Control unit block diagram

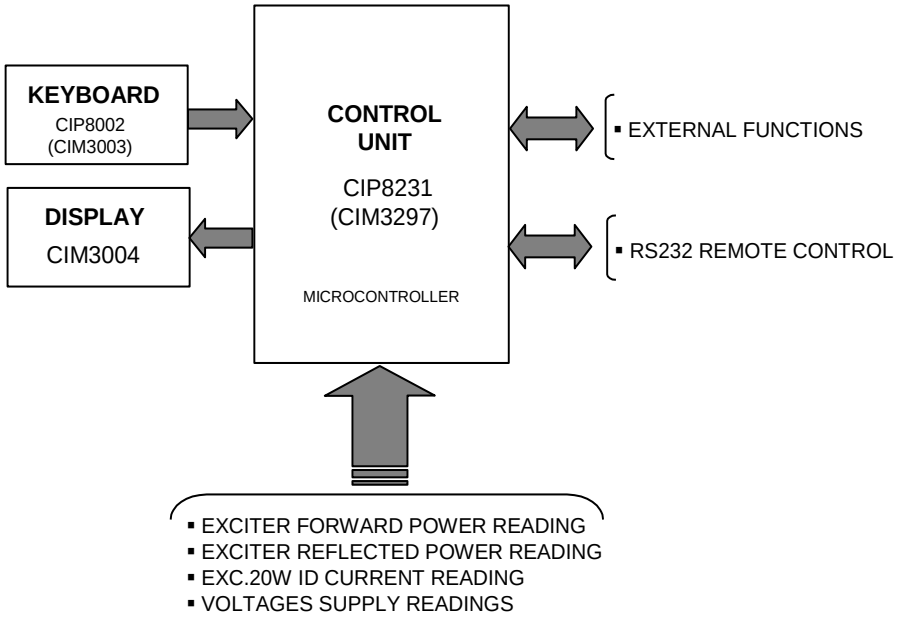
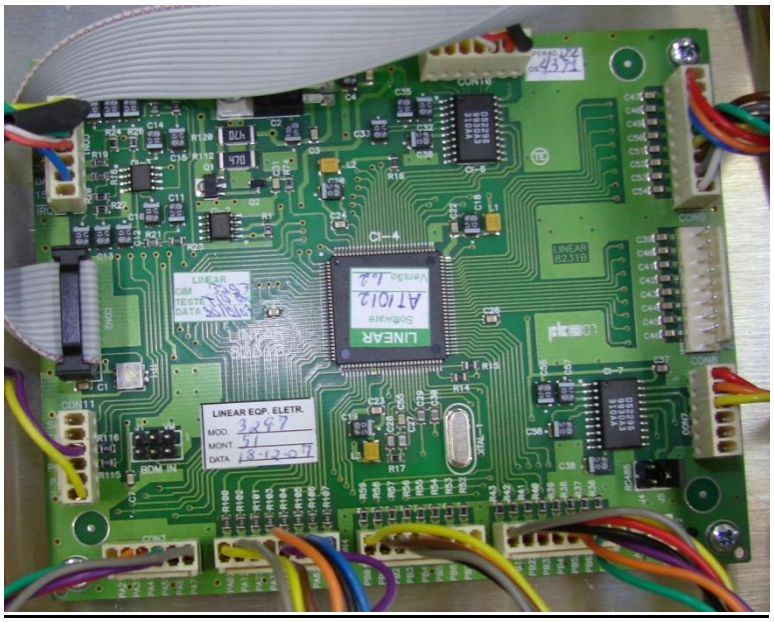


Fig.2.1: Control unit general block diagram

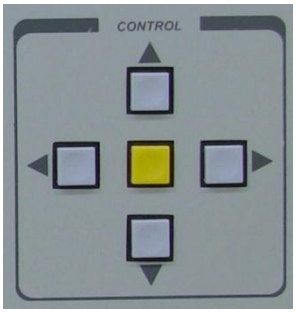
The printed circuit board CIP8231 is referred to as the control unit, and provides the major functionality of the AT7120 digital control unit.

For a better understanding of the functioning of this board please refer to Fig.2.1 “Control unity general block diagram”, above, which depicts the main components and connections. Figure 2.2, below, shows a detailed schematic of CIP8231 including connector pin layout.

01 control unit board - CIP8231 (CIM3297)



01 keypad board - CIP8002 (CIM3003)



01 20 x 2 LCD display board - CIM3004

CIP8231 Connections

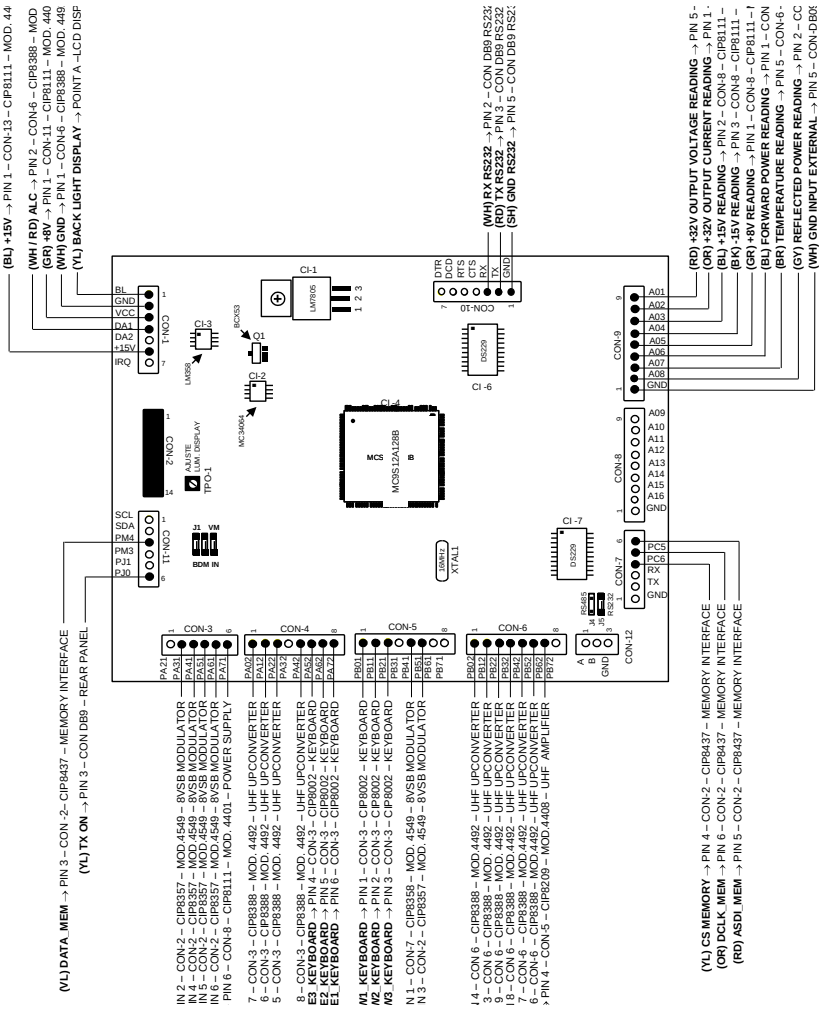


Fig.2.2: CIP8231- the control unit board - components and connections.

The major components and functions of CIP8231 are described below:

Integrated circuit CI-4 (A128) is a 16 bit microcontroller programmed in assembly that performs all system management functions. This component is programmed in the factory and includes a numeral

designation identifying the unity and software version. The unit contains firmware control software that allows the operating system software to be updated as needed.

→ ***In case of substitution of the CI-4 or the entire PCB CIP8231, it is mandatory to provide the factory, prior to replacement, the programming identification number that is clearly indicated on CI-4.***

All the available analog parameter information from the system is sent to connector CON-9 on the CIP8231 board. The parameters monitored and displayed are as follows:

- Direct power – 120W Amplifier
- Reverse power - 120W Amplifier
- (+9V) - Power supply
- (+18V) - Power supply
- (-18V) - Power supply.
- (+32V) - Power supply.
- (I1) – the main power supply electrical current.

The analog signals are sent to microcontroller CI-4, where they are digitalized and processed. The software of this microcontroller compares the readings with the stored nominal values. Readings outside of nominal values generate associated alarms. Values and alarm states are displayed on the LCD panel located on the front of the unit. Important note: The equipment is designed so that a nominal analog reading presents +4 volts DC to the Con-9 connector. The voltage level presented to Con-9 can be adjusted during setup or maintenance when external equipment is used to assure proper calibration / reading.

Each module that generates analog control / monitoring information has an associated test point on the unit. If during the calibration process external measurements indicate the correct nominal value for that function, a trimpot is adjusted to set the voltage on the test point to +4Volts.

Note: Set the voltage on the test point associated with reflected power, if the voltage becomes higher than +4Volts, the control unit will process this event as an alarm. This event is associated with a reverse power in excess of 10% of the transmit power.

Alarm detection

For the alarms listed below, the CIP8231 control unit board shuts down the transmission by Setting the Automatic Level Control (ALC) to zero volts (provided to the up-converter module 4492). For more details see the power control description on the next page.

The following alarms reach the connectors CON-4, CON-5 and CON-6 at the CIP8231 board as digital information.

- Lack of lock voltage of the PLL at the Up-converter - Module 4492.
- Excessive temperature of the 60W UHF amplifier - Module 4407 – (above 65ºC).
- Excessive reverse power (above +4V at CON-9).
- Overflow of the FIFO register in the 8VSB modulator (communication between microcontroller and modulator).
- Failure of synchronization of the transport data (MPEG) stream
- Presence of non-programmed hardware (a false alarm may present during the warm-up phase of the equipment).
- Imperfections associated with the generation of master clock signal in the modulator 8VSB - Module 4549.

Nominal operation of the equipment presents +5Vdc on the alarm pins on CON-4 and CON-6; CON-5 indicates that there is no alarm condition. An alarm state is indicated by a voltage of less than 5 VDC. In most cases the alarm state will present zero volts dc to the associated connector. The microcontroller (CI-4) will inhibit transmission during an alarm state.

The alarms generated in the system are shown in the LCD display of the MCU. The corresponding indication for these alarms are "*" for active alarms - - and "#" for previous alarms (an alarm state that has been resolved or that has ended.) - PAST. The occurrence of an alarm "*" will automatically end the transmission. When the reason for this alarm "*" is resolved, a symbol "#" will appear and the transmission will be restored automatically. To erase old alarms, just press the "CLR.ALL" key on the front panel of the equipment or when using a hyper-terminal press "1" on the keyboard.

Communication with 8VSB modulator

The CIP8231 board communicates with the 8VSB modulator - Module 4549 - through a set of serial port interfaces (SPI). These SPI's are located on pins 2 to 5 of connector CON-3 and on pins 5 and 6 of connector CON-5.

The communication between CIP8231 board and the 8VSB modulator - Module 4549 - monitors and sets the configuration parameters of this module. For example, the adjustment of the pilot programming stream (the 8VSB signal), and adjustment of the superior lateral band rejection are managed over this communication interface.

Setting the FCC/UHF operational channel

The operational channel of the equipment is set via the CIP8231 board. The board generates a code that represents the selected channel (UHF) which is then sent over the SPI to the up-converter - Module 4492 - This stream of information is composed by data, clock and enabling code, and is presented on pins 1, 2 and 3 of connector CON-4 of the CIP8231 board.

The control board also sends the operational channel information to program the PLL circuit at CIP8388, which will then synthesize the local oscillator frequency required to create the desired channel. During normal operation the CIP8231 continuously manages the PLL of module 4492.

It is important to remember that the initial programming of the CIP8231 board for the transmitter AT7120 is made at the factory. These programming procedures are not accessible to the end user.

In turn, Module 4492 sends the lock detected information to the CIP8231 board indicating that the PLL circuitry is in lock and ready for operation. This information is presented as voltage level of approximately +3.6V and is routed to pin 5 of connector CON-4. The absence of this voltage will trigger the lock alarm that will terminate transmission (RF output power is set to zero dbm) and present an alarm "*" on the LCD display located on the front panel of the transmitter.

RF power control

RF transmitter power is set by the end user, via the front panel. The CIP8231 board converts this digital input programming information into analog voltage levels. This voltage is then sent to the up-converter of the exciter. This specific voltage level is called ALC REFERENCE VOLTAGE or trellis voltage, and is shown on the LCD digital display as V.P. Adj.

The trellis voltage is directly proportional to the RF power level at the output of the exciter, in other words, the higher the trellis voltage the higher the exciter RF power level. The typical value of trellis voltage at normal rated power output is between 3V and 4V.

In case of failures or malfunctions, the power control is responsible for acting immediately to set the RF power level to zero, thus correspondingly, the trellis voltage is set to zero. This may occur in during any alarm state where transmission must be terminated to protect equipment or to maintain regulatory compliance.

A warm up period of approximately five (5) seconds is required for the exciter to reach nominal RF power. This period of time, is also known as SLOPE UP time, it is the time necessary for the trellis voltage to increase from its initial zero volts up to its the value, set corresponding to the programmed RF power level as measured at the output of the transmitter.

Programming the off-set operational frequency

The AT7120 transmitter is factory set to a FCC/UHF operational channel, under ATSC standards. The channel off-set frequency can be changed at the end user discretion. The offset can shift the RF channel band up to 30 kHz, in 1Hz increments. The shift of frequency can increase or decrease the start frequency of the band of the UHF channel. The offset is programmed at the CIP8231 board, which provides control signals to the up-converter - Module 4492 - on pins 1, 2, 3 of connector CON-4.

While the equipment is turned on, the CIP8231 board automatically re-confirms the last set of programmed data at the up-converter – module 4492. The programming instructions generated by the CIP8231 board of the transmitter are set at the factory and, therefore, are not accessible to the user.

+32V power supply ON/OFF control.

The CIP8231 board sends a +5 volt dc signal to the power supply - Module 4401- to switch it ON. The signal is located at pin 6 of connector CON-3.

In the absence of this signal, the power supply - Module 4401 - will stop supplying the +32 volt line, which feeds the 60W UHF amplifier - Module 4407. The other voltages remain present if the transmitter is operational.

Serial communication RS232

The access to CIP8231 board is through a PC that has the Windows Hyper Terminal. At the rear panel of the transmitter there is a DB9 connector - tag as RS232- which is linked to connector CON-10, located at CIP8231 board.

Keypad – CIP8002 board

The CIP8002 board contains five key buttons SW1 to SW5, located on the front panel of the transmitter. This board is a matrix of electrical ON/OFF contacts. The responses are made available at the connector CON-3.

LCD - CIM3004 board

CIM3004 board is a LCD - Liquid Crystal Display - of 20 columns by 2 lines. The back light of this display is controlled by the CIP8231 board which sends +5V between a test point termed A+ (yellow wire) and ground test point termed K- (white wire). The trimpot TPO-1 located at CIP8231 board controls the intensity of the characters of the display. The jumper J1, also located at CIP8231 board, can be set to the R61 position, if the LCD back light is desired to stay ON at all time.

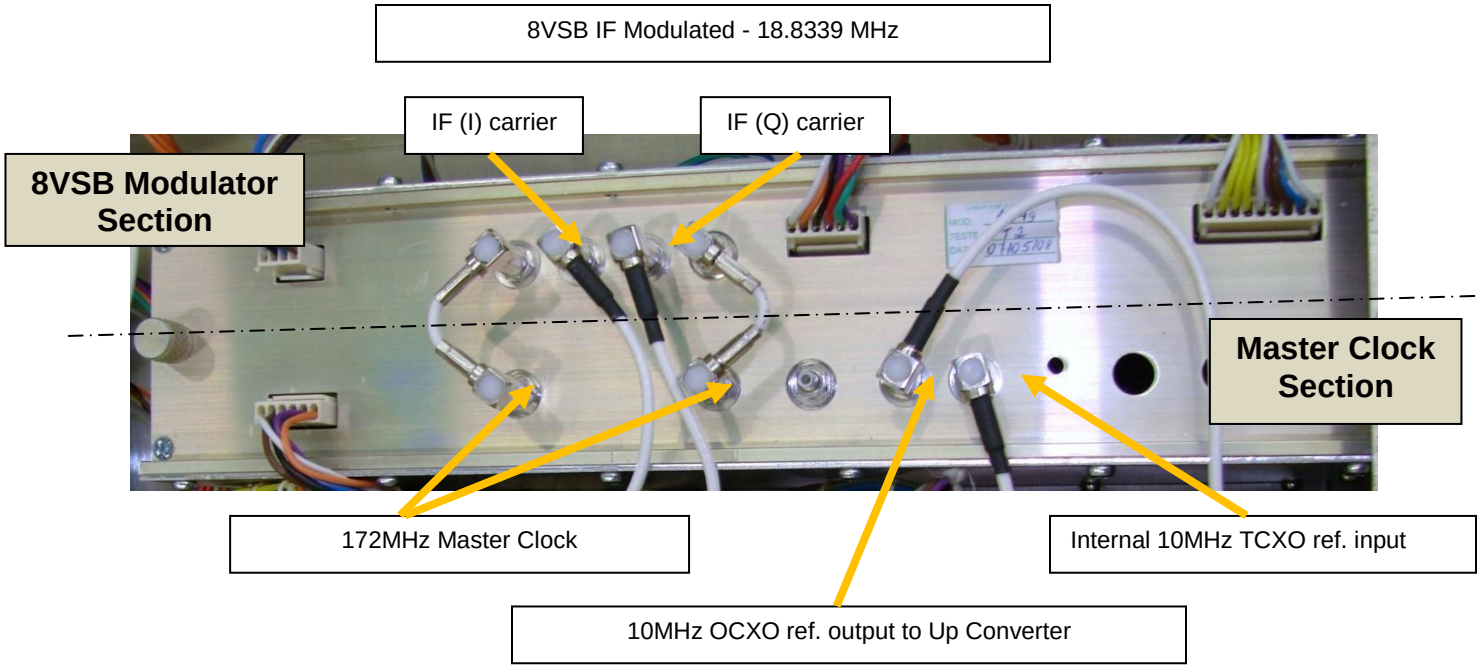
Section 3 – 8VSB Modulator and Master Clock

Module 4549

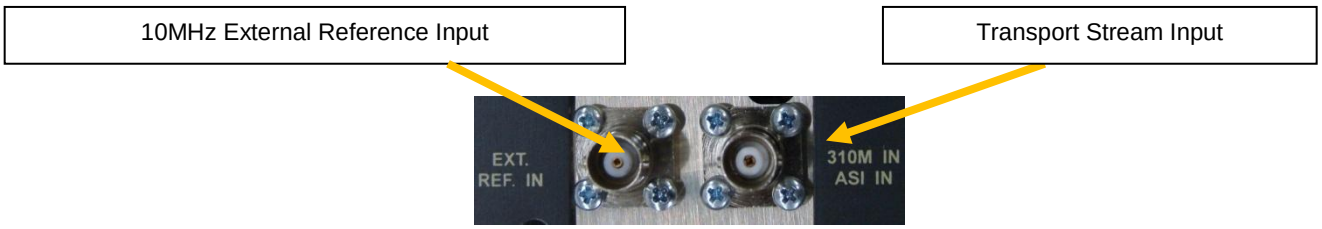
Introduction

The Module 4549 is composed by an 8VSB MODULATOR including an IF pre-correction circuit board (CIM3510) and the MASTER CLOCK UNIT, CIP8358.

Each one of these printed circuit boards are located below one of the two lateral covers of module 4549, as it shows the drawing of external connections of this module.



(a)



(b)

Fig.3.1: Module 4549, (a) top view, (b) connectors, from rear panel

General Functional Description

Module 4549 consists of 2 printed circuit boards. This section describes the 8VSB modulator only; the Master Clock is described in the next section. The two boards are physically located below each side of the top covers, as shown on the figure above.

CIP8412 board - **8VSB Modulator/Pre-corrector**

The CIP8412 is part of the Module 4549. The 8VSB modulator process the transport stream (TS) that carries up to 4 broadcast programming signals including, audio, video and data. All the information is compressed and multiplexed in a MPEG2 format.

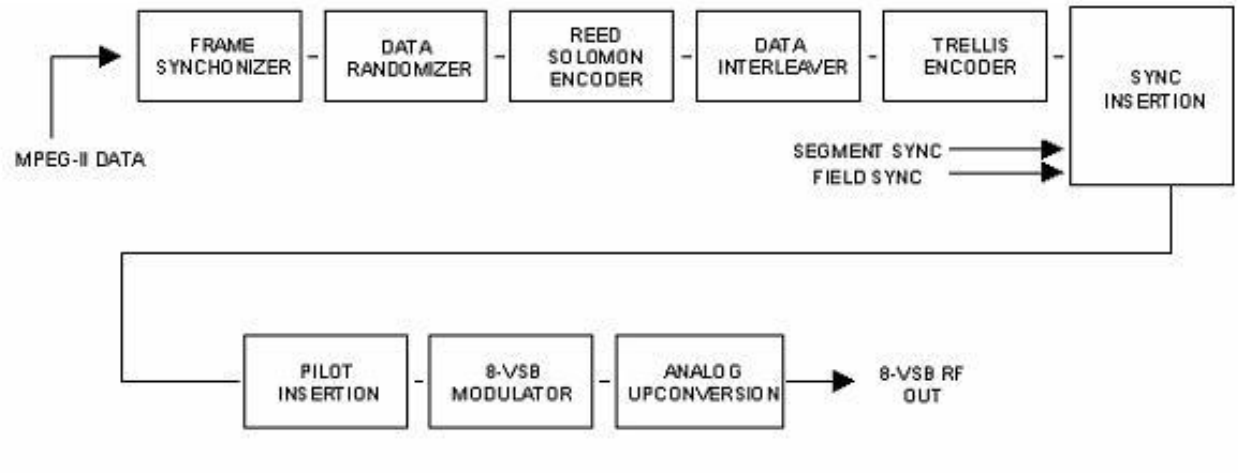


Fig.3.2: CIP8412 – 8VSB Modulator Block Diagram

The 8VSB channel modulator inserts the forward error correction, (FEC), into the MPEG2 transport stream. The modulator follows the ATSC standard A/53 annex D.

CIP8412 board - functional description

The input TS signal to be modulated must be in either ASI or SMPTE310M format, 19.39Mbps bit rate, and 800mVpp @ 75 ohms. The ASI/SMPTE 310M input is located on the rear panel by a BNC connector.

First the circuit responsible for the clock rate is used to perform the protocol interface. After that, there is a rate equalization of the TS performed by the insertion or removal of null packets. At the end, the symbol rate is ready to be stabilized and locked with an external/local reference of 10MHz rather than with the TS that is limited to 2.8ppm accuracy. This processing also includes PCR (Principle Response Curve) re-sampling for multiple programs,.

The entire 8VSB modulation process is digital. This process includes the FIR filters, not analog SAW filters, to create the VSB band. Digital modulation increase the quality of the modulated signal as measured via a proportional improvement of the MER, (Modulation Error Rate). The modulation process generates two identical but orthogonal signals, I and Q. The frequency of the IF carrier is 21.52MHz, and the center of the channel is 18.8MHz.

The benefit of working with two orthogonal carriers is: the possibility to implement corrections on non-linear distortions, or simply implement digital pre-distortion. The digital pre-correction is possible using LUT (Look up Tables); refer to Section 9 for more details. This table synthesizes inverted responses regarding the RF power amplifier transfer function, reducing the IMD products.

The digital processing generates I and Q distorted, and these two signals are then converted analog via a 16 bits DAC, with two balanced outputs, with a total of four output analog signals. These signals are termed; I, I', Q and Q', and are respectively present at the CN9, CN8, CN6, and CN5 connectors on CIM3444.

These four signals will become the UHF up-converter - Module 4453 - input signals. After the data stream is processed to receive the channel coding. This process contains the following steps:

Frame synchronization

For each 188 bytes on the MPEG2 package, this circuit identifies and removes the 47th byte.

Randomizer

This circuit equally spreads the modulated signal's energy over the channel band. The final energy density is similar to an Additive White Gaussian Noise. ; This technique greatly improves bandwidth usage efficiency.

Reed-Solomon

Reed-Solomon is a block coder (207,187) that adds 20 redundant bytes on each 187 bytes of the MPEG2 package. With this method it is possible to detect and correct data errors that occur during the transmission process.

Interleaving

Data stream interleaving is utilized to lower the transmissions susceptibility to interference that causes "burst data errors."

Trellis Code

Trellis code is closely related to the channel modulation. It is a convolution coder utilizing 2/3 rate, i.e. for each 2 bits at the input, there are 3 coded bits at the output, creating the 8 symbols used on the 8VSB modulation process (-7, -5, -3, -1, +1, +3, +5, +7). The encoding effectively improves the ability of the data stream to withstand degradation during transmission effectively increasing the signal-to-noise ratio.

Synchronism Insertion

The synchronism insertion builds the data stream's overall structure, creating the fields and frames as specified on the A/53E standard.

Pilot Insertion

The low-level pilot is created by adding a DC (+1.25) value to the baseband data (data and Sync) . After modulation, the DC value causes an in-phase pilot to be added to the data spectrum for transmission. The low-level pilot is a constant RF level below the average data signal power and has a frequency offset from lower band edge. The low-level pilot aids carrier recovery and is independent of the data.

Master Clock – CIP 8358 board – (CIM 3445)

Introduction

The CIP8358 board embedded into the module 4549, uses a 10MHz internal/external reference signal, to synthesize a 172.16MHz signal that is 16 times the symbol rate used in the modulation process.

This oscillator signal is squared by a Schmitt-trigger circuit with amplitude equal to 0-3.3 volts. This square wave provides the master clock signal that synchronizes all the digital circuits of this system, except the control signals.

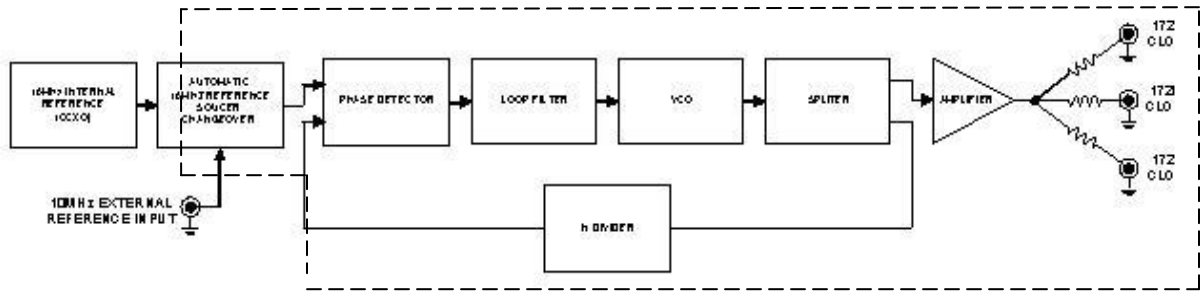


Fig.3.3: CIP8358 master clock – block diagram

CIP8358 board – general functional description:

The 172.16MHz frequency is synthesized via a PLL, a VCO and a DDS circuit. There are two possible 10MHz signals but the external reference takes priority over the internal. The first signal comes to CIP8358 via a SMB connector, CON-1. The second signal is also 10MHz, generated by the DDS (Direct Digital Synthesizer) circuit out of the free running 172.16MHz oscillator.

The loop filter performs the integration of the phase comparator output, generating the error signal that is feed back to the VCO. This way, the VCO is locked to the external reference signal.

The oscillator signal is delivered via 3 connectors located on the CIP8358 board. Two of those signals are routed to the 8VSB Modulator - CIM3510 board.

Section 4 – IF/UHF up-converter

Module 4492

Introduction

The module 4492 performs the following basic functions:

- This module translates the incoming I and Q IF carriers from the 8VSB modulator, to the desired FCC/UHF channel.
- Controls the RF output power of the exciter.

The desired channel is entered via the keypad and the LCD display in the factory. Channel changes are not allowed by the end user.

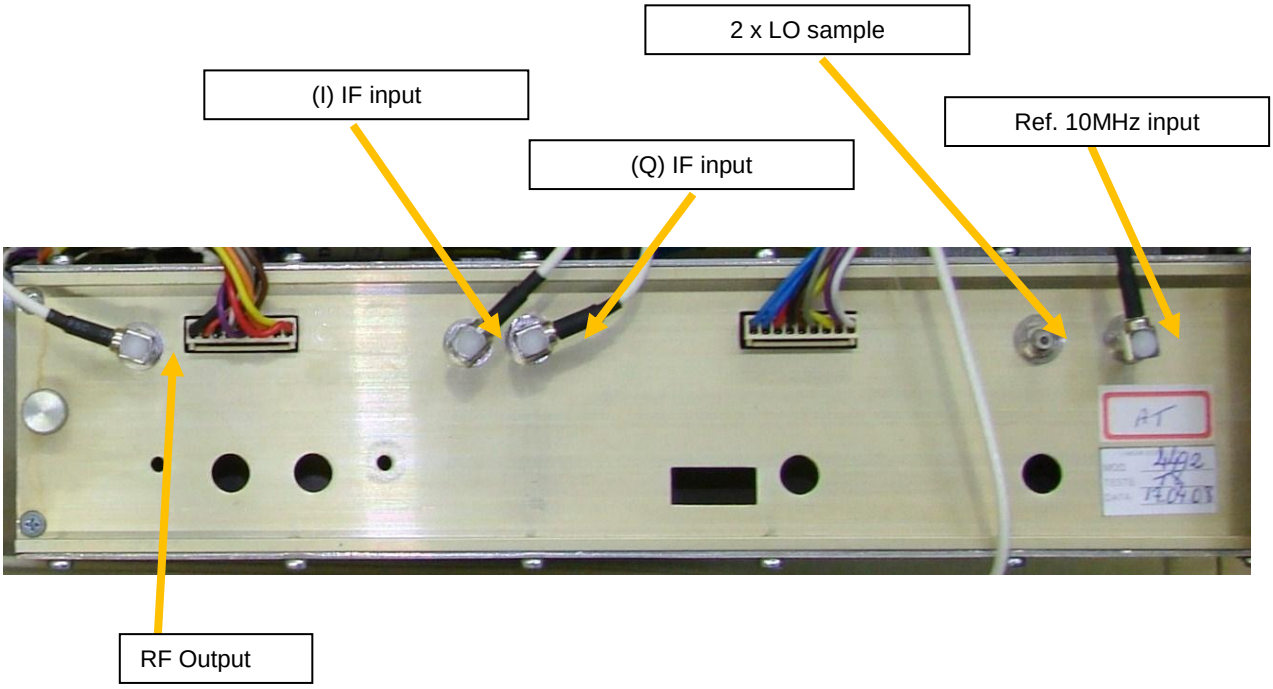


Fig.4.1: Module 4492, RF connections.

The main features associated with this module are:

- Simple conversion
- Orthogonal mixing, which performs the image and LO rejections
- Synthesized local oscillator via PLL, 22 bits serial fractional
- Allows channel offset programming @ 1Hz resolution when using external 10MHz? reference

- The LO frequency is divided by two, to reduce the phase noise level by 6dB
- 10MHz internal reference oscillator, technology OCXO, (Oven Controlled Crystal Oscillator)
- Uses hybrid amplifiers with high linearity
- Overdrive protection circuit, maintains the RF output power at acceptable levels
- Automatically reduces the exciter RF output power in absence of IF signal, either Q or I carriers
- Stand-by for local oscillator, in case of a failure in the external reference signal
- Meets or exceeds the phase noise requirements for DTV transmission

Module 4492 - General functional description - Refer to Fig.4.2.

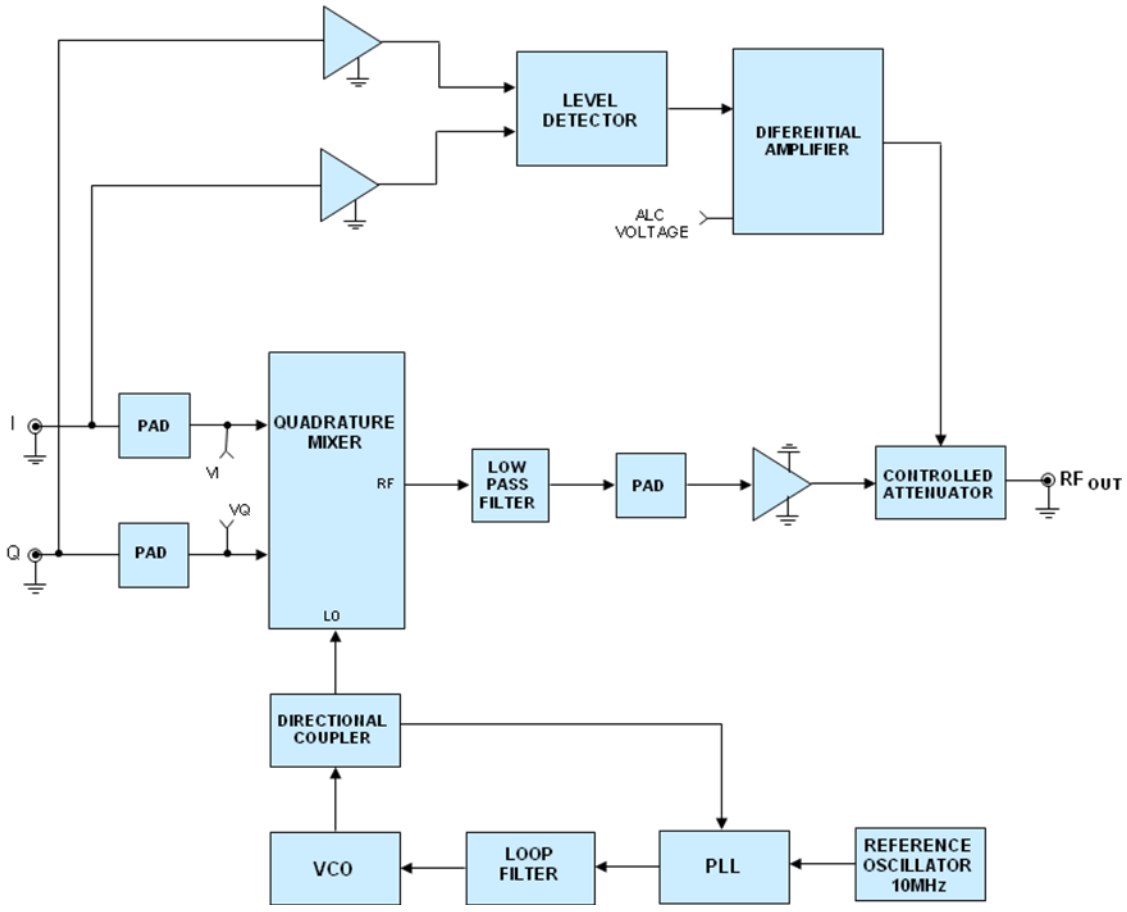


Fig.4.2: Module 4492 – block diagram

The already modulated IF carrier I and Q feed the 2 inputs of the up-converter – Module 4492. The output signal of this module is a FCC/6MHz/UHF channel (14-69). Besides this main function, it also controls the potential overdrive into the final 60W amplifier.

The up-conversion circuit consists of an orthogonal mixer fed by the IF carriers, I and Q respectively with a fixed center frequency and 6 MHz bandwidth. The mixer converts the IF signal using the local oscillator CW (Carrier Wave) signal. This mixing results in two RF lateral bands. The superior lateral band is not desirable and is attenuated by 35dB.

The resultant RF signal is filtered and amplified. The serial data stream that program the PLL circuit is transferred via MICROWIRE interface, composed by 3 high speed transfer lines of 20MHz. The microcontrollers inside the up-converter perform the following functions: {needs clarification}

PCB CIM3443 – Local Oscillator

The local oscillator is designed based on a PLL circuit. This oscillator is able to synthesize frequencies within the band from 450MHz up to 900MHz. To guarantee a high quality local oscillator signal, 4 VCO's (voltage controlled oscillator) are implemented with a shift frequency range of 125MHz each. Just one VCO works at the time to avoid interference. This approach achieves a 102dBc@20Hz phase noise level. The synthesizer on the feedback loop selects the desired frequency inside the chosen VCO band.

The VCO's signal outputs are isolated via sum and inverted circuits. The reference frequency generated by a DDS circuitry completes the up-conversion frequency process. The output local oscillator signal power is +5dBm.

PCB CIM3443 – Local Oscillator – block diagram

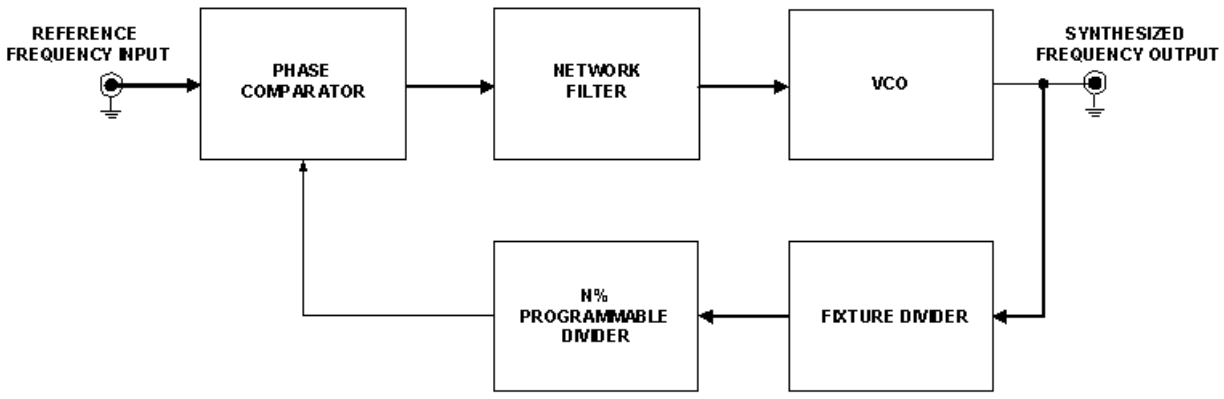


Fig.4.3: CIM3443 local oscillator – block diagram

PCB CIM3442 – UHF Mixer

The mixing operation translates the IF modulated signal frequency up to the assigned UHF broadcasting channel, the operation utilizes the orthogonal pair of signals (I-, I+) and (Q-,Q+) allowing rejection of one side band, and the oscillator itself. The rejection is around 40dB, facilitating the post filtering steps.

Right after the mixing operation, the RF broadband signal is (VHF and UHF) amplified 10dB under a typical 2dB roll-off characteristic. The RF output pass through a 25dB dynamic range variable attenuator. The control of this attenuator is related with the DC level generated by the ALC (Automatic Level Control). In case of absence of an IF signal, a valid IF signal (locked via PLL) or any of the 4 possible IF signals; the attenuator assumes its highest level of attenuation, and shuts down the RF amplification chain.

PCB CIM3442 – UHF Mixer – block diagram

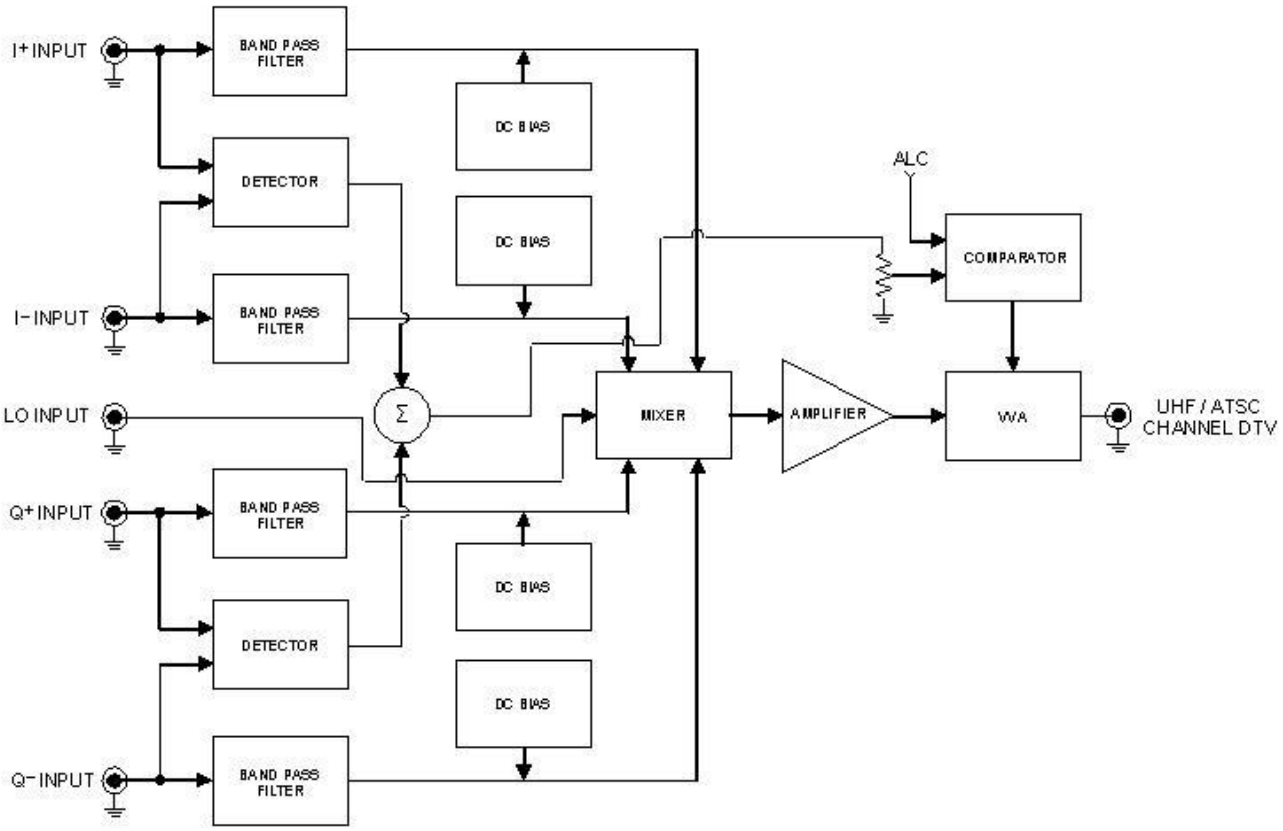


Fig.4.4: CIM3442 UHF mixer – block diagram

PCB CIM3442 – UHF Mixer – adjustment procedures:

The mixer-ALC has two types of adjustments. The first one is a DC level that polarizes each branch of the input of the complex mixer. Each one of the DC levels must be adjusted to assure maximum rejection of the undesired vestigial side band, in conjunction with the LO rejection as well. The level

adjustments are performed by the trim pots: TPO-1, TPO-2, TPO-3, and TPO-4. Voltage range of +1.4V to +1.6V should be present on the following test points.

- TPO-1: readings on L17
- TPO-2: readings on L18
- TPO-3: readings on L19
- TPO-4: readings on L20

Once the first set of adjustments is completed, the fine tuning adjustment should be performed. It is necessary to connect the spectrum analyzer to the UHF RF output of the sub-module 4453. At this point, (Both the LO signals, as the superior RF spectral image of the UHF/ATSC RF channel, must be attenuated by 40dBc to be compliant with product specification.

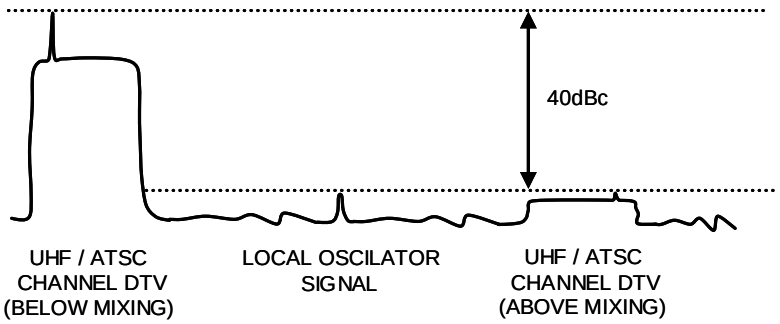


Fig.4.4: Level references for mixer-ALC fine tuning

The second adjust detects the protection signal at the center of the band. If 1 out of 4 controls signals are absent, the DC monitoring voltage level exceeds the min threshold and shuts down the RF output signal. The DC threshold adjust is performed by TPO-5, and should be set for +2.5V.

Module 4466 – Direct Digital Synthesizer (DDS)

Module 4466 is a signal reference generator based on a DDS circuit. This module is able to synthesize frequencies up to 50MHz under mHz precision range. The signal is used as PLL reference on the UHF up-converter, Module 4453 – PCB CIM3442. If necessary, the 10 kHz RF channel off-set is pre-set on the DDS circuitry. The phase noise of the reference signal generated on this module is better than 110dBc/Hz.

The SCU unit – PCB CIM3297 – configures the DDS's circuitry parameters via a serial communication port. The DDS module receives a signal out from the master clock, Module 4454 - PCB CIM3445 and performs the programming operation for the RF output channel as required under mHz precision. A frequency error around 1Hz maximum is achieved as measured at the output of the UHF mixer circuit. Before the DDS signal leaves the module, it is amplified and filtered.

Section 5 – UHF ATSC Exciter

Module 4407

General Functional Description

Module 4407 has high linearity solid performance for TV signals across the entire UHF band. This module was developed to operate in two UHF bands including:

- LOW BAND (LB): channels 14 to 44
- HIGH BAND (MB): channels 45 to 53

A single PCB is used for the two bands of UHF listed above. The components of the PCB determine which UHF bands in which the Module 4407 operates.

UHF / ATSC /8VSB AMPLIFIER - MODULE 4407		
CIRCUIT	CIM	CIP
DRIVER	3391	8208

Module 4407 is divided in the following parts:

First Stage - Class A

This section uses the bipolar transistor T1 (SGA 9289). This transistor's polarization is class A, which insures highly linear amplification.

The transistor T1 is connected to the +18V main power supply, Module 4401. This voltage is available at the pin-1 of connector CON-2 – Module 4407, where voltage regulator CI-1 reduce voltage to +5V; this is the input voltage on T1.

The trimpot TPO-1 adjusts the collector current (IC) of T1. This adjust is made by measuring the loss of voltage in resistor R8 (1Ω/1W), as the voltage is adjusted to 300mV, which corresponds to 300mA in the IC.

Note:
Because this is Class A stage, the measurement of T1's drain current must be the same with or without input RF signal in the module.

T1's gain is adjusted by the trimmer C12 and it is optimized for the highest value possible.

Second Stage – Class A

The transistor LDMOS T2 (MRF9030) is the main device of the second amplifier on Module 4407. This transistor is also configured as a Class A amplifier.

The drain voltage is obtained from the +28V main power supply – Module 4401. This voltage is available at pins 2, 3, 4 and 5 of connector CON-2 of Module 4407.

The trimpot TPO-2 adjusts VGS of T2 and, consequently, the drain bias current (ID) of this transistor. This adjust is made by measuring the loss of voltage in resistor R18 (2 x 10Ω/5W in parallel), as the voltage is adjusted to 1V, which corresponds to 1A in the ID.

Note:
Because this is Class A stage, the measurement of T2's drain current must be the same with or without input RF signal in the module.

Trimmer C32 adjust the gain associate with T2 and is optimized for the highest value possible.

Third Stage – Class AB

This final amplifier device is the LDMOS transistor T3 (MRF373). This amplifier stage is configured as a Class AB to assure superior efficiency without sacrificing linear performance.

The drain voltage in transistor T3 is obtained from the +28V main power supply – Module 4401. This voltage is available at the pins 1, 2, 3, 4, 5 and 6 out of the CON-3 connector found in Module 4407.

The trimpot TPO-3 simultaneously adjusts the VGS for transistor T3 and, consequently, the drain bias current (ID) of this transistor. This adjust is made by measuring the loss of voltage in resistor R40 (0.12Ω/5W), as the voltage is adjusted to 50mV, which corresponds to 416mA in the ID (in standby).

Note:
Because this is Class AB stage, the measurement of T3's drain current increases as the input RF level increases in the module. The correct measurements are obtained when the module is in standby, in other words, there is no input RF signal in the module.

VGS Polarization Circuit for T2 and T3

Integrated circuit CI-5 is responsible for providing VGS to transistors T2 and T3. This circuit is powered by the voltage regulator CI-3, which is powered by the +18V main power supply, Module 4401. This voltage is present at pin-4 of the connector CON-5, Module 4407.

Temperature alarm

Module 4407 is protected against overheating. If the temperature rises above 65˚C, the protection circuit acts and disconnects the module.

The protection circuit is composed basically of the thermal sensor S1 and the CI-2. The temperature of the module converted into a DC voltage can be measured at pin-3 of connector CON-5. This voltage is routed to pin-7 of connector CON-6 at CIP8231 - control unit. The lack of this voltage means that the temperature of Module 4407 exceeded the 65˚ C. Under this circumstance, the control unit CIP8231 will no longer allow the +28V power supply to feed the module.

RF Power Measurements

Through a PCB type directional coupler at CIP8208 board, a RF output sampling is collected in Module 4407. This RF sampling is sent to the direct and reversed power reading circuits.

The detector circuit for direct power is basically composed by diode D2B, the operational amplifier CI-4B and the trimpot TPO-4 that fine adjusts the detected DC level. The detected voltage will be displayed at pin 5 of the connector CON-9 at CIP8231 board.

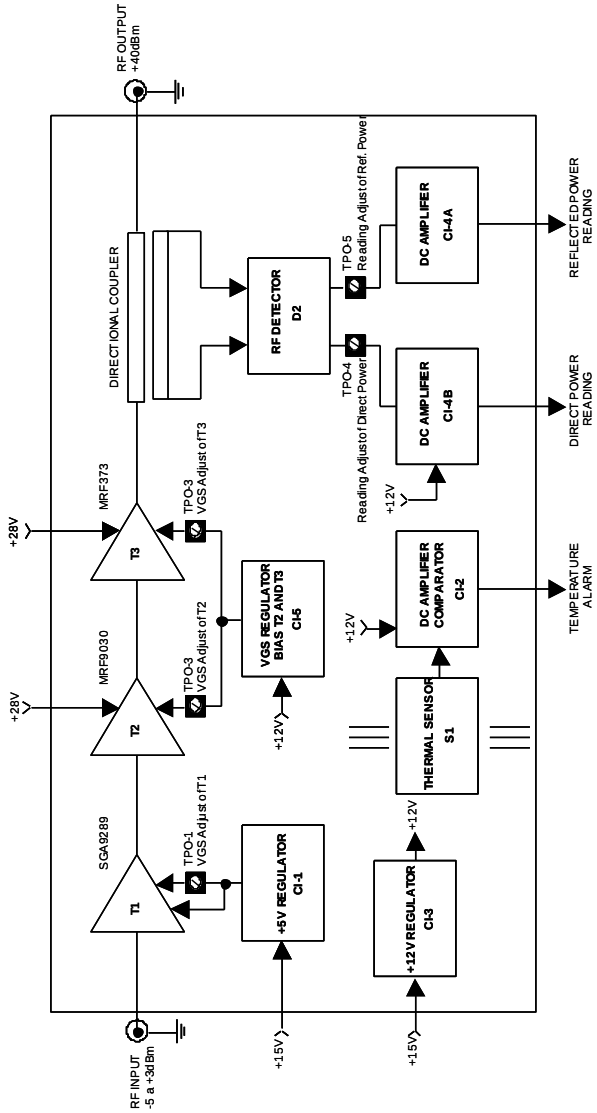
The reverse RF power reading is performed by diode D2A, the operational CI-4A and for trimpot TPO-5, which adjusts the level of reading measured at pin 2 of connector CON-5.

Even though the reverse RF power reading is present at CIP8208, this reading is not planned for the AT7120 transmitter.

Technical specifications

PARAMETERS	SPECS
INPUT	
FREQUENCY	470 to 860MHz
MAXIMUM LEVEL	0dBm
IMPEDANCE	50**Ω**
CONNECTOR	SMB MALE
RETURN LOSS	≥ 13dB
RF OUTPUT	
GAIN	43dB to 49dB
ATSC RMS POWER	Until 10Wms
HARMONICS 2nd	≤ -30dBc
IMPEDANCE	50**Ω**
GENERAL	
VOLTAGE SUPPLY	26V to 30V

Block Diagram



Section 6 – UHF ATSC Amplifier

Module 4442

General Functional Description

AT7120 transmitter has two Modules 4442 connected in parallel, which work as digital TV end amplifiers in all UHF band.

Module 4442 offers high linear precision that works satisfactorily with digital TV signals. However, to achieve optimal gain, this module was divided in 3 operational channel bands, which are:

- Channels 14 to 25
- Channels 26 to 38
- Channels 39 to 53

For the four UHF channel bands described above, the same circuit board is used.

UHF/ATSC amplifier module 4442

CIRCUIT	CIM	CIP
DRIVER	3431	8431

What defines which UHF band of Module 4442 is used are certain components that might or not be excluded or alter the value.

Module 4442 is made of two Push-Pull amplifiers cells, class AB. Each cell has a double Push-Pull transistor, with LDMOS technology. This module can offer up to 70W.

To better understand how the amplifier works, refer to the block diagram in the upcoming pages.

The amplifier is made of the following components:

Input Coupler

The input RF coupler equally divides the UHF signal present in the input connector for the two amplification cells, maintaining 50Ω impedance.

The 3dB 90˚ hybrid coupler SMD built by "sandwiching" together two small boards called stripline. This hybrid coupler has 4 gates (terminals); in one of this gates is applied an input signal, which will be divided internally; the two resulting signals are applied in the direct and adjacent gates. There is also an isolated gate, where a 50Ω balance charge is placed. This charge is delivered by the resistor, R1.

This charge basically guarantees a constant impedance of 50Ω, even if one of the cells comes to fail. By coupling, the other line receives the input signal and transfers it electronically to the two amplification cells.

Cell A – 35W Amplifier

The amplification cell A is obtained by a Push-Pull 35W amplifier, class AB. Transistor T1 is in this cell. The polarization circuit of cell A is made of a VGS timer circuit with temperature compensation, differential amplifier and gate impedance reducer. TPO-1 trimmer adjusts the VGS to the T1 transistor. Adjusting the VGS1, also adjusts the quiescent current (automatic adjustment of the T1 transistor's current). This current is measured indirectly, by dividing the reduction in voltage measured between resistors R34 and R35 (that are in parallel) and its resulting ohm value, that is 0.06Ω.

Trimmers C7, C10 and C13 adjust input paring up and this cell's gain. The circuit RL made of resistors R27 and inductor L8, plus resistor R26 and inductor L7 avoid transistor T1's auto-oscillation in frequencies below 200 MHz, for which it is not pared up. Resistors R25 and R28 together with transistor T3 reduce gate impedance for DC. Capacitors C37, C14 and C15 work as DC non-couplers in transistor T1's gate.

Cell B – 35W Amplifier

Just as cell A, cell B's amplification is obtained by a Push-Pull 35W amplifier, class AB. Transistor T2 is in this cell. The polarization circuit in cell B also is made of a VGS timer circuit with temperature compensation, differential amplifier and gate impedance reducer. TPO-2 trimmer adjusts the VGS to the T2 transistor. After adjusting the VGS2, an automatic adjustment of the T2 transistor's current. This current is measured indirectly, by dividing the reduction in voltage measured between resistors R36 and R37 (that are in parallel) and its resulting ohm value, that is 0.06Ω.

Trimmers C23, C26 and C29 adjust input paring up and this cell's gain. The circuit RL made of resistors R30 and inductor L6, plus resistor R31 and inductor L5 avoid transistor T2's auto-oscillation in frequencies below 200 MHz, for which it is not pared up. Resistors R29 and R32 together with transistor T4 reduce gate impedance for DC. Capacitors C38, C30 and C31 work as DC non-couplers in transistor T2's gate.

Output Coupler

It is a hybrid coupler built with a special semi-rigid coaxial cable, better known as "wireline". This type of cable has 2 internal conductors interlinked; this set has the characteristics of a hybrid coupler. As the input coupler, this coupler also has four gates (input/output; isolated, -3dB 0˚, -3 dB 90˚).

The same concept used with the input coupler is used in the output coupler, what differs is that its function now is to add amplified signals by the 35W cells. The unbalanced output charge is represented by resistor R38 (50Ω/60W). This charge guarantees that the module's output impedance is always 50Ω, even if one of the cells comes to fail.

Temperature Alarm

Module 4442 has a protection circuit that disarms the module in case the temperature rises above 65˚ C. This circuit is basically made of thermal sensor S1, DC amplifier and voltage comparator CI-1. The module temperature is converted into voltage, DC, by the temperature sensor (10 Mv/˚C). This voltage value is amplified and then compared with a reference voltage, thus getting an alarm voltage, which can be measured on the green cable connected to the module. This voltage is sent to pin 2 of connector CON-7 in the subordinate feeding power supply corresponding to the amplification module. In this

power supply the alarm voltage is interlinked to pin 4 of connector CON-4 and finally, sent to the control unit. The loss of this voltage means that the temperature on Module 4442 exceeded 65˚C and in this situation the control unit will order the subordinate power supply to send +28V to the correspondent Module 4442.

Technical Specifications

CHARACTERISTIC	SPECIFICATION
INPUT	
FREQUENCY	***470 - 806MHz***
LEVEL	***+36 to 34dBm***
IMPEDANCE	***50 Ohms***
CONNECTOR	***N FEMALE***
RETURN LOSS	**≥ 25dB**
OUTPUT	
GAIN	***Channels 14 to 25 = 15dB*** ***Channels 26 to 69 = 14dB***
ATSC AVERAGE POWER	***70Wrms***
HARMONICS 2RD	***<-25dBc***
SPURIUS EMISSION	***<-40dBc***
SHOULDER	***36dB***
IMPEDANCE	***50 Ohms***
CONNECTOR	***N FEMALE***
GENERAL	
VOLTAGE SUPPLY	***+32V***
CONSUMPTION	***9A***

Board CIP8431 – Adjustment Procedure

The tests on Module 4442 can be done with the output points connected to the rest of the RF structure of the equipment, or with the output connected to a coaxial charge 50Ω/100W (minimum) that has a good response in UHF TV (470MHz to 860MHz). However, whatever is the use of Module 4442, it is important to make the adjustments with the module RF output connected to a coaxial charge.

Never operate Module 4442 without making sure its output is properly charged. The absence of a coaxial charge, or if it doesn't meet specifications, might cause severe damage not just to the transistors but also to the test equipment.

In case it is decided to adjust Module 4442 outside the transmitter, it will be necessary to use a +28V power supply. The output current of this power supply should not be smaller than 2.5A, as long as the tests that need to be done don't require maximum power output from the module. To adjust currents and the response curve, the +28V/2.5A power supply is sufficient.

ID Current Adjustments

To adjust ID drain currents of both transistors, T1 and T2, Module 4442 must be idle.

Never adjust ID drain currents of Module 4442 LDMOS transistors while there is an input signal in the module. To adjust currents, make sure Module 4442 input signal is in standby, otherwise the transistor might be damaged.

To perform a more accurate adjustment it is best to wait at least 5 minutes after module has been powered up, to make sure there is a thermal stability in the module when in standby.

The measuring instrument to be used during testing procedures is a digital multimeter with scale in mVdc. Avoid the use of multimeter with auto-range.

Transistors T1 and T2

1. Adjust trimpots TPO-1 and TPO-2 totally anti-clock wise, thus zeroing T1 and T2's drain currents.
2. To adjust T1's quiescent current, insert the digital multimeter with a maximum scale of 100mVdc to measure loss of voltage in resistors R34 and R35 (drain resistors for T1).
3. Note: These two resistors are in parallel, thus the voltage can be measured on either of them (R34 or R35).
4. Slowly adjust trimpot TPO-1 clock wise until T1 is set; then some loss in voltage (few mV) will be observed. Continue adjusting TPO-1 until its voltage measures 60mVdc, what translates to a drain current of 900mA for the BLF861A transistor.

5. To adjust T2's quiescent current, slowly adjust trimpot TPO-2 clock wise until T2 is set, when then some loss in voltage, few mV, will be observed. Continue adjusting TPO-2 until its voltage measures 60mVdc, what translates to a drain current of 900mA for the BLF861A transistor

Notes

The BLF861A transistor is type Gemini; this means there are two identical transistors inside the capsule. That is why one trimpot was omitted when balancing the VGS voltage. Another characteristic of this transistor is that the drains are connected internally, so when a 900mA current is measured, it really means that each side of the transistor has a drain of 450mA.

Because this is a phase amplifier class AB, the measured drain current of the LDMOS transistors increases as the RF level increases in the input of the module. The correct values are obtained with the module in standby, in other words, without input RF signal.

In the case that these adjustments are not possible, measure the gate resistance with a multimeter (this resistance got to be at least 330 ohms). If the gate resistance is close to 0 ohm, it is possible that the transistor is broken.

Check for temperature alarm

Module 4442 has a thermal sensor (S1) that when connected to operational circuits (CI-1), generate alarms that detect when the module temperature is above 65˚C.

1. Power Module 4442 with +28V and wait for the pre-heating to be done for around 5 minutes. It is not necessary for Module 4442 to be in maximum power; actually it is better to do this adjust with Module 4442 in standby, in other words, without input RF signal.
2. Measure voltage on pin-2 of thermal sensor S1.
3. Measure voltage on pin-2 of operational circuit CI-1; this voltage is exactly ten times higher than the value of the voltage measured on pin 2 of the thermal sensor, and it relates to the temperature value in Module 4442 (i.e.: for a temperature of 50˚C, it should measure 5V).

Section 7 – Power Supply

Module 4401

General Functional Description

Power supply - Module 4401 - is the switching type, configured in the topology of half bridge, having overall efficiency above 80%. Module 4401 is responsible for the generation and distribution of following voltage DC:

- +32V FIXED
- +32V RE-CONNECTABLE
- +18V
- -18V
- +9V

Module 4401 can be connected to the electric AC network of 120Vac or 240Vac, according with internal jump positions.

Module 4401 is self-protected against DC short-circuit. This protection acts by inhibiting the generation of switching pulses, shutting down the power supply; 0 volts at the DC's outputs. The output +32V RE-CONNECTABLE is managed by the Control unit.

The re-connection command is sent to the power supply, to turn the +32V RE-CONNECTABLE on. This voltage is responsible for feeding the 60W amplifier - Module 4407. The consumption in Amps from the +32V RE-CONNECTABLE power supply is basically the consumption associated with the drain electrical current of the LDMOS transistors of the amplifier. Because of this configuration, the LDMOS currents are measured at the power supply - Module 4401.

These current measurements are routed to the control unit. In case of extreme measured values, the control unit inhibits the +32 RE-CONNECTABLE power supply.

- Module 4401 – Block Diagram
- Input AC filter

The C1, C6 and TF-1 components together assemble the line filter. This filter minimizes the noise generated by the power supply into the AC network.

The varistors V1, V2 and V3 prevent over-voltage damages potentially caused by occurrences on the AC network.

The group of diodes D1/D4 rectifies the AC voltage from the AC network and delivers this rectified voltage to the capacitors C9 and C10 for filtering. These capacitors could be connected in parallel or in series, according with the set of the jumps for 120/240Vac.

The resistances R1 and R2 are the loads for the capacitors C9 and C10 when the power supply is powered ON. R3 and R4 provoke a fast discharge of C9 and C10 when the power supply is OFF. The control of the switching function over the PWM modulator is performed by the components TF-3, D5, D6, D7, R9, T3, C20, C18 and C46.

Switch and Power

The switching function over the DC input voltage is performed by MOSFETs, T1 and T2. The trigger pulses are generated by integrated circuit CI-1, through the transformer TF-4 that also isolates the modulation circuit from the AC network.

The switching voltage created by the transistors is applied across the transformer TF-5 to generate the secondary voltage.

The capacitors C15 and C16 divide the entrance voltage, reducing the voltage over the transistors [seems unlikely as described]. C14 prevents the direct-current flow towards TF-5.

The noise reduction formed by R7, C17, R34, C31, R37, C35, R43 and C42, help to lower high frequency noise generated by the fast and short time switching pulses present on the MOSFET transistors as in TF-4.

Rectification and Filtering

The pulses delivered by switching power devices, are rectified by D8 to D14 and filtered by C32 the C47. The inductor L2 has multiple sections and stores the transferred energy helping to filter the voltage provided.

The resistors at the output act as bleeders avoiding undesirable transients and oscillations.

Pulse Width Modulation

This block is composed basically by the integrated circuit CI-1 that performs the PWM switching process control.

CI-1 output (pins 11 and 14) supply the switching pulses that are applied to the transformer TF-4. The “Soft-Start" system prevents a fast rise of the output voltage. In this circuit, this function is carried through by C23.

Feedback

The resistors R10, R13, R12 and TPO-1 form a voltage divider that takes a sample of +32V output of the power supply and delivers it to CI-1, which compares that with its reference of +5V via R39.

As the result of this sample dictates, the modulation circuit will create a variation in the width of the switching pulses, thus adjusting the output to maintain a nominal + 32 Vdc.

Protection and Readings

In the event of over-current, in any one of the outputs, the voltage in the inverting input of comparators CI-3 and CI-4, transferred by the electrical current readings, will be greater that the voltage of reference in the non inverting entrance.

This event takes the output of the comparator to a low level and will trigger a timer formed by CI-2, R26 and C28 that will shut down, inhibiting the switching process. The electrical current readings are detected over the power resistors (R44, R45, R36, R40, and R38) and amplified by op-amps end of scale (4V), proportional to the nominal current of each output. Each electrical current reading has its proper adjustment:

- TPO-2: +32V/10A
- TPO-3: +18V/1A
- TPO-4: +9V/1A

The output voltage readings are constituted by operational amplifiers (CI-8, CI-9 and CI-10) and each one is equipped with a TPO for full scale adjustment (4V), proportional to the nominal output voltage.

- TPO-5: +32V
- TPO-6: +32V RECONNECTED.
- TPO-7: -18V
- TPO-8: +18V
- TPO-9: +9V

Notes

1. The current reading is only for the output voltage of +32V.
2. It does not have reading for the voltage of +32V RECONNECTED.

Reconnection Process

The output of +32V RECONNECTED power supply - Module 4401 - is used to exclusively feed the UHF amplifier - Module 4407.

The +32V RECONNECTED output is obtained from the +32V FIXED output. This output is enabled or disabled by control unit - CIP8231 card board - through the reconnect command. In normal conditions, this command sends +5V to pin 6 of connector CON-8 of CIM3388 (CIP8111) card in Module 4401. Having this voltage, the switch transistor will be saturated and, consequently, the output voltage of +32V RECONNECTED will be enabled.

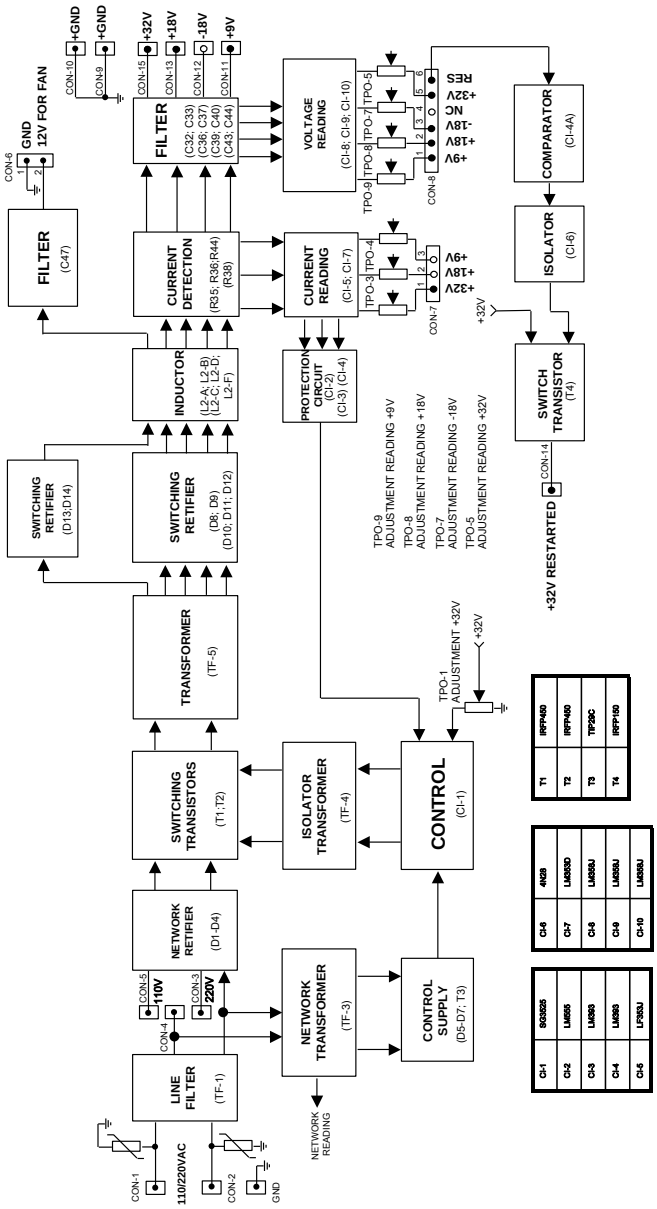


Fig.6.1: Module 4401 Block Diagram

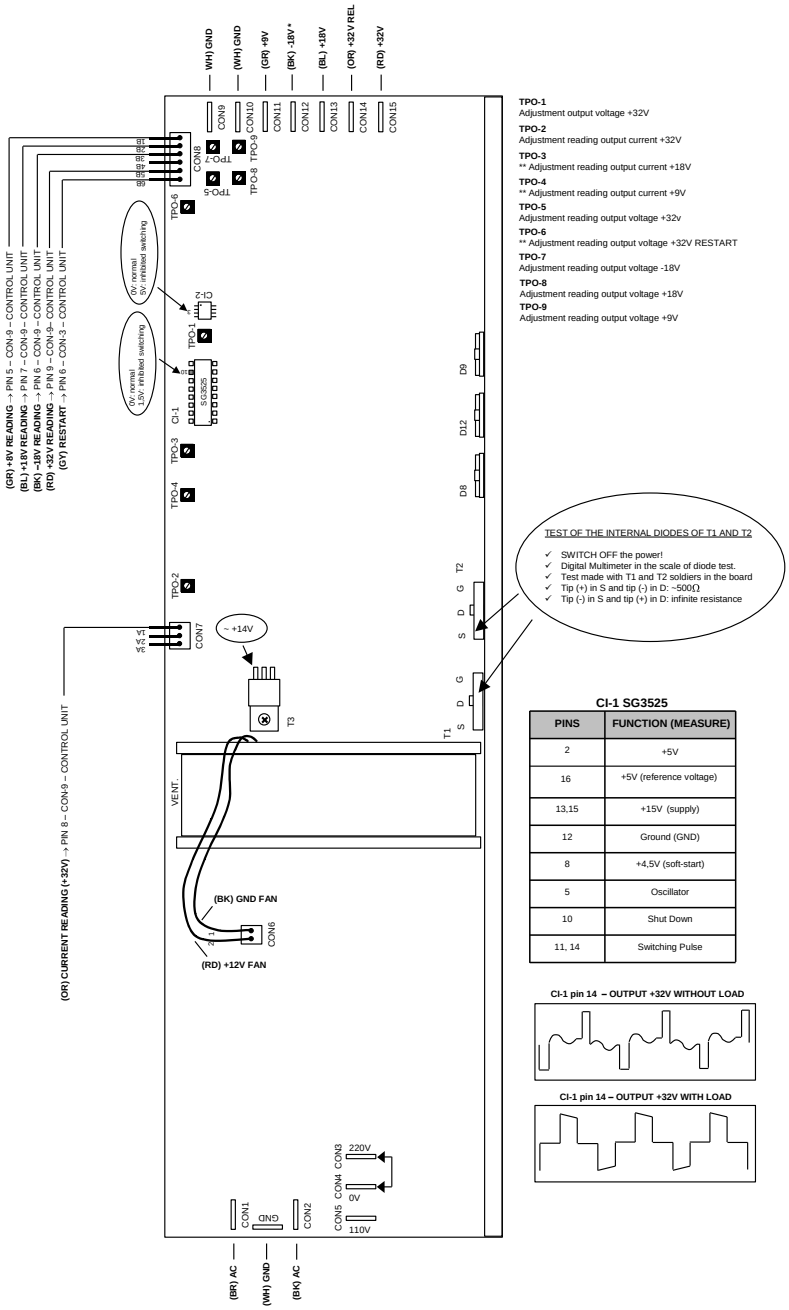


Fig.6.2: Module 4401 – Main components board displacement

MODULE 4401 – Technical Specifications

FEATURE	SPECIFICATION
INPUT AC VOLTAGE	90 TO 140VAC / 180 TO 250VAC
SWITCHING FREQUENCY	50kHz
LINE REGULATION	BETTER THAN 2% FOR ALL OUTPUTS
OUTPUTS NOMINAL VOLTAGES AND CURRENTS	+32V / 10A +18V / 1A -18V / 1A +9V / 1A
RIPPLE	300mV (+32V) 120mV (+18V / +9V) 80mV (-18V)
LOAD REGULATION	BETTER THAN 2% FOR +32V BETTER THAN 25% FOR +18V, -18V, +9V
EFFICIENCY	BETTER THAN 80%
OUTPUT OVER CURRENT LIMIT	30% UPPER NOMINAL VALUE
RESTART VOLTAGE	HIGH LEVEL: > 3.5 TO 5Vdc LOW LEVEL: < 3.3Vdc
SHUTDOWN VOLTAGE	HIGH LEVEL: > 0.7 TO 5Vdc LOW LEVEL: < 0.7Vdc

POWER SUPPLY		
CIRCUIT	**CIM**	**CIP**
POWER	3388A	8111A

MODULE 4401 – Changing the Mains Voltage Operation

The module 4401, on its rear side, is built in such way that it is possible to access the 110/220Vac switching voltage jump. The pictures below illustrate the jump position for each desired operational voltage. This is the only required maneuver to change the voltage operation on the AT7120 unit.

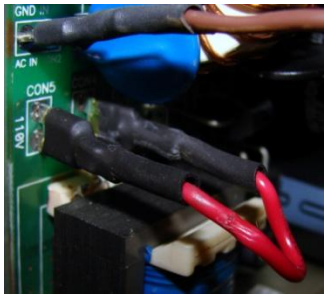


Fig.6.3: Jump connection for 110Vac operation, (CON5-CON4)

Fig.6.4: Jump connection for 110Vac operation, (CON4-CON3)

Fig.6.5: Module 4401 - +32V Switching Power Supply

Section 8 – DC/DC Converter

Module 4567

General Functional Description

This module generates specific voltages not present at the main power supply - module 4401. The module 4567 generates +2.5V and +5V, via standard IC regulators, see below:

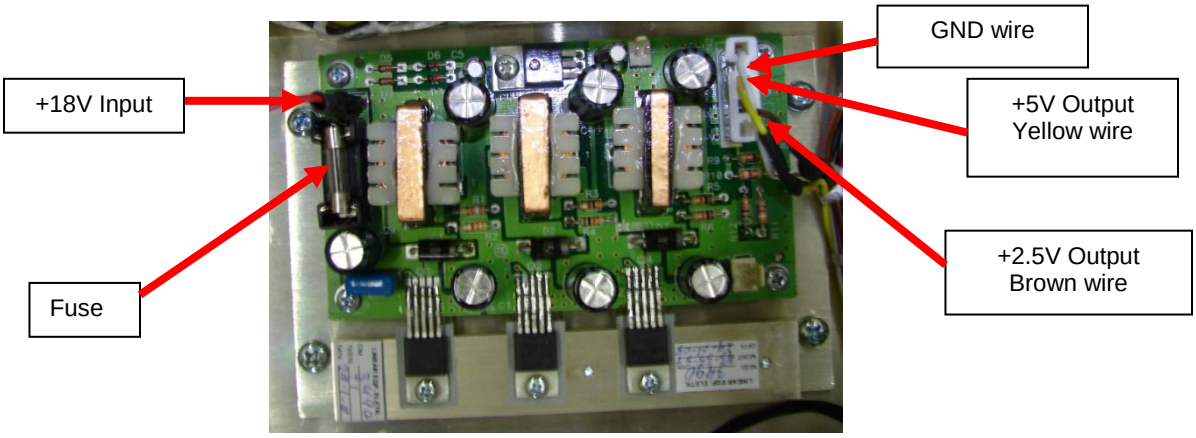


Fig.7.1: DC/DC Converter Board

CIM3490 (CIP8390)	
INPUT	**OUTPUT**
+18V	+2.5V (CON-2/2)
	+5.0V (CON-2/3)

Section 9 – Memory Interface

Module 3535

General Functional Description

CON-4 and CON-10 at the modulator – Module CIM3510 – are communication connectors with the memory interface CIP8421 mother board.

Module CIM3516 – General Functional Description

The 1Mbit LUT memory card – Module CIM3516 - is connected to the memory interface - Module 3535. This module holds all the non-volatile data parameters related with the digital linear and non-linear pre-correction.

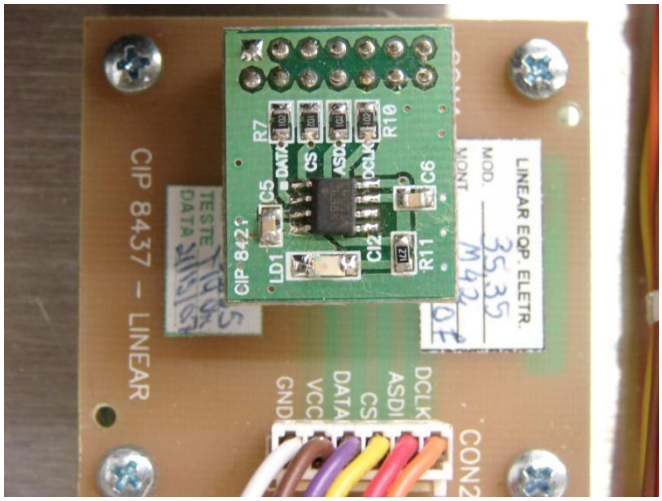


Fig.8.1: LUT Memory card & module 3535

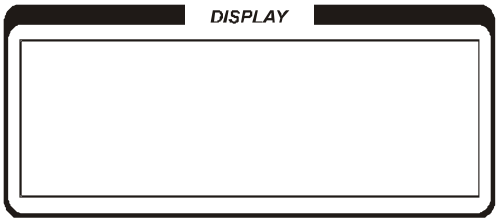
Annex A – AT7120 Operational Software

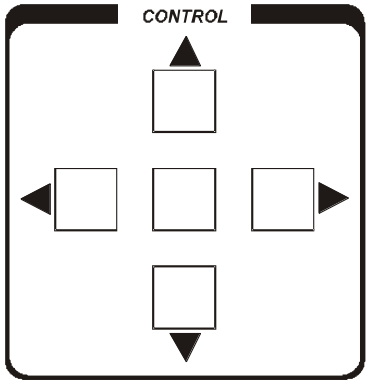
AT1012_ASM version 1.2

1 Introduction

The LINEAR family of ADVANCED TV transmitter equipment possesses a system for measurement (measures), configuration (SETUP) and alarms (alarms) controlled by microprocessor system. This document will demonstrate the navigation, operation and configuration of these functions.

2 Navigation and Signals





2.1 Keypad and Display

2.1.1 Keypad

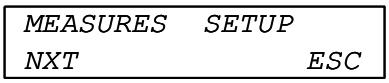
↑ Moves the cursor up
→ Moves the cursor right
← Moves the cursor left
↓ Moves the cursor down

Yellow Key (Center) “ENTER”

2.2 Display

The display navigation works as follows:

- The cursor must be located on the first character of each function to access that function
- It is then activated by pressing the yellow "ENTER" key



During the navigation, special functions will appear in the display to assist the user, these are:

ESC – Used to return to the previous menu

NXT – Used to access the next screen

CLEAR – Used to clear old alarms

2.3 Signals

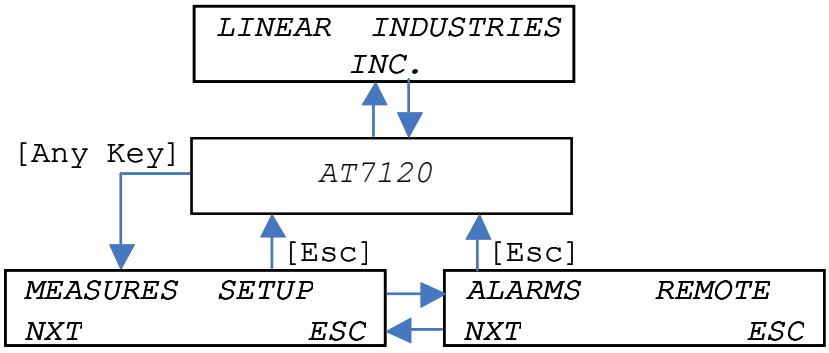
During the navigation, special characters will appear in the display, these are:

*	– Indicates the presence of a current alarm
#	– Indicates the presence of an old alarm
(LOCK)	– Indicates that the equipment is configured with password, and to access that part of the menu, the password must be entered.

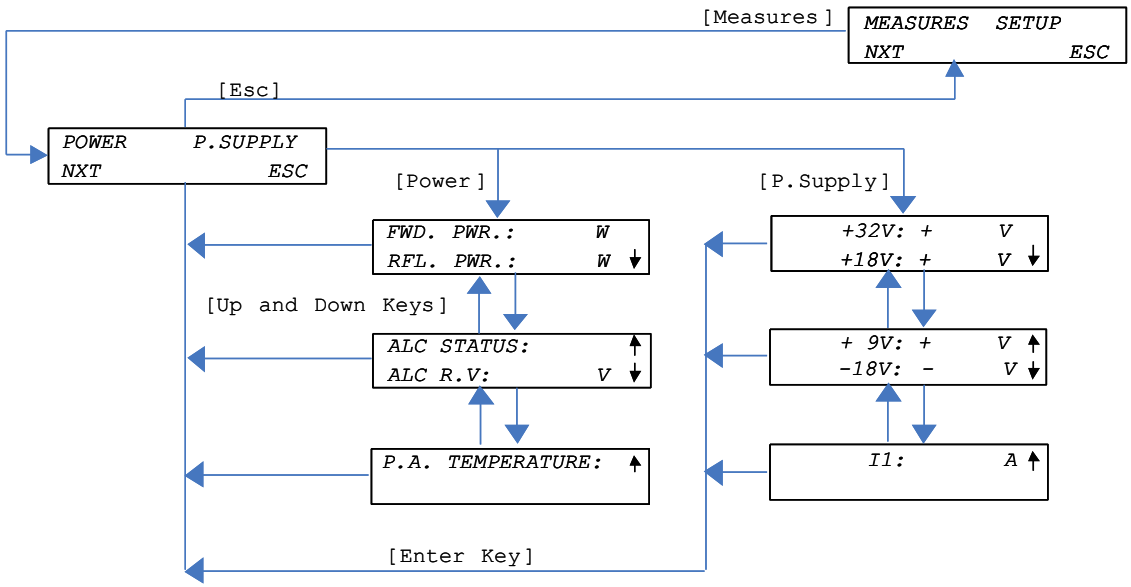
↑↓ – The UP and DOWN arrows assist in the navigation between screens. When they appear, the UP or DOWN key must be used to move between screens. If in a measurement screen, to return to the previous menu, any key can be pressed.

3 Screen Flow Charts

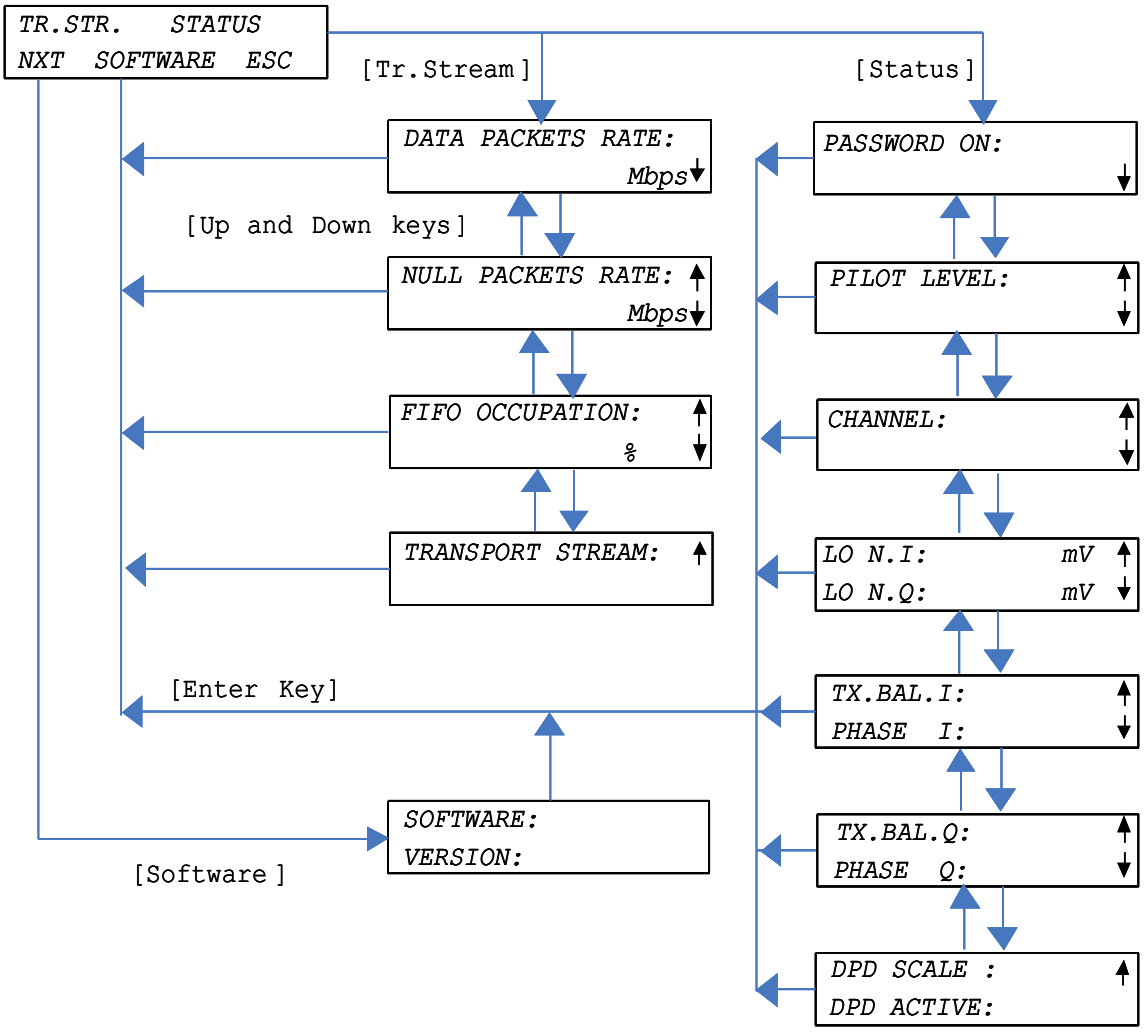
3.1 Main screens



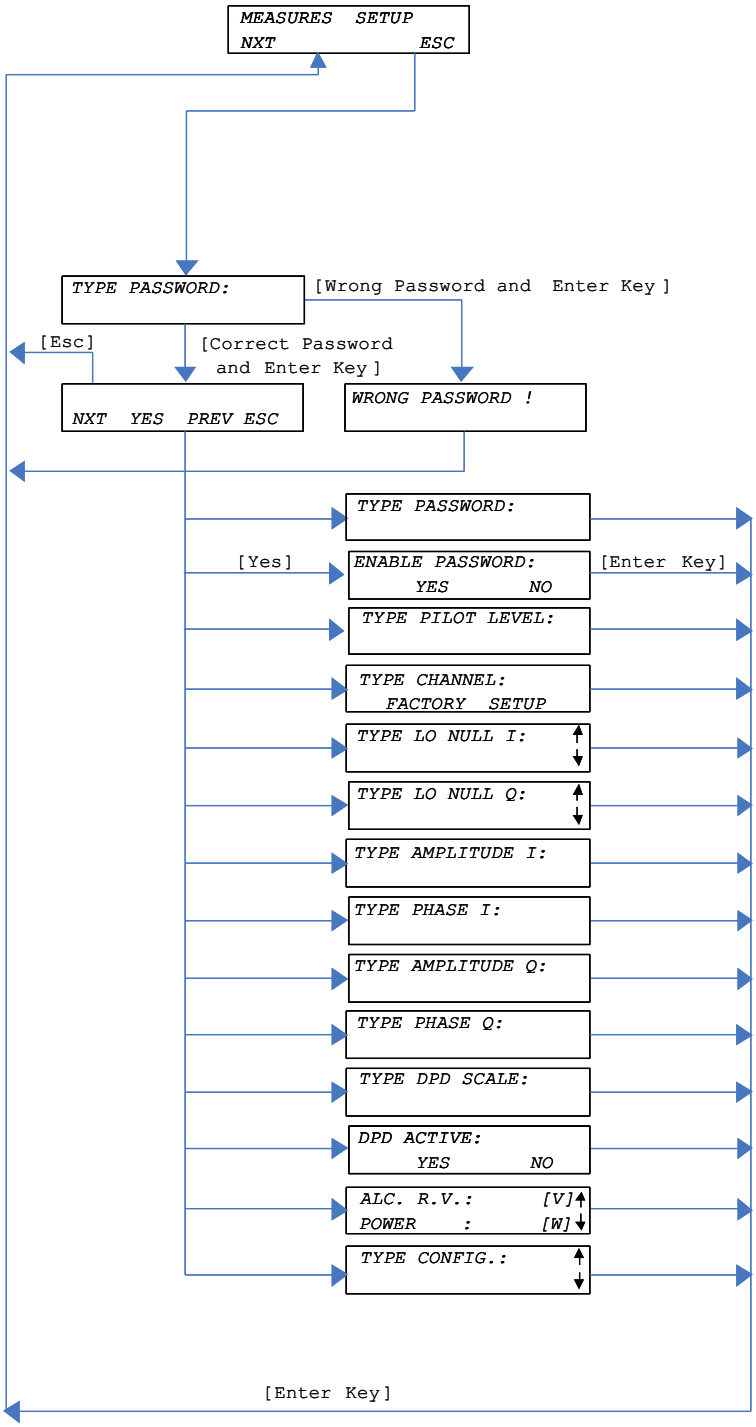
3.2 Measurement Screen 1



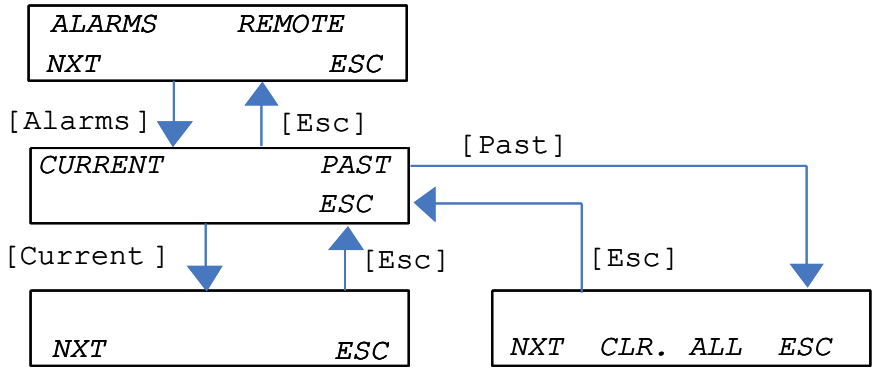
3.3 Measurement Screen 2



3.4 Configuration Screen

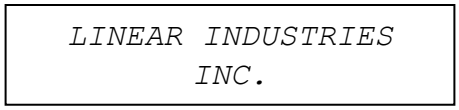


3.5 Alarm Screen



4 Initialization

When the equipment is initially switched on, the screen backlight lights automatically and the message "LOADING"… is displayed, indicating the load process of the modulator has begun. In the unlikely case that the equipment continues showing this message, the possibility of software error has occurred in the load process of the modulator and the equipment may not enter into correct operation. Please report this status to Linear Industries Inc to get the necessary steps of action. Following the LOADING message, the name of the manufacturer, the type number of the equipment, normal rated RMS power and the operating channel are displayed.



This information alternates approximately every 2 seconds. The backlight switches off after approximately 20 seconds. After the initialization of the equipment, this first information will remain indefinitely until another key is pressed. When pressing another key the backlight will light again. Depending on the type of screen the cursor will automatically locate itself in one of the options. To execute some of these options, after the backlight has extinguished it may be necessary to press any key again. If no option is chosen, the backlight will switch off in approximately 20 seconds and then after approximately five minutes the screen returns to the initial display.

4.1 MEASURE MENU

The measure menu allows access to the general equipment configuration parameters; power levels, TS feed and status, qualification of passwords, cancellation of the L.O signal., rejection of image frequency signal, level of scale, activation of look up tables (LUTs) for pre-distortion and the name and version of the installed software on the central microcontroller.

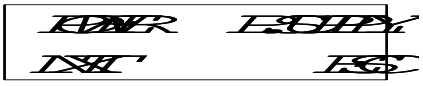
Navigation through these screens is done by pressing the keys UP and DOWN. When these are displayed it is not possible to configure any parameters. The "ENTER" key must be pressed to return to the main screen.

4.1.1 POWER MENU

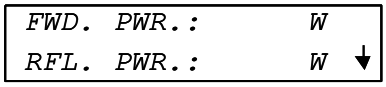
The power menu displays the forward and reflected power at the output of the equipment, measured at the output power reflectometer. Also displayed are the ALC reference voltage and the temperature of the final RF output amplifier.

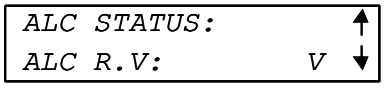
To have access to the POWER screen, the following sequence of screens is necessary:

- Access MEASURES



- Access POWER
- Use the key "DOWN" to see the next set of screens.





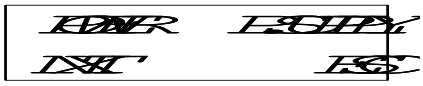
To return to the previous screen, press the UP key. To return to the POWER option presses "ENTER". NOTE: The screens above are a rolling type, allowing access to all of the voltage measurements by using the UP and DOWN keys.

4.1.2 POWER SUPPLY MENU

This screen displays the voltages and currents of the main equipment power supplies.

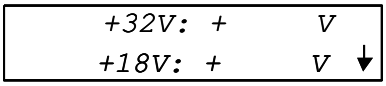
To have access to the P.SUPPLY screen the sequence of screens are:

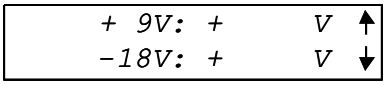
Access MEASURES

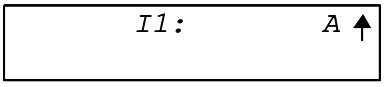


- Access P.SUPPLY

Use the key “UP and DOWN” to move between screens.







To return to the previous screen press the key UP. To return to the option P.SUPPLY press “ENTER”.

4.1.3 MENU ESC

Pressing ESC returns the cursor to the previous screen.

4.1.4 MENU NXT

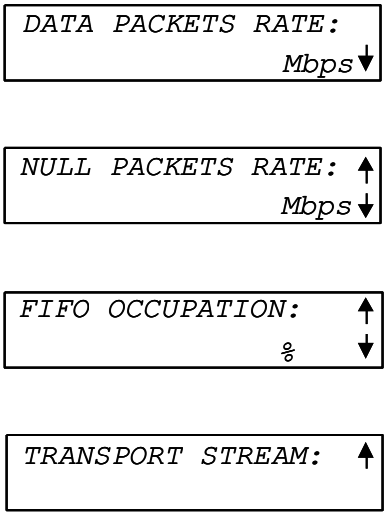
Selecting the “NXT” option provides access to more options of measurement. The sequence for access of these measurements is shown below:

4.1.5 MENU TR.STR.

TR STR shows information about the input digital signal.

Select **NXT** and press **ENTER**

Select **TR.STR** and press **ENTER**



To return to the previous screen press the UP key. To return to the TR.STR options press ENTER.

4.1.6 MENU STATUS

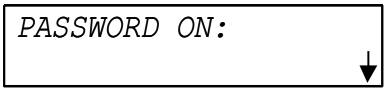
4.1.6.1 Password qualification state

This screen shows the information on the configured parameters:

- **PASSWORD ON: YES -** indicates that a password is required to enter into the SETUP MENU, and the user will be asked for it each time this menu is accessed.
- **PASSWORD ON: NO** - indicates that the requirement of a password is not necessary to enter into the SETUP MENU and open access is available.

Below is the sequence necessary for this option:

- Select **STATUS** and press **ENTER**

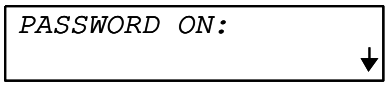


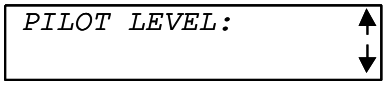
4.1.6.2 Amplitude level of the ATSC Pilot carrier

This is a numerical value relative to the carrier pilot level.

PILOT LEVEL: <+511 TO -2048>

Access to the STATUS menu can be via the far left option or from the PASSWORD ON screen: following viewing the programmed level press the UP and DOWN keys to navigate to other STATUS screens.



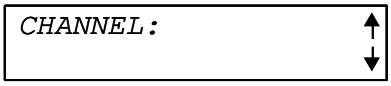


4.1.6.3 Transmission channel

This screen displays the factory programmed transmission channel.

CHANNEL <2 to 53>

To have access to this menu, navigate via the STATUS option and then select PILOT LEVEL, press the UP and DOWN key and then the factory programmed channel can be viewed.

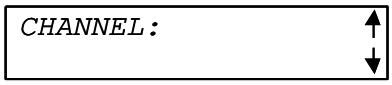


4.1.6.4 DC voltage level adjustment for the cancellation of the L.O signal

This level indicates the voltage programmed in the Up Converter for the cancellation of the local oscillator signal.

LO N.I.: and LO N.Q. <0.00 to 49.75 mV>:

To have access to this menu, select the option STATUSCHANNEL, press UP and DOWN key



4.1.6.5 Rejection of the frequency image

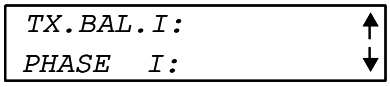
The following are numerical values related to the amplitude and phase signal for rejection of the image frequency.

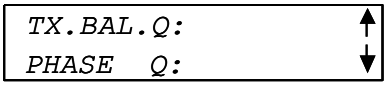
TX. BAL. Q: - <00000 to 32767>

PHASE Q: - <-32767 to +32767>

TX. BAL. I: - <00000 to 32767>

PHASE I: - <-32767 to +32767>

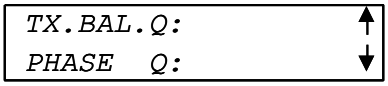


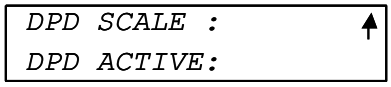


4.1.6.6 Pre-distortion scale level

This is a scale (or intensity) of the pre-distortion level applied to the transmission signal.

DPD SCALE: < 0000 to 4095>

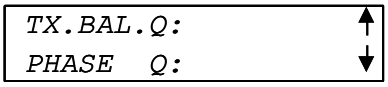


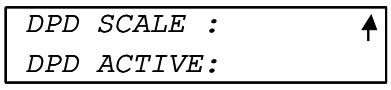


4.1.6.7 Qualification of pre-distortion tables

DPD ACTIVE: YES – indicates the signal pre-distortion tables are active

DPD ACTIVE: NO - - indicates the signal pre-distortion tables are not active.





4.1.6.8 Name and version of software

This menu indicates the name and the version of recorded software in the central microcontroller. This information must be provided to the factory in the case of any maintenance request.

SOFTWARE: < ATXXXX >

VERSION: < X.X >

To verify the name and version of software select do the following:

Select **SOFTWARE** and press **ENTER**

4.2 MENU SETUP

This menu allows access to the configuration functions and parameters of operation of the equipment. The RIGTH ARROW and LEFT ARROW keys locate the cursor in each one of the four possible digits. The "+" and "-" keys, the ENTER and UP and DOWN keys change the digits. The "ENTER" key finalizes the numerical value to the control system. Without pressing the "ENTER" key the value is not saved. Before the "ENTER" key is pressed the parameter is only adjusted in real time for review of the measured results. If the equipment is switched off during a parameter configuration before pressing the "ENTER" key, the configuration will not be saved in the memory and the same values will be as previously stored.

4.2.1 MENU TYPE PASSWORD

This menu sets the four numerical password digits that give access to the SETUP functions. This menu is active only when option YES in the ENABLE PASSWORD menu is indicated. The RIGTH ARROW and LEFT ARROW keys position the cursor in each one of the four possible digits and the ENTER and

UP and DOWN keys edit the digits. The “ENTER” key transmits the value of the password to the control system.

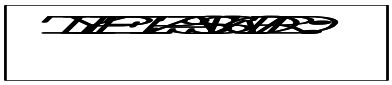
It is only possible to leave this screen after entering the numerical password.

If the correct password is entered, access to the SETUP options is available. If the incorrect password is entered, the following is message is shown “WRONG PASSWORD” and the equipment returns automatically to the main options menu.

TYPE PASSWORD: <XXXX>

Below is the sequence of access for this menu:

Select **SETUP** and press **ENTER**



Type the password number and then press “ENTER”

4.2.2 LIST OF MENU OPTIONS

The following allows navigation in the equipment configuration options:

NXT:	executes the navigation option
PREV:	returns to the previous menu
YES:	indicates access to that particular option
ESC:	returns to the main options menu

To see the options select NXT and press “ENTER”. When the required option is shown, locate the cursor on the “YES” and press “ENTER”.

4.2.2.1 < SET NEW PASSWORD? >

This menu allows the four numerical digits to be configured as a new password for the equipment. The RIGTH ARROW and LEFT ARROW keys locate the cursor on one of the four digits to be changed and the ENTER and UP and DOWN keys change the digits. Pressing “ENTER” key then informs the new password to the control system and returns to the main options menu.

It is only possible to leave this screen after entering the numerical password.

```
TYPE PASSWORD:
```

4.2.2.2 < ENABLE PASSWORD? >

This option allows the qualification or not of the password programmed in SET NEW PASSWORD option.

YES: confirms the requirement of the password to have access to the SETUP options menu.

NO: Indicates that no password is required to have access to the SETUP options menu.

```
ENABLE PASSWORD:
     YES        NO
```

4.2.2.3 < SET PILOT LEVEL? >

This option allows the configuration of the desired level of the ATSC signal pilot carrier with the following range of values: < +511 TO -2048 >.

```
TYPE PILOT LEVEL:
```

4.2.2.4 < SET CHANNEL? >

For equipment safety reasons, changing channel is not allowed in the on-site configuration. This procedure can only be done in the factory. Changing the channel without the permission of a factory trained engineer can potentially void any warranty on the product.

```
TYPE CHANNEL:
  FACTORY  SETUP
```

4.2.2.5 < SET LO NULL I? >

This menu allows the DC voltage adjustment for “nulling” the “I” signal from the local oscillator inter-modulation in the Up -Converter.

The adjustment has the following potential values: < 0.00 to 49.75 mV >.

4.2.2.6 < SET LO NULL Q? >

This menu allows the DC voltage adjustment for “nulling” the “Q” signal from the local oscillator (inter-modulation in the Up-Converter.

The adjustment has the following potential values: < 0.00 to 49.75 mV >.

4.2.2.7 < SET TX BAL. AMP. I? >

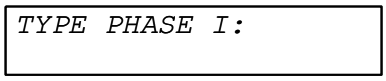
This menu allows the adjustment of the “I” amplitude of the image rejection signal in the 8VSB modulator.

range of values: < 00000 to 32767 >.

4.2.2.8 < SET PHASE I? >

This menu allows the adjustment of the “I” phase of the image rejection signal in the 8VSB modulator.

range of values: < 00000 to 32767 >.



4.2.2.9 < SET TX BAL. AMP. Q? >

This menu allows the adjustment of the "I" balance of the image rejection signal in the 8VSB modulator.

range of values: < 00000 to 32767 >.

```
TYPE AMPLITUDE Q:
```

4.2.2.10 < SET PHASE Q? >

This menu allows the adjustment of the "Q" phase signal amplitude of image rejection signal in the 8VSB modulator.

range of values: < 00000 to 32767 >.

```
TYPE PHASE Q:
```

4.2.2.11 < SET DPD SCALE? >

This menu allows the configuration of the DPD (Digital Pre-distortion) scale (or intensity) of digital pre-distortion applied to ATSC signal.

range of values : < 0000 to 4095 >

```
TYPE DPD SCALE:
```

4.2.2.12 < SET DPD ACTIVE? >

This menu allows the activation or not of the digital pre-distortion tables.

YES: activates the use of the digital pre-distortion look up tables (LUT's)

NO: deactivates the use of the digital pre-distortion look up tables (LUT's)

```
DPD ACTIVE:
     YES        NO
```

4.2.2.13 < SET POWER? >

This allows the configuration of normal rated power at the output of the equipment. The ENTER and UP and DOWN keys increase and decrease the power level. The RIGTH ARROW and LEFT ARROW keys do not possess any function in this screen. The "ENTER" key saves the desired value.

```
ALC. R.V.:       [V]
POWER    :       [W]
```

The power value displayed on this screen is a value fed directly from the output of the reflectometer and is the same value that is provided to the ALC s (Automatic Level Control) system circuit. The system allows for a certain flexibility of adjustment by providing at the same time the power level display in order to verify the actual power level. It is not recommended to adjust for very low values of ALC voltage as this may cause the power to become unstable.

For higher ALC values (above 1.3V), the power will change with the variation of the ALC voltage. In case this simultaneous variation does not occur, it is likely that there is a fault in either or both, the Up Converter or final RF amplifier. This type of occurrence should be reported to the Linear Industries Inc.

In this screen, the ALC is disabled for precision adjustments of the power level and to have full manual control of power, use the ENTER and UP and DOWN keys. In any another environment or screen, the ALC system returns to an enabled mode in order to control the power level.

WARNING: It is important not to set the programmed values of the ALC and consequently the final RF power level above the nominal value of the equipment: This may cause damage to the internal modules and may void the warranty on the unit.

4.3 ALARMS MENU

This transmission equipment has a system of alarms. These are illustrated by symbols at the right side of the display screen: ***** and **#**. The signal ***** represents the occurrence of a current alarm. The signal **#** represents an old alarm, i.e. an alarm that has already occurred and has been cleared. Under normal operating conditions neither of these two symbols will be displayed on the screen.

When the ***** is displayed, the current alarm screen should be accessed to verify which alarm is occurring.

4.3.1 CURRENT MENU

This menu displays the current alarm messages i.e. alarms that are still present and have not yet been cleared.

The current alarm messages are updated when entering the CURRENT MENU.

To update the list, you must leave the menu screen and then return to the ALARMS using the ESC option. Then access the CURRENT menu option again.

Option NXT shows the next alarm message. If there are no alarm messages it will read as follows:

< ALARMS LIST START! >

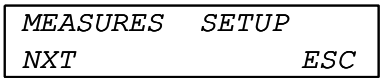
< ALARMS LIST END! >

Option ESC returns to the previous screen.

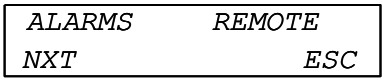
The following messages may appear on the current alarms list:

< ALARMS LIST START! >
< OVER FIFO! >
< MPEG LOSS! >
< DWR. NOT PROGRAMMED! >
< TEMPERATURE! >
< LOCK CLOCK! >
< LOCK LO! >
< OUTPUT POWER ZERO! >
< REFLECTED POWER! >
< ALARMS LIST END! >

Below shows the screens necessary to display the CURRENT alarms menu:



Select **NXT** and press **ENTER**



Select **ALARMS** and press **ENTER**

Select **CURRENT** and press **ENTER**

4.3.2 PAST MENU

This menu displays the past or old alarm messages, i.e. alarms that indicate some equipment alarm occurrence that has been cleared.

The current alarm messages are updated when entering the PAST MENU. To update the list, you must leave the menu and then return to the ALARMS menu using the ESC option and then access the PAST menu option again.

Option NXT shows the next alarm message. If there are no alarm messages it will read as follows:

< ALARMS LIST START! >
< ALARMS LIST END! >

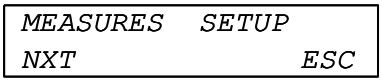
Option CLR. ALL erases all the old alarm messages.

These messages are also erased when the equipment is turned off. Option ESC returns to the previous screen.

The follow are messages that can appear in the past alarms list:

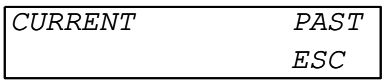
< ALARMS LIST START! >
< OVER FIFO! >
< MPEG LOSS! >
< DWR. NOT PROGRAMMED! >
< TEMPERATURE! >
< LOCK CLOCK! >
< LOCK LO! >
< OUTPUT POWER ZERO! >
< REFLECTED POWER! >
< ALARMS LIST END! >

Below are the screens necessary to display the PAST alarms menu:

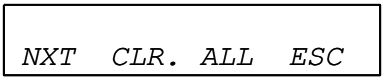


Select **NXT** and press ENTER

Select **ALARMS** and press ENTER



Select **PAST** and press ENTER



4.4 Remote Menu

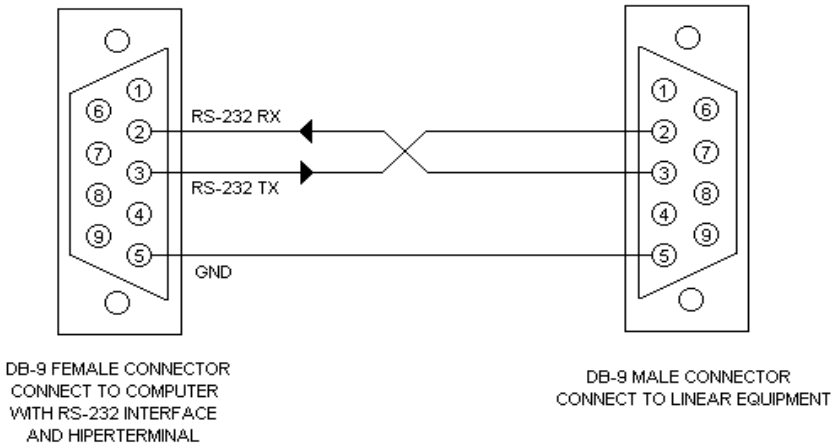
It allows the display of the parameters to be configured in the Windows® Hyper-terminal emulator in order to connect a computer with an RS232 port and have access to the configuration and monitoring of the equipment.

5. Operation of the Hyper-terminal

The AT7120 transmitter system parameters can be monitored and configured using the Windows® Hyper-terminal. The range of values is the same as described previously in the equipment front panel operation (LCD display and keys). It is possible to adjust the transmitter power with the Hyper-terminal interface, however, the ALC system must be first disconnected using the equipment front panel and only within the limits set from the front panel configuration.

The password configuration process is the same as described for the front panel configuration. The password can be accepted or not, and when accepted, it allows access to the SETUP environment. In the SETUP environment it is possible to enable or to disable the password and also to choose a new password. The insertion of new password occurs with the cursor automatically moving to the next digit when the highest value has been reached. After reaching the desired number the cursor is moved automatically to the right, and after the last digit is reached the next typed key returns to the first position.

A cable must be connected between the transmitter RS232 output and RS232 input of the computer. The cable end for the computer is a male DB-9 and the cable end for the transmitter is a female DB-9 connector. Only three of the nine pins are used, with pins 2 and 3 of the cable crossed. Pins used are TX, RX and GND. Pin 3 is TX and pin 2 is RX. In the both connectors pin 5 is GND. The figure below illustrates the RS232 cable and connector:



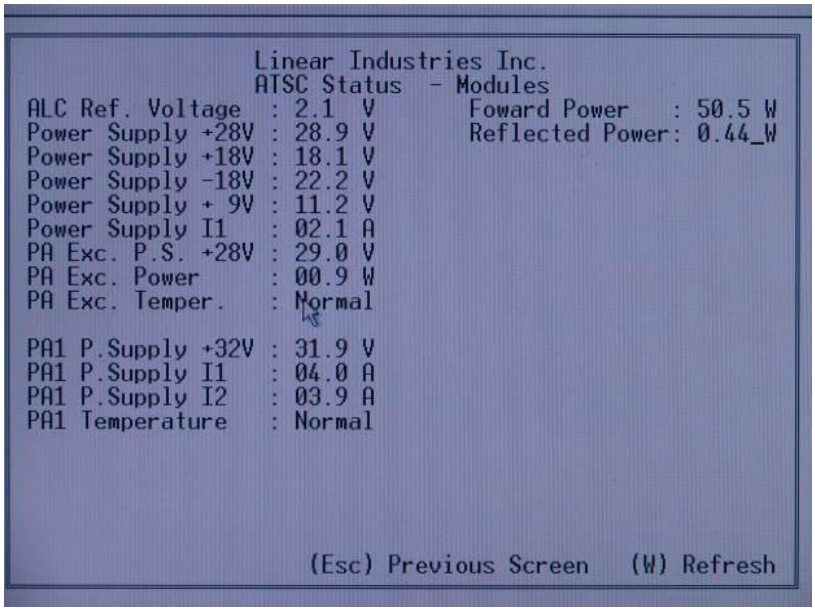
The configuration of the Window® Hyper-terminal must be in accordance with following:

PROPERTIES OF COM4

Configuration of Port

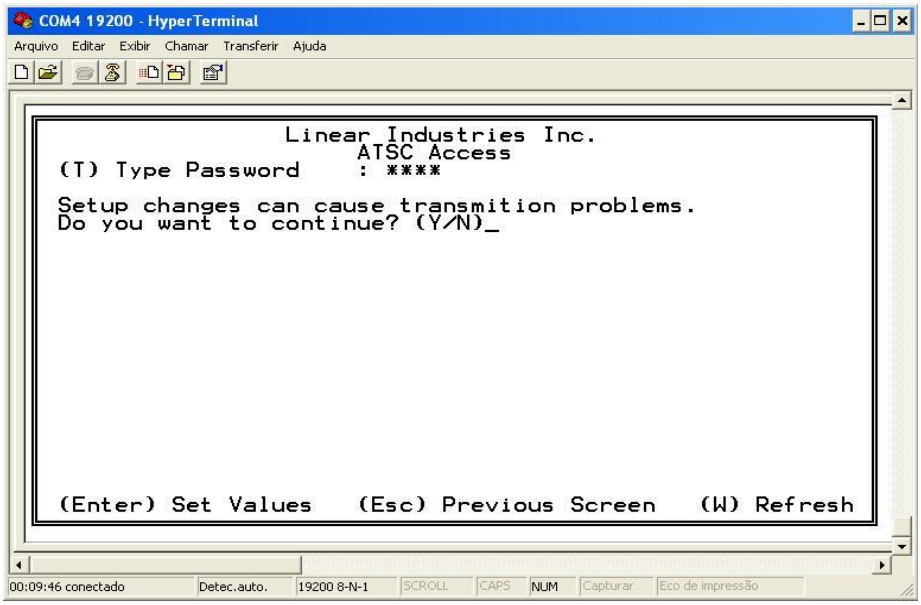
Bits per Second	19200
Bits of data	8
Parity	None
Bits of Parity	1
Flow Control	None

To access the data of the equipment and to bring up to date the screens in the Hyper-terminal use ENTER on the keyboard. Screen 1 indicates some measurements, states of the alarms and offers options for access to other functions of the equipment.

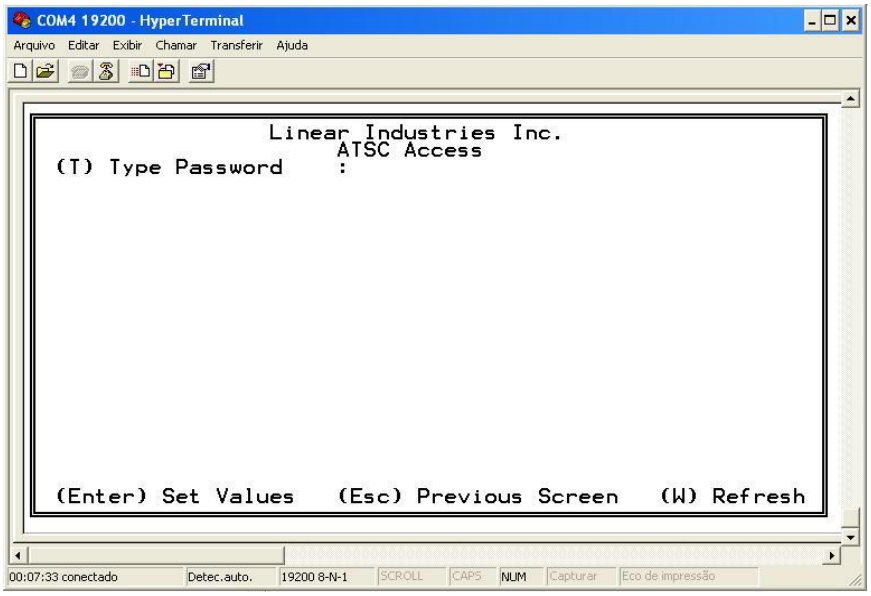


(Typical example of screen shot)

When the password of the equipment is qualified screen 2 will be displayed. A password of 4 digits must be entered to access the SETUP environment. In the case where the typed password is incorrect, the message “WRONG PASSWORD" will be shown. When the password is correct a warning question is asked. Reply YES (y), which then allows access to the SETUP environment. A NO (n) reply will return to the menu to the previous screen 1.

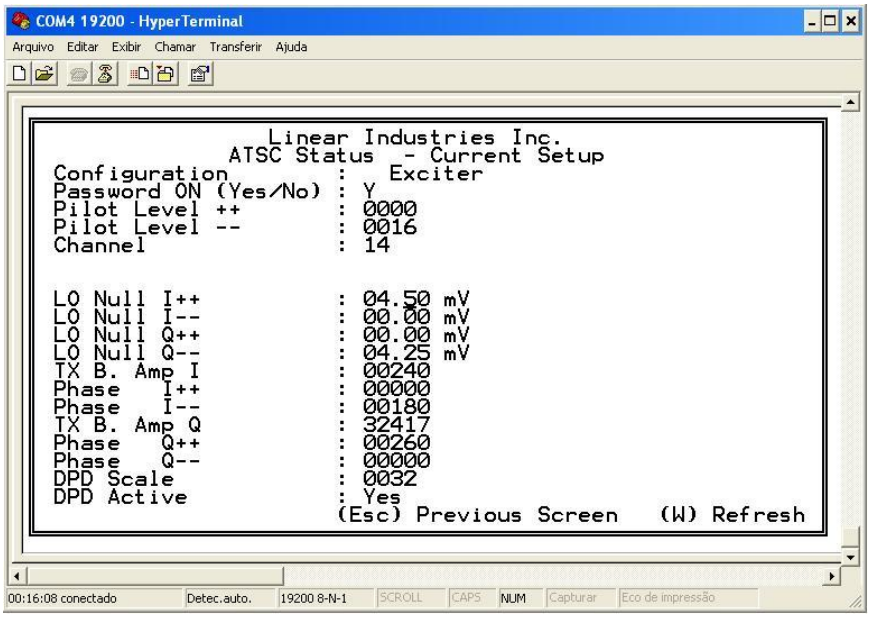


(Typical example of screen shot)



(Typical example of screen shot)

To configure the parameters of screen 3 the characters in the parentheses should be selected by using standard keyboard keys. Select the option desired and then use the keyboard characters U (up) and D (down) or Y (Yes) or N (No) to display the values of the configuration. For safety reasons, the values entered are only confirmed when exiting from the screen. Exit from the screen by using the ESC key. The W key will refresh the screen.



(Typical example of screen shot)

Annex B – Checking the RF Power LDMOS Transistors

All 3 main RF transistors on the module 4407 are LDMOS technology type. The manipulation of these transistors requires some special care, for instance, avoiding manual bare finger direct contact with the parts. Instead, prioritize the usage of metal parts tools and grounded care procedures.

Gate-to-ground conductance test

With the transistors in place, it is possible with a digital multimeter to perform this test. Unplug the DC connectors (CON-2 and CON-3) and measure the conductance between the gate terminal and ground.

T1:

Adjust TPO-1 for the minimum of its value (counterclockwise); the reading at the multimeter should be close of 380Ω. Adjusting TPO-1 for the maximum of its value, the reading at the multimeter should be close of 720Ω.

T2:

Adjust TPO-2 for the minimum of its value (counterclockwise); the reading at the multimeter should be close of 370Ω. Adjusting TPO-1 for the maximum of its value, the reading at the multimeter should be close of 720Ω.

T3:

Adjust TPO-3 for the minimum of its value (counterclockwise); the reading at the multimeter should be close of 550Ω. Adjusting TPO-1 for the maximum of its value, the reading at the multimeter should be close of 705Ω. These readings are expected to remain the same for both T3 gates.

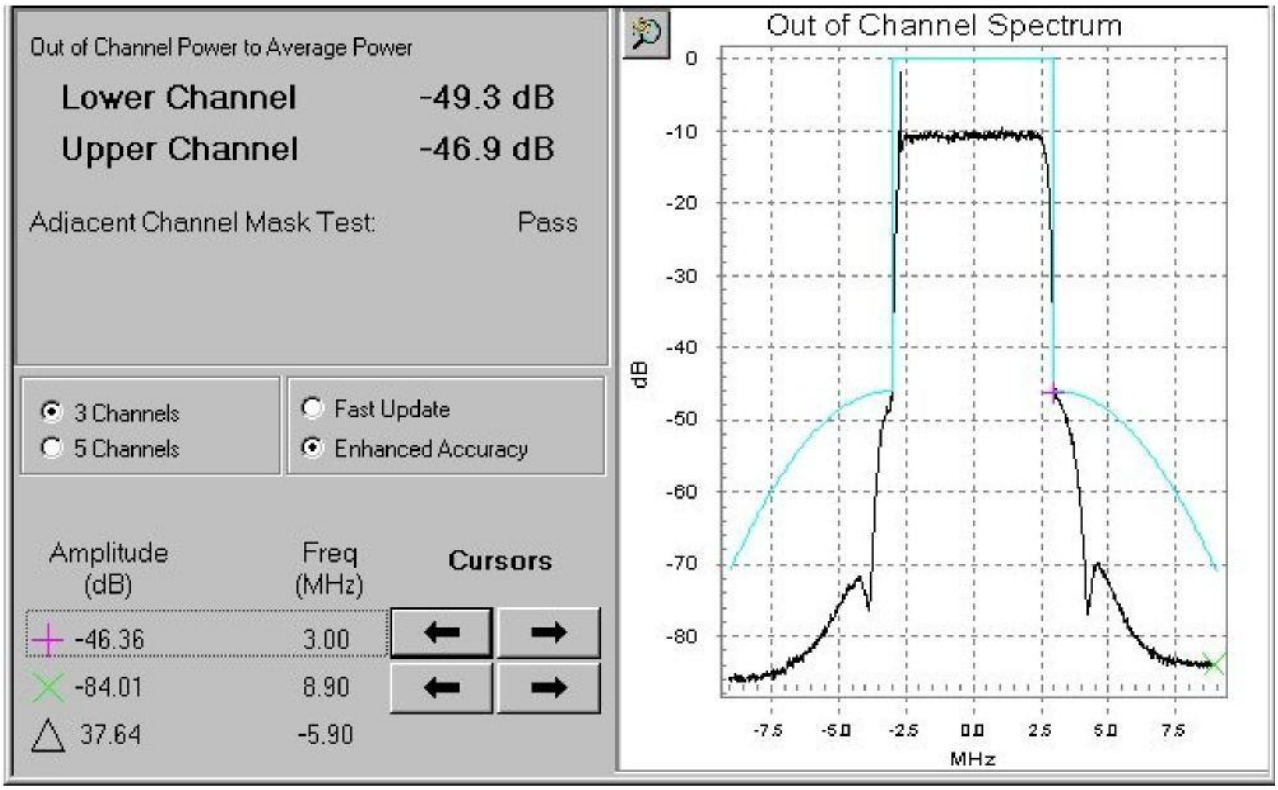
In event that these measurements do not come true, check the possibility of some surrounding components being damaged, and/or initiate a careful visual inspection, looking for abnormal circumstances. Some tests suggested above could be repeated with the transistors detached out from the PCB board; in this case, measurement readings for gate-to-ground should be close of 40MΩ. Also in this situation, detect a diode type behavior by measuring drain-to-source conductance as follows:

(+)	DRAIN	(-)	SOURCE	R=	580Ω
(+)	SOURCE	(-)	DRAIN	R=	∞

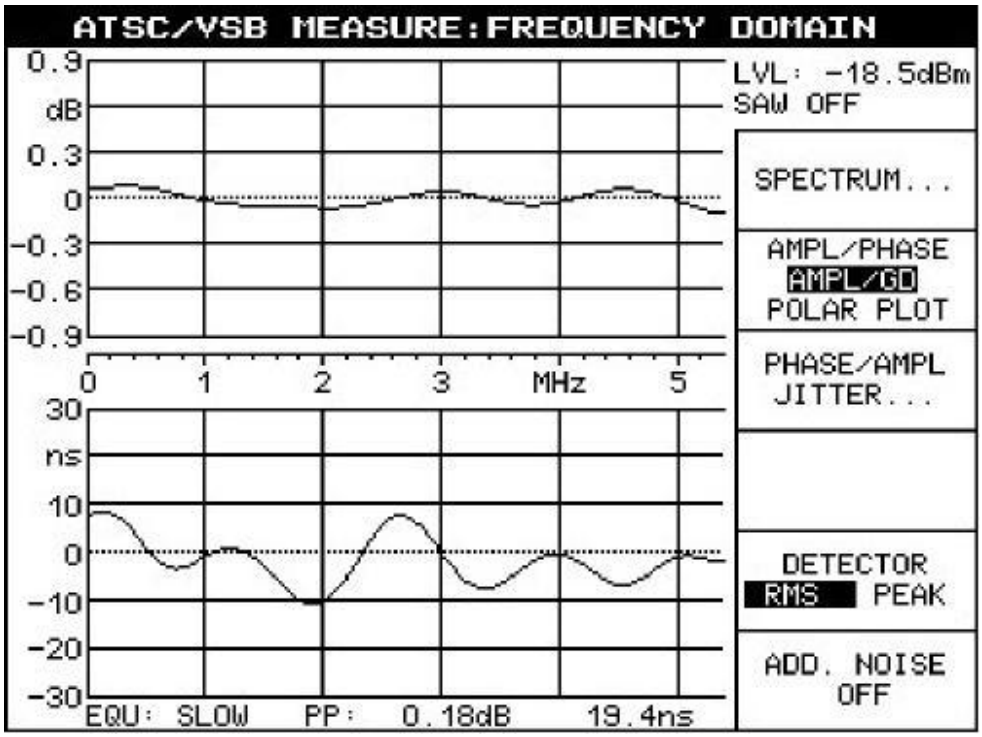
In case these 2 measurements cannot be verified, the transistor must be substituted.

Annex C – Typical Final Test Reports Results

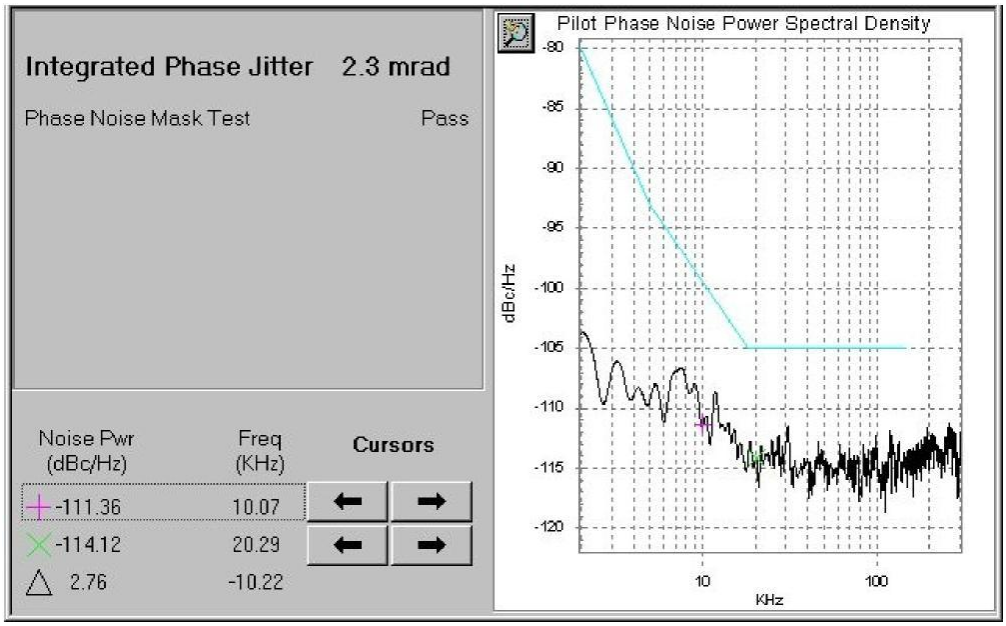
Out of Channel Emissions



Frequency Response and Group Delay



Carrier Phase Noise



Digital Modulation Error Rate

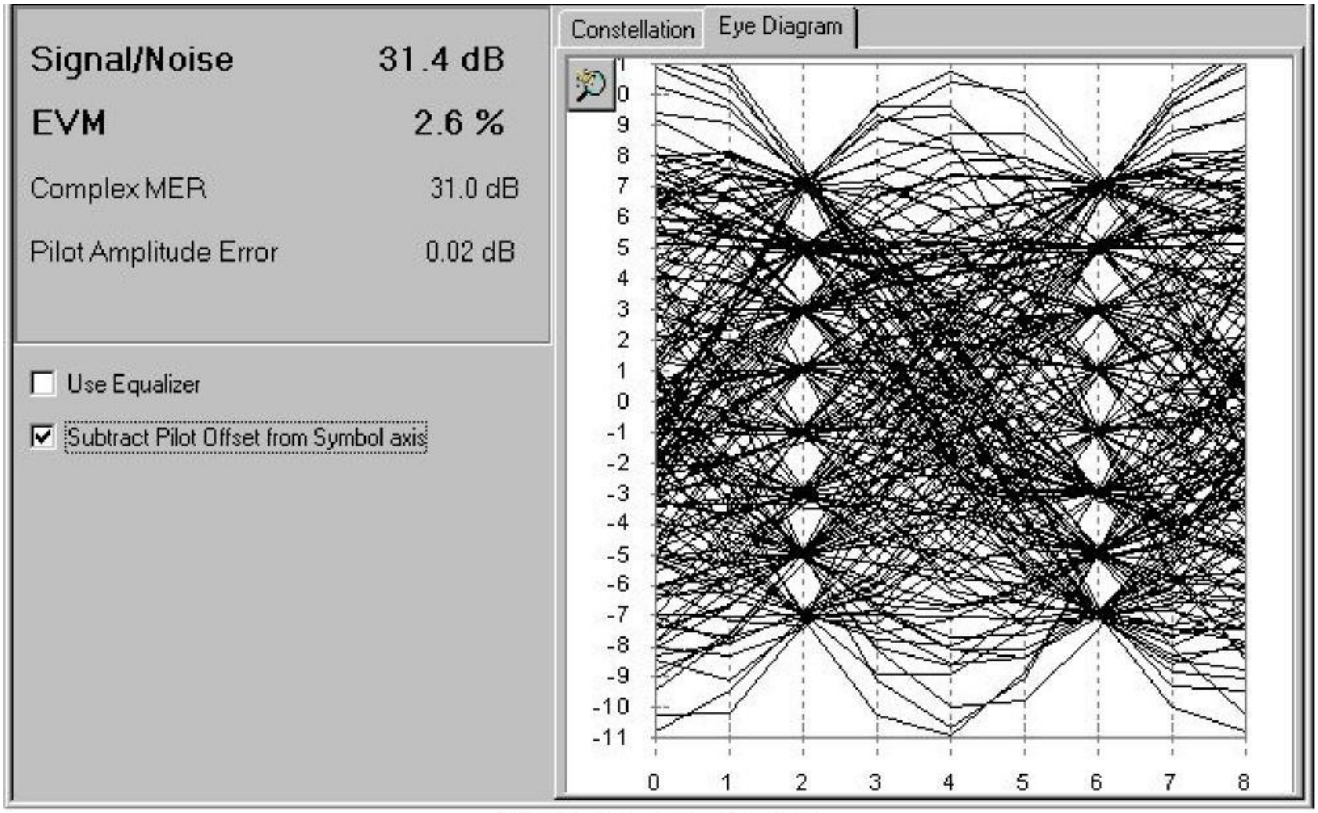


Figure 2-4. Eye diagram

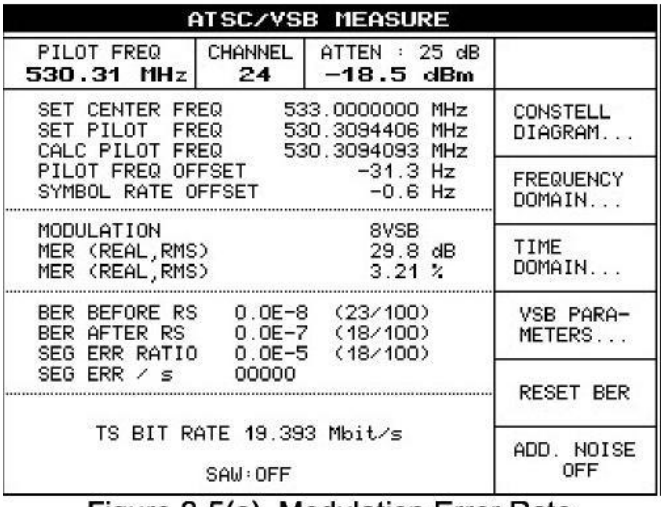


Figure 2-5(a). Modulation Error Rate

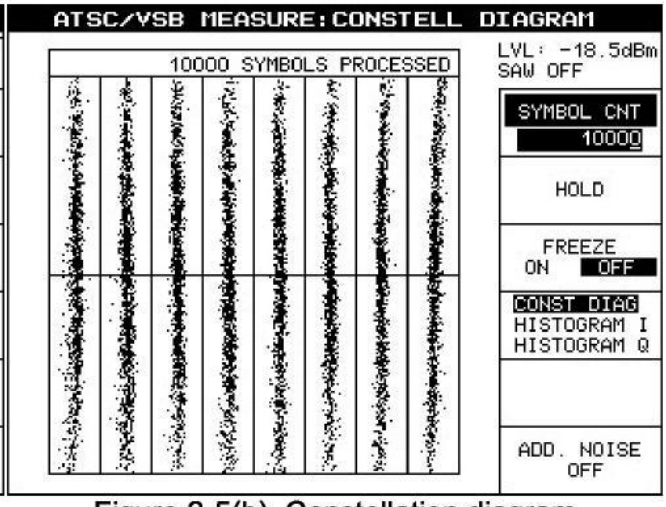


Figure 2-5(b). Constellation diagram

Conducted Spurious Emissions