SISTEMAS ELECTRONICOS S.A.

TECHNICAL MANUAL
v1.1 February 2006

250W SOLID STATE FM TRANSMITTER

EM 250 COMPACT DIG

OMB EUROPE:
Factory: Camino de los Albares,14 -Ph. 976.50.35.80, Fax: 976.50.38.55 – 50410 CUARTE DE HUERVA (Zaragoza) ESPAÑA
Sales Dpt.: Avda. San Antonio,41– Ph. 976.50.46.96, Fax: 976.46.31.70 – 50410 CUARTE DE HUERVA (Zaragoza) ESPAÑA
E-mail: europa@omb.com
Web: www.omb.es

OMB USA:
3100 NW 72nd. Avenue Unit 112 – MIAMI, Florida 33122 – Ph.: 305 477-0973, 305 477-0974, Fax: 305 477-0611
E-mail: usa@omb.com
Web: www.omb.com

SISTEMAS ELECTRÓNICOS

OMB ESPAÑA
Av. San Antonio, 41
50410 Cuarte de Huerva
ZARAGOZA (ESPAÑA)
Website: http://www.omb.com
e-mail: europa@omb.com
Tlf: + 34 976 50 46 96
Fax: + 34 976 46 31 70

Registered ISO 9001:2000 — UKAS QUALITY MANAGEMENT 127-A

Nº Es01-022

Registered ISO 14001:2004 — UKAS QUALITY MANAGEMENT 127-C

Nº Es01-E021

LIMITED WARRANTY

About Installation

1. - Mains Voltage must be kept between ±10% about its nominal value, unless otherwise specified. If were variations exceeding this tolerance, it will be indispensable to install a voltage stabilizer system within station. If transient overvoltages, due to electric motors, or other devices of this sort connected to the distribution line, were present, or if the distribution line is exposed to atmospheric electrical discharges, it must be indispensable the installation of isolation transformers and gaseous dischargers before connecting any equipment within station.

2. - All equipments must be connected to station ground system in order to avoid damage both to equipments and maintenance personnel too. It is necessary to connect a differential automatic switch (lifesaver) at station.

3. - Some equipments does not include interlock protection for open doors, covers or connectors. In that case, these equipments must be kept in key –locked places, with access only to conveniently qualified personnel that is previously noticed about not to open doors, covers or connectors without disconnecting station mains switch before performing this job.

4. - Transmitter equipments NEVER will be operated with output powers over its nominal values, or with signals or input informations others than those specified in its individual characteristics.

5. - Ambient temperature inside equipments' room, will accomplish technical specifications of equipments installed at station lodge. In absence of such specifications, maximum allowable temperatures will be from -5 to + 45ºC for Television equipments, and from 0 to + 40ºC for Sound Broadcast equipments.

6. - In case of operation at abnormally high or extremely high temperatures (over 30 to 40 ° C), it is obligatory to install a forced cooling system that will keep temperature below its upper limit. In case of operation at abnormally or extremely low temperatures, it will be obligatory to install a thermostatic controlled heating system for equipment's room.

7. - Both equipment's surroundings and room must be free of dust and dirt. Ambient relative humidity will be kept below equipment's extreme specifications. In case of absence of this specification, allowable maximum will be 90 % of relative humidity, non-condensing. Average relative humidity will be kept under 70%, non-condensing.

8. - Every transmission equipment that can radiate some quantity of RF power, must be connected to a load or antenna system, suited to its individual specifications , before being energized.

9. - Maximum allowable VSWR in antenna systems both for Television or FM Radio Broadcast operation of a given transmitter, will be 1.25:1, unless otherwise specified.

10.- For those transmitter equipments having power valve amplifiers, and that doesn't has an automatic shutoff cycle, and must be manually turned off, as a first step high voltage, or anode voltage, will be disconnected, keeping forced cooling system working during at least 5 minutes after high voltage disconnection, and only after this time, cooling system & filament voltage can be shutted off. O.M.B. Sistemas Electrónicos, S.A., is not responsible of damages to those power valves caused by sudden AC mains failures at station where our equipments are installed.

11.- Periodically, monthly as a maximum, technical personnel must visit station in order to perform a general equipment maintenance, unless otherwise specified. This maintenance will include output power check, VSWR of antenna systems, forced cooling or heating systems

checks, both for equipments and station itself, including air filters cleaning, measuring of transmission frequency with eventual correction if necessary, and will perform a general check of fundamental parameters of equipments. In the event of any important change in some operation parameter, that will require replacement or readjustment of any unit, Customer **MUST CONTACT FIRST WITH O.M.B. SISTEMAS ELECTRONICOS, S.A. BEFORE ANY ATTEMPT TO READJUST OR REPLACE ANY COMPONENT OR UNIT INSIDE EQUIPMENTS, IN ORDER TO KEEP VALID THIS WARRANTY.**

12.- For equipments who are located in fixed racks or cabinets, those equipments must be effectively connected, according to International Installations Standards, to station ground system, whose total impedance measured to ground can't be higher than 5 ohms. Equipments must be connected to ground system so that they can be kept out of main discharge path between tower and ground.

About Transportation

1. - O.M.B. Sistemas Electrónicos, S.A. is not responsible of damages and/or detriments derived from mishandling, steal, robbery, theft or vandalism during the act of transportation of equipments to final or intermediate destination.

About Storage

1. - O.M.B. Sistemas Electrónicos, S.A. is not responsible of damages and/or detriments derived from unappropiate storage of equipments, within inadequate warehouses or outdoors, once equipments are delivered to transportist agency.

About Projects

1.- O.M.B. Sistemas Electronicos, S.A. is not responsible of inadequate use of equipments made or registered by our Company, accomplishing propagation projects that are not performed by our Specialists.

About Systems

1.- O.M.B. Sistemas Electrónicos, S.A. is not responsible for performance of those equipments or systems that are not made, certified or registered by our Company.

About Operation

1.- O.M.B. Sistemas Electrónicos, S.A. is not responsible of damages and/or detriments derived from inadequate or negligent operation of equipments made, certified or registered by our Company, once those equipments are operated by personnel hired and/or employed by Customer.

General

This Warranty covers and protects, during a period of 18 months after start of operations, all equipments made , certified or registered by O.M.B. Sistemas Electrónicos, S.A., including its components and units, against failures in workmanship that may occur during operation of those equipments, **with the exception of power valves or semiconductor devices** that are covered by its particular Factory's Guarantee. In this case, O.M.B. Sistemas Electrónicos, S.A. only can act as intermediary for negotiation with such Factory, about accomplishment of individual Guarantees.

For Validity of this Warranty, it is indispensable that all Paragraphs be respected by the Customer. Otherwise, this Warranty will be automatically voided. **This Warranty is self-activated with the reception by OMB Sistemas Electrónicos, S.A. of the "Guarantee Activation Manual" returned to OMB by Customer. If such Document is not received, this Warranty will be voided.**

All repairings or adjustments covered by this Warranty are free of workmanship & materials costs and expenses, but postage and transportation expenses of equipments and O.M.B. technical personnel & specialists, if required, will be carried out by the Customer.

O.M.B. Sistemas Electrónicos, S.A.

LIST OF CONTENTS

SECTION 0. GENERAL RECOMMENDATIONS 2

Gives information on safety procedures and good practices to use the equipment.

SECTION 1. GENERAL DESCRIPTION 6

Introduction to the manual, technical specifications and description of the equipment's features.

SECTION 2. DESCRIPTION OF INTERNAL MODULES 14

Contains a deep description of the system operation, including lists of components, schematics and layouts.

SECTION 3. INSTALLATION AND MAINTENANCE 53

Contains basic instructions for unpacking and installing the equipment and recommended maintenance operations for a good system operation.

SECTION 4. SETTINGS 63

Instructions to configure the equipment by using the software installed.

Section 0

GENERAL RECOMMENDATIONS

GENERAL SAFETY RECOMMENDATIONS

When connecting the equipment to the Mains power, please follow these important recommendations:

♦ This product is intended to operate from a power source that will not apply more than 10% of the voltage specified on the rear panel between the supply conductors or between either supply conductor and ground. A protective-ground connection by means of the grounding conductor in the power cord is essential for a safe operation.

♦ This equipment is also grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired socket before connecting to the product input or output terminals.

♦ Upon loss of the protective-ground connection, all accessible conductive parts (including parts that may appear to be insulated) can render an electric shock. **Equipment must be connected to station's ground system before any attempt to connect it to Mains electrical supply.**

♦ To avoid fire hazard, use only fuses of the type, voltage rating, and current rating specified in this manual. For fuse replacement, always refer to User's Manual.

♦ To avoid explosion, do not operate this equipment in an explosive atmosphere.

♦ To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

GOOD PRACTICES

During the maintenance of the equipment covered in this Manual, please keep in mind the following standard good practices:

♦ When connecting any instrument (wattmeter, spectrum analyzer, etc.) to a high frequency output, use the appropriate attenuator or dummy load to protect the final amplifiers and the instrument input.

♦ When inserting or removing printed circuit boards (PCBs), cable connectors, or fuses, always turn off power from the affected part of the equipment. After power is removed, allow sufficient time for the capacitors to bleed down before reinserting PCBs. **Always use discharge stick** when available.

♦ When troubleshooting, remember that FETs and other metal-oxide-semiconductor (MOS) devices may appear defective because of leakage between traces or component leads on the printed circuit board. Clean the printed circuit board and recheck the MOS device before assuming it is defective.

♦ When replacing MOS devices, follow standard practices to avoid damage caused by static charges and soldering.

♦ When removing components from PCBs (particularly ICs), use care to avoid damaging PCB traces.

FIRST AID IN CASE OF ELECTRICAL SHOCK

If someone seems unable to free himself while receiving an electric shock, **turn power off** before rendering aid. A muscular spasm or unconsciousness can make a victim unable to free himself from the electrical power.

DO NOT TOUCH VICTIM OR HIS CLOTHING BEFORE POWER IS DISCONNECTED OR YOU CAN ALSO BECOME A SHOCK VICTIM

If power cannot be turned off immediately, very carefully loop a length of dry non-conducting material (such as a rope, insulating material, or clothing) around the victim and pull him free of the power. Carefully avoid touching him or his clothing until free of power.

EMERGENCY RESUSCITATION TECHNIQUE

Step 1
Check the victim for unresponsiveness. If there is no response, immediately call for medical assistance, and then return to the person.

Step 2
Position the person flat on their back. Kneel by their side and place one hand on the forehead and the other under the chin. Tilt the head back and lift the chin until teeth almost touch. Look and listen for breathing.

Step 3
If not breathing normally, pinch the nose and cover the mouth with yours. Give two full breaths. The person's chest will rise if you are giving enough air.

Step 4
Put the fingertips of your hand on the Adam's apple, slide them into the groove next to the windpipe. Feel for a pulse. If you can not feel a pulse or are unsure, move on to the next step.

Step 5
Position your hands in the center of the chest between the nipples. Place one hand on top of the other.

Step 6
Push down firmly two inches. Push on chest 15 times.

CONTINUE WITH 2 BREATHS AND 15 PUMPS UNTIL HELP ARRIVES.

TREATMENT FOR BURNS

♦ Continue treating victim for electrical shock.

♦ Check for points of entry and exit of current.

♦ Cover burned surface with a clean dressing.

♦ Remove all clothing from the injured area, but cut around any clothing that adheres to the skin and leave it in place. Keep the patient covered, except the injured part, since there is a tendency to chill.

♦ Splint all fractures. (Violent muscle contractions caused by the electricity may result in fractures.)

♦ Never allow burned surfaces to be in contact with each other, such as: areas between the fingers or toes, the ears and the side of the head, the undersurface of the arm and the chest wall, the folds of the groin, and similar places.

♦ Transport the victim as soon as possible to a medical facility.

Section 1

GENERAL DESCRIPTION

CONTENTS :

1.1 Introduction 7
1.2 Description 7
1.3 Front panel 9
1.4 Rear panel 11
1.5 Inner layout 12
1.6 Technical specifications 13

1.1 Introduction.

The OMB EM-250 COMPACT DIG series transmitters are the result of experience gained by OMB during years of producing FM broadcast equipment, transmitters, stl and stereo encoders. These transmitters were specifically designed to comply with the latest international standards and the requirements of advanced broadcasters,meeting tighter specifications than usually required,at an affordable cost.

Great care went into producing a Hi-Fi-quality modulated signal,with low residual noise and distortion.The RF signal is also free from spurious and harmonic components to a higher degree than required by CCIR, European, USA and most other national standards.To obtain this outstanding performance, OMB strongly recommend to rely on qualified personnel to install and verify the equipment which makes up the radio station, i.e.the transmitter, the possible stl and power amplifier, the corresponding antennas,cables and connectors.This will assure to achieve the best performance and stability in time. To this aim,OMB especially recommend that their equipment should not be tampered with by unskilled personnel and its after-sale service is available to customers for any technical problem.Before proceeding to installation, please carefully read at least the general installation part of this manual, to gain confidence with the equipment.

The EM-250 COMPACT DIG transmitters are very stable and changes to the internal pre-setting other than frequency and few other options are not usually required but, if they are, once again they must be done by skilled personnel, fitted with proper instrumentation and service documentation. Improperly tampering with the settings may harm the apparatus or jeopardize the guaranteed performance.

THIS EQUIPMENT COMPLIES WITH ALL RELEVANT EMI /EMC AND SAFETY REQUIREMENTS, ETSI EN300384, ETS300447 AND EN60215 STANDARDS.

NO INTERNAL ADJUSTMENT OR PRESETTING IS REQUIRED DURING NORMAL OPERATION.EQUIPMENT SHALL BE PROPERLY GROUNDED AND BE OPERATED WITH ALL THE COVERS CLOSED TO PREVENT ELECTRICAL HAZARDS AND COMPLY WITH EMC STANDARDS.

OMB hence recommends for these equipments not to be handled by unskilled personnel,together with antenna system, transmission lines and the remaining components, both at Transmitters and related equipments and station's antennas system.

A good installation,made by skilled and trained personnel will avoid many future troubles during station's exploitation process. All the operations described in the Certification of Limited Warranty must be accomplished to have the right of make any claim concerning this Warranty,having free equipment service by OMB's technical personnel during this first exploitaition phase of Equipment.

1.2 Description.

The EM-250 COMPACT DIG is a 250W rated, direct-synthesis, FM-modulated transmitter. Being digitally controlled, it is extensively put on the air on field by front panel or remotely in additional aspects: frequency, power, channel sensitivity, preemphasis, functioning mode (mono, stereo, external mpx), clock and date and many other parameters without adjusting or substituting any part. A powerful 3-level password management permits a very high degree of security and privacy as may be required in different situations. Equipment requires little o no maintenance and its simple modular layout facilitates stage testing and servicing.

Fig. 1-1: THE EM-250 COMPACT DIG DIGITALLY-CONTROLLED F.M. TRANSMITTER

As imposed by various national standards, these transmitters incorporate sophisticated low-pass audio filters on mono and stereo channels,and a sharp acting modulation limiter, which is usually set at a peak deviation slightly higher than 75kHz. Its intervention may nevertheless be avoided, if required, pre-setting its threshold at a deviation higher than 150kHz. Output frequency is phase-locked to a temperature-compensated crystal oscillator,which ensures superior precision and stability. A very low noise,low distortion VCO produces a harmonic-free, spurious-free signal. A lock control circuit inhibits the presence of power on the output until the apparatus is on the right frequency,when turning on.

To lower the noise threshold further, the low-frequency inputs are fitted with balanced input circuitry.The input level is precisely adjustable over a broad range,by means of a 0.5dB stepwise variable attenuators.The transmitter has an auxiliary input,specifically designed for RDS and SCA encoders. A modulation sample output permits to control other transmitters or STL's with the same internally processed high-quality mpx signal.

The alphanumeric display permits easy and accurate metering,adjustment and continuous monitoring of modulation levels,power,operation and internal parameters.All these information may be externally available on the same RS-232 I/O bus that may be used to remotely control the transmitter.

Above Figure 1-1 shows us the external view of Modulator / Exciter's cabinet, whose control panel has been simplified to a maximum, being Microcontroller in charge of practically to select and make all tests and adjustments of all parameters that are relevant to the normal Equipment's performance. Due to this fact, Front Panel has only a few control elements, since with only the four push buttons pertaining to Microcontroller (like those used to control movement of cursor in a Computer) and two keys, these virtually controlling all processes and parameters having place within Equipment. Microcontroller uses a Liquid-Crystal dot matrix as Alphanumeric Display unit in order to watch parameter's values, as it's asked for it, as can be seen in the corresponding section in this Manual.

In addition to the serial I/O port, some signals (RF power, ON THE AIR status, Disable line) are available on a parallel I/O remote socket for easy interfacing with others analog controllers or supervisory systems. A top-quality stereo encoder may be factory installed as option and even retrofitted in the field in a second time, requiring minimum technical skill. The powerful internal software and monitoring functions recognizes its presence and enables its functions.

The RF power amplifier employs a broadband design and has a lot of of reserve: the output power is feedback-controlled for increased stability still higher than nominal level. High reflected power is limited to prevent output stage degradation;direct power is accordingly continuously reduced so as not to exceed the reflected power safety level. A sturdy telecom-grade high efficiency switch-mode power supply allows operation in a very wide and noisy mains environment.

1.3 Front panel.

The EM-250 COMPACT DIG Front Panel is very clean and easy to control.The wide alphanumeric display and the control keyboard allows a simple self-explanatory menu-driven navigation through the various options. A great care was taken in the design of the software to allow natural feeling with the controls to allow operation and programming in every respect of the Equipment without needing to extensively read this manual.

The password management hides some functions and prevents tampering with the most critical options and data to unauthorized people.

Figure 1-2 shows the simple Equipment's Front Panel, indicating all supervision and control elements:

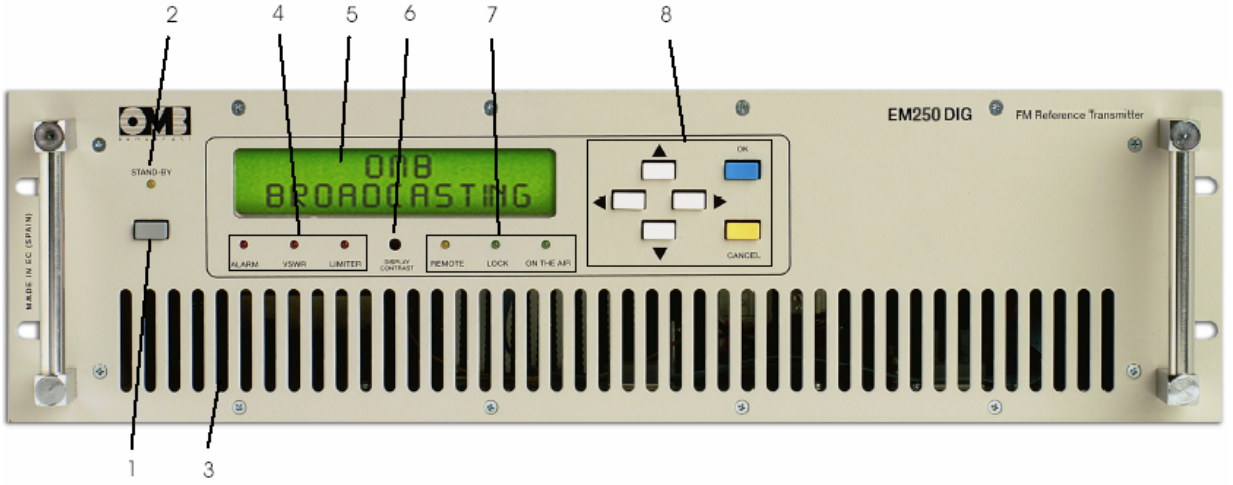


Fig. 1-2: TRANSMITTER CONTROL PANEL.

These supervision andcontrol elements are numbered in Figure 1-2 as follows:

1 - ON/STBY switch. This ON/STANDBY key do not power off equipment, which is still locked on frequency and ready to transmit as soon the key is pushed or a remote command is sent.

2 - STANDBY condition indicator LED.

3 - Cooling system's air intake slots.

4 & 7 - Alarm LEDs panel and operation LEDs panel:

ALARM PANEL:

- **Alarm** red LED lights on in event of any equipment's alarm condition.

- **VSWR** red LED lights on showing that RF output circuit is overloaded by a severe high VSWR condition.

- **Limiter** red LED lights on showing too high audio signal level at equipment's input,and subsequent operation of baseband peak clipper.

OPERATION PANEL:

- **Remote** amber LED shows remote-controlled operation is being carried on.

- **Lock** green LED shows when Channel Oscillator's PLL is properly locked, some tenths of second after equipment is turned on.

• **On the air** green LED works together with STANDBY (2) yellow LED. It lights on when equipment is in normal operating condition, whereas STANDBY (2) LED is turned off, and vice versa.

5 - Twin-row Alphanumeric dot-matrix LCD display, working directly with Microcontroller unit.

6 - DISPLAY CONTRAST potentiometer, to adjust LCD screen backlighting to a comfortable contrast level in order to get easy readings.

8 - Programming and parameter selection keyboard:

- ♦ White keyboard to scroll and navigate through the different menus and options.
- ♦ OK key (blue). Enter key to confirm some order or command.
- ♦ CANCEL key (orange). Escape key to cancel menu or command.

1.4 Rear panel.

All transmitter inputs and outputs are allocated on the rear panel. Figure 1-3 below shows this Panel indicating all connectors and elements.

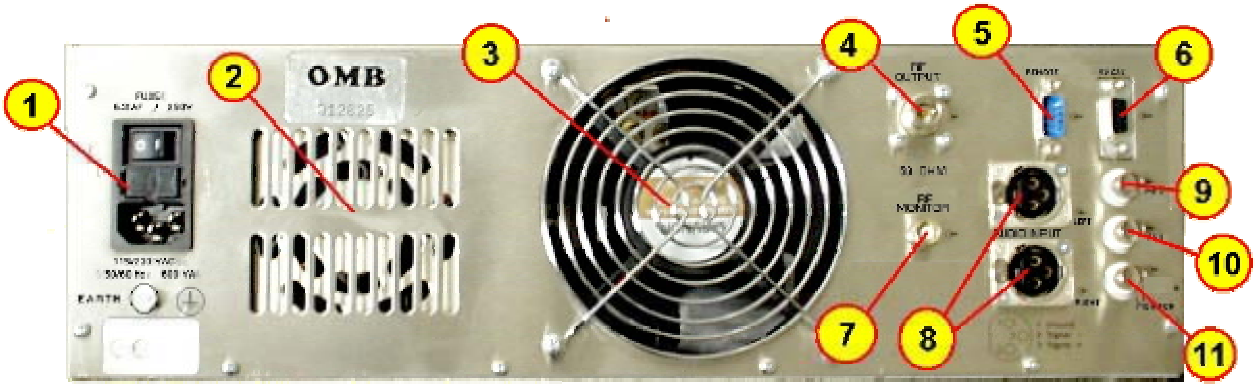


Fig. 1-3: REAR VIEW OF TRANSMITTER CABINET.

These elements are numbered as follows:

1 -Mains IEC ON/OFF switch, mains voltage selector,socket and fuses block. Please note that the transmitter is usually factory pre-set for 220-240V_{AC} nominal Mains voltage.

2 -Main Power Supply's hot air exhaust from internal cooling blower.

3 - RF Power Module's hot air exhaust from cooling fan.

4 -Output RF connector.Type "N"female.

5 - Remote operation DB-9 male connector.

6 - RS-232 serial interface connector. This RS-232 port manages only Tx, Rx and Return data signals,with no handshake. Being the two former wired signals inverted to the port, it needs a simple straight wired serial cable with appropriate connectors:usually a female DB-9 or DB-25 female to the PC port and a male DB9 connector at the transmitter end. Appropriate OMB software is required for communication. Do not connect the serial cable with neither transmitter or PC turned on.

7 - RF sample output for frequency measuring or RF signal monitoring, BNC female type connector. -50dBc.

8 - Right and left channels audio input XLR balanced female connector. For using internal stereo coder. (See equipment's rear panel for pin connections).

9 - MPX input connector. Type BNC female.For use in pre-coded stereo multiplex signal input. Flat response from10Hz to 100KHz to feed stereo multiplex signal. Hi - Z unbalanced input (10KΩ).

10.- AUX connector. Unbalanced Hi-Z BNC female connector,to feed a RDS or SCA encoder output signal.

11.-LF MONITOR output connector. Baseband modulation output for monitoring, re-broadcasting or RDS external synchronization. BNC female type, unbalanced Hi-Z (10KΩ).

1.5 Inner layout.

Figure 1-4 below shows space occupied and allocation of the different units and PC boards within equipment, and internal arrangement of cabinet. All boards and units can be easily and quickly replaced in case of failure:

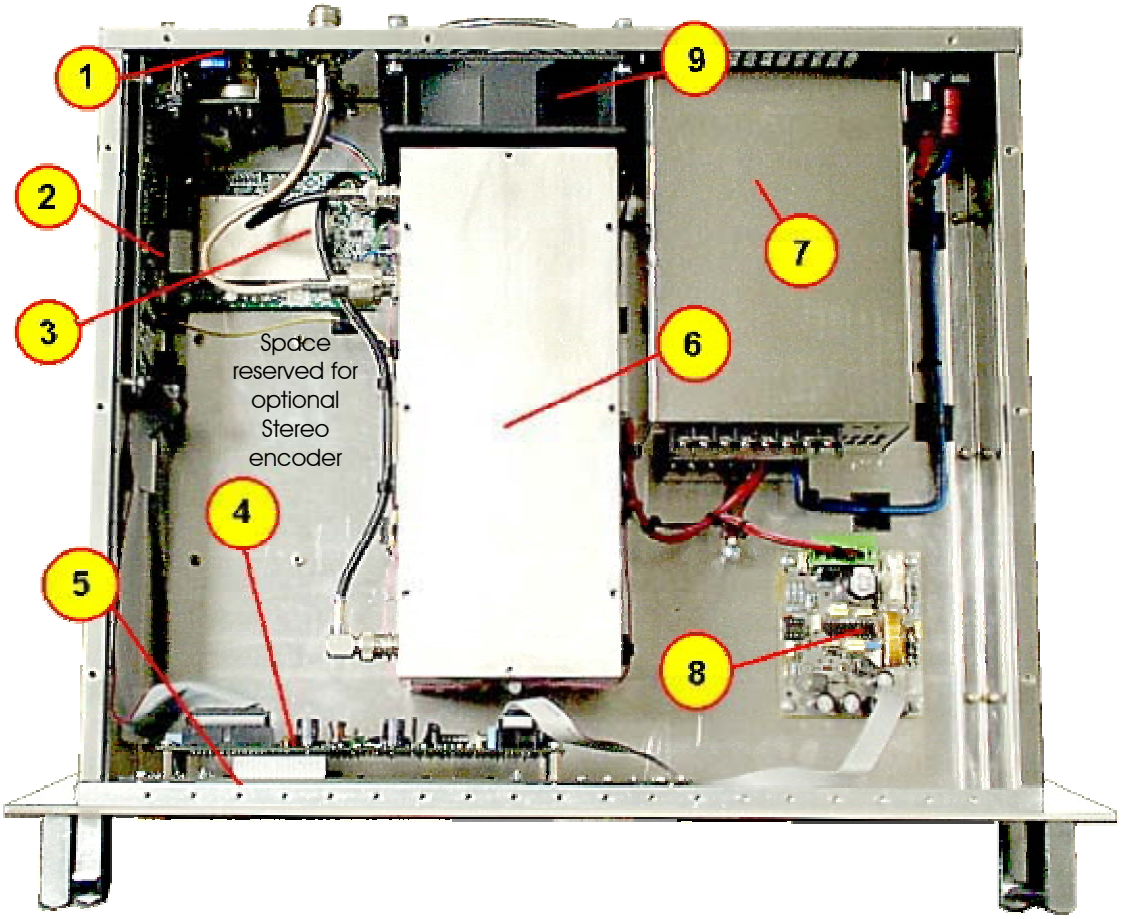


Fig. 1-4: EM-250 COMPACT DIG TRANSMITTER.UPPER VIEW WITH COVER REMOVED.

Units can be easily identified according with their respective position within cabinet, as numbered in above Figure 1-4 :

1 - Audio Input board.

2 - Main board.

3 - RF Exciter and Modulation Unit.

4 - Microcontroller Unit.

5 - LCD Display Unit.

6 - RF Power Amplifier Module.

7 - SP-500/48 Main Switching Power Supply.

8 - $+15V_{DC}$ Auxiliary Power Supply.

1.6 Technical specifications.

SIGNAL TO NOISE RATIO	Monaural >78dB, typical 86dB (from 30 to 20,000Hz) Stereophonic >72dB, typical 77dB (from 30 to 20,000Hz)
CCIR WEIGHTED S/N	Monaural >75dB, typical 81dB. Stereophonic >68dB, typical 77dB.
HARMONIC DISTORTION NOTE:LIMITER SET TO 150KHZ DEVIATION THRESHOLD.	For ± 75 KHz dev <0.05%, typical 0.02% For ±150 KHz dev <0.2%, typical 0.05%
STEREO CROSSTALK	w/External Encoder <-50dB. w/Internal Encoder (from 100 to 5000Hz) <-60dB w/Internal Encoder (from 30 to 15000Hz) <-50dB
PROGRAM AUDIO CHANNEL FREQUENCY RESPONSE FROM 30 TO 15000HZ	± 0.1dB
ATTENUATION AT AUDIO FILTER REJECTION BAND (F =19KHZ)	>50dB
DEVIATION LIMITER THRESHOLD	Adjustable between 0 and +7dBm
STEREO MULTIPLEX INPUT FREQUENCY RESPONSE.FROM 10HZ TO 100KHZ	±0.1 dB
AUXILIARY INPUT FREQUENCY RESPONSE .FROM 10 TO 100KHZ	±0.2 dB
MAINS SUPPLY REQUIREMENTS	90 ~ 260V_{AC} , 50/60 Hz
POWER CONSUMPTION AT 250W RF OUTPUT LEVEL	600 VA / 480W
OPERATING TEMPERATURES RANGE	0 to +35 ºC recomm. -10 to +45 º C max
MOUNTING DIMENSIONS (W/O HANDLES)	Width:19" Height: 3RU in standard 19" Rack.
DIMENSIONS	483mm width x 125mm height x 334mm depth
MODULATION	Frequency, ± 75KHz. peak dev
MODULATION CLASS	F3E, F8E
OSCILLATOR'S SYNTHESIS STEPS	10 /100KHz
FREQUENCY ERROR	<± 200Hz
FREQUENCY DRIFT	<250Hz, over temperature <100Hz/year
RF OUTPUT POWER	Adjustable between 2 and 250W_{RMS} nominal
MAXIMUM ALLOWABLE REFLECTED RF POWER	25W
RF HARMONIC PRODUCTS	< -70dBc
RF SPURIOUS PRODUCTS	<-80dBc.typical -95dBc
RF OUTPUT IMPEDANCE	50Ω unbalanced. N Female connector
AUDIO /MULTIPLEX INPUT LEVEL	Adjustable between -3.5 and +12.5dBm for ±75KHz peak dev
AUDIO /MULTIPLEX INPUT IMPEDANCE	Select.10KΩ /600Ω, bal./unbal
COMMON MODE INPUT REJECTION FROM 20 TO 15000HZ	>50dB, typical >60 dB
AUDIO INPUT CONNECTORS	XLR Female balanced
SCA/RDS CHANNEL INPUT LEVEL	±7.5KHz dev: adjustable between -12.5 to +3.5dBm. ±2.0KHz dev: adjustable between -24 and -8dBm.
SCA/RDS CHANNEL INPUT IMPEDANCE	10 KΩ unbal.BNC Female connector
MODULATION OUTPUT LEVEL	From 0 to +10dBm at ±75KHz peak dev
PRE-EMPHASIS TIME CONSTANT	Variable: 0 /50 /75 μs ± 2%

Section 2

DESCRIPTION OF INTERNAL MODULES

CONTENTS :

2.1 Introduction 15
2.2 Audio processor and R.F. control main board . 19
2.3 Stereo encoder (optional) 24
2.4 R.F. Exciter unit 27
2.5 R.F. Power Amplifier module 30
2.6 Control unit and display board 41
2.7 Power supply units 47

2.1 Introduction.

The EM-250 COMPACT DIG transmitter comprises 5 or 6 internal modules, as can be seen in the general upper view (Figure 1-4) and in the General Wiring Diagram (in next pages). Main units are the following:

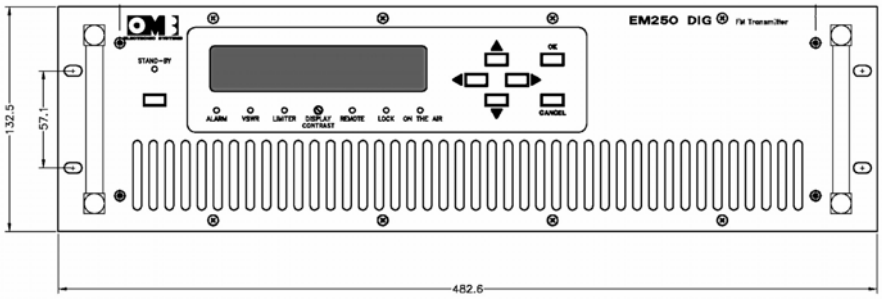
- The Main Audio Processor Board.
- The Microcontroller Unit and Display Board.
- The Stereo Encoder Module (optional).
- -The RF Exciter Board.
- The RF Power Amplifier Module.
- The Switching Regulated Power Supply Units (Main and Auxiliary).

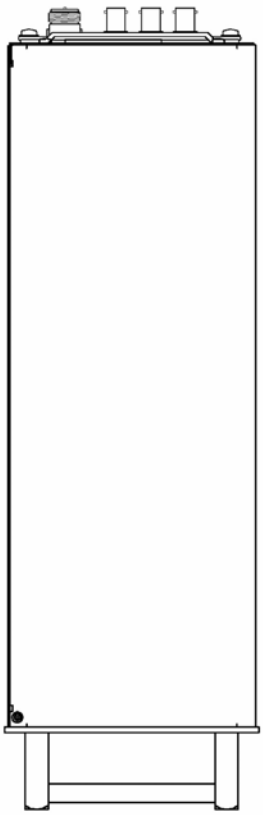
For the detailed description of each module on the following pages, always refer to the corresponding electrical diagram, included in this section.

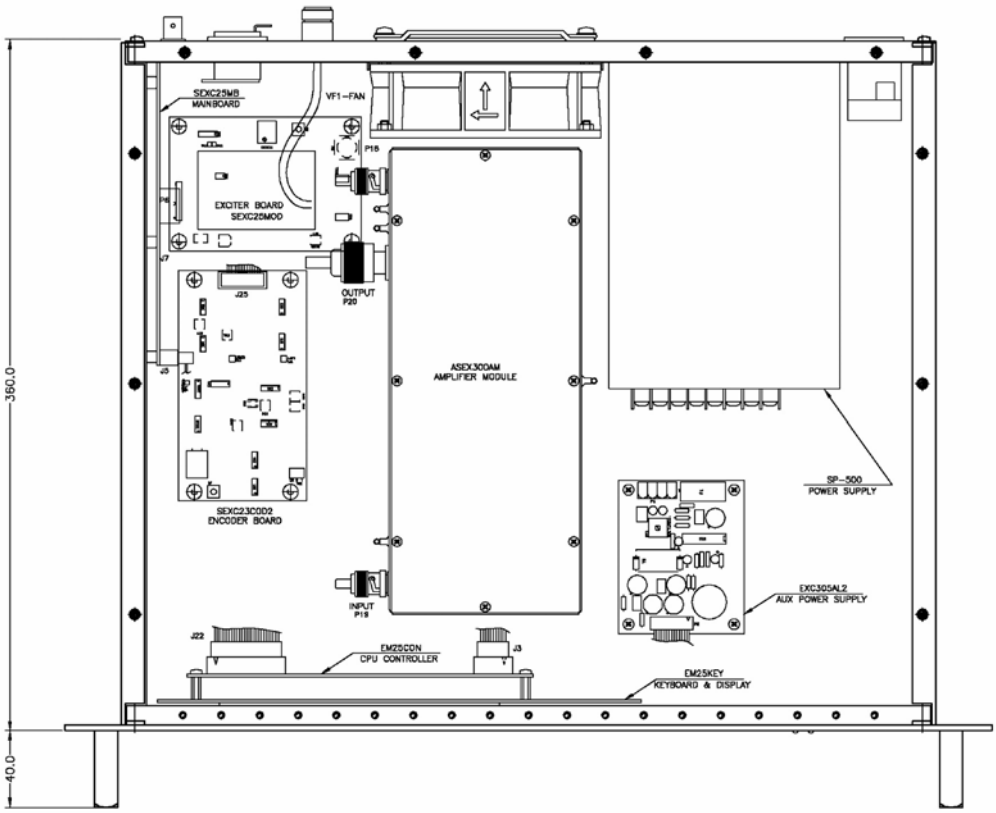
Note: the manufacturer reserves the right to change any component value due to production adjustments.

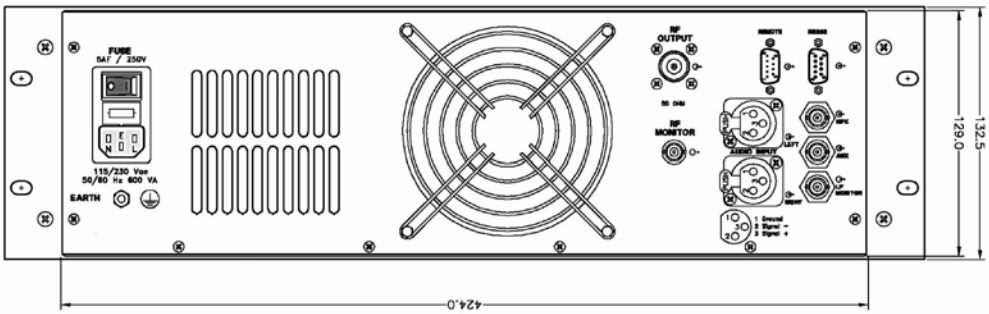
THIS SECTION IS ONLY AIMED TO GENERAL EXPLANATION,REFERENCE AND SERVICE PURPOSE BY SKILLED PERSONNEL. AS EXPLAINED IN THE PREVIOUS SECTIONS, INTERNAL ADJUSTMENTS ARE NOT REQUIRED DURING NORMAL OPERATION. TAMPERING WITH INTERNAL SETTINGS VOIDS THE WARRANTY, MAY HARM THE APPARATUS AND JEOPARDIZE THE GUARANTEED PERFORMANCE.

DUE TO THE TECHNOLOGY USED,MOST MODULES AND ESPECIALLY THOSE IN SMT ARE NOT INTENDED TO BE REPAIRED IN CASE OF FAILURE AND MUST BE REPLACED WITH NEW ONES.

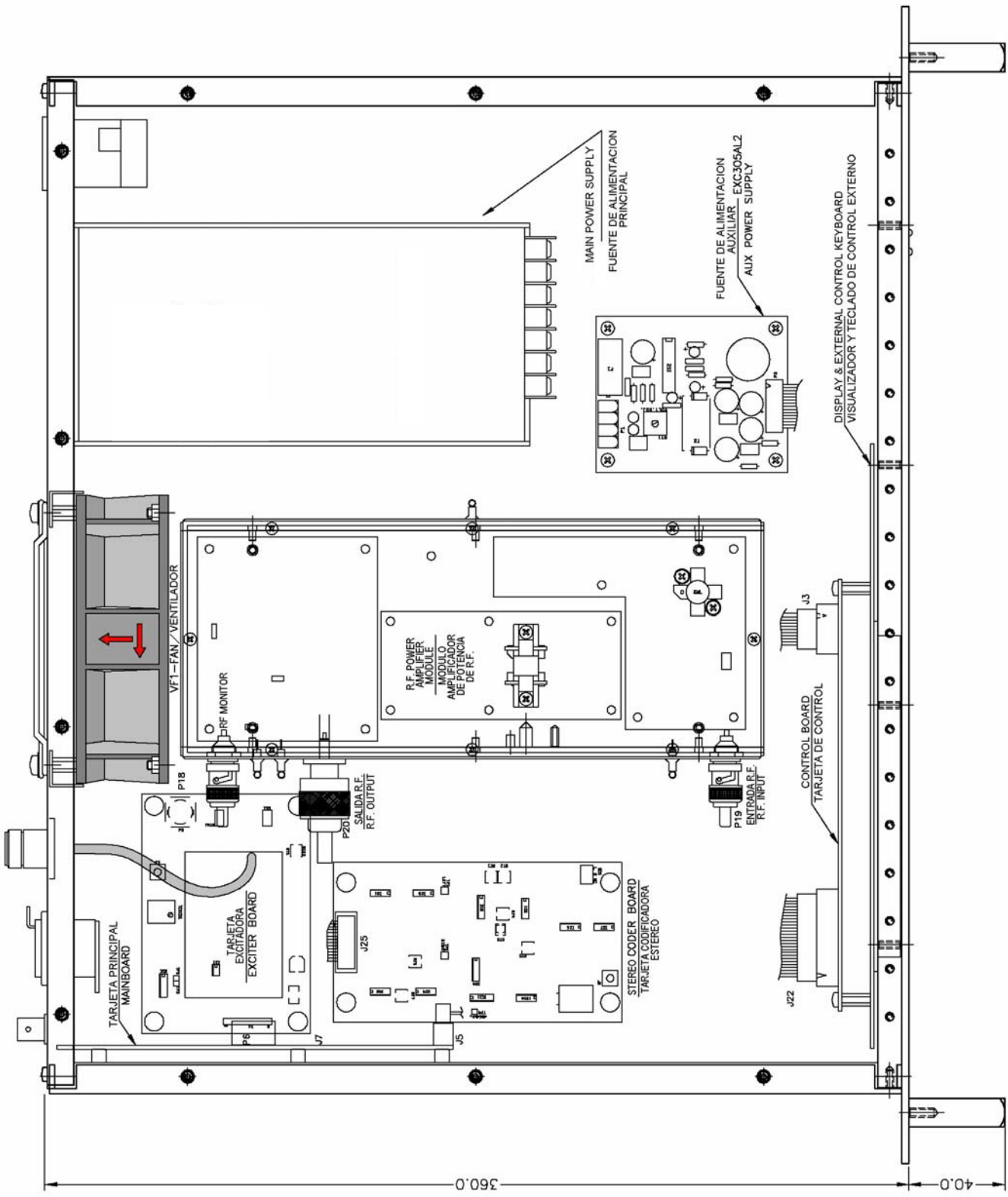








	Date	Name	Signature:	
Drawn		OMB Eng. Dpt.		Sistemas Electrónicos S.A.
Checked				
Standards				
Scale:	Title: EM 250 COMPACT DIG General cabinet layout			Drawing nr:
				Replace:
				Replaced with:



	Date	Name	Signature:
Drawn		OMB Eng. Dpt.	
Checked			
Standards			

Sistemas Electrónicos S.A.

Scale:

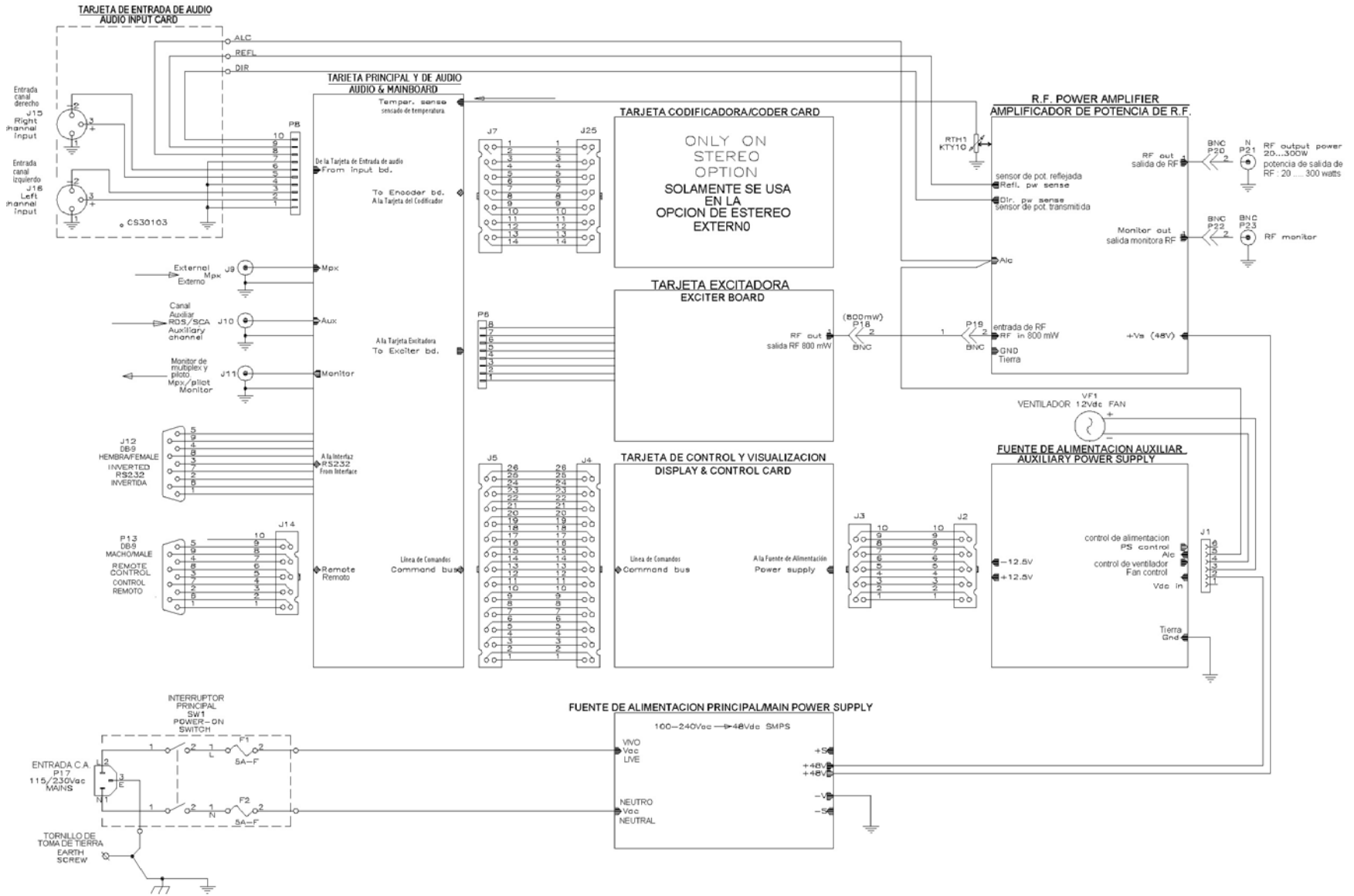
Title: EM 250 COMPACT DIG

Inner layout

Drawing nr.:

Replace:

Replaced with:



	Date	Name	Signature:	
Drawn		OMB Eng. Dpt.		Sistemas Electrónicos S.A.
Checked				
Standards				

Scale :

Title: EM 250 COMPACT DIG

General wiring diagram

Drawing nr:

Replace:

Replaced with:

2.2 Audio processor and R.F. control main board.

This is the most complex board in the transmitter and supports the Audio input processing, its level adjustment, audio-pass filtering and limiting, the RF control section and the I/O interfaces. It also interconnects the various transmitter modules with ribbon-type cables. Its electrical diagram is splitted in two sheets for clarity purpose: they will be examined in sequence. In the first Schematics sheet are situated the I/O interfaces both audio and digital ports and the analog RF control. Let's start to briefly consider each block diagram.

In the upper left side of the diagram are located the audio channels amplifier/buffers made with 6 op-amp sections of IC1 and IC2. Two impedance selector jumpers for the audio channels leads the pack and a protection network made by resistors and diodes protects the inputs from occasional static discharges,as required for **CE** compliance.

Four unity-gain active buffers follow and than two balanced to unbalanced signal converters,which drive the electronic attenuator in the 2nd sheet. The last op-amp in IC2 (d),amplify the auxiliary channel input with a -0.1dB upper corner band >>200kHz and drives the third channel of the electronic attenuator.

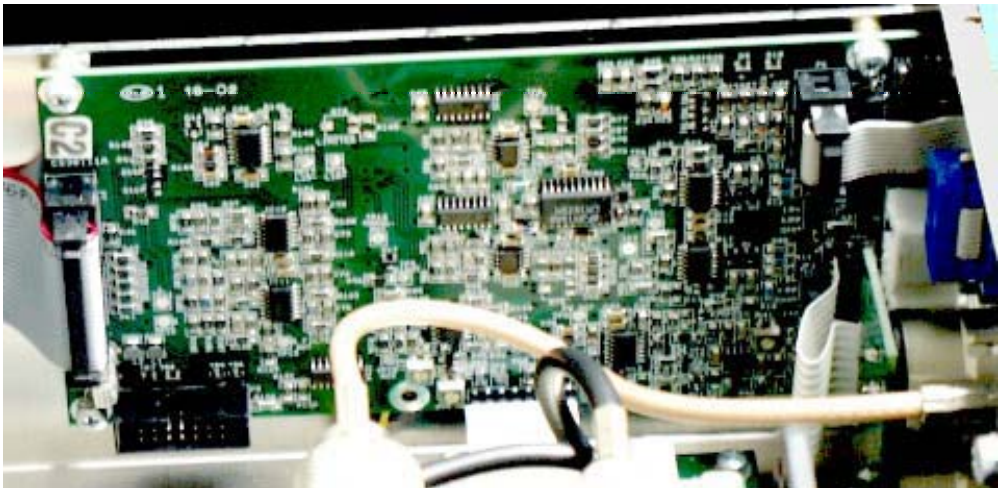


Fig. 2-1: MAIN BOARD IS SITUATED IN THE REAR LEFT SECTION OF CABINET.

On the lower left of the diagram are the RS232 interface (IC5)and the parallel remote I/O active interface with its protection network, built around TR1, TR2 and TR3. A wired OR pull-up makes the logic levels <1V as 0 and 10-15V for 1.

On the lower right section of the diagram it is located the RF power controller. The RF forward and reflected power signals coming from the output directional coupler (this located at RF Power Module) are amplified by IC3 in a symmetrical circuit. The forward-power control circuit,built around IC4a continuously drives the RF output stage gain,varying the bias supply voltage to the RF output MOSFET transistor package. The reflected-power limiting circuit IC4b only acts on the same loop when the IC3b output voltage is greater than the threshold set by the voltage on the R49/R50 network. A third and fourth section of IC4 filters and buffers the signal coming from the Microcontroller and set the reference level for the output power loop. TR4 disables the RF output when the synthesizer is not locked on the correct frequency.

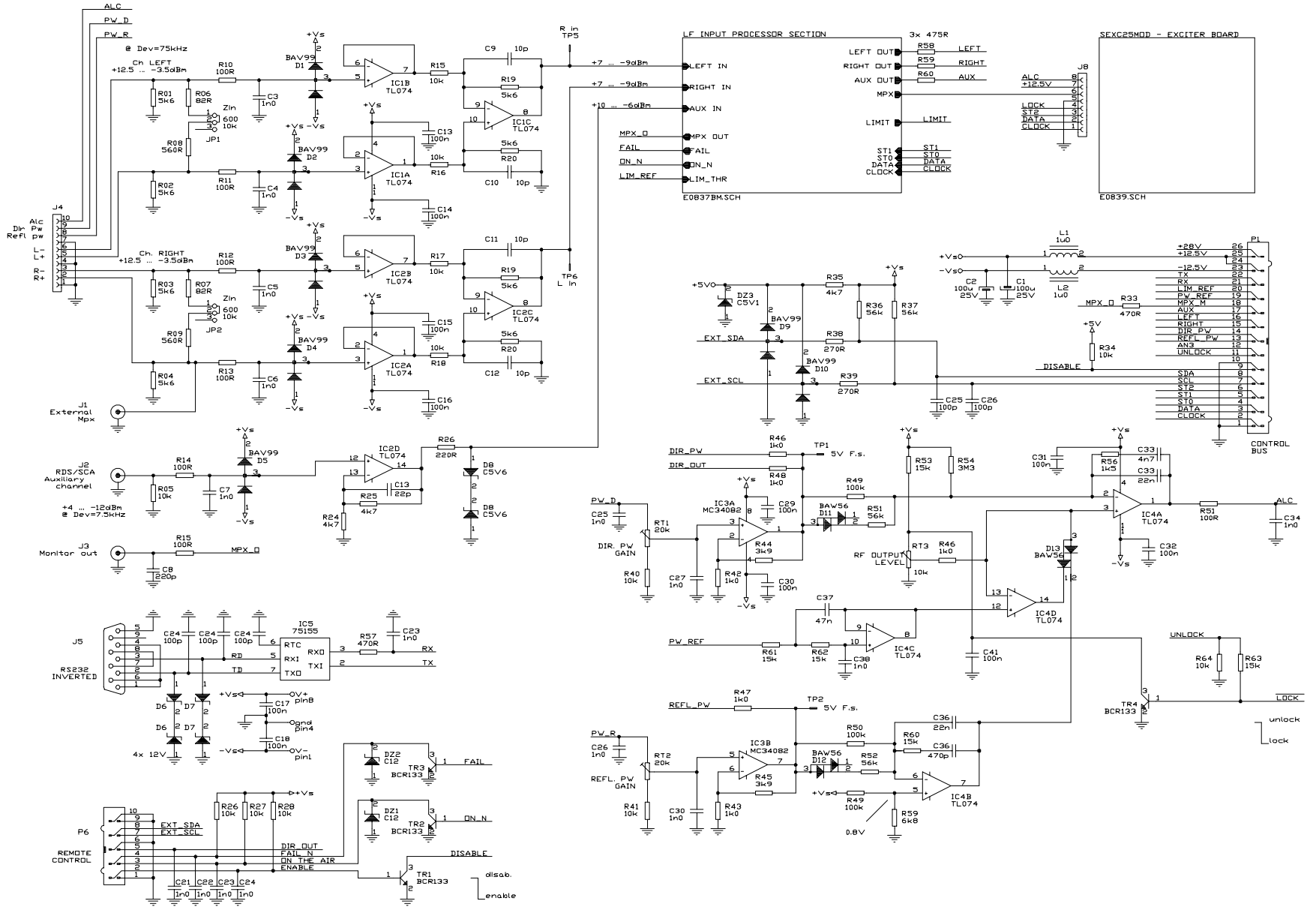
In the upper right section of the sheet it is shown the control bus connector to the Microcontroller Unit, which carries the digital control lines on the lower pins and the analog lines on the upper ones. From this connector comes the power supply too: only +12.5V and -12.5V are used in the board.

Let's now go to the second sheet of this diagram. Beginning from the lower left side,we find IC8, which makes a 3-channel digitally controlled attenuator. It separately manages left, right and auxiliary channel, while the externalmultiplex signal is processed in the same channel as the right one. Three buffer/amplifiers follow each channel: IC7a, IC8a and IC12a. The output of the first two amplifiers drive the pre-emphasis stages, whose time constants can be digitally set at 0, 50 and 75μs, through the analog gates of IC9. A limiter stage follows this arrangement, built around D8 and D9 diodes acting as clippers. By acting on the limiter 's reference voltage driven by the Microcontroller through IC13a, the limiter threshold level +Vl and -Vl can be adjusted. RT4, if present, impose a top limit to the limiter.

The signal is then sent to the stereo-encoder circuit 's input sections if present. At the same time, the signal on the monaural right channel path is sent to a low-pass filter, consisting of the section built around IC10 and IC11, which attenuates the frequencies above 15kHz.

The switch IC14 selects the signal issuing from the non-pre-emphasized input section through R124 or from the pre-emphasis-and-filter section through R128 or from the stereo-encoder through R131. IC12b buffers the chosen signal and mixes it with that issuing from the auxiliary channel. When required, the diode D17 further limits the resulting total signal.The latter is then sent to the FM modulating/exciting circuit via IC12c buffer circuit and adjusted in level by RT6 as required. A separate section of IC12 separately buffers the modulation signal for monitoring purpose,and sends it to the modulation output connector.

IC15 deserialize the digital signal sent by the Microcontroller, to control the transmission channels with IC14 and preemphasis action with IC9. Two output lines from IC15 are used to latch the remote output lines "**FAIL**"and "**ON THE AIR**".



	Date	Name	Signature:	
Drawn	01/11/04	OMB Eng. Dpt.		Sistemas Electrónicos S.A.
Checked				
Standards				

Scale :

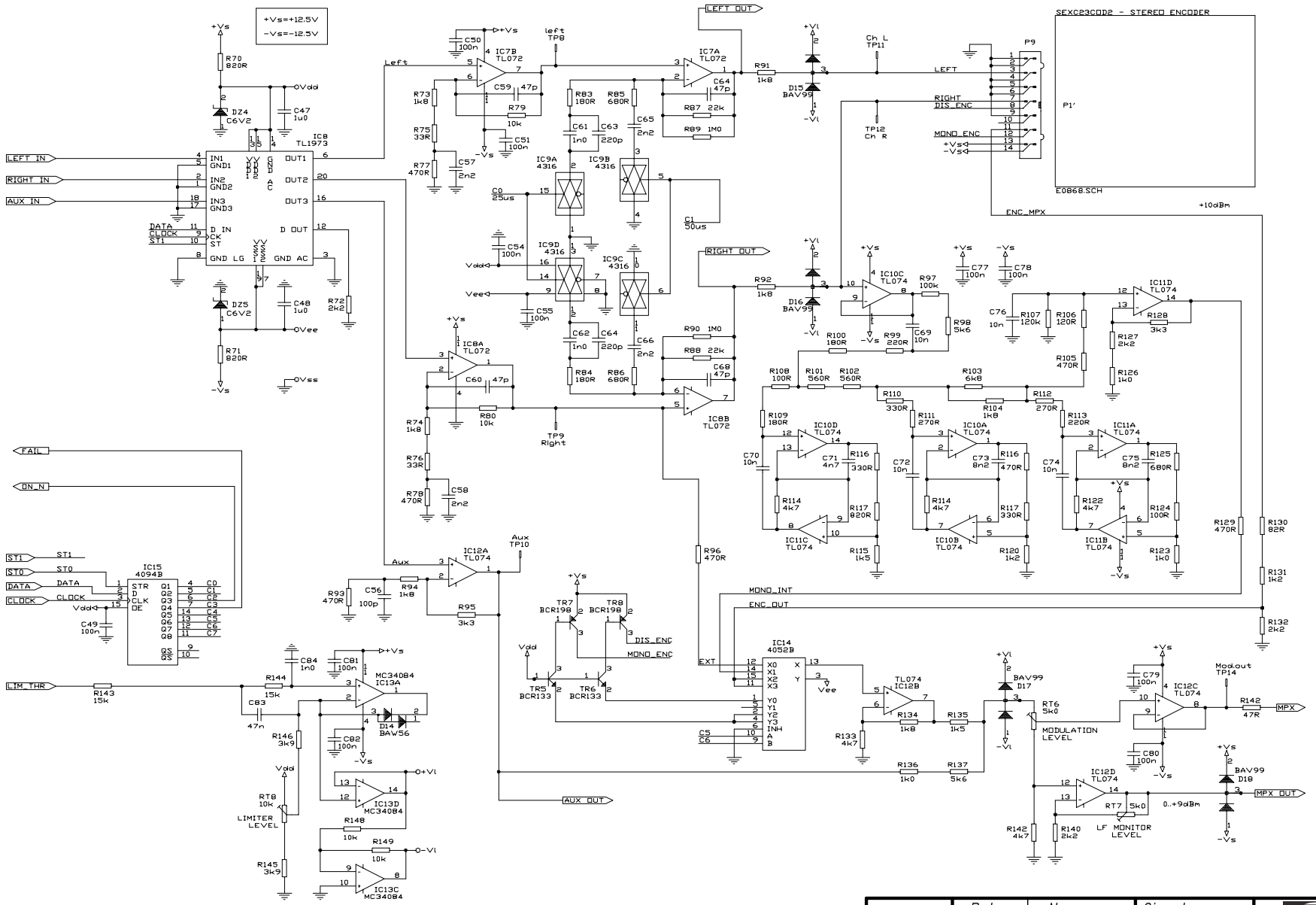
Title: EM 250 COMPACT DIG

MAINBOARD - I/O & R.F. Control Section

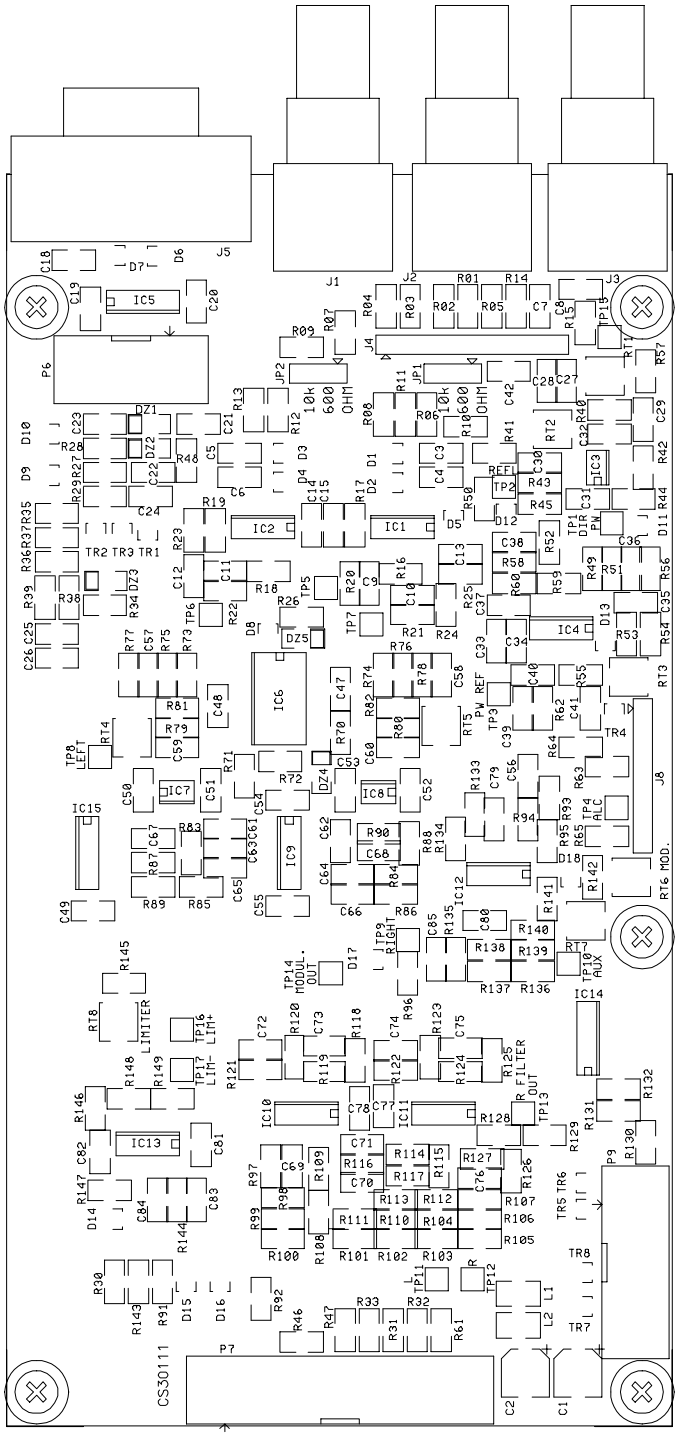
Drawing nr:

Replace:

Replaced with:



	Date	Name	Signature:	Sistemas Electrónicos S.A.
Drawn	101/11/04	OMB Eng. Dpt.		
Checked				
Standards				
Scale :	Title: EM 250 COMPACT DIG			Drawing nr:
	MAINBOARD - LF Process Section			Replace:
				Replaced with:



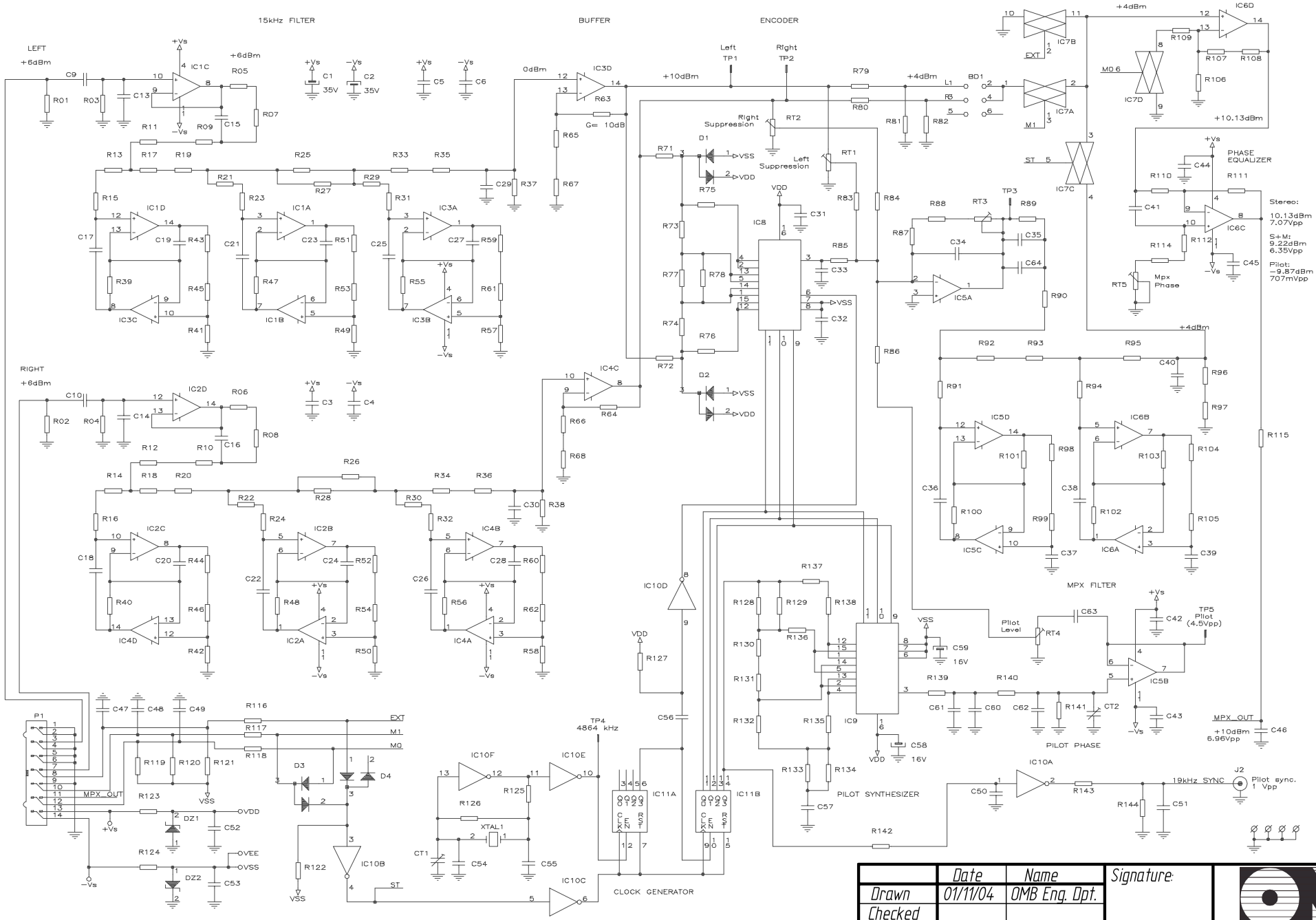
	Date	Name	Signature:	
Drawn	01/11/04	OMB Eng. Dpt.		Sistemas Electrónicos S.A.
Checked				
Standards				
Scale:	Title: EM 250 COMPACT DIG Mainboard			Drawing nr:
				Replace:
				Replaced with:

2.3 Stereo encoder (optional).

The encoding circuit uses an 8-step switching technique,which ensures excellent performance with a relatively simple circuit. In addition, by this technique, the first harmonics that are associated with the switching devices are the 7^{th} and 9^{th} (266 and 342kHz); this simplifies the design of the low-pass filter on the multiplex signal.

The signal is filtered beyond 15kHz by the two precision active low-pass filters built around IC1 ~ IC4. It is then buffered by IC3d and IC4c and applied to the encoding circuit comprised in IC8. Another higher frequency low-pass filter follows to remove higher order harmonic products. This filter is also made with highly precise active circuitry built around IC5 and IC6a,b. The latter section (c) of IC6 performs phase equalization.The four analog switches comprised in IC7 permits to select the mono or the stereo-encoded signal and to slightly vary the encoder gain to adjust for the 90%audio modulation in stereo vs.100% in mono. Two jumpers on BD1 permit to select either Left or Right or Left+Right channel for mono operation,with no output level change. As factory configured, both jumpers are installed, to mix Left and Right channel for "MONO L+R" operation.

Circuits IC10, IC11 make the encoder's time base; IC9 synthesizes the 19kHz pilot frequency, which is filtered and buffered by IC5a. A separate 1Vpp output is provided on J2 to drive carrier synchronization on a possible external RDS generator.



	Date	Name	Signature:	
Drawn	01/11/04	OMB Eng. Dpt.		Sistemas Electrónicos S.A.
Checked				
Standards				

Scale :

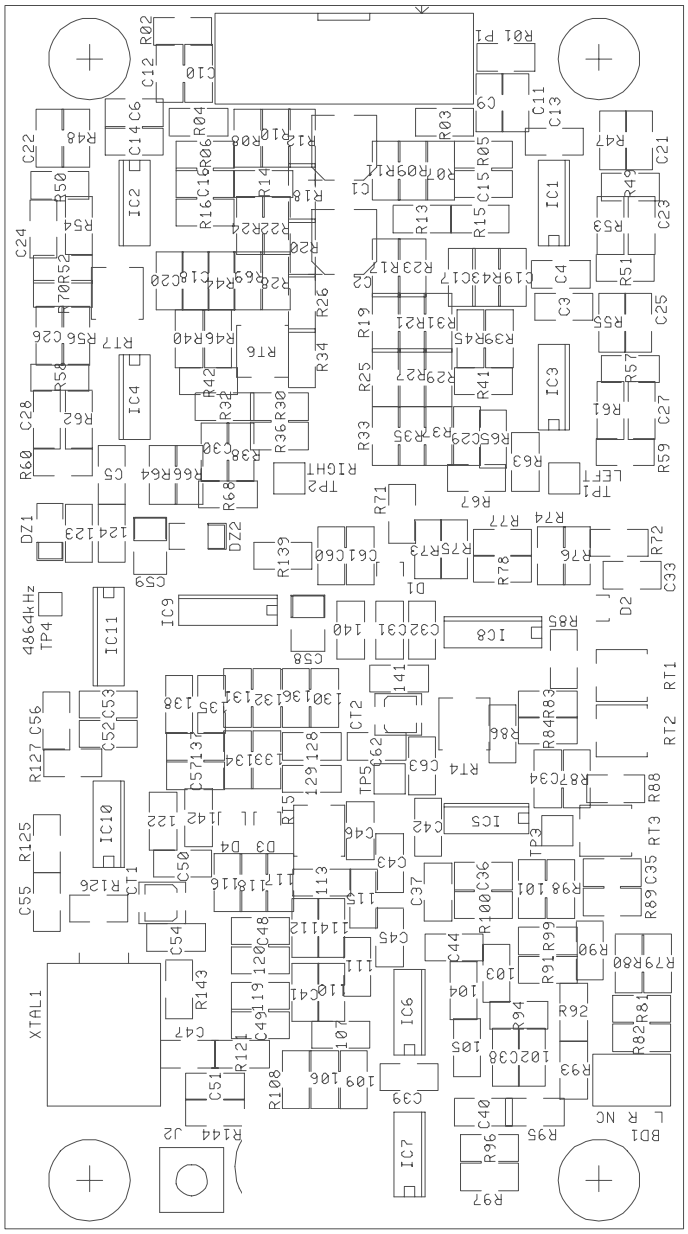
Title: EM 250 COMPACT DIG

Stereo encoder

Drawing nr:

Replace:

Replaced with:



	Date	Name	Signature:
Drawn	01/11/04	OMB Eng. Dpt.	
Checked			
Standards			

Sistemas Electrónicos S.A.

Scale:	Title: EM 250 COMPACT DIG Stereo encoder	Drawing nr:
		Replace:
		Replaced with:

2.4 FM Exciter unit.

This unit includes a classical phase-locked-loop circuit with 10kHz-step synthesis across the entire FM band. The very low-noise, fundamental-frequency VCO (Voltage-Controlled Oscillator) consists of a FETоscillator transistor TR5, modulated by the varactor diode set D4~D7, which also sets the operating frequency. The circuit is sensitivity compensated vs.carrier frequency variation so that its modulation gain varies less then 0.5dB across the entire operating range. Modulation distortion is typically lower than 0.03 % with over 90dB S/N ratio in the mono mode in the 30 - 20,000Hz band.

The RF signal is buffered and amplified by three successive transistors TR6 ~ TR8, from which is derived the feedback signal to the PLL and the drive signal for the output RF stage. This latter is composed by two small MOSFET transistors TR9 and TR10 and attains some 900mW output level (+29dBm) over the full FM range.To correctly operate TR9 and TR10 require a gate bias voltage, which is factory pre-set by RT1.

The digital PLL circuit is entirely contained in IC2, whose frequency reference is derived by a highly precise temperature compensated oscillator (TCXO1) running at 12.8MHz. To correctly operate on the chosen frequency, IC2 must be serially programmed with complex data. This task is done by the Exciter's Microcontroller through 3 control lines.

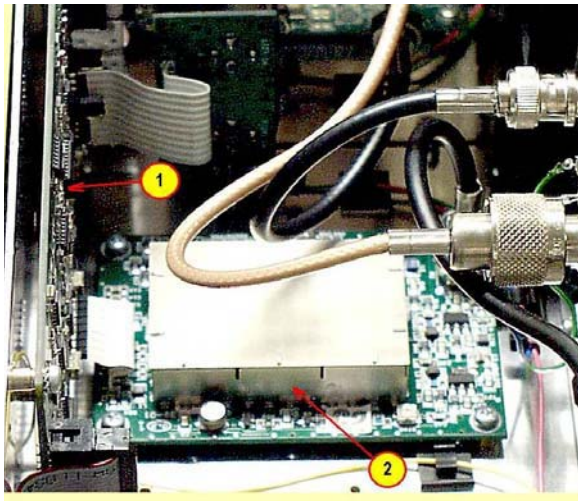
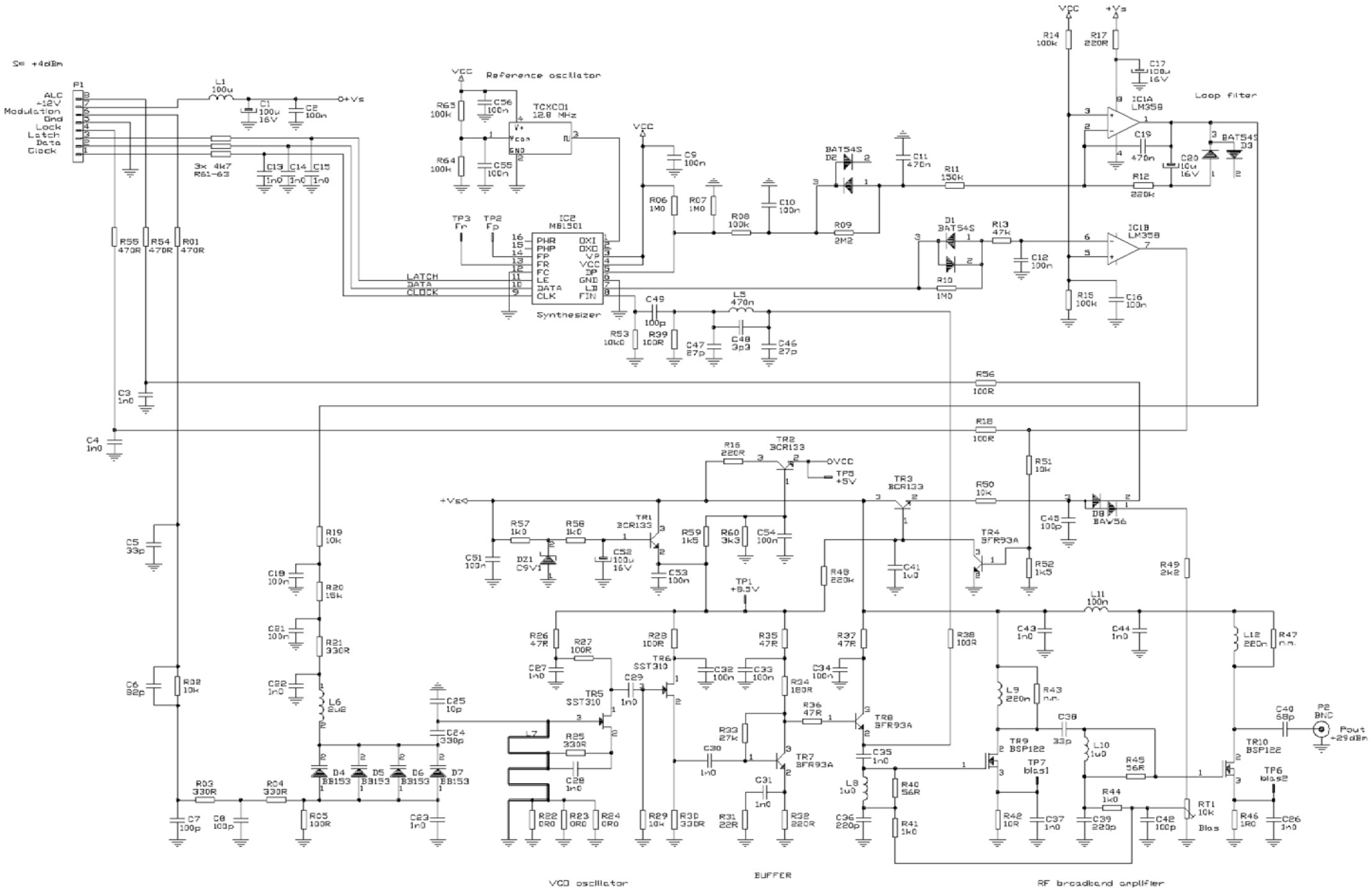


Fig. 2-2: RELATIVE POSITIONS OF (1) CONTROL CARD AND (2) EXCITER UNIT.

IC1 either performs loop filtering from IC2 frequency comparator output to the varactor diodes and lock detection. Note that bias voltage is removed from output transistors through TR4 and TR3 to turn off RF when the PLL is not locked on the right frequency. The control loop was designed to ensure that crosstalk added to stereo-composite signal is below -55dB at 30Hz, and is virtually not influent at just slightly higher frequencies.



	Date	Name	Signature:	
Drawn	01/11/04	OMB Eng. Dpt.		OMB Sistemas Electrónicos S.A.
Checked				
Standards				

Scale :

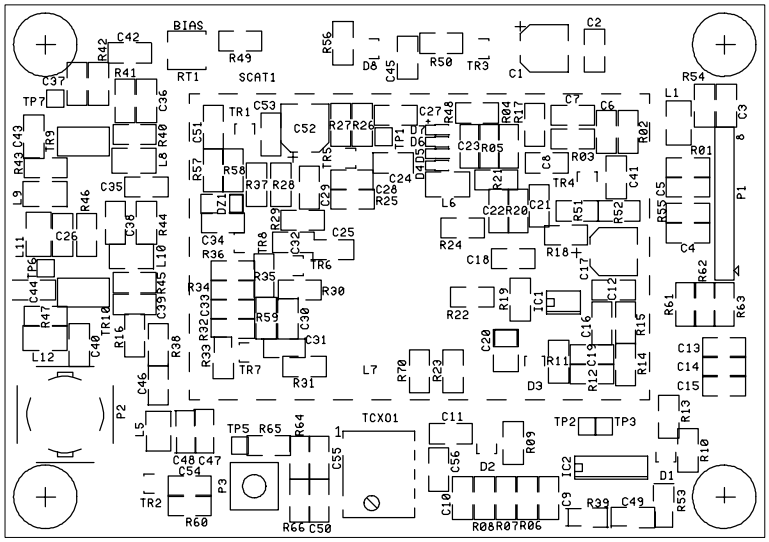
Title: EM 250 COMPACT DIG

FM Exciter

Drawing nr:

Replace:

Replaced with:



	Date	Name	Signature:	
Drawn	01/11/04	OMB Eng. Dpt.		Sistemas Electrónicos S.A.
Checked				
Standards				
Scale:	Title: EM 250 COMPACT DIG FM Exciter			Drawing nr:
				Replace:
				Replaced with:

2.5 R.F. Power Amplifier module.

This stage is designed with only one high gain BLF-278 MOSFET RF power transistor capsule, in a broadband class AB_1 common emitter design, with $+48V_{DC}$ supply :

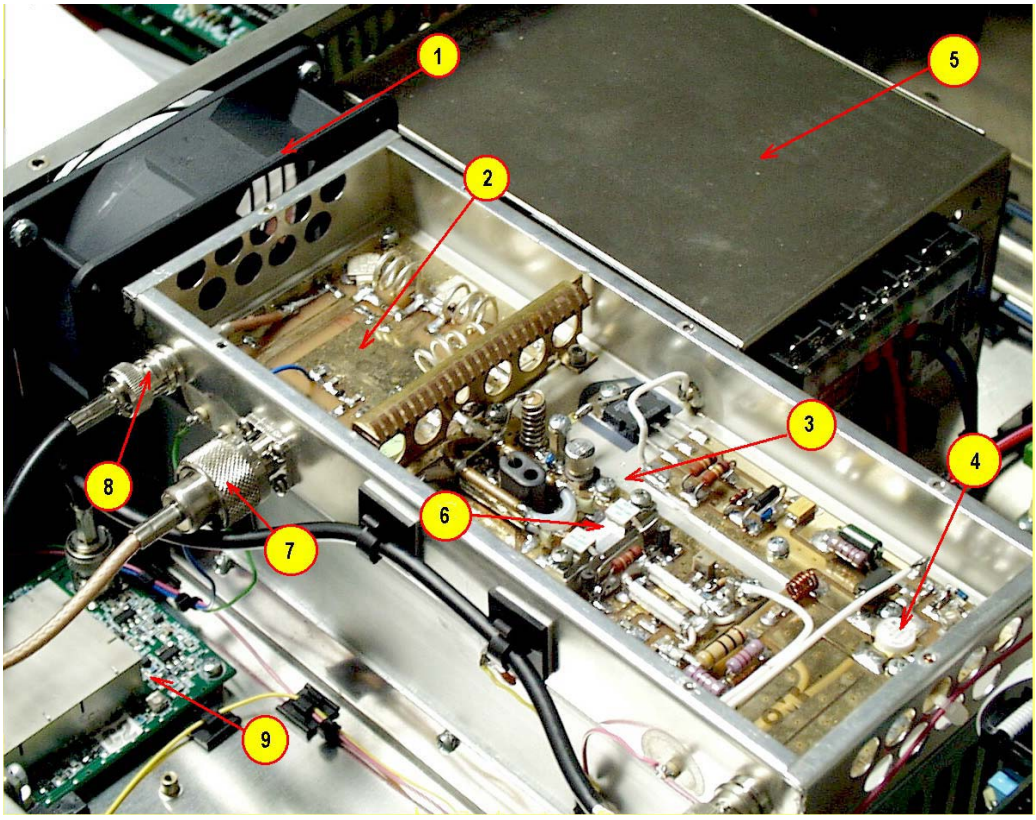


Fig. 2-3: 300W FM POWER AMPLIFIER MODULE.

RF Power module includes a driver stage and an output amplifier stage. Figure 2-3 above shows the general arrangement of this power amplifier module. Numbered elements are as follows:

1 - Cooling fan directed towards heat sink's cooling fins.

2 - Output low pass filter and directional coupler.

3 - RF output Power amplifier section.

4 - RF driver section.

5 - PS-500/48 Main Power supply.

6 - BLF-278 MOSFET output power amplifier twin-transistors capsule.

7 - RF output connector.

8 - RF monitor output.

9 - RF Exciter Unit.

Detailed views of the three sections composing the Power Amplifier module are shown in Figures 2-4, 2-5 and 2-6 below:

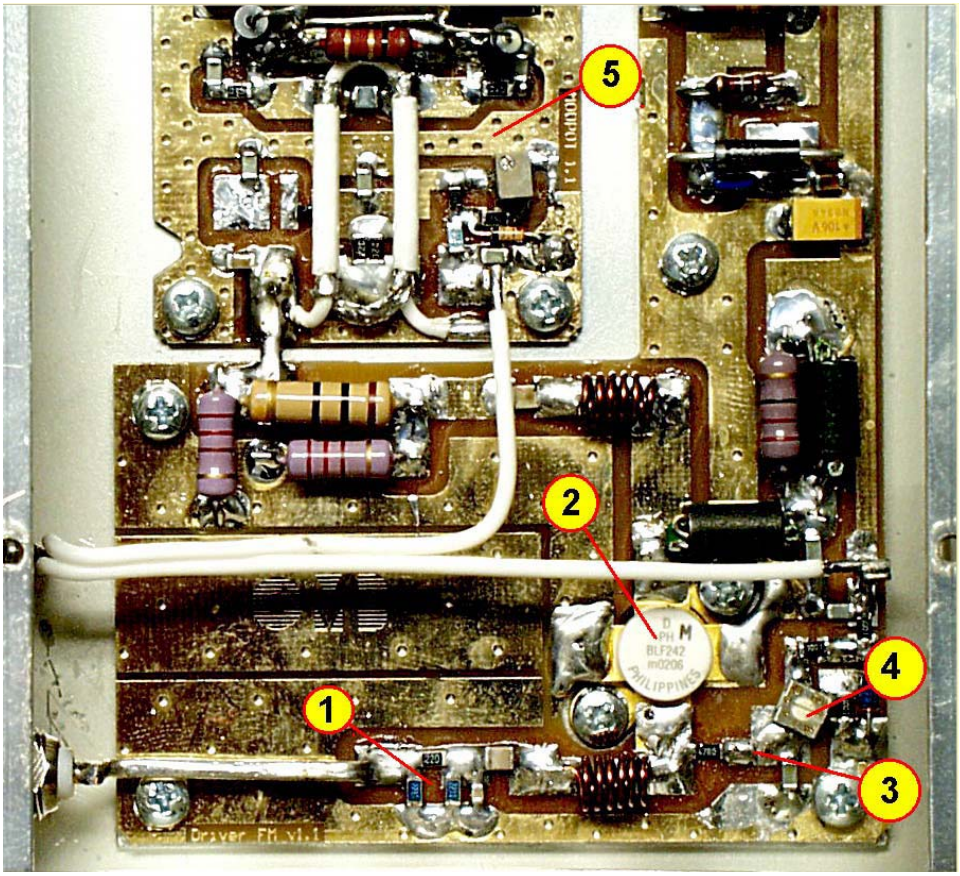


Fig. 2-4: DETAILED VIEW OF INPUT DRIVER STAGE.

Figure 2-4 above shows a magnified view of RF driver stage, a BLF 242 transistor working in class AB configuration. Numbered elements corresponds to the following description:

1 - Input matching attenuator circuit.

2 - BLF 242 RF Driver transistor.

3 - Bias control circuit.

4 - Input impedance-matching transformer.

5 - Output power amplifier stage PC board.

A resistive input attenuator (1), when present, enhances matching with the preceding unit and contributes to insulate the two stages. After that, a broadband matching network feeds the transistor gate.

Output amplifier stage detail can be seen in Figure 2-5.

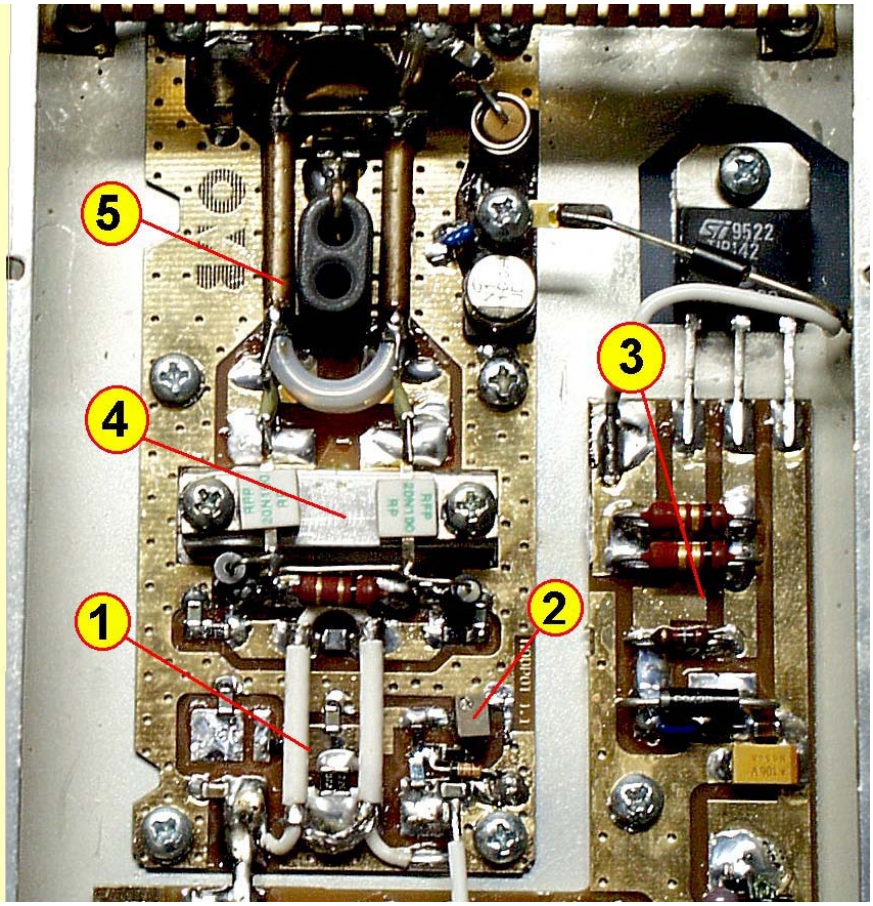


Fig. 2-5: DETAIL OF OUTPUT AMPLIFIER SECTION.

Elements numbered in Figure 2-5 can be described as follows:

1 - Input splitter transformer and coupling circuit.

2 - Bias adjustment potentiometer.

3 - Bias regulator circuit.

4 - MOSFET push-pull arranged, twin-transistor capsule.

5 - Output combiner transformer and matching circuit.

Following this amplifier stage, module includes a low-pass filter in order to attenuate or suppress all harmonics and IM products beyond Band II limits, as shown in Figure 2-6.

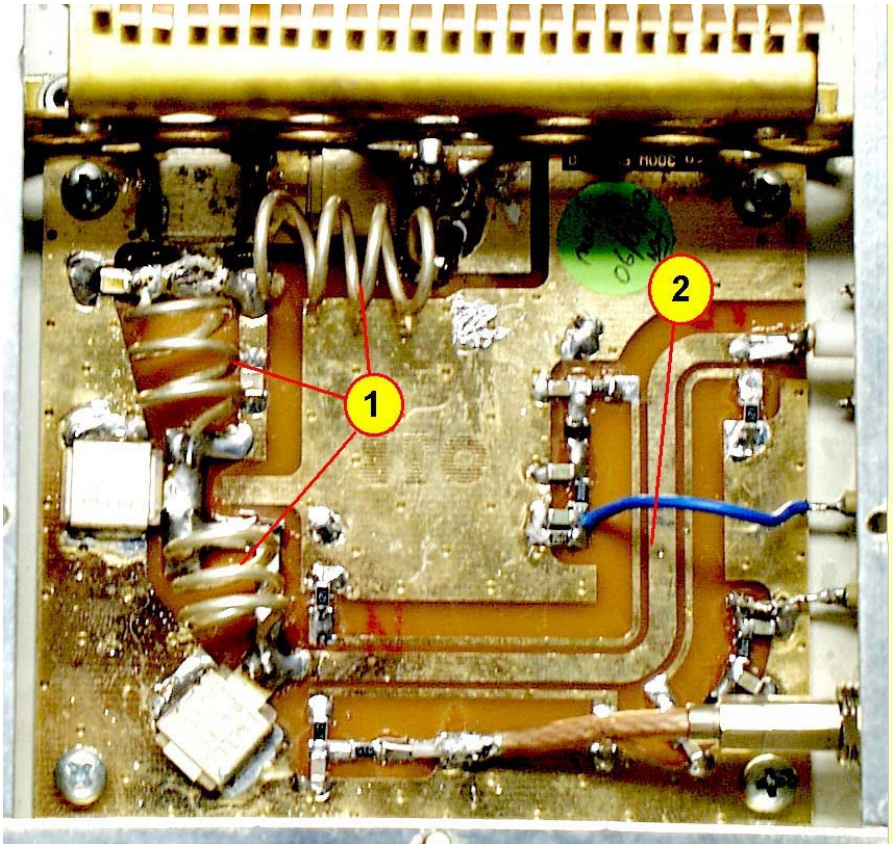


Fig. 2-6: DETAILED VIEW OF LOW-PASS FILTER and DIRECTIONAL COUPLER SECTION.

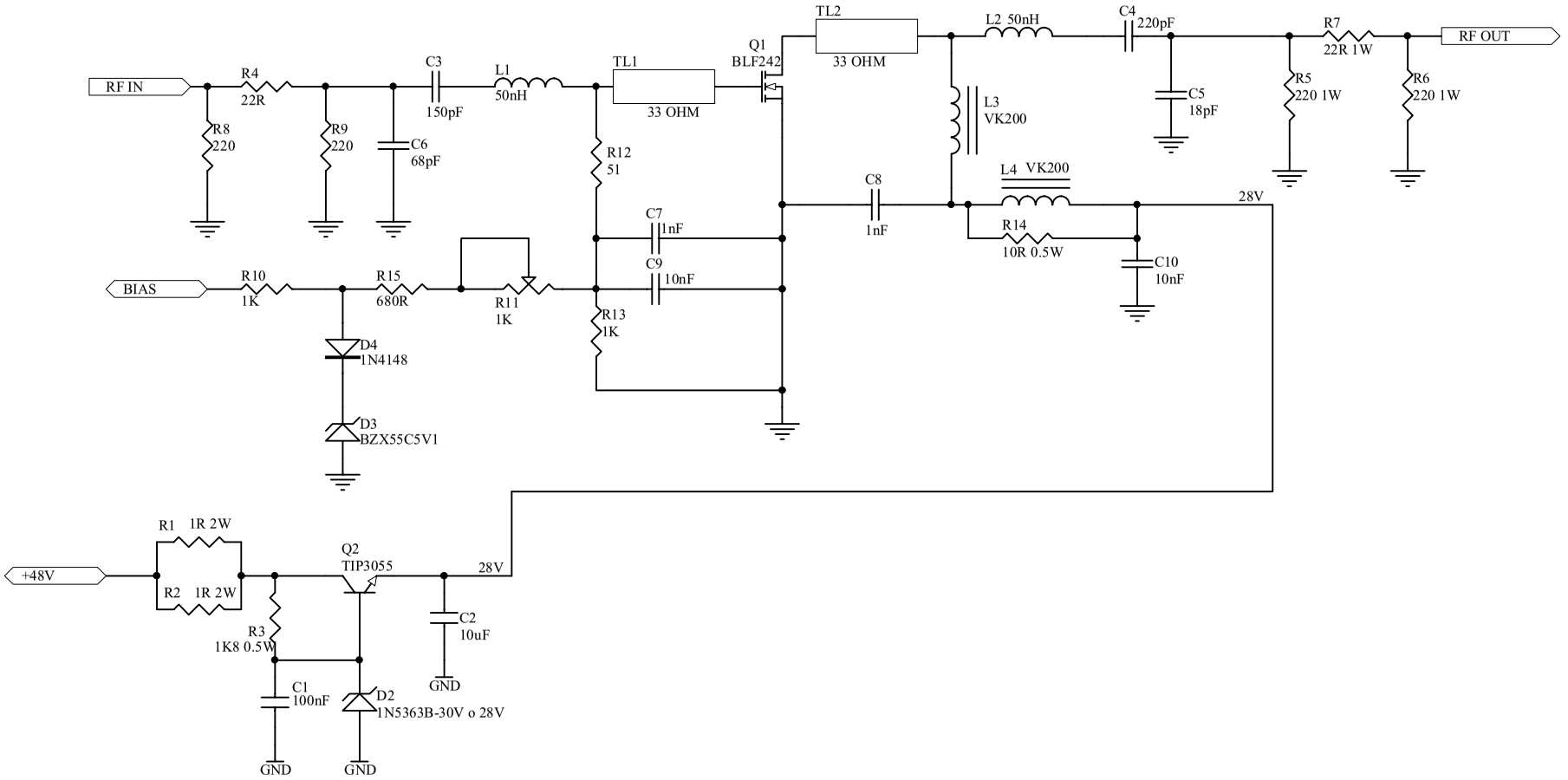
The three-section low-pass filter (1) attenuates the harmonics to a value that is generally below -70dBc, following the output transistor drain circuit. Also, included in the RF output path, a directional coupler (2) generates a dc signal, which is proportional to the forward and reflected RF power, and a RF non-demodulated sample (RF MONITOR) to be externally used by a frequency counter or a modulation monitor, for measurements purposes.

The transistor gate is biased by a Zener network and a resistor to set 50mA drain current, with 2.8Vgs. Varying the control voltage towards a negative supply progressively disables the amplifier transistor,so effectively acting as an AGC input. In fact the power management circuit, in a closed loop driven by the output sensor circuitry, varies this voltage.This will accordingly vary the output power to obtain the pre-set value and cope with alarm and start-up conditions.

The output transistors capsule is a rugged device which easily could pass the nominal 250W power output, even increasing this power output out of limits, to 300W. OMB suggests never exceeding 250 ~ 270W output power, even when the transmitter could generate more than this.

Driver FM v1.2.6

DESCRIPTION	REFERENCE	QUANTITY
100V 100nF	C1	1
Electrolytic cap SMD tantalum TAJ 35V 10uF	C2	1
SMD 200V RF 150pF	C3	1
SMD 200V RF 270pF	C4	1
SMD >=50V 68pF	C6	1
SMD 1206 100V 1nF	C7-C8	2
SMD 1206 10nF	C9-C10	2
Zener diode 30V (o 28V) 1N5363B-30V	D1	1
Rectifier diode SMD BAS16	D2	1
Zener diode 5V1 SMD BZX84-C5V1	D3	1
Wire ∅1mm Cu-enamelled	Material L1&L2	230mm approx
Inductance 6 turns ∅ext=6mm ∅int=4mm 1mm wire 50nH	L1-L2	2
Choke freq=100MHz 800Z B82114RA1	L3-L4	2
Resistor 1R 2W	R1-R2	2
Resistor 1/2W 1K8	R3	1
Resistor SMD 15R	R4	1
Carbon resistor 1W 220R	R5-R6	2
Carbon resistor 1W 10R	R7,R14	2
SMD 1206 1/4W 220R	R8-R9	2
Resistor SMD 1K	R10, R12	2
Potentiometer SMD 1K	R11	1
Resistor SMD 820R	R13	1
Resistor SMD 51R	R15	



	Date	Name	Signature:
Drawn	06/06/02	OMB Eng. Dpt.	
Checked			
Standards			

Sistemas Electrónicos S.A.

Scale :

Title: EM 250 COMPACT DIG

7W FM Driver

Drawing nr: 05.04.01.001

Replace:

Replaced with: