BASF

6106/6108 LSI

Part N° 80307-050

REVISION	RECORD OF REVISION	REMARKS
01	LSI/K	valid for LSI-version
REVISION	RECORD OF REVISION	REMARKS

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SECTION I.
INTRODUCTION

1.1. GENERAL

This manual contains descriptive material and procedures useful in installation, operation, maintenance and repair of the BASF Mini Disk Drive Models BASF 6106 and BASF 6108.

1.2. RELATED DOCUMENTATION

Product- and Interface Specification :
BASF 6106/08 : 80 307-046

1.3. DESCRIPTION

The models BASF 6106 and BASF 6108 are very compact random access data storage units, which utilize a 5.25" Flexy Disk as storage medium. The BASF 6106 stores data on one side of the Flexy Disk, the BASF 6108 on both sides.

The Flexy Disk is rotated at 300 RPM yielding a data transfer rate of 125.000 bits per second in single density, and twice as much in double density.

Data capacity on all 40 tracks varies from 81.92 kbytes (BASF 6106, 16 sectors at 128 bytes) to 368.64 kbytes, so increasing capacity more then four times by using the BASF 6108 with 9 sectors of 512 bytes each.

The Mini Disk Drives are equipped with a DC-controlled spindle drive motor, thus no AC-power is needed. Ceramic read/write heads with tunnel erase are used within the BASF 6106/6108 to ensure reliable data recording.

The heads are positioned with a fourphase DC-stepper motor actuator, utilizing a spiral wheel which provides precise location of the read/write head or heads on the track.

In the electronic, a large scale integrated circuit (LSI) in NMOS technique is used, which contains most of the digital control logic of the drive. The LSI increases the reliability of the electronic and decreases the repair time.

Applications for both types of mini disk drives comprise word processing and text editing systems, program storage for mini and micro computers, "intelligent" desktop calculators and the hobby micro computer market.
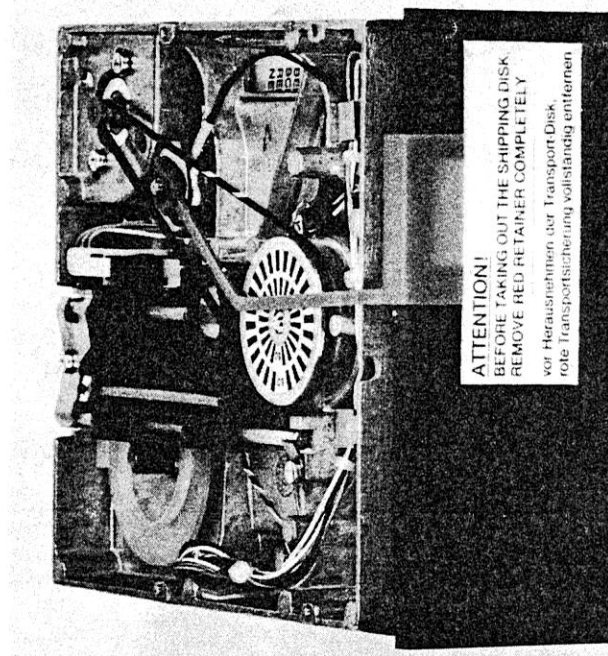
FIGURE 1 - 1 : MODEL BASF 6106/6108 MINI DISK DRIVE

A comprehensive list of principal specifications for model BASF 61o6 and model BASF 61o8 is provided in table 1 - 1.

P E R F O R M A N C E   S P E C I F I C A T I O N S

CAPACITY

	BASF 61o6 (single sided)		BASF 61o8 (double sided)	
Unformatted	Single Density	Double Density	Single Density	Double Density
per Disk	125 Kbytes	25o Kbytes	25o Kbytes	5oo Kbytes
per Surface	125 Kbytes	25o Kbytes	125 Kbytes	25o Kbytes
per Track	3.125 Kbytes	6.25o Kbytes	3.125 Kbytes	6.25 Kbytes

Formatted (16 Sectors/Track)				
per Disk	81.92o Kbytes	163.84o Kbytes	163.84o Kbytes	327.68o Kbytes
per Surface	81.92o Kbytes	163.84o Kbytes	81.92o Kbytes	163.84o Kbytes
per Track	2.o48 Kbytes	4.o96 Kbytes	2.o48 Kbytes	4.o96 Kbytes
per Sector	128 bytes	256 bytes	128 bytes	256 bytes

TRANSFER RATE	125 Kbits/s	25o Kbits/s	125 Kbits/s	25o Kbits/s

LATENCY

Maximum	2oo ms
Average	1oo ms

ACCESS TIME

Track to track positioning	12 ms
Average	24o ms
Settling Time	max. 48 ms
Head Load Time	max. 35 ms
Drive Motor Start Time	max.65o ms

F U N C T I O N A L   S P E C I F I C A T I O N S

	BASF 61o6		BASF 61o8	
	Single Density	Double Density	Single Density	Double Density
Rotational Speed	3oo RPM ± 2,5 %	3oo RPM ± 2,5 %	3oo RPM ± 2,5 %	3oo RPM ± 2,5 %
Recording Density (inside Track)	3979 BPRAD (2768 BPI)	7958 BPRAD (5536 BPI)	3979 BPRAD (2768 BPI)	7958 BPRAD (5536 BPI)
Flux Density	7958 FTPRAD (5536 FCI)	7958 FTPRAD (5536 FCI)	7958 FTRAD (5536 FCI)	7958 FTPRAD (5536 FCI)
Track Density	48 TPI	48 TPI	48 TPI	48 TPI
Track Radius Track 00 Track 39	57,15 mm 36.5125 mm	57,15 mm 36.5125 mm	55,o3 mm [+] 34.3958 mm [+]	55,o3 mm [+] 34.3958 mm [+]
Encoding Method	FM	MFM	FM	MFM
Media Requirements	BASF Flexy Disk 5.25"-1	BASF Flexy Disk 5.25"-1D	BASF Flexy Disk 5.25"-2	BASF Flexy Disk 5.25"-2D

[+] On Side 1, Side 0 see 61o6
   Track radius 1 is 2. 1167 mm
   smaller then track radius 0.

TABLE 1 - 1 : SPECIFICATION SUMMARY (continued)

PHYSICAL SPECIFICATIONS

Environmental limits
Ambient temperature on disk surface (operation) 10^0 to 50^0C (50^0F to 120^0F)
Relative humidity   20 % to 80 %
Maximum wet bulb 29^0C (84^0F)
DC-voltage requirements   + 12 VDC $\pm$ 5 %   0,7 A[+]

                                                                max. 100 mVpp ripple

                                                   + 5 VDC $\pm$ 5 %   0,5 A

                                                                max. 50 mVpp ripple
                                        [+] additional motor starting current :
                                                max. 0.65 A for max. 50 msec
                                                head load start current
                                                0.7 A for 50 msec

Power dissipation   10.0 Watts operating
                                                   4.0 Watts stand by (motor off)
                                                   7.5 Watts motor on and deselected

Mechanical dimensions:
Width   146.1 mm (5.75 inch)
Height   53.5 mm (2.11 inch)
Depth   190.0 mm (7.48 inch)
Weight   1,4 kg

RELIABILITY SPECIFICATIONS

MTBF   10 000 POH under typical usage[+]
Unit life time   5 years
MTTR   30 minutes

Error rates:
Soft read errors   1 per 10^8 bits read
Hard read errors   1 per 10^{11} bits read
Seek errors   1 per 10^6 seeks

                                                   +) Duty cycle of Spindle Drive Motor: 20 % of POH

MEDIA SPECIFICATIONS

Jacket   133.4 mm (5.25 inch) square
Disk   130.2 mm (5.125 inch) diameter
Center hole   28.58 mm (1.125 inch) diameter

TABLE 1 - 1 : SPECIFICATION SUMMARY

1.5. OPTIONS SUMMARY

The following tables list the options of the BASF
6106 and BASF 6108 mini disk drives.

1.5.1. FACTORY INSTALLED OPTION

Option	Function
Door Lock Solenoid	Locks the front door under control of the users software.

TABLE 1 - 2 : FACTORY INSTALLED OPTION

1.5.2. JUMPER OPTIONS

The following options are selectable by jumpers on
the PCB. Refer to table 3 - 10 for jumper option
matrix.

Option	Function
RADIAL SELECT	Allows the connection of four mini disk drives to the host system. Each drive has an own address (0,1,2,3) selectable by jumper.
AUTO SELECT	The interface is always enabled (drive is always selected). The SELECT-lines are not used.
HEAD LOAD	Loading of the head can be accomplished in three modes: ● Selected Head Load (INT.SELECT● HEAD LOAD) ● Auto Head Load (INT. SELECT) ● Radial Head Load (HEAD LOAD) The head will be loaded only if the inserted mini disk rotates.
IN USE	Pin 34 of the interface is used as IN USE input signal and controls the door lock solenoid and the activity indicator. If this option is used the disk change option must be disabled.

Option	Function
DOOR LOCK LATCH	Allows locking of the door without maintaining the IN USE signal activated by storing the state of the IN USE-signal into the IN USE-flipflop. To use this option, the IN USE-option must be jumpered.
DISK CHANGE	Notifies the host system that the mini disk has been changed. If this option is used, the IN USE-option must be disabled.
DOOR LOCK	Locking of the door can be accomplished as follows : 1. by the IN USE-signal 2. by the IN USE-FF (DOOR LOCK LATCH) 3. if the drive is selected (SELECT active) 4. if the head is loaded (HEAD LOAD active) 5. if 1. or 2. is true 6. if 1. or 3. is true 7. if 1. or 4. is true 8. if 2. or 3. is true 9. if 2. or 4. is true 10. if 1. or 2. or 3. is true 11. if 1. or 2. or 4. is true
ACTIVITY INDICATOR OPTIONS	The lighting of the activity LED is selectable by jumper to one of the following conditions: - the head is loaded and the drive is ready - the door is locked and the drive is ready - HEAD LOAD is active - the door is locked
WRITE PROTECT OPTION	Allows protection of the mini disk against overwrite if the write protect notch is closed (ECMA, Shugart).
STEPPER MOTOR SWITCHING	The stepper motor is switched on and off together with the drive motor if a jumper is inserted. If the jumper is not inserted, the stepper motor will be enabled as long as power is supplied.

TABLE 1 - 3 : JUMPER SELECTABLE OPTIONS

1.6. RECORDING MEDIA

The BASF mini disk drives use a removable 130 mm (5.25 inch) diameter flexible disk as storage media. Figure 1 - 2 shows construction and dimensions of a typical 5.25" flexy disk. The recommended recording media is :

- for model BASF 6106 mini disk drives :
  single density : BASF 5.25"-1
  double density : BASF 5.25"-1D

- for model BASF 6108 mini disk drives :
  single or double density : BASF 5.25"-2D

The flexy disk is an oxide coated flexible disk enclosed in a protective plastic envelope. The protective envelope contains apertures for head contact , index detection, write protect detection and drive spindle loading.
The write protect notch is used to protect the written data on the flexy disk (see 2.3.14.4. write protect detector).
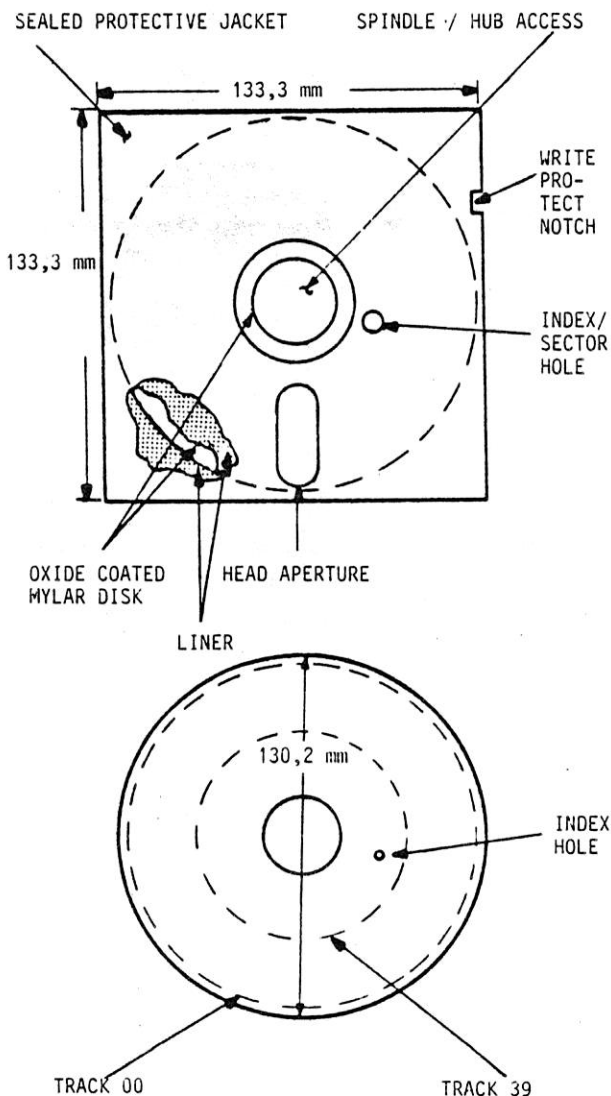
FIGURE 1 - 2 :
FLEXIBLE DISK CONSTRUCTION AND DIMENSIONS

1.7. RECORDING FORMATS

The format of the data recorded on the diskette depends on the host system. There are two encoding schemes used :

- FM - Frequency Modulation
        for single density

- MFM - Modified Frequency Modulation
        for double density

1.7.1. FM-ENCODING

This scheme 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 disk drive and host system, each pulse represents a flux reversal on the diskette.
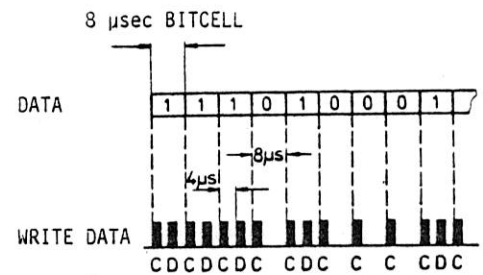
FIGURE 1 - 3 : FM-ENCODING

1.7.2. MFM-ENCODING

A flux transition is always recorded at the center of the bitcell for each "one" data bit. No flux transition is recorded for a "zero" bit, unless it is not followed by another "zero" bit. In this case, the flux transition is provided at the end of the first bit cell.
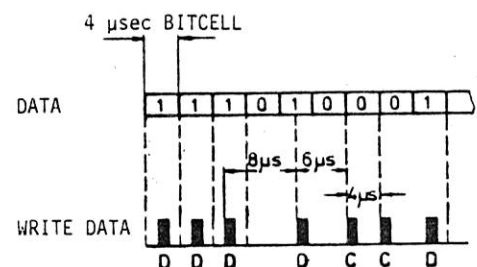
FIGURE 1 - 4 : MFM-ENCODING

1.8. TRACK FORMAT

The tracks of the flexy disk may be formatted in nume-
rous ways, depending on the formatter of the host sys-
tem used. The BASF mini disk drives write and read hard
or soft sectored track formats.

1.8.1. SOFT SECTORED TRACK FORMATS

In a soft sectored track format, the user may record
one long record or several smaller records on a track.
The most common soft sectored track formats are descri-
bed in the following chapters.
(The designer should also consider national and interna-
tional standards for data interchange).

1.8.1.1. SOFT SECTORED TRACK FORMAT FOR SINGLE
DENSITY (16 sectors/track â 128 bytes)

This format is shown in figure 1 - 6. It is similar to
the IBM-format.
The beginning of a track is indicated by a physical in-
dex pulse. Each record is preceded by a unique record
identifier. Record identifiers and data fields are se-
parated by gaps. The gaps are necessary to allow upda-
ting of a data field without disturbing adjacent fields.

INDEX GAP

This gap starts with the index pulse and is 16 bytes in
length. It is not affected by any update write process.

IDENTIFIER GAP

This gap consists of 11 bytes FF and may vary slightly
in length after the data field has been updated.

DATA GAP

This gap separates the data field from the following
ID-field and is nominally 27 bytes in length. It will
vary slightly in length after the data field has been
updated.

TRACK GAP

The gap between the last data field and the index
pulse is defined as track gap. It varies slightly
in length, due to write frequency and disk speed to-
lerances. It is nominally 101 bytes in length.

ADDRESS MARK (AM)-BYTE

The soft sectored track format needs unique bit pat-
terns to identify the beginning of ID and data fields
for synchronizing the deserializer circuit in the
host system. The unique bit pattern is called Address
Mark (AM). AM-patterns do not contain clock bits in
all bit cells (all other data bytes must have clock
bits in each bit cell!).

There are three different AM-patterns used :

- ID-AM   in front of an ID-field
- DATA-AM   in front of a data field
- DELETED DATA-AM   in front of a deleted data
                       field
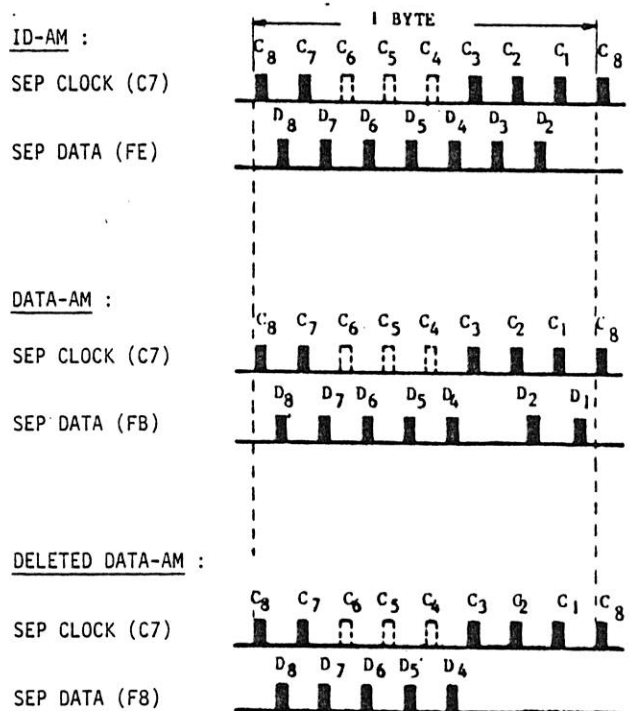
FIGURE 1 - 5 : ADDRESS MARK PATTERNS

SECTOR IDENTIFIER

The sector identifier consists of the identifier mark, the address identifier and the EDC-pattern.

IDENTIFIER MARK

This field comprises 7 bytes (see figure 1 - 6). The 6 bytes of zeros in front of the address mark byte are for synchronisation of the data separator in the host system. The ID-AM-byte contains a data pattern of FE where the clock bits C6, C5 and C4 are missing as explained before.

ADDRESS IDENTIFIER

The address identifier comprises the following 6 bytes :

1. track address (TRK) :

   This byte represents in binary notation the track address from 00 for the outermost track to 39 for the innermost track.

2. side address (SID) :

   Represents in binary notation the side address (00 or 01) of the mini disk.

3. sector address (SEC) :

   Represents in binary notation the sector address from 01 for the 1st sector to 16 for the last sector of a track.

4. sector length (LEN) :

   This byte identifies the length of the data field as follows :

   00 :   128 bytes
   01 :   256 bytes
   02 :   512 bytes
   03 : 1 024 bytes

5. and 6. EDC-bytes (EDC) :

   These two bytes are hardware generated from the host system by shifting serially the bits of the sector identifier starting with the ID-AM and ending with the 4th byte of the sector identifier through a 16-bit shift register described by the generator polynominal :

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

   (for more details, read chapter EDC-implementation !).

FIGURE 1 - 6 : SOFT SECTORED TRACK FORMAT WITH 16 SECTORS/TRACK FOR SINGLE DENSITY (FM)

DATA BLOCK

The data block contains the data mark, the data field and the EDC-bytes.

DATA MARK

This field comprises 7 bytes (see figure 1 - 6).The 6 bytes of zeros in front of the data address mark are for synchronisation of the data separator circuit in the host system. The data address mark byte contains FB in front of a normal data field. When a deleted data field follows, FB must be written. The clock pattern of the data address mark is C7 (C6,C5 and C4 missing).

DATA FIELD

This field comprises 128 bytes. If it comprises less than 128 bytes, the remaining positions shall be filled with zeros.

EDC-BYTES

These two bytes are hardware generated by the host system by shifting serially the bits of the data block starting with the DATA-AM and ending with the last byte of the data field through a 16-bit shift register described by the following generator poly-nominal :

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

EDC-IMPLEMENTATION

Figure 1 - 7 is a simplified logic of a shift register, which may be used to generate the EDC-bytes.

Prior to the operation, all positions of the shift register are set to ONE. Input data are added (exclusive OR) to the contents of position C_{15} of the register to form a feedback. This feedback in turn is added (exclusive OR) to the contents of position C_4 and position C_{11}.

On shifting, the outputs of the exclusive OR gates are entered into positions C_0, C_5 and C_{12} respectively. After the last data bit was added, the register is shifted once more as specified above.
The register than contains the EDC-bytes. When further shifting is to take place during the writing of the EDC-bytes, the control signal inhibits exclusive OR operations.
To check for errors when reading, the data bits are added into the shift register in exactly the same manner as they were during writing. After the data, the EDC bytes are also entered into the shift register as if they were data. After the final shift, the register contents will be all ZERO if the record does not contain errors.
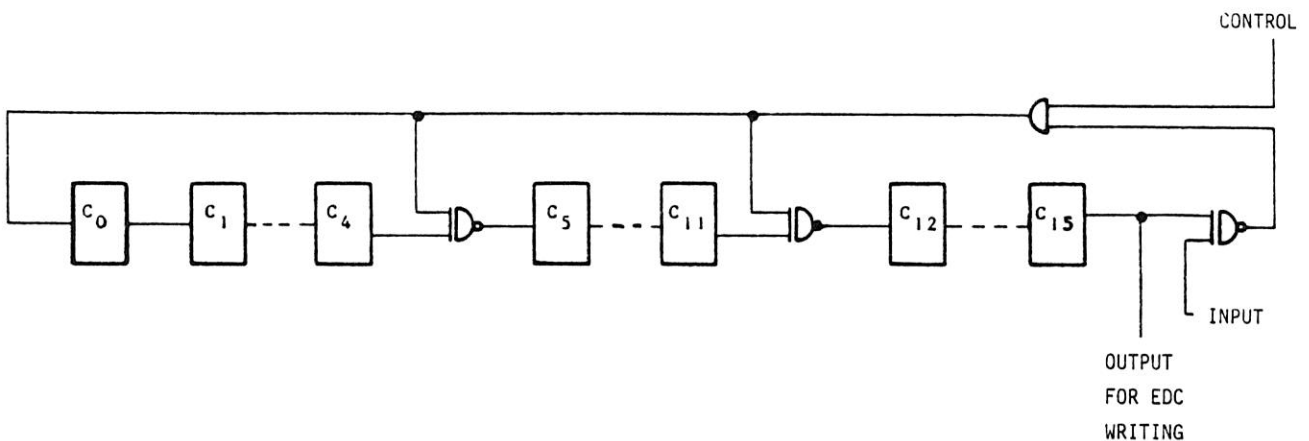
FIGURE 1 - 7 : SIMPLIFIED SHIFT REGISTER

1.8.1.2. SOFT SECTORED TRACK FORMAT FOR SINGLE DENSITY
(9 SECTORS/TRACK à 256 BYTES)

In this format, which is shown in figure 1 - 8, each sector contains 256 bytes.

INDEX GAP	SECTOR IDENTIFIER	IDENTIFIER GAP	FIRST DATA BLOCK	DATA BLOCK GAP		LAST DATA BLOCK	DATA BLOCK GAP	TRACK GAP
X X FF	13 BYTES	11 X FF	256 BYTES	(32+Y) X FF		256 BYTES	(32+Y) X FF	(32+Z)X FF

1st sector ⟶ 9th sector ⟶

INDEX PULSE

$X + Y + Z = 204$ BYTES

SECTOR IDENTIFIER :

IDENTIFIER MARK	ADDRESS IDENTIFIER				E D C
b X 00 FE 1) / C7 2)	TRK	SID	SEC	01	2 BYTES

ID-AM

DATA BLOCK :

DATA MARK	DATA FIELD	E D C
b X 00 FB 1)* / C7 2)	256 B Y T E S	2 BYTES

DATA-AM

1) DATA PATTERN
2) CLOCK PATTERN

DELETED AM : F8

ID-AM :

SEP CLOCK (C7)

SEP DATA (FE)

DATA-AM :

SEP CLOCK (C7)

SEP DATA (FB)

DELETED DATA-AM :
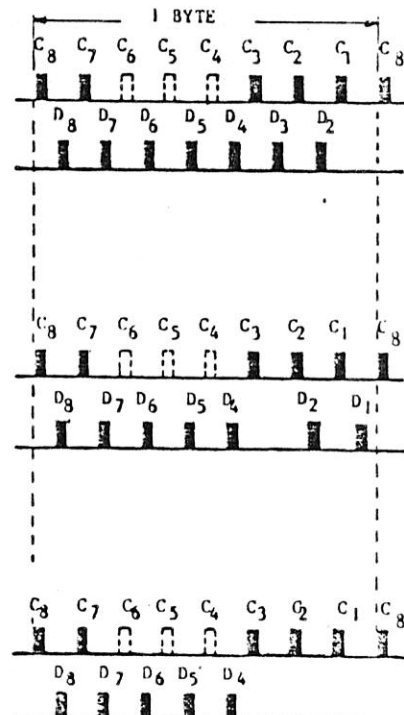
SEP CLOCK (C7)

SEP DATA (F8)

FIGURE 1 - 8 : SOFT SECTORED TRACK FORMAT WITH 9 SECTORS/TRACK

1.8.1.3. SOFT SECTORED FORMAT FOR DOUBLE DENSITY (16 SECTORS à 256 BYTES)

On double sided diskettes for double density, track 0 on side 0 is recorded in FM. For this track, only the previous described track format for single density is valid. All other tracks on the diskette are recorded in MFM. For these tracks, the following track format will be valid (see figure 1 - 9).

The content of the data blocks is doubled to 256 bytes. In MFM recording, the bit density is also doubled, the sector count will be the same as in single density format (1.8.1.1.). The meaning of the different fields and the generation of the EDC-bytes are the same as in single density recording. Only the address mark pattern is changed as shown in figure 1-9.

INDEX GAP	SECTOR IDENTIFIER	IDENTIFIER GAP	FIRST DATA BLOCK	DATA BLOCK GAP		LAST DATA BLOCK	DATA BLOCK GAP	TRACK GAP
146 BYTES	22 BYTES	22 x 4E	274 BYTES	54 x 4E		262 BYTES	54 x 4E	192 x 4E

INDEX - PULSE

1 st SECTOR ← → 16th SECTOR
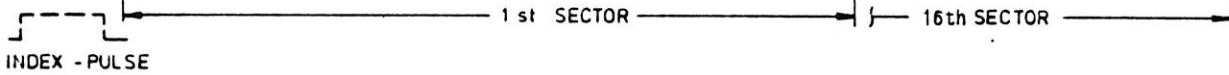
INDEX GAP:

| 80 x 4E | 12 x 00 | 3 x C2 [1] | FC | 50 x 4E |

1) MISSING CLOCK TRANSITIONS BETWEEN BITS 5 AND 4.

INDEX - AM:

1 BYTE

C2   C2   C2   FC

$D_8 D_7 C_5 C_4 C_3 D_2$ $D_8 D_7 C_5 C_4 C_3 D_2$ $D_8 D_7 C_5 C_4 C_3 D_2$ $D_8 D_7 D_6 D_4 D_3 D_2 C_1 C_8$
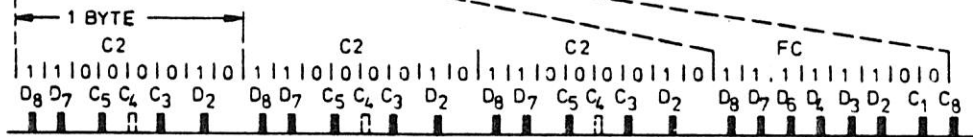
SECTOR IDENTIFIER:

IDENTIFIER MARK		ADDRESS IDENTIFIER				EDC
12 x 00	3 x A1 [2]	FE	CYL	SID	SEC	01	2 BYTES

2) MISSING CLOCK TRANSITIONS BETWEEN BITS 4 AND 3.

ID - AM:

A1   A1   A1   FE

$D_8 D_6 C_4 C_3 C_2 D_1$ $D_8 D_6 C_4 C_3 C_2 D_1$ $D_8 D_6 C_4 C_3 C_2 D_1$ $D_8 D_7 D_6 D_5 D_4 D_3 D_2 C_8$
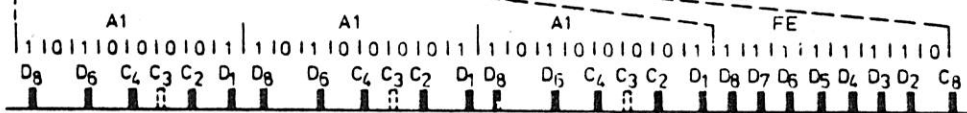
DATA BLOCK:

DATA MARK		DATA FIELD	EDC
12 x 00	3 x A1 [2]	FB [3]	256 BYTES	2 BYTES

2) MISSING CLOCK TRANSITIONS BETWEEN BITS 4 AND 3
3) DELETED RECORD: F8

DATA - AM:

A1   A1   A1   FB

$D_8 D_6 C_4 C_3 C_2 D_1$ $D_8 D_6 C_4 C_3 C_2 D_1$ $D_8 D_6 C_4 C_3 C_2 D_1$ $D_8 D_7 D_6 D_5 D_4 D_2 D_1$

DELETED DATA - AM:

A1   A1   A1   F8

$D_8 D_6 C_4 C_3 C_2 D_1$ $D_8 D_6 C_4 C_3 C_2 D_1$ $D_8 D_6 C_4 C_3 C_2 D_1$ $D_8 D_7 D_6 D_5 D_4 C_2 C_1 C_8$
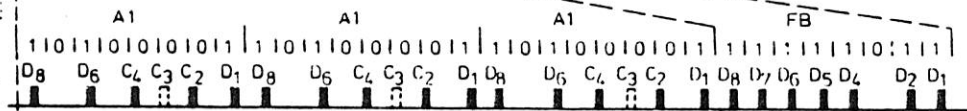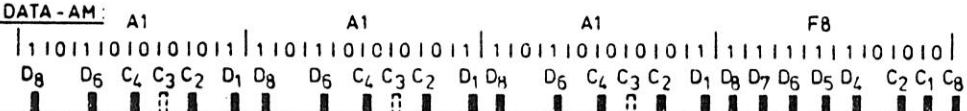
FIGURE 1 - 9 : SOFT SECTORED TRACK FORMAT FOR DOUBLE DENSITY (MFM)

SECTION II.
THEORY OF OPERATION

2.1. GENERAL

This section contains descriptive information on each function of the mini disk drive and detailed theory of operation of mechanism and electronics of the drive.

2.2. FUNCTIONAL DESCRIPTION

The models BASF 6106 and BASF 6108 comprise the following functions :
- drive mechanism
- spindle and front door mechanism
- positioning mechanism
- head load mechanism

2.2.1. DRIVE MECHANISM

The spindle is rotated at 300 rpm by a DC drive motor. Rotation of the spindle is provided by a belt and pulley. The drive motor is started and stopped by the interface signal MOTOR ON.
The ratio between motor and spindle speed is approximately 7:1.

2.2.2. SPINDLE AND FRONT DOOR MECHANISM

The main parts of this mechanism are the drive hub, the centering cone, the centering cone expander and the front door with pressure arm and door latch (see fig. 2 - 1). For loading, a diskette is inserted and the front door pressed. The pressure arm moves down, the centering cone enters the flexy disk. Just before the centering cone reaches the full down position, the centering cone expander is activated and expands the centering cone which grips the inner diameter of the flexy disk to ensure correct alignment. The door latch is activated and holds the front door in a closed position. For unloading a disk, the front door must be pressed again. The door latch opens and the pressure arm is moved upwards by a spring. The centering cone and centering cone expander also move upwards and disengage the mini disk from the drive hub.

FRONT DOOR (opened)

FRONT DOOR (closed)

DOOR LATCH

PRESSURE ARM

DRIVE HUB

CENTERING CONE EXPANDER

CENTERING CONE
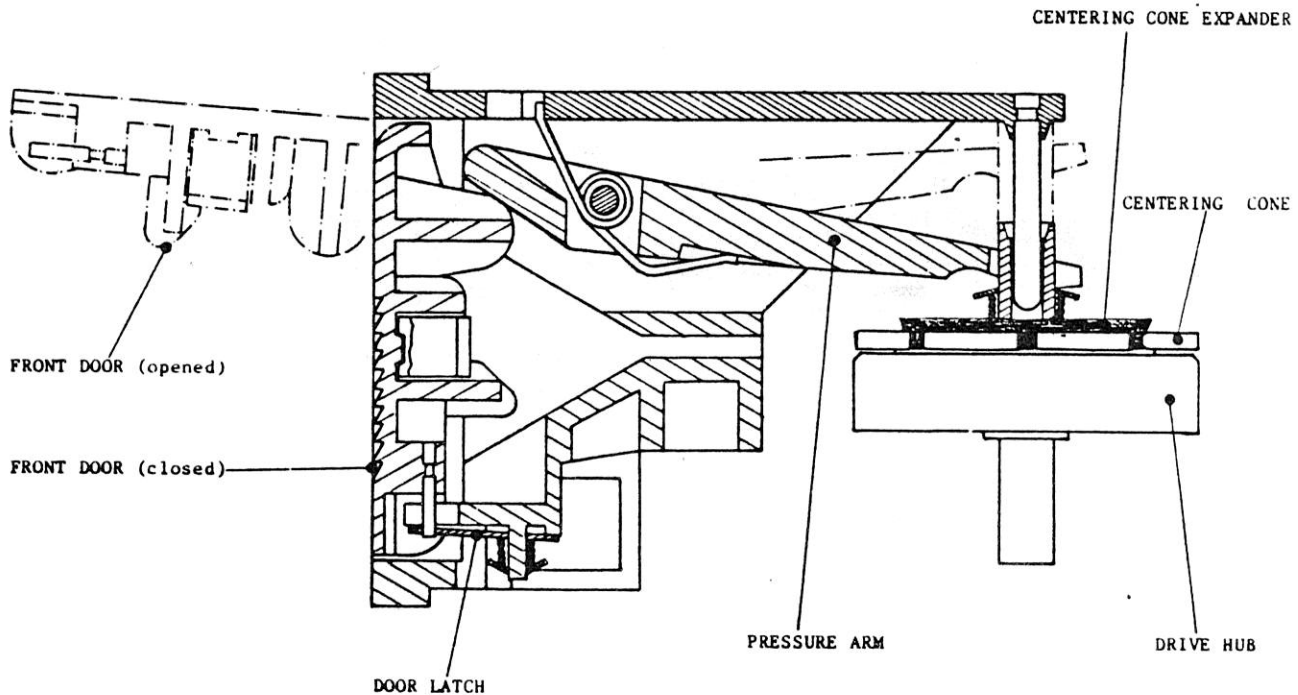
FIGURE 2 - 1 : SPINDLE AND FRONT DOOR MECHANISM

2.2.3. POSITIONING MECHANISM

The main parts of the positioning mechanism are (see fig. 2 - 2 and 2 - 3) :

- stepper motor
- spiral wheel
- carriage assembly

The stepper motor is a four phase motor and is rotated 15° by each step pulse.
The spiral wheel directly connected to the shaft of the stepper motor converts the rotational motion of the stepper motor to a linear motion of the read write head assembly.

The BASF 6106 carriage assembly (see fig.2 - 2) consists of the read/write head, and the head load pressure arm. The read/write head is inserted in the carriage assembly, which rides on two guide bars. The flexy disk is pressed against the read/write head by the head load pressure arm. The head load pressure arm is released by the head load mechanism.
In the BASF 6108 carriage assembly (see fig. 2 - 3), the head load pressure pad is replaced by the upper read/write head.
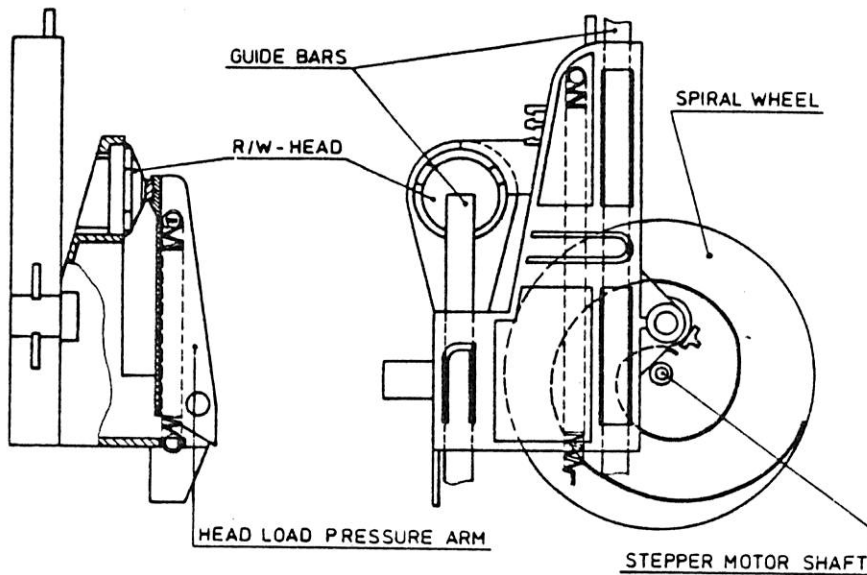
FIGURE 2 - 2 : POSITIONING MECHANISM BASF 6106
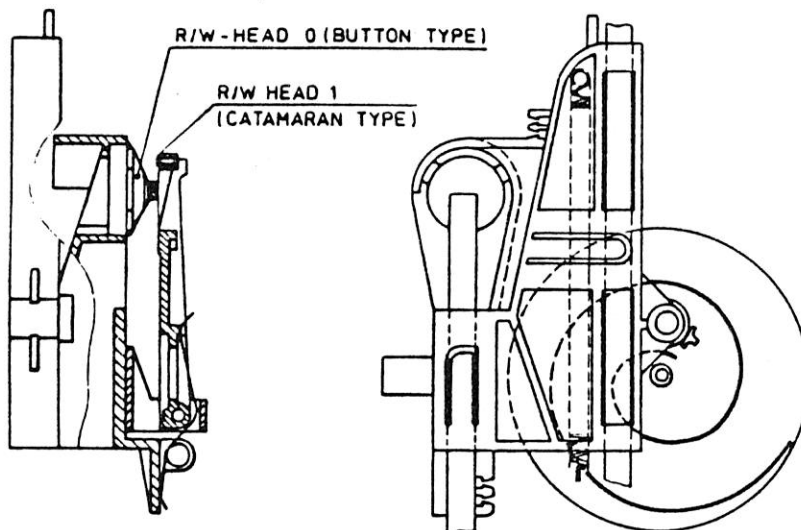
FIGURE 2 - 3 : POSITIONING MECHANISM BASF 6108

2.2.4. HEAD LOAD MECHANISM

The head load mechanism comprises (see fig. 2 - 4 and 2 - 5) :

- head load solenoid
- head load actuator

When the head load solenoid is energized, the head load actuator releases the head load pressure arm of the carriage assembly. On the single sided mini disk drive (BASF 6106), this causes the mini disk to be pressed against the read/write head by the head load pad.

On the double sided mini disk drive (BASF 6108), the flexy disk is pressed against the bottom head (HEAD 0) by the upper head (HEAD 1) mounted in the pressure arm. The pressure foam on the head load actuator stabilizes the flexy disk. When the head load solenoid is deenergized, the head load actuator is lifted by a sping. The head load pressure arm is lifted also.

HEAD LOAD PRESSURE ARM

R/W HEAD

HEAD LOAD PAD

HEAD LOAD ACTUATOR

HEAD LOAD SOLENOID
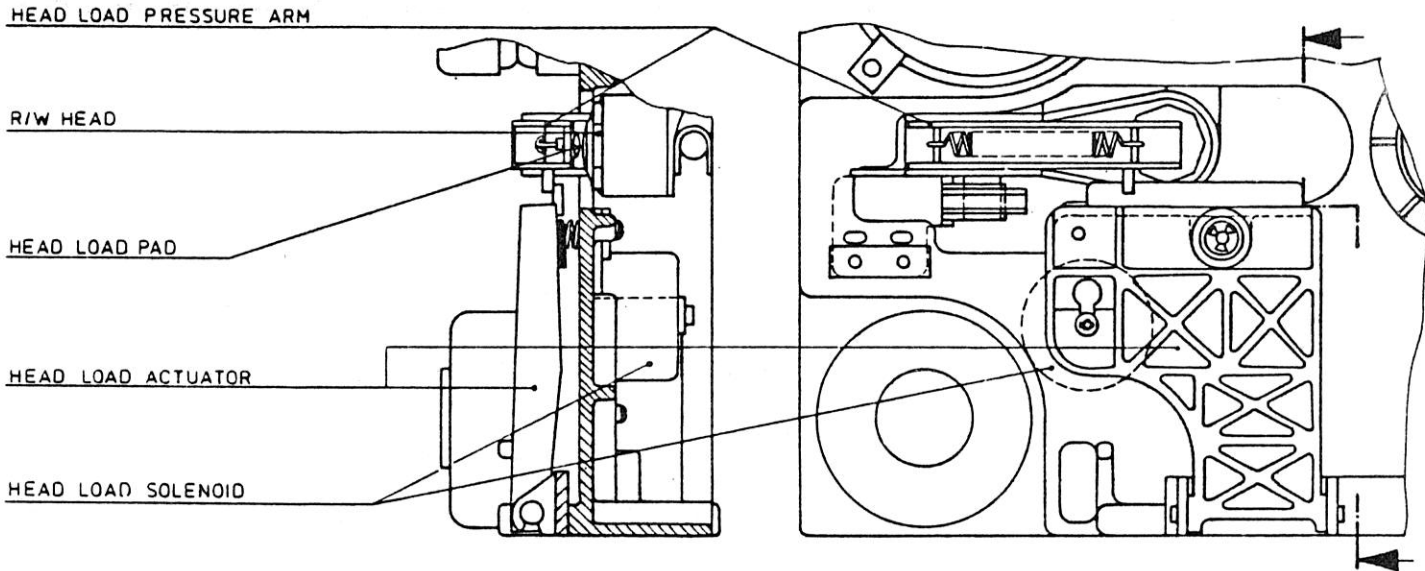
FIGURE 2 - 4 : HEAD LOAD MECHANISM BASF 6106

R/W HEAD 0

R/W HEAD 1
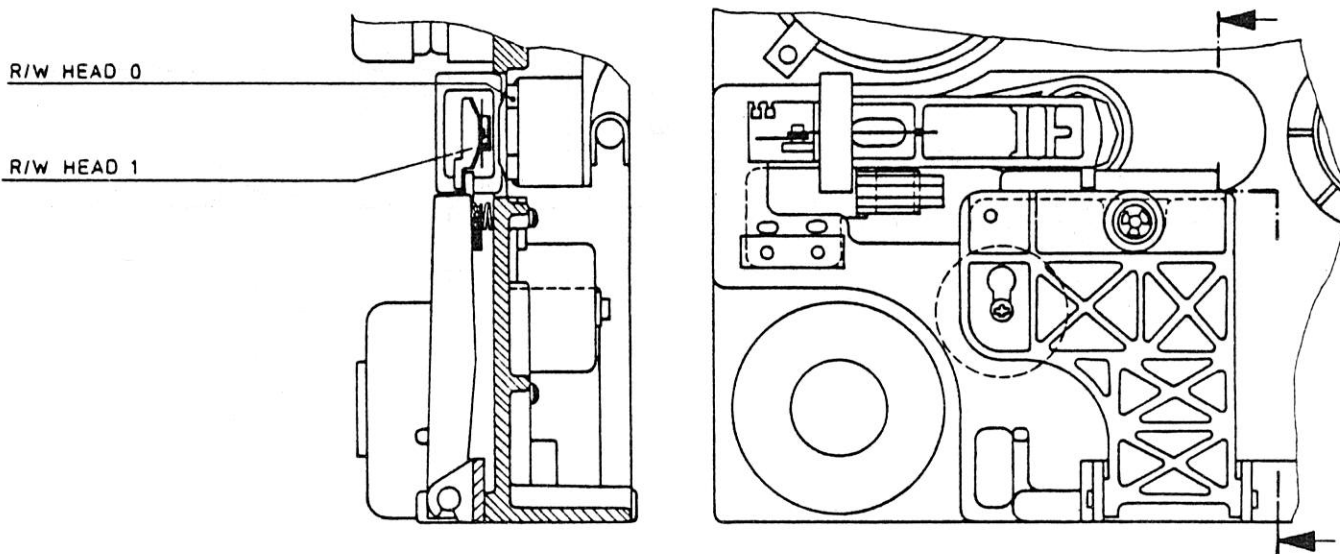
FIGURE 2 - 5 : HEAD LOAD MECHANISM BASF 6108
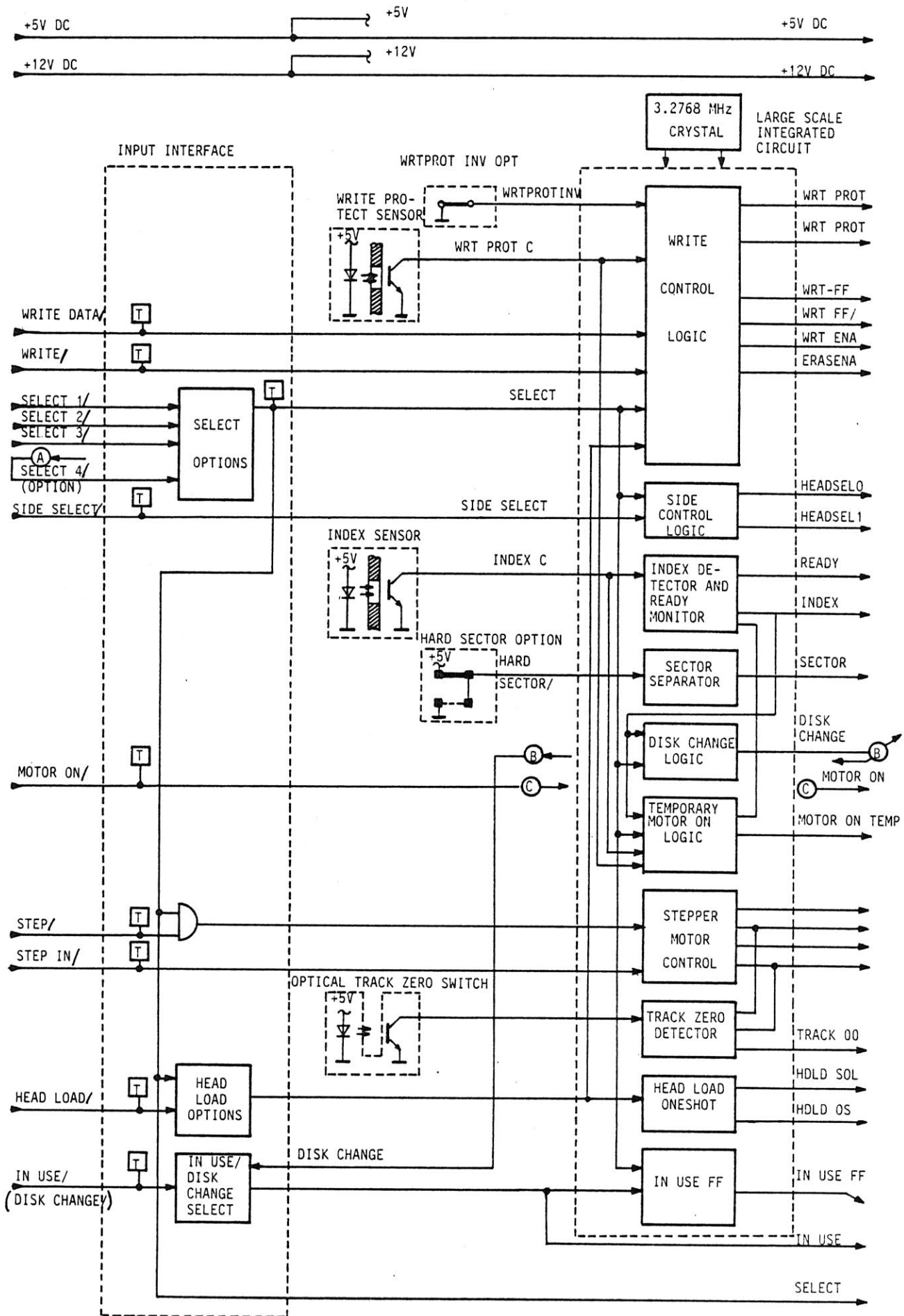
FIGURE 2 - 6 : BLOCK DIAGRAM
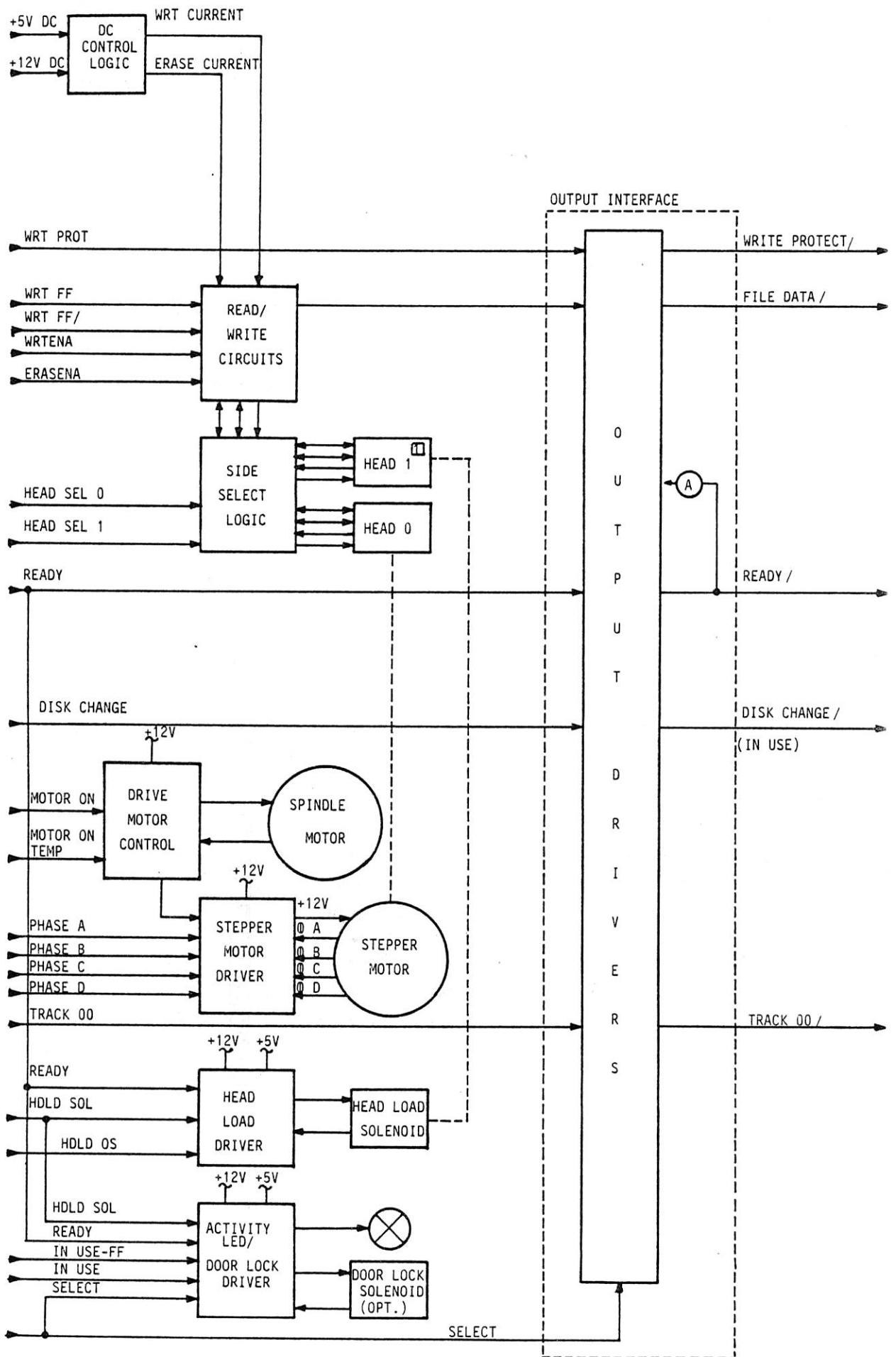
FIGURE 2 - 6 : BLOCK DIAGRAM

2.3. DRIVE ELECTRONIC DESCRIPTION

2.3.1. BLOCK DIAGRAM

Figure 2 - 6 is a block diagram of the drive control
logic. The logic is divided into the following parts:

- input interface
- write control logic [1]
- side control logic [1]
- index detector and ready monitor [1]
- sector separator [1]
- disk change logic [1]
- disk motor on logic [1]
- stepper motor control [1]
- track zero detector [1]
- in use logic [1]
- DC-control logic
- read/write circuits
- side select logic
- drive motor control
- stepper motor driver
- head load driver
- activity LED/door lock driver
- output interface

[1] All these circuits are included in the
BASF LSI-chip 81041

2.3.2. LARGE SCALE INTEGRATED CIRCUIT
BASF 81041-001

The BASF FDD/MDD-LSI is a 40 pin NMOS large scale in-
tegrated circuit, designed for controlling of 8" and
5 1/4" floppy disk drives. The use of this circuit
simplifies the electronic board and increases the re-
liability of the electronics.
The chip is programmed by 2 type select pins on the
PCB for the different drives to be used.
The 3.2768 MHz crystal is used by the LSI-chip for ge-
nerating the different time delay circuits (one shots)
inside the chip. Other inputs (WRTPROTINV, AUTO ERASE,
HARD SECTOR) are used to enable or disable the diffe-
rent options included in the LSI-chip.
Figure 2 - 7 shows the pin assignments of the LSI-
chip.

WRT-PROT-C	1	40	+ 5 V
WRT PROT/	2	39	STEP MTR ENA/
TRACK 00	3	38	HDLD SOL/
TRK-00-SW NC	4	37	WRT ENA
TRK-00-SW NO	5	36	WRT FF
STEP/	6	35	WRT FF/
STEP IN/	7	34	CRYSTAL I
PHASE D	8	33	CRYSTAL II
PHASE C	9	32	WRT DATA/
PHASE B	10	31	IN USE FF
PHASE A	11	30	WRT PROT INV
TYPE SELECT 0	12	29	WRT/
TYPE SELECT 1	13	28	ERASE ENA
INDEX	14	27	IN USE
SECTOR	15	26	NOT USED
READY	16	25	SELECTED/
DISK CHANGE/	17	24	HDSEL 0
+ 5 V	18	23	HDSEL 1
INDEX C	19	22	DISC MTR ON TEMP/
GND	20	21	HARD SECTOR/

FIGURE 2 - 7 : PIN ASSIGNMENTS BASF LSI-CHIP
81041-001

2.3.3. INPUT INTERFACE

2.3.3.1. INPUT SIGNALS DEFINITIONS AND TERMINATION

The input interface receives the signals from the host system. Table 2 - 1 lists and defines the input signals.

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

The receivers send the input signals to the different parts of the drive electronics.

SIGNAL NAME	DEFINITION
SELECT (1-3,4[1])	Selects the desired mini disk drive. Enables all other interface lines except MOTOR ON, WRITE DATA, SIDE SELECT and DIRECTION IN.
WRITE DATA/	This line carries low active pulses representing data to be recorded on the mini disk. 200 nsec min 8.00 µsec ± 40 nsec 4 µs ± 20 ns
WRITE GATE/	Low input enables recording of WRITE DATA on disk. High input enables reading from the Flexy Disk.
MOTOR ON/	This line turns on the drive motor and the stepper motor and is not gated by SELECT. A recalibrate operation must be performed to obtain correct head positioning every time after the MOTOR ON signal goes active. Switching of the stepper motor may be disabled by removing a jumper. This avoids recalibrating after switching on the drive motor.
DIRECTION IN/	Defines motion of the read/ write head LOW = in (towards Track 39) HIGH = out (towards Track 0) This line is not gated by SELECT.
STEP/	Used in conjunction with DIRECTION IN and causes the read/ write head to be moved from track to track.
HEAD LOAD/	This line is used to press the mini disk against the read/ write head if the mini disk drive is ready. To activate this line a jumper has to be changed.
IN USE/	This line controls the door lock solenoid. Also the activity LED can be switched on. If the IN USE/ signal is used, the disk change option must be disabled.
SIDE SELECT/	This line defines whether head 0 or head 1 of the mini disk drive is used. A high signal selects head 0, a low signal selects head 1. This line is not gated by SELECT. On BASF 6106 head 1 is not installed.

1) If SELECT4/ is used, the READY OUTPUT SIGNAL is not available

2.3.3.2. SELECT OPTIONS

There are two possiblities to select the mini disk drive :
- auto select
- radial select

AUTO SELECT

This option is used when no SELECT lines are used. The input and output interfaces are always enabled, because SELECT is forced to a high. To install the AUTO SELECT option 2D(3-4) must be jumpered (see fig. 2 - 8).
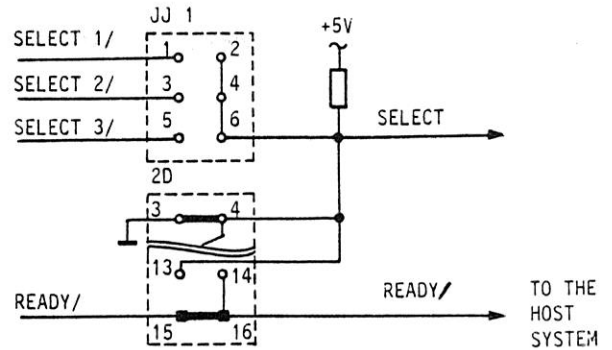
FIGURE 2 - 8 : AUTO SELECT OPTION

RADIAL SELECT

If radial select is normally, 3 mini disk drives can be connected to the host system.

The signal SELECT 1/ will select the mini disk drive jumpered between JJ1 1 - 2, SELECT 2/ will select the mini disk drive jumpered between JJ1 3 - 4 and SELECT 3/ will select the mini disk drive jumpered between JJ1 5 - 6. There is a possibility to select a fourth drive, if the READY-signal is not used. 2D(15-16) must be scratched and a jumper from 2D (13-14) installed. Only one select jumper is allowed in one drive. For enabling of the radial select option JJ2 5 - 6 must be jumpered and the auto select option must be disabled by removing jumper 2D (3-4).
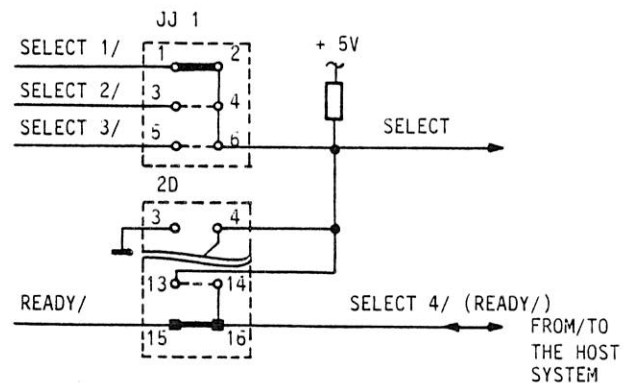
FIGURE 2 - 9 : RADIAL SELECT OPTION

2.3.3.3. HEAD LOAD OPTIONS

There are three possiblilities for the user to load
the head :

- auto head load
- selected head load
- radial head load

SELECTED HEAD LOAD OPTION

In this configuration, the head is loaded when the
mini disk drive is selected and the HEAD LOAD signal
is activated (see fig. 2 - 11).
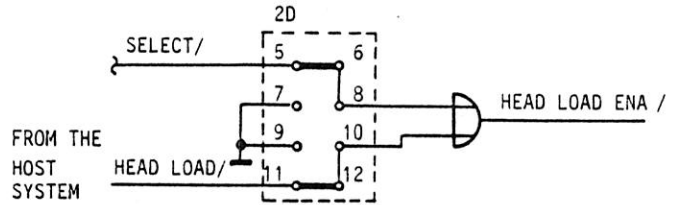
FIGURE 2 - 11 : SELECTED HEAD LOAD OPTION

AUTO HEAD LOAD

This option allows to load the read/write head as soon
as the mini disk drive is selected.
If auto head load is desired, the jumpers must be set
as shown in fig. 2 - 10.

RADIAL HEAD LOAD OPTION

This option allows the user to keep the head loaded
without selection of the mini disk drive. The 48 msec
head load time is then eliminated. To install this
option, see fig. 2 - 12.
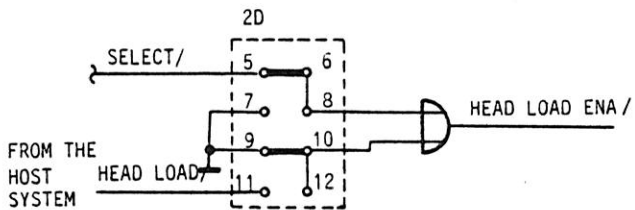
FIGURE 2 - 10 : AUTO HEAD LOAD OPTION
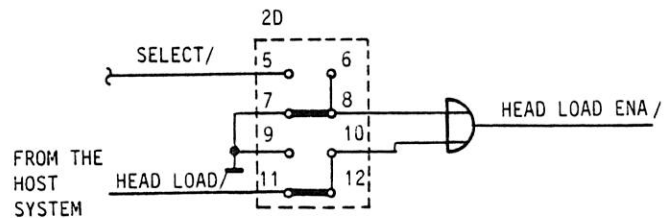
FIGURE 2 - 12 : RADIAL HEAD LOAD OPTION

2.3.4. OUTPUT INTERFACE

The output interface sends the read data pulses and
the status signals WRITE PROTECT, INDEX, READY,
TRACK 00 and DISK CHANGE (optional) to the host sys-
tem (see table 2 - 2).
The output signals are gated by I/O-ENABLE and dri-
ven by the output drivers SN 7438.
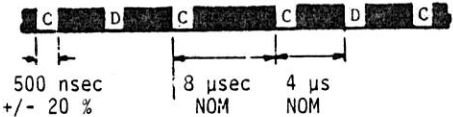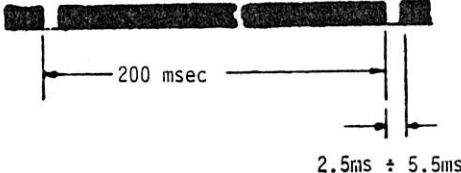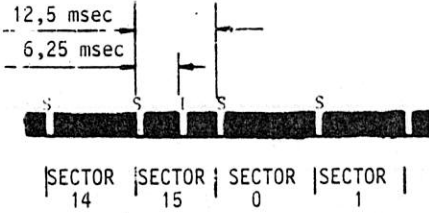
SIGNAL NAME	DEFINITION
READ DATA/	This line provides the "raw data" as detected by the read electronics. 500 nsec +/- 20 % 8 µsec NOM 4 µs NOM
WRITE PROTECT	Low active status indicates that a write protected Flexy Disk is install-ed. The BASF 6106/08 will inhibit writing with a write protected Flexy Disk installed.
INDEX/	The leading edge of this signal indi-cates the beginning of a track when soft sector format is used. 200 msec 2.5ms ± 5.5ms If a hard sectored disk is used this signal indicates the sensing of an index or sector hole. To indicate the beginning of a track one index pulse is sensed in the middle of sector 15. 12,5 msec 6,25 msec SECTOR 14 SECTOR 15 SECTOR 0 SECTOR 1
TRACK 00/	This line indicates that the read/write head is positioned at track 00.
READY/	This line indicates that the inserted Flexy Disk has reached more than 60 % of full operation speed and three con-secutive INDEX pulses have been sensed. For hard sectored Flexy Disks READY is activated as soon as the Flexy Disk starts turning and three consecutive SECTOR pulses have been sensed.
DISK CHANGE/ (OPTION)	An active (low) signal is provided when the SELECT line is activated if the drive while deselected has gone from a Ready to a Not Ready condition.

TABLE 2 - 2 : OUTPUT SIGNALS

2.3.5. STEPPER MOTOR LOGIC

The stepper motor is a four-phase DC-motor and is controlled by the stepper motor logic. The stepper motor logic comprises the stepper motor control logic, located in the LSI-chip and the stepper motor driver. The stepper motor control consists of a divide by four up/down synchron counters with control circuits. Each STEP pulse from the host system rotates the stepper motor for one step. Each step corresponds to a rotation angle of 15°. The rotation of the stepper motor is converted to a linear motion of the R/W-head(s) by the spiral wheel. The direction of the motion of the R/W-head(s) depends on the input signal DIRECTION IN/. If this signal is active (low), the R/W-head(s) will be moved towards track 39 (in). The R/W-head(s) move out by each STEP pulse, when DIRECTION IN/ is in a high state. Multiple track positioning is attained by the host system issuing a series of STEP pulses at 12msec intervals. Table 2 - 3 shows the output signals for "in" and "out" motion of the R/W-head(s). The DIRECTION IN-signal must be at the desired level 1 μsec before the trailing edge of the STEP pulse. Stepping is initiated by the trailing edge of the STEP pulse. The time between two consecutive STEP pulses must be 12 msec minimum (see fig. 2 - 13). As long as WRITE GATE is active during a write operation, the STEP pulse interface line is inhibited.

In figure 2 - 14, a Zener diode is used in addition to four free wheeling diodes. This undamps the magnetic response at switch off time, causes armature to oscillate across target position. This reduces the influence of friction upon target positioning, decreases hysteresis error, resulting in precise settling on target position.

STEPPER MOTOR SWITCHING OPTION

The stepper motor can be switched on and off by the MOTOR ON signal, if there is a jumper installed between 5D (1-2). If this jumper is installed, the power consumption of the drive is reduced, but the stepper motor must be repositioned by a recalibrate operation each time the drive motor is turned on. This option is recommended for battery operated systems.

I N						O U T					
STEP	PHASE	A/	B/	C/	D/	STEP	PHASE	A/	B/	C/	D/
-		L	H	L	H	-		L	H	L	H
1		H	L	L	H	1		L	H	H	L
2		H	L	H	L	2		H	L	H	L
3		L	H	H	L	3		H	L	L	H
4		L	H	L	H	4		L	H	L	H

TABLE 2 - 3 : SEQUENCE OF THE STEPPER MOTOR SIGNALS
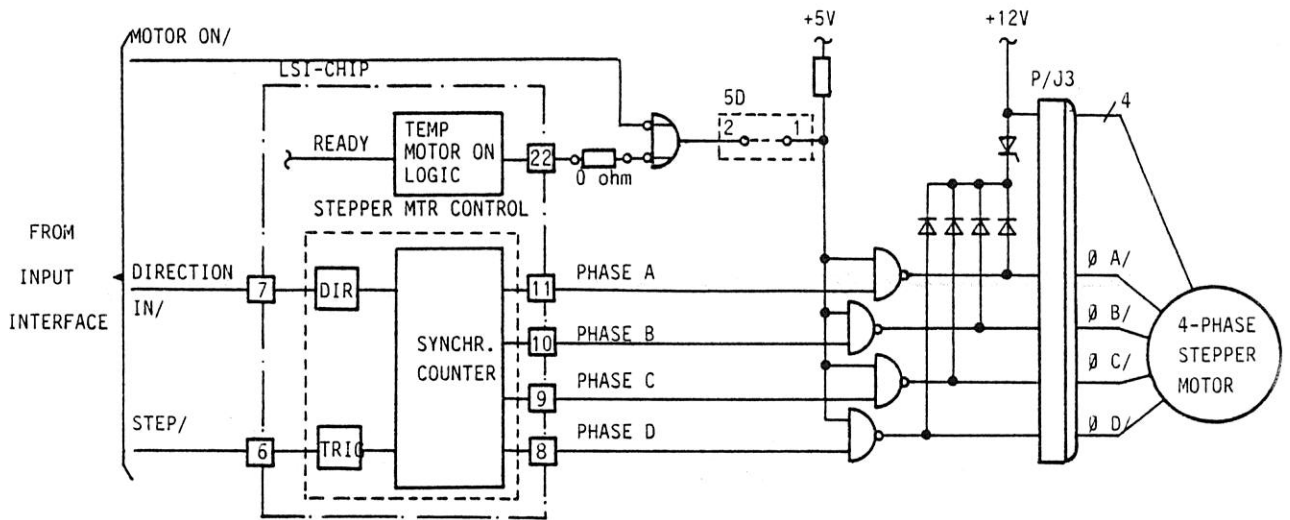
FIGURE 2 - 13 : STEPPER MOTOR LOGIC
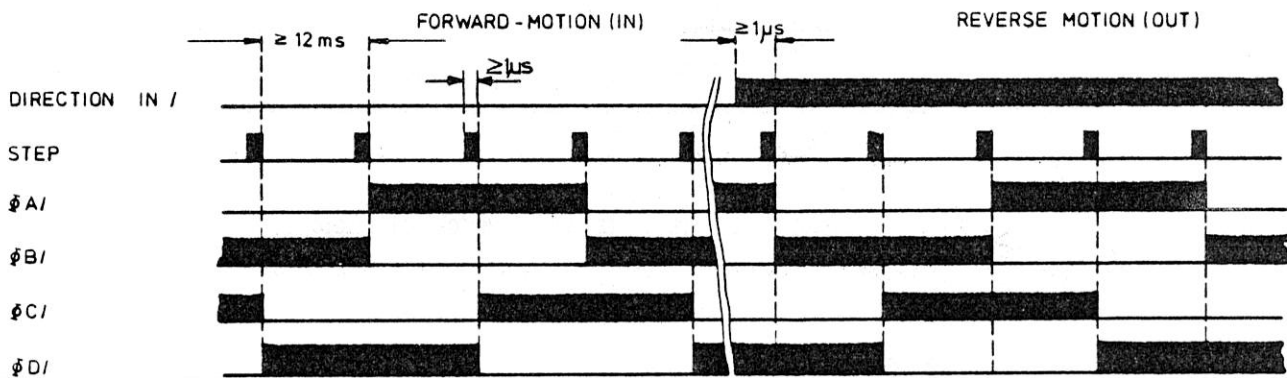
FIGURE 2 - 14 : STEPPER MOTOR - TIMING DIAGRAM

2.3.6. DRIVE MOTOR LOGIC

The drive motor used in the BASF 6106/08 is a DC-motor. Start and stop of the motor are controlled by the MOTOR ON-signal of the host system and the temporary motor on control logic in the LSI-chip.

2.3.6.1. TEMPORARY MOTOR ON LOGIC (fig. 2-15)

This logic is used to turn on the drive motor as soon as a diskette is inserted in the disk drive, even if the MOTOR ON-signal is not activated. The centering of the diskette will be improved during closing the front door by the turning spindle. As soon as the diskette passes the write protect sensor, the 10msec OS and in sequence, the 20sec OS are fired and the WRTPROT LTH is set (see timing diagram 2 - 16). When the diskette passes the index sensor, the IN-DEX-FF is set and MTR ON TEMP/-signal is activated. The motor starts turning. As soon as the door is closed, the disk turns, READY will be generated by the ready monitor, which resets the INDEX FF and the WRTPRTLTH. The motor stops. If the door will not be closed after insertion of the diskette, the motor is stopped after the 20sec OS times out.
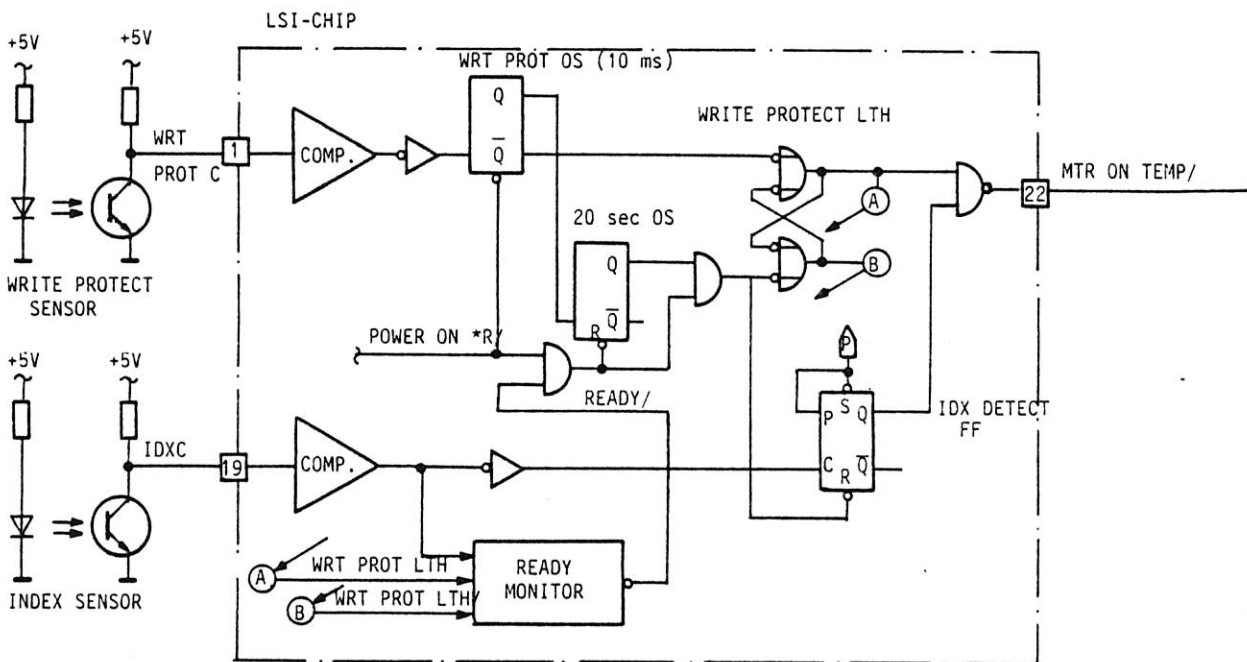
FIGURE 2 - 15 : TEMPORARY MOTOR ON LOGIC

disk passes write protect sensor
disk passes INDEX detector
door closing (disk starts turning)

✗ if door still opens motor will be stopped after 20 sec delay by the 20 sec one shot
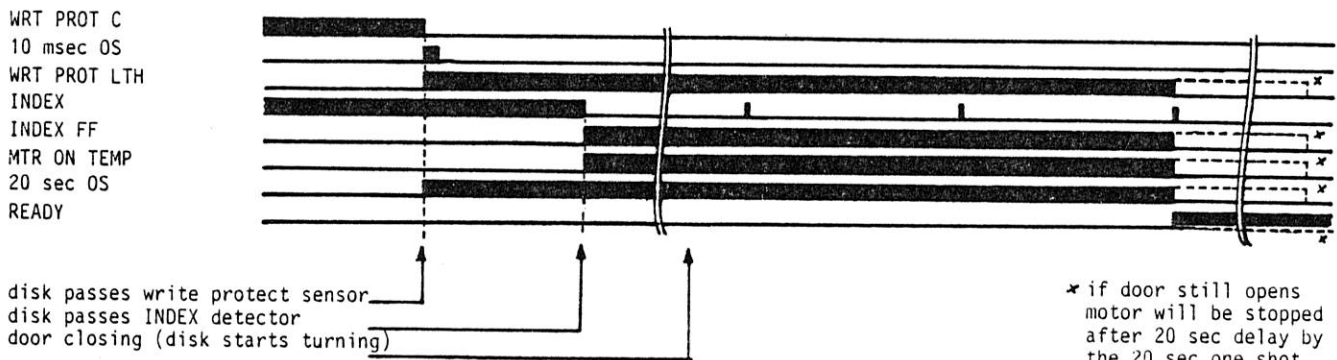
FIGURE 2 - 16 : TIMING DIAGRAM TEMPORARY MOTOR ON LOGIC

2.3.6.2. DRIVE MOTOR CONTROL (FIG. 2 - 17)

The speed of the drive motor is controlled by the integrated circuit ESM 227. It holds the EMF of the drive DC-motor to a constant value. Because the speed of the drive motor is porportional to its EMF, the speed will be also constant. With the potentiometer R47, the drive motor must be adjusted to a disk speed of 300 RPM. The output voltage of the ESM 227 is controlled by the MOTOR ON-signal at pin 12 of the chip.

If MOTOR ON is inactive (low), T1 will be closed and holds T2 open. The drive motor stops. An active MOTOR ON-signal opens T1 and T2 is enabled. The drive motor is running and regulated, so that the flexy disk is rotating at 300 RPM. T10 limits the drive motor start current to 0.7 A.

After the drive motor is started, a delay of 0.5 sec is needed to allow proper motor speed, before reading or writing.
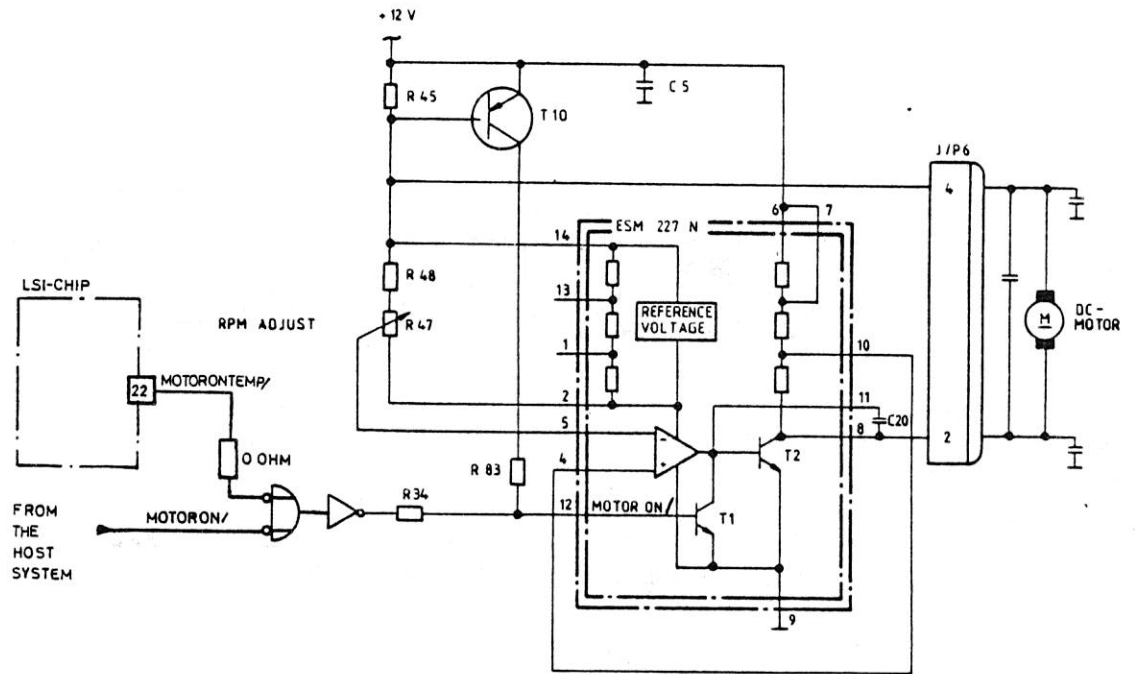
FIGURE 2 - 17 : DRIVE MOTOR CONTROL

2.3.7. HEAD LOAD LOGIC (FIG. 2 - 18)

The head load mechanism is activated by the head load solenoid, which is energized when HEADLOADENA is active and the mini disk drive is ready. READY is activated by the ready monitor in the LSI-chip. As the head load solenoid is activated, TA is closed for 20 ms by the HEAD LOAD ONE SHOT and applies +12V to the head load solenoid to supply sufficient star-

ting current (see fig. 2 - 19). When the HEAD LOAD OS times out, transistor TA turns off, but transistor TB still remains on. +5V is now applied to the head load solenoid by the resistor R and the forward biased DIODE D. The head load solenoid remains activated by decreased power dissipation. DI supresses the spikes on power down.
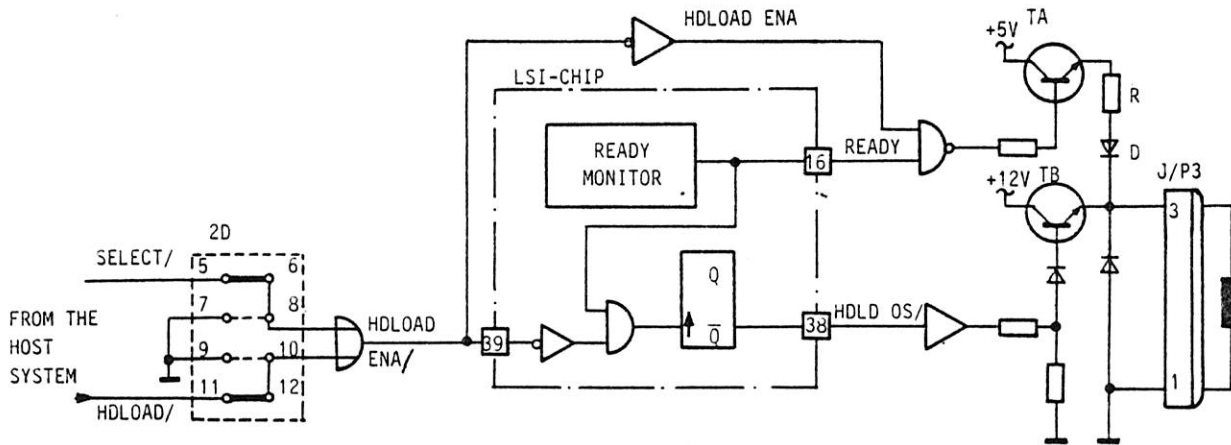
FIGURE 2 - 18 : HEAD LOAD LOGIC
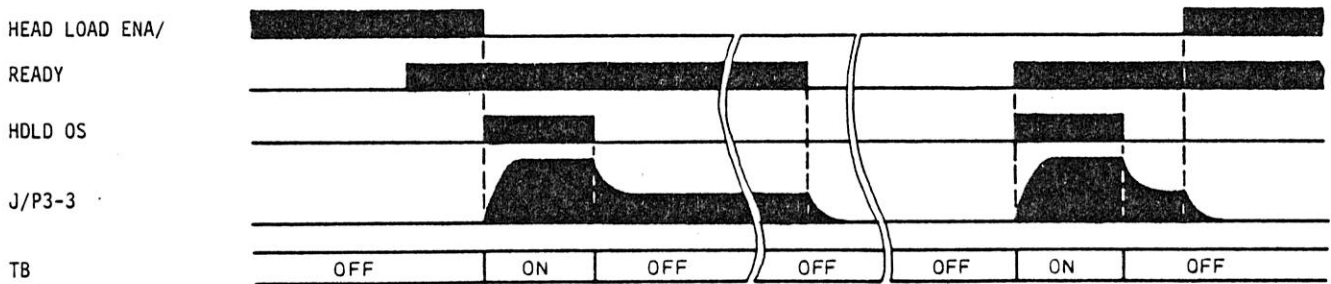
FIGURE 2 - 19 : HEAD LOAD TIMING DIAGRAM

2 - 16

2.3.8. ACTIVITY LED / DOOR LOCK LOGIC

This logic contains the driver, the jumper options
and the door lock latch inside of the LSI-chip. Fig.
2 - 20 shows a circuit diagram of the complete logic.
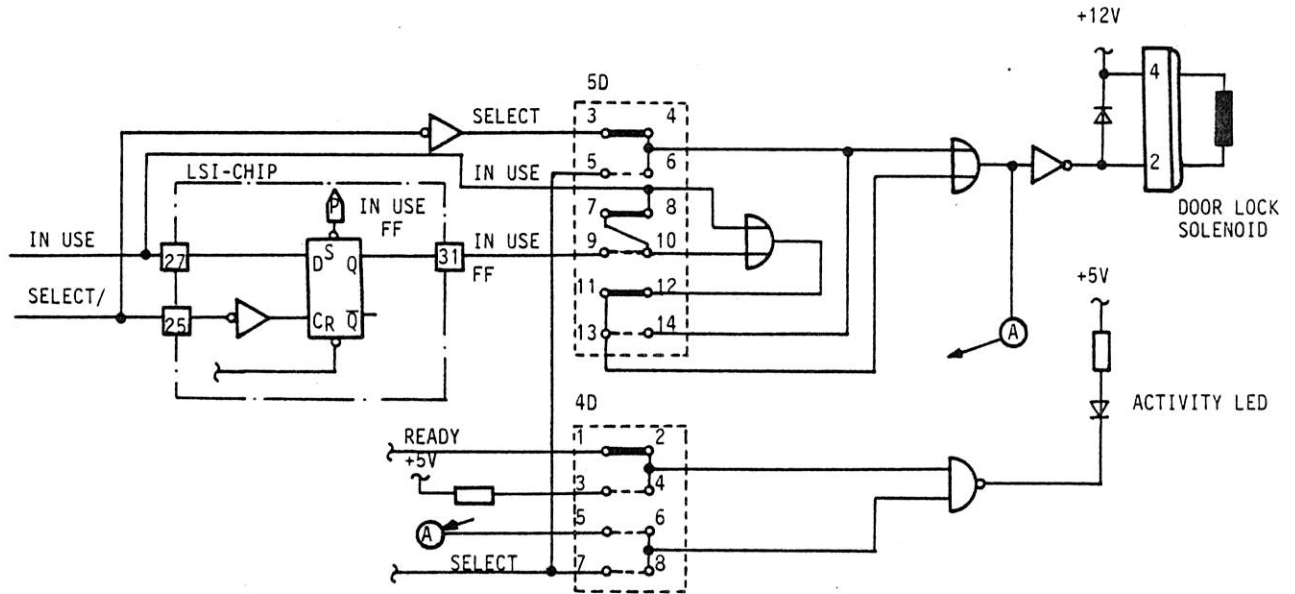
FIGURE 2 - 20 : ACTIVITY LED / DOOR LOCK LOGIC

2.3.8.1. DOOR LOCK LATCH OPTION

This option can be used by the host system, if the
IN USE-signal is available. The door latch option
allows the latching of the door lock solenoid under
control of the SELECT and IN USE-signals, without
maintaining the drive selected and without activa-
ting of the IN USE-signal. The IN USE-FF stores the
state of the IN USE-signal with the selection of the
drive (see timing diagram fig. 2 - 21). The door
lock solenoid remains activated even if the mini
disk drive is deselected and the IN USE-signal is
deactivated. For unlocking of the door, the mini
disk drive must be reselected with the IN USE-si-
gnal inactive. To enable the door lock latch option
jumpers from 5D (9-10) and 5D (11-12) must be in-
serted.
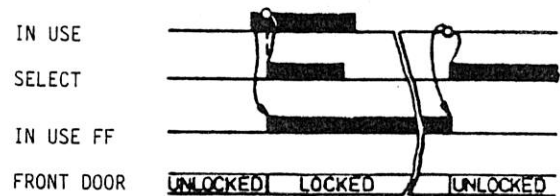
FIGURE 2 - 21 :

TIMING DIAGRAM DOOR LOCK LATCH OPTION

2.3.8.2. DOOR LOCK OPTIONS

There are a lot of possibilities to lock the front
door :

1. - locking by the IN USE-signal
     jumpers : 5D (11-12 ; 7-8 ; 13-14)

2. - locking by the door lock latch option
     jumpers : 5D (9-11 ; 13-14)

3. - locking while the drive is selected
     jumpers : 5D (3-4 ; 13-14)

4. - locking while the heads are loaded
     jumpers : 5D (5-6 ; 13-14)

5. - if 1. or 2. is true (IN USE + IN USE FF)
     jumpers : 5D (9-10 ; 11-12 ; 13-14)

6. - if 1. or 3. is true (IN USE + SELECT)
     jumpers : 5D (3-4 ; 7-8 ; 11-12)

7. - if 1. or 4. is true (IN USE + HEAD LOAD)
     jumpers : 5D (5-6 ; 7-8 ; 11-12)

8. - if 2. or 3. is true (IN USE FF + SELECT)
     jumpers : 5D (3-4 ; 9-11)

9. - if 2. or 4. is true (IN USE FF + HEAD LOAD)
     jumpers : 5D (5-6 ; 9-11)

10. - if 1. or 2. or 3. is true (IN USE + IN USE FF
      + SELECT)
      jumpers : 5D (3-4 ; 9-10 ; 11-12)

11. - if 1. or 2. or 4. is true (IN USE + IN USE FF
      + HEAD LOAD)
      jumpers : 5D (5-6 ; 9-10 ; 11-12)

2.3.8.3. ACTIVITY INDICATOR OPTIONS

For illuminating of the activity indicator, the fol-
lowing conditions are possible :

1. illuminated while ready and head is located
   (READY.HEAD LOAD)
   jumpers : 4D (1-2 ; 7-8)

2. illuminated while ready and door is locked
   (READY.DOOR LOCKEN A)
   jumpers : 4D (1-2 ; 5-6)
   (for jumpering of the door lock, see 2.3.8.2.)

3. illuminated when the head is loaded (HEAD LOAD)
   jumpers : 4D (3-4 ; 7-8)

4. illuminated when the door is locked
   jumpers : 4D (3-4 ; 5-6)

2.3.9. TRACK ZERO DETECTOR

This logic generates the TRACK 00-signal when the read/write head is positioned at track zero. The host system uses this signal to recalibrate the positioning system. When the position of the read/write head is unknown, the host system sends step out pulses until TRACK 00/ goes low.

The track zero detector is comprised of the track zero switch, a comparator, a debounce circuit and a phase detector circuit, which detects the correct phase of the stepper motor. The track zero switch mounted on the deck assembly is activated by the head carriage. The logic circuit supports mechanical and optical track zero switches (see fig.2-22).

When the head carriage moves out, the track zero switch must be open before the read/write head reaches track four. When the head carriage moves to-

wards the track zero position, the track zero switch must close after track four and before track zero. The TRACK ZERO-signal will be active when the track zero switch is closed and phase A and phase C of the stepper motor are activated. SELECT must be high.

Fig. 2 - 23 shows the timing diagram when the host system attempts to step the head carriage beyond track zero. The mechanical stop on the spiral wheel prevents the read/write head from moving out further and holds it near track zero. But the TRACK 00-signal will be deactivated, because the stepper motor is in a wrong phase ($\emptyset$ B/, $\emptyset$ C/). If the host system sends three more step out pulses, the phasing of the stepper motor is correct again, the TRACK 00-signal is activated and the read/write head is positioned at track zero.
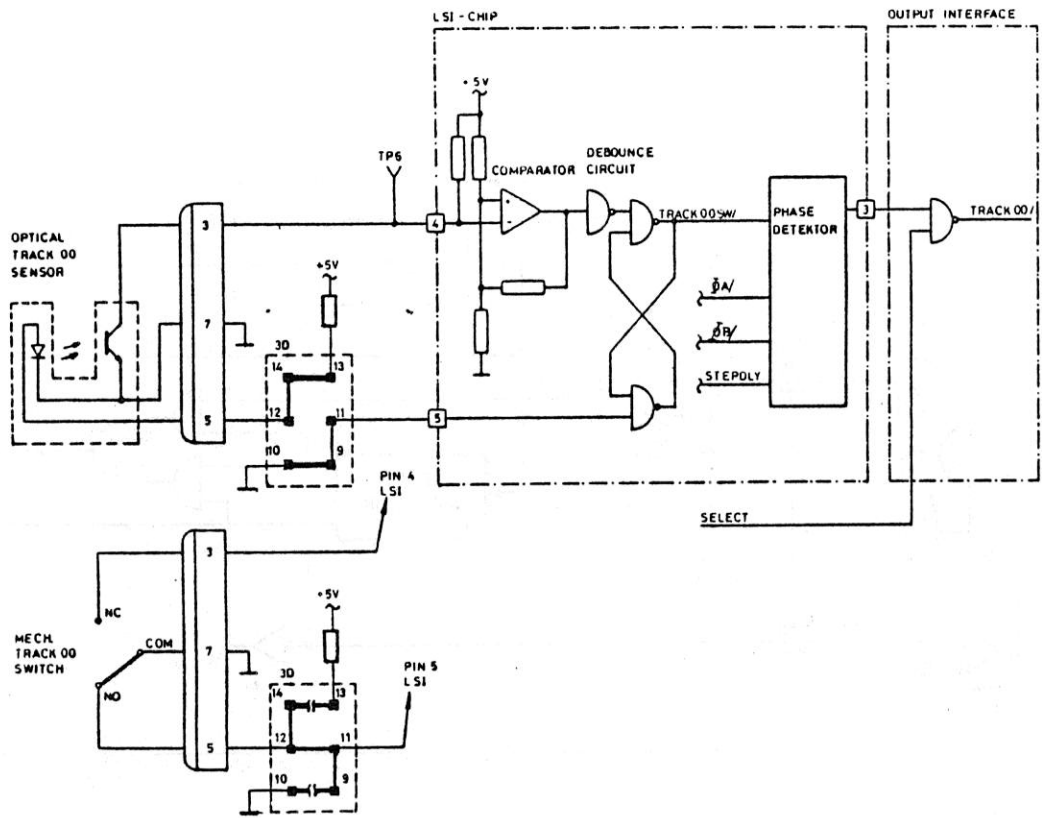
FIGURE 2 - 22 : TRACK ZERO DETECTOR
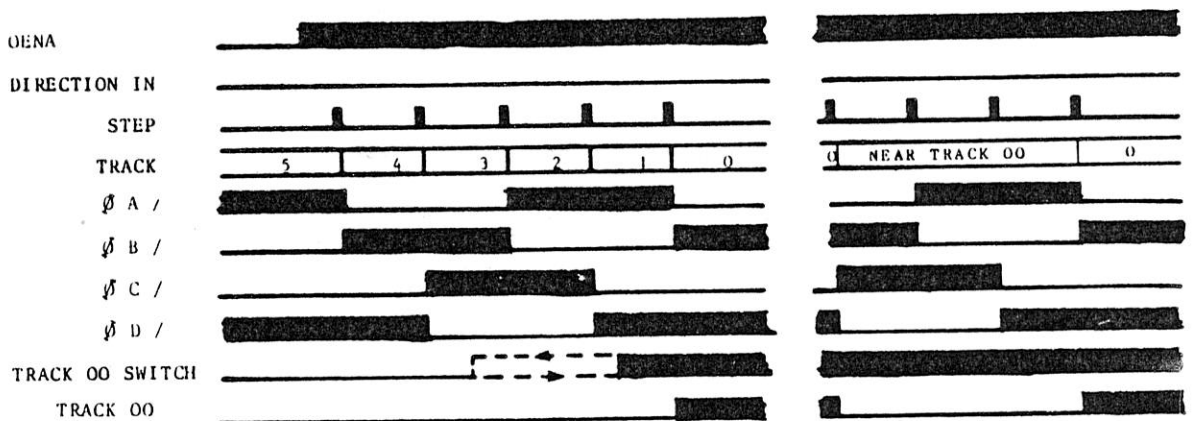
FIGURE 2 - 23 : TRACK ZERO - TIMING DIAGRAM

2.3.10. INDEX DETECTOR, SECTOR SEPARATOR AND READY MONITOR

2.3.10.1. INDEX DETECTOR

The index/sector detector comprises a phototransistor mounted on the deck assembly, a light emitting diode (LED) on the PCB and a comparator inside the LSI (see fig. 2 - 24). As the index hole or sector (optional) hole passes between LED and photo transistor, light from the LED is passed to the photo-transistor. This results in a negative pulse of about 4 msec at the inverting input of the comparator.

The output pulse of the comparator is sent as INDEX signal to the host system when HARD SECTOR/ is high. If HARD SECTOR/ is low, the comparator output INDEX/ SECTOR is separated into SECTOR- and INDEX-pulses by the sector separator option. In this case, hard sectored diskettes must be used.
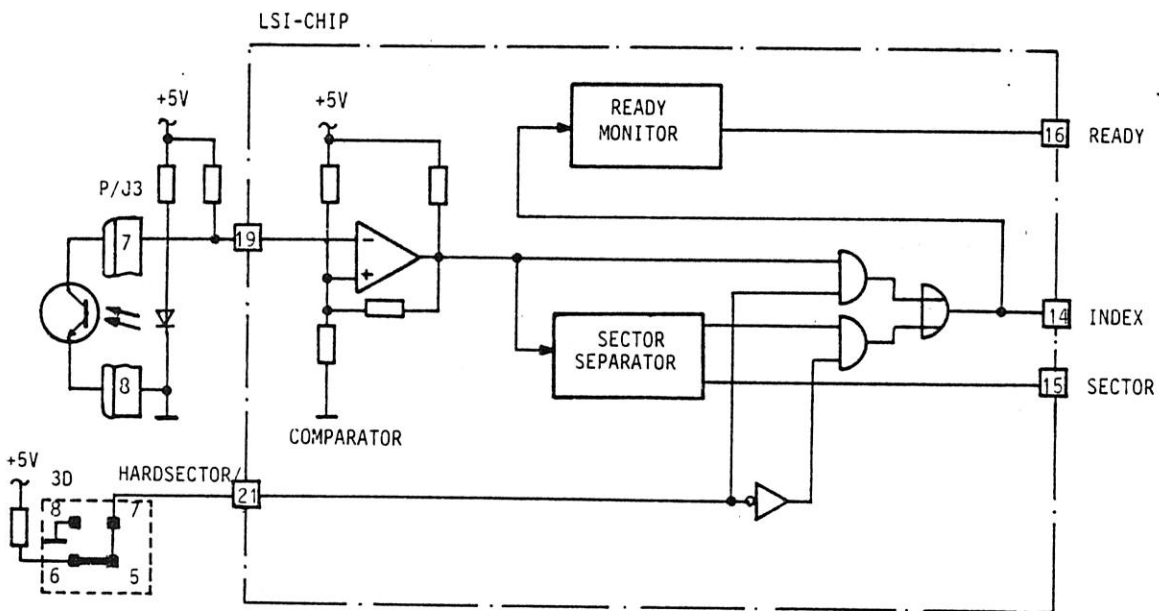
FIGURE 2 - 24 : INDEX DETECTOR

2.3.10.2. SECTOR SEPARATOR

The sector separator is used for hard sector appli-
cations only. A hard sectored mini diskette contains
10 or 16 sector holes and one index hole in the mid-
dle between two sector holes. The INDEX/SECTOR se-
parator logic (see fig. 2 - 25) separates the INDEX
pulse from the SECTOR pulses by the INDEX WINDOW

(11.25 ms one shot), which is triggered by the trai-
ling edge of the 0.4 ms one shot pulses (see timing
diagram fig. 2 - 26). The INDEX-pulse width is limi-
ted to 0.4 ms by the 0.4 ms one shot when the sector
separator option is used.
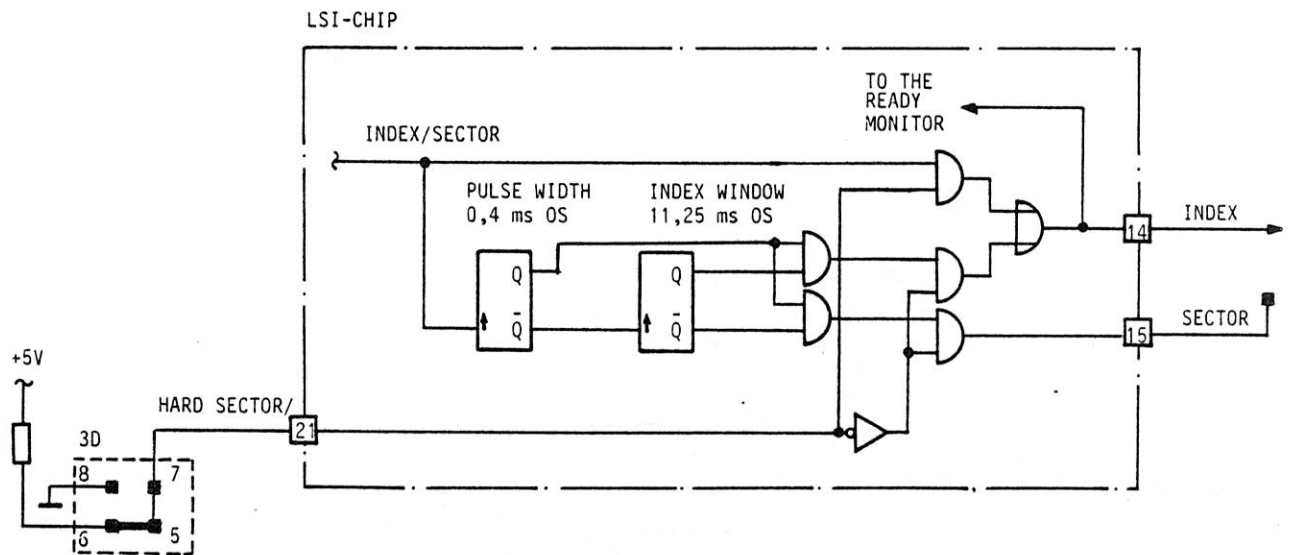
FIGURE 2 - 25 : SECTOR SEPARATOR
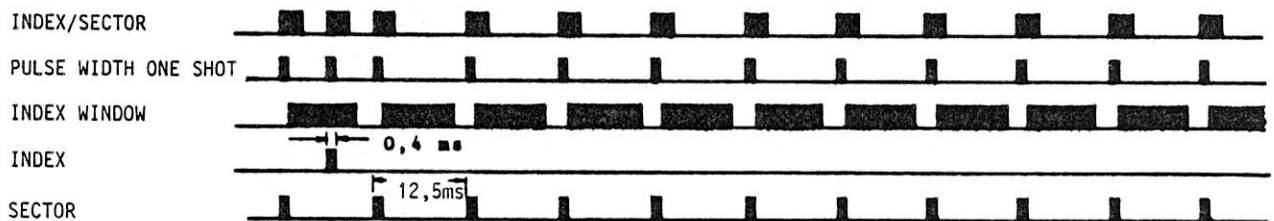
FIGURE 2 - 26 : TIMING DIAGRAM INDEX / SECTOR SEPARATOR

2.3.10.3. READY DETECTION

The ready detector (fig. 2 - 27) is used to monitor the INDEX pulses for the rotational speed of the disk. The INDEX pulses are input to the 430 msec hold-over-one shot. When the time between two consecutive INDEX pulses is greater than 430 msec, the index counter is held reset. If the time is less than 430 msec, the hold-over-one shot is held fired and enables the index counter.

READY is generated in two ways. If the drive motor starts (MOTOR ON = LOW) when the mini diskette has been already inserted, READY will be generated by the first INDEX pulse which occurs in a shorter distance than 430 ms because the WRTPROT FF of the temporary motor on logic is low. When the mini diskette is just inserted and the temporary motor on logic starts the motor (WRTPROT-FF = high) or the motor is already spinning, the READY-signal will be generated by the second INDEX pulse in a shorter distance than 434 ms (see timing diagram fig. 2 - 28).
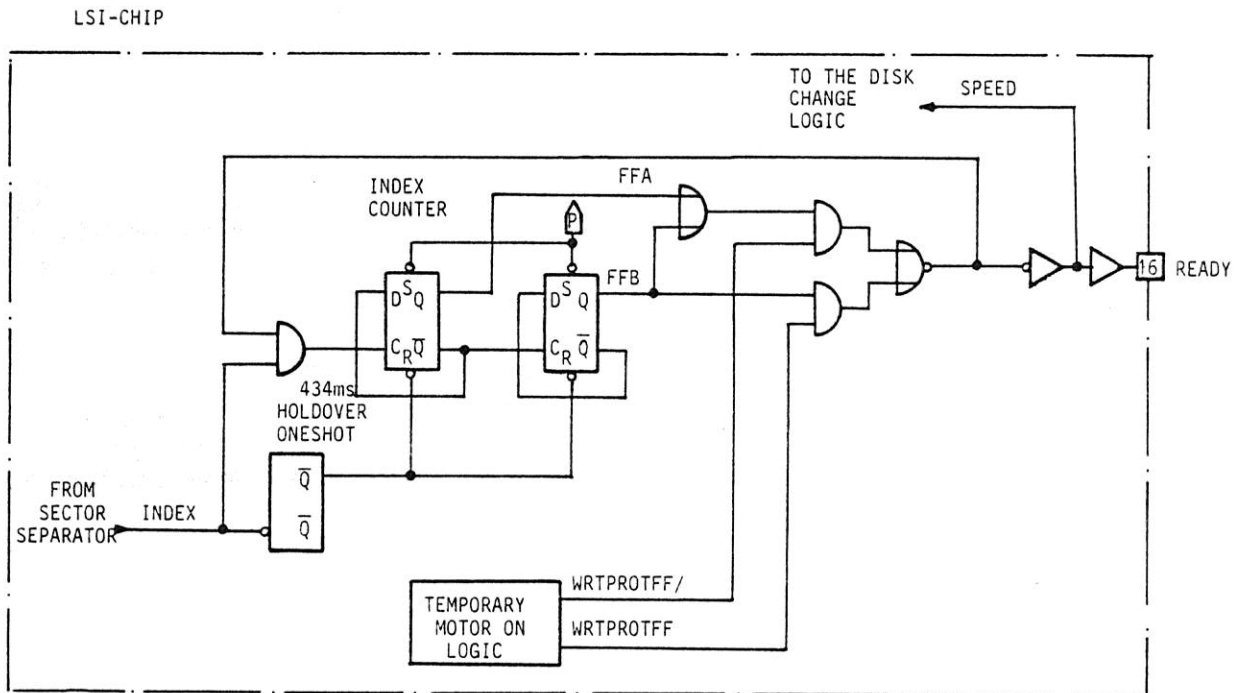
FIGURE 2 - 27 : READY DETECTOR

a) DISK ALREADY INSERTED
b) DISK JUST INSERTED (TEMP. MOTOR ON LOGIC)
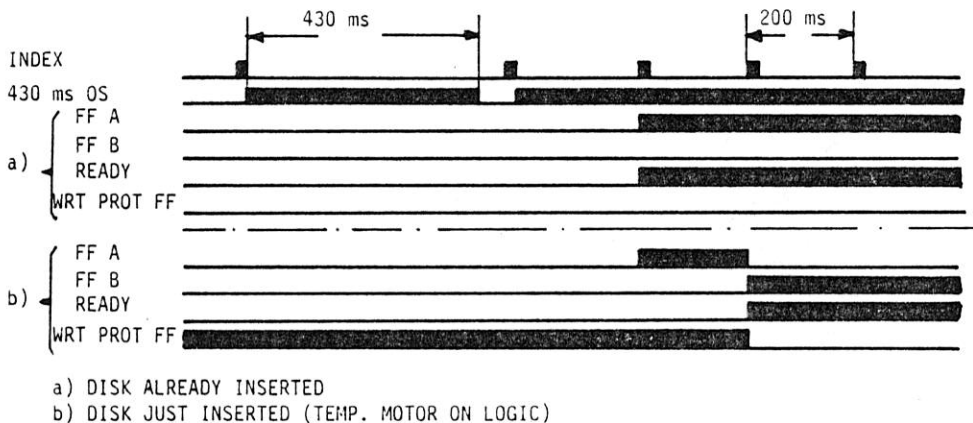
FIGURE 2 - 28 : READY TIMING

2.3.11. DISK CHANGE OPTION (fig. 2 - 29)

Pin 34 of the interface can be used for the disk change option when the IN USE signal is applied to input pin 4 or the IN USE option is not used. The DISK CHANGE signal notifies the host system that the mini disk has been changed even if the drive was deselected. As soon as the mini disk is unloaded, the speed detector will deactivate the SPEED-signal and the DISK CHANGE-FF is set. The DISK CHANGE signal is sent to the host system when the drive is selected. The DISK CHANGE-FF will stay set when the new mini disk is loaded. To deactivate the DISK CHANGE signal, the host system must deselect the drive again. The DISK CHANGE-FF is than reset (see timing diagram fig. 2 - 30). The disk change option is enabled by a jumper from 4D (11-12).
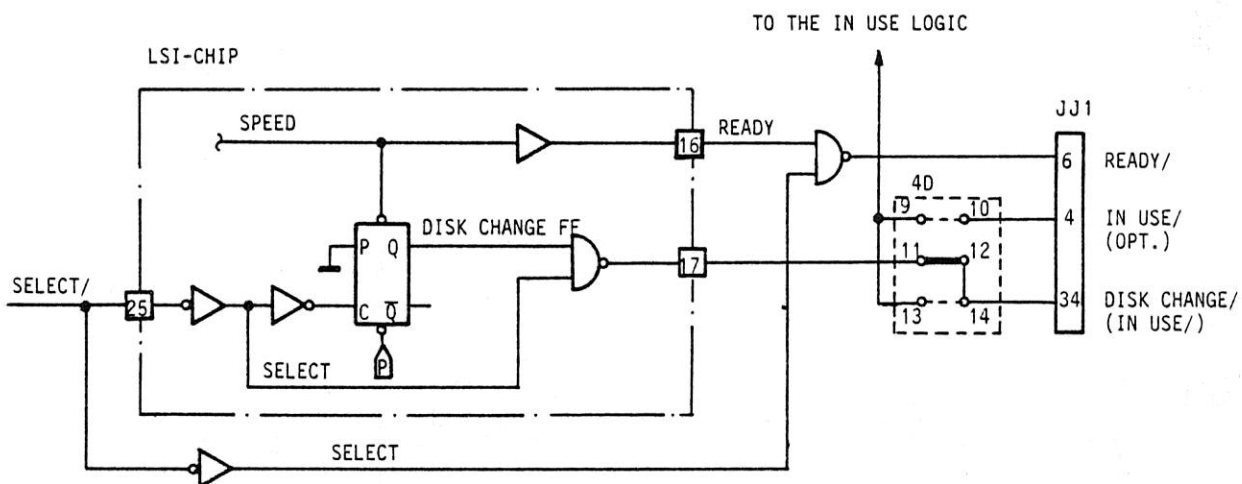
FIGURE 2 - 29 : DISK CHANGE LOGIC
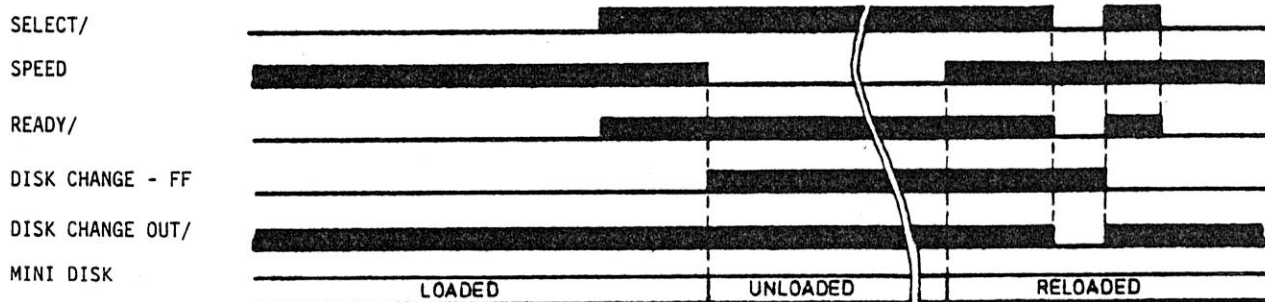
FIGURE 2 - 30 : TIMING DIAGRAM DISK CHANGE LOGIC

2.3.12. SIDE SELECT LOGIC

The side select logic is used by the double sided mini disk drive (BASF 6108) and selects either head 0 or head 1, depending whether the SIDE 1-signal from the input interface is high or low. The side select logic in fig. 2 - 31 consists of two head select switches (T 11, T 12 and associated circuits) and a diode matrix (D1, 2, 11, 12, 16, 17). If the SIDE 1-signal is low, transistor T 12 is on and head 0 is selected. The signal COMO/ is at ground and generates a forward bias to the diodes D 11, D 12 and D 16.

In a read operation, the read signal induced in the read/write coils of head 0, is transfered through the diodes D 11, D 12 to the read circuits. In a write operation, the write current generated in the write circuits flows through these diodes into the read/write coils. The erase current is fed to the erase coil by the diode D16. At the same time, the diodes D 1, D 2 and D 17 are blocked, because transistor T 11 is off. Transistor T 11 will be on when SIDE 1 is high and head 1 is activated.
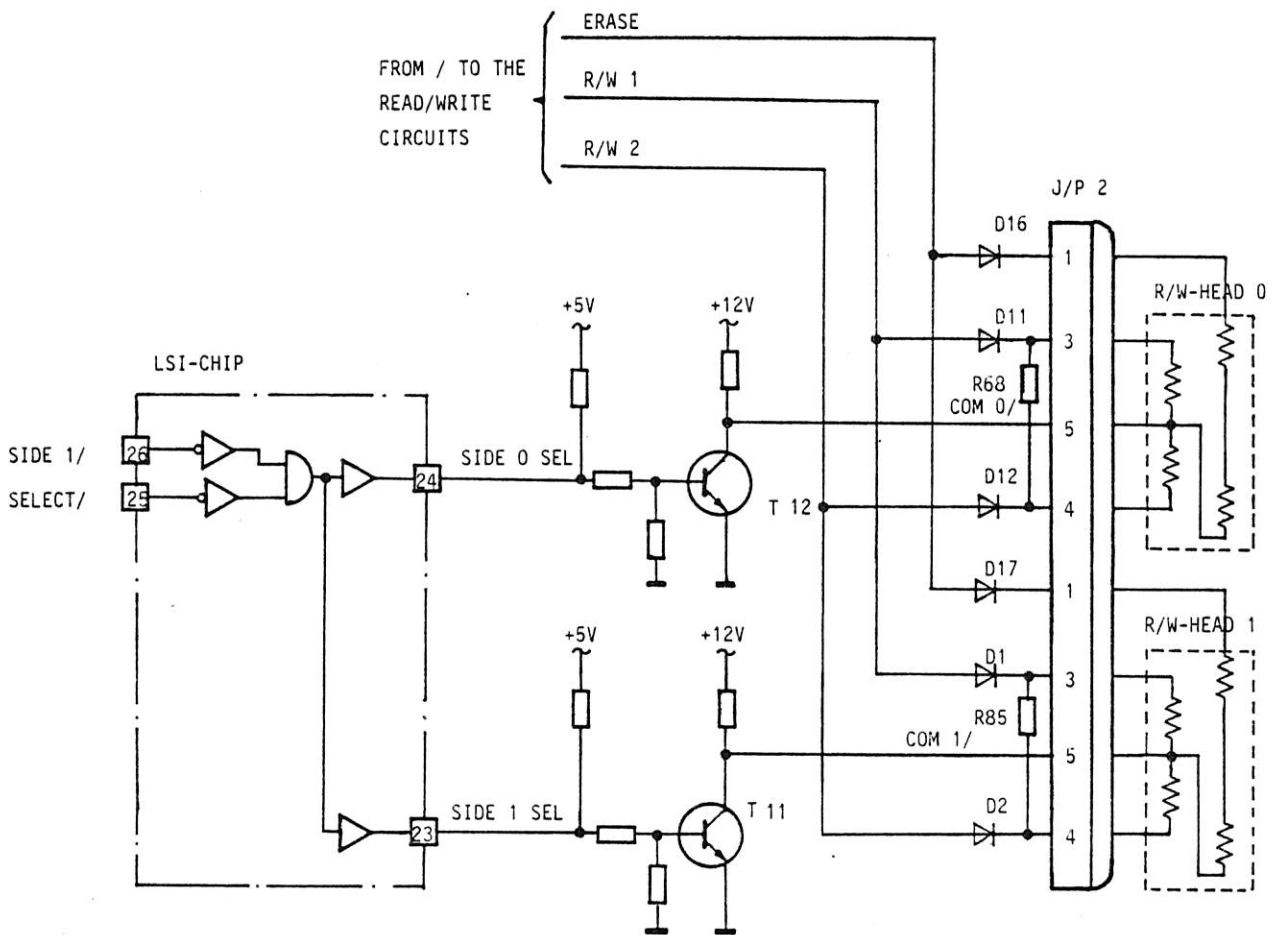
FIGURE 2 - 31 : SIDE SELECT LOGIC

2.3.13. READ/WRITE HEADS

The read/write heads used in the BASF 6106/6108 disk
drives are tunnel erase type heads. Data is recorded
at a flux density of 3536 to 5536 flux changes per
inch (fci).

The nominal frequencies on the read/write head are
62.5 kHz and 125 kHz when FM recording technique and
62.5 kHz, 125 kHz and 83.3 kHz when MFM recording is
used. In FM mode, the nominal distance between flux
reversals is 4 μs or 8 μs. In MFM 6 μs flux reversal
spacings are also encountered.

The radial density is 48 tracks per inch (tpi). This
gives 0.0208 inch nominal track to track spacing. The
tunnel erase gaps trim the track width from 0.014 inch
after write to 0.013 inch after erase (see fig.2-32).

The read/write head contains three coils : two read/
write coils and the erase coil (see fig. 2 -   ). The
erase coil is energized during each write operation
and limits the track width and provides low noise
guard bands on each side of the recorded track. The
two read/write coils are wound on a single core and
are center tapped. The electrical connections of the
read/write head are shown in fig. 2 - 33. During a
write operation, the write current will be directed
alternately to one of the two read/write coils by a
flipflop. This causes a flux change each bit to be
written. The old data on the track will be overwrit-
ten by the new data stream.

On a read operation, an output voltage is induced in
the read/write head by each flux change that passes
the gap of the read/write head. This voltage is used
by the read circuits to recover the written data.

FIGURE 2 - 32 : TRACK GEOMETRY
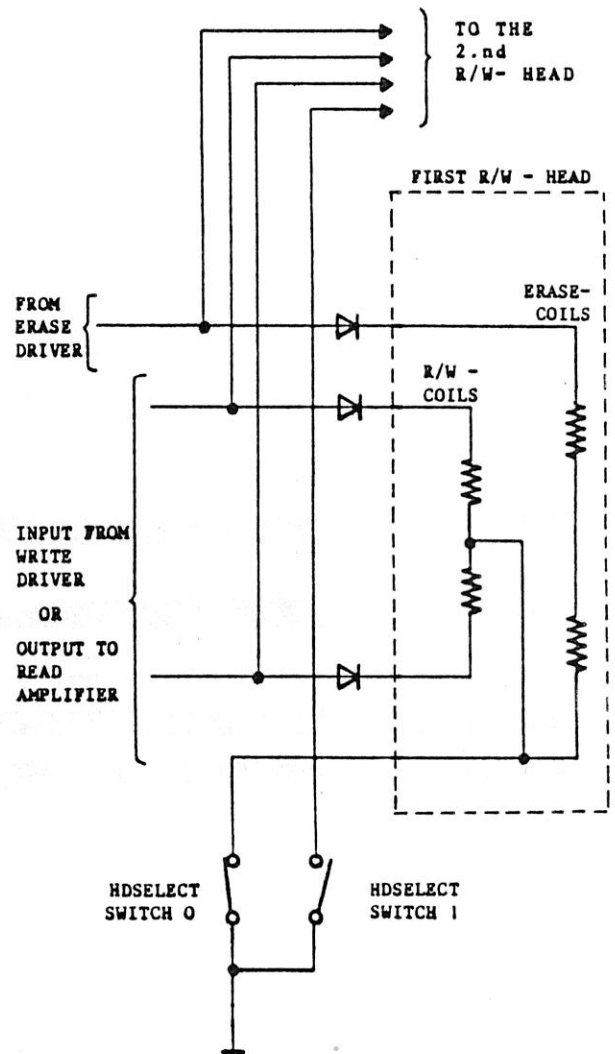
FIGURE 2 - 33 :

ELECTRICAL CONNECTION OF THE READ/WRITE HEAD

2.3.14. WRITE CIRCUITS

2.3.14.1. WRITE INITIATE

The write circuits encode serial data from the host
system to magnetic flux patterns recorded on the
flexy disk. A write operation is initiated by the
host system activating the following input lines
(see fig. 2 -34).

- SELECT/ : selects the drive and loads
the head if no head load op-
tion is installed

- MOTOR ON/ : rotates the mini disk

- WRITE GATE/ : turns on the write circuits

- WRITE DATA/ : encoded write data

- HEAD LOAD/ : loads the head if head load
option is used

2.3.14.2. WRITE LOGIC

A simplified logic of the write circuit is shown on
fig. 2 - 35. The write circuits are activated by
WRTENA/ which is active when the host system sends
WRITE GATE. The drive must be selected and the disk
not write protected. The data stream from the host
system is divided by the write flipflop. It alterna-
tely turns on transistors T3 and T4 (see fig. 2-36).
The write currents I_w and $I_{w'}$ which are determined
by the resistor R 35 flow then alternately through
the windings W_1 and W_2.
The write current and erase current can be blocked
by the DC-control logic, if a power failure has been
detected. The erase current I_E is turned on by tran-
sistor T5 when ERASENA/ is low. The write and erase
current are blocked by the DC-control logic if a po-
wer failure occurs.
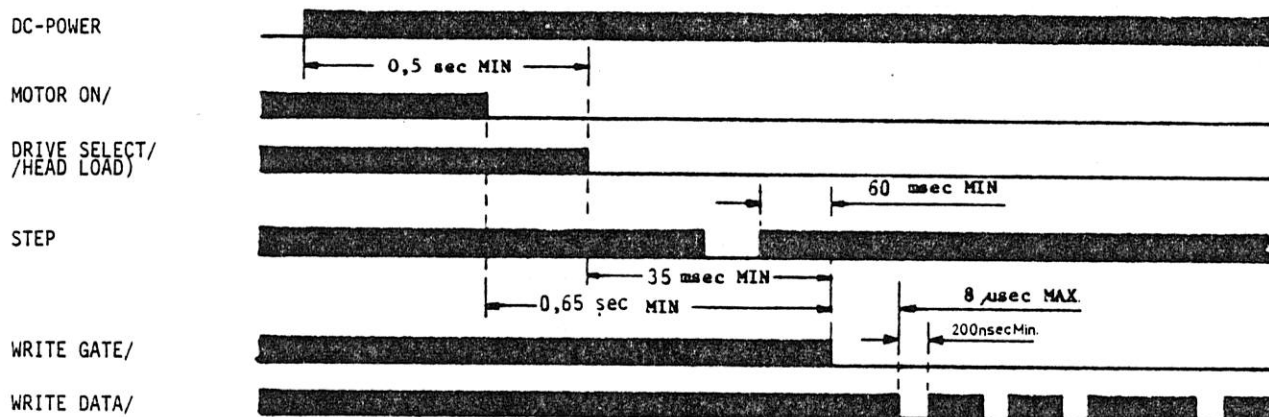
FIGURE 2 - 34 : WRITE INITIATE TIMING
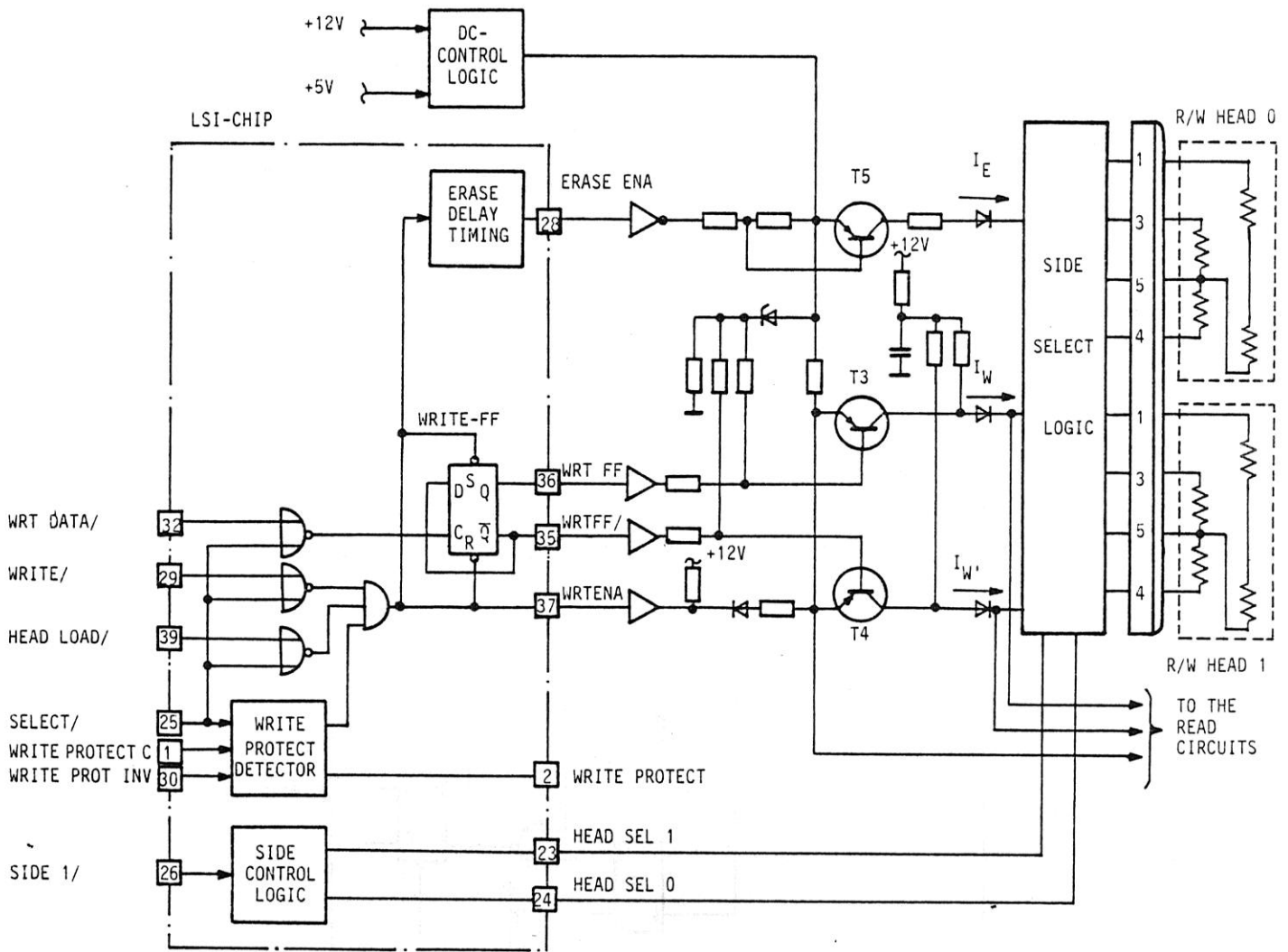
FIGURE 2 - 35 : SIMPLIFIED WRITE CIRCUITS BASF 6106/6108
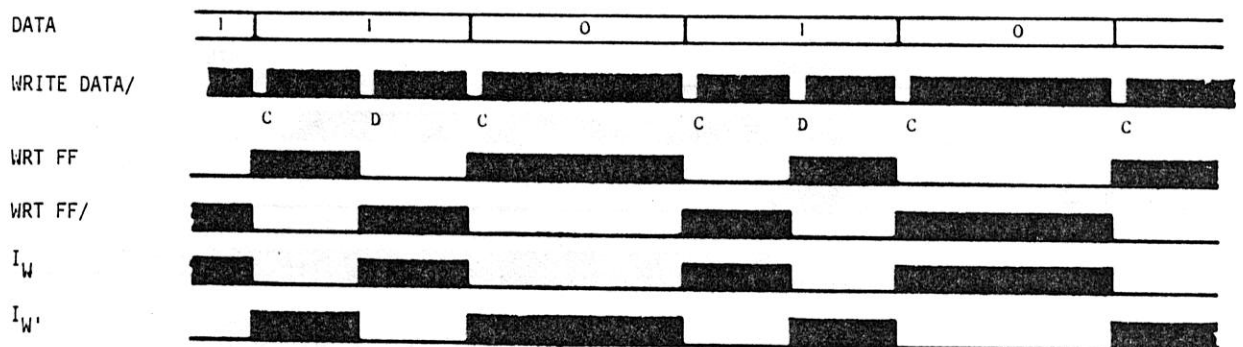
FIGURE 2 - 36 : TIMING DIAGRAM - WRITE OPERATION FM (SIMPLIFIED)

2.3.14.3. ERASE DELAY LOGIC

The erase current must be switched on (off) a certain delay after the write current has been switched on (off). This delay is necessary, because tunnel erase type read/write heads are used. The erase delay logic in the LSI comprises two one shots, one for the erase on delay time, the other for the erase off delay time and the ERASE ENA-FF (see figure 2 - 37).

The ERASE ENA-FF which the erase current turns on is reset during power on by the PWR ON*R/-signal. It is set when the ERASE ON DLY - one shot times out and is reset when the ERASE OFF DLY - one shot times out (see figure 2 - 38).
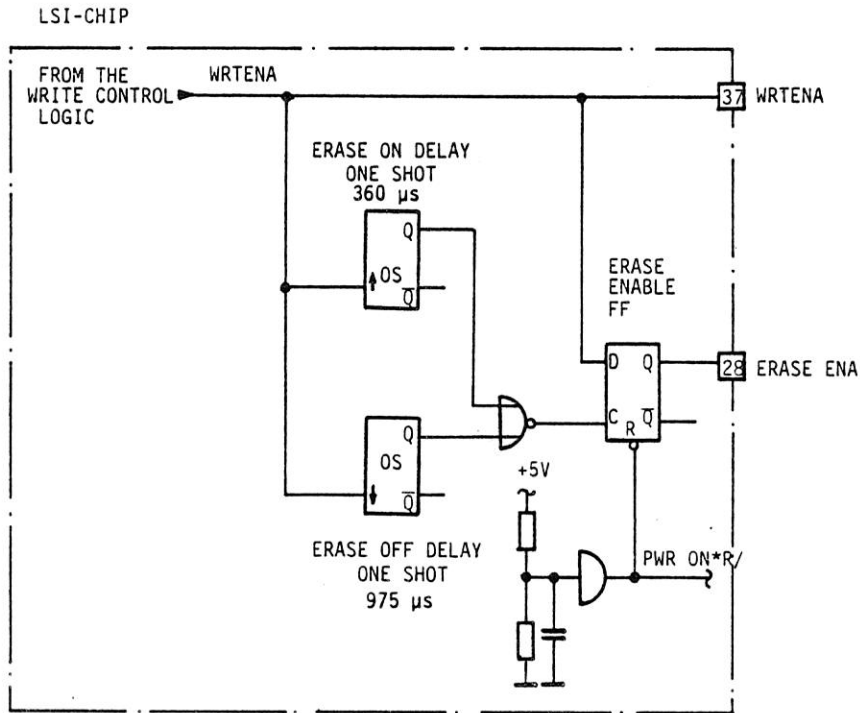
FIGURE 2 - 37 : ERASE DELAY LOGIC
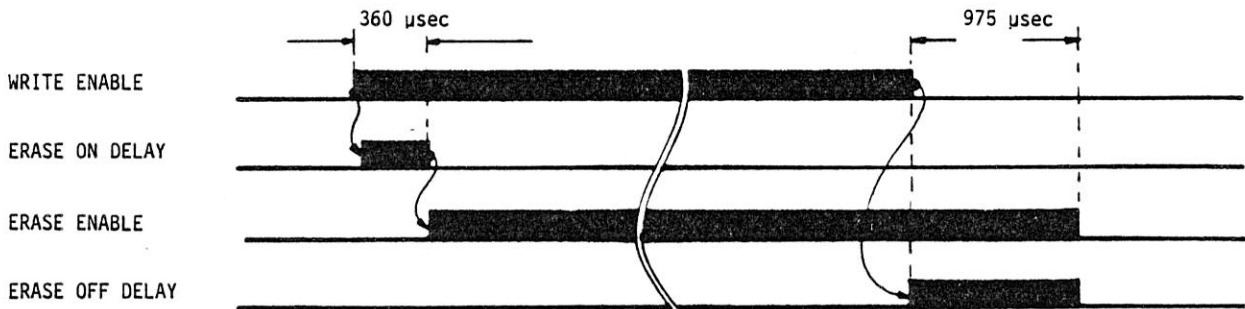
FIGURE 2 - 38 : ERASE DELAY TIMING

2.3.14.4. WRITE PROTECT DETECTOR

The write protect detector (fig. 2 - 39) is implemented like the index detector. A LED and a photo transistor are used with a comparator circuit to detect the write protect notch in the flexy disk. When a flexy disk with an open notch is inserted, the photo transistor will sense the light of the LED causing the negative input of the comparator to go low and the output of the comparator "NOTCH OPEN" will be high. The setting of the write protect inverse option jumper decides, whether writing is allowed or not (see the following table).

If WRITE INHIBIT is high, the WRITE ENABLE-signal is disabled. The mini disk drive is now unable to write even if the host system will activate the WRITE/ interface line. The WRITE PROTECT/-signal is sent to the host system when SELECT is high. The WRITE PROTECT line informs the host system, that a write protected flexy disk is inserted. If an unprotected flexy disk is inserted, WRITE PROTECT/ will be inactive and write operations are allowed.

JUMPER 2D (1-2)	NOTCH COVERED	NOTCH OPEN	REMARKS
INSERTED	unprotected	protected	optional
OPEN	protected	unprotected	ECMA
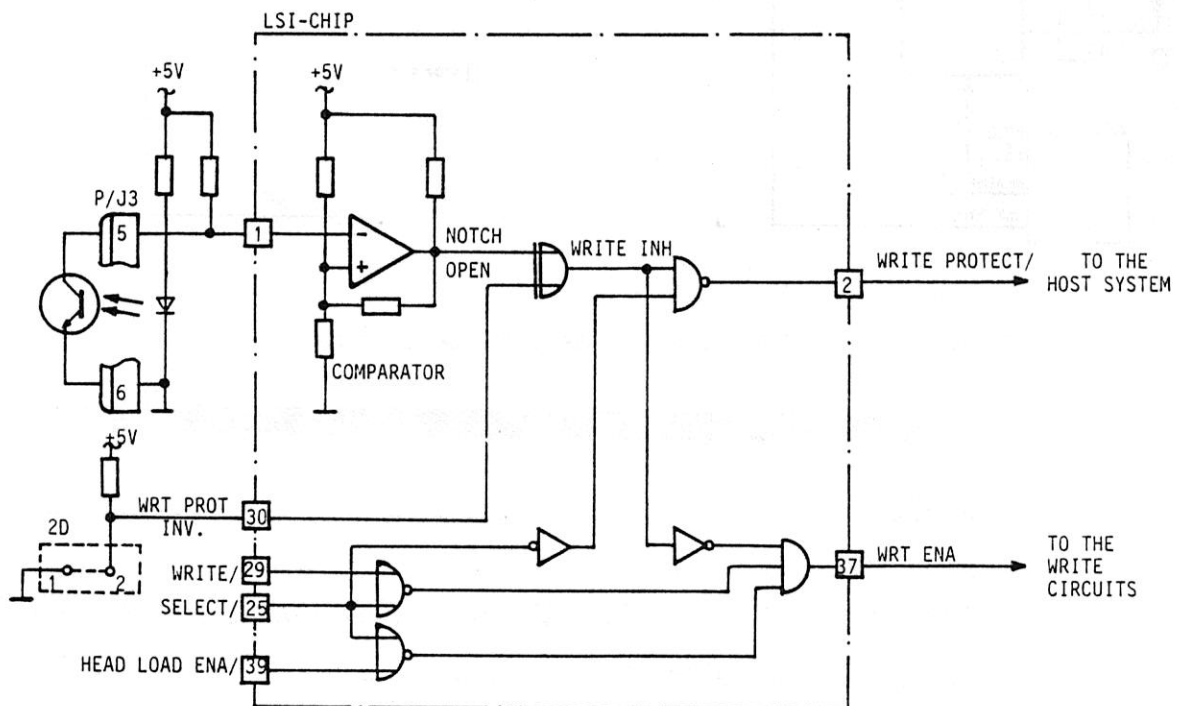
FIGURE 2 - 39 : WRITE PROTECT DETECTOR

2.3.15. READ CIRCUITS

2.3.15.1. READ INITIATE AND READ BLOCK DIAGRAM

The read circuits recover data recorded on the flexy disk by a write operation. A read operation is initiated from the host system by activating the following lines :

- SELECT/ : selects the drive and loads the head if auto head load option is used

- MOTOR ON/ : rotates the flexy disk

- HEAD LOAD/ : loads the head if head load option is used

- SIDE SELECT/ : selects head 0 or 1

The signal WRITE GATE/ must be inactive to enable the read circuits. Fig. 2 - 40 shows the read initiate timing. The read circuits shown on fig. 2 - 41 comprise an integrated read amplifier and the necessary external components.
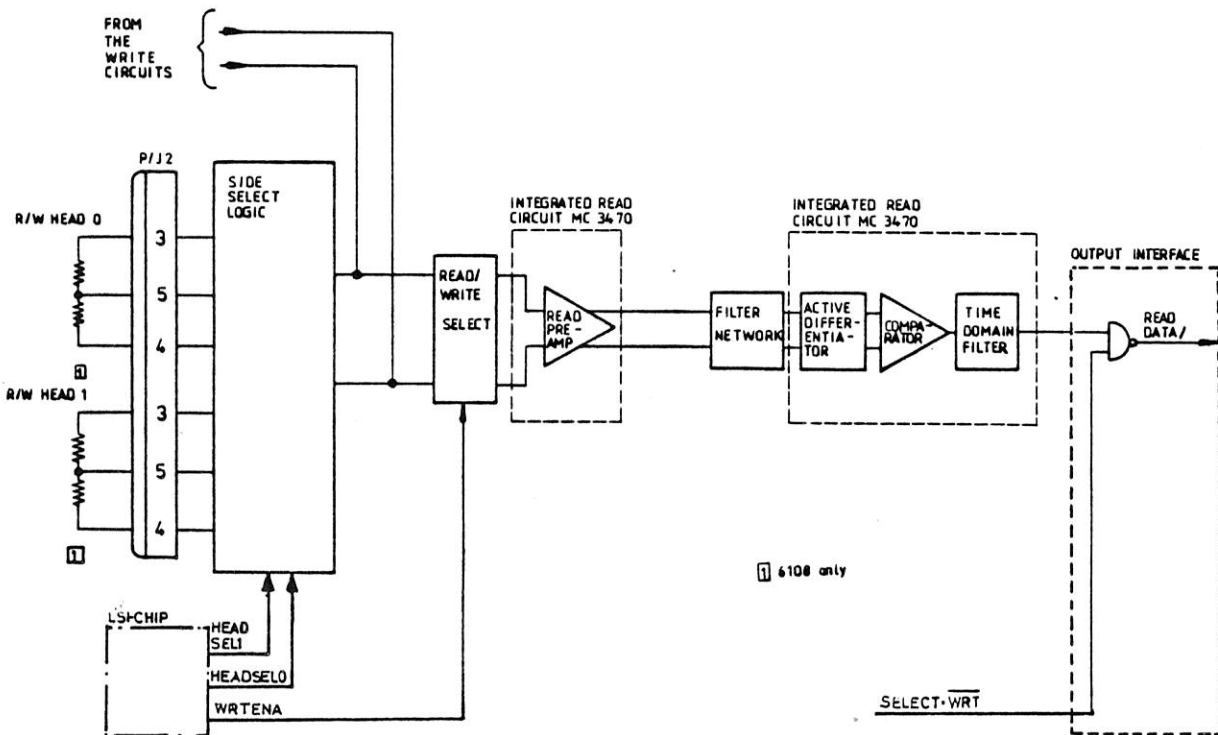
FIGURE 2 - 40 : READ CIRCUITS BASF 6106/6108 (SIMPLIFIED)
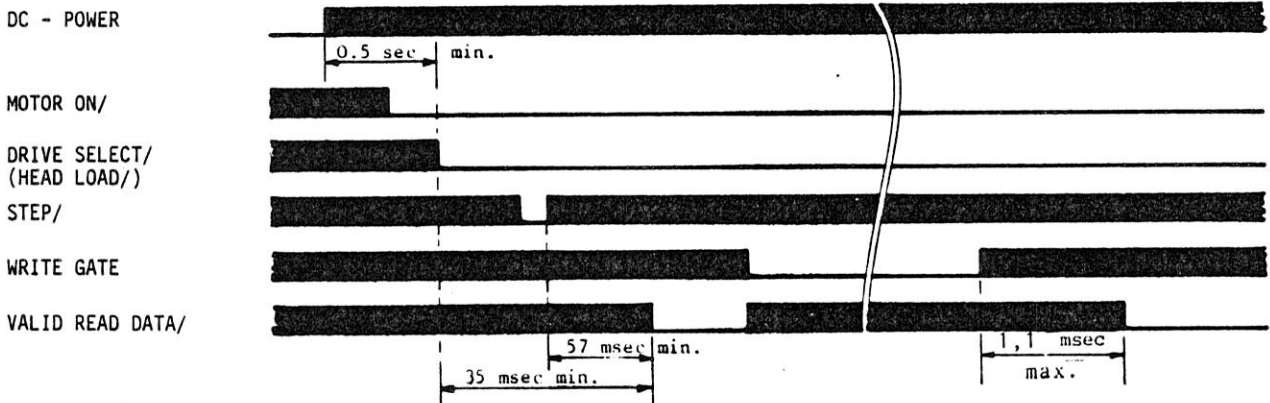
FIGURE 2 - 41 : READ INITIATE TIMING

2 - 30

2.3.15.2. READ/WRITE SELECT

The read/write select circuit consists of two MOS-FET
switches. The inputs of the switches are connected to
the read/write coils of the selected read/write head.
The outputs of the switches are connected to the read
preamplifier (see fig. 2 - 42).

When the disk drive is operating in the WRITE-mode,
WRTENA:01 is high and T6 and T7 are open. The read/
write coils are disconnected from the read preampli-
fier. In the READ-mode WRTENA:01 is low, the output
signal of the selected read write head is switched to
the read preamplifier.

2.3.15.3. READ AMPLIFIERS AND FILTER NETWORK
(FIG. 2 - 43)

For amplification of the read signal, a high gain
linear amplifier of the read LSI is used. The read
signal is amplified by a gain of ~100. The ampli-
fier outputs are used to drive a filter network. The
filter is a linear phase low pass and has a -3db band
width of 400 kilohertz.
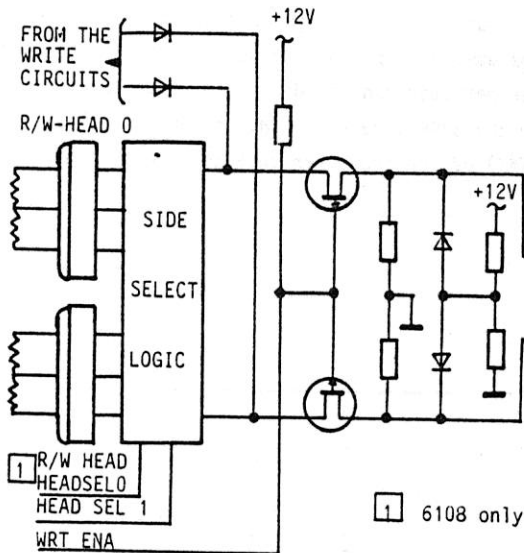
FIGURE 2 - 42 : READ/WRITE SELECT LOGIC
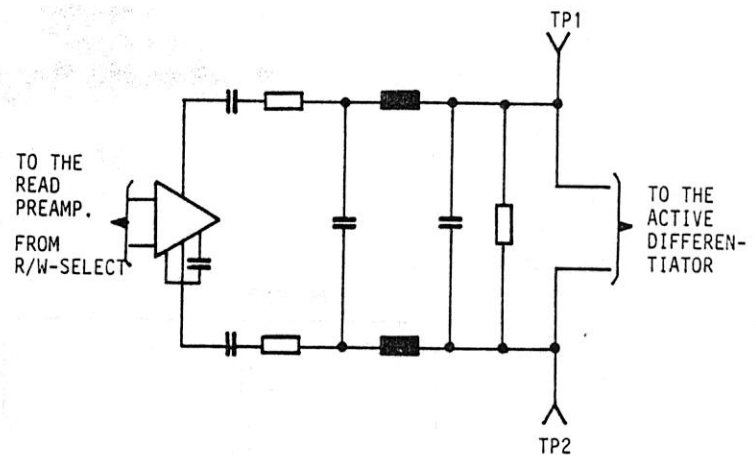
FIGURE 2 - 43 :
READ PREAMPLIFIER AND FILTER NETWORK

2.3.15.4. ACTIVE DIFFERENTIATOR AND COMPARATOR

Both circuits are part of the read LSI MC 3470. A simplified circuit is shown on fig. 2 - 44 . The active differentiator is implemented by a differential amplifier with capacitor coupled emitters. The current through this capacitor and also through the collector resistor will be a derivative of the input voltage.

$$I_C = C \cdot \frac{dV_{in(t)}}{dt}$$

Also the output voltage Vo of the differential amplifier will be a derivative of the input voltage.

$$V_0 = 2 R \cdot I_C = 2 R C \frac{dV_{in(t)}}{dt}$$

The output voltage Vo is applied to the comparator which provides zero crossing detection of the wave - form. Since the capacitor shifts the current $\sim$ 90° to the input voltage peak detection of the input voltage is performed. Fig. 2 - 46 shows a timing diagram of the differentiator and comparator circuit.

2.3.15.5. TIME DOMAIN FILTER AND CROSSOVER DETECTOR

The purpose of the time domain filter is to suppress false crossovers of the comparator caused by shouldering in the differentiated read signal. This can happen on outer tracks of high resolution disks when high resolution heads are used : the time domain filter contains a pulse generator, the time domain one shot and the time domain flipflop (see fig.2-45) and is part of the integrated read LSI. The pulse generator generates a short pulse for each transition on its input. These pulses are used to trigger the time domain one shot. The pulse duration of the time domain one shot is determined by an external RC-combination and is set to less than 2 μsec for the BASF 6106 and 6108. The state of the comparator output is loaded into the time domain flipflop by the trailing edge of the time domain one shot 2 μsec later (see fig. 2 - 46). Because false zero crossings always exist for a shorter time, the time domain flipflop will not change when it is clocked by false crossovers.

The crossover detector consists of a bidirectional one shot which is triggered by each transition of the time domain flipflop. The pulse width of the crossover detector can be adjusted by external elements. For the BASF 6106 and 6108, the output pulses (READ DATA/) of the crossover detector are set to 500nsec.
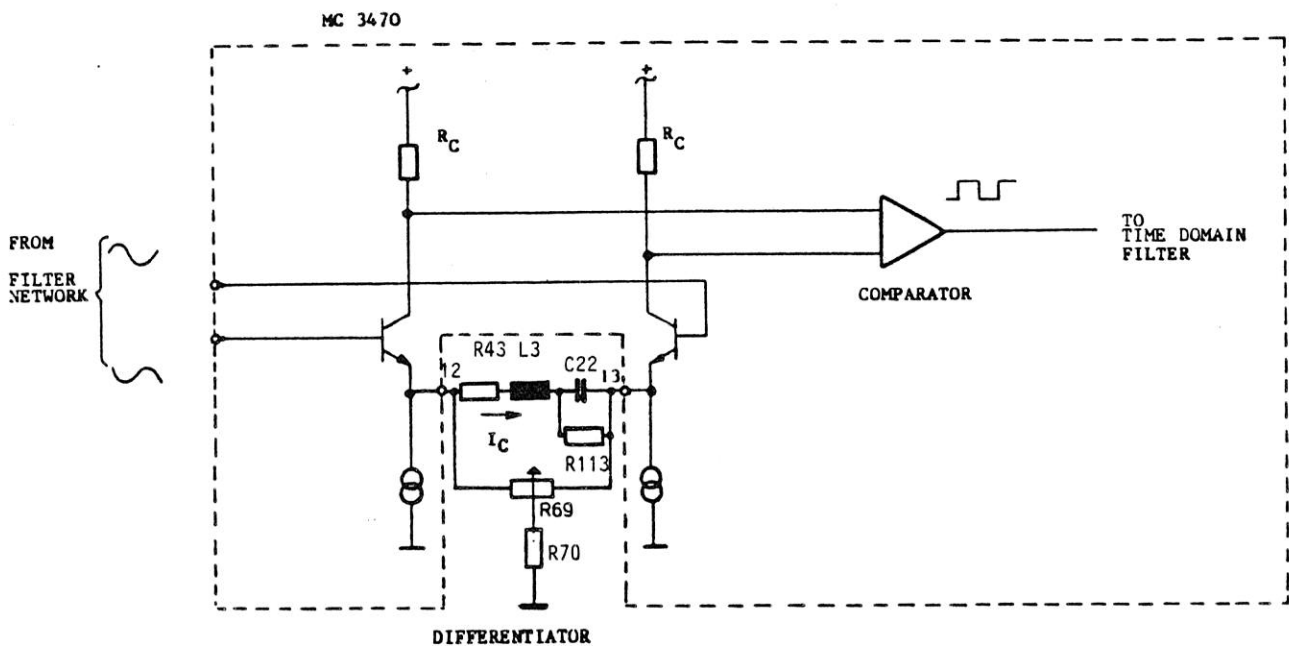
FIGURE 2 - 44 : ACTIVE DIFFERENTIATOR AND COMPARATOR
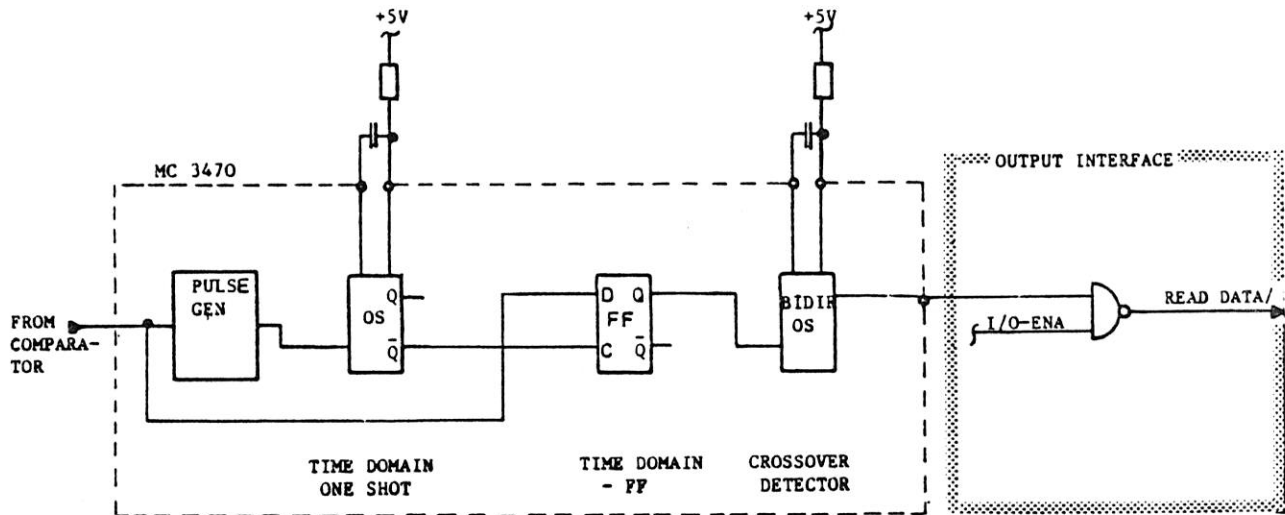
FIGURE 2 - 45 : TIME DOMAIN FILTER AND CROSSOVER DETECTOR

2.3.15.6. TIMING DIAGRAM READ CIRCUIT

Figure 2 - 46 is a timing diagram of the read cir-
cuits and illustrates the functions described above.
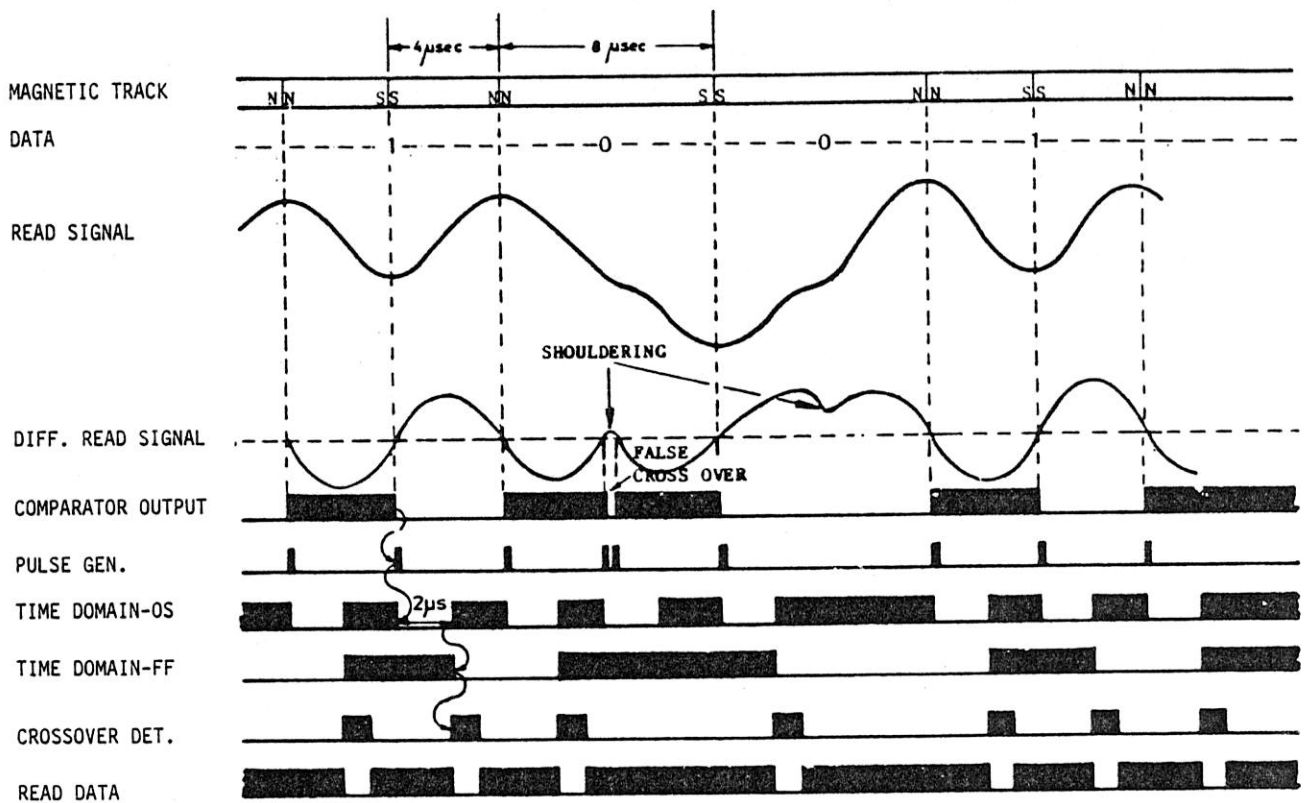
FIGURE 2 - 46 : TIMING DIAGRAM READ CIRCUIT

2.3.16. DC-CONTROL

The DC-control logic is shown on fig. 2 - 47. This lo-
gic monitors the DC-voltages +5V and +12V and disables
the write and erase current source, if one of these
voltages is missing or out of the following limits :

If +5V falls below 4,3V , DC-CONTROL goes high and
disables T2.

If +12V falls below +9V, T2 is also blocked and the
write and erase current inhibited.
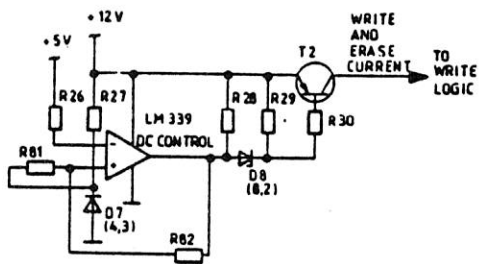
FIGURE 2 - 47 : DC-CONTROL LOGIC

SECTION III.
INSTALLATION AND OPERATION

3.1. INSTALLATION

3.1.1. GENERAL

This section provides informations for installation
and configuration of the mini disk drive.

3.1.2. UNPACKING AND INSPECTION

The mini disk drive is packaged in a heavy duty con-
tainer, designed to ensure adequate protection du-
ring shipping and handling (see figure 3 - 1). When
the mini disk drive is installed, store the contai-
ner and all packing material for possible future
use. Use the following procedure during unpacking
and inspection :

- Remove contents of shipping container and ins-
  pect for in-transit damage. If damage is evi-
  dent, notify the carrier and BASF. Specify na-
  ture and extent of the damage ;

- Verify that content of shipping container
  agrees with shipping list. Notify a BASF repre-
  sentitive if anything is missing ;

- Verify that model designation and serial number
  agree with those on the shipping invoice ;

BASF 6108 :

- Inspect assemblies for loose hardware. Tighten
  hardware if necessary ;

- Remove red retainer ;

- Remove shipping disk ;

- Store shipping disk, red retainer and containers
  for a possible future use.
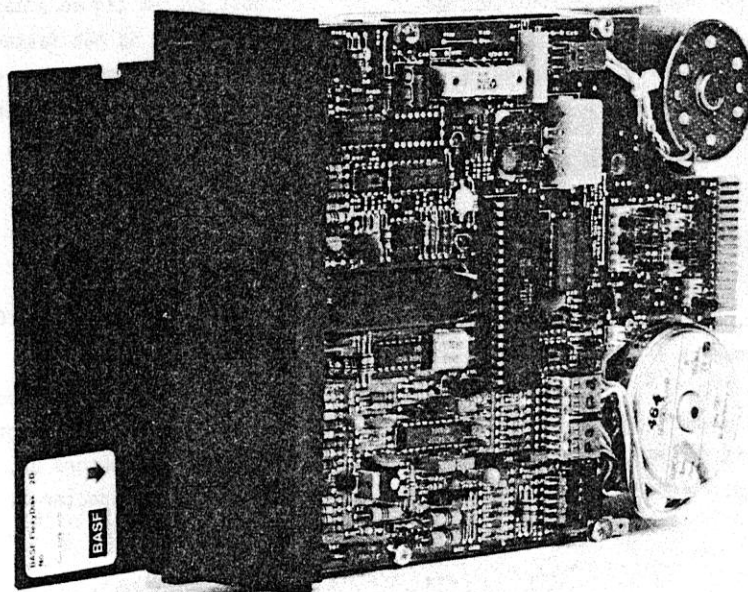
FIGURE 3 - 1 : BASF 6108 DRIVE EQUIPPED WITH SHIPPING PROTECTION

3.1.3. CONNECTING CABLES

The mini disk drive is connected to the host system by two connecting cables, the DC-cable and the interface cable. The DC-cable requires direct connection to each drive, regardless of connecting configuration. The interface cable is connected to the various connecting configurations (see 3.1.6.) and should not exceed 10 feet in length.

3.1.4. CONNECTORS

3.1.4.1. DC-CONNECTOR

DC power is connected to the disk drive through connector J5. The input pin assignments and voltage requirements are listed in table 3 - 1.

PIN No.	DC VOLTAGE	TOLERANCE	CURRENT	MAX. RIPPLE (p - p)
1	+ 12 V	± 0.6 V	+)1.75A	100 mV
2	+ 12V RET	-	-	-
3	+ 5V RET	-	-	-
4	+ 5 V	± 0.25V	0.7 A	50 mV

+) Plus 0.65 A motor starting current for max. 50 msec.

Voltages to be measured on testpoints on drive PCB.

TABLE 3 - 1 : DC-POWER REQUIREMENTS

The return lines for +12V and +5V (pins 2 and 3) should be separate lines and must be connected together in the system. DC power input connector J5 is mounted on the component side of the PCB beside the stepper motor (see figure 3 - 9). The 4 pin connector is BASF P/N 88359-001 (see figure 3 - 2) and is soldered directly to the PCB. The recommended mating connector is AMP P/N 1-480424-0 is using pins P/N 60619-1.
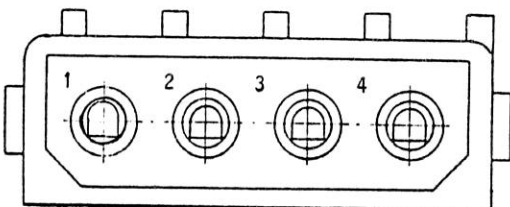
FIGURE 3 - 2 : DC-CONNECTOR

3.1.4.2. SIGNAL CONNECTOR

The signal cable is connected to the mini disk drive through connector J1. Connector J1 is a 34 pin PCB edge card connector located at the rear of the disk drive. The pins are numbered from 1 to 34 with the even pins on the component side. Pin 2 is located closest to the stepper motor and is marked. A key-slot is provided between pins 4 and 6 for optional connector keying. Recommended mating connectors for J1 are listed in table 3 - 2.

CABLE TYPE	MANUFACTURER	CONNECTOR P/N	CONTACT P/N
FLAT CABLE	SCOTCHFLEX	3463-0000	NA
		3463-0001	NA
TWISTED PAIR # 26	AMP	583717-5	1-583616-1

TABLE 3 - 2 : RECOMMENDED J1 MATING CONNECTORS

3.1.4.3. FRAME CONNECTOR

The mini disk drive must be frame grounded to the host system to insure proper operation. A fast on tab is provided on the drive near to the stepper motor. A fast on connector with AC ground from the host system can be attached or soldered if the mini disk drive is not fastened directly to the frame of the host system with a good AC ground. The tab is Grothe-Hartmann 17132 and its mating connector is Grothe-Hartmann 123211.

3.1.4.4. INTERCONNECTING DIAGRAM

Figure 3 - 3 is provided as an interconnecting diagram showing the connections directly to or from the PCB. Connectors J2, J3 and J6 are for internal drive use, connector J1 and J5 are from the controller.
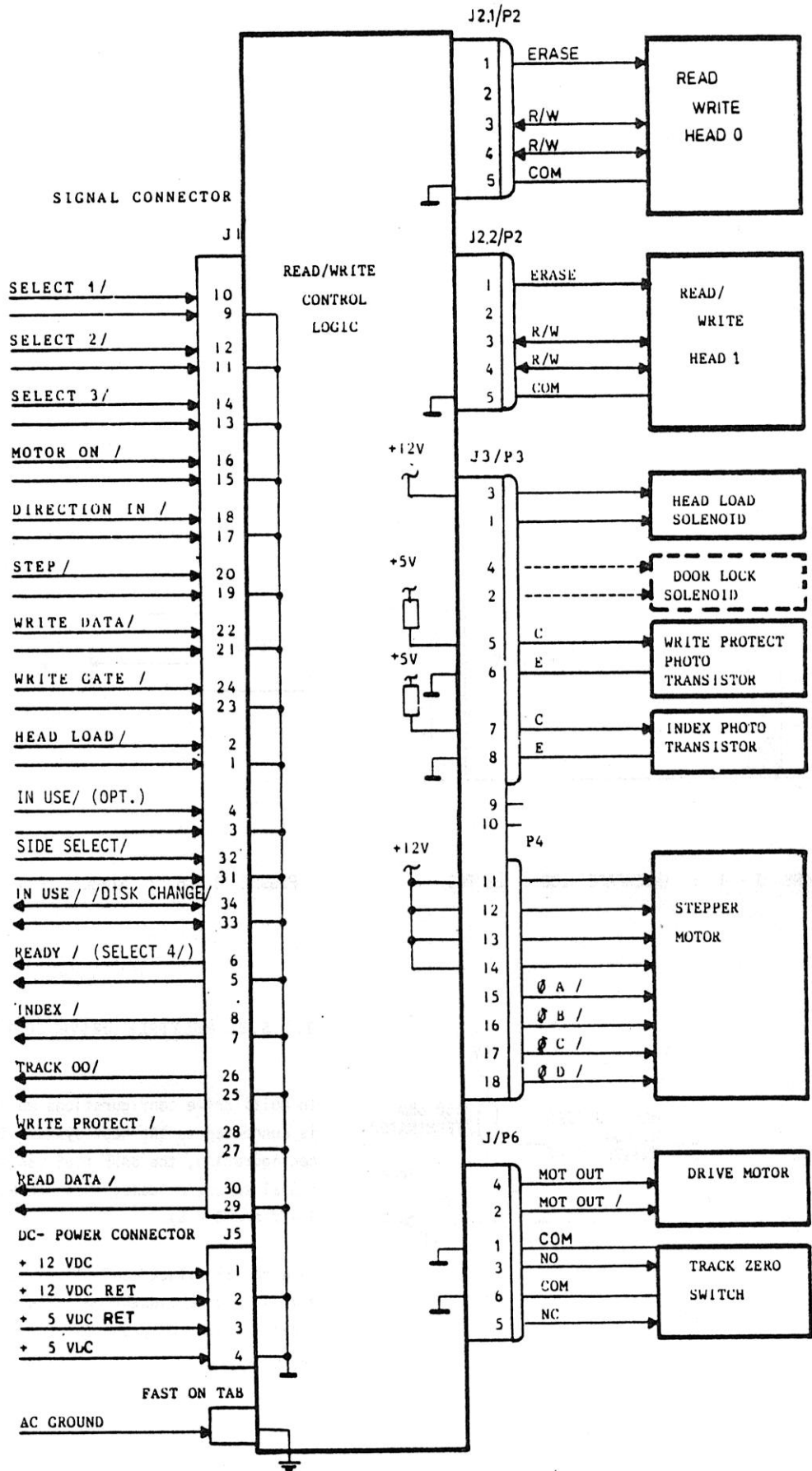
FIGURE 3 - 3 : INTERCONNECTING DIAGRAM

J2.1/P2

1 — ERASE
2
3 — R/W
4 — R/W
5 — COM

READ
WRITE
HEAD 0

SIGNAL CONNECTOR

J1

READ/WRITE
CONTROL
LOGIC

SELECT 1/ — 10
9

SELECT 2/ — 12
11

SELECT 3/ — 14
13

MOTOR ON / — 16
15

DIRECTION IN / — 18
17

STEP / — 20
19

WRITE DATA/ — 22
21

WRITE GATE / — 24
23

HEAD LOAD/ — 2
1

IN USE/ (OPT.) — 4
3

SIDE SELECT/ — 32
31

IN USE/ /DISK CHANGE/ — 34
33

READY / (SELECT 4/) — 6
5

INDEX / — 8
7

TRACK 00/ — 26
25

WRITE PROTECT / — 28
27

READ DATA / — 30
29

DC- POWER CONNECTOR J5

+ 12 VDC — 1
+ 12 VDC RET — 2
+ 5 VDC RET — 3
+ 5 VDC — 4

FAST ON TAB

AC GROUND

J2.2/P2

1 — ERASE
2
3 — R/W
4 — R/W
5 — COM

READ/
WRITE
HEAD 1

+12V   J3/P3

3 — HEAD LOAD SOLENOID
1

+5V
4 ---- DOOR LOCK SOLENOID
2 ----

5 — C   WRITE PROTECT PHOTO TRANSISTOR
+5V
6 — E

7 — C   INDEX PHOTO TRANSISTOR
8 — E

9
10   P4

+12V
11
12   STEPPER MOTOR
13
14
15 — Ø A /
16 — Ø B /
17 — Ø C /
18 — Ø D /

J/P6

4 — MOT OUT   DRIVE MOTOR
2 — MOT OUT /

1 — COM
3 — NO   TRACK ZERO SWITCH
6 — COM
5 — NC

3 - 5

3.1.5. LOGIC LEVELS AND TERMINATION

Interface signals to and from connector J1 have the logic levels represented by figure 3 - 4. All signal inputs are terminated by a 150 ohm resistor network chip (position 4D). This chip can be removed for a daisy chain configuration, where only the last mini disk drive needs a termination network.

The BASF 6106/08 uses SN 7438 or equivalent as output driver. As input receiver SN 7404 or equivalent is used. Figure 3 - 5 shows the recommended interface logic.
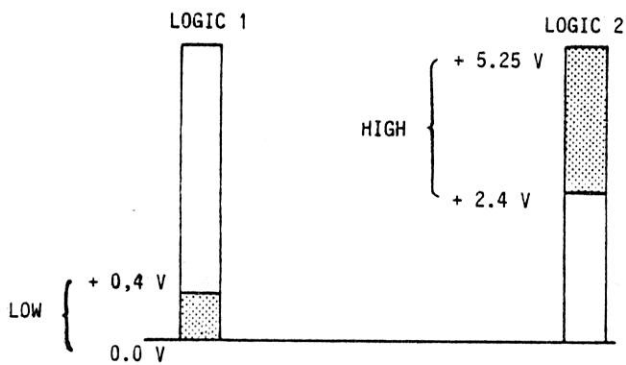
FIGURE 3 - 4 : INTERFACE LOGIC LEVELS
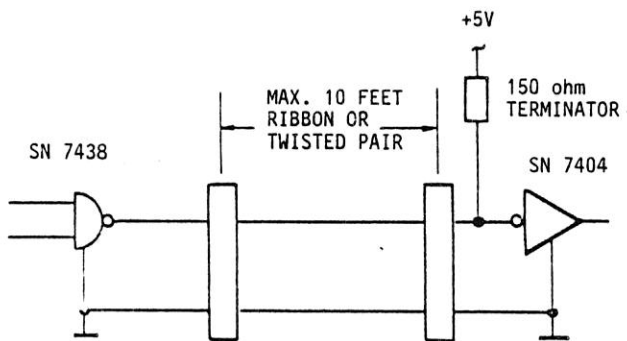
FIGURE 3 - 5 :

RECOMMENDED DRIVER / RECEIVER CIRCUIT

3.1.6. CONNECTING CONFIGURATION

The BASF 6106/6108 can be connected to the host system in different configurations :

- single drive configuration

- multi drive configuration

3.1.6.1. SINGLE DRIVE CONFIGURATION

Only one drive is connected to the host system as shown in figure 3 - 6.
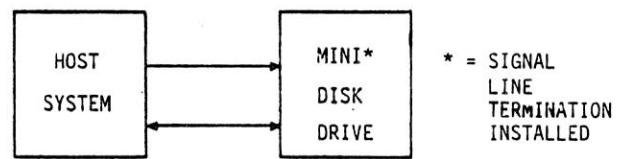
FIGURE 3 - 6 : SINGLE DRIVE CONFIGURATION

3.1.6.2. MULTIPLE DRIVE CONFIGURATION

In multi drive configurations more than one drive is connected to the host system. In a multi drive configuration, the BASF 6106 can be connected in radial select or daisy chain fashion (see figures 3 - 7 and 3 - 8).

In a radial select configuration, all mini disk drives need terminator networks and in a daisy chain configuration, only the last drive needs a terminator chip.

```
                  ┌──────────┐
                  │ MINI  ** │
                  │ DISK     │
                  │ DRIVE    │
                  │    1     │
                  └──────────┘
                   ▲ │    ▲ │
                 DC│ │  S │ │
                   │ ▼  I │ ▼
                         G
                         N
                         A
                         L
    ┌──────────┐         DC    ┌──────────┐
    │ H O S T  │──────────────▶│ MINI  ** │
    │ S Y S T E M│◀────────────│ DISK     │
    │          │   SIGNAL      │ DRIVE    │
    └──────────┘               │    2     │
      ▲ │  ▲ │                 └──────────┘
    S │ │ D│ │
    I │ ▼  C│ ▼
    G
    N
    A
    L
   ┌──────────┐
   │ MINI  ** │
   │ DISK     │
   │ DRIVE    │
   │    3     │
   └──────────┘
```
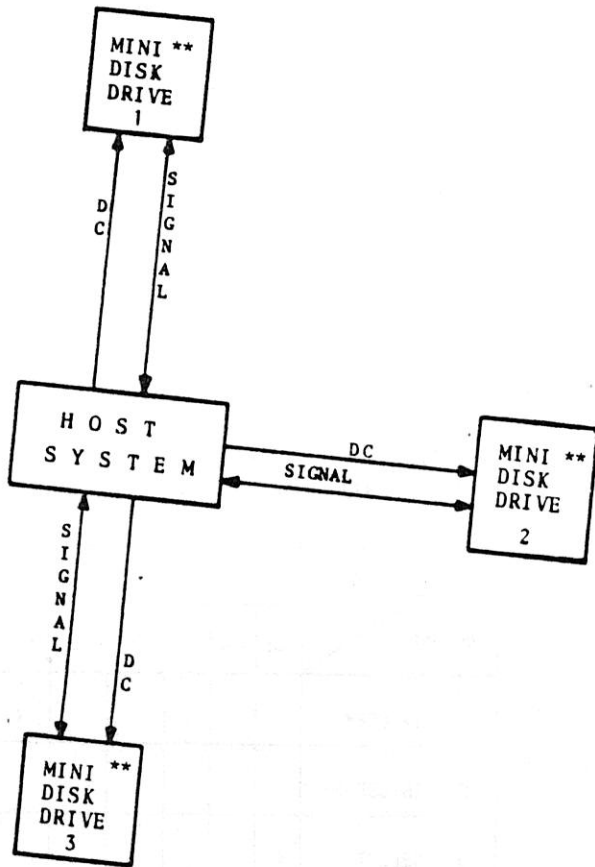
** SIGNAL LINE TERMINATOR

FIGURE 3 - 7 : RADIAL SELECT CONFIGURATION

```
   ┌──────────────┐
   │ H O S T      │◀─────────────┐
   │ S Y S T E M  │              │ S
   └──────────────┘              │ I
     │ │  │                      │ G
     │ │  │                      │ N
     │ │  │              DC      │ A
     │ │  │        ┌──────────┐  │ L
     │ │  └───────▶│ MINI     │◀─┘
     │ │           │ DISK     │
     │ │           │ DRIVE    │
     │ │           │    1     │
     │ │           └──────────┘
     │ │                ▲ │
     │ │              S │ │
     │ │              I │ ▼
     │ │              G
     │ │              N
     │ │              A
     │ │      DC      L
     │ │    ┌──────────┐
     │ └───▶│ MINI     │
     │      │ DISK     │
     │      │ DRIVE    │
     │      │    2     │
     │      └──────────┘
     │           ▲ │
     │         S │ │
     │         I │ ▼
     │         G
     │         N
     │         A
     │   DC    L
     │ ┌──────────┐
     └▶│ MINI  ** │
       │ DISK     │
       │ DRIVE    │
       │    3     │
       └──────────┘
```
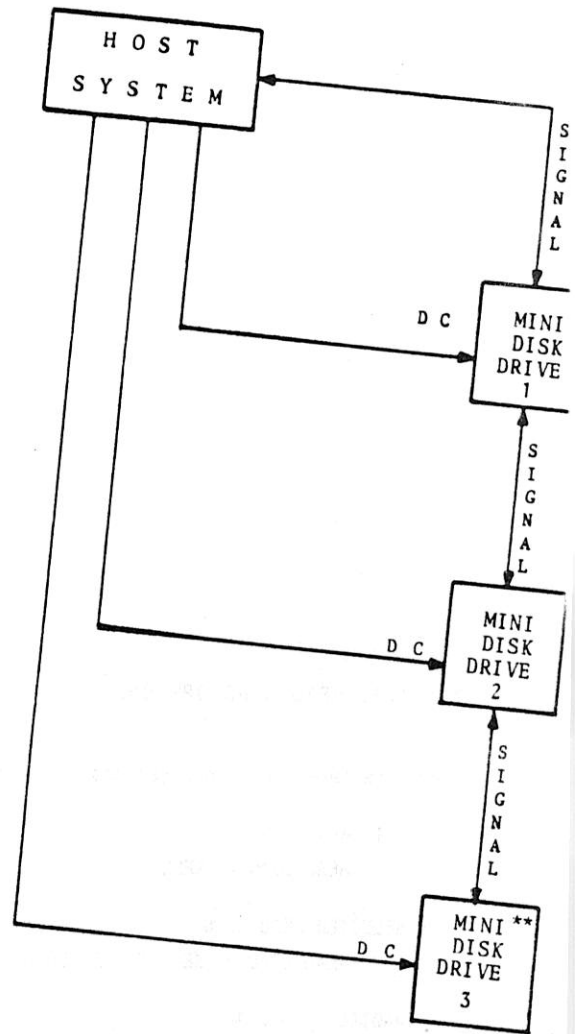
** SIGNAL LINE TERMINATOR

FIGURE 3 - 8 : DAISY CHAIN SELECT CONFIGURATION

3.1.7. SELECTION OF THE DESIRED OPTIONS

3.1.7.1. SELECT OPTIONS

In a single drive configuration, the auto select option will be used, in a multi drive configuration the radial select option must be used.

OPTION \ JUMPER	JJ 1			2 D		
	1-2	3-4	5-6	3-4	13-14	15-16
AUTO SELECT				X		T
RADIAL SELECT — DRIVE #1	X					T
RADIAL SELECT — DRIVE #2		X				T
RADIAL SELECT — DRIVE #3			X			T
RADIAL SELECT — DRIVE #4*					X	C

X = jumper installed
T = trace
C = trace cut
* = no ready signal available on interface pin 6

TABLE 3 - 3 : SELECT OPTIONS JUMPERING

3.1.7.2. HEAD LOAD OPTIONS

There are three head load options :

- AUTO HEAD LOAD
    HEAD LOAD = SELECT

- SELECTED HEAD LOAD
    HEAD LOAD = SELECT.HEAD LOAD

- RADIAL HEAD LOAD
    HEAD LOAD = HEAD LOAD

OPTION \ JUMPER	2 D			
	5 - 6	7 - 8	9 - 10	11 - 12
AUTO HEAD LOAD	X		X	
SELECTED HEAD LOAD	X			X
RADIAL HEAD LOAD		X		X

TABLE 3 - 4 : HEAD LOAD OPTION JUMPERING

3.1.7.3. IN USE / DISK CHANGE OPTION

Pin 34 of the interface can be used as IN USE (INPUT) or DISK CHANGE (OUTPUT). Pin 4 of the interface can be used as IN USE INPUT (see table 3 - 5).

OPTION \ JUMPER	4 D		
	9 - 10	11 - 12	13 - 14
IN USE PIN 34			X
IN USE PIN 4	X		
DISK CHANGE OPTION		X	

TABLE 3 - 5 : IN USE / DISK CHANGE OPTION JUMPERING

3.1.7.4. DOOR LOCK OPTIONS

Locking of the door can be accomplished by the following conditions shown in table 3 - 6.

	OPTION \ JUMPER	5 D						
		3-4	5-6	7-8	9-10	9-11	11-12	13-14
D	IN USE*			X			X	X
O	IN USE-FF					X		X
O	SELECT	X						X
R	HEAD LOAD		X					X
	IN USE + IN USE-FF				X		X	X
L	IN USE + SELECT	X		X			X	
O	IN USE + HEAD LOAD		X	X			X	
C	IN USE-FF + SELECT	X				X		
K	IN USE FF+ HEAD LOAD		X			X		
=	IN USE + IN USE-FF + SELECT	X			X		X	
	IN USE + IN USE-FF+ HEAD LOAD		X		X		X	

TABLE 3 - 6 : DOOR LOCK OPTIONS JUMPERING

3.1.7.5. ACTIVITY LED OPTIONS

The activity LED can be switched on by the following conditions shown in table 3 - 7.

OPTION \ JUMPER		4 D			
		1 - 2	3 - 4	5 - 6	7 - 8
A C T I V I T Y L E D	HEAD LOAD . READY	X			X
	DOOR LOCK . READY	X		X	
	HEAD LOAD		X		X
	DOOR LOCK		X	X	

TABLE 3 - 7 : ACTIVITY LED OPTION JUMPERING

3.1.7.6. WRITE PROTECT OPTION

The manner in which the mini disk is write protected can be selected by a jumper as shown in table 3 - 8.

OPTION	2 D
	1 - 2
WRITE PROTECT = NOTCH COVERED	X
WRITE PROTECT = NOTCH OPEN	

TABLE 3 - 8 : WRITE PROTECT OPTION JUMPERING

3.1.7.7. STEPPER MOTOR SWITCHING

If the stepper motor shall be enabled by the MOTOR ON signal, the following jumper must be installed (see table 3 - 9).

OPTION \ JUMPER	5 D
	1 - 2
STEP MOTOR ENABLE = MOTOR ON	X

TABLE 3 - 9 :

STEPPER MOTOR SWITCHING OPTION JUMPERING

3.1.7.8. HARD SECTOR OPTION

If sectored mini diskettes are used, hard sector option must be selected by the following jumpers (see table 3 - 10).

OPTION \ JUMPER		3 D	
		5 - 6	7 - 8
HARD SECTOR	inactive	T	
	active	C	T

T = TRACE
C = TRACE CUT

TABLE 3 - 10 :

HARD SECTOR OPTION JUMPERING

3.1.7.9. JUMPER MATRIX

Table 3 - 11 provides a jumper matrix for all options. For selecting the desired jumpers provide the following :

- Select <u>one</u> of the SELECT options and install the jumpers ;

- Select <u>one</u> of the HEAD LOAD options and install the jumpers ;

- Select IN USE or DISK CHANGE option ;

- Select <u>one</u> of the DOOR LATCH options, if door locking or activity LED is used. Install the jumpers ;

- Select <u>one</u> of the activity LED options and install the jumpers ;

- Select <u>one</u> of the WRITE PROTECT options and install the jumpers ;

- Install the stepper motor switching jumper if desired ;

- Activate the HARD SECTOR option if desired.

For location of jumpers, refer to figure 3 - 9.

OPTION		JUMPER	JJ1 1-2	JJ1 3-4	JJ1 5-6	2D 1-2	2D 3-4	2D 5-6	2D 7-8	2D 9-10	2D 11-12	2D 13-14	2D 15-16	3D 5-6	3D 7-8	4D 1-2	4D 3-4	4D 5-6	4D 7-8	4D 9-10	4D 11-12	4D 13-14	5D 1-2	5D 3-4	5D 5-6	5D 7-8	5D 9-10	5D 9-11	5D 11-12	5D 13-14
SELECT OPTIONS		AUTO SELECT				X							T																	
		DRIVE # 1	X										T																	
		DRIVE # 2		X									T																	
		DRIVE # 3			X								T																	
		DRIVE # 4										X	C																	
HEAD LOAD OPTIONS		AUTO HEAD LOAD							X		X																			
		SELECTED HEAD LOAD							X			X																		
		RADIAL HEAD LOAD								X		X																		
IN USE/ DISK CHANGE		IN USE = PIN 34																				X								
		IN USE = PIN 4																			X									
		DISK CHANGE = PIN 34																			X									
DOOR LOCK OPTIONS	DOOR LOCK	IN USE																								X			X	X
		IN USE-FF																									X			X
		SELECT																					X							X
		HEAD LOAD																						X						X
		IN USE + IN USE FF																									X		X	X
		IN USE + SELECT																					X		X				X	
		IN USE + HEAD LOAD																						X	X				X	
		IN USE FF + SELECT																					X				X			
		IN USE FF + HEAD LOAD																						X			X			
		IN USE + IN USE FF + SELECT																					X			X			X	
		IN USE + IN USE FF + HDLD																						X		X			X	
ACTIVITY LED OPTIONS	ACTIVITY LED	HEAD LOAD . READY												X			X													
		DOOR LOCK . READY												X		X														
		HEAD LOAD													X		X													
		DOOR LOCK													X	X														
WRITE PROTECT OPTION	WRITE PROTECT	NOTCH COVERED				X																								
		NOTCH OPEN																												
STEPPER MOTOR	STEP.MOT.ENA MOTOR ON																						X							
HARD SECTOR OPT.	HARD SECTOR ENABLED													C	T															

TABLE 3 - 11 : OPTION JUMPER MATRIX

R47
DRIVE MOTOR
ADJUST

J2
DC-CONNECTOR

J/P6 DRIVE MOTOR
TRACK ZERO SWITCH

DRIVE MOTOR

FRONT
DOOR

2D
4D
5D
TERMINATOR NET-
WORK
J1
KEY SLOT
J1 SIGNAL CON-
NECTOR

STEPPER MOTOR

R69
JITTER ADJUST
TP 1-4

J/P2
READ
WRITE
HEADS

P3
HEAD LOAD SOLENOID
DOOR LOCK SOLENOID
WRITE PROTECT PHOTO TRANSISTOR
INDEX PHOTO TRANSISTOR

P4
STEPPER
MOTOR

TP 5-8

FRAME GROUND
CONNECTOR
(FAST ON TAB)

HEAD CARRIAGE

SPIRAL WHEEL

FRONT
DOOR
LATCH

READ/WRITE HEAD

DRIVE MOTOR
PULLEY

DOOR LOCK
SOLENOID

SPINDLE DRIVE
PULLEY

DRIVE
BELT

HEAD LOAD SOLENOID

FIGURE 3 - 9 : PART LOCATIONS (PRINCIPAL)

3.1.8. DRIVE MOUNTING

3.1.8.1. MOUNTING POSITIONS

The mini disk drive may be mounted in any position.

3.1.8.2. MOUNTING DIMENSIONS

Figure 3 - 10 shows the outline and mounting dimensions of the mini disk drive. For more detailed information, see specification of the BASF 6106/08 mini disk drives.

DIMENSIONS IN $\frac{mm}{(inch)}$
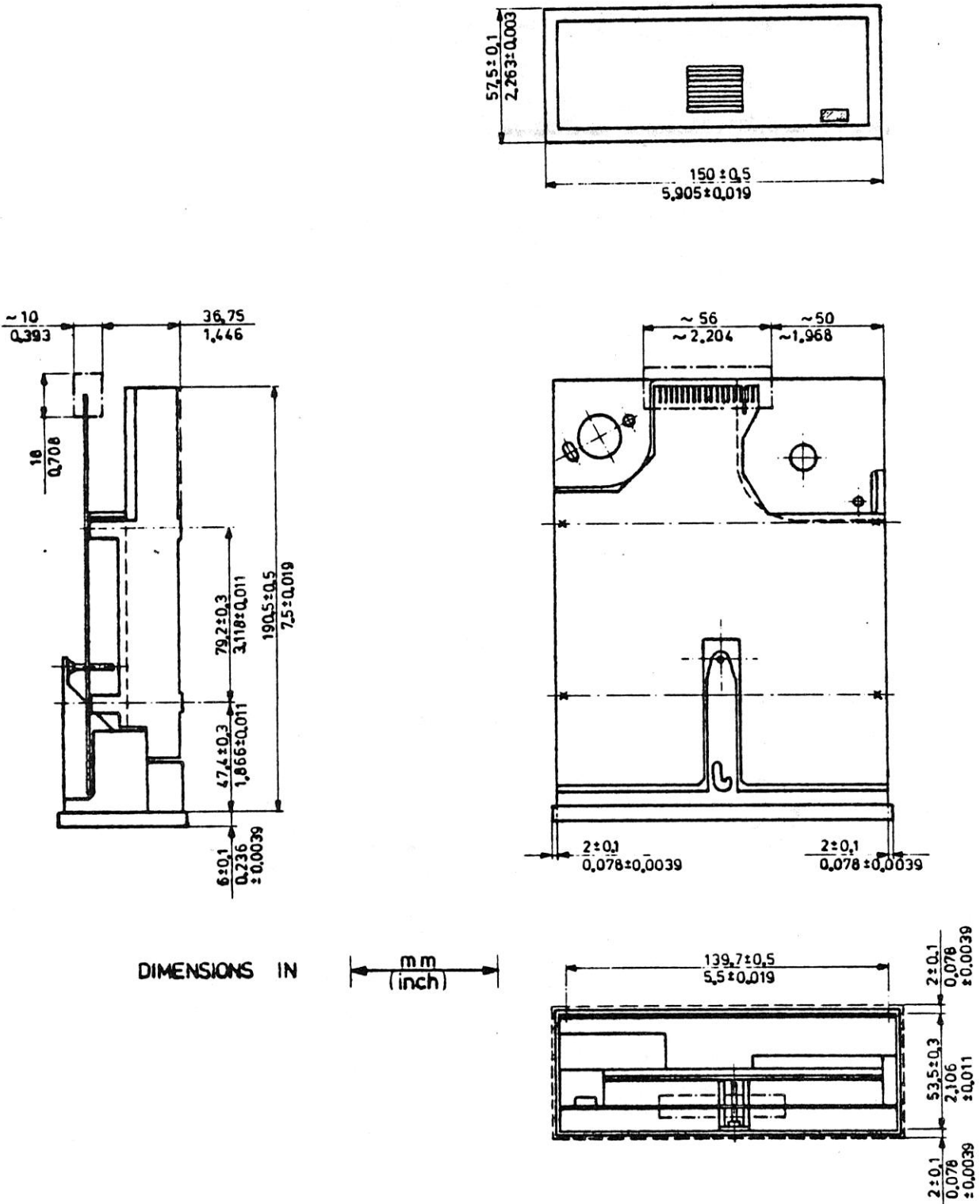
FIGURE 3 - 10 : MOUNTING SPECIFICATION

3.2. OPERATION

3.2.1. GENERAL

There are no front panel controls on the BASF 6106/ 6108. All power and control functions are handled through the interface. Operating procedures consist primarily of loading and unloading the mini disk.

3.2.2. MINI DISK STORAGE AND HANDLING

The following are essential requirements for mini disk storage and handling :

- The mini disk should be stored in an environment that is clean and free from any magnetic influence;

- The mini disk should be in same temperature and humidity environment as the disk drive for a minimum of five minutes prior to use ;

- Return flexy disk to protective envelope when not in use ;

- Never place heavy objects on the mini disk cartridge ;

- Never touch the flexy disk through the cartridge opening when handling ;

- Never attempt to clean the flexy disk ;

- Do not bend of fold the flexy disk ;

- Do not use rubber bands or paper clips on the flexy disk ;

- Never write on cartridge (use labels) ;

- Do not expose flexy disk to excessive heat or sunlight.

Proper loading of the mini disk is vital to the operation of the mini disk and drive. Figure 3-11 shows the proper laoding of the mini disk.

Procedures for loading and unloading the mini disk drive are given in tables 3 - 11 and 3 - 12, respectively.
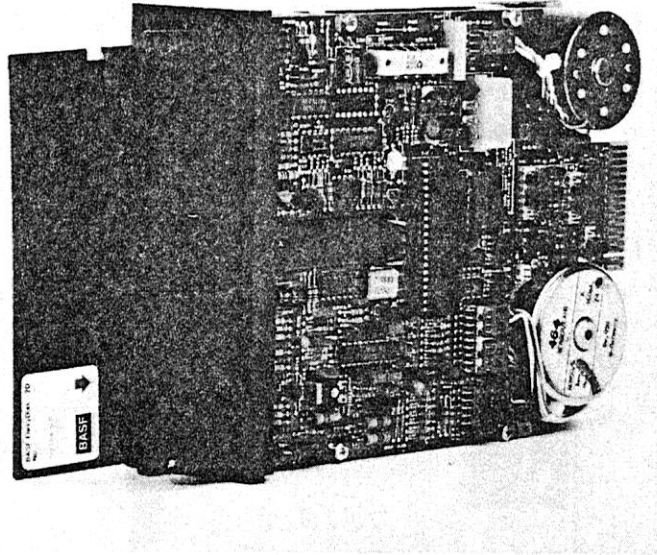
Caution : insert fully before closing the front door !

FIGURE 3 - 11 : FLEXY DISK LOADING

STEP	ACTION
1	Press front door and release to open
2	Insert Flexy Disk fully with label towards front door
3	Close front door

TABLE 3 - 12 : FLEXY DISK LOADING

STEP	ACTION
1	Press front door and release to open
2	Remove Flexy Disk

TABLE 3 - 13 : FLEXY DISK UNLAODING

3.2.3. WRITE PROTECT

There are two methods used to protect a flexy disk
from being written :

a) write protect if notch open (optional)

b) write protect if notch covered (ECMA)

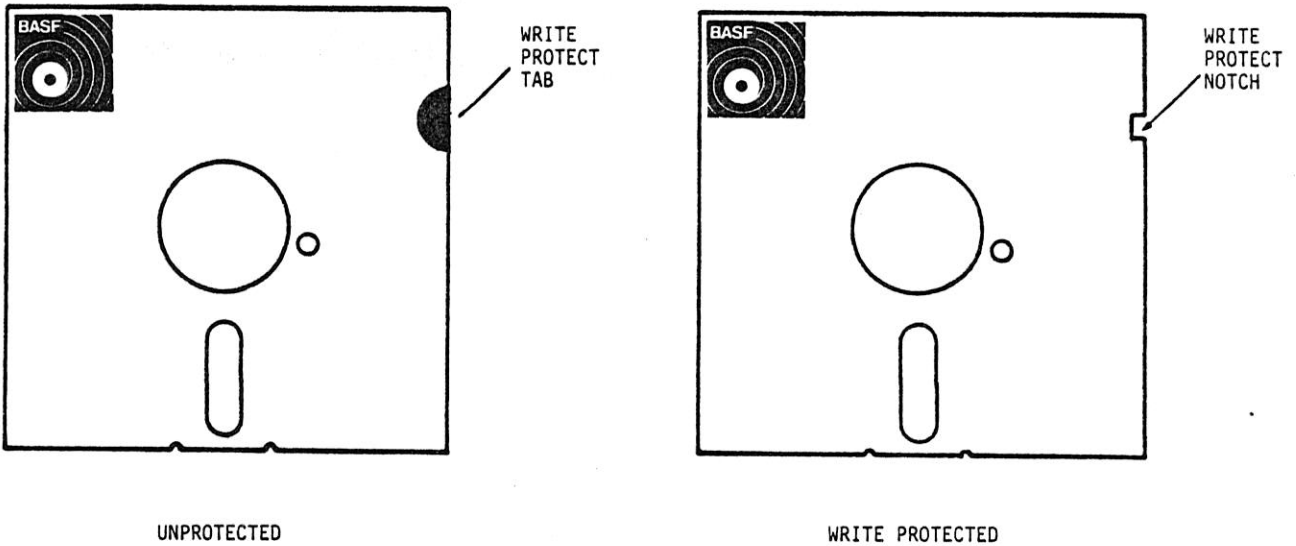### 3.2.3.1. WRITE PROTECT IF NOTCH OPEN (OPTIONAL)

Jumper : 2D (1-2) open

UNPROTECTED   WRITE PROTECTED

FIGURE 3 - 12 : WRITE PROTECT FEATURE (ECMA)

3.2.3.2. WRITE PROTECT IF NOTCH COVERED (ECMA)

Jumper : 2D (1-2)

WRITE PROTECTED   UNPROTECTED
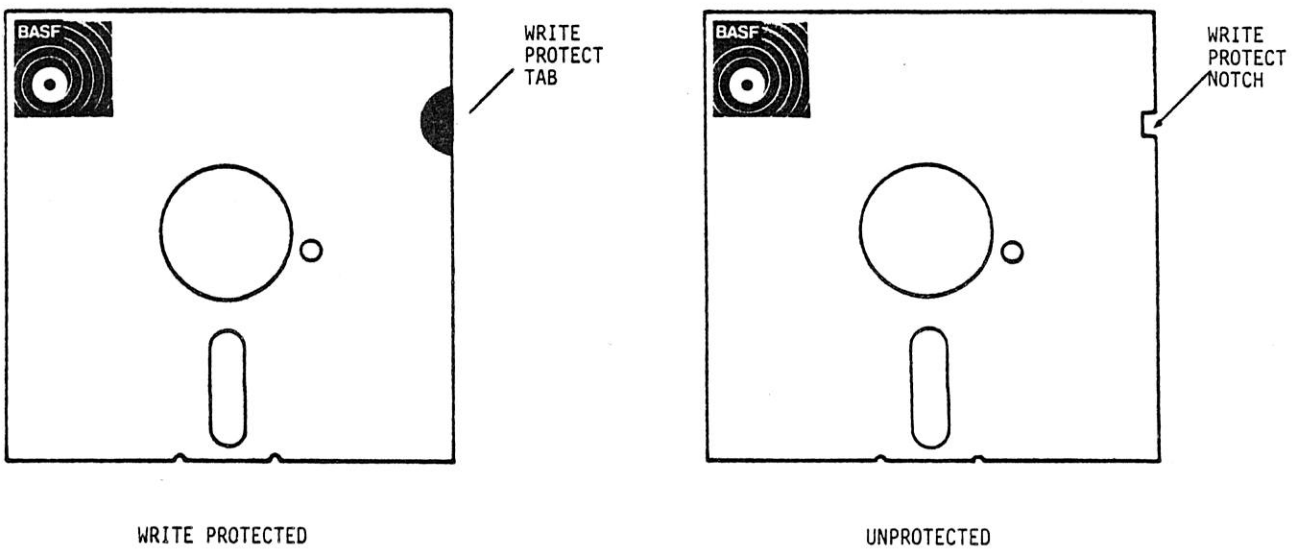
FIGURE 3 - 13 : WRITE PROTECT FEATURE (SHUGART)

SECTION IV.
MAITENANCE

4.1. GENERAL

This section contains the procedures for performing operational checks, alignments and adjustments for the BASF 6106 and BASF 6108 LSI mini disk drives.

4.2. TOOLS AND TEST EQUIPMENT

To perform proper maintenance of the mini disk drive, certain tools, test equipment and supplies are required. A list of standard tools and test equipment is provided in table 4 - 1. Special tools and test equipment are listed in table 4 - 2.

```
Common hand tools
Freon
Cotton tipped swabs (Q-tips)
Soft lint free cloth (gauze)

Voltohmmeter
Oscilloscope
Inspection Mirror
Frequency Counter
```

TABLE 4 - 1 : STANDARD TOOLS AND TEST EQUIPMENT

The BASF 2007 exerciser is a portable unit to operate the mini disk drive off-line. The BASF 2007 will enable the user to make all adjustments and checks required on the BASF 6106 and BASF 6108 mini disk drives. The exerciser is provided with controls and indicators to execute all control operations and simulate and read and write operations.

```
BASF - CE - Mini Disk
BASF - CLEANING Mini Disk
Exerciser BASF 2007
Dial Gauge (Belt Tension Tool)
```

TABLE 4 - 2 : SPECIAL TOOLS AND TEST EQUIPMENT

4.3. READ/WRITE HEADS CLEANING

a. Read use instructions on the cover of the cleaning disk * ;

b. Turn on drive motor ;

c. Insert cleaning disk and clean head 0 ;

d. Remove cleaning disk after recommended cleaning time ;

6108 only :

e. Insert cleaning disk and clean head 1

f. Remove cleaning disk after recommended cleaning time.

```
* CAUTION !

  Observe the recommended cleaning times !
```

4.4. CHECKS, ADJUSTMENTS AND REPLACEMENTS

4.4.1. PCB REPLACEMENT

a. Turn off DC voltages ;

b. Remove P1, P2, P3, P4, P5, P6 ;

c. Remove the 4 mounting screws ;

d. To reinstall, reverse the above ;

e. Check and readjust the index-detector ;

f. Readjust the drive motor speed and jitter, if a
   new PCB was installed.
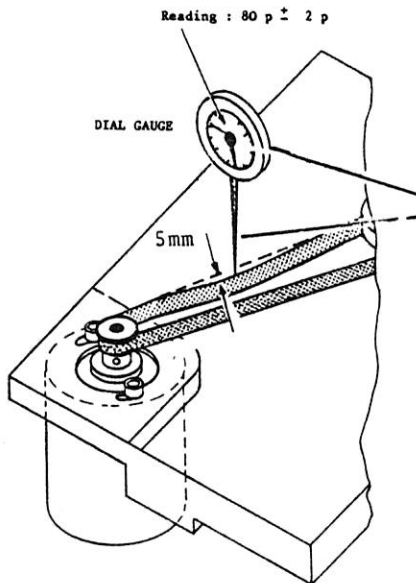
4.4.2. SPINDLE DRIVE SYSTEM

The spindle drive system consists of the drive motor,
the drive motor pulley, the spindle drive belt and the
spindle drive pulley.

4.4.2.1. DRIVE MOTOR AND DRIVE BELT CHECKS

a. Turn off the DC input power ;

b. Rotate drive motor manually and inspect drive belt
   from wear, cracks or fraying edges. Replace drive
   belt, if necessary ;

c. Rotate motor manually and inspect for bearing noise
   or binding. Replace drive motor, if necessary (ref.
   to drive motor replacement procedure) ;

d. Turn on DC power to mini disk drive ;

e. Start drive motor (MOTOR ON/active) ;

f. Verify that drive motor and drive belt operate nor-
   mally and that drive belt tracks evenly and smoothly
   in center of both pulleys.

4.3.2.2. DRIVE BELT TENSION CHECK

a. Take a dial gauge and press it against the drive belt
   until the deflection of the belt is 5 mm ;

b. The reading on the gauge must be ~80 p +/- 5 p ;

c. If the measured value is out of limits, perform drive
   belt tension adjustment.

Reading : 80 p ± 2 p

DIAL GAUGE

5 mm
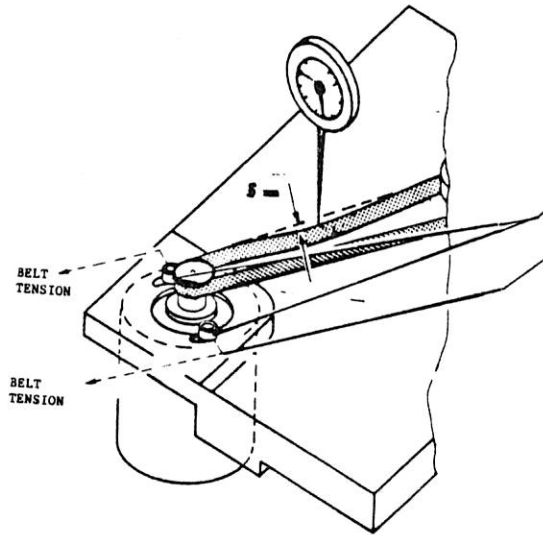
4.4.2.3. DRIVE BELT REPLACEMENT AND TENSION ADJUSTMENT

a. Slightly loosen the drive motor screws ;

b. Adjust the drive belt tension for a reading of 80 p +/- 5 p on the dial gauge, when the drive belt is 5 mm deflected ;

c. Tighten the drive motor setscrews ;

4.4.2.4. DRIVE MOTOR SPEED CHECK

a. Load a BASF CE-mini diskette ;

b. Turn on drive motor ;

c. Check that the dark lines of the tacho disk on the spindle pulley appear motionless. Use the inside ring for 50 Hz and the outside ring for 60 Hz *) ;
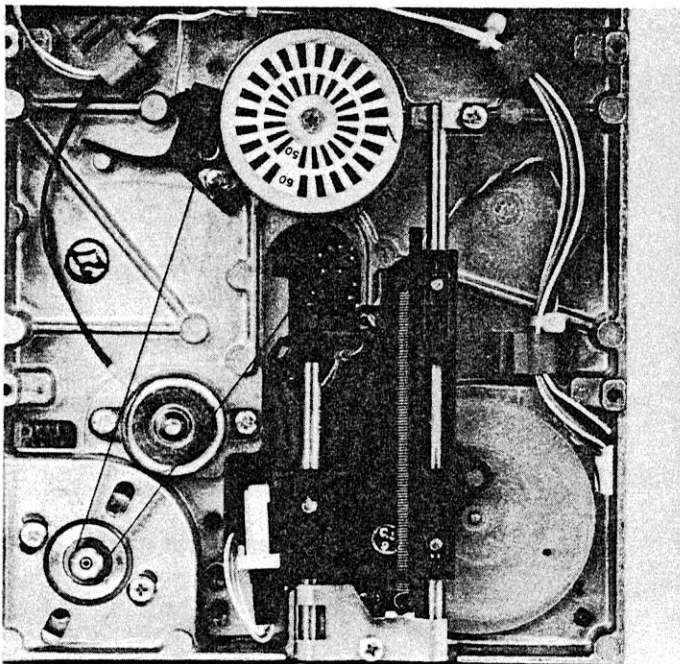
4.4.2.5. DRIVE MOTOR SPEED ADJUSTMENT

a. Load a BASF CE-mini diskette ;

b. Turn on drive motor ;

c. Position to track 16 and load head ;

d. Turn the potentiometer R 47 until the dark lines of the tacho disk on the spindle pulley appear motionless. Use the inside ring for 50 Hz and the outside ring for 60 Hz *).

*) This adjustment is only possible in an area where flourescent light exists. Otherwise, provide the adjustment or check as shown in 4.4.2.6.

4.4.2.6. DRIVE MOTOR SPEED ADJUSTMENT USING A FREQUENCY COUNTER

a. Load a BASF CE-mini diskette ;

b. Connect a frequency counter to TP8 (INDEX) ;

c. Turn on the drive motor ;

d. Position to track 16 and load head ;

e. Measure time between two consecutive index pulses and adjust pot R 47 to 200 msec +/- 1 msec if necessary.

4.4.2.7. DRIVE MOTOR REPLACEMENT

a. Remove mini disk drive from mounting and place it on a clean work surface ;

b. Remove drive belt ;

c. Remove wire 2 and 4 of P6 ;

d. Remove the two drive motor set screws. Drive motor is now removed from disk drive ;

e. Place new drive motor in same position and fasten it snuggly. Tighten drive motor set screws ;

f. Reinstall wires 2 and 6 of P6 ;

g. Install drive belt and verify correct tracking ;

h. Provide drive belt tension adjustment procedure (4.4.2.3.) ;

i. Perform speed adjustment.

BELT TENSION

BELT TENSION
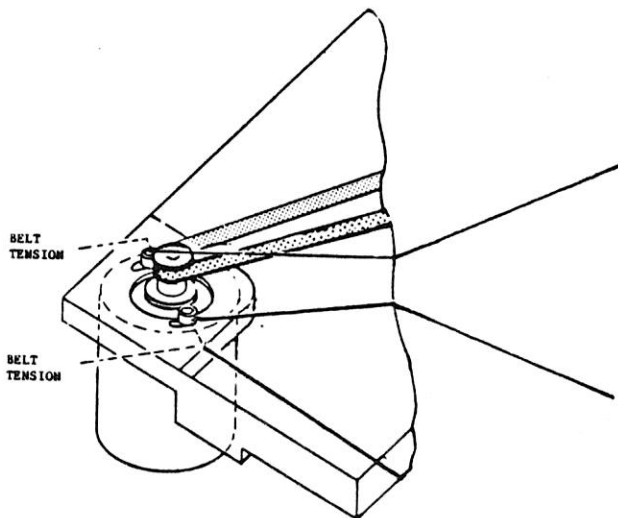
4.4.3. POSITIONING SYSTEM

The positioning system consists of the stepper motor with spiral wheel, the head carriage assembly and the optical track 00 switch.

### 4.4.3.1. TRACK ADJUSTMENT CHECK

a. Load a BASF-CE mini diskette ;

b. Start the drive motor and select the mini disk drive ;

c. Select head 0 ;

d. Step to track 16 ;

e. Measure with oscilloscope :

   SYNC   : EXT. POS. TP 8 INDEX
   CH 1   : AC 50 mV uncalibrated inverted TP 1
   CH 2   : AC 50 mV uncalibrated TP 2
   MODE   : ADD
   TIME BASE: 10 ms/Div. uncalibrated
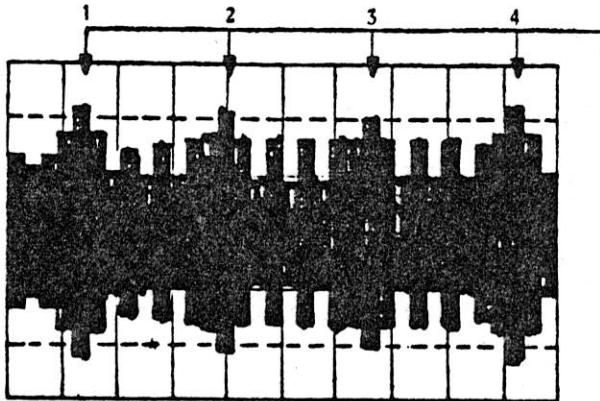
f. Monitor the read signal on the screen and adjust the time base of the scope until four orientation bursts are shown ;

g. Turn the variable gain potentiometer of the scope until the amplitude of the orientation burst reaches 60 scale units ;
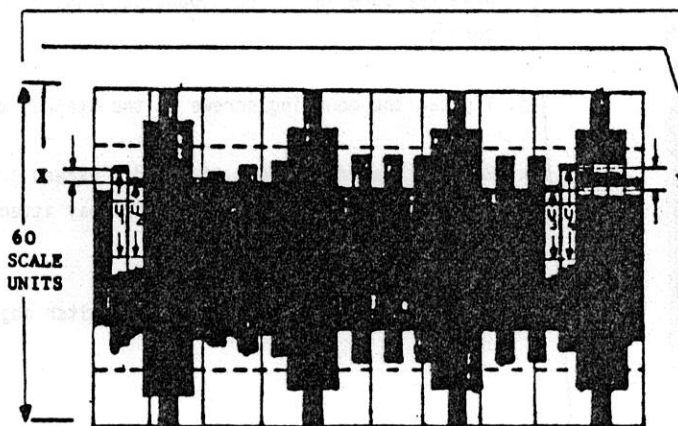
h. Determine X and Y (see example !) :
   $X = U_1 - U_2$ Caution : pay attention to sign
   $Y = U_3 - U_4$

i. Calculate Z :
   $Z = X + Y$

j. If Z exceeds 18 scale units, proceed with point f of track adjustment procedure (4.4.3.2.). Continue for BASF 6108 (1 DIV = 10 SCALE UNITS) ;

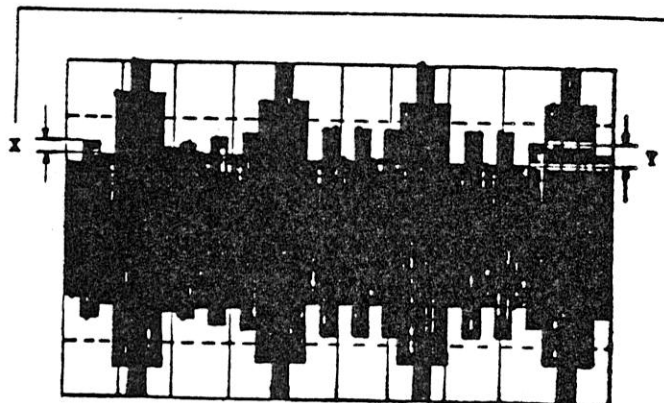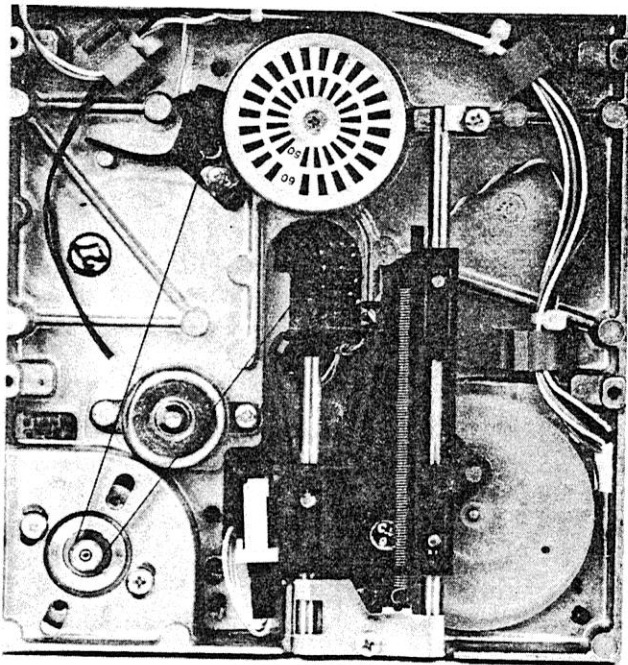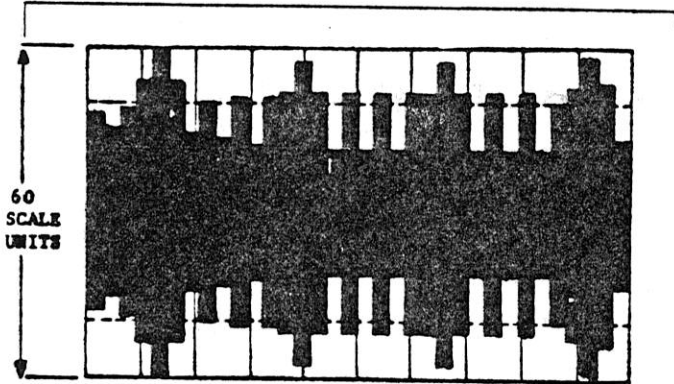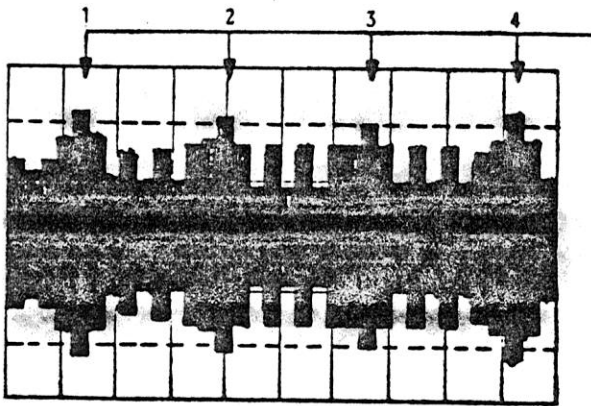k. Select head 1 ;

l. Proceed through point f to i for head 1 ;

m. If Z exceeds 18 scale units, proceed with point f of track adjustment procedure (4.4.3.2.). If Z is lower than 21 scale units, the track adjustment is o.k.

EXAMPLE:
$X = U_1 - U_2 = + 2$ scale units
$Y = U_3 - U_4 = - 4$ scale units
$Z = X + Y = + 2 - 4 = - 2$ scale units

4.4.3.2. TRACK ADJUSTMENT PROCEDURE

a. Load a BASF CE-mini diskette ;

b. Start the drive motor and select the mini disk drive ;

c. Select head 0 ;

d. Step to track 16 ;

e. Measure with oscilloscope :

SYNC	:	EXT. POS. TP 8 INDEX
CH 1	:	AC 100 mV uncalibrated inverted TP 1
CH 2	:	AC 100 mV uncalibrated TP 2
MODE	:	ADD
TIME BASE	:	10 msec/Div. uncalibrated

f. Loosen the mounting screws of the stepper motor and rotate body of the stepper motor until the maximum amplitude of the orientation bursts is reached ;

g. Monitor the read signal on the screen and adjust the time base of the scope until four orientation bursts are shown ;

h. Turn the variable gain potentiometer until the amplitudes of the orientation bursts reach 60 scale units ;

i. Rotate the body of the stepper motor until X and Y have the same value, but opposite sign, or both are zero ;

j. Tighten the mounting screws of the stepper motor ;

k. Recheck the adjustment. If X and Y exceed 4 scale units, readjust the stepper motor (pay attention to sign !) ;

l. For BASF 6106, perform track zero switch adjustment check ;

For BASF 6108 :

m. Select head 1 and begin with d. until f.

n. Provide points g. and h. for head 1 ;

o. Measure X + Y. It must be less than 4 scale units. Readjust, if necessary ;

p. Check the adjustment from head 0, if X + Y is lower than 10 scale units ;

q. Perform track zero switch adjustment check (4.3.3.3.).

4 - 8

4.4.3.3. ADJUSTMENT CHECK FOR OPTICAL TRACK ZERO SWITCH

a. Select mini disk drive and start drive motor ;

b. Monitor TP 6 (TRACK ZERO SWITCH) :
   SYNC   : AUTO
   CH 1   : 2 V/Div. TP 6)
   MODE   : CH 1 only
   TIME BASE : 10 msec/Div.

c. Step out to track 0 ;

d. Check space between head carriage and outer stop for 2,5 mm.
   If the space is not correct, provide track zero switch adjustment ;

e. Check if track zero switch closes (TP 6 low) between track 3 and 2 when stepping towards track zero and opens (TP 6 high) between tracks 2 and 3 when stepping from track 0 to track 4. If the track zero switch will not change within these limits, provide track zero switch adjustment.
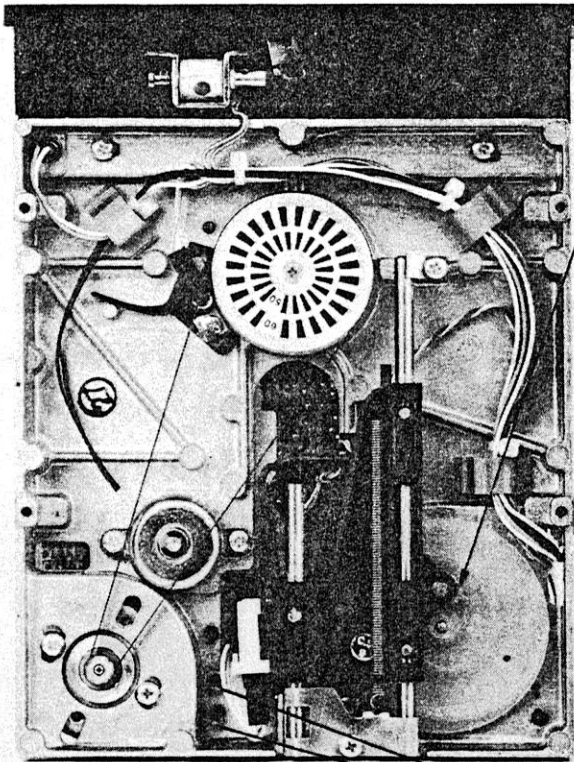
4.4.3.4. ADJUSTMENT FOR OPTICAL TRACK ZERO SWITCH

a. Load BASF flexy disk ;

b. Select mini disk drive and start drive motor ;

c. Measure with oscilloscope :
   SYNC   : AUTO
   CH 1   : 2 V/Div. ID-13 (track 00)
   CH 2   : 2 V/Div. TP 6 (Track 0-switch)
   MODE   : chopped
   TIME BASE : 10 msec/Div.

d. Step the head carriage out until the head carriage touches the outer stop ;

e. Step in until CH 1 goes high (normally one step in). Now the head carriage is positioned at track 0 ;

f. Loosen the track 0 switch and adjust it that it will close (TP 6 : high ➞ low) between tracks 3 and 2 when the head carriage is moved towards track 0 and will open (TP 6 : low ➞ high) between tracks 2 and 3 when the head carriage is stepped from track 0 to track 4.
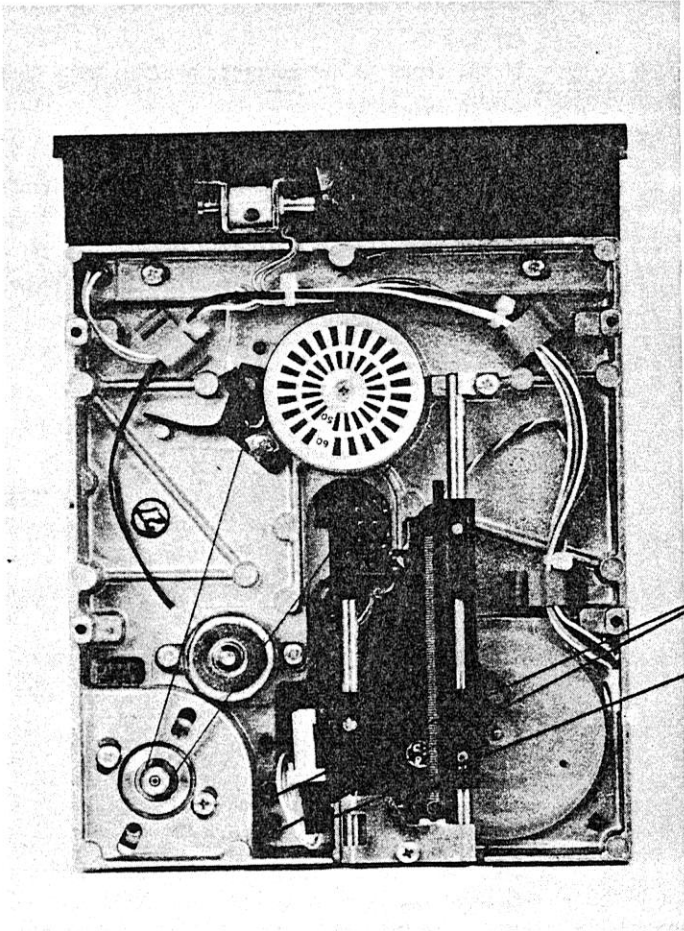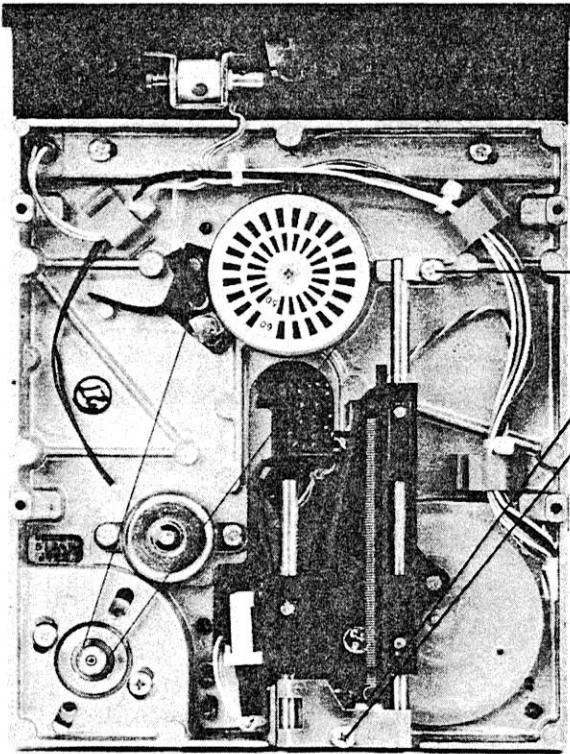
4.4.3.5. TRACK ZERO SWITCH REPLACEMENT

Optical track zero switch :

a. Turn off all DC input power ;

b. Remove PCB ;

c. Remove holding screws of the track zero switch ;

d. Disconnect the track zero switch ;

e. Connect the new track zero switch ;

f. Install the new track zero switch and the PCB ;

g. Provide the track zero switch adjustment.

4.4.3.6. HEAD CARRIAGE REPLACEMENT

a. Remove mini disk drive from mounting and place it on a clean working surface ;

b. Disconnect P 2.1 (2.2) ;

c. Disengage the spring ;

d. Loosen the two holding screws and take out the carriage with the guide bars carefully ;

e. Pull out the guide bars from the R/W head carriage ;

f. To reinstall the new head carriage, reverse the above procedure ;

   CAUTION : Handle spring carefully during reinstallation

g. Provide the track adjustment accordingly (4.4.3.2.) ;

h. Check the track zero switch adjustment (4.4.3.3.).
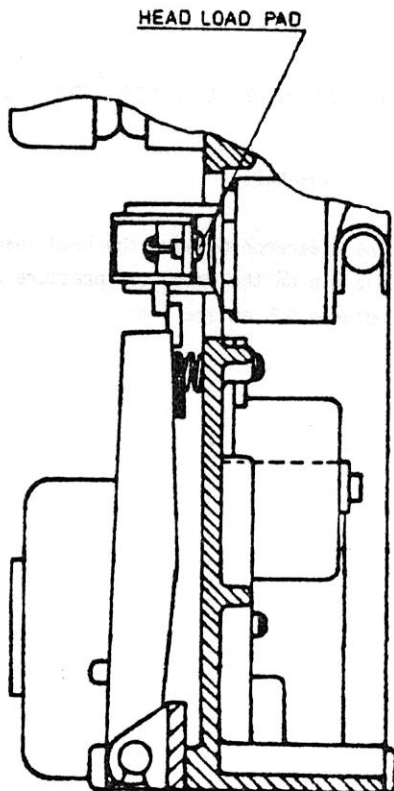
4.4.3.7. HEAD LOAD PAD REPLACEMENT
   (BASF 6106 ONLY !)

a. Remove the PCB (4.3.1.) ;

b. Remove the old head load pad ;

c. Install the new head load pad ;

d. Install the PCB ;

e. Check the jitter adjustment (4.4.5.1.) ;

f. Index adjustment.
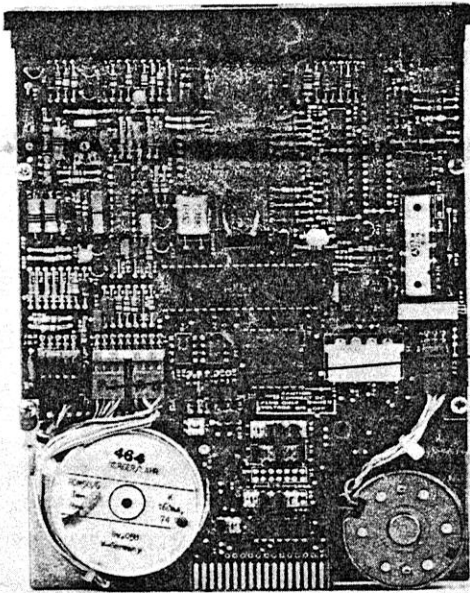
HEAD LOAD PAD

4.4.4. HEAD LOAD MECHANISM

4.4.4.1. HEAD LOAD SONELOID REPLACEMENT

a. Remove mini disk drive from mounting and place it on a clean working surface ;

b. Extract wires 1 and 3 from connector P3 ;

c. Loosen the two holding screws and remove the head load solenoid ;

d. To reinstall the head load solenoid, reverse the above ;

e. Check the airgap between head load actuator and the pin on the head load pressure arm for 0.3 to 1 mm.
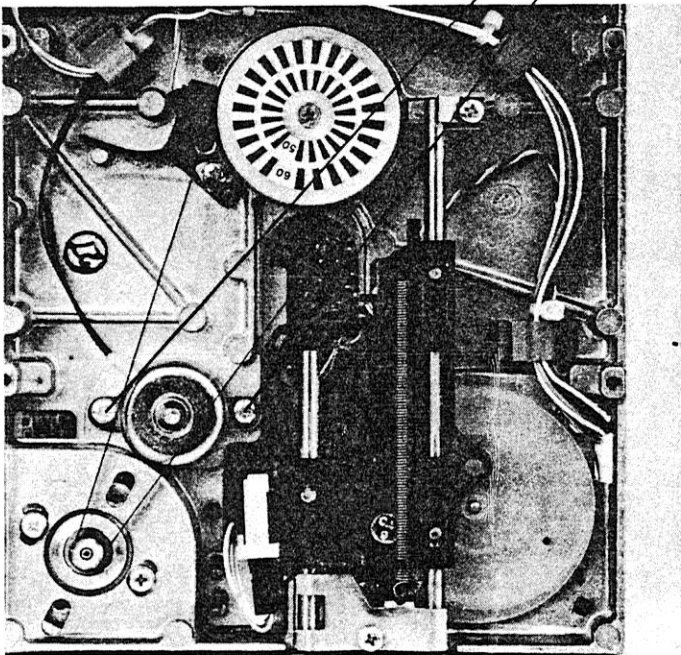
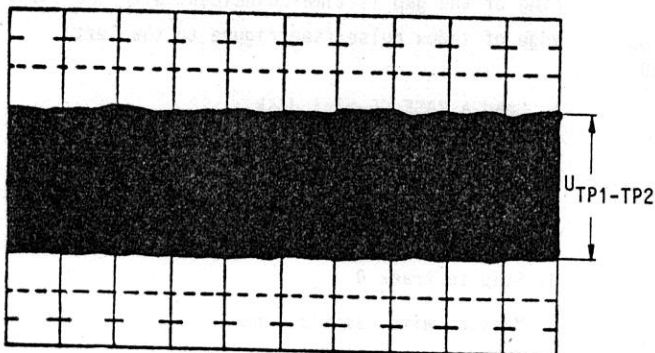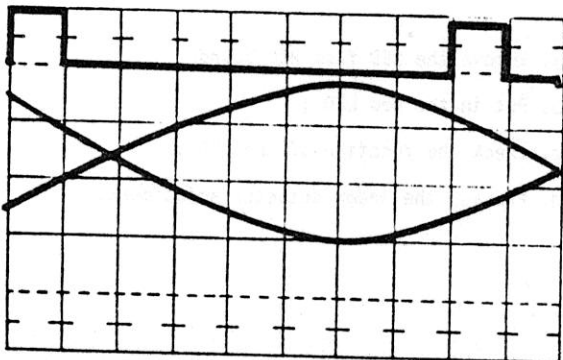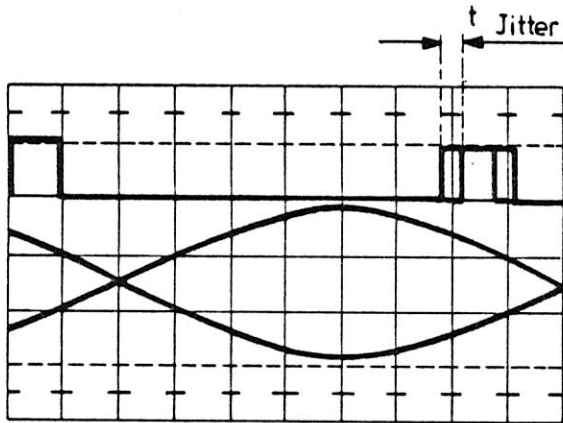

4.4.4.2. HEAD LOAD ACTUATOR CHECK

a. Load the head ;

b. The clearance between the head load actuator and the pin on the head load pressure arm should be between 0.3 mm and 1 mm.

t Jitter

$U_{TP1-TP2}$

4.4.5. READ/WRITE ELECTRONICS

4.4.5.1. JITTER CHECK AND ADJUSTMENT

a. Load a BASF flexy disk ;

b. Turn on drive motor ;

c. Step to track 39 ;

d. Write all FM-ZEROS (1F) for BASF 6106 (head 0),
   for BASF 6108 (head 0 and 1) ;

e. Measure with oscilloscope :

```
SYNC    : INT.     POS.     CH 1
CH 1    : DC       2V/Div.  TP 5 READDATA
CH 2    : AC       50 mV/Div.TP 1
TRIGGER : Read data
```

f. Trigger oscilloscope, that the read data signal
   "cateyes" are displayed ;

g. Measure jitter. If jitter of head 0 or head 1
   (track 39, 1F) is $>$ 500 ns, adjust pot R 69 ;

   - for minimum jitter at BASF 6106

   - for best compromise between jitter of head 0
     and head 1 for BASF 6108.

4.4.5.2. READ AMPLITUDE CHECK

a. Load a BASF flexy disk ;

b. Turn on drive motor ;

c. Step to track 39 ;

d. Select head 0 ;

e. Write all "ones" ;

f. Measure with oscilloscope :

```
SYNC    : EXT. POS. TP 8 INDEX
CH 1    : AC 50 mV/Div. inverted TP 1
CH 2    : AC 50 mV/Div. TP 2
MODE    : ADD
TIME BASE: 20 msec/Div.
```

g. Check the measured read voltage at TP 1-TP 2 for
   the following limits :

$$U_{TP1-2} \geqslant 70 \text{ mVpp}$$

Continue for BASF 6108 !

h. Select head 1 ;

i. Write all "ones" ;

j. Check the measured read voltage at TP1-TP2 for
   the following limits :

   head 0 $U_{TP1-2} \geqslant 70$ mVpp

   head 1 $U_{TP1-2} \geqslant 70$ mVpp

4.4.6. PHOTO TRANSISTORS AND LED'S

4.4.6.1. PHOTO TRANSISTOR REPLACEMENT

a. Disconnect plug of defective photo transistor ;

b. Remove photo transistor ;

c. Insert new photo transistor ;

d. Reconnect plug ;

e. Check the function of the photo transistor ;

f. Provide the index detector adjustment, if the index
   photo transistor has been changed.

4.4.6.2. LED REPLACEMENT

a. Remove the LED from PCB board ;

b. Put in the new LED ;

c. Check the function of the LED ;

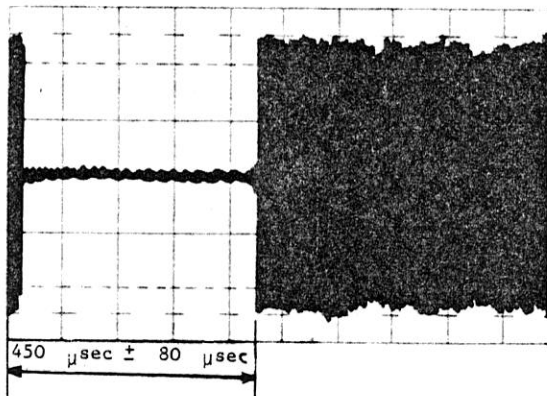d. Provide the index detector adjustment.

4.4.6.3. INDEX DETECTOR ADJUSTMENT CHECK
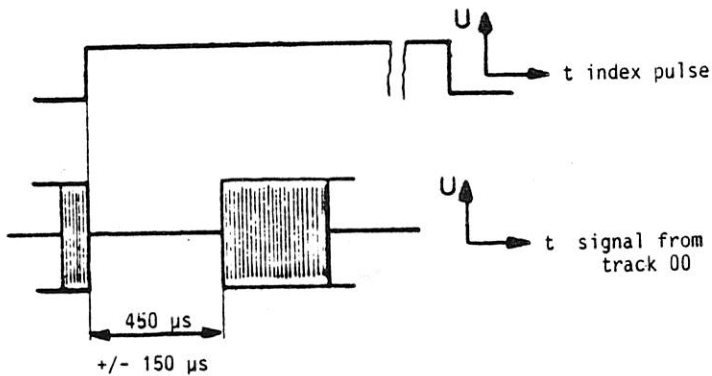
The tracks 00 are prewritten with 1F containing an in-
dex alignment gap at the beginning of track.

The index sensor is aligned properly when the begin-
ning of the gap is time-coincident with the leading
edge of index pulse (see figure to the left).

a. Load a BASF CE-mini disk ;

b. Select head 0 ;

c. Start the drive motor and select the mini disk
   drive ;

d. Step to track 0 ;

e. Measure with oscilloscope :

```
SYNC      :  INT. POS. CH 1
CH 1      :  DC 2V inverted TP 8 (index)
CH 2      :  AC 100 mV TP 1 (read data)
TIME BASE:  100 µsec/Div.
```

f. Check the timing between start of the sweep and the
   data burst for 450 µsec +/- 150 µsec ;

g. Provide the index detector adjustment (4.4.6.4.)
   if necessary.

U → t index pulse

U → t signal from track 00

450 µs
+/- 150 µs

450 μsec ± 80 μsec

4.4.6.4. INDEX DETECTOR ADJUSTMENT

a. Load a BASF CE flexy disk ;

b. Start the drive motor and select the mini disk drive ;

c. Step·to track 0 ;

d. Measure with oscilloscope :

SYNC	: EXT.POS. TP8 INDEX
CH 1	: AC 50 mV inverted TP 1
CH 2	: AC 50 mV
MODE	: 100 μsec/div.
TIME BASE :	100 μsec/div.
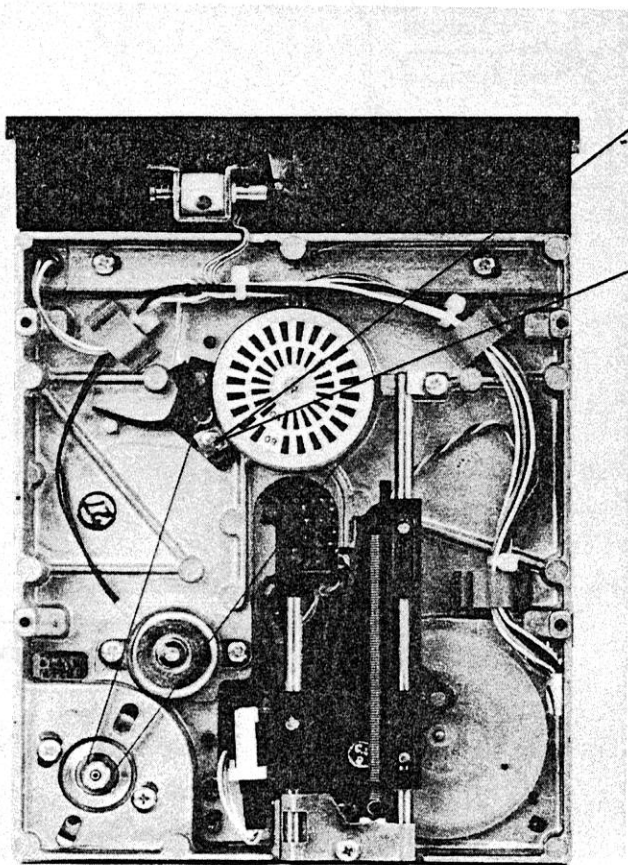
e. Loosen the set screw of the index holder ;

f. Adjust the time delay between start of the sweep and the data burst to 450 μsec +/- 80 μsec ;

g. Tighten the index holder set screw.
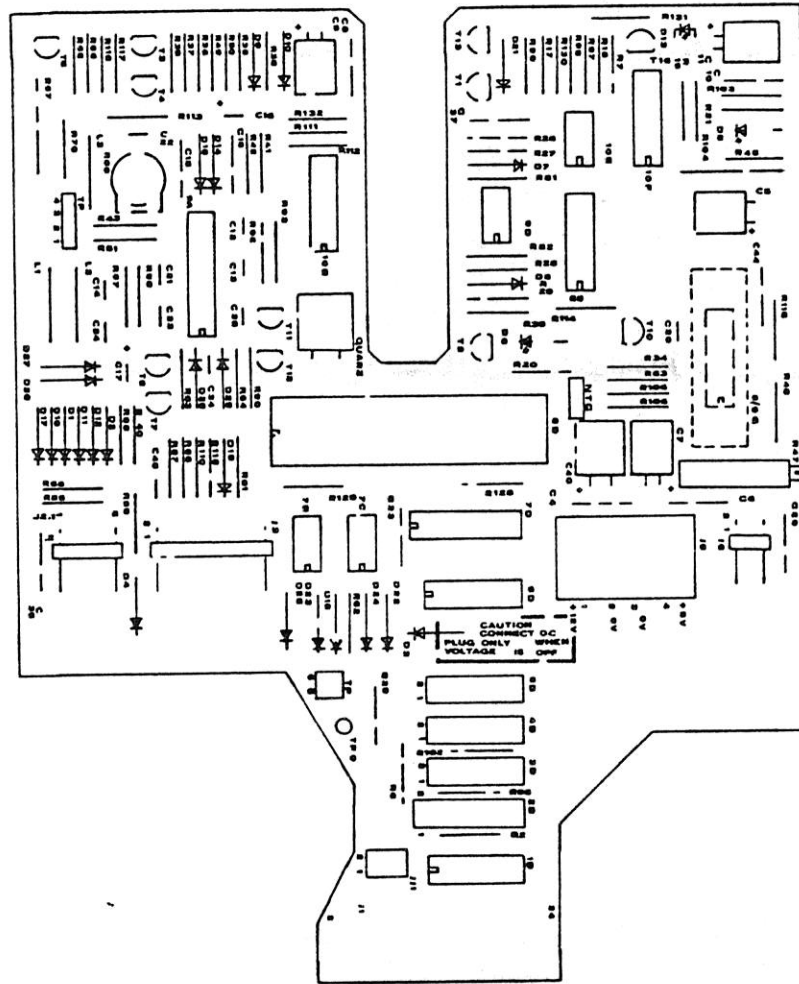
POTI	FUNCTION
R 47	Drive motor adjust
R 69	Jitter adjust

CONNECTOR		FUNCTION
J 1		Signal - Interface
J 2		Read/write - head(s)
J 3	1, 3	Head load solenoid
	2, 4	Door lock solenoid
	5, 6	Write protect phototransistor
	7, 8	Index phototransistor
	11, 18	Stepper motor
J 5		DC - connector
J 6	2, 4	Drive motor
	3,5,6,7	Track zero optical switch

TEST POINTS	SIGNAL
TP 1, 2	Read signal (differentiator input)
TP 3	GND
TP 4	Jitter voltage
TP 5	Read data
TP 6	GND
TP 7	GND
TP 8	Index
TP 9	GND