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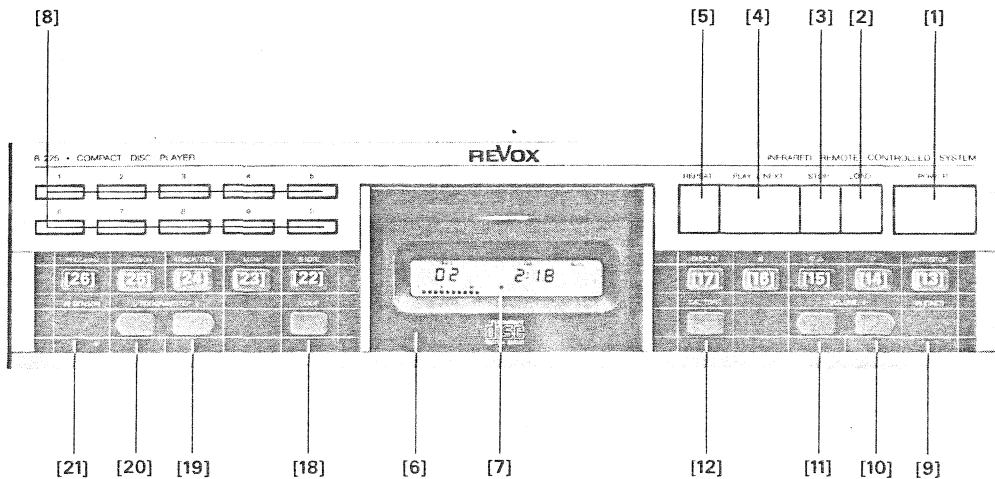
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1. GENERAL

1.1 Index of CD player controls1.1.1 General controls

- [1] POWER * Key for switching the CD player ON and OFF. However, certain assemblies (such as the IR receiver) remain always switched on (in so-called standby mode).
- [2] LOAD The drawer with the player mechanism [6] opens or closes when this key is pressed.
- [3] STOP * Interrupts the player function. The optical laser head is retracted to the starting position and the program is cancelled if the CD player was in program mode. The position in which the laser pickup was operating before STOP was pressed cannot be reproduced. If this is desired, please refer to ▼▲ (PAUSE) key.
- [4] PLAY/NEXT Play key with the following functions:
If pressed after LOAD [2], the CD starts to rotate, the content list is read, and the disc is played starting at the first selection (TRACK). The next selection (TRACK) is accessed when this key is pressed again.
If pressed after PROGRAM MODE [26] has been selected: play program mode is activated.
- [5] REPEAT The selection currently being played is repeated immediately when this key is pressed. If the CD player is in STOP mode, the first selection of the compact disc will be played. If the CD player is in program mode, the current program step will be repeated.
- [6] (CD drive) Drawer module with CD player mechanism and liquid-crystal display. The drawer can be opened or closed with LOAD [2].
- [7] (Display) Multifunction LC display which provides information on all operating modes of the CD player and the content of the loaded compact disc.
- [8] (keys 0-9) Digit keys for direct addressing of a selection (TRACK) in conjunction with PLAY/NEXT [4], or for programming.

The CD player can be switched on by pressing any of the controls [1] through [8] of the upper row (except REPEAT [5] and the digit key 0). The CD player starts in the selected operating mode.

1.1.2 Special controls

The controls in the lower front-panel section can be roughly divided into two function groups: controls for supplementary player functions, and programming controls.

A Controls for supplementary player functions

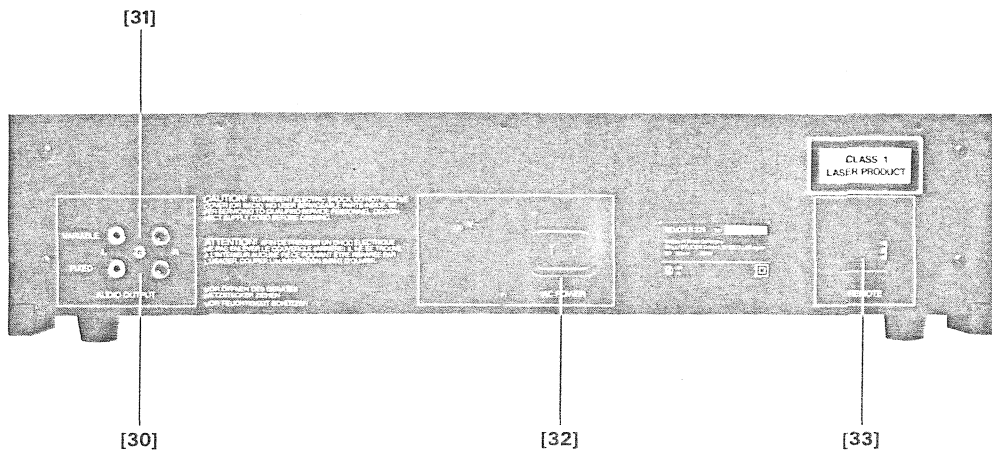
[9] PHONES	Headphones jack socket for headphones 200 to 600 ohms.
[10] VOLUME +	Increases the headphones level and the level of the VARIABLE OUTPUT.
[11] VOLUME -	Decreases the headphones level and the level of the VARIABLE OUTPUT
[12] CAL TONE *	This calibration button connects a 1000 Hz calibration tone to the outputs so that the recording level of a connected tape deck can be accurately adjusted. The 1000 Hz CAL TONE corresponds to the maximum output level. This maximum level is system-dependent and will not be exceeded even by short peak pulses.
[13] AUTOSTOP	Interrupts the playing sequence at the end of the current selection or program step. The laser pickup is automatically positioned at the beginning of the next selection. The next selection is started immediately when PAUSE ▼▲ [15] is pressed. Upon conclusion of this selection, the CD player switches again to PAUSE mode.
[14] Key ▶	Repositions the pickup from any location toward the end.
[15] ▼▲ (pause)*	Interrupts the playing sequence at any time.
[16] ◀ key	Repositions the pickup from any location toward the start.
[17] DISPLAY	Switches over the display mode. The time elapsed since the start of the current selection is displayed in normal PLAY mode. The total play time from the start to the current selection can be displayed by pressing this key.

* These functions can also be programmed.

B PROGRAMMING keys

[18] LOOP *	Command key for repeating the CD or the program until STOP [3] is pressed.
[19] +	Forward "paging" in program mode. Particularly useful for modifying an existing program.
[20] -	Same function as [19] but backward paging.
[21] IR SENSOR	Infrared receiver window
[22] STORE	Memory load key to be pressed after each program step entry. The next program step is subsequently displayed so that the corresponding entries can be made.
[23] MARK	Allows a start and a stop mark to be set in programming mode while a selection is being played. Any CD location can thus be programmed.
[24] TRACK/TIME	Switches the display in programming mode from selection (track) input to time input (minutes and seconds).

- [25] CURSOR Any position on the display can be edited by approaching it with the cursor. NOTE: if the display is in TIME mode, the cursor must be advanced with this key in order to enter the seconds after the minutes.
- [26] PROGRAM Sets the program entry mode. If PLAY/NEXT [4] is pressed after the program entries have been completed, the CD player starts in PROGRAM mode.
If the CD player is to be started in normal mode after the program entries have been completed, press the PROGRAM key [26] again before PLAY/NEXT [4].



1.1.3 Rear-panel connectors

- [30] AUDIO OUTPUT FIXED. Output for connecting an amplifier on which the input can be matched to the level of the CD player (the REVOX B251 amplifier is ideally matched at the factory).
- [31] AUDIO OUTPUT VARIABLE. Active speakers or an output stage, etc. can be connected directly to this output. The volume can be adjusted with VOLUME + and - on the front panel of the CD player.
- [32] AC POWER. Power inlet (the setting of the line voltage selector can be checked adjacent to it).
- [33] REMOTE. This connector can be used for: a) disabling the IR receiver and b) connecting a cable-type remote control device.

2. REMOVAL OF ASSEMBLIES

Important:

Disconnect the CD player from the AC supply before removing any parts of the housing. For certain work it is necessary to open or close the drawer module. This can be done manually without damaging the unit.

2.1 Removing the top cover

- Unfasten five screws [A] on the rear of the CD player.
- Withdraw cover toward the rear.

2.2 Removing the side panels

- Unfasten two screws on each side panel in order to remove them.

2.3 Removing the individual circuit boards

The circuit boards are accessible when the top cover is removed (Section 2.1).

The circuit boards 1.769.280 (DAC PCB), 1.769.300 (DECODER PCB), and 1.769.330 (SERVO 2 PCB) can be pulled out of the interconnection board after the fixing screws [B] have been unfastened.

Four connectors must be detached before the PCB 1.769.320 (MICROPROCESSOR) is removed. Then unfasten screw [B] and withdraw the PCB from the housing toward the rear.

The SERVO 1 PCB 1.769.310 is connected to the chassis via the cooling plate of the voltage regulators. First detach all connectors leading to this PCB. Push the drawer out completely in order to gain access to the three fixing screws. The three screws [C] can subsequently be unfastened and the PCB withdrawn toward the rear.

2.4 Removing the player mechanism

- Remove top cover (Section 2.1)
- Push drawer out part of the way and set the CD player upside down.
- Now pull the drawer out to the point where the screws [D] become accessible.
- Unfasten screw [D] and set the CD player again in its normal operating position on the bench (NOTE: hold the player mechanism with your hand to prevent it from falling out of the drawer).
- Pull drawer out completely and carefully lift the CD player.

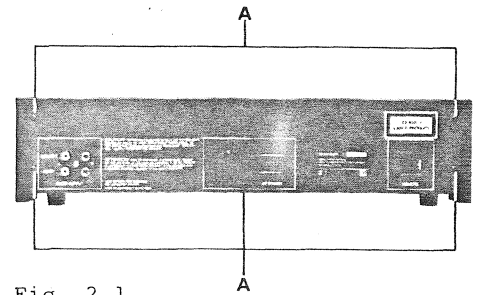


Fig. 2.1

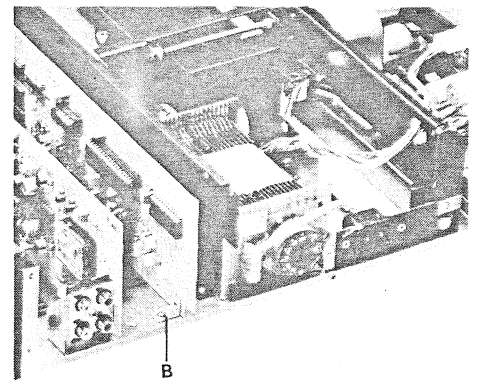


Fig. 2.2

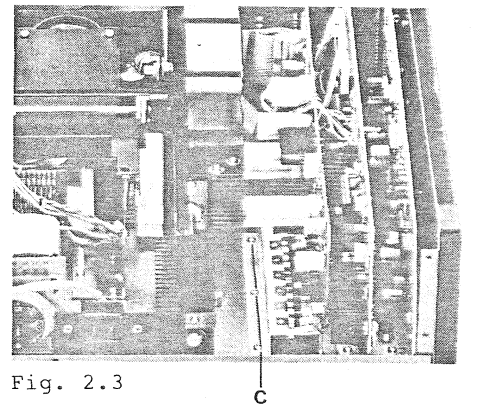


Fig. 2.3

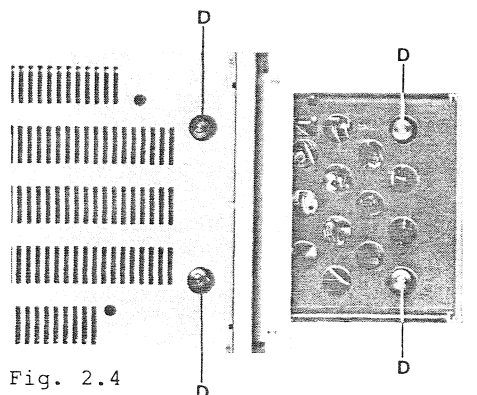


Fig. 2.4

- Detach the six connectors (see Fig. 2.5).
- The player mechanism can now be lifted out of the drawer.

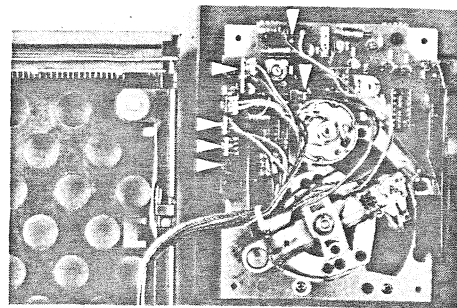


Fig. 2.5

2.5 Removing the display

- Open the drawer and unfasten two screws [E] on each side.
- Unfasten cable clamp [F] and detach connector of cable harness. The display can now be lifted out by carefully sliding the cable harness out below the player mechanism.

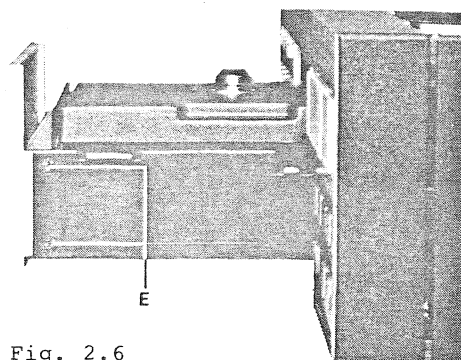


Fig. 2.6

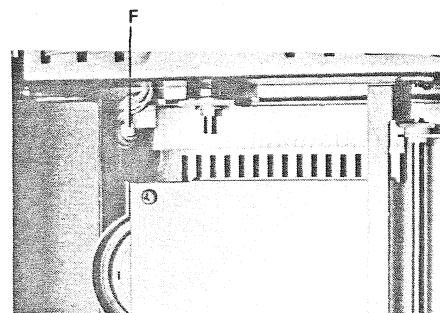


Fig. 2.7

2.6 Removing the power transformer

- Remove top cover (see Section 2.1).
- Unfasten four screws [G] from the bottom.
- Detach the connectors of the power transformer to the SERVO 1 PCB 1.769.310, remove power inlet by unfastening the two screws and unfasten screw [H] (black cable, soldering tag).
- The transformer can now be removed.

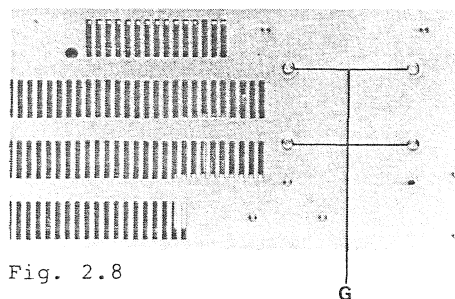


Fig. 2.8

2.7 Removing the drawer motor

- Remove top cover (see Section 2.1).
- Remove power transformer (see Section 2.6).
- Unfasten three screws [H] from the top, unhook spring [I], detach connectors leading from the motor to the microprocessor PCB 1.769.320, and carefully lift out the motor.

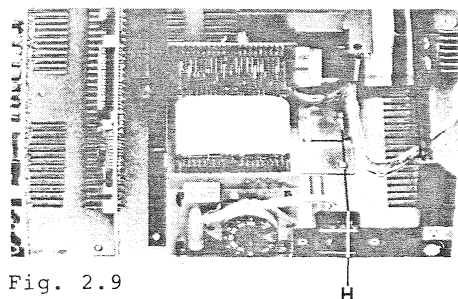


Fig. 2.9

2.8 Removing the operating panel

- Remove top cover (Section 2.1) and side panels (Section 2.2).
- Unfasten four screws [K] each on the top and the bottom of the operating panel.
- Carefully withdraw operating panel from the chassis and detach the connectors.

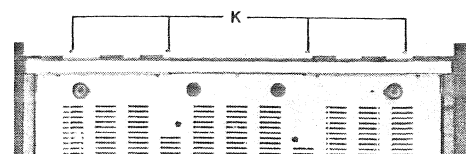
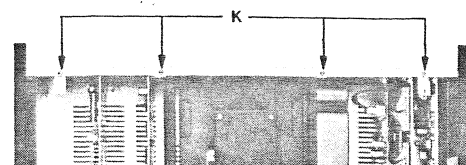


Fig. 2.10

2.9 Removing the guide rods

- Remove top cover (see Section 2.1).
- Unfasten the inner retaining ring [L]; the rod can now be pulled out of the unit from the rear.

Note: Do not lose the small O-ring that cushions the drawer stop.

2.10 Reassembly

The CD player is reassembled by following the dismantling steps in the reverse order. It is absolutely essential to secure the cable harness in the drawer with a clip as illustrated in Fig. 2.7.

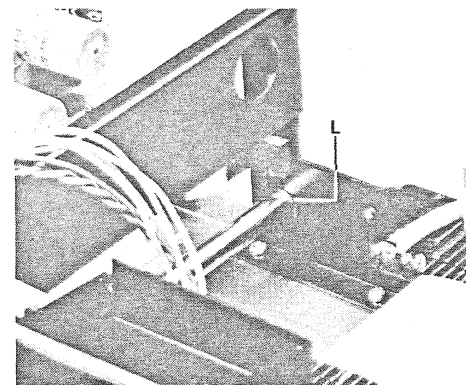


Fig. 2.11

3. CIRCUIT DESCRIPTIONS

3.1 SERVO 1 PCB 1.769.310

The following circuits are implemented on the SERVO 1 PCB:

- Stabilization of the supply voltages
- Drawer position detector
- Focus control loop
- Disc motor control loop

3.1.1 Stabilization of the supply voltages

All supply voltages are stabilized by voltage controllers (IC 4 to IC 9, LM317/LM337).

The +5V supply (+5 V STBY) is always available. It supplies the microprocessor system and the IR receiver even when the CD player is switched off (standby). The remaining supply voltages are switched on or off by the microprocessor with the PS-OFF signal. When the CD player is switched off, PS-OFF becomes "H" (+5 V) and transistors Q9 and Q10 become conductive (saturated), causing the +5 V and +12 V supply voltages to drop to a residual voltage of 1.3 V. The -7 V supply is switched off through the circuit R38, R39, and Q8; the -12 V supply via R52, R54, and Q11; and the -17 V supply via R51, R53, and Q12. This prevents the positive supply voltages from becoming negative. The voltage is doubled through diodes D15, D16, D17 and capacitors C29, C30, and taken to the voltage controller IC9 for the -17 V supply. D18 protects the controller from an excessive direct-axis component of the voltage.

3.1.2 Drawer position detector

The two light barriers DLQ1 and DLQ2 (on PCB 1.769.310) check whether the drawer is open or closed. The corresponding signals indicate the following conditions:

Position	DRA-POS-B	DRA-POS-F
closed	L	L
half way	H	L
open	H	H

L = 0 V
H = +5 V

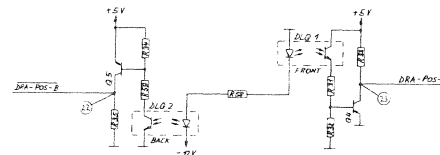


Fig. 3.1

3.1.3 Focus control loop

The lens can be moved vertically and is designed similar to the mechanical system of a speaker. The lens is controlled magnetically. The coil is stationary and the magnet moves. The focus error signal FOC-ERR is first amplified (lead amplifier IC2a, R3, R12, R16, R17, C3, C4) and subsequently taken to the controlling amplifier ("lag" amplifier R1, R2, R5, R11, R15, R29, R30, C2, C12, IC2b, Q6, Q7 and the impedance of the lens coil). In STOP mode, the control loop is interrupted via Q1 by the signal FOC-0 (= H) which means that no unnecessary power is consumed by the output amplifier (Q6 and Q7).

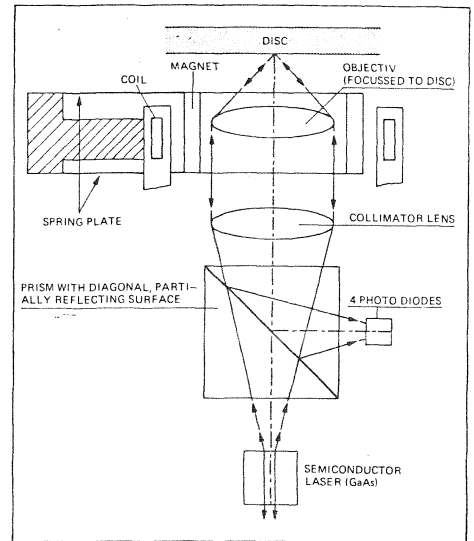


Fig. 3.2

The start-up circuit (IC1, R6, R7) adjusts the focussing to the reflective layer of the compact disc. The signals FC=1 and FC-2 are alternately switched to "H", causing the lens to move alternately up or down. Once the correct focus has been found, the signal FOC-NEG briefly drops to "L". The microprocessor then enables the focus control loop (FOC-0, FC-1, and FC-2 = "L"). Up to 12,000 tracks per second are skipped in fast search mode. Because the focussing lens readjusts for each track, a whistling sound of approximately 12 kHz would develop as is the case with a speaker. This whistling sound is eliminated by R60, R61, C31, Q13 in the control loop. This filter is only active in search mode.

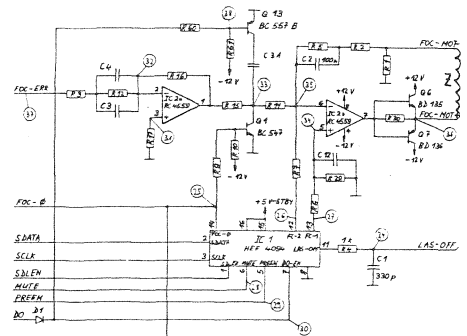


Fig. 3.3

3.1.4 Disc motor control loop

The data from the compact disc must be supplied as steadily as possible to the digital signal processing circuit. The speed with which these data (bits) arrive depends on the position of the laser pick-up (constant peripheral speed between 1.2 and 1.4 m/s). If the laser pick-up reads in the middle of the CD, the speed is much higher than near the edge. The speed correction signal MCES is generated in the error correction IC (SAA 7020 on PCB 1.769.300).

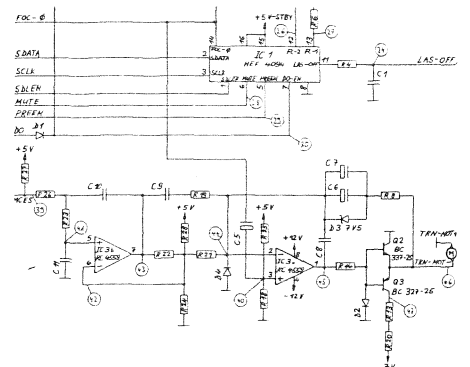


Fig. 3.4

The signal MCES is switched off or on via the signal FOC-0 (R15, R16, IC3b on PCB 1.769.330). The signal is first filtered via a 2nd order low pass (R22, R23, R25, R26, R28, C10, C11, IC3b). The "lead network" is formed by C9, R19, R21, R24, and R28, the "lag network" by IC3a, C6, C7, R8, Q2, and Q3. As soon as the focal point has been found, the signal FOC-0 changes to "LOW" and the signal MCES is enabled. A negative pulse via C5 is simultaneously triggered on IC3a, pin 3, thereby fully driving transistor Q3 in order to rapidly accelerate the compact disc. The speed is subsequently controlled by the MCES signal.

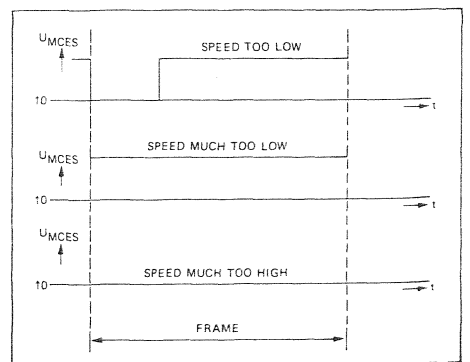


Fig. 3.5

3.2 Microprocessor PCB 1.769.320

The microprocessor system and the drawer control are implemented on the microprocessor PCB 1.769.320.

3.2.1 Microprocessor system

The master microprocessor (M- μ P, IC2) scans the keyboard (P00 to P05, P10 to P14). The microprocessor system is reset when the LOAD key is pressed. To enable differentiation between a power failure and a LOAD command, P15 of the master processor is also pulled to "L" in conjunction with a LOAD command. Capacitor C12 latches this condition until P15 is read. This unconventional circuit arrangement offers the advantage that a RESET command can be initiated at any time by pressing the LOAD key in the event that the system becomes blocked for any reason.

The commands from the IR receiver or the REMOTE socket are read through the interrupt input of the master processor. When a command arrives from the IR remote control, the IR-REC signal is switched to "LOW" for approximately one second, causing the LED in the IR receiver window to turn on (command acknowledgment). The signals DRA-POS-B and DRA-POS-F supply the processor with drawer position information.

The signals CLK, DATA, DLEN-1, and DLEN-2 control the two LCD drivers PCE 2111 (on PCB 1.769.250).

The gain of the headphones amplifier and the VARIABLE OUTPUT is controlled by the signals CLK, DATA, and DLEN-3 (on PCB 1.769.280).

The slave microprocessor (S- μ P, IC4) processes the subcode (supplementary information on the compact disk such as track, time, etc.). The required signals originate from PCB 1.769.300 (IC13, SAA 7010, signals Q-SYNC, SWCLK, Q-DATA, and P-BIT).

The signals RC-0 and RC-0 switch the radial-control loop on or off. When the radial control loop is switched off (RC-0 = L), the laser pick-up can be repositioned with the signals RC1, RC2, CUR-SUM, and CUR-DIR.

The track signal (TRK) is read through the interrupt input of the slave processor. This signal changes to "L" as soon as the laser pick-up passes over a track. The direction in which the laser pick-up moves is reported to the slave processor by the signal T1. This signal also changes to "L" as soon as the laser pick-up passes over a track. It is also used in search mode for counting the tracks. Because the counting speed of the microprocessor is not high enough, only every other track is counted in fast search mode (division by 2, IC6b). Any program entered through the keyboard is stored serially in IC5 (serial RAM).

Both microprocessors are initialized by IC1 (reset chip TL 7705). The +5 V STBY supply is supervised by IC1 via pin 7. A reset is also initiated via R1, R8, and C8 when the LOAD key is pressed.

Commands from a cable-type remote control can be read through the REMOTE socket (pin 2 and pin 3). These commands are electrically isolated through the optocoupler IC 12a. These signals are converted to TTL signals by the comparator circuit (IC9a, R44, R45, R48, and R60). In order to disable the commands from the infrared receiver, the voltage at pin 4 must be higher than on pin 2 by +5 V. The +5 V STBY of the REMOTE socket can be used for this purpose (interconnect pins 1 and 2, pins 4 and 5). The IR signal is thus short-circuited via DLQ2, R41, R42, R43, R62, and IC9b.

3.2.2 Drawer motor control

The drawer motor amplifier (IC10a, R52,53,56,57, and R58, C14, Q8 and Q9) is controlled through the shift register IC3 (pins 4 and 5). If the drawer movement is blocked during the opening or closing operation, the motor current rises and hence the voltage across R64. Signal T1 of the master processor consequently changes to "L" (circuit R40,54,55,59,63, Q6, Q7, C13, and IC10b). In response the master processor reverses the direction of the drawer movement.

3.3 SERVO-2 PCB 1.769.330

The SERVO 2 PCB 1.769.330 contains the circuits for radial control and the IR receiver.

3.3.1 Radial control

A moving arm allows the laser pick-up to follow the track horizontally. This arm basically functions like a moving coil instrument.

The radial-control circuit can be subdivided into four blocks:

- Radial control circuit
- AGC circuit
- Offset control circuit
- Track detection circuit

3.3.2 Radial-control circuit

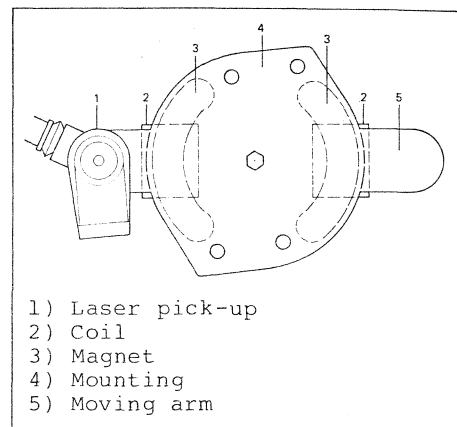
The value of the radial-error signal can be computed as follows: $RE = kd (I1 + I2 + I3 + I4) - k (I1 + I2)$. The value of k is determined by the AGC circuit, and d by the offset control circuit.

$$RAD-ERR2 = I1 + I2$$

$$RAD-ERR1 = I3 + I4$$

The signals RAD-ERR1 and RAD-ERR2 are summed via the circuit IC9b, R58/59/61/62/63 and Q6. The sum flows as a current through R63 and Q6. The error signal RAD-ERR 2 is converted via R55 and R57 to a current that flows through R54 and transistor E of IC8. The factor k is formed by transistors A and B as well as C and D (IC8), factor d is formed by Q5 and transistor F (IC8).

The signal $RAD-ERR 2 \times k (=k [I1 + I2])$ on pin 10 of IC9c appears on pin 9 of IC9c; the signal $[RAD-ERR1 + RAD-ERR2] kd (= kd [I1 + I2 + I3 + I4])$ appears on pin 10 of IC9c. The difference signal (RE), developed in IC9c, appears on Pin 8 ($RE = kd [I1 + I2 + I3 + I4] - K[I1 + I2]$). The "lag" network of the radial control is implemented by R66, R67, R68, C15, and IC9d, the "lead" network by R69, R70, and C16. The signal is conducted to IC5 through the protective diodes D5 and D6. The signal is taken through switch B (IC5) to pin 2 of IC2 which together with Q2, Q3, R6, R7, R8, RT1, and C5 constitutes the output stage for the radial-control signal RAD-MOT+/RAD-MOT-. RT1 protects the coil. The control can be disabled (Signal RC-O). This occurs in search, pause, forward and reverse mode. The laser pick-up can be positioned during this phase with the signals RC-1, RC-2, CUR-DIR, and CUR-SUM.



- 1) Laser pick-up
- 2) Coil
- 3) Magnet
- 4) Mounting
- 5) Moving arm

Fig. 3.6

3.3.3 Automatic gain control (AGC) circuit

The bandwidth of the radial-control circuit is stabilized by this circuit. A 650 Hz sine-wave signal is generated in the circuit IC10c, IC11d, C22, C23, C24, C25, R85, R86, R87, R90, and R91. As the gain increases or decreases the phase relation of the supplied signal becomes also larger or smaller with respect to the returning signal. The two signals are compared in the phase detector (IC11) and a new signal is developed. The latter is proportional to the phase and also to the gain. This signal controls the factor k. The gain is laid out for a phase shift between the signals of -135° . The 650 Hz sine-wave signal is therefore fed into the control loop at pin 13 of IC9d through a 45° phase shifter (R84, C21). The phase shift is 90° at the input of the phase detector. The 650 Hz sine-wave signal is eliminated from the control circuit through a bandpass (IC10d, R82, R83, C19, C20) and converted in IC11a to a square-wave signal. This square-wave signal is input to the phase comparator (IC11c, pin 8). The phase reference is supplied by pin 9 of IC11c.

3.3.4 Offset control circuit

The asymmetry of the reflected laser beam is corrected by this circuit to ensure that the laser beam is kept exactly on the center of the track. The difference between minimum and maximum reflection is the greatest (presence of pit = minimum reflection, between pits = maximum reflection) when the laser beam follows exactly the center of the track.

Through the 650 Hz sine-wave signal the moving arm oscillates with an amplitude of $0.05 \mu\text{m}$. If the laser beam is on the track center, all half-waves of the filtered out signal are folded to the same (positive) side. If the laser beam is to the right of the track center, the signal is in-phase with the 650 Hz oscillations of the moving arm, or antiphase if the beam is on the left of the track center.

The voltage across R63 is proportional to the reflected light intensity ($I_1+I_2+I_3+I_4$). The voltage is amplified through IC6a, R30, R31, and R64, and the 650 Hz component is filtered out in a bandpass (R32, R33, R34, R35, R37, C11, C12, and IC7b). The filtered signal is inverted through IC7a, R36, and R38. The former and the noninverted signal are taken to switch C of IC5. The output of this switch (IC5, pin 4) is integrated through IC7d and C30 and determines the factor d (Q5 and transistor F of IC8). The status of switch C (IC5) is controlled by the 650 Hz signal in the control loop via the bandpass R42, R43, R44, R45, C13, C14, D4, and IC7c.

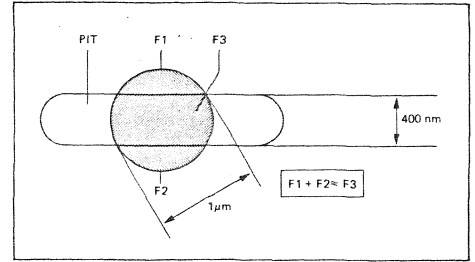


Fig. 3.7

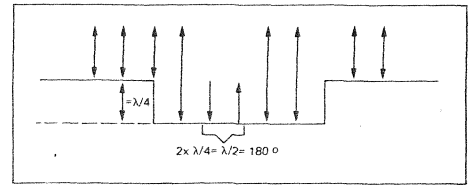


Fig. 3.8

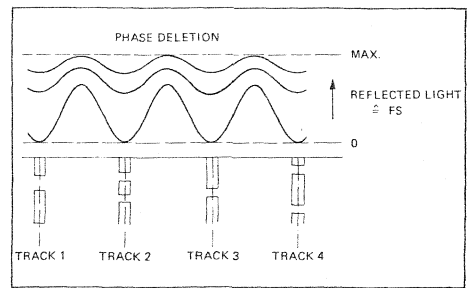


Fig. 3.9

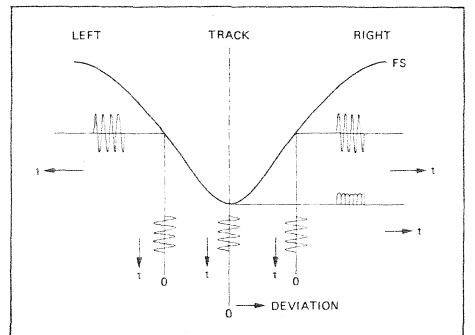


Fig. 3.10

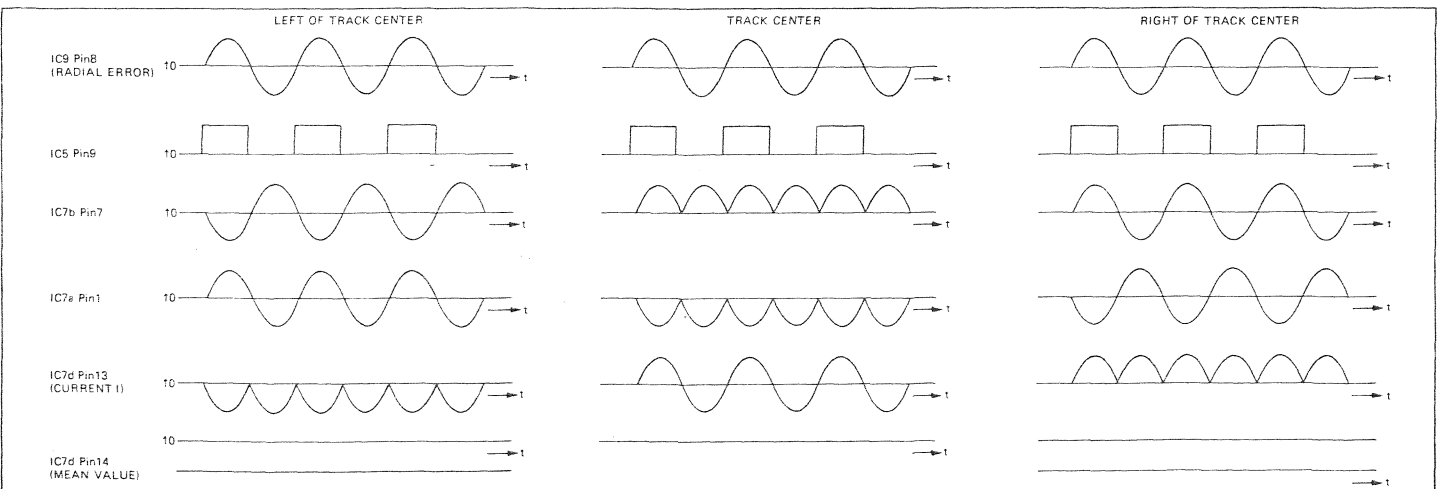


Fig. 3.11

3.3.5 Track detection circuit

The tracks which are skimmed over by the laser pick-up are read through the interrupt input of the slave processor (TRK-SIG). This signal is generated from the signal available at IC6, pin 1 (proportional to $I_1 + I_2 + I_3 + I_4$), the DO and the HFL signal. The signal DO is "L" when no error location is detected on the CD.

The HFL signal is "H" when the HF signal is large enough. The TRK signal is only "L" when the HF signal is too small. For each skipped track, HFL is "L" if no error location is detected on the CD (DO="L"). The radial-error signal RE (IC9c, pin 8) informs whether the laser scanner is positioned to the left or the right of the track. The signal required for this purpose (RAD-POS) is generated via IC3c, R12, R19, and R20 from the radial-error signal.

3.4 Preamplifier and laser PCB 1.769.100.35

This board comprises the following circuits:

- Laser control
- Signals for focus and radial control
- HF signal amplifier

3.4.1 Laser control

The laser diode is supplied via Q4. The intensity of the laser light can be checked through the "monitor photo diode" and adjusted with the trimmer potentiometer R80.

The signal LAS-OFF (from PCB 1.769.310 / IC1) switches the laser on or off. If the intensity of the laser becomes too small, the current flowing through the monitor photodiode decreases correspondingly. The voltage across R84 also drops. The output of opamp IC3a consequently becomes more positive and Q4 more conductive. The intensity of the laser is adjusted by discharging some of the current through the monitor photodiode via R80 and R81.

3.4.2 Focus and radial-control signals

The following signals are generated by this circuit:

- FOC-ERR
- RAD-ERR1
- RAD-ERR2

The currents of the four photodiodes (A1 to A4) are amplified in IC1. The corresponding error signals are developed by the subsequent network. The focus error signal is proportional to $(I_1 + I_4) - (I_2 + I_3)$. $I_3 + I_4$ constitutes the RAD-ERR1 signal, $I_1 + I_2$ the RAD-ERR2 signal. The gain of the focus control loop can be adjusted with R58, the balance with R41 (not included in all versions).

3.4.3 HF signal amplifier

The circuit comprising transistors Q1 through Q7 constitutes the signal amplifier with bandpass characteristic. Low-frequency (e.g. control signals of the servos) and high-frequency disturbance signals are consequently filtered out.

3.5 Decoder PCB 1.769.300

The decoder PCB contains the following circuits:

- Digital signal processing
- Digital sine-wave generator
- HFL and DO detector

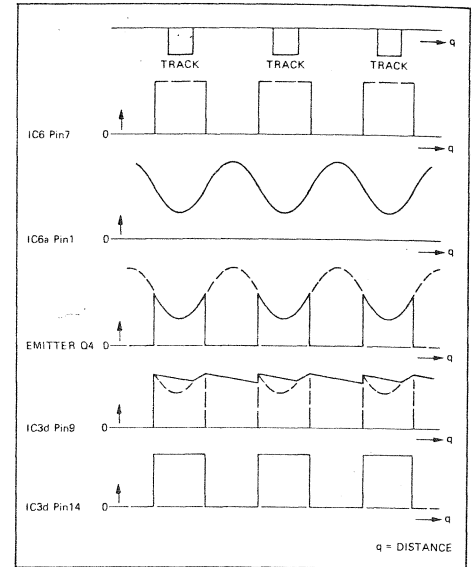


Fig. 3.12

3.5.1 Digital signal processing

The HF signal is converted in IC13 (SAA 7010) into digital signals and split into audio and information data (subcode, for the slave processor). The CLOCK signal is also regenerated in IC13. The audio data are brought into the correct time slot pattern. Corrupted audio data are not recognized in IC12 and corrected if necessary. Should the errors be incorrigible, the missing sample values are replaced in IC10 (SAA 7000) through interpolation. Should this also be infeasible, the HF signal is slowly muted (soft muting). The speed of the CD motor is controlled by the signal MCES (IC1, pin 4).

3.5.2 Digital sine-wave generator

The PROM (IC4) contains a value table for the sine-wave signal which represents the maximum possible level of a CD.

The circuit consists of IC5 through IC9 with IC5 and IC6 supplying the addresses for the PROM. Parallel/serial data conversion is performed in IC3. The change-over between audio data from the CD and the 1 kHz sine-wave signal is controlled by IC1.

3.5.3 HFL and DO detector

The HF signal is fed into the inverting differential amplifier Q1 and Q2 through C6 and R2. The output signals are DC-decoupled via C8 and C9 respectively and tied to DC ground via D2 and D3. D4 and D5 or D6 and D7 respectively constitute a full-wave rectifier each through which the capacitors C10 or C11 are charged. With a normal HF signal the DO signal is "L" and the HFL signal is "H". If the HF signal drops to approximately 70% of the normal value, the HFL signal also changes to "L". Only when the HF signal drops to approximately 10% of the normal value does the DO signal change to "H".

To prevent the output signals of IC11 from being influenced too strongly by minor contaminations (e.g. fingerprints) on the CD, transistor Q3 has been added to the output. When the RF level is at nominal value, pin 7 of IC11 is "H". Q3 becomes conductive and the circuit with C11 receives a smaller time constant. With level fluctuations caused by minor contaminations, the levels of the two input capacitors fluctuate in parallel, but neither the DO nor the HFL signal are affected.

3.6 DAC PCB 1.769.280

The following circuits are implemented on this PCB:

- Digital filtering (oversampling) and digital/analog conversion
- Level adjustment and headphones amplifier

3.6.1 Digital filtering (oversampling) and D/A conversion

IC1 (SAA 7030) contains two identical filters for both channels. These filters feature 3 sections:

- Oversampling section
- Transversal digital filter
- Noise shaper

After each scanning cycle, the new sample values are inserted by interpolation into the 16-bit information arriving from the decoder. The scanning rate thus becomes 4 times greater ($4 \times 44.1 \text{ kHz} = 176.4 \text{ kHz}$). The spectral lines above 20 kHz up to 176.4 kHz - 20 kHz are filtered out by the transversal filter. The sample values are truncated to 14 bits. The noise shaper subsequently delays the truncation error by the scan duration and negatively added to the next sample value. The quantizing noise caused by truncation is thereby largely shifted toward the frequency range above 20 kHz. The digital signal is converted in IC101 or IC201 (TDA 1540) to an analog signal. In order to filter out the residual frequency component at $n (176.4 \text{ kHz} \pm 20 \text{ kHz})$, a low pass of the third order (Bessel filter) has been added to the converter output.

The preemphasis is corrected with the circuit illustrated in Fig. 3.13. The subcode on the CD specifies whether the selection was recorded with or without preemphasis. The characteristic of the corresponding filter can be adjusted with the PREEM signal.

3.6.2 Level adjustment and headphones amplifier

The volume is controlled by a DUAL D/A converter (AD7528). It serves as an attenuator before the corresponding input (IC103a, pin 2 = left-hand channel / IC 203b, pin 6 = right-hand channel). The negative-feedback resistances of both opamps remain unchanged which means that the level can only be attenuated with this circuit. The dual D/A converter is controlled by a CMOS shift register through the signals DLEN-3, DATA, and CLK. The circuit illustrated in Fig. 3.14 constitutes the output amplifier for the headphones socket and also the VARIABLE OUTPUT. The signal is also attenuated for this purpose through a voltage divider so that the signal is the same (2 V RMS) at both outputs (FIXED and VARIABLE). The signal is taken through relay K1 in order to prevent power-on switching clicks. When power is applied, the relay is selected by the KILL signal (which rises to +5 V after approximately 1 to 2 seconds). As a result, the outputs are only through-connected when the supply voltages are stable.

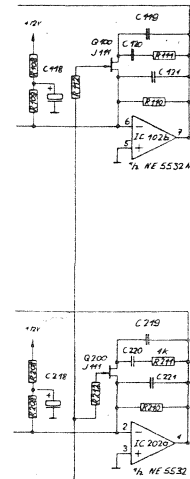


Fig. 3.13

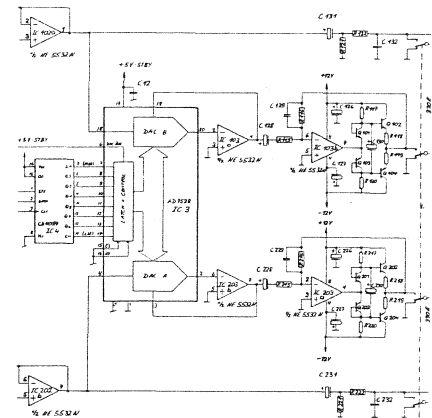


Fig. 3.14

4. TEST POINTS, ADJUSTMENTS ON B225

4.1 Test points on B225

4.1.1 Test points on SERVO 1 PCB 1.769.310

TP	POWER-ON	POWER-OFF
1	+5V +/-5%	+5V +/-5%
2	+5V +/-5%	+1.3V
3	-7V +/-5%	-1.3V
4	+12V +/-5%	+1.3V
5	-12V +/-5%	-1.3V
6	-17V +/-5%	-1.3V

TP	POWER-ON		POWER-OFF	
	Vmin.	Ripple	Vmin.	Ripple
7	+12V	0.8V	+13.5V	0.3V
8	-14V	0.3V	-15V	0.1V
9	+18V	0.8V	+21V	0.2V
10	-18V	0.8V	-21V	0.2V
11	-27V	3.4V	-30V	0.9V

TP 7 to TP11, also refer to Fig. 4.1

TP	POWER-ON	POWER-OFF
12	0V	+5V
13	0V	+0.7V
14	+1.6V	-0.7V
15	0V	+0.7V
16	+6.5V	-0.7V
17	+6.5V	-0.7V
18	14V	15V
19	14V	15V
20	20V	22V
21	20V	22V

TP13 to TP21, also refer to Fig. 4.2

TP	Drawer position		
	closed	half way	open
22	0V	+5V	+5V
23	0V	0V	+5V

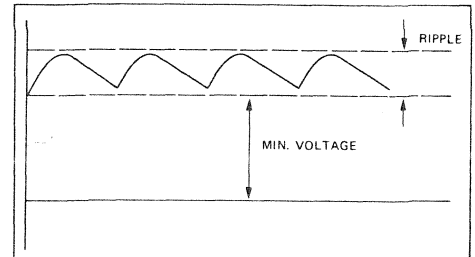


Fig. 4.1

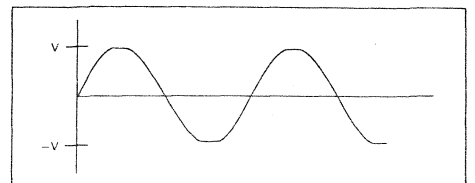


Fig. 4.2

TP	PLAY- Mode	STOP- Mode	TP	PLAY- Mode	PAUSE/SEARCH
24	0V	+5V	28	+5V	0V
25	0V	+5V			
26	0V	0V			
27	0V	0V			

If no CD is mounted when PLAY is selected, the signals on TP26 and 27 become +5V in four intervals of approximately one second each.

TP	Preemphasis	TP	PLAY- Mode	SEARCH
	yes no	30	+5V	0V
29	+5V 0V			

TP	PLAY- Mode	STOP- Mode	TP	PLAY- Mode	SEARCH
31	0V	0V	38	2.6V	-0.7V
32	0V	0V			
33	0V (*)	0V			
34	0V	0V			
35	0V (*)	0V			
36	0V (*)	0V			
37	0V (*)	0V			

(*) In PLAY- mode, the signal pattern of these test points depends on the wobble of the mounted compact disc.

TP	PLAY- Mode	STOP- Mode	
39	7.5kHz (a)	0V	(a) = TTL- square-wave signal
40	+2.5V	+2.5V	
41	+2.7V	+0.1V	
42	+2.7V	+0.6V	
43	±2Vpp (b)	-11V	(b) = Control signal
44	+2.5V	+0.6V	
45	-2.8V (c)	+8.2V	(c) = Control signal, 0.8V superposed
46	-2V (c)	0V	
47	-6.5V (d)	-7V	(d) = Control signal, 0.3V superposed

4.1.2 Test points on SERVO 2 PCB 1.769.330

TP	STOP- Mode	PLAY- Mode	
1	0V	-1V	
2	0V	-1V	
3	0V	0V	
4	0V	0V	
5	0V	+0.6V	
6	0V	+0.3V	
7	0V	+4.4V	
8	0V	-2Vpp	(see Fig. 4.3 D)
9	0V	-2Vpp	(see Fig. 4.3 D)
10	0V	-2Vpp	(see Fig. 4.3 B)
11	0V	-2Vpp	(see Fig. 4.3 A)
12	+0.1V	0V	
13	-12V	+6V	
14	0V	650Hz TTL	(Square wave, see Fig. 4.3 C)
15	+9.5V	+3.4V	
16	+9.5V	+3.4V	
17	0V	1Vpp 650Hz	(sine)
18	0.4Vpp 0.2V DC	0.6Vpp	(sine 650Hz)
19	0V	+5V	
20	+5V	0V	
21	+5V	0V	Search mode: intermittent +5V
22	0V	0V	pulses up to +1V
23	0V	0V	pulses up to +5V
24	0V	0V	pulses up to +5V
25	+0.1V	0V	
26	+0.1V	0V	
27	+1V	4Vpp 650Hz sine	
28	9Vpp 650Hz sine, 3VDC	9Vpp 650Hz sine, 3VDC	
29	650Hz TTL	650Hz TTL	(Square wave, see Fig. 4.3 E)
30	650Hz TTL see Fig. F	650Hz TTL see Fig. H	
31	+8.7V	+8.7V	
32	+2.5V	+2.5V	
33	1300Hz TTL (Fig. G)	1300Hz TTL (Fig. I)	(Square wave)

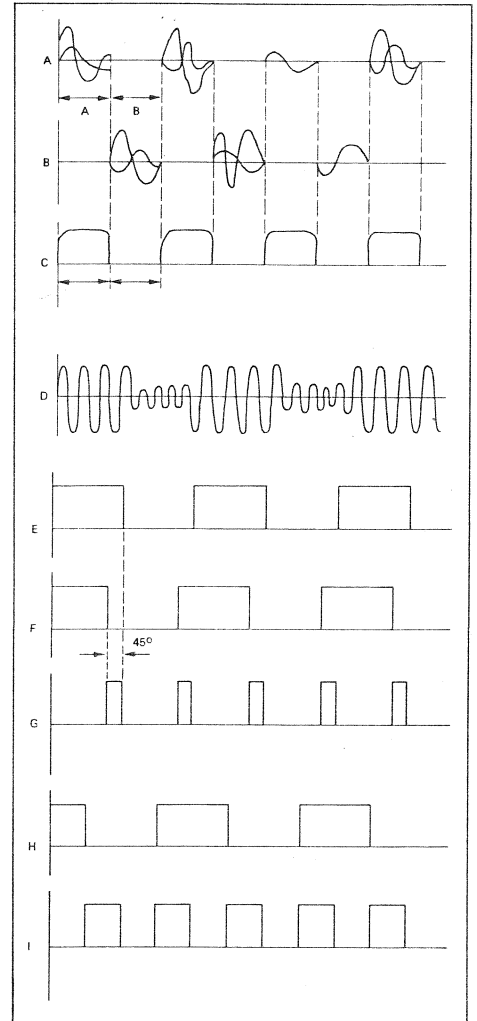


Fig. 4.3

34	+10.5V	-4V	
35	+2.5V	+2.5V	
36	+5V	+4.9V	
37	+5V (e)	+5V	(e) = The signal on TP37 briefly drops to 0V during the change-over from STOP to PLAY
38	650Hz TTL squ. wave	650Hz TTL squ. wave	
39	+0.8V	0V	search mode: 0V
40	+0.2V	+5V	alternating 0V/5V
41	0V	+5V	alternating 0V/5V
42	+5V	0V	alternating 0V/5V
43	0V	+5V	alternating 0V/5V
44	+3.7V	+3.7 V	alternating 4V/8V
45	0V	+4.2V	alternating 3V/6V
46	0V	+3.5V	alternating 3.2V/5.6V
47	0V	+4.3V	

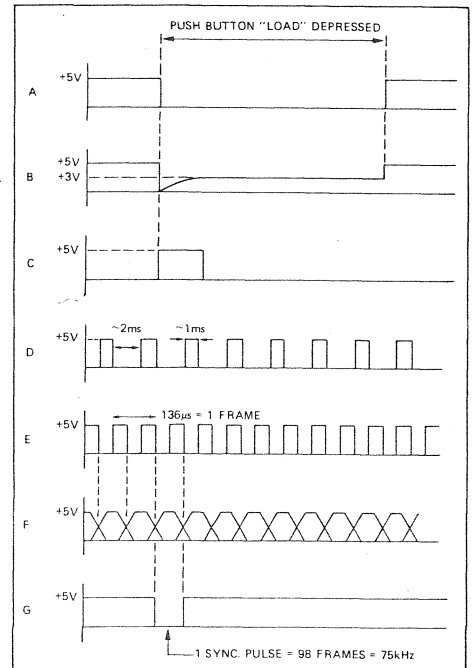


Fig. 4.4

TP	POWER-OFF	POWER-ON
48	+4.3V	+5V
49	+5V	0V
50	+5V	+5V
51	+0.4V	+0.4V
52	+0.3V	+0.3V

When signals are received from the IR- remote control, pulses of +4.3V occur on TP52.

4.1.3 Test points on MICROPROCESSOR PCB 1.769.320

TP	STOP-/PLAY-Mode	Drawer	
		opens	closes
1	0V	0V	+5V
2	0V	+5V	0V
3	0V	+10V	-10V
4	0V	+0.4V	-0.4V
5	+5V	+5V	+5V

During the opening and closing movement, direction change, and blocking of the drawer, the signal on TP5 briefly drops to zero.

TP	STOP-/PLAY-Mode	Pressing the LOAD key
6	+5V	0V (Fig. 4.4 A)
7	+5V	+3V (Fig. 4.4 B)
8	0V	+5V-pulse ca. 30ms
9	+5V	+0.7V (Fig. 4.4 C)

TP	No key pressed	Corresponding key pressed
10	0V	TTL- signal Fig. 4.4 D
11	+5V	TTL- signal Fig. 4.4 D

TP	Drawer		
	closed	half way	open
12	0V	+5V	+5V
13	0V	0V	+5V

TP	Without IR commands	With IR commands
14	+0.9V	3.8V- pulse

TP	PLAY- Mode	
15	3.8Vpp*	* = sine 4.4330MHz
16	3.5Vpp*	* = sine 6.0000MHz
17	+5V	(Drawer open = 0V)
18	+5V	(CAL. TONE 1000Hz = 0V)
19	TTL-signal	(Subcode synchronization 75Hz)
20	TTL-signal	\
21	TTL-signal	
22	TTL-signal	
23	TTL-signal	
24	TTL-signal	
24	TTL-signal	
26	TTL-signal	
27	TTL-signal	
28	TTL-signal	/

These signals are sporadic, (not periodic) and can thus not be represented. They are clock, data and enable signals.

TP	Pause from CD	No pause from CD
29	+5V	0V

TP	PLAY- Mode	Search	
30	+5V	0V*	* = for each skipped track
31	650Hz TTL	TTL-sig.	\
32	650Hz TTL	TTL-sig.	Tracks that are skipped
33	650Hz TTL	TTL-sig.	/
34	0V	+5V (a)	
35	+5V	0V (a)	a = intermittent
36	0V	+5V (a)	

TP	Socket	REMOTE
	open	Interconn. pins 1/2 and 4/5
37	+0.3V	+0.1V
38	0V	+5V
39	+1.7V	+1.7V
		Interconn. pins 1/2 and 3/5
40	+4.2V	+4.2V
41	+5V	0V
42	0V	+3.7V

4.1.4 Test points on DECODER PCB 1.769.300

TP	STOP- Mode	PLAY- Mode	
1	-0.7V	DC -0.7V, AC 1.4Vpp	(CD-data)
2	+5V	DC +3V, AC 4Vpp	
3	+5V	DC +3V, AC 4Vpp	
4	+2V	+2V	
5	+2.1V	+4.6V	
6	4.5MHz *	8.5MHz *	* = AC 3.3Vpp (sine), DC +1.8V
7	4.5MHz (a)	8.5MHz (b)	a = AC 1.9Vpp (sine), DC +1.8V b = AC 1.7Vpp (sine), DC +1.8V

During the change from PLAY to STOP, the frequency drops in approximately 20 seconds to 4.5MHz.

8	-7.9V	-7.9V	
9	-8.6V	-8.6V	
10	-7.9V	-7.9V	
11	-0.2V	+0.6V	
12	-0.5V	+4.3V	
13	-0.5V	+5.8V	
14	-0.3V	+0.1V	
15	+0.9V	+0.1V	Search. +0.1V
16	0V	+5V	0V * * Always when tracks are skipped

Test with reference CD part No. 46241

Black dots are located on track 17 of the disc surface. The following should be measured when this track is played:

TP	Measurement
15	+5V- pulses on the black dots
16	0V- pulses on the black dots

TP	PLAY- Mode
17	TTL- signal Fig. 4.5 D
18	TTL- signal Fig. 4.5 B
19	TTL- signal Fig. 4.5 A
20	TTL- signal Fig. 4.5 C
21	TTL- signal Fig. 4.6 F
22	TTL- signal Fig. 4.6 E
23	TTL- signal Fig. 4.6 G
24	TTL- signal Fig. 4.6 H
25	TTL- signal Fig. 4.7 K
26	TTL- signal Fig. 4.7 L
27	4.233MHz, sine 5Vpp
28	TTL- signal Fig. 4.7 M
29	TTL- signal Fig. 4.7 I
30	TTL- signal Fig. 4.8 O
31	TTL- signal Fig. 4.8 Q
32	TTL- signal Fig. 4.8 P
33	TTL- signal Fig. 4.8 P
34	TTL- signal Fig. 4.9 N
35	TTL- signal Fig. 4.9 R
36	TTL- signal Fig. 4.9 S
37	TTL- signal Fig. 4.9 T
38	TTL- signal Fig. 4.9 U
39	TTL- signal Fig. 4.9 V
40	-2.7V

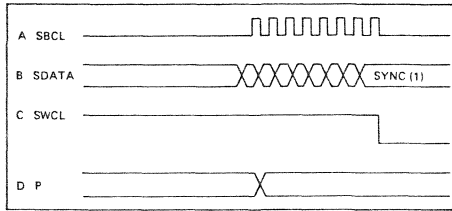


Fig. 4.5

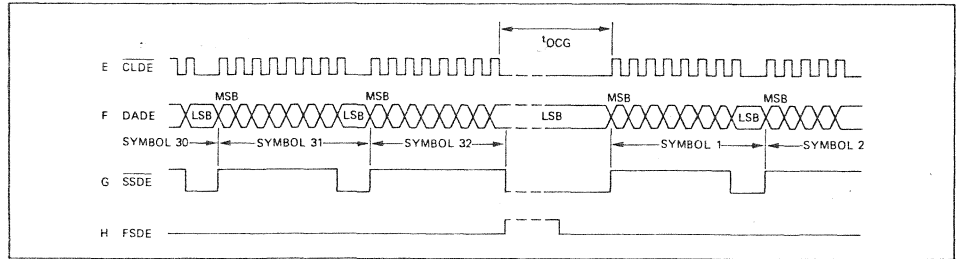


Fig. 4.6

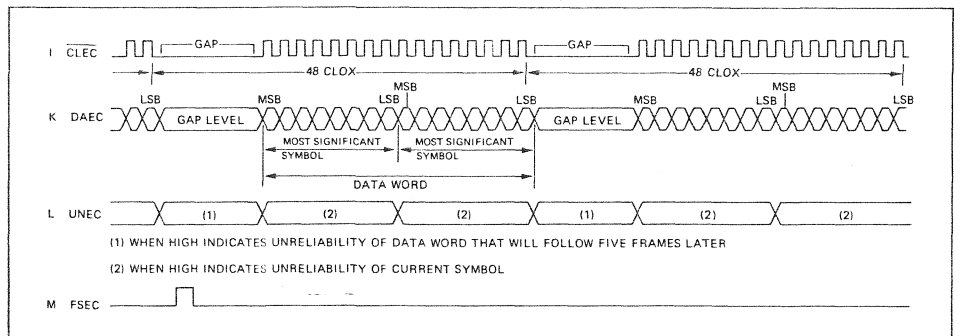


Fig. 4.7

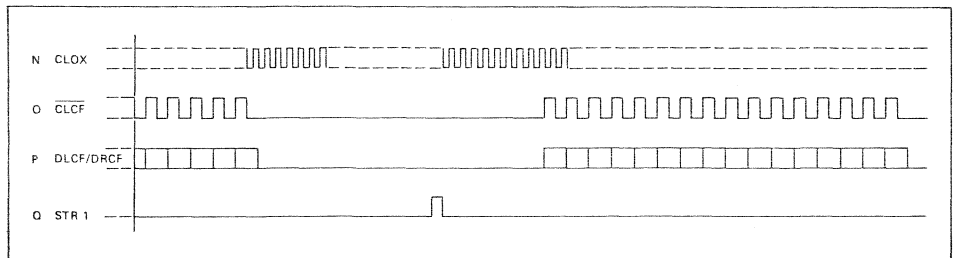


Fig. 4.8

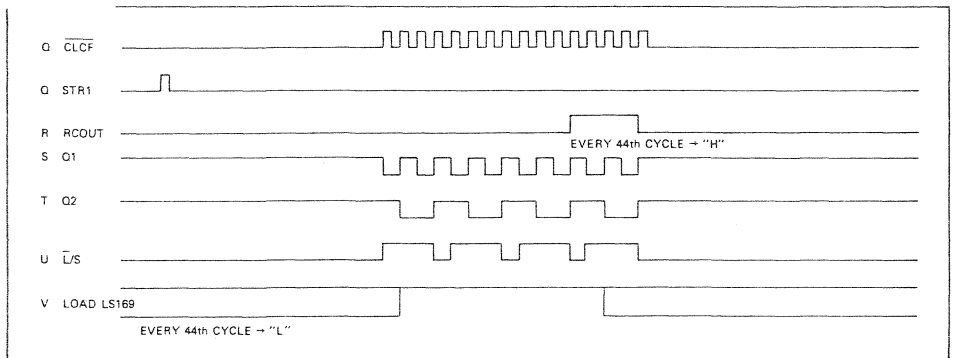


Fig. 4.9

4.1.5 Test points on DAC PCB 1.769.280

The internal calibration must be switched on for the following measurements:

TP	Measurement	
1	TTL- signal Fig. 4.10 A	
2	TTL- signal Fig. 4.10 B	
3	TTL- signal Fig. 4.10 C	
4	TTL- signal Fig. 4.10 D	
5	TTL- signal Fig. 4.10 E	
6	TTL- signal Fig. 4.10 F	
7	TTL- signal Fig. 4.10 G	
8	-5V 5%	
9	0V *	* +5V when playing a CD with preemphasis
10	-12V *	* +12V when playing a CD with preemphasis
11	sine 1kHz, 6Vpp	
12	sine 1kHz, 6Vpp	
13	sine 1kHz, 6Vpp	
14	sine 1kHz, 6Vpp	
15	sine 1kHz, 6Vpp	\
16	sine 1kHz, 14.5Vpp	
17	sine 1kHz, 14.5Vpp	
18	sine 1kHz, 6Vpp	
19	+5V *	* Drawer open = 0V
20	+12V *	* Drawer open = -12V

Maximum level; the level of these test points can be adjusted with the VOLUME keys.

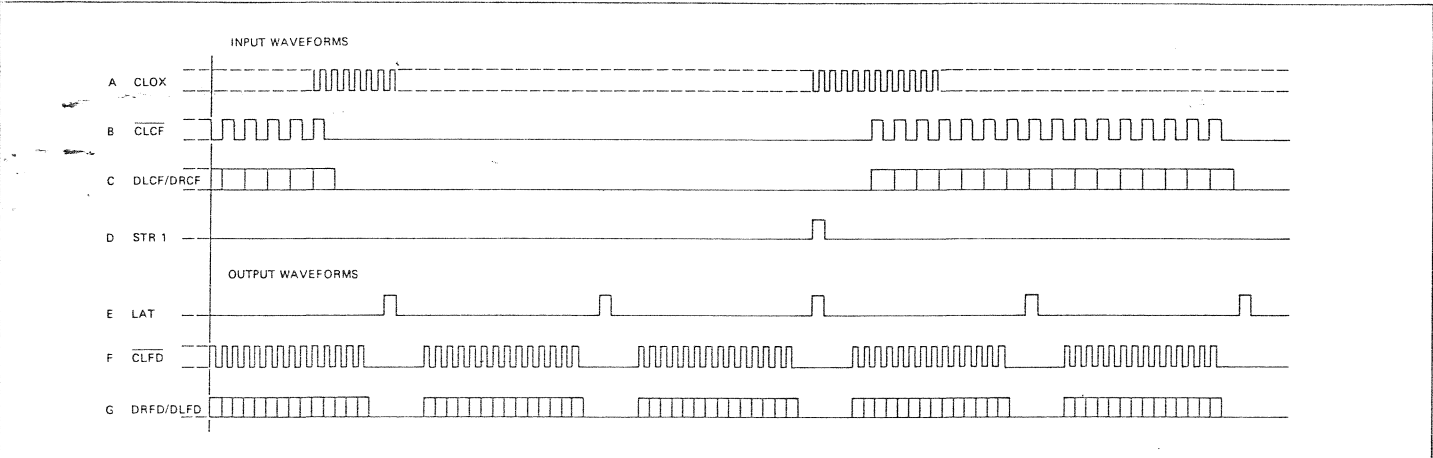


Fig. 4.10

4.2 Adjustments on CD player B225

Note:

Cleanliness in the work area is of outmost importance and ensures that no contaminants or metal particles can enter into the CD mechanism.

If any work on printed circuit boards is necessary, it is essential to observe the ESE recommendations (refer to last page of contents).

Before putting the CD player into operation ensure that the transport screws have been unfastened.

The CD player mechanism is equipped with self-lubricating bearings which should not be lubricated.

If the drawer must be open and a disc mounted in order to perform certain measurements or adjustments, the rear light barrier must be interrupted (the detector responds as if the drawer were closed) and the compact disc must be secured with a removed adhesive magnet.

The optical system of the laser can be cleaned with an air brush.

Coil L1 on the decoder PCB 1.769.300 is automatically aligned by IC13 (SAA7010) and consequently requires no adjustment.

4.2.1 Aids

- DC voltmeter
- Cathode ray oscilloscope
- Reference CD, frequency response, part No. 46240
- Reference CD, drop outs, part No. 46241
- Mirror CD for adjusting the optical system, part No. 46242
- Set of service PCBs and cables, part No. 46230
- ESE work location kit, part No. 46200

4.2.2 Aligning the player mechanism, general

- Remove top cover.
- Connect CD player to AC supply and open the drawer by pressing the LOAD key.
- Cover rear light barrier.
- Mount reference disc 5 (part No. 46241) and secure it with a removed adhesive magnet.
- Selection 1 of the CD is to be played for all alignment work. It is, therefore, advantageous to enter the LOOP command in programming mode.

4.2.3 Adjusting the laser current

- Switch CD player off, remove SERVO 2 PCB 1.769.330 and reinsert it via the service PCB (part No. 46230).
- Connect DC voltmeter to R63 on SERVO 2 PCB.
- Adjust the voltage to 500 mV \pm 50 mV with the trimmer potentiometer R80 (on player mechanism 1.769.100.35).

Adjustments should only be made if the measured voltage is outside the specified tolerance range.

CAUTION:

Voltages above 550 mV shorten the life of the laser pick-up.

- Switch CD player off and reinstall SERVO 2 PCB.

4.2.4 Adjusting the balance (if trimmer is present)

- Set potentiometer R41 (on player mechanism 1.769.100.35) to its center position.

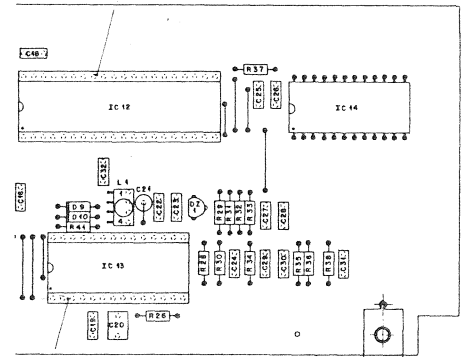


Fig. 4.11

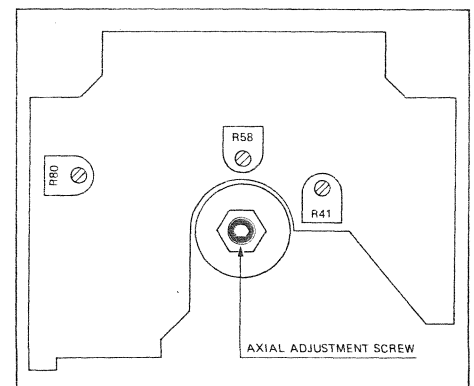


Fig. 4.11a

4.2.5 Adjusting the focus gain

- Switch CD player off, remove SERVO 1 PCB 1.769.310 and reinsert it via the service PCB.
- Connect AF generator to the X input of an oscilloscope and via an R-C-R element (according to Fig. 4.12) to pin 6 of IC2 (on 1.769.310), ($f=600\text{ Hz} \pm 5\text{ Hz}$, $U=250\text{ to }300\text{ mV RMS}$).
- With trimmer potentiometer R58 (on player mechanism PCB 1.769.100.35), align for minimum amplitude A of the Lissajous figure.

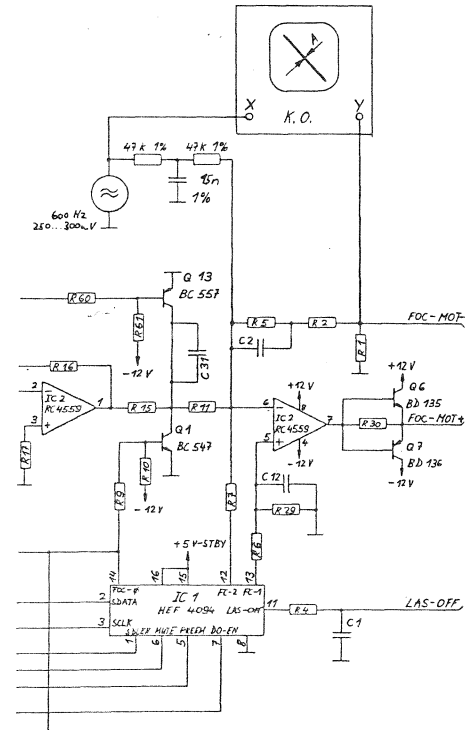


Fig. 4.12

4.2.6 Checking the angle alignment

- Place the mirror on the focussing unit and mount the optical system alignment disc (secure with adhesive magnet).
- Place the player mechanism below a light source that produces a linear, straight shadow.
- Bring the laser scanner arm to its center position and rotate the CD player in such a way that the arm stands parallel to the line below the light source (refer to Fig. 4.13).
- When the reflection on the glass disc and in the mirror is viewed as illustrated in Fig. 4.13. The distance between the two lines should not exceed 2.5 mm.

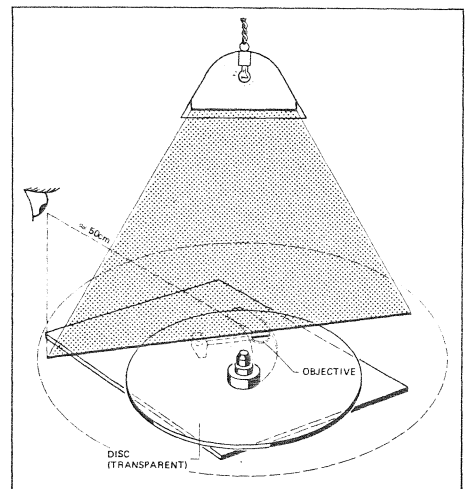


Fig. 4.13

- Position the CD player in such a way that the shadow forms a 90° angle to the scanner arm (see Fig. 4.14). The distance between the two lines (reflections) should not exceed 2.5 mm.

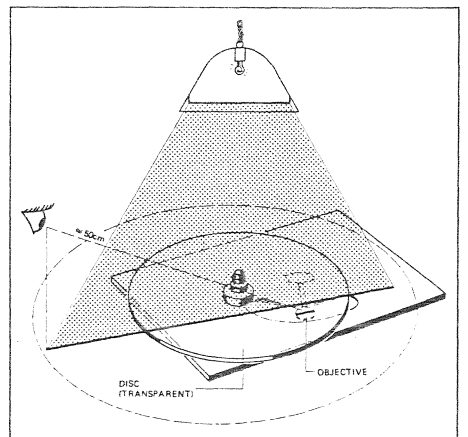


Fig. 4.14

The angle alignment must be corrected if the deviation is too large:

- Unfasten screw [A] until the support plate [B] can be shifted.
- The support plate can now be shifted according to Fig. 4.5. Retighten the screw [A] when the position is correct.
- The angle alignment must be rechecked after the foregoing adjustments have been made.

4.2.7 Adjusting the DC component of the focus signal

- Connect DC voltmeter to R1 (SERVO 1 PCB 1.769.310).

The following adjustment is only necessary if the DC deviation exceeds ± 140 mV. Replace the motor if alignment is not possible.

- Adjust the axial set screw of the disc motor in such a way that $0 \text{ V} \pm 50 \text{ mV}$ is measured.
- If the motor is replaced, perform the adjustments according to 4.2.6 and 4.2.7.

4.3 Measuring the audio data

4.3.1 Aids

- Reference CD, part No. 46240
- Automatic distortion meter (e.g. Tektronix AA 501; the RESPONSE button must be in the RMS position for all measurements)
- Measuring filter (for distortion measurement)
- Frequency counter
- Oscilloscope

4.3.2 Harmonic distortion

- Measuring arrangement according to Fig. 4.16
- Adjust for maximum level with VOLUME + key
- Mount reference disc (part No. 46240). Play track 4 for measuring the left-hand channel and track 8 for measuring the right-hand channel.
- The harmonic distortion should be less than 0.006%.

4.3.3 Output level

- Press CAL TONE button and adjust for maximum level with VOLUME + key.
- The level of the FIXED and VARIABLE outputs should be $2 \text{ V RMS} \pm 10\%$. The balance between channels should be better than -0.2 dB .

4.3.4 Frequency response

- Adjust for maximum level with VOLUME + key.
- The calibration tone (1 kHz) serves as the 0 dB reference.
- Play tracks 4 and 8 (CD part No. 46240) and measure the outputs FIXED and VARIABLE. The frequency response should be within $+0$ to -0.6 dB .

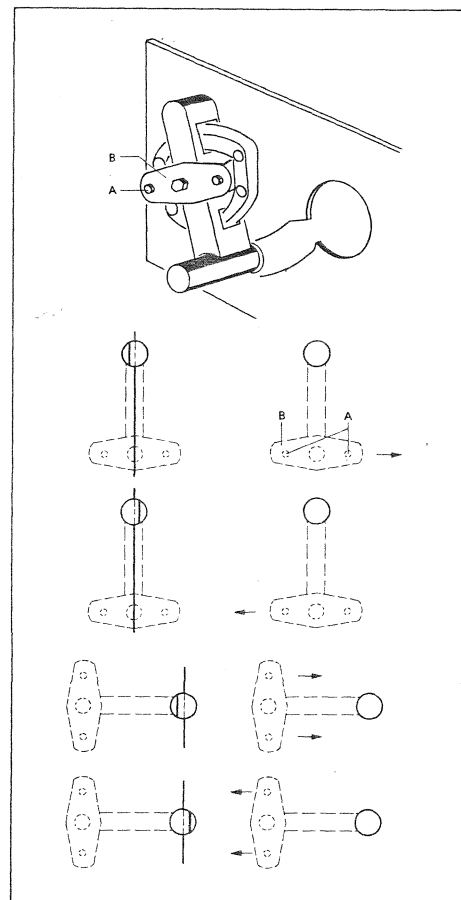


Fig. 4.15

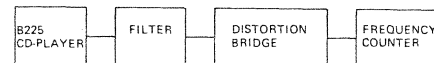


Fig. 4.16

4.3.5 Cross talk

- Adjust for maximum level with VOLUME + key.
- Reference = CAL TONE 1000 Hz)
- Measure both outputs across a 30 kHz low-pass:
 - Play track 8 for measuring cross talk R -> L
 - Play track 4 for measuring cross talk L -> R
- The cross talk attenuation should be at least 90 dB.

4.3.6 Signal-to-noise ratio, linear

- Maximum volume, reference = CAL TONE 1000 Hz.
- Play track 18 and measure the outputs FIXED and VARIABLE via a 30 kHz low-pass.
- The measured value should be higher than 96 dB.

4.3.7 Signal-to-noise ratio, weighted

- Maximum volume, reference = CAL TONE 1000 Hz.
- Play track 18 and measure the outputs FIXED and VARIABLE via an A filter.
- The measured value should be higher than 100 dB.

4.3.8 Phase linearity

- Connect oscilloscope to one of the outputs.
- Play track 20 and visually assess the square-wave signals at 100 Hz, 400 Hz, 1002 Hz, and 5512 Hz. The curve should be shaped symmetrically (see Fig. 4.17).

4.4 Listening test with reference CD (part No. 46241)

The reference CD simulates the following errors for checking the error correction system:

- Information gaps with a length of 400 to 900 μm (tracks 5 through 9)
- Black dots from 300 to 800 micrometers (tracks 11 through track 17)
- Simulated fingerprint (tracks 18 and 19)

The simulated defects should not cause any drop-outs (reproduction gaps). If drop-outs become audible, this can for example be caused by the following errors:

- IC13 (SAA 7010, demodulator), clock regeneration with PLL defect.
- HFL an DO detector defective.

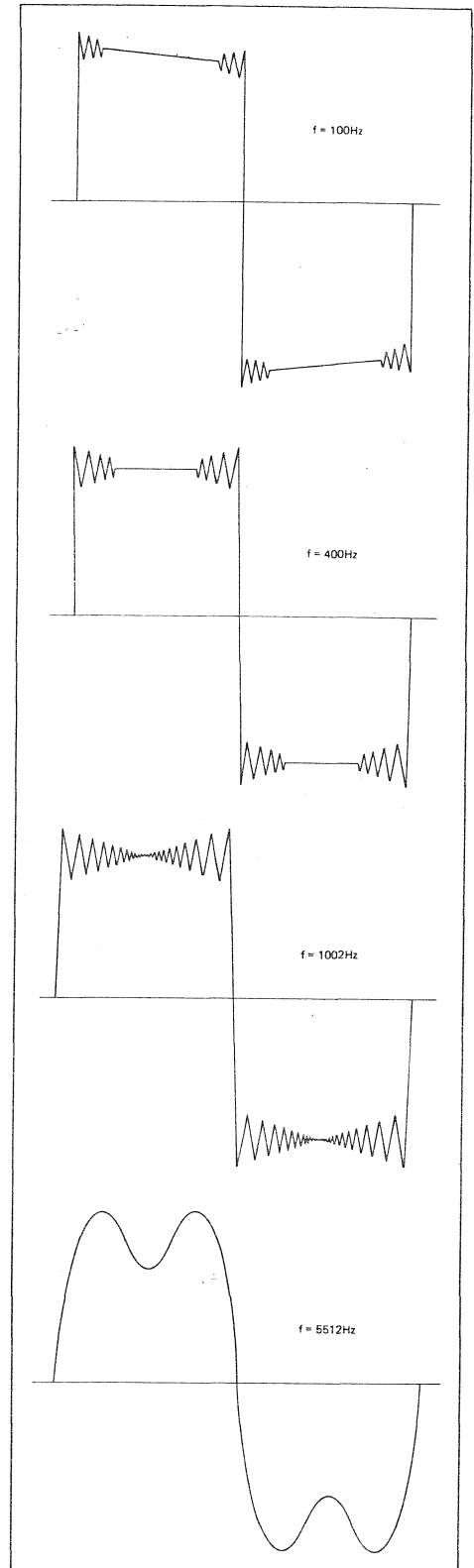
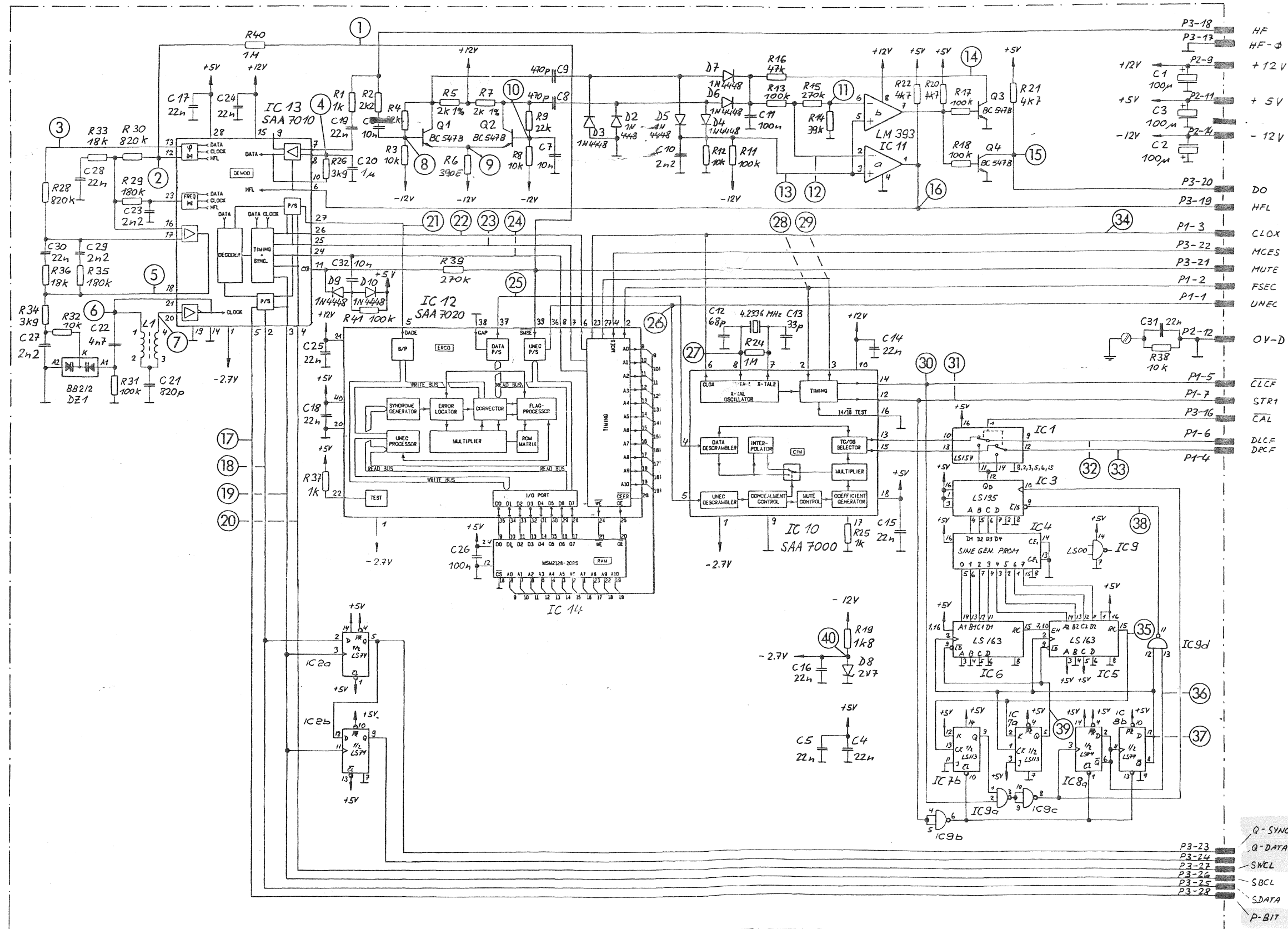


Fig. 4.17

DECODER PCB 1.769.300-00 "ESE"



P3-18 HF
 P3-17 HF-Φ
 P2-9 +12V
 C1 100μ
 P2-11 +5V
 C3 100μ
 P2-4 -12V
 C2 100μ
 P3-20 DO
 P3-19 HFL
 P1-3 CLOX
 P3-22 MCES
 P3-21 MUTE
 P1-2 FSEC
 P1-1 UNEC
 P2-12 OV-D
 R38 10k
 P1-5 CLCF
 P1-7 STR1
 P3-16 CAL
 P1-6 DLCF
 P1-4 DRCF
 P3-23 Q-SYNC
 P3-24 Q-DATA
 P3-27 SWCL
 P3-26 SBCL
 P3-25 SDATA
 P3-28 P-BIT

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