



MPFM250 250W BII MOS AMPLIFIER

p/n. 502422410

Technical Manual

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CHAPTER 1: GENERAL INFORMATION

1.1 INTRODUCTION

1.1.1 Manual applicability

The present technical manual provides information relevant to the following module:

- MPFM250 250W BII Amplifier (MOS) p/n 502422410

For the sake of simplicity, from now on throughout this manual, MPFM250 250W BII Amplifier (MOS) will be referred to as MPFM250.

1.1.2 General information


MPFM250 is a MOS amplifier module working in C class; it is able to work in band II (frequency range from 87.5 to 108MHz, fully broadband) and designed for FM applications. The gain is approx. 40dB \pm 2dB; the output nominal power is as follows:

MPFM250 module is self-protected from overdrive of the RF input power, from incidental reflected power, from overvoltage of the amplifier power supply voltages and from driver and final stage abnormal current absorption. The protections are performed through a *control* board.

With reference to the simplified block diagram of Fig. 1.2, MPFM250 may be divided into 3 sections:

- RF Section including:
 - RF Input Control (*with pre-driver stage*)
 - 300W FM Pallet (*final stage*)
 - Low Pass Filter & Directional Coupler
- Control Section,
- Power Supply Section including an AC/DC Converter

A general layout of MPFM250 is shown on Fig. 1.1. The unit is forced air cooled by a fan located on rear panel external side; a high efficiency heat sink length-wise located into the module provides the RF circuitry cooling.

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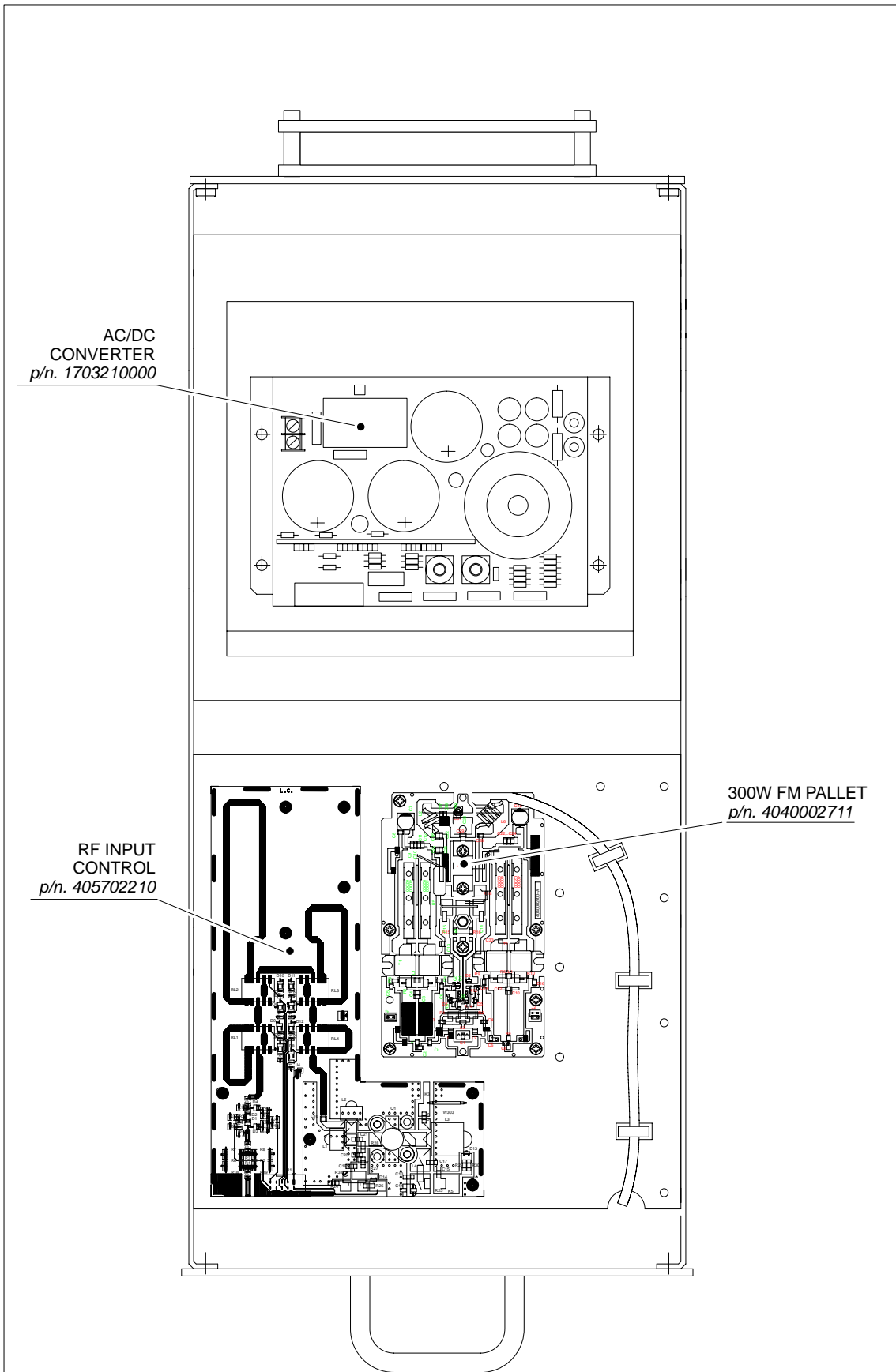


Fig. 1.1 (1/2) – MPFM250 general layout (top view)

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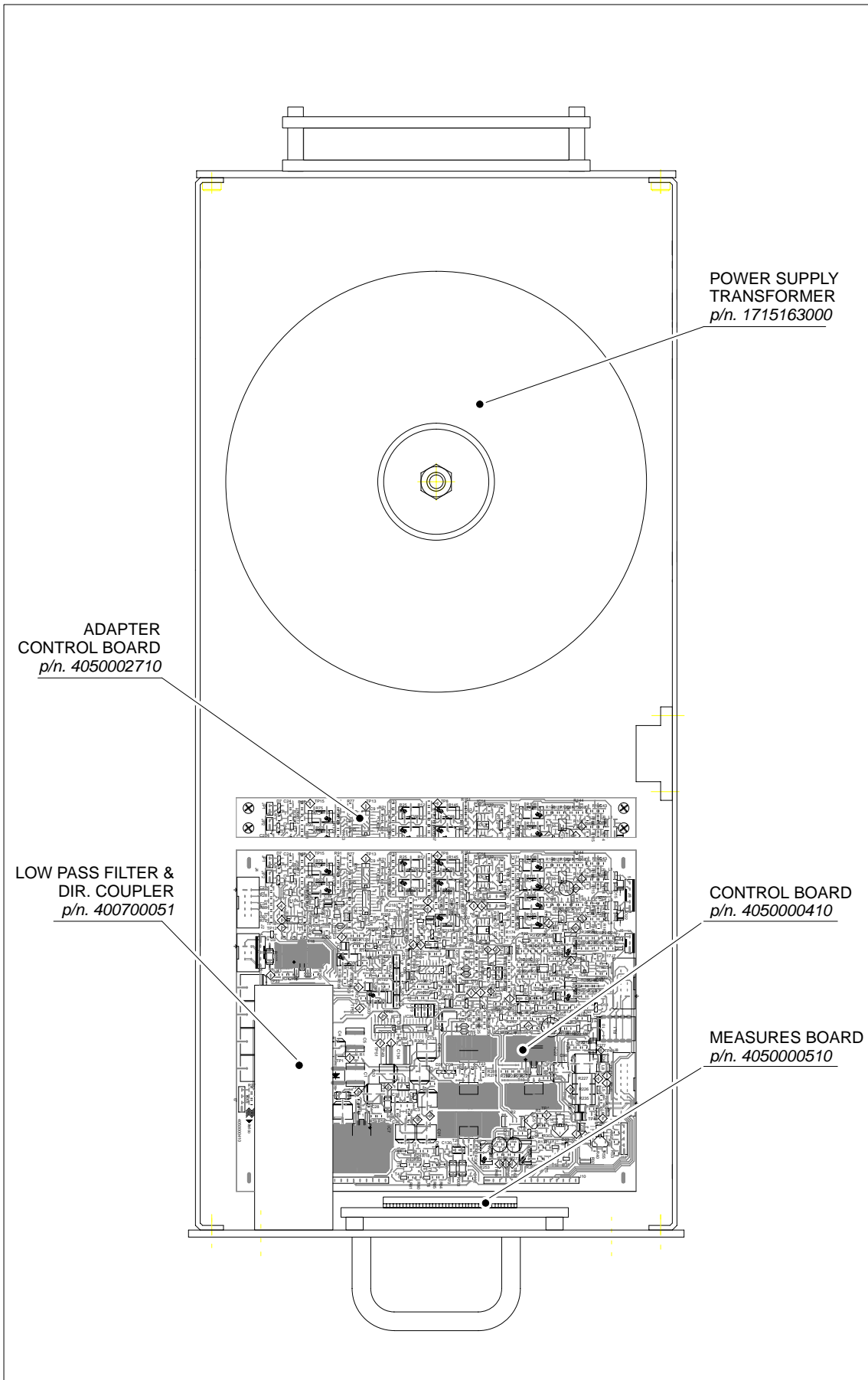



Fig. 1.1 (2/2) – MPFM250 general layout (bottom view)

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1.2 TECHNICAL CHARACTERISTICS

RF CHARACTERISTICS

Frequency Range	87.5 to 108MHz
Input/Output Impedance	50Ω
Output Nominal Power	250W
Input Nominal Power	2.5W (max. 5W)
Working class	B
Harmonic attenuation	> 75dB

PROTECTION CIRCUITS

- RF stages over-temperature
- Excessive current absorption
- Excessive reflected power

TETS POINTS

(*REMOTE* connector 9 pins D female on rear panel)

- forward power
- reflected power

METERING

(3-digit display on front panel)

- forward power
- reflected power
- VD power supply
- ID power supply

POWER SUPPLY VOLTAGE 220V_{AC} (±10%; 50Hz)

POWER CONSUMPTION 500VA

COOLING SYSTEM forced air

ENVIRONMENTAL DATA

- temperature 0 to +45°C
- relative humidity 95%

MECHANICAL

Dimensions (mm)	177x200x420 (<i>hxwxd</i>)
Weight (kg)	15

1.3 FUNCTIONAL DESCRIPTION

This paragraph provides a functional description of the parts which make up MPFM250. The description deals with the following:

- 1.3.1 RF Section
- 1.3.2 Control section
- 1.3.3 Power Supply Section

1.3.1 RF Section

RF INPUT CONTROL p/n. 405702210

The functional description of this assembly is referred to block diagram on Fig. 1.2.

The board includes two Π Attenuators, a Phase Shifter and a driver stage.

The former attenuator delivers a fixed attenuation while the latter (PIN diodes attenuator) may change the attenuation depending on the regulation set on *ALC* (*Automatic Level Control*) or *MLC* (*Manual Level Control*) trimmers. The choice of the functioning mode (*ALC* or *MLC*) is carried out by an internal dip-switch. *ALC* trimmer is arranged on board, *MLC* trimmer is available to the operator on unit front panel.

The Phase Shifter is switched-lines type and allows adjusting the in/out phase of the amplifier; a rotary switch (available on front panel) switches on/off four RF lines in such a way to change the phase of the signal.

RF Driver stage is made up by a single transistor (MOSFET) which is made to work in class B with 20dB gain.


300W FM PALLET p/n. 4040002711

The stage is made up by a MOS device with 22dB gain; the stage is made to work in class B. The pallet includes the necessary circuitry for the biasing.

LOW PASS FILTER & DIRECTIONAL COUPLER p/n. 400700051

The low-pass filter, arranged in a mechanical box, is LC type and has a 110MHz cut-off frequency. The Directional Coupler picks-up, through a detector circuit, two samples of voltage which are proportional to the forward and reflected output power.

The samples of the voltages are sent to *CONTROL BOARD* for the control of the amplifier functioning and are also made available on *REMOTE* connector of the rear panel.

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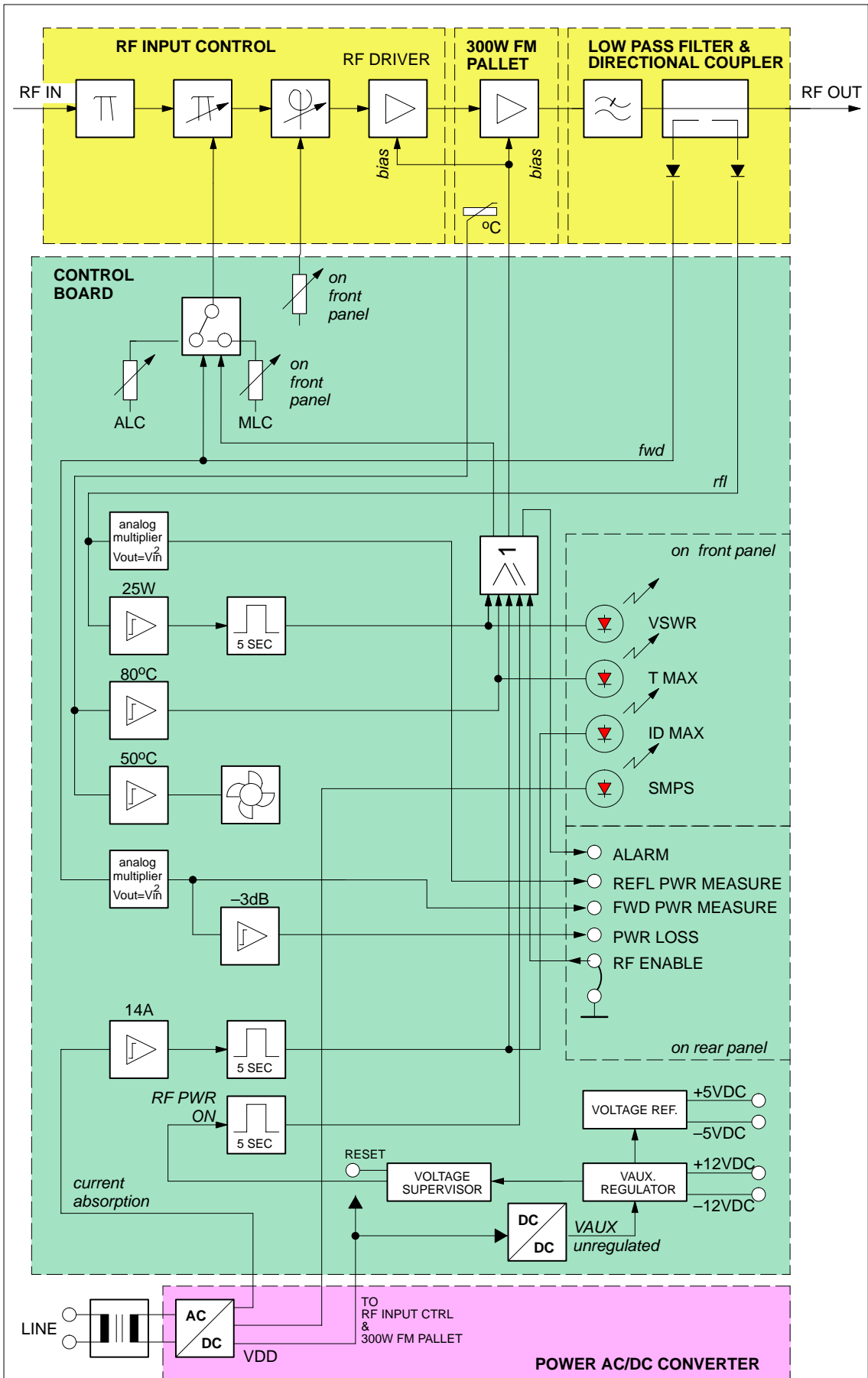


Fig. 1.2 – RF Input control block diagram

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1.3.2 Control Section

The board controls and manages the functioning of the amplifier.

ALC OR MLC CONTROL MODE

The control of the RF output power may be performed in *ALC (Automatic Level Control)* or *MLC (Manual Level Control)* mode. The setting of the mode is done via a dip-switch enabling *ALC* internal trimmer or *MLC* trimmer available on front panel. The setting of these trimmers fixes the attenuation of the variable Π Attenuator. The *ALC* threshold is normally factory set at 280W; the regulation range for *MLC* trimmer goes from ~10W to 300W.



NOTE

- ▶ If MPFM250 operates in stand-alone configuration the *ALC* mode should be set.
- ▶ If MPFM250 operates coupled with other ones, the units must be set on *MLC* mode and the trimmers “PWR” on front panel must be set completely clockwise.

CONTROL OF FWD AND RFL POWER

The samples of the voltages picked-up from the *Directional Coupler*, are used for the protection and monitoring of the amplifier. The sample proportional to forward power is applied to a voltage multiplier. Its output is made available on *REMOTE* connector for the relevant measurement and also enters a comparator which as soon as the output power decreases of 3dB in respect to the nominal value sends “*PWR LOSS*” alarm on *REMOTE* connector of the rear panel.

The sample proportional to the reflected power is applied to a voltage multiplier and to a voltage comparator: the output of the multiplier is made available on *REMOTE* connector for the relevant measurement. The comparator output is sent to a set of diodes in OR-wired connection which, if the reflected power exceeds 25W, causes the cut-off of the RF stages and brings the variable attenuator at its maximum level. The comparator also lights-up “*VSWR*” alarm led on front panel.

This procedure is timed and lasts 5 seconds: when this time is elapsed *CONTROL BOARD* restores the normal operating conditions: if the condition of high reflected power is still active the procedure starts again.

TEMPERATURE CONTROL

A thermal detector is arranged on heatsink of *300W FM PALLET*. The information is sent to two voltage comparators: the former enables the starting of the internal fan if the temperature exceeds 50°C; the latter if the temperature exceeds 80°C, via the OR-wired connection performs the same protection procedure as for reflected power. The alarm led “*T MAX*” on front panel indicates that this protection circuit has been triggered.

CURRENT ABSORPTION CONTROL

The AC/DC converter of the power supply, in case of excessive current absorption, generates a signal which is sent to a voltage comparator. The comparator triggers the OR-wired connection if the current absorption is greater than 14A. The protection procedure is the same of the reflected power and of temperature control.

POWER ON SIGNAL

When the amplifier is connected to line power supply, the voltage regulator which delivers $\pm 5V_{DC}$ also delivers a *power on* signal to a timer circuit which for 5 seconds inhibits the OR-wired connection in order to mask any alarm or spurious conditions that may occur. This signal is also active after a drop of the line supply voltage.

POWER AC/DC CONVERTER ALARM

Any failure conditions of the *AC/DC Converter* that may occur during the functioning of the amplifier is signaled by the “*SMPS*” led on front panel.


1.3.3 Power Supply Section

The Power Supply Section includes a transformer (with two secondary windings) and an *AC/DC Converter* which delivers the necessary voltage for the amplifier functioning. The *AC/DC Converter* is able to deliver a 25A current with an output voltage of 28V_{DC}.

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CHAPTER 2: OPERATING INSTRUCTIONS

2.1 INTRODUCTION

The present Chapter describes all the controls and indicators available to the operating personnel.

Note that the MPFM250 is not provided with turn-on control since the ON/OFF condition is determined by the equipment housing it.

Therefore refer to the equipment technical manual which the MPFM250 is part of, for the operating instruction related to turn-on and off.


An ALARM signal to be sent to the equipment dedicated to the RF Amplifier performance monitoring is available on the REMOTE connector.

Two pins on the same connector (ENABLE RF; normally linked) are available in order to allow the remote control of the MPFM250 amplifier.

2.2 CONTROLS AND INDICATORS

All the indicators are easily available to the operator. The following Tab. 2.1 refers to Fig. 2.1 in which the front and rear panels of the MPFM250 are shown.

In this table the left-column numbers are the call-outs of all controls, indicators, connectors, meters, displays, etc. mounted on the MPFM250. Furthermore, a brief description is given for each function.

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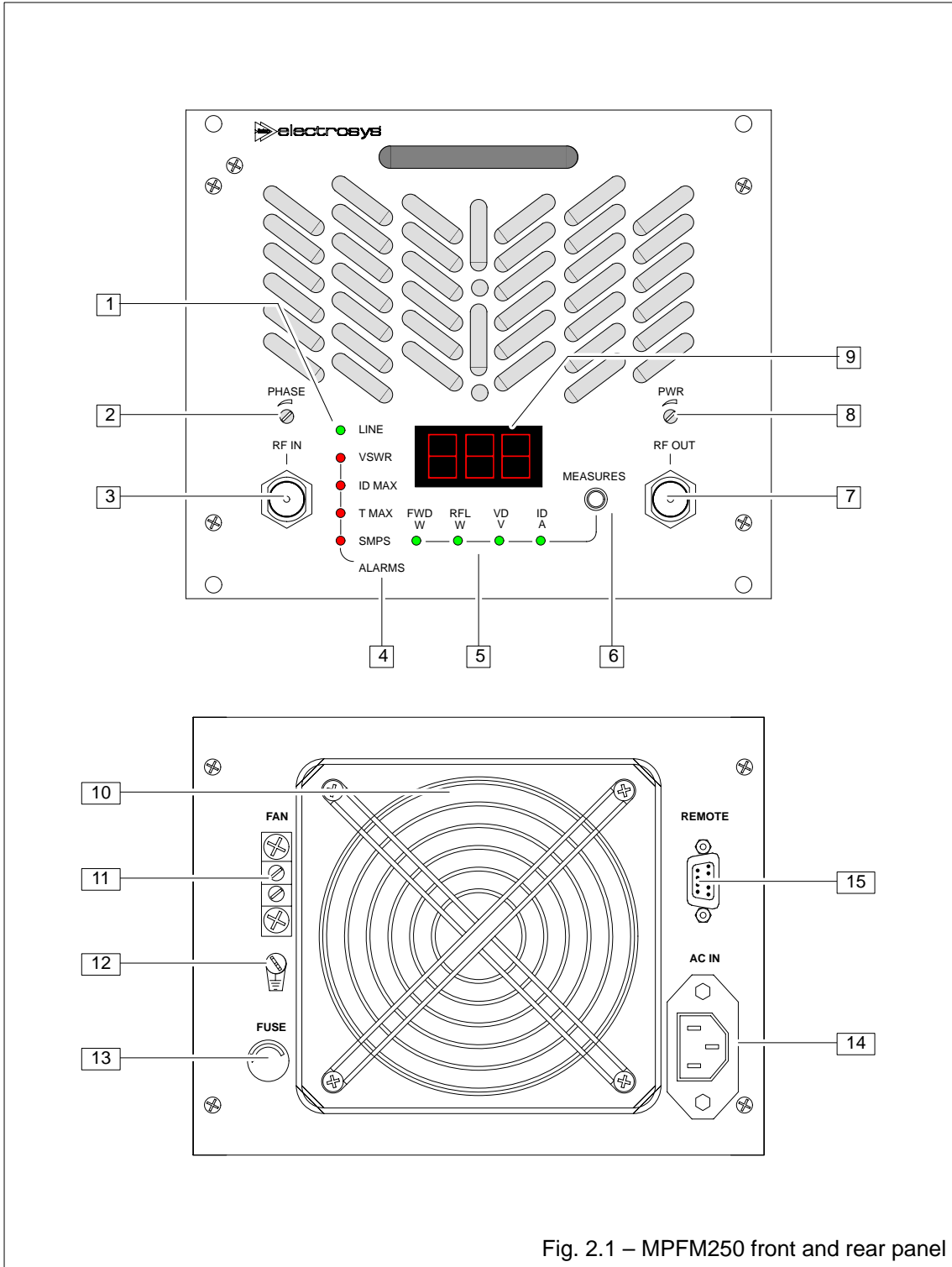



Fig. 2.1 – MPFM250 front and rear panel

Tab. 2.1 – MPFM250 RF Amplifier front and rear panel legend (ref. Fig. 2.1)

NO.	LABEL	FUNCTION
1	LINE	Indicator led (green); indicates the presence of AC line on the relevant socket (14).
2	PHASE	Rotary switch (16 steps); allows adjusting in/out phase of the amplifier (5° per step).
3	RF IN	Connector ("BNC" female); it is the RF input of the amplifier.
4	ALARMS – VSWR – ID MAX – T MAX – SMPS	Set of alarm leds (red); indicate: presence of reflected power $\geq 25W$. current absorption from power supply $\geq 14A$ heatsink temperature of RF final stage $\geq 80^{\circ}C$ a failure of the power supply.
5	MEASURES – FWD (W) – RFL (W) – VD (V) – ID (A)	Set of indicator leds (green); indicate the measurement selected by means of the relevant push-button (6). green/red led; – green led indicates the selection of the forward power measurement (W) – red led (blinking) indicates the ALC circuit intervention (the preset threshold of 280W has been exceeded). green led; indicates the selection of the reflected power measurement (W) green led; indicates the selection of the power supply voltage measurement (V) green led; indicates the selection of the power supply current measurement (A)
6	MEASURES	Push-button; allows selecting the measurement to be displayed on digital display (8). The measurement selected is indicated by the lighting up of relevant green led.
7	RF OUT	Connector ("N" female); it is the RF output of the amplifier.
8	PWR	Trimmer (multi-turn); allows adjusting the gain of the amplifier (~10W to 300W). If MPFM250 is set on <i>MLC</i> mode the regulation range of the trimmer is as above. If MPFM250 is set on <i>ALC</i> mode the regulation range of the trimmer goes from ~10W to the threshold set by the internal trimmer <i>ALC</i> (usually 280W). If MPFM250 operates in stand-alone configuration the <i>ALC</i> mode should be set. If MPFM250 operates coupled with another one, both the units must be set on <i>MLC</i> mode and this trimmer must be set completely clockwise.
9		Three digit digital display; displays the measurements selected by push-button (5). The measurement selected is indicated by the lighting up of relevant green led. The display is activated by pressing the <i>MEASURE</i> push-button (6) and is active for a preset time (15, 30, 60 minutes, set by an internal jumper) before going off.
10		Fan; delivers the air cooling to the amplifier.
11	FAN	Terminal block for the power supply (24V _{DC}) of the fan:
12		Grounding screw of the amplifier frame.

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Tab. 2.1 – MPFM250 RF Amplifier front and rear panel legend (ref. Fig. 2.1)

NO.	LABEL	FUNCTION
13	FUSE	Protection fuse (5A); the luminous cap lights up when the fuse has blown.
14	AC IN	Line socket.
15	REMOTE	Connector ("D" 9-pins male); it makes available I/O signals outwards.

2.3 MPFM250 REMOTE I/O CONNECTOR

The pin-out assignment of REMOTE connector (type "D" 9 pin; #15 on Fig. 2.1), is listed on Tab. 2.2. The connector is available on the rear panel of the amplifier module.

PIN	FUNCTION		NOTES
1	NO ALARM (<i>contacts normally open</i>)	TLS	
2	NO ALARM (<i>contacts normally closed</i>)	TLS	
3	GND		
4	RF ENABLE	TLC	1
5	POWER ON	TLC	
6	ALARM INDICATION COMMON		
7	POWER LOSS	TLS	
8	REFLECTED POWER	TLS	
9	FORWARD POWER	TLS	

NOTES

- 1 If the unit does not have to be controlled from an external enable, this pin must be linked to pin 3(GND)

2.4 ALC/MLC FUNCTIONING MODE OF MPFM250

Two different functioning modes are allowed: *ALC (Automatic Level Control)* and *MLC (Manual Level Control)*. The setting of the mode is carried out on a 2–position swith (U1) located on *Adapter Control Board* p/n. 4050002710 (see Fig. 2.2).

- ▶ **ALC** a suitable circuit keeps the RF output power below the threshold set by the relevant trimmer (R22 on *Adapter Control Board* p/n. 4050002710). The trheshold is factory set at 280W. R56 trimmer (on *Adapter Control Board* p/n. 4050002710) fixes the threshold when "FWD" red led (on front panel) starts to blink signalling the intervention of *ALC* circuit. The adjustment of this threshold may be carried out in such a way the led starts blinking before the threshold set by R22 trimmer.



NOTE

- ▶ **ALC mode is recommended whenever MPFM250 operates in *stand-alone* configuration.**

- ▶ **MLC** a suitable circuit keeps the RF output power below the threshold set by the relevant trimmer ("PWR" #8 on Fig. 2.1) available on unit front panel.



NOTE

- ▶ **MLC mode is recommended whenever MPFM250 operates coupled with other ones. In this event the units must be set on *MLC* and the trimmers "PWR" on front panel must be set completely clockwise.**

2.5 STANDARD SET-UP OF CONTROL BOARD (p/n. 4050000410)

The *Control Board* (p/n. 4050000410) of MPFM250 (location on Fig. 2.2) set-up is factory set, and does not require any other setting. In case replacement it is advisable to check the correct set-up of jumpers and dip-switches. The following paragraphs give the information about the correct settings of *Control Board* of MPFM250.

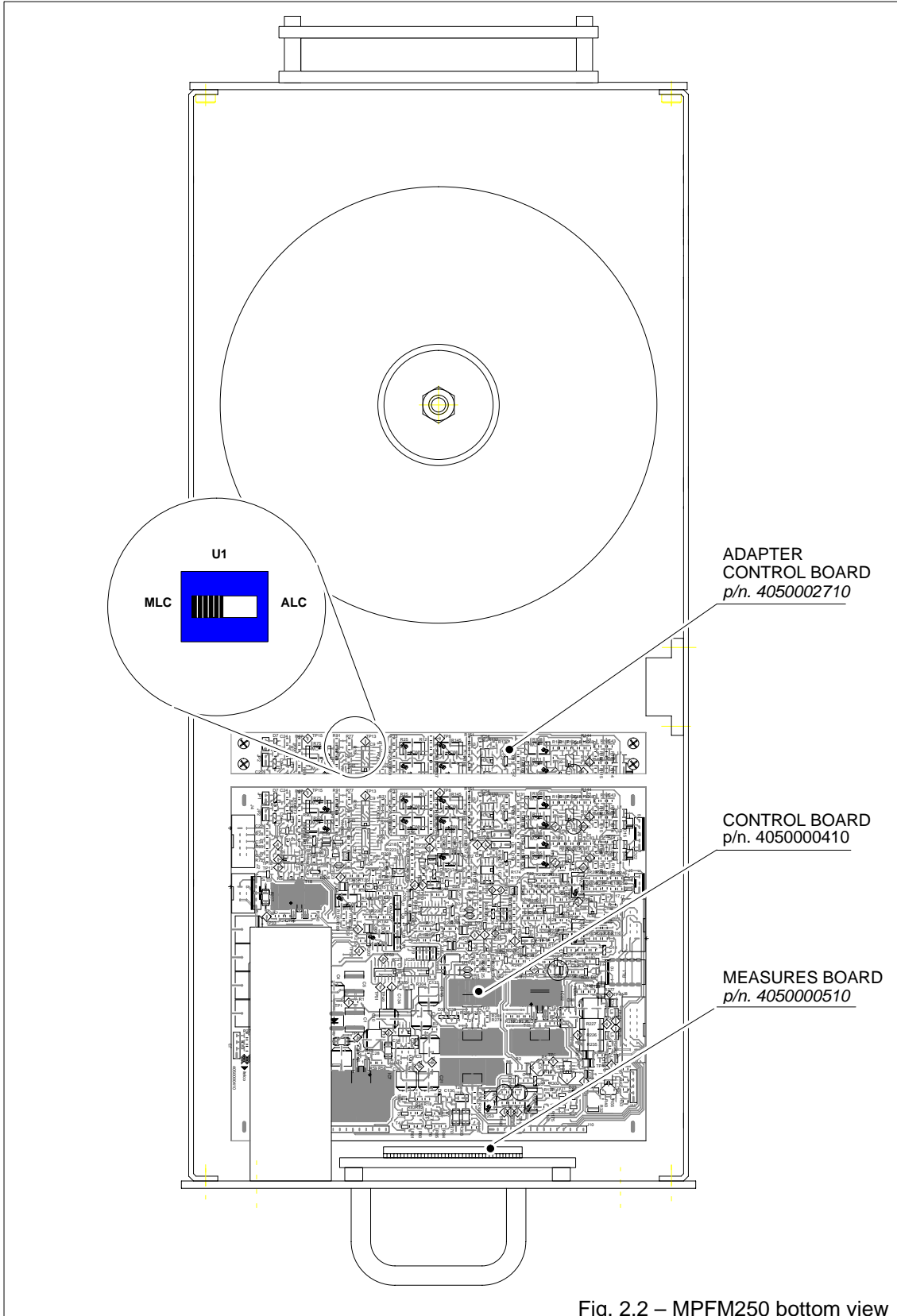


Fig. 2.2 – MPFM250 bottom view

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2.5.1 Jumpers set-up

Jumpers set-up is listed on Tab. 2.3.

Tab. 2.3 – Jumpers set-up of <i>Control Board</i> p/n. 4050000410		
JUMPER	STANDARD SET-UP	CONFIGURATION
JP1	CLOSED	
JP2	CLOSED	
U1	OPEN	
U3	CLOSED	
U4	CLOSED	
U5	OPEN	
U6	CLOSED 2-3	
U7	CLOSED	
U8	OPEN	
U9	CLOSED 1-2	
U10	OPEN	
U11	CLOSED	
U12	CLOSED	
U13	OPEN	
U14	OPEN	
U15	CLOSED	
U16	OPEN	

2.5.2 LEDs location

The functioning state of MPFM250 module may be monitored by LEDs placed on *Control Board* (p/n. 4050000410). LEDs location and their relevant indications are given on Fig. 2.3.

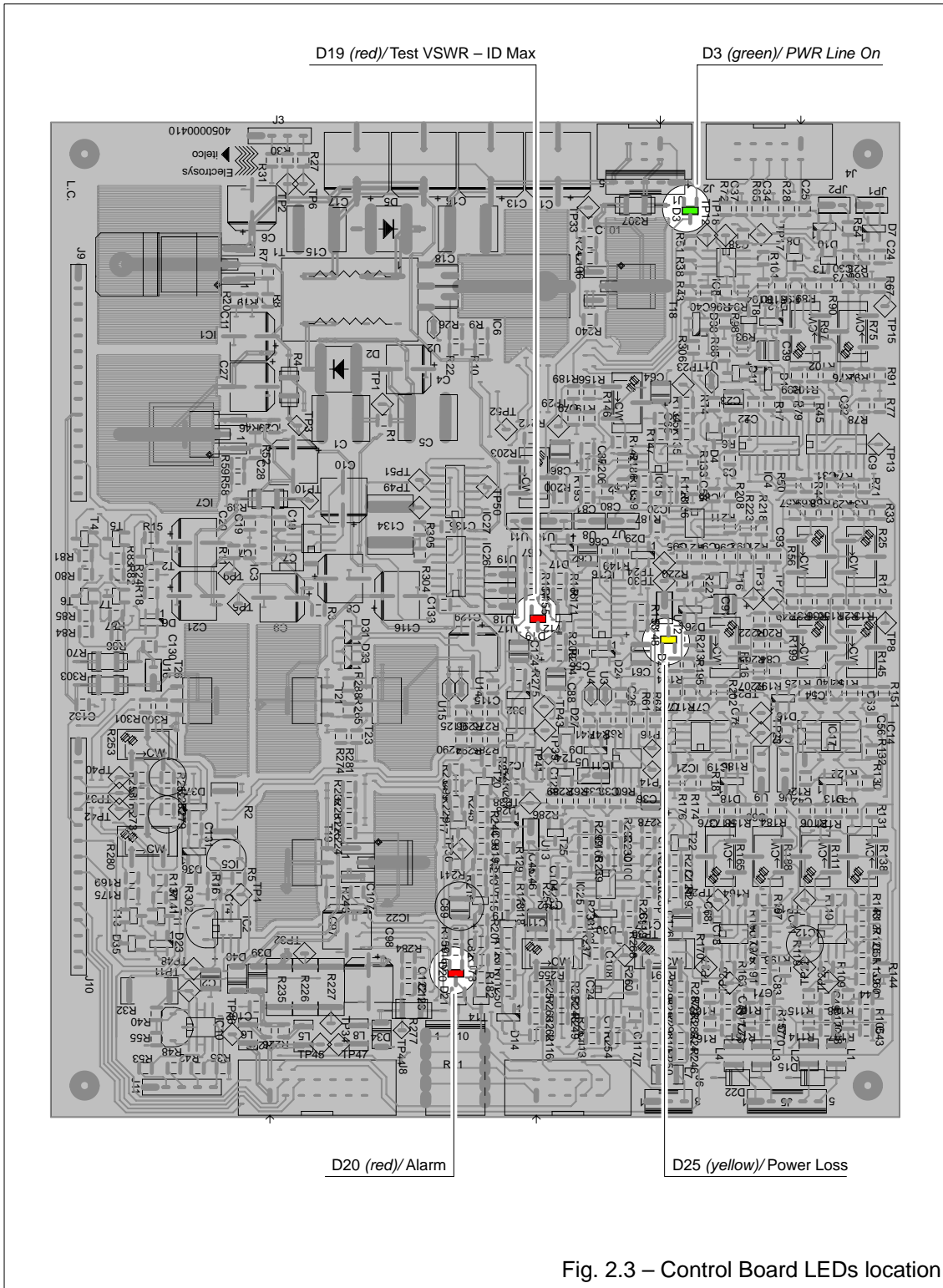



Fig. 2.3 – Control Board LEDs location

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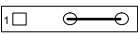

2.6 STANDARD SET-UP OF MEASURES BOARD (p/n. 4050000510)

The *Measures Board* (p/n. 4050000510) of MPFM250 (location on Fig. 2.2) set-up is factory set, and does not require any other setting. In case replacement it is advisable to check the correct set-up of the jumpers as listed on Tab. 2.4.

Tab. 2.4 – Jumpers set-up of <i>Measures Board</i> p/n. 4050000510		
JUMPER	STANDARD SET-UP	CONFIGURATION
U1	CLOSED	
U2	OPEN	
U3	CLOSED	
U4	CLOSED	
U5	OPEN	
U6	CLOSED	
U7	CLOSED 2-3	
U8	CLOSED 1-2	
U9	CLOSED 2-3	

2.7 STANDARD SET-UP OF ADAPTER CONTROL BOARD (p/n. 4050002710)

The *Measures Board* (p/n. 4050002710) of MPFM250 (location on Fig. 2.2) set-up is factory set, and does not require any other setting. In case replacement it is advisable to check the correct set-up of the jumpers as listed on Tab. 2.5.


Tab. 2.5 – Jumpers set-up of Adapter Control Board p/n. 4050002710		
JUMPER	STANDARD SET-UP	CONFIGURATION
U1	CLOSED	
U4	OPEN	1 □ □ □
U5	CLOSED 2-3	
U6	OPEN	□ □
U7	OPEN	□ □
U8	CLOSED 2-3	1 □ 
U9	OPEN	1 □ □ □
U10	OPEN	□ □
U11	OPEN	□ □



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CHAPTER 3: MAINTENANCE

3.1 INTRODUCTION

3.1.1 Introduction to Maintenance

The purpose of this section is to assist the maintenance personnel in keeping the RF Amplifier Unit at best operational status. Maintenance can be subdivided into the following actions:

- PREVENTIVE MAINTENANCE,
- CORRECTIVE MAINTENANCE.

Preventive maintenance refers to maintenance procedures which have to be carried out periodically so as to prevent malfunctions. Corrective maintenance includes a series of tables representing a troubleshooting guide used to locate the most likely area where a malfunction has occurred or reference to the unit manuals.

3.1.2 Maintenance Tools

Maintenance tools include Commercial, Standard and Special Tools used for the 1st and 2nd levels of Maintenance. Commercial Tools include the tools normally used for the maintenance activities (screwdrivers, pliers, soldering irons, etc.) and are normally available on the local market. Standards Tools include those materials considered as standard for maintenance activities (coax cables of standard length, coax adapters, etc.) and are available on the local market and/or from the manufacturer of the unit. Special Tools include tools prepared by the manufacturer for maintenance requirements and are available only from the manufacturer of the unit for which they are designed.

Only Commercial and Standard tools are requested for amplifier maintenance.

3.1.3 Test Instruments

The Test Instruments required on-site in order to carry out the maintenance activities are listed in paragraph 3.4 "Maintenance Procedures". Please note that all the listed Test Instruments are of commercial type and may be substituted by equivalents available on the local market.

3.2 PREVENTIVE MAINTENANCE

This paragraph deals with the suggested preventive maintenance operations to guarantee continued performance of the RF Amplifier Unit.

All unit parts shall be examined to check for dust or dirt, overheating, loose screws and foreign bodies. Dust, for example, may cause current discharges or leakages.

1) *Frames*

Frames, through which the ventilation air flows, need to be internally cleaned from dust. Cleaning can be carried out using a vacuum cleaner for the accessible parts or a clean, dry cloth or bristle brush.

2) *Printed Circuit Boards (PCB)*


PCBs shall not be removed unless dust is noted on their surface. In this case, the PCBs shall be removed one at a time. Use only moderately compressed air or a soft bristle brush to remove the dust. Clean the lance contacts of the connectors on the PCB using a bristle brush soaked in pure alcohol.

3) *Power Supply Modules and Converters*

Removal of the dust accumulated on the housing and components is normally sufficient to clean power supply modules. To clean the PCBs extract them from the Module, then carefully clean the connector pins using a bristle brush soaked in pure alcohol.

4) *Indicator Lamps*

Lamps must be well inserted in their socket. Remove any trace of corrosion, oxidation or dirt by the use of a cloth soaked in carbon tetrachloride.

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5) *Fuses*

Fuse tips are subject to oxidation and must be periodically removed from their holders to check for any presence of oxidation. The oxidation or dust increases the resistance of the electrical circuit. Fuse tips shall be cleaned using a cloth soaked in carbon tetrachloride.

**NOTE**

**FUSES SHALL BE REMOVED ONE AT A TIME
IN ORDER TO AVOID INSERTING THEM INTO A WRONG HOLDER.
THE VALUE PRINTED ON THE FUSES SHALL CORRESPOND
TO THAT PRINTED ON THEIR RELEVANT HOLDERS.**

6) *Connections Cables*

Connection cables shall be periodically examined to ensure that breaks in the external insulating coating are not present to cause possible short-circuits. Cover the parts showing deterioration of the insulating coating. Coaxial cables shall be carefully examined since they can be easily damaged by crushing or sharp bends. Connectors shall be checked to ascertain that corrosion is not present on their metallic contacts. Cables showing damages must be protected and eventually replaced.

7) *Terminal Boards*

Terminal boards shall be examined to ascertain that there are no traces of dirt, loose wires or excess solder on the terminals, which could cause undue contacts with the adjacent terminals. Fixing screws or mounting brackets shall be tightened. Terminal boards shall be cleaned using a dry cloth or bristle brush.

8) *Resistors*

Resistors shall be checked for evidence of cracks, discoloration or "cooking". Discoloration indicates that the resistor is subject to overload which could be caused by an incorrect operation of the circuit. Examine resistor leads for dust, dirt or loose connections.

9) *Transformers and Coils*

Examine transformers and coil leads for any trace of dust, dirt or humidity. Check that they are secured in their seats; tighten fixing screws and mounting brackets. Housings, terminals and insulators supporting transformers and coils should be free from foreign objects. Use a dry cloth or, if necessary, moisten the cloth with a suitable solvent. Should the wiring be corroded, tag each wire, disconnect and clean the contact surface using emery paper with a fine grain and then clean the surfaces using a clean cloth. Reconnect the wires.

10) *Potentiometers and Variable Resistors*

Potentiometers and variable resistors, with the exception of those with special features and mounting, shall be examined to ascertain that there is not mechanical backlash. If necessary, disassemble the knob mounted on the axis and tighten the locking screw. The knob must be reassembled in its original position. The housing, if any, must be cleaned from dust by using a bristle brush or compressed air. Ascertain that there are no traces of overheating which indicates an irregular operation of the circuit on which the potentiometer or the variable resistor is inserted. Look for the cause of overheating and eliminate it as soon as possible.

11) *Mechanical Inspection*

According to the environmental conditions, periodically check and lubricate the following mechanical parts:

- hinges of front doors;
- hinges of rear doors.

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3.3 CORRECTIVE MAINTENANCE

Causes which give rise to a corrective maintenance action can derive from:

- Out of tolerance conditions of standard levels, waveforms and timings, detected during preventive maintenance;
- Failure conditions shown either by indicator lamps, displays, LEDs located on PCB (if any), TTY diagnostic print outs.
- Failure conditions detected by operative personnel.

Restoring the unit to operation in a short time also depends on the availability of spare parts and components.

3.4 MAINTENANCE PROCEDURES

The maintenance procedures can be utilized for periodic performances checks or after a substitution of failed component or board.

These procedures can be utilized one at a time or in sequence, depending from the needs. The procedures are divided in paragraphs as follows:

3.4.1 Functional checks of "RF Input Control" p/n. 405702210 (*Driver*)

3.4.2 Functional checks of "300W FM Pallet" p/n. 4042000711 (*Final*)



NOTE

THE FOLLOWING CHECKING, UNLESS OTHERWISE SPECIFIED, HAVE TO BE PERFORMED WITH THE AMPLIFIER SUPPLIED AND WITHOUT RF INPUT SIGNAL AND AFTER ABOUT HALF AN HOUR OF OPERATING CONDITIONS.

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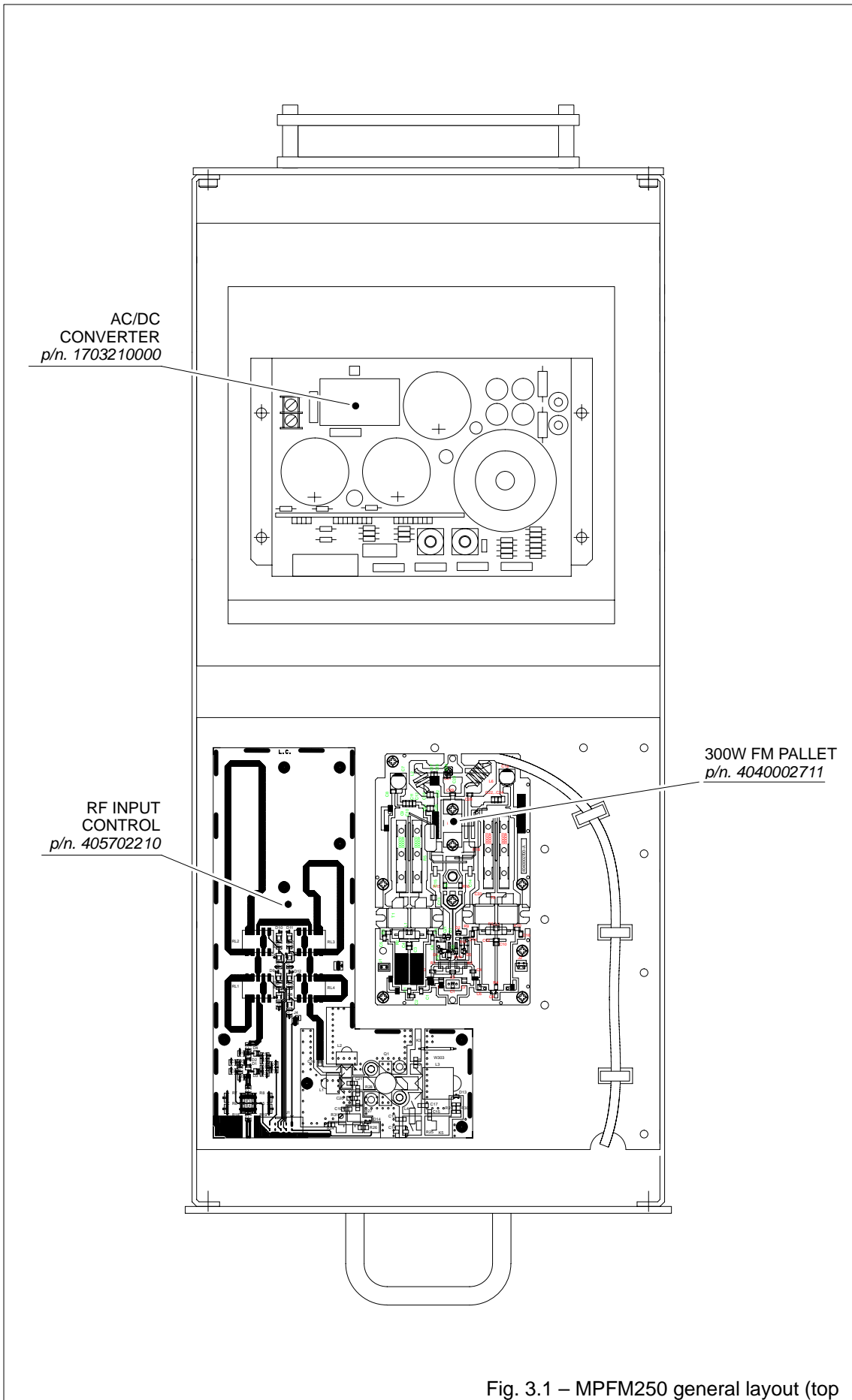


Fig. 3.1 – MPFM250 general layout (top

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3.4.1 Functional checks of "RF Input Control" p/n. 405702210 (Driver)

Remove the top cover of the amplifier module in order to access the "RF Input Control" (driver amplifier); location of the board is shown on Fig. 3.1. Remove the electric shield to access the components. The functional checks on the pallet can be carried out by following the indication given in Tab. 3.1.

Tab. 3.1 – Functional checks on "RF Input Control" p/n. 405702210 (PreDriver)

checking	measure point / component	measurements	regulation
Transistors power supply	Q1 "drain"	$42V_{DC} \pm 0.3V_{DC}$	
Q1 biasing (quiescent curr.)	R25 resistor (measure drop voltage with voltmeter probes) see Fig. 3.2.		adjust R31 (counterclockwise) for the minimum drop voltage on R25 (minimum of the current); re-adjust R31 in order to have 3mV of drop voltage (corresponding to a 30mA current)

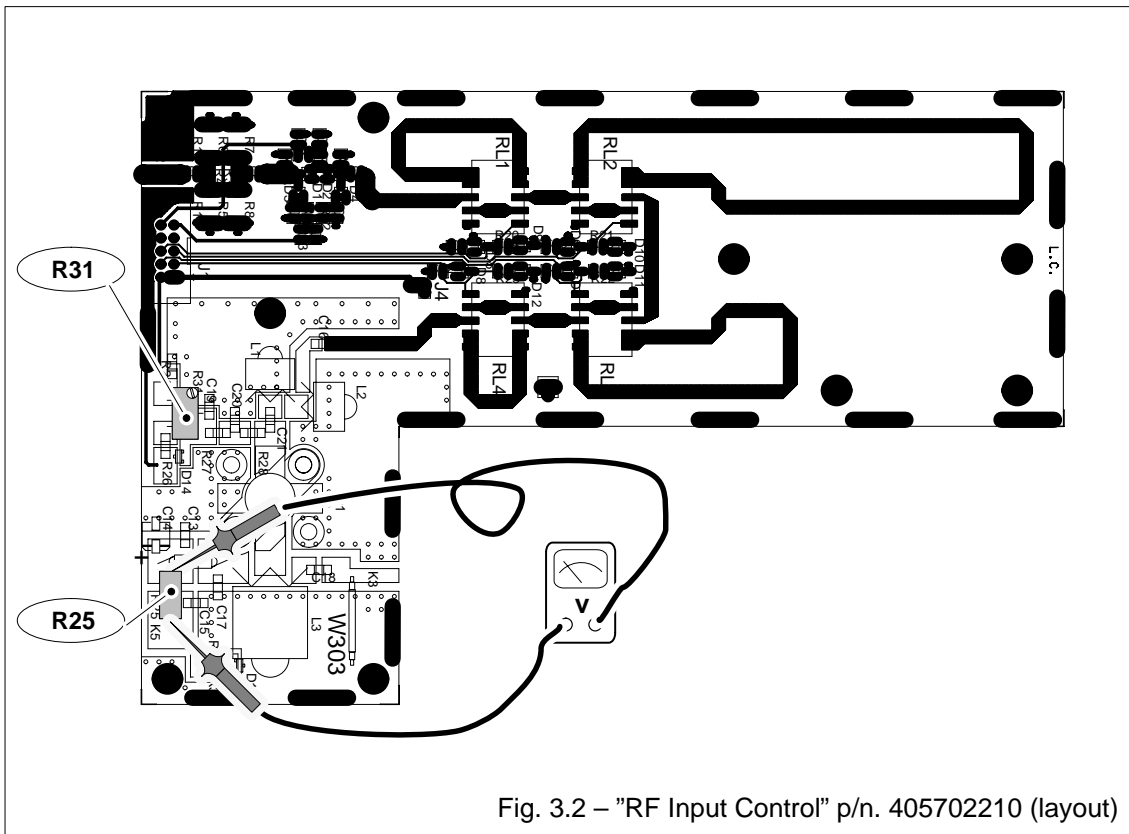


Fig. 3.2 – "RF Input Control" p/n. 405702210 (layout)

3.4.2 Functional checks of "300W FM Pallet" p/n. 4040002711 (Final)

Remove the top cover of the amplifier module in order to access the "300W FM Pallet" (final amplifier); location of the pallet is shown on Fig. 3.1. Remove the electric shield to access the components. The functional checks on the pallet can be carried out by following the indication given in Tab. 3.2.

Tab. 3.2 – Functional checks on "300W FM Pallet" p/n. 4040002711 (Driver)

checking	measure point / component	measurements	regulation
Transistors power supply	T1, "drain"	42V _{DC} ± 0.3V _{DC}	
T1 biasing (quiescent curr.)	R5 resistor (measure drop voltage with voltmeter probes) see Fig. 3.2.		adjust R6 (counterclockwise) for the minimum drop voltage on R5 (minimum of the current); re-adjust R6 in order to have 2mV of drop voltage (corresponding to a 200mA current)

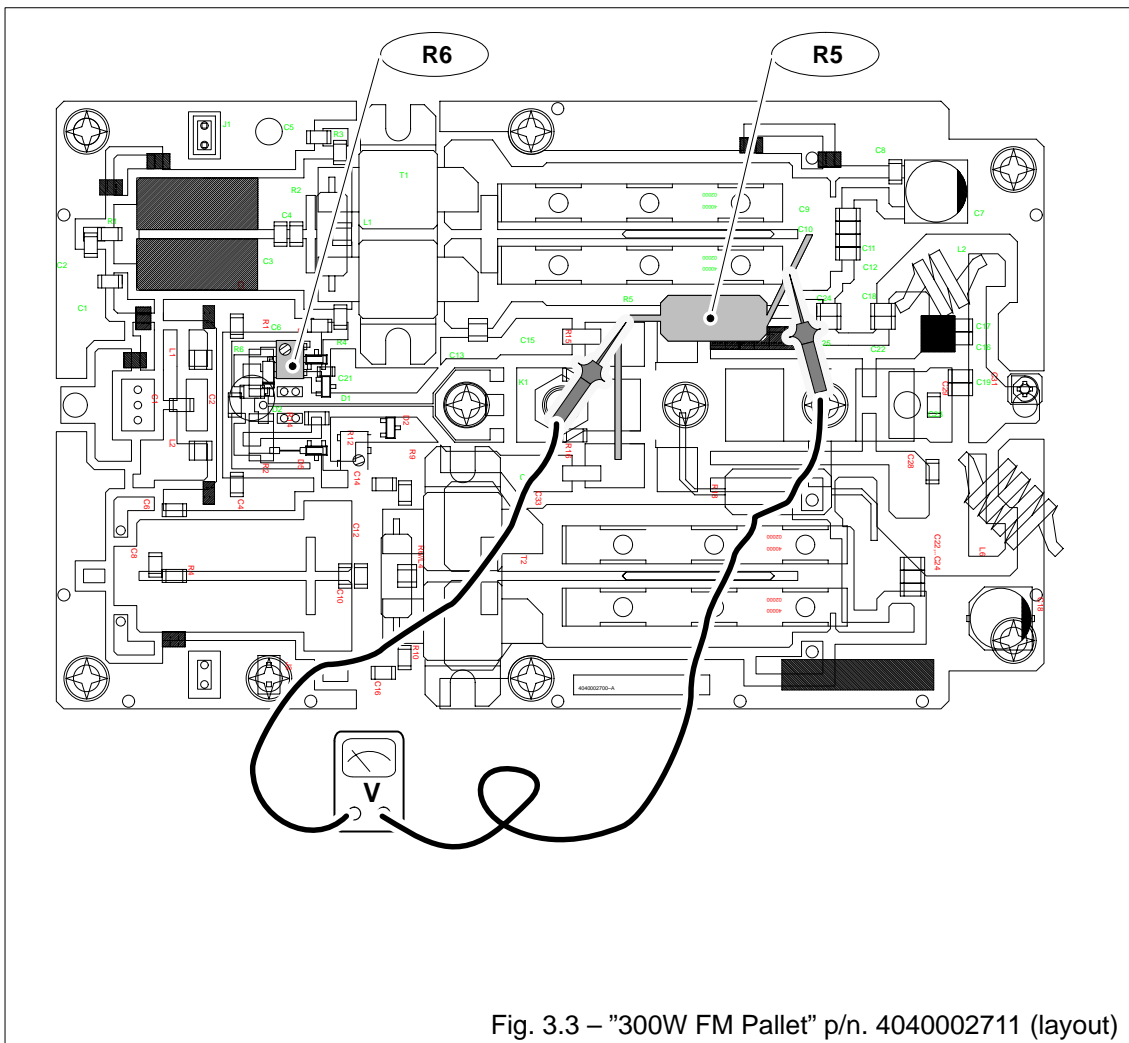


Fig. 3.3 – "300W FM Pallet" p/n. 4040002711 (layout)