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1. Characteristics

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1.1.1 Application

The VHF Transceiver 25 W XU 221 of the R&S equipment series 200 permits the transmission and reception of amplitude-modulated radio signals in the frequency range of 118 to 144 MHz.

This single-channel transceiver is mainly used for ground-to-board and ground-to-ground radio communication in air traffic control and organization.

The 19" Adapter KR 201 accommodates a complete VHF transceiver (see Fig. 1.2). In conjunction with Interface 2 GI 201, the transmitter allows to be used in switchover operation together with a second VHF transceiver (100% standby switchover).

The transceiver is suitable for both local and remote control. That is, it can be controlled from the front panel (local control) as well as via various remote-control interfaces (remote control). Remote control can be performed in three different ways:

- via single lines (parallel operation)
- serial REM BUS (remote-control bus-system especially devised for the radio equipment series 200)
- via control in the band of wanted AF signals (option inband interface), e.g. via telephone lines.

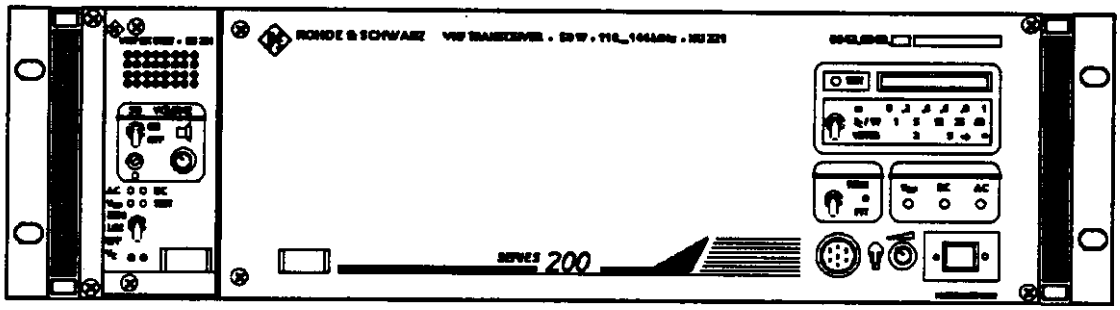


Fig. 1.1 VHF Transceiver 25 W XU 221

1.1.2 Design

(See Fig. 1.2)

The transceiver consists of several modules accommodated in a 19" frame, namely Adapter KR 201.

Due to the usage of flexible cables with clearly identified connectors the individual modules can be easily exchanged, thus also allowing short times to repair.

The VHF Amplifier VU 221V and the heat sink, both located on the rear, form a unit which can be folded out to the rear.

On the front left there is the VHF Rx Unit EU 231, plugged in from the front panel. All other modules are accessible from the top once the cover has been removed.

On the right-hand side of the VHF Rx unit the Modulator GM 201 as well as the VHF Synthesizer GF 201V are installed.

Again on the right-hand side space is provided for installation of a customer-specific option and Circulator Set GD 200V.

Directly on the rear of the front panel the display board is installed and behind the display board there is the regulator (DC supply).

Behind the regulator on the right-hand side panel, the optional Power Supply IN 251A is located.

The following list sums up the transceiver modules:

- Adapter KR 201
- Modulator GM 201
- Modulator Extension GM 201C8
- VHF Synthesizer GF 201V
- VHF Amplifier VU 221V
- VHF Rx Unit EU 231
- Interface 1 GI 201X
- VHF Lowpass Filter GH 200V (models 42 to 47 only)

In addition, Adapter KR 201 is suitable to accommodate the following optional modules:

- Power Supply IN 251A
- Interface 2 GI 201
- Inband Interface GM 211
- VHF Circulator Set GD 200V

For future applications, further optional modules may be installed in the adapter.

For use as a desktop unit, the transceiver may be housed in the optional

- Cabinet KK 251.

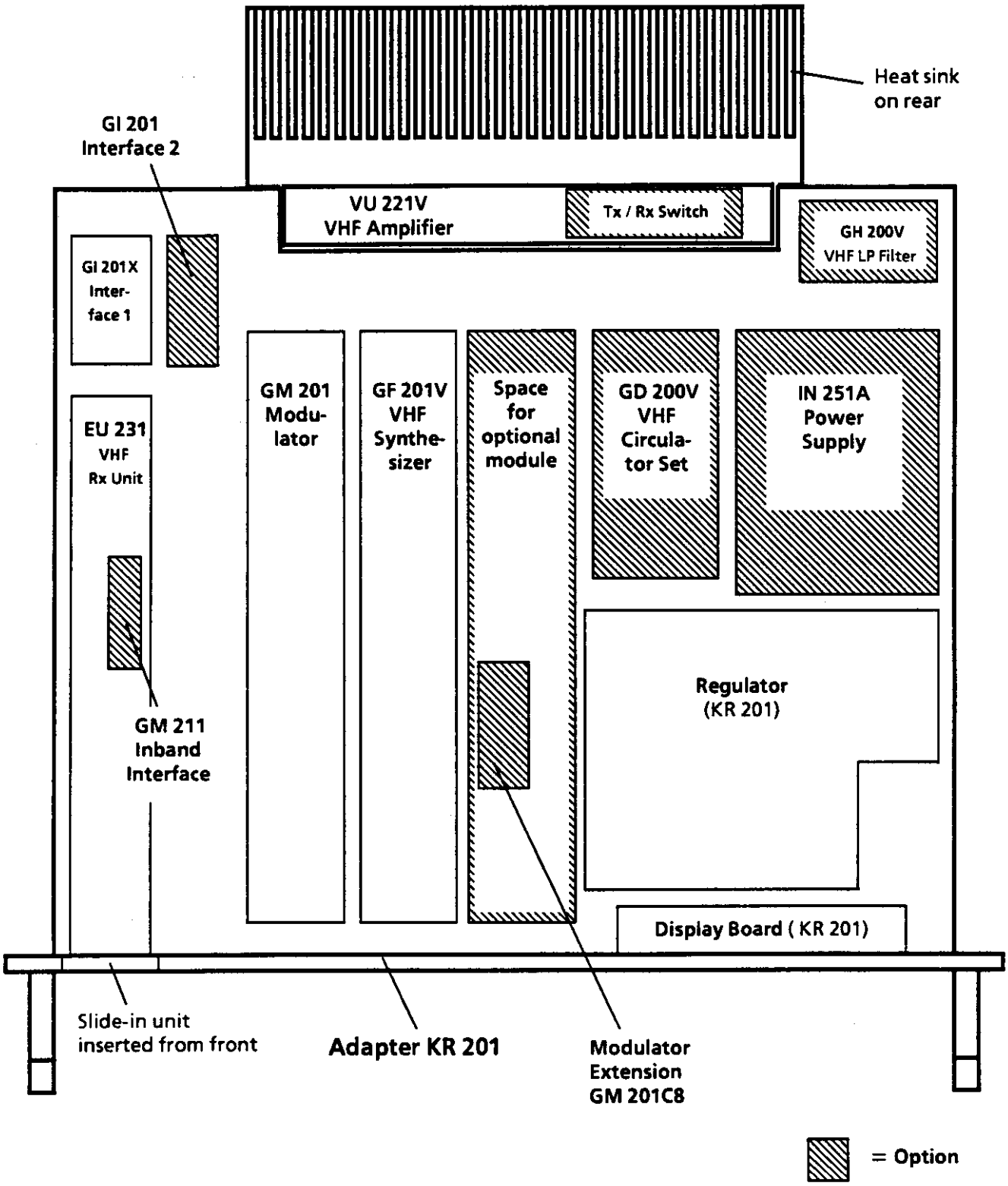


Fig. 1.2 VHF Transceiver 25 W XU 221, Design

1.1.3 Functioning

(See Fig. 1.3)

Receive operation

In receive operation (i.e., when no PTT key is pressed) the VHF receive signal is fed from the VHF antenna to the optional **Tx / Rx diode switch.**

Further the receive signal is routed to the **VHF Rx Unit EU 231.** Here it is applied to a three-circuit bandpass filter and further to the input of a Schottky diode ring mixer.

The oscillator frequency, higher by 10.7 MHz than the receive frequency, is generated by the synthesizer contained in the Rx unit. The first intermediate frequency of 10.7 MHz is routed via two crystal filters with decoupler stages to the second mixer.

Here the 10.7-MHz IF signal is fed to a ring mixer to be converted to the second intermediate frequency of 1.3 MHz. The crystal oscillator generates the required mixer signal. The 1.3-MHz IF signal is applied to a bandpass filter. Subsequently it is routed to an amplifier stage with automatic gain control (AGC). After demodulation it is subjected to combined signal-to-noise / carrier squelch evaluation. The AF signal is amplified and, having passed through an AF bandpass filter, is routed via an AF switchover circuit to the line output (600 Ω) and the loudspeaker on the front panel.

Transmit operation

In transmit operation (i.e., when the PTT key is being pressed) the AF signals are routed from a microphone or from the line input to the **Modulator GM 201.** The modulator carries out all control and monitoring functions, such as power control and conditioning of signals for the display board.

Via the modulation control circuit the AF modulation signal is fed to the input of the **VHF Amplifier VU 221V.** This amplifier module is of broadband design and is not tuned. It consists of a two-stage pre-amplifier, a two-stage driver amplifier as well as a push-pull output stage.

As an option a **VHF Circulator Set GD 200V** may be installed (in the factory) for better suppression of adjacent-channel interferences. In order to suppress the multiples of the transmit frequency a harmonics filter is integrated. A directional coupler supplies analog voltages for evaluation of the forward power, VSWR, and modulation depth. These values are fed to the modulator and the interfaces.

For further reduction of unwanted emissions acc. to BZT-S standard FTZ 17TR2013 the transceiver is also available with integrated VHF Lowpass Filter GH 200V (Models 42 to 47).

The carrier frequency for the VHF amplifier is generated in the **VHF Synthesizer GF 201V.** Three voltage-controlled oscillators (VCOs) generate the frequency which is stabilized in a phase-locked loop. A crystal oscillator generates the reference frequency of 10 MHz. Via a serial bus, a microprocessor programs, controls and monitors the synthesizer IC which operates in the dual-modulus mode (7-bit A-divider / 12-bit N-divider).

A programmable divider is programmed with the frequency information in such a way that it divides the VCO output frequency to approx. 2.5 kHz (for 8.33-kHz frequency spacing to 4.16 kHz). In the discriminator the phase deviation is used to generate a control voltage tuning the VCO and keeping it in the locked state.

Via **Interface 1 GI 201X** control units can be connected which allow remote control of the system with the aid of the serial REM BUS.

The optional **Power Supply IN 251A** transforms the AC mains voltage to a lower value which is then rectified. In the case of a mains power failure a relay switches over to DC supply.

The **regulator** (DC supply - belonging to Adapter KR 201) filters the DC voltage and contains several DC voltage regulators and a DC / DC converter for generation of the various supply voltages.

The **display board** (belonging to Adapter KR 201) comprises an LED bargraph indicator as well as various control and display elements.

The optional **Inband Interface GM 211** permits the transceiver to be remotely controlled via the AF line.

The optional **Interface 2 GI 201** is used for control of external power amplifiers and for automatic main / standby switchover.

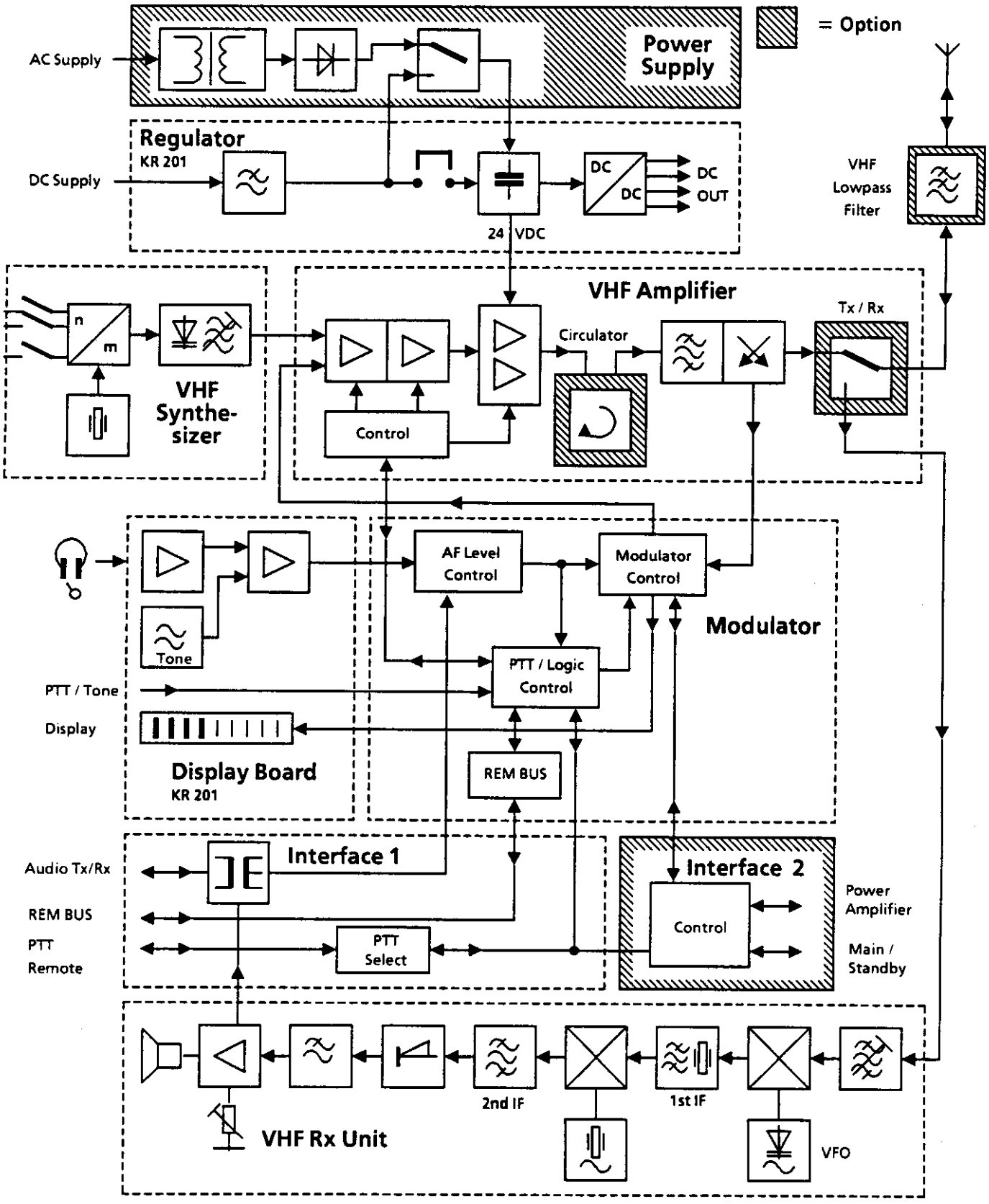


Fig. 1.3 VHF Transceiver 25 W XU 221, Block Diagram

1.2 Design and Functioning of Modules

1.2.1 Modulator GM 201

Application

The Modulator GM 201 is part of the R&S equipment series 200 and is used in VHF Transceiver XU 221 in the frequency range of 118 to 144 MHz.

Design

Modulator GM 201 is designed as a 35 mm wide module to be installed in the adapter (accessible after removal of the top cover).

All functional groups are accommodated on a printed circuit board fitted with screening walls and two screening covers.

On the printed circuit board five ribbon-cable connectors are located for connection of the interface 1, VHF synthesizer, VHF amplifier, regulator and display board.

Modulator GM 201 is inserted and installed from the top into Adapter KR 201 next to VHF Rx Unit EU 231 and fixed with two screws. The ribbon cables are plugged in on the top thus establishing the electrical connection between Modulator GM 201 and the other modules.

Functioning

(See Fig. 1.4)

The AF signal is fed in from the microphone (or a line input) via the display board or an interface.

The pre-amplification is carried out either with a fixed gain or by automatic level control. Next come an AF bandpass filter (0.3 to 3.4 kHz) and a limiting stage. For operation with a frequency spacing of 8.33 kHz, the optional Modulator Extension GM 201C8 is connected between the ALC section and the bandpass filter.

Having passed through these stages, the signal is fed to the input of a reduction stage. This amplifier stage reduces the power as a function of various control signals. In addition, the DC signal parts for the modulation signal are added up.

Subsequently, the power is switched over to either full power or partial power, depending on the setting of the internal variable controls.

The following integrator stage compares the nominal and actual values and compensates any deviations.

A voltage monitoring circuit prevents the power in the absence of the negative supply voltage from being switched to full load. Via an emitter follower, the modulation signal is routed to the VHF amplifier.

In addition, control and monitoring circuits for switch-on and off, PTT control and power indication (VSWR, modulation depth) are available. A circuit evaluating the serial remote control process via REM BUS completes the circuitry.

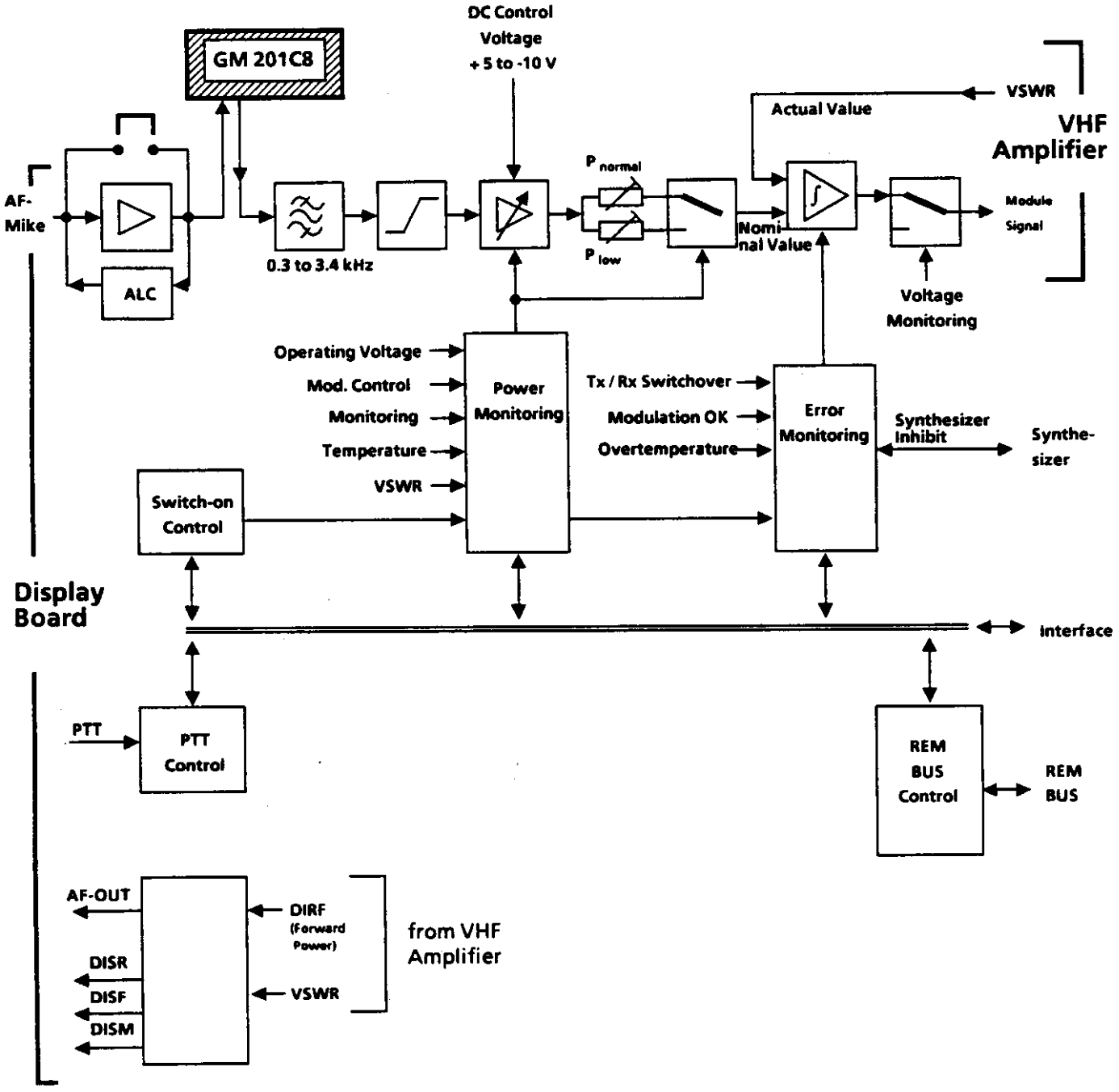


Fig. 1.4 Modulator GM 201, Block Diagram

1.2.2 Modulator Extension GM 201C8 (Option)

This module is installed in Models 26, 27, 46 and 47.

Application

The optional Modulator Extension GM 201C8 is a filter module, which allows the Modulator GM 201 to be used in transmitters or transceivers of the R&S equipment series 200 with a frequency spacing of 8.33 kHz.

Design

All functional groups of Modulator Extension GM 201C8 are accommodated on a printed circuit board measuring 90 x 112 mm, which is screened and mounted on a support located at the space provided for options in the transmitter or transceiver (see Fig. 1.2).

At the top of the module there are two 26-way ribbon cable connectors. Via its connector X1, the modulator extension is connected to the connector X35 at the ribbon cable between Modulator GM 201 and the regulator of Adapter KR 201.

Functioning

(See Fig. 1.5)

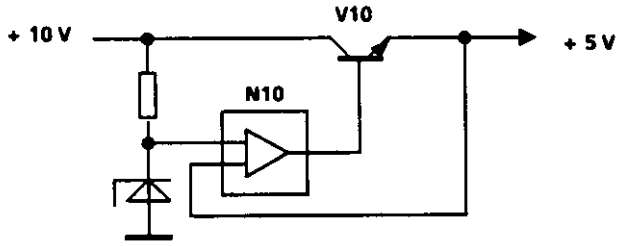
The filter which basically forms this module is connected into the AF signal path of Modulator GM 201 between the ALC section and the standard filter (0.3 to 3.4 kHz).

AF path:
The AF input signal AF-OPT-2 is routed via a lowpass filter (anti-aliasing filter LP1) and the variable switched capacitance filter LP2 to clock filter LP3 and finally to output AF-OPT-3.

The lowpass filters LP1 and LP3 form a 4th-order Butterworth lowpass filter the cutoff frequency of which is f_{cut} = 4.4 kHz. The lowpass filter LP2 is a switched capacitance filter with firmly set Cauer Chebyshev characteristics of the 8th order. The cutoff frequency of this filter is clock-dependent, it is defined as clock frequency divided by 100.

Clock generation:
The crystal oscillator feeds a 3.57-MHz frequency to the programmable divider the division factor of which can be switched via coding switch S30. In this application the division factors 9 to 15 are used. The output frequency can be measured at test connector X30 (238 to 400 kHz). The digital control signal NB/*WB permits the filter to be switched to the highest cutoff frequency, independently of the coding switch.

Power supply:
The module is supplied by Modulator GM 201 with a + 10-VDC voltage. The voltage regulator consisting of N1, Zener diode V16 and series transistor V10 supplies all functional groups except N10.



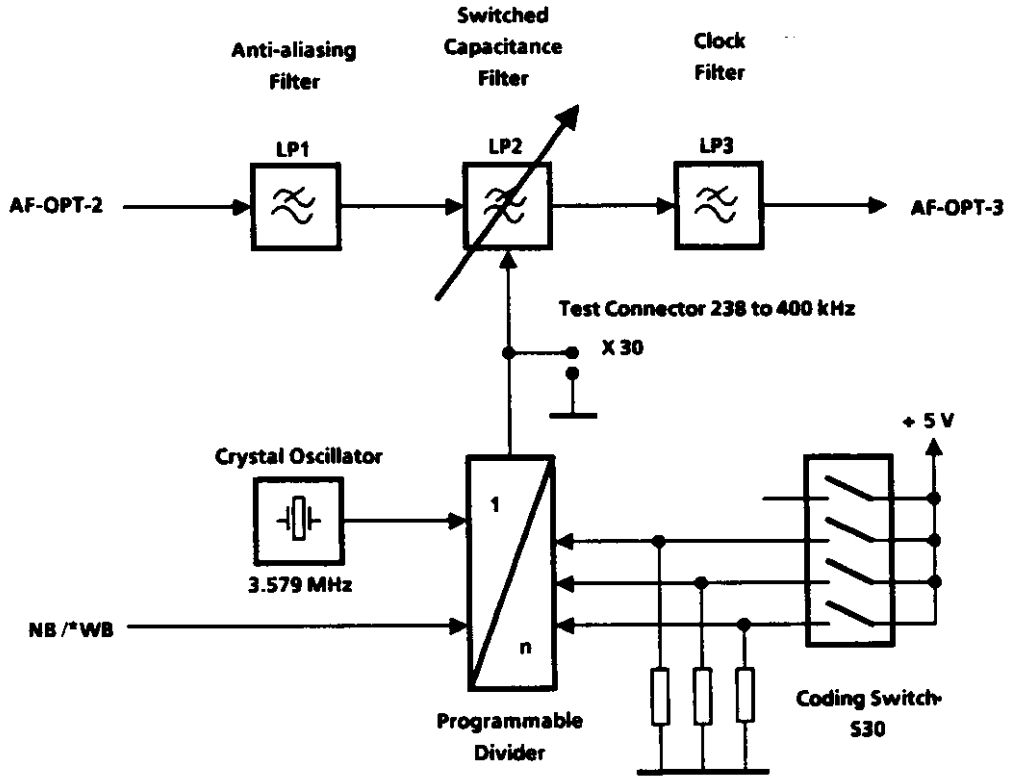


Fig. 1.5 Modulator Extension GM 201C8 (Option), Block Diagram

1.2.3 VHF Synthesizer GF 201V

Application

The VHF Synthesizer GF 201V is part of the R&S equipment series 200 and is used in VHF Transceiver XU 221 for generating the oscillator frequencies of 118 to 144 MHz with variable frequency spacing (e.g. 8.33 kHz).

Design

VHF Synthesizer GF 201V is designed as a 25 mm wide module to be installed in the adapter on the right-hand side of Modulator GM 201 (see Fig. 1.2).

All functional groups of the synthesizer are accommodated on a single printed circuit board which is shielded on both sides.

On the upper side of the module there are a coaxial connector (connection of the VHF amplifier), a 10-way ribbon cable (X43, connection to the modulator with voltage supply) and DIL switches for setting the transmit frequency. In addition, a trimmer for alignment of the OCXO (with Model 23) for tuning the 10-MHz reference is available.

Functioning

(See Fig. 1.6)

A microprocessor programs, controls and monitors, via a serial three-wire bus, the synthesizer IC which operates in the dual-modulus mode (7-bit A / 12-bit N-divider).

The reference frequency is generated by a temperature-compensated 10-MHz crystal oscillator (TCXO) and divided by the reference divider of the IC.

With Model 23 a temperature-controlled crystal oven (OCXO) is used as the reference source.

Three voltage-controlled oscillators (VCOs) cover the entire frequency range. The VCO switched on at the time generates the transmit frequency. The latter is stabilized in a phase-locked loop (PLL). A programmable frequency divider is programmed with the frequency information in such a way that it divides the VCO output frequency to the 2.5-kHz reference (to 4.16 kHz for frequency spacing of 8.33 kHz).

This frequency is compared by a phase discriminator in the synthesizer IC with the reference frequency. From the frequency deviation a control voltage is generated which, via an integrator stage and two filter stages, tunes the VCO to the transmit frequency until the frequencies are identical and the signal is locked. In the discriminator the phase deviation is also used to form a control voltage keeping the VCO in the locked state. The locked state of the phase discriminator is signalled to the microprocessor by the signal UNLOCK.

The programmable divider consists of a variable pre-divider dividing the VCO signal by 64 or 65, an N divider and an A divider, both contained in the synthesizer IC, which also controls the pre-divider.

By means of the DIL switches controlled by the microprocessor, the division factor of both N divider and A divider is set. The output pulses are subsequently evaluated in the phase discriminator in the synthesizer IC for phase and frequency deviation.

An EPROM stores the program for the microprocessor. The latter disables the VCO in the case of impermissible values and emits an error signal.

In reception the VCO frequency is shifted by 50 kHz for the purpose of noise suppression.

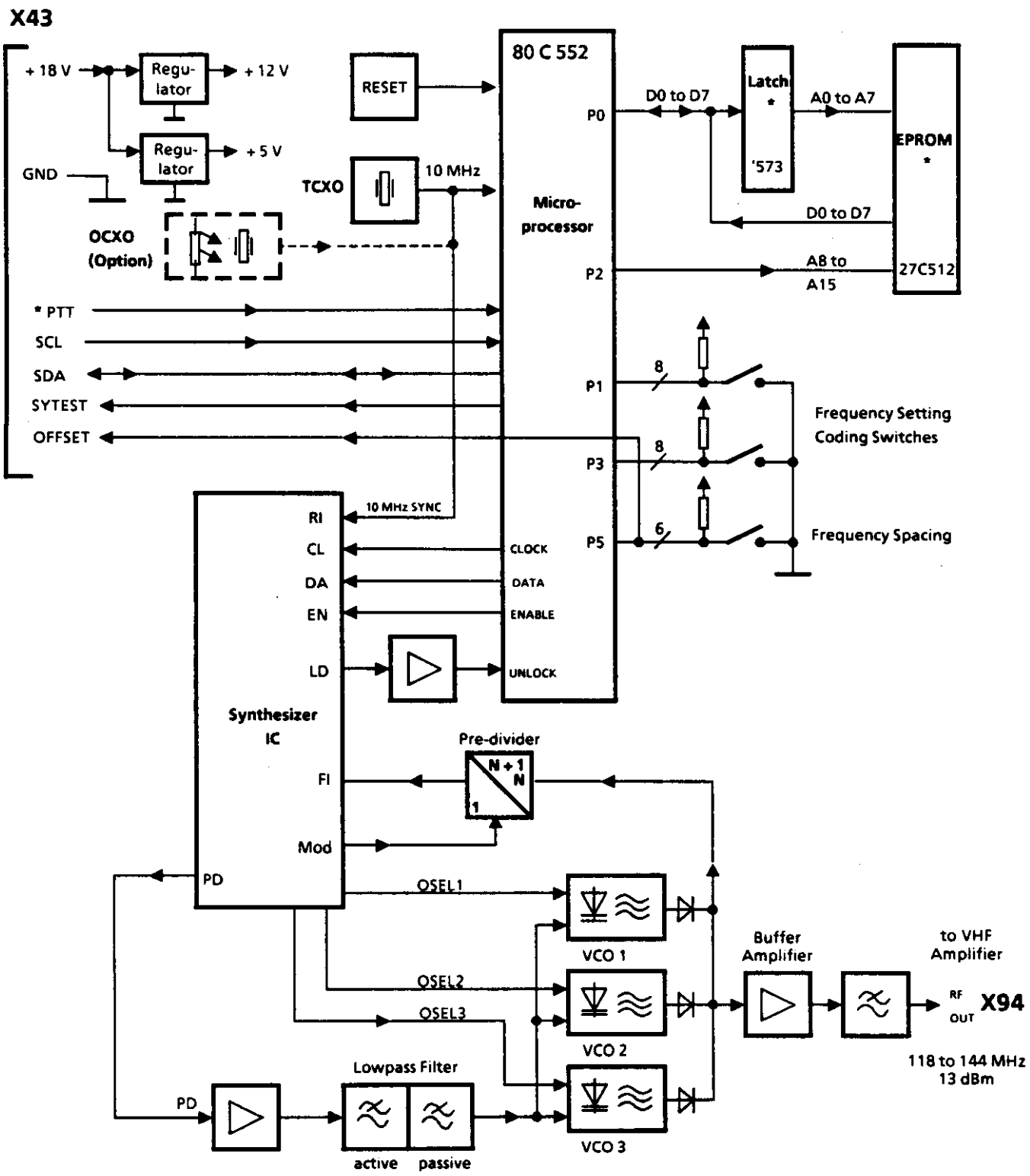


Fig. 1.6 VHF Synthesizer GF 201V, Block Diagram

1.2.4 VHF Amplifier VU 221V

Application

The VHF Amplifier VU 221V is part of the R&S equipment series 200. In the VHF Transceiver XU 221 it is used as 25-W amplifier.

In conjunction with a VHF synthesizer (e.g. GF 201V) the VHF amplifier is employed for amplitude modulation in the range of 118 to 144 MHz.

Design

VHF Amplifier VU 221V and a heat sink with cooling fins located on the rear of the amplifier together form a constructional unit. This unit is mounted to the equipment rear. To the inner side of the heat sink the shielded amplifier module is fixed.

For service and setting purposes the module can be folded out to the rear. In order to do so, there is no need to disconnect any cables. In the fixing strap provision has been made for this in the form of a mechanical guiding facility.

All electrical connections to the other modules are established via internal cables, a ribbon cable and two RF coaxial cables (plus two RF connections for the optional circulator set).

Functioning

(See Fig. 1.7)

VHF Amplifier VU 221V amplifies the VHF signal coming from Synthesizer GF 201V with a power of 20 mW to a carrier power of 25 W (AM).

The amplifier module is of broadband design and is not tuned. It consists of a two-stage preamplifier, a two-stage driver amplifier, a push-pull output stage, a harmonics filter as well as a directional coupler.

As an option, a Circulator Set GD 200V may be installed (in the factory) for better suppression of adjacent-channel interferences.

The harmonics filter suppresses the multiples of the transmit frequency. The directional coupler supplies analog voltages for evaluating the VSWR, modulation depth and power control. These values are fed to the modulator, the interfaces and the display board, followed by the optional PIN diode Tx / Rx switch (for Model 23).

The working points of the pre-stage, the driver stage and the push-pull output stage are set by means of quiescent-current regulators (four variable adjusting elements).

The output signals of the directional coupler are amplified by amplifier stages and decoupled (internally adjustable with three variable control elements).

Amplitude modulation is carried out by way of collector voltage regulation in the pre-stages. Here the AF voltage obtained by demodulation in the directional coupler is compared with a nominal value in the modulator and adjusted. The modulator module carries out the required control and monitoring functions.

The power of the VHF amplifier is reduced for:

- Under- or overvoltage
- VSWR > 2
- Overtemperature

The power of the VHF amplifier is cut out for:

- Failure of control loop
- Failure in Tx / Rx diode switch
- Overvoltage in power transistors.

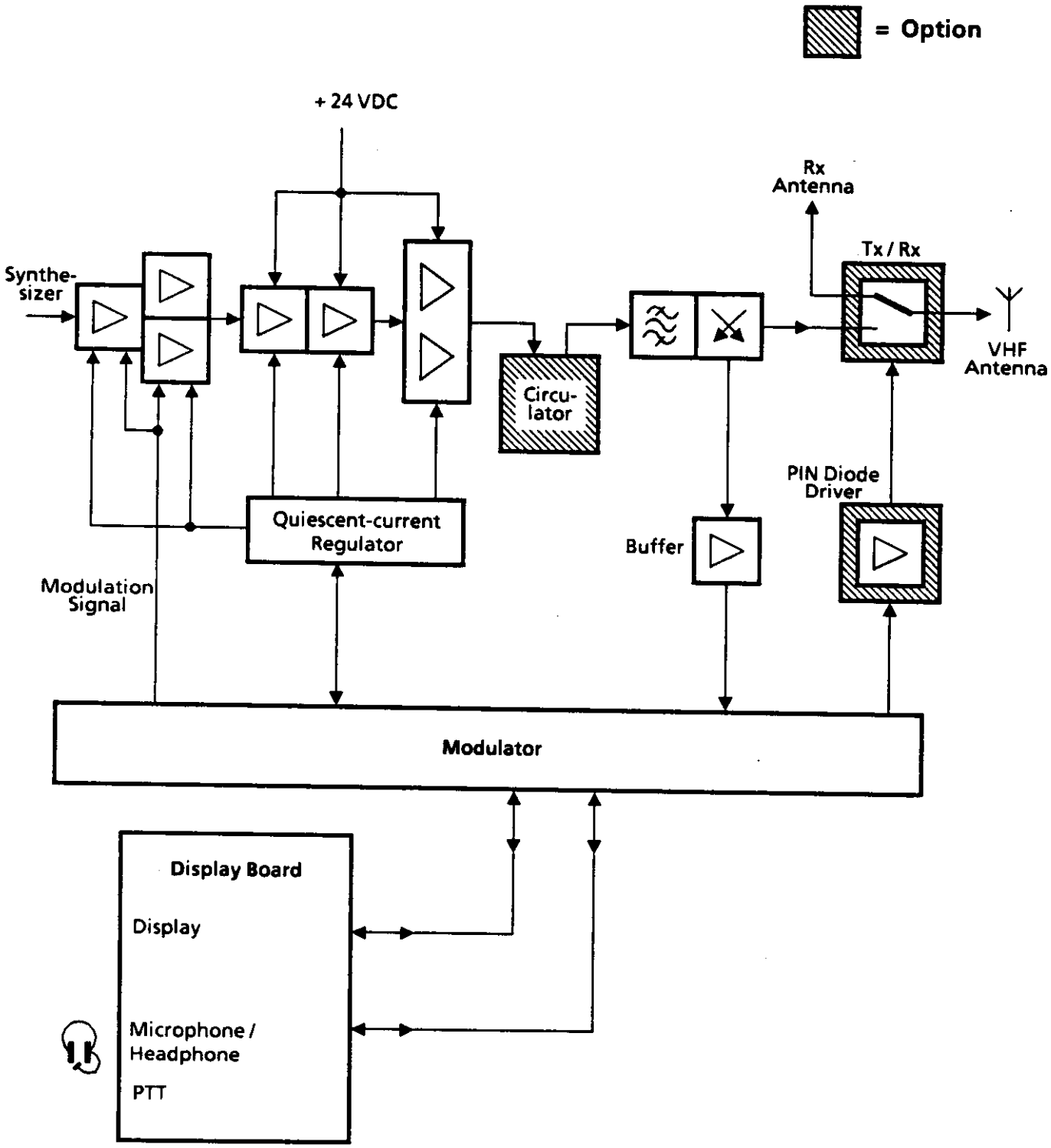


Fig. 1.7 VHF Amplifier VU 221V, Block Diagram

1.2.5 VHF Rx Unit EU 231

Application

The VHF Rx Unit EU 231 is used in receivers and transceivers of the R&S series 200.

Design

Rx Unit EU 231 is designed as a slide-in module. All functional groups are accommodated on a single PCB to which screens and two covers are fixed. On the front panel there are a loudspeaker and control elements.

Rx Unit EU 231 is connected to Power Supply IN 201A/D via plug-in connector strips. Thus the electrical connection between the Rx unit and the system periphery is established via the Power Supply IN 201A/D.

Functioning

(See Fig. 1.8)

RF Section
In the first control stage, the antenna signal is attenuated by the PIN diodes (depending on the signal strength) and routed to the first bandpass filter. The signal then passes through the second control stage and is amplified. Having passed the second bandpass filter, the signal is converted in the mixer stage into the first intermediate frequency of 10.7 MHz.

Synthesizer
A microprocessor programs, controls and monitors the synthesizer via a serial bus. The synthesizer consists of a prescaler, a synthesizer IC, a VCO and a phase-locked loop (PLL). The reference frequency is obtained from a temperature-compensated 10-MHz crystal oscillator (TCXO). With Mod. 23, an oven-controlled crystal oscillator is used as the reference source. By means of coding switches the frequency is set. The locked state of the PLL-VCO is indicated by a green LED.

IF Section
The 10.7-MHz IF signal from the mixer passes through several amplifier stages and two crystal filters. The second mixer converts the signal to the intermediate frequency of 1.3 MHz, and this signal is fed via the following filter to the amplifier stage and the demodulator.

In addition, an AGC control voltage is generated. From the first IF, a logarithmic amplifier generates a signal which can be employed for evaluating the receive-signal quality and driving the PIN diodes of the RF section.

AF Section
The AF signal is preamplified and noise can be suppressed by the noise blanker. Subsequently the AF signal is fed to the AF AGC control circuit and the filter board. Via various AF switches the output is regulated. The volume of the loudspeaker is adjusted with a volume control. The S/N evaluation circuit generates the squelch criterion.

AF Switchover Section (MAIN / STBY)
In the automatic switchover mode with two correlated receivers the AF switchover circuit determines that the receiver with the better signal quality becomes main receiver, whereas the other receiver operates as standby unit.

Sum Test - CBIT
Via the sum test the entire receiver is continuously monitored (continuous built-in test). The signals from the oscillators, the synthesizer, the IF stages and the remote control are combined to form the sum signal. The operating voltages are monitored in just the same way. A test plug simplifies fault detection.

Remote Control
The serial signals of the REM BUS are stored and converted into parallel signals. The logic circuit combines the control signals for the receiver. In the other direction, status signals of the receiver are converted into serial data telegrams via the REM BUS. At the connectors CONTROL and AF the control and status signals are available and permit remote control via parallel lines. The optional inband interface converts data telegrams via control tones (in the AF voice channel) into parallel control signals. In the other direction, status signals of the receiver are converted into control tones.

Power Supply
The input voltage of nominally 24 VDC is converted by a DC/DC converter with regulator to + 12, + 5, and - 5 VDC.

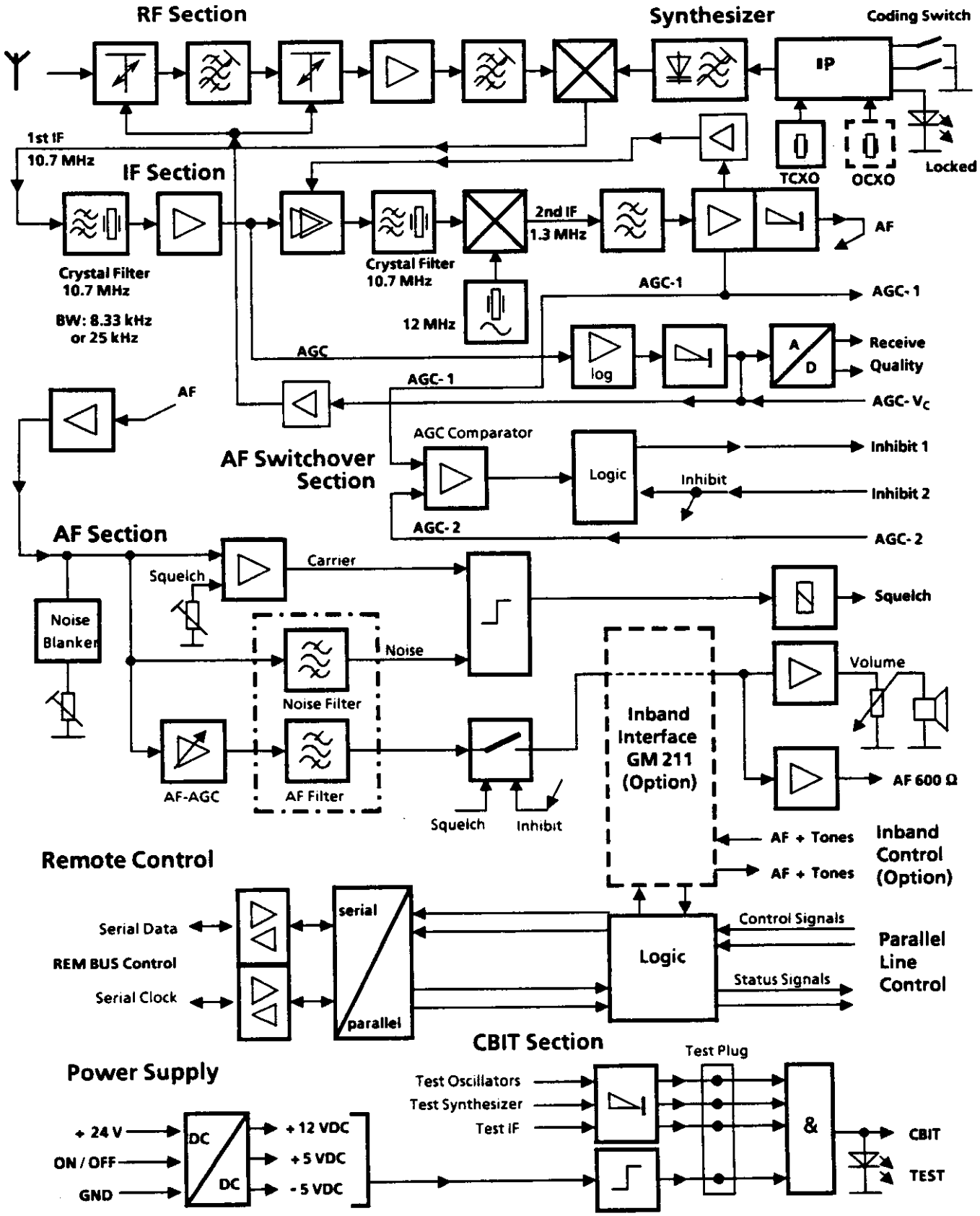


Fig. 1.8 VHF Rx Unit EU 231, Block Diagram

1.2.6 Adapter KR 201

The Adapter KR 201 is part of the R&S equipment series 200 and is used to accommodate the modules of VHF Transceiver XU 221.

The adapter consists of the mechanical parts of the 19" frame, the regulator plus associated cooling and mounting plate and the display board fixed to the front panel of the adapter.

1.2.6.1 Regulator

Design

The regulator is arranged on a U-shaped cooling and mounting plate of approx. 250 x 115 mm. Onto this plate the printed circuit board with the voltage regulators and switching and control transistors (DC board) is mounted. The power rectifier V1 and the electrolytic capacitor C4 are located outside the printed circuit board on the mounting plate. The temperature switch (S1) monitoring the temperature of the U-shaped cooling plate is fixed to the mounting plate by means of screws.

Functioning

(See Fig. 1.9)

The DC voltage (DC IN, 22 to 31 VDC) is routed from the input filter to the rectifier V1. The latter secures the input against polarity confusion and together with the optional Power Supply IN 251A ensures automatic switchover in the case of a mains power failure (AC / DC switchover); in addition, a connected battery is protected during mains operation.

Electrolytic capacitor C4 is an energy store and serves as filter capacitor for both DC and AC operation.

Directly to electrolytic capacitor C4, the voltage supply for the VHF amplifier (24 VDC, 10 A), and via fuse F1 the voltage supply for the Rx unit (-24 V, 1 A) are connected.

Via fuse F2, the integrated voltage regulator N5 (8-VDC output) for generating the control voltage for switchover operation is connected.

Via fuse F2 and the FET switching stage V3 the voltage regulators are connected to the input voltage. By means of a control voltage (switch-on control) the operating voltages of the transmitter can be switched. In the case that the mounting plate has heated up excessively, the thermoswitch cuts out, in order to prevent any damage due to overheating.

The integrated voltage regulators N2, N3 and N4 produce the operating voltages of +5 V, +10 V and +18 V.

Derived from the operating voltage +18 V, the negative voltage is generated in an integrated voltage converter (N6 = switched-capacitor voltage converter). Subsequently, the voltage passes through a voltage-regulation stage with series transistor and stabilizing Zener diode.

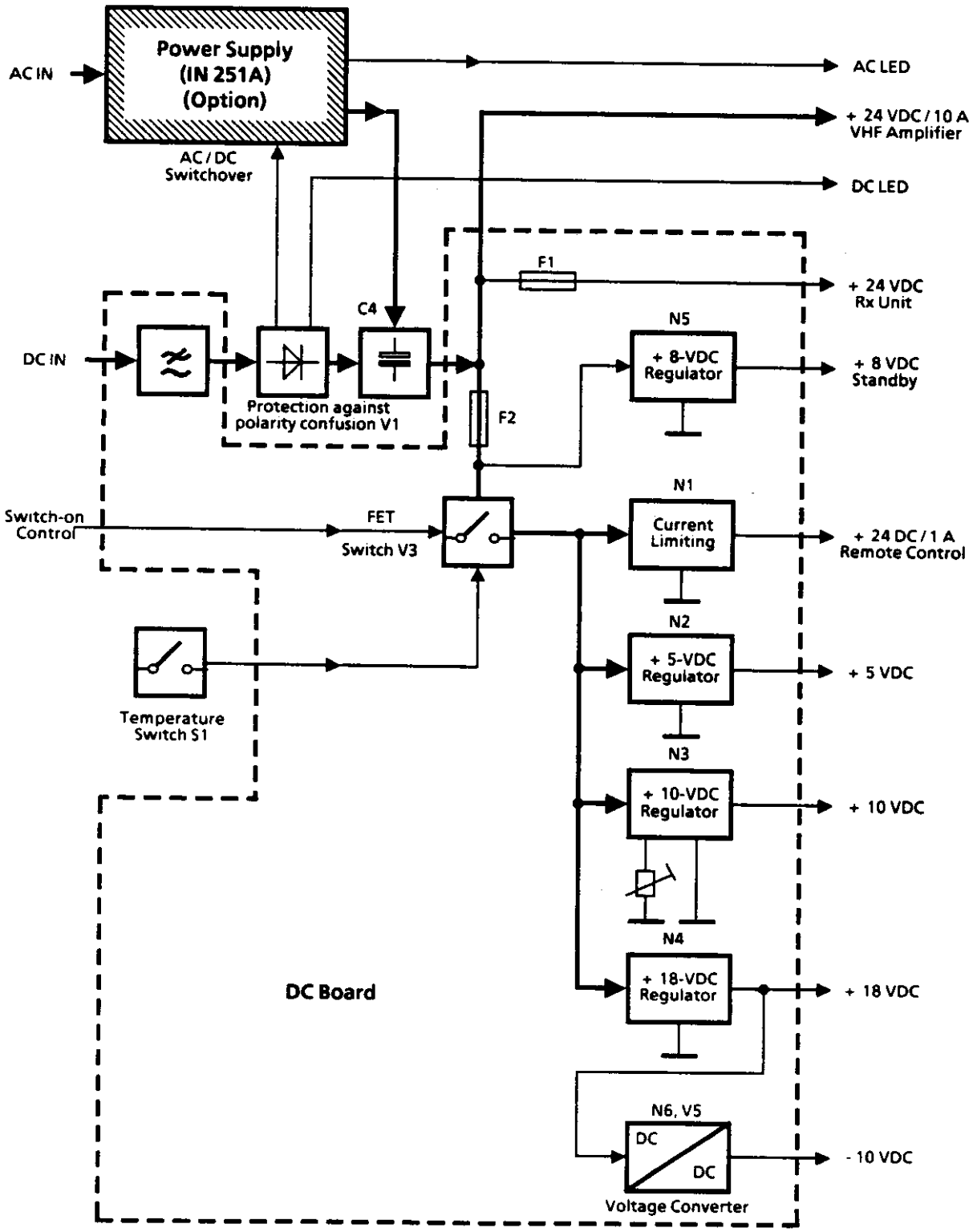


Fig. 1.9 Regulator, Block Diagram

1.2.6.2 Display Board

Design

The display board is designed as a module measuring approx. 100 x 110 mm to be installed into the adapter. It is mounted on the right-hand side directly behind the front panel of the adapter frame thus permitting the display and control elements to be seen and operated from the front. The display board is connected via a ribbon cable and connector X13 to the modulator. The headset connector X5 is located on the front panel.

The display board is designed in the form of a printed circuit board which is partly shielded. The shielded part accommodates the EMC filters for connector X5.

Functioning

(See Fig. 1.10)

In the display section, the LED bargraph indicator is driven by the three analog signals which come from the directional coupler and are conditioned in the modulator. The analog signal DISR is equivalent to the reflected power, the signal DISF to the forward power and the signal DISM to the modulation deviation.

By means of switch S2 the measuring range of the LED bargraph indicator is selected. Via a digital switching logic and multiple demultiplexers the relevant analog signals are switched through to the divider circuit and the respective factors are set. The resulting analog voltage is digitized in the following driver circuit and the driver current for the LED column (20 segments) is switched through.

The display board also contains four light-emitting diodes. Availability of the +5-VDC operating voltage is indicated by the green LED V_{OP}, supply with mains power is shown by the green LED AC and supply with battery power by the green LED DC. "All test signals in order" is indicated by the green LED TEST.

The AF section contains, in a shielded part of the printed circuit board, the EMC filters for the AF inputs and outputs for the headset and the PTT key (connector X5). The volume of the headphone output can be adjusted with a control element on the front panel.

The microphone input for dynamic microphones has an amplifier stage and an internal trimmer by way of which the level can be set.

The amplifier input of the microphone is also suited as line input (600-Ω impedance). The level at this input, too, can be adjusted by means of a control element.

For test purposes, a tone generator can be connected in circuit and its tone be used as modulation signal for the transmitter. The level of the Wien-bridge generator is kept constant by an automatic level-control circuit.

A sum amplifier decouples the signals and at the same time functions as compensating amplifier. Subsequently, the AF signal is switched through to the modulator.

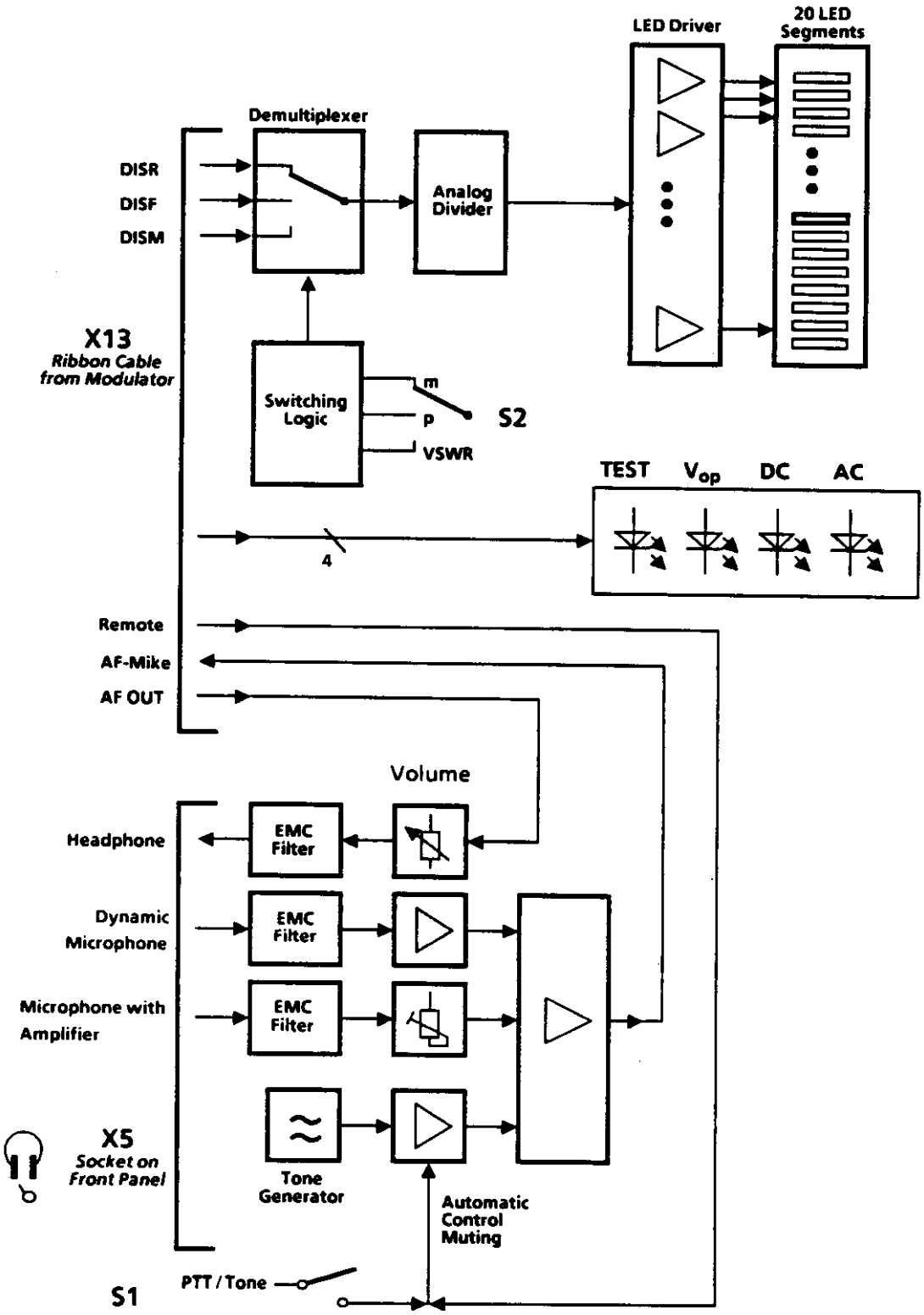


Fig. 1.10 Display Board, Block Diagram

1.2.7 Interface 1 GI 201X

Application

The Interface 1 GI 201X is part of the R&S equipment series 200 and is used in VHF Transceiver XU 221 as interface between the Rx unit, the modulator, the (optional) Interface 2 GI 201 and the external interfaces (REMOTE and REM BUS).

Design

Interface 1 GI 201X is designed as a 25 mm wide module which is installed from the top into the adapter while the cover is removed.

All functional groups of the interface are located on a single printed circuit board extending from the rear panel to connector X27 of the VHF Rx unit. The Rx unit is inserted from the front into the adapter.

Following installation, the connectors X8 (REM BUS) and X9 (REMOTE) extend through the rectangular openings in the rear panel, thus permitting connection even if the equipment covers are fixed.

The ribbon cable X73 firmly soldered to the interface PCB establishes the connection to the modulator. For this it has to be connected to the modulator once the housing cover has been removed. To connector X78 the optional interface 2 can be connected.

Between connectors X8 and X9 on the rear, a potentiometer for AF level adjustment (using a screw driver) is accessible through a small drilling.

Functioning

(See Fig. 1.11)

Interface 1 GI 201X basically performs three functions: establishing the connection to external interfaces, level matching and through-connection of AF lines as well as through-connection and amplification of various digital control signals.

Interface 1 switches the supply voltages through to the VHF Rx unit and the different interface modules.

The external modulation AF (e.g. from a connected control unit) is fed from connector X9 (line input) via an EMC filter and an overvoltage limiter to the transformer (separation of potentials).

Via a level-adjustment facility, the modulation AF is routed to the modulator. The alternative signal path is via the inband interface (with control tones) and back (control tones filtered out) to the modulator.

By means of the directional coupler of the VHF amplifier and the modulator, a monitoring signal is obtained which is switched via a transformer for potential separation and an EMC filter to connector X9.

As an alternative (made possible by the insertion of jumpers), the control tones of the optional inband interface can also be output for signalling the different operating states of the transceiver.

For realizing the function PTT from an external unit, the interface 1 offers several possibilities of internal wiring: positive or negative logic signal, connection to ground potential or phantom circuit. Via jumpers these functions can be activated. The interface is completed by a serial REM BUS connection and an additional feature, allowing a number of digital signals to be output.

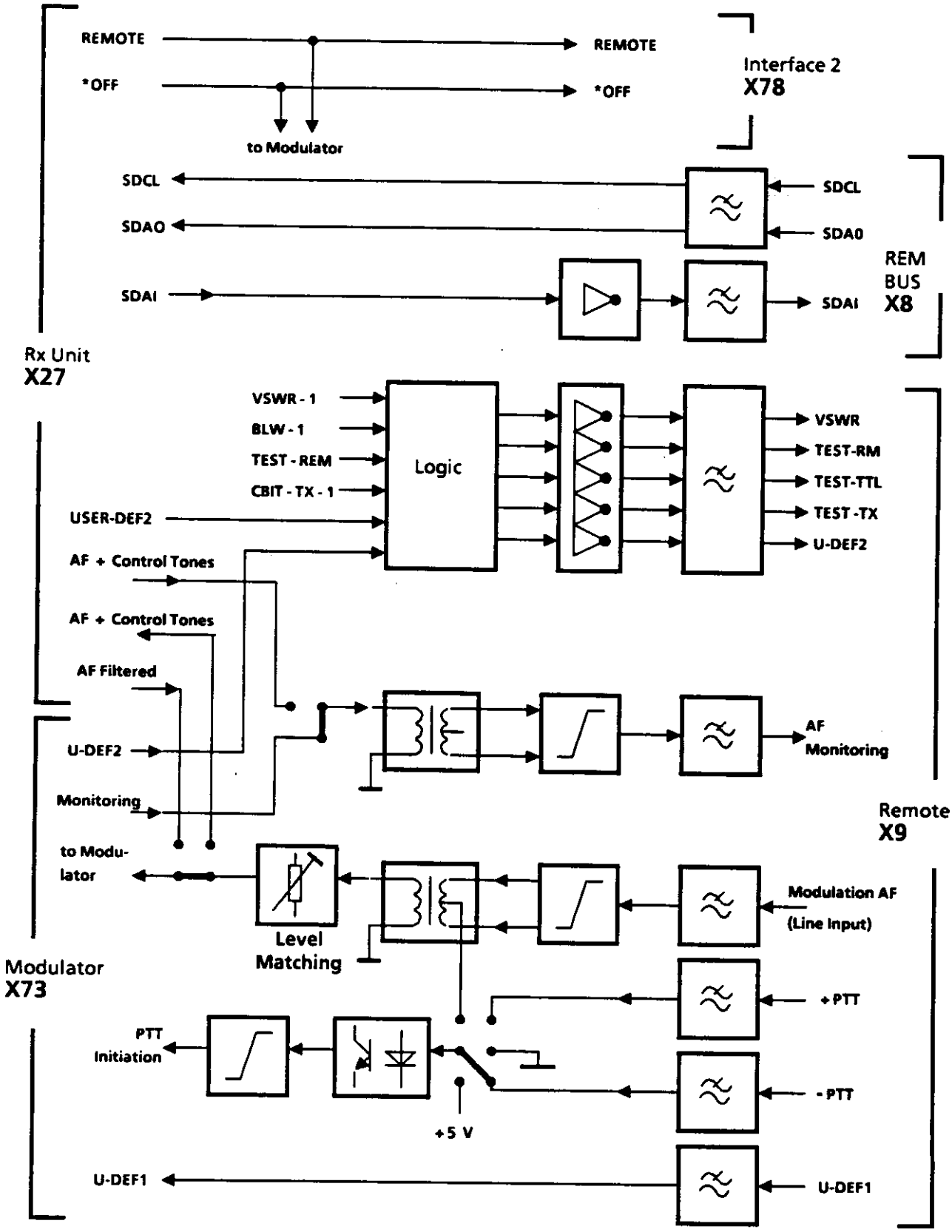


Fig. 1.11 Interface 1 GI 201X, Block Diagram

1.2.8 Interface 2 GI 201 (Option)

Application

The optional Interface 2 GI 201 is part of the R&S equipment series 200 and is used e.g. in the VHF Transceiver XU 221.

The interface 2 is required for

- operation of a transceiver in conjunction with an external power amplifier (regulated or unregulated),
- main / standby operation with two transceivers with extended functions.

Design

Interface 2 GI 201 is designed as a plug-in module to be connected laterally to Interface 1 GI 201S within the transceiver.

All functional groups of the interface are located on a single PCB extending from the equipment rear to connector X78 of interface 1.

After installation the connectors X8 (REM BUS) and X9 (REMOTE) extend through rectangular openings in the rear panel, thus permitting connection even if the equipment covers are fixed.

Functioning

(See Fig. 1.12)

Interface 2 GI 201 provides the external interfaces for connection of a power amplifier (X6, POWER AMP) and a second transceiver (X7, MAIN / STANDBY).

In addition, it establishes the connection to Interface 1 GI 201X via the 48-way connector X78.

Connector X6 POWER AMP

At the 15-way connector X6 (POWER AMP) a regulated or unregulated external power amplifier can be connected. Via X6 all control and test signals required for control of the external power amplifier are transmitted.

The carrier activation signal PTT-AMP (X78.B12) of Interface 1 GI 201S is available via transistor V30 and L / C lowpass filter L30 / C30 at contact 3 of connector X6 (open collector).

All other signals are routed via R / C and L / C lowpass filters to connector X78 (Interface 1 GI 201X).

Connector X7 MAIN / STANDBY

At the 25-way connector X7 (MAIN / STANDBY) a second transceiver can be connected.

All input and output signals of connector X7 are routed via R / C lowpass filters to connector X78.

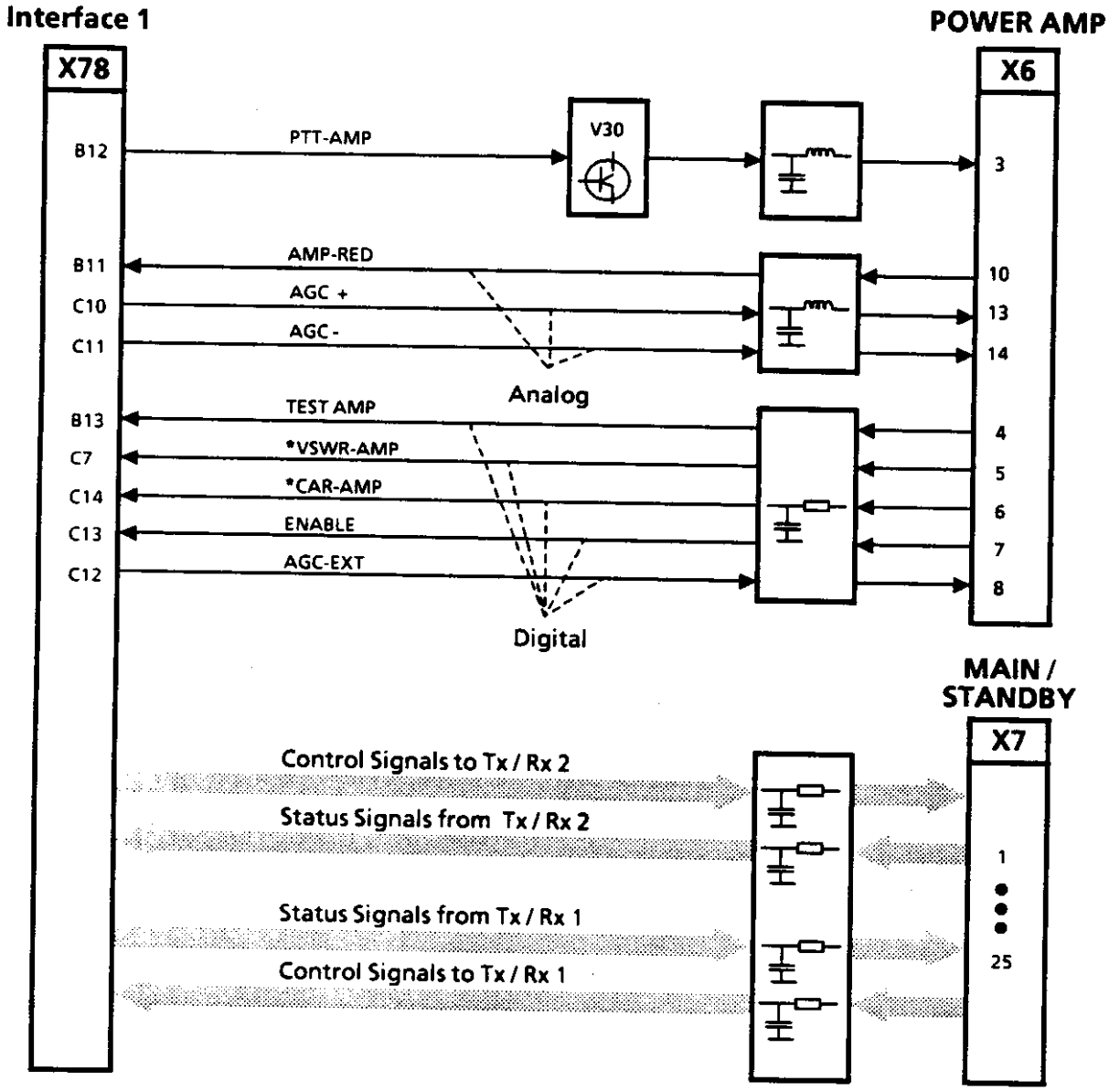


Fig. 1.12 Interface 2 GI 201 (Option), Block Diagram

1.2.9 Power Supply IN 251A (Option)

Application

The optional Power Supply IN 251A is part of the R&S equipment series 200. It is used in VHF Transceiver XU 221 in the event of mains operation and provides the required supply voltage for AC or AC / DC switchover operation.

Depending on the setting of the voltage selector the power supply can be operated on mains voltages of 115 to 230 VAC with a tolerance of -10 to + 15 %. The power supply leaves the factory set to 230 VAC.

Design

Power Supply IN 251A is designed as a module to be installed into the adapter. Being partly covered by rugged sheet-metal walls, the power supply is screwed to the side and the bottom panel of the transceiver.

The mains connection is established via a mains connector combination with filter, voltage selector and fuse holder.

All supply voltage outputs are connected via flat connectors to the other transceiver modules.

Functioning

(See Fig. 1.13)

The mains voltage is supplied via a mains noise filter and two fuses (F1 and F2) to the power switch. Subsequently the primary voltage is fed via a contact of relay 4 to the voltage selector.

Due to the high remanence of the toroidal-core transformer, a switch-on current limiter is required. This circuit is made up of a resistor array and auxiliary circuits controlling relay 4.

Following activation of the power switch, first the reduced switch-on current flows through the resistor array. After a certain delay, the relay switches the transformer directly to the mains voltage.

In the case of a mains voltage interruption the start and reset circuit relay 4 deenergizes immediately, discharging time capacitor C6. After the RC time delay (C6 and R12) the relay 4 again bypasses the current limiter.

The secondary voltage generated in toroidal-core transformer TR1 is routed via the fuses F3 and F4 and rectified by diodes D1 and D2. By means of capacitors, the DC voltage is decoupled RF-wise and fed to the 24-V output.

In the presence of a battery supply, if no AC voltage is present the AC/DC switchover circuit initiates a DC switchover. The 24-V input of the battery (22 to 31 VDC on ST1 / ST2) is fed via relay contacts to the DC output connector ST3/ ST4. The DC voltage is locked by relay 3 (via contact 3.1) if an AC voltage is present.

This circuit brings about an AC / DC switchover, AC supply always having priority over DC supply. The switchover circuit only reacts to the correct polarity and limits the switch-on current by time-staggered switching with a series resistor (via relay 2).

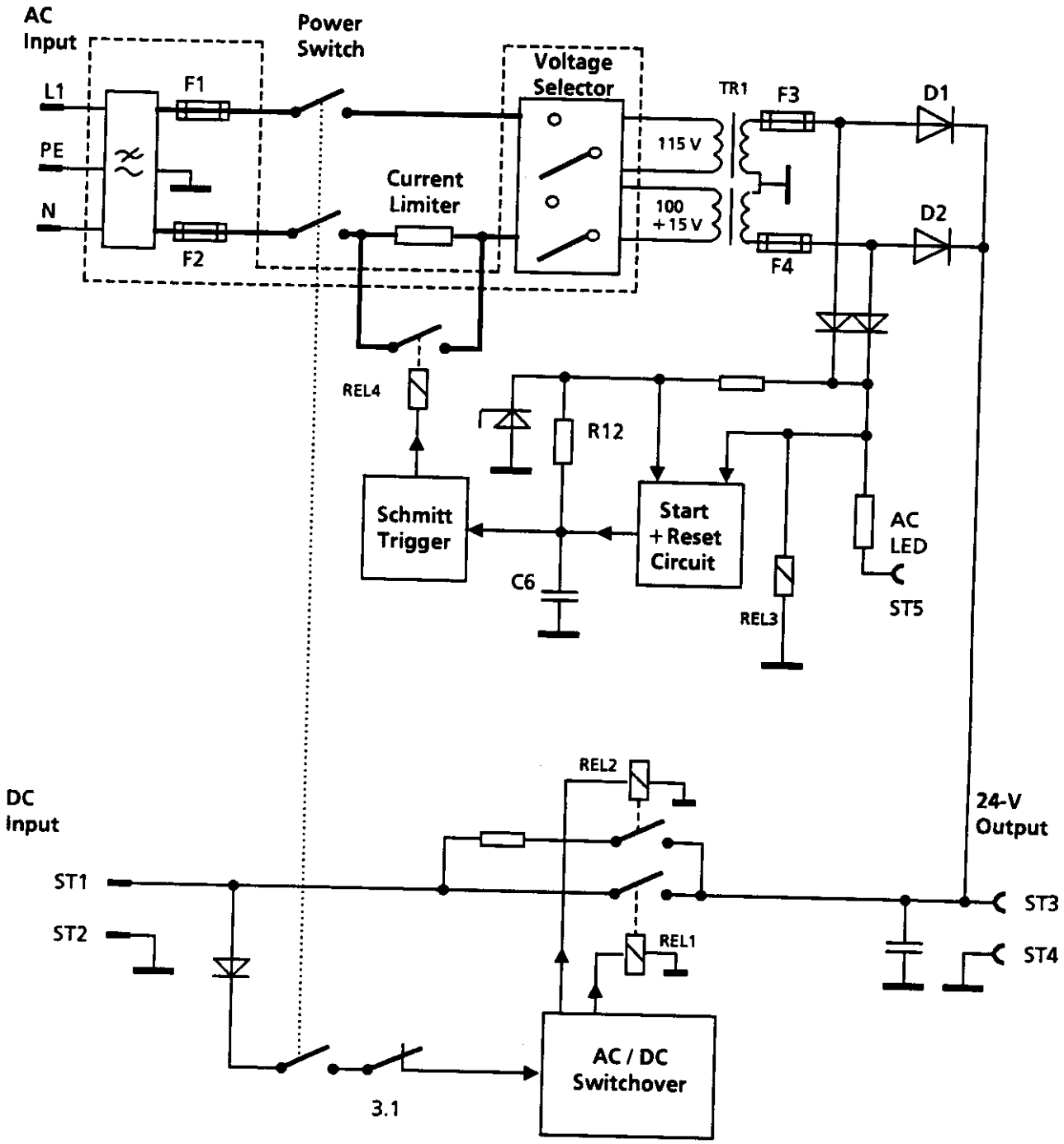


Fig. 1.13 Power Supply IN 251A (Option), Block Diagram

1.2.10 Inband Interface GM 211 (Option)

Application

The optional Inband Interface GM 211 is part of the R&S equipment series 200. In conjunction with a 4-way telephone line, the inband interface allows remote control of several receivers, transmitters or transceivers in all their functions from a central control station.

The telephone line conveys not only voice signals, but also control and status signals. For this purpose a narrow frequency band containing the control information is filtered out of the voice spectrum. The time-critical commands and signals (e.g. Tx / Rx switchover and field strength monitoring) are transmitted in frequency-modulated form, all other commands and messages being amplitude-modulated.

The software implemented in the inband interface is available in five versions thus realizing a variety of application-dependent functions.

SW Version	22	23	25	26	27
Full functionality	x				
PTT 2 040 Hz		x	x	x	
Squelch 2 040 Hz		x			
Line equalizer				x	
Tx muting					x
AGC 30 dB	x	x	x	x	x

Design

Inband Interface GM 211 is designed as a 55 mm wide and 174 mm long plug-in module inserted in Rx Unit EU 231.

The functional groups are located on a printed circuit board fitted with screening walls and two screening covers. One of the covers at the same time forms the upper screening cover of Rx Unit EU 231. The electrical connection to the interface 1 is established via the 48-way connector X1.

Inband Interface GM 211 contains two plug-in submodules: a power supply and a DSP module with a digital signal processor as well as RAM and EEPROM ICs.

Functioning

(See Fig. 1.14)

Analog section, A / D converter
Signal processing is carried out by a digital signal processor. In order to be able to use a single A / D (or D / A) converter for the two required channels, a switchover facility has been provided.

Each of the two analog input signals is fed via an EMC filter and a 4-way lowpass filter (anti-aliasing filter with amplification) as well as the multiplexer (16 kHz) to the A / D converter (32 kHz). In the other direction, the 12-bit data word is converted by an D / A converter into an analog signal to be switched via a demultiplexer to the two output channels. Via a 3-way lowpass filter, an amplifier and an EMC filter the AF signals are routed to the output. The required clock is obtained from a 16-MHz generator by way of frequency division.

Digital section and DSP processor
The DSP module with the digital signal processor and the RAM and EEPROM components provides for control, AF signal generation and evaluation as well as filtering of the AF and control signals (lowpass, bandpass and notch filter functions). Depending on the application, sixteen digital lines can be switched as inputs or outputs.

Power supply
On the basis of the +24-VDC input voltage, a DC / DC switching regulator generates a stabilized voltage of +5 VDC. Also from the +24-VDC input voltage two linear voltage regulators produce the stabilized DC voltages of +12 VDC and -5 VDC.

Monitoring circuit
The monitoring circuit contains a watchdog for processor monitoring and reset control as well as test circuitry for all operating voltages. The resulting signals are combined by a logic circuit to form the monitoring signal CBIT.

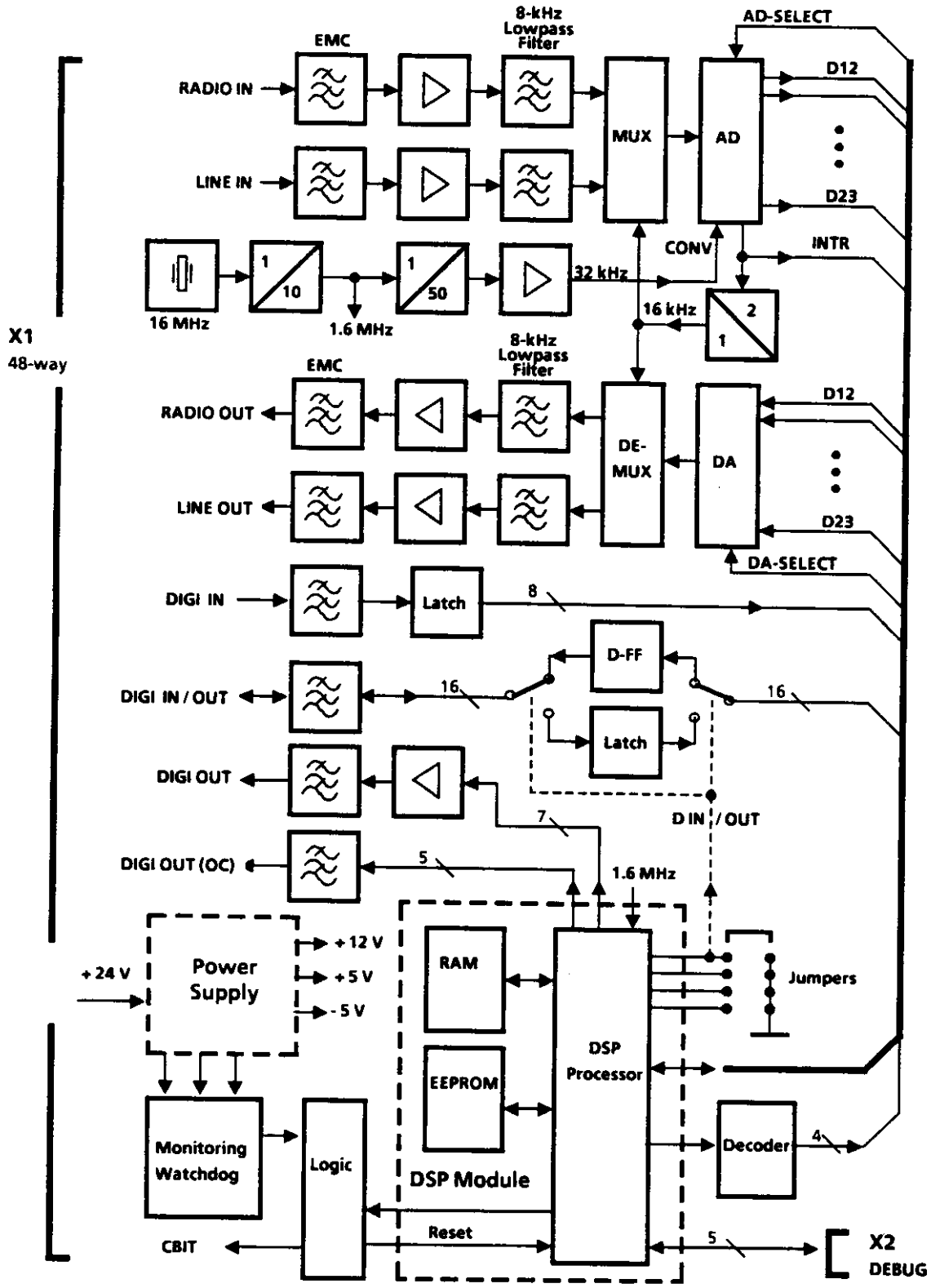


Fig. 1.14 Inband Interface GM 211 (Option), Block Diagram

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
.	XX VARIANTENERKLAERUNG IDENTIFICATION OF MODELS VAR 02 = GRUNDAUSFUEHRUNG MOD 02 = BASIC MODEL VAR 03 = MIT DIODEN- SCHALTER MOD 03 = WITH DIODE SWITCH VAR 04 = MIT GF201V VAR 12 MOD 04 = WITH GF201V MOD12 VAR 05 = MIT DIODEN- SCHALTER MOD 05 = WITH DIODE SWITCH AND GF201V MOD 12 VAR 06 = MIT GF201V VAR 13 MOD 06 = WITH GF201V MOD 13 VAR 07 = MIT DIODEN- SCHALTER UND GF201V/VAR 13 MOD 07 = WITH DIODE SWITCH AND GF201V/MOD 13 VAR 08 = MIT GM201 VAR 03 MOD 08 = WITH GM201 MOD 03 VAR 09 = MIT GM201 VAR 03 U.DIODENSCHALTER MOD 09 = WITH GM201 MOD 03 AND DIODE SWITCH VAR 10 = MIT GF201V VAR12 UND GM201 VAR 03 MOD 10 = WITH GF201V MOD12 AND GM201 MOD 03 VAR 11 = MIT DIODENSCHALT. GF201V VAR 12 UND GM201 VAR 03 MOD 11 = WITH DIODE SWITCH MOD 11 = GF201V VAR 12 AND GM201 MOD 03 VAR 12 = MITGF201V VAR 13 UND GM201 VAR 03 MOD 12 = WITH GF201V MOD13 AND GM201 MOD 03 VAR 13 = MIT DIODENSCHALT. GF201V VAR 13 UND GM201 VAR 03 MOD 13 = WITH DIODE SWITCH GF201V MOD 13 AND GM201 MOD 03 VAR 22 = MIT EU231 VAR 23 UND GM201 VAR 03 UND GF201V VAR 22 MOD 22 = WITH EU231 MOD 23 AND GM201 MOD 03 AND GF201V MOD 22 VAR 23 = M. DIODENSCHALTER UND EU231 VAR 23 UND GM201 VAR 03 UND GF201V VAR 22 MOD 23 = WITH DIODE SWITCH AND EU231 MOD 23 AND GM201 MOD 03 AND GF201V MOD 22 VAR 24 = MIT EU231 VAR 23 UND GM201 VAR 03 UND GF201V VAR 23 MOD 24 = WITH EU231 MOD 23 AND GM201 MOD 03 AND GF201V MOD 23 VAR 25 = M. DIODENSCHALTER UND EU231 VAR 23 UND GM201 VAR 03 UND GF201V VAR 23 MOD 25 = WITH DIODE SWITCH AND EU231 MOD 23 AND GM201 MOD 03 AND GF201V MOD 23 VAR 26 = MIT EU231 VAR 22				

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
	UND GM201 VAR 03 UND GF201V VAR 22 MOD 26 = WITH EU231 MOD 22 AND GM201 MOD 03 AND GF201V MOD 22 VAR 27 = M. DIODENSCHALTER UND EU231 VAR 22 UND GM201 VAR 03 UND GF201V VAR 22 MOD 27 = WITH DIODE SWITCH AND EU231 MOD 22 AND GM201 MOD 03 AND GF201V MOD 22 VAR 42 = MIT EU231 VAR 23 UND GM211 VAR 03 UND GF201V VAR 22 UND GH200V VAR 02 MOD 42 = WITH EU231 MOD 23 AND GM201 MOD 03 AND GM201V MOD 22 AND GH200V MOD 02 VAR 43 = M. DIODENSCHALTER UND EU231 VAR 23 UND GM201 VAR 03 UND GF201V VAR 22 UND GH200V VAR 02 MOD 43 = WITH DIODE SWITCH AND EU231 MOD 23 AND GM201 MOD 03 AND GF201V MOD 22 AND GH200V MOD 02 VAR 44 = MIT EU231 VAR 23 UND GM201 VAR 03 UND GF201V VAR 23 UND GH200V VAR 02 MOD 44 = WITH EU231 MOD 23 AND GM201 MOD 03 AND GF201V MOD 23 AND GH200V MOD 02 VAR 45 = M. DIODENSCHALTER UND EU231 VAR 23 UND GM201 VAR 03 UND GF201V VAR 23 UND GH200V VAR 02 MOD 45 = WITH DIODE SWITCH AND EU231 MOD 23 AND GM201 MOD 03 AND GF201V MOD 23 AND GH200V MOD 02 VAR 46 = MIT EU231 VAR 22 UND GM201 VAR 03 UND GF201V VAR 22 UND GH200V VAR 02 MOD 46 = WITH EU231 MOD 22 AND GM201 MOD 03 AND GF201V MOD 22 AND GH200V MOD 02 VAR 47 = M. DIODENSCHALTER UND EU231 VAR 22 UND GM201 VAR 03 UND GF201V VAR 22 UND GH200V VAR 02 MOD 47 = WITH DIODE SWITCH AND EU231 MOD 22 AND GM201 MOD 03 AND GF201V MOD 22 AND GF200V MOD 02			
A1	GG KR201 ADAPTER	6044.0940.02			
A2	GG EU231 VHF RX UNIT NUR VAR/ONLY MOD: 02 03 04 05 06 07 08 09 10 11 12 13	6043.1942.02			
A2	GG EU231 VHF RX UNIT NUR VAR/ONLY MOD: 26 27 46 47	6043.1942.22			
A2	GG EU231 VHF RX UNIT NUR VAR/ONLY MOD: 22 23 24 25 42 43 44 45	6043.1942.23			

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
A3	GG GM201 MODULATOR NUR VAR/ONLY MOD: 02 03 04 05 06 07	6044.5941.02			
A3	GG GM201 MODULATOR NUR VAR/ONLY MOD: 08 09 10 11 12 13 22 23 24 25 26 27 42 43 44 45	6044.5941.03			
A3	GG GM201 MODULATOR NUR VAR/ONLY MOD: 46 47	6044.5941.03			
A4	GG GF201V VHF SYNTHESIZER NUR VAR/ONLY MOD: 02 03 08 09	6044.6948.02			
A4	GG GF201V VHF SYNTHESIZER NUR VAR/ONLY MOD: 04 05 10 11	6044.6948.12			
A4	GG GF201V VHF SYNTHESIZER NUR VAR/ONLY MOD: 06 07 12 13	6044.6948.13			
A4	GG GF201V VHF SYNTH. NUR VAR/ONLY MOD: 22 23 26 27 42 43 46 47	6044.6948.22			
A4	GG GF201V VHF SYNTH. NUR VAR/ONLY MOD: 24 25 44 45	6044.6948.23			
A6	GG IN251A POWER SUPPLY JE NACH AUFTRAG DEPENDING ON ORDER	6044.8440.02			
A7	GG GI201X INTERFACE 1	6044.2442.02			
A8	GG GI201 INTERFACE 2 JE NACH AUFTRAG DEPENDING ON ORDER	6044.2794.02			
A9	GG VU221V VHF AMPLIF.25W NUR VAR/ONLY MOD: 02 04 06 08 10 12 22 24 26 42 44 46	6044.2942.02			
A9	GG VU221V VHF AMPLIF.25W NUR VAR/ONLY MOD: 03 05 07 09 11 13 23 25 27 43 45 47	6044.2942.03			
A10	GS GD200V VHF ZIRK.SATZ GD200V VHF CIRC.SET JE NACH AUFTRAG DEPENDING ON ORDER	6044.8940.02			
A11	GG KA231F FREQ.TUNING KIT JE NACH AUFTRAG DEPENDING ON ORDER	6051.0341.02			
A12	GG GM211 INBAND INTERFACE GM211 INBAND INTERFACE JE NACH AUFTRAG DEPENDING ON ORDER	6047.8693.02			
A13	GG GH200V VHF LP FILTER NUR VAR/ONLY MOD: 42 43 44 45 46 47	6048.0644.02			
A15	GG GM201C8 MODULATOR EXT. NUR VAR/ONLY MOD: 26 27 46 47	6044.4445.02			
A111	GG GM211-S INB. SOFTWARE JE NACH AUFTRAG DEPENDING ON ORDER	6045.3394.02			
A111	GG GM211-S INB. SOFTWARE JE NACH AUFTRAG DEPENDING ON ORDER	6045.3394.03			
A111	GG GM211-S INB. SOFTWARE JE NACH AUFTRAG DEPENDING ON ORDER	6045.3394.04			

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2. Preparation for Use

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2. Preparation for Use

2.1 General

The preparation for use of the VHF Transceiver XU 221 involves unpacking and checking, connecting the mains voltage as well as the connection of external devices.

This chapter also contains details about the functions set ex works on the individual modules.

For setting the modules to different functions at a later stage, appendix A1 contains all information required.

2.2 Unpacking and Checking

1. Unpack the VHF Transceiver XU 221.
2. Check that nothing has been damaged in transport.
3. Check that nothing is missing.
4. If damage is discovered, notify the forwarding agency immediately.

2.3 Accessories

2.3.1 Accessories for VHF Transceiver XU 221

- 2 spare fuses M 20 A 6.3 x 32 mm (32 V) for battery connection
  - F1 (rear panel) SS 520.4858
- 2 spare fuses M 1 A 5 x 20 mm (32 V) for DC supply
  - F1 SS 020.7430
- 2 spare fuses M 3.15 E 5 x 20 mm (32 V) for DC supply
  - F2 SS 333.0725
- 6 jumpers FP 0491.7042.00
- Mains connecting cable DS 025.2365
- User Manual 6075.6491.12.xx

2.3.2 Mating Connector Set Tx KS 251 (Option)

The Mating Connector Set Tx KS 251 contains a complete number of mating connectors in accordance with the modules installed on the equipment rear side.

2.3.3 Frequency Tuning Kit KA 231F (Option)

The Frequency Tuning Kit KA 231F contains hardware components as well as tools. It can be installed in the transceiver at the space reserved for options. For frequency tuning a digital voltmeter is required in addition.

2.3.4 Service Kit KA 251 (Option)

The Service Kit KA 251 contains hardware components (adapter boards and cable set) as well as a disk with test software for the transmit functions of the transceiver. For frequency tuning on the transmitter side no external measuring equipment is required.

2.3.5 VHF Circulator Set GD 200 V (Option)

The optional Circulator Set GD 200V can be used for improved suppression of spurious emission.

2.3.6 Cabinet KK 251 (Option)

The optional Cabinet KK 251 is intended to accommodate the VHF transceiver in its desktop version.

2.4 Operating Functions Set Ex Works on Individual Modules

2.4.1 Power Supply IN 251A (Option)

Ex works the power supply is set to a mains voltage of 230 VAC (-10 to + 15 %).

The set mains voltage is indicated by the label on the transceiver rear side (above the mains connector).

Make sure that the mains voltage on which the Power Supply IN 251A is to be operated, corresponds to the set mains voltage. Otherwise alter setting by means of voltage selector and replace fuses F1 and F2.

CAUTION

If this is not observed, the transceiver can malfunction or even be destroyed!

The Power Supply IN 251A can be connected to the following mains voltages:

-	100 VAC	- 10 to + 15%	F2, F1 = T 8 A
-	120 VAC	- 15 to + 10%	F2, F1 = T 8 A
-	220 VAC	- 12 to + 12%	F2, F1 = T 4 A
-	230 VAC	- 10 to + 15%	F2, F1 = T 4 A

2.4.2 VHF Synthesizer GF 201V

The synthesizer is set ex works to the transmit frequency indicated by the label on the front panel (15, Fig. 3.1). How the frequency can be changed is described in appendix A1.

2.4.3 Modulator GM 201

The Modulator GM 201 is set ex works to the following operating functions:

- AF filter only internal
- ALC cut in
- VHF operation
- Normal operation, integrating control loop
- No switchover for failure
- PTT time limiting cut out
- Monitoring via directional coupler
- Primary address REM BUS: 56
- Cut-out for failure
- Carrier message switched to CBIT-Tx-1
- VSWR message switched to CBIT-Tx-1

2.4.4 Interface 1 GI 201X

The Interface 1 GI 201X is set ex works to the following operating functions:

- AF input AF TX (A/B) connected with modulator AF Tx (C/D)
- PTT control: PTT initiation via -PTT (contact to ground)

2.4.5 VHF Rx Unit EU 231

Rx Unit EU 231 is set ex works via jumpers for the following operating functions:

- Single receiver operation
- First threshold AGC bit linked with squelch
- Noise blanker disabled
- Both AGC bits linked with field strength evaluation
- Carrier squelch enabled
- AF inhibit for PTT signal enabled
- AF AGC disabled
- Monitoring for signal PTT enabled
- Remote control switched to parallel line
- Test socket switched to field strength evaluation

2.4.6 Inband Interface GM 211 (Option)

Via jumpers Inband Interface GM 211 is set ex works to the following operating functions:

- Use in device "A"
- Use on the "radio side"
- User-defined function switched via software

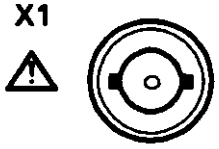
Note:

For more details, also on how all these settings can be altered, refer to appendix A1.

2.5 Cabling

The connectors are listed in accordance with the numbering in Fig. 2.1.

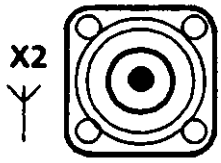
X1



1. Connection of an External Synthesizer

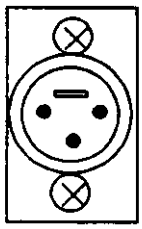
With Transceiver XU 221, the recessed BNC socket X1 is intended for the connection of an external synthesizer. For this purpose, the internal RF cable must be pulled off connector X94 of the internal synthesizer and be reconnected to X1.

X2



2. Connection of the VHF Antenna

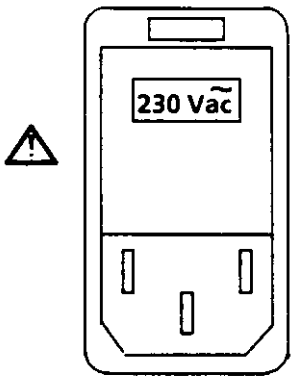
In the event that the antenna is to be connected directly, that is, without transmit filter in between, the connection is to be made directly to the recessed N-type socket X2.



X3
BATT.
22...31 V

3. Connection of the DC Supply

Via the 3-way recessed plug X3, VHF Transceiver XU 221 is connected to an external 24-VDC source (22 to 31 VDC). For AC / DC switchover operation both mains and battery connector are connected, switchover is made within the optional Power Supply IN 251A.



X4 47...63 Hz
500 VA

4. Connection of the Mains Voltage (only with Option Power Supply IN 251A)

Via the combination of recessed plug with fuse holder and voltage selector X4, VHF Transceiver XU 221 is connected to the mains supply.

CAUTION

Make sure that the set and indicated voltage corresponds to the available mains voltage!

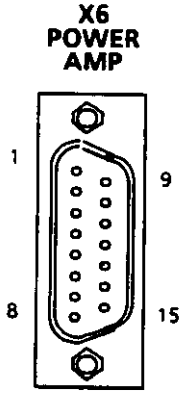
Appendix A1 contains details on how to set the power supply to other mains voltages.

CAUTION

Be sure to connect the mains cable only after all other connections have been established!

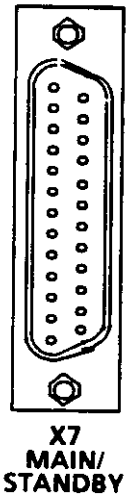
5. Connection of a Handset

The 7-way socket X5 permits the connection of a microphone or a handset at the transceiver front panel (see Fig. 2.2).



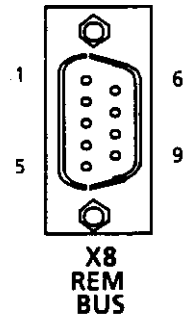
6. Connection of an External Power Amplifier (only with Option Interface 2)

The 15-way female connector strip X6 is used to connect an external power amplifier.



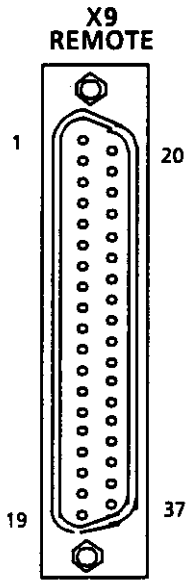
7. Connection of a Second Transceiver (Main / Standby Operation) (only with Option Interface 2)

The 25-way female connector strip X7 is used to connect a second transceiver for main / standby operation.



8. Connection of the REM BUS

The 9-way female connector strip X8 is intended for remote control via the serial REM BUS by a REM BUS Drive Unit GV 201 or a REM BUS Controller GC 201.



9. Connection of the Control and AF Lines (REMOTE)

The 37-way female connector strip X9 permits the parallel connection of AF and control lines for remote control of the transceiver. All AF inputs and outputs (e.g. monitoring), several PTT control lines and various test and monitoring signals are available at this connector. For remote control via parallel connection see example Fig. 2.5.

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3. Operation

3.1 Start-up and Test

(See Fig. 3.1)

1. Make sure that the cabling has been made in line with section 2.

2. In the case the optional Power Supply IN 251A is installed, switch on VHF Transceiver XU 221 by means of power switch (11).

3. Readiness for operation of the optional power supply (AC voltage available) is indicated by illumination of the green LEDs **AC** (10 and 22).

4. The presence of an external DC supply is indicated by illumination of the green LEDs **DC** (9 and 17).

5. Switch on VHF Transceiver XU 221 by setting the toggle switch **REM / LOC / OFF** (20) to **LOC** (or **REM**).

6. If LEDs V_{OP} (8 and 21) are illuminated, the transceiver is switched on.

7. If LEDs **TEST** (6 and 18) are illuminated, the transceiver is functioning properly, i.e., all operating voltages are available, the synthesizer works correctly.

   If one of the LEDs is not illuminated, perform troubleshooting in line with chapter 4.2.

3.2 Local Control

(See Fig. 3.1)

For local control of VHF Transceiver XU 221 proceed as follows:

1. In the case the optional Power Supply IN 251A is installed, switch on VHF Transceiver XU 221 by means of power switch (11).

2. Switch on VHF Transceiver XU 221 by setting the toggle switch **REM / LOC /OFF** (20) to **LOC**.

3. Connect a microphopne with PTT key or a headset at connector (13) on the front panel.

4. For transmission talk into the microphone and simultaneously press the PTT key.

5. Adjust the volume of the monitoring tone by means of the volume control (12).

6. Once transmission has been completed, release the PTT key.

Normally no further operation will be necessary.

Note:

While the transceiver is operating, the TONE / 0 / PTT switch (14) must be in the off-position (0)!

3.3 Remote Control of the Series 200

3.3.1 Introduction

Remote control can be carried out in three different ways:

1. via single line,
   mainly in main / standby parallel operation

2. via the serial REM BUS,
   remote control from a PC and

3. via inband control,
   with control tones inside the AF signal bandwidth (e.g. via telephone lines). For this Inband Interface GM 211 and Inband Control GM 231 (options) are required.

Note:

Please note that combinations of various remote control modes are also possible.

3.3.2 Remote Control Via Single Line

This mode is normally used in conjunction with main / standby applications.

In such a case the lines for the headset with PTT key are connected at connector X9. The headset is detached from the transceiver by several meters.

1. Make sure that the cabling was made acc. to section 2, Figure 2.5.

2. Set toggle switch REM / LOC / OFF (20, Fig. 3.1) on the relevant transceiver to REM.

3. For transmission talk into the microphone and simultaneously press the PTT key.

Note:

There are other application modes, where the CBIT information or the ON / OFF control (via REMOTE, AF, and AGC-inhibit signals) is used.

3.3.3 Remote Control via REM BUS (Serial)

REM BUS Concept

All 200 series devices can be remotely controlled without the necessity of employing additional options.

The serial REM BUS uses four wires:

- SCL serial data clock
- SDAI serial data input
- SDAO serial data output
- GND ground

The transceivers, transmitters and VHF/UHF multicouplers of series 200 are all equipped with such a REM BUS connection for remote control.

REM BUS Capability

With the REM BUS **64 addresses** are available.

A VHF Transceiver XU 221 occupies **two** addresses.

It is possible to operate 32 transceivers on one REM BUS.

REM BUS Devices

A REM BUS Drive Unit GV 201 contains eight Rx REM BUS output connectors.

The Rx REM BUS outputs may also be used as REM BUS connections (in this case the additional select lines are not used).

Normally, a REM BUS Drive Unit GV 201 is controlled by a REM BUS Controller GC 201.

5-KM REM BUS

This is a serial point-to-point connection with V.11 level, push-pull drivers and difference frequency receivers (acc. to RS 422, for line lengths up to max. 5 km). The REM BUS Controller GC 201 has two such output connections, and the REM BUS Drive Unit GV 201 has one input connection.

Central Control Via REM BUS

The central control of radio devices of the series 200 is carried out via a standard PC, fitted with one or two special plug-in card(s), the REM BUS Controller GC 201 and special control software under Microsoft Windows.

Modems

Due to the use of modems the distance otherwise limited to 5 km may be extended. In this case, however, a standard PC and a REM BUS Controller GC 201 plus a modem will be required.

Overview of REM BUS Commands / Messages

REM BUS device	Bit	Command / message to radio	Message from radio
Receiver	0	**ON/OFF** the currently active receiver *switches this particular receiver on / off*	
	1	**SQL ENABLE / DISABLE** *switches the squelch function on / off*	**Rx CBIT GO / NOGO** *readiness for operation*
	2	. . . . .	**AGC BIT 0 (LSB)** **00** *no signal*
	3	. . . . .	*receive signal quality* **01** *poor* **AGC BIT 1 (MSB)** **10** *average*
	4	. . . . .	**11** *good*
	5	. . . . .	**User-defined input** *state of this input*
	6	**ON/OFF** the other receiver *state of the (hitherto) other receiver*	**LOCAL / REMOTE**
	7	. . . . .	*state of the LOC / REM switch at front panel*
Trans-mitter	0	**PTT** *activates the transmitter carrier*	
	1	**ON / OFF** *switches the transmitter on / off*	
	2	**Reduce RF POWER** *switches power reduction on / off*	
	3	**RF POWER amplifier ON / OFF** *switches power amplifier on / off*	
	4	**User-defined output (jumper)** *setting to "0" or "1" via remote control*	**Message of user-defined input** *only if set to "1" (= input)*
	5	. . . . .	**Low-voltage operation** *undervoltage of power supply*
	6	. . . . .	**Tx switched OFF** *Transmitter switching state*
		(contd. on next page)	

REM BUS device	Bit	Command / message to radio	Message from radio
Trans-mitter	7	.....	**LOCAL / REMOTE** *state of REMOTE switch*
	8	.....	**Tx CBIT Go / NoGo** *readiness for operation of transmitter*
	9	.....	**Carrier existent** *RF carrier power is emitted*
	10	.....	**VSWR too high**
	11	.....	**Synthesizer OK**
	12	.....	**Amplifier OK** *power amplifier functioning properly*
	13	.....	**PTT key pushed** *confirmation that PTT was initiated*
	14	.....	**High temperature** *signals overtemperature*
	15	.....	**DC / AC operation** *AC operation*

For more information on the REM BUS system refer to the User Manuals for REM BUS Controller GC 201 and the REM BUS Drive Unit GV 201.

3.3.4 Remote Control via Inband Interface (Option)

For inband operation the optional **Inband Interface GM 211** is installed in the Rx unit of the transceiver.

Inband Control GM 231 is additionally required on the operator side. For more information on the inband interface and inband control refer to the User Manual of GM 231.

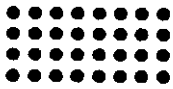
Overview of Commands and Messages

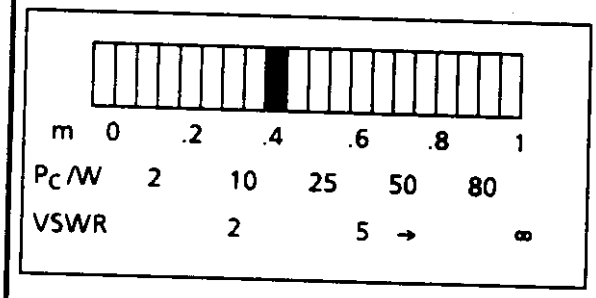
Direction		Command	Message	Remarks
OP → TxRx	fast data / FM	*PTT		Tx mode switchover
OP → TxRx	slow data / AM	*SQUELCH-ON	.....	Squelch on / off
OP → TxRx		TRX - A - ON	.....	Device A on / off
OP → TxRx		TRX - A - ON	.....	Device B on / off
OP → TxRx		USER - DEF - 2	.....	User-defined function
OP → TxRx		IBIT	.....	Built-in test
Rx → OP	fast data / FM	.....	AGC - BIT0 - 1	AGC main Rx
Rx → OP		.....	AGC - BIT1 - 1	AGC main Rx
Rx → OP	slow data / AM	.....	RX - A / *B	Active Rx (0 ≙ B)
Rx → OP		.....	CBIT - RX1	Continuous built-in test Rx1
Rx → OP		.....	*REMOTE1	Remote switch Rx1 (0 ≙ remote)
Rx → OP		.....	CBIT - RX2	Continuous built-in test Rx2
Rx → OP		.....	*REMOTE2	Remote switch Rx2 (0 ≙ remote)
Rx → OP		.....	AGC - BIT0 - 2	AGC standby Rx
Rx → OP		.....	AGC - BIT1 - 2	AGC standby Rx
Tx → OP	slow data / AM	.....	MAIN - TX	Active Tx (0 ≙ B) 1)
Tx → OP		.....	CBIT - TX	Continuous built-in test Tx 1)
Tx → OP		.....	VSWR	VSWR > 3 1)
Tx → OP		.....	TEMP	Overtemperature 1)
Tx → OP		.....	CARRIER	Power > 1 / 4 P_N 1)
Tx → OP		.....	*PTT	PTT acknowledgement 1)
Rx → OP	slow data / AM	.....	USER - DEF - 1	User-defined function
Rx → OP		.....	USER - DEF - 3	User-defined function

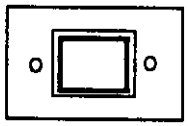
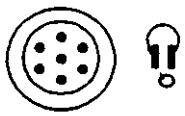
1) refers to the currently active device

3.4 Function of Controls and Indicators

(See Fig. 3.1)

No.	Designation	Design	Function
1		Variable control	The squelch response threshold can be set between 8 and 14 dB (S + N/N). Ex works it is set to 10 dB.
2		Toggle switch, two positions	• Toggle switch in position **ON**: squelch enabled, i.e., the receive signal is only audible above the response threshold. • Toggle switch in position **OFF**: squelch disabled, i.e., the receive signal / noise is continuously audible.
3		Loudspeaker	Built-in loudspeaker, volume adjustable with volume control (4)
4		Variable control	By means of the volume control the volume of the built-in loudspeaker can be adjusted.

No.	Designation	Design	Function
5	m Pc / W VSWR	Toggle switch, 3 positions	Switchover of measuring range for bargraph indicator • Toggle switch in position **m** : Modulation depth in % • Toggle switch in position **Pc / W**: RF output power in W • Toggle switch in position **VSWR**: VSWR (1 to ∞)
6	**TEST**	Green LED	If LED **TEST** is illuminated, the transceiver is in order (i.e. all operating voltages are available and the oscillators and the synthesizer of the Rx unit work correctly).
7		LED bargraph indicator 20 segments	Measurement depending on setting: m, Pc / W, VSWR
8	**V_{OP}**	Green LED	If LED V_{OP} is illuminated, the ransceiver is switched on.

No.	Designation	Design	Function
9	DC 	Green LED	If LED DC is illuminated, a 24-VDC battery supply (22 to 31 VDC) is connected (in parallel to LED (17)).
10	AC 	Green LED	If LED AC is illuminated, an AC supply is connected and cut in (in parallel to LED (22)).
11		Pushbutton green	Switch-on of AC supply (with optional Power Supply IN 251A only).
12		Variable control	This control permits volume setting of the headphones connected.
13		Connector, 7-way	Headset connection

No.	Designation	Design	Function
14	TONE 0 PTT	Toggle switch, two positions	Switchover test tone / PTT: • Toggle switch set to **TONE**: Tone generator switched on for system test **(in local operation only)** • Toggle switch set to **PTT**: Transceiver carrier activated **(in local operation only)**
15	123,325 MHz	Label	Label indicating the set transmit frequency (for altering the frequency refer to appendix A1)
16	123,325 MHz	Label	Label indicating the set receive frequency (for altering the frequency refer to appendix A1)
17	DC	Green LED	If LED **DC** is illuminated, an external DC source is connected (in parallel to LED (9)).
18	TEST	Green LED	If LED **TEST** is illuminated the VHF Rx unit is in order (i.e., all operating voltages are available and the oscillators and the synthesizer of the Rx unit work correctly).

No.	Designation	Design	Function
19	V_C ◉ ◉	Test socket 2 mm	Test socket for measuring the internal control voltage for alignment of the VHF Rx unit
20	REM LOC OFF 	Toggle switch, three positions	• Toggle switch in position **OFF**: The VHF Rx unit is switched off. Only the operating voltages + 24 VDC and + 5 VDC for remote switch-on are active. • Toggle switch in position **LOC**: The VHF Rx unit is switched on. Local control is enabled. • Toggle switch in position **REM**: Remote control is enabled.
21	V_{OP} ○	Green LED	If the LED V_{OP} is illuminated the DC / DC converter of the Rx unit is switched on and the DC supply voltages are available.
22	AC ○	Green LED	If the LED AC is illuminated, AC mains supply of the transceiver is switched on (in parallel to LED (10)).
23	○	Yellow LED	As long as the receive signal is above the response threshold (S / N squelch) set by means of the SQ control, the LED SQ will remain illuminated.

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4. Maintenance and Troubleshooting

4.1 Maintenance

4.1.1 General

Natural aging of the crystal oscillator makes it advisable to check the frequency offset every three years and readjust it, if necessary.

4.1.2 Taking Care

Such measures involve cleaning and touching up slight damage to the paint work of the unit. The following materials are required:

No.	Description
1	Soft brush
2	Duster
3	Isopropyl alcohol
4	Paint, light grey RAL 7911 / 7035

4.1.2.1 Cleaning

WARNING

- ***Beware of risk of explosion when using isopropyl alcohol.***

  Make sure to work in a well ventilated room when cleaning with isopropyl alcohol.

- ***Wear goggles when working with compressed air in order to avoid any injuries to the eyes.***

CAUTION

- ***For use of compressed air first direct the air jet towards the ground until it is free of condensation water.***
- ***For use of compressed air the distance to the unit must be at least 20 cm.***

1. Pre-clean the surface of the unit by means of compressed air.
2. Clean the surface using a soft brush or duster.
3. Clean extremely dirty surfaces, in particular grease stains, carefully using a soft, non-fuzzy cloth moistened with isopropyl alcohol.
4. Clean open PC board carefully using a soft brush and / or compressed air.

4.1.2.2 Touching up the Paint Work

Touch up paint work on the housing of VHF Transceiver XU 221 as follows:

1. Carefully remove loose particles of paint around the area to be touched up.
2. Clean area to be painted using a soft, non-fuzzy cloth moistened with isopropyl alcohol.
3. Wait until isopropyl alcohol has dried.
4. Carefully apply paint and and let dry completely.
5. Subsequently apply second coat of paint and also let dry completely. Touching up is now terminated.

4.2 Troubleshooting

4.2.1 General

A disturbance in VHF Transceiver XU 221 will generally make itself noticeable in that wanted signals are missing or corrupted.

For troubleshooting first of all the external cabling including plugs and sockets should be checked.

Subsequently the troubleshooting in line with the table in section 4.2.4.3 is to be performed. For this the given sequence as stated in the table should be adhered to.

If by these measures the fault cannot be found either, the modules should be substituted one at a time to try to find the one that is defective.

4.2.2 Visual Examination

1. Check the external cabling between the complete VHF transceiver and the peripheral equipment.
2. Unfasten the cover by undoing 18 Phillips screws and remove.
3. Check all connectors for firm seating and the power supply cable and RF coaxial cables at the rear for mechanical damage.

   If necessary, replace cables systematically one after the other until the defective connection is detected.
4. Pull out transceiver after undoing two Phillips screws on the front and check connector strips for mechanical damage (bent or corroded pins). Subsequently reinsert and ensure that the connection is made properly.

CAUTION

If a contact is discoloured, the connector and the mating connector will both be damaged and must be replaced.

4.2.3 Replacement of Fuses

4.2.3.1 Replacement of Fuses on Rear (only with Option IN 251A)

1. Disconnect all connecting cables from Power Supply IN 251A.
2. Open cover of combination with mains connector by means of screw driver (see Fig. 4.1a).
3. Ease fuses F1 and F2 carefully out of their holders acc. to Fig. 4.1b by means of screw driver.

Fuse type: H 260 acc. to IEC

F1	115 V:	T 8 A	5 x 20 mm
	230 V:	T 4 A	5 x 20 mm
F2	115 V:	T 8 A	5 x 20 mm
	230 V:	T 4 A	5 x 20 mm

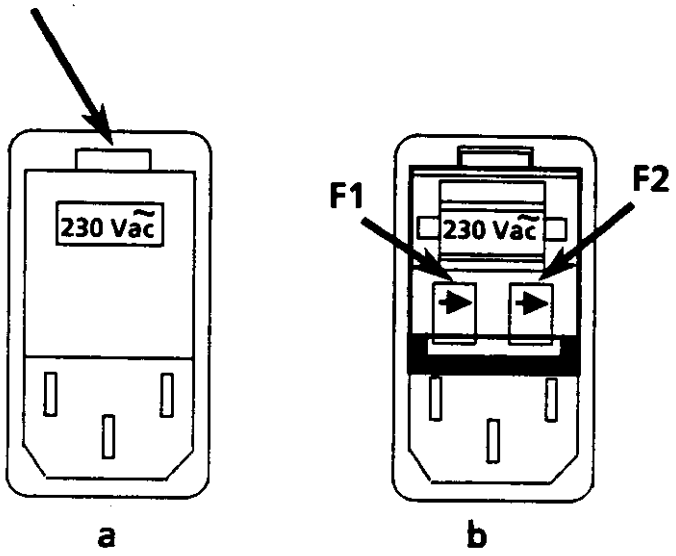


Fig. 4.1 Replacement of Fuses on Rear

4.2.3.2 Replacement of Internal Fuses in Power Supply IN 251A (Option)

1. Disconnect mains and battery cables from VHF Transceiver XU 221.
2. Remove cover of transceiver after undoing 18 Phillips screws.
3. Ease fuses F3 and F4 carefully out of their holders acc. to Fig. 4.2 by means of screw driver and replace.

F3	32 V	T 20 A	6.3 x 32 mm
F4	32 V	T 20 A	6.3 x 32 mm

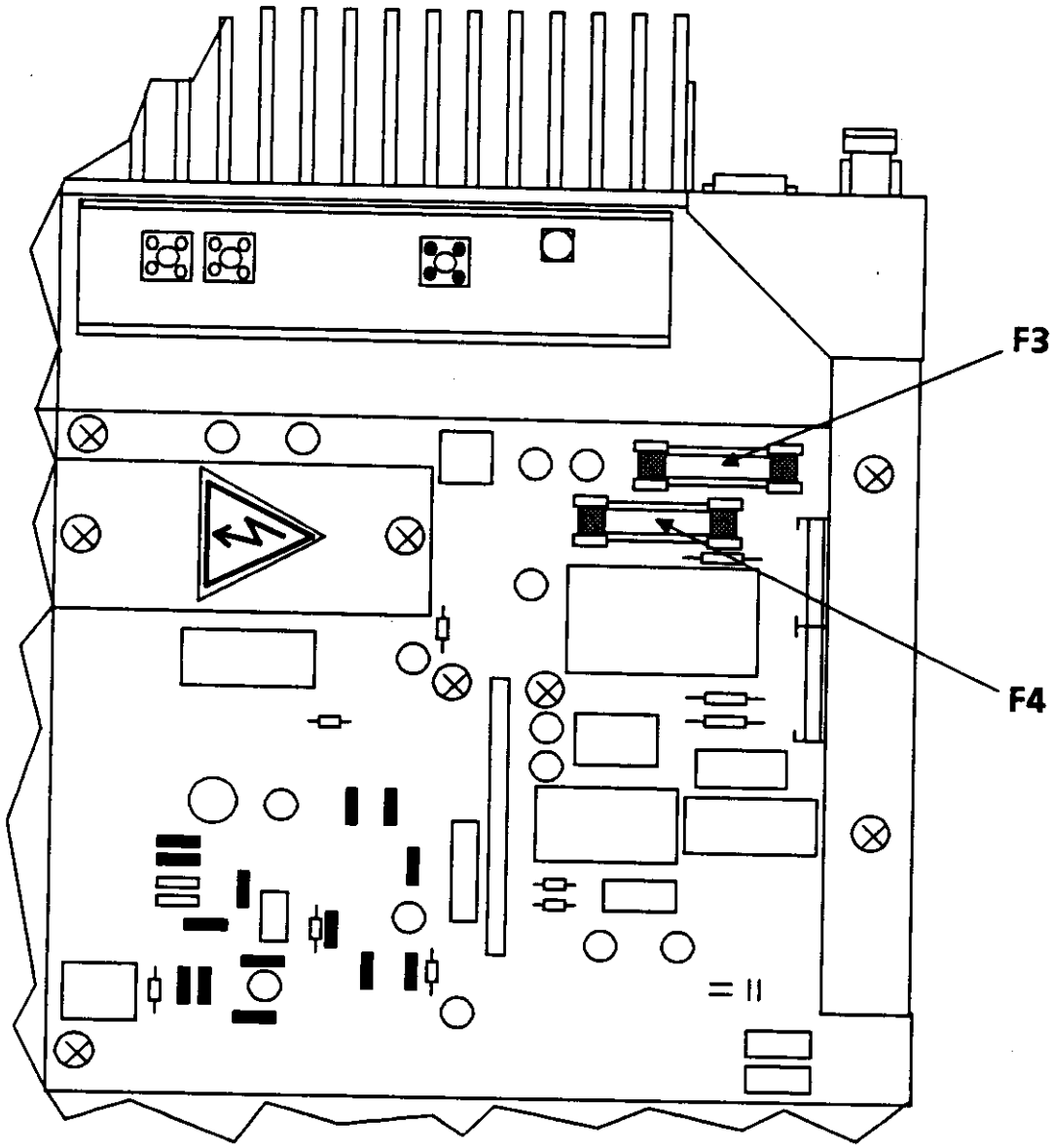


Fig. 4.2 Replacement of Internal Fuses (Option IN 251A)

4.2.3.3 Replacement of Fuses on Regulator

The regulator is part of Adapter KR 201.

1. Set switch **REM / LOC / OFF** (20, Fig. 3.1) to position OFF.
2. Switch off power by means of power switch (11, Fig. 3.1) and disconnect both mains and battery cable.
3. Remove cover on top of VHF Transceiver XU 221 after undoing 18 Phillips screws.
4. Ease fuses F1 and F2 carefully out of their holders by means of screw driver and replace (see Fig. 4.3).
5. Fix cover of VHF Transceiver XU 221 by means of 18 Phillips screws.

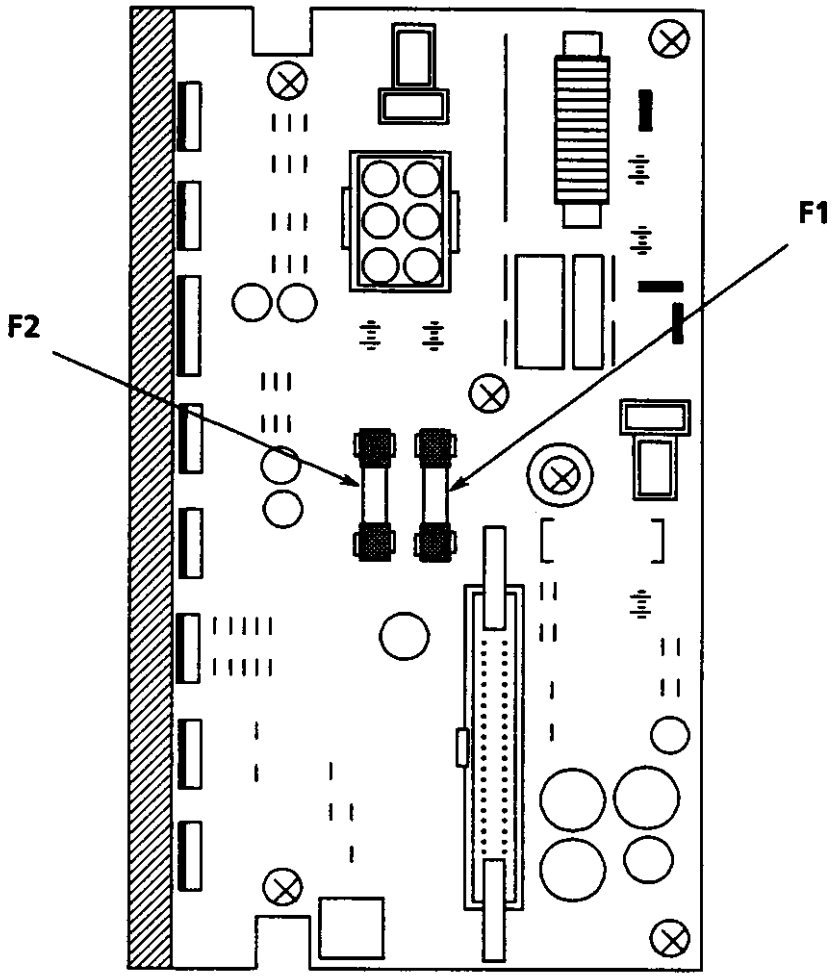


Fig. 4.3 Replacement of Fuses on Regulator

4.2.4 Troubleshooting Instructions

The troubleshooting table is designed for fault localization in the VHF Transceiver XU 221.

Once a module has been found to be defective it must be sent for repair.

4.2.4.1 Requirements for Troubleshooting

Make sure that the VHF Transceiver XU 221 is connected to the mains or the battery supply, respectively (see Fig. 2.2).

Make sure that the cause of the fault is not in the peripherals and / or connecting cables (including plugs and sockets) between the peripherals and the VHF transceiver.

Perform troubleshooting in the sequence given in the table. The numbers given in brackets refer to Fig. 3.1.

4.2.4.2 Required Test Equipment

For checking the voltages a conventional digital multimeter is required.

For checking the frequency error a frequency counter with an accuracy of at least 0.1 ppm is required.

Further, the adapter card from Frequency Tuning Kit KA 231F or the long extension cable from Service Kit KA 251 is required (see section 2.3). Test adapters 1 to 5 used for the following checks are also part of the service kit.

4.2.4.3 Troubleshooting Table

(See Fig. 3.1)

No.	Fault	Possible cause	Remedy
1	LEDs **AC** (10, 22) not illuminated	Mains connector not plugged in, power switch set to OFF or no mains voltage available.	Plug in mains connector, check mains voltage, check voltage selector.
		Fuse F1 or F2 (in connector combination) defective.	Replace fuse F1 or F2 (in connector combination) (see 4.2.3).
		Fuses F3 / F4 defective.	Replace fuses F3 / F4 (see 4.2.3).
		VHF Amplifier VU 221V defective.	Pull off X19 at regulator of amplifier and reconnect. If another fuse blows, replace VHF Amplifier VU 221V.
2	LEDs **DC** (9, 17) not illuminated	Battery connector **X3** not plugged in or no DC voltage available (or confusion of polarities).	Plug in battery connector, check battery voltage.
		Fuse F1 (on rear panel) defective.	Replace fuse F1 (see 4.2.3).
		VHF Amplifier VU 221V defective.	Pull off X19 at regulator of amplifier and reconnect. If another fuse blows, replace VHF Amplifier VU 221V.
3	LED V_{OP} (8) not illuminated	Toggle switch (20) set to **OFF** or remote control with external "Off" command.	Set toggle switch (20) to **LOC**.
		Power supply IN 251A defective.	Disconnect X16 from ST3 / ST4 and measure voltage. If the voltage at ST3 / ST4 is below 25 V, replace Power Supply IN 251A.
		Regulator defective.	Replace fuse F2 on the regulator.
		Regulator defective.	Disconnect X31 and X313. Connect test adapter 2 "low power supply" * (26-way) to X31 and check all voltages. If necessary, replace the regulator.
		Modulator GM 201 defective.	Disconnect X93, X73 and X43 from modulator; if LED V_{OP} remains dark, replace the modulator.

* The test adapters 1 to 5 are part of Service Kit KA 251 (see section 2.3).

No.	Fault	Possible cause	Remedy
4	LED V_{op} (21) not illuminated	Toggle switch (20) set to **OFF** or remote control with external "Off" command.	Set toggle switch (20) to **LOC**.
		Power Supply IN 251A defective.	Disconnect X16 from ST3/ST4 and measure voltage. If the voltage at ST3/ST4 is below 25 V, replace Power Supply IN 251A.
		Regulator defective (fuse F1).	Check fuse F1 on the regulator and replace, if necessary.
		Rx Unit EU 231 defective.	Replace Rx Unit EU 231.
5	LED **TEST** (6) not illuminated	Operating voltage missing.	Refer to steps 1 to 3.
		Synthesizer is not on nominal frequency.	Open cover of case, check whether tuning indicator LED (green) is illuminated. If necessary, align to nominal frequency in line with appendix A1.3.
		Synthesizer defective.	Replace Synthesizer GF 201V.
		VHF Amplifier VU 221V defective.	Disconnect cables at X93 and X73 from modulator, at X93 connect test adapter 1 "power amplifier control" (16-way)*. If LED TEST (6) is illuminated now, replace VHF Amplifier VU 221V.
		Modulator GM 201 defective.	Disconnect cables at X93 and X73 from modulator, at X93 connect test adapter 1 "power amplifier control" (16-way)*. If LED TEST (6) is now dark, replace Modulator GM 201.
6	LED **TEST** (18) not illuminated	The synthesizer in Rx Unit EU 231 is not on nominal frequency.	Remove Rx Unit EU 231 and check position of DIL switch. Adjust to nominal frequency acc. to A1.6, if necessary.
		Rx Unit EU 231 defective.	Replace Rx Unit EU 231.

* The test adapters 1 to 5 are part of Service Kit KA 251 (see section 2.3).

No.	Fault	Possible cause	Remedy
7	LED **TEST** (6) not illuminated for transmit operation with PTT switch (14)	Antenna or termination not connected.	Bargraph (7) shows end-scale deflection for VSWR setting. Terminate RF connector!
		VHF Amplifier VU 221V defective.	Disconnect cables at X93 and X73 from modulator, at X93 connect test adapter 1 "power amplifier control" (16-way)*. If LED TEST (6) is illuminated now, replace VHF Amplifier VU 221V.
		Modulator GM 201 defective.	Disconnect X93, X73 and X43 from modulator; at X93 connect the test adapter 1 "power amplifier control" (16-way)*. If LED TEST (6) remains dark, replace Modulator GM 201.
8	Remote control not in order	Interface 1 GI 201X (or Modulator GM 201) defective.	Check signals and voltages at X73. If they are in order, replace Modulator GM 201, otherwise replace Interface 1 GI 201X.
9	No monitoring tone	Volume control (12) turned fully counter-clockwise.	Set volume control (12) to mid-position.
10	LED bargraph (7) not illuminated	Display board disconnected.	Check flat cable connector X13 at modulator, check voltages. If necessary, replace display board.

* The test adapters 1 to 5 are part of Service Kit KA 251 (see section 2.3).

4.3 Replacement of Modules

4.3.1 Replacement of VHF Rx Unit EU 231

(See Fig. 4.4)

1. Set power switch (11, Fig. 3.1, only with the optional Power Supply IN 251A) to off-position.
2. On Rx Unit EU 231 set toggle switch REM / LOC / OFF (20, Fig. 3.1) to position **OFF**.
3. At the equipment rear disconnect mains (AC) and battery (DC) connectors.
4. Undo two Phillips screws (4, Fig. 4.4) on the front of the Rx Unit EU 231 and pull the unit out to the front.

Installation is to be performed in the reverse order of removal.

4.3.2 Replacement of Interface 1 GI 201X

(See Fig. 4.4)

1. Remove the Rx unit acc. to 4.3.1.
2. Open cover after undoing the Phillips screws and disconnect flat cable connector X73.
3. Undo two Phillips screws (2) on the rear and two screws (1) on the left side panel, with option interface 2 also undo two additional screws (3) on the rear panel.
4. Pull Interface 1 GI 201X to the top and out of the transceiver case.

Installation is to be performed in the reverse order of removal.

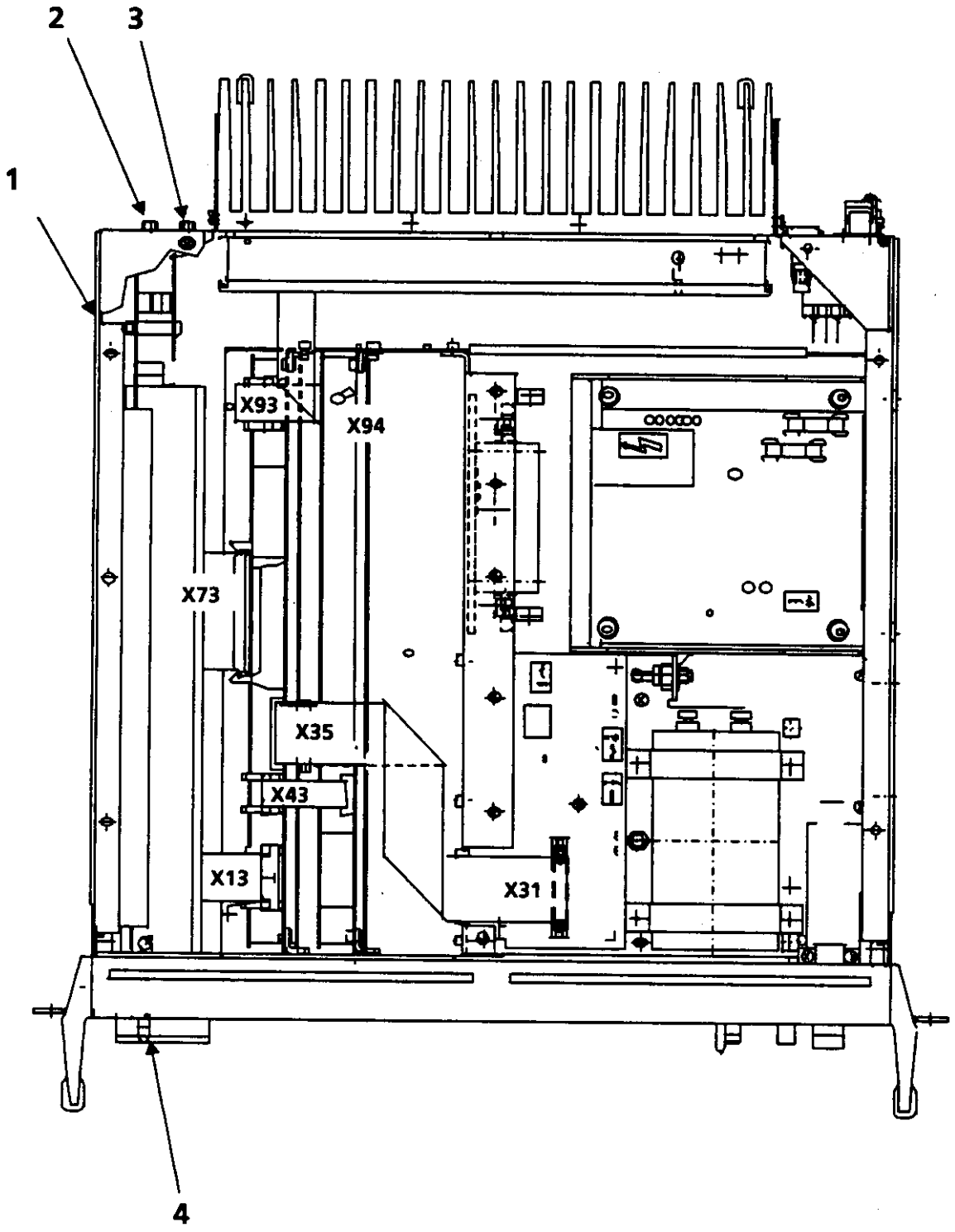


Fig. 4.4 Replacement of VHF Rx Unit and Interface 1

4.3.3 Replacement of Modulator GM 201

(See Fig. 4.5)

1. On front panel set switch **REM / LOC / OFF** (20, Fig. 3.1) to position **OFF**.
2. Set power switch (11, Fig. 3.1, with optional Power Supply IN 251A only) to off-position.
3. On equipment rear pull off connectors X3 (battery connection) and AC mains (with optional power supply only).
4. Open cover of case after undoing Phillips screws and pull off ribbon cable at connectors X31 (on regulator) and X35 (on plug-in slot provided for option).

   Then disconnect ribbon cables X13, X43, X73 and X93 on modulator.
5. Undo two screws on fixing brackets (1) and pull modulator out to the top.

Installation is to be performed in the reverse order of removal.

4.3.4 Replacement of Modulator Extension GM 201C8

(See Fig. 4.5)

1. On front panel set switch **REM / LOC / OFF** (20, Fig. 3.1) to position **OFF**.
2. Set power switch (11, Fig. 3.1, with optional Power Supply IN 251A only) to off-position.
3. On equipment rear pull off connectors X3 (battery connection) and AC mains (with optional power supply only).
4. Open cover of case after undoing Phillips screws. Undo soldered ribbon cable at connectors X31 and X35 (plug-in slot for options) (4).
5. Undo two screws on fixing brackets (3) and pull modulator extension together with the fixing plate out to the top.

Installation is to be performed in the reverse order of removal.

4.3.5 Replacement of VHF Synthesizer GF 201V

(See Fig. 4.5)

1. On front panel set switch **REM / LOC / OFF** (20, Fig. 3.1) to position **OFF**.
2. Set power switch (11, Fig. 3.1, with optional Power Supply IN 251A only) to off-position.
3. On equipment rear pull off connectors X3 (battery connection) and AC mains (with optional power supply only).
4. Open cover of case after undoing Phillips screws.
5. Disconnect ribbon cable X43 on modulator and RF cable X94 on synthesizer.
6. Undo two screws on fixing brackets (2) and pull synthesizer out to the top.

Installation is to be performed in the reverse order of removal.

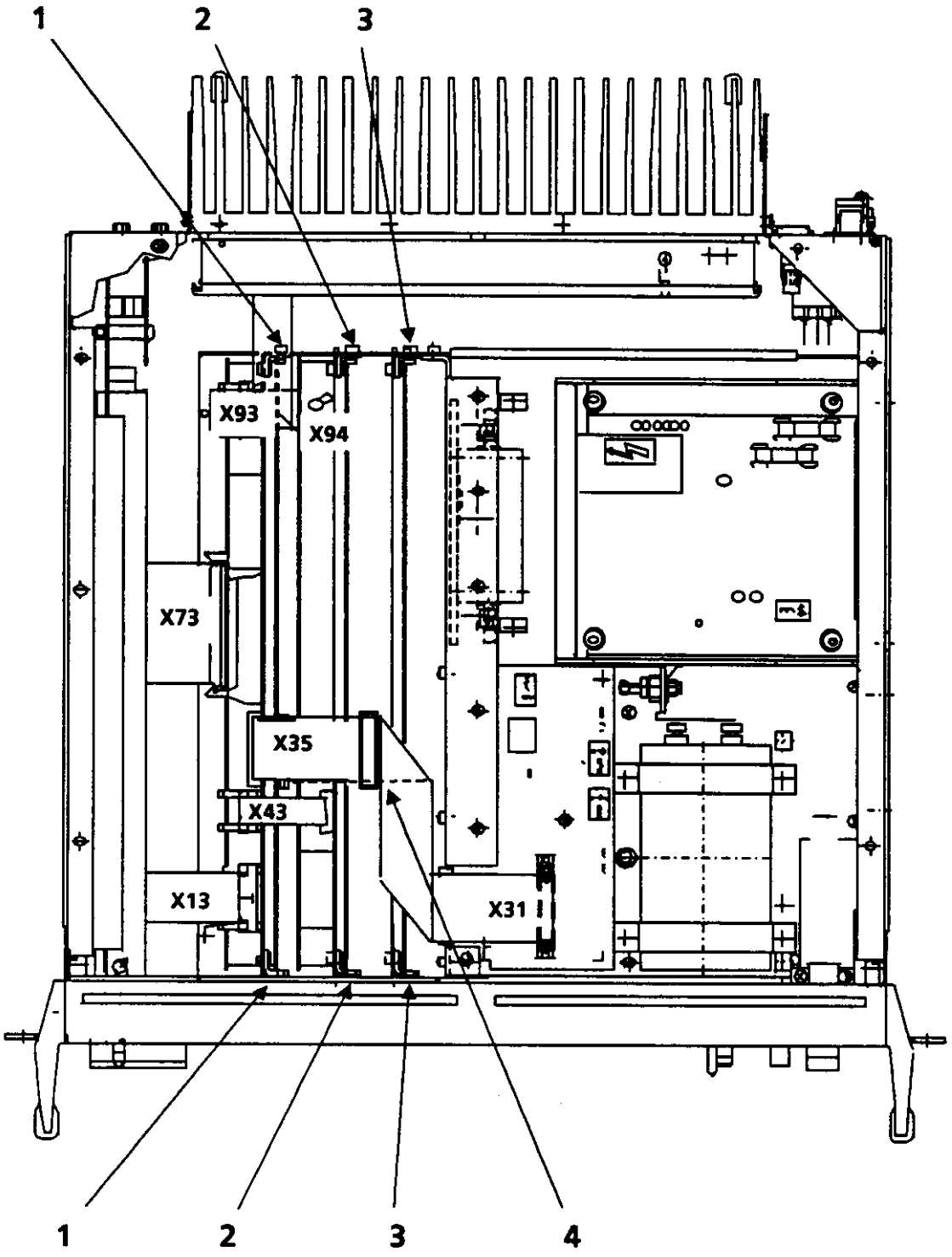


Fig. 4.5 Replacement of Modulator, Modulator Extension and VHF Synthesizer

4.3.6 Replacement of Regulator

(See Fig. 4.6)

The regulator is part of Adapter KR 201. Remove the regulator as follows:

1. On front panel set switch REM / LOC / OFF (20, Fig. 3.1) to position **OFF**.
2. Set power switch (11, Fig. 3.1, with optional Power Supply IN 251A only) to off-position.
3. On equipment rear pull off ribbon-cable connectors X3 (battery connection) and AC mains (with optional power supply only). Also pull off connectors X6, X7, X8 and X9.
4. Open cover of case after undoing Phillips screws.
5. Disconnect ribbon cable X31 (to modulator), supply cable X19 (to VHF amplifier) and flat connectors X3 / X13 (to battery supply).
6. If the optional Power Supply IN 251A is installed, undo connection ST3 / ST4 on the power supply as well as connections X16 / X62, X26 / X61 and flat connector X611 (AC LED) on regulator.

   On front panel remove small cover plate of the power switch (1, Fig. 4.6) after undoing two Phillips screws (M1.6).
7. Unscrew two Phillips screws M3 behind the cover plate and pull line of power switch to the interior of the unit.
8. Undo three fixing screws M3 (2).
9. Open three cable clips (3) and undo three Phillips screws M3.
10. Undo eight fixing screws (4) on base plate and two on right-hand side panel (5).
11. Take out regulator completely together with fixing bracket.

Installation is to be performed in the reverse order of removal.

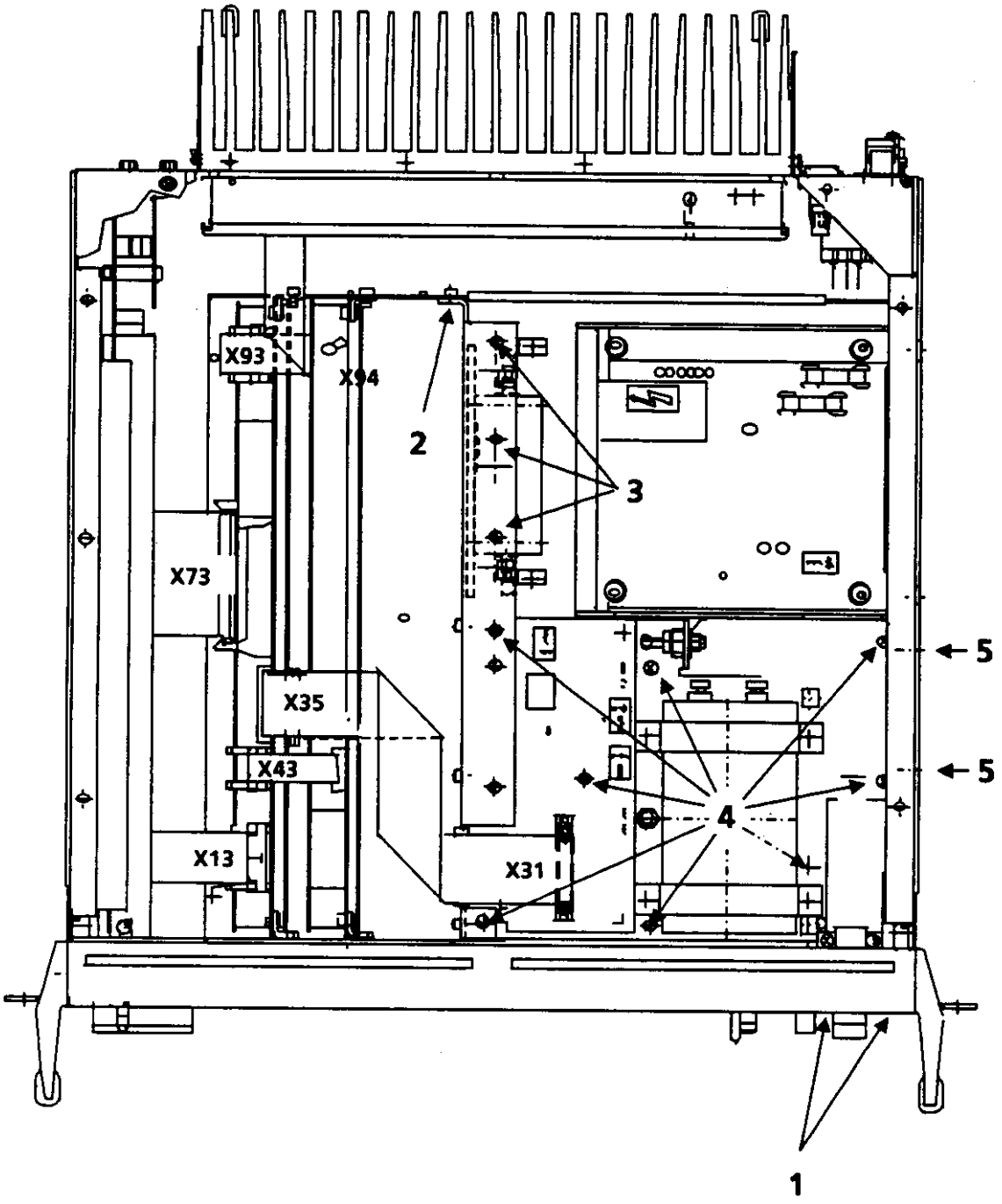


Fig. 4.6 Replacement of Regulator

4.3.7 Replacement of Display Board

(See Fig. 4.7)

1. On front panel set switch REM / LOC / OFF (20, Fig. 3.1) to position **OFF**.
2. Set power switch (11, Fig. 3.1, with optional Power Supply IN 251A only) to off-position.
3. On equipment rear pull off connectors X3 (battery connection) and AC mains (with optional power supply only). Also pull off connectors X6, X7, X8 and X9.
4. Open cover of case after undoing the Phillips screws.
5. Disconnect ribbon cable X13 on modulator.
6. Undo and remove four fixing screws (1) on front panel, and remove the front panel.
7. Undo fixing nuts on headset connector and toggle switches on front of mounting plate.
8. Undo two upper fixing screws (2) on display board and three lower fixing screws (3) on mounting plate and pull display board carefully out to the interior.

Installation is to be performed in the reverse order of removal.

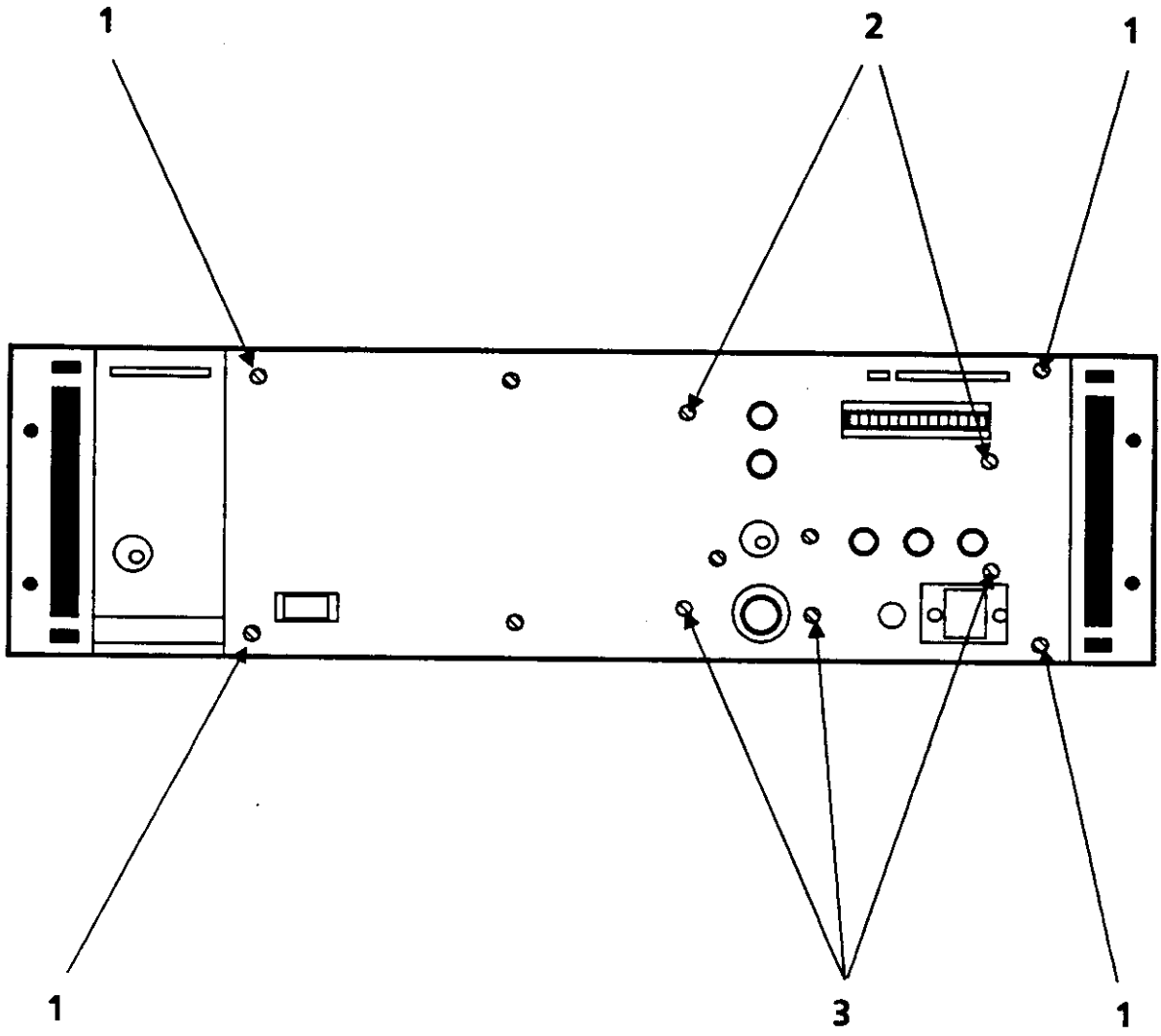


Fig. 4.7 Replacement of Display Board

4.3.8 Replacement of VHF Amplifier VU 221V

(See Fig. 4.8)

1. On front panel set switch REM / LOC / OFF (20, Fig. 3.1) to position **OFF**.

2. Set power switch (11, Fig. 3.1, with optional Power Supply IN 251A only) to off-position.

3. On equipment rear pull off connectors X3 (battery connection) and AC mains (with optional power supply only).

   Also pull off connectors X6, X7, X8 and X9.

4. Open cover of case after undoing Phillips screws.

5. Undo four fixing screws (5) at the bottom of equipment rear panel (those shown are at the top).

6. Undo four lateral fixing screws (2) on heat sink.

7. Push VHF amplifier together with heat sink to the rear and up, then fold back by 90 ° to the service position.

Note:

This position permits any service measures to be performed on the VHF amplifier.

8. Disconnect ribbon cable on modulator X93 (1).

9. Pull off connector X19 (3) to regulator and RF cable on connector X94 (4). Then unscrew RF connector X191.

   If the optional circulator set is installed, the two RF cables to the circulator set must also be undone (unscrew SMA connector).

10. Undo lateral guiding bolts of heat sink.

11. Remove VHF amplifier together with heat sink.

Installation is to be performed in the reverse order of removal.

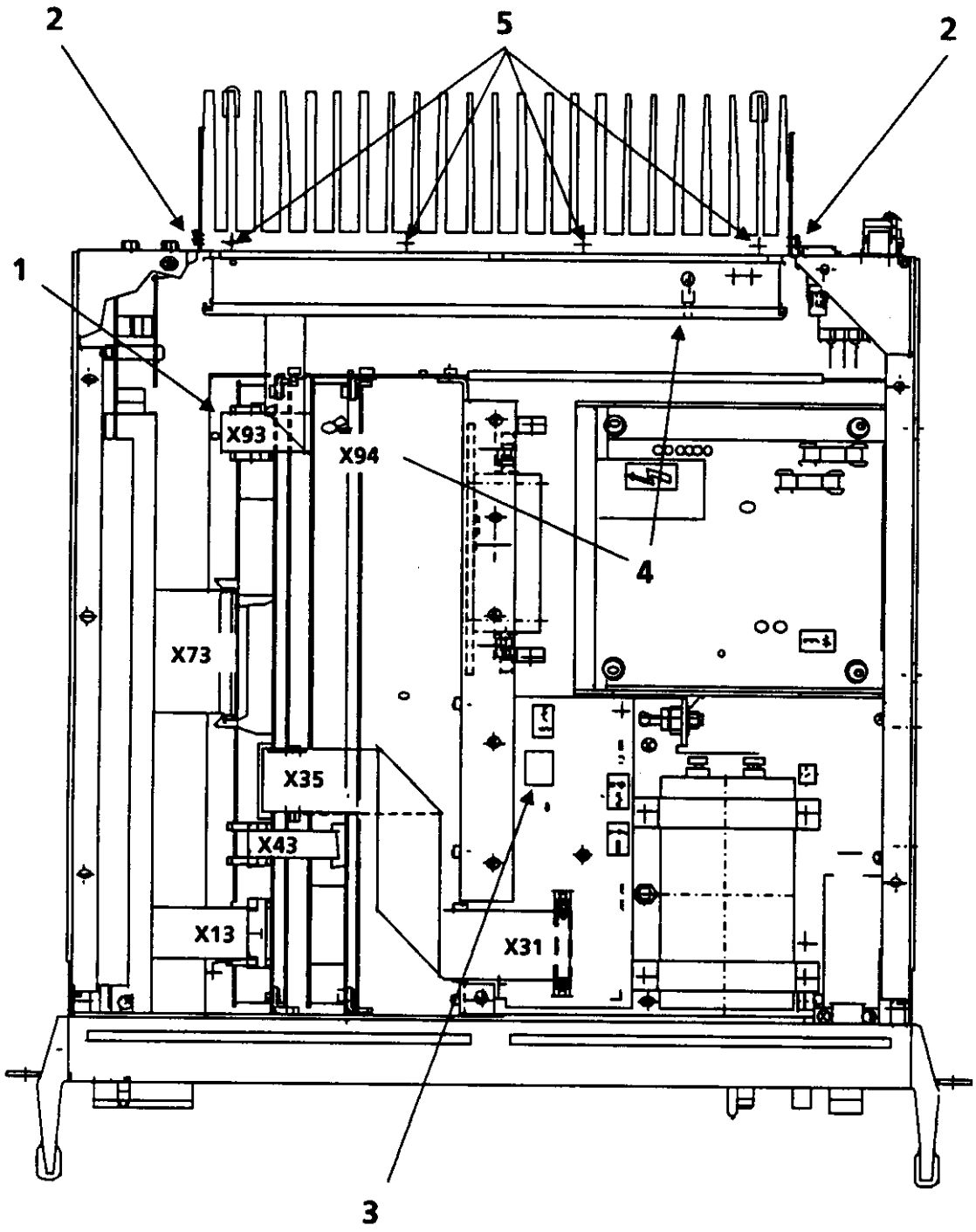


Fig. 4.8 Replacement of VHF Amplifier

4.3.9 Replacement of Power Supply IN 251A (Option)

(See Fig. 4.9)

1. On front panel set switch REM / LOC / OFF (20, Fig. 3.1) to position OFF.
2. Set power switch (11, Fig. 3.1) on front panel to off-position.
3. On equipment rear pull off connectors X3 (battery connection) and AC mains (with optional power supply only). Also pull off connectors X6, X7, X8 and X9.

WARNING

Before opening the cover make sure that the mains connector has been pulled off!

4. Open cover of case after undoing Phillips screws.
5. Disconnect X16 (2-way) (1) from ST3 / ST4 on power supply.
6. On regulator disconnect 2-way flat connector X26 / X61 (3) and flat connector X611 (AC LED) (4).
7. Undo two Phillips screws (5) on mains connector combination and pull mains connector combination to equipment interior.
8. Undo protective earth connection on M3 screw (6).
9. On front panel remove small cover plate of power switch (7) after undoing two Phillips screws (M1.6).

   Unscrew two Phillips screws M3 behind the cover plate and pull line of power switch to the interior of the equipment.
10. Undo four fixing screws M4 (8) on the right-hand side panel of VHF transceiver.
11. Undo four fixing screws M4 (9) on bottom of base plate. Then carefully take out power supply.

Installation is to be performed in the reverse order of removal.

Note:

If the optional Power Supply IN 251A is installed at a later stage, the 2-way connector X16 / X62 (2) must be disconnected from the regulator and re-connected to connector ST3 / ST4 (1) of the power supply. In addition, the cable X61 of the power supply must be connected to X26 / X61 (3) of the regulator.

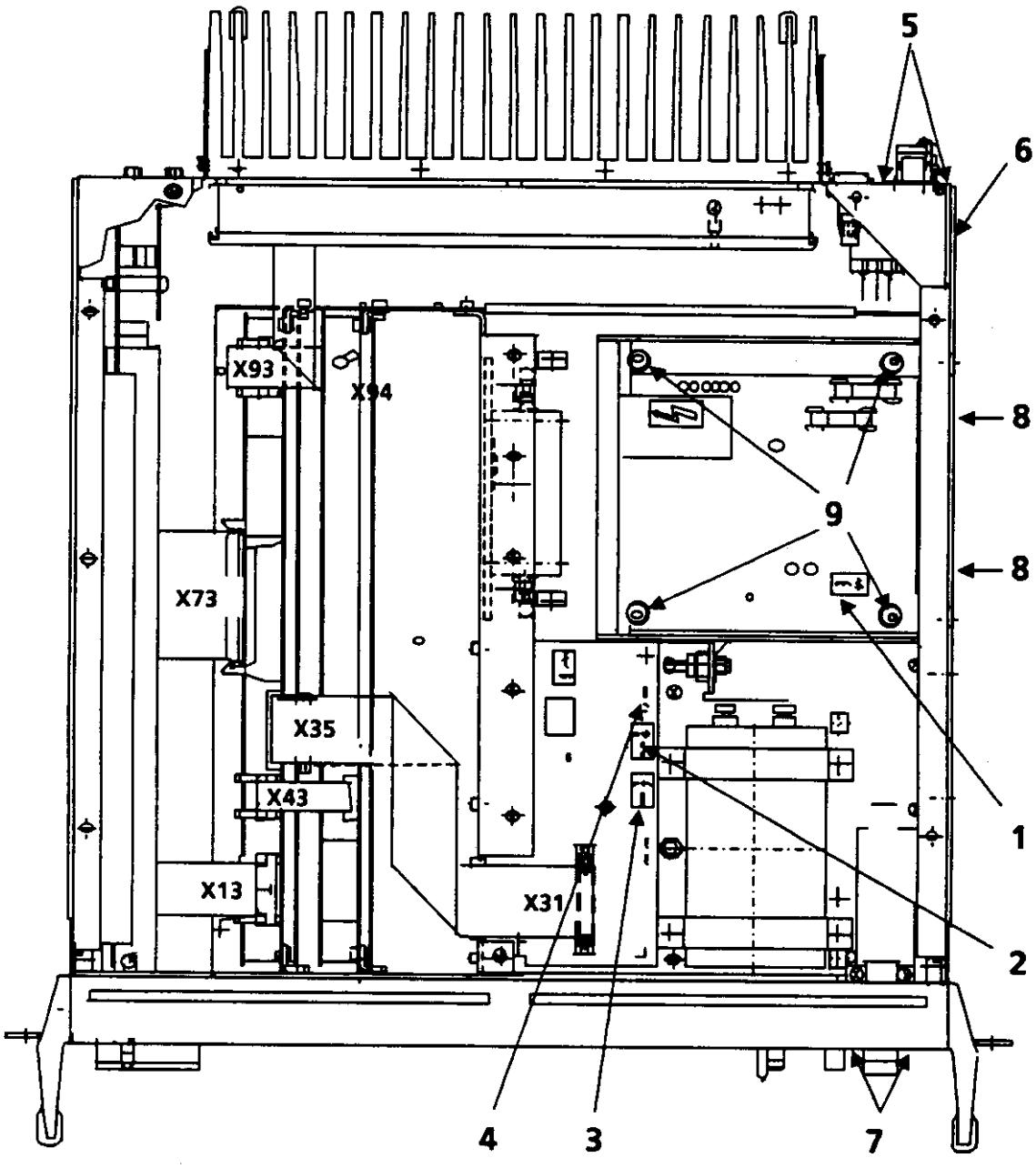


Fig. 4.9 Replacement of Power Supply (Option)

4.3.10 Replacement of Inband Interface GM 211 (Option)

(See Fig. 4.10)

1. Remove VHF Rx Unit EU 231 acc. to 4.3.1.

2. Undo nine Phillips screws on the cover of the Rx unit.

CAUTION

Do not undo screws marked with a square symbol!

3. Carefully remove the cover towards the top. Undo the connection X1 / X69.

The inband interface itself is mounted to the inside of the cover (see Fig. 4.10 below).

4. Undo and remove four Phillips screws fixing the inband interface to the cover of the Rx unit.

Installation is to be performed in the reverse order of removal.

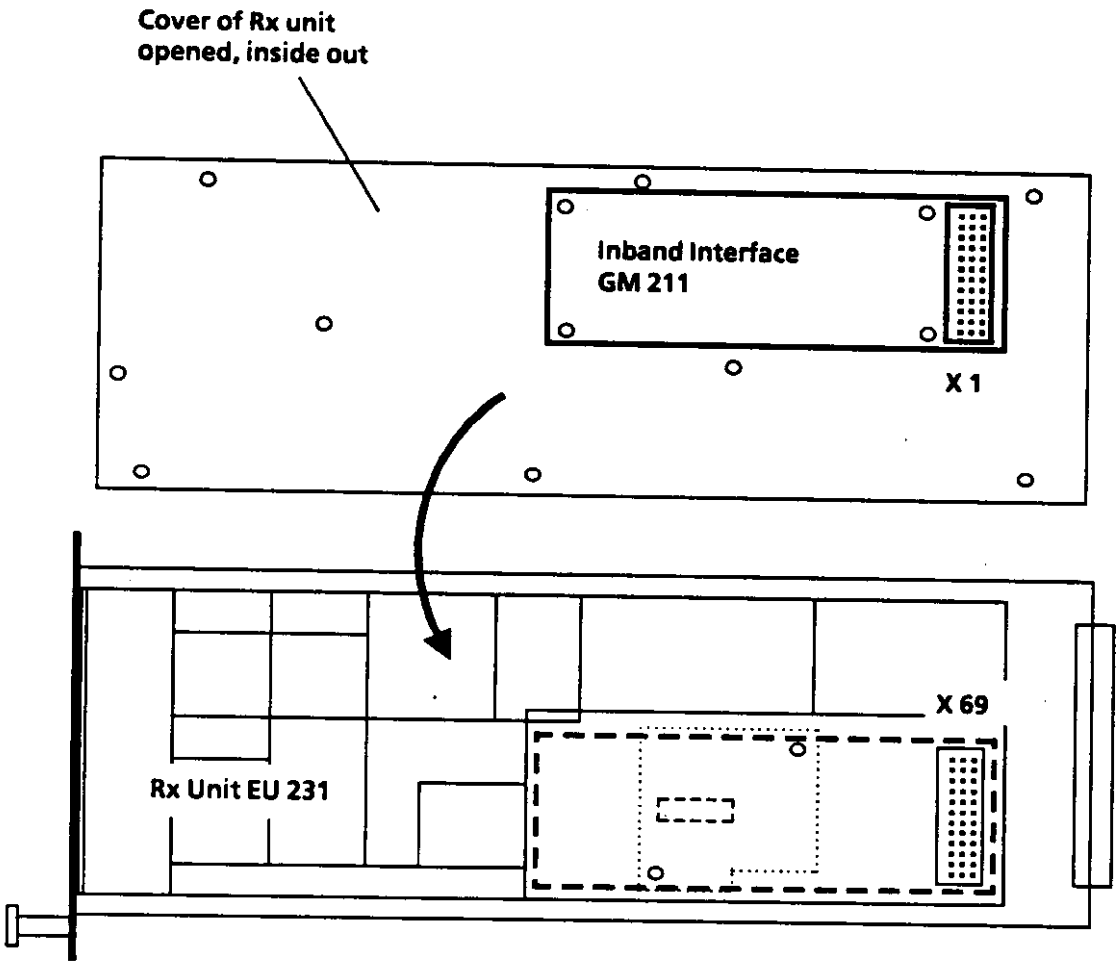


Fig. 4.10 Replacement of Inband Interface (Option)

4.3.11 Replacement of Crystal Filter

(See Fig. 4.11)

When changing from 25-kHz to 8.33-kHz frequency spacing (and vice versa), the crystal filter will have to be replaced. The required filters can be supplied by R&S upon request. Please state the respective Ident. No.:

R&S Ident. No. EP 6043.2384 for 8.33 kHz
R&S Ident. No. EP 6024.3650 for 25 kHz

1. Remove VHF Rx Unit EU 231 acc. to 4.3.1.

2. Undo nine Phillips screws on the cover of the Rx unit.

CAUTION

Do not undo screws marked with a square symbol!

3. Carefully remove the cover towards the top without slanting. This also undoes the connection to the optional inband interface, if installed.

4. Carefully pull the crystal filter off the pins without slanting.

Installation is to be performed in the reverse order of removal.

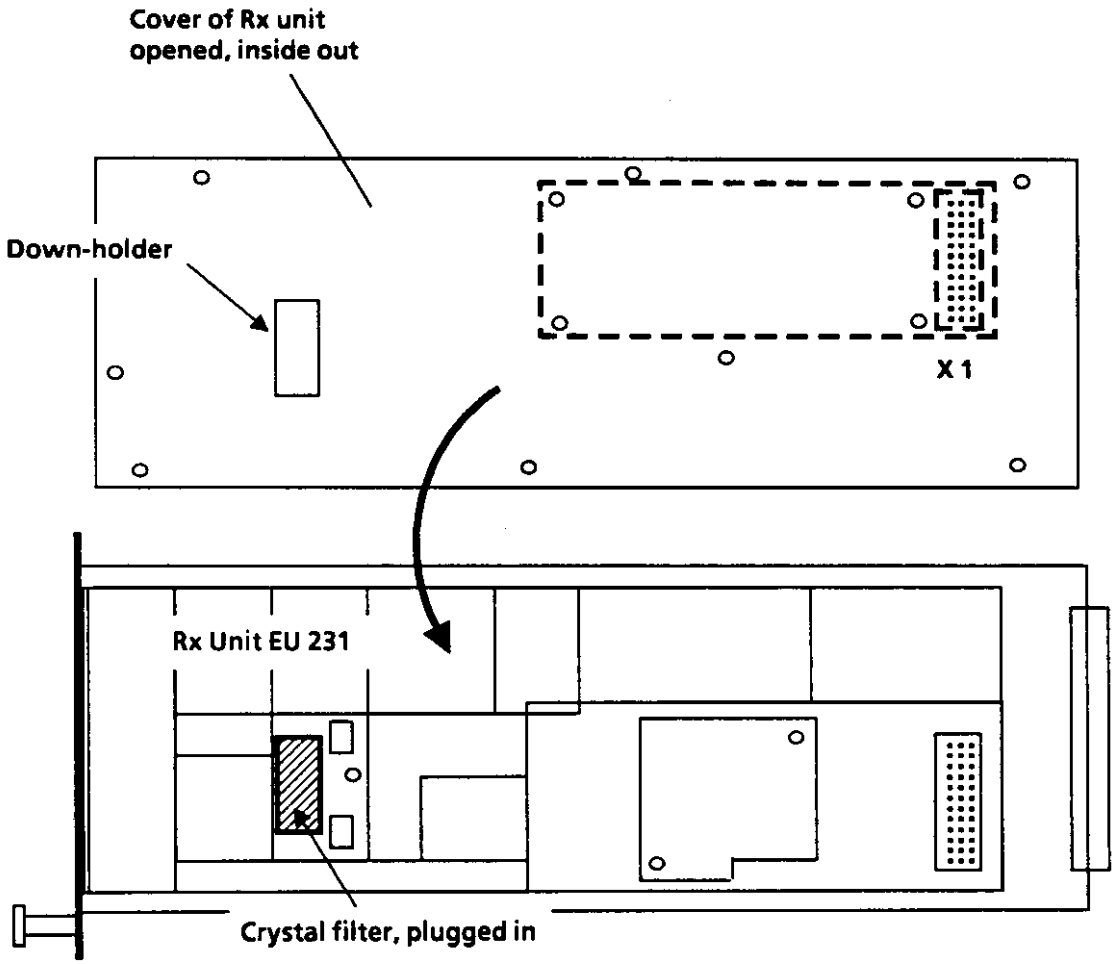


Fig. 4.11 Replacement of Crystal Filter

4.3.12 Retrofit of Options

4.3.12.1 Installation of Tx / Rx Diode Switch

Due to the rather complex soldering and alignment required, the Tx / Rx diode switch must be installed at the factory only.

4.3.12.2 Installation of Cabinet KK 251

For desktop applications the optional Cabinet KK 251 is available.

The heat sink of the transmitter's power section, which may heat up considerably depending on the conditions of transmission, protrudes beyond the cabinet rear.

There is no protection against accidental contact.

WARNING

Beware of touching the heat sink during transmission where temperatures may rise as high as 70 °C!

CAUTION

The maximum permitted unit temperature can only be guaranteed under the following conditions:

- ***ambient temperature of max. 40 °C***
- ***duty cycle (transmission / reception) max. 1:5***

4.3.12.3 Retrofit of VHF Circulator Set GD 200V

CAUTION

For retrofitting the circulator set rather complex soldering on the amplifier PCB is required. Therefore this job should be done by qualified personnel only!

(See Fig. 4.12)

Preparations

1. On front panel set switch REM / LOC / OFF (20, Fig. 3.1) to position **OFF**.
2. Set power switch (11, Fig. 3.1, with optional Power Supply IN 251A only) to off-position.
3. On equipment rear pull off connectors X3 (battery connection) and X4 (AC mains, with optional Power Supply IN 251A only).
4. Open cover after undoing Phillips screws.
5. Remove Modulator GM 201 (1), Synthesizer GF 201V (2) and, if present, Modulator Extension GM 201C8 (3) acc. to the previous chapters of this manual.
6. If present, remove the optional Lowpass Filter GH 200V (4).
7. Remove two cable clips (5).
8. Undo and remove four fixing screws (7) at the bottom of the heat sink. The figure shows the four respective screws at the top.
9. Undo four fixing screws (6) at the heat sink, two at the top and two at the bottom.
10. Push VHF amplifier together with heat sink to the rear and up, then fold back by 90° to the service position.

This position now allows the connection to the VHF amplifier.

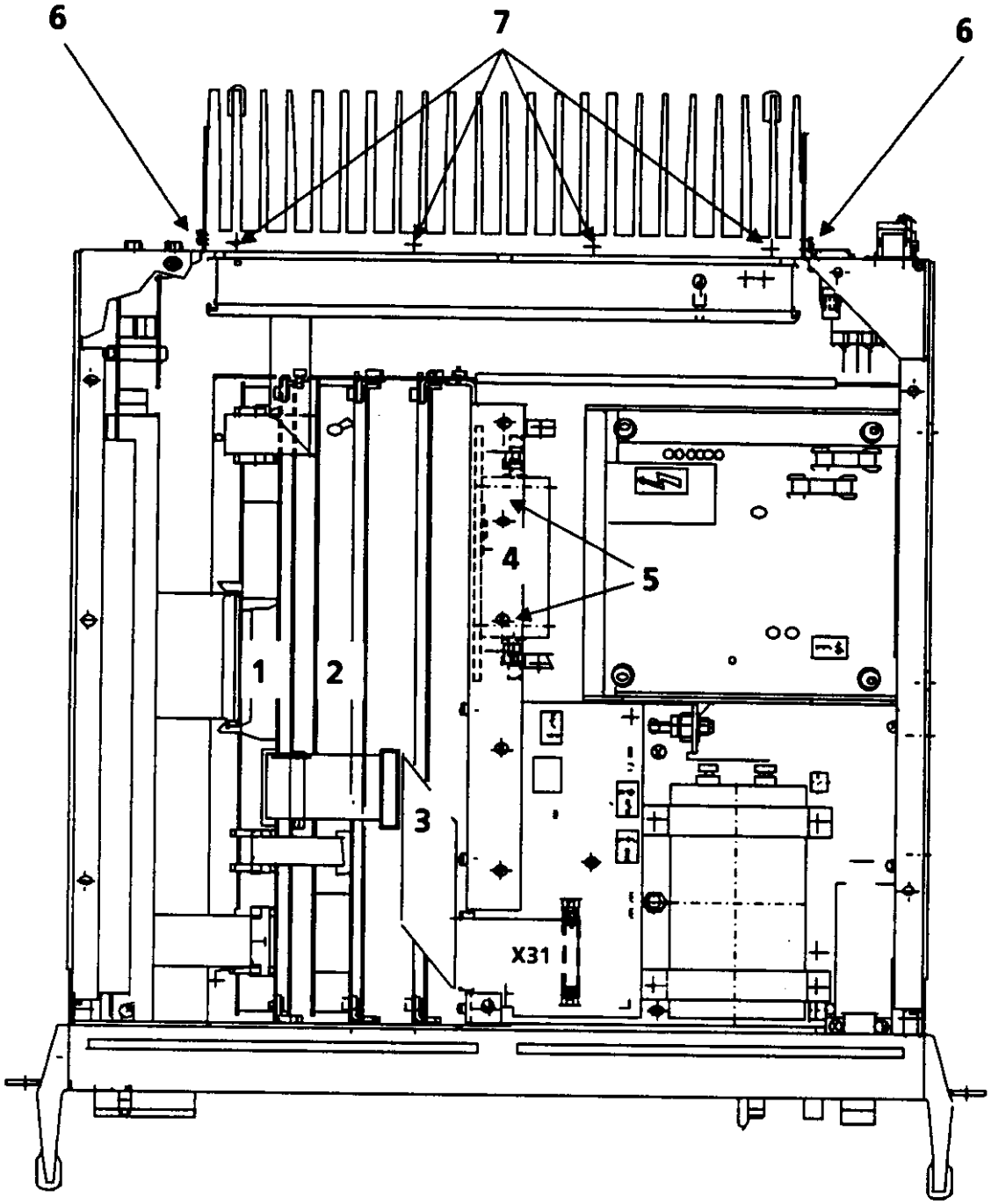


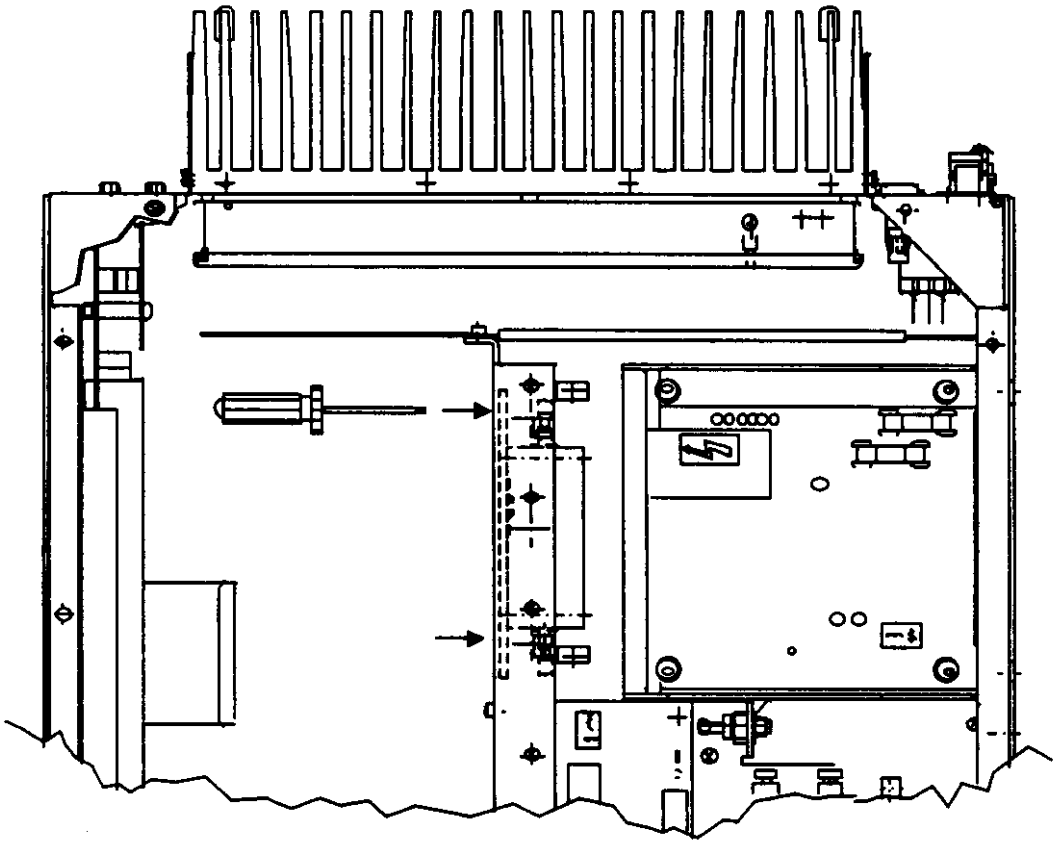
Fig. 4.12 Preparations for Retrofit of Circulator Set (Option)

Installation

1. a) Screw the two supplied RF cables with straight SMA connectors loosely to circulator connectors.

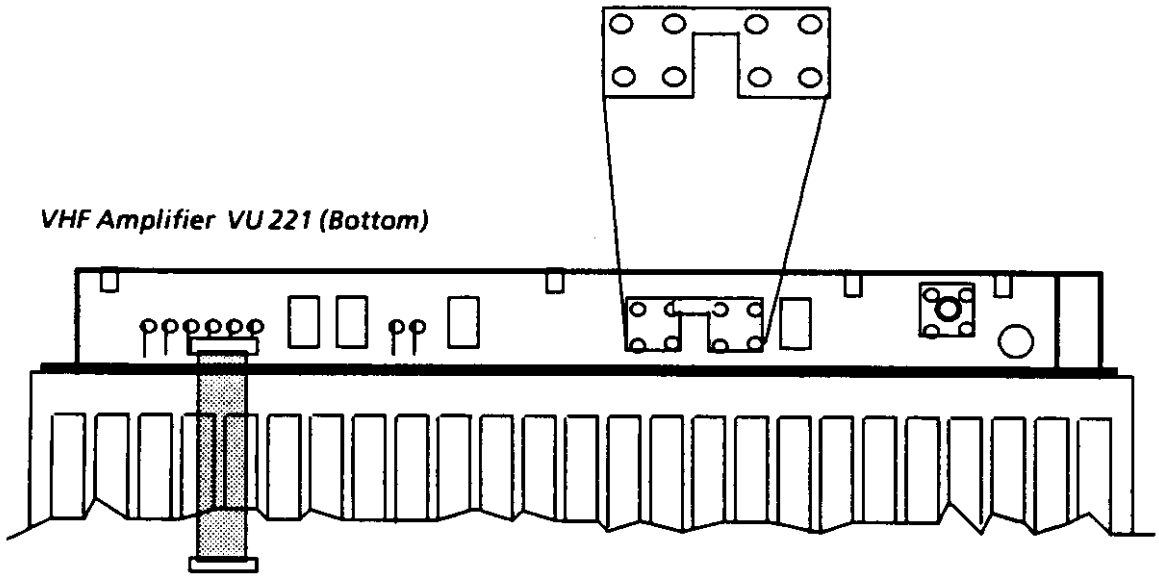
   b) Apply heat-conducting compound to mounting surface of circulator.

   c) Attach circulator from the rear to the intermediate wall by means of four screws (see figure below). For this use a short screw driver or angular screw driver.

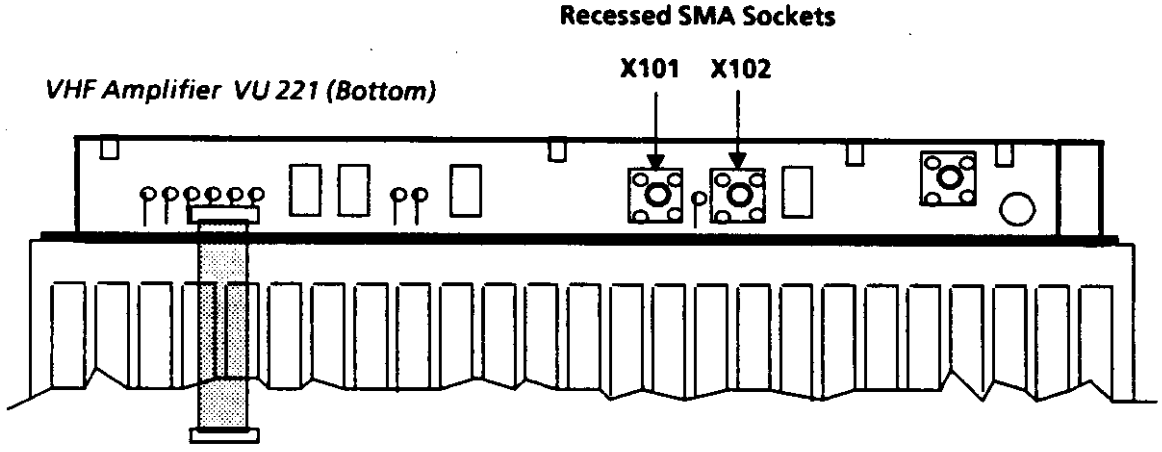


2. Remove screening cover of VHF Amplifier VU 221 after undoing the Phillips screws (torque 35 Ncm).

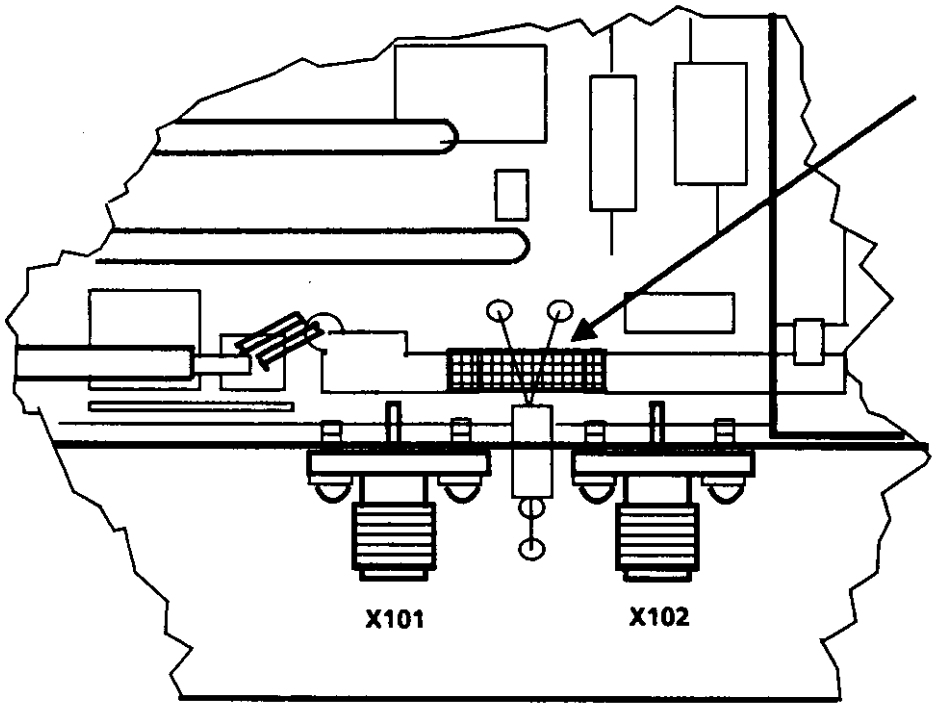
3. On VHF amplifier remove dummy plate (X101 / X102) after undoing and removing the eight screws. Keep the screws and washers for fixture of SMA sockets X101 and X102.



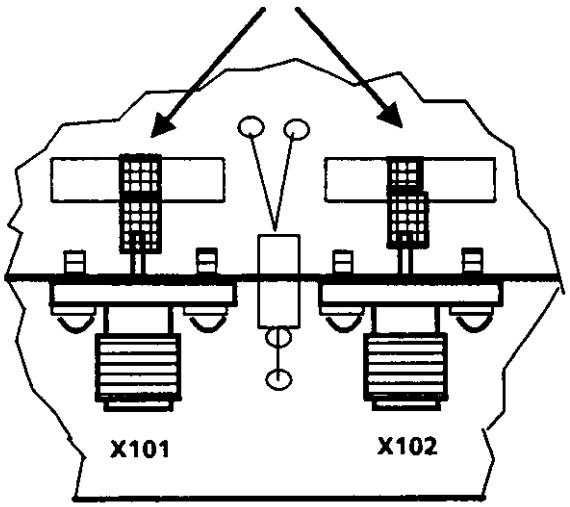
4. Fix recessed SMA sockets to the screening wall by means of eight screws.

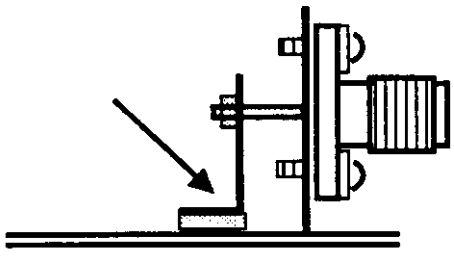


5. On PCB unsolder strap between X101 and X102 (see arrow in figure below) by means of soldering iron and remove.



6. Solder angles to inner conductors of SMA sockets X101 and X102.



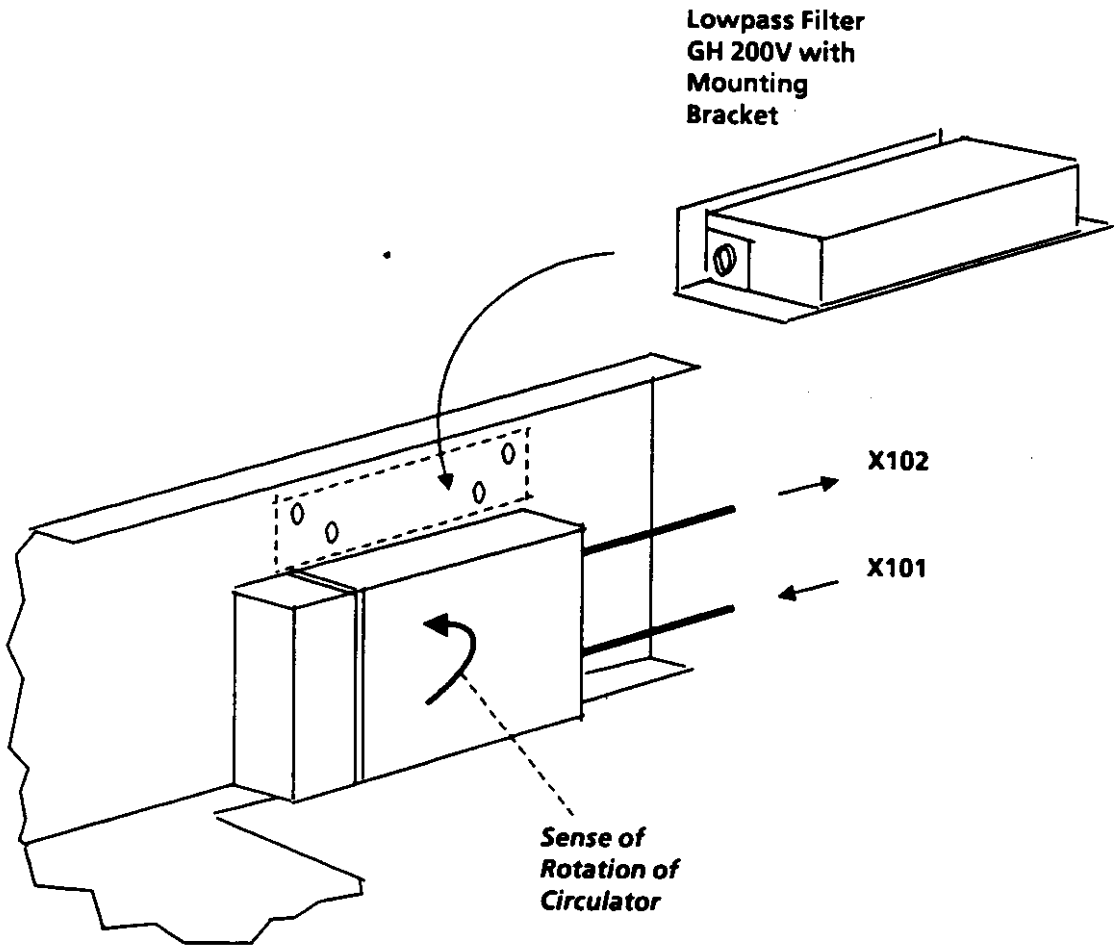


7. Cable-connect the circulator to SMA sockets X101 and X102 with the angular connectors on the amplifier side and the straight connectors on the circulator side. Tighten SMA connectors by using an 8-mm open-end wrench (torque 100 Ncm).

CAUTION

Be absolutely sure to turn the circulator in the correct direction!

8. If present, screw the optional Lowpass Filter GH 200V to the mounting bracket above the circulator.



9. Re-assembly is to be carried out in the reverse order of disassembly.

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Appendix 1
Settings

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A1. Settings

A1.1 General

The following slide-in and plug-in modules of VHF Transceiver XU 221 can be set to particular operating functions, as required:

- Power Supply IN 251A (option)
- VHF Synthesizer GF 201V
- Modulator GM 201
- Interface 1 GI 201X
- VHF Rx Unit EU 231
- Inband Interface GM 211 (option)
- Modulator Extension GM 201C8

The optional **Power Supply IN 251A** is set ex works to a mains voltage of 230 VAC. With the voltage selector (equipment rear) the power supply can be set to other mains voltages.

The **Synthesizer GF 201V** contains several DIL switches serving to select the transmit frequency.

The **Modulator GM 201** contains pin contacts onto which jumpers are attached. By positioning these jumpers onto other contact pairs various operating functions may be set.

The **Interface 1 GI 201X** contains pin contacts onto which jumpers are attached. By positioning these jumpers onto other contact pairs various operating functions may be set.

The **Rx Unit EU 231** contains several contacts onto which jumpers are attached. By positioning these jumpers onto other contact pairs various operating functions may be set.

The optional **Inband Interface GM 211** contains pin contacts onto which jumpers are attached. By positioning these jumpers onto other contact pairs various operating functions may be set.

The **Modulator Extension GM 201C8** contains a coding switch for setting the frequency increment.

The following sections provide detailed information on the possible jumper and switch positions and their respective functions. In addition, setting procedures are described.

A1.2 Settings on Power Supply IN 251A (Option)

A1.2.1 Setting of Mains Voltage

1. For mains operation first of all check which mains voltage is available.

CAUTION

The Power Supply IN 251A installed in the transceiver is set ex works to a mains voltage of 230 VAC.

A window in the combination with mains connector on the equipment rear (Fig. 2.1) indicates the set voltage. For mains voltages available at the installation site other than 230 VAC the power supply has to be switched over accordingly.

2. Alter internally set mains voltage as follows:

   a) Disconnect mains and battery cables. Open cover of combination with mains connector by means of screw driver (see Fig. A1.1a).

   b) Alter setting of voltage selector by turning cylindrical switch with screw driver (see Fig. A1.1b).

   c) Close cover of combination with mains connector.

A1.2.2 Replacement of Fuses after Altering the Mains Voltage Setting

1. Disconnect all connecting cables from power supply.
2. Open cover of combination with mains connector by means of screw driver (see Fig. A1.1a).
3. Ease fuses F1 and F2 carefully out of their holders acc. to Fig. A1.1c by means of screw driver (fuse type H 260 according to IEC).

F 1	115 V:	T 8 A	5 x 20 mm
	230 V:	T 4 A	5 x 20 mm
F 2	115 V:	T 8 A	5 x 20 mm
	230 V:	T 4 A	5 x 20 mm

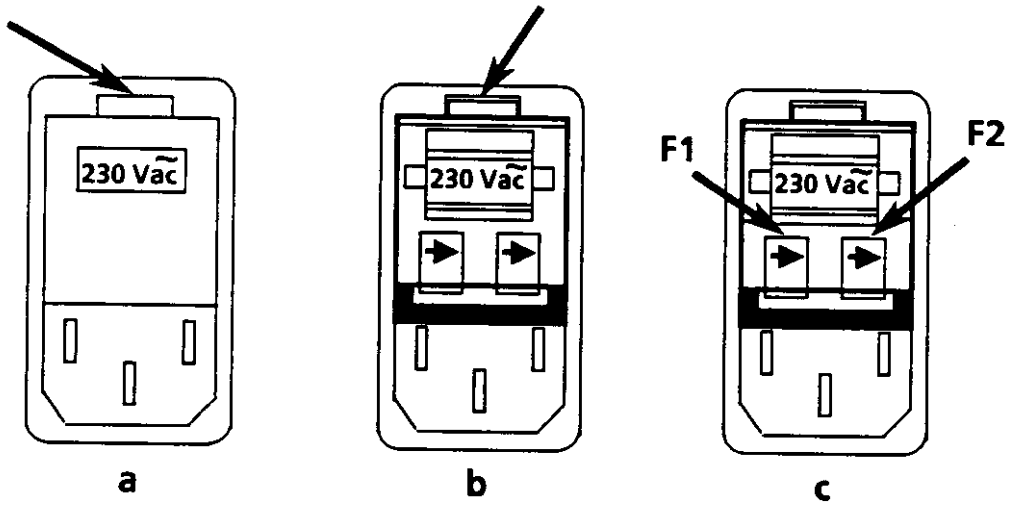


Fig. A1.1 Setting of Voltage Selector / Replacement of Fuses

A1.3 Settings on VHF Synthesizer GF 201V

On the VHF synthesizer the following settings can be made:

- Transmit frequency for different frequency spacings
- Transmit frequency offset and
- Reference frequency.

Depending on the model of the VHF synthesizer different reference oscillators are used. The respective reference frequency also is set by using different methods. In order to find out the relevant method more easily, at this point an overview of the different synthesizer models is given.

A1.3.1 Explanation of Models

Ident. No. XU 221	Ident. No. GF 201V	Version	Reference oscillator	Frequency spacing	Frequency shift *
6043.9343.22 **6043.9343.23** **6043.9343.26** **6043.9343.27** **6043.9343.42** **6043.9343.43**	**6044.6948.22**	**standard**	**TCXO** **1.5 ppm**	**8.33 / 12.5 kHz** **switchable**	**50 kHz**
6043.9343.24 **6043.9343.25** **6043.9343.44** **6043.9343.45** **6043.9343.46** **6043.9343.47**	**6044.6948.23**	**high frequency precision**	**OCXO** **0.2 ppm**	**8.33 / 12.5 kHz** **switchable**	**50 kHz**

TCXO: temperature-compensated crystal oscillator

OCXO: oven-controlled crystal oscillator

*) *automatic shift of synthesizer frequency for reception*

A1.3.2 Setting of Transmit Frequency for 12.5-kHz Frequency Spacing

(See Fig. A1.2)

1. Set switch REM / LOC / OFF (20, Fig. 3.1) on the transceiver front panel to OFF. Set power switch (11) to off-position and disconnect mains and / or battery cable.

2. Remove cover at the top of the VHF transceiver after undoing the Phillips screws.

3. Set Synthesizer GF 201V by means of DIL switches S1 to S3 (at the top of the synthesizer) to new transmit frequency.

   The frequency values of all DIL switches set to ON are added up.

Note:

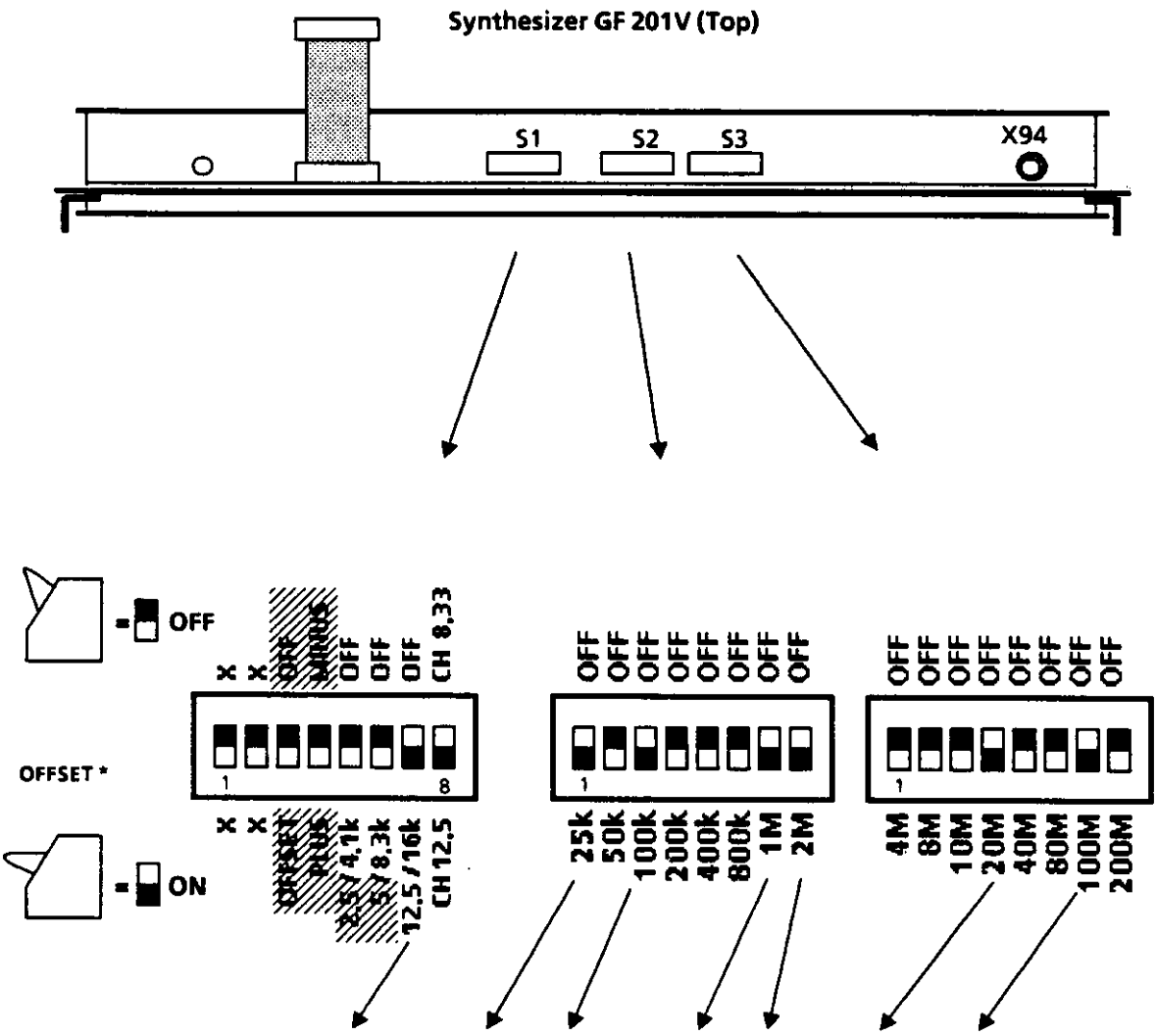
Make sure that DIL switch S1.8 CH (frequency spacing) is set to position 12.5.

The permitted frequency range is between 118 and 144 MHz. Setting of an impermissible frequency causes all three VCOs to be inhibited.

The entry of a pseudotetrade also inhibits all VCOs, that is, per BCD decade no sum value higher than "9" is permitted to be set.

Example: 4 MHz + 8 MHz >9 MHz **not allowed**

The correct setting would be: 10 MHz + 2 MHz



Example: f_{Tx} = 12.5 k + 25 k + 100 k + 1 M + 2 M + 20 M + 100 M = 123.1375 MHz

Notes: *The settings highlighted by hatching refer to the transmit frequency OFFSET setting (see A1.3.4)*

X = This switch position has no significance.

Fig. A1.2 Setting of Transmit Frequency for 12.5-kHz Frequency Spacing

A1.3.3 Setting of Transmit Frequency for 8.33-kHz Frequency Spacing

(See Fig. A1.3)

1. Set switch REM / LOC / OFF (20, Fig. 3.1) on the transceiver front panel to OFF. Set power switch (11) to off-position and disconnect mains and / or battery cable.

2. Remove cover at the top of the VHF transceiver after undoing the Phillips screws.

3. Set Synthesizer GF 201V by means of DIL switches S1 to S3 (at the top of the synthesizer) to new transmit frequency.

   The frequency values of all DIL switches set to ON are added up.

   In this example the 8.33-kHz spacing is selected by means of DIL switch S1.6.

Note:

Make sure that DIL switch S1.8 CH (frequency spacing) is set to position 8.33.

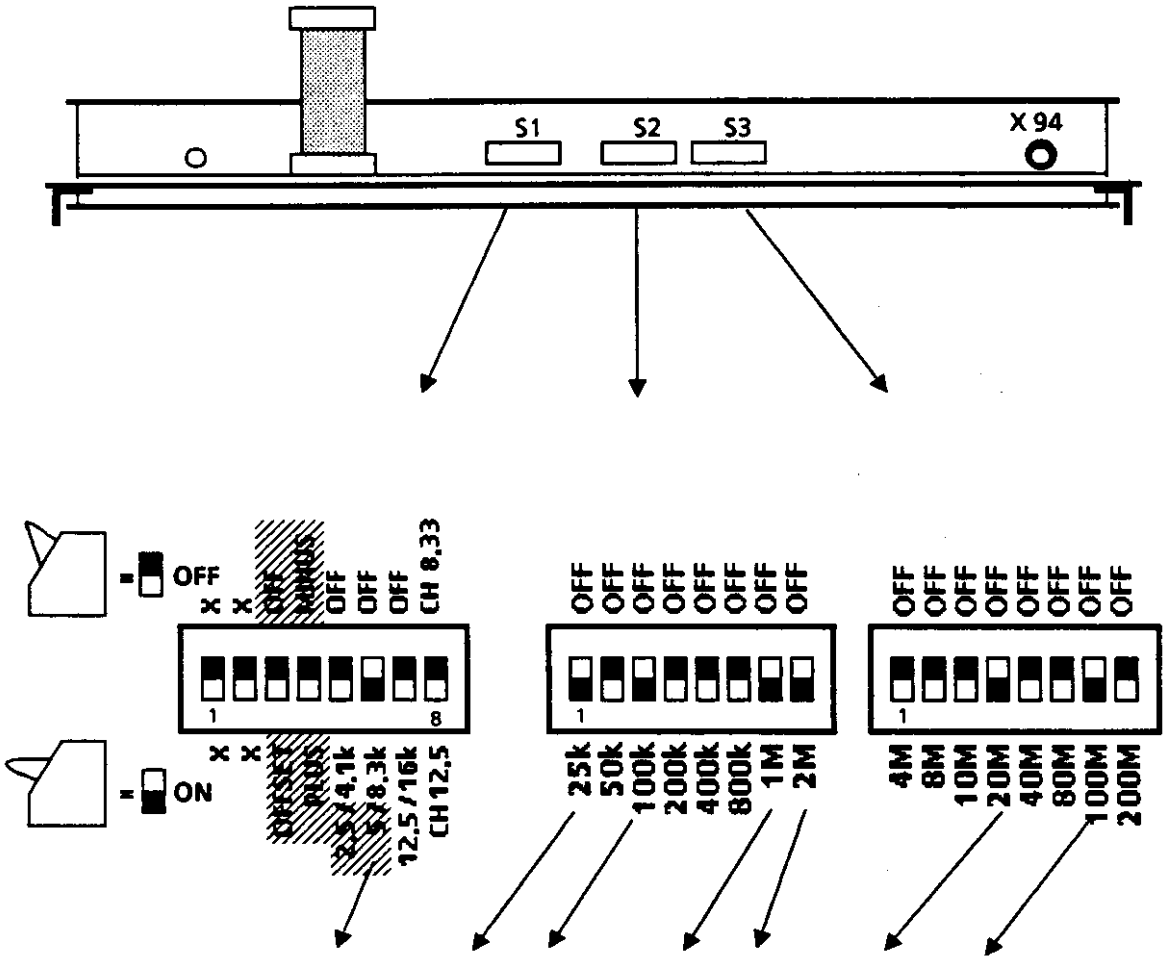
The permitted frequency range is between 118 and 144 MHz. Setting of an impermissible frequency causes all three VCOs to be inhibited.

The entry of a pseudotetrade also inhibits all VCOs, that is, per BCD decade no sum value higher than "9" is permitted to be set.

Example: 4 MHz + 8 MHz > 9 MHz not allowed

The correct setting would be: 10 MHz + 2 MHz

Synthesizer GF 201V (Top)



Example: f_{Tx} = 8.33 k + 25 k + 100 k + 1 M + 2 M + 20 M + 100 M = 123.13333 MHz

Notes: *The settings highlighted by hatching refer to the transmit frequency OFFSET setting (see A1.3.4)*

X = This switch position has no significance.

Fig. A1.3 Setting of Transmit Frequency for 8.33-kHz Frequency Spacing

A1.3.4 Setting of Transmit Frequency Offset

(See Fig. A1.4)

1. Set switch REM / LOC / OFF (20, Fig. 3.1) on the transceiver front panel to OFF. Set power switch (11) to off-position and disconnect mains and / or battery cable.

2. Remove cover at the top of the VHF transceiver after undoing the Phillips screws.

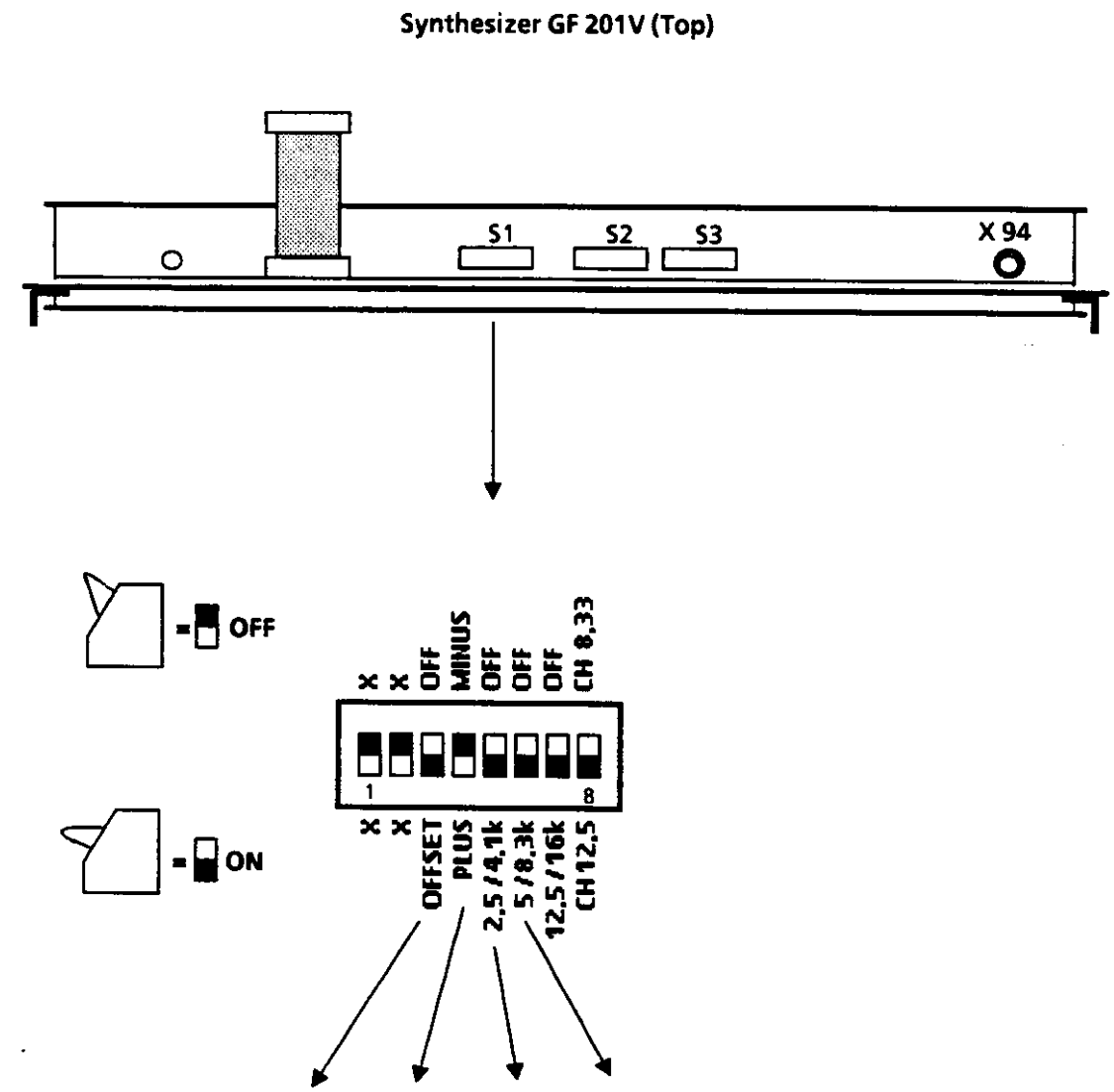
3. Set Synthesizer GF 201V by means of DIL switches S1 to S3 (at the top of the synthesizer) to new transmit frequency (see A1.3.2).

Note:

Make sure that for setting the transmit frequency offset DIL switch S1.8 CH (frequency spacing) is set to position 12.5.

For setting the transmit frequency offset refer to the table below.

	S1.3	S1.4	S1.5	S1.6
OFF	OFFSET off	OFFSET -	0 kHz	0 kHz
ON	OFFSET on	OFFSET +	2.5 kHz	5 kHz



Example: f_{OFFSET} = ON / MINUS / 2.5 k + 5 k = - 7.5-kHz Offset

Fig. A1.4 Setting of Transmit Frequency Offset

A1.3.5 Alignment of Crystal Reference Frequency (Mod. 22 / 23 - TCXO)

(See Fig. A1.5)

Note:

Normally, this alignment of the temperature-compensated crystal oscillator (TCXO) will be required at intervals of approx. three years.

1. Set switch REM / LOC / OFF (20, Fig. 3.1) on the transceiver front panel to **OFF**.
2. Set power switch (11) to off-position and disconnect mains and / or battery cable.
3. Remove cover at the top of the VHF transceiver after undoing the Phillips screws.
4. At X94 connect a frequency counter (accuracy better than 0.1 ppm).
5. By means of DIL switches S1 to S3 set frequency of 120 MHz (no offset).
6. Re-connect mains and / or battery cable, set power switch to on-position and set switch **REM / LOC / OFF** to **LOC**.
7. Switch transceiver on and allow approx. half an hour to warm up.
8. In the event of a frequency deviation, at variable control R101 align frequency to 120 MHz ± 10 Hz by means of a screw driver.
9. Switch off transceiver and disassemble test setup.
10. Re-attach top cover of VHF transceiver by means of the Phillips screws.

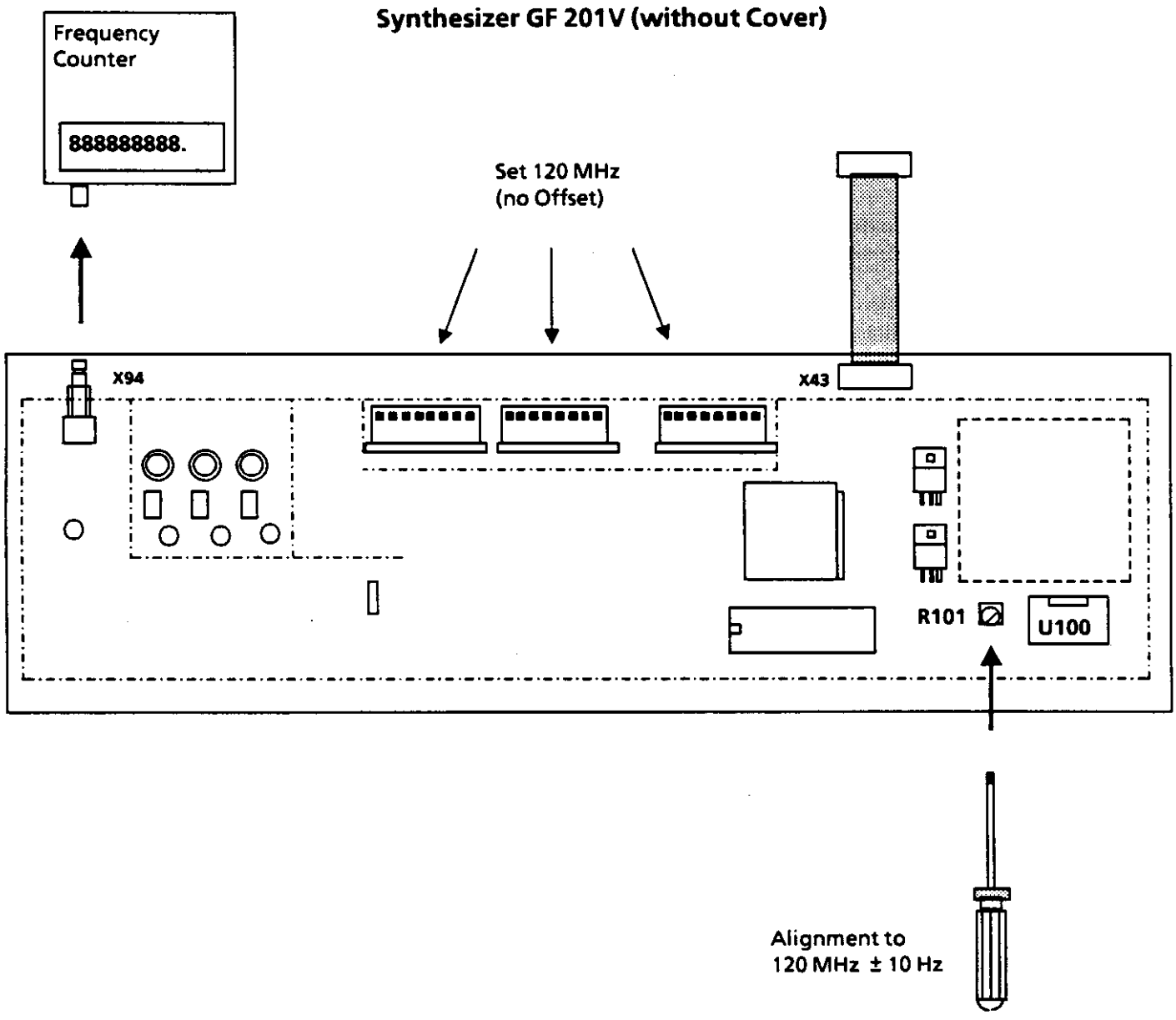


Fig. A1.5 Alignment of Reference Frequency on Synthesizer (Mod. 22 / 23 - TCXO)

A1.3.6 Alignment of Reference Frequency of Oven-controlled Crystal Oscillator (Mod. 24 / 25 - OCXO)

(See Fig. A1.6)

Note:

Normally, this alignment of the oven-controlled crystal oscillator (OCXO) will be required at intervals of approx. three years.

1. Set switch **REM / LOC / OFF** (20, Fig. 3.1) on the transceiver front panel to **OFF**.
2. Set power switch (11) to off-position and disconnect mains and / or battery cable.
3. Remove transceiver top cover after undoing the Phillips screws.
4. At X94 connect a frequency counter (accuracy better than 0.1 ppm).
5. By means of DIL switches S1 to S3 set frequency of 120 MHz (no offset).
6. Re-connect mains and / or battery cable, set power switch to on-position and set switch **REM / LOC / OFF** to **LOC**.
7. Switch transceiver on and allow approx. half an hour to warm up.
8. In the event of a frequency deviation, at the variable control of the OCXO align frequency to 120 MHz ± 1 Hz by means of a screw driver.
9. Switch transceiver off again and disassemble test setup.
10. Re-attach top cover of VHF transceiver and tighten Phillips screws.

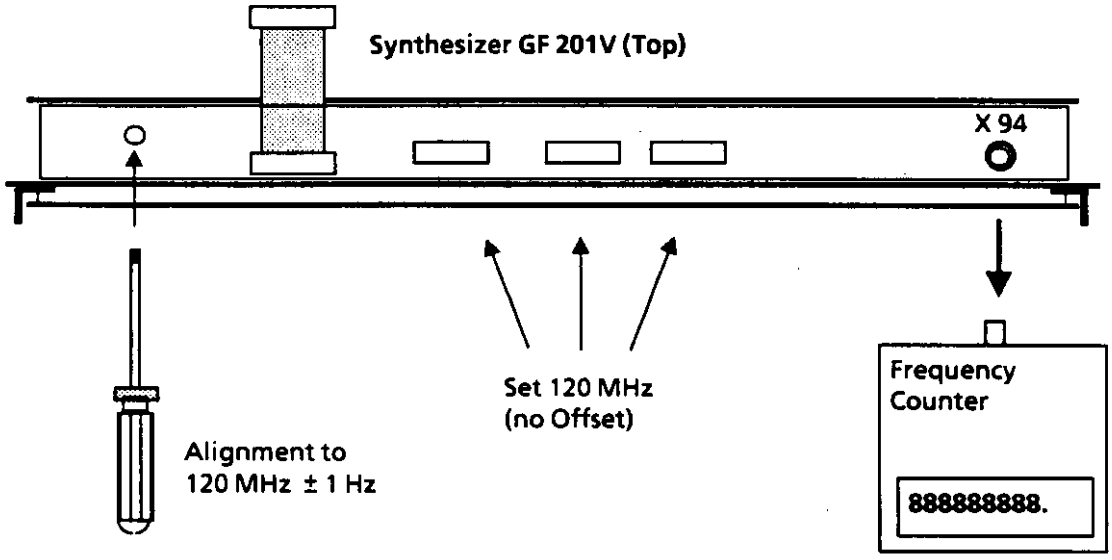


Fig. A1.6 Alignment of Reference Frequency on Synthesizer (Mod. 24 / 25 - OCXO)

A1.4 Settings on Modulator GM 201

A1.4.1 Jumpers

This chapter deals with the jumpers by means of which operating functions can be altered. The text on the following pages applies to **Model 03** of Modulator GM 201 only!

In order to check or alter any settings remove Modulator GM 201 as described in 4.3.2. Open the modulator on its top after undoing 12 Phillips screws. Consequently, all jumpers and pin contacts are accessible.

(See Fig. A1.7, page 1)

AF filter

X10 Setting ex works:
Jumper on contacts X10.1 and .2
Jumper on contacts X10.3 and .5
Jumper on contacts X10.10 and .12
The external 8.33-kHz filter in the optional Modulator Extension GM 201C8 is connected in series with the internal filter (0.3 to 3.4 kHz).

Or: Jumper on contacts X10.2 and .4 and jumper on contacts X10.10 and .12
Only the internal AF filter is used.

ALC

X110 Setting ex works:
Jumper on contacts X110.2 and X110.3
ALC (Automatic Level Control) is enabled.

Or: Jumper on X110.1 and X110.2
AF gain is firmly set.

RF power reduction

X250 Setting ex works:
No jumper on X250
Normal operation, RF power reduction is effective.

Or: Jumper on X250.1 and X250.2
For service purposes only; RF power reduction is ineffective.

VHF / UHF

X322 Setting ex works:
Jumper on contacts X322.1 and X322.2
Equipment operates in VHF range.

Or: Jumper on X322.2 and X322.3
Equipment operates in UHF range
(not used for XU 221).

Control loop

X323 Setting ex works:
No jumper on X323
Normal operation, with integrating phase-locked loop

Or: Jumper on X323.2 and X323.3
For service purposes only; integrating part of phase-locked loop is disabled.

Inband control

X411 Setting ex works:
Jumper on contacts X411.1 and X411.2
Transceiver is cut out by Inband Control GM 211 in the event of a failure.

Or: No jumper on X411
Transceiver is not cut out by Inband Control GM 211 in the event of a failure.

PTT time limiting

X532 Setting ex works:
Jumper on contacts X532.1 and X532.2
PTT time limiting is disabled.

Or: Jumper on X532.2 and X532.3
PTT time limiting is enabled.

Monitoring

X715 Setting ex works:
Jumper on contacts X715.2 and X715.3
Monitoring is via directional coupler.

Or: Jumper on contacts X715.1 and X715.2
Monitoring is via the receiver.)

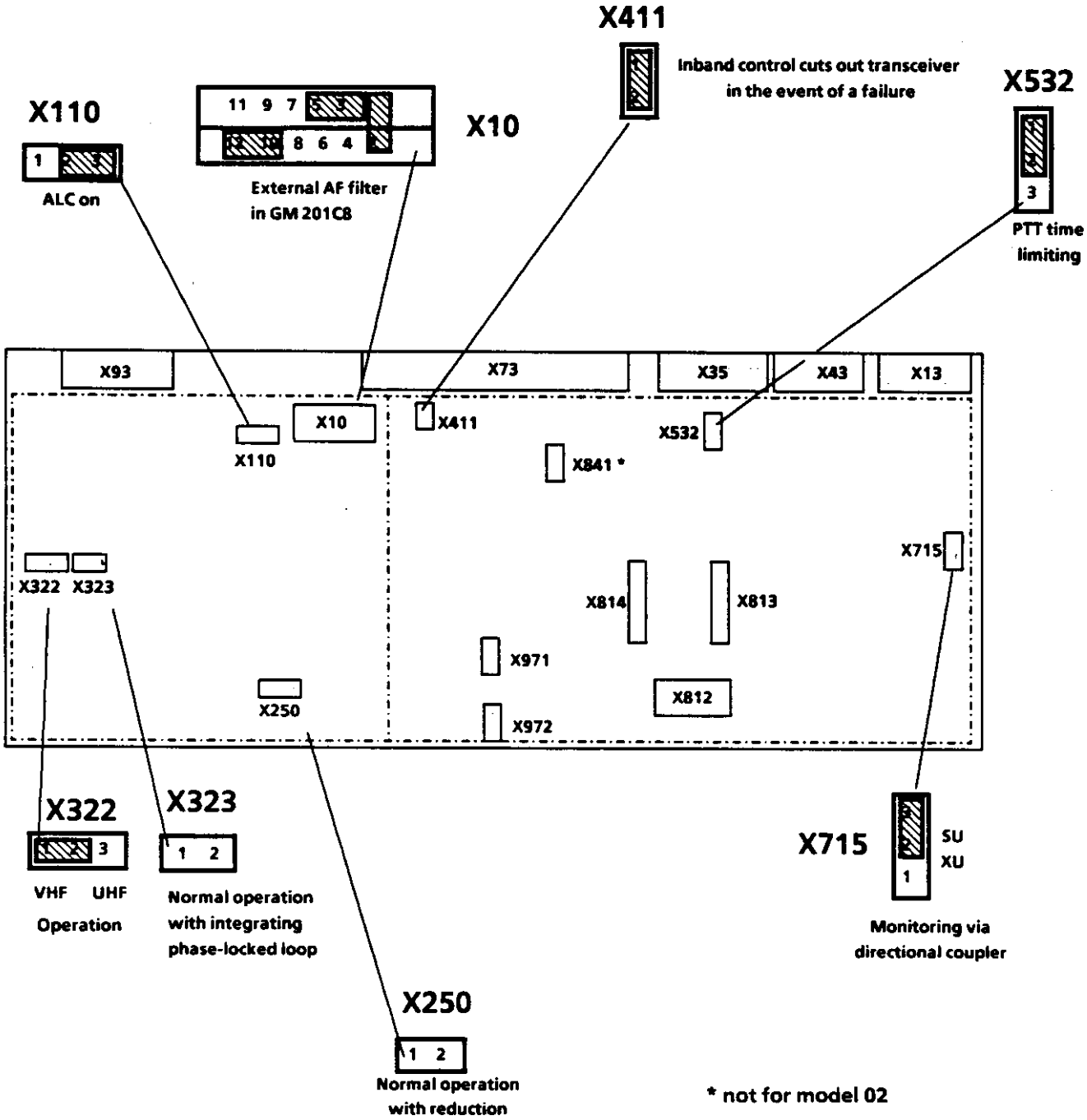


Fig. A1.7 Jumpers in Modulator GM 201 (page 1 of 4)

(See Fig. A1.7, page 2)

User-defined bit

X841 **Not for Model 02 !**

Setting ex works:

Jumper on X841.2 and X841.3
User-defined bit: only output (XU 221)

Or: Jumper on contacts X841.1 and .2
User-defined bit: input / output (SU 221)

Sum test / VSWR

X971 Setting ex works:

Jumper on X971.1 and X971.2

If value of VSWR is above limit, then sum test result is NoGo, but transmission is still possible (***the error is not stored***).

Or: No jumper on X971

Sum test is independent of VSWR message

Or: Jumper on X971.2 and X971.3

If value of VSWR is above limit, then sum test result is NoGo, transmission is blocked (***the error is stored***).

Sum test / carrier message

X972 Setting ex works:

Jumper on X972.1 and X972.2

If value of carrier is below limit, then sum test result is NoGo, but transmission is still possible (***the error is not stored***).

Or: No jumper on X972

Sum test is independent of carrier message.

Or: Jumper on X972.2 and X972.3

If value of carrier is below limit, then sum test result is NoGo, transmission is blocked (***the error is stored***).

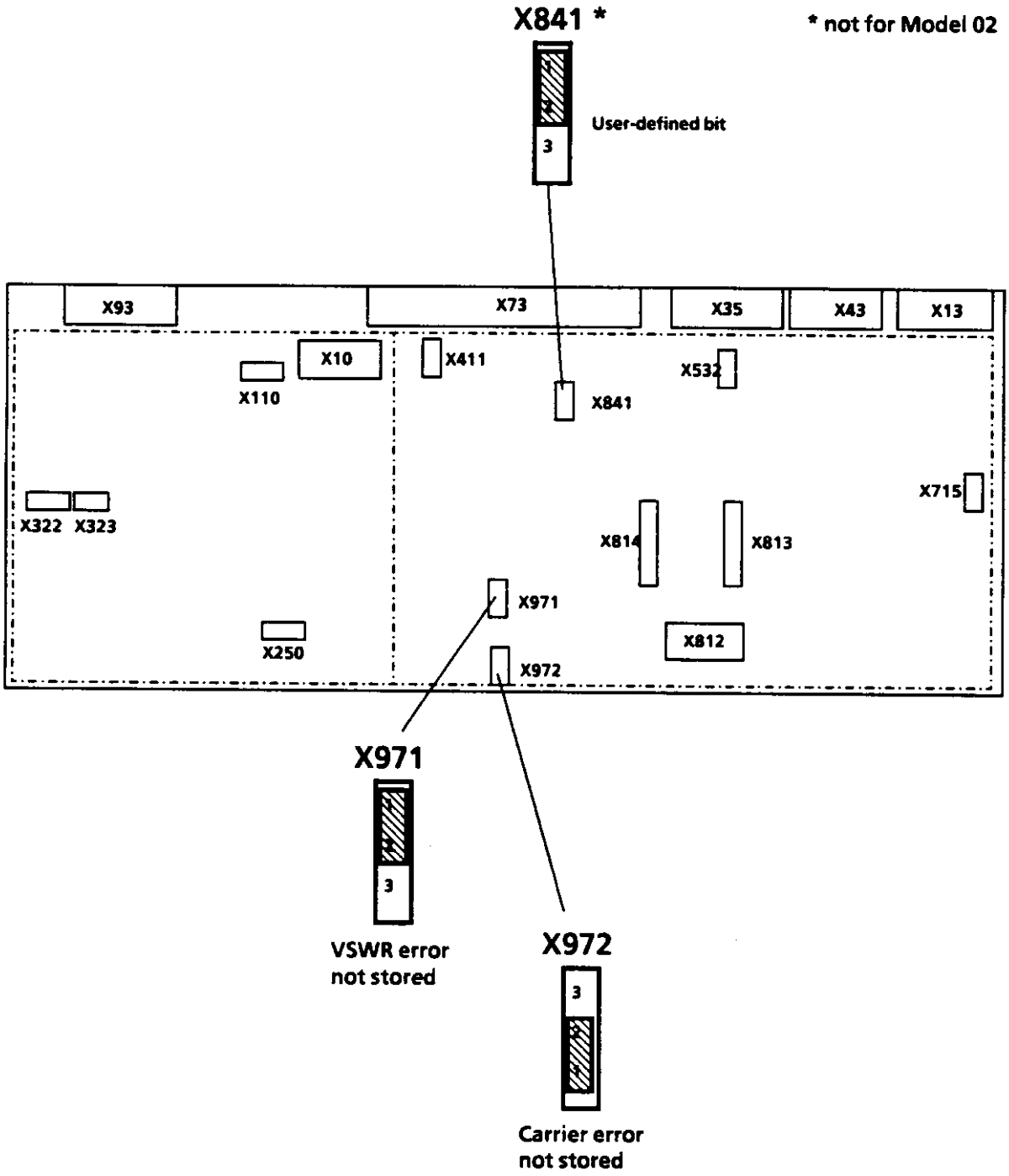


Fig. A1.7 Jumpers in Modulator GM 201 (page 2 of 4)

REM BUS Addressing

(See Fig. A1.7, page 3)

The binary addresses set on jumpers X812 and X813 / X814 are added up. On X812 the MSB address is set.

All jumpers connecting contacts of X812 horizontally do not have any function; this position is used for "parking" only.

X812 Setting ex works:
No jumper on X812
MSB packet address REM BUS ("56")

For further variable settings see Fig. A1.7, page 4.

X813 Setting ex works:
Jumper on contacts X813.1 and X813.2
LSB packet address REM BUS (address "0")

For further variable settings see Fig. A1.7, page 4.

X814 Setting ex works:
No jumper on X814
LSB packet address REM BUS (address "0")

For further variable settings see Fig. A1.7, page 4.

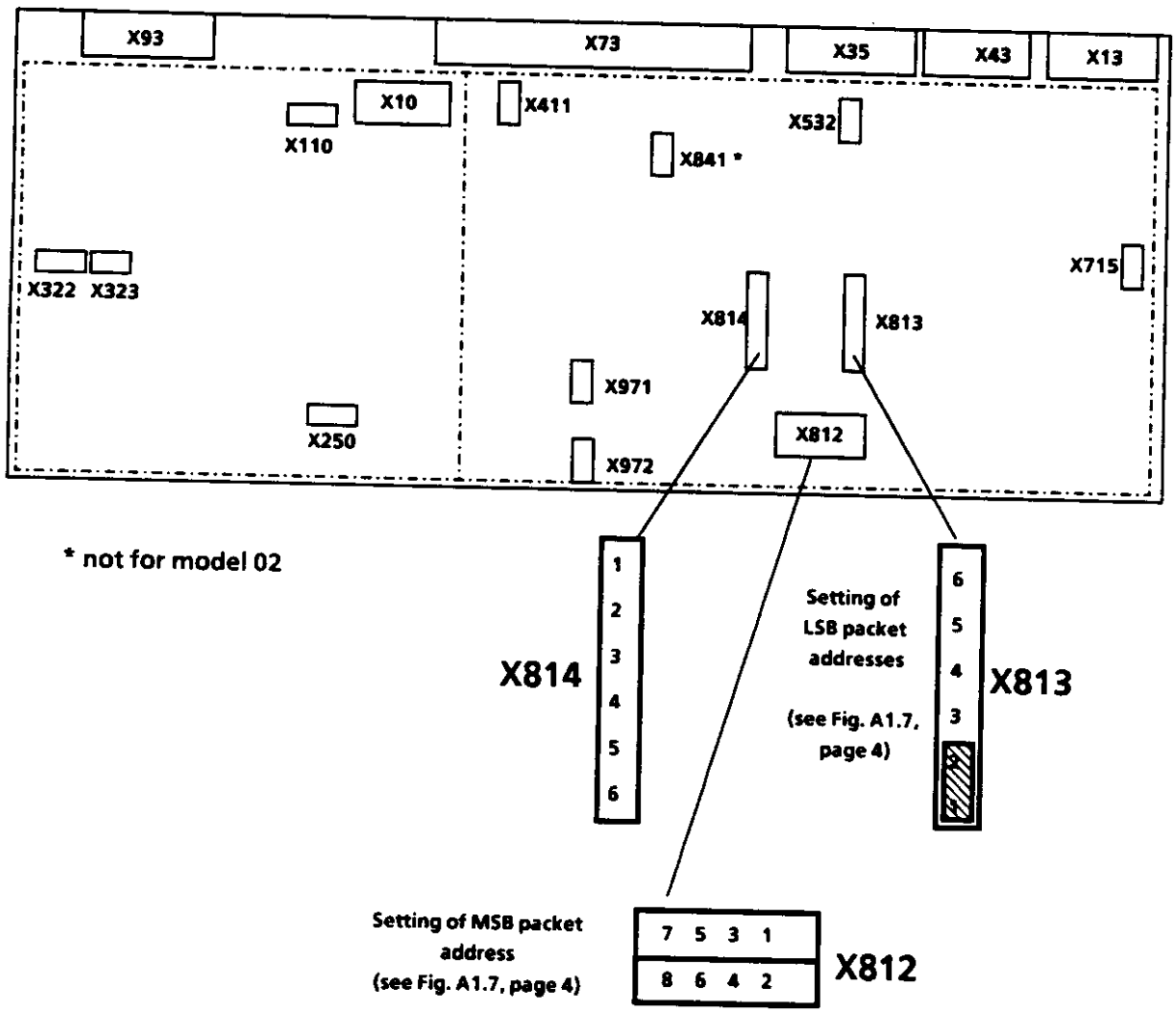


Fig. A1.7 Jumpers in Modulator GM 201 (page 3 of 4)

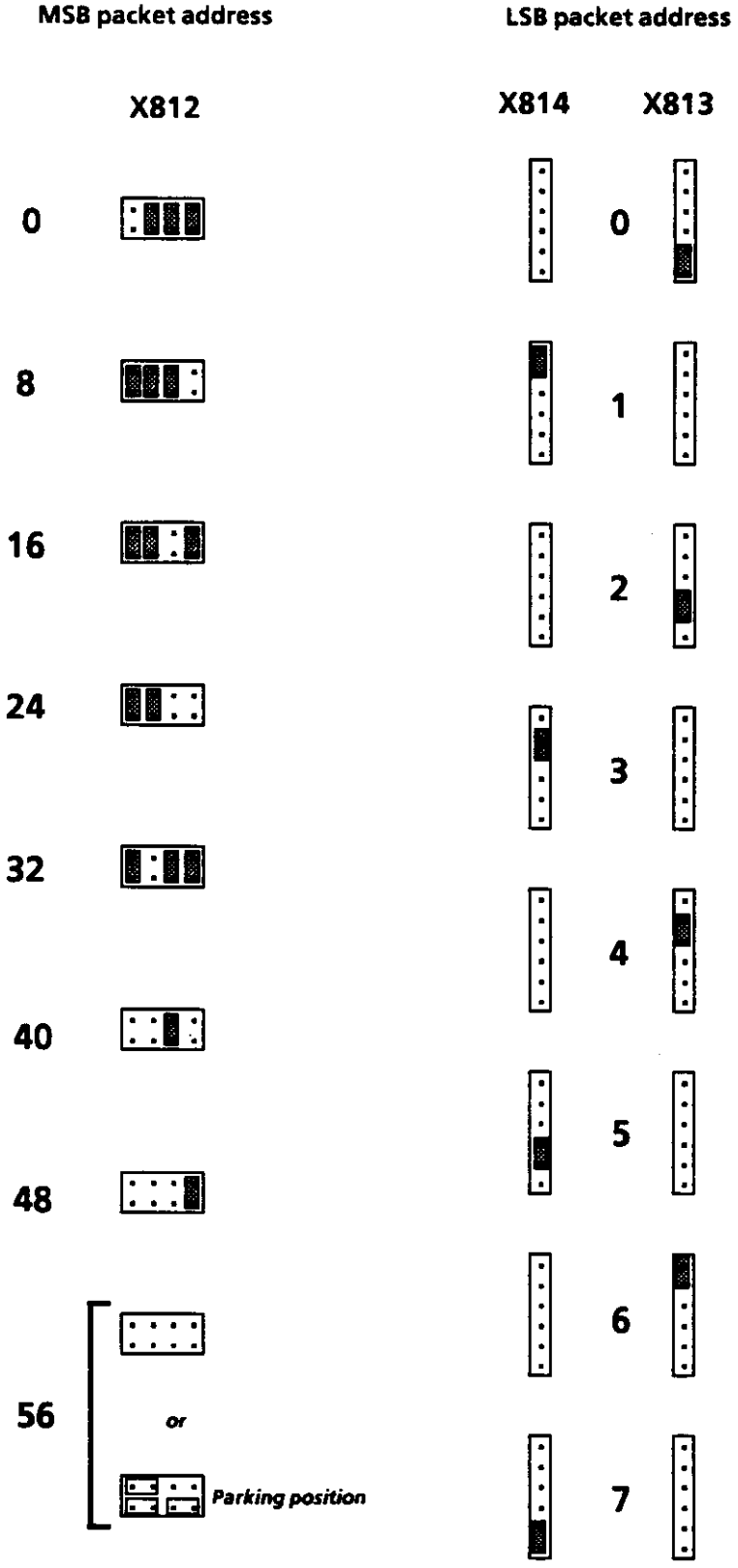


Fig. A1.7 Jumpers in Modulator GM 201 (page 4 of 4)

A1.4.2 Setting of Output Power and Modulation Depth

(See Fig. A1.8)

CAUTION

The following settings are only to be made by service staff with the necessary qualifications, provided appropriate test equipment is available. Careless detuning of values can impair the transceiver's technical data and be the cause of failures!

Setting of normal output power

By means of variable resistor R303 the output power for normal operation is set (PH = Power High).

CAUTION

For power adjustment the antenna connector X2 must be terminated with a sufficient dummy load, failing which the transceiver might be damaged!

Setting of nominal value:
By means of a power meter measure the output power and with variable resistor R303 adjust to 50 W max.

Setting of reduced output power

By means of variable resistor R304 reduced output power is set (PL = Power Low).

Setting of nominal value:
By means of a power meter measure the output power and with variable resistor R304 adjust to desired value.

Setting of modulation depth

By means of variable resistor R254 the modulation depth is set (M = modulation). For this a modulation meter (e.g. FMA from R&S) is required which is connected via an attenuator (e.g. RBU 100 from R&S) to antenna output X2 of the transceiver.

Nominal value: 89 to 91%

CAUTION

Overmodulation will lead to distortions!

Modulator GM 201 (Top)

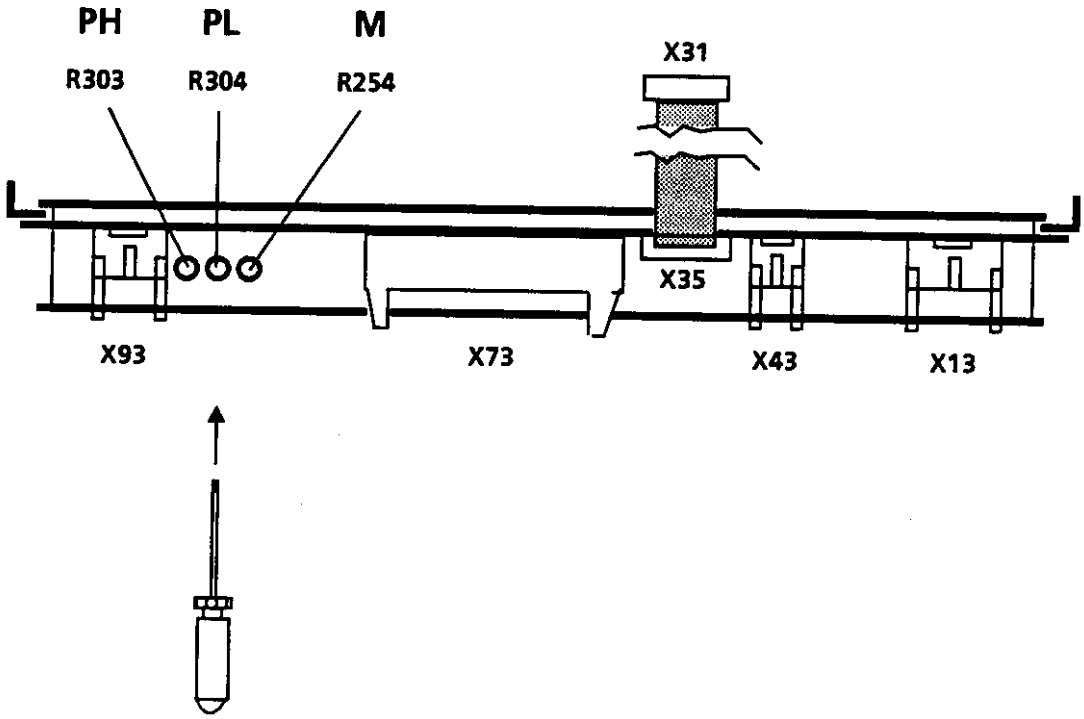


Fig. A1.8 Variable Resistors for Setting of RF Power and Modulation Depth

A1.5 Settings on Interface 1 GI 201X

A1.5.1 Jumpers

This chapter deals with jumpers by means of which operating functions can be altered.

For this purpose remove Interface 1 GI 201X as described in chapter 4.3.2.

(See Fig. A1.9, page 1)

X110 Setting ex works:
Jumpers on the following contacts of X110
.1 and .3, .2 and .4, .5 and .7, .6 and .8

The AF signal from the REMOTE connector (e.g. from remote control unit) is fed in at AF / TX / A (X9.2) and AF / TX / B and routed via transformer T110 and variable resistor R110 for level adjustment to the modulator (X73.31 AF-TX-A / C and X73.32 AF-TX-B / D).

Or:
Jumpers on contacts .1 and .2, .3 and .4, .5 and .6, .7 and .8

The AF signal from the REMOTE connector (e.g. from remote control unit) is fed in at AF / TX / A (X9.2) and AF / TX / B and looped via transformer T110 and variable resistor R110 for level adjustment through the inband interface (X1.C4 / C5 AF-TX-A / B) and routed further to the modulator (X73.31 AF-TX-A / C and X73.32 AF-TX-B / D).

X115 no function!

X120 Setting ex works:
Jumpers on the following contacts X120.1 and .3, X120.7 and .8

- **PTT OPTO / VOP:** At the anode of the optocoupler LED a positive voltage is available (V_{OP}). If -PTT (X9.16) is connected to ground potential, a current will flow through the optocoupler and initiate carrier activation.

Or: Jumpers on .3 and .4, .7 and .8

- **PTT OPTO / FLOAT:** Carrier activation is initiated, if between +PTT (X9.17) and -PTT (X9.16) a voltage of 5 to 35 V is applied.

Or: Jumpers on contacts .3 and .4, .7 and .9

PTT OPTO / GND: Carrier activation is initiated, if between +PTT (X9.17) and GND (X9.20) a voltage of 5 to 35 V is applied.

Or: Jumpers on contacts .2 and .4, .8 and .10

- **PTT NORM:** Carrier activation is initiated, if PTT (X9.16) and GND (X9.20) are interconnected.

Or: Jumper on contacts .3 and .5, .7 and .9

- **PTT PHANTOM:** Carrier activation is initiated, if AF / TX / A (X9.2) and / or AF / TX / B (X9.3) are connected DC-wise to GND (X9.1).

Or: Jumpers on .2 and .4, .10 and .12

PTT PHANTOM / GND: Carrier activation is initiated, if at AF / TX / A and/or AF / TX / B a voltage of +5 to 35 V referred to ground (X9.1) is fed in.

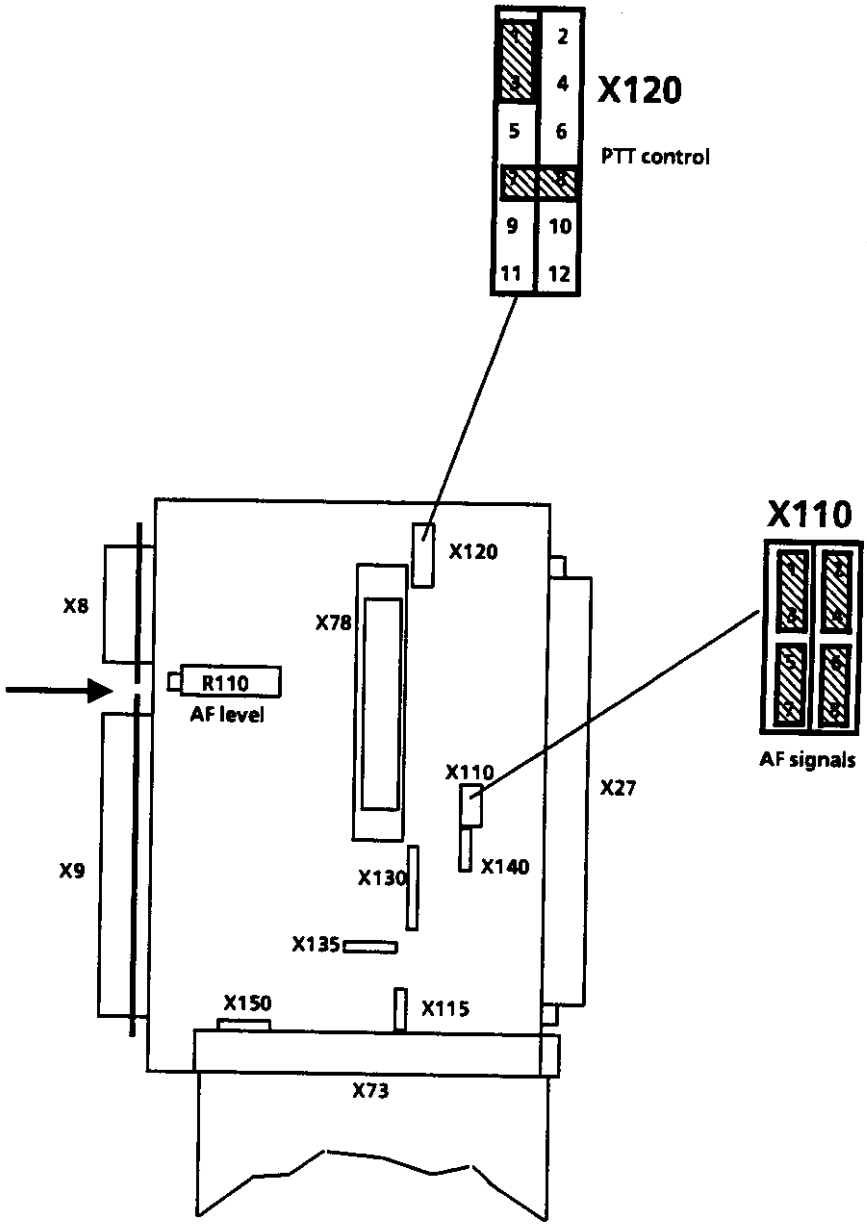


Fig. A1.9 Jumpers on Interface 1 GI 201X (page 1 of 2)

(See Fig. A1.9, page 2)

X130 Setting ex works:
Jumper on X130.1 and X130.2

The monitoring tone coming from the receiver is output via transformer T130 to the REMOTE connector (X9.5 AF / RX / A and X9.6 AF / RX / B).

Or: Jumper on contacts X130.2 and X130.3

The monitoring tone coming from the directional coupler of the transmitter output stage is fed in via the modulator at (X73.19) AF-TX and output via transformer T130 between (X9.5) AF / RX / A and (X9.6) AF / RX / B to the REMOTE connector.

X135 no function!

X140 Setting ex works:
Jumper on contacts X140.1 and X140.2

Phantom Carrier Disable:
no DC voltage at AF / RX / A (X9.5) and AF / RX / B (X9.6).
(Carrier message disconnected by DC voltage at REMOTE connector).

Or: Jumper on X140.2 and X140.3

Phantom Carrier Enable:
AF / RX / A (X9.5) and AF / RX / B (X9.6) DC-wise connected via R132 / R133 to PH-CAR (open collector).
(Carrier message due to DC voltage at REMOTE connector).

X150 Setting ex works:
Jumper on contacts X150.1 and X150.2

No climax: climax (X9.25) open
(transmit frequency offset cut out).

Or: Jumper on X150.2 and X150.3

Climax (X9.25) connected to GND (X9.24)
(transmit frequency offset cut in).

A1.5.2 Level Adjustment

(See Fig. A1.9, page 2)

By means of potentiometer R110, the AF level of the signal AF-TX, fed in on the REMOTE connector, can be adjusted. Ex works the variable control is set for an input level of 0 dBm.

On the rear panel, there is a small drilling between connectors X8 and X9 through which the potentiometer R110 is accessible.

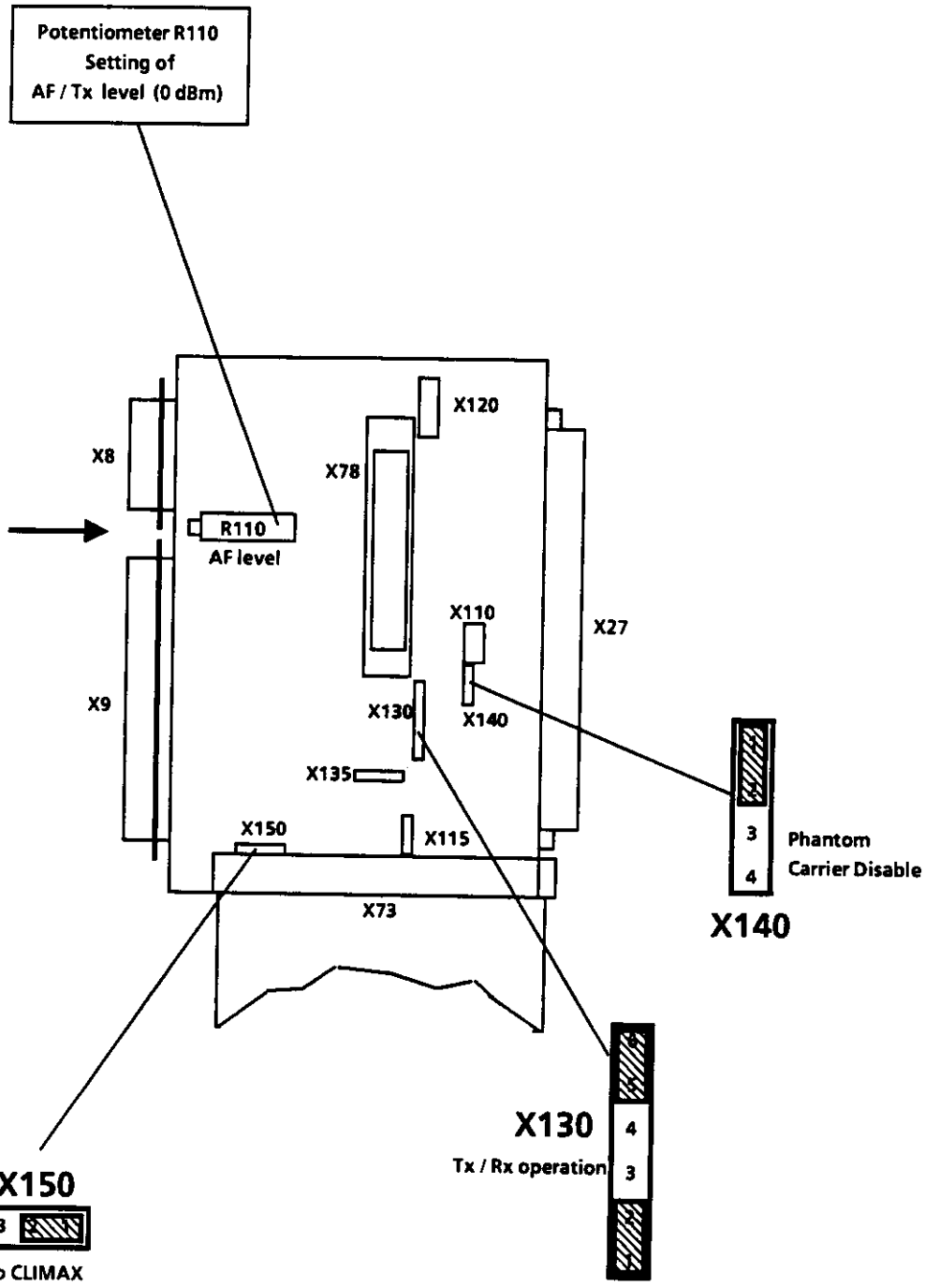


Fig. A1.9 Jumpers on Interface 1 GI 201X (page 2 of 2)

A1.6 Settings in Rx Unit EU 231

A1.6.1 Setting of Receive Frequency

(See Fig. A1.10)

1. Set switch REM / LOC / OFF (20, Fig. 3.1) to OFF.

2. Undo two Phillips screws and remove Rx Unit EU 231 from the adapter.

3. By means of coding switches S1 to S9 at the top of the Rx unit, program synthesizer to new receive frequency.

   The frequency to be set is the sum of the values for coding switches S1 to S9 as listed in the table to the right.

   Fig. A1.11 shows examples of switch settings for 12.5-kHz and 8.33-kHz frequency spacing.

4. After a frequency change input filter and synthesizer have to be aligned anew (see A1.6.2).

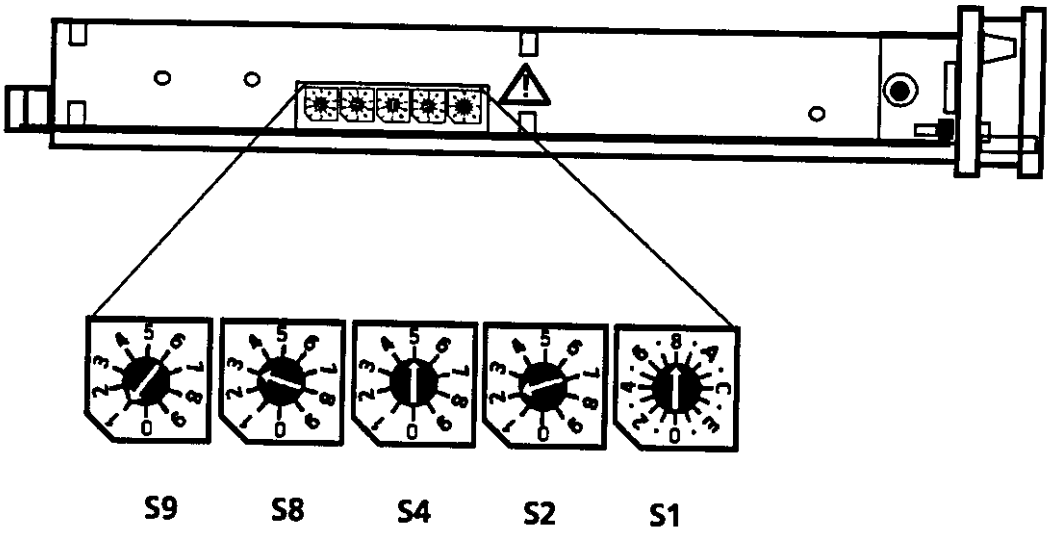


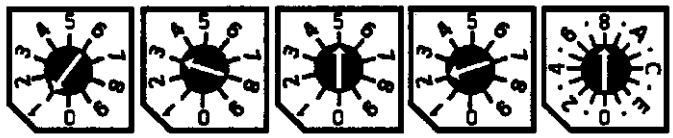
Fig. A1.10 Location of Coding Switches

Inscription on Covers:

Pos.	S9 [MHz]	S8 [MHz]	S4 [MHz]	S2 [kHz]	S1 [kHz]
0	-	0	0	0	0
1	100	10	1	100	8.33
2	-	20	2	200	12.5
3	-	30	3	300	16.66
4	-	40	4	400	25.0
5	-	50	5	500	33.33
6	-	60	6	600	37.5
7	-	70	7	700	41.66
8	-	80	8	800	50
9	-	90	9	900	58.33
A	-	-	-	-	62.5
B	-	-	-	-	66.66
C	-	-	-	-	75.0
D	-	-	-	-	83.33
E	-	-	-	-	87.5
F	-	-	-	-	91.66

Example of setting for 12.5 kHz:

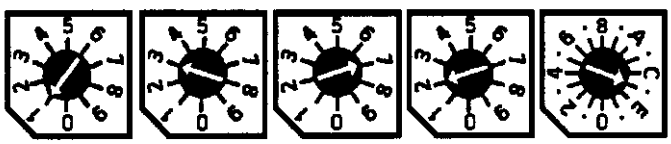
S9 S8 S4 S2 S1



100 MHz + 30 MHz + 5 MHz + 200 kHz + 50 kHz = 135.25 MHz

Example of setting for 8.33 kHz:

S9 S8 S4 S2 S1



100 MHz + 30 MHz + 7 MHz + 200 kHz + 83.33 kHz = 137.28333 MHz

Fig. A1.11 Frequency Setting in Rx Unit EU 231 (Examples)

A1.6.2 Alignment of Synthesizer and Input Filter

Note:

Please note that Frequency Tuning Kit KA 231F (part of Service Kit KA 231) will be required for the following alignment.

Alignment of Synthesizer

1. Set switch **REM / LOC / OFF** (20, Fig. 3.1) to **OFF**.

2. Undo two Phillips screws and remove Rx Unit EU 231 from the adapter.

3. Remove cover on components side after undoing nine Phillips screws.

CAUTION

Do not undo screws marked with a square symbol!

4. Remove protective caps from trimming capacitors C81 to C83, C91 to C93 and C31 (see Fig. A1.17).

5. Plug Rx unit onto adapter card (part of Frequency Tuning Kit KA 231F) and insert into adapter (see Fig. A1.18). Ensure that the connection to the power supply is established correctly. Set switch **REM / LOC/ OFF** (20, Fig. 3.1) to **LOC**.

6. If the red LED **H5** is illuminated, turn **C31** carefully clockwise by means of a screw driver.

   If the red LED **H3** is illuminated, turn **C31** carefully counter-clockwise, until the **green** LED **H4** lights up. Set C31 to the centre of the green range (see Fig. A1.17).

CAUTION

Do not turn out alignment screws completely! Do not turn them in any further once the slightest resistance is felt!

Alignment of Input Filter

For alignment of the input filter use either an external RF signal generator or the installed Synthesizer GF 201V (see Figs. A.17 and A1.18).

First make preparations as for the synthesizer, steps 1 to 4.

1. For mechanical coarse alignment, tune trimming capacitors C81 to C83 and C91 to C93 to **low** frequency (rotor fully turned in), **medium** frequency (rotor in mid-position) or **high** frequency (rotor approx. 3 mm below upper edge).

2. In the case of an external RF signal generator feed in a test signal of f_{Rx}, 100 mV on the adapter card.

   If the internal synthesizer is used, set a Tx frequency lower by 50 kHz (refer to A1.6). The reason for this is the Rx frequency shift. Connect the synthesizer output without attenuators to the adapter card (see Fig. A1.18 c).

   Using a digital multimeter, measure the voltage at test socket VC on the front panel of the Rx unit (applies to both of the above cases).

3. For pre-alignment, tune to maximum voltage (without attenuators) at V_C by using C81 to C83 and C91 to C93. (In the case of an external signal generator: begin at 0 dB and reduce the signal level correspondingly.)

4. For fine alignment by means of an external signal generator reduce the output signal to 30 µV.

   For fine alignment by means of the internal synthesizer first use one (Fig. A1.18 b) and then two 40-dB attenuators (Fig. A1.18 a). Proceed as detailed in step 3.

5. Switch off Rx unit (set switch **REM / LOC / OFF** to **OFF**) and remove adapter card.

6. Screw protective caps onto the seven trimming capacitors, use clamping screw driver, if necessary.

Install the Rx unit in the reverse order to its removal described above.

A1.6.3 Alignment of AF Level / Noise Blanker / AF-Tx Level for Inband Interface

Alignment of level AF 600 Ω
If required, the AF level of the output AF 600 Ω can be set by means of control element R235 at the bottom of the Rx unit (see Fig. A1.12). For this purpose, the Rx unit is to be plugged onto the adapter card as shown in Fig. A1.18. Turning the control R235 clockwise by means of a screw driver leads to a higher AF level.

Alignment of noise blanker
The degree of noise blanking can be set by means of control element R154 at the bottom of the Rx unit (see Fig. A1.12). For this purpose plug the Rx unit onto the adapter card as shown by Fig. A1.18. Turning the control clockwise by means of a screw driver leads to improved noise blanking.

Alignment of AF-Tx level for inband interface
If required, the AF-Tx level for the optional inband interface can be set by means of control element R455 at the bottom of the Rx unit (see Fig. A1.12). For this purpose, the Rx unit is to be plugged onto an adapter card (see Fig. A1.18). Turning the control clockwise by means of a screw driver leads to a higher AF level which can be measured at X143.

Setting of nominal level: To X13.24/.25 (AF-3/AF-4) apply a level of -6 dBm / 1 kHz (R_i = 600 Ω). Measure level at X143 and with control element R455 set to 50 ±3 mV.

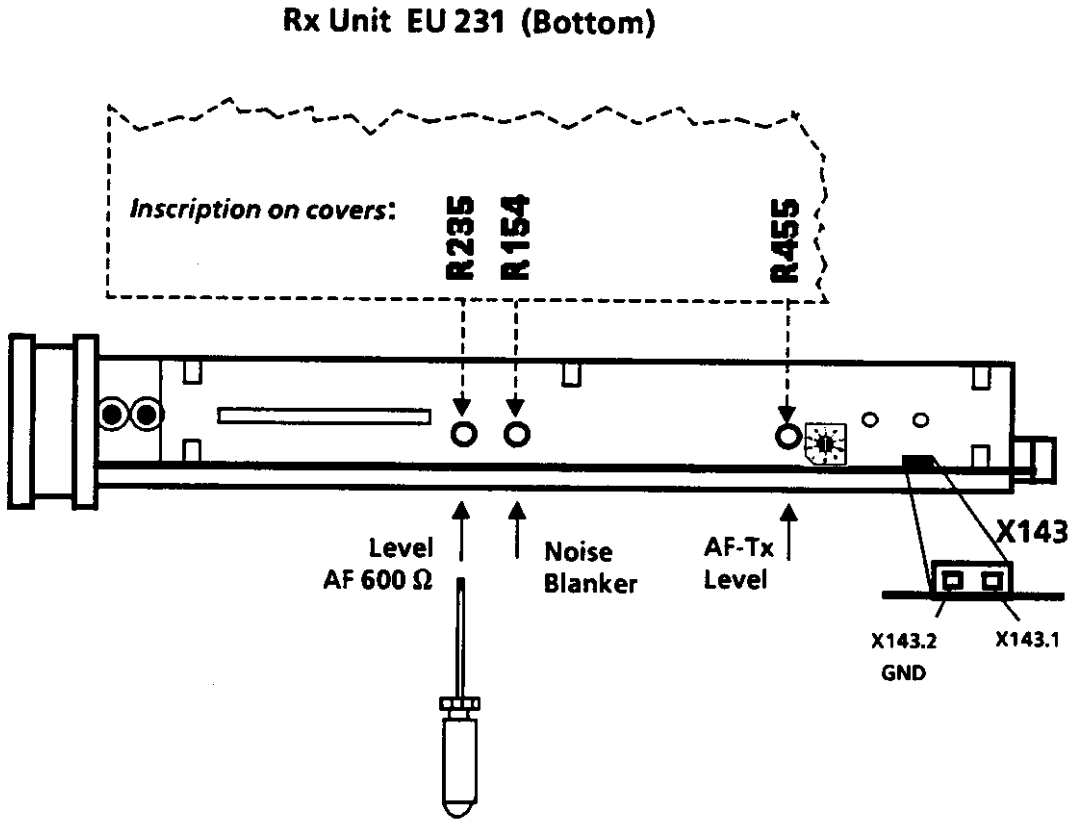


Fig. A1.12 Controls for Setting of AF Levels and Noise Blanking

A1.6.4 Function of Jumpers

This chapter deals with the jumpers by means of which the operating functions can be altered.

Jumpers which are exclusively used for test or service purposes are shown in Fig. A1.19.

(See Fig. A1.13, page 1)

AGC evaluation

X40 Setting ex works:
Jumper on contacts X40.1 and X40.2
AGC bit 01 (1st threshold AGC bit) linked to field strength evaluation

no other setting possible

X42 Setting ex works:
Jumper on contacts X42.2 and X42.3
AGC bit 11 linked to field strength evaluation

no other setting possible

X40 / X42 Setting ex works:
No jumper on contacts

Or:
Jumper on X42.1 and X40.3
Inband without monitoring

X90 Setting ex works:
Jumper on contacts X90.2 and X90.3
AGC line linked to field strength evaluation

Or:
Jumper on X90.1 and X90.2
AGC line linked to AGC-L = AGC-1

X52 Setting ex works:
No jumper on contacts

no other setting possible

X54 Setting ex works - **Without Inband**:
Jumper on contacts X54.1 and X54.2
AF AGC disabled

Setting ex works - **With Inband**:
Jumper on X54.2 and X54.3
AF AGC enabled

Or:
Jumper on X54.2 and X54.3
without Inband (AF AGC enabled)

Carrier squelch

X29 / X30 Setting ex works:
Jumper on contacts X29.1 and X30.1
Carrier squelch enabled

Or:
Jumper on X29.2 and X30.2
Carrier squelch disabled

SQ / phantom circuit

X47 Setting ex works:
No jumper on X47
Squelch phantom circuit disabled

Or:
Jumper on X47.2 and X47.3
Phantom circuit enabled, squelch relay on line AF-Rx-M

Squelch relay

X49 Setting ex works:
No jumper on X49

Squelch relay contacts off DC potential

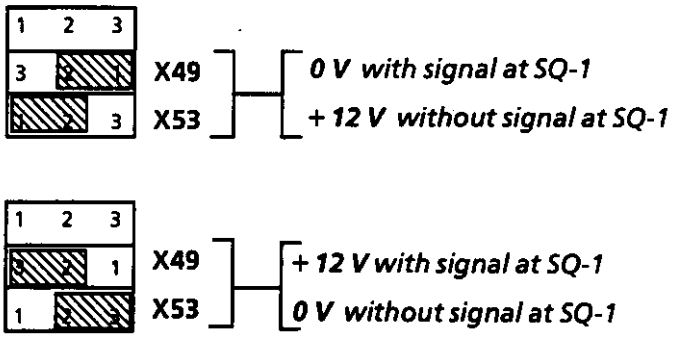
Or:
Jumper on X49.2 and X49.3
+12 V at output SQ-2

Jumper on X49.1 and X49.2
Ground at output SQ-2

X53 Setting ex works:
No jumper on X53
Squelch relay contacts off DC potential

Or:
Jumper on X53.1 and X53.2
+12 V at output SQ-3
Jumper on X53.2 and X53.3
Ground at output SQ-3

Alternative setting of X49 / X53:



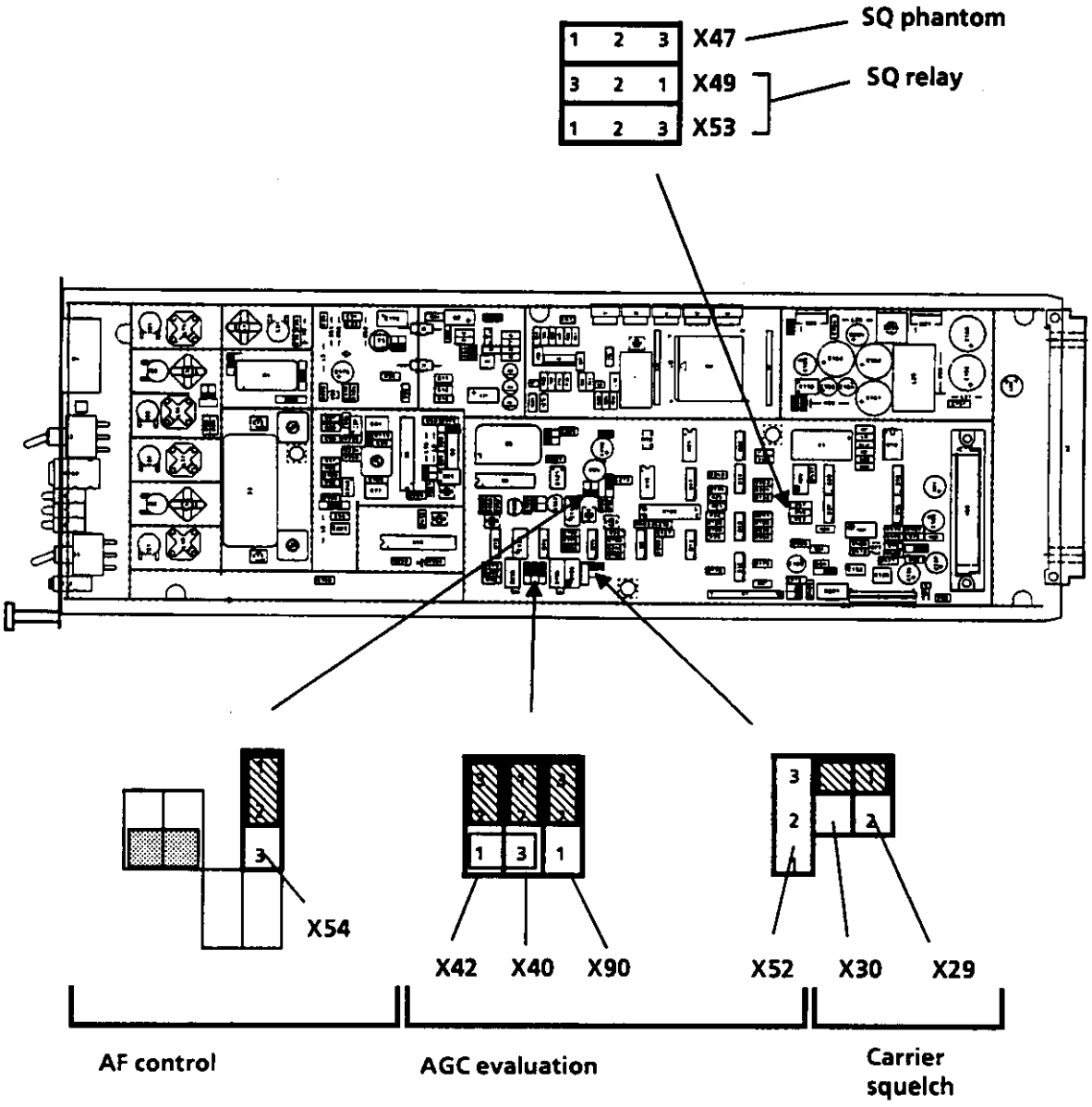


Fig. A1.13 Jumpers in VHF Rx Unit EU 231 (page 1 of 2)

(See Fig. A1.13, page 2)

PTT functions

X44 / X46 Setting ex works:
Jumper on contacts X44.2 and X46.2
Squelch enabled for PTT

Or:
Jumper on X44.1 and X46.1
Squelch and AF inhibit for PTT

X56 Setting ex works:
Jumper on contacts X56.2 and X56.3
for PTT loudspeaker and AF 8 Ω inhibited, AF 600 Ω not inhibited

Or:
Jumper on X56.1 and X56.2
for PTT loudspeaker, AF 8 Ω, AF 600 Ω monitor and AF Rx inhibited

Or:
No jumper on X56
for PTT loudspeaker, AF 8 Ω, AF 600 Ω and AF Rx not inhibited

Monitoring

X64 Setting ex works:
No jumper on X64
Monitoring possible via Rx

No other setting possible

X133 Setting ex works:
Jumper on X133.1 and X133.2
for PTT 50-dB attenuation for Rx cut in

Or:
No jumper on X133
for simplex relay operation with separate Rx / Tx operation:
Monitoring via Rx disabled 1)

Noise blanking

X32 / X33 Setting ex works:
No jumper on X32 / X33
Noise blanking disabled

Or:
Jumper on X32.1 and X33.1
Noise blanking enabled

Parallel interface / inband interface / REM BUS

X60 / X63 Setting ex works:
Jumper on contacts X60.2 and X63.1
without option inband interface

Or:
Jumper on X60.1 and X63.2
with option inband interface

Stand-alone / switchover operation (600 Ω / 1200 Ω)

X100 Setting ex works:
Jumper on contacts X100.1 and .2
Rx stand-alone operation

Or:
Jumper removed: switchover operation

Main / standby switchover

X134 Setting ex works:
Jumper on contacts X134.1 and .2
Tx-NoGo also switches over Rx

Or:
Jumper on contacts X134.3 and .2
Rx-NoGo switches over Rx - independently of Tx-NoGo

1) *In the Rx and Tx sections of the transceiver matching jumper combinations must be selected.*

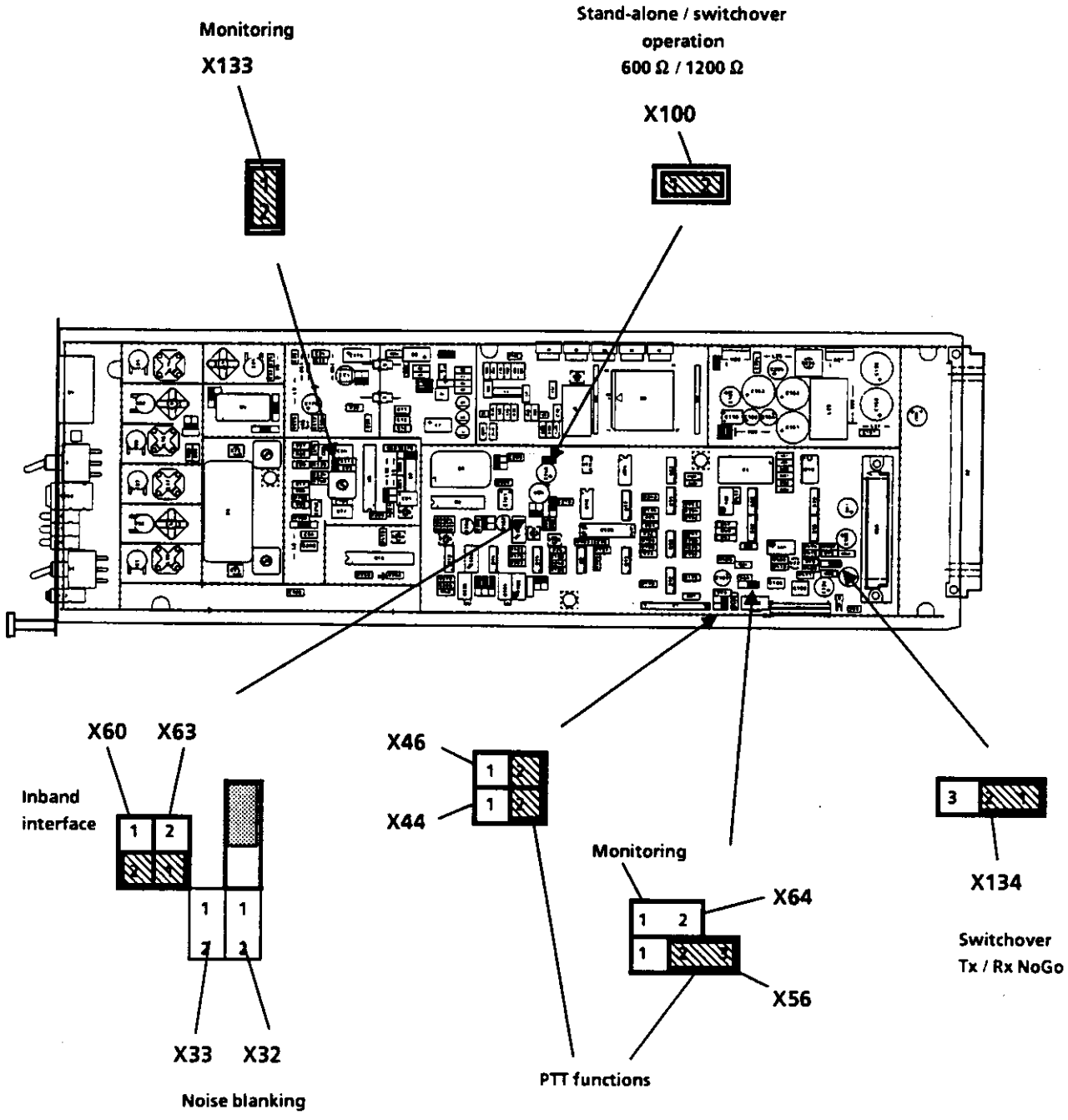


Fig. A1.13 Jumpers in Rx Unit EU 231 (page 2 of 2)

A1.6.5 Setting the Slot Address

Note:

The Rx units EU 231 used in receivers and transceivers are the same and can be exchanged one for the other. This is why here the setting information is given nevertheless for the sake of completeness.

If in an Adapter KR 231A8 up to seven Receivers EU 231A / EU 231D are operated with one VHF/ UHF Multicoupler VT 231, the slot address for the Rx REM BUS will have to be set.

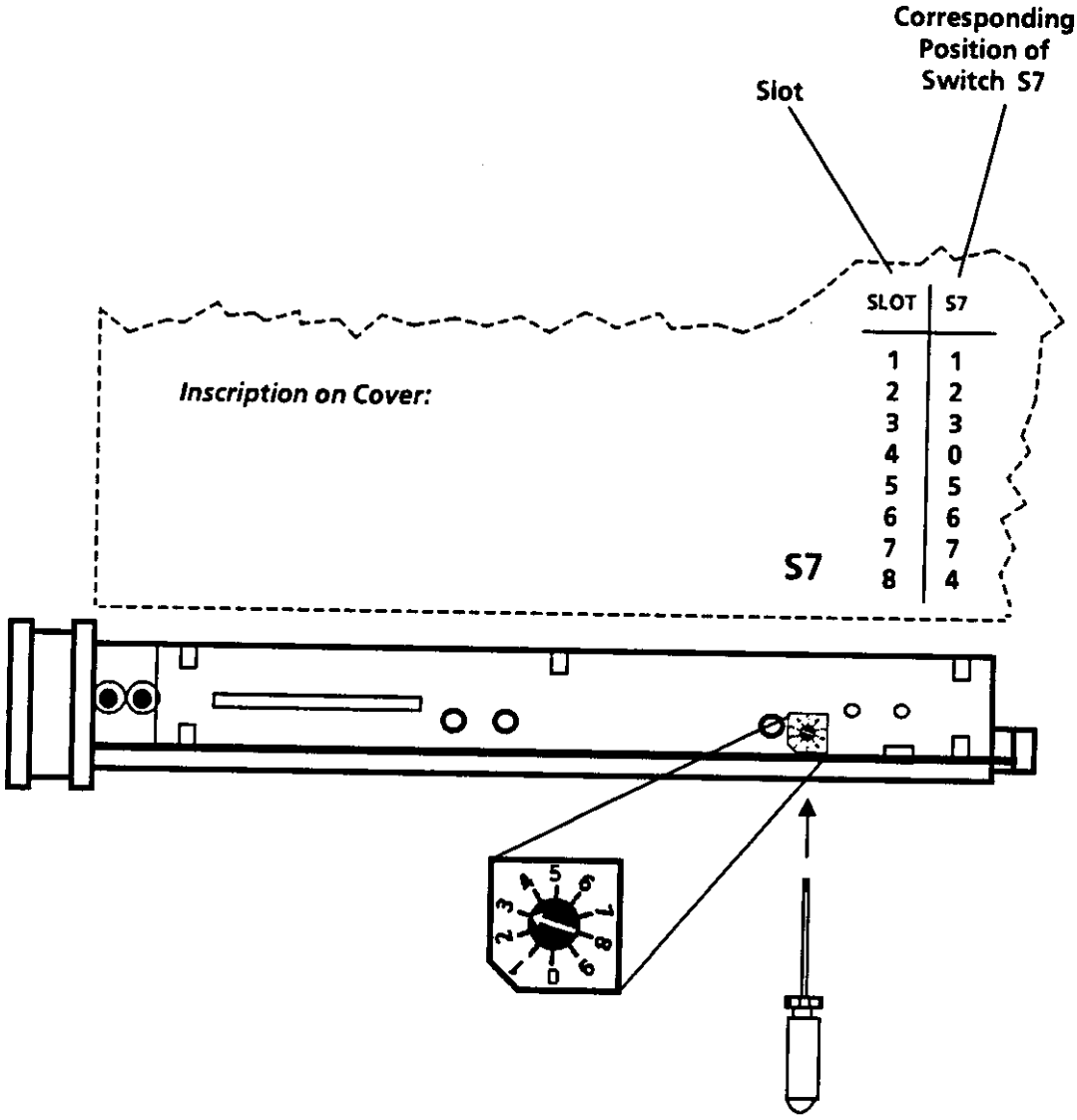
For more details concerning the Rx REM BUS system see chapter 3.4 of this User Manual.

At the bottom of the Rx unit the coding switch S7 is located (see Fig. A1.14).

On the cover of the Rx Unit EU 231 the table SLOT / S7 is provided. Set coding switch S7 in accordance with this table.

For use in transceivers the address of S7 has to be set to 3.

Rx Unit EU 231 (Bottom)



For use of Rx Unit EU 231 in transceivers set switch S7 to "3" !

Fig. A1.14 Setting the Slot Address

A1.7 Settings on Inband Interface GM 211 (Option)

(See Fig. A1.15)

This chapter deals with the jumpers by means of which the operating functions can be altered.

For this purpose remove the Inband Interface GM 211 as described in section 4.3.

The Inband Software GM 211S implemented in the inband interface is available in various versions. The table below gives a survey of these versions.

The setting of jumpers varies depending on the software version. Jumpers X2, X11 and X12 are identical for all software versions.

X2 BOOT_SCI Setting ex works:

Jumper on X2.1 and .2
DSP software is loaded from EPROM.

or:
No jumper on X2
DSP software is loaded via serial interface, for servicing only.

X11 Setting ex works:

Jumper on X11.1 and .2
Output of DC/DC converter (+24 V / +5 V) is connected with operating voltage input of Inband Interface GM 211.

or:
No jumper on X11:
for servicing only

X12 ONCE

for servicing only (ONCE = On Chip Emulator)

Software Version 22:

X5 OPT Setting ex works:

No jumper on X5
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X5
(optional supplementary function ON, to be defined via software)

X6 OPT Setting ex works:

No jumper on X6
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X6
(optional supplementary function ON, to be defined via software)

Function	Vers. 22	Vers. 23	Vers. 25	Vers. 26	Vers. 27
Full functionality	x				
PTT 2 040 Hz		x	x	x	
Squelch 2 040 Hz		x			
Line equalizer				x	
Tx muting					x
AGC 30 dB	x	x	x	x	x

Versions of Inband Software GM 211S

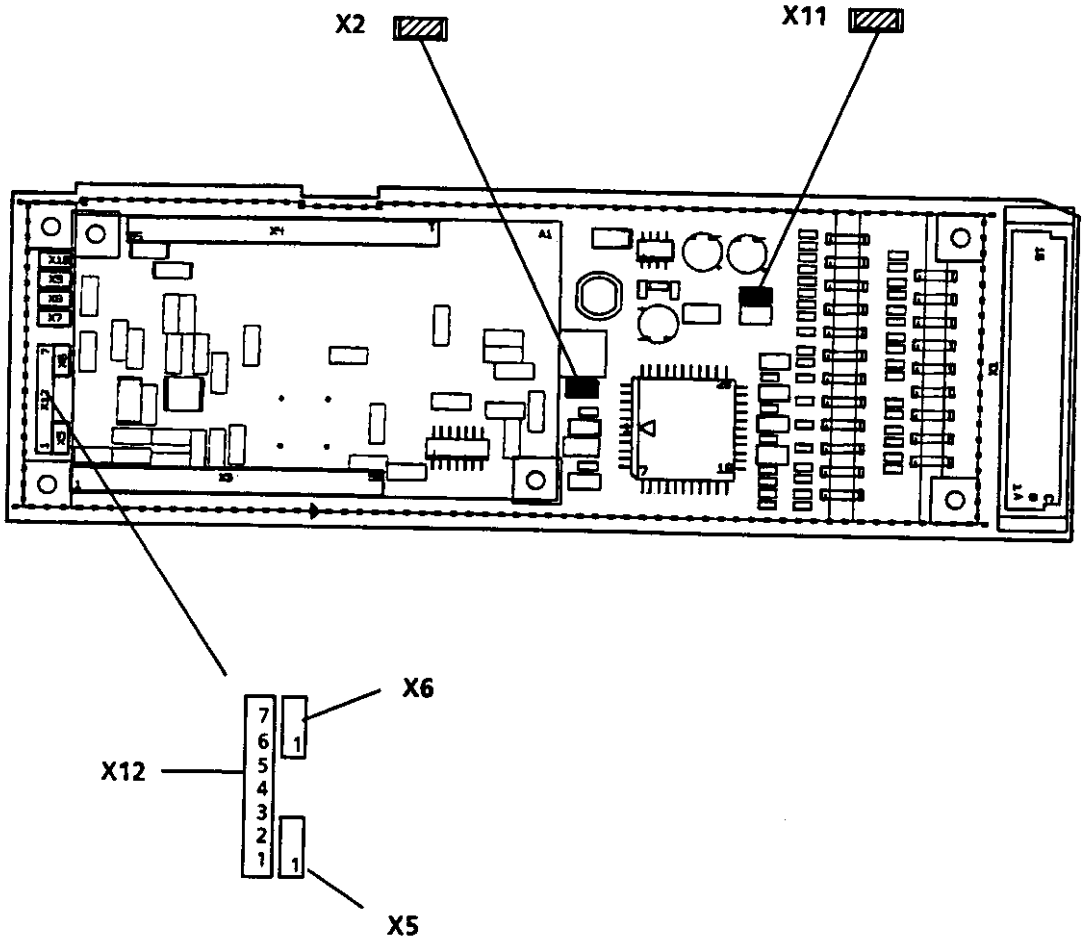


Fig. A1.15 Jumpers in Inband Interface GM 211 (page 1 of 4)

(Software version 22, continued)

X7 OPT Setting ex works:

No jumper on X7
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X7
(optional supplementary function ON, to be defined via software)

X8 OPT Setting ex works:

No jumper on X8
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X8
(optional supplementary function ON, to be defined via software)

X9 RAD/OP (Radio / Operator)

Setting ex works:

No jumper on X9
Inband interface is installed on radio side (Tx / Rx).

or:
Jumper on X9:
Inband interface is installed on operator side.

X10 A/*B Setting ex works:

No jumper on X10 (A /* B = high)
Inband interface is installed in **device A**.

or:
Jumper on X10 (A /* B = low):
Inband interface is installed in **device B**.

Software Versions 23 and 25:

X5 OPT Setting ex works:

No jumper on X5
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X5
(optional supplementary function ON, to be defined via software)

X6 OPT Setting ex works:

No jumper on X6
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X6
(optional supplementary function ON, to be defined via software)

X7 OPT Setting ex works:

No jumper on X7
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X7
(optional supplementary function ON, to be defined via software)

X8 OPT Setting ex works:

No jumper on X8
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X8
(optional supplementary function ON, to be defined via software)

X9 OPT Setting ex works:

No jumper on X59
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X9
(optional supplementary function ON, to be defined via software)

X10 OPT Setting ex works:

No jumper on X10
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X10
(optional supplementary function ON, to be defined via software)

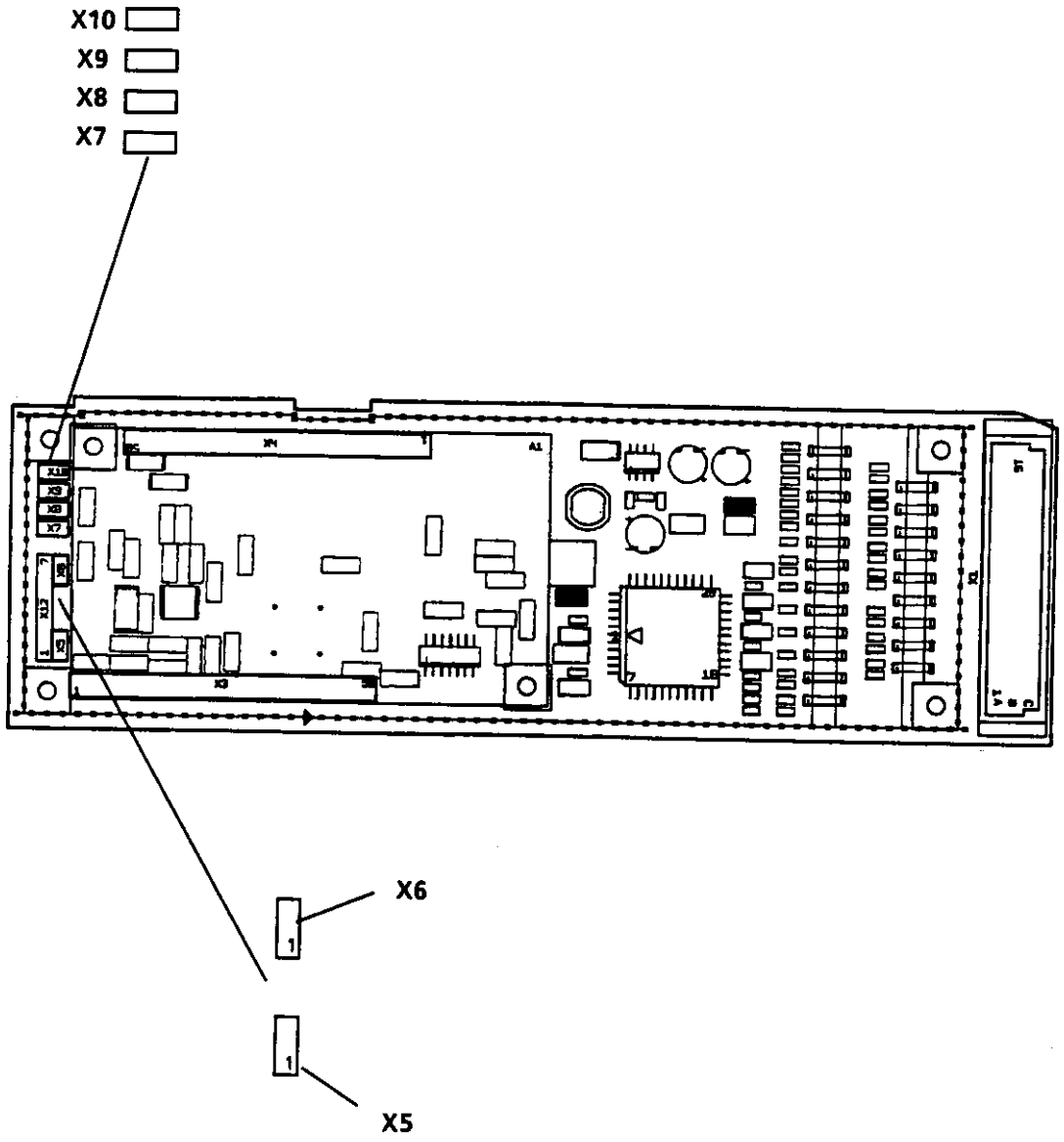


Fig. A1.15 Jumpers in Inband Interface GM 211 (page 2 of 4)

Software Version 26:

X5 OPT Setting ex works:

No jumper on X5
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X5
(optional supplementary function ON, to be defined via software)

X6 OPT Setting ex works:

No jumper on X6
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X6
(optional supplementary function ON, to be defined via software)

X7, X8 Trigger response threshold for PTT control with 2 040-Hz tone

Setting ex works:

No jumpers on X7, X8
(PTT control via 2 040-Hz tone, level -24 dB)

or:

X7	X8	Rel. level of 2 040-Hz tone ref. to wanted signal of 60 mV_{rms}
o	o	-24 dB
o	x	-18 dB
x	o	-12 dB
x	x	-6 dB

X = jumper in place, o = no jumper

X9, X10 Setting of line equalizer

Setting ex works:

No jumpers on X9, X10
(line equalizer, 0 dB)

or:

X9	X10	Frequency response attenuation at 800 Hz ref. to 3 400 Hz
o	o	0 dB
o	x	5 dB
x	o	10 dB
x	x	15 dB

X = jumper in place, o = no jumper

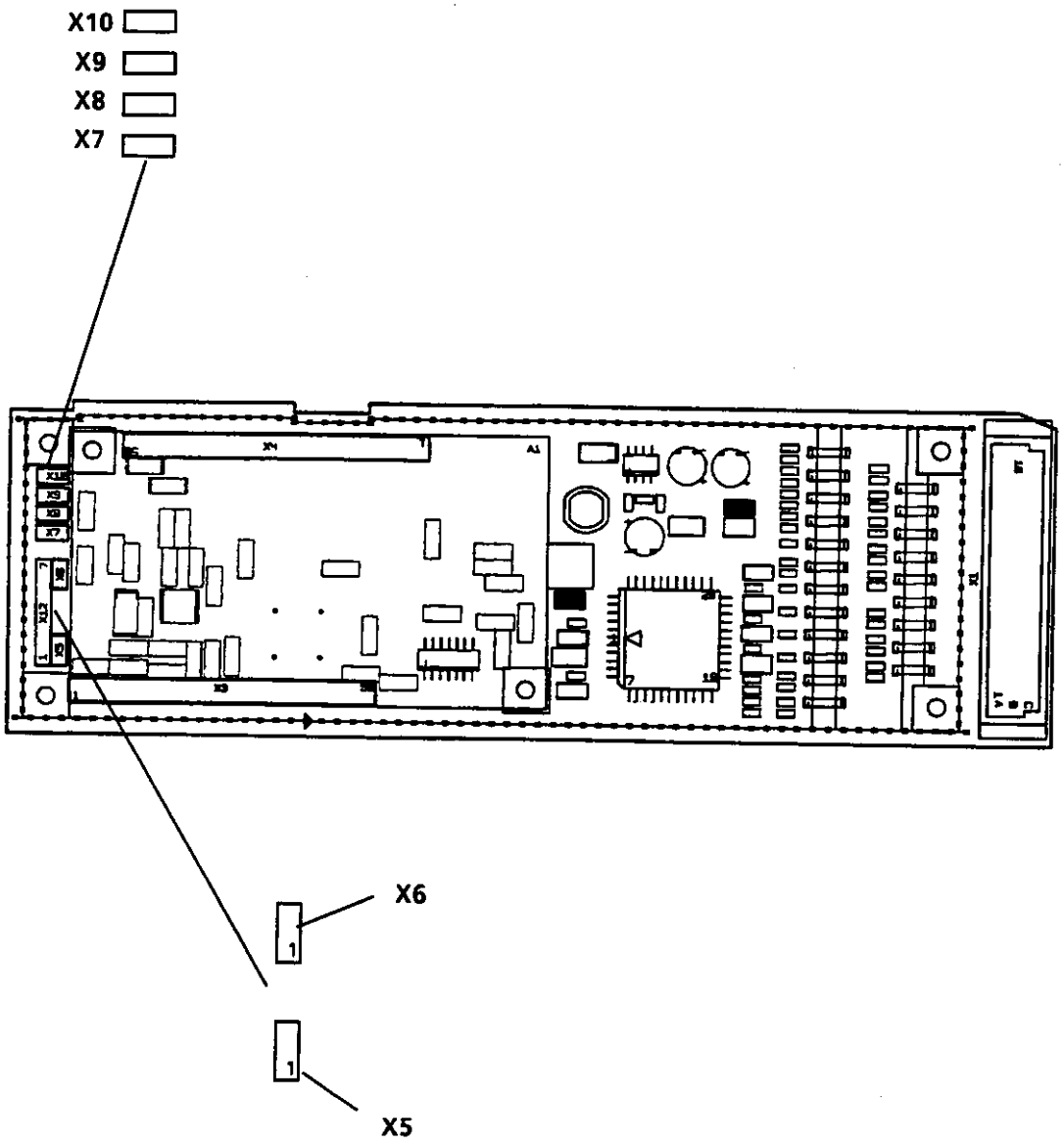


Fig. A1.15 Jumpers in Inband Interface GM 211 (page 3 of 4)

Software Version 27:

X5, X7, X8 Setting of delay for disconnection of AF output signal

Setting ex works:

No jumpers on X5, X7, X8
(AF disconnection disabled)

or:

X5	X7	X8	Delay
x	x	x	no AF disconnection
x	x	o	0.5 s
o	x	x	1.0 s
o	x	o	1.5 s
x	o	x	2.0 s
x	o	o	2.5 s
o	o	x	3.0 s
o	o	o	no AF disconnection

X = jumper in place, o = no jumper

X6 OPT Setting ex works:

No jumper on X6
(optional supplementary function OFF, to be defined via software)

or:
Jumper on X6
(optional supplementary function ON, to be defined via software)

X9 **No jumper allowed on X9!**

X10 Activation of AGC for AF signal

Setting ex works:

Jumper on X10
(AGC enabled)

or:

No jumper on X10
(AGC disabled)

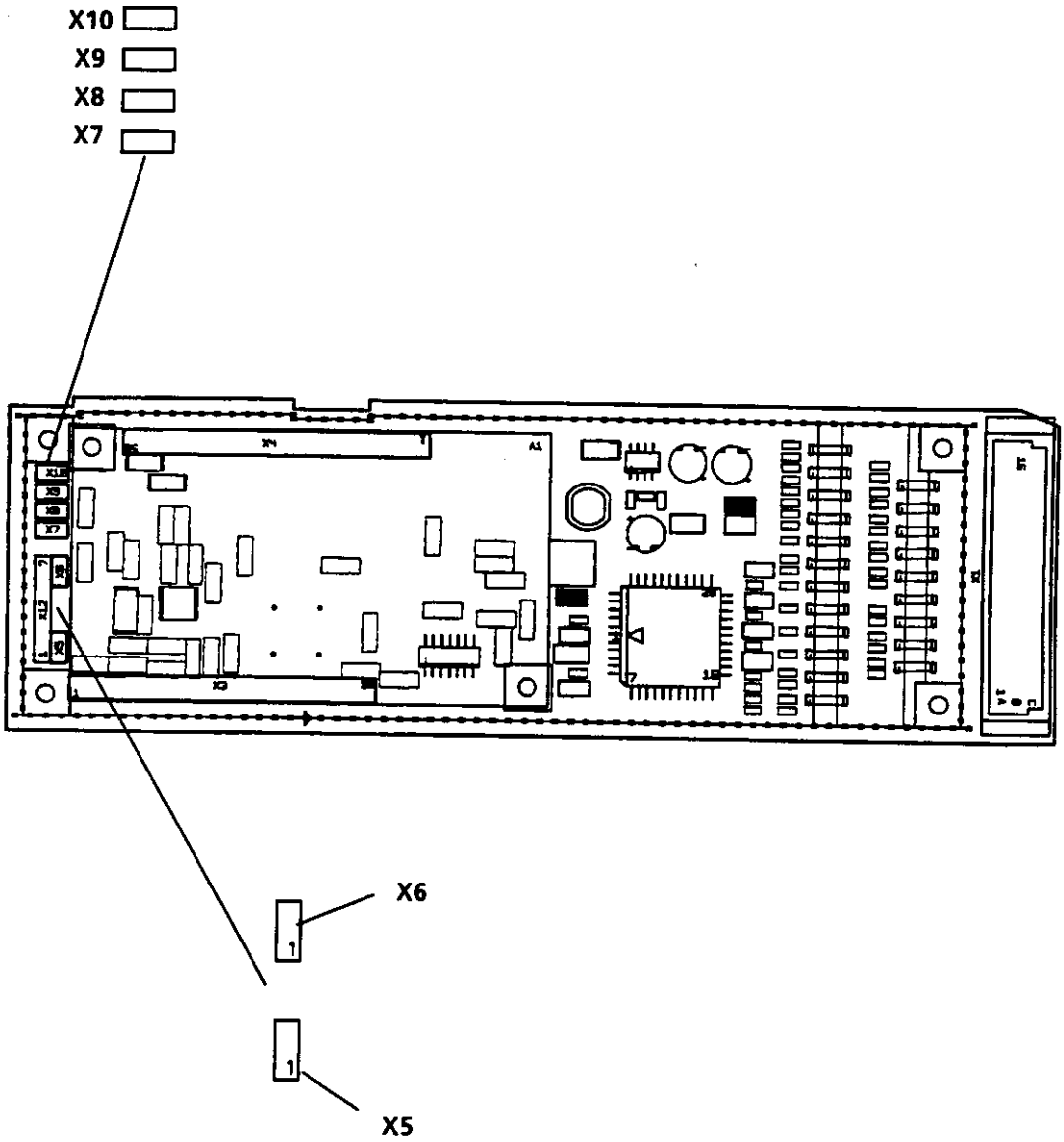


Fig. A1.15 Jumpers in Inband Interface GM 211 (page 4 of 4)

A1.8 Settings on Modulator Extension GM 201C8

(See Fig. A1.16)

This chapter deals with the elements by means of which the operating functions can be altered.

For this purpose remove the complete modulator extension together with the mounting plate acc. to 4.3.4.

Remove the top screening plate after undoing three Phillips screws.

X30 Setting ex works:

Coding switch S30 in position 6
for 8.33-kHz frequency spacing
(i.e. cutoff frequency of 2.55 kHz and clock frequency of 255.672 kHz)

At test connector X30 the clock frequency can be measured.

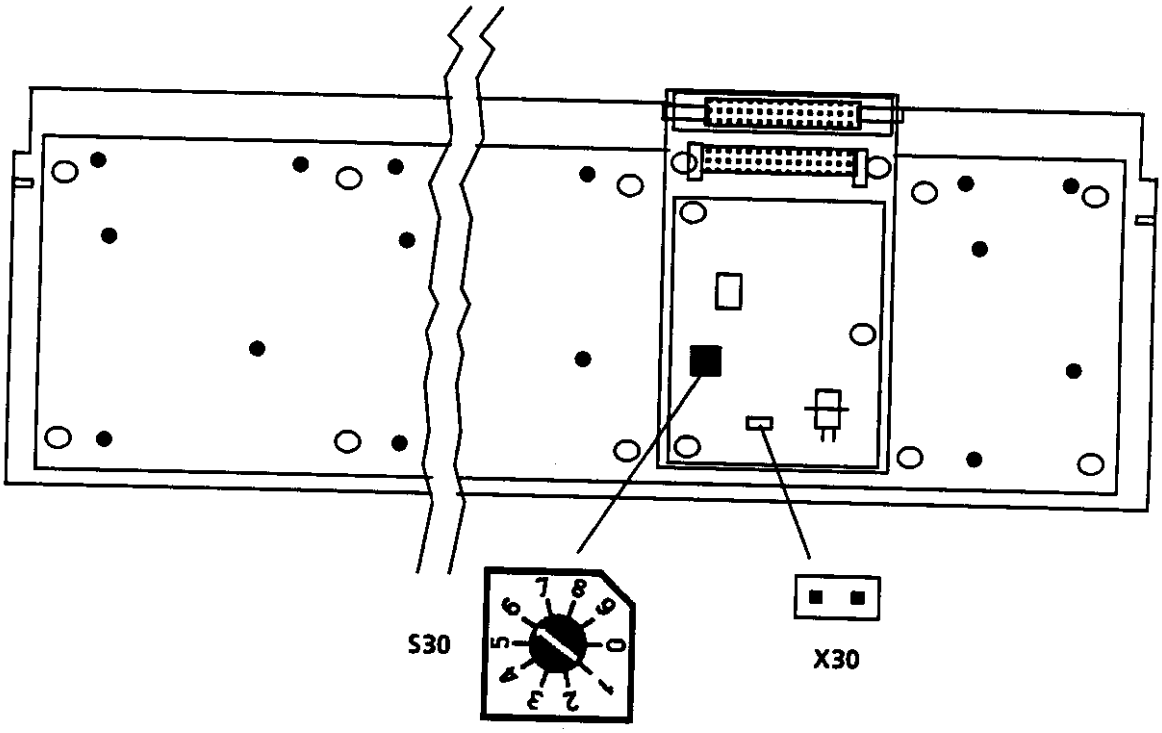


Fig. A1.16 Coding Switch on Modulator Extension GM 201C8

A1.9 Jumper Settings Ex Works

Module	Meaning	Jumper	Position	Remarks
Modulator GM 201	GM 201C8	X10	1 - 2, 3 - 5, 10 - 12	Filter in GM 201C8 is switched on.
	ALC	X110	2 - 3	ALC is enabled.
	RF level reduction	X250	removed	Reduction is effective.
	VHF/UHF	X322	1 - 2	System operates in VHF range.
	Phase-locked loop	X323	2 - 3	Phase-locked loop is enabled.
	Switch-off by receiver in case of failure	X411	1 - 2	Switch-off in case of failure
	PTT time limiting	X532	1 - 2	PTT time limiting is disabled.
	Monitoring	X715	2 - 3	Monitoring is via directional coupler.
	User-defined bit	X841	1 - 2	Input or output
	VSWR message	X971	1 - 2	VSWR message does not block transmit operation.
	Carrier message	X972	1 - 2	Carrier message does not block transmit operation.
	REM BUS address MSB	X812	removed	MSB = 56
	REM BUS address LSB	X813	1 - 2	LSB = 0
	REM BUS address LSB	X814	removed	LSB = 0
Modulator Extension GM 201C8	Filter setting (coding switch)	S1	6	Filter is set for 8.33-kHz channel spacing.

Module	Meaning	Jumper	Position	Remarks
Interface GI 201X	AF signal path	X110	1 - 3, 2 - 4, 5 - 7, 6 - 8	AF signal path from X9 via transformer T110 and variable resistor R110 to modulator (without inband interface)
	PTT connection	X120	1 - 3, 7 - 8	*-PTT OPTO/VOP:* If X9.16 is connected to GND, current flows via the optocoupler and initiates PTT.
	Monitoring	X130	1 - 2, 5 - 6	Monitoring tone from receiver via transformer T130 to X9.5 - X9.6 (without inband interface).
	Phantom Carrier Disable	X140	1 - 2	Phantom Carrier Disable (no DC voltage at AF/RX (X9.5 - X9.6)
	Climax	X150	1 - 2	No climax (transmit frequency offset disabled)
Inband Interface GM 211	SW version 22:	X5 to X8 X9 X10	removed removed removed	additional optional function OFF GM 211 on radio side GM 211 installed in device A
	SW versions 23 and 25:	X5 to X10	removed	additional optional function OFF
	SW version 26:	X5, X6 X7, X8 X9, X10	removed removed removed	additional optional function OFF PTT control via 2 040-Hz tone Line equalizer, 0 dB
	SW version 27:	X6 X5, X7, X8 X10	removed removed attached	additional optional function OFF AF disconnection disabled AGC enabled
	all SW versions:	X2 X11	1 - 2 1 - 2	DSP software loaded from EPROM Output of DC/DC converter connected with operating voltage input of GM 211

Module	Meaning	Jumper	Position	Remarks
Rx Unit EU 231	Carrier squelch	X29/X30	X29.1-X30.1	Carrier squelch enabled
	Noise blanking	X32/X33	removed	Noise blanking disabled
	AGC bit 01	X40	1 - 2	AGC bit 01 linked with field strength evaluation
	AGC bit 11	X42	2 - 3	AGC bit 11 linked with field strength evaluation
	PTT squelch	X44/X46	X44.2 - X46.2	Squelch for PTT operation
	SQ phantom circuit	X47	removed	SQ phantom circuit disabled
	Squelch relay	X49	removed	Squelch relay contacts off DC potential
	AGC-1 evaluation	X52	1 - 2	AGC bit 01 linked with squelch
	Squelch relay	X53	removed	Squelch relay contacts off DC potential
	AGC control	X54	1 - 2	AGC control disabled
	PTT AF inhibit	X56	2 - 3	For PTT loudspeaker and AF-8-Ω inhibited, AF-600-Ω not inhibited.
	Inband interface	X60/ X63	X60.2 - X63.1	Option inband interface not installed
	Monitoring via Rx	X64	removed	Monitoring via Rx enabled
	AGC LINE	X90	2 - 3	AGC line linked with field strength evaluation
	Stand-alone/ switchover operation	X100	1 - 2	Rx stand-alone operation
	Monitoring/ attenuation	X133	1 - 2	For PTT 50 dB attenuation for Rx
	Main / standby operation	X134	1 - 2	Tx-NoGo switches over Rx.

FCC ID: KVW60431942

List of Contents

Appendix 2
External Interfaces

FCC ID: KVW60431942

A2. External Interfaces

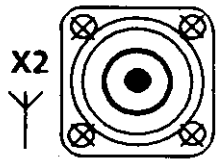
(See Fig. 2.1)

A2.1 Additional RF Input X1 (depending on order)

Connector	Contact	Designation, function, direction, level
BNC recessed socket FJ 080.2270 X1  Mating connector: BNC cable plug 602.4144		For the optional external synthesizer. For this disconnect the internal RF cable for X94 and re-connect to X1!
	1	SYNTH RF input I 118 to 144 MHz 50 Ω 13 dBm
	2	Ground

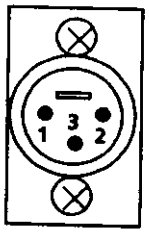
B = bidirectional, I = input, O = output

A2.2 VHF Antenna Connection X2

Connector	Contact	Designation, function, direction, level
N-type recessed socket FJ 503.4830 X2  Mating connector: N-type cable plug 018.4466		
	1	ANT RF output O 118 to 144 MHz 50 Ω 50 W
	2	Ground

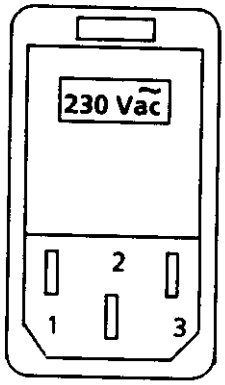
B = bidirectional, I = input, O = output

A2.3 24-V Battery Connection X3

Connector	Contact	Designation, function, direction, level			
 Mating connector: Cable socket (Neutrik), 3-way 591.1997	1	+ 24 V DC	DC input	I	22 to 31 VDC < 14 A
	2	GND 24 V	0 VDC	GND	
	3	Not used			

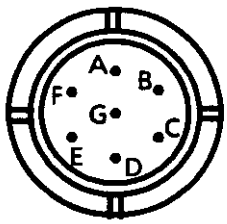
B = bidirectional, I = input, O = output

A2.4 Mains Connection X4 (only with Option IN 251A)

Connector	Contact	Designation, function, direction, level			
 X4 47...63 Hz 500 VA Mating connector: Rubber Euro connector on mains cable 025.2365		Mains connection: 100 / 120 / 220 / 230 VAC 47 to 63 Hz 300 VA (typ.). The set mains voltage is indicated in the window. For settings refer to Appendix A1.			
	1	L1	mains input / neutral	I	90 to132 VAC / 194 to 264 VAC
	2	PE	protective earth	B	
	3	N	neutral / mains input	I	

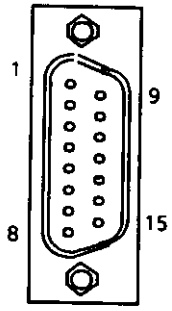
B = bidirectional, I = input, O = output

A2.5 Headphone Connection X5 (on Front Panel)

Connector X5	Contact	Designation, function, direction, level			
7-way recessed plug R&S 0586.7855  (shown enlarged) Mating connector: 7-way R&S 0586.8239 and R&S 0586.8245	A	HEAD-A	headphones	O	0 to 1 V_{rms}
	B	HEAD-B	headphones GND	O	0 to 1 V_{rms}
	C	DMIC-A	dyn. microphone	I	0 to 25 mV_{rms}
	D	DMIC-B	dyn. microphone GND	I	
	E	VMIC-A	ampl. microphone	I	0 to 1 V_{rms}
	F	* PTT-MIC	microphone PTT	I	low = Tx on pull-up 10 kΩ / 10 V
	G	VMIC-B	ampl. microphone GND	I	

B = bidirectional, I = input, O = output, * = low-active, HCMOS level: 0 to + 5.5 V

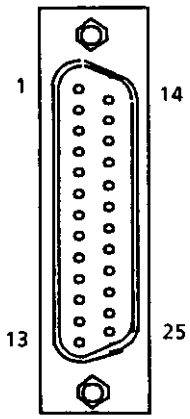
A2.6 VHF Power Amplifier Connection X6
(only with Optional Interface 2 GI 201)

Connector	Contact	Designation, function, direction, level			
Female connector strip, 15-way 447.0452	1	GND	ground		
	2	Not used			
	3	* PTT- AMP	PTT for power amplifier	O	low = PTT
	4	TEST - AMP	sum error power amp.	I	low = no error HCMOS
 **X6 POWER AMP**	5	* VSWR - AMP	VSWR power amp.	I	low = VSWR HCMOS
	6	* CAR - AMP	carrier message power amp.	I	low = carrier HCMOS
	7	ENABLE	power amp. ready	I	high = ready HCMOS
	8	AGC - EXT	AGC via power amp.	I	high = external control loop
	9	Not used			
	10	AMP - RED	reduction via power amp.	I	analog - 10 to + 10 V
	11	Not used			
	12	GND	ground		
	13	AGC +	control voltage positive	I	0 to + 5 V
Mating connector: 15-way Min D plug 273.4037 and 586.9564	14	AGC-	control voltage negative	I	
	15	GND	ground		

B = bidirectional, I = input, O = output, * = low-active, HCMOS level: 0 to + 5.5 V

A2.7 Main / Standby Connection X7 (only with Optional Interface 2 GI 201)

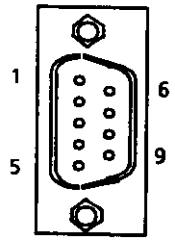
Connector	Contact	Designation, function, direction, level			
Female connector strip, 25-way 243.0962	1	CBIT-TX-1	sum error Tx message	O	high = no error
	2	CBIT-RM-1	error inband message	O	high = no error
	3	TEMP-1	overtemp.	O	high = overtemp.
	4	* OFF-TX-1	transmitter switched off	O	low = off
	5	CARRIER-1	carrier message	O	high = carrier act.
	6	VSWR-1	VSWR message	O	high = VSWR
	7	GND	ground		
	8	VSWR-2	VSWR input (inband interface)	I	high = VSWR only to inband i.
	9	CARRIER-2	carrier input (inband interface)	I	high = carrier act. only to inband i.
	10	*OFF-TX-2	Tx off (inband interface)	I	low = off only to inband i.
	11	TEMP-2	overtemp. (inband interface)	I	high = overtemp. only to inband i.
	12	CBIT-RM-2	error inband interface input	I	high = no error only to inband i.
	13	CBIT-TX-2	sum error transmitter input	I	high = no error only to inband i.
	14	Not used			
	15	Not used			
	16	Not used			
	17	Not used			
	18	Not used			
	19	* REMOTE-1	remote control message	O	low = remote control
	20	* REMOTE-2	remote control input	I	low = remote only to inband i.
Mating connector: 25-way Min D plug 063.4861 and 627.1826	21	Not used			
	22	Not used			
	23	Not used			
	24	Not used			
	25	Not used			



X7
MAIN
STANDBY

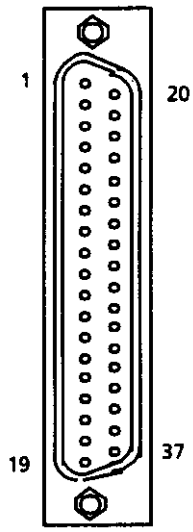
B = bidirectional, I = input, O = output, * = low-active, logic level: 0 to + 5.5 V

A2.8 REM BUS Connection X8

Connector	Contact	Designation, function, direction, level			
Female connector strip 9-way 680.9634  **X8 REM BUS** Mating connector for single connection: 434.9362 and 586.9870	1	Not used			
	2	Not used			
	3	SCL	clock input REM BUS	I	HCMOS
	4	SDA0	data input REM BUS	I	HCMOS
	5	SDAI	data output REM BUS	O	open collector
	6	GND	ground		
	7	+ 24 VDC	supply for REM BUS		17 to 31 VDC
	8	Not used			
	9	GND	ground		

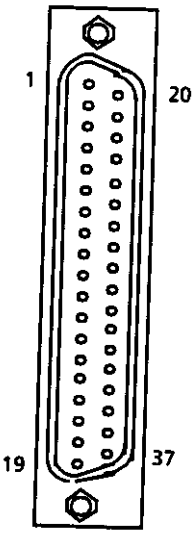
B = bidirectional, I = input, O = output, HCMOS level: 0 to + 5.5 V

A2.9 REMOTE Connection X9

Connector	Contact	Designation, function, direction, level			
Female connector strip, 37-way 436.1723 X9 REMOTE  Mating connector: 37-way Min D plug 436.1717 and 586.9570	1	GND	ground		
	2	AF / TX / A	AF input balanced	I	-15 to + 6 dBm
	3	AF / TX / B	AF input balanced	I	-15 to +6 dBm
	4	GND	ground		
	5	AF / RX / A	AF output balanced	O	- 6 dBm
	6	AF / RX / B	AF output balanced	O	- 6 dBm
	7	GND	ground		
	8	TEST-TX	sum test Tx	O	low = no error open collector
	9	TEST-TTL	sum test Tx	O	high = no error TTL compatible
	10	TEST-RM	test signal inband	O	low = no error open collector
	11	*OFF-1	switch off Tx	I	low = off open collector
	12	CARRIER	carrier message	O	low = carrier open collector
	13	VSWR	VSWR message	O	low = VSWR open collector
	14	NOPTT	PTT inhibit	I	high = PTT inhibit open collector
	15	U-DEF-1	User-defined input	I	0 to 5.5 V
	16	- PTT	PTT input	I	acc. to jumper setting
	17	+ PTT	PTT input	I	acc. to jumper setting

B = bidirectional, I = input, O = output, * = low-active, HCMOS level: 0 to +5.5 V

Connector	Contact	Designation, function, direction, level			
Female connector strip 37-way 436.1723 cont.	18	*PTT-2	PTT universal	B	open coll.
	19	VOPSW	switched voltage	O	22 to 31 VDC
	20	GND	ground		
X9 REMOTE	21	SQ-1	Squelch Relay C **	B	0 V/+12 V/open
	22	SQ-2	Squelch Relay NO **	B	0 V/+12 V/open
	23	SQ-3	Squelch Relay NC **	B	0 V/+12 V/open
	24	*SQ-ON	Squelch on	I	HCMOS, only with remote
	25	CLIMAX	Tx detection bit	O	open / GND
	26	SQ-LINE	Squelch answer	O	open coll.
	27	SQ / TTL	Squelch answer	O	TTL
	28	GND	ground		
	29	AF-8-OHM	Loudspeaker output	O	adjustable in Rx Unit
	30	AF-8-GND	ground	O	
	31	U-DEF-2	User-defined output	O	open coll.
	32	AF RELAY	high level input	I	0 to 3 V_{rms}
	33	*OFF-2	Rx Unit 1 manual	I	HCMOS
	34	AGC-LINE	Control Voltage	O	0 to 5 V, 5 mA
Mating connector: 37-way Min D plug 436.1717 and 586.9570	35	*PHIGH	cut-in power ampl.	I	open coll.
	36	*PLOW	low power	I	open coll.
	37	*BLW	external blower	O	open drain



B = bidirectional, I = input, O = output, * = low-active, HCMOS level: 0 to +5.5 V, TTL= Transistor-Transistor logic, ** according to jumper setting - see chapter A1.6

5. Description of Function

5.1 General

(See Circuit Diagram 6043.2449.01S and Fig. 5.1)

The VHF Rx Unit EU 231 operates in the frequency range of 118.000 to 143.975 MHz and is made up of the following functional groups:

- RF section,
- Synthesizer,
- IF section,
- AF section,
- Control and monitoring circuits,
- Voltage processing circuit.

5.2 RF Section

(See Circuit Diagram 6043.2449.01S, Sheet 4)

In the RF section the RF input signal is preselected, regulated and amplified, and, finally, converted into the first IF of 10.7 MHz.

From the antenna socket (ANTENNA) the RF input signal is routed via coaxial cable W1 to a tap of coil L19. The latter together with coils L17 and L18 as well as trimming capacitors C91 to C93 forms a three-section filter.

The transmission loss (RF regulation) is adjusted by means of PIN diodes V64 and V16.

The transmission loss is controlled by a DC voltage which is fed to the PIN diodes via decoupling chokes L31 and L12.

The passband curve of the filter is set by means of trimming capacitors C91 to C93 in accordance with the receive frequency. For the purpose of impedance matching, coupling and coupling-out of the RF signals take place via coil taps.

From the tap of coil L17 the signal is routed via capacitor C74 to the base of low-noise transistor V15. The base bias is generated by voltage divider R92, R90 and routed via decoupling choke L11.

The DC current feedback by resistors R91 and R320 in the emitter branch of the transistor is compensated for the RF signal by means of capacitor C86. The collector voltage is routed to the transistor via RF choke L13.

Via capacitor C75, the Pi element (R87 to R89) and a jumper placed on the appropriate contacts of X15 the amplified signal is fed to a second three-section filter, consisting of L14, L15 and C81 to C83.

The passband curve of the filter is set by means of trimming capacitors C81 to C83 in accordance with the receive frequency. For the purpose of impedance matching, coupling and coupling-out of the RF signals take place via coil taps.

The output signal of the filter is routed via a jumper on the appropriate contacts of X16 to mixer input U4.1. Signal OSC1 is applied to the second input of the mixer.

The latter, the buffered VCO output signal of the synthesizer, is 10.7 MHz below the receive frequency. The difference frequency of 10.7 MHz is available at the mixer output. The 10.7 MHz are routed to crystal filter B3 and to the 10.7-MHz IF amplifier.

5.3 Synthesizer

5.3.1 General Synthesizer Information

(See Circuit Diagram 6043.2449.01S, Sheets 2 and 3)

The synthesizer used for the generation of the heterodyne signals for the mixer generates signals in the frequency range between 107.3 and 133.3 MHz. The frequency spacing is either 12.5 kHz or 8.33 kHz. The receive frequency and thus the correct synthesizer frequency with IF offset is adjusted using five rotary coding switches.

The synthesizer consists of the high-integrated PLL component N53, the PLL loop filter, a watchdog circuit, the dual modulus prescaler N10, a voltage-controlled oscillator (VCO) with a following buffer amplifier, and the TCXO U5 for generating the reference frequency. The PLL is supplied by the microcontroller D30 with the correct division factors in line with the settings of the rotary coding switches.

The LO signal is generated using the voltage-controlled oscillator and routed via a buffer stage to the reception mixer. The VCO signal is also divided by the prescaler N10 by factor 64 or 65 and sent to the PLL module N53. This module is also supplied with the 10-MHz reference signal from the TCXO.

The prescaler output signal is applied in the PLL circuit to two further dividers (dividers N and A) and compared in a frequency phase discriminator with the reference signal which has also been divided down.

Following filtering in the PLL loop filter, the output signal of the discriminator sets the frequency of the VCO to the correct value. Via a serial control line, the microcontroller programs the three dividers in the PLL module to the settings of the rotary coding switches.

5.3.2 VCO (Voltage-controlled Oscillator)

(See Circuit Diagram 6043.2449.01S, Sheet 2)

The VCO is made up of active element transistor V7 and the resonant circuit, consisting of L4, C31, C32, C36 and V8.

The circuit is coupled into line by the emitter of transistor V7 via the capacitive voltage divider, consisting of C33 and C34. Via the filter section, consisting of R45, R46, C28 and L3, the tuning voltage is routed to capacitance diode V8.

The range of capacitance diode V8 is such that any temperature deviation and aging of the circuit can be compensated.

Coarse detuning of the resonance frequency is carried out by capacitor C31. Thus excellent noise suppression in the sideband of the VCO is achieved.

The buffer stage V5, V6 ensures that decoupling of the VCO from all following stages is extremely smooth. The buffer stage operates as cascodes, since the latter keep any feedback effects to an absolute minimum. The signal from buffer stage V5, V6 is routed to mixer U4.

5.3.3 PLL Module, Dual Modulus Prescaler and Loop Filter

(See Circuit Diagram 6043.2449.01S, Sheet 2)

The main component of the synthesizer is the complex CMOS PLL integrated circuit N53. This circuit contains all of the function blocks needed to make up a PLL synthesizer.

Taken individually, these are the following function blocks:

- Reference divider (R divider), used for generating the comparison signal for the phase detector at the frequencies 2.5 kHz (division factor: 4000) or 4.16 kHz (division factor: 2403).

- A divider (division factors: 0 to 127) and the N divider (division factors: 3 to 4095), used for dividing the output signals from the prescaler and for controlling the dual modulus function of the prescaler.

- Phase / frequency discriminator, used for generating a control signal for the VCO from a comparison of the output signals of the R divider with the output signals of the A / N divider.

- Serial interface, used for programming the division factors and for controlling the PLL module.

The dual modulus prescaler N10 divides the output frequency of the VCO by a factor of 64 or 65, depending on the value of the control signal at N10.6.

The output signal of the phase / frequency discriminator in the PLL integrated circuit is routed via a loop filter with R3, R4, C1 to the integrator with N1, C4, R7.

Its output signal is routed as tuning voltage to the capacitance diode V8 of the VCO via the active low-pass filter with N2, R8 to R11, C6 to C8 and the passive notch filter with R12 to R16, C9 to C12 for suppressing the phase comparison frequency.

5.3.4 Temperature-compensated Quartz Oscillator (TCXO)

(See Circuit Diagram 6043.2449.01S, Sheet 3)

Component N5 contains a temperature-compensated quartz oscillator for generating the 10-MHz reference frequency.

With the adjustable voltage divider R501 to R503 the frequency of the TCXO can be fine-tuned. The output signal of the TCXO is routed without feedback effects via the inverters D5A, D5B to the PLL component and also supplied to the microcontroller D30 via the inverter D5C as a clock signal.

5.3.5 Monitoring of Synthesizer

(See Circuit Diagram 6043.2449.01S, Sheet 2)

From the lowpass filter output N2.6 the signal is routed via the RC lowpass filter R30, C20 to impedance converter N3D, whose output (N3D.14) controls the window comparator. The latter consists of operational amplifiers N3A, N3B and N3C.

All of the three operational amplifiers operate as comparators. N3A and N3B are used as inverting comparators and N3C as non-inverting comparator.

The reference voltage of the three comparators is generated via the voltage divider R49, R27 and R28. The output of comparator N3A inhibits comparator N3B with a low level. The outputs of the comparators drive LEDs H3 to H5. Only one LED at a time is illuminated.

Output N3B.7 is also used for the control of transistor V3. The signal TUNE A is tapped at the collector. The tuning voltage of the VCO must be adjusted by trimming capacitor C31 at V8 in such a way that LED H4 (green) lights up as soon as the synthesizer is locked.

The PLL component generates in addition the UNLOCK signal at N53.14 as a test criterium for the synchronization of the phase-locked loop.

5.3.6 Controlling the Synthesizer

(See Circuit Diagram 6043.2449.01S, Sheet 3)

Programming of the division factors and all other settings of the PLL integrated circuit is carried out via a serial interface with the microcontroller D30.

The frequency of the synthesizer is set using the rotary coding switches S1, S2, S4, S8 and S9 in accordance with the following table.

Pos.	S9 (MHz)	S8 (MHz)	S4 (MHz)	S2 (kHz)	S1 (kHz)
0	-	0	0	0	0
1	100	10	1	100	8.33
2	-	20	2	200	12.5
3	-	30	3	300	16.66
4	-	40	4	400	25.0
5	-	50	5	500	33.33
6	-	60	6	600	37.5
7	-	70	7	700	41.66
8	-	80	8	800	50.0
9	-	90	9	900	58.33
A	-	-	-	-	62.5
B	-	-	-	-	66.66
C	-	-	-	-	75.0
D	-	-	-	-	83.33
E	-	-	-	-	87.5
F	-	-	-	-	91.66

The frequency set will correspond to the receive frequency, while the actual synthesizer frequency is reduced by the IF offset of 10.7 MHz.

The hex coding switch S1 is used for switching between the 12.5-kHz frequency spacing and the 8.33-kHz spacing.

The comparison frequency of the phase discriminator in the PLL component is 2.5 kHz with the 12.5-kHz spacing and 4.16 kHz with the 8.33-kHz spacing.

The signal TUNE A of the synthesizer watchdog circuit and the signal Unlock of the PLL integrated circuit are applied to the ports P4.0 and P4.1 (D30A.7, D30A.8) of the microcontroller.

When either of the test signals switches to NoGo (logic low), then component D30 at output D30A.9 via R570 with the signal TSYNTH sends a NoGo signal to the watchdog circuit of the receiver.

In addition, all settings of the PLL will be reloaded via the serial interface (Reset).

5.4 IF Section

In the IF section the 10.7-MHz signal is filtered and amplified. In addition, conversion into the second IF (1.3 MHz) is carried out. The 1.3-MHz signal is amplified, filtered and demodulated.

Also, from the 10.7-MHz signal a digital field strength information is obtained.

5.4.1 10.7-MHz IF Amplifier

(See Circuit Diagram 6043.2449.01S, Sheet 4)

The output signal from the mixer U4 is routed to a diplexer with R93, L7, L9, C54, C79. This circuit constitutes a broadband real termination resistor of approx. 50 Ω for the mixer.

Coil L21 and capacitors C72 and C66 together form a transformation circuit, used for impedance matching to the quartz filter. The output signal from the quartz filter is routed via the transformation circuit C67, C73, L20 and capacitor C71 to integrated amplifier N4.

Via resistor R86 and coil L8 the latter is supplied with operating voltage (output N4.3). Via an attenuator in pi-circuit with R84, R85, R112 the amplified signal is fed to input IF IN (N5.18) of the IF amplifier and demodulator N5, and, in addition, as signal IF-FS to a second IF amplifier (N18) (refer also to Circuit Diagram 6043.2994.01S, Sheet 7).

In this signal branch a 4-bit field strength information (signals FS-BIT-01 and FS-BIT-11) is generated.

5.4.2 Digital Field Strength Information (FM IF Amplifier)

(See Circuit Diagram 6043.2449.01S, Sheet 7)

The digital field strength information is derived via FM IF amplifier N18 and a following 2-bit A/D converter. The signal IF-FS is fed by way of capacitor C152 to IF amplifier N18.15. This IC is made up of an FM IF amplifier with demodulator.

In this particular application, however, only the functions of the 4-stage limiter amplifier and the display driver are made use of. Resistor R251 and capacitors C143, C144 and C153 are provided as external circuitry of the limiter amplifier.

The internal 5.3-V reference voltage is applied to N18.12. For alignment purposes this voltage is routed via potentiometer R248 to the display driver N18.14, whose output N18.13 is applied to input 12 of impedance converter N22D via the lowpass filter R392, C214.

Diodes V70 and V71 speed up the charging and discharging process of capacitor C214 during the more significant level changes of the signal. Output N22D.14 is applied to the input of a discrete A / D converter and is also used for controlling the PIN diode control circuit in the VHF preselection.

The A / D converter consists of Schmitt trigger chain N19A, N19B and N19C. The inverting inputs of the operational amplifiers are supplied with a graded reference voltage via the voltage divider R243 to R246.

Signal SQ-TTL, dependent on the field strength, is fed to Schmitt trigger N19C. The signal changes from low to high level before the level of the analog field strength signal causes the Schmitt trigger N19B to trip.

The NAND gates D14A to D14C combine the output levels of the Schmitt triggers to a 2-bit digital output (signals FS-BIT-01 and FS-BIT-11).

The characteristic of the A / D converter is shown in the following Table.

RF input level (µV)	FS-BIT-11	FS-BIT-01
0.5	0	0
3	0	1
30	1	0
300	1	1

By means of jumpers on the appropriate contacts of X40 and X42 (see also Circuit Diagram 6043.2994.01S, Sheet 5) either the AGC voltage or the field strength information from the Rx unit can be applied to the external interface.

5.4.3 IF Amplifier, 2nd Mixer and Demodulator N5

(See Circuit Diagram 6043.2449.01S, Sheet 4)

The IF amplifier and demodulator N5 amplifies the 10.7-MHz signal at N5.18. The amplifier is regulated by the AGC (IF regulation). From N5.3 the signal is routed via coupling capacitor C55 to input N5.4 of the second amplifier.

Via this amplifier, regulated by the AGC, the signal is fed to quartz filter B2.1 by way of output N5.6, capacitor C60, coil L10 and resistor R80. From the output of the quartz filter the signal is routed via coil L6 and capacitor C59 to mixer input N5.7.

Level matching is carried out via resistors R83 and R81.

At mixer input N5.9 the 12-MHz signal of oscillator B5 (see Circuit Diagram 6043.2449.01S, Sheet 5) is coupled in. From output N5.8 the 1.3-MHz difference frequency is fed to input N5.13 via an RC combination and the parallel circuit, consisting of C90, C68 and L22. The signal is first amplified and then routed to the demodulator.

The noise blanker is made up of a mono-flop. Resistor R113 and capacitor C87 determine the time constant. Output signal NOISEBL is not made use of in this particular application.

The demodulated signal AF1 is applied to output N5.15 and, via an impedance converter, to output N5.16 (signal AGC). The signal is smoothed by capacitor C77.

Potentiometer R338 is used for setting the AF level ("AF1"). The scope of the AGC range is 60 dB and the voltage at N5.16 changes between 3.5 and 2 V in a linear fashion.

An A / D converter converts the level of signal AGC into a 2-bit digital value (see Circuit Diagram 6043.2449.01S, Sheet 5).

The signal DAGC from the FM limiter amplifier for controlling the VHF section is routed via resistors R94, R340, R335 and R334 to the operational amplifiers N6A, N6B, N7A and N7B.

All of the operational amplifiers are of the non-inverting type. The output voltage is not linear to the input voltage. The gain is rather small inside the control range of PIN diodes V64 and V16 with N7B, but rather large inside the blocking state region with N7A and V17.

5.4.4 Digital AGC Voltage Information

(See Circuit Diagram 6043.2449.01S, Sheet 5)

From the IF amplifier and demodulator N5.16 signal AGC is routed via inverting amplifier N14A to the input of a discrete A / D converter.

The latter consists of the Schmitt trigger chain N9B, N9C and N9D. The inverting inputs of the operational amplifiers are supplied with a graded reference voltage via the voltage divider R157, R142, R158 and R160.

Schmitt trigger N9D is either driven by the analog AGC voltage or else by the field-strength-dependent signal SQ-TTL.

Selection can be made by a jumper placed on the appropriate contacts of X52.

Control signal	Jumper
AGC voltage	X52.3 ⇒ X52.2
SQ-TTL	X52.1 ⇒ X52.2

The signal changes from low to high level before the level of the analog AGC voltage causes the Schmitt trigger N9D to trip. NAND gates D11A to D11C combine the output levels of the Schmitt triggers to a 2-bit digital output (signals AGC-BIT-01 and AGC-BIT-11).

The characteristic of the A / D converter is shown in the following Table.

RF input level (µV)	AGC-BIT-11	AGC-BIT-01
0.5	0	0
3	0	1
30	1	0
300	1	1

By means of jumpers on the appropriate contacts of X40 and X42 either the AGC voltage information or the field strength information is enabled for output.

5.5 AF Section

The AF section contains the following functional groups:

- Squelch evaluation circuit,
- Noise blanker,
- AF control amplifier,
- AF bandpass filter,
- CMOS switch,
- 8-Ω amplifier,
- 600-Ω amplifier.

5.5.1 Squelch

The squelch circuit consists of a combination made up of carrier and signal-to-noise squelch. The signal-to-noise squelch cannot open for a strong but blurred RF input signal, and the carrier squelch opens the AF path instead.

Carrier squelch detection is carried out by comparison of the AGC voltage with a variable reference voltage.

Signal-to-noise squelch detection is performed by comparison of the directional voltage (carrier voltage of the AM demodulator) with the rectified output voltage of a bandpass filter of 18 to 24 kHz.

5.5.1.1 Carrier and Signal-to-Noise Squelch

(See Circuit Diagram 6043.2449.01S, Sheet 5)

The AGC output voltage of the IF amplifier and demodulator N5 is compared by comparator N9A with a DC voltage variable between 1.2 and 6 V. If the AGC voltage is below the DC voltage, then comparator output N9A.2 switches relay K1 and the comparator input N11D to ground.

Via LED H8 the relay K1 is connected to a voltage of + 12 V. The LED is illuminated and relay K1 is energized. Diode V28 limits the inductance voltage as soon as the relay is de-energized.

The output signal of comparator N11D is limited to 4.7 V by means of resistor R114 and Zener diode V25 and is made available as signal *SQ. Following inversion by comparator N22A this signal is then ready for use as signal SQ-TTL. The latter drives the A / D converter which, in turn, generates the digital field strength and AGC voltage information.

Via impedance converter N22C (see Circuit Diagram 6043.2449.01S, Sheet 9) signal *SQ arrives as signal *SQUELCH at output X2.C11.

Via NAND gate D16A and diode V78 the signal SQ-TTL is routed to control input IN2 (N17.16) of CMOS switch N17 (see Circuit Diagram 6043.2449.01S, Sheets 6 and 9). The latter, in turn, through-connects the AF input signal for the 600-Ω and 8-Ω AF amplifiers.

The squelch function can be switched off manually via NAND gate D16B. The squelch function of the Rx unit is only active, if both gate inputs are at high level. Via diode V62 the output signal of the gate is also available as signal SQ-ON at impedance converter N22C.

Remote switch-on / off of the squelch function is carried out via NAND gate D17A and diode V63 (signal SQ-ON).

Via operational amplifiers N8B and N8C the directional voltage of the demodulator is fed to the inverting input of Schmitt trigger N12B. At the non-inverting input of the latter DC voltage NOISE DC2 is made available. This voltage is derived by rectification of the bandpass filter output signal (18 to 24 kHz) on the filter board.

If the DC voltage is below the directional voltage, then Schmitt trigger output N12B.7 switches relay K1 to ground. Via LED H8 the relay is connected to + 12 V. The LED is illuminated and the relay is energized. Diode V28 limits the inductance voltage as soon as the relay is de-energized.

5.5.1.2 Noise Evaluation Bandpass Filter

(See Circuit Diagram 6043.2249.01S, Sheet 1)

The bandpass filter for noise evaluation is located on the filter board. The filter function is activated by a switched capacity filter. For this purpose a clock signal must be fed to the IC.

Integrated circuit N10 forms a bandpass filter 18 to 24 kHz for the noise portion of signal NOISE BP, coupled out directly from demodulator N5 via operational amplifier N8A. The output signal is routed from N10.13 via impedance converter N17A to active rectifier N17B.

Clock signal CLK1 comes in via contact X210.7. It is generated from the clock frequency of 12-MHz quartz oscillator B5 by means of division. The resulting noise-dependent DC voltage is filtered via RC element R170, C100 and is then applied as signal NOISE DC2 to X210.16 via the voltage divider R141, R115. This signal is required by the evaluation circuit for the squelch.

5.5.2 Noise Blanker

(See Circuit Diagram 6043.2449.01S, Sheet 5)

The noise blanker consists of the inverting comparators N14D and N22B. The reference voltage at N14D.12 and N22B.5 can be adjusted by means of potentiometers R154 and R562 for optimum limiting of the noise signals. For positive noise pulses the noise level is limited to the reference voltage set with potentiometer R154 via resistor R352 and diode V24.

For negative noise pulses the noise level is limited to the reference voltage set with potentiometer R562 via resistor R563 and diode V105.

A jumper placed on the appropriate contacts of X32 and X33 makes it possible to determine whether noise blanking is to take place ahead or following the AF control amplifier and bandpass filter.

5.5.3 AF Control Amplifier

(See Circuit Diagram 6043.2449.01S, Sheet 6)

Signal AF1 is routed from the IF amplifier and demodulator N5.15 (AUD OUT) via operational amplifier N8A to the AF control amplifier.

Control is carried out by the voltage divider, made up of resistors R194 and R195 as well as FET V34. The resistance of the FET can be controlled via the DC voltage at the gate.

The DC voltage is derived from the level of the AF signal. For this purpose the AF signal is routed via the RC element C114, R196 to inverting amplifier N15.

The amplified signal is rectified in active rectification circuit N14B, V36 and then routed to FET V34 as control signal.

Reverse coupling of active rectification circuit N14B is carried out via diode V36, resistor R177, FET V34, resistor R183 and the analog switch N17.10 / N17.11. With the signal NOISEBL from AM demodulator N5 the reverse coupling loop can be opened and the AF signal thereby blanked out.

Because the resistor R357 is not fitted in this particular model of the Rx unit, the noise blanking function of the IF amplifier and demodulator N5 will not be active.

The control time behaviour of the circuit is determined by resistors R177, R180, R181 and capacitors C121, C213.

The reference voltage for operational amplifiers N15 and N14B is generated by means of Zener diode V37 and the following impedance converter N14C. Potentiometer R193 is used to adjust the level of the regulated AF signal.

Via capacitor C112 and a jumper on the appropriate contacts of X120 the amplitude-stabilized signal is fed to the AF bandpass filter on the filter board (AF7).

By means of a jumper placed on contacts of X54 (X54.1 ⇒ X54.2) the control amplifier circuit can be bypassed.

5.5.4 AF Bandpass Filter

(See Circuit Diagram 6043.2249.01S, Sheet 1)

The AF bandpass filter is located on the filter board. The filter function is activated via a switched capacity filter. For this purpose the IC must be supplied with a clock signal.

Circuit N16 acts as AF bandpass filter (300 Hz to 3.4 kHz) upon signal AF7 from the AF control amplifier. The clock signal is applied to N16.8.

Clock signal CLK2 is applied via X210.11 and is derived by means of division from the clock frequency of the 12-MHz crystal oscillator B5. The output signal is routed via X210.15 to CMOS switch N17 of the AF amplifier as signal AF8.

5.5.5 CMOS Switch

(See Circuit Diagram 6043.2449.01S, Sheet 6)

Output signal AF8 of the AF bandpass filter on the filter board is fed to input S2 (N17.14) of CMOS switch N17 via RC lowpass filter R228, C202.

By switching functions 1 to 3 being switched in series the through-connection of the AF signal to the following output amplifier D13 depends on control signals AF-INHI and SQ-ON (control inputs IN1, IN2 and IN4).

Switching function 4 is occupied by signal AF6 of the optional Inband Interface and is also controlled by signal AF-INHI. From output D1 (N17.2) of CMOS switch N17 the AF signal is routed to the 8-Ω loudspeaker amplifier, and via a jumper on the appropriate contacts of X62, to the 600-Ω amplifier.

5.5.6 8-Ω Amplifier

(See Circuit Diagram 6043.2449.01S, Sheet 6)

The AF output signal from CMOS switch N17 is fed to the input of AF amplifier D13.8 via the RC element, consisting of C131, R229, R230. By means of coupling capacitor C137 the signal is fed to the internal loudspeaker on one hand, and on the other, as signal AF-8-Ω to contact X14B.8.

The level of signal AF-8-Ω can be adjusted with potentiometer R231 which is accessible from the bottom of the assembly. The volume of the internal loudspeaker can be adjusted with potentiometer R311 on the front panel.

5.5.7 600-Ω Amplifier

(See Circuit Diagram 6043.2449.01S, Sheet 6)

Via capacitor C193 the AF output signal of CMOS switch N17 is fed to operational amplifier N24. The gain may be adjusted with potentiometer R235 which is accessible from the bottom of the assembly.

Via the RC element, consisting of C140, R371, R239, the amplified signal is routed to the 600-Ω output. Resistor R239 can be bypassed for the purpose of impedance matching by placing a jumper on the appropriate contacts of X100.

5.6 Control Circuit

5.6.1 Remote Control

(See Circuit Diagram 6043.2449.01S, Sheet 9)

5.6.1.1 General

Switch- on / off as well as squelch switch-on / off can be remote-controlled. For this purpose a number of control functions are available, such as parallel, REM Bus (serial) and inband.

These different functions may be selected by means of diodes V90 to V98.

Remote control of the functions is possible if there is a low level on signal *REMOTE-1 (switch S5 set to REMOTE, see Circuit Diagram 6043.2449.01S, Sheet 8). Signal *SQ-ON is applied to the first input of NAND gate D17A.

Remote control of the squelch switch-on / off is enabled via inverter D20F and NAND gate D17A. At the same time signal *REMOTE-1 inhibits the function of the internal squelch switch S3 via NAND gate D16B.

NAND gates D17C and D17D enable the switch-on / off function for remote control. The following parameters of the Rx unit can be interrogated externally.

Function	Designation
CBIT C	BIT-RX-1 (2)
Squelch	SQ-TTL
AGC /	AGC-BIT01 or TTY-BIT01
TTY voltage	AGC-BIT11 or TTY-BIT11

5.6.1.2 Remote Control 'Parallel'

The control signals are routed directly from the interface to the respective stages of the Rx unit. In the same way the signals from the Rx unit are directly routed to the interface.

5.6.1.3 Remote Control 'REM Bus (serial)'

The synchronization of the serial data input / output is carried out by signal SCL (serial clock line). Via resistor R295 and inverter D19B the signal is fed to the clock input of REM Bus I / O expander D18A.14. The data (signal SDAO) are routed to the input / output (terminal 15) via resistor R296, inverter D19A and transistor V57.

Data output is carried out via inverter D19C and resistor R297 (signal SDAI). The address is fixed by means of BCD coding switch S7. Signals SEL 0 and SEL 1 are used for addressing. At the outputs and inputs (D18A.4 to 12) of the REM Bus I / O expander there are the different signals of the Rx unit.

5.6.2 AF Switchover Operation

(See Circuit Diagram 6043.2449.01S, Sheet 9 and Circuit Diagram 6043.2878S of Power Supply IN 201A)

5.6.2.1 General

The switchover function is described by using the example of VHF Single-channel Receiver EU 231A (VHF Rx Unit EU 231 plus Power Supply IN 201A).

Two VHF Single-channel Receivers EU 231A may be connected together at a time to form one single unit. As a result, the clearest AF signal is automatically switched to the common AF line.

For this both receivers must be in the ON-state. The ON-state can be activated from the front panel as well as by remote control.

Each receiver is equipped with an output AF-INHI-1 for the control of input AF-INHI-2, in order to inhibit the AF of the other receiver.

The decision which receiver output is to be switched to the common AF line is made by comparing the AGC voltages of the two receivers. For this purpose output signal AGC-1 is fed to input AGC-2 of the other receiver.

Since only one AGC voltage comparator is required for the comparison, the comparator of one receiver is inhibited via input AGC-INHI-2 by control output AGC-INHI-1 of the other receiver (cross connection).

5.6.2.2 AGC Level Comparator

The AGC level comparator of the receiver first switched on is active and the one of the other receiver inhibited.

The inverter Schmitt triggers D19F of receivers 1 and 2 together form an RS flip-flop. For the switched-off receiver (e.g. receiver 1) inverter Schmitt trigger input D19E.11 is at low level via diode V56 and the mode switch.

Thus output D19F.12 applies high level to the input of the inverter Schmitt trigger contained in the receiver first switched on. The output of the latter, in turn, applies a low level to the input of inverter Schmitt trigger D19F.13 in the switched-off receiver. This state is maintained even if the second receiver is switched on.

NAND gate inputs D16D.13 and D16C.10 of the receiver last switched on are also at low level. At the outputs of these NAND gates (signals AF-INHI-1 and AF-INHI-2) there is now always a high level, irrespective of the level at the second gate input.

The outputs are of the open-collector type for which reason the cross-connected levels of the NAND gate outputs of the second receiver can be set to low level. In other words, receiver 2 decides which AF is to be cut in and which is to be inhibited.

5.6.2.3 AF Switchover between Receivers 1 and 2

AF switchover takes place via output signal AF-INHI of inverters D20A and D20B of the receiver first switched on. Gate outputs D16C.8 and D16D.11 are cross-connected to those of the other receiver. The gate outputs of the second receiver are at high level and can thus be controlled by a low level of the first receiver.

Signal AGC-1 of the first receiver derived from signal AGC of IF amplifier N5 is routed to comparator N19D.11 and to contact X12.9. By means of a jumper placed on contacts X134.1 and X134.2 as well as diode V80 the signal ON-TX from a transmitter can be brought into the switchover circuit. A low level of signal ON-TX (failure of associated transmitter) inhibits the AF of the receiver. However, if the jumper is placed on contacts X134.2 and X134.3 signal CBIT-RX-1 is brought into the switchover circuit. A low level of signal CBIT-RX-1 (failure of receiver) causes the AF to be inhibited.

Via contact X12.15 the AGC signal of the second receiver is applied to comparator input N19D.10.

If the level of signal AGC-1 from the first receiver is higher than the level of signal AGC-2 from the second receiver, the level at comparator output N19D.13 will be high. This level is used to drive NAND gate D16D.12 directly and NAND gate D16C.9 via inverter Schmitt trigger D19D.

Output signal AF-INHI-1 from NAND gate D16C inhibits the AF of the second receiver with a high level. Output signal AF-INHI-2 cuts in the AF of the first receiver via D20A and D20B with a low level.

Signal AF-INHI affects the control input of CMOS switch N17.1. Further switching functions of CMOS switch N17, and control signals SQ-ON and NOISEBL used for this purpose, cause the AF signal to be through-connected or inhibited. Only in the case of a low level, will signal AF8 be through-connected from N17.14 to N17.15.

5.6.3 PTT Control Functions

5.6.3.1 PTT Squelch Suppression

(See Circuit Diagram 6043.2449.01S, Sheet 5)

A low level of the *PTT signal drives the non-inverting input of Schmitt trigger N12B via operational amplifier N11A and diodes V60 and V76 with a high level. Thus relay K1 remains de-energized.

5.6.3.2 PTT RF Control

(See Circuit Diagram 6043.2449.01S, Sheet 4)

The output signal from operational amplifier N11A is also applied via diode V61 and resistor R355 as signal PTT (signal may be cut out by means of a jumper on appropriate contacts of X133) to input 5 of operational amplifier N6B.

The latter is part of the AGC voltage processing circuit (N6A, N6B, N7A and N7B) of the RF control. A low level of the *PTT signal inhibits the RF input of the receiver.

5.6.3.3 Inhibit PTT 600 Ω or 8 Ω

(See Circuit Diagram 6043.2449.01S, Sheets 5 + 6)

The output signal of operational amplifier N11A (Sheet 5) is routed via inverter N12A as signal PTT1 to capacitor C132 and resistor R192 (Sheet 6).

If signal PTT1 has a low level, either the input signal of the 8-Ω amplifier D13 or of the 600-Ω amplifier N24 is used. Selection of the amplifier depends on the configuration of a jumper on the contacts of X56.

5.6.4 Monitoring of the Rx Unit (CBIT)

(See Circuit Diagram 6043.2449.01S, Sheet 6)

5.6.4.1 General

The monitoring functions (CBIT = continuous built-in test) evaluates the signals and voltages of the different functional groups of the Rx unit and combines them to a sum message.

This is indicated via the green LED "TEST" on the front panel of Rx Unit EU 231. When all test signals are within the tolerance, the green LED is illuminated. In addition, signals CBIT-RX-1 and TEST RX1 are made available to the external interface.

The following voltages and signals are monitored by the CBIT:

- + 5-V operating voltage,
- + 12-V operating voltage,
- -5-V operating voltage,
- Inband remote control (option),
- Synthesizer frequency,
- IF signal level,
- VCO signal level (injection frequency mixer 1),
- 12-MHz oscillator signal level (injection frequency mixer 2).

All signals to be monitored are changed to TTL levels by methods described in the following and combined to a sum message by means of eight-fold NAND gate D12.

The output signal of gate D12.8 is routed via resistor R237 to the inverting input of comparator N13D. Capacitor C119 bypasses brief failures of the sum message. The reference voltage OP is approx. 12 V and is generated from the 6.2-V voltage by the divider R240, R356 and R187.

Via series resistor R225 the output of operational amplifier N13D.14 controls the green LED "TEST" on the front panel of Rx Unit EU 231. The signal (TEST RX1) is also applied to connector X1. Via resistor R238 the signal CBIT-RX-1 is coupled out directly.

5.6.4.2 Monitoring of + 5-V Voltage

The voltage of + 5 VDC is applied directly to gate D12.5 and as signal TEST + 5 V to connector X1.

5.6.4.3 Monitoring of + 12-V Voltage

Zener diode V33 and resistor R175 reduce the voltage of + 12 VDC to approx. 5.2 V. The latter is then applied to gate D12.6 and as signal TEST + 12 V to connector X1.

5.6.4.4 Monitoring of -5-V Voltage

The voltage of -5 VDC is applied via resistor R188 to the input of comparator N13C. The output signal of the latter is applied to gate D12.11 and as signal TEST-5 V to connector X1. Zener diode V32 and resistor R186 limit the input voltage of operational amplifier N13C in cases where the voltage of -5 VDC breaks down.

The reference voltage (OP) of the comparator is approx. 1.2 V and is generated from the 6.2-V voltage by the voltage divider R240, R356 and R187.

5.6.4.5 Monitoring of IF Signal Level

For monitoring the IF level the demodulator directional voltage (DF voltage) is routed via the voltage divider R185, R191 to comparator N13B. The output signal from the comparator is applied to gate D12.4 and as signal TEST IF to connector X1. The reference voltage of operational amplifier N13B is approx. 0.6 V and is generated from the 6.2-V the by voltage divider R236, R190 and R241.

5.6.4.6 Monitoring of Option "Inband Interface"

For monitoring option "Inband Interface" signal REM CONT is fed into circuit via contact X69A and then routed to gate D12.12 as signal TEST REM CONT. Pull-up resistor R178 prevents an error message from being output if option "Inband Interface" is not used.

5.6.4.7 Monitoring of Synthesizer Frequency

The signal TSYNTH is applied to gate D12.3 and as signal TEST SYNTH to connector X1.

5.6.4.8 Monitoring of Synthesizer Level

The signal TOSC2 charges capacitor C115 via resistor R227 and diode V31. Resistor R189, in turn, discharges capacitor C115. The DC voltage obtained in this way is proportional to the level of the input signal and is applied to gate D12.2 and as signal TEST OSC2 to connector X1.

5.6.4.9 12-MHz Oscillator Signal Level (Injection Frequency Mixer 2)

The signal TOSC1 charges capacitor C117 via resistor R226 and diode V35. Resistor R184, in turn, discharges capacitor C117. The DC voltage obtained in this way is proportional to the level of the input signal and is applied to the input of comparator N13A.

The comparator output is applied to gate D12.1 and as signal TEST OSC1 to connector X1. The reference voltage of comparator N13A is appr. 0.1 V and is generated from the 6.2-V voltage by the voltage divider R240, R356 and R187.

5.7 Voltage Processing Circuit

(See Circuit Diagram 6043.2449.01S, Sheet 8)

From the unregulated 24-V input voltage the voltage processing circuit generates the following regulated voltages:

- + 5 V,
- -5 V and
- + 12 V.

The input voltage is the unregulated 24-V voltage from Power Supply IN 201 which is routed to the output via coil L27. At the same time the input voltage is fed to switching regulator N21. The latter generates the output voltage of 12 V via free-wheeling diode V39, choke L25 and storage capacitors C161 and C162.

The output voltage can be adjusted with potentiometer R256 and is filtered via coil L26 and capacitors C154 and C163. The switching regulator is switched on and off by means of signal *ON / OFF-RX.

The 12-V voltage is used as input voltage for voltage regulator N20. The latter supplies an output voltage of + 5 V via filter capacitors C204 and C206. Capacitors C155 and C156 suppress the self-oscillations of the voltage regulator. Voltage divider R257, R258 determines the output voltage of the regulator.

The inverter N15D together with resistor R265 and capacitor C167 forms an oscillator. Schmitt trigger inverters D15A, D15E and D15F, which are switched in parallel, invert and amplify the oscillator signal.

Via Schmitt trigger inverters D15B and D15C, also switched in parallel, the signal is once more inverted and amplified. Thus a TTL signal, shifted in phase by 180 °, is applied to capacitors C164 and C166.

The TTL signal is rectified with diodes V41 to V43 and filtered with capacitor C165. The output voltage is -5 V. Voltage balancing takes place by returning the output voltage via resistor R263 and diode V40.

6. Repair

(See also Circuit Diagrams, Parts Lists and Components Layouts in the Appendix to this Repair Manual.)

6.1 Preliminary Remarks

6.1.1 General

The repair of VHF Rx Unit EU 231 starts with the initial checks in order to obtain information on the functional order of the unit and its technical data. In the case where faults cannot be clearly localized the results of the initial checks will be the starting point for repairs.

Note:

During the initial checks the unit will be set to various, clearly defined configurations. Prior to the check a note must be made of the basic configuration, which must be re-established once the final check is completed.

6.1.2 Restoring the Nominal Characteristics

Any component that is proved to be defective by means of the initial checks and other troubleshooting procedures should only be replaced by a component that meets the specifications of the appropriate parts list in the Appendix to this Repair Manual.

Only in this way can the technical data be guaranteed given in section 1 of the User Manual.

After repairs have been carried out, the unit must be subjected to a final check according to Section 6.6.

6.1.3 Spare Parts

All components are subjected to strict quality control before they are built into the unit.

For components from outside suppliers, Rohde & Schwarz have set down their own delivery specifications for the purpose of ensuring maximum reliability.

For this reason we recommend that only original spare parts be used for replacing defective components.

When ordering spare parts, please state the following:

- Type,
- Ordering code of the unit,
- Serial number of the unit,
- Identification number of the parts list,
- Designation plus stock number of the component.

All of these details are to be found in the circuit diagrams, parts lists and components layouts supplied with the manual.

6.1.4 Important User Information

The following contains details which are essential for carrying out repairs. This information is provided to avoid any misunderstanding which may occur at a later stage.

CAUTION

Prior to any soldering, the configuration of jumpers and cables, or the replacement of components the operating voltage must be switched off.

- **Carry out the initial checks of the VHF Rx unit and the resulting troubleshooting and fault elimination in the given order.**
- **If parameters are set for the checks which do not correspond to the operating parameters, make sure that the basic configuration is re-established once repairs are completed.**
- **Perform all measurements and alignment at the given operating voltages.**
- **Perform all measurements referred to ground, unless stated otherwise.**
- **The abbreviations in the text, such as e.g. X28.28 or D7.9, are to be understood as follows:**

  Connector X2B, contacts 28,
  IC D7, pin 9.

- **All signals in the text marked with an asterisk (*) are low-active signals.**
- **Following the elimination of a fault the appropriate check according to the Table "Check of Equipment Function" must be repeated.**

CAUTION ESD

Among the components incorporated in the VHF Rx unit are MOS, MOSFET and CMOS components.

Components of this kind are extremely sensitive to high extraneous voltages (static discharge) and could even be destroyed.

Therefore any repairs involving such components should be carried out at a special CMOS work station.

If no special CMOS work station is available the following minimum requirements must be met:

- **Conductive bench and floor covering**
- **Chair or stool with conductive covering**
- **Grounded, metallic working top and conductive wrist straps with a resistance of > 200 kΩ, < 1 MΩ plus an insulated lead and connector**
- **Soldering iron with safety grounding**
- **All conductive surfaces, wrist straps and working tops must be interconnected by insulated leads.**

6.2 Test Equipment and Special Tools

For the repairs described in this manual the test equipment laid down in the test equipment list is required.

Note:

Equivalent test equipment may be used.
Special tools are not required.

6.2.1 List of Test Equipment

Item	Type of equipment, required data	Equipment recommended by R & S	Ordering code
1	Digital Multimeter accuracy: 1 % of measured value	UDL 45	1037.1507.02
2	Power Supply + 24 VDC / 4 A	NGA 35	192.0010.04
3	Radiocommunication Analyzer - with spectrum analyzer - and storage oscilloscope - with RF probe	CMTA 54 URV-Z7	834.000054 292.5312.02
4	VHF Rx Unit (check of switchover operation) Power Supply	EU 231 IN 201A / IN 201D	6043.1994 6043.2878 / 6043.2584
5	Service Kit Rx	KA 231	6047.8993.02
6	Personal Computer (IBM-compatible)	Standard	
7	Spectrum Analyzer with tracking generator	FSA	804.8010.52
8	Modulation Analyzer	FMA	334.2015.54

6.3 Initial Checks

6.3.1 Visual Check

If a fault occurs first of all subject the VHF Rx unit to a visual check. For this purpose open the unit according to Section 6.5.

1. Carefully examine the connectors for broken, corroded or bent pins / sockets. If necessary, replace defective connectors according to 6.5.2.

   CAUTION

   If a connector shows any discolouration caused by heat, its mating connector is also defective. Both must therefore be replaced.

2. Examine the PCB for discolouration and disrupted tracks.

   If any damage is found on the PCB due to heat, we recommend the replacement of the entire assembly.

3. In order to gurantee the reliability of the VHF Rx unit, it is absolutely essential to replace any discoloured components in compliance with 6.5.2.

6.3.2 Check of Equipment Functions

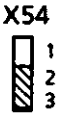
No.	Activity	Nominal value	Fault elimination
1.	**Settings**		
1.1	Configure jumper: X54.1 ⇒ X54.2. (AF control amplifier off) X54 1 2 3		
1.2	Set REM bus address '4' as follows: Set BCD switch S7 to position '4'.		
1.3	Connect VHF Rx Unit EU 231 and Power Supply IN 201.		
1.4	Connect X15 (REM Bus) of IN 201 via the REM Bus cable of the service kit to the REM BUS PC (LPT1, 2 or 3).		
1.5	***CAUTION*** ***Unless stated otherwise, switch on power supply of the unit during the measurements only.*** Switch on Power Supply IN 201.		
1.6	Set switch REM / LOC / OFF to LOC.		
1.7	Start program "serie200". Activate "open channel" and enter "10".		

No.	Activity	Nominal value	Fault elimination
	If necessary, adapt file "serie200.ini" as follows: ;min. one separating space ;number of channel ; keywords Tx#1, Tx#2, Rx#1, Rx#2 ; ':' address (0..63), ; '.' slot number of Rx (1..8) ; ; take address 64 for receiver without ; REMBUS driver or multicoupler No:00 Rx#1:64.2 Rx#2:64.3 ; ; example for separated Rx and Tx; Rx with address + '.' + slot number No:01 Tx#1:56 Rx#1:00.1 Tx#2:57 Rx#2:00.2; ; example for transceiver; Rx only with address No:02 Tx#1:57 Rx#1:57 No:03 Tx#1:57 Rx#1:57 Tx#2:58 Rx#2:58 No:04 Tx#1:57 Rx#1:00.1 Tx#2:58 Rx#2:00.8 ; ; single transmitter No:05 Tx#1:57 ; ; single receivers, some with test generator ; ':' address (0..63), ; '.' slot number of Rx (1..8) ; '-' address of corresponding test generator ; '/' channel of test generator with corresponding frequency No:06 Rx#1:00.1-00/01 Rx#2:00.2-00/01 No:07 Rx#1:00.3 Rx#2:00.4 No:08 Rx#1:00.5 Rx#2:00.6 No:09 Rx#1:00.7 Rx#2:00.8 ; ; the channel numbers 10 to 16 are used for service with ; R&S Service Manuals of series 200 ; ; single receiver, address 4 No:10 Rx#1:64.4 ;	At the lower edge of the screen the following message appears: "REMBUS at port 1, 2 or 3"	

No.	Activity	Nominal value	Fault elimination
	; two receivers (Main-Standby), address 2 and 3 No:11 Rx#1:64.2 Rx#2:64.3 ; ; single transmitter, address 57 No:12 Tx#1:57 ; ; two transmitters (Main-Standby), address 57 and 58 No:13 Tx#1:57 Tx#2:58 ; ; transceiver, address 57 No:14 Tx#1:57 Rx#1:57 ; ; single receivers, with test generator, address 6 No:15 Rx#1:00.6-00/01 ; ; free for service modification ; No:16 Possible cause of fault: V44, V57, D18, D19		
2.	**Test (CBIT)**		
2.1	Check LED TEST.	illuminated	acc. to 6.4.1
2.2	Check indication GO on the REM BUS PC.	■	acc. to 6.4.6
3.	**Power Supply**		
3.1	Measure DC voltage at X104.1 (+ 12 VDC1) and align with potentiometer R256 if necessary. *Note:* *X104.1 and X104.2 must remain connected.*	+ 12 V ± 0.1 V	acc. to 6.4.1
3.2	Measure DC voltage at X102.1 (+ 5 VDC).	+ 5 V ± 0.1 V	acc. to 6.4.1
3.3	Measure DC voltage at X106.1 (-5 VDC).	-5 V ± 0.1 V	acc. to 6.4.1

No.	Activity	Nominal value	Fault elimination
4.	**Synthesizer**		
4.1	Allow a 30-min warm-up phase at 25 °C.		
4.2	Measure the VCO frequency at X22.1 (OSC1) and, if necessary, adjust as follows: - Adjust frequency with potentiometer R502. - Align tuning voltage acc. to 6.4.2, step No. 4.	(Δ fo / fo) $< 1 \times 10^{-6}$	acc. to 6.4.2
4.3	Measure the oscillator level at X22.1 against X22.2.	+ 10 dBm ± 1dB	acc. to 6.4.2
5.	**Check of Sensitivity and AF S / N Ratio**		
5.1	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 2.0 uV, EMF modulation depth = 0.3, modulation frequency = 1 kHz.		
5.2	Measure (S + N) / N between X2B.10 (AF-RX-A) and X2B.11 (AF-RX-B) acc. to CCITT. (S = signal level, N = noise level)	≥ 10 dB	acc. to 6.4.3
5.3	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 1.0 mV, EMF modulation depth = 0.6, modulation frequency = 1 kHz.		
5.4	Measure (S + N) / N between X2B.10 (AF-RX-A) and X2B.11 (AF-RX-B) acc. to CCITT. (S = signal level, N = noise level)	≥ 40 dB	acc. to 6.4.3

No.	Activity	Nominal value	Fault elimination
6.	**8-Ω AF Power Output**		
6.1	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 1.0 mV, EMF, modulation depth = 0.9, modulation frequency = 1 kHz.		
6.2	Set volume control of EU 231 to centre position.		
6.3	Measure AF level at 8-Ω load between X2B.8 (AF-8-Ω) and X2B.9 (AF-8-GND) and, if necessary, align with potentiometer R231.	2.5 V_{rms} ± 50 mV_{rms}	acc. to 6.4.3
6.4	Change modulation frequency in the range between 300 and 3400 Hz (models 02 / 23) or 2500 Hz (model 22) and determine AF level fluctuation.	≤ 4 dB	acc. to 6.4.3
7.	**600-Ω Output**		
7.1	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 1.0 mV, EMF modulation depth = 0.6, modulation frequency = 1 kHz, (Jumper X101 on connector X100)		
7.2	Measure AF level at 600-Ω load between X2B.10 (AF-RX-A) and X2B.11 (AF-RX-B) and, if necessary, align with potentiometer R235.	+ 7 dBm ± 0.2 dB	acc. to 6.4.4
7.3	Change modulation frequency in the range between 300 Hz and 3400 Hz (models 02 / 23) or 2500 Hz (model 22) and determine the AF level fluctuation.	≤ 4 dB	acc. to 6.4.4

No.	Activity	Nominal value	Fault elimination
8.	**AF Control**		
8.1	Configure jumper: X54.2 ⇒ X54.3. (AF control amplifier on) 		
8.2	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 1.0 mV, EMF, modulation depth = 0.6, modulation frequency = 1 kHz, (Jumper X101 on connector X100)		
8.3	Measure AF level at 600-Ω load between X2B.10 (AF-RX-A) and X2B.11 (AF-RX-B) and, if necessary, align with potentiometer R193.	+ 7 dBm ± 0.1 dB	
8.4	Change modulation depth between 0.3 and 0.8 and determine AF level fluctuation.	≤ 1 dB	
8.5	Configure jumper: X54.1 ⇒ X54.2. (AF control amplifier off) 		
9.	**Noise Limiter**		
9.1	Configure jumper: X32.1 ⇒ X33.1, X32.2 / X33.2. ⇒ = jumper, / = open 		

No.	Activity	Nominal value	Fault elimination
9.2	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 1.0 mV, EMF, modulation depth = 0.1, modulation frequency = 1 kHz.		
9.3	Check signal shape by means of oscilloscope between X2B.10 (AF-RX-A) and X2B.11 (AF-RX-B), while increasing the modulation depth from 0.1 to 1.0. Align with potentiometer R154 and align R562 to symmetrical limiting threshold. Possible error cause, if alignment fails to be successful: N14, V24, N22, V105, R154, R562.	Limiting threshold from a modulation depth = 0.9	
10.	**Carrier Squelch**		
10.1	Configure jumper: X29.1 / X30.1, X29.2 ⇒ X30.2. ⇒ = jumper / = open		
10.2	Connect X30.1 via 100-kΩ resistor with + 12 V.		
10.3	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 150 µV, EMF.		

No.	Activity	Nominal value	Fault elimination
10.4	Measure DC voltage at X30.1. With potentiometer R159 adjust the limiting threshold of the carrier squelch.	For 150 µV ± 50 µV the DC voltage changes from 0.5 V ± 0.5 V to ≥ 3.5 V	acc. to 6.4.5
10.5	Remove 100-kΩ resistor between X30.1 and + 12 V.		
11.	**Signal-to-Noise Squelch**		
11.1	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 2 µV, EMF, modulation depth = 0.3, modulation frequency = 1 kHz. Measure (S + N) / N between X2B.10 (AF-FX-A) and X2B.11 (AF-RX-B) acc. to CCITT and if necessary fine-tune signal generator level.	10 dB ± 0.5 dB	
11.2	Adjust the potentiometer R168 such that the squelch barely opens (SQUELCH LED lights up). Possible cause of fault if alignment fails to be successful: N8, N12, H8 or N10, N17, V20, V22 of the filter board with the corresponding circuitry.	LED lights up for input levels above the nominal level and goes out for input levels below the nominal level.	
11.3	Configure jumper: X29.1 ⇒ X30.1, X29.2 / X30.2. ⇒ = jumper, / = open		
11.4	Turn control SQ fully counter-clockwise.		
11.5	Increase RF input level until LED SQUELCH lights up (squelch switching point).		

No.	Activity	Nominal value	Fault elimination
11.6	Measure (S + N) / N between X2B.10 (AF-RX-A) and X2B.11 (AF-RX-B) acc. to CCITT. (S = signal level, N = noise level)	≤ 8 dB	acc. to 6.4.5
11.7	Turn control SQ fully clockwise.		
11.8	Set RF input level to 5 µV.		
11.9	Turn control SQ counter-clockwise until the squelch opens.		
11.10	Measure (S + N) / N between X2B.10 (AF-RX-A) and X2B.11 (AF-RX-B) acc. to CCITT. (S = signal level, N = noise level)	≥ 14 dB	acc. to 6.4.5
12.	**Squelch Control Outputs**		
12.1	Remove all jumpers on X47, X49, X53.		
12.2	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 0 µV.		
12.3	Measure DC voltage at the following contacts: X2.C11 (*Squelch), X2.A14 (SQ-TTL) Possible cause of fault : K1, V28, H8, N12, N11, N22	≥ 3.5 V ≤ 1 V	

No.	Activity	Nominal value	Fault elimination
12.4	Measure passband attenuation between the following contacts: X2B.5 (SQ-1) ⇒ X2B.6 (SQ-2), X2B.5 (SQ-1) ⇒ X2B.7 (SQ-3). Possible cause of fault: K1, V28, H8, N12	 0 Ω ∞ Ω	
12.5	Set the RF input level to 10 µV.		
12.6	Measure DC voltage at the following contacts: X2C.11 (*Squelch), X2A.14 (Sq-TTL). Possible cause of fault: N22, V25, K1, V28, H8, N12, N11	 ≤ 1 V ≥ 3.5 V	
12.7	Measure passband attenuation between the following contacts: X2B.5 (SQ-1) ⇒ X2B.6 (SQ-2), X2B.5 (SQ-1) ⇒ X2B.7 (SQ-3). Possible cause of fault: K1, V28, H8, N12	 ∞ Ω 0 Ω	
12.8	Restore factory configurations of jumpers on X47, X49 and X53.		
13.	**Indication of Field Strength**		
13.1	Configure jumpers: X42.1 / X42.2 ⇒ X42.3, X40.1 ⇒ X40.2 / X40.3, X90.1 / X90.2 ⇒ X90.3. ⇒ = jumper, / = open  		

No.	Activity	Nominal value	Fault elimination
13.2	Feed in RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 6 µV, EMF, modulation depth = 0.		
13.3	Measure DC voltage at the following contacts: X2A.25 (AGC-LINE), X13 (V_c, front panel), X2A.15 (AGC-BIT-01), X2C.12 (AGC-BIT-11). If necessary, align with potentiometer R248. Possible cause of fault if alignment fails to be successful: N18, N22, N19, D14	0.72 V ±0.01 V ≥ 3.5 V ≤ 1 V	
13.4	Check following indications on REM BUS PC: AGC 0, AGC 1, AGC 2, AGC 3.	◇ ◆ ◇ ◇	acc. to 6.4.6
13.5	Set RF input level to 0.2 µV, EMF.		
13.6	Measure DC voltage at the following contacts: X2A.25 (AGC-LINE), X13 (V_c, front panel), X2A.15 (AGC-BIT-01), X2C.12 (AGC-BIT-11). Possible cause of fault: N18, N22, N19, D14	0.15 V ≤ 1 V ≤ 1 V	
13.7	Check following indications on REM BUS PC: AGC 0, AGC 1, AGC 2, AGC 3.	◆ ◇ ◇ ◇	acc. to 6.4.6

No.	Activity	Nominal value	Fault elimination
13.8	Set RF input level to 30 µV, EMF.		
13.9	Measure DC voltage at the following contacts:		
	X2A.25 (AGC-LINE), X13 (V_c, front panel),	1.3 V - 0.1 / +0.4 V	
	X2A.15 (AGC-BIT-01),	≤ 1 V	
	X2C.12 (AGC-BIT-11).	≥ 3.5 V	
	Possible cause of fault:		
	N18, N22, N19, D14		
13.10	Check following indications on REM BUS PC:		acc. to 6.4.6
	AGC 0,	◇	
	AGC 1,	◇	
	AGC 2,	◆	
	AGC 3.	◇	
13.11	Set RF input level to 300 µV, EMF.		
13.12	Measure DC voltage at the following contacts:		
	X2A.25 (AGC-LINE), X13 (V_c, front panel),	2 V - 0.35 V / +0.25 V	
	X2A.15 (AGC-BIT-01),	≥ 3.5 V	
	X2C.12 (AGC-BIT-11).	≥ 3.5 V	
	Possible cause of fault:		
	N18, N22, N19, D14		
13.13	Check following indications on REM BUS PC:		acc. to 6.4.6
	AGC 0,	◇	
	AGC 1,	◇	
	AGC 2,	◇	
	AGC 3.	◆	

No.	Activity	Nominal value	Fault elimination
14.	**AGC Indication**		
14.1	Configure jumpers:  X42.1 ⇒ X42.2 / X42.3, X40.1 / X40.2 ⇒ X40.3, X90.1 ⇒ X90.2 / X90.3. ⇒ = jumper, / = open		
14.2	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 30 µV, EMF, modulation depth = 0.		
14.3	Measure DC voltage at the following contacts: X2A.25 (AGC-LINE), X13 (V_c, front panel), X2A.15 (AGC-BIT-01), X2C.12 (AGC-BIT-11). If necessary, align with potentiometer R345. Possible cause of fault if alignment fails to be successful: N14, N9, D11	3 V ± 0.5 V ≤ 1 V ≥ 3.5 V	
14.4	Check following indications on REM BUS PC: AGC 0, AGC 1, AGC 2, AGC 3.		acc. to 6.4.6
14.5	Set RF input signal to 0.5 µV, EMF.		
14.6	Measure DC voltage at the following contacts: X2A.25 (AGC-LINE), X13 (V_c, front panel), X2A.15 (AGC-BIT-01), X2C.12 (AGC-BIT-11). Possible cause of fault: N14, N9. D11	1.7 V -1.2 V / + 0.8 V ≤ 1 V ≤ 1 V	

No.	Activity	Nominal value	Fault elimination
14.7	Check following indications on REM BUS PC:		acc. to 6.4.6
	AGC 0, AGC 1, AGC 2, AGC 3.	◆ ◇ ◇ ◇	
14.8	Set RF input level to 3 µV.		
14.9	Measure DC voltage at the following contacts:		
	X2A.25 (AGC-LINE), X13 (V_c, front panel), X2A.15 (AGC-BIT-01), X2C.12 (AGC-BIT-11). Possible cause of fault: N18, N22, N19, D14	2.7 V -0.4 + 0.5 V ≥ 3.5 V ≤ 1 V	
14.10	Check following indications on REM BUS PC:		acc. to 6.4.6
	AGC 0, AGC 1, AGC 2, AGC 3.	◇ ◆ ◇ ◇	
14.11	Set RF input level to 300 µV.		
14.12	Measure DC voltage at the following contacts:		
	X2A.25 (AGC-LINE), X13 (V_c, front panel), X2A.15 (AGC-BIT-01), X2C.12 (AGC-BIT-11). Possible cause of fault: N14, N9, D11	3.2 V ± 0.5 V ≥ 3.5 V ≥ 3.5 V	
14.13	Check following indications on REM BUS PC:		
	AGC 0, AGC 1, AGC 2, AGC 3.	◇ ◇ ◇ ◆	

No.	Activity	Nominal value	Fault elimination
14.14	Restore factory configurations of jumpers on X90, X42 and X40.		
15.	**Switchover Operation (AF Switchover)**		
	Note: *The following equipment is required for the purpose:* - *2 VHF Rx Units EU 231,* - *2 Power Supplies IN 201A / D and* - *the cross-connection cable from the service kit.*		
15.1	Arrange test setup acc. to Fig. 6.1 (page 6.39).		
15.2	Set switch REM / LOC / OFF on both Rx units to LOC.		
15.3	On Rx unit under test: Set REM BUS address '2' as follows: Set BCD switch S7 to position '2'.		
15.4	On reference Rx unit: Set REM BUS address '3' as follows: Set BCD switch S7 to position '3'.		
15.5	Actuate 'CLOSE 10'.		
15.6	Actuate 'open channel' and enter '11'.		
15.7	At the Rx unit under test feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, levels = 1 µV, 10 µV, 100 µV, modulation depth = 0.3, modulation frequency = 1 kHz.		

No.	Activity	Nominal value	Fault elimination
15.8	At the Rx unit under test feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 200 µV, modulation depth = 0.3, modulation frequency = 400 Hz.		
15.9	Increase the RF input level of the Rx unit under test to 100 µV for all levels stated in step 15.7, one after the other. Possible cause of fault: N17, D16, D19, N19	The AF of the Rx unit under test is inhibited.	
15.10	Check following indications at REM BUS PC: #1 #2	◇ ◆	acc. to 6.4.6
15.11	On the reference Rx unit feed in an RF signal with the following parameters: frequency = set receive frequency, level = 200 µV, modulation depth = 0.3, modulation frequency = 400 Hz.		
15.12	Reduce the RF input level of the Rx unit under test from 100 µV to 1 µV for all levels stated in step 15.7, one after the other. Possible cause of fault: N17, D16, D19, N19	The AF of the Rx unit under test is switched through.	
15.13	Check following indications on REM BUS PC: #1 #2	◆ ◇	
15.14	Actuate 'CLOSE 11'.		

No.	Activity	Nominal value	Fault elimination
16.	**Remote Control 'Parallel'**		
16.1	Set REM bus address '4' as follows: Set BCD switch to position '4'.		
16.2	Actuate 'open channel' and enter '10'.		
16.3	Set switch REM / LOC / OFF to REM.		
16.4	Check indication LOC on REM BUS PC.	☐	acc. to 6.4.6
16.5	Apply a low level to X2A.17 (*SQ ON).		
16.6	Measure DC voltage at X2C.11 (*SQUELCH). Possible cause of fault: D17, D20, N22	≤ 1 V	
16.7	Remove low level from X2A.17 (* SQ ON).		
16.8	Apply a low level to X2B.13 (*OFF-1).		
16.9	Measure DC voltage at D19.10 (*ON/OFF-RX). Possible cause of fault: D20, D17, D19	≥ 3.5 V	
16.10	Remove low level from X2B.13 (*OFF-1).		
16.11	Apply a low level to X2B.14 (*OFF-2).		
16.12	Measure DC voltage at D19.10 (*ON/OFF-RX). Possible cause of fault: D20, D17, D19	≥ 3.5 V	
16.13	Remove low level from X2B.14 (*OFF-2).		

No.	Activity	Nominal value	Fault elimination
17.	**Inband**		
17.1	Apply a low level to X69C.16 (*SQ ON INB).		
17.2	Measure DC voltage at X2C.11 (*SQUELCH). Possible cause of fault: D17, D20, N22	≤ 1 V	
17.3	Remove low level from X69C.16 (*SQ ON INB).		
17.4	Apply a low level to X69A.12 (*OFF/ON-1 INB).		
17.5	Measure DC voltage at D19.10 (*ON/OFF-RX). Possible cause of fault: D20, D17, D19	≥ 3.5 V	
17.6	Remove low level from X69A.12 (*OFF/ON-1 INB).		
17.7	Apply a low level to X69A.13 (*OFF/ON-2 INB).		
17.8	Measure DC voltage at D19.10 (*ON/OFF-RX). Possible cause of fault: D20, D17, D19	≥ 3.5 V	
17.9	Remove low level from X69A.13 (*OFF/ON-2 INB).		

No.	Activity	Nominal value	Fault elimination
18.	**REM Bus (Control Commands)**		
	Note: *The information from the REM Bus is continuously interrogated by the REM BUS PC and is stated for the respective settings.*		
18.1	Activate OFF at the REM BUS PC.		
18.2	Check message OFF on the REM BUS PC.	◆	acc. to 6.4.6
18.3	Measure DC voltage at D19.10 (*ON/OFF-RX). Possible cause of fault: D20, D17, D19	≥ 3.5 V	
18.4	Activate SQL on the REM BUS PC.		
18.5	Check message SQL on the REM BUS PC.	■	acc. to 6.4.6
18.6	Measure DC voltage at X2C.11 (*SQUELCH). Possible cause of fault: D17, D20, N22	≤ 1 V	
19.	**State Ex Factory**		
19.1	Frequency in order?	Set frequency must be the same as the value on the front plate.	

6.4 Troubleshooting and Fault Elimination

6.4.1 Fault: LED TEST is not Illuminated

No.	Activity	Nominal value	Fault elimination
1.	Check LEDs on the front panel. Possible cause of fault: N21, L25 to L27, V39	LED V_{OP} is illuminated	
2.	Measure DC voltage at X104.1 (+ 12V DC1). Possible cause of fault: N21, L25 to L27, V39	+ 12 V ± 0.1 V	
3.	Measure DC voltage at X1.6 (TEST + 12 V). Possible cause of fault: V33, D12	+ 5.2 V	
4.	Measure DC voltage at X1.7 (TEST + 5 V). Possible cause of fault: N20	+ 5 V ± 0.4 V	
5.	Measure DC voltage at X1.8 (TEST -5 V). Possible cause of fault: V40 to V43, D15	≥ 3.5 V	
6.	Measure DC voltage at X1.1 (TEST OSC1) (synthesizer level error). Possible cause of fault: V5 to V7	≥ 3.5 V	
7.	Measure DC voltage at X1.4 (TEST SYNTH) (synthesizer frequency error).	≥ 3.5 V	acc. to 6.4.2
8.	Measure DC voltage at X1.5 (CBIT-RX-1). Possible cause of fault: D12, N13	≥ 3.5 V	
9.	Measure DC voltage at X1.3 (TEST IF).	≥ 3.5 V	acc. to 6.4.3
10.	Measure DC voltage at X1.2 (TEST OSC2). Possible cause of fault: B5, D10	≥ 3.5 V	
11.	Measure DC voltage at X1.9 (TEST REM CONT).	≥ 3.5 V	(in accordance with repair manual for "Inband Interface")

6.4.2 Fault: Synthesizer Frequency or Level

No.	Activity	Nominal value	Fault elimination
1.	**Check the Set Synthesizer Frequency**		
1.1	The receive frequency is set to within the range of 118.100 to 143.975 MHz by means of the rotary coding switches S1, S2, S4, S8 and S9. S9: *100 MHz S8: *10 MHz S4: *1 MHz S2: *100 kHz S1: *12.5 kHz or *8.33 kHz according to the following table: Switch Position S1: Frequency (kHz): 15 91.66 14 87.50 13 83.33 12 75.00 11 66.66 10 62.50 9 58.33 8 50.00 7 41.66 6 37.50 5 33.33 4 25.00 3 16.66 2 12.50 1 8.33 0 0.00 Possible cause of fault: S1, S2, S4, S8, S9, D30		

No.	Activity	Nominal value	Fault elimination
1.2	Alignment of the synthesizer: When LED H5 (red) lights up, turn C31 carefully clockwise. When LED H3 (red) lights up, turn C31 carefully counter-clockwise. Possible cause of fault: V7, V8, C31, N10, N53, N3, H3 to H5, N2, N1	Green LED H4 must light up. Position C31 in middle of the 'green' sector.	
1.3	Measure tuning voltage at lead-through filter Z1.	6 V ± 0.2 V	acc. to no. 1.2
1.4	Measure oscillator level: Connect level measuring instrument (FSA or CMTA) at X22.1 against X22.2 with $R_i = 50\ \Omega$. Possible cause of fault: V5, V6, V7, T1, V8	10 dBm ± 1 dB	
1.5	Measure signal-to-noise shift: Connect modulation analyzer (FMA) at X22.1 against X22.2. Measure signal-to-noise shift with CCITT-weighted filter. Possible cause of fault: D1	< 8 Hz	
1.6	Measure frequency accuracy: Connect frequency counter at X22.1 against X22.2 (allow 30-minute warm-up phase). Possible cause of fault: U5, R502	$\left\lvert \frac{\Delta f_0}{f_0} \right\rvert < 1$ ppm	

6.4.3 Fault: RF / IF Section

No.	Activity	Nominal value	Fault elimination
1.	**RF Section**		
1.1	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 1.0 mV, modulation depth = 0.9, modulation frequency = 1 kHz.		
1.2	Alignment of the input filter. If necessary, align preselector as follows: - Undo and remove protective caps from trimmers C81 to C83 and C91 to C93. ***CAUTION*** ***Do not turn alignment screw fully out! Stop turning immediately as soon as the slightest resistance is felt!*** Alignment:	42 mV	
	- **Low frequency:** Turn rotors of trimmers C81 to C83 and C91 to C93 fully in. - **Medium frequency:** Rotors of trimmers C81 to C83 and C91 to C93 should be at the half-way mark. - **High frequency:** Rotors of trimmers C81 to C83 and C91 to C93 should be approx. 3 mm below the top edge. - Measure DC voltage at test socket V_c using digital multimeter and set to maximum voltage with the trimmers. - Reduce RF input level to 30 µV. - Measure DC voltage at test socket V_c using digital multimeter and set to maximum voltage with the trimmers. - Screw protective caps back on to trimmers C81 to C83 and C91 to C93. Possible cause of fault if alignment fails to be successful: V15, V64, V16		

No.	Activity	Nominal value	Fault elimination
1.3	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, levels = 6 µV, 75 µV, 500 mV (see step 1.4), modulation depth = 0.0,	–	
1.4	Threshold response of the delayed control circuit:		
	Measure DC voltage at X2A.25 at 6 µV RF input level (if necessary, align with R248).	0.72 V ±20 mV	
	Measure DC voltage at X96.1 at 75 µV RF input level.	≤ -0.3 V	
	Measure DC voltage at X96.1 at 500 mV RF input level.	≥ 1.15 V	
	Possible cause of fault, if alignment fails to be successful: N18, N6, N7, V16 to V18, V64		
1.5	Threshold response of IF control circuit:		
	Measure AF voltage at X2B.10 - X2B.11 (AF-RX-A, B).		
	Increase AF level without modulation from 0.3 to 1.5 µV until the AF level drops by 1 dB.	0.7 to 1.2 µV	
	Turn R336 back fully counter-clockwise. If necessary, align the threshold response with trimming value R82. (Range of values: 20 kΩ to 30.1 kΩ)		
	Possible cause of faults: N5, N4, B3, U4, V15		
1.6	Measure RF level at X22.1 against X22.2 (R_i = 50 Ω).	10 dBm ±1 dB	acc. to 6.4.2
1.7	Measure level of 10.7 MHz at X87.1.	0.1 V	
	Possible cause of fault: U4		

No.	Activity	Nominal value	Fault elimination
1.8	Measure level of 10.7 MHz at X25.1. If necessary, adjust the passband curve of the quartz filter by means of coils L21 and L22 as well as trimmers C72 and C73. Configure jumpers: X87.1 / X89.2, X25.1 / X24.1.  ⇒ = jumper, / = open Possible cause of fault if alignment fails to be successful: B3, N4	1.5 V IF bandwidth 6 dB / 80 dB: ≥ 15 / ≤ 50 kHz (mod. 02 / 23) ≥ 7 / ≤ 17 kHz (mod. 22)	
2.	**IF Section**		
2.1	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 1.0 mV, modulation depth = 0.9, modulation frequency = 1 kHz.		
2.2	Measure AF level at N5.15 (AF1). If necessary, align to maximum with coil L22 and adjust with potentiometer R338. Possible cause of fault if alignment fails to be successful: N5	130 mV	
2.3	Measure AF level at X36.1 (N8.1). Possible cause of fault: N8	1.3 V	

6.4.4 Fault: AF Section

No.	Activity	Nominal value	Fault elimination
1.	**AF Control Amplifier**		
1.1	Configure jumper: X54.1 / X54.2 ➡ X54.3. (AF control amplifier on) ➡ = jumper, / = open 		
1.2	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 1.0 mV, modulation depth = 0.3 to 0.8, modulation frequency = 1 kHz.		
1.3	Measure AF level at X36.1 (N8.1).	1.3 V	acc. to 6.4.3
1.4	Measure AF level at X54.2 (AF7) while the modulation depth is being increased from 0.3 to 0.8. If necessary, adjust with potentiometer R193. Possible cause of fault if alignment fails to be successful: V34, N15, N14, V36, V37	210 mV	
1.5	Configure jumper: X54.1 ⇒ X54.2 / X54.3 (control amplifier off) ⇒ = jumper, / = open 		
2.	**AF Bandpass Filter**		
2.1	Set modulation depth to 0.9.		
2.2	Measure AF level at X120.15 (AF8). Possible cause of fault: N16 on filter board	300 mV	
2.3	Measure AF level at X63.1 (AF5). Possible cause of fault: N17		

6.4.5 Fault: Squelch Section

No.	Activity	Nominal value	Fault elimination
1.	**Carrier Squelch**		
1.1	Configure jumpers: X29.1 / X30.1, X29.2 ⇒ X30.2. ⇒ = jumper, / = open		
1.2	Connect X30.1 via a 100-kΩ resistor to + 12 V.		
1.3	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 50 µV.		
1.4	Measure DC voltage at X30.1, while the RF input level is being increased. If necessary, align with potentiometer R159. Possible cause of fault if alignment fails to be successful: N9	≤ 1 V At 150 µV ± 50 µV the voltage changes to ≥ 3.5 V	
2.	**Signal-to-Noise Ratio Squelch**		
2.1	Configure jumper: X29.1 / X30.1, X29.2 ⇒ X30.2. ⇒ = jumper, / = open		
2.2	Feed in an RF signal with the following parameters (socket ANTENNA): frequency = set receive frequency, level = 0 µV.		

No.	Activity	Nominal value	Fault elimination
2.3	Increase RF input level until LED SQUELCH lights up. If necessary, align with potentiometer R168. Possible cause of fault if alignment fails to be successful: N8, N12 or N10, N17, V20, V22 on the filter board	LED lights up from RF input level of 5 µV	
3.	**Set to Basic Configuration**		
3.1	Remove 100-kΩ resistor between X30.1 and + 12 V.		
3.2	Configure jumper: X29.1 ⇒ X30.1, X29.2 / X30.2. ⇒ = jumper, / = open 		
3.3	Set RF input level to 5 µV.		
3.4	Turn control SQ counter-clockwise until the squelch opens.		

6.4.6 Fault: Remote Control Functions

No.	Activity	Nominal value	Fault elimination
1.	**Parallel**		
1.1	Set switch REM / LOC / OFF to REM.		
1.2	Apply low level to X2A.17 (*SQ ON).		
1.3	Measure DC voltage at X2C.11 (*SQUELCH). Possible cause of fault: D17, D20, N22	≤ 1 V	
1.4	Remove low level from X2A.17 (* SQ ON).		
1.5	Apply low level to X2B.13 (*OFF-1).		
1.6	Measure DC voltage at D19.10 (*ON/OFF-RX). Possible cause of fault: D20, D17, D19	≥ 3.5 V	
1.7	Remove low level from X2B.13 (*OFF-1).		
1.8	Apply low level to X2B.14 (*OFF-2).		
1.9	Measure DC voltage at D19.10 (*ON/OFF-RX). Possible cause of fault: D20, D17, D19	≥ 3.5 V	
1.10	Remove low level from X2B.14 (*OFF-2).		

No.	Activity	Nominal value	Fault elimination
2.	**Inband**		
2.1	Set switch REM / LOC / OFF to REM.		
2.2	Apply low level to X69C.16 (*SQ ON INB).		
2.3	Measure DC voltage at X2C.11 (*SQUELCH). Possible cause of fault: D17, D20, N22	≤ 1 V	
2.4	Remove low level from X69C.16 (*SQ ON INB).		
2.5	Apply low level to X69A.12 (*OFF/ON-1 INB).		
2.6	Measure DC voltage at D19.10 (*ON/OFF-RX). Possible cause of fault: D20, D17, D19	≥ 3.5 V	
2.7	Remove low level from X69A.12 (*OFF/ON-1 INB).		
2.8	Apply low level to X69A.13 (*OFF/ON-2 INB).		
2.9	Measure DC voltage at D19.10 (*ON/OFF-RX). Possible cause of fault: D20, D17, D19	≥ 3.5 V	
2.10	Remove low level from X69A.13 (*OFF/ON-2 INB).		

No.	Activity	Nominal value	Fault elimination
3.	**REM Bus (Control Commands)**		
	Note: *The REM Bus messages are constantly interrogated by the REM BUS PC and are stated for the respective settings.*		
3.1	Set switch REM / LOC / OFF to REM.		
3.2	Check indication local on the REM BUS PC. Possible cause of fault: D18, D19	□	
3.3	Output message OFF on the REM BUS PC.		
3.4	Measure DC voltage at D19.10 (*ON/OFF-RX). Possible cause of fault: D20, D17, D19	≥ 3.5 V	
3.5	Check indication OFF on the REM BUS PC. Possible cause of fault: D18, D19	◆	
3.6	Output message SQL on the REM BUS PC.		
3.7	Measure DC voltage at X2C.11 (*SQUELCH). Possible cause of fault: D17, D20, N22	≤ 1 V	
3.8	Check indication SQL on the REM BUS PC. Possible cause of fault: D18	■	

6.5 Replacement of Components

WARNING

Do not open the Rx unit unless the voltage is switched off!

6.5.1 Opening of VHF Rx Unit EU 231

Undo and remove eight Phillips screws on each screening cover (top and bottom). Take off screening covers.

6.5.2 Replacement of Individual Components

WARNING

Do not remove any components from the VHF Rx unit unless the voltage is switched off!

For the replacement of conventional components use standard soldering and desoldering equipment.

The replacement of components is carried out in line with common workshop practice Special instructions are not needed.

However, the VHF Rx unit contains electrostatic-sensitive devices (ESD) and surface-mounted devices (SMD).

Please take note of the following:

CAUTION

For the replacement of electrostatic-sensitive devices, such as MOS, MOSFET and similar devices, a specially equipped CMOS work station is required (see section 6.1.4).

Note:

- *During soldering on PCBs the metal foil may come away from the basic material if too much heat is applied. For this reason soldering times should be kept as short as possible.*
- *Charred, melted or burnt components, wire insulation or PCBs must be replaced. Components, discoloured as a result of heat, must be thoroughly checked in order to determine whether their technical characteristics are impaired. If so, the respective components must be replaced.*
- *Printed circuits, showing mechanical damage or broken tracks, must also be replaced.*

The replacement of SMDs or other miniature components follows common workshop practice. Special instructions are not needed.

Use the following tools for the replacement of SMDs:

- SMD soldering station,
- SMD desoldering station,
- SMD solder compound and
- SMD fitting tools such as
  - vacuum tool,
  - pair of pliers,
  - pair of pincers.

Following the replacement of components it is absolutely essential to carry out the final check according to 6.6.

6.5.3 Closing of VHF Rx Unit EU 231

Closing of the Rx unit is in the reverse order to the opening described above.

6.6 Final Check

Following any repairs VHF Rx Unit EU 231 must be subjected to a final check in order to ensure that its technical data are still guaranteed.

For the final check carry out the entire initial checks. If the final checks are satisfactory, repairs on the interface may be regarded as completed.

However, if the given nominal values are not obtained, repeat the troubleshooting according to 6.4.

6.7 Interface Description

A detailed description of the interfaces of VHF Rx Unit EU 231 is found in the appendix to this manual.

The description of interfaces offers the following information:

- contact assignment of connectors,
- signal designations and
- signal levels.

Details given in the column "remarks" regarding test points and terminals are provided for use in repairs.

ROHDE&SCHWARZ

Radio Communications Division

FCC ID: KVW60431942

User Manual

VHF TRANSCEIVER 25 W
XU 221

6043.9343.22 to 27
6043.9343.42 to 47

8.33 / 25-kHz Version

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Dear Customer,

You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.
The Rohde & Schwarz quality management system is certified according to ISO 9001.

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Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.
Le système de gestion qualité de Rohde & Schwarz a été homologué conformément à la norme ISO 9001.

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ROHDE&SCHWARZ
EC Certificate of Conformity

CE

Certificate No.: 9502182

This is to certify that:

Equipment type	Order No.	Designation
XU221	6043.9343.xx	VHF Transceiver

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)

- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC)

Conformity is proven by compliance with the following standards:

EN60950 : 1992 + A1 : 1993
prETS 300339

Affixing the EC conformity mark as from 1995

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 04.12.95

Central Quality Management FS-QZ / Becker

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FCC ID: KVW60431942

EVALUATION OF MANUALS

here: **User Manual, Id. No. 6075.6491.12.xx, VHF TRANSCEIVER 25 W XU 221**

Dear Sirs,

we constantly try to improve our technical manuals, so that you, our customer gets the best possible benefit from them.

In order to become better, we need your help and your opinion on the manuals. Therefore, we would like you to evaluate the accompanying manual and tell us your opinion about it. In order to make the job easy for you, we have designed the following matrix. Please tick where appropriate.

1. What is your general impression of the manual?

☐	☐	☐	☐	☐
lousy	not so good	quite ok	good	excellent

2. How do you assess the detail and depth of information in general?

☐	☐	☐	☐	☐
far too detailed	too much information	all information contained	not enough information	important items missing

3. How do you assess the size of the manual in general?

☐	☐	☐	☐	☐
far too bulky	a bit too thick	appropriate to the equipment	a bit too thin	too little information

4. How do you assess the structure of the manual?

☐	☐	☐	☐	☐
opaque	difficult to understand	quite ok	easy to find information	very user friendly

5. How do you assess the understandability (language) of the manual?

☐	☐	☐	☐	☐
very difficult to follow	complicated language	normal to understand	easy to understand	very user friendly

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EVALUATION OF MANUALS

User Manual, Id. No. 6075.6491.12.xx, VHF TRANSCEIVER 25 W XU 221

6. How do you rate the number of illustrations?

far too many	a bit too many	just about right	could be more	not enough illustrations
☐	☐	☐	☐	☐

7. How do you rate the quality of illustrations?

lousy	not so good	quite ok	good	excellent
☐	☐	☐	☐	☐

8. How do you assess the balance of text to illustrations?

lousy	not so good	quite ok	good	excellent
☐	☐	☐	☐	☐

Further Comments and Suggestions for Improvement:

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Date / Signature / Department

ROHDE&SCHWARZ

Radio Communications Division

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0797

Safety Notes

This unit was built and tested in compliance with the enclosed EU Certificate of Conformity and left the factory in perfect condition as far as technical safety is concerned. In order to maintain this condition and guarantee safe operation, the user has to observe all notes as well as cautionary and warning information.

1. Operate the unit only in the operating states and positions specified by the manufacturer allowing sufficient ventilation. If not agreed otherwise, the following applies for R&S products:

   Contamination level 2, class of overvoltage protection 2, IP system of protection 2X, operation up to 2000 m altitude

   Operation is only permitted on supply networks fused with not more than 16 A.

2. For measurements in circuits carrying voltages > 30 V_{rms} take appropriate preventive measures so that any hazard can be excluded (e.g. suitable measuring equipment, fusing, current limiting, grounding, insulation etc.).

3. When a unit is installed and cabled for stationary operation, first of all establish the connection between the local protective ground contact and the equipment ground contact before any other connection. (Installation and cabling are to be carried out by qualified personnel only).

4. For stationary units without integrated fuse, circuit breaker or similar protection fuse the power circuit to provide sufficient protection of both equipment and user.

5. Before switching the unit on, make sure that the set nominal voltage and the available nominal mains voltage are identical. If a change of the voltage setting becomes necessary, also replace the respective mains fuse of the unit, as necessary.

6. For units of class of protection I with flexible mains power cord and connector, operation is only permitted on power outlets with protective ground contact and grounding conductor connected.

7. Any deliberate interruption of the grounding conductor both in the feeder and in the unit itself is inadmissible and can render the unit dangerous. When using extension cords or multiple outlets ensure that they are regularly checked for their safety condition.

8. If the unit is not fitted with a mains power switch for disconnection from the mains, the connector on the connecting cable is to be regarded as the disconnecting device. In such a case ensure that the mains connector is within reach and easily accessible at any time (length of connecting cable approx. 2 m). Function switches or electronic switches are not suitable for mains disconnection. If units without mains power switch are integrated into racks or systems, the disconnection facility is to be provided on system level.

9. In all operations observe the relevant local or national safety rules and regulations for accident prevention. Before carrying out any work on or opening a unit disconnect it from the mains.

   Alignment, replacement of components, maintenance and repair are to be carried out only by expert staff authorized by R&S.

   For replacement of safety-relevant components (e.g. power switch, mains transformer or fuses) only original parts are to be used. After each replacement of such safety-relevant components a safety check will have to be carried out (visual examination, check of grounding conductor, check of insulation resistance, leakage current measurement, functional check).

10. Also observe additional safety notes in this Manual.

Symbols Used on R&S Equipment and in Manuals:

Please observe operating instructions!

Equipment mass for units with a mass > 18 kg

Protective ground contact, for protection only

Ground contacts

Caution,
Voltage involving shock hazard

Caution,
High temperature, Caution, Hot surfaces

Ground

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First Edition and Revisions

First edition .....01 ..... March 1996
Fifth revision .....06 ..... October 1998

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List of Abbreviations

A = address line, e.g. A1
A = ampere
AC = alternating current
AC / DC = alternating current / direct current
AC IN = AC input
AD-Select = address selection
AF = audio frequency
AF-Mike = audio frequency microphone
AF-Rx = audio frequency receiver
AF-Tx = audio frequency transmitter
AGC = automatic gain control
ALC = automatic level control
AM = amplitude modulation
AMP = amplifier
ANT = antenna

B = bidirectional
BLW = blower
BNC = connector designation

CAR = carrier
CBIT = continuous built-in test
CH = channel
CL = clock
CONV = conversion

D = data line, e.g. D1
DA = data
DA-Select = data selection
dB = decibel
DC = direct current
DC / AC = direct current / alternating current
DC / DC = direct current / direct current
DC IN = DC input
DIGI IN = digital input
DIGI OUT = digital output
DMIC = dynamic microphone
DIL = dual in-line
DISF = display forward power
DISM = display modulation

DISR = display reflected power
DSP = digital signal processor

EEPROM = electrically erasable and programmable read-only memory
EMC = electromagnetic compatibility
EN = enable
EPROM = erasable programmable read-only memory
EU = R&S designation for VHF receivers
EXT = external

FET = field effect transistor
FI = frequency input
FM = frequency modulation
F = designation for fuse, e.g. F2
GA = R&S designation for handsets
GD = R&S designation for circulator sets
GF = R&S designation for synthesizers
GI = R&S designation for interfaces
GM = R&S designation for modulators and similar modules
GND = ground

HCMOS = high-speed complementary metal oxide semi-conductor
Hz = hertz

I = input
IC = integrated circuit
ICAO = International Civil Aviation Organization
IEC = International Electrotechnical Commission
IBIT = initiated built-in test
IN = input

KA = R&S designation for service kits
kHz = kilohertz
KK = R&S designation for cases
KR = R&S designation for adapters
KS = R&S designation for mating connector sets
kW = kilowatt
LED = light-emitting diode
LOC = local, e.g. local control
LP = lowpass filter, e.g. LP1
LSB = least significant bit

m = modulation
MHz = megahertz
MIC = microphone
Mod = modulation
Mod = model
MSB = most significant bit
MUX = multiplexer

NB / WB = narrowband / wideband
NOPTT = no PTT (PTT see under PTT)
NORM = normal

O = output (with interfaces)
OC = oscillator
OCXO = oven-controlled crystal oscillator
OK = okay
ONCE = on-chip emulator
OPT = optocoupler
OPTO = optocoupler
OSEL = output select
OUT = output

PC = Personal Computer
Pc / W = RF output power in watt
PD = R&S designation for data sheets
PE = protective earth
PLL = phase-locked loop
PLOW = power low
ppm = parts per million
PTT = push-to-talk = carrier activation
PTT-INT = PTT interrupt

RAM = random access memory
RED = reduction
REL = relay, e.g. REL1
REM = remote, e.g. remote control
REM BUS = remote bus
RF = radio frequency
RI = reference input
RS = interface standard, e.g. RS 422
Rx = receiver
RxD = receive data
Rx / Tx = transceiver

S = R&S designation for switches, e.g. S30
SA = R&S designation for parts list
SCL = system clock
SDA = system data
SDAI = system data input
SDAO = system data output
SMA = connector designation
ST = R&S designation for connectors, e.g. connector ST3
SU = R&S designation for VHF transmitters
SYNTH = synthesizer
SYSTEST = synthesizer test

TCXO = temperature-compensated crystal oscillator
TestIB = test inband
TEMP = temperature
TTL = transistor-transistor logic
TR1 = transformer 1
Tx = transmitter
TxD = transmit data
Tx / Rx = transceiver

U-DEF2 = user-defined input or output, e.g. 2
UHF = ultrahigh frequency
USER-DEF-1 = user-defined input or output, e.g. 1
V = volt
VAC = volt alternating current
VCO = voltage-controlled oscillator
VDC = volt direct current
VDE = Verband Deutscher Elektrotechniker (association of German electrical engineers)
VFO = variable frequency oscillator
Vrms = root-mean-square voltage
VHF = very high frequency
VK = R&S designation for amplifiers
VMIC = amplifier microphone
VOP = operating voltage
VSWR = voltage-standing wave ratio

W = watt

X = R&S designation for connectors, e.g. X1
XU = R&S designation for VHF transceivers

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Definitions

Check	In appropriate measurements by means of the specified test equipment proper functioning of a unit or module is established.
Discolouration	Components such as e.g. connectors and printed circuit boards are examined if they have changed colour due to temperature effects and thus differ widely from their normal condition.
Disconnect	Pull off connector.
Examine	In case of trouble the unit / module or components such as e.g. connectors, are to be thoroughly checked for obvious mechanical damage.
Functional check	This means that components / modules / units are checked for proper functioning while installed.
Hazardous voltages	Voltages > 30 V_{rms} or 50 V_{pp} (AC) or 50 V (DC)
Make sure	Ascertain whether all mentioned requirements are met or all measures are taken to establish the required condition.
Open	Access is to be gained to the unit / module by observing the given instructions and safety precautions.
Perfect condition	This means that a component / module / unit has to be in a state which does not give cause to complaints.
Replacement	In case of trouble the replacement of modules is carried out in order to localize and eliminate the fault.
Replace	Components / modules / units which - due to damage and / or other defects - no longer meet the respective requirements or components / modules / units which during troubleshooting were identified as the cause of fault, are to be replaced.
REM BUS	The REM BUS is a serial bus connection defined by R&S for remote control. Via the REM BUS all units belonging to the 200 series can be remote-controlled without the need of additional options.
Rx REM BUS	The Rx REM BUS is a particular means for interconnection of the 200 series receivers and their combination with the integrated multicoupler. The receivers and the multicoupler form a unit which is remote-controlled via the REM BUS.

5-km REM BUS	The REM BUS Drive Unit GV 201 additionally offers a 5-km REM BUS. To the REM BUS drive unit transmitters, receivers and transceivers can be connected. This permits the units of the 200 series to be remote-controlled over distances of up to 5 km without the need of modems.
Visual examination	This is a visual inspection of the outer appearance and completeness of a component / module / unit without manual interference by the examiner. This does not include the necessary preparations and finishing work such as e.g. opening and closing of covers or similar.

Display Types

The different display types used in this User Manual are preceded by the following headings:

WARNING

This heading is used to indicate that inaccurate observance or nonobservance of instructions or methods can cause injuries or even fatal accidents. It may also lead to hazardous substances escaping into the unit or system.

CAUTION

This heading is used to indicate that inaccurate observance or nonobservance of instructions or methods can cause damage to the unit.

Note:

This heading is used to draw the reader's attention to a particular fact.

This User Manual contains three displays classified as "Warning", namely

WARNING

- ***Beware of risk of explosion when using isopropyl alcohol.***

  Make sure to work in a well ventilated room when cleaning with isopropyl alcohol.

- ***Wear goggles when working with compressed air in order to avoid any injuries to the eyes.***

WARNING

Before opening the cover make sure that the mains connector has been pulled off!

WARNING

Beware of touching the heat sink during transmission where temperatures may rise as high as 70 °C!

User Information

Purpose of the Manual

This Manual provides all information the operators and service staff need to maintain levels 1 and 2 of repairs.

It contains all necessary information and instructions concerning the installation, putting into operation and control of the unit, plus troubleshooting instructions down to module level. In case of trouble this allows straightforward error localization as well as easy replacement of the module concerned. This permits the unit to be put back into proper working order and operation with minimum delay.

We recommend to keep complete spare units / modules in store.

Measuring Units

In this Manual the basic SI measuring units and units coherently derived from them are used by preference. In exceptional cases units legally derived from the SI units acc. to DIN 1301 may also be used.

User Manual

VHF TRANSCEIVER 25 W
XU 221

CHARACTERISTICS

Data Sheet, Application, Design and Functioning of the Transceiver, Design and Functioning of Modules

PREPARATION FOR USE

Unpacking and Checking, Accessories, Operating Functions Set Ex Works on Individual Modules, Cabling

OPERATION

Start-up and Test, Local Control, Remote Control, Function of Controls and Indicators

MAINTENANCE AND TROUBLESHOOTING

Maintenance, Troubleshooting, Visual Examination, Troubleshooting Table, Replacement of Modules

APPENDIX

1: Settings
2: External Interfaces