

ARCAM

**DELTA 70.2/170
COMPACT DISC UNITS
SERVICE MANUAL**

ARCAM DELTA 70.2 / 170 CD PLAYER SERVICE MANUAL

Issue 1 February 90

Arcam Drawing No. H04/0006

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CIRCUIT DESCRIPTION

Disc Playing Mechanism CDM4 (CDM1 Mk II on Delta 170)

The CDM4 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 CDM4 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 CDM4 is doing.

Signals between the CDM4 and Decoder board

SI	Start Initialise - switches on the laser and focus circuit.
\overline{RD}	Ready - signal from CDM4 that the laser is on and that the mechanism has found focus.
\overline{TL}	Track Loss - signal from the CDM unit that it has jumped off track. Outputs a pulse every time a track is crossed, which are counted by the servo micro to determine 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.
\overline{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 Processor 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 photodiodes reading the information off the disc.
- H.F.D. High Frequency Dropout - signal from the CDM4 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 anti-clockwise. 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.)

Decoder PCB

The decoder PCB carries the majority of the CD player digital circuitry. Key to the operation of the player is the servo microprocessor, MAB 8441 T157, which initiates start-up, track jumping and searching in the CDM4. It also has a certain degree of control over the A chip (SAA 7210P). 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). 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 servo micro also controls tray in/out movements by use of the circuit consisting of Q4-Q7 and D3 and D4. The A chip demodulates the HF signal from the CDM4 into digital form, performs a series of decoding / error 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 (SAA 7220P/B).

The A chip also passes the Q channel data extracted in the decoding process to the servo micro as mentioned earlier. The A chip 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 12dB's or mute the digital audio signal under control of the servo micro. The audio samples then pass through a 4 x oversampling digital filter and finally leave the B chip at 4 x the input data rate to go to the DAC.

The B chip also contains an encoder and driving circuit for the serial digital output socket.

of the servo micro. The audio samples then pass through a 4 x oversampling digital filter and finally leave the B chip at 4 x the input data rate to go to the DAC.

The B chip also contains an encoder and driving circuit for the serial digital output socket. The decoder pcb also contains the display/control microprocessor, XC 86606P. The control micro's function is to receive commands from the display board and to interpret any incoming data from the remote receiver for commands to pass on to the servo micro.

Display data is sent in serial form from the control micro to the display PCB.

The decoder board contains 3 regulated supplies and 2 unregulated. One of the supplies is regulated to +5 volts and is used for the decoder and display pcbs and the other supplies are used to power the mechanism via a 5 way connector.

Display PCB

The display PCB contains a display drive and keyboard scan ic, remote control receiver and the display itself. Four AC supplies come from the digital transformer via a 4 way lead and two are used to power the display filament and the other two are rectified and regulated to 30V to power the ic. The display can be dimmed or turned off by use of switch 1. The brightness of the display is determined by the level of dc on the ac filament supply.

Transformer PCB

The transformer board contains two transformers, one for the powering the decoder and display boards and one to power the audio or optical board. It also contains the mains fuse and a full wave bridge rectifier, D1 - D4. Circuitry to provide a dc bias to set the display brightness is formed by ZD1, R1 and C2. The rectified rails, +/- 9v are used to power the decoder pcb and mechanism. The black transformer powers the audio or optical pcb dependant on the model.

Audio PCB (D70.2 only)

The audio board contains 5 regulated supplies, the DAC and audio circuits, the digital output, the master clock oscillator and the mute circuit.

Master clock

This circuitry is additional to the Philips 16 bit ic's and unique to the Arcam Delta CD players. All decoding, motor control, oversampling and audio data rate within the A, B and DAC ic's is synchronized to this clock. The clock circuit replaces the crystal normally connected across pins 10 and 11 of the B chip.

An 11.2896 MHz crystal oscillator based on two inverters in Z206 is connected to pin 11 of the B chip via the 14 way jumper lead to the decoder board. A buffer within the B chip in turn passes this clock signal out of 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 on pin 2.

Power supplies

The audio board is powered by its own transformer via a 3 way connector. The ac input is full wave rectified by diodes D201 - D204 and smoothed by the RC networks C201/R214/C202 and C221/R214/C222. This gives unregulated outputs of +20v and -20v. These are then used to supply the 5 regulator stages. The +/- 12v rails required by the audio stages are regulated by Q201 - 204 and Q205 - 208 with reference voltages provided by zener diodes D205 and D206.

The 3 supplies required for the DAC are provided by regulator ic's Z201 and Z204 for the +/- 5v rails and Z203 for the -15v rail.

Digital to Analogue convertor (DAC)

The DAC requires 3 supplies to operate correctly, +5V, -5V, -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 monitor this output point with an oscilloscope. The first audio stage must be used to convert this current to a measurable voltage.

The DAC in the D70.2 is a selected version of the TDA 1541A chip and so has "S1" stamped on to it.

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 de-emphasis circuit.

The second stage is a NE5534 IC, Z2. 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.

Z1 with C10 and C11 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 op amp with very good offset specification.

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Mute circuit

The audio output is disconnected on switch on, to allow time for the circuitry to stabilize, by the relay. This prevents thumps being transmitted to the amplifier. The circuit operation is explained below. On switch on rectified ac via D207,D211 charges up C224 until the voltage is sufficient to turn on transistors Q209,210 and energise the relay. On switch off Q209 turns off immediately and the relay opens.

Optical Board (D170 only)

The optical pcb on the D170 contains the master clock for the decoder board and also the circuitry required to provide both optical and co-axial digital outputs. The pcb is powered by it's own power transformer and 2 regulated +5 volt supplies are formed from it by the adjustable zener diodes,IC8 and IC9 and their associated resistor networks. A third +5 volt regulated rail is derived from the +12 volt supply which comes to the optical board via the 14 way jumper lead.

The master clock is based on the 11.2896 MHz crystal X1 and two of the inverters of IC3. This clock then passes through two more inverters of the same ic to provide sufficient current drive to supply opto-isolator IC2. R8 is a pull up resistor for the open collector output. It is then passed through one more inverter to clean the signal up before passing to the decoder board and pin 11 of the B chip.

Digital data from the decoder board (DOBM) passes through the parallel connected inverters of IC4 to drive the opto-isolator IC6. The data then passes through an inverter gate of IC7 and into the D-type latch, IC5. The data is clocked out on positive edges into the second half of the latch and is clocked out of this ic on negative edges. The output is fed into four parallel inverters to drive the transformer L2, for the co-axial digital output. R13,14,15 are used to limit the output level of the data. For the optical digital output data is fed direct from the bistable through an inverter to the optical transmitter IC10.

SIGNALS BETWEEN DECODER AND OUTPUT BOARD

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 70.2/170.
WSBD	Word select B to DAC.

CIRC	Cross Interleaved Reed - Solomon Code.
DRAM	Dynamic random access memory. Re-useable memory.
DAC	Digital to Analogue convertor.
EFM	Eight to fourteen modulation. Sixteen bit audio amples 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.

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PLACING THE DELTA 70.2/170 IN SERVICE MODE

To put the unit into service mode the player should be switched on with the following buttons pressed in:

Forward search (>>), Next track (>), Rem/Lap.

The display should now show just "0". This is the stand-by mode. In this state it is possible to move the arm by use of the forward and reverse search buttons. This enables a check to be made of the free movement of the arm across the disc.

Service Position 1

From position 0 the player can be put into position 1 by pressing the next track button (>). In this state the laser emits light and the objective tries to focus. When the focal point has been reached "1" appears on the display. If there is no disc in the machine the objective tries to focus 16 times and then goes back to service position 0. As in position 1 the arm can be moved by use of the search buttons.

Service position 2

This is reached by pressing the next track button after position 1 has been reached. The turntable motor starts to run and "2" appears on the display. The arm is sent to the centre of the disc in preparation for servicing position 3.

Service position 3

Reached by pressing the next track button after position 2 has been reached. The radial control is switched on and subcode information is ignored. $\overline{\text{MUSB}}$ is high so music information is released. The display shows "3".

(Dependant on the length of the lead in track music will be reproduced after approx 1 minute).

In this mode the arm can be moved by use of the search buttons but the motion is controlled by the uP and the arm moves in steps of 64 tracks as long as the button is depressed.

If the service position is disturbed (i.e. braking or removing the disc) the player reverts to the service position 0.

To get out of the service mode switch the unit off and on again.

CHANGE OF MAINS VOLTAGE

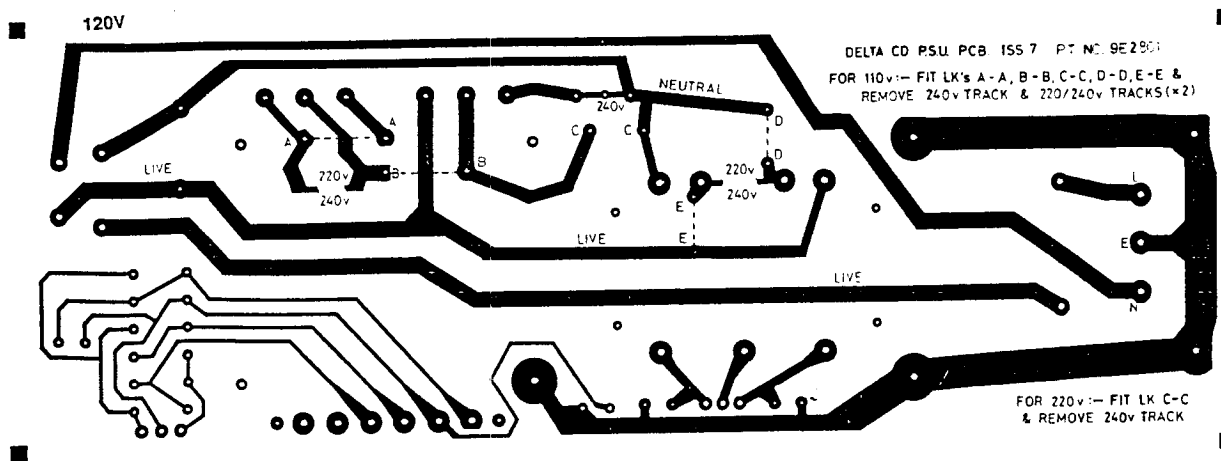
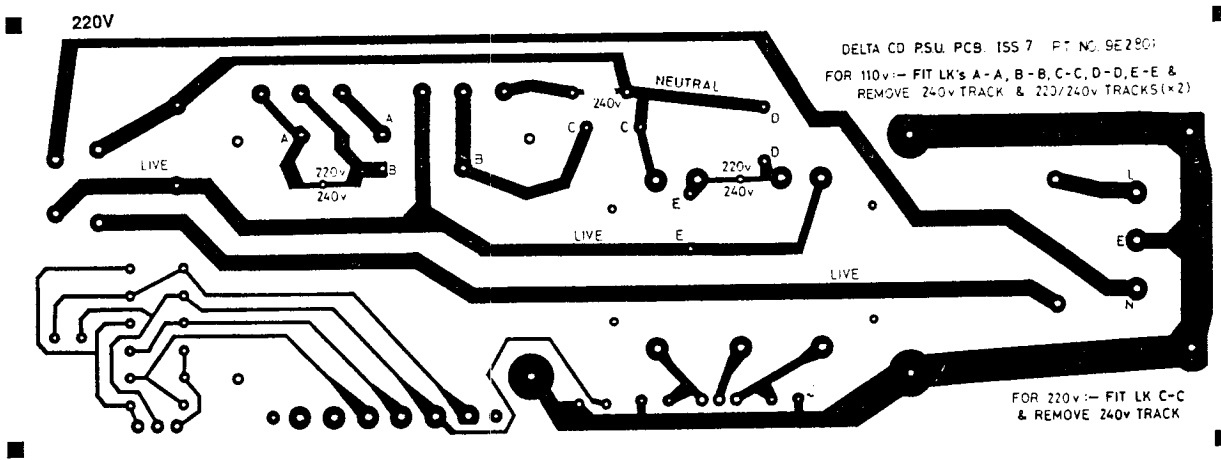
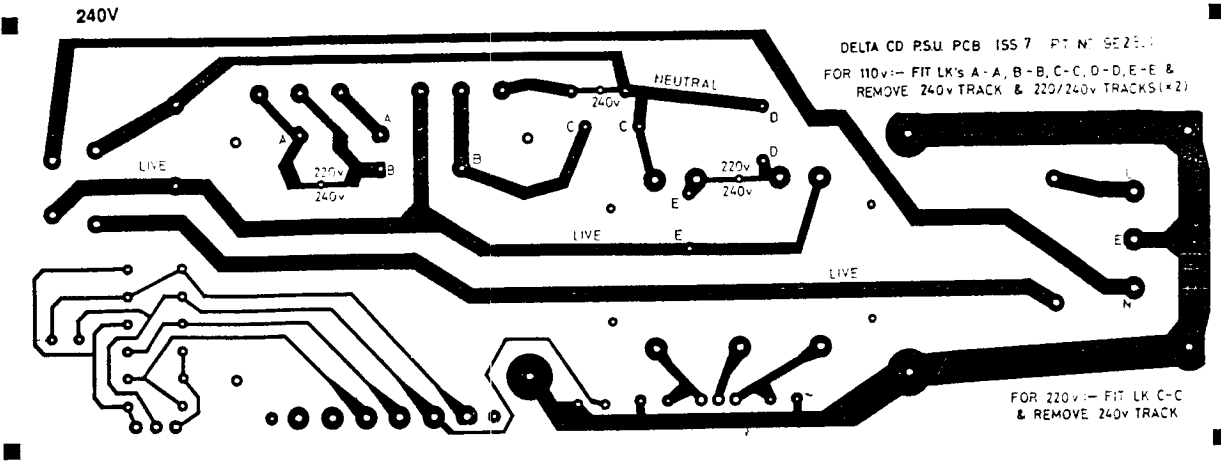
WARNING - The unit **must** be unplugged from the mains supply when changing the wiring or the fuse as the fuse and the mains inlet are at mains potential, even with the unit switched off.

The Delta CD players can be modified to work on other mains voltages by adding or removing links on the transformer pcb and if necessary replacing the mains fuse.

Remove the transformer board by undoing the 6 screws holding the board in place and pull off the button from the mains switch. Then remove all the connecting leads from the board noting where they go for replacing them later. Now modify the board by following the instructions on the underside of the board (which are duplicated overleaf).

Mains fuse rating: 240V/220V 315mA (T)
120V/110V 630mA (T)

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LASER AND FOCUS OFFSET ADJUSTMENT

Laser adjustment for CDM4/CDM1 MKII

Measure the resistance of R3105 + R3106 and adjust potentiometer R3106 so that the combined resistance is 1K ohms.

Put test disc 5 in the machine and press "Play". With a DC voltmeter measure the voltage across R3104.

This voltage should be less than 1260mV.

Check that HF is present. If not stop and analyse fault.

If HF is present play track 1 of test disc 5 and adjust R3106 so that the voltage across R3104 (TP1 and 2) is 50 mV.

Check that during the adjustment that the voltage across R3104 does not exceed 1260mV.

Focus offset adjustment

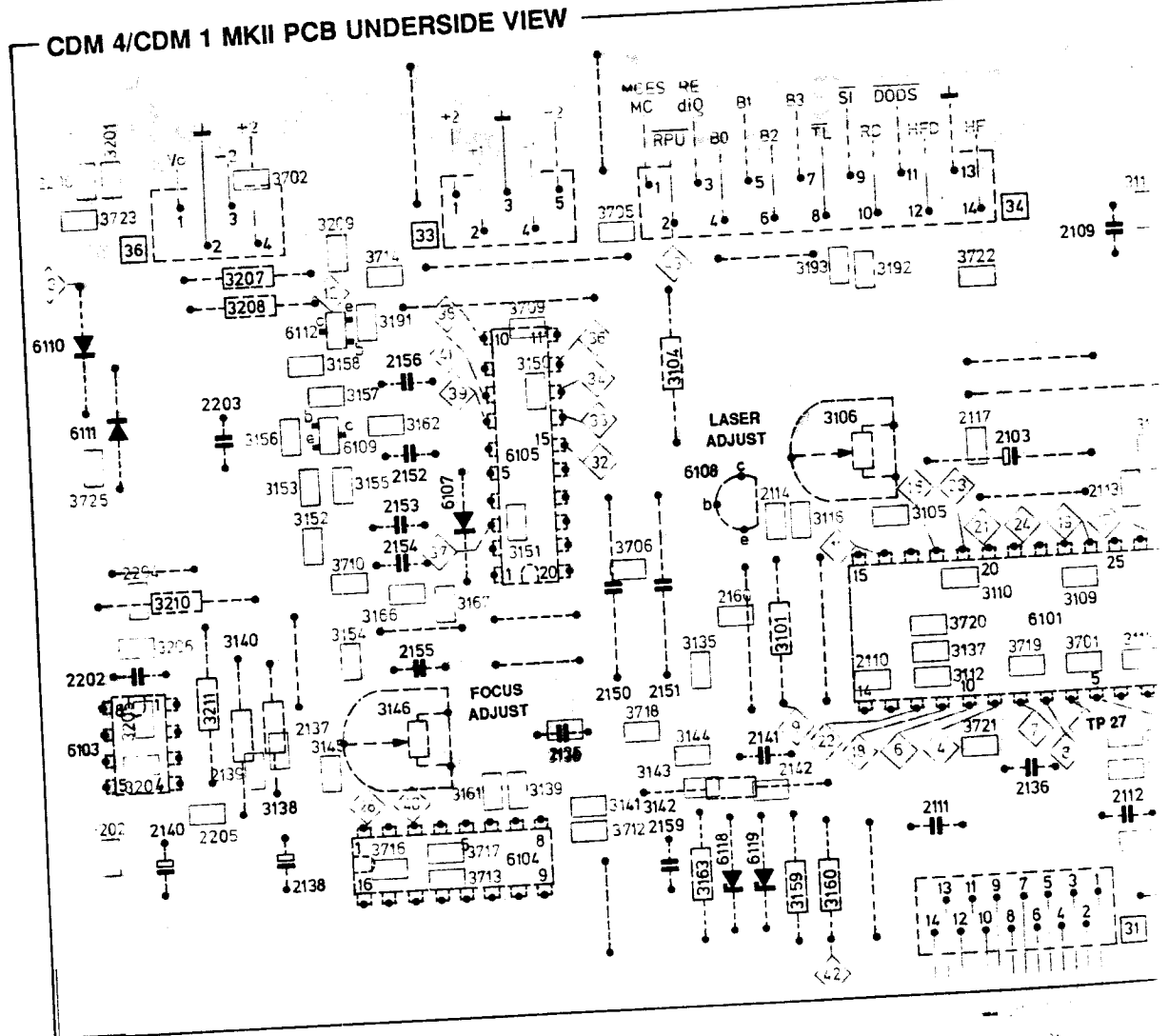
Coarse adjustment

Set potentiometer 3146 to mid position and test disc 5 in unit.

Bring the player to service position 1. The focussing motor can now start focussing when it has found the focal point "1" will appear on the display. If not then turn potentiometer 3517 a little clockwise or anti clockwise. No adjustment has to be carried out.

Fine adjustment

Bring the player to service position "2". Adjust potentiometer 3146 for a voltage of 400mV +/- 40 mV (TP27 and ground).



BOARD MODIFICATIONS TO 06/11/91

DECODER PCB - 3 issues

Issue 1

Issue 2 - Extra components added- R24,25,C32,33,D6 to improve tolerance to bad discs.

Issue 3 - Used in D70.3/170 only, (IC Z6 not fitted when used in D170), but can be retro-fitted in D70.2 if required.

AUDIO PCB - 3 issues

Issue 1

Issue 2

Issue 3 - D70.3 board (Bitstream). Can be retro-fitted in D70.2 if required for upgrade.

Early issue 1,2 boards had a white output relay with a 280R coil. Later boards have a blue relay with a 960R coil. To allow use of this relay the following components were changed- R211 changed from 390R to 1K, R212 changed from 220R to 390R.

OPTICAL BOARD - 3 issues

Issue 4

Issue 5 - Signals to IC5 were re-routed and a capacitor added in series with the crystal to provide a level 1 accuracy output. Can be retro-fitted to issue 4 boards.

Issue 6 - A variable capacitor was fitted instead of a fixed type to provide an adjustment of the clock frequency.

D70.3/ D170 SERVICE SHEET (to be read in conjunction with D70.2 manual)

Delta 70.3 s/n 5371 and D170 s/n 2351 onwards. (See additional circuits)

The Delta 70.3 uses the same mechanism as the Delta 70.2 and the circuitry on the decoder and audio pcbs is very similar to the Delta 70.2 circuits but utilising surface mount ic's and a bitstream DAC.

The A chip is the decoder ic SAA 7310 and the B chip the SAA 7321 and the additional ic PCF 3523 is used to provide a digital output as the SAA 7321 does not have this feature built in.

The audio pcb is very similar to the D70.2 audio board but with an ic replacing the first discrete stage in the D70.2 output stage. Z4 is used to amplify the output from the Bitstream DAC and Z5 and its associated components forms a low pass filter. Z6 is a DC servo to minimise DC offset on the output.

The Bitstream DAC (SAA7350) has 5 regulated supplies connected to it formed by adjustable zener diodes Z2,102,3,103 and also Z204.

The latch Z905 (74HC175) is used to clock through the WSBD,CLBD,DABD and DOBM signals through to the DAC and digital output as the system clock, (XSYS), advances.

The decoder pcb used in D170 's with serial numbers greater than 2350 is the same as the D70.3 decoder but with the SAA7321 chip removed as this is not required. The optical drive pcb and mechanism is identical to earlier units.

Note: The transformer and display boards are identical to the ones used in the D70.2.

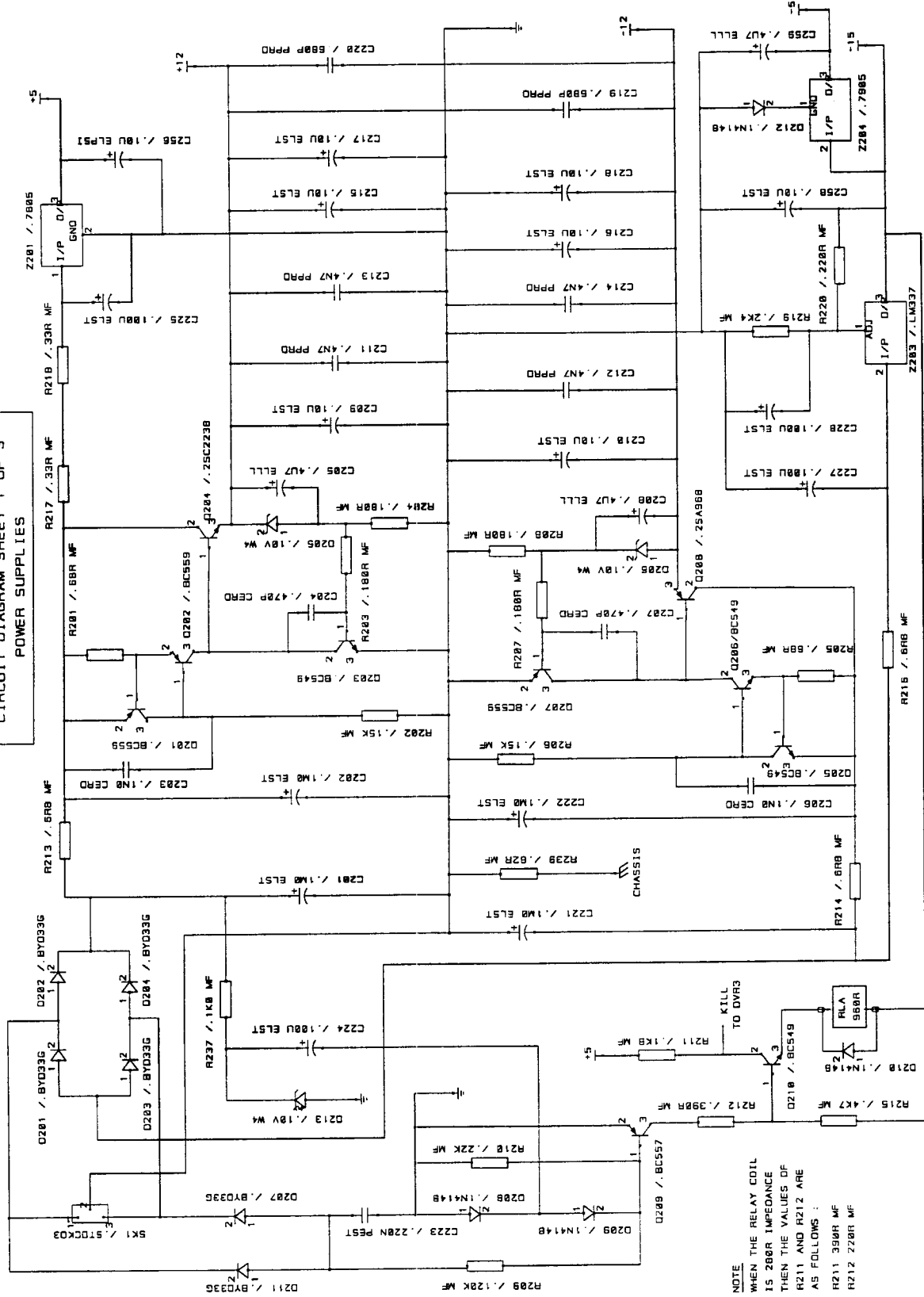
(Paul Newton 11/10/91)

CIRCUIT DIAGRAMS

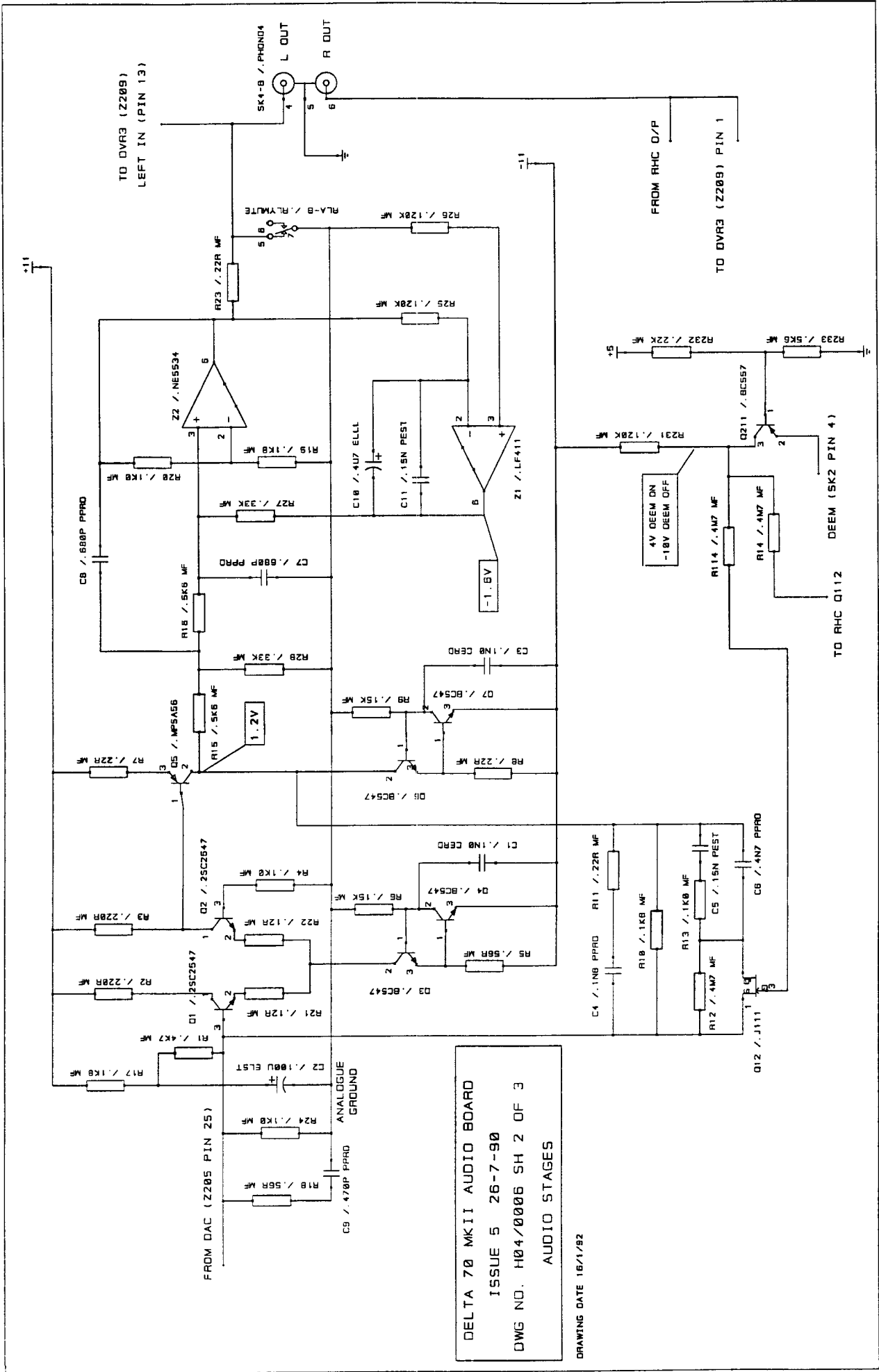
No.	Title of Circuit
1	D70.2/D170 Decoder Issue D1
2	D70.2/D170 Decoder Issue D2
3	D70.2/D170 Decoder Power Supplies Issue D1/D2
4	D70.2 Audio Board Power Supplies
5	D70.2 Audio Board Audio Stages
6	D70.2 Audio Board DAC & Master Clock
7	Delta CD Transformer PCB
8	Delta CD Display PCB
9	D170/D170.2 Digital Output PCB
10	D70.3 Audio Board Power Supplies
11	D70.3 Audio Board DAC & Audio Stage
12	D70.3 Audio Board Digital O/P & Master Clock
13	D70.3/D170.2 Decoder
14	D70.3/D170.2 Decoder Power Supplies

DRAWING DATE 18/1/82

DELTA 70 MK11 AUDIO BOARD
ISSUE 5 26-7-90
CIRCUIT DIAGRAM SHEET 1 OF 3
POWER SUPPLIES

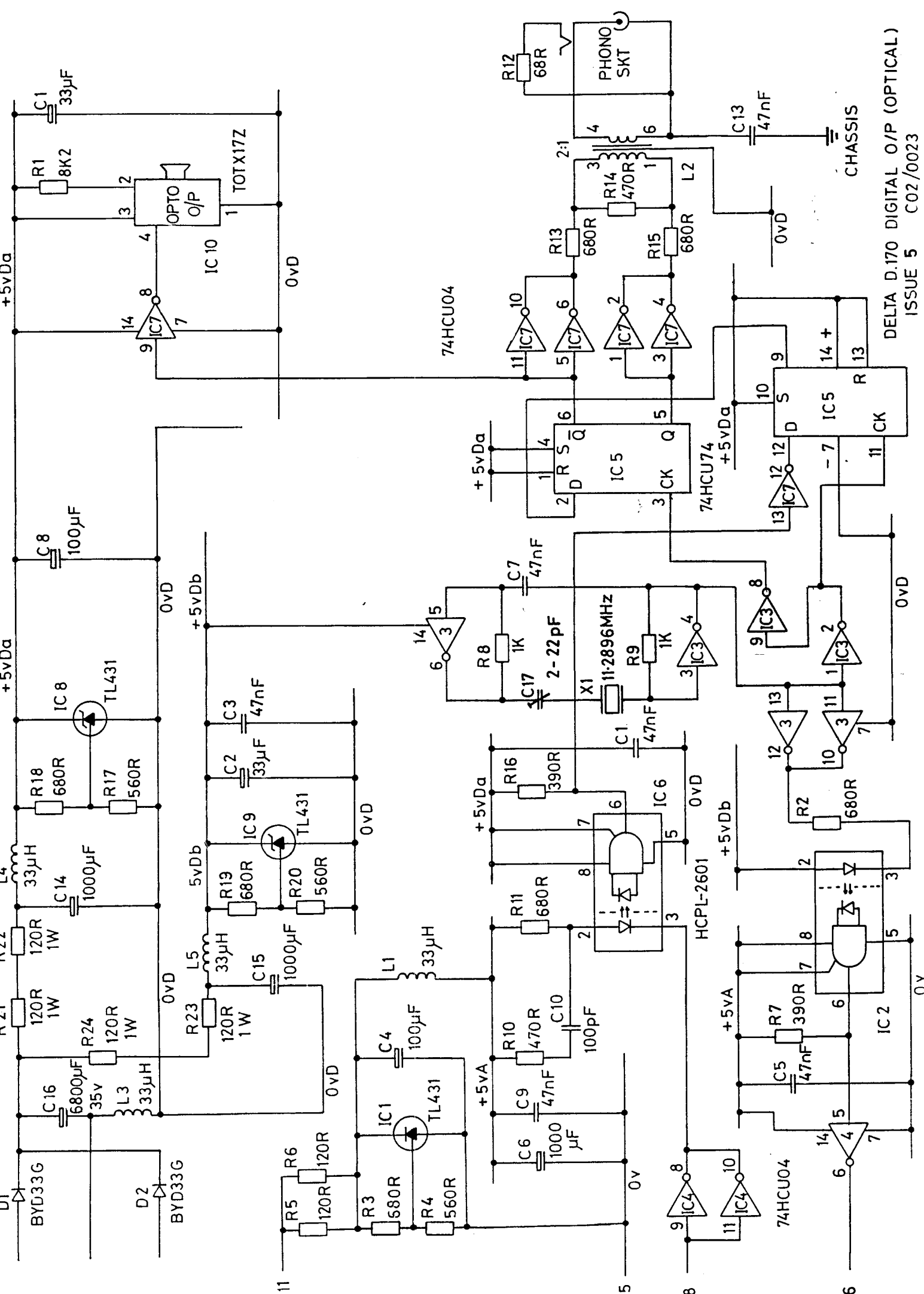


NOTE
WHEN THE RELAY COIL
IS 280R IMPEDANCE
THEN THE VALUES OF
R211 AND R212 ARE
AS FOLLOWS :
R211 390R MF
R212 220R MF

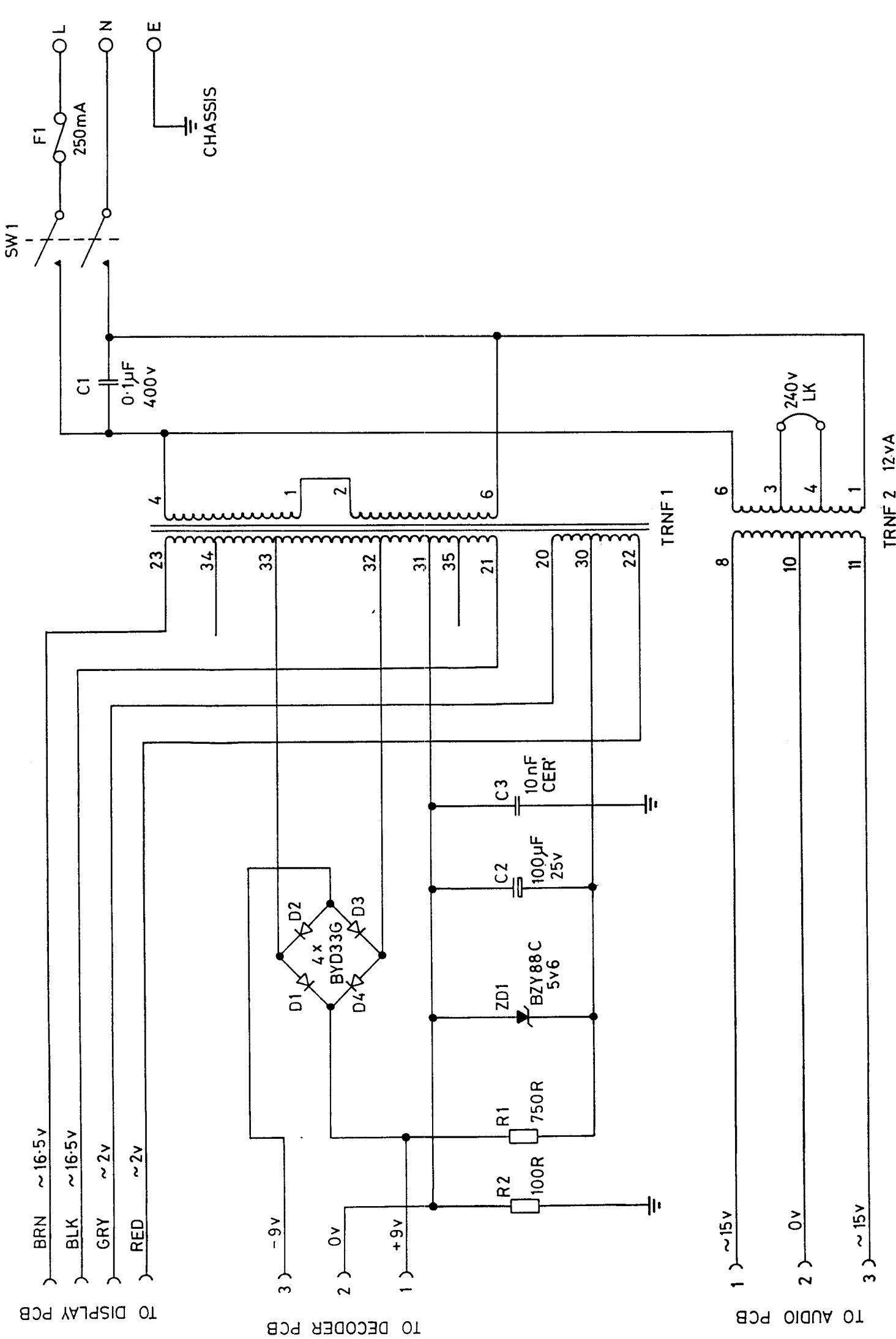


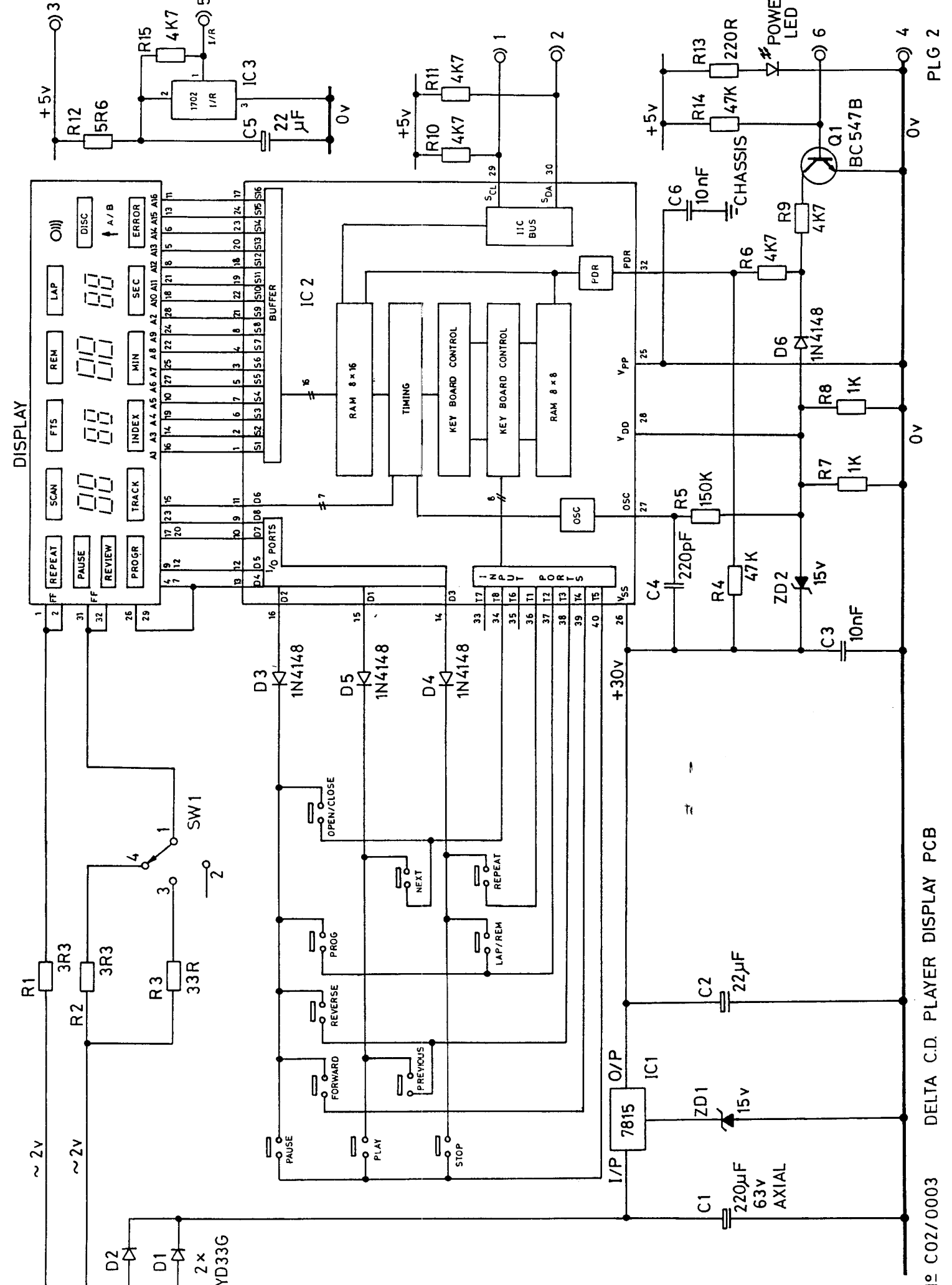
DELTA 70 MKII AUDIO BOARD
 ISSUE 5 26-7-90
 DWG NO. H04/0006 SH 2 OF 3
 AUDIO STAGES

DRAWING DATE 16/1/92

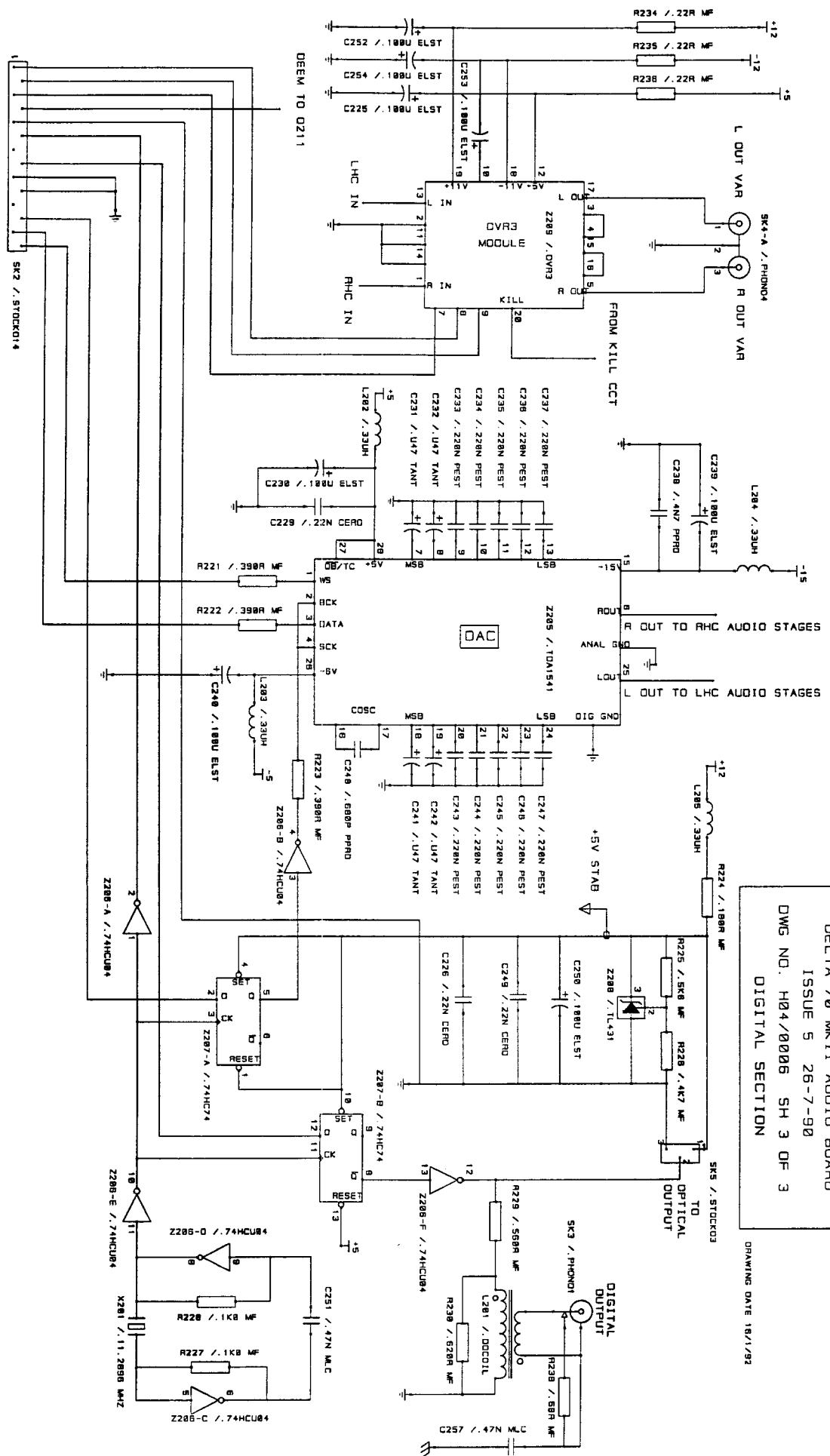


DELTA D.170 DIGITAL O/P (OPTICAL)
 ISSUE 5 C02/0023



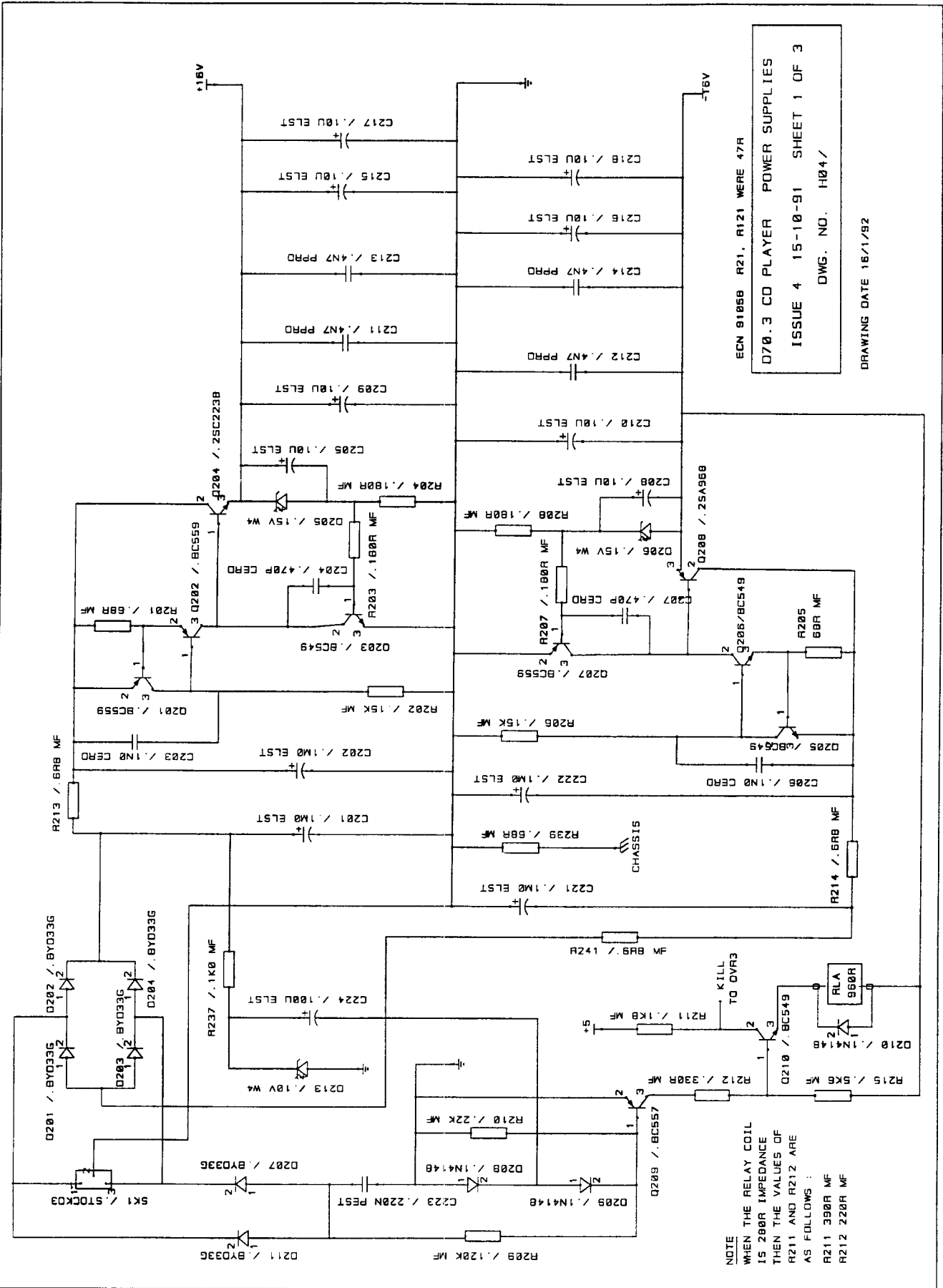


V2
V1
V0
DEEM
0 V
CLOCK
5 V
00B0
0 V
0 V
12 V
CLB0
DAB0
WSB0



DELTA 70 MKII AUDIO BOARD
ISSUE 5 26-7-90
DWS NO. H04/0006 SH 3 OF 3
DIGITAL SECTION

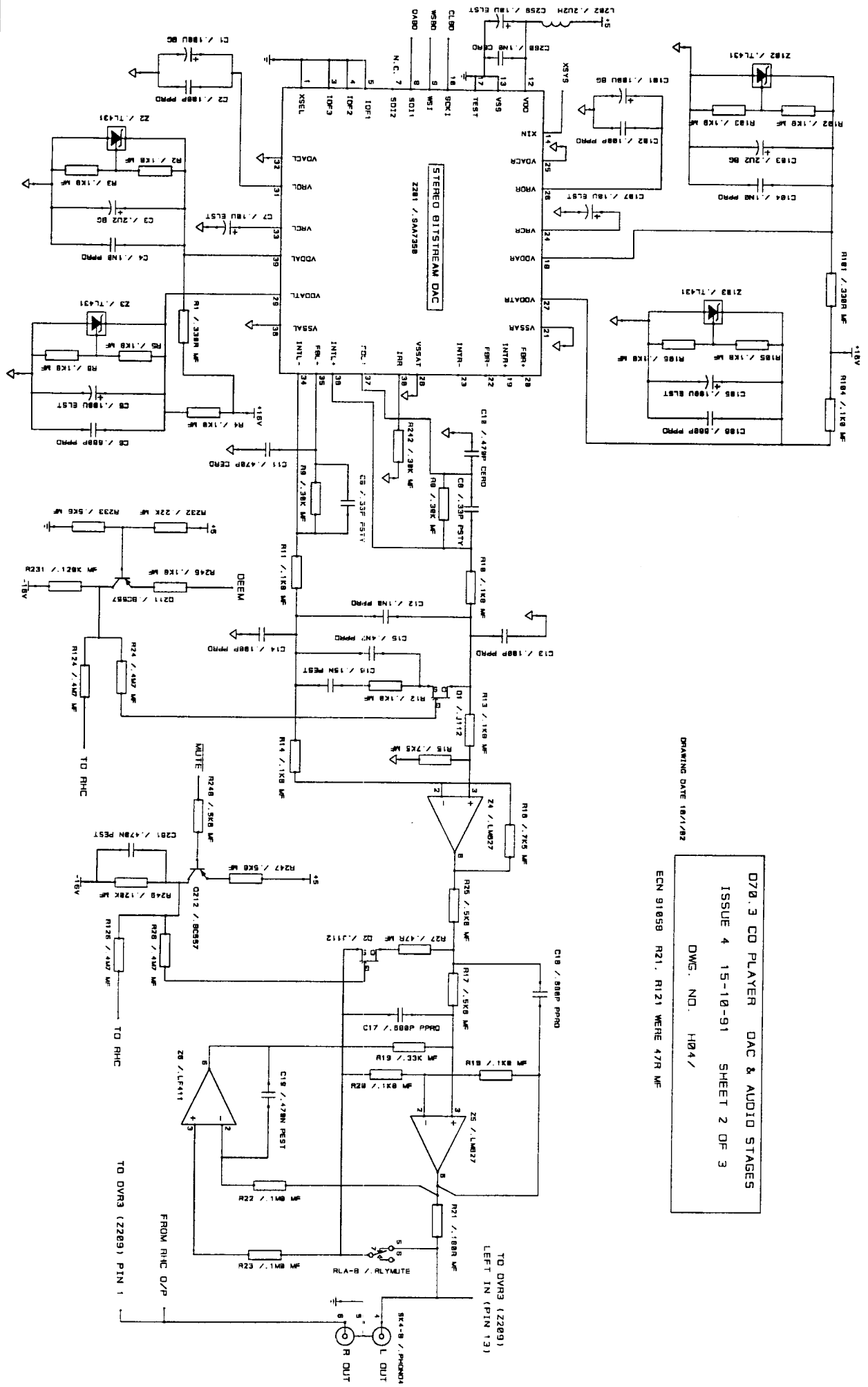
DRAWING DATE 18/1/92



ECN 91050 R21, R121 WERE 47R
 D70.3 CD PLAYER POWER SUPPLIES
 ISSUE 4 15-10-91 SHEET 1 OF 3
 DWG. NO. H04/

DRAWING DATE 16/1/92

NOTE
 WHEN THE RELAY COIL
 IS 280R IMPEDANCE
 THEN THE VALUES OF
 R211 AND R212 ARE
 AS FOLLOWS :
 R211 350R MF
 R212 220R MF



DRAWING DATE 10/1/92

070.3 CD PLAYER DAC & AUDIO STAGES
 ISSUE 4 15-10-91 SHEET 2 OF 3
 DWG. NO. H04/
 ECN 91059 R21, R121 WERE 47R MF

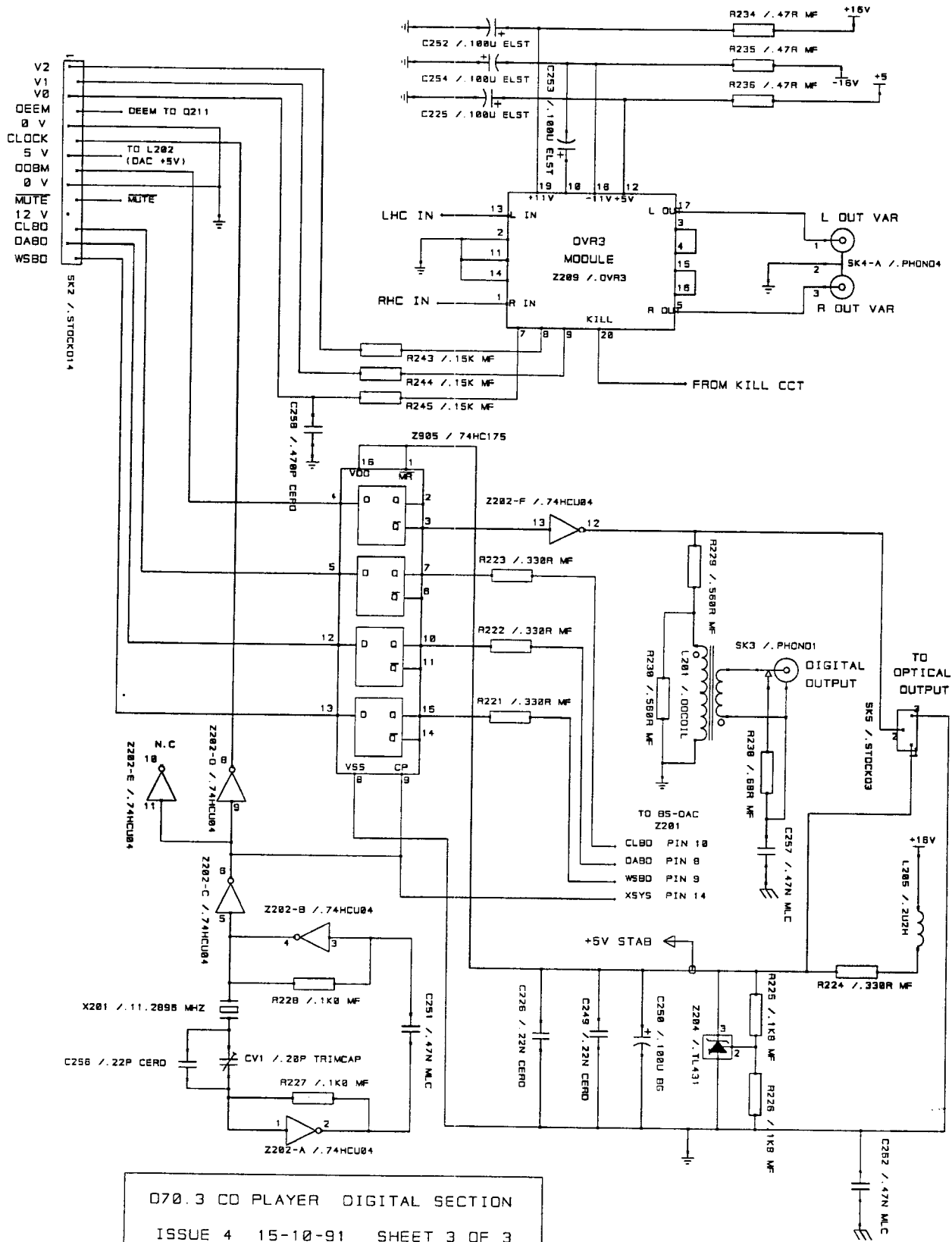
TO DV93 (Z289)
 LEFT IN (PIN 13)

FROM RHC O/P

TO DV93 (Z289) PIN 1

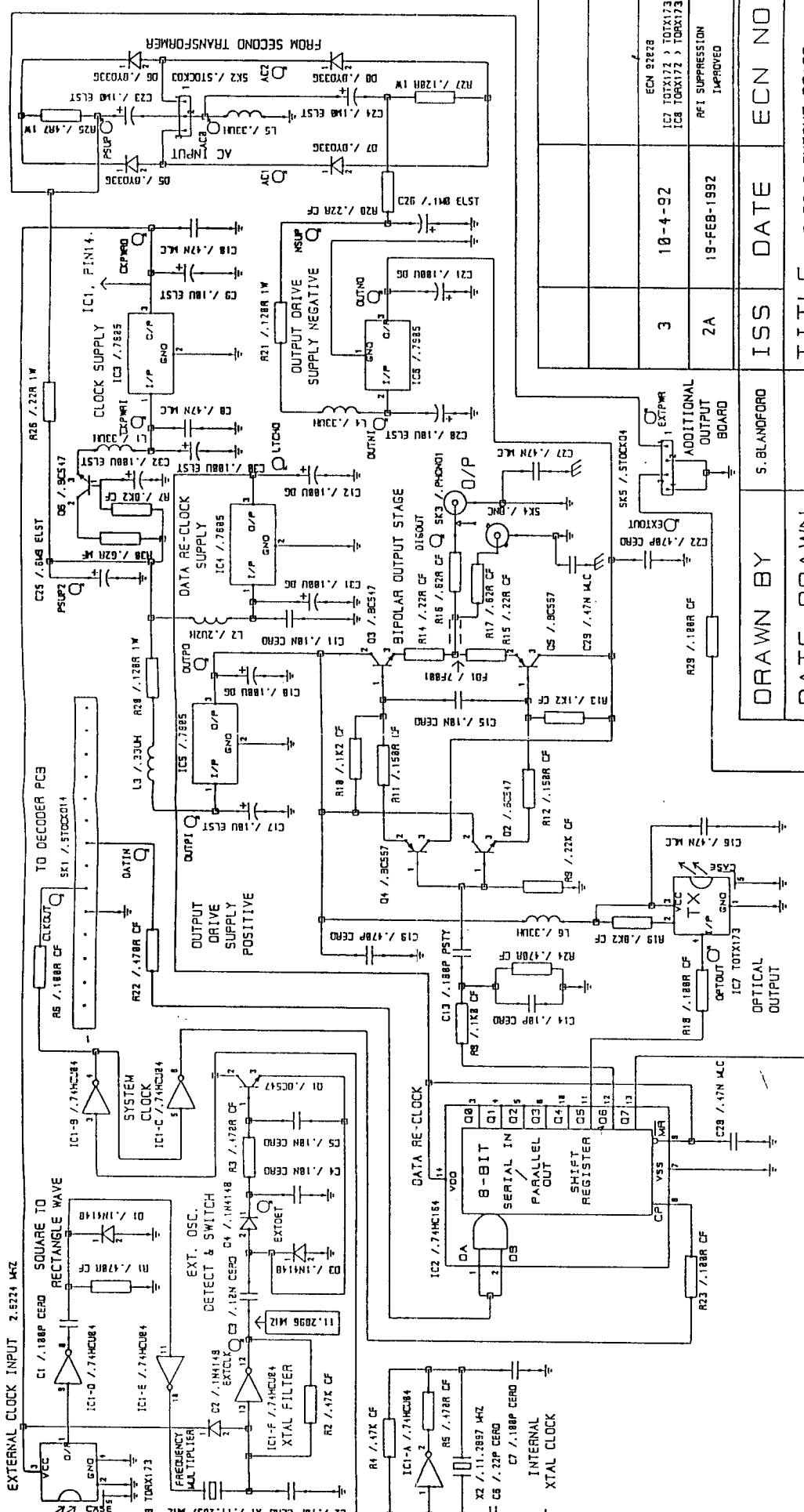
TO RHC

TO RHC



070.3 CD PLAYER DIGITAL SECTION
 ISSUE 4 15-10-91 SHEET 3 OF 3
 DWG. NO. H04/
 DRAWING DATE 16/1/92

ECN 91058 R21, R121 WERE 47R MF

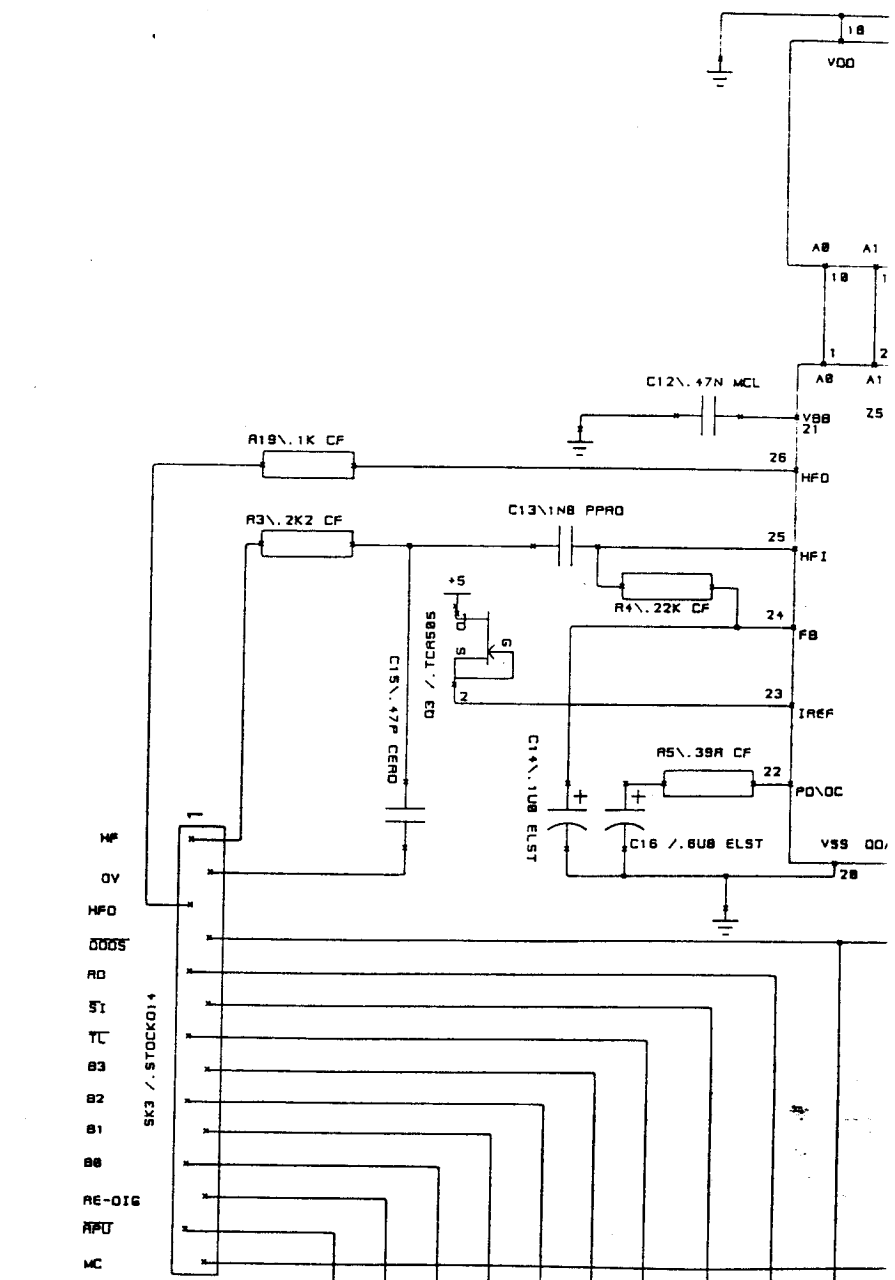


ECN 92828	10-4-92	ISS	DATE	ECN NO.
IC7 TOTX173 > TOTX173		3		
IC8 TORX172 > TORX173		2A	19-FEB-1992	
RF1 SUPPRESSION IMPROVED				

DRAWN BY	S. BLANDFORD	ISS	DATE	ECN NO.
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SHT. 1	OF. 1	ORG NO.	C02 0052	

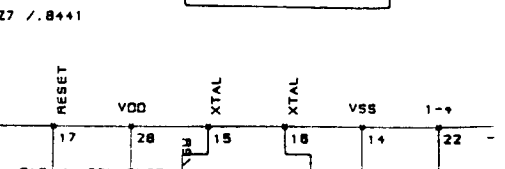
ARCAM. A & R CAMBRIDGE LTD, CBS 9PB

ARCAM



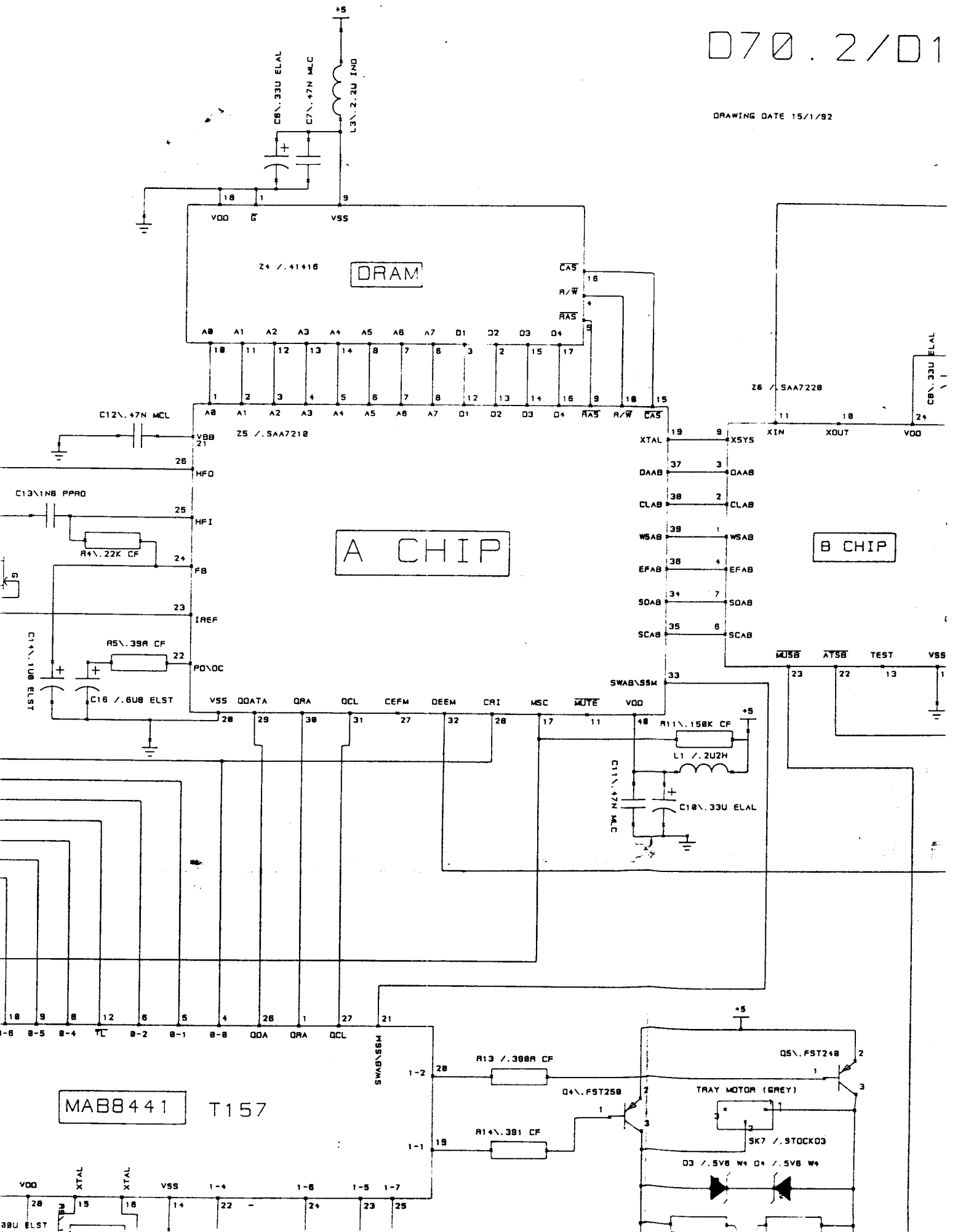
COM4/COM1 MK2

MAB8441 T15



070.2/D1

DRAWING DATE 15/1/92



A CHIP

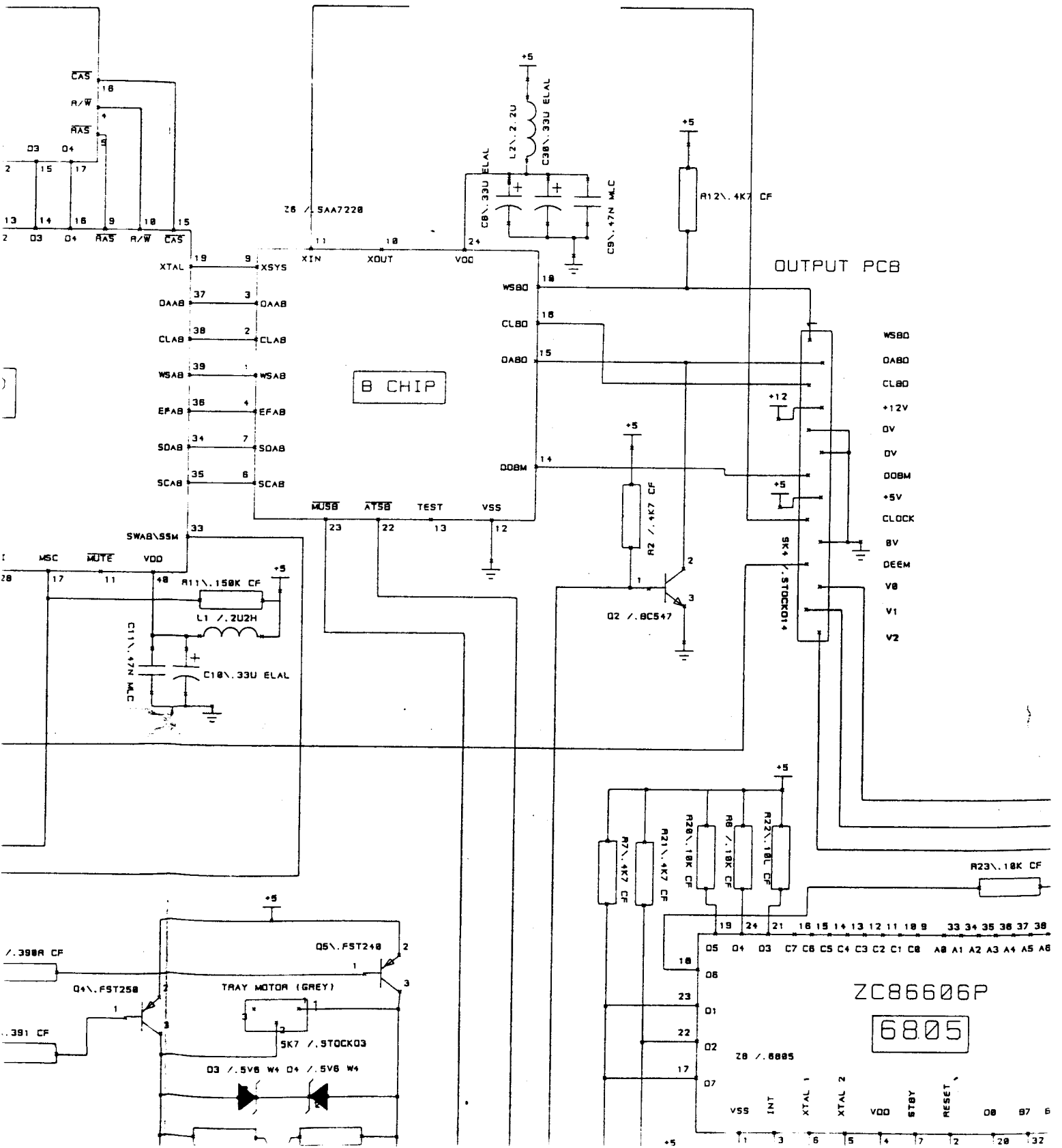
B CHIP

MAB8441 T157

070.2/0170 DECODER CIRCUIT

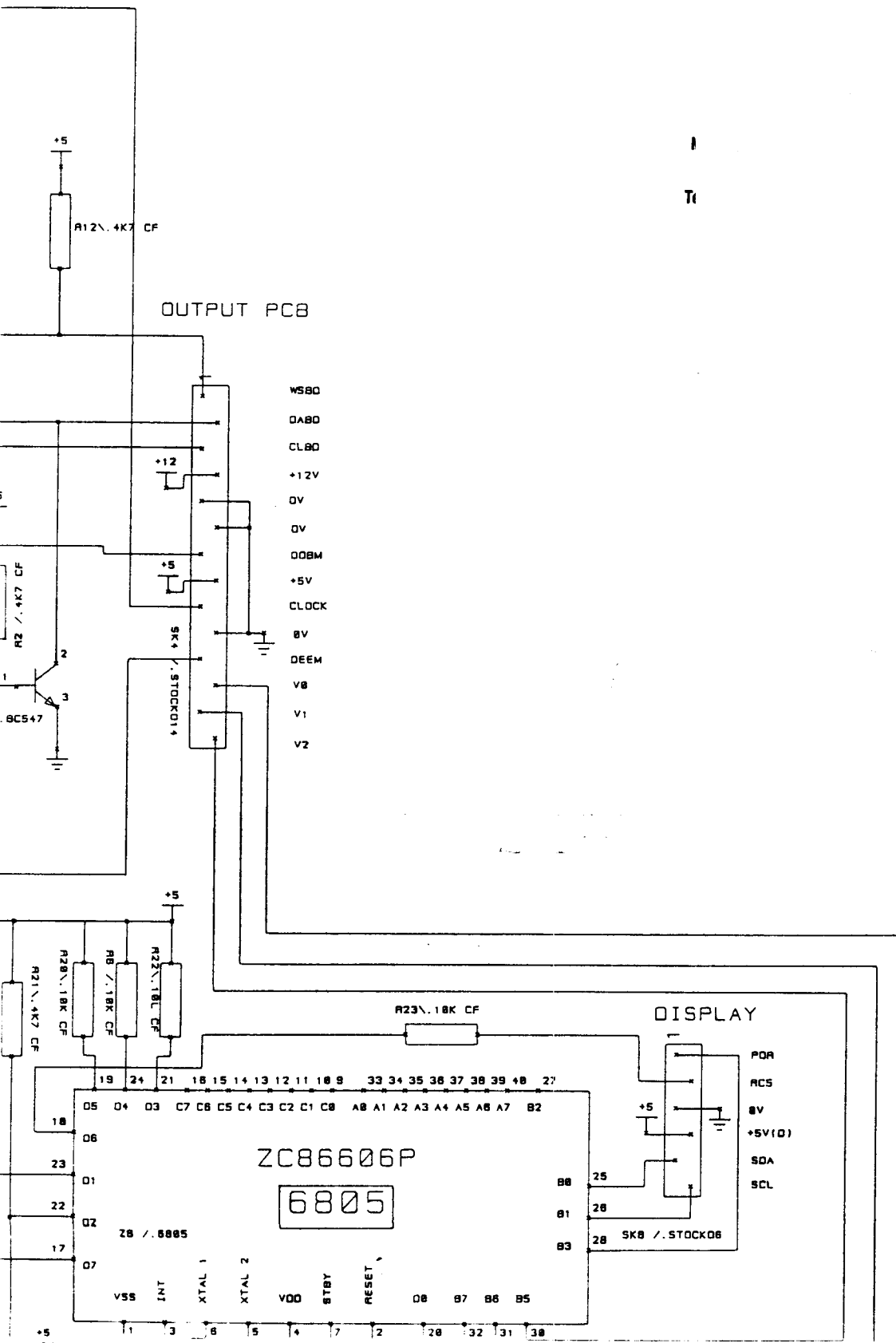
DRAWING DATE 15/1/92

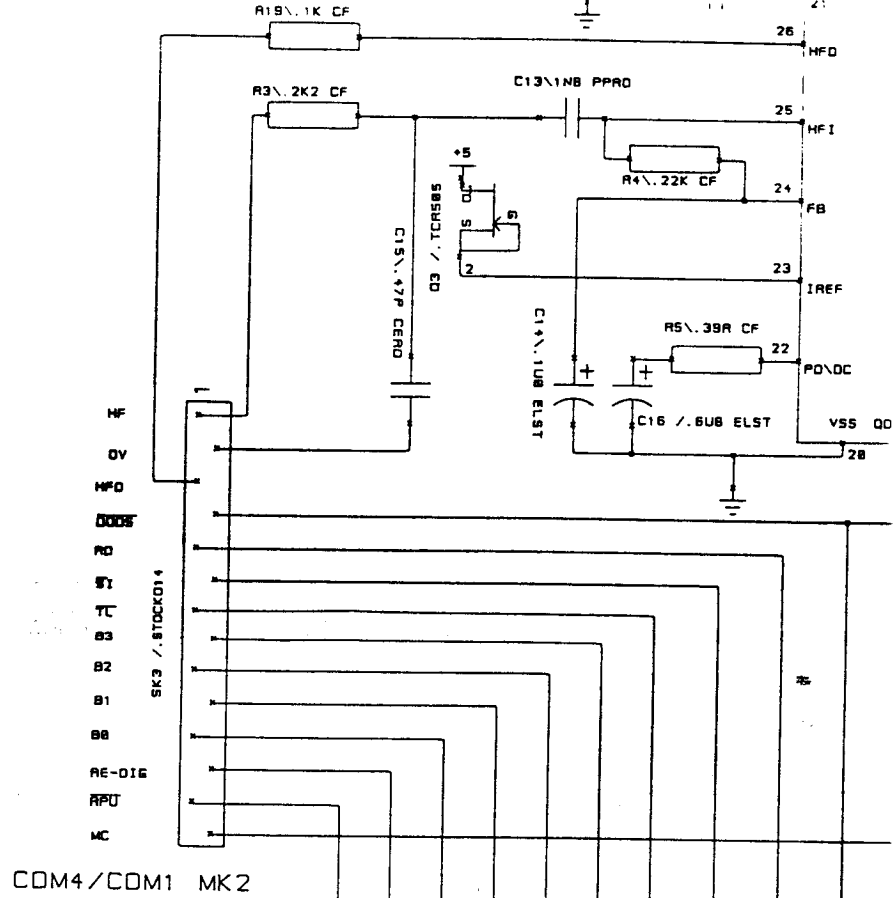
DWG NO. H04/0006 SH



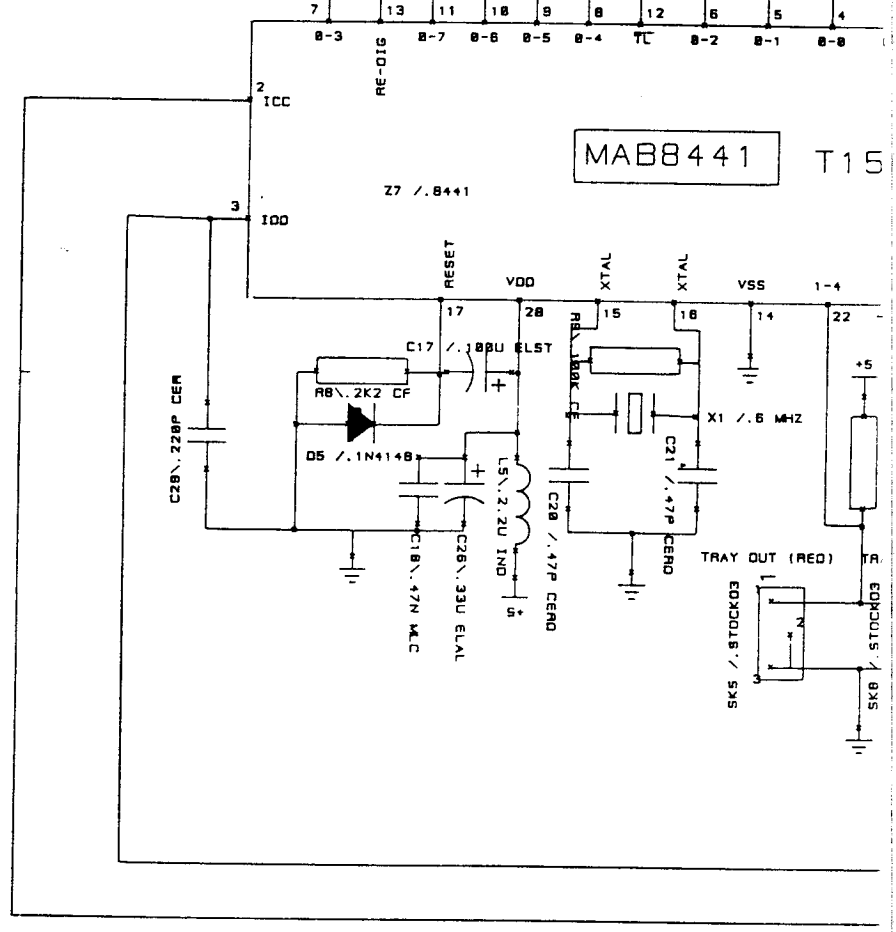
DECODER CIRCUIT ISSUE D1

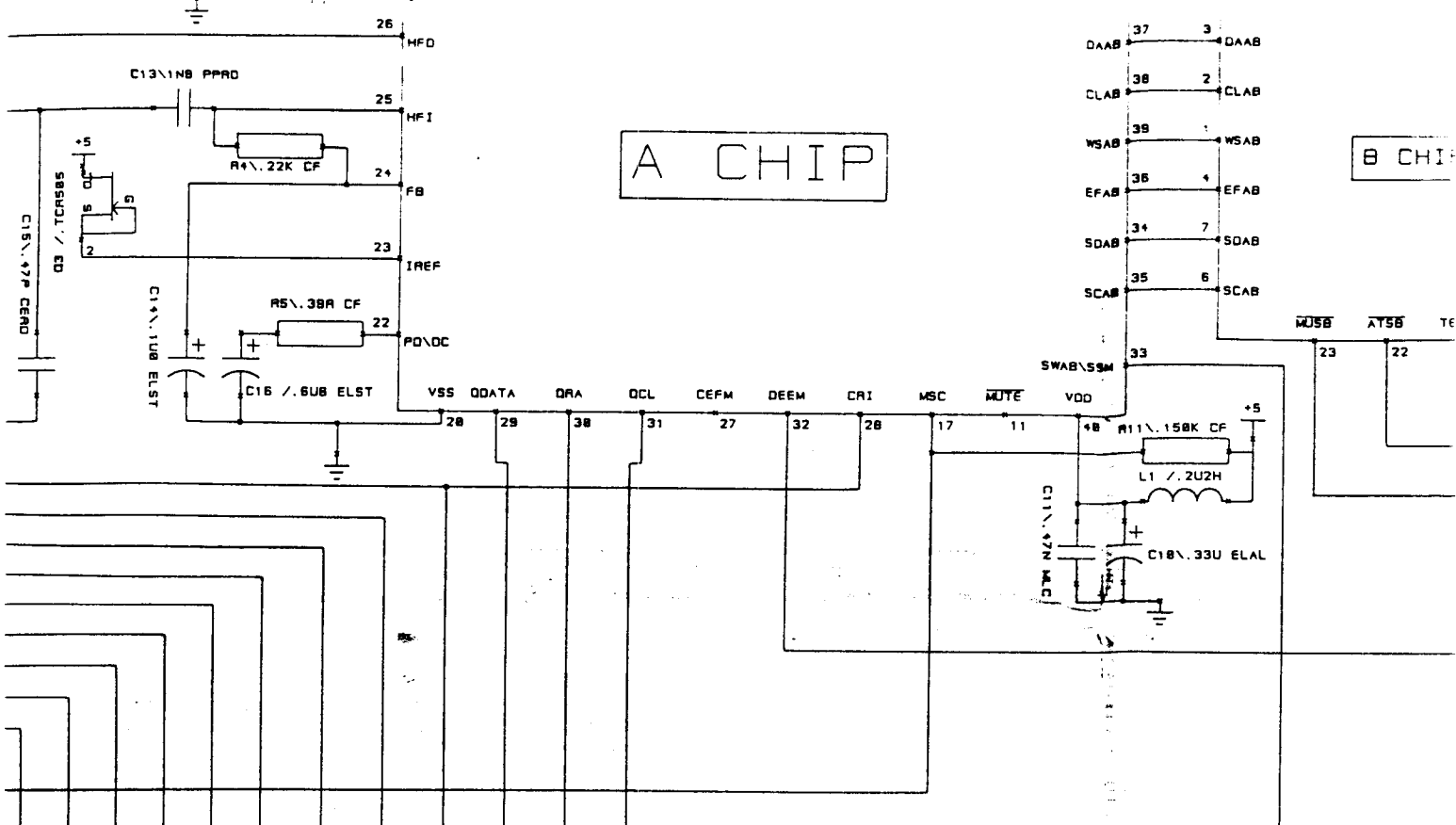
DWG NO. H04/0006 SHEET 1 OF 3





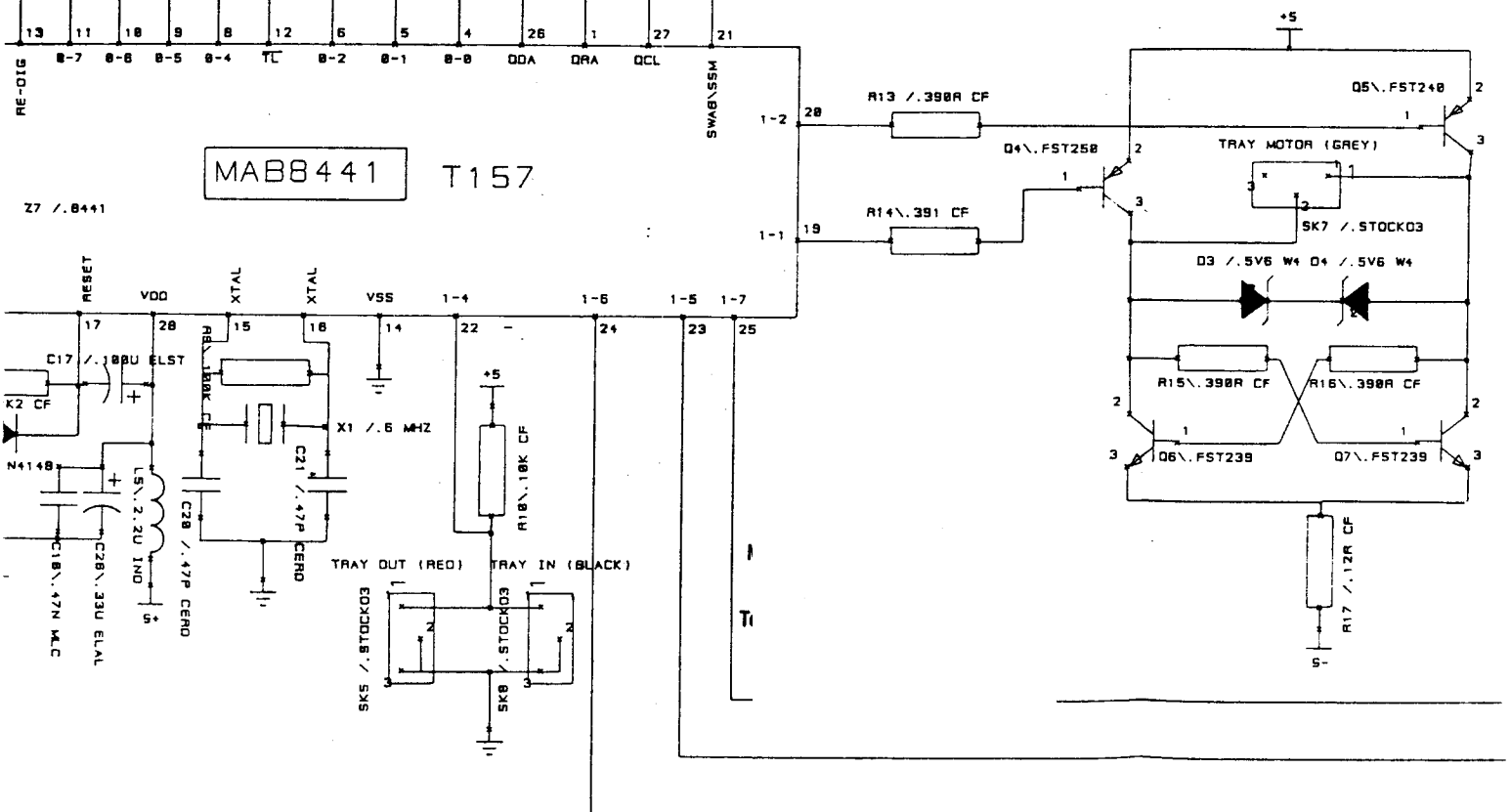
COM4/COM1 MK2





A CHIP

B CHIP



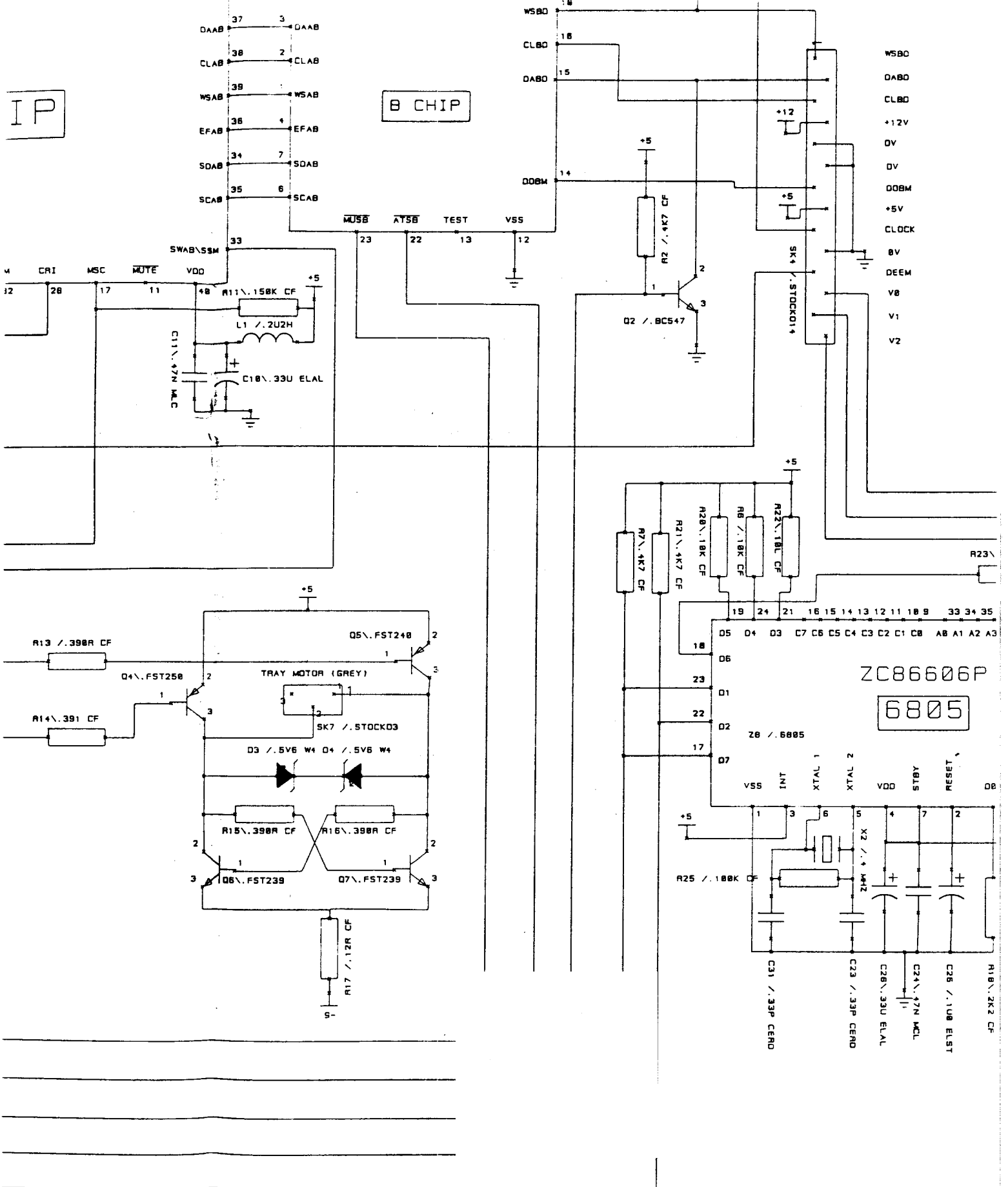
MAB8441

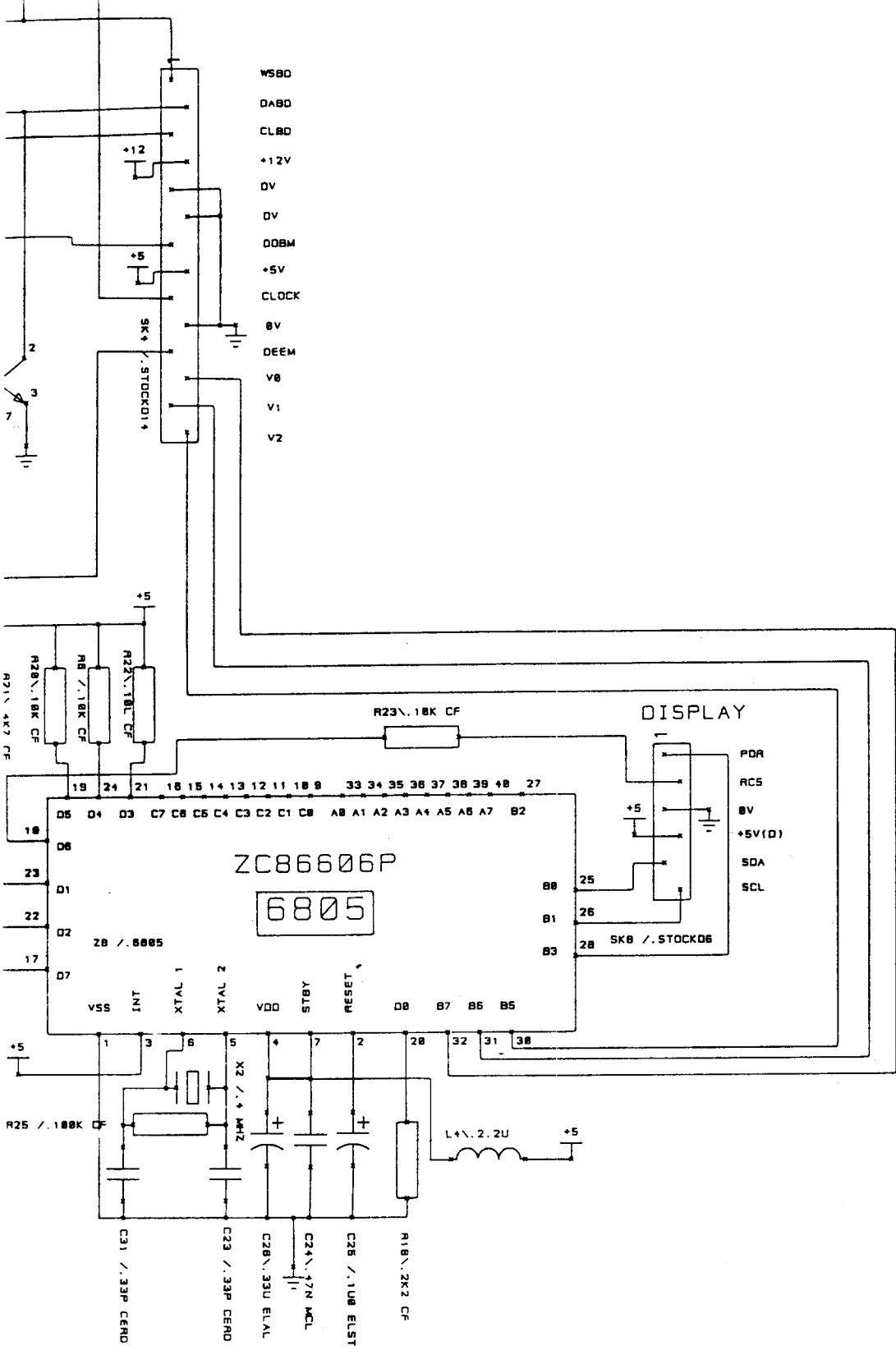
T157

TRAY MOTOR (GREY)

TRAY OUT (RED) TRAY IN (BLACK)

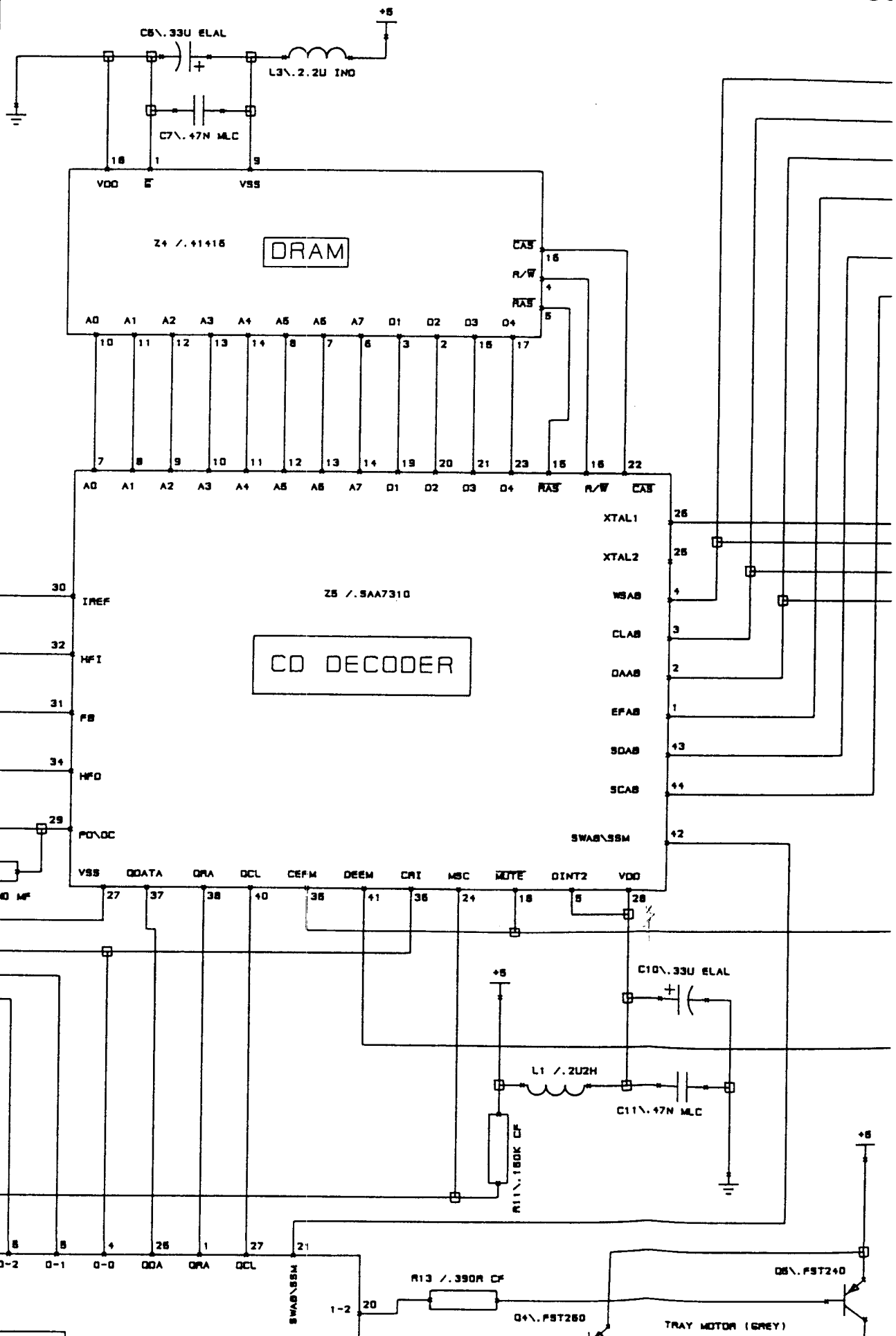
IP





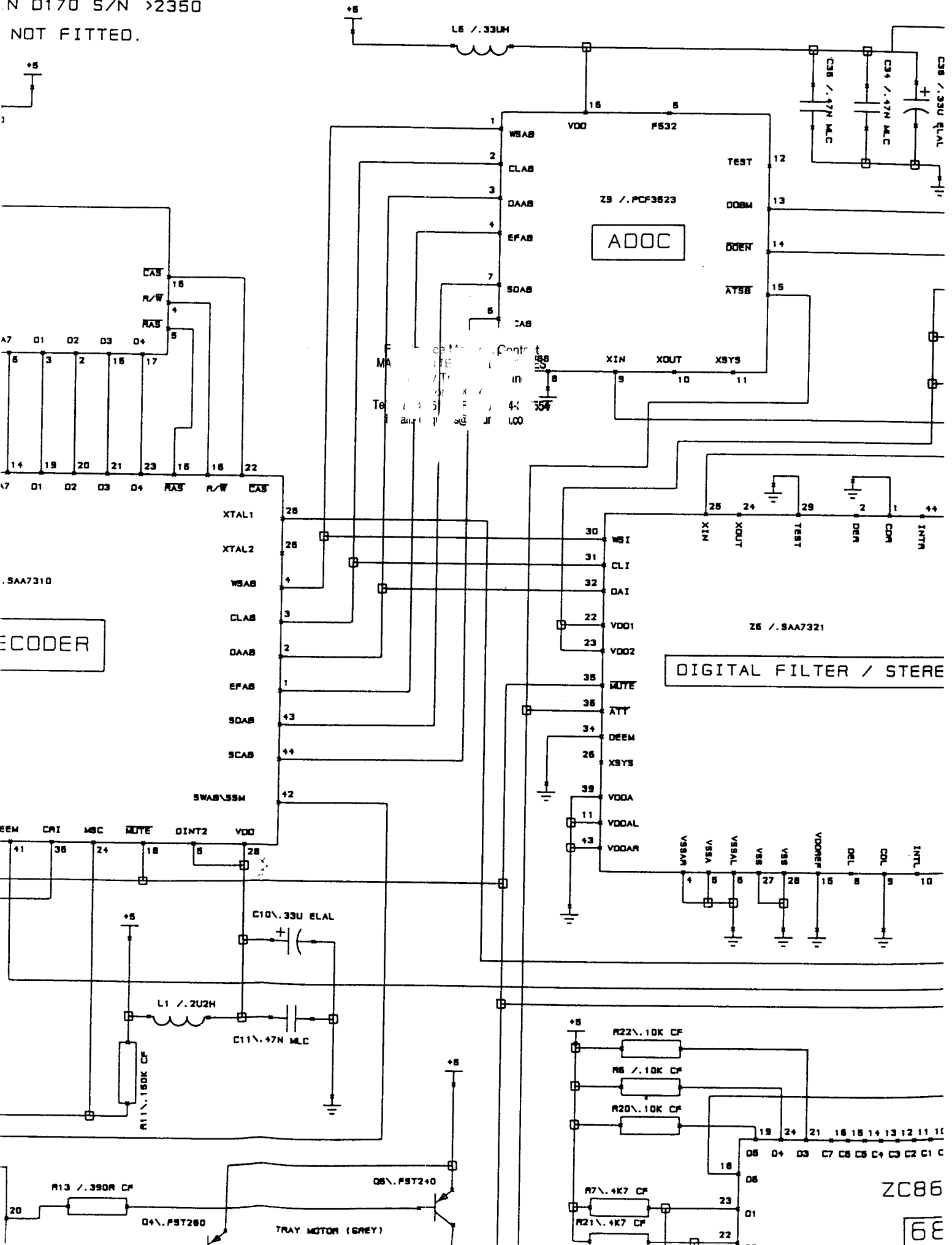
R BOARD
91
SH 1/2

NOTE: ON DECODERS USED IN D170 S/N >2350
THE SAA7321 IC IS NOT FITTED.



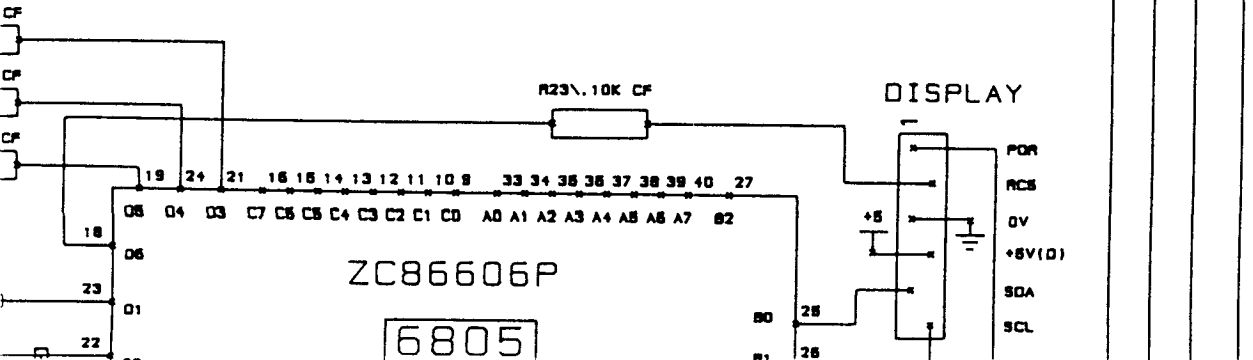
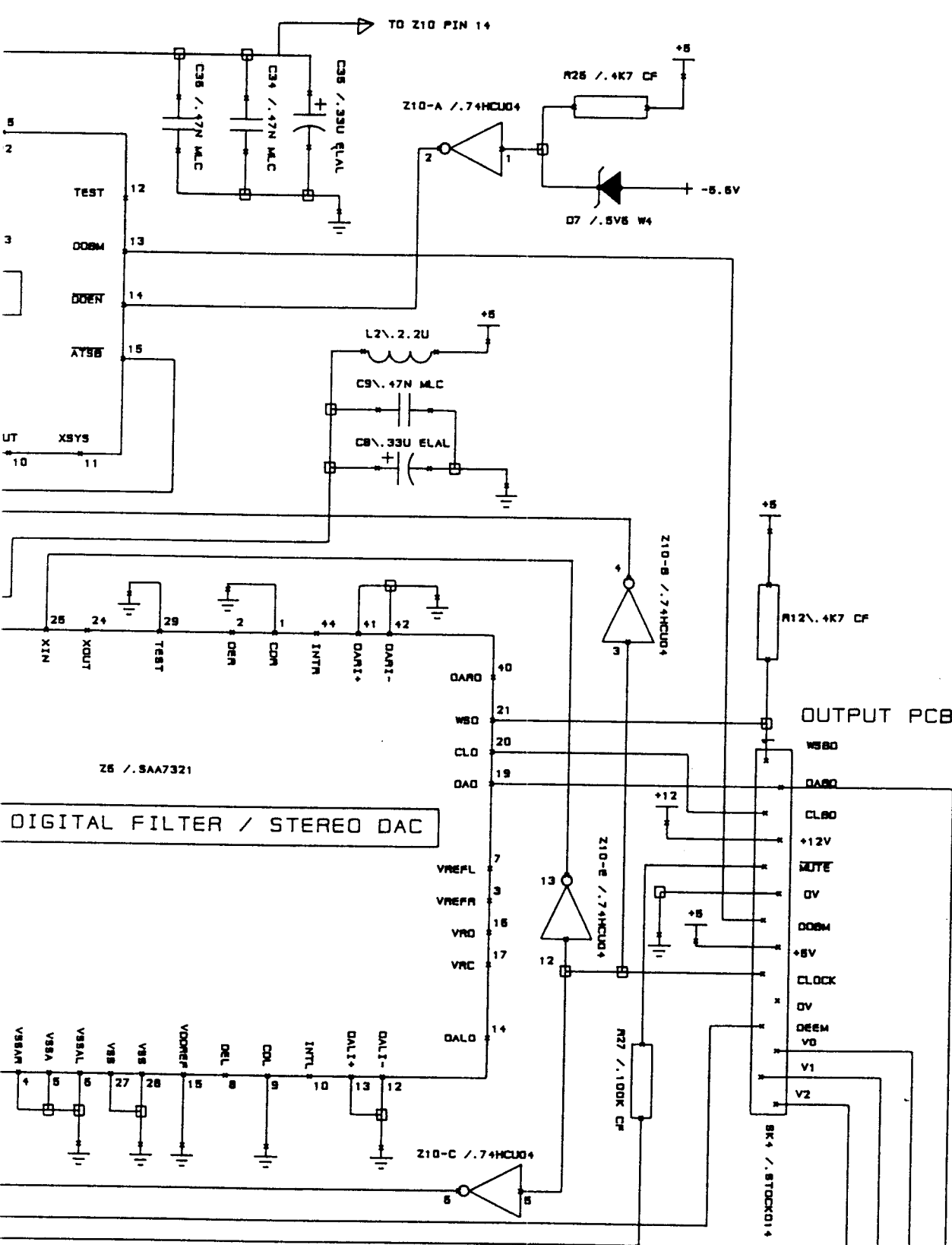
WARRINGTON T167

N 0170 S/N >2350
NOT FITTED.



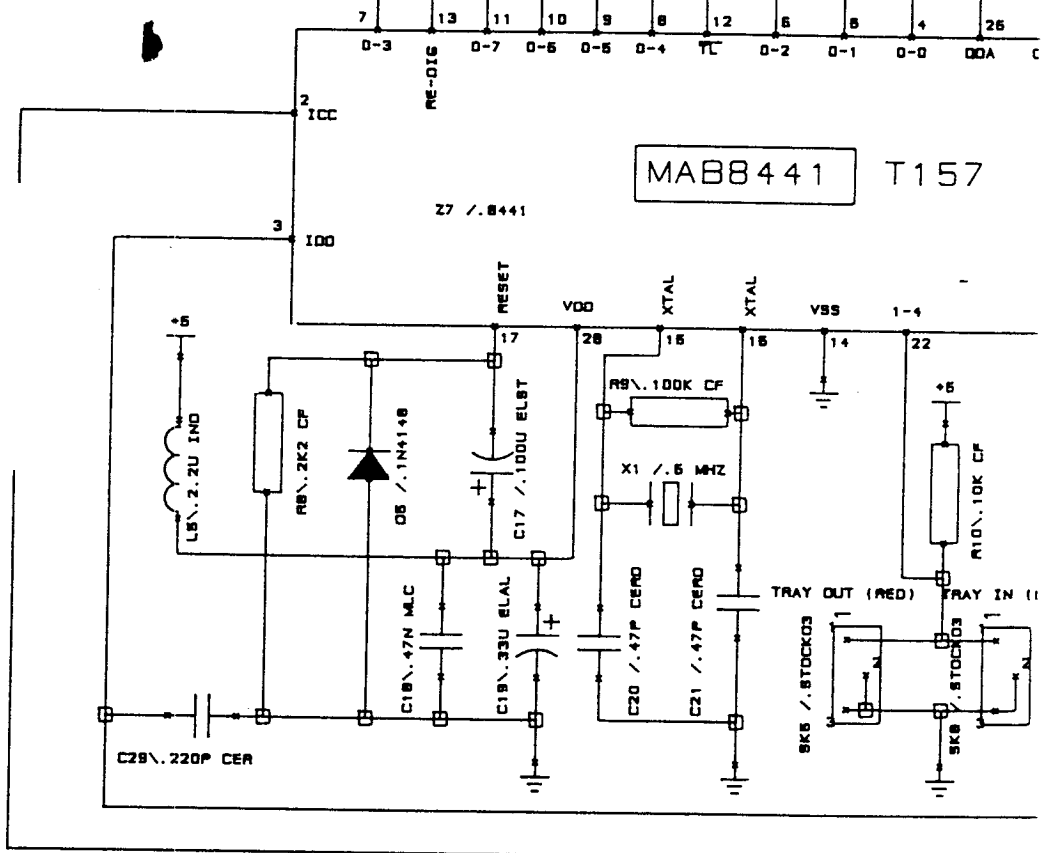
ZC86

6E

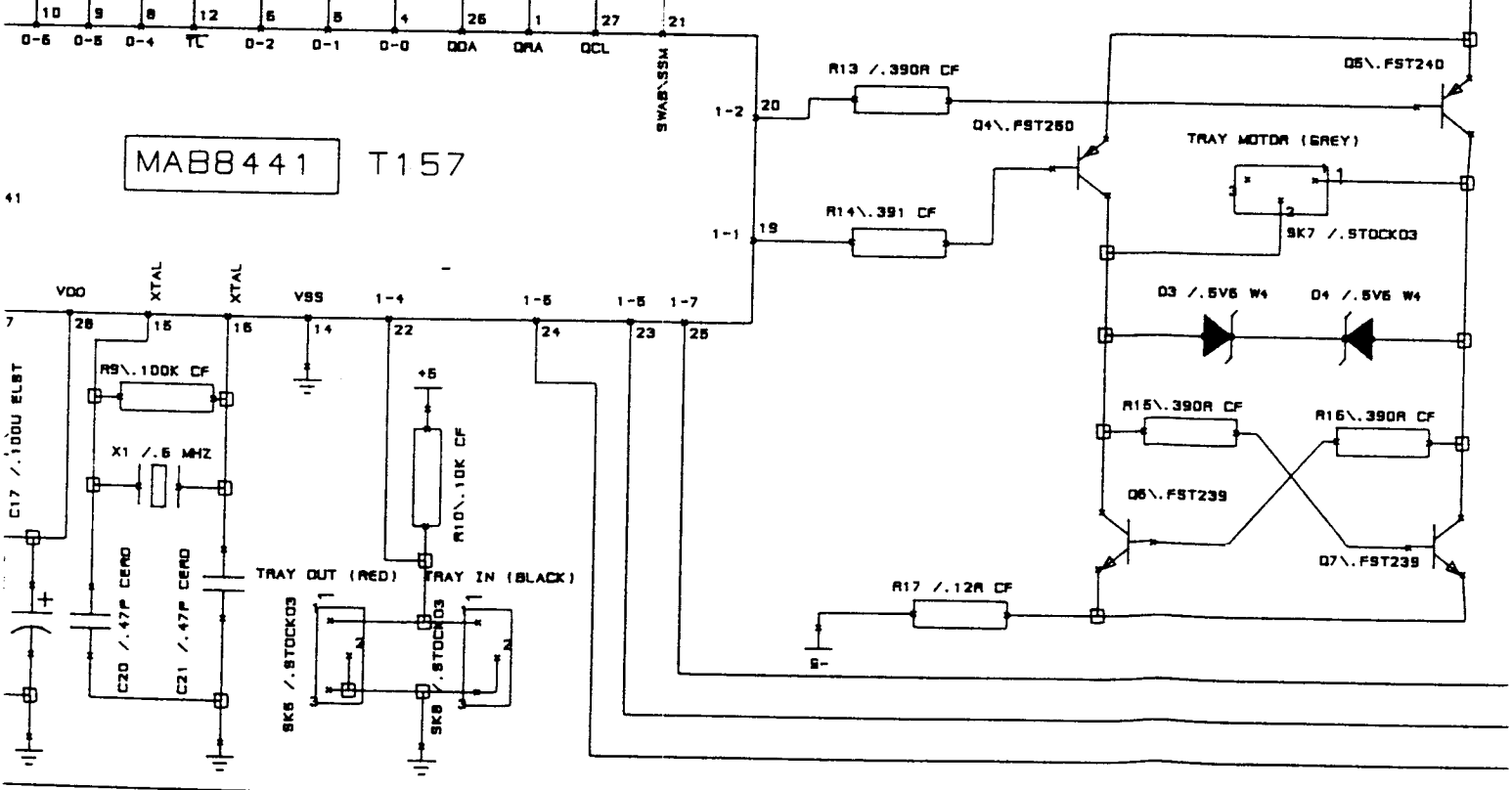
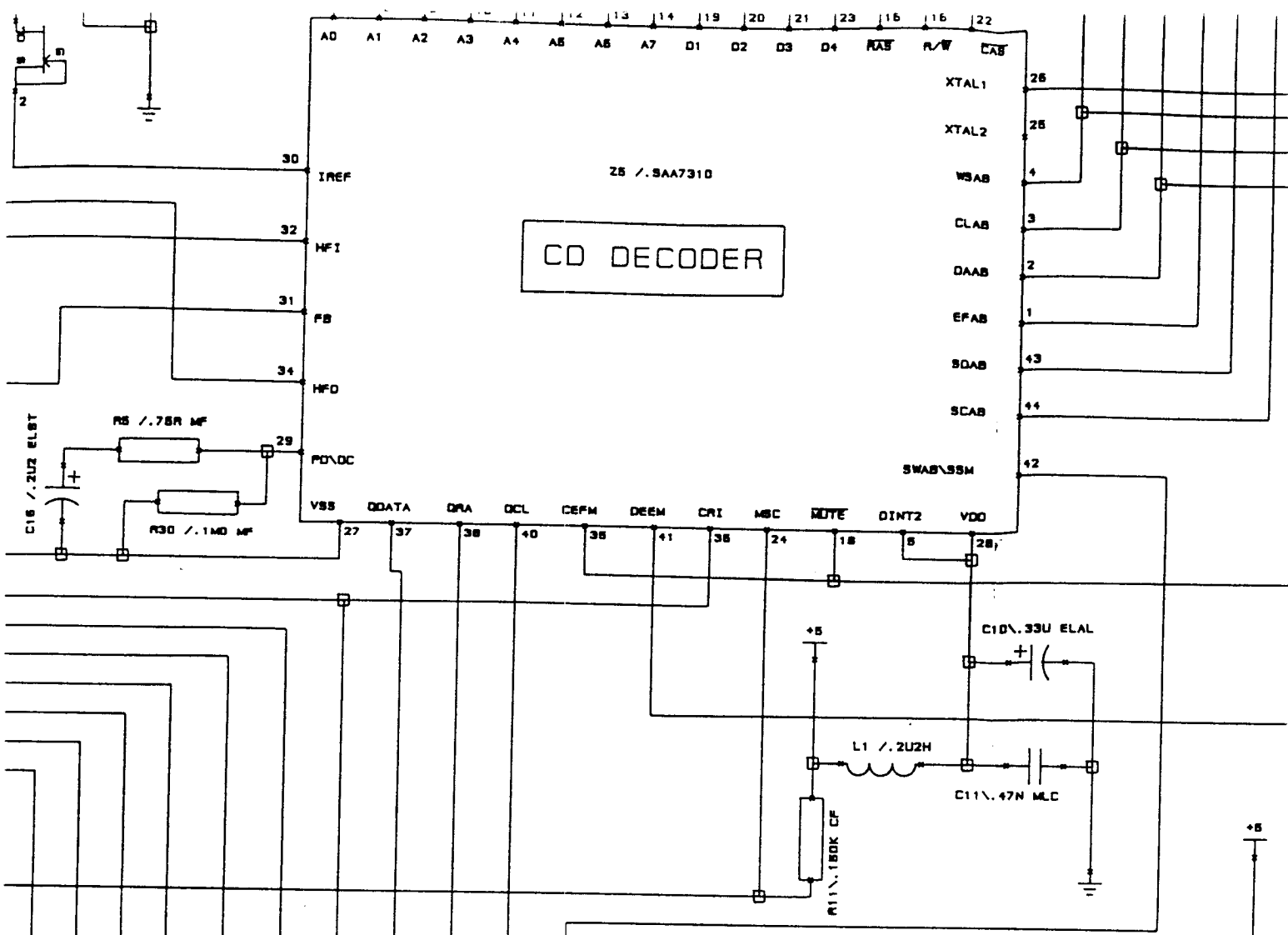


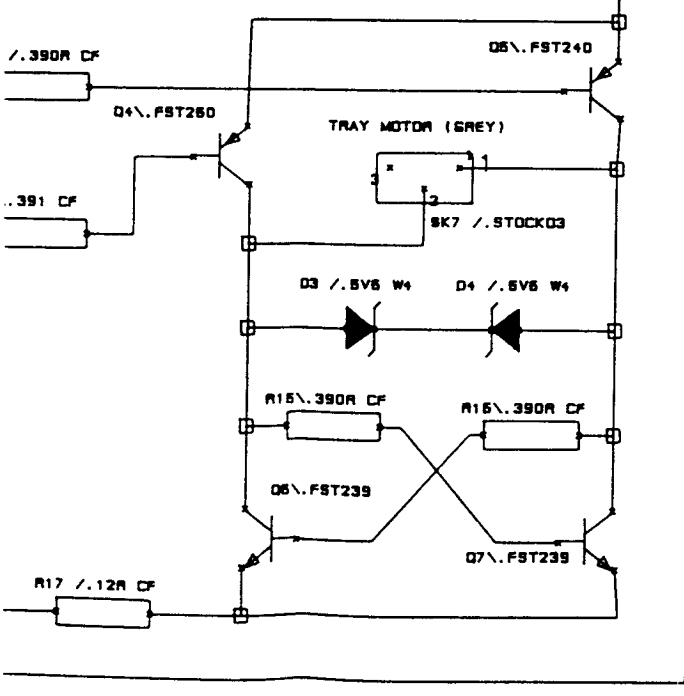
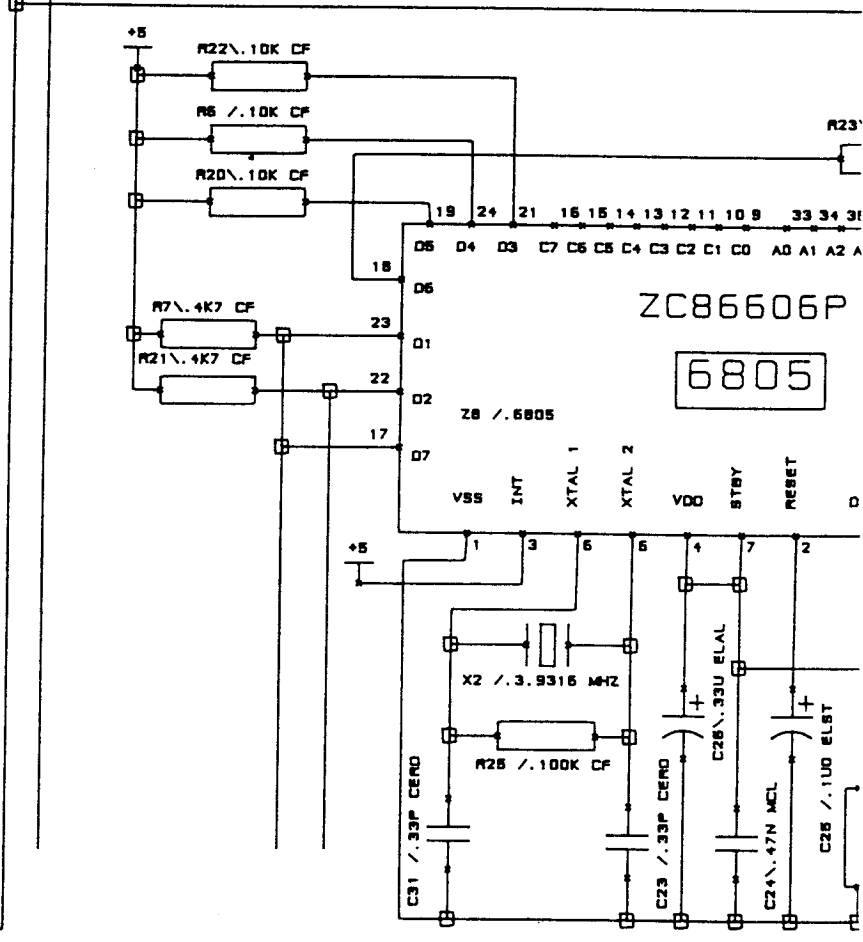
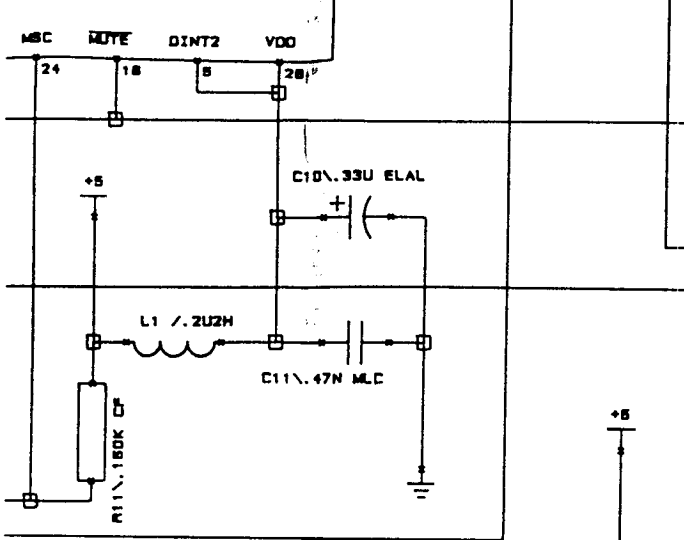
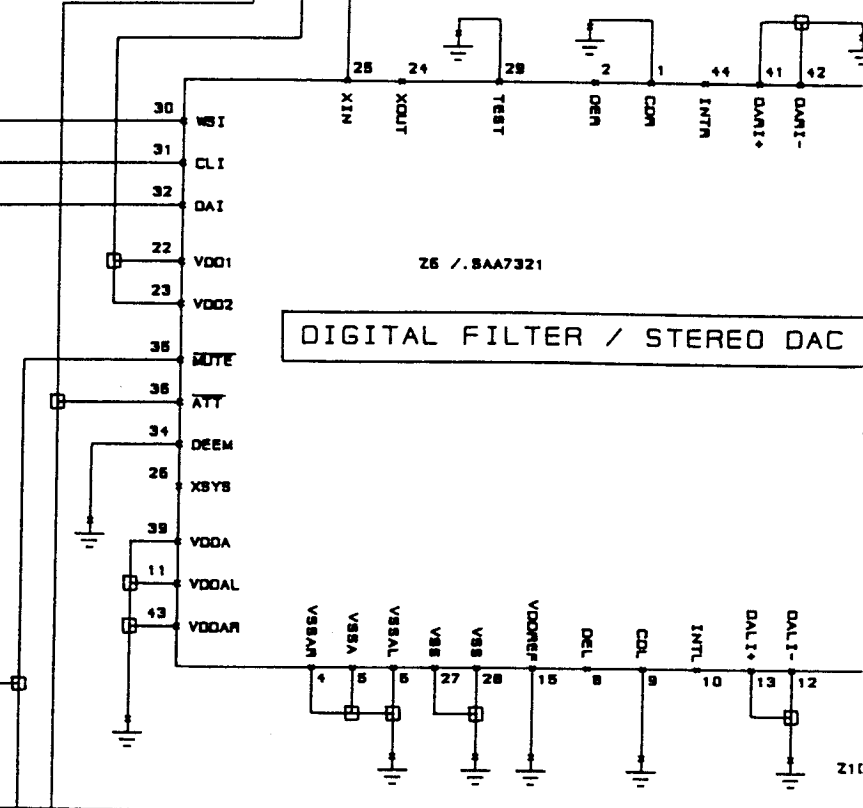
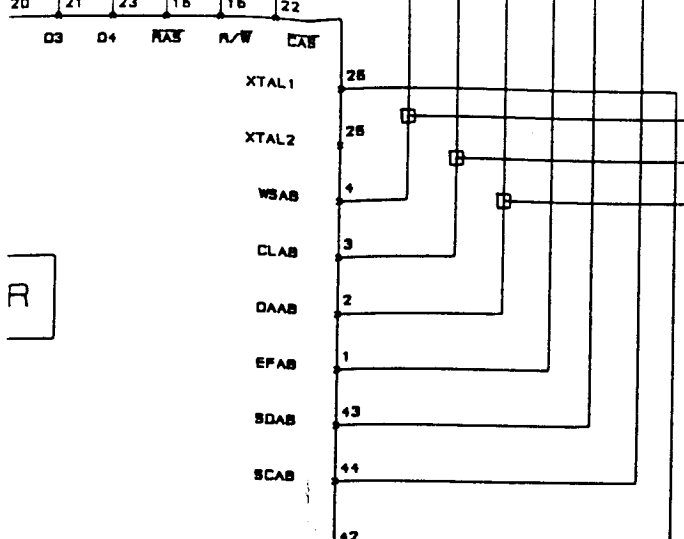
OUTPUT PCB

COM4/CDM1 MK2



MAB8441 T157

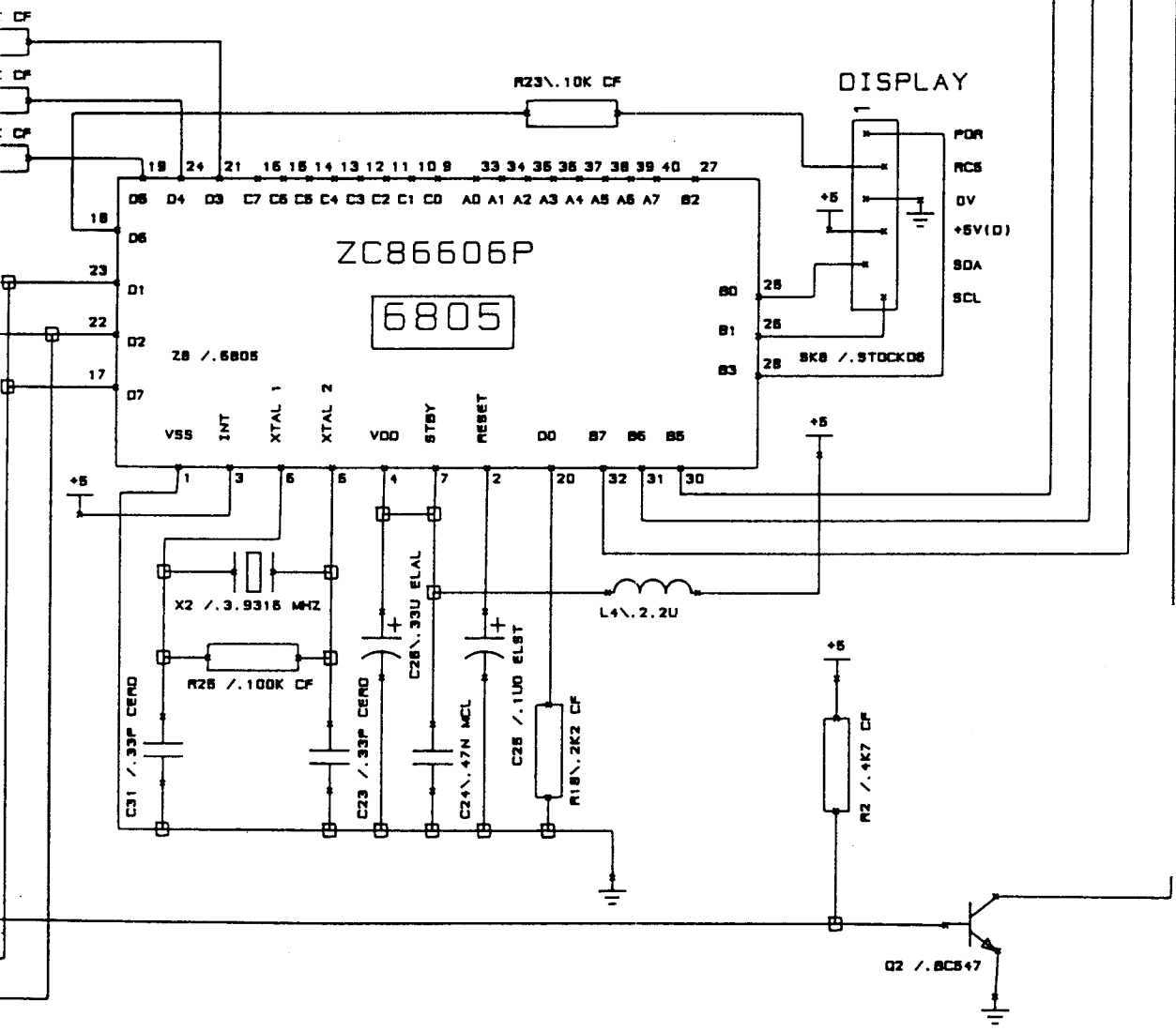
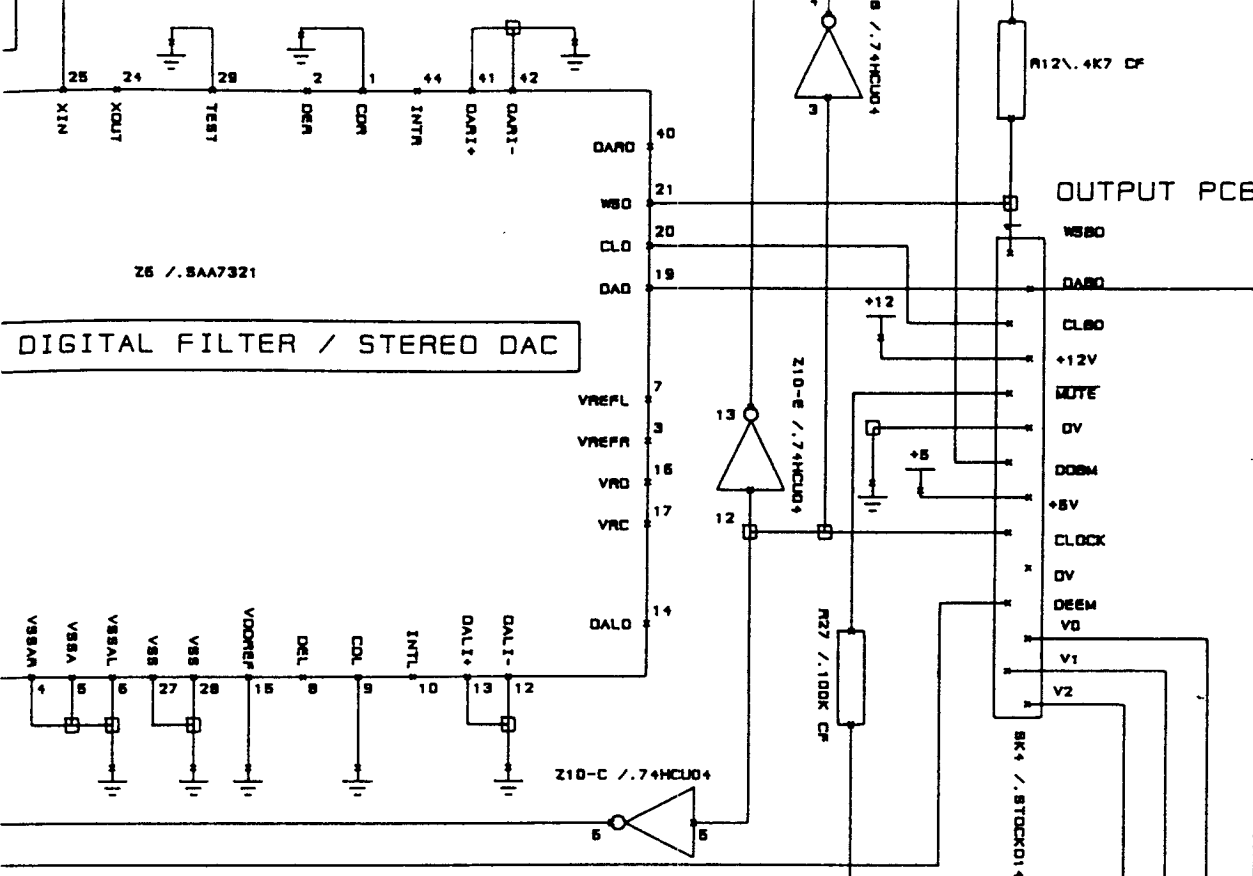


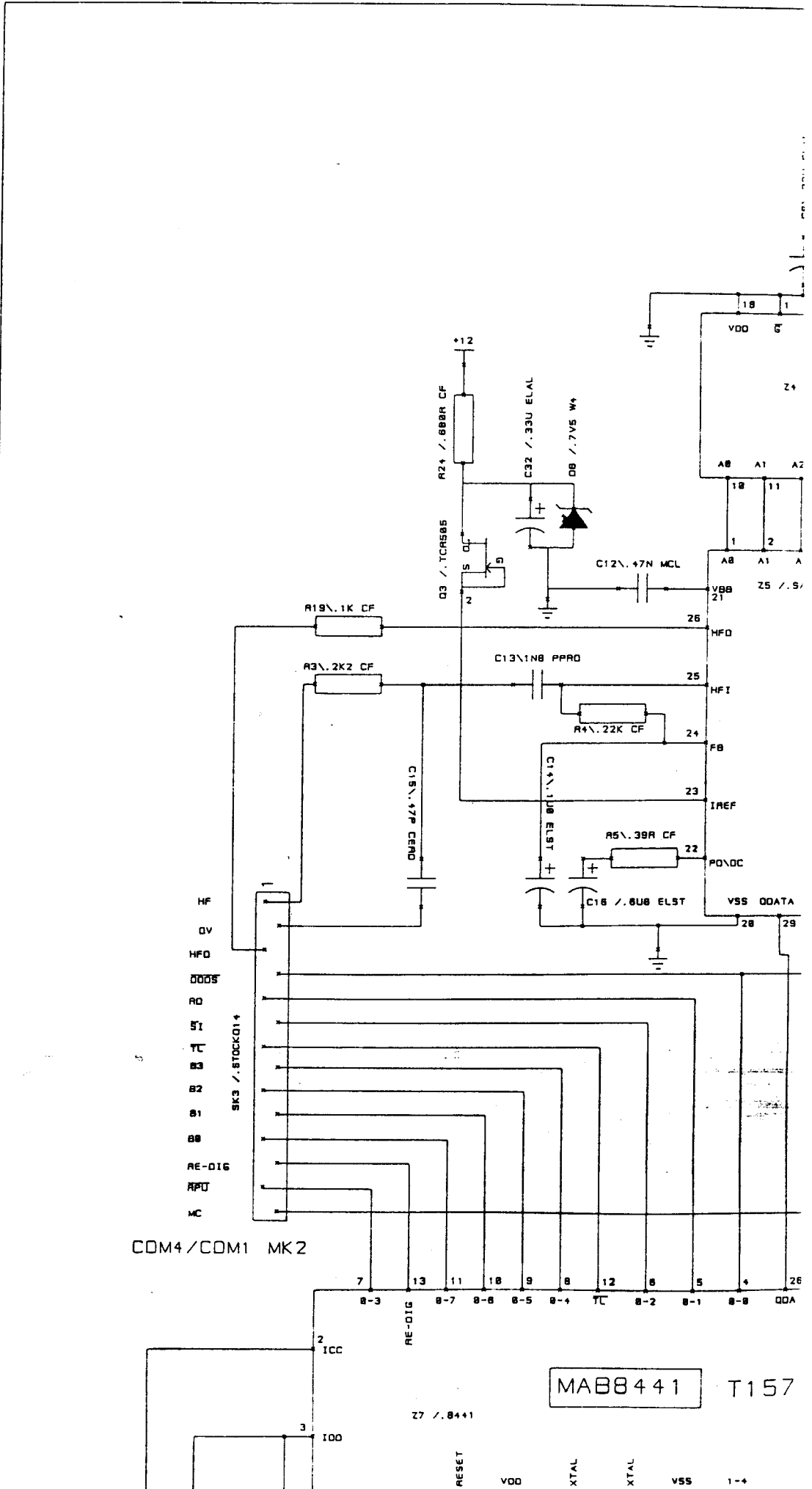


DIGITAL FILTER / STEREO DAC

ZC86606P

6805





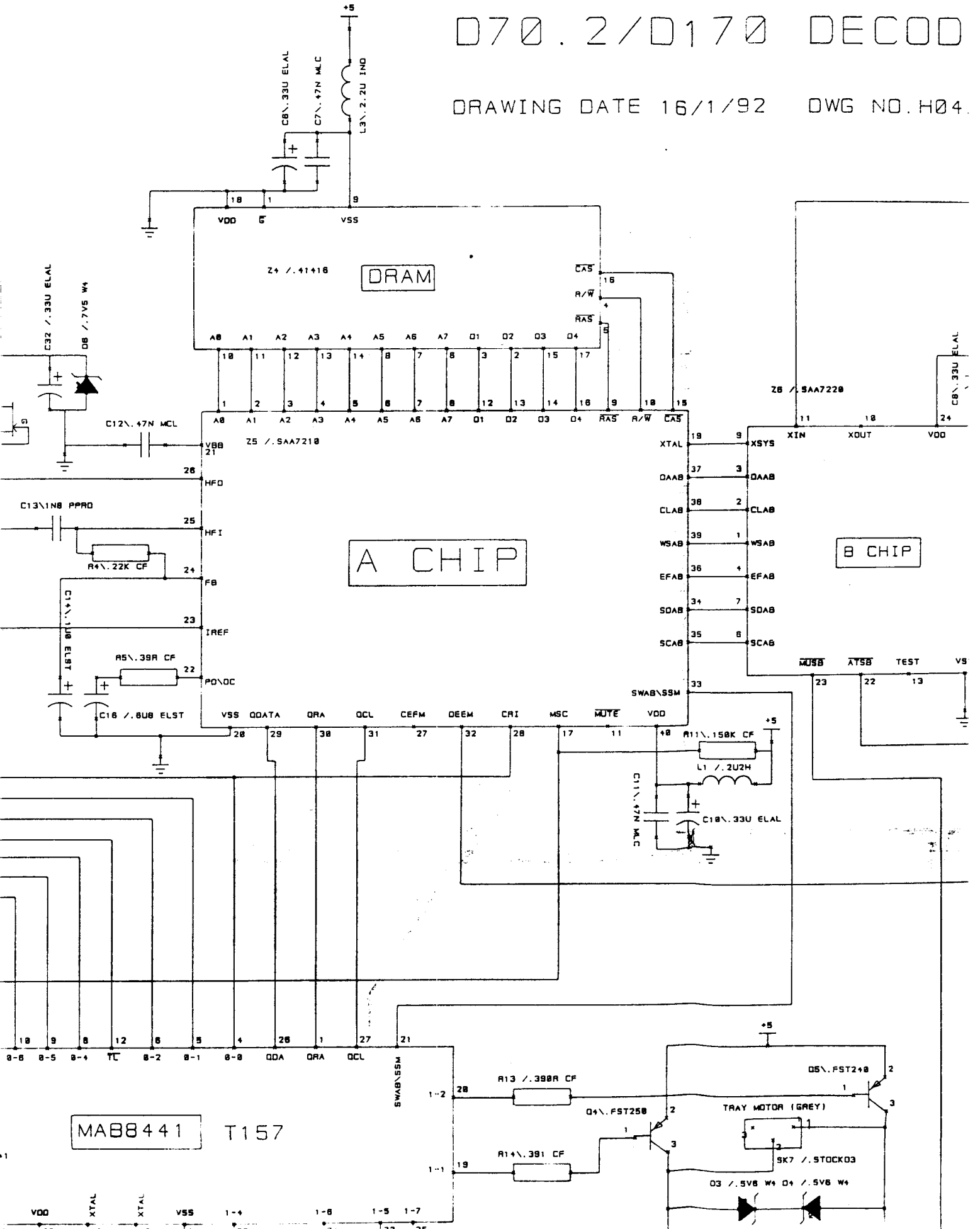
COM4/COM1 MK2

MAB8441 T157

Z7 / .8441

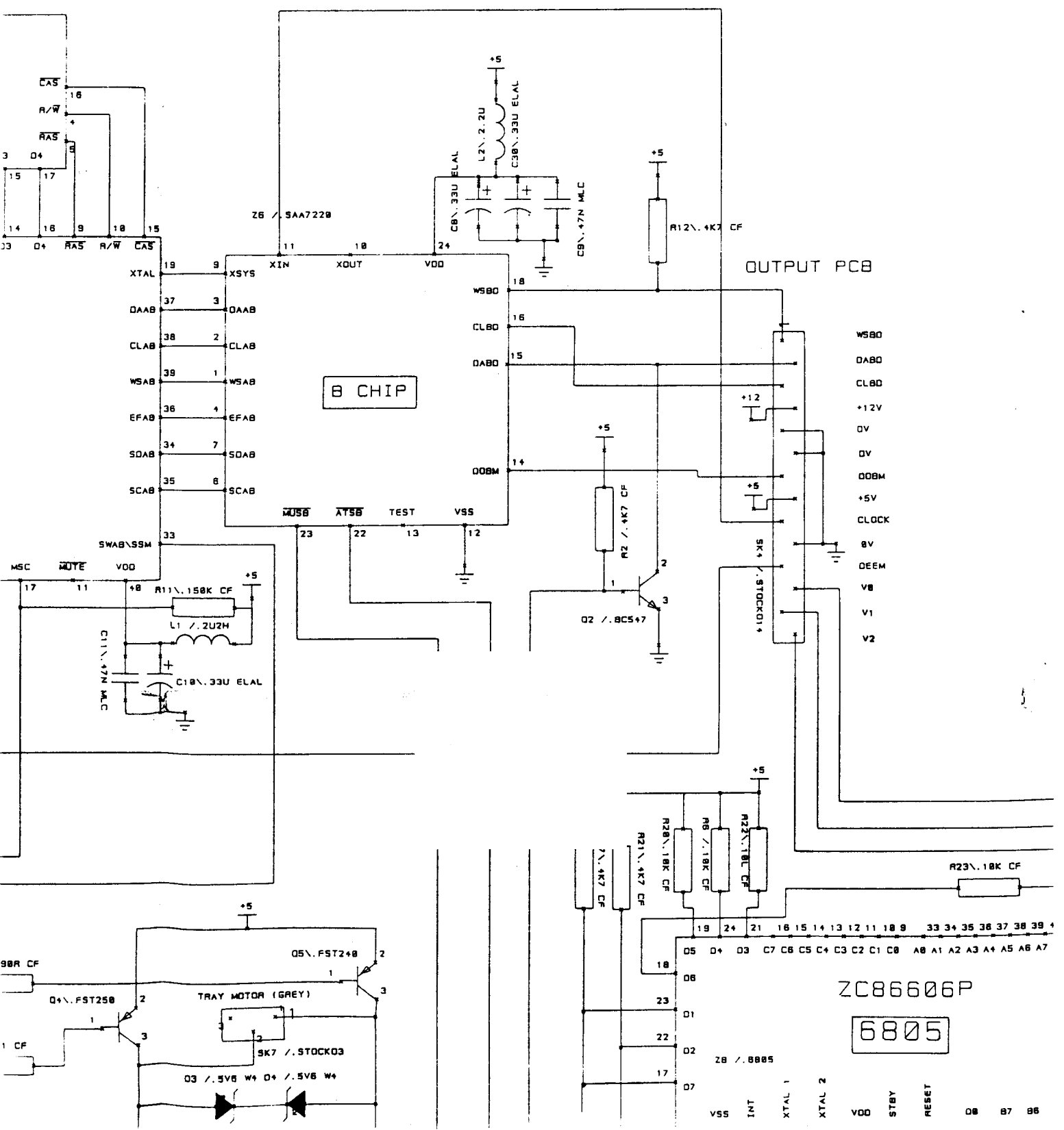
070.2/0170 DECOD

DRAWING DATE 16/1/92 DWG NO.H04.



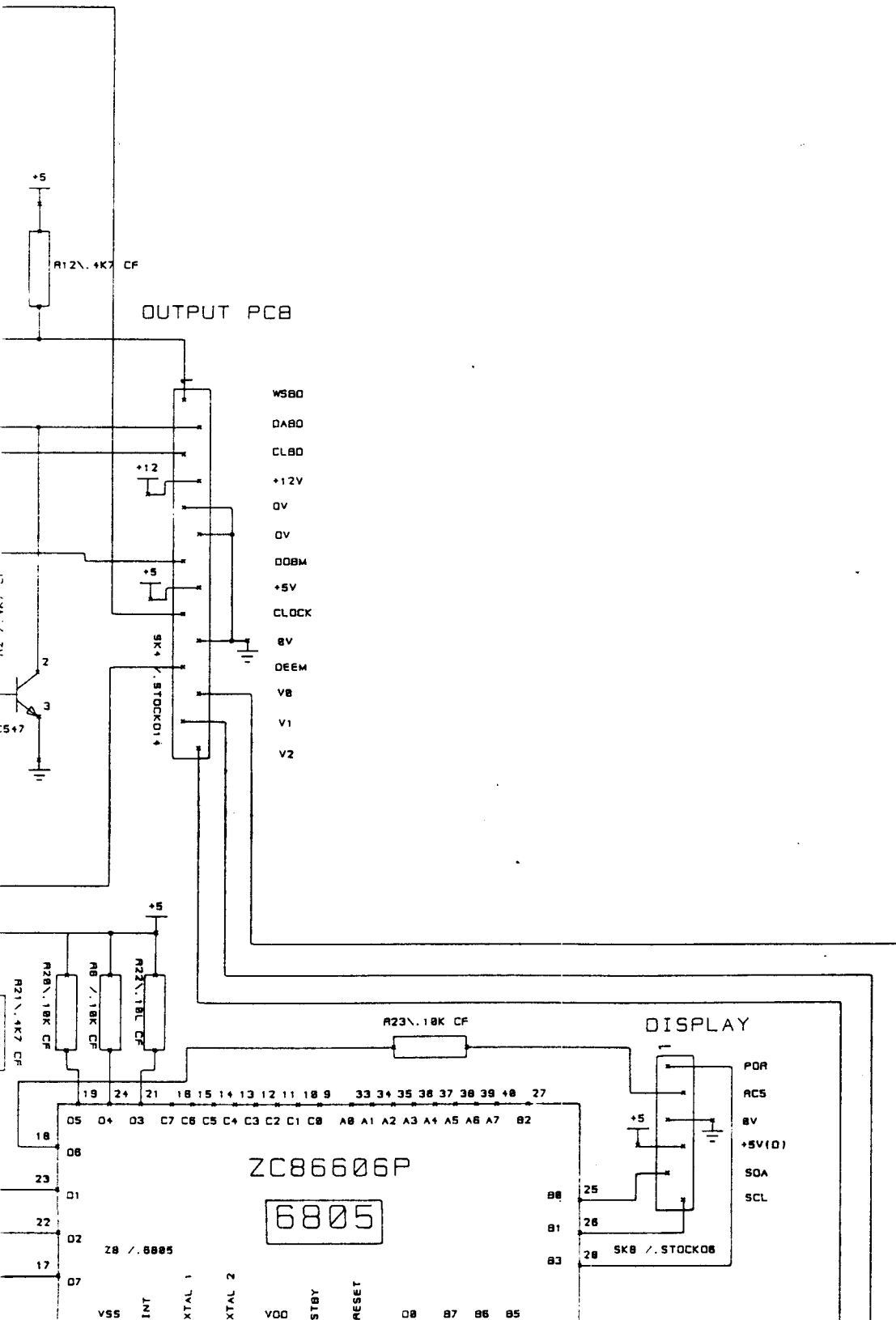
. 2/D170 DECODER CIRCUIT ISSUE

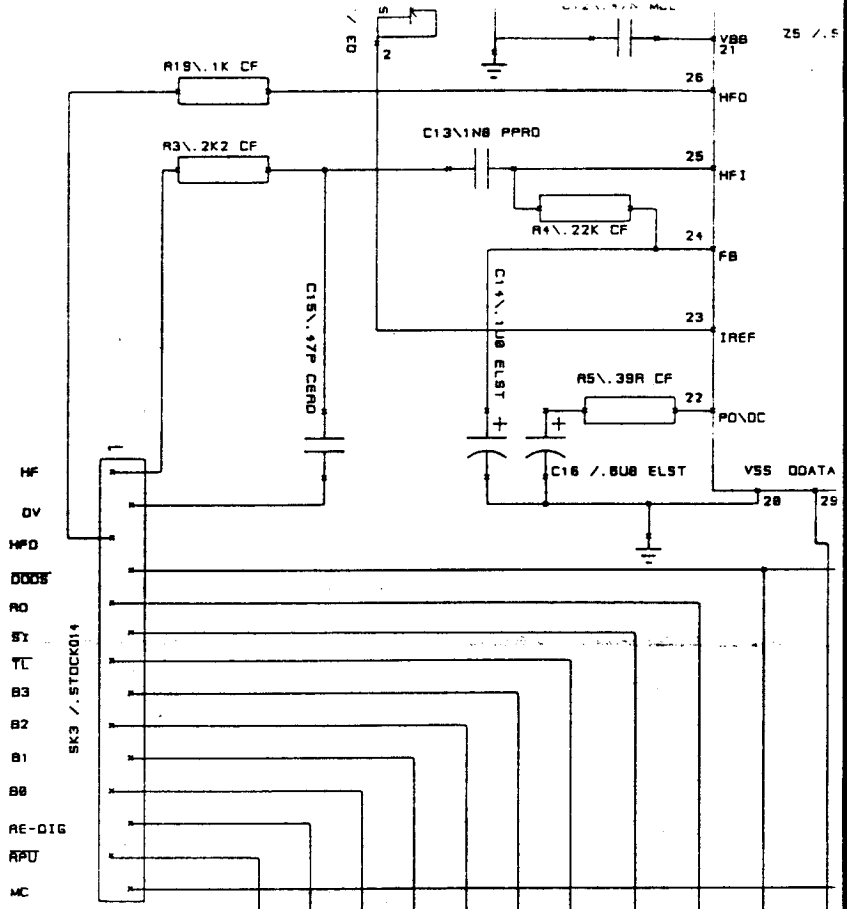
DATE 16/1/92 DWG NO. H04/0006 SHEET 2 OF 3



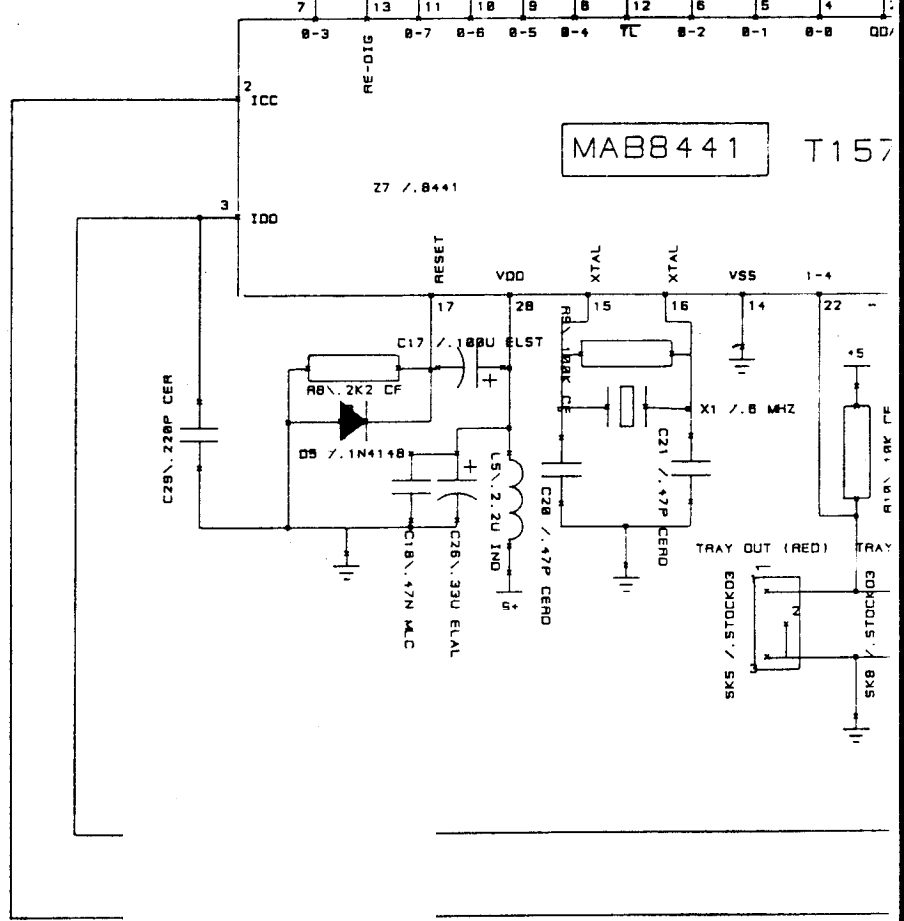
CIRCUIT ISSUE 02 FEB 1990

SHEET 2 OF 3





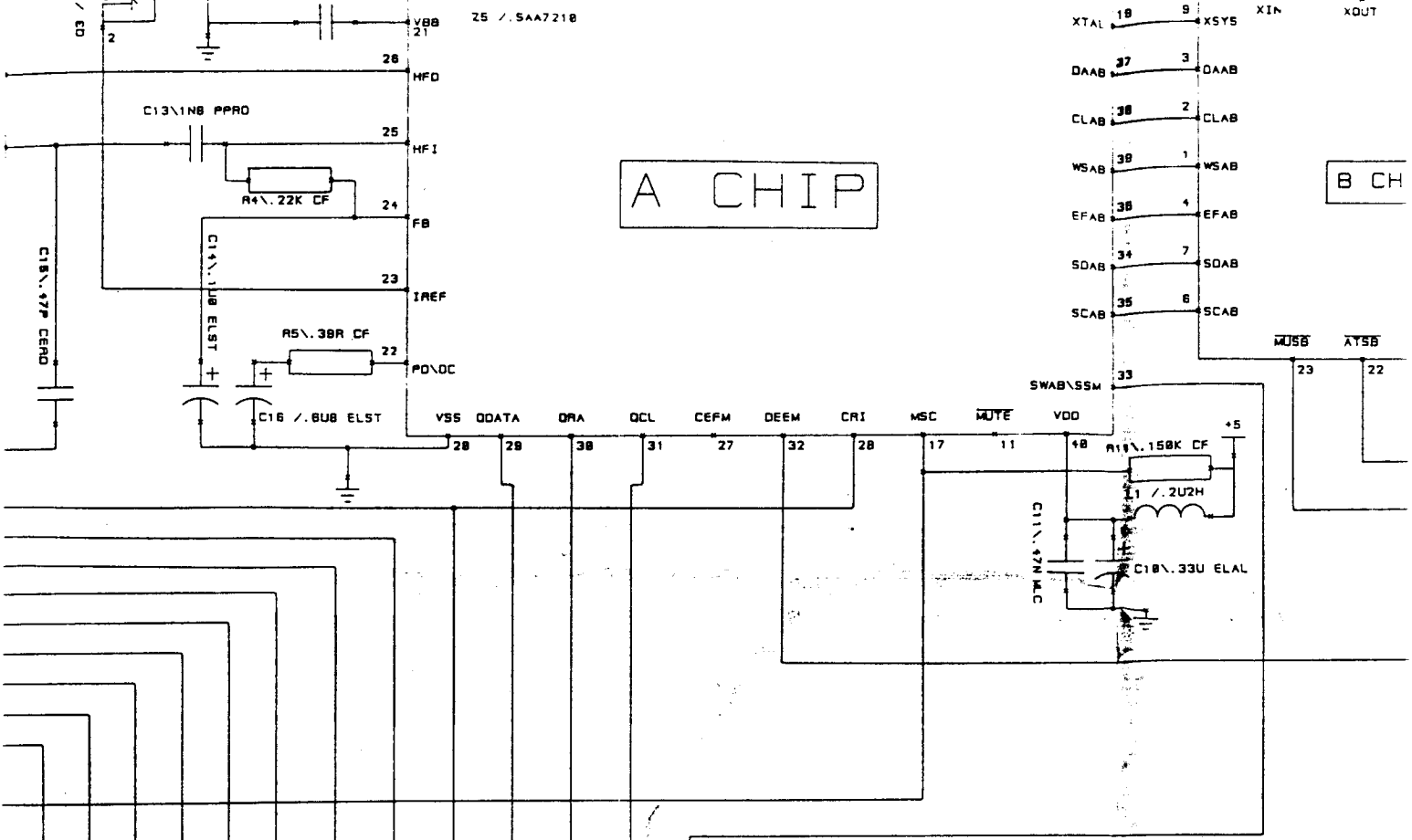
CDM4/CDM1 MK2



Z5 / 5AA7218

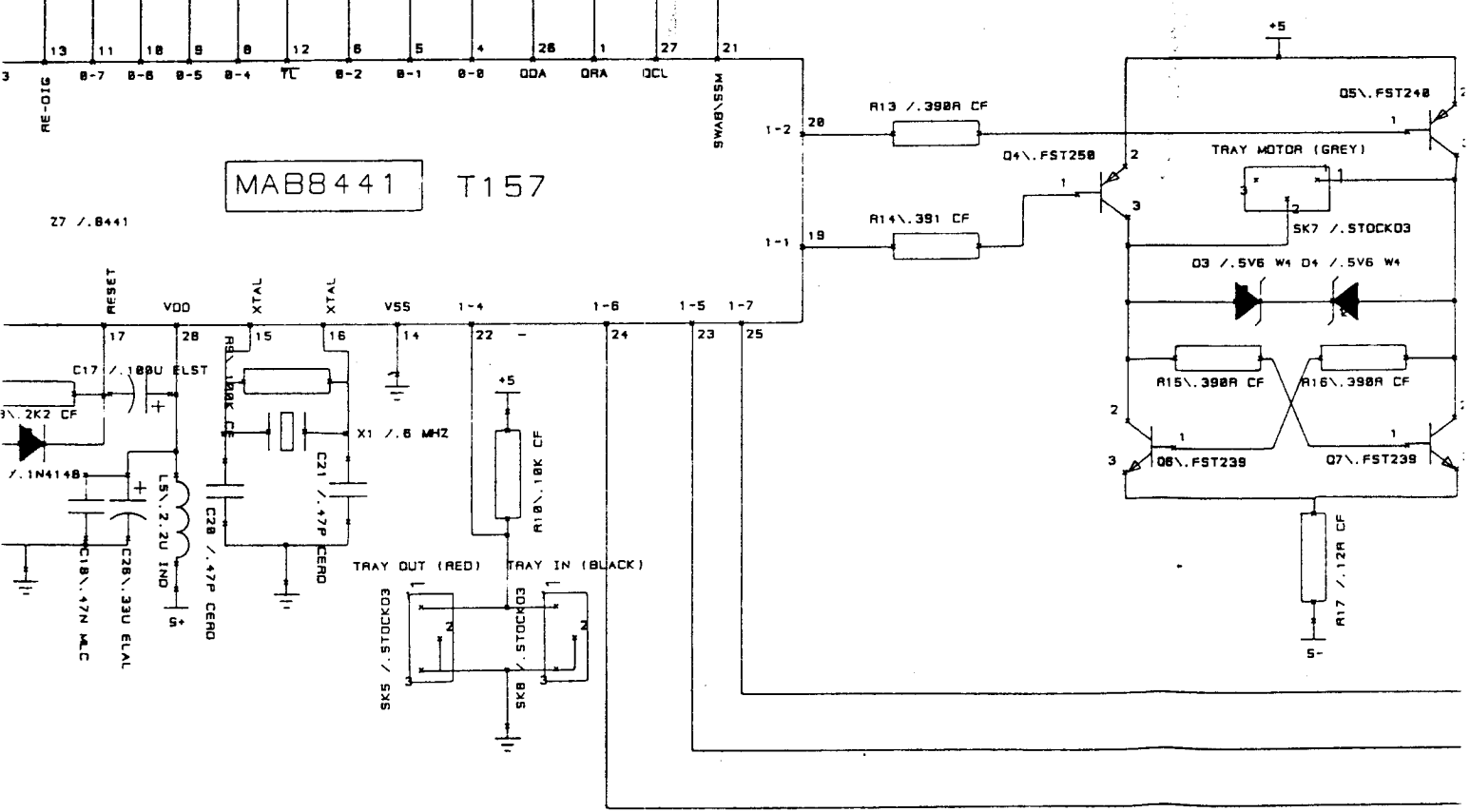
A CHIP

B CH

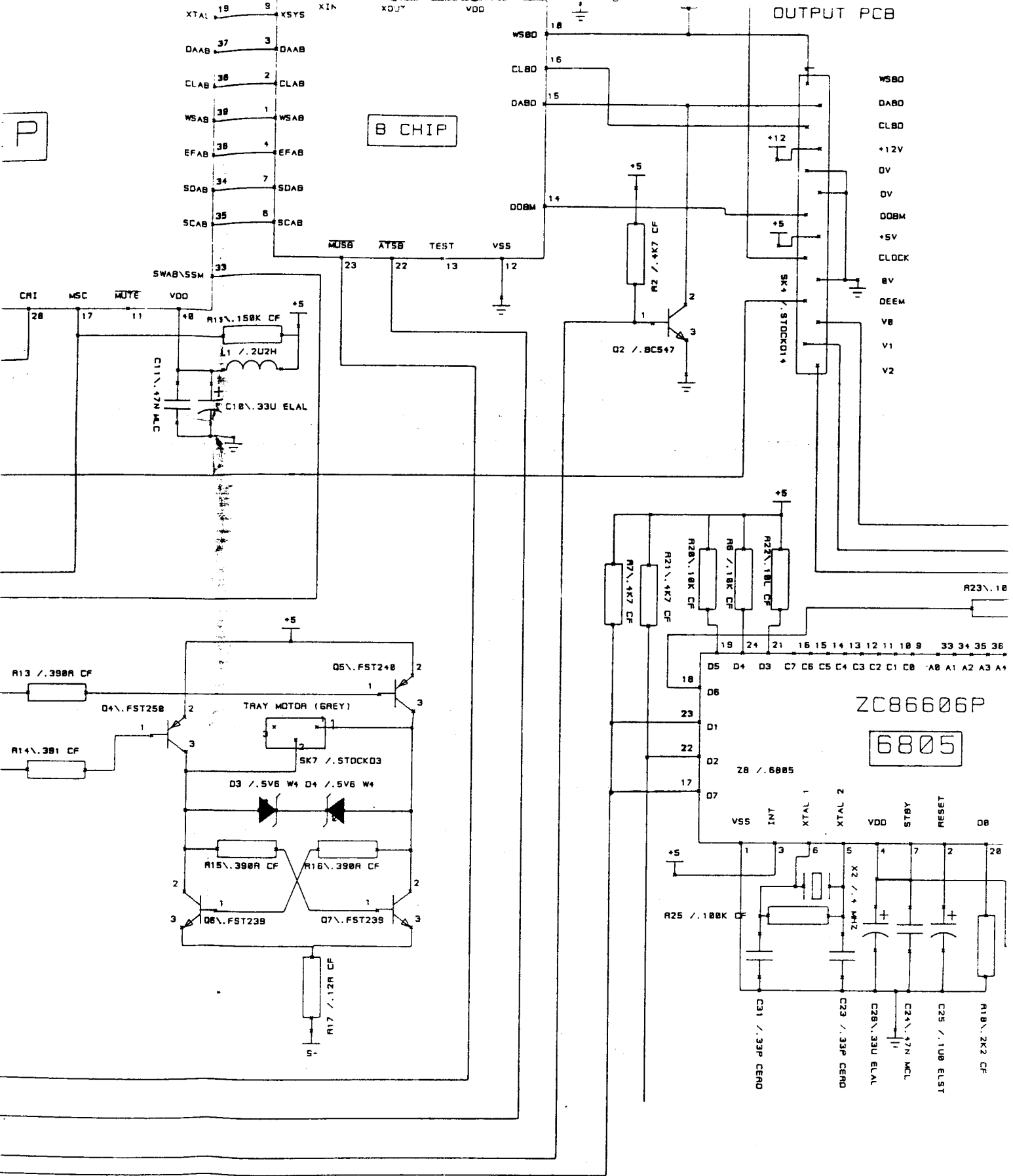


MAB8441 T157

27 / .8441



P



OUTPUT PCB

