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# VF/RF-Test-Signal-Generator VRM100

Universal VF/RF signal generator equipped with all necessary video and audio sources, as well as with vision and sound modulators.



- Inputs and outputs for signals in the Video, Audio, IF and RF domain.
- Video double-sideband measuring modulator; also selectable vestigial-sideband modulator.
- Sound modulator for dual-carrier systems, with encoder.
- Test signals from the Video generator are available as full field or VITS signals.
- Option for insertion of test line signals in the vertical blanking interval of an existing video programme signal.
- May substitute for a faulty TV transmitter drive, with attendant high quality performance.

## General

TV transmission systems such as TV-transmitters, TV-transposers and CATV-systems are analogue systems for the transmission of picture information. The signals are basically video amplitude and pulse modulated carriers, accompanied by two frequency modulated sound carriers (considering the German IRT dual-channel sound system). Transmission errors can occur because of imperfections in the total transmission path, such as bandwidth limitation, linear and non-linear distortion, as well as the actual vestigial sideband process itself. These errors can only be detected and measured by using suitable test signals.

The VF/RF-test-signal-generator VRM100 provides all the signals which are required for static, dynamic and step-function test measurements at base-band frequency, IF or RF bands. The signals are generated with extraordinary accuracy, thus the instrument represents an advanced universal signal source for analogue TV transmission system characterisation.

The equipment is of modular design. Various optional sub-assemblies can be inserted and used independently or in combination with others.

## Brief Description

The VRM100 instrument is fitted with video-, video-sideband- and audio-generators to form a comprehensive base-band signal source. The video generator produces all standard test and test-line signals which are in general use. These are available as full field or vertical interval signals (VITS) and are highly accurate. Furthermore, measurement facilities are provided to study the effects of using differing active picture content or APL; if required, the normal programme being transmitted may be used for this purpose. These techniques depend on the insertion of additional signals on the test lines or on other lines within the VBI.

The video generator incorporates a multiplexer to insert the VF sideband signal and also the output of the audio generator, alternatively a signal derived externally may be used. Thus a composite baseband signal is available, with all the components individually controlled, allowing comprehensive intermodulation measurements over the entire modulation range and under realistic operational conditions to be carried out (eg. with transmitter AGC). Video synchronisation pulses may be selected as line only, or line + field. The amplitude of the syncs is adjustable between 10 % and 200 % of their normal level.

The video side band generator covers frequencies from 70,3125 kHz to 8,0703125 MHz, in steps of 15,625 kHz; amplitude is adjustable between 0 and 1,05 Vpp in 1 % steps. This signal may be swept and then the selected frequency becomes the centre frequency. The sweep amplitude is  $\pm 4$  MHz and is adjustable in 0,1 MHz steps.

The frequency range of the audio generator is 10 Hz to 65 kHz, adjustable in steps of from 0,5 to 100 Hz, depending on the frequency. The amplitude is adjustable between 0 and 3,88 Vrms in 1 % steps. The audio generator also offers a sweep function with 34 discrete, logarithmic frequencies, according to DIN 45401, and a pre-emphasis which may be switched in or out as required.

The vision double-sideband test modulator and the sound test modulator of the VRM100 convert the base-band signal described above into the standard intermediate frequency (IF) range. This IF signal is available at a constant average, or luminance level of -7 dB w.r.t. vision carrier peak sync level. It is adjustable within the range of -80 ... 0 dBm. The sound carrier (when unmodulated) can also be varied over  $\pm 3$  dB w.r.t. its standard level in relation to the vision carrier.

The vision test-modulator is also fitted with switchable receiver group delay pre-distortion. Furthermore, the modulation may be selected as double-sideband or standard vestigial sideband (VSB). In the latter mode it may be employed as high quality calibration source due to its impeccable frequency response, linearity and group delay characteristics. The vision and sound modulators can alternatively be fed with external base-band inputs, separate from the signals generated within the VRM100.

The sound modulator operates according to the dual sound carrier

IRT system, with encoding. 50  $\mu$ s pre-emphasis for both sound modulators may be switched in or out, as required. Both sound carriers can be switched on or off independently. The two audio signal inputs for the dual-channel sound may be switched on or off independently.

The instrument includes an RF converter which serves for the up-conversion from the IF into the RF range, which extends from 40 to 860 MHz. It is also possible to up-convert an external IF signal, not generated in the VRM100 itself. Also, in either case, the LO signal required for the mixer may be fed in externally. For transposer measurements it can thus be derived from the LO monitoring output of the transposer's down-converter, as long as the IFs employed are both the same. The final RF output level is adjustable over a wide range of -100 ... -20 dBm.

The VRM100 can be equipped with an option for the insertion of other test signals into the vertical blanking interval (VBI) in which case selection is possible between standard test-line and extended test-line insertion. The standard test-line VITS signals are those according to CCIR recommendations. When the extended insertion facility is used, additional test signals from the video generator are inserted in the VBI, thus enabling a wide variety of measurements to be carried out on the transmission system. This technique can provide a permanent quality check without any interruption or other effect on the programme being transmitted.

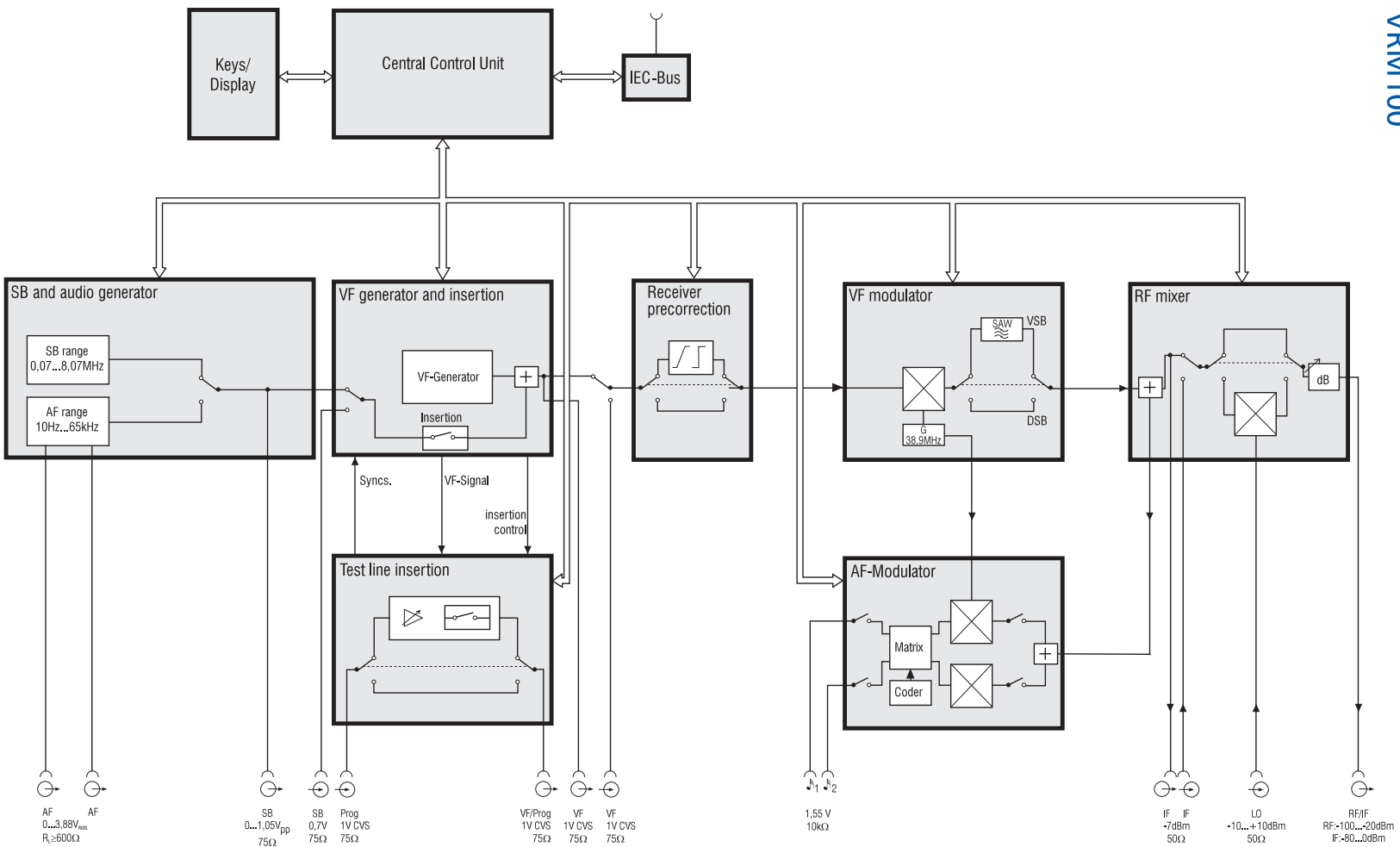
Moreover, a selection of two operational modes may be made for test or monitoring applications of the VRM100. In one mode, the VRM100 is used to substitute for a TV transmitter drive, and the incoming programme video level should be adjusted externally to 1 Vpp, the normal level used in the VRM100 video generator. If the other mode is chosen, the VRM100 is used as test-line signal inserter in the TV transmitter VF input feed. The level of the transmitter video input signal remains unchanged because the VRM100 video generator VITS level automatically matches that of the transmitter VF feed.



The VRM100 together with the TV-measurement-equipment FMS100.



Together with the IF/RF-converter ZRM100, the VRM100 forms a TV-transmitter with excellent quality features.



## Technical Data

VF-S/N (line22)

VF Generator		VF-S/N (line22)	
Luminance Signal		Black level	
Black level offset	0 mV ± 3,5 mV	200 kHz ... 5 MHz, weighted	> 85 dB
White level	700 mV ± 3,5 mV	200 kHz ... 5 MHz, unweighted	> 77 dB
Sync/white pulse	1000 mV ± 5 mV		
Line frequency tilt	< 0,2 %	AF Generator	
50 Hz distortion	< 0,2 %	Frequency range	10 Hz ... 65 kHz
Bounce test distortion	< 0,2 %	Steps size	0,5 Hz within the range 10 Hz ... 100 Hz 5 Hz within the range 100 Hz ... 1 kHz 50 Hz within the range 1 kHz ... 20 kHz 100 Hz within the range 20 kHz ... 65 kHz 0,1 Hz within the entire range via IEC bus
Luminance non-linearity (staircase)	< 0,4 %	Frequency error	< 150 ppm
1T pulse rise/fall times	100 ns ± 2 ns	Amplitude adjustment range	0 ... 3,88 Vrms (0 ... 250 %, 100 % ± 1,55 Vrms) adjustable in 1% steps Load impedance 600 Ω
Δ-rise/fall time	< 0,5 ns	Internal resistance	≤ 30 Ω
2T pulse rise/fall time	200 ns ± 4 ns	Frequency response	@ 1,55 V < 0,02 dB
Δ-rise/fall time	< 1 ns	Crosstalk of the two AF outputs	> 100 dB
Chrominance Signal		Distortion factor	< 0,05 % up to 20 kHz
Differential gain	< ± 0,2 %	Harmonics	> 50 dB
Differential phase	< ± 0,25°	Sweep range	16 Hz ... 20 kHz linear or with 50 μs-de-emphasis
CCIR331:		Sweep frequency Hz (acc. DIN 45401)	16 / 20 / 25 / 31,5 / 40 / 50 / 63 / 80 / 100 / 125 / 160 / 200 / 250 / 315 / 400 / 500 / 630 / 800 / 1000 / 1250 / 1600 / 2000 / 2500 / 3150 / 4000 / 5000 / 6300 / 8000 / 10000 / 12500 / 15000 / 16000 / 18000 / 20000
Amplitude error	< ± 0,5 % (w.r.t. 420 mV burst)	Sweep speed	1 s/step below 500 Hz 0,5 s/step above 500 Hz
Phase error	< ± 0,5° (w.r.t. 420 mV burst)		
Chrominance/luminance cross-talk	< ± 0,1 % (100 % = white)	SB Generator	
2T Pulse		Frequency range	70,3125 kHz ... 8,0703125 MHz
Pulse amplitude	700 mV ± 3,5 mV	Frequency step size	15625 Hz
k-factor	≤ 0,3	Frequency error	< 150 ppm
50 % amplitude duration	200 ... 205 ns	Amplitude	0 ... 1,05 V <sub>pp</sub> (0 ... 150 %, 100 % ± 0,7 V <sub>pp</sub> ) adjustable in 1 % steps
20T Pulse		Internal impedance	75 Ω
Pulse amplitude	700 mV ± 15 mV	Harmonics	> 56 dB
Bottom distortion	< 0,8 %	Frequency response	< 0,1 dB
Chroma gain	100 % ± 1,5 %	Sweep	0 ... ± 4 MHz adjustable in 0,1 MHz steps
Chroma delay	± 5 ns		
Sin x/x			
frequency response	< ± 0,1 dB (0 ... 5,5 MHz)		
Group delay	< ± 5 ns (0 ... 5,5 MHz)		
Multiburst (CCIR18)			
frequency response	< ± 0,1 dB		
SB inserter/mixer			
Frequency response	< 0,1 dB (0 ... 5 MHz) < 0,2 dB (0 ... 8 MHz)		
Synchronising Signal			
Sync level	30 ... 600 mV (0 ... 200 %, 100 % ± 0,3 V) adjustable in 5 % steps up to 95 %, above 95 % in 1 % steps.		
H sync width	4,7 μs ± 0,05 μs		
Pre- and post-equalising pulse duration	2,35 μs ± 0,05 μs		
Equalising pulse duration	4,65 μs ± 0,05 μs		
Rise/fall time	200 ns ± 4 ns		
Colour burst duration	2,25 μs ± 0,05 μs		
Start of the colour burst	5,6 μs ± 0,05 μs		
Colour burst amplitude	300 mV ± 3 mV		
H-sync jitter	< 5 ns		
V-sync jitter	< 5 ns		

# VF/RF-Test-Signal-Generator VRM100

## Receiver Precorrection Standard B/G

Frequency response	
0 ... 4,8 MHz	< ± 0,1 dB
4,8 ... 5,2 MHz	< + 0,3/-0,0 dB
Group Delay distortion	
0 ... 4,43 MHz	< ± 6 ns
4,43 ... 4,8 MHz	< ± 12 ns

## VF-Modulator DSB Operation

Frequency response:	
38,9 ± 5 MHz	< ± 0,06 dB
38,9 ± 8 MHz	< ± 0,12 dB
Static non-linearity	> 99,7 %
Differential phase	< 0,5°
Group delay distortion (20T)	± 5 ns
Harmonics	> 40 dB
S/N (200 kHz ... 5 MHz unweighted)	> 74 dB
Frequency error	< 75 ppm (T <sub>amb</sub> 5 °C ... 45 °C)

## VF-Modulator VSB Operation

Standard B/G (Other standards on request)	
Frequency response	
39,5 MHz ... 34 MHz	< ± 0,4 dB
Linearity	> 99,3 %
Differential phase	< 0,7°
S/N (200 kHz ... 5 MHz unweighted)	> 71 dB
Group delay distortion	± 30 ns

## AF Modulator

Frequency response	
40 Hz ... 15 kHz	< ± 0,05 dB
40 Hz ... 50 kHz	< ± 0,1 dB
Distortion factor	
50 kHz deviation	< 0,075 %
70 kHz deviation	< 0,15 %
FM-S/N	
(w.r.t. 30 kHz deviation with de-emphasis)	
unweighted	> 78 dB
weighted (CCIR)	> 78 dB
Frequency error	as for the VF modulator

## RF Mixer

Frequency range	40 MHz ... 860 MHz (bd.I ... bd.IV/V)
RF gain	-13 ± 0,5 dB
IF gain	0 ± 0,2 dB
ICP <sub>3</sub>	> 20 dBm
RF frequency response	< ± 0,1 dB (± 8 MHz)
IF frequency response	< ± 0,015 dB (± 5 MHz)

## Test Line Insertion

### General Data

Internal Impedance	75 Ω
Return loss inputs and outputs	≥ 34 dB

### Permissible Input Data

Input level range (CVS)	0,7 ... 1,4 V <sub>pp</sub>
Superimposed hum	≤ 0,5 V <sub>pp</sub>
Superimposed d.c.	± 2 V
S/N rms	≥ 30 dB

## Transmission Characteristics of the Programme Signal Insertion facility by-passed

Crosstalk	> 70 dB
Frequency response	< 0,15 dB
Gain	0 ± 0,1 dB

## Transmission Characteristics of the Programme Signal Insertion facility in-circuit

Frequency response	≤ 0,1 dB (@ rated level) ≤ 0,2 dB (U <sub>e</sub> = 0,7 ... 1,4 V <sub>pp</sub> )
Output level	Input level ± 1 %
2T amplitude	± 0,2 %
2T k factor	0,1 (CCIR mask)
15 kHz tilt	≤ 0,5 %
Differential gain	≤ 1 %
Differential phase	≤ 1°
Blanking peaks	≤ 1 %
DC offset	≤ ± 0,1 V

## Quality of the Inserted Signals

Differential white pulse line 17/18	< 1 %
Frequency response sinx/x	≤ 0,1 dB
2T amplitude	≤ 1 %
2T k factor	≤ 0,3 (CCIR mask)
15 kHz tilt	≤ 0,5 %
Differential gain	≤ 1 %
Differential phase	≤ 1°

## Signal Waveforms

0,05 Hz square wave	10 step staircase + 200 mV subcarrier
0,125 Hz square wave	subcarrier
50 Hz square wave	10 step blacker than black staircase + 200 mV subcarrier
15 kHz square wave, rise time T/2T	1 x 10 step staircase + 200 mV subcarrier / 3 x white
250 kHz square wave, rise time T/2T	1 x 10 step staircase + 200 mV subcarrier / 3 x black
CCIR 17	50 % picture + blanking + 700 mV subcarrier
CCIR 18	4 % picture + blanking + 420 mV subcarrier
CCIR 330	50 Hz + sideband + set-up (white 5 ... 95 %, black 5%) sideband + CW
CCIR 331 with/without step	sideband + setup
sinx/x pulse	sawtooth + sideband + setup
2T pulse	sawtooth + 200 mV subcarrier + setup

## General Data

Operational temperature range	10 ... 40 °C
Mains voltage	230 V ± 15 %, 40 ... 63 Hz
Power consumption	110 VA
Mechanical dimensions (w x h x d)	437 (19") x 133 (3 HE) x 439 mm
Weight	approx. 15 kg

## Interfaces

IEC-Bus

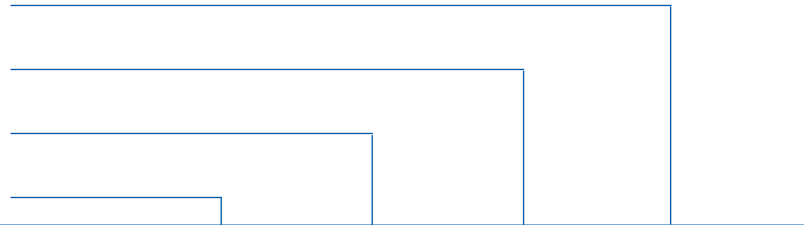
## Test-line signals

Test-line insertion for modes B and D (extended test-ligne insertion)

Test-line insertion for modes A and C (standard insertion), version 1

Test-line insertion for modes A and C (standard insertion), version 2

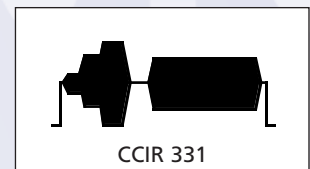
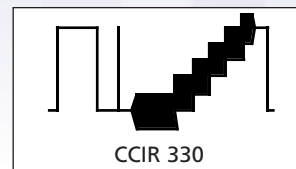
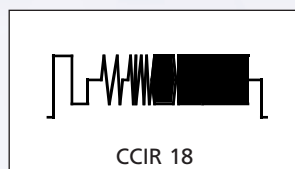
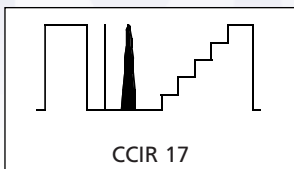
Test-line assignment of the VRM100 (disconnectable)



## Test-line signals

inserted in line

Field	Signal	Line 1	Line 2	Line 3	Line 4
1. field	50 % picture + blanking + 700 mV subcarrier	6	6	-	6
	sinx/x-pulse	7	7	-	7
	10 step staircase + 200 mV subcarrier	8	-	-	8
	250 kHz square wave	9	-	-	9
	Data line (source)	16	-	-	-
	CCIR 17 (source)	17	-	-	-
	CCIR 17 (section)	18	18	18	18
	CCIR 18 (section)	19	-	19	19
2. field	black line	22	22	22	22
	4 % picture + blanking + 420 mV subcarrier	319	-	-	319
	2T-pulse	320	320	-	320
	10 step ultra-black staircase + 200 mV subcarrier	321	-	-	321
	250 kHz square wave 2T rise time	322	-	-	322
	CCIR 330 (source)	330	-	-	-
	CCIR 330 (section)	331	331	331	331
	CCIR 331 (steps)	332	-	332	332



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