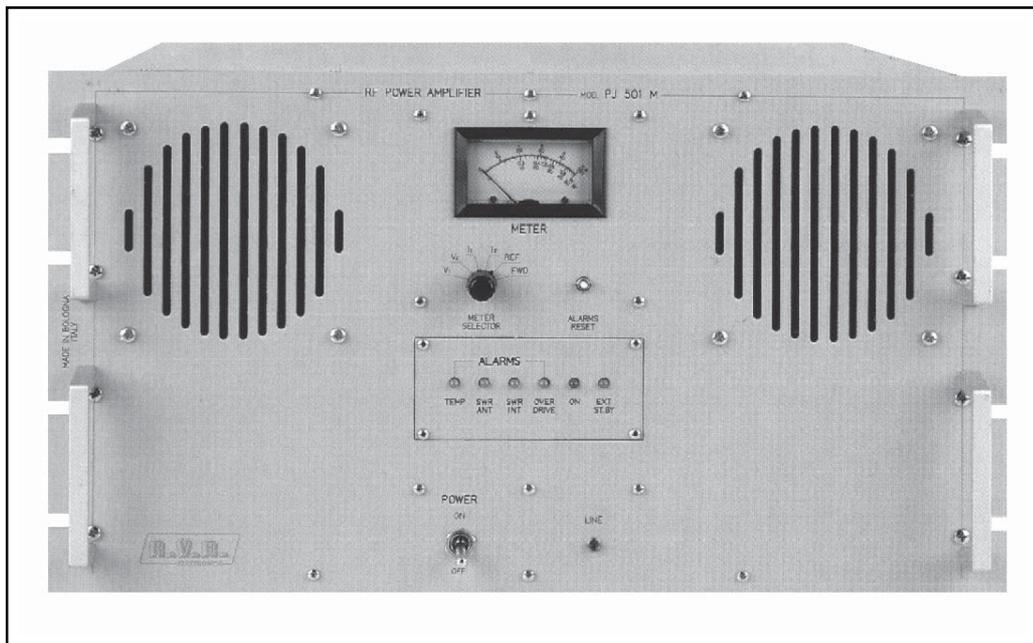

PJ501M



User Manual

Manufactured by  Italy



PJ501M - User Manual
Versione 7.0

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Notification of intended purpose and limitations of product use

This product is a FM transmitter intended for FM audio broadcasting. It utilises operating frequencies not harmonised in the intended countries of use.

The user must obtain a license before using the product in intended country of use. Ensure respective country licensing requirements are complied with.

Limitations of use can apply in respect of operating frequency, transmitter power and/or channel spacing.

Declaration of Conformity

Hereby, R.V.R. Elettronica SpA, declares that this FM transmitter is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.



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1. Preliminary instructions

This manual is written as a general guide for those having previous knowledge and experience with this kind of equipment.

It is not intended to contain a complete statement of all safety rules which should be observed by personnel in using this or other electronic equipment.

The installation, use and maintenance of this piece of equipment involve risks both for the personnel performing them and for the device itself, that shall be used only by trained personnel.

R.V.R. doesn't assume responsibility for injury or damage resulting from improper procedures or practices by untrained/unqualified personnel in the handling of this unit.

Please observe all local codes and fire protection standards in the operations of this unit.



WARNING: always disconnect power before opening covers or removing any part of this unit.

Use appropriate grounding procedures to short out capacitors and high voltage points before servicing.



WARNING: This is a "CLASS A" equipment. In a residential place this equipment can cause hash. In this case can be requested to user to take the necessary measures.

R.V.R. Elettronica SpA reserves the right to modify the design and/or the technical specifications of the product and this manual without notice.

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2. Warranty

Any product of **R.V.R. Elettronica** is covered by a 12 (twelve) month warranty.

For components like tubes for power amplifiers, the original manufacturer's warranty applies.

R.V.R. extends to the original end-user purchaser all original manufacturers warranties which are transferable and all claims are to be made directly to R.V.R. per indicated procedures.

R.V.R.'s warranty shall not include:

- 1) Re-shipment of the unit to R.V.R. for repair purposes
- 2) Any unauthorized repair/modification
- 3) Incidental/consequential damages as a result of any defect
- 4) Nominal non-incidental defects
- 5) Re-shipment costs or insurance of the unit or replacement units/parts

Warranty shall come into force from invoice date and for the period of the manufactures warranty.

Any damage to the goods must be reported to the carrier in writing on the shipment receipt.

Any discrepancy or damage discovered subsequent to delivery, shall be reported to R.V.R. within five (5) days from its receipt.

To claim your rights under this warranty:

- a. Contact the dealer or distributor where you purchased the unit. Describe the problem and ask if he has an easy solution. Dealers and Distributors are supplied with all the information about problems that may occur and usually they can repair the unit quicker than what the manufacturer could do. Very often installing errors are discovered by dealers.
- b. If your dealer cannot help you, contact R.V.R. in Bologna and explain the problem. If it is decided to return the unit to the factory, R.V.R. will mail you a regular authorization with all the necessary instructions to send back the goods.
- c. When you receive the authorization, you can return the unit. Pack it carefully for the shipment, preferably using the original packing and seal the package perfectly. The customer always assumes the risks of loss (i.e., R.V.R. is never responsible for damage or loss), until the package reaches R.V.R. premises. For this reason, we suggest you to insure the goods for the whole value. Shipment must be effected C.I.F. (PREPAID) to the address specified by R.V.R.'s service manager on the authorization.



DO NOT RETURN UNITS WITHOUT OUR AUTHORIZATION AS THEY WILL BE REFUSED.

- a Be sure to enclose a written technical report where mention all the problems found and a copy of your original invoice establishing the starting date of the warranty.

Replacement and warranty parts may be order from the following address. Be sure to include the equipment model and serial number as well as part description and part number.



R.V.R. Elettronica SpA
Via del Fonditore, 2/2c
40138 BOLOGNA
ITALY
Tel. +39 051 6010506

3. First Aid

The personnel employed in the installation, use and maintenance of the device, shall be familiar with theory and practice of first aid.

3.1 Treatment of electrical shocks

3.1.1 If victim is not responsive

follow the A-B-C's of basic life support

- Place victim flat on his back on a hard surface.
- Open airway: lift up neck, push forehead back
- clear out mouth if necessary and observe for breathing
- if not breathing, begin artificial breathing (Figure 2): tilt head, pinch nostrils, make airtight seal, four quick full breaths. Remember mouth to mouth resuscitation must be commenced as soon as possible

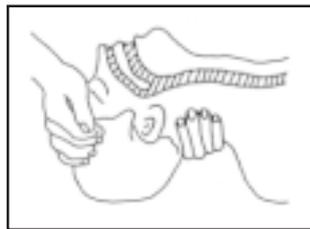


Figure 1

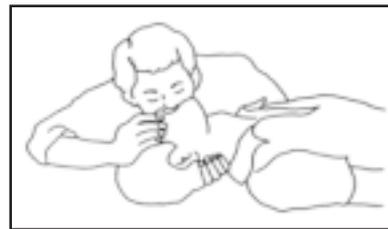


Figure 2

- Check carotid pulse (**Figure 3**); if pulse is absent, begin artificial circulation (**Figure 4**) depressing sternum 1 1/2" TO 2" (**Figure 5**).



Figure 3

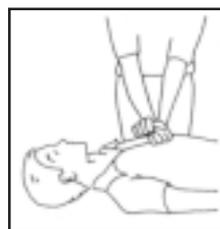


Figure 4

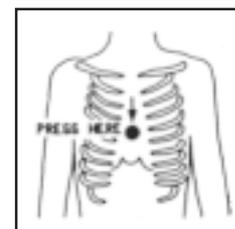


Figure 5

- APPROX. 80 SEC. : ONE RESCUER, 15 COMPRESSIONS
- APPROX. 60 SEC.: TWO RESCUERS, 5 COMPRESSIONS, 1 BREATH
- DO NOT INTERRUPT RHYTHM OF COMPRESSIONS WHEN SECOND PERSON IS GIVING BREATH
- Call for medical assistance as soon as possible.

3.1.2 If victim is responsive

- Keep them warm
- Keep them as quiet as possible
- Loosen their clothing (a reclining position is recommended)
- Call for medical help as soon as possible

3.2 Treatment of electrical Burns

3.2.1 Extensive burned and broken skin

- Cover area with clean sheet or cloth (Cleansed available cloth article).
- Do not break blisters, remove tissue, remove adhered particles of clothing, or apply any salve or ointment.
- Treat victim for shock as required.
- Arrange transportation to a hospital as quickly as possible.
- If arms or legs are affected keep them elevated

If medical help will not be available within an hour and the victim is conscious and not vomiting, give him a weak solution of salt and soda: 1 level teaspoonful of salt and 1/2 level teaspoonful of baking soda to each quart of water (neither hot or cold). Allow victim to sip slowly about 4 ounces (half a glass) over a period of 15 minutes. Discontinue fluid if vomiting occurs



Do not give alcohol

3.2.2 Less severe burns (1st and 2nd degree)

- Apply cool (not ice cold) compresses using the cleansed available cloth article.
- Do not break blisters, remove tissue, remove adhered particles of clothing, or apply salve or ointment.
- Apply clean dry dressing if necessary.
- Treat victim for shock as required.
- Arrange transportation to a hospital as quickly as possible
- If arms or legs are affected keep them elevated.

4. General Description

RVR Elettronica's PJ300M is a 19" rack-mountable, 3 HE high, solid-state broadband power amplifier for FM audio broadcasting. It works without adjustment on the whole 87.5 - 108 MHz FM band and its power output is 500 W nominal with a drive level of about 15W.

The RF power section employs two high power MOSFET module, able to deliver more than 300 W, with two independent power supplies for high efficiency.

Each power supply is a switching mode one, and a "soft-start" circuit is included to minimize the transformer's current spikes when the device is switched on.

The amplifier features a built-in protection system against situations than can be dangerous for the device like exceeding output power or reflected power, overdrive or overtemperature. The protection system is conceived to return the machine in its normal status if the conditions that generated the warnings were temporary.

The front panel includes an analog display to measure the main working parameters. The different parameters are selected with a rotating selector.

A series of LEDs on the front panel give to the user immediate signalling of conditions that have to be noticed. The group includes four red alarm LEDs (temperature, external SWR, internal SWR, overdrive), a green LED that indicates the ON status of the amplifier and a yellow LED that indicates if the machine is forced to stand-by status by an external signal through the telemetry connector.

On the telemetry connector the main parameters are available for the user under the form of dc voltage levels proportional to the value of the parameter under consideration.

A built-in low pass filter keeps the harmonic emission level below the CCIR and FCC permitted thresholds.

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5. Installation and Use

This chapter is intended to summarize the necessary points for the installation of the device. In case any of the arguments is unclear, for example when you use it for the first time, please read carefully the whole manual.

5.1 Preparation

Unpack the amplifier and before any other operation check that the amplifier didn't suffer any damage e.g. during the transport, and specifically check whether all the controls and connectors on the front and rear panel are in good conditions.

Check the mains voltage selector on the rear panel: the position of the jumpers to chose between 110 V or 240 V are indicated on the panel.

If it is necessary to change the voltage, check the value of the fuse inside the voltage changer block. The required values are the following:

- AC Line (vers. 110V) 20A 6X30
- AC Line (vers. 240V) 10A 6X30

The other fuses in the amplifier are:

- RF Module 1 10A 6X30
- RF Module 2 10A 6X30

Verify that the mains switch is in the OFF positon.

Connect to the RF Input the RF Output of suitable exciter, able to deliver a power comprises between 15 and 30W (for example the RVR Elettronica's PTX30) using a cable terminated N-type connectors; the exciter shall be set for minimum power and OFF.

Link one of the Alarms/Interlock connectors to the interlock connector of the exciter, if available (it is in RVR Elettronica's exciters).

Connect the RF output to the antenna cable or to a suitable dummy load.

Finally, connect a proper cable to the amplifier's mains input.



ATTENTION: the cable has to be disconnected from the mains outlet.

After the cable has been safely connected to the amplifier's mains plug, it is possible to plug it into the mains outlet.

The amplifier shall be mounted in one rack that contain a anti-strap device to not expose accidentally the mains conductors.



ATTENTION: It is essential that the unit is properly earthed to ensure both the safety of operation as well as the correct working of the equipment.

5.2 Operation

Switch ON the amplifier and verify the green “ON” LED being it.

The analog instrument, joined with the rotating selector, is used to visualize the working parameters of the unit (Fig. 5.1):

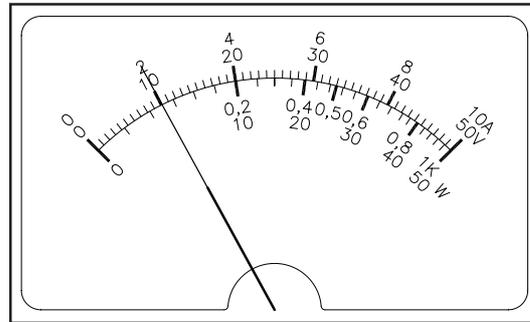


Figure 5.1

Rotating Selector Position	Full Scale Value	Visualization Line
I	10 A	1
V	50 V	2
FWD	1 KW	3
REF	50 W	4

Check on the analog instrument using the rotating selector if the internal supply voltage (parameter “V1”, “V2”) is 50V. Check that the standby current (“I1”, “I2”) is approx 200 mA. These values confirm that the power supplies are operating and that the quiescent setting of the RF power modules are all right.

Swit ON the exciter (set for minimum power) and wait for it to lock on the working frequency. When the PLL locked, progressively increase the exciter’s ouput power, while checking on the amplifier’s instrument its emitted power (FWD). Along with the increase in the emitted power, one can notice a proportional increase in the drawn current (“I1”, “I2”). Keep increasing the exciter output power until the amplifier reaches the desired level, that is at most 500 W. At this point, the normal working values for the PJ501M are:

- V1, V2 \cong 50 V
- I1, I2 \cong 7,5 ÷ 8,2 A

With an external wattmeter, it is possible to verify the precision of the built-in wattmeter using an external measurement instrument like a through wattmeter. A tolerance of 10% is tolerated.

To check the functionality of the “alarms reset” button, push it while the amplifier is transmitting.



ATTENTION: While the button is pushed, the power output of the amplifier is cut.

With the button pushed, verify that “FWD”, “V1”, “V2”, “I1” and “I2” are reduced to 0. If the connection of the interlock has been correctly, the exciter power is also cut while the button is pressed.

Releasing the button, all the parameters will return to their former value.

To test the amplifier protection system you can increase the drive level until the red overdrive LED “overdrive” lights up. The protection system is triggered by this condition, and the amplifier is disabled for about 10 seconds. The exciter is also disabled via the interlock connector. After the delay, the amplifier and the exciter will be enabled again.

The device doesn't require any human supervision for its normal operation. If any alarm condition arise, these are automatically managed by the embedded protection system; if the protection system doesn't succeed in re-establishing the normal conditions, it will be necessary to remove the causes of the malfunctioning and to manually reset the system (using the button “alarms reset”, or via the telemetry connector).

5.3 Protection System

Basically, the protection system of the amplifier forces it in standby mode in case a situation that is considered “dangerous” for the machine takes place.

After approx 10 seconds, the amplifier will be reenabled. If in the meantime the blocking condition has not been removed, the amplifier will be disabled again. After four attempts the device will be disabled for approx 90 seconds.

After this longer interval is expired, the amplifier starts a new cycle of disabling/reenabling, analogous to the previous one. If at the end of this cycle the fault condition is still present, the amplifier will be definitely disabled. As already said, at this point it will be necessary to manually reset the amplifier using the button “alarms reset”, or via the telemetry connector.

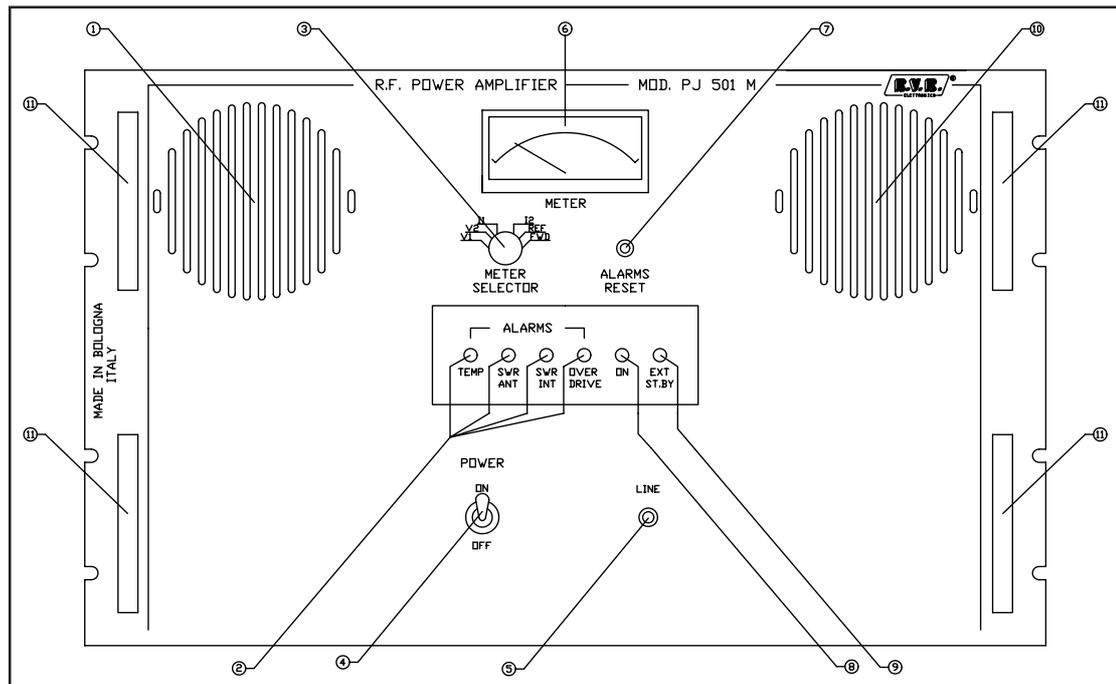
If, during the cycles of the protection, the amplifier works regularly for 90 seconds, the counters of the protection system are reset.

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6. External Description

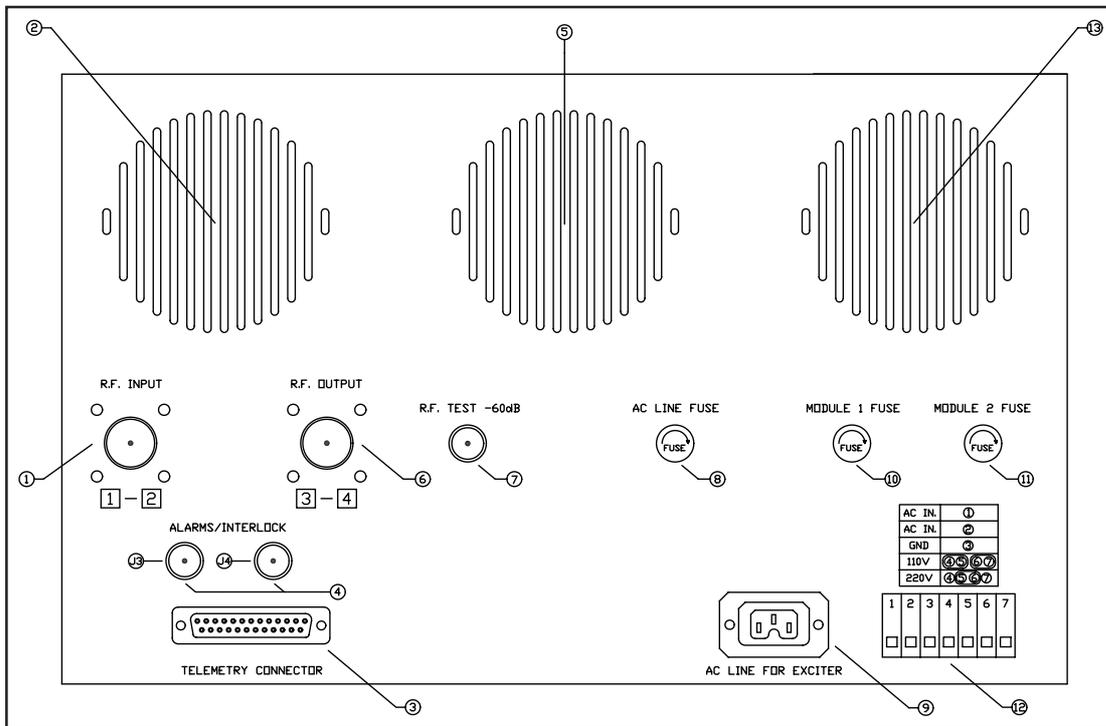
This chapter described the front and rear panel of PJ501M, with a brief indication of all the different components.

6.1 Front Panel



- | | |
|--------------------|--|
| [1] Fan | Cooling for R.F. Module 1 and Power Supply 1 |
| [2] Alarms | Leds indicating the PJ501-M's alarms status |
| [3] Meter Selector | Selector to monitor operating parameters: |
| | V1 R.F. Module 1's voltage |
| | V2 R.F. Module 2's voltage |
| | I1 R.F. Module 1's current |
| | I2 R.F. Module 2's current |
| | REF Reflected power |
| | FWD Forward power |
| [4] On / Off | On/Off power switch |
| [5] Line | A.C. line indicator |
| [6] Meter | Analog meter used to monitor the operating parameters of the amplifier |
| [7] Alarms Reset | Press the button to reset the alarm status |
| [8] On | A.C. On power indicator |
| [9] Ext. St. By | Led indicating an external stand-by |
| [10] Fan | Cooling for R.F. Module 2 and Power Supply 2 |
| [11] Handle | Handles |

6.2 Rear Panel

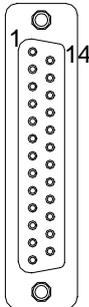


- | | |
|---------------------------|---|
| [1] R.F. Input | Input RF connector ("N" type) |
| [2] Fan | Forced ventilation |
| [3] Telemetry Connector | Connectors for remote measurement of operating parameters |
| [4] Alarms/Interlock | BNC connector which permits the exciter to be put in stand-by, by grounding the central contact, in case of amplifier |
| [5] Fan | Forced ventilation |
| [6] R.F. Output | Output RF connector (tipo "N") |
| [7] R.F. Test -60 dB | -60dB with respect to the output level |
| [8] AC Line Fuse | AC Line Protection Fuse |
| [9] A.C. Line for Exciter | A.C. Power Line for exciter |
| [10] RF Module Fuse 1 | Protection fuse for R.F. Module 1 |
| [11] RF Module Fuse 2 | Protection fuse for R.F. Module 2 |
| [12] Mains Voltage Socket | Main Voltage & Voltage Changer |
| [13] Fan | Forced ventilation |

6.3 Connectors Description

6.3.1 Telemetry Connector

Tipo: DB25 Female



1	R.F. Module 1's Voltage	2.0V X 50V
2	R.F. Module 1's Current	2.0V X 10A
3	GND	0V
4	Reflected power	1.4V X 40W
5	Inhibitor TX	12V
6	Internal SWR	15V -> fault
7	GND	0V
8	ON command	Input, pulse to ground
9	Internally connected	
10	Internally connected	
11	Internally connected	
12	Internally connected	
13	Internally connected	
14	R.F. Module 2's Voltage	2.0V X 50V
15	R.F. Module 2's Current	2.0V X 10A
16	Forward power	1.6V X 500W
17	Temperature	15V -> fault
18	SWR antenna	15V -> fault
19	Over drive	15V -> fault
20	Stand-by command	Input, pulse to ground
21	GND	0V
22	Internally connected	
23	Internally connected	
24	Internally connected	
25	Internally connected	

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7. Technical Specifications

7.1 Dimensional and Environmental Specifications

Cabinet Dimensions	265.0 mm (10,43") x 454.0 mm (17,87") x 507.0 mm (19,98")
Panel dimensions	483 mm (19") x 266,0 mm (10,47")
Weight	37 Kg
Operating temperature range	-10 °C ÷ 50 °C
Umidity	95% Maximum, without condensation

7.2 Electrical Specifications

A.C. power supply	100-130 V, 50-60 Hz 198-250 V, 50-60 Hz
Cooling	Forced ventilation
Frequency range	87.5 MHz ÷ 108 MHz
Output power	500 W
Drive power	Approx 15 W for Pout = 500 W
Input connector	"N" type standard connector
Input impedance	50 Ohm
Output connector	"N" type standard connector
Output impedance	50 Ohm
Harmonic and spurious soppression	Respect or exceed all requirments FCC and CCIR

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8. Theory of Operation

The figure 8.1 shows the block diagrams of PJ501M. The blocks are described in the following chapter:

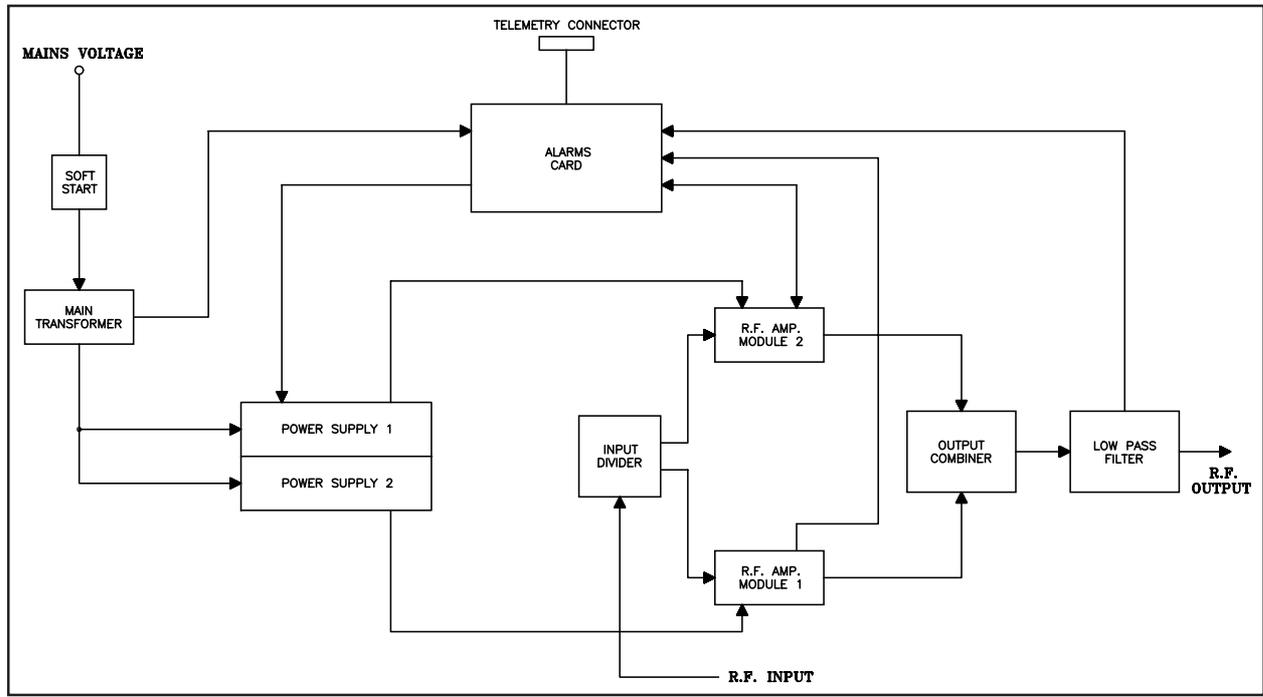


Figure 8.1

8.1 Power Supply

The PJ501M contains one main transformer with a selectable input for voltages between 110 and 240 Volt and three outputs: A) 30-0-30 V, B) 30-0-30 V and C) 18-0-18 V.

The A and B outputs drive the two switching power supply units that generate the 50 Volt needed by the RF modules and the output C supplies the soft-start circuit and alarms card.

Inside the alarms card a rectifying and stabilization circuit provides the $\pm 15V$ needed by the electronics.

The 50 Volt switcher regulate the RF output power using a voltage detected by a directional coupler mounted inside the low pass filter box.

8.2 Soft Start

The soft start board is able to eliminate the current spikes generated by the transformer when it is powered.

8.3 R.F. Power Amplifier

The RF Power Amplifier section is composed of two power modules completely shielded and it is mounted on a heat sink that allows its cooling through forced ventilation.

Each module is supplied separately, and delivers 300 W of RF power with 5 - 7,5 W of drive.

The quiescent parameters of the module are:

$V_{dc} = 50V$, $V_{gs} = 3.5 V$, $I_{dq} = 200 mA$

The active device employed is a MOSFET (BLF278).

8.4 Low Pass Filter

The filter pulls down the level of the spurious emissions under the levels allowed from the international norms, so that the amplifier can be connected directly to the transmission antenna.

Thanks to this low pass filter we have a harmonic suppression of more than 75 dB.

8.5 Wilkinson "2 way" Splitter and Combiner

This module is a totally passive device that splits the input power in two parts and drives the RF modules.

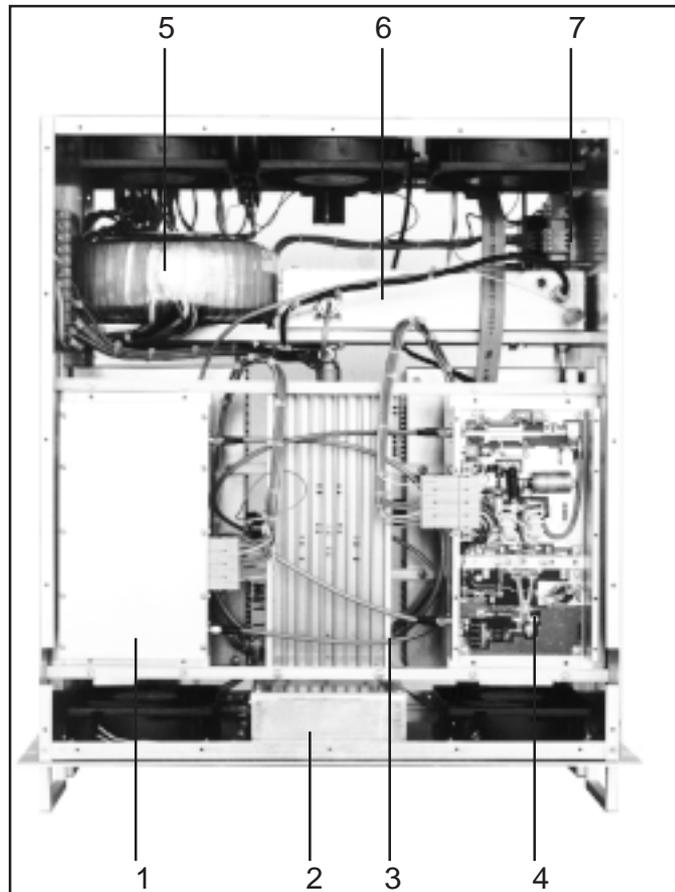
In the same way it combines the outputs of the RF modules and sends the power to the low pass filter.

8.6 Alarms Card

This card detect any system anomaly such as excessive SWR, internal or antenna, overtemperature, etc... . This module will also, whenever possible, reset the system to its original condition, after a fault has accused.

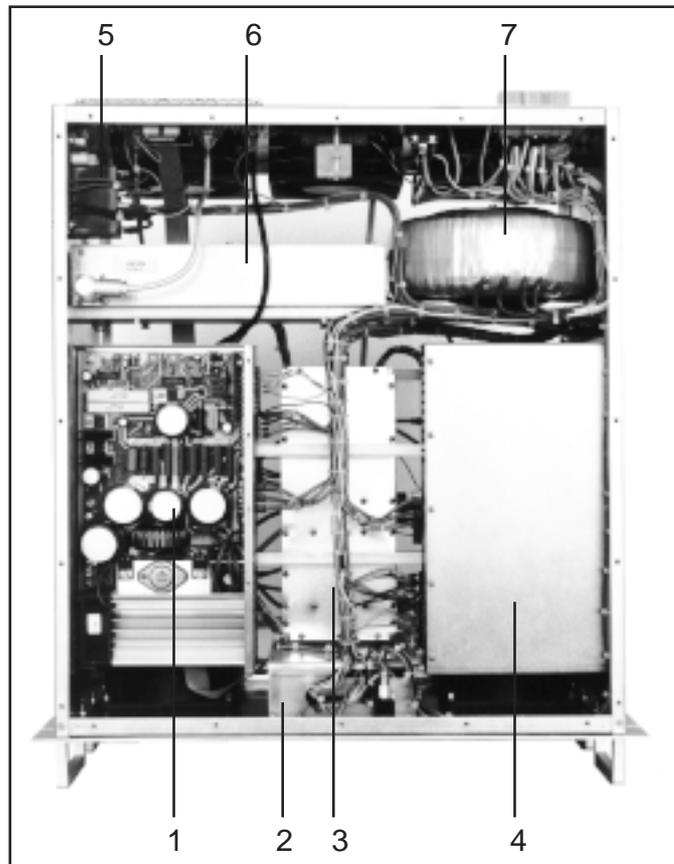
9. Identification and Access to Modules

9.1 Modules Identification (top view)



- [1] RF power module 1
- [2] Alarms card
- [3] Wilkinson "2 way" splitter and combiner
- [4] RF power module 2
- [5] Transformer
- [6] Low pass filter
- [7] Soft start

9.2 Modules Identification (bottom view)



- [1] Power supply 2 (PSSW5010)
- [2] Alarms card
- [3] Wilkinson "2 way" splitter and combiner
- [4] Power supply (PSSW5010)
- [5] Soft start
- [6] Low pass filter
- [7] Transformer

9.3 Removal of the Modules



ATTENTION: When the amplifier is operated with the cover removed, hazardous voltages and heavy current are accessible. Ensure all primary power is disconnected from the amplifier before attempting equipment maintenance.

To reinstall the card is enough to execute operations sequence in the opposite way.

Remove all the screws that are located on the top and bottom covers of the machine. After that the covers have been removed, extract, with the help of the chapters 9.1 and 9.2, all the amplifier's modules.

These operations must be doing from highly specialistic technicians and equipped of the necessary equipments. Wrong operations can cause a serious damagement of the machine and make to decay the guarantee automatically.

FIRST LEVEL MAINTENANCE

9.4 Ordinary Maintenance

The only regular maintenance needed by PJ501M, is the periodic substitution of the blowers, and the cleaning of dust filters and any dust accumulated inside the amplifier.

The time between overhauling of the blowers depends upon several environmental factors, temperature, humidity, dust pollution etc. It's advisable to check the unit every 6 months, and to substitute noisy blowers.

Blowers should be changed as a matter of course at least every 18 months.

SECOND LEVEL MAINTENANCE

9.4.1 Power Supply Replacement

- With the help of the wiring diagram shown in appendix, take the note of the cable position inside the terminal boards J1, J2 and J3.
- Disconnect the external terminal boards loosening just the screws of the connectors mounted on the board.
- Loosen the two screws 1 (Fig. 9.1) and remove the two screws 2 (Fig. 9.1) situated on the right and left side of the amplifier.

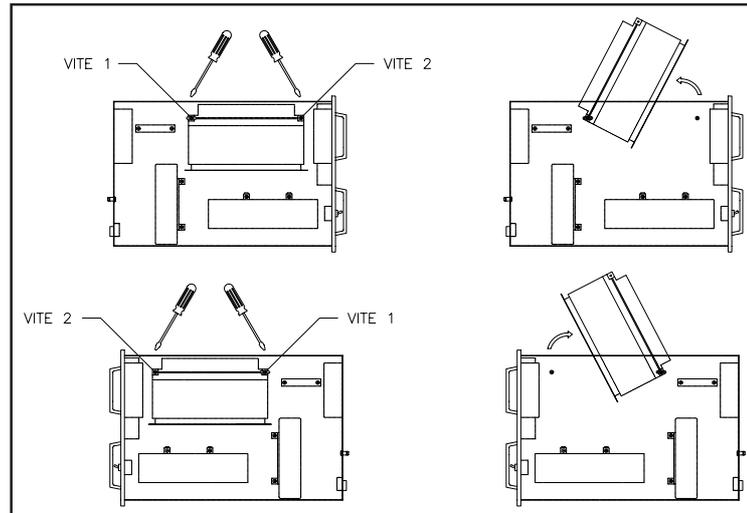


Figure 9.1

- Lift the internal part of the amplifier and put it on one side.
- Remove the power supply unscrewing the four screws that secure it to the supports, paying attention to the weight of the power supply itself.

9.4.2 R.F. Power Amplifier Module Replacement

- Loosen the two screws 1 (Fig. 9.1) and remove the two screws 2 (Fig. 9.1) situated on the right and left side of the amplifier.
- Lift the internal part of the amplifier and put it on one side.
- With the help of the wiring diagram shown in appendix, take the note of the cable position.
- Disconnect CN1, J1 and J2 R.F. module's connectors.
- Remove the screws securing the module to the rails.
- Carefully remove the card.

9.4.3 Soft Start Card Replacement

- With the help of the wiring diagram shown in Appendix, take the note of the cable position.
- Disconnect M1 and M2 connectors.
- Disconnect M3.
- Dismount the four securing screws and remove the board.

9.4.4 Alarms Card Replacement

- Loosen the two screws 1 (Fig. 9.1) and remove the two screws 2 (Fig. 9.1) situated on the right and left side of the amplifier.
- Lift the internal part of the amplifier and put it on one side.

- Remove the screws of the shielded cover and remove it.
- Remove the knob of the meter selector loosening the screw inside the knob.
- Dismount the screws of the meter selector switch and alarms reset push-button.
- Disconnect CN1 and CN3 alarms card's connectors.
- Disconnect CN2 telemetry card's connector.
- Remove the screws securing the board to the front panel.
- Carefully extract the card.

9.4.5 Wilkinson "2 way" Splitter and Combiner Replacement

- Loosen the two screws 1 (Fig. 9.1) and remove the two screws 2 (Fig. 9.1) situated on the right and left side of the amplifier.
- Lift the internal part of the amplifier and put it on one side.
- Disconnect J1, J3, J4, J5 and J6 Wilkinson splitter and combiner's connectors.
- Remove the screws of J2 connector (R.F. Input) on the rear panel.
- Remove the four long screws that fix the heat sink to the rails.
- Carefully remove the card.

9.4.6 Low Pass Filter Replacement

- Loosen the two screws 1 (Fig. 9.1) and remove the two screws 2 (Fig. 9.1) situated on the right and left side of the amplifier.
- Lift the internal part of the amplifier and put it on one side.
- With the help of the wiring diagram shown in appendix, take the note of the cable position.
- Disconnect J1, J2, J3, J4 and J5 low pass filter's connectors.
- Disconnect the low pass filter's connector.
- Remove the four screws that fix the filter to the rails.
- Place the amplifier on one side.
- Extract the low pass filter by moving it sideways.

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10. Internal Adjustment

10.1 Power Supply Adjustment (PSSW5010)

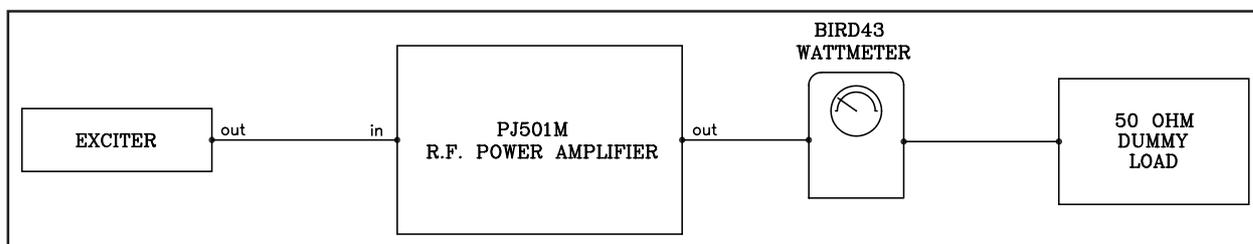
The power supply module is a factory adjusted device, and doesn't need normally any adjustment. If it has been necessary to substitute or repair the module, it is useful to do the following tests and adjustments:

- Disconnect CN1 from the appropriate RF power module.
- Connect a suitable dummy load (500W on 50 Ohm) to the amplifier output and switch the amplifier on.
- Verify that the output voltage of the power supply is 50V using a digital multimeter connected to pins 1-2 and 3-4 of connector JP3 and, if necessary, adjust the value through the trimmer R15 of the power supply.
- Verify that test point TP2 is present a voltage of 5.0V; if this value is different, adjust R59 to obtain the correct voltage.
- Switch off the amplifier and reconnect the power supply to the RF module.

10.2 R.F. Power Amplifier Module Adjustment

After you have changed the module perform the following operations:

- Connect CN1 (coming from power supply) to the RF module.
- Connect the input connectors J1 and J2 to the wilkinson "2 way" combiner.



- See setup shown in figure, that comprises a dummy load (500W at 50 Ohm) with a wattmeter in series, to verify the deliver power of the amplifier.
- Connect to the RF input connector an exciter able to deliver a variable power of 20 W max.
- Connect the alarms/interlock connector to the appropriate connector on the exciter.
- Set the output power of the exciter to its minimum value.
- Switch on the PJ501M, keeping off the exciter (switched off or in stand-by mode) and measure the quiescent current of the module. At working temperature, an RF module has to drain approx 200 mA. If the current is different from this value, use trimmer R20 on the module to compensate the difference.

At this point, it is possible verify how the module works at nominal power:

- Enable the power output from the exciter (switching it on and waiting for the PLL to lock, or exiting from the stand-by mode).
- Gradually rise the power of the exciter and monitor the power output of the amplifier, until it reaches its nominal value of 500W.

A correctly adjusted amplifier has :

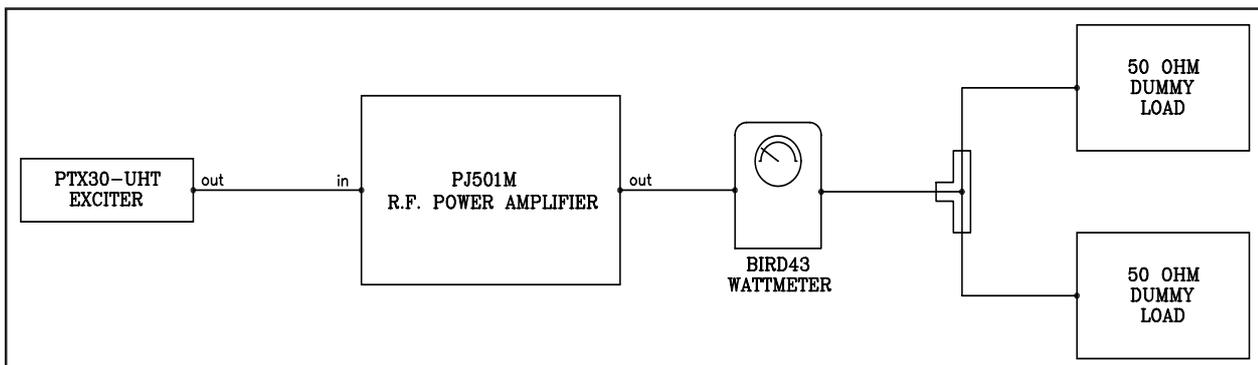
Pot= 500W, 10W < Pin < 18W and 7.5A < Ipa < 8.4A

Some differences in the current drawn are related to the different gains of the MOS-FET devices (BLF 278) and must be compensated with the trimmer R20 placed in each power amplifier board. The trimmer to be adjusted will be the one related to the RF module that has a higher current consumption. This one must be adjusted turning it counter-clockwise to obtain the same current consumption in each RF module. Differences of less than 500mA between the two modules are acceptable.

10.3 Alarms Card Adjustment

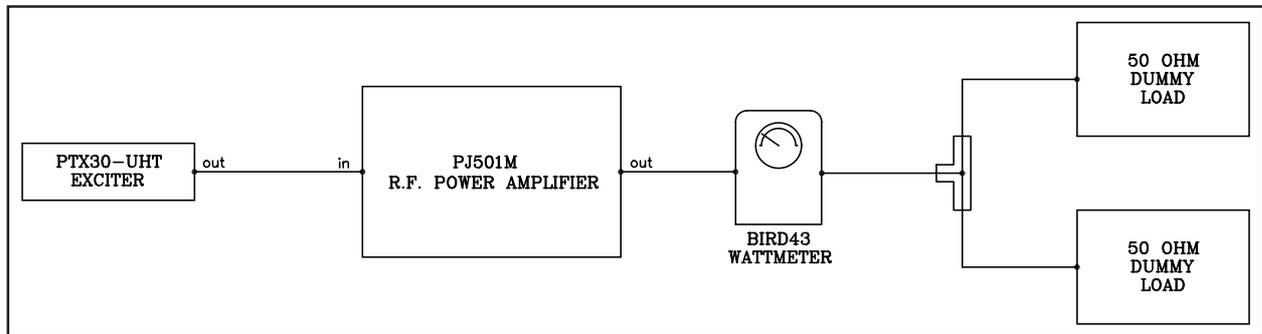
NOTE: Make sure that this replacement is really necessary.

- After changing the board, connect the amplifier as shown in the figure.



- Switch on the PJ501M.
- Place the meter selector on “V1” or “V2”.
- Adjust trimmer R14 to obtain a reading of 50V (of course, the output voltage of the power supply has to be really 50V).
- Switch on the exciter and wait for the PLL lock.
- Increase the output power to a level of 500W.
- Adjust the FWD reading with trimmer R11.
- Now increase again the drive until “V1” and “V2” decrease and you obtain a lock condition of the amplifier due to the overdrive protection; this protection is adjustable by means of trimmer R26 on the alarms card. This protection must come on when “V1” and “V2” voltages are about 48Vdc.

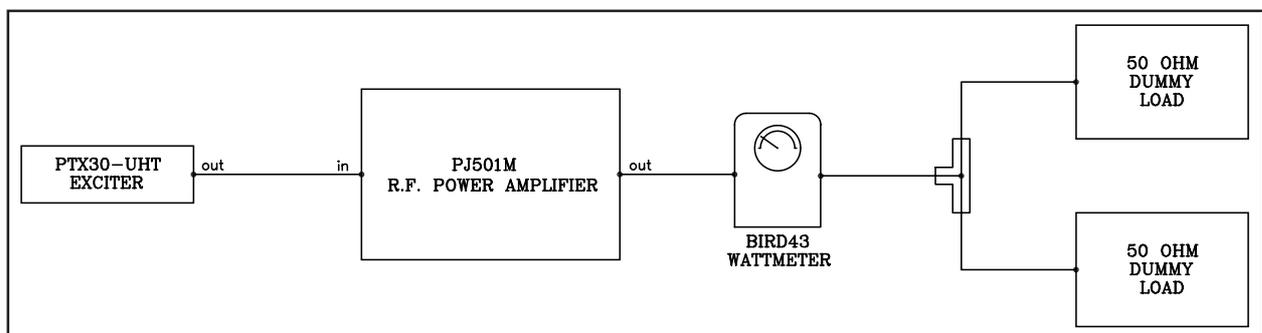
- Antenna S.W.R. calibration (S.W.R. ANT.)
- Reduce the drive power to the minimum value, switch off the amplifier and the exciter.



- Connect two paralleled dummy loads to the RF output connector of the amplifier as in shown in figure.
- Switch on the amplifier and the exciter and wait for the PLL to lock.
- Select " REF " with the meter selector, and set the external wattmeter for reflected power reading.
- Increase the output power to obtain a reading of 30W of reflected power on the external wattmeter. Now adjust the trimmer R13 on the alarms card to obtain the same reading on the PJ501M meter.
- Increase again the output power, until you read 45W of reflected power, adjust the trimmer R56 on the alarms card (remove the metallic shield that covers the alarms card) until SWR ANT. protection acts.

NOTE: This setting may vary with the working frequency, it is preferable to make this adjustment at the operating frequency.

- Internal S.W.R. calibration (S.W.R. INT.)
- Reduce the drive power to the minimum value, switch off the amplifier and the exciter.



- Connect two paralleled dummy loads to the RF output connector of the amplifier as in shown in figure.
- Switch on the amplifier and the exciter and the exciter and wait for the PLL to lock.

- Select “REF” with the meter selector, and set the external wattmeter for reflected power reading.
- Increase the output power to obtain a reading of 30W of reflected power on the external wattmeter. Now adjust the trimpot R13 on the alarms card to obtain the same reading on the PJ501M meter.
- Increase again the power, until you read 40W of reflected power, adjust the trimmer R40 on the alarms card (remove the metallic shield that covers that alarms card) until SWR INT. protection acts.
- Using a voltmeter, measure the voltage value on the central pin of R40 or on the pin 2 of the integrated circuit U2A or on the pin 13 of the integrated circuit U1D. Multiply this value by 1.4 and adjust R40 to obtain this new value.

NOTE: This setting may vary with the working frequency, it is preferable to make this adjustment at the operating frequency.

- Overtemperature alarm check (temp.)
- Check the overtemperature protection by short circuiting the terminals of the temperature sensor placed on the RF power amplifier module; the appropriate led will light, and the amplifier will stop.
- External stand-by check (EXT. ST. BY)
- Check the EXT. ST. BY protection by short circuiting the pin 8 and 22 of the telemetry connector and verify that the EXT. ST. BY led lights and the amplifier will stop.
- Short circuiting the pin 21 and 22 of the telemetry connector will regularly restart.

NOTE: The operation performed in the last two steps will reset all the alarm memories returning the amplifier to the conditions of the first power on.

10.4 Soft-Start Adjustment

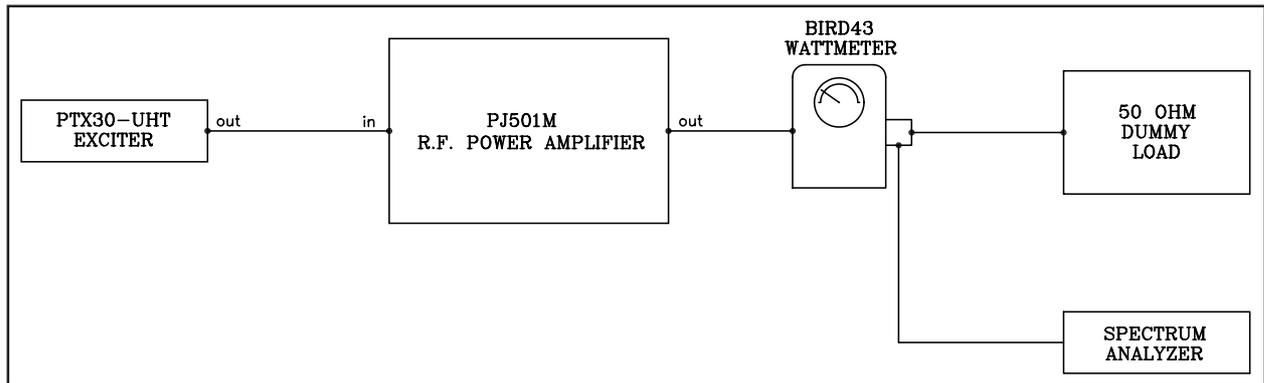
No adjustment are needed after this board has been changed.

NOTE: Pay attention to the correct insertion of the connectors.

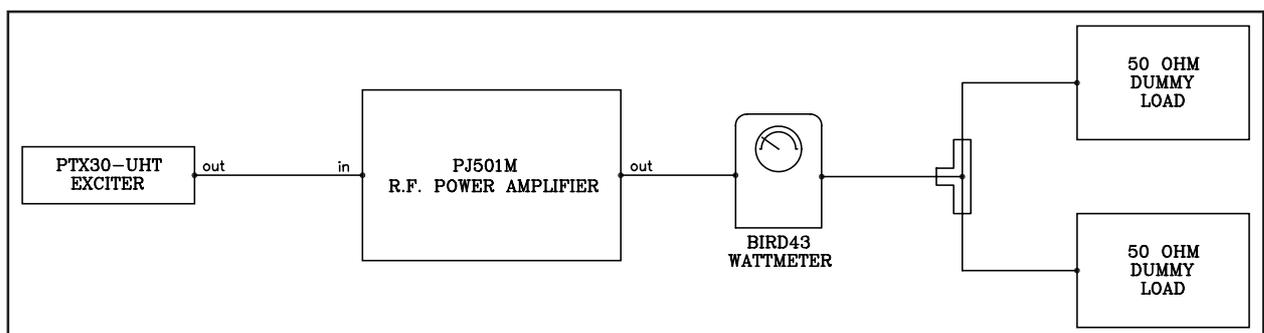
10.5 Low Pass Filter adjustment

No adjustment are requested inside the low pass filter module because it is a factory adjusted device. In case of replacement of a unit, perform the following operations:

- Reconnect all the modules and turn the trimmer TR1 of the filter completely clockwise.



- Follow the setup shown in the figure, that comprises a dummy load (500W at 50 Ohm) with a trough wattmeter in series, to verify the power deliver from the amplifier.
- Connect to RF input connector a exciter able to deliver a variable power of 20 W max.
- Connect one of the two connectors alarms/interlock and the appropriate connector to the exciter.
- Switch on the amplifier PJ501M and the exciter and wait for the PLL to lock.
- Slowly increase the drive power to obtain 500W of otuput power.
- Check with a spectrum analyzer connected to a suitable directional coupler that the harmonics level is be -75 dBu.
- Adjust the trimpot TR1 in the low pass filter until you obtain a little slight output power drop in the PJ501M. This power drop tells us that the power limit system is acting.
- Now increase again the drive until “V1” and “V2” decrease and you obtain a lock condition of the amplifier due to the overdrive system; this protection is adjustable by means of trimpot R26 on the alarms card. This protection must come on when “V1” and “V2” voltage is at about 48 Vdc.
- Verify that for an output power of 500W the readings on the internal wattmeter (the reading is possible trough the analogic meter placed on the front panel) and the external wattmeter coincide, if not adjust R11 on the alarms card.
- Antenna S.W.R. calibration (S.W.R. ANT.)
- Reduce the drive power to the minimum value, switch off the amplifier and the exciter.



- Connect two paralleled dummy loads to the RF output connector of the amplifier as in shown in figure.
- Switch on the amplifier and the exciter and wait for the PLL to lock.
- Select “REF” with the meter selector, and set the external wattmeter for reflected power reading.
- Increase the output power to obtain a reading of 30W of reflected power on the external wattmeter. Now adjust the trimpot R13 on the alarms cad to obtain the same reading on the PJ501M meter.
- Increase again the output power, until you read 45W of reflected power, adjust the trimmer R56 on the alarms card (remove the metallic shield that covers the alarms card) until SWR ANT. protection acts.

NOTE: This setting may vary with the working frequency, it is preferable to make this adjustment at the operating frequency.

10.6 Wilkinson "2 way" Splitter and Combiner Adjustment

No adjustment are needed after this board has been changed.

NOTE: Pay attention to the correct insertion of the connectors.

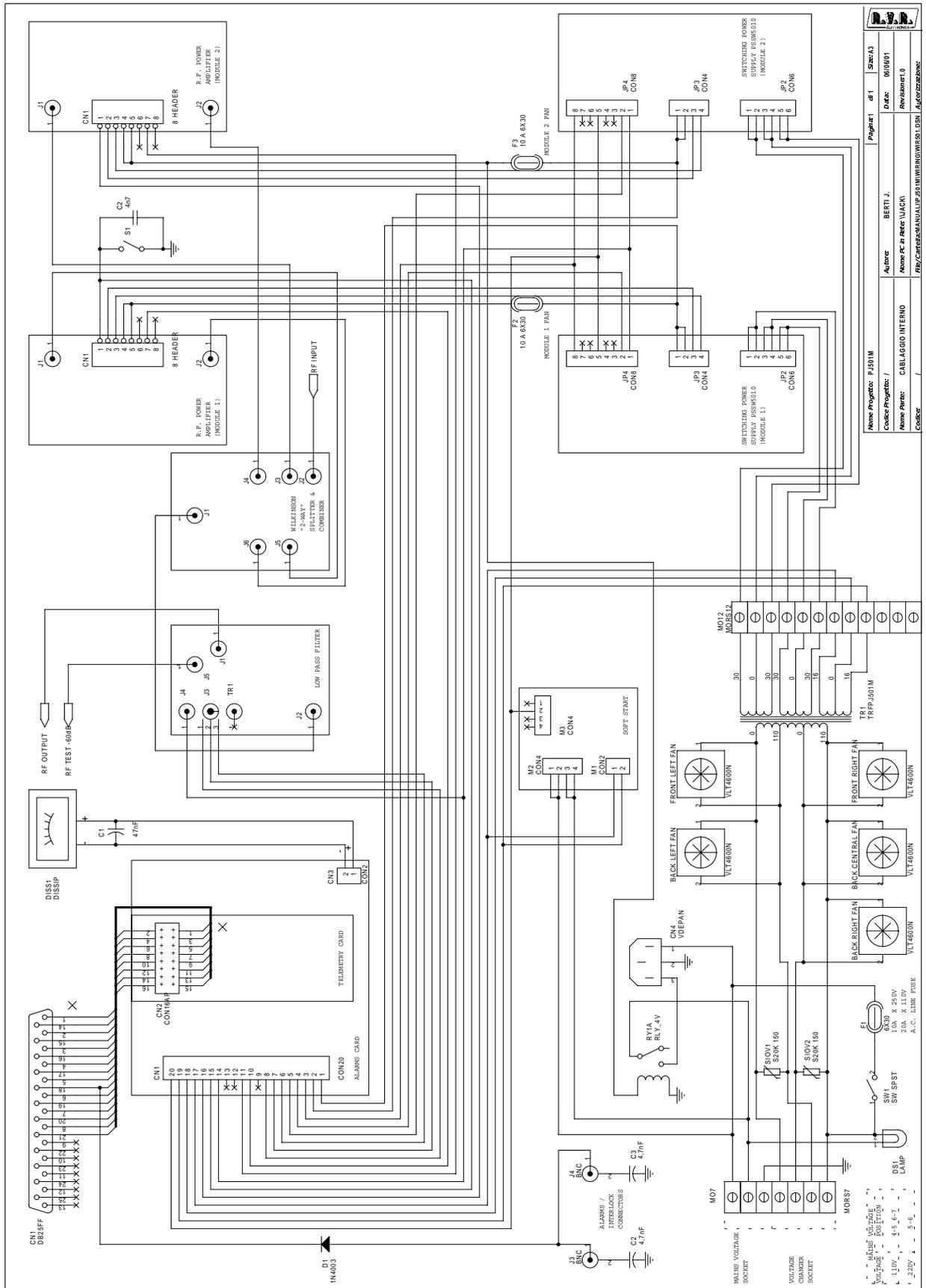
Appendix Piani di montaggio, schemi elettrici, liste componenti / *Component layouts, schematics, bills of material*

Questa parte del manuale contiene i dettagli tecnici riguardanti la costruzione delle singole schede componenti il PJ501M. L'appendice è composta dalle seguenti sezioni:

This part of the manual contains the technical details about the different boards of the PJ501M. This appendix is composed of the following sections:

Description	RVR Code	Vers.	
	Pages		
Wiring diagrams	Wiring diagrams	1.0	2
R.F. Power Amplifier Module	PJ301.3OUT/PJ301.3IN	1.0	4
Alarms Card	CSPROTPJ501	1.0	4
Telemetry Card	CSPROTA2	1.0	4
Directional Coupler Card	SLWSTDPJ501M	1.0	4
Switching Power Supply	PSSW5010	1.0	4
Soft Start Card	CSSOFTS	1.0	4

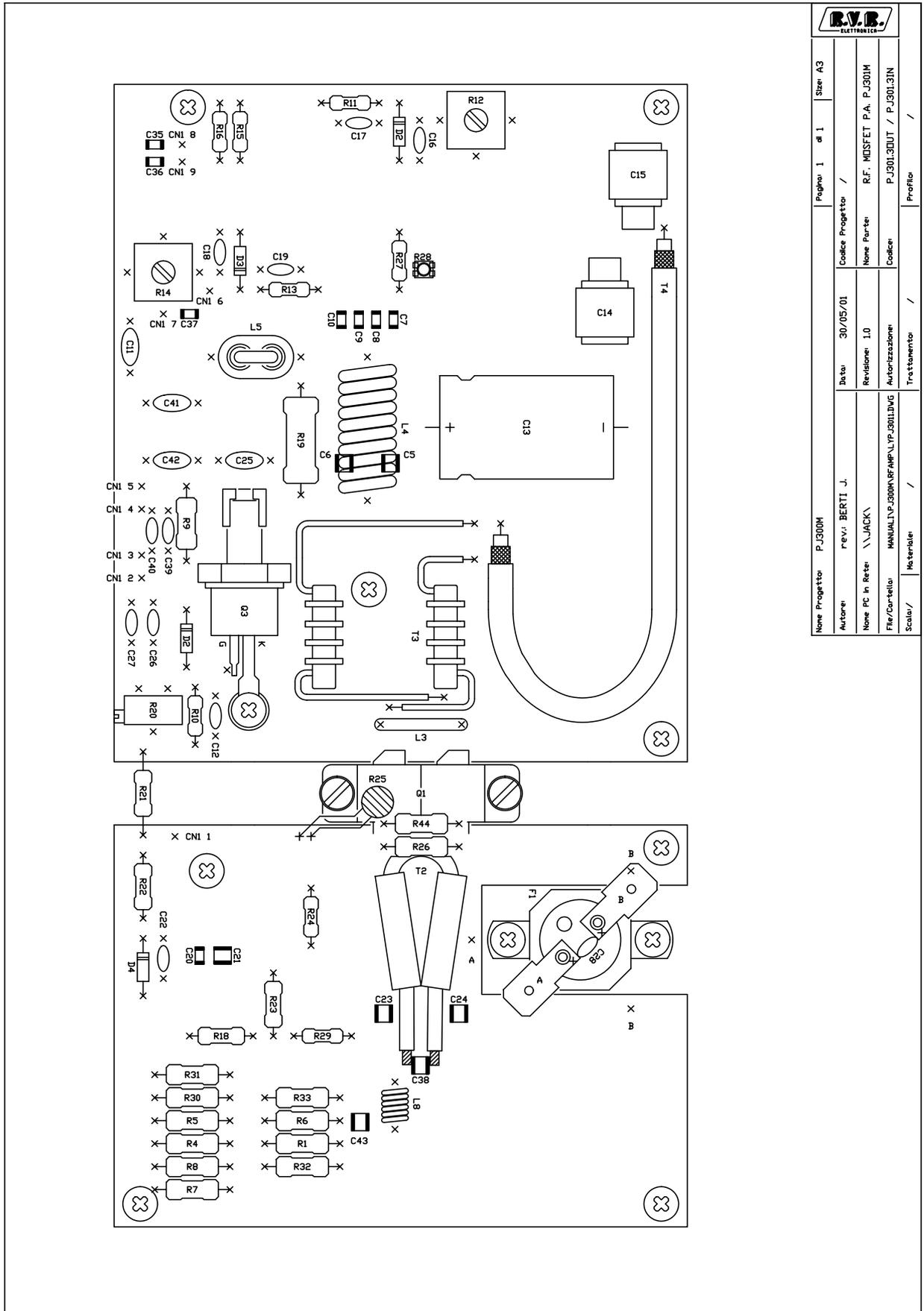
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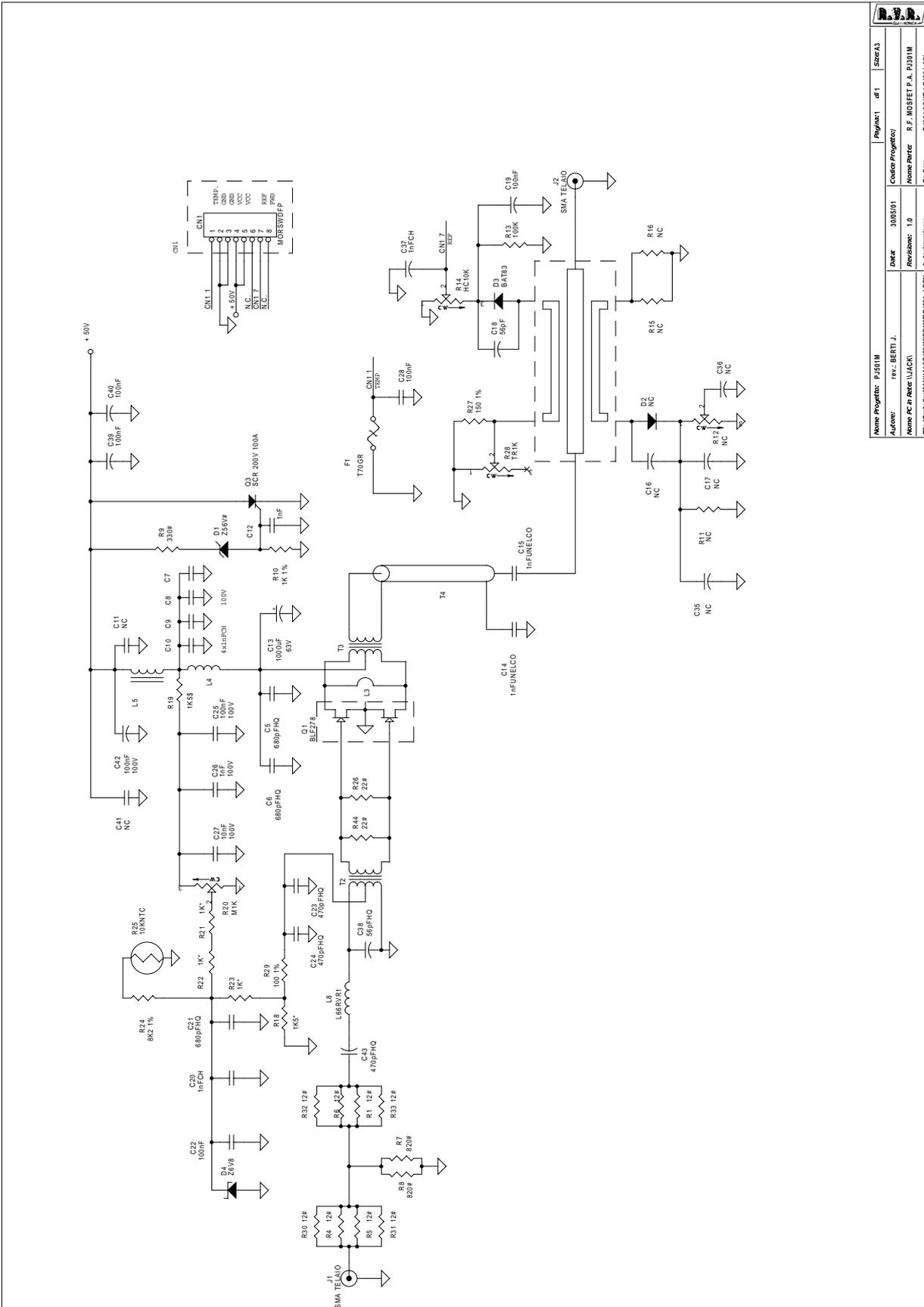
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Nome Parte:	CABLAGGIO INTERNO	Nome PC:	PC IN RETE (UACR)	Revisione:	1.0
Code:		Rev:			

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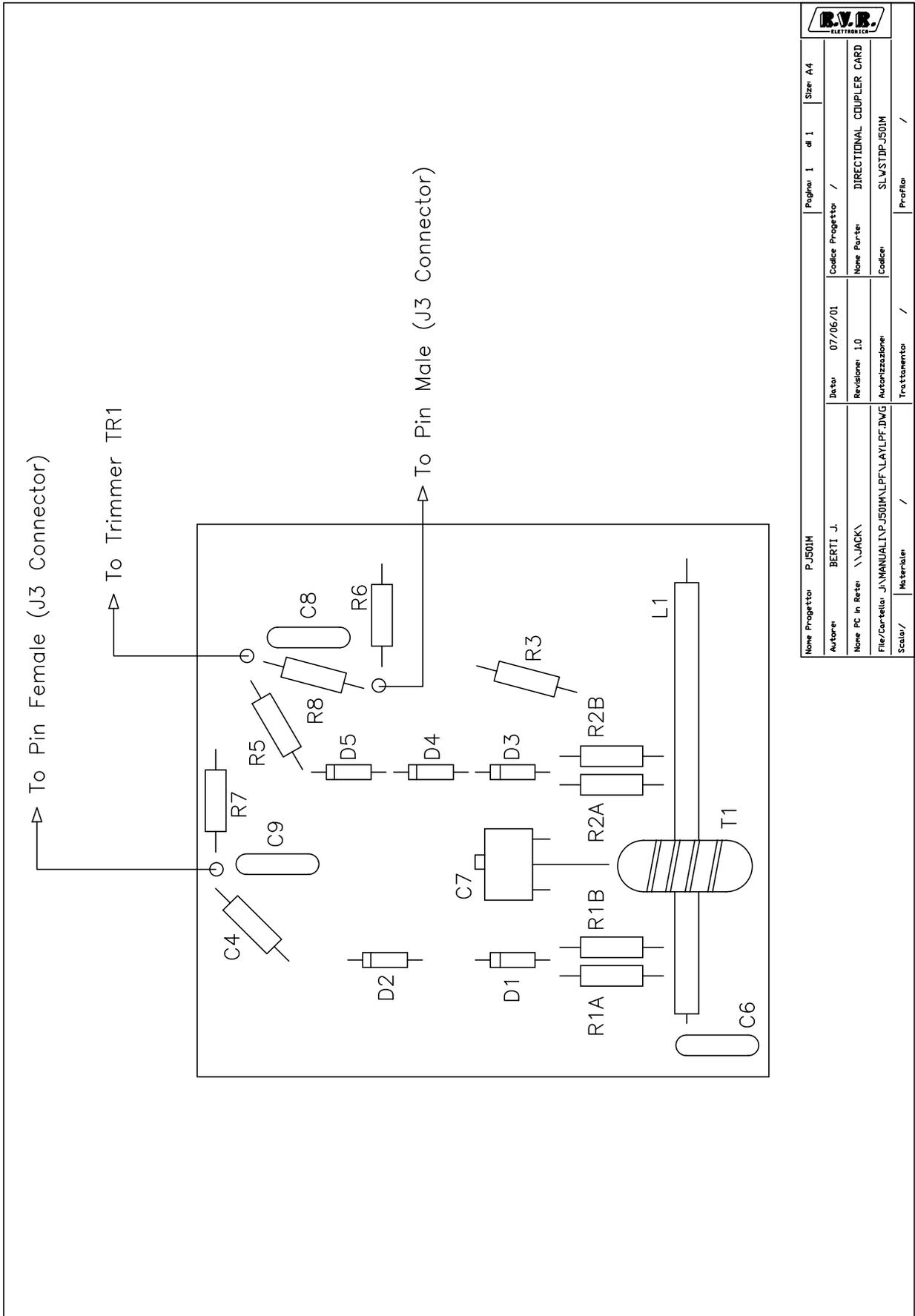
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File/Cartella	MANUALI\PJ500M\AMP\L\PJ501M.DWG		Autore	R.F. MOSFET P.A. PJ500M			
Scala	/		Trattamento	PJ501.3OUT / PJ501.3IN			
Materiali		/		Profilo			



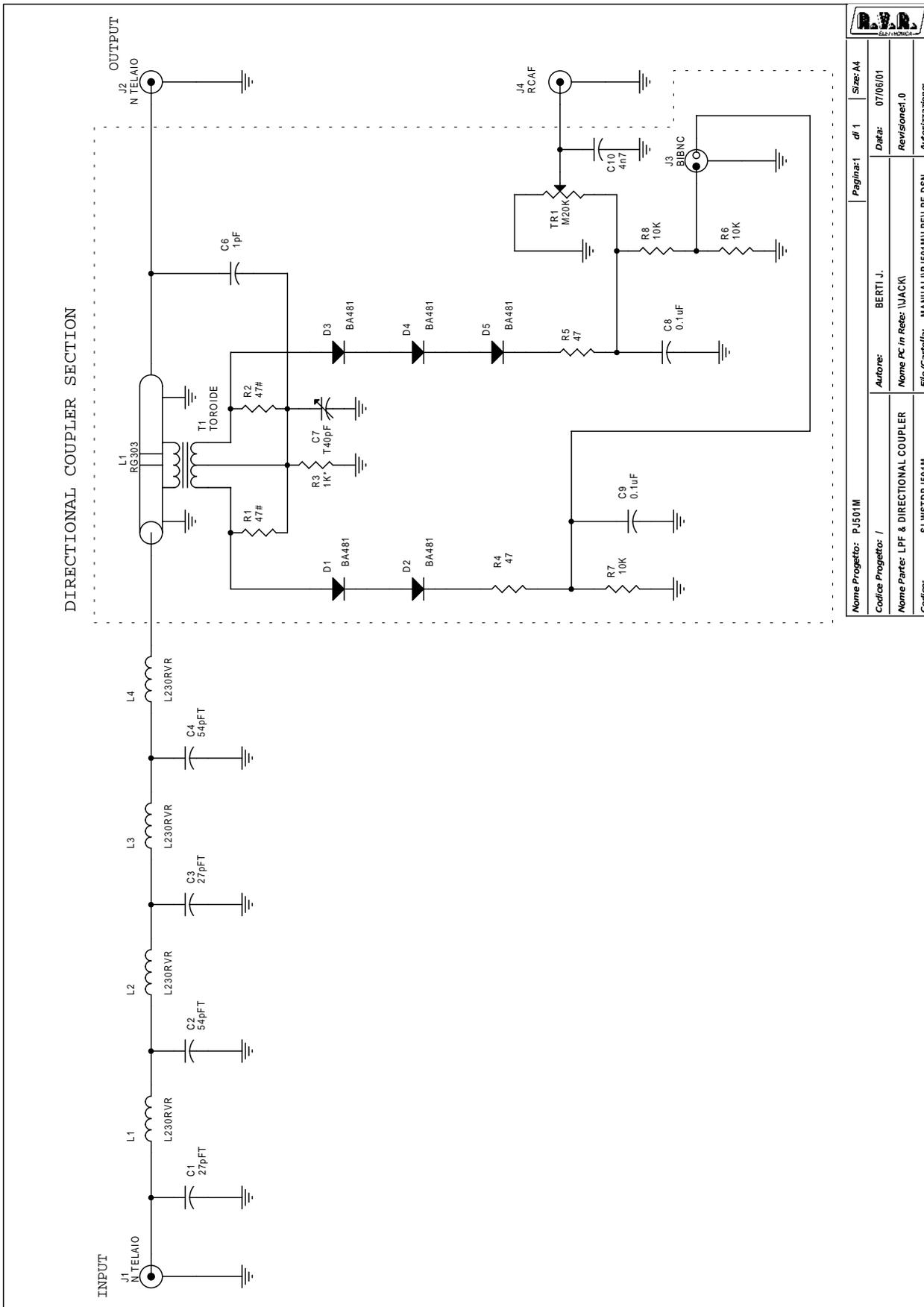
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Autore/Revisione:	1.0
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Autore/Revisione:	1.0
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Autore/Revisione:	1.0

R.F. Pow. Amp. Module			Bill of Materials/Lista Componenti		Pag. 1
Item	Quantity	Reference	Part	Description	Part Order Code
1	8	R1,R4,R5,R6, R30,R31,R32,R33	12#	RESISTOR 2W	
2	2	R26,R44	22#	RESISTOR 2W	
3	1	R29	100 1%	RESISTOR 1/4W 1%	
4	2	R7,R8	820#	RESISTOR 2W 5%	
5	1	R9	330#	RESISTOR 2W	
6	1	R10	1K 1%	RESISTOR 1/4W 1%	
7	3	R21,R22,R23	1K*	RESISTOR 1/2W 5%	
8	1	R18	1K5*	RESISTOR 1/2W 5%	
9	1	R19	1K5\$	RESISTOR 5W 5%	
10	1	R24	8K2 1%	RESISTOR 1/4W 1%	
11	1	R13	100K	RESISTOR 1/4W 5%	
12	1	R25	10KNTC	NTC	
13	1	R14	HC10K	TRIM.REG. ORIZZ. CERMET	
14	1	R20	M1K	TRIMMER MULTIGIRI	
15	1	C18	56pF	CERAMIC CAPACITOR NP0	
16	1	R27	150 1%	RESISTOR 1/4W 1%	
17	1	C38	56pFHQ	HIGHT Q CAPACITOR	
18	3	C5,C6,C21	680pFHQ	HIGHT Q CAPACITOR	
19	2	C12,C26	1nF	CERAMIC CAPACITOR	
20	6	C7,C8,C9, C10,C20,C37	1nFCH	CERAMIC CHIP CAPACITOR	
21	2	C14,C15	1nFUNELCO	SILVER MICA CAPACITOR	
22	1	C27	10nF	CERAMIC CAPACITOR	
23	3	C23,C24,C43	470pFHQ	HIGHT Q CAPACITOR	
24	7	C19,C40, C22,C25, C28,C39,C42	100nF	CERAMIC CAPACITOR	
25	1	C13	1000µF	ELECTROLYTIC CAPACITOR	

26	1	L5	POWER IND. RF BINOC. CHOCKE
27	1	L4	L105RVR2 10 SP DIA 5 F 2mm
28	1	L8	L66RVR1 6 SP DIA 6 F 1MM
29	1	L3	L0510RVR 0.5 SP DIA 10 F 1.5mm
30	1	T2	RFTRANSF. TRASF. RF. OTTONE+CS
31	4	CN1	MORSWDFP MORS. WEID. F DA PANN.
32	1	T3	RG188 COAX CABLE RG188
33	1	T4	RG303 COAX CABLE RG303
34	2	J1,J2	SMA TELAIO CONN. SMA A TELAIO
35	1	F1	T70GR DISG. TERMICO 70 GRADI
36	1	D3	BAT83 HOT CARRIER DIODE
37	1	Q3	SCR200V100A SCR DIODE 200V 100A
38	1	D4	Z6V8 ZENER DIODE 6.8V 0.4W
39	1	D1	Z56V# ZENER DIODE 56V 1W
40	1	Q1	BLF278 DUAL TMOS POWER
41	1	R28	TR1K TRIMMER SMD 1KH
42	11	D2,R11,R12,R15, NC R16,C16,C17,C35, C36,C41,C11	NON CONNESSO



Nome Progetto: PJ501M		Pagina: 1 di 1		Size: A4	
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Nome PC in Rete:	\\JACK\	Revisione:	1.0	Nome Parte:	DIRECTIONAL COUPLER CARD
File/Cartella:	J:\MANUALI\PJ501M\LP\LAY\PF.DWG	Autore/Revisione:		Codice:	SLWSTDPJ501M
Scala:	/	Trattamento:	/	Profilo:	/



Low Pass Filter &
Directional Coupler

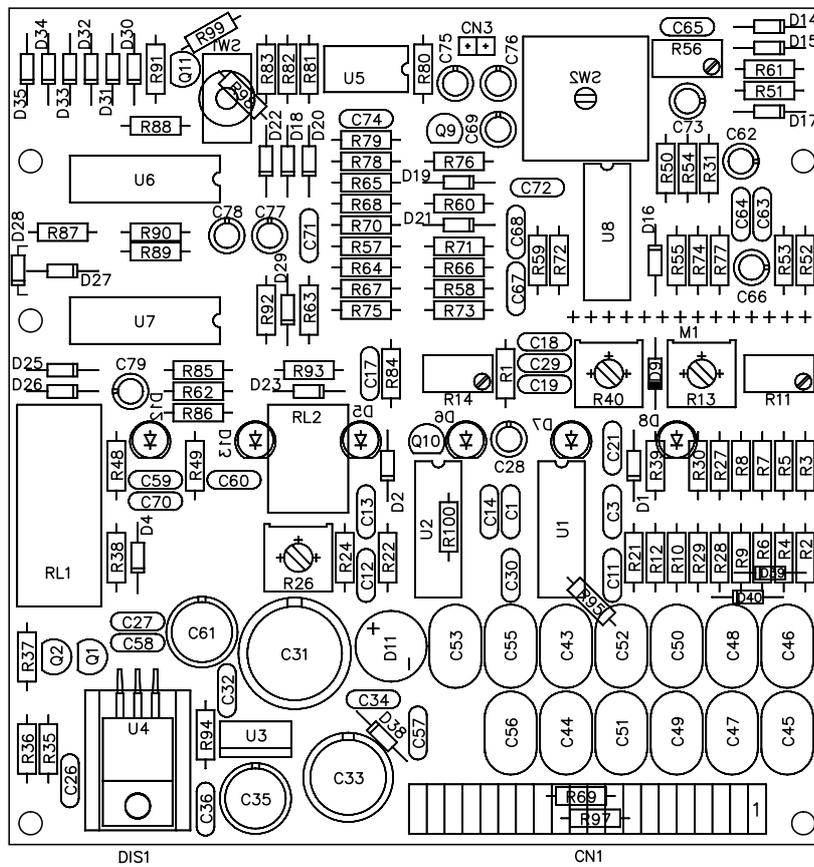
Bill of Materials/Lista Componenti

Pag. 1

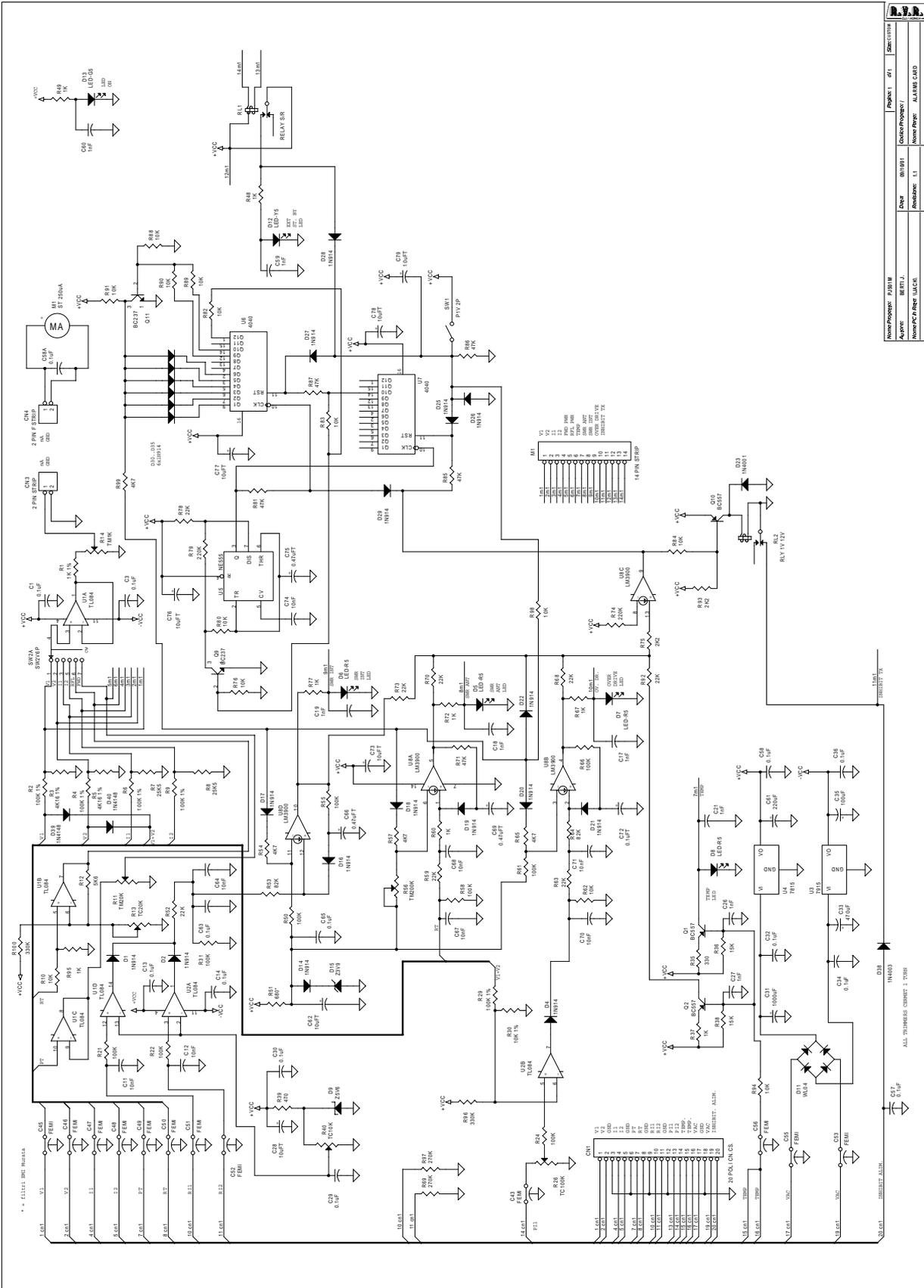
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1	2	R4,R5	47	RESISTOR 1/4W 5%	
2	2	R1,R2	47#	RESISTOR 2W	
3	1	R3	1K*	RESISTOR 1/2W 5%	
4	3	R6,R7,R8	10K	RESISTOR 1/4W 5%	
5	1	TR1	M20K	TRIMMER MULTIGIRI	
6	1	C6	1pF	CERAMIC CAPACITOR NP0	
7	2	C1,C5	27pFT	COND. BAND. RAME TEFLON	
8	2	C2,C4	54pFT	COND. BAND. RAME TEFLON	
9	1	C3	55pFT	COND. BAND. RAME TEFLON	
10	1	C7	T40pF	TRIMMER CAPACITOR	
11	1	C10	4n7	CERAMIC CAPACITOR	
12	2	C8,C9	0.1µF	CERAMIC CAPACITOR	
13	4	L1,L2,L3, L4	L230RVR	2 SP DIA 30 BAND. RAME	
14	1	T1	TOROIDE	TOROIDE DIA. 10 MM	
15	1	L1	RG303	COAX CABLE RG303	
16	1	J3	BIBNC	CONN. BNC F TWINAX	
17	1	J4	RCAF	CONN. RCA DA TELAIO	
18	2	J1,J2	N TELAIO	CONN. N A TELAIO	
19	5	D1,D2,D3, D4,D5	BA481	HOT CARRIER DIODE	

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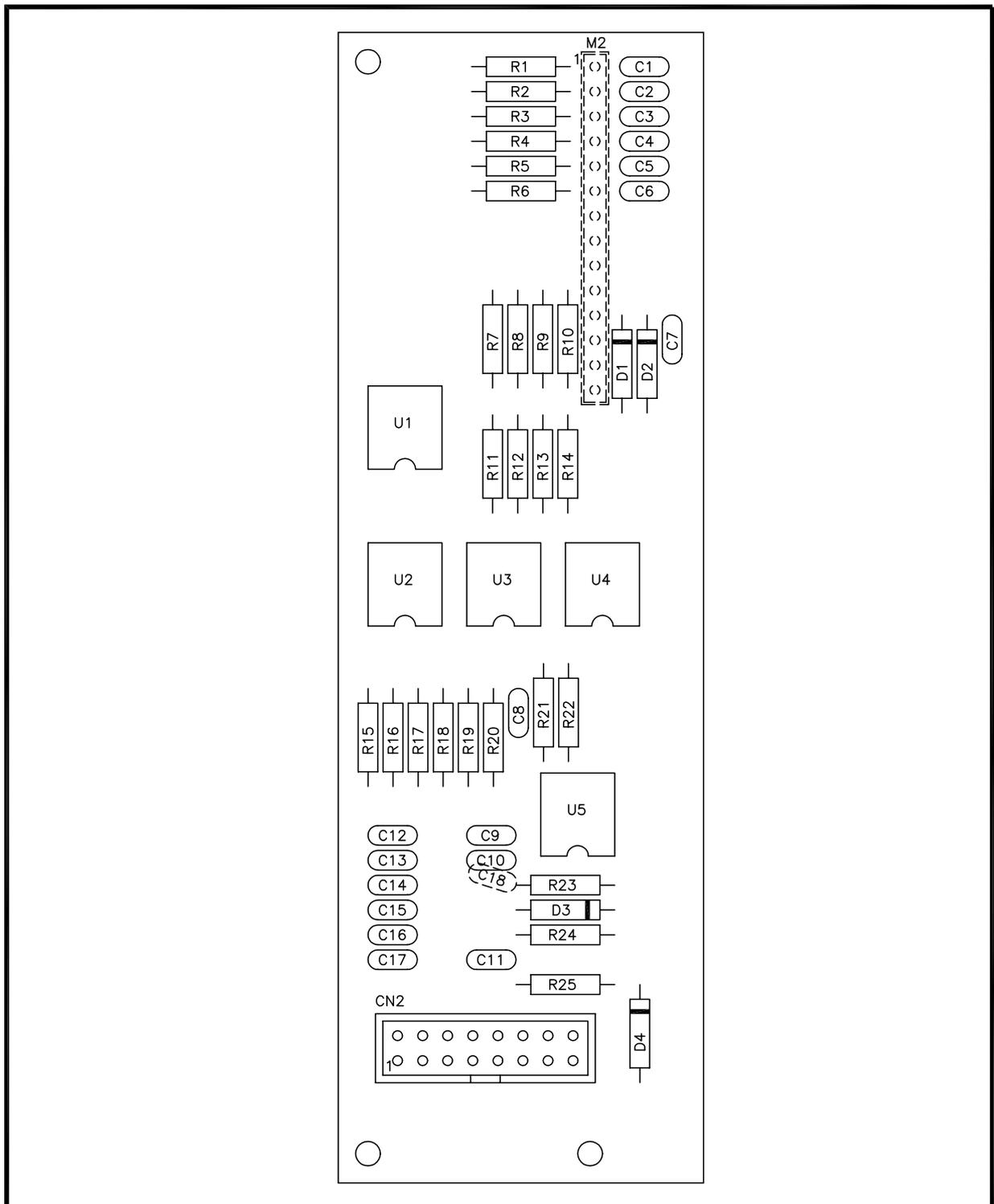
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Scatola: /	Materiale: /	Autorizzazione: /	Codice: CSPROTPJ501
Spazio: /	Metodo: /	Trattamento: /	Profilo: /



Nome Progetto:	PJ501M	Progetto:	01/10/01
Autore:	BEPI J.	Controllo Progetto:	
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File Componenti:	MANUALI/ET/ALARM/ET/PC/ALARM	Approvato:	
		Consente:	CSPROTJ501

Item	Quantity	Reference	Part	DESCRIPTION	PART ORDER CODE
1	1	R35	330	RESISTOR 1/4W 5%	
2	1	R39	470	RESISTOR 1/4W 5%	
3	1	R51	680*	RESISTOR 1/2W 5%	
4	1	R1	1K 1%	RESISTOR 1/4W 1%	
5	8	R37,R48,R49,R60,R67, R72,R77,R95	1K	RESISTOR 1/4W 5%	
6	2	R75,R93	2K2	RESISTOR 1/4W 5%	
7	2	R30,R27	10K 1%	RESISTOR 1/4W 1%	
8	2	R3,R5	4K16 1%	RESISTOR 1/4W 1%	
9	4	R54,R57,R65,R99	4K7	RESISTOR 1/4W 5%	
10	1	R12	5K6	RESISTOR 1/4W 5%	
11	13	R10,R62,R76,R80,R82, R83,R84,R88,R89,R90,R91, R94,R98	10K	RESISTOR 1/4W 5%	
12	2	R36,R38	15K	RESISTOR 1/4W 5%	
13	8	R52,R59,R63,R68,R70, R73,R78,R92	22K	RESISTOR 1/4W 5%	
14	2	R8,R7	TM100K	TRIM.MULT. REG.VERT	
15	5	R71,R81,R85,R86,R87	47K	RESISTOR 1/4W 5%	
16	2	R53,R64	82K	RESISTOR 1/4W 5%	
17	6	R2,R4,R6,R9,R29,R28	100K 1%	RESISTOR 1/4W 1%	
18	9	R21,R22,R24,R31,R50, R55,R58,R61,R66	100K	RESISTOR 1/4W 5%	
19	2	R74,R79	220K	RESISTOR 1/4W 5%	
20	1	R100	330K	RESISTOR 1/4W 5%	
21	1	R14	TC1K	TRIM.MULT. REG.VERT	
22	1	R40	TC10K	TRIM.MULT. REG.ORIZ	
23	1	R13	TC20K	TRIM.MULT. REG.ORIZ	
24	1	R26	TC100K	TRIM.MULT. REG.ORIZ	
25	1	R56	TM220K	TRIM.MULT. REG.VERT	
26	8	C17,C18,C19,C21,C26, C27,C59,C60	1NF	CERAMIC CAPACITOR	
27	8	C11,C12,C64,C67,C68, C70,C71,C74	10NF	CERAMIC CAPACITOR	
28	14	C1,C3,C13,C14,C29, C30,C32,C34,C36,C57,C58A,C58, C63,C65	0.1UF	CERAMIC CAPACITOR	
29	1	C72	0.1UFT	TANTALIUM CAPACITOR	
30	3	C66,C69,C75	0.47UFT	TANTALIUM CAPACITOR	
31	7	C28,C62,C73,C76,10UFT C77,C78,C79		TANTALIUM CAPACITOR	

32	1	C35	100UF	ELECTROLYTIC CAPACITOR
33	1	C61	220UF	ELECTROLYTIC CAPACITOR
34	1	C33	470UF	ELECTROLYTIC CAPACITOR
35	1	C31	1000UF	ELECTROLYTIC CAPACITOR
36	1	M1	ST 250UA	STRUMENTO 250uA
37	1	CN3	2 PIN STRIP	STRIP M P 2.54 2 PIN
38	1	M1	14 PIN STRIP	STRIP M P 2.54 14 PIN
39	1	CN4	2 PIN F STRIP	STRIP F P 2.54 2 PIN
40	1	CN1	20 POLI CN.CS.	CON.STRIP 20P MASC.CS POL.
41	12	C43,C45,C46,C47,FEMI C48,C49,C50,C51, C52,C53,C55,C56		FILTRO EMI MURATA
42	1	RL2	RLY 1V 12V	RELAY 1 VIA 12V
43	1	RL1	RELAY S/R	RELAY SET / RESET 12V
44	1	SW1	P1V 2P	PULSANTE 1 VIA 2 POS
45	1	SW2	SW2V6P	COMMUT. 2 VIE 6 POS FEME
46	2	D39,D40	1N4148	SILICON DIODE
47	22	D1,D2,D4,D14,D16,1N4148 D17,D18,D19,D20,D21,D22, D25,D26,D27,D28,D29,D30, D31,D32,D33,D34,D35		SILICON DIODE
48	1	D23	1N4148	SILICON DIODE
49	1	D38	1N4004	SILICON DIODE
50	1	D11	WL04	DIODE BRIDGE 1.5A
51	5	D5,D6,D7,D8,D12	LED-R5	RED LED DIODE
52	1	D13	LED-G5	GREEN LED DIODE
53	1	D15	Z3V9	ZENER DIODE 3.9V 1/4W
54	1	D9	Z5V6	ZENER DIODE 5.6V 1/4W
55	1	U4	7815	POS. STABILIZER 1A
56	1	U3	7915	NEG. STABILIZER 1A
57	2	Q9,Q11	BC237	NPN TRANSISTOR
58	3	Q1,Q2,Q10	BC557	PNP TRANSISTOR
59	2	U1,U2	TL084	QUAD OP. AMP.
60	1	U5	NE555	TIMER
61	2	U6,U7	4040	CMOS DIVIDER
62	1	U8	LM3900	NORTON QUAD AMP.
63	1	R11	TM20K	TRIM.MULTIGIRI REG.VERT
64	2	R69,R97	270K	RESISTOR 1/4W 5%



	DENOMINAZIONE	
	Telemetry Card (Mod. PROT-A2) Component Layout / Piano di Montaggio	
DISPOSITIVO		
SEMILAVORATO	DISEGNATO	DISEGNO
MATERIALE	D'Alessio D. U	
TRATTAMENTO	SCALA	TAVOLA n di

Item	Quantity	Reference	Part	DESCRIPTION	PART ORDER CODE
1	9	R15,R16,R17,R19,R20, R22,R23,R24,R25	1K 1%	RESISTOR 1/4W 1%	
2	1	R18	1K	RESISTOR 1/4W 5%	
3	1	R21	2K2 1%	RESISTOR 1/4W 1%	
4	14	R1,R2,R3,R4,R5,R6,R7, R8,R9,R10,R11,R12,R13, R14	100K 1%	RESISTOR 1/4W 1%	
5	18	C1,C2,C3,C4,C5,C6,C7, C8,C9,C10,C11,C12,C13, C14,C15,C16,C17,C18	100NF	CERAMIC CAPACITOR	
6	1	M2	14 PIN F STRIP	STRIP F P 2.54 14 PIN	
7	1	CN2	16 PIN CONN.	CONN. M 2*8 P 2.54	
8	2	D3,D4	1N4148	SILICON DIODE	
9	2	D2,D3	1N4007	SILICON DIODE 1000V	
10	5	U1,U2,U3,U4,U5	LM358N	DOUBLE OP. AMP.	

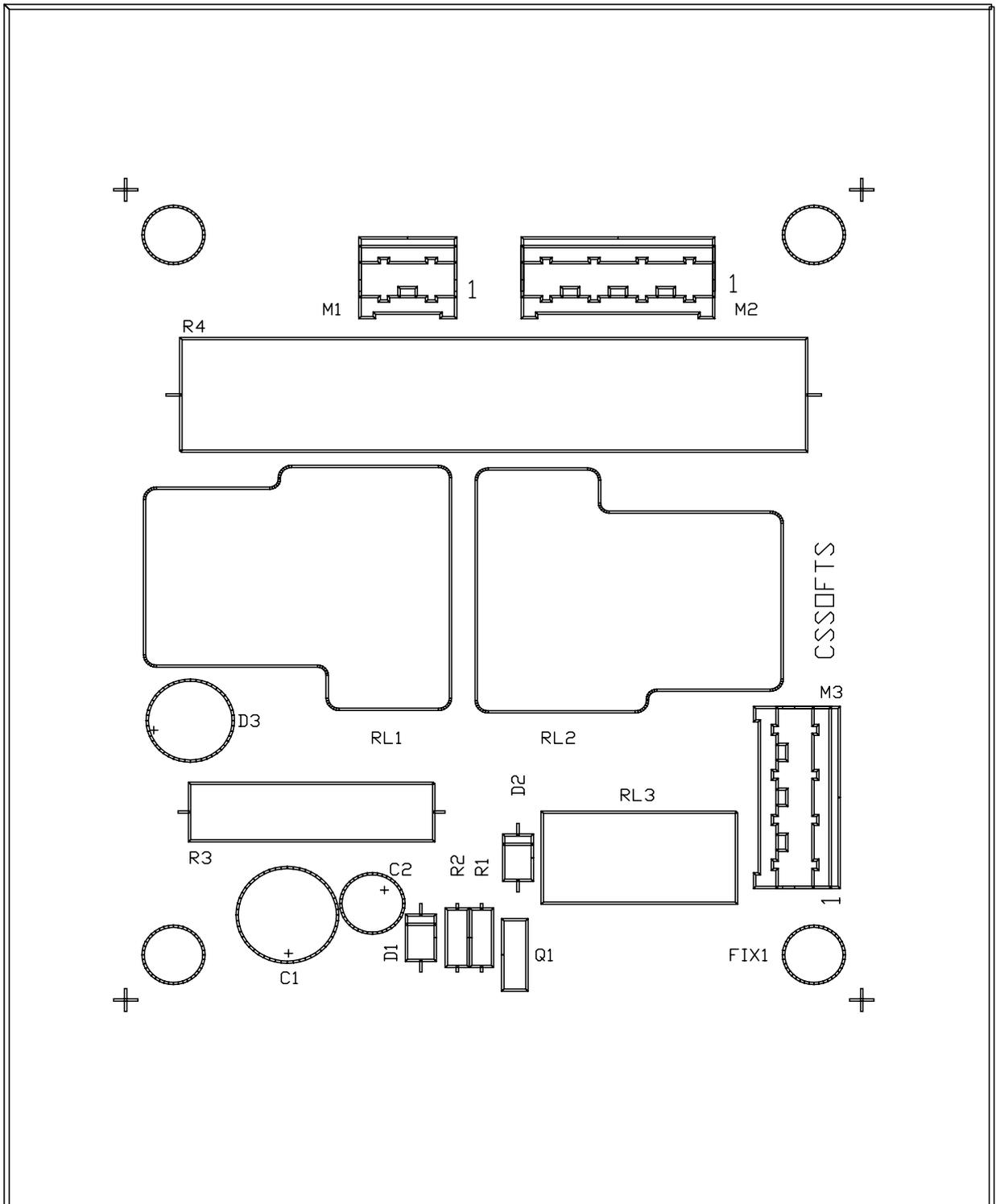
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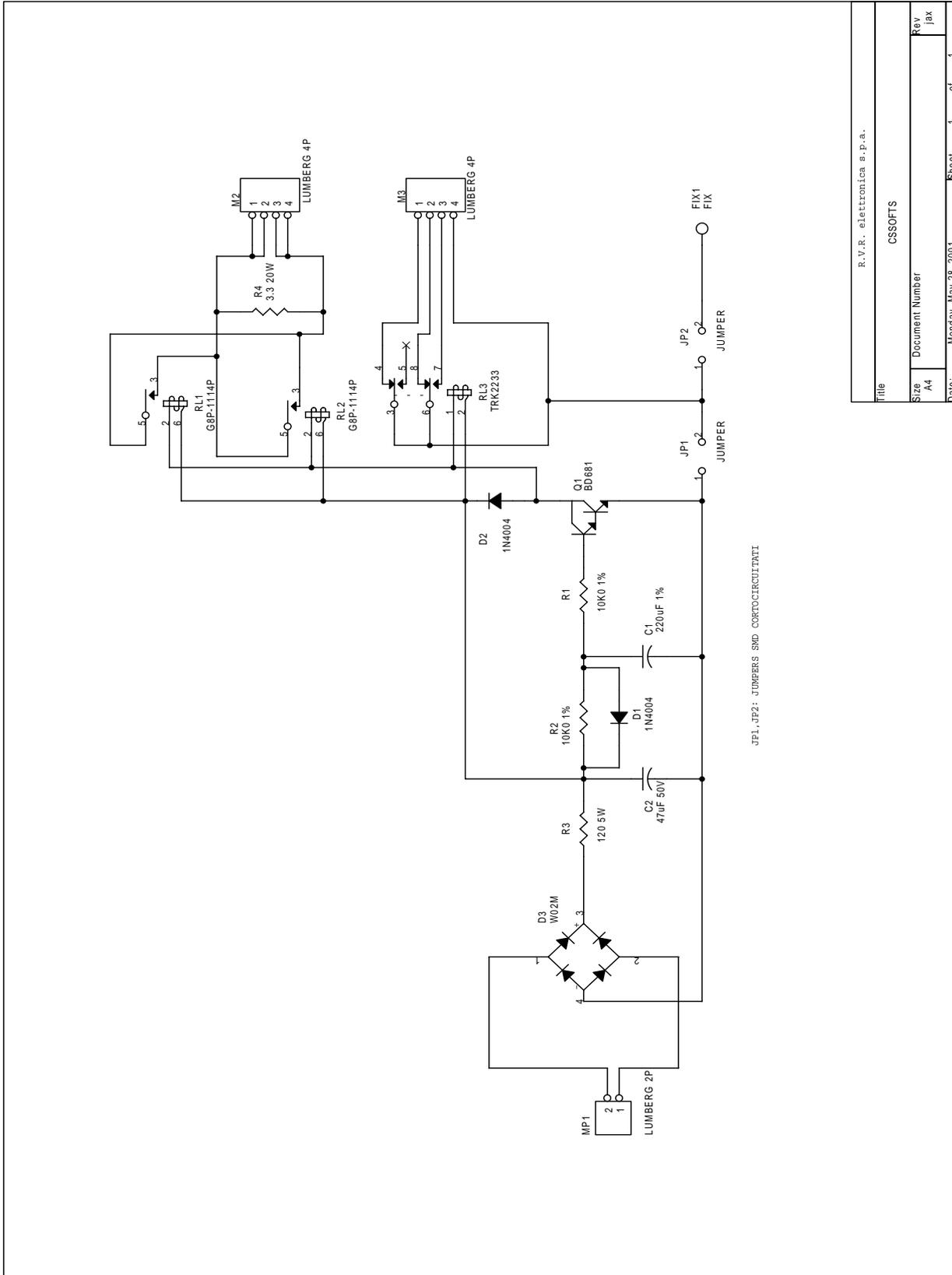
PSSW5010.SCH Bill Of Materials Page1

Item	Quantity	Reference	Part
1	2	C19,C1	1/16
2	1	C2	180pF
3	16	C3,C4,C12,C13,C17,C26, C44,C45,C46,C48,C50,C51, C55,C65,C67,C68	.1UF
4	1	C5	EKM470UF/40
5	12	C6,C7,C8,C9,C10,C11,C14, C15,C16,C59,C60,C61	100PF
6	1	C18	1KpF
7	2	C35,C20	MKP1nF/600
8	1	C21	C
9	1	C22	.1UF CER
10	1	C23	CP10nF
11	3	C24,C25,C43	47UF/25
12	1	C27	MKT-1UF-250V
13	2	C29,C28	EYS3300/100
14	5	C30,C31,C32,C33,C34	MKP-0.1-250
15	4	C36,C37,C38,C39	EKE1000/63
16	2	C47,C40	EKR470/63
17	3	C41,C49,C62	100uF/25
18	1	C42	22KPF
19	3	C52,C56,C66	2.2UF/16
20	2	C53,C54	1UF
21	1	C57	EKM470/63
22	1	C58	EKM220uF/40
23	1	C63	MKP4n7-2.5%
24	1	C64	CM0.33UF
25	1	D1	WL02
26	3	D2,D16,D26	LED V
27	6	D3,D4,D5,D6,D7,D24	1N4148
28	1	D8	5V/0.5W
29	2	D10,D9	15V/1W
30	4	D11,D12,D22,D23	20ETS08
31	1	D13	HFA15PB60
32	2	D14,D19	1N4004
33	4	D15,D17,D18,D20	11DQ06
34	1	D21	LM336-5V
35	4	F1,F2,F4,F5	BL02
36	2	F3,R23	220R/2W
37	1	IS1	4N26
38	1	JP1	STRIP
39	1	JP2	KRA6
40	1	JP3	KRA4
41	1	JP4	KRA8
42	2	L2,L1	BFV0710
43	1	L3	77083
44	1	L4	INDUCTOR
45	1	PNT	
46	3	Q1,Q5,Q6	IRFD120
47	1	Q2	IRFP250
48	1	Q3	IRFD9120
49	2	Q7,Q4	BC237
50	1	RV1	V120ZA6
51	1	R1	390R

52	1	R2	2K49
53	1	R3	4K02
54	2	R4, R39	10R/2W
55	1	R5	80R2
56	3	R6, R7, R83	3K3
57	2	R8, R9	2K61
58	2	R10, R38	22K/1W
59	2	R45, R11	237R
60	2	R59, R12	87W/5K
61	3	R13, R60, R68	2K21
62	4	R14, R19, R49, R67	1M0
63	1	R15	87W-500R
64	2	R16, R73	2K0
65	1	R17	2K37
66	3	R18, R21, R35	1K0
67	1	R20	87W-2K
68	1	R22	22K
69	4	R24, R25, R26, R28	20K0
70	4	R27, R29, R55, R57	40K2
71	2	R30, R31	14R7
72	2	R52, R32	549R
73	2	R33, R34	820R
74	1	R36	5K6
75	1	R37	270R-1W
76	1	R40	SHUNT-10
77	1	R41	10K0
78	2	R42, R63	1K
79	1	R43	47K5
80	1	R44	R
81	1	R46	5K1
82	1	R47	511K
83	2	R50, R48	2K0-0.1%
84	2	R51, R70	10K0-0.1%
85	1	R53	470R
86	5	R54, R61, R76, R77, R78	10K
87	2	R58, R56	180R
88	1	R62	150R/5W
89	1	R64	100R0
90	1	R65	6k81
91	4	R66, R69, R71, R81	49K9
92	1	R72	87W-20K
93	2	R75, R74	10R0
94	1	R79	604R
95	1	R80	301K
96	1	R82	27K4
97	5	TP1, TP2, TP3, TP4, TP5	TP
98	1	T1	TAP/24
99	1	U1	TC427
100	3	U2, U3, U7	LM358
101	1	U4	HCPL2611
102	1	U5	LM258
103	1	U6	4049
104	1	U8	HTP25
105	1	U9	UC3823
106	1	U10	LM317



	DENOMINAZIONE soft start	
	DISPOSITIVO	
SEMILAVORATO	DISEGNATO D'Alessio D.li 4/12/00	DISEGNO
MATERIALE	SCALA 1:1	TAVOLA n 1di 1
TRATTAMENTO		



Title		R.V.R. elettronica s.p.a.	
Size		CSSOFTS	
Rev	Document Number		
A4			
Date:	Monday, May 28, 2001	Sheet	1 of 1

Item	Quantity	Reference	Part	
1	1	C1	220UF 50V	COND. ELETTR.
2	1	C2	47UF 50V	COND. ELETTR.
3	2	D1,D2	1N4004	DIODO AL SILICIO
4	1	D3	W02M	PONTE DI DIODI
5	1	FIX1	FIX	
6	2	JP1,JP2	JUMPER 2P	
7	1	M1	LUMBERG 2P	MORS. 2 PIN
8	2	M2,M3	LUMBERG 4P	MORS. 4 PIN
9	1	Q1	BD681	TRANSISTOR
10	2	RL1,RL2	G8P-1114P	RELÈ G8-1114P
11	1	RL3	V23042 A 2003	RELÈ 2SC. 2VIE
12	2	R1,R2	10K	RES. STRATO MET.
13	1	R3	120 5W	RES. A FILO
14	1	R4	3.3 20W	RES. A FILO

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