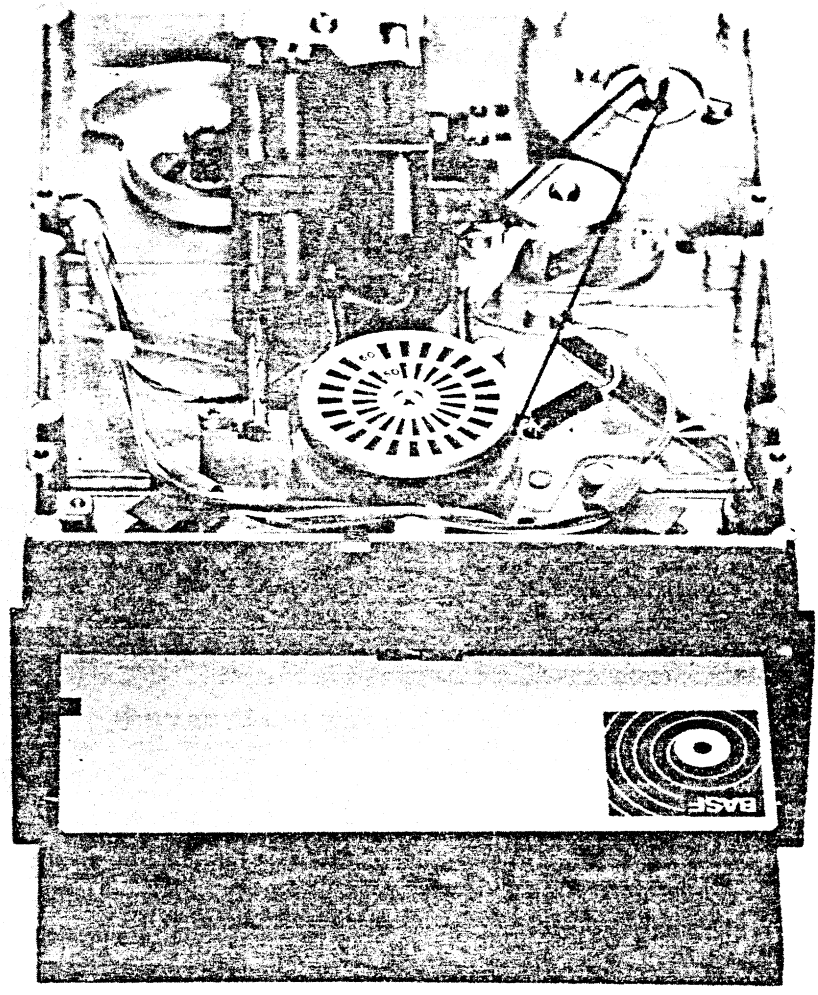
BASF Aktiengesellschaft

BASF 6106
MINI DISK DRIVE

PRODUCT AND INTERFACE SPECIFICATION



VMT/EG
VMD/VS

SPEC. 80308-038
Rev. 8
December 1978
PAGES: 33

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F.C.A. Green
Ambachtsweg 17
2241 EV Wateringen

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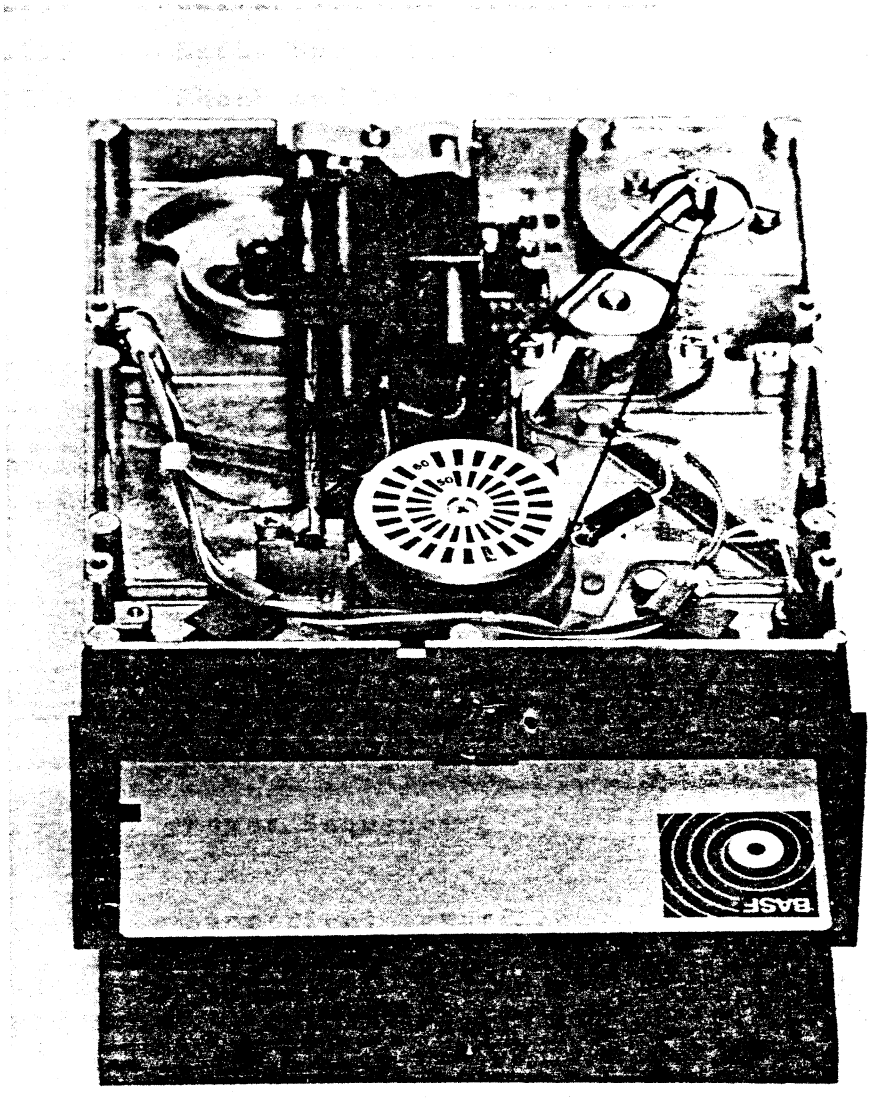

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1. INTRODUCTION

1.1 General Description

The BASF 6106 Mini Disk Drive is a very small, high performance, compact low cost floppy disk drive. The BASF 6106 is intended for the calculator, desk-top computer, point of sale terminal and word processing market.
In most applications the BASF 6106 is an excellent alternative to paper tape, magnetic tape cassettes and magnetic card devices offering a more powerful, more reliable solution while being competitive in size and cost.

1.2 Specification Summary

1.2.1 Performance Specifications

Capacity (unformatted)	
per disk	125.000 bytes
per track	3.125 bytes
transfer-rate	125 kilobits/sec
latency (average)	100 msec
Positioning time:	
track to track	12 msec
average	240 msec
head settling time	max. 48 msec
head load time	max. 35 msec
drive motor start time	max. 650 msec

1.2.2 Functional Specifications

rotational speed	300 rpm ± 2,5 %
recording density (inside track)	2768 bpi
flux density	5536 fci
track density	48 tpi
tracks	40
track radius (outside)	57,15 mm = 2.25 inch
(inside)	36,51 mm = 1.437 inch
data sectors:	
softsectoring	9 or 16 sectors recommended
hardsectoring	10 or 16 sectors
index	1
encoding method	FM
media requirements	BASF Flexydisk 5.25 or equivalent

1.2.3 Physical Specifications

Environmental limits

ambient temperature (operation) = 10° to 50°C (50° to 120°F)
Shipping condition = - 40° to 62°C (- 40° to 143°F)
Storage conditon = - 22° to 55°C (- 4° to 131°F)
Relative humidity = 20 % to 80 %
Maximum wet bulb = 29°C (84°F)

Power Requirements:

+ 5 V ± 5 %, 50 mVpp Ripple, .5 A
+ 12 V ± 5 %, 100 mVpp Ripple, .7 A (with Doorlock)

12 V Power Distribution	Additional	Total
Standby	.10 A	.10 A
Stepper Motor on	.25 A	.35 A
Drive Motor on	.05 A	.40 A
Head Load	.20 A	.60 A
Doorlock (optional)	.10 A	.70 A
Total, incl. Doorlock	.70 A	.70 A

Drive Motor start current does not exceed 1,4 A, typical 1,2 A for 50 ms.
Headload start current .7 A for 50 ms.

Mechanical dimensions:

Width = 146,1 mm (5,75 in.)
Height = 53,5 mm (2,11 in.)
Depth = 196,5 mm (7,74 in.)
Weight = 1,4 kg
Power dissipation: 10 watts operating
4,0 watts stand by (motor off)
7,5 watts motor-on and deselect

1.2.4 Reliability Specifications

MTBF:	8000 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

1.2.5 Media Specifications

BASF Flexydisk 5.25 or equivalent

Jacket:	133.4 mm (5.25 in.) square
Disk:	130.2 mm (5.125 in.) diameter
Center hole:	28.575 mm (1.125 in.)

1.2.6 Shock and Vibration

a) Operating - The drive as normally installed and positioned shall meet the full specified performance while subject to the following conditions injected in the three major mutually perpendicular axes.

Vibration: 1 g acceleration 5 - 100 Hz

b) Shipping (as packed by factory) - The drive shall withstand the conditions of vibration injected in the three major mutually perpendicular axes for:

Vibration: 2 g acceleration 5 - 100 Hz

Free fall of 0.5 m (20 inches) as packed by factory will not cause any damage to the drive.

+) Duty cycle of Spindle Drive Motor to be 25 % of POH

2. FUNCTIONAL CHARACTERISTICS

2.1 General Operation

The BASF 6106 Mini Disk Drive consists of read/write and control electronics, drive mechanism, read/write head, track positioning mechanism. These components perform the following functions:

Interpret and generate control signals
Move read/write head to the selected track
Read and write data
Rotate disk

A block diagram for the interface signals for the internal functions of the BASF 6106 is shown in fig. 2.1.

The head positioning actuator positions the read/write head to the desired track on the disk. The head load actuator loads the disk against the read/write head and data may then be recorded onto or read from the disk.

2.2 Read/write and Control Electronics

The electronic is packed on one PCB. This logic board is located on the upper side of the drive.

The logic PCB contains:

- select logic
- index/sector detector circuit
- positioning control logic
- head load driver
- write protect logic
- track 00 logic
- drive motor control
- ready logic
- software interlock logic
- read chain with comparator
- write chain

The connection to the host system is via two connectors on the logic PCB.

Blockdiagram BASF 6106

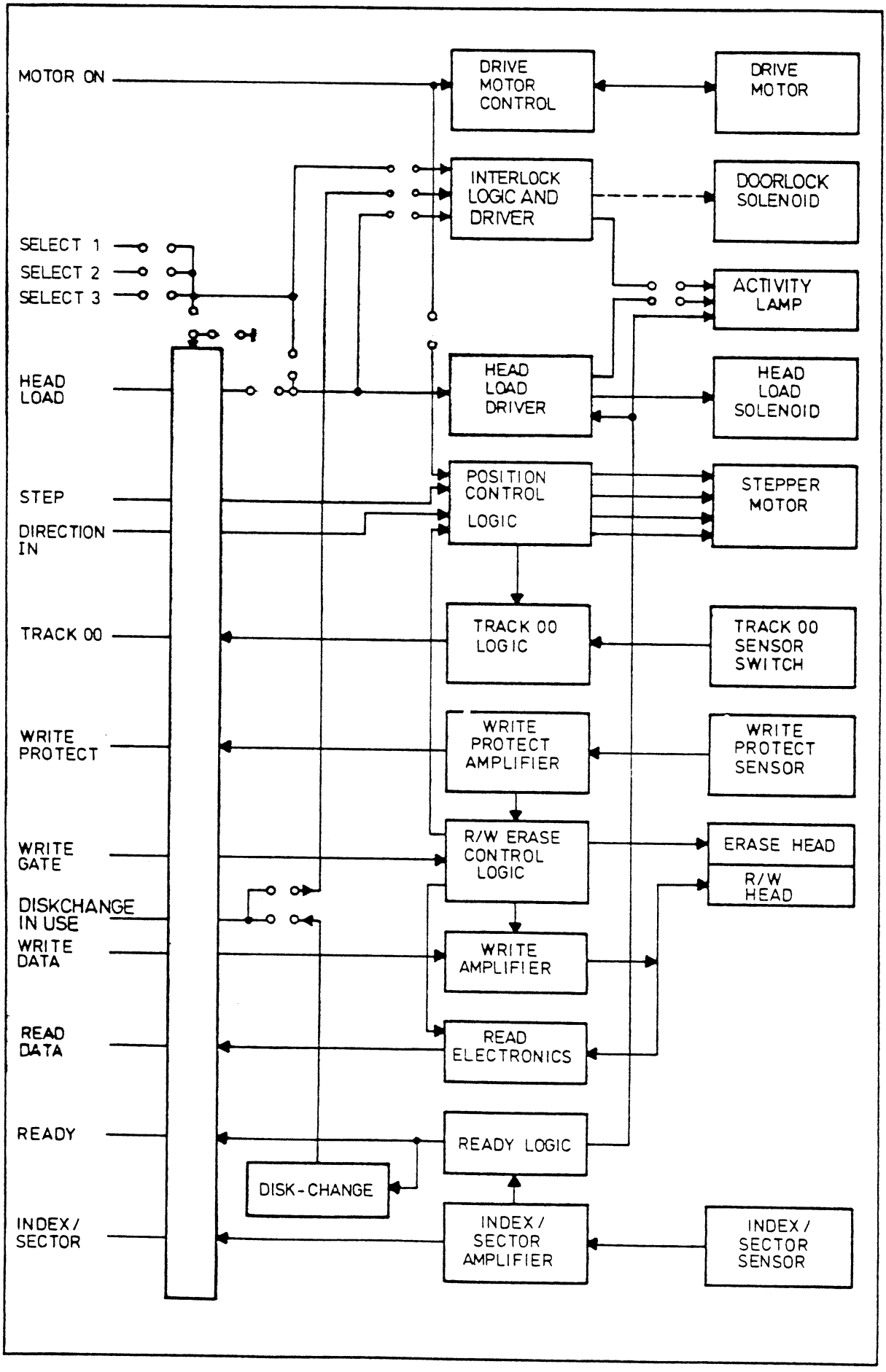


Figure 2.1

2.3 Drive Mechansim

The DC drive motor rotates the spindle at 300 rpm ± 2,5 % through a belt-driven system. A centering cone that moves in conjunction with the front door fixes the minidisk to the spindle.

2.4 Positioning Mechanism

The carriage will be positioned by moving an attached ball-bearing over a spiral disk. The stepping motor rotates the spiral disk clockwise or counterclockwise in increments. Each step pulse on the interface causes the head to be positioned to an adjacent track position.

2.5 Read/Write Head

The BASF 6106 has a single gap ceramic read/write head with tunnel erase elements to provide erased areas between data tracks. Thus normal interchange tolerances between media and drives will not degrade the signal to noise ratio and insures mini disk interchangeability.

The read/write head is mounted on a carriage which is moved by the head position actuator. The disk is held in a fixed position to the read/write head by two guide ways. These guide ways together with a reference plate on the casting assures accurate compliance with the read/write head. The minidisk is loaded against the head with a load pad actuated by the head load solenoid to accomplish data transfer.

The head surface has been designed to obtain maximum signal transfer to and from the magnetic surface with minimum wear.

2.6 Door-Interlock

This feature allows to control by software if a Flexy Disk may be removed or not. A signal from the host system activates a solenoid and locks the front door. The front door can not be opened and this prevents to remove the Flexy Disk errouneously. Depending on jumper conditions the door-lock can be controlled by the interface signals:

In Use, Select, Head Load.

2.7 Activity-LED

An activity LED behind a lens in the front door may be used to indicate to the user certain operating conditions of the drive. It can be activated by one or a combination of the following interface signals depending of the jumper connections:
In Use, Select, Head Load, in connection with the internal Ready signal.

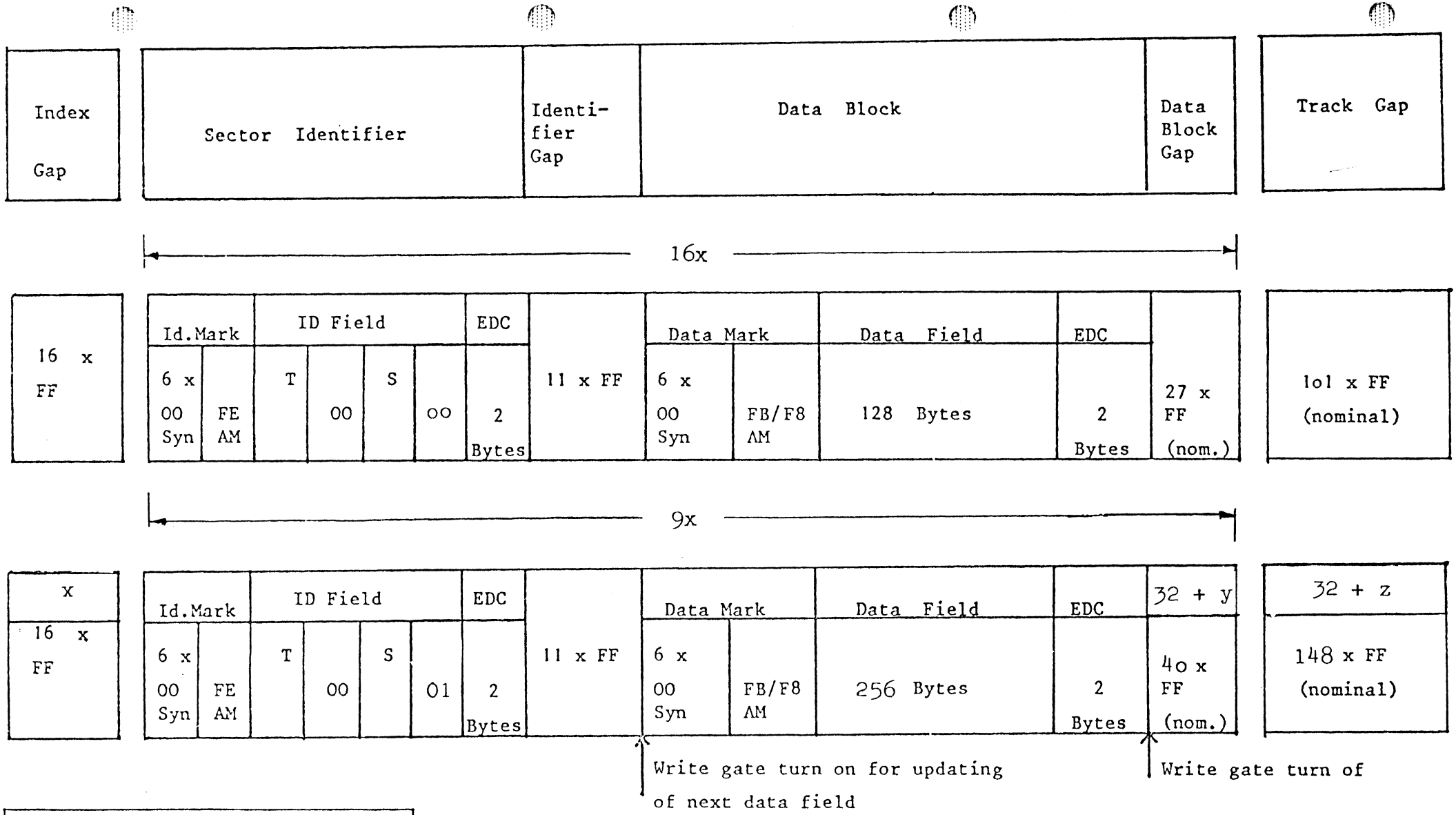
2.8 Recording Format

The BASF 6106 can handle hard- or soft-sectored Flexydisks. The data organization on the disk is totally a function of the host system and can be designed as it is necessary for the user's application.

Recommended soft sectoring is either 16 sectors with 128 Bytes or 9 sectors with 256 Bytes.

The format for 16 sectors with 128 Bytes and 9 sectors with 256 Bytes are shown in fig. 2.6.

The handling of invalid sectors has not yet been defined. The ECMA-Standard (Draft) includes at this moment the soft-sectored version with 9 sectors, 256 Bytes each.
Detail information of track format (IBM type) refer page 9.



$$x + \sum(y_1 + \ldots + y_9) + z = 2o4$$

T = Trackaddress (00 - 27) hex. (= 0 - 39 dec.) 1 Byte
S = Sectoraddress (01 - 10) hex. (= 1 - 16 dec.) 1 Byte
A = FB Data valid
AM = F8 Data deleted
EDC = Error detection code (2Bytes)

Figure 2.6 recommended RECORDING FORMAT 16 SECTORS and 9 SECTORS (SOFT)

2.8.1 Track Format, 9x256 Bytes, softsectored

Index Gap:

This gap is normally 16 Bytes of FF in length and the length is not affected by a possible overwriting process.

Identifier Gap:

11 Bytes of FF between the ID-field and the data field. This gap may vary slightly in length and become ill defined after data field has been updated.

The data block gap:

The 40 Bytes of FF between the data field and the next ID-Mark is defined as data block gap. The data gap may vary slightly in length and may become ill defined when the data field has been updated.

Track Gap:

The 148 Bytes of FF between the last data block gap on a track and the index gap is defined as track gap. Initially this gap consists of nominally 148 Bytes, however due to write frequency tolerances and disc speed tolerances this gap may vary slightly in length.

Address Marks (AM):

Address marks are unique bit patterns one byte in length which are used in this recommended recording format to identify the beginning of ID and data fields and to synchronize the deserializing circuitry with the first byte of each field. AM-bytes are unique from other data bytes in that they do not contain all clock bits (3 missing). There are three different types of AM's used. Each of these is used to identify different types of fields.

Typ I: ID-Address-Mark written Data bits = FE (hex)
written Clock bits = C7 (hex)

Typ II: Data Address Mark written Data bits = FB (hex)
written Clock bits = C7 (hex)

Typ III: Deleted Data Address Mark written Data bits = F8 (hex)
written Clock bits = C7 (hex)

Sync. Field

The Sync. field is used to synchronize the phase lock loop circuit.

EDC Gap (CRC):

To each field written on the diskette two EDC bytes are added. These two EDC bytes are hardware generated by shifting serially the relevant bits through a 16-bit shift register described by the generator polynomial:

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

2.8.2 Read/Write Errors

To guard against degradation from imperfections in the media, it is recommended that no more than 4 attempts to write a record be used when read after write errors are encountered. In the event a record cannot be successfully written within 4 attempts, it is recommended that the sector or track will be labelled as defective and an alternate sector or track assigned. If more than 2 defective tracks are encountered, it is recommended that the disk be replaced.

In the event of a read error, up to 10 attempts should be made to recover with re-reads. If after 10 attempts the data has not been recovered, unload and load the head, then step the head several tracks away and re-position to recover the data. If the error persists, the sequence should be attempted at least 10 times.

Unloading the head when data transfers are not imminent will increase the data reliability and extend the disk life.

The recoverable read error rate is one in 10^8 bits.
The unrecoverable read error rate is one in 10^{11} bits.

2.8.3 Seek Errors

Seek errors will rarely occur unless the stepping rate is exceeded. In the event of a seek error, recalibration of track location can be achieved by repetitive Step-Out commands until a Track 00 signal is received. The access mechanism positioning error rate shall be less than one position error per 10^6 seek operations.

2.9 Power Sequenzing

Power-up and Power-down can be done in any sequence. An internal DC-control-logic will prevent any erroneous writing during Power-up or down. At the interface, Write-Gate must be kept high during Power-sequenzing.

3. ELECTRICAL INTERFACE

The interface of the BASF 6106 can be divided into two basic parts:

1. signal
2. power

The following sections provide the electrical definition for each line.
Reference fig. 3.0 for all interface connections.
Reference fig. 3.2 on page 24 for timing.

3.1 Signal Interface

The signal interface is either daisy-chained or radial. Up to 3 BASF 6106's can be connected.
In case of a radial connection all drives are terminated. In case of daisy-chained connection only the last drive is terminated.

The resistor chip on the logic PCB close to the connector J 1 is provided for termination. This chip can be removed.

Without the resistor chip no termination except for the select line is provided.

Signals consist of two categories:

1. Control Status
2. Data Transfer

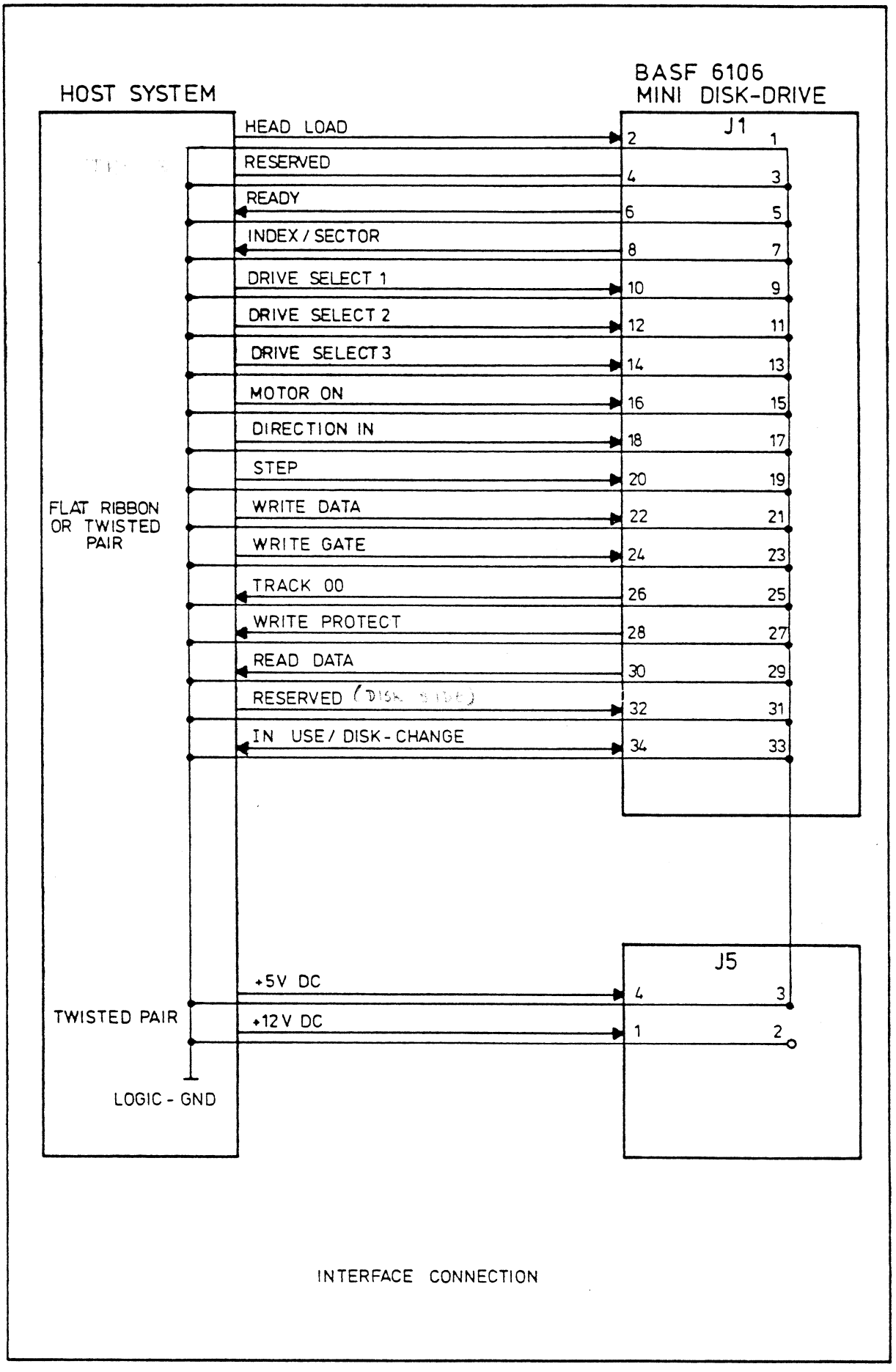
All lines in the signal interface either provide signals to the drive (input), or provide signals to the host (output), via interface connector P1/J1.

The pin assignments for Interface Connector P1 are:

Ground Return Pin	Signal Pin Pin	Signal
1	2	Headload
3	4	Reserved
5	6	Ready
7	8	Index
9	10	Select 1
11	12	Select 2
13	14	Select 3
15	16	Motor On
17	18	Direction In
19	20	Step
21	22	Write Data
23	24	Write Gate
25	26	Track 00
27	28	Write Protect
29	30	Read Data
31	32	Reserved
33	34	In Use / Disk Change

The pin assignments for the DC-power connector P 5 are:

Pin	Name
1	+ 12 V DC
2	+ 12 V Ground
3	+ 5 V Ground
4	+ 5 V DC



INTERFACE CONNECTION

Figure 3.0

3.1.1 Input Lines

There are 10 signal input lines in the basic unit interface. The recommended circuit is:

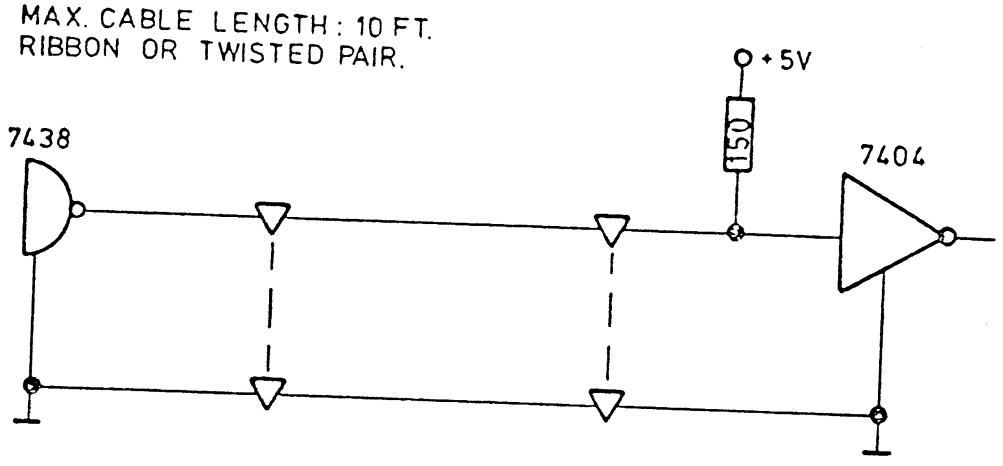


Fig. 3.1.1 Control signal driver/receiver

The specification for the signal interface is:

Logical Zero = 0.0 V to 0.4 V (active state)
Logical One = + 2.5 V to 5.25 V (inactive state)

3.1.1.1 Select 1-3

Drive selection activates a particular drive on the daisy-chain interface. Only the activated drive will respond to the input lines and gate the output lines.

Three separate input lines, Select 1, Select 2 and Select 3, are provided so that up to three drives may be daisy-chained in a system.

A jumper on the logic PCB (close to the connector J 1) defines whether Select 1, 2 or 3 is connected. Standard Drives from production are jumpered to Select 1 if not otherwise ordered.

The Select line is normally connected with the Head Load, i.e. the activating of selection loads and the deselection unloads the R/W-head.
In changing a jumper the head load function can be made independent from selection. In this case the loading and unloading is a function of the status of the signal line Head Load.
In systems with a single drive a special select mode can be chosen by changing a jumper. In this case the drive is always selected and the select line may then be used for head loading.

See Jumper options, Figure 3.1.3 (P. 23)

3.1.1.2 Motor On

This input when activated to a logical zero level, will turn on the drive motor and the stepper motor. Reading or writing are not permitted before the Ready-Line becomes active. For hard-sectoring an additional delay of 500 ms is required before Ready is valid. In addition a recalibrate function (positioning onto track 00) must be performed to obtain correct head positioning.
Control of the stepper motor by Motor On may be disabled by removing a jumper.
This avoids recalibrating after switching on the motor. The Motor-On-Line is not gated with select. The motor will not be switched off, when the drive is deselected.

3.1.1.3 Direction In

This interface line is a control signal which defines direction of motion the read/write head will take when the step line is pulsed. An open circuit or logical one defines the direction as "out" and if a pulse is applied to the Step line the read/write head will move away from the center of the disk. Conversely, if this input is connected to ground or to logical zero level, the direction of motion is defined as "in" and if a pulse is applied to the Step line, the read/write head will move towards the center of the disk.

3.1.1.4 Step

This interface line is a control signal which causes the read/write head to move with the direction of motion as defined by the Direction-In line. This signal must be a logical zero going pulse. The nominal step rate is 12 msec. The access motion is initiated on each logical zero to logical one transition, or the trailing edge of the signal pulse. Any change in the Direction-In line must be made at least 1 µs before the trailing edge of the Step pulse. Stepping will be inhibited if the write gate signal is at logical zero level.

3.1.1.5 Write Gate

The active state of this signal, or logical zero, enables Write-Data to be written on the disk. If the disk is Write Protected, the writing is internally inhibited. The inactive state, or logical one enables the read data logic (Read Data). Write Gate will activate internally erase, and erase will stay enabeled up to 1050 µs after Write Gate was turned off.

3.1.1.6 Write Data

This interface line provides the data to be written on the disk. Each transition from a logical one to logical zero will cause the current through the read/write head to be reversed thereby generating a flux change. This line is enabled within the drive by Write Gate being active. No pulses should be on the Write Data line, when the drive is reading.

3.1.1.7 In Use

This signal will control the door-lock solenoid and the activity LED. Depending on the jumper connections, two modes of operation are possible:

a) As long as this line is kept continuously at a zero level the door-lock solenoid is activated and the Flexy Disk cannot be removed.
b) A zero level on this line will be set with Select into a latch and this latch activates the door-lock. A high level will in conjunction with Select reset the latch and release the door-lock.

The installation of the In Use option disables the Disk-change option.

3.1.1.8 Head Load

A logical zero on this line loads the head. A transition back to logical one unloads the head. This allows the loading and unloading of the head separately from the selection. Depending of jumper settings, the head can be loaded with Head-Load, Head-Load and Select or with Select only. The head is loaded only when the drive is ready and will unload when the ready signal disappears.

3.1.2 Output Lines

There are five output control lines. Refer to figure 3.1.1 for the recommended circuit.

Logical zero = 0.0 V to + 0.4 V
Logical one = +2.5 V to 5.25 V

3.1.2.1 Ready

The Ready line will be at a logical zero when power is on, a disk is inserted and is rotating correctly. A logical one is the indication that either no disk is inserted are not rotating or a failure within the drive (no Index) exist.

3.1.2.2 Track 00

This signal is a logical zero when the drive read/write head is physically positioned at track zero (the most outer track) and the motor Control-circuitry is driving current through phase A and C of the stepper motor. Being at track 00 and issueing a step out the track 00 signal will go logical one, even though a mechanical stop keeps the head over track zero. Because the four-phase stepper is in a wrong phase, there are three more steps out necessary to put the stepper back in the proper phase (phase A and C) and to get the Track 00 signal logical zero.

This signal is at logical one when the selected drives read/write head is not on track 00.

3.1.2.3 Index

This interface signal is provided by the drive for each sector or index hole which appears under the sector/index photo detection transducer. Normally this signal is logical one and makes the transition to the logical zero level for a period of approx. 2 ms for each hole.
One hole indicates the beginning of a track for a soft sectored disk.

To indicate the beginning of the track with hardsectoring, once per revolution there is one index transition centered between sixteen equally spaced sector transitions. The timing of this signal is shown in figure 3.1.2.2.
The index signal remains logical zero if no disk is inserted.

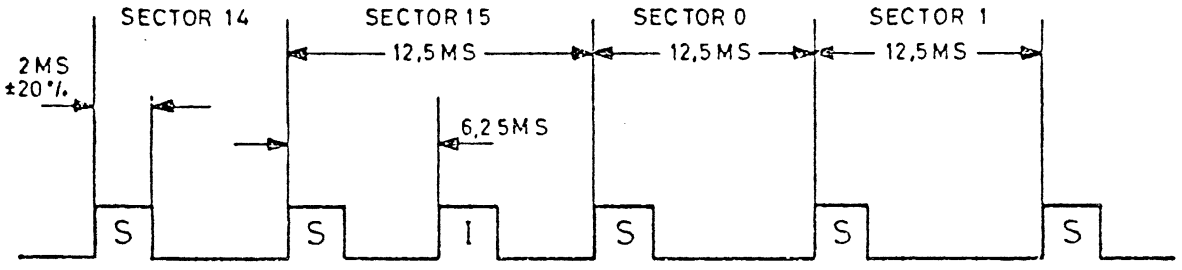


Fig. 3.1.2.2 Index/Sector Timing (Hard sectored disk)

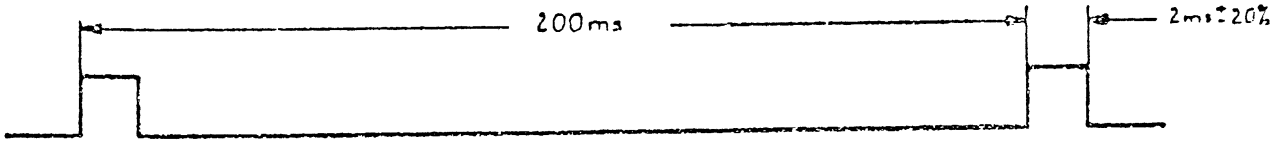


Fig. 3.1.2.3 Index Timing (Soft sectored disk)

3.1.2.4 Read Data

This interface line provides the "raw data" (clock and data together) as detected by the drive's read electronics. Normally, this signal is logical one and becomes logical zero for every flux transition detected on the medium.
Figure 3.1.2.3 represents bit timing for FM.

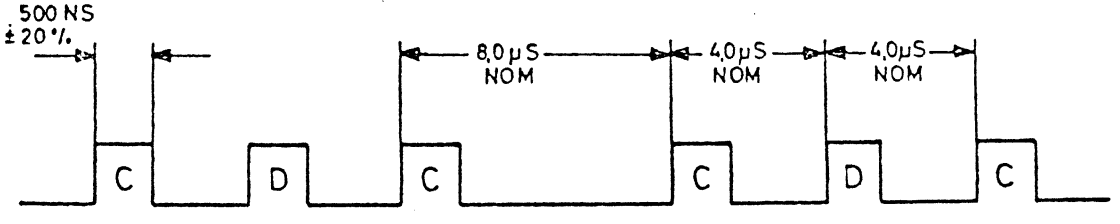


Figure 3.1.2.3 Read Data

3.1.2.5 Write Protect

This interface signal is provided by the drive to give the user an indication when a write protected Flexy-Disk is installed. The signal is at logical zero when the Flexy-Disk is protected. The drive will inhibit writing with a protected diskette installed.

The write protect notch in the jacket must be covered by a non-transparent label to protect the Flexy-Disk against writing. By changing jumpers on the PC-board, an open notch can be defined as write protected.

3.1.2.6 Disk Change

Whenever the Mini Disk is removed from the drive a disk change flip-flop is set. This flip-flop is reset by de-selecting the drive. The status of this flip-flop is given with Select on the Diskchange line. Is the line at zero level, the disk has been changed. The line will stay at zero level as long as no other disk is inserted. The installation of Disk Change disables the In Use function.

3.1.3 Jumper Options

As previously discribed, certain functions can be alternated in their performance by setting jumpers on the PC-board differently. Fig. 3.1.3 is a blockdiagram in true logic to illustrate how Headload, Activity LED, Writeprotect and the Steppermotor can be controlled by jumpers JJ1 to JJ4.

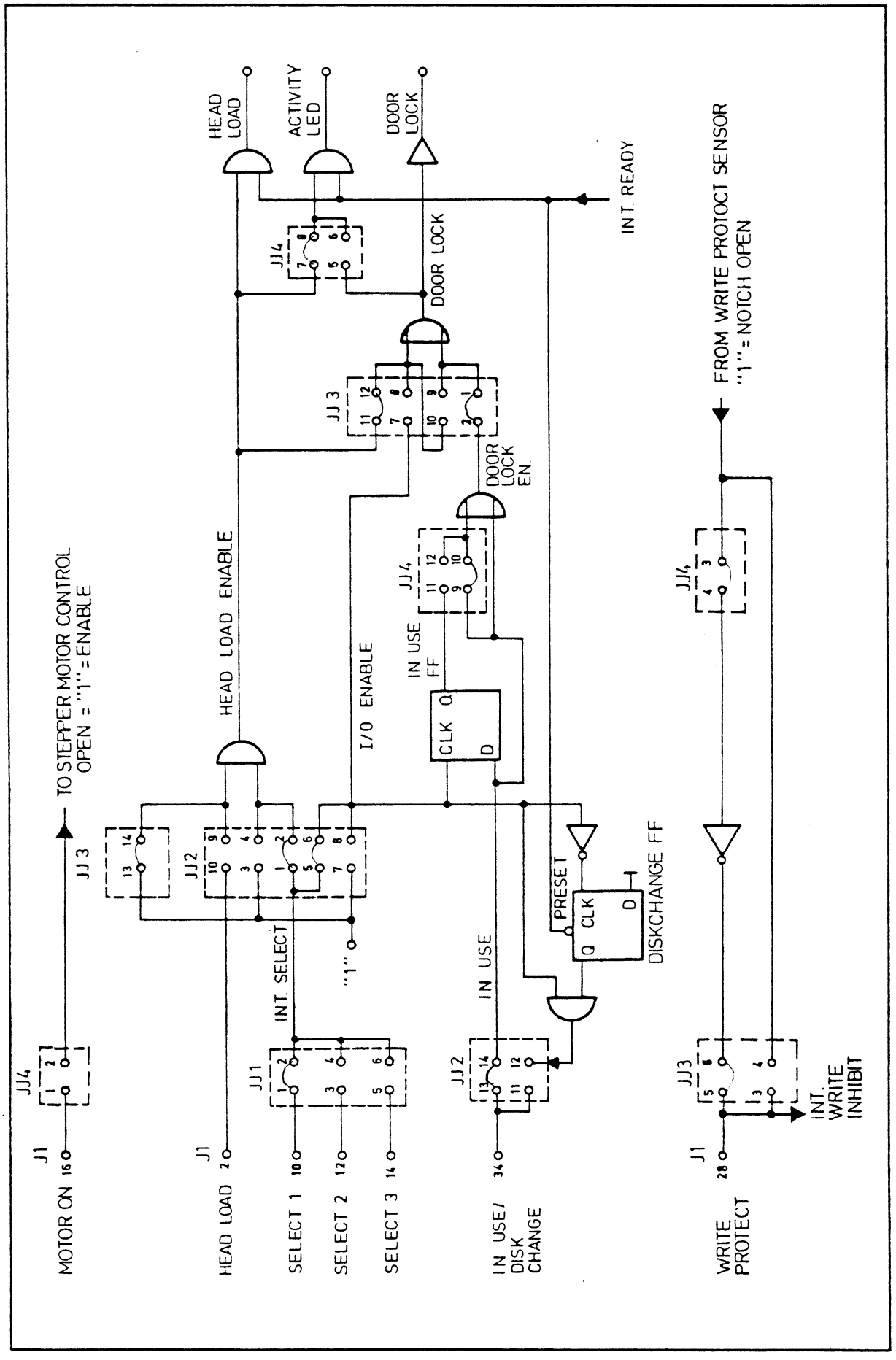
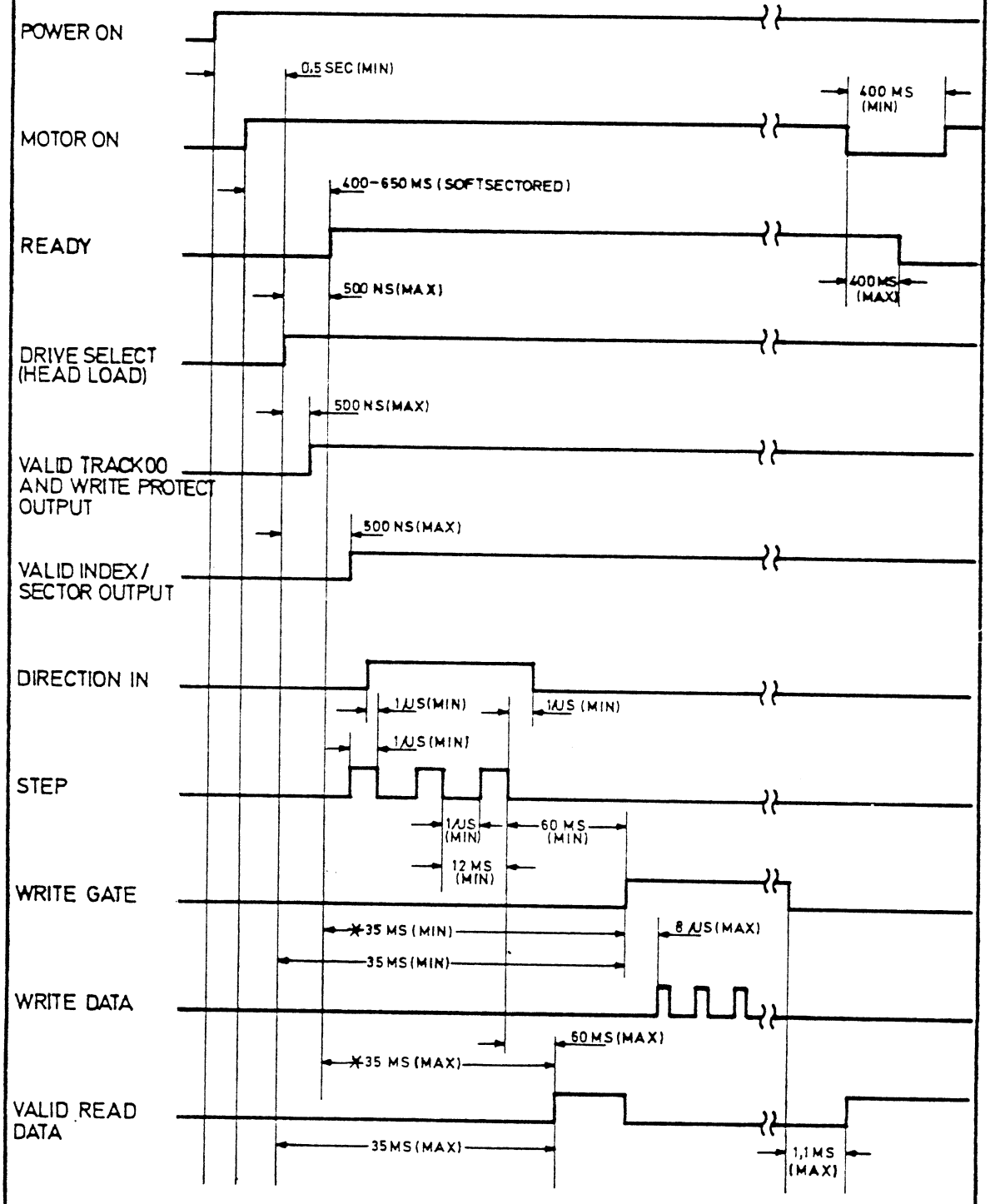

HEAD LOAD
ACTIVITY LED
DOOR LOCK
INT. READY
JJ4
DOOR LOCK
JJ 3
DOOR LOCK EN.
FROM WRITE PROTOCT SENSOR
"1" = NOTCH OPEN
TO STEPPER MOTOR CONTROL
OPEN = "1" = ENABLE
HEAD LOAD ENABLE
I/O ENABLE
IN USE FF
CLK Q
D
JJ2
JJ1
INT. SELECT
"1"
IN USE
PRESET
CLK
Q
D
DISKCHANGE FF
J1
MOTOR ON 16
HEAD LOAD 2
SELECT 1 10
SELECT 2 12
SELECT 3 14
IN USE/ DISK CHANGE 34
WRITE PROTECT 28
INT. WRITE INHIBIT

Figure 3.1.3

GENERAL CONTROL/TIMING REQUIREMENTS



NOTE: ABOVE TIMING IS SHOWN AS POSITIVE LOGIC. SIGNAL LINES AT INTERFACE ARE NEGATIVE LOGIC.

* 535 MS, WHEN USING HARD SECTORED DISKS.

BASF Aktiengesellschaft 6700 Ludwigshafen Tag _____ Name _____	Maßst.	Urheberschutz nach DIN 34

4. PHYSICAL INTERFACE

The electrical interface between the host system and the BASF 6106 is via two connectors. The first, J 1, provides the signal interface and the second, J 5, provides the DC power interface. A plug-kit containing all mating-connectors is available under BASF P/N 80641-102.

4.1 Signal Connector (J 1)

J 1 is a 34 pin PCB edge card type connector whose dimensions are shown in figure 4.1. The pins are numbered 1 to 34 with the even pins on the component side of the board. Each signal requires a "Pin/pair" with the signal always going to an even numbered pin located on the component side and its ground return going to the odd numbered pins on the other side of the connector.

Pin 2 is located on the end of the PCB connector closest to the stepper motor and is labelled. A key slot is provided between pins 4 and 6. The recommended mating connector is Scotchflex ribbon connector P/N 3463-0000 or P/N 3463-0001 and Key 3M3439 or Amp. printed circuit connector P/N 583717-5 utilizing Amp. contacts P/N 1-583616-1 (see fig. 4.1).

4.2 Power Connector (J 5)

DC power connector is a 4 pin connector mounted on the component side of the PC (see fig. 4.2). The recommended mating connector (P 5) is Amp. P/N 1-480424-0 utilizing Amp. pins P/N 60619-1.

4.3 Frame Connector

To insure proper operation, the BASF 6106 must be frame-grounded. If the drive is not fastend directly to the frame of the host system, grounding can be accomplished by connecting a solid wire with a connector (Amp, P/N 609721-1) to the provided ground-tab.

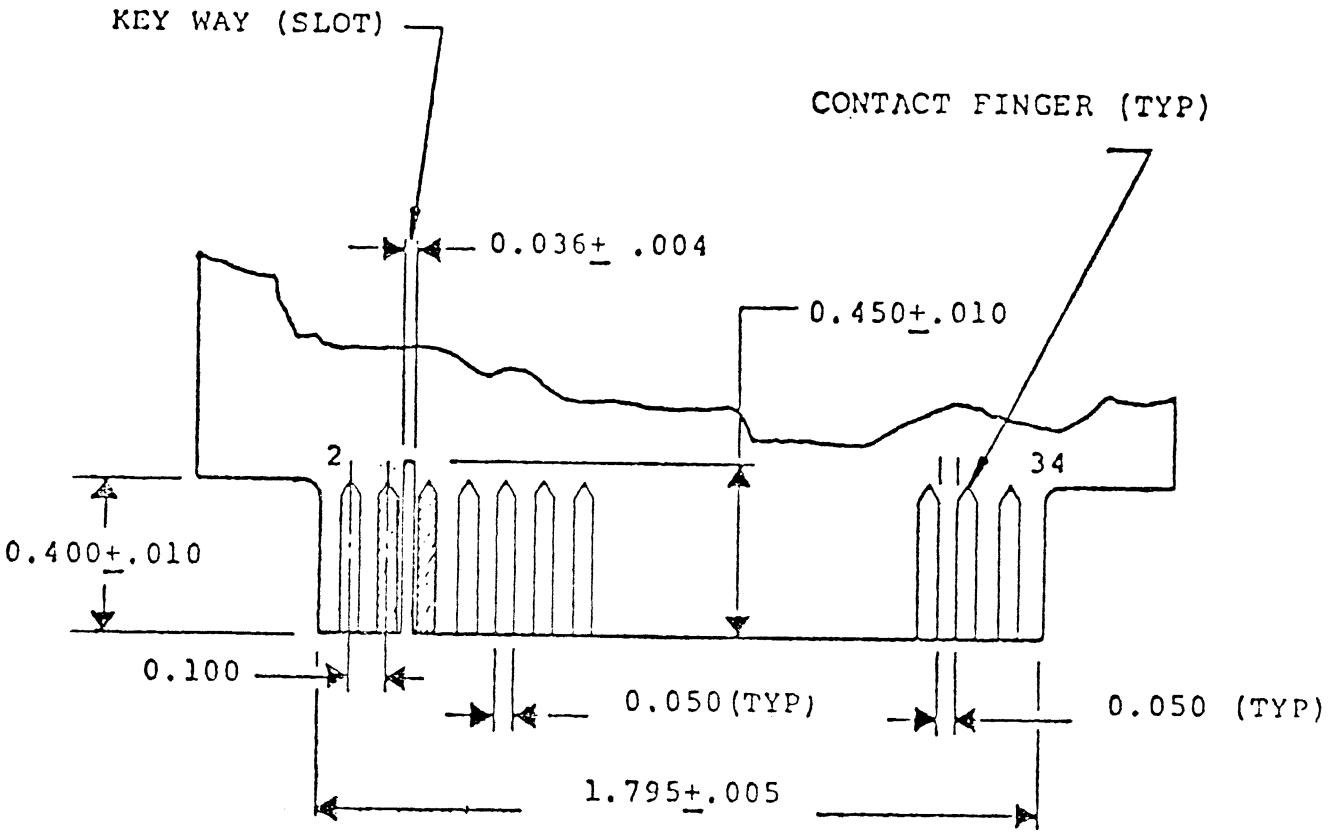
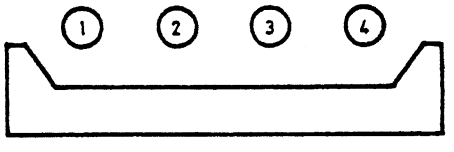


Figure 4.1 SIGNAL CONNECTOR (J1)



POWER CONNECTOR (J5)

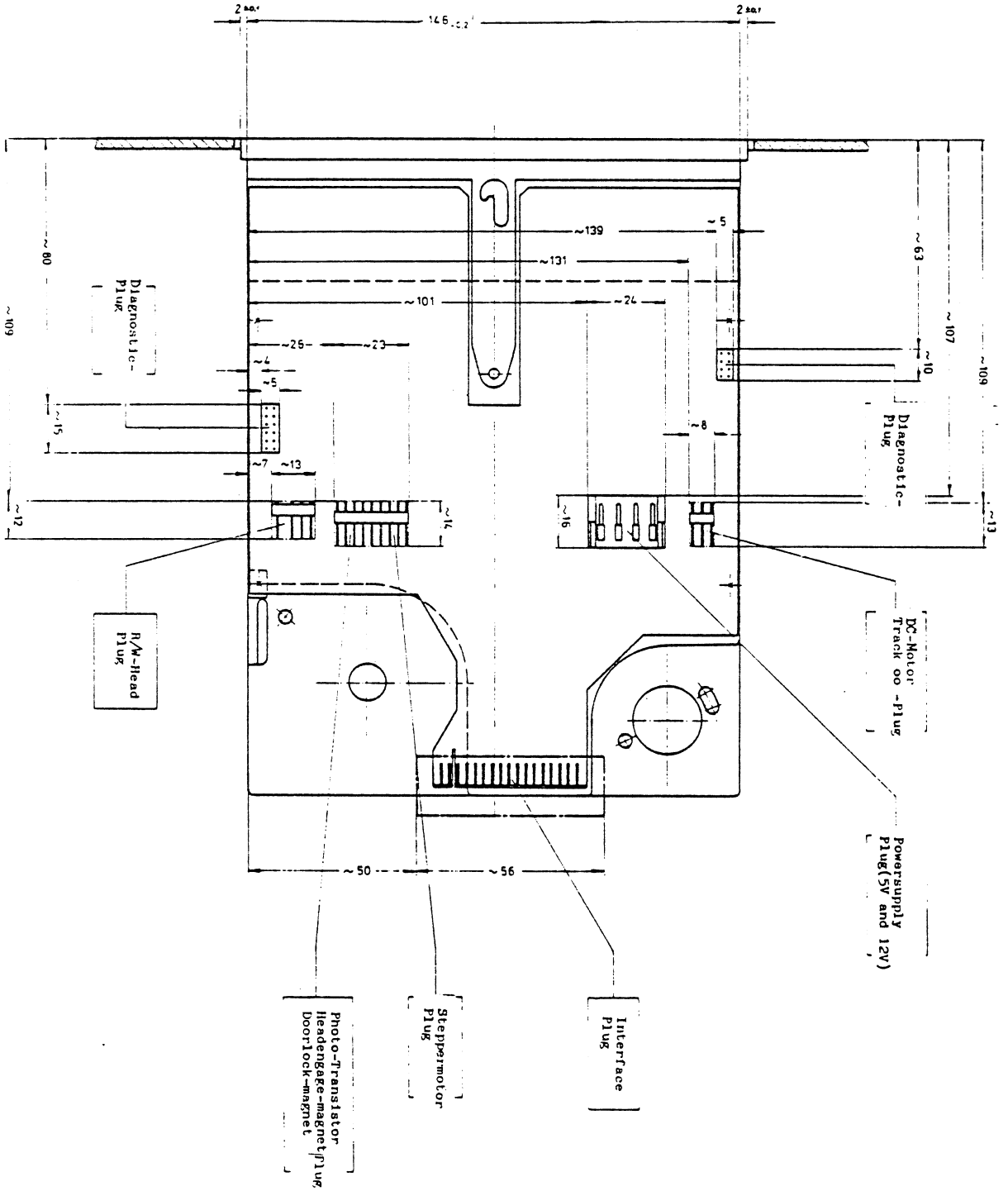
POWER CONNECTOR NO. 1 --- +12 VDC
2 --- +12 V RETURN (GROUND)
3 --- + 5 V RETURN (GROUND)
4 --- + 5 VDC

Figure 4.2 POWER CONNECTOR

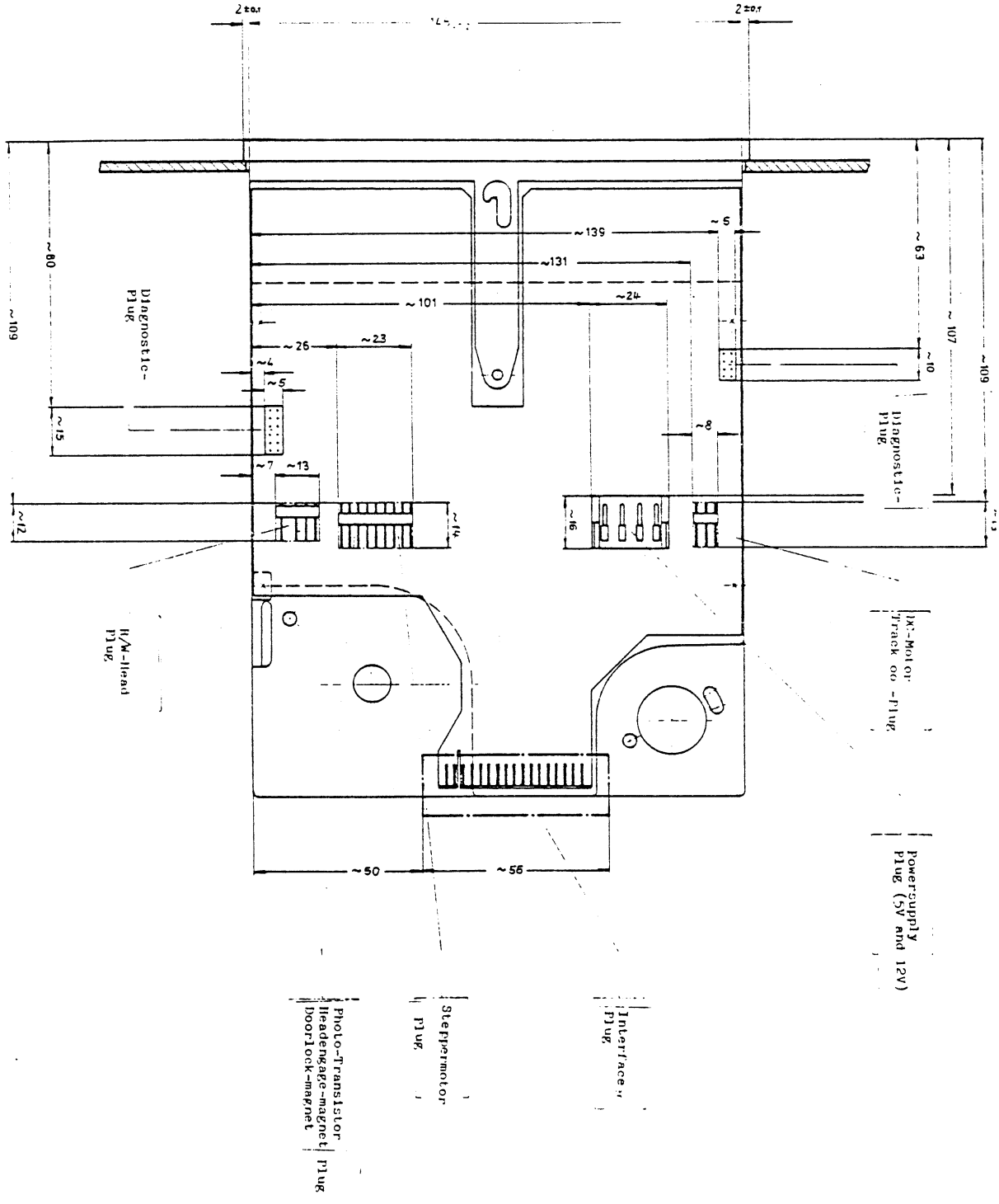
5. DRIVE PHYSICAL SPECIFICATION

This section describes the mechanical dimensions and mounting recommendations for the BASF 6106.
The BASF 6106 is also available with a Shugart compatible Frontplate.

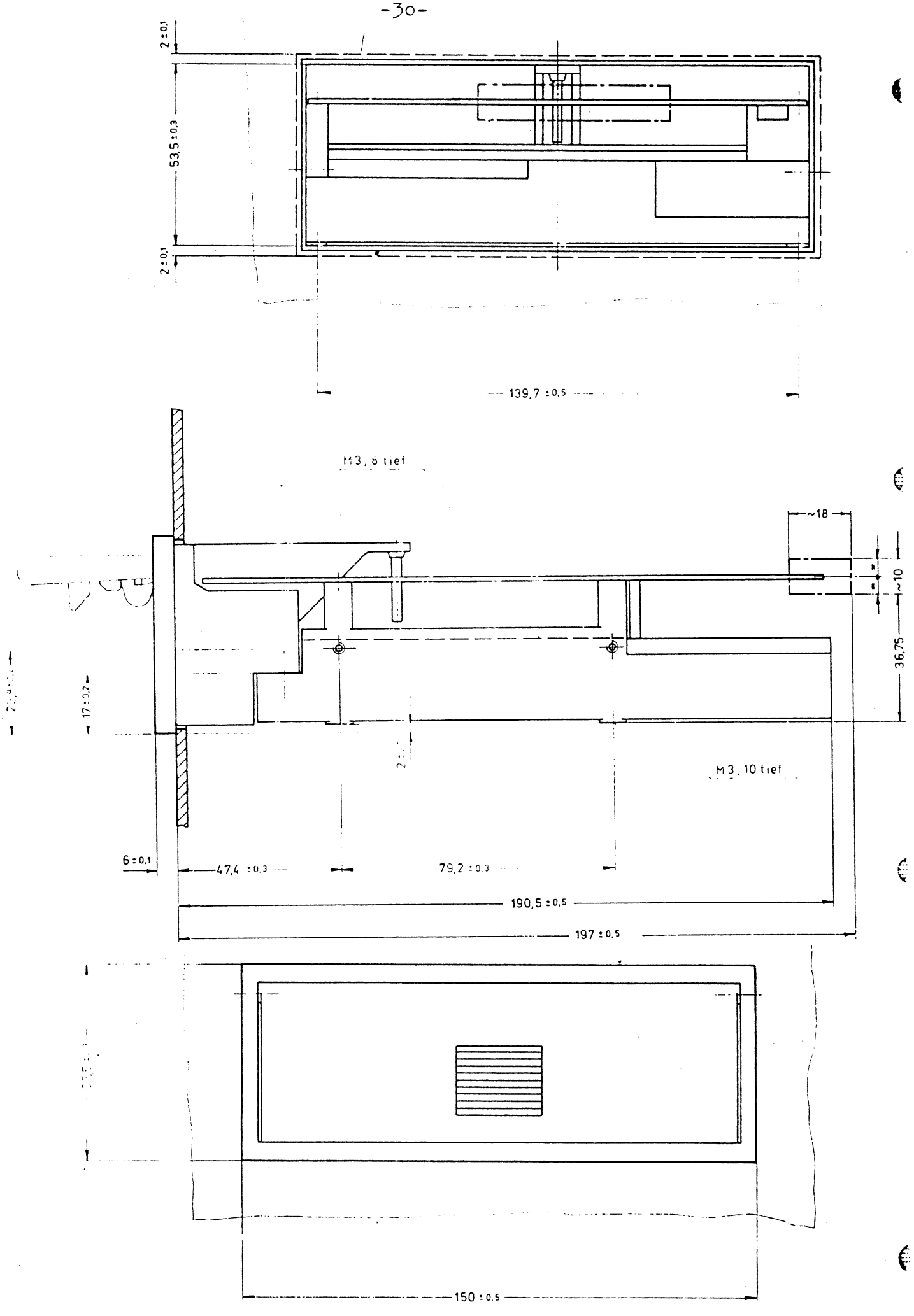
The BASF 6106 allows to be mounted in any position.



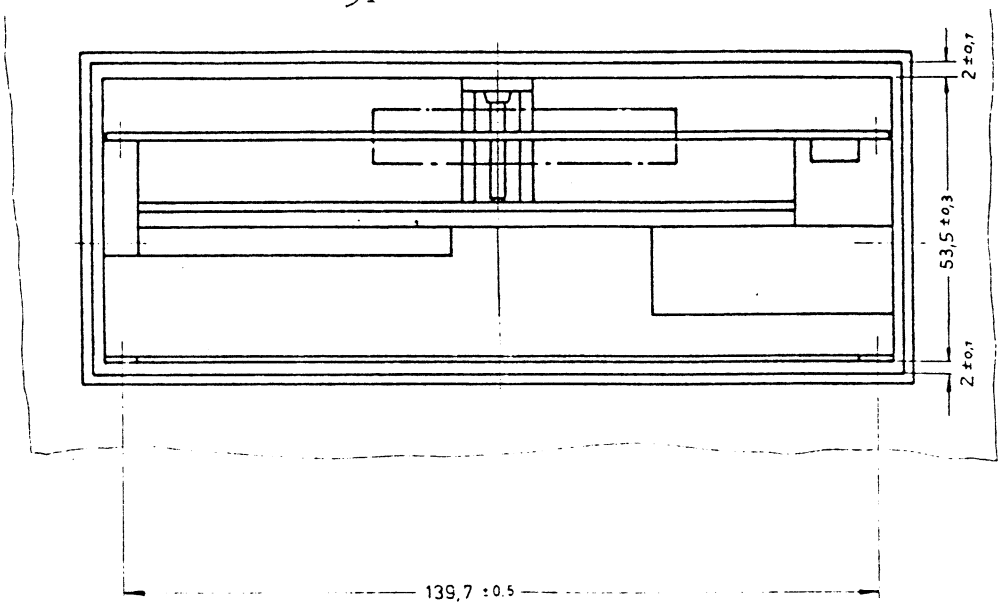
Mounting BASF 6106, Top View
Frontcabinet in line with panel

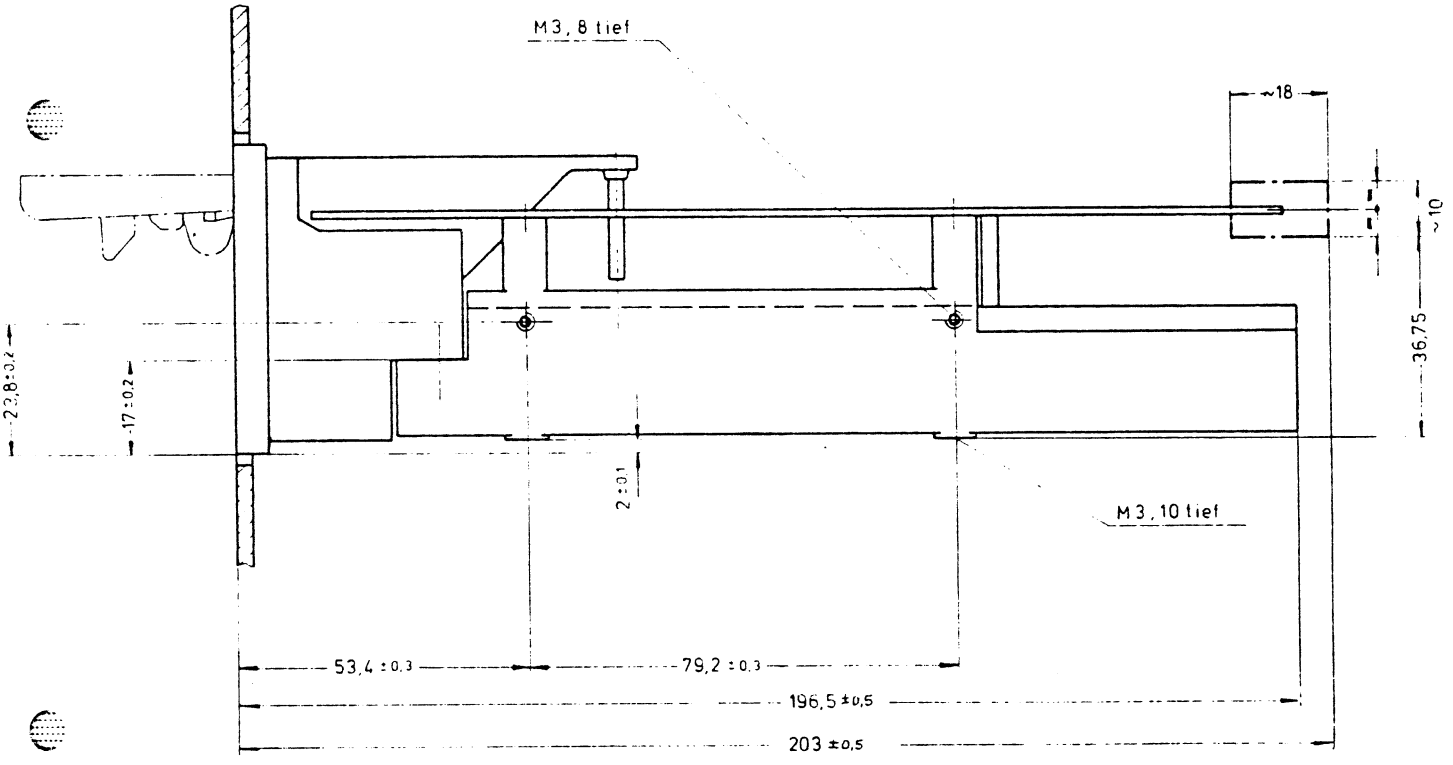


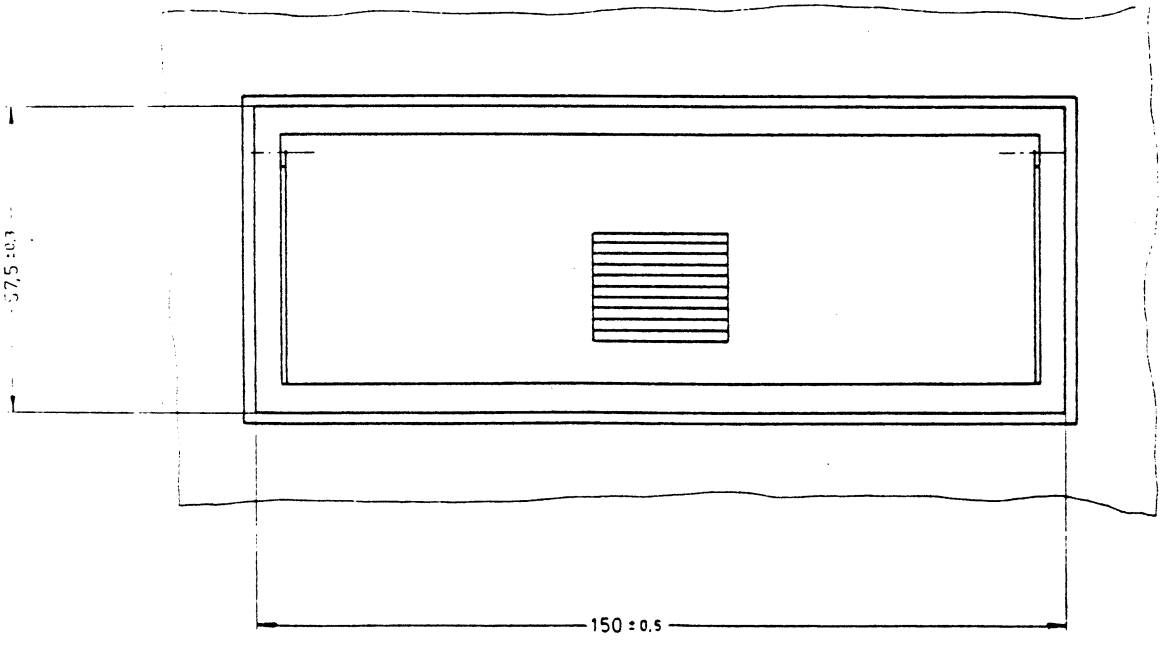
Mounting BASF 6106, Top View
Frontcabinet on top of panel



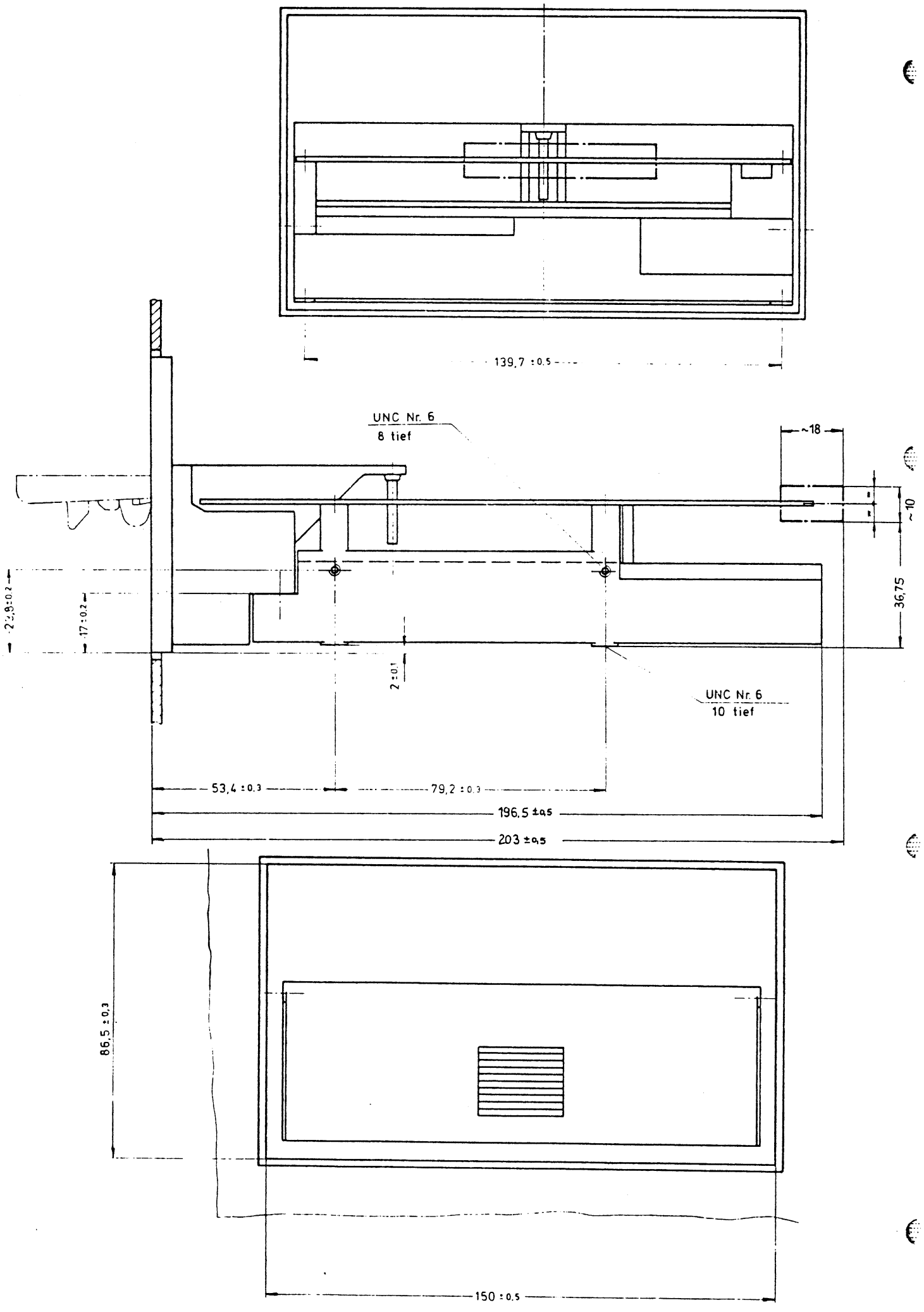
Mounting BASF 6106
Frontcabinet on top of panel



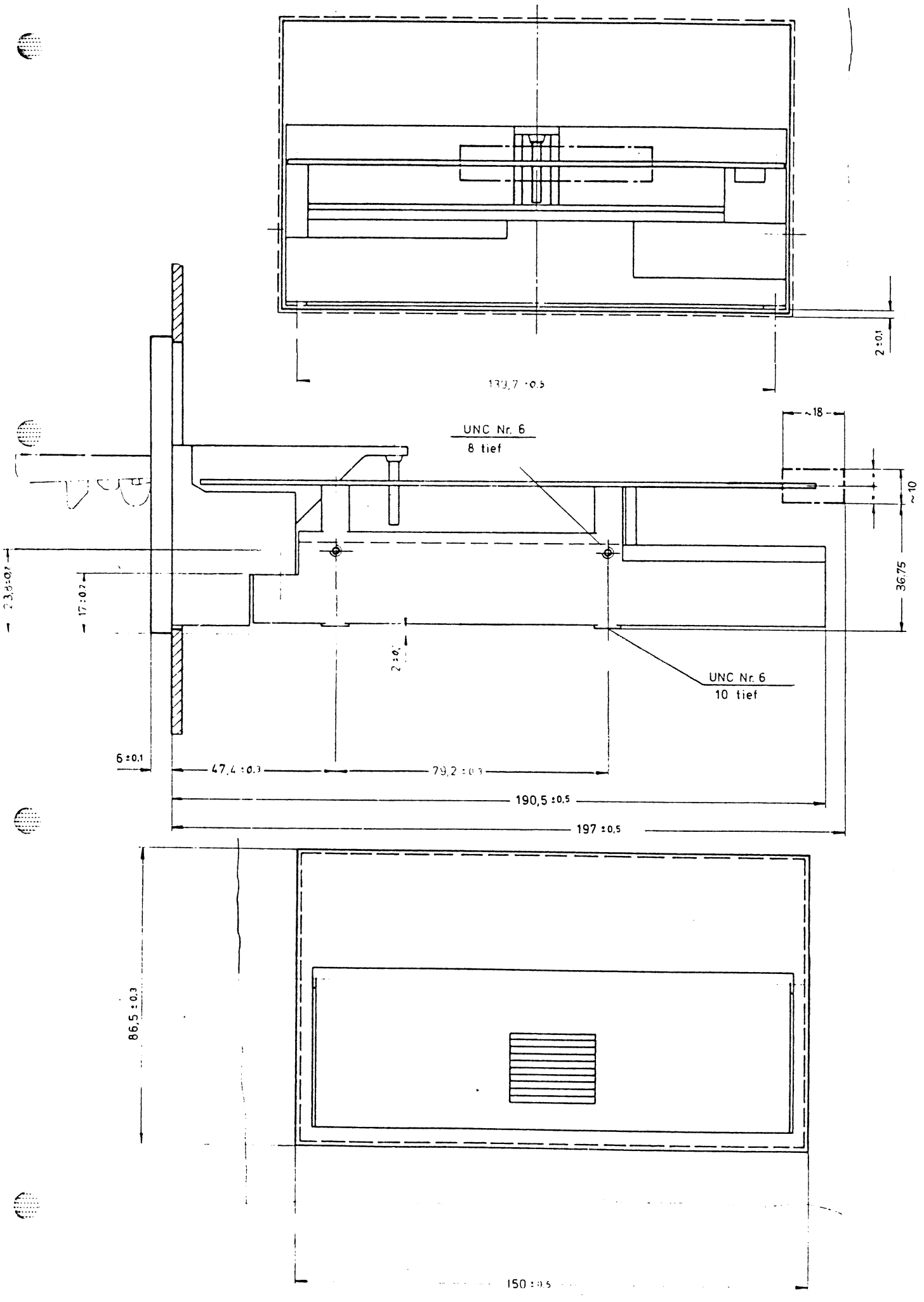




Mounting BASF 6106
Frontcabinet in line with panel



Mounting BASF 6106, Shugart compatible



Mounting BASF 6106, Shugart compatible