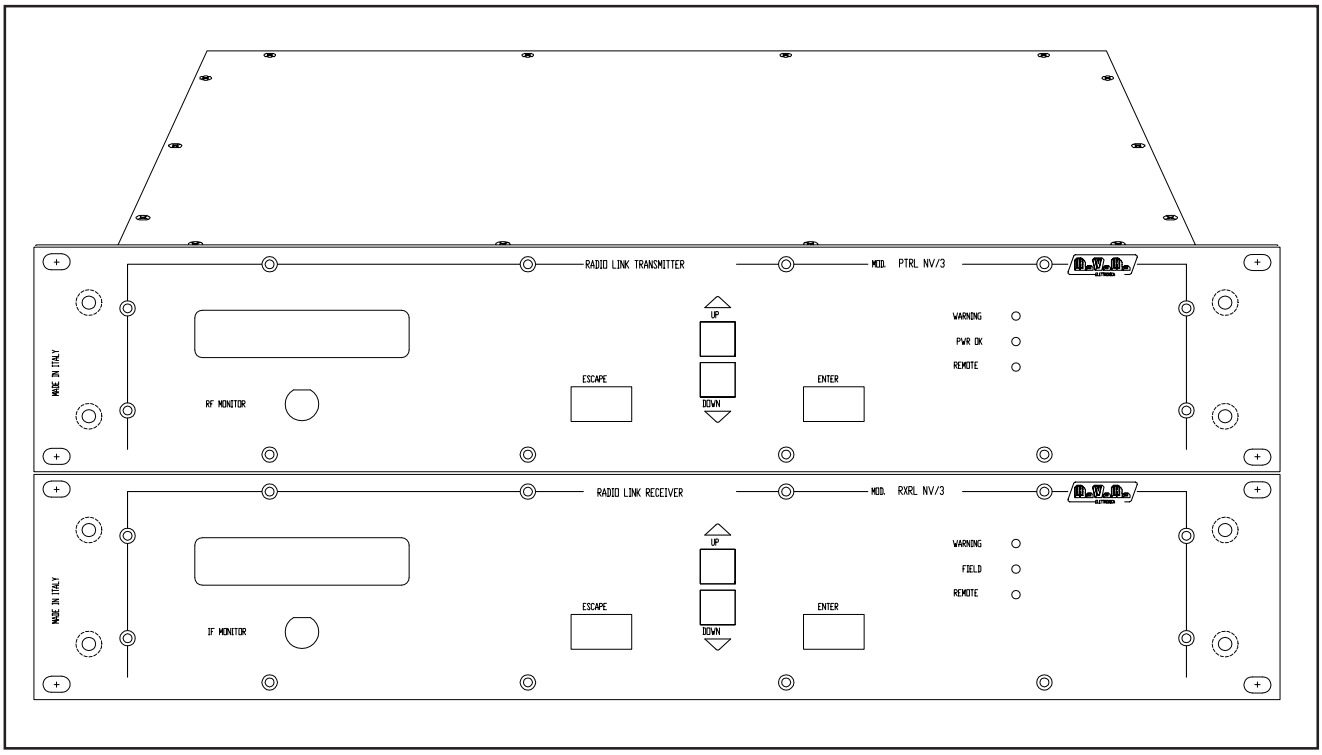
PTRL NV/3
& RXRL NV/3



User Manual

Volume 1

Manufactured by R.V.R. ELETTRONICA **Italy**

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PTRL NV/3 & RXRL NV/3 - User Manual
Version 1.0

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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 freuency, 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, well conscious of the risks connected with the operation of electrical 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. Elettronica SpA 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.

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

WARNING: this device can irradiate radio frequency waves, and if it's not installed following the instructions contained in the manual and local regulations it could generate interferences in radio communications.

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.

2. Warranty

Any product of **R.V.R. Elettronica** is covered by a 24 (twenty-four) month warranty.

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

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

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.

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. Elettronica** within **5** (five) days from delivery date.

To claim your rights under this warranty, you shold follow this procedure:

1 Contact the dealer or distributor where you purchased the unit. Describe the problem and, so that a possible easy solution can be detected.

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.

2 If your dealer cannot help you, contact **R.V.R. Elettronica** and explain the problem. If it is decided to return the unit to the factory, **R.V.R. Elettronica** will mail you a regular authorization with all the necessary instructions to send back the goods;

3 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

4 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 ordered 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 the victim is not responsive

Follow the A-B-C's of basic life support.

- Place victim flat on his backon a hard surface.
- Open airway: lift up neck, push forehead back (**Figure 1**).

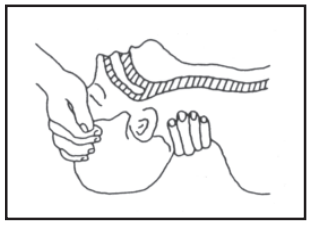

Figure 1

- clear out mouth if necessary and observe for breathing
- if not breathing, begin artificial breathing (**Figura 2**): tilt head, pinch nostrils, make airtight seal, four quick full breaths. Remember mouth to mouth resuscitation must be commenced as soon as possible.

Figura 2

- Check carotid pulse (**Figura 3**); if pulse is absent, begin artificial circulation (**Figura 4**) depressing sternum (**Figura 5**).

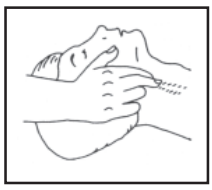

Figure 3

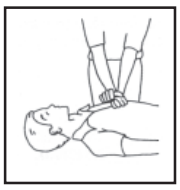

Figure 4

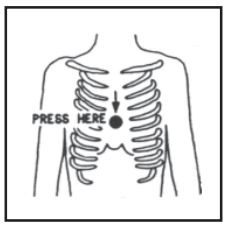

Figure 5

- In case of only one rescuer, 15 compressions alternated to two breaths.
- If there are two rescuers, the rythm shall be of one brath each 5 compressions.
- Do not interrupt the rythm of compressions when the 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.
- 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

- 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. Unpacking

The system is made up of the **PTRL NV/3** transmitter and the matching **RXRL NV/3** receiver and is designed to achieve a high-quality radio link for broadcasting and FM repeaters.

This radio link series operates in a broad range of frequencies, from the UHF up into the SHF band. While offering the same appearance and basic features, certain internal components may vary as required to cover the different frequency bands. Normally, such components are the local oscillator, power RF amplifier, receiver front end and input and output filters.

This model is designed to operate in the 1400 to 2600 MHz band. This band is divided into several sub-bands which must be specified on order so the components can be calibrated appropriately at the factory. The maximum amplitude of each sub-band is limited to a few tens of MHz, depending on frequency. The equipment may be set for varying frequencies and powers within each sub-band in the field.

The equipment is digitally controlled and all operating parameters can be programmed from the front panel or remotely. The alphanumerical display lets you control and fine-tune modulation, sensitivity and BF output levels, power, as well as other operating parameters. Such information is brought to same RS232 line that can also be used to remote-control the transmitter. In addition to the serial I/O line, some signals are also brought to a separate parallel I/O port to facilitate interfacing with other analogue controls or monitoring systems. A three-level password protection system ensures excellent security and privacy protection, to suit specific user requirements.

As provided for by several international standards, the transmitter incorporates advanced audio filters on mono and stereo channels as well as a fast-acting modulation limiter with a setting range from 75 to 170 kHz which may also be disabled. Input and output BF levels can be fine-tuned throughout a broad range using 0.5dB steps variable attenuators. The transmitter also features an auxiliary input specifically designed for RDS or SCA coders. A modulation monitor output enables accurate external control or lets you use the same high-quality MPX signal processed internally to control other transmitters or radio links. The equipment is also compatible with external digital audio coder/decoder systems.

Optional high-quality stereo coder or decoder boards may be installed at the factory or retrofitted by the customer in the field at a later time, with just basic technical skills required for installation. The powerful internal software will recognise the new board and enable its functions.

The last-generation universal switching power supply accepts mains voltages between 95 and 250Vac. A 24V input for trickle-charge backup batteries is also provided.

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5. Installation and configuration procedure

5.1 Foreword to Installation

Install the equipment in a dry, well-ventilated room and away from dust; room temperature should be between + 10 and + 35 degrees °C. The units accept a wide input voltage range (95 to 250Vac) with no need for any special setup procedures.

Provide adequate cables and connectors to connect the antenna and audio signal connectors and inspect them at regular intervals. The audio signal requires the same precautions as a common hi-fi system, so make sure to avoid ground loops. Follow the above indications to ensure proper operation and performance.

The transmitter is adequately shielded and can be installed near the production studio with no adverse effects on audio equipment. This layout conveniently enables continuous monitoring of audio level parameters, deviation and power parameters. On the other hand, the transmitter is normally installed well away from the studio and the notable length of BF coaxial cable required in this layout does not affect modulation quality.

Do not place the equipment in racks exposed to heavy vibration or magnetic fields, such as large-size power amplifier transformers, to avoid adverse effects on modulation quality.

Final modulation level is dependant on overall system layout and must be considered at the project design stage. Some useful suggestions can be found in the relevant paragraph in this manual.

5.2 System connections

1) Use a 50 Ohm shielded cable of adequate quality to connect the antenna connector. Use only low attenuation cable (such as Celflex or equivalent ½'' cable). A poor quality cable will attenuate the outgoing or incoming RF signal exceedingly.

2) Connect BF inputs as required for specific operation (more details are provided in the next sections). If needed, connect the serial and/or parallel remote control to the I/O ports - or you may skip this step and perform this connection at a later time.

3) Connect the units to the mains and the earthing system and power them on. The display will switch on and the units will run a system and LED check-up. The units are ready for operation within 20-30 seconds. If all connections were performed properly, output power is set correctly and a signal is present at the receiver antenna, the following lights will come on:

- Green ''*On the air*'' light on the transmitter.
- Green ''*Field*'' light on the receiver.

4) Review and set operating parameters, such as frequency, power, BF input sensitivity and output levels and so on, from the keyboard.

5) The units come with the first two security levels disabled (see ''*password* management''). This enables access to all necessary functions. If the user has limited access rights, the unit may prompt for a password and provide limited access to programming functions unless the password is entered.

Entering the *passwords* when you first power on a brand new unit is very important. At least the third (highest) level *password* must be modified **immediately**: for security reasons, this *password* cannot be modified in the event it has been changed by unauthorised personnel or if it is lost, and the equipment may become unserviceable. **The only way to gain access to the unit is to have it reprogrammed at the factory or to have the internal CPU replaced**. For this reason, write down the *password* immediately and store it in a safe place; once it has been set and confirmed, it cannot be retrieved from the unit. Basically all parameter settings require the second level *password*, which may be used for standard service requirements. The main purpose of the third-level password is to enable the user to maintain control over lower-level *passwords*.

6) Units are tested at the factory; however, it is a good rule to run an overall system check-up using adequate equipment. Be sure to check that input signal strength is sufficient and ensure that output and input spectrum is clean using a spectrum analyser.

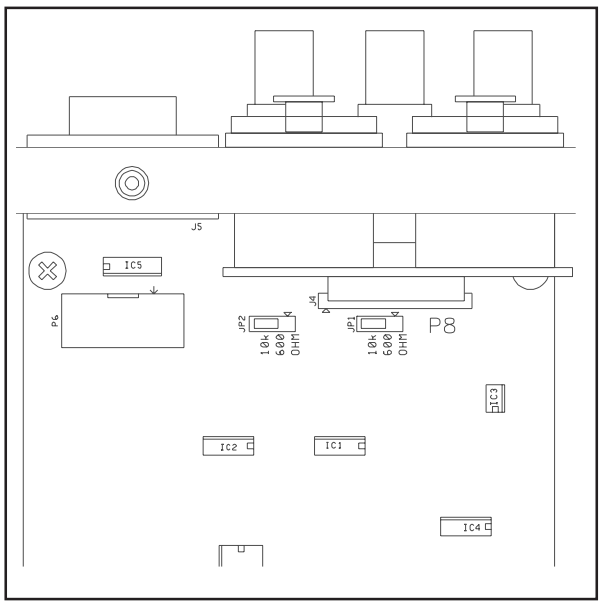
5.3 Presettings and BF Connections

5.3.1 Selecting BF cable and impedance

Units support balanced or unbalanced input and output signals, with internally selectable 600 Ω or 10 kΩ impedance. Factory setting is10 kΩ.

Transmitter input impedance is one of the very few settings which may only be done internally. To this end, remove the top cover to gain access to unit internals. This operation involves no hazards, however, you must disconnect the units from the power mains before proceeding.

Input impedance is easily set by appropriately selecting the jumpers JP1 and JP2 on the input board, right behind the input connectors as shown in the figure on the right. Impedance settings (600/10k ohm) are printed on the board.

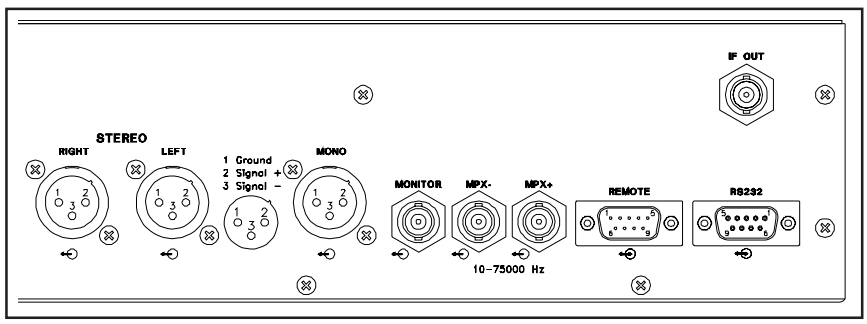


Input board with impedance jumpers.

Mono or stereo BF inputs feature female "XLR" connectors. These connectors must be connected to the output of the *mixer* or of any audio processor controlling the transmitter by connecting a balanced coaxial cable to pin 3 (-) and pin 2 (+). Cable shield is connected to the audio drive device ground and must be connected to pin 1. Likewise, connect mono and stereo audio outputs to the male "XLR" connectors of the receiver.

If you opt for unbalanced signal drive, short input pin 3 to ground and shield to pin 1, and bring signal to pin 2. In this case, highest impedance setting will be 5 kOhm instead of 10 kOhm. With balanced audio signals, source or transmitter connection cables may well exceed a 100-metre length.

A stereo MPX signal or a - normally unbalanced - signal processed externally may be connected to the female BNC connector marked "MPX" which is internally connected to the RIGHT channel connector in parallel: as a result, signals cannot brought to these two connectors at the same time. Again, the highest impedance setting will be 5 kOhm.



RF, BF and receiver control I/O connectors

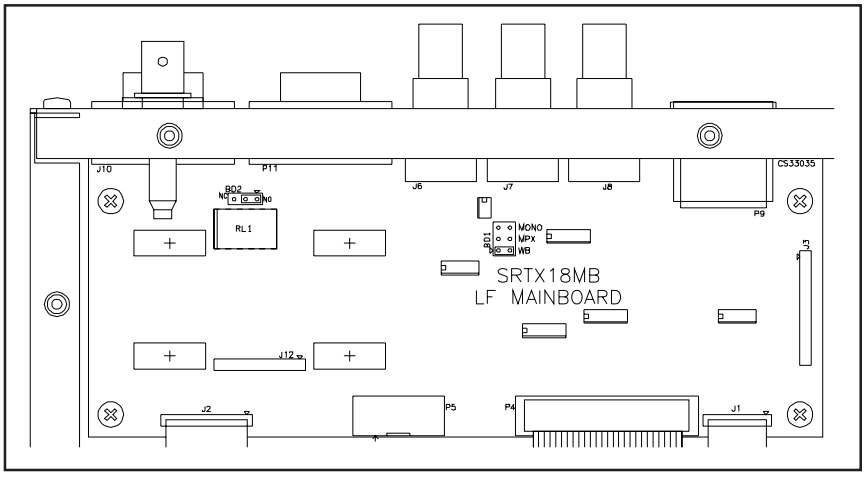
The receiver features two push-pull MPX outputs at two different BNC connectors. These outputs may be used to drive two different transmitters separately, bearing in mind that one of the two connectors will feature a phase-inverted signal. Or the two outputs may be used for a balanced connection.

A 50-ohm (RG58) cable is recommended for connections to BNC inputs/outputs up to few metres in length; for distances longer than a few dozen metres, you may also use 75-ohm (RG59) or 92-ohm (RG62) cable.

The auxiliary channel connector is a female BNC connector with grounded shield, like the receiver "MONITOR" connector.

With the appropriate internal setting, you may bring the MPX signal to the MONITOR connector to obtain a third MPX signal output; other options for this connector are the FM demodulator broadband output or the processed mono signal to achieve a second, unbalance output of this type.

For output selection, please see the figure at the side showing the audio output board with the selection jumpers and the three different settings available.



Detail of receiver mainboard with setup jumpers

5.3.2 Preemphasis

The low-frequency audio signals of mono and stereo channels need to be appropriately preemphasized. Standard preemphasis is 50 and 75 µs, factory setting usually is 50 µs. Factory setting is the standard preemphasis used in all European countries; ensure that it meets local requirements. FCC standards in use in North America require 75 µs preemphasis.

If you need to change factory setting, enter the new setting from the transmitter setup menu.The same is true for the receiver. The preemphasis/deemphasis network will affect the Mono and Stereo input or output channels, but not the MPX or broadband outputs.

5.3.3 Setting the transmitter BF input level

In the following paragraphs, 0dBm is treated as the audio signal producing 1mW on 600 ohm, i.e. a sinusoidal waveform with 775mVeff / 2200mVpp amplitude. For the purpose of our discussion, 0 dBm will be considered as the BF signal with + or - 1100 mV peak, regardless of impedance and of whether the signal is not a sinusoidal waveform.

Likewise, when discussing modulation, 0 dB will be treated as the signal producing 100% of maximum modulation allowed, i.e. 75kHz deviation. There are no world standards establishing the input level of a transmitter modulation signal for peak value or mean deviation. Many broadcasting stations use a 0 or +6dBm BF peak level for 100% modulation (mostly +10dBm in the USA). Many European countries require +6dBm at 40kHz deviation, which is considered as a "mid" deviation level. This gives a 5.5 dB margin for 75kHz, i.e. +11.5 dBm for 100% modulation.

Higher levels reduce system and ambient noise. Too high a level might overload the transmitter input circuits, reducing distortion-free dynamic field below normal levels. In addition, obtaining a good-quality, very broad signal may prove costly.

R.V.R. recommends to choose a nominal peak level for audio modulation between +6 and + 11.5 dBm wherever possible. The factory setting used for R.V.R. units is a +6dBm reference level.

To achieve 100% modulation, the transmitter permits BF input level on main channels to be set within a -3.5 to +12.5 dBm range, which only affects modulation efficiency moderately, while providing a good quality signal. Even at the highest level, at least a +6dB margin, i.e. a deviation up to 150 kHz is acceptable without causing distortion. Obviously enough, the limiter threshold should be set to maximum level so as to avoid distortion; however, this kind of deviation is not allowed or accepted by any transmission standards.

Auxiliary channel level can be set within a -12 to +4dBm range to obtain 10% modulation, i.e. 7.5kHz deviation. As a result, input levels for an SCA signal (10% of maximum deviation allowed) may be set to within 0.2 to 1.0Veff (566 ÷ 2830 mVpp), when the input is set for a nominal sensitivity between -11.5 and +2.5 dBm. Likewise, an RDS signal (2kHz standard peak deviation) may be set to within 0.052÷0.33 Veff (150÷930 mVpp) to give full modulation. If you wish to set deviation to higher than standard levels (some Radio Authorities require a deviation determined by the RDS signal as high as 3 to 4 kHz instead of the generally accepted 2kHz), you will have to increase signal level or auxiliary input sensitivity accordingly.

Setting nominal input level for 0dB modulation in the transmitter is an easy task. The field in the appropriate menu shows how modulation changes as you set input level in 0.5dB increments. Modulation is expressed both in kHz as absolute deviation, and in dB for 75kHz. In this measurement, displayed deviation includes all other auxiliary signals, such as pilot tone, if stereo, and RDS / SCA signals if relevant. To measure the input signal of audio channels alone, go to the LEFT/RIGHT channel level menu.

Auxiliary channel level is also very easy to set, as it is also shown as deviation in kHz or as sensitivity in dB. Please note that, in this case, 0dB equals 7.5kHz deviation, i.e. 10% of total standard modulation. As a result, the level for the RDS coder will turn out to be -11.5dB for the corresponding 2kHz deviation. The reading shown in this menu field reflects deviation as determined by the auxiliary signal only. To observe additional effects on total deviation, go to the MPX menu.

Because of the special characteristics of the RDS signal and the measurement method, auxiliary channel modulation readout is slow to respond to changes. Allow some time for the reading to become stable: correct reading will be the highest reading shown among those fluctuating by a few tenths of dB.

The limiter incorporated in the transmitter is of the clipping type: as soon as it kicks in, modulation distortion will increase significantly, so it is a good rule to keep the signal under control to prevent the limiter from kicking in. However, limiter operation is hardly appreciable when it kicks in rarely.

Normally, the limiter is disabled at the factory. However, recommended setting for the limiter operation threshold is +2.5 dB (100kHz peak value). Threshold setting range is from 0dB (75kHz) to +7.1 dB (170 kHz). This setting is often established (mandatory) by national standards and acceptance of short overmodulation peaks varies from country to country. In some countries, it is forbidden for users to disable the limiter or modify its level. It should be noted that limiters will kick in shortly after the calibration level, never before it. The difference between threshold level and operation at full capacity (hard clipping) is about 0.5 dB, i.e. deviation 3-4kHz above the threshold.

Under Italian law, the limiter must kick in at over 75kHz. This transmitter conforms to Italian law requirements when the limiter is set to +0.5dB (80 kHz). Under these conditions, the limiter produces a signal with 1 dB (85 kHz) maximum deviation compared to nominal deviation, when a modulating audio signal with +6dB overload is applied. Users who adopt less stringent limiter settings do so under their sole responsibility.

Anyway, the internationally accepted peak modulation for FM transmission is 75kHz for longer peaks. For this reason, limiter operation threshold should never be set too high, and users are advised to use an external multi-band limiter to achieve optimal modulation, as this will provide greater tolerance in the event of audio signal peaks.

This type of limiter temporarily reduces amplifier circuit gain whenever the threshold is exceeded, so as to avoid heavy distortion.

Any external compressor, limiter or audio meter must be frequency compensated with the same time constant used for preemphasis, so as to ensure correct deviation modulation or control.

The transmitter provides extremely flat audio response, without any appreciable drop at high or low audio frequencies; for this reason, we advise against making significant changes to spectrum content at the different audio signal frequencies using the so-called frequency equalizers. Unless limited to a few dB, an increase in the low and high frequencies contained in the audio signal may lead to an overall degradation of modulation or improper limiter operation.

5.3.4 Setting the receiver BF input level

Just like the transmitter, the receiver offers a broad range of setting options for the output signal, which may be set from the front panel.

Main outputs MPX and Mono outputs are driven by the same level, which can be set from -1.5 to +12 dBm in 0.5 dB steps. The Broadband Monitor output or the output of the stereo decoder (if fitted) use a fixed +6dBm level.

5.3.5 Functionality of Remote-Control

Both units of the radio link provide full control of transmission and reception parameters from the keyboard and the front panel display. Remote access to the same functions can be achieved via the RS232 serial ports at the rear of the units. Remote access via the serial port requires a dedicated software that is not supplied as standard (a demo is included in the scope of supply).

A parallel port is also provided in addition to the serial port to obtain access to certain signals and control lines. Both ports and the relevant signals are discussed below.

5.3.6 RS232 port

The RS232 port only handles Tx and Rx data signals and their return within the RS232 standard, with no handshake signal. Because these signals are inversely connected to the port, a simple pin-to-pin serial cable needs to be connected directly to the suitable connectors, typically a DB9 or a female DB25 connector at the matching PC port and a male DB9 connector at the transmitter end. A communication software is also necessary. Do not connect the cable when the PC or the transmitter are on.

5.3.7 Remote-control parallel port

At this port, some lines are brought to a male DB9 connector so the units can be controlled directly through an external system controller. The lines are listed below:

5.3.7.1 Transmitter

- Pins 1, 5 and 8, ground.
- Pin 2, on-the-air signal: a high logic state (+ 12V with 10kW) indicates that the transmitter is supplying significant RF power. This does not necessarily mean that level is correct.
- Pin 3, forward power: signal proportional to forward power with pseudo-quadratic like relationship. Variation range is 0-5Vdc with 1kW impedance. Full power voltage is around 3.5-4 V.
- Pin 6, RF output disable: when this line is grounded, the RF output is disabled. Maximum signal level is about + 12V/1mA.
- Pin 7, alarm: a low logic signal denotes an alarm. Correct operation is indicated by +12V on 10kW. Maximum input current draw from an external source is limited to <10mA.
- Pins 4 and 9, future expansion.

5.3.7.2 Receiver

- Pins 1 and 5, ground.
- Pin 2, ''*modulation presence*'' signal: a low logic state indicates that modulation is present on the incoming signal; a high logic state (+ 12V with 10kW) denotes no modulation. This option is software dependant and is not available on the current software release.
- Pins 3 and 8, field indication sufficient. These pins are connected to the contacts of a relay that is triggered by the incoming RF field. When the field exceeds the preset threshold, the relay changes state. An internal jumper lets you determine whether the relay is at rest with ''*normally open (NO)*'' or ''*normally closed (NC)*'' contacts. Factory setting is ''*NO*''.
- Pin 6, unit disable: grounding this line disables the main outputs of BF and the field indication relay. Maximum signal level at the pin is about + 12V/1mA.
- Pin 7, alarm: a low logic signal denotes an alarm. Correct operation is indicated by +12V on 10kW. Maximum input current draw from an external source is limited to <10mA.
- Pins 4 and 9, future expansion.

5.4 Modes of Operation

5.4.1 Mono transmission from mono audio source on main mono channel

1) Connect the RIGHT input connector of the radio link transmitter to the corresponding audio signal as described in section ''system connection''. Connection to the LEFT channel input is not necessary. The signal runs through the channel processor, is filtered at 15 kHz and preemphasized.

2) Select ''MONO R'' mode in the setup menu (see relevant section in this manual). Confirm preemphasis or choose the 50 or 75 µs setting as required.

5.4.2 Mono transmission from stereo audio source through internal coder (option)

1) Connect the RIGHT and LEFT input connectors of the radio link transmitter to their audio signals as described above. Applied audio signals run through the incorporated channel processor, are filtered at 15 kHz and preemphasized in both channels. The incorporated stereo coder will mix the stereo input signal to provide mono transmission. The transmitter is set up for stereo transmission, in the event it is necessary. All you need to do is select ''STEREO'' transmission mode in the ''MODE'' menu mentioned above.

2) Select ''MONO L+R'' mode in the setup menu. Confirm preemphasis or choose the 50 or 75 µs setting as required.

Note: The incorporated coder lets you choose if you want the sum of left and right channel, the left channel only or the right channel only sent in mono transmission. This option is set using the internal jumpers on the BD1 selector on the coder board (see stereo coder description in the service section of this manual). Factory setting is mixed left and right channels.

5.4.3 Mono or stereo transmission from external coder or other radio link receiver

1) This is a preemphasized ''Multiplex'' signal (MPX). Use the ''MPX'' input of the radio link transmitter. The signal will skip the filtering and stereo coding stages and requires no additional preemphasis.

2) Select ''EXT MPX'' mode from the setup menu. We recommend selecting the appropriate preemphasis as required (50 µs for Italy); this setting takes no effect in this mode, however the unit will be ready for the other operation modes.

5.4.4 Stereo transmission from an audio signal through internal stereo coder (option)

1) Connect the RIGHT and LEFT audio input connectors to the matching output of the stereo audio source. Signals are filtered at 15 kHz and preemphasized.

2) Select "STEREO" mode from the setup menu. Confirm preemphasis or choose the 50 or 75 µs setting as required.

5.4.5 Operation with RDS and SCA coders

1) Connect the "AUX" connector of the radio link transmitter to the output of the RDS or SCA coder. If you use the internal stereo coder option, connect the "MODULATION" monitor output to the "pilot tone" synchronisation input of the RDS coder, if available.

2) Change channel input sensitivity in the auxiliary channel sensitivity setup to obtain correct deviation. Adjust transmitter sensitivity and/or external generator level to achieve the required deviation as explained in the previous sections of this manual. Please note that a 0dB modulation (not input level) reading in this field indicates 10% of maximum modulation or 7.5kHz deviation, which is the default setting for the SCA auxiliary channel.

For the RDS coder, a -11.5 dB or 2kHz reading is the standard modulation value. At any rate, in this menu the deviation for the RDS/SCA signal alone is also shown in kHz, to avoid possible mistakes when converting the reading in dB. Many users use a slightly higher deviation than the standard 2kHz, i.e. set deviation to 3/3.5kHz to achieve a greater margin on FM receivers.

3) Modulation and total deviation can be viewed on the "MPX" display along with any other multiplex signal available at the time.

5.4.6 Final modulation adjustment

Check to ensure that overall modulation level is adequate as follows:

1) Select menu field "MPX" on the display: total modulation will be shown both in dB and as deviation in kHz. Display shows both an analogue bar indicator and a digital peak readout.

2) Send a sufficiently constant music signal to the modulation input; ensure that the reading is slightly less than 0dB and only exceeds this threshold occasionally by no more than 1 or 2 dB under any transmission programme conditions that can be

reasonably expected. Set mixer "MASTER" volume so as to achieve this condition. Ensure that the transmitter internal limiter does not kick in, as this would cause a more or less appreciable distortion level.

If the limiter is set to slightly more than 75 kHz, it will kick in right above the 0dB level and modulation readings on the transmitter and receiver displays may not be much higher. **Factory setting dictated by law requirements for Italy is 80kHz (+0.5dB).**

5.4.7 Pilot tone control in stereo transmission

If the internal stereo coder is fitted, stereo pilot tone level cannot be modified externally; usually, it is preset internally for 9-10% modulation, (-21÷-20dB) which corresponds to specified standard 7÷7.5 kHz deviation.

If the stereo modulation signal is generated externally by a separate stereo coder, pilot tone may be measured when audio modulation and any other auxiliary signals are absent as follows:

1) Disconnect all signals from the external stereo coder input and all RDS or SCA signals.

2) Select "MPX" level on the radio link transmitter display and observe pilot tone (it should be the only signal left). As mentioned earlier, standard level is 9-10% (-21÷-20dB) and may be set accordingly at the external stereo coder as required.

3) Reconnect the signals you had disconnected previously.

5.4.8 Transmission at low power levels

The radio link transmitter cannot be programmed for output power levels below 0.5 Watt.

5.4.9 Radio link RX connection to next transmitter

Basically, the only connection between the two units is the receiver MPX output connection to the matching input of the next transmitter, which must be set to "External MPX" operation mode. Do not use the decoded "Mono" or "Stereo" outputs. No additional stereo coder is needed for stereo signal transmission; the coder available at the source station or at the radio link transmitter is sufficient.

Set the receiver output level and the input level of the next transmitter to obtain correct deviation.

5.4.10 Checking incoming field and noise

The receiver input signal must have sufficient strength to ensure proper receiver operation and good quality of the carried low-frequency signal. Quality being equal, stereo transmission requires a much stronger signal than mono transmission. Typically, signal needs to be 20dB higher.

Incoming field expressed in dBm may be viewed on receiver display. However, we recommend taking an accurate reading using a spectrum analyser.

The recommend incoming signal for good stereo reception is -50 ÷ -60 dBm, the equivalent of 200 ÷ 700 mV . On the other hand, an incoming signal in the -70 to -80 dBm range, i.e. 20 to 70 mV will be sufficient to provide good quality mono transmission when the reception channel is free from noise.

In spite of the high-quality front end circuitry and the input filters, the incoming signal needs to be reasonably clean in the reception channel. Perform a spectrum analysis to ensure that channel is clean (incoming frequency ±300 kHz). In addition, any strong signals falling within the input filter pass-band may cause the receiver to malfunction or damage. In the event there are other radio link transmitters nearby, ensure that the return signals from such transmitters to the antenna do not exceed -30dBm in the preset reception band, which is typically about 50 MHz. Any stronger signals up to -20 dBm require a verification to establish proper receiver operation under such conditions.

Providing an adequate margin for the incoming signal is important to compensate for possible fluctuation due to fading, multipath or added noise caused by adverse weather or ambient conditions. It is a good rule to provide up to 20-30 dB as a worst-case margin. In practice, however, this is hard to achieve.

5.4.11 "Muting" operation and setting and field relay

The receiver incorporates a muting circuit for the event the incoming field drops below a predetermined level. When signal is weak or missing, a strong white noise will be present at the receiver audio output, leading to severe inconvenience.

The muting threshold can be set from the setup menu; we recommend setting this threshold well below the incoming signal level. Recommended settings are -90 dBm for mono transmission and -80 dBm for stereo transmission (highly disturbed signal). Muting operation may be enabled or disabled from the menu.

Regardless of whether muting is enabled or disabled, an internal field relay will energise/deenergise upon reaching the set threshold; relay contacts have output connections to enable remote control.

5.4.12 System layout

In addition to meeting these connection requirements, a preliminary ambient verification is indispensable before installing the radio link in order to ensure the channel to be used is clean and establish correct optical visibility of transmission and reception sites. Any obstacle affecting used frequencies will impair correct reception.

All components, antennas and cables must be selected carefully and an adequate margin to compensate for variations in ambient conditions must be allowed to ensure good performance.

This study must be performed by expert, suitably trained personnel and is not covered in this manual.

Please do not hesitate to contact R.V.R. for any clarifications you may need or any issues relating to your specific application.

OPERATING THE TRANSMITTER WHEN DISCONNECTED FROM THE ANTENNA OR WITH A FAULTY ANTENNA CONNECTION MAY LEAD TO DEGRADED PERFORMANCE OR IRREPARABLE DAMAGE TO THE FINAL STAGE.

- SUCH DAMAGE IS NOT COVERED BY WARRANTY -

5.5 Operation on Batteries or DC Power Supply

Like all R.V.R. radio link systems, the pair of PTRL&RXRL NV/3 units features terminals for connection to an external backup DC power supply source in the event of mains failure. However, this is the first series to be supplied with an incorporated battery charger as standard. These terminals are for a 24Vdc nominal voltage with negative connected to ground and accept input voltage in a 22 to 28 Vdc range in the event of mains failure. When mains power is available, they supply a steady regulated 27.6V to trickle-charge the batteries.

The main switch takes no effect on the battery power supply input, which is connected internally. There are no switches in series; a diode and an internal resettable fuse protect the batteries from polarity inversion.

If voltages in excess of 28Vdc are applied to battery terminals or current draw at the terminals exceeds the power supply for battery charging, severe damage to the equipment or its power supply unit may result.

5.5.1 Notes on the batteries and their connection

Any type of lead batteries with 24 V nominal voltage in a broad range of capacities may be used. Pricing and performance considerations suggest the use of sealed or normal batteries.

Normally, sealed batteries are well suited for small-size systems with 20-40 Ah capacity. Standard automotive batteries provide a low-cost alternative for larger capacities (40 to 100 Ah or higher). In the latter case, we strongly recommend installing these batteries in a well-ventilated place, as the charging process produces acid gas which may damage electronic components and **the hydrogen generated by the hydrolysis process may create an explosive atmosphere** if it is not removed.

The terminals of 2 or more PTRL&RXRL NV/3 systems may be connected in parallel to the same battery assembly, as long as all internal regulators are properly set to 28.6±0.1V (factory setting). In this case the power supply units will operate in parallel, which benefits system redundancy, and both will provide a higher charging current than they would supply individually.

Lead batteries are typically rated 12V; this application requires two such 12V batteries connected in series. Use cables with adequate thickness to connect the batteries to each other and to the units. Normally, 1 sq mm wires will suffice; larger cross-section areas may be required if wiring connections span long distances.

Ensure the batteries can supply the system for the maximum expected duration of mains failure events. Do not let the batteries run flat or permanent damage may result. The battery controller disconnects the batteries when voltage drops below 22V; however, the control circuits will draw a test current of about 10-15mA during a mains failure event. However low, such current draw can drain the batteries over time in the event of prolonged mains failure. To avoid draining the batteries, disconnect them if the equipment is to remain powered off or disconnected from the mains for prolonged periods of time.

5.5.2 Estimated battery life

Battery installation and life are not covered in this manual; do not underrate this matter and refer to specific literature and to the battery manufacturer instructions. Thanks to the incorporated battery charger, for most applications the user will simply need to provide the external batteries with a little extra cost.

Following are a few suggestions:

- Choose batteries with minimum current capacity at least 4 up to 10 times average current draw,

- Never let the batteries drain completely; this may happen when mains power remains disconnected for several days or weeks.

If these basic rules are observed, the service life of your batteries may span 2 up to 5 years, depending on quality, service duty and operating temperature (power output will be lower at low temperatures, but battery life will be extended).

5.5.3 Back-up and charging time

Back-up time may be easily estimated based on the following assumptions:

- Manufacturers typically rate the nominal capacity of a battery with steady current discharge at 20, or rarely 10 hours.
- For discharge rates greater than 20 hours, capacity will be reduced by a certain percentage. For lower discharge rates, capacity is increased. Typical capacity ratings are 70% of nominal capacity for 2-3 hours discharge time and 110% for 50 hours.
- Capacity will decrease over time and depending on usage, typically by 10-30% on a yearly basis.
- Maximum current output of charging equipment is estimated at 0.5-1 A for PTRL NV/3 and 1.5-2A for RXRL NV/3 when the batteries are nearly flat. Please note that trickle-charge voltage is virtually constant, not so the current. Full recharge time may prove long, spanning as long as several days, especially for large-size battery systems, with high discharge rates or in the event of severe heavy duty.

The example table is based on the above assumptions; it refers to an application comprising one PTRL NV/3, one RXRL NV/3 and a pair using back-up power supply from 3 different battery systems with new, fully charged batteries. Current draw is the typical rating of PTRL NV/3 transmitter operating on 5W at 2400MHz or on 10W at 900MHz. Higher output power values (for 900MHz only) may involve up to 20-30% more current draw, whereas lower power values may require 20-30% less current, for both frequency ranges.

	PTRL NV/3	**RXRL NV/3**	**PTRL NV/3 + RXRL NV/3**	EQUIPMENT MODEL
Typ. absorption	1.95	0.50	2.45	[A]
Batteries backup time 20 A/h	9	40	7.3	[hours]
Batteries backup time 40 A/h	20.5	85	16.3	[hours]
Batteries backup time 100 A/h	52	230	41	[hours]

5.6 Service and Maintenance

Radio link units use natural convection cooling and are not prone to clogging up with dust. Depending on ambient conditions in the place of installation, the unit may need cleaning; when this is the case, disconnect the unit from power supply and clean it outside using a soft brush and a wet cloth.

Equipment must be installed in a rack cabinet or on a stable mount, providing proper flow of air to the heat sink at the rear of the transmitter.

The equipment is constructed from high quality materials and will need no special maintenance for some time if the indications provided in paragraph "INSTALLATION AND OPERATION" are observed.

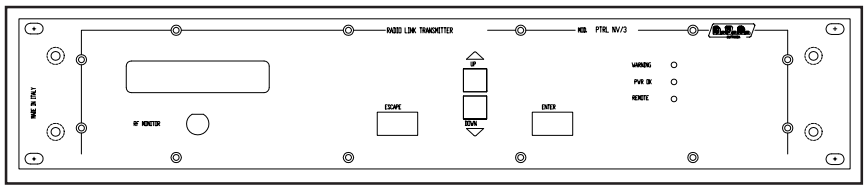
After a few years continuous duty, have the equipment inspected at the factory or a specialised centre to ensure it has retained its original specifications. Considering the high quality and accuracy of the components used, it is very unlikely that the equipment will need calibrating even after years of service (although it is possible that the performance of a few components will prove degraded).

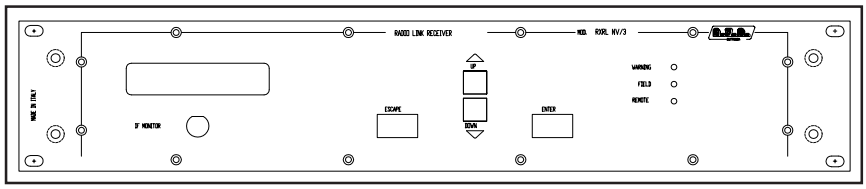
Do not alter the internal calibration settings or you will alter the performance data stated for the transmitter.

It is essential to have the power supply unit carefully inspected in the event the equipment has been working at high temperatures (higher than 30/35° C).

6 External Description

6.1 Front Panel





The transmitter and receiver units are housed in the same type of rack and look very similar when viewed from the front.

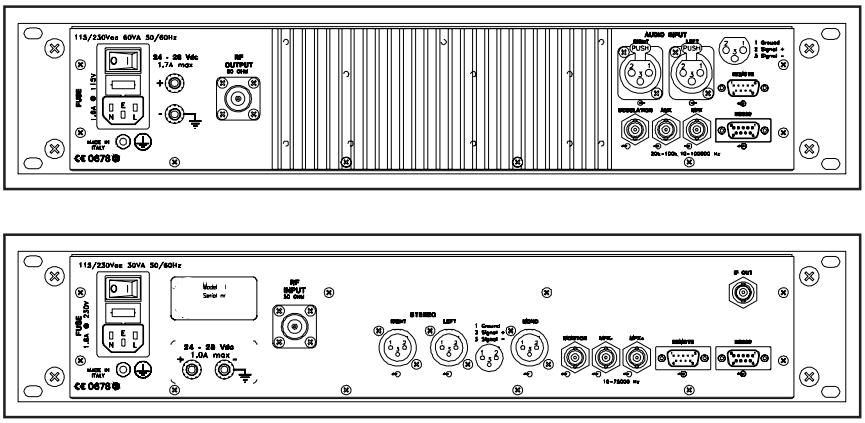
The front panels of **PTRL NV/3** and **RXRL NV/3** feature a simple design for the utmost user-friendliness in spite of the many functions they offer. The large alphanumerical display and the keyboard ensure simple, intuitive navigation through the various menu options.

Great care was taken to design the software with intuitive commands so as to facilitate operation and programming even in the event user is not fully conversant with the instructions provided in the manual.

Three warning lights provide real-time indication of proper operation and alarm states at a glance. Two of these warning lights are found in both units: these are the "Warning" light and the "Remote" control warning light. The transmitter also features the "On the air" light indicating that RF output power is available. Likewise, the receiver is equipped with a "Field" signal warning light that turns on to indicate adequate incoming field for proper operation.

The optional password management feature prevents tampering with optional functions and data at critical work stations by unauthorised personnel.

6.2 Rear Panel



The rear panel accommodates all inputs and outputs listed below:

On both units:

- IEC-320 mains power supply jack incorporating switch and mains fuses. Separate earthing screw and terminals for one 24V backup battery.
- Input/output jacks of audio channels at balanced XLR connectors.
- RS232 serial remote control port at female sub-D9 connector with inverted wiring.
- Parallel remote control port at male sub-D9 connector.
- Antenna RF connector, N-type.

Transmitter:

- Broadband input for externally processed stereo composite signal (MPX) at unbalanced BNC connector.
- Low-frequency (20÷100 kHz) auxiliary channel input at unbalanced BNC connector.
- BF modulation output for monitoring and synchronisation of external RDS coder or for rebroadcasting, at BNC connector.

  Please note that the central pin at the MPX signal BNC input is physically in parallel with the - input signal (pin 3) of the mono/right channel XLR jack. For this reason, the two connectors cannot be used at the same time

Receiver:

- Main MPX output at two BNC connectors with push-pull signal driving two separate transmitters or a single balanced transmitter.
- Filtered and de-emphasised mono signal output at balanced male XLR connector.
- One optional output for stereo decoded channels at a pair of balanced male XLR connectors.

- A buffered monitor output that can be connected internally to obtain an additional MPX output, or a broadband modulation output or a mono signal output.
- A BNC-type monitor connector for IF.

Please note that the units come ready to operate on a 95-250 Vac range.

7. Technical Specifications

- Factory preset frequency ranges:
  1429÷1433MHz 1510÷1530MHz
  1660÷1670MHz 2367.5÷2372.5MHz
  2440÷2.450MHz 2468.1÷2483.3MHz
  Other sub-ranges on request

- Modulation: FM, 75 kHz peak dev.
  180k F3E mono
  256k F3E stereo
- Synthesis step: 10kHz (215÷960 Mhz)
  100 kHz (1.4÷2.6 Ghz)

- Composite Mpx output response:
  15 Hz ÷ 67 kHz +0.1/-0.5dB
  <-6 dB @ 100 kHz
  <-20 dB @ 125 kHz

- Monitor output wide-band response:
  15 Hz ÷ 100 kHz +0.1/-1.5dB
  -3 dB tip. @ 125 kHz
  -6 dB tip. @ 160 kHz

- Mono/stereo decoded response:
  30 Hz ÷ 15 kHz ±0.2dB

- S/N ratio (30÷20000Hz rms):
  >70 dB, 76 tip. mono
  >66 dB, 72 tip. stereo

- Modulation distortion (100% dev.):
  @ 1 kHz
  mono <0.1% 0.03% typ.
  stereo, 1ch <0.30% 0.20% typ.

  30÷7500 Hz
  mono <0.25% 0.12% typ.
  stereo, 1ch <0.30% 0.20% typ.

- Stereo crosstalk (typical):
  >50 dB (400÷10000 Hz)
  >40 dB (100÷15000 Hz)

- I/O lines: Alarm, RF/LF disable,
  Low RF field,
  RS232 for monitoring and control

- Mains requirements:
  95 / 250 Vac 50/60 Hz
  22.0 ÷ 28.0 Vcc

- Operating temperature range:
  0÷35° C recomm.
  -10÷45 °C max.

7.1 PTRL NV/3 transmitter

- Frequency error: <2,5 ppM 3' from start-up
- Frequency drift: <1 ppM/year

- RF output power: 2W / 5W (1.4÷2.6 Ghz)
- Max allowed reflected power: 1W / 2W

- RF harmonic products: <-60 dBc
- RF spurious products: <-70 dBc, -80 dBc typ.
- RF output: 50 ohm, N connector

- Audio/Mpx input level: -3.5 ÷ +12.5dBm
  @ ± 75kHz deviation

- Audio/Mpx input:
  10k ohm/600 ohm, bal./unbalanced

- Common mode rejection:
  >50 dB, >60dB typ. (20÷15000 Hz)

- Audio input connectors: female XLR type

- Livello d'ingresso del canale ausiliario:
  -12.5 ÷ +3.5dBm @±7.5 kHz dev.
  -24 ÷ -8dBm @±2 kHz dev.

- Auxiliary channel input level: 10k ohm
- MPX and Aux channel input: BNC

- Monitor LF output:
  0 ÷ +10 dBm @ ±75kHz dev.

- Pre-emphasis time constant: 0/50/75 µs ±2%

- S/N noise ratio (30÷20000Hz rms):
  >70 dB, 76 typ. mono
  >66 dB, 72 typ. stereo

- Modulation distortion, 30÷15000 Hz:
  <0.02% @ 75kHz dev.
- Stereo crosstalk: >50 dB (100÷5000 Hz)
  >45 dB (30÷15000 Hz)
- Audio channels response:
  30 Hz ÷ 15 kHz ±0.1dB
- Out of band audio attenuation:
  >50 dB @ F>19 kHz
- Deviation limiter: 0 ÷ +7.1 dB, adjustable
- Mpx composite response:
  10 Hz÷100kHz ±0.1dB
- Auxiliary channel response:
  10÷ 100 kHz ±0.2dB
- I/O lines: RF disable, RF power,
  On-the-Air, Alarm,
  RS232 control and monitoring
- Mains absorption:
  50 Wmax @ 90 / 250 Vac (Po= 5W)
  80 Wmax @ 90 / 250 Vac (Po= 15W)
- Battery absorption:
  <1.8A @ 24 Vcc (Po= 5W)
  <3.0A @ 24 Vcc (Po= 15W)
- Dimensions, without handles: 19" 2 un. std. rack
  483 x 88 x 334 mm

7.2 RXRL NV/3 Receiver

- Noise figure: <10 dB
- Image frequency rejection:>50 dB 60 typ.
- Dynamic selectivity: >+10dB typ @ dF=300 kHz
  >+35dB typ @ dF=500 kHz
  >+45dB typ @ dF=1.0 MHz
- AM suppression: >45 dB
- Usable input level: -90 ÷ -10dBm
  (7mV÷70mV)
- Sensitivity (typical): Sin= -90dBm (7mV) mono
  (S/N=60dB) Sin= -70dBm (70mV) stereo
- IF monitor output: 10.7 MHz / 0dBm
- Wide-band demodulated output response:
  15 Hz ÷ 120 kHz +0.1/-3dB
- Wide-band demodulated output level: +6dBm
- MPX output level: -1.5 ÷ +12 dBm,
  0.5dB/Step
- Mpx output response:
  15 Hz ÷ 67 kHz +0.1/-0.5dB
- Mono or stereo decoded response:
  30 Hz ÷ 15 kHz ±0.1dB
- Out-of-band mono or stereo audio response:
  >50 dB @ F>19 kHz
- De-emphasis time constant: 0/50/75 µs ±2%
- S/N ratio (30÷20000Hz rms):
  >70 dB, 76 typ. mono
  >66 dB, 72 typ. stereo
- Modulation distortion @ 1kHz / 100% dev.:
  mono <0.1% 0.03% typ.
  stereo, 1ch <0.30% 0.20% typ.
- Stereo crosstalk: >50 dB (100÷5000 Hz)
  >45 dB (30÷15000 Hz)
- I/O lines: LF disable, Low RF field,
  Alarm, Lack of modulation
  RS232 control and monitoring
- Mains absorption:
  20 Wmax @ 90 / 250 Vac
- Battery absorption:
  <0.6A @ 24 Vcc
- Dimensions, without handles: 19" 2 un. std. rack
  483 x 88 x 334 mm

8. Operating principles

8.1 Description of transmitter componentry

The radio link transmitter comprises 7 internal modules shown in the "Assembly view drawings" and in the "Main wiring diagram" included in the annex to this manual. The following modules may vary depending on frequency range:

- Control and display CPU board
- BF and RF control mainboard
- Stereo coder board (option)
- Modulated oscillator board
- RF power amplifier
- Main power supply (mains power)
- Stabilised backup power supply and battery charger

For a detailed description of the modules discussed at the following pages, please refer to the relevant wiring diagram in the relevant section of the manual.

8.1.1 Control and display CPU board

In spite of its complex tasks, the transmitter controller board is basically simple. It houses the CPU, the keyboard and a few other circuits briefly described below.

The CPU has three 8-bit digital ports and one analogue port. The analogue port is interfaced with the analogue signals that need to be measured in the transmitter.

A fast peak rectifier built around IC4 drives the first analogue line *AN0/ANA_MUX*. All audio/BF modulation signals and some constant or slow-varying signals are multiplexed to this input by IC3. This way, a single, accurate peak rectifier is sufficient and a greater number of analogue channels are made available on the board.

An analogue channel carries the temperature reading of sensor T3.

The CPU queries the keyboard continually to determine whether any key has been pressed. Serial/parallel converter IC5 drives the front panel LEDs and display backlighting via TR2.

The alphanumerical LCD (Liquid Crystal Display) is a separate module connected to the board through a small flat cable. 11 digital lines of the CPU drive this module. Trimmer RT1 on the control board adjusts LCD contrast and may be used to improve visibility under particular lighting conditions. The operating current for the backlighting LEDs of the display is supplied by resistors R41 and R42; these resistors run hot when the display is fully lit and their heat may somehow affect the internal temperature sensed by TR3.

For this reason, the software will dim (but not turn off) display lighting a few seconds after the last command has been entered from the keyboard and will restore full lighting as soon as the next key is pressed.

No other adjustment is present on the board. Reading accuracy has been ensured at the design stage by selecting high-quality, accurate passive and active components, including the reference voltage generator IC1.

8.1.2 BF and RF Main Control Board

This is the most complex among transmitter boards; it controls the BF input signal process, with level regulation, filtering and audio limitation. It includes the RF control section and I/O (input/output) interfaces. Most transmitter modules are connected to this board via flat cables.

Its wiring diagram comprises two sheets which are discussed in a given sequence for better understanding. The first sheet shows the I/O interfaces, audio and digital ports and the RF control section. Let us take a look at each block shown in the diagram.

Shown in the top left portion of the diagram are the audio channel amplifiers/separators that consist in 6 operational amplifiers included in IC1 and IC2. Two impedance selector jumpers are located on the audio channel input circuit, and a protection network made up of resistors and diodes protects them from statics discharges as required by EC regulations. Next are four active unit-gain separators and two balanced to unbalanced signal converters that drive the next electronic attenuator.

The last operational amplifier in IC2(d) amplifies the auxiliary channel input with a flat pass-band within -0.1dB up to frequencies >>200kHz and drives the third channel of the electronic attenuator.

The lower left portion of the diagram shows the RS232 interface (IC5) and the parallel remote interface circuits with their protection network built around TR1, TR2 and TR3. Logic levels are <1V for logic 0 and +10-12 V for logic 1, with wired-or interface and resistive pull-up.

The RF power control circuit is shown in bottom right corner of the diagram. The forward and reflected power signals from the output directional coupler on the final amplifier are amplified by IC3 into symmetrical circuits.

The forward power control circuit built around IC4a continually regulates final stage gain by varying the polarisation voltage of RF output MOSFET transistors. The reflected power limiting circuit IC4b operates on the same regulation loop when the output voltage of IC3b rises above the voltage threshold set by the R49/R50 network. The third and fourth sections of IC4 filter and amplify the signal from the CPU, setting the reference level for the output power regulation loop. TR4 disables the RF output when the synthesiser is not locked to the correct frequency.

The top right portion of the diagram shows the connections and signals at the control bus connector connected to the CPU. The digital control lines are brought to the lowermost pins of this connectors, whereas the analogue lines are brought to the uppermost pins. The power supply lines also depart from this connector; however, only the +12.5V and -12.5V lines are used in this board and the connected boards.

Let us now take a look at sheet two of the diagram. The lower left corner shows the digitally controlled three-channel attenuator IC8. It controls the right, left and auxiliary channels separately. The external multiplex signal is processed in the right channel and then relayed without filtering and preemphasis. Each channel is monitored by 3 amplifiers IC7a, IC8a and IC12a. The output of the first two amplifiers drives preemphasis stages; the time constant of preemphasis stages may be digitally set to 0.50 and 75 µs via the analogue ports of IC9. The limiting stage is made up of diodes D8 and D9 that act as clippers. Limiter threshold levels +Vl and -Vl can be set by changing the reference voltage of the limiter driven by the CPU via IC13a. RT4, if fitted, dictates a maximum value for the limiting threshold.

The signal is sent to the input sections of the stereo coder circuit, if fitted (internally). At the same time, the signal running along the right channel path is sent to a low-pass filter which is made up of the circuit section built around IC10 and IC11 that attenuates any frequencies higher than 15kHz for the mono section.

IC14 selects the non-preemphasized signal coming from the input section via R124 or from the preemphasis and filtering section via R128 or from the stereo coder via R131. IC12b amplifies the selected signal and mixes it with the signal from the auxiliary channel. If needed, diode D17 provides further limitation for the final total signal. This signal is sent to the FM modulator circuit via buffer IC12c and adjusted to the level required by RT6. A separate section of IC12 amplifies the modulation signal separately and sends it to the modulation monitor output connector.

IC15 deserialises the commands sent by the CPU to control transmission channels with IC14 and preemphasis action with IC9. Two output lines of IC15 are used to drive the ''Alarm'' and ''On the air'' remote output lines.

8.1.3 Stereo Coder Module

The coder circuit uses an 8-stage sequential switching technique that ensures excellent performance coupled with simple circuit design. With this technique, the first harmonics associated with the switching process are the 7th and 9th harmonics (266 and 342 kHz); this simplifies the layout of the low-pass filter on the multiplex signal that eliminates these harmonics.

Above 15 kHz, the signal is filtered by the two precision low-pass filters built around IC1 ¸ IC4. The signal is then amplified by IC3d and IC4c and applied to the coder circuit IC8.

Next is another, higher-frequency low-pass filter that removes multiplex signal harmonics. Again, this filter is a high-precision active circuit built around IC5 and IC6. Another section (c) of IC6 provides for phase equalisation on the filtered signal. The four analogue switches comprised in IC7 let you select the mono signal or the stereo coder signal. They also achieve a slight variation of coder gain when toggling between the mono position (100% of audio modulation) and the stereo position (90% audio, 10% pilot frequency). Two jumpers let you select the left channel (L), the right channel (R) or the mean value of the summed channels (L+R) for mono operation, while the output level remains unchanged as the combinations vary. Both jumpers are present at the L and R positions to mix the right and left channels in the "MONOL+R" transmission mode (factory setting).

Circuits IC10 and IC11 provide the time base of the coder; IC9 synthesises the pilot frequency filtered and amplified by IC5a. A separate output with a 1Vpp signal is provided at connector J2 to enable carrier synchronisation on an external RDS generator (if fitted). However, this output is not connected externally to the transmitters of series PTRLxx5, as these incorporate a modulation monitor output the serves the same purpose.

8.1.4 Modulated Oscillator

Like the oscillator discussed previously, this oscillator is made up of a PLL circuit: in this instance, synthesisation step is 100kHz throughout the preset operation band.

The VCO operates in the 600 to 900 MHz frequency range with very low noise. It uses a FET transistor (TR2) as an oscillator modulated by varactor diodes D1 and D2. Again, typical modulation distortion is less than 0.03% with an excellent S/D ratio

The RF signal is separated and amplified by a sequence of amplifier microcircuits IC1÷IC3 that also provide a feedback signal for PLL. IC3 drives the TR3 transistor, that acts as a frequency doubler or tripler, as required by the final operating range. A subsequent band-pass filter centred around output frequency removes any residual spurious content from the signal.

Programmable synthesiser IC4 is very similar to that of the lower frequency oscillator, just like its temperature compensated time base TCXO1 operating at 12.8MHz.

IC5 acts as an error amplifier and loop filter, whereas the lock detector is built around IC6b.

8.1.5 Power Amplifier, Circulator and Output Filter

This module comprises three amplifier stages arranged in a sequence. A variable pin diode attenuator (D1, D2) and a fixed resistive attenuator are provided at the input end to achieve gain control and improve adaptation.

The power stages made up of GaAs-Fet TR1 and TR2 transistors are fed 7 and 10V, respectively, via the resistors arranged in series with their respective drains. TR4 and TR5 keep the polarisation circuit stable as transistor parameters and temperature vary.

A negative polarisation voltage is required to ensure correct operation of the final transistors; this voltage is generated from the positive power supply voltage inside this module by IC1. On the other hand, TR8 and the control circuit comprising TR7 and D6 ensure that power is removed from the final stage when negative polarisation is missing.

Likewise, TR6 cuts off supply voltage when ALC voltage drops below the minimum value.

ALC is built around pin diodes D1 and D2 that enable the CPU to vary input power with a closed control loop as the input signal to IC3 varies.

Two lines with directional coupler provide output signal sampling for an RF monitor output and a power detector. The latter consists in a compensated bridge circuit (D4, D5) and its signal is amplified by IC2.

A circulator and an output-tuned band-pass filter are connected in series on the power signal outside this module to protect the final stage from poor antenna adaptation and remove harmonics and spurious content from the output frequency as required by applicable regulations.

8.1.6 Power Supply Section

The power supply regulator is an advanced, efficient direct mains switching power supply unit. It incorporates suitable mains filters to reduce noise to and from the power line in compliance with the latest, most stringent standards and accepts mains input voltages from 95 to 250Vac. Two models with different capacities are available to accommodate specific power demands: MODS4028 provides 40W output power, MODRS7524 up to 75W. The modules interchange both in terms of electric connections and overall dimensions.

Output voltage is regulated at 27.8 Vdc, trickle-charges the optional external battery and is brought to the next auxiliary power supply and battery control board.

The latter board is also available in two models with different power ratings; both models are based on a common layout but their components feature different dimensions. An integrated switching circuit IC1 efficiently generates the two voltages that feed the whole system. A first +12.5V voltage is well stabilised, whereas negative voltage is mildly stabilised at around -12.5±1V. Additional LC filters remove switching noise from the main and power outputs of the DC-fed fan (where fitted).

A small section of the board, based on TR1/TR2 driven by trigger TR3/TR4, disconnects the trickle-charge backup battery when voltage across its terminals drops below 21V and restores the connection when voltage rises above 23.5V.

The lower rated model provides no output voltage fine-tuning and has a fixed output voltage. The higher rated model can be equipped with a trimmer to fine-tune main output voltage (nominal +12.5V). This voltage may be fined-tuned upon testing to adjust (typically, decrease) maximum output power so as to prevent overheating. This means that in some specific applications, correct voltage may be lower than the nominal voltage.

8.2 Description of receiver componentry

The radio link receiver comprises up to 8 internal modules shown in the ''Assembly view drawings'' and in the ''Main wiring diagram'' included in the annex to this manual. Again, some modules may vary depending on whether the unit operates in the 220 ÷ 960 MHz range or in the 1400 ÷ 2600 MHz range. The following modules may or may not be fitted accordingly:

- Main stabilised power supply
- Auxiliary power supply
- Control and display CPU board
- Local oscillator board
- LNA, FI & and FM demodulator board
- Main interface, control and BF output board
- Input filter
- Stereo coder board (option)

The first four modules are the same as those used in the transmitter; see the relevant paragraphs above for their descriptions. For a detailed description of the other modules discussed at the following pages, please refer to the relevant wiring diagram in the relevant section of the manual.

Please note that, while the CPU control board is identical with that used in the matching transmitter, the CPU installed on it needs to be specifically programmed with the suitable firmware for the receiver.

8.2.1 LNA, FI & FM Demodulator board

A suitable input band is installed before board input. The board is the front end of the SHF receiver, for the 1400 ÷ 2600 MHz version, provides a triple conversion at mean frequency and final demodulation and post-correction of the modulated signal.

It is also used on receivers operating in the 220 to 960 MHz range, only for the 10.7MHz IF and demodulation sections, with an input at the P4 connector shown in the diagram.

The incoming signal is broadband amplified in the LNA amplifier IC1. Module output is converted by diode mixer IC2 and the local oscillator signal at P3 input.

The local oscillator is normally synthesised at reception frequency less mean frequency, i.e. 70 MHz. In some cases, depending on operating range, the local oscillator may be synthesised to incoming frequency value summed up with FI value.

Right after the first mixer, a duplexer sends the signal through a variable pin diode attenuator (D1, D2) controlled by AGC via TR1. The signal is then amplified by IC3 and filtered by the first FI filter at 70MHz (L5, L6, L7 and associated components). RT1 enables accurate setting of IF gain and sends the signal to the second (active) filter IC4. Here, the signal is converted at 10.7MHz and processed through the TR2-TR6 chain that includes amplifiers with local AGC and band-pass filters. The output signal from this chain is applied to the third mixer IC8 and to the FI monitor output buffer TR7.

The signal converted by IC8 at 460 kHz is squared by IC9 and demodulated using a very-high linearity "pulse count" circuit with very low added noise and distortion. The two monostable devices accommodated in IC11 are energised by the individual half-waves of the modulated signal and provide output pulses with strictly constant duration that are summed up and buffered by TR8, TR9, IC12. At IC12 output, the signal is integrated by the filter comprising L18-L20 and amplified by IC13a.

IC13b allows for amplitude compensation of the demodulated signal after FI filtering according to varying frequency. Likewise, IC13c provides for phase compensation on the same signal. IC13d provides an output voltage proportional to incoming signal tuning with respect to frequency centre.

8.2.2 Mainboard, Interface, Control and BF Output Board

The mainboard provides the main interface between control circuits, the other receiver board and the BF signal. It distributes the control signals from the CPU to the other boards and the power supplies; its also processes and buffers the BF signal for the outputs

The signal coming from and broadband-filtered by the FM demodulator is pre-processed in the circuit made up of IC1 and IC2; the latter two components form a mild phase-compensated low-pass multiplex filter that provides mild attenuation of the BF signal at frequencies above 75kHz to reduce the noise caused by the signal on the adjacent channel in stereo demodulation.

From the IC1b output, the signal is made to pass through the programmable attenuator comprising IC3 and IC4 that operate on a 1/2 dB step to provide output dynamics in a -1.5 to +12 dBm range. IC7b and IC8 make up the buffer for the output multiplex signal. Please note that IC8b uses an inverted signal with respect to IC8a so as to obtain two identical push-pull outputs or a single differential output.

The signal from IC7b is de-emphasized by the programmable deemphasis assembly built around IC6 and IC7a and then filtered above 15kHz to extract a clean mono signal from the multiplex signal. The signal from the IC7d output is applied to the mono output balanced buffer IC9. IC7c is the buffer for the BF mono output; hardware jumper BD1 is used to select which signal - among the broadband modulated, multiplex filtered or mono signals - is to be applied to IC7.

Shift-register circuit IC5 provides the interface between the serial command from the CPU and the programmable switches of the board. The circuit around IC10 acts as an amplifier for low-level signals to enable measurement, IC12 is the RS232 interface, whereas TR1-TR3 provide interfacing with the parallel remote control output. Lastly, TR4 controls field relay RL1 based on CPU commands.

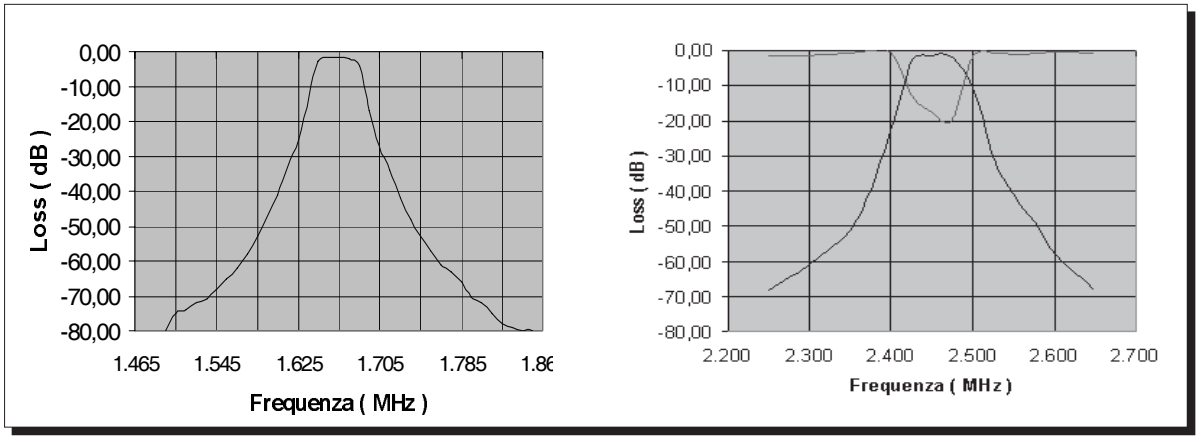
8.2.3 RF Input Filter

On radio links in the 1400 ÷ 2600 range, the input filter is a separate module accommodated on the inside of the unit back panel.

According with its rating, this filter determines receiver sensitivity and off-band spurious noise rejection. This filter is a superior quality component and may only be calibrated using suitable microwave equipment.

Do not alter its calibration unless you have such equipment available. The filter is centred on the receiver band set at the factory and is broad enough to cover the whole band, while providing good attenuation of reception image frequency.

Shown below is the typical chart for standard filters for two ranges at production extremes. Filters with smaller bands are available as an option.



Response of standard internal filters for the 1660 ÷ 1670 MHz and 2440 ÷ 2483 MHz ranges.

8.2.4 Stereo Decoder

The optional stereo decoder board must be specified on order and is installed at the factory. It interfaces with the multiplex signal from the mainboard. If may be retrofitted to units in the field, after replacing the receiver control CPU if its software release is older than the 1.03 version. Later software releases (1.04 and higher) recognise the board and enable its associated functions.

This board uses advanced technology to provide very high performance, such as basic 70dB separation from 400 to 5000 Hz and over 60dB separation throughout the audio band up to 15 kHz. Typical distortion is 0.01% or less and filters are flat to within 0.1 dB from 30 to 15000 Hz. Deemphasis circuits may be enabled or disabled via software.

The PLL decoder features output pilot frequency cancellation. Next are the deemphasis circuits that are controlled by central control circuits and channel low-pass filters. The pilot frequency cancellation technology enables the use of lower-specs filters, with great benefits in terms of phase and output frequency linearity.

A local microcontroller installed on the board provides accurate time base generation through a precision quartz, provides local deemphasis and PLL hook controls and manages communications with the central CPU of the transmitter.

Audio output level on both channels is fixed and is set to +12dBm @ 400Hz (8.8Vpp), balanced in the absence of deemphasis, at male XLR connectors. Since the positive and negative lines use separate drivers, the signal may be relayed without balancing, as the high output level - in this instance +6dBm (4.4Vpp) - allows the noise/signal ratio to remain unchanged. The two fine-tuning trimmers for the output level on the board are used for factory settings only during the channel balancing process; actually, output level variation is limited to a narrow range (±1dB).

9. FM Radio Link Firmware

9.1 Foreword

The R.V.R. radio link family PTRL&RXRL NV/3 incorporates a latest state-of-art microcontroller (CPU) that controls its functions based on user's selections, monitors equipment operation and also controls measurement, computation and remote control functions.

The microcontroller firmware undergoes periodic reviews to includes fixes (if needed) or add new features. Firmware is uploaded at the factory and may be updated by uploading the latest updated version. Updating the firmware is a simple procedure that requires no specific skills. New features included in the updated version become available as soon as uploading is completed.

The firmware programmes of the radio link transmitter PTRL NV/3 and of the receiver RXRL NV/3 do not interchange because they are written to meet different requirements. Care must be taken to use the appropriate CPU programmed for the transmitter (firmware TX15) or for the receiver (firmware RX15).

Except for some menus that are specifically written for the transmitter or the receiver, the two software programmes feature the same user interface and most functions and operation modes are the same. Whenever possible, care is taken to design software functions for the utmost user-friendliness and to ensure consistent operating principles for a soft transition to later versions or added features.

NOTE: Software is systematically updated through subsequent releases to accommodate new manufacturing processes, know-how and to add new functions. Units are supplied with the latest stable release available at the time of delivery. Users may update their firmware at their full discretion and may decide to retain the existing release unless it contains bugs or the user requires new added features.

R.V.R. SHALL NOT BE HELD LIABLE FOR DAMAGE RESULTING FROM THE CONTROL FUNCTIONS OF THE RADIO LINK TRANSMITTER OR RECEIVER BEHAVING DIFFERENTLY FROM PRE-EXISTING FUNCTIONS, IN THE EVENT THE MICROCONTROLLER AND ITS FIRMWARE HAVE BEEN REPLACED. WARRANTY ONLY COVERS REPLACEMENT OF THE CPU WHICH IS DEEMED TO OFFER UNWANTED FUNCTIONS OR REFUND OF CPU PRICE.

9.2 Setting the Passwords

The software includes a password management system that provides limited access to functions according to the different password levels, to ensure data protection and prevent unauthorised changes to equipment settings. Changing the passwords is the user's responsibility and should only be done when actually needed. The units are supplied with the security levels disabled to ensure convenient access to functions.

The system provides for three access levels, each with its own password. Each password provides access to its matching level and to lower levels.

Each password is made up of 4 alphanumeric characters, including upper and lower case characters and special symbols. R.V.R. recommends using an increasing variety of characters for higher levels, as this increases the number of possible combinations.

Passwords are never displayed and are always masked using substitute characters such as ''…'' or ''****''. However, lower-level passwords may be changed after entering a higher-level password. Outlined below are the access rights associated with each security level:

Level 1: Lowest security level (where high security is required)

It provides access to most control menu screen pages, but does not enable changes to operating parameters. It is set to ''OFF'' at the factory, meaning that the system will not prompt for a password so as to allow free access to and navigation of the control menu.

R.V.R. recommends that this default setting be left unchanged, unless user wants to restrict viewing of operating parameters to authorised personnel. When this level is set to ''ON'', the default menu field #00 (see menu tree), is shown and the system will prompt for a password before displaying any additional data or settings. In the event the correct password is not entered for any one of the three levels, further access to controls will be inhibited for a preset time (time-out), typically 3 minutes. Entering the wrong password will not affect unit mode of operation. The display simply provides no information on unit operation.

Level 2: Service level

In this level, the password is required to gain access to any operating parameter settings, such as frequency, power, sensitivity, output levels, etc. This password is restricted to service engineers who need unrestricted access to functions and calibrations for servicing purposes. This password is not required to view modes and operating parameters during operation.

Again, default factory setting is ''OFF''. R.V.R recommends changing both the password and the configuration (if needed) soon after installation, to prevent tampering with commands by unauthorised personnel.

Level 3: Highest security level and factory settings

This password is set to ''ON'' by default and - for safety reasons - will automatically switch back to ''ON'' after the display timer times out, even when it is disabled. Access to this password must be restricted to a **small group** of persons; as soon as you have set this password, write it down and store it in a safe place.

Once set and **confirmed, this password may not be retrieved**.

The original password set at the factory **must be changed immediately** during the initial installation procedure; you need to enter to original password before you can set a new password; if the original password is accidentally changed or lost by unauthorised personnel, it will be impossible to set a new password. In worst-case scenarios, the unit may become unserviceable. **When this is the case, the unit will have to be returned to the factory to have it reprogrammed or to have the internal CPU replaced before you can regain access to the transmitter.**

Basically all parameter settings that may need to be set in the field require the second level password, which may be used for standard service requirements if the matching level is enabled. The main purpose of the third level password is to provide enhanced security for the event the user has lost control over lower-level passwords. Among all parameters, just a few critical settings (typically factory settings) require the use of the 3rd level password.

9.3 Default passwords

The default passwords set at the factory as are follows:

Livel 1: **P001**

Livel 2: **P002**

Livel 3: **ABCD**

As mentioned above, be sure to change at least the third level password (possibly the second level password as well) soon after delivery.

WARNING: WHEN THE PASSWORDS ARE ENABLED, THOSE OPERATORS WHO ARE NOT FAMILIAR WITH THE PROCEDURES REQUIRED TO ENTER, CHANGE AND ENABLE THE PASSWORDS MAY FIND IT DIFFICULT TO ACCESS THE SYSTEM AND MAKE THE NECESSARY SETTINGS. THE PASSWORD SHOULD ONLY BE ENABLED WHEN STRICTLY NECESSARY.

9.4 Menus and controls

The commands menu is a tree structure with two main branches arranged vertically. Navigating the different display screens with the arrow keys is a simple and intuitive procedure; in display mode, the "Up" and "Down" keys let you scroll the two measurement/command and setup branches up and down.

After the first (default) screen is displayed, user is prompted to choose between the measurement and the setup branch. Press "Esc" (Escape) to return to the default screen. To go from the measurement to the setup branch or vice versa, you must first go back to the default screen.

In those screens that hold editable parameters (normally, the setup screens), pressing ''Enter'' changes current mode from navigation and parameter display to input or ''command'' mode within the current screen. Input mode is indicated by the editable field flashing; press the ''Up'' and ''Down'' keys to edit characters or the numeric value in the highlighted field. Press ''Enter'' again to confirm any data you have entered. Press ''Esc'' to cancel any changes and restore previous settings.

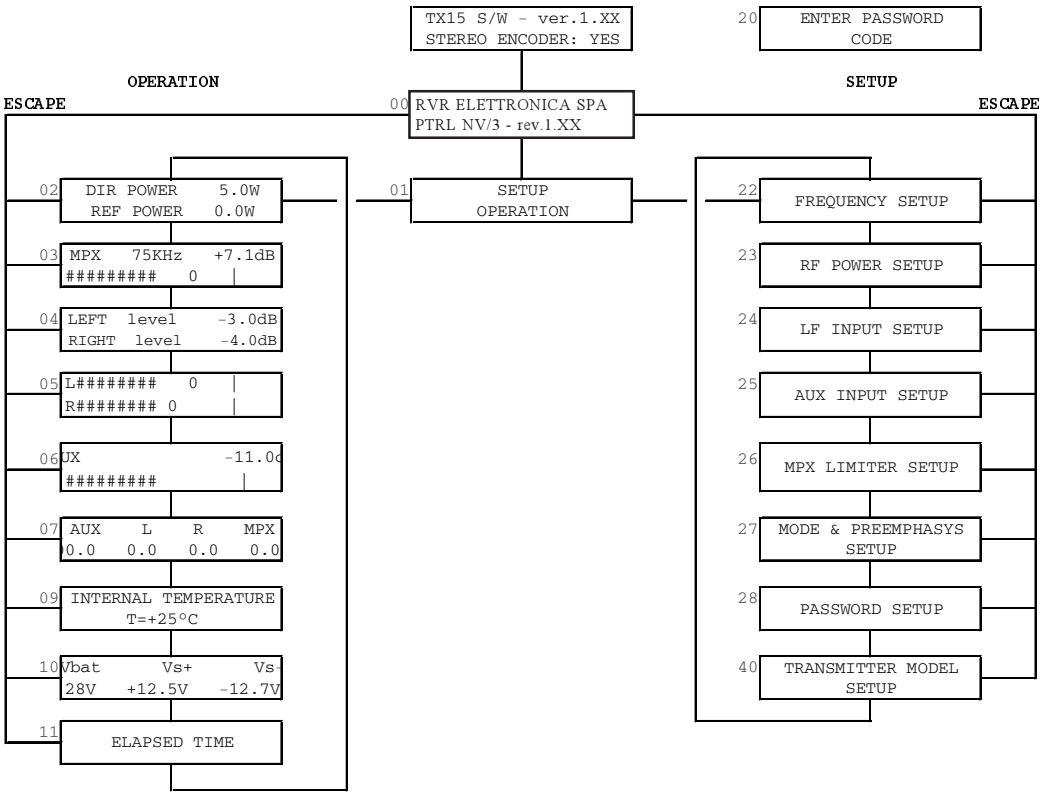
Entering the input mode starts a local timer that cancels any changes you have made unless you confirm them within 60 seconds of the last change made. Likewise, after 3 minutes since the last change made, the system will automatically exit the setup branch and go to the modulation control screen.

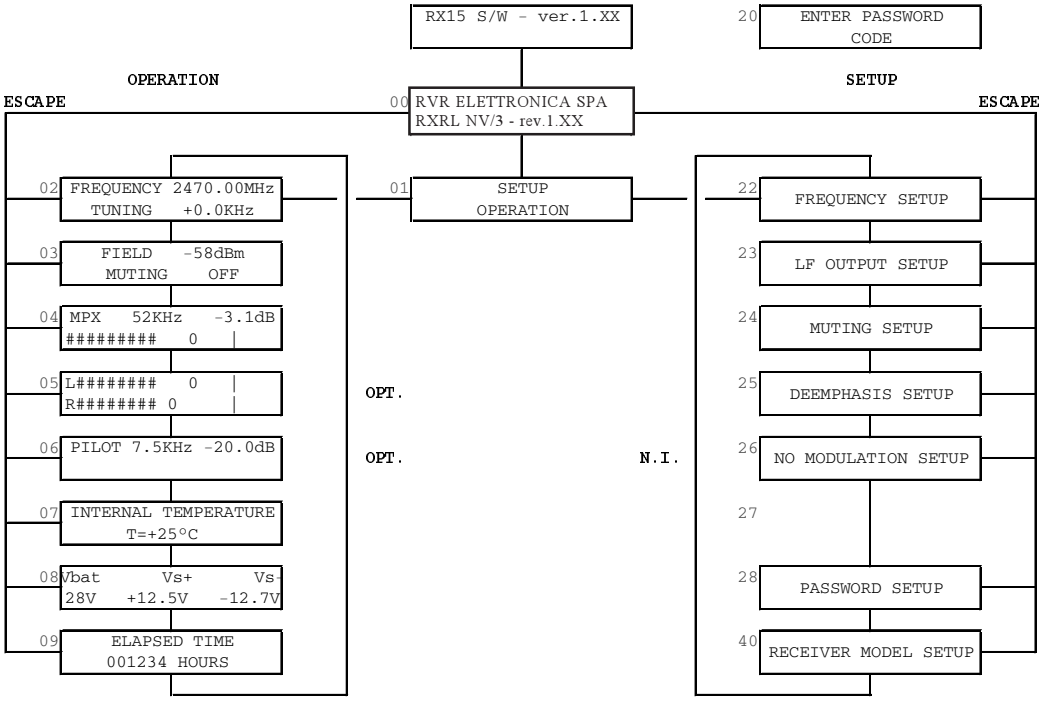
Menu navigation is dependant on password-enabled access rights, when the matching security levels are enabled. Navigating the measurement/control menu requires 1st level access rights and the matching password must be entered if that level is enabled. In common practice, this is not needed. Likewise, you will need 2nd level access rights or the associated password to access the setup menu. Again, the 2nd level is set to Off at the factory and no additional procedure is required unless the user makes any changes.

The 3rd level password is only required to change a few hardware settings (normally set at the factory) and to edit the first line in the default screen.

It takes just a few minutes to become familiar with control keys and menus and learn how to access all main functions with no need for lengthy instructions or training.

Unit menu trees are shown below; note the identification numbers on the left of each box. The same numbers are used throughout the next pages when discussing each field and its associated options for ease of reference.





User menu trees of transmitter and receiver

9.5 Transmitter

The commands menu is a tree structure with two main branches arranged vertically. Navigating through the different display panels with the direction keys is a simple and intuitive procedure; in display mode, the "Up" and "Down" keys let you scroll the two measurement/command and setup branches up and down.

9.5.1 Start-up screen

The menu star-up screen is at the top of the diagram and has no identification number. It is only displayed when the unit is powered on and it shows firmware release while the system initialises. During this process, all LEDs and the display will turn on and off to establish proper operation.

```
STEREO ENCODER: YES
 TX15 SW rev. 1.XX
```

Soon after completion of the initialisation process, the screen displays an indication of whether the internal Stereo Coder is fitted (YES/NO) to save you the trouble of opening the unit in case you need to make sure. The display automatically goes to the next screen.

9.5.2 Screen #00: Default message

```
RVR ELETTRONICA SPA
PTRL NV/3 - rev.1.XX
```

This is the default screen and it reports type of unit and software version. It is displayed right after the start-up screen and it is to this same screen you will return to after pressing "Esc" repeatedly.

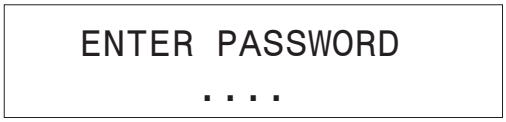
If the third level password has been entered and the display is in the command mode, the first line of this screen can be edited after pressing "Enter"; user may enter a test string of 20 alphanumeric characters as shown in the example below:

```
  NORTH-WEST RADIO
PTRL NV/3 - rev.1.XX
```

Unless the microcontroller has been setup at the factory, upon first power-up (basically, after a CPU update) the system will automatically go from this screen to the transmitter type selection menu; the system offers a list of transmitter types for the user to select the appropriate one, see screen #40. This screen may be accessed at any time after entering the 3rd level password; please note that this screen is best left undisturbed.

Pressing any one key will switch to a different screen (#20) that prompts for a valid password. However, if the security level is not enabled (default setting), the system will automatically go to the next screen #01.

9.5.3 Screen #20: Initial password

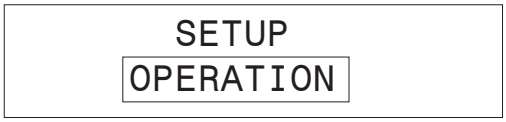


This screen prompts for a valid password. When you press Enter to confirm, the password you entered is checked against stored passwords; a correct match will give access to the next security level. If the password is wrong or input is cancelled by pressing ''Esc'', an invalid password warning appears. In this case, access is only granted to the security level stored currently, i.e. 0 (access denied), 1 or 2.

The 1st and 2nd security levels are set to ''OFF'' at the factory; this is the most convenient setting, as no password is required to navigate the menus and set basic operating parameters. As mentioned above, the screen will not be displayed unless it is specifically recalled (see screen #28).

When a valid password is recognised and the associated level is displayed, press ''Esc'' to go to the first menu screen (#01).

9.5.4 Quadro #01: Scelta menù Operativo o di Setup



From this screen, you may choose to access the operation or the setup menu branch. The first branch is selected by default and label ''OPERATION'' is highlighted. Press ''Enter'' or the ''Down'' arrow key to open this menu

If you wish to go to the setup menu, highlight the corresponding line with the ''Up'' arrow and press ''Enter''.

9.5.5 Screen #02: Forward and reflected power

```
Dir  Power:  4.0 W
Refl Power:  0.0 W
```

This screen shows actual output forward power available at the time and associated reflected power. On UHF/SHF radio links (those in the 1400-2600 MHz range), reflected power normally is not detected.

9.5.6 Screen #03: Multiplex signal level (Output modulation)

```
MPX  75.0kHz + 0.0dB
############ 0|
```

This screen shows the current modulation peak in dB for 75kHz and actual deviation in kHz. A pseudo-analogue bar changes to reflect modulation, while a marker denoting achieved peak remains displayed for 1 or 2 seconds. A vertical bar (I) on this line indicates 0dB position.

9.5.7 Screen #04: Right and left channel levels in dB

```
 LEFT level - 3.0dB
RIGHT level - 4.5dB
```

This screen shows the current peak level in the left and right channel signals expressed in dB for actual 75kHz modulation.

Reading is extremely accurate with actual audio signals. However, some repetitive test signals, for instance sinusoidal signals, especially at very low audio frequencies may cause aliasing with the steady-sampling rate analogue to digital converter, leading to unstable readings. In this case, the total MPX modulation reading in the previous screen provides a stable, accurate measure of modulation.

9.5.8 Screen #05: LH and RH channel levels with analogue sliding bar

```
L########### 0  |
R#########  0  |
```

Like the previous screen, this screen shows current peak level in the left and right channel signals in the form of two analogue sliding bars. A vertical line indicates 0dB position; unstable readings associated with repetitive test signals are possible in this menu as well.

9.5.9 Screen #06: RDS or SCA auxiliary signal level and modulation

```
AUX  2.0kHz  -11.2dB
#########0       |
```

This screen shows current modulation as determined by the auxiliary signal (RDS, SCA) alone in kHz and peak level expressed in dB for 7.5kHz deviation, i.e. 10% of maximum modulation. Standard modulation of RDS level is 2kHz, i.e. -11.5dB. Modulation for an SCA signal is usually higher, typically 7.5kHz, i.e. 0dB.

9.5.10 Screen #07: RH, LH auxiliary signal levels and total modulation in dB

```
 AUX     L     R    MPX
-11.2 -3.0 -4.5 +0.0
```

This screen provides an overview of modulation level in dB for the auxiliary (AUX), left (L), right (R) and total or multiplex (MPX) signals, as shown in the previous screens.

9.5.11 Menu #09: Internal temperature

```
INTERNAL TEMPERATURE
        +30°C
```

This screen shows internal temperature in degrees Celsius. The ambient temperature sensor detects internal temperature right behind the front panel: at full output power and rpm, its reading will be several degrees higher than room temperature.

At regular operating speed, external (room) temperature may be up to 6 - 8 °C higher than internal temperature. Maximum operating temperature allowed (45°C) corresponds to a 51 - 53°C readout on the screen.

At full power, outer cooler temperature is normally 10-15°C higher than ambient temperature.

When the machine reaches the maximum temperature allowed, output power will be reduced gradually. A 5°C margin for overheating normally allows for emergency operation at limited power.

Please note that the higher the ambient temperature, the shorter the average unit life: service life is nearly halved with each 10° C increment in temperature. Assuming 10 years service life at +25°C - a realistic estimate - at +45°C unit life will be 2.5 years shorter.

9.5.12 Quadro #10: Internal voltages

```
 Vbat    Vs+    Vs-
+27.8V +12.5V -12.4V
```

This screen shows internal operating voltages.

Vs+ and Vs- are the same throughout the radio link transmitter family and are as follows: Vs+ = +12.5±0.3V, Vs - = -12.4V (+1/-2V).

Battery voltage is: Vbat= +27.4V ±0.5V when the battery is fully charged. When fed from the battery, the unit will require a voltage within a 22 to 28V range in order to operate.

9.5.13 Screen #11: Time counter

```
   ELAPSED TIME
   000356 HOURS
```

This screen shows how long the transmitter has been in the on-the-air or in the stand-by mode. Its reading may not be modified

9.6 Transmitter Setup menu

Use the "Up" and "Down" arrow key to navigate the screens of the setup menu. Press "Enter" to change screen mode: the arrow keys may now be used to change editable numeric values or parameters.

Press "Enter" repeatedly to confirm all the different sections. Press "Esc" to cancel changes when you have not completed all settings; previous settings will be restored. All screens in this menu sections operate as described above.

9.6.1 Screen #22: Transmission frequency setting

```
FREQUENCY  SETUP
2470.00 MHz
```

In this screen, you may change operating frequency through two subsequent steps: first edit the digits to the left of the comma (MHz) and then those to the right (tens and hundreds of kHz).

9.6.2 Screen #23: Output power setting

```
 RF POWER SETUP [W]
Set:  4.0  Out:  4.0
```

This screen lets you set the required output power (Set), which must not exceed maximum unit capacity or licensed power. Actual output power is shown on the right, in the second line.

Actual power may be lower than set power when the maximum limits are reached. Likewise, certain transmitter series have a minimum output power limit that must not be exceeded.

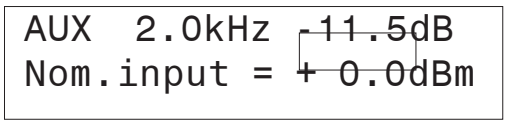
9.6.3 Screen #24: BF input level setting

```
MPX 75.0kHz + 0.0dB
Nom.input = + 6.0dBm
```

This screen lets you set the sensitivity of BF input channels, i.e. the multiplex, right and left channels. Please note that multiplex signal and right channel use the same circuits and sensitivity is set to the same value for all audio and multiplex channels, with a differential error <0.2dB at any level. Maximum setting range is -3.5 ÷ +12.5 dBm.

The upper display line shows actual modulation with the low-frequency signal currently present, whereas the lower line shows nominal input level for 100% modulation (75kHz). Increasing nominal input level will decrease modulation accordingly, modulating signal being equal.

9.6.4 Screen #25: Auxiliary input channel level setting



This screen lets you set auxiliary channel sensitivity. Acceptance field is from -12 to +4 dBm to achieve 10% modulation, corresponding to 7.5kHz deviation, i.e. 0dB in the upper display line. The upper line shows actual channel modulation in real time. The lower line shows nominal sensitivity value in dBm.

9.6.5 Screen #26: Limiter setting

This screen lets you set limiter operation. You may set the limiter threshold level and enable/disable the limiter (ON/OFF).

Depending on local regulations, the limiter may be set to maximum nominal level (0dB, i.e. 75kHz modulation) so as to cut just above this level, or to a slightly higher level so as to allow for some margin to accommodate peaks, for instance to +2.5dB, which corresponds to a peak 100kHz deviation. Maximum setting allowed is +7.1dB, which triggers limitation at over 170kHz: with this setting, it makes no difference whether the limiter is enabled or disabled.

It is a good rule to prevent the audio signal from exceeding limiter threshold too frequently, or modulation distortion will result.

9.6.6 Screen #27: Setting transmission mode and preemphasis

From this screen, you may set transmission mode (MONO R, STEREO, MONOL+R, EXT MPX) and preemphasis (0, 25, 50 and 75µs).

Standard preemphasis adopted throughout Europe and in many other countries is 50us. In the American area, standard preemphasis is 75us. Preemphasis only takes effect on audio channels and will not affect an external multiplex signal.

9.6.7 Screen #28: Password management

```
  PASSWORD  LEVEL X
code=**** status=OFF
```

This screen shows the security level and lets you change passwords and/or disable/ enable them when in the command mode, provided that you are cleared for that level or a higher level. Passwords are never shown and access to higher levels than that of your password will be denied.

If the password is unknown, was lost or has been mistyped, you may change level, password and state when you know the next higher level password. In this case, change and confirm the lower level passwords, as the previous passwords cannot be retrieved. This means that, say, 2nd level password and state may be changed even when you do not know the associated password, provided that you enter the correct 3rd level password when prompted.

If the password or the ON/OFF state have been changed, the system will ask you to confirm the correct password for that level.

```
CONFIRM PASSWORD
      ....
```

Once changed, clearance to the 3rd level remains valid until the display timer times out (three minutes after the last command entered). Any movement within the menu or pressing any key will postpone time-out.

If the first level is enabled, the transmitter will deny all access after the timer times out. This feature prevents unauthorised personnel from viewing transmitter parameters, when the user so desires. Obviously enough, transmitter operation is not affected by this state: any attempts to gain access to the transmitter will trigger a password prompt; if a wrong password is entered, the prompt will not reappear until the timer times out.

When an invalid password is entered, the following error message is shown and the display freezes for 5 seconds, to prevent any further action. Afterwards, the ''Esc'' key is enabled to exit the screen and maybe try again.

9.7 Factory Menu

The factory menu holds certain settings that must not be altered by final users. The only screen user may access is the screen for unit model and operating frequency selection, which is described below.

9.7.1 Screen #40: Model and frequency range selection

```
EQUIPMENT MODEL SET
SHF STL Tx 2468-2484
```

This screen lets you set the type of transmitter or its operating frequency range. It has been made accessible to users for the event the microcontroller is replaced with a new microcontroller which has not been pre-programmed at the factory. It may only be accessed with the 3rd level password, for service only.

Unit is selected from a preset list of the units the microcontroller is compatible with. The screen offers a dozen operating frequency ranges in MHz to choose from. If selected range does not match the range the unit is rated for, the unit will not operate.

9.8 Receiver

The receiver and transmitter menus are very similar and feature the same layout. Many screens are identical, so only the different screens are covered below. Listed below are the new screens or those that include significant differences.

9.8.1 Screen #02: Operating frequency and tuning

```
FREQUENCY 2470.00MHz
  TUNING    +1.2kHz
```

This is the first control screen; it shows the operating frequency and tuning of the incoming signal. When no incoming signal is present (Tng<-90dBm), a random tuning indication is provided. The signal is tuned correctly when "TUNING" is in the ±6.0 kHz range.

9.8.2 Screen #03: Incoming field and muting

```
   FIELD   -58dBm
   MUTING   OFF
```

This screen shows incoming field in dBm and indicates whether muting is on or off.

9.8.3 Screen #04: Output Multiplex signal level

```
MPX  75.0kHz + 0.0dB
##############O|
```

This screen shows current modulation peak in dB for 75kHz and actual deviation of incoming signal in kHz, like the matching transmitter screen.

9.8.4 Screens #05 and #06: Left and right channel levels in dB and analogue bar

```
 LEFT level - 3.0dB
RIGHT level - 4.5dB
```

```
L########### O  |
R#########  O  |
```

Like similar transmitter screens, these screens show current peak level in the decoded audio signal in the left and right channels expressed in dB for achieved 75kHz modulation. The next screen shows the same information in the form of an analogue bar.

These screens are only available when the optional internal stereo decoder board is fitted.

9.8.5 Screen #07: Stereo pilot frequency level

```
  PILOT TONE LEVEL
DEV.  7.5kHz -20.0dB
```

This screen is only available when the optional internal stereo decoder board is fitted. This screen enables accurate monitoring of any movement and of stereo pilot tone deviation, with no need for complicated procedures and without interrupting modulation.

9.9 Receiver Setup menu

9.9.1 Screen #23: BF output level setting

```
LF out lev. + 2.5dBm
Nom. level: + 6.0dBm
```

From this screen, you may vary the levels of main BF outputs, "MPX" output and "Mono" output at the same time. The screen shows nominal output level with 75kHz incoming signal modulation and the level determined by current modulation. Variation range of nominal output level is from -1.5 and +12dBm.

9.9.2 Screen #24: Useful Field level setting and Muting

```
   MUTING  SETUP
level:-75dBm  / OFF
```

This screen lets you edit the field threshold that energises the incoming useful field internal relay and the audio muting function. Both functions use the same threshold, however the muting function may also be enabled (ON) or disabled (OFF) from the setup menu.

If the threshold is set to the lower limit (-99dBm), the function will not be triggered.

9.9.3 Screens #25 and #26: Deemphasis setting

```
DEEMPHASIS TIME CST.
       50 us
```

```
 DEEMPHASIS ON/OFF
MONO:on   STEREO:on
```

From these two screens, you may choose among 0, 25, 50 and 75µs deemphasis settings. Deemphasis may be enabled separately for the mono output and for the stereo channel outputs, if fitted.

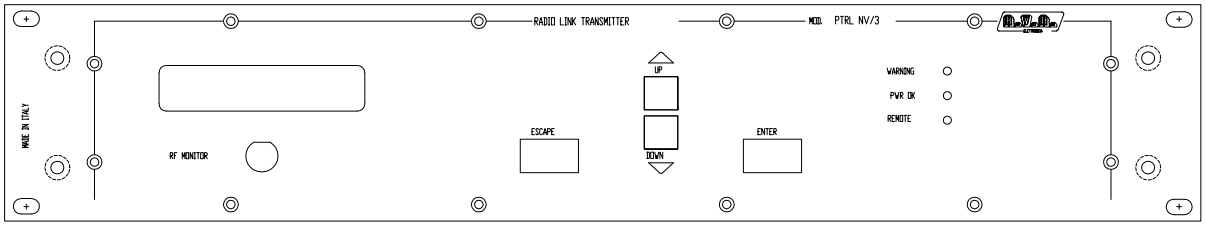
9.9.4 Screen #31: Optional internal board recognition

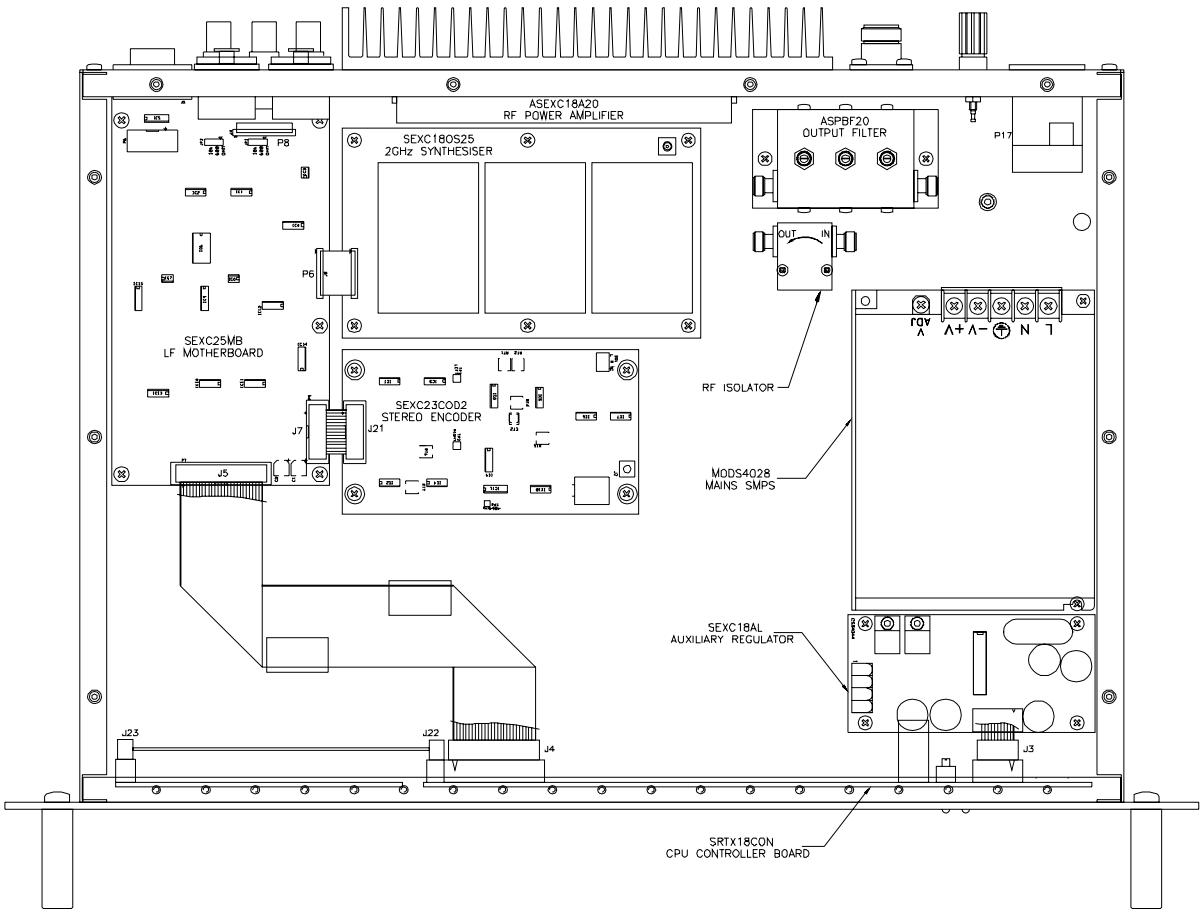
```
      OPTIONS:
STEREO DECODER: NO
```

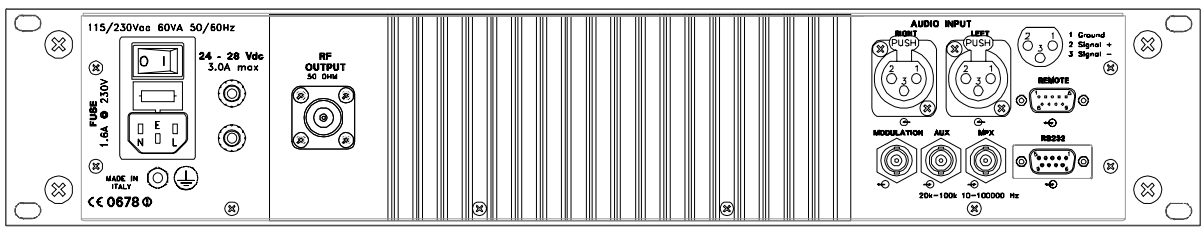
This screen lists any optional internal boards installed with no need for complicated procedures. It saves the user the trouble to open the unit to establish whether any one optional board is installed.

10. Ensemble View

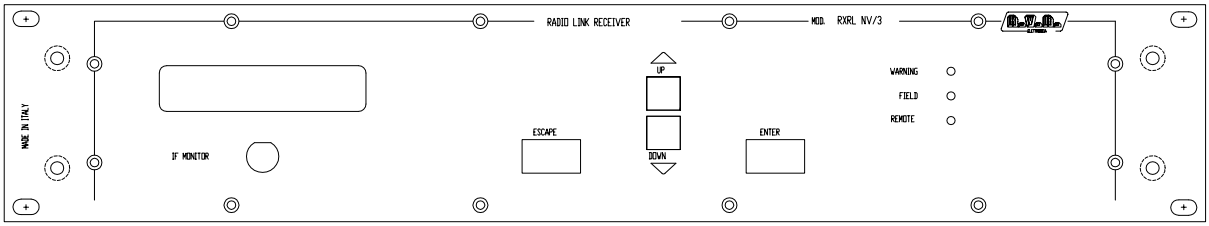
10.1 PTRL NV/3

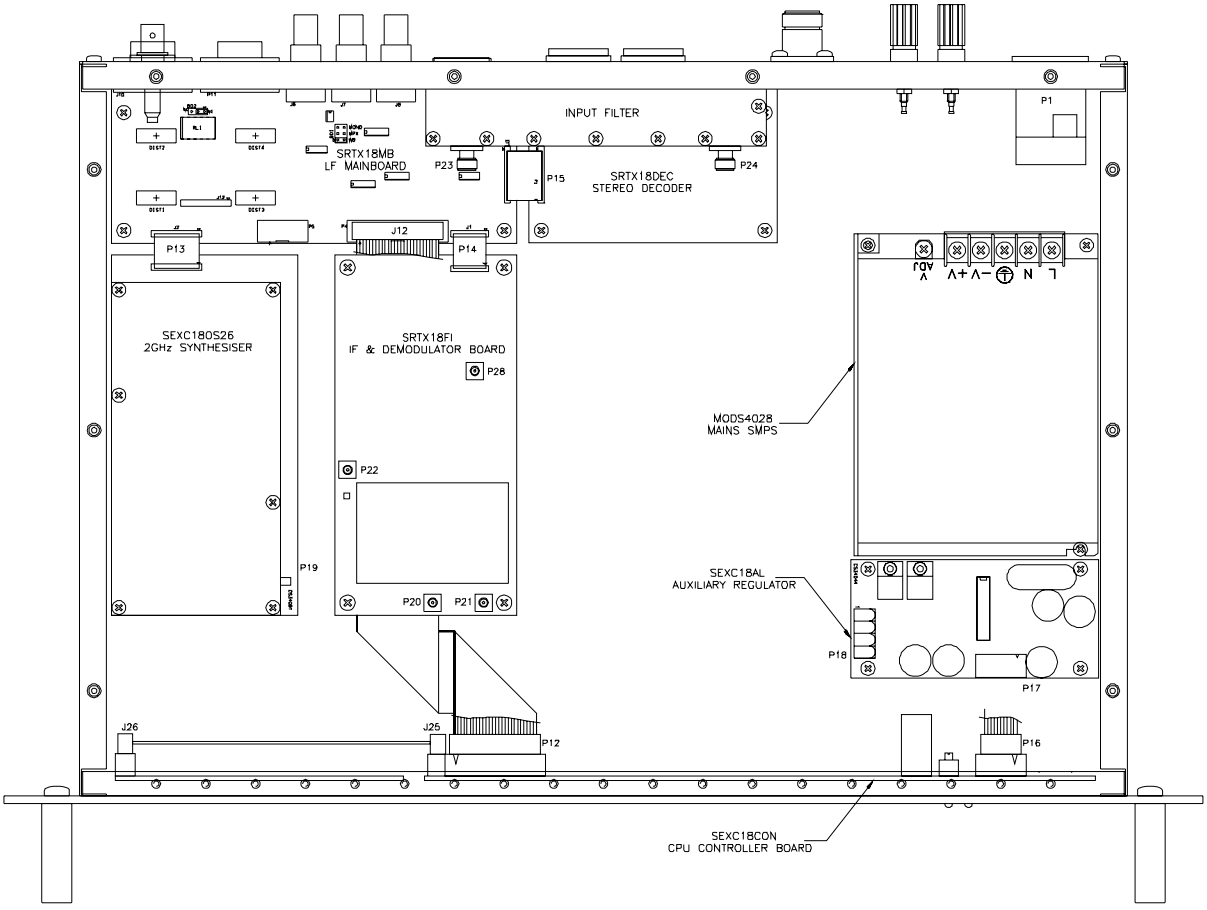


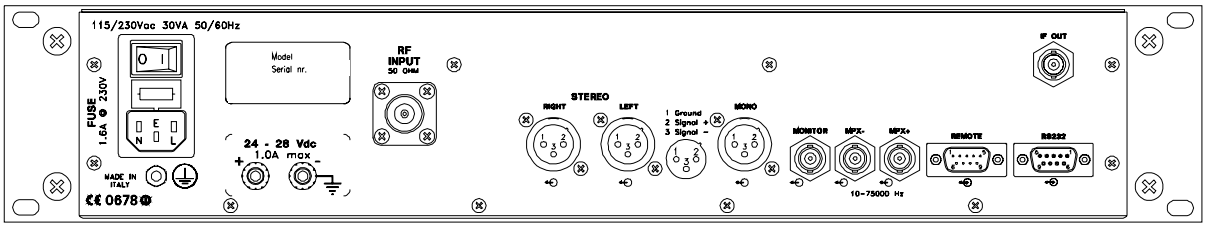




10.2 RXRL NV/3


RADIO LINK RECEIVER
MOD. RXRL NV/3
MADE IN ITALY
IF MONITOR
ESCAPE
UP
DOWN
ENTER
WARNING
FIELD
REMOTE


INPUT FILTER
SRTX18MB
LF MAINBOARD
SRTX18DEC
STEREO DECODER
P1
P13
P14
P15
P23
P24
J12
SEXC18OS26
2GHz SYNTHESISER
SRTX18FI
IF & DEMODULATOR BOARD
P28
P22
P19
P20
P21
MODS4Q28
MAINS SMPS
SEXC18AL
AUXILIARY REGULATOR
P18
P17
J26
J25
P12
P16
SEXC18CON
CPU CONTROLLER BOARD


115/230Vac 30VA 50/60Hz
FUSE
1.6A @ 230V
Model
Serial nr.
RF
INPUT
50 OHM
IF OUT
STEREO
RIGHT
LEFT
MONO
1 Ground
2 Signal +
3 Signal -
MONITOR
MPX-
MPX+
10-75000 Hz
REMOTE
RS232
24 - 28 Vdc
1.0A max
MADE IN
ITALY
CE 0678