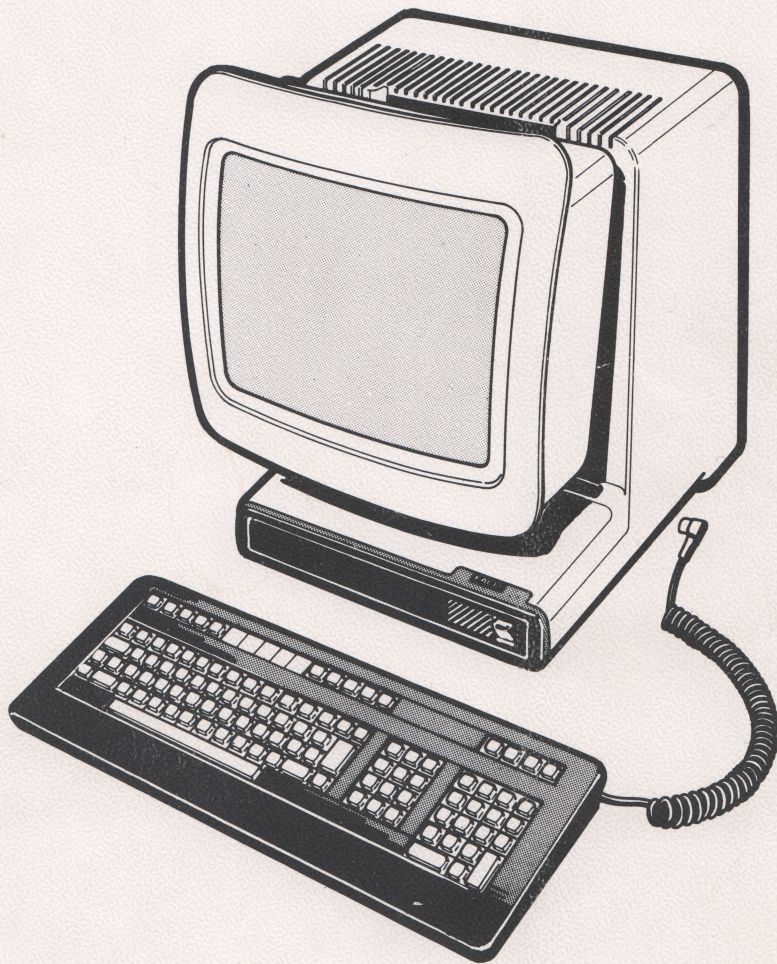


# FACIT

**SERVICE**



**➔ SERVICE INSTRUCTION**

**☐ SPARE PARTS LIST**

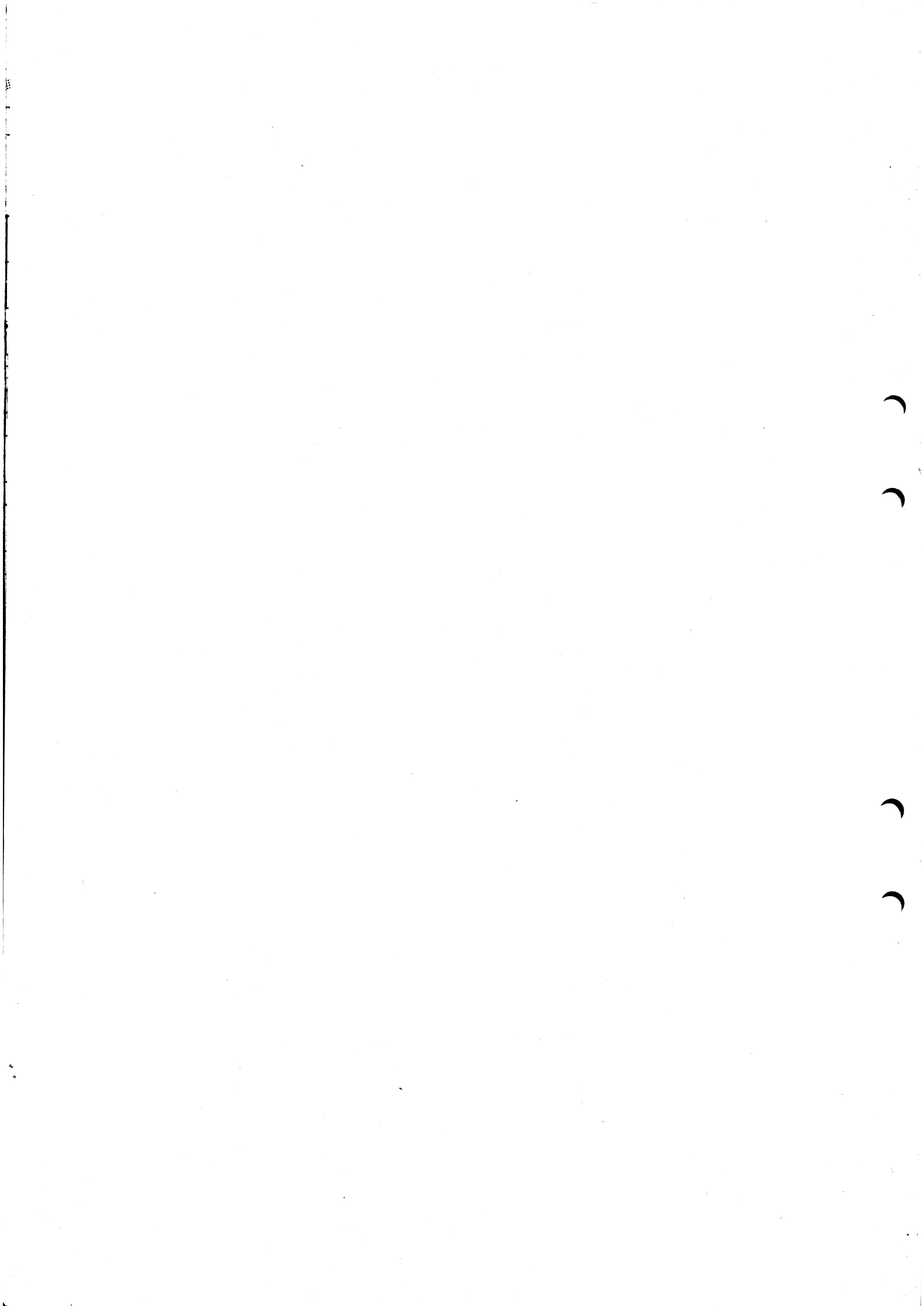
**4440  
TWIST**

**VIDEO TERMINAL**

**Edition 1**

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**Facit AB. Service Support Department. S-597 00 ÅTVIDABERG. SWEDEN**



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## SCOPE OF THE MANUAL

This manual is intended for the maintenance group and contains information about faultfinding, repair and adjustments. Other available documents are:

Technical description Publ.No. 1103 89 34-00

Operators guide Publ.No. 1103 89 35-00

1 INTRODUCTION

As with any electronic equipment, all standard safety precautions should be observed while servicing the Facit TWIST Video Terminal. Any servicing which requires opening of the cabinet must be performed only by qualified service personnel.

\*\*\*\*\*

## W A R N I N G

Hazardous voltages are exposed when the cabinet is removed. Use extreme caution when servicing the monitor assembly or power supply. Under certain conditions dangerous potentials may exist even when the power is off due to the cathode ray tube.

\*\*\*\*\*

In the text and on the schematics, locations are referenced in the following manner:

Example:

Reference from CPU to CRTIC schematic.

Signal name, schematic (page no.) and coordinates on schematic.

SIGNAL NAME	PAGE	COORDINATE
WR.WAIT	(2	E2)

1.1 DESIGN

The Facit TWIST Video Terminal consist of five major physical subassemblies:

- the Main Logic Board (MLB)
- the Data Graphic Display tube (DGD)
- the Monitor Control Boards (MCB)
- the Power Supply (PSU)
- the Keyboard (KBD)

The majority of serviceable components are on the Main Logic Board, which is mounted to the rear panel and provides six (6) major circuit functions:

- 1 Microprocessor control
- 2 Synchronization generator
- 3 Address multiplexor
- 4 Display memory
- 5 Input/Output interfaces
- 6 EAROM control

The switching power supply is built up on one printed circuit board. The PSU is mounted to the rear cover and contained in an aluminium case.

The Monitor Control is built up on two (2) Printed Circuit Boards. One board is mounted to the Display Tube Socket Connector and the other board to a support bracket at the bottom of the Cabinet.

The keyboard is using a masked programmed 6801 type microprocessor. The communication with the terminal Main Logic is performed through the flexible coiled cable via a serial (V24/RS-232) interface using 2400 baud. Power is fed to the keyboard from the terminal through the same cable.

1.2 SPECIFICATIONS

## MONITOR

Display format: 24 lines, 80char/line + a 25th status line or "twisted"  
72 lines, 80char/line + 73rd status line

No of pages: 3 pages of 24 lines or  
1 page of 72 lines

Screen: 15 inch white or amber, non glare high resolution 40MHz monitor, 65Hz refresh rate

Character set: 128 + 128 ASCII

Character cell: 20 x 16 matrix (landscape)  
16 x 7 matrix (portrait)

## INTERFACES

One I/O port and one intelligent printer port with: CCITT V.24/RS-232-C 20mA Current loop (option)  
V.11/RS-422 (option)

Data rate: 75-19200 bps split speed

## LINE PROTOCOLS

XON/XOFF  
Ready / Busy  
No protocol

## COMMANDS PROTOCOLS

Soft selection :  
ANSI  
NON-ANSI  
CUSTOM MODE, soft definable

## KEYBOARD

Superslim keyboard with integrated palmrest, two tilt angles and 102 keys totally (9 national versions available)

Separate cursor and editing block (12 keys), soft definable in Custom mode

Separate complete (18 keys) numeric block

Separate function keys (12 soft definable keys for a total of 36 different function strings)

## FUNCTIONAL HIGHLIGHTS

Block mode/character-by-character mode  
Full editing  
Multitude of character and field attributes  
Scrolling region and vertical margins  
Extended printed handling

## SELF TESTS

Power up self test  
Diagnostic self test  
Diagnostic status line  
Transparency mode

## 2 RECEIVING, UNPACKING AND INSPECTION

The Facit TWIST terminals are carefully packed to insure safety during shipment, however, when the terminal arrives check the following;

- the invoice against your original purchase order
- examine the outside of the shipping container closely for sign of abuse or damage in transit

A crushed or punctured carton naturally calls for a careful inspection of the contents. If any damage is found inform the delivery agent.

### 2.1 POWER AND SIGNAL WIRING

The TWIST terminal power wiring consists of an AC power cord connected to the terminals mains inlet.

The Keyboard is connected to the display unit by a flexible coiled cable.

The Interface cable(s) are provided by the customer.

### 2.2 POWER-UP PERFORMANCE CHECK

Inspection before power-on.

- check that the model plate corresponds to order and packing case marking.
- check for proper keyset
- check that accessories and documentation are supplied
- check that the power cable supplied corresponds to your national standard. Make sure that proper grounding is performed and that proper voltage is selected

In order to avoid possible damage to the Line Driver/Receiver circuits, because of eventual high voltage discharge through the interface cable, see to it that the terminal is connected to a mains outlet with proper grounding before the connection to any data source is made.

#### Power-On

To perform this check you need a Test gear such as Facit Text Generator or similar.

- allow for a few minutes of warm up.
- set communication parameters to confirm with the external test device.
- if during Power-on a suspected fault is detected, the bell will ring and the ERROR CODE is displayed. If the terminal halts, the processor has determined that the scratchpad memory is defective and no further tests are attempted.

Note The TWIST terminal will display the software version code if the keyboard is disconnected before Power-on.

### 2.3 ERROR CODES

- 2 DISPLAY MEMORY FAILURE
- 3 EAROM PARITY ERROR
- 6 EPROM CHECK SUM ERROR

If a fault is recognized see section 7 for details.

### 3 INSTALLATION

The Facit TWIST should be installed on a firm surface. The display unit tilts on its stand to allow the user to optimize the viewing angle. The keyboard connector plugs into the socket at the right side of the display unit. The keyboard may then be positioned to best suit the user.

Make sure that the mains supply lead is terminated in a suitable plug for the local power outlet (a ground connection must be incorporated). See section 2.2.

#### 3.1 ACCESS TO THE MAIN LOGIC BOARD IN DISPLAY UNIT

Access to the MLB is gained as follows:

- 1 Switch off the unit and disconnect from the mains supply. Ensure that there is a stable flat surface behind the unit, large enough to rest the back panel on, when it is folded down.
- 2 Unscrew the outer six (6) screws from the rear of the Display unit.
- 3 Cables connected to the rear panel are long enough to allow the MLB and PSU to be serviced without disconnecting the internal cables.
- 4 To refit the rear panel, first rise it and engage the three tabs at the bottom edge in their slots at the back of the main casing. Close the rear panel and secure it with the six securing screws.

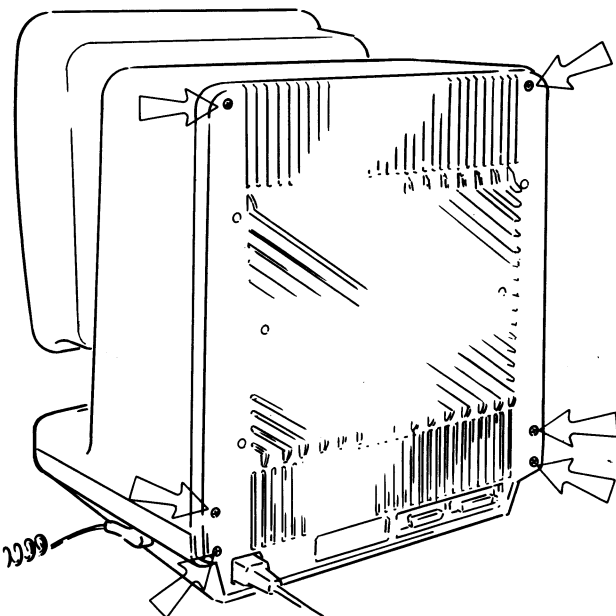


FIG 3.1 REAR PANEL DISASSEMBLY

#### 3.2 ACCESS TO THE KBD LOGIC BOARD

- 1 Switch off the unit and disconnect the Keyboard from the Display unit. Turn the Keyboard over and remove the six screws holding the top and bottom cover together.
- 2 Separate the two halves to obtain access to the printed circuit board.
- 3 To reassemble the Keyboard, put the two halves together. Before securing the screws, check that the printed circuit board fits into the slot at the front of the bottom plate and that the circuit board is positioned correctly so that all keytops move free from the top cover.

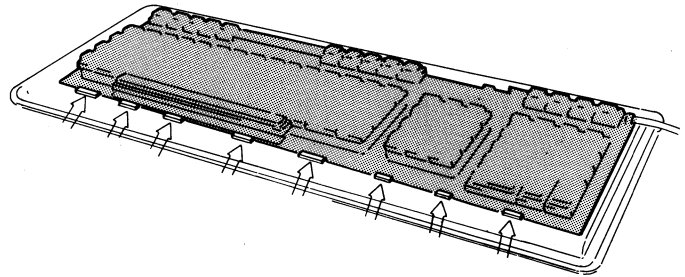
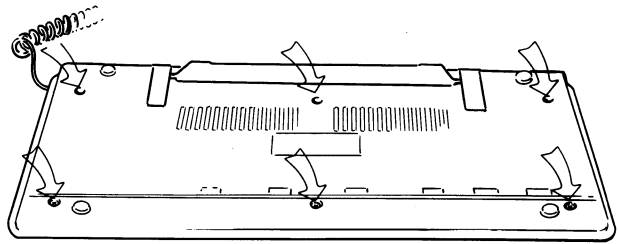


FIG 3.2 KEYBOARD DISASSEMBLY

#### 3.3 KEYCLICK AND BELL VOLUME ADJUSTMENT

The volume potentiometer is accessible through the rear panel, see Fig 4.1, for details.

#### 3.4 JUMPERS

The Main Logic Board has seven pug-in jumpers, which are used as links to alter certain interface functions on the board as detailed in the table below. In some cases, e.g. W5, the jumper socket has three pins. The connections made possible by this arrangement are referred to as W5:1 or W5:2, as shown in Fig 3.4.

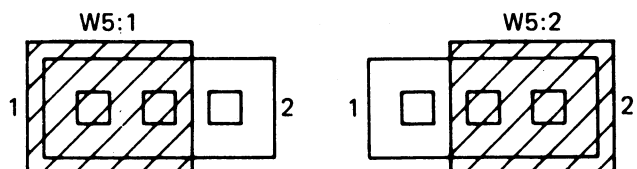


FIG 3.4 3-pin Jumper Notation

### 3.4.1 MLB JUMPERS

JUMPER	FUNCTION
W1	FACTORY USE ONLY
W2	+5V TO PIN 18 IN THE I/O CONNECTOR
W3	PIN 19 OR PIN 20 AS READY/BUSY IN THE PRINTER CONNECTOR
W4	SERVICE USE ONLY (SEE TABLE)
W5	FOR FUTURE USE/SELECT 8k RAM
W6	FOR FUTURE USE/SELECT 8k RAM
W7	FOR SYSTEMS AND SERVICE USE ONLY (SEE TABLE)

W4	W7	FUNCTION
1	1	Normal
0	1	Factory Test Mode
0	0	Test Request Mode
1	0	EAROM Save Inhibit

### 3.4.2 KBD JUMPERS

JUMPER	FUNCTION
W2 W3 W4 W5 W6	
1 1 1 1 1	SWE
1 1 1 1 0	NOR
1 1 1 0 1	DAN
1 1 1 0 0	GER
1 1 0 1 1	FRA
1 1 0 1 0	UK
1 1 0 0 1	SPA
1 1 0 0 0	US
1 0 1 1 1	SWISS

The jumpers on the Keyboard PCB are actually wire links, which are cut according to the National version requirements as follows (0 = cut).

## 4 INTERFACE INFORMATION

The interface connection at the rear of the terminal are shown below.

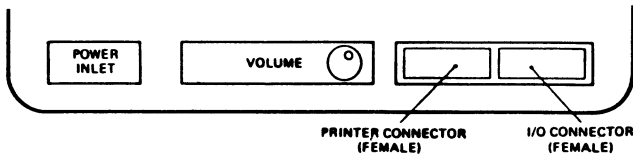
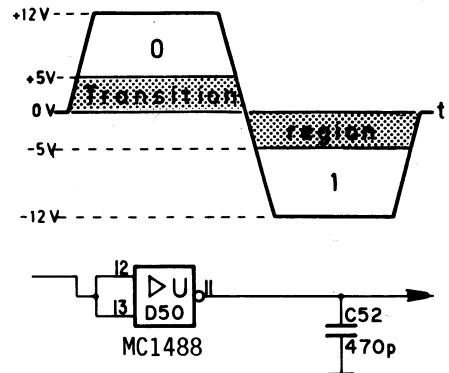


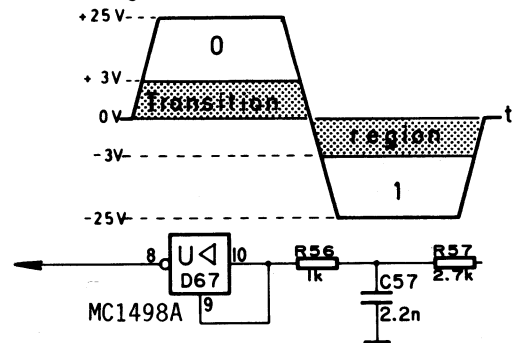
FIG 4.1 Location of interface connection volume adjustment

## 4.1 V.24/RS-232-C SIGNAL LEVELS

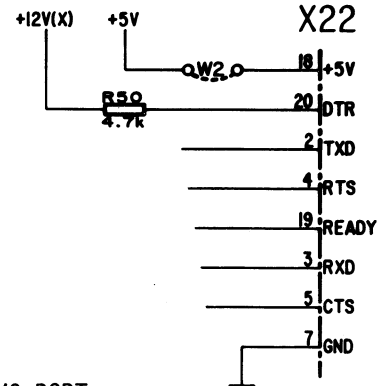
Transmitted signals:



Received signals:

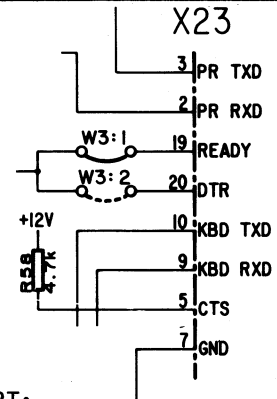


## 4.2 I/O CONNECTOR PIN ASSIGNMENTS



NOTE I/O PORT:  
Pin 20, +12 Volt (internal pull up to +12V through a 4.7k resistor)

## 4.3 PRINTER CONNECTOR PIN ASSIGNMENTS



NOTE PRINTER PORT:  
Pin 5, +12 Volt (internal pull up to +12V through a 4.7k resistor).  
Pin 9 and 10 are used by the factory. For testing purposes. TTL level data from the keyboard are present for factory test purposes only.

## 5 SET - UP MODE

### 5.1 SET-UP MODE STRUCTURE

The SET-UP mode is used to configure the operating parameters in the Facit TWIST system. This Mode contains two different sets of menus- SET-UP A,B,C and Custom Mode SET-UP 1,2,3,4. Each menu contains a number of "soft switches" that can be changed by the operator (and in some cases also by the host computer). The vast of possibilities that the Set-up mode offers are described in details in the Technical Description. In this chapter only the service related Set-Up parameters are discussed.

### 5.2 SWITCH GROUP C.3 & 4 (STATUS LINE)

Set-Up Switch Groups 3 and 4 control the configuration of the Status/Diagnostic line which will appear at the bottom of the screen display. The Status Line must be enabled according to the settings of Switch 3.2 in set up B, for this information to be displayed.

#### 5.2.1 USER STATUS, SWITCH 3:1

Default setting is (0 = User). This switch must be set to 1 for users message to be displayed at the bottom of the screen. With the switch set to 0, status and diagnostic information (as selected in set-up C) is displayed on the Status Line.

#### 5.2.2 STATUS LINE- CURSOR POSITION, SWITCH 3:2

With this feature enabled (Switch = 1, Default) the current cursor position, defined in terms of the page, row and column will be displayed on the Status Line.

#### 5.2.3 STATUS LINE-TIME, SWITCH 3:3

With this feature enabled (Switch = 1, Default) the real time will be displayed in a 24 hour format on the Status Line. The time readout may be set by the host using the Load Command.

#### 5.2.4 STATUS LINE - TERMINAL MODE, SWITCH 3:4

The Default setting is "Enabled". The indication will be:  
Mode: Insert ON/OFF Keypad=Appl/Num.  
"Insert" indicates whether the terminal is in "insert mode" or in "replacement mode".  
"Keypad" indicates whether the numeric keypad is set for "Keypad numeric" or "Keypad application" mode.

#### 5.2.5 STATUS LINE - PRINTER STATUS, SWITCH 4:1

With this feature enabled (Switch = 1) the type of Print Operation currently selected is displayed on the Status Line.

#### 5.2.6 STATUS LINE - TRANSMIT MODE, SWITCH 4:2

With this feature enabled (Switch = 1) the type of Send Operation currently selected is displayed on Status Line and is displayed as follows:

Xmit: OFF/char/all/part (one of this only)

"OFF" indicates local mode (Off-line)

"char" indicates On-line character-by-character mode

"all" indicates "Block mode" and "send all". If "all" is displayed in reverse video, that indicates that format mode is on.

"part" indicates "Block mode" and "send partial" if "part" is displayed in reverse video, that indicates that format mode is on.

For Status Line "Transmit mode" a flashing entry indicates an operation in progress.

#### 5.2.7 STATUS LINE - INTERFACE MONITOR, SWITCH 4:3

With this feature enabled (Switch = 1) the Status Line will display the following:

Interface: P=Rdy/Busy I/O=XON/XOFF CTS=low/-high

P (=Printer Port) displays "Bsy" if the last protocol character from the Printer was "XOFF" or if the pin 19 from the printer is low. Otherwise it displays "Rdy".

I/O (=I/O interface) displays the last received protocol character from the host.

CTS (=Clear To Send) displays whether pin 5 in the I/O interface is high or low.

#### 5.2.8 STATUS LINE - BUFFER %

With this feature enabled (Switch=1) the number of characters in the input buffer is displayed in a Bar-Graph format. There are 8-blocks on the graph which fill from left to right as the buffer is loaded (up to a maximum of 256 characters). When the first block position is filled there are between 1 and 32 characters in the buffer. For each additional 32 characters in the buffer, another block in the bar graph is filled in. When the buffer contains 160 or more characters, the bar graph appears in reverse video and blinks. If the buffer over-



Error Marker is inserted in the data stream and hence displayed on the screen. If it happens is it very likely that there is a protocol problem, which must be investigated.

5.3 TRANSPARENCY MODE- GROUP C, SWITCH 2:2

When this switch is set to 0 (Default value=0), the terminal displays only normal displayable characters. When the switch is set to 1 any control codes (Hex 00 to 1F and 7F) are displayed on the screen in reverse video as a \* followed by the corresponding alpha character, e.g. Control A (Hex 01) is displayed as <A>. The Commands are not obeyed, so that the terminal displays a continuous string of intermixed control codes and characters.

5.4 CUSTOM MODE SET-UP

Custom Mode Set-Up 4 contains some very system dependent functions and re-assignment of function keys and editing keys. This may cause some problem for the service technician, therefore, check this set-up mode prior to any troubleshooting.

6 GENERAL BLOCK DIAGRAM DESCRIPTION

6.1 MICRO-PROCESSOR CONTROL UNIT

The Facit TWIST terminal is based upon the Z80A Microprocessor. The principal function is to decode each character as it is received (from the host computer or from the keyboard), detect characters and character sequences representing terminal commands, and obey these commands. The microprocessor also performs background tasks of keyboard scanning, character and cursor blinking, bell generation, loading the display refresh RAM starting address for each of the display rows, and various other real-time functions. The microprocessor controls all communication on the CPU bus, reading all data from the EPROMs, the EAROMs, display refresh RAM, the I/O DART, the keyboard, writing to the display refresh RAM, DART, CTC, CRTC, EAROMs, and various hardware latches. The 2k x 8 scratchpad RAM is part of the Screen MAP RAM.

A block diagram of the Microprocessor control unit is shown in Fig 6.1

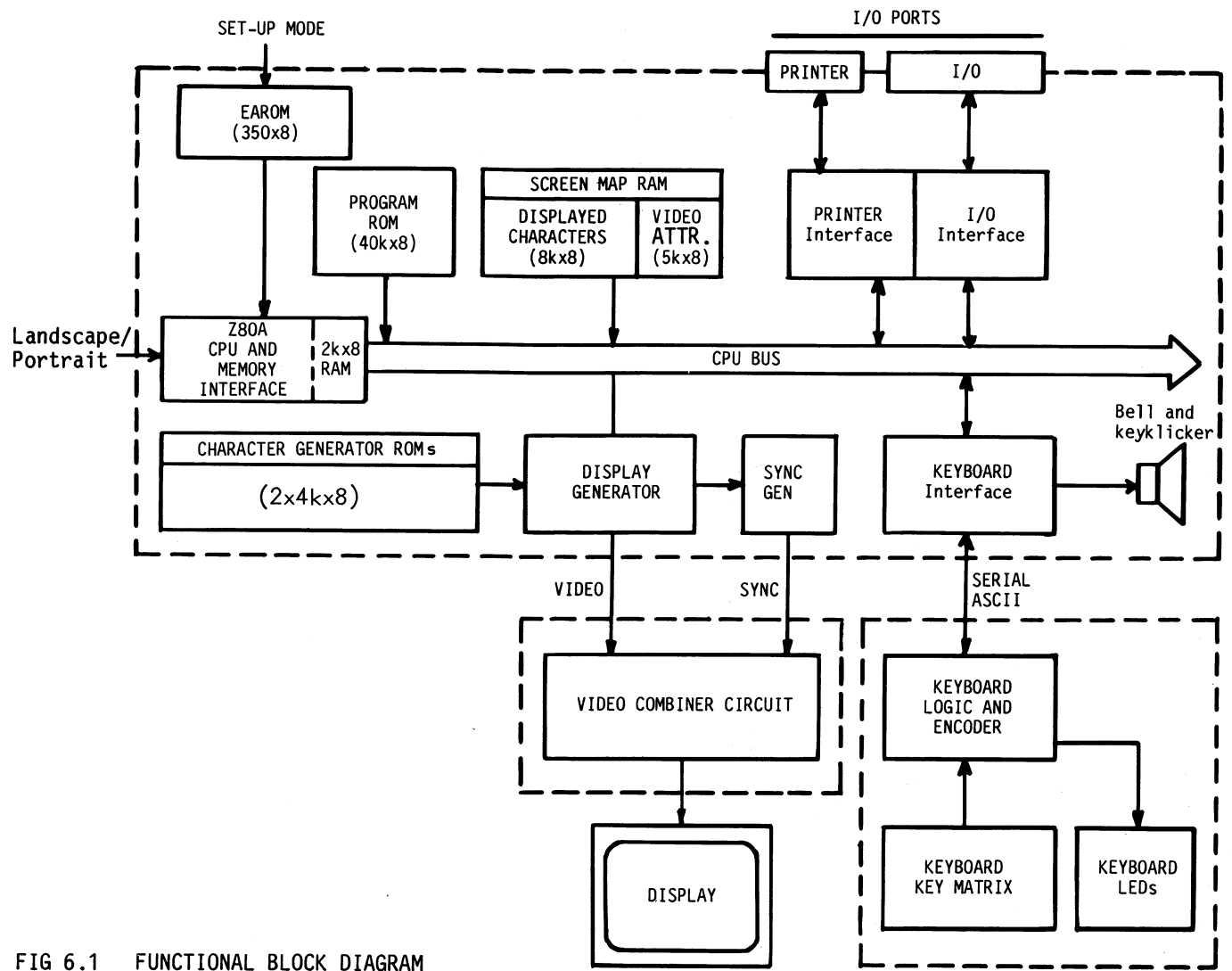


FIG 6.1 FUNCTIONAL BLOCK DIAGRAM

### 6.2 DISPLAY REFRESH MEMORY

The Display Refresh memory stores the ASCII code and Video Attribute status of each character to be displayed on the screen. The Facit TWIST has 8k 13 bits word of display memory to provide 3 pages of memory in the Flip Page mode, or one page of memory in the Big Page mode. Access to the display memory by the CPU (to write and read date) is controlled by the ADMU (Address Multiplexor circuitry), and the CRTIC circuitry.

### 6.3 SYNCHRONIZATION GENERATOR

The sync generator circuit is based on a 68B45S and is synchronized to the CPU by using the same clock pulse. The CRTIC is programmed by the CPU to produce the timing signals required to control the Video generator and ADMU in both Landscape and Portrait mode.

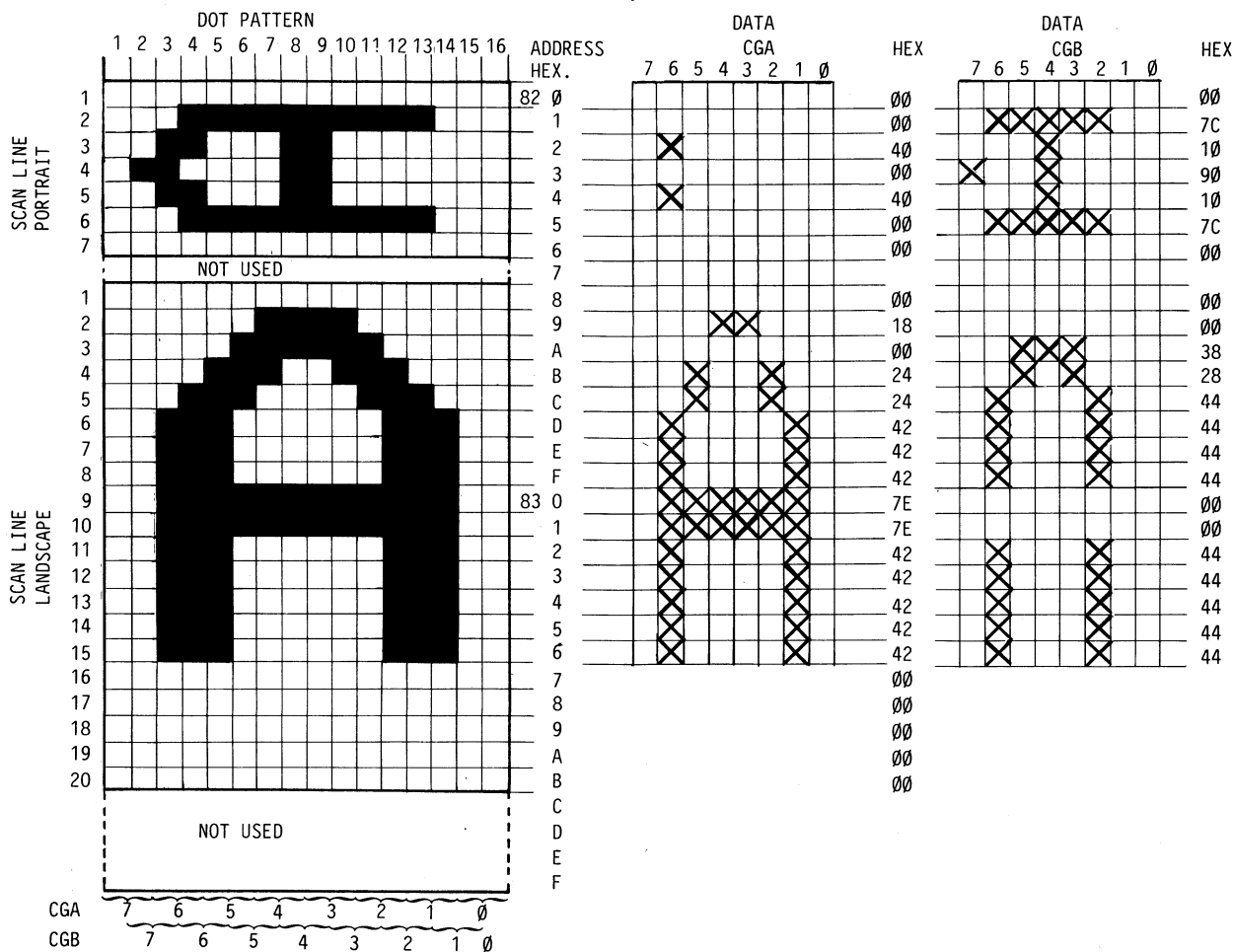
### 6.4 VIDEO GENERATOR

The Video generator uses the outputs of the sync generator and the display memory circuits to create the appropriate video signals for each character to be displayed. The ASCII character code from the display memory, the scan line count, and the double high/double wide control lines are combined to generate the

The sync generator also generates the following timing signals required to:

- provide shift and load commands to the video shift registers.
- interrupt the Z80A.
- indicate to the video generator the presence of double width and or double height character rows.
- provide count and load pulses to the row and column counters.
- control of the display serial data.

address in the character generator EPROM where the dot pattern for the character to be displayed either in landscape mode or portrait mode is stored. The dot pattern is then converted to serial form by the video shift registers and combined with the attribute data before being sent to the monitor.



## 6.5 INPUT/OUTPUT INTERFACE

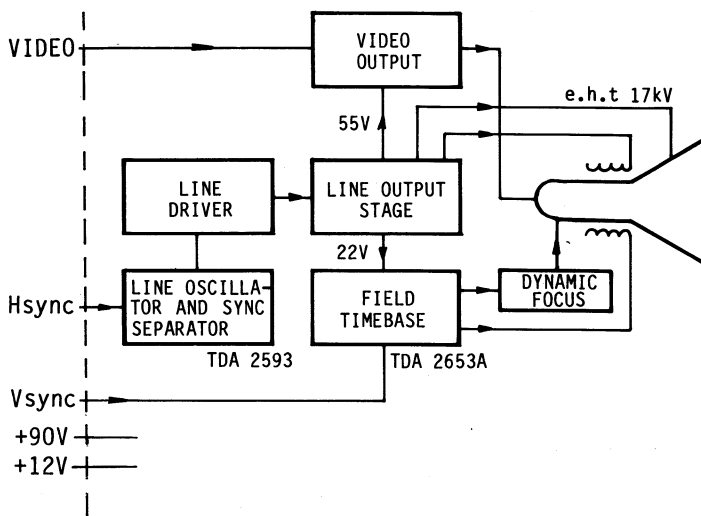
Communication between the Facit TWIST terminal and the host computer and local printer is passed through bidirectional, asynchronous serial V24/ RS-232-C ports. Two dual channel DARTs perform the parallel to serial data conversion required to adapt and synchronize the terminal's internal parallel data to the serial format of the external devices. Communication parameters such as data rate, parity, and word length are selected by the operator in the SETUP mode, and stored in the EAROM. The CPU reads these parameters from the EAROM upon power-up, and uses this data to configure the DARTs and the CTC, the baud rate clock generator.

## 6.6 KEYBOARD SYSTEM

The keyboard is a separate item connected to the display unit by a flexible coil cable. Communication parameters are fixed to 2400 baud, 1 start bit, 8 data bit, and no parity. To simplify the connection, the keyboard encoding is performed on the keyboard itself producing a serial code which is received by a DART on the terminal Main Logic Board. The keyboard logic is based on the 68701 microprocessor used on a masked program. National character versions are jumper selectable.

## 6.7 MONITOR ASSEMBLY

The Facit TWIST Monitor is a full-page 15 inch, 110 degree data graphic display unit operating at a line frequency of 39,21kHz, and a field frequency of 63,8Hz. The Video bandwidth is about 40MHz. Apart from dynamic focus, which is applied to both axes, standard television circuits are used. The picture tube is a high-resolution Data Graphic Display tube operating in non-interlaced mode. The number of visible scan lines are 540, and the total number of scan lines are 621. The unit accepts positive going video and sync at TTL levels. The unit is energized from the power supply using +90V/0.5A and +12V/0.1A.



## 6.7.1 Monitor Control Board

The circuit of the complete DGD unit is shown in Fig 6.7. The main stages of the monitor control circuit board are described below.

### 6.7.1.1 Line output stage

The line output stage consists of an orthodox parallel efficiency diode scanning circuit. It comprises the transformer T1, a line output transistor, V102, and a parallel efficiency diode V1. The line deflection coils L2 are directly driven (effectively in parallel with the line output switch).

The flyback capacitor C15 gives a nominal flyback time of 4 $\mu$ S. A symmetric scan linearity correction is achieved with the line linearity coil L1, and symmetric linearisation is obtained from the 820nF S-correction capacitor C21.

The line output stage is energized from the power supply using the +90V output.

The decoupling network R19 a, b c, and C17 provides flashover protection for the line output transistor, and helps to stabilize the picture width against variations in beam current.

### 6.7.1.2 Line driver

The waveforms required to drive the line output transistor V102 are provided by a transformer-coupled driver stage. This comprises the driver transistor V101 and driver transformer T2. The line driver stage is energized from the same power supply as the line output stage but a separate decoupling network is used.

### 6.7.1.3 Line oscillator combination

The pulses required at the base of the driver transistor V101 are provided by a TDA 2593 line oscillator combination IC (D1). This IC provides the functions of coincidence detector, sync separator, and line oscillator. The oscillator timing components have been chosen for 32kHz operation, and fine frequency adjustments can be made via the variable resistor VR1. A flyback pulse, required for phase detection, is taken from the collector of the line output transistor V102. This pulse is fed to pin 6 of IC D1 via a shaping network which provides phase adjustment of the video information via VR2.

#### 6.7.1.4 Field timebase

The field timebase functions are performed by the TDA2653A integrated circuit D2 and its peripheral networks.

This IC has a class B output stage incorporating thermal and short-circuit protection, which drives the impedance-matched field coils L3 in series connection. The +22V required to energize the field time base is generated by scan rectification of the voltage across windings 1 and 2 of the line output transformer. Field sync pulses at TTL levels come from the MLB to D2 pin 2.

#### 6.7.1.5 Video output stage

The DGD uses an emitter-driven video output stage with output transistor V105 and driver transistor V106. To minimize stray capacitance, the video amplifier is placed on the picture tube circuit board. The +55V supply line for the video output stage is obtained from windings 8 and 11 of the line output transformer. The D.C. level (black level) of the output should be set to about 43V via potentiometer VR6.

#### 6.7.1.6 Picture tube supplies

All supplies to the picture tube are derived from the line output transformer. The e.h.t. is generated within the special overwind, which is constructed in three layers with built in diodes, so that the D.C. e.h.t. voltage is available directly from the screw-type output terminal A special cable with built-in capacitance and top cap, containing a series resistor and a resistive e.h.t. bleed, is used to mate with this output terminal.

The grid 2 and focus voltage supplies are obtained by peak rectification of the line output transistor collector voltage. This line also provides the e.h.t. for the dynamic focus circuit. Separate voltage dividing chains are fitted for the grid 2 and focus supplies, the latter being returned to a negative supply to allow for negative focus voltages.

To ensure the best possible resolution, the picture tube is supplied with the maximum allowable grid 2 to grid 1 voltage of 700V. This gives a range cut-off voltages of 75 to 115V. Because of the low video output supply voltage, this cut-off range can be provided by the negative supply obtained by rectification of the voltage across windings 1 and 6 of the line output transformer (also used as the return voltage in the focus circuit). The picture heater supply is obtained from a winding of three turns on the line output transformer core opposite to the primary winding.

#### 6.7.1.7 Dynamic focus

The difference in the electron beam path lengths for axial beams and beams reflected to the corners of the 110 degr. tube produces slight variations in the focusing requirements. These are corrected by providing a parabolic dynamic focus voltage waveform in both line and field directions. This voltage increases with deflection, and has an amplitude about 250V for both frequencies.

The line parabolic waveform is obtained directly from across the S-correction capacitor C21. For field frequencies, a parabolic waveform is obtained by integrating and shaping the sawtooth voltage across the feedback resistor R61. The same amplifier circuit is used to amplify both waveforms to the correct level. Because of the voltage requirements of the dynamic circuit (up to 500V), this amplifier uses two video output transistors V103 and V104 connected in series. The base of the upper transistor is decoupled only for line frequencies so that the lower transistor amplifies only the field frequency component of the waveform and the upper transistor only the line frequency component. Both parabolic waveforms are taken from the collector of V103, and are A.C. coupled to the focus electrode of the tube. Because the electron gun is a unipotential type, the tube has a fairly flat focus characteristic. The amplitude of the dynamic focus can therefore be preset and adjustment should not be necessary.

#### 6.7.1.8 Picture shift

Picture shift is supplied in both the line and field directions by passing a D.C. current through the appropriate deflection coils. The required voltage for the line coils is obtained from transformer T3, diode V6, smoothing capacitor C19, and variable resistor VR3 which controls the amount of shift. The polarity of the shifting voltage may be reversed by the switch S2. The voltage of the picture shift in the field direction is obtained from the variable resistor VR 10 across the 22V line, and is set directly to the cold end of the field deflection coils.

It should be noted that the deflection coils are fitted with picture shift magnets. At the start of the adjustment procedure these magnets should be set to zero. They should only be used to offset any bowing of the centre lines of the raster. The D.C. picture shift should then be used to centre the raster on the screen.

## 6.8 POWER SUPPLY UNIT

The TWIST terminal using a Switching Power Supply which is housed in an aluminium case and mounted to the inside of the terminal at the rear panel. The PSU is made in two versions:

230V AC +/- 15% 47-63Hz

115V AB +/- 15% 47-63Hz

Incoming AC voltage from the power line passes through an RFI filter designed to prevent contamination of the AC power line by switching transients generated within the power supply. The filtered AC is converted to DC by a bridge rectifier and is filtered stored in a capacitor. This unregulated DC voltage is chopped by the switching element, Power MOS transistor BUZ 42, to about 45kHz. The output from this power switch is passed through a transformer and rectified to the different secondary output voltages. A feedback circuit controls the switching frequency and provide shortcircuit protection. The voltage adjustment potentiometer affects all the output voltages, and should be set so that +5V measured at the MLB connector (27 pin 7,8 indicates 5.1V).

## 7 SERVICE

### GENERAL

This section suggests methods for determining which circuit is faulty in a malfunctioning unit.

The primary objective is to determine which sub assembly (Main logic board, Power supply, Monitor control board or the Keyboard) is faulty.

### 7.1 POWER-UP SELF TEST

Upon power-up, or when the reset command is received by the terminal, the power-up self test is performing a check of the following:

EPRom checksum  
 EAROM checksum  
 Display refresh RAM, and scratchpad RAM.

If during this test, the terminal halts because the processor has determined that the scratchpad RAM is at fault, no further testing of the terminal is performed but the keyboard burn-in test will start running.

If any error is detected, the bell will ring five times and the error code will be displayed in the upper left portion of the screen.

### 7.1.1 ERROR CODES

-----  
 2 EAROM CHECKSUM ERROR  
 3 DISPLAY MEMORY FAULT  
 6 EPROM CHECKSUM ERROR

### 7.1.2 REMEDY

#### 7.1.2.1 Error code 2

-----  
 EAROM checksum error, indicates that the D64 and/or D65 are faulty.

NOTE Check also the -23V control circuit, as this circuit may cause the malfunction.

#### 7.1.2.2 Error code 3

-----  
 Display Memory Fault. The error code 3 will also give the memory address information so that the faulty memory IC can be identified, the read/write data informs about the memory contents. Information about the memory contents is insignificant in order to select the bad memory IC during this test sequence.

(screen is blank) display memory Replace IC D89  
 (screen is blank) scratch pad memory Replace IC D86

To select which one is faulty, run the special test program.

3 address C803 read/write XX/XX Replace IC D88  
 3 address D003 read/write XX/XX Replace IC D87  
 3 address E003 read/write XX/XX Replace IC D73  
 3 address E803 read/write XX/XX Replace IC D72  
 3 address F003 read/write XX/XX Replace IC D71  
 3 address F803 read/write XX/XX Replace IC D70

#### 7.1.2.3 Error code 6

-----  
 Indicates that D79 or D80, or both contains wrong data. Replace both EPROM's, with the latest program version if this failure occurs.

NOTE The first version of the TWIST terminal can not use the same program as the later version of the terminal. See Service Bulletins for further information.

## 7.2 FIELD SELF TEST DESCRIPTION

A special test program for the Facit TWIST terminal is available as a "tool" for the first version of the TWIST terminal and will be a part of the normal firmware when the new etch revision is released to the production (MLB 1142 46 10-30).

### 7.2.1 HANDLING INSTRUCTION, FIRST VERSION

-----  
 The special test program is stored in an 2764 EPROM marked 5536 20 90-01/5 this EPROM should be inserted at IC position D80 on the Main Logic Board. It is not necessary to remove the IC D79 during the test.

7.2.1.1 Operating instruction, BURN IN TEST

Remove Jumper W4.

This mode is BURN IN TEST MODE, i.e. auto test starting with:

RAM TEST, this test is able to point out a failing RAM.

EAROM TEST, this test calculates the EAROM's checksum.

PROM TEST, the checksum is calculated for both EPROM's.

SYNC TEST, basic test to verify that the CRTC is alive.

I/O HANDSHAKE TEST, this test will test the RTS-CTS and READY lines.

SERIAL DATA, this test will send and receive data on all three data lines (I/O, PRINTER and KBD).

Make a test connections as showed in the figure below.

Turn on the terminal, this test is running until interrupted by power-off.

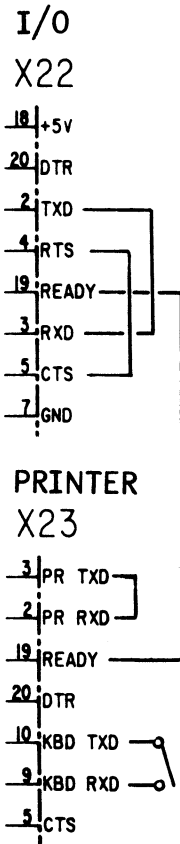


FIG 7.2 TEST CONNECTIONS

7.2.1.2 Operating instruction, MANUEL TEST MODE

Remove Jumper W7 and W4.

In this test mode it is possible to select any of the burn in test modes and more, like special test pictures as described below.

NOTE: THE SPECIAL I/O PRINTER CONNECTORS USED IN BURN IN TEST MODE MUST NOT HAVE THE PIN'S 9 AND 10 IN THE PRINTER CONNECTOR CONNECTED AS THIS WILL INTERFERE WITH THE KBD COMMUNICATION.

Turn on the terminal.

The terminal will display:  
4440 TEST-MODE

The following test modes are available in the first version of this test program, and will be subjects for change see Service Bulletins for further informations .

Active keys are as follows:

In the alphanumeric keypad.

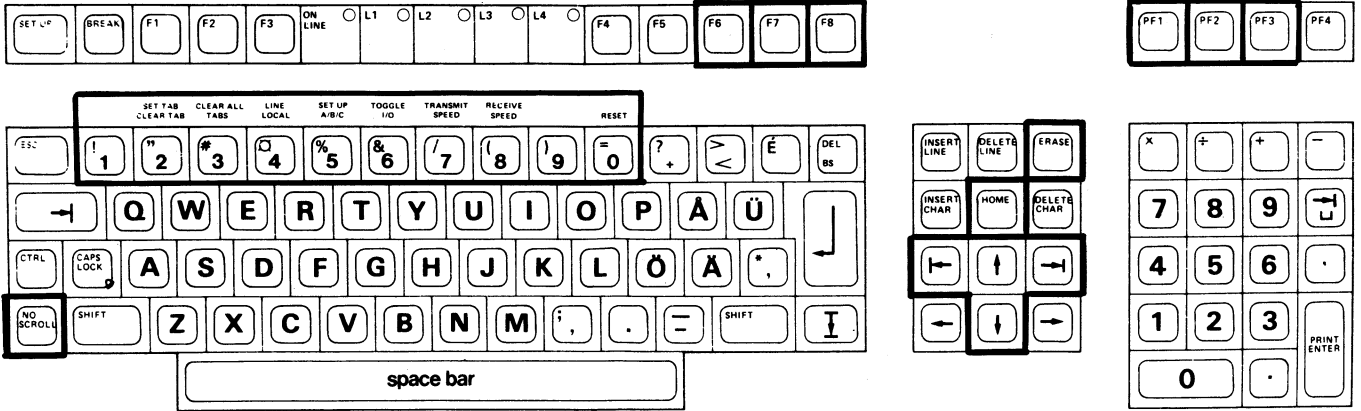
1-2-3-4-5-6-7-8-9-0-a-e-NO SCROLL

In the editing block keypad:

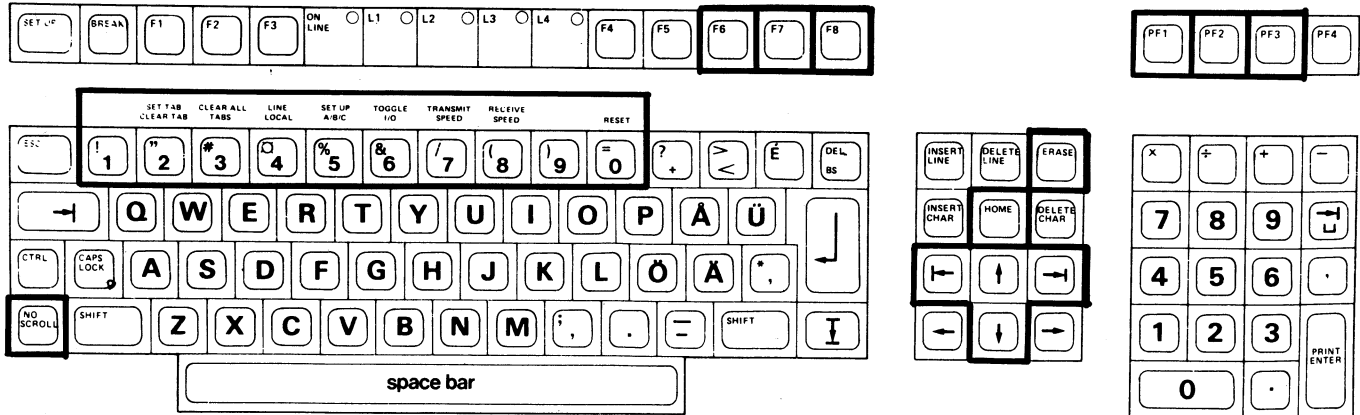
ERASE - Home - Tabulation Backward - Tabulation Forward - Cursor Up - Cursor Down

In the Function key block:

F6, F7, F8, PF1, PF2, PF3



COMMAND	TEST	DISPLAY REPORT
Press key 1	RAMTEST	RAMTEST OK  RAMTEST ERROR 1A-1D, 1E-1H (D70-73, D86-89)
Press key 2	EAROMTEST	EAROMTEST OK  EAROMTEST ERROR 2 D64 D65
Press key 3	PROMTEST (to be used in later versions of the TWIST terminal)	
Press key 4	SYNCTEST	SYNCTEST OK  SYNCTEST ERROR 4A HORIZONTAL and/or 4B VERTICAL
Key 5, 6 and 7		# 5, 6, 7 NOT USED
Press key 8	I/O HANDSHAKE (Special connectors required)	I/O HANDSHAKE OK  I/O HANDSHAKE ERROR 8A RTS-CTS and/or 8B I/O-PR READY
Press key 9	SERIAL DATA (Special connectors required)	SERIAL DATA ERROR 9A KBD (always with keyboard KBD connected and 9/10 open)  SERIAL DATA ERROR 9B PRINTER and/or 9C I/O
Press key a		The Screen is filled with a's in order to check the shift registers. If the letter is faulty, i.e. completely filled within the lower portion try to insert a capacitor (10-20 pF) at position C75 or C74. One of these positions will probably cure this fault, if not the MLB may need factory repair.
Press key e		Same as above but character e.



Press Erase	Return to 4440 TEST-MODE
Press Home	Brightness default value
Press Cursor up	Increase brightness, step by step
Press Cursor down	Decrease brightness, step by step
Press Forward tab	Maximum brightness
Press Backward tab	Minimum brightness
Press F6	In Landscape Mode Vertical alignment test In Portrait Mode A frame to adjust the screen geometry
Press F8	In Landscape Mode Screen filled with double wide H's In Portrait Mode Nothing
Press F7	In Landscape Mode (after test 8) Screen filled with H's In Portrait Mode (after test 8) Screen is filled with H's
Press PF1	In Landscape and in Portrait Mode Test picture, cross-ruled for adjustment of the Field and Line linearity
Press PF2	In Landscape back to 4440 TEST-MODE In Portrait Test and Attributes for control of the Black Level setting
Press PF3	In Landscape Screen filled with figures 12345678901234567890 In Portrait Same as above for adjustment of the left and right margins



### 7.2.2 KEYBOARD SELF TEST

The keyboard self test is really a BURN IN TEST. This test sequence will start running as soon as the keyboard processor recognizes that no communication with the terminal is present. Also, if the keyboard is connected to a +12V 1A supply, then the self test will start after a 30 sec. delay. The burn in test will continue until power-off or until a fault is detected. The cause to any detected problem during this test has to be traced further down to the component by using conventional methods. A faulty key-switch module is not recognized during this test. The figure below shows the contact arm in nonactive position. With the key in active position the measured resistance across a contact is approx 100 ohm.

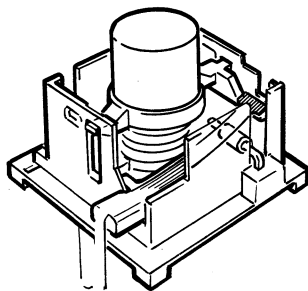


FIG 7.2.2 KEYSWITCH MODULE

### 7.2.3 MONITOR CONTROL BOARD TROUBLESHOOTING

Should the monitor electronic fail, the following symptoms may be observed:

- no picture, regardless of the brightness setting
- a very bright horizontal line in the middle of the screen
- the picture size is too small

#### 7.2.3.1 Monitor electronic troubleshooting hints

The procedure here suggested is to find the faulty component by measurement step by step.

SYMPTOM	POSSIBLE CAUSE	SECONDARY FAULT
No picture regardless of the brightness setting, but the speaker may sound and the keyboard's LEDs work.	Bad V102 D1 C31 No e.h.t. voltage. Bad V3, V5, C22, C23, C25, V105	R11 and R12 12V Fuse
A very bright horizontal line in the middle of the screen.	No +22V to D2 D2	R64, C22, V3. The tube phosphor may be damaged
Vertical picture size too small. No possible adjustment by VR9.	C41 C38	

Display Tube reference voltages:  
Measured by a digital voltmeter and the Video disconnected.

Pin 3 approx +650V  
Pin 4 approx +125V  
Pin 6 approx -65V  
Pin 7 approx +43V

7.3 MONITOR ADJUSTMENTS

CAUTION-LETHAL VOLTAGES ARE PRESENT

If the picture tube or the electronic have been replaced, adjustment may be required.

Before any adjustment is performed the power supply voltage must be checked, and adjusted if necessary.

Any attempt to adjust a monitor control board which have a major component problem might result in unnecessary troublesome and timeconsuming repairs.

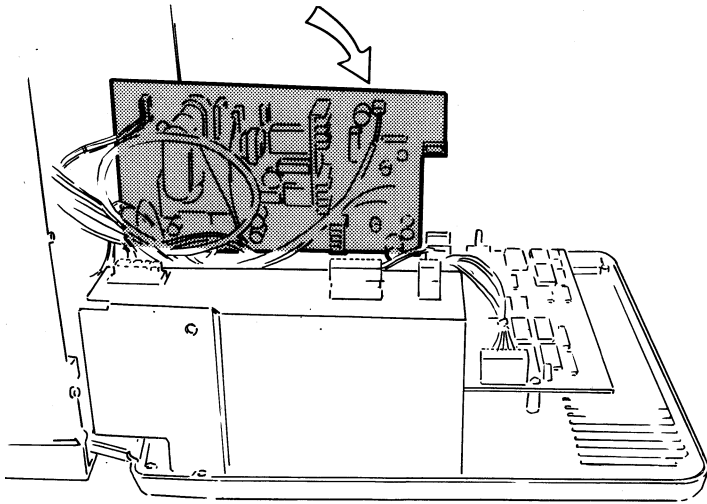


FIG 7.3 The Monitor Control Board can be fold-out as showed.

7.3.1 ADJUSTMENT INSTRUCTION

Adjustment of the monitor is straight forward and, after an initial warm up and check of the operating conditions, the following procedure is suggested:

- a adjustment with instrument
- b adjustment without instrument
- 1 Turn on the terminal in Landscape mode and select test mode, (see section 7.2)
- 2 Black Level adjustment. Use a digital voltmeter and measure the voltage at the tube socket board. Disconnect the cable X21 from the MLB. The Voltage at pin 7 should be adjusted by potentiometer (VR6) to 43V.
- 3a Adjust the Brightness (VR5) to acceptable level (200 lux for the white and 180 lux for the amber DGD).
- 3b Adjust the Brightness. Select test mode. Press backtab to get the lowest brightness. Turn (VR5) so that the text is just visible and readable. Press forward tab to check maximum brightness, the text should not become blurred.
- 4a Set the Field Frequency. Disconnect cable X21 from the MLB. Connect a frequency counter to jumper W5, adjust VR7 to 60Hz +/- 0.5Hz.
- 4b Turn the potentiometer (VR7) so that the picture starts to rolls downwards and then turn the potentiometer so that the picture moves up and appear to "lock" in position.
- 5a Set the Line Frequency. The line sync input from the MLB should be grounded at R5, see visual aid Fig 7.3.1. Use a frequency counter connected to jumper W5, adjust VR1 to 37kHz +/- 0.2kHz. See fig 7.3.1.
- 5b The line sync should be grounded as above. With a test picture adjust (VR1) until the picture stops or almost stops rolling sideways.

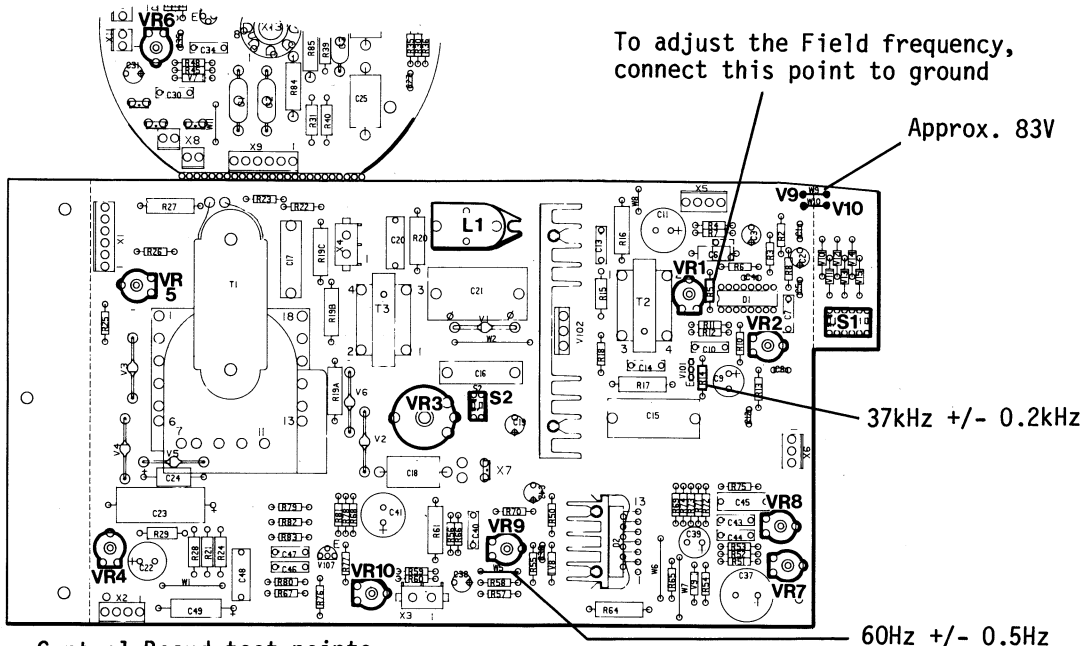
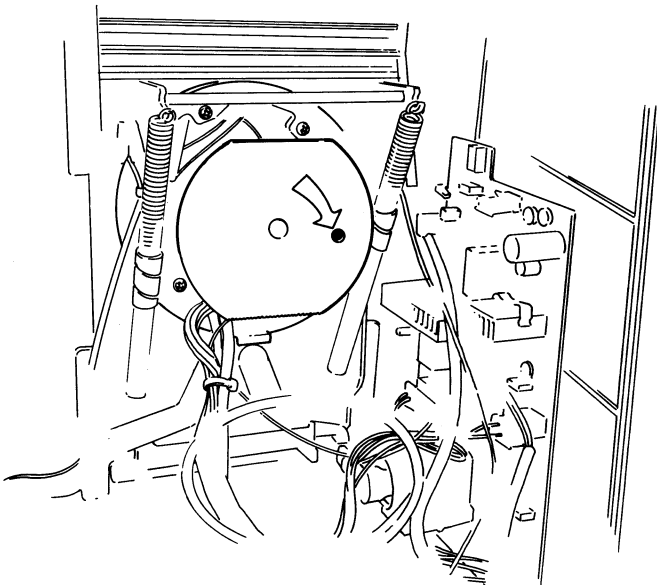


FIG 7.3.1 Monitor Control Board test points

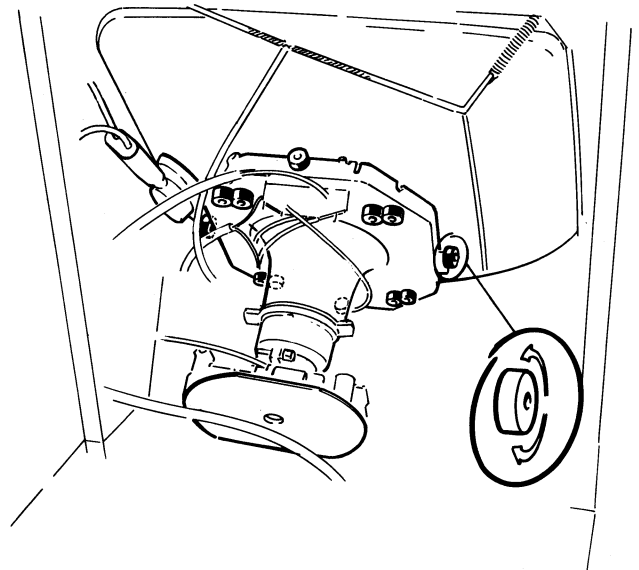
The following adjustments are performed in Portrait mode.

- 6 In portrait mode centre the Video information with respect to the raster using the line phase control (VR2). (Test picture F6P)
- 7 If necessary rotate the deflection coil for a correct picture orientation.  
  
Make sure that the coils are pushed hard against the tube cone and clamped securely.
- 8 Adjust the Field Amplitude (VR9) and Field Linearity (VR8). Select test picture No. PF1P.
- 9 Adjust the Line Linearity coil for maximum picture width (L1). Then carefully readjust this control for correct linearity between the centre of the screen and the LEFT hand margin edge. (Be careful with the core and use a proper tool).

- 10 Check that the Centring magnets are set to zero and observe the position of the test picture No. PF3P. If necessary centre the video using the DC shift controls (VR10 and VR3).
- 11 Straighten any bowing of the centre lines of the test picture No. PF1P by careful adjustment of the centring magnets. Recentre the left/right margins using the DC shift controls (VR10 and VR3).
- 12 Adjust the Focus of the picture for optimum at the centre of the screen. Select test picture F8F7P.
- 13 Finally check the general appearance of the display using all test pictures both in landscape and portrait mode. If any display geometry problem such as pin caution or barrel exists, the correction magnets should be used, see figure for details.



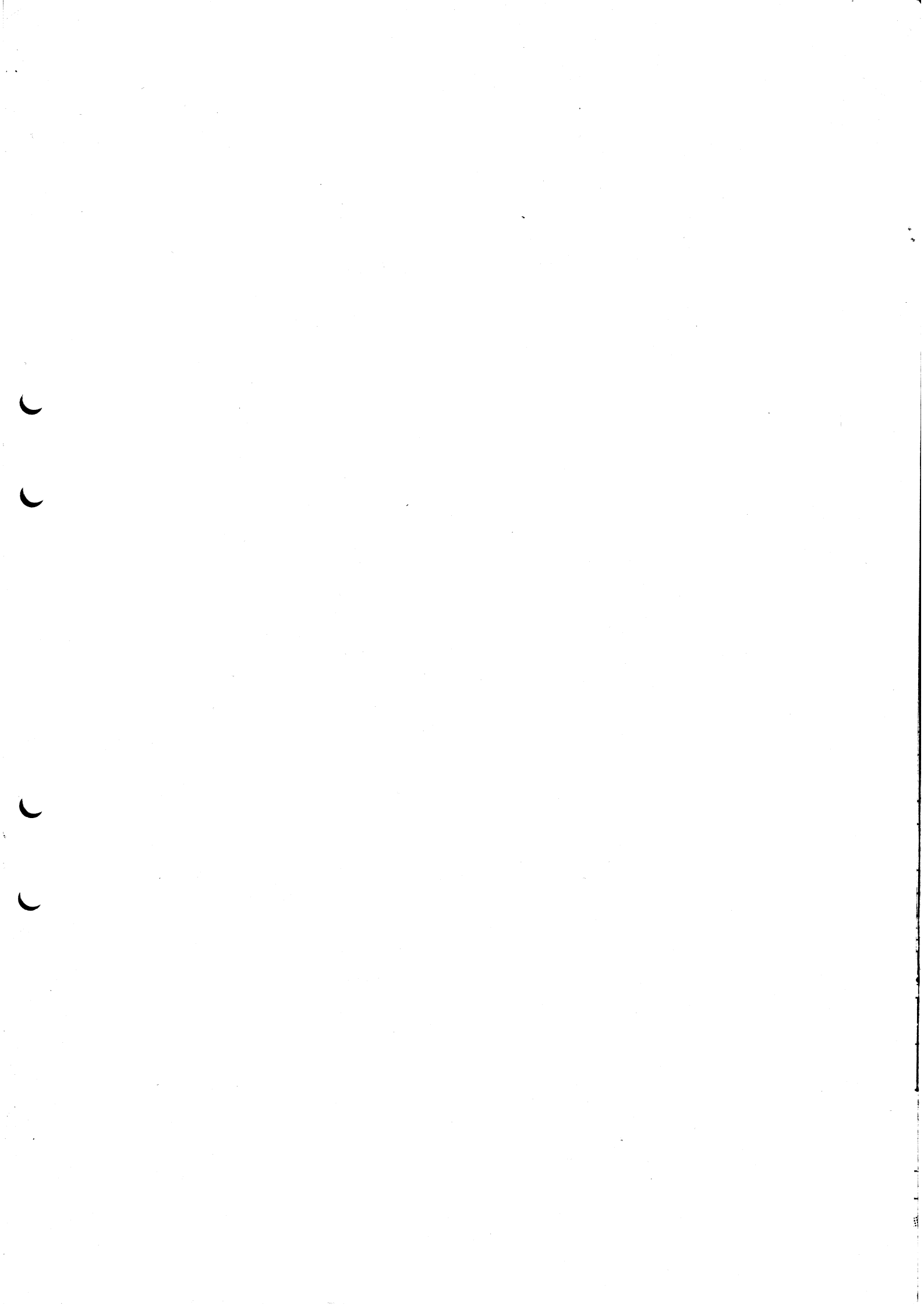
7.3.2 BLACK LEVEL ADJUSTMENT

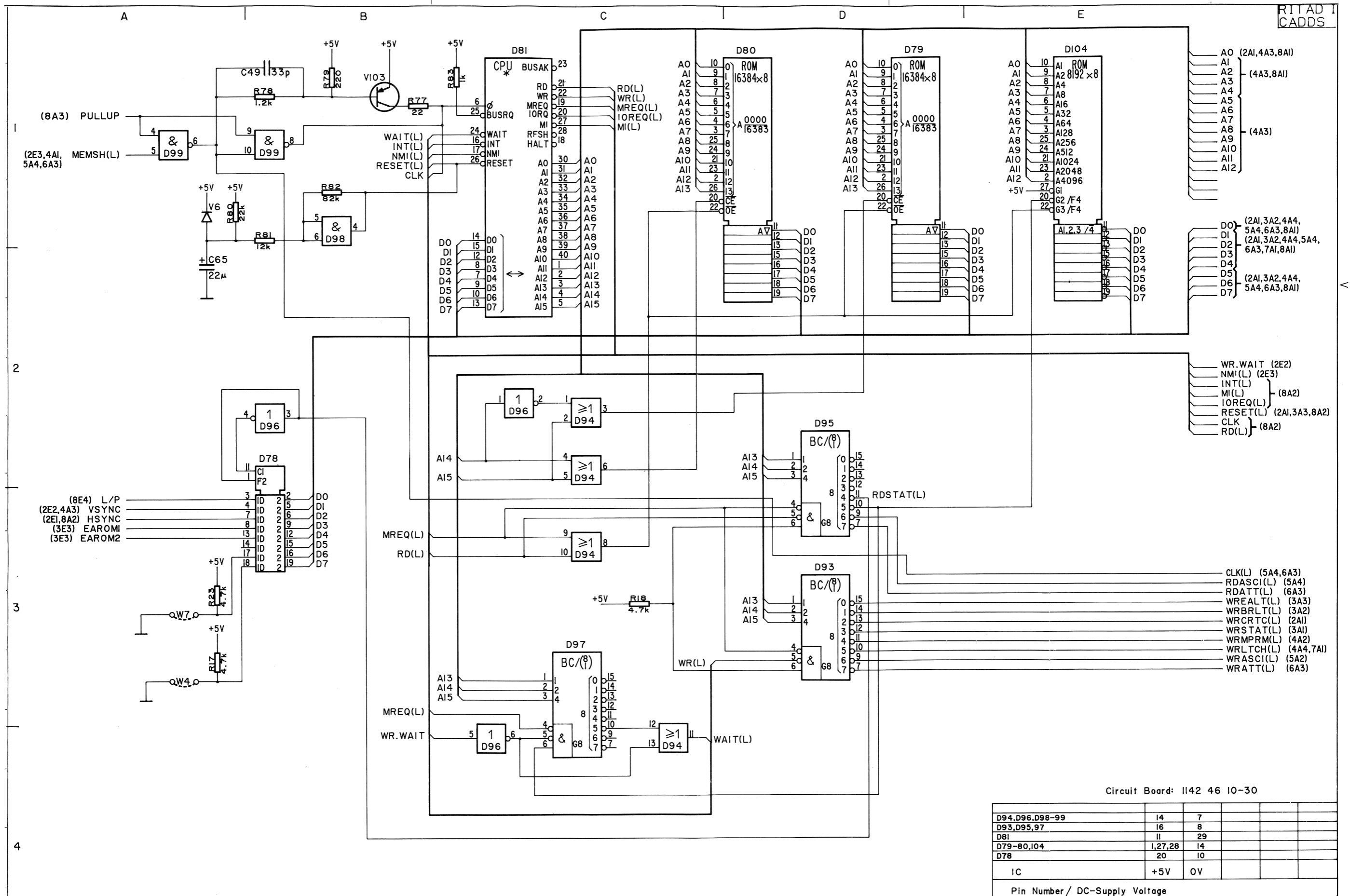


7.3.3 CORRECTION MAGNETS

TEST PICTURES

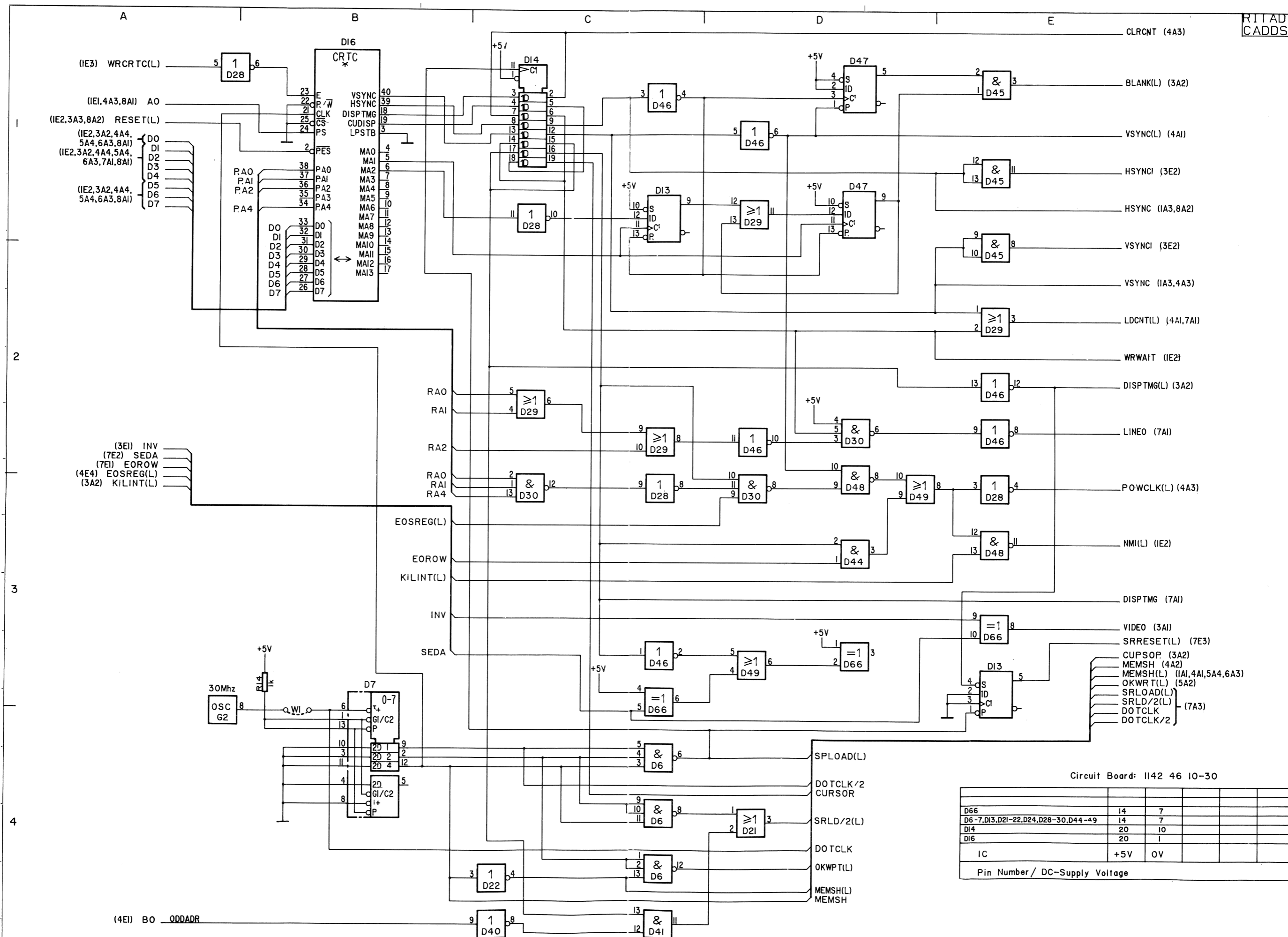
COMMAND	TEST	LANDSCAPE	PORTRAIT
F6	F6L-F6P	Vertical alignment test	Screen geometry test
F8	F8L	Screen is filled with double width upper case H's	
F8+F7	F8F7L F8F7P	If key F7 is pressed after key F8. The screen is filled with upper case. H's for focus adjustment	Screen is filled with upper case. H's for focus adjustment
PF1	PF1L PF1P	Crosse-ruled testpicture for Field and line linearity adjustment	Cross-ruled test picture for Field and line linearity adjustments
PF2	PF2L	Retur to TEST-MODE	TEXT and ATTRIBUTES for Control of the Black level adjustment
PF3	PF2L	Screen is filled with figures 1234 - 0123 - for margin adjustments	Screen is filled with figures 1234 - 0123 for margin adjustments





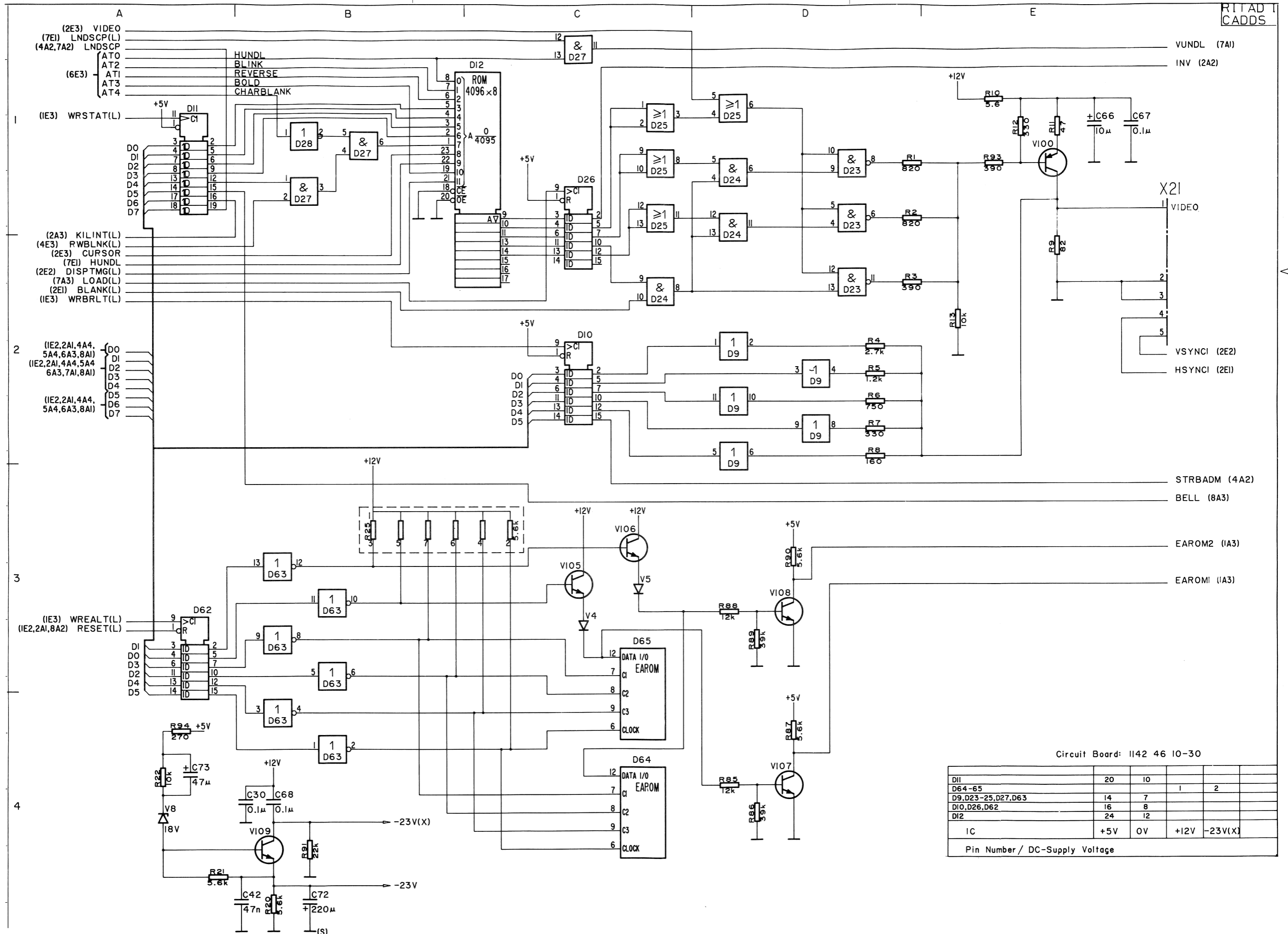
Circuit Board: 1142 46 10-30

D94, D96, D98-99	14	7		
D93, D95, 97	16	8		
D81	11	29		
D79-80, 104	1,27,28	14		
D78	20	10		
IC	+5V	0V		
Pin Number / DC-Supply Voltage				



Circuit Board: 1142 46 10-30

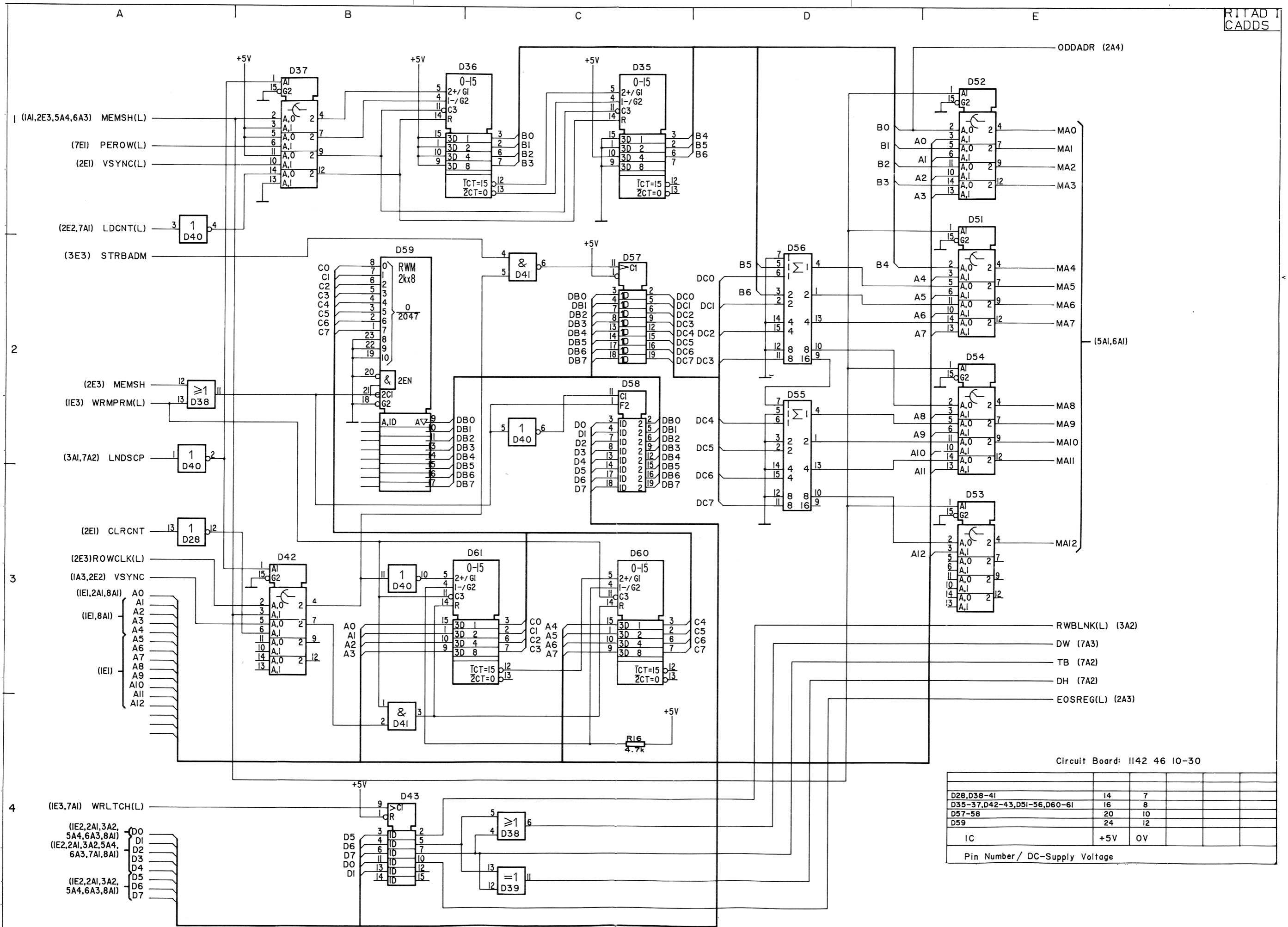
D66	14	7		
D6-7, D13, D21-22, D24, D28-30, D44-49	14	7		
D14	20	10		
D16	20	1		
IC	+5V	0V		
Pin Number / DC-Supply Voltage				



Circuit Board: 1142 46 10-30

D11	20	10		
D64-65			1	2
D9, D23-25, D27, D63	14	7		
D10, D26, D62	16	8		
D12	24	12		
IC	+5V	0V	+12V	-23V(X)
Pin Number / DC-Supply Voltage				

RITAD  
CADD5

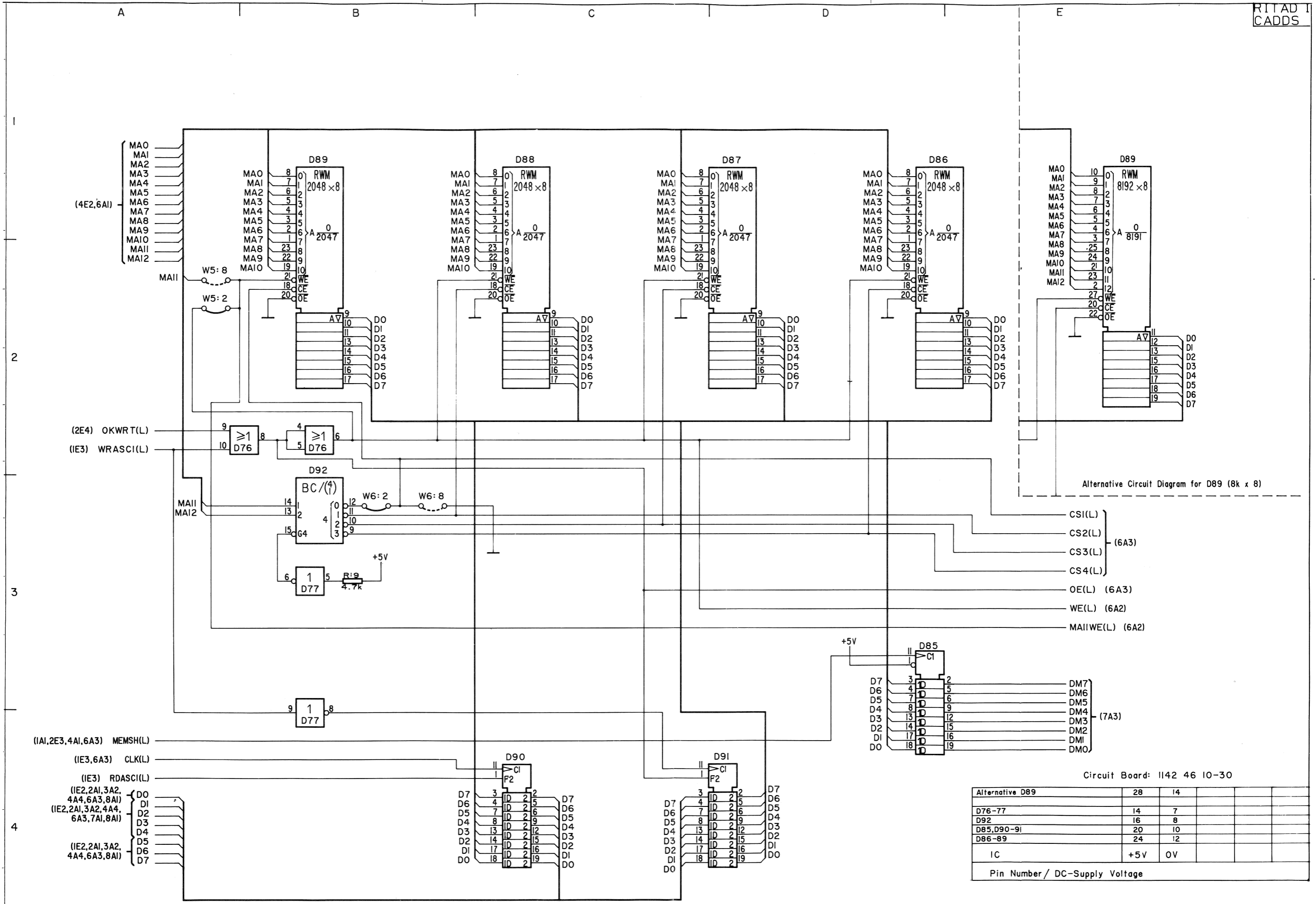


Circuit Board: 1142 46 10-30

D28, D38-41	14	7		
D35-37, D42-43, D51-56, D60-61	16	8		
D57-58	20	10		
D59	24	12		
IC	+5V	OV		
Pin Number / DC-Supply Voltage				

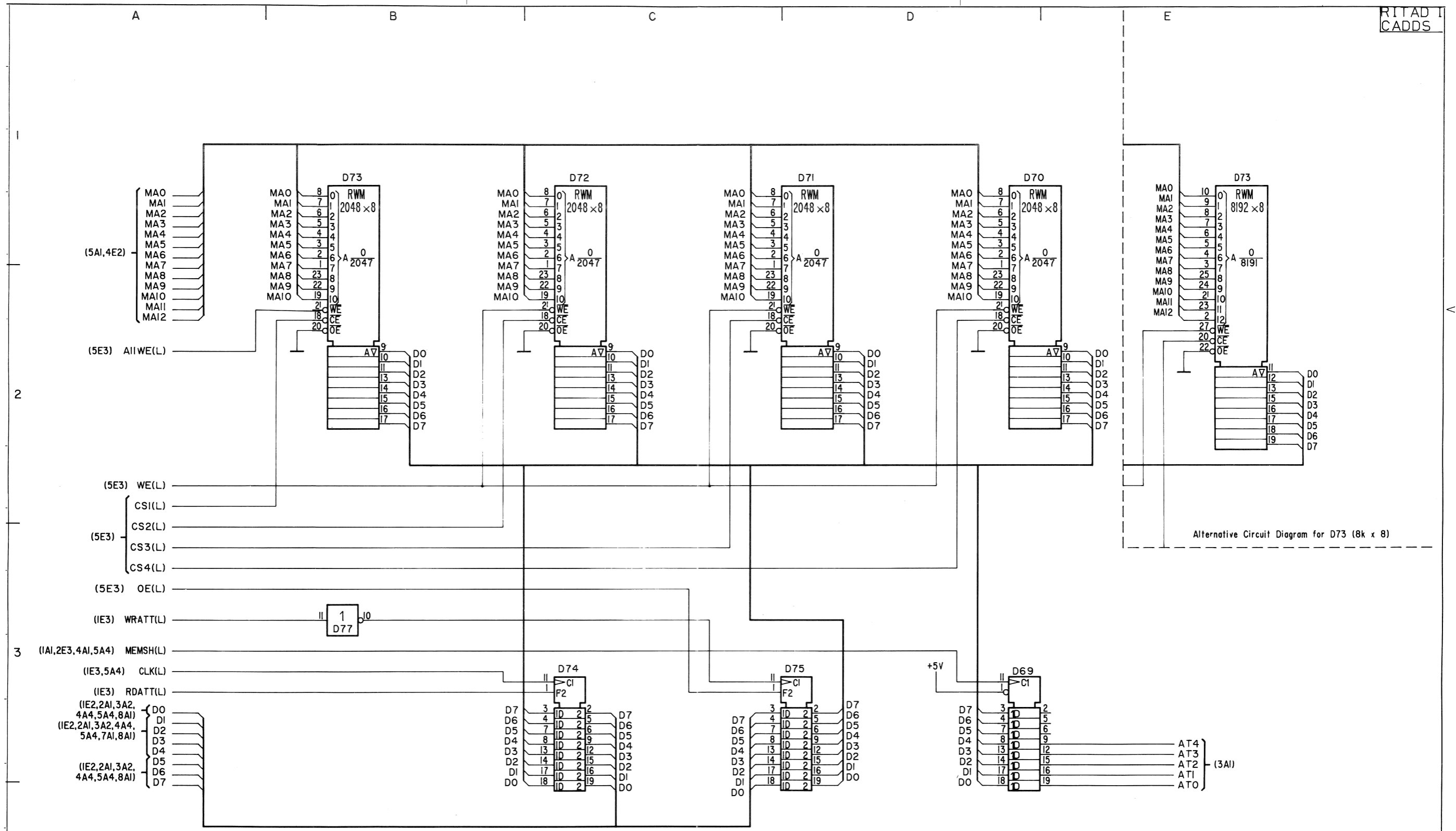


RITAD  
CADD5



Circuit Board: 1142 46 10-30

Alternative D89	28	14		
D76-77	14	7		
D92	16	8		
D85, D90-91	20	10		
D86-89	24	12		
IC	+5V	0V		
Pin Number / DC-Supply Voltage				

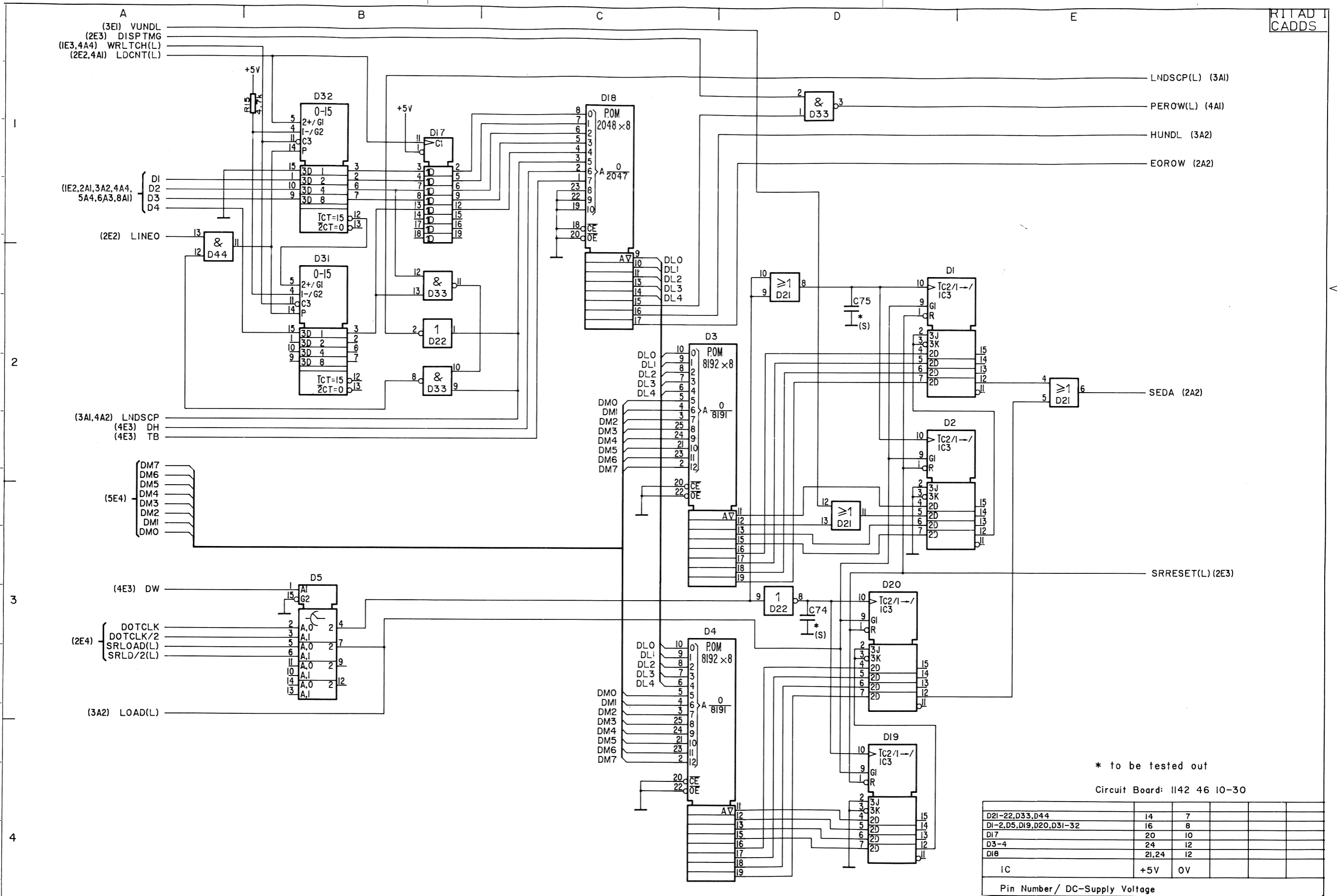


RITAD I  
CADD5

Circuit Board: 1142 46 10-30

Alternative D73	28	14		
D77	14	7		
D69, D74-75	20	10		
D70-73	24	12		
IC	+5V	0V		
Pin Number / DC-Supply Voltage				

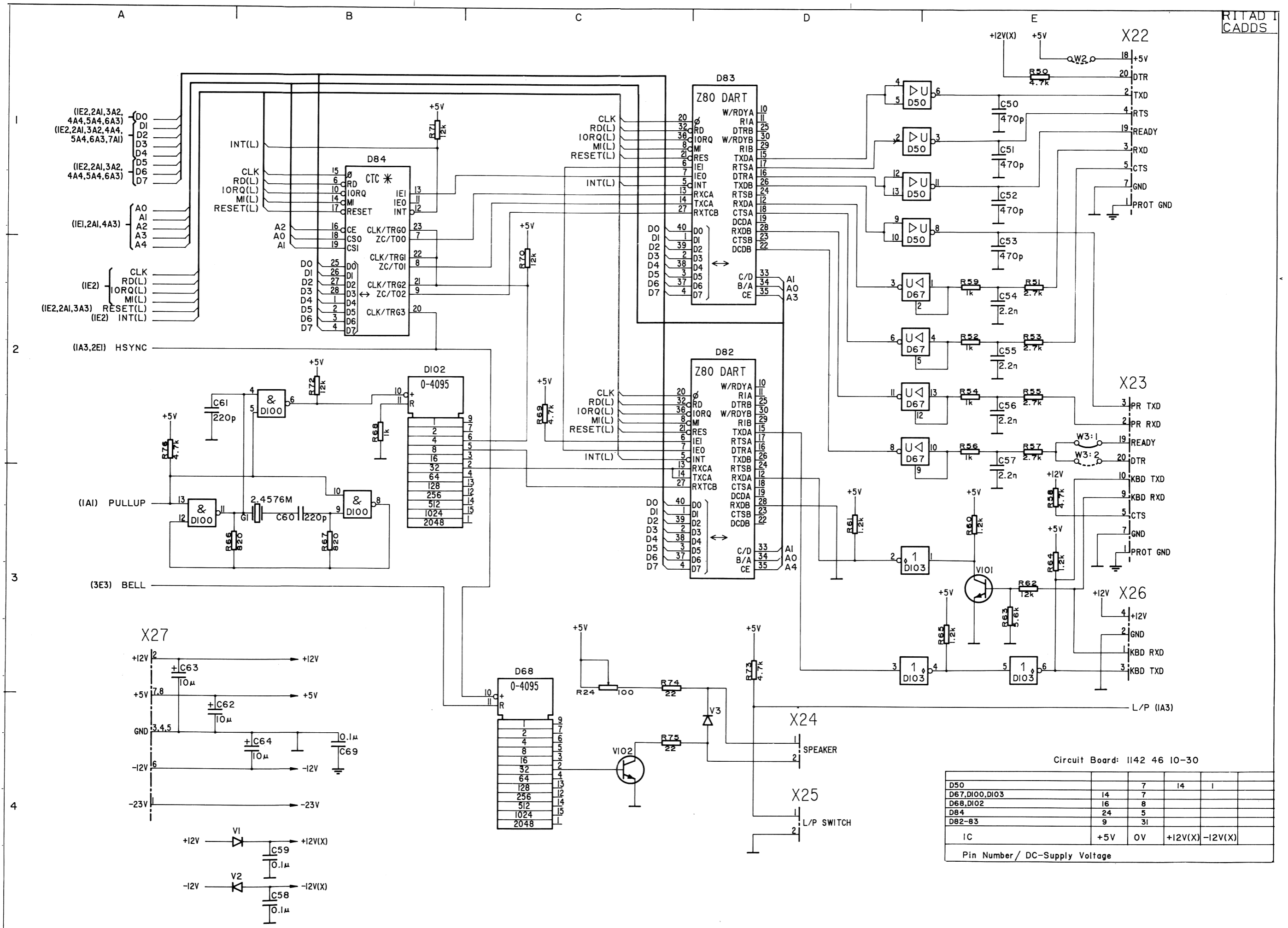
4



\* to be tested out

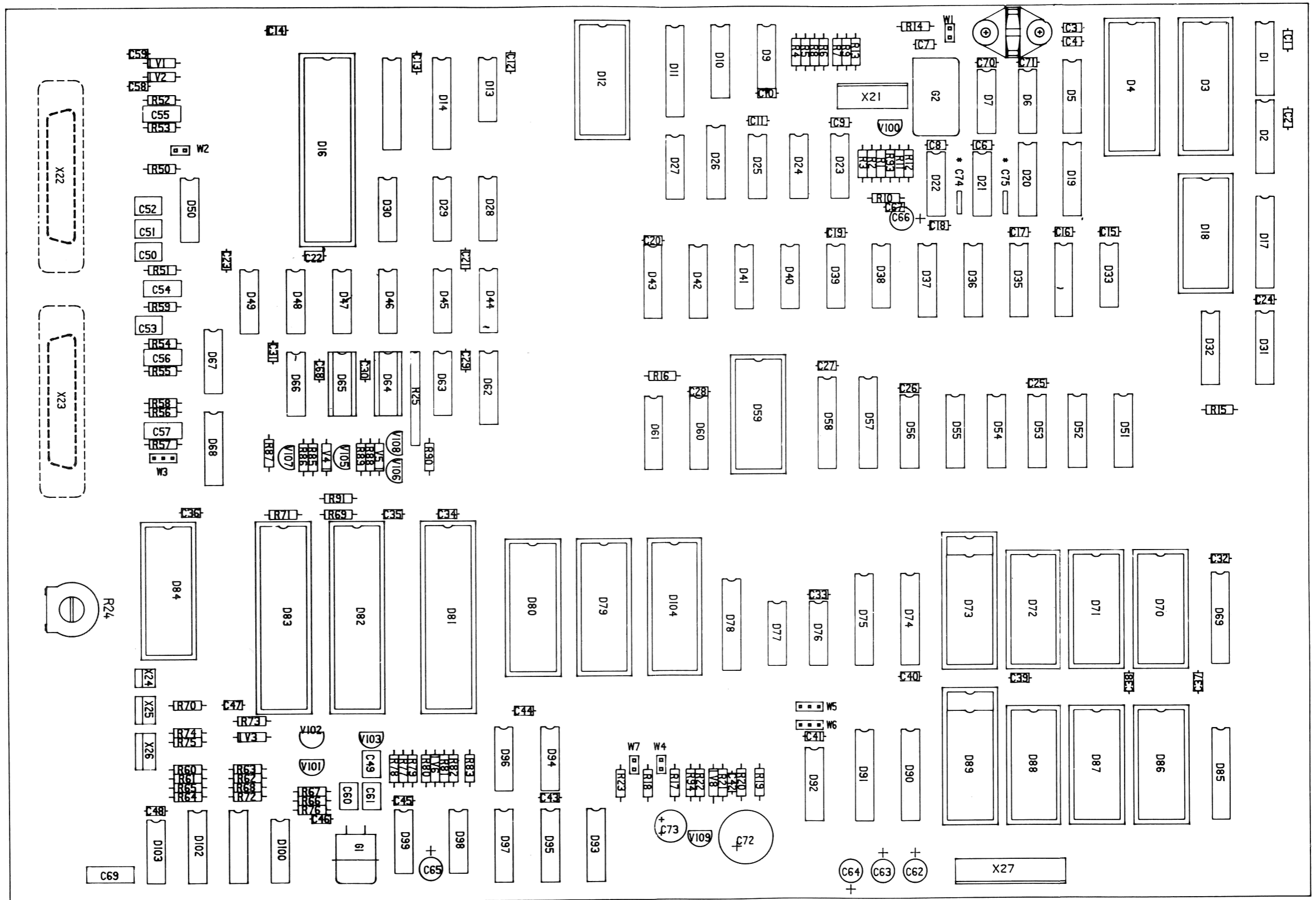
Circuit Board: 1142 46 10-30

D21-22, D33, D44	14	7		
D1-2, D5, D19, D20, D31-32	16	8		
D17	20	10		
D3-4	24	12		
D18	21, 24	12		
IC	+5V	0V		
Pin Number / DC-Supply Voltage				

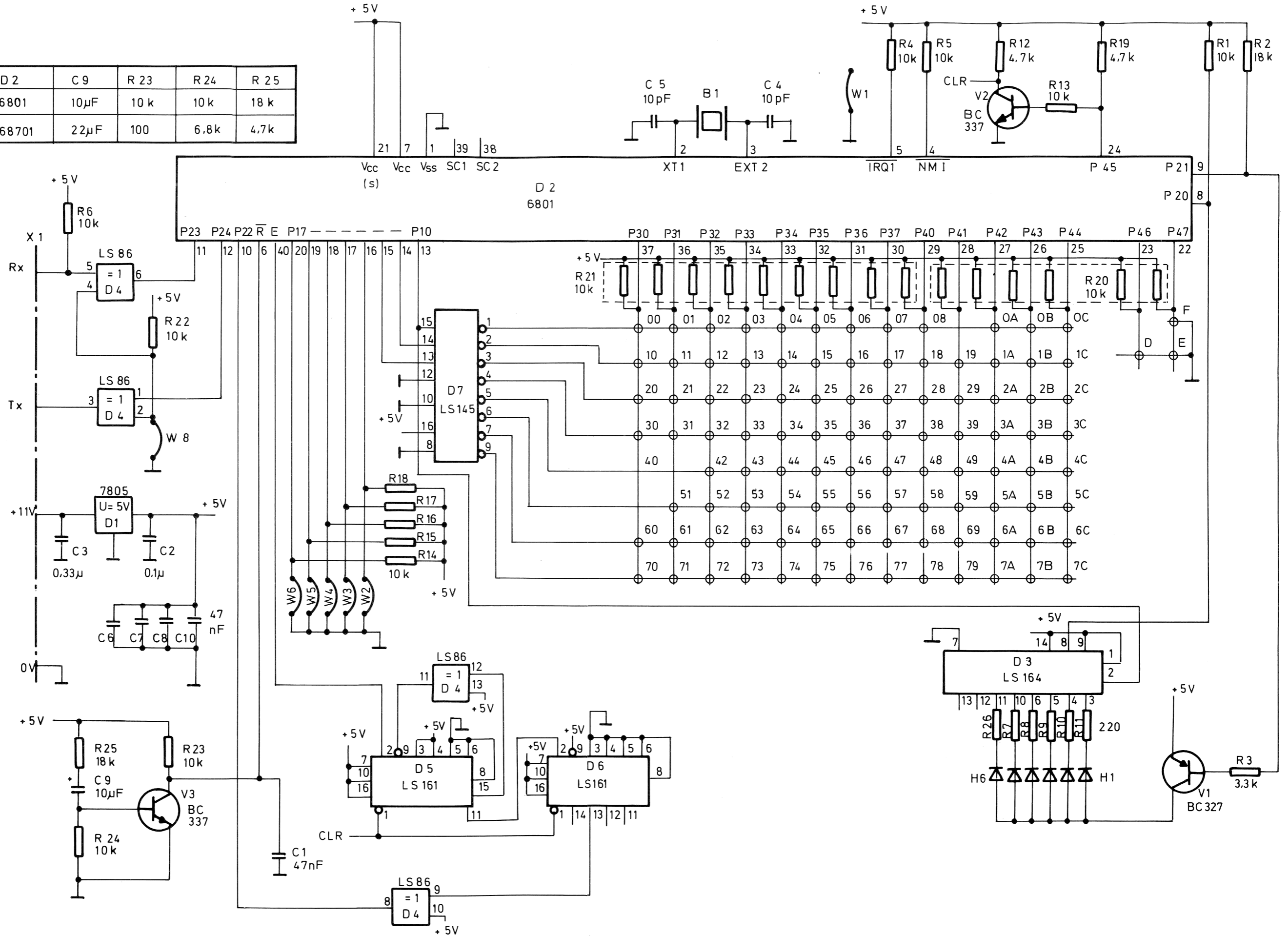


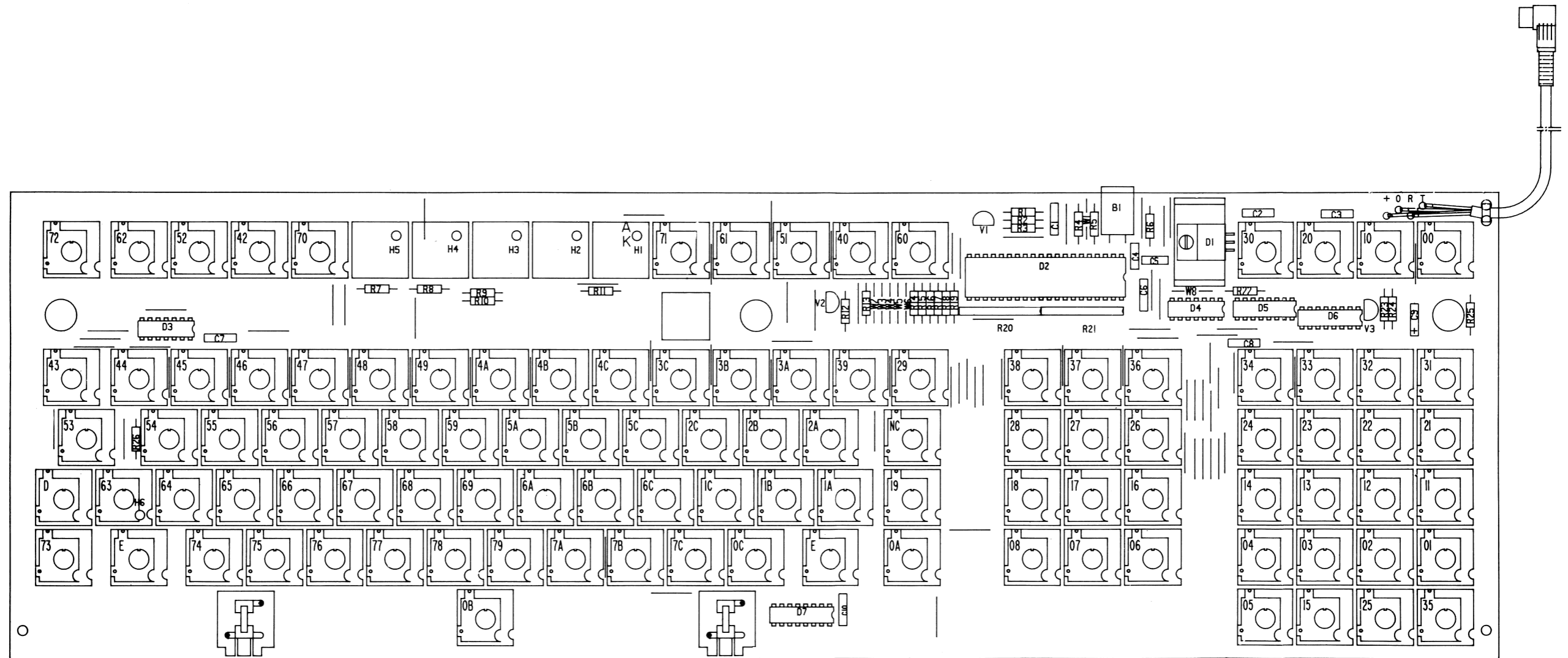
Circuit Board: 1142 46 10-30

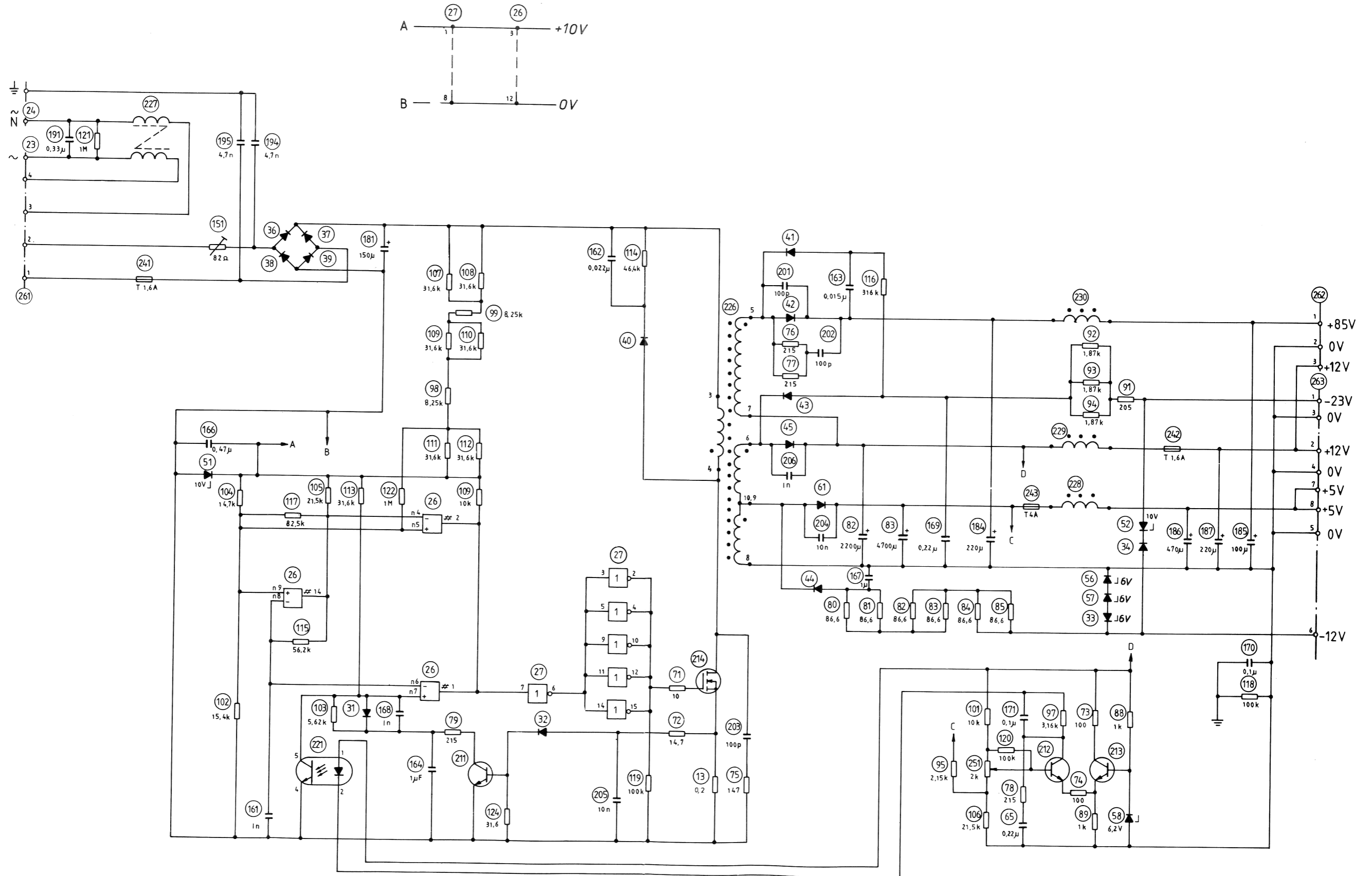
D50		7	14	1
D67, D100, D103	14	7		
D68, D102	16	8		
D84	24	5		
D82-83	9	31		
IC	+5V	OV	+12V(X)	-12V(X)
Pin Number/ DC-Supply Voltage				



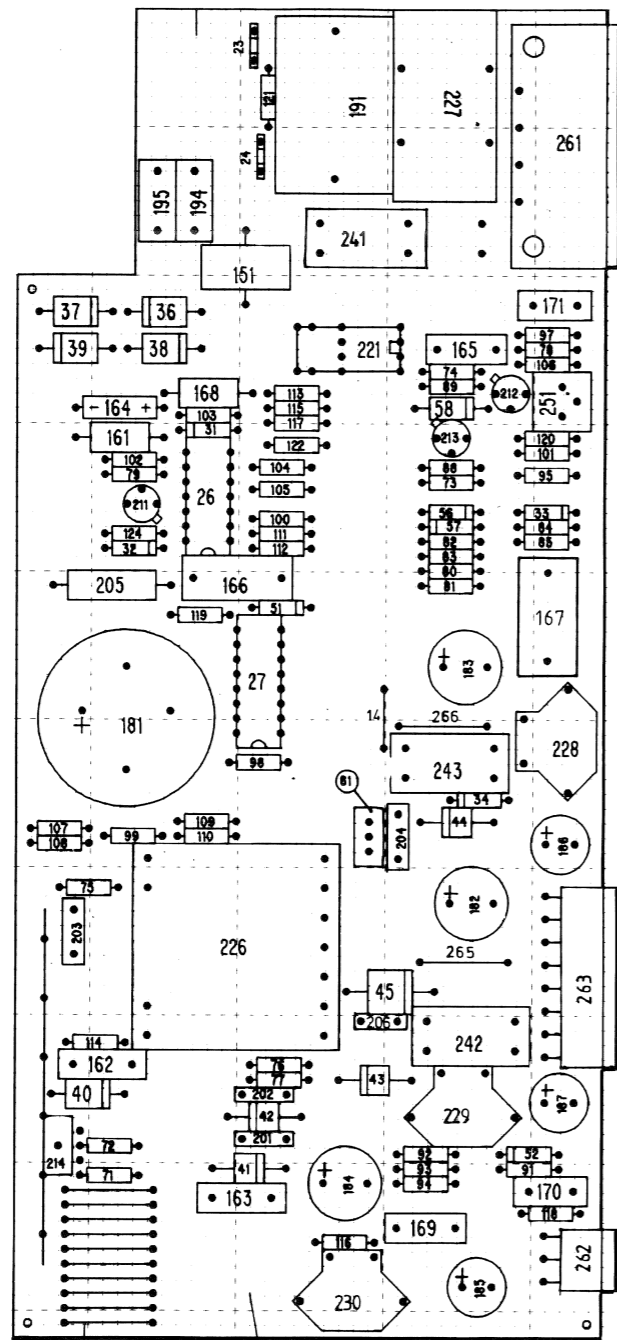
D 2	C 9	R 23	R 24	R 25
6801	10 $\mu$ F	10 k	10 k	18 k
68701	22 $\mu$ F	100	6.8k	4.7k

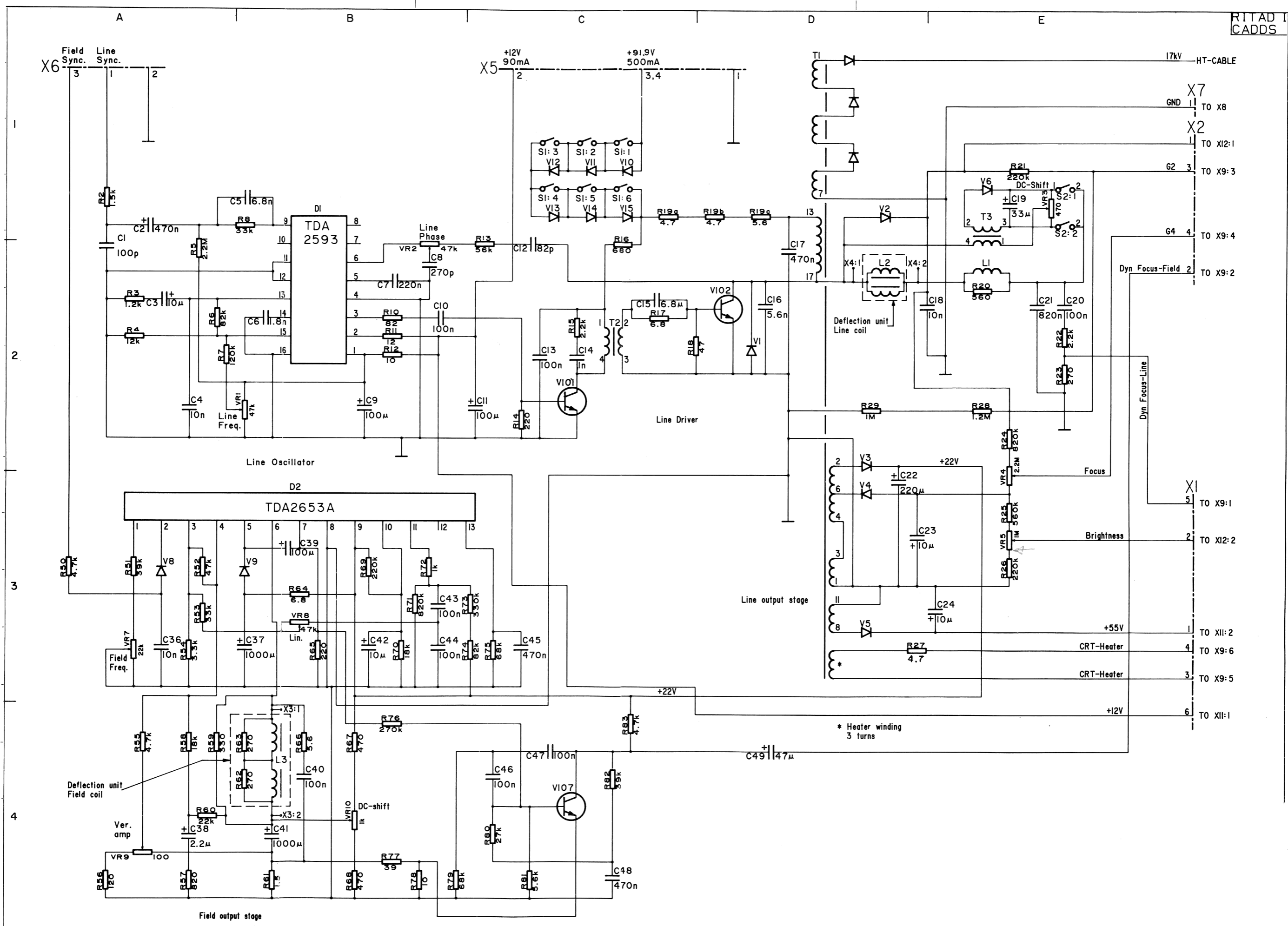






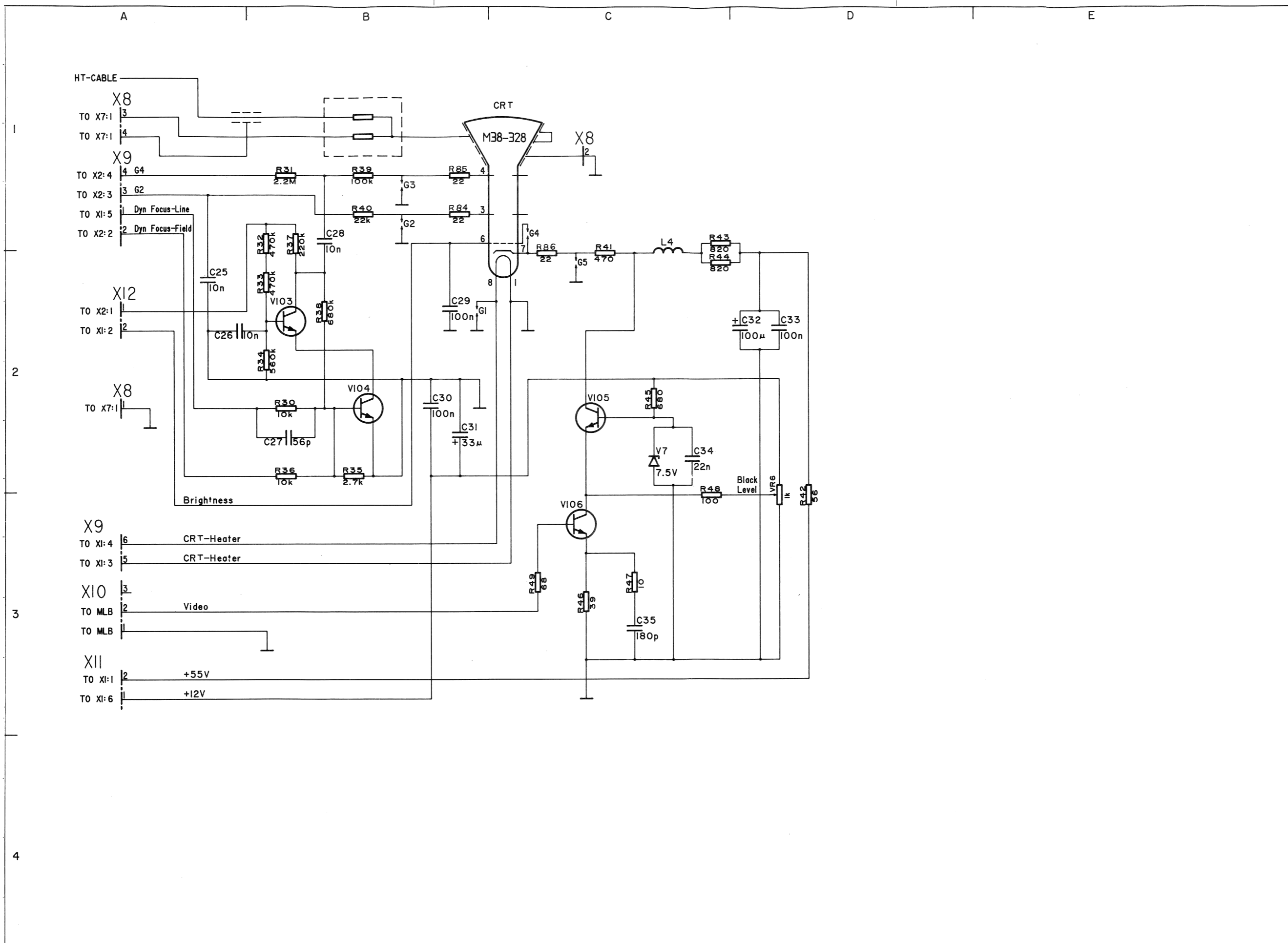


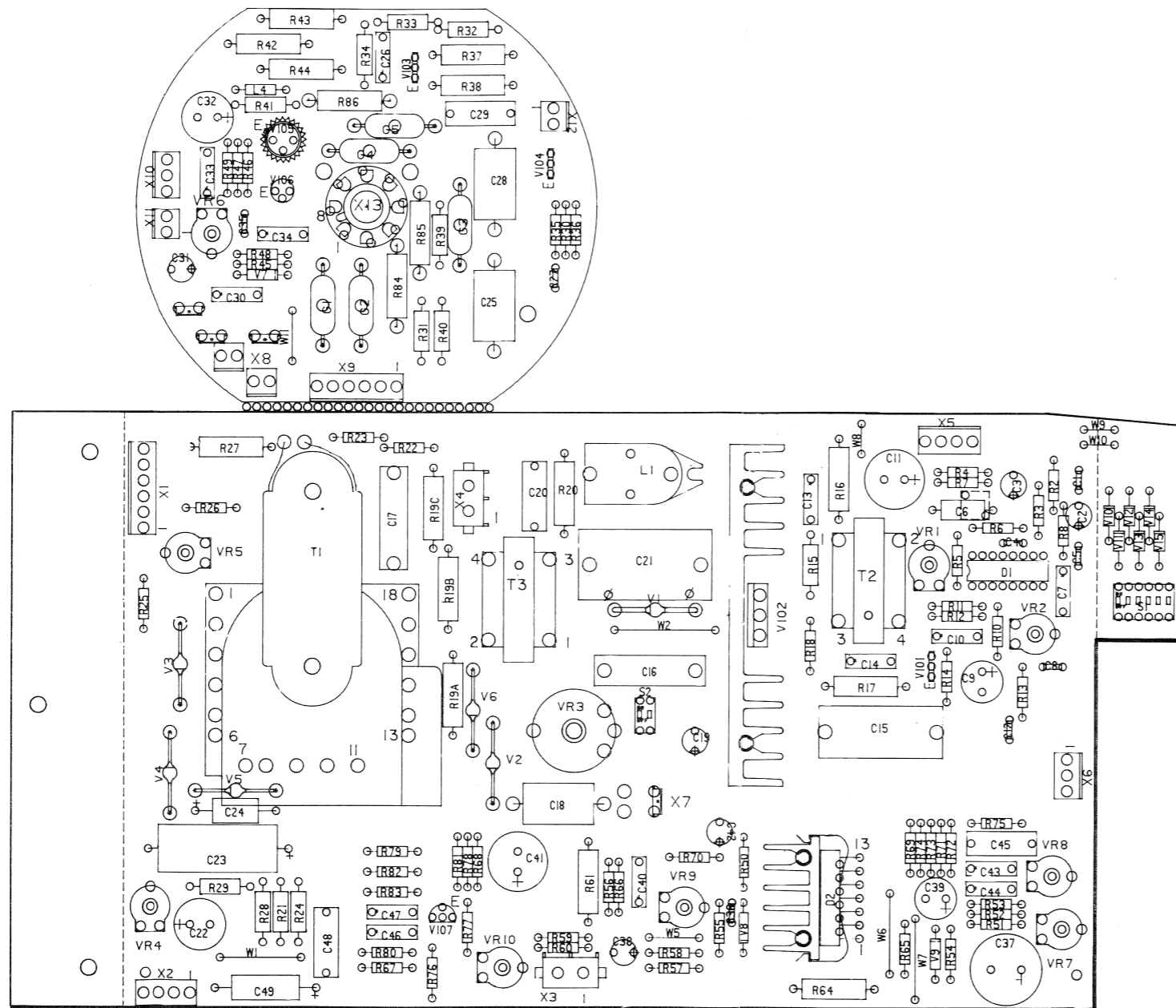




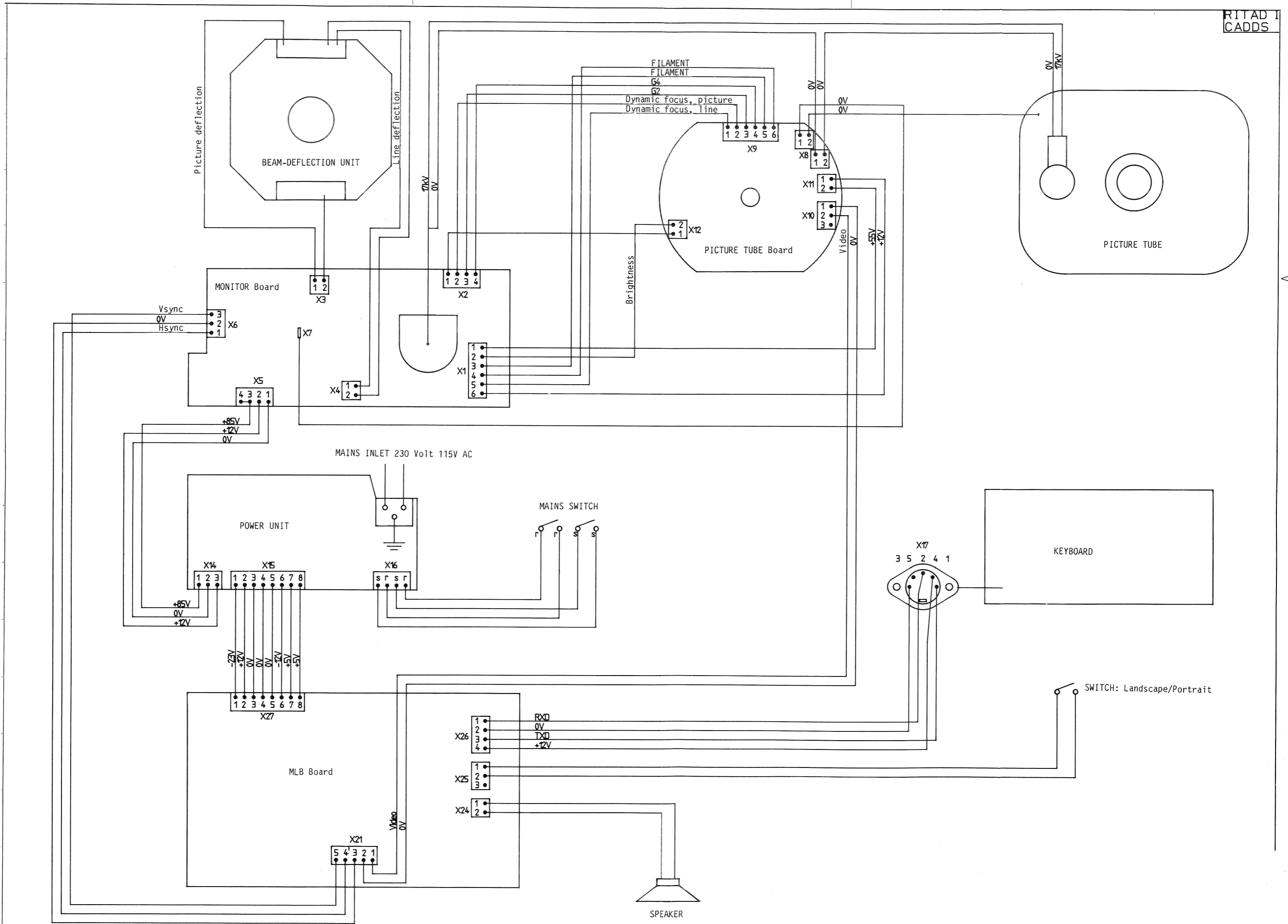
RTTAD I  
CADD5

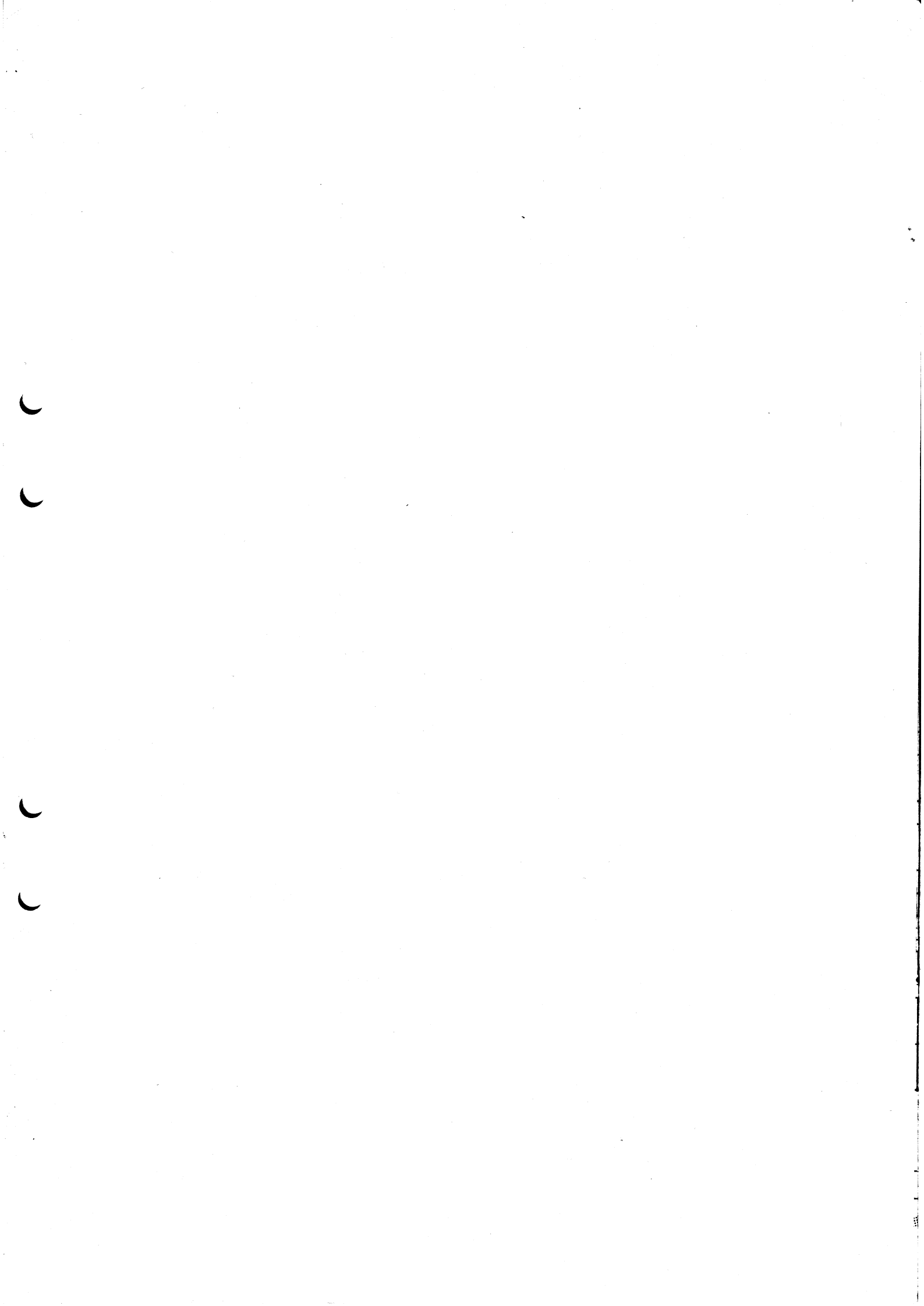
RTAD II  
CADD5





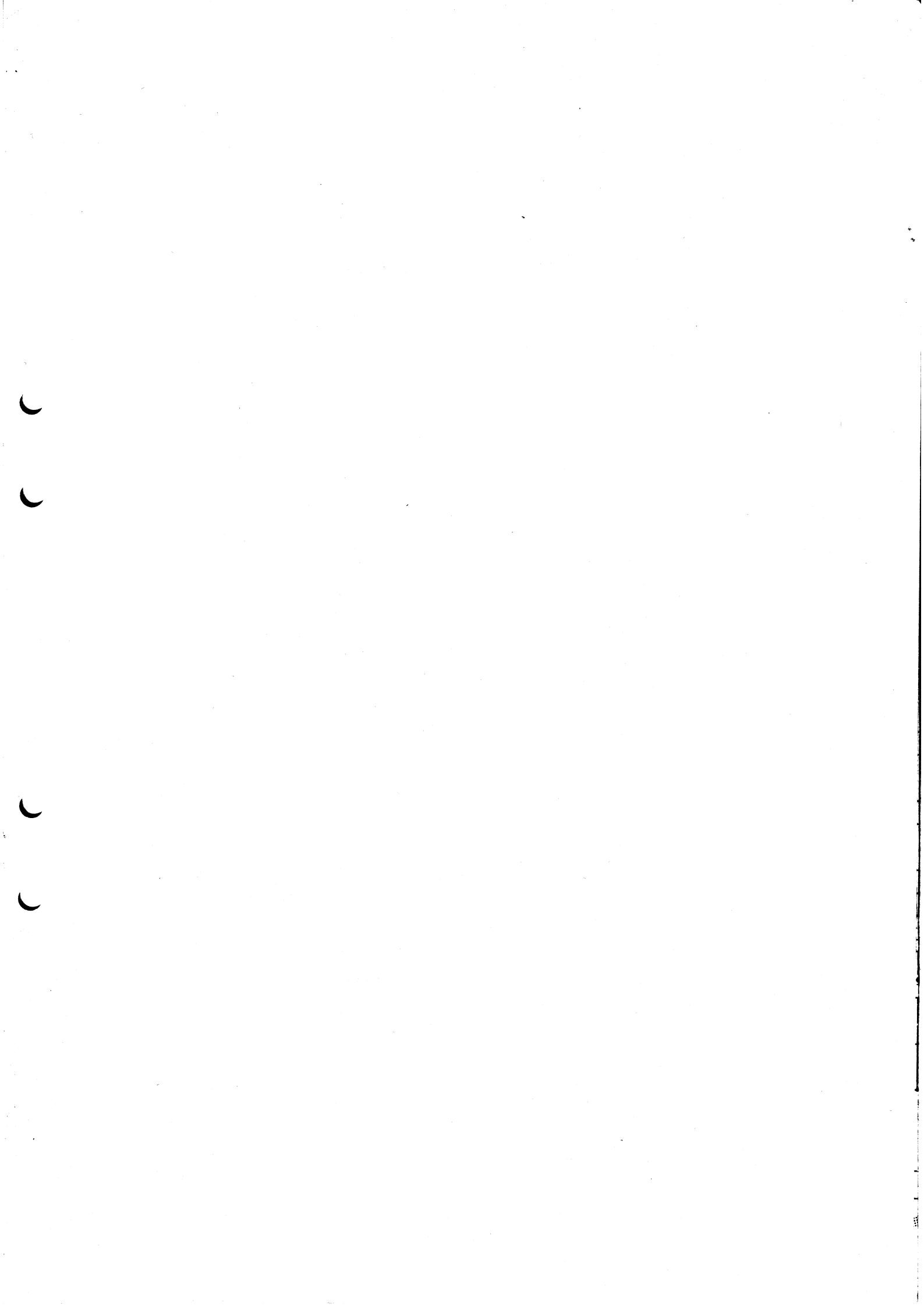
VR10	Ver.shift
VR9	Ver.ampl.
VR8	Ver.lin
VR7	Ver.freq
VR6	Blacklevel
VR5	Brightness
VR4	Focus
VR3	Hor.shift
VR2	Hor.phase
VR1	Hor.freq







A series of horizontal lines spanning the width of the page, providing a template for writing.





001000 001000 001000  
001000 001000 001000  
001000 001000 001000  
001000 001000 001000  
001000 001000 001000  
001000 001000 001000

# FACIT

SERVICE

{ Char (\* (\*x)) (x) }  
main ()