ROHDE&SCHWARZ
Broadcasting Division

Operating Manual

TV TRANSMITTER

NH 6050 V 5 kW

Solid State

Band IV/V

2086.0207

5 kW TV Transmitter NH 6050 V may only be operated and maintained by skilled personnel.

Note:
Any troubleshooting or repair of the transmitter system not described in this manual may only be carried out by service personnel.

Printed in Germany

ROHDE&SCHWARZ

EC Certificate of Conformity

CE

Certificate No.: 2000-09

This is to certify that:

Equipment type	Stock No.	Designation
NH6050E/V	2086.0207.xx	TV Transmitter 5 kW Bd.4

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, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN60215 : 1993
ETS 300447 / 1997

Affixing the EC conformity mark as from 2000

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Central Quality Management FS-QZ / Becker

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1 Safety Instructions

1.1 Introduction

Caution: The safety instructions given in this manual must be adhered to.

Observe the following:

- All electrical installations and connections are to be carried out only by skilled personnel.
- When outfitting operating rooms as well as setting up and operating electrical equipment follow the relevant national and international safety instructions and regulations.
- The following safety regulations apply:

  IEC 364
  VDE 0100
  DIN 57100

  These safety regulations concern:

  - safety precautions for the prevention of accidents
  - safety precautions against overvoltage
  - insulation of electrical equipment and systems
  - grounding of electrical equipment and systems
  - procurement and laying of electrical lines and cables
  - regulations for special operating rooms and systems

- When setting up the rack observe the relevant safety precautions for the prevention of accidents. These precautions especially relate to the following:

  - danger of getting crushed when working with loads
  - danger of falling off ladders while working
  - danger of getting hurt or injured when lifting heavy loads

- **Water-cooled transmitters:**

  When filling and installing the cooling system (pump unit and cooler) observe the regulations for handling hazardous substances (coolant), see section 1.9.

You will be reminded of potential sources of danger in the relevant sections of this manual.

1.2 General

Rohde & Schwarz is continually striving to improve product safety to protect customers more and more effectively. Our transmitters and the auxiliary equipment that is required are built and tested to IEC215/EN60215 and IEC950/ EN60950 which are the relevant safety standards. Our quality assurance department regularly checks if these standards are met.
In addition to the above measures, the following supplementary safety instructions are provided to warn the user about hazards associated with transmitters. These safety instructions are over and above all those safety regulations and instructions which are prescribed by law and must be fully implemented.
Compliance with all legal requirements is a prerequisite for operating radio equipment and systems. The user, or his representative, must ensure that these requirements are met. He should also ensure that operators have the appropriate training and qualifications. This includes obligatory briefings at regular intervals.
To ensure safe operation the user/operator shall observe all instructions and warnings on the product and in this documentation. If there is any doubt, our service centers or the relevant local safety organizations will provide support.
In accordance with IEC215/EN60215, this radio transmitter and auxiliary equipment shall be operated only by qualified technical personnel. The minimum qualifications are stipulated in the standard.

This R&S product has been designed and tested in accordance with the EC Certificate of Conformity and left the manufacturer in a condition fully complying with safety standards.

To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings in this operating manual.

1. The unit/system may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:
   IP safety class 2X, contamination level 2, overvoltage category 2, max. altitude 2000 m.
   The measuring equipment may only be powered from networks with max. fusing of 16 A.
2. For measurements in circuits with voltages V_{rms} > 30 V AC or V > 60V DC, suitable measures should be taken to avoid any hazards.
   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical isolation, insulation).
3. If the unit is to be permanently connected, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made (installation and cabling of the unit to be performed only by qualified technical personnel).
4. With permanently installed units without integral fuses, circuit breakers or similar protective devices, the supply circuit must be fused so as to provide suitable protection for the users and equipment.
5. Prior to switching on the unit, ensure that the nominal voltage set on the unit matches the nominal voltage of the AC supply.
   If a different voltage is selected, it may be necessary to change the fuse.
6. Safety class I units with disconnectible AC supply cable and unit connector may be operated only from a power socket with a protective earth contact which has the PE conductor connected.
7. Do not interrupt the PE conductor, neither in the cabling nor in the unit itself as this is dangerous.
   Any extension lines or multiple connectors that are used must be checked for compliance with relevant safety standards at regular intervals.
8. If the unit does not have a power switch to disconnect it from the AC supply, the plug of the connecting cable is regarded as the disconnecting device.
   In such cases, ensure that the power plug is easily accessible at all times (length of connecting cable approx. 2 m). Function or electronic switches are not suitable for disconnecting the AC supply.
   If units without power switches are installed in racks or integrated into systems, the means of disconnection must be at the system level.
9. Local and national safety regulations and accident prevention regulations must always be observed..

Prior to performing any work on the unit or opening the unit, the unit must be disconnected from the supply.

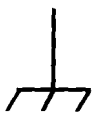
Any adjustments, part replacements, maintenance or repairs may be carried out only by authorized R&S technical personnel.

Only original parts may be used to replace safety-critical parts (eg power switches, power transformers, blowers, fuses). A safety test must be performed whenever a safety-critical part is replaced.

(visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, function test).

10. Ensure that connections to IT equipment comply with IEC950 / EN60950.
11. Any additional safety instructions in this manual must also be observed.

Symbols used on equipment and in documentation from R&S:

						
Follow operating instructions	Weight of units >18 kg	PE terminal	Ground terminals	Danger! Shock hazard	Warning! Hot surface	Ground

1.3 AC Line Hazards

Any voltage V_{rms} > 30V AC or V > 60V DC is a potential hazard. Take appropriate measures to avoid any danger when working with hazardous voltages. As a rule, never work on live parts. It is only permissible to work on live parts under exceptional circumstances and if special safety precautions have been taken.

Power Supply

- Prior to connecting power supply ensure that the AC line data on the product matches the data of the available supply. Fuses or other devices in the supply circuit must guarantee overload and short-circuit protection.

A transmitter may well have several separate power circuits. The following instructions apply to each power circuit:

- All transmitter power circuits have to be connected to the power supply so that the transmitter:
  - can be disconnected at any time
  - can be secured against reconnection
  - is connected to a correctly rated and fused power line [1])
  - and that the rotating field is correctly applied (sense of rotation of blower motors)

The transmitters are usually provided with a socket in the operator's area to connect measuring equipment or a soldering iron. This socket is still live when the transmitter is switched off. Service sockets of this kind are marked as such and should be used only for the purposes mentioned previously. The socket can only supply a limited power as would be expected from its function.
The socket is not suitable for operating heaters or large test systems.

[1]) *Refer to this documentation for performance data and observe the limited switching capacity of fuses and cut-outs in the transmitter.*

- The user is responsible for correct fuse protection (socket marked with maximum value).

- As far as accessories that are not switched with the whole transmitter are concerned, the user is responsible for the measures to ensure safety in the switching state in question.

Replacement of fuses

- The transmitter fuses accessible in the operator area may be replaced with the transmitter turned off. They should be replaced only by fuses with the same electrical specifications, the same switching specification and the same cut-off capacity.
- The protective switches accessible in the operator area may be actuated. If their response range can be adjusted, the setting performed by the manufacturer should not be modified. In case of unintentional misadjustment, the correct setting values are indicated in this documentation.

Emergency off

- At the customer's request, the transmitters can be equipped with an emergency switch which is not operational when the transmitter is delivered. The user should ensure that it operates safely and integrate it into the emergency-off system in the control room as required by the relevant regulations. It must be removed if it is not used as emergency switch as originally intended.
- Important! A transmitter usually has several independent power circuits (main circuit / power for accessories (eg CCU, antenna switch) / power for sockets without switches). The user is responsible for the correct integration of all these circuits into his emergency-off system. Circuits that are not integrated should be marked as such.
- Do not install a transmitter that has an emergency switch that is inoperative.

Opening the transmitter

- When the transmitter is opened to perform mechanical/electrical work (e. g. cleaning, repairs, etc.) the 5 basic rules relating to work on electrical systems must be observed:

1. Disconnect
2. Secure against reconnection
3. Check that no components are live
4. Ground or short-circuits ***²)***
5. Cover neighbouring active circuits

²) *Not all transmitter types can ground or short-circuit by means of grounding or short-circuit switches. If there is no grounding or short-circuiting device, the technician should achieve the same result by measures he deems appropriate.*

CAUTION!
A transmitter usually has several independent power circuits (main circuit / power for accessories (eg CCU, antenna switch) / power for sockets without switches / external interlock circuit, if any). Check the state of the circuits before beginning any work. Disconnect neighbouring circuits to prevent any accidental contact.

- Disconnect the antenna or antennas as well. **Caution!** Other active transmitters which are connected to the same antenna (via RF diplexers) may feed back energy down the antenna cable.
- It is strictly forbidden to open a transmitter which has not been completely disconnected if no measures have been taken to avoid contact with live parts.
- Operation with doors open, front panels unscrewed or plug-ins extracted, etc. is forbidden because of possible contact with the AC line voltage.
- If the transmitter is in operation to carry out internal measurements or repairs, cordon off the work place and post signs warning of possible hazards according to the basic electrical engineering rules. Unauthorized persons should be prevented from entering this area by appropriate measures. After the work has been completed, close the transmitter and restore all safety devices provided by the manufacturer for protection against accidental contacts. Immediately check for correct operation of protective devices (eg interlocks).

CAUTION: Effects of RF radiation on personnel (Chapter 1.5)
Low-impedance operating voltage sources (Chapter 1.4)

1.4 Danger from High-Energy Circuits

A transmitter has low-voltage circuits which can be fed by a very low-impedance voltage source (eg heating circuit in tube transmitters, operating voltage of the output and preamplifiers in transistorized transmitters). These circuits carry large quantities of energy. They must be considered to be voltages that constitute a shock hazard. Normally, they are covered to prevent accidental contact. The covers are marked appropriately.
When the cover of a transmitter that is in operation is removed, there is danger from accidental shorts. A short-circuit generates an electric arc which causes burns, blinding light and further injuries due to the involuntary actions of the person concerned.
Practical experience shows that a short-circuit caused by a metal tool is capable of causing major burns.

- Therefore, no high-energy circuits can be accessed from the operator's work area for safety reasons.

CAUTION!
- Disconnect the operating voltage before removing covers of this kind.
- Wait for 5 minutes to ensure that electrolytic capacitors have discharged adequately.
- Do not discharge electrolytic capacitors by short-circuiting them.

If the voltages have to be measured (eg for repairs or to optimize the power taken by the transmitter), proceed using the same precaution as would be employed for the measurement of hazardous operating voltages (use appropriate protective equipment, if necessary).

1.5 RF Hazards

- The user shall instruct his personnel how to operate the transmitter in compliance with standard EN 60215 (IEC 215). These briefings must deal with the RF hazards associated with transmitters. Operators are only authorized to operate transmitters after they have received proper instruction.

In the transmitter, high-energy RF circuits are fed through common RF connectors (eg N). Depending on the output power, the transmitter outputs are fitted with screw-in RF lines or waveguides.
If RF lines or modules are carrying high powers, the connection point, or the whole module, displays the general danger sign (yellow triangle with black exclamation mark).

CAUTION!
- Never unscrew RF lines when the transmitter is in operation.
- Never open modules displaying the danger sign when the transmitter is in operation.

If RF lines which are in operation are disconnected, electric arcs may be generated and cause burns and eye injuries.

- Never put the transmitter into operation when RF lines are open-circuited.

RF power is output when one tries to put the transmitter into operation. If RF conductors are opened, the transmitter switches off the RF. This attempt to output RF may constitute an injury hazard even if the emission of RF is limited and of short duration due to technical measures implemented in our transmitters.

- The antenna must also be disconnected when the transmitter is switched off.

Note that energy may be fed back on the antenna line, eg from other active transmitters connected to the same antenna (via RF diplexers).

- This transmitter is shielded so that there is no danger from RF radiation even in its immediate vicinity. This applies to statutory provisions in Germany, the regulation concerning electromagnetic fields: 26th regulation of the Federal Immissions Act dated 16.12.96 (26. BImSchV)
  - electric field strength ≤ 27.5 V/m at 10 to 400 MHz
  - magnetic field strength ≤ 0.073 A/m at 10 to 400 MHz

Caution:
If an opened transmitter is switched on and covers and shields with the common warning sign have been removed, dangerous RF levels are radiated.

The responsibility lies with the user to allow his personnel to work and stay at the open and switched on transmitter even if he has taken the necessary safety measures:

⇒ Marking to indicate a work place with RF hazard

⇒ Wearing RF protective clothing

1.6 Fire Risk

There is a risk of fire presented by any live electrical if there is sufficient energy conversion which is the case with radio transmitters. It is, therefore, necessary to establish a safety concept to handle fires in radio transmitters.
Operating personnel must be trained in techniques for fighting fires in electrical systems and repeat fire drills at regular intervals.
Training and drills must meet VDE 0132 and be coordinated with local fire departments.This applies to Germany.
Preventive measures on-site can reduce fire hazards to a large extent and effectively curtail the fire spreading.

CAUTION!

- On installing the transmitter, the user shall ensure that no combustible materials are stored or fitted beneath or above the cable entry. Openings to neighbouring rooms must be sealed so as to prevent fire spreading.
- Firefighting must be performed only with special equipment (eg breathing apparatus with air bottle) even if there are no or few flames.

This is mentioned not only because of the extremely toxic and imperceptible carbon monoxide gas produced by every fire, but also because of the materials in the transmitter which, when flames and heat are applied, produce extremely dangerous toxic fumes, gases and dust such as sulphuric acid and hydrogen sulphide, hydrochloric acid, dioxins, hydrofluoric acid and beryllium oxide dust:

- Rubber in cables, cable sleeves, shock absorbers and equipment feet
- PVC in cables and lines
- PUR (foam) in insulators, moulded parts, sealing mats and insulating strips
- Teflon in cables, lines, insulation and PCBs
- Beryllium oxide ceramics in power transistors and resistors

Generally speaking, the hazard presented by toxic substances in small imperceptible smouldering fires and in fires where combustion is obviously taking place is equally great.

1.7 Safety Instructions for Handling Beryllium Oxide Ceramics

- Parts containing BeO ceramics are not a health hazard provided that safety regulations are followed.

CAUTION!

Parts made from BeO ceramics shall not be machined, ie neither scored, crushed, broken, filed, drilled, ground, heated nor sandblasted even under extractor hoods. BeO dust passes through all common filtering systems including conventional breathing apparatus filters. Particle filter P3 should be used for efficient filtering. There are no technical processes to remove BeO dust that has been released into the environment.

- Parts made from BeO ceramics shall not be opened nor destroyed.
- BeO dust causes a chronic lung disease (berylliosis). Prolonged inhalation at high levels causes poisoning with respiratory paralysis and ultimately death.

We mark all parts containing BeO ceramics in the components list, the circuit diagram and in the transmitter.

- The component list contains the following text:

Berylliumoxid Hinweise beachten Observe Instructions

- The circuit diagram contains the full warning:

Achtung! Hinweise zur Sicherheit beim Umgang mit Teilen aus Berylliumoxid-Keramik beachten Attention! Observe safety instructions for handling parts made from beryllium oxide ceramics

- All the modules with parts containing BeO ceramics are marked with a warning sign and a text warning.

"BERYLLIUM OXIDE Sicherheitshinweise beachten Observe safety instructions"

Measures to deal with breakage and disposal
If BeO dust has formed as a result of a fracture or any other mechanical or electrical process that results in destruction, remove the dust with a damp rag and put it, together with the pieces, into plastic bags which are then sealed. Wear protective gloves for this purpose. The bags shall be marked with the danger symbol and the appropriate text.

Skull and crossbones"

Berylliumoxid-Staub Beryllium oxide dust

They shall be disposed of as special waste according to the waste disposal regulations in force. Desoldered components containing BeO ceramics shall also be disposed of in the same way. Defective parts containing BeO ceramics can be returned free of charge to all manufacturers we know of.

1.8 Lithium Batteries

The system comprises high-power lithium batteries which save the selected device status and ensure proper functioning of the real-time clock. The lifetime of the battery depends on the type of operation (rated for approx. 5 years) and should be exchanged if required (eg after a longer storage at higher temperature).

The following should be noted in connection with handling lithium batteries:

Caution:

- ✓ Batteries must be kept away from children.
- ✓ Lithium batteries must not be exposed to high temperatures or fire.
- ✓ Short circuits and recharging as well as improper exchange of the battery must at all costs be avoided (danger of explosion).
- ✓ Do not open used cells. The cells are hazardous waste and must be disposed of in special containers.
- ✓ A discharged battery may only be exchanged by a battery of the same type (Rohde & Schwarz).

1.9 Safety Data Sheet for Cooling Fluid

Safety data sheet in accordance with 91/155/EEC

1. Identification of the Substance/Preparation and Company

Trade name:
Antifrogen N Wassergemisch 44 %
Name of company:
GHC GERLING, HOLZ & CO. HANDELS GMBH
Ruhrstrasse 113
D-22761 Hamburg

Telephone No.: ++49(0) 40-853123-0

Emergency telephone No.: ++49(0)40-853123-0

2. Composition and Information on Ingredients

Chemical composition:
Monoethylene glycol (1,2-ethane diol) and inhibitors in aqueous solution (44% active)
Hazardous ingredients:
Ethane diol:

Concentration:	44.0000		
CAS number:	107-21-1		
Hazard symbols:	Xn		
R phrases:	22		

Sodium nitrite:

Concentration:	<0.2000 %		
CAS number:	7632-00-0		
Hazard symbols:	T	N	O
R phrases:	8	25	50

3. Hazards Identification

Harmful if swallowed.

4. First Aid Measures

General information:	Remove stained or soaked clothing immediately
After contact with skin:	In case of contact with skin wash off immediately with plenty of water
After contact with eyes:	In case of contact with eyes rinse thoroughly with plenty of water and seek medical advice
After ingestion:	Allow the patient to vomit of his own accord only if fully conscious. Summon a doctor immediately.

5. Fire-Fighting Measures

Suitable extinguishing media:
Product itself is non-combustible. Fire extinguishing method of surrounding areas must be defined.

6. Accidental Release Measures

Methods for cleaning up/taking up:
Pick up with absorbent material (eg sand, siliceous earth, acid binder, universal binder, sawdust).
Dispose of as prescribed.

7. Handling and Storage

Advice on protection against fire and explosion The product is not combustible.
Storage stability:
Storage time: >24 months

8. Exposure Controls and Personal Protection

General protective measures:
Do not inhale vapours:
Hygiene measures:
Keep away from foodstuffs and beverages.
Hand protection:
Protective gloves
Eye protection:
Safety glasses

9. Physical and Chemical Properties

Form	liquid
Colour	light yellow
Odour	perceptible
Freezing point	approx. -30 °C method: DIN 51583
Boiling temperature	approx. 106 °C
Flash point	none
Ignition temperature	none
Vapour pressure	<0.1 mbar (20 °C)
Density	1.075 g/cm^3 (20 °C)
Solubility in water	miscible
pH value	7.8 to 8.3
Viscosity	4 mPa $\times$ s (20 °C)

10. Stability and Reactivity

Thermal decomposition:
>20°C
Hazardous reactions:
Incompatible with oxidizing materials

11. Toxicological Information

Acute oral toxicity:
LD50 4.000 mg/kg (rat)
Source: IUCLID
Information based on the main components.
Irritant effect on skin: non-irritant
Irritant effect on eyes: slightly irritant

Remarks: Vapours and mists cause irritation/burns to eyes, arid respiratory tract.
There is a possibility of kidney damage.
Poisoning affects the central nervous system.
The data on toxicology refer to the active ingredient.

12. Ecological Information

Biodegradability: 90%
good degradability
Method : Zahn-Wellens test
Fish toxicity: LC50 1.500 mg/l (golden orfe)
Remarks: If handled correctly it causes no disturbance in treatment plants.
The ecological number information is based on the undiluted product.

13. Disposal Considerations

Product: In accordance with local authority regulations, transport it to special waste incineration plant.

14. Transport Information

AOR not restricted
RID not restricted
ADNR not restricted
IMDG not restricted
IATA not restricted

15. Regulatory Information

Labelling in accordance with GefStoffV/EC
Hazard warning labelling compulsory.
Classification according to the "Listing Principe" of the guidelines for preparations (88/379/EEC).
Hazard symbols:
Xn Harmful
Hazardous component(s) to be indicated an label: Ethane diol
R phrases:
22 Harmful if swallowed.

S phrases:
26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
28.2 After contact with skin, wash immediately with water and soap
37/39 Wear suitable gloves and eye/face protection.
National regulations: - - -
Other regulations: vbF: not fixed.

16. Other Information

This information is based on our present state of knowledge. It should not therefore be construed as guaranteeing specific properties of the products described or their suitability for a particular application.

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2 Characteristics

2.1 Description

2.1.1 General

TV Transmitter NH 6050 V serves for the transmission of colour TV programs in line with NTSC, or PAL methods (SECAM on request) in band IV/V and operates according to split vision-sound amplification. It is suitable for the transmission of two sound carriers.

In the Exciter (see chapter 3) the input signals for vision and sound are modulated to the set channel frequency and then preamplified.

The amplifier stages generate the output power required for emission via the antenna. Nonlinearities in the amplifier stage are compensated by the precorrector circuit in the exciter to obtain linear transmission with a minimum of intermodulation products.

A harmonics filter is used to suppress harmonic spurious.

An external filter which strongly suppresses unwanted spurious is used to ensure that the stipulated spectral mask is adhered to. This filter may be an individual channel filter or part of a multichannel diplexer. It is not part of the equipment supplied with the transmitter but can be ordered as accessory, if required.

The transmitter is operated via a control circuit. It can also be controlled via the remote-control interfaces.

The power required for transmitter operation is provided via the AC supply which has to comply with the specifications to ensure troublefree operation. The built-in power distribution ensures that the appropriate supply voltage is reliably fed to all units and circuits within the transmitter rack.

A remote-control unit can switch on and off the transmitter and monitor the operating status.

For the protection of the personnel, the transmitter can be immediately switched off by means of emergency keys.

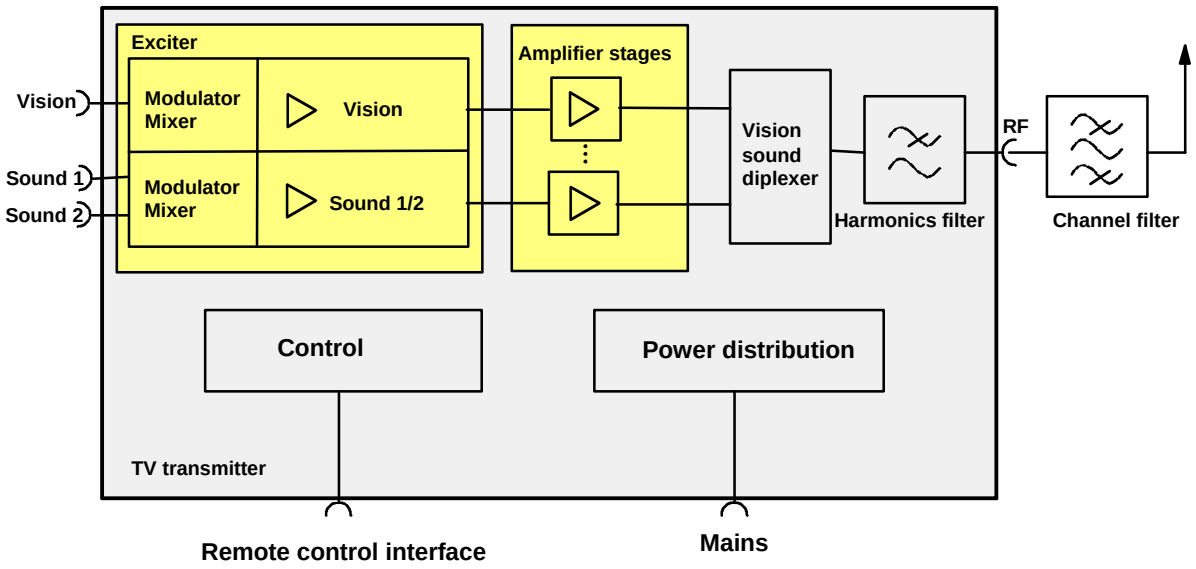


Fig. 1 *Simplified block diagram of TV transmitter*

The transmitter rack comprises the following modules:

- Transmitter control panel and control unit
- Exciter SD200 and blower unit for exciter
- Rack control unit
- 3 UHF vision amplifiers and 1 UHF sound amplifier (with integrated power supply and fan)
- Power splitter and coupler (with absorption resistors)
- Power distribution
- Harmonics filter, colour trap (option) and channel filter (option)
- RF rectifier
- Vision sound diplexer
- Directional coupler

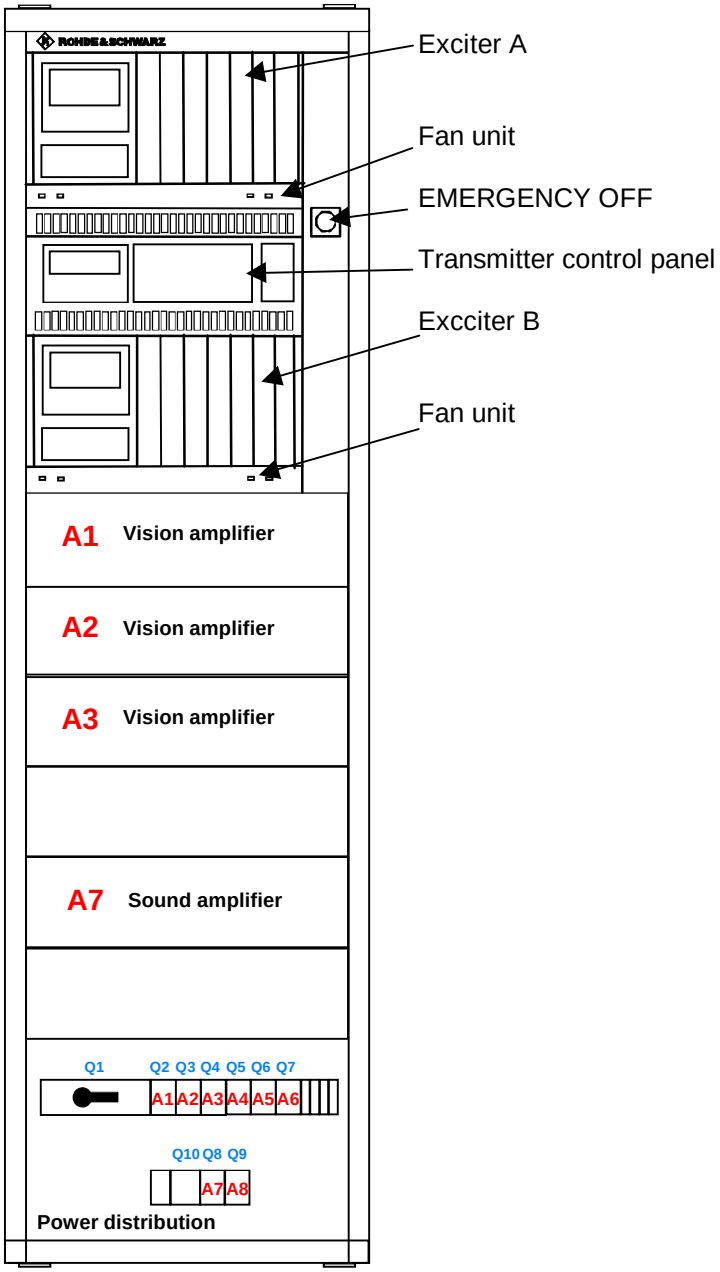


Fig. 2 Front view of TV Transmitter NH 6050 V

2.1.2 Signal Path

See also circuit diagrams in section 10.

This transmitter operates in the UHF range.

SD200 is used as exciter. SD200 consists of a precorrector circuit for the VF input signals and modulator stages, mixers and preamplifiers for the vision and sound signals. For design and operation of the individual circuits see section 3.

The amplifier stages consist of three Amplifiers VH602 for the vision signals, connected in parallel, and one Amplifier VH602 for the sound signals. This parallel connection ensures fail-safe operation. The power supply is integrated into an amplifier plug-in. The transmitter is liquid-cooled. For design and operation of this amplifier see section 4.

The driver signal (vision) of the exciter is taken to the amplifiers via an RF distributor. The distributor designated "A40" (see Fig. 3) is at the rear of the transmitter.

The sound signal is taken directly to the sound amplifier and next to the vision sound diplexer (see Fig. 4).

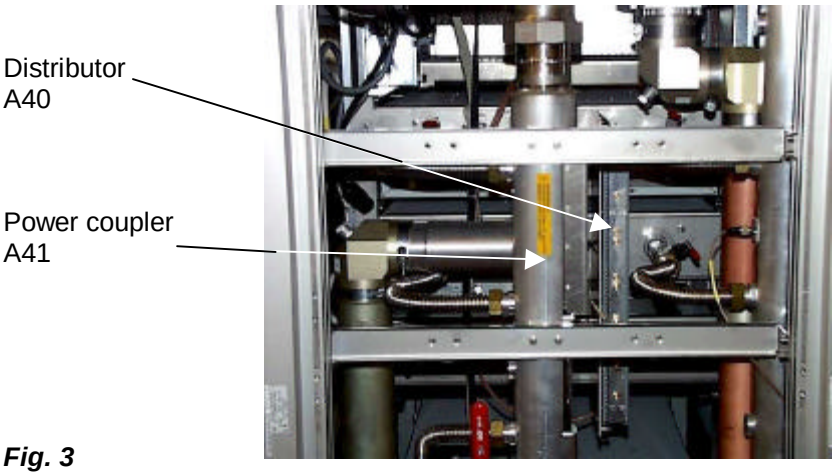


Fig. 3

The vision output power of the 3 amplifier plug-ins is added up in power coupler A41 to obtain the transmitter output power. The power coupler is located directly behind the amplifiers so that no cabling susceptible to interference is required. The absorption resistors for balancing the coupler paths are located on the distributor pipe of the cooling circuit and are thus also cooled.

At the power couplers A41, a pipe is running via the trimming line A47 towards the vision sound diplexer and the following harmonics filter A45. Two types of filter are available:

FD 410	for the	band IV	and
FD 411	for the	band V.	

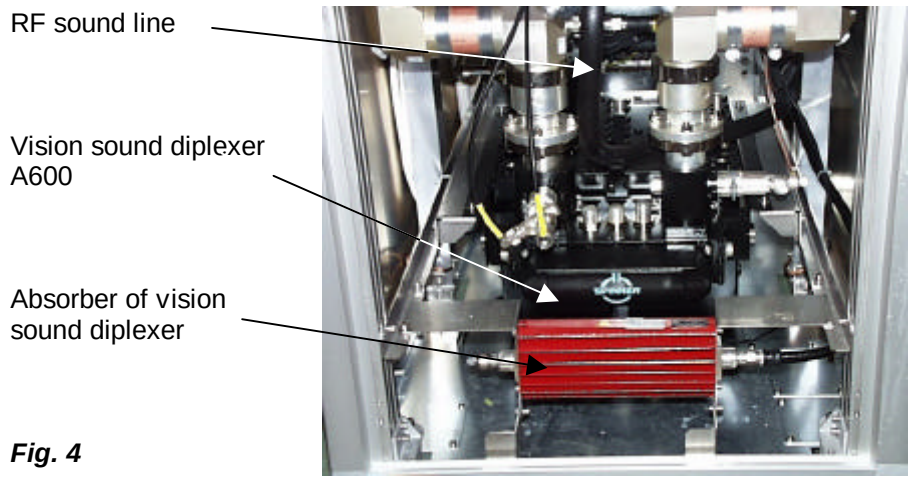


Fig. 4

From the harmonics filter, a pipe runs upwards to the channel filter (Option) resp. to the directional coupler system P14 - type GD058 - (see Fig. 5) for measuring the forward and reflected power. The coupled-out signals are taken to the transmitter control unit via an RF rectifier A55A.

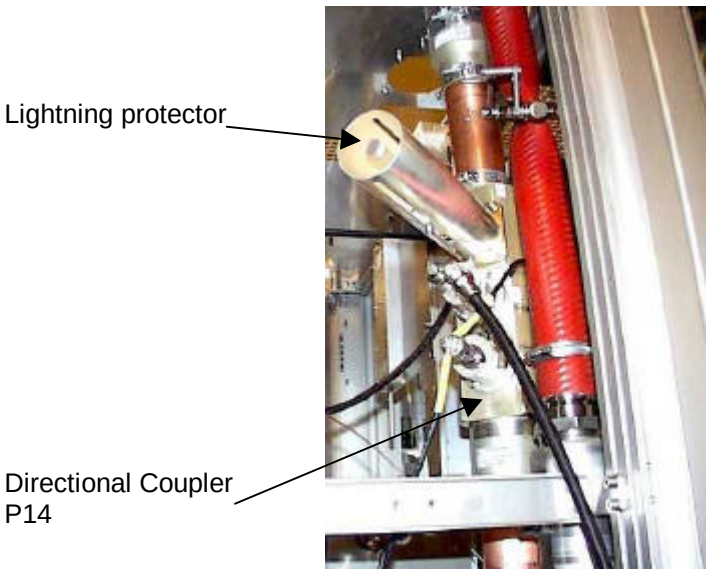


Fig. 5

The RF rectifier (see Fig. 6) is located behind the exciter on a vertical support. A free test point is available for measurements.

RF rectifier A55A

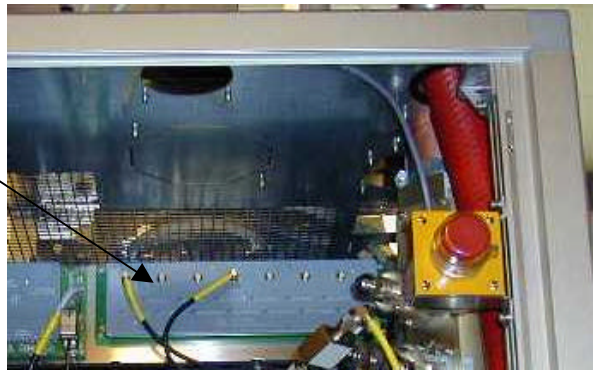


Fig. 6

A protective circuit (see Fig. 5) is integrated into the directional coupler P14 to protect the transmitter against lightning striking the transmit antenna. The protective circuit consists of an angular piece of pipe (located below the transmitter top). The pipe is designed so that an RF signal passes without any problem but that a flash of lightning is shorted.

2.1.3 AC Supply

The AC power connector of the transmitter is provided at the bottom of the rack front. The cut-outs and the main switch are visible at the front panel. Both power distribution are located behind the front panels (see Fig. 7). The modules are named "A31" and have the type designation KG610H1. See section 11 for a circuit diagram of the power distribution.

Power distribution ...

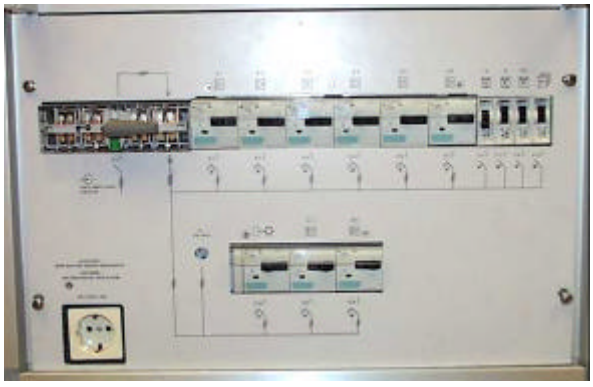


Fig. 7

2.1.4 Operation and Control

The transmitter is operated via the control panels of the transmitter and the exciter (see Fig. 8). Settings at the coder set are made via a serial RS232 interface using the supplied PC program. See section 6 for the position of the individual control elements and for a description of the individual menus of the user interface. Section 11 gives an overview of the control cables. One of the most important elements is the rack control unit (see Fig. 9) which is accommodated below the transmitter top. For an overview of all possible settings and menu items see section 7.

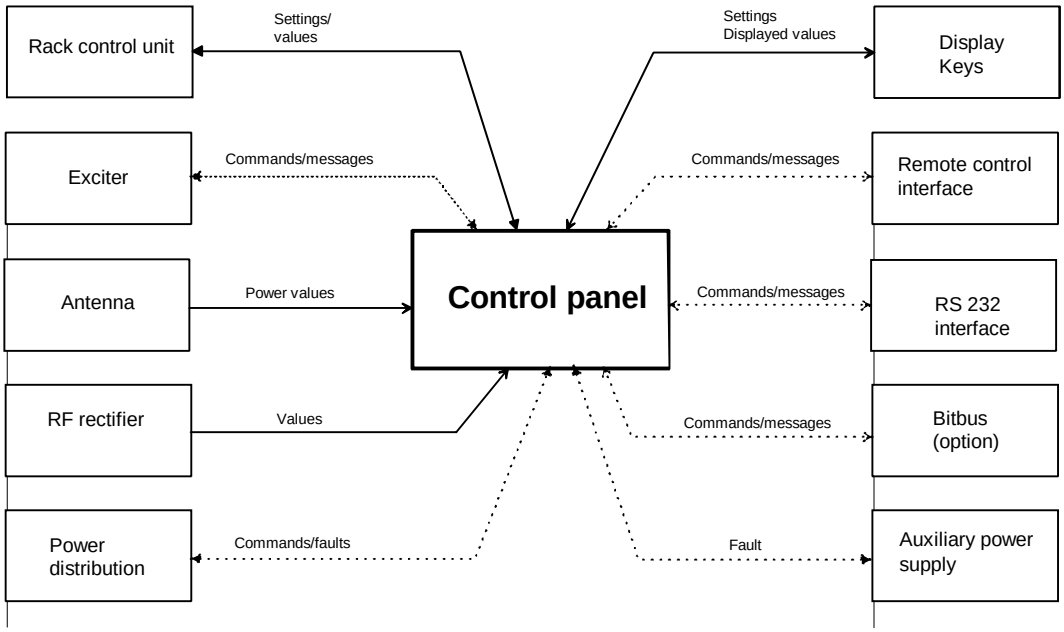


Fig. 8

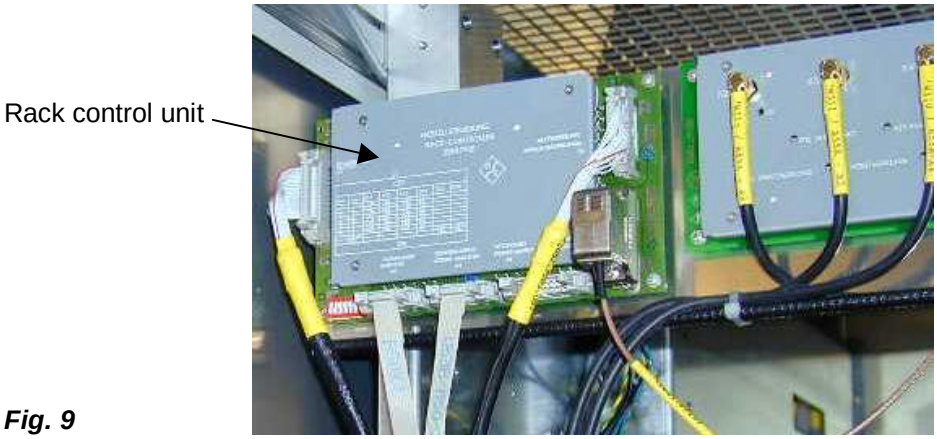


Fig. 9

Various remote-control interfaces are available on the transmitter top (see Fig. 10).

A serial interface is provided at the transmitter top. The optional parallel remote interface is also installed at the transmitter top.

The function of these remote interfaces is described in section 9.

For security reasons, the RF carrier should be switched off if certain situations occur outside the transmitter, eg if certain jumpers are opened. In this case, an external RF carrier loop can be switched into the transmitter. Similar protective circuits also exist within the transmitter. See section 10 for an overview of RF carrier loops.

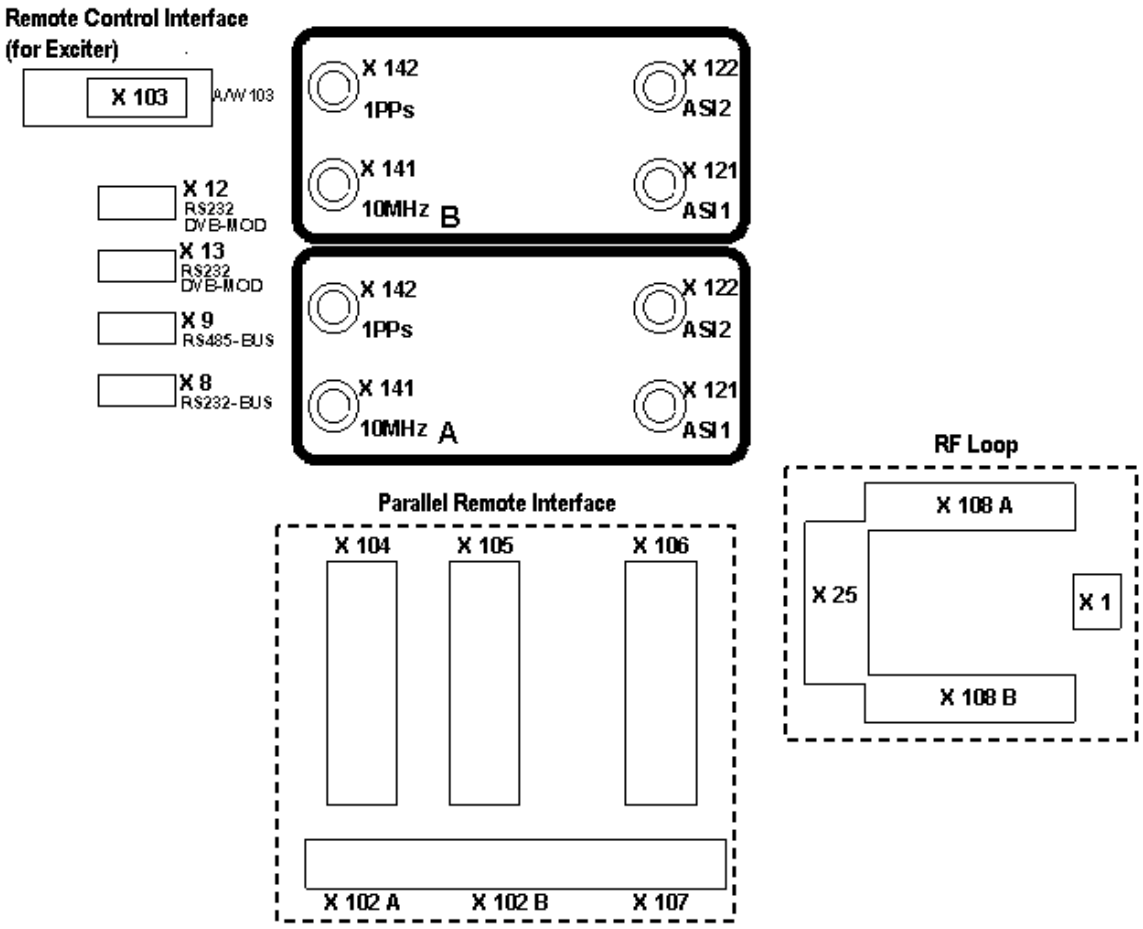


Fig. 10 *Junction panel, transmitter top*

2.1.5 Cooling

Despite the optimized efficiency of this transmitter there is a large amount of waste heat in the amplifiers that has to be dissipated. With transmitters of the NV6000 family heat is dissipated via an especially efficient liquid cooling system. This system made for the compact rack design.

Cooling is performed in a closed circuit (see Fig. 11). The external part of this circuit (pump unit and cooler) is described in a separate manual.

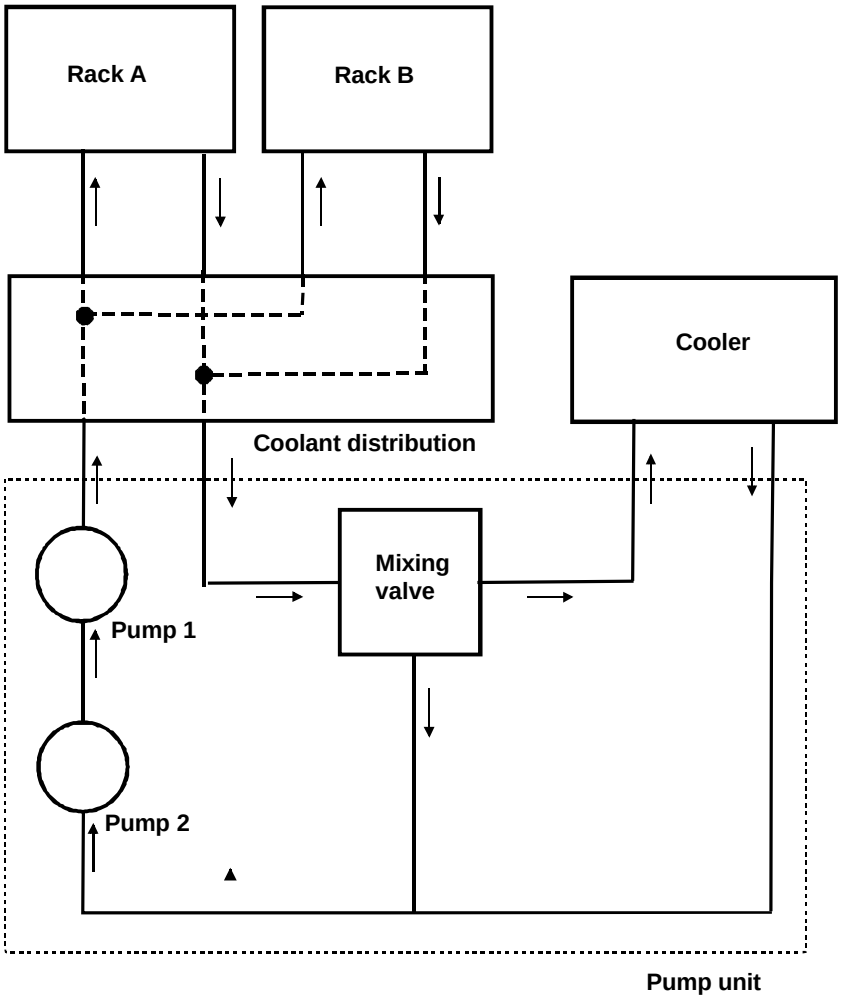


Fig. 11 *Pump unit, block diagram (example)*

The coolant is supplied via an inlet pipe provided on the right-hand side at the rear of the rack. The coolant is taken to the amplifier plug-ins via a distributor and short connections. The liquid passes the heatsink in the amplifiers several times. Sources of heat like transistors or absorption resistors are directly located at the cooling pipes.

The coolant is then taken to a collector which has an outlet pipe.

The temperature difference between inlet and outlet is only 3 °C. The temperature is monitored via a probe provided at the inlet pipe.

Easy-lock connectors were chosen as a transition between the amplifier and cooling circuit in the rack to allow easy module replacement if required. Additional stopcocks between the cooling circuit and the plug-ins can be installed as an option.

2.2 Specifications

2.2.1 Transmitter System in General

Output power
- vision sync peak ..... 5 kW
- sound 1 ..... 250 W
- sound 2 ..... 50 W

Dimensions of transmitter (HxWxD) ..... 2200 mm x 630 mm x 1200 mm

Power consumption without cooling system
- all black picture ..... approx. 14 kW
- grey picture (50 % APL) ..... approx. 10.5 kW

Power consumption of cooling system
- Pump unit ..... approx. 0.8 kW
- cooler (water/air) ..... approx. 0.8 kW

Coolant quantity ..... approx. 72 l/min

Heat dissipation via cooler
- all black picture ..... approx. 10 kW
- grey picture (50 % APL) ..... approx. 8 kW

Heat dissipation to the room ..... approx. 0.5 kW

HF connector ..... $1\ ^{5}/_{8}$ EIA

2.2.2 Tranmitter Series NH 6000

Vision/sound amplification	split/combined
Frequency range	470 to 860 MHz
Standards	G, K, I, M, N
Colour system	PAL, NTSC, SECAM
Sound transmission	dual sound coding to IRT or FM single sound or FM sound 1 and NICAM 728
Output-stage technology	LDMOS transistors
Coolant	demineralized water / Antifrogen N for further information see manufacturer's documentation of the pump unit
Max. installation altitude	2000 m above sea level (3000 m on request)
Operating temperature range	-30 to +45 °C
Permissible air humidity	95 %
AC supply voltage	3x 400 V / 230 V +10 % /-15 % 3x 380 V / 220 V +15 % /-10 %
Line frequency	50 Hz ± 2 %
Power factor	cosφ 0.87 min.
Total noise level	< 60 dBA max.

Vision

VF inputs	2 x; R_{in} = 75 Ω
VF input level	1 V_{pp} / 0,7 V_{pp} ±30 %
VF regulation	using line 17, 18, 19 or 330, 331, 332
Range of regulation	±30% (the amplification set last is maintained in case of signal failure)
White-level limiter	90 to 100 % picture signal
Sync-pulse regeneration	for sync signal V ≥ 150 mV_{pp}
VF input matching	34 dB

Sound

AF inputs	2 x ; balanced or unbalanced
	R_{in} ≥ 10 kΩ / 600 Ω
AF input level	-10 to +10 dBu
Nominal deviation	20 to 75 kHz (at 6 dBu input level)
AF lowpass filter	15 kHz, can be switched off
Preemphasis	50 µs or 75 µs

Connectors

VF inputs	BNC
AF inputs	3-contact (DIN 15931)
VF and IF testpoints	BNC
RF testpoints	N
RF output	7/16, 13/30 or EIA 7/8“

(other connectors on request)

Transmitter protection facilities

VF input monitoring (sync pulse width, period, amplitude)

Reflection monitoring
Amplifier and power supply monitoring
Overtemperature of power amplifier
Air flow monitoring
Inlet/outlet air temperature monitoring
AC voltage monitoring
Smoke detector (Option)

Interfaces
RS232 for exciter data transfer

Remote control
IEC/IEEE bus
Serial interface RS 485 / Bitbus acc. 864-1 IEC (option)
Parallel interface

2.2.3 Exciter SD200

Type of modulation	C3F; F3E
RF output power	2 x 0.25 to 2 W (split amplification) 0.25 to 2 W visionsync peak (combined amplification)
Frequency processing	
Synthesizer (LO)	62.5 to 1000 MHz, adjustable in 12.5-Hz steps for precision offset
IF vision carrier frequencies	32.7 to 45.75 MHz, selectable in 50-kHz steps, depending on TV standard
IF sound carrier frequencies	vision IF - n x 1/2 line frequency
for vision IF of 32.7, 37, 38.9 or 45.75 MHz	n = 0 to 999, selectable in 7.8125-kHz steps
Stability with int. reference	1.2×10^{-7}/3 months
Short-term stability	2×10^{-9}
Pull-in range	2×10^{-6}
Setting accuracy	2×10^{-9}
Precision offset	integrated, 12.5 Hz steps
Reference frequency	1, 2, 5 or 10 MHz
Ref.-frequency input	0.1 to 1.5 V/50 Ω
Return loss	26 dB to 10 MHz
Vision channel	
Return loss	36 dB up to 6 MHz (also applies if no operating voltage is available)
Crosstalk between VF inputs	≥80 dB up to 6 MHz
Max. DC voltage level	±5 V
Input for external test signals	optional 1; 1 V_{pp}/75 Ω
Max. DC voltage level for blanking value	0 V ±0.3 V
VF test outputs	4; 1 V_{pp}/75 Ω at each VF input, output of VF unit output of VF precorrector
IF test outputs	1; 100 $mV_{sync\ peak}$/50 Ω, can be switched over from SAW filter output to delay equalizer output 1; 100 to 200 $mV_{sync\ peak}$/50 Ω, linearity precorrector output
White-level limiter	90 to 115% picture signal; can be switched off
Sync-pulse regeneration	for sync signal min. 150 mV_{pp}

Sync-pulse amplitude control ..... amplitude adjustable to
(at transmitter output)..... 20 to 32% sync (RF)

Test signal insertion ..... optional

VF input monitoring..... monitoring of sync-pulse width, period and amplitude

Transmission characteristics

Linearity parameters:

Group-delay (demodulated)..... ±30 ns up to 4.8 MHz

Receiver precorrector..... to CCIR Rec. 624-4, can be bypassed and replaced

Pulse response:
Tilt 50 Hz ..... ≤1.5%
Tilt 15 kHz..... 1%
2T pulse amplitude..... ≤1.5%
2T k-rating..... ≤1.5%
C/L amplitude..... ≤1.5%

Linear output-stage precorrection:
Amplitude frequency response ..... ±1 dB
Group delay ..... 6 poles for diplexer precorrection (split vision/sound amplification), max. 700 ns for ±25 ns up to 4.8 MHz

3 poles for output filter precorrection (combined vision/sound amplification) max. 100 ns for ±25 ns up to 5 MHz

Nonlinear transmission characteristic:
Luminance nonlinearity to CCIR 17 ..... ≤ 3%
ICPM picture-signal range ..... ≤1°
sync range ..... ≤2°
Differential gain (CCIR 330) ..... ≤3.5%
Differential phase (CCIR 330) ..... ≤2°

Nonlinear output-stage precorrection:
Amplitude..... 40 %
Phase..... 30 °

AM S/N ratio
(referred to 10 to 75% modulation)
Noise (without demodulator)
unweighted, 0.2 to 5 MHz..... ≥60 dB
weighted, CCIR Rec. 567 ..... ≥66 dB

Hum (without demodulator)
peak voltage up to 1 kHz..... ≥52 dB

Intercarrier S/N ratio
(ref. to 30 kHz deviation at 500 Hz,
modulation 10 to 75%)

sinewave up to 100 kHz	≥52 dB
all-black picture, H+V	≥56 dB
FuBK test pattern	≥52 dB

Sound channel:

Dual-sound coding to IRT	controlled from data line (word 5, bits 1 and 2), coder functions can be bypassed
AF inputs	AF 1, AF 2, $R_{in} \geq 10$ kΩ, balanced or unbalanced, can be switched as coder or modulator input
AF input level	-10 to +10 dBu, for +6 dBu at AF test output or for selected nominal deviation
Setting accuracy	0.1 dB
Unbalance rejection	≥50 dB (30 Hz to 1 kHz) ≥42 dB (1 kHz to 15 kHz)
AF test outputs	AF 1 (L + R)/2 AF 2 (R) acc. to coding +6 dBu/100 Ω
Selectable nominal deviation (for +6 dBu at AF test output)	±20 kHz to ±75 kHz, (resolution 100 Hz)
Deviation symmetry	resolution 30 Hz
Deviation limitation	±120 kHz for ±30 kHz nominal deviation
Deviation indication	peak value, charge/discharge time constant 1 x 10^{-4}
Indication accuracy, (ref. to ±30 kHz deviation for deviations ±0.5 to ±50 kHz)	2 % for mod. frequencies up to 15 kHz 3 % for mod. frequencies up to 54 kHz

Pilot signal generation:

Pilot carrier frequency	
synchronized	3.5 x f_{line}
free-running	54.6875 kHz ±10 Hz
Pilot carrier level	-15.6 dBu for ±2.5 kHz deviation,
(unmodulated, in channel 2)	adjustable from ±12.6 dBu to 18.6 dBu
Modulation with identification signal	AM 50% ±10%, adjustable

Sound mode:
Mono unmodulated
Dual-sound ..... modulated with 274.1 Hz (line frequency/57)
Stereo ..... modulated with 117.5 Hz (line frequency/133)

Identification frequencies ..... derived from pilot carrier

Transmission characteristics:
AF lowpass filter ..... 15 kHz, disconnectible
Preemphasis ..... 50 µs/75 µs, depending on standard
±0.2 dB (30 Hz to 10 kHz)
±0.3 dB (30 Hz to 15 kHz)

Modulation-frequency response
(without pre- and deemphasis)
Coder functions on ..... ≤±0.3 dB (30 Hz to 15 kHz)
Coder functions bypassed ..... ≤±0.2 dB (30 Hz to 20 kHz)
≤+0.2/-0.4 dB (30 Hz to 56 kHz)
≤+0.2/-1.0 dB (30 Hz to 100 kHz)

Crosstalk:
Stereo
(R--L, deviation R = ±30 kHz) ..... ≥48 dB (30 Hz to 15 kHz)
Dual-sound
(up to ±55 kHz deviation
determined by selective measurement) ..... ≥80 dB (30 Hz to 15 kHz)

Modulation distortion ..... ≤0.3% (30 Hz to 15 kHz, ref. to 30 kHz deviation)

Intermodulation distortion
(for ±50 kHz deviation)
d2 ..... ≤0.3%
d3 ..... ≤0.4%

FM S/N ratio
unweighted ..... ≥68 dB (ref. to 30 kHz deviation)
weighted ..... ≥70 dB (ref. to 30 kHz deviation)

AM S/N ratio
synchronous, unweighted ..... ≥40 dB (ref. to 100% AM)
(for ±50 kHz deviation)
asynchronous, unweighted ..... ≥50 dB (ref. to 100% AM)

Split vison/sound amplification

	Single-sound mode	Dual-sound mode
Vision carrier power (sync peak)	1 W w/o correction	1 W w/o correction
Sound carrier power	2 W max.	0.5/0.1 W w/o correction
Harmonic emissions	≥66 dB*	≥66 dB*
Spurious emissions outside vision channel	≥66 dB*	≥66 dB*
Intermodulation products from two sound carriers ...	-----	≥60 dB

Intermodulation products outside operating channel	≥60 dB	≥60 dB

Note: * = applies to exciters operated as transmitters with an additional filter at the output.

Interfaces

IEC/IEEE bus	selection of measurement mode via transmitter test rack
RS-232/RS-485	communication with Control Unit GS 125, can be extended to all internal data communication
RS-232 (front panel)	access via PC user software for configuration and setting of exciter and for basic alignment of plug-ins
Remote-control interface, dual-sound coder	optional, for sound data transfer to and from coder via floating parallel interface

Power supply

Operating voltage	115/230 V +10/-15%, 43 to 62 Hz
Power consumption	190 W (for 2 x 2 W RF)
RFI suppression	VDE 871, curve B
Storage temperature range	-20 to +50°C
Operating temperature range	0 to +45°C
Dimensions	483 mm x 223 mm x 498 mm (19"/5 HU)
Weight	28 kg

CONTENTS

3 Exciter SD200 .....3.1

3.1 Design.....3.1

3.2 Operation.....3.2

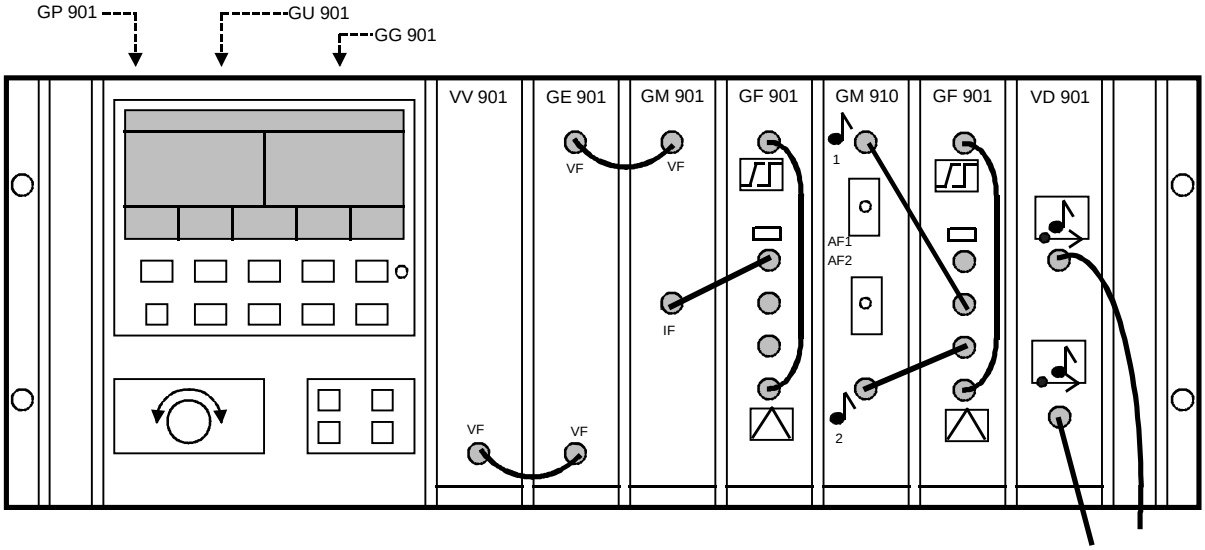
3 Exciter SD200

3.1 Design

The TV Exciter SD200 is a 19-inch rackmount accommodated in a frame of five height units. It mainly consists of the following plug-ins:

For the function of the operating and diplay elements see section 5.

KR 901-Z1	Fold-out display unit, menu-control keys and spinwheel
VV 901	VF Unit
GE 901	VF Precorrector with receiver precorrector
GM 901	Vision Modulator with vestigial sideband filter and group delay equalizer
GF 901	Mixer with linearity precorrector (vision)
GM 910	Sound Modulator
GF 901	Mixer with linearity precorrector (sound)
VD 901	2×1-W Amplifier vision and sound band IV/V
GP 901	Processor (behind display unit)
GU 901	Monitor (behind display unit)
GG 901	Synthesizer (behind display unit)
FD 901	Channel filter band IV/V (in rear part of frame)
IN 901	Power Supply (in rear part of frame)



Exciter SD 200

3.2 Operation

Exciter SD 200 comprises several function blocks which will be described in detail in the following. See block diagram on next page.

The TV Exciter is used in TV transmitters with split vision/sound amplification for driving subsequent solid-state drivers and output stages. It operates in band IV/V and delivers a drive power of 1 W for vision and sound. The TV Exciter is designed for the IRT dual-sound method and can be optionally equipped for the NICAM-728 standard.

Control, regulation and monitoring facilities effectively protect transistor transmitters against excessive power or damages, including those caused by non-standard input signals and inadmissible operating conditions.

Most of the plug-ins contain microprocessors, which are controlled by a master processor. All settings are made electronically supported by suitable software. Changes of setting parameters, such as basic settings, level adjustments and output-stage-specific precorrections are carried out using the keys and the spinwheel of the display unit. Once the settings have been determined, eg for precorrection of nonlinear errors of the power output stages, they are stored in a non-volatile memory and can be defined as nominal values.

The video signal is taken to and processed in ***VF Unit 901***. When used together with the appropriate option, this unit allows the insertion and blanking of test signals as well as VF gain control by means of the luminance bar in the test line. The electronic switchover between two VF signals and the limitation of the input signal in the case of superimposed DC fluctuations are effected at the input. DC restoration is performed either by black-level or sync-level clamping. The sync pulse is regenerated by shaping a new pulse and the previous pulse is separated. Black-level and white-level limitation as well as monitoring of the sync pulse and the luminance bar in the input signal are also carried out in the VF unit. Status signals are issued, if parameters under- or overrange electronically set thresholds.

A digital section integrated in the VF unit and equipped with its own microcontroller controls and monitors all internal functions and communicates with the peripherals within the exciter via an RS-485 bus. An I^2C bus is used for the control of VF Precorrector GE 901 and of an optional test line adapter.

The ***VF Precorrector GE 901*** accommodates the receiver precorrector in compliance with the TV standard used. The ***receiver precorrector*** is screwed to the GE 901 plug-in and, therefore, can be replaced separately. The precorrector, which represents the standardized inverse characteristic of the receiver, can be bypassed by means of a software instruction.

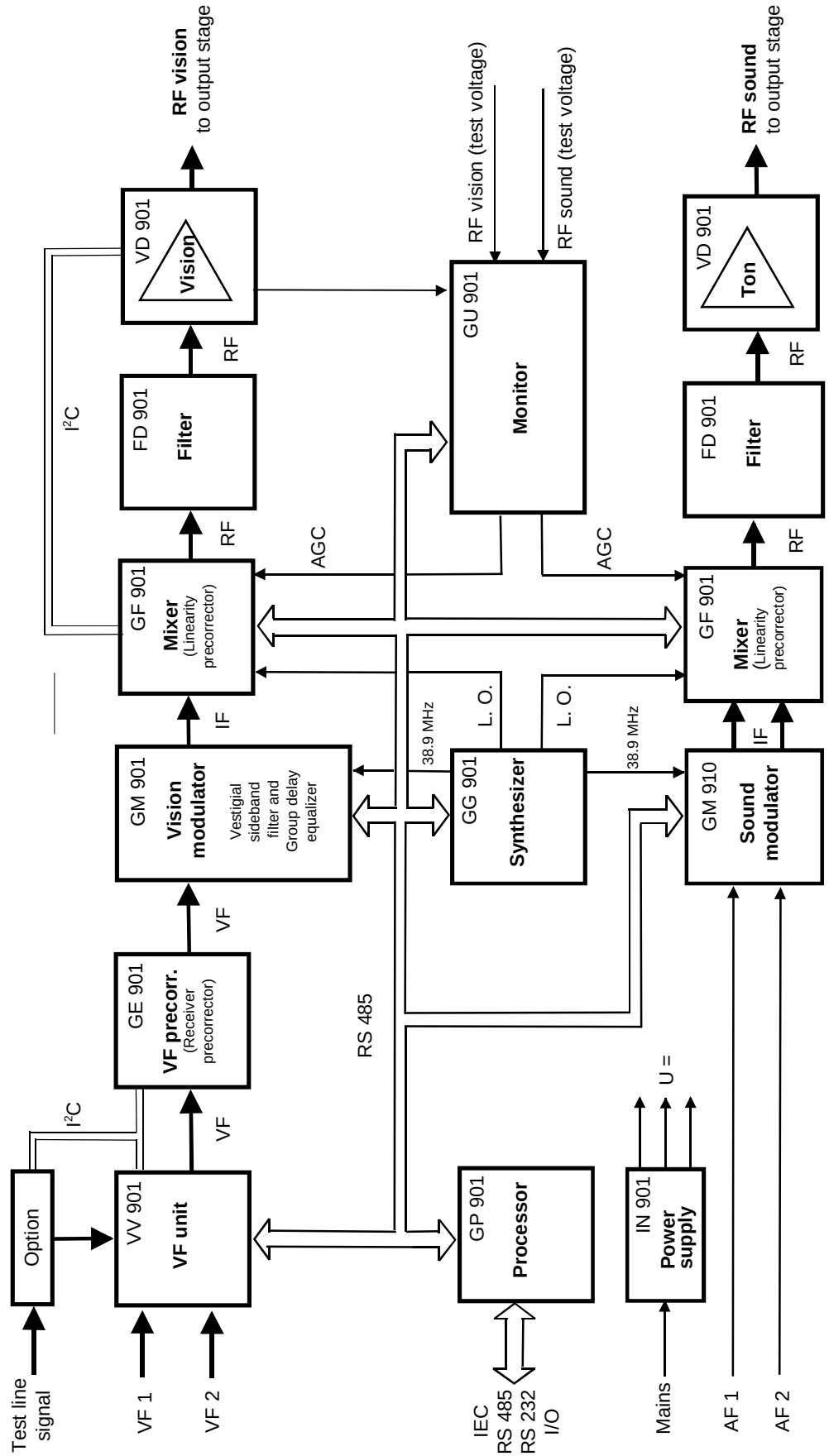
The VF precorrector is controlled by the interface of the VF unit via a local I^2C bus.

Depending on the TV standard, the ***Vision Modulator GM 901*** carries out the positive or negative amplitude modulation of the IF carrier delivered by the synthesizer using the video signal. The GM 901 contains a control circuit made up of a demodulator, a sampling-pulse generator and a switchover facility for the selection between sync-peak clamping and back porch clamping. The vision modulator also accommodates the vestigial sideband filter whose sideband characteristic is obtained by means of a transmitter-specific SAW filter. This filter features steep edges and low group-delay variations in the passband.

The GM 901 plug-in is provided with space for taking up the ***group delay equalizer***, which is mounted on a separate board and so can be replaced independently of the other modules, and for accommodating an optional board for transmitters equipped with ABC.

The group delay equalizer compensates for group-delay distortions caused by the diplexer in transmitters with split vision/sound amplification and corrects departures from flat frequency response. The group delay (gamma), centre frequency (f_0), attenuation at the pole frequency (alpha) and the pole-frequency response (phi) can be adjusted for each of the six allpasses of the group delay equalizer. The number of allpasses depends on the type of transmitter.

The integrated digital section fitted with its own microcontroller controls and monitors all internal functions and communicates with the peripherals within the exciter via an RS-485 bus. The microcontroller also controls the group delay equalizer and the ABC option.



Exciter SD 200, block diagram

The amplitude-modulated, sideband-limited IF vision signal is taken to ***Mixer GF 901***. The mixer converts the IF signal to the transmit frequency using the synthesizer signal. The unwanted sideband and the synthesizer signal are reduced sufficiently to a level below that of the wanted signal. Electronically controlled PIN-diode attenuators allow the modules to be matched to the system configuration and to be looped into the level control circuit of the transmitter.

The ***linearity precorrector*** accommodated in the mixer generates a nonlinear characteristic that is inverse to the characteristic of the subsequent power amplifiers. This provides a linear response for the transmitter as a whole. A hybrid circuit contains some attenuators made up of diodes and resistors which generate the curved portions of the inverse characteristic. The module has a group of attenuators (polygonal equalizers) for the correction of the differential gain and differential phase.

The integrated digital section fitted with a microcontroller controls and monitors all internal functions and communicates with the peripherals within the exciter via an RS-485 bus. The controller also controls the linearity precorrector. A further I^2C bus acts upon the output amplifier of the exciter.

After having passed through ***Bandpass Filter FD 901***, the RF signal is taken to Output ***Amplifier VD 901*** which is broadband over its whole range. The amplifier consists of two identical stages, one operating as vision amplifier and the other as sound amplifier.

The vision and sound amplifier stages are digitally controlled by the controller of the vision mixer via an I^2C bus.

Sound Modulator GM 910 provides for the transmission of two sound channels according to the dual-sound method or for the transmission of one FM sound channel and a second sound channel according to NICAM 728 (option). The IF generated in two free-running oscillators is frequency-modulated with the AF signals. Two synthesizers together with PLL circuits ensure the required frequency accuracy by locking the oscillators to the vision IF or the line frequency. The frequency spacing between the sound carrier and the vision carrier is settable in steps of half the line frequency.

The sound modulator contains a signal generator that outputs a pilot tone for the particular sound mode (mono/stereo/dual-sound) and a matrix circuit for matricing the AF signals for stereo or dual-sound operation.

The integrated digital section with its own microcontroller controls and monitors all internal functions and communicates with the peripherals within the exciter via an RS-485 bus.

The two sound channels are combined in the subsequent mixer. The other circuits of the sound section are identical with those of the vision section. The output amplifier delivers the sound signal with the required level.

Synthesizer GG 901 provides the conversion frequency for Mixers GF 901. It generates an output signal of f = 500 to 1000 MHz by means of PLL circuits. For lower frequencies, attenuators are connected after the synthesizer.

The reference oscillator operates at 10 MHz. For precision offset, it can be locked to an external reference frequency of 1, 2, 4, 5, 8 or 10 MHz.

The vision IF, which can be adapted to all TV standards in 50-kHz steps in the range 32.7 to 45.75 MHz, is derived from the reference frequency.

The integrated digital section fitted with a microcontroller controls and monitors all internal functions and communicates with the peripherals within the exciter via an RS-485 bus.

As the master within the exciter the ***Processor GP 901*** effects the central control of all plug-ins via a serial bus (RS-485) and initiates actions in the plug-ins (slaves) by transmitting commands or requests.

The processor control has a hierarchical structure. Most of the plug-ins contain an interface with a microcontroller, program and data memories, multiplexers for port extensions, D/A and A/D converters and monitoring circuits.

If used in conjunction with an optional interface PCB, the processor is able to control transmitters of simple design.

RF Monitor GU 901 consists of two independent demodulators, one being allocated to the exciter output, the other to the output stage. The gain control can thus be switched over between the exciter

for solid-state transmitters and the output stage for valve transmitters. The gain control of the vision transmitter can be clamped to the constant power of the black level or the sync-peak power, whereas the gain control of the sound transmitter is clamped to sound channel 1.

The ***Power Supply IN 901*** is a primary-switched power supply. A completely closed aluminium case ensures high suppression of the switching frequency and excellent heat dissipation.

The IN 901 provides the following supply voltages:

+24 V
+12 V
+5.2 V
-12 V
-5 V.

The power supply is flanged to the rear part of the exciter frame and connected to the backplanes via plug and socket connections.

CONTENTS

4 UHF Amplifier VH 602 B5 ..... 4.1

4.1 Design 4.1

4.2 Operation 4.4

4 UHF Amplifier VH 602 B5

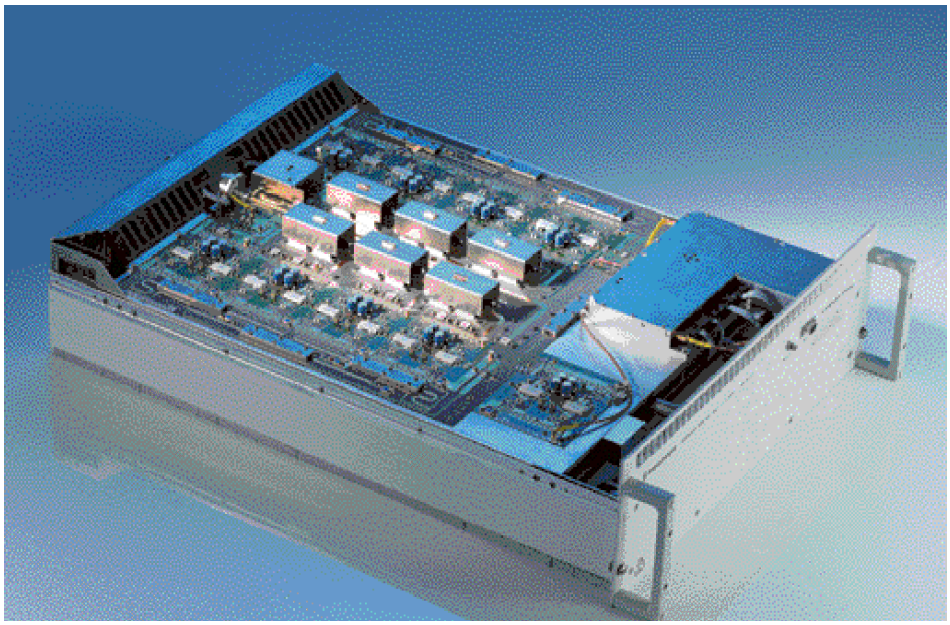
4.1 Design

Transistorized UHF Amplifier VH 602 B5 is designed as a 19" plug-in. The power transistors are LDMOS-type transistors.

The amplifier module is liquid-cooled. A fan is provided in addition to dissipate the residual heat that might form (at the built-in power supply) to the coolant.

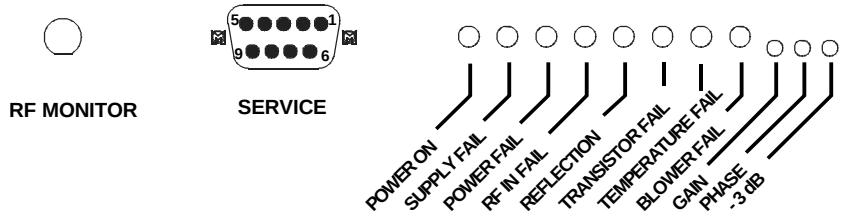
Amplifier VH 602 B5 comprises the following modules:

- UHF preamplifier with monitor
- Driver
- Input board A
- Input board B
- Output board
- Power supply
- Power distribution
- Fan



UHF Amplifier VH 602 B5

The front panel comprises the following: RF output RF MONITOR (X3), 9-pin flat connector SERVICE (X5) for maintenance and repair, LEDs H1 to H8 for status and error signalling as well as three potentiometers for adjustment and setting.



Designation	**Function**
RF MONITOR	RF test output, SMA (X3)
SERVICE	Service connector, SUB-D, 9-pin connector (X5)
POWER ON	LED H1 (green), lights up if command "Amplifier on" is applied
SUPPLY FAIL	LED H2 (red), lights up if a cumulative fault of the power supply in the amplifier is signalled
POWER FAIL	LED H3 (red), lights up at an RF output power <-3 dB
RF IN FAIL	LED H4 (yellow), lights up if the drive power is not within the control window (0 dBm -6/+10 dBm)
REFLECTION	LED H5 (red), lights up for reflection at the amplifier output (S ≥1.5) (Message is stored)
TRANSISTOR FAIL	LED H6 (red), lights up in case of transistor failure
TEMPERATURE FAIL	LED H7 (red), lights up for overtemperature at amplifier (Message is stored)
BLOWER FAIL	LED H8 (red), lights up in case of defective fan
GAIN	Potentiometer R162 for gain (amplitude) adjustment
PHASE	Potentiometer R10 for phase adjustment
-3 dB	Potentiometer R1271 for setting the threshold "RF output power" (This threshold defines the power value to signal the error message RF IN FAIL).

Assignment of the connector SERVICE (X5):

Connector	Signal name	Meaning	Range
X5.1	Ground		0 V
X5.2	V_REGEL	Output power control voltage	0 to 1.2 V (corresponds to 0 to 12 V)
X5.3	PWR_OUT	Measured output power	0 to 5 V; 4 V = P_{nom}
X5.4	PWR_B	Measured forward power path B	0 to 5 V; 4 V = P_{nom}
X5.5	I_DC	Total DC current	0 to 1 V; 1 V = I_{max}
X5.6	V_PHASE	Phase response setting voltage	0 to 1.2 V (corresponds to 0 to 12 V)
X5.7	V_DC	Power supply voltage	0 to 3.2 V (corresponds to 0 to 32 V)
X5.8	PWR_A	Measured forward power path A	0 to 5 V; 4 V = S_{max}
X5.9	REFL_OUT	Output reflection	0 to 5 V; 4 V = P_{nom}

The following connectors are provided at the **rear** of the amplifier:

RF IN (X10)
RF OUTPUT (X1)
AC supply input (3 phases, 400 V; X2)
CONTROL INTERFACE, SUB-D, 9-pin connector (X11)
TESTPORT CURRENT, SUB-D, 15-pin connector (X6).

4.2 Operation

See also block diagram on next page.

Der Verstärker VH 602 B5 arbeitet im Frequenzbereich von 640 MHz bis 862 MHz (Band V; Kanäle 42 bis 69).

The input power for **DVB** uses (P_{rms} = -4 dBm nom.) should be between -10 dBm and +6 dBm (rms). The nominal output power is 440 W.

The input power for **PAL TV** uses (P_{sync} = 0 dBm nom.) should be between -3 dBm and +13 dBm (sync.). The nominal output power is 2 kW (sync peak).

The output amplifier of Exciter provides the drive power for UHF Amplifier VH 602 B5. The input signal is preamplified by the preamplifier and the driver and is taken via a 2-way splitter (output board) to the input boards A and B.

The input signal of each input board passes through a 4-way splitter, is amplified by four parallel transistor stages and then combined on the output board by an 8-way combiner.

The amplifier has its own internal power control circuit but the output power can be set with the phase and amplitude controls especially when several VH 602 B5 amplifiers are operated in parallel. Normally, factory settings should be maintained.

The monitor provided on the preamplifier monitors the following operating parameters:

RF input power

RF forward power

RF reflected power

Power supply fault

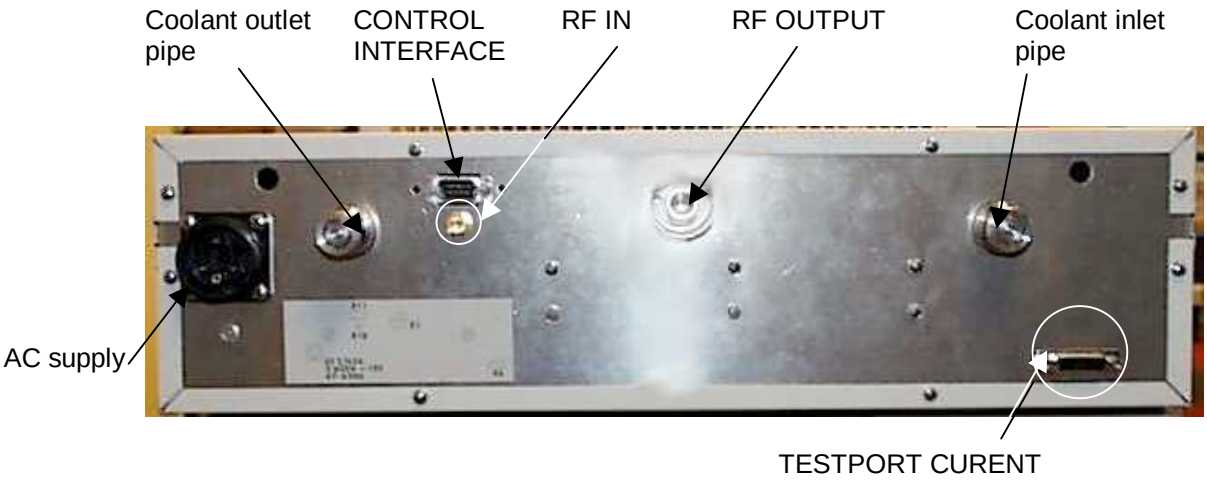
Operating temperature

Fan current

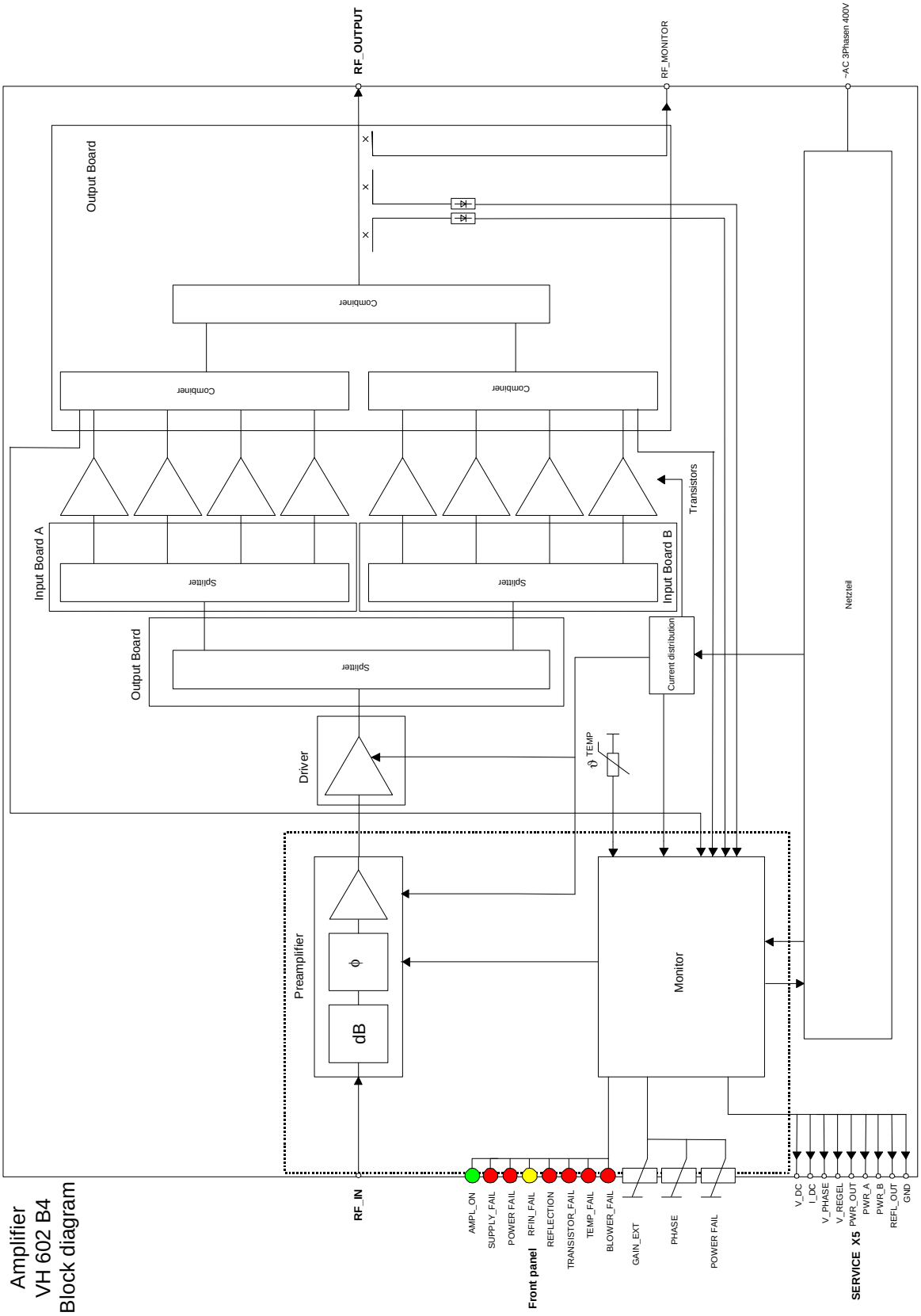
Transistor breakdown

If there is a fault, eg "VSWR too high", the output power is reduced and the appropriate LED lights up on the front panel of the rackmount. The amplifier remains switched on and continues to operate at reduced output power.

The power supply unit is rated for a 3-phase supply of 400 V AC (without N). The output power is 30 V DC. The monitor recognizes overcurrent, overvoltage and phase failure. The heat loss of the power supply unit is partly dissipated by the fan but mostly by the coolant. The power supply is also liquid-cooled.



VH 602 B5, rear view


RF_OUTPUT
RF_MONITOR
~AC 3Phasen 400V
Output Board
Combiner
Combiner
Combiner
Transistors
Input Board A
Splitter
Splitter
Input Board B
Output Board
Splitter
Current distribution
Netzteil
Driver
ϑ TEMP
Preamplifier
ϕ
dB
Monitor
RF_IN
AMPL_ON
SUPPLY_FAIL
POWER FAIL
RFIN_FAIL
REFLECTION
TRANSISTOR_FAIL
TEMP_FAIL
BLOWER_FAIL
GAIN_EXT
PHASE
POWER FAIL
Front panel
V_DC
I_DC
V_PHASE
V_REGEL
PWR_OUT
PWR_A
PWR_B
REFL_OUT
GND
SERVICE X5
Amplifier
VH 602 B4
Block diagram

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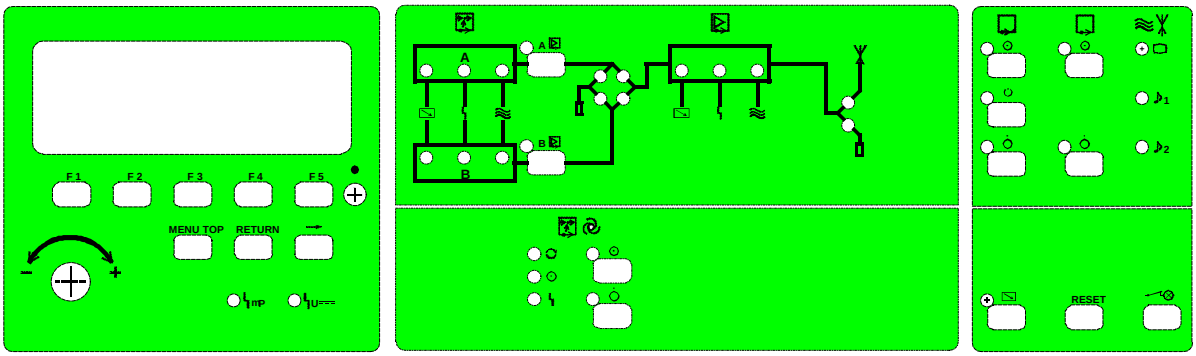
5 Operating and Display Elements for Exciter Standby

5.1 Operating and Display Elements of the Transmitter Control Panel

First, the operating and display elements at the front panel are explained.

The front panel of the output stage control panel is divided into three areas.

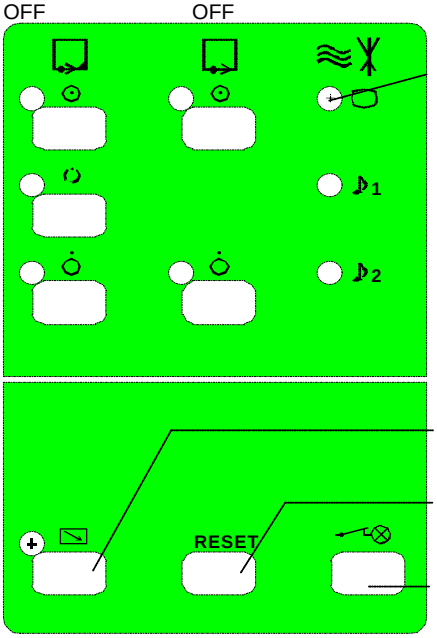
Left	Display with function keys
Center	Block diagram of transmitter with control and display elements of automatic switchover
Right	Transmitter control keys and RF messages



5.1.1 Right Front-Panel Area

Standby exciter
ON
STANDBY
OFF

Main transmitter
ON
OFF



LED "RF present"

Switchover LOCAL/REMOTE ORT/FERN

Reset sum fault

Lamp test

Upper part

The standby exciter can be switched on, off or to standby with the three keys in the upper part. With the other two keys the main transmitter and the main exciter can be switched on or off.

The LED at the right indicates whether RF is output. The following is signalled: RF present

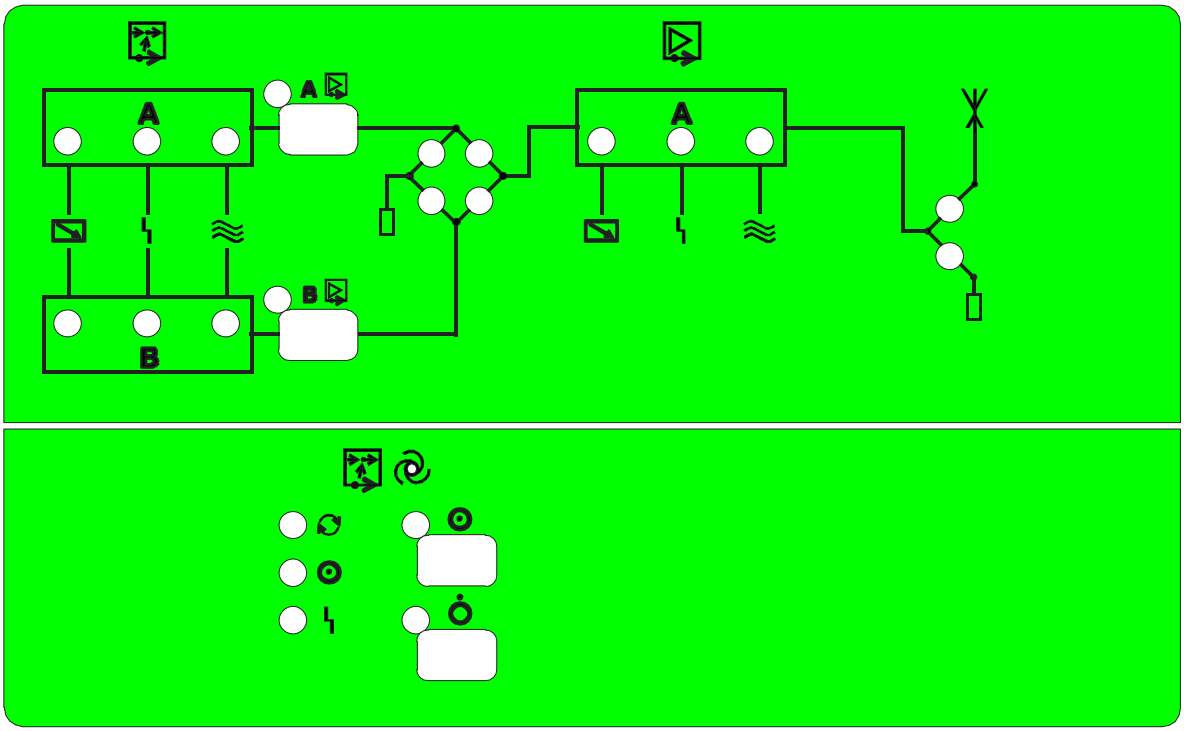
Lower part

With the left-hand key in the lower part, the automatic switchover unit can be switched between LOCAL and REMOTE.

The RESET key in the middle is used to reset a stored sum fault, however a reset of the processor does not take place.

The LEDs can be checked with the key at the right.

5.1.2 Central Front-Panel Area



In the upper part of the central front-panel area there is a block diagram of the complete transmitter. The status of the individual stages is indicated by LEDs. They also indicate the through-connected RF path. With keys A and B shown at the exciter output in the diagram it is possible to select an exciter to act as an active exciter. The second exciter is then the standby exciter which is switched to the termination using the coaxial switch.

LEDs:

Exciter A (B) local/remote
Exciter A (B) fault
Exciter A (B) RF present

Output stage local/remote
Output stage fault
Output stage RF present.

Output stage connected to antenna
Output stage connected to dummy antenna

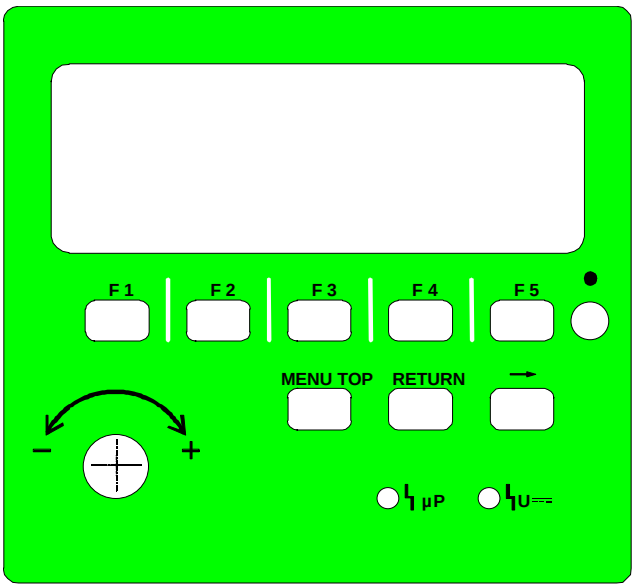
In the lower part there are the automatic-switchover keys for the exciter. The LEDs indicate the status of the switchover units. The lower part comprises the following:

Keys:
Automatic switchover unit ON
Automatic switchover unit OFF

LEDs:
Automatic switchover unit has switched over
Automatic switchover unit ready
Automatic switchover unit faulty

5.1.3 Left Front-Panel Area

With the left front-panel area the transmitter can be operated via the menus (see chapter 7).



MENU TOP
When this key is pressed the main menu and the software version is displayed.

RETURN
This key takes the user from a submenu to the next higher menu.

Arrow key
With this key, the function keys which are outside the display at the right hand side can be used.

The function keys (softkeys) are used to set various parameters in the displayed menus. The assignment of the keys changes depending on the selected function.

The menu keys have fixed functions and are used to select menus.

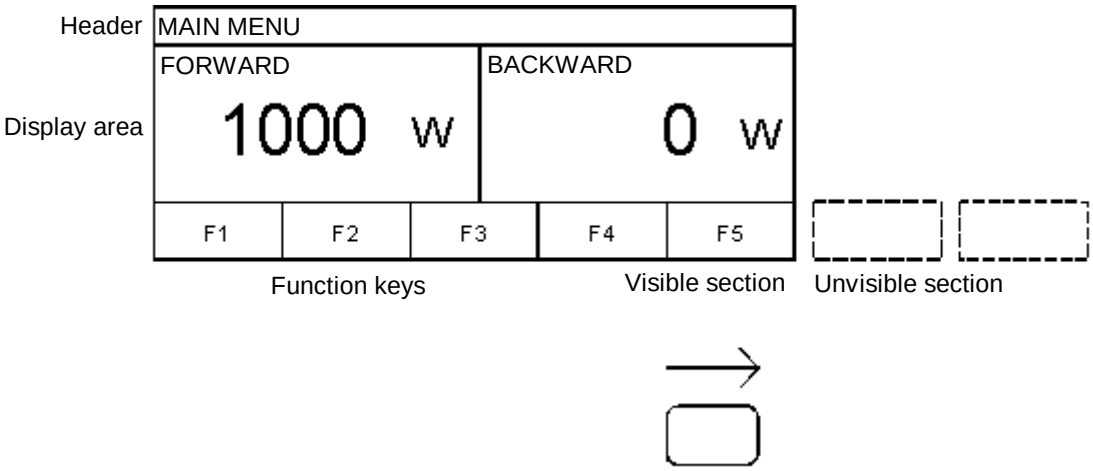
The spinwheel allows rapid variation of settings in the menus.

5.1.4 Display

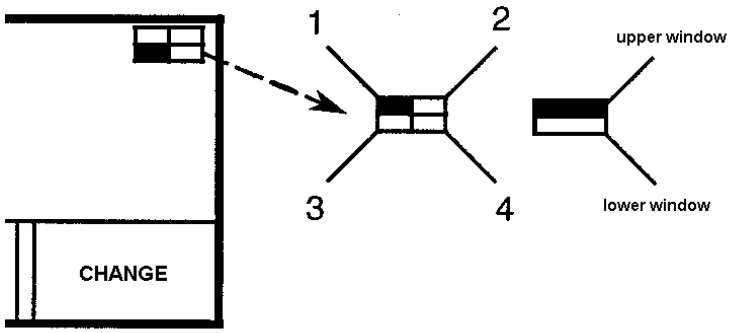
The display is a monochrome, graphics LCD with a resolution of 64 x 240 pixels. The contrast can be manually adjusted with a potentiometer in the display section. Behind the display is a box for the background illumination which can be switched on and off via the menu.

The display is divided into three areas:

Top: Header (1 line)
Center: Display area (number of fields and lines depending on application)
Bottom: Function keys (5 keys with 1 or 2 labels)



Header
The current menu is always displayed on the left. Submenus are separated by slashes.
The status is indicated on the right. Here the IEC/IEEE-bus SRQ (service request) and the IEC/IEEE-bus mode (LOCAL/REMOTE) are displayed. If a menu comprises several windows, the selected window is shown in the display (see below).



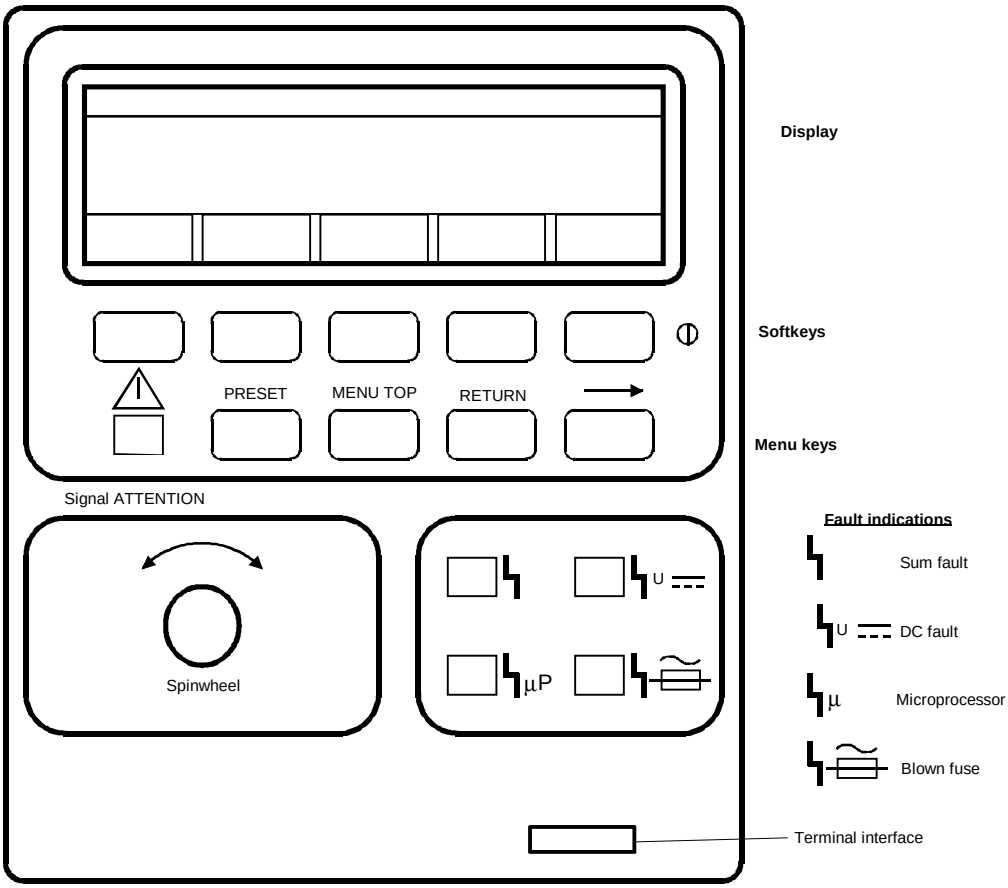
Display area
The various data types are displayed in plain text and as graphics (bargraphs, arrows). All continuously variable parameters are displayed with values and units. Some parameters can be set with the aid of the spinwheel whose step width can be selected with the appropriate function keys in the menu.

Function keys
These five keys can be used as cursor keys (labelled with arrows) or as function keys (text labels). Their labels change according to the selected function.

If there are more softkeys in the menu than the five that are displayed, the arrow-right key can be used to select the others. An arrow above the function keys indicates that this can be done.

5.2 Operating and Display Elements of Exciter SD200

5.2.1 General



The monochrome LCD, which is also for graphical representations, has a resolution of 64 x 240 pixels. The contrast can be manually adjusted with a potentiometer on the display unit. Back-lighting is provided for the display unit; it can be switched on and off via the menu.

The softkeys are used to set the different parameters in the menu displayed. The assignment of the keys changes in accordance with the selected function.

The menu keys are assigned fixed functions and are used to move from one menu to another.

MENU TOP	Selects the main menu
RETURN	Selects the next higher-order menu
PRESET	Resets the complete exciter to the ready-to-transmit status. The main menu is displayed again.
Arrow	This key gives access to the softkeys which are arranged to the right of the screen but are invisible.

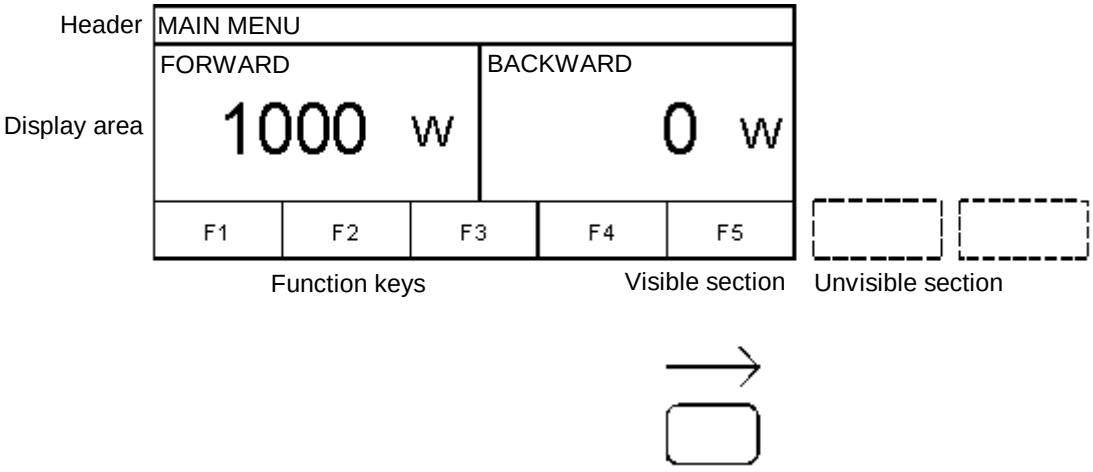
The LED ATTENTION comes on if the current settings do not comply with the preset status (see section "Storage").

The spinwheel enables fast variations of the setting values.

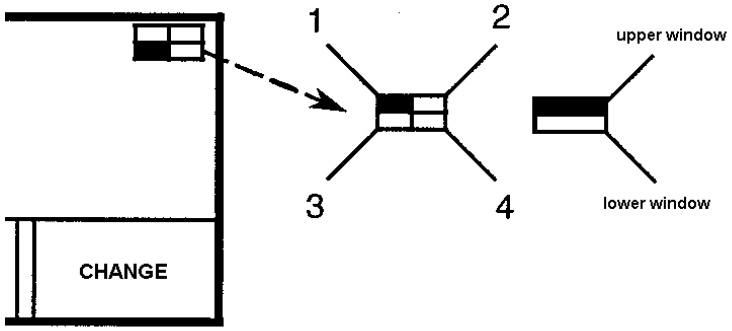
5.2.2 Display

The display is divided into three areas:

Top: Header (1 line)
Center: Display area (number of fields and lines depending on application)
Bottom: Function keys (5 keys with 1 or 2 labels)



Header
The current menu is always displayed on the left. Submenus are separated by slashes.
The status is indicated on the right. Here the IEC/IEEE-bus SRQ (service request) and the IEC/IEEE-bus mode (LOCAL/REMOTE) are displayed. If a menu comprises several windows, the selected window is shown in the display (see below).



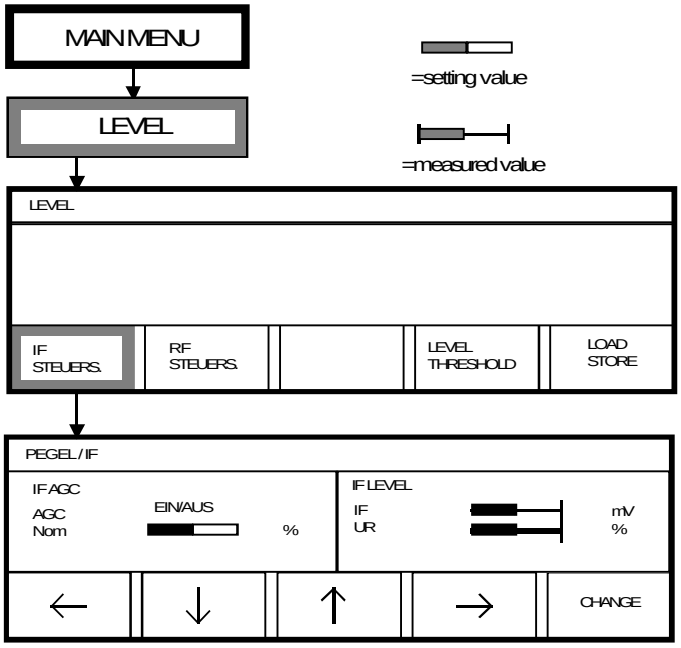
Display area
The various data types are displayed in plain text and as graphics (bargraphs, arrows). All continuously variable parameters are displayed with values and units. Some parameters can be set with the aid of the spinwheel whose step width can be selected with the appropriate function keys in the menu.

Function keys
These five keys can be used as cursor keys (labelled with arrows) or as function keys (text labels). Their labels change according to the selected function.

If there are more softkeys in the menu than the five that are displayed, the arrow-right key can be used to select the others. An arrow above the function keys indicates that this can be done.

5.2.2.1 Menu Operations

The following masks illustrate menu guidance using the Level submenu for the vision transmitter IF and RF parameters as an example.



Select the submenu **LEVEL** in the main menu.

Select the option **IF EXCITER** using softkey F1.

All parameters that can be set in this menu are displayed. The functions of the softkeys change (cursor keys).

LEVEL/IF appears on the left-hand side of the heading line.

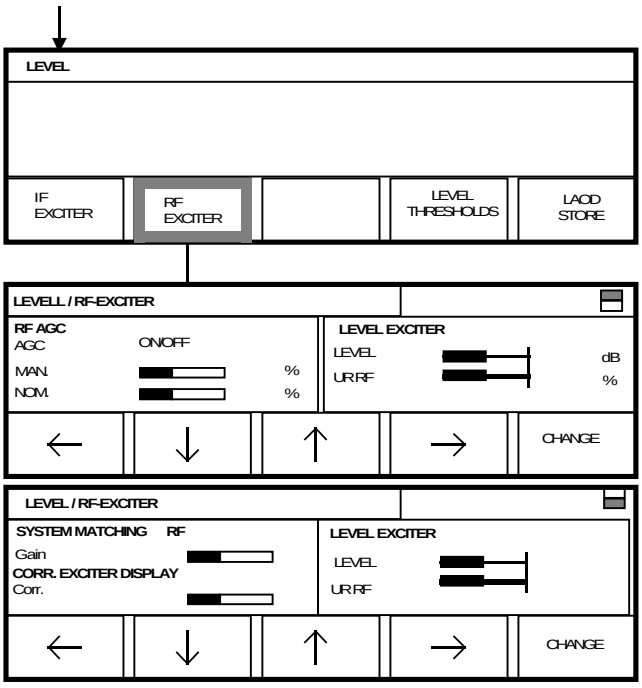
The procedure is described in section "Settings in the Menu".

Note:

If a measured value is displayed instead of a variable parameter or a fixed value, it cannot be varied with the cursor keys and is merely for user information.

The parameters are varied with the spinwheel whose step width can be selected using the softkeys displayed in the menu.

Press the key **RETURN** to go back to the higher-level menu **LEVEL/VISION** and, if desired, branch to the menu **RF EXCITER** or **LEVEL THRESHOLD**. If the **RETURN** key is pressed several times, a higher-level menu is entered every time until the main menu is attained. The main menu can be selected directly with **MENU TOP**.



Select the option IF using the softkey F2 in the menu **LEVEL/ RF EXCITER**.

All parameters that can be set in this menu are displayed. The functions of the softkeys change (cursor keys).

LEVEL/RF EXCITER appears on the left-hand side of the heading line, while the selected menu is displayed on the right-hand side. A special symbol indicates that this menu provides two windows. With the cursor keys it is possible to move between the windows and so select the desired parameter.

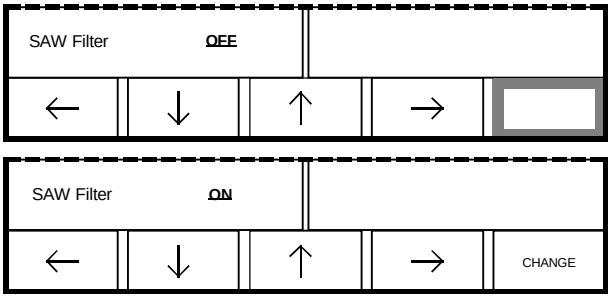
Go back to the higher-level menu with **RETURN** or to the main menu with **MENU TOP.**

5.2.2.2 Settings in the Menus

Various settings can be made in the display area. The first four softkeys are used as cursor keys (4 arrows).

Note: Only part of the displays is represented in the following.

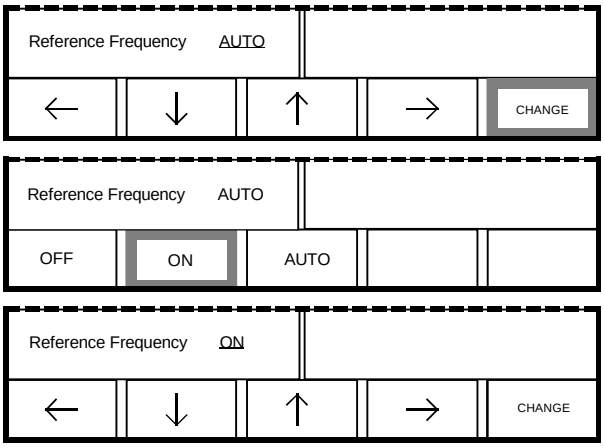
A) If the cursor is placed on a parameter with fixed settings, the softkey F5 is assigned the function CHANGE. If the parameter can only be switched between two states, the switchover is accomplished immediately (eg ON/OFF).



Example:
Parameter with two setting states. The cursor is placed on **SAW filter.** The switching state (OFF) is displayed in inverted form (underlined in this example).

The cursor is moved with the cursor keys. When the key **CHANGE** is pressed, the parameter immediately changes its state (from OFF to ON) without changing the assignment of the corresponding softkey.

B) If the parameter can be assigned more than two states, it is possible to select between several settings after pressing F5. The new setting can be selected by pressing the corresponding softkey.



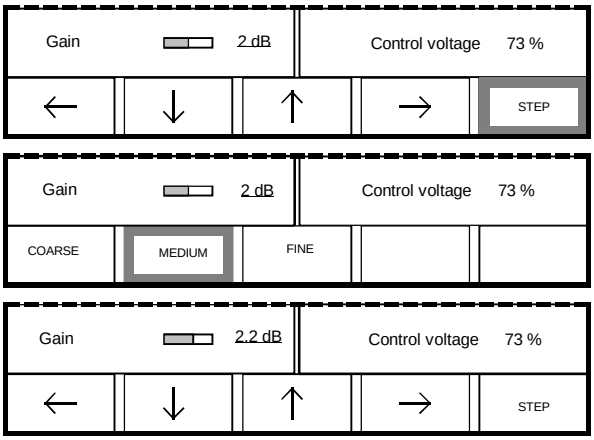
Example:
Parameter with more than two setting states. The cursor is placed on **Reference Frequency.** The switching state (AUTO) is displayed in inverted form (underlined in this example).

The cursor is moved with the cursor keys. When the key CHANGE is pressed, the functions of the softkeys change **(OFF, ON, AUTO)**.

When the key ON is pressed, the parameter immediately changes its state (from AUTO to ON).

The cursor keys reappear.

C) If the cursor is placed on a continuously variable value, the softkey F5 is assigned the function **STEP**, which is used to set the step width of the spinwheel.



Example:
Parameter with continuously variable value. The cursor is placed on **GAIN**. The setting value (2 dB) is displayed in inverted form (underlined in this example).

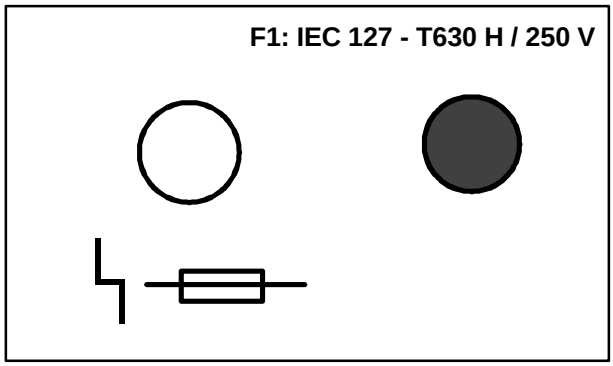
The cursor is moved with the cursor keys. When the key STEP is pressed, the functions of the softkeys change **(COARSE, AVERAGE, FINE)**.

When the key **AVERAGE** is pressed, the step width of the spinwheel used to set the parameter changes (eg to 2.2 dB).

The cursor keys reappear.

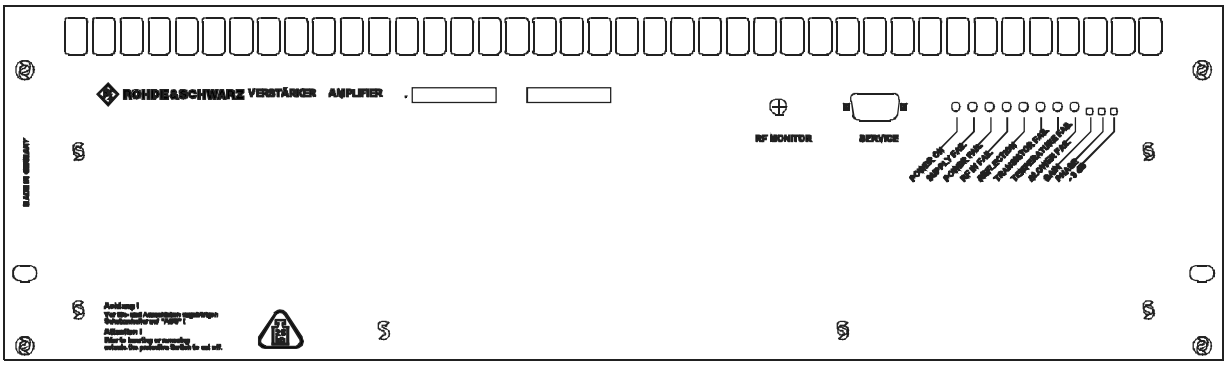
5.3 Display and Control Elements of Fans

NOTE: ***The fans are provided below exciters A and B.***

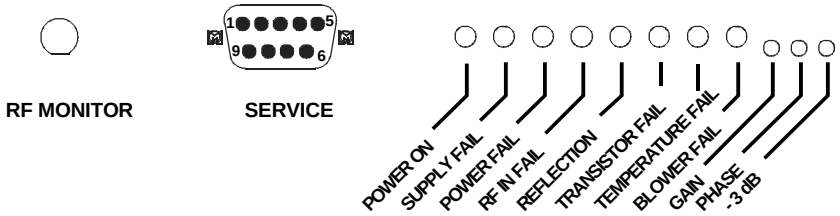


Designation	Element
"Fuse symbol"	LED (red), lights up to indicate that the fuse has blown
F1: IEC 127 - T630 H / 250 V	Fuse holder with fuse

5.4 Control and Display Elements of Amplifier VH602



Amplifier VH602, *Front view*

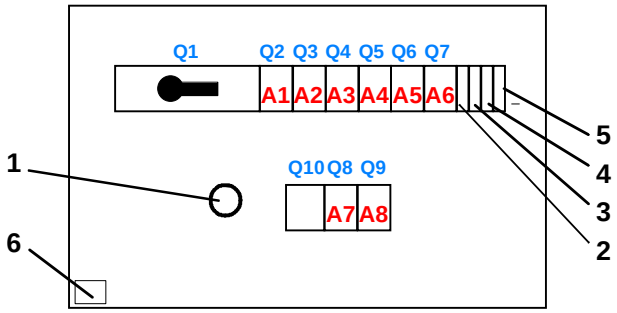


Amplifier VH602, *control and display elements*

Designation	**Function**
RF-MONITOR	RF test output (X3), SMA connector
SERVICE	Service connector (X5), SUB-D, 9-pin connector, for maintenance
POWER ON	LED (green), lights up if command "Amplifier on" is applied
SUPPLY FAIL	LED (red), lights up if a cumulative fault of Power Supply IN605A1 (in amplifier) is signalled
POWER FAIL	LED (red), lights up at an RF output power <-3 dB
RF IN FAIL	LED (red), lights up if the drive power is not within the control window (0 dBm -6/+10 dBm)
REFLECTION	LED (red), lights up for reflection at the amplifier output (S ≥1.5)
TRANSISTOR FAIL	LED (red), lights up in case of transistor failure
TEMPERATURE FAIL	LED (red), lights up for overtemperature at amplifier
BLOWER FAIL	LED (red), lights up in case of defective fan
GAIN	Gain (amplitude) control
PHASE	Phase control
-3 dB	"RF output power" threshold control (this threshold defines the power value at which the error message RF IN FAIL is issued).

5.5 Display and Control Elements of Power Distribution

In addition to other elements the power distribution comprises the isolator switch and several overcurrent trips:



Designation	Element
Q1 230 V / 400 V / 50 HZ ≤ 80 kVA	Isolator switch (3 phases)
Q2 A1	Overcurrent trip for amplifier A1
Q3 A2	Overcurrent trip for amplifier A2
Q4 A3	Overcurrent trip for amplifier A3
Q5 A4	Overcurrent trip for amplifier A4
Q6 A5	Overcurrent trip for amplifier A5
Q7 A6	Overcurrent trip for amplifier A6
Q8 A7	Overcurrent trip for amplifier A7 (option)
Q9 A8	Overcurrent trip for amplifier A8 (Option)
Q10	Overcurrent trip for pump unit
F1 3 N - 50 Hz (see Fig., item 1)	LED (green) for phase monitor. Lights up if the 3 phases are applied in the correct order.
F2 A (see figure, item 2)	Overcurrent trip for exciter A
F3 B (see figure, item 3)	Overcurrent trip for exciter B
F4 TCU (see figure, item 4)	Overcurrent trip for auxiliary power supply which supplies the transmitter control unit, the rack control unit and the RF rectifier.
F5 OPT (see figure, item 5)	Overcurrent trip, free for an option
230 V / 50 Hz / 10 A (see figure, item 6)	Power plug CAUTION! IS NOT SWITCHED OFF WITH SYSTEM

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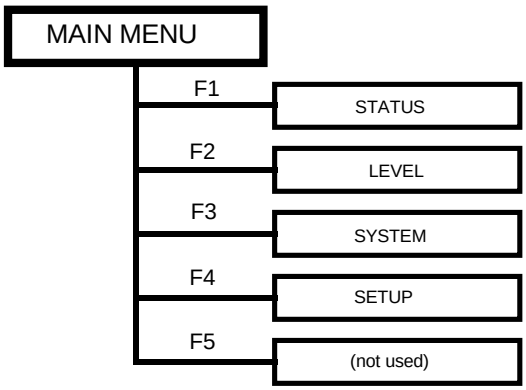
6 Settings via Menus

6.1 Transmitter Control Panel

6.1.1 Menu Overview

The following submenus can be accessed from the main menu:



The CONFIG. DEBUG submenu is opened when the Shift (→) key and function keys F5, F4, F4, F5 are pressed in the SYSTEM menu. If the keys are pressed again in the same order, the SYSTEM menu is displayed (toggle function).

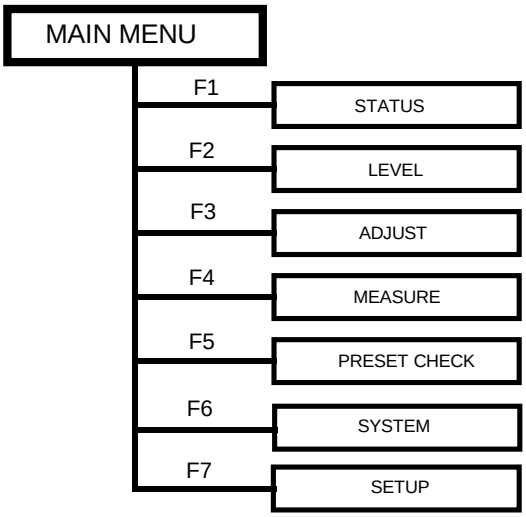
Selections within the menus and submenus with the aid of the cursor keys as well as switchover and setting capabilities are basically the same as those of the exciter and described in detail in the exciter manual.

The MENU TOP key opens the main menu. Other menus can be selected with softkeys F1 to F5 and the cursor key, depending on the display.

6.1.2 Menus of Transmitter Control Panel

6.2 Exciter Control Panel

6.2.1 Menu Overview



6.2.2 Groups of Menus

There are eight groups of menus selectable from the main menu. The individual parameters are also combined in groups to facilitate operation. The underlining philosophy of each menu is described in the following paragraphs.

The menus most frequently selected determine the order of functions assigned to the softkeys. The STATUS menu, for example, which gives an overview of the current status, will most probably be used very often and, therefore, is allocated to softkey F1. When the transmitter is put into service, appropriate level adjustment should be carried out first to allow the operating points to be fixed. Following are the fine adjustment and the correction of system faults, so fixing the assignment of softkeys F2 (LEVEL) and F3 (ADJUST). The menus MEASURE and PRESET CHECK have been given the priorities 4 and 5 (softkeys F4 and F5), since these menus should be easily accessible as well. The other menus (SYSTEM, SETUP, TEST), which are used less frequently, can be selected by pressing the key marked by an arrow pointing to the right.

· **STATUS**

This menu informs the user of the current status of the exciter and the complete system. Settings cannot be made in this menu. Only measured values, settings and fault messages are displayed.

· **LEVEL**

This menu contains all setting parameters required for level adjustment of the exciter and the transmitter. The settings in this menu refer to the corresponding operating point. Output stage corrections, such as nonlinearity corrections, etc., cannot be made. The menu is divided into a ZF section and a IF section. The measured values are displayed together with the setting parameters so that a separate measuring instrument is normally not required.

· **ADJUST**

This menu offers the means of correcting the faults of the complete transmitter, such as nonlinearities or departures from flat frequency response. The menu displays all equalizers (group delay equalizer, linearity precorrector) contained in the exciter and the associated parameters.

· **MEASURE**

This menu includes the setting elements whose values must be changed during certain measurements on the transmitter. This avoids the need to switch between the menus. It is possible, for example, to bypass equalizers and filters, etc.

· **PRESET CHECK**
This menu does not include submenus. It allows the comparison between the current settings and the preset values so that deviations can be identified quickly.

· **SYSTEM**
This menu serves for configuring the exciter within a particular transmitter type. Various site-specific settings can be made in this menu.

· **SETUP**
This menu allows the configuration of the interfaces, which enable communication with external equipment and the setting of voice, time and date parameters.

6.2.3 Fault Indications

All faults occurring in the exciter are displayed. These messages are divided up into "faults" and "warnings".

If faults are indicated, reliability and proper functioning of the transmitter can no longer be guaranteed.

If warnings are indicated, transmission can be guaranteed with certain restrictions. Operation, however, can be continued in the preset operating status without endangering the safety of the system.

There are two different display modes:

Fault indications
All fault messages are indicated in plain text on the display unit and by a red LED on the front panel of the exciter.

The LED remains on even after erasure of the plain text. It only goes off if the sum fault has been cleared.

Once the processor has detected a primary fault, a fault window appears superimposed on the current display and with a large arrow on the left-hand side. The last fault is indicated in plain text next to the arrow.

The window disappears as soon as one of the softkeys or menu keys is pressed; the previous menu reappears.

Warning indications
The warnings are displayed in a separate window; an LED is not provided. The window only covers half of the display area and its position can be varied. It always appears opposite the cursor so that the cursor is not covered. The window is deleted when the warning message is no longer active.

A configuration switch allows the warning message to be represented in the form of an icon, which then appears as a small window with an exclamation mark in the heading line. The switch is available in the second softkey group of each menu (accessible by means of the key with the arrow pointing to the right).

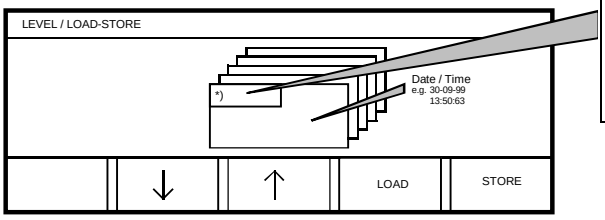
6.2.4 Memories

NOTE: Load and storage operations do not apply to the DVB modulator because the latter stores its data internally non-volatile.

The processor has five memories in addition to the main memory. These five memories are designated 1, 2, 3 and PRESET and are accessible from the submenu LOAD/STORE which can be selected from several menus. In each of these five memories the complete exciter configuration can be stored including all data and plug-in settings.

All settings can be recalled in the submenu LOAD-STORE; the contents of the PRESET memory is displayed additionally when the blue PRESET key on the front panel is pressed.

Example:
When LOAD/STORE is selected from the submenu LEVEL, the following window appears:



*) One of the following texts appears in the window:

a) MEMORY 1 (to 4)
b) PLUG-INS
c) PRESET

Under a) and c) the date and time of the last storage, under b) the date and time of the last loading are indicated.

a) MEMORIES 1 to 4
The options LOAD and STORE are displayed next to the up/down keys (F2/F3) which are used to switch between the memories 1 to 4.

STORE
When the key STORE (F5) is actuated, the processor writes the current values and settings of all plug-ins to one of the nonvolatile memories (1 to 4). So the complete exciter configuration is stored in the memory selected. Thanks to the four memories it is possible to retain four different settings and to load them whenever required.

LOAD
When the key LOAD (F4) is pressed, the values and settings filed in the selected memory (1 to 4) (see paragraph STORE) are sent to all the plug-ins. One of the four exciter configurations stored can thus be quickly transferred.

Note: With each loading or storing process, the processor asks for confirmation (ARE YOU SURE?); this query must be answered with YES or NO before the operation is continued.

b) PLUG-INS
This display is obtained by pressing the up/down keys (F2/F3).

The option READ appears. When this key is actuated, the processor reads all current values from the plug-ins and files them in its main memory. This is necessary, for example, when the processor has been replaced, since the new processor must be informed of current plug-in settings.

c) PRESET
The PRESET memory can also be selected with the up/down keys (F2/F3).

The options LOAD and STORE are displayed.

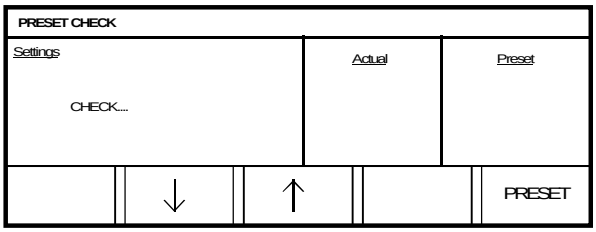
Loading and storing are accomplished in the same way as with memories 1 to 4 (see above). PRESET LOAD is identical with the process activated by pressing the blue PRESET key. The last preset values are transferred to the corresponding plug-in. PRESET STORE, however, overwrites the PRESET memory which contains the basic exciter configuration. Therefore, this process has to be carried out with due consideration.

6.2.5 PRESET CHECK Menu

NOTE: Preset comparison applies to the exciter only since the storage of its data is non-volatile.

The PRESET memory of the main processor contains the exciter configuration and a list of all plug-in data and settings. The current values are also filed in the main memory of the processor.

If a modification is made, the main processor compares the contents of the PRESET memory with that of the main memory. The following is displayed in the PRESET CHECK menu (accessible via key F5 in the main menu):

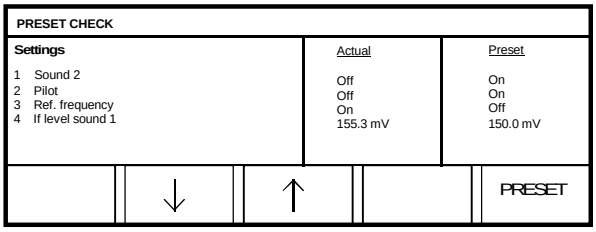


CHECK means that the comparison program is running.

At the same time, the yellow LED ATTENTION on the display unit goes on.

When the comparison routine is terminated, the deviations are indicated in plain text.

Example:



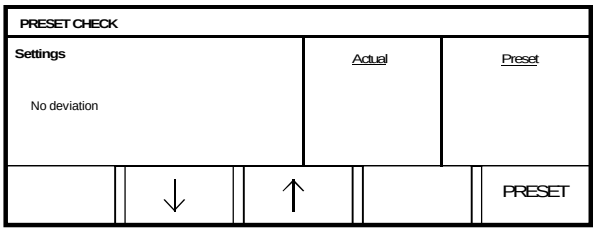
If more deviations than those displayed have been found, they can be scrolled up and down with the cursor keys.

Individual parameters selected with the cursor keys can be reset to the preset state using the PRESET key (F5).

Like in all other menus, a complete reset of all parameters to the PRESET state can be achieved with the blue PRESET key in the lower row of keys on the display unit.

In both cases, the processor asks for confirmation (ARE YOU SURE?) before the command is executed. This query can be aborted by means of RETURN or MENU TOP.

If all deviations between the PRESET and main memories have been corrected, the PRESET CHECK menu is empty. The following is displayed:



The yellow LED ATTENTION on the display unit goes off.

6.2.6 Protective Functions

The exciter comprises a number of devices that protect it against inadvertent change ofsettings. The protective functions are active simultaneously.

- Protective functions provided are:
- Local/remote lockout
- Confirmation query
- Preset LED
- Preset comparison
- Preset memory
- LOCK function

Local/remote lockout
In the remote mode, menus permitting parameters to be varied cannot be called up.

Confirmation query
When critical settings are to be changed, confirmation is requested before the respective parameter can be varied.

Preset LED
An LED on the front panel of the exciter signals that one or several settings of the have been changed as against the preset state.

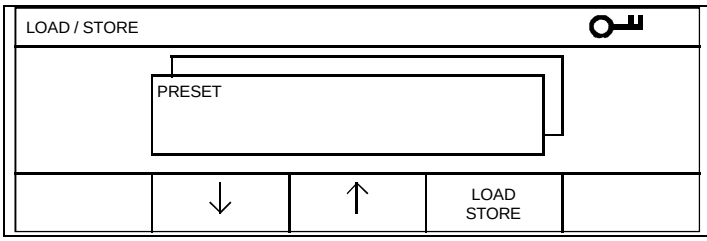
Preset comparison
All parameters differing from preset are displayed in plain text in a special menu. The actual and the nominal value of each parameter are indicated.

Preset memory
With the aid of this memory, the preset state of the system can be restored by a single keystroke. This permits the original status to be restored after parameters have been changed inadvertently or on purpose (eg for measurements).

Detailed information on these protective functions can be found in the General Description of the Exciter. Another function in the software package is the

LOCK function.
It is activated with the aid of a PC via the IEC/IEEE bus and prevents the preset memory being overwritten. The default setting is LOCK function OFF (PRESET:LOCK OFF; see table below).

Effect of LOCK function
A key symbol in the top line of the menu signals that the function is activated.



The STORE parameter is blanked, ie the function LOAD/STORE cannot be used. Thus overwriting the preset memory is not possible but parameters from the preset memory can be loaded.

Associated IEC/IEEE-bus commands

IEC/IEEE-bus command	data range	Deascription
PRESET:LOCK	ON OFF	Protective function activated Protective function deactivated
PRESET:LOCK?	ON OFF	Query for current status of protective function

If the preset memory is to be overwritten with new data, the protective function has to be disabled by means of a PC via the IEC/IEEE function (PRESET:LOCK OFF).

6.2.7 Exciter Menus

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7 Maintenance and Software Update

7.1 Maintenance Intervals

Interval	What to do	Described in
Every six months	Check operating values, eg output power, control circuits etc.	
Every year	Check backup battery of control unit and exchange, if required	Section 7.2.1
Every year	Check backup battery of exciter and change, if required	Section 7.2.1
Every year	1. Measure pH value of coolant Antifrogen N. If pH value <7, use fresh coolant. *2.* Measurement of antifrogen N concentration. The concentration should be at least 20 % by volume which guarantees freeze-free operation down to at least -10 °C.	Manufacturer documentation of cooling system See under ***) NOTE**
Every four years	Exchange fans for Exciter SD100/200	Section 7.2.2
Every four years	Exchange fans of amplifiers plug-ins	Section 7.2.3
Every four years	Exchange pump of pump unit	Manufacturer documentation of pump unit
Every four years	Exchange fan of cooler	Manufacturer documentation of cooler

*) NOTE:

Service and checking
Experience based on its use in systems over many years has shown the suitability of antifrogen N. However, the concentration of this anti-freeze should be checked annually. A check of this kind is also recommended after topping up. Antifreeze testers for antifrogen N are obtainable from specialized shops or dealers.

The concentration should not fall below 20 % by volume to ensure anti-corrosive properties.

7.2 Maintenance Work

7.2.1 Testing and Replacing Backup Batteries

Technical background

The transmitter must be able to store operating states and data so that they are not lost when there is a power failure. This is guaranteed by lithium batteries integrated in the unit. The batteries supply the RAM with the voltage required to maintain the stored data. As soon as power is restored to the unit, the batteries are disconnected to prevent them being discharged.

Location of batteries

The lithium batteries are fitted on Processors GP 901 in the control units and the exciter. The battery voltages are applied to all units in the system so that all RAMs receive power even if the transmitter is switched off.

Nonvolatile storage of operating data

Not all stored data need to be protected against power supply failure as a great number of operating states and data are reinitialized when the unit is restarted. However, the following data are backed up should there be a power failure:

- Operating status of exciter (off/standby/on, local/remote)
- Operating status of CCU (optional)
- System time (time, date)

Monitoring the battery function

The transmitter does not contain an electronic circuit for monitoring the battery voltages. The following events indicate a battery failure:

- The previous transmitter status is not restored after a power failure (does not apply to transmitter networks)
- The displayed time differs considerably from the true time.

Service life

Two operating modes must be considered. On the one hand, the durability of the battery without tapping its energy and on the other, the lifetime of the battery when it supplies power. The shelflife of the battery is determined by the battery's self-discharge; the operational service life is the time the unit can maintain data without external power supply.

Operating service life

Normally, the operating service life of the batteries depends on the following factors:

- Battery capacity
- Battery current during operation
- Nominal voltage to backup stored data

Shelflife

Manufacturer's guarantee for their lithium batteries can be as long as several years (approx. 5 years) provided the batteries are stored under normal conditions.

Service interval

The batteries should be tested about once a year.

Test methods

The battery voltage should be tested under two different operating conditions.

1.) Open-circuit testing
2.) Testing with load

Open-circuit testing

Whenever the transmitter is operated with external power supply, the battery is not loaded. The no-load voltage between its contacts can be measured with a multimeter.

Testing with load

When the transmitter is switched off (POWER OFF), the battery function supplies power. The battery voltage is required to back up the data in the memory ICs. In this state, the voltage between the battery contacts can be measured with a multimeter. The measurement is easy to perform when Processor GP 901 is removed from the unit and the battery voltage is measured on the test bench.

Test results/tolerances

The batteries are functioning properly when results are within the following limits:

	Open-circuit	**With load**
Battery voltage	≥ 3,2 V	2.8 V

Replacing batteries

Remove the processor from the unit and take off the shielding covers. The flat battery can then be easily unsoldered and a new one soldered into place. Before replacing the batteries, set jumper X13 to the following position:

	Jumper X13
Jumper position	2-3

CAUTION!

When inserting a replacement battery make sure that the polarity is correct. The positive pole is marked by a symbol on the board.

Solder the correctly inserted battery into place and again set jumper X13 to the following operating position:

	Jumper X13
Jumper position	1-2

Reinsert processor into the unit.

Restoring data

Setting the operating status of the transmitter
Enter transmitter commands (off/standby/on, local/remote) locally or via remote control.

Setting the time

The time can be set via the SETUP menu.

7.2.2 Exchange of Fan for Exciter SD 100/200

CAUTION: All installations have to be performed with the power switched off.

NOTE: For the position of fan plug-ins for Exciter SD 100/200 see Fig. in section 3.1.

DISASSEMBLY:

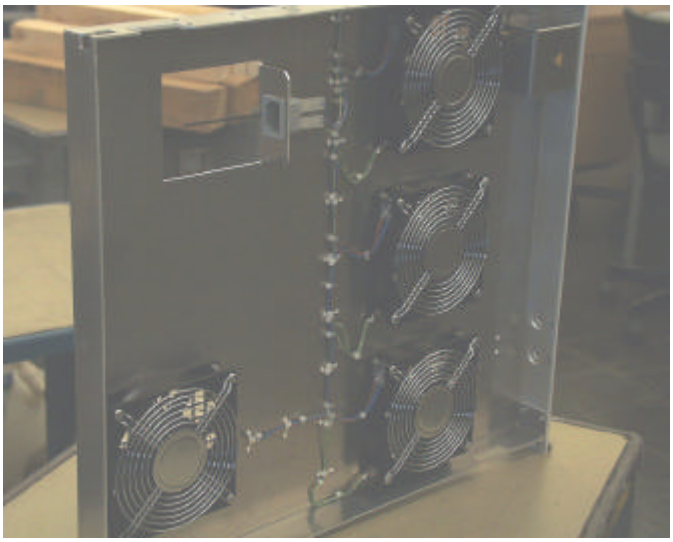
- Switch transmitter at control panel to OFF.
- Switch isolator switch Q1 at power distribution to OFF.
- Remove rear panel of transmitter rack.

NOTE: The power switch of the fan plug-in is accessible behind the auxiliary power supply (see Fig. Transmitter rack, rear view, in section 3.1) (a ladder is required to access the power switch).

- Remove pull relief of power plug from tie and disconnect power plug.
- Remove front panel with vents at front panel of transmitter rack below fan plug-in (undo two cross-head screws) and let it hang down at the cable of the emergency key.
- Remove connecting cables from SMA connectors on front panel of fan.
- Undo fixing nuts of SMA connectors and remove them together with toothed washer.
- Undo four cross-head screws of fan plug-in and remove plug-in towards the front.
- Remove two connecting cables of fan.
- Undo four fixing screws of fan and remove fan.

ASSEMBLY:

Assemble the unit in the reverse order.



Fan plug-in for Exciter SD 100/200

7.2.3 Replacement of Amplifier VH602

CAUTION: If the transmitter is required to operate during the replacement of the amplifier (at reduced transmit power), it need not be disconnected completely from the AC supply.

In this case switch off the overcurrent release for the amplifier plug-in under replacement at the power distribution (see section 6.6).

REMOVAL:

- Switch transmitter at control panel to OFF.
- Switch isolator switch Q1 at power distribution to OFF.
- Undo two captive cross-recess screws on amplifier front panel.
- Carefully pull amplifier plug-in out of rack.

INSTALLATION:

- For installing the amplifier, perform the same steps in reverse order.

7.2.4 Replacement of Amplifier VH602 Fan

CAUTION: If the transmitter is required to operate during the replacement of the fan (at reduced transmit power), it need not be disconnected completely from the AC supply.

In this case switch off the overcurrent release for the amplifier plug-in under replacement at the power distribution (see section 6.6).

REMOVAL:

- Switch transmitter at control panel to OFF.
- Switch isolator switch Q1 at power distribution to OFF.
- Undo two captive cross-recess screws on amplifier front panel.
- Carefully pull amplifier plug-in out of rack.
- Undo 4 screws (Fig. 2) on bottom cover of the amplifier plug-in and take of the cover.

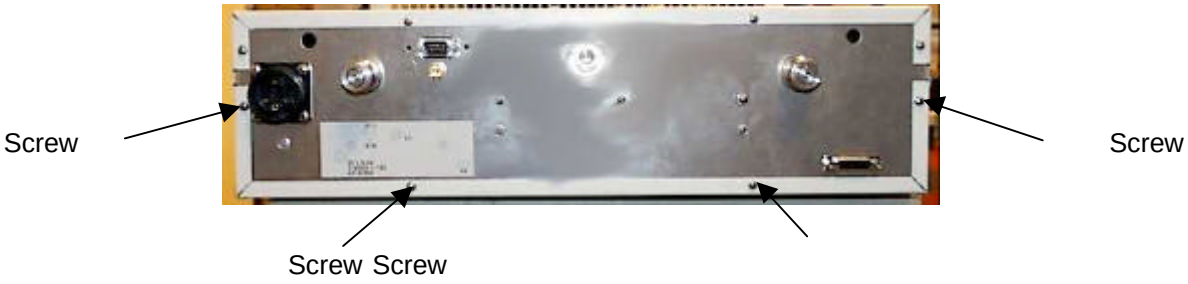


Fig. 2

- Place amplifier plug-in on its side and undo 4 screws (see Fig. 3) to remove the fan.

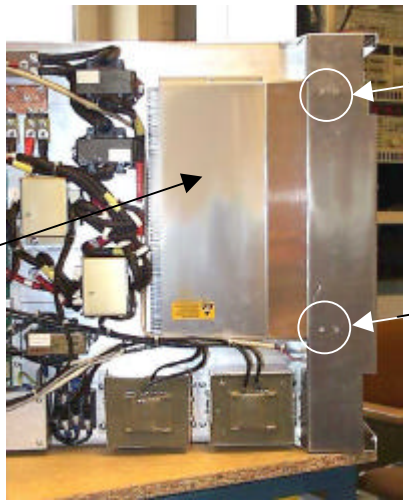


Fig. 3

- Undo 6 cross-recess screws on the front panel of the amplifier plug-in.
- Unscrew and remove locking nut of RF MONITOR connector at the front panel.
- Pull out connector of the flat-cable between the SERVICE connector at the front panel and the PCB in the side slot.
- Take off front panel.
- Pull out fan somewhat towards the front and unsolder 2 connecting wires. Note down polarity of the connectors for installation of the new fan.
- Take out fan.

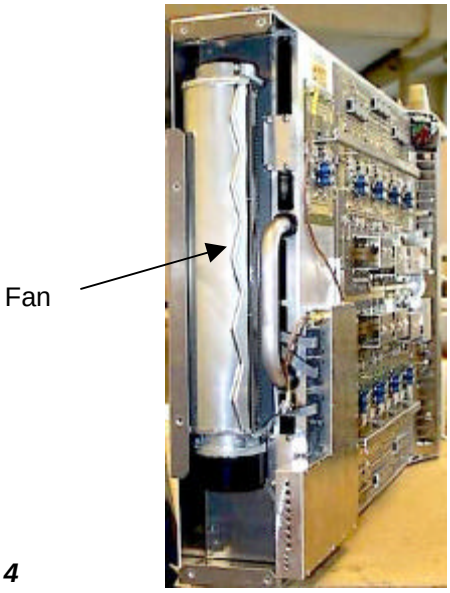


Fig. 4

INSTALLATION:

NOTE: When inserting the new fan into the chassis, slightly push back lower part of metal plate (see Fig. 3) so that the fan can snap in.

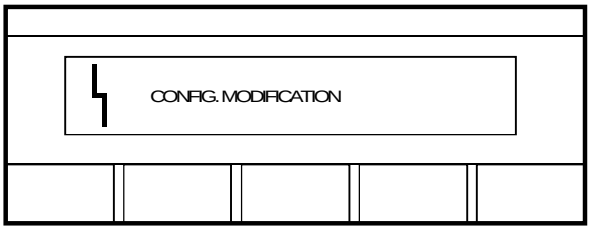
- For installing the amplifier, perform the same steps in reverse order.

7.2.5 Replacing the Plug-ins of Exciter SD 100/200

A nonvolatile memory (E2PROM) in the digital section of every plug-in stores the complete device configuration and all data required for the identification of the plug-in (however without the DVB modulator).

The memory of the main processor contains a list with the identifications of all exciter plug-ins.

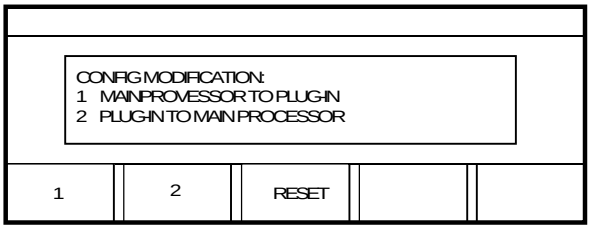
If a plug-in is replaced (except the processor plug-in), the main processor detects this and issues a fault message. (This however does not apply to the DVB modulator).



The display is as shown on the left-hand side.

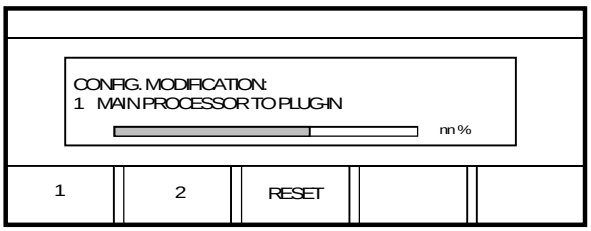
At the same time, the red LED FAULT in the lower section of the display unit comes on.

A corresponding entry is made in the fault memory of the processor (including date and time).



When pressing any key, the fault message is acknowledged and the display shown on the left-hand side appears.

The system configuration data stored in the memory of the main processor must be transferred to the new plug-in. Therefore, select option 1 MAIN PROCESSOR TO PLUG-IN (key F1).



The display changes as shown.

In this case, a data transfer takes place from the main processor to the new plug-in. All data and setting values of the new plug-in are stored in the nonvolatile memory (E^2PROM) of the plug-in. The progress of this process is displayed in per cent and as a moving bar.

At the same time, the main processor stores the identification data of the new plug-in, so recognizing the new plug-in as being part of the system.

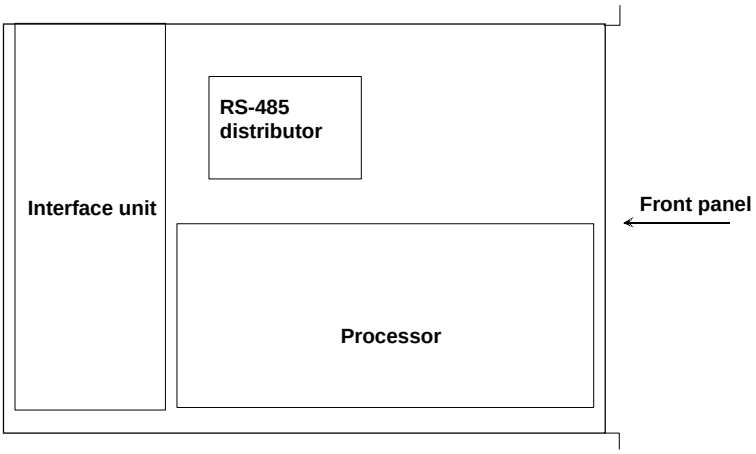
After data transfer, the display changes to the main menu. The red LED FAULT stays on. It extinguishes when the fault message in the fault memory is erased.

Replacing the processor plug-in is basically the same. In this case, the data and setting values of all plug-ins are transferred to the main processor after selecting option 2 PLUG-IN TO MAIN PROCESSOR (key F2).

If the previous plug-in is reinserted by mistake, the process can be aborted with the RESET key. The status remains unchanged.

7.2.6 Opening the Control Unit

After loosening the fixing screws on the front of the control unit, the frame can be withdrawn to the front like drawers. The control unit proper with processor, interface unit and RS-485 distributor modules is accommodated in this frame (see drawing below).



7.3 Software-Update

7.3.1 Software Updates for Transmitter Control Unit and Exciter with Program FLASHPRO

NOTE: This section applies to software versions

BOOT version 1.02
Applic version 1.20

or higher.

The update program provides an easy way of installing a new software for the transmitter control unit. It is designed such that normally no action on part of the user is required once the update procedure has been started. The program performs all steps required for the update fully automatically.

Some additional settings may be performed, however they are normally of no relevance for the user and should only be used for special purposes by users with the appropriate know-how. These settings are described in detail in the section Additional Settings.

7.3.1.1 Software Supplied with Disk

The update program is supplied on a disk containing the following files:

- UPDATE.EXE: Control program for the update procedure. This program is to be called up by the user.
- BF.DAT: Compressed data to be unpacked and used for the update.
- README.TXT: General notes for the user on how to start the update program.

7.3.1.2 Preparations

- Power supply of the transmitter control unit must be switched on.
- The PC must be connected to the control unit by a RS232 cable (modem-bypass cable with crossed RXD/TXD lines). The connector for the control unit is located on the top of the transmitter.
- Normally, the first serial interface COM1 (also "serial interface A") of the PC will be used. If this interface is already occupied (eg by the mouse), the second serial interface COM2 (also "serial interface B") may also be used if available. How to start the update program in this case is described in the following chapter.
- The UPDATE disk must be inserted in the appropriate PC disk drive.
- The update program requires a minimum of 4 Mbyte free harddisk space on the PC. This amount of memory does not necessarily have to be available on harddisk drive C:; if this harddisk does not contain enough free space, the program will automatically attempt to find another disk drive with enough space. However an update can only be performed successfully if the PC has at least one drive offering sufficient memory space.

7.3.1.3 Update Procedure

A) Performing the Update in the Transmitter Control Unit Program

- Changing to the disk drive containing the UPDATE disk:
  - If the disk is inserted in drive A:, enter "A:".
  - If the disk is inserted in drive B:, enter "B:".
- Select the "Status" menu on the transmitter control unit.
  Call up the next page of the status menu by pressing the "->" key.
  Press the "Start Update" key on the transmitter control unit to switch on the update mode.
  After approx. 2 s the message
  START UPDATE PROGRAM NOW ... is displayed on the control unit.
  The transmitter control unit is now ready for the update.

- If the first serial interface (COM1) is used, start the update program on the PC by entering UPDATE. If the second serial interface is used, start the update program on the PC by entering UPDATE COM2.

  This general information on how to start the UPDATE program is also contained in the README.TXT file on the supplied disk. It can be displayed on the PC screen by entering TYPE.README:TXT. **The update will now be performed fully automatically as long as no error occurs; no further action is required on part of the user.**

- Starting from drive C:, the update program will now search for a PC harddisk containing sufficient free memory space.

  As soon as it has been found, a directory R&S_BF.TMP will be created on the harddisk. If the harddisk already contains a directory with this name, this directory will be used. In this case the directory will not be deleted upon completion of the update and will therefore be retained on the harddisk.

  The update program now copies the required file BF.DAT into this directory. This is a compressed file that is unpacked on the harddisk by the update program. The following files are created in the directory R&S_BF.TMP:

  - FLASHPRO.EXE
  - BF1.BIN
  - BF2.BIN
  - BF.CFG
  - BF.ORG
  - T115K.BIN

CAUTION: *If a file with one of the above names is already contained in this directory – which is only possible if this directory already existed before the start of the update program – this file will be overwritten. If a file with one of the above names is contained in the directory R&S_BF.TMP and should not be deleted, either the directory has to be renamed before starting the update program (eg R&S_BF.ORG), or the file has to be saved on a disk or another harddisk drive*.

The PC screen indicates that the files are being unpacked:

BF.CNF .
BF1.BIN .....
BF2.BIN .....
T115K.BIN .
FLASHPRO.EXE .....

The actual loading program FLASHPRO.EXE is then started to perform the loading procedure and to show it on the PC screen.

FLASHUP... is now indicated on the transmitter control unit. This keeps being displayed throughout the update procedure. ?????

Upon successful completion of the update, the new program is started automatically on the control unit.

OK is displayed on the PC screen.

- Press the ENTER key (or click on OK with the mouse) to complete the update procedure.

  The files installed by the update program are now deleted; the directory R&S_BF.TMP is also deleted from the harddisk unless it already existed before the start of the update program.

- Upon completion of the update, quit the current disk drive by entering "C:". The update disk should be removed from the disk drive.

B) Performing the Update with Transmitter Control Unit Program not Running

In some cases, it may not be possible to start the update procedure from the transmitter control unit program:

- If the transmitter control unit program is loaded for the first time.
- If the loading of the transmitter control unit program was interrupted eg due to power failure and the old version was therefore destroyed before the new version was completely loaded.

In these cases the update mode cannot be started from the transmitter control unit menu. The new program can be loaded in the following way.

- Switch off the transmitter control unit.
- Select the disk drive containing the update disk: if the disk is inserted in drive A:, enter "A:"; if the disk is inserted in drive B:, enter "B:".
- If the first serial interface (COM1) is used, start the update program on the PC by entering UPDATE. If the second serial interface is used, start the update program on the PC by entering UPDATE COM2.

This general information on how to start the UPDATE program is also contained in the README.TXT file on the supplied disk. It can be shown on the PC screen by entering TYPE.README:TXT.

- Starting from disk drive C:, the update program searches for a harddisk in the PC containing sufficient free memory space. As soon as it has been found, a directory R&S_BF.TMP will be created on the harddisk. If the harddisk already contains a directory with this name, this directory will be used. In this case the directory will not be deleted upon completion of the update and will therefore be retained on the harddisk. The update program now copies the required file BF.DAT into this directory. This is a compressed file that is unpacked on the harddisk by the update program. The following files are created in the directory R&S_BF.TMP:

  - FLASHPRO.EXE
  - BF1.BIN
  - BF2.BIN
  - BF.CFG
  - BF.ORG
  - T115K.BIN

CAUTION: *If a file with one of the above names is already contained in this directory – which is only possible if this directory already existed before the start of the update program – this file will be overwritten. If a file with one of the above names is contained in the directory R&S_BF.TMP and should not be deleted, either the directory has to be renamed before starting the update program (eg R&S_BF.ORG), or the file has to be saved on a disk or another harddisk drive*.

The PC screen indicates that the files are being unpacked:

```
BF.CNF .
BF1.BIN .....
BF2.BIN .....
T115K.BIN .
FLASHPRO.EXE .....
```

The actual loading program FLASHPRO.EXE is then started to perform the loading procedure and to show it on the PC screen.

- After a few seconds, the loading program shows a window with the message "Enable software update on target now (see user manual) and press OK button".
- Switch on the transmitter control unit for a short time; press the F5 key several times during the first ½ second after switching on until FLASHUP is displayed on the control unit. If SYSTEM HALT is displayed instead of FLASHUP, the F5 key was pressed too late. (Note: F5 must not be pressed before the unit is switched on but must be actuated and released at least once within the first ½ second.) If unsuccessful, try again to force the control unit into the FLASHUP mode by means of the F5 key until FLASHUP is displayed on the control unit.

- Press the Enter key on the PC to inform the loading program that the transmitter control unit is ready for a flashup.

  From now on, the update will be performed fully automatically as long as no error occurs; no further action is required on part of the user.

- FLASHUP keeps being displayed on the transmitter control unit throughout the update procedure. Upon successful completion of the update, the new program is started automatically on the control unit.
  OK is displayed on the PC screen.
- Press the ENTER key (or click on OK with the mouse) to complete the update procedure. The files installed by the update program are now deleted; the directory R&S_BF.TMP is also deleted from the harddisk unless it already existed before the start of the update program.
- Upon completion of the update, quit the current disk drive by entering "C:". The update disk should be removed from the disk drive.

7.3.1.4 Error Messages / Troubleshooting

Error Messages of the Update Program
These error messages are output in the command line of the operating system.

Message	Cause	Troubleshooting
Illegal Option	An invalid parameter was entered in calling up the update program from the command line	Identify the invalid parameter and repeat the update call-up using a reliable parameter. If this error occurs, the list of permissible parameters is displayed on the PC screen automatically (see also the following section "Settings").
File BF.DAT missing	The file BF.DAT, which is required for the update, was not found on the current disk drive.	Make sure the disk drive/directory containing UPDATE.EXE has been selected. Checking if the file BF.DAT is contained in the same directory as UPDATE.EXE.
The update program requires a drive with at least 4000000 bytes available space. No drive with sufficient free disk space was found.	No harddisk with sufficient free memory space was found on the PC.	Delete files that are no longer required from a harddisk until more than 4 MB free disk space is available.
File xxxxx not found.	One of the files required for the update has not been found.	These files are generated from the BF.DAT file, so this error can only occur if an invalid BF.DAT file is used. Make sure the BF.DAT file on the disk is the original file.

7.3.1.5 Additional Settings

The update program offers additional settings which can be performed by entering parameters in the command line.

These additional settings should only be performed for handling special requirements or troubleshooting and only by users with the appropriate know-how. For the standard use of the update program these settings are normally irrelevant.

These parameters are all optional and are normally entered as follows:
UPDATE [parameter] [parameter] ....

Any number of parameters may be entered. Each parameter may be entered several times, in which case only the parameter entered last becomes effective. If an invalid parameter is entered, the program is quit and a list of the valid parameters is shown.

-c1	Use of the COM1 port for communication with the transmitter control unit; same effect as entering the parameter COM1.
-c2	Use of the COM2 port for communication with the transmitter control unit; same effect as entering the parameter COM2.
-dx	Disk drive to be used for creating the temporary directory (eg de = use drive E:). If this parameter is entered, the program will not search for a disk drive with sufficient free memory space but it will assume there is enough space on the entered drive.
-e	The return of error codes to the executing program is suppressed. Normally, the program confirms successful program execution with 0, while in the event of an error a value other than 0 is returned. This value can then be evaluated eg at the DOS level by polling ERRORLEVEL. If the parameter –e was entered, 0 is always returned by the program.
-f	The enclosed README.TXT file is shown.
-h	The Help screen listing all additional parameter settings is shown. This screen is also shown if an invalid parameter was entered.
-i	Every program action is indicated on the screen. This option is particularly suited for troubleshooting, ie to find out at exactly which action the program halts. As large amounts of information are output at a high rate, it is useful to record this information in a file (eg UPDATE -i >> C:update.txt).
-n	The download program is not loaded, ie no data transfer to the unit. Apart from that, normal flashup procedure.
-t	Entering the name of the directory to be used for the temporary files of the update program. If no parameter is entered, the program uses the name R&S_BF.TMP. If this parameter is entered here, the program is forced to use a different directory (eg -tTMP\BF). If there is already a directory with the name entered here, this directory will be used. Otherwise, a directory with the specified name will be created. If this directory was created by the update program, it will be deleted after completion of the program (however see parameter –r). The entered directory name must not contain a disk drive. However parameter –t may also be used in combination with parameter –d: for the update program to use directory xyz on drive L:, enter the following: -dl -tXYZ
-o	Outputting the selected options on the screen; this may be useful for checking the effects the entries may have on the update program.
-r	Normally, the update program deletes the temporary files and directories it has created. If parameter -r is entered, they will not be deleted. This option may be used for debugging and if several flashups are to be performed in succession without having to install the flashup anew each time. If this parameter is entered, the actual loading program will have to be started from the installation directory by entering FLASPRO BF.CNF.

8 Troubleshooting

((will be issued later))

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9 Remote Control

9.1 Remote Control of the Transmitter

9.1.1 Introduction

This specification contains lists of all remote commands and messages of the serial BITBUS interface for remote control of all transmitters of the NH 6000 family. It is based on the following documents:

- BITBUS standard (IEC 864-2)
- Standard specifications of public broadcasters No. 5/1.0 part 2 (D)

The following transmitter concepts are considered in the BITBUS interface command tables:

- Single transmitter (chapter 9.1.4),
- Transmitter with passive exciter standby (chapter 9.1.5)
- Transmitter with passive transmitter standby (chapter 9.1.6
- Transmitter with active output stage standby (chapter 9.1.7).

9.1.2 General

The serial remote-control interface to IEC/IEEE 864-2 (BITBUS) has the following format:

	Remote command	**Remote message**
Byte 1	Upload and	Upload and
Byte 2	Download address	Download address
Byte 3	*See*	*See*
Byte 4	*Tables*	*Tables*
Byte 5	*Remote commands*	*Remote messages*

Byte 4 describes the logic/physical subsystem which is addresses via a remote command or sends a remote message:

Byte 4	**Output stage**	**Transmitter with passive exciter standby**	**Transmitter with passive transmitter standby**	**Transmitter with active output stage standby**	**Reference to system components**
60		Logic unit		Logic unit exciter	Logical (IEC)
70				Logic unit output stage	Logical (IEC)
01	Transmitter	Main transmitter	Main transmitter	Main transmitter	Logical (IEC)
11		Standby exciter	Standby transmitter	Standby transmitter	Logical (IEC)
10		Exciter A	Transmitter A	Exciter A	Physical (D)
20		Exciter B	Transmitter B	Exciter B	Physical (D)
30		Output stage		Output stage A	Physical (D)
40				Output stage B	Physical (D)

Explanations:

- "Logical" means that the system components are assigned according to the setting of the RF switch.
- "Physical" reference means that the system components have a fixed assignment.
- Set and Get commands of the logic unit of the exciter can also be assigned to the logic unit of the output stage depending on the system configuration.

9.1.3 Notes on Remote Commands and Messages

- All remote messages indicate the current state. They are not a confirmation of remote commands.
- The remote commands and messages in the tables are valid when automatic RF switches are used throughout the system. If patch panels are used instead of the automatic RF switches, only the remote commands and messages in the 'Patch panel' column are active.
- The terms 'Logic unit' and 'Logic unit output stage' as well as 'Automatic switchover' and 'Automatic output stage' have the same meaning for remote commands and messages of the configuration 'active output stage standby with passive exciter standby'. The terms 'Logic unit' and 'Automatic switchover' are used, as defined in IEC 864-2, for transmitters with active output stage standby.

9.1.3.1 System Components

- Exciter A,
- Exciter B,
- Output stage A,
- Output stage B,
- Central control unit (CCU).

9.1.3.2 Operating Transmitter

All components of the transmitter system connected to the antenna and involved in broadcasting.

9.1.3.3 Standby Transmitter

All components connected to the dummy antenna and not involved in broadcasting.

9.1.3.4 Preselection

Remote command:

- Select exciter A,
- Select exciter B,
- Select output stage A (remote command when the patch panel is not active),
- Select output stage B (remote command when the patch panel is not active),

The preselection command defines the components that are to function as the main transmitter. It is independent of the setting of the RF switch. Presettings do not change after an automatic exciter or output stage switchover.

Remote message:

- Exciter A preselected,
- Exciter B preselected,
- Output stage A preselected,
- Output stage B preselected,
- Operation with exciter A,
- Operation with exciter B,
- Output stage A connected to antenna,
- Output stage B connected to antenna.

The messages 'Exciter preselected' and 'Output stage preselected' indicate the preselected exciter or output stage. The remote messages 'Operation with exciter' and 'Output stage connected to antenna' indicate which exciter or output stage is a component of the main transmitter.

9.1.3.5 Sum Fault - Exciter / Output Stage

Remote message:

- Sum fault exciter A,
- Sum fault exciter B,
- Sum fault output stage A,
- Sum fault output stage B.

Remote messages are output when:

- Exciter or output stage signals a sum fault or
- Exciter or output stage signals an RF fault or
- No communication is possible with the exciter or output stage.

9.1.3.6 RF Fault - Exciter / Output Stage / Transmitter

An RF fault message is generated when the power is below the set power threshold (RF fault limit) of a component (exciter, output stage, transmitter) for a specified period of time (7 seconds) although the component should output RF power.

9.1.3.7 RF Warning - Exciter / Output Stage / Transmitter

An RF warning is generated when the power is below the set power threshold (RF warning limit) of a component (exciter, output stage, transmitter) for a specified period of time (7 seconds) although the component should output RF power.

9.1.3.8 Automatic Switchover / Automatic Switchover Ready

Remote command

- Automatic exciter switchover on,
- Automatic exciter switchover off,
- Automatic switchover on (remote command when the patch panel is not active),
- Automatic switchover off (remote command when the patch panel is not active),

Remote message:

- Automatic switchover exciter on,
- Automatic switchover exciter off,
- Automatic switchover on (remote command when the patch panel is not active),
- Automatic switchover off (remote command when the patch panel is not active),
- Automatic switchover exciter ready
- Automatic switchover ready (remote command when the patch panel is not active).

The message 'Automatic switchover ready' and 'Automatic switchover exciter ready' indicate that a switchover has taken place to the output stage or exciter that was not preselected following a sum fault message from the output stage or exciter.

9.1.3.9 Automatic Switchover Has Responded

Remote message:

- Automatic exciter switchover has responded,
- Automatic switchover has responded (remote message when the patch panel is not active).

An automatic switchover of the exciter or output stage has taken place in response to a sum fault message issued by the exciter or output stage.

9.1.3.10 Automatic Switchover Faulty

Remote message:

- Automatic switchover exciter faulty,
- Automatic switchover faulty

Automatic switchover faulty, eg RF switches cannot be set to desired position.

9.1.3.11 RF Present

This remote message is output when the following applies:

RF level > RF nominal level - RF fault limit

- RF level [dB]
- RF nominal level = 0 dB
- RF fault limit [dB]

Definitions related to messages:

Remote message	RF level [dB]	RF fault limit [dB]
Exciter A, RF present	RF level output, exciter A	Exciter A, RF fault limit
Exciter B, RF present	RF level output, exciter B	Exciter A, RF fault limit
Output stage A, RF present	RF level output, output stage A	Power amplifier A, RF fault limit
Output stage B, RF present	RF level output, output stage B	Power amplifier B, RF fault limit
Main transmitter, RF present	RF level antenna	Antenna, RF fault limit

All parameters can be set within their appropriate ranges.

9.1.3.12 RF OK

This remote message is output when the following applies:

RF level > RF nominal level - RF warning limit

- RF level [dB]
- RF nominal level = 0 dB
- RF warning limit [dB]

The table below illustrates again the relationship between the set warning and fault thresholds and the issued messages and displays:

Standard configuration (warning threshold above fault threshold)**:**

		Remote message 'RF present' and RF LED on front panel	**Remote message 'RF OK'**	**RF warning message displayed**
	↑	yes	yes	no
Warning threshold -1 dB	-----	----------	----------	----------
	|	yes	no	yes
Fault threshold -3 dB	-----	----------	----------	----------
	↓	no	no	no

Inverted configuration (fault threshold above warning threshold)**:**

		Remote message 'RF present' and RF LED on front panel	**Remote message 'RF OK'**	**RF warning message displayed**
	↑	yes	yes	no
Fault threshold -1 dB	-----	----------	----------	----------
	|	no	yes	no
Warning threshold -3 dB	-----	----------	----------	----------
	↓	no	no	yes, if 'Output stage ON'

9.1.3.13 Central Control Unit (CCU)

There is a hardware fault in the CCU, eg the processor watchdog has been activated.

9.1.3.14 Local Mode - Exciter, Output Stage, CCU

Remote message:

- Local mode exciter A,
- Local mode exciter B,
- Local mode output stage A,
- Local mode output stage B,
- Local mode CCU.

The components exciter / output stage / CCU can be operated from the front panel only in the local mode.

Upon a change of the CCU operating mode from LOCAL to REMOTE, the operating parameters stored before the switchover are set. The following parameters are set:

- Operating status of transmitter (on/off)

9.1.3.15 Measured Values

Remote message:

- Forward power, antenna,
- Forward power, sound 1 antenna
- Forward power, sound 2 antenna
- Reflected power, antenna,
- Intake air temperature,
- Outlet air temperature.

The specified power values are always actual values, the indicated temperatures are the actual maximum values in the output rack(s).

9.1.4 Single Transmitter

9.1.4.1 Remote Commands

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	User-defined	Parallel interface Connector and contact
Transmitter	Operating mode	Transmitter off	Π	00-01-10	IEC	X104.A3 X104.A18
		Transmitter standby	Π	00-01-30	IEC	X104.A4 X104.A18
		Transmitter on	Π	00-01-40	IEC	X104.A5 X104.A18
	Reset	Reset sum fault	Π	1F-01	R&S	X104.A10 X104.A18
	Special function	Special function off	Π	10-01-00	D	X104.C2 X104.A18
		Special function on	Π	10-01-01	D	X104.C1 X104.A18
	Modulation type and Coding	TV mono	Π	03-01-60	IEC	X102A.3 X102A.6
		TV dual sound	Π	03-01-61	IEC	X102A.5 X102A.6
		TV stereo	Π	03-01-62	IEC	X102A.4 X102A.6
	Coding Control	Control by dataline	Π	12-01-00	D	X102A.1 X102A.6
		Control by remote interface	Π	12-01-01	D	X102A.2 X102A.6

9.1.4.2 Remote Messages

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined status	Parallel interface Connector and contact
Transmitter	Operating status	Transmitter off	Π	20-01-10	yes	IEC	X106.C7 X106.D7
		Transmitter standby	Π	20-01-30	yes	IEC	X106.C8 X106.D8
		Transmitter on	Π	20-01-40	yes	IEC	X106.C6 X106.D6
		Transmitter on	Π	20-01-40	yes	IEC	X106.C6 X106.D6
	Special function	Special function off	Π	30-01-00	yes	D	X105.D1 X105.D2
		Special function on	Π	30-01-01	yes	D	X105.B1 X105.B2
	Modulation type and Coding	TV mono	Π	23-01-60		IEC	X102A.11 X102A.12
		TV dual	Π	23-01-61	yes	IEC	X102A.15 X102A.16
		TV stereo	Π	23-01-62	yes	IEC	X102A.13 X102A.14
	Coding Control	Control by dataline	Π	31-01-00	yes	D	X102A.9 X102A.10 open
		Control by remote interface	Π	31-01-01	yes	D	X102A.9 X102A.10 closed
	Status dual sound coder	Data line missing	Π	32-01-xxxx.xxx1	yes	R&S	X102A.7 X102A.8
		Control by remote interface	Π	32-01-xxxx.xx1x	yes	R&S	X102A.9 X102A.10 closed
		Operating mode TV mono	Π	32-01-xxxx.x1xx	yes	R&S	X102A.11 X102A.12
		Operating mode TV dual sound	Π	32-01-xxxx.1xxx	yes	R&S	X102A.15 X102A.16
		Operating mode TV stereo	Π	32-01-xxx1.xxxx	yes	R&S	X102A.13 X102A.14
		Operating mode manual (pilot off)	Π	32-01-xx1x.xxxx	yes	R&S	
		Dual sound coder switched off	Π	32-01-x1xx.xxxx	yes	R&S	
		Dual sound coder local	Π	32-01-1xxx.xxxx	yes	R&S	
	Status 0	Summary fault	Π	40-01-xxxx.xxx1	yes	IEC	X105.B10 X105.B11 open
		Summary warning	Π	40-01-xxxx.xx1x	yes	IEC	X105.C13 X105.D13
		Local mode	Π	40-01-0xxx.xxxx	yes	IEC	X106.A15 X106.B15 bist.
	Status 1	RF present	Π	50-01-xxxx.xxx1	yes	R&S	X106.A3 X106.B3
		Summary fault	Π	50-01-xxxx.xx1x	yes	D	X105.B10 X105.B11 open
		Summary warning	Π	50-01-xxxx.x1xx	yes	D	X105.C13 X105.D13
		Local mode	Π	50-01-xx1x.xxxx	yes	D	X106.A15 X106.B15 bist.
		Status change		50-01-x1xx.xxxx	---	D	
		RF OK		50-01-1xxx.xxxx	yes	R&S	X106.C10 X106.D10
	Status 2	Frequency sync has failed	Π	51-01-xxxx.xxx1	yes	D	X105.A1 X105.A2
		VF control range exceeded	Π	51-01-xxxx.xx1x	yes	D	X105.B5 X105.B6
		Summary fault exciter	Π	51-01-xxxx.x1xx	yes	D	X106.C16 X106.D16 open
		Summary warning exciter	Π	51-01-xxxx.1xxx	yes	D	X106.C14 X105.D14
		RF exciter present	Π	51-01-xxx1.xxxx	yes	R&S	

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined status	Parallel interface Connector and contact
	Group status	Overall status	Π	A0-01-yy1	no	D	
	Single fault	Fault memory, transmitter	Π	52-01- 00..312	no	D	
	Register	Fault register	Π	53-01- aaaabbbb3	yes	R&S	
		Warning register	Π	54-01- aaaabbbb	yes	R&S	
		Status register	Π	55-01- aaaabbbb	yes	R&S	
	Transmitter ID	Manufacturer ID and rated power	Π	61-01- aabb4	no	R&S	

9.1.4.3 List of Measured Values

	Measured value	Coding to IEC 864-2 (user-defined area) Command bytes	Message bytes
Transmitter	Forward power, vision	62-01-18	62-01-18-aabbccdd5
	Forward power, sound 1	62-01-19	62-01-19-aabbccdd
	Forward power, sound 2	62-01-29	62-01-29-aabbccdd
	Reflected power, antenna	62-01-26	62-01-26-aabbccdd
	Forward power, vision output stage	62-01-16	62-01-16-aabbccdd
	Reflected power, vision output stage	62-01-17	62-01-17-aabbccdd
	Forward power, sound output stage	62-01-27	62-01-27-aabbccdd
	Reflected power, sound output stage	62-01-28	62-01-28-aabbccdd
	Intake air temperature	62-01-10	62-01-10-aabbccdd
	Outlet air temperature.	62-01-12	62-01-12-aabbccdd

Example (Result messages to IEC-559)**:**

```
Message 62-01-18-00404244  (<02>FF011600404244<03>)

Conversion into a floating point number: (M = mantissa; S = sign; E = exponent)
   $00      $40      $42      $44
   MMMMMMMM MMMMMMMM MMMMMMMM SEEEEEEE
   00000000 01000000 01000010 01000100
   S = 0 (sign)
   E = #10001000 - 127 = 136-127 = 9 (exponent)
   M = #10000100100000000000000 (binary notation of mantissa)
   M = #1.10000100100000000000000 (normal notation of mantissa)
   positive exponent = shift of decimal point towards the right
Measured value = #1100001001.0 = 777

Forward power of output stage A = 777 W
```

[1] yy: corresponds to the n bytes for the total status. Transmission of message bytes is organized in bytes 4 and then bytes 3.
[2] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory
[3] Meaning of aaaabbbb: 32 bits of status, fault or warning register.
[4] 1st. data byte aa: manufacturer code, constant 0x54= R&S Transmitter NH6000.
2nd data byte bb: rated power:
MSB set => bits 0 to 6 give the rated power in kW (example: 0x85 = 5 kW)
MSB not set => bits 0 to 6 give the rated power in 10 W. (example: 0x3C = 600 W)
[5] aabbccdd: corresponds to a floating-point number in the 4-byte format to IEC-559. resp. IEEE-754.

9.1.5 Transmitter with Passive Exciter Standby

9.1.5.1 Remote Commands

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	User-defined	Parallel interface Connector and contact
Logic unit	Operating mode	Automatic switchover off	Π	00-60-10	IEC	X104.B14 X104.A18
		Automatic switchover on	Π	00-60-40	IEC	X104.B15 X104.A18
	Preselection	Exciter A	Π	10-60-10	IEC	X104.A15 X104.A18
		Exciter B	Π	10-60-20	IEC	X104.A16 X104.A18
		Reset sum fault	Π	40-60	IEC	X104.A10 X104.A18
Main transmitter	Operating mode	Automatic switchover off	Π	00-60-10	IEC	X104.B14 X104.A18
		Automatic switchover on	Π	00-60-40	IEC	X104.B15 X104.A18
	Presetting	Exciter A	Π	10-60-10	IEC	X104.A15 X104.A18
		Exciter B	Π	10-60-20	IEC	X104.A16 X104.A18
	Reset	Reset summary fault	Π	40-60	IEC	X104.A10 X104.A18
Main transmitter	Operating mode	Main transmitter off	Π	00-01-10	IEC	X104.A1 X104.A18
		Main transmitter on	Π	00-01-40	IEC	X104.A2 X104.A18
Standby exciter	Operating mode	Standby exciter off	Π	00-11-10	IEC	X104.A3 X104.A18
		Standby exciter standby	Π	00-11-30	IEC	X104.A4 X104.A18
		Standby exciter on	Π	00-11-40	IEC	X104.A5 X104.A18
Exciter A	Special function	Special function off	Π	10-10-00	D	X104.C2 X104.A18
		Special function on	Π	10-10-01	D	X104.C1 X104.A18
	Modulation Type and Coding	TV mono	Π	03-10-60	IEC	X102A.3 X102A.6
		TV dual	Π	03-10-61	IEC	X102A.5 X102A.6
		TV stereo	Π	03-10-62	IEC	X102A.4 X102A.6
	Coding Control	Control by data line	Π	12-10-00	D	X102A.1 X102A.6
		Control by remote interface	Π	12-10-01	D	X102A.2 X102A.6
Exciter B	Special function	Special function off	Π	10-20-00	D	X104.D2 X104.A18
		Special function on	Π	10-20-01	D	X104.D1 X104.A18
	Modulation Type and Coding	TV mono	Π	03-20-60	IEC	X102B.3 X102B.6
		TV dual	Π	03-20-61	IEC	X102B.5 X102A.6
		TV stereo	Π	03-20-62	IEC	X102B.4 X102B.6
	Coding Control	Control by data line	Π	12-20-00	D	X102B.1 X102B.6
		Control by remote interface	Π	12-20-01	D	X102B.2 X102B.6

9.1.5.2 Remote Messages

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined Status	Parallel interface Connector and contact
Logic unit	Operating mode	Automatic switchover off	Π	20-60-10	yes	IEC	X105.A15 X105.A16
		Automatic switchover on	Π	20-60-40	yes	IEC	X105.A13 X105.A14
	Presetting	Exciter A preselected	Π	30-60-10	yes	IEC	X105.C6 X105.D6
		Exciter B preselected	Π	30-60-20	yes	IEC	X105.C7 X105.D7
	Status 0	CCU faulty	Π	50-60- xxxx.xxx1	yes	IEC	X106.A8 X106.B8 (open)
		Automatic switchover has responded	Π	50-60- xxxx.xx1x	yes	IEC	X105.A11 X105.A12
		Standby exciter standby	Π	50-60- xxxx.x1xx	yes	IEC	X106.C8 X106.D8
		Automatic switchover ready	Π	50-60- xxxx.1xxx	yes	IEC	X105.C14 X105.D14
		Operation with exciter A	Π	50-60- xxx1.xxxx	yes	DIEC	X106.A12 X106.B12
		Operation with exciter B	Π	50-60- xx1x.xxxx	yes	IEC	X106.A13 X106.B13
		Status change		50-60- x1xx.xxxx	---	D	
		CCU, local mode	Π	50-60- 0xxx.xxxx	yes	IEC	X106.A14 X106.B14 (bist.)
	Status 1	Automatic switchover faulty	Π	51-60-xxxx.xxx1	yes	R&S	X106.C2 X106:D2 open
	Group status	Partial status	Π	A1-60-yy[6]	no	R&S	
		Overall status	Π	A0-60-yy[7]	no	D	
	Single fault	Fault memory, logic unit	Π	52-60-00..31[8]	no	D	
	Register	Fault register	Π	53-60-aaaabbbb[9]	yes	R&S	
		Warning register	Π	54-60-aaaabbbb	yes	R&S	
		Status register	Π	55-60-aaaabbbb	yes	R&S	
Main transmitter	Operating status	Main transmitter off	Π	20-01-10	yes	IEC	X105.B17 X105.B18
		Main transmitter on	Π	20-01-40	yes	IEC	X105.B3 X105.B4
	Status 1	RF present	Π	50-01- xxxx.xxx1	yes	R&S	X106.C5 X106.D5
	Group status	Partial status	Π	A1-01-yy[10]	no	R&S	
Standby exciter	Operating status	Standby exciter off	Π	20-11-10	yes	IEC	X106.C7 X106.D7
		Standby exciter standby	Π	20-11-30	yes	IEC	X106.C8 X106.D8
		Standby exciter on	Π	20-11-40	yes	IEC	X106.C6 X106.D6
	Group status	Partial status	Π	A1-11-yy[11]	no	R&S	

[6] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.
[7] yy: corresponds to the n bytes for the overall status of the function group. Transmission of message bytes follows sorted on byte 3.
[8] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory
[9] Meaning of aaaabbbb: 32 bits of status, fault or warning register.
[10] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.
[11] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined Status	Parallel interface Connector and contact
Exciter A	Special function	Special function off	Π	30-10-00	yes	D	X105.D1 X105.D2
		Special function on	Π	30-10-01	yes	D	X105.B1 X105.B2
	Modulation type and Coding	TV mono	Π	23-10-60		IEC	X102A.11 X102A.12
		TV dual	Π	23-10-61	yes	IEC	X102A.15 X102A.16
		TV stereo	Π	23-10-62	yes	IEC	X102A.13 X102A.14
	Coding Control	Control by dataline	Π	31-10-00	yes	D	X102A.9 X102A.10 open
		Control by remote interface	Π	31-10-01	yes	D	X102A.9 X102A.10 closed
	Status dual sound coder	Data line missing	Π	32-10-xxxx.xxx1	yes	R&S	X102A.7 X102A.8
		Control by remote interface	Π	32-10-xxxx.xx1x	yes	R&S	X102A.9 X102A.10 closed
		Operating mode TV mono	Π	32-10-xxxx.x1xx	yes	R&S	X102A.11 X102A.12
		Operating mode TV dual sound	Π	32-10-xxxx.1xxx	yes	R&S	X102A.15 X102A.16
		Operating mode TV stereo	Π	32-10-xxx1.xxxx	yes	R&S	X102A.13 X102A.14
		Operating mode manual (pilot off)	Π	32-10-xx1x.xxxx	yes	R&S	
		Dual sound coder switched off	Π	32-10-x1xx.xxxx	yes	R&S	
		Dual sound coder local	Π	32-10-1xxx.xxxx	yes	R&S	
	Status 0	Summary fault	Π	40-10-xxxx.xxx1	yes	IEC	X106:C16 X106.D16 open
		Summary warning	Π	40-10-xxxx.xx1x	yes	IEC	X106.C14 X106.D14
		Local mode	Π	40-10-0xxx.xxxx	yes	IEC	X106.A17 X106.B17 bist.
	Status 1	RF present	Π	50-10-xxxx.xxx1	yes	R&S	
		Summary fault	Π	50-10-xxxx.xx1x	yes	D	X106.C16 X106.D16 open
		Summary warning	Π	50-10-xxxx.x1xx	yes	D	X106.C14 X106.D14
		Local mode	Π	50-10-xx1x.xxxx	yes	D	X106.A17 X106.B17 bist.
	Status 2	Frequency sync has failed	Π	51-10-xxxx.xxx1	yes	D	X105.A1 X105.A2
		VF control range exceeded	Π	51-10-xxxx.xx1x	yes	D	X105.B5 X105.B6
		Summary fault exciter	Π	51-10-xxxx.x1xx	yes	D	X106.C16 X106.D16 open
		Summary warning exciter	Π	51-10-xxxx.1xxx	yes	D	X106.C14 X105.D14
		RF exciter present	Π	51-10-xxx1.xxxx	yes	R&S	
	Group status	Partial status	Π	A1-10-yy[12]	no	R&S	
	Single fault	Fault memory, exciter A	Π	52-10-00..31[13]	no	D	
	Register	Fault register	Π	53-10-aaaabbbb[14]	yes	R&S	
		Warning register	Π	54-10-aaaabbbb	yes	R&S	
		Status register	Π	55-10-aaaabbbb	yes	R&S	

[12] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.
[13] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory
[14] Meaning of aaaabbbb: 32 bits of status, fault or warning register.

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined Status	Parallel interface Connector and contact
Exciter B	Special function	Special function off	Π	30-20-00	yes	D	X105.C3 X105.C4
		Special function on	Π	30-20-01	yes	D	X105.C1 X105.C2
	Modulation type and Coding	TV mono	Π	23-20-60		IEC	X102B.11 X102B.12
		TV dual	Π	23-20-61	yes	IEC	X102B.15 X102B.16
		TV stereo	Π	23-20-62	yes	IEC	X102B.13 X102B.14
	Coding Control	Control by dataline	Π	31-20-00	yes	D	X102B.9 X102B.10 open
		Control by remote interface	Π	31-20-01	yes	D	X102B.9 X102B.10 closed
	Status dual sound coder	Data line missing	Π	32-20-xxxx.xxx1	yes	R&S	X102B.7 X102B.8
		Control by remote interface	Π	32-20-xxxx.xx1x	yes	R&S	X102B.9 X102B.10 closed
		Operating mode TV mono	Π	32-20-xxxx.x1xx	yes	R&S	X102B.11 X102B.12
		Operating mode TV dual sound	Π	32-20-xxxx.1xxx	yes	R&S	X102B.15 X102B.16
		Operating mode TV stereo	Π	32-20-xxx1.xxxx	yes	R&S	X102B.13 X102B.14
		Operating mode manual (pilot off)	Π	32-20-xx1x.xxxx	yes	R&S	
		Dual sound coder switched off	Π	32-20-x1xx.xxxx	yes	R&S	
		Dual sound coder local	Π	32-20-1xxx.xxxx	yes	R&S	
	Status 0	Summary fault	Π	40-20-xxxx.xxx1	yes	IEC	X106:C17 X106.D17 open
		Summary warning	Π	40-20-xxxx.xx1x	yes	IEC	X106.C9 X106.D9
		Local mode	Π	40-20-0xxx.xxxx	yes	IEC	X106.A18 X106.B18 bist.
	Status 1	RF present	Π	50-20-xxxx.xxx1	yes	R&S	
		Summary fault	Π	50-20-xxxx.xx1x	yes	D	X106.C17 X106.D17 open
		Summary warning	Π	50-20-xxxx.x1xx	yes	D	X106.C9 X106.D9
		Local mode	Π	50-20-xx1x.xxxx	yes	D	X106.A18 X106.B18 bist.
	Status 2	Frequency sync has failed	Π	51-20-xxxx.xxx1	yes	D	X105.A3 X105.A4
		VF control range exceeded	Π	51-20-xxxx.xx1x	yes	D	X105.B7 X105.B8
		Summary fault exciter	Π	51-20-xxxx.x1xx	yes	D	X106.C17 X106.D17 open
		Summary warning exciter	Π	51-20-xxxx.1xxx	yes	D	X106.C19 X105.D9
		RF exciter present	Π	51-20-xxx1.xxxx	yes	R&S	
	Group status	Partial status	Π	A1-20-yy[15]	no	R&S	
	Single fault	Fault memory, exciter A	Π	52-20-00..31[16]	no	D	
	Register	Fault register	Π	53-20-aaaabbbb[17]	yes	R&S	
		Warning register	Π	54-20-aaaabbbb	yes	R&S	
		Status register	Π	55-20-aaaabbbb	yes	R&S	

Output stage	Status 0	Sum fault	Π	40-30- xxxx.xxx1	yes	IEC	X105.B10 X105.B11 (open)

[15] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.
[16] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory
[17] Meaning of aaaabbbb: 32 bits of status, fault or warning register.

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined Status	Parallel interface Connector and contact
		Sum warning	Π	40-30- xxxx.xx1x	yes	IEC	X105.C13 X105.D13
		Local mode	Π	40-30- 0xxx.xxxx	yes	IEC	X106.A15 X106.B15 (bist.)
	Status 1	RF present	Π	50-30- xxxx.xxx1	yes	D	X106.A3 X106.B3
		Sum fault	Π	50-30- xxxx.xx1x	yes	D	X105.B10 X105.B11 (open)
		Sum warning	Π	50-30- xxxx.x1xx	yes	D	X105.C13 X105.D13
		Local mode	Π	50-30- xx1x.xxxx	yes	D	X106.A15 X106.B15 (bist.)
		RF OK	Π	50-30- 1xxx.xxxx	yes	R&S	X106.C10 X106.D10
	Group status	Partial status	Π	A1-30-yy[18]	no	R&S	
	Single fault	Fault memory, transmitter	Π	52-30- 00..31[19]	no	D	
	Register	Fault register	Π	53-30-aaaabbbb[20]	yes	R&S	
		Warning register	Π	54-30-aaaabbbb	yes	R&S	
		Status register	Π	55-30-aaaabbbb	yes	R&S	
	Transmitter ID	Manufacturer ID and rated power	Π	61-30-aabb[21]	no	R&S	

[18] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.

[19] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory

[20] Meaning of aaaabbbb: 32 bits of status, fault or warning register.

[21] 1st. data byte aa: manufacturer code, constant 0x54= R&S Transmitter NH6000.
2nd data byte bb: rated power:
MSB set => bits 0 to 6 give the rated power in kW (example: 0x85 = 5 kW)
MSB not set => bits 0 to 6 give the rated power in 10 W. (example: 0x3C = 600 W)

9.1.5.3 List of Measured Values

	Measured value	Coding to IEC 864-2 (user-defined area)	
		Command bytes	Message bytes
Main transmitter	Forward power, vision	62-01-18	62-01-18-aabbccdd[22]
	Forward power, sound 1	62-01-19	62-01-19-aabbccdd
	Forward power, sound 2	62-01-29	62-01-29-aabbccdd
	Reflected power, antenna	62-01-26	62-01-26-aabbccdd
Output stage	Forward power, sound output stage	62-30-16	62-30-16-aabbccdd
	Reflected power, sound output stage	62-30-17	62-30-17-aabbccdd
	Forward power, vision output stage	62-30-27	62-30-27-aabbccdd
	Reflected power, vision output stage	62-30-28	62-30-28-aabbccdd
	Intake air temperature	62-30-10	62-30-10-aabbccdd
	Outlet air temperature.	62-30-12	62-30-12-aabbccdd

Example (Result messages to IEC-559)**:**

```
Message: 62-01-18-00404244  (<02>FF011800404244<03>)

Conversion into a floating point number: (M = mantissa; S = sign; E = exponent)
   $00      $40      $42      $44
   MMMMMMMM MMMMMMMM MMMMMMMM SEEEEEEE
   00000000 01000000 01000010 01000100
   S = 0 (sign)
   E = #10001000 - 127 = 136-127 = 9 (exponent)
   M = #10000100100000000000000 (binary notation of mantissa)
   M = #1.10000100100000000000000 (normal notation of mantissa)
   positive exponent = shift of decimal point towards the right
Measured value = #1100001001.0 = 777

Forward power of output stage A = 777 W
```

[22] aabbccdd: corresponds to a floating-point number in the 4-byte format to IEC-559.

9.1.6 Transmitter with Passive Transmitter Standby

9.1.6.1 Remote Commands

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	User-defined	Parallel interface Connector and contact
Logic unit	Operating mode	Automatic switchover off		00-50-10	IEC	X104.A8 X104.A18
		Automatic switchover on		00-50-40	IEC	X104.A9 X104.A18
	Presetting	Transmitter A		10-50-10	IEC	X104.A6 X104.A18
		Transmitter B		10-50-20	IEC	X104.A7 X104.A18
	Reset	Reset sum fault		40-50	IEC	X104.A10 X104.A18
Main transmitter	Operating mode	Main transmitter off	Π	00-01-10	IEC	X104.A1 X104.A18
		Main transmitter on	Π	00-01-40	IEC	X104.A2 X104.A18
Standby transmitter	Operating mode	Standby transmitter off	Π	00-11-10	IEC	X104.A3 X104.A18
		Standby transmitter standby	Π	00-11-30	IEC	X104.A4 X104.A18
		Standby transmitter on	Π	00-11-40	IEC	X104.A5 X104.A18
Transmitter A	Special function	Special function off	Π	10-10-00	D	X104.C2 X104.A18
		Special function on	Π	10-10-01	D	X104.C1 X104.A18
	Modulation type and	TV mono	Π	03-10-60	IEC	X102A.3 X102A.6
	Coding	TV dual	Π	03-10-61	IEC	X102A.5 X102A.6
		TV stereo	Π	03-10-62	IEC	X102A.4 X102A.6
	Coding Control	Control by dataline	Π	12-10-00	D	X102A.1 X102A.6
		Control by remote interface	Π	12-10-01	D	X102A.2 X102A.6
Transmitter B	Special function	Special function off	Π	10-20-00	D	X104.D2 X104.A18
		Special function on	Π	10-20-01	D	X104.D1 X104.A18
	Modulation type and	TV mono	Π	03-20-60	IEC	X102B.3 X102B.6
	Coding	TV dual	Π	03-20-61	IEC	X102B.5 X102B.6
		TV stereo	Π	03-20-62	IEC	X102B.4 X102B.6
	Coding Control	Control by dataline	Π	12-20-00	D	X102B.1 X102B.6
		Control by remote interface	Π	12-20-01	D	X102B.2 X102B.6

9.1.6.2 Remote messages

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined status	Parallel interface Connector and contact
Logic unit	Operating mode	Automatic switchover off	Π	20-50-10	yes	IEC	X105.C8 X105.D8
		Automatic switchover on	Π	20-50-40	yes	IEC	X105.A17 X105.A18
	Presetting	Transmitter A selected	Π	30-50-10	yes	IEC	X106.A9 X106.B9
		Transmitter B selected	Π	30-50-20	yes	IEC	X106.A10 X106.B10
	Status 0	CCU faulty	Π	50-50-xxxx.xxx1	yes	IEC	X106.A8 X106.B8 (open)
		Automatic switchover has responded	Π	50-50-xxxx.xx1x	yes	IEC	X105.C10 X105.D10
		Standby transmitter standby	Π	50-50-xxxx.x1xx	yes	IEC	X106.C8 X106.D8
		Automatic switchover ready	Π	50-50-xxxx.1xxx	yes	D	X106.C15 X106.D15
		Transmitter A connected to antenna	Π	50-50-xxx1.xxxx	yes	D	X105.C16 X105.D16
		Transmitter B connected to antenna	Π	50-50-xx1x.xxxx	yes	D	X105.C17 X105.D17
		Status change		50-50-x1xx.xxxx	---	D	
		CCU, local mode	Π	50-50-0xxx.xxxx	yes	IEC	X106.A14 X106.B14 (bist.)
	Status 1	Automatic switchover faulty	Π	51-50-xxxx.xxx1	yes	R&S	X106.C1 X106.D1 (open)
	Group status	Partial status	Π	A1-50-yy[23]	no	R&S	
		Overall status	Π	A0-50-yy[24]	no	D	
	Single fault	Fault memory, logic unit	Π	52-50-00..31[25]	no	D	
	Register	Fault register	Π	53-50-aaaabbbb[26]	yes	R&S	
		Warning register	Π	54-50-aaaabbbb	yes	R&S	
		Status register	Π	55-50-aaaabbbb	yes	R&S	
Main transmitter	Operating status	Main transmitter off	Π	20-01-10	yes	IEC	X105.B17 X105.B18
		Main transmitter on	Π	20-01-40	yes	IEC	X105.B3 X106.B4
	Status 1	RF present	Π	50-01- xxxx.xxx1	yes	R&S	X106.C5 X106.D5
	Group status	Partial status	Π	A1-01-yy[27]	yes	R&S	
Standby exciter	Operating status	Standby transmitter off	Π	20-11-10	yes	IEC	X106.C7 X106.D7
		Standby transmitter standby	Π	20-11-30	yes	IEC	X106.C8 X106.D8
		Standby transmitter on	Π	20-11-40	yes	IEC	X106.C6 X106.D6
	Group status	Partial status	Π	A1-11-yy[28]	yes	R&S	

[23] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.

[24] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.

[25] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory

[26] Meaning of aaaabbbb: 32 bits of status, fault or warning register.

[27] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.

[28] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined status	Parallel interface Connector and contact
Transmitter A	Special function	Special function off	Π	30-10-00	yes	D	X105.D1 X105.D2
		Special function on	Π	30-10-01	yes	D	X105.B1 X105.B2
	Modulation type and Coding	TV mono	Π	23-10-60	yes	IEC	X102A.11 X102A.12
		TV dual	Π	23-10-61	yes	IEC	X102A.15 X102A.16
		TV stereo	Π	23-10-62	yes	IEC	X102A.13 X102A.14
	Coding Control	Control by dataline	Π	31-10-00	yes	D	X102A.9 X102A.10 open
		Control by remote interface	Π	31-10-01	yes	D	X102A.9 X102A.10 closed
	Status dual sound coder	Data line missing	Π	32-10-xxxx.xxx1	yes	R&S	X102A.7 X102A.8
		Control by remote interface	Π	32-10-xxxx.xx1x	yes	R&S	X102A.9 X102A.10 closed
		Operating mode TV mono	Π	32-10-xxxx.x1xx	yes	R&S	X102A.11 X102A.12
		Operating mode TV dual sound	Π	32-10-xxxx.1xxx	yes	R&S	X102A.15 X102A.16
		Operating mode TV stereo	Π	32-10-xxx1.xxxx	yes	R&S	X102A.13 X102A.14
		Operating mode manual (pilot off)	Π	32-10-xx1x.xxxx	yes	R&S	
		Dual sound coder switched off	Π	32-10-x1xx.xxxx	yes	R&S	
		Dual sound coder local	Π	32-10-1xxx.xxxx	yes	R&S	
	Status 0	Summary fault	Π	40-10-xxxx.xxx1	yes	IEC	X105.B10 X105.B11 open
		Summary warning	Π	40-10-xxxx.xx1x	yes	IEC	X105.C13 X105.D13
		Local mode	Π	40-10-0xxx.xxxx	yes	IEC	X106.A15 X106.B15 bist.
	Status 1	RF present	Π	50-10-xxxx.xxx1	yes	R&S	X106.A3 X106.B3
		Summary fault	Π	50-10-xxxx.xx1x	yes	D	X105.B10 X105.B11 open
		Summary warning	Π	50-10-xxxx.x1xx	yes	D	X105.C13 X105.D13
		Local mode	Π	50-10-xx1x.xxxx	yes	D	X106.A15 X106.B15 bist.
		RF OK		50-10-1xxx.xxxx	yes	R&S	X106.C10 X106.D10
	Status 2	Frequency sync has failed	Π	51-10-xxxx.xxx1	yes	D	X105.A1 X105.A2
		VF control range exceeded	Π	51-10-xxxx.xx1x	yes	D	X105.B5 X105.B6
		Summary fault exciter	Π	51-10-xxxx.x1xx	yes	D	X106.C16 X106.D16 open
		Summary warning exciter	Π	51-10-xxxx.1xxx	yes	D	X106.C14 X105.D14
		RF exciter present	Π	51-10-xxx1.xxxx	yes	R&S	
	Group status	Partial status	Π	A1-10-yy[29]	no	R&S	
	Single fault	Fault memory, transmitter A	Π	52-10-00...31[30]	no	D	
	Register	Fault register	Π	53-10-aaaabbbb[31]	yes	R&S	
		Warning register Status register	Π Π	54-10-aaaabbbb 55-10-aaaabbbb	yes yes	R&S R&S	

[29] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.
[30] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory
[31] Meaning of aaaabbbb: 32 bits of status, fault or warning register.

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined status	Parallel interface Connector and contact
	Transmitter ID	Manufacturer ID and rated power	Π	61-10-aabb[32]	no	R&S	
Transmitter B	Special function	Special function off	Π	30-20-00	yes	D	X105.C3 X105.C4
		Special function on	Π	30-20-01	yes	D	X105.C1 X105.C2
	Modulation type and Coding	TV mono	Π	23-20-60	yes	IEC	X102B.11 X102B.12
		TV dual	Π	23-20-61	yes	IEC	X102B.15 X102B.16
		TV stereo	Π	23-20-62	yes	IEC	X102B.13 X102B.14
	Coding Control	Control by dataline	Π	31-20-00	yes	D	X102B.9 X102B.10 open
		Control by remote interface	Π	31-20-01	yes	D	X102B.9 X102B.10 closed
	Status dual sound coder	Data line missing	Π	32-20-xxxx.xxx1	yes	R&S	X102B.7 X102B.8
		Control by remote interface	Π	32-20-xxxx.xx1x	yes	R&S	X102B.9 X102B.10 closed
		Operating mode TV mono	Π	32-20-xxxx.x1xx	yes	R&S	X102B.11 X102B.12
		Operating mode TV dual sound	Π	32-20-xxxx.1xxx	yes	R&S	X102B.15 X102B.16
		Operating mode TV stereo	Π	32-20-xxx1.xxxx	yes	R&S	X102B.13 X102B.14
		Operating mode manual (pilot off)	Π	32-20-xx1x.xxxx	yes	R&S	
		Dual sound coder switched off	Π	32-20-x1xx.xxxx	yes	R&S	
		Dual sound coder local	Π	32-20-1xxx.xxxx	yes	R&S	
	Status 0	Summary fault	Π	40-20-xxxx.xxx1	yes	IEC	X105.B10 X105.B11 open
		Summary warning	Π	40-20-xxxx.xx1x	yes	IEC	X105.C13 X105.D13
		Local mode	Π	40-20-0xxx.xxxx	yes	IEC	X106.A15 X106.B15 bist.
	Status 1	RF present	Π	50-20-xxxx.xxx1	yes	R&S	X106.A3 X106.B3
		Summary fault	Π	50-20-xxxx.xx1x	yes	D	X105.B10 X105.B11 open
		Summary warning	Π	50-20-xxxx.x1xx	yes	D	X105.C13 X105.D13
		Local mode	Π	50-20-xx1x.xxxx	yes	D	X106.A15 X106.B15 bist.
		RF OK		50-20-1xxx.xxxx	yes	R&S	X106.C10 X106.D10
	Status 2	Frequency sync has failed	Π	51-20-xxxx.xxx1	yes	D	X105.A3 X105.A4
		VF control range exceeded	Π	51-20-xxxx.xx1x	yes	D	X105.B7 X105.B8
		Summary fault exciter	Π	51-20-xxxx.x1xx	yes	D	X106.C17 X106.D17 open
		Summary warning exciter	Π	51-20-xxxx.1xxx	yes	D	X106.C9 X105.D9
		RF exciter present	Π	51-20-xxx1.xxxx	yes	R&S	

	Group status	Partial status	Π	A1-20-yy[33]	no	R&S	
	Single fault	Fault memory, transmitter A	Π	52-20-00...31[34]	no	D	

[32] 1st. data byte aa: manufacturer code, constant 0x54= R&S Transmitter NH6000.
2nd data byte bb: rated power:
MSB set => bits 0 to 6 give the rated power in kW (example: 0x85 = 5 kW)
MSB not set => bits 0 to 6 give the rated power in 10 W. (example: 0x3C = 600 W)

[33] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.

[34] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined status	Parallel interface Connector and contact
	Register	Fault register	Π	53-20-aaaabbbb[35]	yes	R&S	
		Warning register	Π	54-20-aaaabbbb	yes	R&S	
		Status register	Π	55-20-aaaabbbb	yes	R&S	
	Transmitter ID	Manufacturer ID and rated power	Π	61-20-aabb[36]	no	R&S	

00 = no entries in fault memory

[35] Meaning of aaaabbbb: 32 bits of status, fault or warning register.

[36] 1st. data byte aa: manufacturer code, constant 0x54= R&S Transmitter NH6000.
2nd data byte bb: rated power:
MSB set => bits 0 to 6 give the rated power in kW (example: 0x85 = 5 kW)
MSB not set => bits 0 to 6 give the rated power in 10 W. (example: 0x3C = 600 W)

9.1.6.3 List of Measured Values

	Measured value	Coding to IEC 864-2 (User Defined Area) Command bytes	Message bytes
Transmitter A	Forward power vision	62-10-18	62-10-18- aabbccdd[37]
	Forward power sound 1	62-10-19	62-10-19-aabbccdd
	Forward power sound 2	62-10-29	62-10-29-aabbccdd
	Reflected power antenna	62-10-26	62-10-26- aabbccdd
	Forward power vision output stage A	62-10-16	62-10-16-aabbccdd
	Reflected power vision output stage A	62-10-17	62-10-17-aabbccdd
	Forward power sound output stage A	62-10-27	62-10-27-aabbccdd
	Reflected power sound output stage A	62-10-28	62-10-28-aabbccdd
	Intake air temperature, transmitter A	62-10-10	62-10-10- aabbccdd
	Outlet air temperature, transmitter A	62-10-12	62-10-12- aabbccdd
Transmitter B	Forward power vision	62-20-18	62-20-18- aabbccdd
	Forward power sound 1	62-20-19	62-20-19-aabbccdd
	Forward power sound 2	62-20-29	62-20-29-aabbccdd
	Reflected power antenna	62-20-26	62-20-26- aabbccdd
	Forward power vision output stage B	62-20-16	62-20-16-aabbccdd
	Reflected power vision output stage B	62-20-17	62-20-17-aabbccdd
	Forward power sound output stage B	62-20-27	62-20-27-aabbccdd
	Reflected power sound utput stage B	62-20-28	62-20-28-aabbccdd
	Intake air temperature, transmitter B	62-20-10	62-20-10- aabbccdd
	Outlet air temperature, transmitter B	62-20-12	62-20-12- aabbccdd

Example (result messages to IEC-559)**:**

```
Message: 62-20-26-00404244  (<02>FF202600404244<03>)

Conversion into floating point number: (M = mantissa; S = sign; E = exponent)
   $00      $40      $42      $44
   MMMMMMMM MMMMMMMM MMMMMMMM SEEEEEEE
   00000000 01000000 01000010 01000100
   S = 0 (sign)
   E = #10001000 - 127 = 136-127 = 9 (exponent)
   M = #10000100100000000000000 (binary notation of mantissa)
   M = #1.10000100100000000000000 (normal notation of mantissa)
   positive exponent = decimal point shifted towards the right
Measured value = #1100001001.0 = 777

Forward power of output stage A = 777 W
```

[37] aabbccdd: corresponds to a floating-point number in the 4-byte format to IEC-559 resp. IEEE-754

9.1.7 Transmitter with active Output Stage Standby

9.1.7.1 Remote Commands

NOTE:

- Entries in italics explain the function of commands in the 'Half antenna' configuration.

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	User-defined	Parallel interface Connector and contact
Logic unit exciter	Operating mode	Automatic switchover off	Π	00-60-10	IEC	X104.B14 X104.A18
		Automatic switchover on	Π	00-60-40	IEC	X104.B15 X104.A18
	Presetting	Exciter A	Π	10-60-10	IEC	X104.A15 X104.A18
		Exciter B	Π	10-60-20	IEC	X104.A16 X104.A18
	Reset	Reset sum fault	Π	40-50	IEC	X104.A10 X104.A18
Logic unit output stage	Operating mode	Automatic switchover off	Π	00-70-10	IEC	X104.A8 X104.A18
		Automatic switchover on	Π	00-70-40	IEC	X104.A9 X104.A18
	Presetting	Output stage A *(A connected to half antennas 1 and 2)*	Π	10-70-10	IEC	X104.A6 X104.A18
		Output stage B *(B connected to half antennas 1 and 2)*	Π	10-70-20	IEC	X104.A7 X104.A18
		Output stage A+B *(A+B connected to half antenna 1)*	Π	10-70-30	IEC	X104.A14 X104.A18
		Output stages A+B to dummy load *(A+B connected to half antenna 2)*	Π	10-70-40	IEC	X104.A17 X104.A18
Main transmitter	Operating mode	Main transmitter off	Π	00-01-10	IEC	X104.A1 X104.A18
		Main transmitter on	Π	00-01-40	IEC	X104.A2 X104.A18
Standby transmitter	Operating mode	Standby transmitter off	Π	00-11-10	IEC	X104.A3 X104.A18
		Standby transmitter standby	Π	00-11-30	IEC	X104.A4 X104.A18
		Standby transmitter on	Π	00-11-40	IEC	X104.A5 X104.A18
Exciter A	Special function	Special function off	Π	10-10-00	D	X105.C2 X105.A18
		Special function on	Π	10-10-01	D	X105.C1 X105.A18
	Modulation type and Coding	TV mono	Π	03-10-60	IEC	X102A.3 X102A.6
		TV dual	Π	03-10-61	IEC	X102A.5 X102A.6
		TV stereo	Π	03-10-62	IEC	X102A.4 X102A.6
	Coding Control	Control by dataline	Π	12-10-00	D	X102A.1 X102A.6
		Control by remote interface	Π	12-10-01	D	X102A.2 X102A.6
Exciter B	Special function	Special function off	Π	10-20-00	D	X105.D2 X105.A18
		Special function on	Π	10-20-01	D	X105.D1 X105.A18
	Modulation type and Coding	TV mono	Π	03-20-60	IEC	X102B.3 X102B.6
		TV dual	Π	03-20-61	IEC	X102B.5 X102B.6
		TV stereo	Π	03-20-62	IEC	X102B.4 X102B.6
	Coding Control	Control by dataline	Π	12-20-00	D	X102B.1 X102B.6
		Control by remote interface	Π	12-20-01	D	X102B.2 X102B.6

9.1.7.2 Remote Messages

Note:

- Entries in italics explain the function of messages in the 'Half antenna' configuration.
- With passive output stage standby, the commands and messages for A+B are not available.

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined status	Parallel interface Connector and contact
Logic unit exciter	Operating mode	Automatic switchover off	Π	20-60-10	yes	IEC	X105.A15 X105.A16
		Automatic switchover on	Π	20-60-40	yes	IEC	X105.A13 X105.A14
	Presetting	Exciter A preselected	Π	30-60-10	yes	IEC	X105.C6 X105.D6
		Exciter B preselected	Π	30-60-20	yes	IEC	X105.C7 X105.D7
	Status 0	Automatic switchover has responded	Π	50-60-xxxx.xx1x	yes	IEC	X105.A11 X106.A12
		Automatic switchover ready	Π	50-60-xxxx.1xxx	yes	IEC	X105.C14 X105.D14
		Operation with exciter A	Π	50-60-xxx1.xxxx	yes	IEC	X106.A12 X106.B12
		Operation with exciter B	Π	50-60-xx1x.xxxx	yes	IEC	X106.A13 X106.B13
		Automatic switchover, local mode	Π	50-60-0xxx.xxxx	yes	IEC	
	Status 1	Automatic switchover faulty	Π	50-60-xxxx.xxx1	yes	R&S	X106.C2 X106.D2
	Group status	Partial status	Π	A1-60-yy[38]	no	R&S	
	Single fault	Fault memory, logic unit exciter	Π	52-60-00...31[39]	no	D	
	Register	Fault register	Π	53-60-aaaabbbb[40]	yes	R&S	
		Warning register	Π	54-60-aaaabbbb	yes	R&S	
		Status register	Π	55-60-aaaabbbb	yes	R&S	
Logic unit output stage	Operating mode	Automatic switchover off	Π	20-70-10	yes	IEC	X105.C8 X105.D8
		Automatic switchover on	Π	20-70-40	yes	IEC	X105.A17 X105.A18
	Presetting	Output stage A preselected *(B connected to half antennas 1 and 2)*	Π	30-70-10	yes	IEC	X106.A9 X106.B9
		Output stage B preselected *(B connected to half antennas 1 and 2)*	Π	30-70-20	yes	IEC	X106.A10 X106.B10
		Output stages A+B preselected *(A+B connected to half antenna 1)*	Π	30-70-30	yes	IEC	X106.A11 X106.B11
		Output stages A+B on dummy antenna, preselected *(A+B connected to half antenna 2)*	Π	30-70-40	yes	IEC	
	Status 0	CCU faulty	Π	50-70- xxxx.xxx1	yes	IEC	X106.A8 X106.B8 (open)
		Automatic switchover has responded	Π	50-70- xxxx.xx1x	yes	IEC	X105.C10 X105.D10
		Standby transmitter standby	Π	50-70- xxxx.x1xx	yes	IEC	X106.C8 X106.D8
		Automatic switchover ready	Π	50-70-xxxx.1xxx	yes	D	X106.C15 X106.D15
		Output stage A+B connected to dummy antenna *(A+B connected to half antenna 2)*	Π	50-70-xx00.xxxx	yes	IEC	

[38] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.

[39] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory

[40] Meaning of aaaabbbb: 32 bits of status, fault or warning register.

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined status	Parallel interface Connector and contact
		Output stage A connected to antenna *(A connected to half antennas 1 and 2)*	Π	50-70-xx01.xxxx	yes	IEC	X105.C16 X105.D16
		Output stage B connected to antenna *(B connected to half antennas 1 and 2)*	Π	50-70-xx10.xxxx	yes	IEC	X105.C17 X105.D17
		Output stages A+B connected to antenna *(A+B connected to half antenna 1)*	Π	50-70-xx11.xxxx	yes	IEC	X105.C15 X105.D15
		Status change		50-70-x1xx.xxxx	---	D	
		Automatic switchover, local mode	Π	50-70-0xxx.xxxx	yes	IEC	X106.A14 X106.B14 (bist.)
	Status 1	Automatic switchover faulty		51-70-xxxx.xxx1	yes	R&S	X106.C1 X106.D1 open
		Half antenna 1 activated		51-70-xxxx.xx1x	yes	R&S	X106.C12 X106.D13
		Half antenna 2 activated		51-70-xxxx.x1xx	yes	R&S	X106.A2 X106.B2
	Group status	Partial status	Π	A1-70-yy[41]	no	R&S	
		Overall status	Π	A0-70-yy[42]	no	D	
	Single fault	Fault memory, logic unit output stage	Π	52-70-00...31[43]	no	D	
	Register	Fault register	Π	53-70-aaaabbbb[44]	yes	R&S	
		Warning register	Π	54-70-aaaabbbb	yes	R&S	
		Status register	Π	55-70-aaaabbbb	yes	R&S	
Main transmitter	Operating status	Main transmitter off	Π	20-01-10	yes	IEC	X105.B17 X105.B18
		Main transmitter on	Π	20-01-40	yes	IEC	X105.B3 X106.B4
	Status 1	RF present	Π	50-01-xxxx.xxx1	yes	R&S	X106.C5 X106.D5
	Group status	Partial status	Π	A1-01-yy[45]	no	R&S	
Standby transmitter	Operating status	Standby transmitter off	Π	20-11-10	yes	IEC	X106.C7 X106.D7
		Standby transmitter standby	Π	20-11-30	yes	IEC	X106.C8 X106.D8
		Standby transmitter on	Π	20-11-40	yes	IEC	X106.C6 X106.D6
	Group status	Partial status	Π	A1-11-yy[46]	no	R&S	

[41] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.
[42] yy: corresponds to the n bytes for the overall status. Transmission of message bytes follows sorted on byte 4 and then on byte 3.
[43] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory
[44] Meaning of aaaabbbb: 32 bits of status, fault or warning register.
[45] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.
[46] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined status	Parallel interface Connector and contact
Exciter A	Special function	Special function off	Π	30-10-00	yes	D	X105.D1 X105.D2
		Special function on	Π	30-10-01	yes	D	X105.B1 X105.B2
	Modulation type and Coding	TV mono	Π	23-10-60	yes	IEC	X102A.11 X102A.12
		TV dual	Π	23-10-61	yes	IEC	X102A.15 X102A.16
		TV stereo	Π	23-10-62	yes	IEC	X102A.13 X102A.14
	Coding Control	Control by dataline	Π	31-10-00	yes	D	X102A.9 X102A.10 open
		Control by remote interface	Π	31-10-01	yes	D	X102A.9 X102A.10 closed
	Status dual sound coder	Data line missing	Π	32-10-xxxx.xxx1	yes	R&S	X102A.7 X102A.8
		Control by remote interface	Π	32-10-xxxx.xx1x	yes	R&S	X102A.9 X102A.10 closed
		Operating mode TV mono	Π	32-10-xxxx.x1xx	yes	R&S	X102A.11 X102A.12
		Operating mode TV dual sound	Π	32-10-xxxx.1xxx	yes	R&S	X102A.15 X102A.16
		Operating mode TV stereo	Π	32-10-xxx1.xxxx	yes	R&S	X102A.13 X102A.14
		Operating mode manual (pilot off)	Π	32-10-xx1x.xxxx	yes	R&S	
		Dual sound coder switched off	Π	32-10-x1xx.xxxx	yes	R&S	
		Dual sound coder local	Π	32-10-1xxx.xxxx	yes	R&S	
	Status 0	Summary fault	Π	40-10-xxxx.xxx1	yes	IEC	X106.C16 X106.D16 open
		Summary warning	Π	40-10-xxxx.xx1x	yes	IEC	X106.C14 X106.D14
		Local mode	Π	40-10-0xxx.xxxx	yes	IEC	X106.A17 X106.B17 bist.
	Status 1	RF present	Π	50-10-xxxx.xxx1	yes	R&S	
		Summary fault	Π	50-10-xxxx.xx1x	yes	D	X106.C16 X106.D16 open
		Summary warning	Π	50-10-xxxx.x1xx	yes	D	X106.C14 X106.D14
		Local mode	Π	50-10-xx1x.xxxx	yes	D	X106.A17 X106.B17 bist.
	Status 2	Frequency sync has failed	Π	51-10-xxxx.xxx1	yes	D	X105.A1 X105.A2
		VF control range exceeded	Π	51-10-xxxx.xx1x	yes	D	X105.B5 X105.B6
		Summary fault exciter	Π	51-10-xxxx.x1xx	yes	D	X106.C16 X106.D16 open
		Summary warning exciter	Π	51-10-xxxx.1xxx	yes	D	X106.C14 X105.D14
		RF present	Π	51-10-xxx1.xxxx	yes	R&S	
	Group status	Partial status	Π	A1-10-yy[47]	no	R&S	
	Single fault	Fault memory, exciter A	Π	52-10-00...31[48]	no	D	
	Register	Fault register	Π	53-10-aaaabbbb[49]	yes	R&S	
		Warning register Status register	Π Π	54-10-aaaabbbb 55-10-aaaabbbb	yes yes	R&S R&S	

[47] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.
[48] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory
[49] Meaning of aaaabbbb: 32 bits of status, fault or warning register.

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined status	Parallel interface Connector and contact
Exciter B	Special function	Special function off	Π	30-20-00	yes	D	X105.C3 X105.C4
		Special function on	Π	30-20-01	yes	D	X105.C1 X105.C2
	Modulation type and Coding	TV mono	Π	23-20-60	yes	IEC	X102B.11 X102B.12
		TV dual	Π	23-20-61	yes	IEC	X102B.15 X102B.16
		TV stereo	Π	23-20-62	yes	IEC	X102B.13 X102B.14
	Coding Control	Control by dataline	Π	31-20-00	yes	D	X102B.9 X102B.10 open
		Control by remote interface	Π	31-20-01	yes	D	X102B.9 X102B.10 closed
	Status dual sound coder	Data line missing	Π	32-20-xxxx.xxx1	yes	R&S	X102B.7 X102B.8
		Control by remote interface	Π	32-20-xxxx.xx1x	yes	R&S	X102B.9 X102B.10 closed
		Operating mode TV mono	Π	32-20-xxxx.x1xx	yes	R&S	X102B.11 X102B.12
		Operating mode TV dual sound	Π	32-20-xxxx.1xxx	yes	R&S	X102B.15 X102B.16
		Operating mode TV stereo	Π	32-20-xxx1.xxxx	yes	R&S	X102B.13 X102B.14
		Operating mode manual (pilot off)	Π	32-20-xx1x.xxxx	yes	R&S	
		Dual sound coder switched off	Π	32-20-x1xx.xxxx	yes	R&S	
		Dual sound coder local	Π	32-20-1xxx.xxxx	yes	R&S	
	Status 0	Summary fault	Π	40-20-xxxx.xxx1	yes	IEC	X106.C17 X106.D17 open
		Summary warning	Π	40-20-xxxx.xx1x	yes	IEC	X106.C9 X106.D9
		Local mode	Π	40-20-0xxx.xxxx	yes	IEC	X106.A18 X106.B18.
	Status 1	RF present	Π	50-20-xxxx.xxx1	yes	R&S	
		Summary fault	Π	50-20-xxxx.xx1x	yes	IEC	X106.C17 X106.D17 open
		Summary warning	Π	50-20-xxxx.x1xx	yes	IEC	X105.C9 X105.D9
		Local mode	Π	50-20-xx1x.xxxx	yes	IEC	X106.A18 X106.B18 bist.
	Status 2	Frequency sync has failed	Π	51-20-xxxx.xxx1	yes	D	X105.A3 X105.A4
		VF control range exceeded	Π	51-20-xxxx.xx1x	yes	D	X105.B7 X105.B8
		Summary fault exciter	Π	51-20-xxxx.x1xx	yes	D	X106.C17 X106.D17 open
		Summary warning exciter	Π	51-20-xxxx.1xxx	yes	D	X106.C9 X105.D9
		RF exciter present	Π	51-20-xxx1.xxxx	yes	R&S	
	Group status	Partial status	Π	A1-20-yy[50]	no	R&S	
	Single fault	Fault memory, exciter B	Π	52-20-00...31[51]	no	D	
	Register	Fault register	Π	53-20-aaaabbbb[52]	yes	R&S	
		Warning register	Π	54-20-aaaabbbb	yes	R&S	
		Status register	Π	55-20-aaaabbbb	yes	R&S	
Output stage A	Status 0	Sum fault	Π	40-30-xxxx.xxx1	yes	IEC	X105.B10 X105.B11 (open)
		Sum warning	Π	40-30-xxxx.xx1x	yes	IEC	X105.C13 X105.D13

[50] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.

[51] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory

[52] Meaning of aaaabbbb: 32 bits of status, fault or warning register.

	Command	Meaning	Patch panel	Serial interface Coding to IEC 864-2	Change bit affected?	Defined status	Parallel interface Connector and contact
		Local mode	Π	40-30-0xxx.xxxx	yes	IEC	X106.A15 X106.B15 (bist.)
	Status 1	RF present	Π	50-30-xxxx.xxx1	yes	D	X106.A3 X106.B3
		Sum fault	Π	50-30-xxxx.xx1x	yes	D	X105.B10 X105.B11 (open)
		Sum warning	Π	50-30-xxxx.x1xx	yes	D	X105.C13 X105.D13
		Local mode	Π	50-30-xx1x.xxxx	yes	D	X106.A15 X106.B15 (bist.)
		RF OK	Π	50-30-1xxx.xxxx	yes	R&S	X106.C10 X106.D10
	Group status	Partial status	Π	A1-30-yy[53]	no	R&S	
	Single fault	Fault memory, output stage A	Π	52-30-00...31[54]	no	D	
	Register	Fault register	Π	53-30-aaaabbbb[55]	yes	R&S	
		Warning register	Π	54-30-aaaabbbb	yes	R&S	
		Status register	Π	55-30-aaaabbbb	yes	R&S	
	Tx ID	Manufact ID and rated power	Π	61-30-aabb[56]	no	R&S	
Output stage B	Status 0	Sum fault	Π	40-40-xxxx.xxx1	yes	IEC	X105.B12 X105.B13 (open)
		Sum warning	Π	40-40-xxxx.xx1x	yes	IEC	X105.C18 X105.D18
		Local mode	Π	40-40-0xxx.xxxx	yes	IEC	X106.A16 X106.B16 (bist.)
	Status 1	RF present	Π	50-40-xxxx.xxx1	yes	D	X106.A4 X106.B4
		Sum fault	Π	50-40-xxxx.xx1x	yes	D	X105.B12 X105.B13 (open)
		Sum warning	Π	50-40-xxxx.x1xx	yes	D	X105.C18 X105.D18
		Local mode	Π	50-40-xx1x.xxxx	yes	D	X106.A16 X106.B16 (bist.)
		RF OK	Π	50-40-1xxx.xxxx	yes	R&S	X106.C11 X106.D11
	Group status	Partial status	Π	A1-40-yy[57]	no	R&S	
	Single fault	Fault memory, output stage B	Π	52-40-00...31[58]	no	D	
	Register	Fault register	Π	53-40-aaaabbbb[59]	yes	R&S	
		Warning register	Π	54-40-aaaabbbb	yes	R&S	
		Status register	Π	55-40-aaaabbbb	yes	R&S	
	Tx ID	Manufact. ID and rated power	Π	61-30-aabb [56]	no	R&S	

[53] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.
[54] Byte 5: number of fault entered last in the fault memory
00 to 31 = number of fault
00 = no entries in fault memory
[55] Meaning of aaaabbbb: 32 bits of status, fault or warning register.
[56] 1st. data byte aa: manufacturer code, constant 0x54= R&S Transmitter NH6000. 2nd data byte bb: rated power:
MSB set => bits 0 to 6 give the rated power in kW (example: 0x85 = 5 kW)
MSB not set => bits 0 to 6 give the rated power in 10 W. (example: 0x3C = 600 W)
[57] yy: corresponds to the n bytes for the partial status of the function group. Transmission of message bytes follows sorted on byte 3.
[58] Byte 5: number of fault entered last in the fault memory. 00 to 31 = number of fault. 00 = no entries in fault memory
[59] Meaning of aaaabbbb: 32 bits of status, fault or warning register.

9.1.7.3 List of Measured Values

	Measured value	Coding to IEC 864-2 (User Defined Area) Command bytes	Message bytes
Main transmitter	Forward power vision	62-01-18	62-01-18-aabbccdd[60]
	Forward power sound 1	62-01-19	62-01-19-aabbccdd
	Forward power sound 2	62-01-29	62-01-29-aabbccdd
	Reflected power antenna	62-01-26	62-01-26-aabbccdd
Output stage A	Forward power vision output stage A	62-30-16	62-30-16-aabbccdd
	Reflected power vision output stage A	62-30-17	62-30-17-aabbccdd
	Forward power sound output stage A	62-30-27	62-30-27-aabbccdd
	Reflected power sound output stage A	62-30-28	62-30-28-aabbccdd
	Intake air temperature, output stage A	62-30-10	62-30-10-aabbccdd
	Outlet air temperature, output stage A	62-30-12	62-30-12-aabbccdd
Output stage B	Forward power vision	62-40-18	62-40-18-aabbccdd
	Forward power sound 1	62-40-19	62-40-19-aabbccdd
	Forward power sound 2	62-40-29	62-40-29-aabbccdd
	Reflected power antenna	62-40-26	62-40-26-aabbccdd
	Forward power vision output stage B	62-40-16	62-40-16-aabbccdd
	Reflected power vision output stage B	62-40-17	62-40-17-aabbccdd
	Forward power sound output stage B	62-40-27	62-40-27-aabbccdd
	Reflected power sound utput stage B	62-40-28	62-40-28-aabbccdd
	Intake air temperature, output stage B	62-40-10	62-40-10-aabbccdd
	Outlet air temperature, output stage B	62-40-12	62-20-12-aabbccdd

Example (result messages to IEC-559)**:**

```
Message: 62-30-16-00404244  (<02>FF301600404244<03>)

Conversion into floating point number: (M = mantissa; S = sign; E = exponent)
   $00      $40      $42      $44
   MMMMMMMM MMMMMMMM MMMMMMMM SEEEEEEE
   00000000 01000000 01000010 01000100
   S = 0 (sign)
   E = #10001000 - 127 = 136-127 = 9 (exponent)
   M = #10000100100000000000000 (binary notation of mantissa)
   M = #1.10000100100000000000000 (normal notation of mantissa)
   positive exponent = decimal point shifted towards the right
Measured value = #1100001001.0 = 777

Forward power of output stage A = 777 W
```

[60] aabbccdd: corresponds to a floating-point number in the 4-byte format to IEC-559 resp. IEEE-754

9.1.8 Control via RS-232 Interface

9.1.8.1 General

Control via BITBUS can also be performed via the serial interface 3. During initialization the module checks via which path it receives data and via which path the answers should be sent: BITBUS or serial interface. The data format of the BITBUS protocol can also be used for communication via the serial interface. Thus a layer can be implemented in the BITINOUT module which fetches the data from the currently used driver or passes it to the driver without the superordinate processing layer being affected. For command processing, the data flow is completely transparent.

9.1.8.2 Telegram/ Procedure Definition

Telegram Structure of Commands

A command sent by the control program contains 3 information data bytes between STX and ETX irrespective of whether it is a setting command or a query. The information data are ASCII coded in hexadecimal form (2 ASCII characters for 1 byte of binary information data). Permissible ASCII characters for hexadecimal representation:

- Numbers from 0 to 9 (0x30 to 0x39)
- Upper-case letters A to F (0x41 to 0x46)
- Lower-case letters a to f (0x61 to 0x66)

Example 1 (values given are arbitrary and just for illustration)

Binary data to be transmitted (hexadecimal)

0x10	0x01	0x40

ASCII-coded data

'1' (0x31)	'0' (0x30)	'0' (0x30)	'1' (0x31)	'4' (0x34)	'0' (0x30)

Telegram structure

STX (0x02)	'1' (0x31)	'0' (0x30)	'0' (0x30)	'1' (0x31)	'4' (0x34)	'0' (0x30)	ETX (0x03)

The length of the 3 information bytes is the same in all commands. This also applies to commands which would not really require 3 bytes such as queries and special setting commands (eg sum fault reset). In this case, the 3rd information byte is not evaluated and should have the value 0x00. This byte will, however, be included in the checksum calculation (see also section 3.3.3, Optional Checksum).

Example 2 (values given are arbitrary and just for illustration)

Binary data to be transmitted (hexadecimal)

0x20	0x11	0x00

ASCII-coded data

'2' (0x32)	'0' (0x30)	'1' (0x31)	'1' (0x31)	'0' (0x30)	'0' (0x30)

Telegram structure

STX (0x02)	'2' (0x32)	'0' (0x30)	'1' (0x31)	'1' (0x31)	'0' (0x30)	'0' (0x30)	ETX (0x03)

Queries for measurement results contain the hexadecimal value 0x62 as a command code (= 1st information byte), the 2nd byte contains the device code and the 3rd byte the code for the result to be queried. Queries are like all other commands but special conditions are valid for the answers (see below).

Answers

According to the BITBUS protocol, all commands meeting the prescribed structure and procedure are answered (see section on Procedure). The answer complies with the definitions of commands specified above.

The following applies to legal and successful processed commands:

In the case of setting commands, the command is returned with the first byte (command byte) set to ACK (= 0xff) as the response:

Example 1 (values given are arbitrary and just for illustration)

Telegram structure

STX (0x02)	'F' (0x46)	'F' (0x46)	'0' (0x30)	'1' (0x31)	'4' (0x34)	'0' (0x30)	ETX (0x03)

ASCII-coded information data (hexadecimal)

'F' (0x46)	'F' (0x46)	'0' (0x30)	'1' (0x31)	'4' (0x34)	'0' (0x30)

Binary-coded answer (hexadecimal)

0xFF	0x01	0x40

With successfully processed queries, not associated measurement results, the first byte is set to ACK, the second contains the original device code and the third the queried data:

Example 2 (values given are arbitrary and just for illustration)

Telegram structure

STX (0x02)	'F' (0x46)	'F' (0x46)	'1' (0x31)	'1' (0x31)	'3' (0x33)	'2' (0x32)	ETX (0x03)

ASCII-coded information data (hexadecimal)

'F' (0x46)	'F' (0x46)	'1' (0x31)	'1' (0x31)	'3' (0x33)	'2' (0x32)

Binary-coded answer

0xFF	0x11	0x32

Result: 0x32 was determined as query value.

An exception is the answer to measurement result queries. In addition to ACK, device code and measured value code, it contains 4 bytes of information data which are to be interpreted as a floating-point number as defined in IEEE 559.

Example 3 for measurement result answers (values given are arbitrary and just for illustration)

Telegram structure

STX 0x02	'F' 0x46	'F' 0x46	'1' 0x31	'1' 0x31	'1' 0x31	'8' 0x38	'1' 0x31	'2' 0x32	'3' 0x33	'4' 0x34	'5' 0x35	'6' 0x36	'7' 0x37	'8' 0x38	ETX 0x03

--------- IEEE-coded floating-point value -----

ASCII-coded information data (hexadecimal)

'F' 0x46	'F' 0x46	'1' 0x31	'1' 0x31	'1' 0x31	'8' 0x38	'1' 0x31	'2' 0x32	'3' 0x33	'4' 0x34	'5' 0x35	'6' 0x36	'7' 0x37	'8' 0x38

--------- IEEE-coded floating-point value -----

Binary-coded answer

0xFF	0x11	0x18	0x12	0x34	0x56	0x78

--------- IEEE-coded floating-point value -----

Other exceptions:

- Debug functions

  Provided debug functions query values, the difference between them and other _get.... functions is that the answer to a debug function can be of variable length. This applies to functions which directly determine discrete values. In this case, the returned value may be 1 or 2 bytes long because leading zeros are not transmitted. Note that the returned value uses the inverted Intel form if it is 2 bytes long or more:

Example: 0xfe is transmitted as FE, 0x1fe as FE01.

- Query for manufacturer code
  The answer contains two data bytes (see above)

Otherwise, everything else remains applicable - even for these exceptions.

9.1.8.3 Optional Checksum

An ASCII-coded 8-bit checksum can be used as an option in the telegrams. It is added to the information bits of the telegram, ie the latter is extended by 2 ASCII characters. Whether a checksum is sent or not is automatically detected because of the varying telegram length.

If a checksum is part of the command, it is also appended to the answer. Commands with or without checksum can be sent in any order and are individually processed.

The checksum is obtained from the sum of the binary values of user data modulo 256.

Example (values given are arbitrary and just for illustration)

Binary data to be transmitted (hexadecimal)

0x10	0x01	0x40	0x51
			(checksum)

ASCII-coded data

'1' (0x31)	'0' (0x30)	'0' (0x30)	'1' (0x31)	'4' (0x34)	'0' (0x30)	'5' (0x35)	'1' (0x31)
						(checksum)	

Telegram structure

STX (0x02)	'1' (0x31)	'0' (0x30)	'0' (0x30)	'1' (0x31)	'4' (0x34)	'0' (0x30)	'5' (0x35)	'1' (0x31)	ETX (0x03)
							(checksum)		

The three preceding information bytes are included in the checksum. This is also the case when the third byte is a filler byte (see Ex. 2 above). To prevent the checksum being invalidated by the filler byte, the latter should be set to 0x00.

The checksum for answers is formed in the same way. If the answer contains measurement results, the 7 preceding bytes are included in the checksum calculation.

9.1.8.4 Overview of Telegram Lengths

Telegrams without checksum

	Command			Answer		
	Binary	ASCII	Total ASCII with STX/ETX	Binary	ASCII	Total ASCII with STX/ETX
Setting	3	6	8	3	6	8
Query	3	6	8	3	6	8
Measured value	3	6	8	7	14	16
Debug	3	6	8	3-4	6-8	8-10
Manufacturer code	3	6	8	4	8	10

Telegrams with checksum

	Command			Answer		
	Binary	ASCII	Total ASCII with STX/ETX	Binary	ASCII	Total ASCII with STX/ETX
Setting	4	8	10	4	8	10
Query	4	8	10	4	8	10
Measured value	4	8	10	8	16	18
Debug	4	8	10	4-5	8-10	10-12
Manufacturer code	4	8	10	5	10	12

All other telegram lengths are invalid.

9.1.8.5 Procedure

Ping-pong communication is employed, ie once a command has been sent, the response to this command must be received before the next command can be sent. After a timeout of max. 1 s, each data block identified as a command is either confirmed or answered with an error message. Any 3- or 4-byte data block between STX .... ETX is accepted as a command. Data blocks of any other length are ignored and not answered.

If no answer has been received before the 1-s timeout, the control program assumes that communication has completely failed (faulty cable, device not powered, etc). In this case, the control program should repeat the command every second until an answer is received.

Commands not complying with the described procedure are ignored; characters received before a response is sent are rejected. The first complete command received after an answer has been sent is accepted as the next valid command.

9.1.8.6 Errors

Any entry identified as a command (ie included in the ping-pong sequence and sent between STX-ETX) with an invalid length or containing an invalid code or checksum is considered an error. Commands not complying with the described procedure or exceeding a length of 128 ASCII characters are ignored and not answered.

If an error has occurred, the command is sent back with the first (binary) byte set to NACK (= 0xfe).

Example 1 Command containing an invalid device code (values given are arbitrary and just for illustration)

Binary data of the command to be transmitted (hexadecimal)

0x10	0x99	0x40
	(invalid device code)	

ASCII-coded data

'1' (0x31)	'0' (0x30)	'9' (0x39)	'9' (0x39)	'4' (0x34)	'0' (0x30)

Telegram structure

STX (0x02)	'1' (0x31)	'0' (0x30)	'9' (0x39)	'9' (0x39)	'4' (0x34)	'0' (0x30)	ETX (0x03)

Telegram structure of answer

STX (0x02)	'F' (0x46)	'E' (0x45)	'9' (0x39)	'9' (0x39)	'3' (0x33)	'2' (0x32)	ETX (0x03)

ASCII-coded information data (hexadecimal)

'F' (0x46)	'E' (0x45)	'9' (0x39)	'9' (0x39)	'3' (0x33)	'2' (0x32)

Binary-coded answer

0xFE	0x99	0x32

If there is a checksum error, the checksum is not recalculated in the answer. The faulty command with the incorrect checksum is returned:

Example 2 Command containing an invalid device code (values given are arbitrary and just for illustration)

Binary data to be transmitted (hexadecimal)

0x10	0x01	0x40	0x62
			(checksum)

ASCII-coded data

'1' (0x31)	'0' (0x30)	'0' (0x30)	'1' (0x31)	'4' (0x34)	'0' (0x30)	'6' (0x36)	'2' (0x32)
						(checksum)	

Telegram structure

STX (0x02)	'1' (0x31)	'0' (0x30)	'0' (0x30)	'1' (0x31)	'4' (0x34)	'0' (0x30)	'6' (0x36)	'2' (0x32)	ETX (0x03)
							(checksum)		

Telegram structure of answer

STX (0x02)	'F' (0x46)	'E' (0x45)	'0' (0x30)	'1' (0x31)	'4' (0x34)	'0' (0x30)	'6' (0x36)	'2' (0x32)	ETX (0x03)
							(checksum)		

ASCII-coded answer data

'F' (0x46)	'E' (0x45)	'0' (0x30)	'1' (0x31)	'4' (0x34)	'0' (0x30)	'6' (0x36)	'2' (0x32)
						(checksum)	

Answer binary data to be transmitted (hexadecimal)

0xFE	0x01	0x40	0x62
			(checksum)

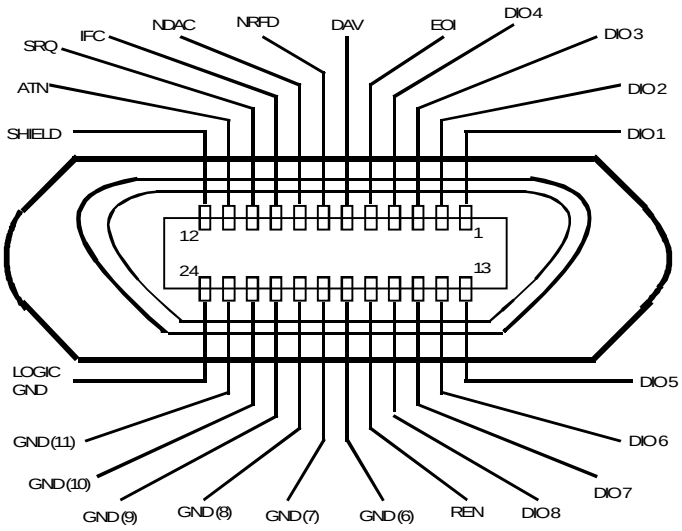
Commands with an illegal length are returned in full with the first byte set to 0xFE.

9.2 Remote Control of the Exciter via IEC/IEEE Bus

9.2.1 General

A controller (eg PSA5) may be connected to the exciter for remote control via the IEC-625/IEEE-488 bus. As a consequence, the exciter is fully system-compatible.

The exciter is fitted with an IEC/IEEE-bus connector as standard. The interface complies with standards IEC 625-1 and IEC 625-2 (IEEE 488.1 and IEEE 488.2). The IEEE 488.2 standard specifies, for instance, data transmission formats and common commands and queries.



Contact assignment
of IEC/IEEE-bus connector

The 24-contact bus connector according to IEEE 488 is located on the rear of the unit. The interface includes three groups of bus lines:

1) Data bus with 8 lines DIO 1 to DIO 8
Data transmission is effected in bit-parallel and byte-serial form, characters are transmitted in the ISO 7-bit code (ASCII code).

DIO 1 represents the least significant and DIO 8 the most significant bit.

2) Control bus with 5 lines
These lines are used for transferring control functions:

ATN (Attention)
becomes active low during transmission of addresses, common or addressed commands to the devices connected.

REN (Remote Enable)
for switching the device to the remote control mode.

SRQ (Service Request)
in active condition enables a device to send a service request to the controller.

IFC (Interface Clear)
is activated by the controller and sets the IEC/IEEE-bus interfaces of the devices connected to a defined initial condition.

EOI (End or Identify)
identifies the end of a data transmission and is used in parallel poll.

3) Handshake bus with 3 lines
It controls data transmission timing.

NRFD (Not Ready for Data)
Active low on this line signals to the talker/controller that one of the devices is not ready to accept data.

DAV (Data Valid)
is activated by the talker/controller shortly after a new data byte has been sent on the data bus.

NDAC (Not Data Accepted)
is kept at active low by the device until the device has accepted the data on the bus.

For more detailed information, eg data transmission timing, refer to IEC 625-1 standard.

According to IEC 625-1, devices which are remote-controlled via IEC bus may be provided with different interface functions. The following table contains the interface functions of the exciter:

Control character	Interface function
SH1	Source handshake, complete capability
AH1	Acceptor handshake, complete capability
L4	Listener, complete capability, unaddress if MTA
T6	Talker, complete capability, capability to answer serial poll, unaddress if MLA
SR1	Service request, complete capability
PP1	Parallel poll, complete capability
DC1	Device clear, complete capability
C1, C2, C3, C11	Controller, system controller, send IFC and take charge, send REN, send interface messages, receive and pass control, take control synchronously

Table 1 *Interface function*

9.2.2 Setting the Device Address

The device address may be set in the SETUP menu. For further details, refer to the menu description of the exciter. The address can have values from 0 to 30; it remains stored even after the device has been switched off.

The address is the decimal equivalent of bits 1 to 5 of the talker or listener address. This format is also used for the IEC-625/IEEE-488 bus commands and queries of the controllers.

9.2.3 Interface Messages

Interface messages (to IEC 625-1/IEEE 488 standard) are sent to the device on data lines, the ATN line being active low.

9.2.4 Common Commands

Common commands are in the code range 10 to 1F hex (see Table 4). They affect all devices on the bus without any addressing being required.

Command	BASIC Commands in R&S Controllers	Function
DCL (Device Clear)	IECDCL	Interrupts processing of received commands and sets the command processing software to a defined initial state. Device setups remain unchanged.
SPE (Serial Poll Enable)	IECSPE	Ready for serial poll
SPD (Serial Poll Disable)	IECSPD	End of serial poll

Table 2 *Common Commands*

9.2.5 Addressed Commands

The addressed commands are in the code range 00 to 0F hex (see Table 4). They only affect devices addressed as a listener (by BASIC command "IECLAD adr").

Command	BASIC Commands in R&S Controllers	Function
SDC (Selected Device Clear)	IECSDC	Interrupts processing of received commands and sets the command processing software to a defined initial state. Device setups remain unchanged

Table 3 *Addressed Commands*

Control Characters						Numbers and Special Characters				Upper Case Letters				Lower Case Letters			
0	NUL		16	DLE		32	SP	48	0	64	@	80	P	96	`	112	p
1	SOH	GTL	17	DC1	LLO	33	!	49	1	65	A	81	Q	97	a	113	q
2	STX		18	DC2		34	"	50	2	66	B	82	R	98	b	114	r
3	ETX		19	DC3		35	#	51	3	67	C	83	S	99	c	115	s
4	EOT	SDC	20	DC4	DCL	36	$	52	4	68	D	84	T	100	d	116	t
5	ENQ	PPC	21	NAK	PPU	37	%	53	5	69	E	85	U	101	e	117	u
6	ACK		22	SYN		38	&	54	6	70	F	86	V	102	f	118	v
7	BEL		23	ETB		39	'	55	7	71	G	87	W	103	g	119	w
8	BS	GET	24	CAN	SPE	40	(	56	8	72	H	88	X	104	h	120	x
9	HT	TCT	25	EM	SPD	41	)	57	9	73	I	89	Y	105	i	121	y
10	LF		26	SUB		42	*	58	:	74	J	90	Z	106	j	122	z
11	VT		27	ESC		43	+	59	;	75	K	91	[	107	k	123	{
12	FF		28	FS		44	,	60	<	76	L	92	\	108	l	124	|
13	CR		29	GS		45	-	61	=	77	M	93	]	109	m	125	}
14	SO		30	RS		46	.	62	>	78	N	94	^	110	n	126	~
15	SI		31	US		47	/	63	? / UNL	79	O	95	_	111	o	127	DEL
Addressed Commands			**Common Commands**			**Listener Addresses**				**Talker Addresses**				**Secondary Addresses and Commands**			

Explanation:

Table 10-4 ASCII and IEC character set

9.2.6 Device Messages

Device messages (to IEC 625-1) are transferred on data lines with the ATN line being high, ie not active. The ASCII code (ISO 7-bit code) is used for data transfer (see also Table 4).

As can be seen from the following table, device messages may be classified under two different aspects:

Device dependence	**Direction of transmission**	
	Message received by device	*Message sent by device*
Common commands and queries that are not device-dependent (to IEEE 488.2)	see 9.9.2 and Table 6	see 9.2.9 and Table 7
Device-specific commands and queries (depending on device characteristics)	see 9.9.3 and Table "Device-specific commands and queries"	see 9.9.4 and Table "Device-specific commands and queries"

Table 5 *Classification of device messages*

In the following, device messages received by the exciter are referred to as "commands".

Queries (ie commands followed by "?") such as "CODER:COMMAND?" request the exciter to output a set value using the same format as in the command table. For the given example, this is:

"CODER:COMMAND MONO"

9.2.7 Commands Received by the Exciter in Listener Mode (Controller-to-Device Messages)

Input buffer:
The exciter buffers all commands received in a buffer having a maximum capacity of 256 bytes; it is, however, possible to process longer command lines with the previously received part being processed within the device.

Command line syntax:
The syntax diagram on the following page shows the syntax of a command line (program message). Each program message must end with a terminator.

Terminators:
New Line (ASCII code 10 decimal)
Carriage Return (ASCII code 13 decimal)
End (EOI line active) together with the last useful character of the program message or the LF character (Line Feed)

All IEC/IEEE-bus controllers from Rohde & Schwarz output terminators that are accepted by the device. A program message may require more than one line on the controller screen since it is only limited by the terminator. The terminator is automatically added to the useful text by most IEC/IEEE-bus controllers.

Separators:
A program message may contain several commands (program message units) separated by semicolons?(;).

Command syntax:
A command may consist of the following parts:

- Header alone
- Example: *RST

- Header and question mark (query)
- Example: CODER:COMMAND?

This combination requests the exciter to place the desired data in an output queue in order to transfer them via the IEC/IEEE bus as soon as the exciter is addressed as a talker (see section 9.2.8).

- Header and numerical value
- Example: MEASURE:VIDEO 1

According to the IEEE 488.2 standard, header and numerical value must be separated by at least one space (ASCII code 32 decimal).

- Header and string
- Example: CODER:COMMAND STEREO

The headers and their meaning are explained in section 9.2.10

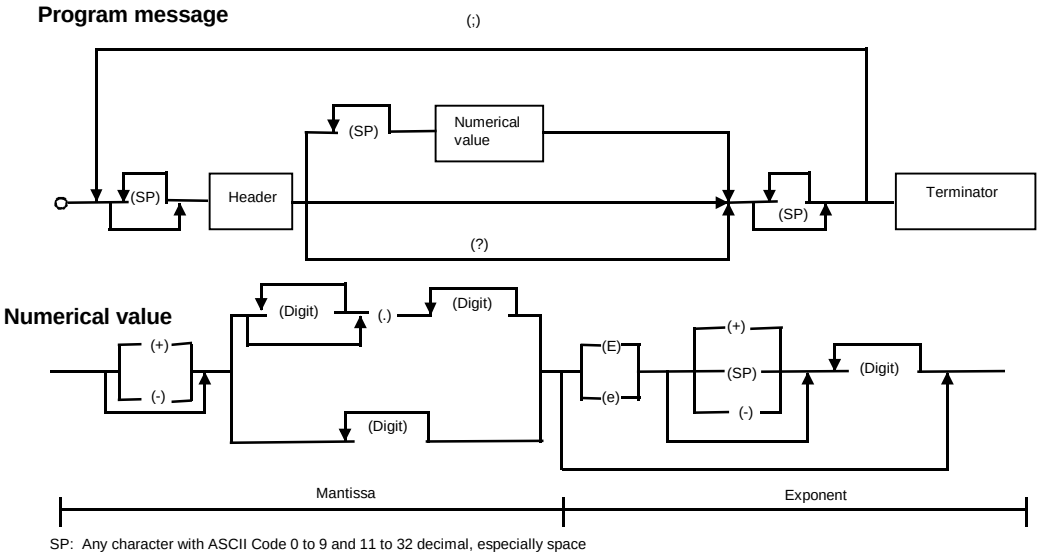
Lower-case/upper-case letters:
Lower-case letters are permissible; they are equivalent to the corresponding upper-case letters.

Spaces:
Additional spaces may be inserted at the following positions:

- Before the header
- Between the header and the numerical value
- Before and after comma (,) and semicolon (;)
- Before the terminator

Numerical values:
Only decimal number are allowed as numerical values; the following notations are permissible:

- With and without sign
- eg 5, +5, -5
- With and without decimal point, any position of decimal point being permissible
- eg 1.234, -100.5, .327



Syntax diagram of a program message

9.2.8 Messages Sent by the Exciter in Talker Mode

(Device-to-Controller Messages)

The exciter sends messages via the IEC/IEEE bus if

it has been requested by one or more query messages within one program message

or if

it has set bit 4 in the status byte (MAV = message available); the requested data are now available in the output queue (see also section 1.4),

or if

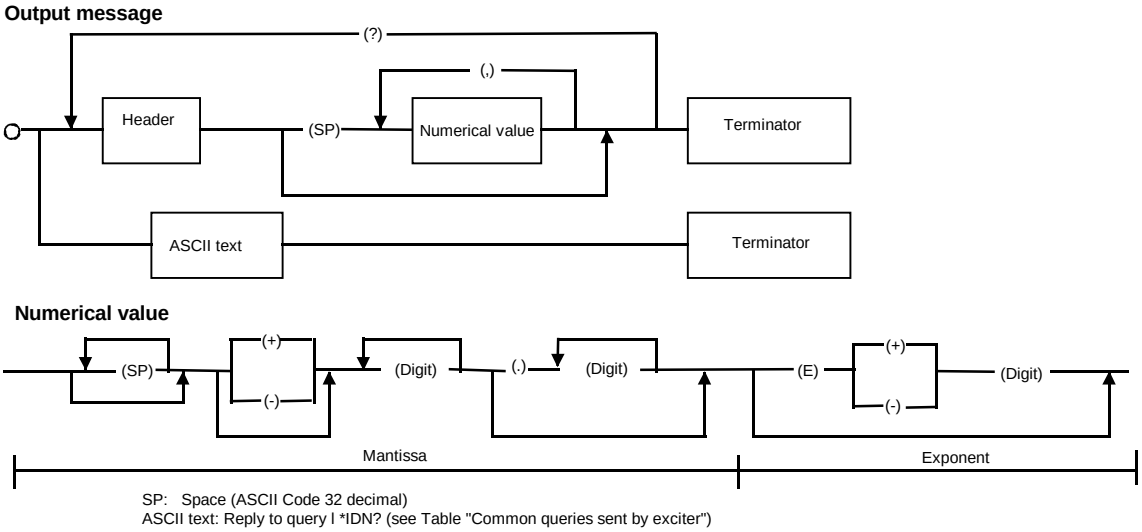
it has been addressed as a talker (basic command "IECIN adr, stringvariable").

It is necessary for the program message with the queries to be transmitted before talker addressing; if another program message is present in between, the output queue is cleared.

A query is formed by adding a question mark "?" to the header, eg "CODER:COMMAND?".

If the exciter is addressed as a talker directly after the query, the bus handshake is disabled until the requested data are available.

The syntax of the messages sent by the device is shown in the following diagram. The syntax is similar to that for commands received by the exciter.



Syntax diagram of messages output by the exciter

New Line (ASCII code 10 decimal) together with End (EOI line active) is used as terminator.

If the exciter receives several queries, it also returns several messages within one line separated by semicolons (;).

Headers and numerical values are always separated by a space.

Headers only consist of upper-case letters and the characters ":","_" and "*".

Messages output by the exciter do not contain physical units.

9.2.9 Common Commands and Queries

These commands and queries are listed in Tables 6 and 7 and concern:

Commands and queries referring to the service request function and the relevant status and enable registers.

Commands and queries for device identification.

Commands and queries referring to the parallel poll function.

Commands and queries for device-internal sequences (reset, calibration) and for synchronizing sequences.

These commands and queries are taken from the standard which ensures they have the same effect in different devices.

The header of these commands and queries consists of (*) followed by three letters.

Command	Numerical value, range	Meaning
*RST	- - -	**Reset** Command Restores initial status of the device. This command does neither change the status of the IEC/IEEE-bus interface, the set bus address, the enable registers of the service request function nor the output queue. A current service request is only reset if it has not been produced by a message in the output queue.
*PSC	0 to 65535	**Power On Status Clear Command** If >0: On power-up, the service request enable register (SRE) and the event status enable register (ESE) are cleared too. If 0: The above-mentioned registers retain their contents even when the device is switched off and on again. This enables a service request when the device is switched on.
*OPC	- - -	**Operation Complete Command** Sets bit O (operation complete) in the event status register provided all previous commands have been processed and executed.
*CLS	- - -	**Clear Status Command** • Sets the status registers (ESR and STB) to zero. The enable registers of the service request function (ESE and SRE) are not changed. • Clears the output queue. A current service request is cleared (see section 9.2.11).
*ESE	0 to 255	**Event Status Enable Command** The event status enable register is set to the specified value which is interpreted as a decimal number (see section "Service Request").
*SRE	0 to 255	**Service Request Enable Command** The service request enable register is set to the specified value which is interpreted as a decimal number (see section ."Service Request").
*PRE	0 to 255	**Parallel Poll Enable Command** The parallel poll enable register is set to the specified value which is interpreted as a decimal number (see section "Service Request").
*WAI	- - -	**Wait To Continue Command** The subsequent commands are only processed when all previous commands have been completely executed (see section "Service Request").

Table 6*Common commands received by the exciter*

Query	Output message, data value		Meaning
	Digits	**Range**	
*IDN?	23	alpha-numeric	**Identification Query** The following identification text is sent via the IEC/IEEE bus in reply to the *IDN? query (always without header): Example: Rohde&Schwarz, Exciter, 0, V 1.20 Rohde&Schwarz = manufacturer Exciter= type of equipment 0 (optional)= serial number V 1.20 = firmware version (example)
*PSC?	1	0 or 1	**Power On Status Clear Query**
*OPC?	1	1	**Operation Complete Query** The message "*OPC 1" is entered in the output queue and bit 4 (message available) set in the status byte provided all previous commands have been processed and executed. Bit 0 (operation complete) in the event status register is also set (section 9.2.11).
*ESR?	1 to 3	0 to 255	**Event Status Register Query** The contents of the event status register are output in decimal form and the register is reset to zero.
*ESE?	1 to 3	0 to 255	**Event Status Enable Query** The contents of the event status enable register are output in decimal form.
*STB?	1 to 3	0 to 255	**Read Status Byte Query** The contents of the status byte register are output in decimal form.
*SRE?	1 to 3	0 to 255	**Service Request Enable Query** The contents of the service request enable register are output in decimal form.
*PPE?	1 to 3	0 to 255	**Parallel Poll Enable Query** The contents of the parallel poll enable register are output in decimal form.
*TST?	1 to 3	0 to 255	**Self-Test Query** (not active)
*OPT?	1	0 to 255	**Option Query** (not active)
*IST?	1	0 oder 1	**Individual Status Query** For reading out the device status "IST" (section 9.2.11).

Table 7 *Common queries sent by the exciter*

9.2.10 Device-specific Commands and Queries

These commands and queries are listed in Table 8.

Many of the functions which can be set via the keyboard can also be controlled via the IEC/IEEE bus. The effect of the remote-control commands is identical to the corresponding entries via the keyboard. The settings can also be read out via the bus.

The table below shows the commands and queries with the associated messages transmitted by the exciter.

Headers are easy to understand and even identical with some of the key labels so that easy-to-read and self-documenting programs are obtained.

Headers may be shortened almost at will by leaving out characters at the end (eg MEM instead of MEMORY). The shortest possible form is printed in bold in the table.

Many headers consist of several parts separated by colons (:), eg "CODER:COMMAND". Each part of the header may be abbreviated (eg "C:C"). Some headers contain the underline character (ASCII code 95 decimal) for ease of reading.

All commands and queries which can be provided with a numerical value are marked in the column "Data" of the table below. Some commands, however, may also have a character string as the data.

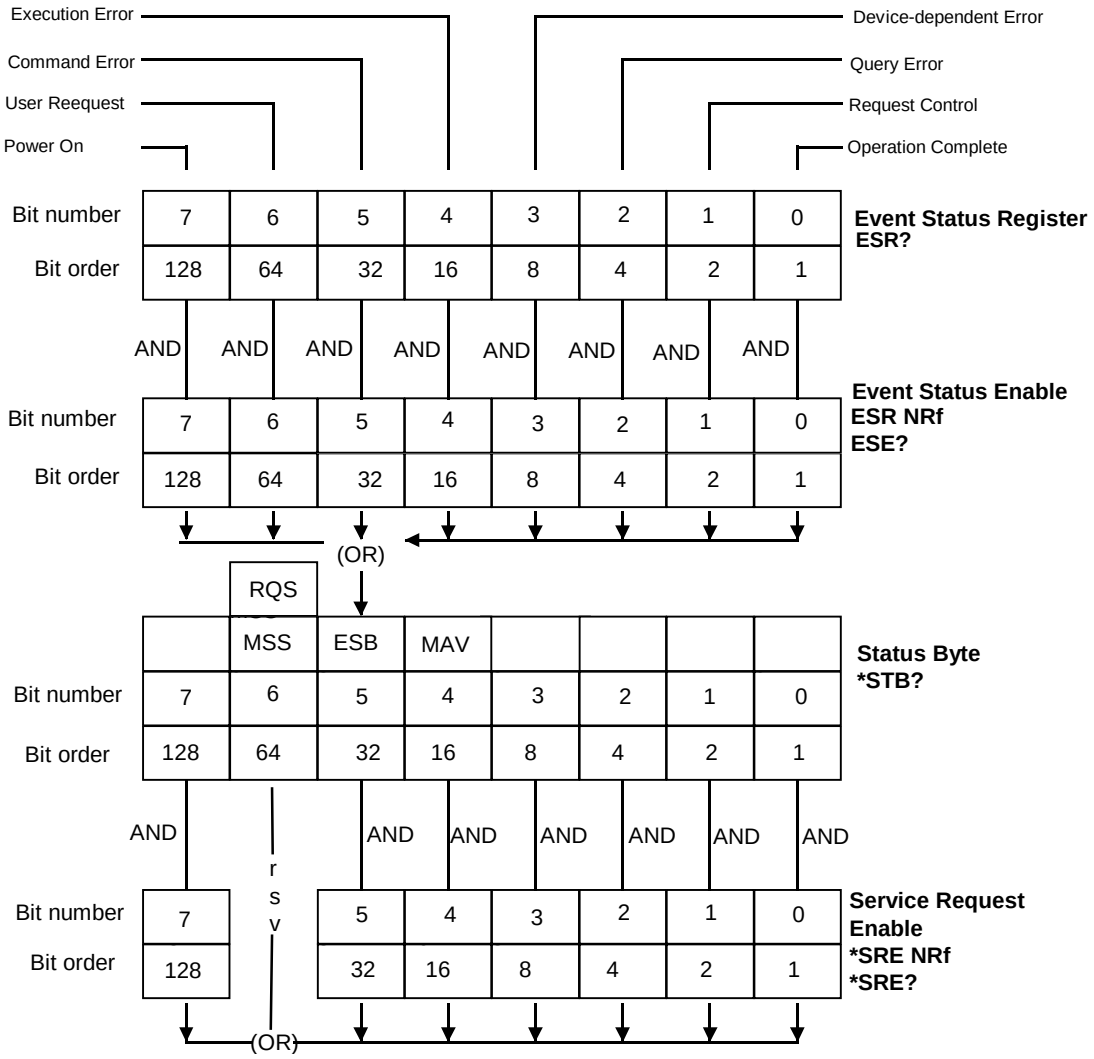
Command	**Daa**	**Meaning**
CODER:**C**OMMAND	**D**ATALINE **R**EMOTE	Betriebsarteninformation aus der Datenzeile oder von Fernwirksignalen.
CODER:**C**OMMAND**?**	DATALINE REMOTE	Abfrage, ob Betriebsarteninformation aus der Datenzeile oder von Fernwirksignalen vorliegt.
CODER:**S**OUND	**M**ONO **S**TEREO **D**UAL	Betriebsarteneinstellung Mono, Stereo oder Zeiton
CODER:**S**OUND**?**	MONO STEREO DUAL	Abfrage der aktuellen Betriebsart.
EXCITER:**C**OMMAND	**OF**F **S**TANDBY **ON**	Setting of current exciter operating status OFF: Exciter completely off. STANDBY: All modules on, but carrier disabled. ON: Exciter on the air, carriers enabled.
EXCITER:**C**OMMAND**?**	OFF STANDBY ON INVALID	Operating status query INVALID: Query was started while exciter was switching.
EXCITER:**R**ESET	- - -	Clearing of sum fault and return to PRESET mode. The exciter clears the fault, returns to the PRESET status and checks the fault messages again.
EXCITER:**F**AULT**?**	0 1	Query whether exciter outputs a sum fault message. 0: No sum fault 1: Sum fault
EXCITER:**S**PECIAL_FUNCTION**?**	**ON** **OF**F	Query whether special functions are enabled or disabled
MEMORY:**L**OAD	1...5	Loading of data into a memory 1 to 4: No. of memory 5: PRESET memory No response of device with parameters other than 1 to 5. The setting values of the selected memory are loaded into the main memory.
MEMORY:**L**OAD**?**	1...5, -	Memory query. Indication of memory from which data were loaded into the main memory. - : A dash means that the memory no. selected is outside the permissible range.
MEMORY:BUSY**?**	0 1	Query if loading/storage is being carried out. 0: No

		1: Yes
MEASURE:**VIDEO**	1 2	VF-Eingang 1 oder 2 eingeschaltet
MEASURE:**VIDEO?**	1 2	Abfrage des aktuellen VF-Eingangs.
MEASURE:**PREC**ORRECTOR	**ON** **OF**F	Empfängervorentzerrung eingeschaltet oder überbrückt
MEASURE:**PREC**ORRECTOR**?**	ON OFF	Abfrage der Empfängervorentzerrung
MEASURE:**R**EGULATION:**V**F	**ON** **OF**F	VF-Regelung ein oder aus
MEASURE:**R**EGULATION:**V**F**?**	ON OFF	Abfrage der VF-Regelung
MEASURE:**VISIONCARRIER**	**ON** **OF**F	Bildträger ein oder aus
MEASURE:**VISIONCARRIER?**	ON OFF	Abfrage des Bildträgers
MEASURE:**SOUNDCARRIER_1**	**ON** **OF**F	Tonträger 1 ein oder aus
MEASURE:**SOUNDCARRIER_1?**	ON OFF	Abfrage des Tonträgers 1
MEASURE:**SOUNDCARRIER_2**	**ON** **OF**F	Tonträger 2 ein oder aus
MEASURE:**SOUNDCARRIER_2?**	ON OFF	Abfrage des Tonträgers 2
MEASURE:**PREE**MPHASIS	**ON** **OF**F	Preemphasis ein oder aus
MEASURE:**PREE**MPHASIS**?**	ON OFF	Abfrage der Preemphasis
MEASURE:**Z**F	**F**ILTER **O**UTPUT	Meßstellen nach dem Restseitenbandfilter oder am ZF-Ausgang
MEASURE:**Z**F	FILTER OUTPUT	Abfrage der ZF-Meßstellen

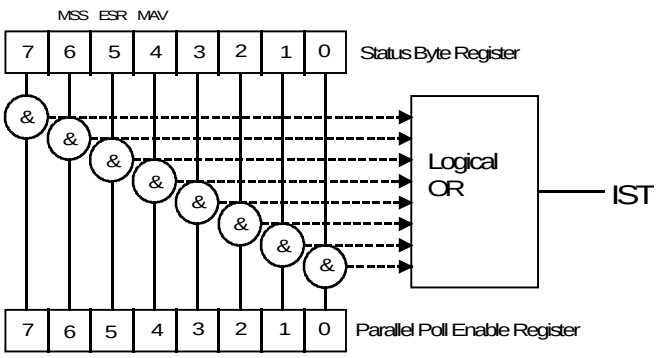
Table 8 *Device-specific commands and queries*

9.2.11 Service Request and Status Registers

The following diagram shows the status registers and the effective links between them. In line with standard IEEE 488.2, the status byte (STB) and its associated enable register (SRE), which are also incorporated in older devices, have been supplemented by the event status register (ESR) and the event status enable register (ESE).



Event Status Register



Logical OR operation of device status "IST"

Bit No.	Order	Meaning
7	128	**Power On** This bit is set when the device is switched on or when the power returns after a failure.
6	64	**User Request** (Fault Request) (not active)
5	32	**Command Error** This bit is set if one of the following errors is detected in the commands received: • Syntax error • Illegal header • A numerical value has been combined with a header where no numerical value is allowed.
4	16	**Execution Error** This bit is set if one of the following errors is detected during the execution of the commands received: • A numerical value is outside the permissible range (for the respective parameter). • A command received is not compatible with the current device setting.
3	8	**Device-dependent Error** This bit is set if functional errors occur.
2	4	**Query Error** This bit is set: • If the controller wishes to read data from the exciter but has not output any query previously. • If the data present in the output queue of the exciter have not been read out and a new command is sent to the device instead. The output queue is cleared in this case.
1	2	Reserved for future applications (Request Control)
0	1	**Operation Complete** This bit is set by the command "*OPC" and the query "*OPC?" if all previous commands and queries have been executed.

Table 9 *Meaning of event status register*

Using the service request enable register (SRE), the user can determine whether the RQS bit of the status byte is also set when the ESB and/or MAV bits of the status byte are set, and whether a service request is sent to the controller by activating the SRQ line. Since each bit in the service request enable register is assigned to the corresponding bit in the status byte, the following settings (see table below) or ensuing combinations are obtained.

Contents of SRE (decimal)	Bit set in SRE	Effect
0	- - -	No service request
61	4	Service request if MAV bit is set (message in output queue)
32	5	Service request if ESB bit is set (at least 1 bit set and not enabled in ESR)

Table 10 *Meaning of service request enable register*
The service request enable register (SRE) is written by the command "*SRE NRf" ("NRf" is the contents in decimal form) and can be read out by the query "*SRE?". It is set to "0" when the AC power is switched on provided the power-on-status-clear flag is "1"; the service request function of the exciter is thus disabled. The SRE register is not changed by other commands or interface messages (DCL, SDC).

Several devices can trigger a service request simultaneously. The open-collector drivers generate an OR function on the SRQ line. The controller must read the status bytes of the devices in order to identify the device triggering the service request. An RQS bit set (bit 6/DIO 7) indicates that the device is sending a service request.

The status byte of the exciter can be read in the following manner:

- By the "*STB?" query.

  The contents are then output in decimal form. The status byte is not changed by reading out and the service request is not cleared.

  (With R&S controllers: IECSPL adr, status%). The contents are transferred in binary form as one byte. The RQS bit is then set to "0" and the service request becomes inactive; the other bits of the status byte are not changed.

The status byte is cleared:

- By the "*CLS" command

  This command clears the ESR and the output queue; the ESB and MAV bits in the status byte are also set to "0". This in turn clears the RQS bit and the service request.

- By reading the event status register ("*ESR?" query) or setting the event status enable register to "0" ("*ESE" command) and by reading the contents of the output queue.

9.2.12 Service Request Message and Display

The exciter sends a service request (SRQ) to the controller only when the ESE and ESR registers are set accordingly. Subsequently, the controller detects the set RQS bit in the status byte and checks it using a serial poll or "*STB?".

9.2.13 Resetting of Device Functions

The following table lists the various commands and events which cause individual device functions to be reset.

Event	**Switch-on of operating voltage**		**DCL, SDC (Device Clear, Selected Device Clear)**	**Command**	
	Power-on-status-clear flag			***RST**	***CLS**
	0	**1**			
PRESET configuration of device	- -	- -	- -	yes	- -
Setting to 0 of event status register ESR	yes	yes	- -	yes	yes
Setting to 0 of enable registers ESE and SRE	- -	yes	- -	- -	- -
Clearing of output queue	yes	yes	yes	- -	yes
Clearing of service request	yes	1)	2)	3)	yes
Clearing of command processing and resetting of input buffer	yes	yes	yes	- -	- -

Table 11 *Resetting of device functions*

1) Yes, but "service request on power on" possible
2) Yes, if only caused by message in output queue
3) Yes, if not caused by message in output queue

9.2.14 Command Processing Sequence and Synchronization

The commands received by the exciter are first stored in an input buffer which can accommodate up to 256 characters. Once the terminator has been received, the commands are processed in the sequence in which they were sent. During this time, the IEC/IEEE bus can be used for communication with other devices. Program messages which exceed the capacity of the input buffer are processed in several sections. The bus is occupied during this time.

9.2.15 Error Handling

All errors detected by the exciter in connection with operations via the IEC/IEEE bus are indicated by setting a bit (bit 2, 4 or 5) in the event status register (see Table 9). These bits remain set until the ESR is read out or cleared by the commands *RST or *CLS. This corresponds to the IEEE-488.2 standard.

9.2.16 Programming Examples

NOTE:
The following programming examples are based on the Rohde & Schwarz BASIC syntax.

Reading out of identification

Listing:

```
10      IECDCL
20      IECTERM 10
30      IECOUT 20, ”*IDN?”
40      IECIN 20, A¤
50      PRINT A¤
60      END
```

Explanation:

```
10      Send device clear
20      IEC/IEEE terminator (LF)
30      Query to device with address 20
40      Load contents of output queue and store in string variable A$
50      Printout of contents (eg Rohde & Schwarz, Exciter, 0, V1.20)
60      End
```

Exciter settings

Listing:

```
10      IECDCL
20      IECTERM 10
30      IECOUT 20, ”CODER:COMMAND MONO”

40      IECOUT 20, ”MEASURE:SOUNDCARRIER 1 ON”
50      END
```

Explanation:

```
10      Send device clear
20      IEC/IEEE terminator (LF)
30      Command to device with address 20; switch coder to mono
40      Command to device with address 20; switch on sound carrier?1
50      End
```

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