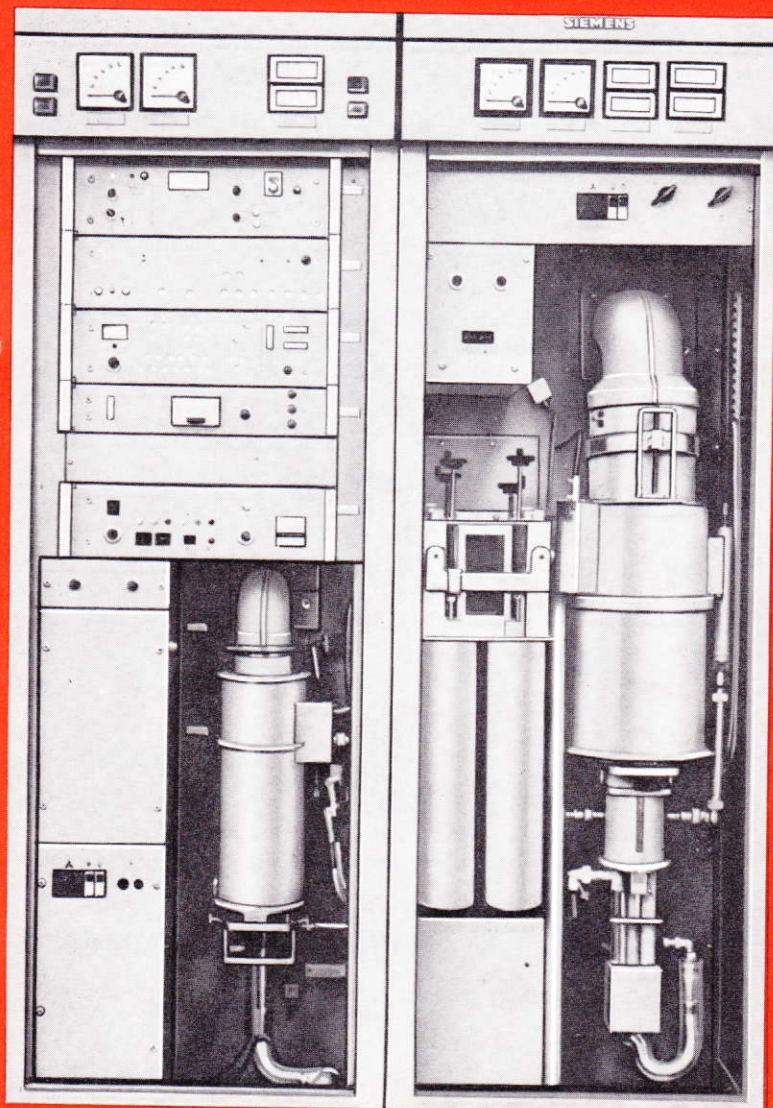


**SIEMENS**

# TV Transmitter 5/0.5 kW Band III with modulation at a fixed IF

Type Q 20-A 1010



# Contents

- I. Design
- II. Features
- III. Construction
- IV. Principles of Operation
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## I. Design

The 5/0.5 kW VHF Band III television transmitter with combined picture/sound amplification consists of the 150/15 W picture/sound stage and the 5/0.5 kW picture/sound final stage.

The 150/15 W stage with associated power supplies is located in one cabinet, the 5/0.5 kW stage with power supplies in a second cabinet.

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 5 W output power incorporate silicon transistors, the power stages tetrodes. The transmitter can be tuned over the entire band III range of 174 to 230 MHz. Before delivery, the transmitter is tuned to a fixed channel.

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

## II. Features

Small dimensions.

Picture and sound transmitter 150/15 W, with associated power supply in one cabinet, picture and sound power amplifier, 5/0.5 kW, with associated power supply in a second cabinet.

Combined picture/sound amplification.

Transmitter interlock in accordance with IEC Recommendations 215-1.

Fault memory for 39 functions.

Transmitter preamplifier stages up to an output power of approx. 5 W fitted with silicon transistors.

The electronic voltage regulators for the grid 1 and grid 2 voltages are transistorized.

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, if requested.

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

## III. Construction

(fig. 2)

The cabinets 685 mm wide, 1072 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 150/15 W cabinet contains the video preequalizer, exciter with FM exciter unit, video modulator, frequency converter with 5/0.5 W output power 150/15 W power amplifier together with the power supply and protection circuits.

The second cabinet contains the 5/0.5 kW PA and the four-circuit adjacent channel filter with associated power supply and protection circuits.

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 manned stations the transmitter is switched on centrally from the transmitter control bay.

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

The transmitter contains all monitoring instruments required for constant supervision and measurements 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 pre-equalizer 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. A separate control bay containing a video-tracer, video oscilloscope, and Nyquist demodulator can also be supplied on request.

## IV. Principles of operation

(fig. 3)

### 150/15 W picture/sound stage

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 bay. A remote-controlled change-over switch connects the video pre-equalizer input to one of the two program lines.

The subsequent video pre-equalizer equalizes and prepares the video signal. It contains an adjustable correction network to compensate for differential phase in the power amplifier stages. The video pre-equalizer also assumes the functions of levelling, white level clamping, indication of excessive white level and correction of the frequency response at the upper end of the video frequency band.

The exciter supplies a standard 38.9 MHz IF sinewave for the video and sound modulators, and an RF sinewave for the converter at a frequency obtained by adding the channel frequency  $f_C$  to the intermediate frequency  $f_{IF}$ . As the frequency  $f_{IF}$  is subtracted 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 months 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 picture and sound signals are also combined in the modulator. They are combined after vestigial sideband clipping but before the linearity correction circuit.

The picture and sound IF signal from the modulator is fed to the frequency converter where it is converted to the channel frequency and amplified to about 3/0.3 W. This signal drives the RF penultimate amplifier (YL 1056) to 150/15 W peak sync across 50 ohm.

The FM exciter contains an oscillator that is frequency modulated by the studio 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. The IF signal at the output of the frequency modulator is fed to the modulator for combined amplification.

With the control unit the transmitter can be controlled locally or remotely. The unit contains circuits to control the switch-on sequence and to prevent damage to the transmitter under fault conditions. The fault causes are stored in a memory unaffected by power failures.

Contactless logic circuits are used throughout the control unit to assure maximum operational reliability.

### 5/0.5 kW picture/sound stage \*

The 5/0.5 kW PA fitted with the tetrode RS 2022 CL for combined picture/sound amplification is a straight amplifier operating in class A/B.

An adjacent channel filter tunable throughout band III at the output of 5/0.5 kW PA attenuates the intermodulation products

$f_{\text{picture}} - 5.5 \text{ MHz}$ ,  $f_{\text{picture}} - 11 \text{ MHz}$ ,  
 $f_{\text{picture}} + 11.0 \text{ MHz}$  and  $f_{\text{picture}} + 16 \text{ MHz}$ .

These undesired intermodulation products are therefore much lower than the admissible levels.

## V. Electrical Data for CCIR Standard G

### General

Rated output power, single and double transmitter	5/0.5 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	$\pm 50 \text{ kHz}$
Maximum frequency deviation	$\geq 70 \text{ kHz}$
Sound frequency modulation bandwidth	30 to 15,000 Hz

### 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
<b>Rated output power</b>		
Picture transmitter (Peak pulse power)	> 5 kW	> 5 kW
Sound transmitter	> 0.5 kW	> 0.5 kW
<b>Mains input*)</b>	3 × 380/220 V ±3% 50 Hz ±5%	3 × 380/220 V ±3% 50 Hz ±5%
<b>Power input including blowers</b>		
a) with 5/0.5 kW rated power, white picture	approx. 23 kVA $\cos \varphi \geq 0.95$	approx. 23 kVA $\cos \varphi \geq 0.95$
b) with 5/0.5 kW rated power, black picture without lift	approx. 26 kVA $\cos \varphi \geq 0.95$	approx. 26 kVA $\cos \varphi \geq 0.95$
c) Operating transmitter with 5/0.5 kW into the antenna, standby transmitter with 5/0.5 kW into dummy load, black picture without lift	—	approx. 52 kVA $\cos \varphi \geq 0.95$
<b>Phase current</b>	max. 45 A	max. 90 A
<b>Fuses (fast trip)</b>	3 × 63 A	2 × (3 × 63 A)
<b>Blowers</b>		
a) Inlet air	4.0 kW	2 × 4.0 kW
b) Exhaust air	0.37 kW	2 × 0.37 kW
<b>Mains voltage regulator</b>	3 × 10 kVA	2 × (3 × 10 kVA) alternativ: 1 × (3 × 20 kVA)

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

## Picture transmitter

Output power, measured at diplexer output	$\geq 5$ kW
Terminations	
Transmitter output	50 $\Omega$ unbalanced
Admissible VSWR	1.1 ( $\approx a_r = 26$ 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	$\times 18$
Pulling range of carrier frequency	approx. $\pm 4$ kHz
Setting accuracy of carrier frequency	better than $\pm 50$ Hz
Maximum deviation of carrier frequency from set value	
after 30 min. uninterrupted operation	$\leq \pm 500$ Hz
after 1 month with oscillator crystal ovens switched on	$\leq \pm 150$ Hz
Input for external exciter	1
Input impedance	50 $\Omega$
Input frequency ( $f_c$ = carrier frequency)	$f_c/6$
Cross-talk attenuation of the input out of circuit	$\geq 80$ dB
Return loss of external input	$\geq 20$ dB
Rated input voltage	1 V <sub>rms</sub> $\pm 10\%$
Remote changeover internal/external	Floating contact (60 V, 0.2 A)
Number of video inputs	2
Input impedance	75 $\Omega$
Return loss of VF input for frequencies up to 5 MHz when terminated with 75 $\Omega$	$\geq 34$ 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	$\geq 56$ 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	$< \pm 1\%$
Operate level	adjustable in the range 0 to 25%
Envelope delay response	
Deviation from a constant for	
f = 0 to 4.5 MHz	$\leq \pm 50$ ns
f = 4.8 MHz	$\leq \pm 100$ 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  $\geq 0.9$

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  $\geq 0.9$

## 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  $\leq \pm 3^\circ$

## 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%  $\leq \pm 2\%$

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%  $\geq 56$  dB rms rating

Hum  
Level of hum voltage up to 1 kHz referred  
to black-white step 10/75%  $\geq 43$  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
 <b>Sound transmitter</b>	
Output power measured at diplexer output	≥ 0.5 kW
Termination	
Output	50 Ω unbalanced
Admissible VSWR	1.3 : 1 (≅ a <sub>r</sub> ≈ 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)	≤ 1,000 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 $\pm 30$ kHz and $\pm 50$ kHz deviation Control steps	$-4$ to $+8$ dBm $2 \times 10$ dB (coarse) / $20 \times 0.5$ dB (fine)
AF frequency response (referred to 1,000 Hz) between 40 and 15,000 Hz	$\leq \pm 0.5$ dB
Distortion factor between 40 and 15,000 Hz referred to 50 kHz deviation	$\leq 1\%$
Amplitude/frequency response between 40 and 15,000 Hz without preemphasis with preemphasis corresponding to a time constant of 50 $\mu$ s	level $\pm 0.5$ dB $\pm 1$ dB
Spurious modulation (referred to 500 Hz) FM unweighted voltage referred to $\pm 30$ kHz deviation FM weighted voltage (through an ear filter in accordance with CCIR 1949) referred to $\pm 30$ kHz deviation AM unweighted voltage referred to 100% AM AM synchronous voltage referred to 100% AM	$\geq 50$ dB $\geq 60$ dB $\geq 48$ dB $\geq 54$ dB
Spurious emission Harmonics Out-of-band combination signals	$\leq 1$ mW $\leq 1$ $\mu$ W

## Test points

### RF test points

Measuring head	at output frequency converter
Directional couplers for forward and reflected power	Output of LV 1 (150/15 W) Output of LV 2 (5/0,5 kW)
RF output voltage of coupler loops	1 V <sub>rms</sub>
Output impedance	50 $\Omega$
Directivity	$\geq 34$ dB

### IF test points

	Output modulator Output equalizer amplifier
IF output voltage	250 mV <sub>rms</sub> +1/-4 dB
Output impedance	50 $\Omega$

### VF test points

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

Sideband spectrum of picture transmitter

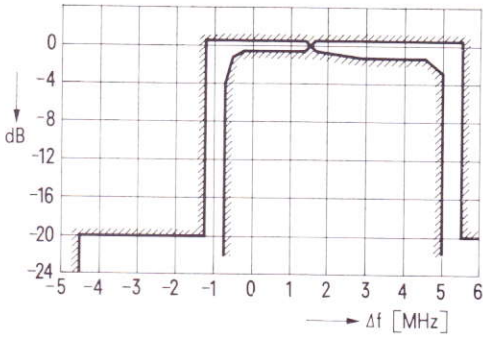


Fig. 1-1

$\Delta f$ [MHz]	high Limit [dB]	low Limit [dB]
-4.43	-30	—
$\leq -1.25$	-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	—
$\geq +5.5$	-20	—

Overall amplitude characteristic picture transmitter + nyquist demodulator\*)

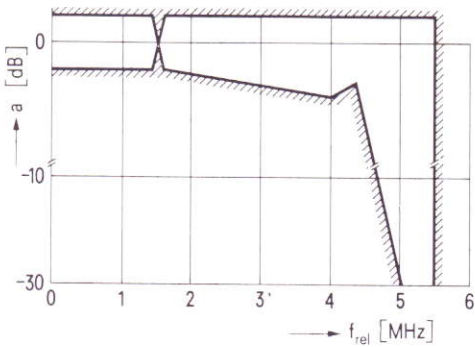


Fig. 1-2

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
$\geq 5.5$	-30 / —

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

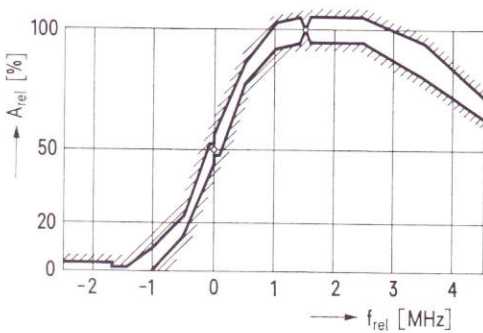


Fig. 1-3

$f_{rel}$ MHz	low Limit	$A_{rel}$ [%] 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

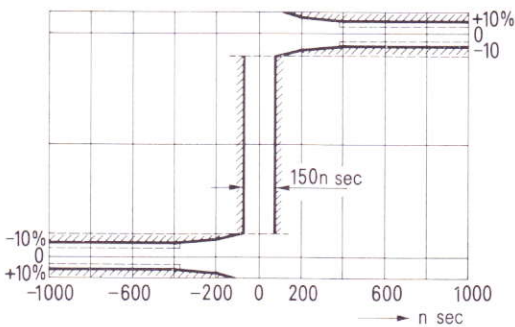


Fig. 1-4

Time [ns]	Limits [%]
$\pm 75$	-10
$\pm 100$	+11
$\pm 200$	$\pm 7$
$\pm [400 \text{ to } 1000]$	$\pm 5$
$\pm [400 \text{ to } 1000]$	$\pm 3$ for smear

\*) Transm. with receiver precorrection and with sound trap

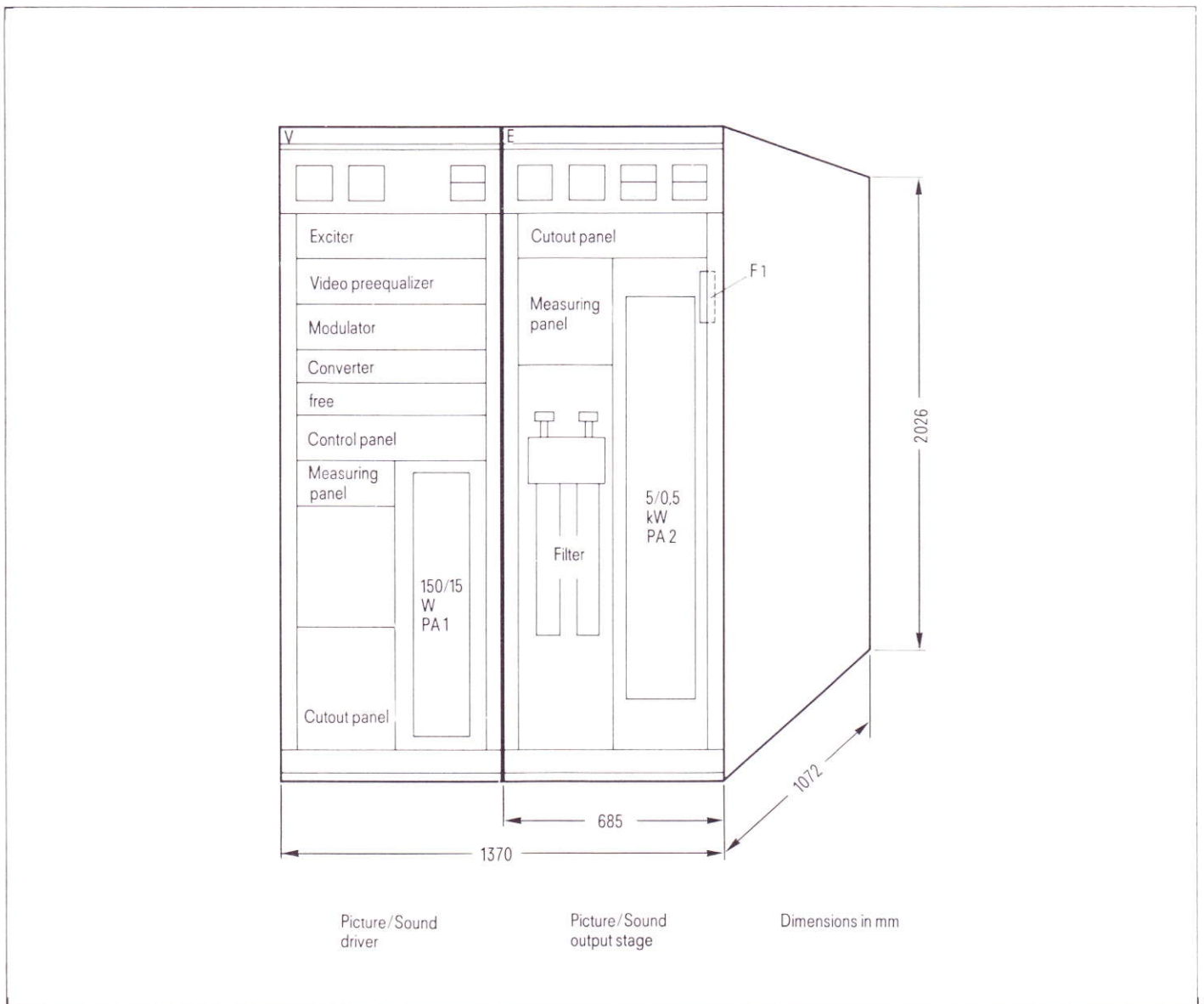


Fig. 2

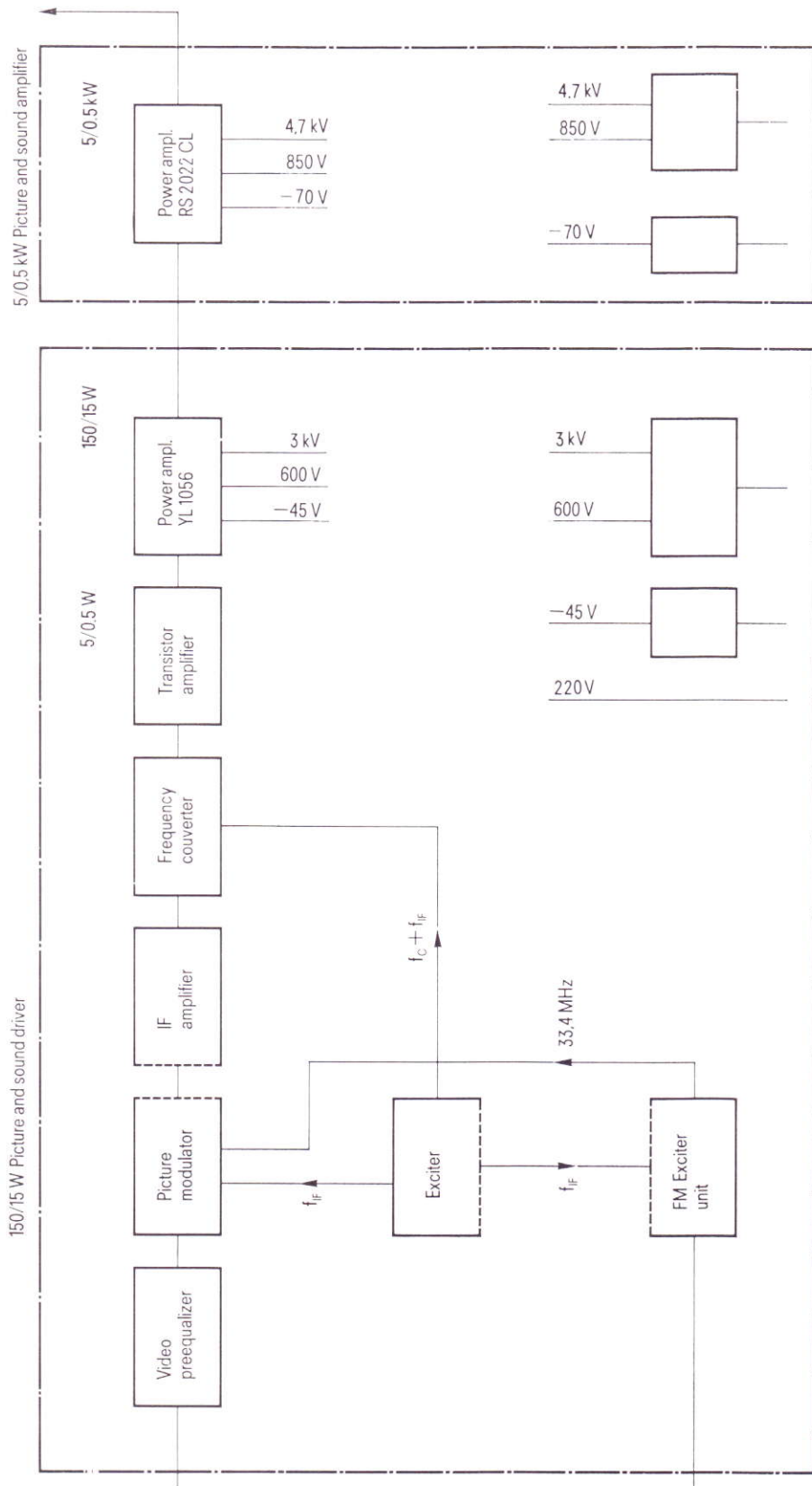


Fig. 3

$f_{IF}$  = intermediate frequency picture  
 $f_c$  = channel frequency

## VI. Scope of Delivery

### Designations, sizes and weight

Designation	Dimensions B × D × H (mm) Weight
<b>Band III TV Transmitter 5/0.5 kW</b>	2055 × 1072 × 2026 about 1400 kg

#### Cabinet 1:

Designation	Dimensions B × D × H (mm)
<b>Picture/sound driver comprising:</b>	685 × 1072 × 2026
1 Instrument panel	685 × 120 × 181
1 Exciter	483 × 375 × 133
1 VF preequalizer	483 × 375 × 133
1 Picture modulator	483 × 488 × 133
1 Picture/sound converter	483 × 448 × 88
1 Control panel	483 × 448 × 133
1 Measuring panel	230 × 70 × 90
1 Cutout panel	226 × 242 × 430
1 Power amplifier (cavity) YL 1056	230 × 230 × 750
1 Power supply 3	420 × 280 × 860
1 3-phase transformer	340 × 225 × 287
3 Directional couplers	—
4 Diode probes	—

Designation	Dimensions B × D × H (mm)
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#### Cabinet 2:

Designation	Dimensions B × D × H (mm)
<b>Picture/sound power amplifier 5/0.5 kW comprising:</b>	685 × 1072 × 2026
1 Instrument panel	685 × 120 × 181
1 Cutout panel	365 × 120 × 118
1 Measuring panel	195 × 120 × 260
1 Filter	315 × 290 × 940
1 Power amplifier (cavity) RS 2022 C	350 × 270 × 1170
1 Filament power supply	620 × 150 × 470
1 Power supply 1	460 × 280 × 870
1 Power supply 2	460 × 280 × 870
1 Rectifier unit	—
1 3-phase transformer	575 × 255 × 665
1 Quadruple directional coupler	—
1 Diode probe	—
1 Indication amplifier	—

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### Sudan

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