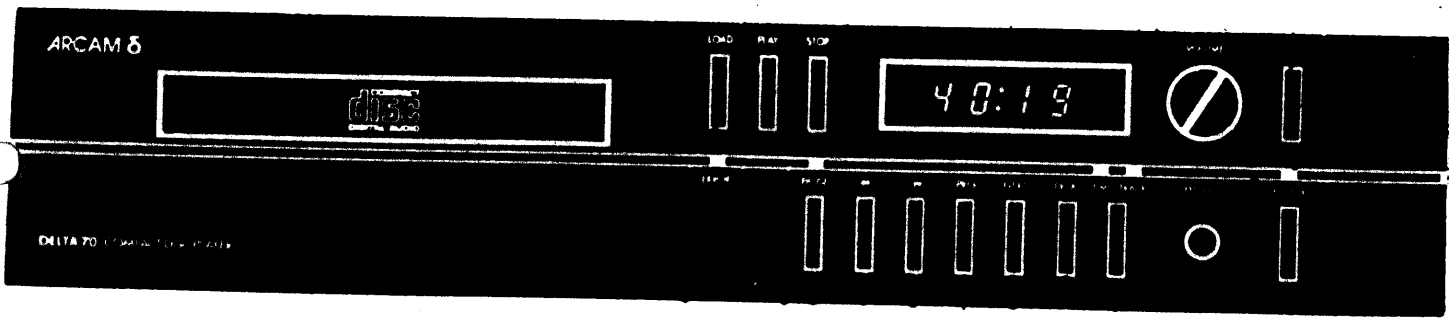
ARCAM DELTA

DELTA 70 COMPACT DISC PLAYER



ARCAM DELTA 70 COMPACT DISC PLAYER SERVICE DATA

(Iss. 3 12/5/87 MM)

INDEX

1. SYSTEM OVERVIEW - Modules

1.1 Loading Mechanism

This incorporates two switches to indicate TRAY IN and TRAY OUT to the control microprocessor. There is also the tray motor which is operated by the control microprocessor via a motor drive circuit.

1.2 Disc Playing Mechanism CDM 2

The CDM2 is contained within the loading mechanism over a floating suspension and consists of the turntable motor, laser swingarm assembly or RAFOC unit (Radial\Focus), and a control PCB. The CDM2 can be likened to a conventional analogue turntable in that it rotates the disc, follows track and produces a signal (the HF signal) which is directly related to the information on the track.

Unlike an analogue turntable it is under control from the decoder board circuitry for start-up procedure, turntable motor speed control and jumping tracks. It also sends signals related to these functions back to the A chip and servo micro so that they can monitor what the CDM2 is doing.

1.3 Decoder PCB

The decoder PCB carries the majority of the CD player circuitry together with the power supplies. Key to the operation of the player is the servo microprocessor which initiates start-up, track jumping and searching in the CDM2. It also has a certain degree of control over the A chip. In turn the A chip provides decoded Q channel data (disc time and track no. information) back to the microprocessor. The servo micro is also in two way contact with the control micro via the I2C bus which can request this Q channel data for display purposes. The servo micro can also receive commands from the control micro (e.g. start\stop\go to track 7). In this situation the control micro merely passes on an instruction it has received from the keyboard or remote control receiver. On receipt of this instruction the servo micro carries out the appropriate routines for the instruction.

The A chip demodulates the HF signal from the CDM2 into digital form, performs a series of decoding / eror correcting functions on the data using the 64k DRAM as working space. It finally outputs a serial data stream containing the 16 bit audio samples (left and right alternately) to the B chip. The A chip also passes the Q channel data extracted in the decoding process to the servo micro as mentioned earlier. The A chip also governs the speed of the turntable motor by comparing the rate of data read off the disc with the master clock frequency then increasing or decreasing the turntable speed for the required data rate.

The B chip takes the recovered 16 bit audio samples from the A chip. It can "fill in" up to 8 missing samples, attenuate by 12 dB's or mute the digital audio signal under control of the servo micro. The audio samples then pass through a 4 x upsampling digital filter and finally leave the B chip at 4 x the input data rate to go to the DAC. The B chip also containes an encoder and driving circuit for the serial digital output socket.

The DAC I.C. contains two 16 bit DAC's. The input data is separated to left and right DAC's and is converted into an output current (not voltage) proportional to the 16 bit data samples.

The clock circuit has its own stabilised supply and outputs two frequencies, 11.2896 MHz to the B chip (which passes it on to the A chip) and half this frequency to the DAC.
All decoding and digital signal processing is directly controlled by this clock frequency.

The low pass filter is a discrete transistor design with its own "clean" discrete regulator power supply. Because of the current output from the DAC the input to this filter is virtual earth (low impedance). The filter removes unwanted ultrasonic signals produced by the digital to analogue conversion process and is in 2 stages and has an output mute relay.

Power supplies are both regulated and unregulated. Regulated supplies are used for all I.C.S. and the audio (LPF) stages. Unregulated voltages are used for the servo drive circuits on the CDM2 and for a zener regulated supply on the display PCB. The headphone amplifier is also powered from the unregulated supply.

1.4 Control PCB

The control PCB carries the control microprocessor, the front panel keys and the motor drive circuitry for the tray motor.

The control micro's function is to scan the front panel keys for commands and to interpret any incoming data from the remote receiver for commands to pass on to the servo micro. The micro also operates the tray motor via the motor drive circuit when required. Display data is sent in serial form from the control micro to the display PCB.

1.5 Display PCB

The display PCB contains a number of ICs to decode the serial data from the control micro into a parallel form to drive the display segments and LED's. The remote receiver circuit is also located at one end of the PCB. Power supplies and signals to and from the PCB travel via an 8 way link between the display PCB and the control PCB.

1.6 Headphone PCB

The headphone PCB carries the output level control and headphone drive circuit. Audio signals from the low pass filter pass through the level control then back to the variable output on the main PCB. The level control also adjusts signal level to the headphone drive circuit.

N.B. It is useful to refer to the service information for a recent Philips based player for details of signals and typical waveforms.

The Decoder Board

Power supplies

The centre-tapped power transformer produces two sets of unregulated supply rails after rectification; +/- 12V at high current and +/- 20V at lower current. From these four rails a series of regulated supplies are derived for different parts of the circuitry. These are detailed in the table. I.C. voltage regulators are used for all but the audio supply which uses discrete regulation circuitry.

Discrete audio supply circit (+/- 11V)

For the positive rail a current source made up of Q201, Q202 biasses Q204 on until the output voltage on the emitter is sufficient to switch on Q203 via the zener D205. Q203 then robs current from the base of Q204 so that a stable output voltage is obtained. This output voltage will be equivalent to the zener voltage plus the base-emitter voltage of Q203; approxmately 10.7V. The negative reglator operates in an identical mode.

Crowbar and mute circuits

Q302 and zener D306 act as a crowbar circuit on the -6V rail. Should the +5V fail Q302 switches on and lowers the -6V rail to protect circuitry from damage caused by loss of the +5v supply.

The audio output mute circuit consists of a relay driven by Q209. On switch on, rectified a.c. via D207 and R209 gradually charges up C216 until after about 3 seconds the voltage is sufficient to switch on Q209 and hence the relay. On switch off Q209 immediately releases the relay and the audio output is muted.

The mute ciruit is there to prevent switch on and switch off surges from creating audible annoyance.

Abbreviations

DAAB	Data A to B
CLAB	Clock A to B (1.4112MHz)
WSAB	Word select A to B
DABD	Data B to DAC
CLBD	Clock B to DAC (5.6448 MHz). Sourced direct from the precision clock circuit in the Delta 70.
WSBD	Word select B to DAC

LIST OF ABBREVIATIONS

CIRC	Cross Interleaved Reed - Solomon Code.
CDM2	Model number of the disc playing unit.
DRAM	Dynamic random access memory. Re-useable memory.
DAC	Digital to Analogue converter.
EFM	Eight to fourteen modulation. Sixteen bit audio samples are split into two 8 bit words which in turn are coded into 14 bit words incorporating error detection bits before encoding onto the disc.
FIFO	First in First out. Serial buffer in one section of the DRAM where data from the disc is read in one end then read out at the other. A "reservoir" for data that absorbs differences between the rate that data comes off the disc and the master clock frequency.
FRAME	Block of 588 bits of data on the disc containing 12 x 16 bit samples (6 left and 6 right) including error correction, synchronisation and sub coder.
OPU	Optical Pickup Unit. Optical assembly or "light pen".
RADIAL	Movement across the disc.

Subcode Processing

Subcode, which includes track, index, and time data is decoded from the H.F. signal within the A chip. The information is passed from the A chip to the servo micro by QDA, QCL, QRA. The servo micro in turn passes this information onto the display micro via the I2C bus.

Digital output

All coding for the digital output DOBM is done in the B chip. Subcode data SDAB from the A chip is combined with audio samples into a specified format and output via an impedance matching network and isolation transformer to the rear panel socket.

QDA	Q code data (time and track information)
QCL	Q code clock
QRA	Q code request/acknowledge (handshake line)
SCAB	Subcode clock A to B
SDAB	Subcode data A to B

Master Clock

This circuitry is additional to the Philips 16 bit I.C.s and unique to the Arcam Delta 70. All decoding, motor control, oversampling and audio data rate within the A, B and DAC I.C.s is synchronised to this clock. The clock circuit relaces the crystal normally connected across pins 10 and 11 of the B chip.

An 11.2896 MHz crystal oscillator based on two inverters in IC306 is connected to pin 11 of the B chip. A buffer within the B chip in turn passes this clock signal from pin 9 into pin 19 of the A chip.

The master clock circuit also outputs a half rate (5.6448MHz) stable clock frequency to the DAC.

Power supply for the master oscillator is separately stabilised to +5.5V from the +20V rail by use of the precision adjustable zener IC311.

A signal directly representative of the track information on the disc, the H.F. signal, enters pin 25 of the A chip. This signal is cleaned up and a clock waveform extracted from it by use of a phase locked loop. The loop filter network is on pin 22 and the clock frequency (which can be useful for syncing a scope to examine the H.F. signal) appears on pin 27. Data buffering and error correction is undertaken in the DRAM. Audio data is transferred to the B chip on the DAAB line. The clock for DAAB is CLAB and Left/Right data words are defined by WSAB. Erroneous data is flagged by EFAB.

The B chip can interpolate erroneous data and contains digital attenuation and mute circuitry controlled by the servo micro. Four times oversampling digital filtering means that data leaving the B chip to the DAC (DABD) is at four times the rate as DAAB input. The signals DABD, CLBD, WSBD have the same relationship with each other as DAAB, CLAB, WSAB but at 4 x the frequency.

In the Arcam Delta 70, CLBD is not connected to the DAC as is normal for Philips/Marantz players. Instead, an identical but more stable clock for the DAC is provided by the master clock circuit, IC306, 307.

The DAC requires 3 supplies to operate correctly, +5V, -6V, -15V. Also a series of averaging capacitors for the bit-switches in each channel of the DAC are necessary for good linearity and low distortion. Left and Right audio samples on DABD are separated by use of WSBD and are decoded to become an output current to the audio stages, proportional to the value of the audio samples. Note that this current output means that it is not possible to directly moniter this output point with an oscilloscope. The first audio stage must be use to convert this current to a measureable voltage.

Audio stages

The audio output filter/amplifier is in two stages. The first stage consisting of Q1-Q7 takes the output current from the DAC into the base of Q1 and converts it to a voltage on the collector of Q5. Q1 and Q2 form a long-tail pair with Q5 as the output amplifying stage. Q3/4 and Q6/7 are two current sources. The feedback network from the collector of Q5 back to the base of Q1 determines the amplifier gain. R10 sets the gain in the audio band while C4 progressively reduces it above 20KHz, this being the first stage of filtering. A network consisting of R13, C5, C6 can be switched in to provide a de-emphasis rolloff in the audio band for discs with pre-emphasis. FET Q12 is used as a switch for the deemphasis circuit.

The second stage is a two transistor pair, Q8/9 with current source Q10/11. Audio band gain is set by R19/20. Outside the audio band the stage acts as a 2 pole filter set by R15/16 and C7/8. This filter, combined with the first stage roll off forms a 3 pole Bessel characteristic linear phase filter, - 3dB point set at 35KHz.

IC1 with C10 forms an integrator with high d.c. gain and acts as a D.C. servo so that the D.C. offset on the output stage is very low. For this reason IC1 is an LF411 CN op amp with very good offset specification.

The audio output is shorted by RLA1 until the audio stages have stabilised on switch on. This delay period is set by a time delay in the mute circuit.

Display functional description

Subcoded data from the servoprocessor is read by the keyboard processor which prepares the relevant parts of data for the display. Data is sent to the display circuit via the control bus in non-acknowledge mode when data enable is low.

Input data format

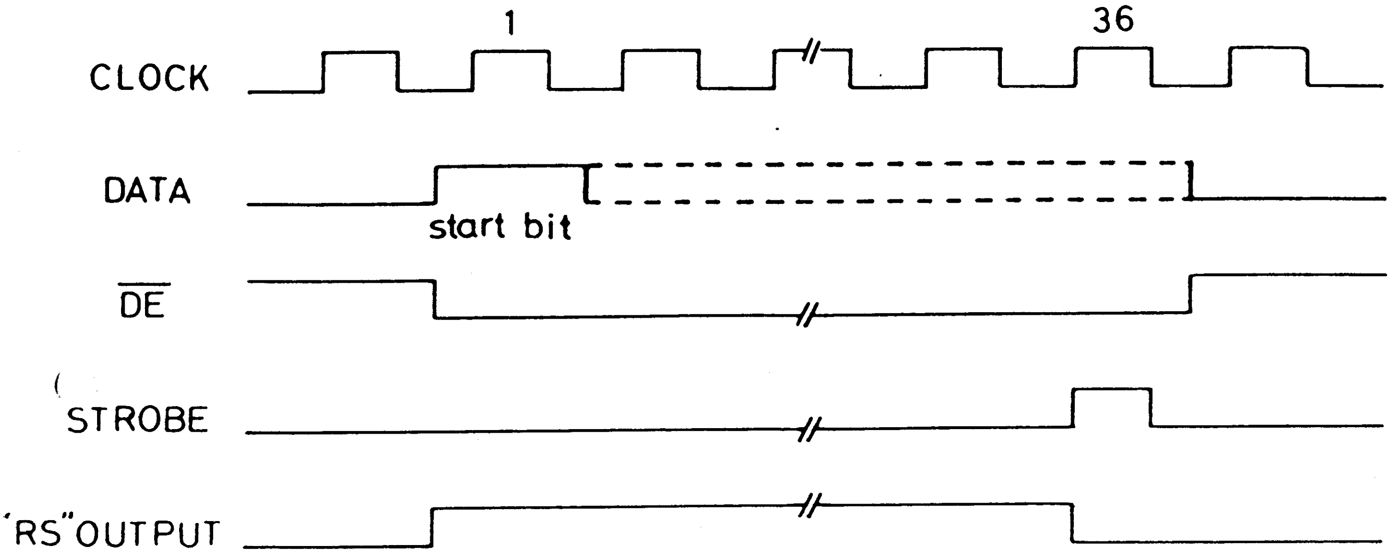
The display serial data is made up from two signals,serial data and clock.
Using a format of a leading "1" followed by the 35 data bits allows data transfer without an additional load (strobe) signal.
The 35 data bits are latched after the 36 data bit is complete.
The display changes only if the serial data bits differ from the previous time.

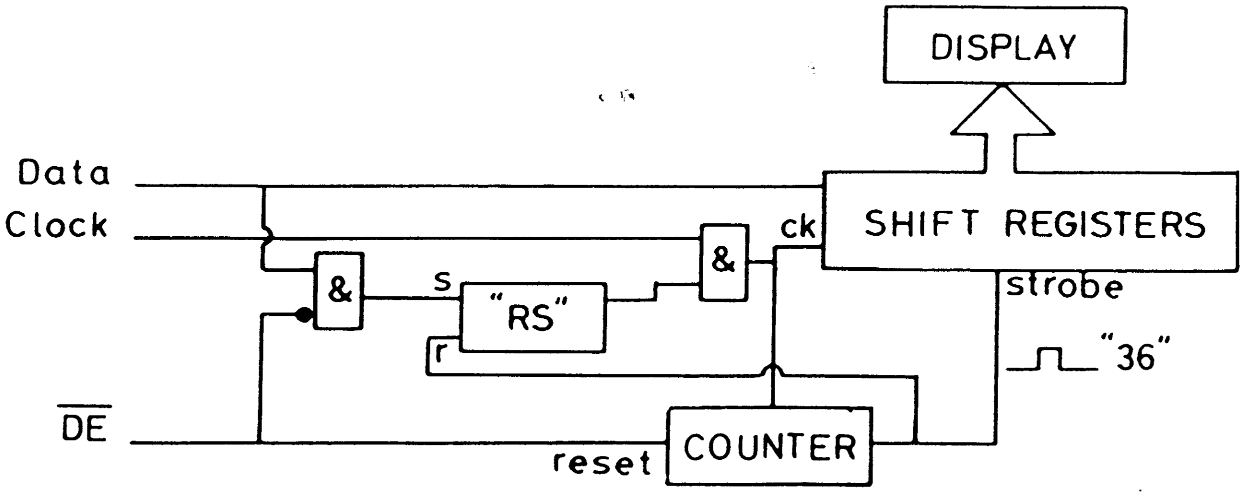
The timing diagram shows the start bit "1" preceeded by the 35 bits of data. At the 36 clock strobe signal is generated by a BCD counter & some logic. at the same time as the clock which loads the 35 bits of data into the shift registers when latched drive the display.
At the same time as the strobe going high the output of the RS bistable goes low which stops the clock until the next start bit is present.
The BCD counter is reset when data enable goes low.

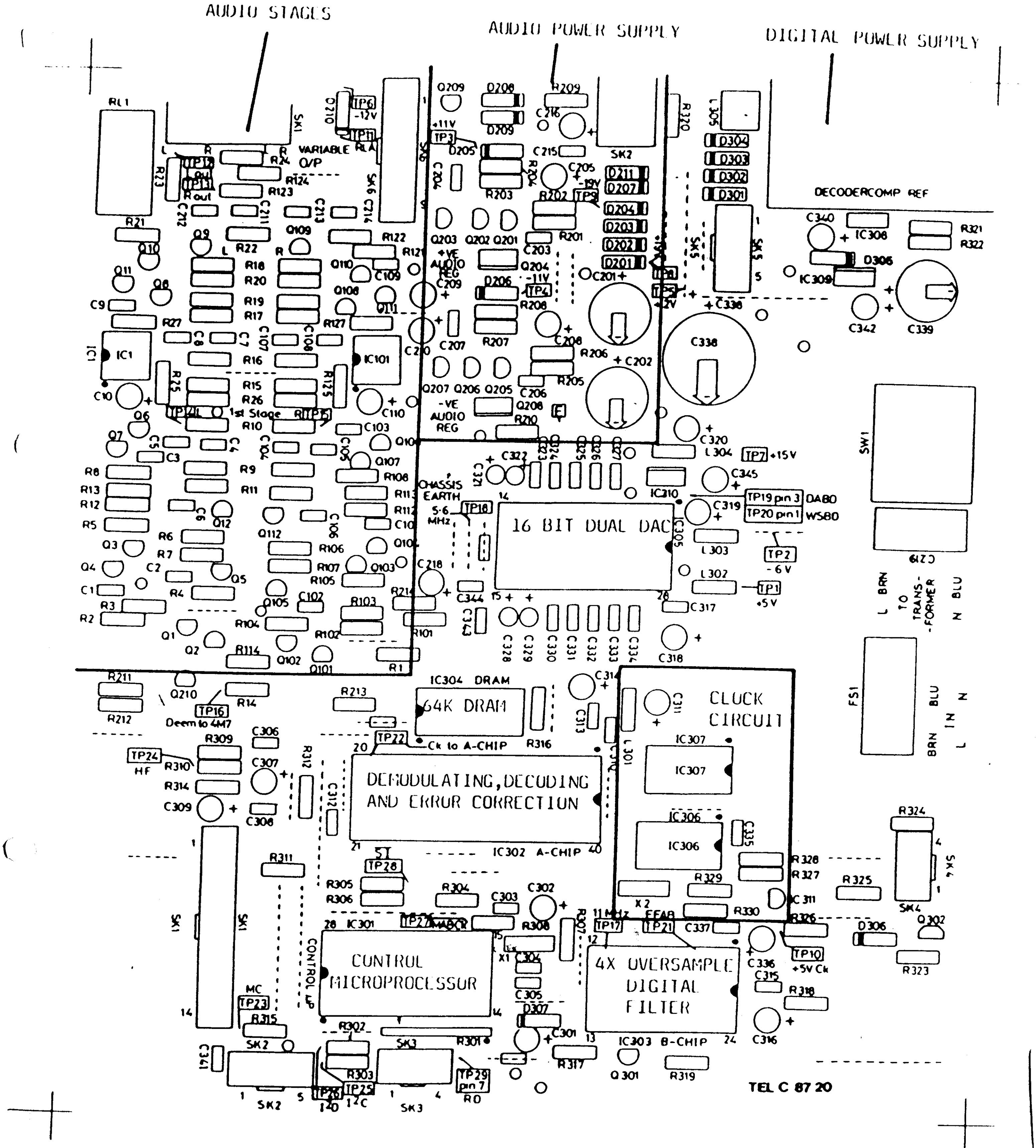
3. CDM2 - DECODER SIGNALS

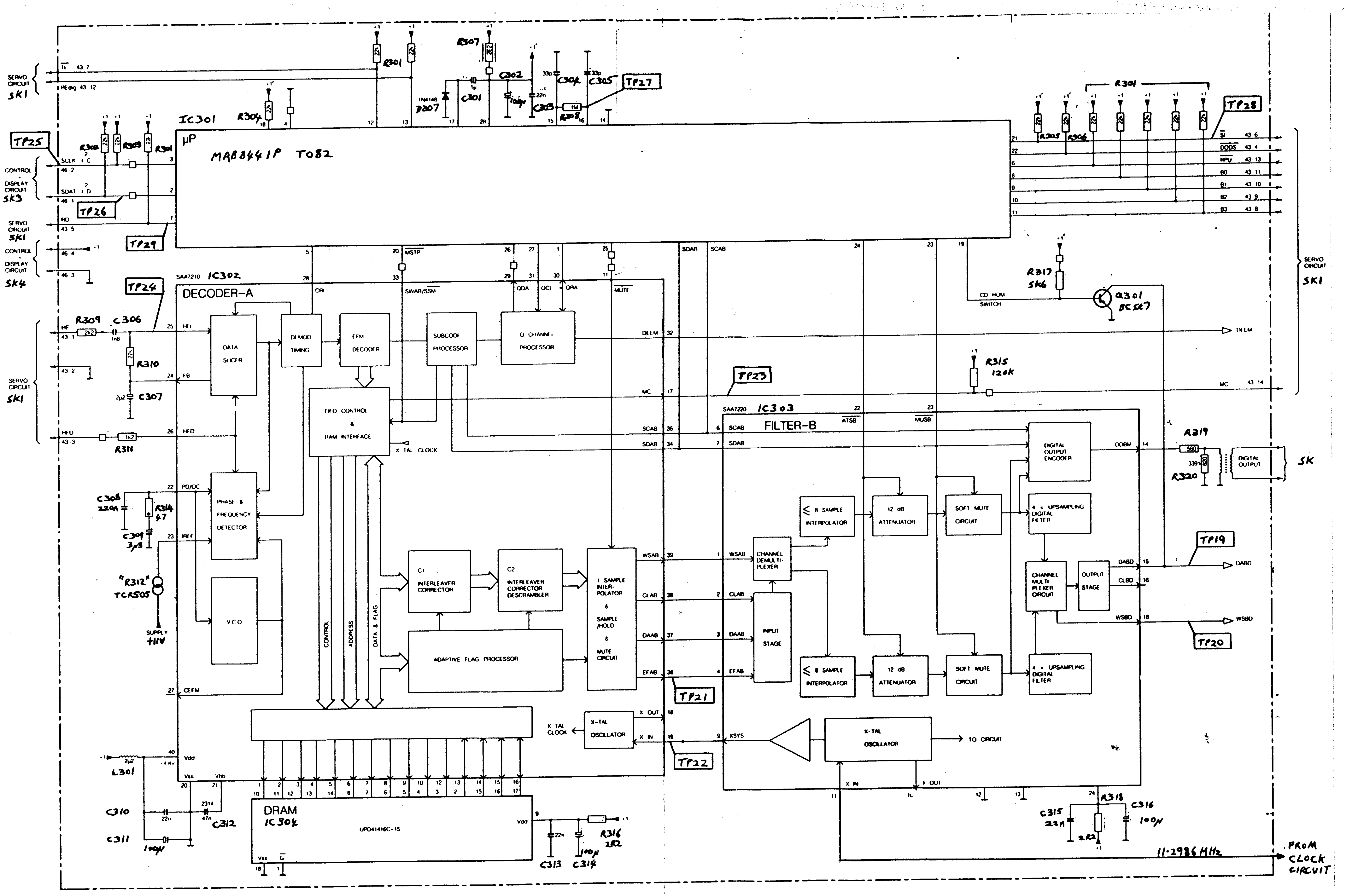
Signals between the CDM2 and Decoder board

$\overline{\text{SI}}$	Start Initialise - switches on the laser and focus circuit.
RD	Ready - signal from CDM2 that the laser is on and that the mechanism has found focus.
TL	Track Loss - signal from CDM2 that it has jumped off track. Outputs a pulse every time a track is crossed, so can be counted by the servo micro to tell where the pickup is.
RE dig	Radial Error digital - Indication of radial error signal in digital form. Indicates to the servo micro if the light pen is moving from the inside of the disc to the outside by making a 0 - 1 transition or outside to inside by making a 1 - 0 transition.
DODS	Drop out detection supression. When the servo micro detects that the signal from the disc has been lost (i.e. a dropout of data) it sets this line low. The line clamps the AGC of the photodiode amplifier to its present level until signal is restored.
RPU	Radial Pulse. Used by the servo micro to alter the gain of the radial control amplifier depending on whether there is local control of the radial position (Radial Error processor I.C.) or control by servo micro using the 4 bit DAC.
B0-B3	4 Bit control lines from the servo micro to the internal DAC in the Radial Error Processer I.C. Used by the servo to move the lightpen to the inside or outside of the disc and at what velocity.
H.F.	High Frequency signal. An amplified signal from the photodiods reading the information off the disc.
HFD	High Frequency Dropout - signal from the CDM2 to the A chip that a dropout in signal has occurred. Automatic level setting in the data slicer and phase detector in the A chip are clamped to their present level on receipt of this signal.
M.C.	Motor control. This is a high frequency square wave for control of the turntable motor speed and direction. As a 1:1 mark\space square wave (i.e. a mean D.C. level of 50%) the motor is stationary. If the M\S ratio alters so that the mean level rises then the disc will rotate clockwise (from above), the normal direction for playback. If the M\S ratio causes the mean level to fall below 50% then the turntable will turn anticlockwise. Speed is governed by how far the mean level is from 50%. ("Hyperdrive"occurs when the M.C. signal is faulty and is at either 0V or +5V.)


1
36
CLOCK
DATA
start bit
DE
STROBE
"RS" OUTPUT

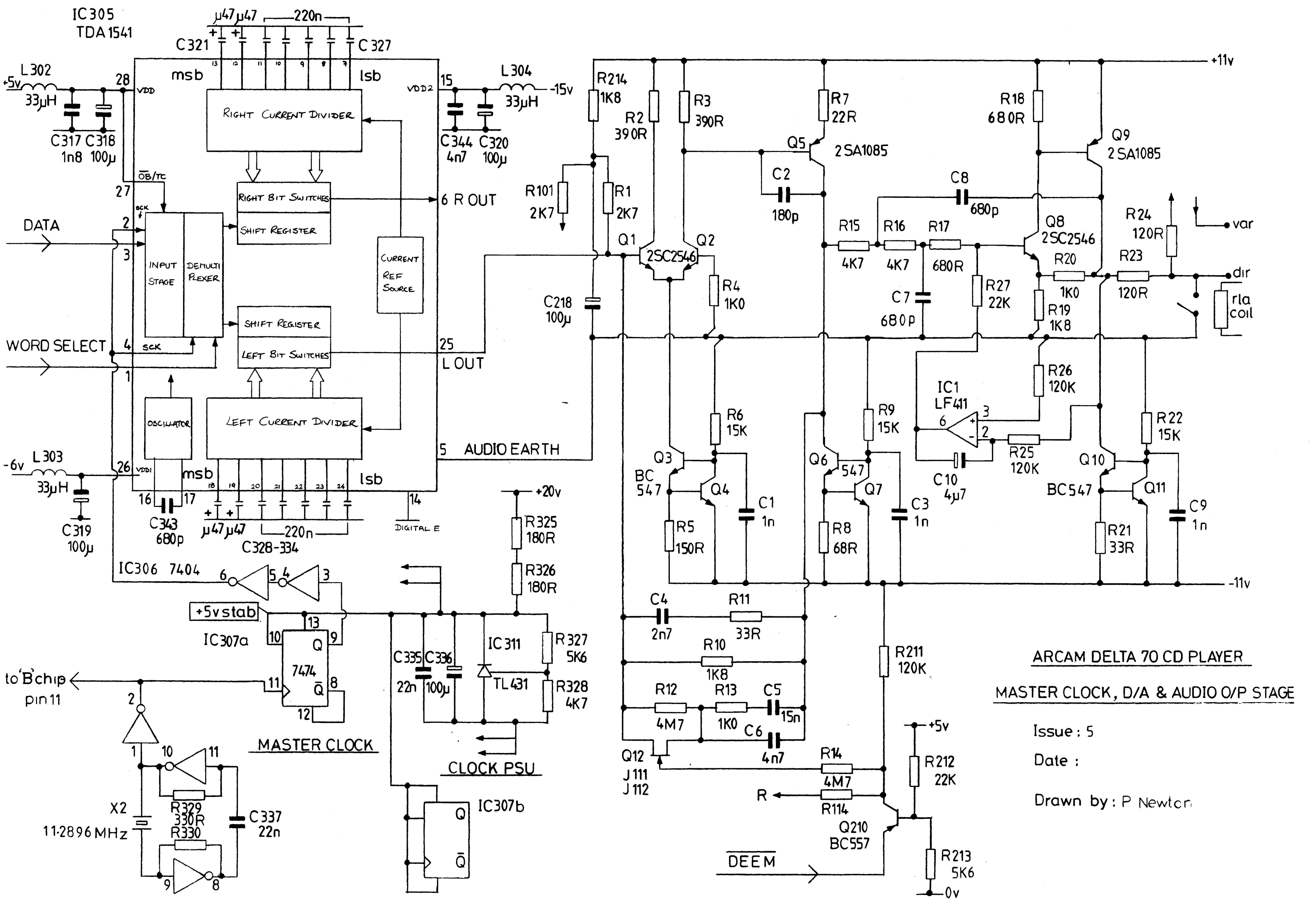

DISPLAY
Data
Clock
ck
SHIFT REGISTERS
&
&
s
"RS"
r
strobe
"36"
DE
COUNTER
reset


AUDIO STAGES
AUDIO POWER SUPPLY
DIGITAL POWER SUPPLY
RL1
SK1
VARIABLE O/P
TP6 -12V
TP11 RLA
TP12 L out
TP13 R out
SK6
+11V
TP3
Q209
D208
D209
R209
C216
C215
SK2
R320
D305
D304
D303
D302
D301
DECODERCOMP REF
-19V
TP9
D211
D207
D204
D203
D202
D201
+VE AUDIO REG
Q203 Q202 Q201
Q204
-11V
TP4
TP8
TP5
+12V
SK5
C340
IC308
R321
R322
D306
IC309
C342
C339
C338
C201
C202
IC1
IC101
1st Stage
TP14
TP15
-VE AUDIO REG
Q207 Q206 Q205
Q208
R210
SW1
C320
L304
TP7 +15V
C345
IC310
TP19 pin 3 DAB0
TP20 pin 1 WS80
CHASSIS EARTH
5·6 MHz
TP18
16 BIT DUAL DAC
C305
L303
TP2 -6V
L302
TP1 +5V
C317
C219
L BRN TO TRANS-FORMER N BLU
C318
FS1
BLU N BRN L IN
R211
Q210
TP16 Deem to 4M7
R212
R213
IC304 DRAM
64K DRAM
R316
C314
C311
CLOCK CIRCUIT
IC307
IC306
TP22 Ck to A-CHIP
TP24 HF
R309
R310
R314
C307
C309
C306
C308
R312
C312
DEMODULATING, DECODING AND ERROR CORRECTION
IC302 A-CHIP
L301
C313
C335
R324
SK4
R325
R328
R327
R329
X2
R330
C311
R326
D306
Q302
R311
TP28
R305
R306
R304
C303
C302
R307
11 MHz TP17
EFAB TP21
C337
TP10 +5V Ck
C336
C315
R323
SK1
CONTROL µP
IC301
TP27 MABCK
R308
X1
C304
C305
CONTROL MICROPROCESSOR
4X OVERSAMPLE DIGITAL FILTER
R318
MC TP23
R315
D307
C301
C316
R302
R301
SK3
C341
SK2
R303
TP26 I²D
TP25 I²C
TP29 pin 7 RO
R317
IC303 B-CHIP
Q301
R319
TEL C 87 20



A+R DELTA 70 DECODING SECTION

DECODER PCB ISS 2 3.3.88



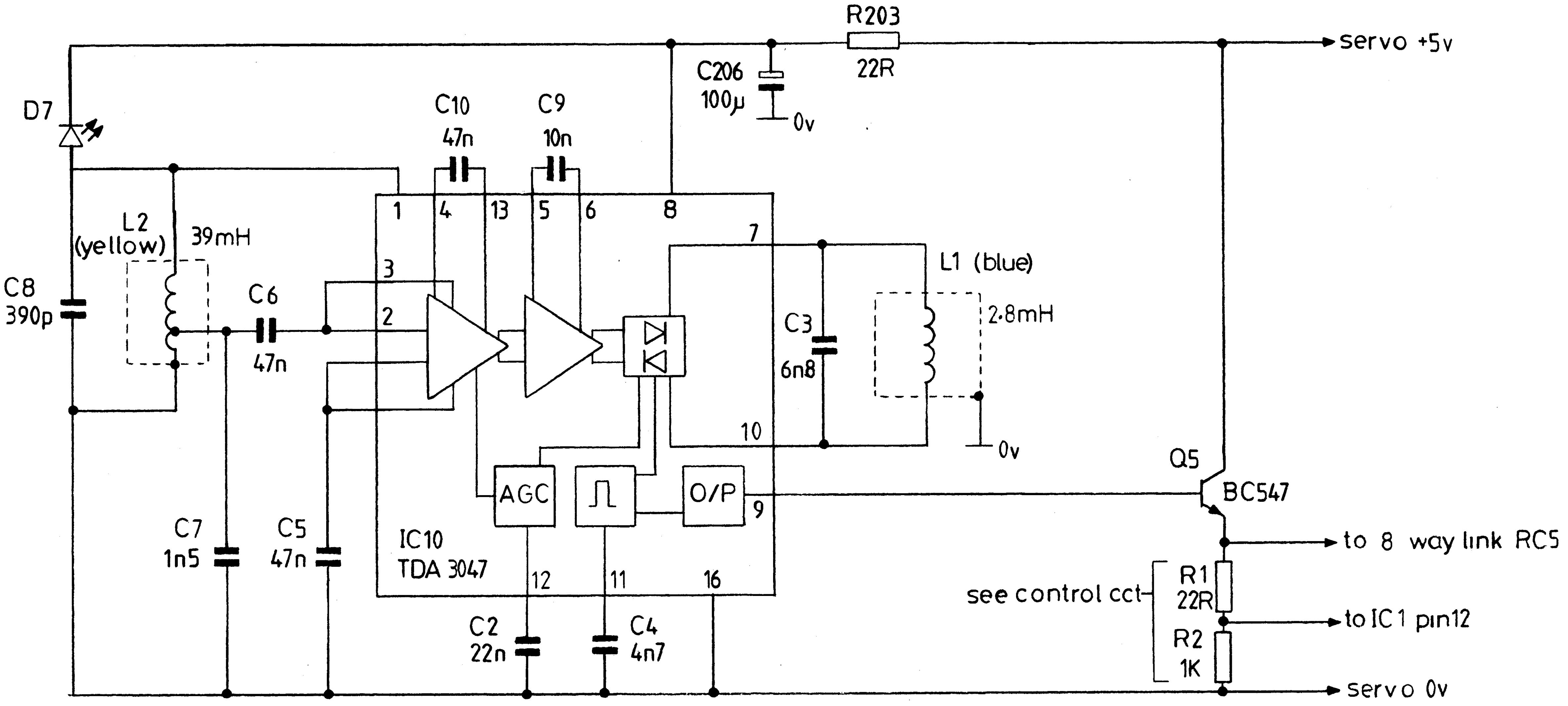
ARCAM DELTA 70 CD PLAYER

MASTER CLOCK, D/A & AUDIO O/P STAGE

Issue : 5

Date :

Drawn by : P Newton



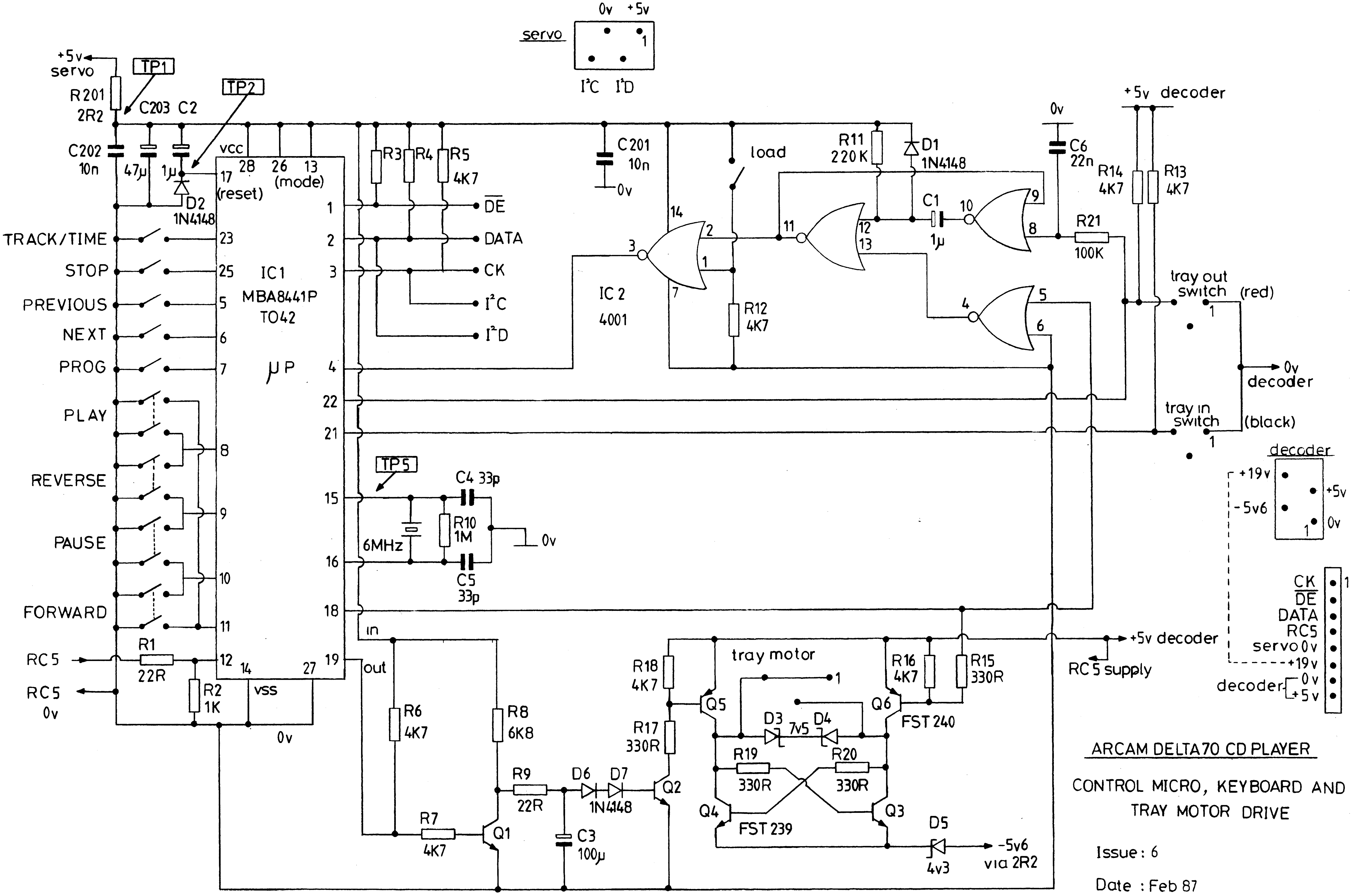
ARCAM DELTA 70 C.D. PLAYER

REMOTE CONTROL RECEIVER

Issue: 5

Date :

Drawn by: P Newton



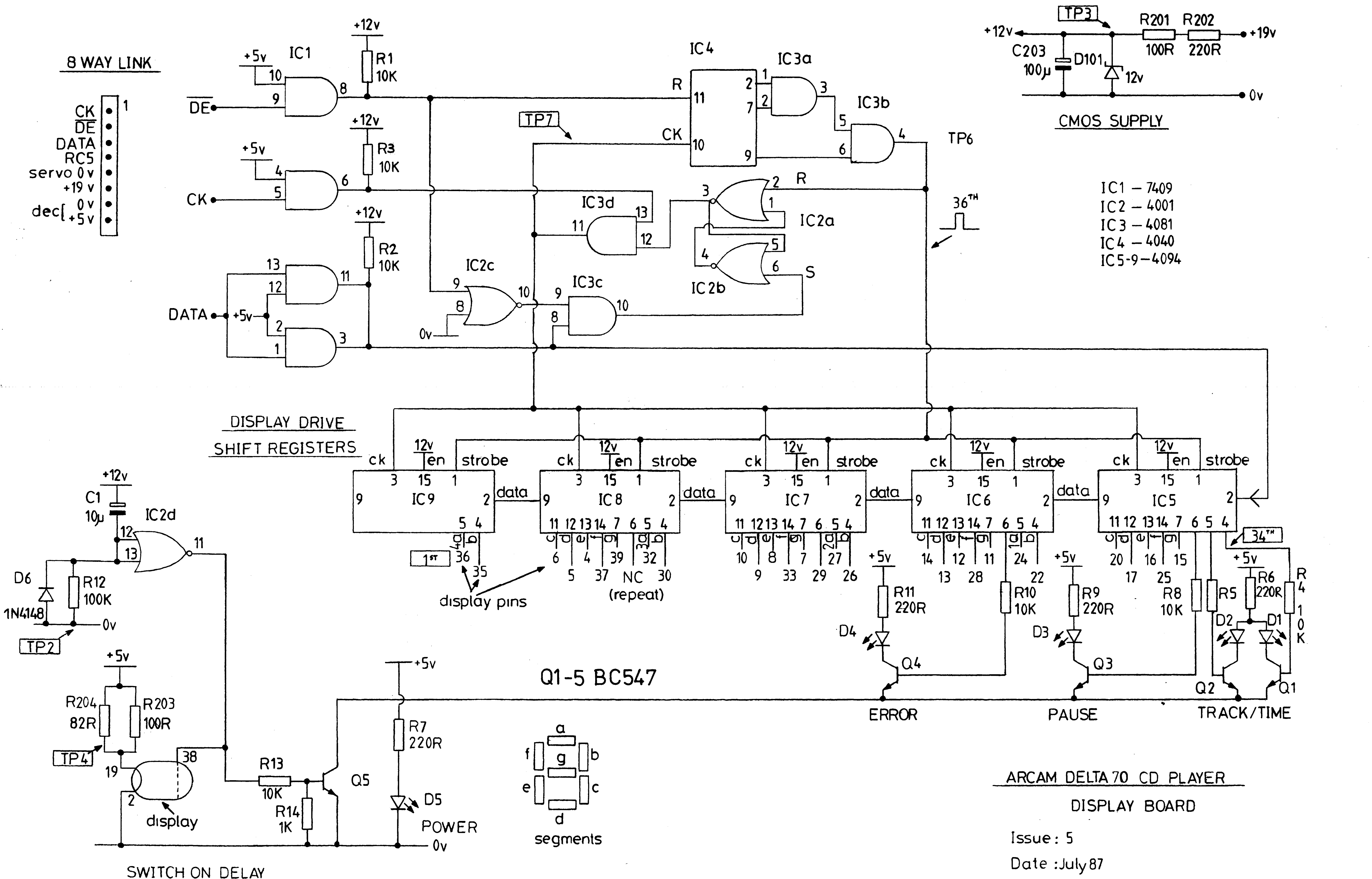
ARCAM DELTA70 CD PLAYER

CONTROL MICRO, KEYBOARD AND
TRAY MOTOR DRIVE

Issue : 6

Date : Feb 87

Drawn by : P. Newton



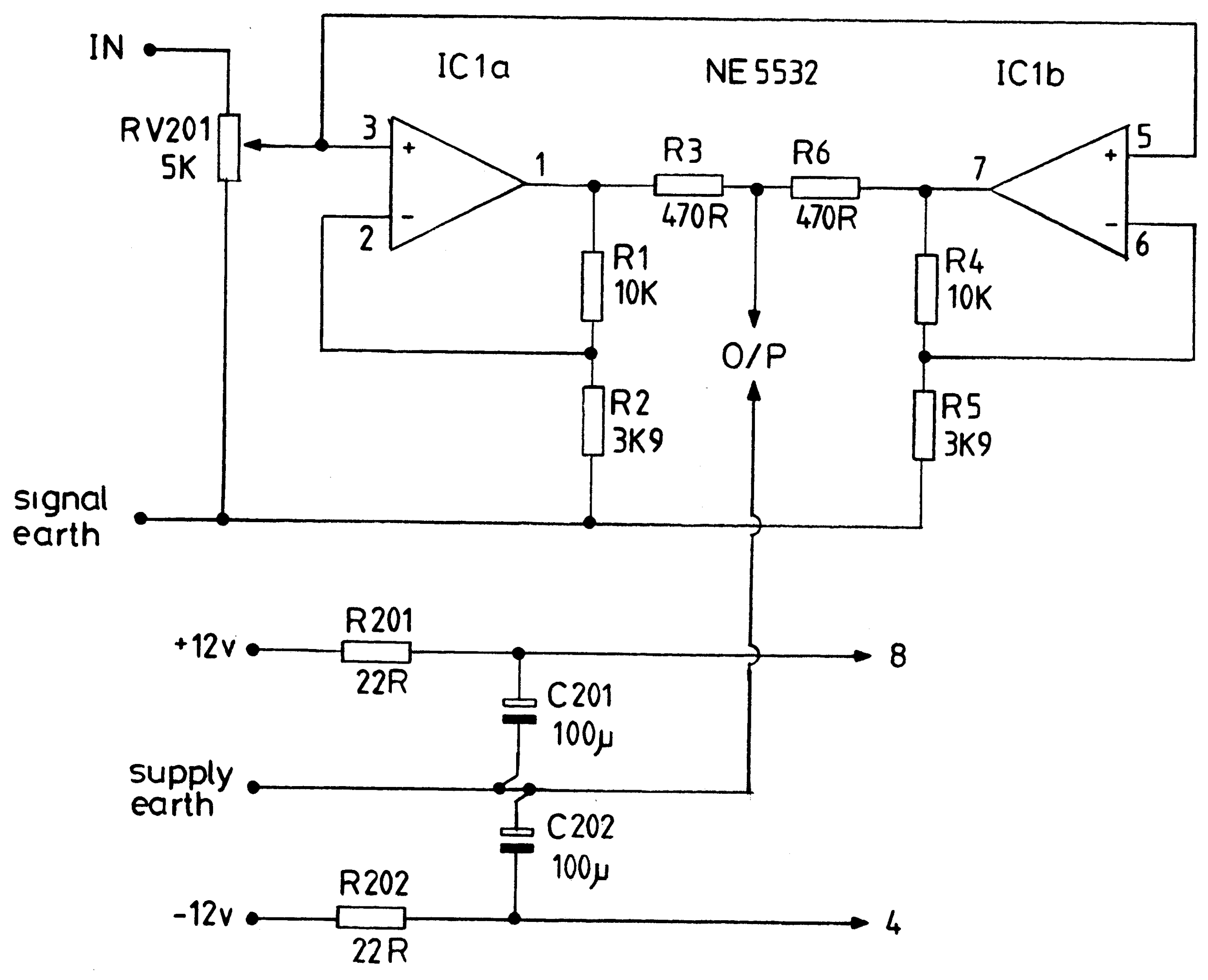
ARCAM DELTA 70 CD PLAYER

DISPLAY BOARD

Issue: 5

Date: July 87

Drawn by: P Newton



N.B.

ON ISSUE 3 HP BOARDS ONLY LEFT/RIGHT CHANNELS TRANSPOSED
FOR LHC COMPONENT REF
ADD 100 ie LHC = R104
RHC = R4

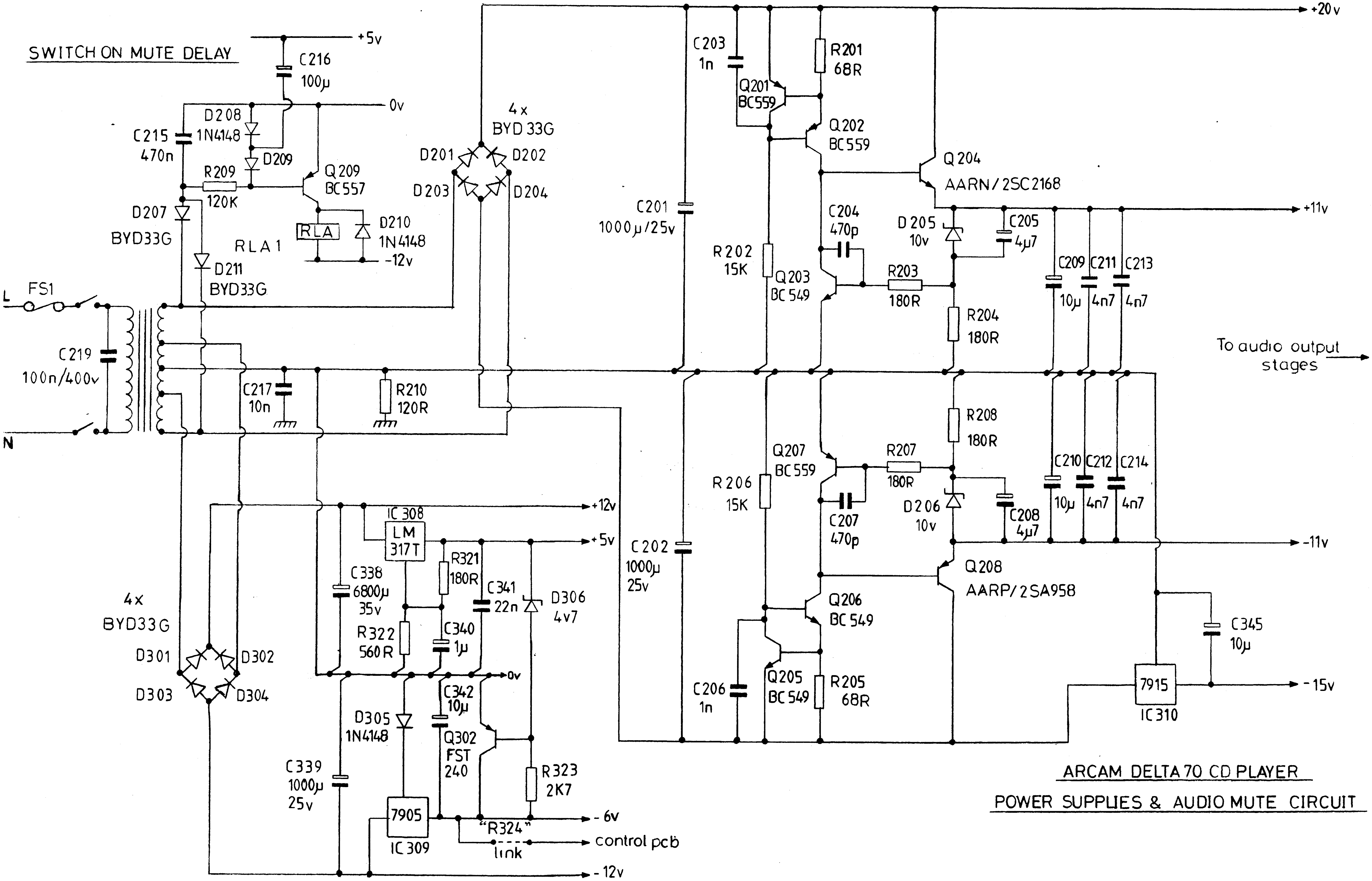
ARCAM DELTA 70 CD PLAYER

HEADPHONE BOARD

Issue: 3,4

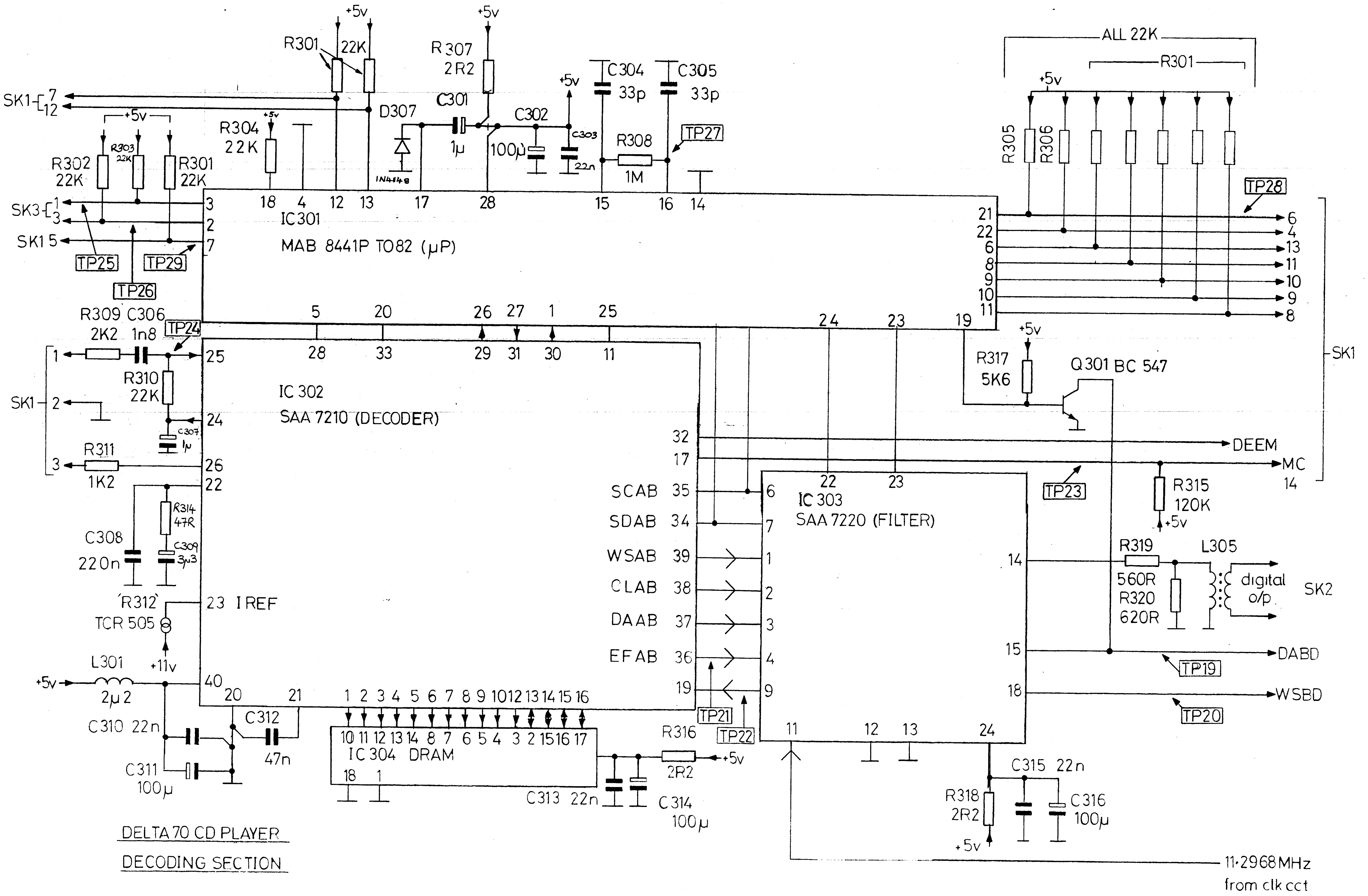
Date :

Drawn by: P Newton



ARCAM DELTA 70 CD PLAYER

POWER SUPPLIES & AUDIO MUTE CIRCUIT



DELTA 70 CD PLAYER

DECODING SECTION