

Important notice

Dear Customer,

On 7 February 2017 the former NXP Standard Product business became a new company with the tradename **Nexperia**. Nexperia is an industry leading supplier of Discrete, Logic and PowerMOS semiconductors with its focus on the automotive, industrial, computing, consumer and wearable application markets

In data sheets and application notes which still contain NXP or Philips Semiconductors references, use the references to Nexperia, as shown below.

Instead of <http://www.nxp.com>, <http://www.philips.com/> or <http://www.semiconductors.philips.com/>, use <http://www.nexperia.com>

Instead of sales.addresses@www.nxp.com or sales.addresses@www.semiconductors.philips.com, use salesaddresses@nexperia.com (email)

Replace the copyright notice at the bottom of each page or elsewhere in the document, depending on the version, as shown below:

- © NXP N.V. (year). All rights reserved or © Koninklijke Philips Electronics N.V. (year). All rights reserved

Should be replaced with:

- © **Nexperia B.V. (year). All rights reserved.**

If you have any questions related to the data sheet, please contact our nearest sales office via e-mail or telephone (details via salesaddresses@nexperia.com). Thank you for your cooperation and understanding,

Kind regards,

Team Nexperia

APPLICATION NOTE

**Circuit description of CCM420
monitor**

AN97032

Abstract

The CCM420 demo monitor is a full I²C-bus controlled 17" colour monitor. It's extensive geometry control and excellent video performance with a high level of integration make it a high-performance monitor at moderate cost and easy application.



Purchase of Philips I²C components conveys a license under the I²C patent to use the components in the I²C system, provided the system conforms to the I²C specifications defined by Philips.

© Philips Electronics N.V. 1997

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

APPLICATION NOTE

**Circuit description of CCM420
monitor**

AN97032

Author:

Hans Verhees

**Philips Semiconductors Systems Laboratory Eindhoven,
The Netherlands**

Keywords

Colour Monitor
Geometry control
EHT supply
I²C control
17" HiRes

Number of pages: 50

Date: 97-10-14

Summary

This application note includes a brief description of the circuits of the CCM420 demo monitor excluding the video part (see references); complete circuit diagrams plus printed circuit board lay-out and parts list as well as hints on the pcb lay-out are given. Debugging of the main printed circuit board and alignment in a complete monitor is also included in the report. Highlights of this design are the I²C controlled monitor deflection controller TDA4854, I²C controlled video controller TDA4885, full-bridge vertical deflection booster TDA8354, monitor Microcontroller P83C181* and the control software CCM420S. Combining this board with the CMT M41EHN323X145 and video board completes the CCM420 monitor.

* The Microcontroller P83C181 is pruned. It can be replaced by the P83C180. This device however has 42 pins (additional DACs are included) which requires a redesign of the pcb. See also appendix CICT IC newsletter no. 17

CONTENTS

1. INTRODUCTION	7
1.1 CCM420 Specification	8
1.2 List of abbreviations.....	9
2. BLOCK DIAGRAM.....	12
3. CIRCUIT DESCRIPTIONS.....	14
3.1 Switched mode power supply	14
3.2 Microcontroller.....	14
3.3 I ² C-bus autosync deflection controller for PC/TV monitors TDA4854.....	14
3.3.1 Brightness uniformity	15
3.4 Horizontal deflection output stage	15
3.4.1 B+ supply	15
3.4.2 Line driver and output stage.....	15
3.4.3 Linearity and S-correction control.....	15
3.5 Vertical deflection output stage	16
3.6 EHT supply.....	16
3.6.1 Grid 1 supply	17
3.6.2 Grid 2 supply	17
3.6.3 Focus supply	17
3.7 Rotation circuit.....	17
3.8 Sound circuit.....	17
4. CIRCUIT DIAGRAMS	18
4.1 Last minute changes.....	18
5. PARTS LIST	25
5.1 Resistors and potentiometers	25
5.2 Capacitors	28
5.3 Transistors	29
5.4 Diodes.....	30
5.5 Integrated circuits	31
5.6 Wire-wound components	31
5.7 Miscellaneous.....	31
6. PRINTED CIRCUIT BOARD LAYOUT.....	33
6.1 Lay-out hints.....	33
7. ALIGNMENT PROCEDURE	38
7.1 Equipment.....	38
7.2 Alignment	38
8. DEBUGGING PROCEDURE.....	40
9. REFERENCES.....	42

1. INTRODUCTION

The CCM420 demo monitor is a full I²C bus controlled monitor. Extensive geometry control, a very wide deflection frequency range (horizontal: 15 - 84 kHz; vertical: 50 - 160 Hz), wide bandwidth video channels (maximum pixel rate 180 Mhz) with perfect grey scale tracking, a full mains range supply combined with complete software control result in a monitor with outstanding specifications while maintaining an economic design.

The CCM420 demo monitor is meant to show the latest products of Philips Semiconductors and Philips Components. Key components are:

- monitor microcontroller P83C181
- CCM420S monitor control software
- I²C-bus autosync deflection controller for PC/TV monitors TDA4854
- I²C-bus controlled octuple eight bit DAC TDA8447
- full bridge vertical booster TDA8354
- 150 Mhz video controller with I²C-bus TDA4885
- hybrid video output stage CR6927
- low power line driver transformer CU15/35
- monitor line deflection transistor BU2532AL
- DC controlled linearity corrector PE4025/01
- EHT transformer AT2097/M1
- 0.27 mm dot triplet pitch CRT M41EHN
- Optionally available is an active convergence control circuit with the vector processor TDA4845

The monitor microcontroller P83C181 has a DDC interface, auto-sync detection and a hardware sync processor. The DDC interface is DDC2AB compliant. The hardware mode detector has 12 bit resolution for the horizontal and vertical frequency, polarity detection and sync presence detection. The built-in sync processor also has a free-running mode. In this design the microcontroller runs with newly developed software CCM420S. This software allows extensive user control of geometry and colour adjustment.

The autosync deflection controller for PC/TV monitors TDA4854 is fully I²C-bus controlled and in this application operating with a horizontal frequency range of 15 to 90 kHz (maximum 150 kHz; maximum ratio 6.5 :1). It allows very extensive control of geometry both horizontally and vertically, built-in B+ control part and focus section. Built-in soft-start as well as controlled shut down for B+ and deflection drive signals safeguard the output stages at power-up and power-down, while smooth caption of horizontal frequency during mode-changes ensures adequate protection of the line output stage. The B+ control part is used in the feed-forward mode without any feedback (omitting loop stability problems). The focus section has a fixed correction for the delay in the high voltage output stage.

The vertical booster is the newly introduced TDA8354. This is a LVDMOS full bridge current driven output stage for 3.2 Ampere peak-peak maximum and a flyback supply voltage of 68 Volt maximum.

The horizontal output stage is separated from the EHT supply to get maximum front of screen performance. The line driver uses a low-power design with the CU15/35 driver transformer and a high-speed switching line output transistor BU2532AL. To obtain optimum scan performance six S-correction switches and a newly designed DC-controlled linearity corrector PE4025/01 are used.

The separate EHT supply section is synchronised with the horizontal deflection and uses a dedicated transformer AT2097/M1. Incorporated in this application are a number of protections to prevent spot burn-in.

The M41EHN tube is fitted with a rotation control coil. The tilt adjustment in this monitor allows an additional control of the bottom line (Tilt respectively NS trapezium).

Front of screen performance is further enhanced by means of a brightness-uniformity circuit which can be switched on/off via I²C.

1.1 CCM420 Specification

General

- Mains voltage 90 - 264 Volts AC
- Mains frequency 50 - 60 Hz
- Power consumption 100 W typical
- Operating ambient temperature 10 °C to 40 °C
- Weight 20 kg
- Dimensions (W x H x D) 417 x 426 x 446 mm³

Picture tube

- Type M41 EHN 323 x 145 2F01R
- Horizontal deflection impedance 130 μH (max. hor. freq. 84 kHz)
- Vertical deflection impedance 7.7 Ω
- Dot triplet pitch 0.27 mm
- Recommended active screen area 312 x 234 mm²
- Anode voltage 26.0 kV

Video

- Maximum dot rate 180 Mhz
- Video input signal 700 mVpp linear via three BNC inputs
- Video input impedance 75 Ω
- Horizontal shift range > ±12.5 mm
- Vertical shift range > ±12.5 mm
- Horizontal amplitude < 210 mm to > 340 mm
- Vertical amplitude < 160 mm to > 240 mm
- Reference white point x = 0.313; y = 0.329 (D6500)
- White point deviation Δx < 0.01; Δy < 0.01
- Grey scale tracking Δx < 0.02; Δy < 0.02

Sync signals

- Inputs Separate Horizontal/Composite and Vertical inputs via BNC

-
- Level TTL
 - Polarity Positive or negative
 - Horizontal frequency 15 to 84 kHz
 - Vertical frequency 50 to 160 Hz

User interface

- Control Five button keyboard plus USER/SERVICE switch
- Indication On Screen Display with 4 lines of 12 characters

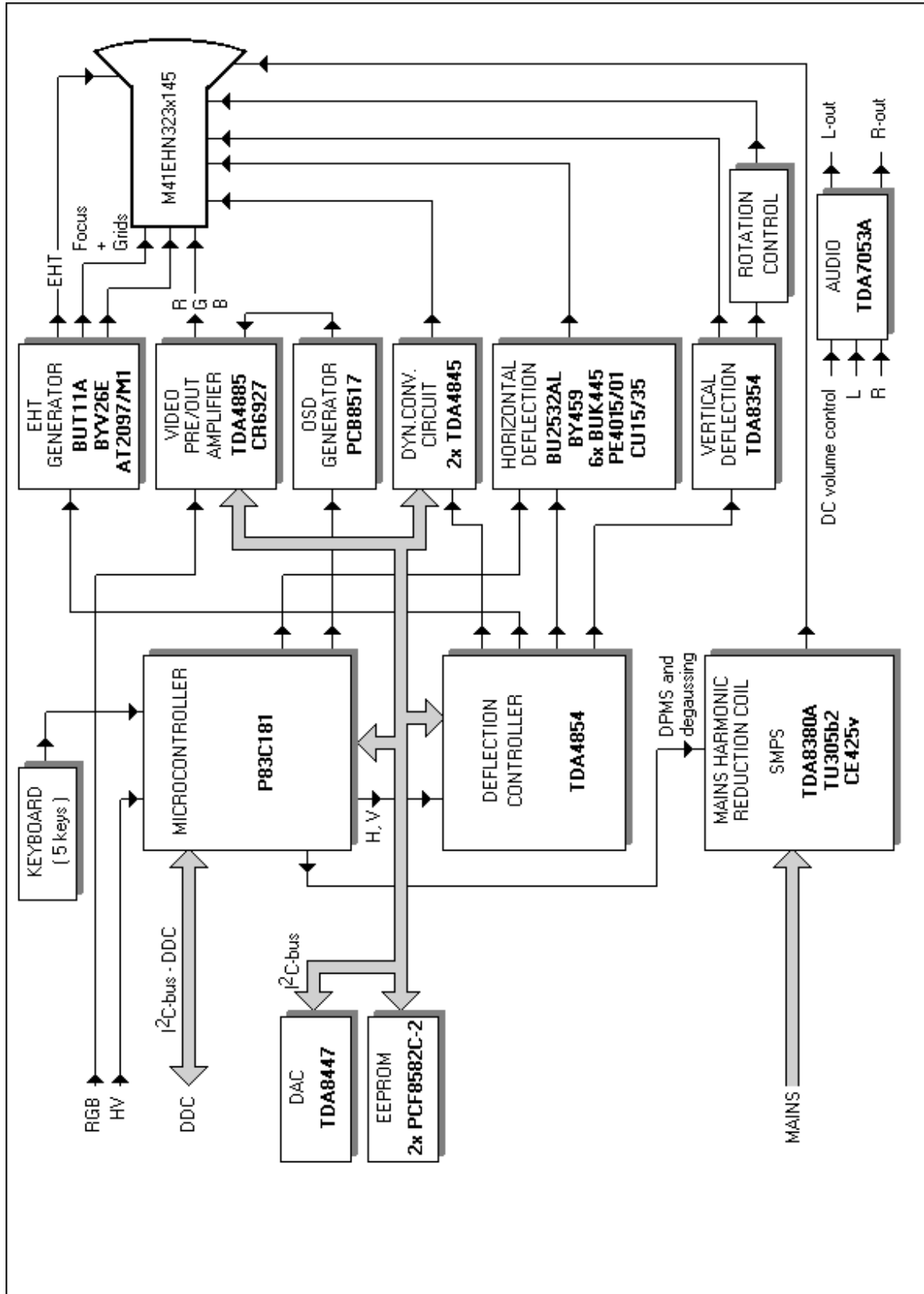
1.2 List of abbreviations

A1	Auxiliary 1
A2	Auxiliary 2
A3	Auxiliary 3
A4	Auxiliary 4
AGCDIS	Automatic gain control in vertical oscillator enabled/disabled
ASDC	Auto-Sync Deflection Controller
BB	Blue Black level
BG	Blue gain
Black Lvl B	Blue channel black level control register in the TDA4885
Black Lvl G	Green channel black level control register in the TDA4885
Black Lvl R	Red channel black level control register in the TDA4885
BLKDIS	Vertical protection at 'Clamping/blanking' and 'Horizontal unlock' enabled/disabled in the TDA4854
Brightness	Brightness control register in the TDA4885
CLAMP	Selection of trailing/leading edge horizontal clamping pulse in the TDA4854
Contrast	Contrast control register in the TDA4885
CRT	Cathode Ray Tube
CT	Colour temperature
DDC	Display Data Channel
DISO	On Screen Display enabled/disabled in the TDA4885
DISV	Video signals enabled/disabled in the TDA4885
DPMS	Display Power Management Signalling
EHT	Extreme High Tension
ENN	Fast blanking pulse for On Screen Display
EW	East-West
FHMULT	East-West output tracking with / independent of horizontal frequency in the TDA4854

FPOL	Selection of positive / negative feedback polarity in the TDA4885
G2	CRT grid 2
Gain B	Blue channel gain control register in the TDA4885
Gain G	Green channel gain control register in the TDA4885
Gain R	Red channel gain control register in the TDA4885
GB	Green Black level
GG	Green gain
H	Horizontal
H-corner	Horizontal corner control register in the TDA4854
H-focus	Horizontal focus control register in the TDA4854
H-moiré	Horizontal Moiré control register in the TDA4854
H-paral	Horizontal parallelogram control register in the TDA4854
H-pin	Horizontal pincushion control register in the TDA4854
H-pin-bal	Horizontal pin-balance control register in the TDA4854
H-pos	Horizontal position control register in the TDA4854
H-Rot	Horizontal Rotation or Tilt control register in the TDA8447
H-size	Horizontal size register in the TDA4854
H-trap	Horizontal trapezium control register in the TDA4854
HB	Horizontal Pin-balance
HBC	Horizontal pin-balance enable/disable
HC	Horizontal Corner
HF	Horizontal focus
HL	Horizontal linearity
Hlin	Horizontal linearity control register in the TDA8447
HP	Horizontal Pincushion
HPC	Horizontal pincushion enable/disable
HT	Horizontal Trapezium
I ² C	Inter IC
LVDMOS	Low Voltage Depletion Metal Oxide Semiconductor
MOD	Horizontal and vertical moiré cancellation enabled/disabled in the TDA4854
NS	North-South
NStrap	North-South trapezium control register in the TDA8447
OC	On Screen Display contrast
Oh	On Screen Display Horizontal position
OSD	On Screen Display
OSD Ctrst	On Screen Display contrast control register in the TDA4885
Ov	On Screen Display Vertical position

PA	Parallelogram
PEDST	Pedestal blanking enabled/disabled in the TDA4885
RB	Red Black level
RG	Red gain
SCK	Serial clock
SDI	Serial data
SMPS	Switched Mode Power Supply
SMPTE	Society of Motion Picture and Television Engineers
SOFTST	Softstart control bit in the TDA4854
STDBY	Standby control bit in the TDA4854
TI	Tilt
TVMOD	TV mode at F_{min} activated/de-activated in the TDA4854
USB	Universal Serial Bus
V	Vertical
V-focus	Vertical focus control register in the TDA4854
V-lin	Vertical linearity control register in the TDA4854
V-lin-bal	Vertical linearity balance control register in the TDA4854
V-moiré	Vertical Moiré control register in the TDA4854
V-pos	Vertical position control register in the TDA4854
V-size	Vertical size control register in the TDA4854
VB	Vertical linearity balance
VBLK	Selection of duration of vertical blanking pulse in the TDA4854
VESA	Video Electronics Standard Association
VF	Vertical focus
Vg1	Voltage on grid 1 of the CRT
Vg2	Voltage on grid 2 of the CRT
Vg2	Grid 2 voltage control register in the TDA8447
VL	Vertical linearity
VLC	Vertical linearity balance control enabled/disabled in the TDA4854
VOVSCN	VGA vertical size control bit in the TDA4854
VPC	Vertical position and Horizontal trapezium control enabled/disabled in the TDA4854
VSC	Vertical linearity and Horizontal corner corrections enabled/disabled in the TDA4854
VT	Vertical trapezium

2. BLOCK DIAGRAM



Remarks to the block diagram:

1. The Dynamic convergence circuit is optional. The Vector Processor TDA4845 is not commercially available.
2. Due to time limitation and mechanical restrictions the sound part is, although present in the printed circuit board layout, not inserted and therefor not operational.

3. CIRCUIT DESCRIPTIONS

3.1 Switched mode power supply

The SMPS is preceded by a mains harmonic reduction coil (L1: TU305b2) in order to reduce mains harmonics distortion. This coil is short-circuited for mains voltages below 175 VAC (T6, T7 and TH2).

An additional connector 'USB-supply' is present for an optional USB supply (under development; available ???; see references).

In this SMPS only DPMS level 1 is realised resulting in a burst-mode operation of the SMPS. Transistor T10 and T11 act as comparator to control the burst mode. In this burst mode the mains input power reduces to less than 2.5 W. In case the USB supply is present, the SMPS is switched-off completely while the microcontroller supply is maintained from the USB supply part (header X3).

DPMS level 2 is realised by using the Standby-mode of the TDA4854 activated via I²C bus.

Overcurrent protection is achieved by means of resistors R32, R33, and R34 connected to pin 13 of the TDA8380. In case of continuous short circuit diodes D32 and D33 provide extra protection by increasing the delay time before the next slow-start is initiated.

The only adjustment is the 185 Volt output by means of potentiometer P1.

The output voltages of the supply are:

185 V horizontal deflection and EHT output stages; reference voltage for Vg2.

78 V video output stages;

18 V driver stages, rotation circuit and 12 Volt stabiliser;

11 V vertical deflection output stage, 5 Volt stabiliser and heater current;

-18 V rotation circuit.

3.2 Microcontroller

The microcontroller P83C181 controls all adjustments in the complete monitor by I²C bus. The only two adjustments not accessible by I²C bus are the "SMPS 185 Volt" and the "EHT 26.0 kV". The user interface consists of a five button keyboard and an On-Screen-Display.

Communication with the OSD controller on the video board is via a high speed interface bus (signals ENN, SDI and SCK).

In normal operation the user has only access to the first two levels of the software program. The first level being the video mode information displaying horizontal and vertical frequencies and mode number/identification. The second level gives access to control the brightness, contrast, degaussing, horizontal and vertical moiré cancellation, picture position and size. Brightness and contrast control can be directly accessed by respectively menu u/d buttons and cursor u/d buttons.

In the service mode (jumper J301 closed; service switch down on the front keyboard) the higher levels for control of colour (black levels, gain, etc.) and geometry (pin-cushion, pin-balance, trapezium, etc.) can be accessed.

3.3 I²C-bus autosync deflection controller for PC/TV monitors TDA4854

The TDA4854 is applied here in a basic configuration. This means HSMOD, VSMOD and ASCOR pins are not used (separate horizontal deflection and EHT supply; no DC shift circuit for horizontal deflection). ASCOR is internally connected to PLL2 (bit ACD = 1).

The horizontal oscillator can be synchronised in the frequency range from 15 to 85 kHz (determined by resistors R350 and R351 and capacitor C318). The value of R350 and R351 can be determined according to the equations in appendix 3.

The B+ section is fed with the EWDRV signal from pin 11 with the FHMULT bit = 0 (multiplication with the frequency is achieved in the output stage). The sawtooth generator uses a current source to minimise influence of the supply voltage. Capacitor C312 must have a low temperature coefficient (preferably NP0) to minimise temperature effects. Capacitor C314 must be placed as close as possible to pins 3 and 7 to minimise EMS.

The HUNLOCK signal is used as interrupt for the microcontroller in case of a mode change and insertion of vertical blanking pulses on the CRT grid 1 voltage (12 Volt peak). Via diode D303 the sawtooth generator of the North-South trapezium circuit is reset.

3.3.1 Brightness uniformity

A brightness uniformity signal can be extracted from the focus signal on pin 32. The signal is buffered by T304 to drive the modulation inputs of the TDA4885 video preamplifier. The brightness uniformity function can be switched on and off by I²C control via IC303 register 4 and T305 (Brightness uniformity OFF: register contents set to '255'; Brightness uniformity ON: register contents set to '0').

3.4 Horizontal deflection output stage

The horizontal deflection output stage consists of three main parts:

3.4.1 B+ supply

The signal BDRV from the TDA4854 is buffered (T400/T401) and then fed to the PMOS output transistor. Diode D401 and resistor R403 are added for protection.

3.4.2 Line driver and output stage

The line driver stage is built around TR401. The use of the BU2532AL results in a low power driver stage (typically 1.8 W) capable of driving the line output transistor over a wide frequency range. The stage is designed to operate from 15 to 90 kHz.

The diode D405 in the collector of T403 BU2532AL ensures the high efficiency of the driver stage. Here a Schottky-barrier type is used for its low forward voltage drop. In fact any diode capable of handling the peak deflection current can be used but forward voltage drop should be minimal (in order not to deteriorate linearity). Maximum reverse voltage for D405 is the forward recovery voltage of the deflection flyback diode D404.

See also application note ETV/AN97002

3.4.3 Linearity and S-correction control

Horizontal linearity is controlled with a newly designed DC-controlled linearity corrector PE4025/01. The control coil is current driven by T405 under I²C control via IC303 register 7.

S-correction is performed with five switches for the frequency range of 30 to 90 kHz and one extra switch for the TV mode.

The S-correction capacitors are switched according to the following table:

Freq.range	C423 47 nF	C417 120 nF	C418 220 nF	C419 470 nF	C420 1.2 μ F	C421 5.6 μ F
< 30 kHz	x	x	x	x	x	x
30 - 34 kHz	-	-	x	x	x	-
34 - 37 kHz	-	-	x	-	x	-
37 - 45 kHz	-	-	-	-	x	-
45 - 53 kHz	x	x	-	x	-	-
53 - 61 kHz	x	x	x	-	-	-
61 - 65 kHz	x	-	x	-	-	-
65 - 71 kHz	x	x	-	-	-	-
71 - 78 kHz	-	x	-	-	-	-
78 - 85 kHz	x	-	-	-	-	-
> 85 kHz	-	-	-	-	-	-

3.5 Vertical deflection output stage

The vertical deflection output stage is the new full-bridge current driven booster TDA8354 which has output stages with low saturation voltage allowing low power dissipation (depending upon power supply voltage).

The circuit around transistor pair T418/ T419 is used as interface for the active convergence control circuit (optional).

3.6 EHT supply

The EHT supply is in fact a flyback generator with controlled supply voltage by means of a B+ down converter to enable stabilisation of the EHT output voltage. In order to prevent any kind of visible interaction with the horizontal deflection the EHT generator is synchronised with the horizontal deflection. Although the flyback of the EHT generator lags the flyback of the horizontal deflection with $\approx 3\mu\text{s}$. The high-voltage transformer AT2097/M1 is specially designed for this EHT generator: primary inductance 450 μH , circuit flyback time 3.3 μs , maximum operating frequency 84 kHz. The extreme high tension output voltage is 26.0 kV with a maximum average load current of 700 μA (short term peak 1.5 mA).

The flyback transistor T109 BUT11A is driven by a one-shot circuit built around IC102A. Using the well defined sawtooth of the PWM controller IC101 and its temperature stable reference voltage an accurate pulse is generated. The pulse length is defined by two more or less fixed intervals:

1. storage time of the flyback transistor ($\approx 1.2\ \mu\text{s}$)
2. flyback time of the output stage ($\approx 3.4\ \mu\text{s}$)

Increasing this period with an extra wait interval for safety a total pulse length of 7 μs is required.

The reference voltage for the X-ray sensor IC102B is increased with a small part of the supply voltage to prevent false triggering at power-up. This is achieved by means of R116 and R117.

The EHT output voltage is adjusted with potentiometer P101.

The following protections are included:

- No horizontal deflection (horizontal flyback voltage below 500 Voltpp): EHT generator stops; automatic soft start when horizontal deflection starts again.
- Overvoltage / X-ray: EHT generator is stopped and latched in an off-mode; a restart is only possible after a mains switch-off and on again.

- Overcurrent: First level protection is here the beam-current level limiter reducing the contrast of the video stages. Second level is the maximum duty-cycle of the UC3843 ($\approx 99\%$) that cannot be handled by the AC coupling of the PMOS output stage (T119 will not be driven in conduction anymore); in this situation the generator part will continue operating but the output voltage will drop to zero. Restart is only possible after a mains switch-off and on again.

3.6.1 Grid 1 supply

The CRT grid 1 (Vg1) voltage is fixed at -62 Volt DC with vertical blanking pulses of 12 Volt pp. Protection by pulling Vg1 to -200 Volt is activated in case of absence of horizontal deflection, HUNLOCK signal continuously high, absence of '11Volt' supply voltage and/or a high vertical guard signal.

3.6.2 Grid 2 supply

The CRT grid 2 (Vg2) voltage is generated using a high voltage DC amplifier. Its input is driven by a DAC output of the TDA8447 to allow I²C bus control.

The range is 280 to 665 Volt.

3.6.3 Focus supply

The dynamic focus voltage from the output of the TDA4854 is amplified by a high-voltage amplifier and then connected to the coupling capacitor in the EHT transformer.

Resistor R173 and diodes D132 and D133 prevent cross-over distortion of the output stage.

3.7 Rotation circuit

The circuit for driving the rotation coil on the CRT is extended with a sawtooth generator (IC201 B) to allow separate control of the top and bottom horizontal line. So the adjustment sequence is to align the top line with the tilt control (the complete picture is rotated with this adjustment) and then the bottom line can be aligned with the NS-trapezium adjustment.

3.8 Sound circuit

The sound part is a 2 x 1 Watt output stage with DC volume control TDA7053A. In this application 25 Ω speakers should be used.

Note: Due to mechanical problems it was not possible to implement the sound input connectors and the speakers in the cabinet. Therefore the circuit is not present in the demo monitors although the lay-out is prepared for it.

4. CIRCUIT DIAGRAMS

On the next pages the following circuit diagrams are presented:

- Switched mode power supply;
- Microcontroller plus deflection controller part;
- Horizontal and vertical deflection output stages;
- CRT grid supply circuits: Vg1, Vg2, focus and dynamic focus amplifier, EHT supply;
- Rotation and sound.

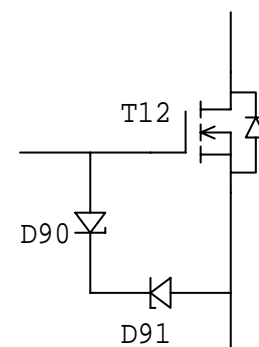
4.1 Last minute changes

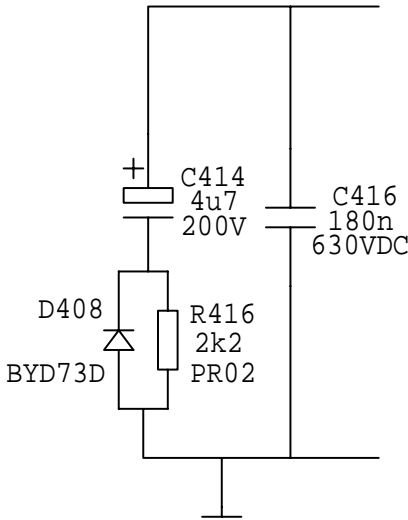
When debugging the final monitor a few small changes were necessary to obtain maximum performance.

Component number	Old value	New value	Reason
C8	470 μ F / 25 V	220 μ F / 25V	Decrease start-up time SMPS
C12	3.9 pF / NP0	18 pF / NP0	Current sense SMPS
C414	(not present)	4.7 μ F / 200 V	Horizontal ringing damper
D19	BZX79C15	BZX79C18	Increase output power during "OFF" mode
D90	(not present)	BZX79C15	Protection of T12 during mains switching
D91	(not present)	BZX79C15	Protection of T12 during mains switching
D408	(not present)	BYD73D	Horizontal ringing damper
R50	270 Ω / PR03	270 Ω / AC04	PCB may overheat
R62	120 k Ω / SFR25	180 k Ω / SFR25	Increase output power during "OFF" mode
R344	56 k Ω / SMD 0805	33 k Ω / SMD 0805	Pin-cushion range
R353	8.2 k Ω / SMD 0805	3.3 k Ω / SMD 0805	Jitter
R390	(not present)	3.3 k Ω / SFR25	See text and drawing below
R391	(not present)	3.3 k Ω / SFR25	See text and drawing below
R416	(not present)	2.2 k Ω / PR02	Horizontal ringing damper
R432	2.7 k Ω / PR02	2.2 k Ω / PR02	Horizontal ringing
R441	2.7 k Ω / PR01	2.2 k Ω / PR01	Vertical flyback

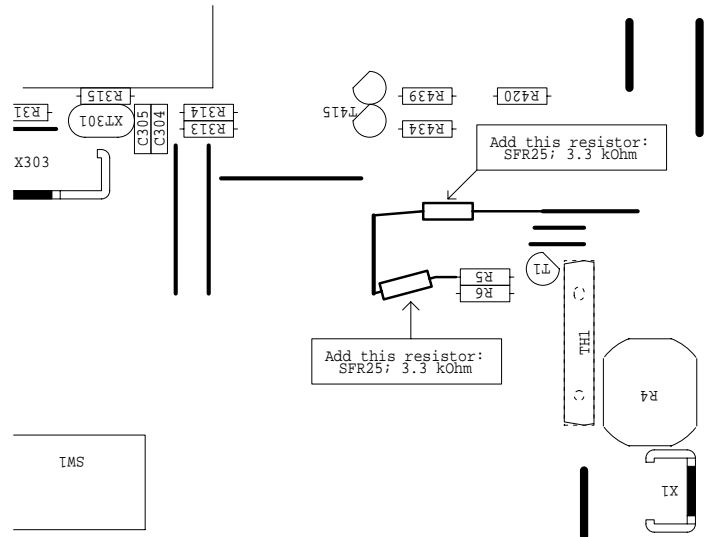
Zenerdiodes D90 and D91 have to be connected back-to-back (i.e. cathodes tied together) and the two anodes must be connected to Gate respectively Source of T12. In the circuit diagram on the right one can see how it looks.

The two zenerdiodes D90 and D91 are placed on the copperside of the board.





An additional damper for the horizontal deflection cannot be combined with the largest S-correction capacitor. Therefore an additional damper is necessary as drawn in the circuit diagram on the left hand side.



The outputs P0.5 pin 16 and P0.7 pin 14 of IC304 respectively signal “DEGS” and “DPMS” should be equipped with a pull-up resistor of 3k3 to +5 Volt. These resistors are not present in the lay-out. Best location to add these resistors is near R5 and R6 according to the drawing on the right:

The transistors BC375b and BC376 will be pruned. Best replacements for these types are BC337 respectively BC327. No further modifications are necessary.

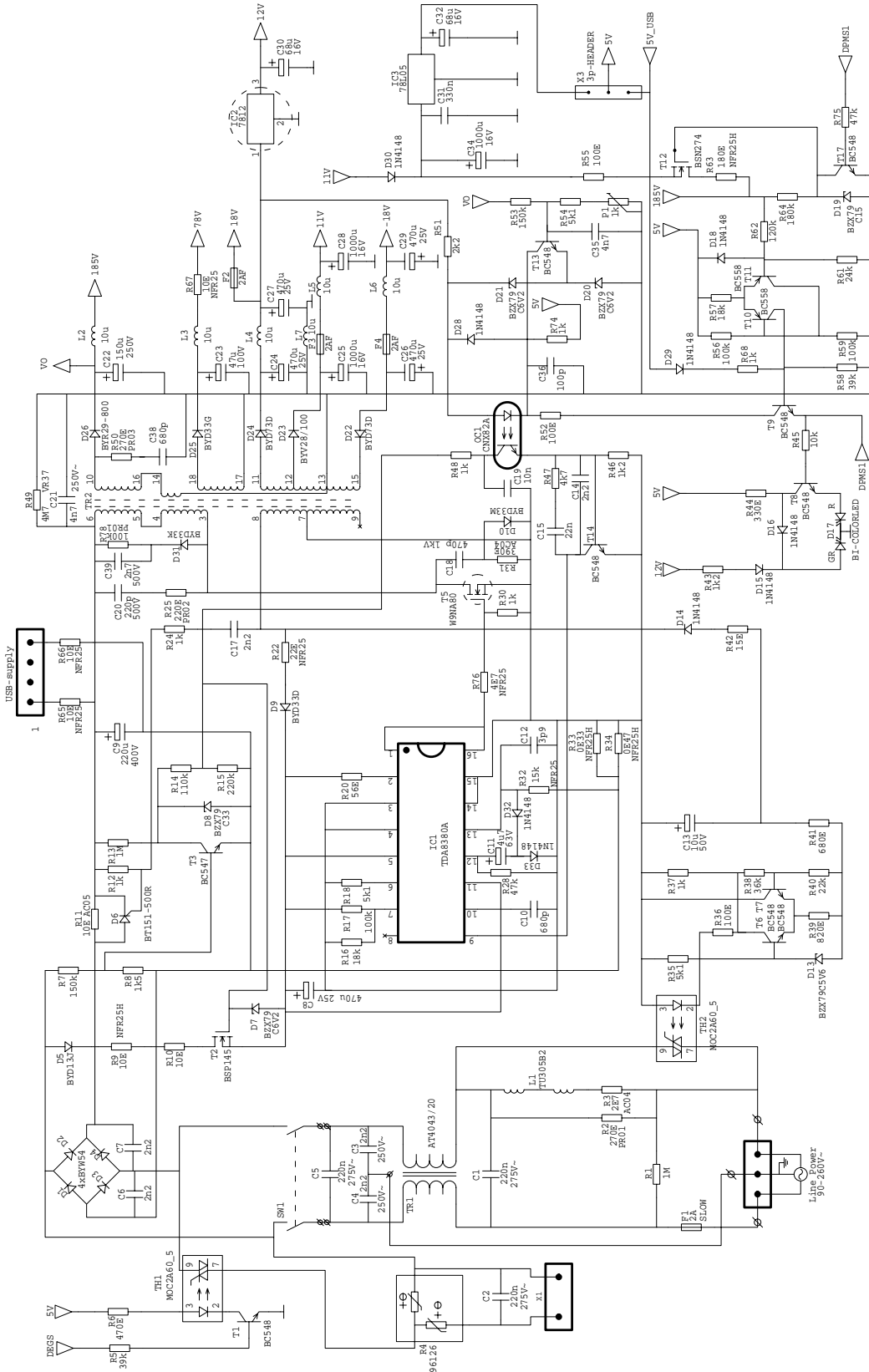
Transistor T124 is not correctly placed in the printed circuit board design : collector and emitter connections are interchanged on the board. The circuit diagram and parts list however are correct.

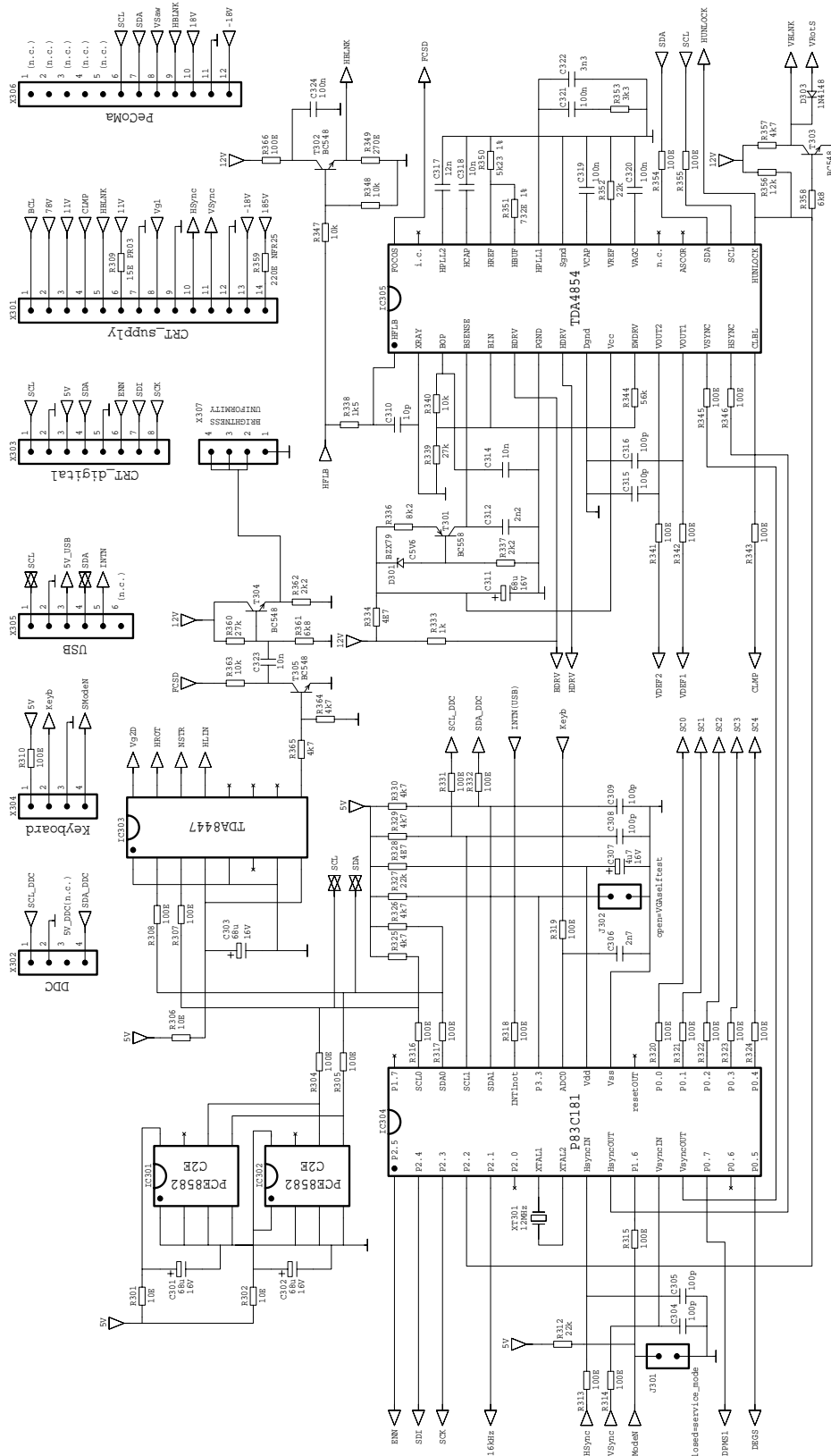
C124 and C403 are replaced with 27 nF / 250 Volt due to temporary unavailability of 22 nF / 250 Volt.

The following component on the video board has to be changed:

Video board:

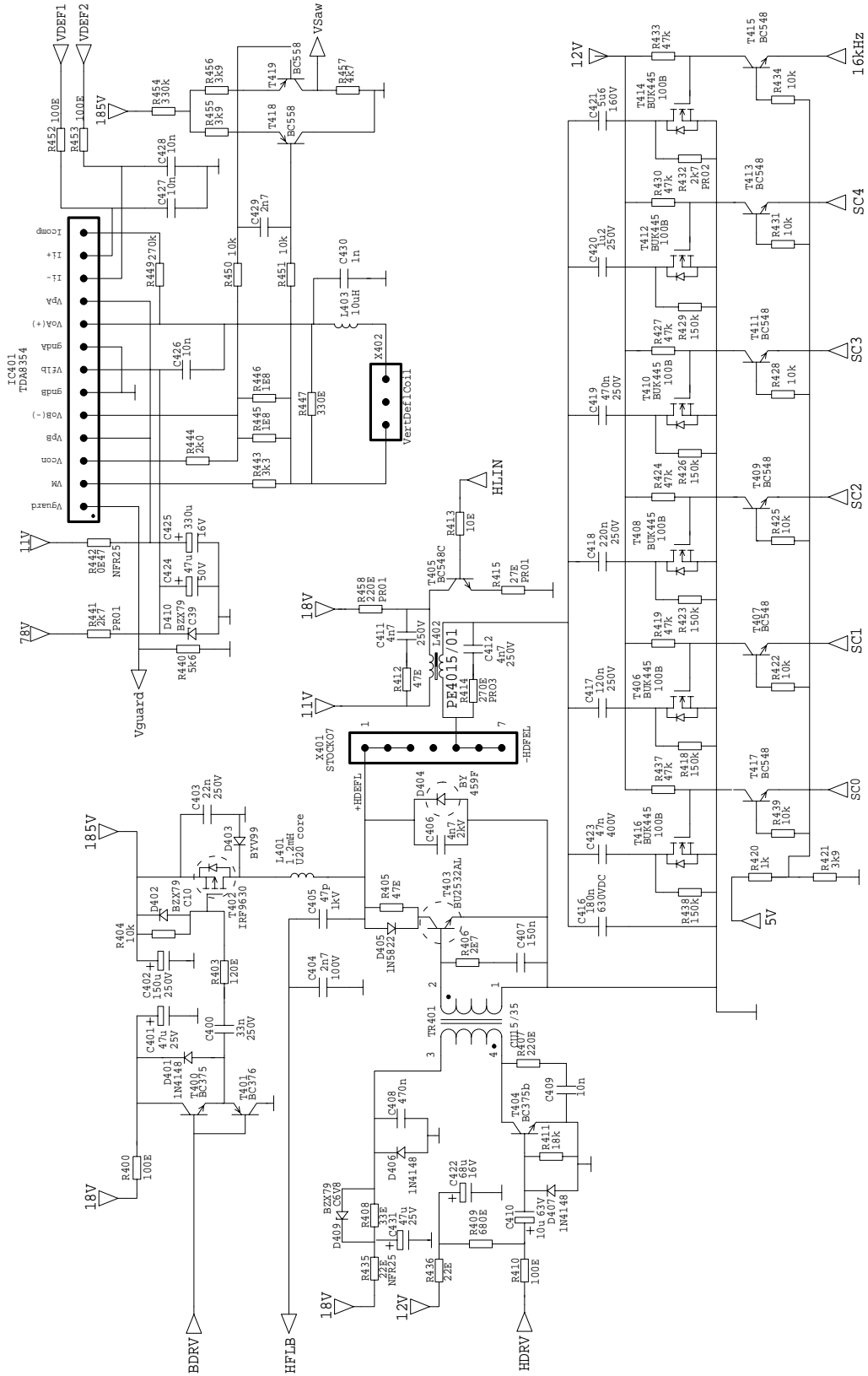
Component number	Old value	New value	Reason
R29	1.0 Ω / SFR16	3.3 Ω / SFR16	Heater tension
PCB track		Cut track to pin 3 of connector 1	+5 Volt of Video must be disconnected of + 5 Volt of main board.





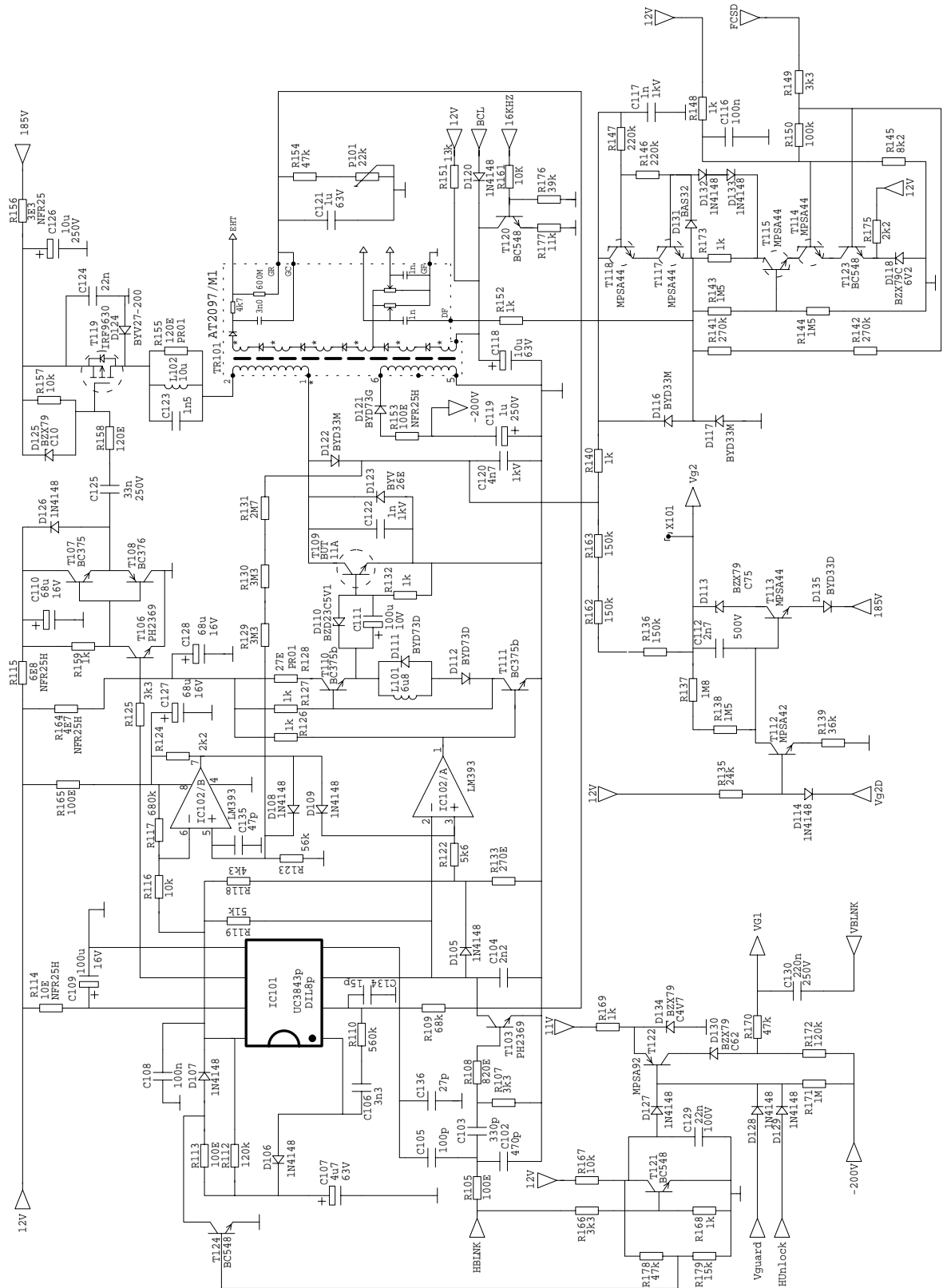
Circuit description of CCM420 monitor

Application Note
AN97032



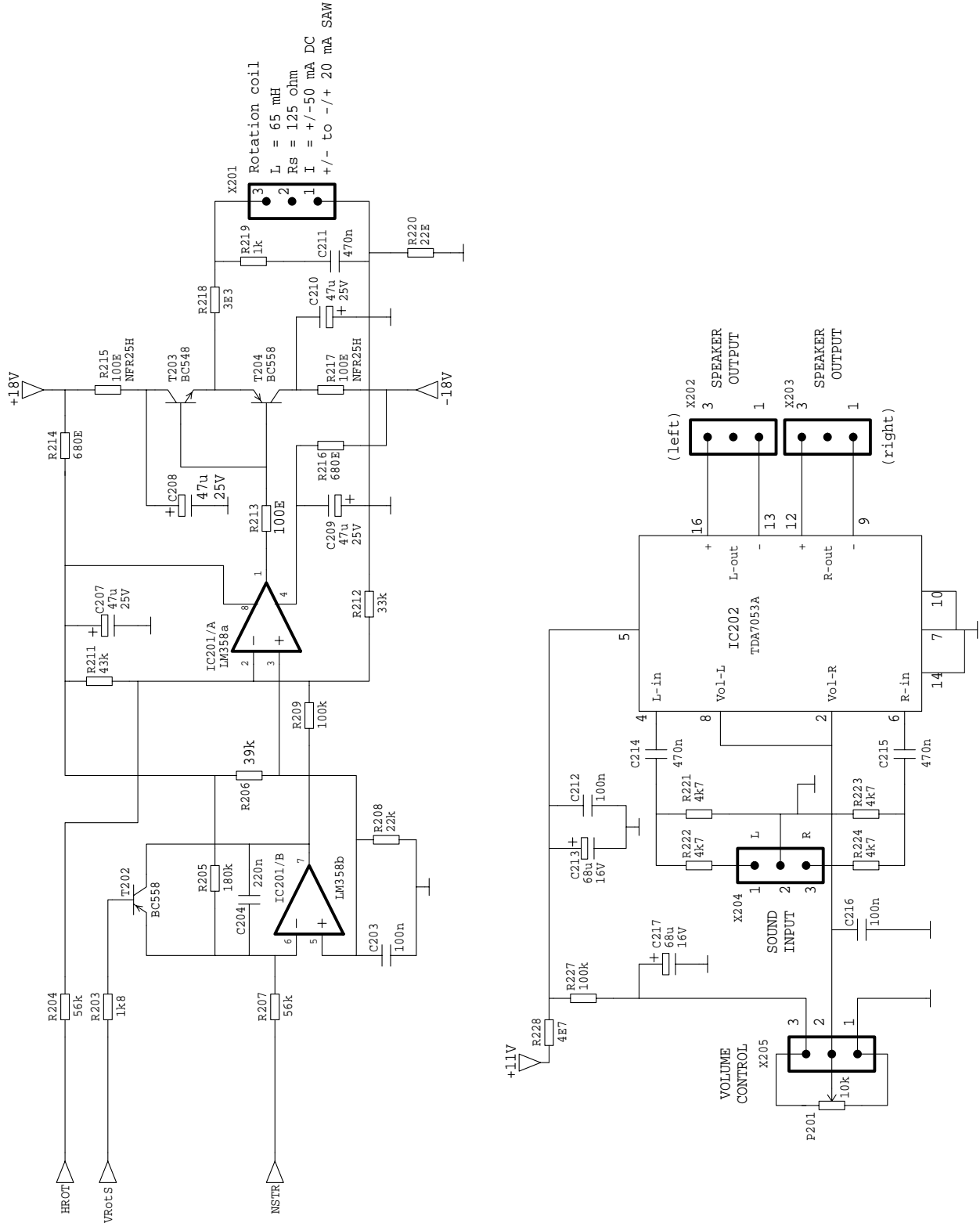
Circuit description of CCM420 monitor

Application Note
AN97032



Circuit description of CCM420 monitor

Application Note
AN97032



5. PARTS LIST

The parts list is only for the main board. No parts are listed to complete the CCM420 monitor.

5.1 Resistors and potentiometers

Note: Where no type is mentioned a SFR25 is used.

Number	Value	Type	Number	Value	Type
R1	1M		R51	2k2	
R2	270E	PR01	R52	100E	
R3	2E7	AC04	R53	150k	
R4	2322 622 96126	PTC	R54	5k1	
R5	39k		R55	100E	
R6	470E		R56	100k	
R7	150k		R57	18k	
R8	1k5		R58	39k	
R9	10E	NFR25	R59	100k	
R10	10E		R61	24k	
R11	10E	AC05	R62	120k	
R12	1k		R63	180E	NFR25
R13	1M		R64	180k	
R14	110k		R65	10E	NFR25
R15	220k		R66	10E	NFR25
R16	18k		R67	10E	NFR25
R17	100k		R68	1k	
R18	5k1		R74	1k	
R20	56E		R75	47k	
R22	22E	NFR25	R76	4E7	NFR25
R24	1k		R78	100k	PR01
R25	220E	PR02	R105	100E	
R28	47k		R107	3k3	
R30	1k		R108	820E	
R31	390E	AC04	R109	68k	
R32	15k	NFR25	R110	560k	
R33	0E33	NFR25	R112	120k	SMD 0805
R34	0E47	NFR25	R113	100E	
R35	5k1		R114	10E	NFR25
R36	100E		R115	6E8	NFR25
R37	1k		R116	10k	
R38	36k		R117	680k	SMD 0805
R39	820E		R118	4k3	
R40	22k		R119	51k	SMD 0805
R41	680E		R122	5k6	
R42	15E		R123	56k	
R43	1k2		R124	2k2	
R44	330E		R125	3k3	
R45	10k		R126	1k	
R46	1k2		R127	1k	
R47	4k7		R128	27 E	PR01
R48	1k		R129	3M3	
R49	4M7	VR37	R130	3M3	
R50	270E	PR03	R131	2M7	

Circuit description of CCM420 monitor**Application Note
AN97032**

Number	Value	Type	Number	Value	Type
R132	1k		R209	100k	
R133	270E		R211	43k	
R135	24k		R212	33k	
R136	150k		R213	100E	
R137	1M8		R214	680E	
R138	1M5		R215	100E	NFR25
R139	36k		R216	680E	
R140	1k		R217	100E	NFR25
R141	270k		R218	3E3	
R142	270k		R219	1k	
R143	1M5		R220	22E	
R144	1M5		R221	4k7	
R145	8k2		R222	4k7	
R146	220k		R223	4k7	
R147	220k		R224	4k7	
R148	1k		R227	100k	
R149	3k3		R228	4E7	
R150	100k		R301	10E	
R151	13k		R302	10E	
R152	1k	Allen Bradley	R304	100E	
R153	100E	NFR25	R305	100E	
R154	47k		R306	10E	
R155	120E	PR01	R307	100E	
R156	3E3	NFR25	R308	100E	
R157	10k		R309	15E	PR03
R158	120E		R310	100E	
R159	1k		R312	22k	
R161	10k		R313	100E	
R162	150k		R314	100E	
R163	150k		R315	100E	
R164	4E7	NFR25	R316	100E	
R165	100E		R317	100E	
R166	3k3		R318	100E	
R167	10k		R319	100E	
R168	1k		R320	100E	
R169	1k		R321	100E	
R170	47k		R322	100E	
R171	1M		R323	100E	
R172	120k		R324	100E	
R173	1k		R325	4k7	
R175	2k2		R326	4k7	
R176	39k		R327	22k	
R177	11k		R328	4E7	
R178	47k		R329	4k7	
R179	15k		R330	4k7	
R203	1k8		R331	100E	
R204	56k		R332	100E	
R205	180k		R333	1k	
R206	39k		R334	4E7	
R207	56k		R336	8k2	
R208	22k		R337	2k2	

Circuit description of CCM420 monitor**Application Note
AN97032**

Number	Value	Type	Number	Value	Type
R338	1k5		R426	150k	
R339	27k	SMD 0805	R427	47k	
R340	10k	SMD 0805	R428	10k	
R341	100E		R429	150k	
R342	100E		R430	47k	
R343	100E		R431	10k	
R344	56k	SMD 0805	R432	2k7	PR02
R345	100E		R433	47k	
R346	100E		R434	10k	
R347	10k		R435	22	NFR25
R348	10k		R436	22E	
R349	270E		R437	47k	
R350	5k23/1%	SMD 0805	R438	150k	
R351	732E/1%	SMD 0805	R439	10k	
R352	22k		R440	5k6	
R353	8k2	SMD 0805	R441	2k7	PR01
R354	100E		R442	0E47	NFR25
R355	100E		R443	3k3	
R356	12k		R444	2k0	
R357	4k7		R445	1E8	
R358	6k8		R446	1E	
R359	220E	NFR25	R447	330E	
R360	27k		R449	270k	
R361	6k8		R450	10k	
R362	2k2		R451	10k	
R363	10k		R452	100E	
R364	4k7		R453	100E	
R365	4k7		R454	330k	
R366	100E		R455	3k9	
R400	100E		R456	3k9	
R403	120E		R457	4k7	
R404	10k		R458	220E	PR01
R405	47E				
R406	2E7				
R407	220E				
R408	33E				
R409	680E				
R410	100E				
R411	18k				
R412	47E				
R413	10E				
R414	270E	PR03			
R415	27E	PR01			
R418	150k				
R419	47k				
R420	1k				
R421	3k9				
R422	10k				
R423	150k				
R424	47k				
R425	10k				

Potentiometers		
Number	Value	Type
P1	1k	EMP10
P101	22k	EMP10

5.2 Capacitors

Electrolytic capacitors

Number	Value	Type	Number	Value	Type
C8	470μ/25V	037	C126	10μ/250V	044
C9	220μ/400V	057	C127	68μ/16V	037
C11	4μ7/63V	037	C128	68μ/16V	037
C13	10μ/50V	037	C207	47μ/25V	037
C22	150μ/250V	057	C208	47μ/25V	037
C23	47μ/100V	037	C209	47μ/25V	037
C24	470μ/25V	037	C210	47μ/25V	037
C25	1000μ/16V	037	C213	68μ/16V	037
C26	470μ/25V	037	C217	68μ/16V	037
C27	470μ/25V	037	C301	68μ/16V	037
C28	1000μ/16V	037	C302	68μ/16V	037
C29	470μ/25V	037	C303	68μ/16V	037
C30	68μ/16V	037	C307	47μ/63V	037
C32	68μ/16V	037	C311	68μ/16V	037
C34	1000μ/16V	037	C401	47μ/25V	037
C107	47μ/63V	037	C402	150μ/250V	057
C109	100μ/25V	037	C410	10μ/63V	037
C110	68μ/16V	037	C422	68μ/16V	037
C111	100μ/10V	037	C424	47μ/50V	037
C118	10μ/63V	037	C425	330μ/16V	037
C119	1μ/250V	044	C431	47μ/25V	037

Film and ceramic capacitors

Number	Value	Type	Number	Value	Type
C1	220n/275V~	336-1	C102	470p/100V	630
C2	220n/275V~	336-1	C103	330p	630
C3	2n2/250V~	336-1	C104	2n2	730
C4	2n2/250V~	336-1	C105	100p/100V	NP0
C5	220n/275V~	336-1	C106	3n3	630
C6	2n2/250V~	336-1	C108	100n	SMD 0805/X7R
C7	2n2/250V~	336-1	C112	2n7/500V	655
C10	680p	730	C116	100n/63V	370
C12	10p/100V	638	C117	1n/1kV	Murata
C14	2n2/100V	630	C120	4n7/1kV	Murata
C15	22n/100V	370	C121	1u/63V	370
C17	2n2/500V	655	C122	1n/1kV	Murata
C18	470p/2kV	Murata	C123	1n5	630
C19	10n/250V	370	C124	22n/250V	365
C20	220p/500V	655	C125	33n/250V	365
C21	4n7/250V~	336-6	C129	22n/100V	370
C31	330n	370	C130	220n/250V	373
C35	4n7	630	C134	15p	SMD 0805/NP0
C36	100p/100V	NP0	C135	47p	NP0
C38	680p/500V	655	C136	27p	SMD 0805/NP0
C39	2n7/500V	655	C203	100n/63V	370

Circuit description of CCM420 monitor**Application Note
AN97032**

Number	Type	Remarks	Number	Type	Remarks
C204	220n/63V	370	C400	33n/250V	365
C211	470n/63V	370	C403	22n/250V	365
C212	100n/63V	370	C404	2n7/100V	630
C214	470n/63V	370	C405	47p/1kV	694
C215	470n/63V	370	C406	4n7/2kV	376
C216	100n/63V	370	C407	150n/63V	370
C304	100p/100V	NP0	C408	470n/63V	370
C306	2n7/500V	655	C409	10n/250V	370
C308	100p/100V	NP0	C411	4n7/250V	370
C309	100p/100V	NP0	C412	4n7/250V	370
C310	10p/100V	638	C416	180n/630VDC	378
C312	2n2	730	C417	120n/250V	379
C314	10n/250V	370	C418	220n/250V	379
C315	100p/100V	NP0	C419	470n/250V	379
C316	100p/100V	NP0	C420	1μ2/250V	379
C317	12n	SMD 0805/X7R	C421	5μ6/160V	379
C318	10n	SMD 1210/NP0	C423	47n/400V	379
C319	100n/63V	370	C426	10n/250V	370
C320	100n/63V	370	C427	10n/250V	370
C321	100n	SMD 0805/X7R	C428	10n/250V	370
C322	3n3	SMD 0805/X7R	C429	2n7/500V	655
C324	100n/63V	370	C430	1n/500V	655

5.3 Transistors

Number	Type	Remarks	Number	Type	Remarks
T1	BC548c		T114	MPSA44	
T2	BSP145	SMD	T115	MPSA44	
T3	BC547		T117	MPSA44	
T5	W9NA80	(to heatsink)	T118	MPSA44	
T6	BC548c		T119	IRF9630	(to heatsink)
T7	BC548c		T120	BC548c	
T8	BC548c		T121	BC548c	
T9	BC548c		T122	MPSA92	
T10	BC558		T123	BC548c	
T11	BC558		T124	BC548c	
T12	BSN274		T202	BC558	
T13	BC548c		T203	BC548c	
T14	BC548c		T204	BC558	
T17	BC548c		T301	BC558	
T103	PH2369		T302	BC548c	
T106	PH2369		T303	BC548c	
T107	BC375b		T304	BC548c	
T108	BC376		T305	BC548c	
T109	BUT11A	(to heatsink)	T400	BC375b	
T110	BC375b		T401	BC376	
T111	BC375b		T402	IRF9630	(to heatsink)
T112	MPSA42		T403	BU2532AL	(to heatsink)
T113	MPSA44		T404	BC375b	

Circuit description of CCM420 monitor**Application Note
AN97032**

Number	Type	Remarks	Number	Type	Remarks
T405	BC548c		T413	BC548c	
T406	BUK445-100B		T414	BUK445-100B	
T407	BC548c		T415	BC548c	
T408	BUK445-100B		T416	BUK445-100B	
T409	BC548c		T417	BC548c	
T410	BUK445-100B		T418	BC558	
T411	BC548c		T419	BC558	
T412	BUK445-100B				

5.4 Diodes

Number	Type	Remarks	Number	Type	Remarks
D1	BYW54		D112	BYD73D	
D2	BYW54		D113	BZX79C75	
D3	BYW54		D114	1N4148	
D4	BYW54		D116	BYD33M	
D5	BYD13J		D117	BYD33M	
D6	BT151-500R	Thyristor	D118	BZX79C6V2	
D7	BZX79C6V2		D120	1N4148	
D8	BZX79C33		D121	BYD73G	
D9	BYD33D		D122	BYD33M	
D10	BYD33M		D123	BYV26E	
D13	BZX79C5V6		D124	BYV27-200	
D14	1N4148		D125	BZX79C10	
D15	1N4148		D126	1N4148	
D16	1N4148		D127	1N4148	
D17	BICOLOUR-LED		D128	1N4148	
D18	1N4148		D129	1N4148	
D19	BZX79C15		D130	BZX79C62	
D20	BZX79C6V2		D131	BAS32	SMD
D21	BZX79C6V2		D132	1N4148	
D22	BYD73D		D133	1N4148	
D23	BYV28/100		D134	BZX79C4V7	
D24	BYD73D		D135	BYD33D	
D25	BYD33G		D301	BZX79C5V6	
D26	BYR29-800		D303	1N4148	
D28	1N4148		D401	1N4148	
D29	1N4148		D402	BZX79C10	
D30	1N4148		D403	BYV99	
D31	BYD33K		D404	BY459F	(to heatsink)
D32	1N4148		D405	1N5822	
D33	1N4148		D406	1N4148	
D105	1N4148		D407	1N4148	
D106	1N4148		D409	BZX79C6V8	
D107	1N4148		D410	BZX79C39	
D108	1N4148				
D109	1N4148				
D110	BZD23C5V1				
D111	BYD73D				

5.5 Integrated circuits

Number	Type	Remarks
IC1	TDA8380A	
IC2	L7812	(to heatsink)
IC3	78L05	
IC101	UC3843P	
IC102	LM393	
IC201	LM358	
IC202	TDA7053A	
IC301	PCE8582C-2E	
IC302	PCE8582C-2E	
IC303	TDA8447	
IC304	P83C181	see appendix 7
IC305	TDA4854	
IC401	TDA8354	(to heatsink)

5.6 Wire-wound components

Number	Type/Value	Remarks
L1	TU305b2	3121 218 61281
L2	10 μ	TDK
L3	10 μ	TDK
L4	10 μ	TDK
L5	10 μ	TDK
L6	10 μ	TDK
L7	10 μ	TDK
L101	6 μ 8	TDK
L102	10 μ	TDK
L401	CU20 / 1.2mH	8228 001 25771
L402	PE4025/01	8228 001 28021
L403	10 μ	TDK
TR1	CU20d	3112 338 32032
TR2	CE425V	8228 001 23415
TR101	AT2097/M1	3122 268 31292
TR401	CU15/35	3128 138 35141

5.7 Miscellaneous

Optical devices

Number	Type	Remarks
OC1	CNX82A	
TH1	M0C2A60_5	
TH2	M0C2A60_5	

Others

F1	2A SLOW
F2	2A FAST
F3	2A FAST
F4	2A FAST
SW1	MAINS-SWITCH

Connectors Number	Type	Remarks
XT301	Crystal	12MHz
J3	HEADER 3p	
J301	HEADER 2p	
J302	HEADER 2p	
X1	STOCKO 3p	remove middle pin
X2	STOCKO 4p	
X201	STOCKO 3p	
X202	STOCKO 3p	
X203	STOCKO 3p	
X204	STOCKO 3p	
X205	STOCKO 3p	
X301	STOCKO 14p	
X302	STOCKO 4p	
X303	STOCKO 8p	
X304	STOCKO 4p	
X305	STOCKO 6p	
X306	STOCKO 12p	
X307	STOCKO 4p	
X401	STOCKO 7p	remove middle pin
X402	STOCKO 3p	remove middle pin

Heatsinks:

The areas of the heatsinks are:

- horizontal deflection: 140 cm^2 ; $R_{th} \approx 4 \text{ K/W}$.
- vertical deflection: extruded heatsink with $\approx 60 \text{ cm}^2$; $R_{th} \approx 3 \text{ K/W}$.
- EHT: 50 cm^2 ; $R_{th} \approx 9 \text{ K/W}$.
- SMPS: 60 cm^2 ; $R_{th} \approx 8 \text{ K/W}$.

Mounting studs for heatsinks:

The heatsinks for horizontal deflection, EHT and SMPS are mounted on the PCB via special mounting studs. For each heatsink one of these studs is connected to the ground plane of the circuit to ensure the heatsink is correctly grounded. The heatsink for the vertical deflection is mounted with screws. Again one of these screws is connected to ground to define the heatsink's potential.

Clips for device mounting on heatsinks.

Note: the mains voltage is interrupted on the board between filter output and mains switch. This connection must be made by two wires soldered between the appropriate points on the board. The reason for not implementing this connection in the board lay-out is that it requires too much space.

6. PRINTED CIRCUIT BOARD LAYOUT

On the next pages the following drawings can be found:

- component placement with position numbers as seen from the component side;
- component placement with values as seen from the component side;
- SMD placement with position numbers as seen from the solder side;
- copper pattern of printed circuit board.

The board dimensions are: 388 mm long by 250 mm wide.

6.1 Lay-out hints

Ground track:

The common ground track should be kept as clean as possible. This means that only DC currents should be flowing through this track indicating that the AC current is short circuited at it's source! Therefor you will find resistor capacitor supply filters at every stage.

Focus:

The focus signal of the TDA4854 and it's reference ground should be kept close to each other up to the input of the focus output amplifier due to the high gain of this output stage (and the neighbourhood of the EHT circuit as well as the long distance between source and amplifier).

Vertical deflection:

Keep vertical drive signals of the TDA4854 close together at all places to avoid coupling of magnetic fields in the loop.

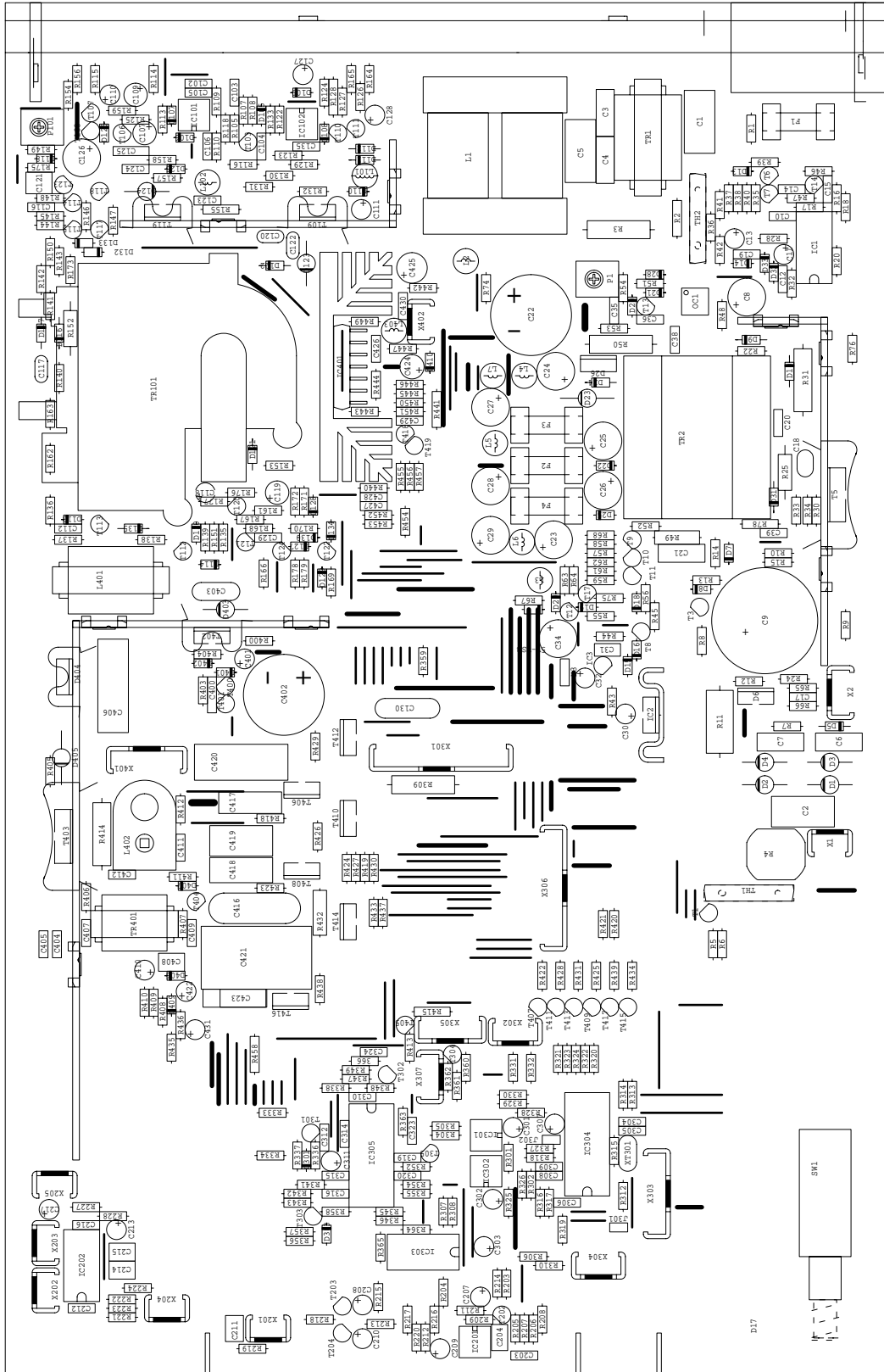
Horizontal deflection output stage:

Keep flyback capacitor and diode of the horizontal deflection stage located close together to damp the forward recovery ringing of the flyback diode.

Due to the low leakage inductance of the driver transformer the tracks between transformer and line output transistor should be kept as short as possible.

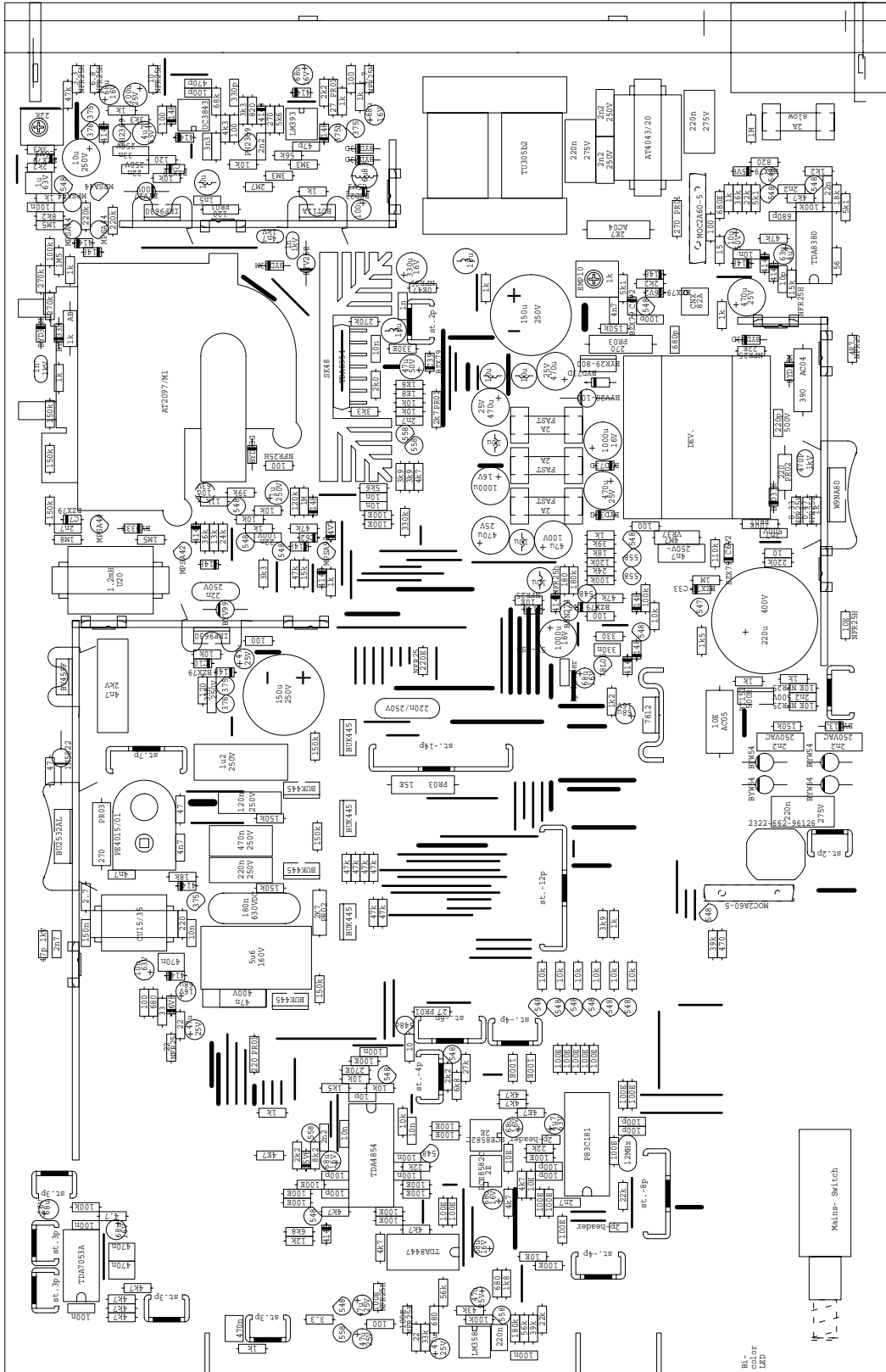
EHT X-ray protection:

The connecting points of R129/R130 and R130/R131 are very sensitive due to their high impedance. These points should therefor be kept as small as possible and far away from points with a high voltage swing (i.e. the collector voltage of the BUT11A).

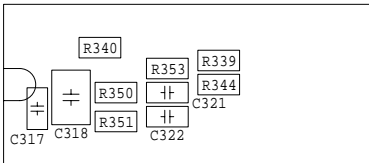


Circuit description of CCM420 monitor

Application Note AN97032

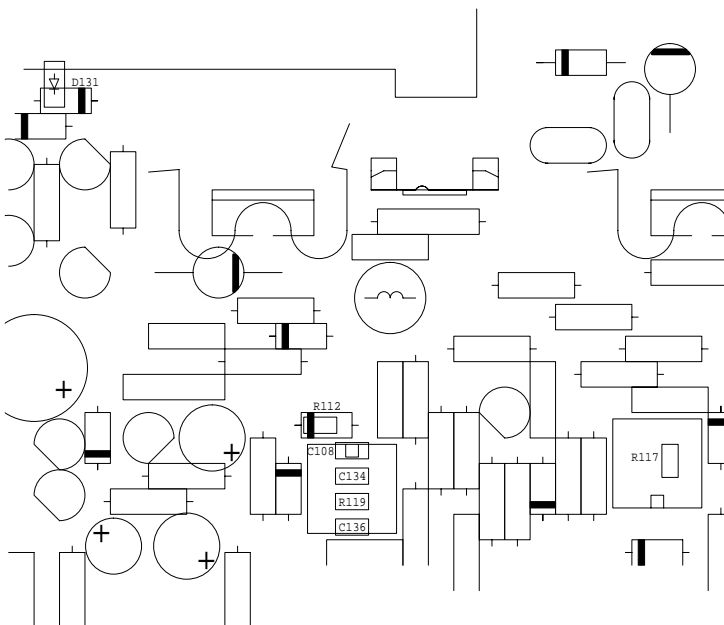


Location of SMD parts.



Control part:

This drawing shows the SMD components underneath the deflection controller TDA4854 seen from the solder side.

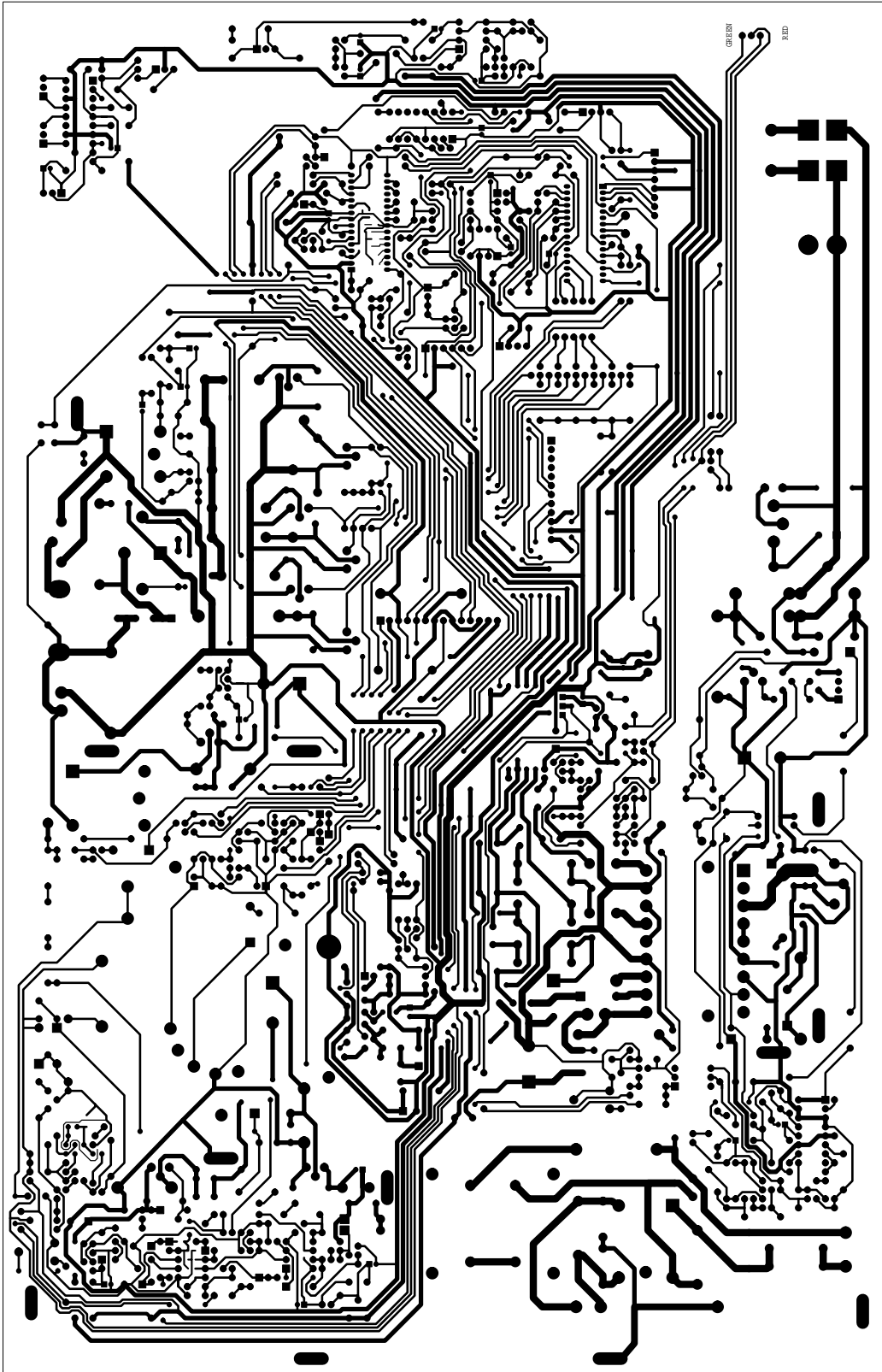


EHT and focus part: SMD parts seen from solder side:

- D131: located underneath D132.
- R112, R119, C108, C134, C136: located underneath IC101.
- R117: located underneath IC102.

SMPS part:

T2: located underneath D7.
(No drawing shown)



7. ALIGNMENT PROCEDURE

This alignment procedure is written for a complete CCM420 monitor: main board, key board, video board and CRT. In case of failure refer to chapter 8: debugging procedure.

7.1 Equipment

Video generator	Quantum Data QD903: formats ranging from 640 x 400 to 1280 x 1024 pixels; refresh rates ranging from 60 to 85 Hz.
DMM	Fluke PM2421
EHT meter	Brandenburg
Oscilloscope	Fluke PM3384A
Colour analyser	Philips PM5639
PC	min. '486' with windows 3.11 with I ² C interface card
Software	I ² C control software version 1.60 for TDA4854, TDA4885 and TDA8447.

7.2 Alignment

1. Turn both potentiometers on the main board ccw.
2. Connect the video generator and apply a signal with 1024 x 768 pixels at 76 Hz refresh rate ($F_h \approx 64$ kHz). Choose testpattern SMPTE.
3. Connect the EHT voltmeter between anode and aquadag of the CRT.
4. Be sure the EEPROM's are filled with the values as given in appendix Starting values of I2C registers on page 43.
5. If possible make use of a separate degaussing device to demagnetise the CRT.
6. Connect the mains supply voltage and switch the monitor on with the mains switch.
7. Check that the monitor displays a picture after a few seconds. If not refer to the debug section.
8. Adjust the SMPS '185 Volt' output to 185.0 ± 0.20 Volt measured across C22.
9. Adjust the EHT to 26.0 ± 0.2 kV.
10. Display a cross-hatch pattern.
11. Adjust static focus with the focus potentiometers on the EHT transformer.
12. Front panel switch "USER - SERV." must be placed in SERV. position.
13. Press the Menu button once: check that the OSD shows the mode information. If not refer to the debug section.
14. Press the Menu button again: the OSD now displays the user control menu.
15. Position the picture in the centre of the screen and adjust width and height to nominal size $312 \times 234 \text{ mm}^2$.
16. Adjust the pincushion, pincushion-balance, corner, trapezium, parallelogram, horizontal and vertical linearity and rotation to obtain optimum geometry.
17. Display a pattern with a 1 Nit luminance. See appendix Video drive levels on page 44.

18. Adjust grid 2 such that the brightest colour reaches the required level for a total luminance of 1.0 Nit. Note: the required level for each of the three colours for a total luminance of 1.0 Nit is: Red: 0.3 Nit; Green 0.59 Nit; Blue: 0.11 Nit.
19. Then decrease the cathode voltage of the two remaining colours to their respective brightness for a total brightness of 1.0 Nit.
20. Display a pattern with a 10x10 cm² box in the middle of the screen with RGB input signals of 700 mV. See also appendix Video drive levels on page 44.
21. Adjust the gain of the three channels to a total luminance of 100 Nit with reference D6500.
22. Check the black levels again and re-adjust if necessary.
23. Display a focus pattern (i.e. Randomtext).
24. Adjust the static focus potentiometers on the EHT transformer for optimum sharpness on a screen position in a circle of 150 mm diameter around the centre of the screen.
25. Adjust the dynamic focus for optimum sharpness on the centre and the edges of the screen.
26. Readjust static focus (and then dynamic focus) if necessary.
27. Save the settings.

8. DEBUGGING PROCEDURE

The debugging of the main board is described in a complete monitor set-up fitted with CRT M41EHN323X145 and video amplifier board PR37981. Only the most common failures are described.

1. No picture:

- Check: 185 Volt output of SMPS;
all other output voltages of the SMPS (+11 V; +18 V; -18 V; +78 V; limits for all output voltages +/- 10 %);
+12 Volt (+/- 0.75 V) on pin 10 of the TDA4854;
+5 Volt (+/- 0.25 V) on pin 24 of the P83C181;
line deflection;
EHT part;
grid voltages Vg1 (-62 +/- 2 Volt) and Vg2 (400 - 600 Volt);
vertical deflection;

2. 185 Volt output not present:

- Check: mains fuse F1;
output rectifier D26;
fusible resistors R9, R22, R32, R33 and R34;
line deflection parts T402 and T403;
supply voltage of IC1;
output drive signals of IC1;
main switching device T5;
over-current protection level on pin 13 of IC1;

3. Auxiliary SMPS output voltages missing:

- Check: output rectifiers D22, D23, D24, D25;
fuses F2, F3, F4;
voltage stabilisers IC2 and IC3;

4. Distorted picture:

- Check: alignment;
S-correction switches (see table in chapter 3.4.3 Linearity and S-correction control);
linearity control circuit of horizontal deflection;
flyback voltage of vertical deflection ($T_{fb} = 300 \pm 50 \mu s$; $V_{peak} = 43 \pm 3$ Volt);
all supply voltages for excess ripple voltages (185 V: < 0.200 Vpp; 11 V: < 0.800 Vpp);

5. No line deflection:

- Check: presence of horizontal and B+ drive signals of TDA4854;
base drive voltage of T403;
gate drive voltage of T402;
line deflection parts T402 and T403;

6. No vertical deflection:

Check: vertical drive signals of TDA4854;
flyback supply voltage;
vertical deflection output stage;

7. EHT not present:

Note: the horizontal deflection stage must be operating!

Check: all fusible resistors R114, R115, R156 and R164;
duty-cycle of PWM output pin 6 of IC101 (< 90 %);
base drive signal of T109
X-ray output pin 7 of IC102

8. Vg1 not present:

Check: supply voltage -200 Volt;
protection signals 'Vguard', 'HUNLOCK' and presence of horizontal flyback pulses;
polarity and value of D130;

9. Vg2 not present:

Check: supply voltage on C120: 700....900 Volt;
output voltage of TDA8447 pin 16 Vg2D: 0.4 to 4.6 Volt;
polarity of D135;
base voltage of T113;

10. Dynamic focus signals not present:

Check: focus signal on pin 32 of TDA4854
supply voltage on C117: 700....900 Volt;
emitter voltage of T123;
position of D116 and D117;

11. No rotation control:

Check: fusible resistors R215, R217;
presence of vertical blanking pulse VrotS;
signals NSTR and HROT (both 0.4 to 4.6 Volt);
signal VRotS;
resistor R220.

12. No OSD:

Check: connector X303 and the cable to the video board;
signals ENN, SDI and SCK on pins 1, 2, 3 of the P83C181 while operating the key board.

9. REFERENCES

- AN97072 Pin description of TDA4854 I²C controlled ASDC.
AN97039 Video amplifier board with TDA4885 and CR6927.
ETV/AN97002 Low power and low cost horizontal drive circuits with U15 core.

Data sheets:

- TDA4854 I²C-autosync deflection controller for PC/TV monitors
 Date of issue: 1997 Apr. 16
- TDA4885 150 MHz video controller with I²C-bus
 Date of issue: 1996 Mar. 13
- TDA8354 Full bridge current driven vertical deflection output circuit in LVDMOS
 Date of issue: 1996 July
- P83C181 Microcontroller for monitor with DDC interface, auto-sync mode detection and sync processor
 Date of issue: 1997 Mar. 14
- TDA8447 Bus controlled octuple 8-bit DAC
 Date of issue: 1996 Mar. 11
- CR6927 Triple video driver hybrid amplifier
 Date of issue: 1996 Apr. 19

APPENDIX 1 STARTING VALUES OF I²C REGISTERS

In the following tables the starting values for the I²C registers and the switch position are shown. These values should either be present in the EEPROM or loaded via the I²C software control program in the applicable device.

TDA4854 control registers and switch positions:

Register	Value	Switch	0/1
H-size	150	BLKDIS	0
H-pos	127	HBC	0
V-size	85	HPC	0
V-pos	63	AGCDIS	0
V-lin	8	VSC	0
V-lin-bal	8	MOD	1
H-pin	40	TVMOD	0
H-pin-bal	8	FHMULT	0
H-trap	8	VOVSCN	0
H-paral	8	CLAMP	1
H-corner	4	VBLK	0
H-focus	27	VLC	0
V-focus	6	VPC	0
H-moire	0	ACD	0
V-moire	0	STDBY	0
		SOFTST	1

TDA8447 control registers:

Register	Value
Hlin	127
NStrap	127
H-Rot	127
Vg2	185

TDA4885 control registers and switch positions:

Register	Value	Switch	0/1
Contrast	58	PEDST	1
Brightness	16	DISO	0
OSD Ctrst	15	DISV	0
Gain R	60	FPOL	1
Gain G	55		
Gain B	35		
Black level R	190		
Black Level G	190		
Black Level B	190		

APPENDIX 2 VIDEO DRIVE LEVELS

To display a grey level of X Nit the necessary drive level at the input of the video stage can be calculated according to the following rules:

- For a given drive voltage the output luminance can be calculated according to the following equation: $LUM = (C \times Vdrive)^\gamma$.
- The maximum grey level is set at 100 Nit full screen at a contrast setting of 58 and nominal brightness setting 16
- With a maximum video input level $Vdrive = 0.700$ Volt for $LUM = 100$ Nit one can derive the gain factor of the video channel with the following equation: $C = \sqrt[\gamma]{LUM} / Vdrive$. Inserting above mentioned numbers, assuming $\gamma = 2.25$ result in $C = 11.061$.
- The drive level in Volts for a wanted luminance level LUM can be calculated with the following formula now that all parameters are known: $Vdrive = \sqrt[\gamma]{LUM} / C$
- For example: for 1.0 Nit output, the drive level at the input should be 90.4 mV.

APPENDIX 3 TDA4854 HORIZONTAL FREQUENCY RANGE

The horizontal frequency range of the TDA4854 is determined by the value of two resistors and one capacitor. The value of resistors R350 and R351 is determined by the frequency limits of the application. The capacitor C318 (horizontal oscillator capacitor connected to pin 29) though should be 10 nF for optimum jitter performance. The value of this capacitor should not be changed.

Given a specified frequency range (and C318 = 10 nF) the value of the resistors R350 and R351 can then be calculated with the following formulas:

Note: the minimum and maximum frequencies in the formulas should be inserted in 'kHz'. Tolerance taken in account is 3 % for the IC, 2 % for the horizontal oscillator capacitor and 1 % for the resistors R350 and R351.

$$R_{350} = \frac{78}{F_{\min} + 0.0012 \times F_{\min}^2} \text{ k}\Omega$$

$$R'_{351} = \frac{78}{F_{\max} + 0.0012 \times F_{\max}^2} \text{ k}\Omega$$

$$R_{351} = \frac{R_{350} \times R'_{351}}{R_{350} - R'_{351}} \times 0.8 \text{ k}\Omega$$

Note : R'_{351} does not really exist; this is only for the calculation.

For a sync frequency range of 15.6 kHz to 85 kHz the resistor values become:

R350 = 5208 Ω ; nearest available value: 5230 Ω (1 % SMD resistor);

R351 = 735 Ω ; nearest available value: 732 Ω (1 % SMD resistor).

APPENDIX 4 USER INTERFACE

The user interface in the CCM420 monitor consists of a five button keyboard and the control software CCM420S. An OSD window pops up when the user operates one of the pushbuttons:

1. The MENU button gives access to the various levels of user control and service control.
2. The SHIFT left/right and ADJUST down/up perform different actions depending upon the control level: When the MENU button was not activated the SHIFT buttons give direct access to the Brightness control, while the ADJUST buttons give direct access to the Contrast control. In both cases an OSD pops up to inform the user about the action taken.
3. With the MENU button one can scroll down through the control levels. In each control level the desired function can be selected by pushing the SHIFT down or up button.

The control is divided into a number of levels. Each of these levels will now be discussed shortly:

First level: Mode identification; no user control possible.

First line: Horizontal frequency

Second line: Vertical frequency

Third line: Mode information; either the standard VESA identification (if applicable) is shown or the number of this user defined mode.

Second level: User controls.

First line: Brightness, Contrast, Degauss, Horizontal Moiré, Vertical Moiré

Second line: Horizontal position, Horizontal size, Vertical position, Vertical size

Third line: momentary setting of actual control

Fourth line: name of actual control function.

Note: The following control levels can only be accessed if the switch on the left hand side of the keyboard is set in "Service" position.

Third level: Video control.

Circuit description of CCM420 monitor

**Application Note
AN97032**

First line: Red Black level (RB), Green Black level (GB), Blue Black level (BB), OSD contrast (OC), Colour temperature (CT)

Second line: Red gain (RG), Green gain (GG), Blue gain (BG), CRT grid 2 (G2)

Third line: momentary setting of actual control

Fourth line: name of actual control function.

Fourth level: Horizontal control.

First line: Pincushion (HP), Pin-balance (HB), horizontal linearity (HL), Corner (HC), Trapezium (HT)

Second line: Parallelogram (PA)

Third line: momentary setting of actual control

Fourth line: name of actual control function.

Fifth level: Vertical control.

First line: Vertical linearity (VL), Vertical linearity balance (VB), Vertical trapezium (VT), Tilt (TI)

Second line: (not used)

Third line: momentary setting of actual control

Fourth line: name of actual control function.

Sixth level: Miscellaneous control.

First line: Vertical focus (VF), Horizontal focus (HF), Aux 1 (A1)

Second line: Aux 2 (A2), Aux 3 (A3), Aux 4 (A4), OSD Hor. pos. (Oh), OSD Vert. pos. (Ov)

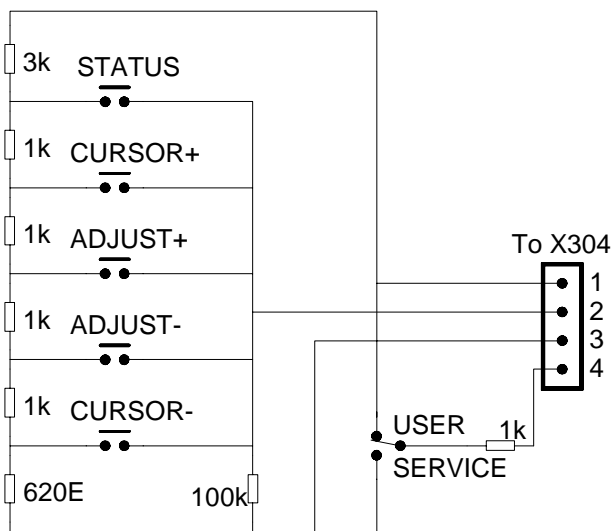
Third line: momentary setting of actual control

Fourth line: name of actual control function.

Seventh level: Automatic save and quit.

APPENDIX 5 KEYBOARD

The circuit diagram of the keyboard to be used with this main board and software is as follows:



APPENDIX 6 I²C CONTROL MENUS

This software can be used in a debugging phase of the hardware for instance in case no μ Controller is available (mind the setting of the S-correction switches).

The I²C Control Menus control the IC's via a Personal Computer, which should fulfil the following system requirements:

Hardware Requirements:

- 80486 compatible PC or a Pentium with a microprocessor running at least 100 Mhz
- a hard disk
- Centronics parallel printer port
- One of the following I²C -bus interfaces:
 - Hardwareless
 - Single Master (OM 4777; external +5Volt power supply needed)
 - Multi Master (OM 1022; external +5Volt power supply needed)
 - HighspeedBoard (Philips PC-MIO board)

Software Requirements:

- MicroSoft MS-DOS version 3.1 or later
- MicroSoft Windows 3.0 or later in standard or enhanced mode

GENERAL INFORMATION.

ERROR MESSAGES:

When starting an I²C-Control Menus program an hard- and software test is performed to test whether the Interface card is connected correctly and to test the I²C transfer channel. If one of these tests fails an Error Message Window will be displayed, explaining the type of error. If such an error occurs at start-up the program will run in the "demo-mode", which means that all functions can be controlled but there will be NO I²C data transfer. To be able to control the IC's you should stop the program, solve the problem mentioned in the Error Message Window and restart the program again.

SAVING DEFAULT SETTINGS:

There are two types of savings:

- Application Settings
- Set-up Settings

The settings of all controls (Potentiometers & CheckBoxes) can be saved within a file called 'filename.DEF', in this way several default settings for different Applications can be saved. (The 'filename' information can be defined by the user).

The Program Environment can be saved by saving the Set-up Settings into a file called 'program_name.INI' (The 'program_name' will be defined by the program itself, and will correspond to the name of the Program Name). The set-up settings include the following information:

- I²C data (Interface type, PrinterPort Number, Device address etc.)
- Last loaded Application Default File
- Screen Position of the Menu Window

Both saving actions can be performed via the 'File' Menu.

LOADING DEFAULT SETTINGS:

Loading Application Default settings can be performed by activating the “Load Application Settings” Menu Item within the “File”-Menu.

When the IC’s are situated within the CCM420 monitor, it is also possible to load the actual default settings of the Monitor, which are saved within the EPROM of the monitor. Before the program is able to perform this action it must be initialised to know what mapping is used. This can be done by performing the “Load Monitors Mapping EPROM File” Menu-Item within the “File”-Menu. After loading the mapping file, called ‘filename.MAP’, a test is performed to control this function. If this test is successful the “Read Defaults CCM420”-Button will become visible in the Menu Window.

MENU WINDOW SIZE:

The I²C Control menu written for the IC’s used in the CCM420 monitor can be displayed in two or more appearances. The first one shows all Controls that can be performed, either by Potentiometers or by CheckBoxes, and the Information Box showing what actual I²C data is transferred. By pressing the Expand-Button the Menu Window will show more detailed information, such as Register Contents, etc. Within the I²C-Control menu shown below, the Expand Button(s) are indicated by the characters “A” and/or “B” and the several Visible Areas are separated by Vertical Black Line(s).

I²C-CONTROL MENU OF THE DEFLECTION CONTROLLER IC TDA4854.

Register	Value
00	201
01	32
02	126
03	64
04	41
05	0
06	174
07	135
08	172
09	5
0A	21
0B	128
0C	136
0D	2

I²C-CONTROL MENU OF THE VIDEO CONTROLLER IC TDA4885

TDA4885 Video Controller, I2c Menu (version 1.30)

File Configuration View Help

VIDEO IN

- 6 Contrast: 57
- 8 Brightness: 14
- 10 VIDEO: On, Off
- 1 OSD: 15, On, Off
- 2 OSD Contrast
- 3 OSD Contrast
- 4 OSD Contrast

VIDEO OUT

- 30 Channel 1: Gain 53, Black Level 170
- 25 Channel 2: Gain 61, Black Level 161
- 20 Channel 3: Gain 33, Black Level 183

Assign Colours

Ch	R	G	B
Ch 1	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Ch 2	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ch 3	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Registers

00	11
01	14
02	57
03	15
04	53
05	61
06	33
07	170
08	161
09	183

TDA4885 Blockdiagram

Pedestal Blanking: On, Off

Feedback Polarity: Positive, Negative

(Re-)Init ALL

Read Defaults CCM420

I2C Commands: H88 H09 183

FileName Loaded: ccm420_2.def

I²C-CONTROL MENU OF THE D-A CONVERTER IC TDA8447

TDA8447 Octuple DAC, I2C Menu (version 1.21)

File Configuration View Help

Device Address: A0 A1 A2 **H48**

Control Name	Pin	1	7	8	Volt	Pin
				0	0.40	9
				0	0.40	10
				0	0.40	11
				0	0.40	12
Hlin				104	2.11	13
NSTrap				205	3.78	14
HRotation				169	3.18	15
VG2 Drive				188	3.50	16

Registers

00	143
01	0
02	0
03	0
04	0
05	104
06	205
07	169
08	188

Data Transfer to the DAC's

Immediate to each separate DAC

To all DAC's simultaneously at I2C-Stop Condition

Maximum Output Voltage Show Graph

VMAX:

Reference to Use:

Power Supply of Volt

BandGap Voltage of Volt

Maximum Output Voltage:

(Re-)Init ALL

I2C Commands: H48 H05 104

FileName Loaded: CCM420_3.DEF

P83Cx81 will not be taken to RFS

CICT has decide not to proceed with plans to make available the P83Cx81 family of DDC monitor microcontrollers. This family was originally intended to serve the market for DDC monitors which were I²C bus controlled. The P83Cx81 was positioned as a cost down version of the P83Cx80 family.

However for the following reasons this positioning no longer makes sense:

- most customers do not think the P83Cx81 32 pins are enough and they prefer the 42 pins P83Cx80 versions.
- the actual cost difference between the P83Cx80 and the P83Cx81 is very small.
- the P83Cx80 family can also be easily used for I²C bus controlled designs, it is not only for DC controlled designs.
- we have no customer orders currently for P83Cx81.

Therefore we will not proceed with the development of this family. The P83Cx80 family are of course not affected by this decision.

If you have any customer interest in the P83Cx81 family please inform them of this decision ASAP.

For those customers investigating the CCM420 demo monitor (which uses P83Cx81) from SLE please be informed that functionally the P83Cx81 is a subset of the P83Cx80 so the CCM420 software can also be run on the P83Cx80.

If you have any further questions please contact me directly.

Ian Jackson

IPM Monitor Microcontrollers

Consumer IC Taipei