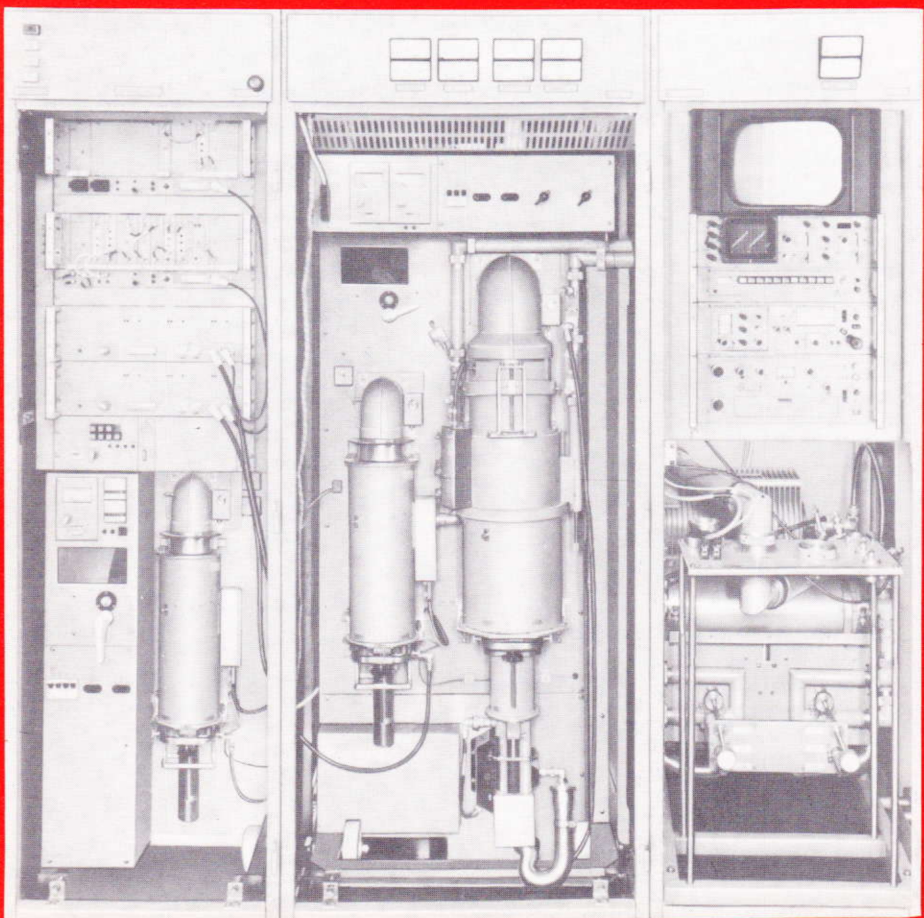
SIEMENS

20/2 kW TV Transmitter Band III with Modulation at Fixed Intermediate Frequency

Type Q 20-A 1032



20/2 kW TV Transmitter Band III with Modulation at Fixed Intermediate Frequency

Contents

Published by
Siemens AG, Bereich Bauelemente, Produkt-Information, Balanstraße 73, D-8000 München 80

1. General description

This 20/2 kW VHF band III television transmitter contains two separate amplifier chains, one for vision the other for sound signals.

The standard version is designed for operation in accordance with the CCIR Recommendations (625 lines, 7 MHz channel bandwidth). If required the transmitter can also be supplied to the FCC standard (525 lines, 6 MHz channel bandwidth), or OIRT standard (625 lines, 8 MHz channel bandwidth). For these systems the transmitter is fully color-compatible to the NTSC, PAL or SECAM standards.

Modulation at fixed IF assures the transmitter meets high quality requirements with excellent long-term stability. The lower signal level stages up to 20 W output power incorporate silicon transistors, the power stages tetrodes. Both the picture and sound amplifier and diplexer combining unit can be tuned over the entire band III range of 174 to 230 MHz. Before delivery, they are tuned to a fixed channel.

The transmitter is suitable for two-tone transmission according to the IRT 2-carrier-process.

The layout of the equipment, the electrical and mechanical construction and safety devices are all in accordance with the specifications of VDE (Union of German Electrical Engineers) and the IEC.

Forced air cooling only is employed. The transmitter operates from a three-phase 380/220 V ±3%, 50 Hz mains. For mains variations greater than 3%, a mains regulator is required. This is not supplied as part of the transmitter.

2. Special features

Latest ideas in semiconductor drivers for vision and sound transmission and in air-cooled tetrode amplifiers in the driver stage vision and in both the high performance final stages for vision and sound.

Three tube stages, but only two types of tubes because driver stage vision and amplifier stage sound are fitted with tubes of the same type.

Modulation in vision and sound section at a fixed intermediate frequency at low power level.

Common subcarrier frequency generation for vision and sound section by incorporated quartz oscillator.

Operation with precision offset conditions possible.

Sound section prepared for mounting of equipment suitable for two-tone transmission in accordance with IRT 2-carrier-process.

Driver vision sound assembled as independent units in one "cabinet".

Comfortable servicing provided by modular construction using slide-in cassette systems for the functional units of the prestages vision/sound and of the control panels.

Clear and logical monitoring of operations and interlocking.

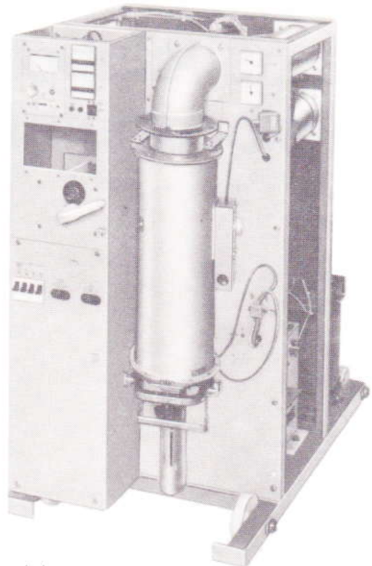
Non-volatile storage of major faults at power failure; total of 49 memory locations.

Exclusive use of silicon semiconductors in the driver interlocking equipment and power supplies.

Electronically regulated supply voltage for the driver from clocked switched-mode power supplies in the slide-in cassettes and in the semiconductor linear amplifiers.

The high voltage power supply units contain silicon rectifiers with controlled breakdown voltage.

Individual electronic control of control grid and screen-grid voltage for each tube.



Driver stage vision

3. Construction

The transmitter is built according to the "modular packaging system". Simple assembly of the transmitter by means of easily unbolted cabinets, and mounting of the driver stage and the final amplifier vision/sound on units that are easily wheeled out on castors.

Cooling air can be supplied either through the top of the cabinets or through the floor plates, depending on the customer's requirements.

The transmitter can be set up on a solid flat floor, without intermediate floor. Small size permits setting up in a container as a mobile transmitter.

All assemblies, with the exception of the necessary external cooling equipment, are housed in cabinets.

The transmitter consists of the following cabinet units:

Driver vision/sound, BTV (cabinet V)

including semiconductor linear amplifiers for vision and sound together with control panel for switching on transmitter and interlocking.

The structural units are fitted in a "frame V1" and are fixedly cabled together. "Frame V1" occupies the upper half of the cabinet. The lower half contains

Driver stage (carriage D)

with vision driver amplifier LV1 using tetrode YL 1057 complete with power supply and equipment.

Final stage vision/sound, BTE (cabinet E)

with the power amplifiers, i.e. the 20 kW vision amplifier stage LV2 using tetrode RS 2026 CL, and the 2 kW sound amplifier stage LV3 using tetrode type YL 1057 together with power supplies.

RF combining unit, KE (cabinet K)

with diplexer vision/sound for 20/2 kW and RF changeover panel. The vision/sound diplexer occupies the lower third of the cabinet. The remaining space is at the client's disposal for housing such things as measuring equipment.

Cooling equipment

consisting of filters, blower and piping up to 5 metres long.

In view of the noise produced, the cooling equipment should not be housed in the transmitter room but rather in an adjacent sound-absorbing one.

The good long-term stability of the operating conditions makes the transmitter ideally suited for unmanned operation. A remote control system issues instructions to the transmitter and sends the status information back to the control centre. When the transmitter is manned, it is controlled by press buttons on the control panel (in the first cabinet).

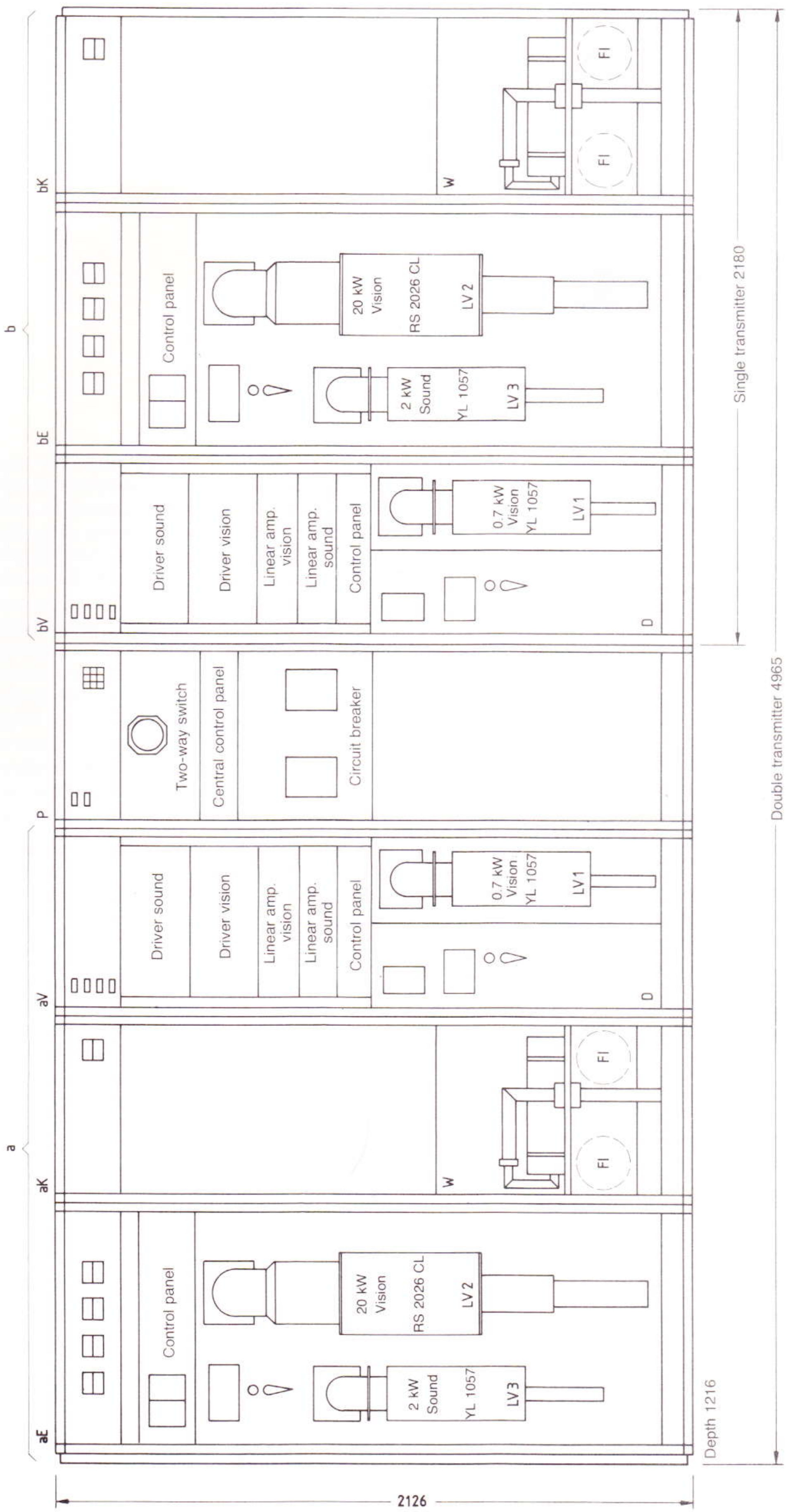
An interlock loop ensures that no damage can be caused by any incorrect commands. Control knobs and sliders, which must be adjusted from time to time, are arranged in such a way that the operator is in no danger whatsoever.

The mode of construction guarantees that conductors, switch points, and connectors which carry line voltage or voltages greater than 42 V are out of reach and, where necessary, are mechanically locked. Thus, the front doors can be opened, by the operators without any danger. A visible key interlock breaker in accordance with IEC recommendation 215-1, assures that before any action required for servicing, for example, the energy sources are shorted and grounded.

The transmitter is fitted with all instruments necessary for continuous monitoring and measurement of operating voltages and currents. In addition to the above instrument panel, the front panels of some slide-in units also contain – where necessary – measuring instruments. Visual displays and signal lamps indicate disturbances and deviations from normal functioning of individual stages.

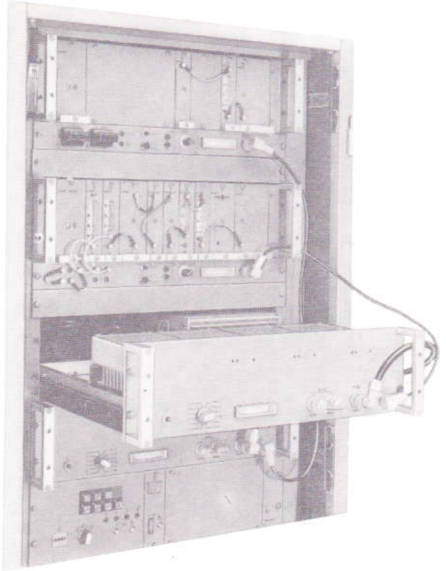
The quality of the transmitted video and audio signals can be checked at various points. Thus, for example, the video frequency pre-corrector has additionally decoupled 75 ohm control outputs for the connection of video frequency test equipment. The IF and RF power stages are provided with directional couplers for the connection of IF and RF test instruments with 50 ohm input impedance.

Extended monitoring of operation is possible on a separate test rack in the transmitter. This rack can accommodate such things as VF picture gear, VF oscilloscope, Nyquist-demodulator, etc.



Double transmitter 2×20/2 kW, band III with automatic changeover unit

Dimensions in mm



Prestage vision/sound

4. Mode of operation

Driver vision/sound, BTV (cabinet V)

The driver vision/sound supplies completely processed vision and sound signals at the power levels and with the pre-correction required to directly drive the transmitter's vision/sound final power amplifiers. The driver stages can be subdivided into:

driver stage vision
driver stage sound
linear amplifier vision/sound

Semiconductor prestage

The modular units of the vision/sound section are constructed in the form of plug-in cassettes, which are grouped together in a cassette system with associated power supplies. The command and signaling lines are made via flexible cables with multiple plugs.

A small front panel is provided beneath each row of slide-ins. The video, audio, and intermediate frequency outputs and measuring points are brought out to readily available points on the front panels. The front panel also contains a control instrument with a measuring point selector switch for control of the operating values. The space behind these front panels contains the output filters and the video frequency receiver pre-correction.

The vision and sound branches have monitors that derivate measuring values for the output power and contain threshold switches. These monitors also check the sync pulses in the video signal.

The linear amplifiers for vision and sound are constructed on similar lines and are located with the power supply in a common slide-in unit.

Driver stage vision

The video signal is fed to the vision modulator via a vision amplifier and a delay equalizer. The vision amplifier has two equivalent inputs for a nominal input voltage of 1 Volt peak-to-peak and a level controller, a white level clipper that can be switched off and a circuit for black level blanking. For level control and measuring purposes a measuring output is available. Between the vision amplifier and the vision modulator there is a passive all-pass network for pre-equalization of the receiver delay errors. This receiver delay equalization can be bypassed. The intermediate frequency is modulated with the video signal in the vision modulator. The unmodulated intermediate frequency is produced by a quartz controlled generator located in a thermostat of the vision modulator unit. The modulated IF signal then passes through the vestigial sideband filter housed in an individual cassette. This unit can easily be exchanged if transmission according to a different standard is required. The next delay equalizer in the signal path equalizes the group delay variation in the vestigial sideband filter. A further delay equalizer is available for equalizing the transmitter delay (vision/sound diplexer). The output voltage from the second delay equalizer is regulated to a constant amplitude. The signal now passes through the IF pre-corrector that provides a high degree of linearization of the non-linearities in the transmitter (rise time and phase) especially in the power amplifier. The resulting signal now passes to the *frequency converter* where it is converted to the required channel or transmission frequency. The frequency converter contains a filter that provides sufficient suppression of undesired product frequencies, the oscillator frequency and the auxiliary frequency.

The following 3/3 watt stages are broadband over the complete frequency range. The RF signal is then fed to the linear amplifier via a narrow-band filter centred on the operating frequency.

Driver stage sound

The driver stage sound contains the sound modulator that produces the frequency modulated sound intermediate frequency. For the purpose of frequency stabilization this IF signal is frequency modulated via a phase comparator in such a way that the frequency difference between vision and sound carriers is maintained equal to the line frequency (15 625 Hz). In this way disturbances of the picture by an unmodulated sound carrier during pauses in transmission can cause no moving Moiré fringes at the receiver. If the sync pulses should be lost, synchronization passes automatically to the vision IF carrier.

Linear amplifier

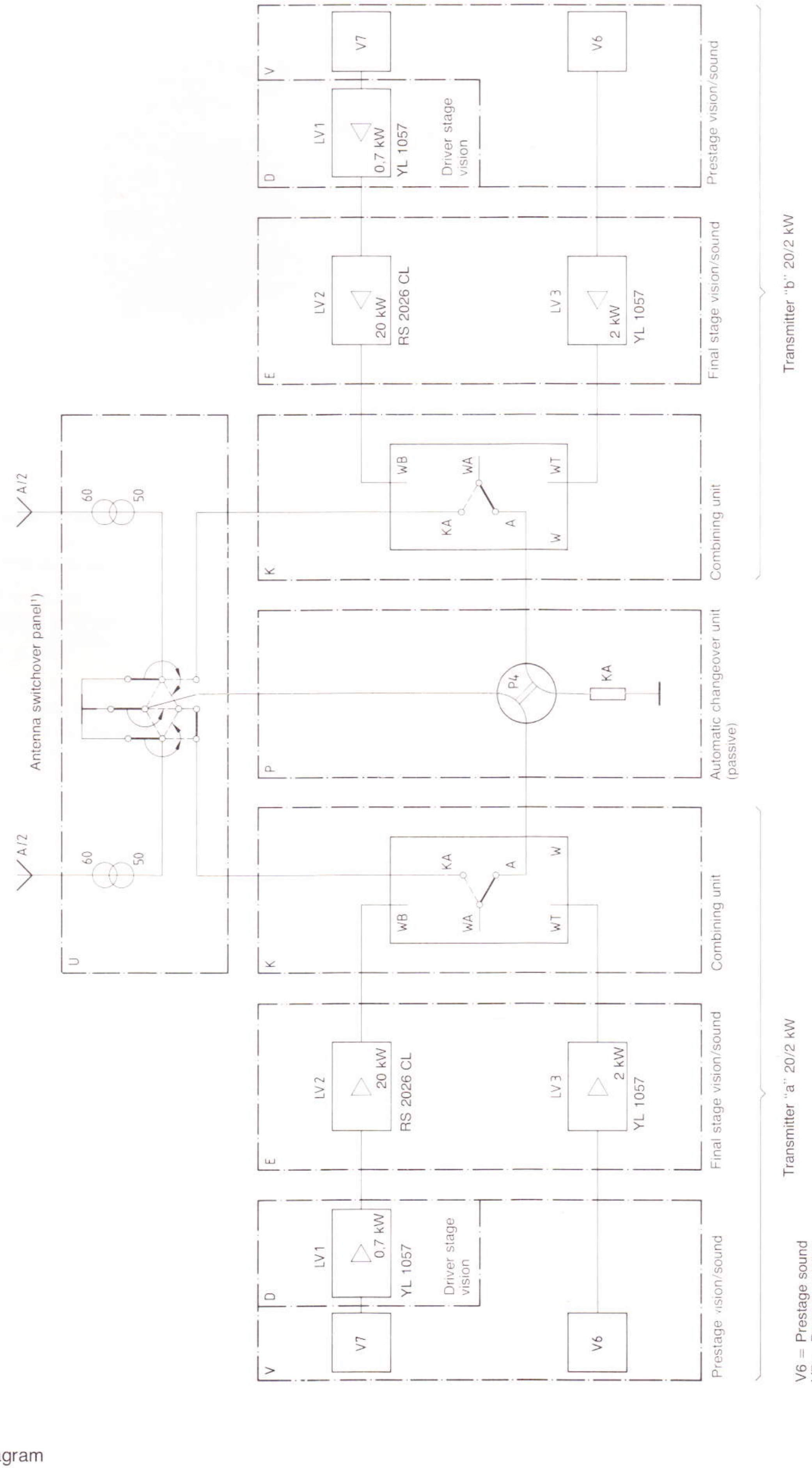
The transistor linear amplifiers raise the vision and sound signals each to 20 watts required to drive the power amplifiers. Each linear amplifier is housed in a slide-in module.

Frequency preparation

The auxiliary frequency needed for frequency conversion originates in a self-excited VHF oscillator whose frequency is controlled in a phase locked loop by the frequency of a quartz oscillator. The frequency determining elements are kept temperature-stable by a thermostat.

A special distributor amplifier (RF buffer amplifier) is used to split the VHF signal into the vision and sound sides.

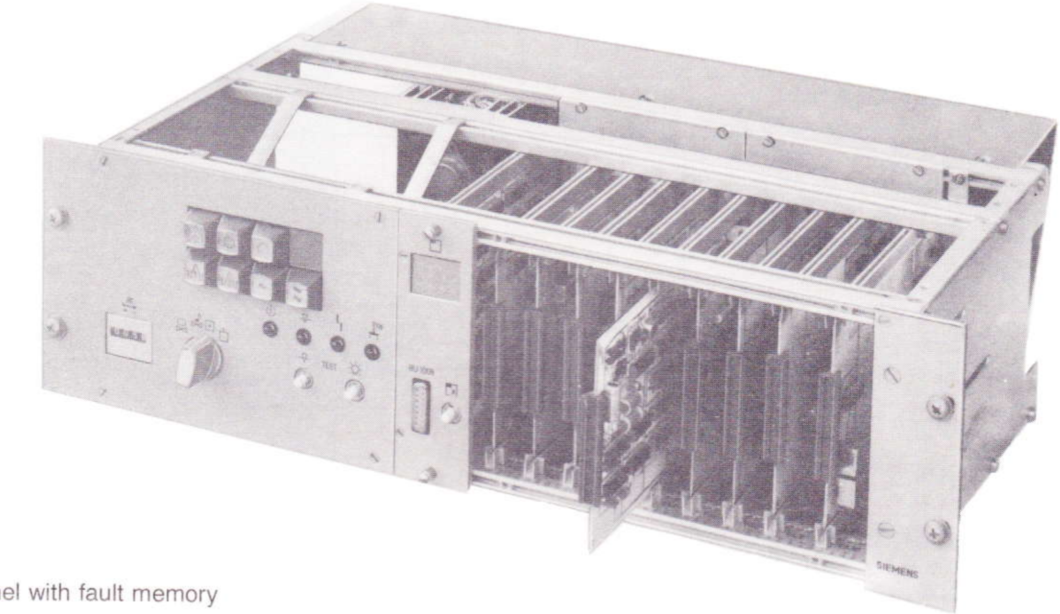
Precision offset of the oscillator circuit is made possible by special additional equipment that can be housed in the sound cassette system.



V6 = Prestage sound
V7 = Prestage vision

[1]) Given arrangement is only example.
Separate units can be supplied upon request.

Block diagram
Double transmitter 2×20/2 kW, band III with automatic changeover unit



Control panel with fault memory

Interlocking and monitoring of transmitter

Below the driver slide-in units there is the slide-in cassette unit "control panel" with switches and interlocks for the individual transmitters.

Driver stage D

The driver stage consists of driver amplifier LV1 with associated power supply and RF measuring equipment. All structural units are mounted on sliding frames. This mode of construction allows the driver stage to be wheeled into either the driver stage cabinet or the combining unit cabinet as circumstances require. There is no provision for the operation of the amplifier while the unit is withdrawn.

The vision driver amplifier can be tuned over the entire band III frequency range. The YL 1057 tetrode is operated in grounded control grid circuitry.

The cavity is cooled by forced air convection, the differential pressure being monitored by a membrane type air-pressure switch.

The anode circuit cavity is subject to the IEC safety lock system.

The power supplies are separated into individual units for heater voltage, control grid, screen grid and plate voltages. The voltages for control and screen grids are controlled by transistorized series regulators. An excess current protection circuit with a folding characteristic protects not only the tetrode but also the power supplying network.

The high voltage rectifier for the plate voltage comprises rectifier elements with "avalanche characteristic" in three-plate bridge circuitry. Special measures have been taken to ensure that when the supply is switched on the filtered output voltage rises smoothly up to the desired value without overshoot.

Any excess of plate current is registered by a DC transducer operating on the magnetic amplifier principle. In series with the DC transducer and in parallel with the tetrode there is a protective spark gap.

Measuring equipment

All important voltages and currents in the tube vision driver amplifier and the RF forward and reflected power at its output are monitored and indicated. The air temperature at the inlet and outlet to the cavity is displayed.

In order to monitor the control power coming from the vision driver there is a measuring directional coupler equipped with diode probes for indicating forward and reflected power. This directional coupler is located behind the circulator at the entrance to the vision driver.

The instruments for indicating the vision driver power are located in control panel E2 of the vision/sound final stage. The forward and reflected powers are monitored by limit indicators.

A free measuring point is provided at the output of the vision driver amplifier LV1 by means of a directional coupler with equal forward and reverse coupling coefficients.

Control panel V3

The control panel unit is constructed in the form of a slide-in cassette unit and is located in "frame V1" of the vision/sound driver cabinet. It contains the switching, monitoring and interlocking devices for the driver and final stages of the tetrode amplifiers of a single transmitter and also devices for the indication of operating conditions in the supervisory "central control panel P2" in the automatic changeover unit P. Logic circuits and timing elements ensure a reliable operating state and protect the tubes and other components in the event of disturbances.

Dynamic disturbances, such as switching off the transmitter by RF reflection or excess plate current monitoring devices, will cause a permanent interruption of the power supplies if three such disturbances occur within 20 s. Static disturbances such as failure of power supply voltage lead to an interruption of the interlocking process if they occur during the start-up procedure or to an immediate permanent interruption if they occur during transmission.

A storage unit with 49 non-volatile fault memories indicates disturbances in the driver stages and final stages and in their power supplies. In order to facilitate trouble-shooting, logic circuitry ensures that only disturbances directly responsible for a failure are stored.

The status of the memory is indicated by a two-digit LED numerical illuminated display. Four polarized relays per digit serve as storage elements. This measure also offers floating contacts for connecting a printer or a remote control unit which outputs BCD coded digits pertinent to a fault.

Apart from the signal memory relays and counters, the control panel contains only semiconductor circuits. For logic operation integrated circuits of the low speed noise-immune logic series FZ 100 (Siemens) are used and operational amplifiers for the analog to digital converters.

Preference has been given to units that have already been proved in large-scale arrangements such as electronic transmitting systems.

The circuits are designed in order to achieve the maximum possible immunity to static and dynamic disturbances.

Amplifier stage vision/sound, BTE (cabinet E)

This cabinet contains the sliding assembly unit that can be wheeled out with "vision/sound amplifier E3" consisting of the cavities "vision amplifier LV2" as 20 kW final stage vision and "sound amplifier LV3" as 2 kW final stage sound. It also contains the associated power supplies and monitoring equipment, the RF measuring and monitoring equipment together with the key-operated IEC interlock with the visible separation point on the earthing circuit breaker. It is not provided to operate the vision/sound amplifier E1 outside the cabinet.

At the top of the cabinet there is the detachable "instrument panel E2" with the limit indicators for monitoring the forward and reflected power of "driver stage D" and "vision/sound amplifier E3".

The 20 kW vision power amplifier employs a tetrode type RS 2026 CL whereas both the 2 kW sound power amplifier and the vision driver stage use a YL 1057 tetrode. All tetrodes are operated in grounded control grid circuitry.

All cavity circuits are tunable over the entire band III.

In the conductor lines to the RF inputs of the cavity amplifiers there are circulators present in order to provide one-way coupling to the vision driver amplifier and the sound driver stage. The cavities are air cooled. The differential air pressure is monitored by a membrane air pressure switch.

The anode cavity resonators are also included in the IEC safety switch system.

The vision/sound final stage following the key-operated mains circuit breaker is the mains connection point for the individual transmitter. The corresponding mains distribution points are isolated by automatic switches in the automatic controller.

The mains power supplies for heater voltage, control and screen grid voltage and plate voltage are separated into vision and sound units. The control and screen grid voltages are electronically stabilized by transistorized, short-circuit protected, voltage regulators.

The high voltage rectifiers for the plate voltages are in three-phase bridge circuitry using avalanche type diodes. Care has been taken to ensure that when the supply is switched on the filtered output voltage rises aperiodically to its desired value.

Measuring equipment

All important voltages and currents in the tube amplifiers vision/sound and the RF forward and reflected power at their outputs are monitored and indicated. The exit air temperatures of the cavities are displayed separately. For monitoring the RF output power, directional couplers are used to couple RF voltages out.

The voltage proportional to the output power is evaluated and rectified in the control section of the prestage. The rectified voltage is used to indicate the output power at the meters with limit indicators at the top of the final stage cabinet. The voltage proportional to the reflected power is subject to peak rectification in the rectifier probe screwed onto the reverse flow connector of the directional coupler. Meters equipped with limit indicators also indicate the reflected power of the final vision and sound stages.

The transmitter is cut off automatically via the limit instruments if power decreases or if the reflected power is too high. The cut-out thresholds for forward and reflected power, easily to be set from the front, can be directly read on the power scales at marked points.

Directional couplers with equal attenuation in both directions are mounted behind the vision and sound power amplifiers to provide free measuring points.

Safety devices

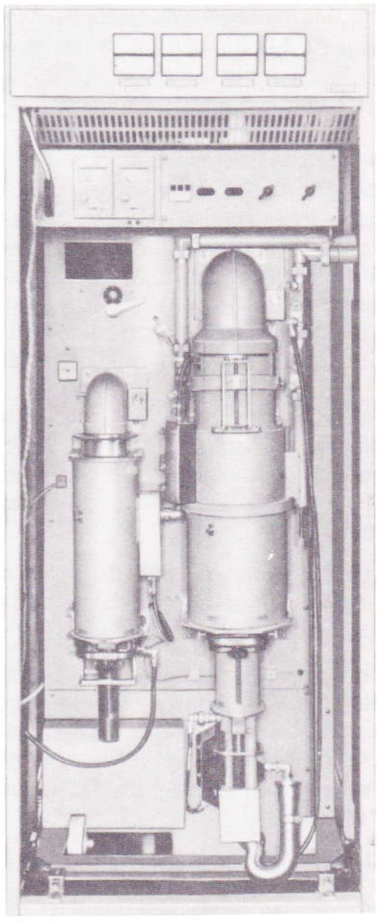
Each transmitter has its own safety system in accordance with IEC recommendation 215-1. This provides for mechanical locking of the parts carrying high tension. These parts are either firmly bolted or, when access is required, provided with key-locking cover panels.

The key locking part includes: both mains circuit breakers in the automatic changeover unit (cabinet P), the grounding switch for driver stage D and vision/sound final stages (cabinet E), and the anode cavity circuits of power amplifiers LV1 to LV3. Each transmitter requires only **one** key.

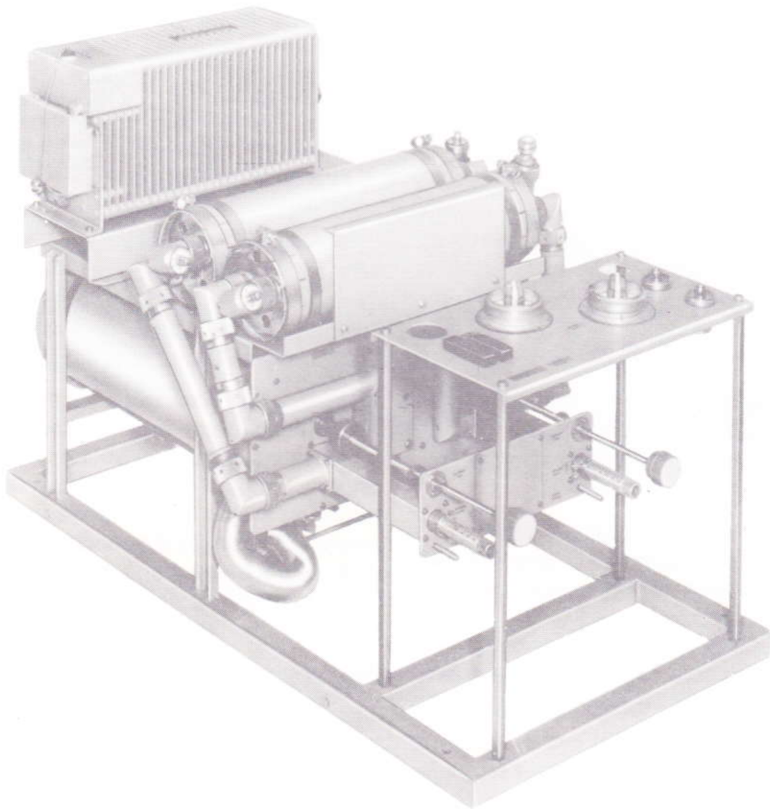
The key is only released after the mains has been switched off by the mains circuit breaker. Then the same key can be used to unlock the grounding switch in the driver stages or in the vision/sound final stages. Then rotation of the appropriate grounding switch into the position marked "filter circuit grounded" releases the mechanical lock on the anode circuit cavity of the driver stage or of the vision/sound final stage. These can now be opened without danger for such purposes as routine maintenance or replacement of CRTs.

Measurement and control equipment

Each unit is provided with measurement and test points for monitoring most of the important voltages, currents and power levels.



Amplifier stage vision/sound 20/2 kW



Diplexer vision/sound

The RF forward and reflected powers are indicated on the instrument panels of the vision/sound final stage and of the combining unit.

There is a separate control panel with multimeter associated with each CRT. According to the selector switch setting, the meter can indicate grid voltage, screen grid voltage, plate voltage, screen grid current or plate current. The excess current switch-off is actuated by a dc measuring probe. The control panel also contains the counter for indicating excess current. A test current can be fed via a socket into the test winding of the DC transducer in order to determine the threshold of the excess plate current switch. This threshold can be determined with great precision using the potentiometer arrangement supplied with the standard accessories. The arrangement comprises the so-called "test set 1" and a "multizet".

Cooling of transmitter

Forced air cooling circuits are necessary in order to remove the heat caused by the plate power dissipation in the tetrode amplifiers and for the cooling of other thermally loaded parts in the cabinet of the final stages.

A pressure and extraction blower supplies fresh air through an air filter to the equipment parts to be cooled and extracts the heated air out of the closed cooling system.

Suitable choices of the inlet and outlet air flow rates guarantee that the cabinets are under slight excess pressure in order to hinder any penetration of unfiltered air that could cause accumulation of dust in the cabinets. The size of the air conditioning unit is chosen to suit particular requirements of the transmitter location.

Combining unit vision/sound, KE (cabinet K)

This cabinet unit contains instrument panel K1 and the vision/sound diplexer with the RF changeover panel. Space above the vision/sound diplexer is available for general use, e.g. for measuring equipment.

The power delivered by the final stages for vision and sound is delivered via the vision/sound diplexer to the common antenna outlet without any interaction.

The vision/sound diplexer is built in the form of a coaxial bridge coupler and can be tuned over the entire band III (174 to 230 MHz). For throughputs in excess of 20/2 kW forced air cooling is provided. Detuning due to temperature changes is negligibly small. This performance is produced by a pair of matched sound rejection filters. The input impedance values of the diplexer are thus approximately constant in the respective rejection ranges.

An improvement in bandpass characteristic in the vision channel frequencies is achieved by filters with adjustable matching inductance in order to increase the side steepness of the rejection bands.

Supervision of transmitter operation is facilitated by a directional coupler with rectifier probes at the RF output of the vision/sound diplexer that indicates the matching of the transmitter to the antenna. If the reflected power on the RF line from the vision/sound diplexer to the antenna exceeds due to mismatching a set value, the RF carrier interlock is released by the limit indicator on the reflected power meter.

Moreover, there are two directional couplers with matched attenuation coefficients connected to test points as well as one directional coupler for the connection of a television instrument demodulator.

The RF switchover panel above the vision/sound diplexer enables switching operations of the output of the transmitter.

The following switching operations are possible:

a) Output of vision/sound diplexer (WA) to antenna (A) which is the normal setup.
b) Output of vision/sound diplexer to dummy load (KA) or to a bypass circuit:
   In the case of double transmitters, it is possible to bypass the motor driven RF switch in the automatic changeover unit and to switch the output of the vision/sound diplexer directly into the RF switching device.

The available RF circuits in the vision/sound diplexer enable the following arrangements:

a) Output of vision transmitter (B) to dummy load (KA) or to antenna (A).
b) Output of sound transmitter (T) to dummy load (KA) or to antenna (A).

Automatic changeover unit with passive load, SAW (cabinet P)

The operation of unmanned stations requires equipment that automatically switches over to reserve or spare sections in the event of failure of interruption. In the case of a double transmitter there are two complete identical transmitters "a" and "b" which are operated according to the principle of passive reserve switching, thereby producing a high degree of "availability" in the whole installation.

While the operating transmitter is connected to the antenna via the motor driven switch, the reserve transmitter is connected to the dummy load and can thus be tested and serviced. When an interruption occurs in the operating transmitter, the service is automatically switched over to the reserve transmitter which immediately takes over the program without any deterioration of quality and with the normal power. The output of the previously operating transmitter then passes through the RF switch to the dummy load and can be checked.

The two transmitters are identical. The choice of operating and reserve transmitter is entirely arbitrary. The entire transmitter can be remotely controlled.

Cabinet P includes the central changeover unit, where, in the case of a double installation, those parts are combined which are common to both transmitters. The various subassemblies are as follows:

Lamp panel P1

with the bank of lamps for indicating the operating state of the double unit and of the automatic changeover unit.

Central control panel P2

with the switch panel for local and remote operation, automatic changeover, and the transmitter preselector with the control logic for the RF switch.

Cross connection unit P3

with the central connections for transmitter control cables and remote connections for commands and communication.

RF two-way switch P4

with motor drive for switching the outputs of transmitter "a" or "b" to the antenna and the dummy load.

Mains distribution unit P5

with the key-locked circuit breakers for transmitters "a" and "b" and the "third mains".

The cassette unit "central control panel" contains those subassemblies which have priority over the switching devices in the individual transmitters, such as "preselection of operating transmitter", "switching in of operating transmitter", and "automatic changeover".

If the control panel is switched from "local operation" to "central" then the control instructions of the whole installation become possible only from the "central control panel". The commands from the remote equipment arrive here also if the appropriate operations mode switch is in the position "remote".

The "automatic changeover unit" causes an automatic changeover from the operating transmitter to the reserve transmitter if any command for a particular switch state is not obeyed or if the prescribed output power of either the vision or sound transmitter is not achieved.

There are two main groups of failure types:

a) If the output power of the final stage gradually decreases because of, say, aging of the CRT until the power drops below the threshold value, then first the reserve transmitter power supply is switched up to the normal value with the carrier lock still in operation. In this way the interruption of transmission is limited to two seconds, even when the reserve transmitter is not on standby.
b) In the case of interruption to the power supply the changeover of transmitters is instantaneous. If the reserve transmitter is running in standby state, the maximum possible disruption of transmission is 7 s.

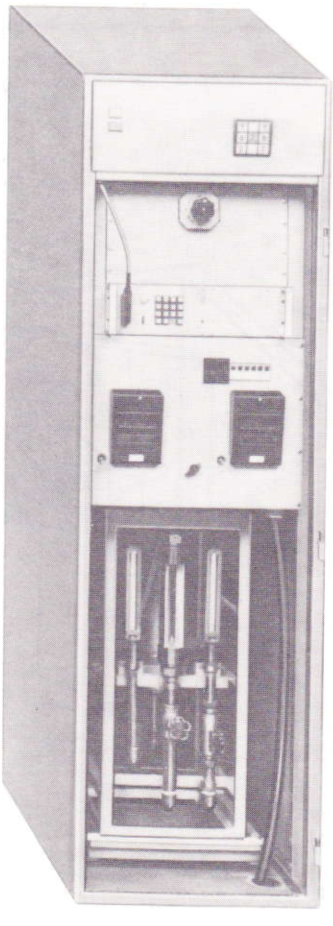
The status of the double transmitter switching is indicated by a block of indicator lamps, even when the cabinet doors are closed.

Apart from the power supplies with rectifiers and smoothing, the "central control panel" has only semiconductor circuits as functional units. The logic functions employ Siemens FZ 100 low speed noise-immune integrated circuits.

The "cross connection unit" is a separate module but functionally a part of the central control panel. Here the lines from both transmitters, from the RF switches and from the remote control are branched and sent to the cassette support.

The cabinet has spare space to be fitted with equipment especially required by the customer, e.g. a water-cooled dummy load with calometric power measuring equipment or an air-cooled dummy load.

The mains power distributor contains not only the interlocked circuit breakers for transmitters "a" and "b" but also a socket for the motor of an air-cooled dummy load. An associated phase monitor protects the motor if one mains phase should fail.



Automatic changeover unit
with incorporated dummy load

Installation advice

Installation in cabinets

Together with associated power supplies all transmitter stages, such as prestages vision/sound, driver stages, and amplifiers vision/sound, instrument and lamp panels, control panels, diplexer vision/sound, RF changeover panel, the mains distribution units and the dummy load are housed in the cabinets, performed as separate subassemblies. i.e. the transmitter is built according to the so-called modular packaging system. This enables one to modify the normal mode of installation in order to meet any special requirements due to the nature of the transmitter room.

The transmitter is free standing in the transmitter room with access to the rear. The rear panels can be easily removed using a switch room high voltage spanner.

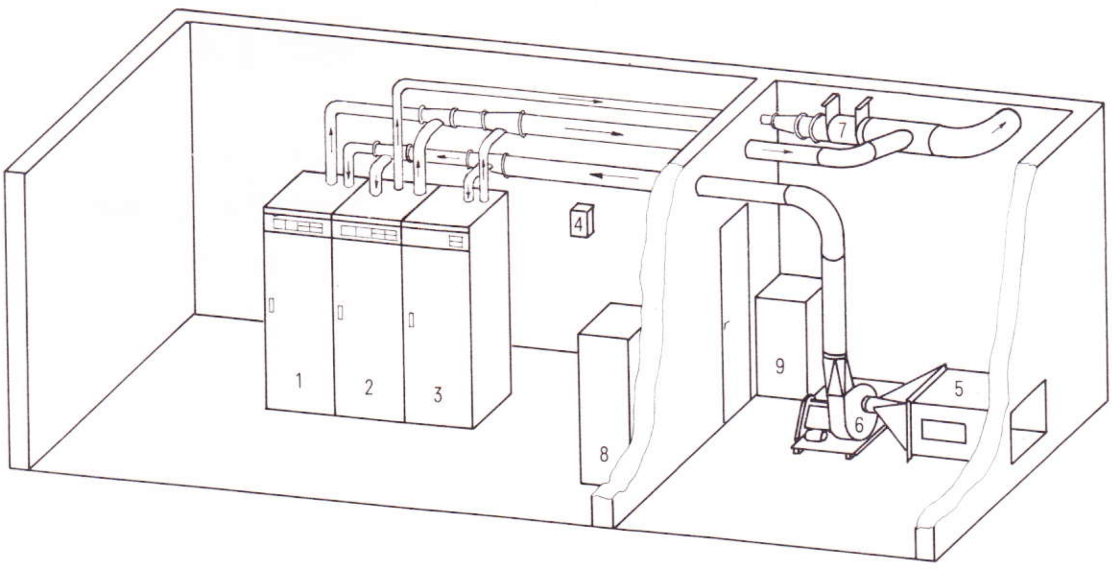
Since the units are on casters, access from the rear is not imperative. This is valuable when the transmitter is mounted in a vehicle as a mobile station.

The transmitter can be mounted on flat ground or above an underfloor space, as required; cooling air can be admitted either from below or from above.

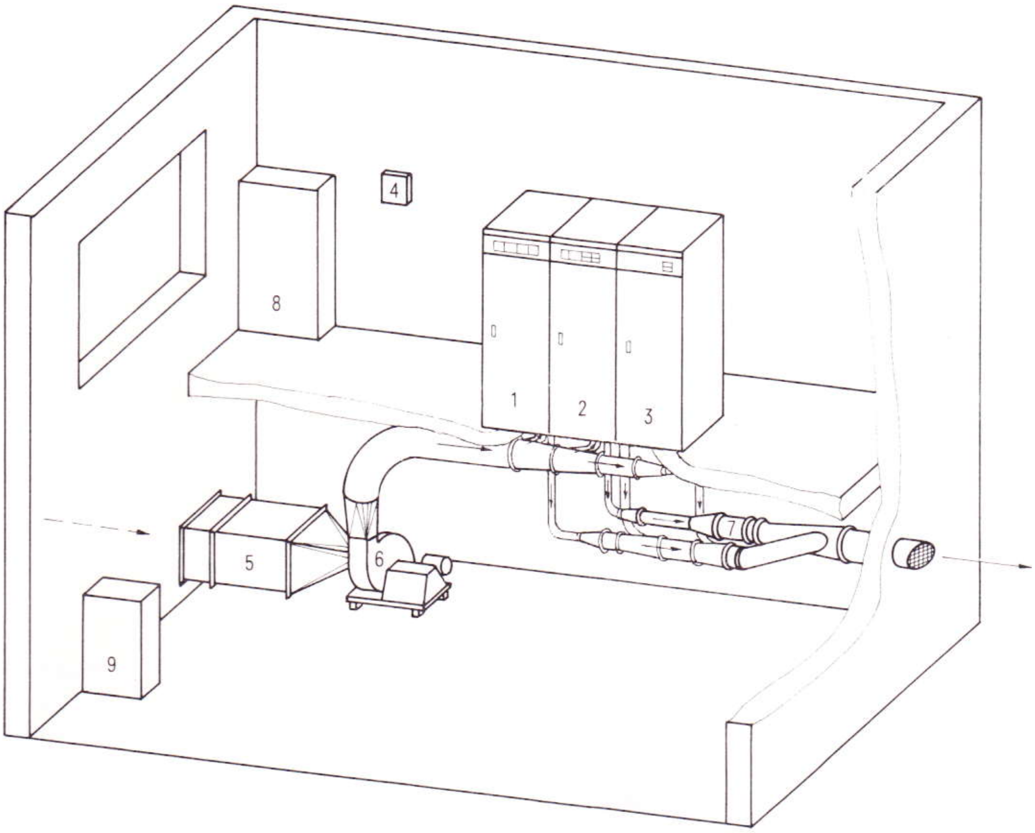
The cabinets can be disassembled, the size of the separate parts allowing transport in containers or by air freight.

None of the external cooling devices is included in the cabinets. These require mounting arrangements that take the local architectural conditions into account.

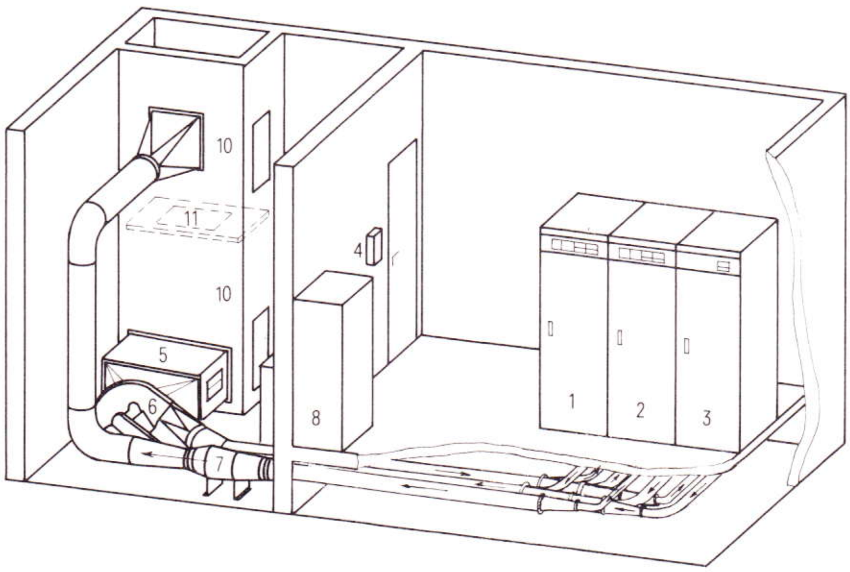
1 Vision/sound prestage
2 Vision/sound final stage
3 Combining unit
4 Circuit breaker
5 Air filter
6 Radial blower (inlet air)
7 Axial blower (exhaust air)
8 Regulator
9 Dummy load
10 Air shaft
11 Air mixing circuit



Example of cooling from above transmitter



Example of cooling from below transmitter



Example of cooling via underfloor space

5. Electrical data for CCIR standard B

General

RF output power of single and double transmitter	20/2 kW
Power ratio vision to sound	10:1 or 20:1
Frequency range Transmitter tuning range	174 to 230 MHz (channels 5 to 12)
Video frequency modulation bandwidth of vision channel	0 to 5 MHz
Mode of operation	Vision: A5C (negative) Sound: F3
Color systems	NTSC, PAL, SECAM
Frequency deviation at 100% modulation	± 50 kHz
Maximum frequency deviation	≥ 70 kHz
AF modulation bandwidth	30 to 15 000 Hz
Cooling	
Cooling agent	Air
Allowable temperature range in transmitter room	+5 to +45°C
Cooling air at entrance to transmitter for specified performance	+10 to +45°C
Maximum allowable relative humidity in operating room	90% at max. +26°C
Warm-up period	≤ 30 min

RF output power and power consumption

	Single transmitter	Double transmitter	
Nominal output power			
Vision transmitter (sync. peak power)	>20 kW	>20 kW	
Sound transmitter (carrier power)	>2.0 kW	>2.0 kW	
Mains supply[1]	3×380/220 V ±3% 50 Hz ± 5%	3×380/220 V ±3% 50 Hz ± 5%	
Power consumption including blower			
a) 20/2 kW nominal power white level	approx. 32 kVA cos φ ≥ 0.93	approx. 32,5 kVA cos φ ≥ 0.93	Reserve transmitter running in standby state
b) 20/2 kW nominal power black level	approx. 45 kVA cos φ ≥ 0.93	approx. 45,5 kVA cos φ ≥ 0.93	Reserve transmitter running in standby state
c) Operating transmitter with 20/2 kW nominal power to antenna Reserve transmitter with 20/2 kW nominal power on dummy load; black level		approx. 90.5 kVA cos φ ≥ 0.93	
Phase loading	max. 65 A	max. 130 A	
Fuses (NH fuse)	3×80 A	2×(3×80 A) or 3×125 A	
Blower			
Air inlet	7.5 kW	2×7.5 kW	
Air outlet	0.75 kW	2×7.5 kW	
Mains voltage regulator	3×20 kVA	2×(3×20 kVA) or 3×40 kVA	
Heat dissipation			
Operating and reserve transmitter unit 20/2 kW			
Nominal power switched on:			
a) into transmitter room	≤ 2.4 kW	≤ 4.8 kW	
b) into cooling room	≤ 1.0 kW	≤ 2.0 kW	

[1]) Larger mains voltage fluctuations necessitate a mains voltage regulator to be connected in series.

Vision transmitter

Output power measured at output of the vision/sound diplexer	≥ 20 kW
Termination The output of the transmitter is designed for unbalanced connection with	50 Ω
Max. allowable return loss of the load impedance	≥ 18 dB
Mode of operation Amplitude negative modulation with partial suppression of the lower sideband	A5C
Method of modulation	Intermediate frequency modulation, IF vestigial sideband filter with separate group delay equalization, delay equalization for transmitter distortion and IF amplitude and phase correction.
Frequency Setting accuracy	better than ± 50 Hz
Max. deviation of carrier frequency generated in transmitter over 3 months	± 150 Hz
Intermediate frequency	38.9 MHz
External drive Input for channel and IF	50 Ω unbalanced
Input voltage for channel and IF	$V_{rms} = 0.1$ to 1 V
External channel modulation	$f_o = \frac{(f_c + f_i)}{3}$ i.e. from 71.383333 MHz to 87.716666 MHz
Switchover "local/external"	automatic switchover of the regulating voltage at precision offset mode of operation
Number of inputs	2 (to be switched over locally or externally)
Video frequency input	75 Ω
Return loss of VF input for frequencies up to 6 MHz	≥ 34 dB
Video input voltage for color composite signal	$V_{pp} = 1$ V positive ± 3 dB adjustable
Cross-talk rejection between both VF inputs for frequencies up to 6 MHz	≥ 56 dB
Preservation of black level	black level blanking without deterioration of sync signal
Modulation failure	arbitrarily long duration allowable. Normal state resumed automatically after resumption of modulation.
White level clipper	can be switched off
White level clipping	can be adjusted
VF group delay frequency response Inherent delay	
a) without receiver pre-correction without sound trap in demodulator	within ± 35 ns
b) with receiver pre-correction without sound trap in demodulator	within ± 50 ns referred to ARD standard curve with 400 ns at 4.8 MHz
Delay difference between luminance and color signal (referred to 20 T – pulses)	
a) without receiver pre-correction without sound trap in demodulator	< 3%
b) with receiver pre-correction with sound trap in demodulator	< 4%
Intercarrier signal-to-noise ratio (up to 100 kHz modulation and unmodulated sound transmitter)	≥ 38 dB relative to 30 kHz deviation
Linearity Linearity $m = \frac{s_{min}}{s_{max}}$	
for frequencies from 0.5 to 4 MHz in the modulation range from 10 to 75%	≥ 0.9
Linearity for color carrier frequency 4.43 MHz in the modulation range from 10 to 87.5%	≥ 0.9

Deviation of the differential phase run of the peak voltage at transmitter output in the modulation range from 10 to 87.5% at 4.43 MHz	≤ ± 3°
Audio frequency transient (tilt) when modulating by 50 Hz square wave in the modulation range 10 to 75% of the sync pulse	≤ ± 2%
AM signal-to-noise ratio relative to black-white step 10/75%	
a) Hum (up to 1 kHz)	≥ 43 dB (peak rating)
b) Noise (100 kHz to 5 MHz, unweighted)	≥ 56 dB (rms rating)
Spurious emission	
a) Harmonics	≤ 1 mW
b) Spurious (inherent combination signals outside the vision channel)	≤ 1 μW

Sound transmitter

RF output power measured at output of vision/sound diplexer	≥ 2 kW
Termination The output of the transmitter is designed for unbalanced termination with	50 Ω
Max. allowable return loss of the load impedance	≥ 18 dB
Mode of operation Frequency modulation	F3
Method of modulation	Intermediate frequency modulation (F3) synchronized with line frequency
Frequency Setting accuracy	better than ± 50 Hz
Centre frequency deviation at modulation up to ± 50 kHz deviation	± 150 Hz + $K\Delta_f$ lines (K = 352 for 33.4 MHz sound IF)
Intermediate frequency	
a) for sound channel 1	33.4 MHz (Standard G)
b) for sound channel 2	33.158 MHz
External drive	as in vision transmitter
Number of AF inputs	1 Input for second sound channel prepared
AF input	≥ 2000 Ω balanced (600 Ω on request) 3-pole socket similar to DIN 41 524 with lock
Adjustment range of AF input voltage	–4 to +8 dBm for ±50 kHz deviation
Gradation of input divider	continuous
AF frequency response between 30 and 15,000 Hz	within ± 1 dB referred to 500 Hz
Distortion factor between 40 and 15,000 Hz	≤ 1% referred to 50 kHz deviation
Intermodulation	
d_2	≤ 0.6%
d_3	≤ 1%
Noise modulation Unweighted FM voltage (referred to 30 kHz deviation with f_{mod} = 500 Hz) for 40 to 15,000 Hz	≥ 60 dB
Weighted FM voltage (referred to 30 kHz deviation with f_{mod} = 500 Hz)	≥ 63 dB
Unweighted AM voltage (referred to 100% AM) asynchronous	≥ 50 dB
Spurious emission Harmonics	≤ 1 mW
Subsidiary waves (inherent combination signals outside the operating channel)	≤ 1 μW

Diplexer vision/sound

Throughput	
Vision transmitter peak power	max. 22.5 kW
Vision transmitter rms power	max. 13.5 kW
Sound transmitter	max. 2.5 kW
Frequency range	
Vision/sound diplexer tuning range	174 to 230 MHz (channels 5 to 12)
Cooling	
Forced air cooling	
Input impedance with output terminated up to 50 Ω	
Vision input	50 Ω unbalanced
VSWR in pass band	≤ 1.1 ($\triangleq a_r > 26$ dB)
Sound input	50 Ω unbalanced
VSWR in pass band	≤ 1.06 ($\triangleq a_r > 30$ dB)
Output impedance	
The output of the diplexer is dimensioned for unbalanced termination with	50 Ω
Admissible load VSWR	≤ 1.4 ($\triangleq a_r > 15.5$ dB)
Decoupling rejection	
Vision input to sound input at	
Vision carrier frequency f_v	≥ 25 dB
Sound carrier frequency f_s	≥ 40 dB
Vision transmitter input to absorber at vision carrier frequency f_v	≥ 20 dB
Attenuation	
Sound transmitter input to antenna at f_s	≤ 0.7 dB
Vision transmitter input to antenna at f_v	≤ 0.2 dB

Measuring points

RF measuring points

Directional couplers for forward and reflected power	Output LV1 Output LV2 (20 kW picture) Output LV3 (2 kW sound) 2×output diplexer vision/sound (Output RF switch to antenna. Output RF switch to dummy only in case of double transmitter)
RF output voltage from directional coupler loops	$V_{rms\,b} = 1$ V
Output	50 Ω 4.1/9.5 socket or 1.8/5.6 socket on request
Directivity	≥ 34 dB

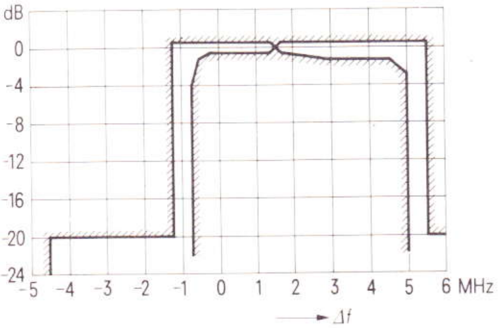
IF measuring points

(via buffer amplifier)	Output modulator Output RSB filter
IF output voltage	$V_{rms\,b} = 0.3 \pm 0.1$ V
Output	50 Ω

VF measuring point

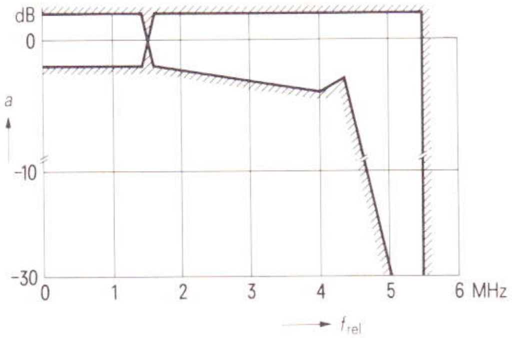
	Output VF amplifier
Output voltage	$V_{pp} = 1$ V
Output	75 Ω

Sideband spectrum of vision transmitter



Δf (MHz)	Upper limit	Lower (dB)
−4.43	−30	–
≤ −1.25	−20	–
−1.25 to −0.75	+0.5	–
−0.75	+0.5	−4.0
−0.5	+0.5	−1.0
−0.25	+0.5	−0.5
0	+0.5	−0.5
+1.5	reference value	
+3 to +4.5	+0.5	−1.0
+5	+0.5	−2.5
+5 to +5.5	+0.5	–
≥ +5.5	−20	–

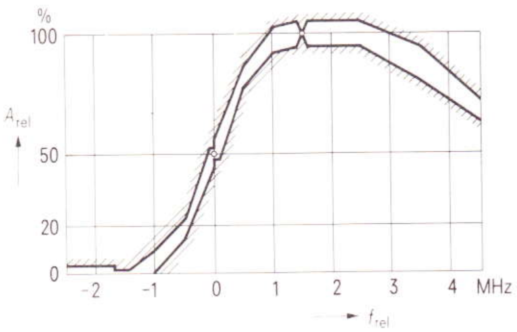
Overall gain of vision transmitter and Nyquist demodulator [1])



f_{rel} (MHz)	Tolerance *a* (dB)
0 to 1.5	+1/−1
1.5	reference value
3	+1/−1.5
4	+1/−2
4.43	+1/−1.5
5	+1/−28.5
≥ 5.5	−30

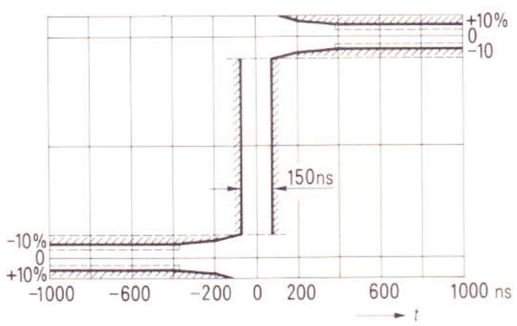
[1]) Transmitter with receiver precorrection, measuring demodulator with receiver standard curve and sound trap.

Gain of Nyquist demodulator RF + IF with switched-on sound trap



f_{rel} (MHz)	A_{rel} Lower limit	Upper (%)
< −1.65	0	2
−1.65	0	0.8
−1.35	0	0.8
−1	0	8.5
−0.5	15	25
0	48	52
+0.5	75	85
+1	91.5	101.5
+1.4	95	105
+1.5	reference value	
+1.6	95	105
+2.5	95	105
+3.5	80	95
+4.43	63	71

Transient of vision transmitter and Nyquist demodulator for steps from 55% to 75% of peak voltage and vice versa



Time *t* (ns)	Limit (%)
± 75	−10
±100	+11
±200	± 7
±[400 to 1000]	± 5
±[400 to 1000]	± 3 for overhang

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