Service
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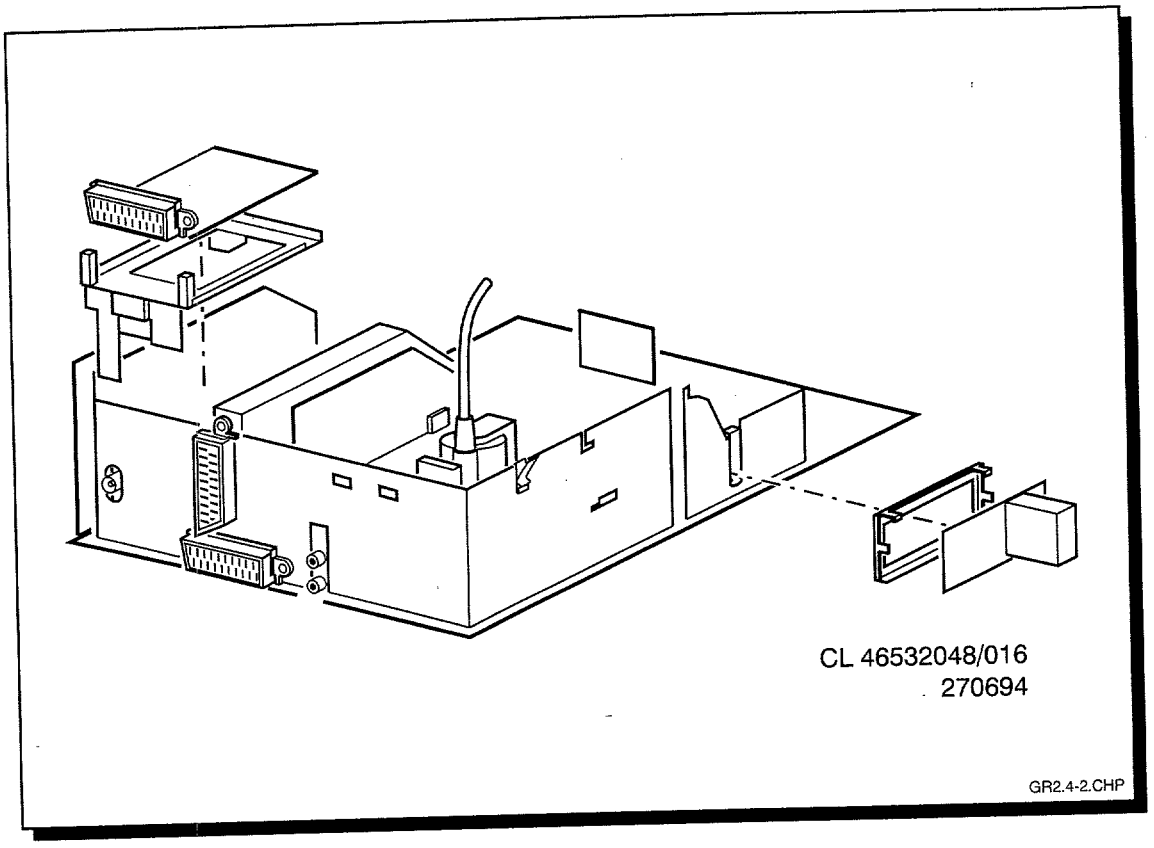
GR2.4

Training Manual

Contents

Published by Consumer Electronics Printed in The Netherlands GB 4822 727 20365

PHILIPS



CL 46532048/016
270694

GR2.4-2.CHP

Reference to the existing publications:

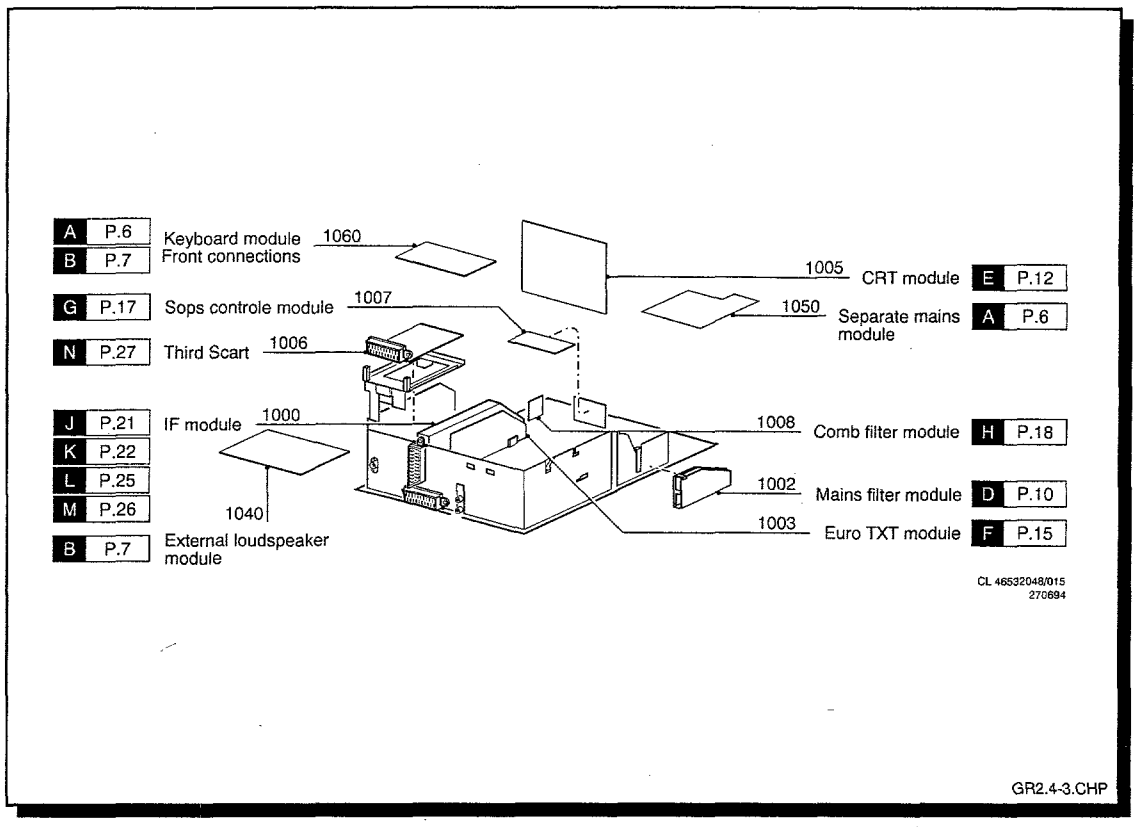
Service codes for the GR2.4 Service manual:

(GB) 4822 727 20358
(NL) 4822 727 20362
(F) 4822 727 20361
(D) 4822 727 20359
(E) 4822 727 20364
(I) 4822 727 20363

Service codes for the GR2.4 Training manual:

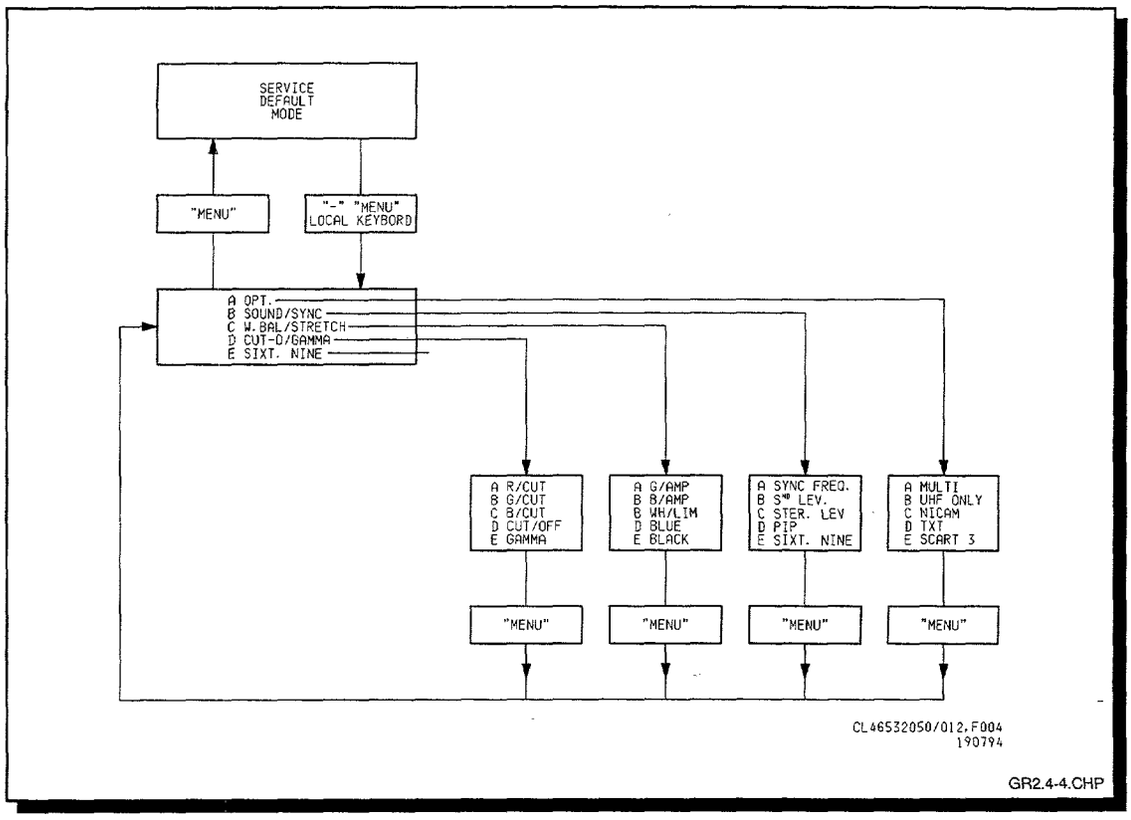
(GB) 4822 727 20365
(NL) 4822 727 20368
(F) 4822 727 20367
(D) 4822 727 20366
(E) 4822 727 20371
(I) 4822 727 20369

Personal notes



1. Chassis for the following picture tubes:
   - 21" "blackline" , "black HIBRI", "HIBRI"
   - 25", 28" "blackline S" and "black matrix";
   - 29" Superflat
2. Chassis suitable for systems PAL BG, PAL I, SECAM BG, SECAM LL' and SECAM DK combined with 2SC or NICAM stereo and NTSC playback only
3. Teletext 8 page (WST, TOP and/or FLOF) are possible
4. Depending on execution, the chassis is featured with 3 "EURO"/"SCART" connectors, Y/C and audio-out (SVHS) connector.
5. Customer controls are menu-controlled.
6. On the carrier panel the following functions are applied:
   - channel selector
   - video processing
   - audio output amplifier
   - synchronisation
   - frame and line deflection circuitry
   - controls
   - power supply
7. On separate modules the following functions are applied:
   - teletext; (TXT module - 1003)
   - picture and sound IF-circuitry (IF module - 1001)
   - power supply control (SOPS control module - 1007)
   - comb-filter (COMB filter module - 1008)
   - circuitries for sourcing and 2ND EURO connector and 3ND EURO connector (EURO module)
   - EXT. LS module (1040)
   - front connector module

Personal notes



1. The carrier is provided panel with (TP1. TP2 etc.).

2. All panels are provided with service printing.

3. In the software there is implemented:

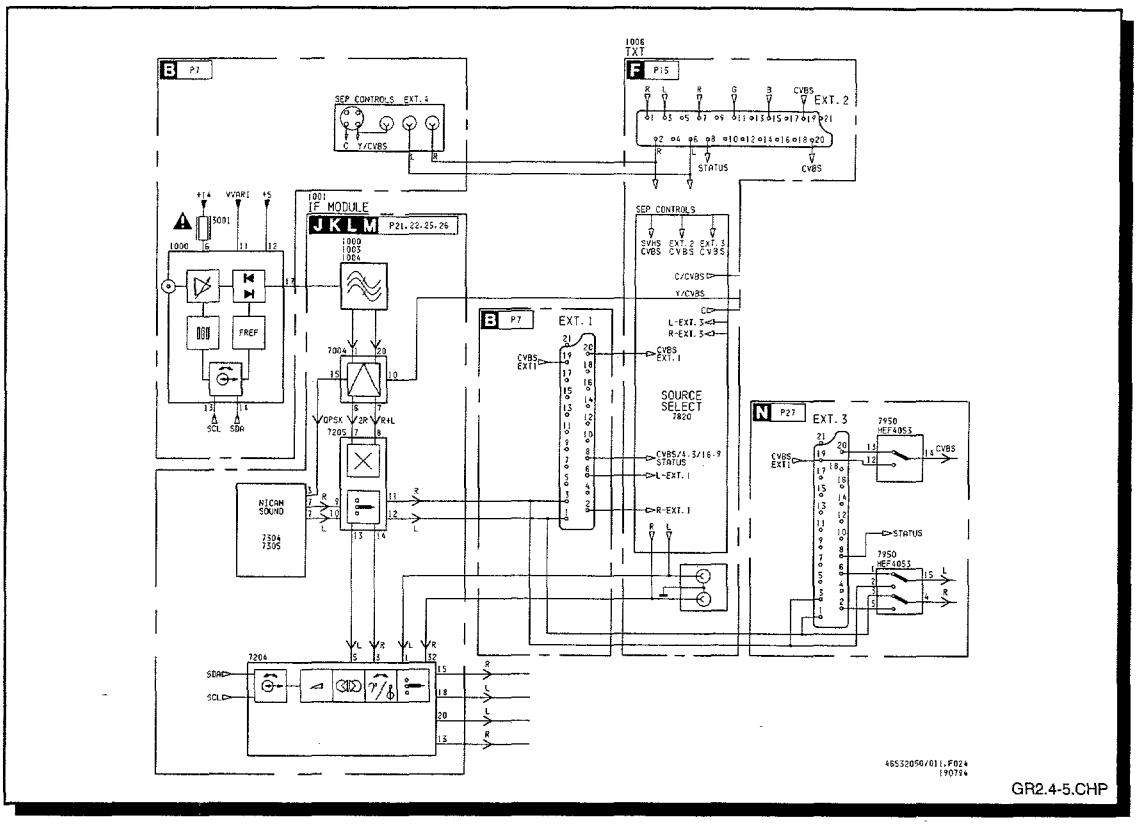
   - **"Service Default Mode"**
     This mode is activated by short circuiting the "service" pins and simultaneously switching on the set with the mains switch.
     After switching on "SER" appears on the screen.
     The set will be set in the following state:
     * set is tuned at 475.25 MHz and a defined system.
     * all linear controls are in mid-position except for volume which is set at its minimum level.

   - **"Service Menu"**
     This mode is activated by simultaneously pressing the "menu" and the "-" button when you are in the Service Default Mode.
     In this mode:
     * different options can be set
     * some software controlled picture settings can be set/adjusted

   - Error-detection system
     Via OSD messages, defective circuits are given.

Personal notes

Block diagram



1. Video input signals

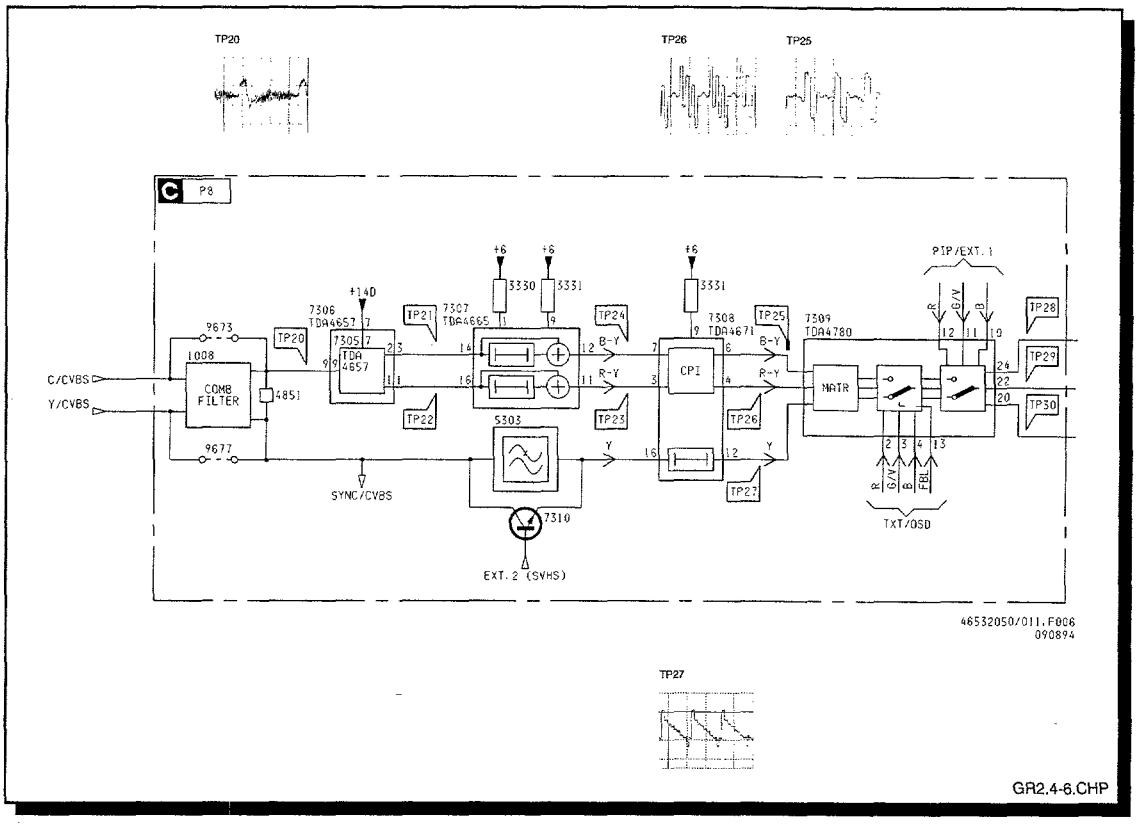
   - Video signals can be offered via the following paths:
     * HF signal via the tuner
     * CVBS signal via "euroconnectors" EXT1, EXT2, EXT3
     * SVHS (separate chrominance and luminance) signals via EXT2
     * RGB signals via "euroconnectors" EXT1 or EXT2*SVHS signals via EXT4(seperate controle on front of the set)
   - HF signal is demodulated to CVBS signal via the tuner and the IF-circuitry in the IF-module
     This CVBS signal will also be fed to EXT1, EXT2 and EXT3.

2. Source select

   - Via a matrix IC on the EURO connector module a choice is made between CVBS/AUDIO signals of the IF module, EXT1, EXT2, EXT3 or the Y/C-AUDIO signals of separate controle module (EXT4).
   - In case of PIP, the PIP-CVBS signal is sent to the PIP-module. The desired PIP picture can be selected from the signal of the IF module or CVBS EXT1, EXT2 or EXT3.

3. IF-sound

   - IF sound-signal gets demodulated in the IF-module. On this module the selection is made between internal and external sound.
   - Before the R and L signals are fed to the sound-output stage, sound regulation takes place in IC7204 and IC7205 on the IF-module.
   - The IF-module has 2 versions; stereo(2CS) and NICAM.



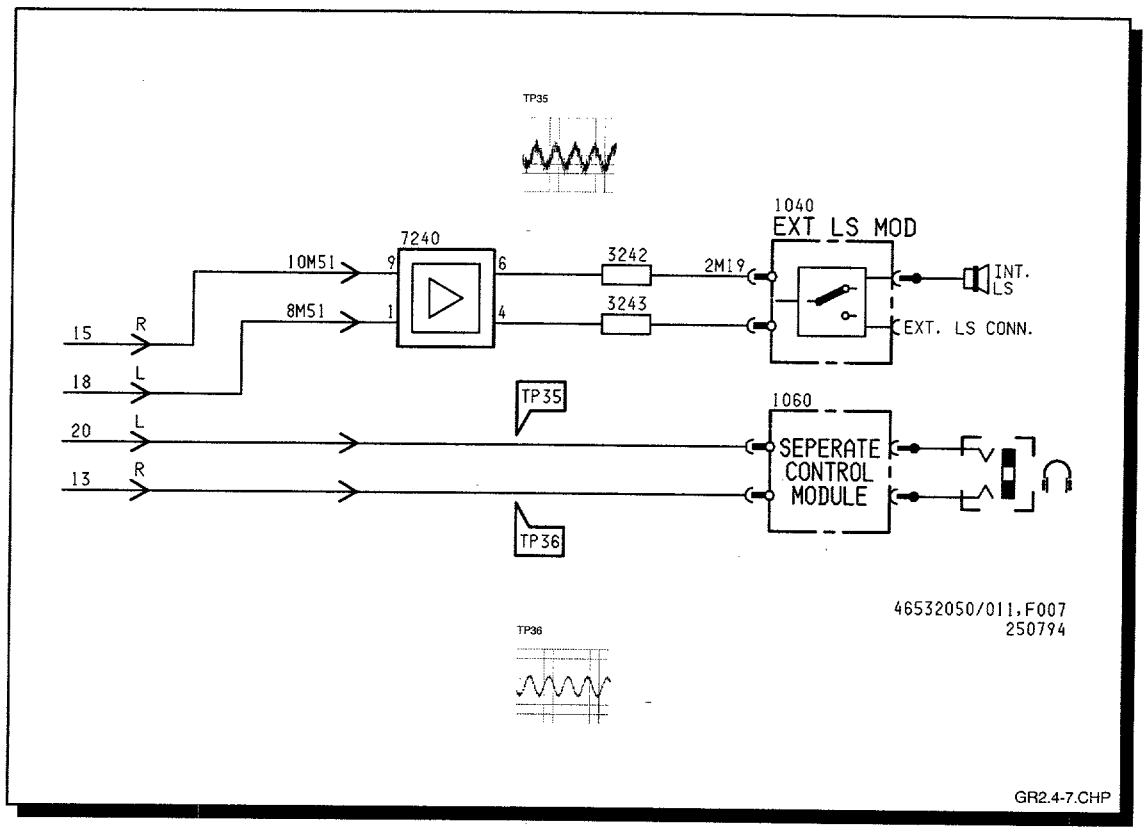
4. Luminance path
   - Via COMB filter 1008, chroma-blocking-filter 7312, delay-line in 7308 to video-control IC7309.
   - In the case of sets without the COMB filter, the jumper 9322 is fitted instead of the COMB filter.
   - Chroma-blocking-filter is shorted by 7312 if the Y signal enters from EXT4/EXT.

5. Chrominance path
   - Via COMB filter 1008, chroma-decoder IC7306 (IC7305).Chroma-decoder gives colour-difference-signals (B-Y) and (R-Y). Via baseband-delay-line IC7307 to CTI IC7308 and video-control IC7309.
   - In the case of sets without COMB filter, the jumper 9322 is fitted instead of the COMB filter.

6. Video-control and RGB output stage
   - In IC7309, (B-Y), (R-Y) and Y are converted into RGB signals.
   - Via source select switches in IC7309, RGB signals from EXT1/EXT2/PIP, TXT-module or OSD generator can be selected.
   - After adjustments of brightness, contrast, cut-off points, white balance, blue and black stretch and peak-white limiting RGB signals are fed to the RGB output stage on the CRT-panel.
   - Circuits for east/west and picture width are situated on the CRT-panel.

Personal notes

Block diagram



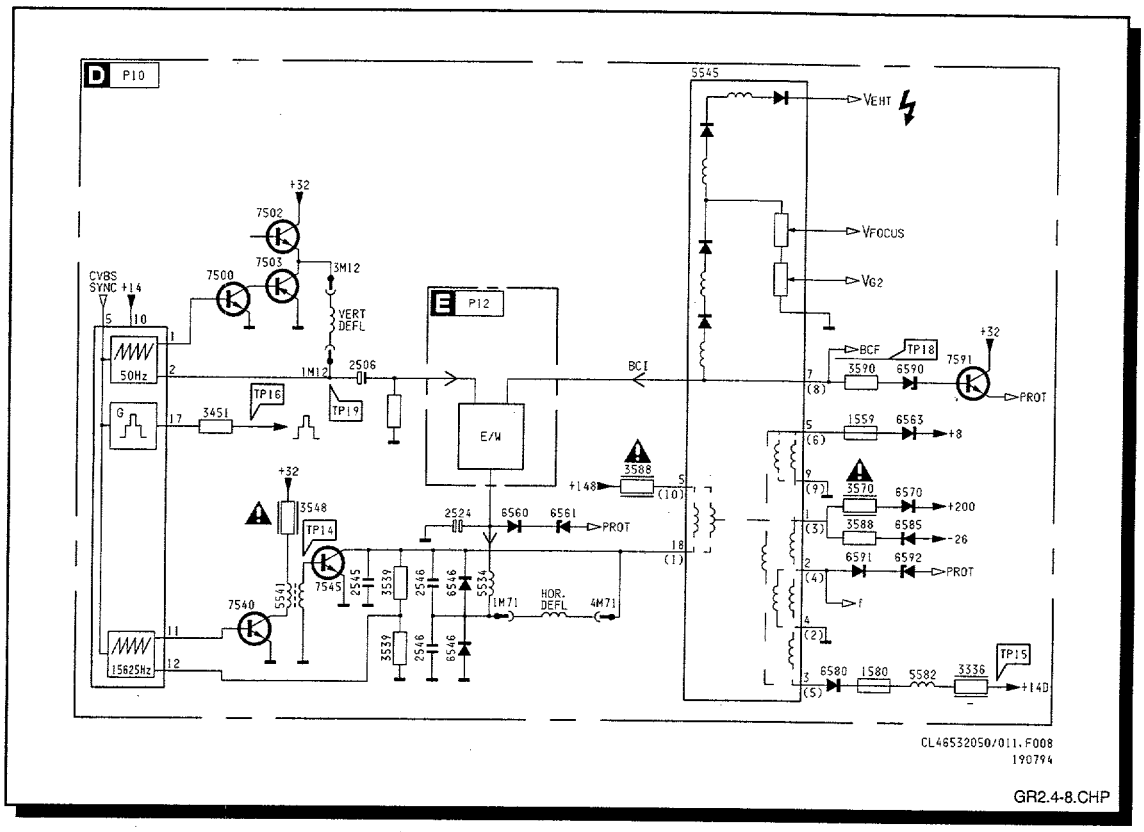
7. Audio-path

   - After source selection IC7820, L and R signals are supplied to fed to the sound-output stage in IC7240.

   - Amplified L and R signals are fed via to:
     * "separate control" module (EXT4) with the headphone connection.
     * internal and/or external loudspeaker via the "EXT. LS" module.

Personal notes

Block diagram

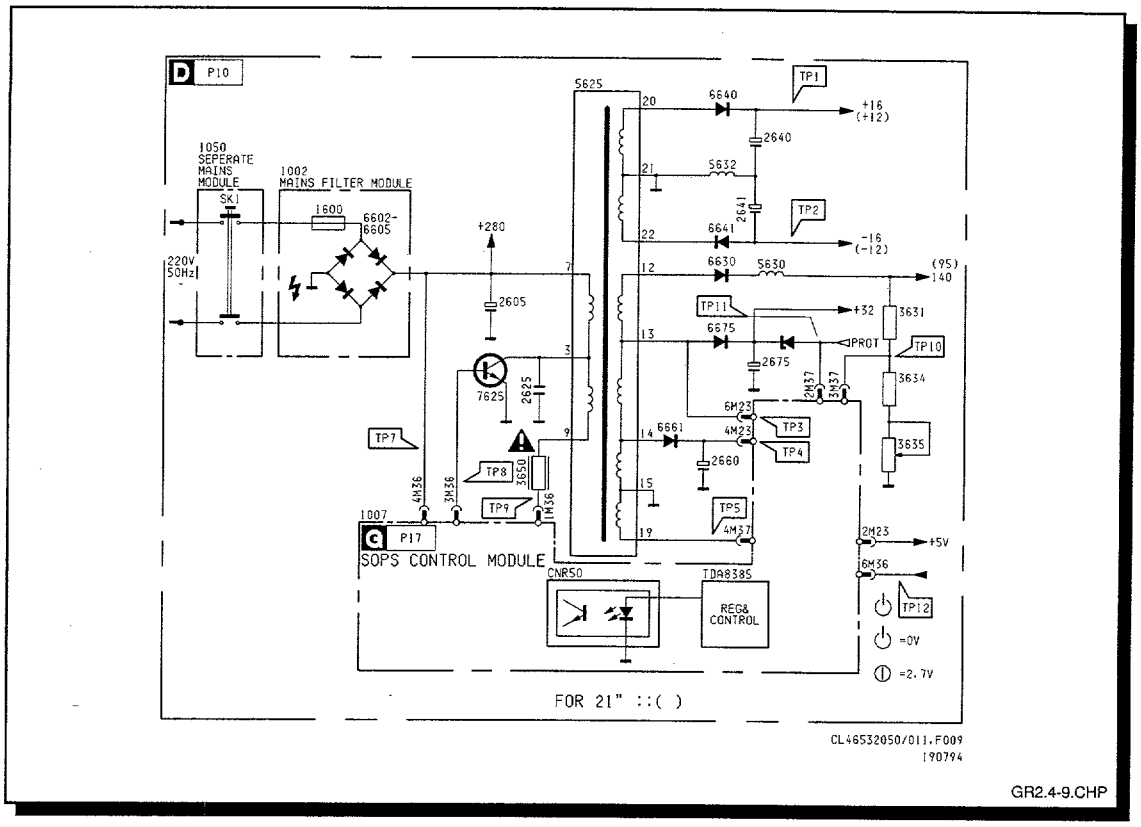


8. Synchronisation-, line- and frame-circuitry

   - CVBS signal to synchronisation chip, IC7470. IC7470 generates frame- and line-drive pulses.
   - Frame circuitry with TS7500, TS7502, TS7503 for vertical deflection.
   - Line circuitry with driver TS7540, line output stage TS7545, LOT 5545 gives horizontal deflection. Line circuitries also give the following supply voltages:
     +200, +14D, +8, -26, Vg2, V-focus and the EHT.

Personal notes

Block diagram

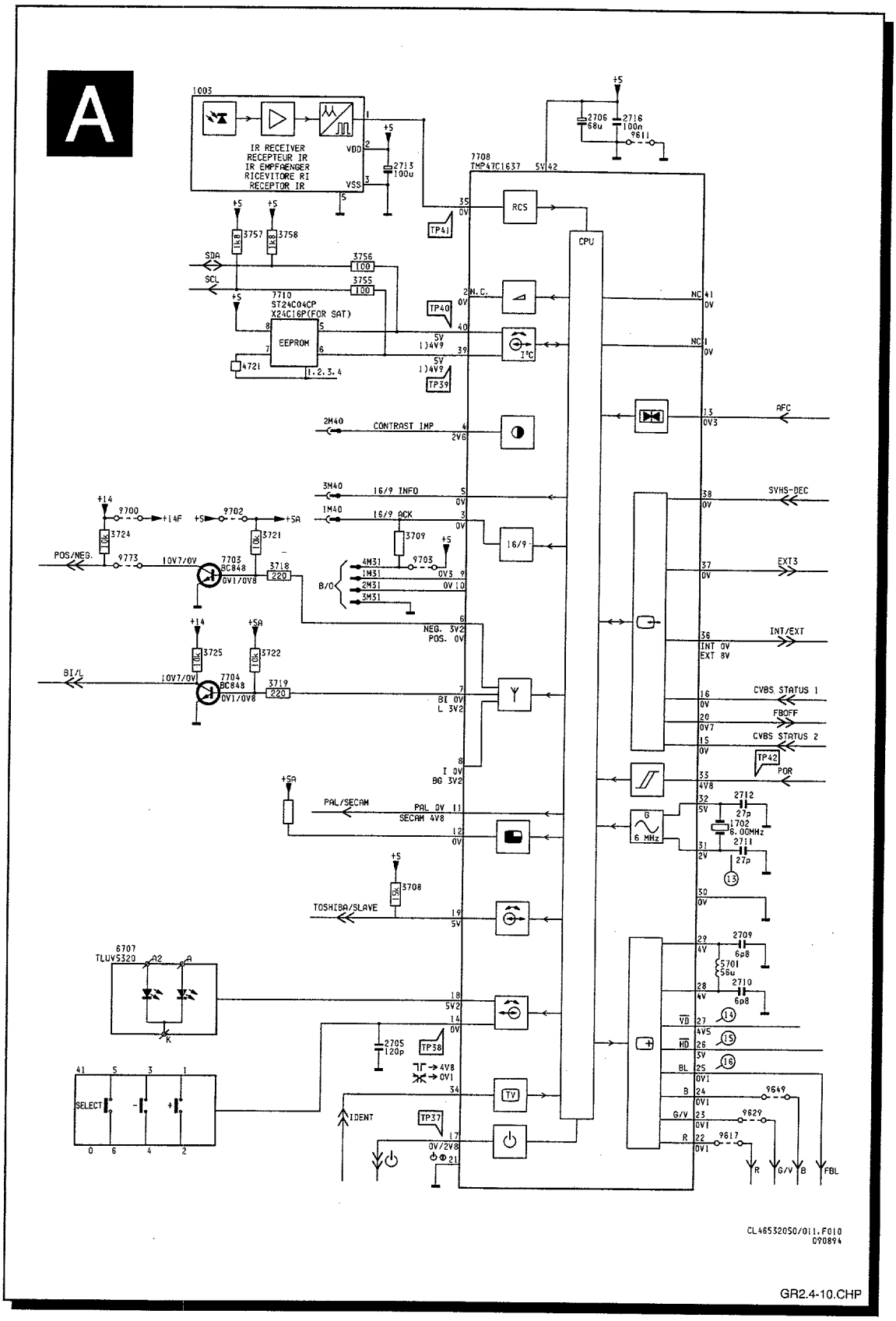


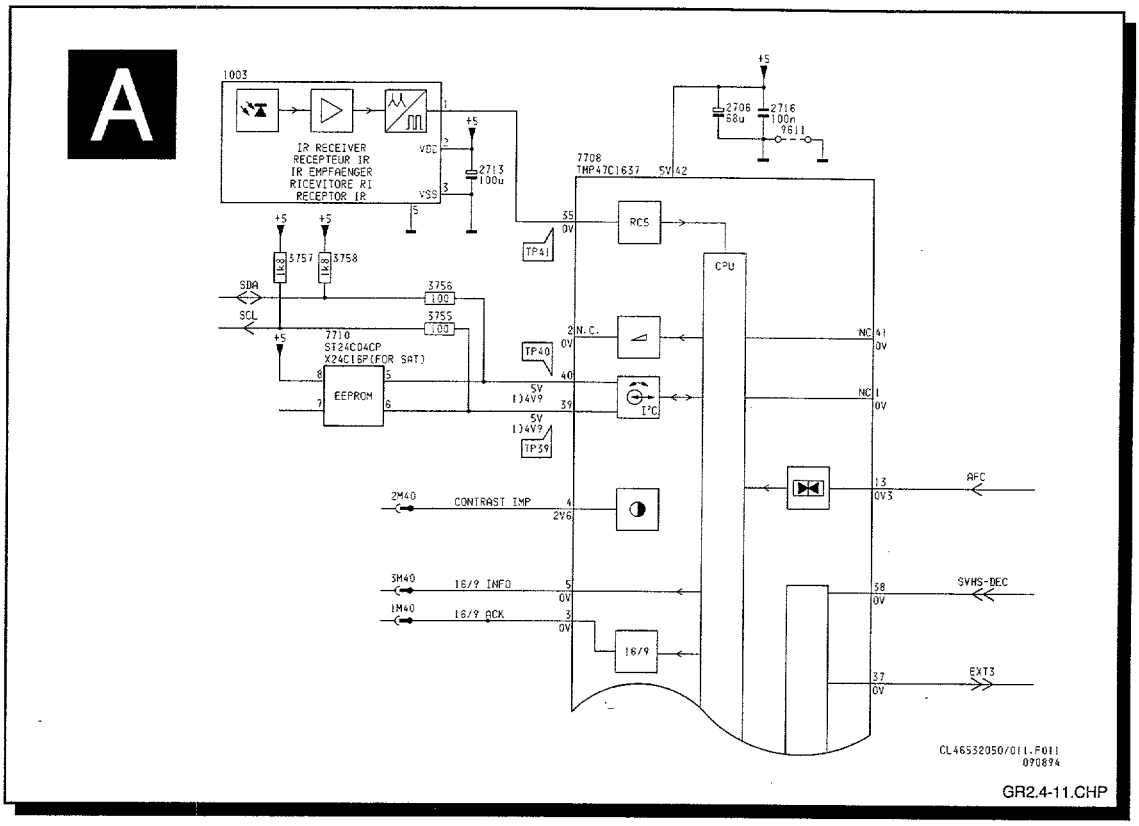
9. Power supply circuitry

   - Power supply is mains-isolated and of the SOPS type.
   - Driving-circuits of the switching transistor 7625 and control-part are situated on the "SOPS control" module 1007.
   - The power supply delivers the following supply voltages:
     +148, +32, +16 , -16 and +5

Personal notes

Block diagram

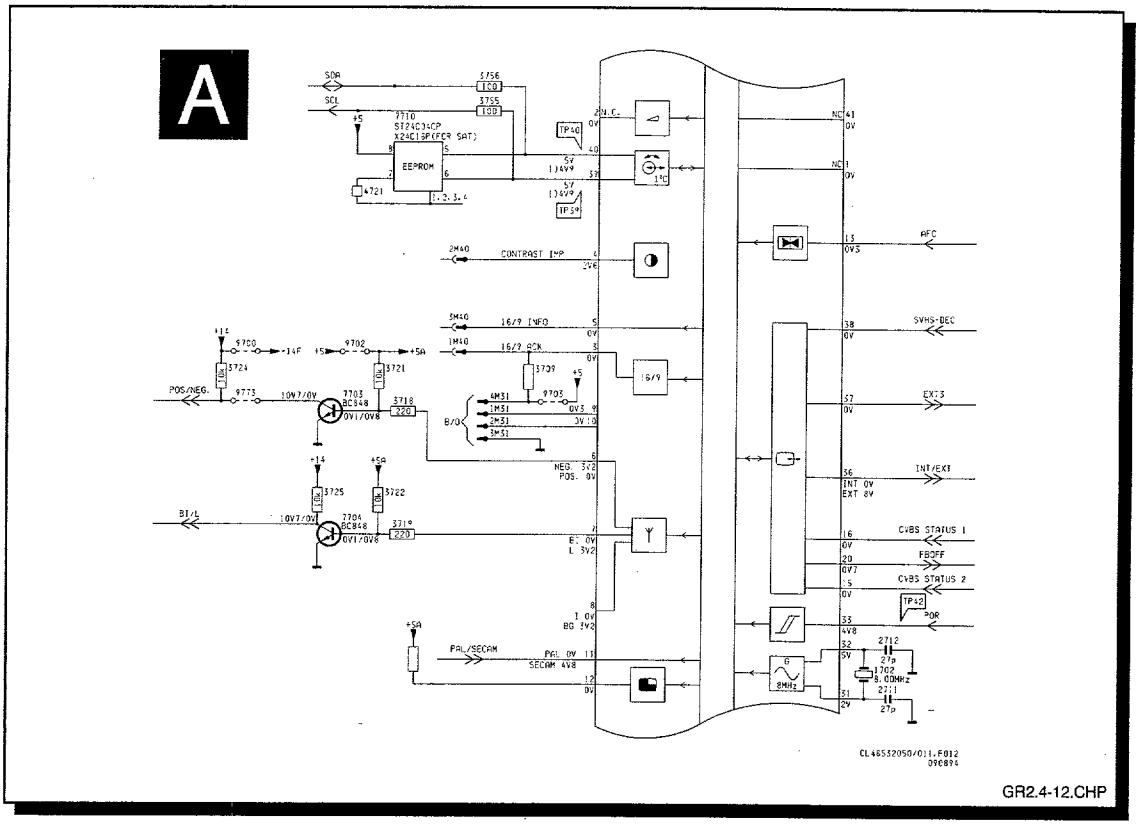




1. Introduction
   - The GR2.4 family has a microcomputer
     * IC7708 (32k; TMP87Cm36) on the mainpanel: the main μC for general controlling and operation of the set

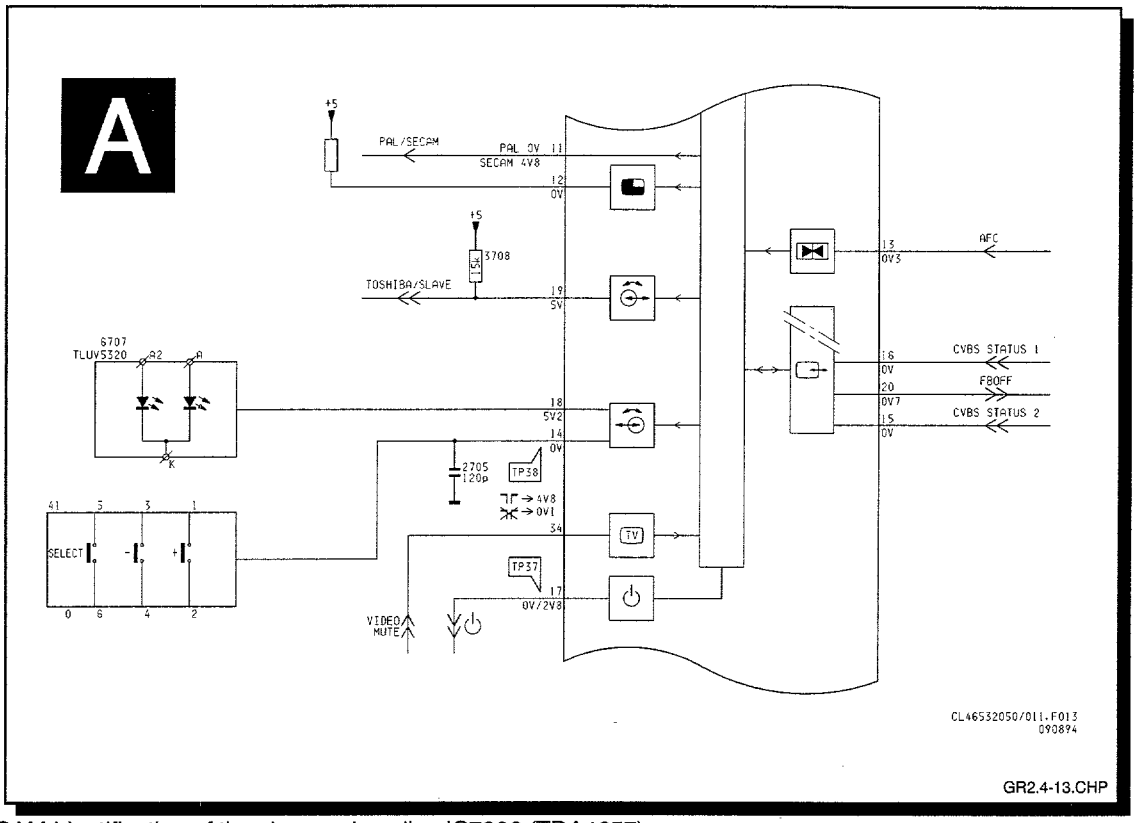
2. Pin-connections of the main microcomputer IC7708
   - Pin 1: Not connected (nc)
   - Pin 2: Not connected (nc)
   - Pin 3: Not used
   - Pin 4: Contrast regulation via the picture tube panel: A pulse width modulated signal from the μC is converted to a control voltage.
     → Minimum pulse width on μC produces 6,2V on picture tube panel: the set is at minimum contrast
     → Maximum pulse width on μC produces 8,2V on picture tube panel: the set is at maximum contrast

Personal notes

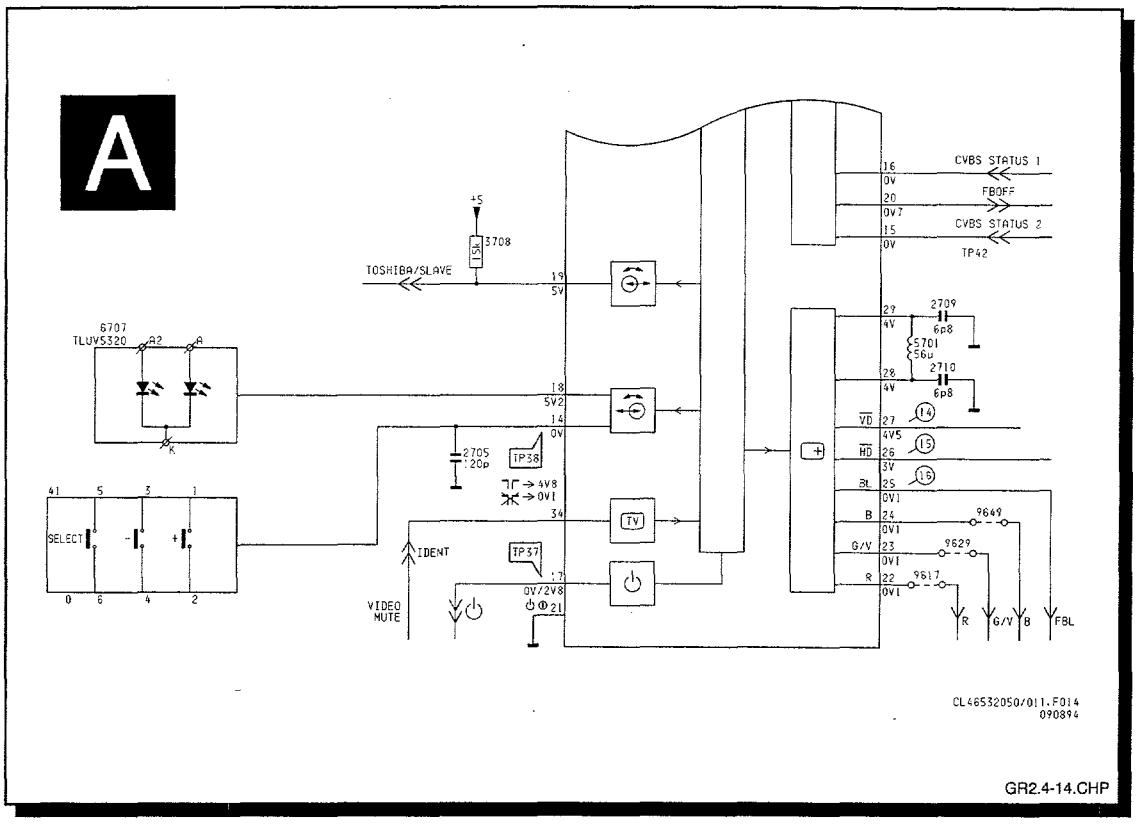


- Pin 5: 16:9 information to the picture tube panel:
  - → 0V on µC: 4:3 picture system
  - → 5V on µC: 16:9 picture system
- Pin 6: Controlling of the demodulation of positive/ negative modulated IF signal in the IF IC IC7004 (TDA9815) and controlling of the demodulation of the AM/FM audio signal:
  - → 0V on µC; via inverter (TS7150) 10,7V on IF IC7004: negative IF modulation and FM sound
  - → 3V on µC; via inverter (TS7150) 0V on IF IC7004: positive IF modulation and AM sound
- Pin 7: Controlling of switching between BG/I and L' sound signal :
  - → 0V on µC; via inverter (TS7151) 10,7V to the tunable filter 1150: BG system is chosen
  - → 3V on µC; via inverter (TS7151) 0V to the tunable filter 1150: L' system is chosen
- Pin 8: not connected
- Pin 9: Feedback CVBS status EXT.3 coming from the Euro module 1006:
  - → 5V on the µC: EXT.3 signal present.
- Pin 10: Switching signal for the EXT.3 connection

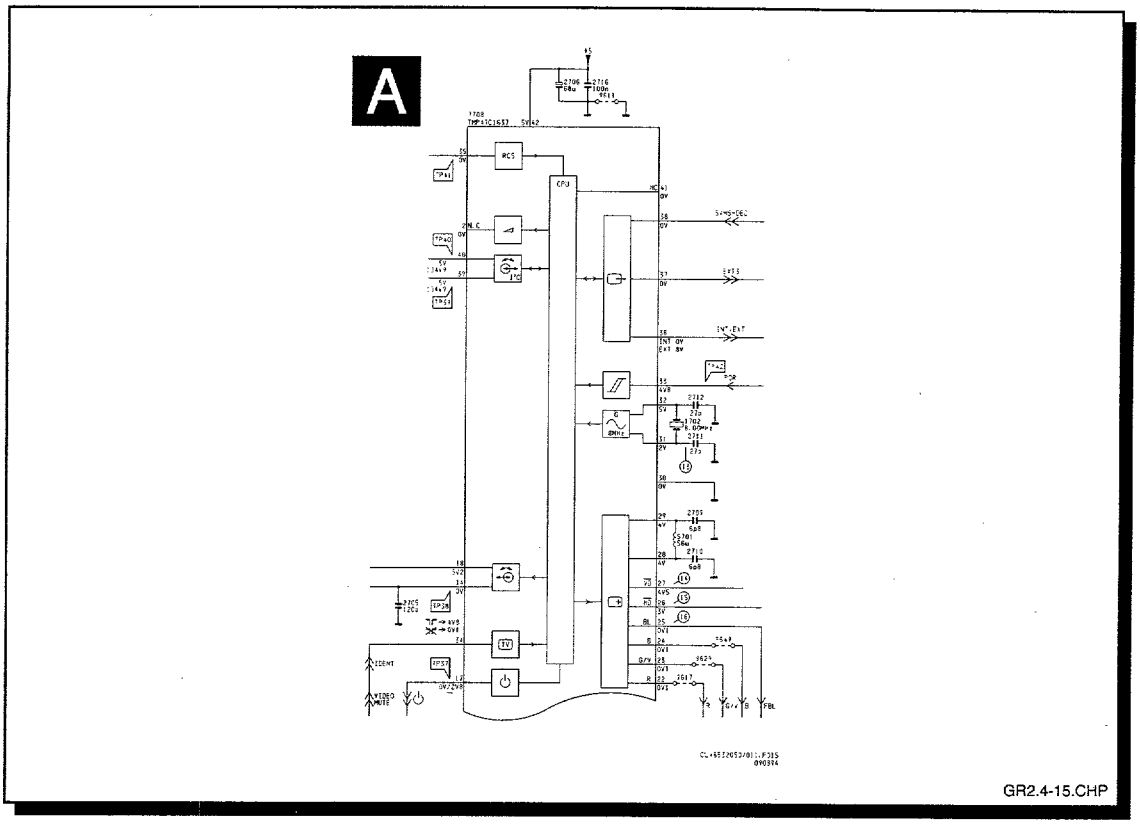
Personal notes



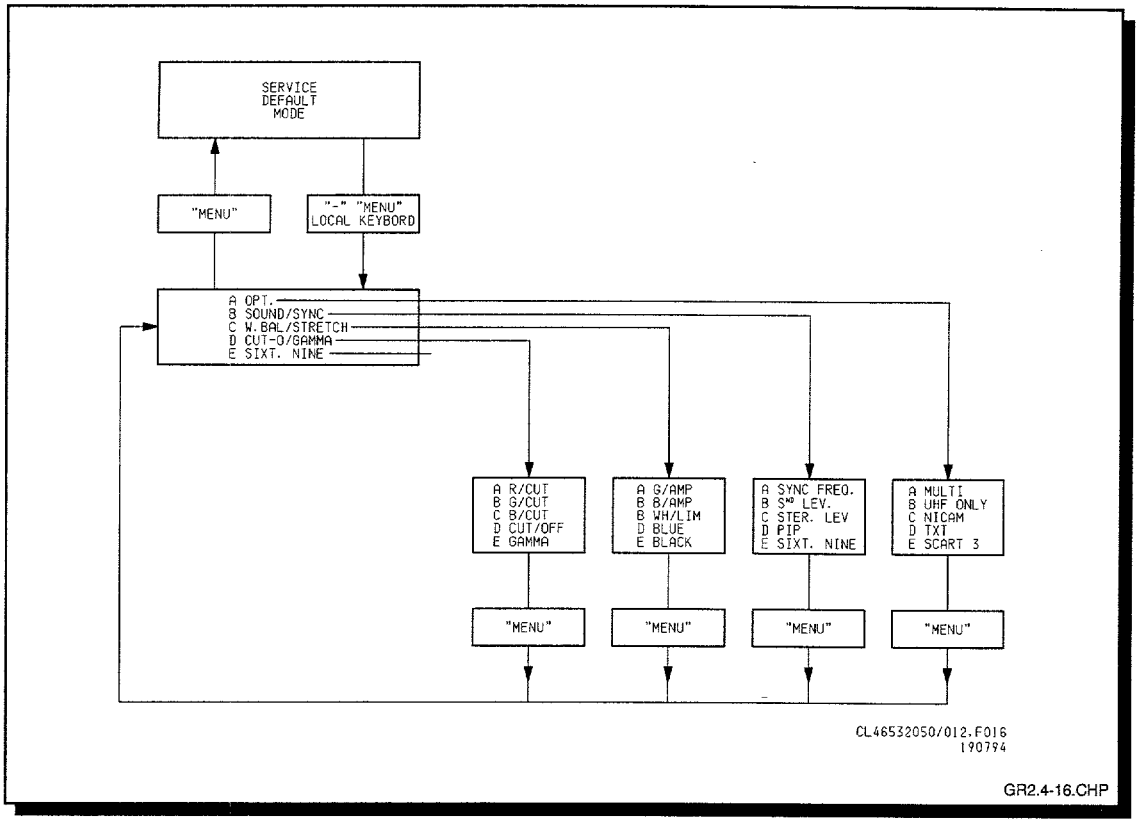
- Pin 11: PAL/SECAM identification of the chroma decoding IC7306 (TDA4657):
  - → 0V on µC: PAL
  - → 5V on µC: SECAM
- Pin 12: Must be high (> 3 Volt) otherwise the µC is in blocking state.
  In the blocking state there is a picture with no sound and the set does not give any reaction on remote control signals !!!!
- Pin 13: Feedback information of the Automatic Frequency Control (AFC) between 0 Volt and 5 Volt.
- Pin 14: Connection of the local control:
  - → Pressing the "+" knob or "-" knob, the program will increase 1 number or decrease 1 number
  - → After pressing the "select" knob, the "+" and "-" knob will change 1 step at the selected function
    - * Normal voltage at this pin is 0V
    - * With "+" pressed: 4,7V
    - * With "-" pressed: 3,0V
    - * With "Select" pressed: 2,3V
- Pin 15: CVBS statussignal EXT.2 coming from the Euroconnector 2 (EXT2) on the Teletextmodule(1003):
  - → 4V on the µC: EXT.2 signal present
  - → < 1,3 Volt no EXT.2 signal present
- Pin 16: CVBS statussignal EXT.1 coming from Euroconnector 1 (EXT1) on the chassis:
  - → 4V on the µC: EXT.1 signal present
  - → < 1,3 V on the µC : no EXT.1 signal present
- Pin 17: "Standby" command : (see fig. next page)
  - → TV on (Power On): 0V
  - → TV in "standby": 5V
- Pin 18: LED drive : (see fig. next page)
  - → TV on (Power On): 5V
    - The green LED in D6707 will light with the current flowing through R3729 (+14F)



- Pin 18: LED drive (continued):
  - → TV in "service mode": 0V
    - The red LED in D6707 will light with the current flowing through R3730 (+5V)
    - If the +14F is not present; the green LED will not light
  - → When RC commands are received: voltage pulses between 0V and 5V are generated
    - The green LED in D6707 will light continuously by the current through R3729/D6705
    - During the pulses the LED in D6707 will light up by the current through R3730
    - By the lighting of both the red and green LED's the orange colour will be visible
- Pin 19: not connected
- Pin 20: Switching off the Fast Blanking (FB OFF) → 5V (RGB kill)
- Pin 21: Ground connection of μC IC7708
- Pin 22: OSD controller (menu display): colour red:
  - → 0V: no OSD
  - → 4V: OSD text or background colour
- Pin 23: OSD controller (menu display): colour green:
  - → 0V: no OSD
  - → 4V: OSD text or background colour
- Pin 24: OSD controller (menu display): colour blue:
  - → 0V: no OSD
  - → 4V: OSD text or background colour
- Pin 25: OSD controller (menu display): "fast blanking"
  - → 0V: no OSD
  - → 4,7V: OSD text or background colour
- Pin 26: OSD controller (menu display): Inverted horizontal synchronisation
  - * The control signal is deducted from the sandcastle signal via TS7707



- Pin 27: OSD controller (menu display): Inverted vertical synchronisation
  * The control signal is deducted from the sandcastle signal via TS7706
- Pin 28: OSD oscillator
- Pin 29: OSD oscillator
- Pin 30: Earth
- Pin 31: µC clock-oscillator (8 MHz)
- Pin 32: µC clock-oscillator (8 MHz)
- Pin 33: Power On Reset (POR) :
  → After switching on the TV: delayed 5V
- Pin 34: TV signal recognition of the sync IC7470:
  → 4,6V on the µC: (antenna) signal present
  → 0,1V on the µC: no signal present
- Pin 35: Remote Control (RC) signals from the RC receiver 1003
- Pin 36: Status-signal internal/external signal :
  → 0V on the µC: internal signal selected
  → 5V on the µC: EXT.1, EXT.2 or EXT.3 selected
- Pin 37: Status-signal EXT.2
  → 5V on the µC: internal signal/EXT.1/ or EXT.3 selected
  → 0V on the µC: EXT.2 selected
- Pin 38: Status-signal SVHS from EXT.2/EXT.4:
  → 5V if SVHS signal on EXT.4 is present
- Pin 39: I^2C control signal: clock SCL
- Pin 40: I^2C control signal: data SDA
- Pin 41: Protection for EEPROM register(5V: protected, 0V: unprotected)
- Pin 42: +5V supply



1. Service Mode

- Function:

  Setting the options and picture tube alignments

- Operation:

  - By shortcircuiting the Service Pins whilst switching on the set. the set will be put in the Service Mode
  - Choices on the menu:
    * Options/options 1
      - Multi system set
      - "UHF only" tuner present
      - Nicam present
      - Teletext present
      - Scart 3 present
    * White balance; settings between 0 and 63
      - White colour settings: red
      - White colour settings: green
      - White colour settings: blue
      - Blue stretch on/off
      - Black stretch on/off
    * Cut off voltages; settings between 0 and 63
      - Cut off for red
      - Cut off for green
      - Cut off for blue
      - Cut off on/off
      - Gamma correctie on/off
    * Sound/synchronisation
      - Synchronisation frequency
      - Sound level
      - Stereo level
      - PIP 16/9 format

Personal notes

Survey of errormessages on the screen

Message on screen	Description
PIP	I^2C error PIP module
NICA	I^2C error IC7305 (NICAM sets)
9860	I^2C error IC7204
9840	I^2C error IC7205
TXT	I^2C error teletext module IC7910/IC7920
EPROM	I^2C error IC7710
TUNE	I^2C error tuner
CHR1	I^2C error IC7308
CHR2	I^2C error IC7309
6415	I^2C error IC7820
BUS + blinking LED	I^2C bus blocked

2. Error messages

- Function:

  Fast diagnosis of defective IC's or problems with some functions

- Operation:

  - If an error has occurred: after switching on the Service Mode, an error message buffer is showed at the bottom left on the screen will appear. This buffer will remember the last five errors. The oldest error is displayed on the left and the latest error on the right and this one will blink if it is still valid. Only errors which are different from the last error in the buffer will be added to this buffer. The errorbuffer will be cleared after leaving the set in service mode by the standby command.

  - After a few seconds this error message will disappear

  - If there is an internal IIC-bus error:
    → The TV on/standby LED will start blinking

Personal notes

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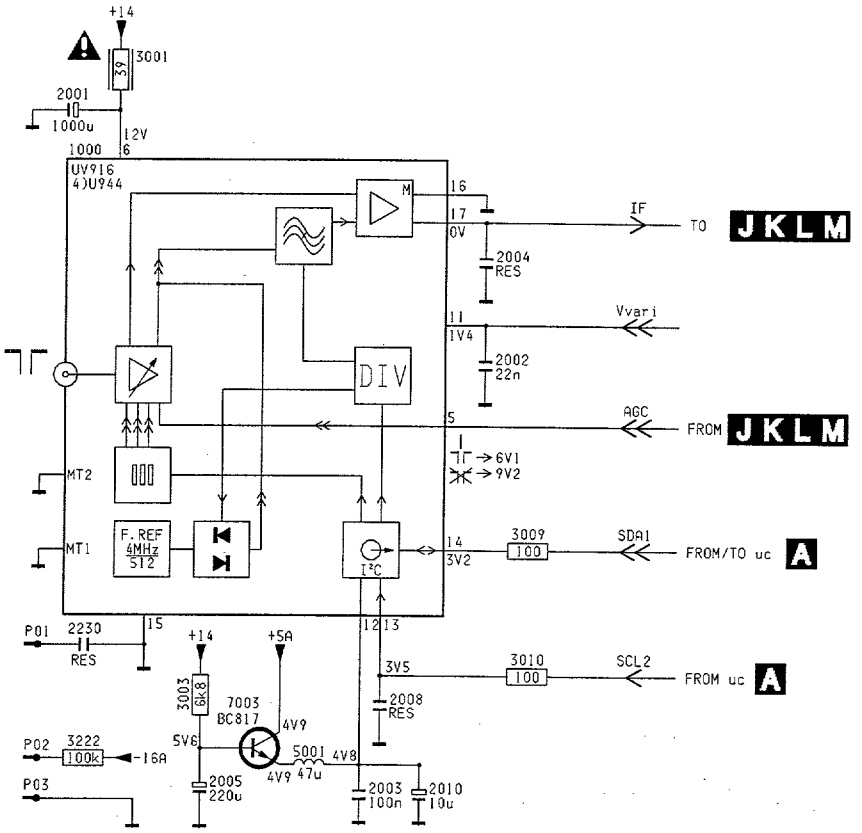

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GR2.4-18.CHP

1. Tuner U1000

   - Only PLL
   - Band I, band III, hyperband and UHF
   - 2 types:
     * UV916 for PAL BGI / SECAM BGLL'DK
     * U944 for PAL I (UHF only)

2. PLL

   - Band-switching, tuning from HF amplifiers and local oscillators controlled via I^2C bus at pin 13 and 14
   - DC varicap-voltages measurable at pin 11 of the tuner (varies between 0 and 30V during tuning)

3. AGC (Automatic Gain Control)

   - AGC voltage from IF-detector to pin 5 of the tuner, controls the IF amplifiers in the tuner
   - If the aerial-signal gets under a certain threshold, the voltage at pin 5 will increase and also the amplification in the tuner

4. IF (intermediate-frequency signal)

   - Pin 17 is the IF output of the tuner
   - This IF signal is fed to the IF/sound-module:
     * the IF/Stereo sound module
     * or the IF/NICAM sound module

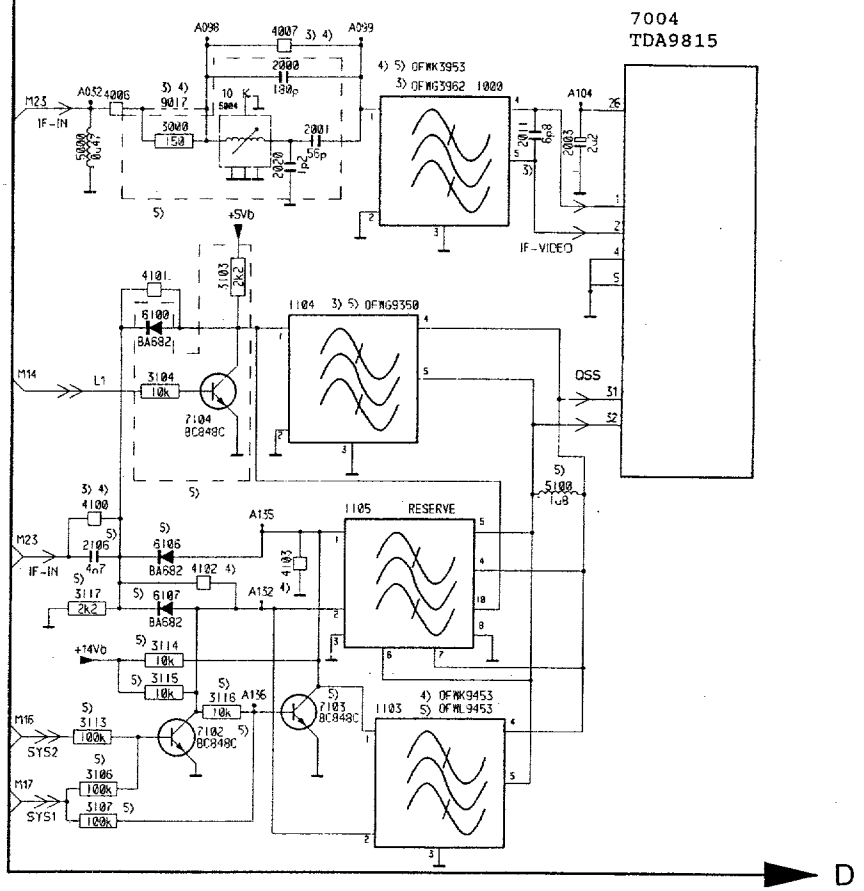
Personal notes

REMARKS / REMARQUES / ANMERKUNGEN / NOTE

PRESENT IN SETS:
PRESENT SUR LES APPAREILS:
ANWESEND IN GERATEN:
PRESENTE SUI MODELLI:
PRESENTE SOBRE MODELLOS:

1) : IN GR2-4 ONLY
2) : IN GR2-2 ONLY
3) : BG ONLY
4) : BGDK ONLY
5) : BGLI ONLY

M



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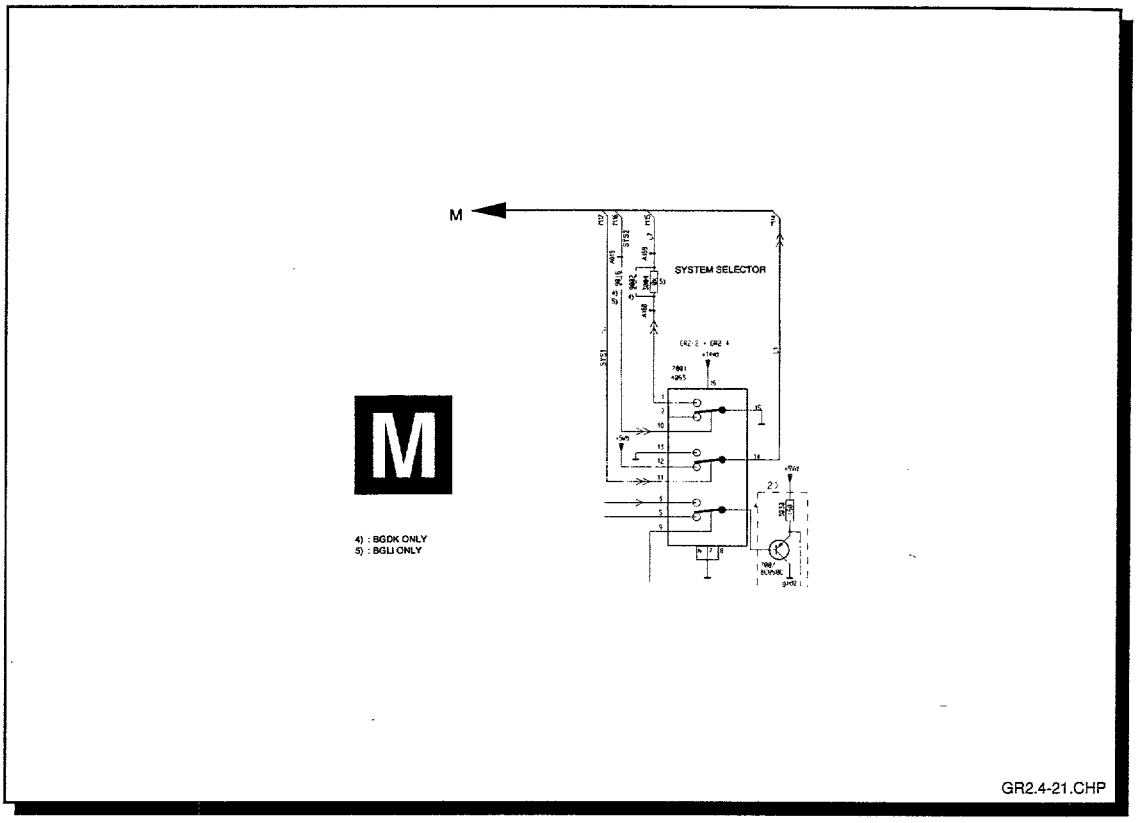


1. Possible IF modules:

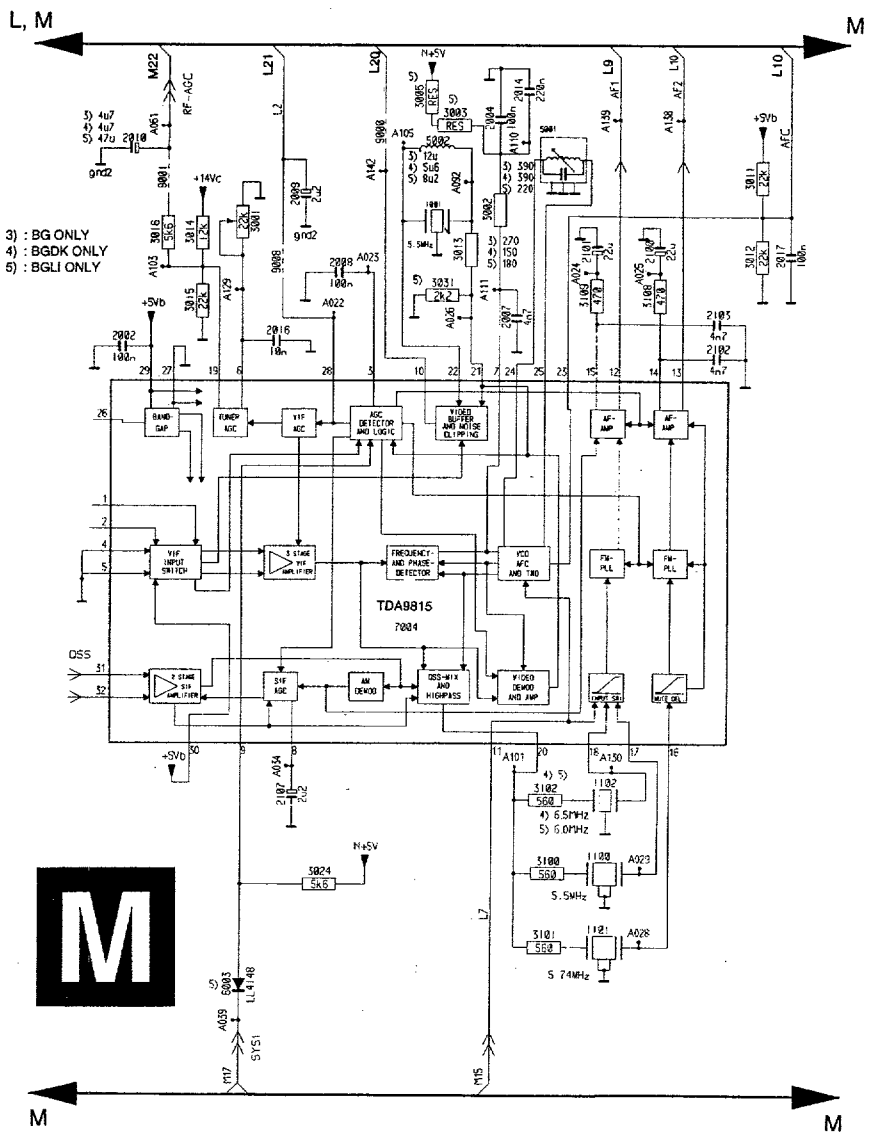
   - PAL BG
   - PAL BG/SECAM BGDK (Multi-East Europe)
   - PAL BGI/SECAM BGLL' (Multi-France)
   - PAL BG/NICAM BG
   - PAL I/NICAM I

2. IF signal path

   - IF signal (signal line D23) from pin 17 of the tuner to SAW filters 1000, 1103 and 1104.
   - SAW filter 1000 passes the video components of the IF signal.
     * IF-video at 38.9 MHz at pin 4-5 of 1000 to pin 1-2 of IF-demodulator (IC7004, TDA9815)
   - SAW filters 1103 and 1104 passes the audio components of the IF signal.
     * IF-sound at 33.4 to 38.9 MHz at pin 5-4 of 1103/1104 to pin 31-32 of IF-demodulator (IC7004, TDA9815)
   - System switching:
     The switching signal are generated by the main μP IC7708 via pin 6 and 7. These signals are inverted and become SYS 1 and SYS 2. Function: see table below.

SYS1	SYS2	SELECTED SYSTEM	IF SIGNAL TO PIN 1 OF 1103	IF SIGNAL TO PIN 2 OF 1103	IF SIGNAL TO PIN 1 OF 1104
0V	14V	SECAM L'	YES	no	no
0V	0V	SECAM L	no	YES	no
14V	0V	BG *)	no	no	YES
14V	14V	PAL I/DK *)	no	no	YES

*) for both PAL and SECAM.

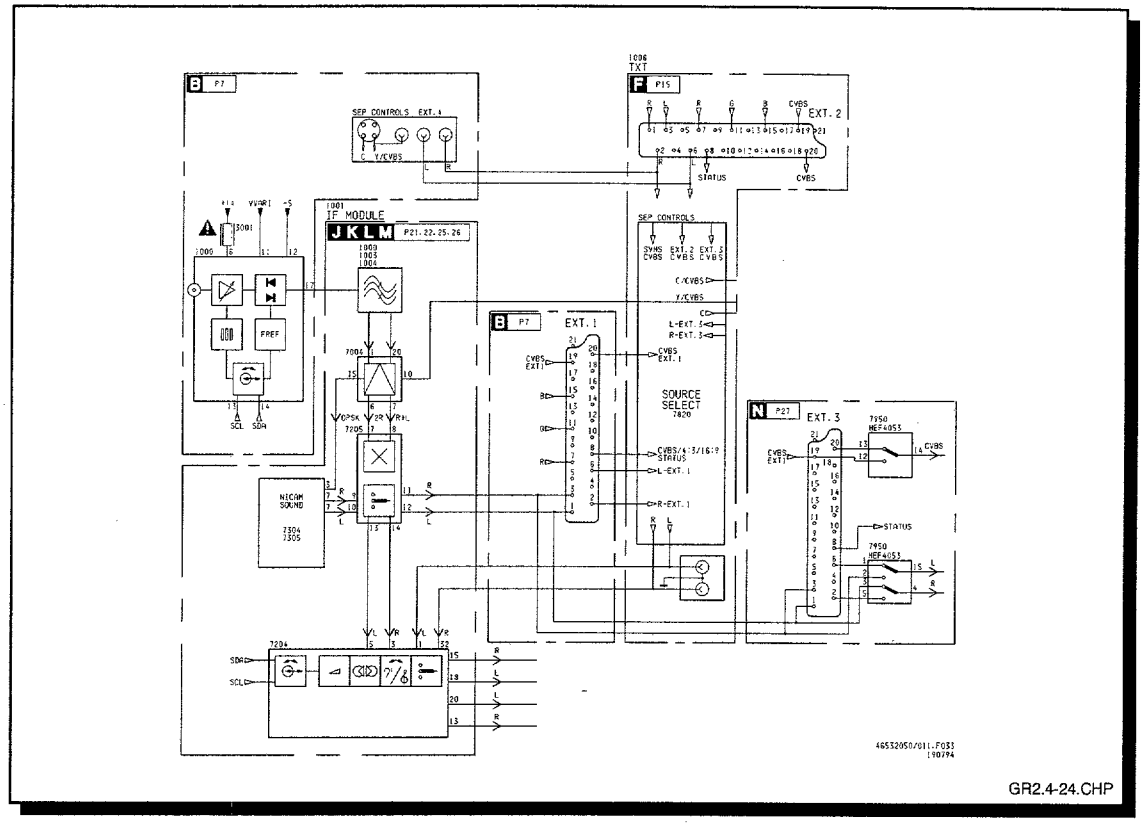

L, M
M
3) : BG ONLY
4) : BGDK ONLY
5) : BGLI ONLY
TDA9815
7004
M
M
M
GR2.4-22.CHP

3. Video and sound IF circuitry IC 7004 TDA9815 (for both the "IF/Stereo sound module" and the "IF/NICAM sound module").
   Specifications and features:
   * Multi standard video IF demodulation
   * In the demodulator stage the video signal polarity can be switched in accordance with the TV standard
   * Integrated low pass filters for attenuation of carrier harmonics
   * AM sound demodulation without extra reference circuit
   * Sound IF input for single reference QSS mode
   * Automatic low-level-stereo-signal detection and stereo mute function
   * Dual PLL-FM sound demodulation, alignment free
   * VCO (voltage controlled oscillator) frequency switchable between system L and system L'
   * Separate video amplifier for sound trap buffering with high video bandwidth
   * AFC detector without extra reference circuit

   Pinning of the TDA9815

   - Pins 1/2: Video IF differential input A
   - Pin 3: Capacitor for black level detector
   - Pins 4/5: Video IF differential input B
     Not used for
   - Pin 6: Tuner AGC takeover adjustment
   - Pin 7: PLL loop filter
   - Pin 8: Capacitor for sound IF AGC
   - Pin 9: System selection switch (not used for IF/NICAM sound module).
     → 0V6: systems SECAM LL'
     → 5V: systems PAL BGI / SECAM BGDK
   - Pin 10: CVBS output
   - Pin 11: (inverted SYS 2 signal)
     A: FM sound input selection switch (not used for IF/NICAM sound module).
     → 5V: systems BG is selected (Pin 17)
     → 0V: systems I/DK is selected (Pin 18)
     B: SECAM system selection switch (not used for IF/NICAM sound module).
     → 5V: systems SECAM L
     → 0V: systems SECAM L' (decreased VCO frequency)
   - Pin 12: Audio frequency output 1 (mono information)
   - Pin 13: Audio frequency output 2 (stereo information)
   - Pin 14: Decoupling capacitor for audio frequency output 2
   - Pin 15: Decoupling capacitor for audio frequency output 1
   - Pin 16: Sound intercarrier input 2 (5.74MHz; stereo information)
     Low-level-stereo-signal detection and stereo mute function
   - Pin 17: Sound intercarrier input 1 (5.5MHz; mono information)
   - Pin 18: Sound intercarrier input 3 (6.0 or 6.5MHz; mono information)
   - Pin 19: Tuner AGC (open-collector) output. Take over point adjustable at Pin 6
   - Pin 20: Single reference QSS output
   - Pin 21: Video and intercarrier output
   - Pin 22: Video buffer input
   - Pin 23: AFC output
   - Pins 24/25: VCO reference circuit for 2x picture carrier frequency
   - Pin 26: Capacitor for U-supply/2 reference
   - Pin 27: Ground
   - Pin 28: Capacitor for Video IF AGC
   - Pin 29: Supply voltage: +5V
   - Pin 30: Selector switch for Video IF input A or B
     Not used for
   - Pins 31/32: Sound IF differential input signal (QSS)

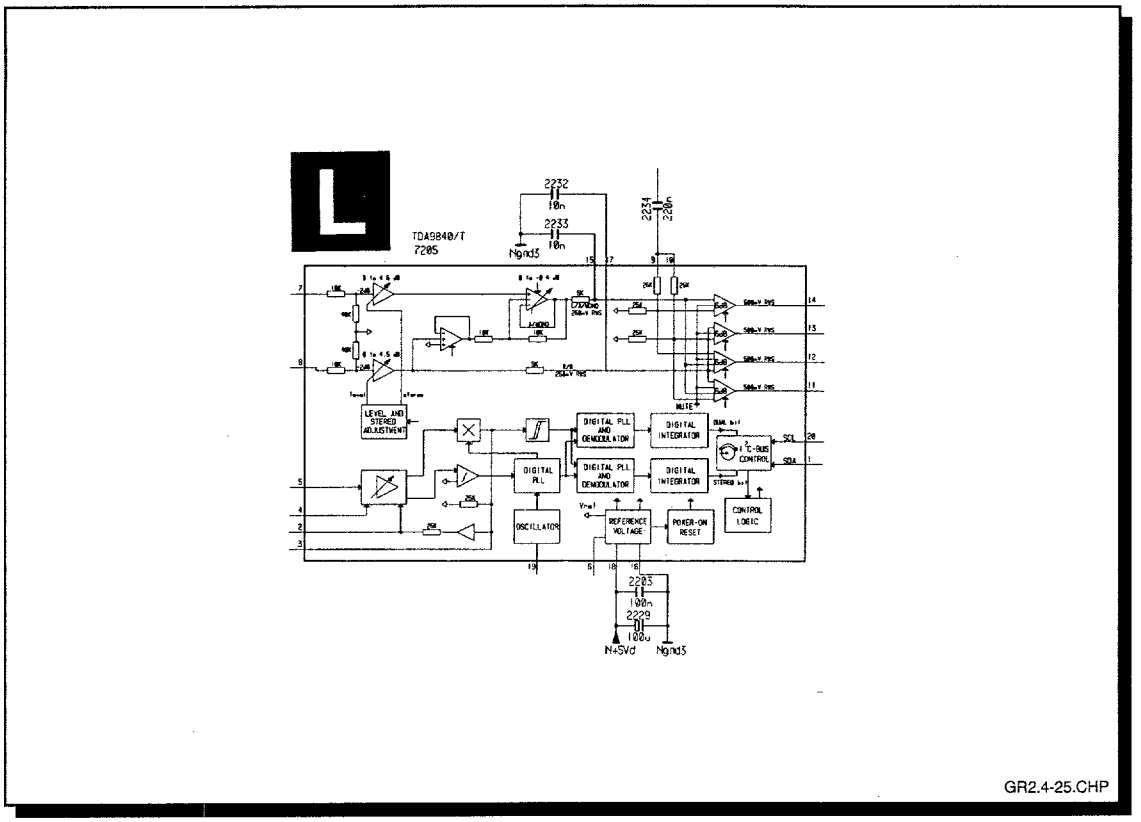
Sound source select



1. External sound can be selected from 4 different sources:
   - Via EXT-1 (L-EXT-1 and R-EXT-1) at chassis
   - Via EXT-2 (L-EXT-2 and R-EXT-2) at EUROTXT module
   - Via EXT-3 (L-EXT-3 and R-EXT-3) at EURO module
   - Via "front" sockets (L-FC and R-FC) EXT-4 at "front" connector panel
   - To "rear" socket EXT-2 (L-EXT-2 and R-EXT-2) at EURO module

2. Selection:
   - Via I^2C selection in matrix IC7820 (TEA6415B) between:
     * External sound of EXT-3 or internal sound (tuner)
     * External sound of EXT-1
   - Via switching signal "EXT 2" selection in IC7201 on Teletext module between:
     * Selected sound of IC7820 (EXT-1/EXT-3/IF)
     * External sound EXT-2 & "front" sockets (EXT-2 and "front" sockets are wired in parallel; no switching possibility)
   - Output signals at pin 17-14 from IC7820 (L-EXT2 and R-EXT2) is switchable with L-EXT-2 and R-EXT-2 or "front" socket EXT-4 (between EXT2 and EXT4 no switching is possible).
   - Each IF/sound-module can select again (via IC7201/ IC7950) between:
     * External sound of EURO module (EXT-1/EXT-2/ EXT-3/"front" sockets)
     * Internal sound of IF (tuner)

Personal notes

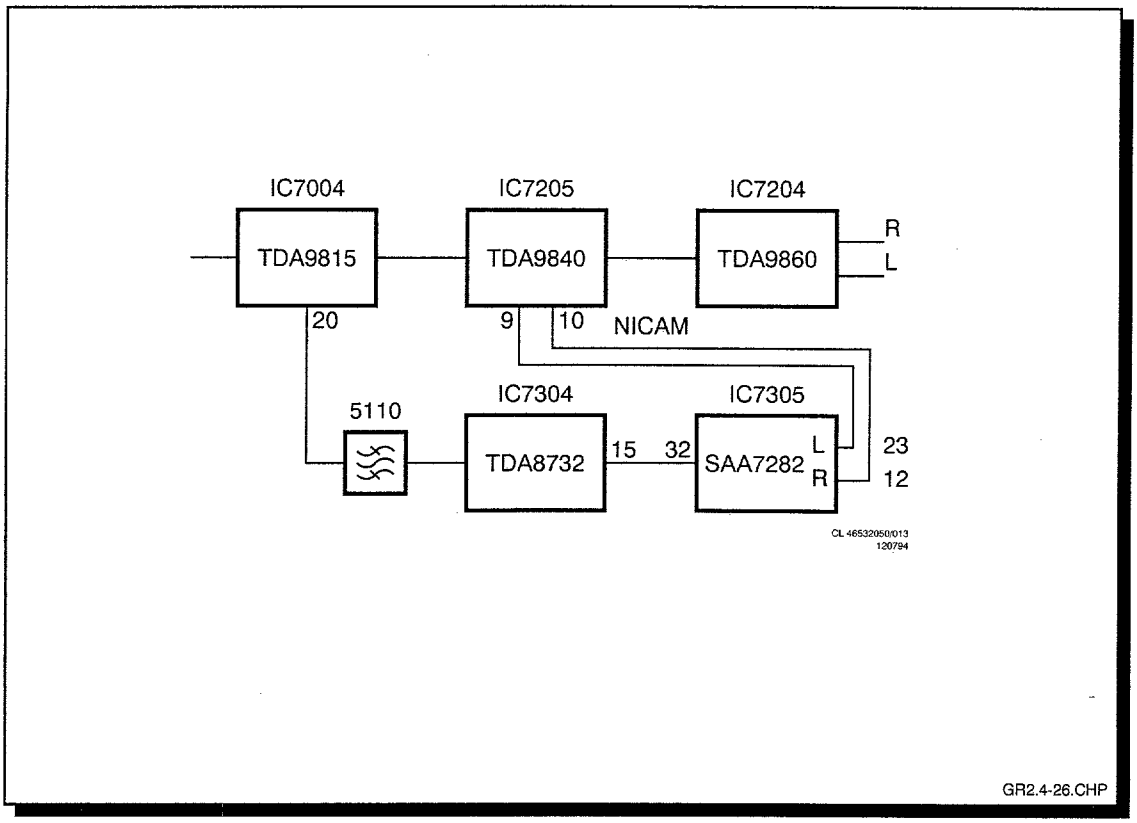


1. Stereo decoder IC7205 (TDA9840)

   - FM-demodulated 2R and L+R (AF1 and AF2) to pin 7-8 IC7205
   - AM-demodulated L+R via AF1 to pin 9/10 IC7205 (Multi-France only)
   - IC7205 gives status (MONO, DUAL LANGUAGE or STEREO). Depending on status, µC drives de-matrix-circuitry via I^2C
   - LF outputs R and L (pin 13-14 IC7205) to stereo-amplifier IC7204
   - LF outputs R IF and L IF of aerial-signal (pin 15-18 IC7204), to EXT-1 /EXT-2 and EXT-3, to outgoing "constant level" "rear" sockets
   - Outgoing mute, pin 31, gives "forced mute" in case the received signal becomes lower than a certain threshold:
     * Pin 19 = "high", then no forced mode
     * Pin 19 = "low", then forced mute

2. Stereo-amplifier IC7204 (TDA9860)

   - Via I^2C selection between L & R of stereo decoder and L & R EXT of EURO module
   - Via I^2C control and/or of "Bass, Treble, Volume, Balance, Spatial, Pseudo and Mono/Stereo"
   - Controlled sound-signals at pin 15-18 IC7204 to sound-output stage (at chassis IC7240). L signal 180$ shifted in phase via TS7201 to connect an eventual subwoofer up to ± 800Hz between L and R
   - Pin 13 and 20 are separate output for headphone amplifiers (R and L), the amplified signals are fed to the headphone connector in the front of the set.



1. On NICAM IF/sound-module, 2 paths are possible:

   - FM path for analog sound
   - NICAM path for digital sound

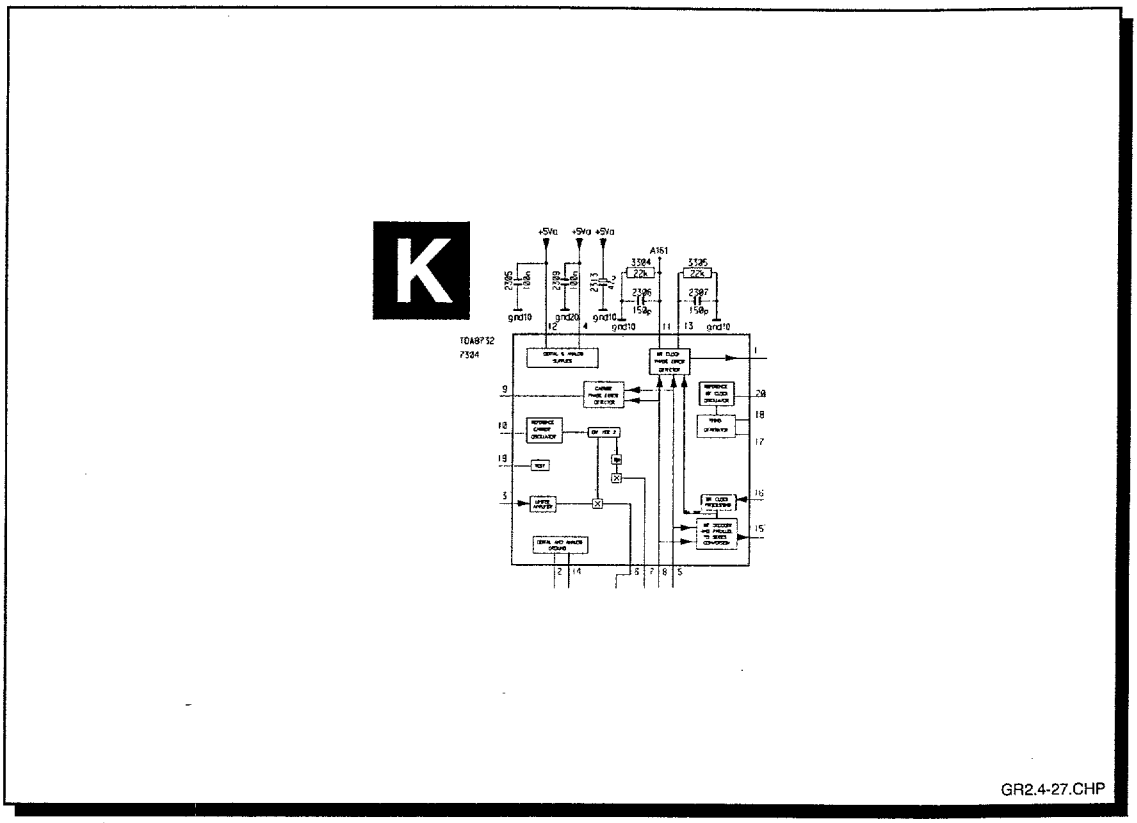
2. FM sound path

   - FM path at NICAM module is the same as stereo module (see 4.2).
     * TDA9815 selects FM or NICAM sound
     * TDA9840 stereo decoder receives FM or NICAM sound signals

3. NICAM sound path

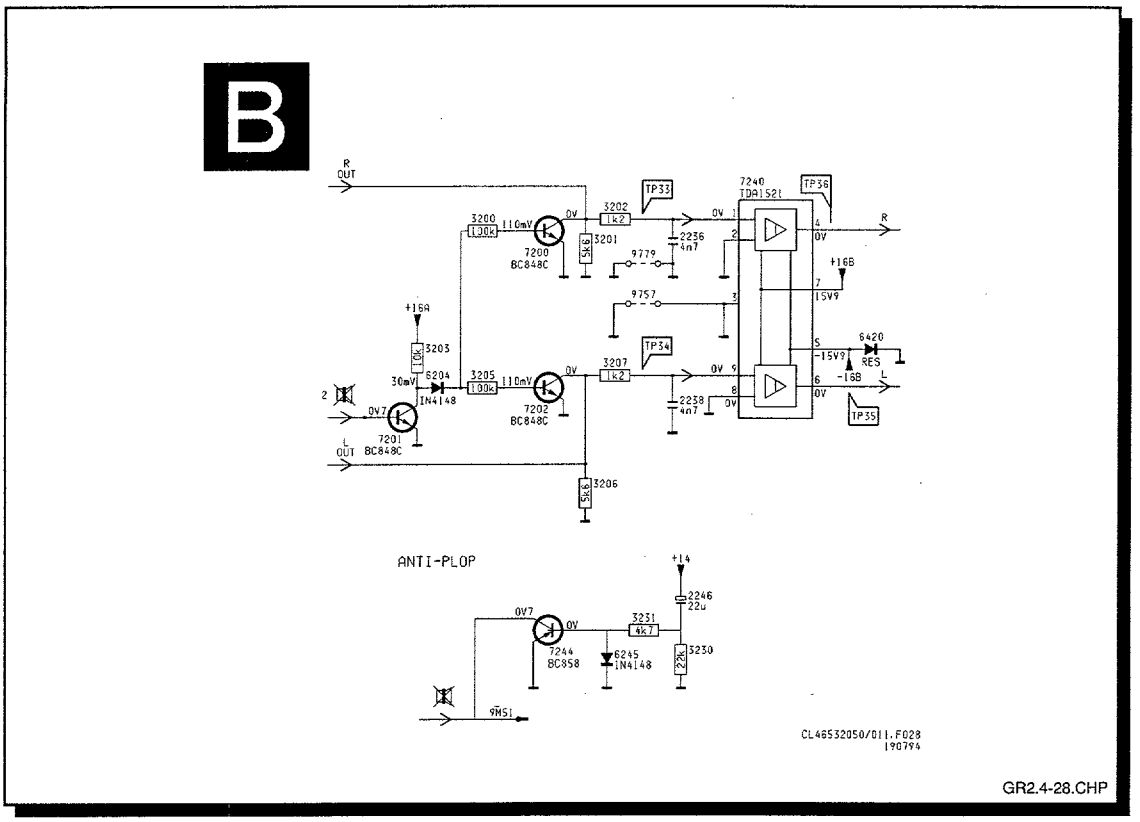
   - NICAM mid-frequency from pin 20 IC7004 (TDA9815), is fed to bandpass-filter (2110) with bandpass-frequency:
     * 5,85 MHz for PAL/NICAM BG
     * 6,552 MHz for PAL/NICAM I
   - NICAM demodulator IC7304 (TDA8732) for phase demodulation
     * 1 bit digital info at pin 3 in
     * Clock info at output pin 1
     * Digital coded info at pin 15
   - QPSK data to NICAM decoder IC7305 (SAA7282)
     * Data in via input pin 32
     * Received NICAM signal translates into LF L & R signal. These signals are inputs for pin 9 and 10 of IC7205(TDA9840)

Personal notes



Pin description IC7120 (TDA8732) QPSK demodulator

1.	CLKLPF	Output for bit-rate lowpass-filter
2.	V_{EEA}	Earth for analog circuitries
3.	QPSK	Input for the QPSK modulated signal
4.	V_{CCA}	Supply voltage for analog circuitries
5.	CFI	Baseband input after filtering (cosine)
6.	CFO	Demodulated output to lowpass-filter (cosine)
7.	SFO	Demodulated output to lowpass-filter (sine)
8.	SFI	Baseband input after filtering (sine)
9.	CARLPF	Output for carrier feedback lowpass-filter
10.	CAROSC	Crystal input for carrier oscillator
11.	QMC	Monostable connection for quadrature data detection
12.	V_{CCD}	Supply for digital circuitries
13.	IMC	Monostable connection for in-phase data detection
14.	V_{EED}	Earth for digital circuitries
15.	DATA	728 kbit/s demodulated and differential decoded serial data output
16.	PCLK	Bit-rate clock input at 728 kHz phase-locked at DATA
17.	CLK	Outgoing clock frequency at 728 kHz
18.	C5M	Reference frequency at 5.824 MHz (5xCLK)
19.	TEST	For digital test-applications
20.	CLKOS	Crystal input for clock oscillator (= 11.648 MHz)



1. "Forced mute"

   "Forced mute" of the stereo decoder is "low" if poor signal or by switching on the set, or changing program therefore OUTPUT R and OUTPUT L will be shorted via TS7202 and TS7200

2. Anti-plop

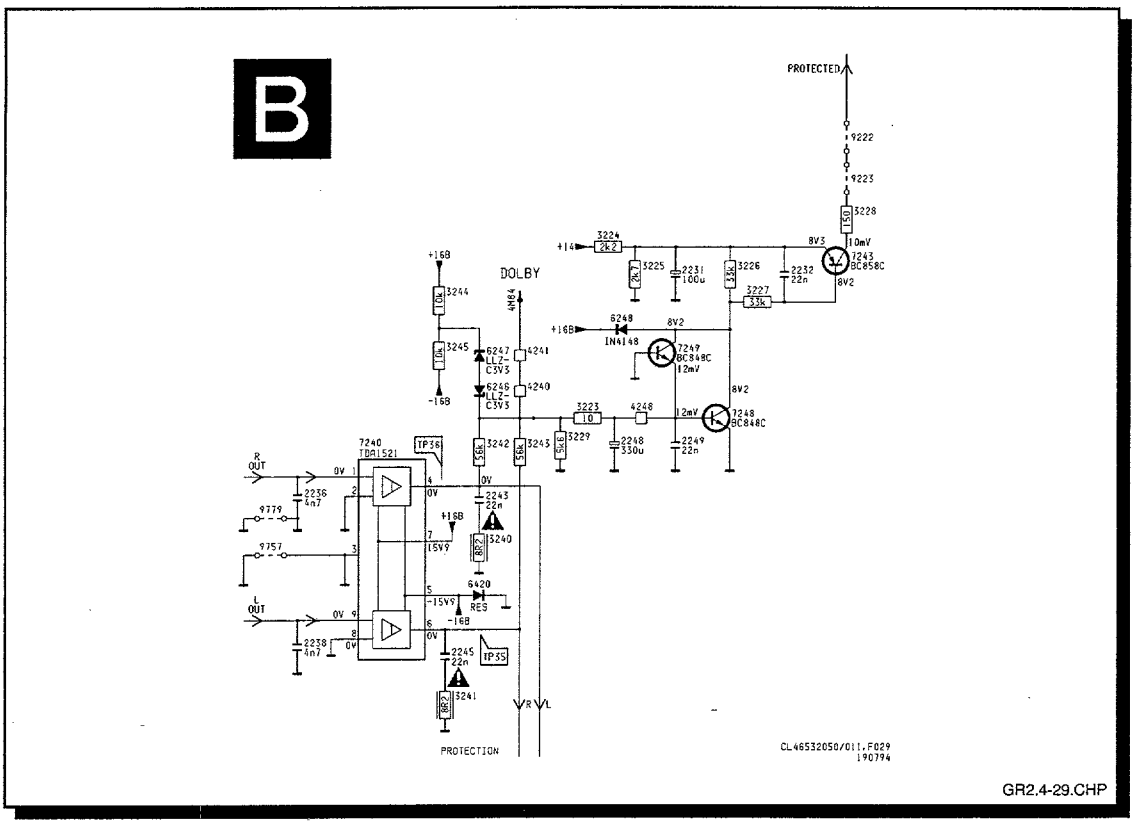
   - Function:

     Prevent disturbing plops at switching "off" the set:

   - Operation:

     At "switch-off" the +14 drops very fast while C2246 is still charged
     → Negative voltage at base TS7244
     → TS7244 conducts
     → Forced mute pin 9M51 is "low"(TS7207 does not conduct)
     → TS7200 and TS7202 conduct
     → Forced mute

Personal notes



3. Output stage

- OUTPUT L and OUTPUT R of AUDIO module, is fed to output stage IC7240 (TDA1521) on the chassis
- Symmetrical supply voltage of +16V and -16V
- Amplified output signal:
  * or direct to loudspeakers
  * or to loudspeakers via EXT-LS module

4. Protection

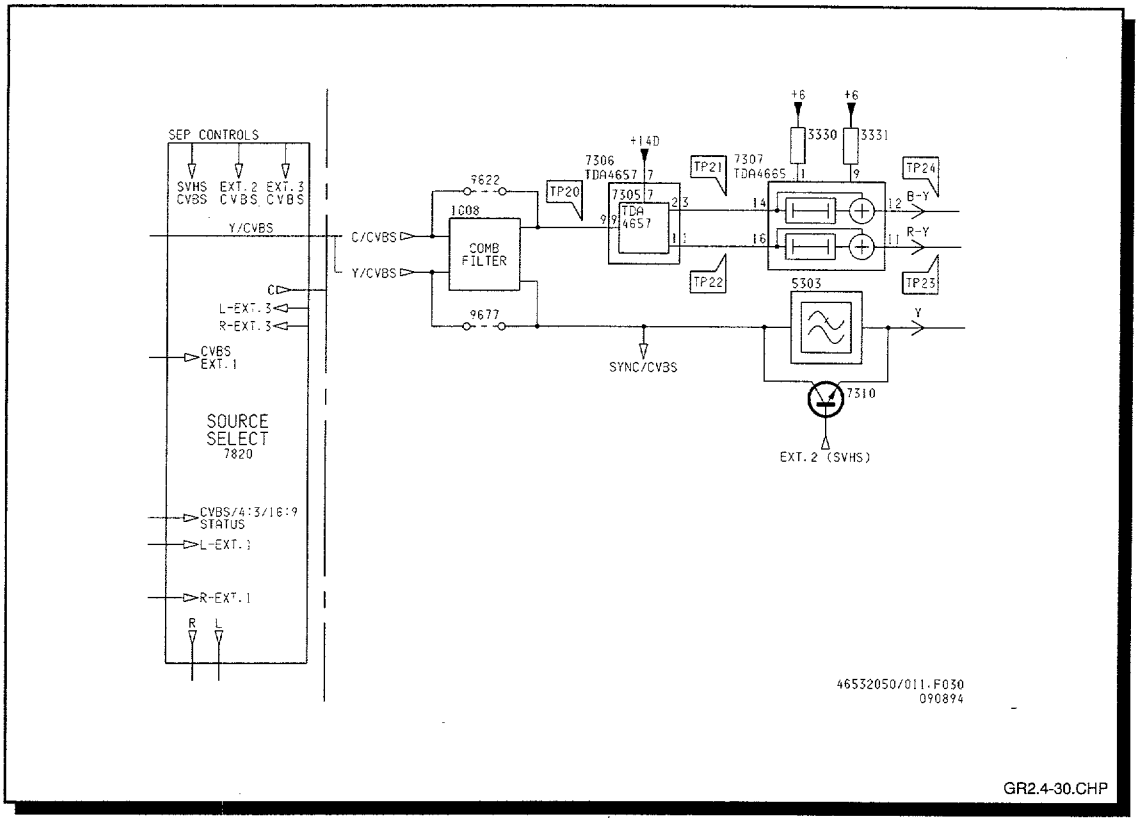
- Function:

  To switch off the power supply at certain error conditions of the sound system

- Operation:

  Switching signal PROTECTED becomes "high" in the event of:
  - Sum of outputs pin 4-6 of IC7240 is not 0V (L and R are 180 degrees in phase):
    → TS7248 or TS7249 conducts
    → TS7243 conducts
  - Supply +16A or -16A is not correct, one of the zeners D6247 or D6246 will conduct:
    → TS7248 or TS7249 conducts
    → TS7243 conducts
  - Supply +16A and -16A both fail D6248 conducts and so TS7243 conducts

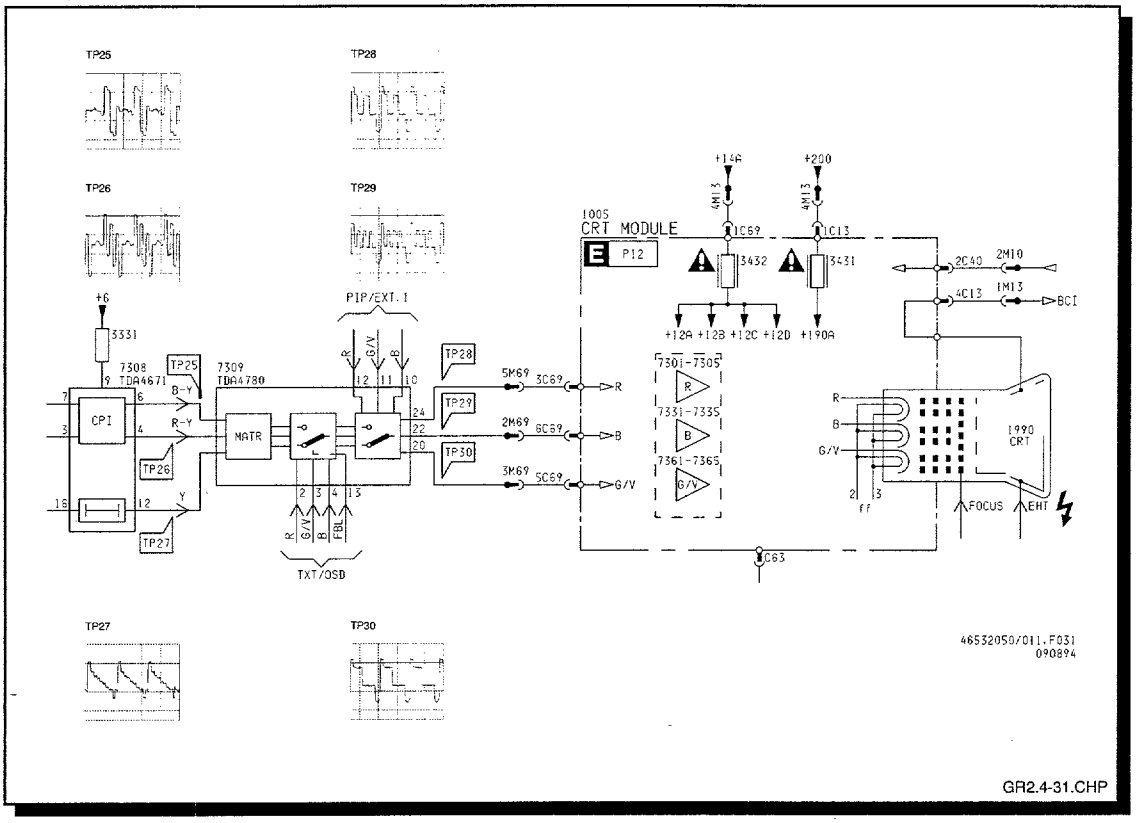
Personal notes



1. Versions

   - PAL only
   - PAL and SECAM

Personal notes



2. The video path

- Source selection
- The CVBS signal via COMB-filter, module 1008
- Chroma-bandpass-filter L5303
- PAL decoding IC7305;
  PAL/SECAM decoding IC7306
- Baseband delay-line IC7307
- Chroma-filter in the luminance path L5303
- Picture Signal Improvement IC7308
- Videocontroler and RGB source selection switches
  IC7309
- RGB amplifiers and peak white limiting

Personal notes

Video, RGB, Y, C, in/output sources:

* **3 Euroconnectors**

- **Euro 1 : RGB in**
  : CVBS in out

- **Euro 2 : RGB in**
  : CVBS in out
  : Y/C in

- **Euro 3 : CVBS in out**
  : TV Front end out

* **1 Cinch CVBS front input**

* **Y/C hosiden input (SVHS input)**

* **Internal CVBS from the tuner**

GR2.4-32.CHP

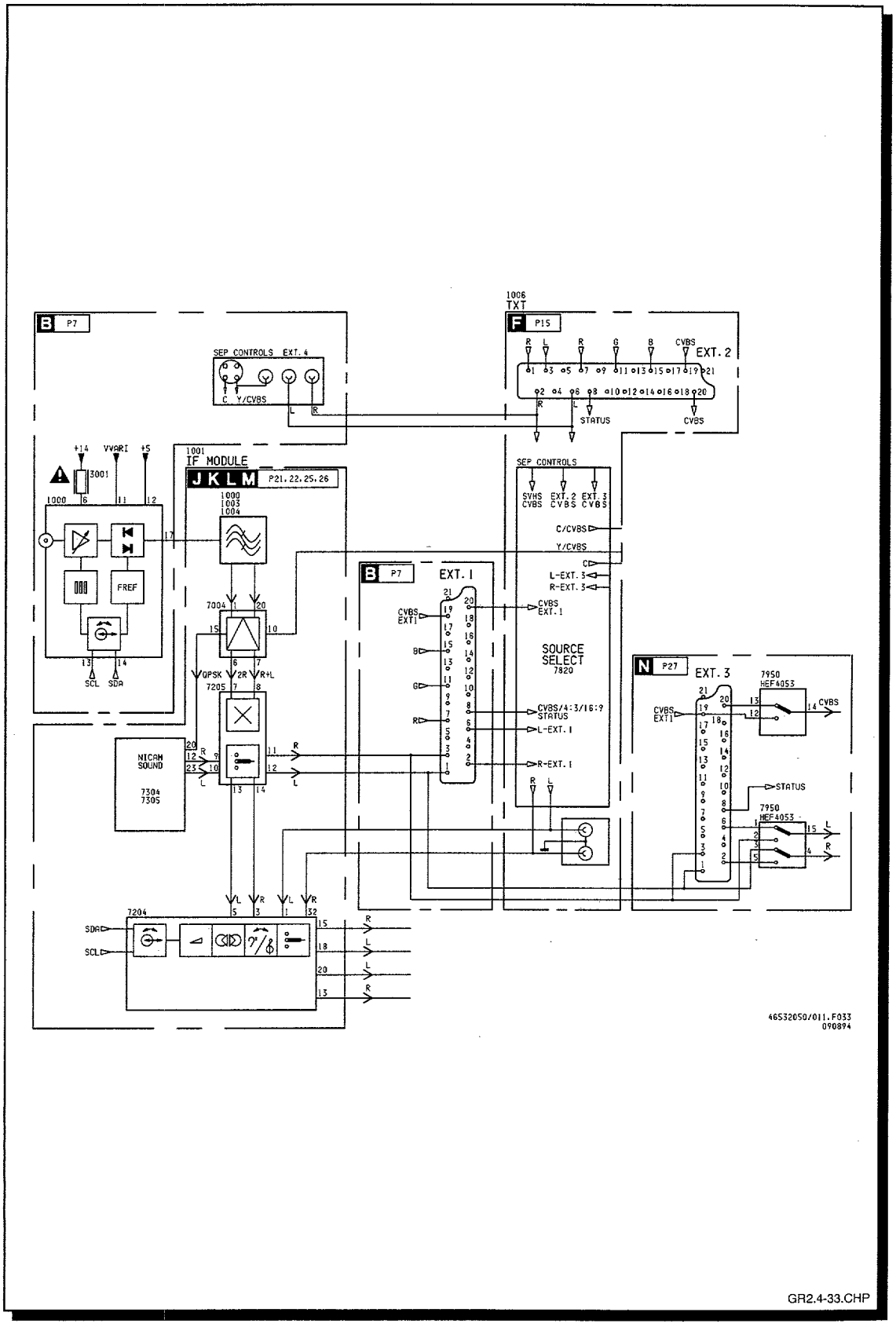
Source/destination selection

- Source selection between:

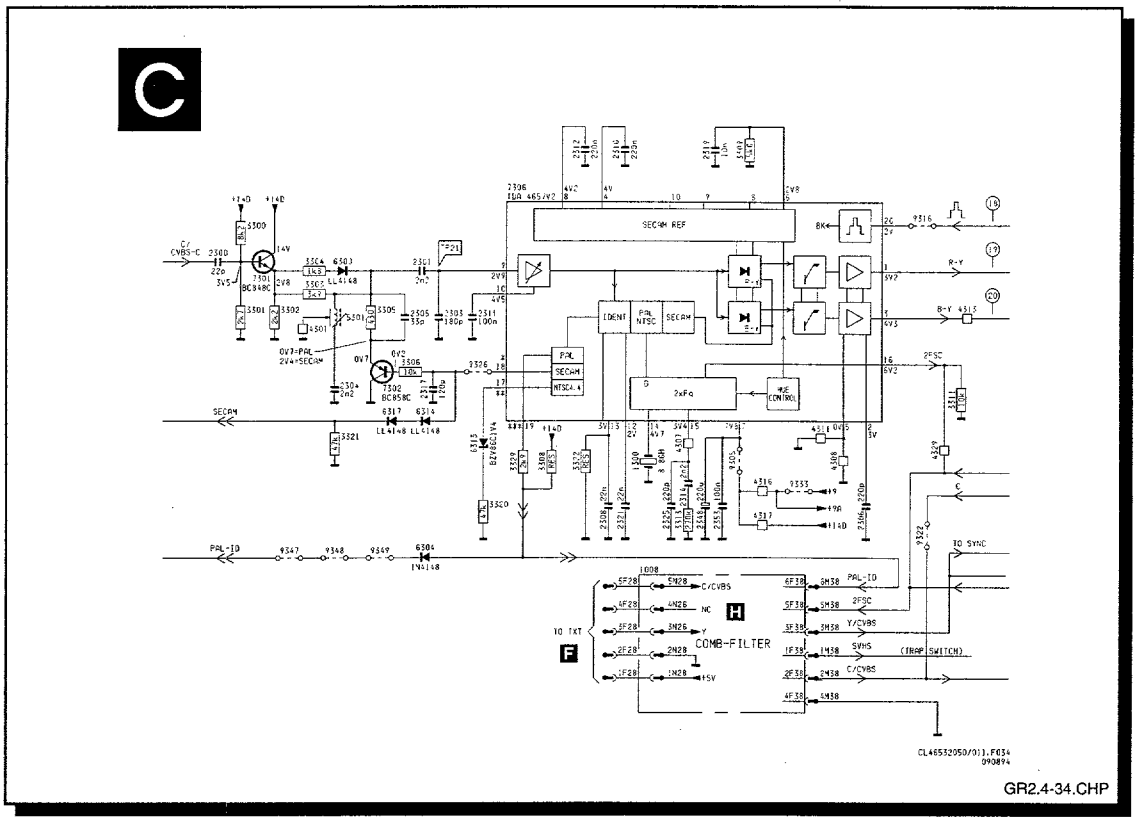
  * Internal CVBS from the tuner
  * EXT. 1: CVBS or RGB via euroconnector 1
  * EXT. 2:
    - RGB/ CVBS via euroconnector 2 on chassis
    - SVHS signal via euroconnector 2
  * EXT. 3: CVBS via euroconnector 3 on Euromodule
  * EXT.4 :CVBS/SVHS via sockets at the front side (seperate controls)

- Selection of the CVBS, RGB and SVHS signals is done in the electronic switches IC7890 on the TXT module, IC 7950 on the 3 SCART Panel and the main switching element the matrix switch IC 7820 on the TXT module. This IC is directly controlled by the μP IC7708 via the I^2C bus.

Personal notes


B P7
SEP CONTROLS EXT. 4
C Y/CVBS
1006
TXT
F P15
R L R G B CVBS EXT. 2
STATUS
CVBS
SEP CONTROLS
SVHS CVBS
EXT. 2 CVBS
EXT. 3 CVBS
C/CVBS
Y/CVBS
C
L-EXT. 3
R-EXT. 3
1001
IF MODULE
J K L M P21, 22, 25, 26
3001
+14
VVARI
+5
FREF
SCL
SDA
QPSK
2R
R+L
7205
7004
B P7 EXT. 1
CVBS EXT1
B
G
R
CVBS EXT. 1
SOURCE SELECT
7820
CVBS/4:3/16:9 STATUS
L-EXT. 1
R-EXT. 1
N P27 EXT. 3
7950 HEF4053
CVBS
STATUS
NICAM SOUND
7304
7305
7204
SDA
SCL
46532050/011.F033
090894
GR2.4-33.CHP

COMB-filter



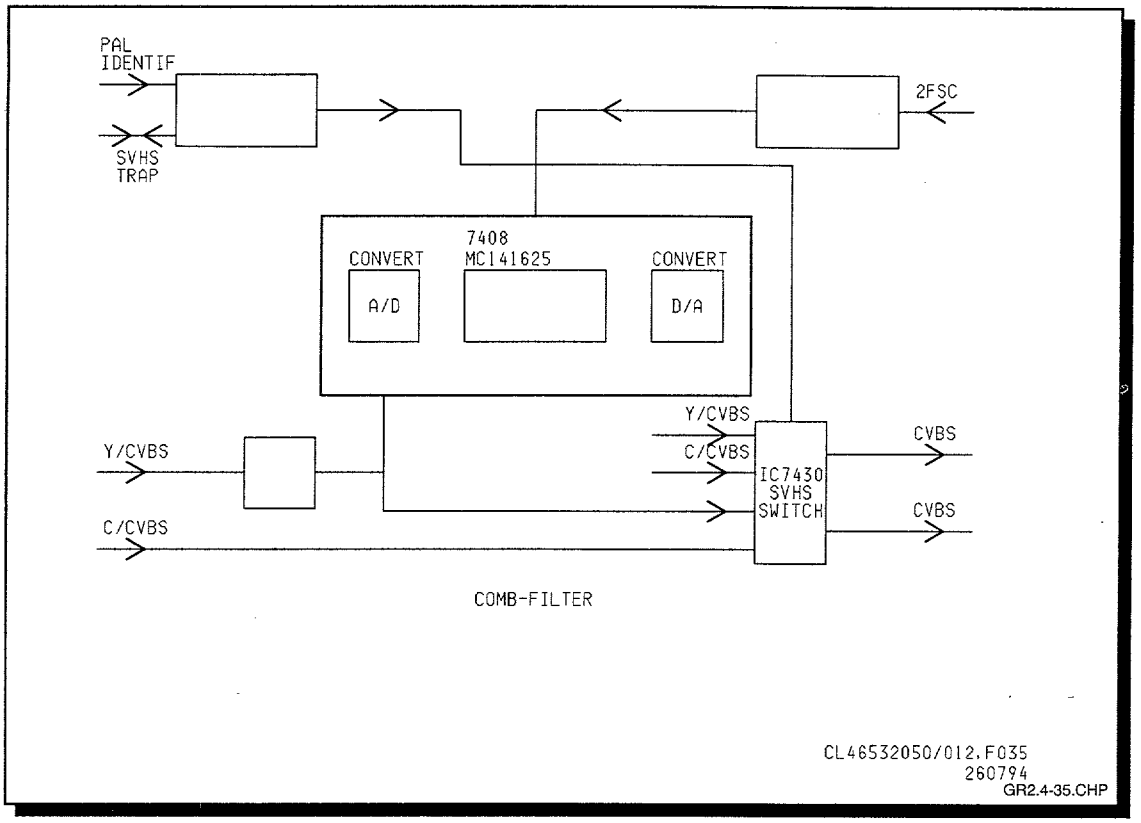
- Function:

  Better separation of the PAL chroma and luminance signals from the CVBS signal

- Operation:

  - The COMB filter operates only for PAL signals
  - The CVBS/SVHS chroma signal enters at pin 5 of plug F28 on the COMB-filter module 1008
  - The CVBS/SVHS luma signal enters at pin 3F28
  - The double chroma-frequency 2FSC, at pin 5F38, is for internal use to split CVBS signal in Y and chroma
  - By the digital process of the COMB-filter, the chroma and luminance components are separated from each other (as filtered through a comb)
  - The filtered chroma-signal at pin 2F38, is connected to the PAL or PAL/SECAM decoding circuit
  - The filtered luminance signal is available at pin 3F38
  - The COMB-filter will be switched off if the PAL identification signal at pin 6F38 is low

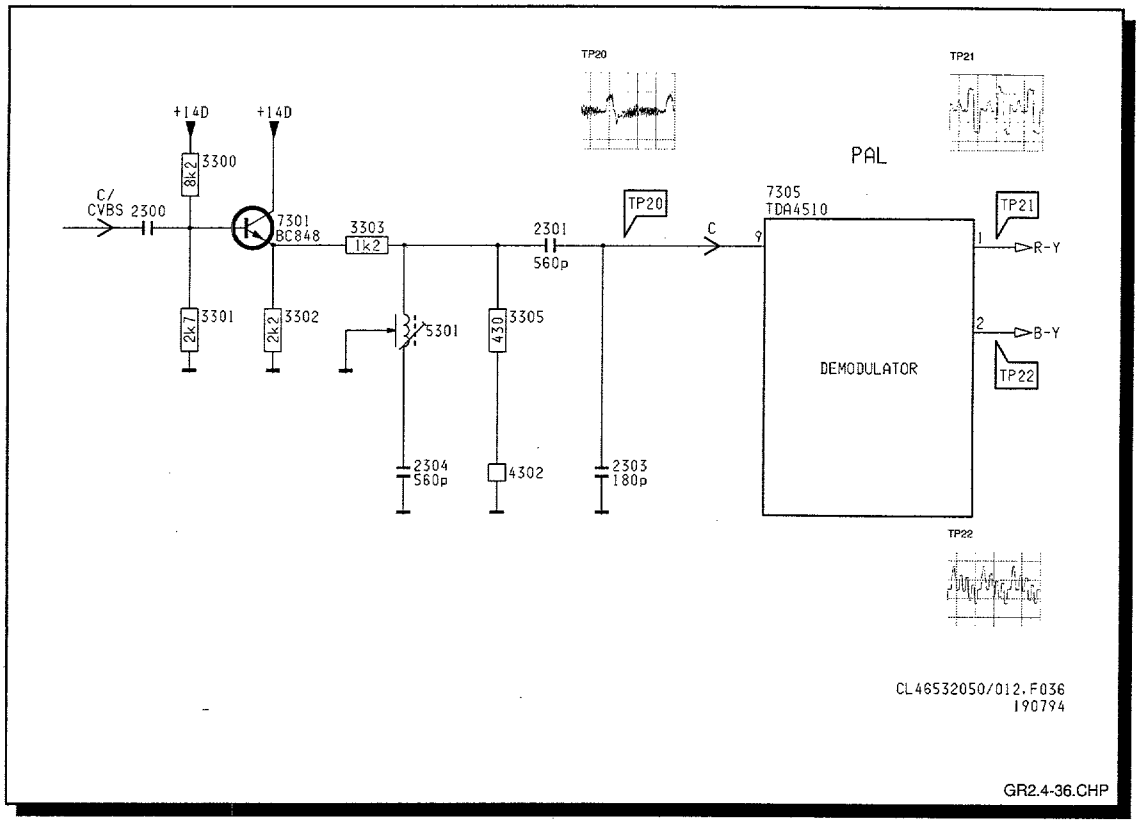
Personal notes



Above the principle block diagram of the COMB-filter is shown.

Personal notes

Chroma-bandpass-filter



- Function:

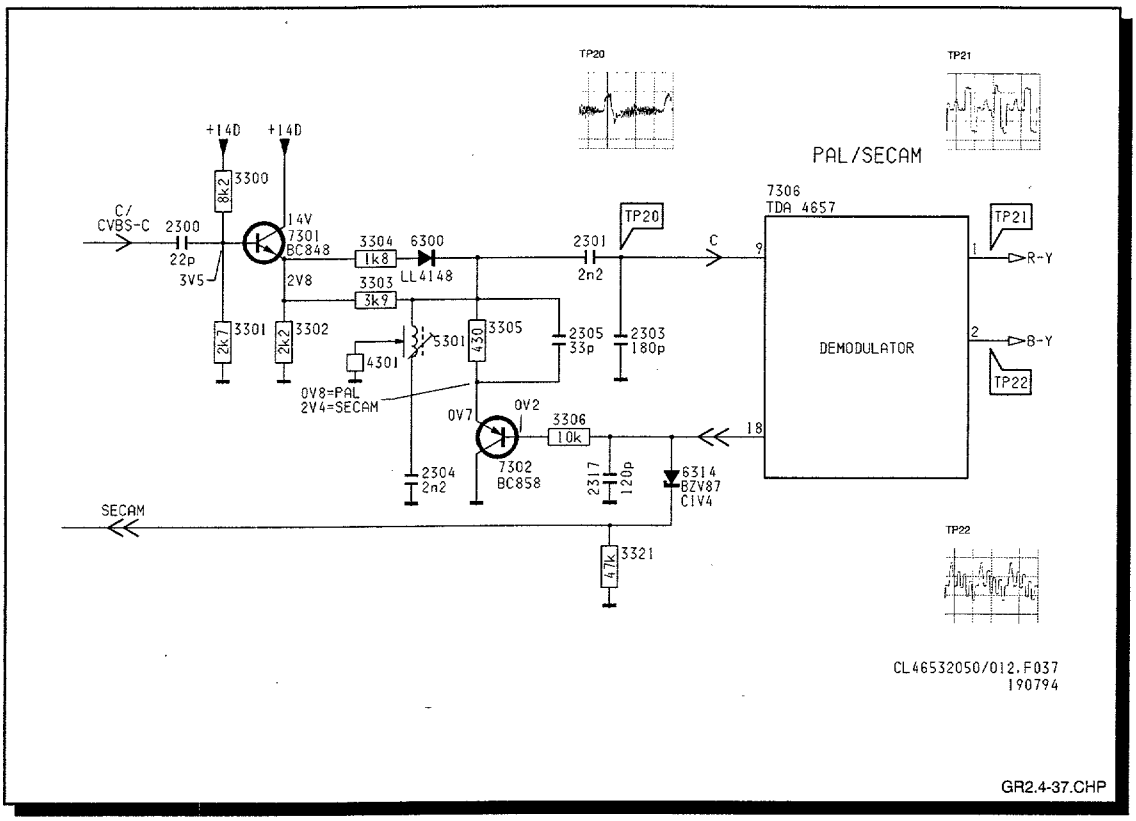
  Separation of the chroma-signal from the CVBS signal

- Operation: for PAL sets:

  - Highpass filter C2300 and R3301
  - Almost flat characteristic for high frequencies : i.e. more than 3 MHz
    * L5301 and C2304 in parallel with C2301, C2303 forms a bandpass-filter at 4,3 MHz
    * R3305 causes a strong damping effect ;
      → This gives a flat characteristic

Personal notes

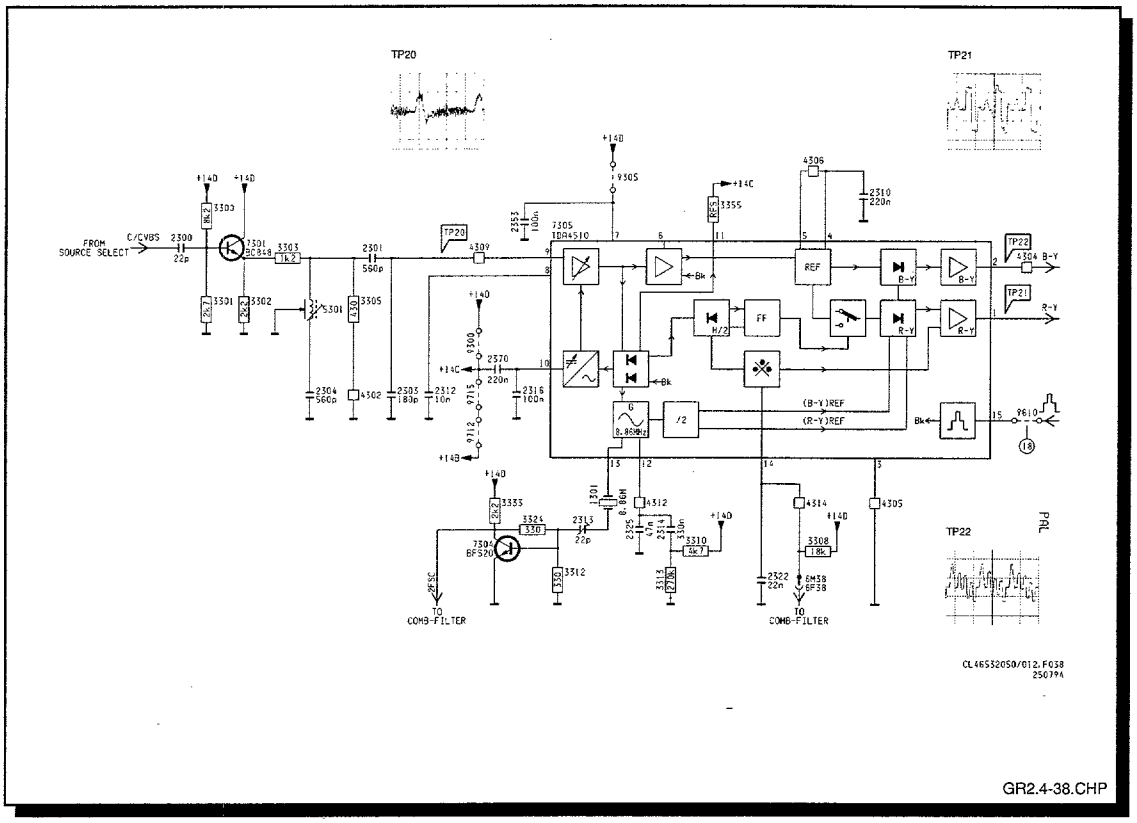
Chroma-bandpass-filter



- Operation: for PAL/SECAM sets:

  - Highpass-filter C2300 and R3301
  - For SECAM; TS7302 is non-conducting
    * L5301 and C2304 in parallel with C2301, C2303 forms a bandpass-filter at 4,3 MHz
  - For PAL; TS7302 is conducting
    * L5301, C2304 in parallel with C2301, C2303 form a bandpass-filter at 4,3 MHz
    * R3305 causes a strong damping and C2305 causes an additional damping for high frequencies;
      → This gives a flat characteristic between 3 MHz and 5 MHz

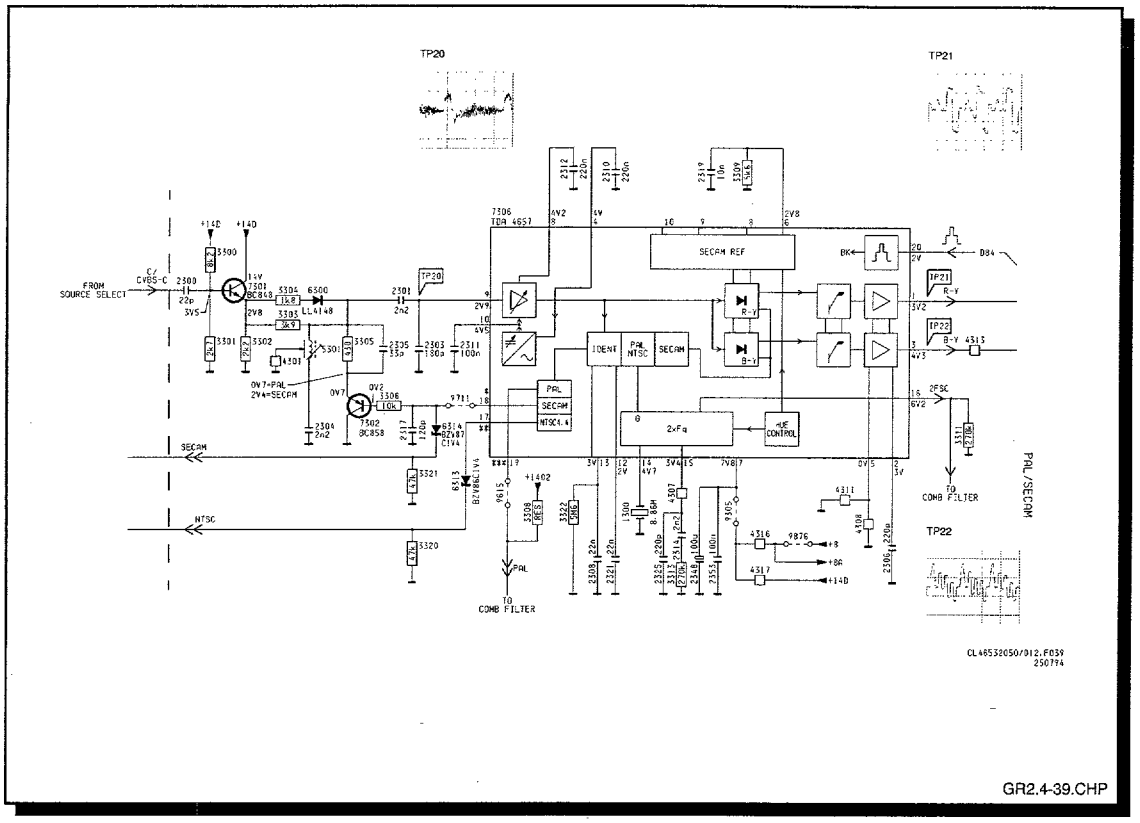
Personal notes



- Function:
  Decoding of chroma in R-Y and B-Y signals

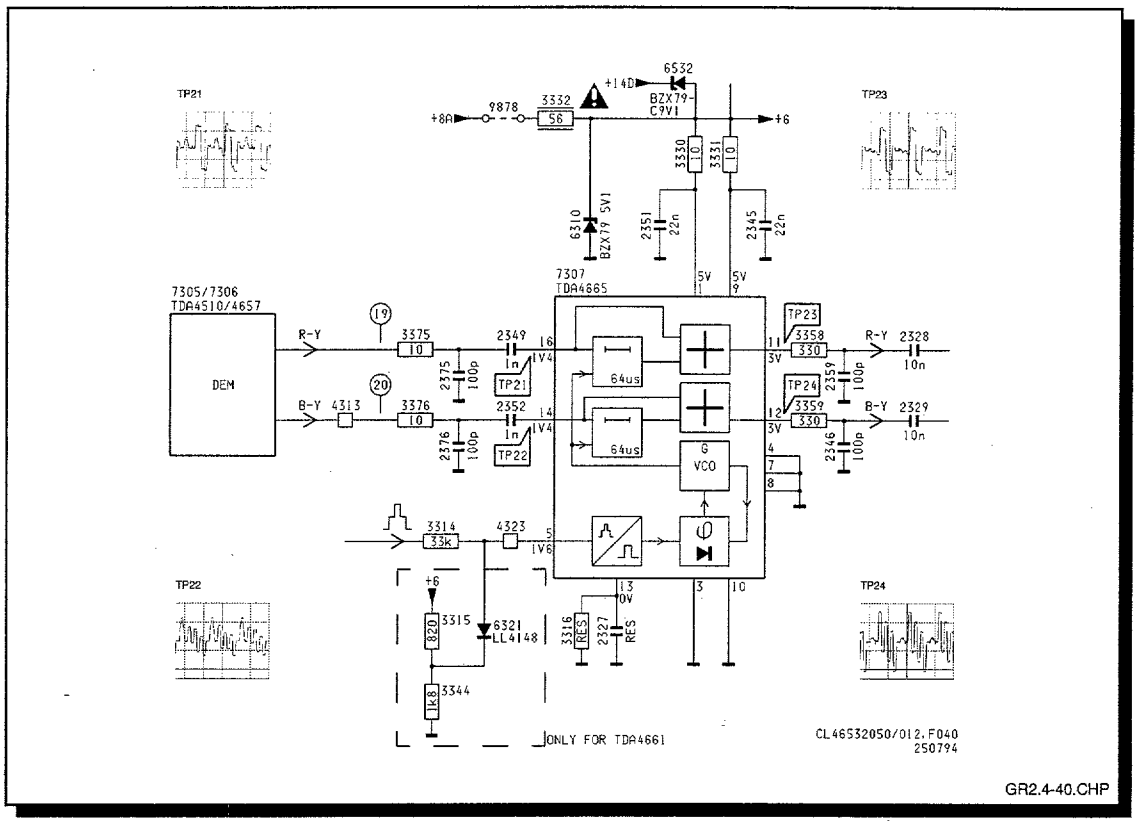
- Operation: for PAL sets
  - The chroma-signal is connected via pin 9 IC7305 (TDA4510) to the Automatic Gain Control (AGC)
  - Next, the signal is split into a chroma-signal and a burst-signal
  - The burst separation is done with the aid of the sandcastle-pulse at pin 15
  - The demodulated burst-signal controls the AGC controlled amplifier, the colour-killer and sets, with the aid of the PAL Flip Flop, the correct PAL phase
  - The reference oscillator, with crystal 1301 at pin 13 -IC7305, operates at 8,86 MHz, double the chroma-subcarrier-frequency
  - C2325, C2314 and R3313 are used as the flywheel-function of this reference oscillator
  - Alignment of the reference oscillator frequency is achieved by temporarily connecting pin 11 of IC7305 to ground and adjusting C2313
  - The oscillator directly controls the B-Y demodulator
  - The R-Y demodulator is controlled via the PAL switch
    * For +(R-Y) the reference signal is not shifted in phase
    * For -(R-Y) the reference signal is phase shifted by 180°
  - The demodulators give a low frequency R-Y signal to pin 1 and B-Y signal to pin 2

Personal notes



- Operation: for PAL/SECAM sets
  - The chroma-signal is connected via pin 9 IC7306 (TDA4657) to the Automatic Gain Control (AGC)
  - The IC switches automatically to PAL or SECAM
    * PAL: the burst-signal always has a frequency of 4,43 MHz
    * SECAM: the burst-signal is 4,406 MHz during R-Y and is 4,25 MHz during B-Y
  - For PAL, pin 19 is high; for SECAM, pin 18 is high
  - The input-signal at pin 9 is split into a chroma-signal and a burst-signal
  - The selection is done with the aid of the sandcastle-pulse at pin 20
  - The demodulated burst-signal, controls the AGC amplifier, the colour-killer and sets, with aid of the PAL Flip Flop, the correct PAL phase
  - The reference oscillator, with crystal 1300 at pin 14 IC7306, operates at 8,86 MHz, double the chroma-subcarrier frequency
  - C2325, C2314 and R3313 are used as the flywheel function of this reference oscillator
  - Alignment of the nominal frequency is not necessary
  - The oscillator directly controls the B-Y demod.
  - For PAL, the R-Y signal is phase shifted by 180° on every other line.
  - For SECAM, every other line the output-signal is the R-Y signal, and the next line the output signal is the B-Y signal
  - The demodulators give a low frequency R-Y signal at pin 1 and B-Y at pin 3

Personal notes



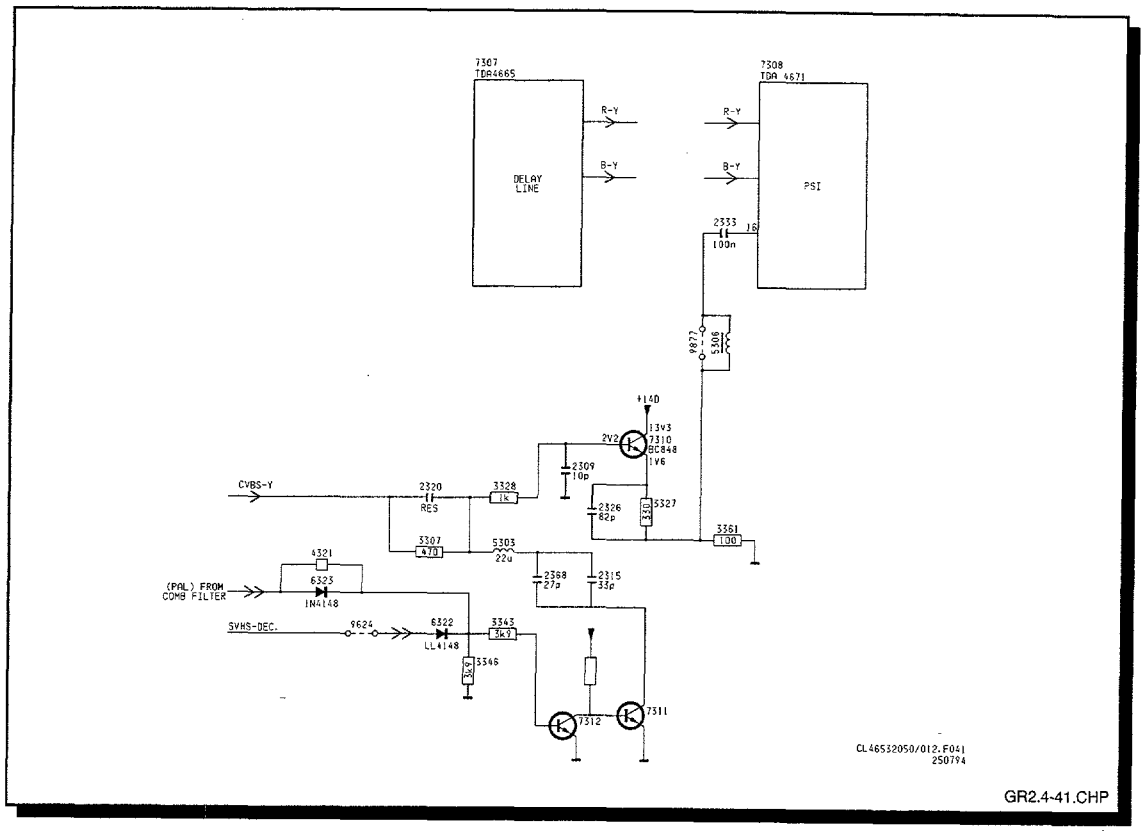
- Functions:

  - Elimination of crosstalk and phase errors of R-Y and B-Y for PAL
  - To fill the missing colour information at every other line for SECAM

- Operation:

  The delayline IC7307 (TDA4665):
  - Internal oscillator of 3 MHz, synchronised by the sandcastle-pulse at pin 5
  - The circuit takes 192 samples, each 0,333 µS, of the input-signals
  - Result: delay lines of (192x0,333)=64 µs
  - A delayed and an un-delayed signal are added
    * PAL:
      - The result is an average of the present line and the previous line
      - This will reduce phase
    * SECAM:
      - R-Y and B-Y signals are available on every alternate line
      - The lines where R-Y signal is blanked, the previous R-Y signal will be added by the delayline; by this method, there will always be an R-Y signal available at pin 11
      - The same principle also applies to the B-Y signal

  Remark: In for the baseband delay line IC7307 type TDA4661 (used in GR2.3) is changed in type TDA4665. The main difference between these types is that the time shift (3 µs), delivered by diode 6321 connected to pin 5 of TDA4661, in TDA4665 is internally performed.



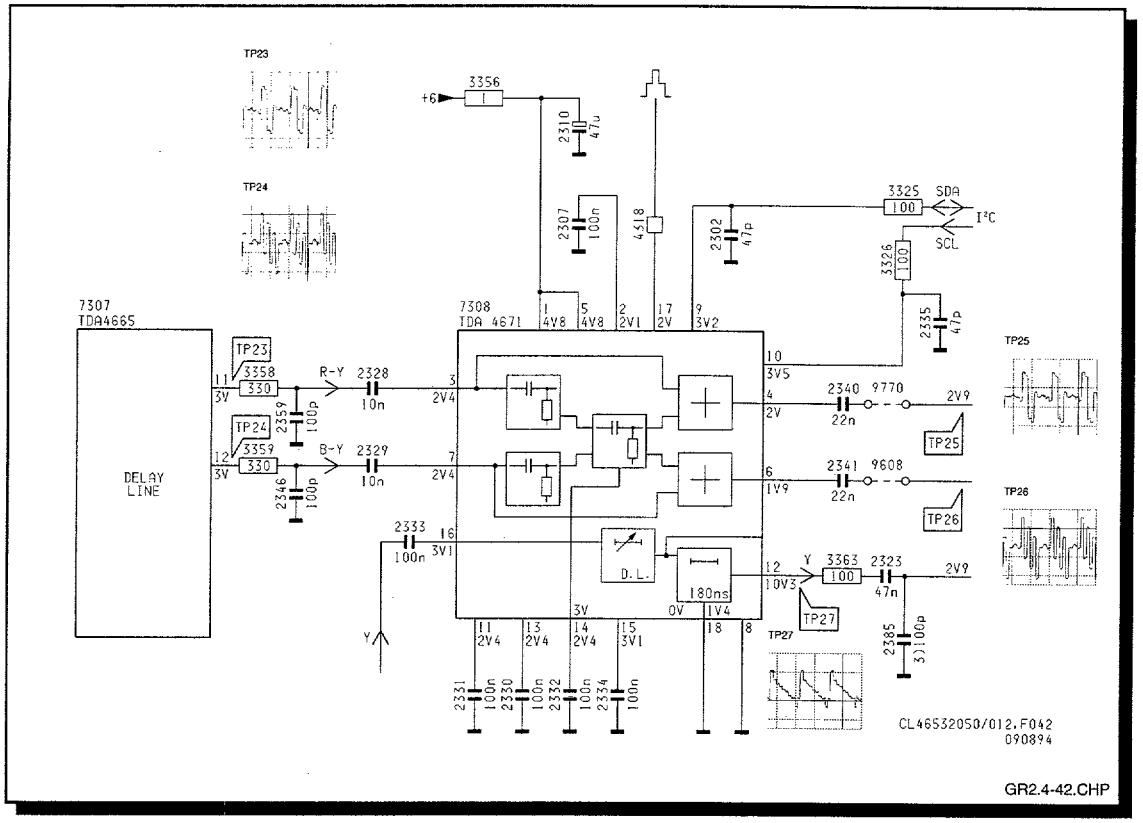
- Function:

  Suppressing the chroma subcarrier in the luminance signal

- Operation:

  - The CVBS signal is fed via R3307 to the chroma filter circuit
  - This circuit, L5303 in series with C2368 and C2315, acts as a notch filter and creates a low impedance for the 4,43 MHz signal
  - The ground connection of this circuit is comprised of transistor 7311, which is normally conducting.
  - The circuit at the emitter of the emitter-follower TS7310 is needed for a the frequency characteristic
  - The Y signal is fed to IC7308
  - In case of SVHS signal, the Y signal will be on the CVBS line
  - The positive level of the SVHS indication is applied, via D6322, to base of transistor 7312. Transistor 7312 is now conducting and 7311 is cut off. The 4,43 MHz trap is inoperative now.

Personal notes

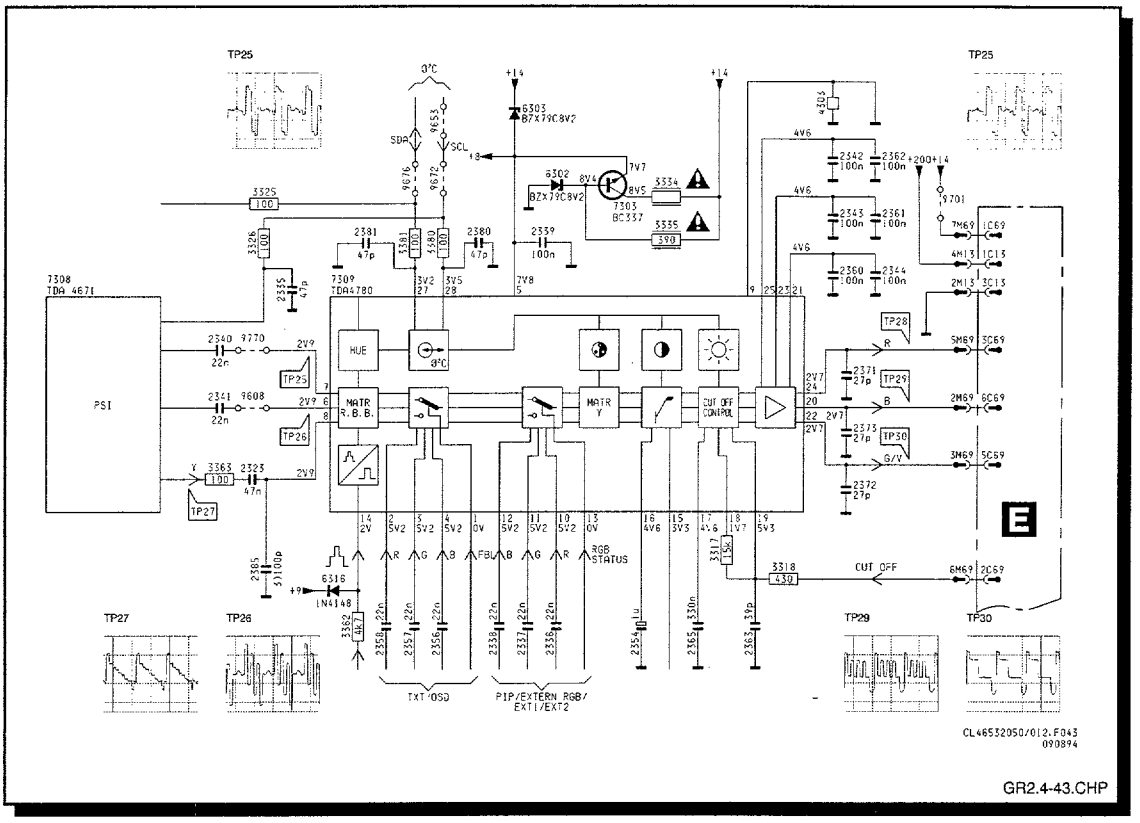


-Picture signal improvent

- Function:
  - Colour Transient Improvement (CTI)
  - Noise-reduction
  - Picture-sharpness control
- Operation:
  - Input-signals to the PSI IC7308 (TDA4671)
    * R-Y and B-Y signals from baseband delay line IC7307, are connected to Pins 3 and 7 IC7308
    * The Y signal from the chroma filter is connected to Pin 16
  - The I^2C control-signals are available at Pins 9 (SDA) and 10 (SCL)
  - Adaptation of the chroma signals
    * Colour transient Improvement (CTI)
      - the colour transients in R-Y and B-Y are adapted by internal filters
  - Adaptation of the Y signal
    * Noise-reduction
    * Picture-sharpness control
    * Delay of the Y signal
      - for timing correction with the adapted chroma signals, R-Y and B-Y
      - a part of the delay is switchable (via I^2C). This is needed for filtering and adaptation of the chroma signals

Personal notes

Video controller and RGB source selection switches



- Function:

  - Conversion of R-Y, B-Y and Y into R,G and B signals
  - RGB source selection, TXT/OSD and PIP(optional)/external RGB
  - Controlling of the picture-settings

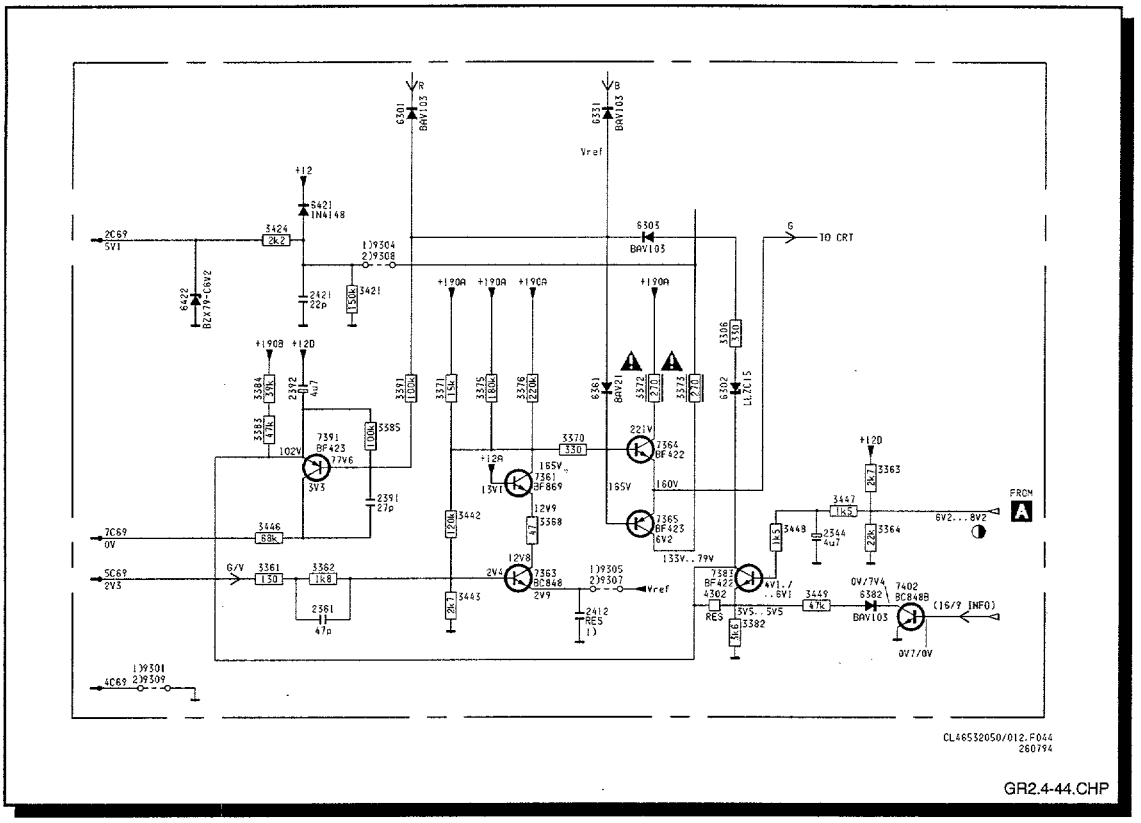
- Operation:

  - The R-Y, B-Y and Y signals enter at pins 7, 6 and 8 of IC7309 (TDA4780)
  - The I^2C control signals are available at pins 27 and 28
  - Conversion of R-Y, B-Y and Y into R,G,B signals :
    * R-Y, B-Y and Y signals determine the G-Y signal
    * Next, the Y signal is added to each of the signals R-Y, G-Y and B-Y: result R, G and B signals
  - RGB source selections :
    * The combined TXT/OSD RGB signals enter at pins 2, 3 and 4 of IC7309
    * The TXT and OSD signals (for the menu) cannot be displayed at the same time
    * The combined picture in picture (PIP,optional)/external RGB signals enter at pins 10, 11 and 12 of IC7309
    * The PIP signal has, via the EURO TXT module, priority on the external RGB signal
  - Controlling the picture-settings :
    * Via the I^2C bus, the colour-saturation, contrast and brightness are controlled, and combined with adjustments for the picturetube
    * The Cut-Off voltage at pin 19 controls, via the brightness-control, the black level for the set
    * The beam-current information controls, via TS7370 to pin 15 of IC7309, the peak white limiting

Remark: In GR2.4 the RGB-video processor TDA4780(IC 7309) is used. The main additional features in respect to the TDA4680 are: gamma adjustment, blue stretch, black stretch (see training manual FL2)

Blue stretch: the blue stretch channel gets additional amplification if the blue signal is greater than 80% of the nominal signal amplitude. So this means the colour temperature(white point) is shifted. White parts of the picture seem to be brighter.

RGB amplifiers and peak white limiting (at the CRT panel)

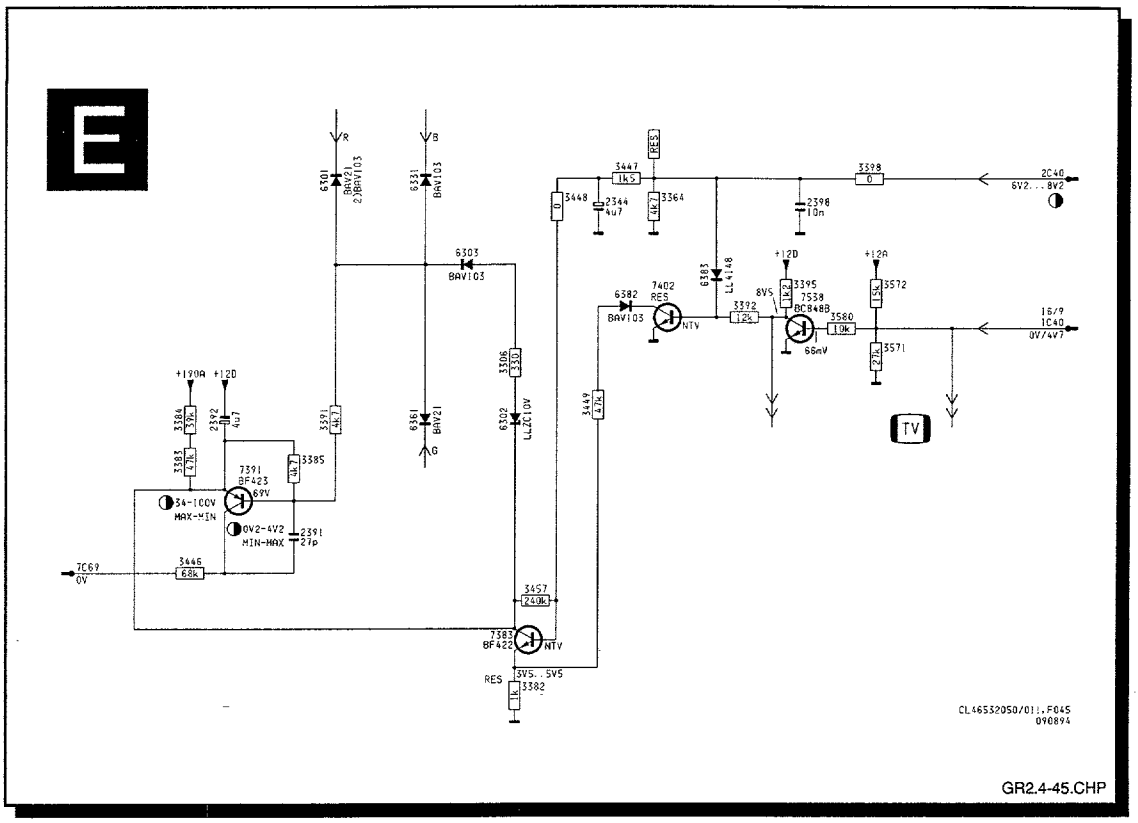


- Function:
  - R, G and B power amplifiers
  - Picturetube protection: via peak white limiting

- Operation:
  - Amplifiers (equal for R, G and B)
    * TS7361 and TS7363 form an operational amplifier
    * The base of TS7363 is the - input
    * The emitter of TS7363 is the + input
    * The feedback-resistor R3442 and input-resistors R3361+R3362 determine the amplification: this is roughly 120k/2k = 60x
    * TS7364 and TS7365 are emitter-followers and sample the cathode-current
    * Normally TS7365 conducts and the beam current flows to earth
    * At steep voltage-transients TS7364 conducts for a short moment and quickly loads the stray capacitance of the picturetube
  - Peak White Limiting
    * The base of TS7391 is normally about 50V
    * At moderate beam current:
      → D6301, D6331 and D6361 are non-conducting
    * If the R, G or B signal is lower then 48V:
      → D6301, D6331 or D6361 conducts, and TS7391 conducts depending off the voltage on 4-IC7708
    * The limiting-signal is sent via plug 7C69, to IC7309, TDA4780

Personal notes

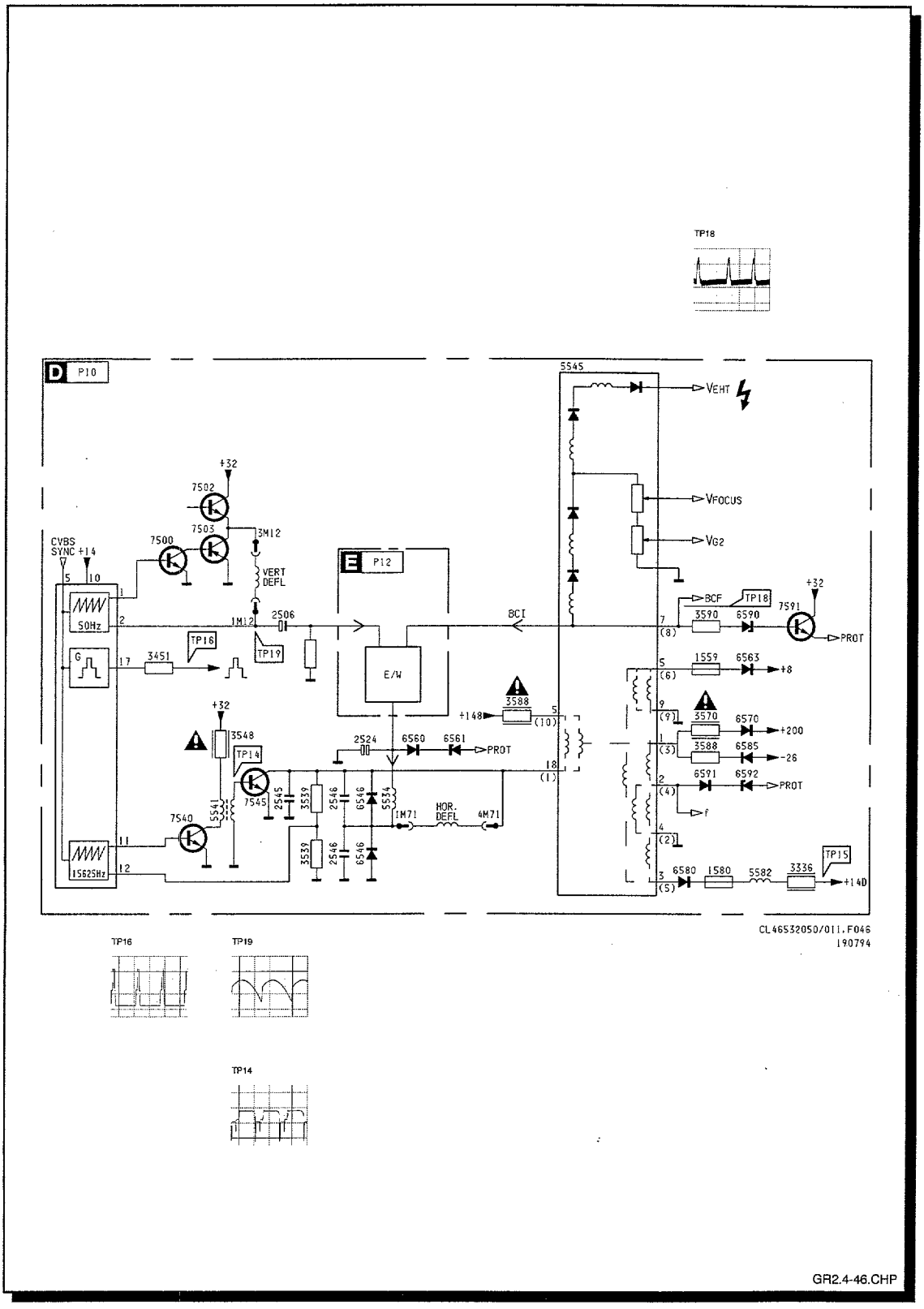
RGB amplifiers and peak white limiting (at the CRT panel)



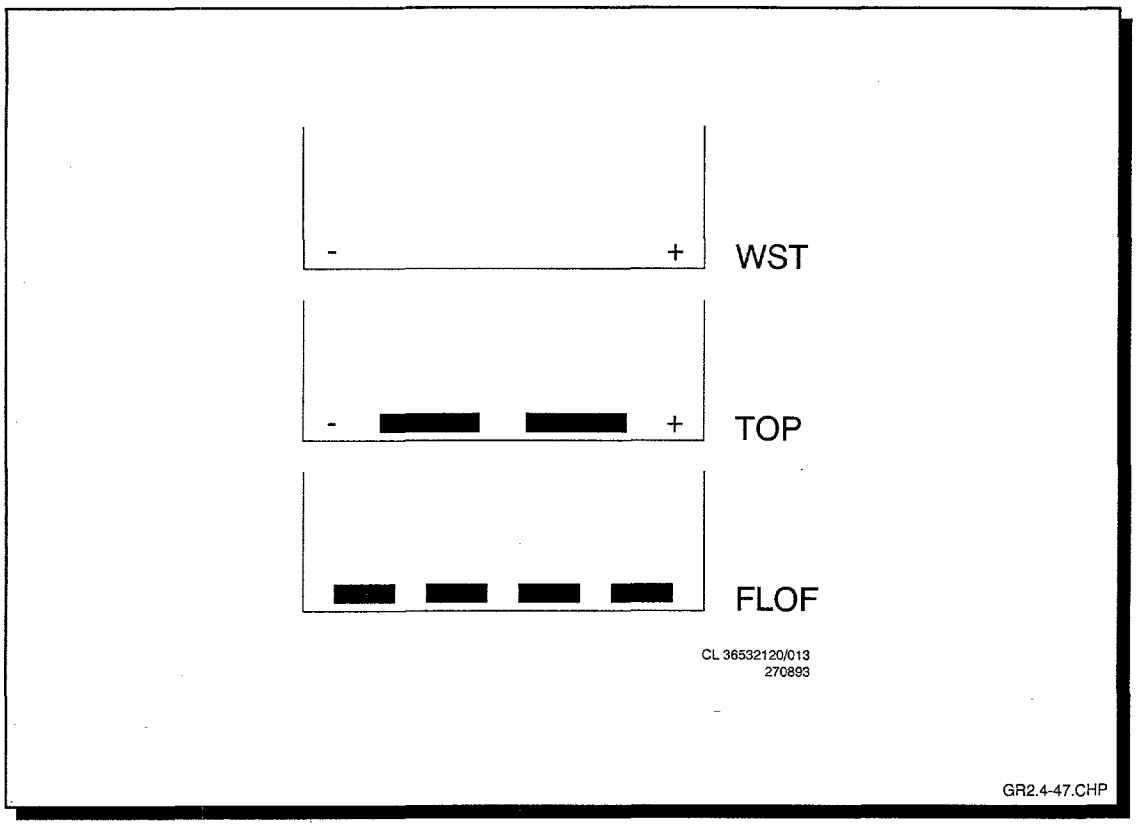
- Operation (continued):

  - Peak White Limiting for a 4:3 set with a 16:9 picture signal
    * The beam current remains the same, but is spread out over a smaller area
    * The limiting should react earlier
    * The 16:9 information signal at 1C40, controls TS7538
    * For 16:9 signal:
      → Base of TS7538 is high; TS7538 conducts
      → TS7402 is non-conducting
      → Parallel-resistor R3449 is decoupled
      → Emitter-voltage of TS7383 increases
      → Collector-voltage of TS7383 increases to ± 60V
      → Reduction of contrast in the TDA4680 will now take place at an R, G or B signal voltage lower than about 58V (instead of lower than 48V)

Personal notes



Above the block diagram of the synchronization and deflection part of the GR2.4 is given.
For a description see the training manual GR2.3, chapter 6.



1. Suitable for processing the following teletext signals:
   - the "World Teletext System" (WST)
   - the "UK" page choice system; FLOF (Full Level One Features)
     The teletext page is extended with a status line which gives information about pages coupled by the transmitter to the coloured RC-buttons (FastText)
   - the "german" choice system; TOP (Table Of Pages)
     The teletext page is extended with a status line which gives information about the next information block and group.
   - WST level 1,5; use of special characters necessary for some languages (ghost row 26).

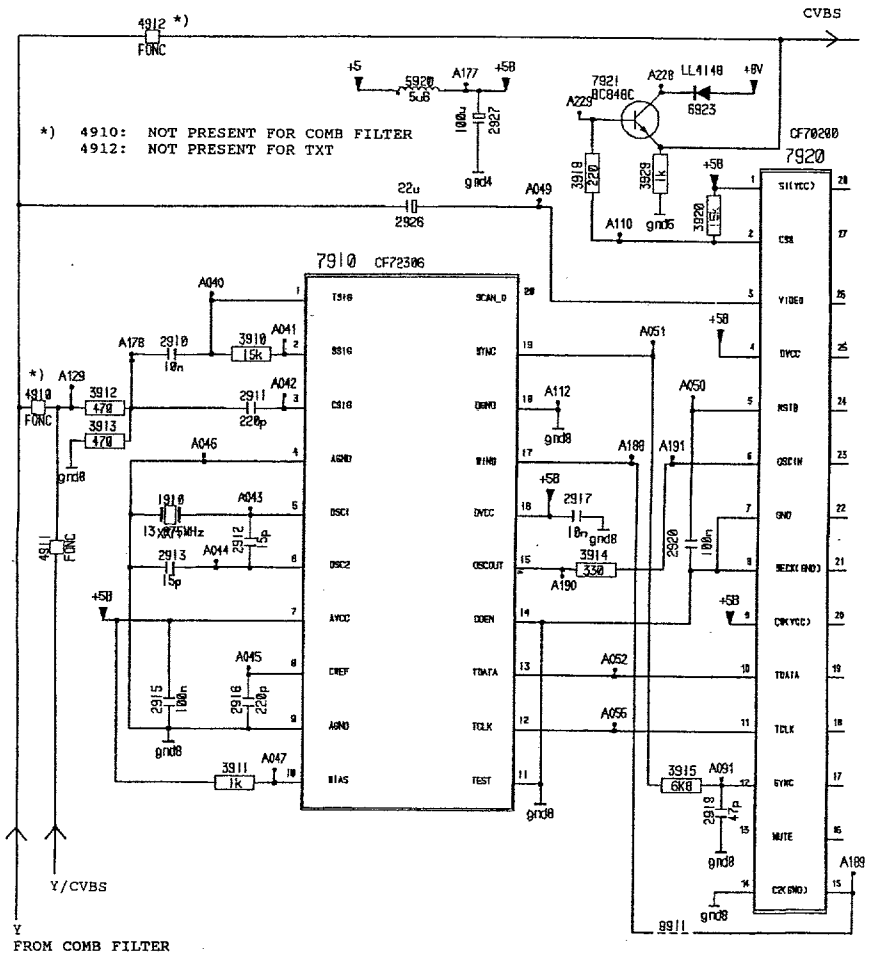
2. Possibility to store 8 pages:
   - 1 display memory; for the page displayed on the TV screen
   - 7 background memories; for reducing the waiting time
   - the content of the 7 background memories depends on the teletext system.

     This content is as follows:
     * WST with pages without sub-codes: page-1, page+1, page+2, page+3, page+4, last page received, inventory page
     * WST with pages with sub-codes: page-1, page+1, page+2, next sub-page, next next sub-page, last page received, inventory page
     * FLOF: 4 pages coupled to the coloured RC-buttons (red/green/yellow/cyan/), page-1, last displayed page, index page
     * TOP: basic TOP table, page+1, 1 or 2 next group, 2 or 3 next blocks, or Page+1/page+2

3. Upon reception of WST and FLOF, the "Page Look UP Table" (PLUT) will be built up after switch-on of the set or switching to another program.
   - PLUT: identifies and stores the numbers of pages which are broadcasted.

   The page listed in the PLUT table are stored into the background memory.
   Upon reception of TOP, the PLUT will be stored with basic TOP table.

F


CVBS
4912 *)
FONC
*) 4910: NOT PRESENT FOR COMB FILTER
4912: NOT PRESENT FOR TXT
+5
5920
5u6
A177
+5B
100u
2927
gnd4
7921
BC848C
A228
LL4148
+8V
6923
A229
CF70200
7920
3918
220
3929
1k
+5B
3920
15k
A110
gnd5
22u
2926
A049
7910 CF72306
A040
A178
2910
10n
3910
15k
A041
*) A129
4910
FONC
3912
470
3913
470
gnd8
A042
2911
220p
A046
1910
13x8?5MHz
A043
2912
15p
4911
FONC
2913
15p
A044
+5B
A045
2915
100n
2916
220p
gnd8
3911
1k
A047
A051
+5B
A112
gnd8
A050
A188
A191
+5B
2917
10n
gnd8
2920
100n
3914
330
A190
+5B
A052
A056
3915
6K8
A091
2918
47p
gnd8
A189
gnd8
8911
Y/CVBS
Y
FROM COMB FILTER

GR2.4-48.CHP

Teletext circuit

1. The teletext circuit consists of 2 IC's.
   * IC 7910, Teletext Data Slicer: CF72306
   * IC 7920, Universal Teletext Decoder "Eurotext": CF70200

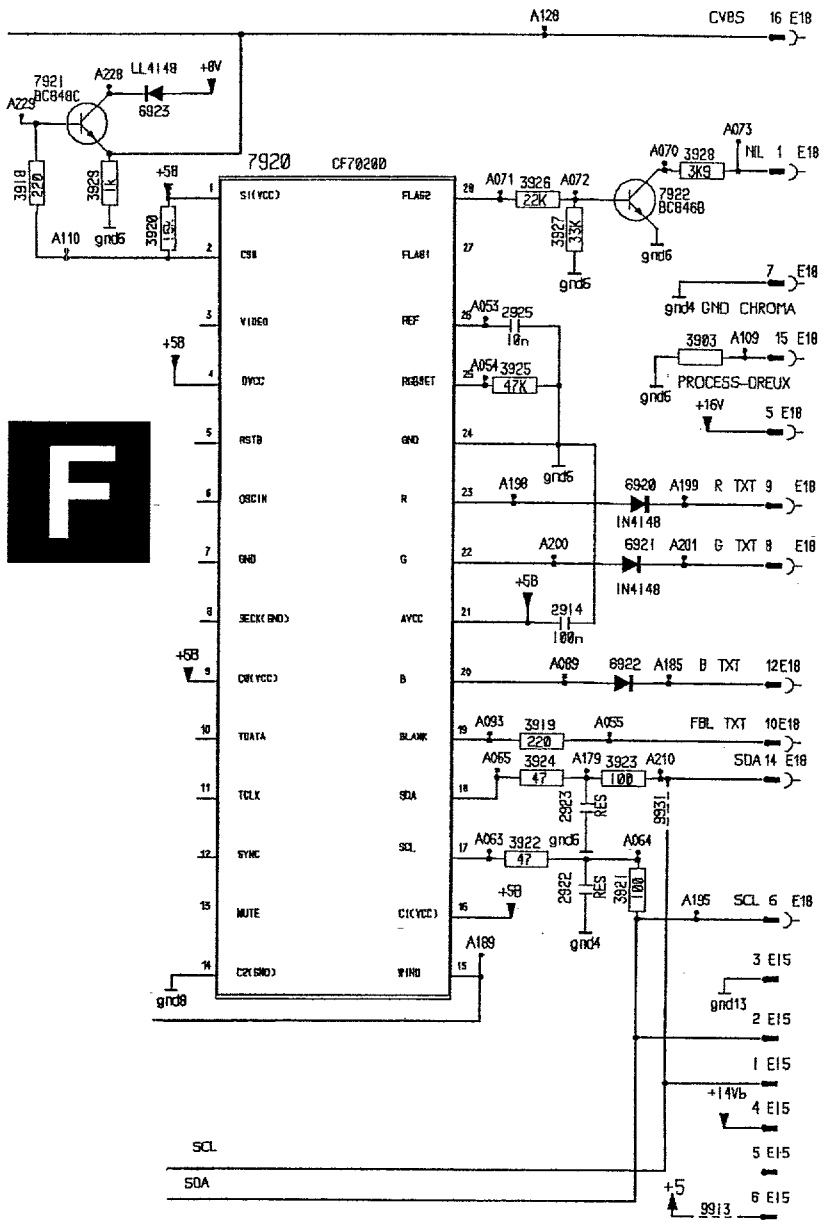
2. Description of the Teletext Data Slicer: CF72306
   - Analogue device for
     * Sync-separation
     * Teletext data extraction
     * Data clock regeneration
     * Transfer of clock, data and composite sync signals to the digital teletext decoder IC
   - The sync-separator slicing level is adaptive so that it can operate with a range of video amplitudes and signal distortions
   - The data-slicer uses an adaptive signal recognition and clock-phasing algorithm so that it can operate with a wide range of clock run-in amplitudes

   Pinning of the Teletext Data Slicer: CF72306

   - Pin 1: TSIG Video synchronisation input 1
   - Pin 2: SSIG Video synchronisation input 2
   - Pin 3: CSIG Video data input
   - Pin 4: AGND1 Ground for analogue part
   - Pin 5: OSC1 13.875 MHz oscillator
   - Pin 6: OSC2 13.875 MHz oscillator
   - Pin 7: AVCC Supply +5V for analogue part
   - Pin 8: CREF Capacitor for video data reference
   - Pin 9: AGND2 Ground for analogue part
   - Pin 10: BIAS Internal reference input
   - Pin 11: TSTAPLB Test/Application for factory device testing. Not used in operation
   - Pin 12: TCLK Teletext clock output
   - Pin 13: TDATA Teletext data output
   - Pin 14: DGND2 Ground for digital part
   - Pin 15: OSCOUT Oscillator output
   - Pin 16: DVCC Supply +5V for digital part
   - Pin 17: WIND Timing signal from decoder IC
   - Pin 18: DGND1 Ground for digital part
   - Pin 19: SYNC Separated sync output
   - Pin 20: SCANOUT Test scan output. Not used in GR2.4

Personal notes

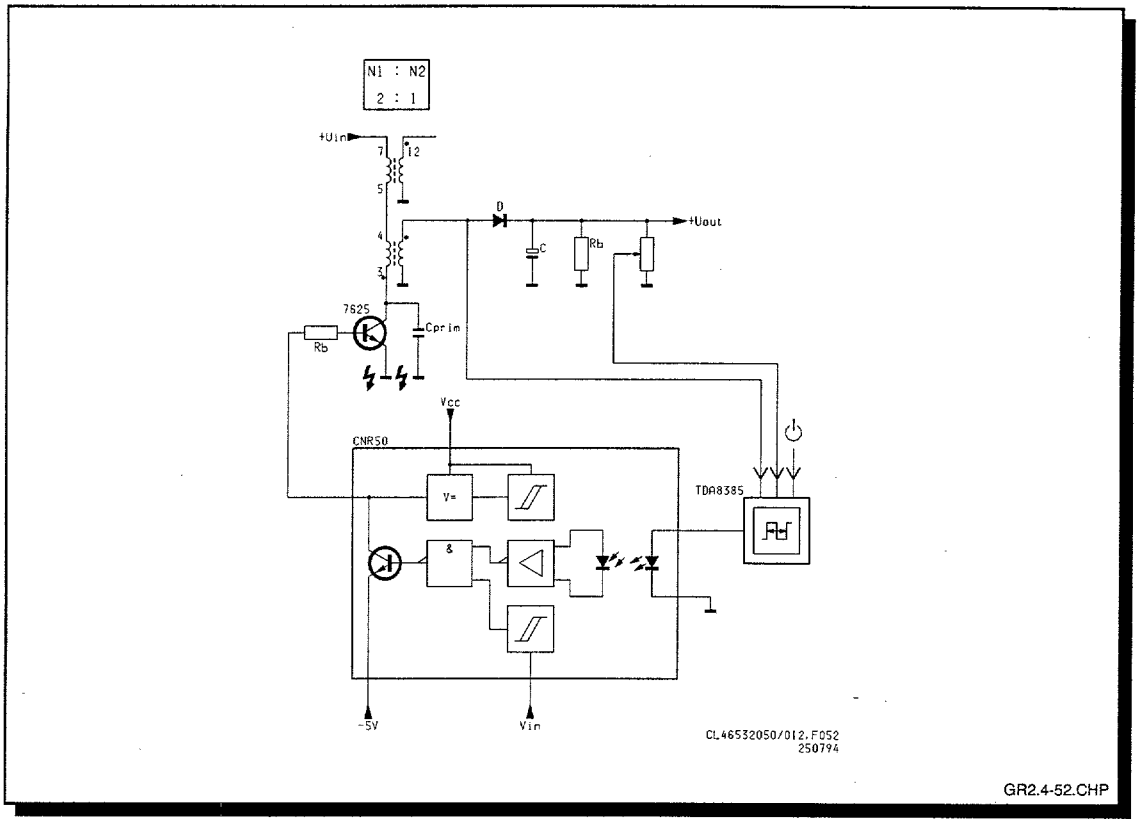
Teletext circuit



3. Description of the Universal Teletext Decoder "Eurotext": CF70200
   - Digital device for decoding of the world teletext standards
     * On board 8 pages memory
     * Automatic detection of WST, FLOF or TOP
     * Packet 26 flicker free character processing
     * Single solution for West and East Europe languages

   Pinning of the Universal Teletext Decoder "Eurotext": CF70200

   - Pin 1: TEST5 Test pin for factory device testing. Not used in operation
   - Pin 2: SYNC Output of an external sync switch. It will either output the composite sync pulse from the internal sync generator in teletext mode or it will be connected to the video input pin when any picture information is being displayed
   - Pin 3: VIDEO Video to sync switch
   - Pin 4: DVCC Supply +5V for digital part
   - Pin 5: RSTB System reset; active low. The teletext decoder has an internal reset circuit which is an option for hardware system reset. Not used for GR2.4
   - Pin 6: CLKIN Clock from Data Slicer
   - Pin 7: DGND Ground for digital part
   - Pin 8: TEST1 Test pin for factory device testing. Not used in operation
   - Pin 9: TEST4 Test pin for factory device testing. Not used in operation
   - Pin 10: TDATA
   - Pin 11: TCLK Teletext clock signal. From Data Slicer
   - Pin 12: CSB Composite sync input. From Data Slicer
   - Pin 13: MUTE Audio mute control. This signal is low when just text is displayed on the screen and a bad incoming video is detected and can be optionally connected to the TV audio mute. Not used for the GR2.4
   - Pin 14: TEST2 Test pin 2 for factory device testing. Not used in operation
   - Pin 15: WIND Teletext signals window. When this output is high it used as gating signal to capture of teletext signals. Connected to Data Slicer
   - Pin 16: TEST3 Test pin for factory device testing. Not used in operation
   - Pin 17: SCL I^2C clock line from the main μP
   - Pin 18: SDA I^2C data line for communication with the main μP
   - Pin 19: BLANK Blanking . This signal is high when the teletext information is displayed on the RGB lines
   - Pin 20: BLUE Output signal connected to the video controller IC7309, TDA4780
   - Pin 21: AVCC Supply +5V for analogue part
   - Pin 22: GREEN Output signal connected to the video controller IC7309, TDA4780
   - Pin 23: RED Output signal connected to the video controller IC7309, TDA4780
   - Pin 24: AGND Ground for analogue part
   - Pin 25: RGBSET Adjustment for the RGB and I levels. The level of the RGB signals can be adjusted from 0.5V to 1.5V by setting the current through this pin using an external resistor
   - Pin 26: REF Capacitor for internal reference
   - Pin 27: FLAG1 System information terminal. Not used
   - Pin 28: FLAG2 System information terminal. Used for None-InterLace (NIL) signal output to deactivate the frame interlacing in TXT mode

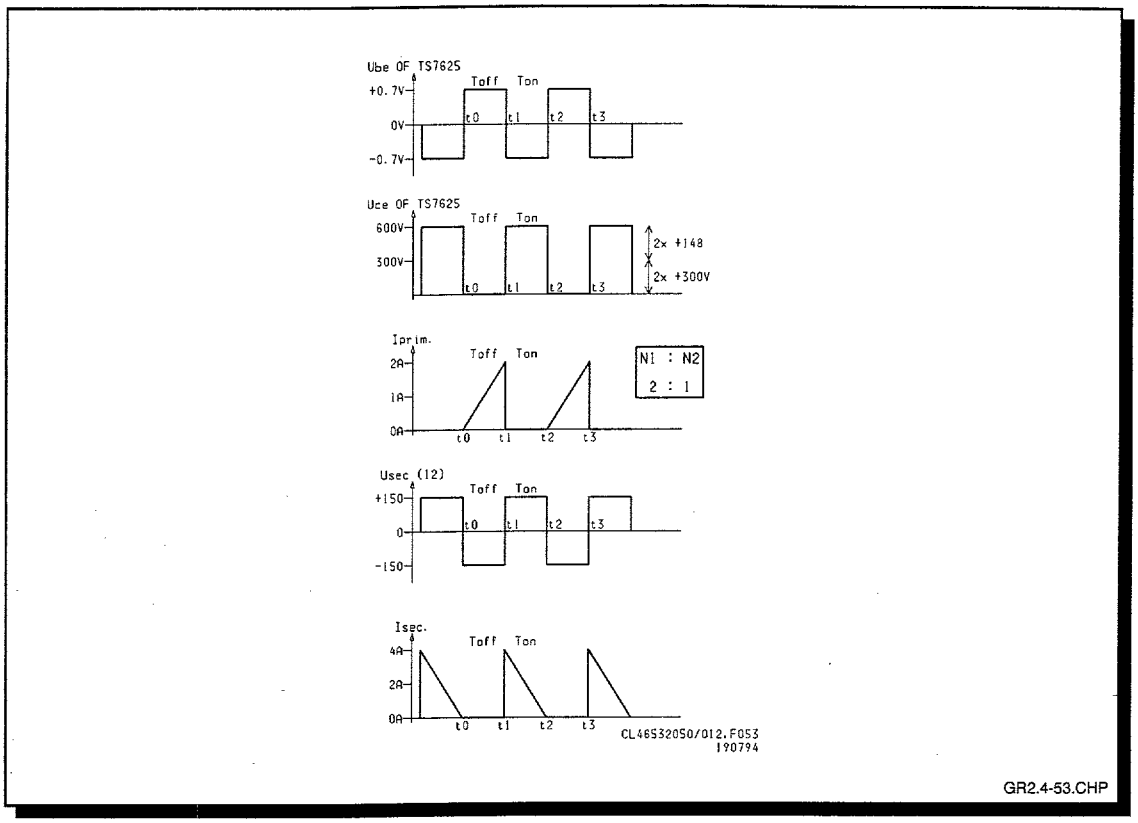


- The power supply is a mains isolated, self oscillating power supply (SOPS), suitable for 220V æ 10%, 50Hz operation.

- Function:
  Delivers the supply voltages:
  - +148V for the line output stage
  - +5V for the microprocessor
  - +32V for the frame output stage
  - +16V/-16V for the sound output stage
  - Switches "off" the set in case of overvoltage, undervoltage, overload or protection

- Operation:
  - The rectified DC mains voltage $+U_{in}$ (e.g. +300V DC) is fed via a transformer to the switching transistor TS (TS7625).
    The switching transistor is controlled by the SOPS control IC (TDA8385), and is switched "on" and "off" via the opto coupler (CNR50)
  - At the secondary side of the transformer, AC-voltages are extracted and rectified
  - The duty cycle of the switching transistor determines the value of the output voltages.
    The output voltage is measured via a voltage-divider and fed back to the control IC for stabilisation.
  - In "Stand-by" the SOPS is switched in "burst-mode"; the output voltages will decrease and the line output stage will be switched "off".

Personal notes

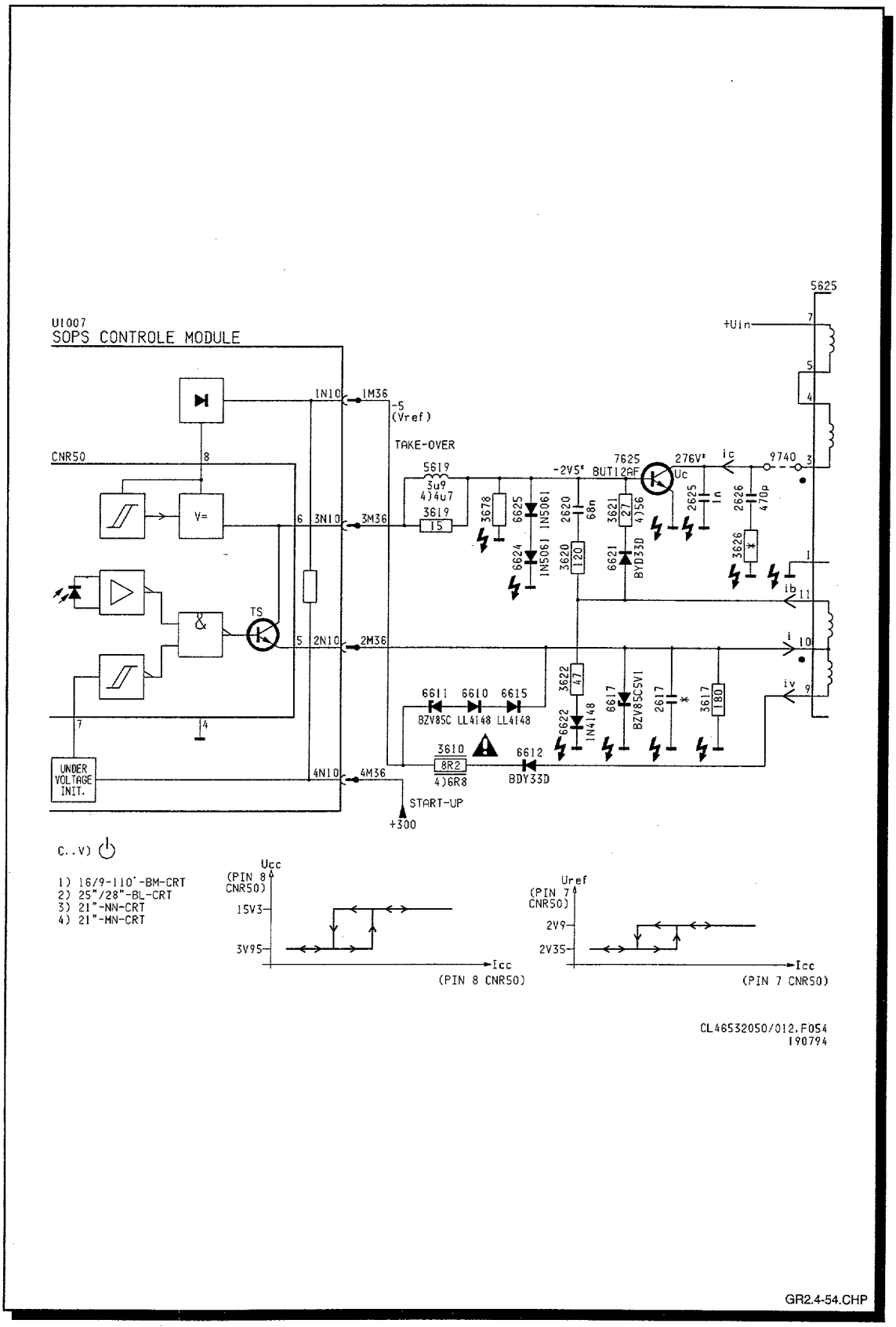


- Principle of SOPS:

  - During "T-on" (t0-t1) TS conducts and energy is stored in the transformer (U_{BE} of TS = +0,7V).
  - During "T-off" (t1-t2) TS blocks and energy is delivered to the load (U_{BE} of TS = -0,7V).
  - On t0 the transistor TS is driven in conduction by the CNR50 and taken over by the positive winding (11-9) of the transformer. As TS conducts, the DC rectified mains voltage $+U_{in}$, gives a positive voltage across the primary winding 3-7 of the SOPS transformer. This voltage gives a linear increasing current I-prim through TS. The steepness of this current is determined by the mains voltage and the inductance of the coil of the transformer. The maximum value of I-prim is depending on the t0-t1 and is for a nominal load 2A peak. All secondary windings have inverted polarity, so during "T-on" a negative secondary voltage is induced. This negative voltage is blocked by diode D.
  - On t1, via the pulse width modulator and the opto-coupler, the base of TS is connected to the -5V. TS blocks and the collector voltage is increasing. The secondary side becomes positive, the diode D conducts and current flows through Rb and C. The voltage on the secondary side of the transformer becomes positive. As the SOPS takes care of a constant +148, the current I-sec is decreasing linearty.
    All stored energy in the transformer during "T-on" (t0-t1) is now transferred into the load. The U_{CE} of TS is U_{in} + (U_{out} * winding ratio) (so for GR2.4 e.g. 300 + (2 * 148) = +600V DC. The I-sec current is 2 * 2 = 4A peak).
  - On t2 the I-sec becomes zero; all energy stored in the transformer is delivered to the load.
    The voltage U_{CE} of TS7625 across C-prim (+600V DC) will discharge via the primary winding to the $+U_{in}$. If this U_{CE} becomes lower than +300V then the polarity is changing and with a delay, the transistor is going into conduction via the positive primary winding 3-7.
  - The cycle starts again.

- The SOPS control module

  On the SOPS control module the CNR50 and the TDA8385 are situated.
  - The CNR50 takes care of: "Start-up" and "Switching off of the switching transistor (undervoltage protection)".
  - The TDA8385 takes care of: "Pulse width modulation", "Slow-start", "Stand-by" and "Protection".


UI007
SOPS CONTROLE MODULE
CNR50
8
V=
6
3N10
3M36
1N10
1M36
-5
(Vref)
TAKE-OVER
5619
3u9
4)4u7
3619
15
3678
6625
1N5061
6824
1N5061
2620
68n
3620
120
-2V5*
7625
BUT12AF
276V*
ic
Uc
9740
3621
27
4)56
BYD33D
6821
2625
1n
2626
470p
3626
*
5625
+Uin
7
5
4
3
1
ib
11
i
10
iv
9
TS
5
2N10
2M36
6611
6610
6615
BZV85C
LL4148
LL4148
3622
47
6622
IN4148
6617
BZV85C5V1
2617
*
3617
180
3610
8R2
4)6R8
6612
BDY33D
7
4
UNDER
VOLTAGE
INIT.
4N10
4M36
START-UP
+300
C..V)
1) 16/9-110°-BM-CRT
2) 25"/28"-BL-CRT
3) 21"-NN-CRT
4) 21"-MN-CRT
Ucc
(PIN 8
CNR50)
15V3
3V95
Icc
(PIN 8 CNR50)
Uref
(PIN 7
CNR50)
2V9
2V35
Icc
(PIN 7 CNR50)
CL46532050/012.FOS4
190794
GR2.4-54.CHP

1. Mains filter module

   On the mains filter module the following functions are applied:
   - Mains filtering via coil L5600.
   - Degaussing via Dual PTC 3601.
     At switch "on" of the set the PTC's are cold, so low-ohmic
     → I_{deg} is "high".
     After degaussing the PTC's are heated, so high ohmic
     → In normal operation I_{deg} is "low".
   - Mains rectification via the diodes D6602-6603-6604-6605 and smoothed by C2605 to the DC supply voltage of the SOPS U_{in} (in case the mains voltage is 220V AC → U_{in} = +300V DC).

2. CNR50 supply

   - The CNR50 is powered by pin 8 (U_{cc}) and has a supply reference at pin 7 (U_{ref}).
   - At start up the CNR50 is powered by the rectified mains voltage $+U_{in}$.
   - After CNR50 initialisation the SOPS will start up (see chapter 8.4). After start up of the SOPS the CNR50 supply will be taken over by the positive winding 9-10.

3. CNR50 initialisation

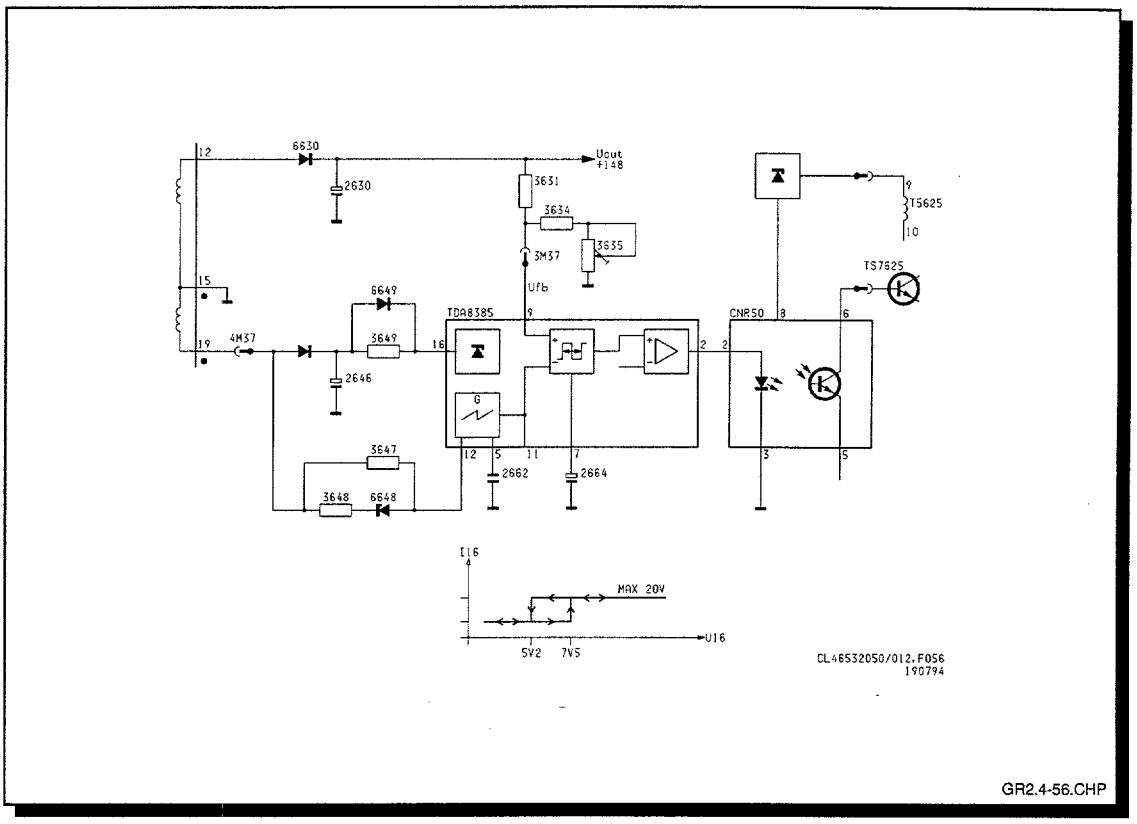
   The power supply can only start up if pin 6 of CNR50 will drive the switching transistor TS7625 into conduction.
   Pin 6 CNR50 can only give pulses if all following conditions are fulfilled:
   - Pin 8 is U_{cc} of CNR50 > 15V3 (from $+U_{in}$ via 4M36 and "D200") (see hysteresis figure)
   - Pin 7 is U_{ref} of CNR50 > 2V9 (from $+U_{in}$ via 4M36 and "D200") (see hysteresis figure)
   - The LED is not lightning already (current from pin 2 to pin 3 CNR50 though the LED < 5mA)

4. Switching "off" of the switching transistor

   The CNR50 will stop driving pin 6 and so stop driving TS7625 in case of one of the following conditions:
   - Pin 8 is U_{cc} of CNR50 < 3V9 (see hysteresis figure); the driving transistor in the CNR50 will conduct and so TS7625 will block → undervoltage protection (see chapter 8.5).
   - Pin 7 is U_{ref} of CNR50 < 2V35 (see hysteresis figure); the driving transistor in the CNR50 will conduct and so TS7625 will block → undervoltage protection (see chapter 8.5).
   - The current through the opto-coppler LED (from pin 2 to pin 3 CNR50) gets > 5mA, then the CNR50 blocks → TS7625 blocks.

5. Base drive circuitry of the switching transistor

   - The switching transistor will be driven into conduction by pin 6 of the CNR50.
   - When the switching transistor is conducting, the base drive current i_b will be provided by the primary winding 10-11.
   - Switching "off" takes place by a negative switch-off voltage U_{ref} of -5V DC, which is built up by means of the current i. This current i consists of the sum of the base drive current i_b and the CNR power supply current i_v.
   - D6621 and R3621 determine the size of the base drive current.
   - R3620 and C2620 take care that the supply circuit can start up according to the blocking oscillator principle.
   - C2625, R3626 and C2626 limit the $\delta U_{CE}/\delta t$ of TS7625.
   - The negative turn off voltage is determined by D6622, R3622, C2617, R3617 and limited to max negative value of -5V1 DC by means of D6617.



- On the secondary side of the SOPS the following supply voltages are obtained via a rectifier diode and a smoothing capacitor (e.g. D6630 and C2630 for the +148):

  - +148V for the line output stage
  - +5V for the microprocessor
  - +32V for the frame output stage
  - +16V/-16V for the sound output stage

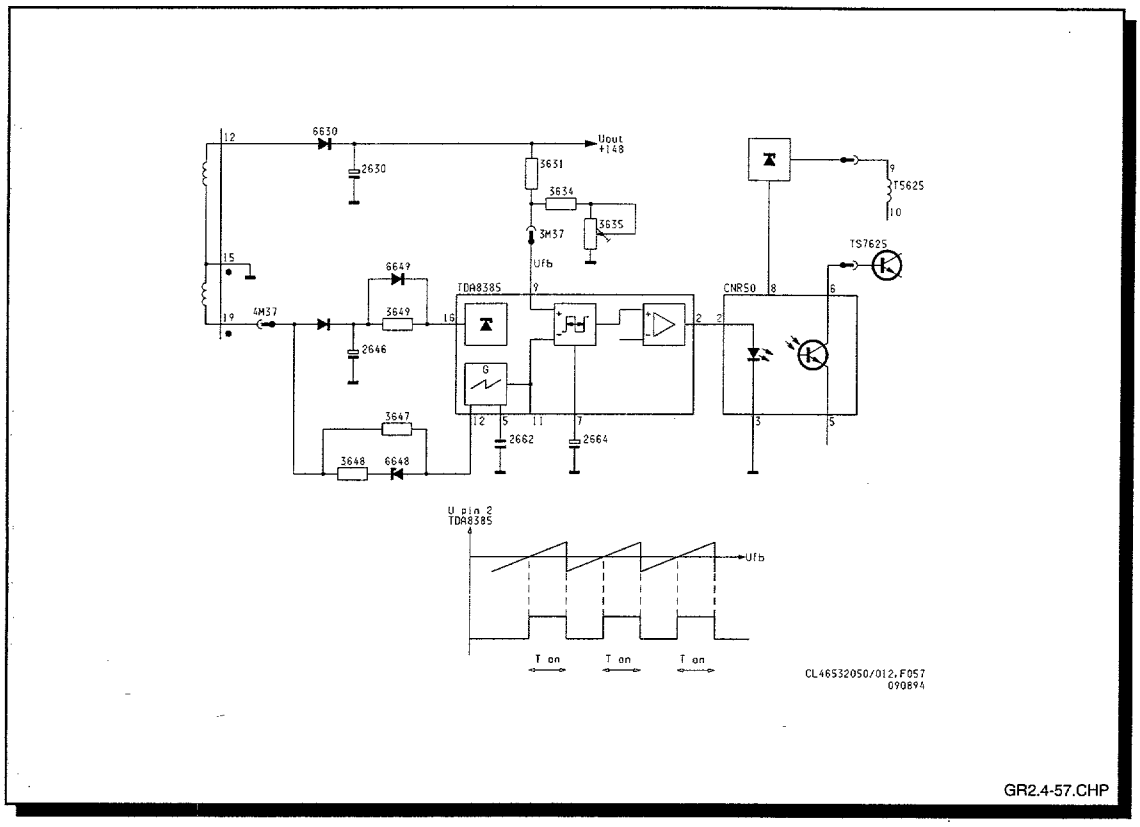
- The TDA8385

  The following main functions can be identified in the TDA8385:
  "Supply and initialisation", "Sawtooth generator", "Pulse width modulator", "Slow start" and "Protection"

1. Supply and initialisation

   - The TDA8385 is supplied by winding 15-19 and only works if U_{16} (voltage at pin 16 TDA8385) is between 7V5 and 20V.
   - After initialisation of the TDA8385 the U_{16} may drop till 5V2 (see hysteresis figure).

Personal notes



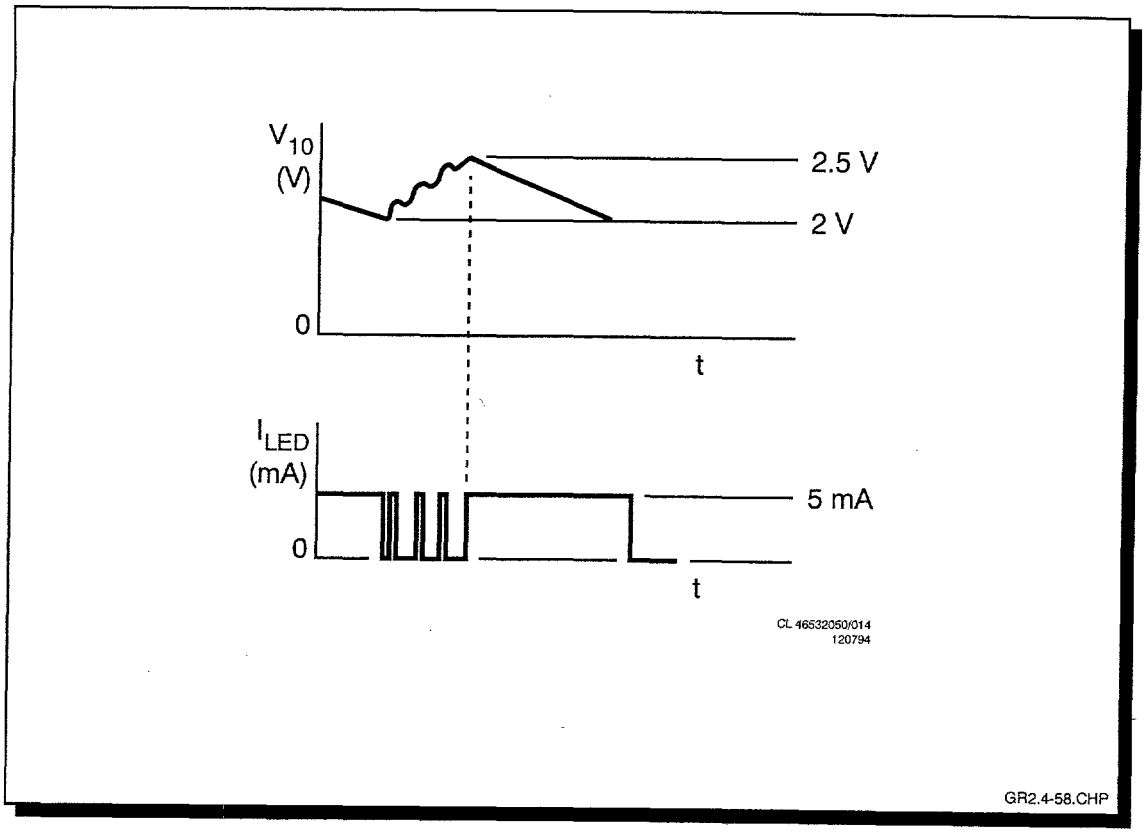
2. Sawtooth generator

- The voltage across winding 19-15 is a measure of the collector current and the mains voltage. This is measured at pin 12 of the TDA8385.
- During "T-on" C2662 is charged with an internal current source and so a sawtooth is generated across this C2662. The slope of the sawtooth depends on the height of the voltage at pin 12.
  → This gives an U_{out} stabilisation for changing mains voltages.

3. Pulse width modulator

- The duty cycle of the pulse-width modulator in TDA8385 is controlled by:
  * A control block inside the TDA8385 which compares the feedback voltage U_{fb} at pin 9 with an internal reference voltage of 2V5 DC.
  * A capacitor C2662 on pin 5 which controls the sawtooth generator.
  * A DC offset voltage which is controlled by a resistor at pin 4 of the TDA8385 (R3663) which determines the minimum value of "T-on".
- The sawtooth voltage is compared with the U_{fb} at pin 9 which is a measure of the U_{out} (+148V) output feedback voltage via 3M37. If the sawtooth voltage becomes higher than U_{fb}, then via the pulse-width modulator, pin 2 becomes high. The LED in the CNR50 lights and so the transistor TS7625 is switched "off" (see figure).

Personal notes



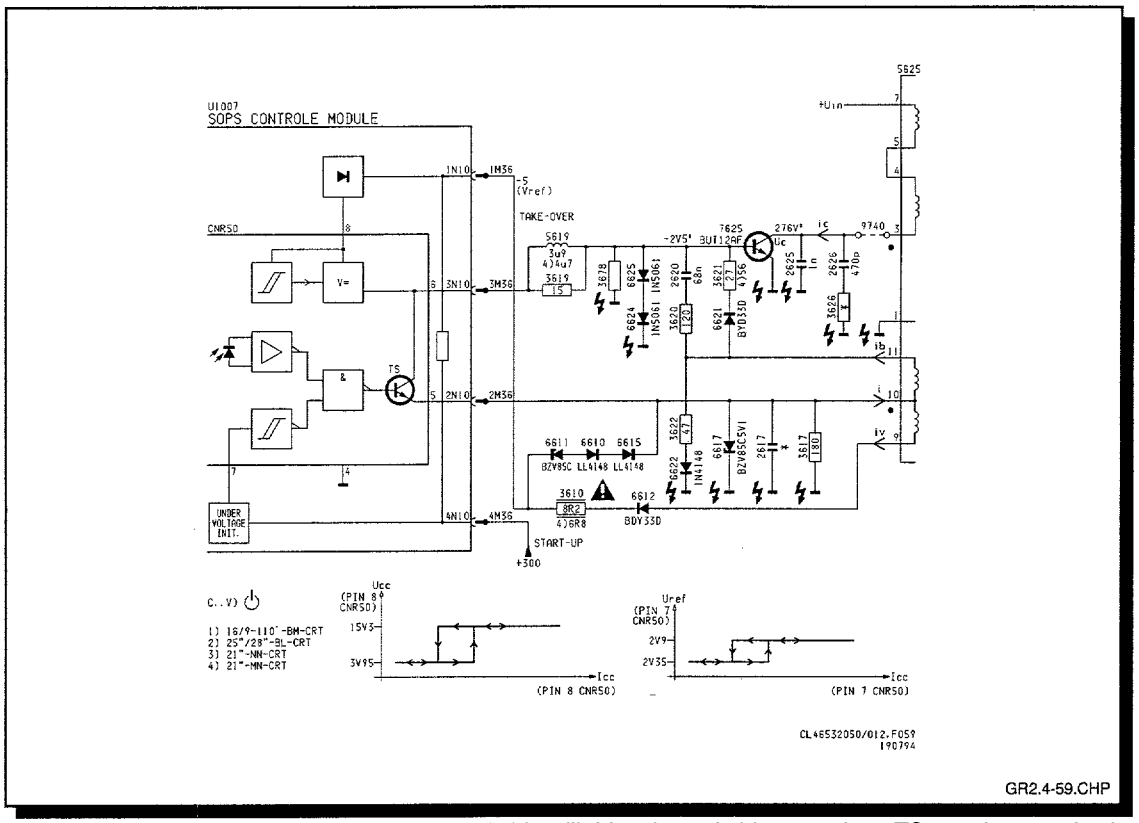
4. Slow-start

- Slow start takes place:
  * at start-up of the SOPS
  * after a protection occured (see chapter 8.5)
  * switching from stand-by to normal operation
- During start up the C2664 gets charged with an internal current source. As the voltage across this C2664 determines the duty cycle of the switching transistor, at start up the duty cycle is always low.
- During normal operation C2664 gets discharged via D6664. So at start-up and after stand-by or protection always a slow-start takes place.

5. Protection

- All protection lines of the set are fed to an add-up point. This logical sum is fed to pin 8 of the TDA8385.
- If the voltage at pin 8 TDA8385 is 2V5, then the slow-start capacitor C2664 gets fast discharged via a circuitry inside the TDA8385. This causes the switching transistor TS7625 to be turned "off" until the voltage on pin 8 of the TDA8385 drops below 2V. By then a slow-start takes place, the set goes in protection again, etc..
  → The power supply is in Hick-up mode

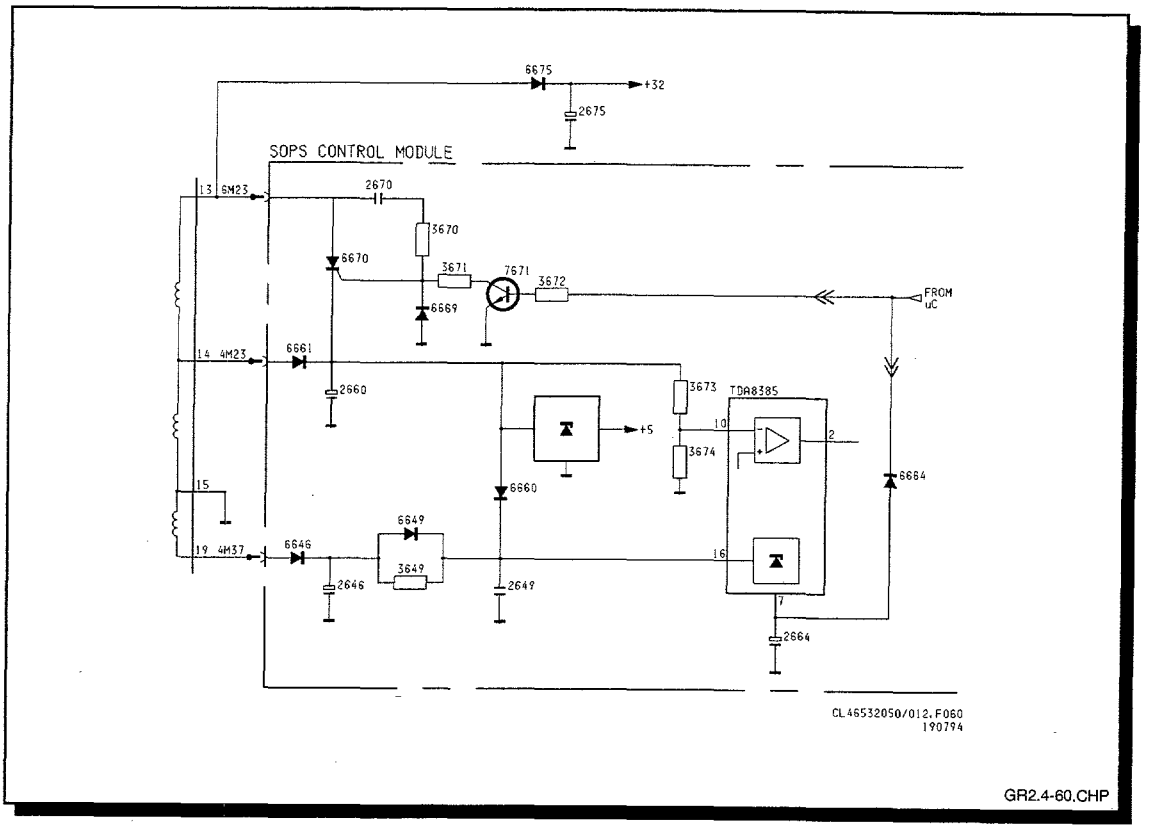
Personal notes



Start up

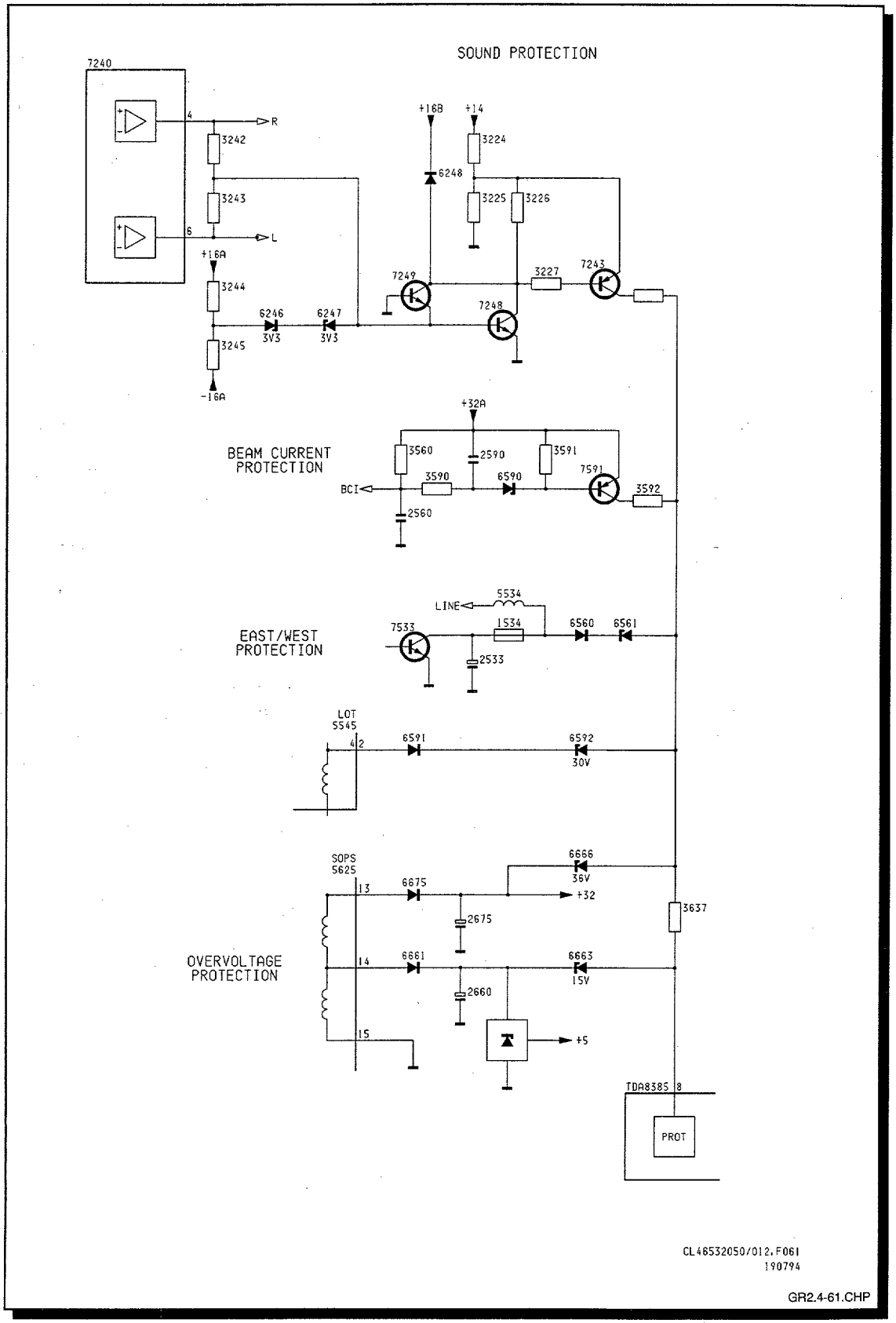
- First the CNR50 has to be initialised (see chapter 8.2) this will drive the switching transistor TS7625 into conduction.
- As TS7625 conducts the voltage on pin 3 of the transformer decreases and the voltage on pin 11 of the transformer increases.
- As the voltage on pin 11 increases the initial driving current for the TS7625 from the CNR50 is taken over by the i_b via R3620 and C2620 (at start up C2620 is completely discharged, so this C is completely shorted in the first cycles, resulting in a very high i_b (shape like a sawtooth).
- TS7625 will be driven into conduction even faster by this i_b and so pin 3 of the transformer will decrease even faster (i_b has to be large enough to have the desired collector current, as $i_c = h_{fe} \times i_b$)
- Starting up takes place according the blocking oscillator principle.
- The -5V DC at pin 5 of the CNR50 is built up by means of the base current i_b which sinks the current i, which in its turn makes a negative voltage drop over R3617. This -5V DC is smoothed by C2617 and limited to -5V1 DC by zener D6617.
- If TS7625 is not blocked, due to a faulty regulation or voltage protection, the SOPS comes into a self oscillation mode:
  At starting up the mains rectified input voltage and so the current through the primary windings are still low. After a short time δI_c in the primary winding is "finished" and so the polarity changes. TS7625 blocks and U_{CE} (and so also the voltage across C2625) will be charged to U_{in} + (U_{out} * winding ratio).
  The secondary windings are delivering current. As the transformer has low energy at start up, secondary side decreases very fast to zero. C2625 discharges though U_{in}. When U_{CE} becomes lower as $+U_{in}$, the polarity changes and a new cycle will start again.
- After the first start up cycles the supply voltages of the CNR50 (pin 7 and pin 8) will be taken over by winding 9-10 via 1M36.

2. Normal operation
   - If the load increases the +148 will decrease. The feedback voltage V_{fb} at pin 9 of the TDA8385 will decrease also. As a result, the duty cycle in the TDA8385 will be increased. Via the CNR50 the switching transistor TS7625 will conduct longer. More energy will be transferred by the transformer until pin 9 of the TDA8385 is stabile at 2V5 DC.
   - If the load decreases, the SOPS will lower the duty cycle to prevent the voltages to rise.



3. Stand-by
   - In "stand-by" the STAND BY status signal from the μC is "low"(0), so TS7671 does not conduct → the thyristor TH6670 conducts.
     → +5 power supply is powered by winding 13-15 i.s.o. winding 14-15.
   - The voltage across winding 13-15 is approx. 3 times higher as the voltage across winding 14-15 during normal operation. This voltage is measured on pin 10.
   - As a result the voltage at pin 10 drops down the 2V5 threshold very fast. The stand-by block in the TDA8385 will switch on the CNR50 LED continuously and so the switching transistor TS7625 will be turned "off".
   - As TS7625 is turned "off", all secondary voltages will drop. If pin 10 drops below 2V, the TDA8385 will release the LED again; The SOPS start up again until the voltage on pin 10 exceeds 2.5 V again.
     → Power supply operates in Burst-mode.
     → All the supply voltages of the SOPS, except the +5, will be a factor of three lower.
   - To ensure a good functioning of the TDA8385 in stand-by, the power supply at pin 16 will be taken over by D6660.
   - During normal operation the STAND BY status signal is "high".
   - D6669 takes over the current for negative pulses on the thyristor TH6670.

Personal notes


SOUND PROTECTION
7240
4
R
6
L
3242
3243
3244
3245
+16A
-16A
6246
3V3
6247
3V3
+16B
+14
3224
6248
3225
3226
7249
7248
3227
7243
BEAM CURRENT PROTECTION
+32A
3560
2590
3591
3590
6590
7591
3592
BCI
2560
EAST/WEST PROTECTION
LINE
5534
7533
1534
6560
6561
2533
LOT
5545
4
2
6591
6592
30V
SOPS
5625
13
6675
6666
36V
+32
3637
2675
OVERVOLTAGE PROTECTION
14
6661
6663
15V
2660
15
+5
TDA8385
8
PROT
CL46532050/012.F061
190794
GR2.4-61.CHP

- The protections which are taken of by the TDA8385 are:

  - Overload protection
  - Shortcircuit protection
  - Overvoltage protection
  - Sound protection
  - Beam current protection
  - East/west protection

- The protection which is taken care of by the CNR50 is:

  - Undervoltage protection

1. Overload protection (via pin 9 TDA8385)

   - In case of an increased load the secondary voltages will drop and so the duty cycle will increase.
   - In case of an overload the feedback output voltage V_{fb} (pin 9) drops under 2V5;this will be detected by the TDA8385.
   - The duty cycle is reduced, and so the secondary voltages will drop and the current will decrease.

2. Shortcircuit protection (via pin 9 TDA8385)

   - In case of a short circuit, the feedback output voltage will drop drastically. As a result the overload protection in the TDA8385 will be activated; CNR 50 will be activated and TS7625 will be blocked.
   - The voltages will be dropping. The power supply voltage of the CNR50 drops under 3V9.
   - The CNR50 blocks the start current for the switching transistor; the switching transistor blocks and there will be no secondary voltages any more.
   - After a while the V_{cc} at pin 8 of CNR50 will charge up to 15V3 via the start up circuitry.
   - The CNR50 will deliver a start-up current and restart.
   - The overload protection will be activated again.
     → If the short circuit remains present, the SOPS will be in hick-up mode with a squeking sound

3. Overvoltage protection (via pin 8 TDA8385)

   If the +32 supply voltage exceeds 38,5V, the 36V zener diode D6666 starts conducting and so pin 8 of the TDA8385 will exceed 2V5. The TDA8385 will go into protection mode (see chapter 8.3).

4. Sound protection (via pin 8 TDA8385)

   - The sound output amplifier is powered by a symmetrical power supply (+16 and -16). To prevent the loudspeakers to become defective, the +16 and -16 supply voltages and the outputs are monitored in case of:
     * Sum of the output pins 4-6 of IC7240 is not 0V (L and R are 180 degrees out of phase)
       → TS7248 or TS7249 will conduct → TS7243 will conduct → Protection
     * Supply +16A or -16A is not OK, zeners D6247 or D6246 will conduct (threshold of 4V7):
       → TS7248 ord TS7249 will conduct → TS7243 will conduct → Protection
     * Supply +16A and -16A both fail D6248 conducts and so TS7243 conducts → Protection

5. Beam current protection (via pin 8 TDA8385)

   The beam current in principle flows through 3560 and is translated into a voltage across this resistor. If the voltage across this resistor increases (larger beam current), transistor 7591 will be driven into conduction via zener diode 6590. The protection circuitry of the TDA8385 will be activated.

6. East/west protection (via pin 8 TDA8385)

   If, due to a defect of transistor 7533, the line circuit is no longer connected to the east/west modulator, the voltage on coil 5534 will increase. Zener diode 6561 will start conducting and the supply circuit protection will be activated.

7. Undervoltage protection (via CNR50)

   The power supply voltage on pin 8 of the CNR50 also serves as undervoltage protection (see chapter 8.2).
   If the power supply voltage drops under 3V9(pin 8), then the switching transistor continuously is blocked.

µP =	µCMicroprocessor
16:9	16 by 9 width at height ratio
2FSC	Double chroma frequency
4:34	by 3 width at height ratio
ADC	Analog Digital Converter
AFC	Automatic Frequency Control
AM	Amplitude Modulation
AGC	Automatic Gain Control
B-Y	Blue - Luminance signal
BCI	Beam Current Info
C-SVHS	Chrominance signal of the SVHS-input
CNR50	Opto coupler of the SOPS control module
COR	Constant Output Regulation
CRT	Picture tube
CTI	Colour Transient Improvement
CVBS	Colour Video Blanking Synchronisation
DAC	Digital Analog Converter
E/W	East/West (modulator)
EEPROM	Electrical Erasable Programmable Read Only Memory
EURO	Euro module (interface-module with euroconnectors)
EXT. LS	External loudspeakers
EXT1/2/3	Euroconnector nr. 1/2/3
FBL	Fast blanking signal for 25 Hz frame-frequency by teletext
FF	Flip Flop
FLOF	Full Level One Feature (see chapter 7)
FM	Frequency Modulation
HF	High Frequency
I^2C	Digital control-bus of the microprocessor
EURO-TXT	Integrated video-input processor and teletext-decoder
COMB	Comb filter in the IF-part which gives a better split-up of the chrominance and the luminance signals
L	Left audio-signal
LED	Light Emitting Diode
LOT	Line Output Transformer
IF	Intermediate Frequency
MHz	Mega Hertz
NICAM	Near Instantaneous Companding Audio Multiplex
NIL	Non Interlace
OSD	On Screen Display
PAL	Phase Alternating Line
PIP	Picture In Picture
PLL	Phase Locked Loop tuning system
PLUT	Page Look Up Table
POR	Power On Reset
QPSK	Quadrature Phase Shift Keying
QSS	Quasi Split Sound
R	Right audio-signal
R-Y	Red - Luminance signal
RAM	Random Access Memory
ROM	Read Only Memory
RC5	Remote Control 5 system
RGB	Red Green Blue
SAW	Surface Acoustic Wave filter in the IF-part
SCAVEM	SCAn VElocity Modulation
SCL	Clock of the I^2C-bus
SDA	Data of the I^2C-bus
SECAM	Sequential Couleur á Memoire
SOPS	Self Oscillating Power Supply
SVHS	Super Video Home System
SYNC	Synchronisation
TDA8385	Regulation IC of the SOPS control module
TOP	Table Of Pages (see chapter 7)
TP	Test Point
TXT	Teletext
VG2	Voltage on Grid 2 of the picture tube
VST	Voltage Synthesized Tuning system
WST	World Teletext System (see chapter 7)
Y-SVHS	Luminance signal of the SVHS-input