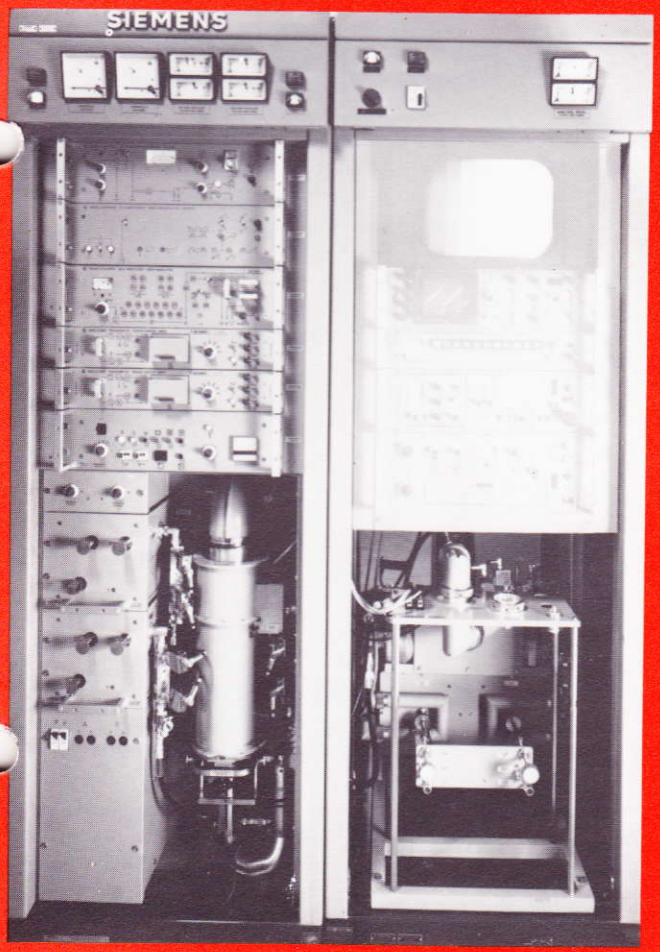
SIEMENS

TV Transmitter 2/0.2 kW Band III with modulation at a fixed IF

Type Q 20-A 1067



Contents

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I. Design

The 2/0.2 kW VHF Band III television transmitter consists of separate amplifier chains for the picture and sound signals with a combining network at the output. The picture and sound pre stage with associated power supply is located in one cabinet together with the 2/0.2 kW output stage with power supply and the diplexer in a second cabinet, the combining unit. It is possible to house in this cabinet also some monitoring equipment. As picture monitor, oscilloscope, switch point selector, sound demodulator, Nyquist demodulator, but note this equipment is not part of the transmitter.
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 10 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.

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

II. Features

Small dimensions.

Picture and sound transmitters 2/0.2 kW, with associated power supply in one cabinet. Diplexer with probable monitoring equipment in a second cabinet.

Transmitter interlock in accordance with IEC Recommendations 215-1.
Fault memory for 39 functions.

Transmitter preamplifier stages up to an output power of approx. 10 W fitted with silicon transistors.

Modulation at fixed IF.

For TV transmission in accordance with CCIR Recommendations (625 lines, channel bandwidth 7 MHz).

Also available for FCC or OIRT standards.

Completely color-compatible for NTSC, PAL or SECAM standards.

III. Construction

(fig. 2)

The cabinets 685 mm wide, 1070 mm deep and 2026 mm high have lockable doors at the back and front. Meters for monitoring all important parameters are located in an instrument panel above the front doors.

For signal processing and amplification the prestage cabinet contains the video preequalizer, exciter with FM exciter unit, picture modulator, picture converter, 5 W transistorized picture driver stage 100 W power amplifier, sound converter with 10 W transistorized sound driver stage together with the power supply and protection circuits. As well as the 2 kW picture PA, 0.2 kW sound PA with associated power supply and protection circuits. The second cabinet, the combining unit, contains the diplexer and on request also monitoring assembly units.

It is advisable because of noise to install the air cooling equipment in a separate sound-proof room.

High long-term stability of its characteristics makes the transmitter especially suitable for operation on unattended stations. A remote control system carries commands to the transmitter and transmits back the corresponding signals. On attended stations the transmitter is switched on centrally from the transmitter control panel.

An interlock loop prevents damage to the transmitter by operators errors. All control knobs and sliders that may have to be adjusted occassionally cannot endanger personnel.

The transmitter contains all monitoring instruments required for constant supervision and measurement of the operating voltages and currents. In addition to meters in the instrument panel across the top of the transmitter, meters are provided on the front panel of individual units where necessary. Visual indicators and lamps indicate deviations from normal operation and faults in each stage.

The quality of the picture and sound signals can be checked at various points. For example the video preequalizer has well decoupled 75 ohm outputs to which video control instruments can be connected. A number of directional couplers with 50 ohm outputs are provided for IF and RF test equipment. Separate control units containing a video-tracer, video oscilloscope, and Nyquist demodulator can also be supplied on request, and located above the diplexer.

IV. Principles of operation

(fig. 3)

2/0.2 kW picture and sound transmitters

The two video inputs of the picture transmitter are designed as coaxial insertion filters. The incoming video line therefore does not terminate in the transmitter but can be continued to any other points such as the picture transmitter monitoring equipment. A remote controlled change over switch connects the video preequalizer input to one of the two program lines.

The subsequent video preequalizer equalizes and prepares the video signal. It contains an adjustable correction network to compensate for non-linear distortion in the power amplifier stages following (linearity correction), and a delay equalization network adjustable in steps and mainly effective at the upper end of the video frequency band. The video preequalizer also assumes the functions of levelling, white level clamping, indication of excessive white level and precorrection of the differential phase occuring in the subsequent power amplifier stages.

The exciter supplies a standard 38.9 MHz IF sinewave for the video and sound modulators, and an RF sinewave for the two converters at a frequency obtained by adding the channel frequency f_C to the intermediate frequency f_{IF}. As the frequency f_{IF} is substracted again in the converters, frequency errors of the IF oscillator cancel out at the transmitter output.

The channel frequency is obtained by multiplication from a quartz crystal oscillator in a thermostatically controlled oven. The oscillator frequency remains within the admissible tolerance over many month without requiring correction.

In the modulator the standard IF of 38.9 MHz is amplitude modulated (negative modulation) with the video signal. The blanking level determines the level clamping, and is such that with color transmission the color burst remains practically unaffected. A band-pass filter following the modulator stage also acts as vestigial sideband filter.

This is followed by a delay equalizing circuit which in the vestigial sideband range provides better possibilities of equalizing than video frequency equalization. Both the vestigial sideband filter and delay equalizer can be switched out of the signal path from the front panel and measured separately. The modulator also contains a further equalizing circuit to correct for amplitude non-linearity in the subsequent RF power amplifier stages.

The IF signal from the modulator is fed to the picture frequency converter, where it is converted to the channel frequency and amplified to about 0.5 W. Another transistor stage amplifies the RF signal to the 5 W level to drive the RF penultimate amplifier to 100 W peak sync across 50 ohms.

The FM exciter contains an oscillator that is frequency modulated by the audio signal from a two stage regulator and AF amplifier. An AFC circuit keeps the center frequency of the FM signal within the usual tolerances by a large safety margin. In accordance with the CCIR standard, the frequency modulator operates at 33.4 MHz. After amplification the IF sound signal is applied to the sound converter, which resembles the picture converter. This is followed by a 10 W transistorized driver.

2/0.2 kW picture and sound stage

The 2 kW picture output stage fitted with the tetrode type YL 1056 is a straight amplifier operating in class AB.

The sound output stage is preparing the 200 W output power.

Combining unit

The diplexer in this unit combines the picture and sound transmitter outputs to the common antenna input without mutual interference. It also helps to suppress the color subcarrier at −4.43 MHz in the lower sideband.

Its characteristic is obtained with two identical band stop filters inserted in a double bridge with absorber.

For measuring purposes, the picture or sound transmitter can be connected directly to the antenna or a dummy load.

The diplexer is situated in the lower part of this cabinet, up to a height of about 80 cm. Above the diplexer, another 85 cm can be used for taking up additional monitoring equipment.

V. Electrical Data for CCIR Standard B

General

Rated output power, single and double transmitter	2/0.2 kW
Ratio of picture to sound output power	10 : 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
Color subcarrier frequency	4.43 MHz
Color system	NTSC, PAL or SECAM
Frequency deviation with 100% drive Maximum frequency deviation	± 50 kHz ≧ 70 kHz
Sound frequency modulation bandwidth	30 to 15,000 Hz

Cooling

Air cooling

Admissible ambient temperature range in transmitter room to meet specified performance	+ 5 to +45 °C for b/w operation +15 to +45 °C for color operation
Maximum admissible humidity in transmitter room	90% at max. +26 °C
Running-in time	30 minutes

Output power and power consumption

	Single transmitter	Double transmitter
Rated output power		
Picture transmitter (Peak pulse power)	> 2 kW	> 2 kW
Sound transmitter	> 0.2 kW	> 0.2 kW
Mains input*)	3×380/220 V ±3% 50 Hz ±5%	3×380/220 V ±3% 50 Hz ±5%
Power input including blowers		
a) with 2/0.2 kW rated power, white picture	approx. 4.6 kVA cos φ ≧ 0.93	approx. 4.6 kVA cos φ ≧ 0.93
b) with 2/0.2 kW rated power, black picture without lift	approx. 5.1 kVA cos φ ≧ 0.93	approx. 5.1 kVA cos φ ≧ 0.93
c) Operating transmitter with 2/0.2 kW into the antenna, standby transmitter with 2/0.2 kW into dummy load, black picture without lift	—	approx. 10.2 kVA cos φ ≧ 0.93
Phase current	max. 9 A	max. 18 A
Fuses (fast trip)	3×20 A	2×(3×20 A)
Blowers		
a) Inlet air	0.55 kW	2×0.55 kW
Mains voltage regulator	3×2.5 kVA	2×(3×2.5 kVA) alternativ: 1×(3×7.5 kVA)

*) For larger mains voltage fluctuations a mains voltage regulator is required.

Picture transmitter

Output power, measured at diplexer output	≧ 2 kW
Terminations	
Transmitter output	50 Ω unbalanced
Admissible VSWR	1.1 : 1 (≙ a_r = 26 dB)
Class of emission	
Negative-going amplitude modulation with partial suppression of lower sideband	A5C
Type of modulation	Frequency modulation at intermediate frequency
Intermediate frequency generation	
Oscillator frequency	38.9 MHz
Carrier frequency generation	
Carrier frequency = (Carrier frequency + IF) – IF	
Oscillator frequency range	approx. 9.6 to 12.8 MHz
Multiplication	×18
Pulling range of carrier frequency	approx. ±4 kHz
Setting accuracy of carrier frequency	better than ±50 Hz
Maximum deviation of carrier frequency from set value	
after 30 min. uninterrupted operation	≦ ±500 Hz
after 1 month with oscillator crystal ovens switched on	≦ ±150 Hz
Input for external exciter	1
Input impedance	50 Ω
Input frequency (f_c = carrier frequency)	$f_c/6$
Cross-talk attenuation of the input out of circuit	≧ 80 dB
Return loss of external input	≧ 20 dB
Rated input voltage	1 V_{rms} ±10%
Remote changeover internal/external	Floating contact (60 V, 0.2 A)
Number of video inputs	2
Input impedance	75 Ω
Return loss of VF input for frequencies up to 5 MHz when terminated with 75 Ω	≧ 34 dB
Peak-peak VF input voltage for composite color signal	0.7 to 1.3 V positive
Cross-talk attenuation between the two video inputs for frequencies up to 5 MHz	≧ 56 dB
Level clamping, switch-selected	
Keyed	Clamping of blanking level without impairing color sync signal
Unkeyed	Sync level clamping
Level stability	
Peak voltage (sync pulse)	100%
Peak voltage variation when changing from black to white picture	< 0.5 dB
Blanking level with standard input signal	75% +0%, –4%
White level with standard input signal	10 to 12.5%
White level clipping (can be switched off)	
Attenuation of signal components above 4.5 MHz exceeding clipping level	< 0.5 dB
Operate uncertainty	< ±1%
Operate level	adjustable in the range 0 to 25%
Envelope delay response	
Deviation from a constant for	
f = 0 to 4.5 MHz	≦ ± 40 ns
f = 4.8 MHz	≦ ± 100 ns

*) The reduced quality of certain transmission functions dependent on the VSWR of the load must be taken into consideration.

Linearity

Linearity measure m = ratio of minimum to maximum slope of modulation characteristic between black and white picture measured with constant modulation frequency across transmitter and Nyquist demodulator

For f = 0 to 4 MHz
when modulating signal changes from
12 to 75% with white clipper or
10 to 75% without white clipper — ≧ 0.9

For color subcarrier frequency 4.43 MHz
when modulating signal changes from
12 to 87.5% with white clipper or
10 to 87.5% without white clipper — ≧ 0.9

Differential phase

for color subcarrier frequency 4.43 MHz
when modulating signal changes from
12 to 87.5% with white clipper or
10 to 87.5% without white clipper — ≦ ±3°

Amplitude/frequency response

Sideband spectrum of picture transmitter including diplexer — Fig. 1-1

Frequency response measured across transmitter including diplexer and Nyquist demodulator assuming frequency response of Nyquist demodulator as shown in fig. 1-3 — Fig. 1-2

Build-up transient
(measured across transmitter and Nyquist demodulator)

Low frequencies

Tilt of 50 Hz square wave when modulating signal changes from 10 to 75% — ≦ ±2%

High frequencies

Build-up transient of a 250 kHz square wave measured at Nyquist demodulator when modulating signal changes from 55 to 75% — Fig. 1-4

Spurious output

Noise

Random noise voltage level between 10 kHz and 5 MHz referred to black-white step 10/75% — ≧ 56 dB rms rating

Hum

Level of hum voltage up to 1 kHz referred to black-white step 10/75% — ≧ 43 dB peak rating

Intercarrier interference ratio (measured across transmitter, diplexer and Nyquist demodulator) referred to 30 kHz deviation of sound transmitter with a modulating frequency of 500 Hz	≧ 38 dB
Spurious emissions	
Harmonics	≦ 1 mW
Combination signals produced by transmitter	≦ 1 µW

Sound transmitter

Output power measured at diplexer output	≧ 0.2 kW
Termination	
Output	50 Ω unbalanced
Admissible VSWR	(1.3 : 1 (≙ $a_r \approx 18$ dB)
Class of emission	
Frequency modulation	F3
Type of modulation	IF modulation (F3)
Sound carrier intermediate frequency	33.4 MHz
IF carrier frequency generation	
Oscillator frequency	33.4 MHz
Regulating circuit with phase discriminator. Spacing between picture and sound carriers held constant at 5.5 MHz (standard B)	
Auxiliary carrier frequency generation	
Same auxiliary carrier used as in picture transmitter: Carrier frequency = (picture carrier frequency + picture IF) – sound IF	
Maximum deviation of sound carrier frequency from set value within one month (transmitter run in)	≦ 1000 Hz
Center frequency shift with modulation up to ±50 kHz deviation	none
Frequency deviation	
with 100% TV signal	±50 kHz
maximum deviation	±75 kHz
maximum shift from set value within 1 month	≦ ±5%
AF input	
Input impedance	≧ 2000 Ω balanced to ground 600 Ω (if desired)
Control range of AF input voltage (manual control on site) for both ±30 kHz and ±50 kHz deviation	–4 to +8 dBm
Control steps	2×10 dB (coarse) / 20×0.5 dB (fine)
AF frequency response (referred to 1,000 Hz) between 40 and 15,000 Hz	≦ ±0.5 dB
Distortion factor between 40 and 15,000 Hz referred to 50 kHz deviation	≦ 1%
Amplitude/frequency response between 40 and 15,000 Hz	
without preemphasis	level ±0.5 dB
with preemphasis corresponding to a time constant of 50 µs	±1 dB
Spurious modulation (referred to 500 Hz)	
FM unweighted voltage referred to ±30 kHz deviation	≧ 50 dB
FM weighted voltage (through an ear filter in accordance with CCIR 1949) referred to ±30 kHz deviation	≧ 60 dB

AM unweighted voltage referred to 100% AM	≧ 48 dB
AM synchronous voltage referred to 100% AM	≧ 54 dB
Spurious emission	
Harmonics	≦ 1 mW
Out-of-band combination signals	≦ 1 µW

Diplexer

Power rating	
Picture transmitter peak power	2.5 kW
Picture transmitter average power	1.5 kW
Sound transmitter	0.5 kW
Frequency range	
Diplexer tuning range	170 to 230 MHz (channels 5 to 12)
Cooling	air
Input impedance with output terminated up to 50 Ω	
Picture input	50 Ω unbalanced
VSWR in passband	≦ 1.1 : 1 (≙ a_r > 26 dB)
Sound input	50 Ω unbalanced
VSWR in passband	≦ 1.03 : 1 (≙ a_r > 30 dB)
Output impedance	50 Ω unbalanced
Admissible load VSWR	≦ 1.4 : 1 (≙ a_r > 15.5 dB)
Decoupling	
Picture input to sound input	
at picture carrier frequency f_B	≧ 25 dB
at sound carrier frequency f_T	≧ 40 dB
Picture input to absorber	
at picture carrier frequency f_B	≧ 20 dB
Attenuation	
Sound input to antenna at sound carrier frequency f_T	≦ 0.7 dB
Picture input to antenna at picture carrier frequency f_B	≦ 0.2 dB

Test points

RF test points

Measuring head	at output 5 W frequency converter picture Output of LV 1 (100 W picture) Output of LV 2 (2 kW picture) Output of LV 3 (0.2 kW sound) 2 × output of diplexer
RF output voltage of coupler loops	1 V_{rms}
Output impedance	50 Ω
Directivity	≧ 34 dB

IF test points

	Output modulator Output equalizer amplifier
IF output voltage	250 mV_{rms} +1/−4 dB
Output impedance	50 Ω

VF test points

	Output white clipper
(switched)	or output VF precorrector (color composite signal)
Output voltage	1 V peak-peak
Output impedance	75 Ω

Sideband spectrum of picture transmitter

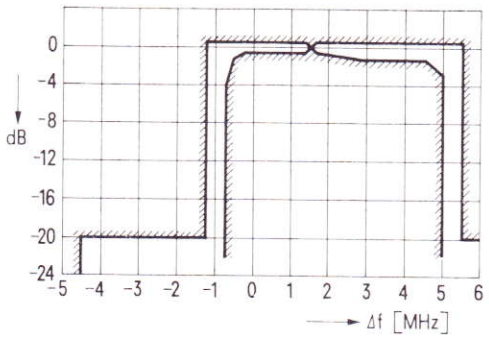

Fig. 1-1

Δf [MHz]	high Limit [dB]	low
−4.43	−30	—
≦ −1.25	−20	—
−1.25 to −0.75	+0.5	—
−0.75	+0.5	−4
−0.5	+0.5	−1.0
−0.25	+0.5	−0.5
0	+0.5	−0.5
+1,5	Ref value	
+3 to +4.5	+0.5	−1,0
+5	+0.5	−2.5
+5 to +5.5	+0.5	—
≧ +5.5	−20	—

Overall amplitude characteristic
picture transmitter + nyquist demodulator*)

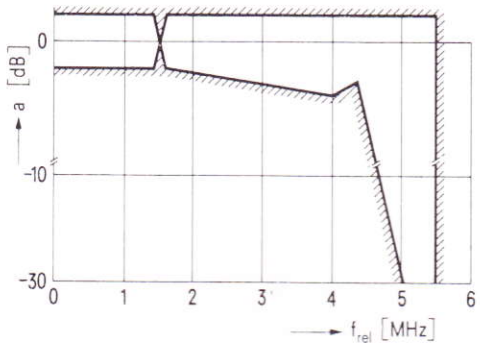

Fig. 1-2

Frequency MHz	Limit dB
0 to 1.5	+1 / −1
1.5	Ref value
3	+1 / −1.5
4	+1 / −2
4.43	+1 / −1.5
5	+1 / −28.5
≧ 5.5	−30 / —

Amplitude characteristic of nyquist demodulator RF + ZF
with switched on sound trap

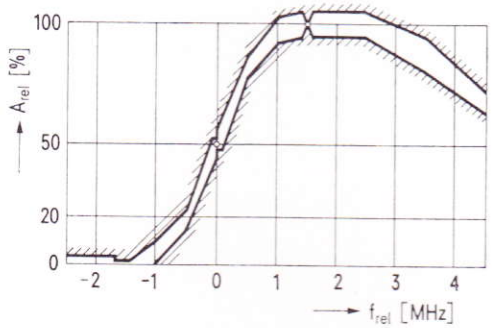

Fig. 1-3

f_{rel} MHz	A_{rel} [%] low	high Limit
< −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	Ref value	
+1.6	95	105
+2.5	95	105
+3.5	80	95
+4.43	63	71

Buildup transient of picture transmitter + nyquist demodulator with
sudden changes from 55% to 75% of the peak voltage and vice versa

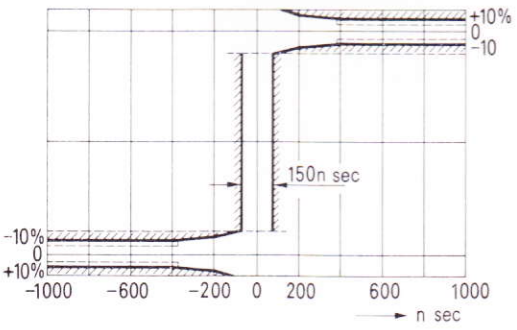

Fig. 1-4

Time [ns]	Limits [%]
± 75	−10
±100	+11
±200	± 7
± [400 to 1000]	± 5
± [400 to 1000]	±3 for smear

*) Transm. with receiver precorrection and with sound trap

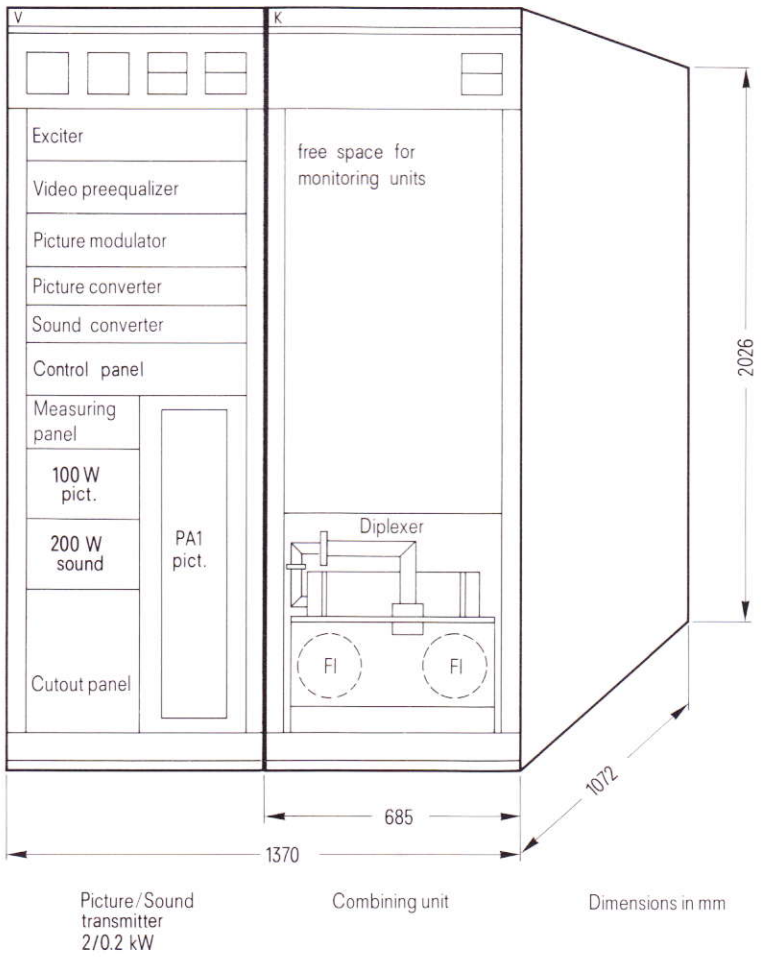
V
K
Exciter
Video preequalizer
Picture modulator
Picture converter
Sound converter
Control panel
Measuring panel
100 W pict.
200 W sound
Cutout panel
PA1 pict.
free space for monitoring units
Diplexer
FI
FI
2026
1072
685
1370
Picture/Sound transmitter 2/0.2 kW
Combining unit
Dimensions in mm

Fig. 2

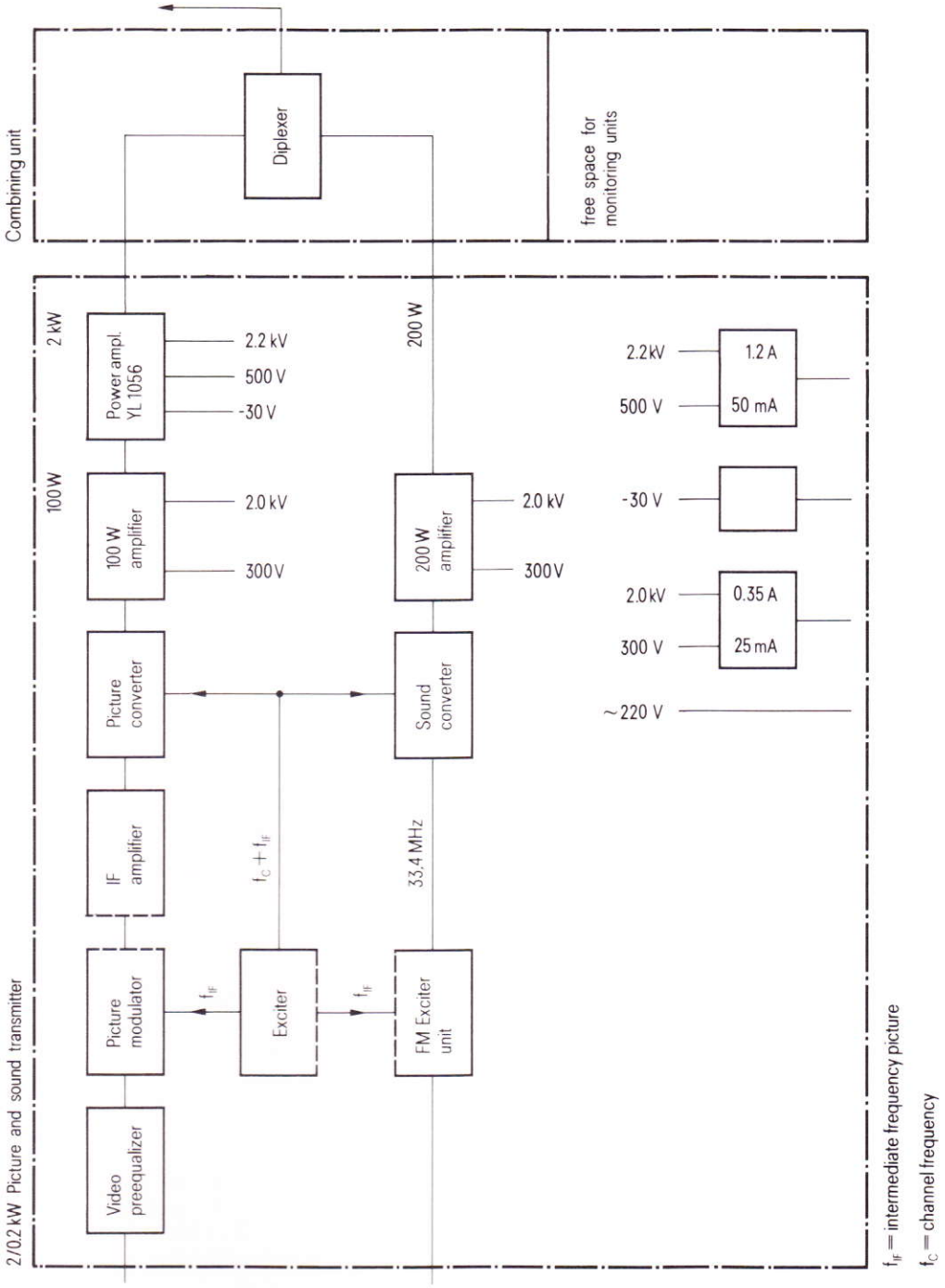
Combining unit
Diplexer
free space for monitoring units
2/0.2 kW Picture and sound transmitter
2 kW
Power ampl. YL 1056
2.2 kV
500 V
-30 V
100 W
100 W amplifier
2.0 kV
300 V
Picture converter
IF amplifier
Picture modulator
Video preequalizer
f_{IF}
Exciter
$f_C + f_{IF}$
f_{IF}
200 W
200 W amplifier
2.0 kV
300 V
Sound converter
33.4 MHz
FM Exciter unit
2.2kV
500 V
1.2 A
50 mA
-30 V
2.0kV
300 V
0.35 A
25 mA
~220 V
f_{IF} = intermediate frequency picture
f_C = channel frequency

Fig. 3

VI. Scope of Delivery

VI. Designations, sizes and weight

Designation	Dimensions/Weight B × D × H (mm)
Band III TV Transmitter 2/0.2 kW	1370×1072×2026 ca. 1200 kg
Cabinet 1:	
Picture/sound transmitter 2/0.2 kW comprising:	685×1072×2026
1 Instrument panel	685×120×181
1 Exciter	483×375×133
1 VF preequalizer	483×375×133
1 Picture modulator	483×448×133
1 Picture converter	483×448×88
1 Sound converter	483×448×88
1 Control panel	483×448×133
1 Measuring panel	230×70×90
1 Cutout panel	226×242×430
1 Picture amplifier 100 W	230×220×450
1 Sound amplifier 200 W	230×220×450
1 Power amplifier (cavity) YL 1056 picture driver	230×230×750
1 Power supply	420×280×860
1 3-phase transformer	340×225×287
4 Directional couplers	—
1 Measuring head	—
6 Diode probes	—
1 Blower	—
1 Air ducting system with filter and silencer	—

Designation	Dimensions B × D × H (mm)
Cabinet 2:	
Combining unit comprising:	685×1072×2026
1 Instrument panel	685×120×181
1 Diplexer containing	525×964×600
2 Filter cavities	456×861×218
2 3-dB couplers	426×120 ⌀
1 Double directional coupler	60×650×90
2 Diode probes	—
1 Termination resistor prepared for housing monitoring equipment	—

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