4. W I N C H E S T E R - D R I V E SMEA 04,/05

T A B L E O F C O N T E N T S

4. Winchester-Drive

4.1 General

The Micropolis-drives 43 and 86 MB are high-efficiency 5 1/4 Inch Winchester-drives, with very rapid access times. The interfaces of the two devices are completely compatible with the industry standard interface ST506 / ST412.

Two Winchester-interfaces are available:

serial-number	module-designation	gross-capacity per drive
1323	SMEA 04	43 MB
1325	SMEA 05	86 MB

Features of the Micropolis series 1320:

- The high efficiency positioner has an average positioning time of 28 ms.
- The standard interface ST506 / ST412 permits the connection of existing controllers.
- The drive is shock- and vibration protected, therefore it can be installed in any position.
- Save media protection is guaranted by the use of the spindle motor frame, spindle motor interlock and positioning of the data heads into a data free landing area.
- MTBF-time for the complete drive is approx. 20.000 hours.
- The electronic is built up on micro processor basis. Adjustments and periodical maintenance are not necessary.

4.2 Technical data

Winchester-drive:	SMEA 04	SMEA 05
gross-capacity:		
total capacity of the disks	42,7 MB	85,3 MB
capacity per surface	10,67 MB	10,67 MB
capacity per cylinder	41664 B	83328 B
capacity per track	10416 B	10416 B
net capacity for 18 sect/track:		
total net capacity	36,8 MB	73,6 MB
capacity per surface	9,2 MB	9,2 MB
capacity per cylinder	36864 B	73728 B
capacity per track	9216 B	9216 B
drive data general:		
number of the disks	3	5
number of the data heads	4	8
distance between heads and disk	0,0005 mm	0,0005 mm
number of the cylinders	1024	1024
number of the used cylinders	1022	1022
number of the sectors per track	18	18
sector per cylinder	72	144
sector length	512 Byte	512 Byte
track density	1000 TPI	1000 TPI
rotation number per minute	3600 +-0,5%	3600 +-0,5%
recording procedure	MFM	MFM

data transfer:		
data transfer rate	5	Mbits/sec
maximal access time	62	msec
average access time	28	msec
track to track access time	6	msec
average latency time	8,33	msec
start time	25	sec
stop time	15	sec
installation values:		
weight	2,7	Kg
efficiency capacity stand-by	28	Watt
efficienty capacity operation	38	Watt
MTBF-time fixed module part	25000	hours
MTBF-time electronic	15000	hours
temperature in operation	10 -35	degr.C
time of acclimatization	2	degr.C per 5 minutes
noise gauge	46	dB (A)
shock during operation	5	msec 3G ss
	20	msec 1G ss
drop hight unwraped drive	2	cm

4.3 Main components of the Winchester-drive

The drive is composed of an electronic and a mechanical part.

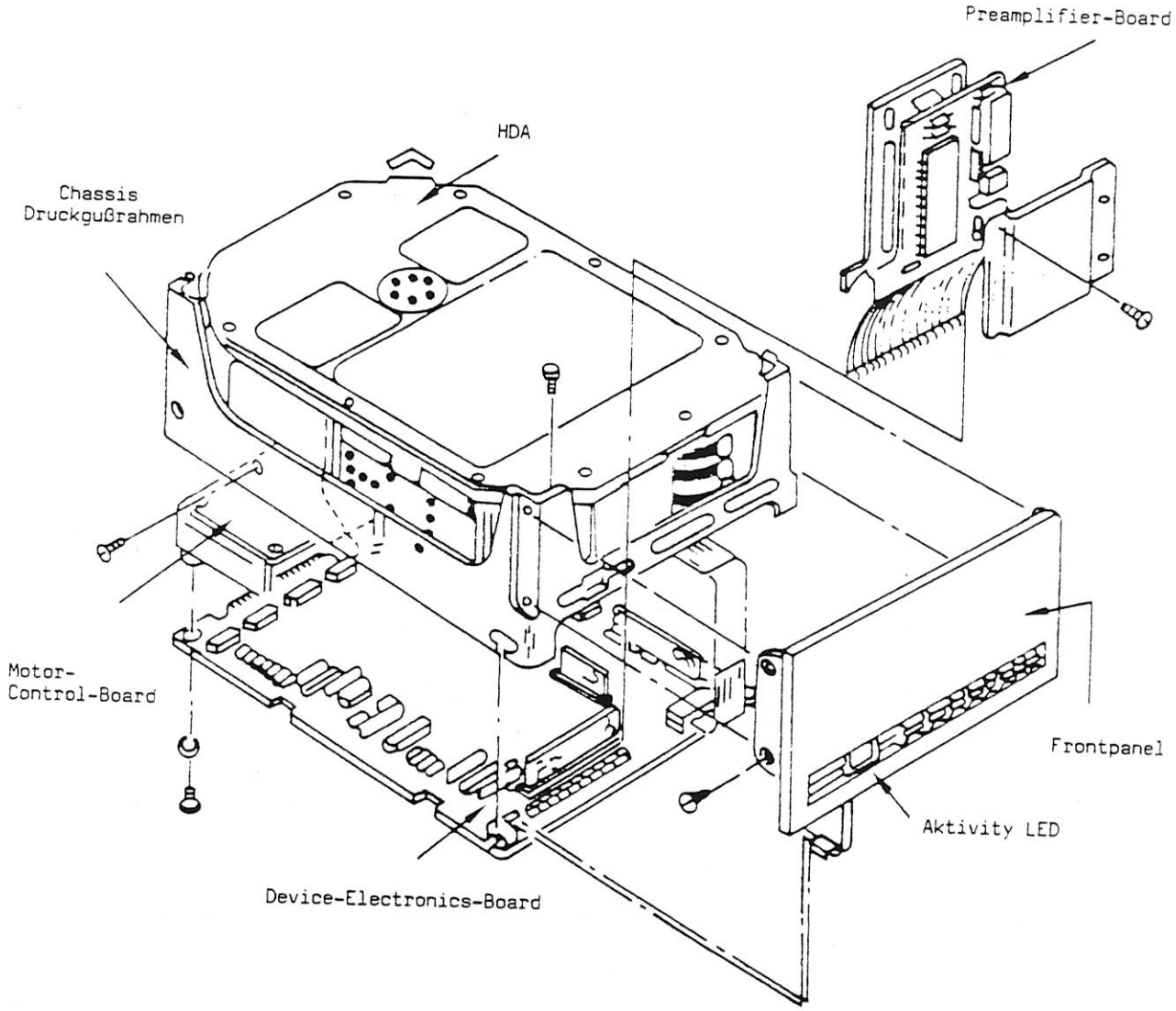


Fig. 4.1 Main components of the Winchester drive

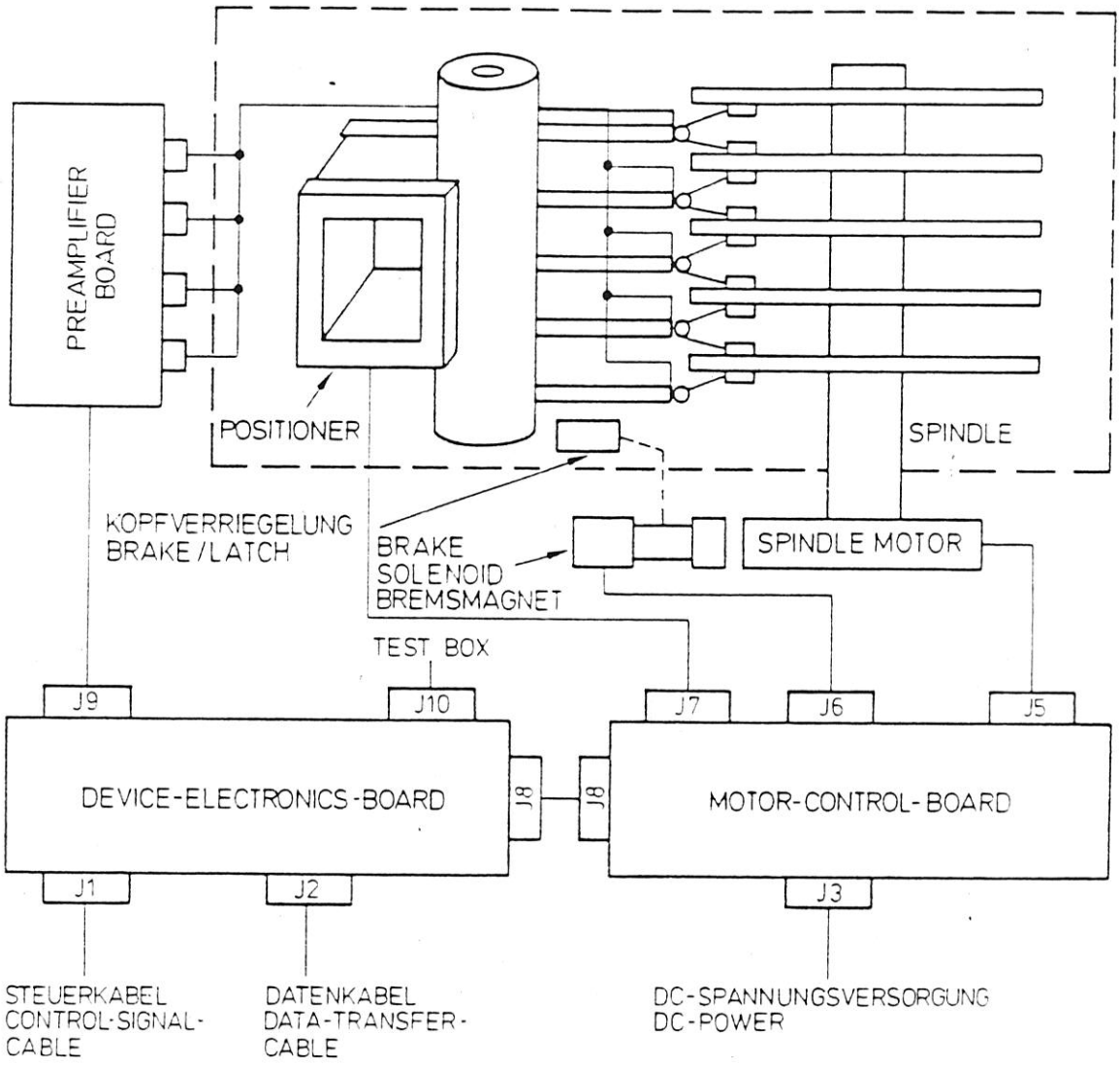


Fig. 4.2 Internal wiring of the Winchester-drive

4.3.1 The electronic components

Device-Electronics-Board:

The device electronic steers all control functions for the drive. The logic, controlled by a micro processor, monitors the start-stop- as well as all in-output functions for the data transfer between medium and interface, positioning of the data heads is controlled by the servo logic.

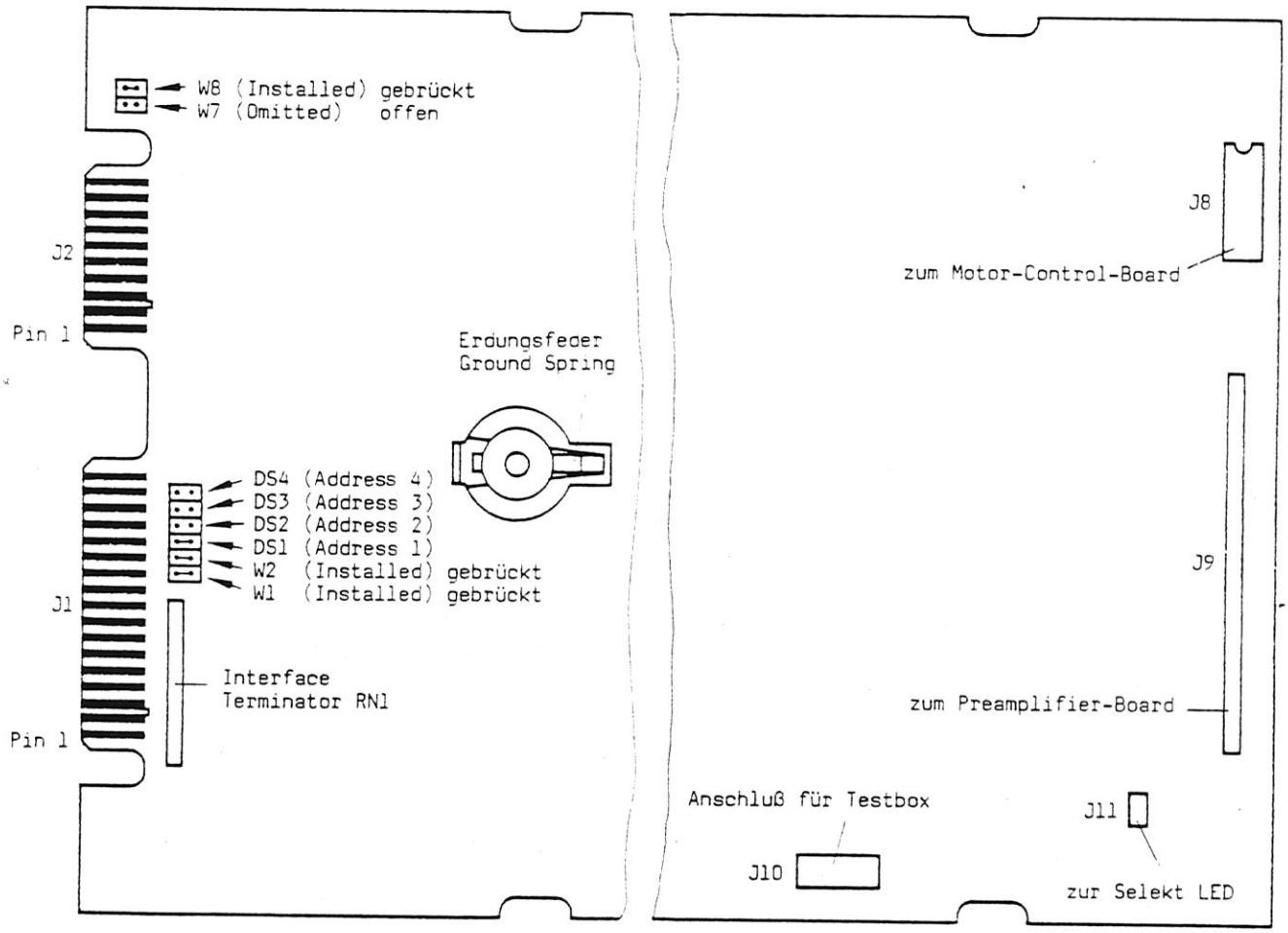


Abb. 4.3 Device-Elektronics-Board
outlet and switch position

jumpers			designation	
DS1-DS4		=	device address 1-4	
W1	ON	=	fault memorized	Standard
	OFF	=	fault not memorized	
W2	ON	=	select via DS1-4	Standard
	OFF	=	device perm. selected	
W7	OFF	=	read-data	Standard
W8	ON	=	write-data	Standard
W9	ON	=	operation with test device	
	OFF	=	normal operation	Standard

Preamplifier-Board: (see fig. 4.1)

The pre-amplifier controls the transfer of MFM read-/ write data. The read servo- and real-data are preamplified on this board, the head selection is executed, the write current is adjusted and the read-write faults are recognized.

Motor-Control-Board: (see fig. 4.1)

The motor control receives control signals of the device electronic, in order to drive the spindle motor and to activate the motor frame. Moreover the voltage supply for the positioner is realized on this board.

Activity LED:

This LED on the front panel of the drive indicates the activities of the device.

ON The device is selected by the controller
OFF Device is not selected (Idle state)

4.3.2 Drive Mechanics

The mechanical part consists of the outer frame, head-disk-assembly (HDA) and the solenoid and brake assembly.

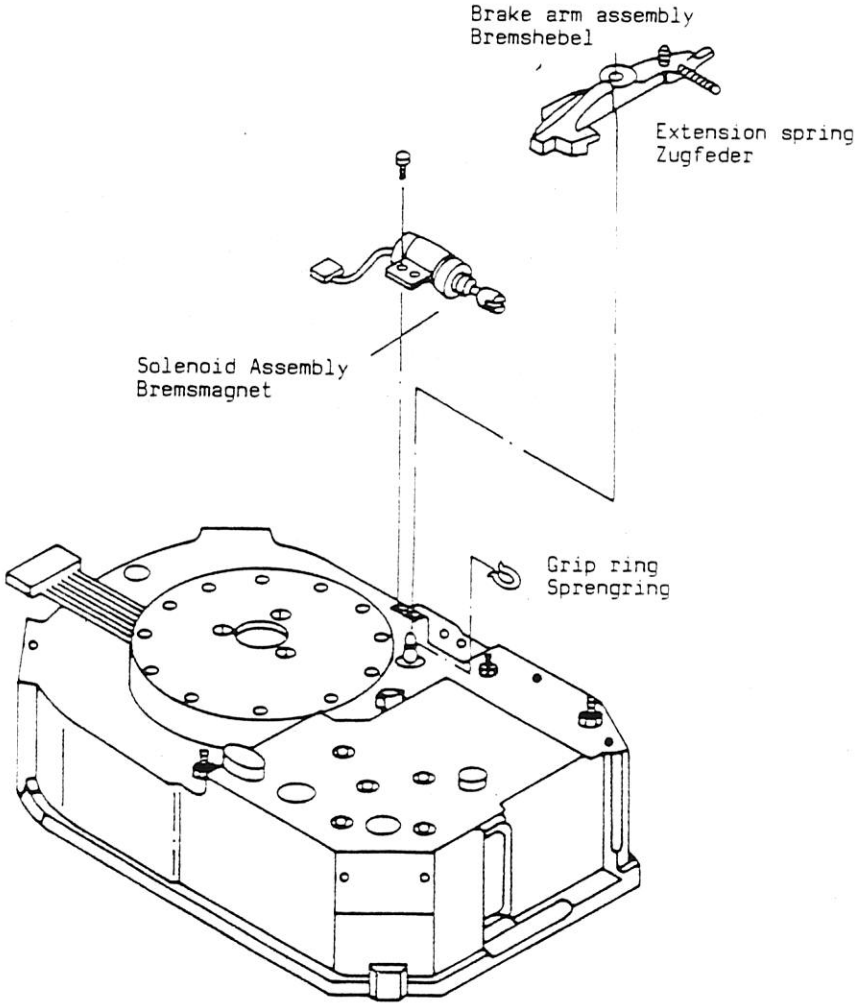


Fig. 4.4 HDA and solenoid and brake assembly

The head-disk-assembly (HDA):

This part is swinging connected with the frame of the drive via rubber shock absorber, in order to mitigate shocks occuring during the transport or the operation.
The HDA is isolated hermetically and contains the following components:

- Servo- und data heads
- Disk stack
- Spindle and spindlemotor
- Positioner system
- Air filter system

Spindle motor:

The number of spindle revolutions is supplied by a noise reduced 3 phase stepper motor. The controlling of the motor and the speed range is realized by hall generators, mounted into the spindle motor, in connection with the micro processor and the motor-control-board.

Positioning system:

The positioner consists of a linear magnet with a spindle and a swing arm mechanism for the positioning of the heads. The reference for the positioning of the data heads is taken out of the servo information. The servo information is written to a separate surface.

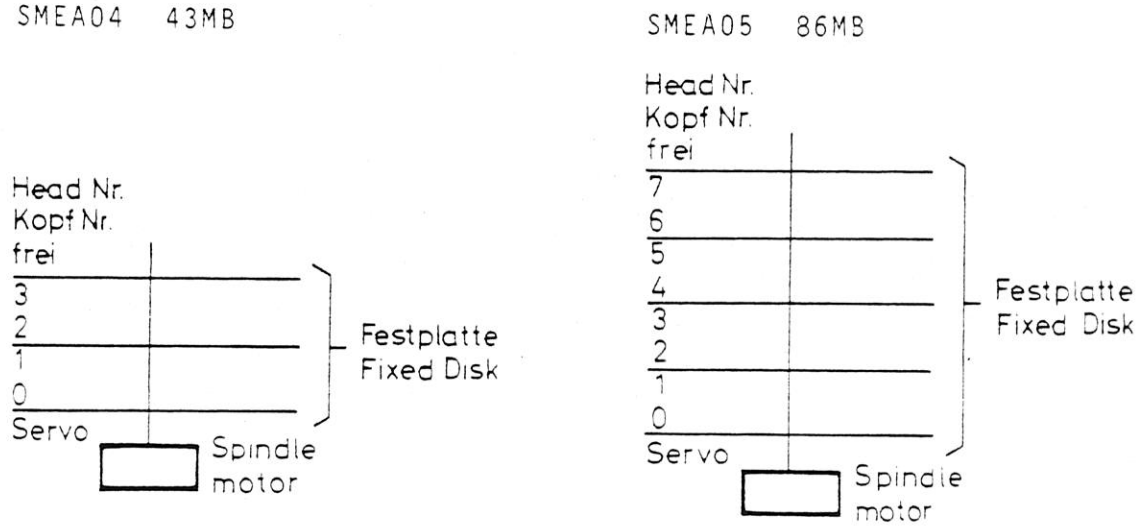


Fig. 4.5 Physical head arrangement

4.4 Description of function

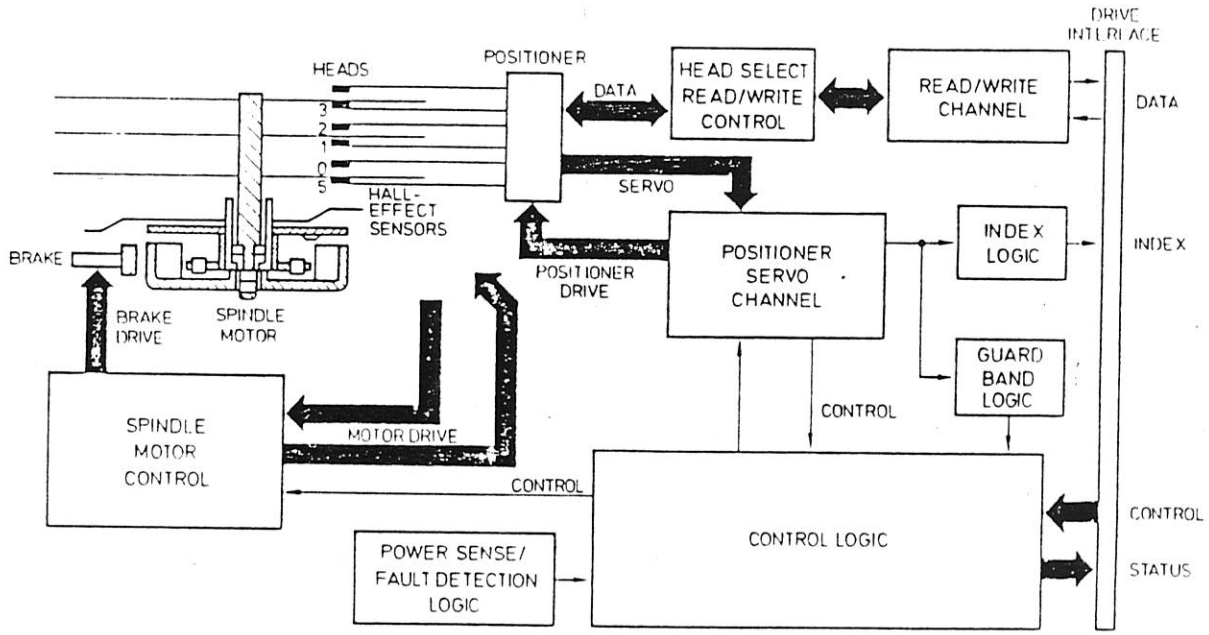


Fig. 4.6 Block circuit scheme Winchester-drive

When switching on the drive, a Power-On-Reset-Signal is generated in order to bring the micro processor and the logic into a defined position.
The spindle frame and the lock of the positioner are eliminated. The spindle motor is accelerated untilthe nominal speed of 3600 is reached. The micro processor executes a restore function and positions the data heads to track 0. Only in this moment the drive is READY and can be selected by the controller. Selection is executed by attaching the respective SELECT signals on the interface of the drive. Starting with this selected state, the controller can initiate a seek mode, write mode, read mode or deselection.

a) Seek-mode: The drive turns to the seek mode, after having received several step impulses by the controller. The positioner moves the data heads, depending on the direction of the number of step impulses, to the desired cylinder.

b) Write mode: If the controller dismisses the Write-Gate Signal and the drive is not in seek mode and ready to write, the drive goes to write mode. The write data, offered by the controller are then written onto the disk in bit serial mode.

c) Read-mode: If no Write-Gate-Signal is executed in the drive, and it is not in Seek mode, it is automatically in read mode. The drive reads the recorded data on the track with the chosen data head. The read signal are amplified, digitalized and given out via the read lines to the controller.

The micro processor controlls permanentely the state of the drive. Various fault states can be indicated; discovered faults result in the respective state indications being communicated to the controller via the interface line "-WRITE FAULT-"
Thus operations, endangering data, can be eliminated. If a fault cannot be corrected, the drive positions the heads into the landing area and switches off the spindle motor.

4.4.1 Servo-Information

The read/write heads must be positioned very precisely above the data, in order to enshure, that the written data can be re-read. In order to get a precise positioning with the high track density of 1000 TPI, the reference information, defining the track, must derive from the disk itself. The information (servo information) has been written in the case of this drive onto a disk surface during the production process.

Organisation of the servo surface (see Fig. 4.7):

The servo surface has been subdivided into 5 different areas:

- Outer Gard Band
- Track 0
- Servo Data
- Inner Gard Band
- Landing

Each servo-track is subdivided in 30 zones (zone 0 to 29), and each zone contains 56 servo lines.

Zone 29	Zone 0	Zone 1	Zone 2 - 28

Zone Zero differs from the remaining zones owing to its index mark.

ZONE 0

6 cells	8 cells	20 cells	16 cells	6 cells
111111	Radial-Position-Code	11....11	Index Mark	111111

ZONE 1-29

6 cells	8 cells	42 cells
111111	Radial-Position-Code	11....11

Radial-Position-Code	designated area
0 1 1 1 1 1 1 0	Outer Gard Band
0 1 1 1 1 1 1 1	Inner Gard Band and Landing area
1 1 1 1 1 1 1 0	Track Zero
1 1 1 1 1 1 1 1	Servo Data

Index-Mark

Index-Mark Index 1	(Code) Index 2
10110111	10101111

Servo cells: (see Fig. 4.7)

Each servo track consists of 1680 servo cells. The limit of the servo cell is defined by S1 and S2. The A,B,C,D information is required for the positioning. An even track is defined by A=B, an odd track by C=D, (see fig. 4.8) Moreover S1 and S2 have apart from the synchronizing tasks the following special tasks for the recognition of the servo oscillator.

S1 is used to synchronize the servo oscillator ,
S2 for the index and area recognition.

As you can learn from the illustration, a 480 TPI head is used as servo head, the information however was recorded in 960 TPI. Thanks to this trick two servo tracks are read in one process.

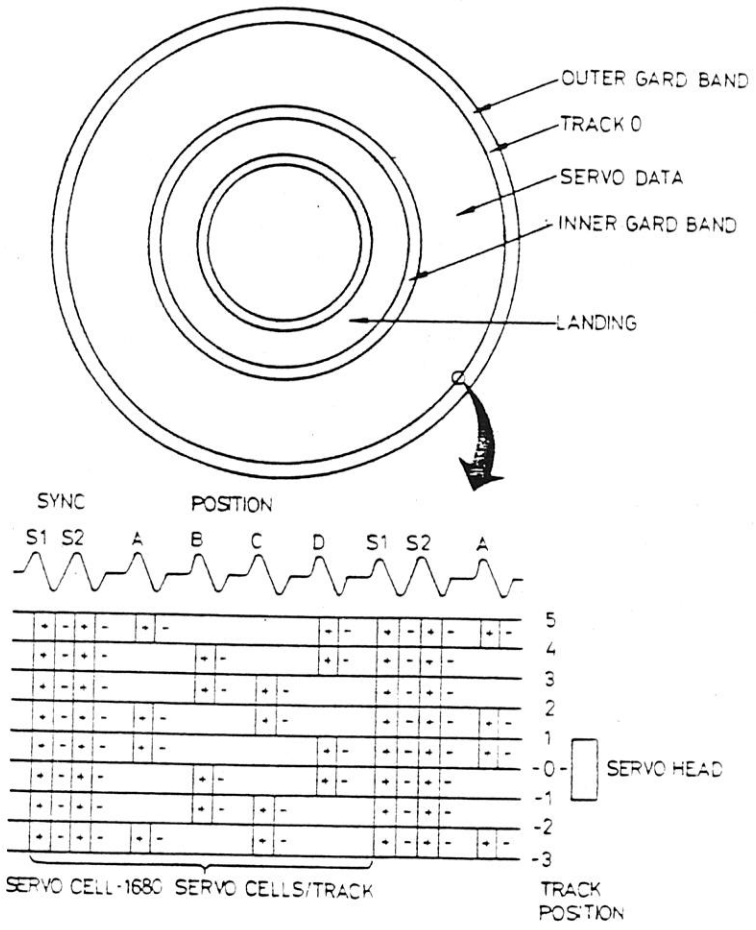
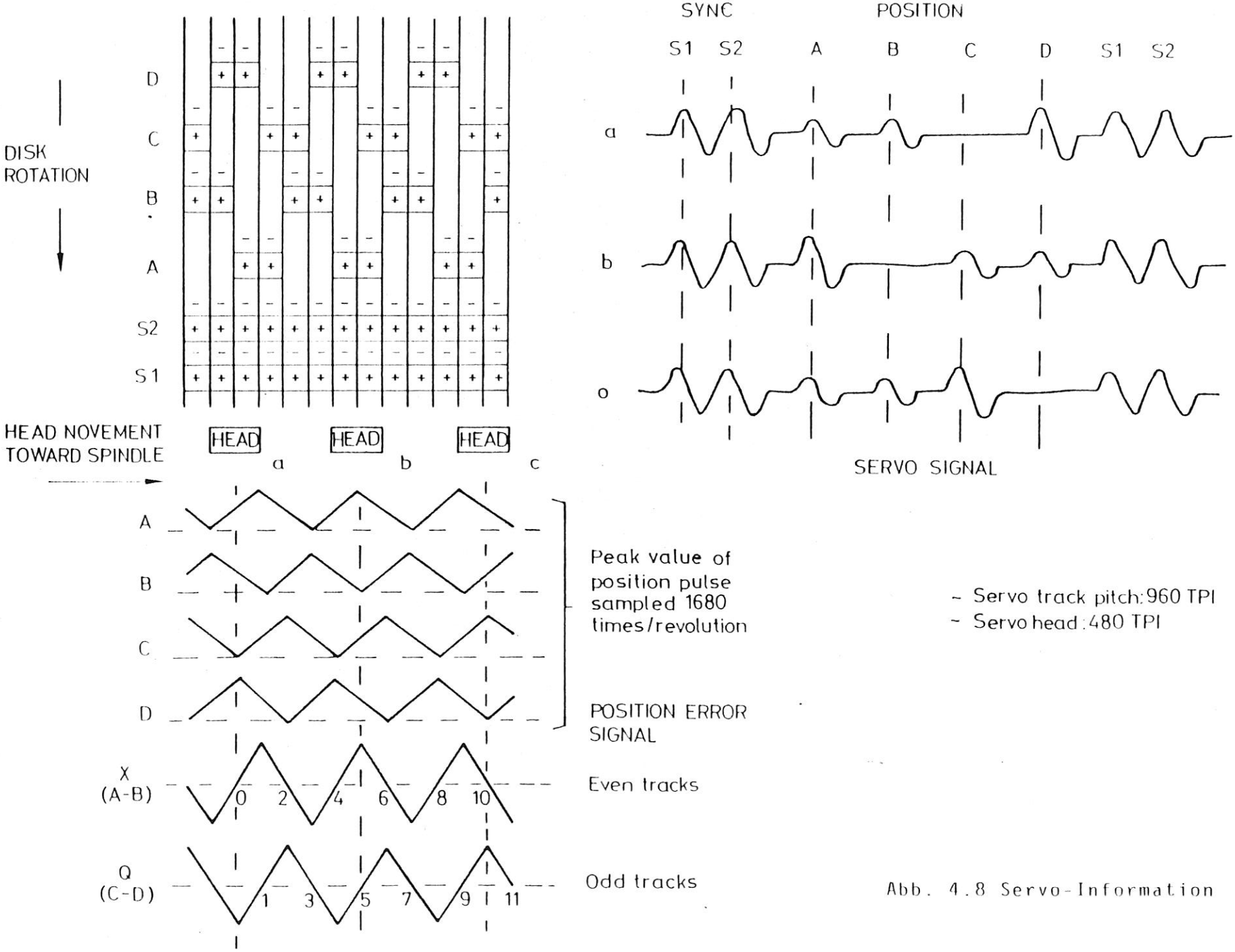


Fig. 4.7

Division of areas for servo surface and servo cell



- Servo track pitch: 960 TPI
- Servo head : 480 TPI

Abb. 4.8 Servo-Information

4.4.2 head positioning

The micro processor of the drive calculates the difference between the actual and the desired track address. The Velocity-Reference-function generator is advised to generate the required velocity,proportionally to the address difference. Accessing for the positioner is brought into velocity mode. Via the power-amplifier the positioner is accelerated, until it has reached the desired velocity. While positioning the micro processor counts the crossed tracks and actualizes the required acceleration. Two tracks before the desired destination, the calculated address difference is zero. The positioner is moved in Track-Following-Mode, at the same time also the position-reference-signal is zero, thus the positioner can reach and keep the desired track.

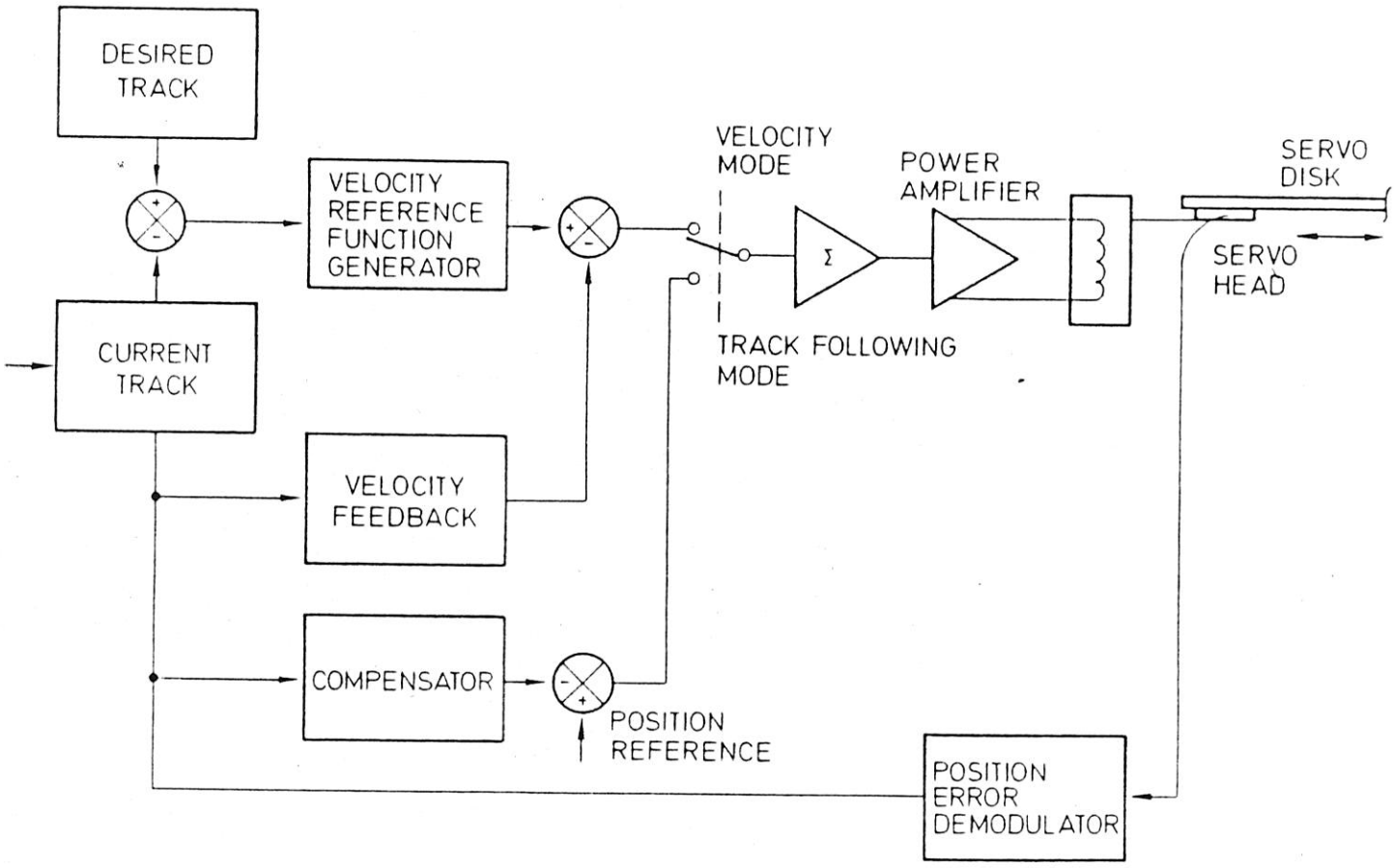


Fig. 4.9 Block board positioner movement

4.4.3 Description of function of the spindle motor

a) Start:

When switching on the drive, the spindle frame and the lock of the positioner are removed.

The spindle motor is accelerated until the nominal velocity of 3600 Rpm is reached. The acknowledgement is executed via sound generator S3, which serves the micro processor as a speedometer.

c) Velocity regulation:

The spindle motor velocity of 3600 rpm is kept constant by a servo loop and the speedometer at +-0,5 %. With decreasing velocity a IMS signal (increase motor speed) is produced and brought to the controlling electronic in order to accelerate the spindle motor.

If the velocity is correct or too high, the spindle motor executes a measuring periode in free run. At the end of the measuring period, the logic distinguishes, whether the motor is to be accelerated with IMS or another free run is to be allowed.

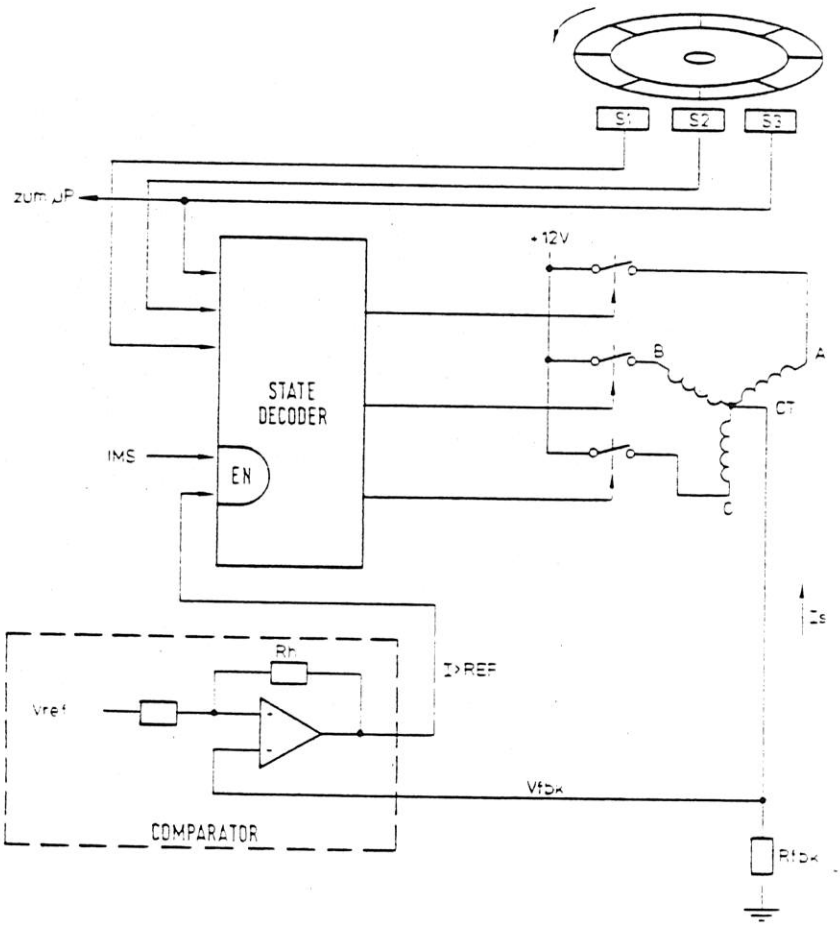


Fig. 4.10 block diagram spindle motor movement

4.5 interface and connecting plug

The interface of the drive is pin- and function compatabel with the industry standard interface ST506 / ST412.

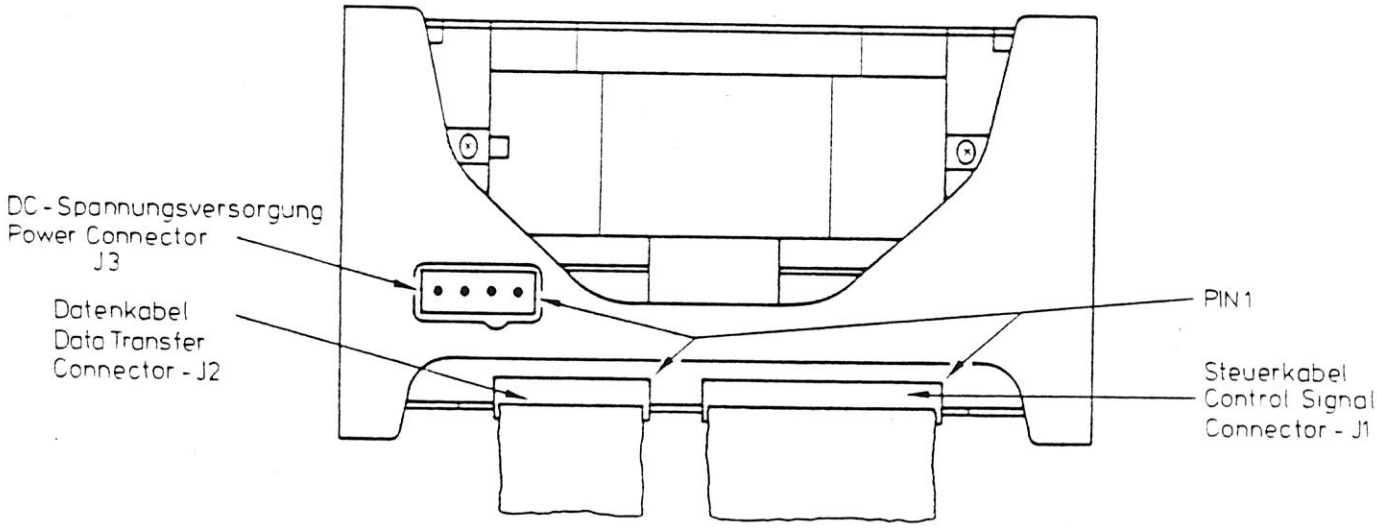


Fig. 4.11 Cable connections Winchester-drive

The interface signals are led out at the two connection plugs on the device electronics board:

connection plug	signals	cable ->controller
J1	Control	control cable
J2	Data	data cable

Table 4.1 Pin-allocation plug J1 (control cable Fig. 4.11)

plug Signals	J1 Pin Ground	Signal designations	source
2	1	reserved	-
4	3	Head Select 2/	Controller
6	5	Write Gate/	Controller
8	7	Seek Complete/	drive
10	9	Track 0/	drive
12	11	Write Fault/	drive
14	13	Head Select 2 /	Controller
16	15	reserved	-
18	17	Head Select 2 /	Controller
20	19	Index/	drive
22	21	Ready/	drive
24	23	Step/	drive
26	25	Drive Select 1/	Controller
28	27	Drive Select 2/	Controller
30	29	Drive Select 3/	Controller
32	31	Drive Select 4/	Controller
34	33	Direction In/ /	Controller

Table 4.2 Pin-allocation plug J2 (Data cable Fig. 4.11)

plug J2 Pin Signals	Ground	Signal designations	source
1	2	Drive Selected	drive
3	4	reserved	-
5	6	reserved	-
7	8	reserved	-
9	10	reserved	-
-	11	Ground	-
13	-	MFM Write Data+	Controller
14	-	MFM Write Data-	Controller
-	15	Ground	-
-	16	Ground	-
17	-	MFM Read Data+	drive
18	-	MFM Read Data-	Laufwerk
-	19	Ground	-
-	20	Ground	-

The power supply with the required continuous voltage is supplied at plug J3 of the motor control boards (fig. 4.11)

Table 4.3 Pin-allocation plug J3

Pin	Volt
1	+12 Volt
2	+12 Return
3	+5 Return
4	+5 Volt