Bang&Olufsen

TECHNICAL SPECIFICATIONS	BEOVISION M20 – MX2000
Type No.	3101-3102-3103-3116-3117-3118
CTV system	B/G PAL S-tuner
Picture tube size	20" – 51 cm
Cabinet	M20 – grey
	MX2000 red – grey metallic – white – black
	Stereo sound
	Stereo decoder, billingual sound
	Stereo enhancement
	Mono ambio sound
	Contrast screen – MX2000 only
TV programmes	1-32
VCR programmes	9, 31, 32
AV programmes	0, 33, 34
Satellite programme	0
Digital tuning system	100 channels (0-99)
Tuner range	VHF 2-12, S1-S19
	UHF 21-69
Picture tube	110°in line, black matrix, self converging
Start time	Approx. 5 sec.
Speakers, stereo	Log line system, 2 pcs. 3"-8 cm
Sound power output	2 x 7 watts/8 ohms
Harmonic distortion	<0.5%/2 watts, <3%/7 watts
Intermodulation	<1%
Frequency range ±1.5 dB	30-20,000 Hz (25-25,000 Hz ±6 dB
Power bandwidth	60-15,000 Hz
Signal-to-noise ratio	>50 dB
Bass control	±10 dB/60 Hz
Treble control	±10 dB/10,000 Hz
Power supply	220-240 volts/50-60 Hz
Power consumption	70 (50-120) watts
Stand by	<5 watts
Dimensions W x H x D/weight	49 x 53 x 40 cm/23 kg
Connections:	
A/V, audio/video IN/OUT	21 pin
Headphones output	Max. 5V/200 ohms
External speakers	4-8 ohms
Tape output	300 mV/47 kohms
Amplifier output	300 mV/47 kohms
Terminal controlled output	0-300 mV/55 kohms
Accessories:	
Stereo headphones	Form1 – 8964020
Loop amplifier	8003316
Indoor antenna	8720024
TV Stand	Type 3069
Video Stand – Beocord VHS	Type 3070
Video Stand – Video 2000/VHS62	Type 3071
Installation kit for:	
Teletext S	8003557
Teletext D	8003558
Teletext GB	8003559
PAL/SECAM decoder	8003659

Subject to change without notice

TECHNICAL SPECIFICATIONS	BEOVISION M20 – MX2000
Type No.	3104-3105-3119-3120
CTV system	I PAL S-tuner
Picture tube size	20" – 51 cm
Cabinet	M20 – grey
	MX2000 – red – grey metallic – white – black
	Infrared cordless remote control
	Stereo sound
	Stereo enhancement
	Mono ambio sound
	Contrast screen – MX2000 only
TV programmes	1-32
VCR programmes	9, 31, 32
AV programmes	0, 33, 34
Satellite programme	0
Digital tuning system	100 channels (0-99)
Tuner range	VHF 2-12, S1-S19
	UHF 21-69
Picture tube	110°in line, black matrix, self converging
Start time	Approx. 5 sec.
Speakers, stereo	Log line system, 2 pcs. 3"-8 cm
Sound power output	2 x 7 watts/8 ohms
Harmonic distortion	<0.5%/2 watts, <3%/7 watts
Intermodulation	<1%
Frequency range ±1.5 dB	30-20,000 Hz (25-25,000 Hz ±6 dB)
Power bandwidth	60-15,000 Hz
Signal-to-noise ratio	>50 dB
Bass control	±10 dB/60 Hz
Treble control	±10 dB/10,000 Hz
Power supply	240-265 volts/50-60 Hz
Power consumption	70 (50-120) watts
Stand by	<5 watts
Dimensions W x H x D/weight	49 x 53 x 40 cm/23 kg
Connections:	
A/V, audio/video IN/OUT	21 pin
Headphones output	Max. 5V/200 ohms
External speakers	4-8 ohms
Tape output	300 mV/47 kohms
Amplifier output	300 mV/47 kohms
Terminal controlled output	0-300 mV/55 kohms
Accessories:	
Stereo headphones	Form1 – 8964020
Ldop amplifier	8003316
Indoor antenna	8720024
TV Stand	Type 3069
Video Stand – Beocord VHS	Type 3070
Video Stand – Video 2000/VHS62	Type 3071
Installation kit for:	
Teletext GB	8003559
Teletext D	8003558
Teletext S	8003557
PAL/SECAM decoder	8003659

Subject to change without notice

CIRCUIT DESCRIPTION

INTRODUCTION

This description explains circuits and functions which in some way or other are special, while no mention is made of circuits which are considered familiar.
Certain circuits are not being dealt with since, probably, they will not be repaired, but replaced as a unit if faulty. This applies to the RF block and the IR receiver.
When in the text reference is made to components which are not shown by illustrations, the circuit diagram should be used.

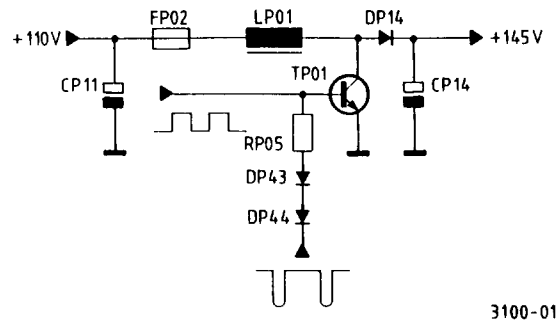
CONTENTS

SMPS Power Supply

Functional principle (see diagram)

A "Step-up" power supply unit is used. The U8 of 110V is stepped up to 145V and stabilized.

The switch transistor TP01 is triggered ON for part of the line scan time by means of a pulse from IL01, pin 7. This causes a current to flow from U8 (110V) through FP02, LP01, TP01, and RP03 to chassis. In LP01 magnetic energy is charged.
From the line transformer (UL02, pin 11) a horizontal flyback pulse is passed via DP44, DP43, and RP05 to the base of TP01 and blocks the latter.
The magnetic energy in LP01 will now create a current which via DP14 will charge the capacitor CP14.



Control circuit

From the voltage divider RL46, PP01, and RL47 part of the supply voltage U1 is returned to IL01, pin 9.

Internally in IL01 the voltage is compared with a reference voltage of 1.26V, and it controls a phase modulator which varies the point in time when TP01 wil start conducting.

If, by way of example, U1 should drop due to a higher load or fluctuations in the mains voltage, this will cause TP01 to conduct earlier. Thus, the coil LP01 will get time to collect more energy which it passes on to CP14 when TP01 is blocking again. U1 will then rise to its correct value.

Stand by

When the mains switch is closed the power supply unit will supply U8 (110V) and the start-up voltage will supply Us (12.5V).

As long as the TV set is in stand-by mode, U8 is a preliminary supply voltage for horizontal output stage through the components FP02, LP01, DP14, RP14, and UL02, pin 8.

The horizontal driver is supplied with Us (12.5V) via the diode DP13.

Start up

When the TV set is brought ON the system control (PCB08) will supply a low level to the base of TP21. TP21 will be conducting and the 12.5V voltage will be conducted via the diodes DP21, DP24, DP03, TP21, and RP27 to IL01 as its supply voltage (reduced to *approx. 10V* by the voltage drop of the diodes).

The horizontal oscillator will start to oscillate, the line deflection circuit will be driven and will in the line transformer generate the required operative voltages (U2-U3-U4-U5).

The supply for the driver stage (TL01) and for the switch-transistor TP21 will now be taken over by U3 (21V) and U2a (13V) via the diodes DP23 and DP15.

Soft start

When starting up the vertical and horizontal deflection circuits in TEA 2026 will begin to function at a voltage of approx. 6V on pin 8.

The SMPS power supply unit is slowly started up by an internal "Soft-start" circuit.

Protective circuit

If the voltage on IL01, pin 28, should exceed 1.26V, both vertical, horizontal and the SMPS power supply unit will be turned off. If the voltage then again falls below 1.26V the SMPS power supply unit will be restarted via the Soft-start circuit. If this is repeated for a total of three times, the power supply unit will be turned off completely and will be restartable only when the supply voltage for IL01 has been removed.

If U1 (145V) increases, then U3 (21V) will be increased as well. The Zener diode DF25 will be conducting and will via DF25 increase the voltage on IL01, pin 28. This will activate the protective circuit.

In case of excessive power consumption the voltage across RP03 will increase to such an extent that the protective circuit will be activated via RP04 and RF30.

Horizontal Deflection

Horizontal generator

The horizontal generator is located in IL01. It delivers a control pulse for the horizontal driver and the output on pin 10. The line frequency is generated by dividing the 500kHz VCO (500kHz - 32 = 15,625Hz).

After dividing the 500 kHz the line frequency is passed to phase detector 1 where it is compared with the horizontal sync. pulses from the sync. separator.

The resultant voltage will control the VCO and will thus maintain the phase ratio between horizontal sync. pulses and keep the divided frequency of the VCO constant.

Normally the controlling time constant is long which results in a high noise immunity. But in AV mode this time constant is made short by activation of IL01, pin 23. This will reduce picture swaying resulting from unstable sync. timing from, e.g. a video tape recorder.

The 2nd phase detector keeps constant the phase ratio between horizontal oscillator and horizontal flyback pulses. It is possible to influence the phase ratio by means of the DC voltage on IL01, pin 16. The potentiometer PG01 will thus adjust the horizontal centering.

In the horizontal output (IL01) a constant pulse time of 26µs is applied to the pulse before it is passed to pin 10 with an amplitude of 6.5Vpp.

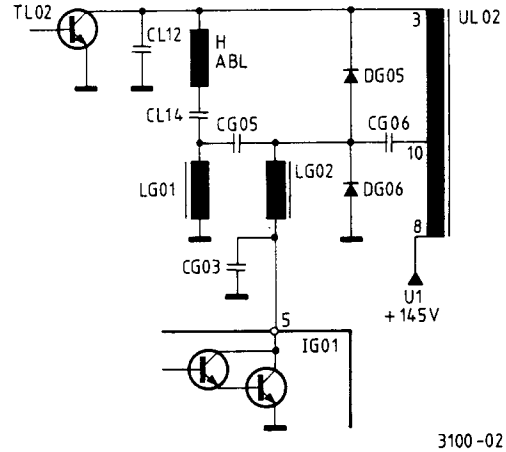
Fault situations

In case of faults (Voltage, pin 28 bigger than 1.26V) the horizontal output will be cut out by the protective circuit.

Horizontal output stage

The driver transistor TL01 will amplify the line pulses and will drive TL02 with sufficient base current via the transformer UL01. RL21, CL21 will suppress voltage spikes arising at the end of the line pulse.

The transistor TL02 operates as a switch and is closed in the latter half part of the horizontal scanning time.
In the former half part of the horizontal scanning time the diodes DG05 and DG06 will conduct.
Neither TL02, DG05 nor DG06 will be conducting during the flyback time. Current will now flow in the flyback capacitor CL12. Fig. 02 shows the deflection circuit in a simplified form.

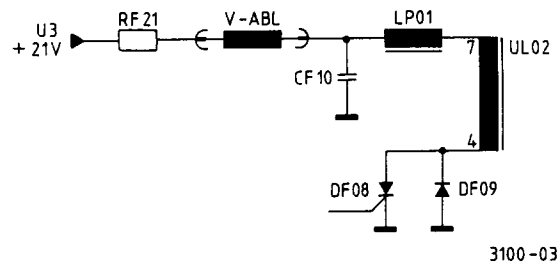


The deflection coil is dampened by means of the components DL18, RL18, CL18, CL19.

Vertical Deflection
Functional principle

The vertical output stage is driven from IL02 by pulse width modulated horizontal frequency pulses. The objective is to obtain a low power consumption.

Since these pulses are purely positive, the vertical deflection coil is included in a bridge coupling between U3 (21V) and the vertical generator. This will result in positive as well as negative going current in the deflection coil.



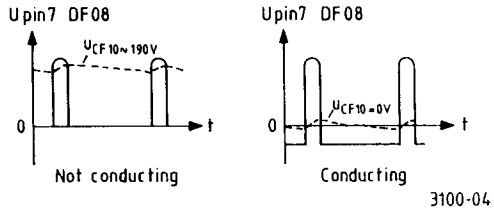
The following two fictive situations will illustrate the functions of the circuit.

1. Thyristor DF08 is constantly open

The positively going horizontal flyback pulses are grounded through DF09. This rectifier effect causes positive going flyback pulses on UL02, pin 7, and these will charge the capacitor CF10 to approx. 190V. A current will flow from CF10 via the deflection coil to the power supply unit U3 (21V).

2. The thyristor is constantly conducting

Pin 4 of UL2 is constantly connected to chassis. Therefore the flyback pulses on pin 7 will be symmetrical around 0. The voltage present on CF10 will be 0V, and the deflection current will now flow from U3 (21V) through the deflection coil.



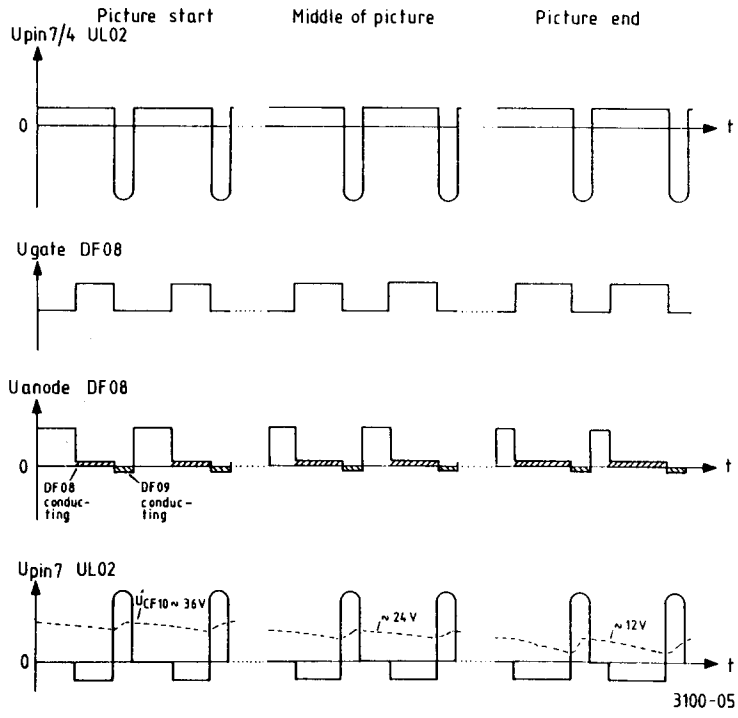
Scanning

The thyristor will be driven ON from IL04, pin 4, by means of a pulse-width modulated voltage. The control voltage will always end at the leading edge of the flyback pulse. The thyristor will be turned OFF by the negatively going flyback pulses from UL02, pin 4.

When a vertical scanning is initiated the control pulses are relatively narrow, and will result in a voltage of approx. 36V on CF10. Nearer the end of a scanning operation the control pulses become wider and wider. The thyristor will be conducting for longer and longer periods of time, and on termination of the scanning a voltage of approx. 12V will be present on CF10.

During the picture fly-back the thyristor will remain open. This means that max. voltage (approx. 190V) is stored in CF10, which results in a rapid fly-back.

Fig. 05 shows the individual pulses at the start, the centre and the end of a half-picture.



Control

The complete control circuit is located in the IC IL01 (see diagram).

On pin 5 of IL01 a sawtooth pulse of 3.5Vpp is built up. CL64 is a charging capacitor and via RL64 and RL65 the voltage U4 (200V) is the power source. The 50Hz (60Hz) frequency is formed by dividing the 500kHz by the quartz oscillator and synchronising it with vertical sync. pulses from a TV signal, if present.

The sawtooth pulse controls a phase modulator which is operating with horizontal frequency. The higher the instant value of the sawtooth, the wider the line frequency square pulse on the output of the modulator.

By means of the potentiometer PF04 the DC operative point for the [illegible] is set and thus the vertical centering.

The pulse-width modulated voltage passes the vertical out and controls, via pin 4 of IL01, the thyristor DF08.

Fault situations

In case of faults (IL01, pin 28 bigger than 1.26V) the vertical output pulses will stop.

Feedback

RF21 is in series with the vertical deflection coil with the result that it will have a voltage across which is proportional to the deflection current. This voltage is taken to the phase modulator in IL01 as a feedback voltage.

By means of PF02 the amplitude of the feedback voltage is altered and thus the picture height.

S correction

The components DF03, DF05, and RF19 are used for S correction.

In the centre of the picture the voltage across RF21 is so low that the two diodes are not conducting.

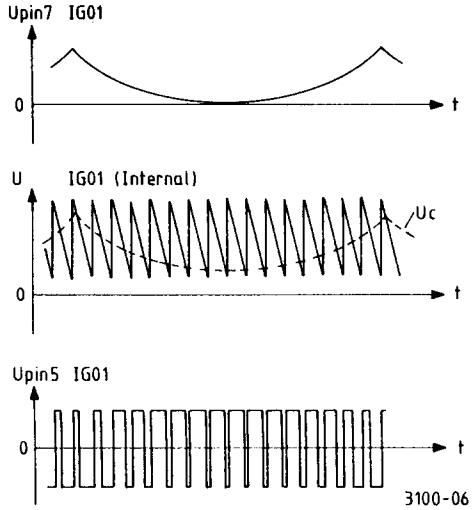
At the top and bottom quarters of the picture the diodes are conducting whereby the feedback voltage is increased, via RF19. Thereby the increase of the deflection current is being reduced in the top and bottom sections of the picture.

East/West Correction

The complete East/West correction circuit is integrated in IG01, TDA4950 (see diagram).

A vertical sawtooth voltage is present on the inverted input of the operative amplifier (IG01, pin 2). By means of the adjustable voltage on the negative input (IG01, pin 1) adjustment is made in such a manner that the sawtooth on the output of the operational amplifier is placed symmetrically around the zero line. By varying this DC voltage the keystone (trapezoidal) adjustment of the picture is made.
The two subsequent blocks will convert the sawtooth voltage to a parabolic voltage (Fig. 06) dependent of the picture frequency.

The parabolic voltage is passed to a comparator. On the negative input a linefrequency sawtooth voltage is present which has been generated by charging CG01 with positive horizontal flyback pulses from UL02, pin 9, across DG01, PG01, RG01, and RL51. Discharging takes place during the horizontal scanning time via a current source in IG01, pin 8. Then the comparator will supply linefrequency pulse modulated square voltages



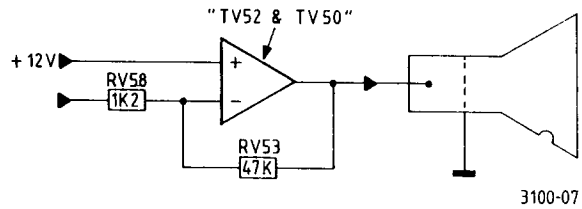
Via LG02 the subsequent Darlington coupled output stage draws a parabolic shaped current in the diode modulator DG05, DG06 and the associated components.

By means of PG01 the charging of CG01 is varied and thus the DC share of the line-frequency sawtooth. This will vary the width of all square pulses from the comparator, and thus the current in the diode modulator corresponding to an alteration of the current in the horizontal deflection coil. This will cause an alteration of the picture width.

By means of PG03, RG03 and CG02 the pulse-width modulated square voltages become integrated into a parabolic voltage. This is passed to the input of the comparator as a feedback. At the same point a voltage is applied from the "chassis point" of the line transformer. This voltage represents the current in the picture tube. This will correct the width alteration consequential upon varying beam current.

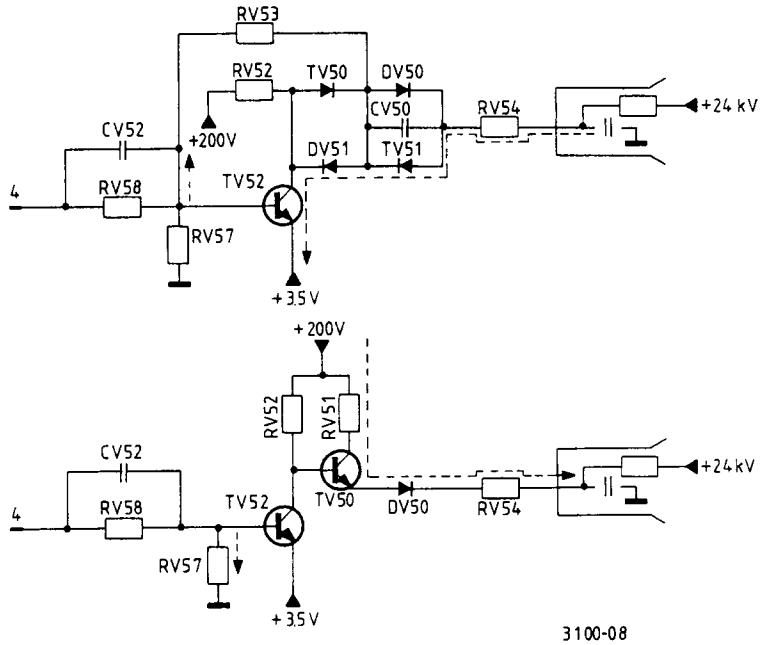
Automatic cut-off
Video output stage

The description explains red output only, but the functions are identical for the green and blue outputs.



The voltage amplification takes place in the transistor TV52. The ratio of the resistors RV58 and RV53 determine the magnitude of this amplification (40 times).
The internal capacitance of the picture must be charged and discharged by the video output stage.

The currents for charging (a) and discharging (b) respectively are shown in Fig. 08.

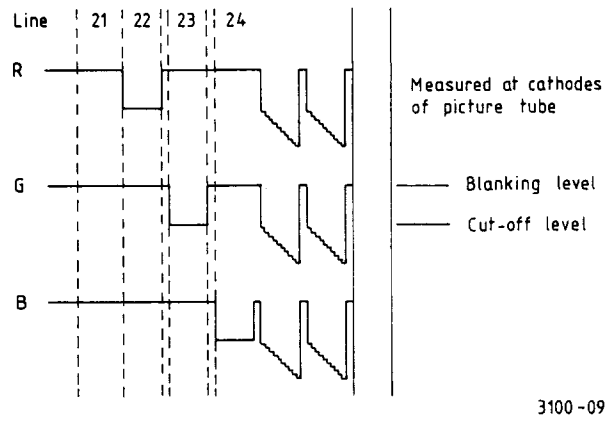


Other functions

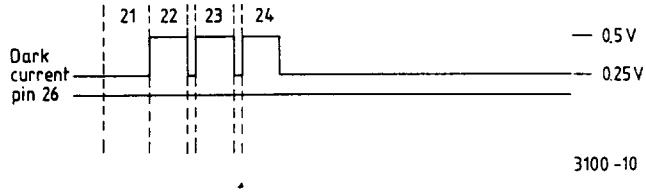
- TV81 is a cut-out transistor
- CV52 is a speed-up capacitor
- PV50/PV70 are adjustment potentiometers for cut-off values

Cut-off control

Automatic cut-off control is performed in IV02 (TDA 3506) via the video output amplifier. By means of an internal counter in TDA 3506 a defined level is supplied in the lines 21 - 22 - 23 - 24 to drive the picture tube.



Drive for "Blanking" takes place in line 21. Drive for cut-off level takes place in the lines 22(R), 23(G) and 24(B) (approx. 10µA beam current). The beam current is passed through TV51 to the resistors PV50 and RV50 and will in these result in a certain voltage, Um.



Um is taken to IV02 TDA 3506, pin 26.
In line 21 (R, G, B) Um equals the leakage current of the picture tube. It is sampled and a voltage which is an expression of the value is stored on pin 27.
In line 22(R) the beam current is measured and in the comparator the result is compared with a reference voltage. This is the sum of an internal reference voltage (0.5V) and a voltage which is an expression of the leakage current of the picture tube.
The resultant voltage is stored in CV40 until the next measuring period 20ms later. This is passed on to video output in IV02 where it determines the cut-off point for the appropriate gun in the picture tube.

Sound Module
General

5.5MHz and 5.74MHz are demodulated in the sound module PCB20(21). The IC's ID35 and ID26 are used for this function. After de-emphasis the signal is matrixed in ID51 which also performs the switching between languages 1/2 and stereo. This switching is controlled by ID01, which identifies the composition of the sound signal and controls the indication logic, which is made up of TS32, TS35, TS42, and TS43 etc.

IS04 switches between internal/external signal and IS07 switches between

Stereo
Stereo enhanced
Mono
Pseudo-stereo

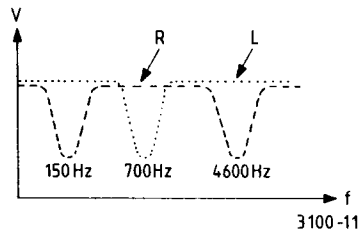
IS08 regulates Bass, Treble, Balance, and Volume before the signal reaches the integrated output stage IS01, IS11, which drive the loudspeakers.

Stereo enhanced

The two operational amplifiers IS06 are used to provide a larger base expansion of a stereo signal. This is obtained by a 180° phase inversion of the audio information in the two channels and adding it to the opposite channel.
Signals with the same phase and amplitude in the two channels are reduced (the centre signal), which provides the impression of a wider channel separation and thus a wider base width.
Since low-frequency (bass) signals often have the same phase and amplitude in the two channels, they will be reduced = less bass. To avoid this drawback the transmission capacitors for the phase inverted signals have been selected so as not to transmit frequencies below 150Hz.

Pseudo stereo

This effect is obtained by making the frequency response characteristics different for the left-hand and the right-hand outputs (see Fig. 11)



The frequencies have been selected so as to give the impression that the human voice is centered between the two loudspeakers whereas other sounds seem spread out.
The frequency filter consists of the components in the input of IS06, pins 3, 5, and 6.

System Control
General

The System Control has been designed with a 4-bit microcomputer IR01 (HMS46).

IR01 handles the following functions:

- decoding of IR signals
- operating panel scanning
- display control
- tuning control
- program storage
- audio and video regulation controls
- teletext decoder control
- miscellaneous functions

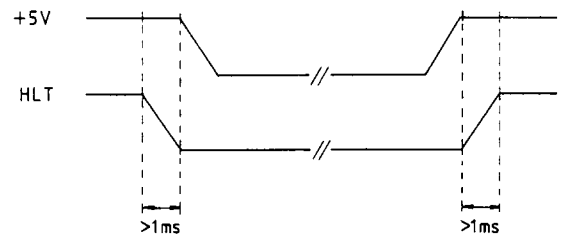
HMS has a storage capacity of 4k nibble (ROM) and 256 nibble (RAM).

Reset circuit

IR01 is reset by a high level on pin 15. TR84 and its surrounding components make up the reset circuit (see diagram).
When 5V starts up the collector of TR78 will go from 0V to 5V. TR84 will go ON for approx. 6 ms which is the time it takes to charge CR82 to +5V.
At turn off CR82 is rapidly discharged via DR84 and RR86.

The "HALT" function

In "halt" mode (pin 19 = LOW) the microprocessor has a greatly reduced power consumption (less than 12μA), and the battery BR87 will be able to supply it for up to 6 months to avoid loss of data in the RAM and other registers.
It is important that, on start up, HLT goes high only when +5V is present.
At turn off HLT must go low before +5V disappears (see time diagram).



3100-12

These delays are obtained by means of the transistors TR71, TR76, TR78, and TR81.

Start up

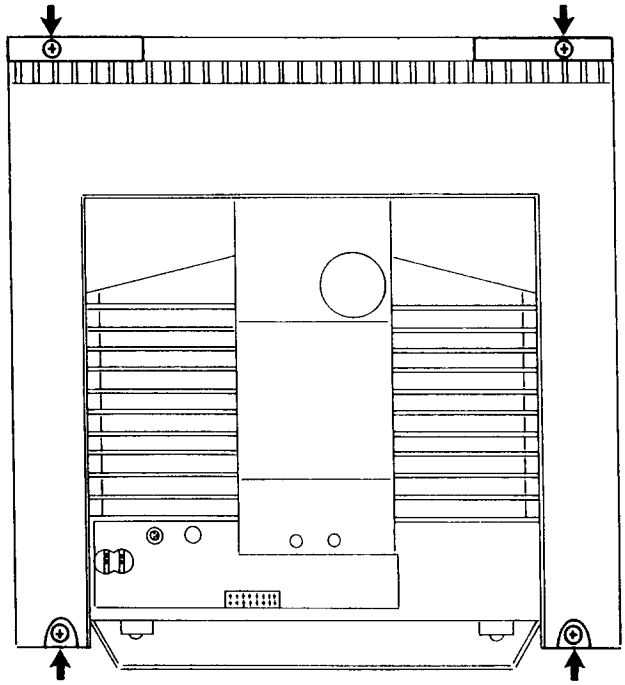
TR78 is considered shorted during start up.
TR76 is off and HLT is thus low until the collector of TR74 goes low. This occurs when +5V overrides the zener voltage in DR75, in other words: *when* +5V *is* indeed present.
Then HLT will go high.

Turn Off

During normal operation TR78 is kept ON by TR81/TR71.
When +12.5V starts to drop, the base voltage on TR71 will also drop.
At approx. 9.5V TR71 and thus TR81 and TR78 will go OFF.
HLT will then drop to 0V whereas +5V will remain intact.

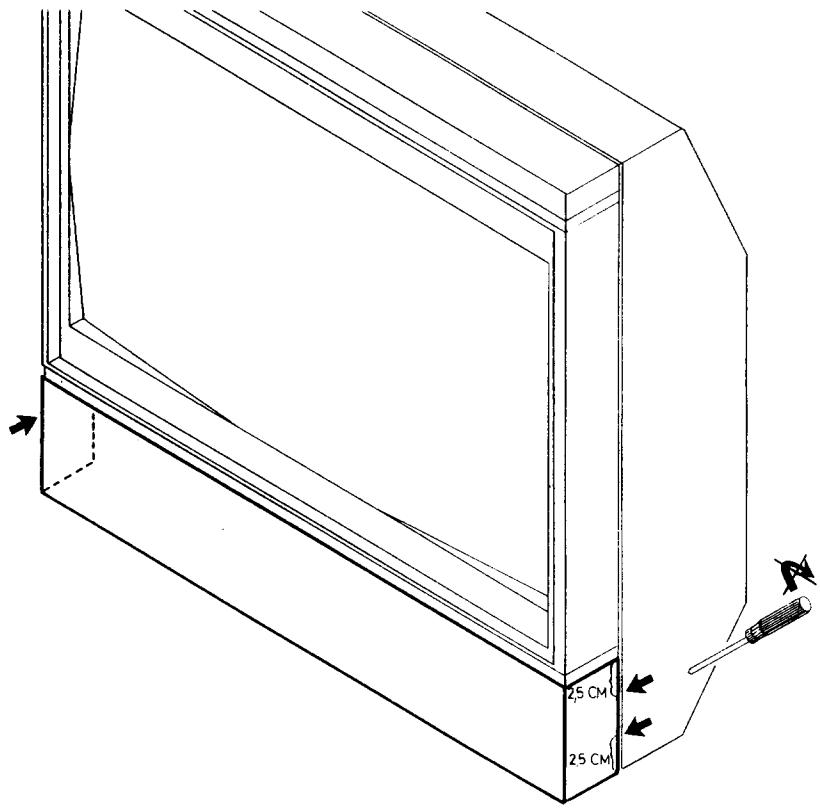
DISMANTLING

Rear part



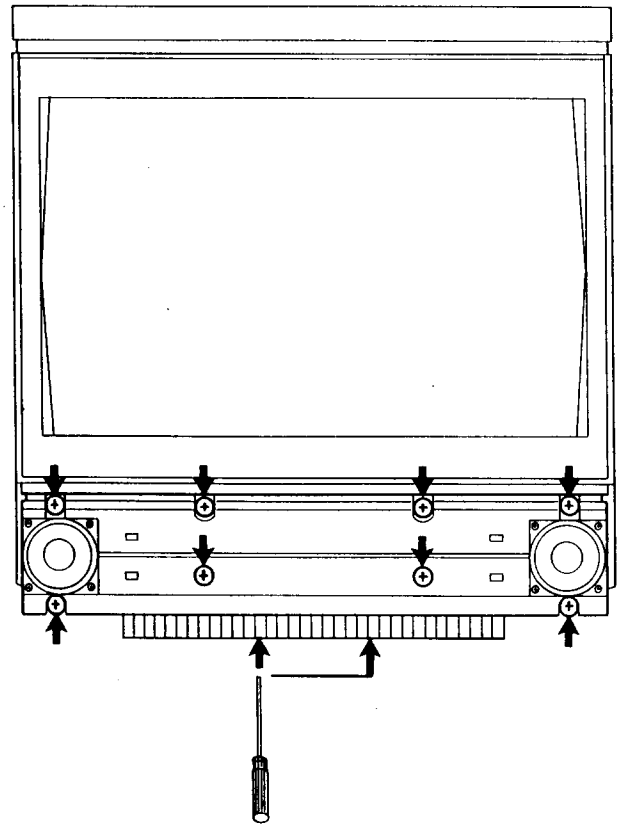
Loosen the four screws in the rear part, which can then be removed.

Loudspeaker panel



Insert a screwdriver between the loudspeaker panel and the main frame at the *right side.* A slight pressure will loosen the loudspeaker panel, and it is removable from the left towards the right.
A slight rearwards pressure against the left corner will release the loudspeaker panel completely.

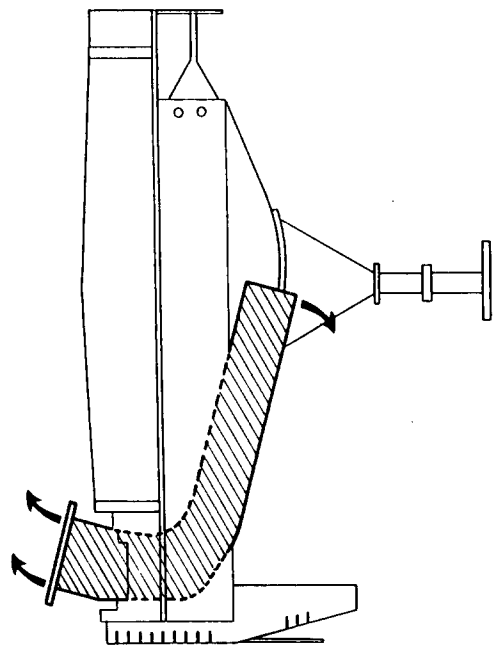
Loudspeaker baffle



Remove the eight screws, and a slight pressure from below against the points indicated will release the loudspeaker baffle.

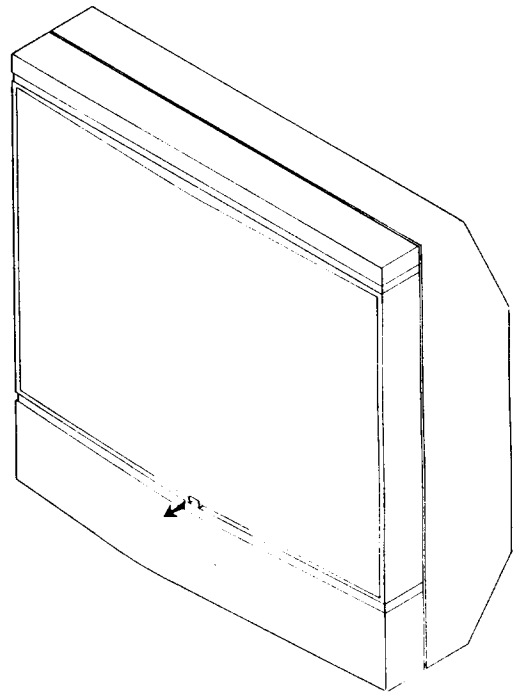
When removing the loudspeaker baffle, pull slightly upwards, whereby the two loudspeaker damper tubes are moved to horizontal position.

Loudspeaker



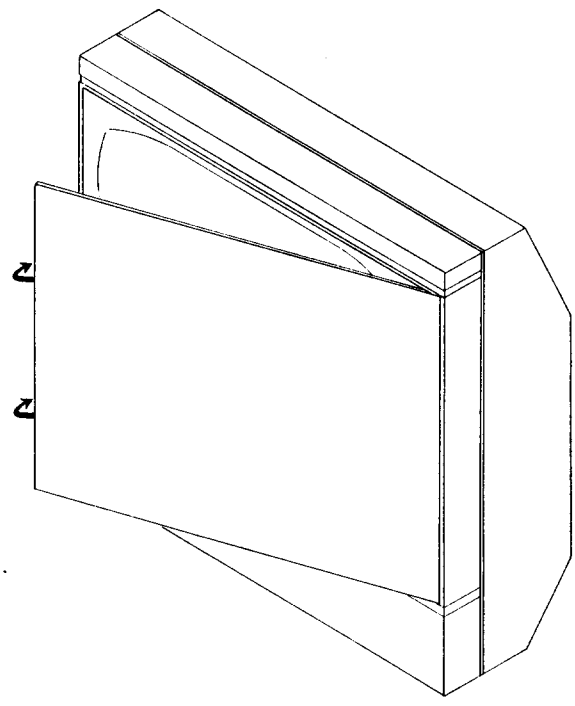
When replacing a loudspeaker, make certain that the new unit is oriented with its terminals downwards, and finally *tighten diagonally.*

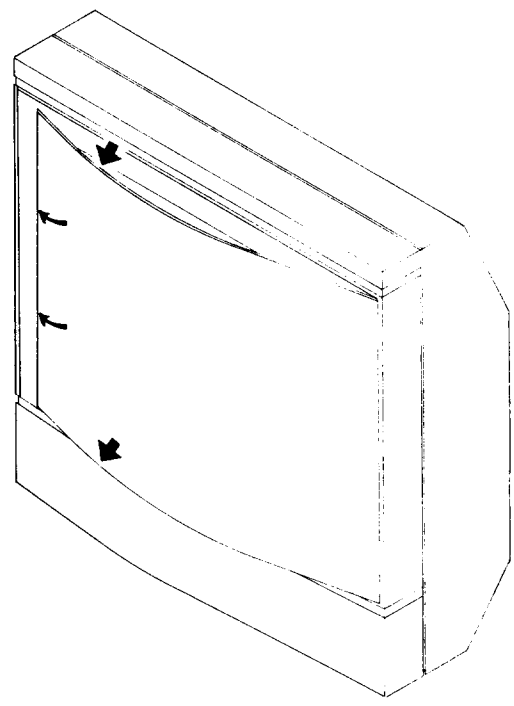
Dismantling of contrast screen



The contrast screen may be removed by pulling at the slot illustrated.

Fitting of contrast screen





Place one edge in the groove and hold in place.
Bend the screen slightly by holding at the top and the bottom at the other edge and press the contrast screen into the groove.
Make sure the screen is pressed down in the full length of the groove.

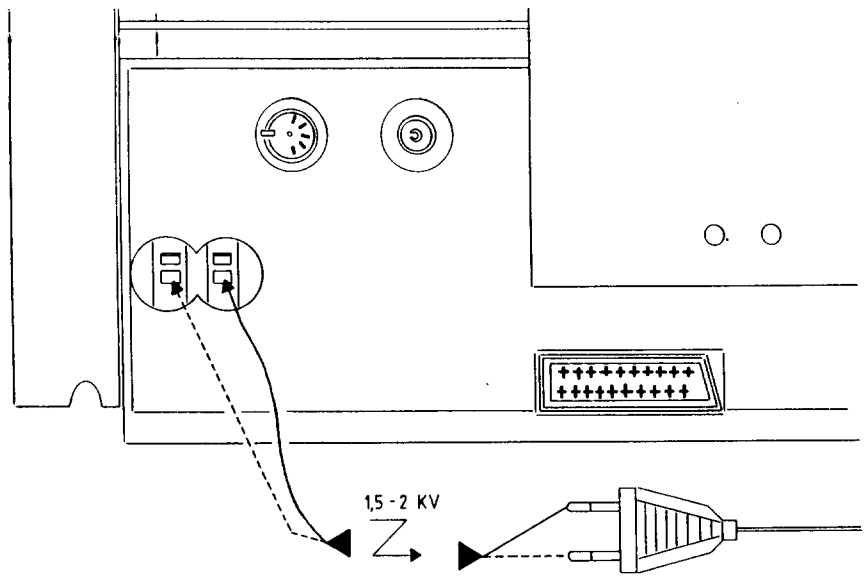
INSULATION TEST

Each set **must** be insulation tested after it has been dismantled. The test is to be carried out when the set has been re-assembled and is ready for delivery to the customer.

The insulation test is carried out in the following way:

Short-circuit the two plug pins of the main plug and connect one of the terminals of the insulation tester. Connect the other terminal of the insulation tester to the chassis pin of one of the loudspeaker sockets.

Set the mains switch in ON position.



NOTE!
To avoid ruining the set, it is essential that both insulator test terminals are in really good mechanical contact.

Now turn slowly the voltage control up on the insulation tester until a voltage of 1.5-2 kV is obtained. Hold it there for 1 sec., the turn slowly the voltage down again.

At no point during the test procedure any flash-overs are permissible.

SERVICE TIPS

When replacing the 01DF08 thyristor, diode 01DF09 must be replaced also.
Both parts are available under part no. 8300488.

FINAL TESTS

1.01 Connect the TV set to an aerial and a power supply.

Connection

1.02 Set the ON/OFF switch to on → display will show red dot.

Close Operation

2.01 Activate "tune" → the TV set comes ON, the screen lights up. Tune and fine tune are functioning on Program 1.

2.02 Activate "tune" to the TV station wanted.

2.03 Activate "fine tune" until a sharp picture is obtained.

2.04 Activate "volume" up and down → display counting.

2.05 Activate "contrast" up and down → display counting.

2.06 Activate "brilliance" up and down → display counting.

2.07 Activate "colour" up and down → display counting.

2.08 Regulate "balance" < >.

2.09 Regulate "bass" - +.

2.10 Regulate "treble" - +.

2.11 Set "expand" to + → display shows/, and it becomes audible that the sound picture has been expanded.

2.12 Set "expand" to -.

Inputs/Outputs

3.01 Check ancillary loudspeaker connection.

3.02 Check AMP/TAPE.

3.03 Check 21-pole A/V socket.

3.04 Check VHF/UHF aerial socket.

3.05 Connect e.g. a video tape recorder to the 21-pole A/V socket. When playing back the TV set switches to A/V mode.

3.06 Test the headphone socket.

Remote Control

4.01 Tuning: First activate "TV" and next "tune" → and the TV set will advance the nearest next station. Display will show: Ch and xx.

4.02 Fine tuning: Activate "fine tune" on the control panel until the picture becomes sharpest. Display will show: Ch, xx, Pr, and xx.

4.03 Activate "store". This will store the set transmitter frequency under a program number. The Display will show: Ch, xx, Pr, and xx.

4.04 Activate "volume" up and down. The sound will increase and decrease, → the display will be counting.

4.05 Activate "brilliance" up an down. The brightness will increase and decrease, → the display will be counting.

4.06 Activate "colour" up and down. The colours will get more or less saturated, → the counter will be counting.

4.07 Activate "step" up and down. Program will advance to - or go backwards from - the next program, → display will show program No. xx.

4.08 Activate "mute" and the sound will disappear, → the display will show - . When "mute" is again activated, the sound will return. The display will show - .

4.09 Activate "reset". The TV set will be set to the value of the setting for close operation. Display will show - .

4.10 "sound". Tune the TV set to a station telecasting a dual language programme. When activating "sound", language A or B is selected. The display will show < or >.

4.11 "sound". Tune the TV set to a station telecasting a stereo programme. The display will show < >. Activating "sound" switches between stereo and mono. The TV set will start up in stereo mode.

4.12 Activate " - ". The TV set will go into stand by mode, → the display will show ".".

4.13 The TV set can be turned ON by activation of:
A Any Programme No. from 0-34
B "step"
C "TV"
D "reset"
E "mute"

4.14 When selecting programmes 33 or 34, → the display will show < > AV.

4.15 Direct selection of channel: Activate "TV" - "tune", next select the channel required (0-99).

Picture

5.01 Check that the picture has the correct geometry, white balance and grey balance.

Cabinet

6.01 Check the cabinet for cosmetic blemishes.

Cleaning of screen/contrast screen

7.01 The screen/contrast screen may be wiped with a cloth wrung in water with ordinary detergent.
A little rinse aid may be added in order to avoid static electricity.
Methylated spirits should be avoided.

For further information, consult the owner's manual.