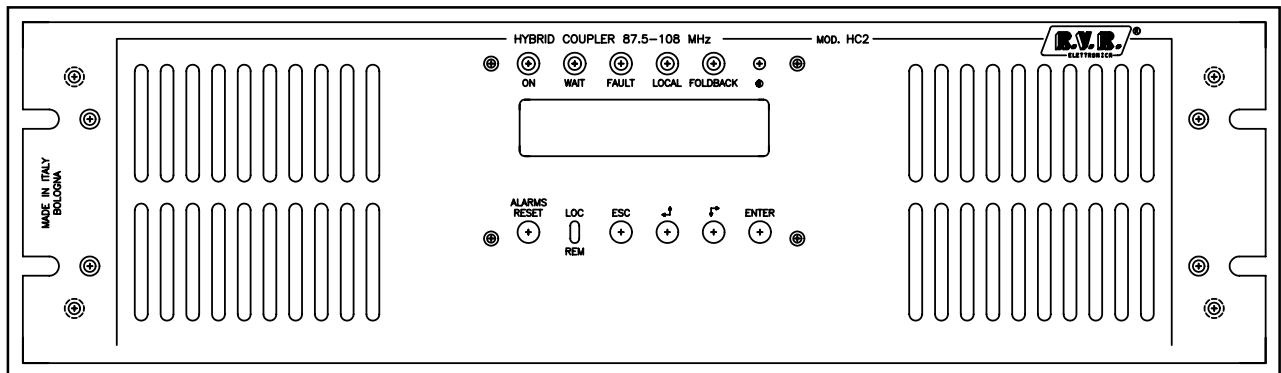


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# HC2 LCD



## User Manual Volume 1

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Manufactured by



Italy



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## Revision History

Version	Date	Reason	Editor
1.0L	19/11/2001	First electronic version	J. Berti
1.1L	07/07/2003	New format in two volumes	J.Berti

HC2 LCD - User Manual  
Version 1.1L

© Copyright 2001-2003  
R.V.R. Elettronica SpA  
Via del Fonditore 2/2c - 40138 - Bologna (Italia)  
Telefono: +39 051 6010506  
Fax: +39 051 6011104  
Email: info@rvr.it  
Web: www.rvr.it

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# Table of Content

<b>1. Preliminary instructions</b>	<b>1</b>
<b>2. Warranty</b>	<b>3</b>
<b>3. First Aid</b>	<b>5</b>
3.1 Treatment of electrical shocks	5
3.2 Treatment of electrical Burns	6
<b>4. General Description</b>	<b>7</b>
<b>5. Installation and use</b>	<b>9</b>
5.1 Preparation	9
5.2 Operation	9
5.3 Software	10
<b>6. Controls, Indicators e Connectors</b>	<b>19</b>
6.1 Front Panel	19
6.2 Rear panel	20
6.3 Connectors Description	21
<b>7. Technical Specifications</b>	<b>23</b>
7.1 Physical and Environmental Specifications	23
7.2 Electrical Specifications	23
<b>8. Internal Description</b>	<b>25</b>
8.1 Modules identification	25
8.2 Modules description	26
8.3 Adjustment	27
<b>Appendix:</b>	
Component layouts, schematics, bills of material	

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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

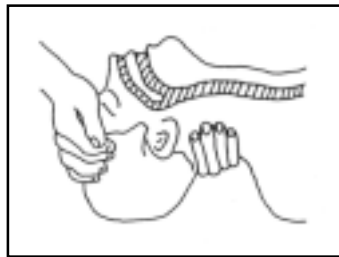


Figure 1



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**).

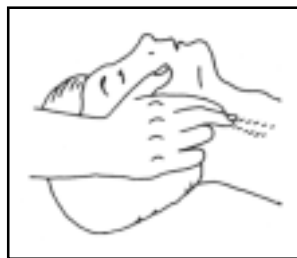


Figura 3

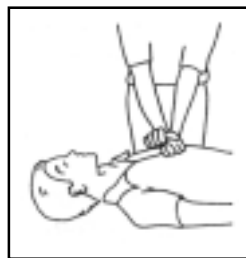


Figura 4

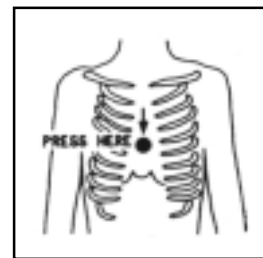


Figura 5

- 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.

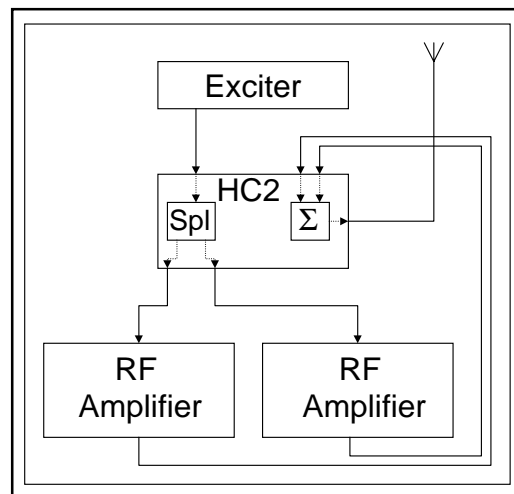
## 4. General Description

The HC2, produced by R.V.R. Elettronica, is a hybrid coupler for FM audio broadcasting realized in "Strip-Lines" technology. Its function is to split into two portions the RF signal coming from a RF exciter, adjusting the relative phases, to pass them through two external RF power amplifiers and then to combine the output of the amplifiers into a single RF amplified signal to be forwarded to the antenna output.

The HC2 is produced in two variants:

- HC2/1 For transmitters with 500 W + 500 W max output power (total 1 kW)
- HC2/2 For transmitters with 1 kW + 1 kW max output power (total 2 kW)

The variants are different essentially in the kind of used RF connectors and for the software configurations, that have to cope with different nominal RF power levels.



The nominal working principle of a FM transmitter based on a hybrid coupler scheme (like HC2) foresees that the used amplifiers shall produce the same RF power that will be added with the same phase. Possible differences in the power level or phase of the amplifiers generate the so-called *unbalancement power* that is in part dissipated inside the coupler. The HC2 guarantees the overall working of the transmitter even if one of the amplifiers is completely off-service. In such case, approximately half of the power generated by the surviving amplifier is routed to the antenna anyway; the other part of the delivered power (that is unbalancement power) is dissipated inside the combiner.

The HC2 is controlled by a microcontroller system, that includes a LCD display and a series of keys for the interaction with the user, that realizes the following functions:

- Measurement and visualization of the coupler's working parameters
- Activation and deactivation of the power output of the system
- Protection of the coupler with respect to potentially dangerous situations like exceeding emitted or unbalancement power, overdrive or overtemperature

- Detection of user-settable attention thresholds (e.g. output power being below a certain value), that are made externally available as digital states on the "telemetry" connector
- Communications with external devices

The management software of the HC2 is based on a menu system.

The user can navigate through the menu system using four buttons, ESC, move LEFT/UP, move RIGHT/DOWN and ENTER. A fifth button is used to reset the alarm counters, if any alarm has been triggered before.

Five LEDs on the front panel of the amplifier show the current status of the machine: ON/OFF, WAIT, FAULT, LOCAL and FOLDBACK

A switch on the front panel allows to select the LOCAL or REMOTE working mode:

- LOCAL mode allows to control the machine using the buttons on the front panel, while remote control (that is using the telemetry connector) is disabled;
- In REMOTE mode, remote control is enabled, while the buttons on the front panel can be used only to read parameters and not to change them

The LOCAL working mode is signalled by a yellow LED on the front panel being lit.

The different working parameters are made available for the remote control applications on the telemetry connector, as voltage levels that are proportional to the value of the parameter under consideration. Digital output signals related to alarms or warnings are also present on the connector, together with the digital input like ON/OFF switching or alarms reset.

The hybrid coupler includes an input for optional external 24 V dc power supply. This power source will automatically be used to supply the CPU section in case the mains power goes off. In this way, it is possible to interact (locally or remotely) with the device even in absence of mains supply.

The HC2 can be connected to the exciter of the transmitter using a "interlock" cable, so that it is possible for it to deactivate RF power emission in case of malfunctioning of the transmitting system. An analogous effect can be reached also in case the exciter misses the interlock functionality, connecting the mains supply of the exciter to the auxiliary mains plug of the HC2 "AUX OUT AC LINE". This plug is in fact opened using a relay under the same conditions that cause the activation of the interlock.

## 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 the combiner for the first time, we suggest to carefully read the whole manual.

### 5.1 Preparation

Unpack the HC2 and before any other operation check the unit for any shipping damage; in particular, check that all the controls and connectors on the front and rear panels are in good conditions.

Check the mains voltage selector on the rear panel: the selected value is indicated by an arrow. If required, extract the selector block levering with a screwdriver. Rotate the block until the correct printed value corresponds with the arrow, and then reinsert the fuse block.

If it is necessary, check the integrity and the value of the fuse inside the voltage changer block; the required fuse type is:

- Aux 6.3A 5X20      Mains 1A 5X20      (230-240V)
- Aux 6.3A 5X20      Mains 1A 5X20      (100-120V)

Connect the RF output cable of the exciter to the N-type input of the splitting section of the combiner. Connect two cables between the output N connectors of the splitting section of the combiner and the RF input of two suitable amplifiers. Connect two cables between the RF output of the amplifiers and the input connectors of the combining section of the coupler.

Connect the output connector of the combining section to the antenna feeder or to a dummy load with a power rating suitable for your application. Link, using a coaxial cable, the BNC “Alarms” connector to the “Interlock” connector of the exciter. Connect the “Fold back” connector to the “EXT AGC” input of the exciter, if such a functionality is present.

All the above connections are described in the documentation of the transmitting station, if the HC2 is supplied as a part of a complete transmitter.



**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.

After all the connections have been made, connect a proper cable to the hybrid coupler’s mains input plug.

### 5.2 Operation

To perform its intended purpose, the HC2 is always used in a transmitter comprising an exciter and two RF amplifiers. In the following description, we will in

general refer to these external devices.

As soon as the HC2 is supplied, verify that the ON LED is lit. The LCD display shows a presentatio screen, and after a few seconds it will pass to the default screen, showing the values of the forward and reflected power.

Switch the exciter on (at its minimum power level) and wait for it to lock on the working frequency. When the PLL has locked, progressively increase its output power, while controlling the displays of the exciter, of the amplifiers and of the hybrid coupler. Keep increasing the exciter output overall output of the combiner reaches the desired value, that is at most the nominal power rating of the transmitting station.

At this point, it is possible for the user to verify all the working parameters of the amplifier using the management software.

Normally, 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, and notified to the user with the LEDs on the panel or via messages on the LCD display.

### 5.3 Software

This chapter describes the way the microprocessor system controls the hybrid coupler, and how the user can interact with it.

Note that the user can give commands to the device only when it's set in LOCAL mode using the switch on the front panel. Otherwise, the user will only be allowed to read the parameters, but not to change any of them.

The management of the HC2 is performed by a generic software used in different classes of equipment produced by R.V.R. Elettronica SpA, like the HC combiners or the RF amplifiers PJ500M-C and PJ1000M.

For this reason, some options that are related to other kinds of devices are deactivated in the software version that is installed in the HC2 (see for example the P.A. menu).

Note that some of the parameters that are measured and can be read may be, in some circumstances, not available. This situation mostly arises when, for physical reasons, the measured values are not significant to be used in the control software.

When the value for a parameter is not available for such reasons, it's substituted with the symbol “==”.

Figure 5-1 shows the complete flow diagram of the management software of the coupler, that can be basically seen as build up of a default screen, plus a series of submenus.

At power on, the LCD display will show the following presentation screen, indicating the name of the device:

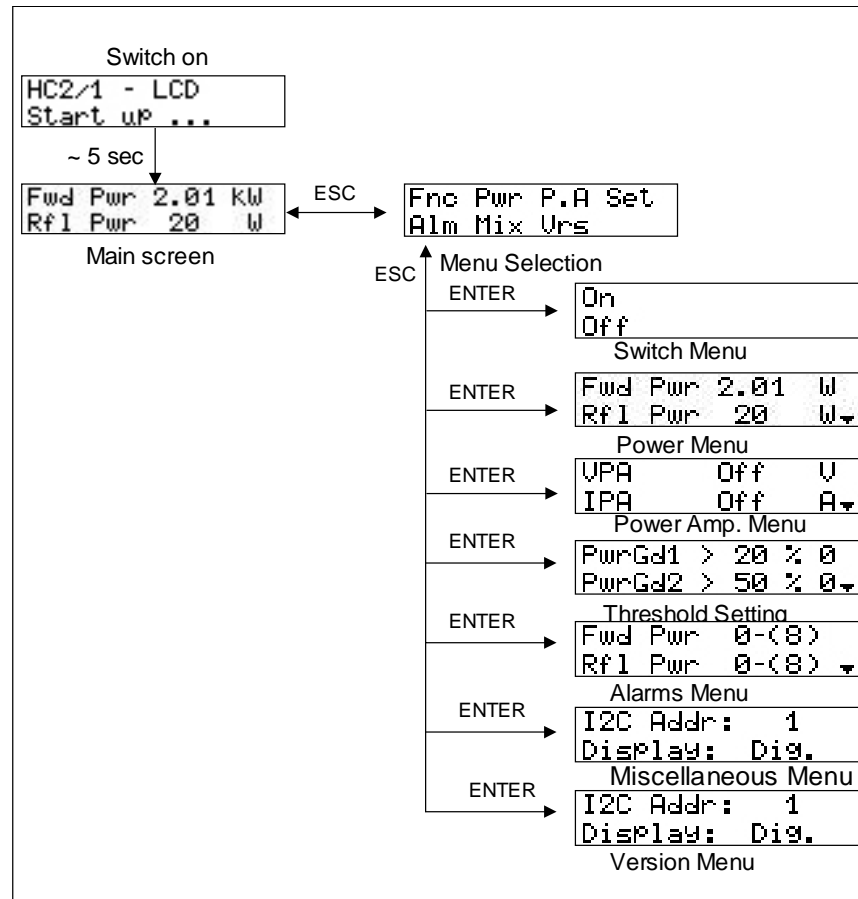
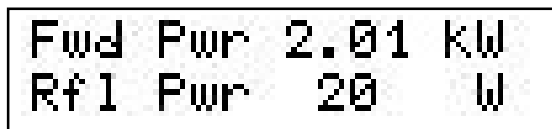


Figure 5-1: HC2's management software

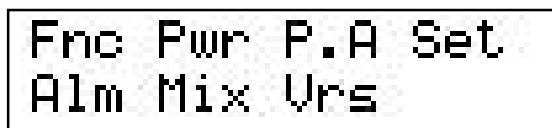


After a few seconds, the main screen will be displayed, reporting the values of Forward power and Reflected power:



The management software will remain indefinitely in this default screen, until the user pushes the ESC button.

Pushing the ESC button, the user will be presented with the menu selection screen, from which the other screens can be accessed:



Pushing again the ESC button, the software goes back to the default screen.

To enter into one of the submenus, just select the corresponding name (that will be indicated by a flashing underscore) with the LEFT and RIGHT buttons, and then push ENTER.

### 5.3.1 RF Power switch menu (Fnc)



From this menu, the user can “switch” ON and OFF the hybrid coupler.

The result of this command is that when the HC2 is put in OFF mode, the inner conductor of the “Alarm” connector is shorted to ground, so that the exciter is put in stand-by mode (this will happen only if provided with an interlock connector, and if correctly connected with the hybrid coupler). At the same time, the auxiliary mains output is opened, so that if an exciter is connected to it, it will be shut off.

When the hybrid coupler is switched OFF, the software waits a few minutes to permit the proper cooling of the device, and then sends a signal to the relays of the blowers to turn them off too.

Each two hours, while the machine is OFF, the software enables the blowers for a while to dissipate the heat generated by the circuitry and to avoid possible malfunctions of the blowers due to long inactivity periods.

Switching ON again the hybrid coupler, the interlock circuit is opened, reenabling the power emission in the connected exciter, the auxiliary mains plug supply is powered and the blowers are restarted.

### 5.3.2 Power menu (Pwr)

This multi-line scrollable menu allows the user to read all the measurements related to the behaviour of the power section of the combiner:

- Forward Power (Fwd Pwr)
- Reflected Power (Rfl Pwr)
- Standing Wave Ratio (SWR) (Not active)
- Input Power (Inp Pwr) (Not active)
- Rejected PWR (Rej PWR)

Depending on the configuration of the machine, some of the measures could be deactivated.

The complete aspect of the screen is the following figure (please note that only two lines at a time are visible, use the UP and DOWN buttons to scroll):



Fwd Pwr	2.01	W
Rfl Pwr	20	W
SWR	Off	
InP Pwr	Off	
Rej PWR	17	W

### 5.3.3 Power Amplifier Menu (P.A.)

This multi-line scrollable menu reports to the user some internal measurement of the device:

- Voltage (VPA) - Not active
- Current (IPA) - Not active
- Efficiency - Not active
- Temperature
- Mains voltage (Mains - percentage variation with respect to the nominal voltage)

The complete aspect of the screen is the following figure (please note that only two lines at a time are visible, use the UP and DOWN buttons to scroll):

VPA	Off	V
IPA	Off	A
Eff.	Off	%
Temp.	22.8	C
Mains	5	%

Please note that the first three lines of this screen are not active since they are not meaningful for a hybrid coupler.

### 5.3.4 Threshold setting menu (Set)

As described in the introduction, the amplifier offers a maximum of three user settable alarms. For each of them, one of the working parameters is compared against a threshold value that can be modified by the user. The results of the comparisons are available on the telemetry connector or as dry contacts on the optional external telemetry board, and can be read on the display as "O" (open, i.e. the result is false) or "C" (closed, i.e. the result is true).

Two of the settable thresholds are related to the RF emitted power (**Power Good**), while the third is connected to the amount of reflected power (**Reflected Warning**).

The thresholds are expressed as percentage of full-scale value of the relevant

quantity.

The full scale values for the HC2 are the following:

- Forward power 1000W (HC2/1) 2000W (HC2/2)
- Reflected power 100W (HC2/1) 200W (HC2/2)

To change the values of the thresholds, execute the following procedure, after putting the combiner in LOCAL mode:

- Select the line to modify (UP and DOWN buttons)
- Push the ENTER button
- Modify the value of the threshold (UP and DOWN buttons)
- Push the ENTER button to confirm

The following figure shows an example of configuration for this menu.

```

PwrGd1 > 20 % 0
PwrGd2 > 50 % 0
Rf1War > 70 % 0
    
```

In this example, the thresholds settings are (for a HC2/1):

- PwrGd 1 200 W (20% X 1000W)
- PwrGd2 500 W (50% X 1000W)
- Rf1War 70 W (70% X 100W)

### 5.3.5 Alarms Menu (Alm)

This screen gives to the user information regarding the status of the protection system included in the hybrid coupler.

It is constituted by a certain number of lines, each containing the name of a variable controlled by the system and the kind of intervention that is undertaken by the system in case the parameter surpasses its limit.

The latter can be of the kind: **X - (Y)**, **Wait**, or **Dis.** (Disabled).

The explanation of the protection system of the hybrid coupler is given separately in chapter 5.3.8.

The aspect of this multi-line screen is the following (only two lines at a time are visible, use the UP and DOWN buttons to scroll):

Fwd Pwr	0-(8)
Rfl Pwr	0-(8)
Inp Pwr	Dis.
U.P.A.	Dis.
I.P.A.	Dis.
Temp.	Wait
Rej PWR	Dis.
Mains	Wait
SWR	Dis.
Eff.	Dis.

The function of this menu is essentially a help for the technician to identify the causes of possible malfunctions of the transmitter..

### 5.3.6 Various menu

Two operations can be performed using this menu:

- Setup the address of the I<sup>2</sup>C serial bus type connection
- Setup the kind of visualitation in the default menu

I2C Addr:	1
Display:	Dig.

The default address of I<sup>2</sup>C communication is relevant when the coupler is connected with other RVR' devices that use this protocol. We raccomend not to change this parameter if not necessary.

The visualitation mode can be **Digital** (the default mode described in chapter 5.3) or **Analog**:

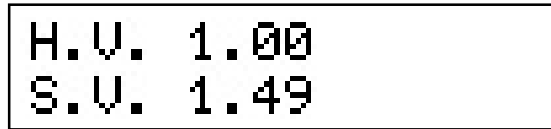
Rfl Pwr	6 ▾
■ ■	

In analog mode, a little triangle indicates the reflected power level set in the threshold set menu (under RflWar), while the bar below shows the in real time level reflected power.

This last kind of visualitation is best used when the combiner output is connected to a device that has to be tuned, as a cavity.

### 5.3.7 Versions menu

This menu shows the hardware (H.V.) and software versions (S.V.) of the machine.



### 5.3.8 Protection system

The protection system implemented in hybrid coupler is based on two types of reactions, the “Foldback” and the temporary disabling.

#### 5.3.8.1 Foldback

The foldback circuit controls the level of a dc voltage that is available on the dedicated BNC connector (F.BACK) on the rear of the HC2.

The foldback voltage remains approximately constant until one of the amounts that are connected to the foldback doesn't surpass its nominal value (full scale). When this happens, the foldback voltage is risen proportionally to the amount the threshold is surpassed, and a yellow LED is lit on the front panel, signalling the intervention of the circuit. In figure 5-2, X represents one of the variables connected to the foldback,  $X_0$  is the full scale of the variable,  $V_{FB}$  is the voltage present on the BNC:

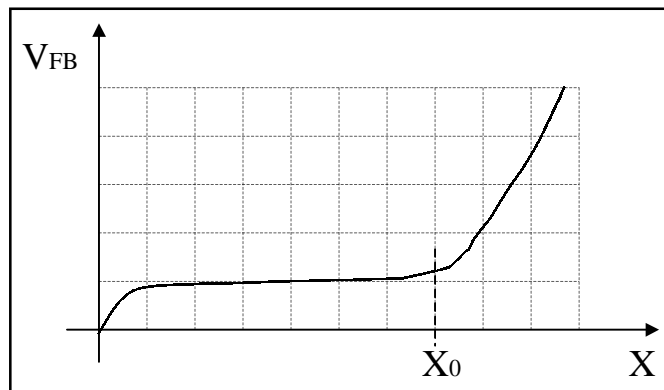


Figure 5-1: Fold back voltage as a function variable “X”

In the HC2, the variables connected to the foldback are:

- Forward power
- Reflected power
- Rejected power
- Temperature

The foldback voltage can be used by the transmitter's exciter to reduce accordingly the driving power. For example, RVR Elettronica's PTX-LCD is designed to use an external foldback signal of this kind.

In general, the reduction of the RF power generated by the exciter will reduce the variable that caused the foldback intervention, so that a new stability point is reached.

If any reason makes it impossible to reach a new stable point, the protection system of the HC2 will react with its Shut off/Restart procedure.

#### 5.3.8.2 Shut off/Restart

The second kind of reaction of the protection system consists in forcing the transmitter in stand-by mode when one of the monitored variables surpasses its maximum allowed value.

To put the transmitter in stand-by, the hybrid coupler disables the exciter's RF power emission using the interlock circuit, thus disabling the overall transmitter RF power.

Depending on the kind of problem that caused the failure, after the transmitter has been inhibited, it will either be reactivated after a fixed time interval, or only when the impeding condition has been solved.

In the Alarm menu, the first kind of configuration is noted by **X - (Y)**, while the second is indicated with **Wait**. The third possibility is that the configuration of the system does not implement any protection based on a certain parameter: This would be noted with **Dis.** (Disabled).

While the amplifier is temporarily shut off for an alarm, the yellow WAIT LED is lit, and the cause of the intervention of the protection system is written on the display.

When the protection intervenes for a parameter of "cyclic" kind, a counter is incremented (the value X in the alarm screen). If the value of the counter reaches the maximum admitted value (Y), the amplifier is definitively switched off, and the red LED "fault" on the front panel is lit.

The button ALARMS RESET gives the user the opportunity to interact with the protection system. Its effect is different depending on the status the amplifier is when the button is pushed:

- If the system is in stand-by, waiting for the cycle time to expire, or if it is definitively off in FAULT state, pushing the ALARMS RESET button will immediately turn the amplifier on and reset the alarm counters
- If the system is transmitting, but some alarm occurred before, so that the alarm counters are not all at "0", pushing the ALARMS RESET button will have no effect unless the button is pushed while the user is reading the Alarm menu. In this way it is made sure that the user doesn't reset possible alarms without knowing they happened

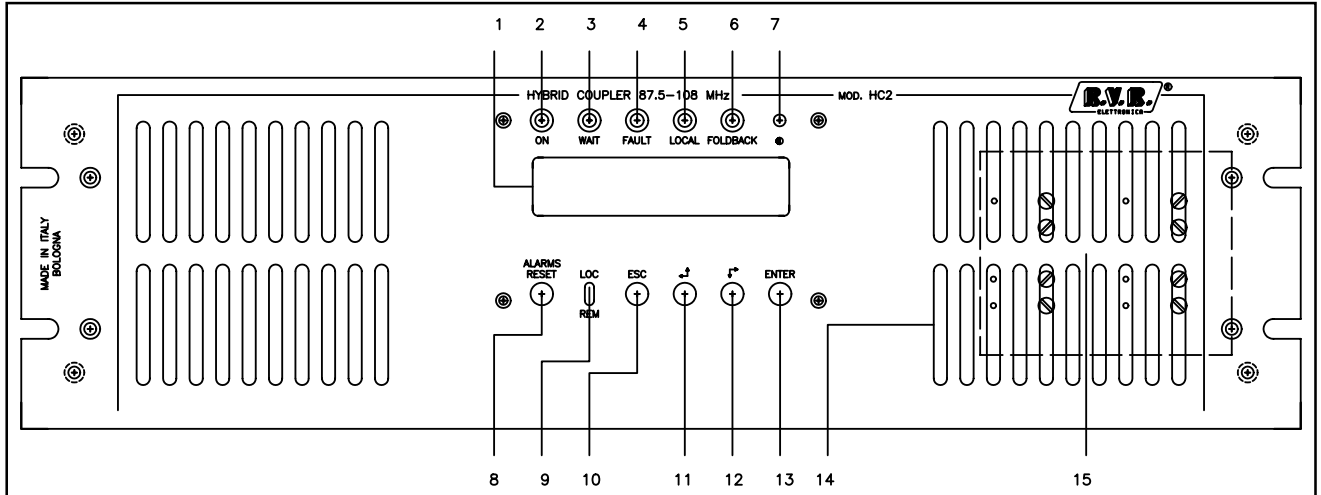
The alarm counters are reset by the system itself without the need for an external intervention after half an hour of undisturbed (i.e. without alarms) working of the hybrid coupler.

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## 6. Controls, Indicators e Connectors

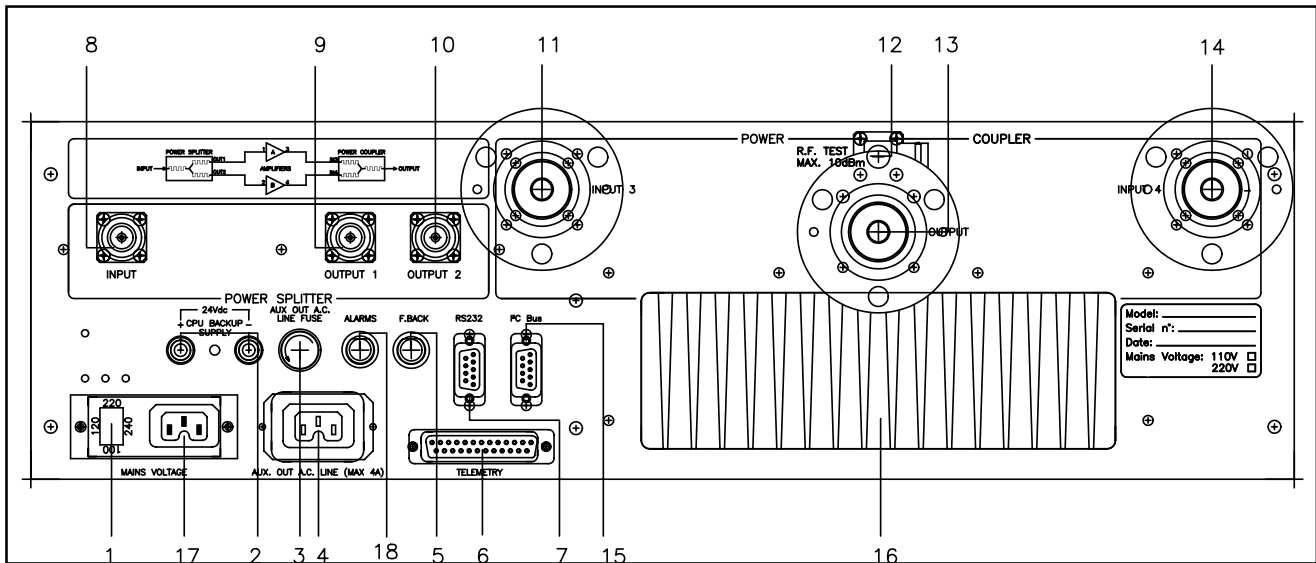
This chapter describes the front and rear panels of the HC2, with a short explanation of the different components, and the pinout of its connectors.

### 6.1 Front Panel



- |                 |   |
|-----------------|---|
| [1] DISPLAY     | Liquid Crystals Display   |
| [2] ON          | Green LED, lit when the hybrid coupler is switched on.  |
| [3] WAIT        | Yellow LED indicating that the amplifier is waiting for a condition that is blocking the power output to be removed.  |
| [4] FAULT       | Red LED indicating the presence of a fault that cannot be automatically reverted.   |
| [5] LOCAL       | Yellow LED indicating that the hybrid coupler is in local control mode.   |
| [6] FOLDBACK    | Yellow LED indicating the intervention of the foldback function (automatic reduction of the output power if connected to an exciter that implements the function, for example the PTX-LCD). |
| [7] CONTRAST    | Trimmer to regulate the contrast of the LCD display.  |
| [8] ALARM RESET | Button used to manually reset the protection system.  |
| [9] LOC/REM     | Switch to select the local or remote control modes.   |
| [10] ESC        | Button to exit from a menu.   |
| [11] LEFT/UP    | Buttons used to navigate in the menu system and to modify the changeable parameters.  |
| [12] RIGHT/DOWN | Buttons used to navigate in the menu system and to modify the changeable parameters.  |
| [13] ENTER      | Button used to accept a parameter's value or to enter into a menu.  |
| [14] AIR IN     | Air flow input for forced ventilation.  |
| [15] PHASE ADJ. | Phase adjustment of the RF channels (depending on the hardware version)   |

## 6.2 Rear panel



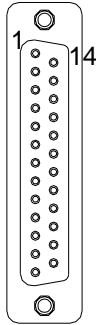
- [1] VOLTAGE CHANGER & A.C. LINE FUSE Fuse block and Line Voltage Selector. Use a small screwdriver to change the fuse or line voltage. Rotate the block and position it for desired voltage.
- [2] 24 V External 24 V dc power supply input for CPU backup power supply approx consumption 250mA
- [3] FUSE Protection Fuse for Auxiliary Out A.C. Power Line 4A max.
- [4] AUX. OUT A.C. LINE VDE-type Auxiliary Out A.C. Power Line to supply external devices (typically an exciter).
- [5] F.BACK BNC connector for "Fold Back" signal
- [6] TELEMETRY DB25 telemetry connector
- [7] RS232 DB9 connector for serial communication. Used for factory programming
- [8] INPUT N-type input connector (RF power from exciter)
- [9] OUTPUT 1 Power splitter Output 1 (7/8" EIA Flange) to drive Power Amplifier A.
- [10] OUTPUT 2 Power splitter Output 2 (7/8" EIA Flange) to drive Power Amplifier B.
- [11] INPUT 1 Power Combiner's Input 1 (N type in version HC2/1, 7/16" or 7/8" on request in version HC2/2) from Power Amplifier A.
- [12] R.F. TEST BNC RF monitor output. The output level is -60 dB below the power output in the band 87.5-108 MHz (this sample is used to verify the FM band).
- [13] OUTPUT Power Combiner's Output (N type in version HC2/1, 7/16" or 7/8" on request in version HC2/2).
- [14] INPUT 2 Power Combiner's Input 2 (N type in version HC2/1, 7/16" or 7/8" on request in version HC2/2) from Power Amplifier A.
- [15] I<sup>2</sup>C DB9 connector for I<sup>2</sup>C bus networking with other RVR devices
- [16] HEAT SINK Heat sink air flow output
- [17] MAINS Mains plug
- [18] INTERLOCK BNC connector to inhibit an external device, as an exciter. In case of fault, the inner connector is shorted to ground.



## 6.3 Connectors Description

### 6.3.1 Telemetry Connector

Type: DB25 Female



PIN	Signal	Type	Notes
1	Unbal. Power	Ana Out	3.9V x 650 W
2	Ch_4	Disabled	
3	GND	GND	
4	Reflected Power	Ana Out	4.3V x 100W
5	OC_ECC	Dig Out OC	Active when interlock is active
6	OC_SET4	Disabled	
7	GND	GND	
8	IN_ON	Dig In	"ON" command
9	OC_SET1	Dig Out OC	Active when SET1 threshold surpassed
10	OC_WAIT	Dig Out OC	Active for "Wait" alarm presence
11	IN_RST	Dig In	"Alarms Reset"
12	OC_OFF	Dig Out OC	Active when the coupler is "OFF"
13	IN_INH	Dig In	Keep at GND potential to inhibit
14	TEMP	Ana Out	3.9V x 70°
15	Ch_5	Disabled	
16	Forward Power	Ana Out	4.3V x 1 kW
17	OC_FAULT	Dig Out OC	Active for "Fault" Alarm presence
18	OC_SET3	Dig Out OC	Active when SET3 threshold surpassed
19	Ch_3	Disabled	
20	IN_OFF	Dig In	"OFF" command
21	GND	GND	
22	OC_SET2	Dig Out OC	Active when SET2 threshold surpassed
23	LOC	Dig Out OC	Active when in local mode
24	VNS	+12 Vcc	Unregulated voltage
25	OC_ON	Dig Out OC	Active when the coupler is "ON"

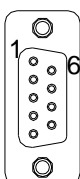
#### Notes:

- To give a command to the HC2 (ON, OFF, Reset), bind the relative pin to ground for approx 500 ms
- OC output (Open Collector) are "Active" when conducting
- For the HC2-2 variant (Nominal Output 2 kW), the following full scale values apply:

4	Reflected Power	Ana Out	4.3V x 200W
16	Forward Power	Ana Out	4.3V x 2 kW

### 6.3.2 RS232 Connector

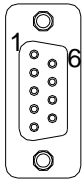
Type: DB9 Female - Used for factory programming



1	N.C.
2	TXD
3	RXD
4	Internally connected to 7 and 8
5	GND
6	N.C.
7	Internally connected to 4 and 8
8	Internally connected to 4 and 7
9	N.C.

### 6.3.3 I<sup>2</sup>C Connector

Type: DB9 Female - Used for I<sup>2</sup>C networking



1	NC	
2	SDA	Serial Data
3	SCL	Serial Clock
4	NC	
5	GND	GND
6	NC	
7	NC	
8	NC	
9	NC	

## 7. Technical Specifications

### 7.1 Physical and Environmental Specifications

Cabinet Dimensions	447.0 mm x 132.5 mm x 507.5 mm
Panel Dimensions	483 mm x 132.5 mm
Weight	17.5 Kg
Operating Temperature Range	-10 °C ÷ 50 °C
Humidity	90% Maximum, not condensing

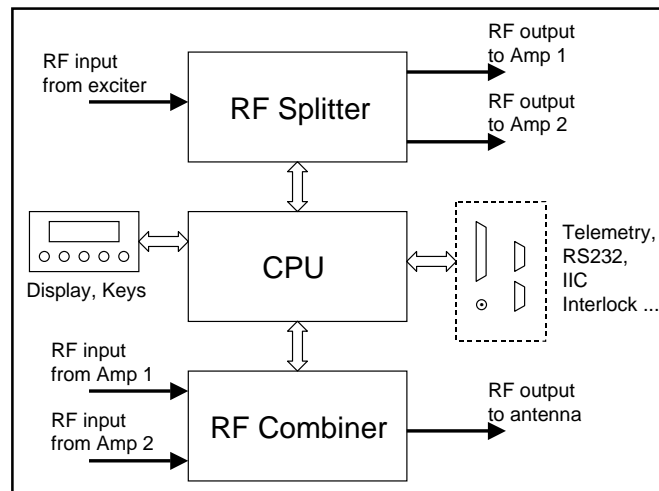
### 7.2 Electrical Specifications

AC power supply	117-230 V, 50-60 Hz	
Cooling system	forced ventilation	
Frequenci range	87.5 MHz ÷ 108 MHz	
Maximum output power	2 kW	HC2/2 version
	1 kW	HC2/1 version
Splitter section	Input impedance	50 Ohm
	Input connector	"N-type"
	Output impedance	50 Ohm
	Output connector	2 x "N-type"
	Adaptation	>16dB
Coupler section	Input impedance	50 Ohm
	Input connector	2 x EIA 7/8" HC2/2 2 x N-type HC2/1
	Output impedance	50 Ohm
	Output connector	EIA 7/8"
	Losses	< 0,25 dB per chann.

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## 8. Internal Description

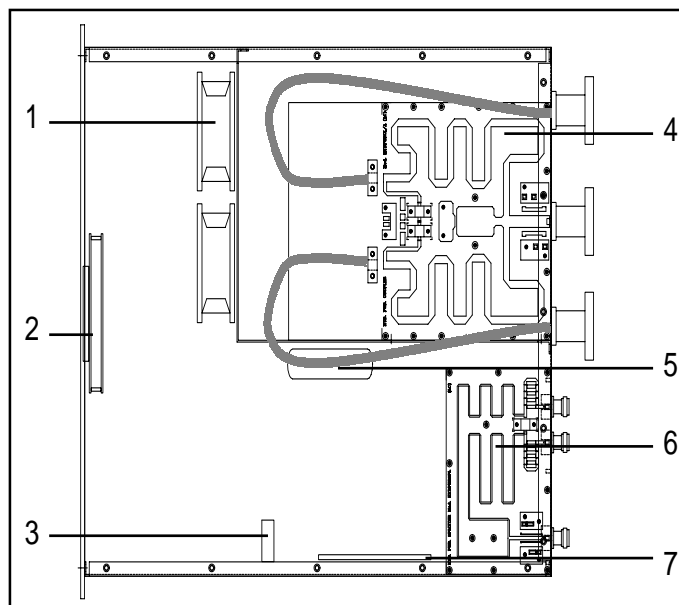
The hybrid coupler HC2 is a modularized device, in which different section are designed to perform a particular function.



This chapter give the necessary indications to identify the modules and to understand their functionalities.

### 8.1 Modules identification

The following figure represents a schematic upper view of the hybrid coupler. The different components are given in the following.



- 1 Fans
- 2 CPU section
- 3 Fans control relay
- 4 RF combiner
- 5 Transformer
- 6 RF splitter
- 7 Remote board

## **8.2 Modules description**

### **8.2.1 Power supply**

The power supply of the HC2 uses a mains transformer (70 VA) with selectable voltage primary circuit (110-120-230-240V) and two secondary windings. The first is a 3A 0-16V used to supply the remote card, the second is a 2A 11.5V that gives power to the CPU section.

The CPU section and the remote card have built-in bridge rectifiers and voltage regulators.

The mains transformer has also the function of an autotransformer for the supply at 115V of the fans.

The CPU section can also be supplied with external 24V dc; this power source is automatically selected by it if the main voltage is missing for any reason.

### **8.2.2 Splitter Section**

The role of the RF splitter is to divide the RF signal provided by the exciter and to pass it to the couple of amplifiers.

The circuit is based on a Wilkinson-type scheme and is designed with strip-lines and coaxial cables. It includes the circuits to adjust the phases of the output feeding the external amplifiers, to maximize the overall output power and to minimize the rejected power.

The splitter includes a resistive termination that dissipates possible unbalancement power due to faults or different performances of the amplifiers.

### **8.2.3 Coupler section**

The function of the coupler section is to add the RF power portions provided by the amplifiers and to pass it through the antenna output.

The circuit is based on a Wilkinson-type scheme and is designed with strip-lines and 50 Ohm coaxial cables.

The coupler section includes resistive terminations mounted on the heat sink that dissipate possible unbalancement power due to non-optimal adjustment, different performances of the amplifiers, or any malfunctioning in the transmitter.

### **8.2.4 Remote Board**

This board is installed on the right side of the device. It is controlled by the CPU, and its function is to cut the power in the auxiliary mains plug in case of alarms.

### 8.2.5 CPU

This subsystem is composed of three parts: the CPU board in itself, the analog section and the interconnection and the EMI filter board.

This section implements all the software functions described in the previous part of the manual (measurement, protection, controls, data visualization, communications). The analog circuitry normalizes and measures the different parameters that are monitored by the device.

The CPU board interfaces itself with external devices using a special telemetry connector, a RS232 serial port and a IIC port.

### 8.2.6 External telemetry board (optional)

This optional device is designed to interface itself with the telemetry connector of the HC2, and its function is to give to the user a set of dry contacts connected to the working status of the machine. The contacts can be configured as Normally Open or Normally Closed and are triggered by the user settable thresholds, and by LOC/REM, WAIT, FAULT, ON, OFF, INHIBIT.

The user input (ON, OFF, ALARM RESET, INHIBIT) are also interfaced in this board using dedicated relays. The relays can be supplied either by the HC2 or by external power and for each user input a contact is provided that shall be shorted to ground to activate the signal.

ON, OFF and ALARM RESET are impulse type inputs, INHIBIT is a permanent type input: while it is grounded, the machine is inhibited and as soon as it's released the coupler (and the whole transmitter) is reenabled.

All the digital input and output are provided to the user on a socket.

The analog signals generated by the hybrid coupler are replicated on a DB connector hosted on the telemetry board.

## 8.3 Adjustment

The hybrid coupler is factory-adjusted so that the transmitter it is included in will work satisfyingly works over the whole FM band.

Cases may happen, that it is necessary to perform the RF adjustment of the HC2, for example if the RF interconnection cables with the amplifiers have been substituted with other of slightly different characteristics or length, or if it is desirable to optimize the transmitter's performances on a certain frequency.



**WARNING: we suggest not to perform the operations described in this chapter to personnel lacking proper instrumentation and deep knowledge of the device and its working principles.**

The variable capacitors used to adjust the phases in the HC2 can be installed in

two different positions, depending on the machine's version:

- directly on the splitter circuit
- on two printed circuits boards that can be accessed from the front panel of the coupler

In general, the rightmost capacitors are the ones used to adjust the RF path related to the amplifier connected to the rightmost output connector of the coupler. For reference, see the scheme silk.graphed on the rear panel of the HC2.

To efficiently adjust the capacitors, it is essential to use an isolated tool, e.g. a plastic screwdriver.

The following procedures are optimized for adjusting the coupler in both cases.

### 8.3.1 Capacitors on the splitter circuit

- 1) Remove the upper cover of the coupler
- 2) Switch on the transmitter, having the exciter set on the working frequency and at minimum power
- 3) On the coupler, set the display for the visualization of forward power
- 4) Set the variable capacitor in their middle position (Figure 3)
- 5) Gradually increase the exciter power until the overall output power of the transmitter reaches around the 80% of its nominal power
- 6) Adjust the variable capacitors (1) and (2) (Figure 4) related to the amplifier "A" (see the silk-graph on the rear panel of the coupler for reference), to maximize the forward power measured in the coupler

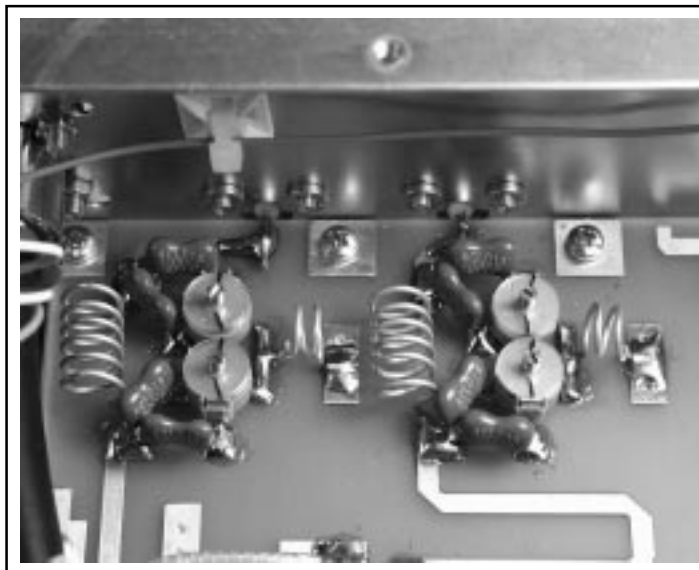
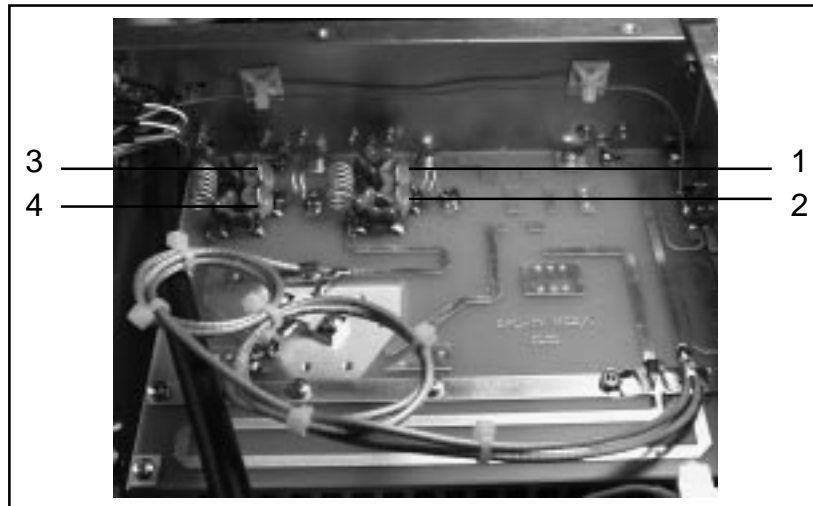


Figure 3

- 7) Adjust the variable capacitors (3) and (4) related to the amplifier "B", still maximizing the forward power measured by the coupler





*Figure 4*

- 8) Repeat steps 6 and 7 until the transmitter's power reaches a value that cannot be further risen
- 9) Increase the exciter power and verify that the system can reach the station's nominal power
- 10) Switch off the transmitter
- 11) Put in place again the coupler's upper cover

**Notes:**

- The described procedure is the one optimized to adjust the coupler to work on a certain channel (frequency). When the coupler has to be adjusted on the whole FM band, start executing the procedure at 98.0 MHz, and then repeat it at 87.5 MHz and 108.0 MHz, until the best tradeoff is met.
- If the adjustment is done because one of the amplifiers has been substituted, it is normally sufficient to operate only on the capacitors related to the substituted amplifier.

### 8.3.2 Capacitors accessible from the front panel

The procedure to be followed in this case is the same as the previous one, with the following different points:

- It is not necessary to remove the cover of the coupler: the trimmer can be directly operated from the front panel through the holes intended for the ventilation air flow (figure 5)

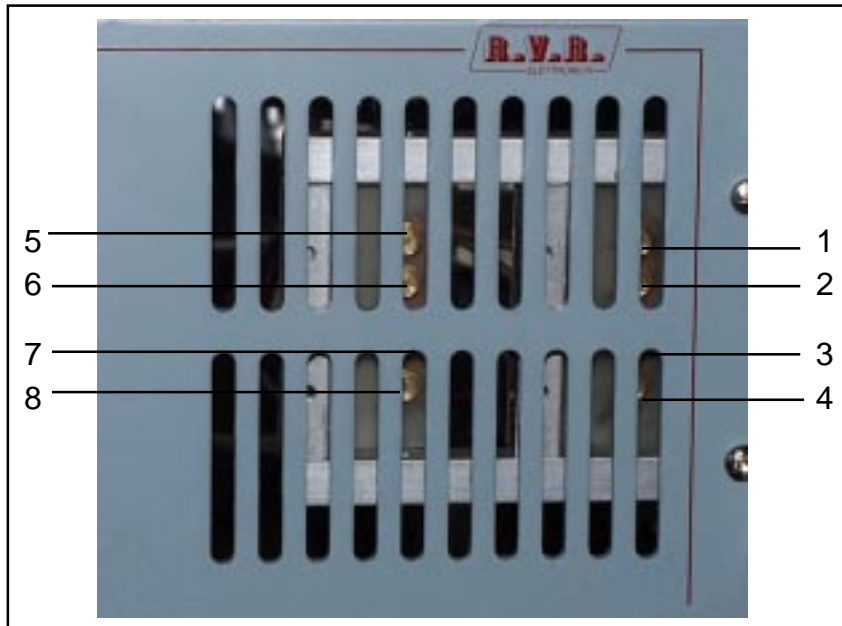


Figure 5

- For each amplifier, two *couples* of variable capacitors are present:  
1,2,3 and 4 for the amplifier “A”, 5,6,7 and 8 for the amplifier “B” (see the silk-graph on the rear of the coupler for reference).
- Please remember to use an isolated screwdriver to adjust the capacitors to avoid misadjustments due to short-circuits.