APPLICATION NOTE

The GTV1000
Global TV Receiver

AN98051

Philips
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Abstract

The GTV1000 receiver has been designed around the TDA884X TV signal processor.
The large signal part is suited for 90° picture tubes and build on one board with the small signal part.
The board design is such that it can easily be adapted for use in the following markets:
USA, South America, Europe and most of the Far East countries.
The board can be fitted with different external AV connectors and sound modules.
When a video processor with YUV interface is used, it is possible to insert feature modules.

The GTV1000 was designed as a demonstration receiver and has been tested on picture, sound and EMC performance, but has not been released for production.

APPLICATION NOTE

The GTV1000 Global TV Receiver

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Summary

This application note describes the GTV1000 global demonstration colour TV receiver, which is based on a TDA884X “one chip” TV processor.

The global concept allows the board to be adapted to the TV standards in different countries all over the world by adding or changing components and connecting or disconnecting solder jumpers.

The micro controller socket is suited for use of non-text micro controllers as well as types with integrated text and types with integrated close caption.

The board contains the small signal part, control and all the large signal circuitry to drive a 90° picture tube.

On the board connectors are available to insert the different types of external input signal connectors needed in the different areas.

The basic board is equipped with mono FM sound, but two connectors are available to add AM sound or different stereo options corresponding to the desired area of use. In case of stereo, a stereo power amplifier can be added on the main board.

In case a video processor type with YUV interface is used, a YUV connector can be mounted where picture improvement options can be inserted.

On the board leaded components are used.

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1. INTRODUCTION.

This application note describes the GTV1000 global demonstration colour TV receiver, which was designed to demonstrate the TDA884X video processor and the different micro controllers that are available for low-end applications.

The GTV1000 is a low-end 90 ° TV receiver based on the TDA884X “one chip” I^2C bus controlled TV processor. The TDA884X contains all small signal circuitry for a colour TV receiver.
The board can be adapted to handle the following TV standards:

1. NTSC-M (TDA8846/47).
2. PAL-M/N, NTSC-M (TDA8841/43).
3. PAL-only (TDA8840).
4. PAL, SECAM (TDA8842/44).

In configuration 2), the set can also handle PAL 4.43 via the external input if a 4.43 MHz crystal is added. If an NTSC-M crystal is added in configuration 3) and 4), the external input can handle NTSC signals here.

The small signal part, control and large signal circuitry are build on one board.

The board can be equipped with a VST (UV1315) or a PLL (UV1316, UV1336) tuner. Via solder jumper, connection for both symmetrical and asymmetrical tuners can be made.

The basic board contains intercarrier FM mono sound and a single audio amplifier (TDA7056B).
It is possible to switch between two sound bandpasses to select one of two sound standards.
Two connectors (sound-1 and sound-2) are available to extend the system with AM sound or different stereo options, as explained in chapter 2.2.2. In case of stereo, a double audio amplifier (TDA7075AQ) can be added on the main board.

In two other connectors (peri-1 and peri-2) different boards containing external input connectors can be inserted, to obtain the correct configuration for each country. A discrete RGB switch can be mounted on the main board when a full scart application is wanted, to switch between RGB from the scart connector and OSD RGB information (see chapter 2.2.4).

To offer the possibility to decode all colour standards and create multi standard applications, it is possible to insert 1, 2, 3 or 4 crystals on the board (PAL 4.43/SECAM, NTSC-M, PAL-M and PAL-N).

When a video processor with YUV interface is used, it is possible to insert a connector on the main board (YUV) where picture improvement options can be inserted.

The circuitry around the micro controller was designed in such way that it is possible to insert different micro’s. The correct configuration can be set by solder jumpers. For non-text countries the 83C054 (MTV) can be used, while for countries with teletext the SAA529X (ETT) with integrated teletext can be inserted. A third option is the P83C770 which has integrated close caption.

On the board a service connector is present, where a PC with I^2C bus interface can be connected.
In this case the service pin of this connector has to be grounded, to stop the micro controller.
A separate local keyboard is delivered with the main board and can be connected to the local keyboard connector.

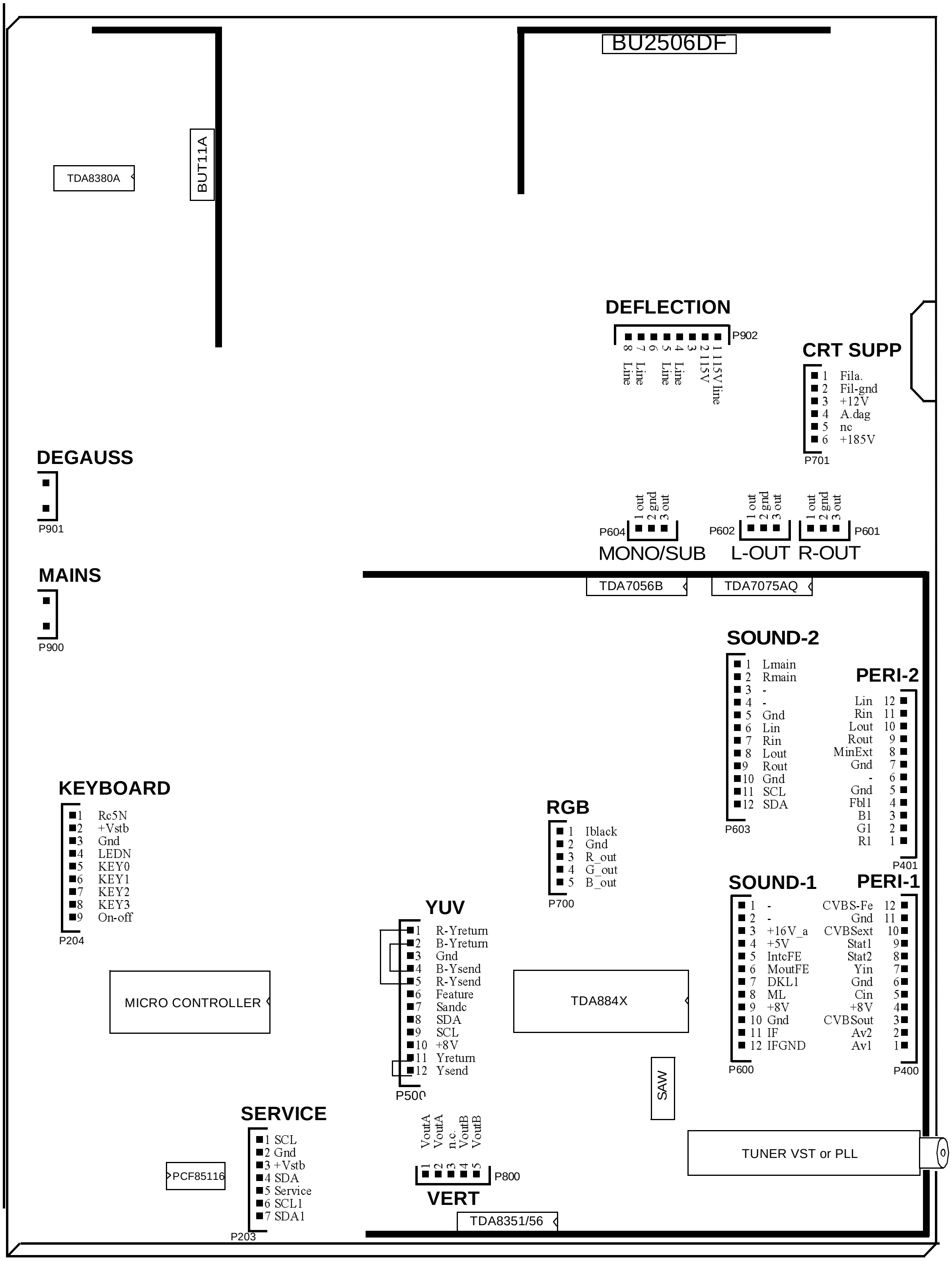


Fig.1 The GTV1000 board.

For the vertical deflection a DC coupled amplifier (TDA8356) is used.

The line deflection was designed to drive a 90° picture tube. The line transformer supplies the voltages to drive the picture tube: EHT, Vfocus, Vg2, filament supply and the video amplifier supply.

The board also contains the mains filter, the degaussing circuit and the switched mode power supply, which delivers the supply voltages for the line deflection, vertical deflection, audio part, video processing and control part.

2. SMALL SIGNAL.

2.1 TV processor TDA884X.

The heart of the total system is formed by the “One Chip” TV processor TDA884X.

This chapter gives a short description of this IC family. More detailed information concerning the internal circuitry can be found in report ref.[3] Report no: AN98002.

Common features of the family:

- Vision IF circuit with alignment-free PLL demodulator
- Alignment-free multi-standard FM sound demodulator (4.5 to 6.5 MHz)
- Audio switch
- Flexible source selection with internal and external CVBS input, Y(CVBS)/C input and selected CVBS out, suited for comb filter use
- Integrated chroma trap (auto calibrated)
- Integrated chroma band pass (auto calibrated) with switchable centre frequency
- Integrated luminance delay line
- Asymmetrical peaking in luminance channel with defeatable coring function
- Black stretching
- Blue stretch circuit which offsets near white colours to blue
- Integrated RGB processor with “continuous cathode calibration” and white point adjustment
- Linear RGB inputs with fast blanking input
- Possibility to insert “blue mute” when no signal is present
- Dynamic skin tone (“flesh”) correction for NTSC signals
- Horizontal synchronisation with two control loops and alignment-free horizontal oscillator
- Slow start and stop of the horizontal drive pulses
- Vertical divider circuit
- Vertical driver stage optimized for DC-coupled output stages
- I^2C bus control
- Low power dissipation

The table below shows the various S-DIL types, which can be inserted in the GTV1000 board.

For the mid-end types (TDA8843/44/47) a YUV interface has been added on the board, however the E-W drive is not used in GTV1000, because the deflection is designed for raster correction free deflection units.

TABLE 1 Features of the different types

IC version (TDA)	8840	8841	8842	8846	8846A	8843	8844	8847
Automatic volume levelling	X	X	X	X	X			
Positive / Negative modulation	N	N	N/P	N	N	N/P	N/P	N
NTSC decoding		X	X	X	X	X	X	X
PAL decoding (integrated delay-line)	X	X	X			X	X	
SECAM decoding (integrated SECAM decoder)			X				X	
Colour matrix PAL / NTSC (Japan)		X	X			X	X	
Colour matrix USA / Japan				X	X[1]			X
YUV interface					X	X	X	X
Horizontal geometry (E-W output)						X	X	X
Linear zoom function						X	X	X
Vertical frequency	50/60	50/60	50/60	60	60	50/60	50/60	60

1. In the TDA8846A version the delay line is present. For NTSC-system it acts like a cross colour reduction as a comb-filter does for PAL.

On the next pages, the pinning of the TDA884X as well as the internal block diagram can be found. The internal block diagram shows the most extended version of the series. The notes at this block diagram correspond to the remarks of the pinning table.

TABLE 2 Pinning of the TDA884X S-DIL 56

Pin	Function	Pin	Function
1	Intercarrier sound-IF_{IN}	56	Sound demodulator decoupling
2[1]	InExternal $audio_{IN}$	55	De-emphasis & Int. $audio_{OUT}$
3	Not connected	54	Tuner AGC_{OUT}
4	Not connected	53	AGC decoupling
5	IF-PLL loop filter	52	Vertical current reference
6	IF-$Video_{OUT}$ ($2V_{PP}$)	51	Vertical sawtooth capacitor
7	SCL I^2C-bus	50	EHT/over-voltage $protection_{IN}$
8	SDA I^2C-bus	49	IF_{IN}
9	Bandgap decoupling	48	IF_{IN}
10	Input $C_{S\text{-}VHS}$	47	Vertical I-$driveA_{OUT}$
11	Input $Y_{S\text{-}VHS}$ (or $CVBS3_{EXT}$)	46	Vertical I-$driveB_{OUT}$
12	Main +8V supply	45[2]	AVL cap. or East-West $drive_{OUT}$
13	CVBS1 (internal CVBS) ($1V_{PP}$)	44	Ground
14	Ground	43	j_1-loop filter
15	$Audio_{OUT}$	42	j_2-loop filter
16[3]	SECAM PLL decoupling	41	H-$flyback_{IN}$ & $Sandcastle_{OUT}$
17	CVBS2 (external CVBS) ($1V_{PP}$)	40	H_{OUT}
18	Black $current_{IN}$	39	Decoupling digital supply
19	B_{OUT}	38	CVBS-$switch_{OUT}$
20	G_{OUT}	37	+8V supply
21	R_{OUT}	36	Colour PLL filter
22	Beam current limiter/V-$guard_{IN}$	35[4]	Xtal 4.43/3.58 MHz
23	R_{IN}	34	Xtal 3.58 MHz
24	G_{IN}	33	Chroma $Reference_{OUT}$
25	B_{IN}	32	R-Y_{IN}
26	Fast Blank RGB_{IN}	31	B-Y_{IN}
27[5]	Y_{IN}	30	R-Y_{OUT}
28[6]	Y_{OUT}	29	B-Y_{OUT}

1. Positive modulation automatically selects pin2 for sound input (external AM demodulator).
2. TDA8840/41/42/46(A) have AVL instead of East-West drive, AVL capacitor at pin 45.
3. Pin 16 (SECAM PLL) only used in TDA8842/44.
4. In NTSC only versions TDA8846(A)/47 pin 35 (Xtal 4.43) is not connected.
5. TDA8840/41/42 have no Y_{IN}, pin 28 is not connected, pin 27 becomes Y_{out}.
6. TDA8840/41/42 pin 28 is not connected.

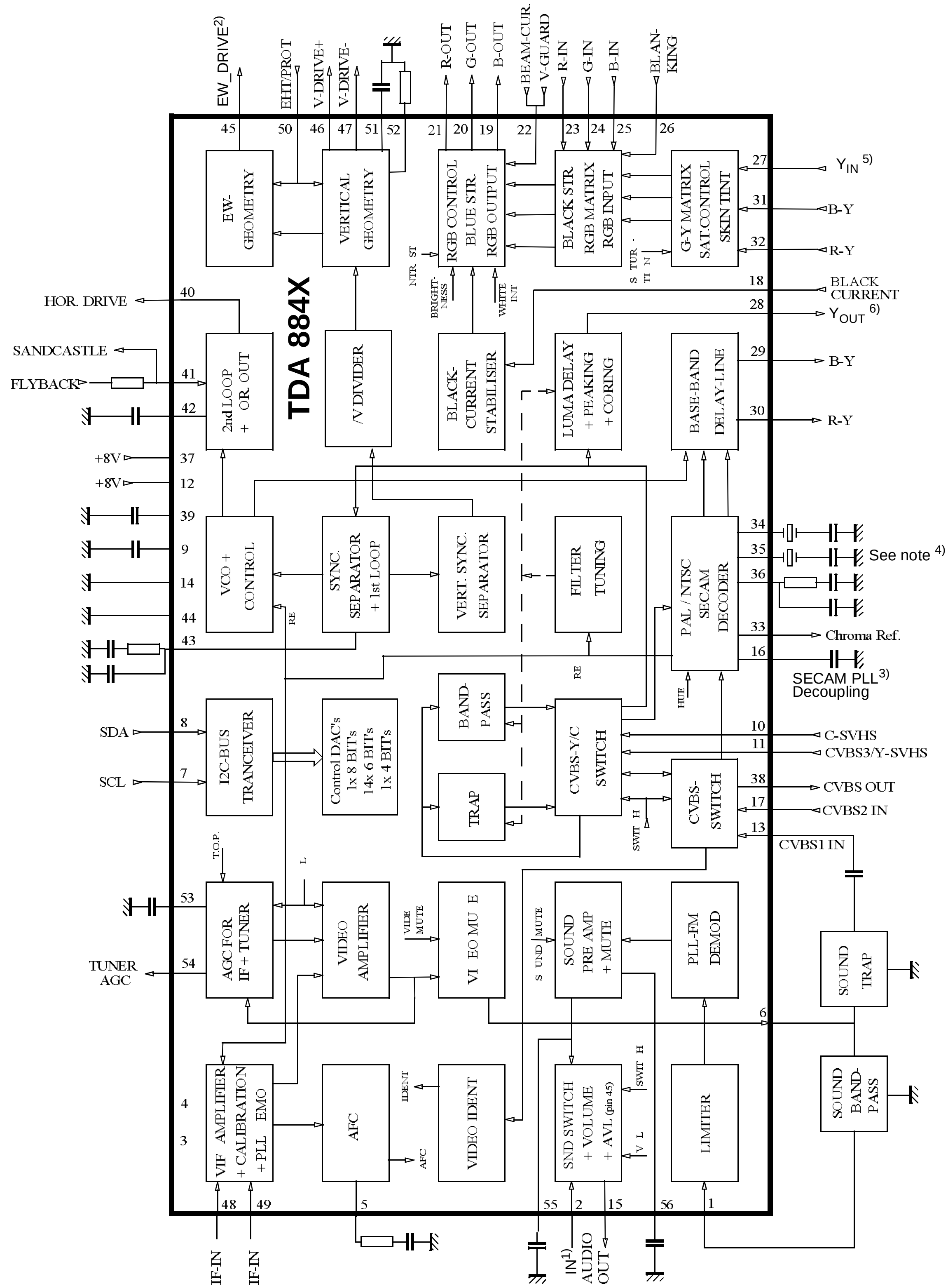


Fig.2 Internal Block diagram of the TDA884X

2.2 Functional description of the small signal part.

To simplify the design process of the GTV receivers, a common basic structure was selected.

This structure can be found in the figure below.

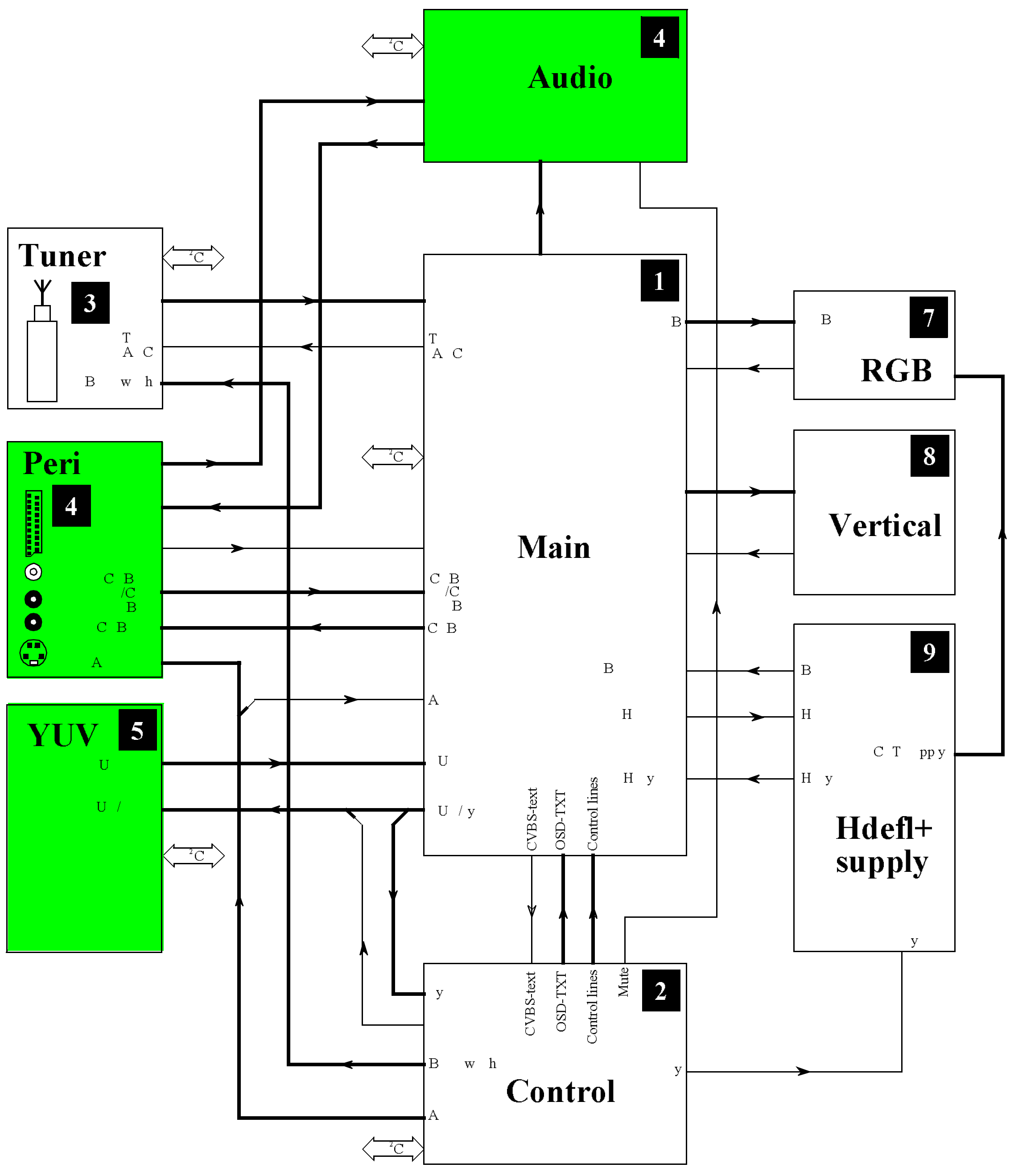


Fig.3 Global design structure

The structure is also found in the appendixes: Schematics.

To obtain flexibility in the GTV1000, the grey blocks are designed as add-on boards. In this way it is possible to add YUV features, the correct external connector combination for each area and different stereo systems. The sound block also contains the audio amplifiers, which are mounted on the main board and not on the add-on board, because they need a heatsink.

2.2.1 Tuner and IF circuit.

The GTV1000 design is made in such way, that a UV1316 / 1336 (PLL) or UV1315 (VST) can be used

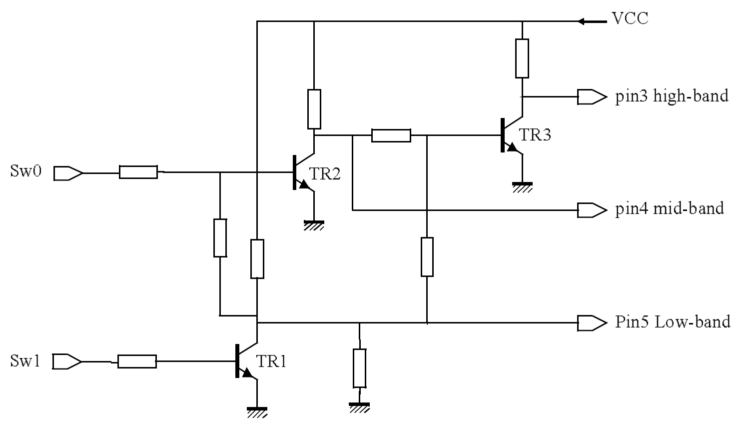
In case a PLL tuner is used, the following measures have to be taken:

- Jumper J300 has to be short circuit to select the right tuner address.
- Jumpers J301 and J302have to be opened to disconnect the bandswitch lines.
- Resistors R3004 and 3007 have to be inserted to connect the I^2C bus.
- Resistor R3002 has to be removed to disconnect the VST tuning voltage.

When a VST tuner is used, the following measures have to be taken:

- Jumper J300 has to be opened.
- Jumpers J301 and J302 have to be closed to connect the bandswitch lines.
- Resistor R3004 and R3007 have to be removed to disconnect the I^2C bus.
- Resistor R3015 has to be removed to disconnect the 33V.
- Resistor R3002 has to be present, to feed the tuning voltage to the tuner.

The three bandswitch signals are decoded from two micro controller outputs Sw0 and Sw1. The circuit and truth table can be found in the figure below.



Sw1	Sw0	TR1	TR2	TR3	Pin3	Pin4	Pin5	Band
0	0	non-cond	cond	cond	Low	Low	High	Low
0	1	non-cond	cond	cond	Low	Low	High	not used
1	0	cond	non-cond	cond	Low	High	Low	Mid
1	1	cond	cond	non-cond	High	Low	Low	High

Fig.4 Band switching with VST.

When a mark 2 version of the UV13XX PLL tuner is used, there is no acknowledge on a read cycle of the registers. This means that the tuner can't be used with the ICP-1 I^2C PC software. For the standard software packages used in GTV1000 this is no problem. Also using this tuner the series resistor R3015 with the tuning supply voltage must be bridged (22K to 0Ω). For the MK2 version it is an internal one.

The AGC output of the TDA884X is an open collector. The maximum and minimum voltage at the tuner pin is determined by three external resistors, as can be found in the figure below.
Resistor R2 and R3 determine the maximum AGC voltage, which is 4V for the UV13XX tuner series. The minimum voltage is determined by R1 and R2 and the saturation voltage of the AGC output of the TDA884X (0.3V). This minimum voltage is important, because most tuners have a fold-back in the lower part of the AGC characteristic (1.1V for UV13XX). The correct resistor values for GTV1000 are indicated in the figure below.

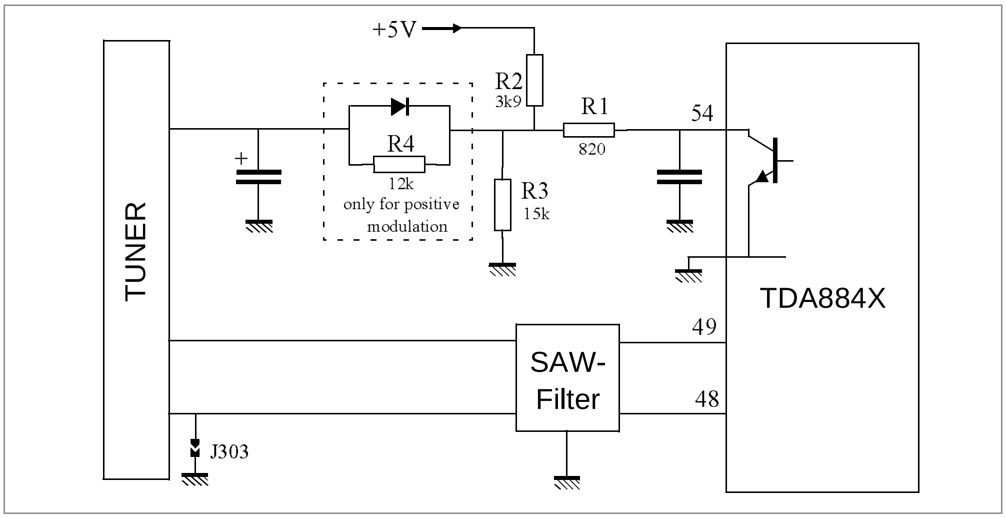


Fig.5 AGC circuit

Note: Resistor R3 to ground is missing in the lay-out of the GTV1000. Please solder a resistor in the PCB in order to prevent that the tuner is driven outside the specification. The performance of the receiver remains the same.

For positive modulation a diode with parallel resistor can be inserted. This circuit takes care of a fast response when the gain has to be reduced, while the charge time of the capacitor at the tuner side is larger, to assure a constant AGC level over one field.

The two IF outputs of the tuner are connected directly to the SAW filter. If an asymmetrical tuner is used, one IF pin can be connected to ground via jumper J303, near the tuner, to keep the connection between the tuner and SAW filter as symmetrical as possible. For the same reason the SAW filter ground is connected to the ground of the IF part of the TDA884X.
The two IF lines are also connected to the sound option connector, for AM demodulation in case an AM add-on board is inserted.

Because the GTV1000 is an economy concept, only 5 pins in line SAW filters can be inserted.
The following table shows the different SAW filters which can be used for different areas.

TABLE 3 Overview TV-system and associated SAW-filter

Area	System	SAW filter
South America	M / N	M1970M
USA	M	M1970M
West Europe	B / G	G1984M
West Europe + U.K.	B / G / I	K2962M
West Europe + France	B / G / I / L / L’	K2962M
Europe (no France)	B / G / D / K / (I)	K2960M

The table shows Siemens Matsushita SAW filters with a sound shelf of -14dB, which have better sound performance compared to the conventional types with a -20 dB sound shelf. These filters can also be used for intercarrier stereo applications.
Saw filters with a -10dB sound shelf are also available, but they are not used in the GTV1000 concept, because the picture quality becomes critical in this case.
The SAW filter used in the configuration west Europe + France is an alternative for the switchable SAW filters. With the K2962M the Nyquist slope for L’ is not optimal, because of the presence of the sound shelf. However the quality of the picture is sufficient.
In the configuration Europe, system I is in principle possible, however the GTV1000 circuit is designed to switch between only two sound systems.

On the lay-out the space for the reference coil is still present. For the N2 version of the TDA884X this coil can be removed.

For more information concerning the IF circuit of the TDA884X, see ref.[3] report no AN98002 page 89.

2.2.2 Intercarrier sound and sound options.

From the video demodulator output of the TDA884X (pin6) the signal is connected to two emitter followers. The first one (TR103) drives the sound-bandpasses, while the second one (TR105) feeds the CVBS signal to the sound traps. This configuration has been selected to reduce the breakthrough from the sound to the video path. For the same reason it is important to keep the sound and video path separated in the lay-out.
The GTV1000 is designed to select between two sound systems. One of the two sound band-passes is selected by the DKL1 signal, coming from the micro controller. Via two transistors (TR101,TR102) one of the diodes D100 or D101 is conducting the sound carrier to the SIF input (pin1). In series with this pin a small inductor (L101) is connected to reduce high frequency pick-up by the pin.

The demodulated sound is present on pin 55, where the de emphasis capacitor is connected. The sound signal on this pin has no volume control and can be used to feed the front-end sound to the SCART connector. An amplifier is added here to avoid loading the pin and to create a gain of 2 to 3 dB, which is needed to bring the signal level to SCART specification.

The connection to the SCART panel is running via the sound option connectors, to offer the possibility to switch also AM sound to the SCART output, in case this is needed (see Fig.6) .

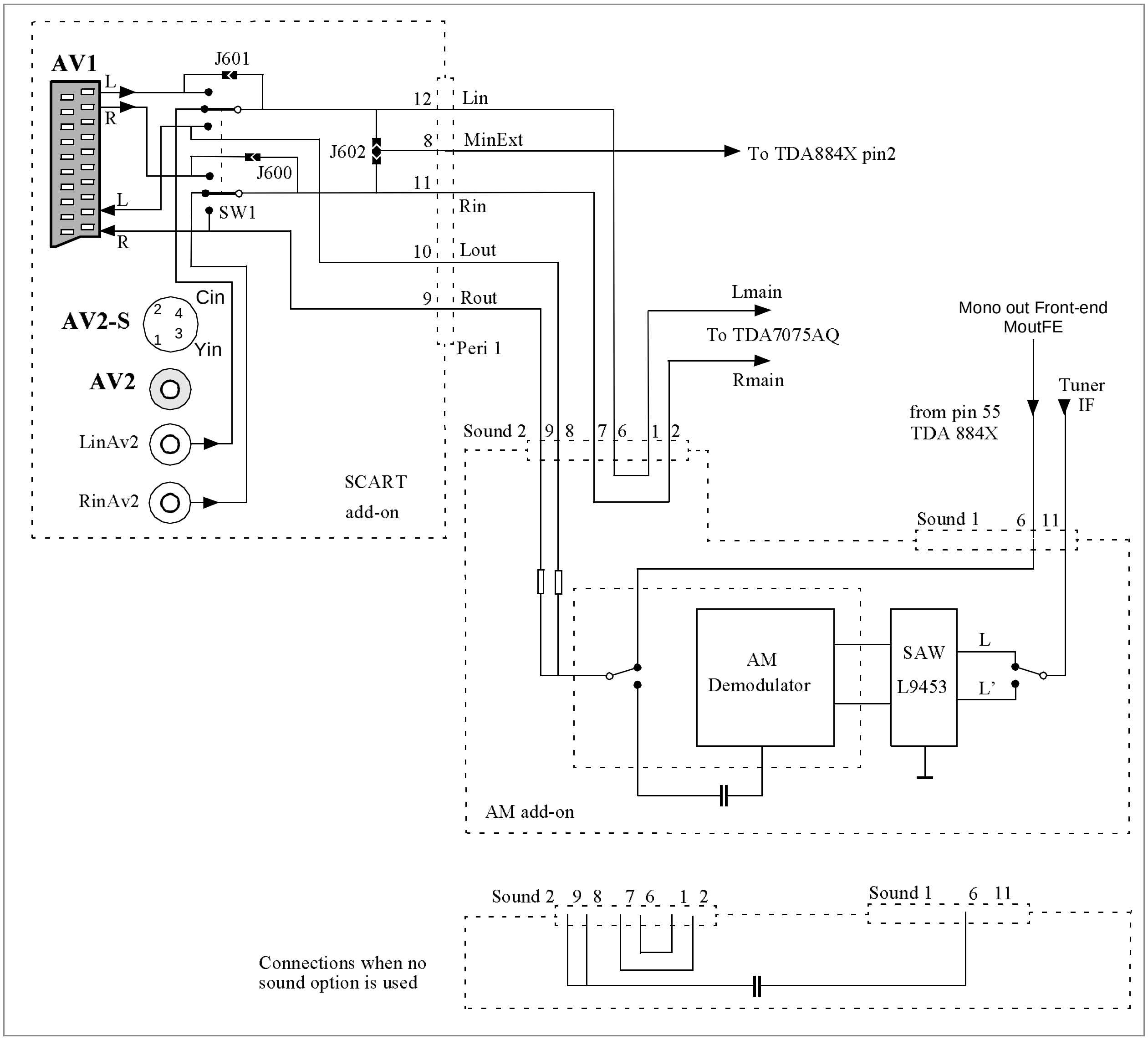


Fig.6 Sound switching.

If positive modulation is selected in the TDA884X, the IC automatically switches to the external sound input. In this case the AM sound coming from the AM demodulator on the add-on board, has to be connected to both the SCART connector and to the external input. This is accomplished by feeding the AM signal to the SCART and switch the source selector (SW1) to the AM signal.

If no AM or other sound option is inserted into the sound option connectors and the front-end sound is needed on the SCART output, a coupling capacitor has to be connected from pin 6 of sound connector1 to pin 8 and 9 of sound connector 2.

To offer the possibility of AM sound, the tuner IF signal is present on the sound option connectors. The AM board itself contains a switch, controlled by the DKL' bit coming from the micro controller to switch between the L and L' sound carrier.

The mono (AM) sound is fed to pin 2 of the TDA884X, by closing jumper J602.

At all incoming and outgoing lines of the external connectors, a spark gap and a filter is connected close to the connector, to protect the internal circuit.

In the TDA884X internal or external sound is selected via bus control and via the volume control the sound is fed to the sound output (pin15). This signal is connected to the sound output amplifier TDA7056B. The volume pin of this IC is connected to the microprocessor to create an extra mute function, in order to avoid any plops on the loudspeaker.

Versions of the TDA884X without E-W control contain an Automatic Volume Levelling (AVL) feature. The capacitor controlling the time constant of this function is connected to pin 45, which is used for E-W drive in versions for 110^{o} deflection. The automatic volume levelling is keeping the sound level constant in case the FM modulation increases. The feature is originally designed for the USA market, where the modulation level of commercials is increased.

A second audio amplifier (TDA7057AQ) can be inserted on the board, which can be used in case stereo options are inserted, or for external stereo only. In this case the left and right signal from the external sources is selected on the external add-on board (SW1), while the internal mono signal (or AM signal) is connected to the left and right channel via the sound option board and is also selected with SW1. In this case jumper J602 has to be opened and the left and right audio signal is fed to the audio amplifier via the sound option board to offer switching possibilities is case stereo options are used. This means that if no sound option board is used the mono channel and the left and right audio signals have to be wired as shown in Fig.6 . The TDA7075AQ amplifier volume control inputs are used for volume control and mute function in this case.

Both the TDA7056B and the TDA7057AQ are BTL amplifiers. For EMC reasons filters are connected in all loudspeaker lines of the audio amplifiers.

Besides the AM sound option a 2 carrier / NICAM stereo option with TDA9875A or the older version of the stereo add-on board containing TDA9820, TDA9840, TDA9860 and the SAA7283 can be inserted. These options are designed for intercarrier stereo, which means that they use the sound IF of the TDA884X as input signal.The external sound-in switching is the same as in the option described above, although the IC's are capable of switching between internal and two external sources. This is not used in the GTV1000, because the system had to be kept flexible.
The front end sound signals to the SCART panel are coming from the fixed level outputs of the sound processor, while the audio amplifiers (TDA7075AQ) are connected to the sound processor outputs.The volume control of the TDA7075AQ in this case, is only used for muting the output.
For more information concerning the TDA9840 / 9860 see ref.[7] report no: HAT/AN92004. The TDA9875A is described in ref.[11] report no: HSIS/TR9801.

A third sound option is the NICAM only board, containing the SAA7283, meant for intercarrier NICAM reception. Also here the IC has the capability to switch between internal and external sound, however in order to keep the system suitable for all options, the switching possibilities of the IC is not used. The way the internal and external sound is switched can be found in Fig.7 . More information about the SAA7283 can be found in ref.[8] report no:AN96002.

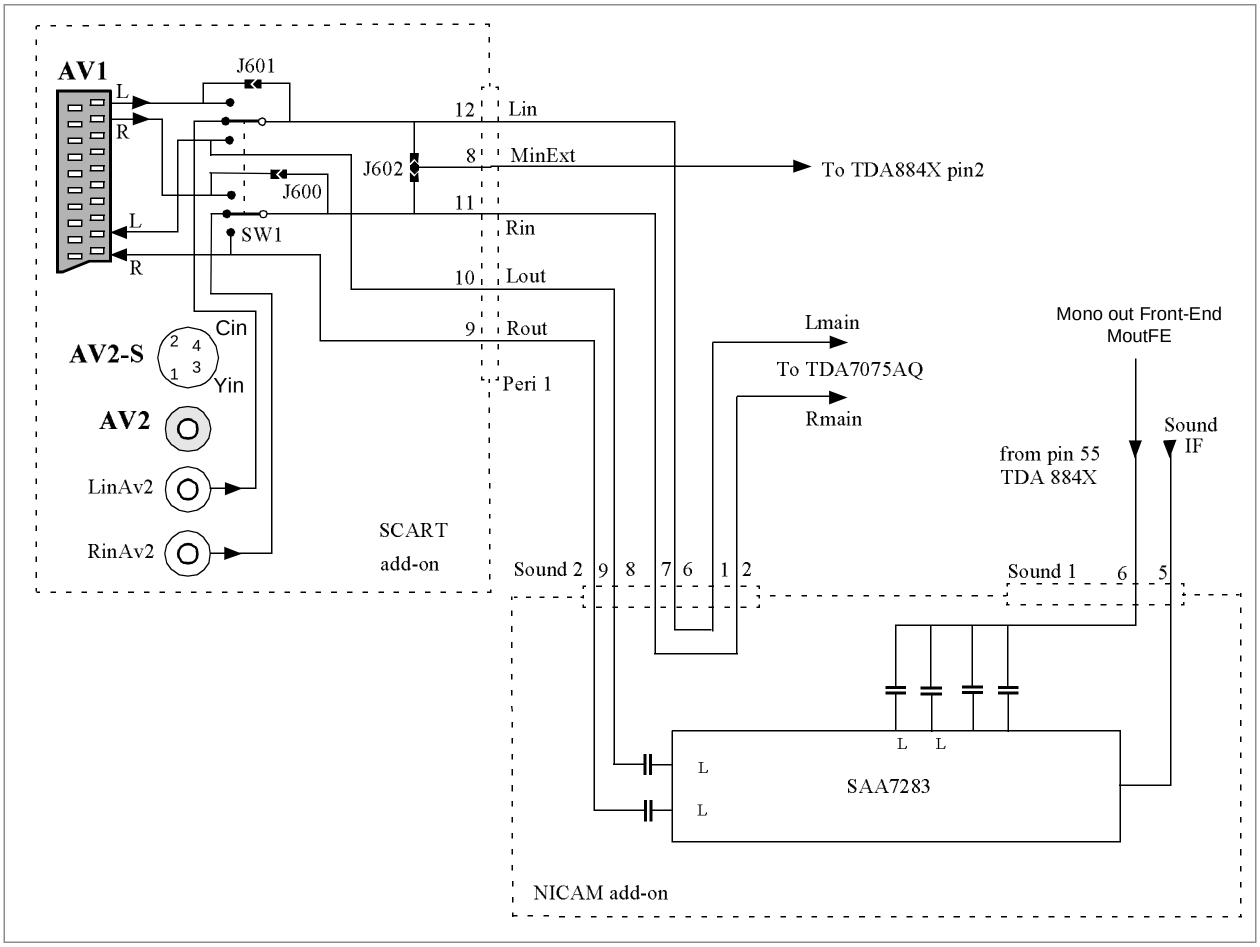


Fig.7 NICAM sound switching.

The fourth stereo option that can be inserted is BTSC stereo sound. The add-on board is designed for the TDA9852 / 9855. The drive signal for the sound processor is coming from the fixed level audio output of the TDA884X. The correct input level can be set in the audio processor. These sound processors have only one external stereo sound input, so here a switch is needed to select more than one external input sources. The front-end sound out is not present here, because the IC has no fixed level sound output. The reason is that in NTSC countries the sound out is not used for low and mid-end sets. The left and right output is fed directly to the TDA7075AQ audio amplifier. The TDA 9855 has extra features with respect to the TDA9852. These are tone control and a sub woofer output. This sub woofer signal can be fed to the mono amplifier (TDA7056B).
If the feature is used, jumper J600 on the main board has to be changed. More information about the TDA9855 can be found in ref.[10] and ref.[12] report no: AN95047 and AN94004.

2.2.3 CVBS path.

On the demodulator output an emitter follower (TR105) is connected, to drive the sound traps. The collector of this transistor has a separate decoupling. The follower, the decoupling and the traps should be connected to one ground track, to avoid disturbance of other circuit parts by the large currents in the

ground pins of the traps. This first follower is build with a PNP transistor. The reason for this choice is that two other followers are connected behind this first one. If all followers would be NPN types, the DC voltage drop towards the SCART connector would be too much.
The traps that are used are of course depending upon the systems that have to be received. In the USA and south america versions only a 4.5 MHz trap is inserted. In the PAL / SECAM versions the triple trap is used. This device traps three frequencies: 5.5, 5.74 and 6.5 MHz. Space for an extra trap of 6.0 MHz is also present. Behind the traps again an emitter follower is connected, to supply low impedance drive to the CVBS input of the TDA884X for proper clamping.
At the SCART output an other emitter follower is present. This one is needed to avoid high currents in the lead from the trap circuit to the SCART connector. These high currents can easily course cross-talk from external to internal CVBS. The high currents are normally caused by the capacitive load of a SCART cable. It is also important to keep the tracks of internal and external CVBS separated.

Note: The crosstalk performance of this GTV1000 board can be improved, by adding a ground track between these CVBS tracks.

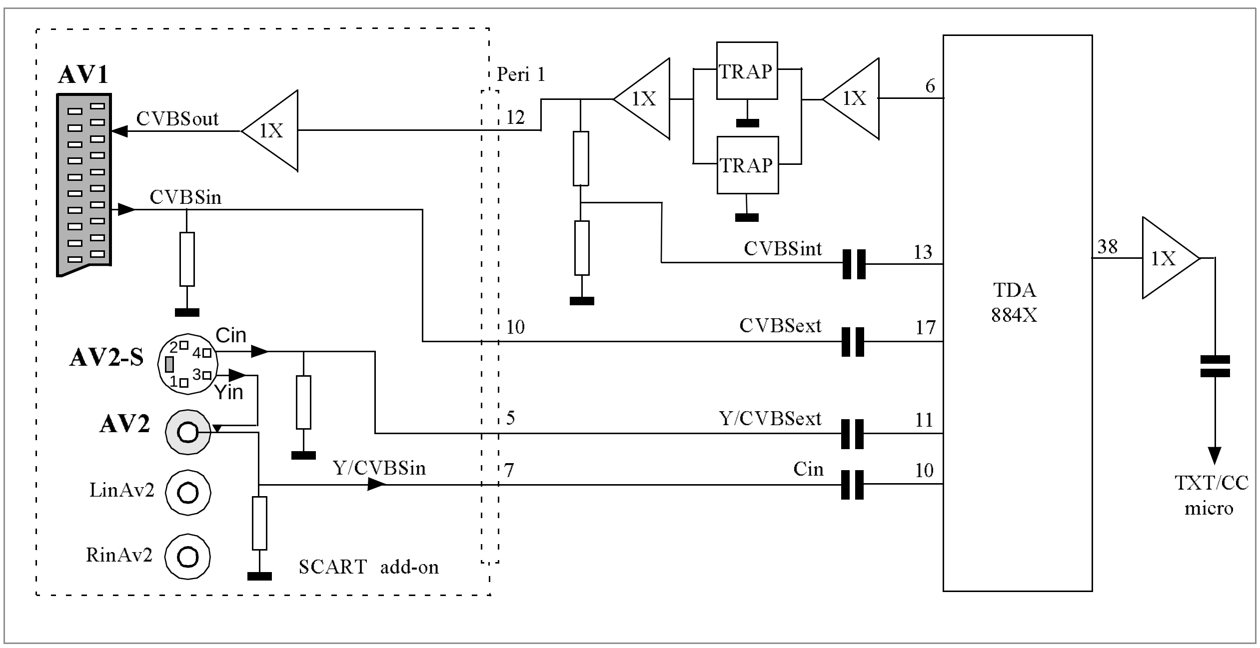


Fig.8 CVBS, Y/C switching.

Different external input configurations can be inserted in the two PERI connectors. This set-up has been selected to keep the board flexible for all TV markets. The different options are:

- Single cinch audio/video in + S-VHS in (mono).
- Double cinch audio/video in + S-VHS in (mono/stereo).
- Full SCART connector + cinch audio/video in + S-VHS in (mono/stereo).

At all the incoming and outgoing lines of the external connectors spark gaps and filters are connected close to the connector, to protect the internal circuit.

The first option offers a simple direct connection to the inputs of the TDA884X.

The second board contains two CVBS inputs, where the second CVBS input is combined with the Y input of the S-VHS connector. The TDA884X offers the possibility to change the Y input into CVBS input. This board can be used for stereo applications. The sound inputs of the second CVBS and S-VHS inputs are combined. To switch between the two sound inputs, CMOS switch HEF4052 is used.

The third option is a full scart connection containing stereo audio in/out, CVBS in/out, RGB+FBlank in and AV status in. The second CVBS input is again combined with the S-VHS input, as well as the sound input. The S-VHS connector contains a switch, witch can be used to generate a status signal. Again HEF4052 switch is used for switching between the two sound inputs.

The CVBS, Y/C inputs contain a terminating resistor of 75Ω, a spark gap and a filter. The lines are connected via a clamp capacitor directly to the corresponding inputs of the TDA884X. The RGB input is described in the next chapter.

2.2.4 RGB input/switch.

The TDA884X offers the possibility to insert the OSD/Text RGB into the output. When the fast blanking pin (pin 26) is pulled above 4V, the RGB outputs are switched to the black level and OSD RGB can be inserted. Because of the automatic black level loop, the black level of the three colours can be different, depending upon the picture tube. This means that if OSD is inserted with a fixed level, different colours can be present for different picture tubes.

An other option is to insert directly into the video amplifiers. Here the reference voltage is present, so the problem described above is not present. However most customers don't like this option, because of the extra wires towards the CRT board, which also increases the EMC problems.

For the reasons mentioned above, in GTV1000 RGB insertion into the analog RGB inputs has been selected. In countries without SCART connections this is no problem and the RGB from the micro is divided down to the correct level and connected via clamp capacitors to the RGB inputs.

For countries with full SCART inputs, two options are available. First is just adding the SCART RGB to the OSD/Text RGB, which of course causes a problem in case OSD and SCART RGB are present simultaneously. The second option is using an RGB switch to switch between SCART and OSD/Text.

In GTV1000 a discrete RGB switch has been selected, which is a little cheaper compared to the TDA8601 RGB switch. The problem however is that in the application as described below, expensive switching transistors have to be used to obtain a proper performance, which decreases the price difference with the IC solution.

The principle of the RGB switch can be found in Fig.9 . On the external connector board a passive clamp is present for the RGB input signal. To compensate the diode voltage of the clamp a reference voltage is made, using the same diode as in the clamp circuit.
The clamped signal is connected to a switch via a resistor. This switch is connecting the line to ground during the line fly-back and when OSD information is present. During the line fly-back the RGB inputs are clamped, so the clamping capacitor has to be connected to ground to obtain a proper reference.

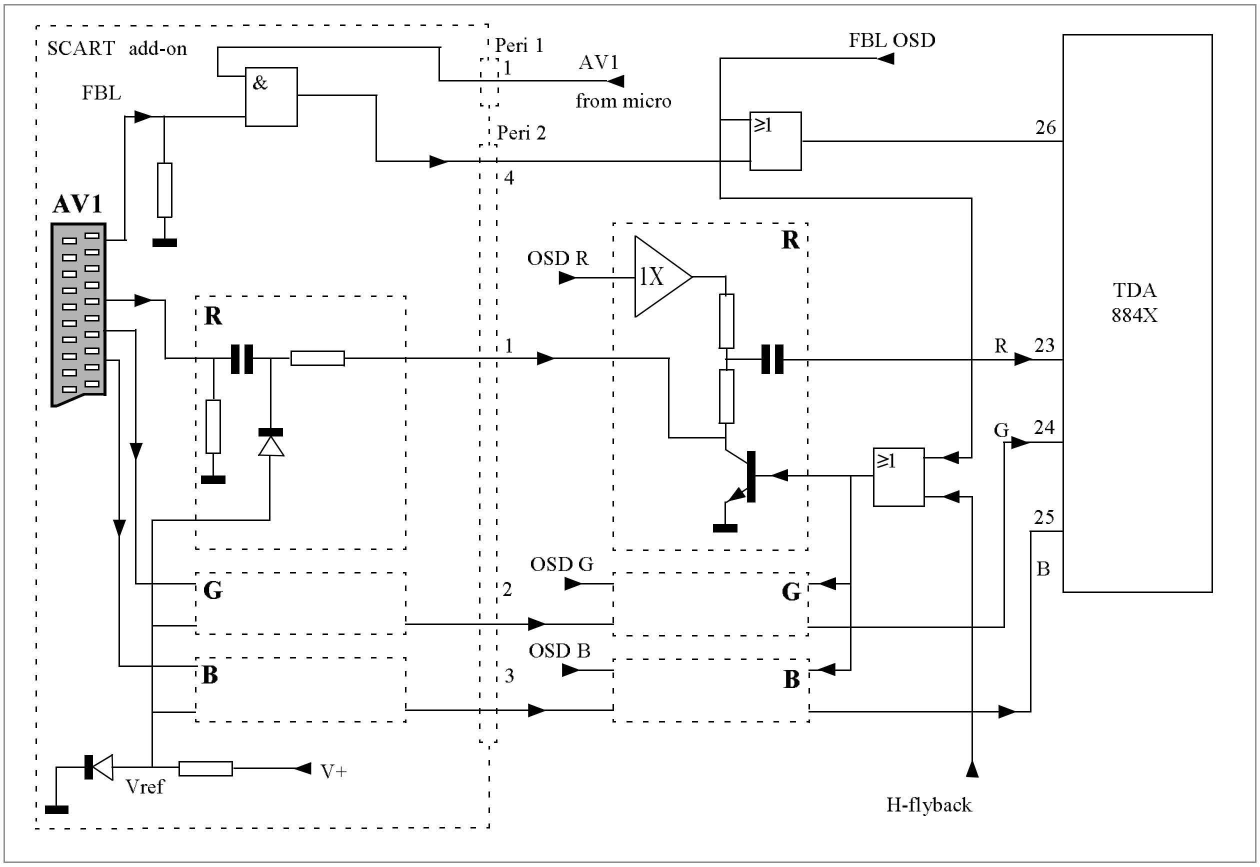


Fig.9 RGB input and switch..

When OSD information is present, the RGB information coming from the SCART-input has to be suppressed. In this case the OSD information coming from the micro via an emitter follower is divided down to the correct level using two resistors.
To obtain a proper OSD performance the switching transistor has to be fast. In the GTV1000 a PH2369 is used.
The fast blank signal coming from the SCART connector is only active when AV1 is selected. In this case the sync signal for the TDA884X is coming from the CVBS input on the same SCART connector. The fast blank signal coming from the SCART-connector is coupled to the one coming from the micro via an OR function.

2.2.5 Colour decoder.

The colour decoding (NTSC, PAL, SECAM) as well as the base band delay line are fully integrated into the TDA884X. On the outside just the crystals and the colour PLL loop filter have to be connected. Information concerning the application around these pins can be found in ref.[3] report no: AN98002 page109.

In the GTV1000 concept the crystal switching has been designed in such a way, that it is possible to connect 1, 2, 3 or 4 crystals.

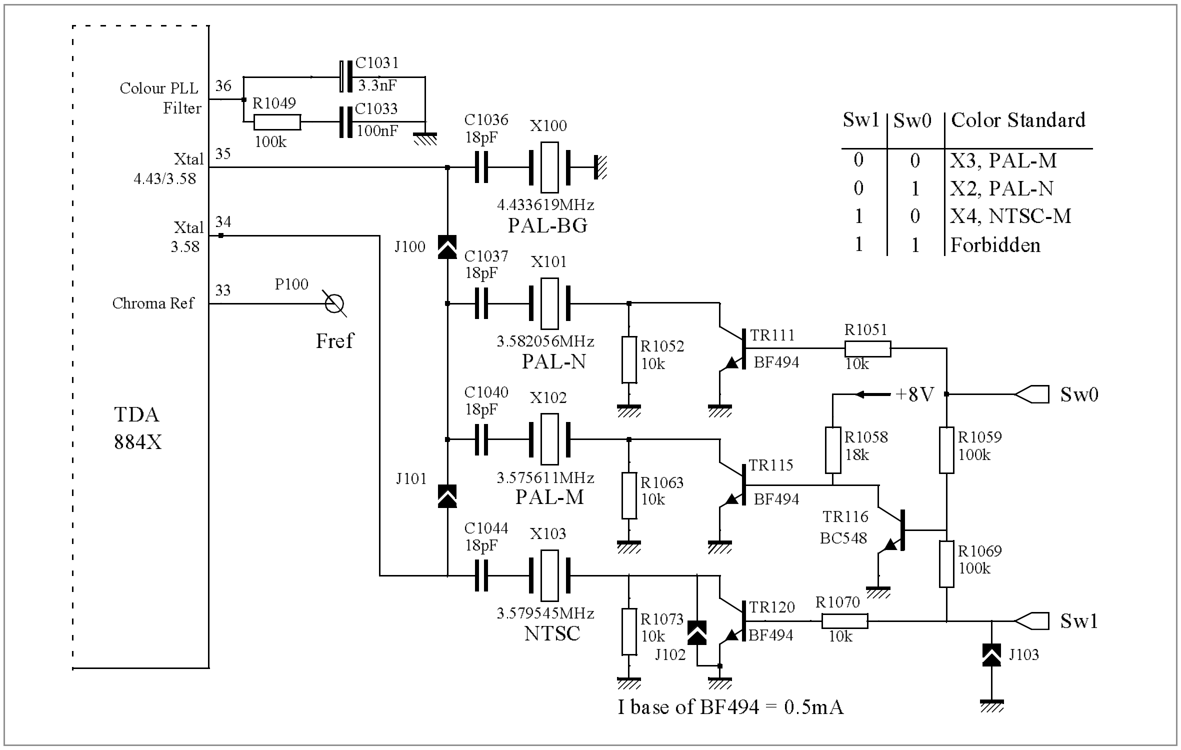


Fig.10 Colour decoder application.

- In case one 4.43 MHz crystal is used (PAL 4.4, SECAM), it is connected to pin 35 (X100).
- For one crystal 3.58 MHz applications (NTSC-M or PAL-M or PAL-N), the crystal is connected to pin 34, by closing jumper J102.
- Two crystal applications, either a combination of 4.43 and 3.58 MHz or two 3.58 MHz crystals can be made by simply connecting one crystal to pin 34 and the other to pin 35 (J102 closed).
- When 3 crystals have to be connected, which can be the case for 3 system reception in South America, the NTCS-M crystal is connected to pin 34, while either the PAL-M or PAL-N crystal can be switched to pin 35, using the line SW0 (J100, J102 and J103 closed).
- The most extended situation is the 4 crystal application, which is sometimes used in South America, to decode PAL 4.43 MHz besides the three existing systems. In this case the 4.43 MHz crystal is connected to pin 35, while the three 3.58 crystals are switched to pin 34, using the switching lines SW0 and SW1 (J101 closed).

The TDA884X contains a chroma reference output, which supplies the selected chroma frequency to the outside. This signal can be used as a reference for a comb filter. In GTV1000 this comb filter option is not included in the board. For information about the comb filter application see ref.[6] Report no: AN98092.

2.2.6 YUV interface.

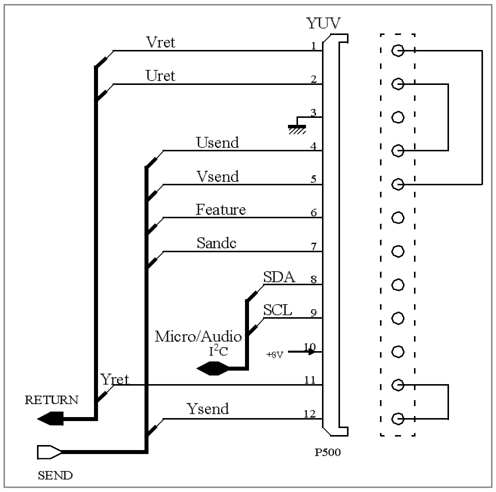


Fig.11 YUV interface

When a version of the TDA884X with YUV interface is used, a YUV connector can be mounted on the GTV1000 board where picture enhancement features can be inserted.

Besides YUV in and out the connector contains ground, supply, I^2C bus, sand castle and a line (feature) coming from the micro to control the feature IC. When a YUV version of the TDA884X is present and no feature board is inserted, a dummy connector as indicated in Fig.11 has to be used.

In a non YUV version of the TDA884X only the YUV outputs are available at the pins. These signals are internally connected to the YUV inputs. This means no dummy connector is needed for these IC's.

More information concerning the YUV in- and outputs can be found in ref.[3] report no: AN98002 page115.

2.2.7 RGB outputs & CRT board.

The RGB outputs of the TDA884X are connected to the CRT board via three small series resistors. The cable from the small signal board to the CRT-board also contains the ground connection of the video amplifier. This ground has to be connected to the ground guard ring around the TDA 884X, as indicated in ref.[5] report no: AN98097.
The TDA884X contains a continuous cathode calibration circuit, which adapts the DC level and the gain of each of the RGB channels every frame. On the RGB outputs every field reference pulses are generated and the current running in the cathodes of the picture tube are fed back to the black current input of the TDA884X. The RGB outputs are regulated to a DC level and a gain, so one field a current of 8mA is flowing into the black current pin and the next field 20mA. The reference pulses producing the 8 and 20mA are not coupled to odd and even field.
The black current feed-back line is the most sensitive part of the loop. For this reason some precautions have to be taken to avoid instability. The first one is to keep the ground line on the board and in the cable to the CRT board between the RGB lines and the Black current feed-back line. The second one is to apply some filtering on the black current feed-back signal. In the GTV1000 a capacitor (330pF) is connected to the black current feed-back line on the main board, just before the series resistor (10kΩ) connecting the line to pin 18 of the TDA884X.

On the CRT board a TDA6107 triple video amplifier with black current output is used. This device has a fixed gain of 52. To reduce the gain to approximately 45 three series resistors have been added at the RGB inputs. The gain of 45 is needed to obtain the proper drive for the 90° picture tube (Philips A51EAL155X01).

If a higher bandwidth is needed, e.g. when picture enhancement features are used, the TDA6107 can be replaced by a TDA6108.

The outputs of the video amplifiers are connected to the picture tube via special flash-proof resistors.

All tube electrodes, not connected to ground, contain a spark-gap connected to the aqua-dag ground. The focus spark-gap is integrated in the tube socket connector. The aqua-dag ground is connected to the ground of the line transformer. This configuration has been selected to keep flash-over-currents in a loop as small as possible.

More information about the RGB outputs and black current loop can be found in ref.[3] report no: AN98002 page119. Additional information about the video amplifier can be found in ref.[4] report no: AN96072.

3. MICRO CONTROLLER.

The micro controller socket is implemented with GTV pinning (Global TeleVision). With this GTV convention different types of micro controllers like SAA5290/96 (ETT), P83C052 (MTV), P83CE366 or P83C196 can be used. APPENDIX 2 shows the pin layout of Philips' popular micro controllers for the consumer television market. With some simple precautions any of the four types shown can be used (see chapter on page 27). In the GTV1000 chassis the micro controller environment can be configured by changing components and solder jumper settings. Together with the versatile TDA884x one-chip family it is possible to develop ONE chassis for multiple markets, that can be optimized for local requirements.

The circuit diagram of the micro controller part can be found in APPENDIX 3. Most I/O pins have series resistors of 100 .. 470Ω. This is done for EMC reasons, to filter unwanted radiated signals from the micro controller. All open-drain outputs have pull up resistors of 3K3 or 15K.

The following table shows the supported PHILIPS micro controllers.

TABLE 4 Supported PHILIPS micro controllers.

Type number	Description	Software Package
P83C053	Micro controller for Television and Video (MTV).	CTV271 / CTV272.
P83Cx66 / P87Cx66	Single chip 8 bit micro controller for TV.	
P83Cx70	Micro controller for NTSC TV with OSD and Close Caption	CTV828.
SAA529x / SAA549x	Micro controller for TV with OSD and One Page Economy Teletext.	CTV832.

By means of jumpers and some component changes, this receiver can be configured for one of the listed micro controllers. The different configurations are explained in this sub-section.

3.1 Universal micro controller interface description.

To simplify a TV hardware platform which can demonstrate all PHILIPS Micro Controller types, an universal pin definition is defined. In a global TV chassis, this pinning can be used to minimize hardware modifications necessary to configure the set for different market segments. For example the:

- ETT in Europe to support Teletext.
- P83Cx70 for the American market to support Close Caption.
- MTV for the low-end sets without teletext.

In this sub-section the functional description of the micro controller input and output lines (I/O-lines) is given. Although the functionality of the pins are discussed in the software manuals of the used software packages the VST-tuning voltage output pin1, Service / Factory input pin35/45, Stand-by input pin13/21 and Reset input pin33/43 are discussed in detail.

3.2 VST-Tuning voltage control output (Micro-controller pin1 application).

With VST the translation from tuning voltage into tuned frequency is far from linear, the tuner steepness e.g. in UHF can vary from 3 to 30 MHz/V (a factor 10 !). It is NOT possible to linearize a tuning curve accurately in software, because of wide tolerances on tuner-vari-cap curves (even within one batch).The tuning resolution must be better than 62.5 kHz (like in PLL tuner systems), because more miss-tuning will be visible on the screen. For UHF (400 .. 850 MHz) a 14-bit resolution is used. Assuming a LINEAR tuning curve would give 450000/16348 = 27.5 kHz/step. But since the tuner steepness can vary by a factor 10, it is better to use a non-linear integration filter (see APPENDIX 3) . This linearizes the tuning curve, reducing steepness variation to a factor 4. The result is about max. 50 kHz per step (is better than 62.5 kHz).

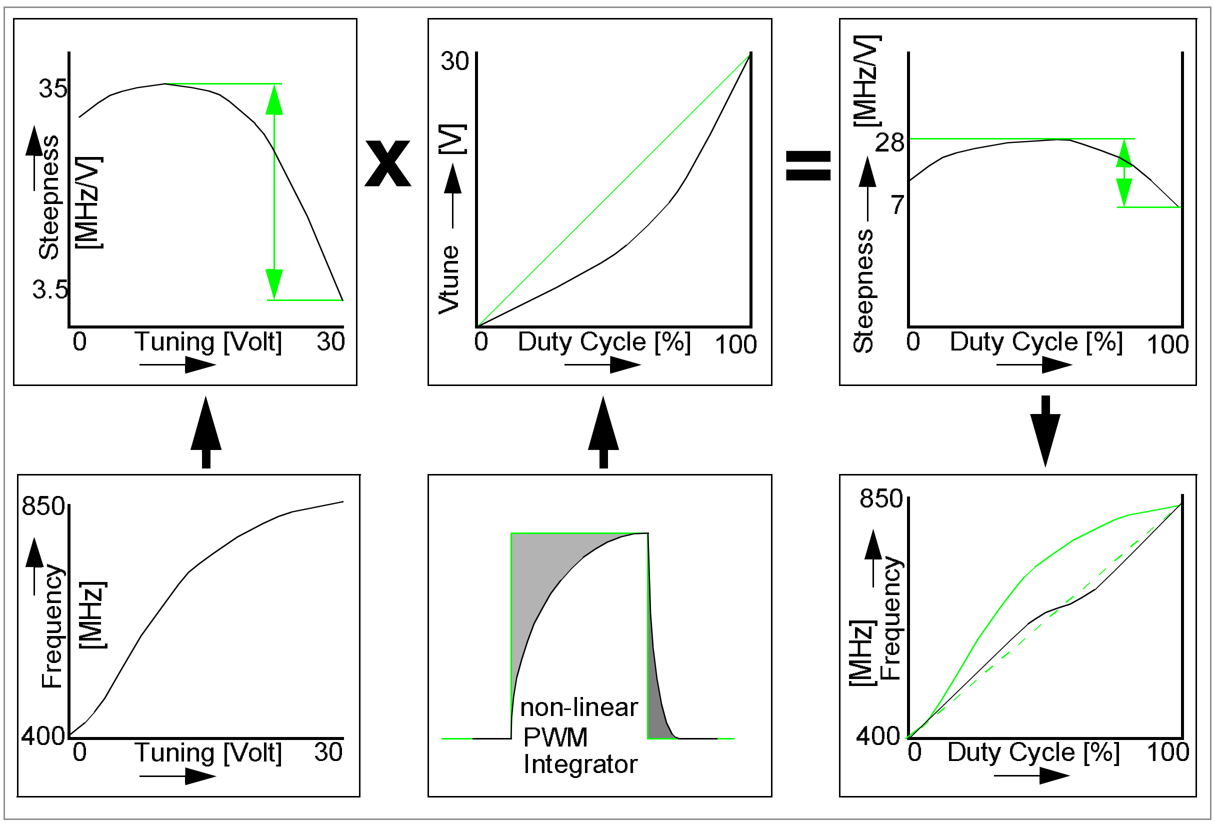


Fig.12 VST tuning curve linearisation for UHF band

After linearisation, a VST system has a more constant step size, but still a variation of a factor four. If a ‘step’ is calculated (worst case) to give 1 MHz frequency increment, the less steep areas will render a fourfold smaller step, so four times slower too.

After each value change, the tuning PWM DAC needs 128 x 42.66us = 5.5ms to produce the new pulse pattern. When the non-linear integration filter has T=5, each tuning step must be followed by a delay of 30 .. 50ms.

3.3 Service connector and Factory mode.

The Service connector P203 (see chapter 'The GTV1000 board." on page 10), gives access to the two (split) I^2C-busses plus the possibility to inactivate the micro controller (service and factory mode). The Service Line is connected to an interrupt pin of the micro controller. This makes it possible in future software packages to implement some kind of protocol e.g. to a factory computer.

When contact "Service" of the service connector is short-circuited to ground during 250ms, the software shows a service menu. The configuration and geometry parameters can now be modified, using a standard remote control or the local keyboard. In service mode, the video processor protections are disabled to avoid RGB_{OUT} blanking. This is easier during repair actions.

When the short circuit lasts longer than 500ms, the software enters the Factory mode. It stops the continuous update via the I^2C-bus and OSD is suppressed. Now a factory production computer can read or write into the EEPROM. When a command from remote control or local keyboard is received, all devices are updated and the processor releases the I^2C-bus again. In this way the non-I^2C-bus controlled outputs of the micro can still be controlled. When the service contact is released the software resets the set automaticly.

APPENDIX 3 shows that the signal "Service" is also used as an EEPROM write protect line. Dependent on the applied type EEPROM, a certain area can not be written, while "Service" is high. This gives extra protection against accidental over writing e.g. alignment data. If the micro controller wishes to write data to the protected area, it will temporarily pull down the Service-line.

3.4 Standby command line "On_$\overline{\text{Off}}$".

Open drain output/input, used to switch the power supply between standby mode and normal operation. When the pin is externally pulled low, this is interpreted as a command to go into standby mode. With this, a local standby key can be implemented.

- Output low = Power supply in standby mode
- Output high, input high (> 3.5 Volt) = Power supply on
- Output high but input pulled low (1.0 .. 1.5 Volt) = Power still on, but local command to go to standby

3.5 OSD outputs FBL, R, G and B.

These outputs have a push-pull outputs for fast OSD transitions. Pin FBL is used as a fast blanking signal and connected to the fast-blanking input of the RGB-switch (see chapter 'RGB input/switch." on page 23). A low output indicates absence of OSD and a high output represents a colour or blanking active. Synchronization input signals Hsync and Vsync are derived from the deflection part to get a stable OSD picture on the television screen. The polarity of these signals is active high.

3.6 I^2C-bus control input/outputs SDA, SCL, SDA1 and SCL1.

These pins are respectively the data and the clock wires of 2 (split-bus) single-master bidirectional I^2C-busses. When the I^2C-bus appears to be blocked the stand-by LED will start blinking. If the bus remains blocked for a longer time (e.g. 5 minutes) the TV-set will go into standby.

SDA1 and SCL1 are only connected to the EEPROM and the TDA884x, to avoid problems with I^2C-bus slave devices blocking the bus e.g. when a power supply voltage fails. With this split-bus system it is now possible to derive supply voltages from the line output transformer (LOT). Further a split-bus construction decreases the chance of data corruption in the EEPROM.

3.7 Reset and supply-voltage-guard circuit.

This demo receiver has a sophisticated reset and supply voltage guard circuit, which triggers the micro controller reset and EEPROM power supply. Most micro-controllers have a internal power-supply guard which will generate an internal reset once the supply-voltage drops below a threshold level. During this reset the outputs do have a defined output condition (most of the time floating). However when the supply falls further, even the internal circuits of the micro stops functioning. This may lead to unpredictable bouncing of the outputs. Because the I^2C-bus is controlled by such outputs, a burst of pulses can appear on the clock and data-lines. This can lead to un-wanted write actions, because some EEPROMs keeps on functioning at very low supply voltages.

Once the supply-voltage starts to fall, an external reset is generated before the internal reset becomes active (even if the supply has a falling glitch the external reset will get a defined duration). At the same time the EEPROM supply voltage is switches-off.

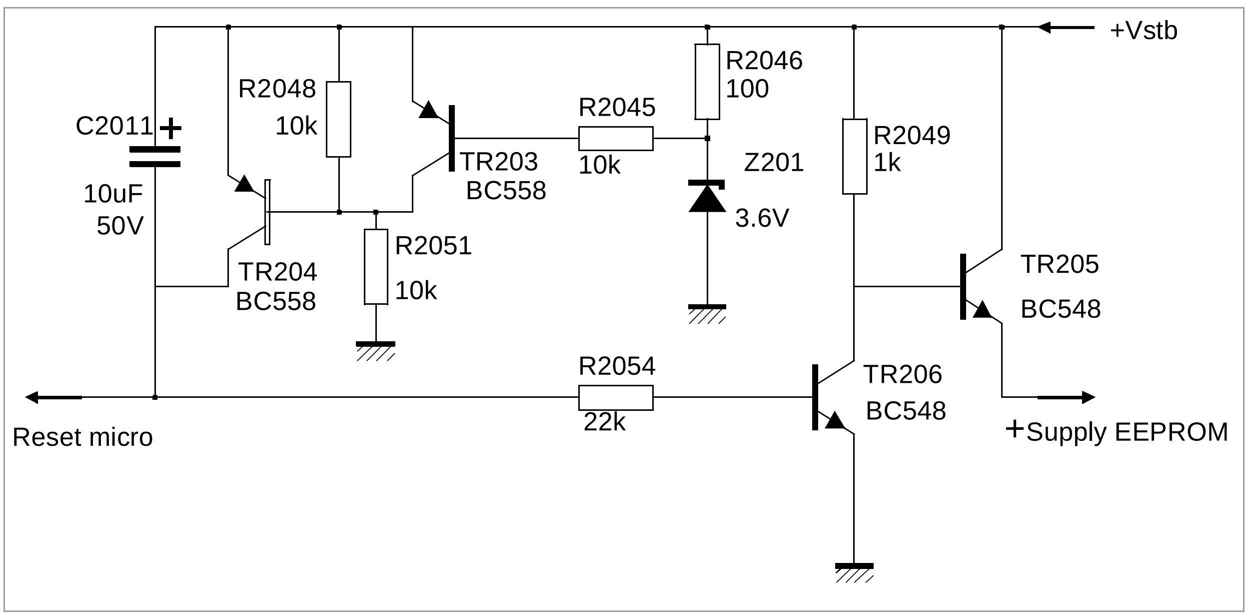


Fig.13 Reset and Voltage guard circuit.

The circuit description refers to the previous picture. Advantages of this circuit are the:

- well defined reset duration after reaching a well defined supply voltage.
- guaranteed reset pulse even after a short supply voltage dip.
- power control of the EEPROM.

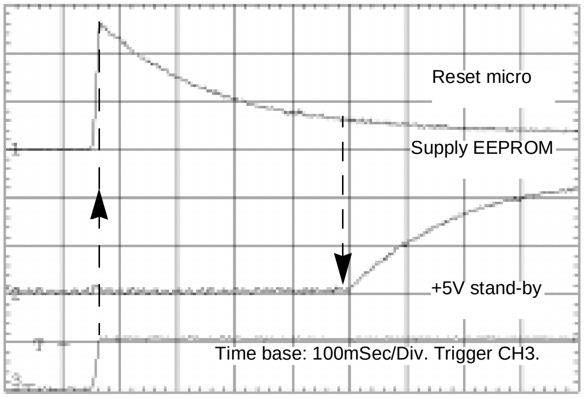


Fig.14 Reset signal during start-up.

The reset input of the micro controller is active high. During start-up of the supply voltage Vstb, TR203 is switched off and consequently TR204 starts conducting. This forces the reset input to follow Vstb. This status remains, until Vstb reaches the threshold level of 4.2V (U_{Z201} + $U_{be\ TR203}$). Starting from this level, TR203 starts conducting and TR204 switches-off. Now C2011 will be charged via the pull down resister[1] inside the micro controller and resistor R2054. This guarantees a sufficient reset pulse duration, after reaching the valid supply voltage.

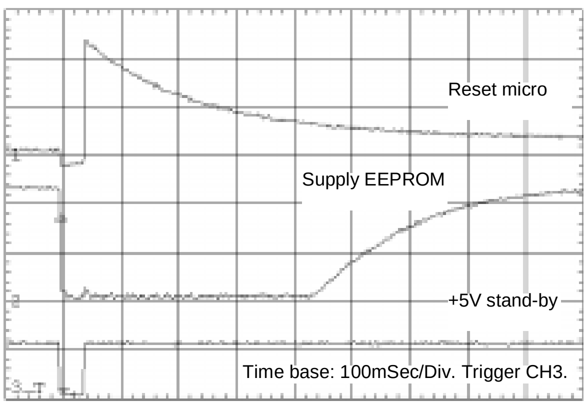


Fig.15 Reset signal during a power dip.

If the supply voltage falls below the threshold voltage, TR203 switches off immediately and TR204 switches on. This discharges C2011 and activates the external reset of the micro controller. Even for short supply voltage drops (below threshold level), a well defined external reset is guaranteed.

The EEPROM supply voltage is also controlled by the reset pulse to protect the EEPROM data during power up, shut down and/or supply glitches. This prevents uncontrolled write actions as a result of bouncing of the I^2C data and clock lines.

3.8 Micro hardware environment configuration.

In this subsection the hardware aspects for the micro environment configuration are give. For each of the supported micros, a detail of the copper (bottom-side underneath the micro) has been included on wich the jumpers to close are marked.
Besides setting of the jumpers, it is necessary the change some components in some of the configurations. The critical one are marked on the copper layout details. The bill of material (BOMs) gives the complete information about the micro related components such as not assembled components around the 42-pins micros (MTV and P83Cx66).

3.8.1 Stereo-playback hardware configuration.

For the sound-options the sound-processor/mono option is shown. The stereo play-back function is discussed here because it is micro independent.
Fig.16 shows the location of the jumpers and resistors involved. Close jumper J201 and open J202. Now assemble resistors R2019, R2025 and R2030.

1. The value of the internal pull-down resister is micro controller type dependent. This resistor is 8K inside the P83Cx70 and 550K for the ETT micro processor.

3.8.2 P83C053 (MTV) Micro controller configuration.

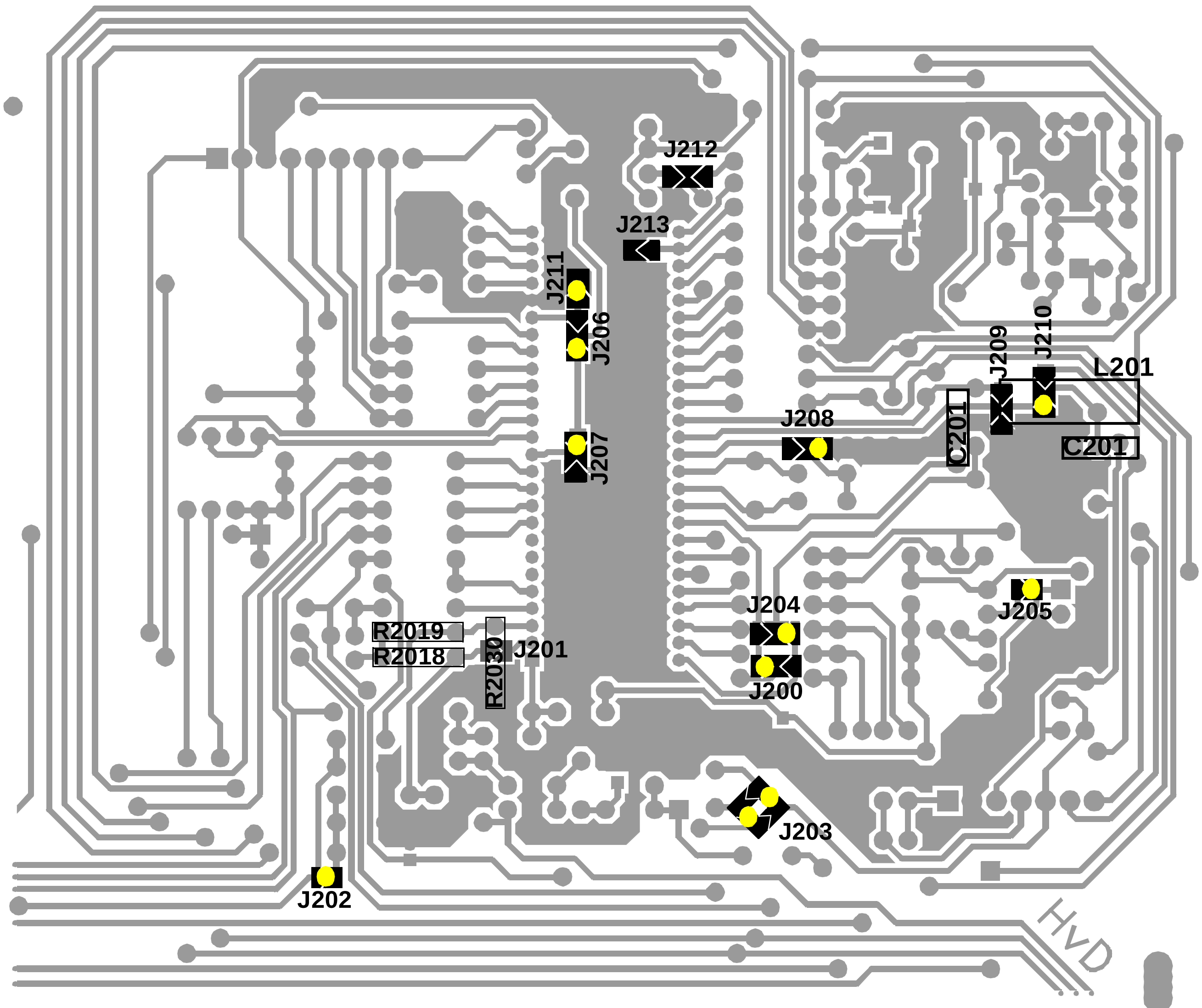


Fig.16 P83C053 (MTV) Micro controller configuration.

The MTV needs additional components for the OSD-oscillator. L201 = 22microH and capacitors C2014 and C2015 are 22pF.

3.8.3 P83Cx66 Micro controller configuration.

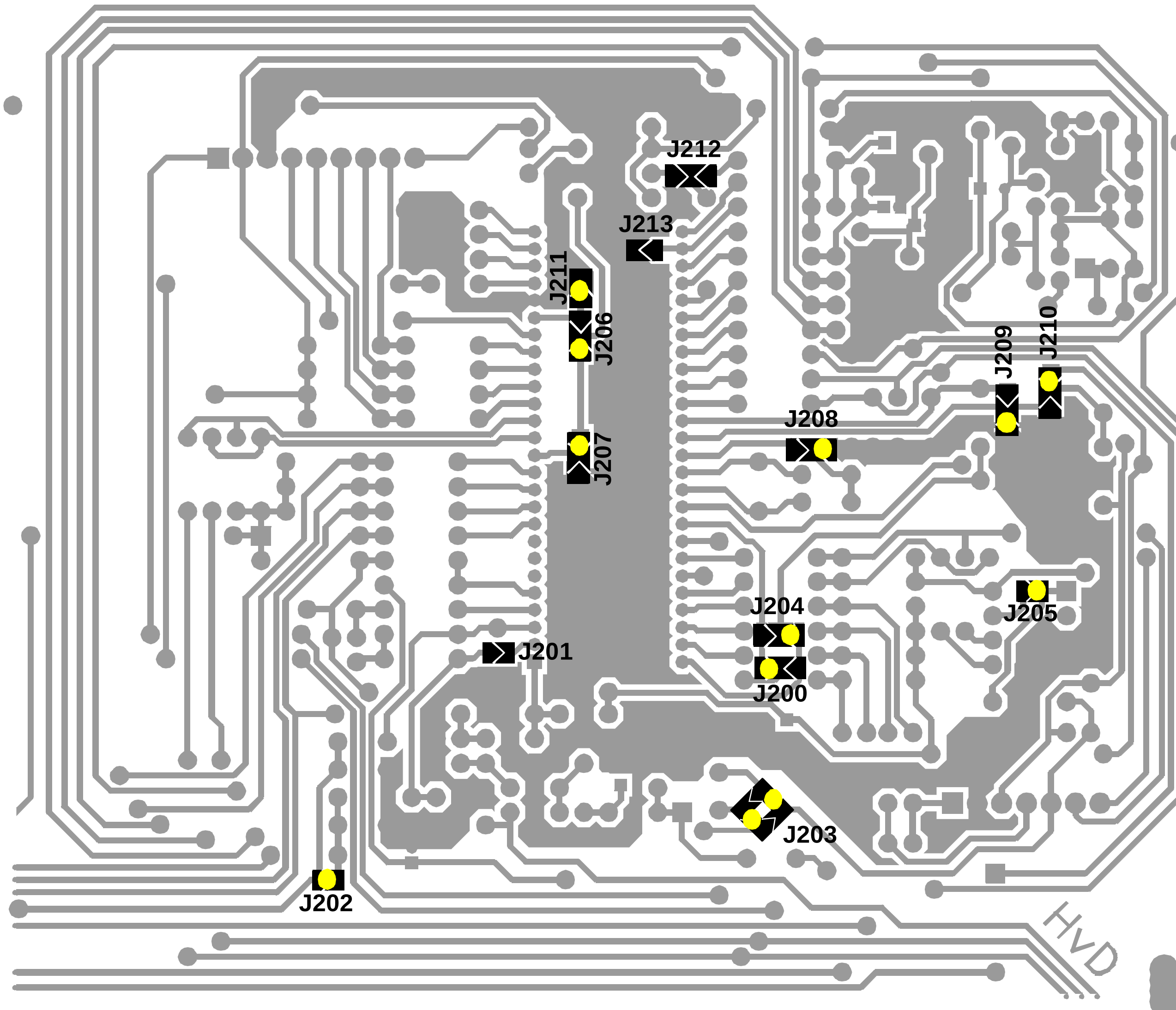


Fig.17 P83Cx66 Micro controller configuration.

The RGB-outputs of this micro are push-pull current sources which can deliver 8mA. This maximum current can be controlled by software to align brightness of the OSD. By means of a resistor (0.82K) to ground (instead of C2019, C2020 and C2021) the R, G and B output current is converted into a voltage which is fed to the RGB switch. The OSD brightness can be set by changing this resistor. The higher the value the higher the OSD brightness.

3.8.4 P83Cx70 Micro controller configuration.

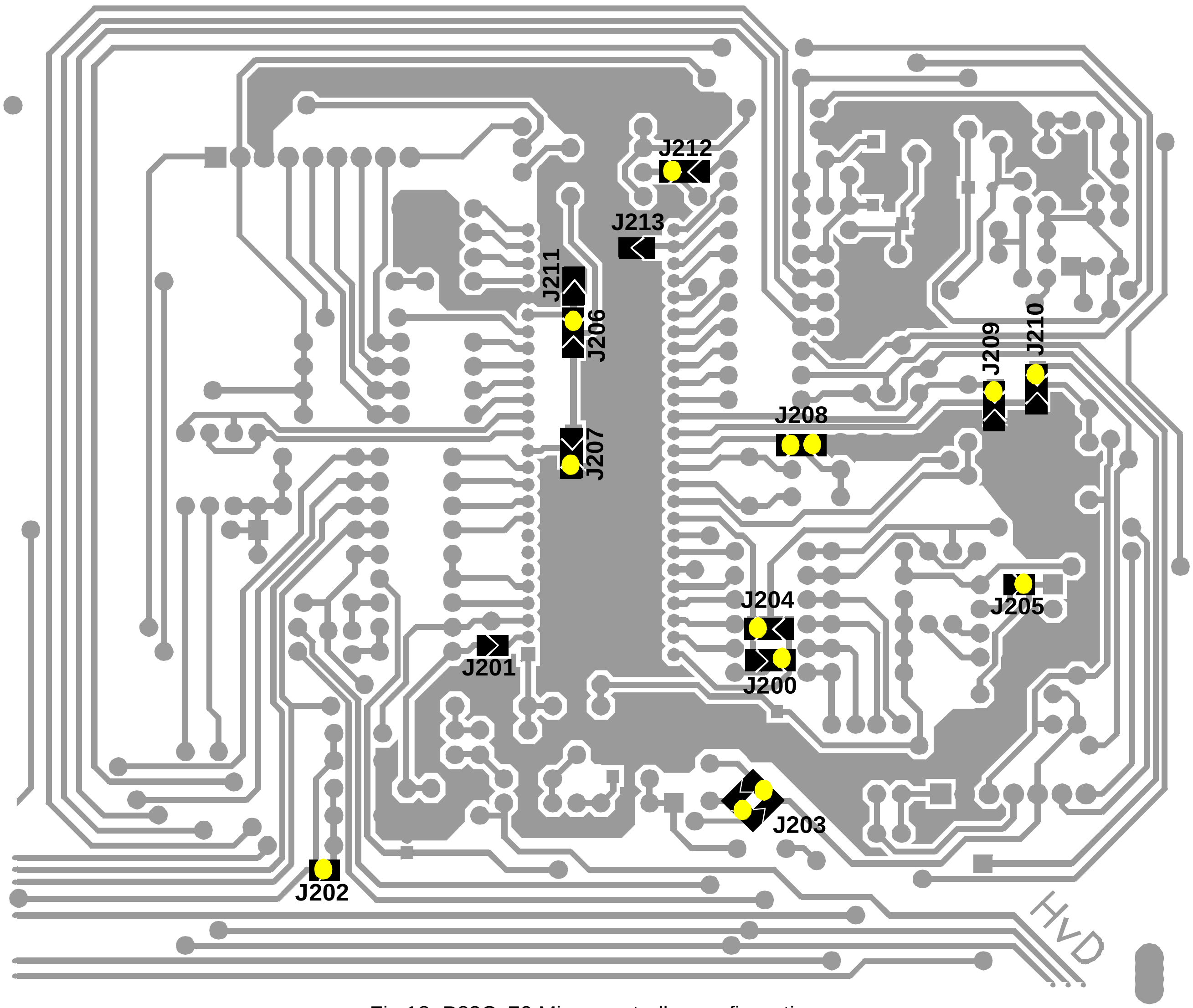


Fig.18 P83Cx70 Micro controller configuration.

The RGB-outputs of this micro are push-pull current sources which can deliver 6mA. This maximum current can be controlled by software to align brightness of the OSD. By means of a resistor (1K) to ground (instead of C2019, C2020 and C2021) the R, G and B output current is converted into a voltage which is fed to the RGB switch. The OSD brightness can be set by changing this resistor. The higher the value the higher the OSD brightness.

3.8.5 SAA549x (ETT) Micro controller configuration.

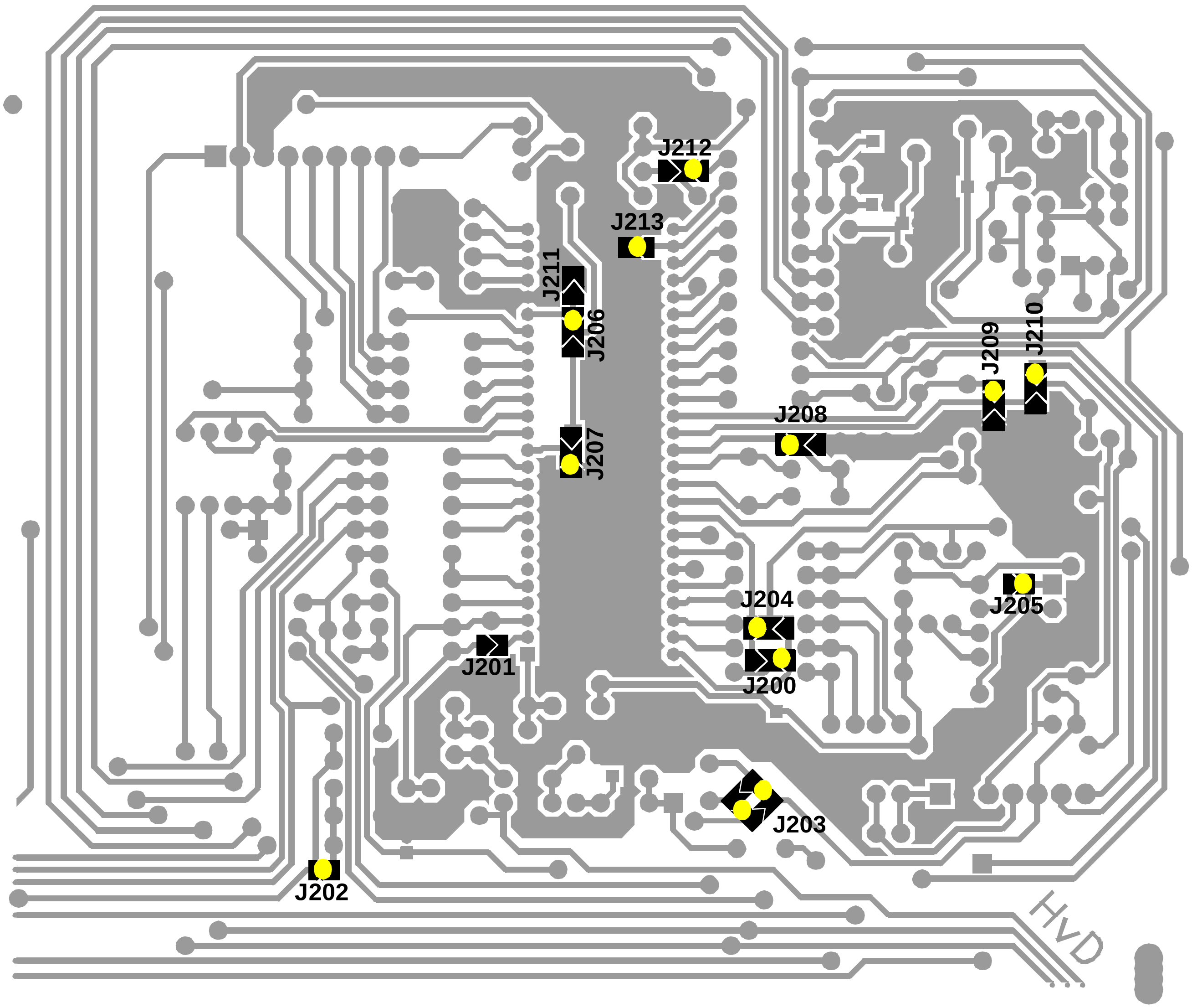


Fig.19 SAA549x (ETT) Micro controller configuration.

3.9 Software package.

As said, the GTV1000 can be controlled by four different types of micro-controllers. For these devices we have different demonstration software packages. For detailed user information about these packages we refer to the user manual. The following table illustrates the micro / software package and user manual reference number.

TABLE 5 Micro controller versus software package.

Micro controller type	Software package	User manual reference.
P83C053	CTV271 / CTV272.	ETV/UM 97012.0 / ETV/UM 97011.3 (see [13]) and (see [14]) .
P83Cx66 / P87Cx66	-	
P83Cx70	CTV828	ETV/UM 98013.1 (see [15])
SAA529x / SAA549x	CTV832	CTV832S/ CTV832R (see [16])

4. LARGE SIGNAL.

4.1 Power supply.

The power supply is a mains insulated flyback converter supporting the full mains range. The supply is built around the TDA8380A Switch Mode Power Supply controller. It operates at a fixed frequency of 28.8 KHz and in a discontinuous current mode. The output voltages are controlled by duty-cycle modulation of the primary current.

The mains insulation is provided by a SMPS transformer for power transfer and an opto-coupler for the feedback from the secondary side. The feedback information guarantees good stable output voltages.

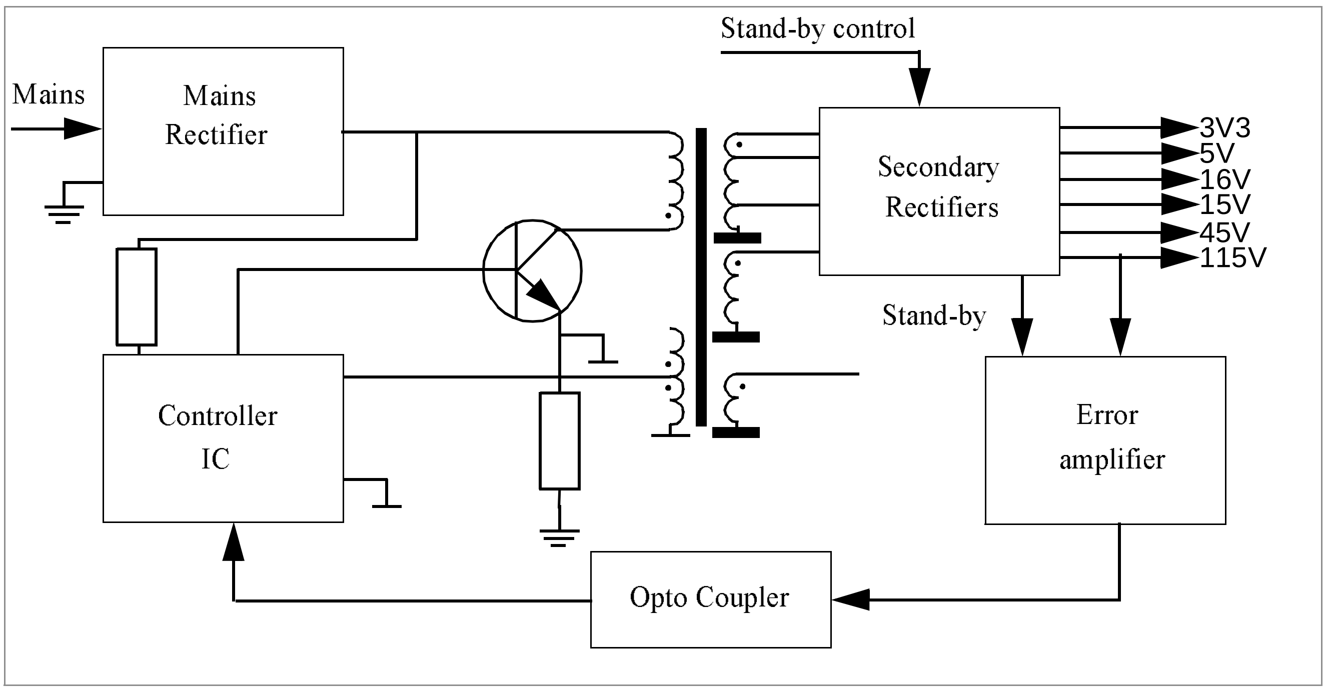


Fig.20 Block Diagram of the power supply.

The principle of a flyback converter is simple, see Fig.20. However we have to deal with non-ideal components. These make the realisation more complex. The TDA8380A SMPS controller IC supports several control and protection functions to handle the complexity more easily.

The mains voltage is rectified and supplied to the SMPS transformer. The primary current is controlled via the power switching transistor. Modulation of the on/off time (duty cycle) controls the output voltages of the SMPS transformer. The 115V supply voltage (line deflection supply voltage) is used as feedback information. Via an error amplifier and opto-coupler the control signal is fed-back to the TDA8380A at the primary side of the supply.

During start-up, the controller is supplied by the rectified mains via a series resistor. Once operational, the controller gets its supply from the auxiliary winding of the SMPS transformer.

Via the stand-by control line the 15V can be switched on and off. If switched into stand-by, the supply reduces its output voltages to 60% of their nominal value.

The TDA8380A is available in a 16-DIL package and incorporates the following features:

- Internal stabilized supply voltage
- High and low supply-voltage protection
- External programmable reference currents
- Operating frequency 10 to 100KHz
- Access to pulse-width modulator to facilitate use of an alternative external error amplifier
- Fail-safe control loop
- Duty factor fold back
- Slow-start or soft-start option.
- Direct-drive output stage
- First level cycle by cycle over-current protection
- Second trip over-current protection
- Protection against power transistor short-circuit
- Demagnetization sensing

The following table shows the pinning of the TDA8380A.

TABLE 6 pinning of the TDA8380A

Pin:	Function
1.	Positive drive output.
2.	Supply voltage of drive output stage.
3.	Demagnetization sense input.
4.	Minimum Vcc threshold setting.
5.	Supply voltage Vcc.
6.	Reference current setting.
7.	Feedback input.
8.	Output error amplifier. Not used in this application.
9.	Pulse width modulator input.
10.	Oscillator capacitor.
11.	Synchronisation input. Not used in this application.
12.	Maximum duty factor (Dmax) setting combined with slow start time programming.
13.	Input current protection.
14.	Ground.
15.	Emitter of output sink transistor.
16.	Collector of sink output.

4.1.1 Circuit description of power supply.

Diodes D903 .. D906 rectifies the mains voltage which feeds buffer capacitor C9010 via a series resistor. This resistor reduces the inrush current during switch on. The diodes are shunted by four capacitors to smooth their switch-off behaviour to reduce mains interference.

To supply the SMPS controller during start-up series resistor R9008 charges C9016. Once reaching the fixed threshold level of 17V, the TDA8380A starts-up the supply. Capacitor C9016 delivers the supply for the controller and transistor base-current, until the auxiliary winding voltage is sufficient to take over the SMPS supply. The following two criterion are considered to dimension C9016:

- Its minimum value must avoid under-voltage lock-out.
  Before taking over, the voltage at C9016 will fall, so the value of C9016 must be sufficient to bridge the period during start-up. This means, once the controller supply voltage falls below the minimum operating voltage of 8.4V, the controller switches off again. Operation below 8.4V is not allowed because the base-drive to the power transistor BUT11A cannot be adequately defined.
- Its maximum value depends on the maximum allowed start-up time.
  To start the SMPS, the U_{C9016} must exceed 17V. The charge current depends on the mains supply voltage and the value of resistor R9008. So the maximum start-up time is found at the lowest mains supply voltage. Decreasing R9008 will improve start-up time, but decreases the efficiency as well.

Beside the controller part, also the primary winding of the SMPS transformer is connected to the rectified mains (+VB). The other side of the winding is attached to power switching transistor TR901. Parallel to this winding a dV/dt limiting network R9002, R9005, C9005 and D900 is connected to protect the power transistor. The maximum dV/dt value for this transistor is 1000V/uS. Resistor R9002 has two functions:

- to discharge C9005 prior to each flyback.
- to damp the transformer ringing which follows each fly-back. This damping must be sufficient to suppress the recurrence of positive pulses at the demagnetization input to the IC during the next oscillator cycle.

To control the output power of the SMPS, the primary current through the transformer is switched. The needed base drive of the bipolar power transistor consist of two separated drives:

- a forward drive to switch on the transistor. The forward base-current can be adjusted by resistance R9022 and R9019. This construction is used to reduce power dissipation in the forward drive transistor of the SMPS controller. For the used transistor the typical base current is 0.5A for the duration of the duty-cycle. The nominal take-over supply voltage is close to 20V. So the nominal base-current is about 20/30 = 0.67A.
- a reverse drive to switch off the transistor. To ensure minimum transistor dissipation, a negative going base current is needed. This requires a negative supply voltage (with respect to the transistor's emitter). Capacitor C9022 acts like such a voltage source. It will be charged by the positive base current and zener diode D910 limits the voltage to 5V1. Inductor L906 limits the dI_{base}/dt ensuring a nominal storage time of about 1uS. R9024 avoids switching of the transistor during the dead time of the clock cycle. During this time both forward and reverse outputs are floating. R9025 damps ringing of inductor L906 and D912 protects the SMPS controller output transistor against electromotive force (EMF) generated by L906.

To control the line deflection supply voltage with 1% accuracy, the secondary +115V output voltage delivers feedback information. This information will be processed in a differential amplifier formed by TR902 and TR903. The base of TR902 is connected to the reference voltage U_{D916} (5V6) and R9043. Via this resistor, beam-current related information is added to compensate the horizontal picture width modulation caused by the average beam-current (See chapter 4.4, page 49). This width gets larger at higher beam-currents. To compensate for this, the horizontal deflection voltage will decrease as function of the beam-current.

Via the base of TR903, the divided +115V output voltage is added to the differential amplifier. The divider is formed by resistors R9034, R9037, R9040, R9045 and R9041. Via R9045 the output voltage can be adjusted. During normal operation transistor TR904 is conducting and the base level is calculated from: {(R9040+R9045)//R9041} / [R9034+R9037+{(R9040+R9045)//R9041}] * +115V. The result is [4 / {68+3,9+4}] * 115V = 6V.

The added diode D914 prevents the +8V to fall once the +115V output is unloaded. In this situation, the output capacitor will integrate the voltage over-shoot at the transformer output caused by transformer ringing. This ringing should lead to 10 to 15% higher output voltages, however the feedback loop corrects this. This correction results to 10 to 15% less output voltage at the loaded low voltage outputs. This will happen during stand-by operation of the TV chassis. Once the +16V falls below +12V, the feedback information will be adjusted to track with this +12V. This take-over voltage is calculated by: {(R9040+R9045)//R9041}+R9037 / [R9034+R9037+{(R9040+R9045)//R9041}] * 115V.

To reduce the stand-by power consumption, TR904, R9041 and capacitor C9035 were added to the feedback input of the differential amplifier. During stand-by, resistor R9041 is de-coupled from the +115V feedback divider. Now the feedback voltage becomes:
(R9040+R9045) / [R9034+R9037+R9040+R9045] * 115V = 9V. The differential amplifier corrects this so that the outputs will drop by about 40%. Only D914 can overrule this output voltage reduction.

To improve the start-up coming from the stand-by mode, capacitor C9035 has been added to guarantee a smooth transition.

The input LED of the opto coupler is controlled by TR903. The collector of TR903 is connected to the cathode while the anode is supplied by a stabilized 8V2 supply voltage. Increase of the +115V output gives more LED-current. As a result the opto coupler’s output transistor starts to conduct more, causing a reduction of the input voltage at the duty-cycle control pin. Now the controller starts to reduce the duty-cycle of the primary supply current.

The following part describes the application topics to realize the SMPS protections:

- Slow-start:
  The slow-start time is programmed via capacitor C9029. It controls the speed of the duty-cycle build-up, preventing current and/or demagnetization protection during start-up. This guarantees a smooth start-up behaviour. The value of this capacitor is a trade off between two situations:
  -The minimal value for this capacitor can be found by checking the current and/or demagnetisation protection signals at the minimum and maximum mains supply input voltages.
  -The maximum value for this slow-start capacitor is related to the buffer capacitor at the controllers power supply (C9016). Increasing the slow-start time also increases the TDA8380A power supply take-over time. To guarantee no under-voltage lockout, C9016 must increase accordingly.
- Maximal Duty cycle:
  To avoid the continuous current mode operation of the SMPS a maximum duty cycle can be programmed via resistor R9027. The maximum duty-cycle is programmed to be 60%.
- Current protection:
  The current protection can be programmed by resistors R9028, R9029, R9030, R9033 and R9032. Resistors R9028 .. R9030 are sensing the emitter current of power transistor TR901. Because the emitter of this transistor is directly connected to the reference ground of the SMPS controller, the base-emitter voltage is independent of the voltage drop over these sense resistors.
  Resistor R9032 and R9033 define a DC-offset voltage at the current protection I/O pin (with respect

to the reference ground). The emitter current of TR901 flows through current sensing resistors R9028 .. R9030. The positive side is connected to the reference ground, while the negative side is connected to pin13 via resistor R9033. If the emitter current increases this causes the voltage level at pin13 to drop. Once reduced to 200mV, the cycle by cycle current protection is activated. At 0V, the supply will be switched-off immediately and will re-start via the slow-start procedure.
The maximum primary current depends on the maximum current specification of the used SMPS transformer (3Amp) and not on the used power transistor BUT11A. For this chassis the current is limited at 2.5A.
Resistor R9032 is added to realize a current fold back due to over-loading one of the SMPS outputs. If a cycle by cycle over-current protection is present, this will result in a lower output and auxiliary voltages. Reduction of the auxiliary voltage reduces the DC-voltage at the current protection pin and herewith the maximal allowed current.

- Over-voltage protection
  The outputs of the SMPS are protected against an over-voltage condition. This can be the result of a defect feedback circuit.
  Via resistors divider R9014 and R9020 the over voltage protection pin (pin7) is connected to the auxiliary winding, in order to monitor the output voltages of the transformer. Once the voltage at input pin7 exceeds 3.2V, the controller switches off and re-starts via the slow-start procedure. During nominal operation this voltage is R9020 / (R9020+R9014) * 20V = 15/106 * 20 = 2.8V.
- Demagnetization protection
  Via resistor R9015 and R9018 the un-rectified auxiliary winding voltage is used to monitor the stored magnetic energy in the SMPS transformer. This must prevent cumulation of magnetic energy inside the transformer. Before starting the next SMPS cycle, the remaining energy must be zero preventing saturation of the SMPS transformer. A saturated transformer results in a very high primary current which can damage the power switching transistor.
  A voltage above 0.6V at the demagnetization input will prevent the power transistor from switching. At the auxiliary winding the switching level is calculated from: R9018/(R9015+R9018)xV_{aux}<=0.6V. V_{aux}<=(11K2/1K2)*0.6V gives 5.6V. This threshold level is chosen to prevent triggering of this protection due to transformer ringing.

The secondary side supports the following output voltages:

- 115V, used to supply the horizontal line deflection.
- 45V, used for the vertical retrace supply voltage.
- 15V, used for Vertical scan supply and audio output amplifiers.
- 8V, used to supply the video processor.
- 5V or 3.3V, used to supply different types of micro controllers, tuner and additional hardware to control the chassis. The output voltage is programmable via resistor divider R9017 and R9023. See the next table for the proper values.

TABLE 7 5V / 3.3V $_{micro}$ resistor values

R9017	R9023	Output voltage
2K4	3K3	5V
1K	3K	3.3V

- 5V / 3.3V $_{stand\text{-}by}$, used to supply the micro controller. This supply is programmable by resistor divider R9004 and R9006. See the next table for the proper values.

TABLE 8 5V / 3.3V $_{stand\text{-}by}$ resistor values

R9004	R9006	Output voltage
2K4	3K3	5V
1K	3K	3.3V

Although this name suggests to be the only stand-by supply, both 5V/3.3V supplies remain powered during stand-by operation. This because most micro controllers must be powered at all its supply pins (Vdd $_{core}$, Vdd $_{peripheral}$ and Vdd $_{analog}$).

Transistor TR900 switches the power supply between normal and stand-by operation. The base current is controlled via a transistor, which is controlled by the on/off-output-pin of the micro controller. Removal of the micro controller results in a normal operation of the power supply. This makes it possible to control the chassis via a personal computer, without extra handling to switch-on the supply.

4.2 Horizontal deflection.

4.2.1 Low voltage horizontal deflection driver circuit.

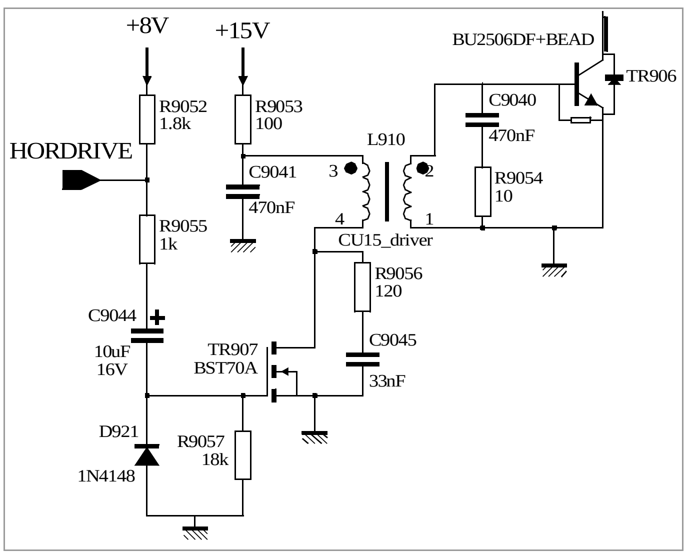


Fig.21 Horizontal drive circuit

The horizontal driver stage requires a 16V supply voltage. The horizontal drive current is extremely low, because of Field Effect Transistor TR907. The horizontal drive is AC coupled via C9044, which prevents excessive power dissipation during stand-by operation.

The selected BU2506DF horizontal output transistor features a:

- a current gain of 5.5x.
- build in efficiency diode ($I_{forward\ max.}$: 3.0A).
- build in resistor between base and emitter of 60Ω.
- isolated package.

Fig.22 shows the signal relationship between the horizontal drive, horizontal flyback, gate source voltage of TR907 and the primary current of L910.

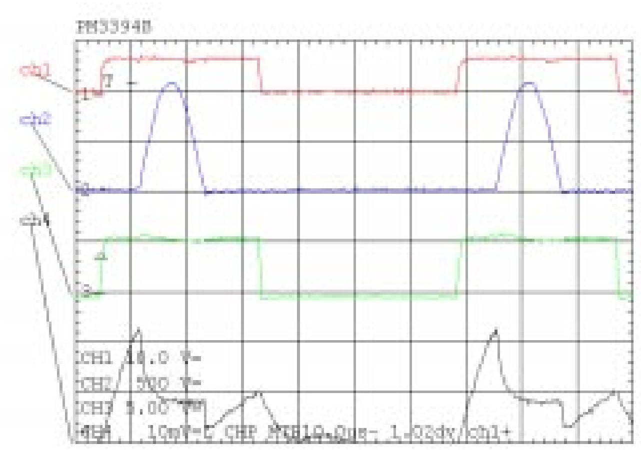


Fig.22 L910 primary signal shapes.

. Legend:

- ch1: HORDRIVE.
- ch2: $U_{Collector}$ of TR906.
- ch3: U_{gs} of TR906.
- ch4: I_{drain} of transistor TR907. Scale: 200mA/ Div.

Once the Hordrive signal is high (CH1), TR907 starts conducting. This results in a rising current at the primary side of transformer L910 (CH4). Now, energy is stored into the core, because the base-emitter diode of TR906 prevents a current to flow at the secondary side.

Resistor R9053 determines the stored energy thus the base-current for TR906. Increasing the resistance value, reduces the base-current. The maximum base-current is set to 600mA, which is sufficient to drive a peak-collector current of about 3A. The average deflection current through the collector of TR906 is about 2.5A.

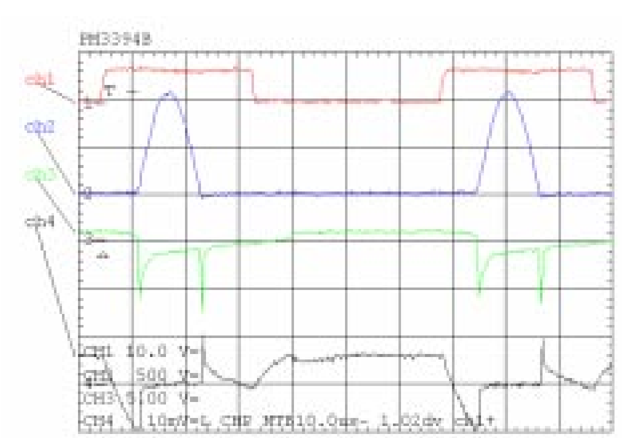


Fig.23 L910 secondary signal shapes.

After a high to low transition of the Hordrive-signal, TR907 will switch-off and a flyback pulse at the secondary side of L910 turns-on transistor TR906. Fig.23 shows the signal shapes at the secondary side of the driver transformer.

Legend:

- ch1: HORDRIVE.
- ch2: $U_{Collector}$ of TR906.
- ch3: U_{be} of TR906.
- ch4: I_{base} of transistor TR906. Scale: 1A/Div.

If Hordrive becomes high again, the output current of L910 changes polarity and TR906 starts to switch-off. This should not to be done too fast to avoid hot-spot effect in TR906. To assure a correct storage time of at least 4.5uS, the driver transformers has a leakage induction of about 9uH at its secondary output winding. CH4 in Fig.23 illustrates the base current of TR906. The duration of the negative going edge (600mA down to -1A) represents the storage time, here about 5uS.

CH3 in Fig.23 shows the base voltage of TR906. The negative going spikes occur when the base current reaches zero. Now the transistor’s base emitter junction enters its reverse breakdown. The voltage ratio between primary and secondary winding of L910 is 7.3:1 (+/-5%).

The preferred horizontal deflection yoke specifications are:

- Inductance: 2mH.
- Resistance: 2,3Ω.
- Maximum allowed current: 3,1A.

4.2.2 Horizontal flyback feedback circuit.

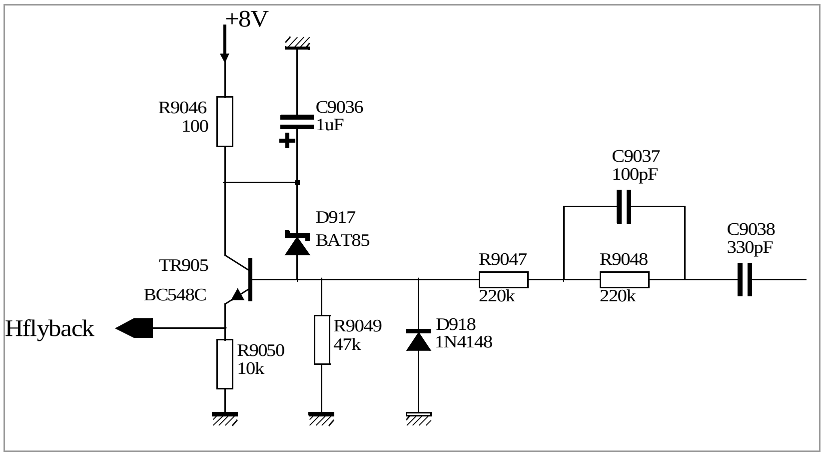


Fig.24 Flyback adapter circuit

To control the phi-2 phase locked loop circuit, the video processor needs an input signal called Hflyback. This signal is generated by the circuit shown in (see Fig.24) . It supports two different threshold levels:

1. 30V for the rising edge. This level can be selected more or less by R9047, R9049 and capacitor C9037.
2. 400V for the falling edge. The hysteresis between rising and falling edge levels can be tuned by C9037, C9038. Decreasing C9037 and increasing C9038 will lower this 400V threshold level.

Because of non-ideal components in the horizontal output stage, the flyback pulse-shape (at C9039) is beam-current dependent. The selected switching levels improve the stability of the generated Hflyback pulse width, resulting in less horizontal jitter. Shifting of the slicing levels makes the Hflyback pulse smaller. This affects:

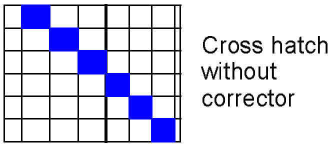
- the horizontal picture position which can be corrected by the horizontal shift control.
- the horizontal blanking. Usually the influence of this blanking is not visible because it normally stays within the over scan. A too small pulse will show retrace-lines at the left-hand side of the screen.
- the horizontal start position of the OSD. If the falling edge of the Hflyback pulse is used by the OSD generator, a shift will affect the horizontal start position on the screen. Most micro’s do have a register to align this position.

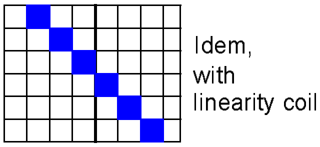
Schotky diode D917 prevents saturation of TR905. This improves the turn-off switch behaviour of this transistor. (Ube + Uec + Uka = 0 -> Ube = Uce+Uak. Assume Uak ~ 0.2V, then the base voltage/ current will be reduced when Uce droppes below 0.4V).

D918 will clamp the base voltage of TR905 to about -0.6V. This will occur during the falling edge of the flyback pulse.Via D918, C9037 and C9038 will be charged again.

4.2.3 Horizontal deflection corrections.

4.2.3.1 Linearity correction.



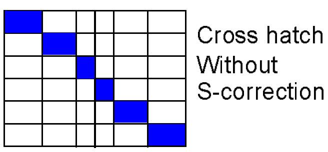


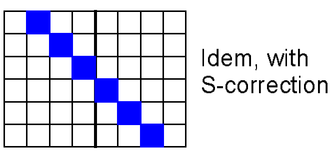
The horizontal linearity correcting device L909 consists of a coil, wounded on a ferroxcube rod with a magnet. Because of the magnet, the core material is close to saturation if the current flows in one direction. This results in a low inductance of the coil. Once the current flows in the other direction, the electro magnetic field will compensate for the magnet, resulting in a high inductance. This corrects for the resistance of the deflection coil.

When a line-scan starts, the linearity corrector consumes energy in its permanent magnet until this is saturated. The rest of the line scan the (saturated) linearity corrector has a low impedance. In the last part of a line-scan, the Ohmic resistance of the H-deflection coils consumes deflection energy. When the linearity coil is well balanced to the deflection yoke, it improves the linearity of the horizontal scan.

L909 is connected in series with capacitor C9042 and the horizontal winding of the deflection yoke. The effectivety of this component is deflection yoke dependent, so the correction must be checked for different picture-tube types. If the horizontal linearity is not good, exchange L909 for a more suitable value. Be sure the current direction through the coil is correct.

4.2.3.2 S-correction.





To correct the horizontal linearity between centre and the left- and right-hand edges of the screen, the supply for the horizontal deflection is not taken directly from $+V_B$ but from a charged capacitor C9042. When the deflection saw-tooth current flows through this capacitor, its voltage will be modulated with a parabola. This in return causes an “S” shaped modulation of the deflection current. The required amount of S-correction depends on the picture tube type.

During the scan period the capacitor is used to realize a S shaped horizontal deflection current (see Fig.25)
The required S-correction is picture tube type dependent. Decreasing the capacitance of C9042 increases the correction.

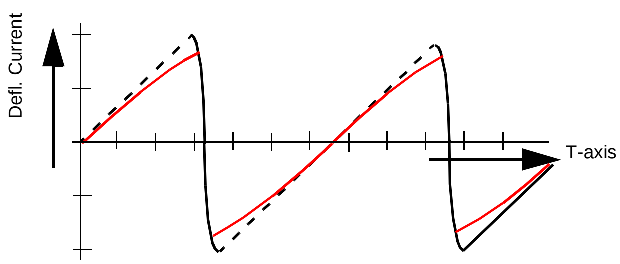
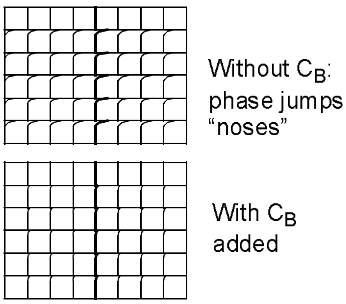


Fig.25 S-corrected horizontal deflection current

4.2.3.3 Dynamic horizontal-phase correction.



Using C_S to supply the horizontal deflection has a disadvantage. When displaying a high intensity horizontal line the required beam-current will discharge the EHT voltage. This EHT energy will be restored in the following horizontal flyback pulse(s), partly via $L_{LOT\text{-}primary}$ from $+V_B$ and partly via $L_{Horizontal\text{-}Yoke}$ from C9042. Consequently the voltage on C9042 will drop, so the next line-scan will start with a phase shift to the right hand side of the screen. In a few lines the equilibrium will be restored, but an effect called "noses" will be visible on the screen. To reduce the voltage drop across C9042. Without precaution a horizontal phase-shift will be visible after displaying a horizontal white line of a cross-hatch pattern.

The energy needed for the white line is delivered by the line output transformer (magnetic energy) during the horizontal flyback. This energy will be restored, partly from the deflection supply (115V) and partly from capacitor C9042. Now U_{C9042} will drop and so will the deflection current at the beginning of the scan (left-hand side of the screen). This horizontal phase shift is visible at the vertical lines of the cross-hatch pattern.

Because $L_{Horizontal\text{-}Yoke}$* dI/dT remains the same, the U_{C9042} is increased at the most right-hand side of the screen giving more deflection current. This extra current causes a phase-shift to the right. Now, the average deflection current is not zero any more, which indicates the energy transfer to the picture tube. Sometimes it takes more line-periods to fully re-charge the picture tube, so it may take a few lines before the phase shift is disappeared completely.

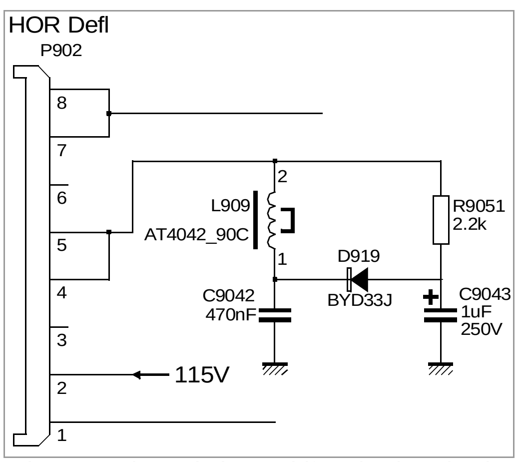


Fig.26 Horizontal phase shift reduction circuit.

To reduce the voltage drop across C9042, capacitor C9043, resistor R9051 and diode D919 are added. C9043 is charged during the fly-back period via R9051. After U_{C9042} drops below the U_{C9043} - U_{D919}, it will be re-charged by C9043. This reduces the horizontal phase shift drastically.

4.3 TDA8351/56 vertical deflection.

The TDA8356 is a 9 pins vertical deflection circuit (2 A_{pp}) for DC-coupled 90° deflection systems with frame frequencies from 50 up to 120 Hz. Two supply voltages are required, one supply voltage for the scan and a second supply for the flyback. For deflection systems that need 3 A_{pp}, the compatible TDA8351 can be used.

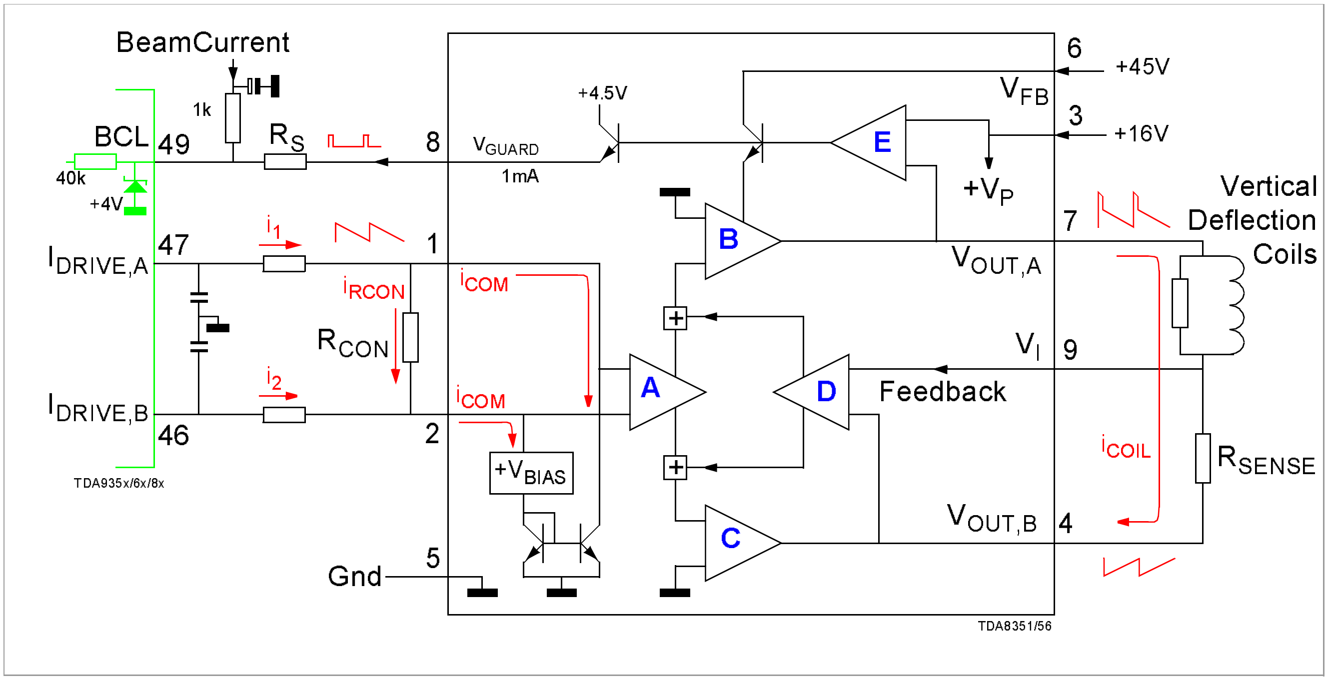


Fig.27 Block diagram of the vertical output stageTDA8351/56

The vertical drive currents of TDA884x pins 47 and 46 are connected to input pins 1 and 2 of the TDA8356. The input bias currents are kept equal: $i_{COM}={}^1/_2[i1+i2]$. The differential input voltage is set by the current through R_{CON}:

$$i_{RCON}=[i_1-i_{COM}]=-[i_2-i_{COM}] \Rightarrow iR_{CON}={}^1/_2[i_1-i_{COM}-i_2+i_{COM}]={}^1/_2[i_1-i_2].$$

Pin 2 is on a fixed DC bias voltage V_{BIAS} = 2.3V. The drive voltage on pin 1 is:

$$V_{DRIVE} = i_{RCON} \times R_{CON}.$$

For optimal signal-to-noise this should be typical 1.4 V_{PP}. The drive voltage is amplified by "A" and fed to two complementary amplifiers "B" and "C". The outputs (pins 4 and 7) are connected to the series connection of the vertical deflection coil and feedback resistor R_{SENSE}. For HF loop stability a damping resistor (330 Ω) is added over the deflection coil. The voltage across R_{SENSE} is fed via pin 9 to correction amplifier "D", to obtain a deflection current which is proportional to the drive voltage. The supply voltage for the TDA8356 is 16V at pin 3. The flyback generator has a separate supply voltage of 45V on pin 6.

According TDA884x specification: $I_{DIFF} = i_1 - i_2$ = 0.76 .. 1.14mA_{PP}, so nominal = 0.95mA_{PP}.

- The TDA8356 differential input voltage specification is 1.2 .. 1.8V_{PP}, so nominal: 1.5V_{PP}.
- Common mode bias currents into TDA8356 pins 1 and 2 should be typical: i_{COM} = 0,40mA

We can calculate the optimal value of the conversion resistor:

$$R_{CON} = 1.5V_{PP} / [{}^1/_2 x0.95mA_{PP}] = 3k\Omega.$$

The TDA8356 output current is defined by:

$$i_{RCON} \times R_{CON} = i_{COIL} \times R_{SENSE}.$$

Knowing the desired deflection current we calculate:

$R_{SENSE} = 1.5 / I_{COIL}$.

Please note that the output voltage at TDA884x pins 46 and 47 should not exceed 4Volt. Maximal peak at TDA8356 input pin 1 is:

$V_{BIAS,PIN2} + {}^{1}/_{2} \times i_{RCON,MAX} \times R_{CON} = 2.3 + {}^{1}/_{2} \times 1.14 \times 3 = 4V.$

The R-C filters at pin 46, 47 form a low-pass filter for better EMC immunity. The value of these resistors should be low in comparison to R_{CON} (e.g. 100Ω), otherwise the maximum V_{DRIVE} amplitude may not be reached. The see chapter 'Vertical Deflection diagram." on page 67 shows the added L-C filters directly at the vertical deflection plug. These suppresses EMI pick-up by the vertical deflection cable.

A vertical guard function generated by "E", can be used to protect the picture tube from burning-in during malfunctioning of the vertical deflection. During the vertical retrace the vertical guard output becomes high (U_{vguard} = 5.0 Volt at I_{vguard} = 500 uA for about 1mSec time period). This is sensed by the TDA884x BCL input pin 49 (combined Vguard + BeamCurr). The condition can be read via bit **NDF**. To protect the picture tube against burn-in, the RGB_{OUT} pins will be blanked (when protection enabled by **EVG** = 1).

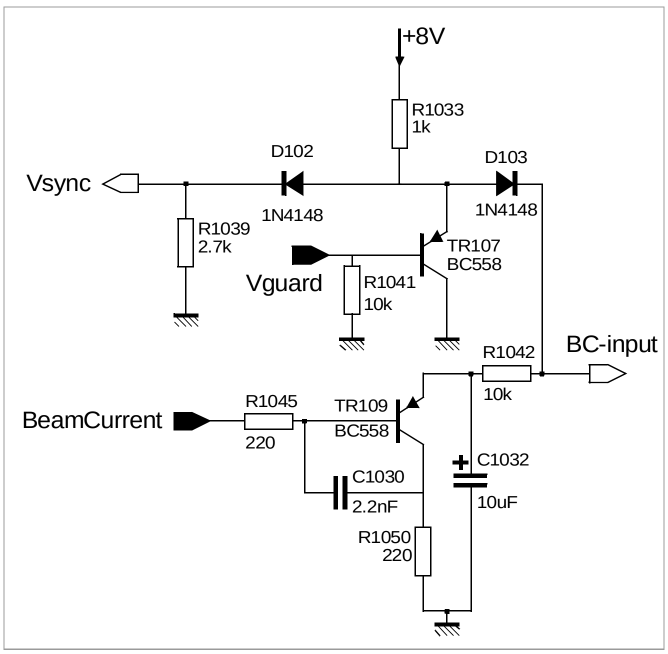


Fig.28 Average Beam current circuit

Emitter follower TR107 is added because the total load of the vertical guard input, Beam-current interface and micro controller V_{sync} input can not be driven by the TDA8356 guard output. This buffered vertical guard signal is used for:

- triggering the video processor vertical guard circuit (pin 22).

To trigger the video processor vertical guard circuit, the input voltage must toggle above and below the 3.65V.The video processor internal bias voltage is 3.3V. However, at low beam currents and because of integration of the guard pulses by capacitor C1032, this 3.3V will rise. The contribution of the vertical guard pulses is about 1/20 (vertical flyback pulse duration of 1mS and a frame scan time of 20mS) of the voltage swing during fly-back and scan. Assume at low beam currents U_{C1032} = 3.3V the worst case contribution is about (5V - 3.3V) * 1/20 = 0.08V.

As long as the average voltage of U_{C1032} does not exceed 3.56V, this additional charge is aloud. The TDA884x input pin 22 is internally clipped at 4V, to protect the input circuits. The guard pulse from TDA8356 can source 1 .. 2.5mA at 4.5V amplitude. To limit the current (= energy) in the pulse, a series resistor R_S can be inserted. Its maximum value is:
$R_{S,MAX}$ = (4.5V - 3.56V) / 1mA = 850Ω
In practice R_S should be lower, because the guard pulse amplitude will be divided over R_S and the series resistor (1k) of the Beam Current integrator capacitor. A practical value for R_S = 100Ω.

- The vertical synchronisation of the on screen display circuit in the micro controller.
D102 will reduce the low level of the PNP emitter follower ($U_{be\ TR109} - U_{D102}$). This is necessary

because the falling switching threshold of the vertical sync. input of some micro controllers is about 0.9V. D103 prevents the influence of U_{C1032} at this low level.

To minimize vertical related disturbances in the ground and supply tracks of the receiver, resistor R8004 and de-couple capacitor C8004 are added near the IC. Also the Fly-back supply voltage at input pin 6 is de-coupled by resistor R8005 and capacitor C8002. Its maximum aloud capacitance is 22uF to limit excessive peak loads in the IC. Instead of connecting C8002 directly to the IC ground, it is de-coupled towards the operating voltage at pin 3. This reduces the internal voltage differences during switching-off the set. Because the load at the 16V supply is higher compared to the 45V supply load, the 16V will drop fast. By de-coupling the 45V to the 16V, it will drop accordingly. This result in less internal stress in the IC.

4.4 Beam current information.

The beam current information is available across resistor R9058. $U_{Beamcurrent}$ is reverse proportional to the beam-current. The video processor needs beam current information to:

- Limiting the total average beam-current at high contrast and brightness settings. This limit is determined by the picture tube specification and also limits the EHT load. Therefore, the video-processor needs average beam-current information at input pin 22. Integration of the beam current results in the needed information, but smooths away large beam current steps. To avoid this, the application around transistor TR109 and capacitor C1032 were implemented (see Fig.28) . High average beam currents will result in fast contrast and eventual brightness reduction (fast attack), while on the other hand the recovery takes more time (slow decay). This avoids contrast and/or brightness flickering on the screen.
  The attack time is mainly determined by C1032 and R1050 (~2.2mSec) while the decay time is C1032, R1042 and an internal pull-up resistor of 40K (~500mSec or a duration of 25 frames). To prevent false triggering, R1045 and C1030 are added to switch TR108 smoothly.
  A second advantage of this circuit is that the AC beam-current information is still available and can be used for horizontal picture width/phase correction in 110-degrees concepts, where a E-W modulator is present.
  The application for the vertical guard function combined at pin 22 of the video processor is discussed in chapter “TDA8351/56 vertical deflection.” on page 46.
- Control the dynamic vertical picture height. The Extreme High Tension (EHT) voltage is reverse proportional to the beam current due to the internal resistance of the LOT.
  Reduction of the EHT increases the picture width and height, because the electrons inside the CRT remain longer in the magnetic field of both the horizontal and vertical deflection coils.
  To correct the vertical amplitude changes due to variations in the average beamcurrent (EHT-tracking), the video processor needs beam current information at input pin 50.
  The input range for this input (pin50) is: 1.2 .. 2.8V.
  In this design the EHT tracking versus beam-current transfer function is:
  $U_{EHT} = 2.4 - 0.7 * I_{beam\text{-}current}$ [mA].
  In 90-degrees concepts the dynamic horizontal amplitude is corrected by control of the horizontal deflection supply voltage, because no East-West drive is available. More beam current will decrease the horizontal supply voltage to correct the picture width. See chapter 4.1.1, page 38.

5. LAY-OUT & EMC RECOMMENDATIONS.

5.1 Lay-out.

All remarks concerning the lay-out of parts of the receiver have been integrated in the chapter describing the specific circuit part. A special report has been created, describing the TDA884X board design step by step.
The information can be found in ref.[5] EMC guidelines for TDA88XX applications, report no: AN98097.

5.2 EMC.

Report AN98097 ref.[5] also describes all design rules, to obtain optimal EMC performance of the board.

The performance of the GTV1000 receiver has been measured with different input signals. In APPENDIX 15 the EMC performance can be found when receiving a SECAM L signal, because this is the most critical situation.

6. ALIGNMENTS.

Before the receiver is switched on, please check the following:

- The presence of all components in the required configuration
- Correct setting of all solder jumpers
- Good connections of all cables, especially the high voltages to the CRT panel and picture tube
- Connection of picture tube Aqua-dag grounding to CRT panel

6.1 Front end IF-PLL.

This only for N1 version of the TDA8844. Apply a 38.9MHz IF-signal, modulated with a PAL test pattern to the IF output of the tuner (at pin 11 of tuner). Force the system in PAL mode. Enter the service menu and select item “**IF**”. Adjust the value until the AFC indication toggles between 01 and 02. The N2 version has an alignment free IF coil inside.

6.2 Tuner AGC.

Apply an RF signal between 10mV and 50mV to the tuner. Tune to this signal. For an asymmetrical tuner, adjust “**AGC**” for 1Vp-p at the input of the SAW filter. For an symmetrical tuner, adjust for $0.5V_{PP}$.

6.3 Vertical geometry.

- Apply a picture with a test circle to Scart input AV1 and selects this input.
- Adjust brightness, contrast and the potentiometers at the EHT transformer for V_{G2} and focus voltage, for a normal picture.
- Set the vertical zoom to its neutral position **VX** = 19_{HEX}.
- Adjust the vertical slope “**VS”** until the middle line of the test circle is half visible (lower half of the screen is temporary blanked by **SBL** = 1).

6.4 Horizontal geometry.

- Apply a picture with a cross-hedge pattern to Scart input AV1 and selects this input.
- Adjust the picture height “**VA**”, vertical shift **“VSH”** and vertical S-correction “**SC**”.
- Adjust the horizontal phase “**HSH**” and picture width “**EW**” (full scan width).
- Adjust the horizontal linearity with the linearity corrector coil on the power & deflection board.
- Adjust the parabola width ”**PW**” and the corner parabola correction “**CP**” for perfect straight vertical lines.
- Adjust the trapezium correction “**TC**”.

6.5 Video amplifiers.

- Apply a video signal for a black picture to Scart input AV1 and selects this input.
- Set brightness and contrast to mid position.
- Set the white “gain” controls “**WPR**”,”**WPG**”,”**WPB**” to mid position = 31_{HEX} make sure that the ABS loop is enabled (**AKB** = 0).
- Adjust V_{G2} voltage to make the black level, on the R, G and B guns, equal to the specified cut-off voltage of the tube. Measure the highest black current measuring pulse of one of the three cathodes, at the beginning of the scan (oscilloscope triggered on vertical). This pulse should be 10V below the desired cut-off voltage of the picture tube. So for a desired cut-off of 160V the highest black current measuring pulse should be 150V.
- Change the video signal to a white picture (contrast control still in mid position).
- Adjust the “white gain” controls “**WPR**”,”**WPG**”,”**WPB**” for the correct white point (use a colour analyser with a 300 NIT scale).
- Change the video to a grey scale and check for linearity and visibility of all bars except the black one.
- Change the video to a cross hatch pattern and set contrast to maximum.
- Adjust the focus potentiometer at the EHT transformer (at high beam-current), so that horizontal and vertical lines are equally sharp on the screen.

6.6 Luminance-Chrominance delay.

The TDA884x has an adjustable luminance delay “**DLY**” to correct for delay in the SAW filter. This can be used to equalise the luminance delay for each colour system, so that the transitions in grey match the colour transitions. (Suggestion: In a multi-standard receiver, the embedded software can store this alignment for each colour system separately).

- Set contrast, brightness, colour saturation and peaking to normal values.
- Select a colour test circle pattern via the front-end (tuner) and adjust the luminance delay **DLY**.

7. MODIFICATIONS WITH RESPECT TO PRINTED CIRCUIT PR31602.

When this report was made, most of the boards had already been delivered, while there are also no plans to make a redesign of the board. For thisTypical performance figures reason this chapter with modifications that were found after finishing the board design has been made.

- The resistor from the AGC lead to ground is missing, see figure 5 on page 17.
- Using the UV13xx MK2 the series resistor R3015 = 22KΩ must become 0Ω.

- The $CVBS_{out}$ track from the demodulator output to the SCART and the track conducting $CVBS_{ext}$ from the external input to the TDA884X are directly next to each other on the GTV1000 board. This situation should be avoided, because this can cause cross-talk between internal and external CVBS. See also Chapter 2.2.3 on page 21.
- A small modification was introduced to improve the stability of the black current feed-back loop. There was a series resistor present of 1k from the current output of the video amplifiers to the black current input of the TDA884X. The resistor is increased to 10kΩ. Also a small capacitor C of 330pF is added between the “guard-ring” ground and black current signal comming from the video amplifier side, see Fig.29 . This modification reduces the bandwidth the black current feed-back loop. This is no problem, because the the reference pulses on the RGB outputs is present during the scan period of one line, while the feed-back current is measured on approximately 2/3 of the line.
-

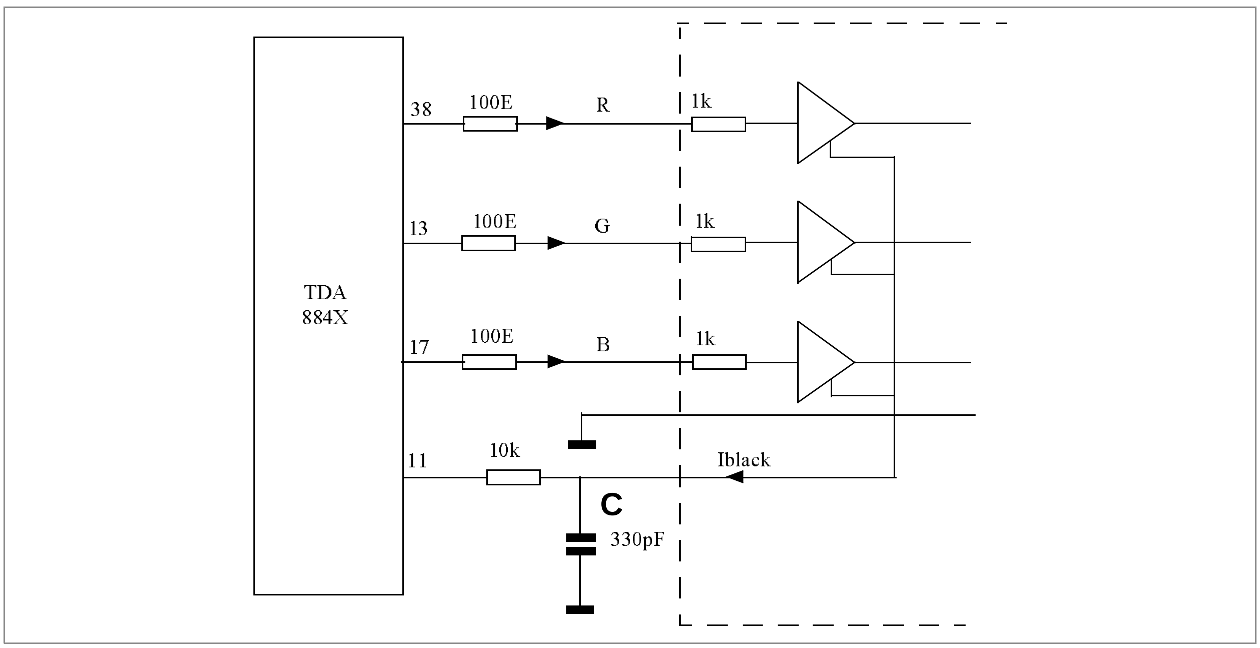


Fig.29 Black current feed-back.

- In the vertical amplifier application several modifications have been introduced. The circuit diagram of the vertical amplifier stage can be found in APPENDIX 12.
  - The first one is the decoupling capacitor on the fly-back supply (45V). This has been reduced from 100µF to 22µF, to reduce the dissipation in the fly-back circuit.
  - One of the decoupling capacitors (C8006) had a value of 100nF. After evaluation 22 nF is recomended.
  - The capacitive load on the outputs has been changed, in order to obtain a better stability of the vertical output and of the vertical sync pulse to the micro controller, whitch is derived from the vertical retrace pulse.
  - Capacitor C8005 must be deleted.
  - Capacitor C8008 must be deleted.
  - Resistor R8009 should change to a short circuit.

- Capacitor C8009 must be changed from 220nF to 10 nF.
  These last changes have been selected, so the circuit functions optimal for the picture tube that is used. If a different tube is used, the capacitive load on the output may have to be adapted.
- In the horizontal drive circuit (see APPENDIX 14) the base drive of the horizontal output transistor was set to a value which was in fact a little high. To reduce this base current from 1A to 600mA, resistor R9053 was increased from 100Ω to 150Ω.
- In the power supply (see APPENDIX 13) a diode has been added to the base of transistor TR902 in the error amplifier, for protection. The kathode of the diode is connected to the base, while the anode is connected to ground, to avoid a negative voltage of more than 0.7V on the base. The base can be pulled to a negative voltage by the beam current line.
- A modification was introduced in the micro controller reset circuit to obtain a better timing for the memory supply switching. By deleting resistor R2059 and reducing the value of resistor R2054 from 39kΩ to 22kΩ the memory supply is switched on after the reset pulse.

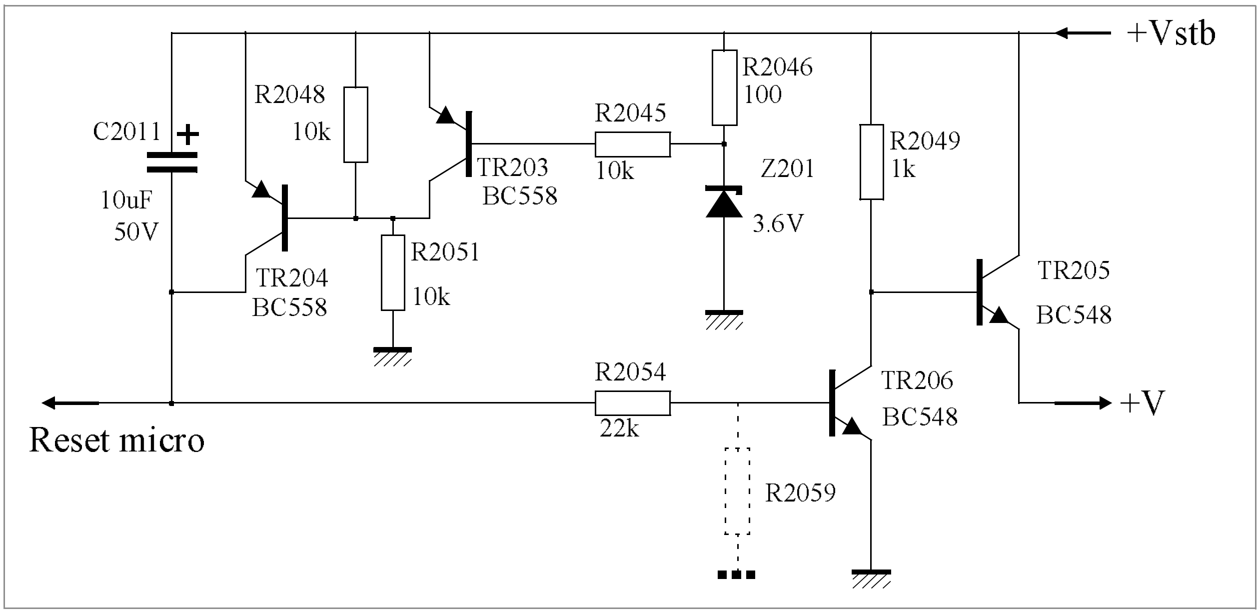


Fig.30 Modified Reset and Voltage guard circuit.

- A second modification around the micro processor is the supply to the write protect pin. In the origional design, the memory protect pin and the service pin were supplied with Vstb. The problem is that the Vstb is present when the Vmem is switched off. This means that when the memory voltage is switched off, and the supply to the service pin connector is still present, the protection dodes inside the memory chip start conducting and via that way supply the IC. For this reason the pull-up resistor of the service pin is now connected to +Vmem.

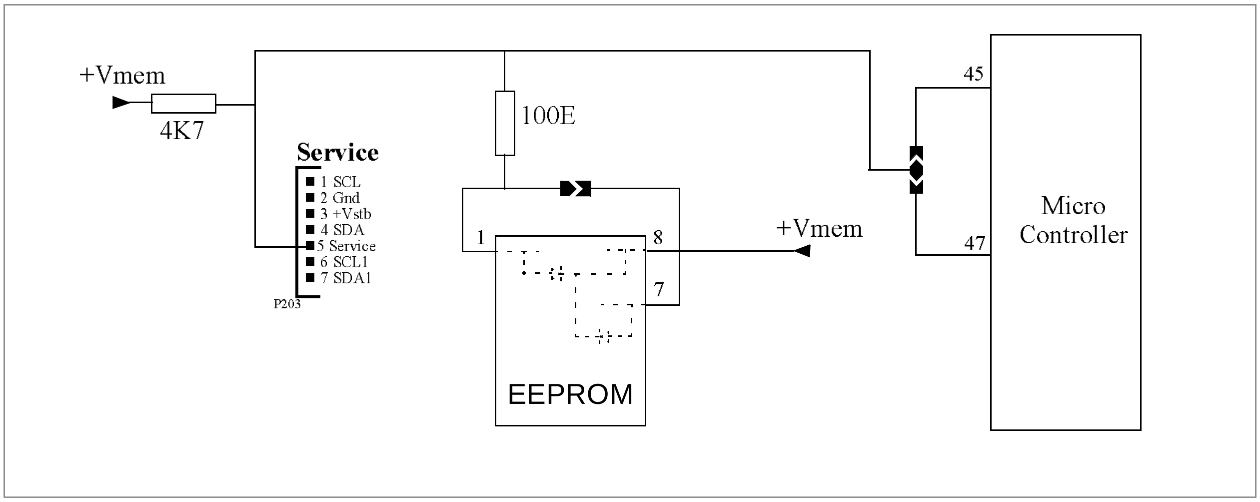


Fig.31 Write protection circuit non volatile memory.

8. REFERENCES.

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Report No: AN96037, April 1996, E.C.P. Arnold, J. van Nieuwenburg (PS-SLE Eindhoven).

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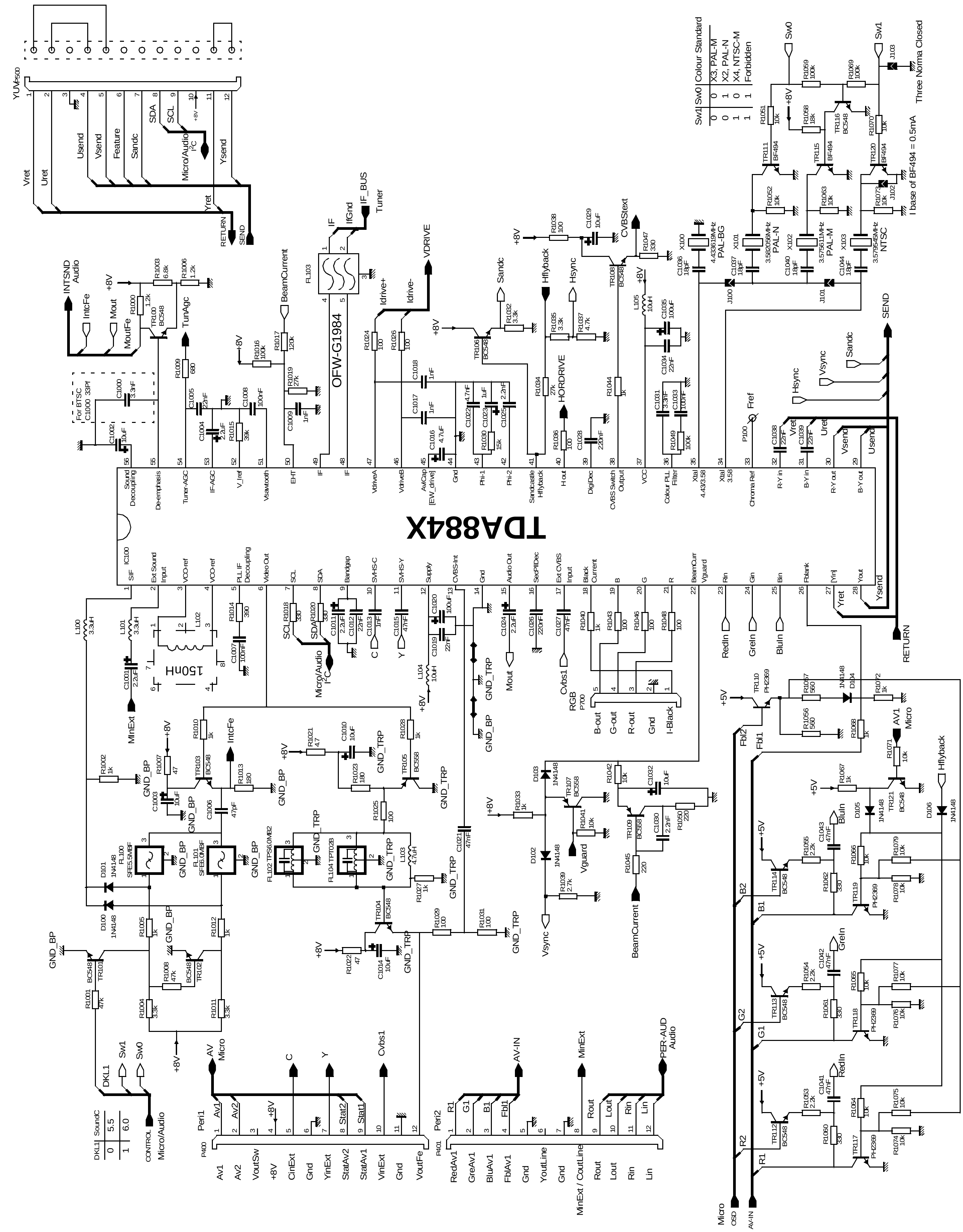
Report No: ETV/UM 97011.3, September 1997, H. Timmerman (PS-SLE Eindhoven).

[15] User Manual TV Control System CTV828S.
Report No: ETV/UM 98013.1, January 1999, J.G.M. Van Velthoven (PS-SLE Eindhoven).

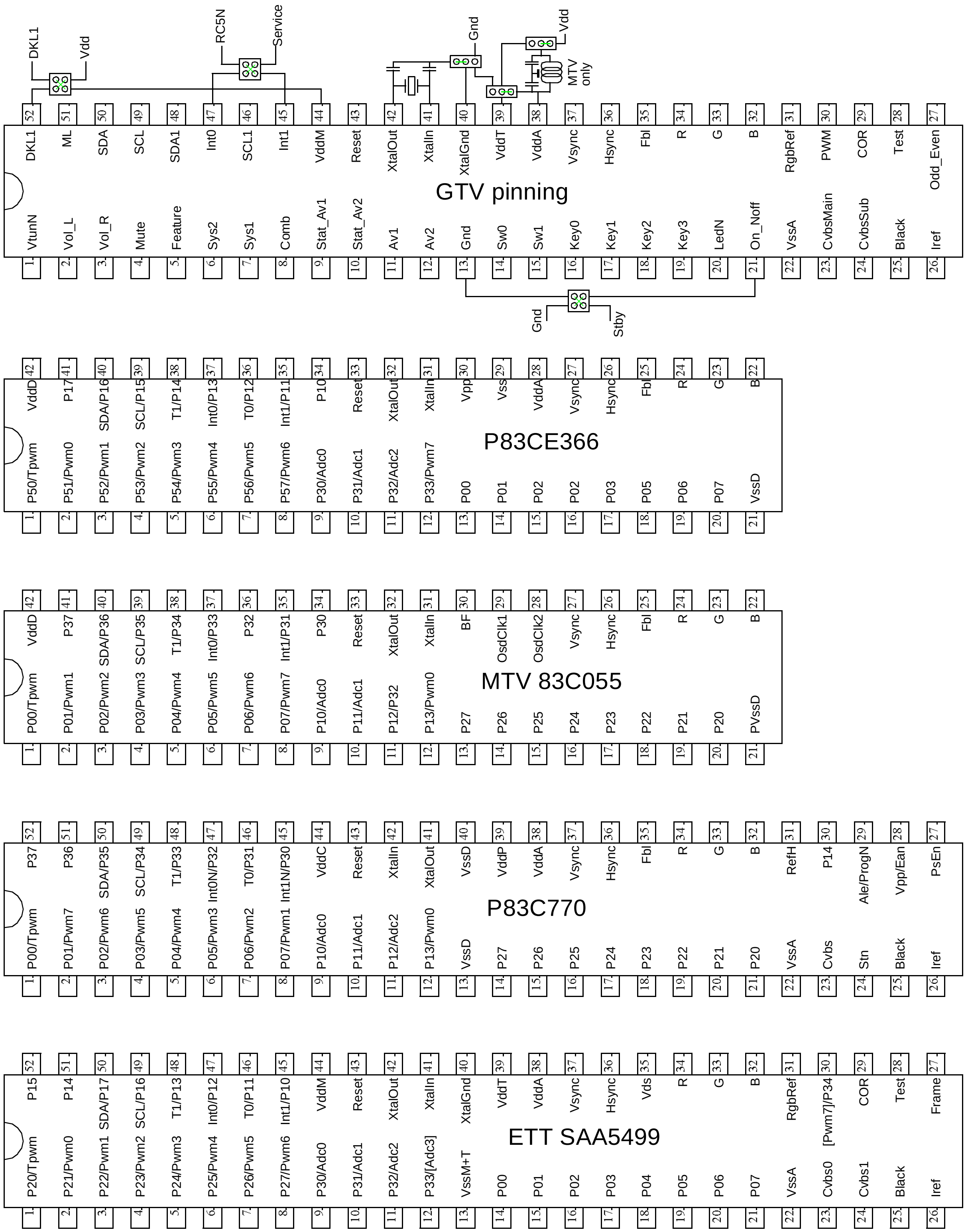
[16] TV System controller CTV832S/ CTV832R. TV control.
Report No: ETV/UM 97010.0, November 1997, R. Van Den Broeck (PS-SLE Eindhoven).

APPENDIX 1 Main diagram

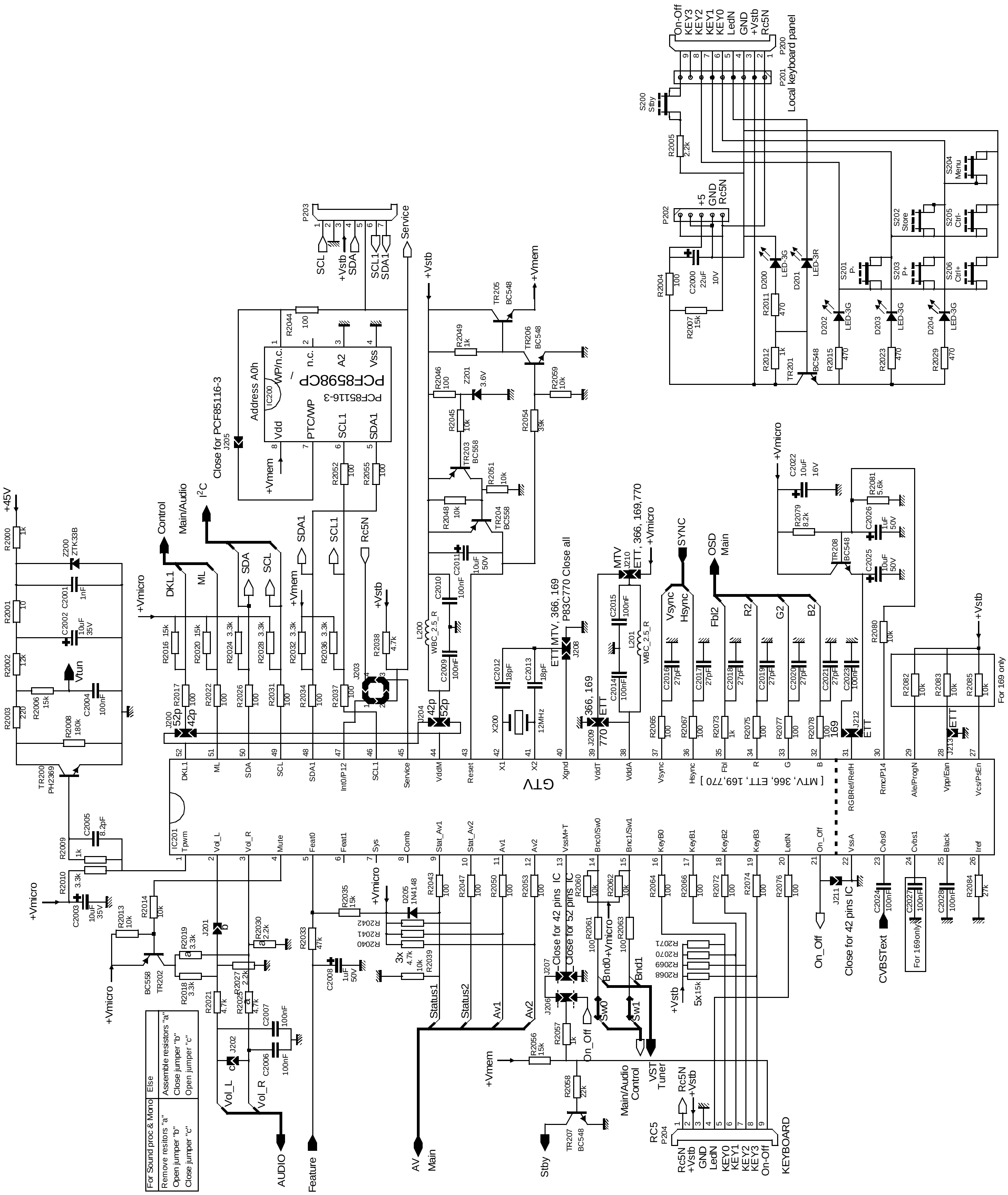


APPENDIX 2 GTV pin-compatibility of Philips TV micro controllers

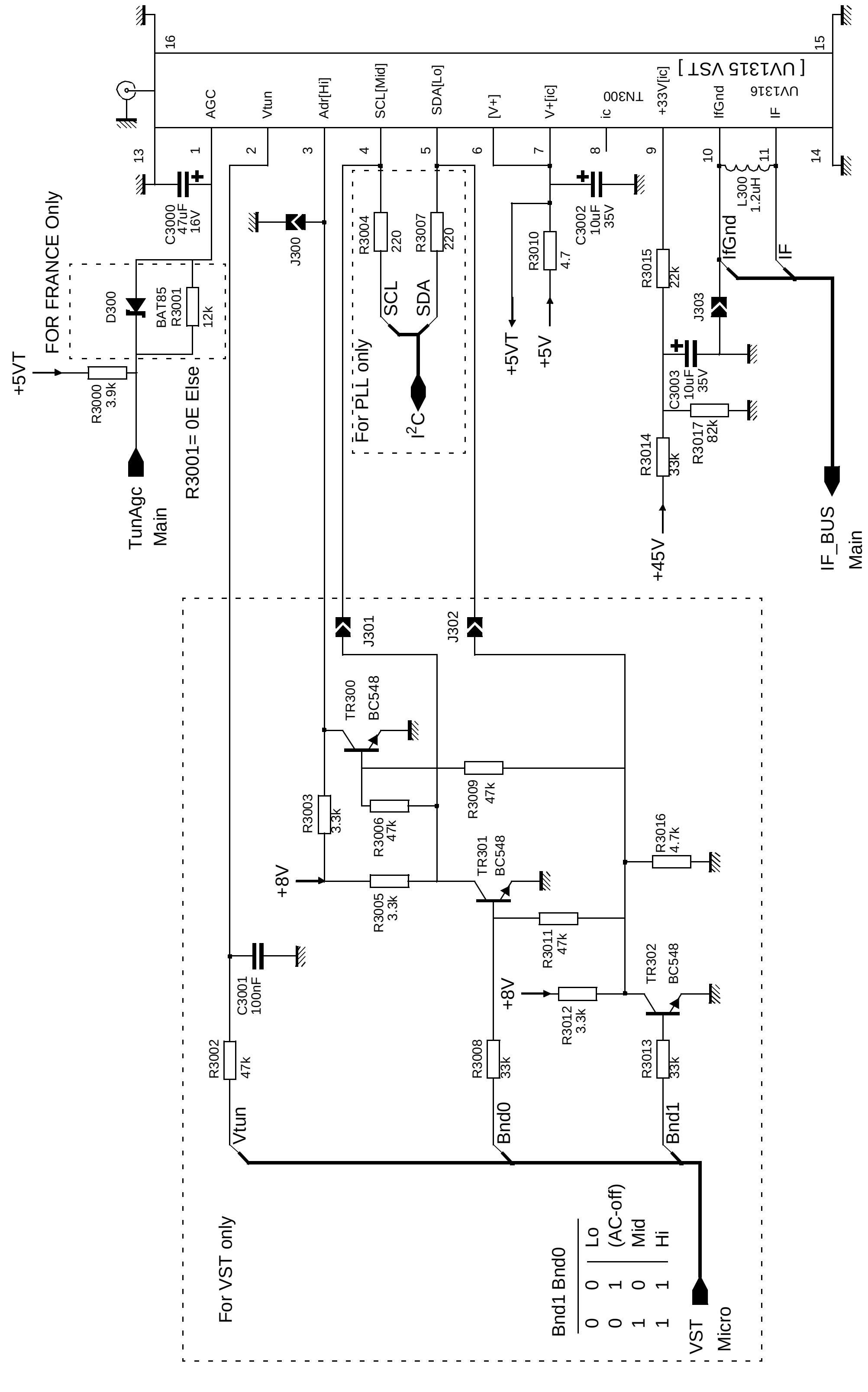
Fig.32 GTV pin-compatibility of Philips TV micro controllers



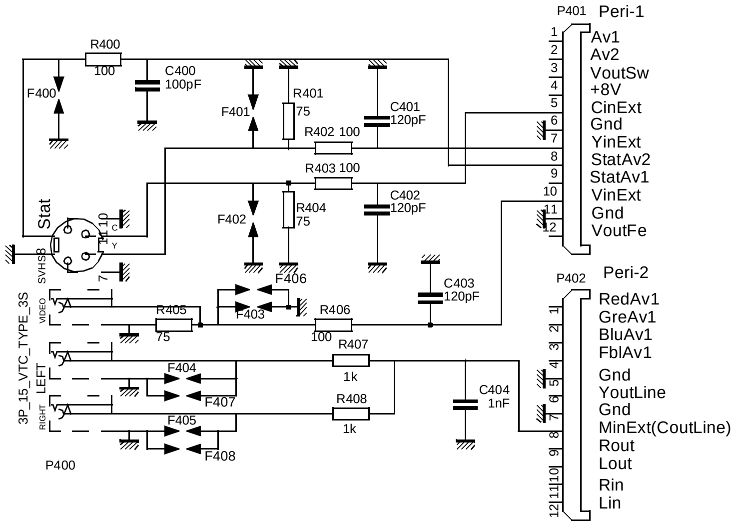
APPENDIX 3 Control diagramdiagram

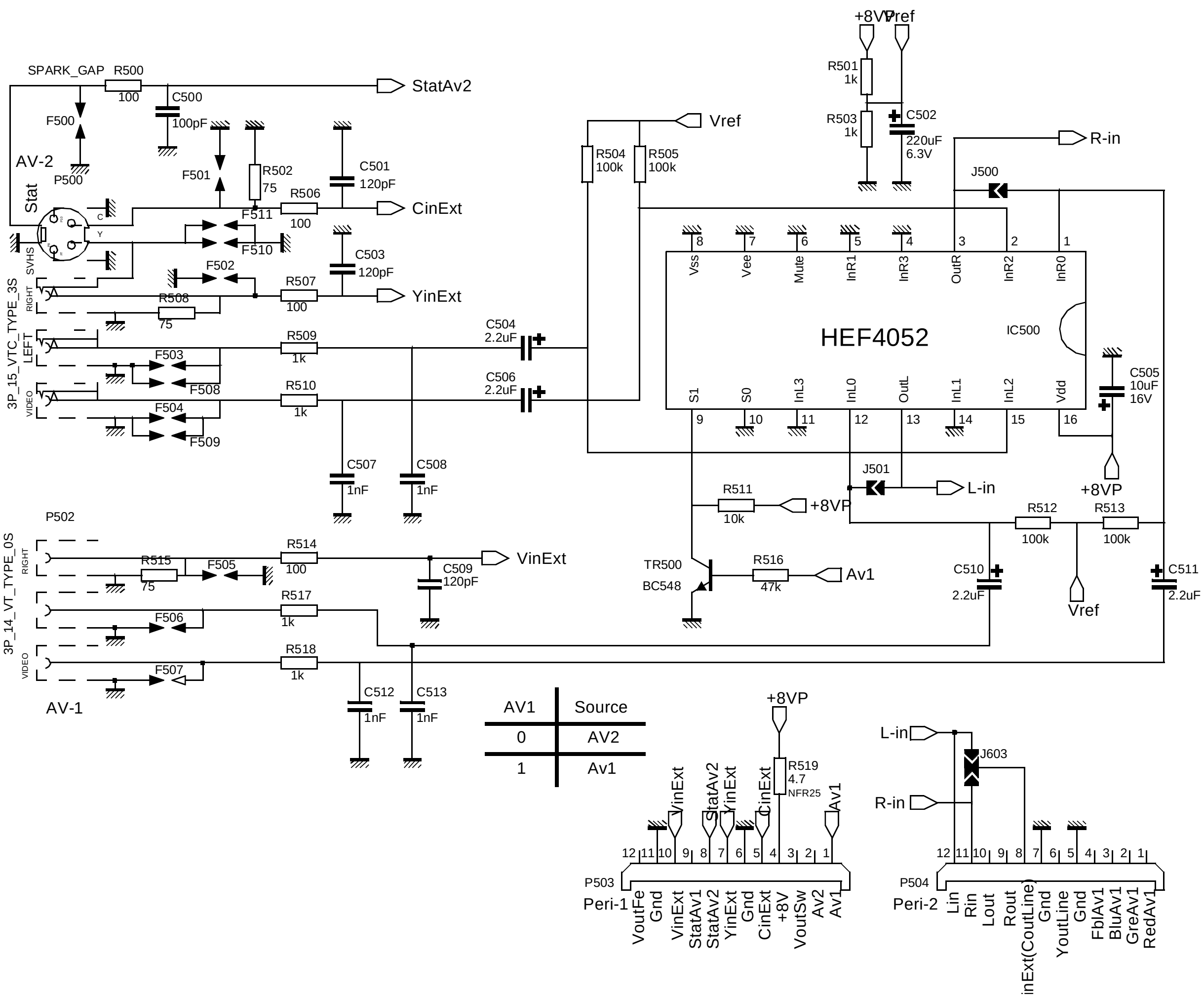


APPENDIX 4 Tuner diagram



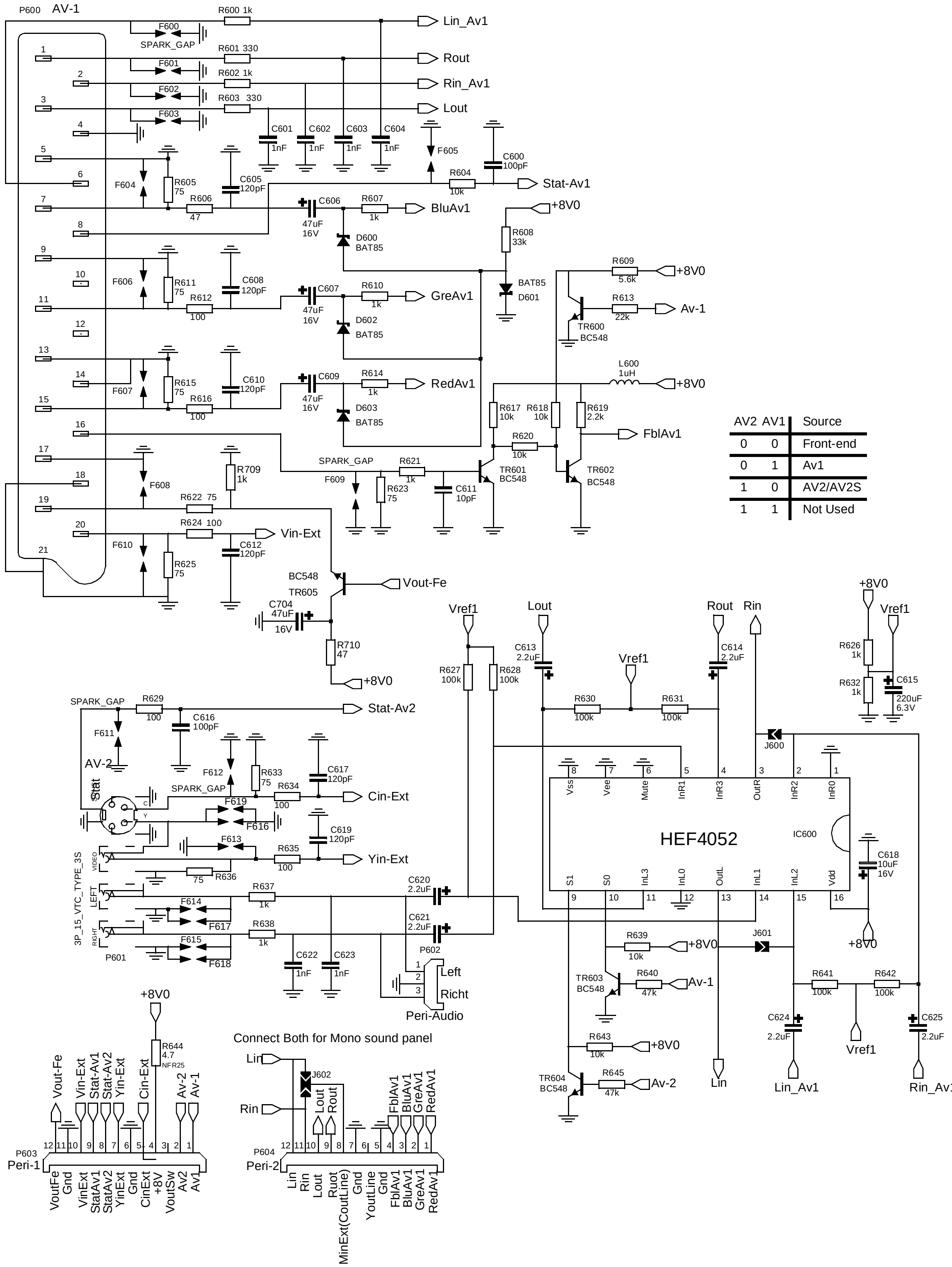
APPENDIX 5 Peri interface cinch diagram





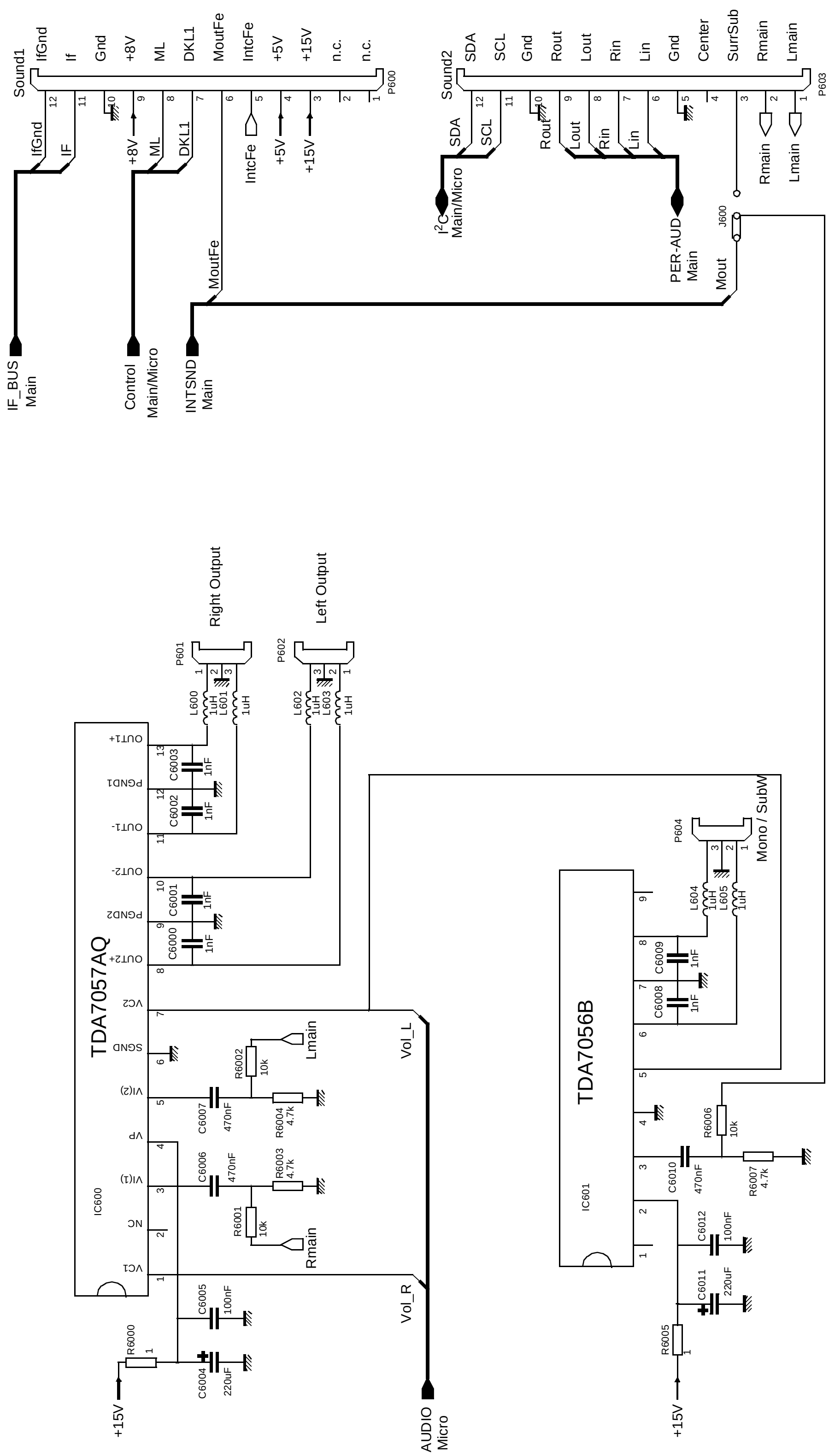
AV1	Source
0	AV2
1	Av1

APPENDIX 6 Peri interface Scart diagram

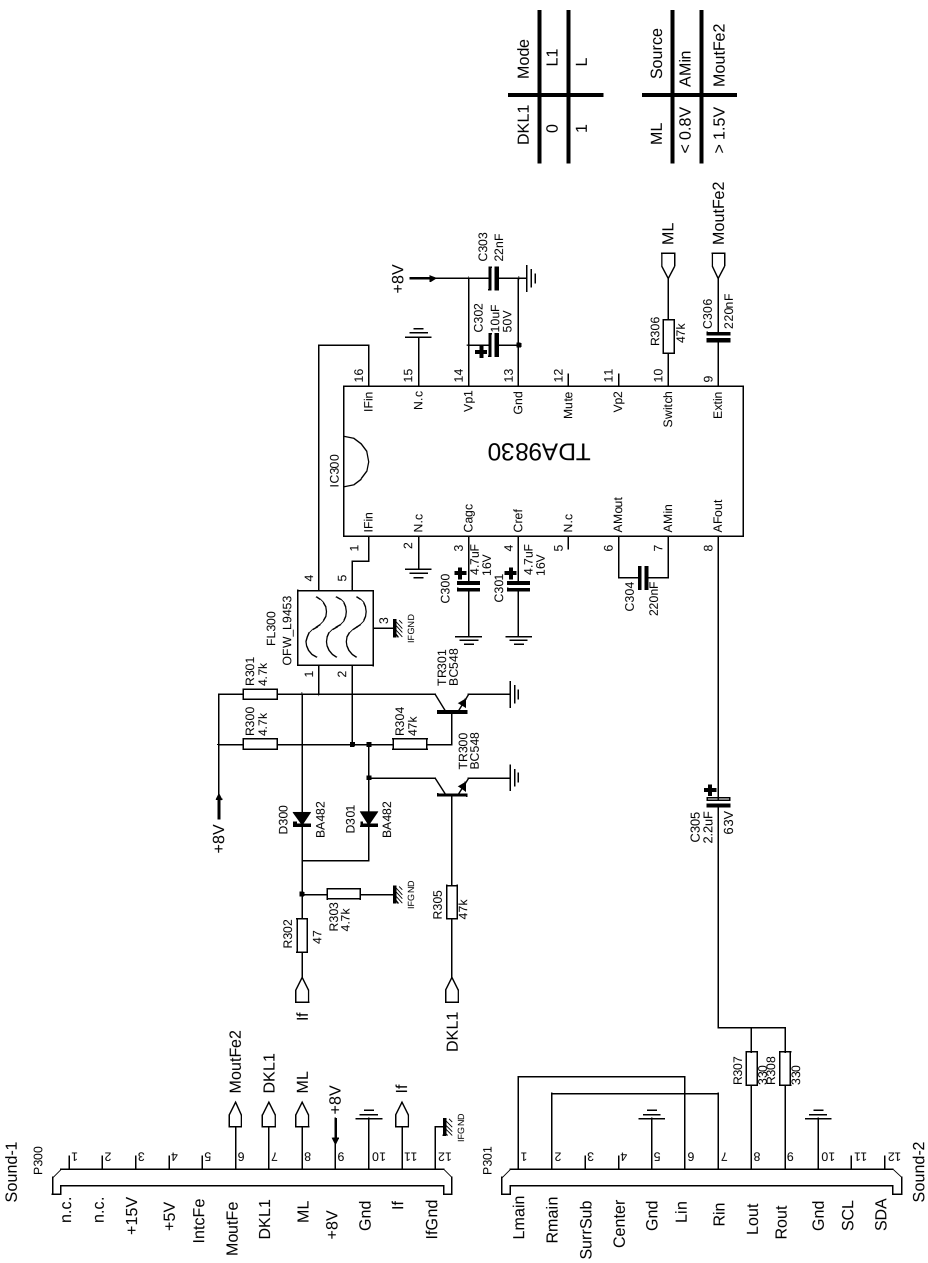


AV2	AV1	Source
0	0	Front-end
0	1	Av1
1	0	AV2/AV2S
1	1	Not Used

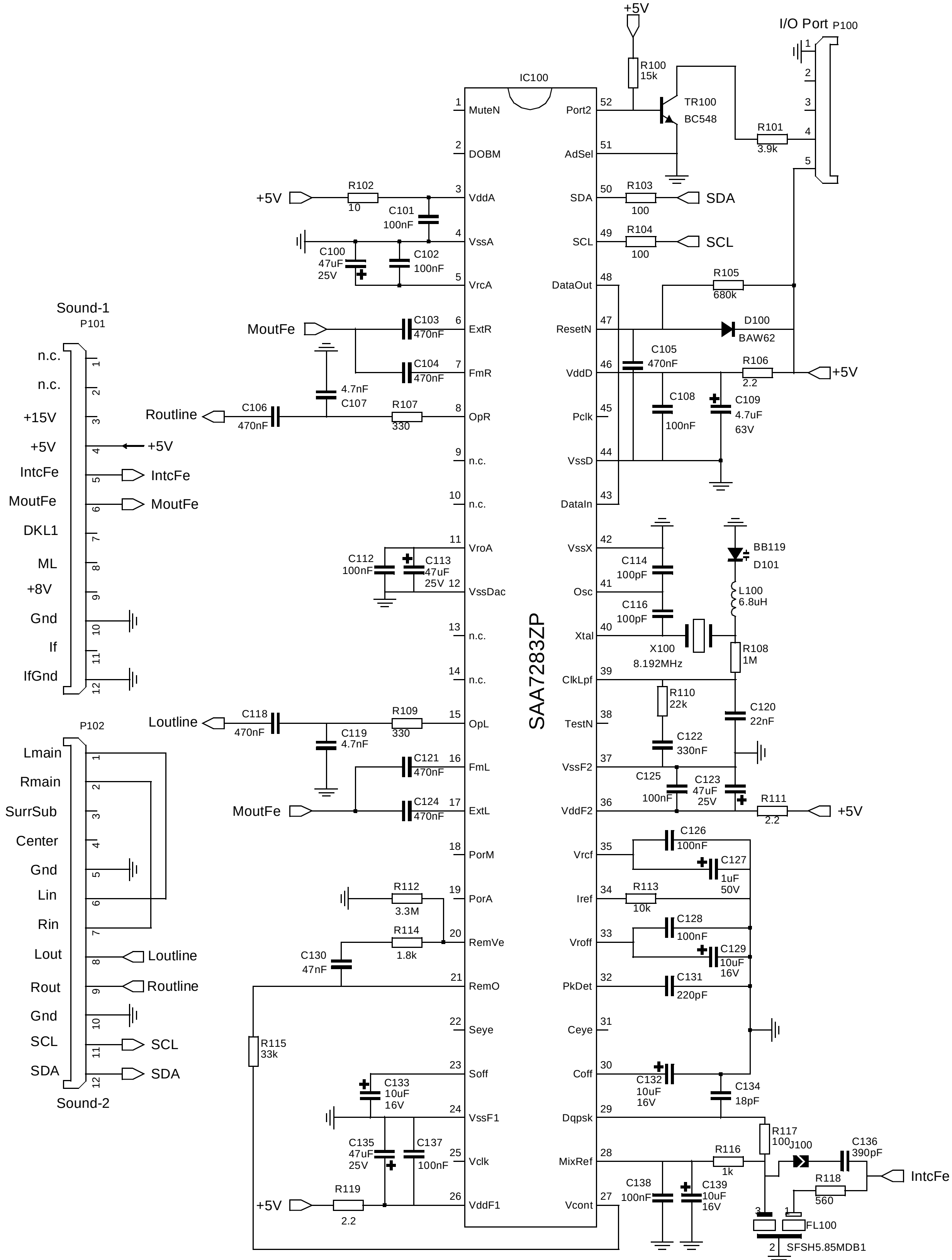
APPENDIX 7 Audio amplifier diagram



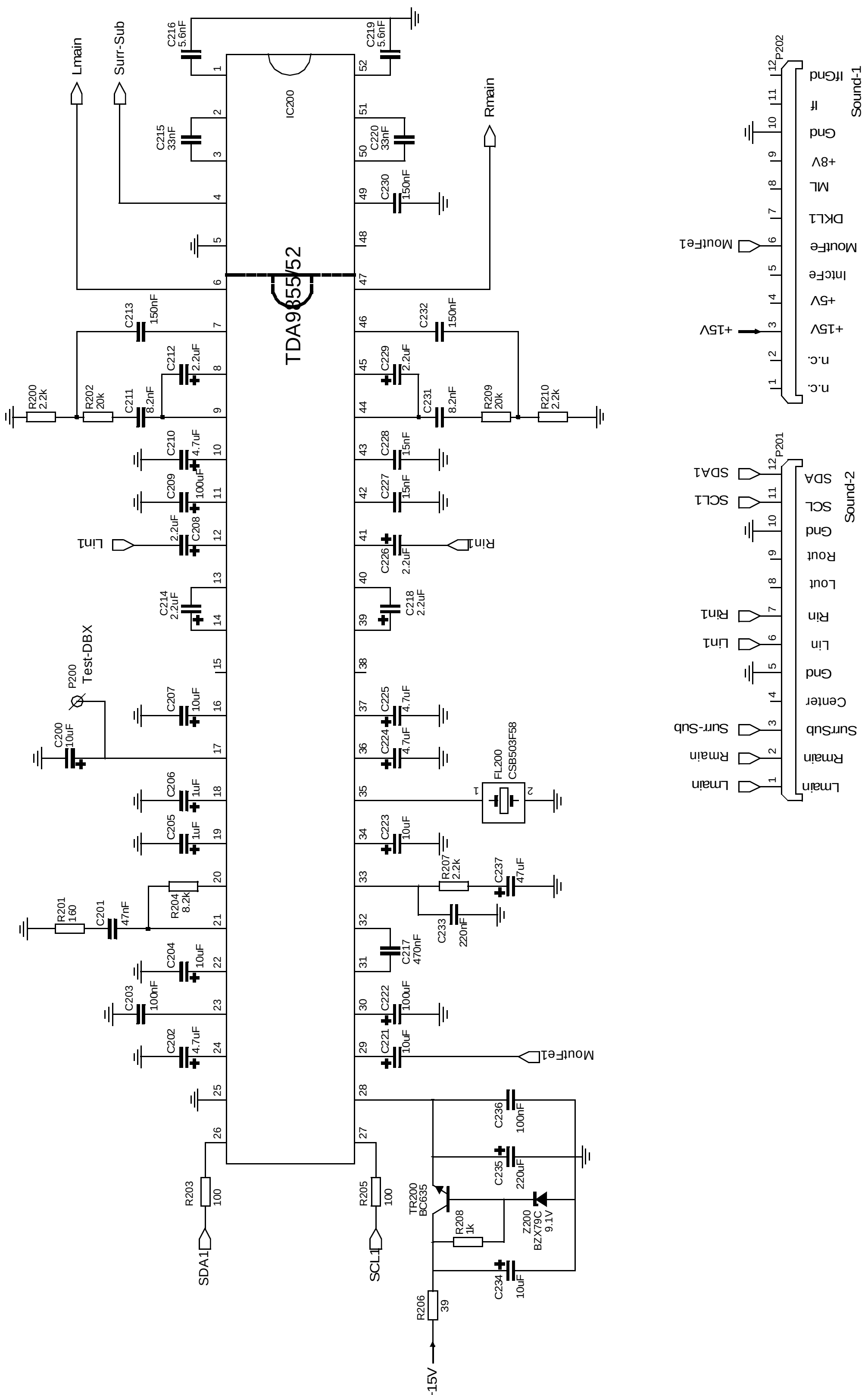
APPENDIX 8 AM Audio diagram.



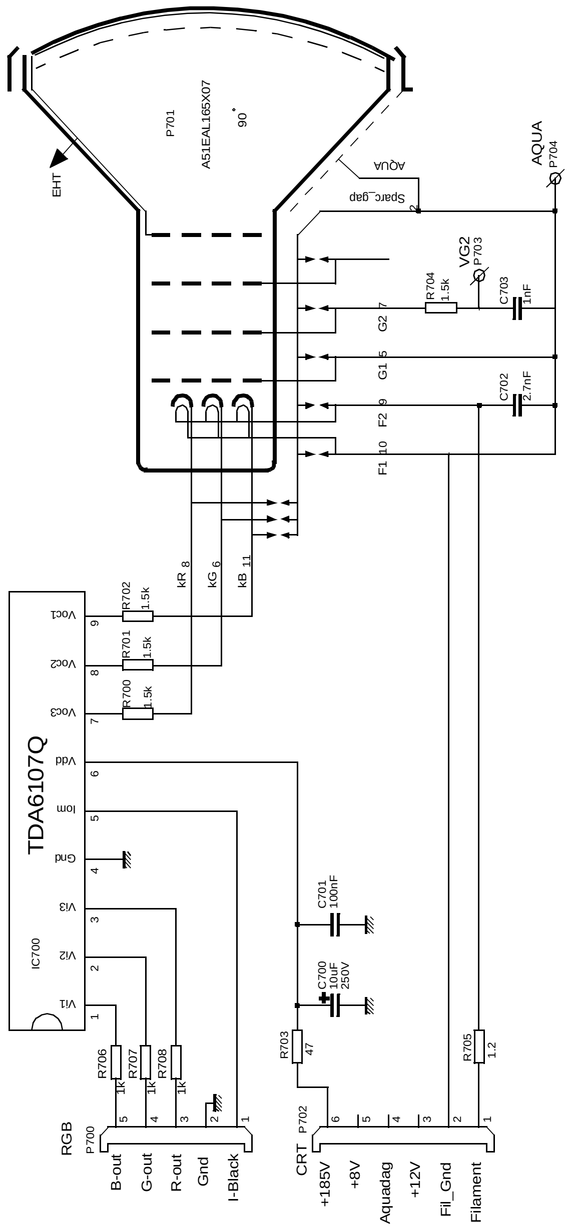
APPENDIX 9 NICAM Audio diagram



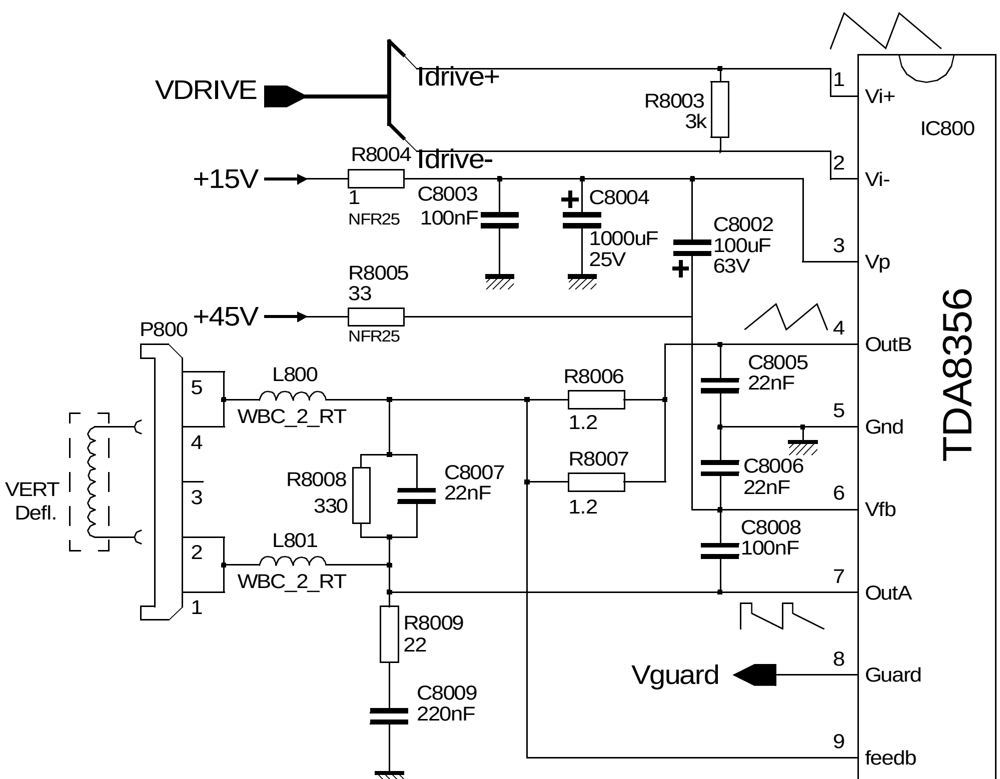
APPENDIX 10 BTSC Audio diagram



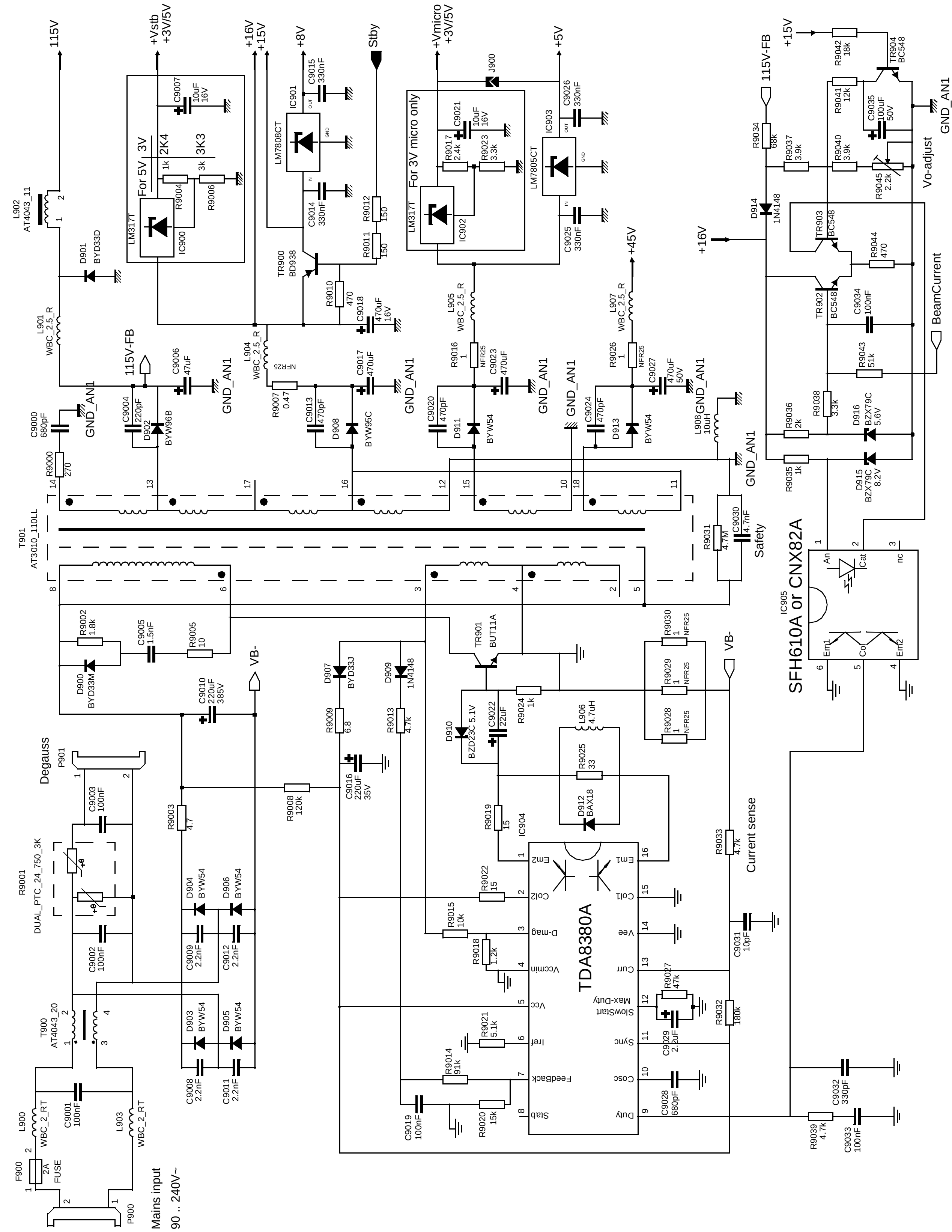
APPENDIX 11 RGB output and CRT panel diagram



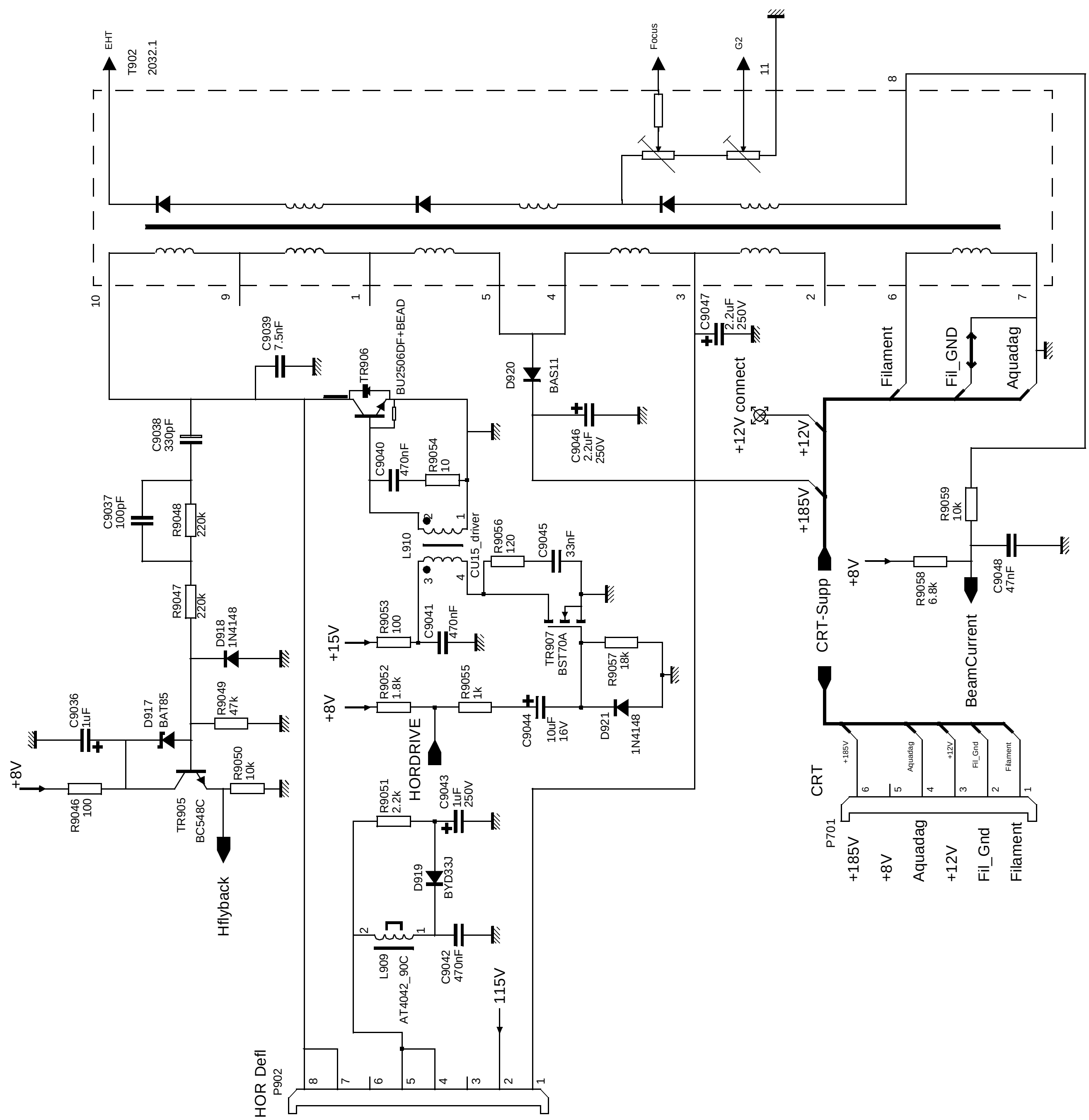
APPENDIX 12 Vertical Deflection diagram.



APPENDIX 13 Power Supply diagram



APPENDIX 14 Horizontal Deflection diagram



APPENDIX 15 EMC test results

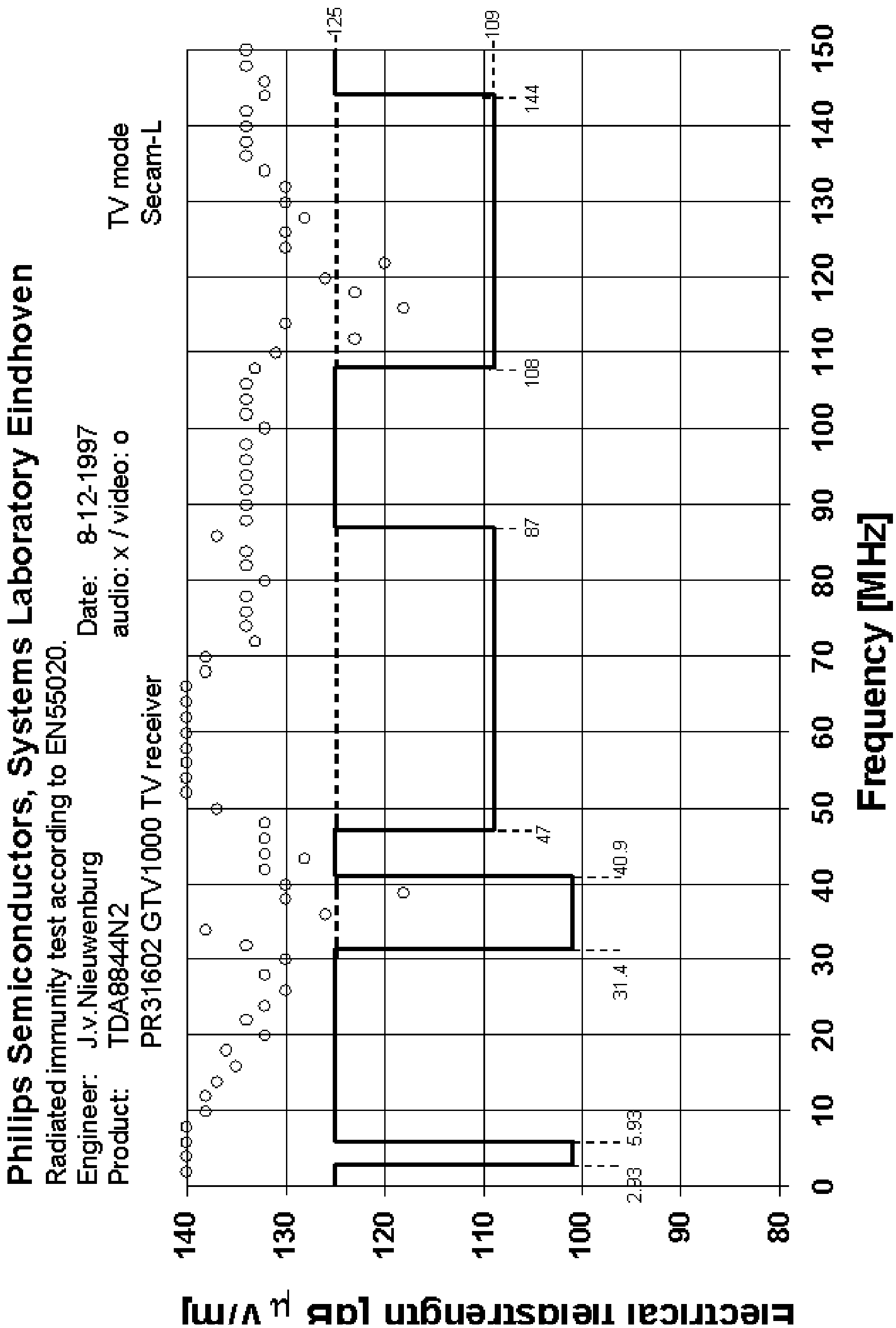


Fig.33 Radiated immunity of GTV1000 receiver measured on SECAM-L.

APPENDIX 16 "Bill Of Materials" of Project: PR31602 Last Update: 1999/02/04

ITEM	CNT	PART_NO	COMPONENT	SERIES	TOL.	RA-TING	VENDOR	GEOMETRY	REFERENCE
1	1	8222-411-31602	BOARD PR31602				PS-SLE	BOARD	
2	1	UV1316	UV1316	UV13			PHILIPS	UV1316	TN300
3	1	TSL0707-4R7M2R6	4.7uH	TSL0707	20%		TDK	TSL0707_2.75e	L906
4	1	TSL0707-100K1R9	10uH	TSL0707	10%		TDK	TSL0707_2e	L908
5	1	TPT02B	TPT02B	TRAP-Filter			muRata	SFE_3p	FL104
6	1	TPS6.0MB2	TPS6.0MB2	TRAP-Filter			muRata	SFE_3p	FL102
7	1	TOKO-7KM	150nH	7KM			TOKO	TOKO_7km	L102
8	1	SFE6.0MBF	SFE6.0MBF	SIF-Filter			muRata	SFE_3p	FL101
9	1	SFE5.5MBF	SFE5.5MBF	SIF-Filter			muRata	SFE_3p	FL100
10	7	RODELCO-4972-964	SKHHAK	print_switch			ALPS	MINI_MATRIX_h	S200 S201 S202 S203 S204 S205 S206
11	1	PN-ZTK-33-B	ZTK33B	Misc			PHILIPS	DO35	Z200
12	1	PN-TDA884x	TDA884x	IC_Universal			*	SDIL56_s	IC100
13	1	PN-TDA8380	TDA8380	IC_Universal			*	SOT38_s	IC904
14	1	PN-TDA7057AQ	TDA7057AQ	Radio_Audio			PHILIPS	SOT141	IC600
15	1	PN-LM7808CT	LM7808CT	Stab_Pos			NAT.SEMIC.	TO220_vc	IC901
16	1	PN-LM7805CT	LM7805CT	Stab_Pos			NAT.SEMIC.	TO220_vc	IC903
17	1	PN-GTV	GTV	IC_Universal			*	SOT247_s	IC201
18	1	PN-BU2506DF-BEAD	BU2506DF+BEAD	Pow_HV_Switch			PHILIPS	SOT199_BEAD_vc	TR906
19	1	PN- SFH610A or CNX82	SFH610A or CNX82A	IC_Universal			*	SOT228	IC905
20	5	MKS4230-1-0-1212	MKS4230_12p	MKS4230			STOCKO	MKS4230_12p	P400 P401 P500 P600 P603
21	2	MKS3739-1-0-909	MKS3730_9p	MKS3730			STOCKO	MKS3730_9p	P200 P204
22	1	MKS3738-1-0-808	MKS3730_8p	MKS3730			STOCKO	MKS3730_8p	P902
23	1	MKS3737-1-0-707	MKS3730_7p	MKS3730			STOCKO	MKS3730_7p	P203
24	1	MKS3736-1-0-606	MKS3730_6p	MKS3730			STOCKO	MKS3730_6p	P701
25	1	MKS3735-1-0-505	VERT-DEFL-COIL_5p	MKS3730			STOCKO	MKS3730_5p	P800
26	1	MKS3735-1-0-505	MKS3730_5p	MKS3730			STOCKO	MKS3730_5p	P700
27	3	MKS3733-1-0-303	MKS3730_3p	MKS3730			STOCKO	MKS3730_3p	P601 P602 P604
28	2	MKS3733-1-0-303	MKS3730_2p_220V	MKS3730			STOCKO	MKS3730_2p_220V	P900 P901
29	2	LM317T	LM317T	Stab_Pos			NAT.SEMIC.	TO220_vc	IC900 IC902
30	1	LED-3R	LED-3R	Low_Cost			TEXIM	SOD53	D201
31	4	LED-3G	LED-3G	Low_Cost			TEXIM	SOD53	D200 D202 D203 D204
32	1	LAL03NA1R2M	1.2uH	LAL03NA	10%		TAIYO-YUDEN	uChoke_3e	L300
33	2	LAL03NA100K	10uH	LAL03NA	10%		TAIYO-YUDEN	uChoke_3e	L104 L105
34	1	LAL02NA4R7K	4.7uH	LAL02NA	10%		TAIYO-YUDEN	uChoke_2e	L103

ITEM	CNT	PART_NO	COMPONENT	SERIES	TOL.	RA-TING	VENDOR	GEOMETRY	REFERENCE
35	2	LAL02NA3R3K	3.3uH	LAL02NA	10%		TAIYO-YUDEN	uChoke_2e	L100 L101
36	6	LAL02NA1ROK	1uH	LAL02NA	10%		TAIYO-YUDEN	uChoke_2e	L600 L601 L602 L603 L604 L605
37	1	B39458-M1962-M100	OFW-G1984	SAW-Filter			S+M	SIP_5K	FL103
38	1	AT4043-11	AT4043_11	DC05			PHILIPS	AT4043_11	L902
39	1	9922-520-12Mc	12MHz	Crystal			PHILIPS	HC49_u13	X200
40	1	9922-520-00481	4.433619Mc	Crystal			SARONIX	HC49_u13	X100
41	1	9922-520-00479	3.575611Mc	Crystal			SARONIX	HC49_u13	X102
42	1	9922-520-00478	3.579545Mc	Crystal			SARONIX	HC49_u13	X103
43	1	9922-520-00477	3.582056Mc	Crystal			SARONIX	HC49_u13	X101
44	1	9350-646-00112	PCF8598CP	EEPROMs			PHILIPS	SOT97_s	IC200
45	1	9350-554-00112	TDA8351_N1	Sync			PHILIPS	SOT131_heat._c	IC800
46	1	9350-544-20112	TDA7056A	Radio_Audio			PHILIPS	SOT110_heat._s	IC601
47	1	9337-533-20153	BZD23C	BZD23C			PHILIPS	SOD81	D910
48	1	9337-410-30113	BYD33M	Rectifier			PHILIPS	SOD81	D900
49	2	9337-234-20113	BYD33J	Rectifier			PHILIPS	SOD81	D907 D919
50	1	9337-234-00113	BYD33D	Rectifier			PHILIPS	SOD81	D901
51	1	9337-105-20112	BST70A	fets			PHILIPS	TO92	TR907
52	2	9336-247-60112	BAT85	Schottky			PHILIPS	SOD68	D300 D917
53	1	9335-003-90127	BUT11A	Pow_HV-Switch			PHILIPS	TO220	TR901
54	1	9335-001-50112	BYW95C	Rectifier			PHILIPS	SOD64	D908
55	1	9335-001-40112	BYW96B	Rectifier			PHILIPS	SOD64	D902
56	2	9334-500-90112	PH2369	Switching			PHILIPS	TO92	TR110 TR200
57	3	9334-500-90112	BC548	Switching			PHILIPS	TO92	TR117 TR118 TR119
58	1	9334-480-50127	BD938	Pow_Low-Freq			PHILIPS	TO220	TR900
59	6	9333-636-10153	BYW54	Rectifier			PHILIPS	SOD57	D903 D904 D905 D906 D911 D913
60	1	9332-979-90153	BAS11	Gen_Purpose			PHILIPS	SOD27	D920
61	3	9331-987-70112	BF494	High_Freq			PHILIPS	TO92	TR111 TR115 TR120
62	6	9331-977-30112	BC558	Gen_Purpose			PHILIPS	TO92	TR105 TR107 TR109 TR202 TR203 TR204
63	1	9331-976-70112	BC548C	Gen_Purpose			PHILIPS	TO92	TR905
64	23	9331-976-40112	BC548	Gen_Purpose			PHILIPS	TO92	TR100 TR101 TR102 TR103 TR104 TR106 TR108 TR112 TR113 TR114 TR116 TR121 TR201 TR205 TR206 TR207 TR208 TR300 TR301 TR302 TR902 TR903 TR904
65	1	9331-178-40153	BZX79C	BZX79C			PHILIPS	SOD27	Z800
66	1	9331-177-70153	BZX79C	BZX79C			PHILIPS	SOD27	D915
67	1	9331-177-30153	BZX79C	BZX79C			PHILIPS	SOD27	D916
68	1	9331-176-80153	BZX79C	BZX79C			PHILIPS	SOD27	Z201
69	12	9330-839-90153	1N4148	Gen_Purpose			PHILIPS	SOD27	D100 D101 D102 D103 D104 D105 D106 D205 D909 D914 D918 D921
70	1	9330-229-10153	BAX18	Gen_Purpose			PHILIPS	SOD27	D912
71	1	8228-001-20321	2032.1	Line_Output			PHILIPS	uS3	T902
72	4	4330-030-41051	WBC_2_RT	Chokes			PHILIPS	WBC_2rt	L800 L801 L900 L903
73	6	4330-030-38081	WBC_2.5_R	Chokes			PHILIPS	WBC_2.5r	L200 L201 L901 L904 L905 L907
74	1	3128-138-35761	CU15_driver	Line_driver			PHILIPS	CU15	L910
75	1	3122-138-31291	AT4042_90C	Fix_Corr			PHILIPS	FIX_LC_A	L909
76	1	3112-338-32032	AT4043_20	Chokes			PHILIPS	CU20d3	T900
77	1	3111-268-30200	AT3010_110LL	Switch_Mode			PHILIPS	AT3010_110LL	T901
78	1	2422-034-15068	SOLDER-PIN_small				PHILIPS	SOLDER_PIN-small	P100

ITEM	CNT	PART_NO	COMPONENT	SERIES	TOL.	RA-TING	VENDOR	GEOMETRY	REFERENCE
79	1	2422-021-98731	JUMPER_3p	print_switch			PHILIPS	JUMPER_3p	J600
80	1	2412-086-28239	2A	SLOW			PHILIPS	GLAS_HOLDER	F900
81	1	2322-662-96116	DUAL_PTC_24_750_3K	PTC	5%	1W	PHILIPS	DUAL_PTC	R9001
82	1	2322-482-40222	2.2k	OMP10	20%	0.5W	PHILIPS	OMP10_h	R9045
83	1	2322-329-34478	4.7	AC04	10%	4W	PHILIPS	AC04	R9003
84	1	2322-329-04182	1.8k	AC04	5%	4W	PHILIPS	AC04	R9002
85	1	2322-242-13475	4.7M	VR37	5%	0.5W	PHILIPS	VR37	R9031
86	2	2322-241-13224	220k	VR25	5%	0.25W	PHILIPS	VR25	R9047 R9048
87	1	2322-205-13477	0.47	NFR25	5%	0.5W	PHILIPS	SFR25H	R9007
88	6	2322-205-13108	1	NFR25	5%	0.5W	PHILIPS	SFR25H	R8004 R9016 R9026 R9028 R9029 R9030
89	1	2322-194-13331	330	PR02	5%	2W	PHILIPS	PR02	R8008
90	1	2322-194-13271	270	PR02	5%	2W	PHILIPS	PR02	R9000
91	2	2322-194-13159	15	PR02	5%	2W	PHILIPS	PR02	R9019 R9022
92	2	2322-194-13108	1	PR02	5%	2W	PHILIPS	PR02	R6000 R6005
93	1	2322-194-13103	10k	PR02	5%	2W	PHILIPS	PR02	R9059
94	1	2322-193-13688	6.8	PR01	5%	1W	PHILIPS	PR01	R9009
95	1	2322-193-13124	120k	PR01	5%	1W	PHILIPS	PR01	R9008
96	1	2322-193-13101	100	PR01	5%	1W	PHILIPS	PR01	R9053
97	1	2322-186-16473	47k	SFR25H	5%	0.5W	PHILIPS	SFR25H	R9049
98	1	2322-186-16472	4.7k	SFR25H	5%	0.5W	PHILIPS	SFR25H	R9033
99	2	2322-186-16339	33	SFR25H	5%	0.5W	PHILIPS	SFR25H	R8005 R9025
100	1	2322-186-16222	2.2k	SFR25H	5%	0.5W	PHILIPS	SFR25H	R9051
101	1	2322-186-16183	18k	SFR25H	5%	0.5W	PHILIPS	SFR25H	R9042
102	2	2322-186-16151	150	SFR25H	5%	0.5W	PHILIPS	SFR25H	R9011 R9012
103	2	2322-186-16128	1.2	SFR25H	5%	0.5W	PHILIPS	SFR25H	R8006 R8007
104	2	2322-186-16122	1.2k	SFR25H	5%	0.5W	PHILIPS	SFR25H	R1000 R9018
105	1	2322-186-16103	10k	SFR25H	5%	0.5W	PHILIPS	SFR25H	R9015
106	1	2322-186-16102	1k	SFR25H	5%	0.5W	PHILIPS	SFR25H	R9024
107	1	2322-180-73913	91k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R9014
108	1	2322-180-73823	82k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R3017
109	1	2322-180-73822	8.2k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R2079
110	2	2322-180-73751	750	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R8000 R8001
111	1	2322-180-73683	68k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R9034
112	1	2322-180-73682	6.8k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1003
113	1	2322-180-73682	6.8k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R9058
114	1	2322-180-73681	680	SFR16T	5%	0.5W	PHILIPS	SFR16T_4e	R1009
115	1	2322-180-73562	5.6k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R2081
116	1	2322-180-73561	560	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1057
117	1	2322-180-73561	560	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1056
118	1	2322-180-73513	51k	SFR16T	5%	0.5W	PHILIPS	SFR16T_4e	R9043
119	1	2322-180-73512	5.1k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R9021
120	1	2322-180-73479	47	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1007
121	1	2322-180-73479	47	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1022
122	2	2322-180-73478	4.7	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1021 R3010
123	8	2322-180-73473	47k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1001 R1008 R2033 R3002 R3006 R3009 R3011 R9027
124	1	2322-180-73472	4.7k	SFR16T	5%	0.5W	PHILIPS	SFR16T_4e	R9013
125	10	2322-180-73472	4.7k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1037 R2021 R2040 R2041 R2042 R3016 R6003 R6004 R6007 R9039
126	2	2322-180-73472	4.7k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R2025 R2038

ITEM	CNT	PART_NO	COMPONENT	SERIES	TOL.	RA-TING	VENDOR	GEOMETRY	REFERENCE
127	6	2322-180-73471	470	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R2011 R2015 R2023 R2029 R9010 R9044
128	1	2322-180-73394	390k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R8002
129	1	2322-180-73393	39k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1015
130	1	2322-180-73393	39k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R2054
131	3	2322-180-73392	3.9k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R3000 R9037 R9040
132	1	2322-180-73391	390	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1014
133	1	2322-180-73333	33k	SFR16T	5%	0.5W	PHILIPS	SFR16T_4e	R3014
134	2	2322-180-73333	33k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R3008 R3013
135	13	2322-180-73332	3.3k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1011 R1032 R1035 R2018 R2019 R2024 R2028 R2032 R2036 R3003 R3005 R3012 R9023
136	3	2322-180-73332	3.3k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1004 R2010 R9038
137	2	2322-180-73331	330	SFR16T	5%	0.5W	PHILIPS	SFR16T_4e	R1018 R1020
138	2	2322-180-73331	330	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1047 R1062
139	2	2322-180-73331	330	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1060 R1061
140	2	2322-180-73302	3k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R8003 R9006
141	3	2322-180-73273	27k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1019 R1034 R2084
142	1	2322-180-73272	2.7k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1039
143	1	2322-180-73242	2.4k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R9017
144	1	2322-180-73229	22	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R8009
145	2	2322-180-73223	22k	SFR16T	5%	0.5W	PHILIPS	SFR16T_4e	R1064 R1065
146	3	2322-180-73223	22k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1066 R2058 R3015
147	4	2322-180-73222	2.2k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1053 R1054 R1055 R2005
148	2	2322-180-73222	2.2k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R2027 R2030
149	4	2322-180-73221	220	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1045 R1050 R3004 R3007
150	1	2322-180-73221	220	SFR16T	5%	0.5W	PHILIPS	SFR16T	R2003
151	1	2322-180-73202	2k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R9036
152	2	2322-180-73184	180k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R2008 R9032
153	1	2322-180-73183	18k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R9057
154	1	2322-180-73183	18k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1058
155	1	2322-180-73182	1.8k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R9052
156	1	2322-180-73181	180	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1013
157	1	2322-180-73181	180	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1023
158	11	2322-180-73153	15k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1030 R2007 R2016 R2020 R2035 R2056 R2068 R2069 R2070 R2071 R9020
159	1	2322-180-73153	15k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R2006
160	1	2322-180-73124	120k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1017
161	2	2322-180-73123	12k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R3001 R9041
162	1	2322-180-73123	12k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R2002
163	1	2322-180-73122	1.2k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1006
164	1	2322-180-73121	120	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R9056
165	1	2322-180-73109	10	SFR16T	5%	0.5W	PHILIPS	SFR16T_4e	R9005
166	1	2322-180-73109	10	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R9054
167	1	2322-180-73109	10	SFR16T	5%	0.5W	PHILIPS	SFR16T	R2001
168	3	2322-180-73104	100k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1016 R1049 R1069
169	1	2322-180-73104	100k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1059
170	2	2322-180-73103	10k	SFR16T	5%	0.5W	PHILIPS	SFR16T_4e	R2039 R6006
171	19	2322-180-73103	10k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1041 R1042 R1074 R1075 R1076 R1077 R1078 R1079 R2014 R2051 R2060 R2062 R2080 R2082 R2083 R2085 R6001 R6002 R9050

ITEM	CNT	PART_NO	COMPONENT	SERIES	TOL.	RA-TING	VENDOR	GEOMETRY	REFERENCE
172	11	2322-180-73103	10k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1051 R1052 R1063 R1067 R1070 R1071 R1073 R2013 R2045 R2048 R2059
173	15	2322-180-73102	1k	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1010 R1027 R1028 R1033 R1040 R1044 R1068 R1072 R2009 R2012 R2057 R2073 R9004 R9035 R9055
174	5	2322-180-73102	1k	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1002 R1005 R1012 R2000 R2049
175	1	2322-180-73101	100	SFR16T	5%	0.5W	PHILIPS	SFR16T_4e	R9046
176	33	2322-180-73101	100	SFR16T	5%	0.5W	PHILIPS	SFR16T_3e	R1024 R1026 R1036 R1038 R1043 R1046 R1048 R2004 R2017 R2022 R2026 R2031 R2034 R2037 R2043 R2044 R2047 R2050 R2052 R2053 R2055 R2061 R2063 R2064 R2065 R2066 R2067 R2072 R2074 R2075 R2076 R2077 R2078
177	4	2322-180-73101	100	SFR16T	5%	0.5W	PHILIPS	SFR16T	R1025 R1029 R1031 R2046
178	2	2222-655-03681	680pF	C655	10%	500V	PHILIPS	CER2_2B	C9000 C9028
179	3	2222-655-03471	470pF	C655	10%	500V	PHILIPS	CER2_2A	C9013 C9020 C9024
180	1	2222-655-03331	330pF	C655	10%	500V	PHILIPS	CER2_1	C9038
181	1	2222-655-03221	220pF	C655	10%	500V	PHILIPS	CER2_1	C9004
182	6	2222-655-03102	1nF	C655	10%	500V	PHILIPS	CER2_2B	C6000 C6001 C6002 C6003 C6008 C6009
183	1	2222-655-03101	100pF	C655	10%	500V	PHILIPS	CER2_1	C9037
184	1	2222-638-58331	330pF	C638-N750	2%	100V	PHILIPS	CER2_5	C9032
185	1	2222-638-10479	47pF	C638-NP0	2%	100V	PHILIPS	CER2_2A	C1006
186	6	2222-638-10279	27pF	C638-NP0	2%	100V	PHILIPS	CER2_1	C2016 C2017 C2018 C2019 C2020 C2021
187	6	2222-638-10189	18pF	C638-NP0	2%	100V	PHILIPS	CER2_1	C1036 C1037 C1040 C1044 C2012 C2013
188	1	2222-638-09828	8.2pF	C638-NP0	0.25pF	100V	PHILIPS	CER2_1	C2005
189	1	2222-631-10109	10pF	C631-NP0	2%	100V	PHILIPS	CER1_1	C9031
190	2	2222-630-03332	3.3nF	C630	10%	100V	PHILIPS	CER2_3	C1000 C1031
191	1	2222-630-02222	2.2nF	C630_1E	10%	100V	PHILIPS	CER1_2B	C1030
192	1	2222-629-03472	4.7nF	C629	20+80%	63V	PHILIPS	CER2_1	C1022
193	9	2222-629-03223	22nF	C629	20+80%	63V	PHILIPS	CER2_4	C1005 C1012 C1019 C1034 C1038 C1039 C8005 C8006 C8007
194	1	2222-629-03222	2.2nF	C629	20+80%	63V	PHILIPS	CER2_1	C1025
195	2	2222-629-03103	10nF	C629	20+80%	63V	PHILIPS	CER2_2B	C8000 C8001
196	5	2222-629-03102	1nF	C629	20+80%	63V	PHILIPS	CER2_1	C1009 C1013 C1017 C1018 C2001
197	3	2222-378-62104	100nF	MKP/MKP 378	5%	630V	PHILIPS	C378_C	C9001 C9002 C9003
198	1	2222-376-92752	7.5nF	KP/MMKP 376	5%	2000V	PHILIPS	C376_F	C9039
199	1	2222-376-92152	1.5nF	KP/MMKP 376	5%	2000V	PHILIPS	C376_A	C9005
200	7	2222-370-21473	47nF	MKT 370	10%	100V	PHILIPS	C370_A	C1015 C1021 C1027 C1041 C1042 C1043 C9048
201	1	2222-370-21333	33nF	MKT 370	10%	100V	PHILIPS	C370_A	C9045
202	5	2222-370-11474	470nF	MKT 370	10%	63V	PHILIPS	C370_C	C6006 C6007 C6010 C9040 C9041
203	4	2222-370-11334	330nF	MKT 370	10%	63V	PHILIPS	C370_B	C9014 C9015 C9025 C9026
204	3	2222-370-11224	220nF	MKT 370	10%	63V	PHILIPS	C370_B	C1026 C1028 C8009
205	22	2222-370-11104	100nF	MKT 370	10%	63V	PHILIPS	C370_A	C1007 C1008 C1033 C2004 C2006 C2007 C2009 C2010 C2014 C2015 C2023 C2024 C2027 C2028 C3001 C6005 C6012 C8003 C8008 C9019 C9033 C9034
206	1	2222-368-45474	470nF	MKT 368	10%	250V	PHILIPS	C368_H	C9042

ITEM	CNT	PART_NO	COMPONENT	SERIES	TOL.	RA-TING	VENDOR	GEOMETRY	REFERENCE
207	1	2222-336-60472	4.7nF	MKP 336	20%	250V	PHILIPS	C336_A	C9030
208	4	2222-336-60222	2.2nF	MKP 336	20%	250V	PHILIPS	C336_A	C9008 C9009 C9011 C9012
209	1	2222-136-66102	1000uF	RVI136	20%	25V	PHILIPS	CASE_R17	C8004
210	3	2222-136-65471	470uF	RVI136	20%	16V	PHILIPS	CASE_R15	C9017 C9018 C9023
211	1	2222-136-61471	470uF	RVI136	20%	50V	PHILIPS	CASE_R18	C9027
212	1	2222-136-61101	100uF	RVI136	20%	50V	PHILIPS	CASE_R14	C9035
213	1	2222-136-60221	220uF	RVI136	20%	35V	PHILIPS	CASE_R15	C9016
214	1	2222-134-55479	47uF	RLP5 134	20%	16V	PHILIPS	CASE_R55_CA	C3000
215	1	2222-134-55109	10uF	RLP5 134	20%	16V	PHILIPS	CASE_R52_CA	C2022
216	1	2222-134-51478	4.7uF	RLP5 134	20%	50V	PHILIPS	CASE_R54_CA	C1016
217	2	2222-134-51109	10uF	RLP5 134	20%	50V	PHILIPS	CASE_R55_CA	C2011 C2025
218	3	2222-134-51108	1uF	RLP5 134	20%	50V	PHILIPS	CASE_R51_CA	C2008 C2026 C9036
219	9	2222-134-50109	10uF	RLP5 134	20%	35V	PHILIPS	CASE_R54_CA	C1002 C1003 C1010 C1014 C1029 C2002 C2003 C3002 C3003
220	4	2222-134-35109	10uF	RLP5 134	20%	16V	PHILIPS	CASE_R52_TFA	C1032 C9007 C9021 C9044
221	4	2222-097-58228	2.2uF	RLP7 097	20%	63V	PHILIPS	CASE_R71_m	C1001 C1004 C1011 C1024
222	1	2222-097-58108	1uF	RLP7 097	20%	63V	PHILIPS	CASE_R71_m	C1023
223	2	2222-097-55101	100uF	RLP7 097	20%	16V	PHILIPS	CASE_R74_m	C1020 C1035
224	1	2222-057-58221	220uF	PSM-SI 057	20%	385V	PHILIPS	CASE_30x40	C9010
225	1	2222-044-90502	1uF	RSH 044	20%	250V	PHILIPS	CASE_R13	C9043
226	1	2222-044-90479	47uF	RSH 044	20%	160V	PHILIPS	CASE_R19	C9006
227	2	2222-044-90016	2.2uF	RSH 044	20%	250V	PHILIPS	CASE_R13	C9046 C9047
228	1	2222-037-68101	100uF	RSM 037	20%	63V	PHILIPS	CASE_R14	C8002
229	1	2222-037-58229	22uF	RSM 037	20%	63V	PHILIPS	CASE_R12_m	C9022
230	1	2222-037-58228	2.2uF	RSM 037	20%	63V	PHILIPS	CASE_R11_m	C9029
231	2	2222-037-56221	220uF	RSM 037	20%	25V	PHILIPS	CASE_R13_m	C6004 C6011
232	1	2222-030-34229	22uF	AS 030	-10/ +50%	10V	PHILIPS	CASE_A2	C2000
233	1	05-88-1736	ARRAY_BUS-H_1x5p	SINGLE_ARRAY_BU			DISPLAY	ARRAY_BUS_H_1x5p	P202

APPENDIX 17 Component layout for the NTSC-Only configuration.

See supplement document AN98051A of this report.

APPENDIX 18 Component layout for the South America configuration.

See supplement document AN98051A of this report.

APPENDIX 19 Component layout for the Pal Multi Sandard VST configuration.

See supplement document AN98051A of this report.