Compact disc player CD880/00R/05R/07R

Service
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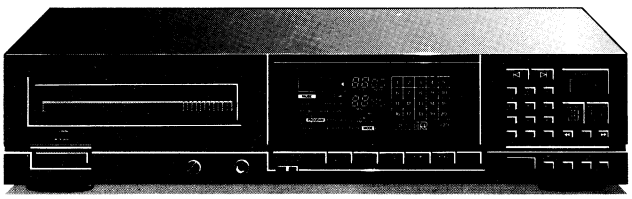

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Service Manual

COMPACT disc DIGITAL AUDIO

CONTENTS

CLASS 1 LASER PRODUCT

3122 110 03420

Safety regulations require that the set be restored to its original condition and that parts which are identical with those specified be used.

Documentation Technique Service Dokumentation Documentazione di Servizio Huolte-Ohje Manual de Servicio Manual de Serviçio

Subject to modification

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EXPLANATION OF THE LAYOUT OF THE DOCUMENTATION

The documentation consists of chapters.
The number of the chapter is indicated by the first digit of the page number.
The second digit of the page number is the sequence numbering.

If modifications or supplements require new supplementary or replacement pages, the page number is extended with a third part:

A digit behind the page number indicates that it concerns a supplementary page.
A replacement page is indicated by a letter behind the page number.

Example

3-6	is page 6 of chapter 3
3-6-1	is a supplementary page behind page 3-6
3-6-a	is the replacement page of page 3-6 (so page 3-6 can be removed from the documentation).

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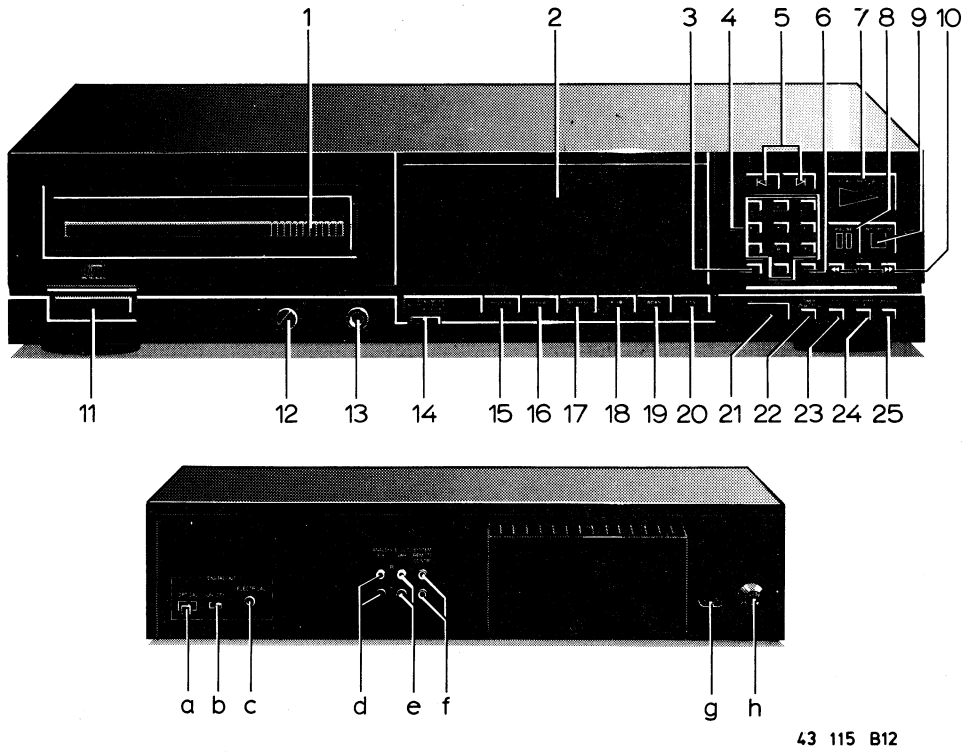

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CONTROL BUTTONS

Front of player

1 Disc tray on which the OPEN button is situated; the tray closes when the front is pressed briefly.
2 Display: gives information about the number of tracks on the disc, the playing time, the state of play at any given moment and about the special functions of the player. It also indicates when no disc has been inserted or when you make a mistake in operating the player.
3 CLEAR button: for cancelling mistakes when compiling a program, for deleting an item from a program or for erasing a favourite selection.
4 1-0 digit buttons: for moving on to a particular position on the disc or for compiling a program.
5 ⏮ TRACK ⏭ buttons: for selecting a previous or a later track, both before and during play and when programming.
6 STORE button: for storing details when compiling a program.
7 PLAY/REPLAY button: for starting play (PLAY) and returning to the beginning of a track (REPLAY).
8 PAUSE button: for holding play at the start of a track or passage, or interrupting play.
9 STOP/CM button: for stopping play: press twice to erase a program from the temporary memory (CM = Clear Memory).
10 ◀◀ SEARCH ▶▶ buttons: for fast forwards or backwards search for a particular passage. When used in conjunction with FAST, the search speed is increased and the sound switched off.
11 ON/OFF button: for switching the player on and off The blue lights above the button and on the right-hand side serve as on/off indicators.
12 VOLUME control: for adjusting the volume when listening with headphones.
13 PHONES socket: for connecting headphones.
14 PLAY MODE switch with three positions: NORM, COPY and AUTO.
15 SHUFFLE button: for playing the tracks on a disc or in a program in random order.
16 REPEAT button: for repeating a disc or program.
17 TIME button: for selecting which time information you want to appear on the display: "REM TOTAL"-the total remaining playing time ("REM" = remaining), "REM TRACK"-the remaining playing time of the current track, or "TRACK LAP"-the elapsed playing time of the current track ("LAP" = elapsed).
18 A > B button: for setting the start and stop point of a continuous play loop.
19 SCAN button: for automatically playing the beginning of each track on the disc.
20 FTS button: for activating the Favourite Track Selection circuit.
21 IR receiver: for receiving infrared signals from the remote control handset.
22 TIMER ON/OFF: for making the player automatically begin playing when a timer is used. If there is an FTS program of the disc in the memory then this will be played.
23 SELECT button: for selecting the SELECT setting to enter data when searching or programming.
24 PROGRAM PLAY button: permits direct selection and play (PLAY) or direct programming (PROGRAM) of tracks.
25 REVIEW button: for reviewing and checking a program. The contents of the program are displayed one by one.
26 ⏮ INDEX button: for returning to a previous index number during play.
INDEX ⏭ button: for moving on to a later index number during play.
27 – VOLUME + buttons: for adjusting the level of the signal sent out from the ANALOGUE OUT VAR sockets. When the player is switched off and then switched back or again, the last selected volume level will still be set.

Rear of player

a OPTICAL: output for digital signal processing via an optical cable.
b DIGITAL OUT ON/OFF: for switching off the DIGITAL OUT sockets in case they disturb the signal from the analogue sockets.
c ELECTRICAL: output for digital signal processing or future applications such as CD-I
d ANALOGUE OUT FIX: these analogue outputs produce a uniform signal.
e ANALOGUE OUT VAR: these analogue outputs produce a variable signal, the strength of which is determined by the – VOLUME + buttons on the remote control handset.
f SYSTEM REMOTE CONTROL IN/OUT: connection for external signal receiver for the remote control or for the remote control system of a HiFi system.
g FUSE (fuse holder): contains the main fuse for the player. If this should become defective, a new fuse of the same type must be used.

TECHNICAL DATA

Typical Audio Performance
- Number of Channels: 2
- Frequency Range: 2-20 000 Hz
- Amplitude Linearity: ± 0,01 dB (20-20 000 Hz)
- Phase Linearity: ± 0,2° (20-20 000 Hz)
- Dynamic Range: 94 dB (20-20 000 Hz)
- Signal-to-Noise Ratio: 103 dB (20-20 000 Hz)
- Channel Separation: 98 dB (20-20 000 Hz)
- Total Harmonic Distortion: 0,0015% (20-20 000 Hz)
- Wow and Flutter: quartz crystal precision
- D/A Conversion: quadruple oversampling (176.4 kHz) with digital filter and two 16 bit D/A converters
- Error Correction System: Cross Interleaved Reed Solomon Code (CIRC)
- Audio Output Level: 2 $V_{ams.}$
- Headphones load impedance: 8-2000 Ω

Optical Readout System
- Laser: semi-conductor AlGaAs
- Wavelength: 780 nm

Signal Format
- Sampling Frequency: 44.1 kHz
- Quantization: 16 bit linear/channel

Power Supply
- Mains Voltage: see type plate at rear of player
- Mains Frequencies: 50 and 60 Hz
- Power Consumption: 30 W approx.
- Safety Requirements: IEC

Cabinet, general
- Material/finish: metal and polystyrene with decorative trim
- Dimensions (w x h x d): 462 x 104 x 363 mm
- Weight: 10 kg approx.

Disc
- Diameter: 120 mm
- Thickness: 1.2 mm
- Direction of Rotation (seen from reading side): anti-clockwise
- Scanning Velocity: 1.2-1.4 m/s
- Rotation Speed: 500-200 rpm
- Playing Time (theoretical): 74 min (stereo)
- Track Pitch: 1.6 µm
- Material: plastic

The right is reserved to change data if necessary

This Compact Disc player complies with the radio interference requirements as laid down in EEC (European Economic Community) regulations.

SERVICING HINTS

ESD

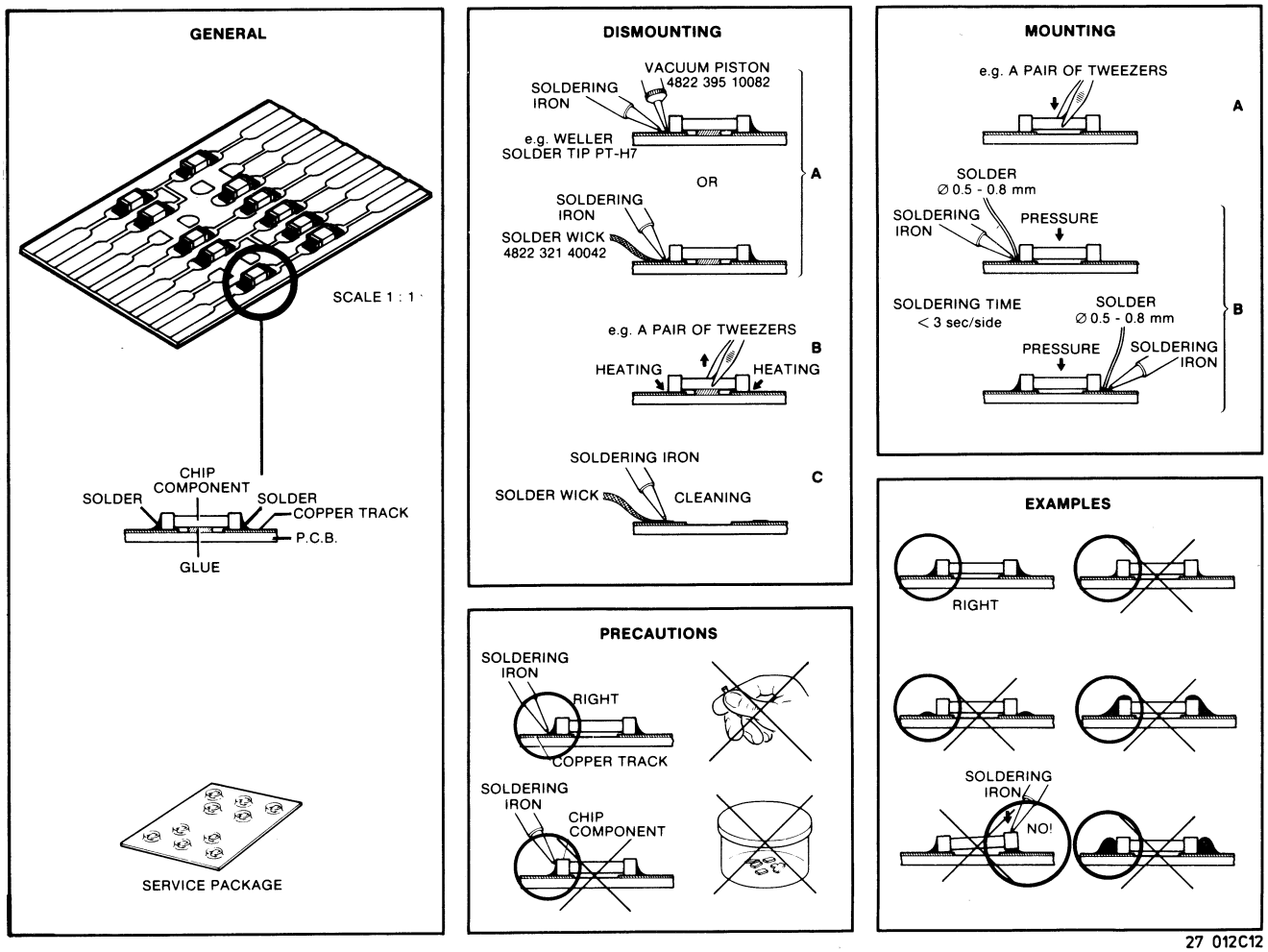
All ICs and many other semi-conductors are susceptible to electrostatic discharges (ESD).
Careless handling during repair can drastically reduce life expectancy.
When repairing, make sure that you are connected via a wrist wrap with resistance to the same potential as the chassis of the set. Keep components and aids also at the same potential.

In the set chip components have been applied.
For disassembly and assembly of chip components see the figure below.

The disc should always rest properly on the turntable.
To achieve this a disc hold–down has been mounted in a bracket of the tray mechanism.
If the tray mechanism has to be disassembled for servicing, a separate disc hold-down should be used. For a service disc hold–down see page 3-2

SERVICE AIDS

Audio test disc	4822 397 30085
Disc without errors + disc with DO errors, black spots and fingerprints	4822 397 30096
Disc 65 min 1kHz without pause	4822 397 30155
Torx screwdrivers	
Set (straight)	4822 395 50145
Set (square)	4822 395 50132
13th order filter	4822 395 30204
Service cable (5p)	4822 321 21273
Service cable (14p)	4822 321 21598
Service flexfoil (14p)	4822 322 40066
Service connector (14p)	4822 267 50676
Glass disc	4822 395 90204



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DISASSEMBLY OF TOP COVER

- Remove the 4 screws out of side walls of top cover.
- Remove the 2 screws at rear of top cover.
- Take top cover from set.

DISASSEMBLY OF BOTTOM COVER

- Remove the 9 screws
- Take bottom from set
- Now all panels are accessible for measurements

REPLACEMENT OF GLASS FUSE

- The glass fuse is situated on the cabinet in the left-hand rear corner of the set.

REPLACEMENT OF TRANSFORMER FUSE

- Remove top cover.
- Remove safety-cap on the transformer (pos. 517)
- Now the transformer fuse is accessible.

SERVICING OF THE FRONT PANEL

Disassembly of the tray-front (pos. 214÷218)

- Drive the tray out by turning the main gear wheel item no. 116
- The fixing point is on the left-hand bottom corner of the tray-front.
- Slide the tray-front to the left after lifting the fixing bracket over the fixing point.
- Now the tray-front can be taken out.

Disassembly of front panel

- Remove top cover.
- Remove the tray-front.
- Remove the 3 fixing screws at upper side of front panel.
- Remove the 3 fixing screws at the bottom of the front panel.
- Now the front panel can be taken off.
- Ensure during mounting that the 2 bosses of the set frame engage with the appropriate holes of the frontpanel.

Disassembly of control + display panel

- The control and display PCB can be detached by removing the 9 screws at the bottom of the display panel.
- Then the control + display panel can be taken out of the front.

SERVICING OF THE TRAY MECHANISM

1. Demounting the tray mechanism

- Make sure that the tray is completely ridden in.
- Undo all connector connections of the loading and CDM on the set.
- Undo the 3 screws with which the loading has been mounted into the set. Two screws are situated in front and one in the centre at the rear. The latter is attainable via the cut-out in item no. 101.
- Now take the tray mechanism out of the set.

2. Demounting the CDM

- Put the tray mechanism upside down
- Remove the 4 screws on the servo panel.
- Now disconnect the foil print and short-circuit the connections by means of a paperclip.
- Remove the servo panel.
- Put the mechanism in normal position again.
- Remove pos 122.
- Drive the tray out by turning the main gearwheel item no. 116.
- Turn the main gearwheel until the tray is released. The tray can now be taken out of the mechanism.
- Take the CDM out of the mechanism.

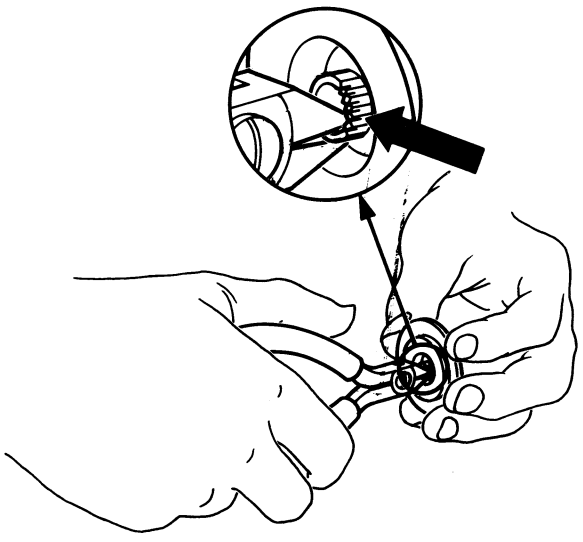
Mounting is done in reverse order.
Attention: When inserting the tray again, the lever of the tray-out end switch should manually be brought over the guiding onto the tray

A service disc-holddown

The disc should always bed down well on the tuntable. If the mechanism has to be dismounted for repair, a service disc-holddown should be used.
The CD mechanism then can function normally as in the set.

Compose a service Disc hold-down in the following way

- Cut in the most inner ring of a disc hold-down (4822 462 50383) with small and sharp nippers, See fig. below.
- Enlarge the diameter of the innermost ring slightly with the hind part of a pencil or ballpoint, so that it jams onto the turntable with sufficient force.
- If the jamming force decreases after certain time of use, the diameter has to be enlarged with a pencil or ballpoint again.



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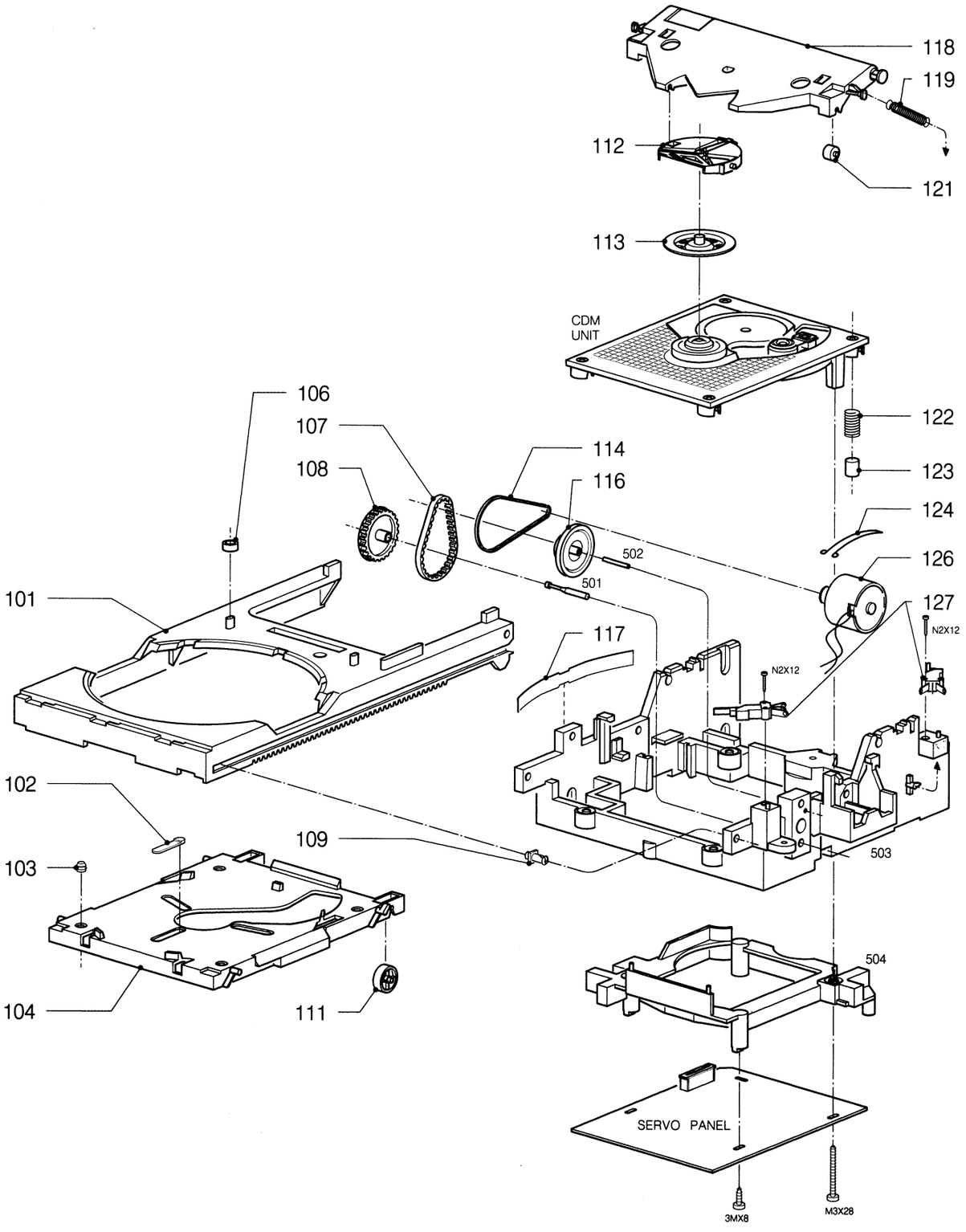
EXPLODED VIEW TRAY MECHANISM



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PARTSLIST OF CABINET AND TRAY MECHANISM

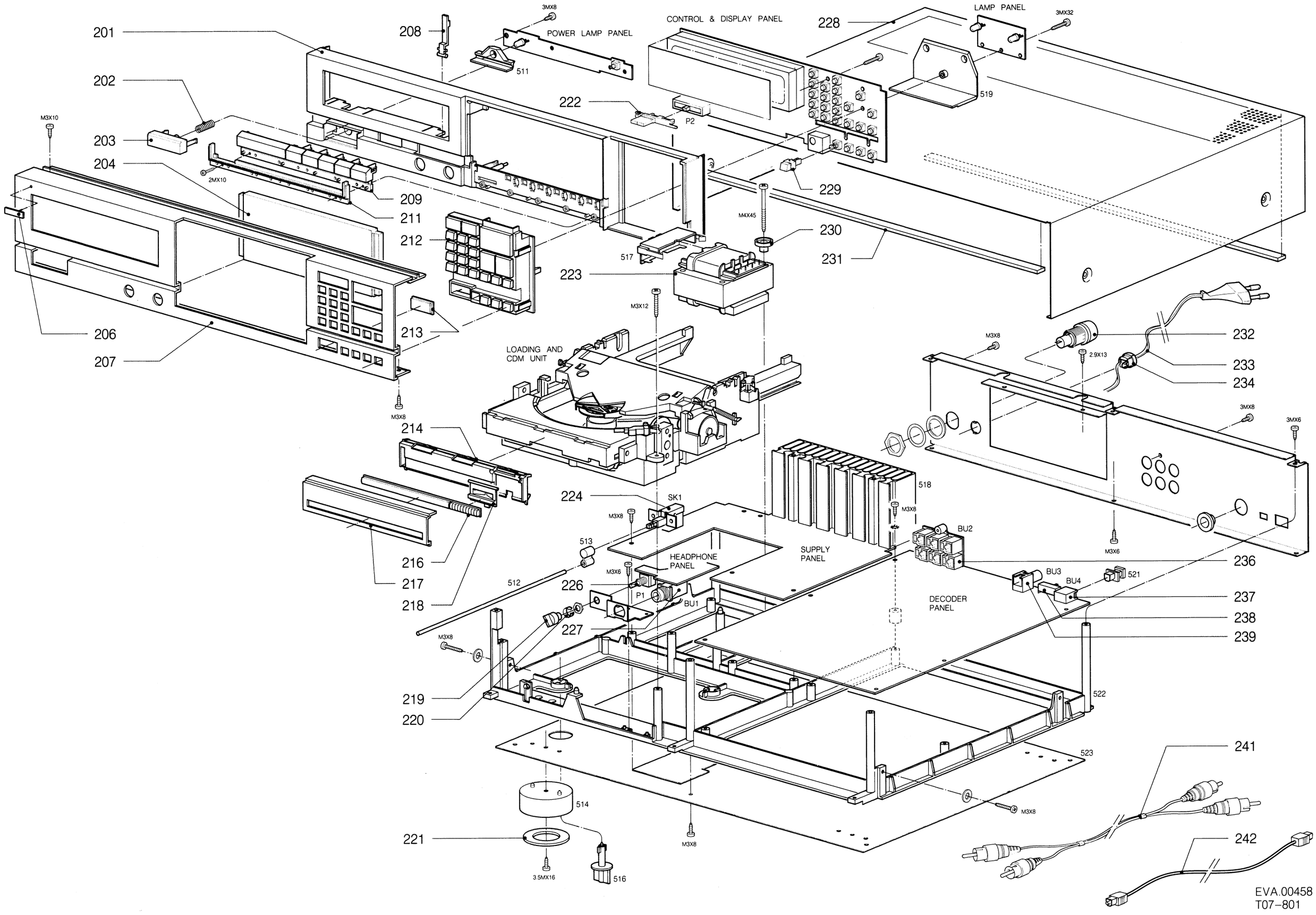
Loading parts

101	4822 444 50566
102	4822 325 60319
103	4822 325 60317
104	4822 466 92111
106	4822 532 51756
107	4822 358 20262
108	4822 522 32271
109	4822 402 61081
111	4822 528 90638
112	4822 532 11547
113	4822 462 50383
114	4822 358 30335
116	4822 528 81146
117	4822 492 63659
118	4822 444 60467
119	4822 492 32687
121	4822 528 90639
122	4822 492 51964
123	4822 325 60318
124	4822 492 63218
126	4822 361 20483
127	4822 276 11277

Cabinet parts

201	4822 454 30401
202	4822 492 51723
203	4822 410 26271
204	4822 450 61164
206	4822 459 10803
207	4822 444 40234
208	4822 402 61163
209	4822 410 26289
211	4822 460 20737
212	4822 410 26269
213	4822 450 61165
214	4822 444 50598
216	4822 466 61638
217	4822 460 20736
218	4822 402 50252
219	4822 413 41423
220	4822 492 64624
221	4822 444 30404
222	4822 411 61459
223	4822 146 30664/00R
223	4822 146 30676/07R/47R
224	4822 276 12343
226	4822 100 30061
227	4822 267 40661
228	4822 444 60547
229	4822 410 26272
230	4822 466 61641
231	4822 466 61639
232	4822 256 30231
233	4822 321 10539/05R
233	4822 321 10541/07R
233	4822 321 10538/47R
234	4822 325 60282
236	4822 265 20374
237	4822 218 20752
238	4822 276 12339
239	4822 265 30598
241	4822 321 22416
242	4822 321 22568

EXPLODED VIEW CABINET



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SERVICING THE CDM UNIT

To prevent loose metal objects from getting in the CD mechanism, it will be necessary to see to a clean repair station.

The objective can be cleaned with a blow brush.

When effecting repairs to, or making measurements on the CD mechanism, be careful not to damage the flat springs of the focusing unit.

THE PHOTODIODES AND THE LASER ARE MORE SENSITIVE TO ELECTROSTATIC DISCHARGES THAN MOS ICS.
CARELESS HANDLING DURING SERVICING MAY REDUCE LIFE EXPECTANCY DRASTICALLY.
FOR THIS REASON CARE SHOULD BE TAKEN THAT DURING SERVICING THE POTENTIALS OF THE AIDS AND YOURSELF ARE EQUAL TO THAT OF THE SCREENING OF THE SET.

For measurements and adjustments it is possible to position the working mechanism outside the set.
For this purpose, an extension cable can be made from the following parts.

- Service flat cable (14-pole) 4822 322 40066
- Service connector (14-pole) 4822 290 60602

These two items should be used to assemble an extension cable between the connector and the flex cable of the CDM unit.
The two connections to the motor should be lengthened with loose wires.

Remark: The service cable should be assembled as follows; (see Fig. 1)

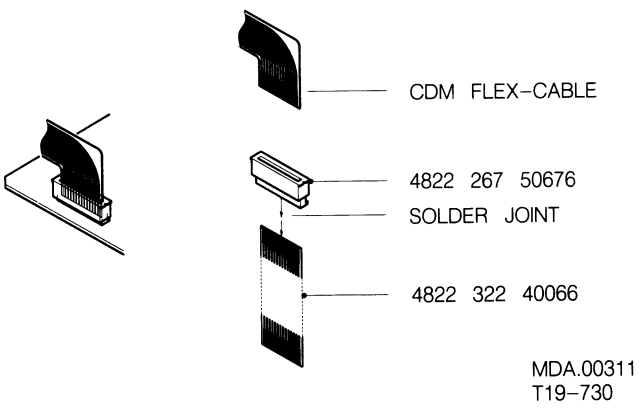


Fig. 1.

Demounting the Rafoc unit

- Take the CD-mechanism out of the set.
- Remove the flexible PCB from the connector on the PCB by lifting the upper part of the connector and taking the flexible PCB out. (see Fig. 2)

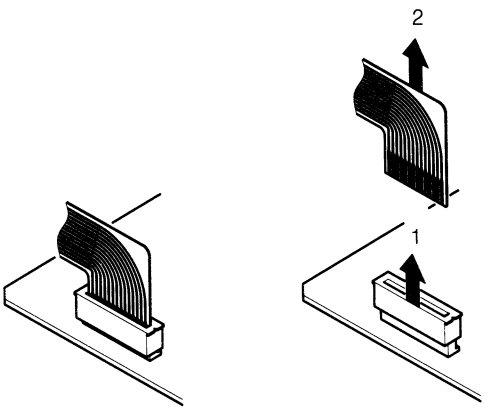


Fig. 2

- The RAFOC unit can be removed after the two fixing screws M3 x 22 have been loosened.
- Now the pivot plate, item no. 54, can be removed.
- After removing the clamping piece, item no. 52, the RAFOC unit/flexible PCB assembly can be taken out.
  Attention: when mounting the RAFOC unit, see to it that the flexible PCB reset well against the mounting plate at the height of the clamping piece (item no. 52).
  In some cases, after exchanging flexible PCB assembly, it may be necessary to glue the flexible PCB with a fast-drying glue to prevent the RAFOC unit from rubbing against the flexible PCB.
  The glueing should be done very carefully.
- When the laser and/or the monitor diodes are defective, it will be necessary to replace the complete CDM unit.
- After mounting the RAFOC unit you should make sure that the arm runs clear over the entire disc diameter.
  This can be checked by means of a spring-pressure gauge which is held against the magnet of the focusing unit.
  The friction of the arm, measured over the entire meter reading, may not be greater than 25mN.
- A fast check of the clearance of the arm is possible in service position 0.
  For servicing positions see detailed measuring method for the decoder circuit: Initiating the service program.
- After mounting, the angle setting should be adjusted.

Replacing the flexible PCB pos. 53

- Demount the RAFOC unit.
- Desolder the connections A (see Fig. 3) of the flexible PCB.

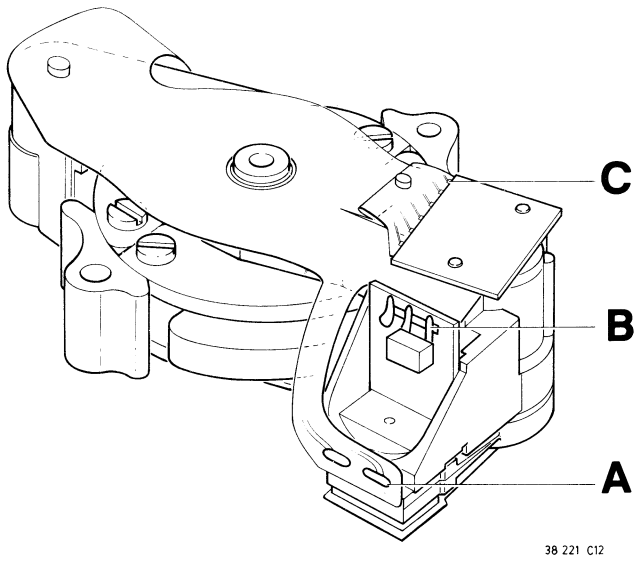


Fig. 3

- Before desoldering the connections C of the photodiode PCB, the positions of the connecting points of the photodiode PCB should be marked, so that afterwards the PCB can correctly be replaced.
- Now the 6 connections C of the photodiode PCB can be desoldered by heating the pins C one by one until the flexible PCB comes loose.
  This should be done very carefully.
- Desolder the 4 connections of the radial coils.
- Desolder the 3 connections of the laser PCB.

Mounting the flexible PCB (pos. 53).

- Solder the 4 connections of the radial coils.
- Apply the connections A and B (see Fig. 3).
- Before the 6 connections of the photodiode PCB can be soldered, they should be provided with an extra coating of tin.
- Place the flexible PCB under the photodiode PCB.
- In order to hold this position, the flexible PCB may be supported (for example by an expanded paper-clip between the arm and the underside of the flexible PCB).
- Then the 6 connections C can be heated so that they become soldered to the photodiode PCB.

Replacing electrical components

- If one of the following components is defective: photodiodes, laser diode, focus motor, radial actuator, the entire CDM unit should be replaced.
- If the turntable motor is defective item 51 should be replaced, using the old RAFOC unit. Adjust the angle setting after mounting the RAFOC unit on the motor plate assy.

MEASUREMENTS AND ADJUSTMENTS

Check of the laser supply

The laser and the laser supply in IC6101 plus the monitor diode form a feedback system. A defect in the laser supply may result in the destruction of the laser.
If, in that case, the laser (= complete CDM unit) is replaced, the new laser will also become defective.
However, it is impossible to check and repair a feedback system if a link is missing. For this reason the laser supply can be checked with the circuit below. The green LED replaces the laser, the voltage across the 18-Ohm resistor is fed back as monitor voltage, the 33-Ohm resistor and the switch serve to draw more current from the laser supply.

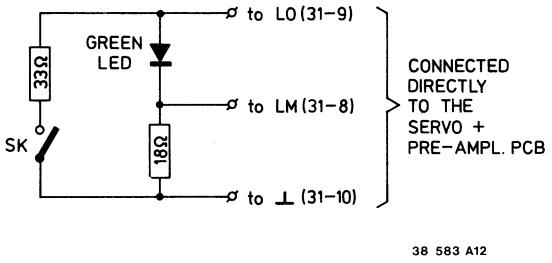


Fig. 4

LED GREEN e.g. CQY 94 IV **5322 130 32182**

The above circuit is connected to connector 31 via an extension cable instead of a flex print. The normal flex print is not suited for this purpose because of its high internal resistance.

Code no. extension cable 4822 322 40066

- The above flex print out of connector 31 on the servo + pre- amplifier PCB.
- Connect the circuit via the extension cable to connector 31.
- Select the play mode by grounding Si (pin 20 of IC6101).
  Note: Si = 0, start initialization low, is the play mode.
- Measure the voltage LO (Laser Out) at test point 9.

  SK open: 1,8 V LO 2,3V
  170 mV LM 220 mV
  The green LED emits little light.

  SK closed: 1,8 V LO 2,3 V
  170 mV LM 220 mV
  The green LED emits little light.

- During the change- over from SK closed to SK open, the LED will emit more light for a short moment.
- The control sees to it that the same amount of current flows through the LED when SK is open and when SK is closed.

At $\overline{Si}$ = 1, in the STANDBY state, LO = 0V ± 0,2 V.

Repair procedure

Since laser, monitor diode and photodiodes are very sensitive to static charges, care should be taken that during measurements and adjustments the aids and yourself have a potential that is equal to that of the CD mechanism.

Laser adjustment for CDM4

- Measure the resistance of R3105 + R3106 with an ohmmeter and adjust potentiometer R3106 so that R3106 + 3105 have a combined value of 1 kΩ.
- Check the monitor diode connections. Measure at test point 11 and ground (⊥).
- Put test disc 5 on the turntable.
- Switch on the set and select the PLAY mode or a similar service position.
- Take a DC voltmeter and measure across R3104. The voltage across this resistor should **stay smaller than 1260 mV.**
- Check if HF is present. IF not, stop the measurement immediately and analyse the fault.
- If HF is present, play track 1 of test disc 5 and adjust the sum HF across R3102 (test points 1 and2) to 50 mV with a DC voltmeter.
  Check, during the adjustment, that the voltage across R3104 does not exceed 1260 mV.
- If the adjustment is not successful within the 1260 mV margin across R3104, check the angle setting.

Checking the angle setting

The angle setting can be checked with the glass-disc method which is explained below.

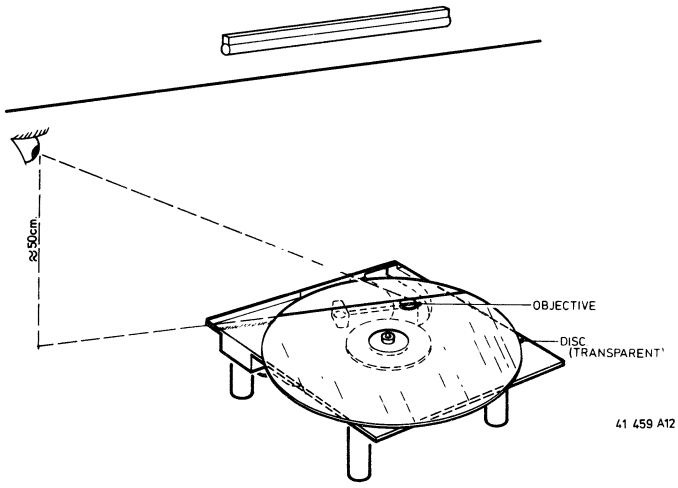


Fig. 5

Put glass disc 4822 395 90204 on the turntable.
Make sure that the glass disc beds down well on the turntable.
Place the CD mechanism under a light source, under which there is a straight line (e.g. under a fluorescent tube with grid).
Set the arm to mid-position of its radial track.
Turn the mechanism until the arm is parallel to the line under the light source (see figure below).
Look into the direction and in the extension of the line to the reflection there of on the glass disc and in the objective.
Locate the CDM in such a way that the line reflected by the glass disc runs across the centre of the objective.
The line reflected by the objective should fall just within the surface of the objective. If this is the case, the two lines are not more than 4 mm apart and squareness is correct.

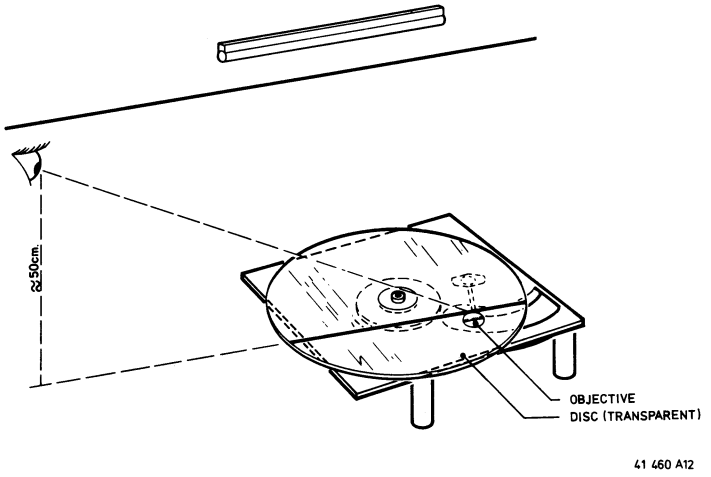


Fig. 6

Turn the CD mechanism through 90° relative to the previous position. The arm must be kept in mid-position (see figure above).
Repeat the previous check.

Adjusting the angle setting

For adjusting the angle setting one or both of the two locking knocks for the bearing plate on pos. 51 must be taken out.
If a check on the angle setting shows that the angle falls outside the tolerance, the angle should NOT be adjusted for minimum deviation, but it should be adjusted within the tolerance.
The new setting should lie between the old setting and the optimum setting. After adjusting the setting, the friction of the arm must be checked. This is done by means of a spring pressure gauge which is held against the magnet of the focusing unit.
The friction of the arm, measured over the entire meter reading, should not be greater than 25 mN.
When the friction appears to be too high, the RAFOC unit must be replaced and the angle between disc and light path adjusted.

The lock is adjusted as follows:

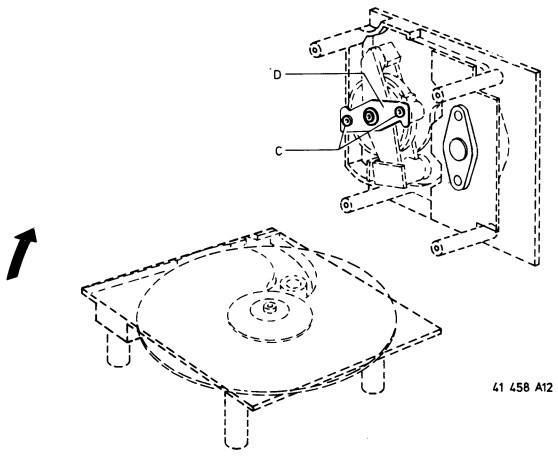
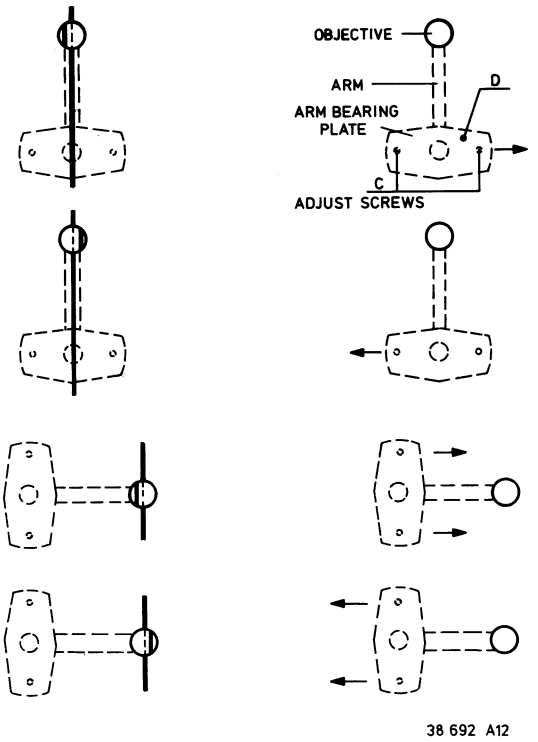


Fig. 7

Loosen screws C (see figure above) until bearing plate D can be displaced. Correct the angle setting by moving the bearing plate into the direction shown in figure below. Tighten screws C, ensuring that the setting does not drift. Then double check the setting in two directions.



Check of the motor control (Hall control) (see motor PCB)

Principle

With the oscilloscope the form of the voltage across resistor 3094 in the +2 lead and across resistor 3093 in the −2 lead is seen. This voltage is a consequence of the current and in this way current signals (pictures) are formed.
The current through the motor−coils A and B is sinusoidal. This current is switched on and controlled by the Hall ICs.
The Hall ICs are mounted at an angle of 90 degrees with respect to each other. Consequently the currents through A and B are shifted in phase 90 degrees.
In the following figures the origin of the current signal through the +2 and −2 leads is shown graphically.

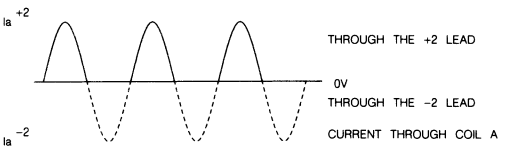


FIG.1

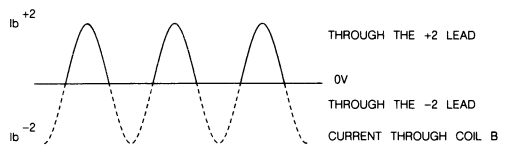


FIG.2

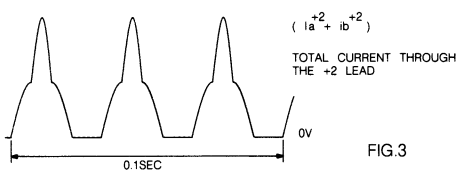


FIG.3

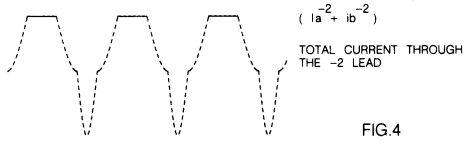
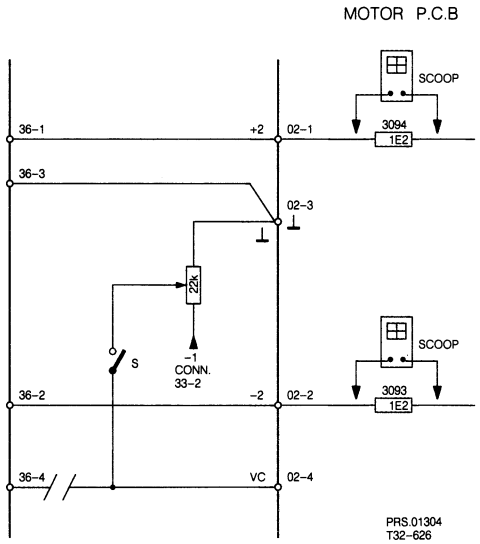


FIG.4

MDA.00336
T32−646



1. Interrupt the Vc connection by unsoldering the connector point 36–4 on the servo + preamplifier p.c.b.

2. Connect a trimming potentiometer of 22K Ohm to the motor print between 02–3( ) and connector 33–2(–1) on the servo board.

3. Connect the slider with 02–4(Vc) via switch S.

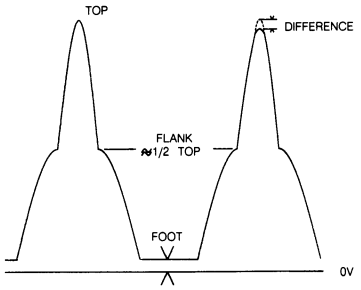
4. Measure with an oscilloscope first across 3094 and hereafter across 3093.
   Do not measure across both resistors at the sametime, since the currents are measured through the +2 lead and –2 lead.

5. Put the trimming potentiometer in the maximum position (the slider is then connected to connector 33–2(–1)).

6. With a disc on the turntable, put the set in service–loop 0. Switch S on and adjust the trimming potentiometer back in such a way that 3 complete pulses are visible during 0.1 sec. (fig. 3). The polarity of the oscilloscope must be chosen so that the tops of the pulses are in upward position.
   The rotor magnet of the motor has 3 polespairs. Therefore the behaviour of the motor during one revolution with a speed of 600 r.p.m. is visible.

7. Measure with a DC–voltmeter on 02–4(Vc).
   A. V_c = –1.7 +/– 0.5 V.
   B. Measure across 3094, value 1 = maximum 56.4 mV.
   C. Measure across 3093, value 2 = maximum 58.8 mV.
   D. Difference: **(value 1 - value 2)** maximum 6 mV. If the difference exceeds 6 mV, while value 1 and value 2 are below the maximum the motor is then wrong!

8. For a good functioning the signal has to meet the following values:

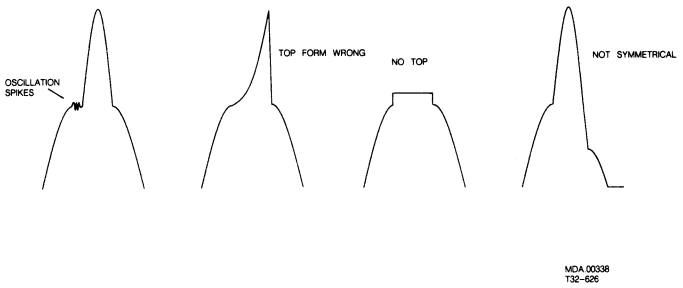


Top is not specified by value, see 7 (value 1 and value 2).

Top difference	<24 mV
Flank difference	<36 mV
Foot	is not specified

Remark:
Flank difference is at one asymmetrical pulse.
Foot is DC offset.

9. Examples of the wave form faults:



10. Adjust the voltage on 02–4(Vc) with the potentiometer back to –0,9 V. The motor must still turn. Although the top height is much lower now the wave form has to be symmetrical and rounded.

Adjustment of the focus off-set (FE lag) R3146

Coarse adjustment

A – Place potentiometer 3146 approximately in mid-position.
  – Put test disc 5 on the turntable.
  – Bring the player in service position 1.
  – The focussing motor can now start focussing and when it has found the focal point a "1" will appear on the display.
  – If this does not happen turn potentiometer 3517 clockwise or anticlockwise a little.
  – Hereafter the fine adjustment of the focus offset has to be carried out.

B – Place with potentiometer 3146 the focussing motor in optical horizontal position.
  – Hereafter the fine adjustment of the focus offset has to be carried out.

Fine adjustment

  – Bring the player in service position 2.
  – Adjust potentiometer 3146 for a voltage across 2136 (testpoint 27) of 400 mV ± 40 mV.

Note:
Notice that the CDM is in a horizontal position.

DETAILED MEASURING METHOD FOR THE SERVO + PRE-AMPLIFIER CIRCUIT

Test discs

It is important that the test discs be treated with great care.
The disturbances on the discs (black spots, finger-prints, etc.) are exclusive and are unamibiguously positioned. Damages may cause extra drop-outs etc., thus putting an end to the exclusivity of the intentional error on the disc.
In that case it is not possible anymore to check for example the good functioning of the track detector.

Measurements on op-amps

In the electronic circuits, op-amps have frequently been used.
The applications include amplifiers, filters, invertors and buffers.

In those cases where in one way or the other feedback has been applied, the voltage difference at the differential inputs converges to zero.
This applies to both DC and AC signals.
The cause can be traced to the properties of an ideal op-amp ($Z_i=\infty$, $G=\infty$, $Z_o=0$).
If one input of an op-amp is directly connected to ground, it will be virtually impossible to measure at the inverting and non-inverting inputs.
In such cases only the output signal will be measurable.

That is why in most cases the AC voltage at the inputs will not be given.
The DC voltages at the inputs are equal.

Stimulating with "0" and "1"

During faultfinding it is sometimes necessary to connect certain points to ground or to supply voltage.
As a result certain circuits can be brought in a desired state, thus shortening the diagnosis time.
In a number of cases the relevant points are outputs of op-amps.
These outputs are short-circuit-resistant, that is, they can be brought to "0" or ground without problems.
The output of an op-amp, however, should never be connected directly to the supply voltage.

Measurements on microprocessors

Inputs and outputs of microprocessors should **never** be connected directly to the supply voltage.
The inputs and outputs should only be brought to "0" or ground if this is stated explicitly.

Measurements with an oscilloscope

During measurements with an oscilloscope it is recommended to use a 1:10 test probe, since a 1:10 probe has a considerably smaller input capacitance than a 1:1 probe.

Selection of the ground potential

It is very important to select a ground point that is as close as possible to the test point.

Conditions for injection

- Injection of levels or signals from an **external** source should **never** take place if the relevant circuit has no supply voltage.
- The injected levels or signals should **never** be greater than the supply voltage of the relevant circuit.

Indication of the test points

In the drawing of the diagrams and PCBs the test points are indicated by a number (e.g. ◇12◇) to which the measuring method refers.
In the following measuring method the symbol ◇ has been omitted for the test points indicated.

GENERAL CHECK POINTS

In the detailed measuring method below, a number of general conditions, required for a properly functioning set, will not be mentioned.
Before the detailed measuring method is started, these general points should be checked:

a. Ensure that the disc and objective are clean (remove dust, fingerprints, etc.) and use undamaged discs.

b. Check that all supply voltages are present and that they have the correct values.

Initiation of the service programme of the µP

For the initiation of the service programme of the µP, see detailed measuring method for the decoder circuit: Initiating the service programme.

PHOTODIODE SIGNAL PROCESSOR IC 6101

•$\overline{Si}$ (pin 20; test point 21)
LO (pin 17; test point 9)
LM (pin 16; test point 11)

– With the $\overline{Si}$ signal (=Start Initialization) the laser supply, among other things, is switched on.
When the $\overline{Si}$ signal is "low", the LO signal (=Laser Out) should be "high".
Via the LM signal (=Laser Monitor) the power supply for the laser diode is controlled.

Position of player	POWER ON	Servicing pos. 1*)	PLAY
$\overline{Si}$ signal	"high"	"low"	"low"
LO signal	"low"	"high"	"high"

*) To ensure that the player stays in servicing pos. 1, there should be a disc on the turntable.

To check the laser supply, see "CHECK OF THE LASER SUPPLY"

•FE (pin 5; test point 26)

– The FE signal (=Focus Error) is used to drive the focusing unit.
When the $\overline{Si}$ signal goes "high", the focal point will be searched for.

– When the player is brought into servicing position 1 without disc, the objective will search for the focal point.
At test point 26 the FE signal varies between +3 V and -3 V.

– The FE signal ensures that the spot stays in focus.
When an error signal is injected, the FE signal will correct.
Bring the player in servicing position 2 (with disc on turntable).

Inject successively a voltage of +5 V and -5 V (=+1B and -1B) via a 200 kΩ resistance to testpoint 25 and check the FE signal.

Signal injected testpoint 25	+5 V	-5 V
FE signal	negative	positive

•FE lag (pin 6; test point 27)

– See adjustment of the focus off-set.

• RD signal (pin 21; test point 24)
HIGH-OHMIC MEASUREMENT

The RD signal (=READY) goes "high" when the starting procedure of IC6101 has been completed.

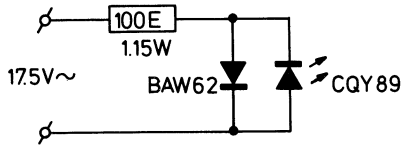
Position of player	POWER ON	Servicing pos. 1	PLAY
RD signal	"low"	"high"	"high"

•D1 (pin 9; test point 4)
D2 (pin 10; test point 6)
D3 (pin 8; test point 7)
D4 (pin 7; test point 8)

– The signals D1÷D4 are the error signals from the photodetector circuits.
– When in servicing position 1 the disc is moved, the focusing unit should keep in track.
When the disc is moving, there should be a changing signal on test points 4, 6, 7 and 8.

– Check of the photodiodes

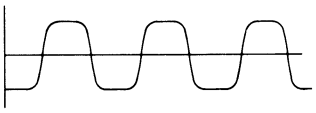
Connected the circuit below to an alternating voltage of 17,5 V.



39 368 A12

100 E-1.15 W	-	4822 116 51098
BAW 62	-	4822 130 30613
CQY 89	-	4822 130 31332

Switch on the supply voltage and bring the player in the stand-by mode or in servicing position 0.
In this measurement, infrared diode CQY89 replaces the function of the laser diode.
When this diode is held above the objective unit, the infrared light falls on the 4 photodiodes.
When the 4 photodiodes are functioning, the following voltage form will be visible on test point 4, 6, 7 and 8 on the servo + pre-amplifier PCB.
(the amplitude depends on the distance between the IR diode and the objective).



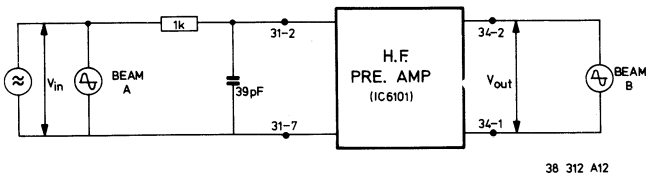
38 314 A12

Position of the oscilloscope: 100 ms/div.

•HF-in (pin 3, test point 3)
– The HF-in signal (=High Frequency in) is the information signal from the 4 photodiodes.

Check of the HF amplifier in IC6101

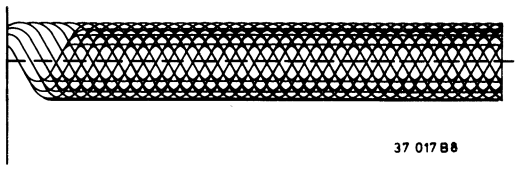
– Take the flexible PCB out of connector 31.
– Switch on the supply voltage.
– Inject a signal V-in of about 10 mVpp, 50 kHz, via the RC network, between connector pin 31-2 and connector pin 31-7 according to the diagram below.
– The output voltage between connector pins 34-2 and 34-1 should be about 1 Vpp.



38 312 A12

•HF-out (pin 27; measure at connector pin 34-14)

- The HF-out signal (=High-Frequency) is the amplified information signal for the decoder circuit.
  During playback of test disc no. 5 (4822 897 30096), a so-called "eye pattern" should be present on test point 17 (see figure below).
- The HF signal should be present and stable in:
  the PLAY mode and in
  servicing position 3 after the lead-in track has been read.
  In servicing position 2 and during the reading of the lead-in track, the HF signal is present, but is not stable.



Position of the oscilloscope: 0,5 µs/div.
Amplitude about 1,5 Vpp.

•DET (pin 26)
HFD (pin 19; test point 23)
$\overline{\text{TL}}$ (pin 18; test point 16)

- The DET signal (=Detector) gives information on the level of the HF signal to the high-frequency Level/Drop-out detector of IC6101.
- When the level of the HF signal is too low, the HFD signal (=High-Frequency Detector) will go "low".
- The $\overline{\text{TL}}$ signal (=Track Lost) will then go "low" in order to tell the servo µP that the tracking signals are unreliable.

Method:
(Can only be used in a playing set).

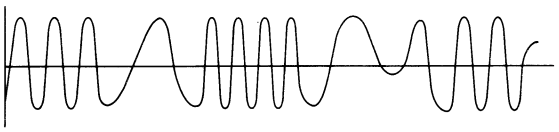
- Put test disc 5A (4822 397 30096) on the turntable.
- Switch on the power-supply switch and press the PLAY key.
- Play track number 10 or 15 and check the HFD signal at test point 23.
  When drop-out pulses are present on the DET signal (pin 26), the HFD pulses should also be present at test point 23.
  (Position of oscilloscope: 2 ms/div).

When the disc is slowly braked by hand, $\overline{\text{TL}}$ pulses will be visible at test point 16.

•RE 1 (pin 11; test point 18)
RE 2 (pin 12; test point 22)

- Signals RE1 and RE2 (Radial Error) are the control signals for the arm during tracking.

- In servicing position 2, the following signals should be visible at test point 18 and 22:



Position of the oscilloscope: 2ms/Div.
The frequency strongly depends on the eccentricity of the disc.

•$\overline{\text{DODS}}$ (pin 24: test point 19)

The $\overline{\text{DODS}}$ signal (= Drop Out Detector Suppression) avoids that Drop-Out signals influence the arm control during track jumping.

•SC (pin 25)
SC (=Start Capacitor)
HIGH-OHMIC MEASUREMENT

Position of player	SC (pin 25)
POWER ON	-4 V
PLAY	+5 V
Servicing pos. 1	+5 V

•FE lag (pin 6, test point 27)

- In service position 2,3 and in the PLAY mode, a voltage of about 400 mV is present at this point.
  When the disc is moved by hand in service position 1, the FE lag will vary.

RADIAL ERROR PROCESSOR

•Check the signals coming from the servo μP and from photodiode signal processor IC6101.

•RE-dig (pin 3; test point 37)

- With the RE dig signal (=Radial Error digital=Radial Polarity), the movement of the arm is controlled/corrected in case of track jumping and bumping against the player).

- In servicing position 3 or in the PLAY mode a square wave should be present at test point 37. Because of frequency variations this square wave is hard to trigger.

- In the positions PREVIOUS and NEXT the frequency of the square wave decreases.

•DAC (pin 10; test point 38).
With the DAC signal (=Digital to Analogue Converter) the track jumping speed is controlled.
This signal is derived from the signals B0 ÷ B3 coming from the decoder μP.

•RE (pin 7; test point 39)

- With the RE signal (=Radial Error) the light spot is kept on the track.
  When an error signal is injected, the RE signal will correct.
- Bring the player in servicing position 3.
- Inject successively a voltage of +5 V and -5 V (=+1B and −1B), via a 120 k Ω resistance, to pin 5 of IC6104B and check the RE signal.

Signal injected test point 38	+5 V	-5 V
RE signal	Negative	Positive

•RE lag (pin 8; test point 41)

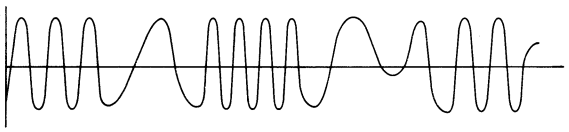
Capacitor 2156 in the RE-lag circuit has a memory function.
It memorizes the degree of inclination of the disc.
When a jump is made to a certain track on the disc, the memory should be cleared.
This takes place by the decoder μP ($\overline{\text{RPU}}$ signal) via transistor 6109.

During track jumping (SEARCH), slow pulses should be visible at test point 43 (position of the oscilloscope 0,1 ms/Div).
In that case pulses should also be visible on the collector of transistor 6109.

•RE 1 (pin 20; test point 18)
•RE 2 (pin 1; test point 22)

- Signals RE1 and RE2 (Radial Error) are the control signals for the arm during tracking.

- In servicing position 2, the following signals should be visible at test point 18 and 22.



30 743 B12/A

Position of the oscilloscope: 2 ms/Div.-Ac.
The frequency strongly depends on the eccentricity of the disc.

•B0 (pin 12; test point 36)
B1 (pin 13; test point 34)
B2 (pin 14; test point 33)
B3 (pin 15; test point 32)

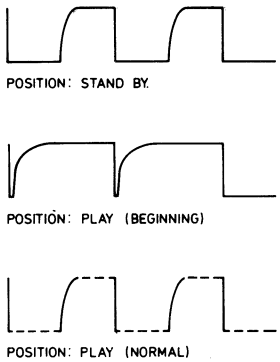
With the B0 ÷ B3 signals
•The radial control is switched on and
•The level on the DAC output is controlled.
- In the SEARCH mode, there should be activity on all 4 test points.

	STOP	PLAY	SERVICING POSISTION 0,1,2 ≪SEARCH	SERVICING POSITION 0,1,2 SEARCH ≫
B0	"low"	"high"	"low"	"high"
B1	"high"	"high"	"high"	"low"
B2	"high"	"high"	"high"	"high"
B3	"low"	"low"	"low"	"low"

•MCES (test point 12)

The MC signal (= Motor Control) is used to control the speed of the turntable.

- In the standby position (= power on), a signal as shown in the figure below is present at test point 12. The frequency is 88,2 kHz.
- With a disc on the turntable and with the player in service position 3 or in the PLAY mode, a signal as shown in the figure below should be present at test point 12. The frequency is 44,1 kHz.



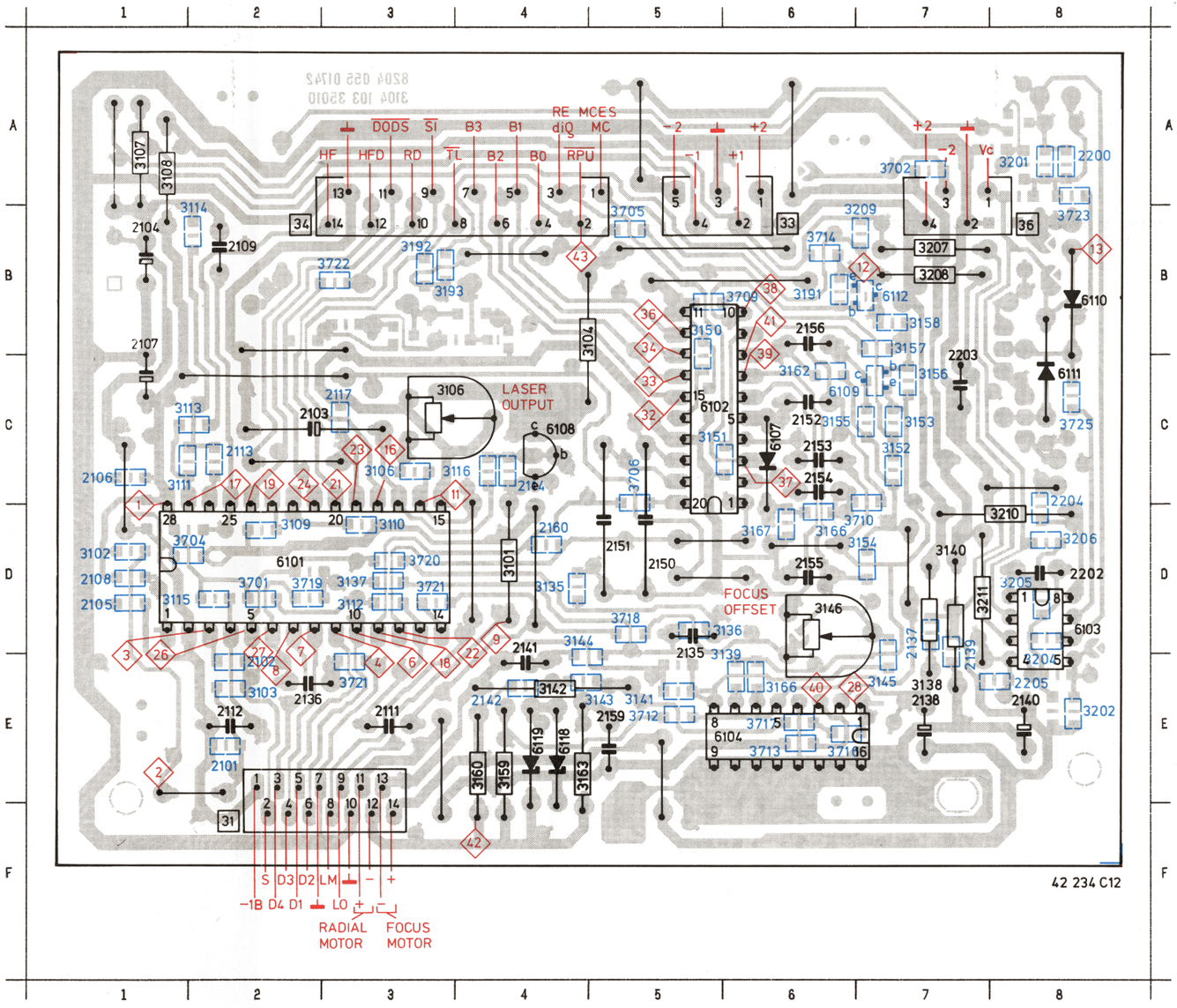
When the MCES signal is correct the turntable motor must be rotating.
(See also "Check of the motor control Hall (control) page 4-2).

•VC (connector point 36-1)

Fast check.

- Place a disc on the turntable. The voltage at connector point 36-1 will be about Vc = 0 > Vc > −1.7 V during playback.

SERVO + PRE-AMPLIFIER PANEL



2101	E 2	3152	C 7	3723	B 8
2102	E 2	3153	C 7	3725	C 8
2103	C 2	3154	D 7	6101	D 2
2104	B 1	3155	C 6	6102	C 5
2105	D 1	3156	C 7	6103	D 8
2106	C 1	3157	B 7	6104	E 6
2107	B 1	3158	B 7	6107	C 6
2108	D 1	3159	E 4	6108	C 4
2109	B 2	3160	E 4	6109	C 6
2111	E 3	3162	C 6	6110	B 8
2112	E 2	3163	E 5	6111	C 8
2113	C 2	3166	D 6	6112	B 7
2114	C 4	3166	E 6	6118	E 4
2117	C 3	3167	D 6	6119	E 4
2135	D 5	3191	B 6		
2136	E 2	3201	A 8		
2137	D 7	3202	E 8		
2137	E 7	3204	E 8		
2138	E 7	3205	D 8		
2140	E 8	3206	D 8		
2141	D 4	3207	B 7		
2142	E 4	3208	B 7		
2150	D 5	3209	B 7		
2151	D 5	3210	D 8		
2152	C 6	3211	D 7		
2153	C 6	3701	D 2		
2154	C 6	3702	A 7		
2155	D 6	3704	D 2		
2156	B 6	3705	B 5		
2159	E 5	3706	C 5		
2160	D 4	3709	B 6		
2200	A 8	3710	D 7		
2202	D 8	3712	E 5		
2203	C 7	3713	E 6		
2204	C 8	3714	B 6		
2205	E 8	3716	E 6		
3101	D 4	3717	E 6		
3102	D 1	3718	D 5		
3103	E 2	3719	D 2		
3106	C 3	3720	D 3		
3106	C 3	3721	D 3		
3107	A 1	3721	E 3		
3108	A 1	3723	B 8		
3109	D 2	3725	C 8		
3110	D 3	6101	D 2		
3111	C 1	6102	C 5		
3112	D 3	6103	D 8		
3113	C 2	6104	E 6		
3114	B 2	6107	C 6		
3115	D 1	6108	C 4		
3116	C 4	6109	C 6		
3135	D 4	6110	B 8		
3136	D 6	6111	C 8		
3137	D 3	6112	B 7		
3138	E 7	6118	E 4		
3139	E 6	6119	E 4		
3140	D 7				
3141	E 5				
3142	E 4				
3143	E 5				
3144	D 4				
3145	E 7				
3146	D 6				
3150	B 5				
3151	C 5				

PRS.02850

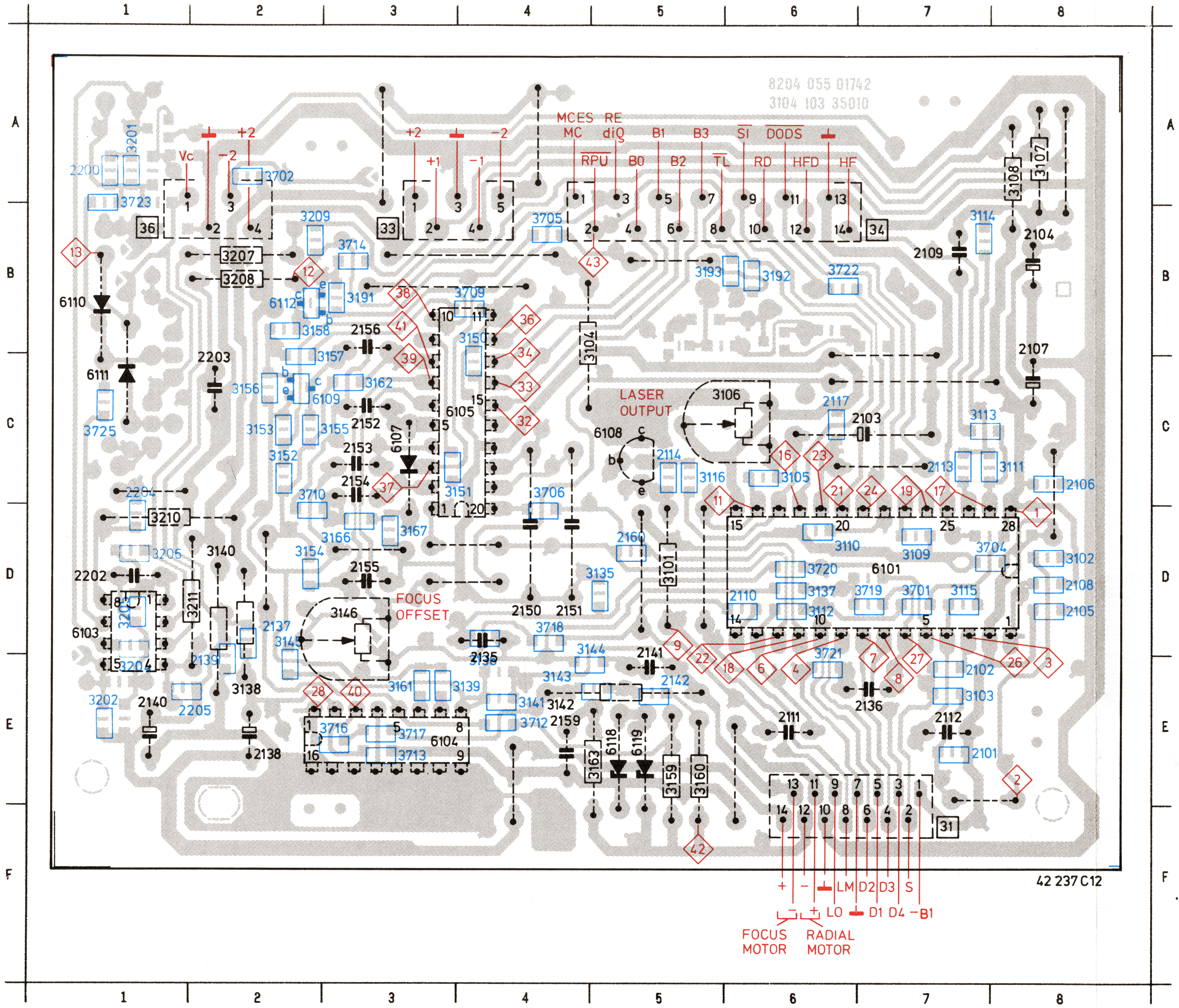
B0-B3	–	Control bits for radial circuit
DAC	–	Current output for track jumping (Digital to Analogue Converted)
$\overline{\text{DODS}}$	–	Drop out detector suppression
D1÷4	–	Photodiode currents
FE	–	Focus error signal
FE lag	–	Focus error signal for LAG network
HF	–	HF output for DEMOD
HFD	–	HF detector output for DEMOD
HF-in	–	HF current input
LM	–	Laser monitor diode input
LO	–	Laser amplifier current output
MC	–	Motor control signal
RE	–	Radial error signal (Amplified RE_2-RE_1 currents)
RE1	–	Radial error signal 1 (summation of amplified currents D_3 and D_4
RE2	–	Radial error signal 2 (summation of amplified currents D_1 and D_2
RE dig	–	Radial error digital = RP
RE lag	–	Radial error signal for LAG network
RD	–	Ready signal, Starting up procedure finished.
$\overline{\text{RPU}}$	–	Radial puls after track jumping
$\overline{\text{Si}}$	–	On/off control for laser supply and focus circuit
$\overline{\text{TL}}$	–	Track loss signal
Vc	–	Control voltage for turntable motor

6101	TDA5708	4822 209 83202
6102	TDA5709	4822 209 83203
6103	NJM4560D	4822 209 83274
6104	TCA0372DP2	4822 209 72587
6109	BC858B	5322 130 41983
6108	BC338-16	4822 130 40892
6110,6111	BAT85	4822 130 31983
6118,6119	HZ7C2	4822 130 32862

14P	Flex print connector		4822 290 60602
2150,2151	3.6 nF-160 V-1%		4822 121 51001
3101	12	Ω NFR25	4822 111 30511
3104	18	Ω NFR25	4822 111 30515
3106	1	-Ω NFR25-5%	4822 111 30499
3138,3140	1	Ω NFR25	4822 111 30483
3146	22	kΩ Trimpot	4822 100 11193
3160	4.7	kΩ MRS25	4822 116 52858

CS 13 343

SERVO + PRE-AMPLIFIER PANEL



2101	E 7	3146	D 3
2102	E 7	3150	B 4
2103	C 7	3151	C 4
2104	B 8	3152	C 2
2105	D 8	3153	C 2
2106	C 8	3154	D 2
2107	B 8	3155	C 3
2108	D 8	3156	C 2
2109	B 7	3157	C 3
2110	D 6	3158	B 2
2111	E 6	3159	E 5
2112	E 7	3160	E 5
2113	C 7	3161	E 3
2114	C 5	3162	C 3
2117	C 6	3163	E 5
2135	E 4	3166	D 3
2136	E 7	3167	D 3
2137	D 2	3191	B 3
2138	E 2	3192	B 6
2139	E 2	3193	B 5
2140	E 1	3201	A 1
2141	D 5	3202	E 1
2142	E 5	3204	E 1
2150	D 4	3205	D 1
2151	D 4	3206	D 1
2152	C 3	3207	B 2
2153	C 3	3208	B 2
2154	C 3	3209	B 2
2155	D 3	3210	D 1
2156	B 3	3211	D 2
2159	E 4	3701	D 7
2160	D 5	3702	A 2
2200	A 1	3704	D 7
2202	D 1	3705	B 4
2203	C 2	3706	C 4
2204	C 1	3709	B 4
2205	E 2	3710	C 2
3101	D 5	3712	E 4
3102	D 8	3713	E 3
3103	E 7	3714	B 3
3104	B 5	3716	E 3
3105	C 6	3717	E 3
3106	C 6	3718	D 4
3107	A 8	3720	D 6
3108	A 8	3721	D 6
3109	D 7	3722	B 6
3110	D 6	3723	A 1
3111	C 8	3725	C 1
3112	D 6	6101	D 7
3113	C 7	6103	D 1
3114	B 7	6104	E 3
3115	D 7	6105	C 4
3116	C 5	6107	C 3
3119	D 7	6108	C 5
3135	D 4	6109	C 2
3135	E 4	6110	B 1
3137	D 6	6111	C 1
3138	E 2	6112	B 2
3139	E 4	6118	E 5
3140	D 2	6119	E 5
3141	E 4		
3142	E 4		
3143	E 4		
3144	D 4		
3145	D 2		

PRS.02853

Carbon film 0.2 W	70°C	5%
Carbon film 0.33 W	70°C	5%
Metal film 0.33 W	70°C	5%
Carbon film 0.5 W	70°C	5%
Carbon film 0.67 W	70°C	5%
Carbon film 1.15 W	70°C	5%

Ⓒ Chip component

Ceramic plate Tuning ⩽ 120 pF NP.0	2%
Others	−20/+80%
Polyester flat foil	10%
Metalized polyester flat film	10%
Polyester flat foil small size (Mylar)	10%
Polysterene film/foil	1%
Tubular ceramic	
Miniature single	
Subminiature tantalum	± 20%

*a	= 2,5 V
b	= 4 V
c	= 6,3 V
d	= 10 V
e	= 16 V
f	= 25 V
g	= 40 V
h	= 63 V
j	= 100 V
l	= 125 V
m	= 150 V
n	= 160 V
q	= 200 V
r	= 250 V
s	= 300 V
t	= 350 V
u	= 400 V
v	= 500 V
w	= 630 V
x	= 1000 V
A	= 1,6 V
B	= 6 V
C	= 12 V
D	= 15 V
E	= 20 V
F	= 35 V
G	= 50 V
H	= 75 V
I	= 80 V

6101	TDA5708	4822 209 83202
6102	TDA5709	4822 209 83203
6103	NJM4560D	4822 209 83274
6104	TCA0372DP2	4822 209 72587
6109	BC858B	5322 130 41983
6108	BC338-16	4822 130 40892
6110,6111	BAT85	4822 130 31983
6118,6119	HZ7C2	4822 130 32862

14P		Flex print connector	4822 290 60602
2150,2151		3.6 nF-160 V-1%	4822 121 51001
3101	12 Ω	NFR25	4822 111 30511
3104	18 Ω	NFR25	4822 111 30515
3106	1 -Ω	NFR25-5%	4822 111 30499
3138,3140	1 Ω	NFR25	4822 111 30483
3146	22 kΩ	Trimpot	4822 100 11193
3160	4.7 kΩ	MRS25	4822 116 52858

SERVO + PRE-AMPLIFIER CIRCUIT 5999

TO DECODER CIRCUIT
TO DECODER µP
43-2 43-1 43-3 43-7 43-4 43-6 43-5 43-13 43-12 43-11 43-10 43-9 43-8
⊥ HF HFD TL DODS Si RD RPU RE dig B0 B1 B2 B3
34-13 34-14 34-12 34-8 34-11 34-9 34-10 34-2 34-3 34-4 34-5 34-6 34-7

+1	+5V
−1	−6V
+2	+9V ±2V
−2	−9V ±2V

TO DECODER CIRCUIT (SUPPLY PART)
42-5 +2 33-1 +2
42-4 +1 33-2 +1
42-3 ⊥ 33-3 −1
42-2 −1 33-4 −1B
42-1 −2 33-5 −2
3108 4R7 +1B
3107 4R7 3704 0E −1B
3709 0E 3710 0E −1C

6102 TDA5709 RADIAL ERROR PROCESSOR
ROM 3½-BIT DAC switches
INTEGRATING AMPLIFIER
OSCILLATOR 570Hz
INTEGRATING AMPLIFIER
RADIAL DRIVE
6104 −B L272MB
6118 HZ7C2 7V5
6119 HZ7C2 7V5
TO RADIAL MOTOR VIA FLEX.PRINT
RAD+ RAD−

C.D.M.−2
FLEX PRINT (FOIL)
DIODE ASSEMBLY
D1 D2 D3 D4
★ GUARD RING PHOTODIODE
LASER ASSEMBLY
1003 1001 10µ 1k 47n 1002 LASER MONITOR

HF AMPLIFIER
EQUALIZER
AMPLITUDE DETECTOR
GAIN CONTROL
HF AMPLITUDE SLICERS
STARTING CIRCUIT
LASER SUPPLY
FOCUS NORMALIZING CIRCUIT
6101 TDA5708 PHOTO DIODE SIGNAL PROCESSOR
ref 0 ref 1 ref 2 ref 3 ref 4 ref 5 ref 6

MOTOR DRIVE
LASER OUTPUT ADJ
6103 −A NJM4560
6103 −B NJM4560
6108 BC338
6109 BC848
6112 BC858
6110 BAT85
6111 BAT85

FOCUS DRIVE
6104 −A L272
TO FOCUS MOTOR VIA FLEX.PRINT
FOC− FOC+

MCES
TO DECODER CIRCUIT 43-1
34-1

TO MOTOR CIRCUIT
36-2 36-4 +2 36-1 Vc 36-3 −2

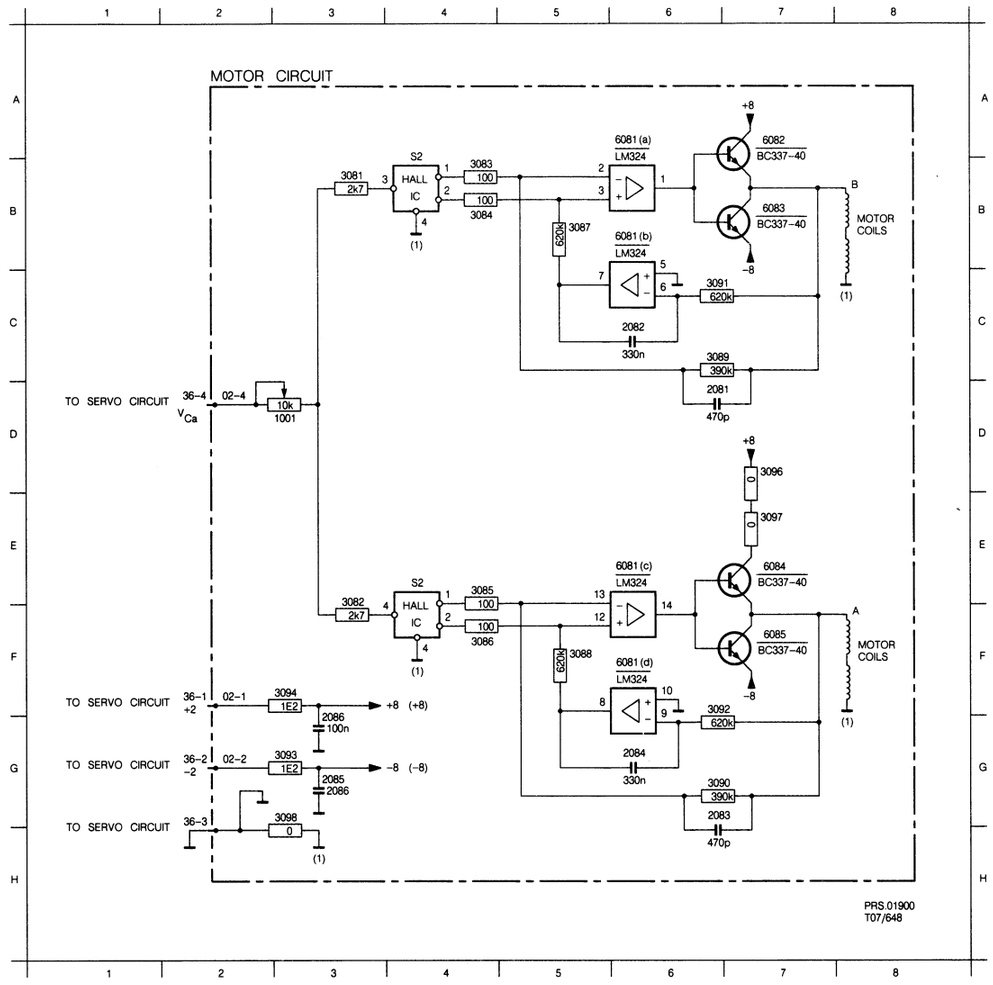
−CHIP JUMPER (0Ω)
ALL RESISTORS AND CAPACITORS ARE CHIP COMPONENTS UNLESS SPECIFIED OTHERWISE

PRS.03687
T07−752

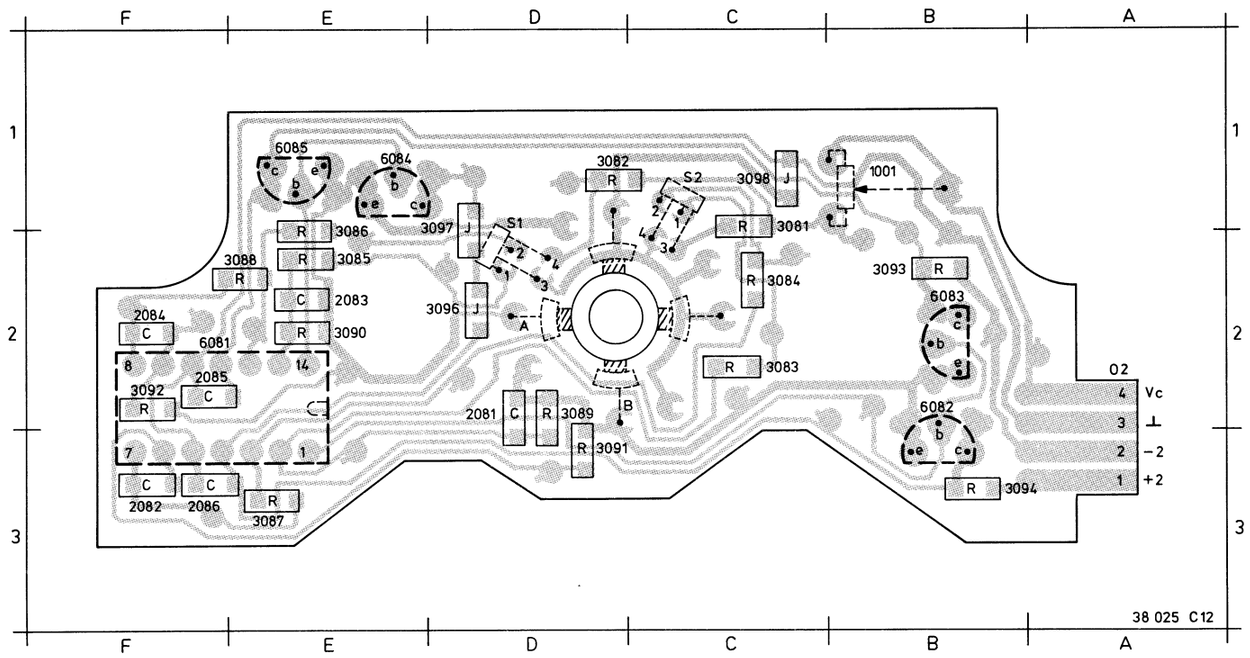
CS 13 345

MOTOR CIRCUIT

1001 D 3 2084 G 6 3082 E 3 3086 F 4 3090 G 6 3094 F 3 6081 A 6 6082 A 7
2081 D 6 2085 G 3 3083 B 4 3087 B 5 3091 C 6 3096 D 7 6081 B 6 6083 B 7
2082 C 6 2086 G 3 3084 B 4 3088 F 5 3092 F 6 3097 E 7 6081 E 6 6084 E 7
2083 G 6 3081 B 3 3085 E 4 3089 C 6 3093 G 3 3098 G 3 6081 F 6 6085 F 7

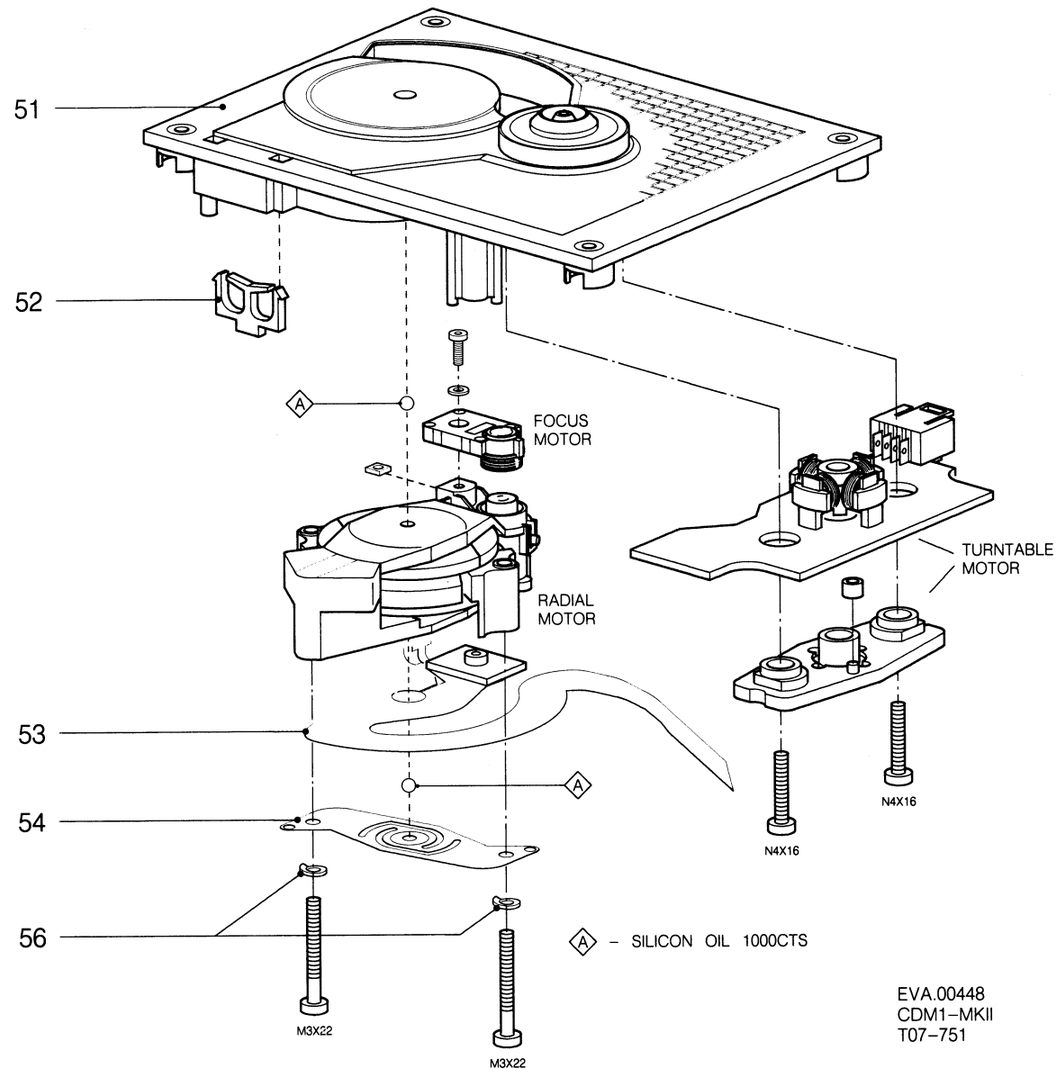


MOTOR PANEL



CS 13 346

EXPLODED VIEW C.D. MECHANISM



EVA.00448
CDM1–MKII
T07–751

Mechanism parts

Complete unit	4822 691 20449
51	4822 361 21115
52	4822 401 10895
53	4822 323 50124
54	4822 520 10555
56	4822 530 80188
A	4822 390 80145
Ball	4822 520 40177

DETAILED MEASURING METHOD FOR THE DECODER CIRCUIT

HINTS

Test discs

It is important to treat the test discs with great care. The disorders on the discs (black spots, fingerprints, etc.) are exclusive and unambiguously positioned. Damage may cause additional drop-outs etc. rendering the intentional errors no longer exclusive. In that case it will no longer be possible to check e.g. the good working of the track detectors.

Measurements on op-amps

In the electronic circuits op-amps have been used frequently. Some of the applications are amplifiers, filters, inverters and buffers.

In those cases where in one way or the other feedback has been applied the voltage difference at the differential inputs converges to zero. This applies to both DC and AC signals. The cause can be traced to the properties of an ideal op-amp ($Z_i=\infty$, $G=\infty$, $Z_o=0$). If one input of an op-amp is directly connected to ground it will be virtually impossible to measure at the inverting and the non-inverting inputs. In such cases only the output signal will be measurable.

That is why in most cases the AC voltage at the inputs will not be given. The DC voltages at the inputs are equal.

Stimulation with "0" and "1"

During troubleshooting sometimes certain points should be connected to ground or supply voltage. As a result certain circuits can be brought in a desired state thus shortening the diagnosis time. In a number of cases the related points are outputs of op-amps. These outputs are short-circuit-resistant, i.e. they can be brought to "0" or ground without problems.
The output of an op-amp, however, should never be connected directly to the power supply voltage.

Measurements on microprocessors

Inputs and outputs of microprocessors should **never** be connected directly to the power supply voltage. The inputs and outputs should only be brought to "0" or ground if this is stated explicitly.

Measurements with an oscilloscope

During measurements with an oscilloscope it is recommended to measure with a 1:10 test probe, since a 1:10 probe has a considerably smaller input capacitance than a 1:1 probe.

Selection of ground potential

It is very important to select a ground point that is as close as possible to the test point.

Conditions for injection

- Injection of levels or signals from an **external** source should **never** take place if the related circuit has no supply voltage.
- The injected levels or signals should **never** be greater than the supply voltage of the related circuit.

Continuous burning of the laser

See: Initiating the Service programme, service position "0"

Indication of test points

In the drawings of the diagrams and the panels the test points have been indicated by a number (e.g. ◇12◇) to which the measuring method refers. In the measuring method below, the symbol (◇) has been omitted for the test points indicated.

GENERAL CHECKPOINTS

In the detailed measuring method below a number of general conditions, required for a properly functioning set, will not be mentioned. Before the detailed measuring method is started, these general points should first be checked.

a. Ensure that disc and objective are clean (remove dust, fingerprints, etc.) and work with undamaged discs.
b. Check if all supply voltages are present and if they have the correct values.
c. Check the good working of the microprocessors and the CD mechanism by means of the service programme.

Initiating the service programme

Service position "0"

- Press "STOP/CM", "PLAY" and "REPEAT" while switching on the mains voltage.
- The display shows:
  - The number of the internal ROM programme, e.g.: P202;
  - The minutes and seconds field: 00 00.
- Fast CDM check:
  - With "SEARCH>>" and "SEARCH<<: arm outward and inward.
  - Laser control and focus control in.
  - Check that the focus unit jumps over the tracks.

ATTENTION: AFTER ONE OF THESE KEYS (SEARCH) IS PRESSED, THE LASER REMAINS DRIVEN UNTIL SERVICE POSITION 3. THEREFORE, AVOID DIRECT EXPOSURE TO THE BEAM IN SERVICE POSITIONS 0, 1 AND 2.

Service position "1"

- Press "NEXT".
- The display shows:
  - The minutes and seconds field: 00 01;
- Functions:
  - Laser control in;
  - Focus start procedure is repeated unlimitedly;
- With "SEARCH>>" and "SEARCH<<" : arm outward and inward.
- With "PREVIOUS" one can go back to service position "0".

Service position "2"

- Move arm inward with "SEARCH<<".
- Put a disc on the turntable.
- Bring player in service position "1"
- Press "NEXT".
- The display shows:
  - The minutes and seconds field: 00 02;
- Functions:
  - Laser control in;
  - Focus control in;
  - Turntable motor control in;
  - Decoder generates MC signal;
- With "SEARCH>>" and "SEARCH<<" : arm outward and inward.
- With "PREVIOUS" one can go back to service position "1".

Service position "3"

- Bring player in service position "2".
- Press "NEXT".
- The display shows:
  - The minutes and seconds field: 00 03;
- Functions:
  - Test procedures: EPROM; RAM; EEPROM; CLEARING FTS MEMORY!!
    These test procedures may only be carried out if the IC concerned is suspicious.
  - Test EEPROM IC:
  - Press "REPEAT"
  - If test is OK, service position "3" will return, otherwise the indication "Er 11" will appear on the display.
- Test RAM of MC68HC11:
  - Press "STORE".
  - If test OK, service position "3" will return, otherwise the indication "Er 12" will appear on the display.
- Test EEPROM IC:
  - The FTS memory that is filled by the customer is saved, but the mains voltage must not be switched off!!!
  - Press the "FTS" and "STORE" keys.
  - During this test the cell number examined will appear on the display.
  - If test OK, service position "3" will return, otherwise the indication "Er 09" and the deviating cell number will appear on the display.
- Clearing FTS memory:
  - The entire FTS memory, filled by the customer, is cleared. So avoid contact with this test as much as possible!
  - Press the "FTS", "REPEAT" and "CLEAR" keys.
  - The characters "All" will be displayed.
    If an error is detected, the indication "Er 09" will be displayed.
- With "PREVIOUS" one can go back to service position "2".

Service position "D"

- Bring the player in service position "3".
- Put test disc 5A on the turntable.
- Press "STOP" and "PLAY" keys.
- Functions: this is a life test procedure. See life test functions table.
- If an error is detected, the player will stop and give an error message on the display. For a description of the error message: See Error table.

Service position "E"

- Bring the player in service position "3" or "D".
- Put a disc on the turntable.
- Press the "PLAY" key.
- Functions: all keys have their original functions.
- If an error is detected, the player will stop and give an error message on the display. For a description of the error message: See Error table.
- If the µP observes a system error, a system error indication will appear on the display: Er 01 through Er 12.
- If the µP observes an operating error, an operating error indication will be displayed for 1.5 seconds: Er 30 through Er 57 and Er 60.

The service programme can be abandoned again by turning the mains switch (POWER ON/OFF) off and on again (Hardware reset).

ERROR TABLE

System errors

Indication	Cause	Check
Er 01	No RD	$\overline{Si}$, Sc, RD, Photodiode signal processor
Er 02	No $\overline{TL}$ pulse at start-up	$\overline{TL}$, HF, Photodiode signal processor, CD disc present
Er 03	No lead-in track found	CD disc, radial arm position, REdig, Radial error processor
Er 04	Too many $\overline{TL}$ pulses in PLAY	CD disc, $\overline{HFD}$
Er 05	$\overline{TL}$ pulse > 50 msec. in PLAY	CD disc, HF in, photodiodes
Er 06	No $\overline{TL}$ pulse within 0.5 sec. during track jumping	RE-lag circuit
Er 07	Subcoding error during PLAY	HF
Er 08	TOC error	CD disc, turntable motor control, radial arm position
Er 09	EEPROM cell error	Replace EEPROM
Er 10	Search error: selected point on disc cannot be reached	CD disc
Er 11	EEPROM error: programme deviation	Replace EEPROM
Er 12	RAM in µP MC68HC11 defective	Replace µP MC68HC11

Operating errors

Er 30 "NEXT" key operated during the last track, with "REPEAT" turned off.
Er 31 "PREVIOUS" key operated during the first track, with "REPEAT" turned off.
Er 32 Index selected before a track has been selected.
Er 33 The selected index number does not exist on this disc.
Er 34 Programme survey requested; no programme present.
Er 35 The programme memory is full.
Er 36 The progammed track is not present on this CD disc.
Er 37 The selected track is not present on this CD disc.
Er 38 Selected time in seconds greater than 59.
Er 39 Error in the selection procedure.
Er 40 Wrong time programmed.
Er 41 The selected time does not exist.
Er 42 The selected track does not exist.
Er 43 FTS data storage error: memory full.
Er 44 FTS data storage error: no programme presented.
Er 45 FTS data storage error: no more free disc number.
Er 46 FTS playback error: no FTS programme in the memory.
Er 47 FTS selection error: "NEXT" key actuated while FTS points towards the end of the number of tracks.
Er 48 FTS selection error: "PREVIOUS" key actuated while the FTS points to the beginning of the number of tracks.
Er 49 FTS selection error: "NEXT" or "PREVIOUS" key actuated at the moment the µP is storing data.
Er 50 FTS selection error: "REVIEW" key actuated while the CD disc has not yet been stored in the FTS memory; or TOC of the disc has not yet been read in.
Er 51 FTS selection error: "REVIEW" key actuated.
Er 52 FTS selection "CLEAR": "CLEAR" key actuated while data are being stored in the memory.
Er 53 "CLEAR" key actuated, but clear function has not been carried out.
Er 54 FTS data storage error: TOC of the CD disc, of which data should be saved, has not yet been read in.
Er 55 FTS playback error: Insufficient data of the TOC of the CD disc read in for processing in the FTS memory. Check the lead-in track.
Er 56 "A→B" key actuated while the player was not in PLAY mode.
Er 57 "SEARCH" key actuated during "SCAN" mode.
Er 60 End of the "FAST FORWARD/REVERSE" search motion.

TABLE: LIFE TEST FUNCTIONS

Function	Time	Remark
start	0 sec	Test disc 5A on the turntable.
repeat	1 sec	Plays track 1 for 1 sec.
fast search forward	60 sec	Fast search from beginning to end, without sound until Er 60 appears.
fast search reverse	60 sec	Fast search from end to beginning, without sound until Er 60 appears.
previous	60 sec	Plays track 24 for 1 minute (last track).
next	120 sec	Plays track 1 and 10 sec. of track 2 (2 minutes in total).
pause (in)	60 sec	1 minute pause. Display shows pause.
pause (off)	1 sec	Plays track 2 for 1 second after pause mode.
next	120 sec	Plays track 3 and 5 sec. of track 4 (2 minutes in total).
next	120 sec	Plays track 5 for 2 minutes.
next	120 sec	Plays tracks 6 and 3 sec. of track 7 (2 minutes in total).
next	120 sec	Plays track 8 for 2 minutes.
next	120 sec	Plays track 9 for 2 minutes.
next	120 sec	Plays track 10 for 2 minutes.
next	120 sec	Plays track 11 for 2 minutes.
next	120 sec	Plays track 12 and 30 sec. of track 13 (2 minutes in total).
next	120 sec	Plays track 14 and 30 sec. of track 15 (2 minutes in total).
search forward	120 sec	With search sound from track 15 to track 22 for 2 minutes.
search reverse	120 sec	With search sound from track 22 to track 17 for 2 minutes.
next	120 sec	Plays track 18 for 2 minutes.
open	10 sec	Tray opens for 10 sec.
close	10 sec	Tray is closed again. ☐ Then these functions are repeated.

I MICRO PROCESSOR MC68HC11 (IC6303)

- **$\overline{\text{Reset}}$ (pin 39; test point 103)**

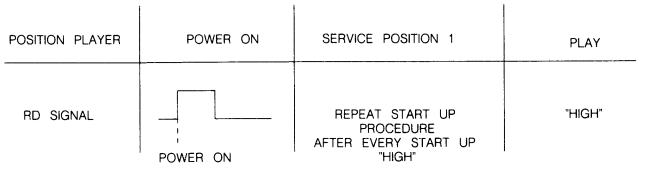
After switching on the supply voltage, a positive voltage should be present.

- **X-TAL out (pen 30; test point 31)**

The frequency of this signal should be 8 MHz.

- **RD (pin 18; test point 24)**

The RD signal (= Ready) goes "high" when the focal point has been found.
So there should be a disc on the turntable.



- **SWAB/$\overline{\text{SSM}}$ (pin 43; test point 78)**

When, after RD "high", the SWAB/$\overline{\text{SSM}}$ is "high" for a short moment (> 0.2 sec), the turntable motor control will be switched on.
The turntable motor is controlled by the MC-signal (test point 81).
To check MC, see: "Decoder A IC". To check the turntable motor control, see Servicing the CDM unit: "Checking of the motor control".

- **$\overline{\text{TL}}$ (pin 18; test point 16)**

- The $\overline{\text{TL}}$ signal (Track Loss) is used to tell the µP that track loss threatens. The µP then can give correction signals with B0 ÷ B3.
- In the "SEARCH" mode, or when the player is bumped against, there are pulses on test point 16.

- **REdig (test point 37)**

The REdig signal (= Radial Error Digital = radial deviation) is used to determine the place of the arm relative to the track and to check/correct in case of track jumping or bumping against the player.

In position PLAY or PAUSE mode, a square wave should be present on test point 37.
Because of frequency variations, this square wave is hard to trigger.

- **$\overline{\text{DODS}}$ (pin 13; test point 19)**

The $\overline{\text{DODS}}$ signal (= Drop Out Detector Suppression) avoids that Drop-Out signals influence the arm control during track jumping.

- **RP/4 (pin 6; test point 94)**

RP/4 enables very fast searching in position SEARCH. In that position, there should be activity at test point 94.

- **E (pin 27; test point 96)**

E is the internal microprocessor block signal of 2 MHz.

- **AS (pin 26; test point 97)**

AS is the Address Select strobe signal working with a 2 MHz clock frequency.

- **Data I (pin 44; test point 98)**
- **Data O (pin 45; test point 99)**
- **SCK (pin 46; test point 100)**
- **ACK (pin 47; test point 100)**

After the player is switched on, there should be activity at test points 98 through 101.

II MICROPROCESSOR SLAVE MC68HC24 (IC6332)

- **$\overline{\text{Reset}}$ (pin 39; test point 103)**

When the supply voltage is switched on, a positive voltage should be present.

- **$\overline{\text{Si}}$ (pin 21; test point 21)**

When the $\overline{\text{Si}}$ signal (= Start Initialization) is "low", the laser supply and the focusing control are switched on.

Position of player	POWER ON	Servicing pos. 1	PLAY
$\overline{\text{Si}}$ signal	"high"	When repeating the start procedure "low"	"low"

- **B0 (pin 7 ; test point 36)**
  B1 (pin 8 ; test point 34)
  B2 (pin 9 ; test point 33)
  B3 (pin 10; test point 32)

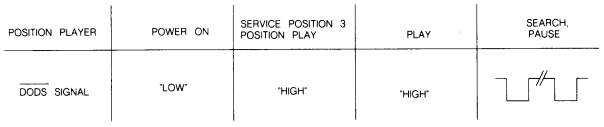
With the B0 ÷ B3 signals
- The radial control is switched on.
- The level on the DAC output is controlled.
- In the SEARCH mode, there should be activity on all 4 test points.

- In the following positions the signals B0 ÷ B3 are stable:

signal	STOP	PLAY	Service pos. 0,1,2 SEARCH ≪	Service pos. 3 SEARCH ≫
B0	"low"	"high"	"low"	"high"
B1	"high"	"high"	"high"	"low"
B2	"high"	"high"	"high"	"high"
B3	"low"	"low"	"low"	"low"

- **$\overline{\text{DODS}}$ (pin 13; test point 19)**

The $\overline{\text{DODS}}$ signal (= Drop Out Detector Suppression) avoids that Drop-Out signals influence the arm control during track jumping.



III DECODER-A (IC6310)

- **Check the MC signal (pin 17; test point 81)**

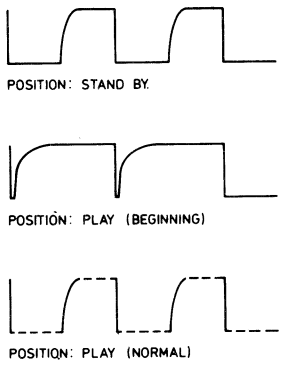
- In stand-by mode, the MC signal (Motor Control) corresponds to the figure below.

  Note:
  The repetition time of the MC signal is 11.3 µsec.

- Place a disc on the turntable.
- In position PLAY or SERVICE POSITION 2, the MC signal corresponds to the figure below.

  Note:
  During start-up the duty cycle is 98%, then the duty cycle of the signal becomes about 50%.

See also servicing the CDM unit: "Check of the motor control".

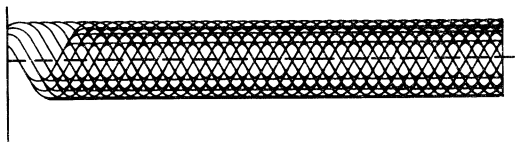


- **Check the HF signal on test point 65 (eye pattern)**

- Insert a disc.
- The HF signal should be present and be stable in the PLAY mode.
- In SERVICING POSITION 2 and during reading of the lead-in track the HF signal is not stable.

Position of oscilloscope 0.5 µs/DIV.

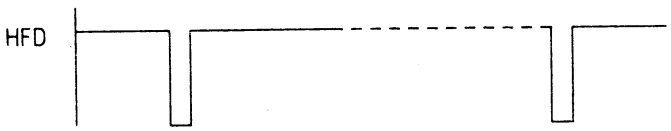
Amplitude ≈ 1.5 V_{pp}



- **Check the HFD signal on test point 66**

- Insert a disc.
- In the PLAY mode the HFD signal is "high"; however, minor pulses may be present and in cause of disorders on the disc.
- In SERVICING POSITION 2 and during playback of track no. 15 of test disc 5A HFD pulses are visible.
- When the disc is braked a little, HFD pulses are visible.

Position of the oscilloscope 5 ms/DIV



- **Check if the $\overline{\text{MUTE}}$ signal (pin 11; test point 67) is "high"**

When Filter-B IC is applied, the $\overline{\text{MUTE}}$ input will not be used.

- **Check the CEFM signal (pin 27; test point 68)**

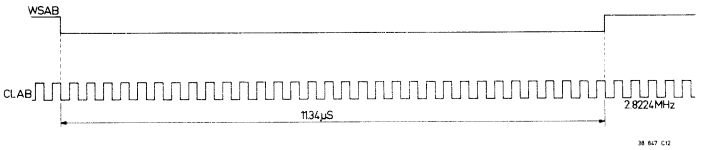
- Place a disc on the turntable.
- In stand-by mode (only the mains switch is depressed), the frequency lies between 2.82 MHz and 5.64 MHz.
- In the position PLAY and SERVICE POSITION 2, the frequency is 4.32 MHz.

- **Check the Xin signal (pin 19; test point 69)**

- The Xin frequency is 11.2896 MHz.
- If this frequency deviates, check test point 70; Xout signal, on Filter-B IC.
  This frequency should also be 11.2896 MHz.

- **Check the timing signals meant for Filter-B IC**

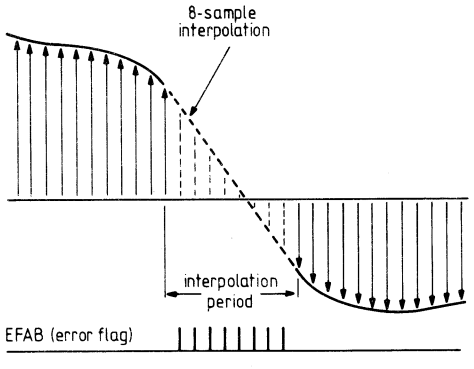
- Place a disc on the turntable.
- Select one of the following positions:
  SERVICE POSITION 2, or position PLAY.
- Trigger the oscilloscope with the WSAB signal (test point 71; pin 39).
- Check signals:
  WSAB at test point 71 (pin 39)
  (Word Select from Decoder-A to Filter-B)
  CLAB at test point 72 (pin 38)
  (Clock from Decoder-A to Filter-B)
  and their interrelation.
- There must be activity at test point 73 (pin 37), DAAB signal (DATA from Decoder-A to Filter-B).



- **Check the EFAB signal (Error Flag from Decoder-A to Filter-B) at test point 74 (pin 36)**

- Place test disc 5A on the turntable.
- During playback, EFAB pulses should be present at test point 74 for soft braking of the disc and during fast search (F.Forward, F.Reverse).

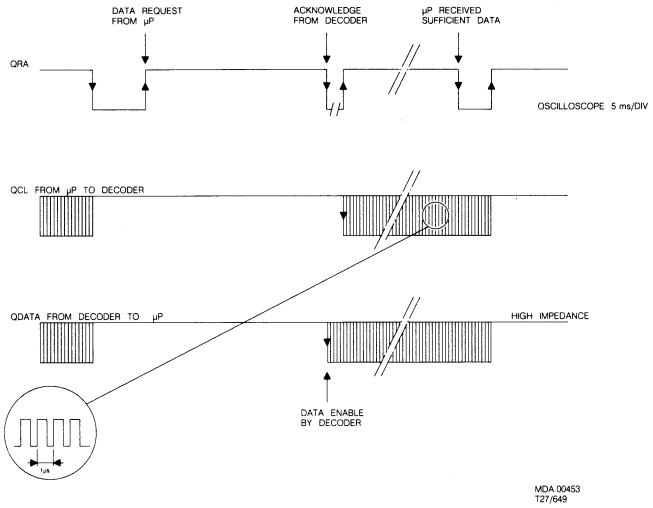
  Note:
  Filter-B IC is capable of interpolating linearly 8 successive EFAB pulses.



- **Check the Q-channel signals**

- Place a disc on the turntable.
- Select one of the following positions:
  SERVICE POSITION 3 or position PLAY.
- Trigger on the QRA signal (Q-channel Request Acknowledge) test point 75; pin 30.
- Check signals QRA at test point 75 (pin 30)
  QCL at test point 76 (pin 31)
  (Q-channel-clock)
  and their interrelation.
- There should then be activity at test point 77 (pin 29) QDA (Q-channel Data).

Note:
The QRA request is initiated by decoder µP (QRA "high"). Then Decoder-A answers this request (QRA goes "low"). With the next leading clock pulse (QCL) the QRA signal is rendered "high" again by the decoder µP.



As soon as the Decoder-A has taken in enough information via QDA, QRA will go low again. That is why the QRA times vary each time.

- **Check the $\overline{\text{SSM}}$ signal (test point 78; pin 33) = Start-Stop turntable motor**

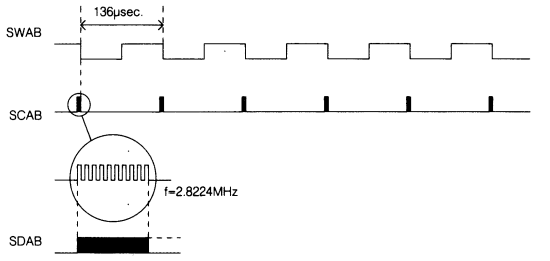
- Motor start pulse when test point 78 is "high" for ⩾ 0.2 sec.
- Motor stop pulse when test point 78 is "low" for ⩾ 0.2 sec.

  Note:
  After the motor start pulse, SWAB information (Subcoding Word clock) will become visible at this point. The period time of that signal is 136 µsec.

- **Check the subcode clock signals**

- Place a disc on the turntable.
- Select position PLAY.
- Trigger the oscilloscope with the SWAB signal at test point 78.
- Check the following signals:
  SWAB at test point 78; pin 33
  SCAB at test point 79; pin 35 (Subcode Clock from Decoder-A to Filter B)
  SDAB at test point 80; pin 34 (Subcode Data from Decoder-A to Filter B)
  and their interrelations.

Note:
While the burst of 10 clock pulses, appear on SCAB the Q-channel information is transferred on SDAB. Hereafter the P-bit indication follows.
The P-bit is "high" between two bursts of 10 clock pulses in case of pause indication and "low" in case of music indication.



- **Check the $\overline{\text{CRI}}$ signal (pin 28; test point 19)**

  The CRI signal is "low" in case of track jumping. Player in position SEARCH.

- **Check the DEEM signal (test point 84; pin 32)**

- Place test disc 5 on the turntable.
- During playback of track no. 14 (recorded without PRE-EMPHASIS), the DEEM signal should be "low".
- During playback of track no. 15 (recorded with PRE-EMPHASIS), the DEEM signal should be "high".

IV FILTER-B (IC6316)

- **Check the signals between Decoder-A IC and Filter-B IC**

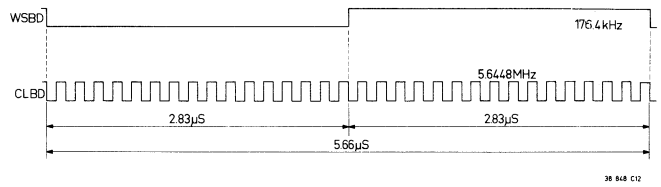
- See sub. "III Decoder-A":
  * Check the X IN signal (test points 69 and 70)
  * Check the timing signals meant for Filter B (WSAB, CLAB, DAAB signals; test points 71, 72 and 73).
  * Check the EFAB signal (test point 74)
  * Check the subcode clock signals (SWAB, SCAB, SDAB signals; test points 78, 79 and 80).

- **Check the timing signals between Filter-B and DAC IC**

- Place a disc on the turntable.
- Select the position PLAY.
- Trigger the oscilloscope with the WSBD signal (Word Select from Filter B to DAC) test point 85 (pin 18).

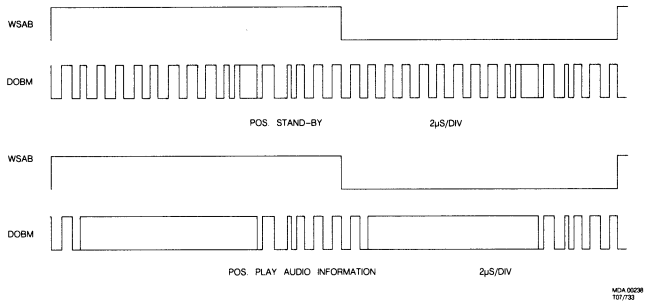
- **Check the following signals:**
  WSBD at test point 85; pin 18
  CLBD at test point 87; pin 16 (Clock signal from Filter B to DAC) and their interrelation.

If an Audio disc is used, there should be activity at test point 86 (pin 15) DABD signal (DATA from Filter B to DAC).
If a disc with Digital Data (CD–ROM) is used, this point is continuously switched "low" by transistor 6318. Then the ANI signal test point 95 is "HIGH".
In that case the word "data" appears on the display.



- **Check the DOBM signal (Digital Output)**

- Place a disc on the turntable.
- Select the stand-by mode (only mains switch depressed).
- Trigger the oscilloscope with the WSAB signal (test point 71).
- Check the DOBM signal (test point 88; pin 14). An empty audio signal has a fixed pattern. See drawing, "Stand-by".
- Select the PLAY mode. Check the DOBM signal. See drawing "PLAY".



- **In position SEARCH the $\overline{\text{ATSB}}$ signal is "low" test point 89; pin 22 (Attenuation Audio Signal)**

- **Check the $\overline{\text{MUSB}}$ signal test point 90; pin 23 (Soft Mute)**

This signal is "low" in positions:
PAUSE
NEXT or PREVIOUS when jumping from one track to another.
During fast SEARCH, when the FAST and SEARCH keys have been actuated.

V DAC IC (Dual Digital Analog Converter)

- **Check the signals between Filter-B and DAC IC**

- See sub. "IV Filter-B":
  * Check the timing signals between Filter-B and DAC IC.

- **Check the output of the OP-AMP after the DAC IC**

- Place a disc on the turntable.
- In position PLAY the analog (= music) signal should be available at the output of the operational amplifier.

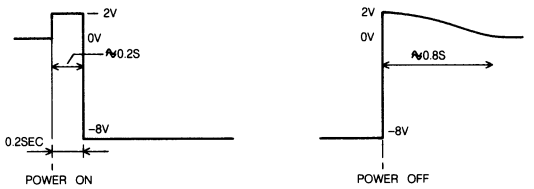
VI DEEM CIRCUIT

- **Check DEEM circuit**

- Place test disc 5 on the turntable.
- During playback of track no. 14 (recorded without PRE-EMPHASIS) the DEEM signal at test point 84 should be "low".
- During playback of track no. 15 (recorded with PRE-EMPHASIS), the DEEM signal at test point 84 should be "high".
- During playback of track no. 14 the analogue signal should be present at the source of 6383 (test point 91) and 6382 (test point 92).
- During playback of track no. 15 the analog signal at the source of 6383 (test point 91) and 6383 (test point 92) should be 0 V.

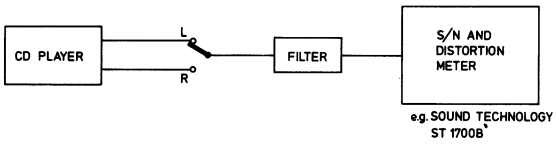
VII KILL CIRCUIT

- During switching on and off the mains voltage the signal on test point should be as indicated in the figure below.



MDA.00134
T07/733

VIII SPECIFICATIONS MEASUREMENT



30 459 A12

To measure the specification use can be made of audio test disc 4822 397 30085 use 13th order filter 4822 395 30204 to measure:
- Total harmonic distorsion
- Intermodulation distorsion
- Signal–to–noise ratio (s/n)

© Chips 50 V NP0 S1206

1 pF	5%	4822 122 32479
1,2 pF	5%	4822 122 33013
1,5 pF	5%	4822 122 31792
1,8 pF	5%	4822 122 32087
2,2 pF	5%	4822 122 32425
3,3 pF	5%	4822 122 32079
3,9 pF	5%	4822 122 32081
4,7 pF	5%	4822 122 32082
5,6 pF	5%	4822 122 32506
6,8 pF	5%	4822 122 32507
8,2 pF	5%	4822 122 32083
10 pF	5%	4822 122 31971
12 pF	5%	4822 122 32139
15 pF	5%	4822 122 32504
18 pF	5%	4822 122 31769
22 pF	10%	4822 122 31837
27 pF	5%	4822 122 31966
33 pF	5%	4822 122 31756
39 pF	5%	4822 122 31972
47 pF	5%	4822 122 31772
56 pF	5%	4822 122 31774
68 pF	5%	4822 122 31961
82 pF	10%	4822 122 31839
100 pF	5%	4822 122 31765
120 pF	5%	4822 122 31766
150 pF	5%	4822 122 31767
180 pF	2%	4822 122 31794
220 pF	5%	4822 122 31965
270 pF	5%	4822 122 32142
330 pF	10%	4822 122 31642
390 pF	5%	4822 122 31771
470 pF	5%	4822 122 31727
560 pF	5%	4822 122 31773
680 pF	5%	4822 122 31775
820 pF	5%	4822 122 31974
1 nF	10%	5322 122 31647
1,2 nF	5%	4822 122 31807
1,5 nF	10%	4822 122 31781
1,8 nF	10%	4822 122 32153
2,2 nF	10%	4822 122 31644
2,7 nF	10%	4822 122 31783
3,3 nF	10%	4822 122 31969
3,9 nF	10%	4822 122 32566
4,7 nF	10%	4822 122 31784
5,6 nF	10%	4822 122 31916
6,8 nF	10%	4822 122 31976
10 nF	10%	4822 122 31728
12 nF	10%	5322 122 31648
15 nF	10%	4822 122 31782
18 nF	10%	4822 122 31759
22 nF	10%	4822 122 31797
27 nF	10%	4822 122 32541
33 nF	10%	4822 122 31981
47 nF	10%	4822 122 32542
56 nF	10%	4822 122 32183
100 nF	10%	4822 122 31947
180 nF	10%	4822 122 32915
220 nF	20%	4822 122 32715

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0 E	jumper	4822 111 90163
1 E	5%	4822 111 90184
1,1 E	5%	4822 111 90377
1,2 E	5%	4822 111 90378
1,3 E	5%	4822 111 90379
1,5 E	5%	4822 111 90381
1,6 E	5%	4822 111 90382
1,8 E	5%	4822 111 90383
2 E	5%	4822 111 90384
2,2 E	5%	5322 111 90104
2,4 E	5%	4822 111 90385
2,7 E	5%	4822 111 90386
3 E	5%	4822 111 90387
3,3 E	5%	4822 111 90388
3,6 E	5%	4822 111 90389
3,9 E	5%	4822 111 90391
4,3 E	5%	4822 111 90392

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4,7 E	5%	5322 111 90376
5,1 E	5%	4822 111 90393
5,6 E	5%	4822 111 90394
6,2 E	5%	4822 111 90395
6,8 E	5%	4822 111 90254
7,5 E	5%	4822 111 90396
8,2 E	5%	4822 111 90397
9,1 E	5%	4822 111 90398
10 E	2%	5322 111 90095
11 E	2%	4822 111 90338
12 E	2%	4822 111 90341
13 E	2%	4822 111 90343
15 E	2%	4822 111 90344
16 E	2%	4822 111 90347
18 E	2%	5322 111 90139
20 E	2%	4822 111 90352
22 E	2%	4822 111 90186
24 E	2%	4822 111 90355
27 E	2%	5322 111 90105
30 E	2%	4822 111 90356
33 E	2%	4822 111 90357
36 E	2%	4822 111 90359
39 E	2%	4822 111 90361
43 E	2%	5322 116 90125
47 E	2%	4822 111 90217
51 E	2%	4822 111 90365
56 E	2%	4822 111 90239
62 E	2%	4822 111 90367
68 E	2%	4822 111 90203
75 E	2%	4822 111 90371
82 E	2%	4822 111 90124
91 E	2%	4822 111 90375
100 E	2%	5322 111 90091
110 E	2%	4822 111 90335
120 E	2%	4822 111 90339
130 E	2%	4822 111 90164
150 E	2%	5322 111 90098
160 E	2%	4822 111 90345
180 E	2%	5322 111 90242
200 E	2%	4822 111 90348
220 E	2%	4822 111 90178
240 E	2%	4822 111 90353
270 E	2%	4822 111 90154
300 E	2%	4822 111 90156
330 E	2%	5322 111 90106
360 E	1%	4822 111 90288
360 E	2%	4822 111 90358
390 E	2%	5322 111 90138
430 E	2%	4822 111 90362
470 E	2%	5322 111 90109
510 E	2%	4822 111 90245
560 E	2%	5322 111 90113
620 E	2%	4822 111 90366
680 E	2%	4822 111 90162
750 E	2%	5322 111 90306
820 E	2%	4822 111 90171
910 E	2%	4822 111 90372
1 k	2%	5322 111 90092
1,1 k	2%	4822 111 90336
1,2 k	2%	5322 111 90096
1,3 k	2%	4822 111 90244
1,5 k	2%	4822 111 90151
1,6 k	2%	5322 111 90265
1,8 k	2%	5322 111 90101
2 k	2%	4822 111 90165
2,2 k	2%	4822 111 90248
2,4 k	2%	4822 111 90289
2,7 k	2%	4822 111 90569
3 k	2%	4822 111 90198
3,3 k	2%	4822 111 90157
3,6 k	2%	5322 111 90107
3,9 k	2%	4822 111 90571
4,3 k	2%	4822 111 90167
4,7 k	2%	5322 111 90111
5,1 k	2%	5322 111 90268
5,6 k	2%	4822 111 90572
6,2 k	2%	4822 111 90545

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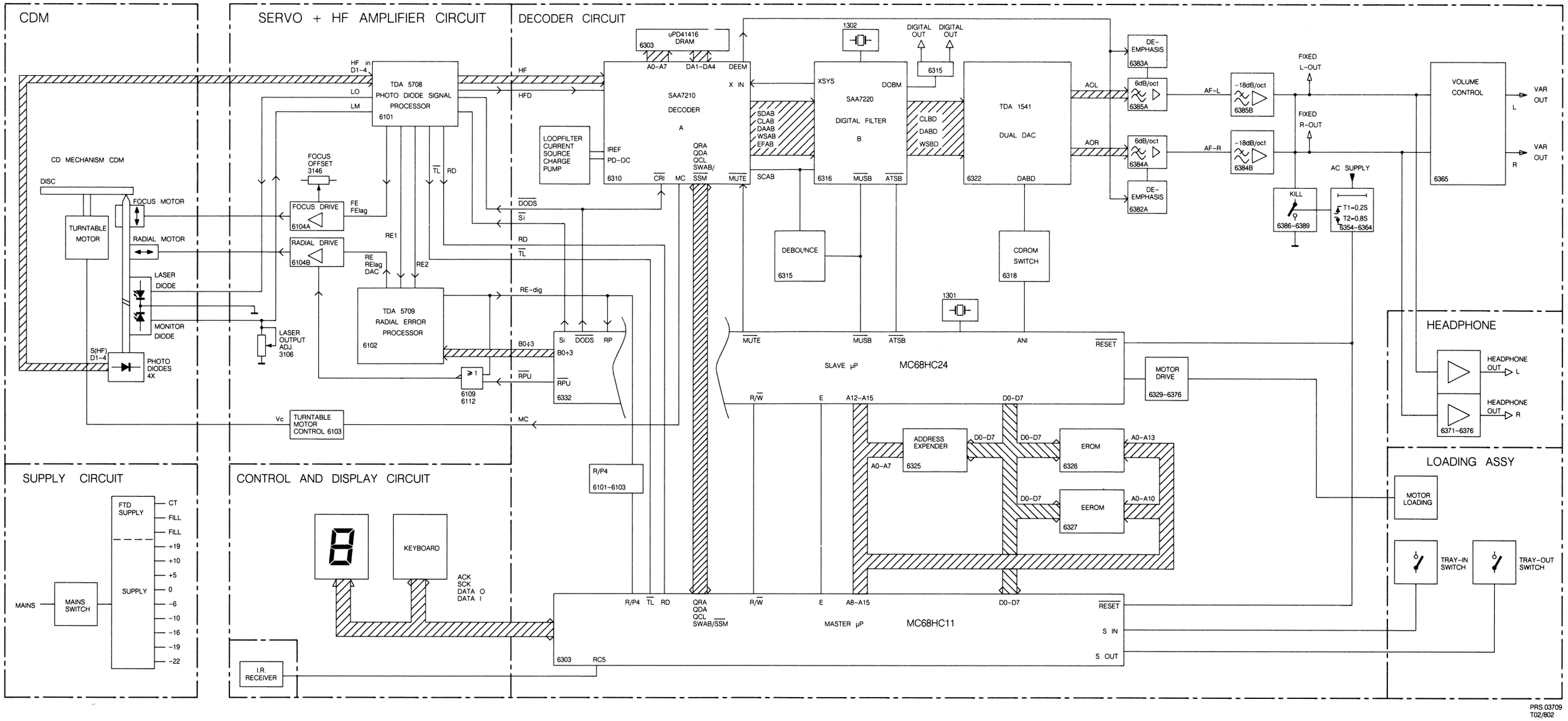
1U

6,8 k	2%	4822 111 90544
7,5 k	2%	4822 111 90276
8,2 k	2%	5322 111 90118
9,1 k	2%	4822 111 90373
10 k	2%	4822 111 90249
11 k	2%	4822 111 90337
12 k	2%	4822 111 90253
13 k	2%	4822 111 90509
15 k	2%	4822 111 90196
16 k	2%	4822 111 90346
18 k	2%	4822 111 90238
20 k	2%	4822 111 90349
22 k	2%	4822 111 90251
24 k	2%	4822 111 90512
27 k	2%	4822 111 90542
30 k	2%	4822 111 90216
33 k	2%	5322 111 90267
36 k	2%	4822 111 90514
39 k	2%	5322 111 90108
43 k	2%	4822 111 90363
47 k	2%	4822 111 90543
51 k	2%	5322 111 90274
56 k	2%	4822 111 90573
62 k	2%	5322 111 90275
68 k	2%	4822 111 90202
75 k	2%	4822 111 90574
82 k	2%	4822 111 90575
91 k	2%	5322 111 90277
100 k	2%	4822 111 90214
110 k	2%	5322 111 90269
120 k	2%	4822 111 90568
130 k	2%	4822 111 90511
150 k	2%	5322 111 90099
160 k	2%	5322 111 90264
180 k	2%	4822 111 90565
200 k	2%	4822 111 90351
220 k	2%	4822 111 90197
240 k	2%	4822 111 90215
270 k	2%	4822 111 90302
300 k	2%	5322 111 90266
330 k	2%	4822 111 90513
360 k	2%	4822 111 90515
390 k	2%	4822 111 90182
430 k	2%	4822 111 90168
470 k	2%	4822 111 90161
510 k	2%	4822 111 90364
560 k	2%	4822 111 90169
620 k	2%	4822 111 90213
680 k	2%	4822 111 90368
750 k	2%	4822 111 90369
820 k	2%	4822 111 90205
910 k	2%	4822 111 90374
1 M	2%	4822 111 90252
1,1 M	5%	4822 111 90408
1,2 M	5%	4822 111 90409
1,3 M	5%	4822 111 90411
1,5 M	5%	4822 111 90412
1,6 M	5%	4822 111 90413
1,8 M	5%	4822 111 90414
2 M	5%	4822 111 90415
2,2 M	5%	4822 111 90185
2,4 M	5%	4822 111 90416
2,7 M	5%	4822 111 90417
3 M	5%	4822 111 90418
3,3 M	5%	4822 111 90191
3,6 M	5%	4822 111 90419
3,9 M	5%	4822 111 90421
4,3 M	5%	4822 111 90422
4,7 M	5%	4822 111 90423
5,1 M	5%	4822 111 90424
5,6 M	5%	4822 111 90425
6,2 M	5%	4822 111 90426
6,8 M	5%	4822 111 90235
7,5 M	5%	4822 111 90427
8,2 M	5%	4822 111 90237
9,1 M	5%	4822 111 90428
10M	5%	5322 111 91141

BLOCK DIAGRAM



PRS.03709
T02/802

B0-B3 – Control bits for radial circuit
DAC – Current output for track jumping (Digital to Analogue Converted)
$\overline{DODS}$ – Drop out detector suppression
D1÷4 – Photodiode currents
FE – Focus error signal
FE lag – Focus error signal for LAG network
HF – HF output for DEMOD
HFD – HF detector output for DEMOD
HF-in – HF current input
LM – Laser monitor diode input
LO – Laser amplifier current output
MC – Motor control signal
RE – Radial error signal (Amplified RE_2-RE_1 currents)

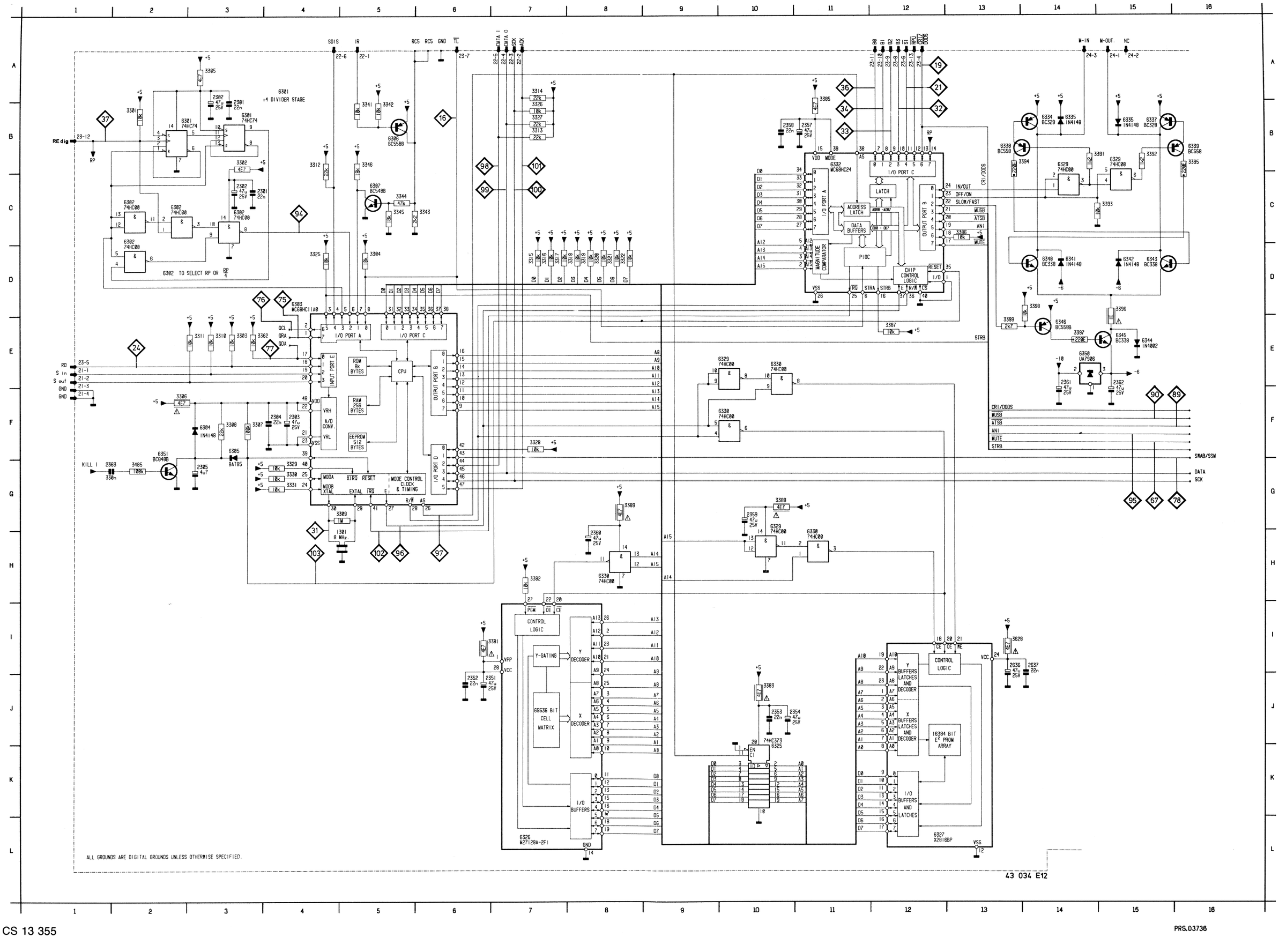
RE1 – Radial error signal 1 (summation of amplified currents D_3 and D_4
RE2 – Radial error signal 2 (summation of amplified currents D_1 and D_2
RE dig – Radial error digital = RP
RE lag – Radial error signal for LAG network
RD – Ready signal, Starting up procedure finished.
$\overline{RPU}$ – Radial puls after track jumping
$\overline{Si}$ – On/off control for laser supply and focus circuit
$\overline{TL}$ – Track loss signal
Vc – Control voltage for turntable motor

$\overline{ATSB}$ – Attenuation of Audio level in Search position (Cueing)
CD ROM Switch – Digital Data information on disc signal
CEFM – Clock Eight-to-Fourteen Modulator
CLAB – Clock signal Decoder-A to Filter-B
$\underline{CLBD}$ – Clock signal Filter-B to DAC
$\overline{CRI}$ – Counter Reset Inhibit
DAAB – Data signal Decoder-A to Filter-B
$\underline{DABD}$ – Data signal Filter-B to DAC
$\overline{DEEM}$ – Deemphasis
DOBM – Digital out signal
EFAB – Error flag Decoder-A to Filter-B
$\underline{CREF}$ – Reference Current
$\overline{MUTE}$ – Mute signal

$\overline{MUSB}$ – Soft Mute signal
PD/OC – Phase detector - oscillator control
QCL – Q-channel Clock signal
QDA – Q-channel Data signal
QRA – Q-channel Request Aknowledge
SCAB – Subcode clock Decoder-A to Filter-B
SDAB – Subcode data Decoder-A to Filter-B
SWAB/$\overline{SSM}$ – Subcode Word/Start-stop motor signal
WSAB – Word select Decoder-A to Filter-B
WSBD – Word Select Filter-B to DAC
XIN – Oscillator signal in Decoder-A
XSYS – Oscillator signal out Filter-B

CS 13 354

DECODING 1



1301	Q	5
2301	C	4
2301	A	3
2302	C	3
2302	A	3
2303	F	4
2304	F	4
2305	G	3
2351	J	7
2352	J	8
2353	J	10
2354	J	11
2357	B	11
2358	B	10
2360	G	8
2361	E	14
2362	E	15
2363	G	2
2636	I	13
2637	I	14
3301	B	2
3302	B	3
3303	E	3
3304	D	5
3305	A	3
3306	F	2
3307	F	4
3308	F	3
3309	G	5
3310	E	3
3311	E	3
3312	B	4
3313	B	7
3314	A	7
3315	D	7
3316	D	7
3317	D	7
3318	D	8
3319	D	8
3320	D	8
3321	D	8
3322	D	8
3325	D	4
3326	B	7
3327	B	7
3328	F	7
3329	G	4
3330	G	4
3331	G	4
3341	B	5
3342	A	5
3343	C	6
3344	C	6
3345	C	5
3346	B	5
3362	E	4
3381	I	7
3382	H	7
3383	J	10
3385	A	11
3386	C	13
3387	E	12
3388	Q	8
3389	B	15
3392	B	15
3393	C	15
3394	B	14
3395	B	16
3396	D	15
3397	E	14
3398	D	14
3399	E	13
3485	Q	2
3628	I	14
6301	B	3
6302	C	2
6303	D	4
6304	F	3
6305	F	3
6306	B	5
6307	C	5
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6329	E	10
6329	B	14
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6330	E	10
6332	B	11
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6335	B	15
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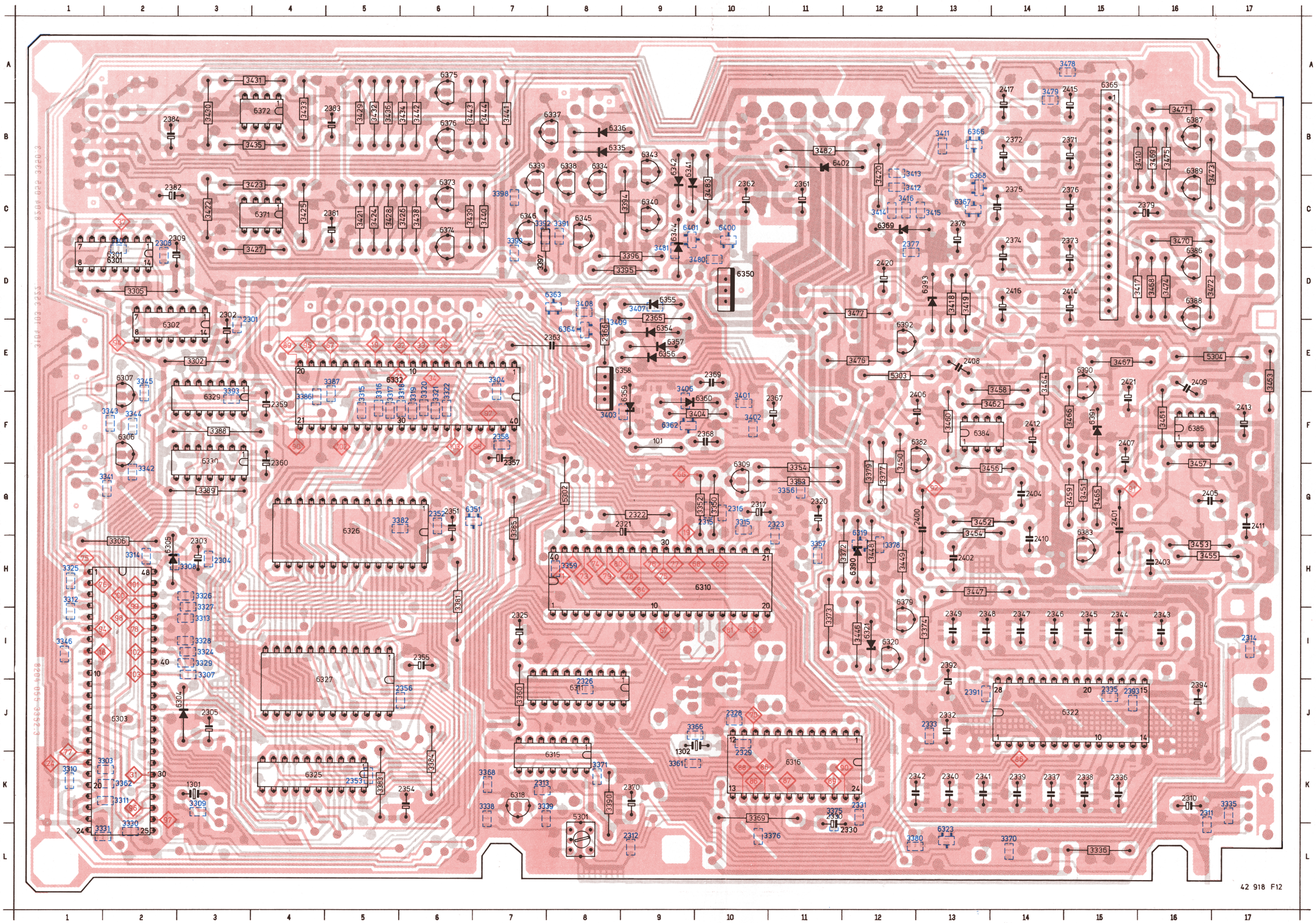

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2311	K16	3327	H 3	3461	F16		
2312	L 9	3328	I 3	3462	F13		
2313	K 7	3329	I 3	3463	E17		
2314	I17	3330	K 2	3464	E14		
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2316	G10	3335	K17	3466	F15		
2317	G10	3336	L15	3467	E15		
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2328	J10	3345	E 2	3474	D16		
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2332	J13	3353	G11	3478	A14		
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2335	J15	3356	G11	3480	D10		
2336	K15	3357	H11	3481	D 9		
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2339	K14	3361	K 9	5301	K 8		
2340	K13	3362	K 2	5302	G 8		
2341	K13	3366	J10	5303	E12		
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2374	C14	3398	C 7	6339	B 7		
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2381	C 5	3406	E 9	6346	C 7		
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2383	B 5	3408	D 8	6351	G 6		
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42 918 F12

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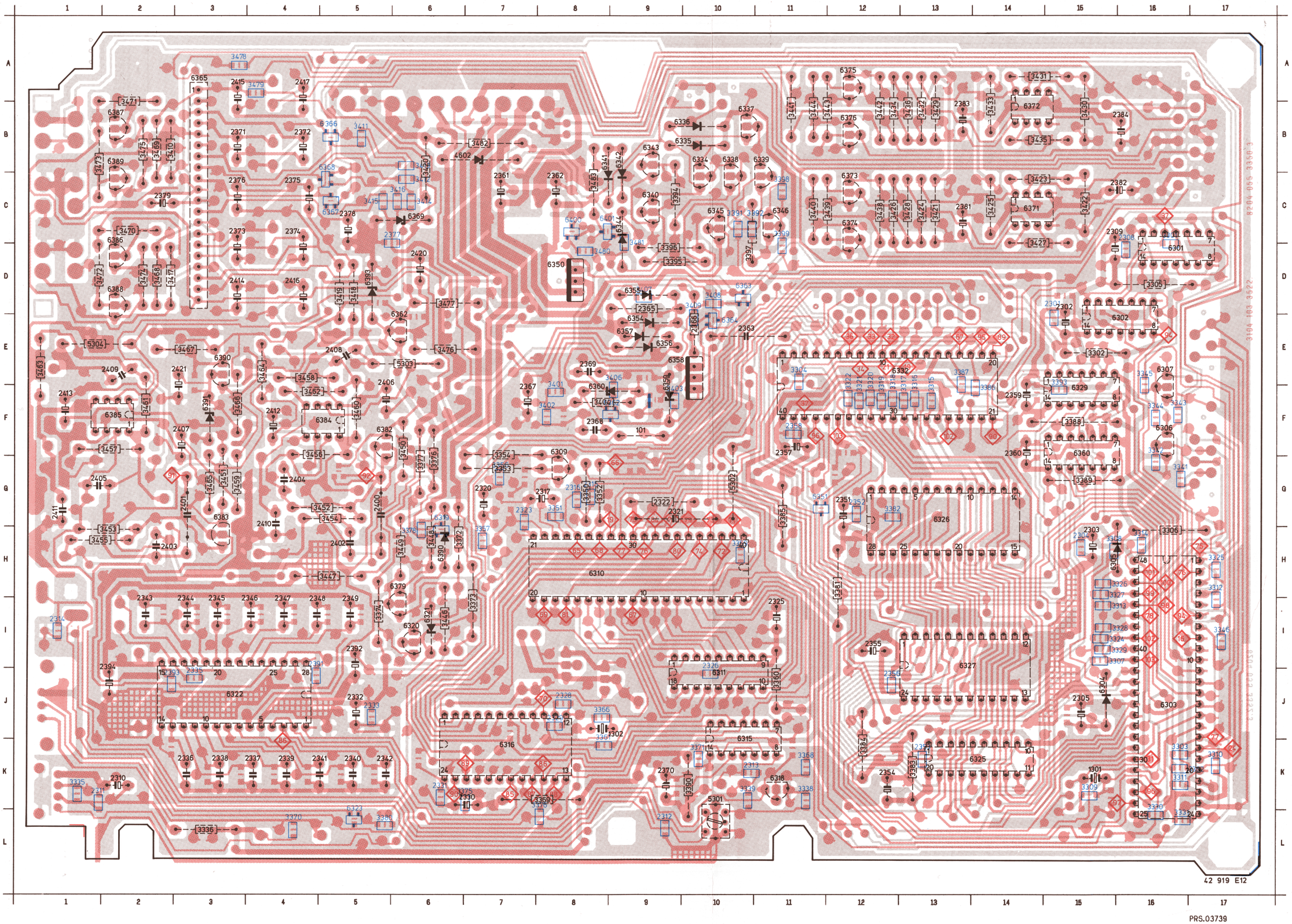
DECODERPANEL



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2379	C 2	3403	E 9	6343	B 9		
2381	C13	3404	F 8	6344	C 9		
2382	C16	3406	E 9	6345	C10		
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2401	G 3	3414	C 6	6358	E 9		
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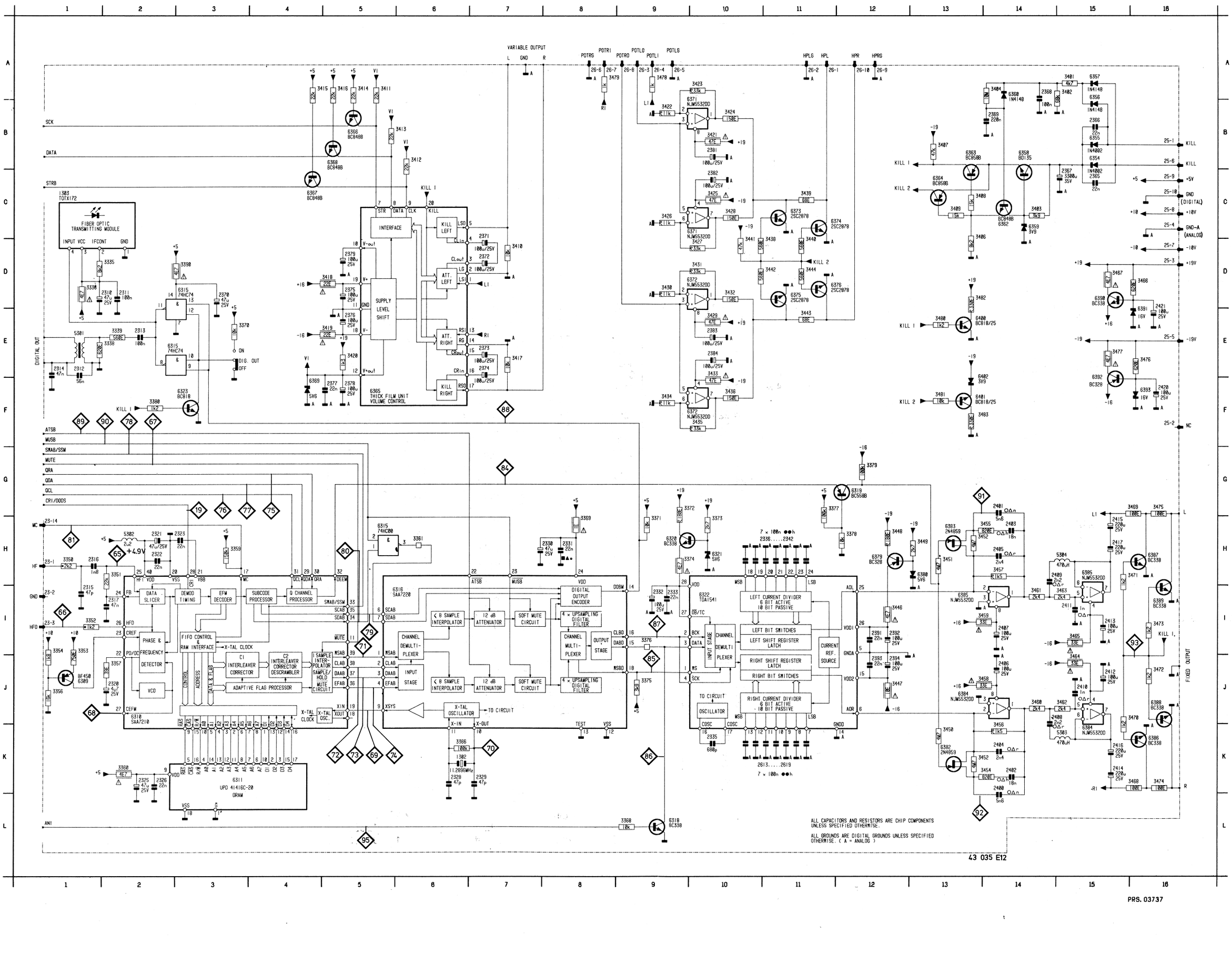
				6401	C 9		

DECODING 2



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2321	H 2	3452	K14
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2323	H 3	3455	H14
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2329	K 7	3459	I 14
2330	H 8	3460	J14
2331	H 8	3461	I 14
2332	I 9	3462	J15
2333	I 9	3463	I 15
2335	K10	3464	I 15
2336	H11	3465	I 15
2342	H11	3466	D16
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2413	I 15	6357	A15
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2416	K15	6360	A14
2417	H15	6362	C14
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2421	D16	6364	C13
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3356	J 1	6375	D11
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3368	L 9	6383	H13
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3402	A15	6402	E14
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3404	A14		
3406	C14		
3407	B13		
3408	C13		
3409	C13		
3410	D 7		
3411	A 5		
3412	B 6		
3413	B 6		
3414	A 5		
3415	A 5		
3416	A 5		
3417	E 7		
3418	D 5		
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3421	B10		
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3429	E10		
3430	D 9		
3431	D10		
3432	D10		
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3438	F10		
3438	C11		
3439	C11		
3440	C11		

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ELECTRICAL PARTSLIST DECODER PANEL
For non active chip components see separate stocklist

MC68HC11A0/..	4822 209 72537
MC68HC24 /..	4822 209 72538
MC74HC00N	4822 209 72542
MC74HC373N	4822 209 72543
MC79M05CT	4822 209 11079
M27128A-2F1	4822 209 72541
NE5532P	4822 209 72539
PC74HC74P	5322 209 82575
SAA7210P/04	4822 209 71001
SAA7220P/B	4822 209 72545
SN4LS08N (MTLA)	5322 209 81626
TDA1541A/N2	4822 209 72544
UPD41416C-20	4822 209 50582
X2816BP	4822 209 72102

BC328	4822 130 44104
BC338	4822 130 44121
BC548B	4822 130 40937
BC558B	4822 130 44197
BC818-25	4822 130 42696
BC848B	5322 130 41982
BC858B	5322 130 41983
BC858C	4822 130 42513
BD135	4822 130 40823
BF450	4822 130 44287
2N4859	4822 130 60933
2SC2878	4822 130 42022

BAT85	4822 130 31983
HZ6-2	4822 130 31318
HZ4B2	4822 130 32843
HZ6A3	4822 130 32697
1N4002 (TOSJ)	4822 130 30684
1N4148	4822 130 30621

1301	Quartz Crystal 8 MHz	4822 242 72066
1302	Quartz Crystal 11.2896 MHz	4822 242 71644
1303	TOTX172 Optical out	4822 218 20752

5301	Transformer	4822 148 80281
5302	Coil 2,2 µH	4822 157 50963
5303	Coil	4822 157 51193
5304	Coil	4822 157 51193

2302	47	µF 20%	25 V	4822 124 40433
2303	47	µF 20%	25 V	4822 124 40433
2305	4,7	µF 20%	63 V	4822 124 40246
2309	47	µF 20%	25 V	4822 124 40433
2310	47	µF 20%	25 V	4822 124 40433
2320	4,7	µF 20%	63 V	4822 124 40246
2325	47	µF 20%	25 V	4822 124 40433
2330	47	µF 20%	25 V	4822 124 40433
2332	100	µF	25 V	4822 124 22473
2351	47	µF 20%	25 V	4822 124 40433
2354	47	µF 20%	25 V	4822 124 40433
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2361	47	µF 20%	25 V	4822 124 40433
2362	47	µF 20%	25 V	4822 124 40433
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2365	22	nF		4822 122 10289
2366	22	nF		4822 122 10289
2367	3300	µF	35 V	4822 124 22474
2370	47	µF 20%	25 V	4822 124 40433
2371	100	µF	25 V	4822 124 22473
2372	100	µF	25 V	4822 124 22473
2373	100	µF	25 V	4822 124 22473
2374	100	µF	25 V	4822 124 22473
2375	100	µF	25 V	4822 124 22473
2376	100	µF	25 V	4822 124 22473
2378	100	µF	25 V	4822 124 22473
2379	100	µF 20%	40 V	5322 124 21189
2381	100	µF 20%	40 V	5322 124 21189
2382	100	µF 20%	40 V	5322 124 21189
2383	100	µF 20%	40 V	5322 124 21189
2384	100	µF 20%	40 V	5322 124 21189
2392	100	µF	25 V	4822 124 22473
2394	100	µF	25 V	4822 124 22473
2400	5600	pF 1%	160 V	4822 121 51079
2401	5600	pF 1%	160 V	4822 121 51079
2402	18	nF 2%	63 V	4822 121 51225
2403	18	nF 2%	63 V	4822 121 51225
2404	2	N 4		4822 121 51227
2405	2	N 4		4822 121 51227
2406	100	µF	25 V	4822 124 22473
2407	100	µF	25 V	4822 124 22473
2408	2	N 2		4822 121 51126
2409	2	N 2		4822 121 51126
2410	1	N		4822 121 51135
2411	1	N		4822 121 51135
2412	100	µF	25 V	4822 124 22473
2413	100	µF	25 V	4822 124 22473
2414	220	µF	25 V	4822 124 22472
2415	220	µF	25 V	4822 124 22472
2416	220	µF	25 V	4822 124 22472
2417	220	µF	25 V	4822 124 22472
2420	100	µF	25 V	4822 124 22473
2421	100	µF	25 V	4822 124 22473

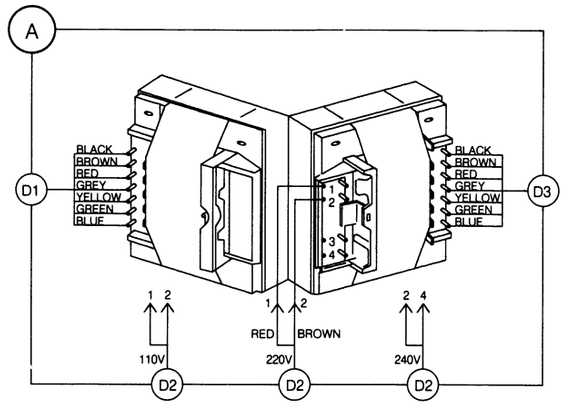
ELECTRICAL PARTSLIST DECODER PANEL
For non active chip components see separate stocklist

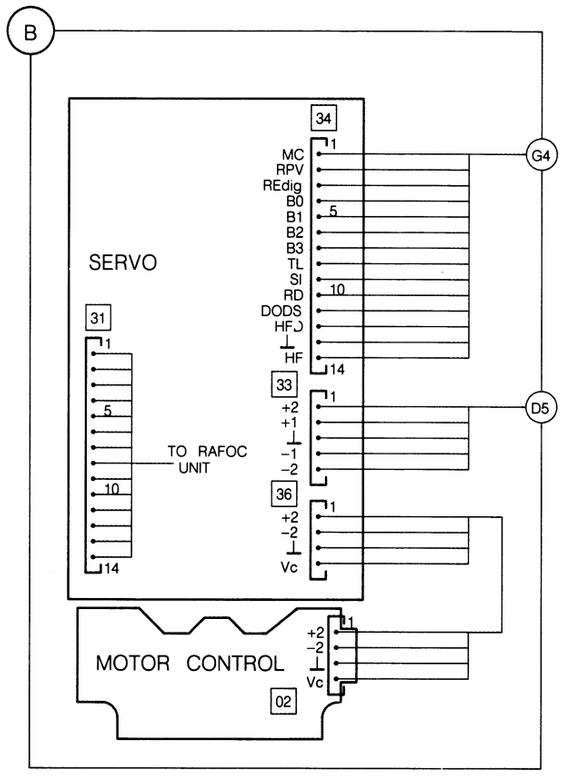
3302	4 E 7	5%	0,33	W	4822 111 30499
3305	4 E 7	5%	0,33	W	4822 111 30499
3306	4 E 7	5%	0,33	W	4822 111 30499
3336	4 E 7	5%	0,33	W	4822 111 30499
3360	4 E 7	5%	0,33	W	4822 111 30499
3369	1 R	5%	0,33	W	4822 111 30483
3372	4 E 7	5%	0,33	W	4822 111 30499
3374	4 E 7	5%	0,33	W	4822 111 30499
3381	4 E 7	5%	0,33	W	4822 111 30499
3383	4 E 7	5%	0,33	W	4822 111 30499
3384	4 E 7	5%	0,33	W	4822 111 30499
3385	4 E 7	5%	0,33	W	4822 111 30499
3388	4 E 7	5%	0,33	W	4822 111 30499
3389	4 E 7	5%	0,33	W	4822 111 30499
3390	4 E 7	5%	0,33	W	4822 111 30499
3396	1 R	5%	0,33	W	4822 111 30483
3404	10 M	5%	0,5	W	4822 116 52494
3418	22 E	5%	0,33	W	4822 111 30517
3419	22 E	5%	0,33	W	4822 111 30517
3421	47 E	5%	0,33	W	4822 111 30526
3422	11 K	1%	0,6	W	4822 116 52907
3424	150 E	1%	0,6	W	4822 116 52846
3425	47 E	5%	0,33	W	4822 111 30526
3426	11 K	1%	0,6	W	4822 116 52907
3428	150 E	1%	0,6	W	4822 116 52846
3429	47 E	5%	0,33	W	4822 111 30526
3430	11 K	1%	0,6	W	4822 116 52907
3432	150 E	1%	0,6	W	4822 116 52846
3433	47 E	5%	0,33	W	4822 111 30526
3434	11 K	1%	0,6	W	4822 116 52907
3436	150 E	1%	0,6	W	4822 116 52846
3446	4 E 7	5%	0,33	W	4822 111 30499
3447	10 E	5%	0,33	W	4822 111 30508
3448	4 E 7	5%	0,33	W	4822 111 30499
3454	820 E	1%	0,6	W	4822 116 52864
3455	820 E	1%	0,6	W	4822 116 52864
3458	33 E	5%	0,33	W	4822 111 30522
3459	33 E	5%	0,33	W	4822 111 30522
3460	2 K 4	1%	0,6	W	4822 116 52851
3461	2 K 4	1%	0,6	W	4822 116 52851
3462	2 K 4	1%	0,6	W	4822 116 52851
3463	2 K 4	1%	0,6	W	4822 116 52851
3464	33 E	5%	0,33	W	4822 111 30522
3465	33 E	5%	0,33	W	4822 111 30522
3466	620 E	5%	0,5	W	4822 116 52429
3467	4 E 7	5%	0,33	W	4822 111 30499
3476	620 E	5%	0,5	W	4822 116 52429
3477	4 E 7	5%	0,33	W	4822 111 30499
3482	330 R	1%	0,6	W	5322 116 53736
3483	270 E	1%	0,6	W	5322 116 53288

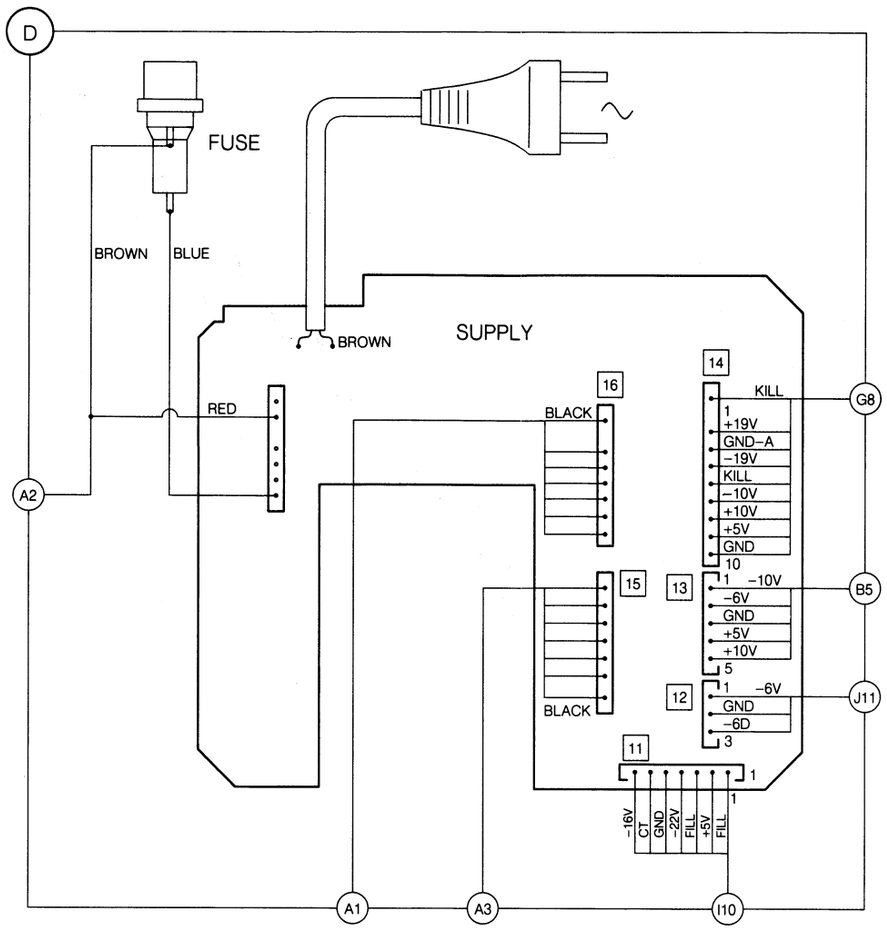
Miscellaneous

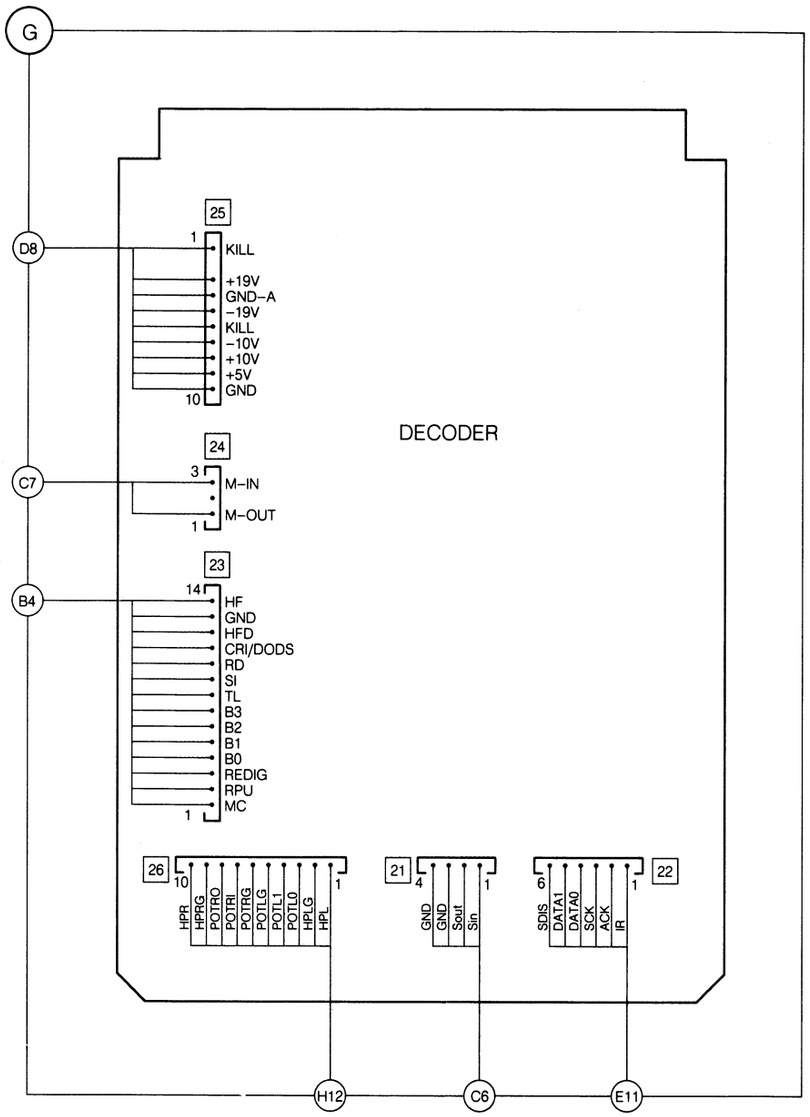
	Spring clip	4822 255 40179
	Cinch socket 6 pins	4822 265 20374
	Cinch socket digital out 1 pin	4822 265 30598
	Switch digital output	4822 276 12339
6365	Volume Control Unit	4822 116 90318

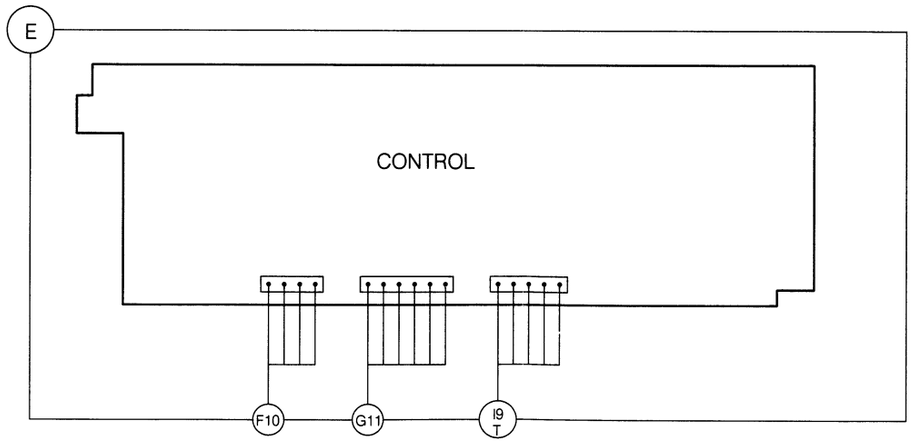
WIRING DIAGRAM

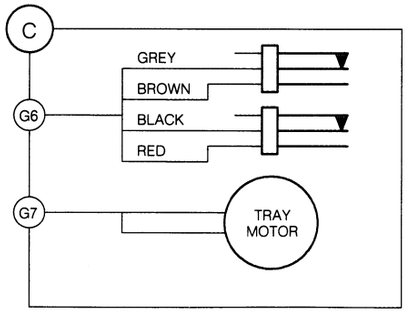


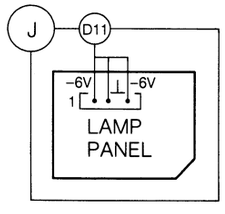


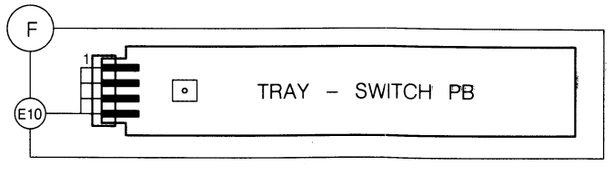


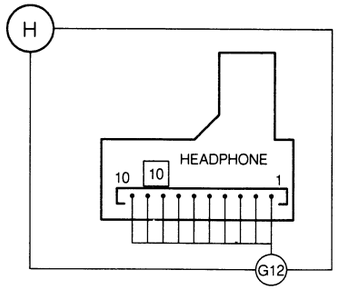


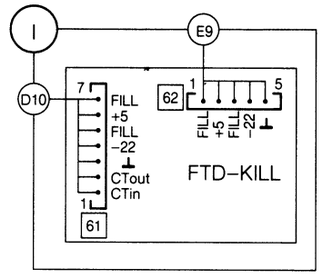








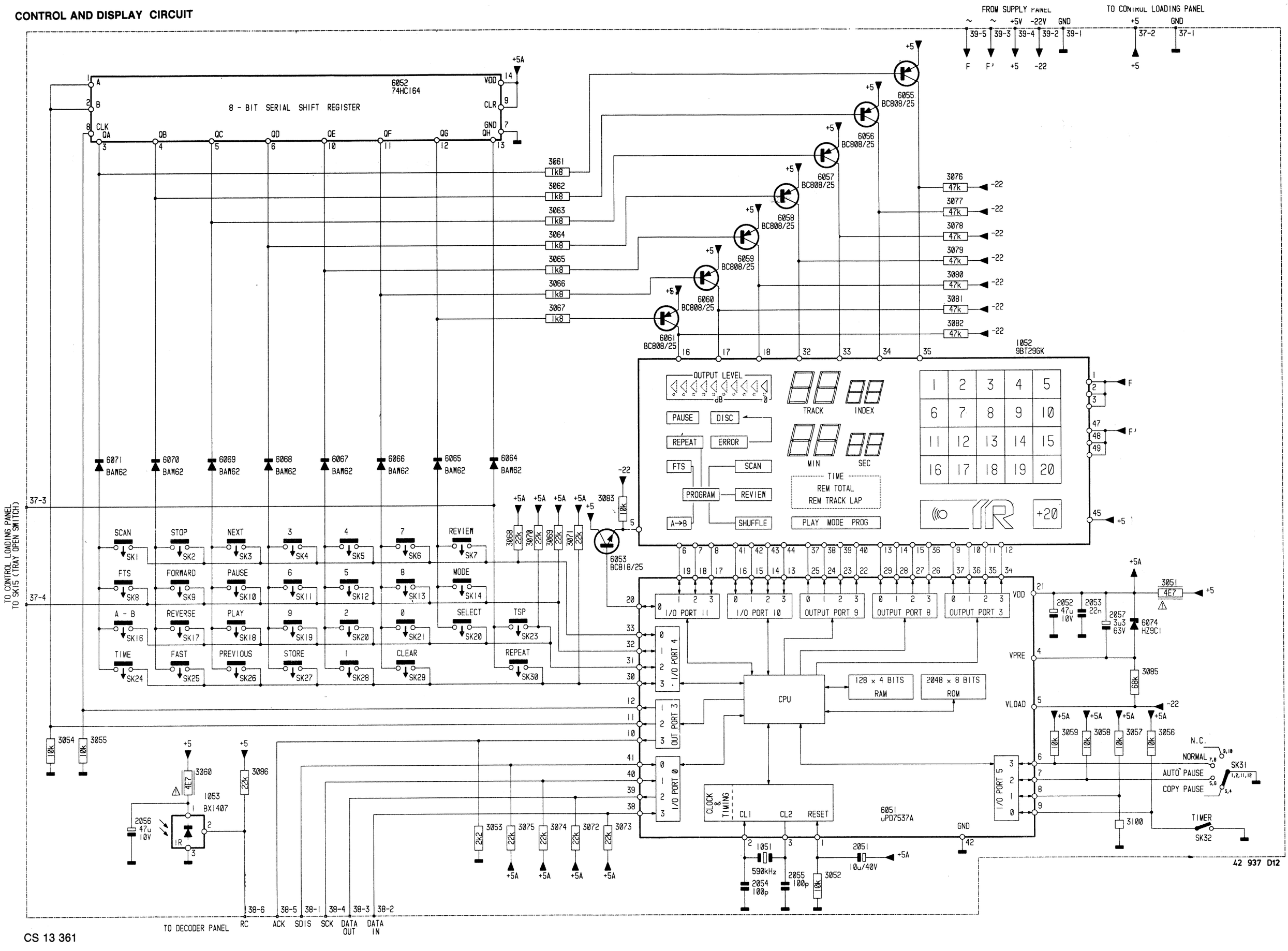




MDA.01196
T32–801

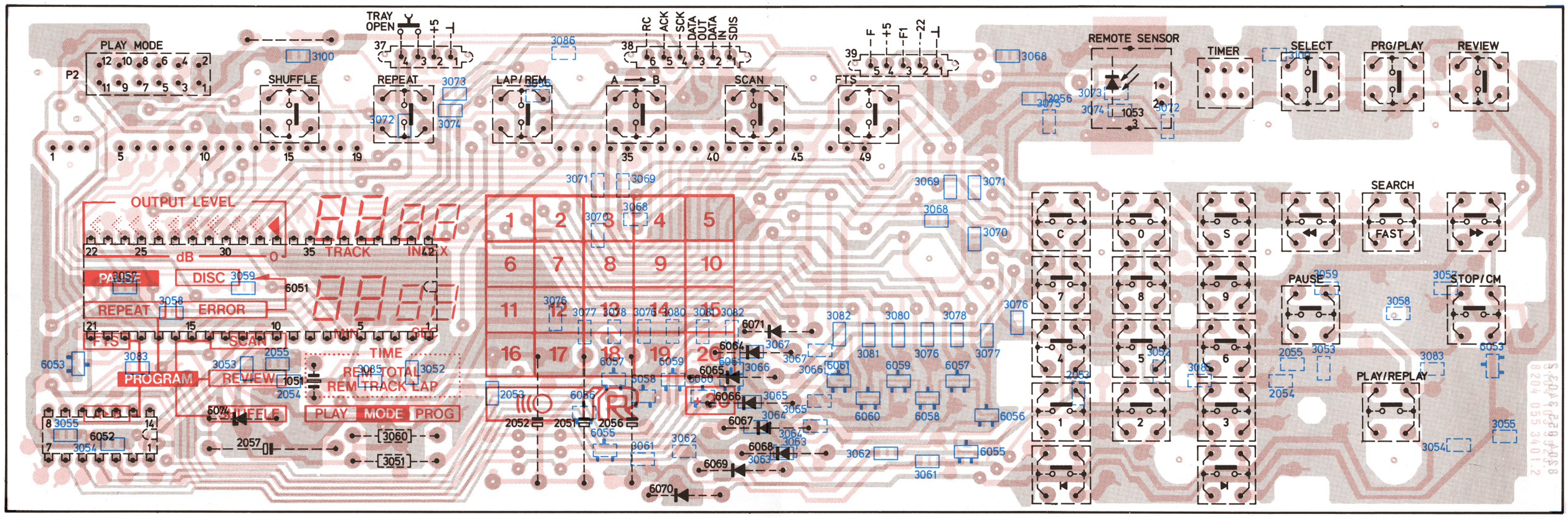
CS 13 360

CONTROL AND DISPLAY CIRCUIT



CS 13 361

CONTROL AND DISPLAY PANEL

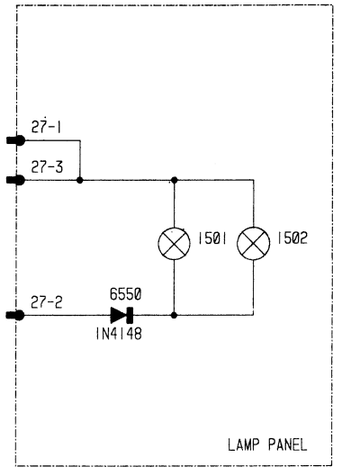


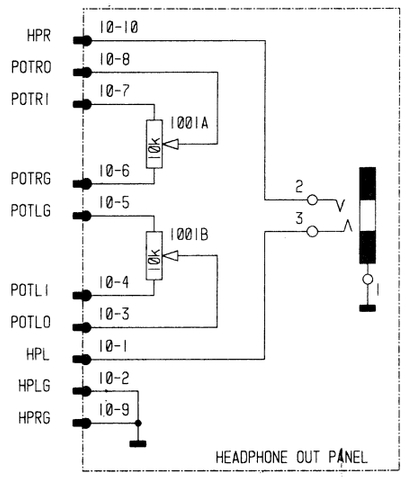
ELECTRICAL PARTS LIST CONTROL AND DISPLAY

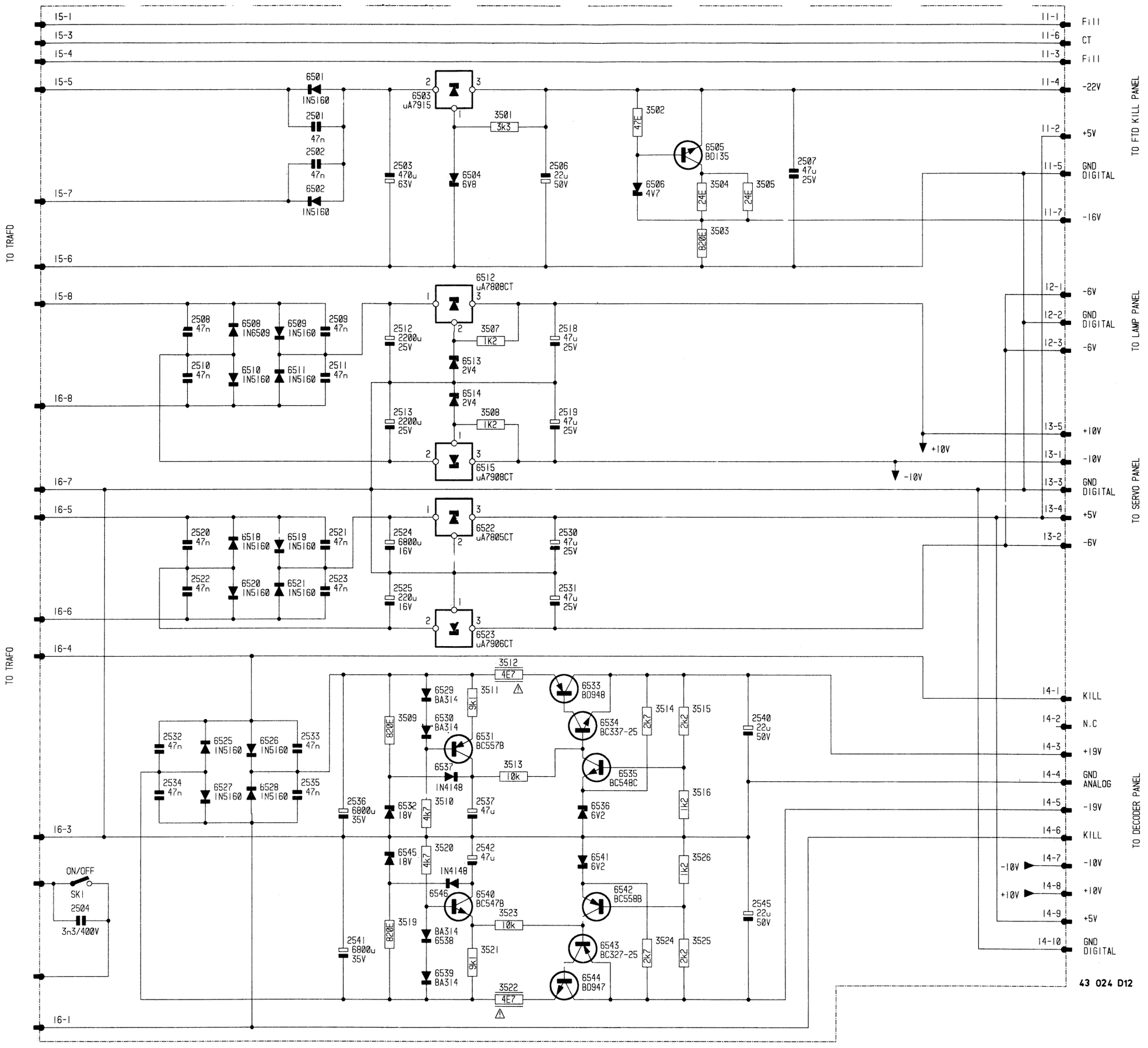
4PD7537A	4822 209 75552
PC74HC164P	4822 209 11605
c	
6053 BC818-25	4822 130 42696
6055÷6061 BC808-25	5322 130 42048
BAW 62	4822 130 30613
6074 HZ9C1	4822 209 70289
Safety Res. 4E7	4822 111 30499

Miscellaneous	
Slide switch	4822 277 21057
Timer on/off switch	4822 276 20463
Control switches	4822 276 11276
Cer. reson. 590 kHz	4822 242 72068
Display	4822 130 90496
I.R. receiver	4822 218 10212
I.R. transmitter	4822 218 20681
Dir. for use /00R/07R	4822 736 13763
Dir. for use /05R	4822 736 13788

SUPPLY, HEADPHONE AND LAMP CIRCUIT

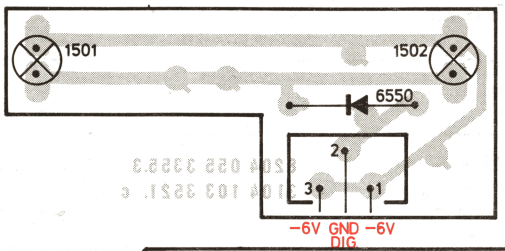


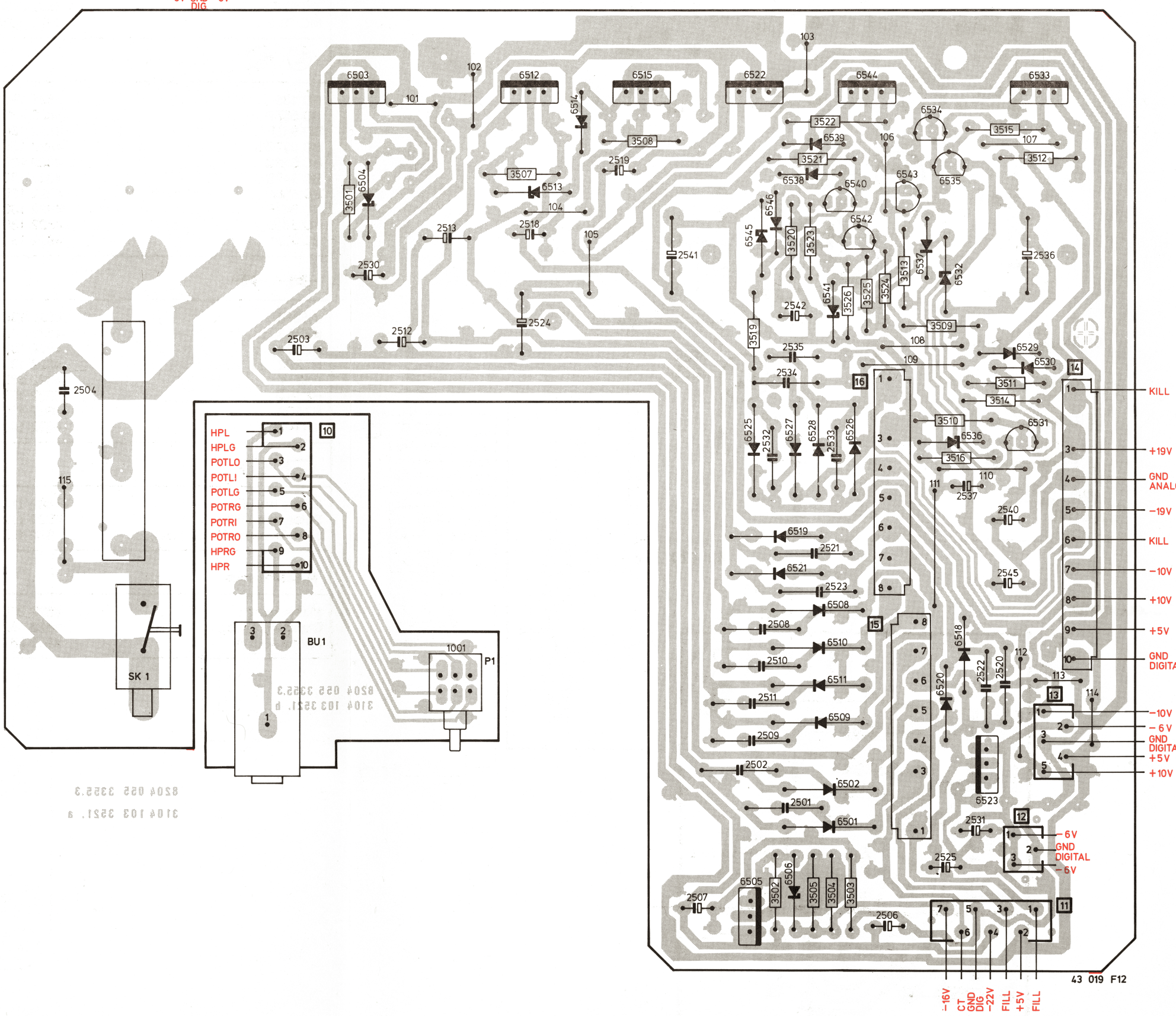




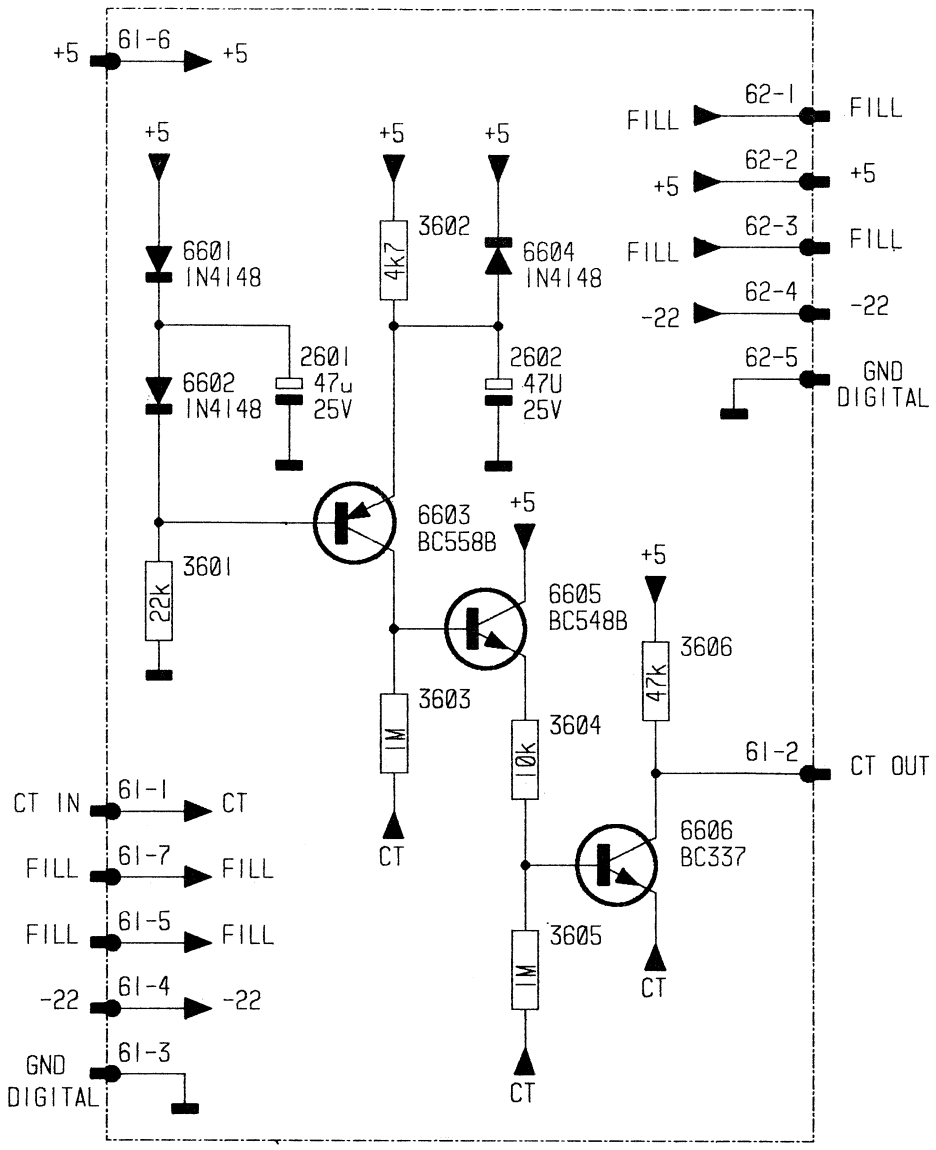
CS 13 363

SUPPLY, HEADPHONE AND LAMP PANEL



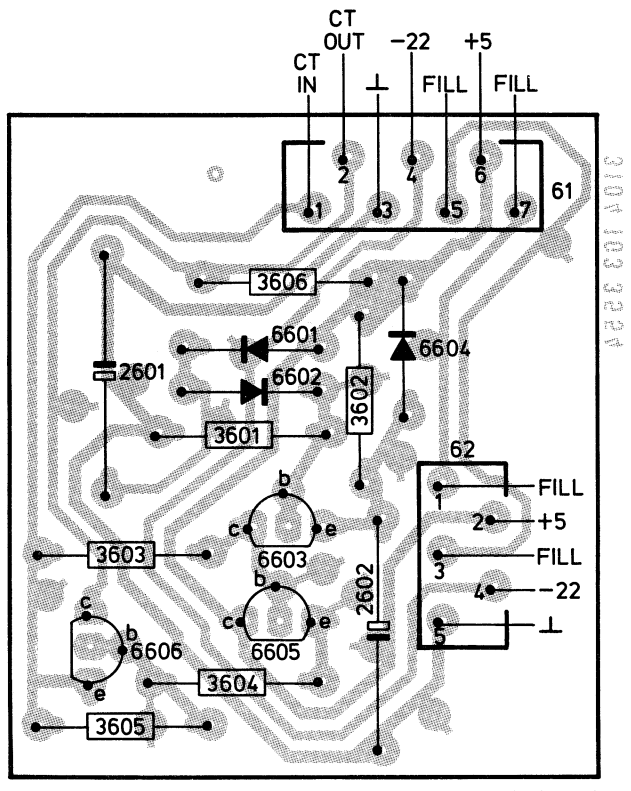


FTD-KILL CIRCUIT



43 020 A12

FTD-KILL PANEL

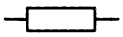
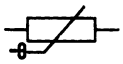
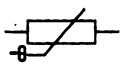
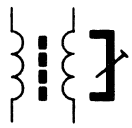


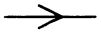
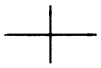
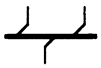
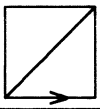
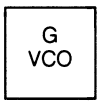
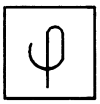
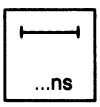
43 008 A12

CS 13 365

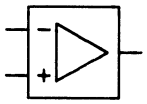
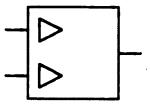
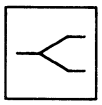
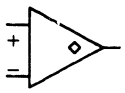
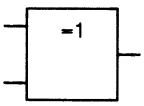
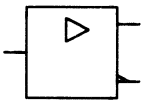
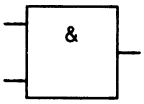
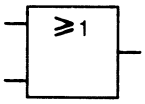
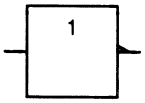
ELECTRICAL PARTSLIST SUPPLY, HEADPHONE, LAMP AND FTD-KILL CIRCUITRY

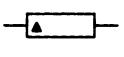
MC 79M15 CT	5322 209 86361
MC 7808 CT	4822 209 72554
MC 7908 CT	4822 209 82112
TY 40408	4822 209 71579
MC 7906 CT	4822 209 82056
BD 135	4822 130 40823
BC 557B	4822 130 44568
BD 948F	4822 130 60935
BC 337-25	4822 130 40981
BC 548C	4822 130 44196
BC 547B	4822 130 40959
BC 558B	4822 130 44197
BD 947F	4822 130 60934
BC 548B	4822 130 40937
BC 337	4822 130 40855
IN5060	4822 130 31164
HZ7A3	4822 130 33523
HZ5B1	4822 130 32986
HZ2C2	4822 130 32861
BA314	4822 130 30879
HZ18-3	4822 130 80422
HZ6C2	4822 130 32698
IN4148	4822 130 30621
Safety res. 47R	4822 111 30526
Safety res. 4E7	4822 111 30499
1001 Trim pot 10 kΩ LOG.	4822 100 30061
Miscellaneous	
Mains switch	4822 276 12343
Clamping spring	4822 492 63076
Phone socket	4822 267 40661

SYMBOL	DESCRIPTION
	Capaeitor, general
	Electrolytic capacitor (+ and – may be omitted)
	Bipolar electrolytic capacitor (+ may be omitted)
	Resistor, general
	N.T.C. resistor
	P.T.C. resistor
	Voltage divider with preset adjustment
	Chip jumper
	Pin contact
	Bus contact
	Coil, self–induction
	Transformer with electrically poor conducting core and adjustable pre–magnetization
	Diode
	Zener diode
	Stabistor
	Double variable capacity diode (in one envelope)
	Photo conductive diode
	L.E.D.

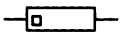
SYMBOL	DESCRIPTION
	Transistor (N.P.N.)
	Transistor (P.N.P.)
	Direct current (DC)
	Alternating current (AC)
	Earth (functional)
	Frame or chassis connection
	Direction in which AC voltages are passed on (optional present)
	Interrupted line
	Not–connected crossing lines
	Connected lines
	Cable tree with lead–outs
	Changer, general (arrow is optional)
	Voltage Controlled Oscillator
	Band–pass filter
	Phase changing network
	Delay element
	Amplifier, general

MDA.00083
T32–735

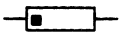
SYMBOL	DESCRIPTION
	Operational amplifier
	Differential amplifier
	Splitter
	Operational amplifier with open output
	Exclusive OR gate
	True/complement amplifier with high input
	Flip Flop
	AND gate
	OR gate
	Inverter with high input



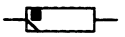
0.2W (CR 16) ⩽ 220kΩ 5%
> 270kΩ 10%



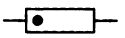
0.33W (CR 25) ⩽ 1MΩ 5%
> 1MΩ 10%



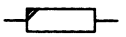
0.33W (SFR25) 5%



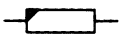
0.25W (VR 25) ⩽ 10MΩ 5%
> 10MΩ 10%



0.5W (CR 37) ⩽ 1MΩ 5%
> 1MΩ 10%



0.67W (CR 52) 5%



1.15W (CR 68) 5%

Ceramic plate

Polyester flat foil

Polyester mepolesco

Mylar (Polyester flat foil small sized)

Micropoco

Tubular ceramic (body colour pink or yellow/green)

Miniature single elco

Subminiature tantalum

* a=2,5V
b=4V
c=6,3V
d=10V
e=16V
f=25V
g=40V
h=63V
i=100V
j=125V
l=125V
m=150V
n=160V
q=200V
r=250V
s=300V
t=350V
u=400V
v=500V
w=630V
x=1000V
A=1.6V
B=6V
C=12V
D=15V
E=20V
F=35V
G=50V
H=75V
I=80V

MDA.00084
T32–735