



MODEL MCD-1
MICRO CASSETTE DISK DRIVE

Technical manual

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MICRO CASSETTE DISK DRIVE

Dr.No. 3B50-703/-A



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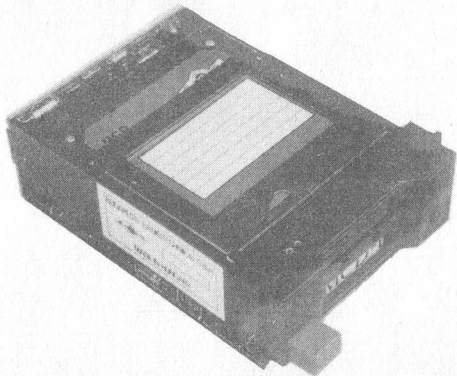
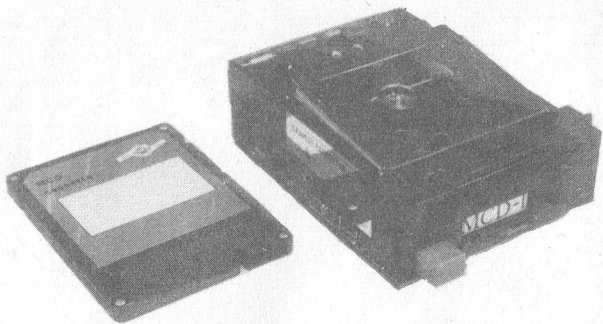
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1. INTRODUCTION

1.1. General

This manual contains the general technical specifications of the BRG Model MCD-1 Micro Cassette Disk System.

1.2. Related Documentation

Service manual, which aids personnel in the installation, operation, maintenance and repair of the MCD-1.

Dr.No.: 3B50L703/-A

1.3. Description

The MCD-1 Micro Cassette Disk Drive is a random access mass storage unit with compact size, lower power consumption, ease of use and high reliability at minimal cost.

MCD-1 is based on a small 3" single sided floppy disk - totally enclosed within a rigid plastic cassette.

Inside the cassette, the disk material is safeguarded against physical damage by bending, dust, scratching or grease from finger contact. Opening of a shutter covering the read/write head and drive spindle access holes takes place automatically only on insertion of the cassette into the drive.

Capacity of the present version is (formatted) up to 150 Kbyte and the transfer rate is up to 250 Kbits/second. Average access times are comparable to the normal mini-floppy disk. The hardware design of the drive is simple and strong and is functionally compatible with standard mini-floppy controllers.

2. SPECIFICATION SUMMARY

2.1. Performance specifications

Capacity	FM	- MFM
Unformatted		
Per Disk	100KB	- 200KB
Formatted		
Per Disk	74.8KB	- 149.6KB
Per Track	13x128B	- 13x256B
Per Disk	92KB	- 184KB
Per Track	1x2048B	- 1x4096B
Transfer Rate	125Kbit/s	- 250Kbit/s
Access Time		
Latency max.		142 ms \pm 3
avg.		71 ms
Track to Track		20 ms
Average		305 ms
Head Settling Time		10 ms
Head Load Time		35 ms
Drive Motor Start Time		650 ms

2.2 Functional Specifications

Rotational Speed	422 r.p.m.	+0.0% -5.0%
Recording Density (nominal) (inside track)	3125 b.p.i./ 6250 b.p.i.	
Flux Density	6250 f.c.i.	
Track Density	100 t.p.i.	
Tracks	45	
Encoding Method	FM/MFM	
Media dimensions	MCD Cassette 100mmx75mmx7.5mm	

2.3. Physical Specifications

ENVIRONMENTAL LIMITS^①

Ambient Temperature	5-40°C operating
Relative Humidity	20-80% operating at 29°C max.with no frost
Vibration	0.25G max.(5-100Hz) operating

POWER REQUIREMENTS

DC Voltages	+12V ^{+5%} typ ^②	0.21A
	max ^③	0.38A
	max ^④	0.05A
	+ 5V ^{+5%} typ ^②	0.49A
	max ^③	0.55A
	max ^④	0.27A

Power Dissipation		
Operating ^②		5 W
Stand by		1.95 W

Notes: ① Without date of reliability

specifications , only practically operating, without any damages.

- ② These values are valid with a typical electric component in the READ mode
- ③ These values are valid at the worst case component base at the WRITE mode
- ④ Stand by mode

MECHANICAL DIMENSIONS (Nominal)

Width	85mm
Height	42mm
Depth	117mm
Mass	0.42kg

2.4. Reliability Specifications

MTBF	8000 POH [*]
Unit Life Time	five years
MTTR	max. 30min.
Error Rates:	
Soft Read Errors:	10^{-9} bit ^{**}
Hard Read Errors:	10^{-12} bit ^{**}
Seek Errors:	10^{-6} seek ^{**}
Media Life:	
Passes per Track	2.5×10^6 ^{**}

* Typical usage (duty cycle of spindle drive motor: 25% of POH).

** Environmental conditions at measurements: $22 \pm 4^{\circ}\text{C}$ with no frost, no vibration.

3. RECORDING FORMAT

The encoding method used for MCD-1 is frequency modulation recording (FM) or modified frequency modulation recording (MFM).

The FM mode utilizes clocks to define bit cell times. The presence of a flux reversal between clock pulses is defined as a "one" bit. The absence of a flux reversal between clocks is defined as a "zero" bit. On the write data and read data interface lines, between the MCD-1 and the host system, every pulse represents a flux reversal on the MCD-1.

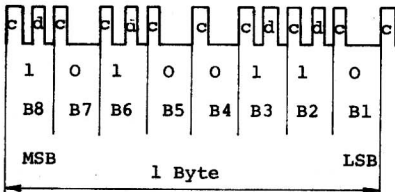


Fig.1 FM Mode

The MFM mode is used to double bit density. The basic principle is to eliminate as many superfluous clock bits as possible.

In the MFM mode the data bit also appears in the middle of the bit cell. The clock bit is written at the beginning of the bit cell only if two conditions are met: - no data bit will appear in the current bit cell
- there was no data bit in the previous bit cell

In other words, a clock bit is inserted only if at least two consecutive bit cells would contain "00".

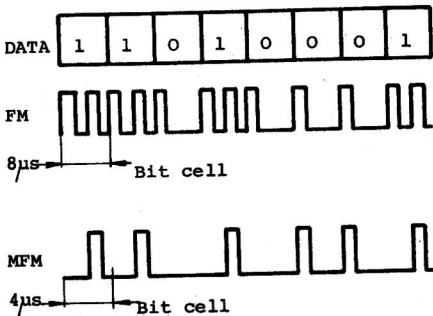


Fig.2 MFM Mode

The MCD-1 drive supports both the FM and the MFM encoding mode. The flux density is the same in the both case, but twice as much data can record on the same cassette because of the above mentioned different encoding mode. This fact requires from the user's controller unit that the transfer rate must be 125 Kbits/Sec in the FM mode and 250 Kbits/Sec in the MFM mode both for reading and writing. Consider the chosen encoding mode in the designing of the controller unit, since not every controller IC is suitable for both the FM and MFM encoding mode. In the MFM mode the recommended precompensation is 250 ns early or late according to bit pattern.

4. TRACK FORMAT

The MCD-1 can write and read soft sectorized track format. In a soft sectorized track format the user may record one long record or several smaller records on a track. The division of the disk or tracks into sectors is performed by software.

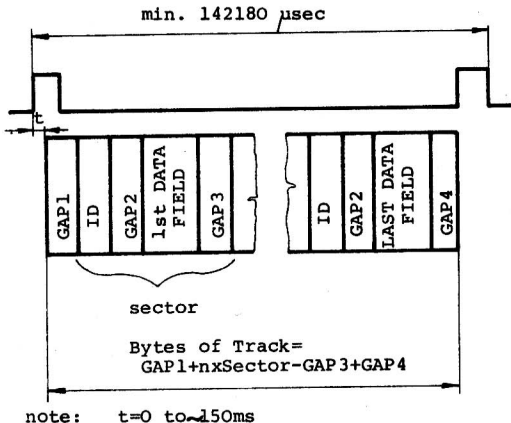
In soft sectoring, each track is started by a physical index pulse, corresponding to the detection of the index stripe on the flywheel of the drive:

Note! The index pulse is independent of the cassette, and can be measured in that case as well, even if there is no cassette in the drive, only the motor working. But the "Ready" signal is active low if a cassette is inserted into the drive and the "Motor on" signal is active low.

Every record is preceded by a unique record identifier. Successive records are separated by gaps. Gaps are necessary in order to upgrade information without erasing the following or preceding record.

The MCD-1 track format is shown in fig.3. This figure shows capacity per disk depending on the number of sectors.

MCD-1 Track Format



t=0 if the measuring was performed with original cassette. The cassette was formatted and measured on the same drive.

t>0 if on the other drive formatted cassette used.

Fig.3 General Track Format

Capacity per Disk	Number of Sectors	Number of Bytes									Bytes per track
		Gap 1		ID Field	Gap 2		Data Field	Gap 3		Gap 4 min.	
		Ones	Sync		Ones	Sync		Ones	Sync		
74.8	13	8	6	7	11	6	131	10	6	0	2221
80.6	7	8	6	7	11	6	259	20	6	70	2221
69.1	3	8	6	7	11	6	515	40	6	510	2221
92.1	2	8	6	7	11	6	1027	65	6	34	2221
92.1	1	8	6	7	11	6	2051	0	0	132	2221

Fig.4 MCD-1 Track Format

Gap 1 is called the index gap and is used at the beginning of every track. The length of gap 1 may never vary in length. The six bytes of zeros are for synchronisation of the data separator. The index gap is followed by the identification of the record. Thus ID field consists of ID address mark, the track address, head address, the sector address, the sector length and two CRC check-sum bytes. (Detailed below).

Gap 2 is called the identifier (ID) gap and separates each successive identification field from its data field. The six bytes of zeros are also for synchronisation of the data separator.

Gap 2 is followed by the data field. The first byte contains address mark. It is followed by the actual 128×2^N bytes of user data. It is terminated by the two usual CRC check-sum bytes.

Note: $N=0$ to 4

Gap 3 is called the data gap, which separates the data field from the following ID field. The six bytes of zeros are for synchronisation too.

Finally, gap 4 is called track gap. It is used only once on the track. It appears at the end of the track before the index pulse.

The soft sectored track format needs unique bit patterns to identify the beginning of ID and Data Fields for synchronizing the deserializer circuit.

always 00.

- SEC : Sector Address, this byte represents in binary notation the sector address.
- N : Sector Length, 00-04
sector length = 128×2^N
- CRC : two bytes CRC Character (detailed below).

Data Field



- MARK : DATA-AM
- DATA : 128×2^N bytes, N=0 to 4
- CRC : two bytes CRC character (detailed below)

CRC Character

The 16-bit CRC Character is generated using the generator polynomial:

$$x^{16} + x^{12} + x^5 + 1$$

It is generated including all characters except the CRC in the ID or data field, including the data (not the clocks) in the mark.

Note: All marks, data, ID characters and CRC characters are written and read most significant bit first.

5. INTERFACE

5.1. Connector CS1

The MCD-1 is connected to the control logic via interface connector CS1. (GO8D 26A4BEAA ITT). This is a 26 pin indirect connector, for the logic signals and the power supply to the drive. The recommended connector on the IF cable: GO8 26A3 BLAA-075 ITT
Fig.5-1 and 5-2 show the interface connector.

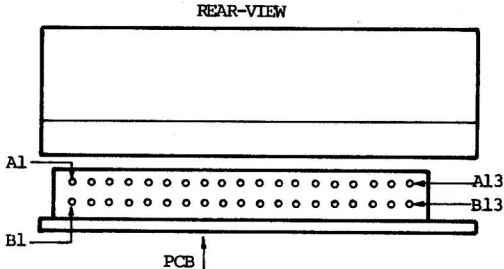


Fig.5-1. Interface Connector

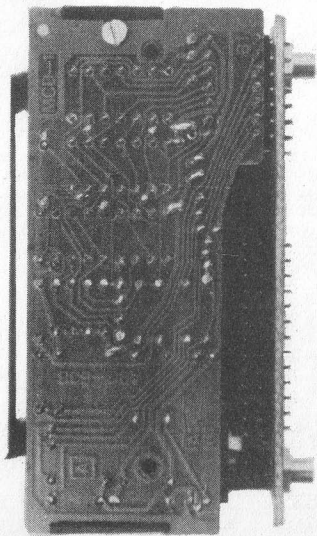


Fig.5-2. Photo of the Interface Connector

5.2. Logic Signals

The interface signals include commands and data to the drive and status and data from the drive to the controller. Figure 6 shows the interface signals.

5.2.1. Input interface

The input interface receives the signals from the controller.

The input lines are terminated by pull up resistors of 150 Ohm. In a daisy chain configuration only the last drive will contain the pull up resistor network.

Input signals:

DRIVE SELECT (1-2) (DS)

This lines select the desired drive. The drive has two select inputs, which allow directly two-drive selection. The selection is detailed below.

WRITE GATE (WG)

Low input enables WRITE DATA to be written on the cassette. High level allows reading from the cassette.

WRITE DATA (WD)

Serial data stream (combination of clock and data bits) to be written on the cassette.

DIRECTION IN (DI)

This input selects the direction in which the read/write head will be moved.

Low = in - toward Track 44 - the centre of the disk.

HIGH=out - toward Track 00

STEP (ST)

This signal moved the read/write head from track to track.

HEAD LOAD (HL)

This line is used to press the media against the read/write head if the drive is selected.

MON

This signal turns on the drive motor and the stepper motor and is not gated by DRIVE SELECT.

5.2.2. Output Interface

The output interface sends the read data pulses and the status signals to the controller.

The output signals are gated by DRIVE SELECT lines.

Output Signals:

READ DATA (RD)

This is the data input signal directly from the drive. This line provides the "raw data" as detected by the read electronics.

WRITE PROTECT (WP)

Low active status of this line indicates that a write protected cassette is installed. The drive will inhibit writing to this write protected cassette.

The cassette has a window on its back side. There is a write protect indicator - slidable tab - in the window. This indicator has two discrete fixed positions. The tab in the window being at the edge of the cassette means the writing is protected. In the inside position of the window can write on the cassette.

TRACK 00 (TOO)

This line indicates that the read/write head is positioned at track 00.

READY

This line goes into low level when the cassette has been correctly inserted, on the DRIVE SELECT lines and MOTOR ON line the low level has been sensed.

INDEX

The leading edge of this signal indicates the beginning of a track.

Figure 7 shows the timing diagram of the logic interface.

5.3. Logic Levels and Termination

Interface signals to and from connector CS1 have the logic levels represented by Fig.8.

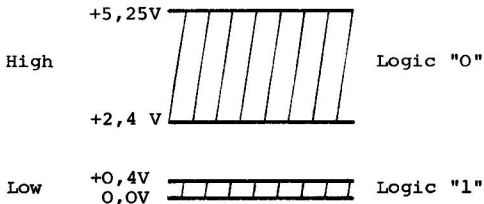


Fig.8. Interface Logic Levels

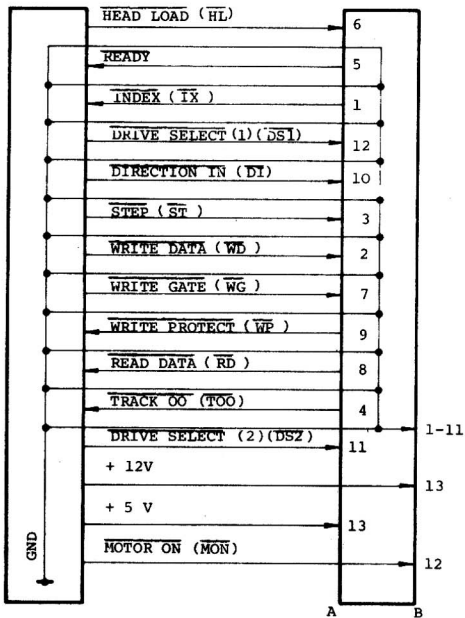


Fig.6. Interface

All signal inputs are terminated by a 150 Ohm resistor network by the manufacturer. This resistors can be removed for a daisy chain configuration where only the last drive needs the termination network. If the removal of the resistors is necessary the solder connection can be cut with a soldering iron on both PCB. Fig. 9-1 and Fig. 9-2 show the photo of two PCB-s marked with the solder connection.

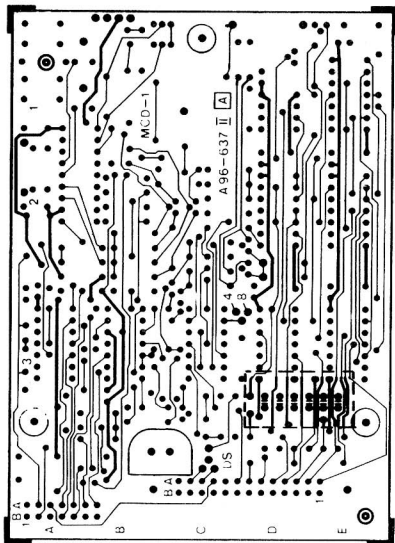


Fig.9-1. Terminated Network Connection on the Large PCB

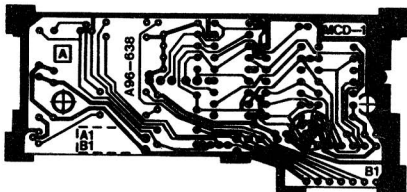


Fig.9-2. Terminated Network Connection on the Little PCB

The MCD-1 drive uses the SN7404 or equivalent integrated circuit as Input receiver. As output driver SN7438 or equivalent is used. Fig.10. shows the recommended driver/receiver circuit.

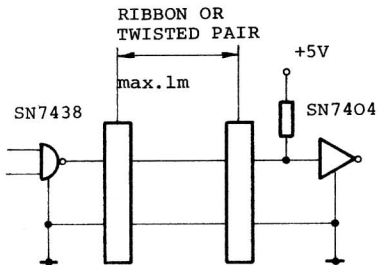


Fig.10. Recommended Driver/
Receiver Circuit

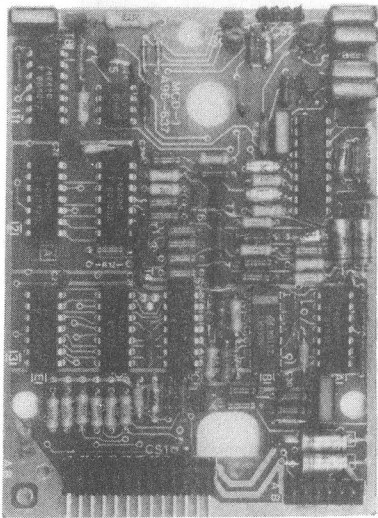


Fig.11-1.Component Side Photo
of the Large PCB.

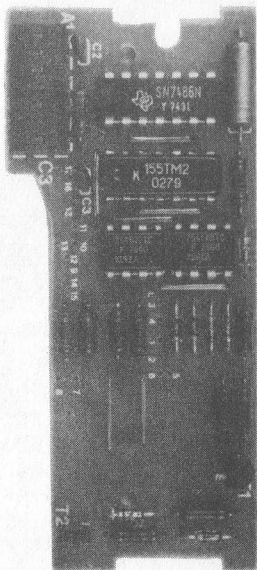


Fig.11-2. Component Side Photo
of the Little PCB.

5.4. Drive Select

There are two possibilities to select the MCD-1 drive: auto select
radial select

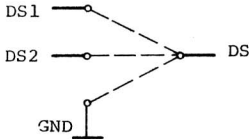


Fig.12. Drive Select

5.4.1. Auto Select

In this case no DRIVE SELECT lines are used. The input and output interface are enabled.

To install the auto select mode the DS line must be connected to GND.
(See Fig.12.)

5.4.2. Radial Select

This mode allows directly two-drive selection. The DRIVE SELECT 1 will select the drive connected between DS1-DS, DRIVE SELECT 2 will select the drive connected between DS2-DS. Only one select connection is allowed in one drive! (see Fig.12). Drives are normally supplied

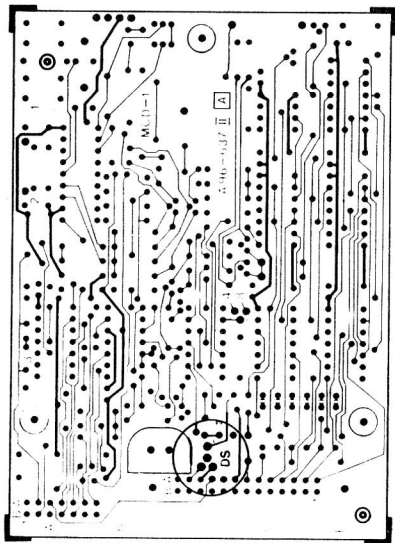


Fig.13. The Select Lines on
the Large PCB

with DS1-DS connection.

The Fig.13. shows the photo of that part of the large PCB, which contains the DS, DS1, DS2 points.

5.5. Connection to the host system

Generally the floppy disks connect to the host system via a controller unit. The current control units are based on a floppy controller chip, which is a VLSI IC. The advantages of this solution are the following, on the hardware side:

- small size
- low cost
- high-reliability
- reduced amount of support hardware
- smaller power consumption

The controller unit based upon a controller IC makes simpler the software design and produces automatically the earlier mentioned track format.

If you are not well trained in designing of controller units, you have to ask from the controller IC manufactures "application reports" in which you can find every detail about the controller IC and how to interface it to the host system and to the floppy disk.

In the Appendix A there are mentioned some controller IC-s, which have been already used for the MCD-1.

6. DRIVE MOUNTING

The MCD-1 drive may be mounted in three positions.

The Fig.14a,b,c show the schematic picture of the possible mounting positions of the drive. The Fig.14a is the horizontal mounting. On the Fig.14b the drive is lying on its side. This mounting is also realizable with turning the drive to its other side. (through 180°). The Fig. 14c is the vertical mounting. The allowable deviation from all three demonstrated positions is 30° .

The Fig.15 shows the outline and mounting dimensions of the drive. The dimension marked with "*" is the maximum value when cassette holder is opened.

Fig.16 shows the fastening of the drive. The large PCB is connected to the mechanical part of the MCD-1 with three screws. In the lower part of the screws there are holes for fastening the MCD-1 to the other parts with three screws (M3x6). On the figure can be seen the exact position of the screws from each other and from the front plate.

The recommended fastening mode of the MCD-1 is shown in the Fig.18.

Note! For the easy mounting of the drive
the size of the boxwindow for the MCD-1
is correctly
32.5 (31.5+1) mm x 86 (85+1) mm.
(See the Fig.17).

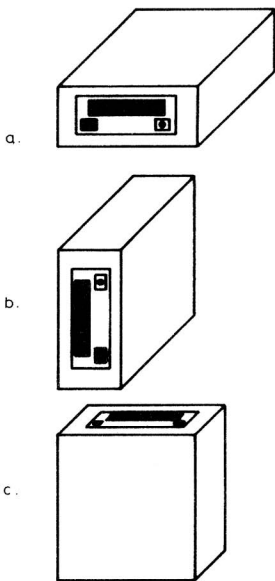
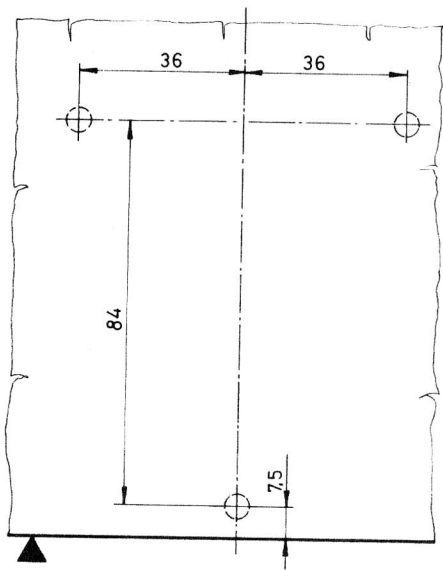


Fig.14. Possible Mounting of the Drive



All tolerances $\pm 0,5$

Fig.16. Fastening of the Drive

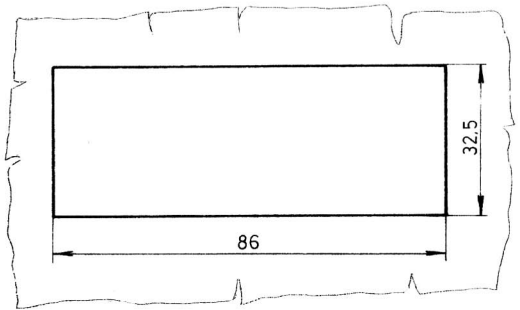


Fig.17 The size of the boxwindow
for the MCD-1.

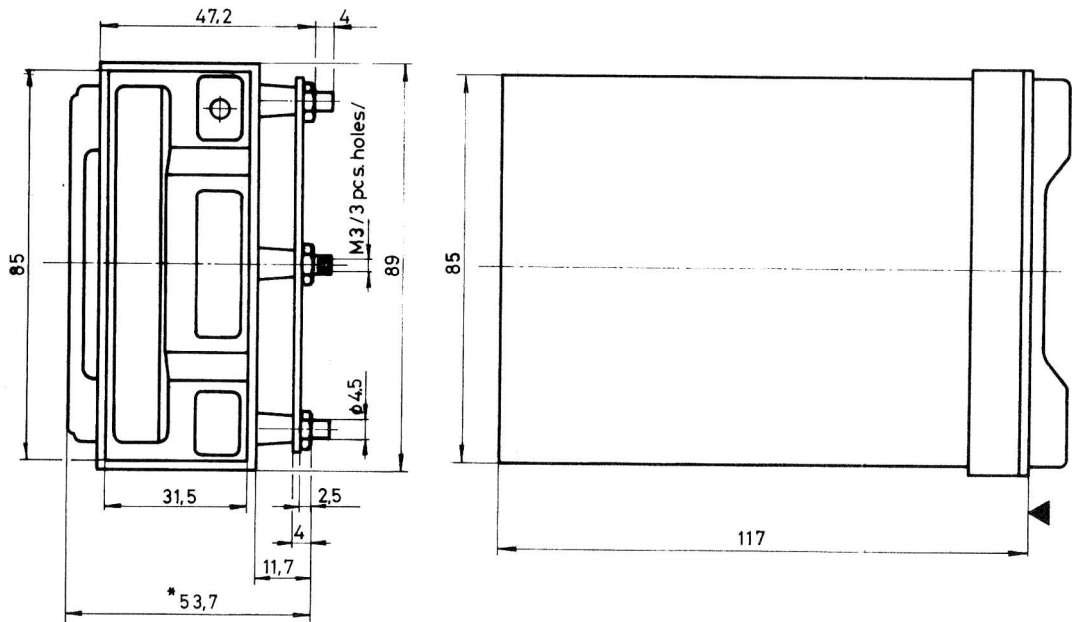


Fig.15. Outline and Mounting Dimensions of the Drive

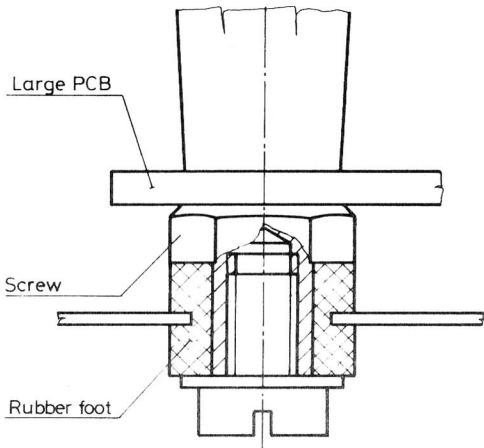


Fig.18. Recommended Fastening Mode

7. INSTALLATION

7.1. Unpacking and Inspection

Before unpacking the drive inspect for damage of the packaging. If damage is evident, notify the carrier. After packaging inspect the drive for damage. If damage is evident, notify the carrier. Specify nature and extent of damage.

7.2. Possible Modifications

Before connecting the drive to the system

- cut the solder contact at the termination network if necessary (in daisy chain configuration except the last drive) on both PCB.
- if DRIVE SELECT 2 line will be used, the DS1-DS connection needs removing and the DS2-DS connecting. In AUTO SELECT mode the DS needs connecting to GND. -on the large PCB.
- check on the connector with cable marked "CS1" if the power supplies (+5V, +12V) are correct or not.
- be sure that the two connectors are connected in the correct posi-

tion.

7.3. Loading of the Cassette

Within the packaging, the cassette holder of the MCD-1 is in such a position as if there were a cassette inserted into the drive. This is the operating position of the cassette holder. So the first thing to do is to push the red eject button until its endposition. Now the cassette holder is opened, the cassette may be loaded.

The MCD-1 allows only one way to load the cassette into the drive. If the drive is mounted according to Fig. 14a, then to load the cassette correctly, you have to take the cassette by its grooved part, so that the label is on the upper part of the cassette, and then push the cassette into the drive as far as possible. Now the drive is ready to work. You can start!

All the cassettes manufactured by BRG are initialized. The exact format of the initializing you can find in Appendix B. If you need another format then you have to make the initialization with your system.

After finishing work with the loaded cassette you push the red eject button as written in the first part of this

section. The cassette comes out automatically from the holder.

APPENDIX A

Some types of controllers, which have been successfully tried out by the manufacturer and the users:

FD 1771 Western Digital

FD 179X Western Digital

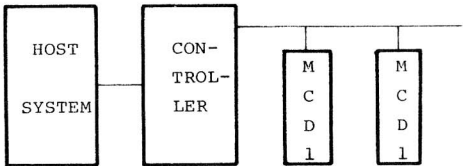
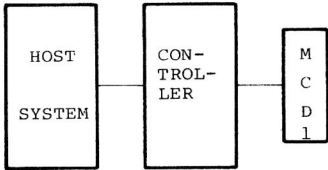
μ PD 372 NEC

μ PD 765 NEC

8271 Intel

8272 Intel

APPENDIX A



Connection to the Host System

APPENDIX B

The format of the cassette initializing by BRG in FM scheme

	Number of Bytes	Hex Value of Byte Written	
	8	FF	GAP1
	6	ϕϕ	ID
	1	FE (ID-AM)	
	1	Track No. (ϕ-2CH)	
	1	ϕϕ Side No.	
	1	Sector No. (1-ϕDH)	
	1	ϕϕ Rec. lenght	
	1	CRC	
13x	1	CRC	GAP2
	11	FF	
	6	ϕϕ	
	1	FB (DATA-AM)	
	128	E5 (DATA)	
	1	CRC	
	1	CRC	
12x	10*	FF	GAP3
1x	0*	FF	GAP4

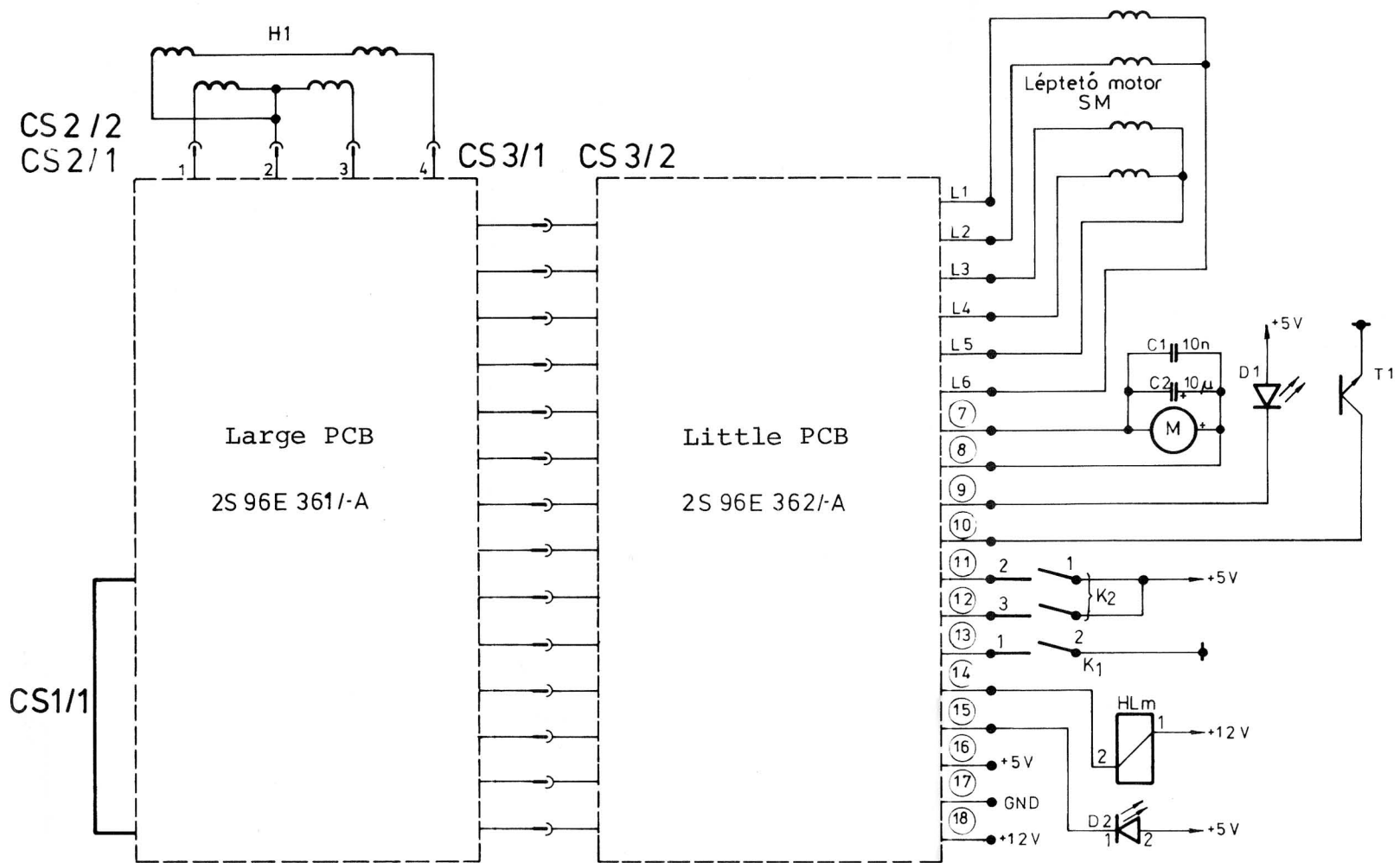
2221

Note: *: 0 is at the nominal disk rotational speed
 This value can vary 0-67, if the motor rotational speed is less than the nominal value.

APPENDIX C

Optional accessories:

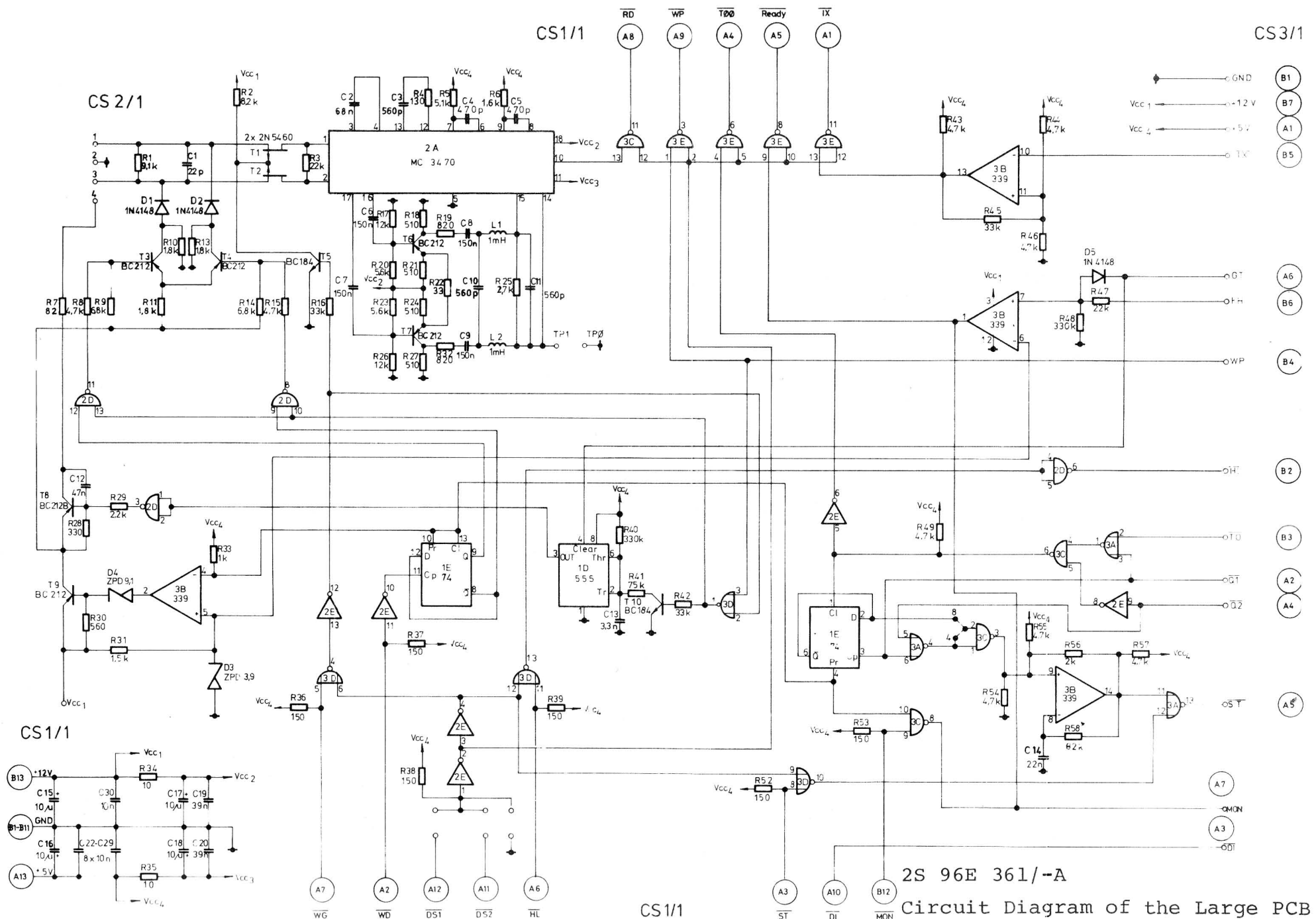
- | | |
|---|-------------|
| 1. IF cable | 3S56-635/-A |
| 2. Special cassette for adjusting of head
and adjusting manual | 3S83-901/-C |
| 3. Shielding plate | 2A32-368/-1 |
| 4. Cassette | 3S83-901/-A |
| 5. Formatted cassette | 3S83-901/-B |
| 6. Special gear-formed-screw driver for
head adjusting | 4S83-932 |



3S 78E 157/-A
Circuit Diagram of the MCD-1

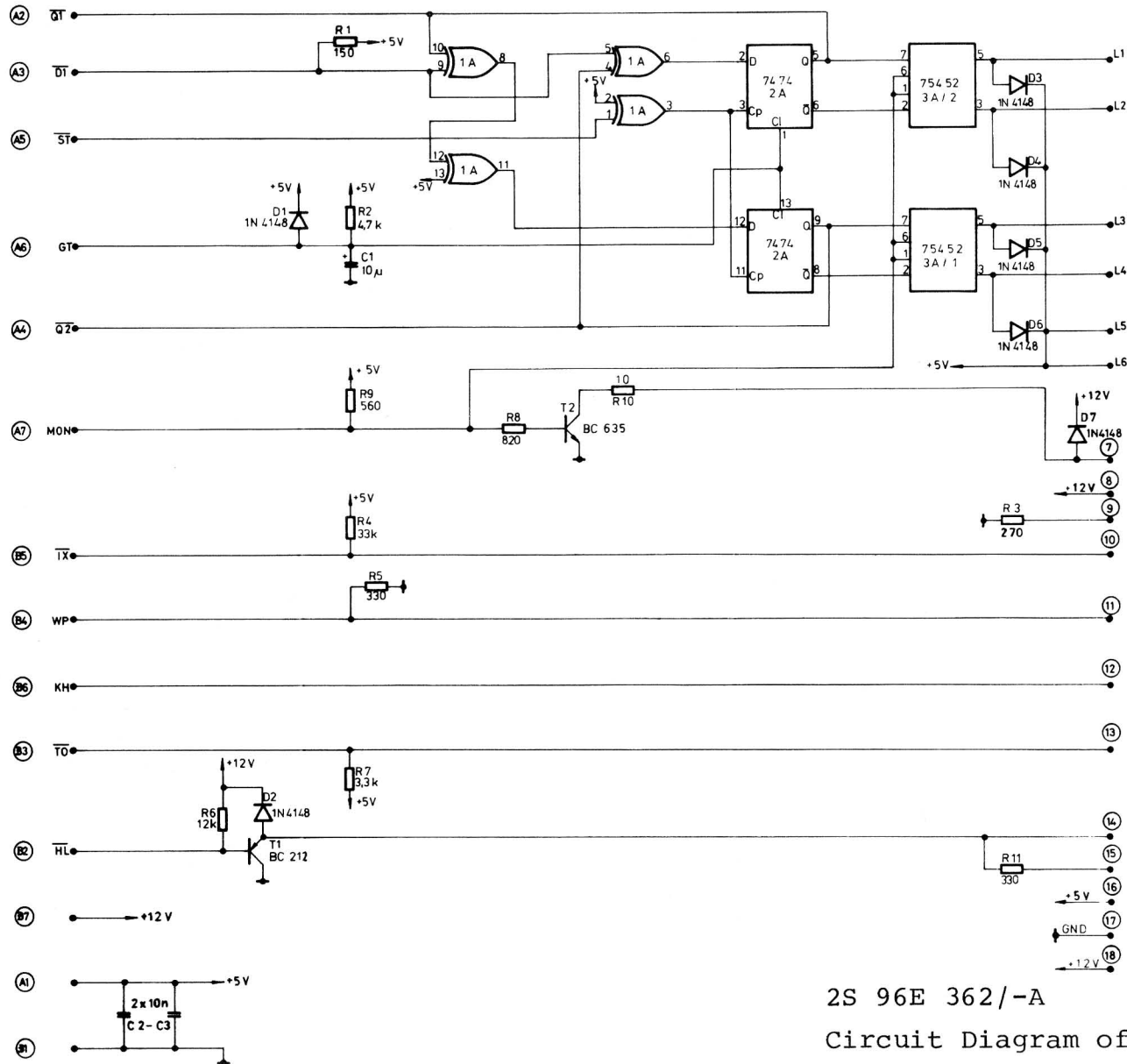
CS1/1

CS3/1



2S 96E 361/-A
Circuit Diagram of the Large PCB

CS3/2



2S 96E 362/-A

Circuit Diagram of the Little PCB

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