CDM, SERVO AND MOTOR CIRCUIT DESCRIPTION FOR CDV495

1 CDM

The CDM operates according to the principle of three–beam tracking.
The parts of the CDM are mounted on the chassis pos.506 together with the LOADING parts.
See exploded view of CDM and exploded view of LOADING.
Definitions: (see fig. 1)

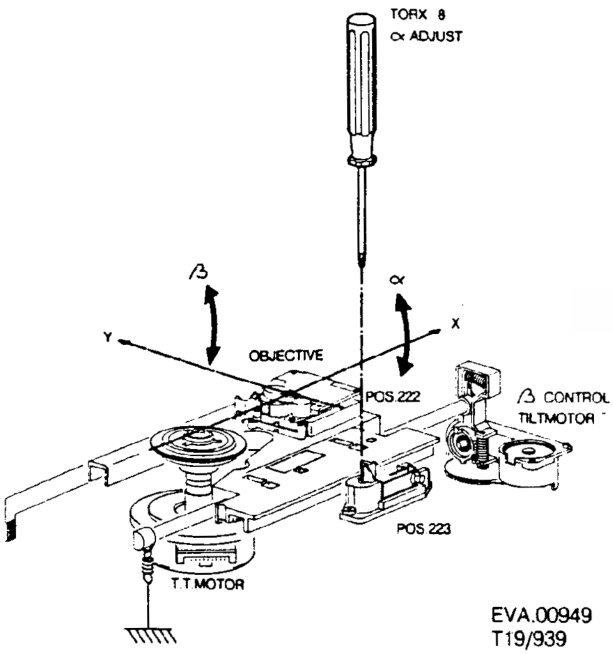

Fig. 1

- Movement of the objective perpendicular to the tracks from the centre of the turntable motor is the X direction.
- Movement of the objective perpendicular to the X direction is the Y direction.
- Rotation around the X axis is the α setting.
- Rotation around the Y axis is the β setting.

1.1 Mechanical parts

The most important parts are: (see fig. 2)
- pos. 222 the carriage, on which the light path is mounted.
- pos. 214 to pos. 221 constitute the carriage drive, for movement in the X direction.
- pos. 224 to pos. 234 constitute the tilt control mechanism for the β setting.
- pos. 223 is the mechanism for the α setting.
- pos. 208 is the turntable motor, a Hall motor.
- Sigma pi board, with the circuits for the generation of the tracking signals, HF signal and laser supply.

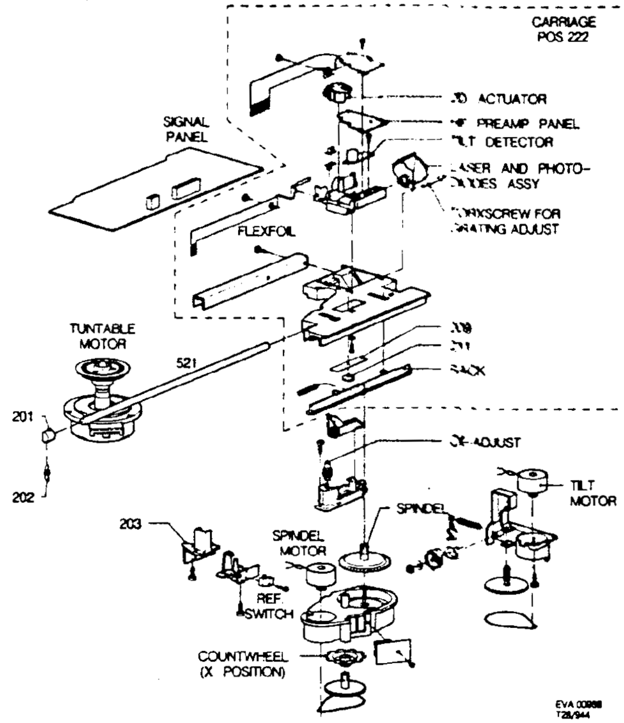

Fig. 2

1.1.1 Dismantling the carriage

1. Detach the flexprints from the connectors.
2. Detach the spring pos. 202 from pos. 203.
3. Loosen the two screws of the α setting mechanism pos. 223.
4. Withdraw the carriage bracket from the tilt motor suspension.
5. The carriage can now be taken out of the CDM.
6. Measure the distance D of the faulty carriage, shown in fig. 19, for the Y setting of the new carriage!! See 1.4.2 Y setting.

1.1.2 Mounting the carriage

See fig. 2 and fig. 3.

1. Ensure that the new carriage has the same Y setting as the faulty carriage. See 1.4.2 Y setting.
2. Mount pos. 201, 209, 211 and 521 of the old carriage in the new one. Do not yet mount the spring, pos. 202.
3. Place the carriage in the CDM and slide pos. 223 over the carriage.
4. Insert the carriage bracket pos. 521 into the tilt motor suspension.
5. Slide the rack pos. 213 over the spindle pos. 214 by turning a 3 mm screwdriver in opening A (see fig. 3).

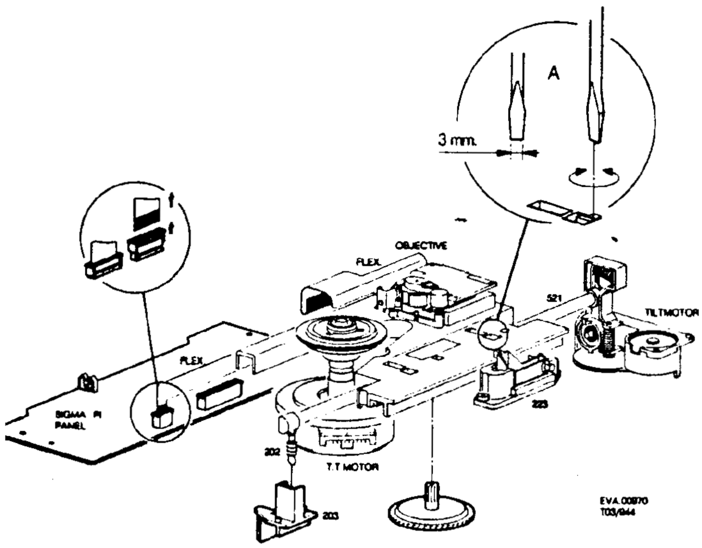

Fig. 3

6. Mount the spring pos. 202. First hook onto pos. 203 and then onto pos. 201.
7. Remove the short-circuit clip from the flexprints and connect them.
8. Mount the α setting mechanism pos. 223.
9. Check the α setting, see 1.4.1.
10. Set the grating, see 1.4.3.

1.2 The light path

See fig. 4.

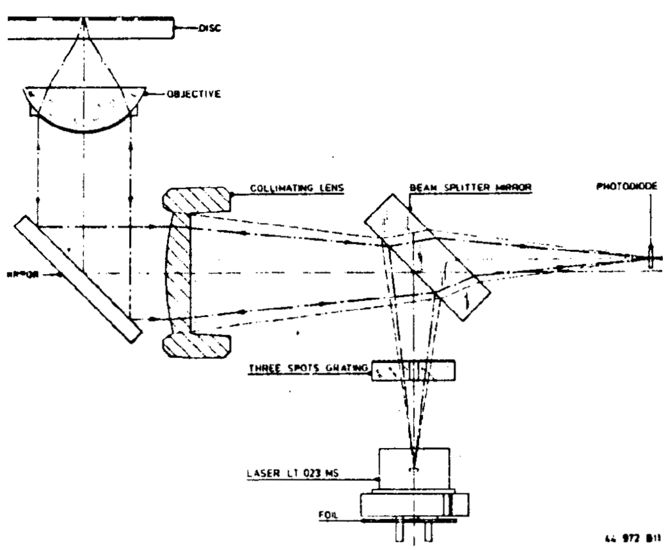

Fig. 4

The light path is divided mechanically into two parts:

- The laser and photodiode assy, see fig. 5.
- The 2D actuator assy, see fig. 6.

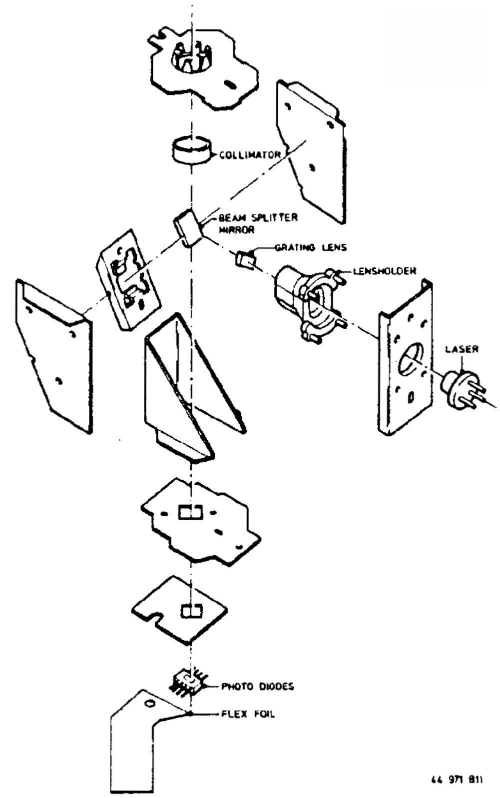

Fig. 5

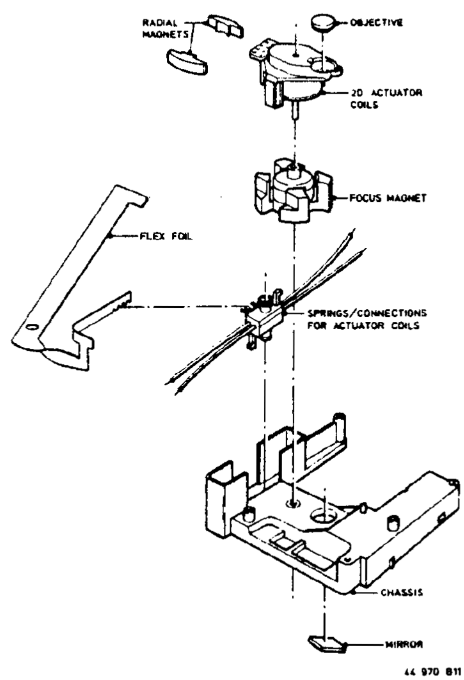

Fig. 6

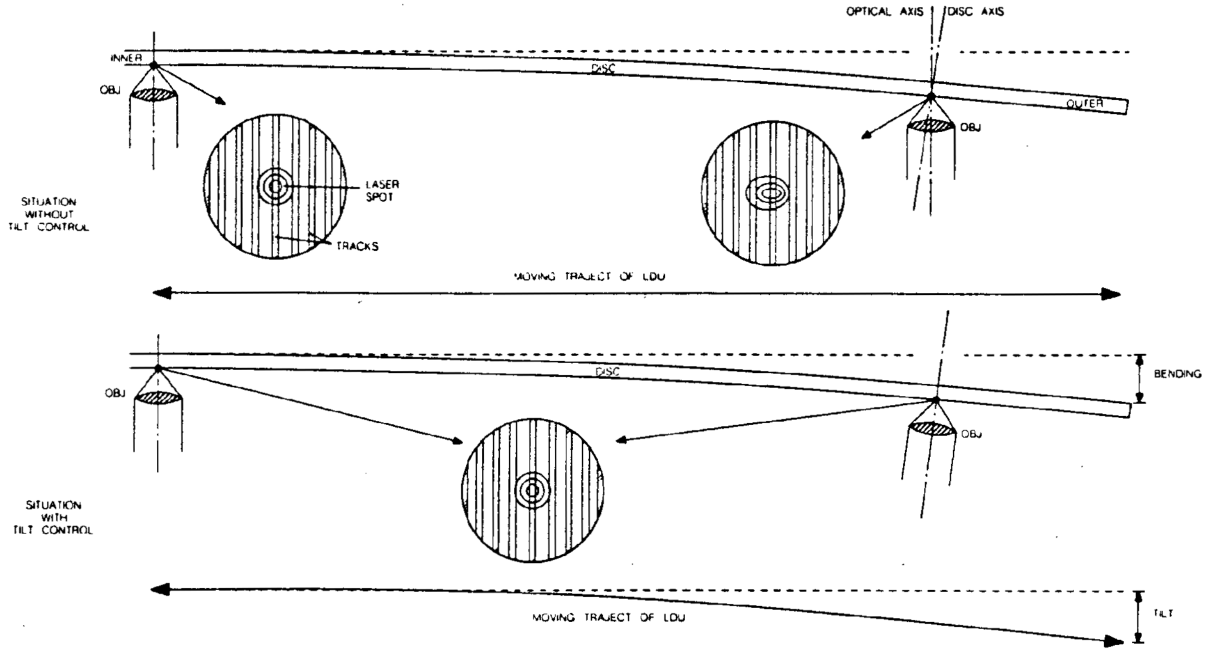

Fig OD4 ACTIVE TILT CONTROL PRINCIPLE

Fig. 10

1.3 Sigma PI board

The Sigma PI board accommodates the following circuits: (see diagram number PRS.05892)

- The laser supply
- HF amplifier
- EFM amplifier
- EFM level detector
- Focus error signal generation
- Radial error signal generation
- Tilt error signal generation with tilt led power supply.

1.3.1 The laser supply

The power supply is switched on with the LASON signal from the µP. Part of the light which is emitted by the laser falls onto the monitor diode. If the intensity of the light varies, the voltage across the monitor diode will also vary proportionately. The variation is measured in relation to the reference voltage of zener diode D6008 and is eliminated with IC 7506A via TR7020 by varying the current to the laser diode in inverse proportion. With R3155 the laser current is set so that the EFM signal on measurement point 16 is 2 V–pp ± 10%.

1.3.2 HF amplifier

TR7001 and TR7002 constitute the HF amplifier. The output branches to two circuits, one goes to the video circuit and the other goes to the EFM amplifier via buffer TR7003.
The content of the HF signal in the CDV mode differs from that in the CD mode:

- In the CD mode the HF signal contains only EFM. The level of the EFM signal is 28 dB higher than the level of the signal in the CDV mode.
- In the CDV mode the HF signal contains CVBS, FM–modulated and EFM, see fig. 11.

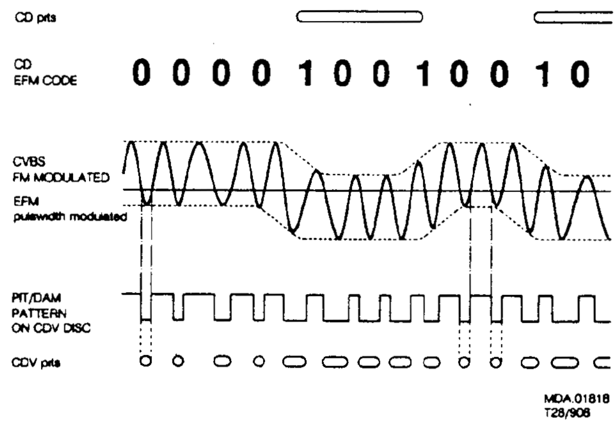

Fig. 11

1.3.3 EFM amplifier

In order to obtain EFM the HF signal is fed through a seventh–order Bessel filter, TR7004, L5001, L5002 and TR7005. In the CDV mode the EFM signal must be amplified a further 28 dB. This happens in the branch with TR7008 and TR7010. In the CD mode the EFM goes via TR7011. Switching over from CD to CDV mode is realised by the µP by means of the CDMODE signal. TR7006 provides for the MTF correction in the CD mode. As the speed of rotation in the CDV mode is high, the variation in the dimensions of the pits on the disc have no influence on the amplitude of the EFM signal. In the branch with TR7008 and TR7010 there is therefore no MTF correction.

'ith the aid of the grating lens the laser beam coming ɔm the laser assy is split into several beams. Three of ıose beams are used to read the information from the sc, see fig. 7.

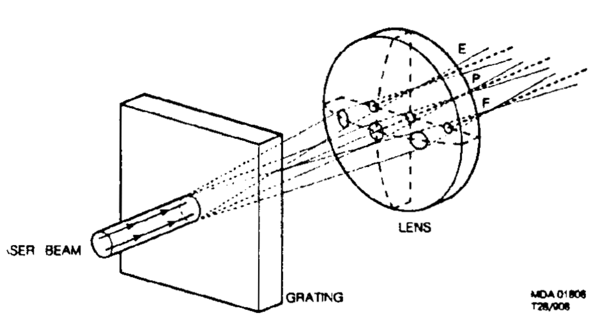

Fig. 7

Behind the grating lens the beams E, P and F arise, which via the light path and reflection from the disc fall on the photodiodes. The construction of the photodiode assy is such that beam P falls onto diodes D1 to D4, beam E onto diode E and beam F onto diode F, see fig. 8.

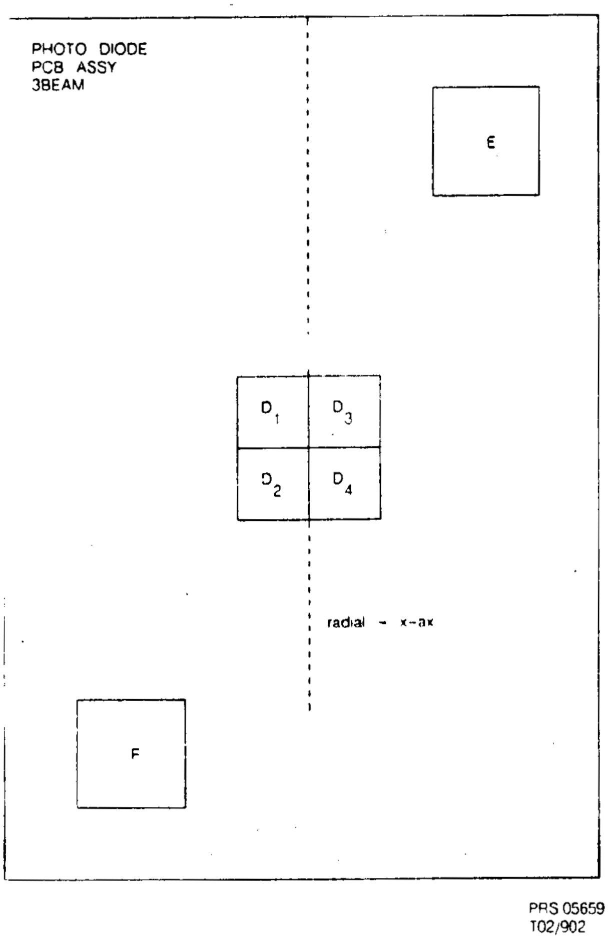

Fig. 8

3 BEAM TRACK FOLLOWING PRINCIPLE

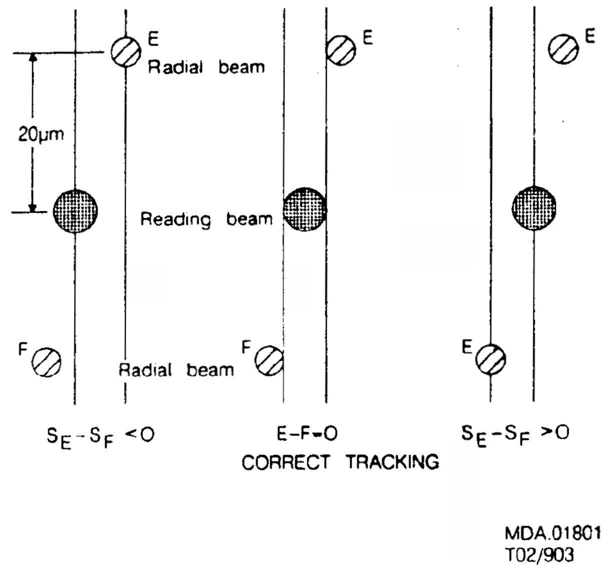

Fig. 9

The principle of three-beam tracking is shown in fig. 9. The so-called satellite spots, which are used for linear tracking, fall onto the diodes E and F. Beam P is the main beam and with the aid of the signals from D1 to D4 the beam is focused on the disc and the data read from the disc.

After replacing a faulty light path the angle between E, P, F and the track must be adjusted, see chapter entitled adjustments. On the optical pick-up board is the HF preamplifier, the transistors 7001 to 7003 and the diode signals are also filtered on it. The carriage also accommodates the Tilt detector, the transparent cylinder next to the 2D actuator, which detects the umbrella effect in CDV and LV discs so that the tilt control can correct the fault. In the transparent cylinder are the Tilt LED and the photodiodes. See fig. 10 for the principle of the tilt control; only the main spot is drawn. An incorrect angle will cause cross-talk between the tracks.

1.3.4 EFM level detector

After amplification the EFM signal is full-wave rectified, TR7012, TR7013, D6001 to D6003. The peak value is stored with a long RC time R3048, C2022 and with a short RC time R3043, C2021. In the CDV mode the $\overline{\text{CDMODE}}$ signal is "high" and the voltage on pin 2 of the level detector IC7051A will always be slightly higher than on pin 3. The HFD signal will as a result always stay "low". In the CD mode $\overline{\text{CDMODE}}$ is "low". By switching on R3045 the voltage on pin 2 will decrease by 50% and as a result the HFD will be "high". If the amplitude of the EFM signal decreases, then the voltage across C2021 will drop much faster than the voltage across C2022. If the voltage across C2021 drops by more than 50%, then HFD will become "low". The HFD signal goes to the DECODER-A IC in the audio circuit.

1.3.5 Focus error signal generation

The focus error signal is measured according to the astigmatic principle. This means that whether or not the disc is in focus influences the shape of the spot on the four central diodes D1 to D4, see fig. 12.

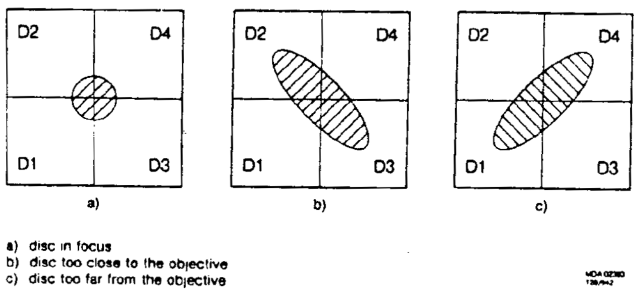

Fig. 12

When the disc is in the focus point the shape of the spot will be circular, fig. a). When the disc is too close to the objective the spot becomes ellipsoidal fig. b). Fig. c) shows the shape of the spot when the disc is too far from the objective. The focus error signal becomes ((D1+D4) – (D2+D3)). The signals from the photodiodes go to IC7502. In this IC the error signal is normalised by division by the sum currents. In this way the error signal becomes independent of the total current through the photodiodes and errors which arise through radial and tangential interactions. On the output of IC7505 on pin 1 there arises:

$$FE = \frac{F1-F2}{F1+F2} - \frac{F3-F4}{F3+F4}$$

For the purposes of the start-up procedure and the track position detection (TP) the sum signal of the four central diodes must be generated. The sum signal is LFSOM:

LFSOM = F1+F2+F3+F4

$TP = k^{*}\{SUB - (F1+F2+F3+F4)\} - H = K(RE1+RE2) - H.$

K is set with R3104.

H is peak-to-peak value of the HF.

See fig. 13 for the radial error signal generation.

LFSOM and TP are made in IC7502.

1.3.6 Radial error signal generation

Symmetrically adjacent to the four diodes for HF and FE signals are the two satellite diodes for the radial tracking, see fig. 13. The position of R1 and R2 on the track is set by rotating the laser and photodiode assy: this sets the grating. The R1 and R2 signals must be shifted 180 degrees in phase.

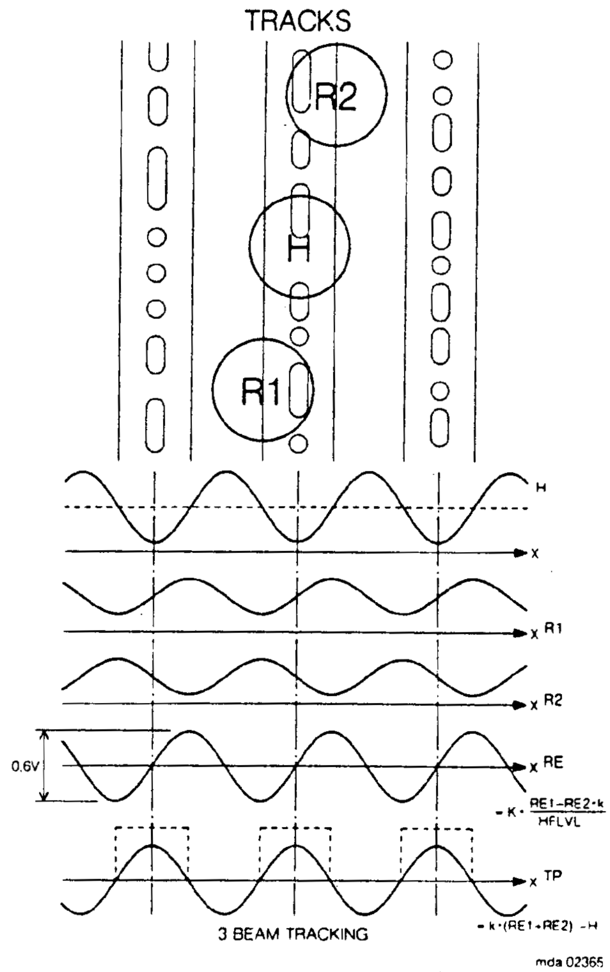

Fig. 13

1.3.7 Tilt error signal generation with Tilt LED power supply

The bending of CDV discs, the so-called umbrella effect, causes the tilt error to arise. Fig. 14 shows how this error is detected.
IC7505B, C and D constitute the circuit for the generation of TE. With the DREFL signal the presence of a disc on the turntable is detected.
The power supply of the Tilt LED is provided by IC7506B and TR7019.
The Tilt LED is switched on with the $\overline{\text{LASON}}$ signal.

TILT ERROR DETECTION

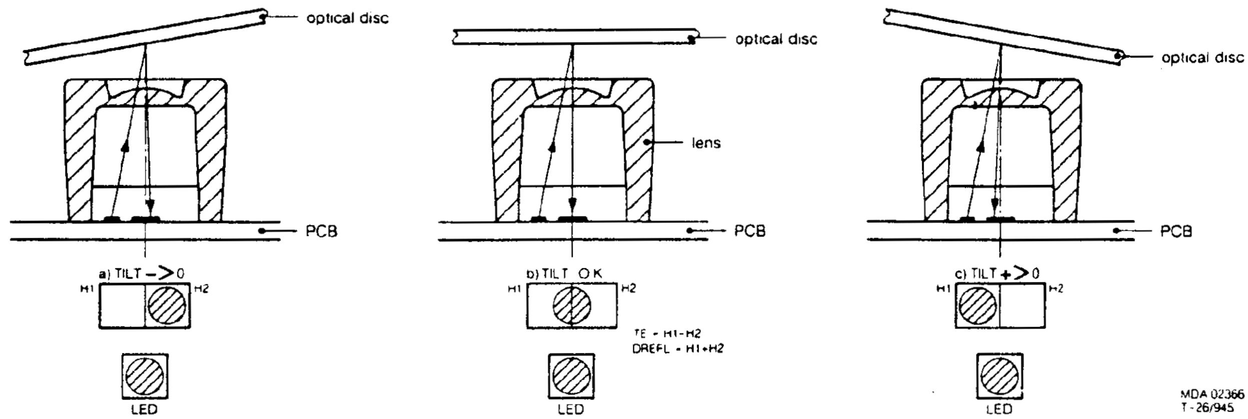

Fig. 14

1.4 Adjustments

In the case of a defect on the light path or 2D actuator the entire carriage, pos. 222 must be replaced. After the insertion of a new carriage the light path must be adjusted. The adjustment comprises two parts:

Mechanical adjustments

1. α setting with pos. 223 and glass plate, service code number 4822 395 90574. This ensures that the laser beams fall onto the disc at right angle of 90 degrees.
2. Y setting, to ensure that the imaginary line formed by the path of the objective passes through the centre of the turntable axis.
3. Grating setting, this is a mechanical setting which is however measured electrically. With this setting the satellite spots are set on the right track and in such a way that the phase difference of the signals R1 and R2 is 180 degrees.

Electrical settings

1. Laser current setting with R3155.
2. RE amplitude setting with R3123.
3. RE offset setting with R3119.
4. TP duty cycle setting with R3104.
5. Tilt error TE offset setting with R3130.

1.4.1 α setting

1. Place the glass plate 4822 395 90574 on the turntable.
2. Ensure that the glass plate is properly positioned on the turntable by lowering the disc hold-down mechanism pos. 101 to 107 and pos. 502 by hand using the drive rod pos. 504.
3. Position the CD mechanism directly under a light source under which there is a line, for example under a fluorescent luminaire with louvre. Position the CDM so that the line is parallel to the Y direction. Look in that direction and in the extension of the line towards its reflection on the glass plate and in the objective, see fig. 15.

The brightness of the reflection in the objective is less than that on the glass plate, but has a greyish blue colour. Turn the pulley of the tilt motor until the reflection of the line on the glass plate is directly over the reflection of the line in the objective, see fig. 16.

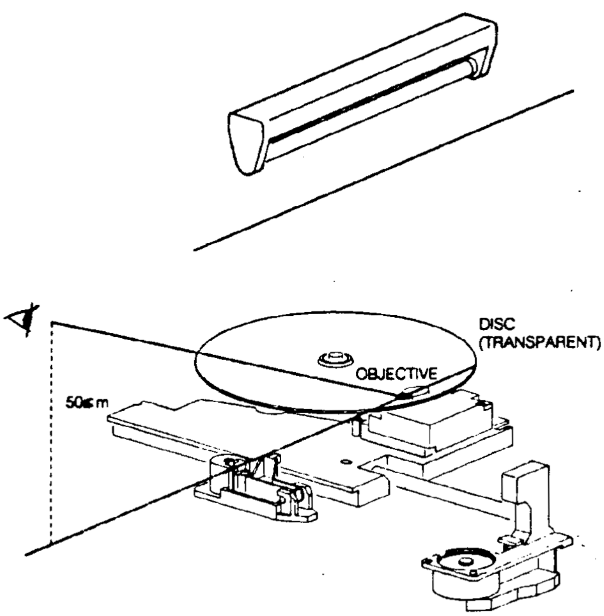

Fig. 15

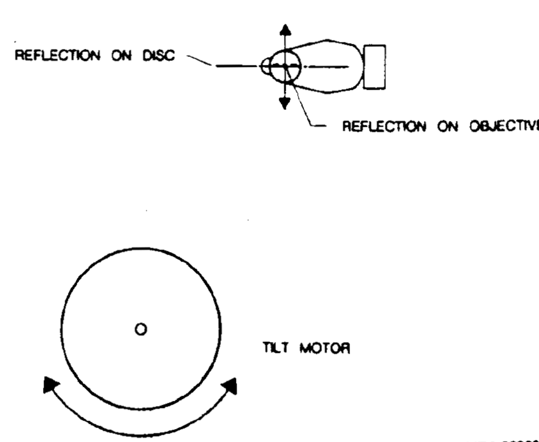

Fig. 16

i. Now turn the CDM through 90 degrees so that the line is now parallel to the X direction, see fig. 17. Check whether the two reflections are now on top of each other again.

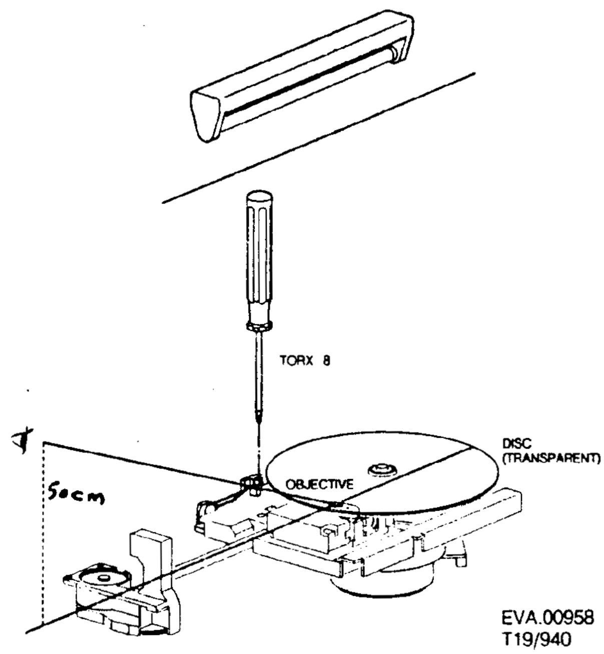

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Fig. 17

If this is not the case, then:

j. Using a torx 8 screwdriver turn the adjusting screw on the α setting mechanism three turns to the right or until the reflection in the objective passes the setting point.

k. Now turn the adjusting screw back so that the reflections are directly on top of each other, see fig. 18.

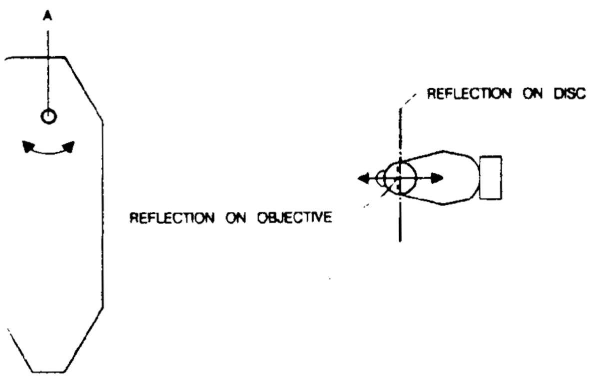

Fig. 18

1.4.2 Y setting

1. Dismantle the faulty carriage.
2. Using a slide gauge, measure with an accuracy of +/−0.05 mm the distance D, shown in fig. 19, of the faulty carriage.

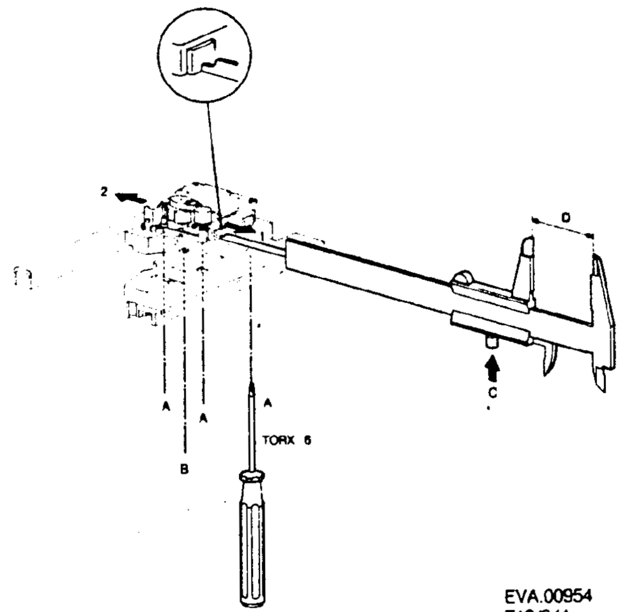

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Fig. 19

N.B. The starting point of the measurement must be the cam!

3. Loosen the three screws A on the new carriage by turning them through 90°. The carrier of the light path can now be moved in the Y direction.
4. Now move the carrier so that the distance D is the same as that of the faulty carriage, +/− 0.05 mm.
5. Tighten the three screws A again and fit the new carriage in the CDM.

1.4.3 Grating setting

The grating setting is measured electrically according to the circuit in fig. 20.

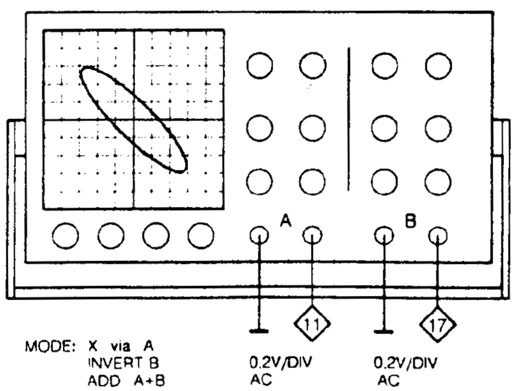

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Fig. 20

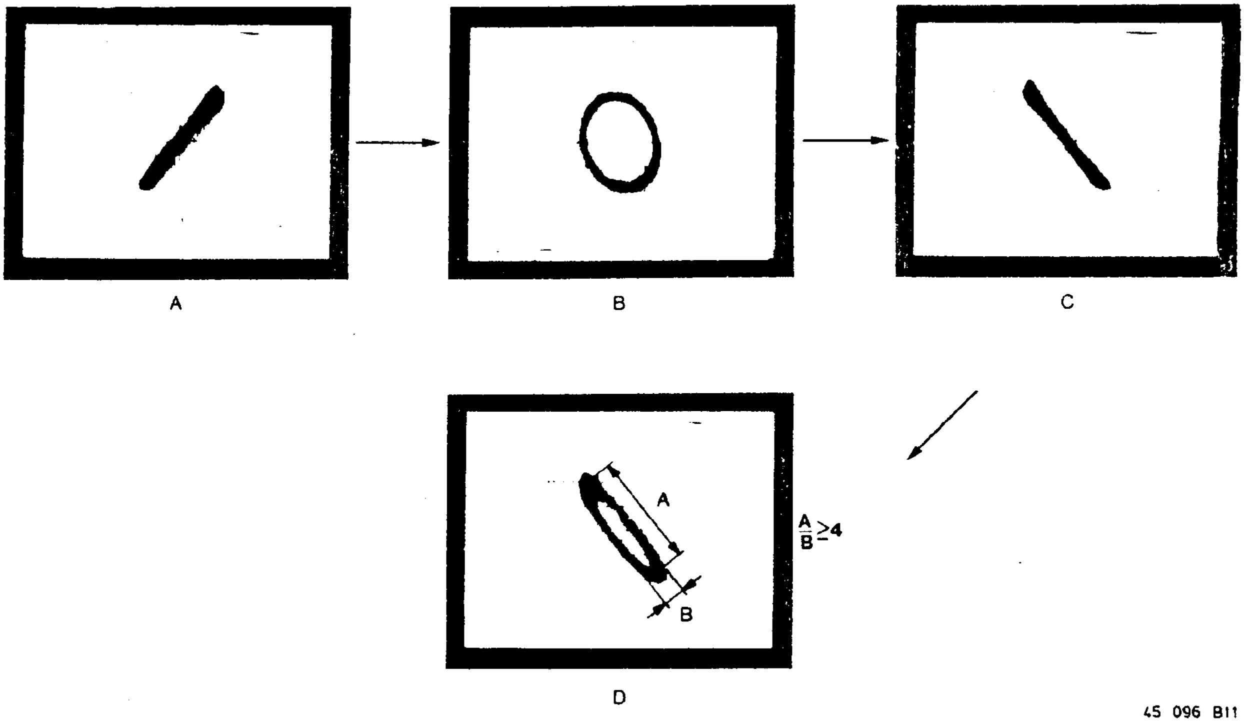


Fig. 21

1. Check the α setting. If necessary this must be set.
2. The Y setting must be equal to the setting on the carriage to be replaced!!
3. On the Sigma PI board connect bridging wire 9111 with bridging wire 9119. This switches off the normalising of RE.
4. Set R3123 to maximum RE signal.
5. Connect an oscilloscope according to fig. 20. Measurement point 11, the RE2 signal, on channel A (AC – 0.2 V/DIV). Measurement point 17, the RE signal, on channel B (INVERT, AC – 0.2 V/DIV). Set the time base to X via A and the display mode to ADD A+B.
6. Mount the tray pos. 503 and place audio test disc 5 (test disc without errors 4822 397 30096) on the turntable.
7. Bring the player into the service step mode in sequence 2, see chapter 2.5. The turntable motor is now running, but the radial control loop is not in operation.
8. Turn the torx adjusting screw for the grating setting anti-clockwise (see fig. 2) as far as the stop. Fig. 21A on the oscilloscope.
9. Now carefully turn the torx adjusting screw clockwise until the first correct Lissajous figure appears on the oscilloscope, see fig. 21C. Set the grating so that the width B of the figure is minimal.
10. Turn the pulley of the carriage motor by hand so that the carriage moves outwards and check whether the Lissajous figure, fig. 21D, (A : B) ⩾ 4 remains. Should this not be the case, then the Y setting must be checked and corrected. The Lissajous figure must at all events be completely closed on the inside of the disc, according to fig. 21c, as this is the most critical place in terms of starting–up.
11. Play track 1 of test disc 5. If during starting–up the tracking is poor, then potentiometer R3123 must be turned back half-way. Now set the laser current, see chapter 1.4.4.
12. Remove the connection between bridging wire 9111 and bridging wire 9119.
13. With the oscilloscope channel A on measurement point 26 measure the RADSVR signal on the servo board and with channel B on measurement point 17 measure the RE signal on the sigma pi board. Time base 0.2 msec./div, channel A: DC 2 V/div, channel B: DC 0.2 V/div. Trigger on the leading edge of RADSVR on channel A.

14. Play track 1 of test disc 5 and bring the player into the PAUSE mode. The signals as in fig. 22 now become visible on the oscilloscope. With potentiometer R3123 adjust the RE signal to 800 mV–pp, see fig. 22.

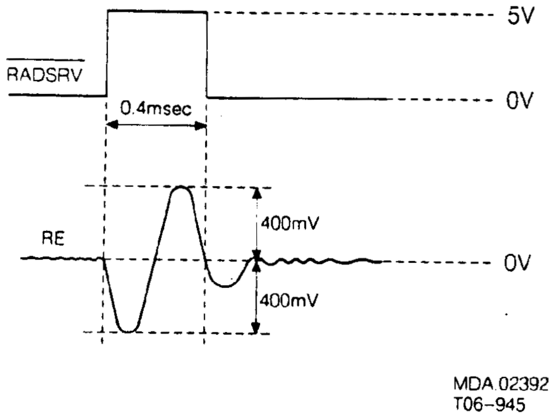


Fig. 22

15. With potentiometer R3119 set the RE signal symmetrically around 0 volt.
16. With the oscilloscope channel A on measurement point 27 measure the TP signal **on the servo board** and with channel B on measurement point 24 measure the HFD signal. Time base 20 μsec/div and sensitivity DC 2 V/div. Trigger on the trailing edge of the TP signal.
17. With potentiometer R3104 adjust the TP signal so that the leading edge of the HFD signal comes 10 to 20 μsec after the leading edge of the TP signal, fig. 23.

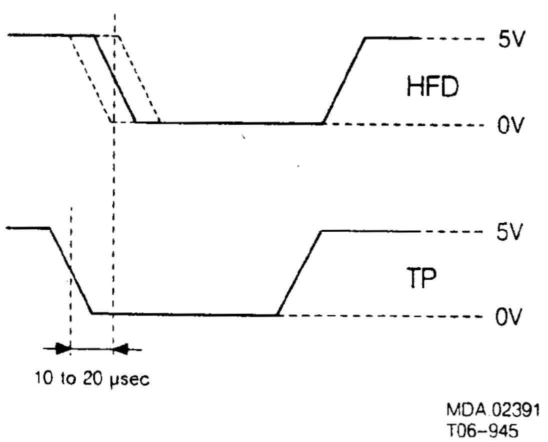


Fig. 23

On the leading edge of the HFD signal there is jitter. The average of this must be taken. Dependent on the setting of the potentiometer, the TP may be narrower than HFD or even non–existent.

1.4.4 Laser current setting

1. With an oscilloscope on measurement point 16 measure the EFM signal.
2. Play track 1 of audio test disc 5.
3. With potentiometer R3155 adjust the EFM signal to $2V_{pp}$ ± 10%, see fig. 24. The potentiometer is accessible from the bottom of the CDM.

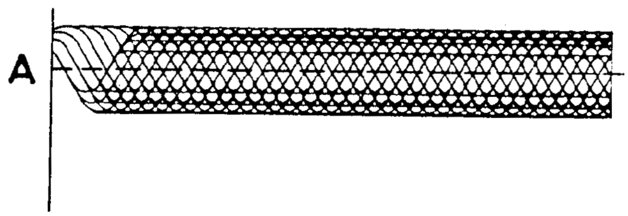


Fig. 24

1.4.5 Tilt error (TE) offset setting

1. Play picture number .... of the video test disc 4822 ... . in STILL picture mode.
2. With potentiometer R3130 adjust the cross–talk of picture number ... and picture number ... to a minimum.

2 SERVICE SOFTWARE

The Servo µProcessor is connected via the serial port to the User µProcessor. The transfer of information takes place via lines RXD pin 10 and TXD pin 11 of IC7200 on the servo board. ACKNOW pin 24 has been added as an extra handshaking line to confirm the transfer. The transfer Is started up by the servo µP, which first sends an identification byte. The identification byte indicates what information will follow or must be sent. In order to be able to distinguish the identification byte from normal data bytes a ninth bit is sent with the bytes. This bit is only logic "1" in the case of the identification byte. The handshake line ensures that the transfer is synchronised. This line is always "1" if there is no communication. At the beginning of a transfer ACKNOW is made "1" by the transmitter. The receiver reports the receipt of the data by toggling the logic level of this line.

Fig. 25 Fig. 26

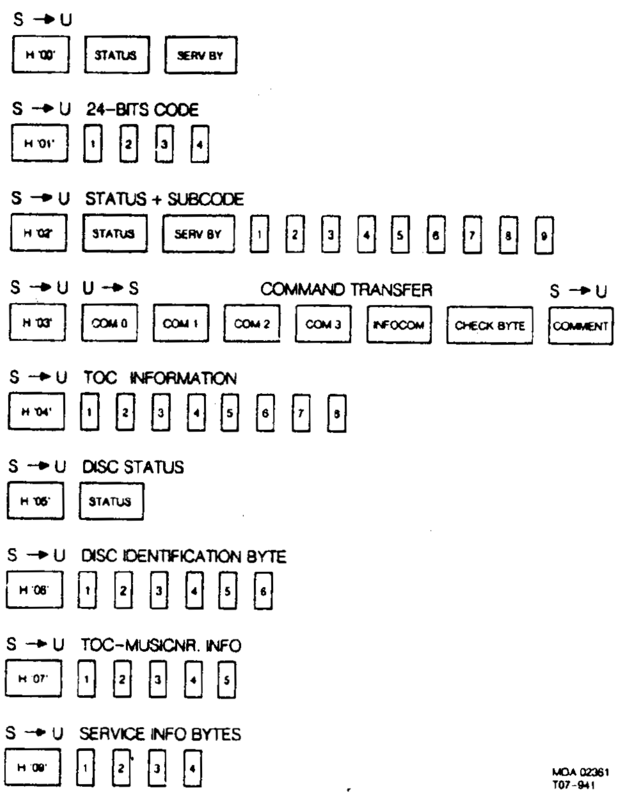


Fig. 25

Identification byte	The data bytes following it
H'00'	Status + service byte
H'01'	24-bit code
H'02'	Status + service byte + subcode CD
H'03'	Command request
H'04'	T.O.C. information
H'05'	Disc status
H'06'	Disc identification byte
H'07'	TOC/music number info
H'09'	Service info bytes

The content of the various bytes is indicated in the service mode via the OSD (On Screen Display) and also on the FTD.

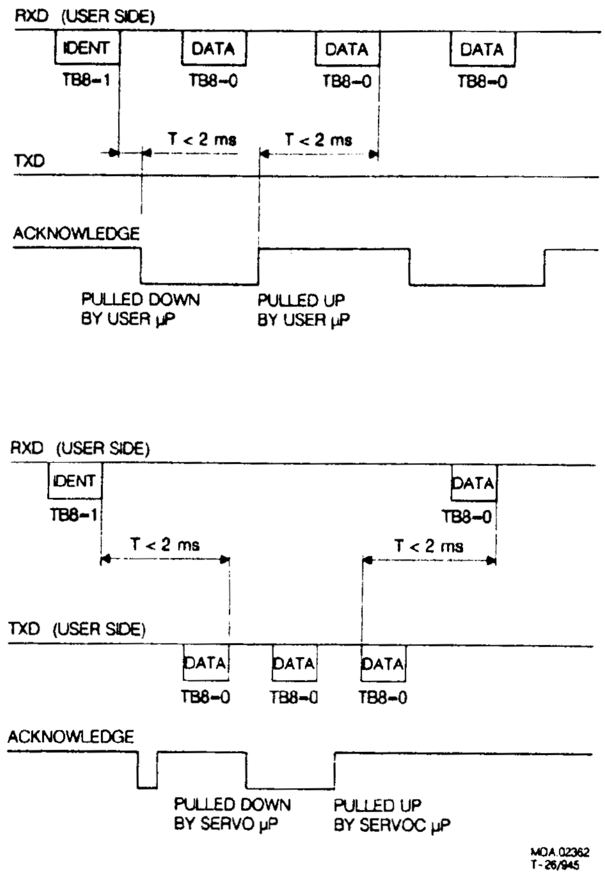


Fig. 26

2.1 Start-up procedure

If the Servo µP starts the disc after a PLAY command for example, the start-up procedure begins by running through sequence 1 to sequence 5. In the service step mode there is a break point in sequence 1, 2, 3.

2.2 Calling up the service mode

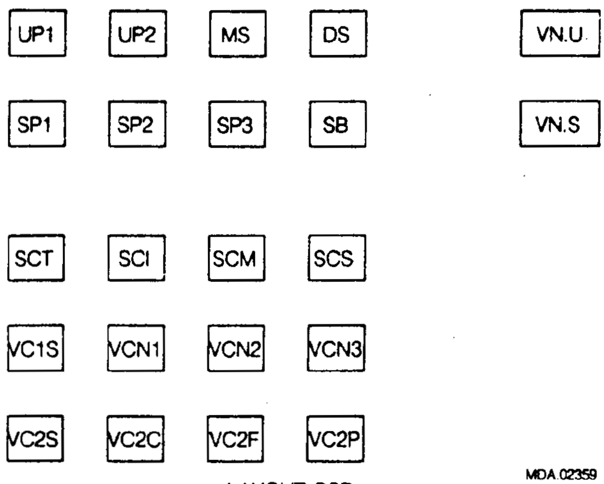
The service mode is called up by, in the STOP mode, pressing simultaneously the keys:

"DISP" (press first) + "<<" + "PLAY" (press last).

On the OSD and on the FTD the service information appears. The player can now be operated normally in the service mode. When the "FTS" key is pressed the player comes into the service step mode. In sequence 1, 2, 3 there are now break points, so that the "FTS" key must be operated again in order to get into the following sequence. After sequence 5 the step mode is switched off again and can only be called up again after an "OPEN/CLOSE" command.

2.3 On Screen Display

The OSD has the following layout in the service mode:



LAYOUT OSD

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Fig. 27

All numbers have a hexadecimal value.
UP1: (User Processor) Last user command.

00	STOP	0E	digit 9	1C	.
01	PLAY	0F	PROGRAM	1D	.
02	PAUSE	10	STORE	1E	.
03	STANDBY	11	CLEAR	1F	DISPLAY
04	OPEN /CLOSE	12	SELECT	20	SOUND
05	digit 0	13	NEXT	21	SLOW FORWARD
06	digit 1	14	PREVIOUS	22	SLOW REVERSE
07	digit 2	15	RANDOM	23	STILL FORWARD
08	digit 3	16	FTS	24	STILL REVERSE
09	digit 4	17	TITLE	25	SPEED +
0A	digit 5	18	PP	26	SPEED –
0B	digit 6	19	EDIT	27	A–B REPEAT
0C	digit 7	1A	REPEAT	28	SEARCH FORWARD
0D	digit 8	1B	MODE	29	SEARCH REVERSE

UP2: (User Processor) Error status.

00 No errors

Tray errors:
- 04 Open position not reached on time
- 07 Close from open position not started on time
- 09 Stop position not reached on time in the case of close
- 0D Down position not reached on time
- 10 Down position not left on time in the case of stopping
- 11 Stop position not reached on time in the case of stopping

General errors:
4 Communication with servo µP longer than 3 sec.
E FTD driver communication error

VN.U: Software version number User µP

VN.S: Software version number Servo µP

SP1: Time between two consecutive tacho pulses

SP2: Motor control status register
- MSB ---
- b6 ---
- b5 TOK, motor tacho o.k.
- b4 Motor Reverse Flag
- b3 Overspeed Flag
- b2 zrpm, motor still
- b1 PLOCK, motor in phase lock
- LSB MPLL, motor in lock

SP3: Error Flags
- MSB Focus error
- b6 TPI error
- b5 Radial servo error
- b4 Offset error
- b3 Motor reverse error
- b2 Eccentricity test failure
- b1 Motor speed lost error
- LSB Subcode error

SB: Service byte
- MSB 24 bit code correct
- b6 Subcode correct
- b5 TOC reading is over (sequ 5)
- b4 Scale is calibrated (sequ 4)
- b3 Radial servo + motor o.k. (sequ 3)
- b2 Main motor is started (sequ 2)
- b1 Focus o.k. (sequ 1)
- LSB Start position reached (sequ 0)

MS: Main status
- MSB Stop flag
- b6 In Service mode
- b5 TOC ready
- b4 Busy
- b3 Picture flag
- b2 Service step ready
- b1 Servo error
- LSB Address error (command error)

DS: Disc status
- MSB No disc
- b6 VLP disc
- b5 CD disc
- b4 PAL/CLIP disc
- b3 Digital audio available
- b2 Clip disc
- b1 Bilingual sound (CD)
- LSB CLV mode

SCT: Subcode track number

SCI: Subcode Index

SCM: Subcode minutes

SCS: Subcode seconds

VC2S: Field 2 status info
VC1S: Field 1 status info
- MSB '0'= field 2, '1'= field 1
- b6 PSC in field
- b5 Area or mode:
  - 00 Program area
  - + 01 Lead–in area
  - 10 Lead–out area
- b4 11 Picture stop mode
- b3 Detection of chapter number on disc
- b2 CX flag : '0'= off, '1'= on
- b1 CLV flag: '1'= CLV
- LSB Free

VC2C: Chapter number

VC2F: In program area always FF.

VC2P: Field 2 program status code.

3.4 Radial control circuit

The radial error signal comes in via switch IC7305A. For good radial control the following two items of information must be obtained from the RE signal:
1. The deviation from the centre of the track.
2. The speed of the deviation.

The deviation is the proportional part and is the RE itself after a little more amplification in IC7306A.
The speed information is obtained by differentiating the RE signal. This is done with IC7306B.
The bandwidth and amplification are greater in the CDV mode than in the CD mode. Changeover is via RADBB signal on switch IC7305A. During start-up RADBB also switches the control to high amplification.
The two error signals are added together again in IC7316A. The RADSVR signal on switch IC7335C sends the result to the output stage and this switches on the control loop. The output stage operates as an integrator from the moment RADINT releases the integration capacitor. The 2D actuator is driven, the voltage on the actuator RAD+ is measured and the value of the voltage is transmitted via an ADC circuit IC74903A and IC7403B to the servo µP. The value of the voltage is proportional to the excursion of the actuator. If the excursion exceeds a certain value, then the µP will drive the carriage motor so that the excursion begins at zero again. This is the mechanical mid- position of the 2D actuator. The carriage motor is controlled entirely by the µP by means of the signals CARIN and CAROUT. The CARSPL signal influences the speed of the motor and the control is switched on with the CARON signal. The pulse recorder by the pulley of the carriage motor indicates to the µP how far the motor has moved the carriage.
In the case of "tricks" such as STILL PICTURE, REVERSE PLAY and SCAN the RADSVR signal switches the radial control to µP control. The µP signals RADP- and RADP+ now go to the output stage, whereby the integrator operation is switched off.
With IC7300A a block-wave signal, REDIG, is made from the RE signal. REDIG is high on the left of the track and low on the right of the track.

3.5 TPI correction circuit

In order to prevent an impact from causing the radial control to pass into error and the spots from gliding over the tracks, the "Track Position Indicator" signal is incorporated in the radial control. The TPI signal reduces the impact sensitivity and prevents starting-up problems in scanning, for example. If the TPI signal is low the proportional part of the RE is interrupted by the switching over of switch IC7305B. The value at that moment is stored in C2316 and amplified twice. By the switching over of switch IC7305C the differentiated part of RE is inverted. As a result, the movement which the actuator makes due to an impact will be braked heavily and countered. The TPI signal will however have a detrimental effect on the control in the case of disc errors. For this reason the TPI signal will have to be corrected and the TPIC(orrected) will influence the radial control in the case of an impact. The correction circuit predicts a disc error.
If as a result of a disc error (play audio test disc 5A track 9) the TPI signal (pin 3 of IC7501) is > 75 µsec on a previous revolution, then the TPIC signal (pin 12 of IC7501) is suppressed at that same place for 600 µsec, see fig. 30.
The position information is measured per revolution by means of 18 tacho pulses. On the tracks the TPI signal is high and between the tracks it is low.

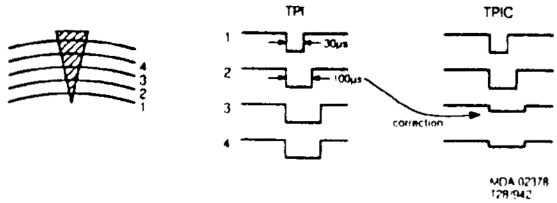


Fig. 30

3.6 Tilt motor control

As a result of the umbrella effect a tilt error TE arises. The tilt control ensures that this error is eliminated. The µP controls the tilt motor output stage with the signals TILTUP and TILDWN. The measure of control is dependent on the TE signal. The value of TE is measured with the ADC circuit IC7403A and IC7403B, with which the value of RAD+ is also measured. The signal T/CAR is switched every half revolution of the disc and determines whether TE or RAD+ is measured. On pin 3 and pin 5 of IC7403 there is a sawtooth signal, which is started with ADCST by the µP. The µP measures the time difference between the starting of the sawtooth and the moment at which the amplitude of the sawtooth is greater than the voltage on pin 2 or pin 6 of IC7403. Either ADCP or ADCN becomes high. The time difference between the becoming high of ADCP or ADCN and the becoming high of ADCST is thus proportional to the value of TE and/or RAD+.
After replacing a faulty carriage the TE signal must be adjusted with potentiometer R3130 on the sigma pi board.

4 MOTOR CIRCUIT

The motor board accommodates the carriage motor circuit and the turntable motor circuit. The turntable motor is a Hall motor. The motor is controlled mainly via software in the servo µP, which drives the DSCM2-IC IC7001. The purpose of the control is:

- With the TACHO to bring the speed of the motor rapidly to approximately the right value. At TOK = 1 the tacho frequency is correct within -0.4Hz/+2Hz.
- To make the FREQUENCY of CSYNC equal to the real line frequency HREF for stability of the control loop and reliable measurement in the case of CLV-SCAN.
- To match the PHASE of CSYNC1 and the line frequency as accurately as possible, so that the time-base correction circuit in the video circuit has to make the minimum amount of correction in order to obtain the correct video colour information from the disc.
- In the BRAKE mode to bring the motor rapidly to a standstill.

4.1 DSCM2 circuit

At the external clock input pin 55 a frequency of 7.5 MHz is presented, which serves as a reference for the internal timing and control. The DSCM2 IC7001 is controlled by the servo µP, which always sends four controller bytes via DIN pin 6. The byte information switches on the various functions of the IC and in fact closes the control loop of the motor circuit. The output stage consists of three drivers, formed by IC7020 and IC7021. The drivers are controlled with signals from the commutator block, the degree of control is dependent on the content of the four controller bytes, the tacho signal and the PWM signal. The tacho signal determines which driver must be driven and the PWM signal how and how much. The PWM is pulse-width-modulated. The pulse width is proportional to the error signal on pin 12 of IC7030-4D. The control loop has two branches, one branch for CD and the other branch for CDV. The CDV signal on S4, S5 and S6 determines which branch is switched on. In the CD branch the control is driven by the MCES signal, in the CDV branch the CSYNC is compared with HREF, whereby frequency error and phase error are eliminated. The status signals from the control loop go back via the output interface serial via pin 5 of IC7001-4D to the servo µP, as do TACHO, MH1 and MV1. The TACHO18 signal is used in the servo circuit for the TPI correction circuit. PHLOCK is used in the video circuit in the time error correction circuit.
The circuit with TR7011 and TR7012 serves as the load on the power supply in the STANDBY mode.

4.2 Tray motor circuit

IC7101 is the driver of the tray motor, which is controlled by the User 230P. The µP signals go to the driver via register IC7200, where on pin 11 to pin 14 there are also µP signals for the audio circuit. On the motor board there is also the power supply for the FTD display TR7091, TR7081 to TR7084.

VCN1: Field 1
CAV, Picture number high byte
CLV, Program time minutes

VCN2: Field 1
CAV, Picture number low byte
CLV, Program time seconds

VCN3: Field 1
CAV, Program status code
CLV, Program time frames

2.4 Service info on the FTD

The track bar numbers have the following meaning:

Motor functions
1 Motor tacho o.k.
2 Motor reverse indication
3 Overspeed indication
4 Motor still indication
5 Motor in phase lock indication
6 Moock indication

Error indications
7 Focus error
8 TPI error
9 Radial servo error
10 Offset error
11 Motor reverse error
12 Eccentricity test failure
13 Motor speed error
14 Subcode error

Indication of start-up phase
15 seq 0: Starting position reached
16 seq 1: Focus o.k.
17 seq 2: Turntable motor started
18 seq 3: Radial servo o.k. and motor o.k.
19 seq 4: Scale calibrated
20 seq 5: TOC reading done

Indication good disc info code.
CDV 24-bit code o.k.
CD Subcode o.k.

2.5 Start-up phases with a CD (8 cm and 12 cm) or CDV clip disc

The objective departs from the stop position. This is on a diameter of 68 mm, detected by the REFSWITCH. A subsequent sequence can only begin when the current sequence has been completed.

Seq. 0:
Initial parameters are set.
Laser and Tilt LED are actuated.
Delay focus start.
Determine from disc reflection whether there is a CDV LP or CDV single disc on the turntable. If there is no reflection the carriage is moved to a diameter of 25 mm.

Seq. 1:
Wait until the carriage movement is completed.
Determine from the disc reflection whether there is a disc on the turntable. If there is no disc, then "no disc" indication and carriage back to stop position.
Focus start and wait for focus ready.

In the service step mode there is a break point here. With the FTS key give a step instruction for the next sequence.

Seq. 2:
Clear stop status.
Start turntable motor.

In the service step mode there is a break point here. With the FTS key give a step instruction for the next sequence.

Seq. 3:
Wait until motor tacho is o.k.
Switch on radial servo and wait until it is switched on.

In the service step mode there is a break point here. With the FTS key give a step instruction for the next sequence.

Seq. 4:
Find the point of transition from lead-in to program area and note the position of the carriage at this point.
Scale calibration: subcode or 24-bit code must be o.k.

Seq. 5:
Read Table of Contents. If impossible ... > servo error.

2.6 Start-up phases with a CDV LP or CDV single

The objective departs from the stop position. This is on a diameter of 68 mm. The next sequence can only begin when the current one has been completed.

Seq. 0:
Initial parameters are set.
Laser and tilt led are actuated.
Delay for focus start.
Determine from disc reflection whether there is a CDV LP on the turntable.

Seq. 1:
If there is no disc on the turntable, then return to stop position.
Focus start and wait for focus ready.

In the service step mode there is a break point here. With the FTS key give a step instruction for the next sequence.

Seq. 2:
Clear stop status.
Start turntable motor.
Carry out eccentricity test. If more than 768 track cross-overs are seen on the REDIG signal, then there is an error, stop the motor and return to stop position.
Start movement of carriage to a diameter of 59 mm.

In the service step mode there is a break point here. With the FTS key give a step instruction for the next sequence.

Seq. 3:
Wait until the carriage movement has finished.
Wait until the motor tacho is o.k.
Switch on radial servo and wait until it has been switched on.

In the service step mode there is a break point here. With the FTS key give a step instruction for the next sequence.

Seq. 4:
Wait until MPLL is reached.
Find the point of transition from lead-in to program area and note the position of the carriage at this point.
Scale calibration: subcode or 24-bit code must be o.k.

Seq. 5:
Read Table of Contents, if impossible ... > servo error.

3 SERVO CIRCUIT

The servo circuit consists of:
- Servo µProcessor circuit.
- Focus circuit.
- Radial control circuit.
- TPI correction circuit.
- TILT control circuit.

3.2 Servo-µP circuit

The servo µP circuit is the central control unit of the player. Via RXD, TXD and ACKNOW the µP IC7200 is connected with the user µP (see Service Software chapter 2). The subcode information comes in from the decoder circuit on the audio panel via the signals QDATA, QCLOCK AND QSYNC. If a CDV disc is played, the main loop of the program is synchronised by the VSYNC signal and in the case of a CD audio disc by the subcode. The main loop begins with the sending of four service info bytes to the user µP, see fig. 28 for the main loop. IC7202 decodes the 24-bit code, the data comes in on pin 21. IC7201 is also included to increase the I/O possibilities.

3.3 Focus circuit

The focus circuit consists of:
- Input circuit with lead and lag filters IC7002B. The lead and lag filters are different for CD and CDV mode. Switching over takes place via the $\overline{\text{CDMODE}}$ signal on switch IC7001B. If the FE signal is large in the CDV mode, the input stage is switched over by TR7010 and TR7057 to a high bandwidth for at least one revolution. TR7055 and TR7056 detect the amplitude of FE. At a low FE TR7010 and TR7057 continue to conduct and the bandwidth is low.
- IC7002A and TR7036 to TR7039 constitute the output stage. The loop is switched on with the FOCRDY signal on switch IC7001C. If FOCRDY is low, the output stage is controlled by the voltage on C2025, which is determined by the FOCSTA during start-up.
- LFSOM and FE detection circuit for determining FOCRDY, on IC7003A and IC7003C. See fig. 29 for the focus start-up cycle.

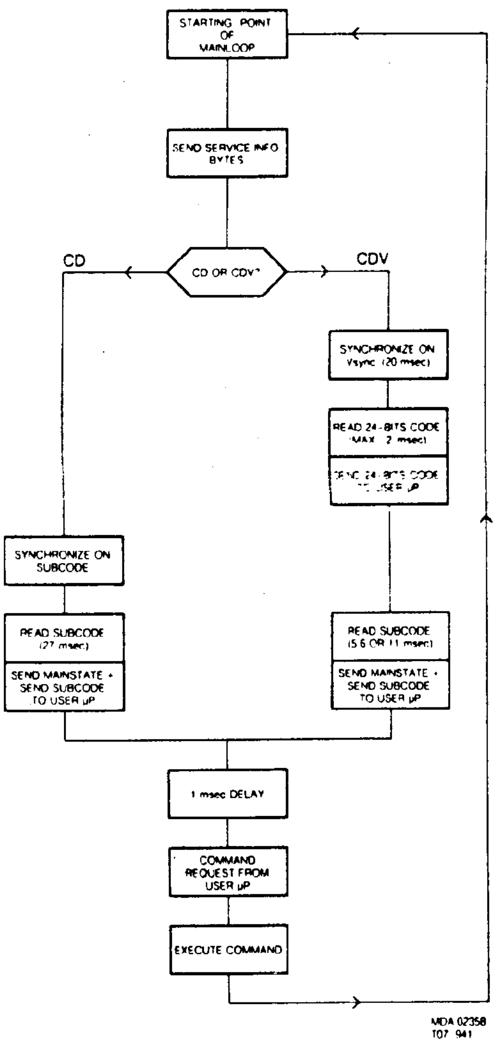


Fig. 28

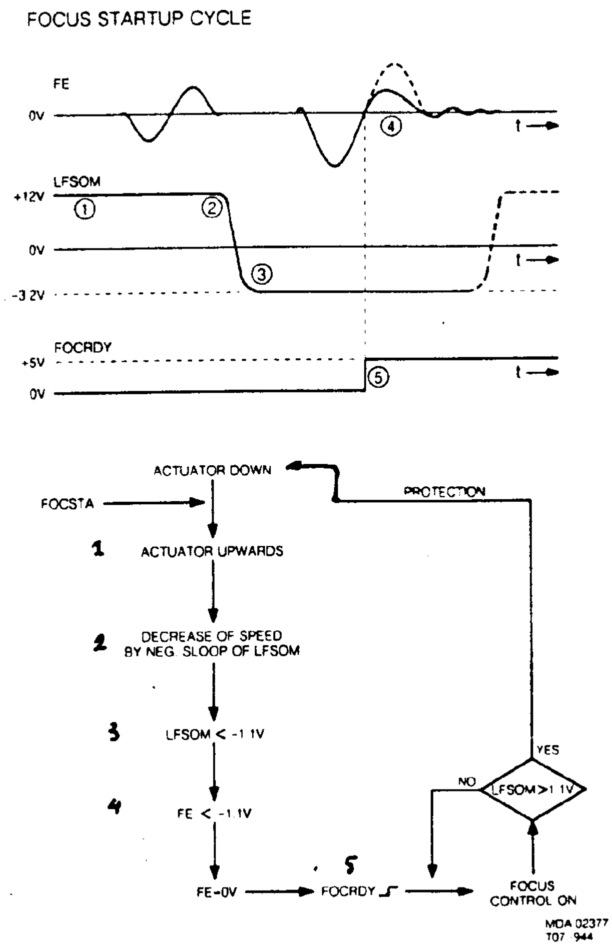


Fig. 29

MOTORCONTROL BLOCK DIAGRAM

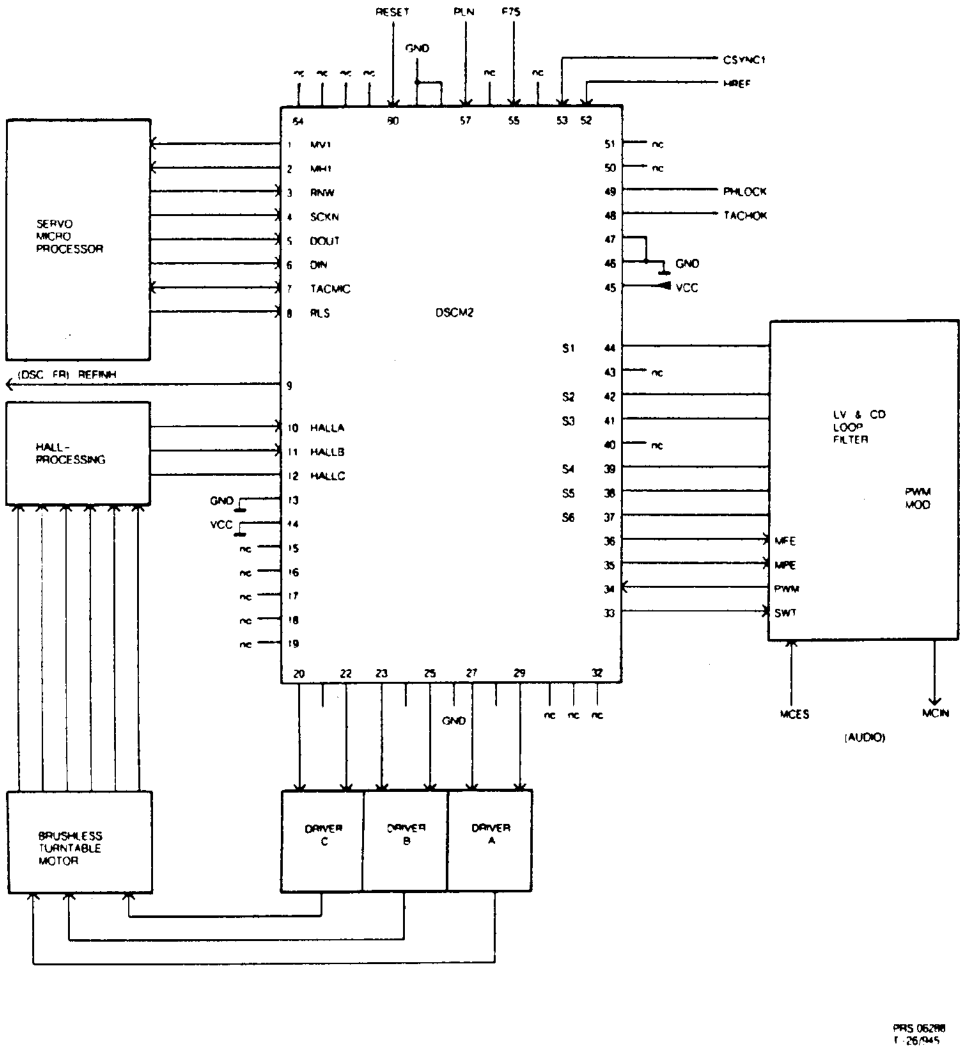
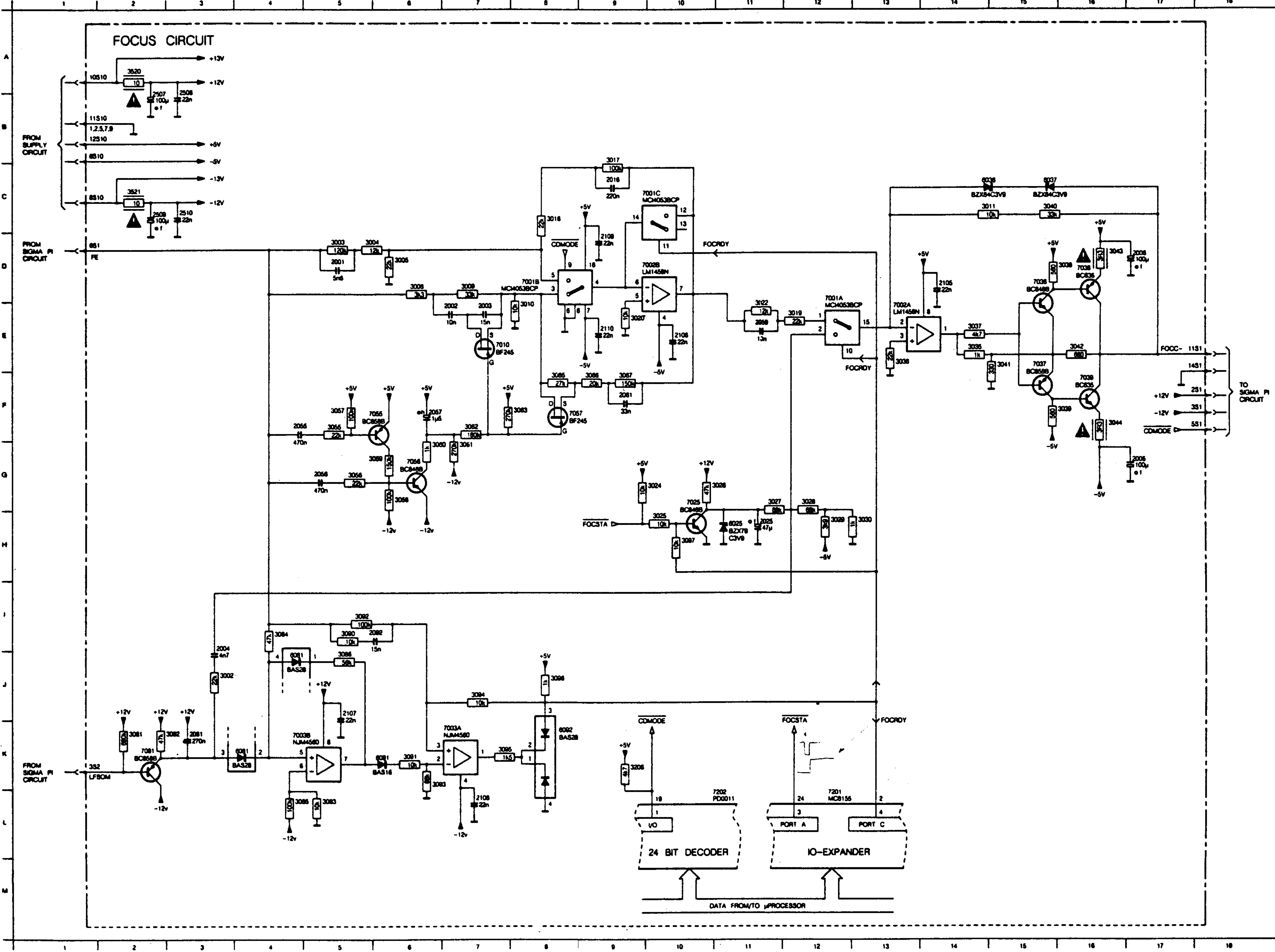
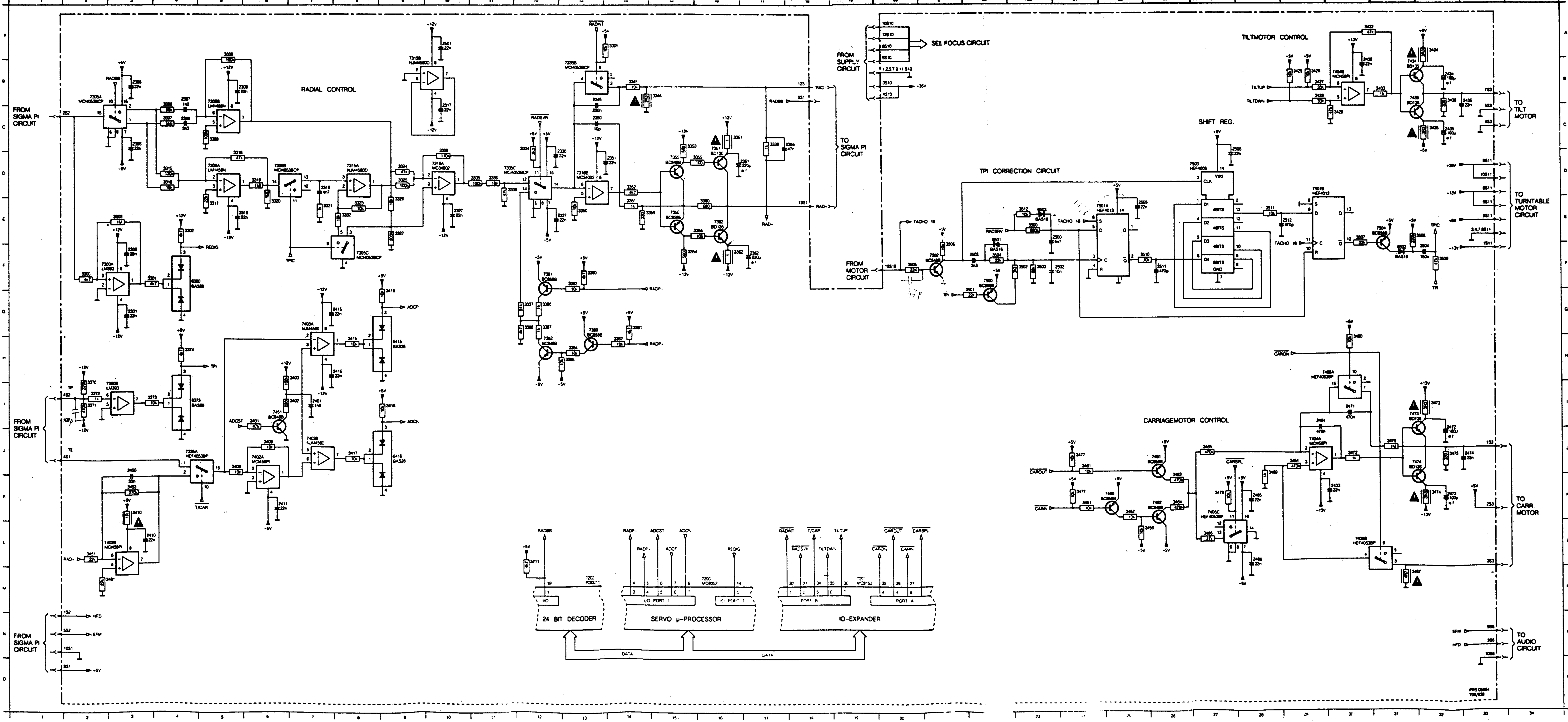


Fig. 31



2001	D 5
2002	E 7
2003	E 7
2004	I 3
2005	G17
2006	D17
2016	C 9
2025	H11
2055	F 4
2056	G 5
2057	F 6
2059	E11
2061	F 9
2081	K 3
2092	I 6
2105	D14
2106	E10
2107	J 5
2108	L 7
2109	D 9
2110	E 9
2507	A 2
2508	A 3
2509	C 2
2510	C 3
3002	J 3
3003	D 5
3004	D 6
3005	D 6
3008	D 6
3009	D 7
3010	E 8
3011	C15
3016	C 8
3017	B 9
3019	E12
3020	E 9
3022	E11
3024	G10
3025	H10
3026	G11
3027	G11
3028	G12
3029	H12
3030	H13
3035	E14
3036	E13
3037	E14
3038	D16
3039	F16
3040	C15
3041	E15
3042	E16
3043	D16
3044	F16
3055	F 5
3056	G 5
3057	F 5
3058	G 6
3059	G 6
3060	G 7
3061	G 7
3062	F 7
3063	F 8
3065	F 8
3066	F 9
3067	F 9
3081	K 2
3082	K 3
3083	L 5
3084	I 4
3085	L 5
3086	J 5
3090	I 5
3091	K 6
3092	I 5
3093	K 7
3094	J 7
3095	K 7
3096	J 8
3097	H10
3208	K 9
3520	A 2
3521	C 2
6025	H11
6036	C15
6037	C15
6081	J 4
6081	K 4
6091	K 6
6092	K 8
7001A	D12
7001B	D 8
7001C	C10
7002A	E13
7002B	D10
7003A	K 7
7003B	K 4
7010	E 7
7025	G10
7036	D15
7037	E15
7038	D16
7039	F16
7055	F 6
7056	G 6
7057	F 9
7081	K 2
7201	L12
7202	L11



2300	F 3	3501	F22
2301	G 3	3502	F23
2305	B 3	3503	F23
2306	C 3	3504	F22
2307	B 4	3505	F20
2308	C 4	3506	F21
2309	B 6	3507	E30
2315	E 6	3508	E32
2316	D 7	3509	F32
2317	B10	3510	F25
2327	E10	3511	E28
2336	C13	3512	E23
2337	E13	6300	F 4
2345	B13	6373	I 4
2350	C13	6415	H 9
2351	D14	6416	J 9
2356	C18	6501	E22
2361	D17	6502	F31
2362	F17	6503	E23
2401	I 7	7200	M16
2410	L 3	7201	M19
2411	K 8	7202	M13
2415	G 8	7300A	F 3
2416	H 8	7300B	I 3
2432	B30	7305A	B 2
2433	K30	7305B	D 6
2434	B32	7305C	F 8
2435	C32	7306A	D 5
2436	B33	7306B	B 5
2450	J 3	7315A	D 8
2464	I 29	7315B	A 9
2465	K28	7316A	D10
2466	L28	7316B	D13
2471	I 30	7335A	J 4
2472	J32	7335B	B13
2473	K32	7335C	D11
2474	J33	7355	D15
2500	E24	7356	E15
2501	A10	7361	C16
2502	F24	7362	E16
2503	F22	7380	G13
2504	F32	7381	F12
2505	E26	7382	H12
2506	C28	7402A	J 6
2511	F26	7402B	L 3
2512	E29	7403A	G 7
3211	L12	7403B	J 7
3300	F 2	7404A	J29
3301	F 3	7404B	B30
3302	E 4	7405A	H30
3303	E 3	7405B	L30
3304	C12	7405C	K27
3305	A14	7434	B31
3306	B 4	7435	B31
3307	C 4	7451	I 6
3308	C 5	7460	K25
3309	A 5	7461	J26
3315	D 4	7462	K26
3316	D 4	7473	I 31
3317	E 5	7474	J31
3318	D 5	7500	F22
3319	D 6	7501A	E25
3320	E 6	7501B	D29
3321	E 7	7502	F21
3323	E 8	7503	D27
3324	D 9	7504	E31
3325	D 9		
3326	E 9		
3327	E 9		
3328	C10		
3332	E 8		
3335	D11		
3336	D11		
3337	G12		
3338	D12		
3339	C17		
3345	B14		
3346	B15		
3350	E13		
3351	E14		
3352	D14		
3353	C15		
3354	F15		
3355	D16		
3356	E16		
3359	E15		
3360	E16		
3361	C16		
3362	F16		
3370	H 2		
3371	I 2		
3372	I 2		
3373	I 3		
3374	H 4		
3380	F13		
3381	G14		
3382	H14		
3383	F13		
3384	H13		
3385	H13		
3386	G12		
3387	G12		
3388	G12		
3401	I 6		
3402	I 7		
3403	H 7		
3408	J 5		
3409	J 6		
3410	K 3		
3415	H 8		
3416	F 9		
3417	J 8		
3418	I 9		
3425	B29		
3426	B29		
3427	B29		
3428	B29		
3429	C30		
3432	A30		
3433	B31		
3434	A32		
3435	C32		
3436	B32		
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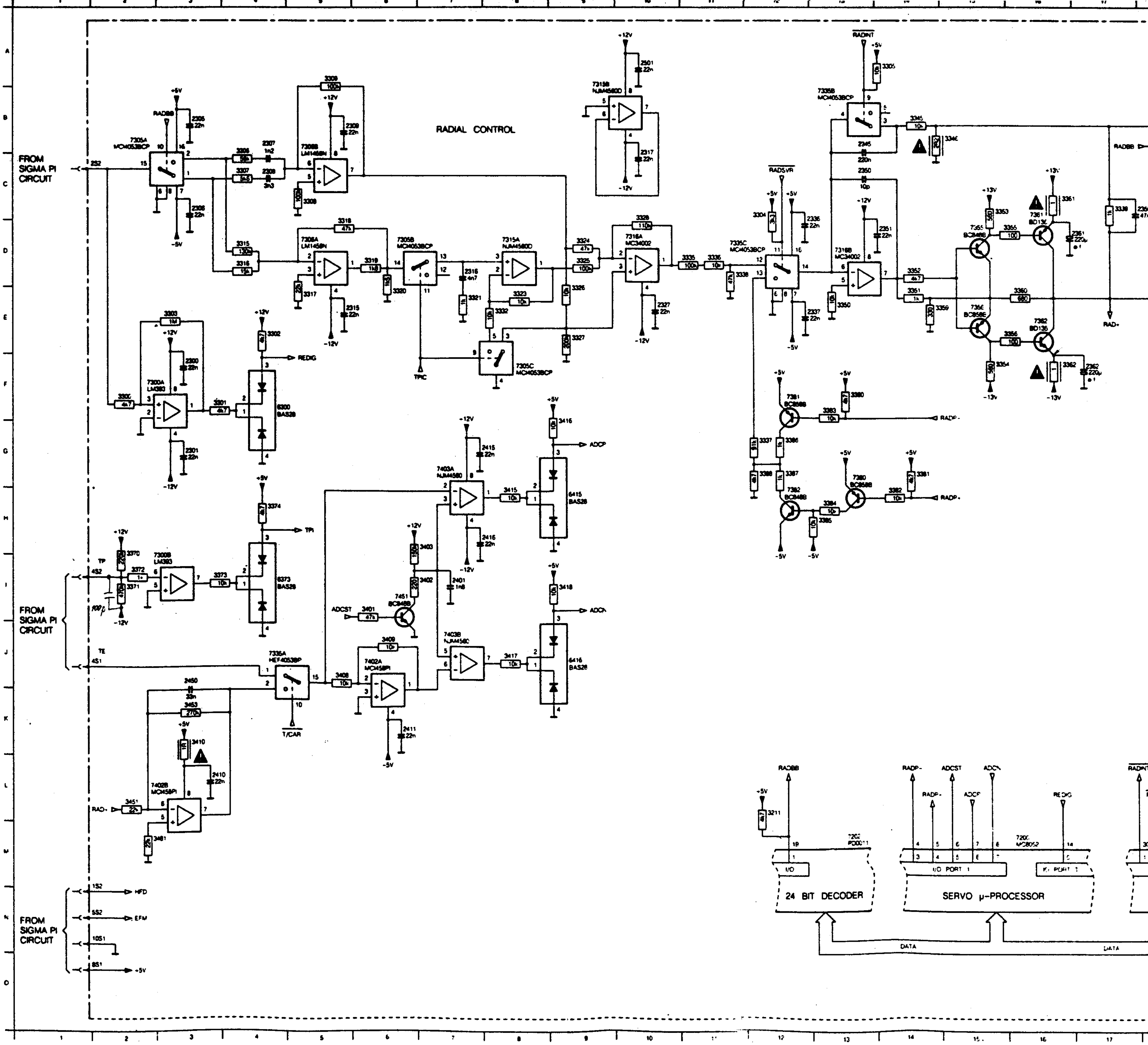
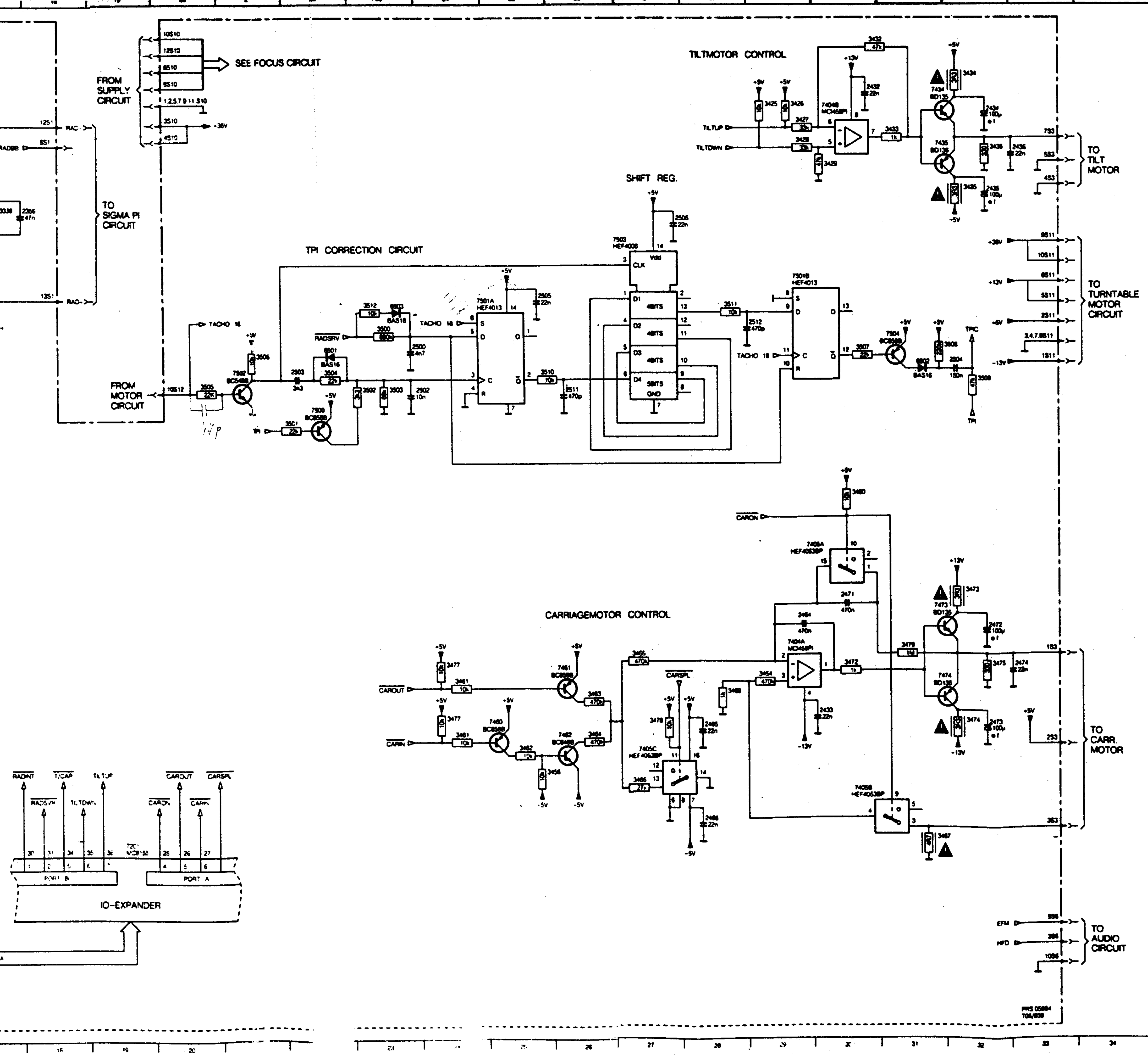
3453	K 3		
3454	J29		
3456	L26		
3461	K24		
3461	J24		
3462	K25		
3463	K26		
3464	K26		
3465	J27		
3466	L27		
3467	M32		
3469	J28		
3472	J30		
3473	I 32		
3474	K32		
3475	J32		
3477	K24		
3477	J24		
3478	K27		
3479	J31		
3480	H30		
3481	[illegible] 3		
3500	F23		


RADIAL CONTROL
FROM SIGMA PI CIRCUIT
FROM SIGMA PI CIRCUIT
FROM SIGMA PI CIRCUIT
7305A MC14053BCP
7308B LM1458N
7308A LM1458N
7305B MC14053BCP
7315A NJM4580D
7315B NJM4580D
7316A MC34002
7335B MC14053BCP
7335C MC14053BCP
7316B MC34002
7300A LM393
7300B LM393
6300 BAS28
6373 BAS28
7403A NJM4580
7403B NJM4580
6415 BAS28
6416 BAS28
7451 BC848B
7335A HEF4053BP
7402A MC1458P1
7402B MC1458P1
7305C MC14053BCP
7355 BC848B
7356 BC858B
7361 BD136
7362 BD135
7381 BC858B
7380 BC858B
7382 BC848B
REDIG
TPI
ADCP
ADCN
ADCST
TPIC
T/CAR
RADBB
RADINT
RADSVR
RAD+
RADP-
HFD
EFM
+5V
24 BIT DECODER
SERVO μ-PROCESSOR
I/O PORT 1
DATA
DATA



2300	F 3	3501	F22
2301	G 3	3502	F23
2305	B 3	3503	F23
2306	C 3	3504	F22
2307	B 4	3505	F20
2308	C 4	3506	F21
2309	B 6	3507	E30
2315	E 6	3508	E32
2316	D 7	3509	F32
2317	B10	3510	F25
2327	E10	3511	E28
2336	C13	3512	E23
2337	E13	6300	F 4
2345	B13	6373	I 4
2350	C13	6415	H 9
2351	D14	6416	J 9
2356	C18	6501	E22
2361	D17	6502	F31
2362	F17	6503	E23
2401	I 7	7200	M16
2410	L 3	7201	M19
2411	K 8	7202	M13
2415	G 8	7300A	F 3
2416	H 8	7300B	I 3
2432	B30	7305A	B 2
2433	K30	7305B	D 6
2434	B32	7305C	F 8
2435	C32	7306A	D 5
2436	B33	7306B	B 5
2450	J 3	7315A	D 8
2464	I 29	7315B	A 9
2465	K28	7316A	D10
2466	L28	7316B	D13
2471	I 30	7335A	J 4
2472	J32	7335B	B13
2473	K32	7335C	D11
2474	J33	7355	D15
2500	E24	7356	E15
2501	A10	7361	C16
2502	F24	7362	E16
2503	F22	7380	G13
2504	F32	7381	F12
2505	E26	7382	H12
2506	C28	7402A	J 6
2511	F26	7402B	L 3
2512	E29	7403A	G 7
3211	L12	7403B	J 7
3300	F 2	7404A	J29
3301	F 3	7404B	B30
3302	E 4	7405A	H30
3303	E 3	7405B	L30
3304	C12	7405C	K27
3305	A14	7434	B31
3306	B 4	7435	B31
3307	C 4	7451	I 6
3308	C 5	7460	K25
3309	A 5	7461	J26
3315	D 4	7462	K26
3316	D 4	7473	I 31
3317	E 5	7474	J31
3318	D 5	7500	F22
3319	D 6	7501A	E25
3320	E 6	7501B	D29
3321	E 7	7502	F21
3323	E 8	7503	D27
3324	D 9	7504	E31
3325	D 9		
3326	E 9		
3327	E 9		
3328	C10		
3332	E 8		
3335	D11		
3336	D11		
3337	G12		
3338	D12		
3339	C17		
3345	B14		
3346	B15		
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3351	E14		
3352	D14		
3353	C15		
3354	F15		
3355	D16		
3356	E16		
3359	E15		
3360	E16		
3361	C16		
3362	F16		
3370	H 2		
3371	I 2		
3372	I 2		
3373	I 3		
3374	H 4		
3380	F13		
3381	G14		
3382	H14		
3383	F13		
3384	H13		
3385	H13		
3386	G12		
3387	G12		
3388	G12		
3401	I 6		
3402	I 7		
3403	H 7		
3408	J 5		
3409	J 6		
3410	K 3		
3415	H 8		
3416	F 9		
3417	J 8		
3418	I 9		
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3429	C30		
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3435	C32		
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3466	L27		
3467	M32		
3469	J28		
3472	J30		
3473	I 32		
3474	K32		
3475	J32		
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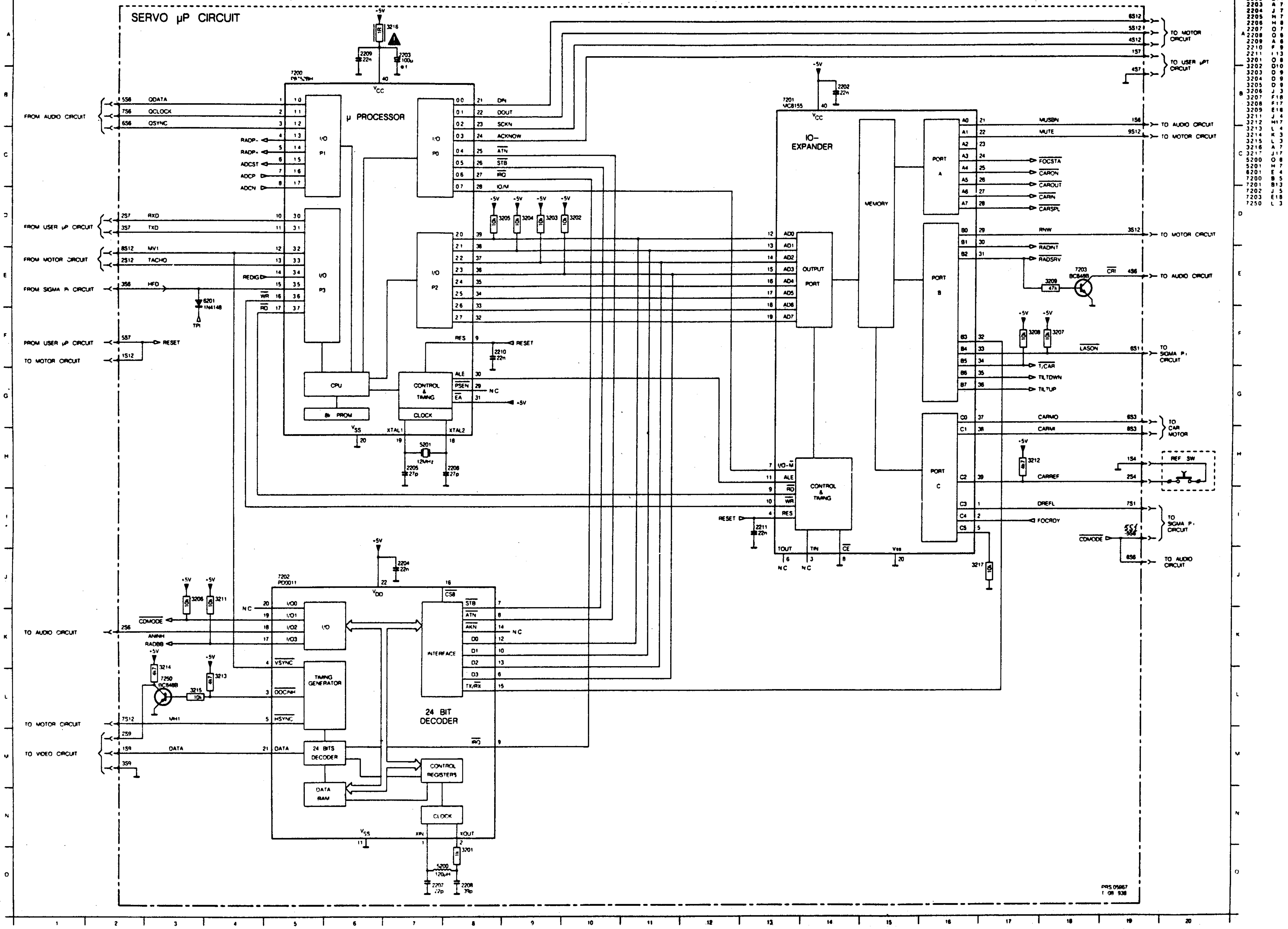
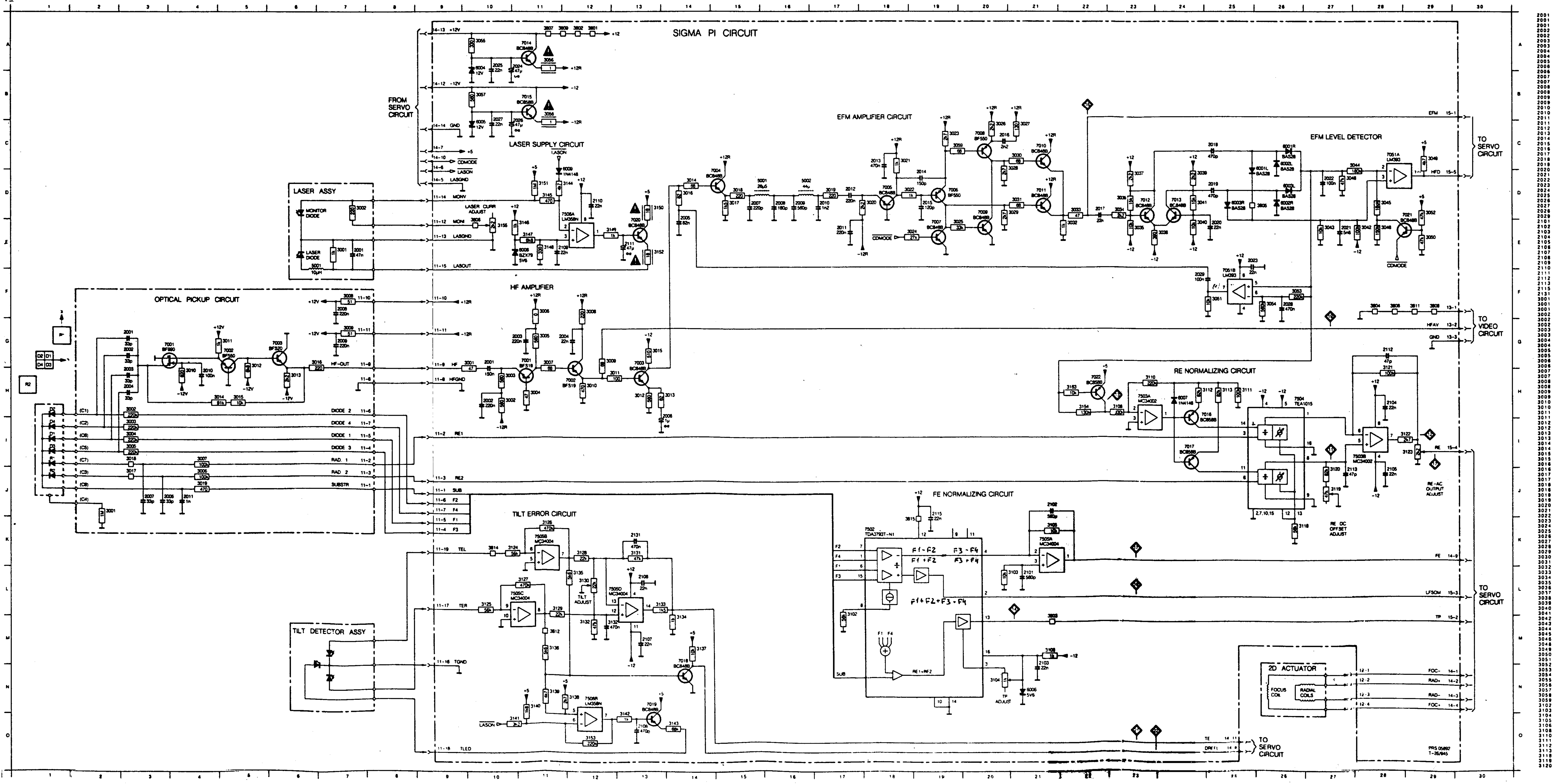

SERVO µP CIRCUIT
µ PROCESSOR
IO-EXPANDER
MEMORY
PORT A
PORT B
PORT C
OUTPUT PORT
CONTROL & TIMING
CPU
8k PROM
CLOCK
24 BIT DECODER
INTERFACE
TIMING GENERATOR
24 BITS DECODER
DATA RAM
CONTROL REGISTERS
FROM AUDIO CIRCUIT
FROM USER µP CIRCUIT
FROM MOTOR CIRCUIT
FROM SIGMA Pi CIRCUIT
TO MOTOR CIRCUIT
TO USER µP CIRCUIT
TO AUDIO CIRCUIT
TO SIGMA Pi CIRCUIT
TO CAR MOTOR
TO VIDEO CIRCUIT
REF SW
PRS 05867



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2003	H 3	3127	L11
2004	G12	3128	K12
2004	H 3	3129	L11
2005	D14	3130	L12
2006	H14	3131	K13
2006	J 4	3132	M12
2007	D15	3132	M12
2007	J 3	3133	L13
2008	D16	3134	M14
2008	F 7	3135	L12
2009	D16	3136	M11
2009	G 7	3137	M14
2010	D17	3138	N12
2010	H 4	3139	N11
2011	E17	3140	N11
2011	J 4	3141	O10
2012	D17	3142	N13
2013	C18	3143	O14
2014	D19	3144	D12
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2016	C20	3146	E11
2017	D22	3147	E11
2018	C25	3148	E11
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2022	D27	3152	E13
2023	E25	3153	O12
2024	A11	3154	H22
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2026	C11	3163	H22
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2029	F24	3803	L21
2101	L21	3804	F28
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2103	M21	3806	E10
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2108	O13	3811	F29
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2110	D12	3814	K10
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2112	G28	5001	D16
2113	J28	5001	E 6
2115	J19	5002	D16
2131	K13	6001L	C26
3001	G10	6001R	C26
3001	J 2	6002L	C26
3001	E 7	6002R	D26
3002	H10	6003L	D26
3002	H 3	6003R	D25
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3003	H10	6005	C10
3003	I 3	6006	N21
3004	H11	6007	H24
3004	I 3	6008	E11
3005	G11	6009	C12
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3006	F11	7002	H12
3006	J 4	7002	G 5
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3011	H13	7010	C21
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3012	H13	7012	D23
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3013	H14	7014	A11
3013	H 6	7015	B11
3014	D14	7016	H25
3014	H 5	7017	I 24
3015	G13	7018	M14
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3017	D15	7022	H22
3017	J 3	7051A	C28
3018	D15	7051B	F25
3018	I 3	7502	K18
3018	D17	7503A	H23
3019	J 4	7503B	I 28
3020	D18	7504	H26
3021	C18	7505A	K21
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3023	C19	7505C	L11
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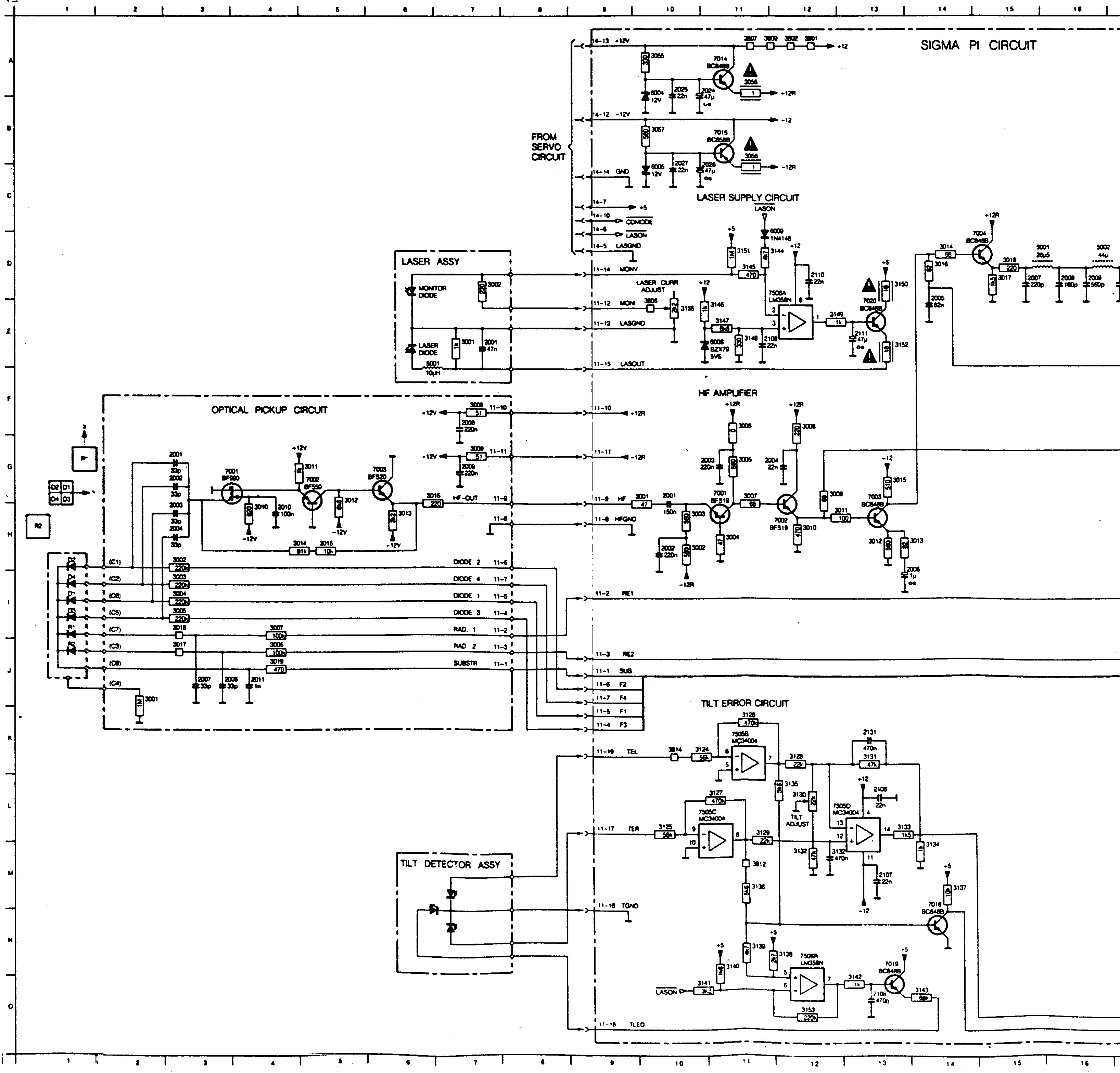

SIGMA PI CIRCUIT
FROM SERVO CIRCUIT
LASER SUPPLY CIRCUIT
LASER ASSY
MONITOR DIODE
LASER DIODE
LASER CURR ADJUST
OPTICAL PICKUP CIRCUIT
HF AMPLIFIER
TILT ERROR CIRCUIT
TILT ADJUST
TILT DETECTOR ASSY
14-13 +12V
14-12 -12V
14-14 GND
14-7
14-10 CDMODE
14-6 LASON
14-5 LASGND
11-14 MONV
11-12 MONI
11-13 LASGND
11-15 LASOUT
11-10
11-11
11-9 HF
11-8 HFGND
11-2 RE1
11-3 RE2
11-1 SUB
11-6 F2
11-7 F4
11-5 F1
11-4 F3
11-19 TEL
11-17 TER
11-16 TGND
11-18 TLED
HF-OUT
DIODE 2
DIODE 4
DIODE 1
DIODE 3
RAD. 1
RAD. 2
SUBSTR
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7015 BC858B
7004 BC848B
7020 BC848B
7506A LM358N
7506B LM358N
7505B MC34004
7505C MC34004
7505D MC34004
7001 BF990
7002 BF550
7003 BFS20
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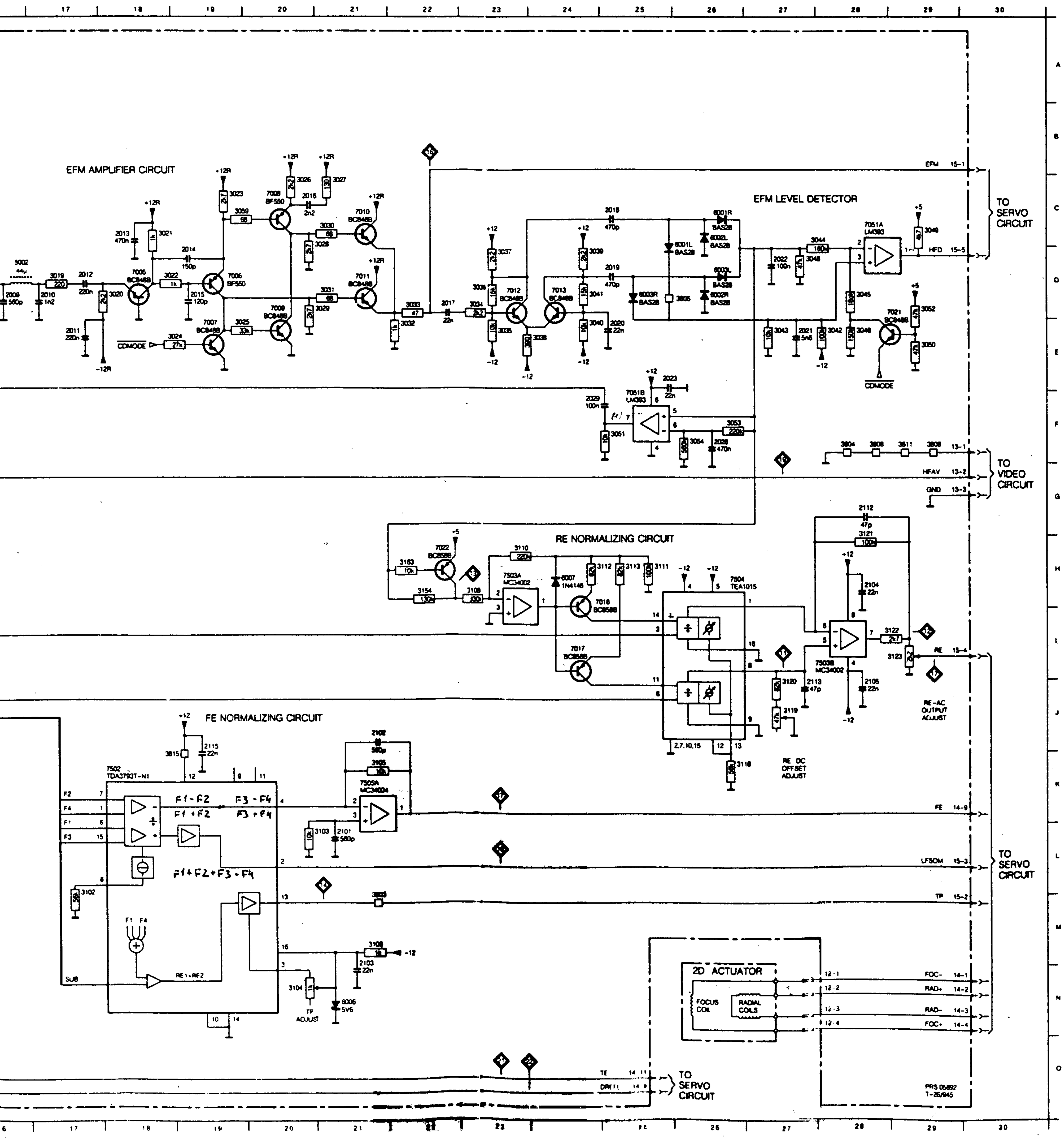
6008 BZX79 5V6
LASON



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2003	H 3	3127	L11
2004	G12	3128	K12
2004	H 3	3129	L11
2005	D14	3130	L12
2006	H14	3131	K13
2006	J 4	3132	M12
2007	D15	3132	M12
2007	J 3	3133	L13
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2008	F 7	3135	L12
2009	D16	3136	M11
2009	G 7	3137	M14
2010	D17	3138	N12
2010	H 4	3139	N11
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2011	J 4	3141	O10
2012	D17	3142	N13
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2016	C20	3146	E11
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2021	E27	3151	D11
2022	D27	3152	E13
2023	E25	3153	O12
2024	A11	3154	H22
2025	A10	3155	E10
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2028	F26	3802	A12
2029	F24	3803	L21
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3004	H11	6007	H24
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3006	J 4	7002	G 5
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3008	F 7	7005	D18
3009	G12	7006	D19
3009	G 7	7007	E19
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3010	H 4	7009	D20
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3011	G 5	7011	D21
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3012	G 5	7013	D24
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3013	H 6	7015	B11
3014	D14	7016	H25
3014	H 5	7017	I 24
3015	G13	7018	M14
3015	H 5	7019	N13
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3018	D15	7051B	F25
3018	I 3	7502	K18
3018	D17	7503A	H23
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3020	D18	7504	H26
3021	C18	7505A	K21
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3023	C19	7505C	L11
3024	E18	7505D	L13
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3026	C20	7506B	N12
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3108	H23		
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3119	J27		
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