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General Information for
FDC 100,
an interface between
RC 3500 and a Floppy Disc Drive

Keywords: RC 3500 Interfaces, Floppy Disc, FDC 100, General
Information.

Abstracts: This paper describes the logical structure of FDC 100, an
interface between RC 3500 and a Floppy Disc Drive (CDC 9400).

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The FDC 100 (Floppy Disc Controller) is an interface between CDC 9400 Floppy Disc Drive and RC 3500. This Flexible Disc System provides the user with an on-line capacity of over 250K bytes. Off-line capacity is unlimited by use of the removable IBM compatible Diskette.

The FDC 100 is connected to two I/O channels on RC 3500; one to transfer commands to FDC 100 and status information back to RC 3500, the other to transfer data between FDC 100 and RC 3500.

It should be noted that writing of check information and checking of this information during reading are included in the hardware of FDC 100.

The CDC 9400 Floppy Disc Drive is composed of a drive mechanism, read/write head, head activator, and associated control circuits. It can write and read disc cartridges (diskettes) interchangeable from unit to unit; it enables data transfer rates at max. 30,875 8-bit bytes per sec., random access capability, and it can store up to 252,928 8-bit bytes on a single cartridge. The CDC 9400 is full format compatible in accordance with the IBM 3740 Diskette System. Included in the CDC 9400 is an interlock to prevent damage to a disc cartridge during loading or unloading.

segetid: min: 20 msec
til spor gen: 260 msec
max: 770 msec

+
"Avg. Latency time": 83 msec

Data Medium.

2.1

The data medium, the IBM formatted flexible disc cartridge - also called the diskette, used in the CDC 9400 Floppy Disc Drive, is a flat disc composed of a Mylar substrate coated with a magnetic oxide. For protective purposes during handling, operation, and storage, the disc is encased in a flexible plastic envelope, eight inches square by one sixteenth inch thick. The disc itself rotates, during operation, inside this plastic envelope, which protects and cleans the surface.

The disc, 7.5 inches in diameter, has one hole for indexing.

Fig. 2.1 shows the disc cartridge and disc configuration.

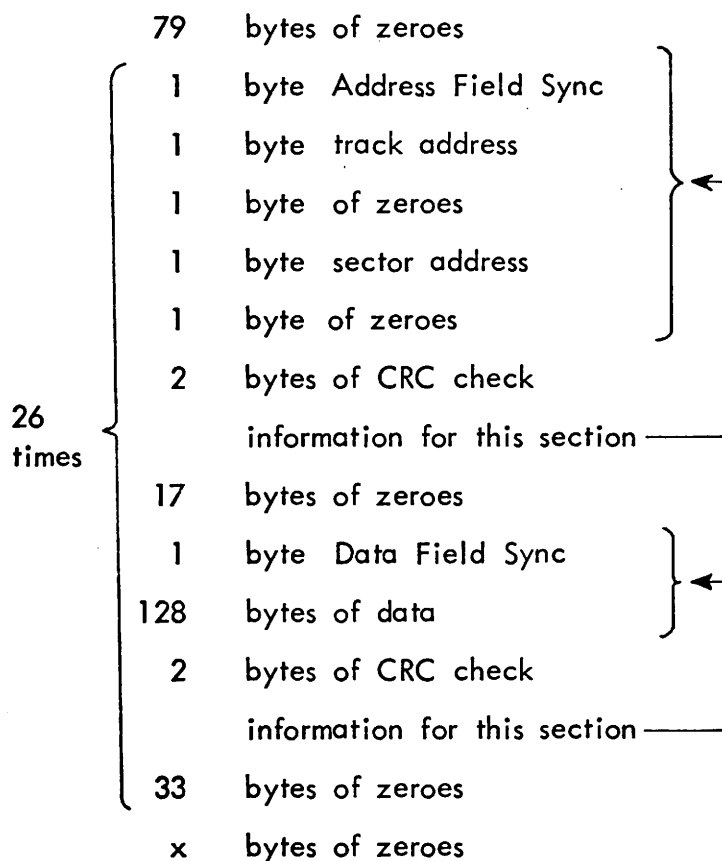
Through the read/write head opening, the read/write head is in direct contact with the disc surface.

Data Formats.

2.2

The disc is physically divided into 77 tracks. Each track is divided into 26 sectors. Each sector holds by definition one record of data. This sector recording format is shown below.

One track recording format :



The number of bytes in a sector are 188. The nominal time required for a sector is 6.08 msec.

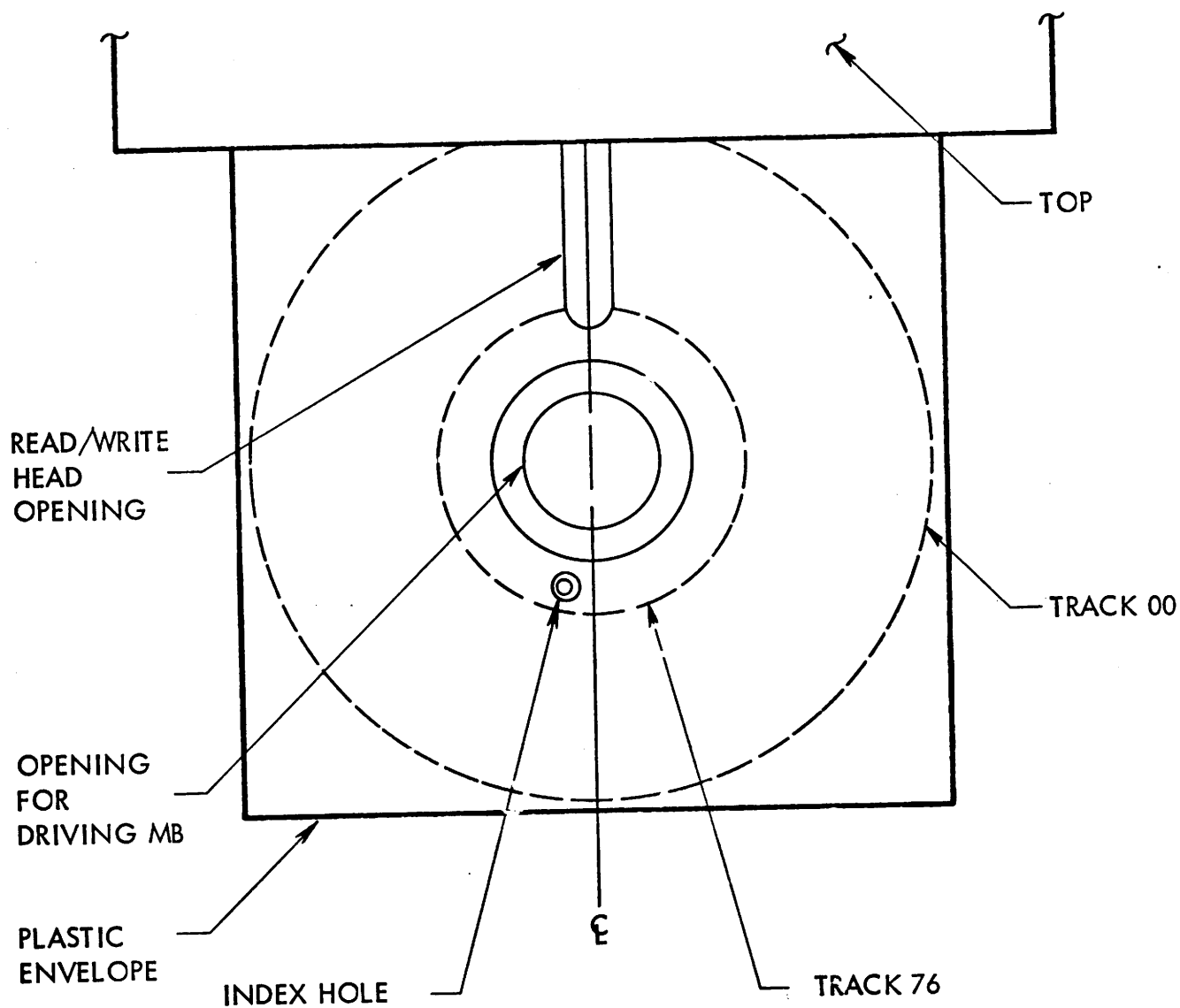
The nominal numbers of bytes in a track are 5125. Due to tolerances on the disc speed, the number of x bytes may vary.

IBM Compatible Format.

2.2.1

Fig. 2.2 is a simplified summary of the compatible format. Complete details of the format are given in CDC Spec. 75270400.

The Index Gap (GI) with the FC/D7 Field Sync Byte (Address Mark) is present on disks as formatted by special initializing equipment (as received from the factory). However, if the disk is formatted by the 3740 equipment, the GI and G! gaps are combined resulting in 79 bytes of (00) Hex and a single FE/C7 Field Sync Byte (FE/C7 denotes data transitions of FE and clock transitions coded C7). This does not interfere with operation since the 3740 equipment does not utilize the GI Field Sync Byte.



Disc Cartridge and disc configuration

Write Splices, points at which an update starts and ends during a write to a data field, occur 6 bytes ahead of the Field Sync Byte in the Address Gaps and 2 bits after the Polynomial Check Bytes (CRC) for the Data Field. The write operation comprises writing the last 6 bytes of zeroes in the Address Gap, a Field Sync Byte, 128 bytes of data and/or blanks, 2 CRC bytes, and 2 bits of zeroes.

In addition to providing the control logic with the required information to distinguish the beginning of Address Fields and Data Fields (missing clocks provide unique distinction from normal data), the Field Sync Bytes are used to uniquely identify Deleted Records and Defective Tracks. A Deleted Record has the normal F5/C7 Field Sync Byte at the end of the Address Gap replaced with an F8/C7 Field Sync Byte.

As factory formatted, Sectors 9-26 of Track 00 contain the Deleted Record Field Sync Bytes since the disk is originally organized for one Data Set with a Beginning of Extent (BOE) of Track 01 Sector 01 and End of Extent (EOE) of Track 73 Sector 26. In use, if multiple Data Sets are required on one disk, Track 00 Sector 8 would be updated to call out a shorter Data Set and Sectors 9 through 26, as required, would be updated from Deleted Records to active Data Set Labels with Field Sync Bytes of FB/C7. (In addition to changing the Field Sync Byte, the first data byte of a Deleted Record is normally changed to a D which accounts for the fact that the inactive Data Set Labels initially begin DDR1 rather than HDR1. However, for applications where it is desirable to leave the first data byte unchanged in a Deleted Record, the 3740 provides an alternate control sequence which only changes the Field Sync Byte content.)

Polynomial Code Generation.

2.2.2

The polynomial codes recorded at the end of each field are the remainder (in each stage of the shift register) resulting from dividing the bits in the field being checked by the polynomial $X^{16} + X^{12} +$

$X^5 + 1$. The field being checked extends from the first bit of the Field Sync Byte to the last bit in the Address or Data Field. During a write operation the required Polynomial Check Bytes are generated by: first setting all stages of the shift register to ones; then shifting the first bit of the Field Sync Byte and all subsequent bits through the last bit of the last byte of the field (exclusive of the 2 CRC bytes); after the last bit is shifted through the last stage of the register, the bits remaining in the 16 shift register stages are the 2 CRC bytes to be recorded.

When reading back, the checking operation consists of: first setting all stages of the shift register to ones; then shifting all bits starting with the first bit of the Field Sync Byte through the last bit of the second CRC Byte through the register; after the last bit has been shifted through, a one present in any stage of the shift register indicates an error has occurred in the field or in the Field Sync Byte or the CRC Bytes (presumably the Field Sync Byte has already been confirmed as valid due to apriori information used to establish field synchronization).

Although not utilized by the 3740 equipment as originally announced, the initialization of the shift register for the Address Field could be utilized for data privacy and protection by setting it to predetermined pattern other than all ones. This would not give absolute security, but would provide 65,536 codes including the compatible all ones case.

Index Track Utilization (Track 00).

2.2.3

Sectors 1, 2, 4, and 6:

These sectors are not used by the 3740 equipment originally announced, but are assumed to be for use by later features or related equipment announcements.

Sector 3:

Byte Position 1 of the Sector 3 Data Field is used to verify that the equipment is able to write successfully. The 3740 equipment, during the initial set up and verification sequence, reads this byte, compliments each bit, re-records the complimented byte, and a subsequent read verifies that each bit was successfully complimented. (In effect this seems to be a somewhat less effective, but less expensive method of confirming a write operation as opposed to monitoring write current.)

Sector 5:

Sector 5 is used to identify the physical location of defective tracks. Byte positions 7 and 8 contain the track number of the first bad track and positions 11 and 12 indicate the second bad track. Byte position 9 and 13 must contain a 0 if the prior two bytes have a bad track indicated. Defective track information is typed in by the operator as part of the initialization procedure.

Sector 7:

Sector 7 is used as the Volume Label. Byte positions 1 to 4 must contain VOL1 and positions 5 to 10 are 6 byte Volume ID assigned by the user.

Byte position 11 is an Accessibility Byte. Any nonblank character defines the disk as non-accessible.

Bytes 12 through 76 are blanks.

Bytes 77 and 78 define the sector sequence.

Byte 80 should be a w.

Sectors 8 through 26:

These sectors are used as Data Set Labels. Active Data Set Labels must contain HDR1 in byte positions 1 to 4. Inactive (Deleted) Data Set Labels have DDR1 in these positions.

Positions 6-13 are the user's name for the Data Set. Ordinarily, 6 to 9 are DATA.

Positions 23 to 27 contain the Logical Record Length where 23 and 24 are always 00 and 25 through 27 range from 001 to 128. For operation with a 3742 without the 128 byte feature, the Logical Record Length must always be 00080.

Positions 29 through 33 are used for the BOE with 29 and 30 designating track number, position 31 must be 0, and position 32 and 33 designating the sector number.

Positions 35 through 39 are used for the EOE with the same sequence as BOE.

Position 41 is a Bypass Data Set Byte which must contain a B or a Blank. If a B is present, the IBM 3747 will ignore the Data Set when transferring to or from tape. This allows the user to mix data and programs on the same disk.

Position 42 is a Data Set accessibility Byte which must be Blank to allow processing of the Data Set.

Position 43 is the Write Protect Byte. A P causes the Data Set to be Write Protected allowing only read operations. To allow Write, this position must be a Blank.

Position 45 is the Multivolume Indicator Byte. A Blank indicates the Data Set is complete on one disk. A C indicates the Data Set is continued on another Disk. An L indicates that this is the last disk of a Multivolume Data Set.

Position 73 is a Verify Mark which is either a Blank or a V which indicates the Data Set has been verified.

Positions 75 through 79 are used for the End of Data (EOD). The usage is slightly different in that it actually designates the next unused sector.

The other byte positions are reserved and should contain Blanks.

Disc Drive.

2.3

The disc drive rotates the disc at 360 rpm., meaning that a full revolution of the disc takes 166.67 msec.

The time from power on until the drive is operable is approximately 2 sec.

After a power up, the position of the head is undefined, and the program should initially move the head to the outer track, track 00, before any other operation is initiated.

The time for a single track move is 20 msec. including settling time. This is defined as the time to move between any pair of adjacent tracks. Multiple track moves can be made at 10 msec. per step plus 10 msec. settling time.

The random average positioning time is 260 msec. This is defined as the summation of the move times for all possible moves.

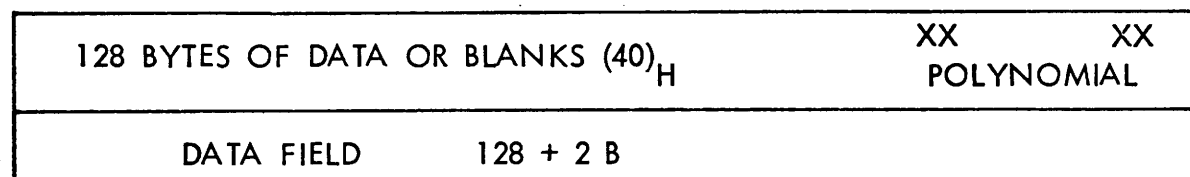
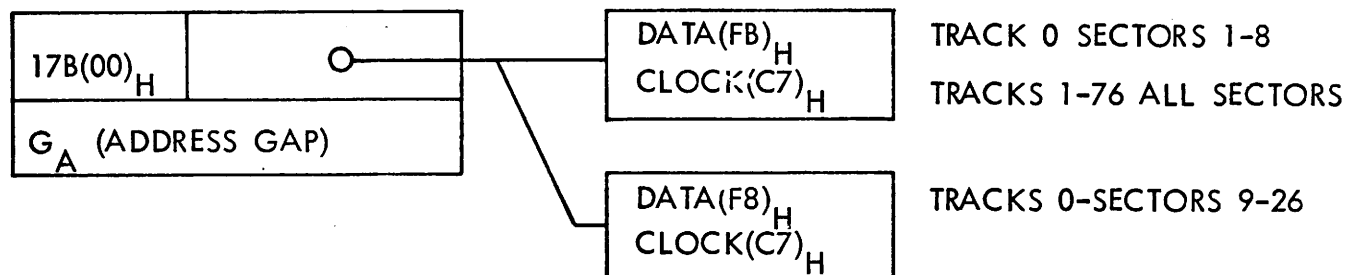
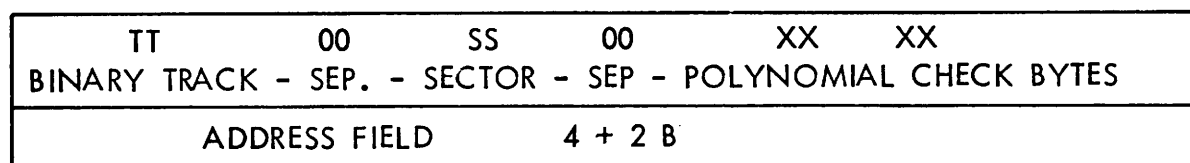
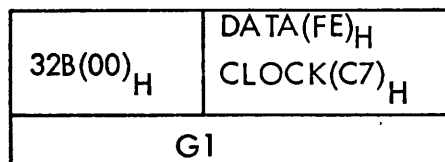
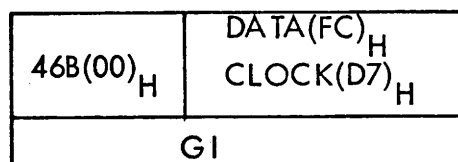
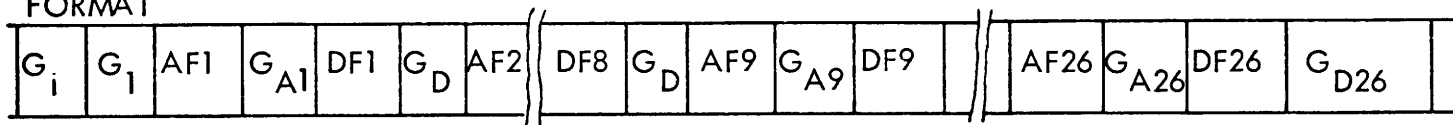
The maximum positioning time is 770 msec. This is defined as the time to move the head from track 00 to track 75 or from track 75 to 00 and includes settling time.

Loading of the read/write head is performed by software control.

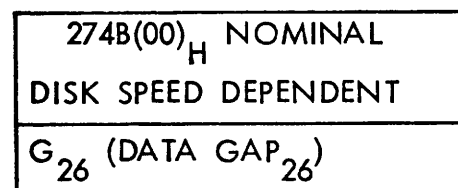
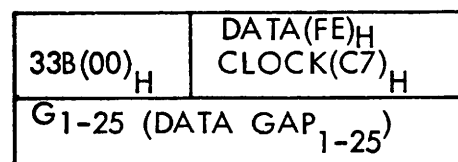
The read/write can be loaded when the disk is fully installed and the front panel door is closed. Closing the front panel door activates the door interlock switch which completes the circuit to the head load solenoid. The head load settling time is 60 msec.

INDEX

FORMAT



NOTES:



1. Recording Double Frequency -
Zero - Clock transition only
One - Clock and Data transition
2. Field Sync Byte (Address Mark) at end of gaps identified as if recording was two channel multiplexed NRZ1.
3. Track 0 ordinarily used for disk usage information such as write protect, logical sector length, defective tracks, etc.
4. Track 76 ordinarily used for CE Mode.
5. B = Bytes; ()H = Hex Byte

If more than four revolutions of the disk have occurred without any data transfer or head movements, hardware unloads the head from the disk surface, to cause minimum wear.

The number of tracks per disc is 77, and the number of sectors per track is 26, giving a total of 2002 sectors per disc. The number of data bytes per sector is 128 giving a total of 256,256K bytes per disc.

Data transfer rate within a byte is 30,825K bytes per sec.

Access time within a track is on an average slightly more than time for half a revolution of the disc, i.e. 84 msec.

List of Characteristics for CDC 9400.

2.4

<u>BPI</u>	TK00	1836 BPI
	TK76	3268 BPI
<u>RECORDING METHOD</u>		FM
<u>TPI</u>		48 TPI
<u>TRACK WIDTH</u>		.014 IN
<u>MAGNETIC HEAD</u>		TUNNEL ERASE IN-CONTACT HEAD
<u>HEAD MATERIALS</u>		MU-METAL IN STAINLESS STEEL PAD
<u>MEDIA</u>		OXIDE ON .003 IN MYLAR
<u>ROTATIONAL SPEED</u>		360 RPM.
<u>RELATIVE HEAD/MEDIA VELOCITY</u>	TK00	- 136 IPS
	TK76	- 76 IPS
<u>CAPACITY - PER DISK</u>		3,208,128 BITS
<u>PER TRACK</u>		41,664 BITS (UNFORMATTED)

<u>TRACKS</u>	77
<u>HEADS</u>	1
<u>TRANSFER RATE</u>	249,984 BITS/SEC.
<u>SEEK TIME - MIN.</u>	20 MSEC.
AVG.	260 MSEC.
MAX.	770 MSEC.
	(10 MSEC./TRACK PLUS 10 MSEC. SETTLING)
<u>AVG. LATENCY TIME</u>	83 MSEC.
<u>MEDIA</u>	CDC 9878 (AND OTHER IBM DISKETTE COMPATIBLE MEDIA)
<u>COMPATIBILITY</u>	IBM 3740 (MEDIA AND TRACK LOCATION)

POWER REQUIREMENTS

AC:	120V/60 HZ	0.7A START/0.5A RUN
	220V/50 HZ	0.35A START/0.25A RUN
DC:	+ 24V	2.0A
	+ 5V	1.6A
	- 5V	0.15A

PHYSICAL DIMENSIONS

	W.O./FRONT PANEL	W/FRONT PANEL
HEIGHT	4.625 INCHES	4.97 INCHES
WIDTH	8.59 INCHES	8.78 INCHES
DEPTH	13.75 INCHES	14.00 INCHES
WEIGHT		12 LBS

MTBF (WARRANTED AND GUARANTEED)

DESIGN GOAL	8000 HRS
1974	2600 HRS
1975	3200 HRS
AFTER 1975	4000 HRS

<u>MTTR</u>	20 MINS
<u>USEFUL LIFE OF UNIT</u>	5 YRS (BEFORE FACTORY OVERHAUL OR REPLACEMENT)
<u>MINIMUM HEAD LIFE</u>	IN EXCESS OF 10,000 HRS
<u>MINIMUM MEDIA LIFE</u>	IN EXCESS OF 2,000,000 PASSES ON A SINGLE TRACK

3

3.1

3.1.1

3.1.1

3.1.1



3.1.1

3.1.1

3.1.1

3.1.1

3.1.1

Read Data Command.

3.1.3

Not used on the Control Channel in the FDC 100.

Read Status Command.

3.1.4

From FDC 100 to RC 3500.

0	7 8	15
0	CUR. TRACK	STATUS

bit 15: READY.

Bit 15 = 1 whenever the FDC 100 is ready to accept a new Control Command (section 3.1.1).

During the power up sequence bit 15 = 0; when the power up sequence terminates, bit 15 switches to logic 1 and interrupt is sent to RC 3500, if the diskette is fully installed and the front panel door is closed.

If the front panel door is open, bit 15 = 0; when the door is closed, bit 15 switches to logic 1 and interrupt is sent to RC 3500.

When a Control Command (section 3.1.1) is decoded by the FDC 100 interface, bit 15 switches to logic 0; when the command terminates, bit 15 switches to logic 1, and interrupt is sent to RC 3500.

bit 14: WRITE PROTECTION.

This status bit simply follows the Write Protection Switch on the Front Panel.

bit 13: LOCAL.

Bit 13 switches to logic 1 when the front panel door is opened, at the same time interrupt is sent to RC 3500 (bit 15 = 0 in this situation).

When the door is closed again, the FDC 100 interface starts to monitor the distance between the index hole pulses (one per revolution of the diskette) to indicate

when the diskette rotates with the nominal speed.

When the speed is correct, bit 13 switches to logic 0, bit 15 to logic 1, and interrupt is sent to RC 3500.

bit 12: HEAD UNLOADED.

If a Write Control Command (section 3.1.1) or a Write Data Command (section 3.1.2) is received in the FDC 100 interface, the read/write is loaded against the disc surface and bit 12 is logic 0.

If more than four revolutions of the diskette have occurred without head-movements or data transfer at the data channel (section 3.2), hardware unloads the head from diskette surface to reduce wear on both the diskette and the head. In this situation bit 12 switches to logic 1, and interrupt is sent to RC 3500.

bit 11: ADDRESS CRC ERROR.

Bit 11 = 1 indicates that the polynomial check characters, in the address section of the sector corresponding to the sector number specified in the write command (section 3.1.2), was in error. If bit 11 = 1, the current read/write operation is terminated, and bit 15 switches to logic 1, and interrupt is sent to RC 3500.

Bit 11 is cleared when a new Control Command is issued.

bit 10: DATA CRC ERROR.

Bit 10 = 1 indicates that a CRC error is found during reading or check reading the data part of a sector.

Bit 10 is valid, when bit 15 switches to logic 1 to indicate termination of the current command.

Bit 10 is cleared when a new Control Command is issued.

bit 9: TRACK ERROR.

If during reading the address part of a sector, the track number read from the diskette does not correspond to the

number selected by RC 3500 during a TRACK SEARCH command, bit 9 switches to logic 1, and the current read/write command is terminated by bit 15 switching to logic 1; and interrupt is sent to RC 3500.

Bit 9 is cleared when a new Control Command is issued. The correct software response to this Track Error situation is to start a track recalibration procedure.

bit 8: HARDWARE ERROR.

Bit 8 = 1 indicates one or more of the following fault conditions:

- a. Write Enable to the Disc Drive without head loaded.
- b. Incorrect data rate.

Bit 8 is valid when the current WRITE ONE SECTOR command terminates with bit 15 switching to logic 1 and interrupt to RC 3500.

Remember that no valid data in this situation is written on the diskette, and the write command must be repeated on the same sector.

Bit 8 is cleared when a new Control Command is issued.

bit 7- 1: CURRENT TRACK.

Bit 7-1 contain the current track number selected by RC 3500 during a TRACK SEARCH command.

After termination of a RECALIBRATION command bit 7-1 are all zeroes (track 00).

Bit 7 corresponds to the least significant bit of the current track number.

Remember that bit 7-1 are not valid when a TRACK SEARCH command is in progress; bit 7-1 are first valid when the command is terminated.

bit 0: Logic zero.

Data Channel.

3.2

This channel is used to transfer data between RC 3500 and the FDC 100 interface, after this data transport is started by using the Control Channel (section 3.1).

Write Control Command.

3.2.1

Not used on this Channel.

Write Data Command.

3.2.2

From RC 3500 to FDC 100.

0	7 8	15
1st BYTE	2nd BYTE	

bit 0- 7: 1st Data Byte to be written on the diskette.
Bit 7 is the least significant bit of the byte.

bit 8-15: 2nd Data Byte to be written on the diskette.
Bit 15 is the least significant bit of the byte.

After a WRITE ONE SECTOR command (section 3.1.1) is sent to the FDC 100 including a sector number (section 3.1.2), the FDC 100 will go to search after this sector; when this is found and the head reaches the correct position in the sector (3 bytes before the Data Field Sync), the first interrupt is sent on the data channel; to execute this and the following interrupts the software has a time corresponding to writing two bytes (64 usec.).

The following data block must be sent by using the Write Block of Word instruction:

ALL ZEROES	DATA FIELD SYNC	FIRST WORD
1st Data BYTE	2nd Data BYTE	
⋮	⋮	
127th DATA BYTE	128th DATA BYTE	LAST WORD

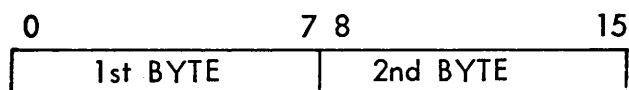
After the FDC 100 receives the last word, no further interrupts are sent on the data channel.

The transfer rate is about 15K words per sec. For details about the meaning about the Data Field Sync refer to section 2.2.

Read Data Command.

3.2.3

From FDC 100 to RC 3500.



bit 0- 7: 1st Data Byte read from the diskette.
Bit 7 is the least significant bit of the byte.

bit 8-15: 2nd Data Byte read from the diskette.
Bit 15 is the least significant bit of the byte.

After a READ ONE SECTOR command (section 3.1.1) is sent to the FDC 100 including a sector number (section 3.1.2), the FDC 100 will go to search after this sector; when this is found and the head reaches the correct position in the sector (after reading of the Data Field Sync byte), the first interrupt is sent on the data channel; to execute this and the following interrupts the software has a time corresponding to reading two bytes from the diskette (64 usec.).

The following data block is sent to RC 3500 by using the Read Block of Words instruction:

ALL ZEROES	DATA FIELD SYNC	FIRST WORD
1st DATA BYTE	2nd DATA BYTE	
127th DATA BYTE	128th DATA BYTE	LAST WORD

The transfer rate is about 15K words per sec.

For details about the meaning of the Data Field Sync byte refer to section 2.2.

Read Status Command.

3.2.4

Not used on this channel.

In this section the commands listed in section 3.1.1 are described in details.

Power up Sequence.

4.1

The time from power on, until the drive is operable, is approximately 2 sec.

During this time period bit 15 in the status word (section 3.1.4) is logic 0.

After termination of the 2 sec. timer the FDC 100 is ready to operate; if a diskette is fully installed and the front panel door is closed, this situation causes an interrupt to be sent to RC 3500 on the Control Channel. The corresponding status word has the following bit-pattern:

0								7	8							15
0	0	0	0	0	0	0	0	0	0	0	0	1	0	x	1	

If the door is open when the power up sequence terminates, no interrupt is sent to RC 3500. But when the door is closed, the interrupt is sent to RC 3500, and the corresponding status word has the bit-pattern shown above.

Reset.

4.2

This command is always accepted in the FDC 100. When this command is received in the FCD 100, bit 15 (READY, section 3.1.4) is reset, and a reset pulse with a length of 3 usec. is generated to clear all the logic circuits.

All current commands (both head movements and data transfer) are terminated; and the head is unloaded.

After termination of this command, interrupt is sent to RC 3500.

The corresponding status word has the following bit-pattern:

0	7						8	15						
0	x	x	x	x	x	x	0	0	0	0	1	0	x	1

When pushing the AUTO switch on the operator panel of RC 3500 (or receiving an EXTERNAL AUTO load) the autoloader program will start with sending a Write Control Command with a data word containing all zeroes to all devices (0-31), and also to the device number, to which the Control Channel of FDC 100 is connected; and so setting the FDC 100 to a well defined state before starting the Floppy Disc Autoloader Driver.

Recalibration.

4.3

For details refer to the Flow Chart fig. 4.3.

When this command is accepted in the FDC 100 interface, bit 15 (READY, section 3.1.4) is reset; then Step Out pulses (duration 10 ms.) are supplied to the head, until the head is positioned over track 00, the outer track.

The track-counter is reset, and interrupt is sent to RC 3500 on the Control Channel.

The corresponding status word has the following bit-pattern:

0							7	8							15
0	0	0	0	0	0	0	0	0	0	0	0	0	0	x	1

This command should be issued before operation after powering up.

This command should also be issued, if a Track Error is found during executing one of the data commands.

For details refer to the Flow Chart fig. 4.4.

A Write Data Command (section 3.1.2) is sent to FDC 100, containing information about the wanted track number; this command, too, loads the head if it is not already loaded.

Then a Write Control Command (section 3.1.1) is sent containing the TRACK SEARCH command code. This command is issued in FDC 100 by setting bit 15 (READY, section 3.1.4) = 0.

The delivered number for Wanted Track is compared with the contents of the track counter (CUR TRACK). If the wanted track number is greater than CUR TRACK, step in pulses (10 msec.) are supplied to the head drive, and the track counter is incremented by each step in pulse, until wanted track number is equal to the contents of the track counter.

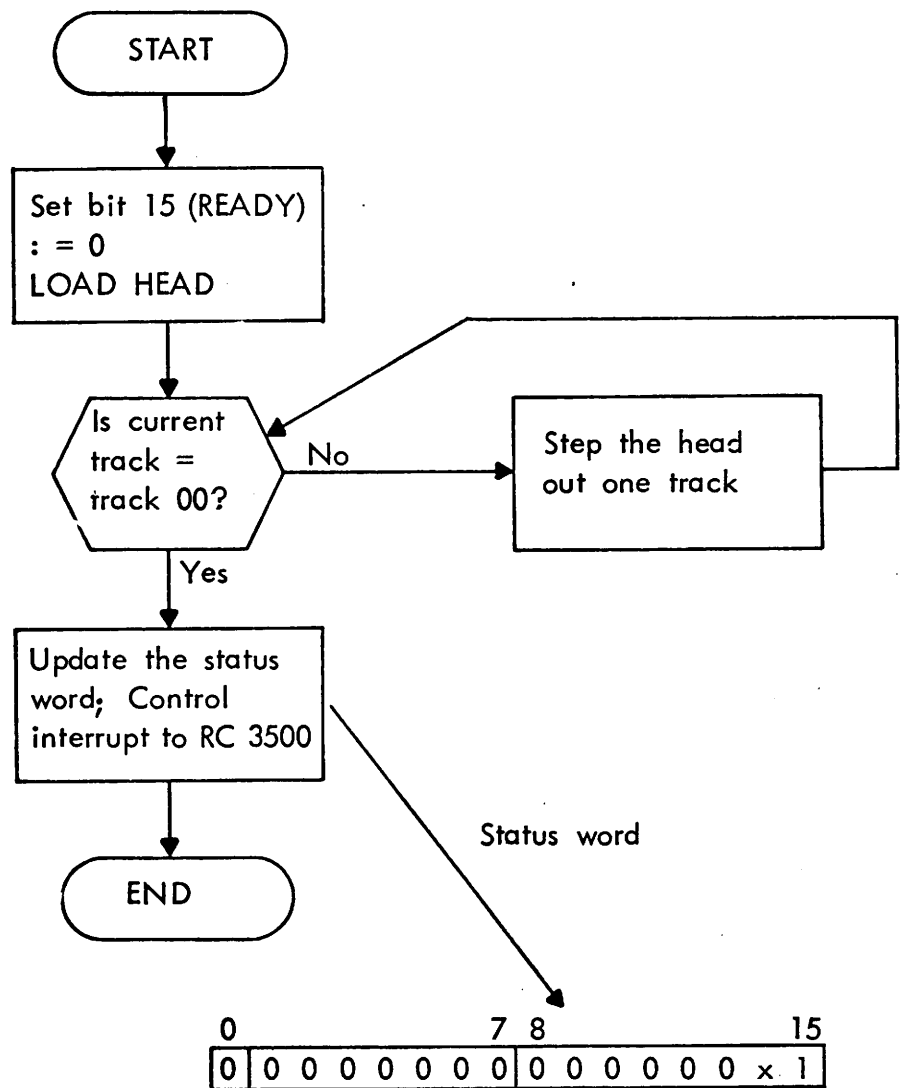
If the Wanted Track number is lesser than CUR TRACK, step out pulses (10 msec.) are supplied to the head drive, and the track counter is decremented by each step out pulse, until wanted track number is equal to the contents of the track counter.

When Wanted Track is equal to CUR TRACK, the command is terminated and interrupt is sent to RC 3500 on the Control Channel.

The corresponding status word has the following bit-pattern:

0		7	8							15
0	CUR. TRACK	0	0	0	0	0	0	0	x	1

Remember that if a Read Status Command is issued when TRACK SEARCH is in progress, bit 1-7 in the status word are not valid. Bit 1-7 are first valid in the moment the TRACK SEARCH command terminates.



Recalibration Command

Flow Chart

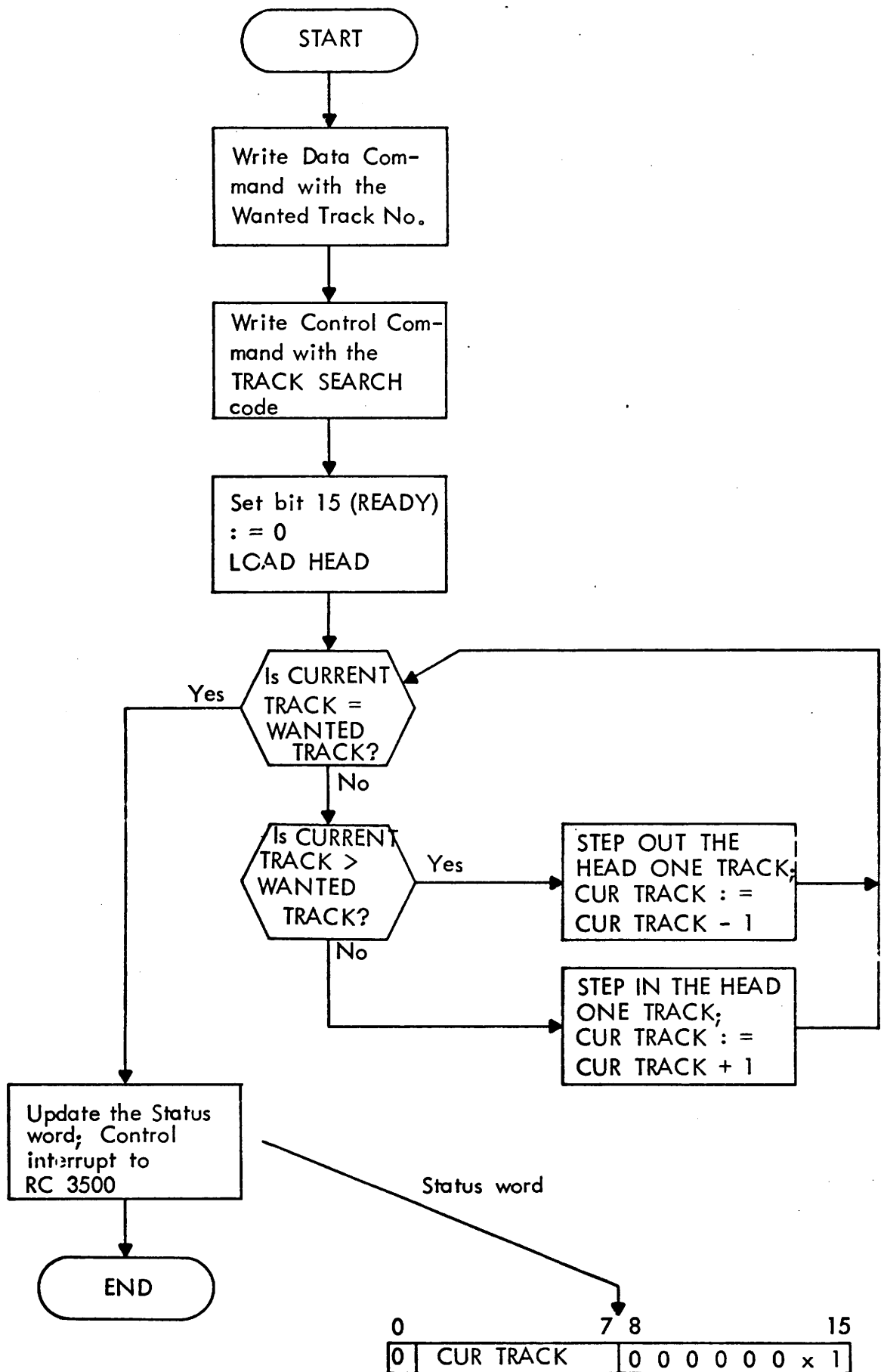
Fig. 4.3

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FDC 100

4-4



Interrupt if Ready.

4.5

When issued this command causes an interrupt to RC 3500 on the Control Channel, if bit 15 (READY, section 3.1.4) is logic 1; if bit 15 is logic 0, nothing occurs.

This command can be issued during executing of all other commands.

Read One Sector.

4.6

A Write Data Command (section 3.1.2) is sent to FDC 100, containing information about the sector number (in the range 1-26) from which the data block should be read.

Then a Write Control Command (section 3.1.1) is sent, containing the READ ONE SECTOR command code.

This command is issued in FDC 100 by setting bit 15 (READY, section 3.1.4) = 0.

If the necessary settling time for the head has gone (10 msec. after last track move and 60 msec. after head loading) - or the hardware waits until the settling time is terminated - the FDC 100 starts to monitor the serial data from the diskette to look after an ADDRESS FIELD SYNC byte.

When such a byte is found, the following address block is read.

The track number in the address block is compared with the contents of the track counter; if not equal, the command is terminated and interrupt is sent to RC 3500 on the Control Channel.

The corresponding status word has the following bit-pattern:

0		7	8		15				
0	CUR. TRACK	0	1	0	0	0	0	x	1

In the event of such a track error, recalibration of track location can be achieved by using the RECALIBRATION command (section 4.3).

If the track number in the address block is equal to the contents of the track counter, the sector number in the address block is compared with the wanted sector number. If not equal, the hardware in FDC 100 goes to look after next Address Field Sync byte and the track examine procedure above is repeated. When the correct sector number is found, the cyclic polynomial check characters for this block are checked. If a CRC error is found, the command is terminated, and interrupt is sent to RC 3500 on the Control Channel. The corresponding status word has the following bit-pattern:

0		7	8		15
0	CUR. TRACK	0	0	0	1 0 0 x 1

In the event of such a read error, up to 10 attempts should be made to recover with re-reads. If after 10 attempts the data have not been recovered, step the head several tracks away and then re-position to recover the data. If a read error is still found, the current track has to be deleted.

If the CRC check mentioned above is OK, reading from the diskette continues.

When the head reaches the Data Field Sync byte, the interrupts on the Data Channel start. The data block mentioned in section 3.2.3 is sent to RC 3500 word by word. When this data block is read from the diskette, the cyclic polynomial check characters following the data bytes are checked. The command is terminated and interrupt is sent to RC 3500 on the Control Channel. The following status word has this bit-pattern:

0		7	8		15
0	CUR. TRACK	0	0	1	0 0 0 0 x 1

CRC ERROR in Data block

0		7	8		15
0	CUR. TRACK	0	0	0	0 0 0 0 x 1

CRC OK

If the software wants to read the next sector following this without waiting the time corresponding to a revolution of the diskette, the new READ ONE SECTOR command has to be issued within 400 usec. after the termination of the first sector reading.

If no correct sector number is found, the command is terminated after four revolutions of the diskette, the head is unloaded, and interrupt is sent to RC 3500 on the Control Channel.

The corresponding status word has the following bit-pattern:

0		7	8		15				
0	CUR. TRACK	0	0	0	0	1	0	x	1

Read Check One Sector.

4.7

This command is the same as READ ONE SECTOR mentioned in section 4.6, but during executing of READ CHECK ONE SECTOR command no interrupts are sent to RC 3500 on the Data Channel.

This command is terminated in the same situations as mentioned in section 4.6.

Write One Sector.

4.8

A Write Data Command (section 3.1.2) is sent to FDC 100, containing information about the sector number (in the range 1 to 26) into which RC 3500 wants to write data. Then a Write Control Command (section 3.1.1) is sent containing the WRITE ONE SECTOR command code.

This command is issued in FDC 100 by setting bit 15 (READY, section 3.1.4) = 0.

If the necessary settling time for the read/write head has gone (10 msec. after last track move and 60 msec. after head loading), or the hardware waits until this time has elapsed, the FDC 100 starts to monitor the serial data from the diskette to look after an Address Field Sync byte.

When such a byte is found, the following address block is read.

The track number in the address block is compared with the contents of the track counter; if not equal the command is terminated and interrupt is sent to RC 3500 on the Control Channel.

The corresponding status word has the following bit-pattern:

0		7	8		15				
0	CUR. TRACK	0	1	0	0	0	0	x	1

In the event of such a track error, recalibration of track location can be achieved by using the RECALIBRATION command (section 4.3).

If the track number in the address block is equal to the contents of the track counter, the sector number in the address block is compared with the wanted sector number. If not equal the hardware in FDC 100 continues to look after next Address Field Sync byte, and the track examine procedure mentioned above is repeated. When the correct sector number is found, the cyclic polynomial check characters for this block are checked, and the state of the Write Protection is tested.

if a CRC error is found, the command is terminated, and interrupt is sent to RC 3500 on the Control Channel.

The corresponding status word has the following bit-pattern:

0		7	8		15				
0	CUR. TRACK	0	0	0	1	0	0	x	1

If Write Protection is selected, the command is terminated, and interrupt is sent to RC 3500 on the Control Channel.

The corresponding status word has the following bit-pattern:

0		7	8		15				
0	CUR. TRACK	0	0	0	0	0	0	1	1

If the CRC check mentioned above is OK, and Write Protection is not selected, the reading from the diskette continues until 6 bytes before the Data Field Sync byte.

After writing 3 bytes with all zeroes on the diskette, the first interrupt is sent to RC 3500 on the Data Channel. From this point RC 3500 sends the data block mentioned in section 3.2.2 word by word.

After this data block is written on the diskette, two bytes more are written, the cyclic polynomial check characters generated by hardware in FDC 100.

FDC 100 switches back to read mode, the command is terminated, and interrupt is sent to RC 3500 on the Control Channel.

The corresponding status word has the following bit-pattern:

0		7	8					15
0	CUR. TRACK	0	0	0	0	0	0	1

If no correct sector number is found, the command is terminated after four revolutions of the diskette, the head is unloaded, and interrupt is sent to RC 3500 on the Control Channel.

The corresponding status word has the following bit-pattern:

0		7	8					15
0	CUR. TRACK	0	0	0	0	1	0	x 1

Diskette Removal.

4.9

Open Disc Door, this causes rotation to stop, and disengage spindle.

Remove the diskette from Disc Drive and put it in its storage envelope.

Remember that the door can be opened both when the FDC 100 is performing a command or not. When the door is opened, the FDC 100 is cleared, and the read/write head is unloaded and interrupt is sent to RC 3500 on the Control Channel.

The corresponding status word has the following bit-pattern:

0								7	8						15
0	0	0	0	0	0	0	0	0	0	0	0	1	1	x	0

Diskette Loading.

4.10

Remove the diskette from storage envelope. Carefully slide diskette into Disc Drive, until jacket is solidly seated against stops.

Carefully close unit door. Ensure that jacket is properly seated, spindle has engaged diskette, and door is closed and latched.

Protect the empty envelope from liquids, dust, and metallic materials.

When the door is closed, the FDC 100 starts to monitor the distance between the index hole pulses (one per revolution of the diskette) to indicate when the diskette rotates with nominal speed. This detection takes about 2 sec. (15 revolutions). When the speed of the diskette is nominal, interrupt is sent to RC 3500 on the Control Channel.

The corresponding status word has the following bit-pattern:

0								7	8						15
0	0	0	0	0	0	0	0	0	0	0	0	1	0	x	1

Remember that the head position is undefined after the load procedure above, so the software has to start with a recalibration of the head position.

Operator Controls.

4.11

The only operator control is the WRITE PROtection switch (refer to fig. 5.0).

This switch is connected to a Flip-Flop in FDC 100; the state of this Flip-Flop is alternated every time the operator pushes the WRITE PRO switch.

When this Flip-Flop is in the Write Protection state, all write operations are inhibited, as described in section 4.8.

After Power Up (section 4.1) and after FDC 100 has been in LOCAL mode (section 3.1.4), FDC 100 is forced into write protection mode.

Indicators.

4.12

For details refer to Fig. 5.0.

In the WRITE PRO switch mentioned in section 4.11 is placed a lamp, lighting when FDC 100 is in write protection mode.

POW OK, a lightemitting diode placed in the CHS 701 cabinet, lighting when the DC voltages to the Disc Drive and the FDC 100 controller are within their nominal values.

For details refer to fig. 5.0.

Disc Drive Cabinet.

5.1

This is a cabinet to mount up to two CDC 9400 Disc Drives side by side, each Disc Drive being vertically oriented.

On the front panel of this cabinet are placed two WRITE PRO switches/indicators, one for each drive. If only one Disc Drive is mounted, a spare plate is placed over the hole to the other Disc Drive. Between the two Disc Drives is placed a magazine to the empty diskette transport covers.

Height: 31 cm.

Width: For 19" rack mounting

Depth: For 19" rack mounting

Controller Cabinet.

5.2

The controller cabinet includes its separate power supply expandable to supply maximum four Disc Drives and four FDC 100 controller boards. There are five slots for controller boards.

On fig. 5.2.1 is shown:

- a. Mounting of FDC 100 controller boards in CHS 701
- b. Mounting of power-modules in the power supply
- c. Mounting of jacks on the back of CHS 701

On fig. 5.2.2 is shown the internal cables in CHS 701 to connect the FDC 100 controller board with the jacks on the back of CHS 701.

Height: 7 inches

Width: For 19" rack mounting

Depth: For 19" rack mounting

External Cables.

5.3

For details refer to fig. 5.3.

2 cables CBL 410 are used between FDC 100 and RC 3500. Max. length of CBL 410 is 100 m.

CBL 208 is used to connect FDC 100 with the Disc Drive.

2 cables CBL 432 are used to supply AC-power to the controller cabinet and the Disc Drive.

Power Requirements.

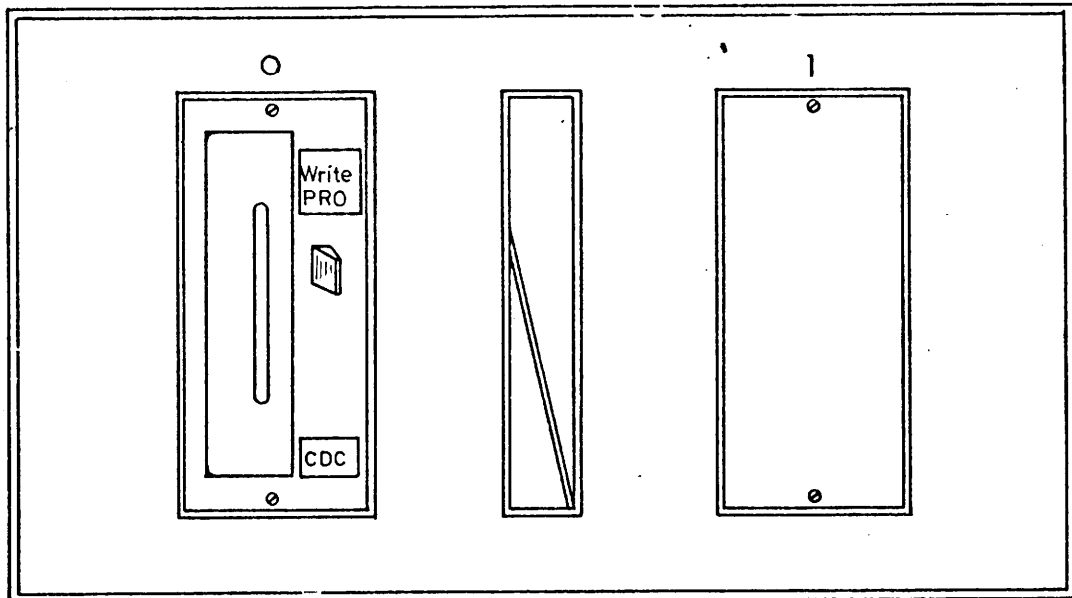
5.4

220V AC ($\pm 10\%$) single phase, 50 HZ ($\pm 2\%$). The power dissipation in a system with one Disc Drive is:

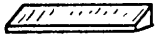
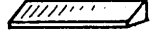
302W, 250 KCAL/h, 1025 BTU/h.

For every Disc Drive the system is expanded, the power dissipation is increased by 200 W.

Front View of Drive Cabinet



Front View of Controller Cabinet

 POW ○ OK CHS 701	SPARE		 cabinet system
	[FDC 100	Drive 3] *	
	[FDC 100	Drive 2] *	
	[FDC 100	Drive 1] *	
	FDC 100	Drive 0	

* Used when the system is extended to more than one Disc Drive.

Back View of Controller Cabinet

J3	J6	J9	J12		J11	J5	J1
J4	J7	J10	J13		J14	J8	J2

J1, J2: not used in this application (Nova I/O-Bus)

J3: Control Channel to RC 3500 for Drive 0

J4: Data Channel to RC 3500 for Drive 0

J5: Connector to Disc Drive 0

The dashed jacks are extension options for Drive 1 - 2 - 3

J6 - J9 - J12: Control Channel to RC 3500 for Drive 1 - 2 - 3

J7 - J10 - J13: Data Channel to RC 3500 for Drive 1 - 2 - 3

J8 - J11 - J14: Connector to Disc Drive 1 - 2 - 3

Placering af printkort, spændingsmoduler og kabelstik i CHS 701

Kortskuffe		Strømforsyning
E	SPARE	
D	[FDC 100 Drive 3] *	
C	[FDC 100 Drive 2] *	
B	[FDC 100 Drive 1] *	
A	FDC 100 Drive 0	

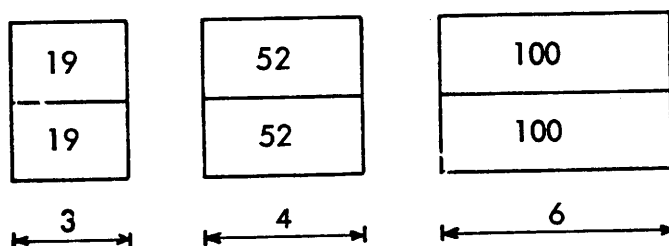
Kabelstik

Strømforsyning		
1	POW 709	POW 710 4
2	POW 706 Drive 0	(POW 706) * Drive 2 5
3	(POW 706) * Drive 1	(POW 706) * Drive 3 6

Kabelstik								
Udgave	J3	J6 *	J9 *	J12 *	SPARE	J11 *	J5	CHS 701 J1
	J4	J7 *	J10 *	J13 *	SPARE	J14 *	J8 *	CHS 701 J2

24 enheder

* Used when the system is extended to more than one Disc Drive.



Benævnelse: FDC 100 CONTROLLER CABINET	Nr.: Fig. 5.2.1	Blad:
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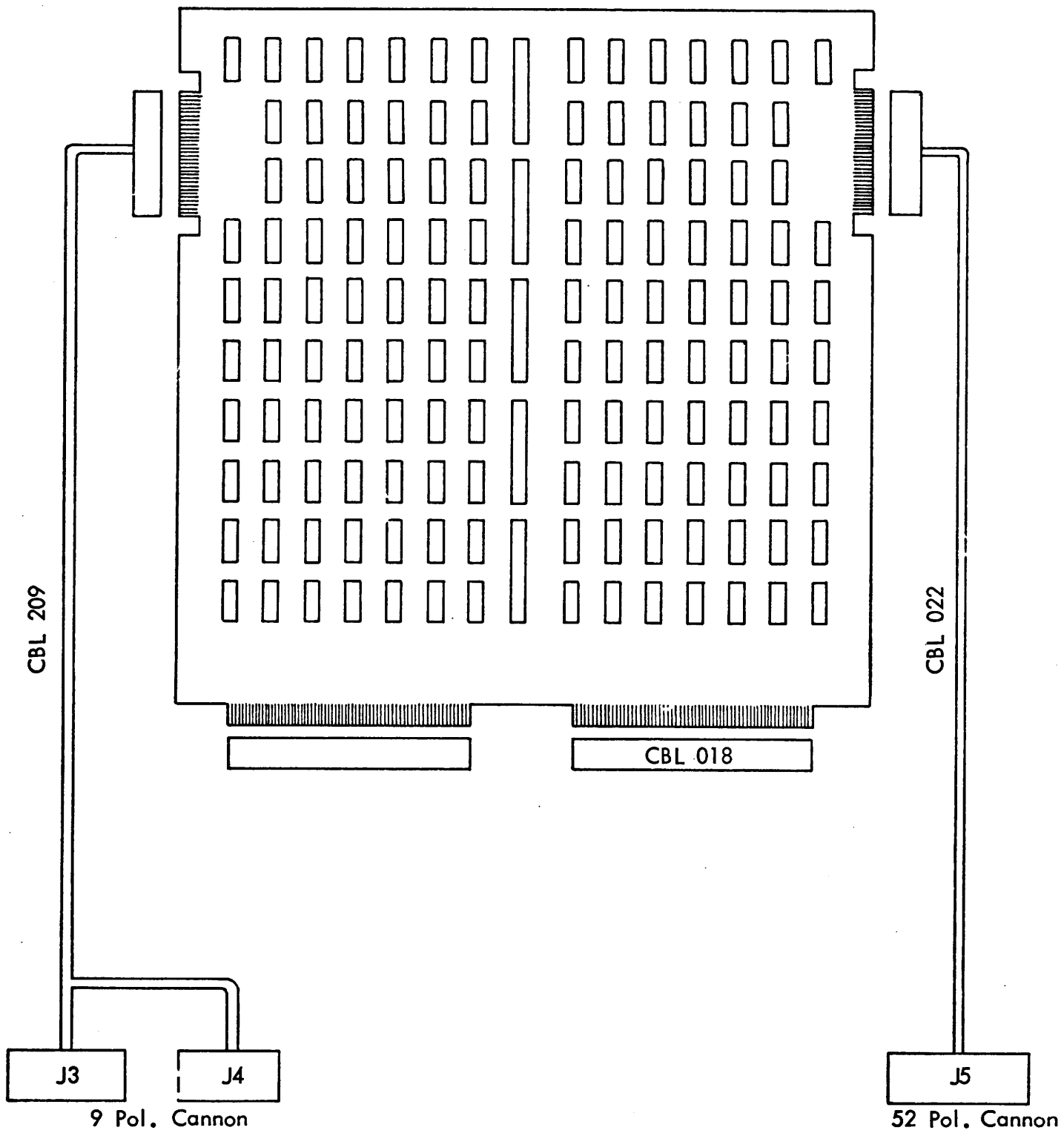
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FDC 100

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FDC 100 POS. A



A23611

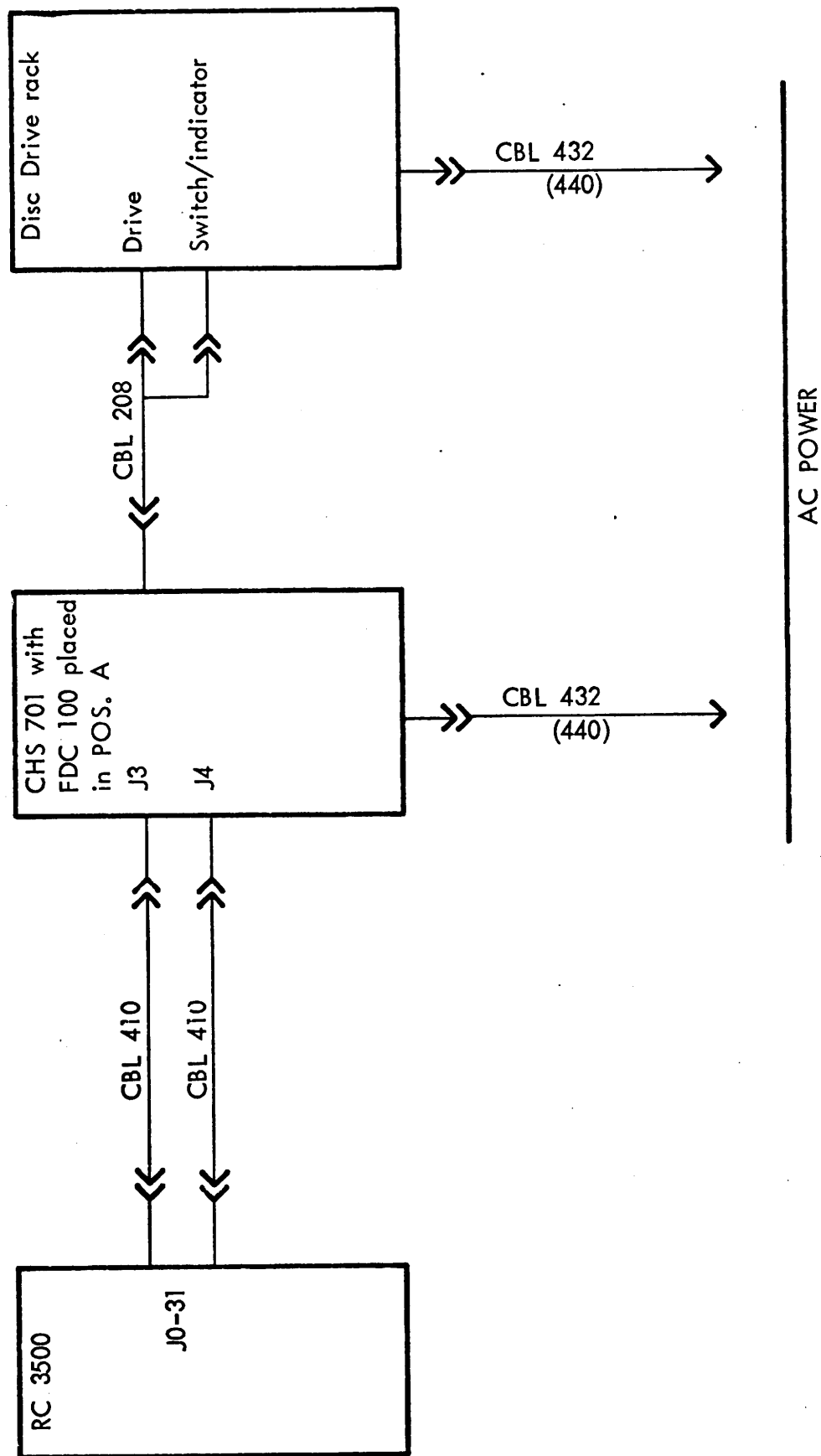
AA313

CHS 701
Internal Cables

FDC 100

Fig. 5.2.2

5-5



A23612

AA313

System Outline
Figure

FDC 100

Fig. 5.3

5-6

For detailed information about preventive maintenance, trouble shooting, and corrective maintenance to maintain the Disc Drive CDC 9400, refer to the Technical Manual for this unit:

Publication No. CDC 75735100.