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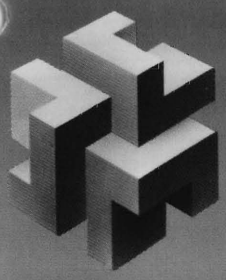

Flexible Disc Control Units
MIFZ PTS6751-103

Field Support Manual

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MIFZ PTS6751-103

Field Support Manual

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MIFZ PTS6751-103

Field Support Manual

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1.1 INTRODUCTION

The MIFZ control unit transfers data between the system and the mini floppy diskette drive NEC FD 1155C. The CU operates via the GP Bus-Simplified or the UPL Bus on IOP channel only. Up to two "daisy chain" connected drives can be interfaced with one CU, but the drives must all be of the same type. (See fig. 1.1). NEC drives are supplied without door lock option.

The characteristics of the drive are given in table 1.1.

The CU performs the following functions;

- Input/Output of 16 bit parallel data into memory via the system bus.
- Serial/parallel conversion of data with CRC word generation and checking.
- Input/output of serial data to disk drives with data encoding and decoding.
- Control of disk "read-write" operation.
- Status word generation.

1.2 PHYSICAL DESCRIPTION

The CU is implemented on one double sided printed circuit card of the double Eurocard format.
The card is fitted with an F068 type connector which mates with a connector mounted on the back panel of the main chassis and which provides the interface with the bus. See fig. 1.2.

1.3 TECHNICAL DATA

1.3.1 Performance Data

Throughput	:	250 bits/sec
Recording mode	:	FM (double frequency)
Throughput	:	500 K bits/sec
Recording mode	:	MFM (double density)

1.3.2 Power Requirments

Voltage	:	+5V + 5%
Typ. Current	:	2 amps with I.H.C. chip; 1.8 amps without I.H.C. chip

1.3.3 Environmental Conditions

Maximum ambient temperature range: 0 - 50°C

NOTE: *For the disk drives this is only 10 - 38°C.*

Maximum relative humidity : 90%

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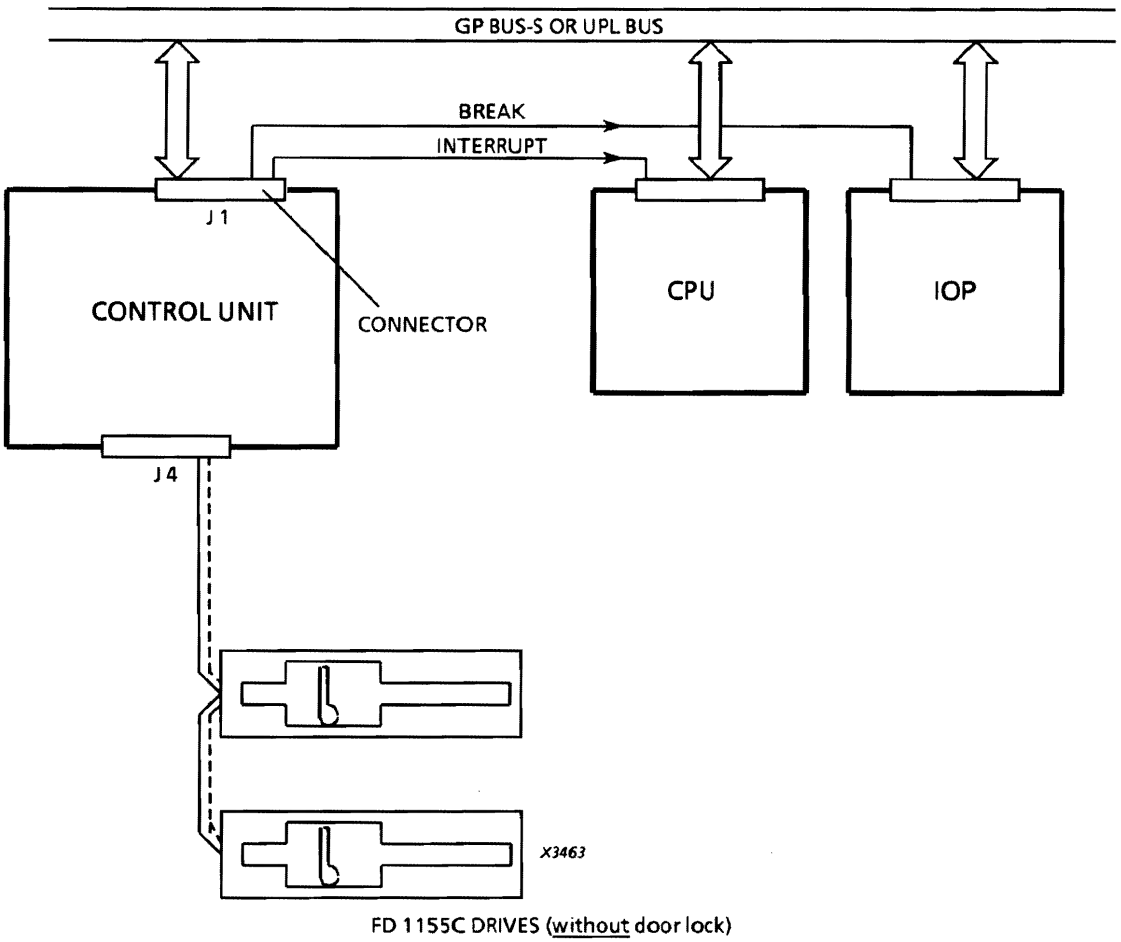

Figure 1.1 Position of CU in the System

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1.4 INTERFACE

The CU communicates with the system via the bus. Discrete interrupts and break connections are made with jump leads on the back panel (the binary coded interrupt used with the UPL bus is a bussed signal). The connections are made via connector J1, see table 1.2a, and 1.2b.

Connector J4 is provided for $5\frac{1}{4}$ inch drives (see table 1.4).

Another connector also mounted on the front of the card, J5 is provided for test purposes, see table 1.4 coincidence tool or a logic analyser can be connected.

1.5 APPLICATIONS NOTES

1.5.1 Configuration

The CU puts the disk drives into communication with the rest of the system via the bus. Figure 1.1 shows the place of the CU in the system.

1.5.2 Initial Program Loading (ECMA99 Format Type)

The IPL can be loaded from floppy disk using the standard P800 bootstrap (P843-053 sequential and disk bootstrap). The control panel data switches must be positioned as follows:

0	1	2	3	4 5 6 7	8	9	10 11	12 13 14 15
0	1	1	0	Sector n° (0-15)	1	1	Drive n°	CU Address

With this bootstrap thr IPL is loaded from cylinder 0, head 0.
This track is always formatted with format 0 (single density, 26 sectors/track and 128 bytes/sectors).

For PTS 6920 systems, the normal IPL procedure can be applied.

1.5.3 Power Failure/Automatic Restart

The CU and disk drive will be restarted after a power failure without operator action. Information on the disk will not be destroyed but a sector of the disk being written when a power failure occures must be completely re-written after the CU is restarted.

1.5.4 Drive Control

Up to two drives may be controlled from a single CU but all drives must be of the same type. The drives cannot operate simultaneously, a command for one drive must be finished before a command for another drive is sent by the CPU.

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1.6 INSTALLATION DATA

1.6.1 Strap Settings (Refer to Figure 1.2)

U-links on the card are used to select:

- CU address
- Binary interrupt priority level (when binary coded interrupts are used)
- Bus timing for exchange timing signal TSMN
- Drive type selection
  These U-links are set at system installation time
- U-links for test purposes: U-links must be fitted for normal operation as indicated in figure 1.2.

1.6.2 Mounting

The CU card is mounted in a slide in the main chassis. Connector chassis and the card is held in place with two plastic safety catches. The slide position for mounting the card is chosen at system installation time and is given in the configuration sheets provided with the system.

1.6.3 Break and Discrete Interrupt Connections

These are dedicated connections made by jump leads between the CU connector on the back panel of the main chassis and the CPU (interrupt) or IOP (break) connectors. The connections at the CPU and IOP connectors determine the priority level of the CU and are chosen at system installation time.
Interrupt IRN is situation at pin 1C05.
Break signal BRN is situated at pin 1A05.

1.6.4 Binary Coded Interrupts

When the CU is used with ther UPL bus a binary coded interrupt may be used. In this case an Interrupt Handler Chip (IHC) must be ordered separately and plugged into the empty socket at position A3 on the card. The interrupt priority level is then selected with the six U-links as described at para 1.6.1 above.
The jump lead connection for the discrete interrupt request is not fitted in this case.

1.6.5 Drive Connections

NEC DRIVES:

A 34 wires, 1 to 1 flat cable, interconnects connector J4 and the NEC drives. See table 1.4.

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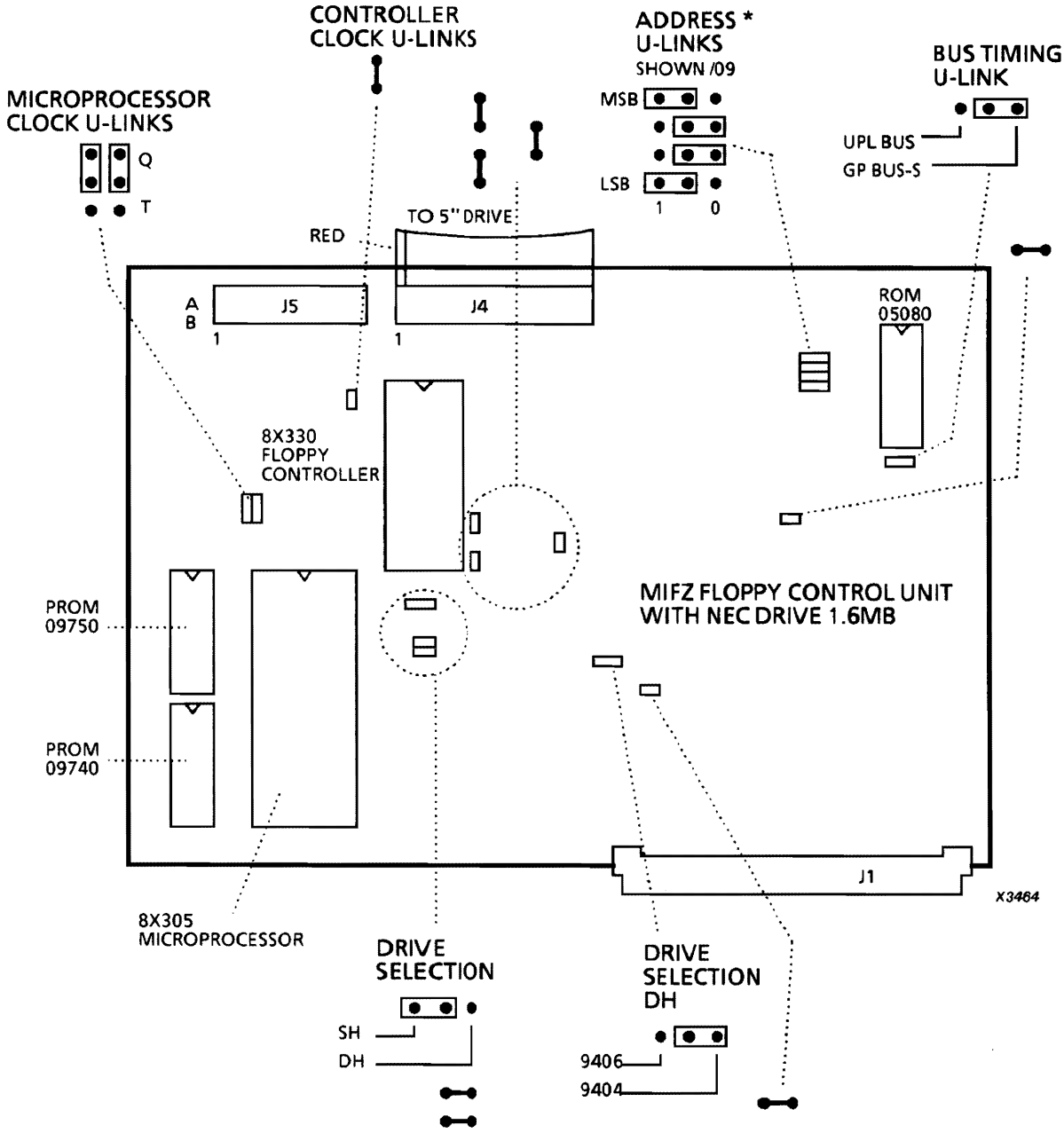
Strapsettings of MIFZ



* FOR CONNECTION TO HU02 EXTENSION CABINET
THE CU ADDRESS MUST BE /08

Figure 1.2 Layout of CU Card

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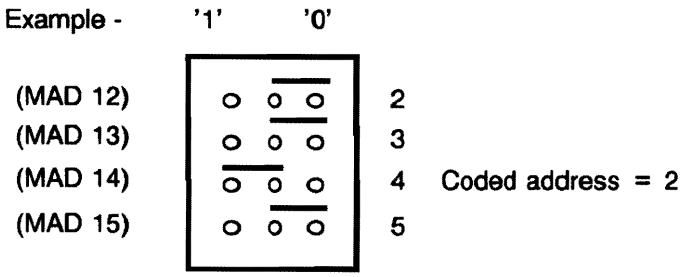
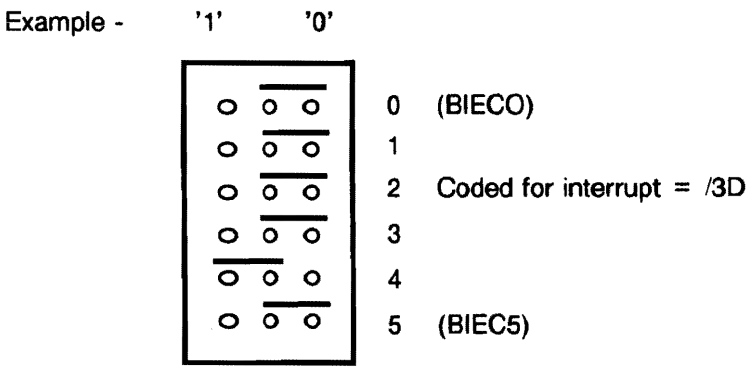
Address Coding Links

These for U-links are located at B5 on the card and are identified by the letters AD, an example of address coding is shown below.



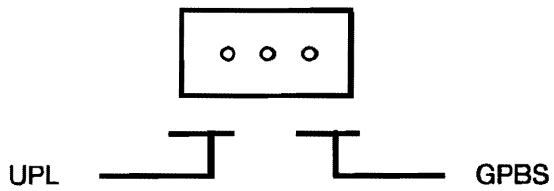
Interrupt Coding Links

These six U-links may be located at A4 on the card and are used with the UPL Bus and an Interrupt Handler Chip for coding the interrupt level; an example of interrupt coding is shown below.



GPBS or UPL Bus Selection Link

The selection of either GPBS or UPL Bus timing is made with one U-link located at A4 on the card. The two positions for the link are shown below.



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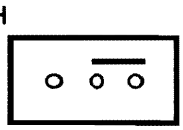
Mini-Floppy Drive Selection Links

There are two U-links used to select the required operation for the mini-floppy drive unit used with this CU. One is at K3 and one at F2 on the card, and the positions for the links are shown below:

- the link at K3: must be set to SH



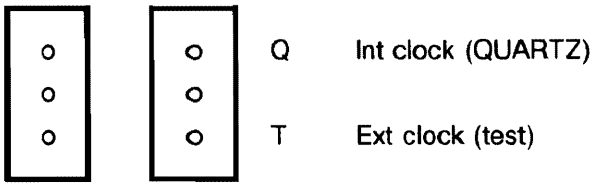
- the link at F2: must be set to the unmarked side



Clock Selection Link

The selection of either the internal clock or external clock (used in Test mode), is made with two U-link located at P4.

The two possible positions for the links are shown below:



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Disc Drive Characteristics

Capacity (unformatted)	1.6M-bytes
Capacity (formatted with spare tracks included)	Format's type dependant (see table 2.1)
Number of heads	2
Number of tracks/surface	80
Number of sectors/tracks	Format's type dependant (see table 2.1)
Positioning times: (including settling time)	
-single track	18 ms
-average	95 ms
-maximum	255 ms
Average latency time (half revolution)	83 ms
Start time	800 ms Max.
Recording method	FM and MFM
Transfer rate (FM) high density and (MFM) low density	250 Kbits/s
Transfer rate (MFM) high density	500 Kbits/s
DC Power Supplies	+ 12VDC ±5% 0.39A Max. + 5VDC ±5% 0.46A Max.

Table 1.1 Disk Drive Characteristics

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J1 - UPL Bus Connector Pinning

PIN NUMBER	SIGNAL NAME	PIN NUMBER	SIGNAL NAME	PIN NUMBER	SIGNAL NAME
1C01		1B01		1A01	
1C02		1B02		1A02	
1C03	BCI	1B03		1A03	INCL
1C04		1B04		1A04	
1C05	IRON*	1B05		1A05	BRON*
1C06	OV	1B06		1A06	OV
1C07		1B07		1A07	RSLN
1C08	CLEARN	1B08		1A08	ACN
1C09	OV	1B09		1A09	OV
1C10	TMPN	1B10		1A10	TSMN
1C11		1B11		1A11	
1C12	OV	1B12		1A12	OV
1C13		1B13		1A13	
1C14		1B14		1A14	MAD03
1C15	MAD04	1B15		1A15	
1C16		1B16		1A16	
1C17	MAD08	1B17		1A17	MAD09
1C18	MAD10	1B18		1A18	MAD11
1C19	MAD12	1B19		1A19	MAD13
1C20	MAD14	1B20		1A20	MAD15
1C21		1B21		1A21	
1C22	OV	1B22		1A22	0V
1C23	BI008N	1B23		1A23	BI000N
1C24	BI009N	1B24		1A24	BI001N
1C25	BI010N	1B25		1A25	BI002N
1C26	BI011N	1B26		1A26	BI003N
1C27	BI012N	1B27		1A27	BI004N
1C28	BIO13N	1B28		1A28	BI005N
1C29	BI014N	1B29		1A29	BI006N
1C30	BI015N	1B30		1A30	BI007N
1C31		1B31		1A31	
1C32	+5VL	1B32		1A32	+5VL

Table 1.2a Bus Signals (Connector J1) UPL - Bus

* These signals are not connected on the back panel Bus. If coded interrupts are used (which use the signals on pins IC03 and 1A03), the signal IRON will not need to be wired.

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GPBS Bus Connector Pinning

PIN NUMBER	SIGNAL NAME		PIN NUMBER	SIGNAL NAME
1C01			1A01	
1C02			1A02	
1C03			1A03	
1C04			1A04	
1C05	IRON		1A05	BRON
1C06	0V		1A06	0V
1C07			1A07	RSLN
1C08	CLEARN		1A08	ACN
1C09	0V		1A09	0V
1C10	TMPN		1A10	TSMN
1C11			1A11	
1C12	0V		1A12	0V
1C13			1A13	
1C14			1A14	MAD03
1C15	MAD04		1A15	
1C16			1A16	
1C17	MAD08		1A17	MAD09
1C18	MAD10		1A18	MAD11
1C19	MAD12		1A19	MAD13
1C20	MAD14		1A20	MAD15
1C21			1A21	
1C22	0V		1A22	0V
1C23	BI008N		1A23	BI000N
1C24	BI009N		1A24	BI001N
1C25	BI010N		1A25	BI002N
1C26	BI011N		1A26	BI003N
1C27	BI012N		1A27	BI004N
1C28	BI013N		1A28	BI005N
1C29	BI014N		1A29	BI006N
1C30	BI015N		1A30	BI007N
1C31			1A31	
1C32	+ 5VL		1A32	+ 5VL

Table 1.2b Bus Signals (Connector J1) GPBS - Bus

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CU/Drive Connector Pinning

MIFZ PIN NUMBER	MIFZ SIGNAL NAME	MIFZ PIN NUMBER	MIFZ SIGNAL NAME	DRIVE SIGNAL NAME	DRIVE PIN NUMBER
4A01	GND	4B01	DS50N	READY	34
4A02	GND	4B02	DC40N	HEAD SELECT	32
4A03	GND	4B03	RDLN	READ DATA	30
4A04	GND	4B04	WRPN	WRITE PROTECT	28
4A05	GND	4B05	TRON	TRACK 00	26
4A06	GND	4B06	WEN	WRITE GATE	24
4A07	GND	4B07	WDN	WRITE DATA	22
4A08	GND	4B08	STEPN	STEP	20
4A09	GND	4B09	DIRN	DIRECTION	18
4A10	GND	4B10	HLN	MOTOR ON	16
4A11	GND	4B11	*		
4A12	GND	4B12	DC48N	SELECT2	12
4A13	GND	4B13	DC42N	SELECT1	10
4A14	GND	4B14	INDN	INDEX	8
4A15	GND	4B15	*		
4A16	GND	4B16	DC45N	IN USE	4
4A17	GND	4B17	DC50N	HIGH DENSITY	2

Table 1.3 CU/Mini-Floppy Disk Drive Pinning

* Not connected, at the CU side.

Pinning of J5 connector

PIN NUMBER	SIGNAL MNEMONIC	SIGNAL FUNCTION
5A13, 12	+5V	Power supply
5B13-06	IVB7N-0N	CU internal bus lines
5A01, 02	RA02-12	PROM address lines
5B05 5B04	CX1 TEST CX2 TEST	) Test input for) microprocessor clock
5B02, 03	0V	Power supply

Table 1.4 Test Connector Signals

1.6.6 Compatibility

The CU can be used with any system based on the GP Bus-simplified or on the UPL bus.

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2.1 DISK ORGANISATION

2.1.1 Tracks and Cylinders

FEATURES	ECMA99 *	IBM AT **	IMB PC-9 **	IBM PC-8 **	COMMENTS
Rotationnal speed Rpmn	360	360	300	300	
Track Density Tpi	96	96	48	48	
Number of formatted tracks per side	77	80	40	40	
Format of track 0 head 0	26 sectors of 128 tytes FM	15 sectors of 512 bytes MFM	9 sectors of 512 bytes MFM	8 sectors of 512 bytes MFM	
Format of the other tracks	26 sectors of 256 bytes FM	15 sectors of 512 bytes MFM	9 sectors of 512 bytes MFM	8 sectors of 512 bytes MFM	
Cells duration us	Track 0, Head 0 : 4 Others :2	2	4	4	
Bad track handling	yes	no	no	no	
Transfer rate Kbit/sec	Track 0, Head 0 : 250 Others :500	500	250	250	
Recording method	Track 0, Head 0 : FM Others :MFM	MFM	MFM	MFM	IBM AT-PC9-PC8 use write pre-compensation
Capacity unformatted	1.666 Mb	1.666 Mb	500Kb	500Kb	
Capacity formatted excluding track 0 head 0	153x26x256 1.018368Mb				
Total Data Capacity	1.021696Mb	1.2288Mb	368.64Kb	327.68Kb	

Table 2.1 Tracks and Cylinders

* Write FORMAT, Read and Write Commands
(FORMAT: from Rel.3 microprogram)

** Only Read Commands available
(from Rel. 2 microprogram)

Example: description of an ECMA99 diskette:

One or two surfaces of a single disk may be used to record data. Each surface is organised into 77 concentric tracks (tracks 00 - 76). Track 76 is nearest the center of the disk.
A track consists of a single channel on one surface of a disk for the length of one disk revolution. In the case of a double sided disk, a track position common to both sides of a disk is called a cylinder.
Tracks 1 - 73 are used for storing data while tracks 74 and 75 are used as replacements tracks in case of defects in any data track. In the case if double sided disks a complete cylinder is replaced if either one of its tracks become defective.
Track/cylinder 0 is used as an index track and track 76 is reserved for test purposes.
A "read/write" head is provided for each disk surface of a two sided disk and the required track is obtained by addressing the cylinder and positioning the heads over that cylinder and then selecting the upper or lower head.
(5¼ inch diskettes are organised using 80 cylinders max.).

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2.1.2 Sectors

Tracks are divided into equally spaced sectors (the number depending on the format used). Each sector contains an identification (ID) field and a data field. The data field is used to store a number of data words (depending on the format used) and a CRC word. The ID field contains complete information to identify the sector and a CRC word. The ID fields for the complete disk are prerecorded onto the disk before use.

2.1.3 Data Organisation

Data is recorded bit-serially along a track, with bits grouped into 8 bit character (bytes). Bits are grouped into 16 bit words (2 bytes) by the CU for transfer to memory. The most significant bit of each word is read or written first. Several sectors may be read or written with a single CIO command.

The maximum transfer between the CU and memory is limited by IOP initialisation to 4096 words which is sufficient for a complete track (see table 2.1), The CU does not stop reading or writing at the end of a track but continues through to sectors 0, 1 etc, thus a complete track may be read or written with one CIO command. When all the sectors of a track have been read or written the CU automatically stops the exchange and informs the CPU. The fact that the CU continues to read or write through to the beginning of a track also permits the average data transfer rate to be increased by using a 'skew' factor to choose the first sector to be read or written on each successive track (this takes account of head seek and settling times).

2.1.4 Data Recording Techniques

Information is stored on the disk in the form of flux changes on the magnetic surface. These flux changes are represented as pulses (one per flux change) at the interface between the CU and disk drive. One of to two methods of encoding the data, before recording are used.
These are shown in figure 2.1.

Frequency Modulation (FM)

A clock pulse is recorded at the start of each bit cell. For a 'one' bit, a data pulse is recorded in the middle of the bit cell. For a 'zero' bit no data pulse is used. Thus for a 'one' bit the frequency of pulses is doubled. This method is also called double frequency recording, and records data in single density. (bit cell = 4 us).

Modified Frequency Modulation (MFM)

For a 'one' bit a pulse is recorded at the center of a bit cell. For a 'zero' bit a pulse is recorded at the start of a bit cell except when preceeded or/and succeed by a 'one' bit in which case no pulse is recorded . The frequency of pulses is the same as for FM recording but data is recorded at double the density. (bit cell = 2 us).

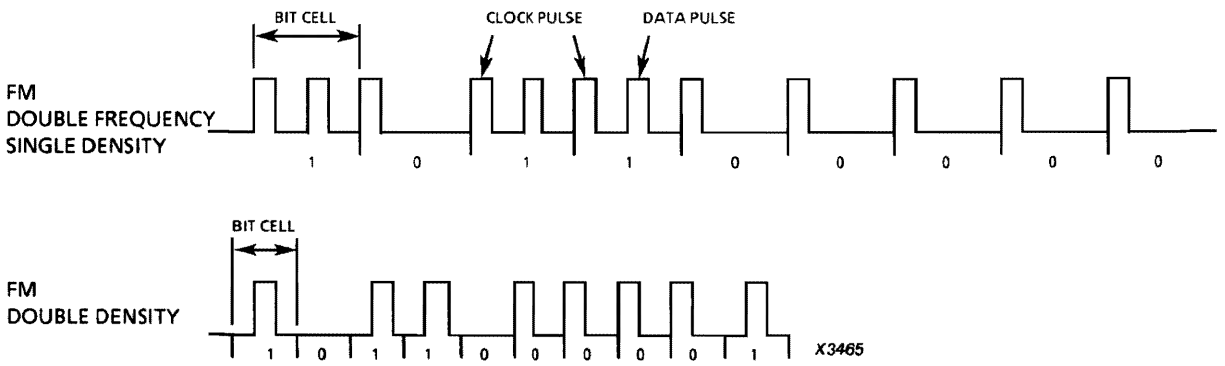

Figure 2.1 Data recording Technics

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2.1.5 Disk Formats

The MIFZ CU is a controller derived from the F1MZA CU (controller for Philips version of CDC Flexible Disk Drives using IBM standard formats 8 inch performatted diskettes) and has been designed to control up to 2 NEC Mini Flexible Disk Drive FD1155C using 5 inch preformatted diskettes.

Four $5\frac{1}{4}$ inch formats the available (see table 2.1).

For Read, Write and Format Operation

The double density 26 sectors per 256 bytes format (logically equivalent to the one available on 8 inch diskette), standard ECMA-99 or IBM GA21-9388-0.

For Read Operation Only

The double density 15 sectors per 512 bytes format, available on IBM PC AT diskettes, 1.2MB.

The double density 9 sectors per 512 bytes format, available on IBM PC diskettes, 360kB.

The double density 8 sectors per 512 bytes format available, on IBM PC diskettes, 320kB.

2.1.6 Physical Characteristics

Diskette should conform to ECMA 99 (double sided). Diskette and cartridge details are shown in figure 2.2. The index hole and the write enable slot are optically detected.

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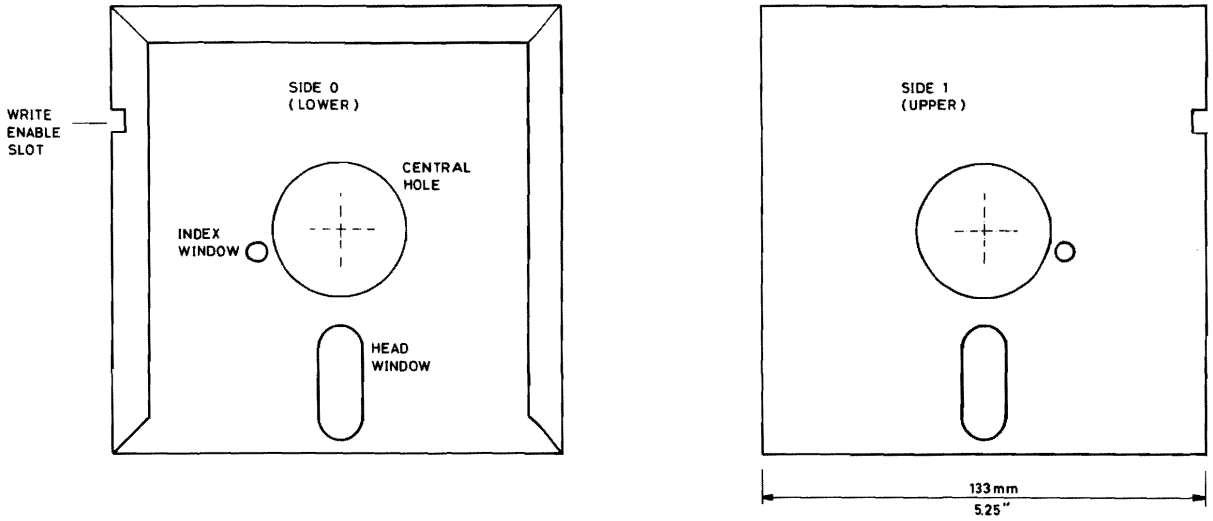

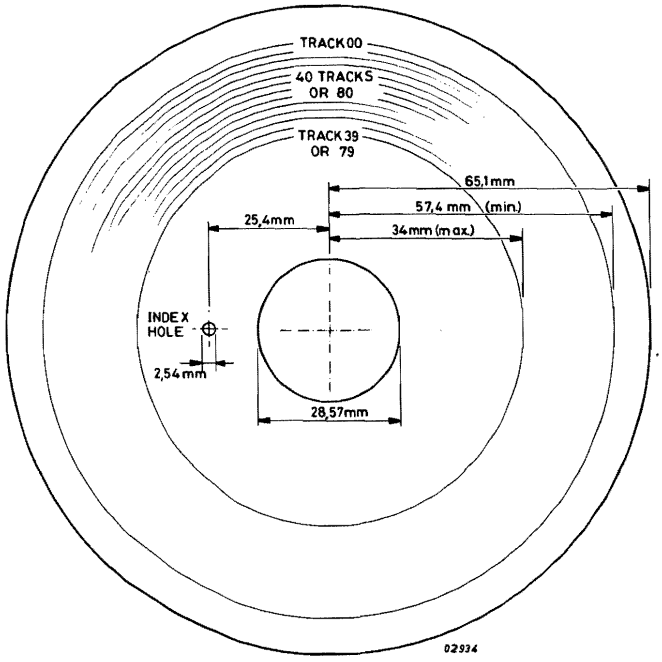

Figure 2.2 Diskette Dimensions (5¼ Inch)

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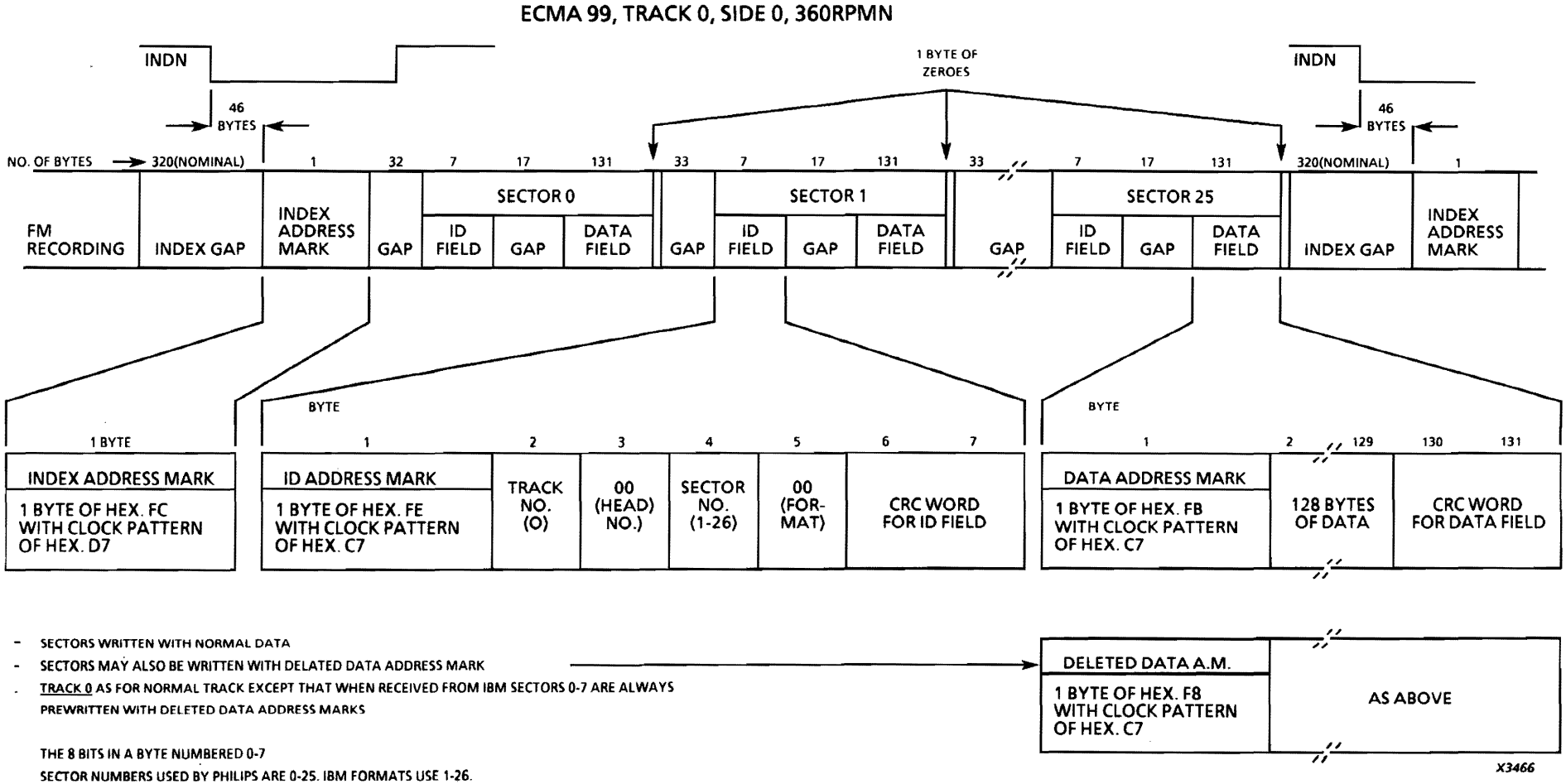

Figure 2.3 Format 0 Single Sided Disk, Single Density Recording (FM)

- SECTORS WRITTEN WITH NORMAL DATA
- SECTORS MAY ALSO BE WRITTEN WITH DELATED DATA ADDRESS MARK
- TRACK 0 AS FOR NORMAL TRACK EXCEPT THAT WHEN RECEIVED FROM IBM SECTORS 0-7 ARE ALWAYS PREWRITTEN WITH DELETED DATA ADDRESS MARKS

THE 8 BITS IN A BYTE NUMBERED 0-7

SECTOR NUMBERS USED BY PHILIPS ARE 0-25. IBM FORMATS USE 1-26.

ALL GAPS ARE COMPOSED OF AN APPROPRIATE NUMBER OF BYTES OF HEXADECIMAL FF, FOLLOWED BY 6 BYTES OF 00.

SOME IBM FORMATS USE ALL ZEROES IN THE GAPS. THE CU TAKES ACCOUNT OF THIS.

THE TOTAL NUMBER OF BYTES IN THE INDEX GAP CAN VARY SLIGHTLY DUE TO TIMING TOLERANCES (THERE ARE ALWAYS 6 BYTES OF 00 HOWEVER).

FORMAT 0: 26 SECTORS x 64 WORDS = 1664 WORDS/TRACK

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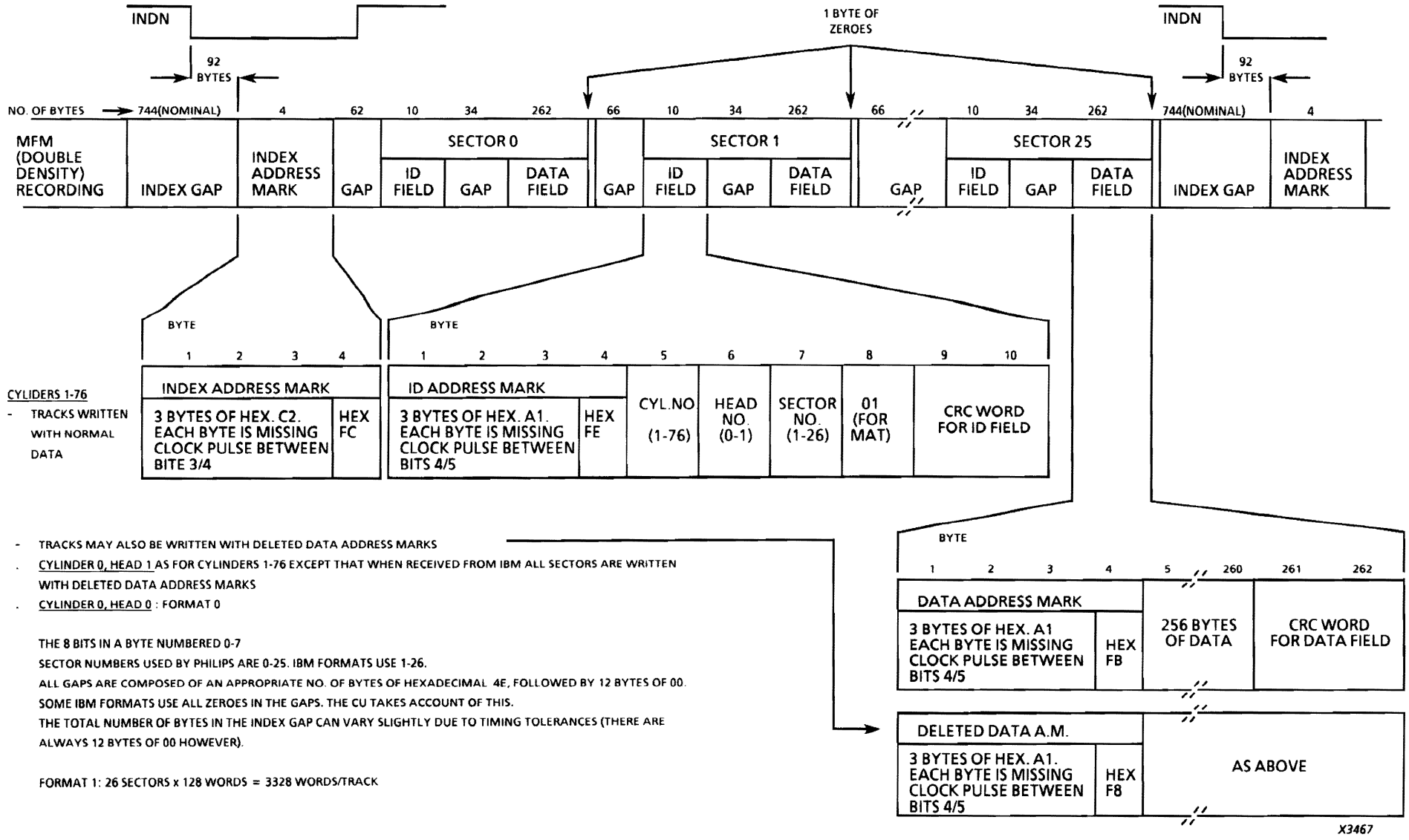
ECMA 99, OTHER TRACKS THAN TRACK 0, SIDE 0,360RPMN

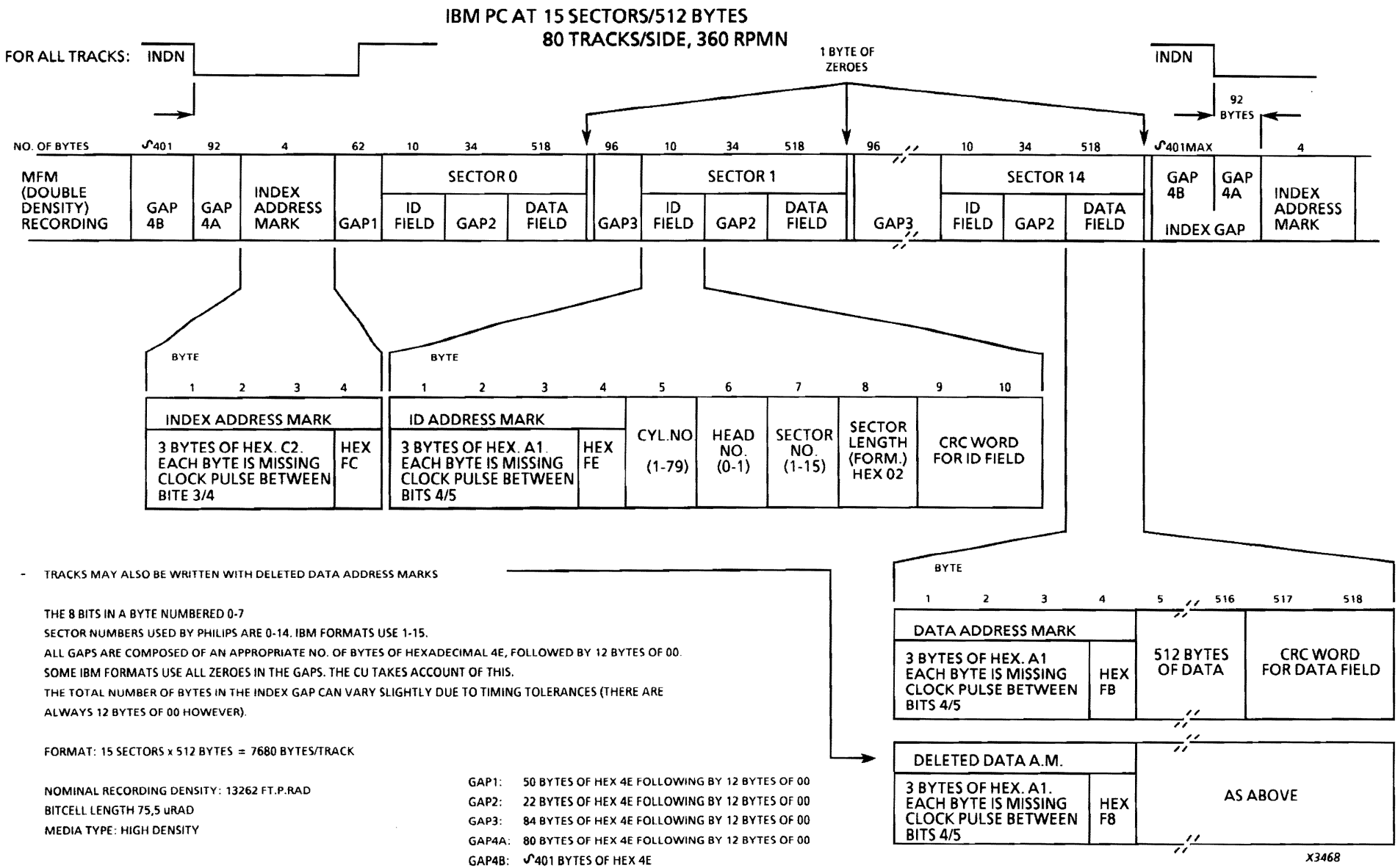


- TRACKS MAY ALSO BE WRITTEN WITH DELETED DATA ADDRESS MARKS
- CYLINDER 0, HEAD 1 AS FOR CYLINDERS 1-76 EXCEPT THAT WHEN RECEIVED FROM IBM ALL SECTORS ARE WRITTEN WITH DELETED DATA ADDRESS MARKS
- CYLINDER 0, HEAD 0 : FORMAT 0

THE 8 BITS IN A BYTE NUMBERED 0-7
SECTOR NUMBERS USED BY PHILIPS ARE 0-25. IBM FORMATS USE 1-26.
ALL GAPS ARE COMPOSED OF AN APPROPRIATE NO. OF BYTES OF HEXADECIMAL 4E, FOLLOWED BY 12 BYTES OF 00.
SOME IBM FORMATS USE ALL ZEROES IN THE GAPS. THE CU TAKES ACCOUNT OF THIS.
THE TOTAL NUMBER OF BYTES IN THE INDEX GAP CAN VARY SLIGHTLY DUE TO TIMING TOLERANCES (THERE ARE ALWAYS 12 BYTES OF 00 HOWEVER).

FORMAT 1: 26 SECTORS x 128 WORDS = 3328 WORDS/TRACK

Figure 2.4 Format 1 Double Sided Disk, Double Density Recording (MFM)



- TRACKS MAY ALSO BE WRITTEN WITH DELETED DATA ADDRESS MARKS

THE 8 BITS IN A BYTE NUMBERED 0-7
SECTOR NUMBERS USED BY PHILIPS ARE 0-14. IBM FORMATS USE 1-15.
ALL GAPS ARE COMPOSED OF AN APPROPRIATE NO. OF BYTES OF HEXADECIMAL 4E, FOLLOWED BY 12 BYTES OF 00.
SOME IBM FORMATS USE ALL ZEROES IN THE GAPS. THE CU TAKES ACCOUNT OF THIS.
THE TOTAL NUMBER OF BYTES IN THE INDEX GAP CAN VARY SLIGHTLY DUE TO TIMING TOLERANCES (THERE ARE ALWAYS 12 BYTES OF 00 HOWEVER).

FORMAT: 15 SECTORS x 512 BYTES = 7680 BYTES/TRACK

NOMINAL RECORDING DENSITY: 13262 FT.P.RAD
BITCELL LENGTH 75,5 uRAD
MEDIA TYPE: HIGH DENSITY

GAP1: 50 BYTES OF HEX 4E FOLLOWING BY 12 BYTES OF 00
GAP2: 22 BYTES OF HEX 4E FOLLOWING BY 12 BYTES OF 00
GAP3: 84 BYTES OF HEX 4E FOLLOWING BY 12 BYTES OF 00
GAP4A: 80 BYTES OF HEX 4E FOLLOWING BY 12 BYTES OF 00
GAP4B: ≥401 BYTES OF HEX 4E

Figure 2.5 Format PC-AT Double Sided Disk, Double Density Recording (MFM)

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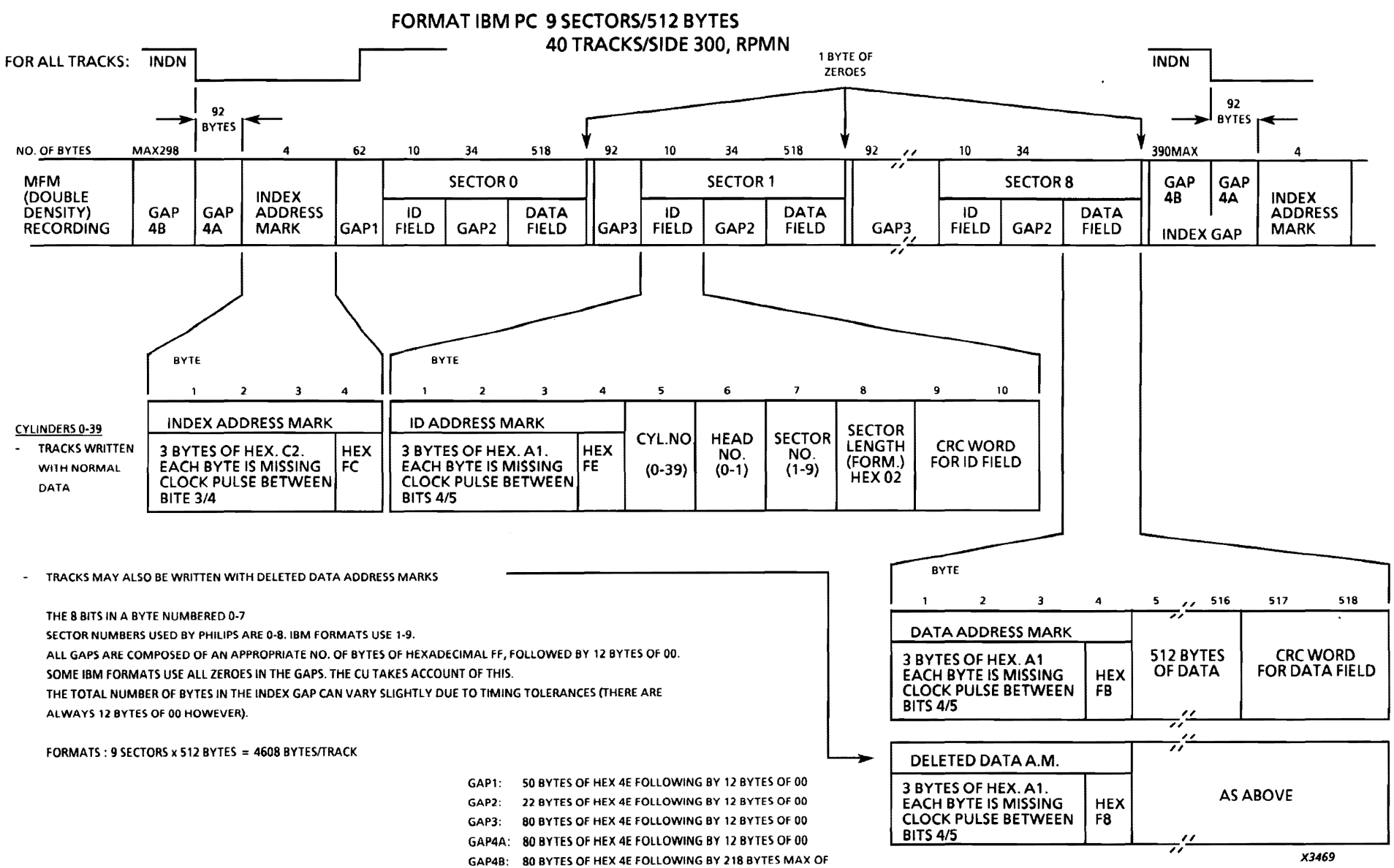

Figure 2.6 Format PC Double Sided Disk, Double Density Recording (MFM), 9 Sector.

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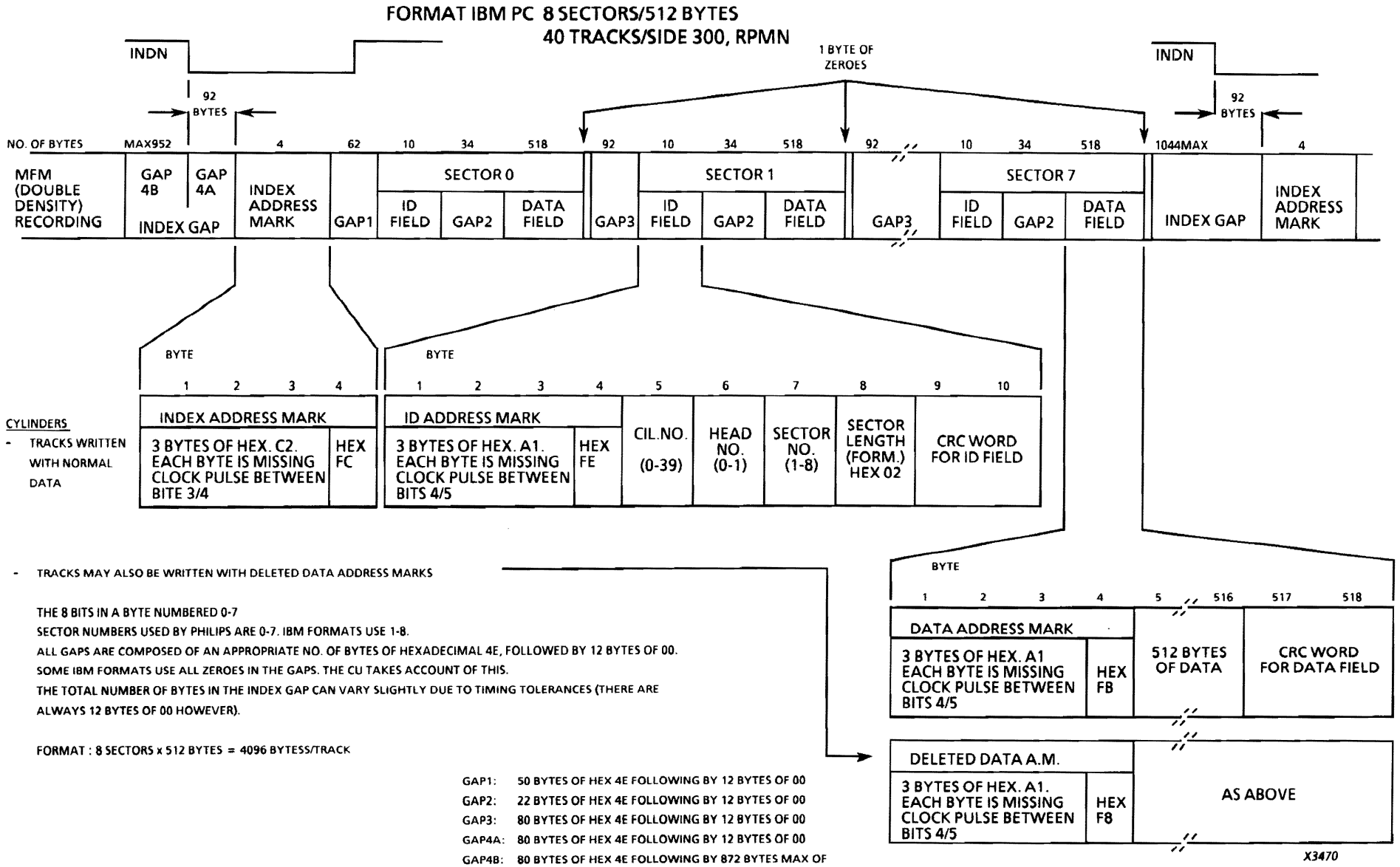

Figure 2.7 Format PC Double Sided Disk, Double Density Recording (MFM), 8 Sector

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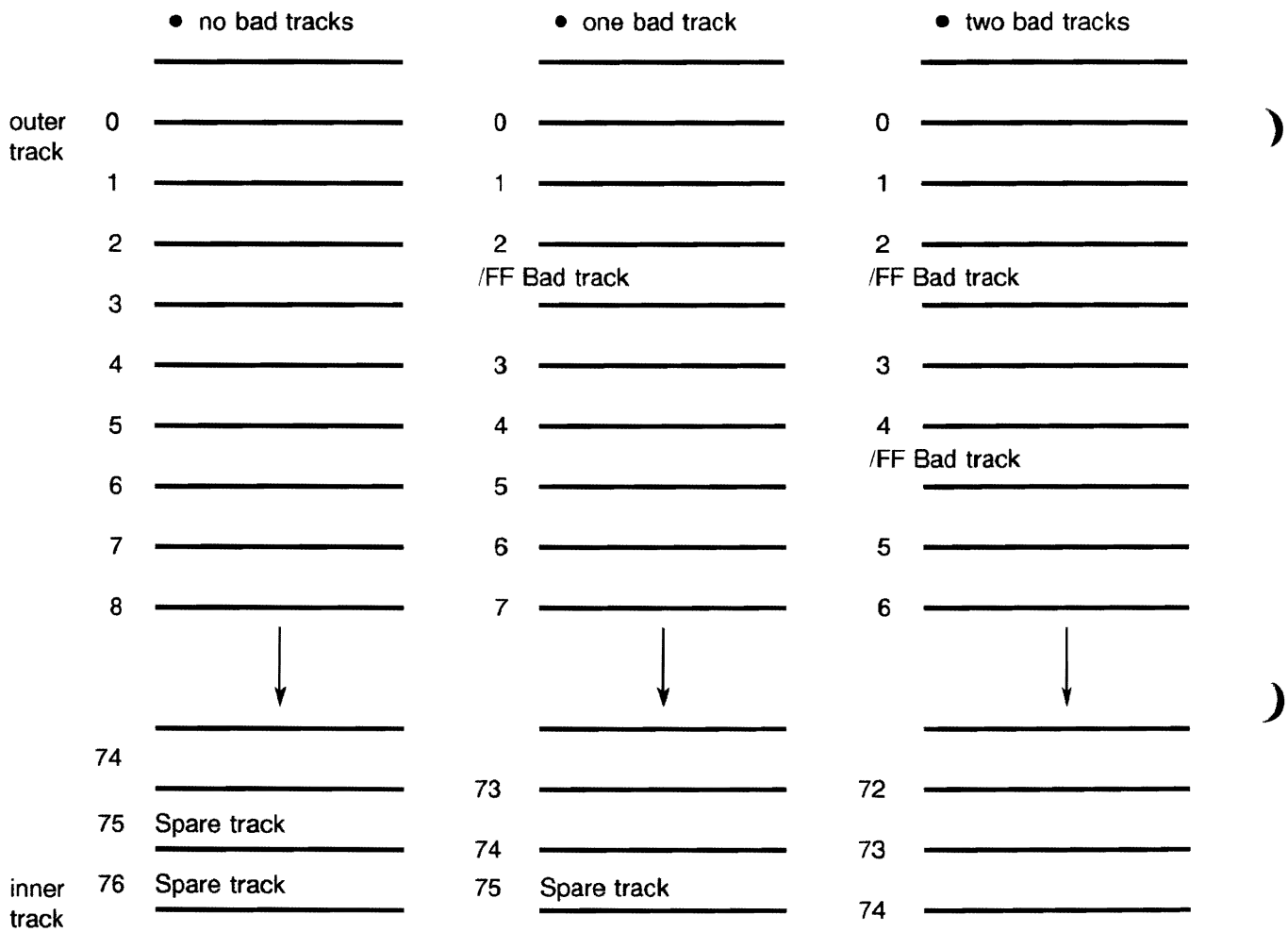
2.1.7 Bad Track Handling

New preformatted disks are initially supplied without bad tracks.

However, due to normal wear of the disk surface, it may become impossible to read or write correctly some of the tracks. For this reason tracks 75 and 76 are reserved as replacement tracks, for up to two bad tracks per disk. In the case of double sided disks a complete cylinder is replaced if one of its tracks becomes unservicable.

When a bad track is replaced the disk must be re-formatted. The bad tracks are filled with bad track codes (hexadecimal FF), the next track/cylinder takes the track number previously assigned to the bad track and the track numbering then carries on sequentially for the following tracks/cylinders as shwon in the diagram below.

Track numbering for disks with:



2.1.8 Disk Formatting

A brand new disk must be formatted before use. Also when bad track is discovered the disk must be reformatted.

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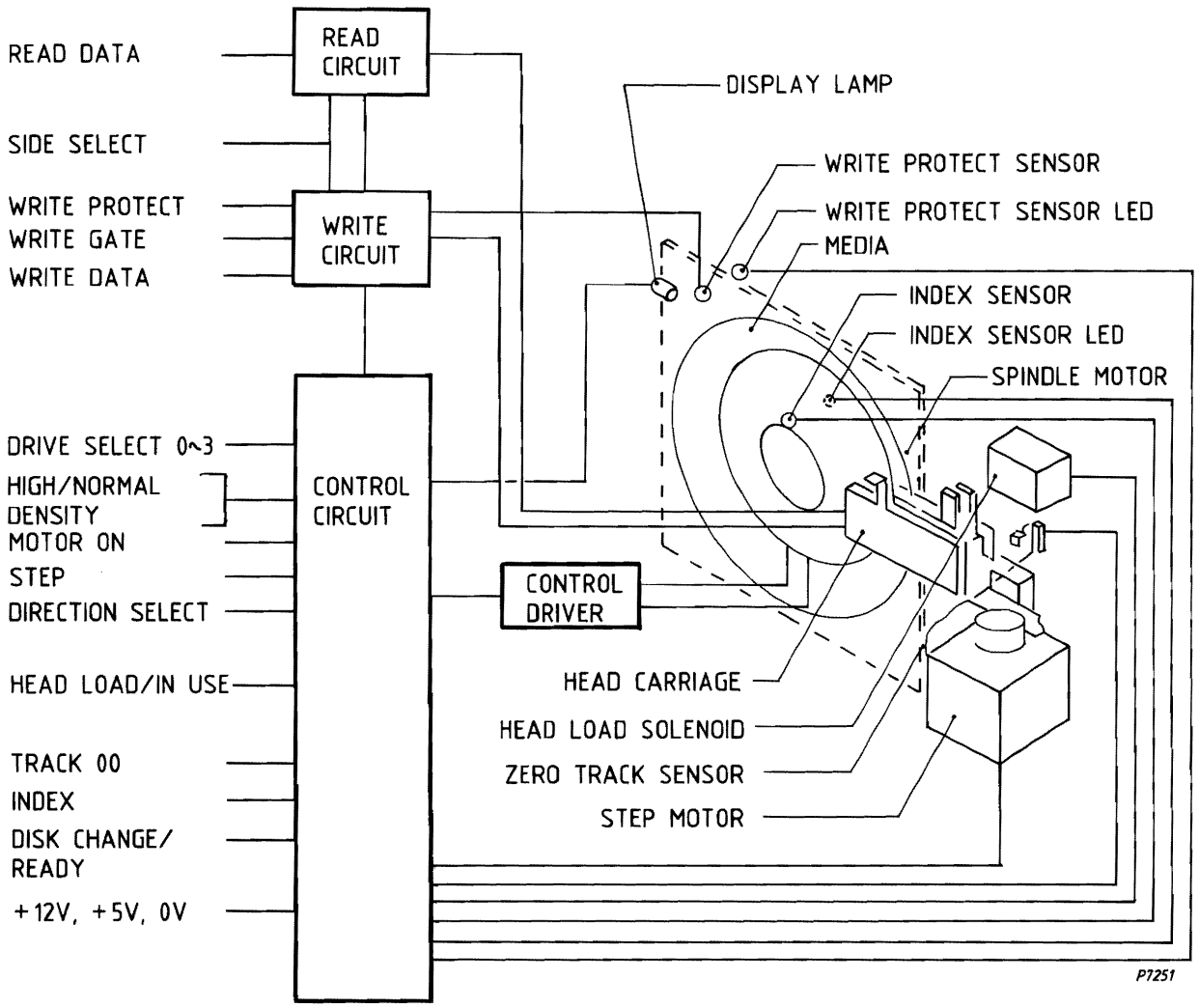

Figure 2.8 Basic Drive Block Diagram

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2.2 DISK OPERATION

2.2.1 Track Zero Detection

The head(s) are mounted on an arm which moves across the disk to select the required track/cylinder. When the head is over track/cylinder zero a micro-switch is operated which generates signal TRON.

2.2.2 Index Pulse

One index pulse, INDN, per disk revolution, photosensed by the drive unit from a hole in the disk, is used by the CU to recognise the start of each track. Signal INDN is electically coincident with the index Gap at the start of the track (see figure 2.3 - 2.7).

2.2.3 Head Control

During 'seek' operations the head is positioned by a stepping motor which moves the head one track at a time in response to each pulse of signal STEPN in the direction specified by signal DIRN.

As the tracks get nearer the center of the disk the bit density increases.

Before executing any seek, read or write operation the motors are start-on and the moving heads are loaded. MON signal is used to start or stop the motors of both drive. Signal DC 45N is used to load the moving heads of both drive.

In case of double sided disks signal DC40N is used to select head 0 or heads 1 (side 0 fixed head, side 1 moving head).
Signal WEN when set enables the drive unit to write on the disk.
If a disk is not to be re-written a square slot is hidden on the jacket of the disk. This slot is photo-sensed in the drive which generates the write Protect signal WRPN.

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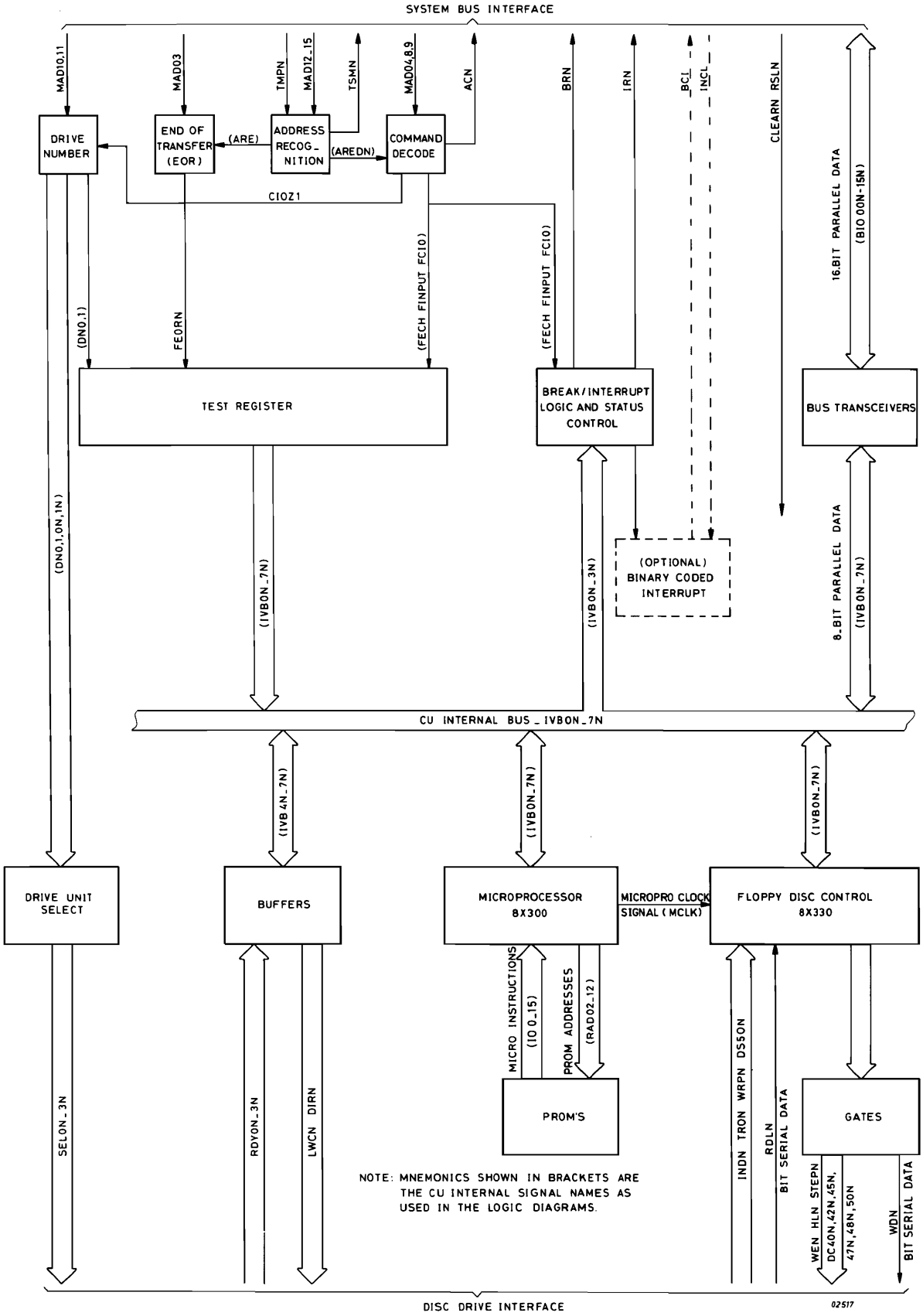

Figure 2.9 Block Diagram of MIFZ Control Unit

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2.3 CONTROL UNIT STRUCTURE

The CU comprises four basic parts; Data transfer circuits, Interface with the system bus, Interface with the drives and Control. These basic parts are shown in figure 2.9.

2.3.1 Data Transfer Circuits

Data transfer is the main function of the CU. (In addition the CU performs other functions concerned with control of the disk drive, data verification and sector skipping).

The overall operation of a data transfer sequence from the system to disk drive is as follows, refer to figure 2.9.
Data is sent from the IOP one word at a time (16 bits) via the bi-directional data lines BIO00N-15N.
Each data word is entered into the bus transceivers. 8 bits at a time are loaded into the floppy disc controller via the CU internal bus lines IVB0N-7N.
The floppy controller performs parallel to serial conversion on the data.
Serial data is gated out of the CU and written on the disk via data path WDN.

For a transfer sequence from disk to system the reverse process occurs but the serial data read from the disk is input to the CU via data path RDLN.

2.3.2 Bus Interface

Parallel data is transferred to and from the CU via BIO00N-15N. The CU address and commands are sent to the CU on the MAD lines and timing signal TMPN is set low to validate the command. When the CU recognises the address it sets TSMN low. When the command is from the CPU and the CU is in the correct status state to accept the command the CU replies with ACN. Commands accepted by the CU are shown in figure 2.10.

During a data transfer sequence a break request, BRN, is sent to the IOP before each data word is tranferred. After completion of a CIO command an interrupt request, IRN, is sent to the CPU. These signals are controlled by the microprocessor and the CU status states.

In future systems, based on the UPL bus, a binary coded interrupt option may be used, BCI, instread of the discrete interrupt IRN. In this case the interrupt is sent to the CPU in the form of a serial code synchronised with an incoming clock signal INCL.

Signal CLEARN is the master reset signal from the CPU which clears the main registers of the CU and resets the microprocessor back to the first instruction (instruction/00).

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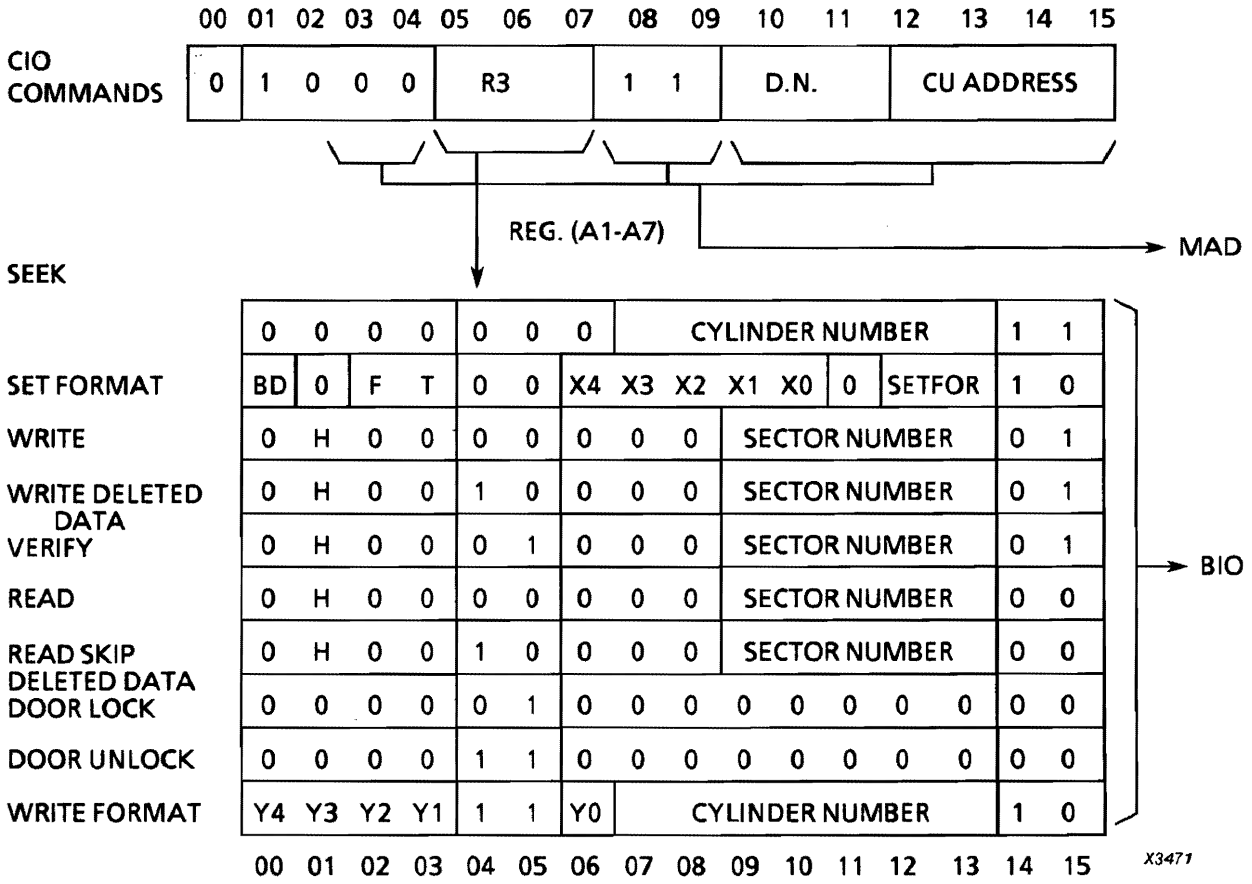

Where: R3 = The address of the Operand Register (1 to 7).
DN = The Drive Number (0 or 1)
CUA = The Control Unit Address.

SETFOR = 00 for ECMA 99 (IBM GA 21-9388-0) format.
01 for 15 sectors/512 bytes IBM PCAT Recommended format P3200.
10 for 9 sectors/512 bytes IBM PC Recommended format (PC3100 format).
11 for 8 sectors/512 bytes IBM PC Recommended format (PC3100 format).

X = skew factor for the next intended Write Format command.
Y = interlace factor for the next intended Write Format command.

BD = Blank Diskette Check
- BD = 1 no blank diskette check
- BD = 0 check blank diskette

FT = Format Type bit (at cylinder position)
Value 00 : cylinder format command (side 0, then side 1)
Value 01 : side 0 format command
Value 10 : side 1 format command
Value 11 : command error

For software compatibility reasons, the default format of ECMA 99 is assumed without sending any CIO set format (i.e. SETFOR = 00, Field X = 0, BDC = 0, FT = 0).
The software has the possibility to check the format of the present inserted diskette by performing a dedicated routine using several set format commands followed by seek command or seek and read commands.

Figure 2.10 Command Word Formats

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Numbering the Sectors

The origin for the sector numbering in our commands is 0, and in the format is 1 (number written inside the identifiers). The following table shows the correspondence. (Example given for ECMA 99 standard).

Sector Number in the command	Sector Number in the format
0	1
1	2
2	3
3	4
•	•
•	•
•	•
25	26

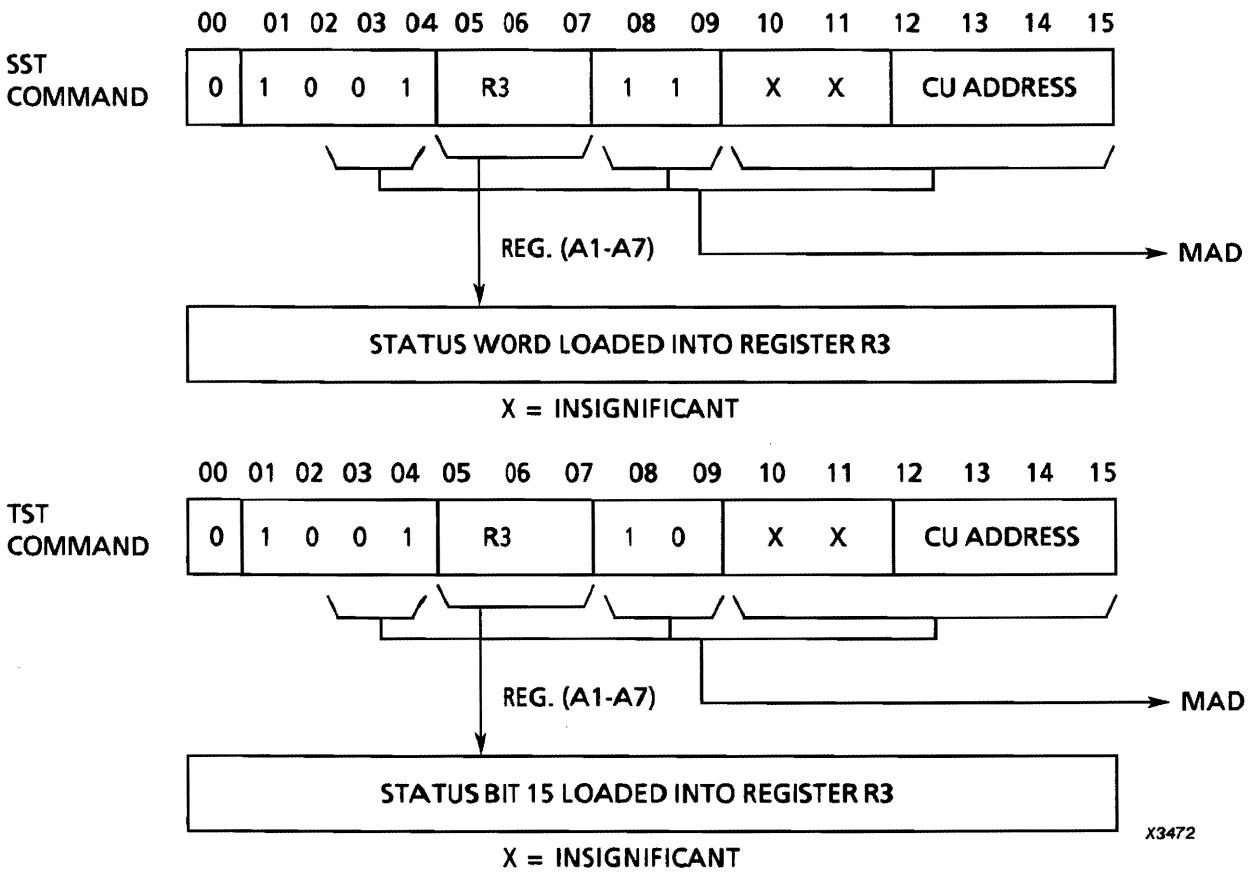

Figure 2.10 Command Word Formats (Continued)

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2.3.3 Disk Drive Interface

Serial 'read' data is input to the CU at RDLN and serial 'write' data is output at WDN.
Drive ready is indicated by the drive with signal READY and selection of one of the drives is made with signals SELECT 1 - DC42N, SELECT 2 - DC48N.
The other signals of the disk interface are indicated in figure 2.8 and table 1.4.

2.3.4 Control

Overall control of the CU is provided by the 8-bit microprocessor type 8 x 305. Two PROM's addressed by the microprocessor contain the microprogram. Communication between the microprocessor and the reset of the CU is via the CU internal bus IVB0N - 7N.
The main control functions of the drives, including data processing, are performed by the Floppy Disk Controller chip type 8 x 330. This chip is compatible with the 8 x 305 and is synchronised with its clock pulse MCLK.

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2.4 CONTROL UNIT OPERATION

2.4.1 CU Status States

Four operating states of the CU are defined by flag signals F0 and F1.
These signals control the sending of break and interrupt requests, (BRN and IRN) and command acceptance.

F0	F1	Status state	Commands Accepted		Break or interrupt
0	0	Inactive	CIO start (seek, write, write with deleted data, verify read, read skip deleted data, lock or unlock)	TST command Always accepted	--
0	1	Execute	--		--
1	1	Exchange	INR or OTR		
1	0	Wait	SST		BRN - reset by INR or OTR command IRN - reset by SST command

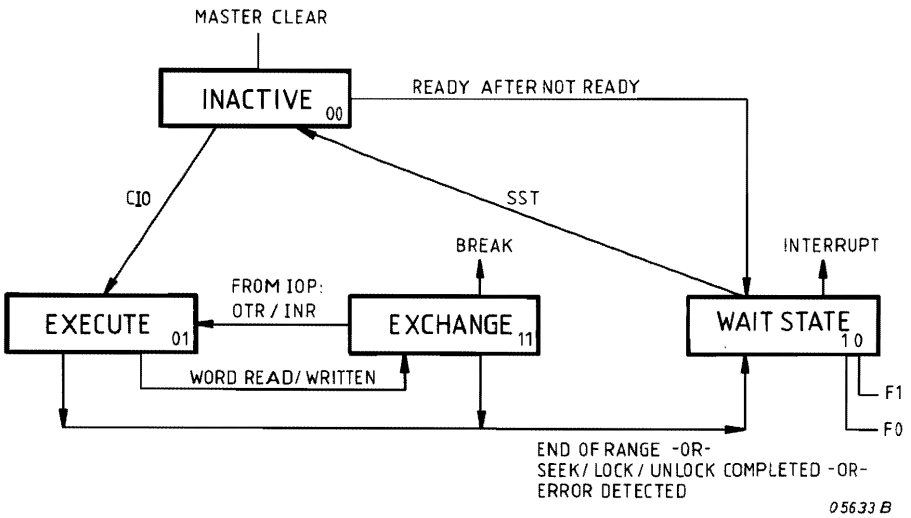

Figure 2.11 CU States

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2.4.2 I/O Command

The commands used by the software are shown in figure 2.10 MAD bits 03, 04 and 08 - 15 are sent directly to the CU and are decoded.

- MAD bit 03 is used as the end of transfer bit at the end of an IOP data exchange (EOR).

For a CIO start command the R3 field of the instruction word (bit 5 - 7) indicates the CPU register from which the specific command code is sent to the CU via the BIO lines.

For an SST or TST command the R3 field indicates the CPU register where the status word (or bit) is sent. There is no Seek to Zero command, this function is performed automatically by the CU during a Seek command when necessary.
When power has been switched on to a drive it runs under the CU control, so there are no stop/start commands.

NOTE: *Disk drives controlled from a single CU cannot be operated simultaneously. Thus a command for one drive must be finished before a new command is accepted by the CU.*

2.4.3 CPU Condition Register

During the execution of any I/O command the CPU condition register is set according to the response of the CU:

- The CR is set to (CR = 11) if the address code on MAD12-15 is not recognised.
- The CR is set to 1 (CR = 01) if the address is recognised but the command is not accepted by the CU. Nothing is altered in the CU.
- The CR is set to 0 (CR = 00) is the command is accepted.

2.4.4 CU Status Word

If during the execution of a CIO start command, an error is detected by the CU, the CU goes immediately to the wait state, sets the appropriate error status bit and sends an interrupt request (IRN) to the CPU. The CPU responds by sending an SST command which requests the transfer of the CU status word (see figure 2.10). When the status word has been transferred, the CU goes to the inactive state ready for the next CIO command.

When a command has been successfully executed the CU goes to the wait state and sends IRN to the CPU. In this case the status word is sent with all of the error status bits reset (STATUS OK).

2.4.5 IOP Simulated Commands

During data transfers each word is transferred to memory via the IOP by an INR command and each word is transferred to the drive by an OTR command. These commands are generated by the IOP and are shown in figure 2.12.

NOTE: *These commands do not contain the drive number of the disk unit used. This was already specified in the CIO command which originally started on the transfer.*

Data transfer between this CU and the system are made in word mode, which each word containing two characters. If an odd number of characters is to be transferred a final character of all zeroes must be sent in the last word of the transfer.

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2.4.6 CU Input - Output Sequence

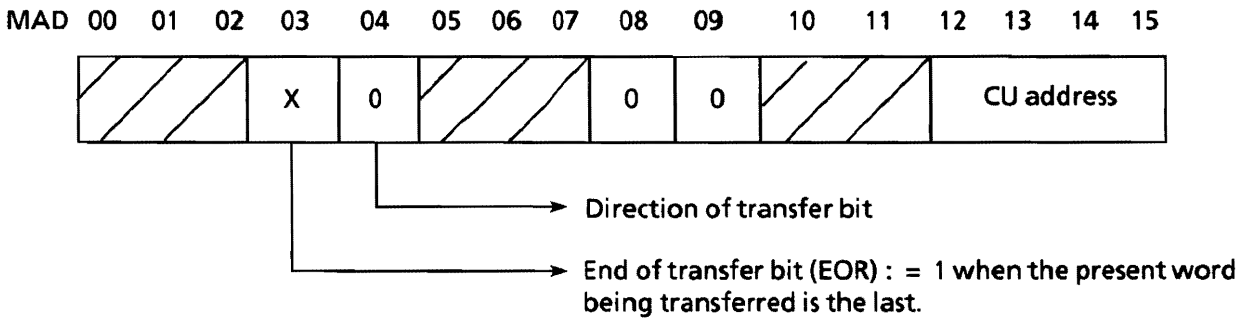
Data is transferred on IOP channel only.

The general sequence of the transfer is shown in figure 2.13. Once the CIO start command has been accepted by the CU IOP handles the complete exchange and the CPU program is free. The IOP indicates to the CU that the exchange is finished by setting the end of transfer bit (EOR) MAD03. The last data word is then transferred and the CPU takes control again to transfer the CU status word, after receiving an interrupt request.

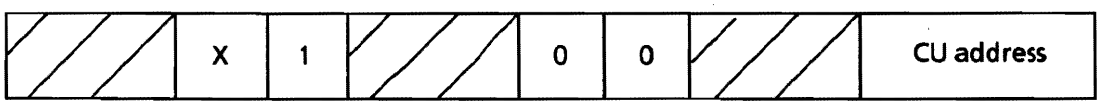
2.4.7 Drive Ready/Not Ready

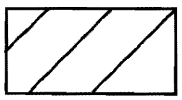
If the CU receives a command for a drive which is not ready or if the selected drive becomes not ready during the execution of a command the CU goes immediately to the wait state, sets the Not Operable status bit (see figure 2.14) and sends an interrupt request to the CPU. If a drive becomes not ready while the CU is not busy, the CU memorize this event and will only report it at the next CIO concerning this drive in setting bit 1 (Has Been Not Ready).

OTR Command



INR Command




= insignificant

These commands are simulated in the sense that they are not generated by the software

Figure 2.12 IOP Simulated Commands

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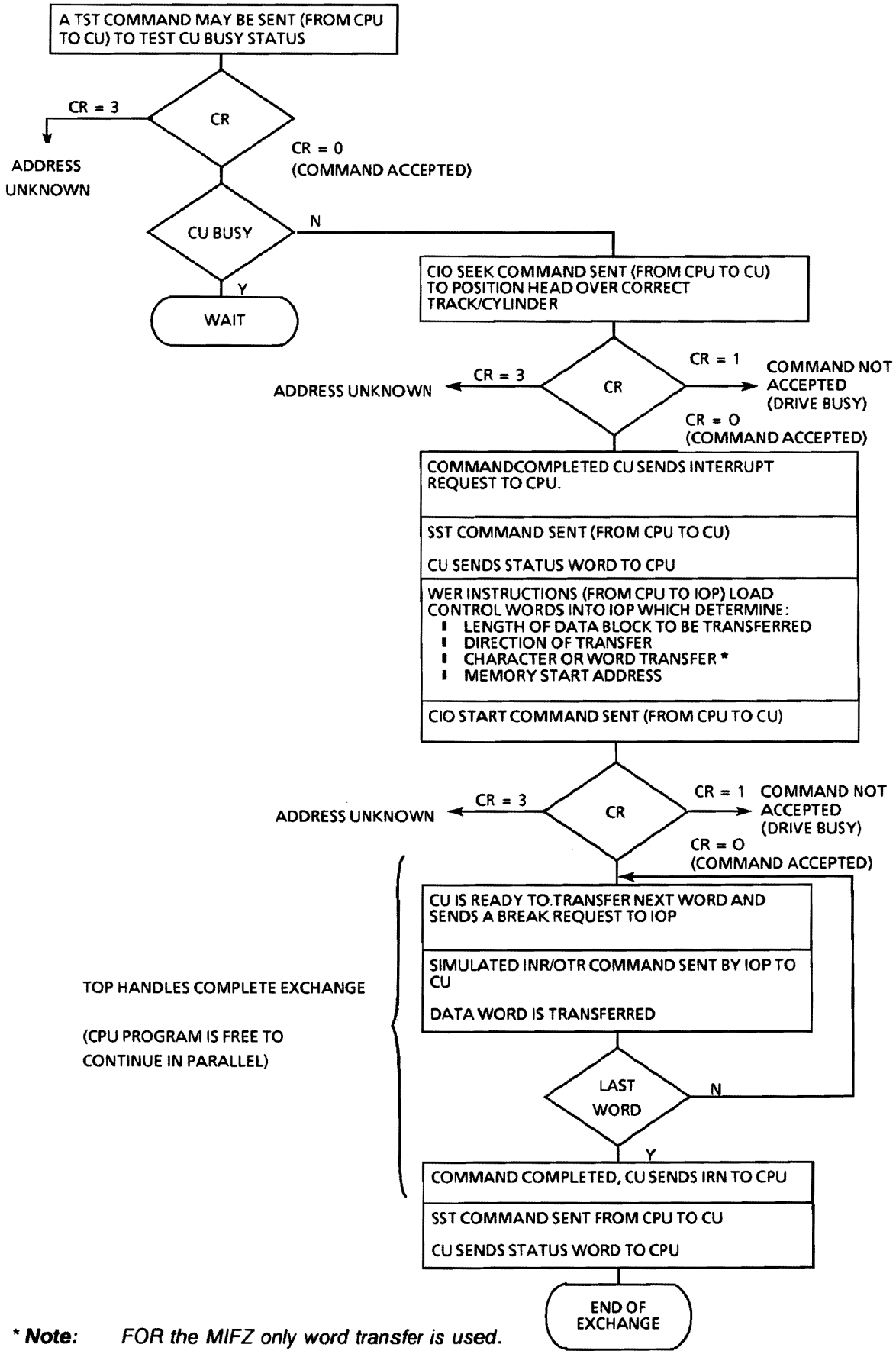

* ***Note:*** *FOR the MIFZ only word transfer is used.*

Figure 2.13 Input/Output Transfer Sequence

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2.4.8 Retry Procedure

The retry procedure is performed if ; 1) none of the ID fields of a track can be read during verification after a Seek command, 2) the ID field of one of the sectors to be read or written during a Read or Write command cannot be read, 3) the data address mark of one of the sectors to be read with a Read command cannot be read. No retry is performed in the case of a data fault after a Read command, this must be generated by the software.

Theprocedure is performed until the error is recovered or until the procedure is completed. If the retry procedure is started the retry status is set, even if the command was eventually successfully completed.

The retry procedure consists of:

- Re-read the track four times
- Seek to track zero (counting the number of tracks
- Re-seek to original track (recounting the tracks
- Re-read the track four times
- Seek to track 74
- Re-seek to original track
- Re-read track four times

} Perform this part of the sequence twice

2.4.9 CRC Error Checking

During disk write operations the 8 x 330 chip generates a Cyclic Redundancy check (CRC) word from each data field written. This word is the remainder from the division of all the bits in the data field (represented as an algebraic polynomial) by the polynomial $_x16 + _x12 + _x5 + 1$. The CRC word is generated while the data is being written on the disk and after the complete data field has been written the CRC word is sent to the disk drive and is written at the end of the data field.

The CRC word at the end of each ID field is written in the same way as when a disk is formatted.
During disk read operations the 8 x 330 performs a CRC error check. All the bits in the data field (including the bits of the CRC word) are divided by the same polynomial used for CRC word generation. At the end of the data field, if no detectable error has occurred, the remainder of the division is zero. If the remainder is not zero, the Data Fault status bit (see figure 2.14) is set in the status word.

Identifier Field information is checked in the same way while the ID Field of each sector is being read.

2.4.10 Multiple Sector Read and Write

The CU can read or write several sectors with one command. The first sector to be read or written is given in the command. The CU begins to read or write on this sector and then continues with the following sector until all the words for which the IOP was initialised have been transferred.

Example, for ECMA99 when the CU has read or written the last physical sector of a track (sector 25) it then continues to read or write sectors 0, 1, etc. The maximum block length that can be transferred is 4K words (fixed by the IOP initialisation) which is sufficient to read or write a full track, with one CIO command.

If the CU reads or writes a full track (ie. the sector number given in the command is reached again after one revolution of the disk) and if the IOP doesn't stop the exchange, the CU automatically stops the exchange to prevent overlapping of the transfers. In this case the Full Track Processed status bit is set (see figure 2.14) in the status word.

During a read command, if the IOP stops the exchange before the end of a sector, the CU continues reading till the end of the sector without transferring data to check the CRC error.
During a write command, if the IOP stops the exchange before the end of a sector the CU writes all zeroes until the end of the sector and generates the CRC word which is written at the end of the data field.

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2.5 CU FUNCTIONS

2.5.1 CIO Seek

This command is used to position the heads on the cylinder that is specified in the command. The CU automatically takes care of bad track handling, thus the heads are correctly positioned at the end of this command.

When the command is accepted, the CU performs the following actions:

- Calculates the displacement and executes the seek.
- Verifies the new cylinder number by reading the identifier. If this cylinder number is not correct (because of bad tracks between the old and new cylinder) or if the new cylinder is a bad cylinder, the CU performs a special routine of the microprogram to position the heads on the correct cylinder. Finally the correct position of the heads is verified.
- Sends an interrupt to the CPU.

Important:
A SEEK command must be sent before any Read/Write operations in the following cases;
- after a Master Clear of the system (following power ON or Automatic Restart after a power failure),
- after the status Not Operable or Has Been Not Ready
- A seek to track 0 (or an available seek according to the set format) after a CIO set-format which has a track density different from the previous format.

The following error status bits may be set at the end of seek command.

Bit 15: **Not Operable:** Set if the addressed drive is not operable during execution of the CIO command, or if the drive is still not operable after a certain time out (800 ms max.). The next intended CIO command for this drive must be an available CIO seek command. To the following commands, if the drive is still not ready, the Not Operable Status will be reported.

Note: *If a program error has been detected, no check of the drive operability is done, the program error status is always reported prior doing any physical action with the drive in order to prevent any damage for the media, or the drive itself.*

Bit 11: **Program Error:**
- Set if the drive number is 1
- Set if the command word syntax in not correct
- Set if the cylinder number specified in the command is greater than maximum number available in the set format

Bit 10: **Retry:** Set if the retry procedure was necessary to read the identifiers in any of the cylinder verifications.

Bit 6: **Seek Error:** Set if the head is not correctly positioned at the end of the command.

Bit 5: **Sector Not found:** Set if none of the indentifiers of a track was correctly read during a cylinder verification even after a retry procedure in this case bit 6 is also set.

Bit 1: **Has Been Not Ready:** Set if the drive has been not ready during an inactive state. This status is only reported for the first CIO command specified to this drive. The CIO command is not executed and the next intended CIO command must be an available CIO seek if the drive is still not ready, the Not Operable status will be reported to the following command.

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2.5.2 CIO Set Format

This command is used to initialise CU parameters to suit the specifications of one, among four available diskette formats.
The command is accepted only if the CU is in the inactive state. If the command is accepted:

1. The CU checks if the specified drive number is 00 or 01, checks if the command word syntax is correct.

2. The CU set the parameters according to the wanted set format.

3. The CU set the flag PNC (unknown position).

   Note: *The next intended CIO command following a CIO set format must be an available CIO seek.*

4. The CU goes to the Wait State and sends an interrupt request to the CPU.

The following error status bits may be set at the end of a Set Format command:

Bit 11: Program error: if the function information do not match those handled by the CU.

Bit 1: Has been not ready; this status bit is set if the addressed drive becomes not ready in the time interval between this command and a previous command addressing the same drive (the command is then not executed).

2.5.3 CIO Write

This command is used to write data (with normal data address marks) onto successive sectors of the track selected with the previous CIO seek command (with the limit of a full track capacity). The first sector to be written is specified in the command. The command is accepted only if the CU is in the inactive state. If the command is accepted:

1. The CU checks if the specified drive number is 00 or 01. Then the CU checks if the syntax of the command word is correct.

2. The CU checks if the drive heads position is known, and checks if the head number is correct and if the starting sector number is not too large, checks if the write protect signal from the drive is active.

3. The CU checks if the specified drive is ready to operate.

4. The CU reads the identifiers of sector after sector until it finds the addressed sector. If the sector cannot be found or if the identifiers is read with a CRC error, it performs the retry procedure.

5. The CU writes data on the specified sector with a normal data address mark. Data is transferred word by word to the CU via the BIO lines of the bus. For this purpose it sends a break request before each word and the IOP must reply with an OTR command within 30us (for double density records) or 60us (for single density records).

6. If at the end of the sector there are still more words to be transferred the CU searches the identifier of the next sector and continues writing on this new sector. The transfer is completed when the IOP stops the exchange or if the sector specified in the command is reached again after one revolution of the disk.

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7. During the writing of a sector the CRC error character is generated and is written at the end of the data field. If the IOP stops the exchange before the end of a sector the CU continues to write all zeroes until the end of the sector so that the CRC character can still be generated.

The following error status bits may be set at the end of a verify command:

8. At the end of the write command the CU goes to the wait state and sends an interrupt to the CPU.

The following error status bit may be set at the end of a write command.

Bit 15: **Not Operable:** Set if the addressed drive is not operable during execution of the CIO command, or if the drive is still not operable after a certain time out (800 ms max). The next intended CIO command for this drive must be an available CIO seek command. To the following command, if the drive is still not ready, the not operable status will be reported.

Note: *If a program error has been detected, no check of the drive operability is done, the program error status is always reported prior doing any physical action with the drive, in order to prevent any damage for the media, or the drive itself.*

Bit 14: **Throughput Error:** Set if the IOP doesn't reply to a break request within the speccified time. In this case the rest of the sector is written with zeroes.

Bit 12: **Full Track Processed:** Set if the sector number specified in the command is reached again after one revolution, and if the IOP hasn't stopped the exchange.

Bit 11: **Program Error:** Set if:

- Drive number is too high (>1)
- Word syntax of command is not correct
- Starting cylinder number too high
- A seek command wasn't sent before the write command in the following cases;

: after a Master Clear of the system (ie. power on, automatic restart after power failure)

: after a reported status 'NOT OPERABLE, HAS BEEN NOT READY'.

In these three cases the command is not executed.

- IOP sends an INR command in reply to the break.

In this case first sector only is written with all zeroes

Bit 10: **Retry:** Set if the retry procedure was necessary to read the identifier in any of the sectors to be written.

Bit 7: **Write Protect:** Set if the addressed drive contains a write protected diskette - in this case the command is not executed.

Bit 5: **Sector Not Found:** Set if the identifier of one or the sectors to be written could not be found or was read with a CRC error (even after a retry procedure).

Bit 1: **Has been not ready:** Set if the drive has been not ready during an inactive state. This status is only reported for the first CIO command specified for this drive. The CIO command is not executed, and the next intended CIO command must be an available CIO seek. If the drive is still not ready, the Not Operable status will be reported to the following commands.

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2.5.4 CIO Write Deleted Data

This command is identical to the CIO write command except that the data is written with deleted data address marks at the beginning of each data field.

2.5.5 CIO Verify

This command may be used after a write (or write deleted data) command to read back and check byte by byte the written data. For this purpose the I/O buffer in main memory must remain unchanged between the write and consecutive verify command. Before executing a verify command the IOP must be initialised again with the same/values as for the preceeding write command. The first sector to be verified is specified in the command. The CU then verifies sector after sector until the IOP stops the exchange or until a full track has been processed. Sectors with both normal and deleted data address marks are verified.
The command is accepted only if the CU is in the inactive state.If the command is accepted:

1. The CU checks if the specified drive number is 00 or 01. Then the CU checks if the syntax of the command word is correct.

2. The CU checks if the drive heads position is known, and checks if the head number is correct and if the starting sector number is not too large.

3. The CU checks if the specified drive is ready to operate.

4. The CU reads identifiers of sector after sector until it finds the addressed sector. If the CU cannot be found or if the identifiers are read with a CRC error, a retry procedure is performed.

5. The CU reads the data of the addressed sector and compares each word with the corresponding word read from main memory. For each word transferred from memory the CU sends a break request and the IOP must reply with an OTR command within 30us (for double density records) or 60us (for single density records).

6. If at the end of the sector there are still more words to be verified the CU searches the identifier of the next sector and continues the verification on this new sector.
The process is completed when the IOP stops the exchange or if the sector specified in the command is reached again after one revolution of the disk, or if an error is detected during data comparison.

7. At the and of the command the CU goes to the wait state and sends an interrupt to the CPU.

The following error status bits may be set at the end of a verify command.

Bit 15: **Not Operable:** Set if the addressed drive is not operable.

Bit 14: **Throughput error:** Set if the IOP doesn't reply to a break request within the specified time.

Bit 13: **Data Fault:** Set with bit 10 = 0 if a comparison error is found during the command.

: Set with bit 10 = 1 if the data address mark of one of the sectors could not be found.

Bit 12: **Full Track Processed:** Set if the sector number specified in the command is reached again after one revolution of the disc and if the IOP hasn't stopped the exchange.

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Bit 11: **Program Error:** Set if:

- Word syntax of command is not correct.
- Drive number is too high: 1
  Starting sector number too high: 25
- A seek command wasn't sent before the verify command in the following cases:

  : after a Master Clear of the system (ie power on, automatic restart after power failure)

  : after a reported a status NOT OPERABLE, or HAS BEEN NOT READY.

- IOP send an INR command in reply to break request

Bit 10: **Retry:** Set if the retry of procedure was necessary to read the identifier in any of the sectors to be verified.

Bit 5: **Sector Not Found:** Set if the identifier of one of the sectors to be verified could not be found or was read with a CRC error (even after a retry procedure).

Bit 4: **DDAM:** Set if one of the sectors has been read with a deleted Data Address Mark.

2.5.6 CIO Read

This command is used to read data (with either normal or deleted data address marks) from successive sectors of a track (with the limit of a full track capacity). The first sector to be read is specified in the command. The CU then reads sector after sector until the IOP stops the exchange or until a full track has been processed. The command is only accepted if the CU is in the inactive state. If the command is accepted:

1. The CU checks if the specified drive number is 00 or 01, checks if the syntax of the command word is correct.

2. The CU checks if the drive heads position is known, and checks if the head number is correct and if the starting sector number is not too large.

3. The CU checks if the specified drive is ready to operate.

4. The CU reads the identifiers of sector until it finds the addressed sector. If the sector cannot be found or if the identifier is read with a CRC error, a retry procedure is performed.

5. The CU reads the data from the specified sector and transfers it word by word to the IOP via the BIO lines of the bus. For each word transferred the CU sends a break request and the IOP must reply within 30us (for double density record) or 60us (for single density record) with an INR command.

6. If at the end of a sector there are still more words to be transferred, the CU searches the identifier of the next sector and continues reading on this new sector. The transfer is completed when the IOP stops the exchange or if the sector specified in the command is reached again after one revolution of the disk.

7. While reading each sector the CRC error is calculated. At the end of the sector this error should be zero, in which case the CU continues to read the next sector. If the CRC error is not zero the CU goes immediatly to the Wait status without reading the following sectors. The status word which is transferred after a CRC error does not give the number of the sector read with an error. Also no retry procedure is performed for a data error. Thus for error recovery the complete CIO read command must be repeated.

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8. If the IOP stops the exchange before the end of a sector the CU continues to read till the end of the sector (without data transfer) in order to check the CRC error.

9. At the end of the command the CU goes to the wait status and sends an interrupt to the CPU.

The following error status bits may be set at the end of a read command.

Bit 15: **Not Operable:** Set if the addressed drive is not operable during execution of the CIO command, or if the drive is still not operable after a certain time-out (800ms max).

The next intended CIO command for this drive must be an available CIO seek command. To the following commands, if the drive is still not ready, the Not Operable Status will be reported.

Note: *If a program error has been detected, no check of the drive operability is done, the program error status is always reported prior doing any physical action with the drive, in order to prevent any damage for the media, or the drive itself.*

Bit 14: **Throughput error:** Set if the IOP doesn't reply to a break request within the specified time.

Bit 13: **Data Fault:** Set with bit 10 = 0 if one of the sectors is read with a CRC error. Set with bit 10 = 1 if the data address of one of the sectors could not be found.

Bit 12: **Full Track Processed:** Set if the sector number specified in the command is reached again after one revolution of the disc, and if IOP hasn't stopped the exchange.

Bit 11: **Program Error:** Set if:

- Drive number is too high
- Sector number is too high
- A seek command wasn't sent before the read command in the following cases:

: after a Master Clear of the system (ie. power on, automatic restart after power failure)

: after a reported status 'NOT OPERABLE, HAS BEEN NOT READY'.

- If the command word syntax is not correct.
- IOP sends an OTR command in reply to break request.

Bit 10: **Retry:** Set if the retry procedure was necessary to read the identifier or the data address mark of one of the sectors to be read.

Bit 5: **Sector Not Found:** Set if the identifier of one of the sectors to be read could not be found (or was read with a CRC error) even after a retry procedure.

Bit 4: **Deleted Data:** Set if one of the sectors to be read has a deleted data address mark. (These sectors are read normally).

Bit 1: **HAS BEEN NOT READY:** Set if the drive Has Been Not Ready during an inactive state. This status is only reported for the first CIO command specified for this drive.The CIO command is not executed, and the next intended CIO command must be an available CIO seek. If the drive is still not ready, the Not Operable Status will be reported to the following commands.

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2.5.7 CIO Read, Skip Deleted Data Address Marks

This command is identical to the CIO read command except that the sectors, with deleted data, (i.e. sectors which data field starts with a deleted data address mark), are skipped. The CU continues reading the next sector with normal data address mark.

Status bit 4 (Deleted Data) is set if one or more sectors with deleted Data have been skipped.

2.5.8 CIO Door Lock

NEC FLOPPY DISK DRIVE FD1155C has no door lock option. This command was used to lock the door of the addressed floppy disk drive. The command was effective only if the addressed drive has a door lock option. If not the command was executed normally by the CU but has no effect on the drive.

For software compatibility reason the CU recognizes this command, but it has no action on the drive. The command is accepted only if the CU is in the inactive state. If the command is accepted:
The CU goes to the wait state and send an interrupt request to the CPU.

The following error status bit can be set at the end of the command.

Bit 1: **Has Been Not Ready:** Set if the drive has been not ready during an inactive state. This status is only reported for the first CIO command specified for this drive. The CIO command is not executed, and the next intended CIO command must be available CIO seek. If the drive is still not ready, the not operable status will be reported to the following commands.

2.5.9 CIO Door Unlock

This command is identical to the CIO Door Lock command.

2.5.10 CIO Write Format

Providing that the current format is set for ECMA-99, this command is used to initialize brand new diskettes on a cylinder (or track per track basis).

Accept condition: The CU must be in the inactive state

Functions: Address recognized, command accepted 0 to CR
Address recognized, command not accepted 1 to CR
Address not recognized 3 to CR

Drive recommandation: The diskette drive has to be correctly calibrated. This is mandatory for diskettes exchanged in different systems.

Since each WRITE FORMAT command deals with one specific cylinder position, it will be possible to issue a WRITE command and then a VERIFY command in order to soft initialize the cylinder.

Thus at the end of the format initialization process, when all available tracks have been handled, the media surface would have been:

1. "hard" sectored
2. soft initalised
3. verified

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And we would have gained seek time and settle time, twice for each track, so a complete initialization if a diskette three times faster.

Important: a WRITE FORMAT command to cylinder 0 must be sent at first when initializing brand new diskettes (no write action if diskette track is already written i.e. BD = 0) and when sending WRITE FORMAT command after the following event:

- after a Master Clear of the system (following power ON or Automatic Restart after a power failure).
- after the status Not Operable or Has Been Not Ready
- after a CIO set format which has a track density different from the previous format.

This command is used to position the heads on the cylinder that is specified in the command.
Thus the heads are correctly positioned at the end of this command.

When the command is accepted, the CU performs the following actions:

- calculates the displacement and executes the seek
- verifies if the track is already written providing BD - bit = 0, if the diskette is write protected.
- format the cylinder or the specified track (according to FT bits) following the parameters sent by the previous set format command (skew and interlace factors).
- sends an interrupt to the CPU.
  Field Y is a five bit field defining interlace factor for the next intended Write Format command.

Note: - *Only zeroes value in Field Y is specified for ECMA-99 standard.*
- *If modified ECMA-99 diskette is needed:*

0 ≤ Field Y ≤ 25

If not, program error status bit will be sent.

- *The skew factor is defined in the "Set FORMAT" command, field X.*

The following status bits may be set as a result of this command:

Bit 15: **Not Operable:** This bit is set if the addressed drive is not operable. If bit 1 (Has Been Not R Ready) must be reported, bit 15 is not set.

Bit 13: **Data Fault:** This status bit is set if the cylinder (or track) processed by the command is already written (providing BDC bit = 0).

Bit 11: **Program Error:** This status bit is set if the cylinder number is greater than the maximum track number of the set-format. Operability of the addressed drive is not checked, so bit 15 is not set.
Is also set, if the command is not allowed according to the current Set Format.

Bit 7: **Write protect:** This status is sent if the specified drive have an inserted write protected diskette.

Bit 1: **Has Been Not Ready.**

- Relation between the WRITE FORMAT and the SET FORMAT commands:

- RECALL: - The SET FORMAT command put the control unit and the drive in a situation corresponding to one of the 4 allowed formats.

- In case control unit receives a WRITE FORMAT command while it is not in the ECMA 99 FORMAT state, then this WRITE FORMAT command will be aborted and a warning sent in the returned status. (bit 11 program error). Therefore, before to send a WRITE FORMAT command to the control unit, the programmer must take care to put it in this ECMA 99 format state by sending the appropriate SET FORMAT command, unless he is sure that the control unit is already in this state.

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- **The WRITE FORMAT command** executes the formatting process on one cylinder or one track i.e. the write format command must be issued for each cylinder or track. This way of working will provide an advantage to the software (see fig. 2.14).

Two bits are used with the following meaning:

Format type bits (FT): (at cylinder position)

Value 00 cylinder format command (side 0, then side 1)
Value 01 side 0 format command
Value 10 side 1 format command
Value 11 command error

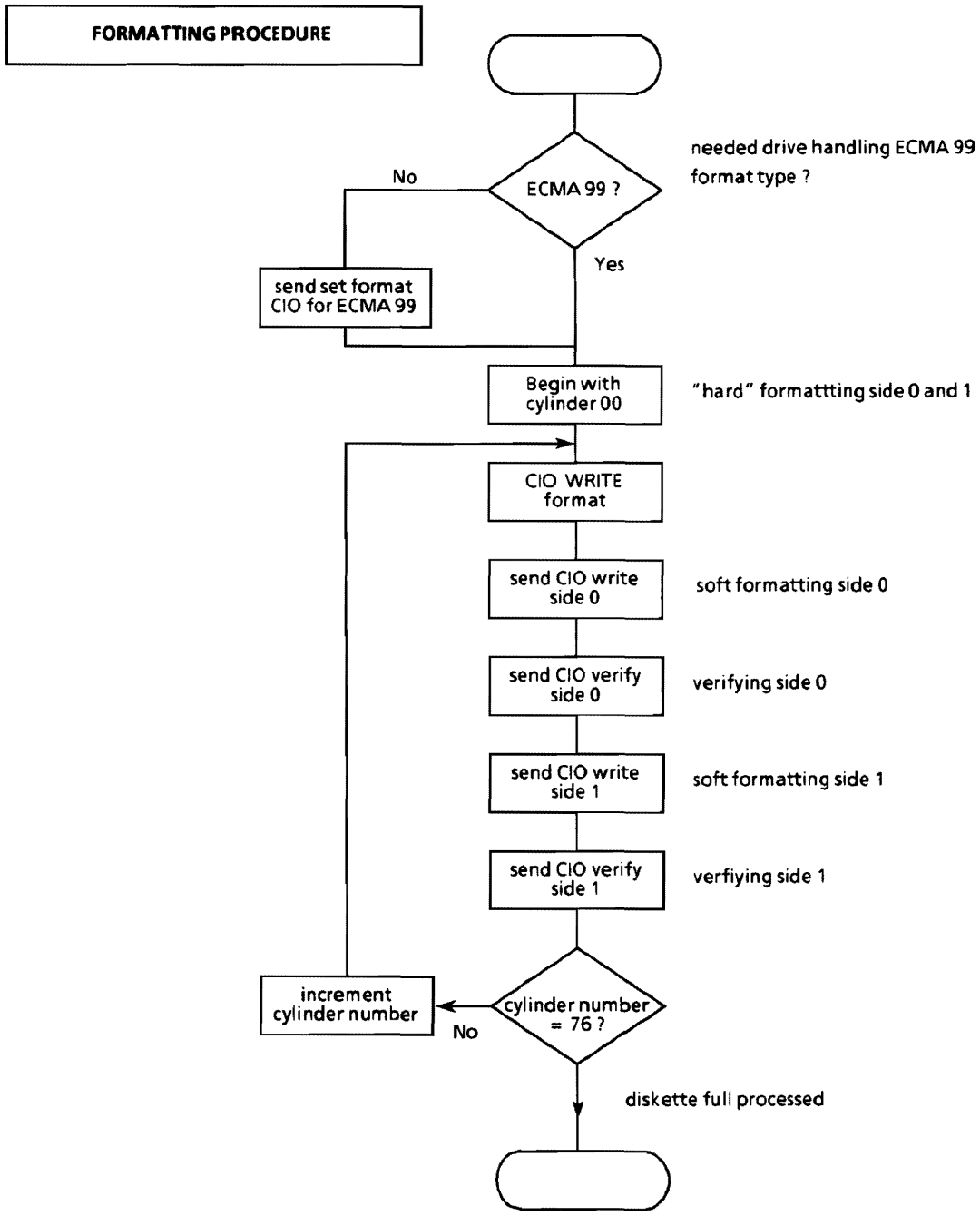

Figure 2.14 Formatting Procedure

Note: *All CIO sent are under driver control*

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2.5.11 SST Command (send status)

This command is used to send the CU status word to the CPU, after an interrupt. The command is accepted only if the CU is in the wait state. If the command is accepted:

1. The status word is loaded onto the BIO lines of the bus (See fig. 2.15 for an explanation of the status word).

2. The CU goes to the inactive state.

3. The status word is reset in the CU.

2.5.12 TST Command (test Status)

This command may be used before IOP initialisation to check if the CU is busy. The command is always accepted. When the command is received the CU sets BIO-N line 15 of the bus low (active) if the CU is busy or does nothing if it is not busy.

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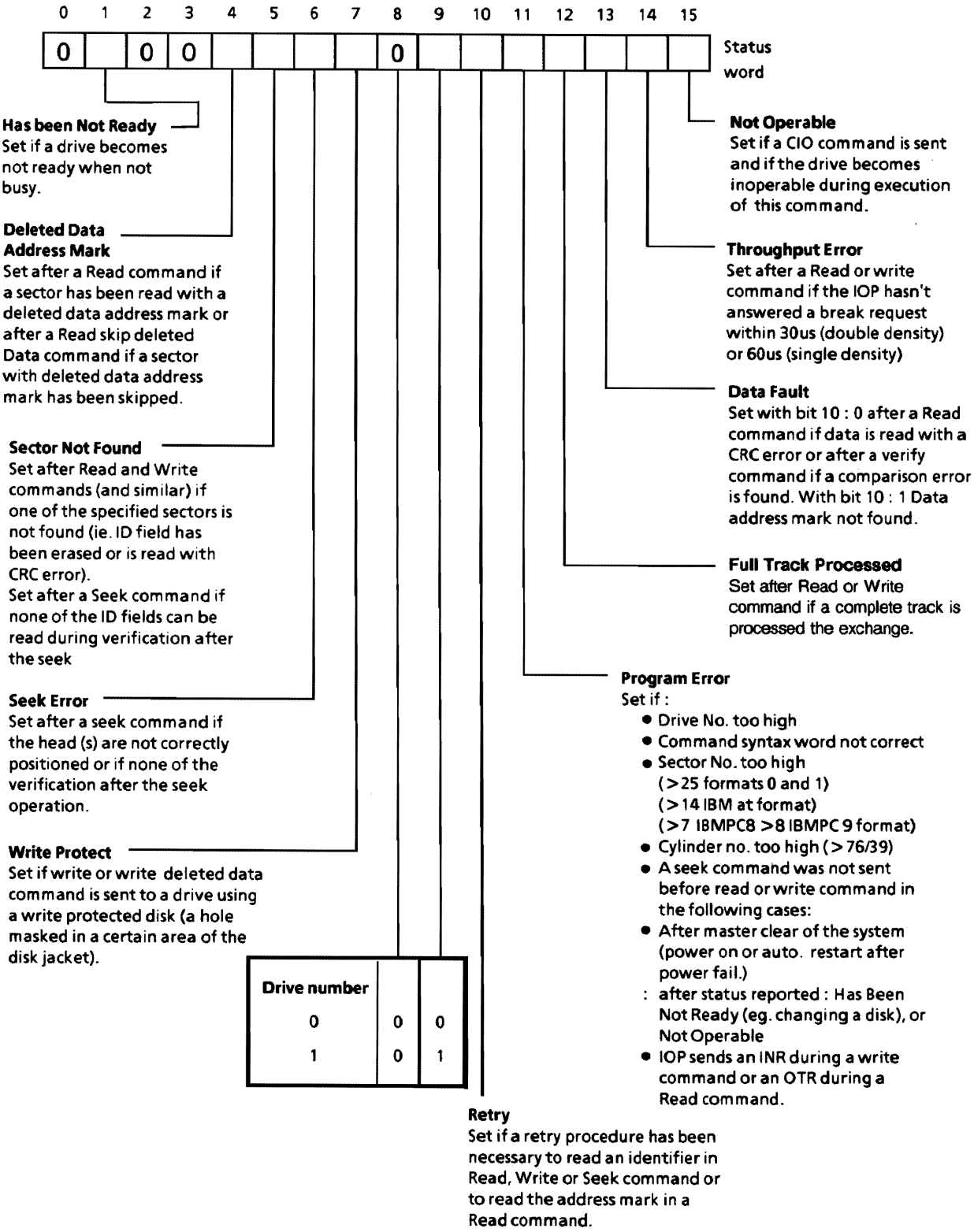

Figure 2.15 Explanation of Status Word

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2.5.13 Drive Operability

When the CU receives a command for a drive which Has Been Not Ready, during the time interval where this drive was inactive, the CU switches immediately into the wait status state and sends an interrupt to the CPU. When the CPU answers with an SST command, the CU reports status word with bit 1 set (HAS BEEN NOT READY), and also indicates the appropriate drive number in bit 9.

To the following commands sent to the drive (which is still not ready) to CU sets bit 15 of the status word (NOT OPERABLE) and the appropriate drive number in bit 9.

Note: *The following command send to the CU after a Has Been Not Ready status reported must be a seek, IF NOT program error status will be reported.*

When a selected drive becomes inoperable during the execution of a command, or when a new command was received for a drive which is still not operable (the drive is still not ready from reception of the command to the time out of the motor start time). The CU immediately switches into the wait status state and send an interrupt to the CPU. When the CPU answers with an SST command, the CU report status word with bit 15 set.

Note: *The following command, send to the CU after a Not Operable status reported must be a seek, if not Program error status will be reported.*

The following three examples resume operability situations:

Two situations with HAS BEEN NOT READY, and one situation witn NOT OPERABLE are providing:

1. HAS BEEN NOT READY SITUATION NUMBER ONE, describes the possible events encountered when a drive becomes not ready (drive is then not operable), during an inactive state, and becomes again ready, in the inactive state, before any CIO command have been sent.

2. HAS BEEN NOT READY SITUATION NUMBER TWO, describes the possible events encountered when a drive becomes not ready (drive is then not operable), during an inactive state, and is still not ready when the first CIO command is sent.

3. NOT OPERABLE SITUATION, describes the possible events encountered when a drive becomes not operable during execution of a CIO command, and still remains not operable during a certain time.

A. The first line describes the activity state of the control unit: the control unit is said in an active state, if the control unit has accepted a CIO command and is trying to process the command, This active state ends at the completion of the command, at that moment an interrupt is sent.

   The control unit is said in an inactive state since the interrupt has been sent, up to the reception of another CIO command (at the reception of an SST command the control unit is inactive, but scanning drive operability).

B. The second line describes the drive operability. The drive is operable when a diskette is inserted and when the front door of the drive is closed.

   The drive is not operable when there is no diskette and when the door is open, or when there is no diskette and the door is closed, or when there is a diskette but the door is open.

   This feature don't take into account problems which can be encountered by mean of a dummy diskette, or if a diskette is inserted in the bad side.

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C. The third line describes the commands send to the control unit.

These are a set of commands send to the control unit which resume situations that can be encountered when a drive becomes not operable.

D. The fourth line describes the actions taken by the control unit according to:

1. the control unit active or inactive state
2. the operability or non operability of the drive
3. The type of CIO command send

E. The fifth line describes the actions taken by the control unit, in the same way as D., but including an erroneous situation.

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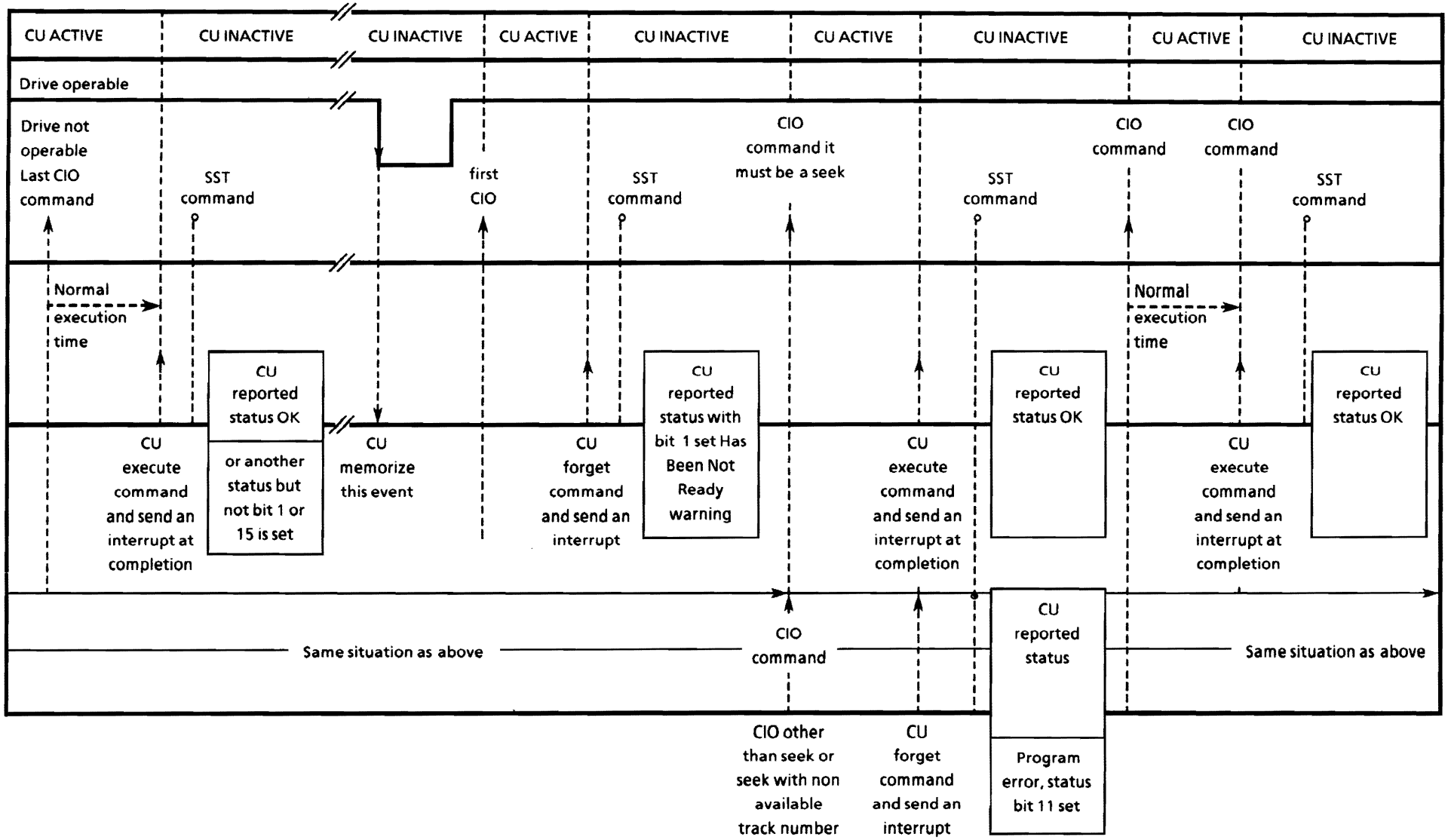

Figure 2.16 HAS BEEN NOT READY Situation Number One

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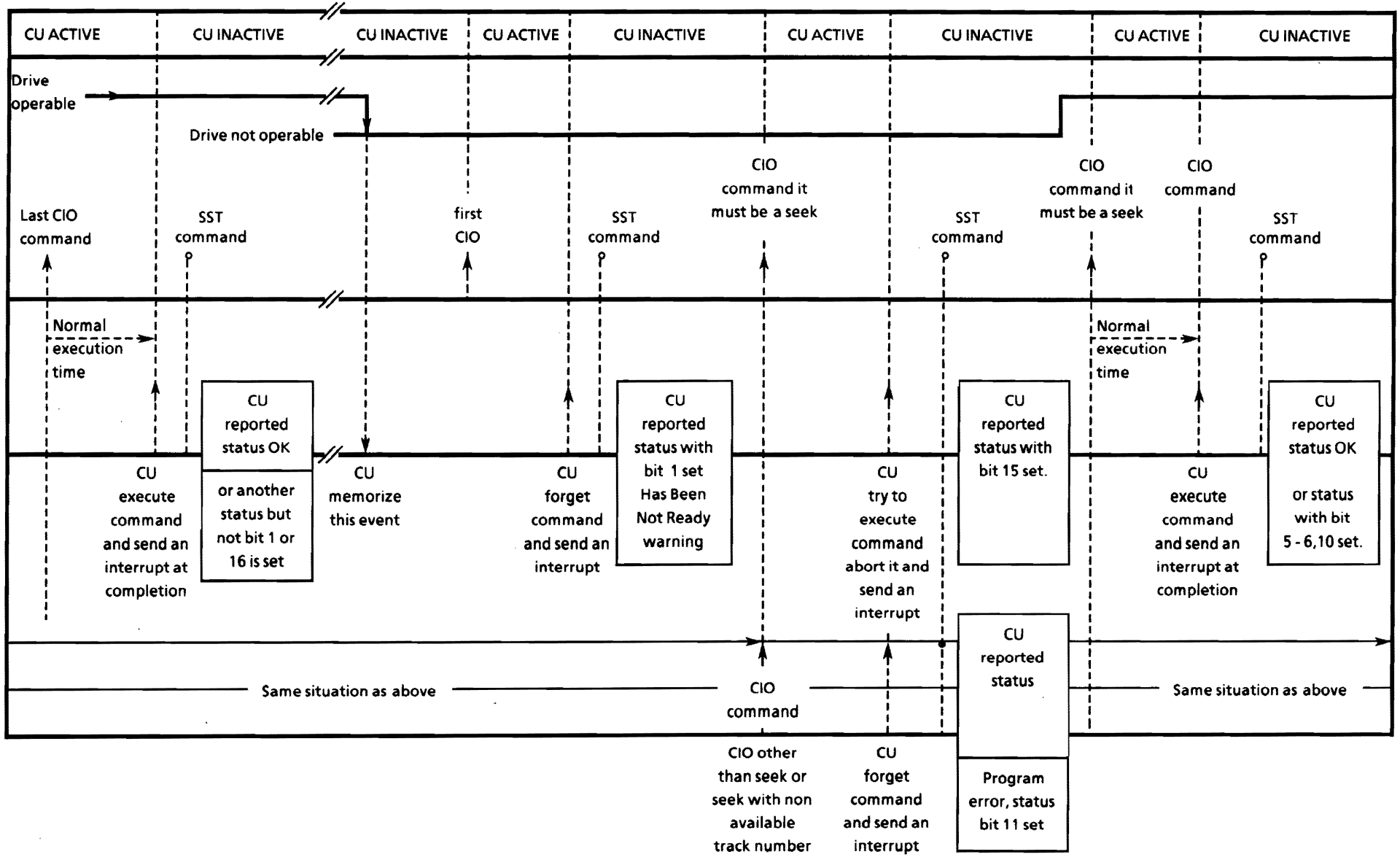

Figure 2.17 HAS BEEN NOT READY Situation Number Two

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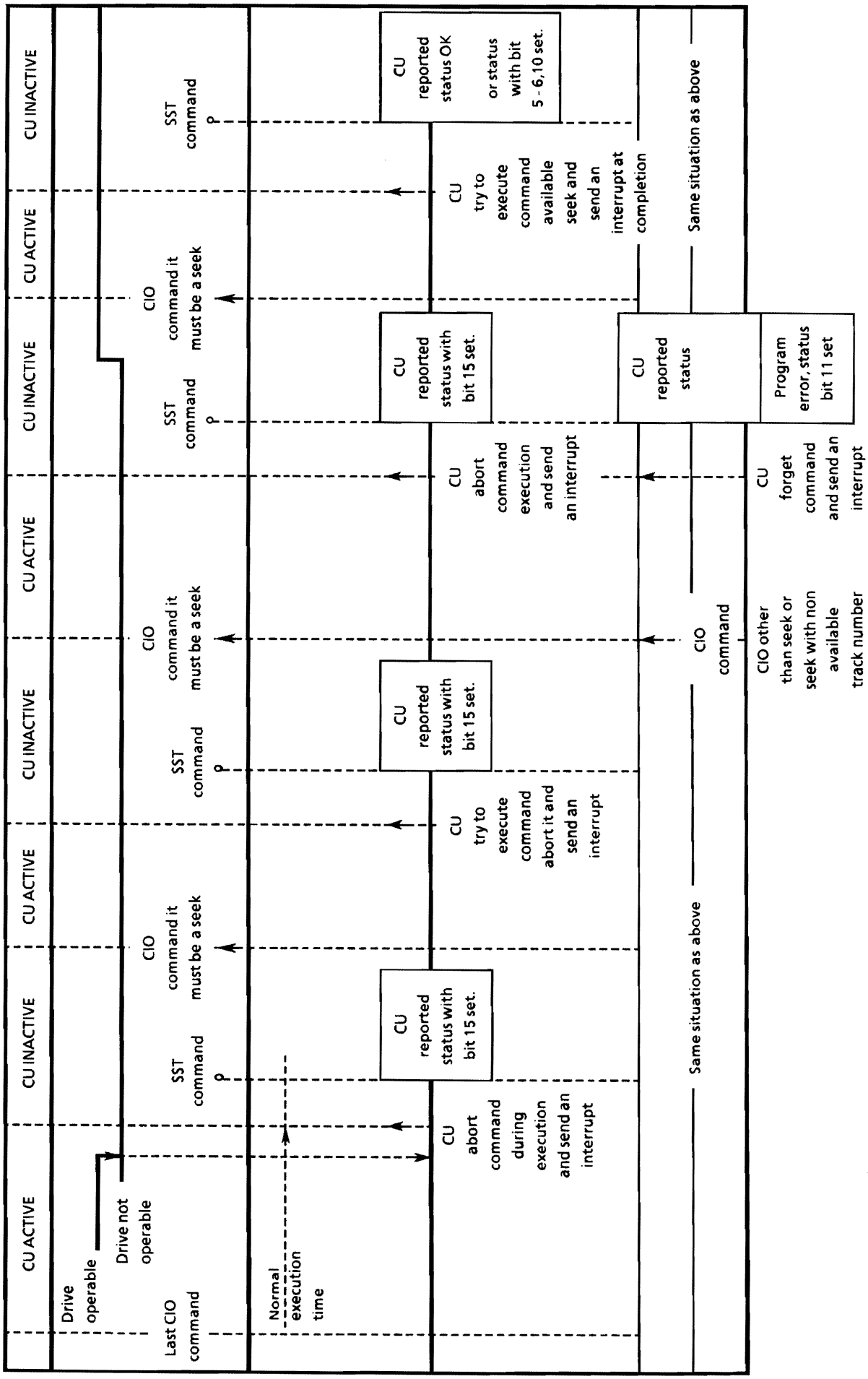

Figure 2.18 NOT OPERABLE Situation

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3 DETAILED HARDWARE DESCRIPTION

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3.1 BUS INTERFACE (Refer to Table 1.2)

3.1.1 CU Initialisation

The CU is initialised by the system general reset signal CLEARN. This occurs:

- During a normal switch on sequence
- During an automatic restart sequence after a power failure
- After operation of the control panel Master Clear button

Signal CLEAR (and CLEARAN, CLEARBN, CLEARDN) is enabled which reset the main registers and flip-flops of the CU, reset the floppy disk controller chip 8 x 330 and reset the microprocessor 8 x 305 to instruction /00. The CU as a whole is thus reset to the inactive state.

3.1.2 CU Addressing

The CU address is chosen with four U-links on the card. The CPU or IOP initiates a command by setting the address and command code on the MAD lines and activating timing signal TMPN. The address on MAD lines 12 - 15 is compared with the CU address in comparator chip C4. The chip is enabled by signal TMP. If the address is correct signal ARE goes high, which with signal TMP generates AREN. After a time delay selectable with a U-link, TSMAN goes low which with ARED generates timing signal TSMN (see figure 3.1).

3.1.3 Command Decoding

TMP also clocks the command code on MAD04, 8 and 9 into register C1 along with flag signals FECH and F1A. These five signals are decoded by PROM A5 which is enabled by signal AREDN. The flag signals are used to ensure that the CU is in the correct operating (status) state before a command is accepted (see paragraph 2.4.1). The outputs from the PROM are shown in table 3.1. When a command is accepted signal ACAN goes low which with TMP generates accept command signal ACN, (see figure 3.1)

Note that F1A corresponds with function F1 and FECH corresponds with function F0.

When signal ARE goes high and while TSMAN is still high, MAD line 03 is enabled as signal EORZ1N. MAD03 is the end of transfer bit (EOR) sent by the IOP to indicates when an exchange is finished. If MAD03 is high, signal FEORN is set low. Signal FEORN is also clocked into register E3 which is scanned by the microprocessor.

When a CIO command is accepted signal CIOZ1N goes low which clocks the drive address code on MAD10 and 11, which are buffered in C1, into register D3. The outputs of this register are decoded to enable one of the drive selection signals (figure 4.3). Signals DN0 and DN1 are also clocked into register E3.

Four of the output signals from the PROM are used to operate the four latches F4. The outputs of the latches FECH, FINPUT, FCIO and FEORN are clocked into register E3 (these indicate the CU status).

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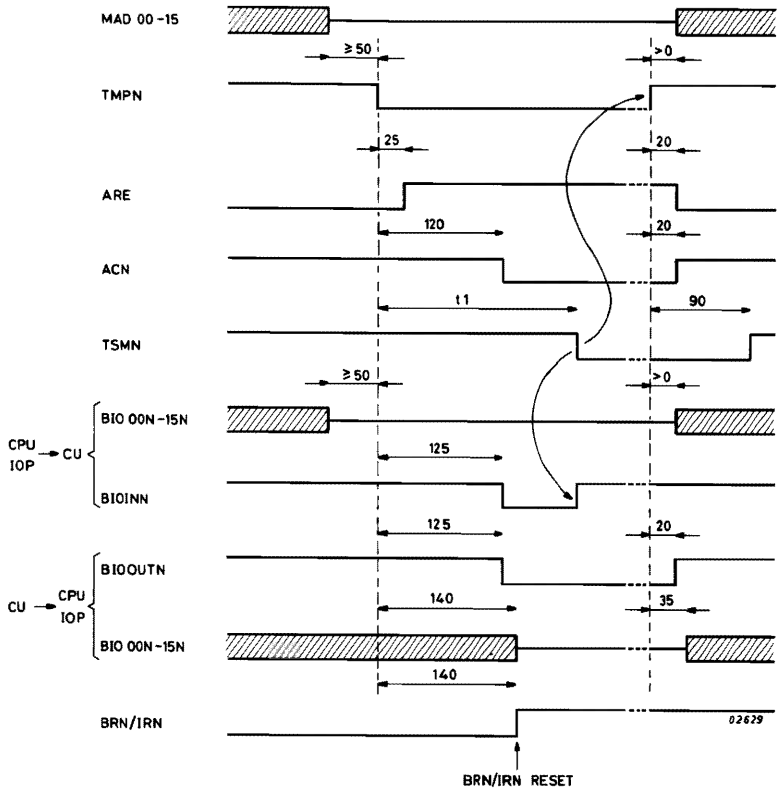

Figure 3.1 Exchange Timing on GP Bus-S

3.1.4 Break/Interrupt Logic

The four operating states of the CU (see paragraph 2.4.1) are determined by flag signals FECH and F1A which are generated by signals FCIO, FINPUT and FECH. The flag signals control command acceptance, and, the sending of break and interrupt requests (BRN and IRN). IRN is sent:

- at the end of a successfully completed CIO command
- if an error is detected during the execution of a CIO command
- if a CIO command is received for a drive which is not ready.
- if, while the CU was not busy, a drive has been found not ready, and a CIO is receiving and concerns this drive; (or, if a program error is detected).

BRN is sent before each data word is transferred during a data exchange. Control Units used with the UPL bus and with binary coded interrupts are provided with an interrupt priority encoder chip IHC. This chip is plugged into a chip socket mounted on the card, when required. The chip sends a Binary Coded Interrupt, BCI, synchronised with an Incoming Clock pulse, INCL, instead of the discrete interrupt IRN.

The priority level of this interrupt is determined with six U-links on the card, when used. Figure 3.2 shown typical data transfer sequence showing the flag signals and the CU operating states.

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Command type (indicated by MAD04, 08, 09)	Address (input to PROM)					CU Operating State (indicated by flags F0 and F1)	PROM Output							
	MADXXC			FIC	FOC		ACAN	BUSYN	OUTN	INN	CIOZIN	INPUTZIAN	INPUTZOAN	ECHZOAN
	09	08	04											
OTR A	0	0	0	0	0		1	1	1	1	1	1	1	1
	0	0	0	0	1		1	1	1	1	1	1	1	1
	0	0	0	1	0		1	1	1	1	1	1	1	1
	0	0	0	1	1	EXCHANGE	0	1	1	0	1	0	1	0
INR A	0	0	1	0	0		1	1	1	1	1	1	1	1
	0	0	1	0	1		1	1	1	1	1	1	1	1
	0	0	1	1	0		1	1	1	1	1	1	1	1
	0	0	1	1	1	EXCHANGE	0	1	0	1	1	1	0	0
CIO Halt	0	1	0	0	0	INACTIVE	0	1	1	1	1	1	1	1
	0	1	0	0	1	WAIT STATUS	0	1	1	1	1	1	1	1
	0	1	0	1	0	EXECUTE	0	1	1	1	1	1	1	1
	0	1	0	1	1	EXCHANGE	0	1	1	1	1	1	1	1
TST	0	1	1	0	0	INACTIVE	0	1	1	1	1	1	1	1
	0	1	1	0	1	WAIT STATUS	0	0	1	1	1	1	1	1
	0	1	1	1	0	EXECUTE	0	0	1	1	1	1	1	1
	0	1	1	1	1	EXCHANGE	0	0	1	1	1	1	1	1
OTR B	1	0	0	0	0		1	1	1	1	1	1	1	1
	1	0	0	0	1		1	1	1	1	1	1	1	1
	1	0	0	1	0		1	1	1	1	1	1	1	1
	1	0	0	1	1	EXCHANGE	0	1	1	0	1	0	1	0
INR B	1	0	1	0	0		1	1	1	1	1	1	1	1
	1	0	1	0	1		1	1	1	1	1	1	1	1
	1	0	1	1	0		1	1	1	1	1	1	1	1
	1	0	1	1	1	EXCHANGE	0	1	0	1	1	1	0	0
CIO Start	1	1	0	0	0	INACTIVE	0	1	1	0	0	0	1	1
	1	1	0	0	1		1	1	1	1	1	1	1	1
	1	1	0	1	0		1	1	1	1	1	1	1	1
	1	1	0	1	1		1	1	1	1	1	1	1	1
SST	1	1	1	0	0		1	1	1	1	1	1	1	1
	1	1	1	0	1	WAIT STATUS	0	1	0	1	1	1	1	0
	1	1	1	1	0		1	1	1	1	1	1	1	1
	1	1	1	1	1		1	1	1	1	1	1	1	1

Table 3.1 Contents of PROM 5081 (Loc. A5)

Note: *CIO Halt, OTR B and INR B commands are not used with this CU although they are programmed into the PROM.*

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3.2 DATA HANDLING LOGIC

3.2.1 Memory to Disk Drive (Write Operation)

16-bit words are loaded from the bus (BIO00N-15N) into four transceivers type 2917A by signal BIOINN during a CIO Start or OTR command. The data is set onto the CU internal bus IVB0N-7N, eight bits at a time, by signals BUSMSBN (8msb) and BUSLSBN (8 lsb), controlled by the micro-processor (figure 4.2).

For a CIO command the BIO lines contain control information used by the microprocessor to control the transfer; For an OTR command the BIO lines contain a data word to be written on the disk. The data is transferred 8 bits at a time via the microprocessor to the Floppy Disk Controller type 8 x 330 (figure 4.3) which performs parallel to serial conversion. This chip also generates the CRC word and encodes the data before gating it to the disk drive as signal WDN.

The internal write clock of the 8 x 330 is synchronised with the externally connected quartz crystal Y2 (8 MHz).

3.2.2 Disk Drive to Memory (Read Operation)

Serial data input RDLN to the CU is input to the 8 x 330 chip (figure 4.3) which decodes the data, performs the CRC error check and performs serial to parallel conversion. Parallel data is loaded via the microprocessor (figure 4.2) into tranceivers 8 bits at a time by signals CLIVMSBN (8 msb) and CLIVLSBN (8 lsb). 16 bit words are set onto the BIO lines of the system bus by signal BIOOUTN during either an INR or SST command.

The internal read clock of the 8 x 330 is synchronized with incoming data by a phase locked loop. The frequency of the clock is controlled by signal CCO. A phase detector, internal to the 8 x 330, detects any phase difference between clock pulses and input data pulses. Output signals PUP or PDN from the 8 x 330 are pulse width modulated signals which indicate that the clock frequency is low or high respectively. There signals operate into the charge pump of chip type MC4044 which adjusts the level of signal CCO accordingly, via a low-pass (active) filter.

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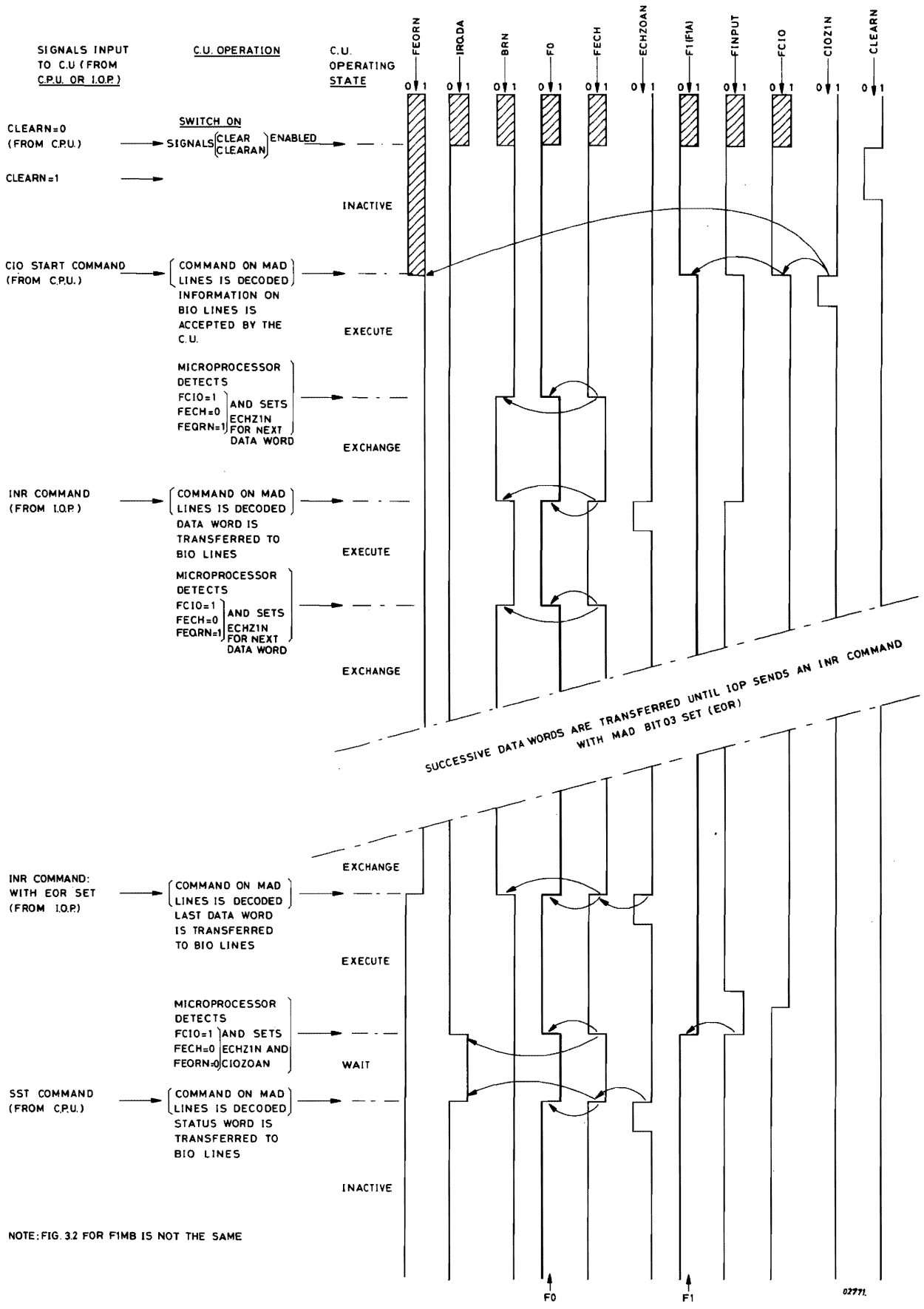

Figure 3.2 Typical Transfer of Read Operation Showing CU Operation States

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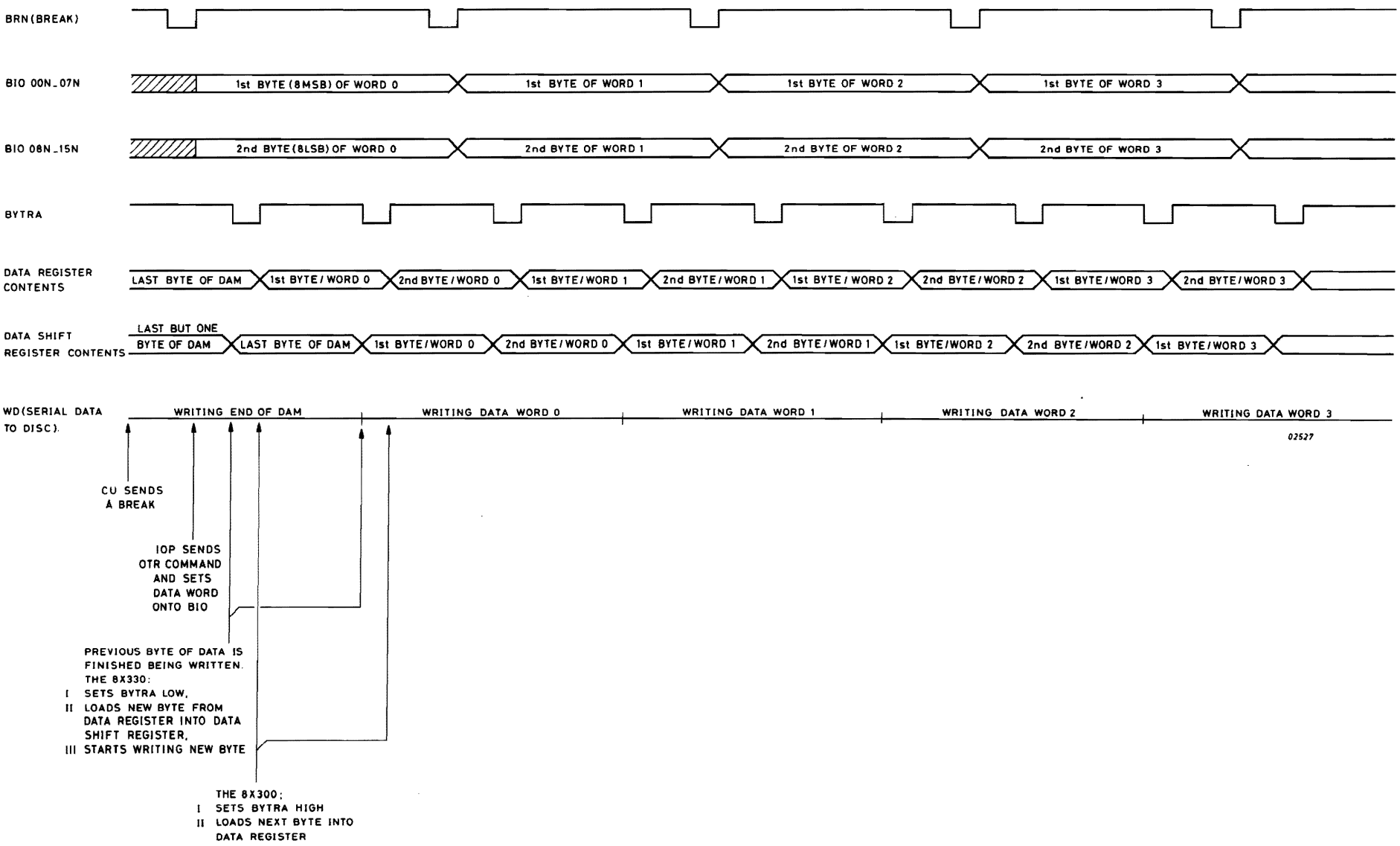

Figure 3.3 Timing Diagram for Transfer of Data via 8x330 - Write Mode

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3.3 DISK DRIVE OPERATION (refer to Figure 4.3)

3.3.1 Drive Selection

Drive 'Ready' status is indicated by signal READY which is input at transceiver D54 and monitored by the microprocessor. Drives are selected with SEL0N-1N which are generated by decoding signals DN0, DN1, (DC42N, DC48N) see paragraph 3.1.3.

3.3.2 Drive Control

Drive control signal DIRN is generated by the microprocessor. The other drive control signals are generated by the Floppy Disk Controller chip 8 x 330. Signals WEN, HLN and STEPN are described in paragraph 2.2.3. If during a Write command a power failure occurs signal RSLN from the power supply goes low and inhibits the write enable signal, WEN, thus protecting the disk.

Drive status signals INDN, TRON, WRPN are input directly to the Floppy Controller chip. Their functions are described in paragraph 2.2.1/2.2.2/2.2.3.

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3.4 CU CONTROL

3.4.1 Microprocessor 8 x 305 (Figure 4.2.)

The 8 x 305 performs the main control function of the CU card under control of the microprogram. The microprogram is stored in PROM's located at R1 and R3, which are addressed via address lines RA02-12. The microprocessor performs the following major functions:

- generation of CU internal control signals
- control of floppy disk controller (chip 8 x 305)
- generation of certain disk control signals
- control of interrupt (IRN) and break (BRN) signals
- generation of status word
- master clock output MCLK is used as a synchronous clock signal for all logic on the CU card.

MCLK is generated by the microprocessor during the last quarter of each instruction cycle. This cycle time is set at 400ns by the link connected quartz crystal Y1. The CU internal control signals are clocked into register L1 from the IV bus by signal SELIVLB.

Table 3.2(a) cross refers the signal names used in data sheets with those used in the logic diagrams in chapter 4.

8 X 305

PIN NO.	SIGNAL MNEMONIC		SIGNAL FUNCTION
	DATA SHEET	LOGIC DIAGRAMS	
7-2 49-45	A2-A12	RA2-RA12	PROM Address Lines
13-28	I0-I15	I00-I15	Instruction Lines from PROM's
41-38 36-33	$\overline{IVB0}$-$\overline{IVB7}$	IVBON-IVB7N	Bi-directional data Lines
10,11	X1,X2	CX1,CX2	Microprocessor Clock Input
43	$\overline{RESET}$	CLEARAN	Microprocessor reset signal
42	MCLK	MCLK	Microprocessor clock signal
29,30	SC,WC	SC,WC	Indicate type of output from microprocessor. Used to control floppy Controller 8X330.
32	$\overline{RB}$	RBN	Selects one of two sets of IO devices. Used to control 8X330.
44	$\overline{HALT}$	HALTN	Microprocessor inhibit (held high)
9,8	A0,A1	Not Used	
31	$\overline{LB}$	Not Used	

Table 3.2a Microprocessor Signal Names

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3.4.2 Floppy Disk Controller 8 x 330 (Figure 4.3)

This chip is controlled from the microprocessor with signals SCA, WCA and LBA. The chip is synchronised with microprocessor clock pulse MCLK. The chip performs the following functions:

- Serial/parallel conversion of data
- Data encoding/decoding (FM, MFM) - programmed from 8 x 305.
- Read data synchronisation using a phase locked loop
- Data/clock pulse separation for Read data
- CRC error character generation/checking
- Address mark detection - programmed from 8 x 330

Table 3.2b cross-refers the signal names used in the data sheets with those used in the logic diagrams in chapter 4.

8 x 330:

PIN NO.	SIGNAL MNEMONIC USED IN		SIGNAL FUNCTION
	DATA SHEET	LOGIC DIAGRAMS	
25-32	$\overline{IV0}$-$\overline{IV7}$	IVB0N-IVB7N	Bi-directional data lines
23	SC	SCA	Indicates that information from 8X300 is an address
24	WC	WCA	Indicates that information from 8X300 is data
21	$\overline{ME}$	LBA	RB (= $\overline{LBA}$) selects 8X300
22	MCLK	MCLK	Microprocessor clock signal
19	$\overline{W_{Gate}}$	WEAN	Disc write enable
20	$\overline{PFAIL}$	Clearn	A low signal disables $\overline{W_{Gate}}$
4	$\overline{Data_W}$	WDAN	Write data to disc
5	$\overline{Data_r}$	RDLN	Read data from disc

Table 3.2b Floppy Disc Controller Signal Names

3.4.3 Microprogram

A detailed flow diagram is given in chapter 3 the general flow of the whole microprogram being shown in figure 3.6.

During a Write operation data is transferred via:

- BIO lines (from IOP)
- microprocessor 8 x 305
- 8 x 330 DATA registrer
- 8 x 330 DATA shift register (which performs parallel/serial conversion)
- WD the serial data output line of the 8 x 330, under control of the microprogram. This is illustrated in figure 3.3.

During operation of the microprogram, use is made of the internal registers of both the 8 x 305 and the 8 x 330. Figure 3.4 shows the use of the microprocessor internal registers which vary according to the part of the microprogram in which they are used.

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Used Abbreviations:

BIT CELL	Indicates the bit cell in which the first data change is expected within an address mark. Always set = 00 (bit cell 0)
BT 1	Set = 1 when first bad track correction is made
BT2	Set = 1 when second track correction is made
BYTRA	Set = 0 when DATA register of 8 x 330 is ready for the transfer of a byte or half byte of data. In Read mode the data must be transferred from the data register to the 8 x 305. In Write mode the data must be transferred from the 8 x 305 to the DATA register. Set = 1 when DATA register is selected (in READ or WRITE mode) by 8 x 330
CION	Set = 0 when a CIO command is received. Reset in Wait status by 8 x 305
CIOZO	When set = 1 (by 8 x 305) it sets CION = 1; (CION is inverse of signal FCIO)
CRCE	When set = 1 CRC word is calculated by 8 x 330 (if SYNE is set = 1) When set = 0 CRC register becomes a source of data
CT256	Msb of word counter, during write mode
CTX	Msb of word counter, during read mode
DCMXN	Set = 0 when DATA register contains a 1/2 byte of data:clock pulses interleaved. Set = 1 when DATA register contains a byte of data only.
DDAM	Set = 1 if a deleted data address mark has been detected
DIR	Set = 0 to displace drive head towards track 0 (outer) Set = 1 to displace drive head towards track Max (inner)
DN0, DN1, (DNX)	Drive number selected with the last CIO command
DN0N, DN1N (DNXN)	Drive number selected with current CIO command (inverted)
ECHN	Set = 0 to send a break or interrupt request. Reset by INR, OTR, or SST
ECHZ1	When set = 1 by 8 x 305 it sets ECHN = 0: (ECHN is inverse of signal FECH)
EOR	Set = 1 (by INR or OTR) when next word transfer is the last Reset = 0 by the next CIO command: (EOR is inverse of signal FEORN)
F/2	Set = 0: The 8 x 330 half frequency facility, Set = 1: Full frequency
FDIR	Used to memorise the direction the drive head has just moved (i.e. DIR) Set = 0 towards track 0, Set = 1 towards track Max
FM	Set = 1 for FM recording, Set = 0 for MFM recording
FR	Set = 1 if a retry procedure has been performed or started
FSTRO	Set = 1 for a seek to zero (normal or retry)

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Used Abbreviations: (Continued)

FSK1 seek FSKN flags	Set = 0 for other seeks (normal or retry) Set = 1 for a normal seek Set = 0 for a retry seek
FTP	Set = 1 if a full track is processed and transfer is not stopped by IOP
H1SEL	Set = 0 to select head 0, set = 1 to select head 1
HEADL	Set = 1 to load head on floppy disk
INDN	Index pulse from drive. Active = 0
INPUTN	Set = 0 by CIO or OTR Indicates direction of an exchange. Set = 1 by INR Can be set = 1 by µPRO after a CIO or set = 0 to block CIO commands (INPUTN is inverse of signal FINPUT)
INZO, INZI	When set = 1 (by 8 x 305) they set INPUTN = 0 or 1 respectively
M²FM	Always set = 0. The M²FM recording mode is not used
MIC500	Number of times the MIC500 procedure must be repeated in order to wait the required length of time (each MIC500 = 500 microseconds)
NOPx	Set = 1 when corresponding drive (0-1) is not operable
PNC	Set = 1 when head position of corresponding drive is not known
PREAMB	Always set = 0 to indicate that the preamble data (before AM) is all zeroes
PROGER	Set = 1 if a program error is detected
RDR	Read retry counter. Initially set = 4
RDY	Set = 0 when selected drive (0-1) is ready
READN	Set = 0 for read. Set = 1 (with WEN = 0) for write. Set = 1 (with WEN = 1) for synchronisation before writing
RERY	Set = 1 if a retry or bad track correction is currently being performed
SID	Set = 1 if an ID address mark is currently being searched for Set = 0 if a data address mark is currently being searched for
SKR	Seek retry counter. Initially set = 4
SP0 -15	Scratch pad registers of 8 x 330
STEP	Set = 1 for 500µs to step the head one track in the direction specified by DIR
SYNE	When set = 0 the CRC register is set to all 'ones' and synchronisation of the PLL is enable on Read Data (if READN = 1 and WEN = 1. When set = 1 CRC calculation begins as soon as the address mark is detected (if CRCE is set = 1). The Address Mark is part of the CRC calculation
THER	Set = 1 throughput error is detected
TRON	Set = 0 when the drive head(s) is over track zero
WEN	Set = 0 (with READN set = 1) for write mode
WRPN	Set = 0 if the diskette is write protected

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8 x 305 Registers:



The following registers are mainly used for the indicated functions:

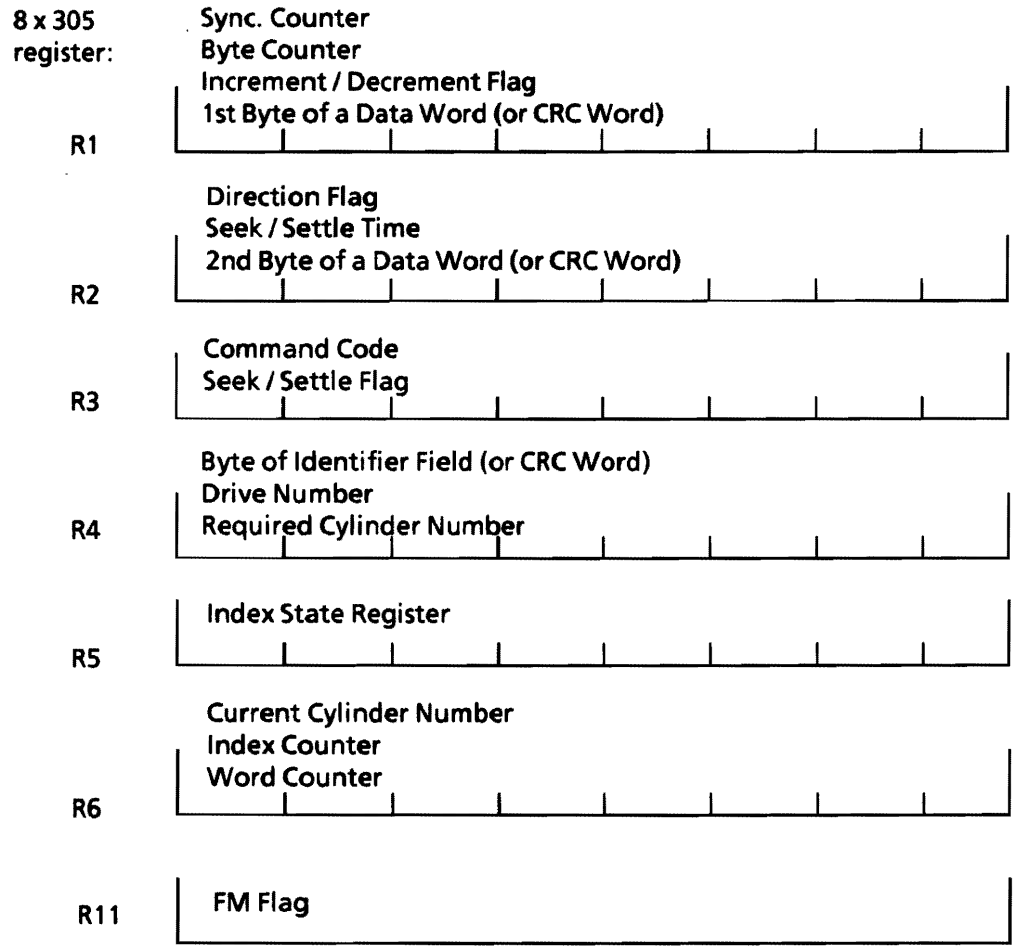

Figure 3.4 Use of Microprocessor Internal Registers

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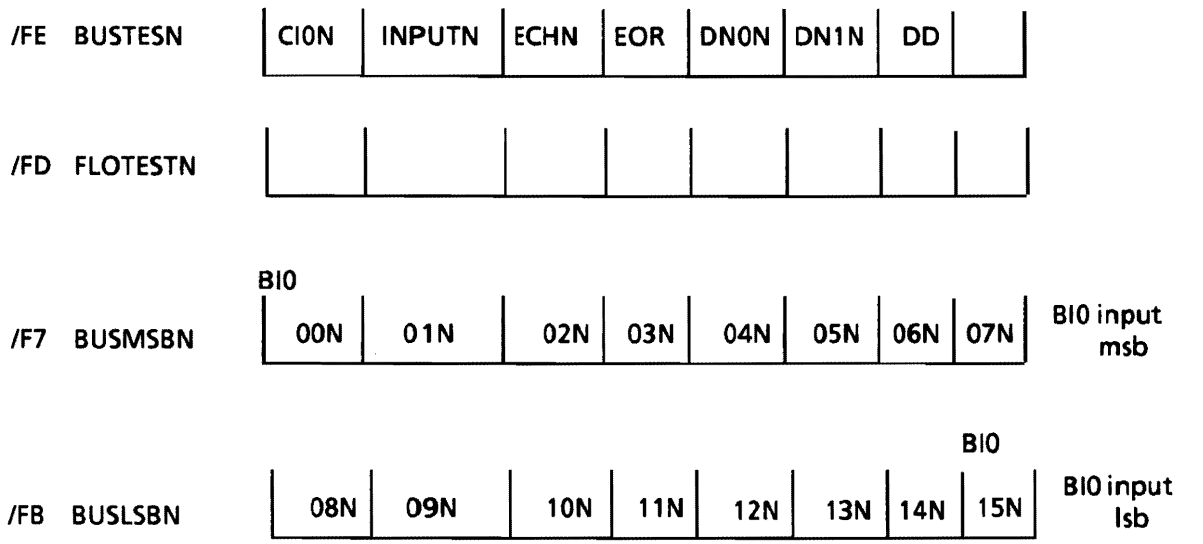
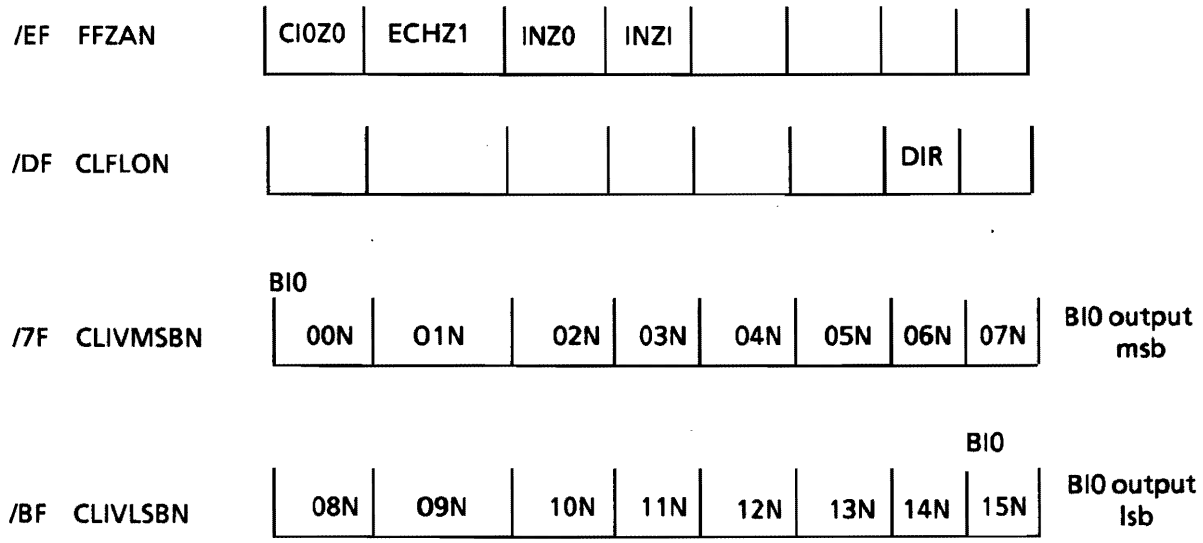
8 x 305 LB - Selection in IVB

Address
(hexa.)

Input:



Output:



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8 x 330 Registers:

Internal registers Right bank

SP0 Drive state

DNX NOPX HBNRX

Store					NOP	NOP	HBNR	HBNR
	DN0	DN1			0	1	0	1
	0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	48	110	72

DNX : Select ed Drive Number
NOPX : Not operationnal state of selected drive
HBNRX : Has been not ready state of each drive if not busy

SP1 Head position drive 0

Current cylinder number drive 0

Store	PNC0							
	0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	49	111	73

PNC0 : Set to 1 when head position is declared not known

SP2 Head position drive 1

Current cylinder number drive 1

Store	PNC1							
	0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	4A	112	74

PNC1 : Set to 1 when head position is declared not known

SP3 Drives format

Setfor 0 Setfor 1

Store								
	0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	4B	113	75

Set for 0: Format handle for drive 0 according CIO Set Format
Set for 1: Format handle for drive 1 according CIO Set Format

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8 x 330 Registers: (Continued)

Internal registers Right bank

SP4

Reset

0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	46	114	76

Use to store ID information when a write command is done for the following sector, concerning the write operation: in order to insure a safe state of the drive up to the end of the write

SP5

Reset

			FS	FS			PROG
BT0	BT1	FDIR	TR0	KN	FTP	THER	ER
0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	4D	115	77

Bad track 1: 1 = first bad track correction made
Bad track 2: 1 = 2d bad track correction made
FDIR : (seek direction) 0 = towards track 0, 1 = towards inner track
FSTR0 : 1 = seek is 0, 0 = seek to another track than 0
FSKN : 1 = normal seek, 0 = retry seek
FTP : 1 = full track proceed
THER : 1 = throughput error
PROGR : 1 = program error

SP6 SNC — Sector number specified in command

Reset

DDAM	FR	SID					
0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	4E	116	78

DDAM : set = 1 if a deleted data address mark has been detected, set = 0 else
FR : set = 1 if a retry procedure has been performed or started
SID : address mark is searched for: 1 Id AM; 0 Data AM

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8 x 330 Registers: (Continued)

Internal registers Right bank

SP7 CYLC
Cylinder number specified in command

Reset

RTRY							
0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	4F	117	79

RETRY : set to 1 if a bad track correction or a retry is being performed

SP8 CYL ID

0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	50	120	80

Value (0 - 127) (possibility 0 - 255)

SP9 SID ID

0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	51	121	81

Value (0 or 1)

SP10 Sector ID

0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	52	122	82

Value (0 - 31) (possibiity 0 - 255)

SP11 Data length ID

0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	53	123	83

Value 00 126 bytes/sector
01 256 bytes/sector
10 512 bytes/sector
11 1024 not used

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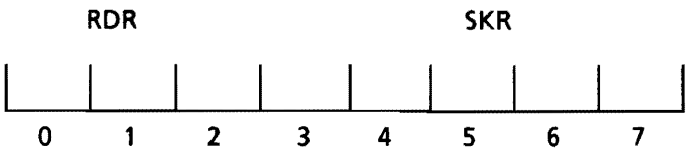
8 x 330 Registers: (Continued)

Internal registers Right bank

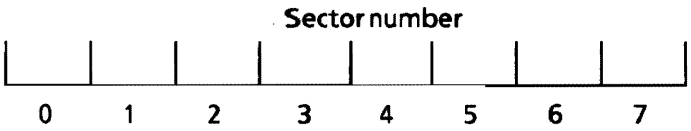
SP12



Add:	Hex	Oct	Dec
	54	124	84

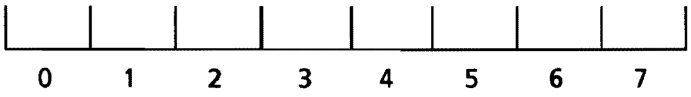
RDR : Read Retry Counter
SKR : Seek Retry Counter

SP13 Working sector number



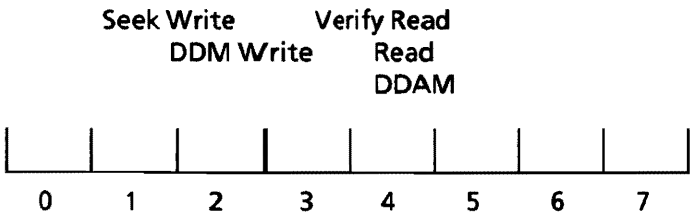
Add:	Hex	Oct	Dec
	55	125	85

SP14 Index viewed counter in SSP subroutine



Add:	Hex	Oct	Dec
	56	126	86

SP15 Command type (1 bit set to "1" when active)



Add:	Hex	Oct	Dec
	57	127	87

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8 x 330 Registers: (Continued)

Internal registers Right bank

CONTROL

	WEN	CRCE	DCMXN	SYNE			BYTRA	DS1
	0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	5A	132	90

WEN: 0 = $\overline{WG}$ = 0 actif; 1 = $\overline{WG}$ = 1 inactive 
CRCE (CRC)
DCMXN (DRC)
SYNE (SE)
BYTRA: Read only: set to "1" when a byte has to be handled, reset to "0" when data register is addressed
DS1: input signal INDN = 0 when index signal active

COMMAND

DC1	DC2	DC3	DC4	DC5	DC6	DC7	
0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	50	134	92

DC1: Output:  Motor-on 1 = ON (0 drive line) 0 = OFF (1 drive line)
DC2: " :  H1 SEL; DC2 = 0 head 0
DC3: " :  SEL0
DC4: " :  SEL1 } SELX command address drive
DC5 " :  In = use: 1 loads heads, 0 unloads head (both drives)
DC6: " :  high density: 1 = 360Rpmn, 0 = 300Rpmn
DC7: " :  Step 0 1

	PE		BS1 BS0		PS		M2 FM	
	0	RM	0	0	0	FM	0	1/2F
	0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	5B	133	91

READN: "0" = Read Mode; "1" write mode if WEN = 0, if not cristal lock-on mode

FM: "0" = MFM "1" = FM
1/2F: "0" = 1/2F; "1" = 1F
4MHz 8MHz

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8 x 330 Registers: (Continued)

Internal registers Right bank

STATUS

DS2	DS3	DS4	DS5	0	0	0	0
0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	5D	135	93

DS2: Input: TRON: "0" when track 0 detector is active
DS3: Input: WRPN: "0" when write protect detector is active
DS4: Input: ReadyN: "0" when Ready signal active
DS5: Input: Not used

DATA: CONTROL bit 2 = "1"

0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	5F	137	95

SECTOR LENGTH REGISTER (not used)

0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	5E	136	94

DATA CLOCK MIXED: CONTROL BIT 2 = "0"

0	1	2	3	4	5	6	7

Add:	Hex	Oct	Dec
	5F	137	95

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Microprogram Flowcharts, Overview:

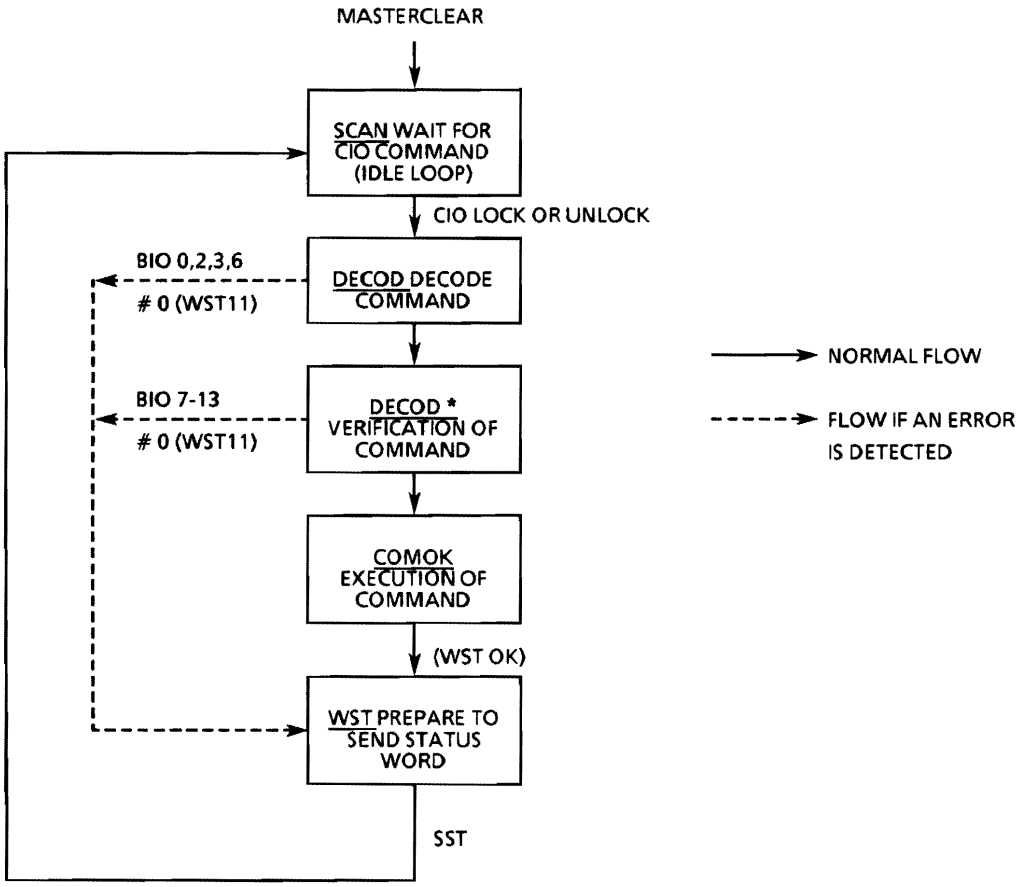

Figure 3.6a General Flowchart for CIO Lock or Unlock Commands and for Set Format Command

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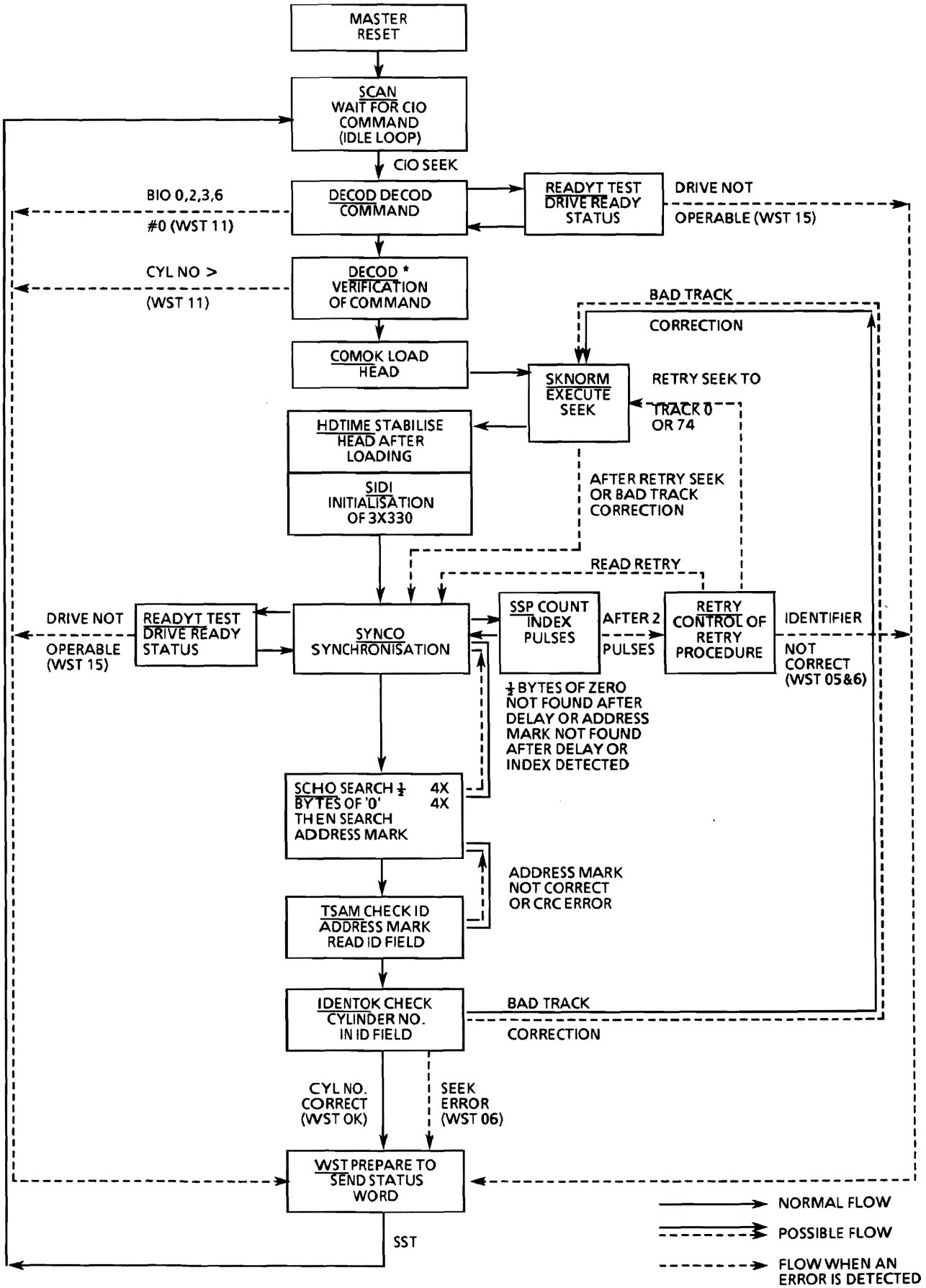

Figure 3.6b General Flowchart for CIO Seek Command

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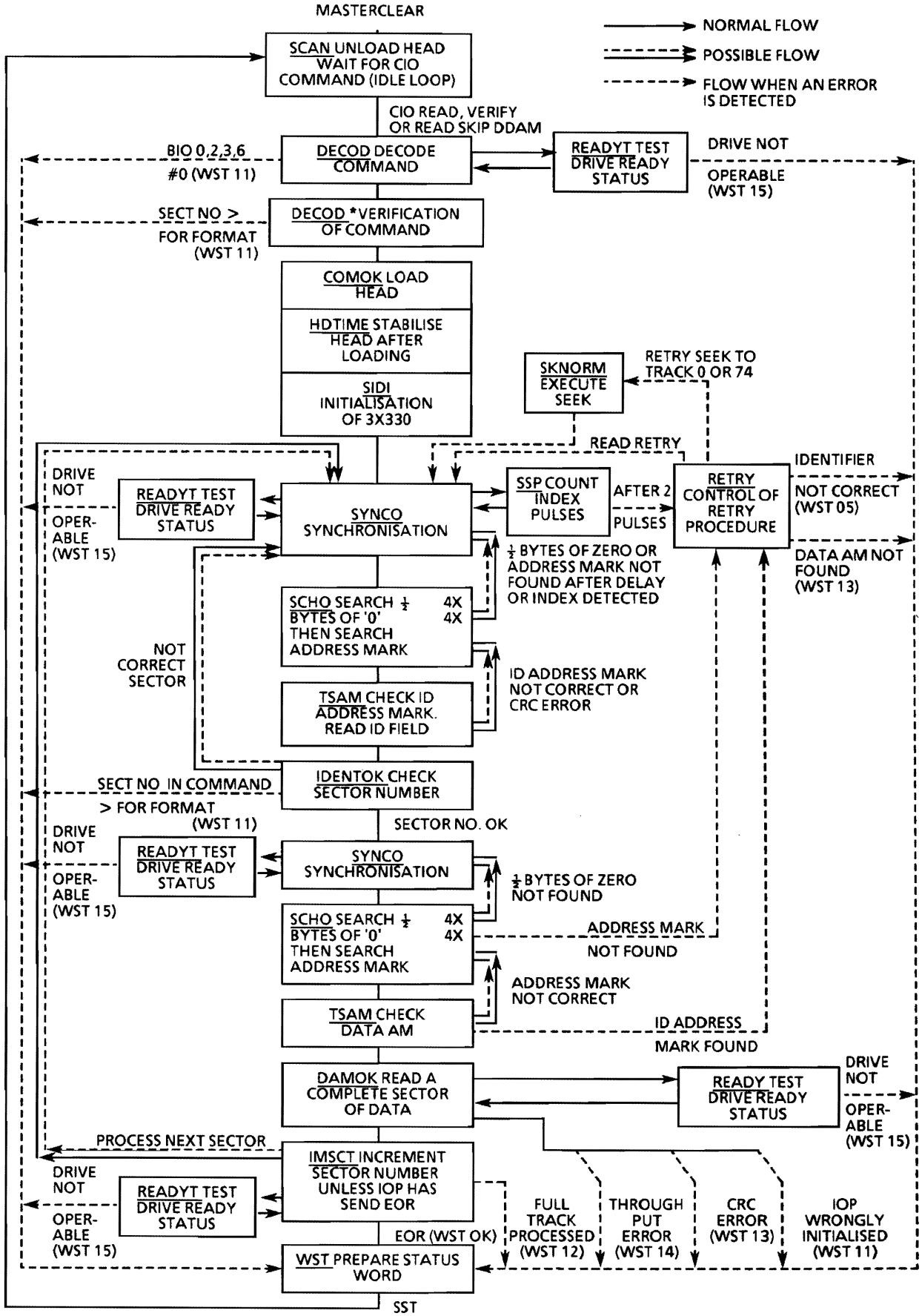

Figure 3.6c General Flowchart for a CIO Read, Verify or Read Skip Sectors with DDAM Comm;and

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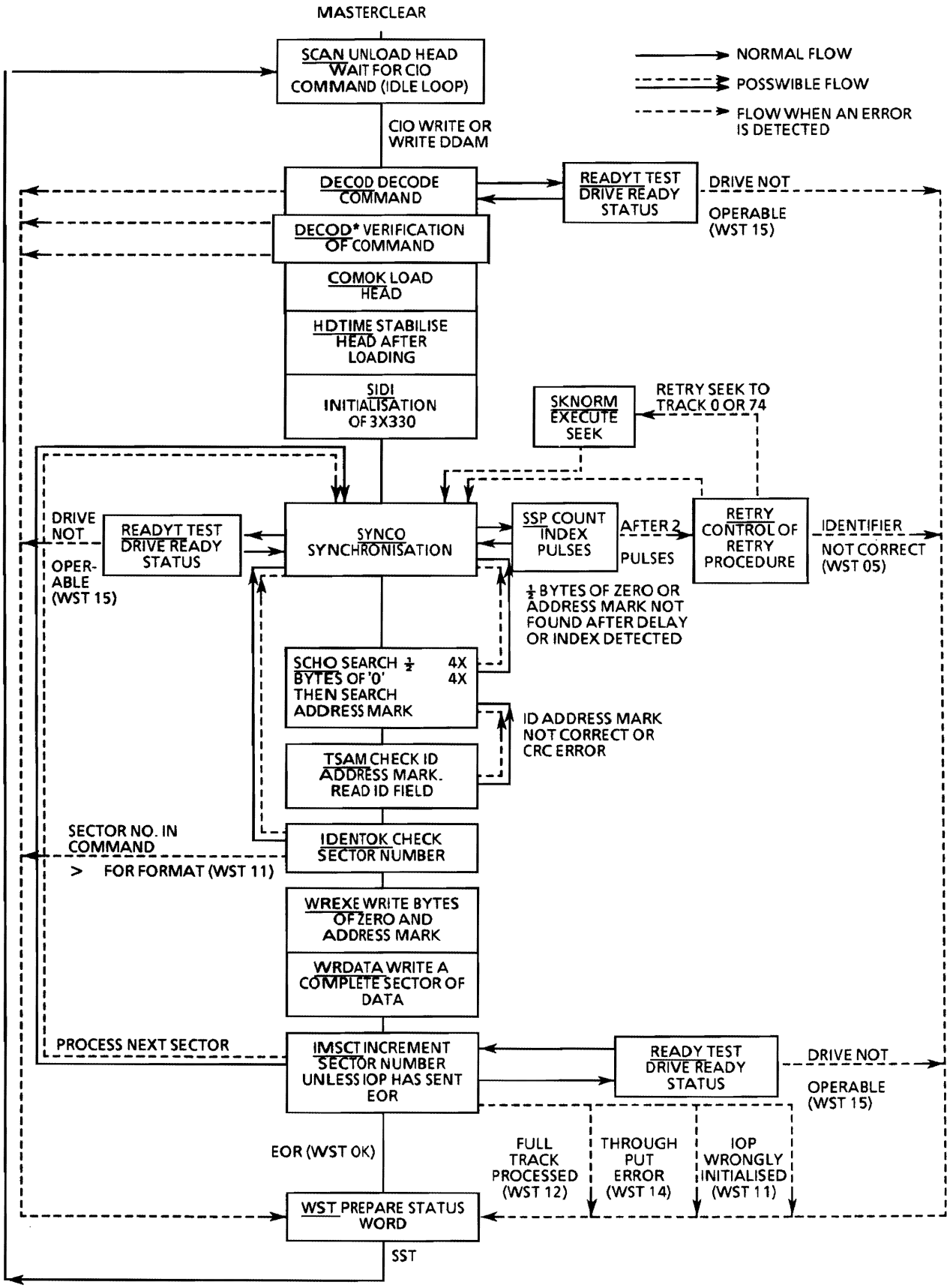

Figure 3.6d General Flowchart for a CIO Read, or Write with DDAM Command

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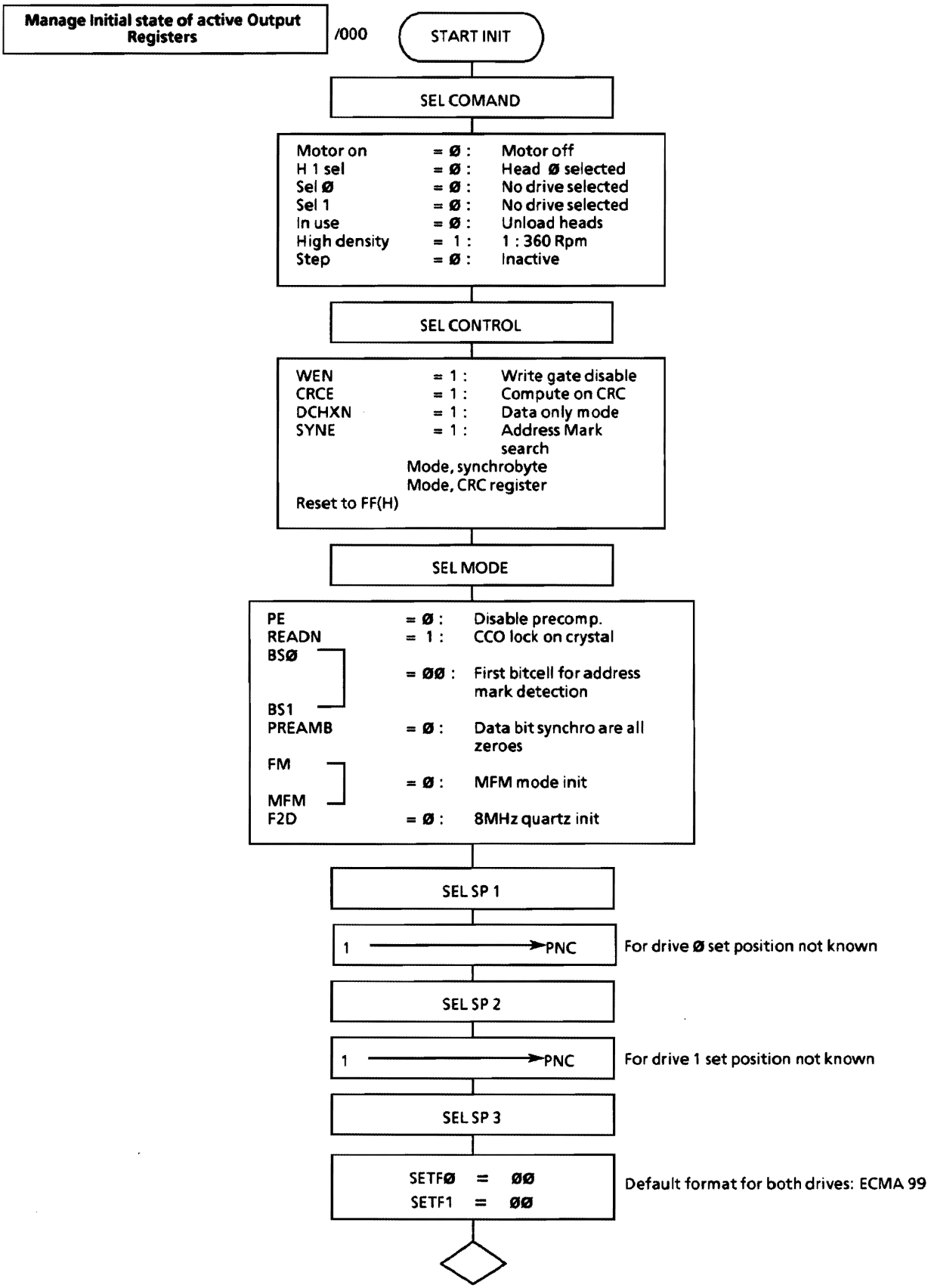
MICRO PROGRAM FLOWCHARTS:



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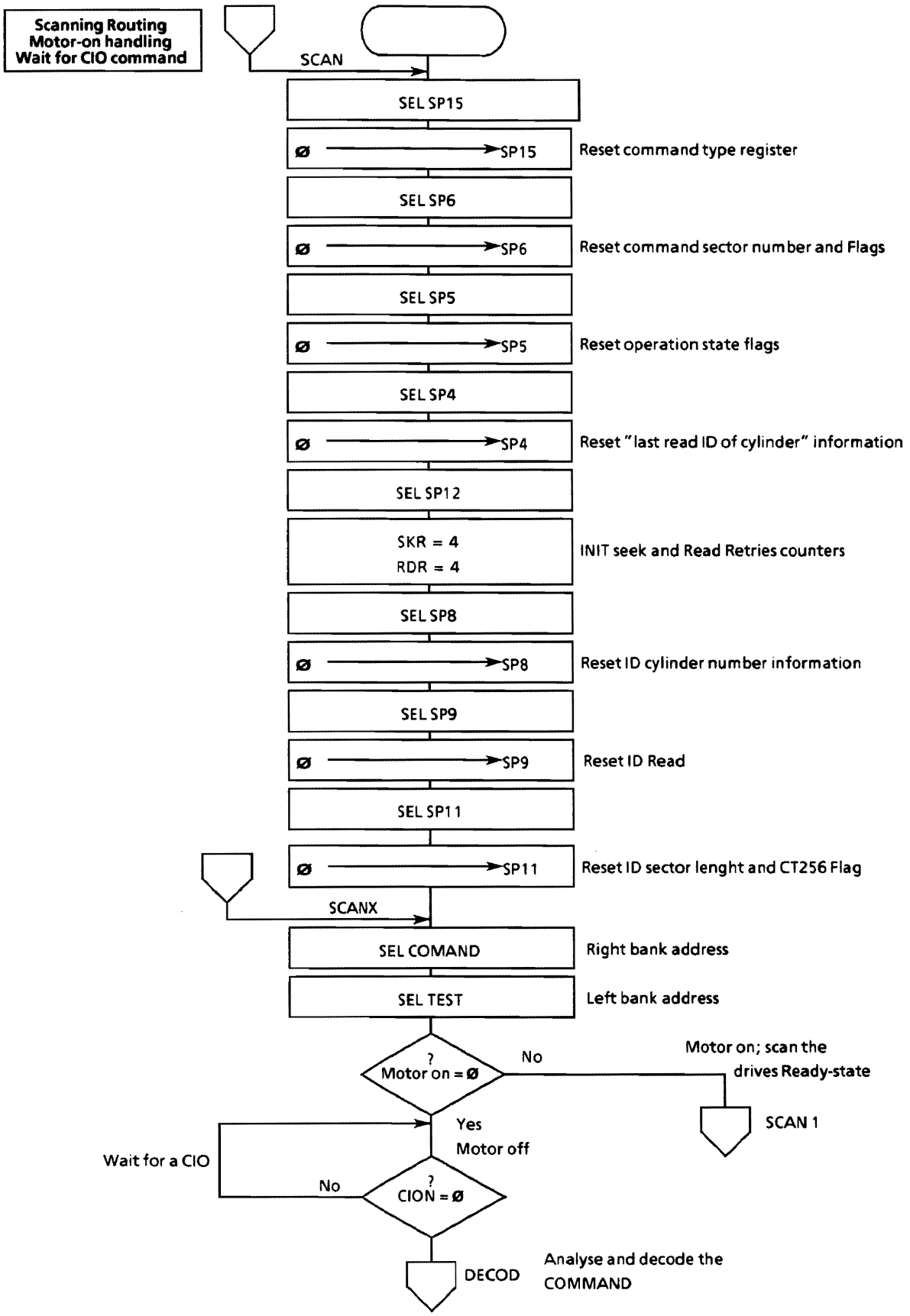

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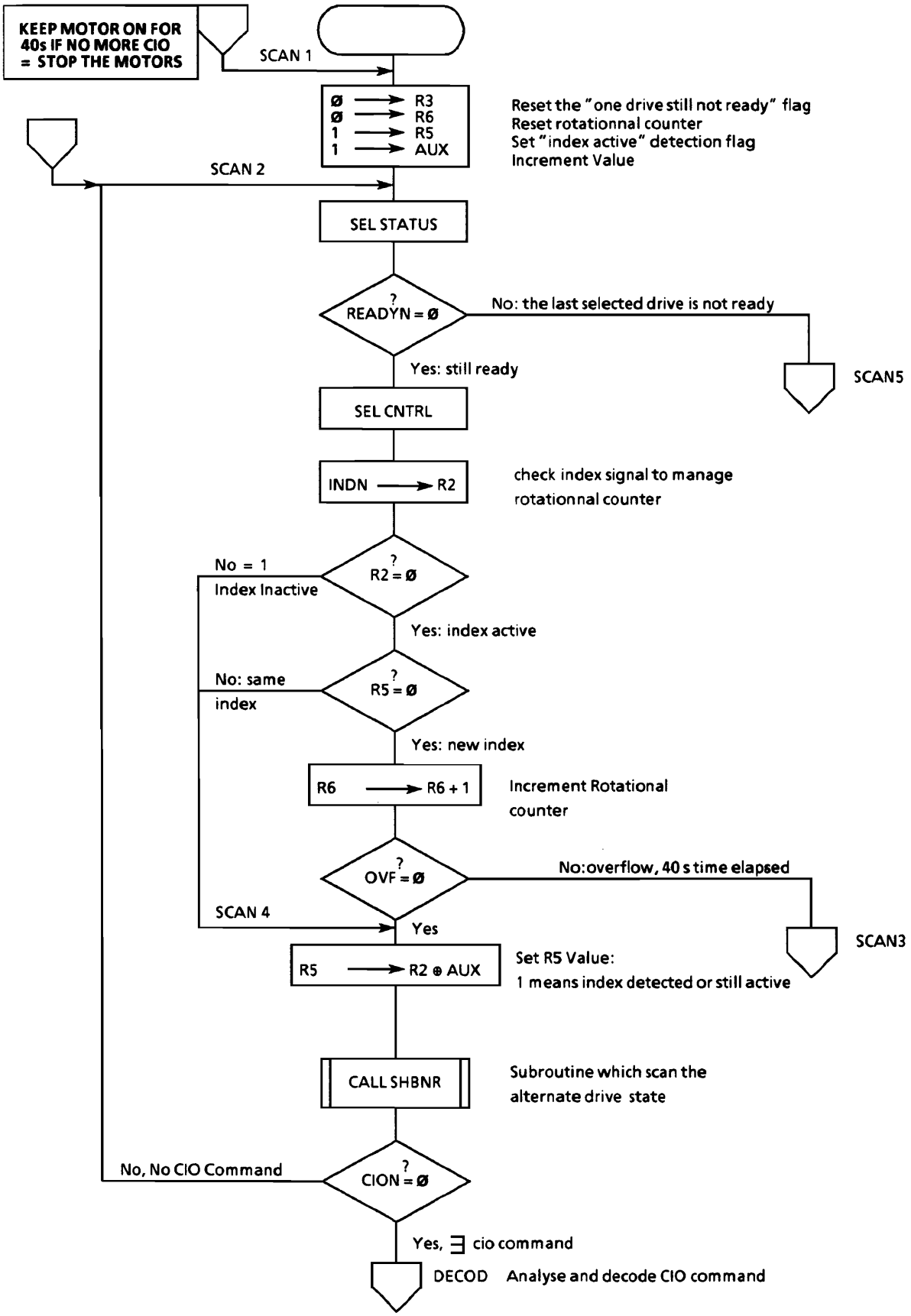

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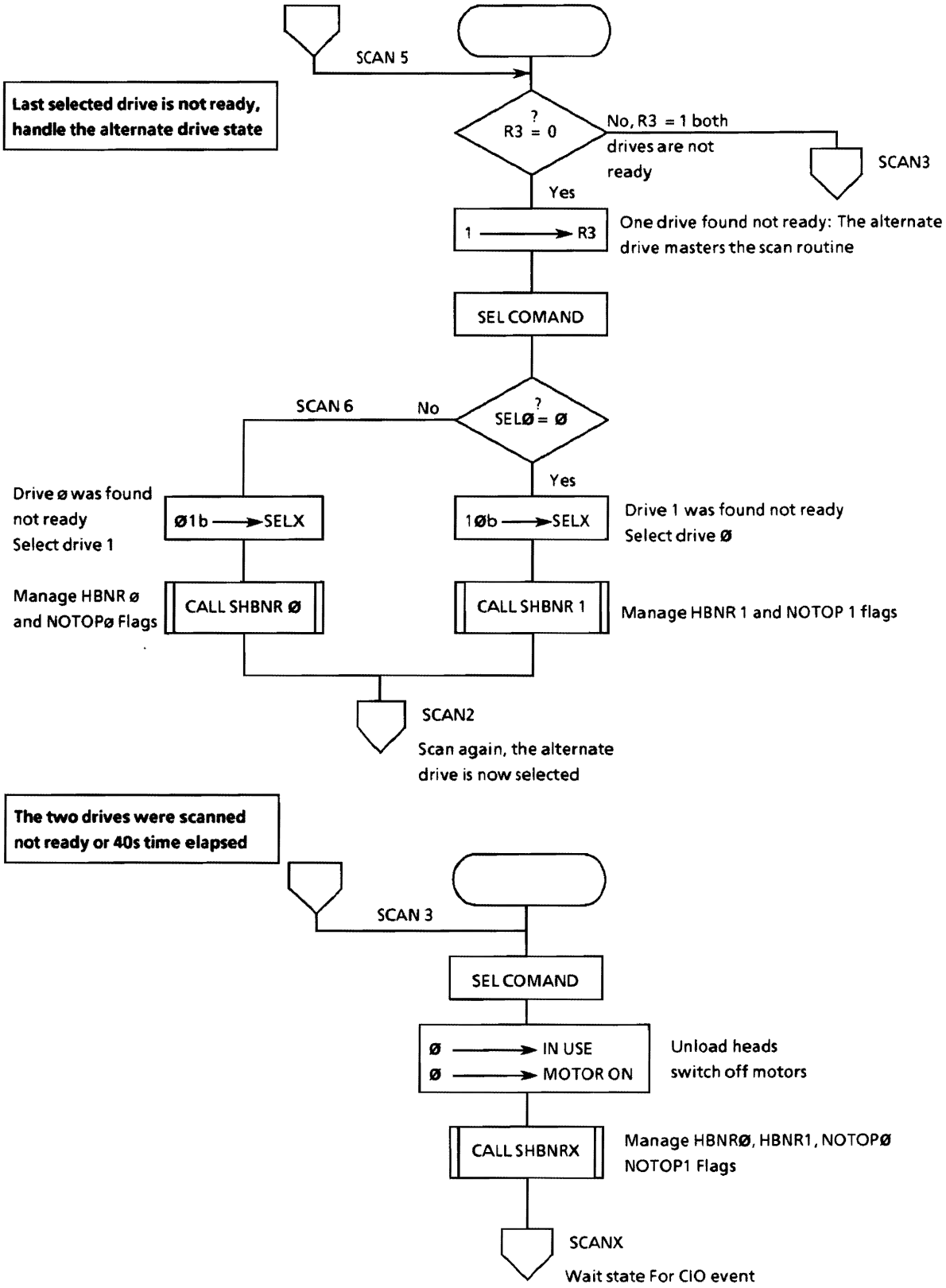

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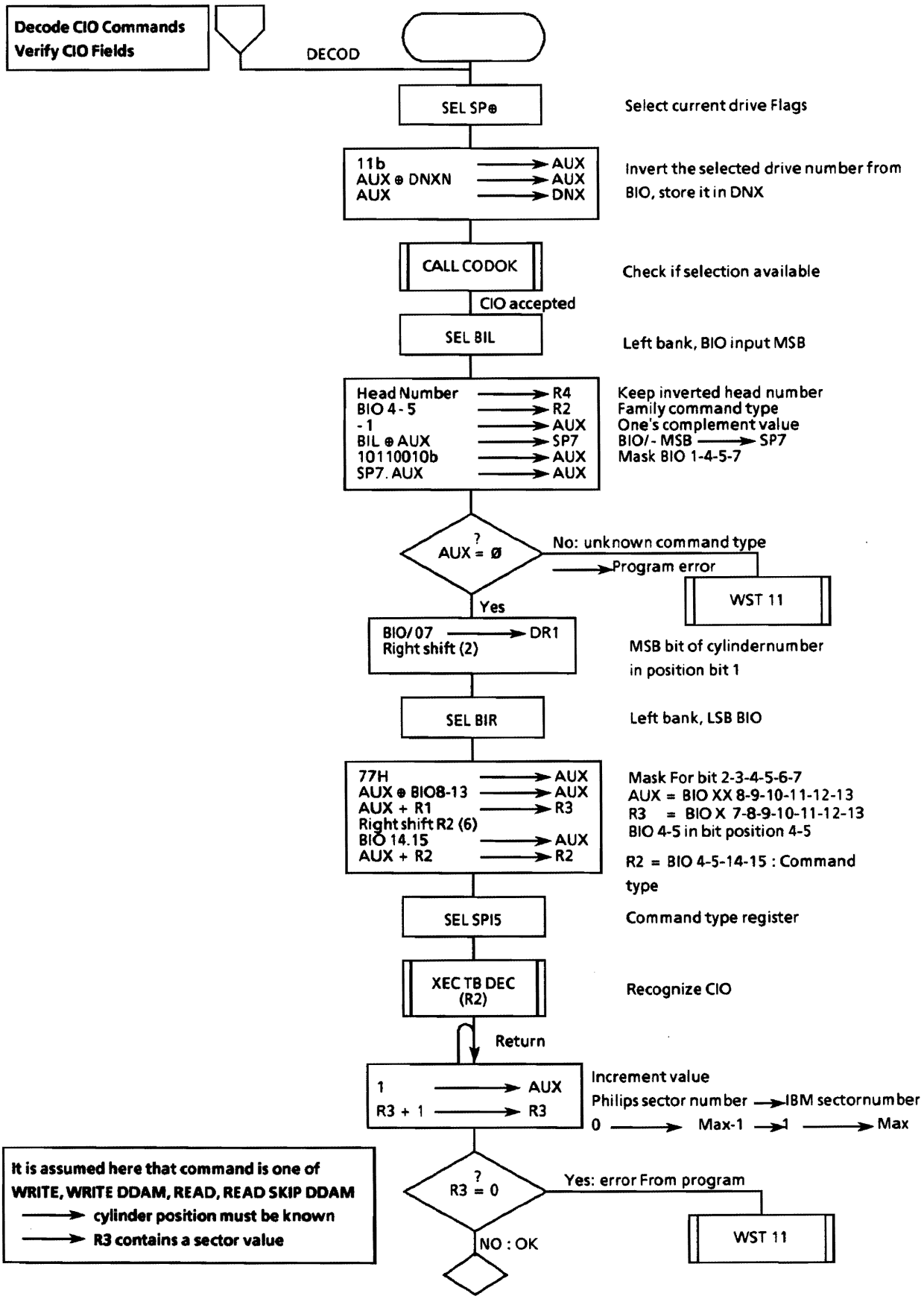

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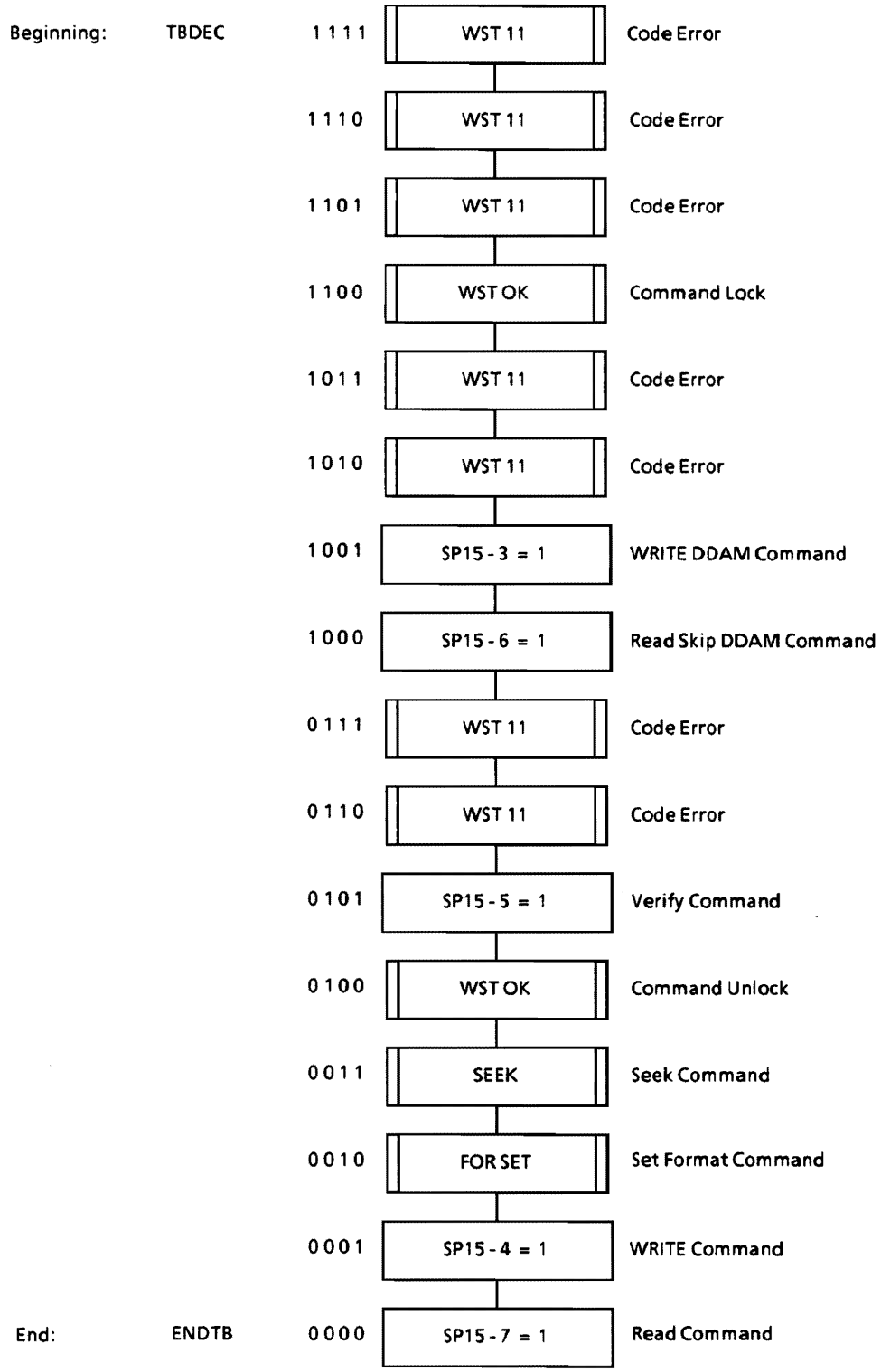
TABLE: TBDEC



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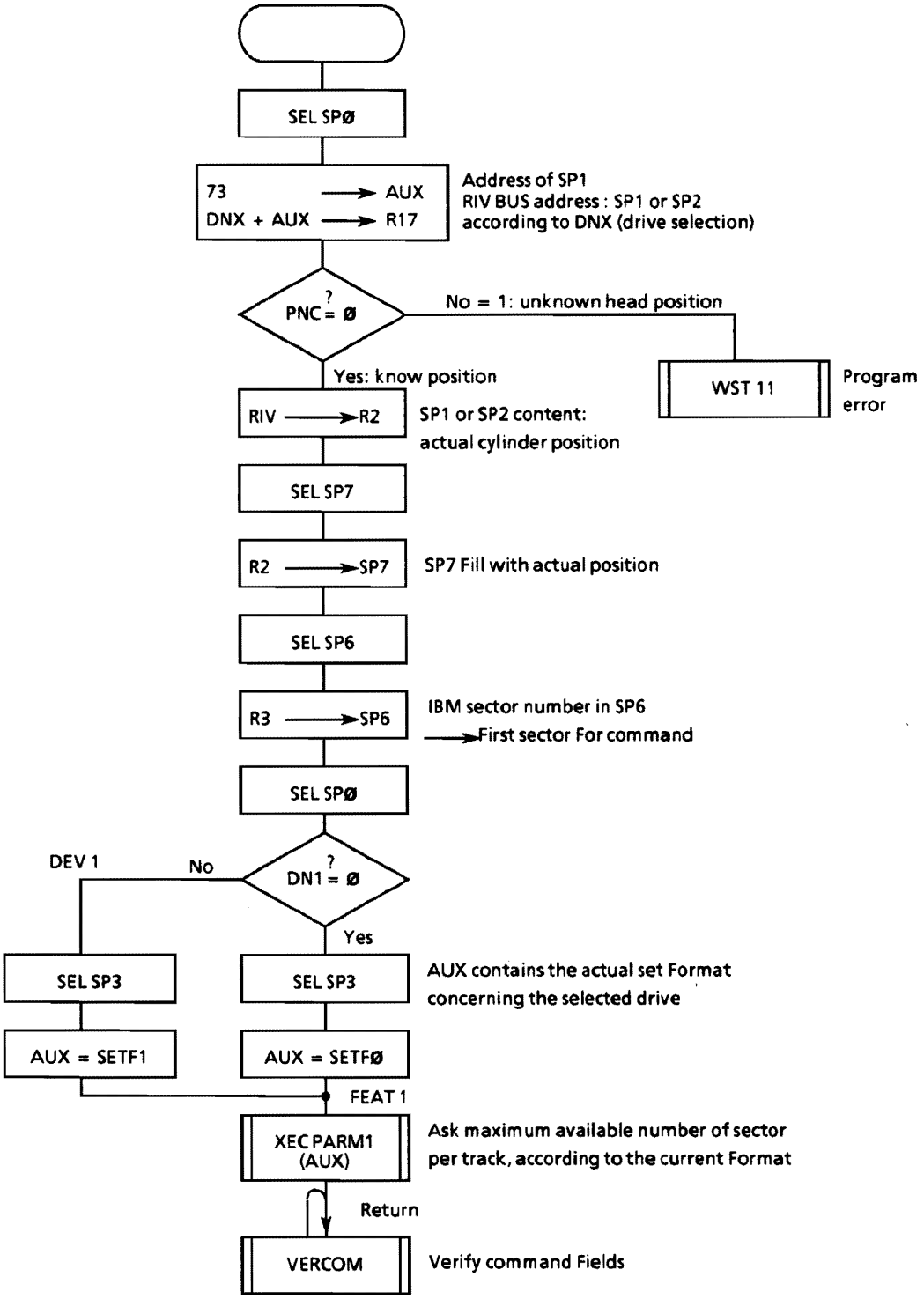

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TABLE: PARM1

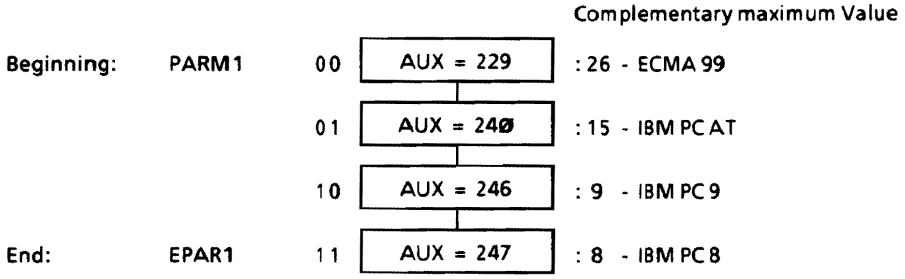
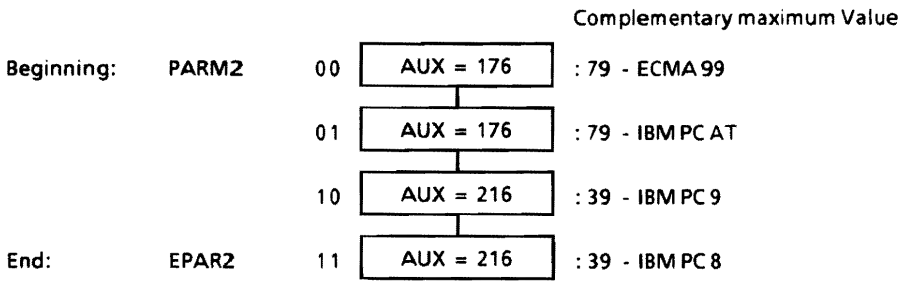


TABLE: PARM2



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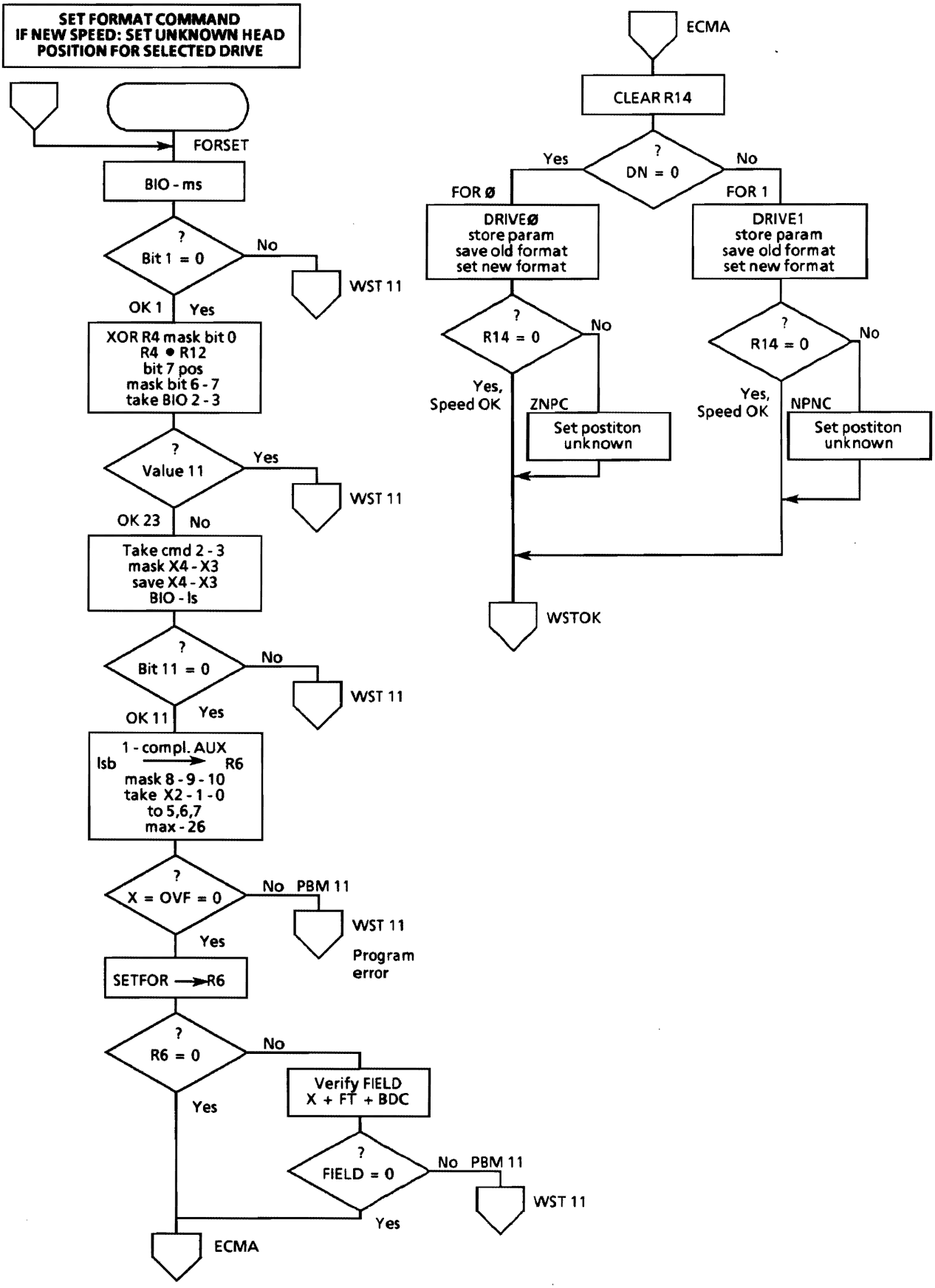

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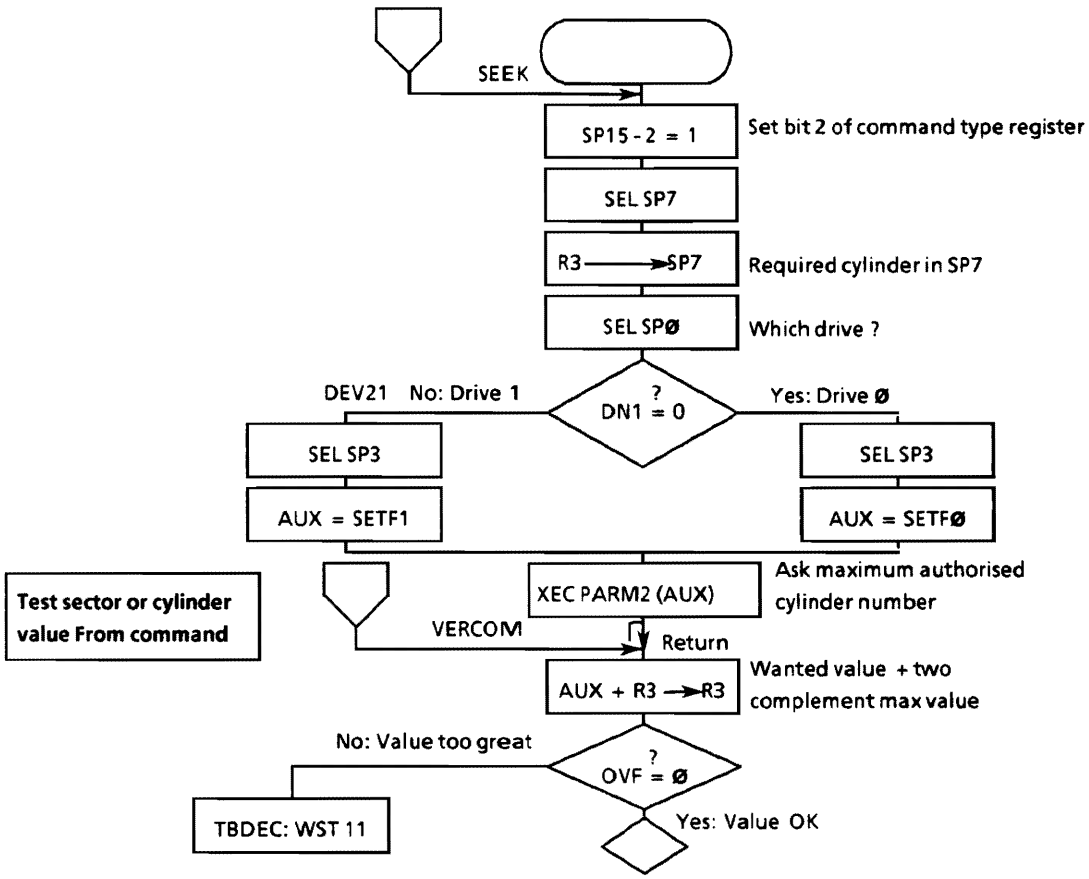
SEEK COMMAND:
Verify cylinder value according to the current Format



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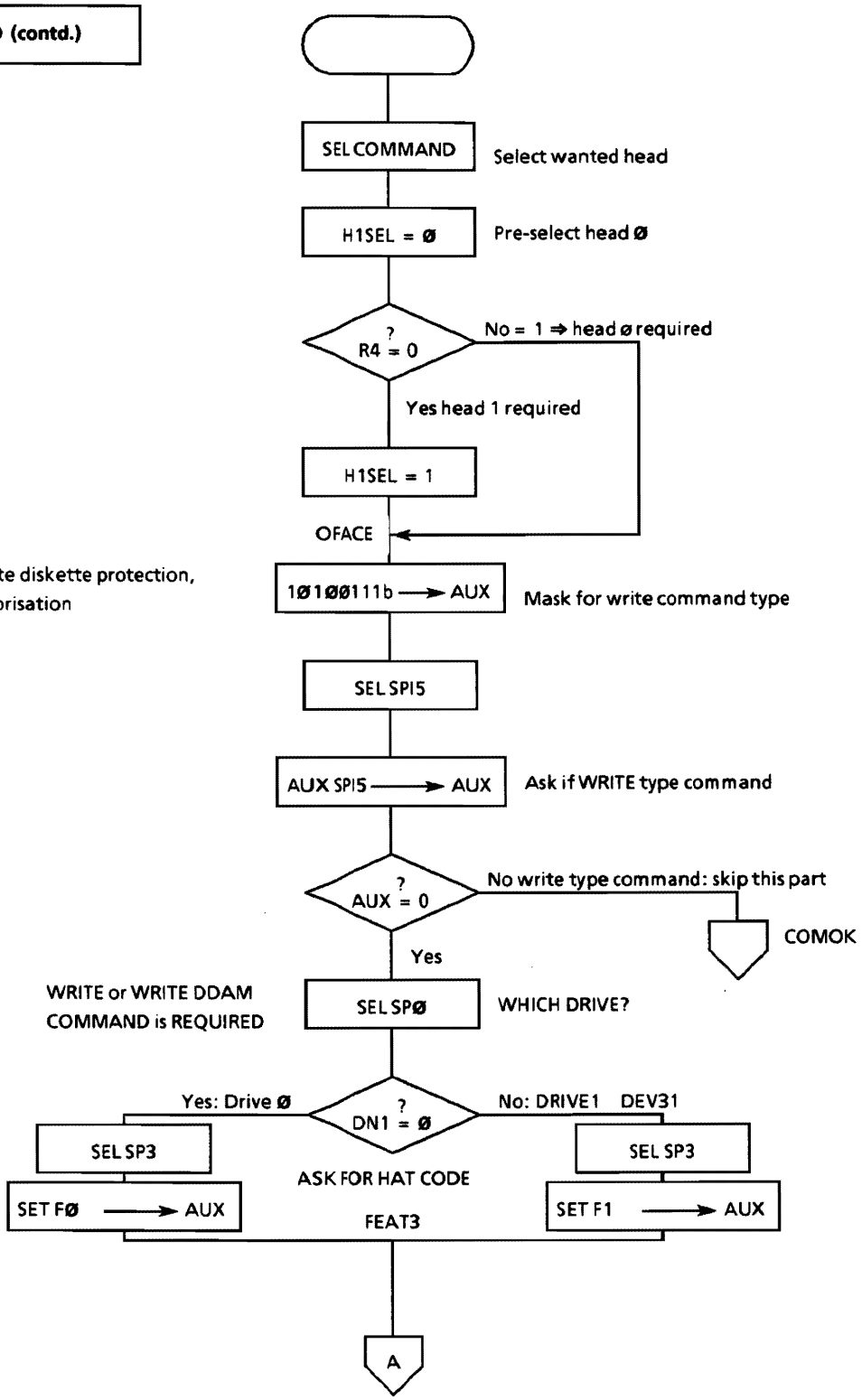
Seek CMD (contd.)



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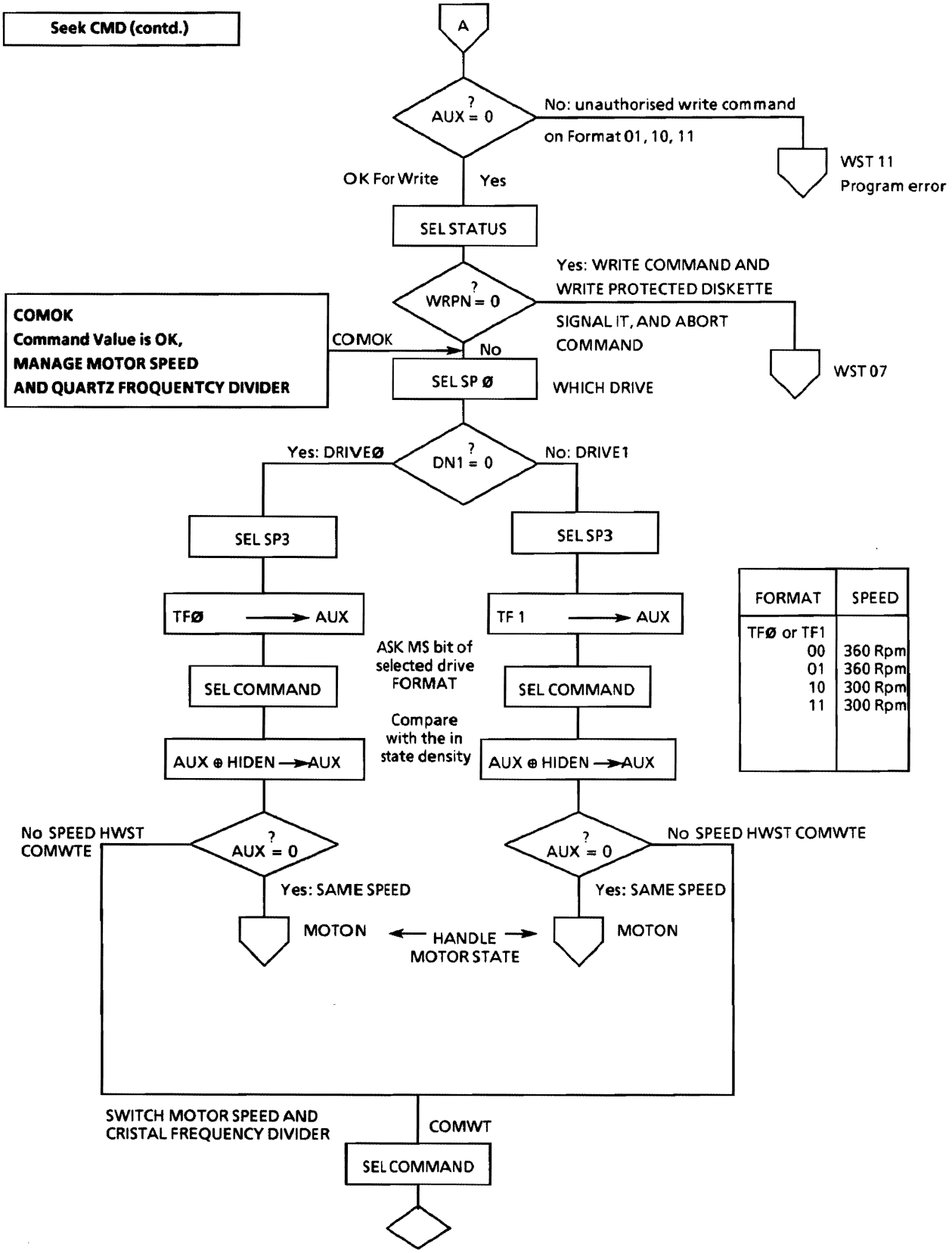

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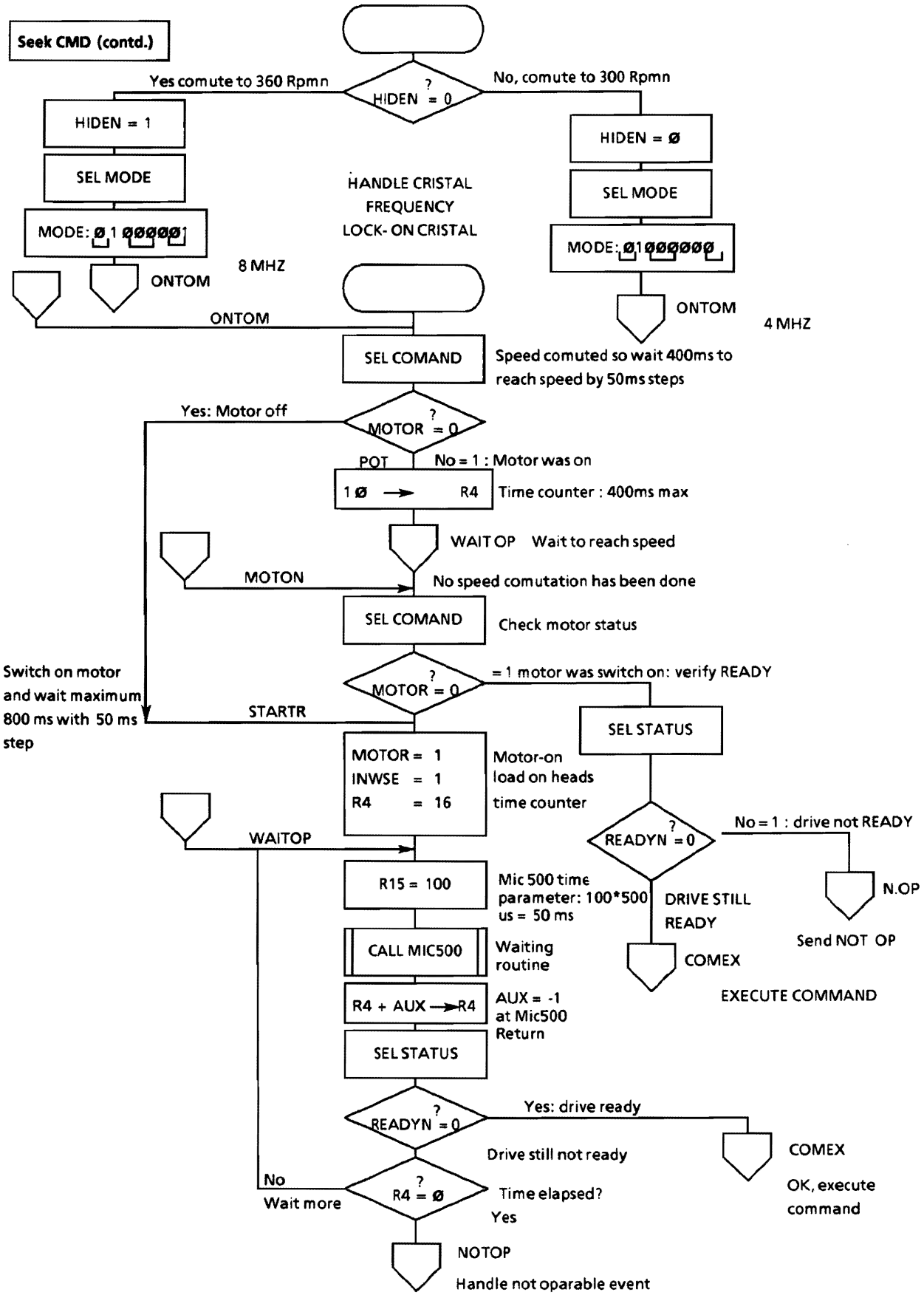

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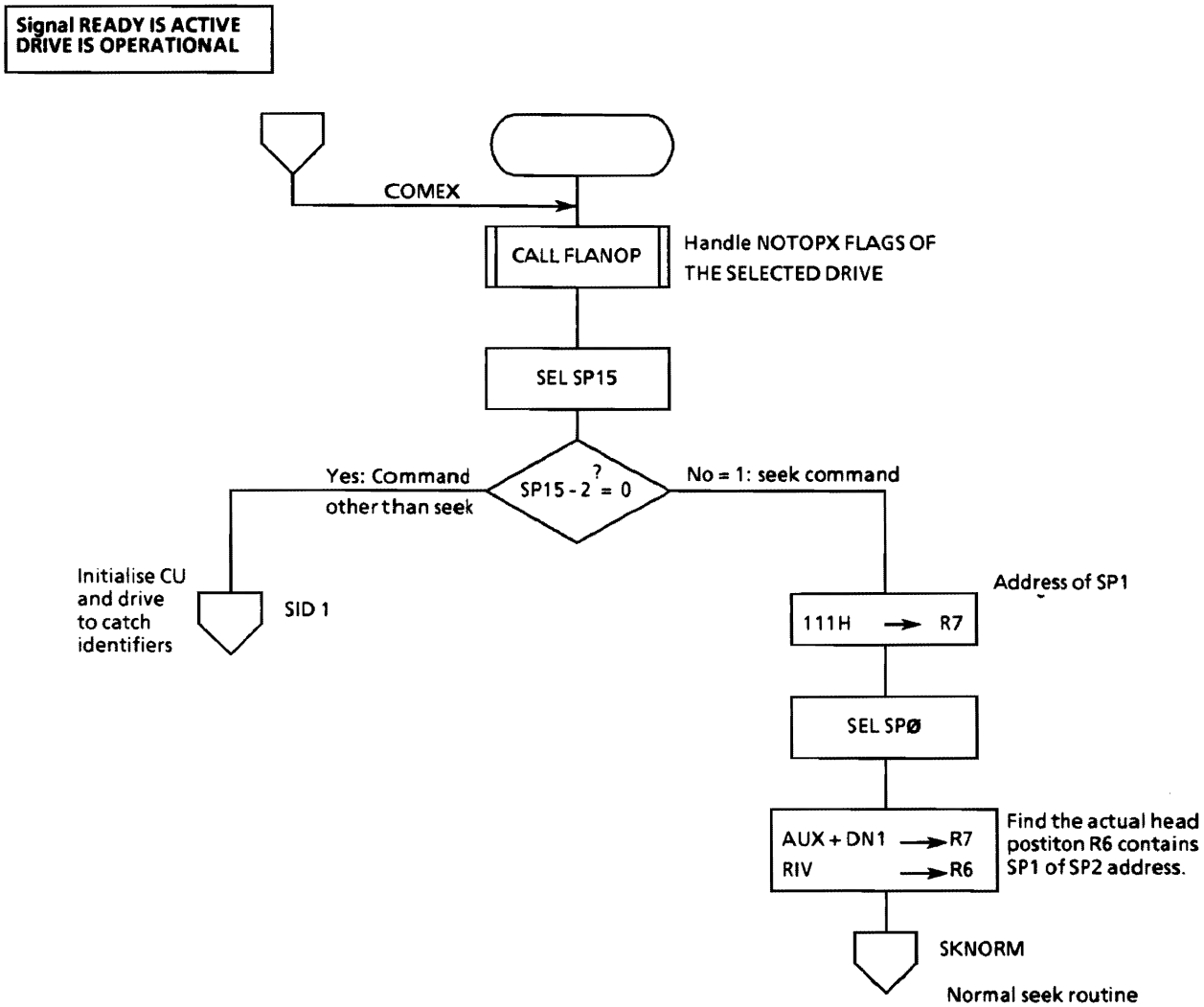

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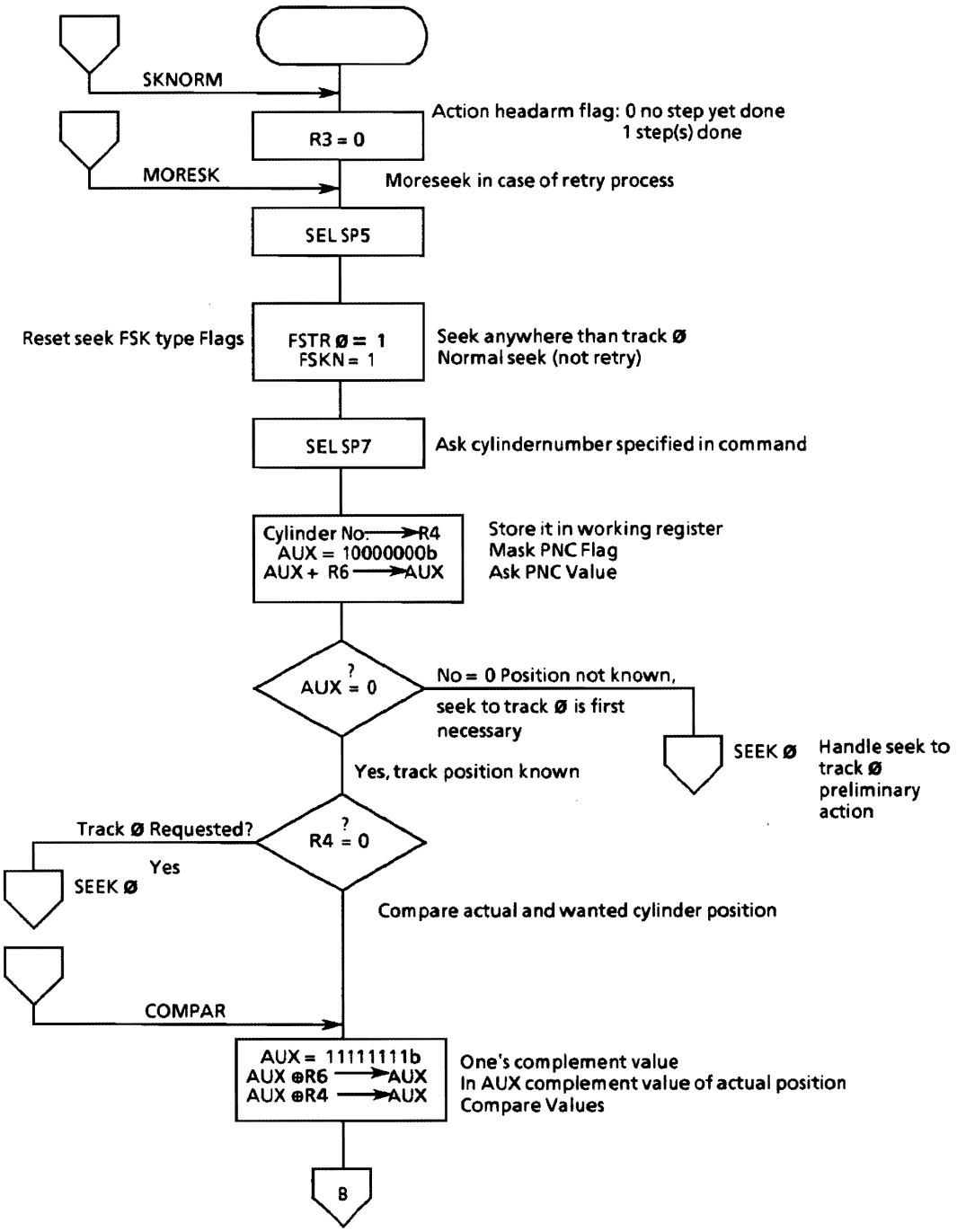
SKNORM
Execute steps to seek to the wanted track
96 tpi : track by track
48 tpi : 2 tracks by 2 tracks



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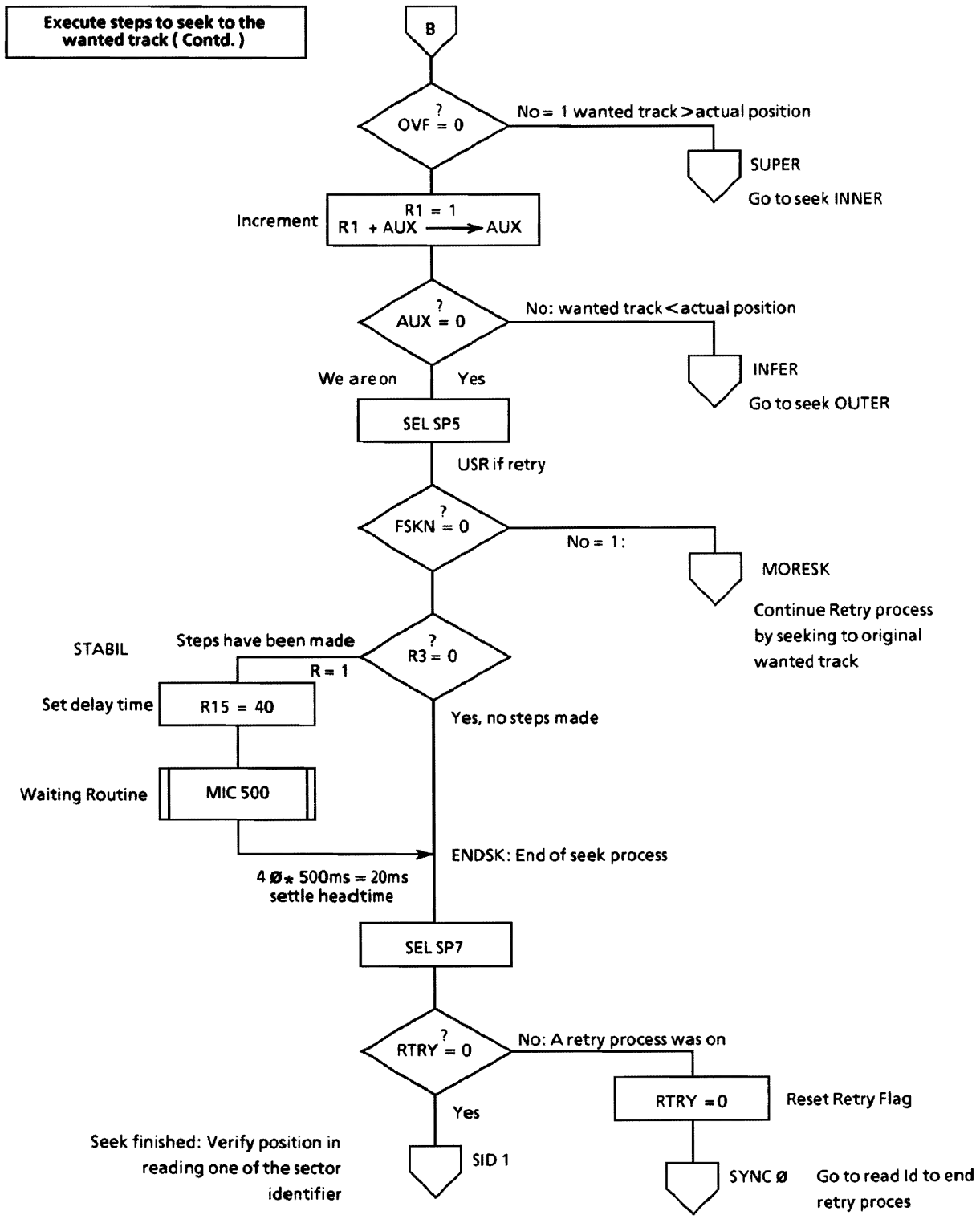

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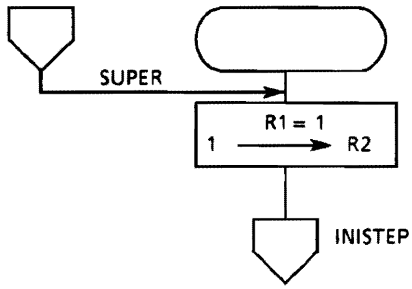
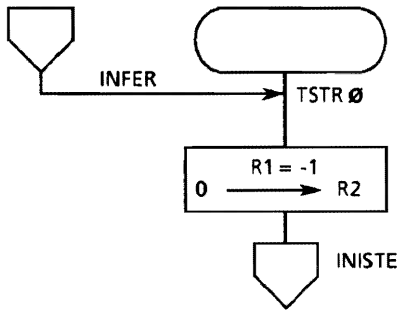
Wanted track number > current track number
= 0 seek Inner



Increment Value (we seek inner)
Direction Flag 1 ⇒ inner
0 ⇒ outer

Init step action

Wanted track number < current track number
Or inconditionnal seek to track Ø requested
= seek outer

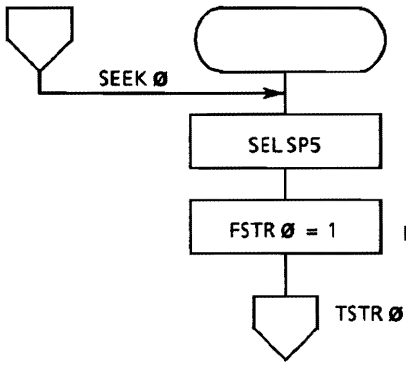


Inconditionnal seek to track Ø

Decrement Value (we seek outer)
Direction Flag 1 ⇒ inner
0 ⇒ outer

Init step action

Inconditionnal seek to track Ø requested
- **track Ø command**
- **part of retry proces**
- **unknown position**



Flag seek to track Ø event

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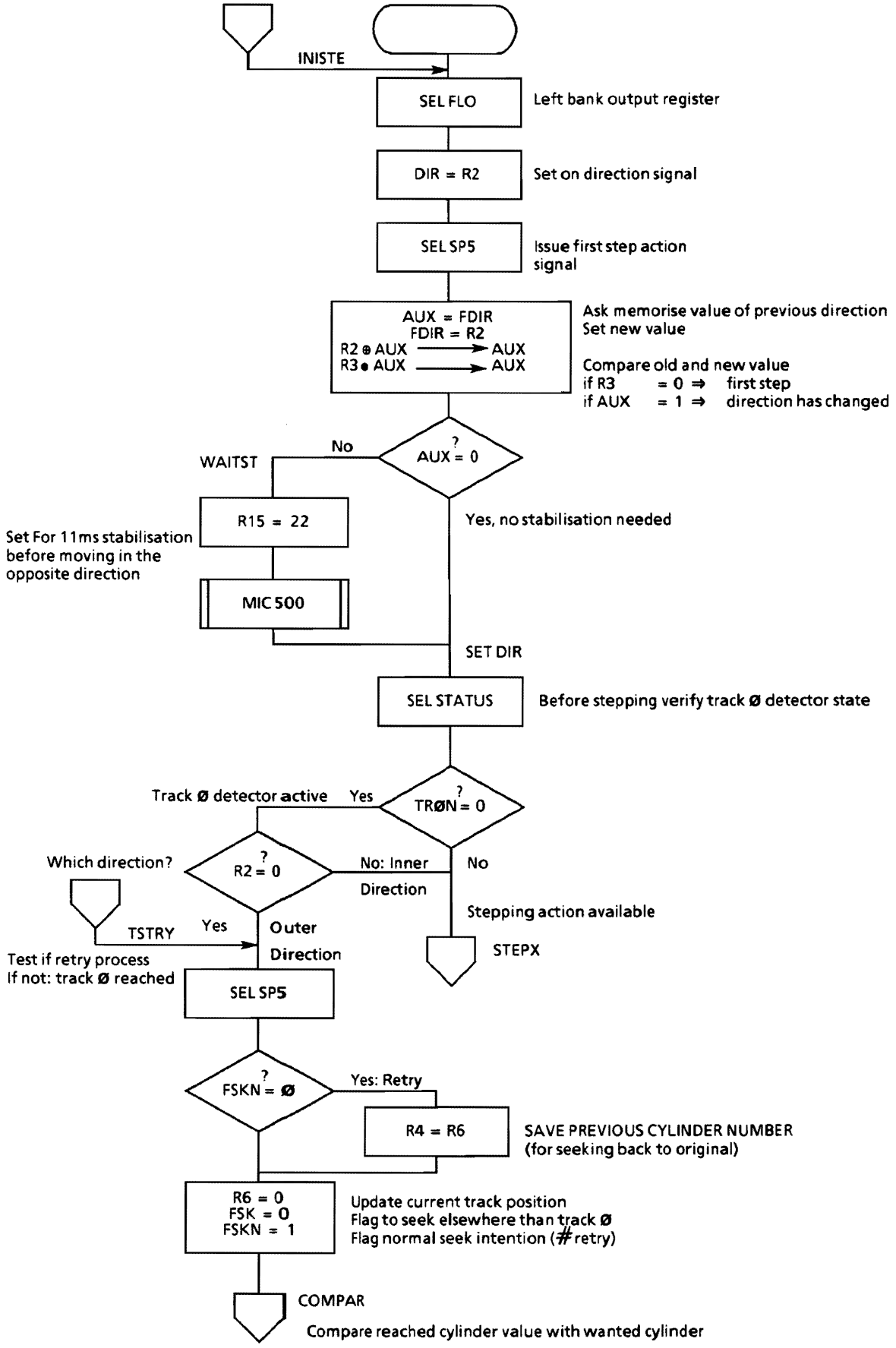

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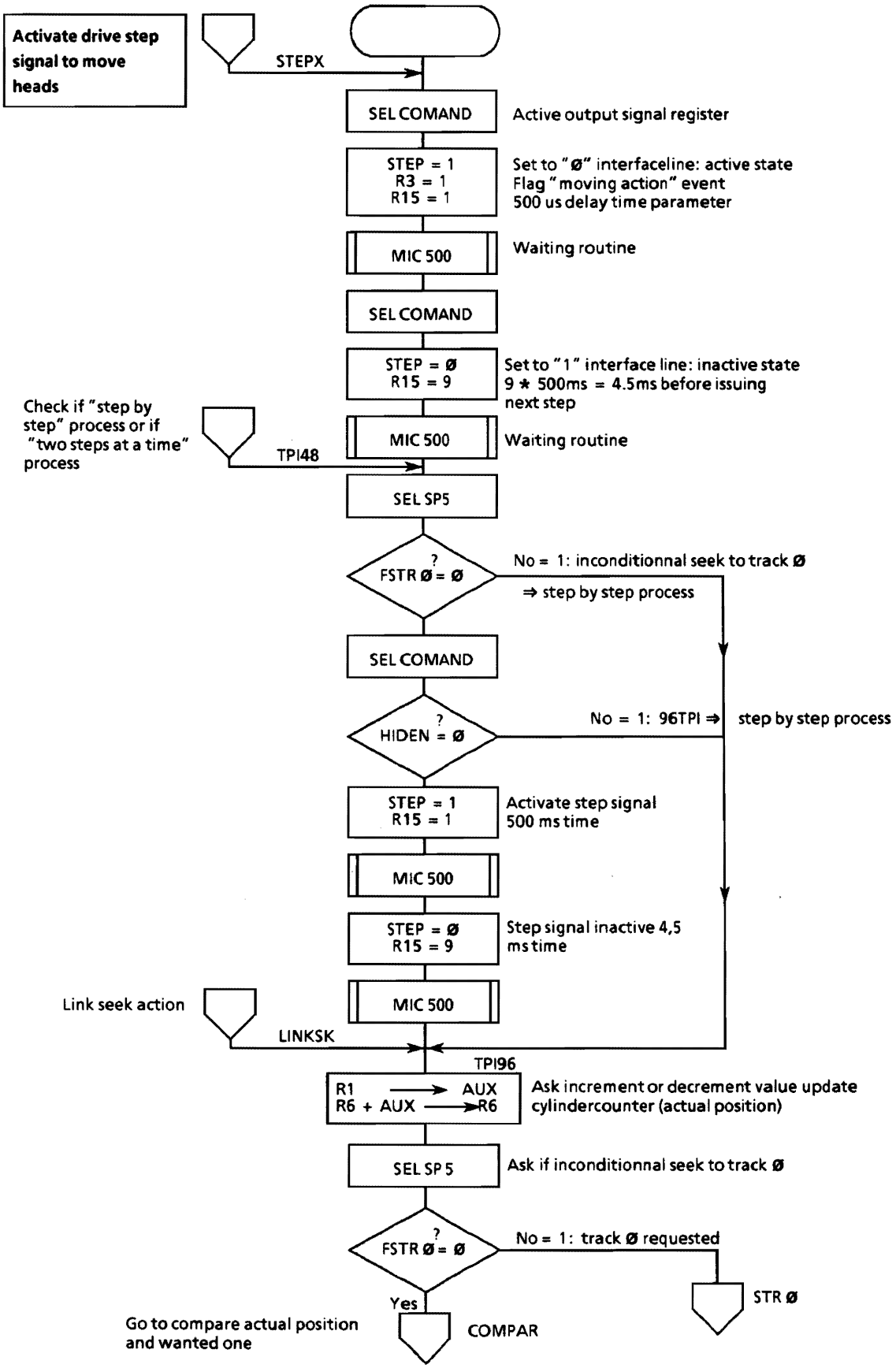

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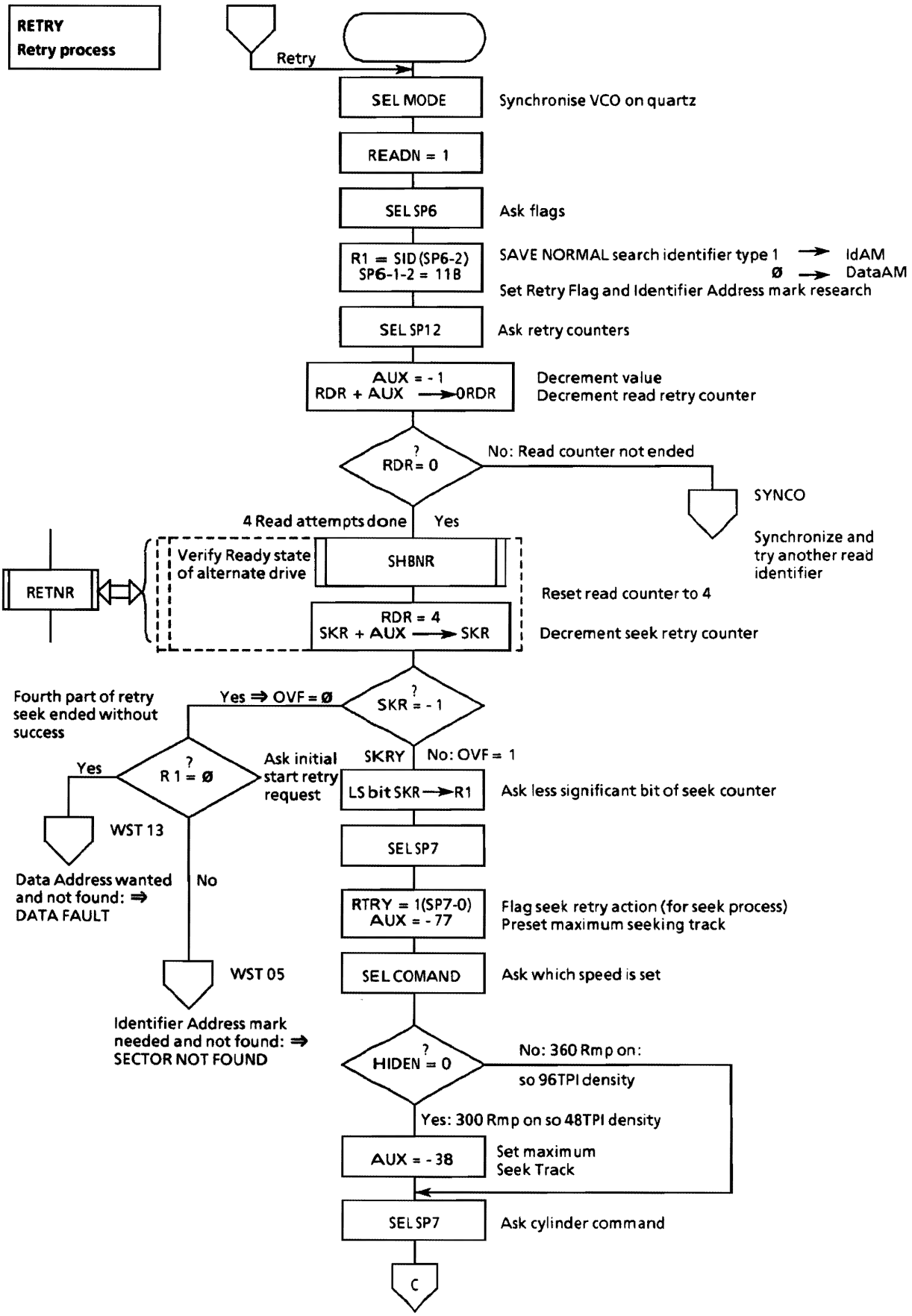

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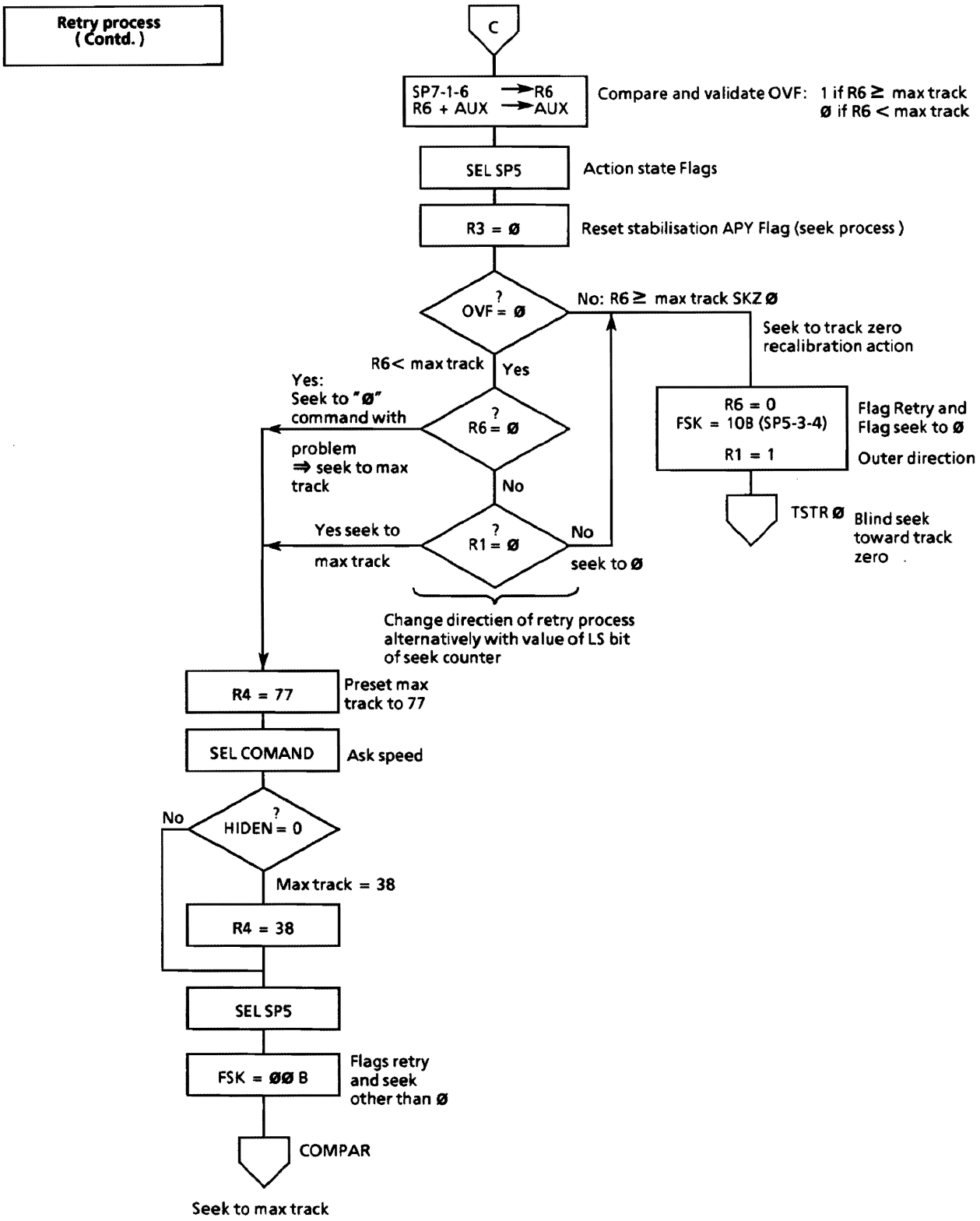

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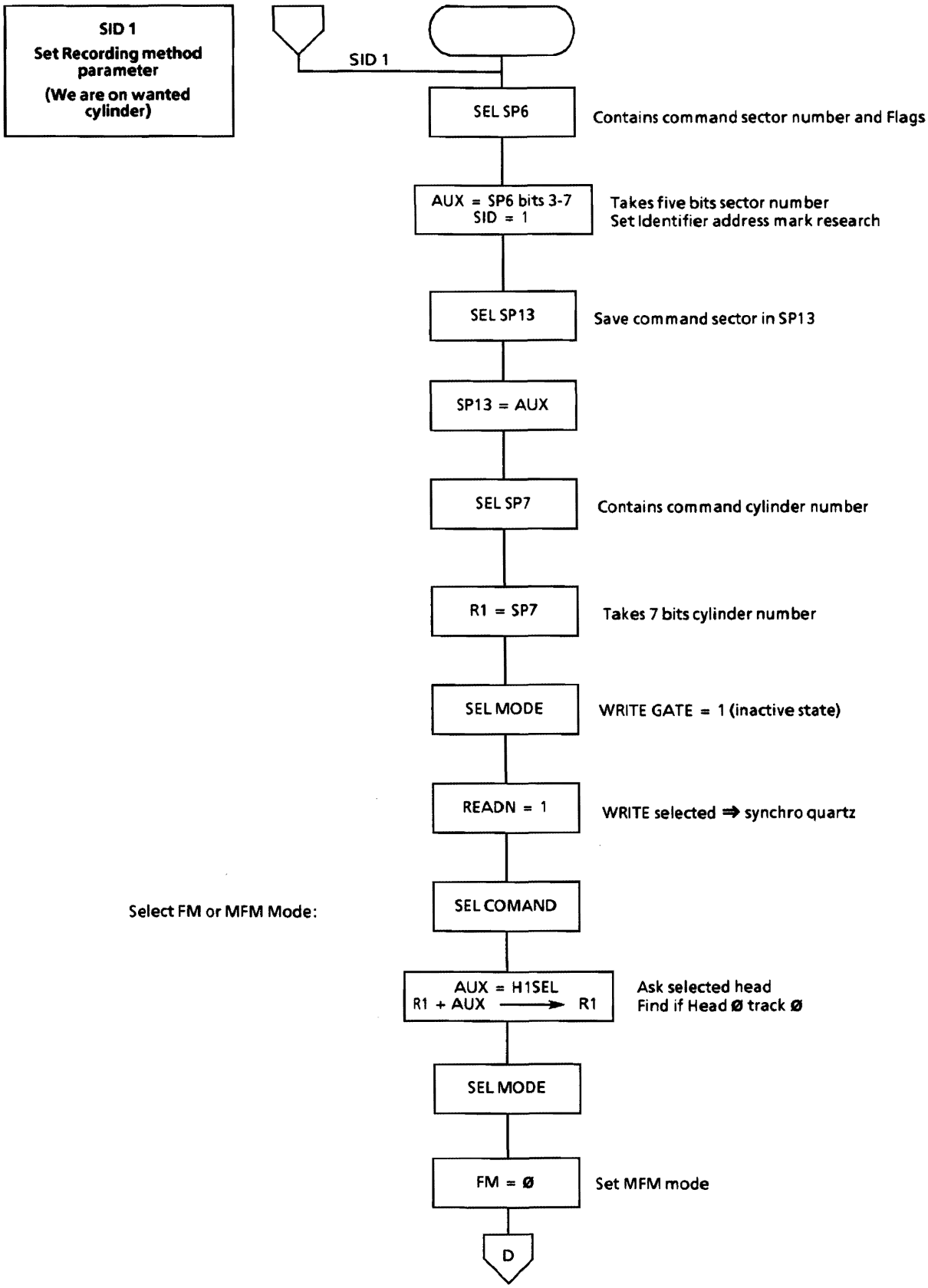

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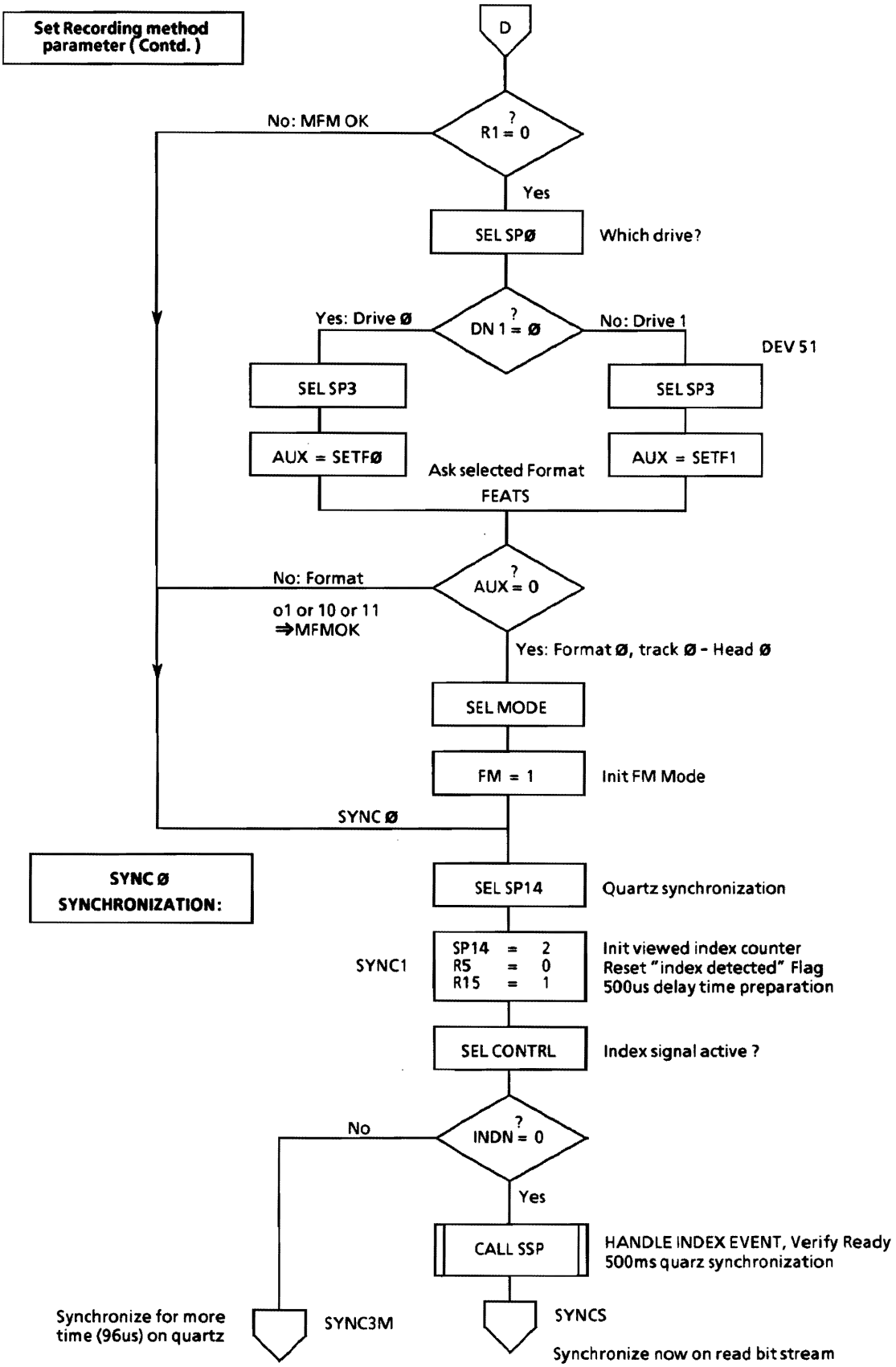

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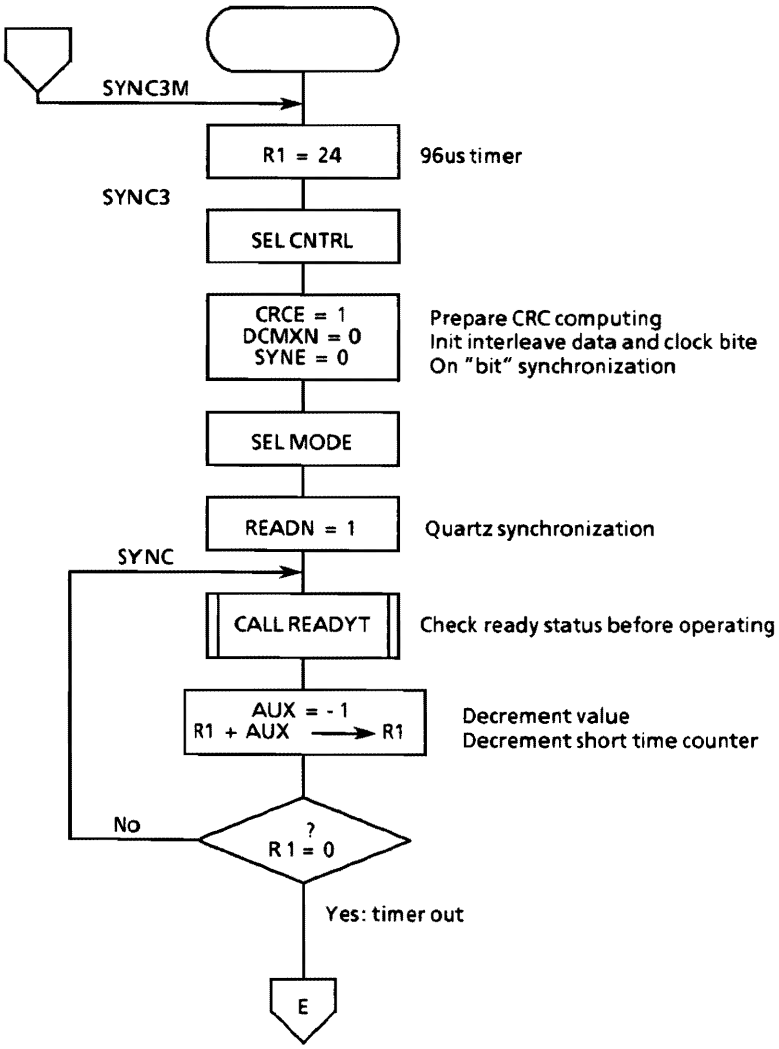

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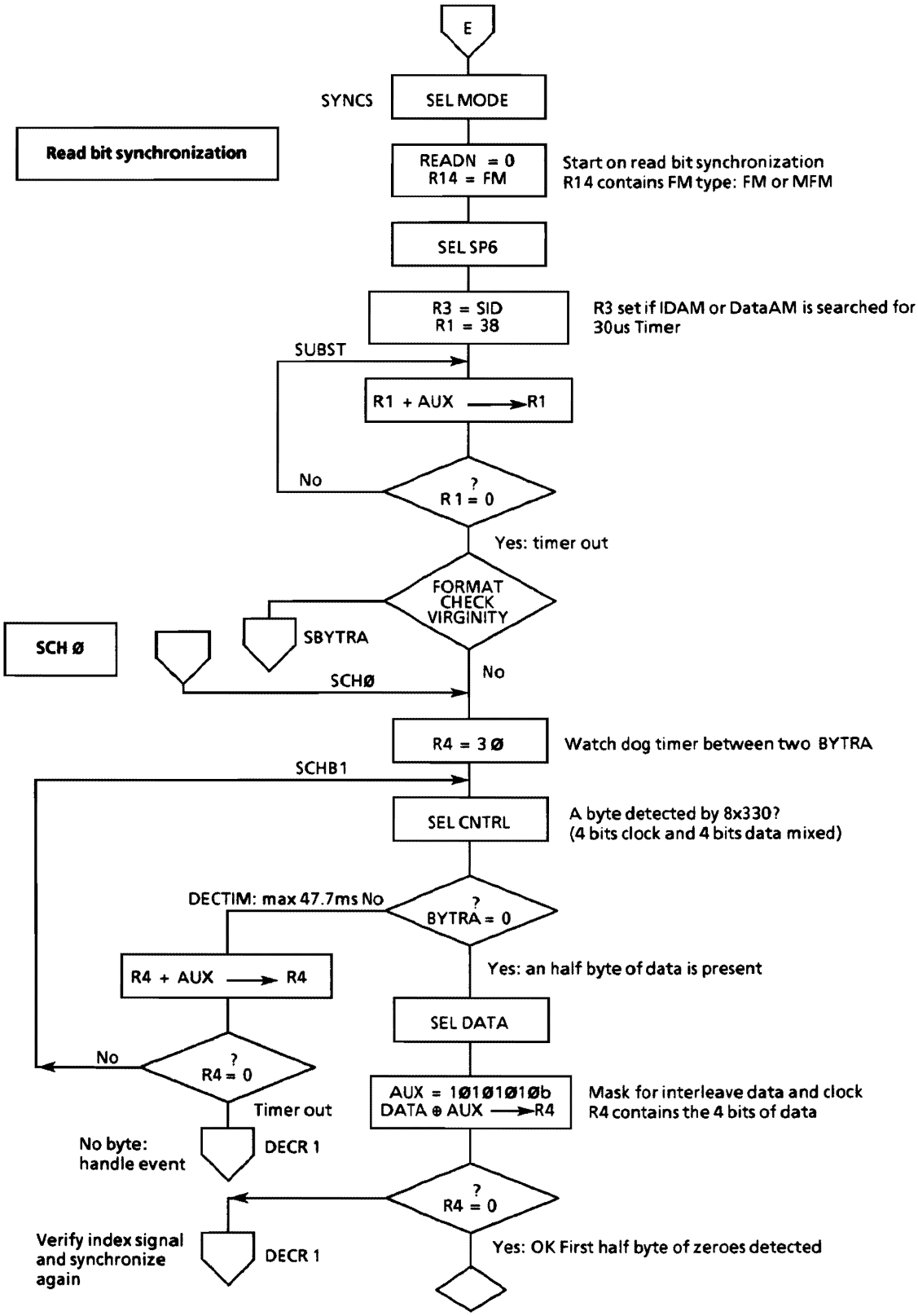

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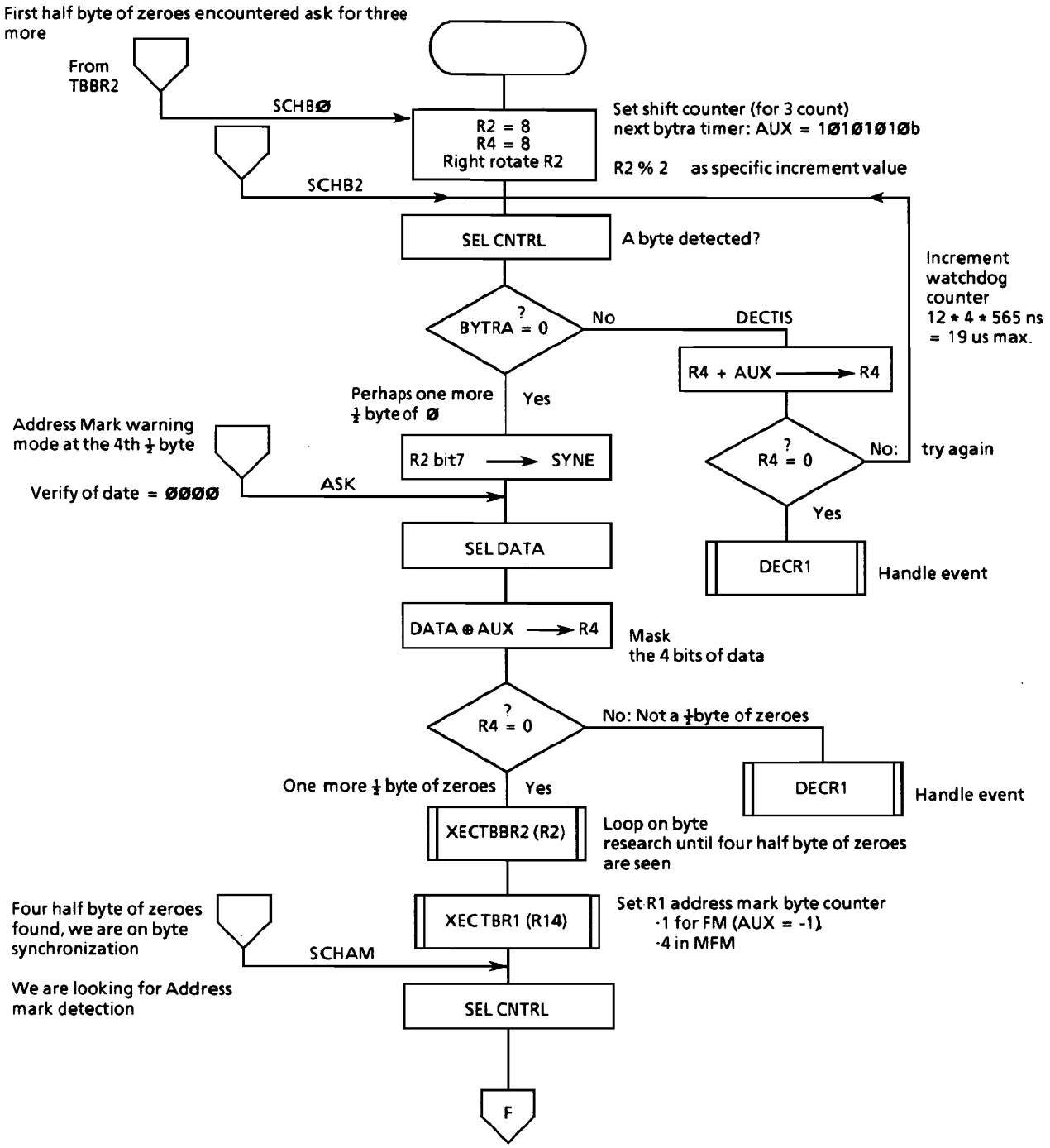

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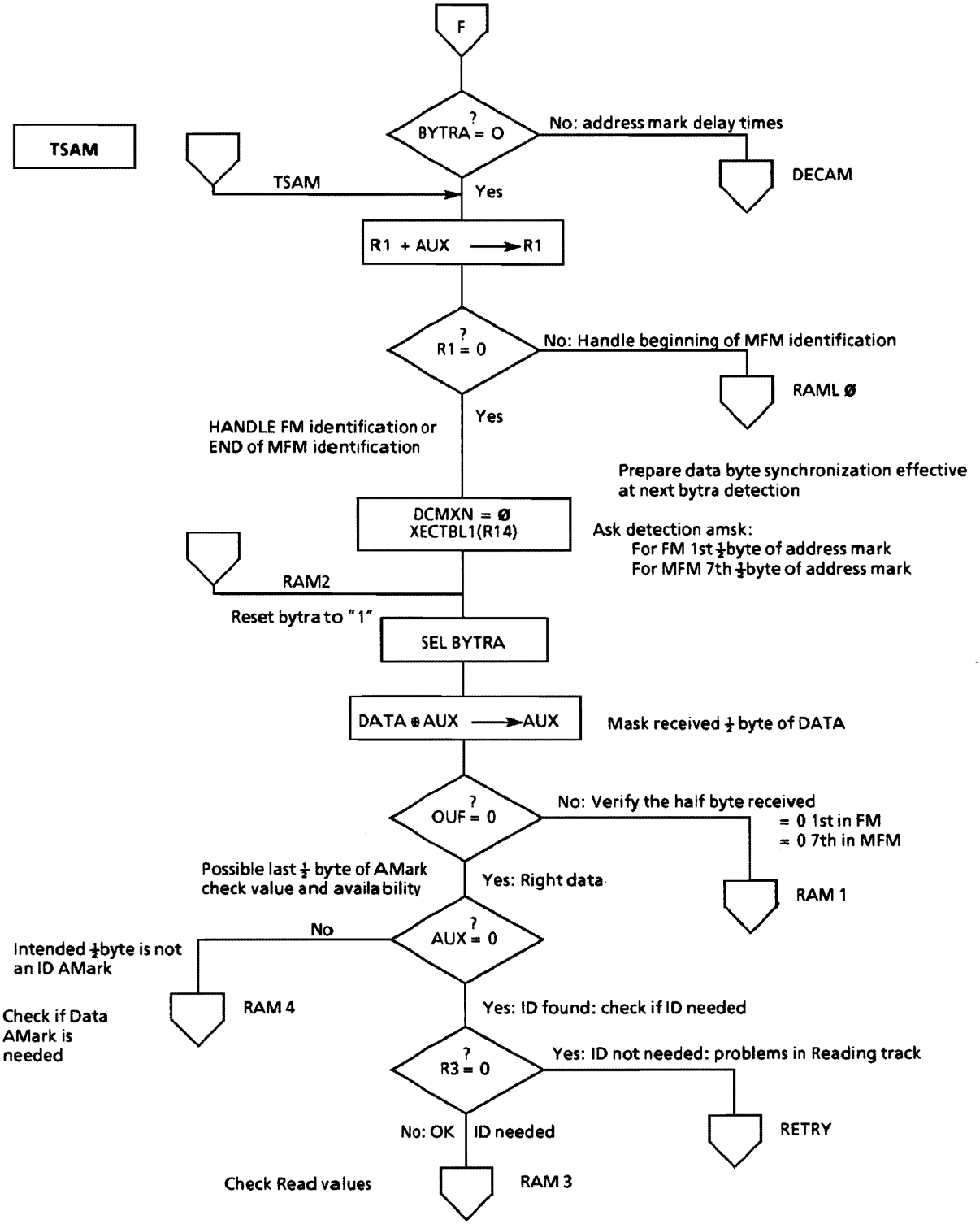

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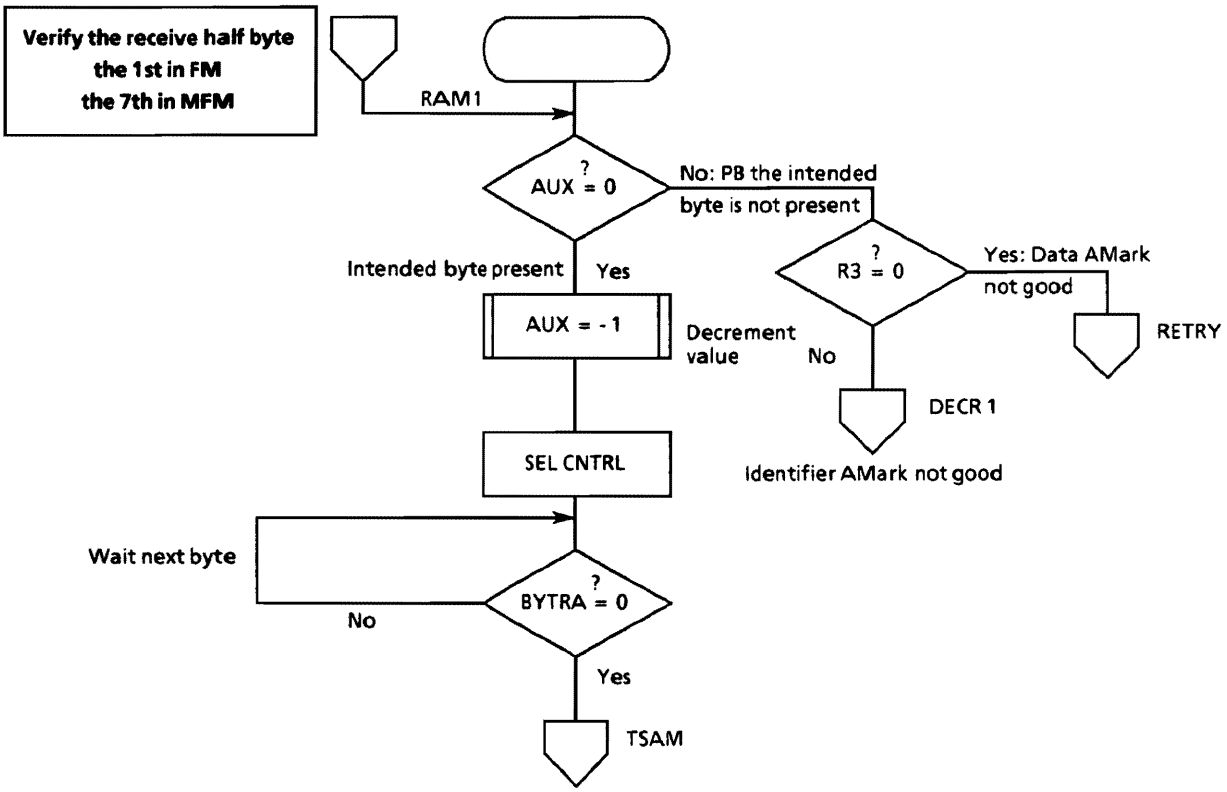

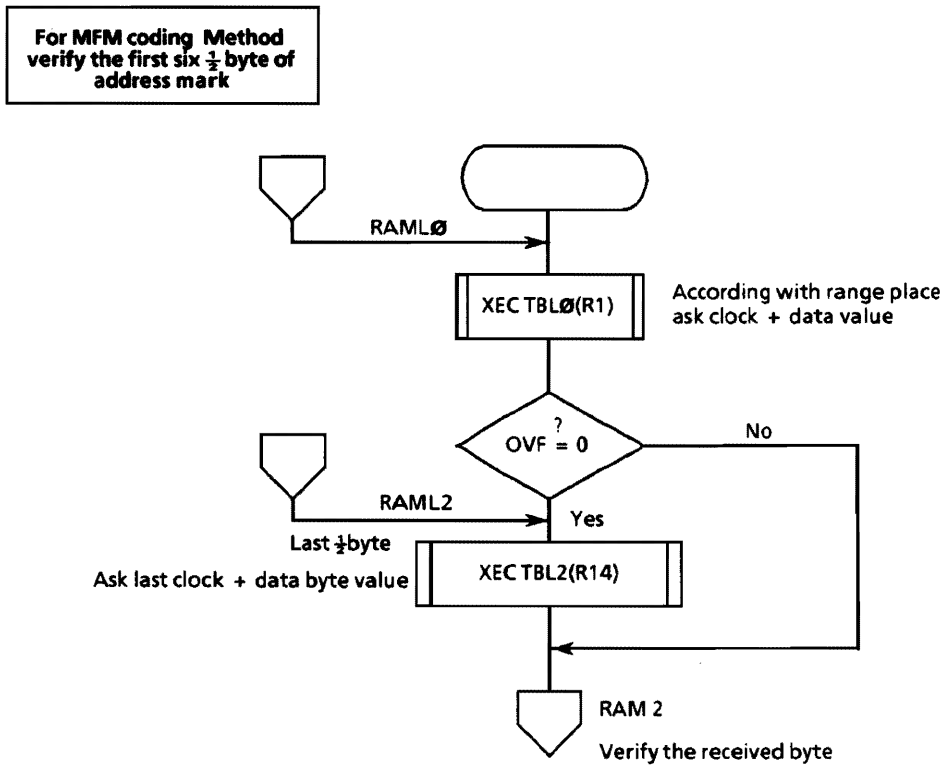

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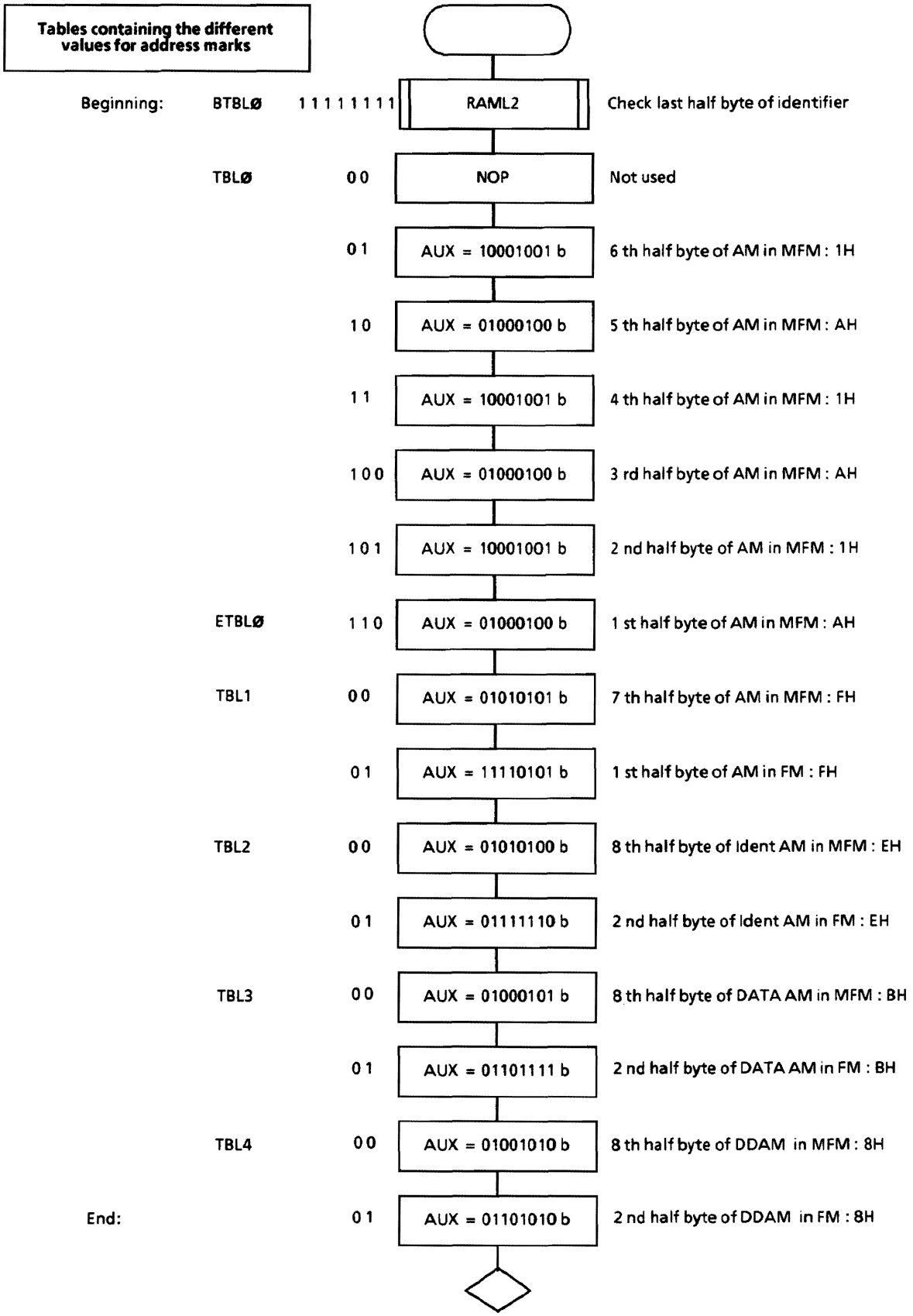
Tables containing the different values for address marks



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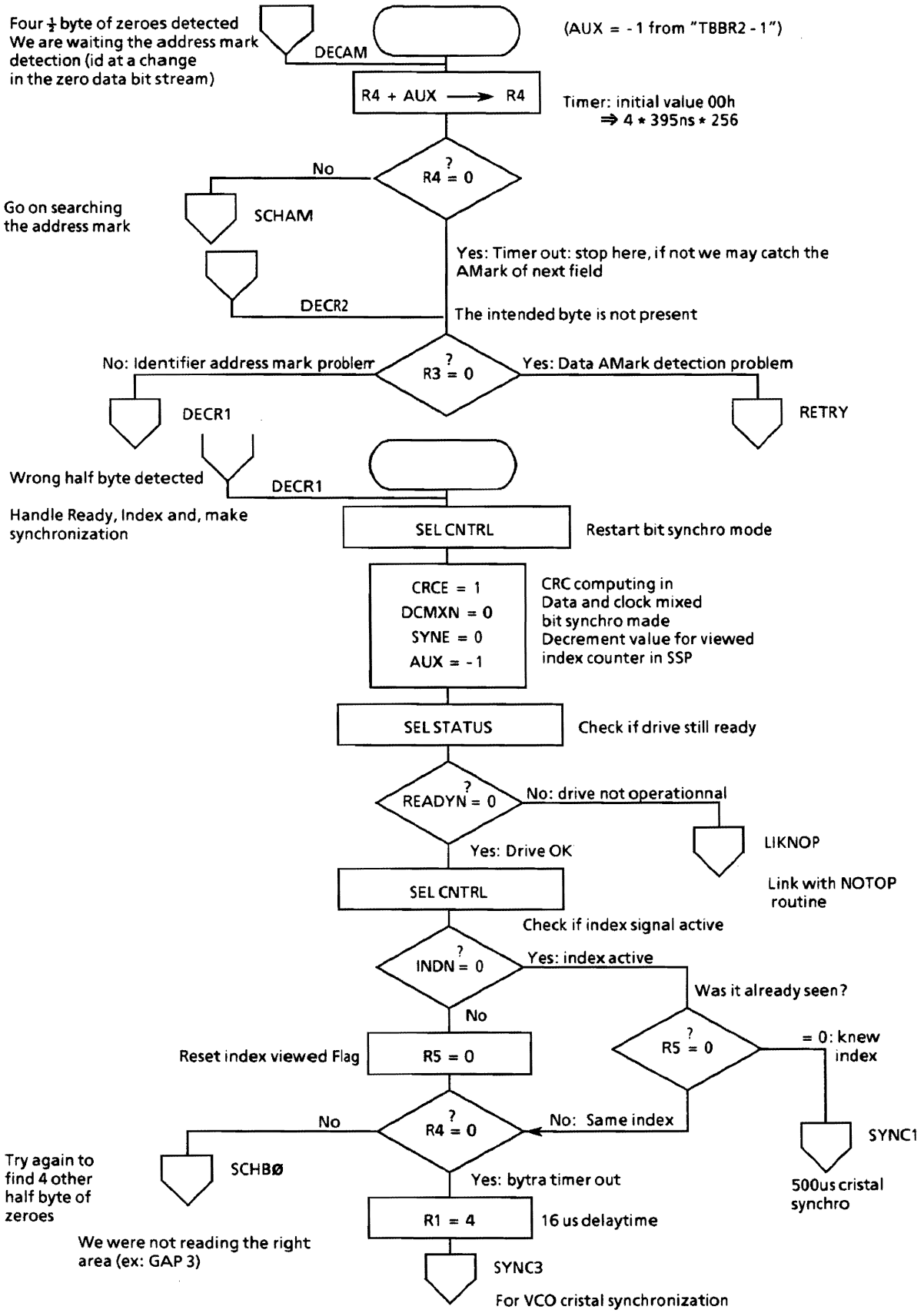

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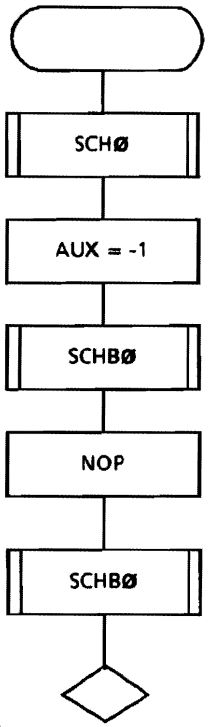
Loop untill four half byte of "0" are found

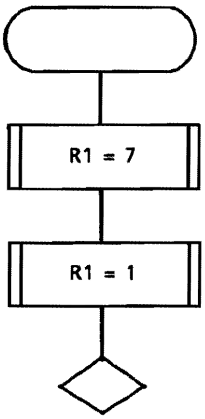
Table TBBR2



Beginning:	TBBR2	0 0	SCHØ	Go to search other zero bytes
		0 1	AUX = -1	Decrement value (4 th half byte found)
		1 0	SCHBØ	Search 3rd half Ø byte
		1 1	NOP	Not used
End:	ETBBR2	1 0 0	SCHBØ	Search 2nd half Ø byte

Give the number of half bytes containing in the address mark

Table TBR1



Beginning:	TBR1	0 0	R1 = 7	: 8half byte in MFM
End:	ETBR1	0 1	R1 = 1	:2half byte in FM

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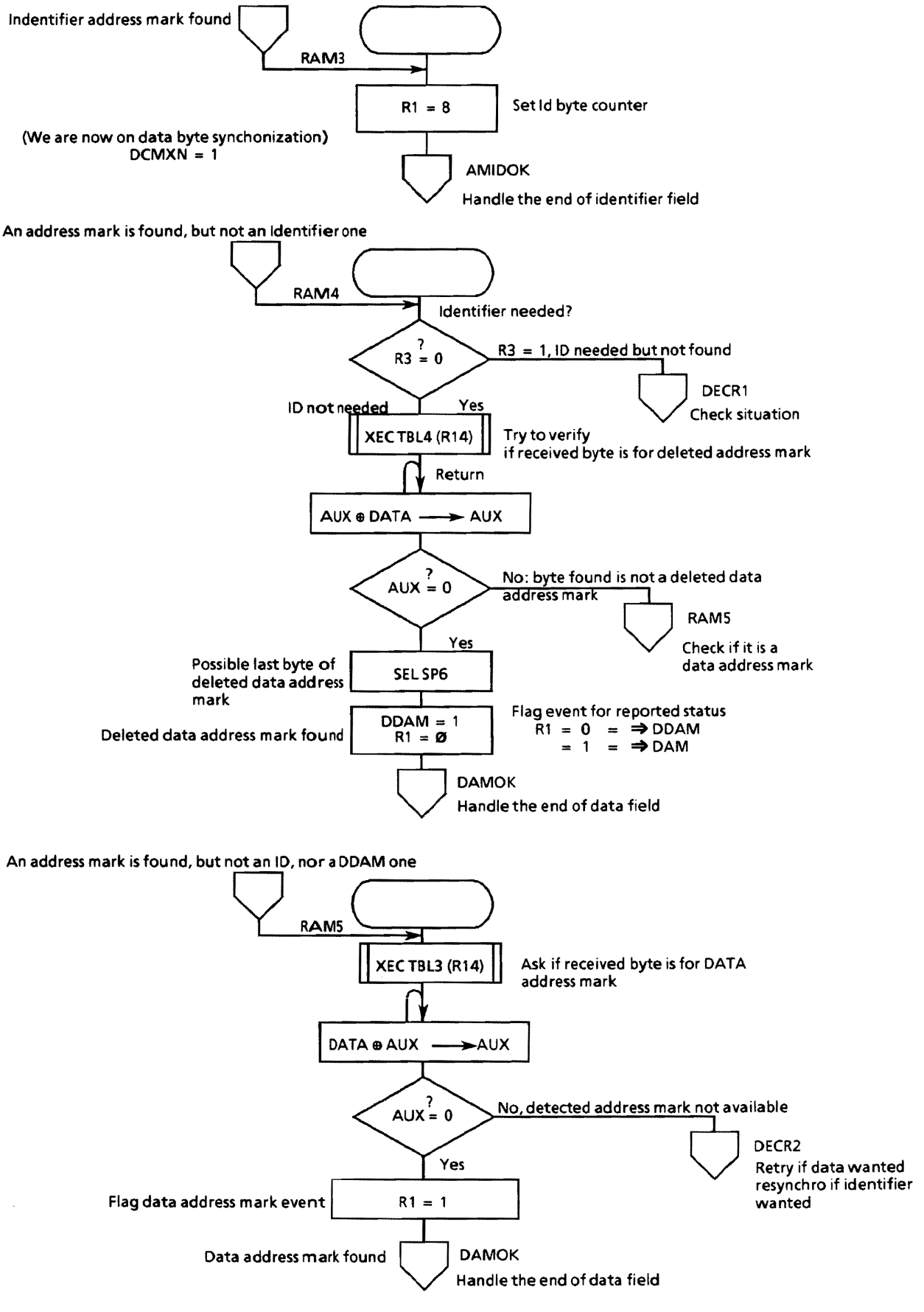

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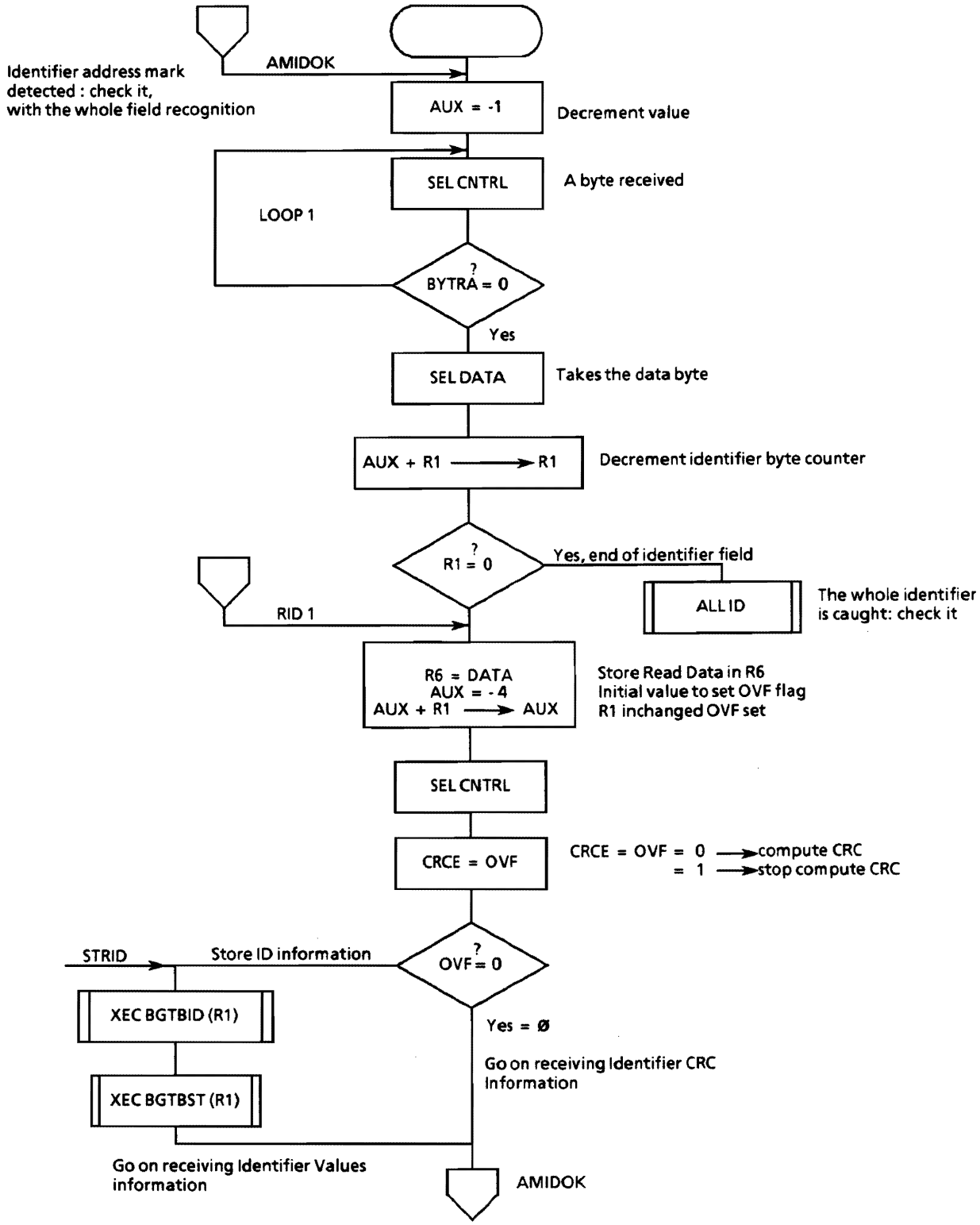

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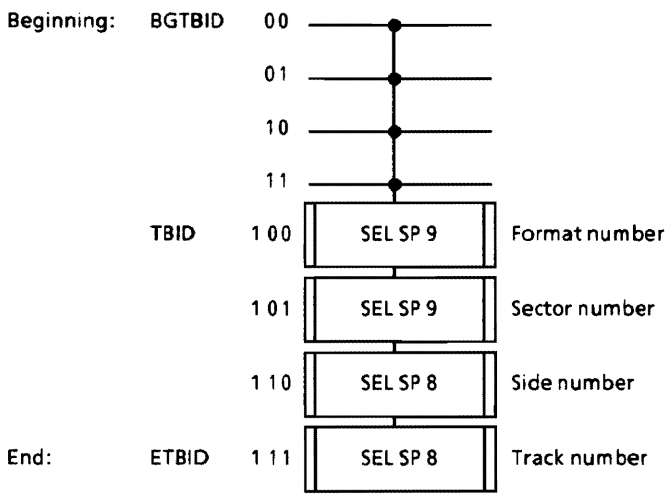
Table storing Identifier information



R1	OVF	
7	1	STORE CYLINDER NO.
6	1	STORE HEAD NO.
5	1	STORE SECTOR NO.
4	1	STORE FORMAT NO.
3	0	Compute first CRC
2	0	Compute 2nd CRC
1	0	Ask 1st CRC in R6
0	0	ASK 2ND IN DATA

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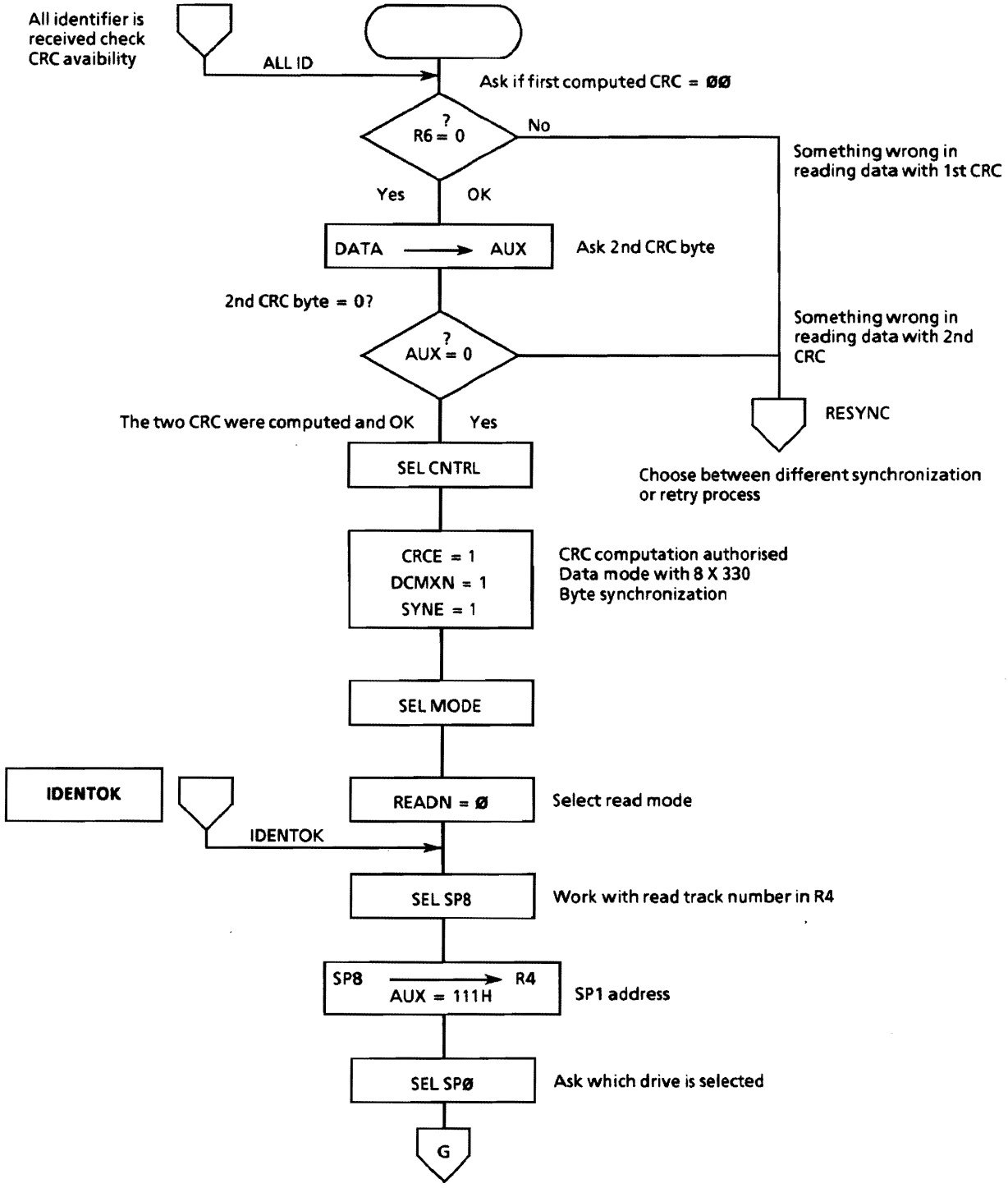

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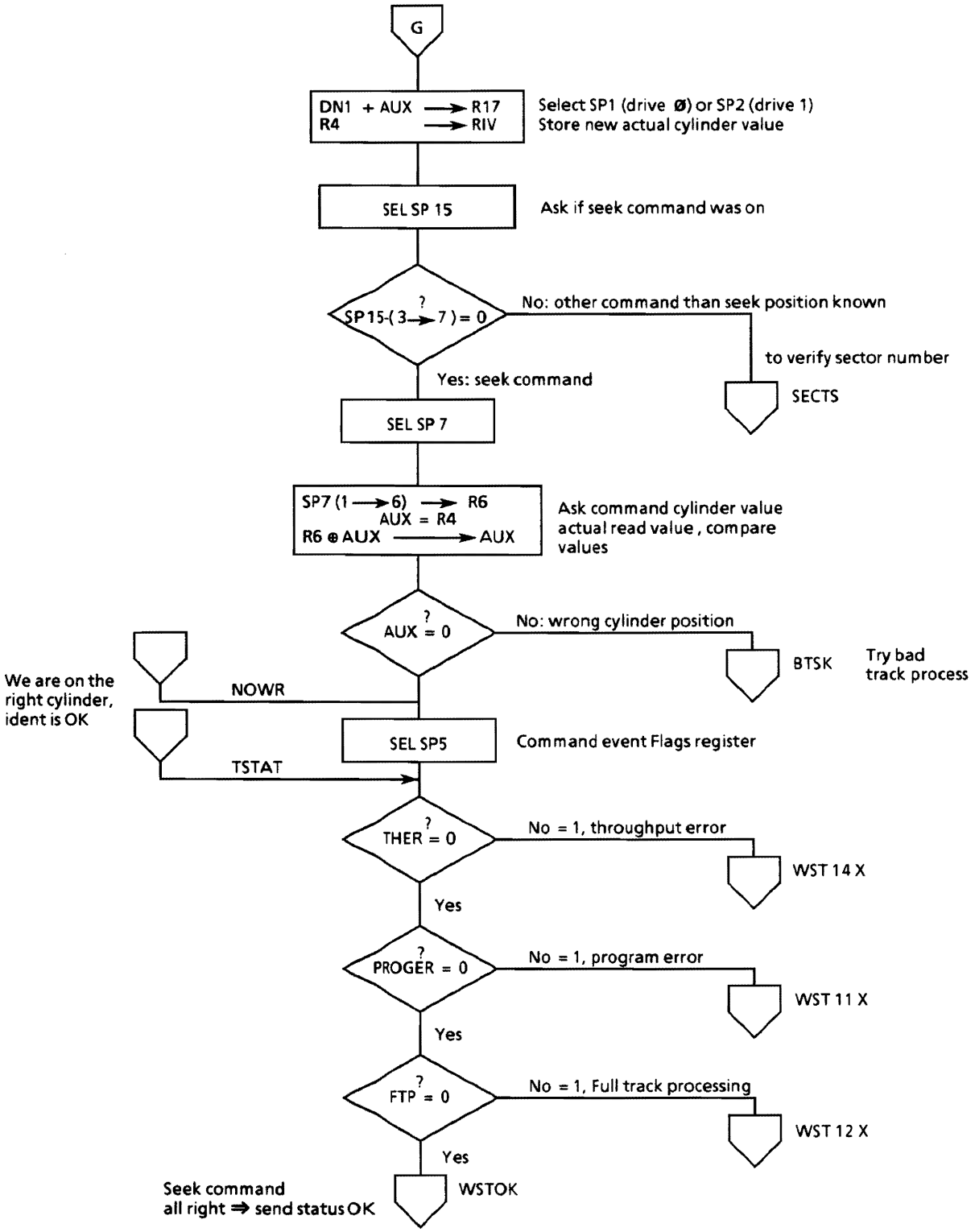

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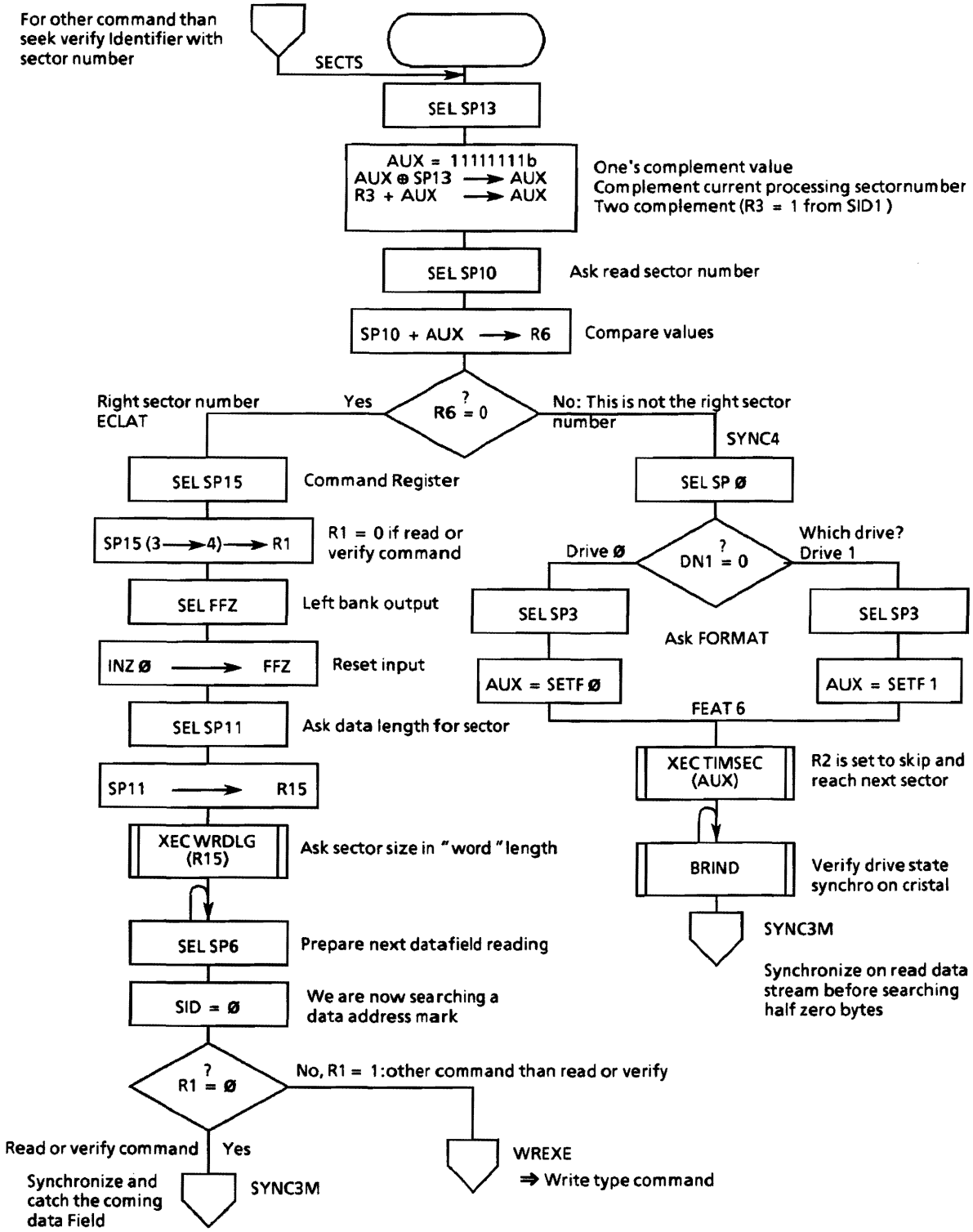

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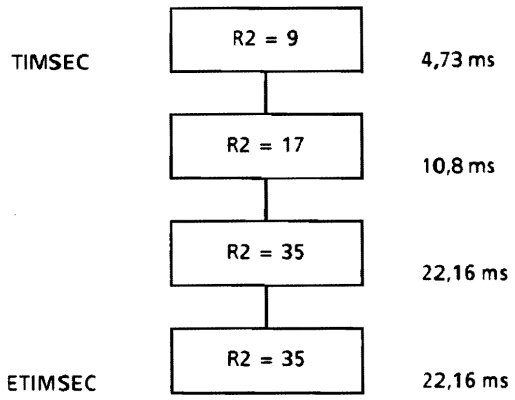
Table to set R2 value, cristal synchronization timer



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Identifier found OK, execute read or write process

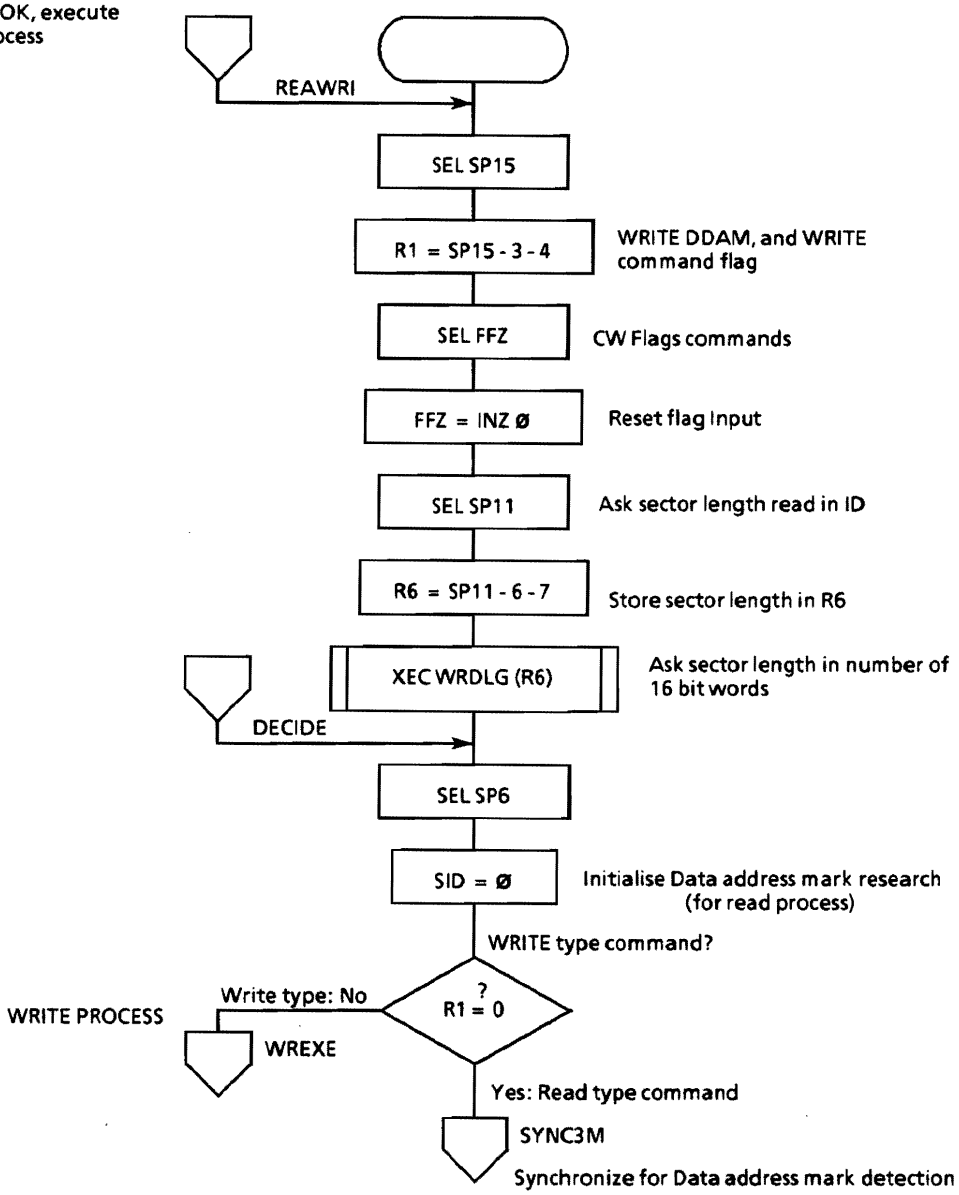

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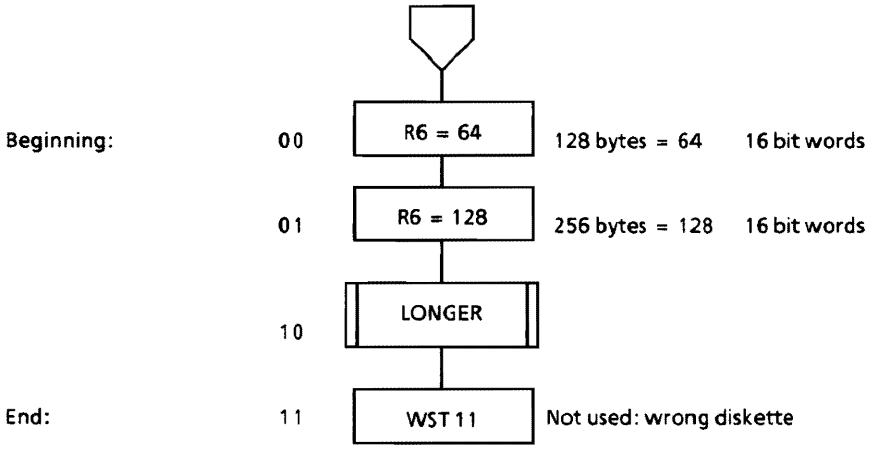
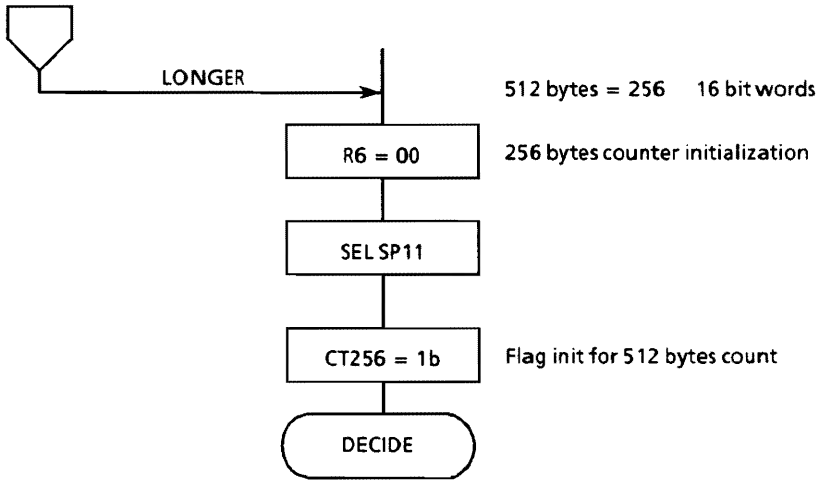
Table WRDLG (R6):





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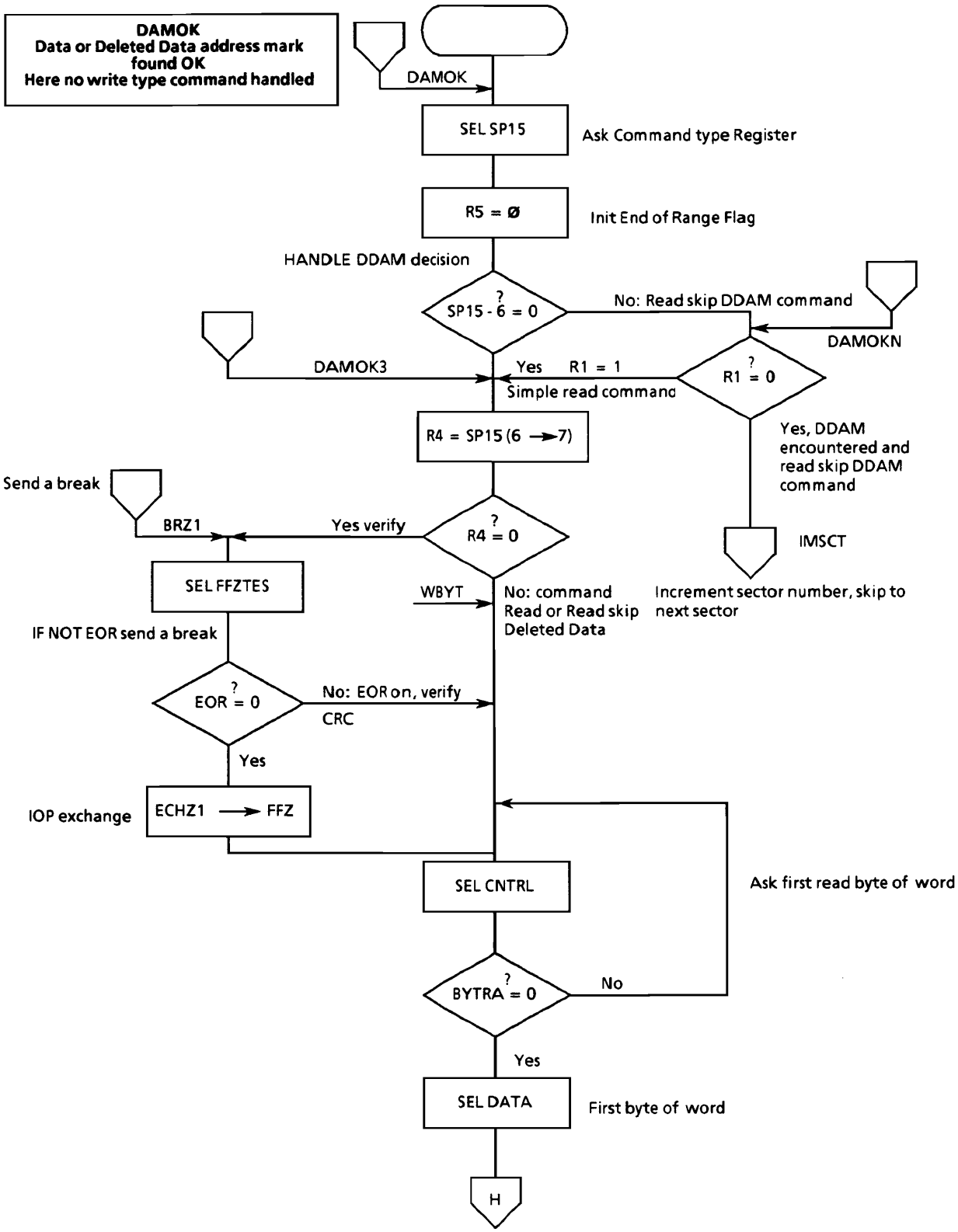

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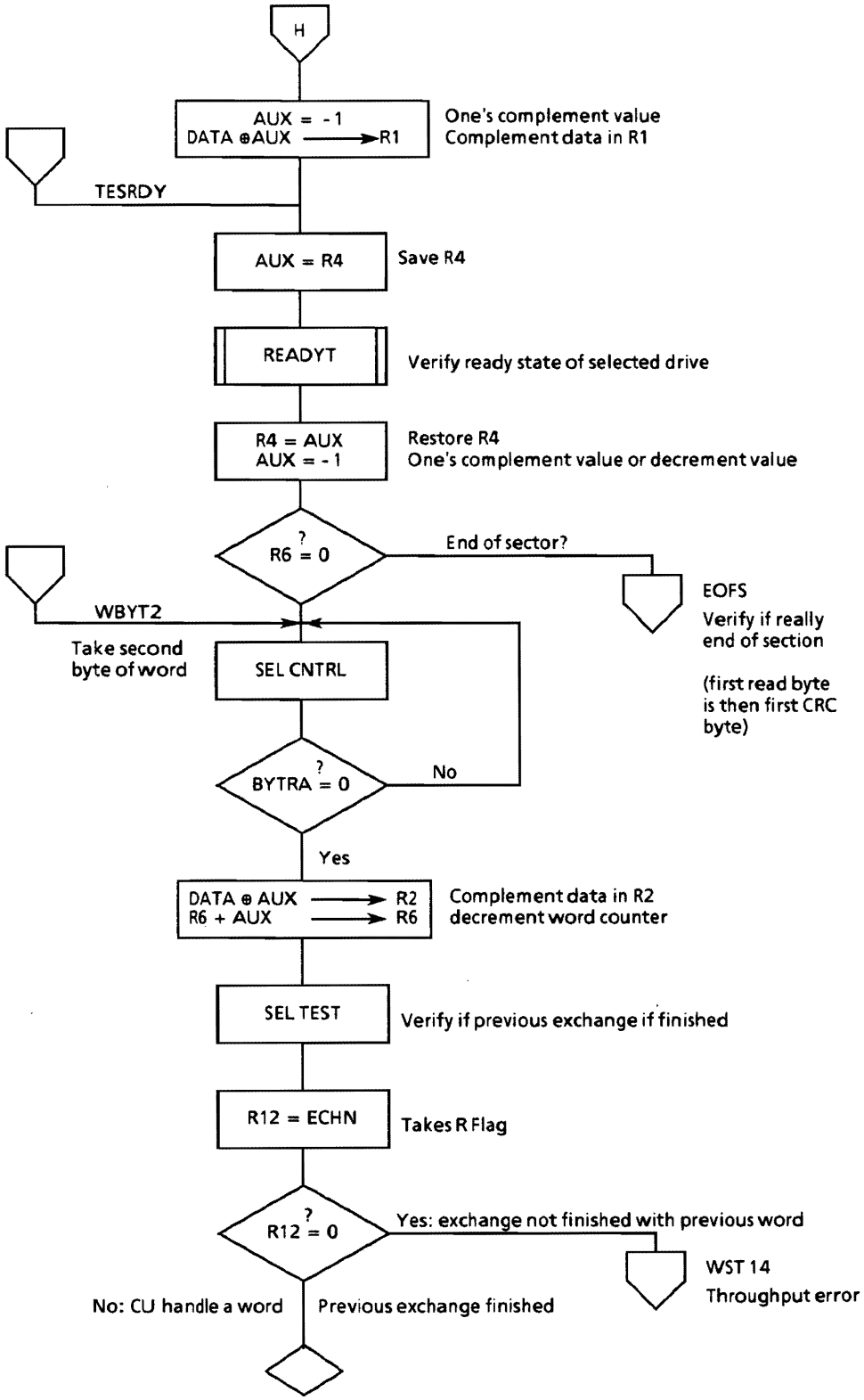

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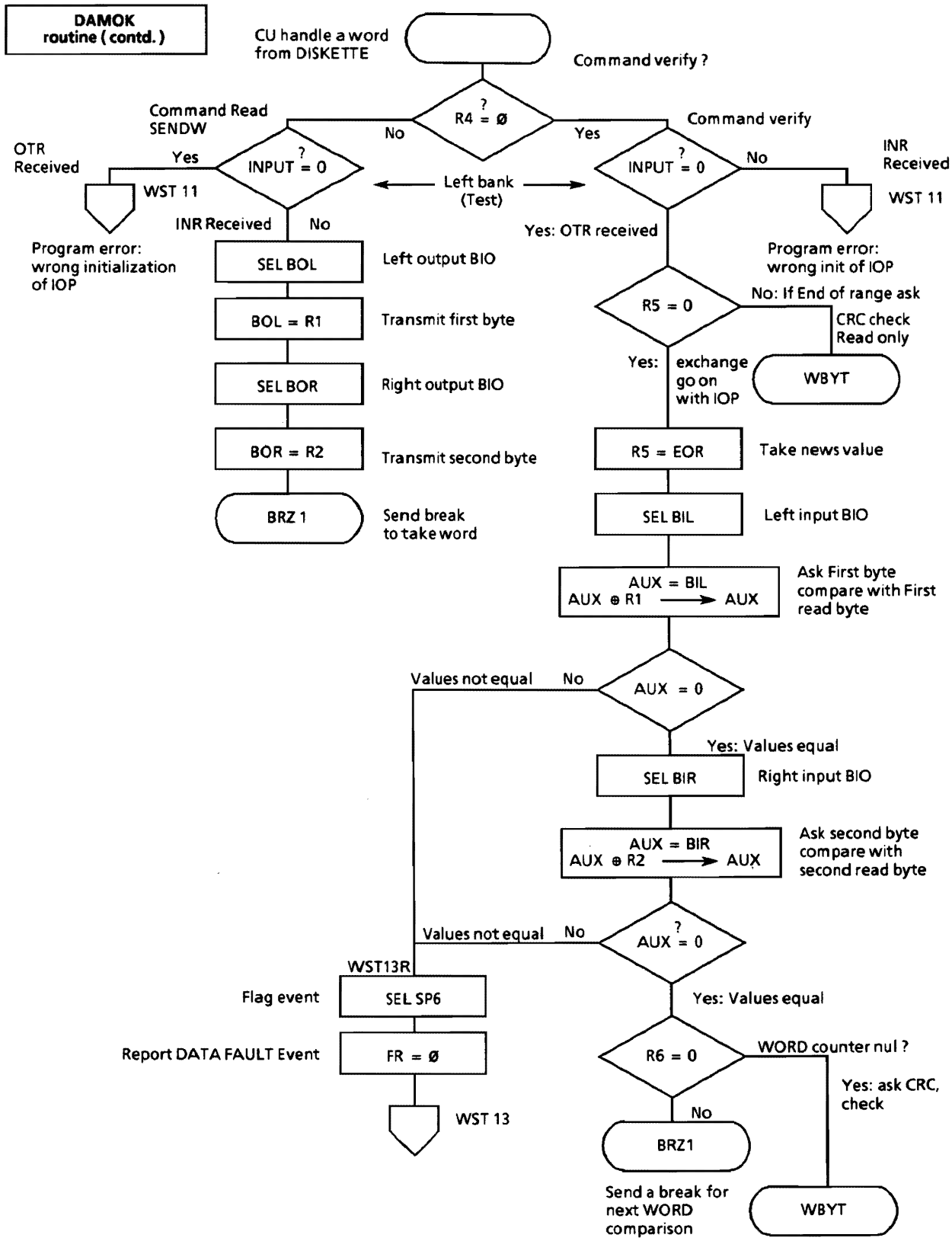

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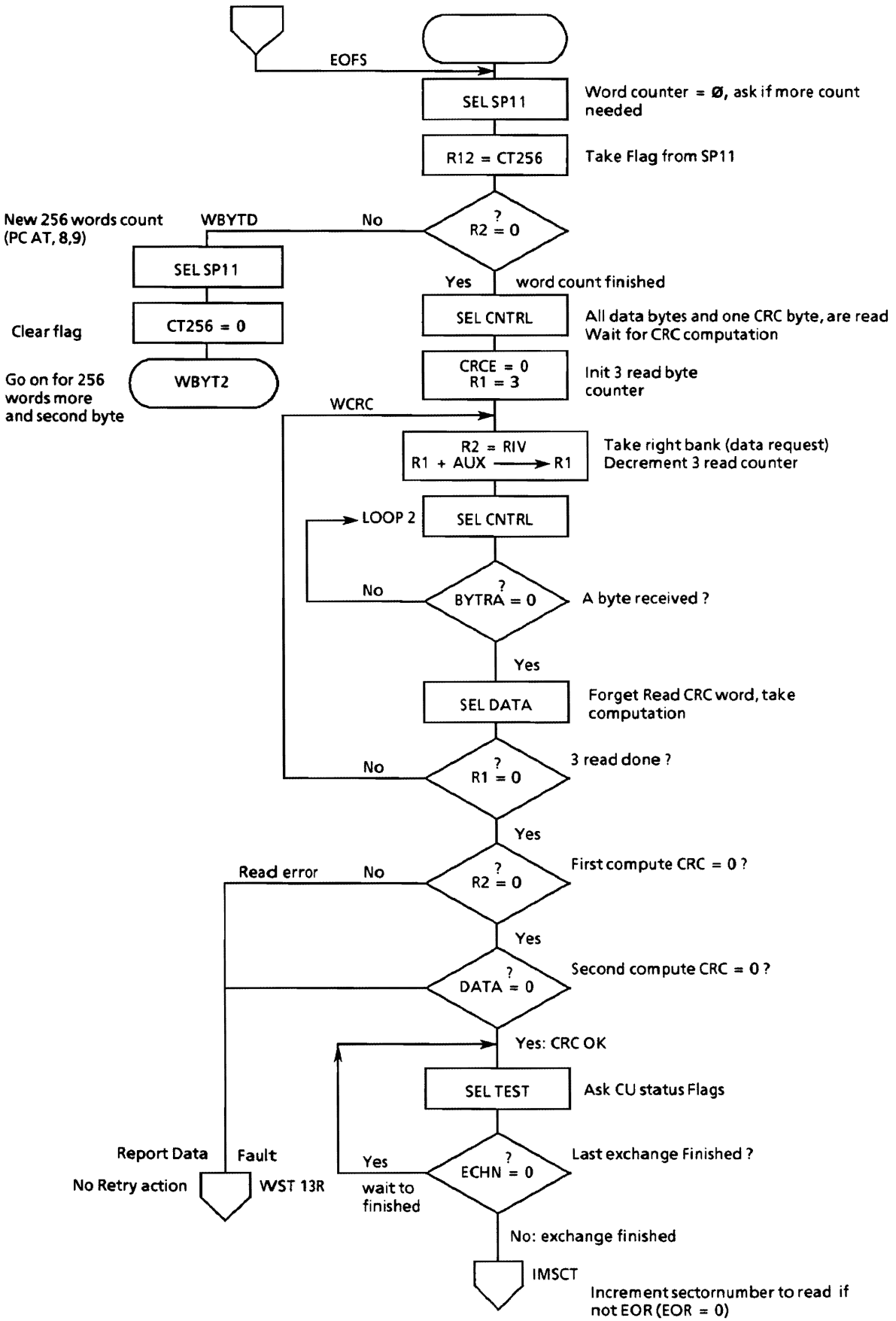

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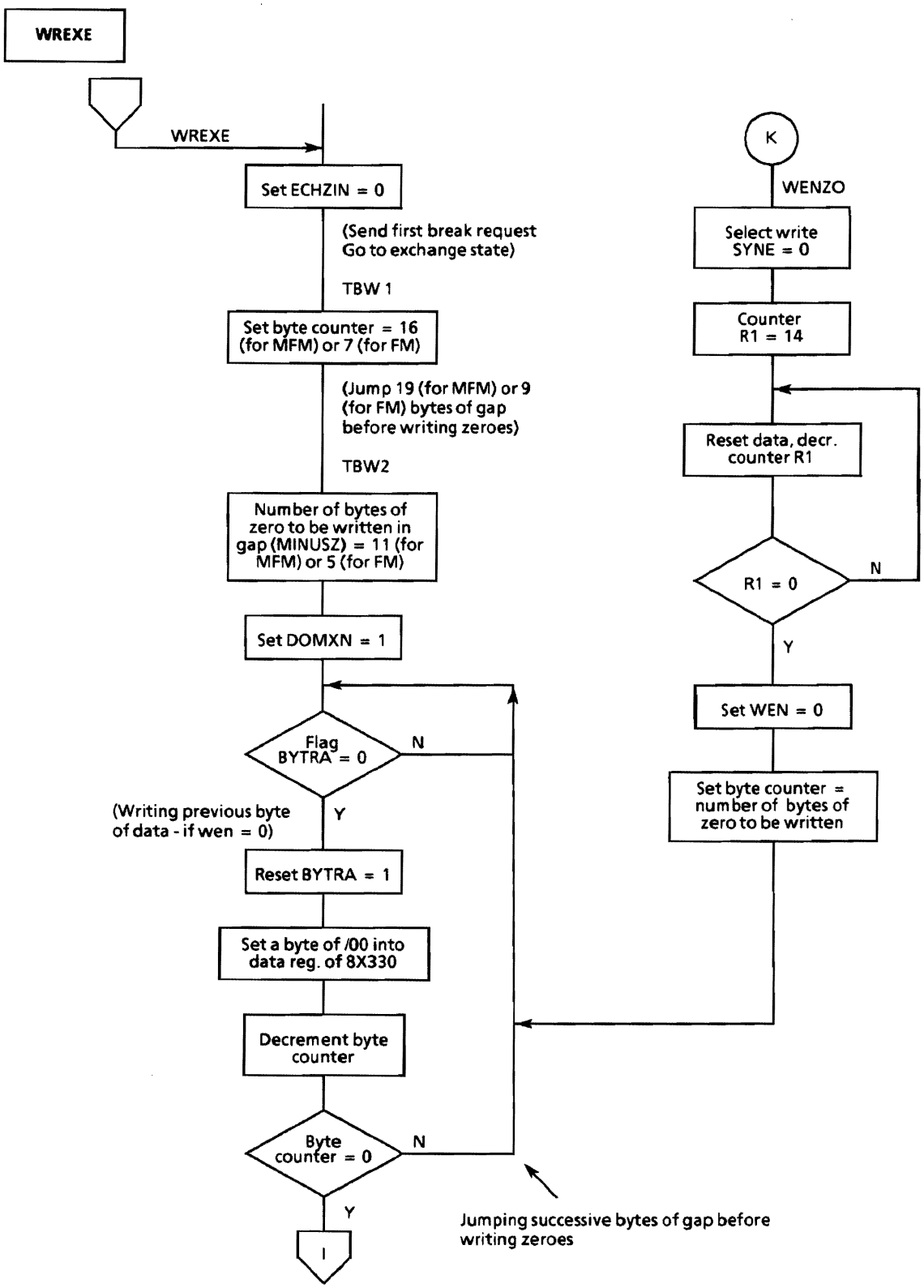

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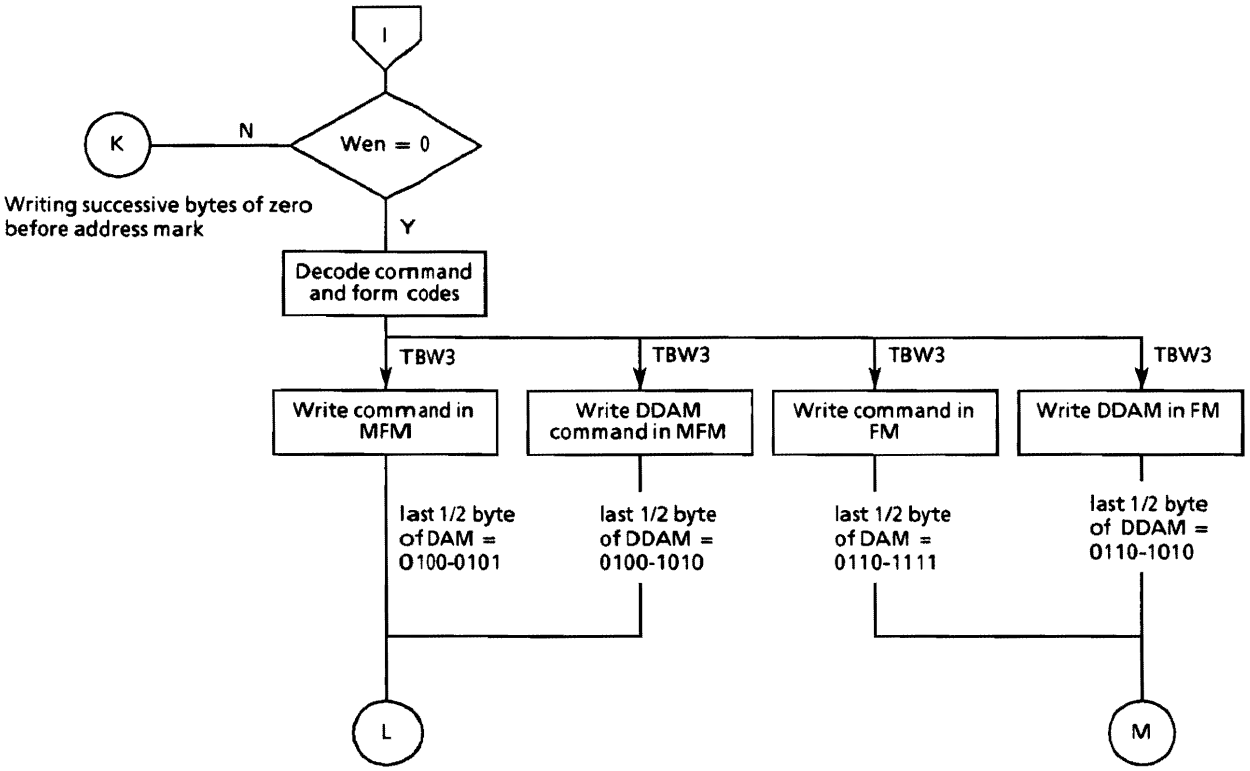

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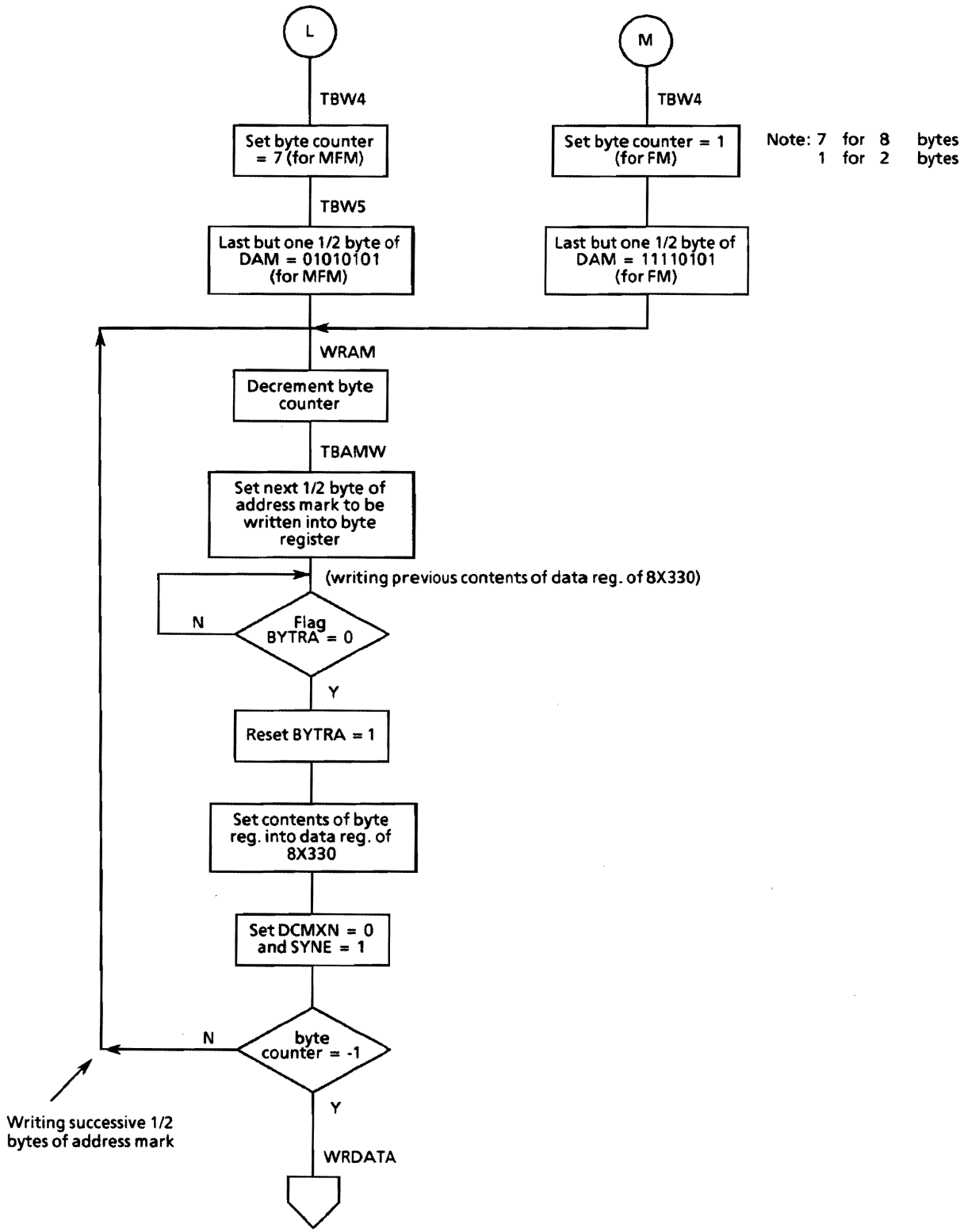

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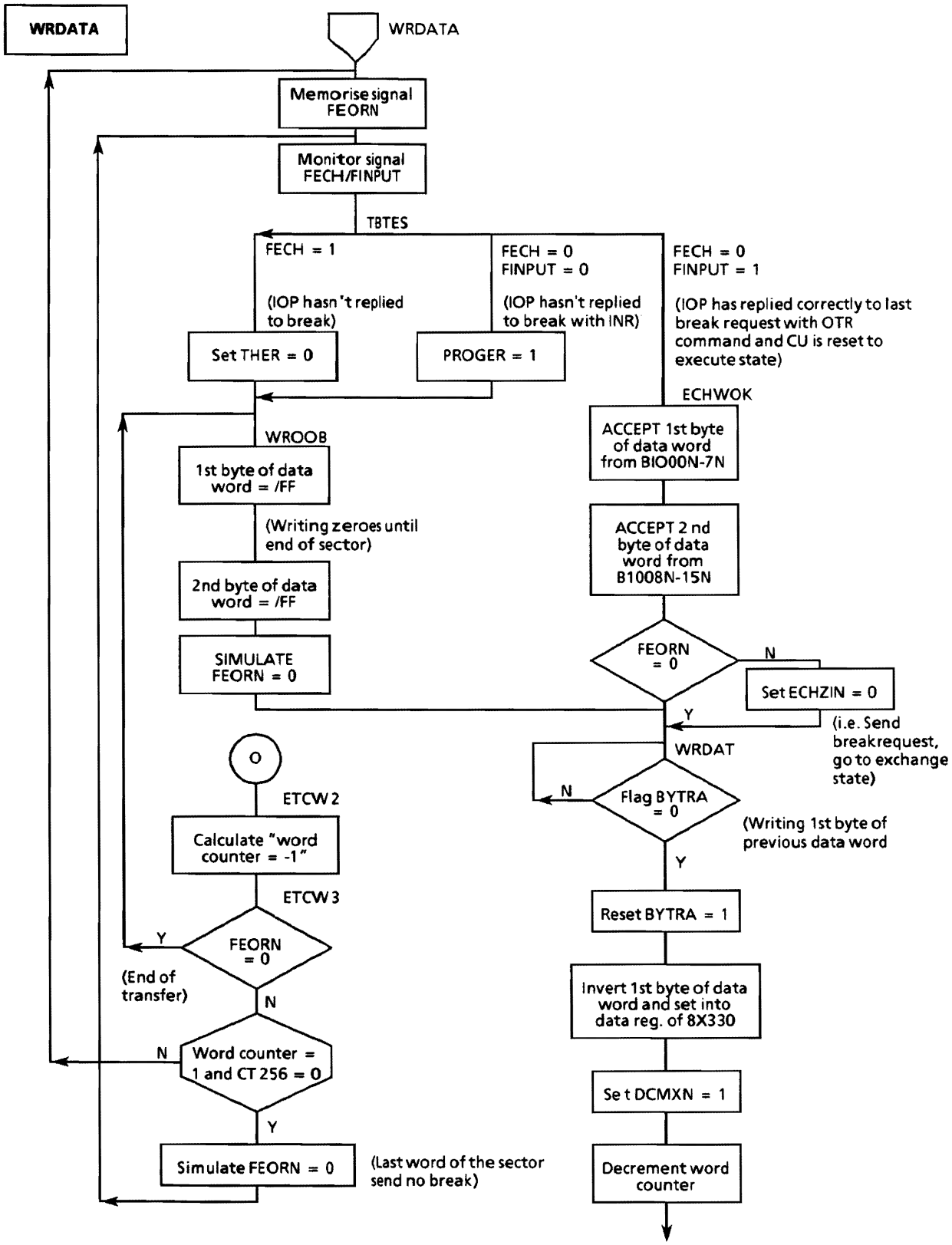

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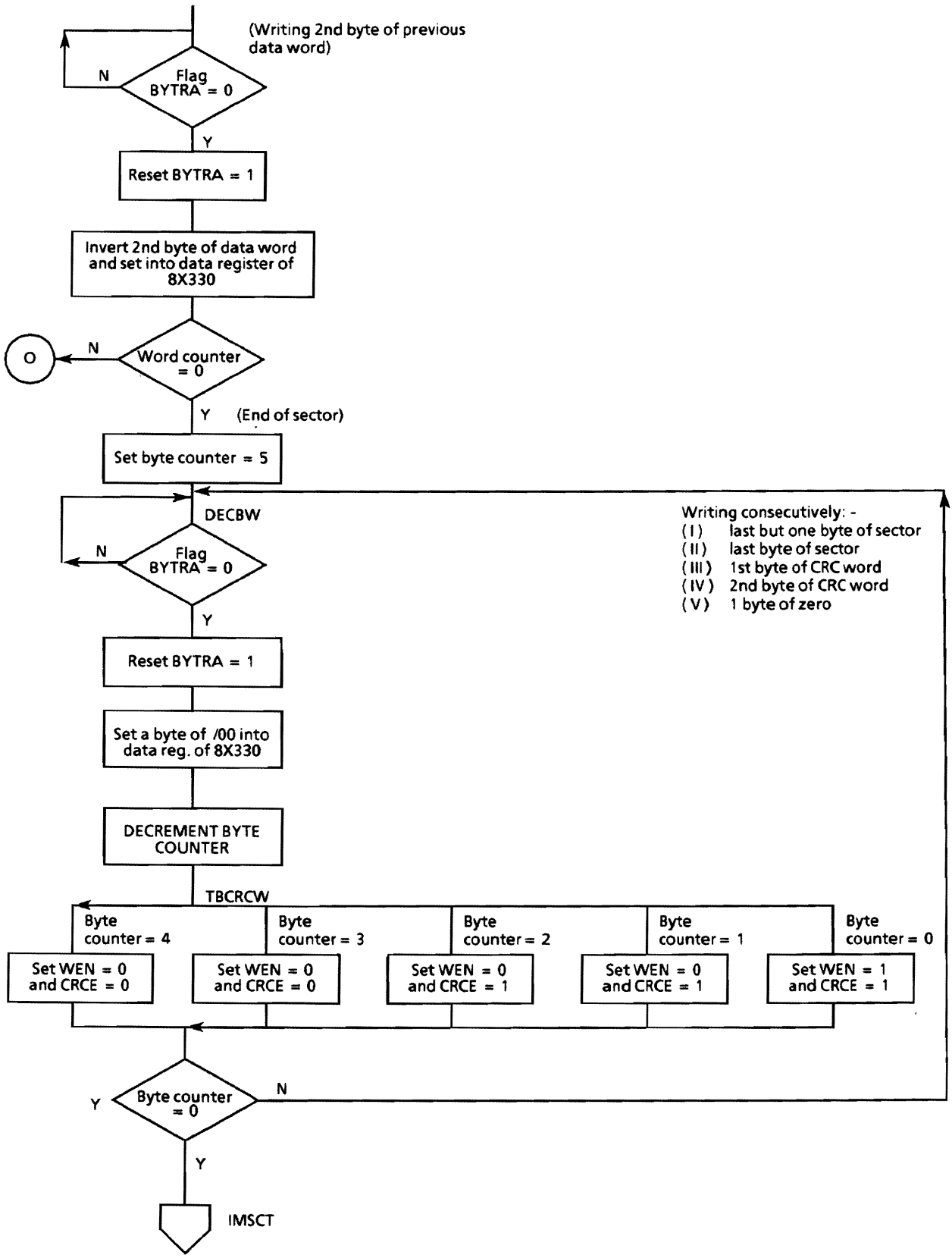

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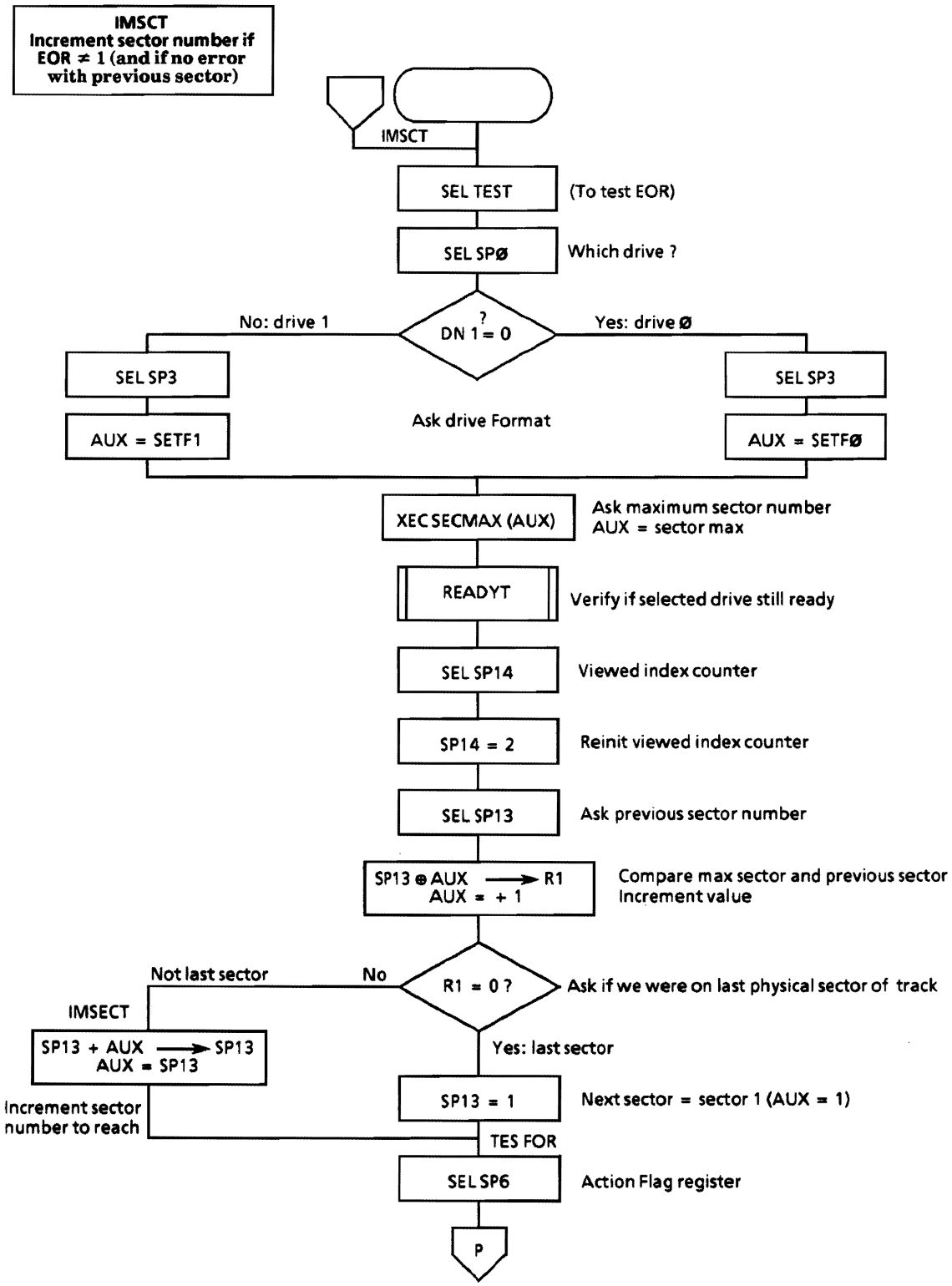

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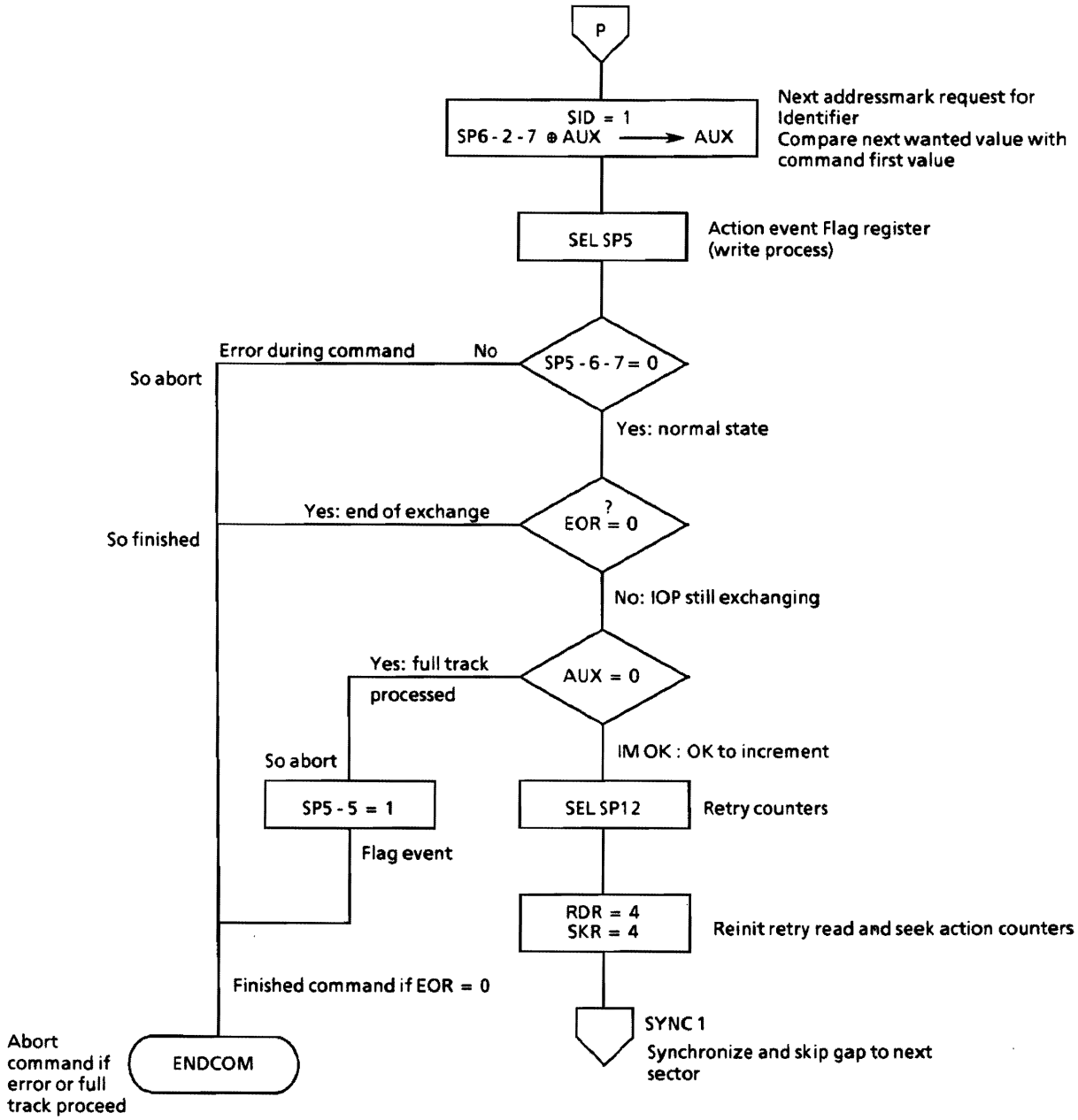

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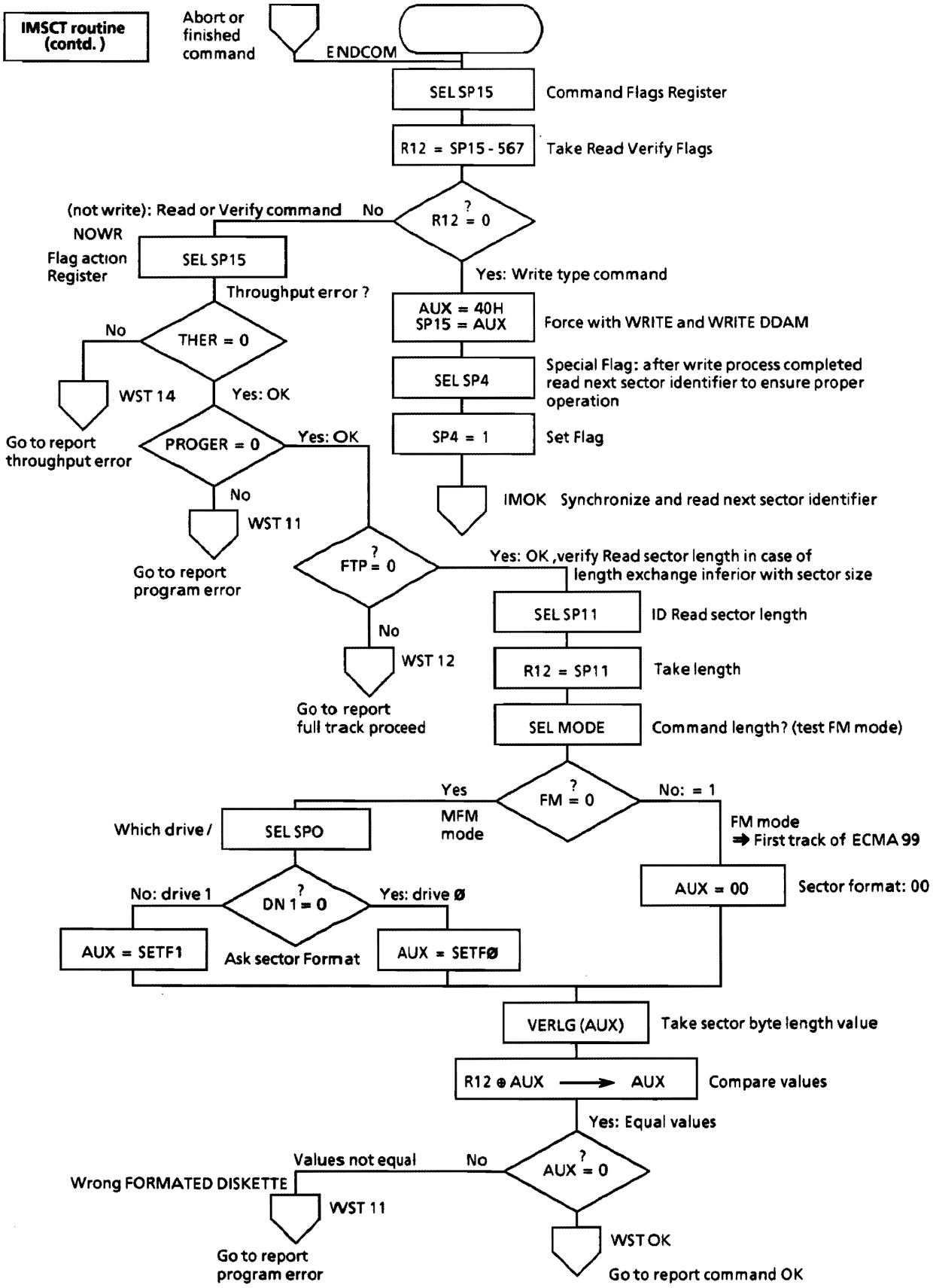

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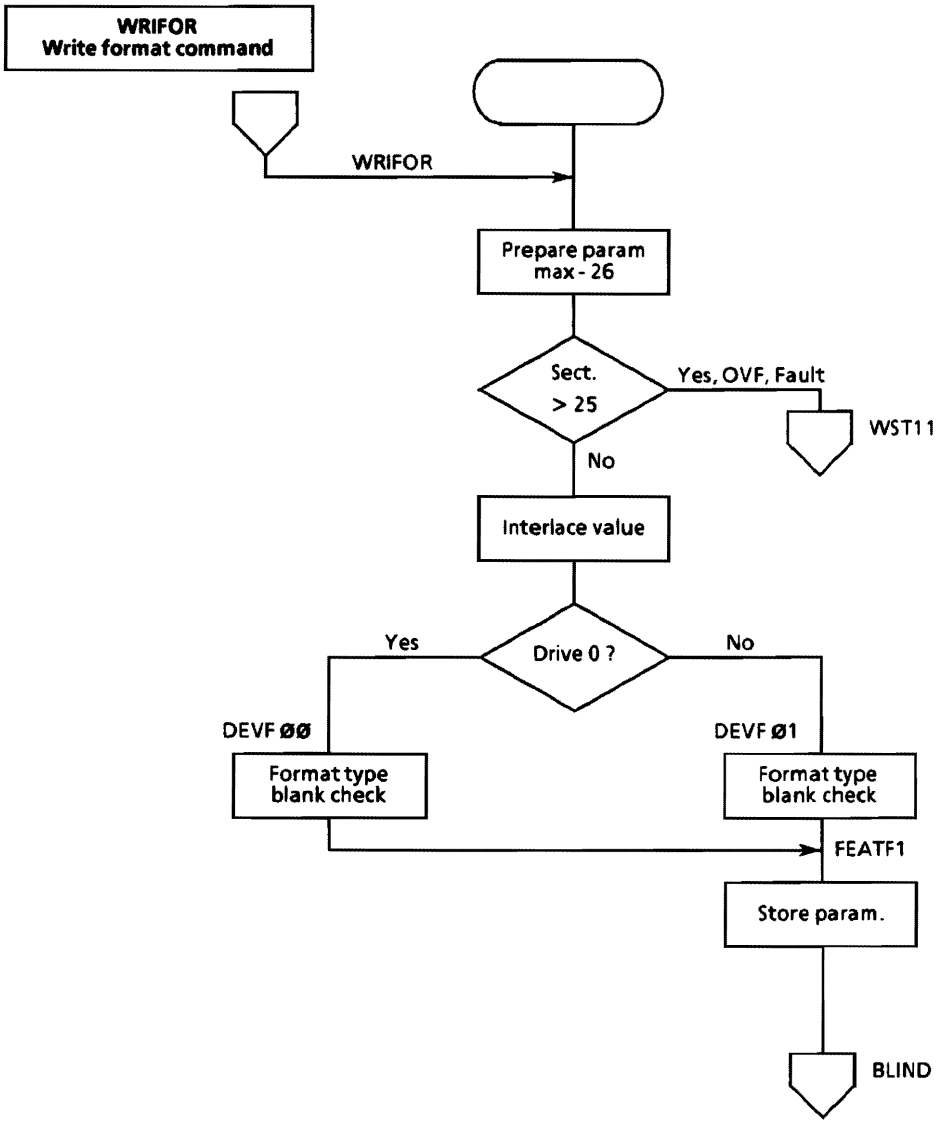

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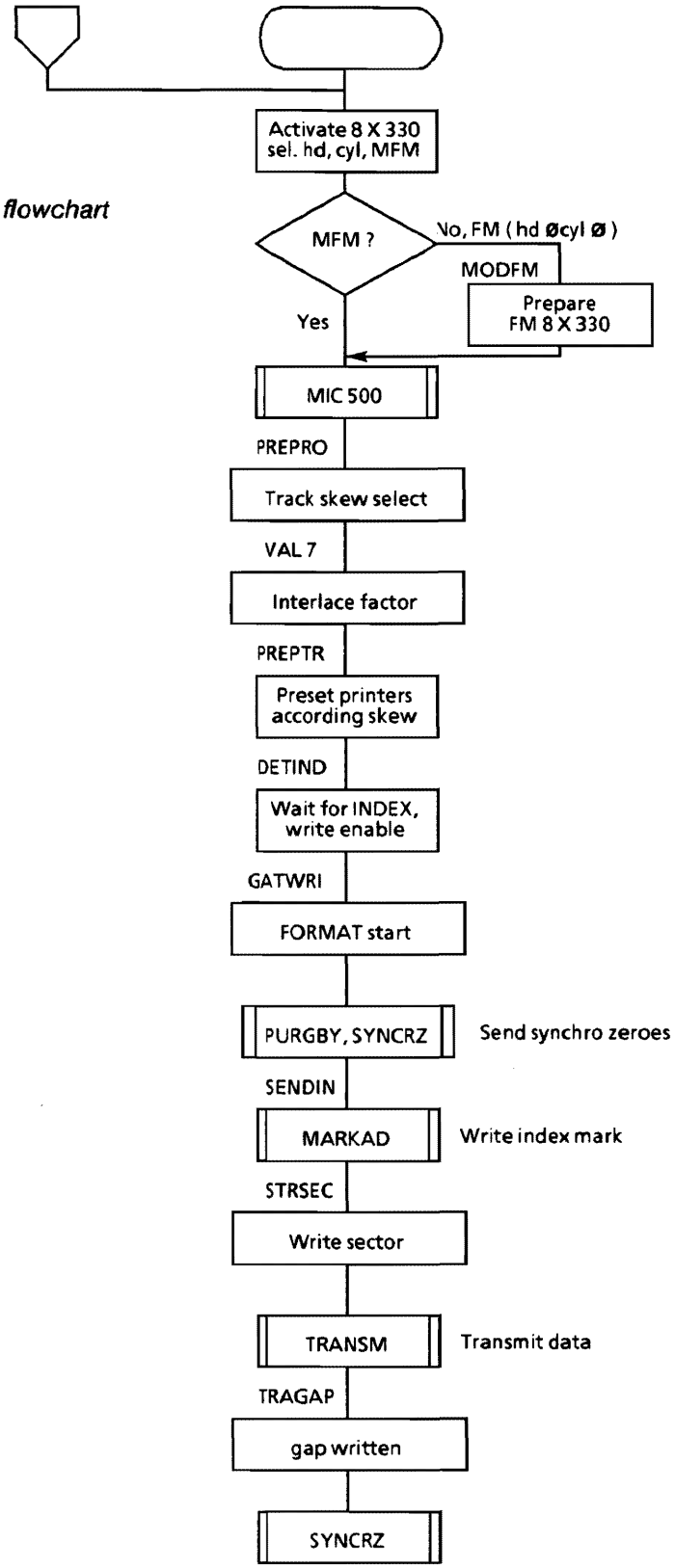
PREPAR
prepare for writing format

Note: *No detailed flowchart available*



Followed by send identifier (SENDID)
and send data (SENDDA)
in similar sequence

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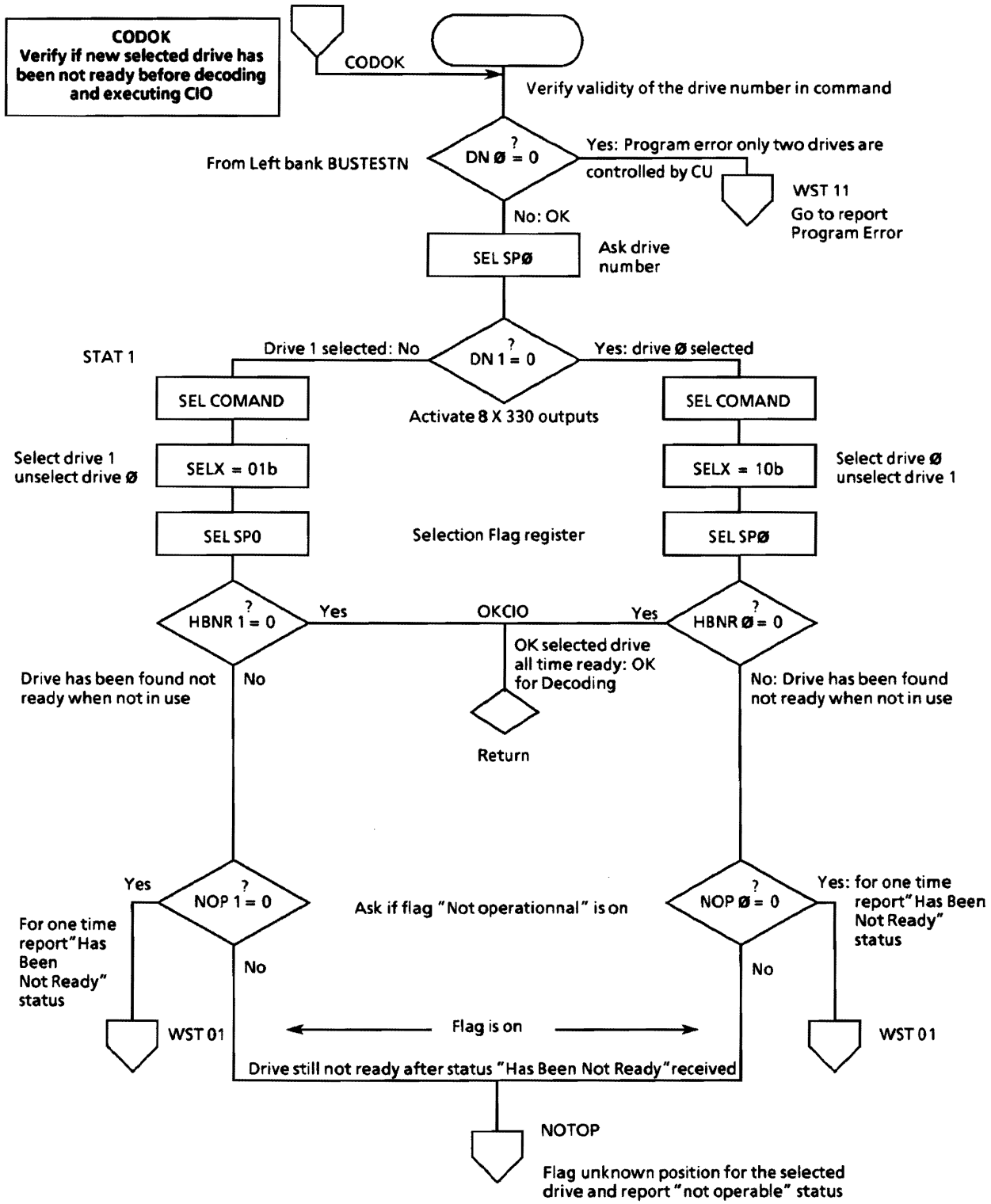

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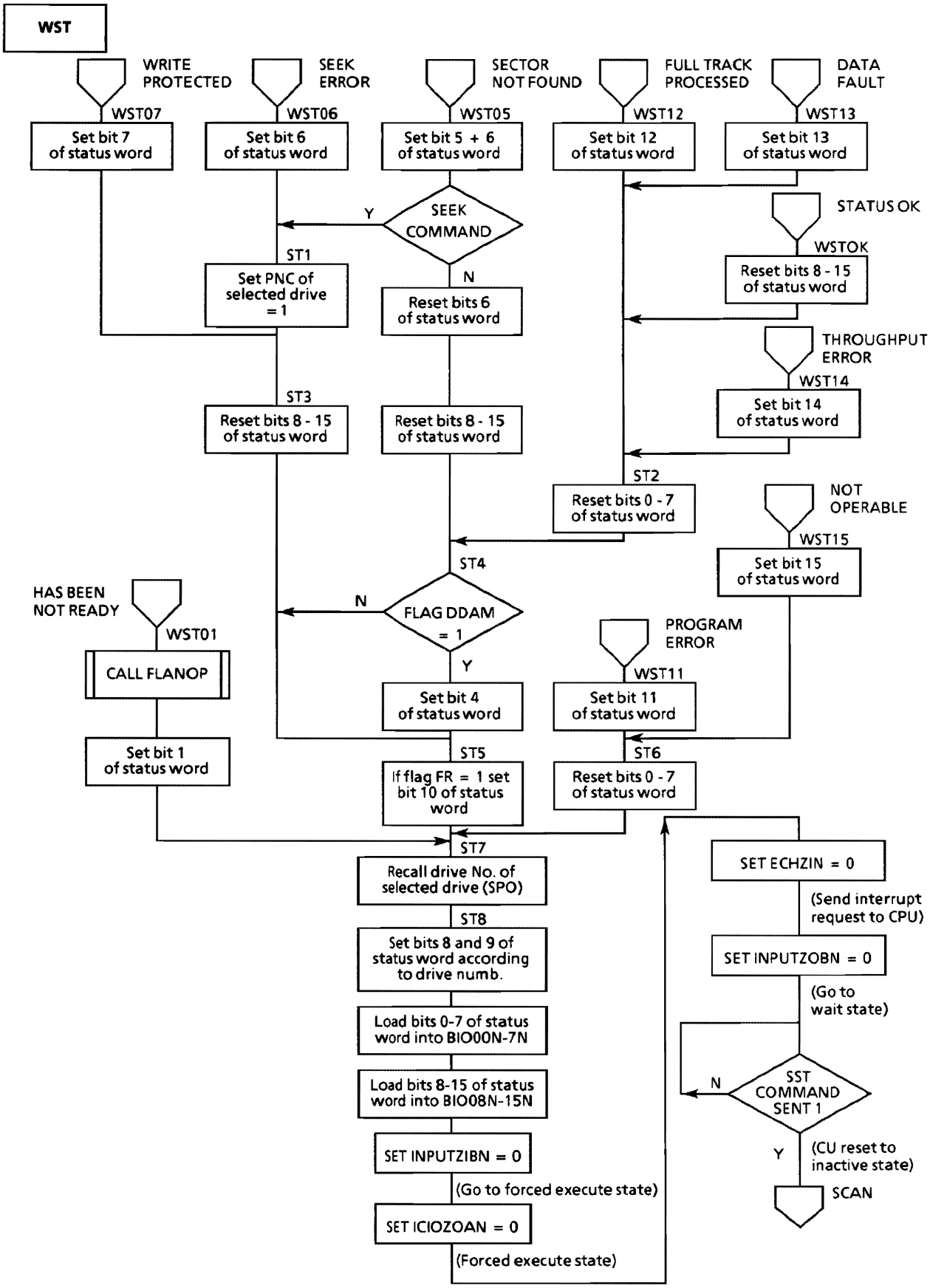

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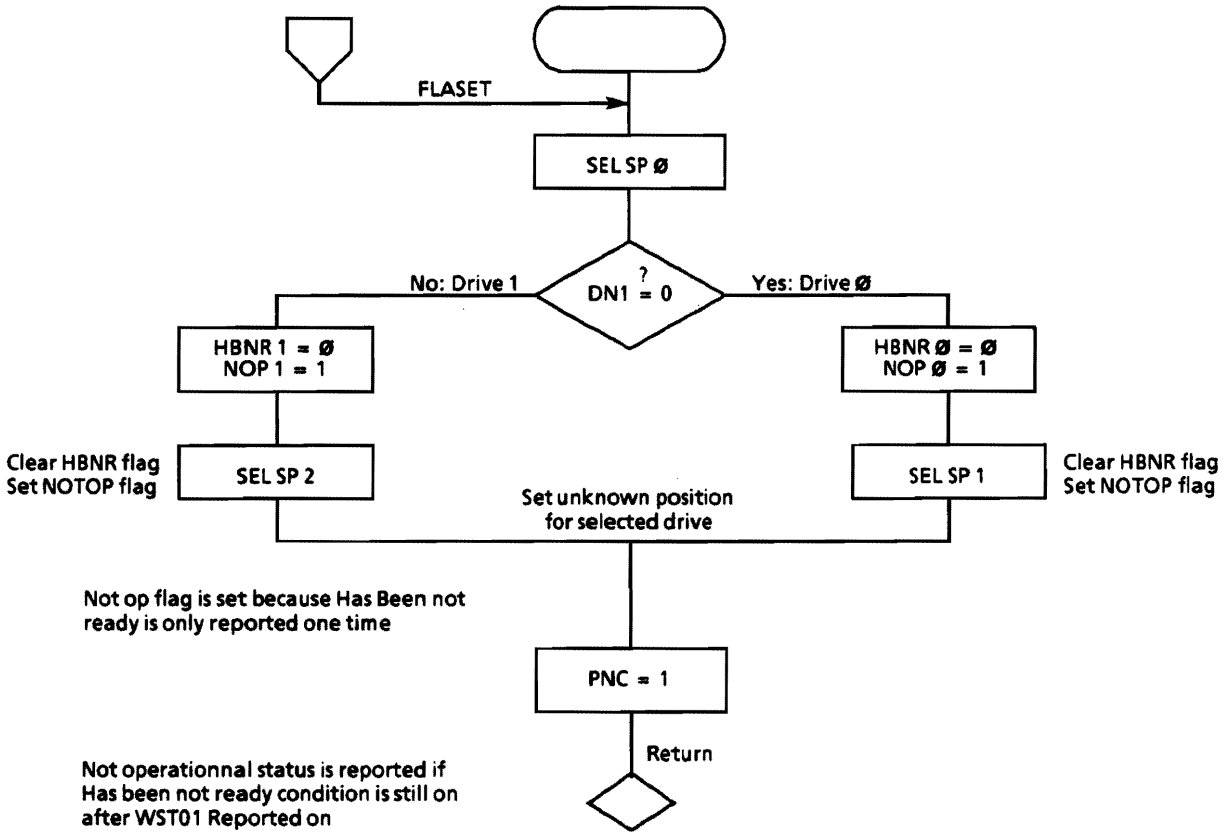
SUBROUTINES:
The return address is found in a return address table,
where R11 is used as index

FLASET (subroutine)

Before Reporting Status "WST01"
Handle flags



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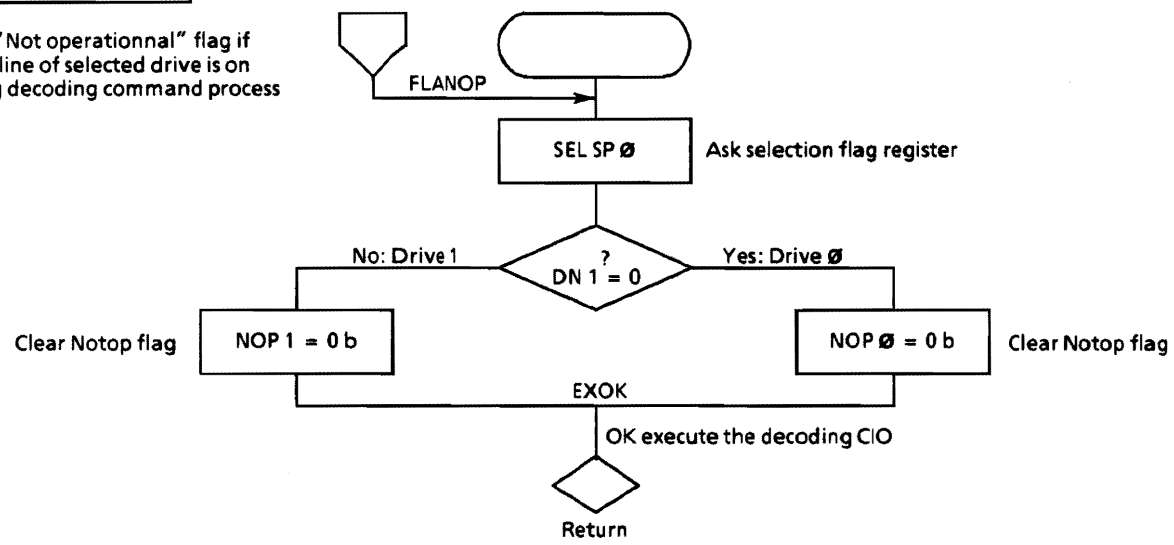
FLANOP (subroutine)

Clear "Not operationnal" flag if ready line of selected drive is on during decoding command process



SHBNRX (subroutine)

Set "Has Been not ready" flag following NOTOPX value

The two drives are not operable during "wait state"

If NOTOP flag is on ⇒ Has been not ready report done or not needed

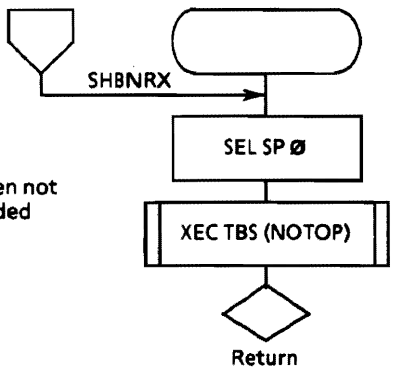
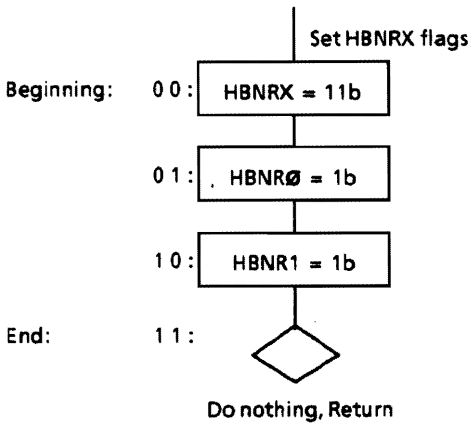


Table TSB (NOTOPX) :



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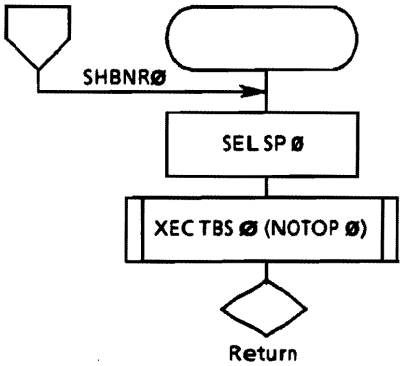
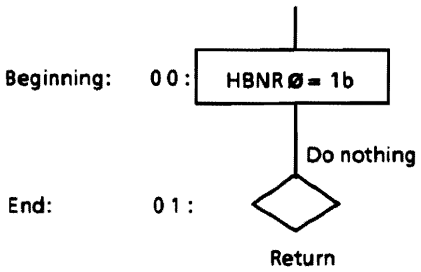
SHBNR Ø (subroutine)

Drive Ø is found not ready and not in use



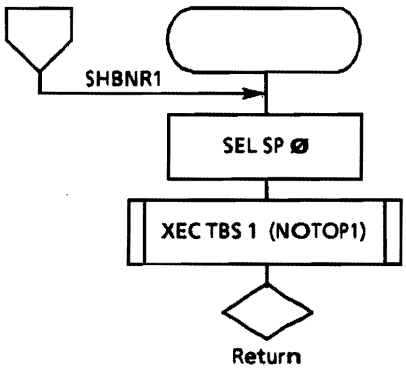
Set HBNR Ø flag if flag NOTOP Ø is cleared

Table TBSØ (NOTOPØ) :



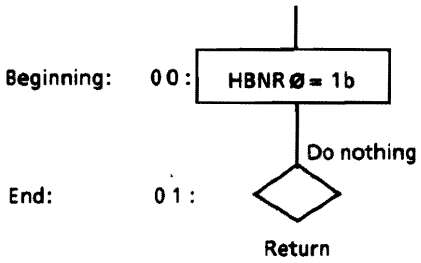
SHBNR 1 (subroutine)

Drive 1 is found not Ready and not in use



Set HBNR1 flag if flag NOTOP1 is cleared

Table TBS1 (NOTOP 1) :



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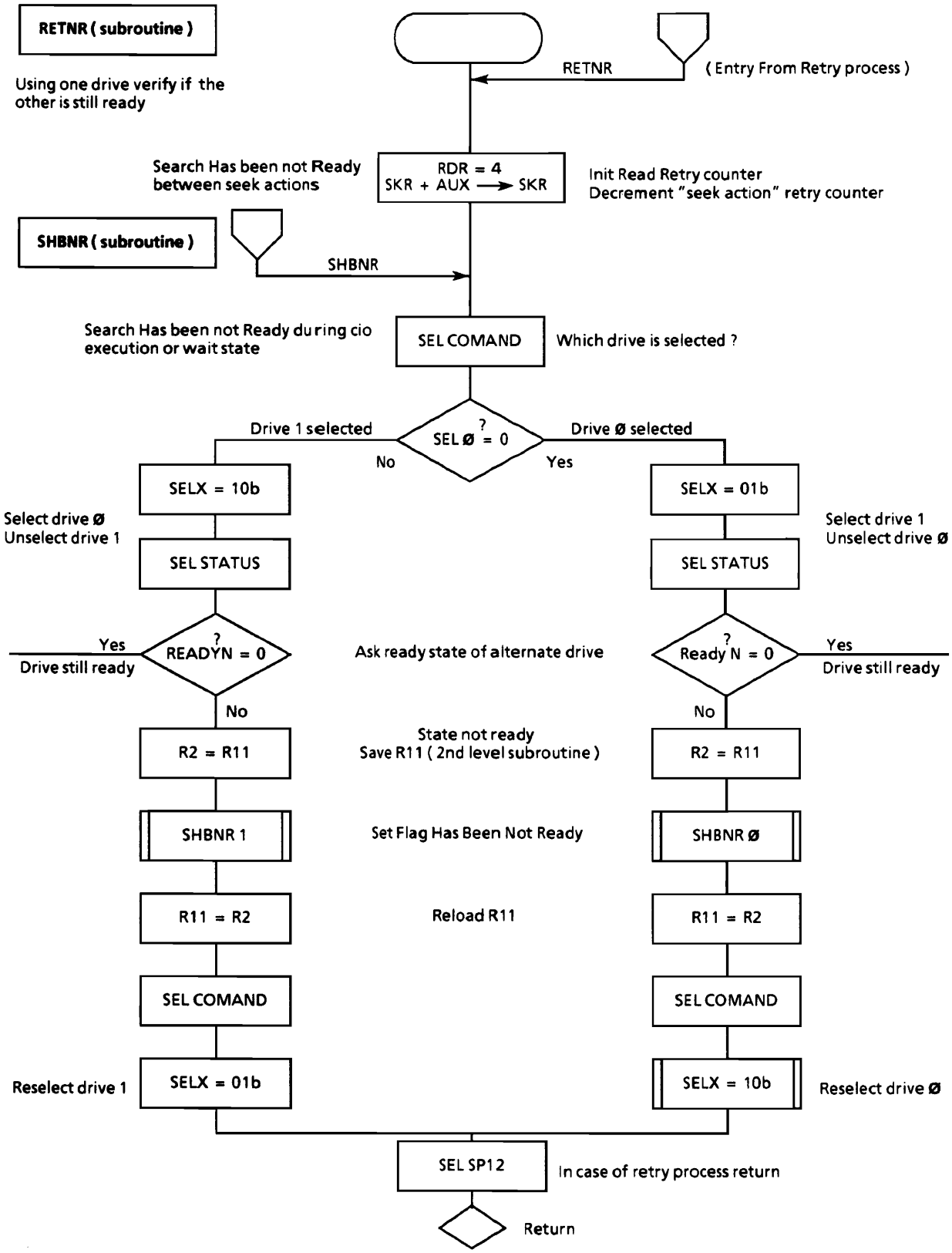

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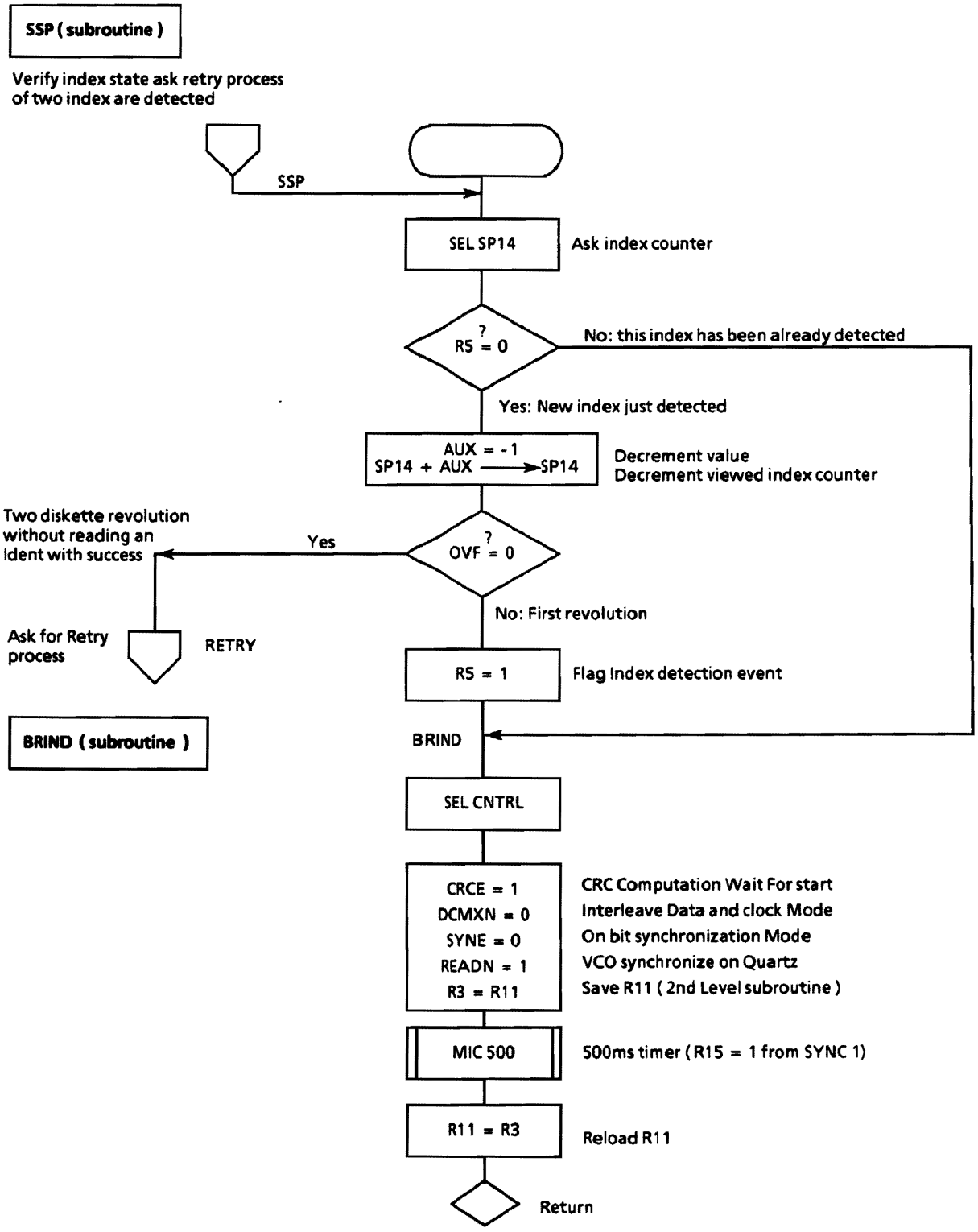

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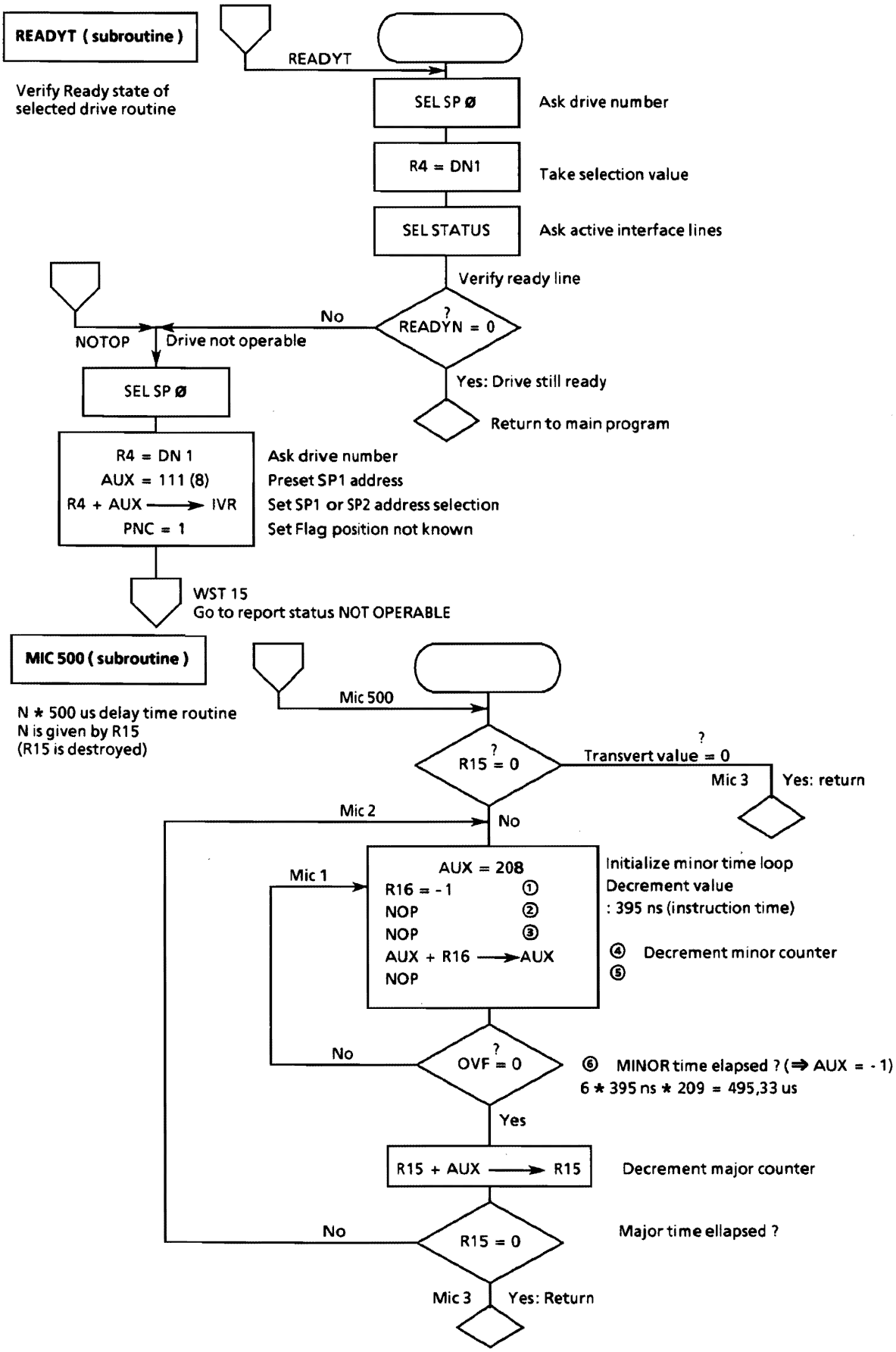

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4 DIAGRAMS

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	4.2	Microprocessor and Bus Transceivers	4-5
	4.3	Disc Drive Control Logic	4-7

Note: *There are two versions:*

MIFZ	*(old version)*	*5111 199 49920*
MIFZ - CMS	*(Surface Mounted Components - SMC - version)*	*5111 199 49160*

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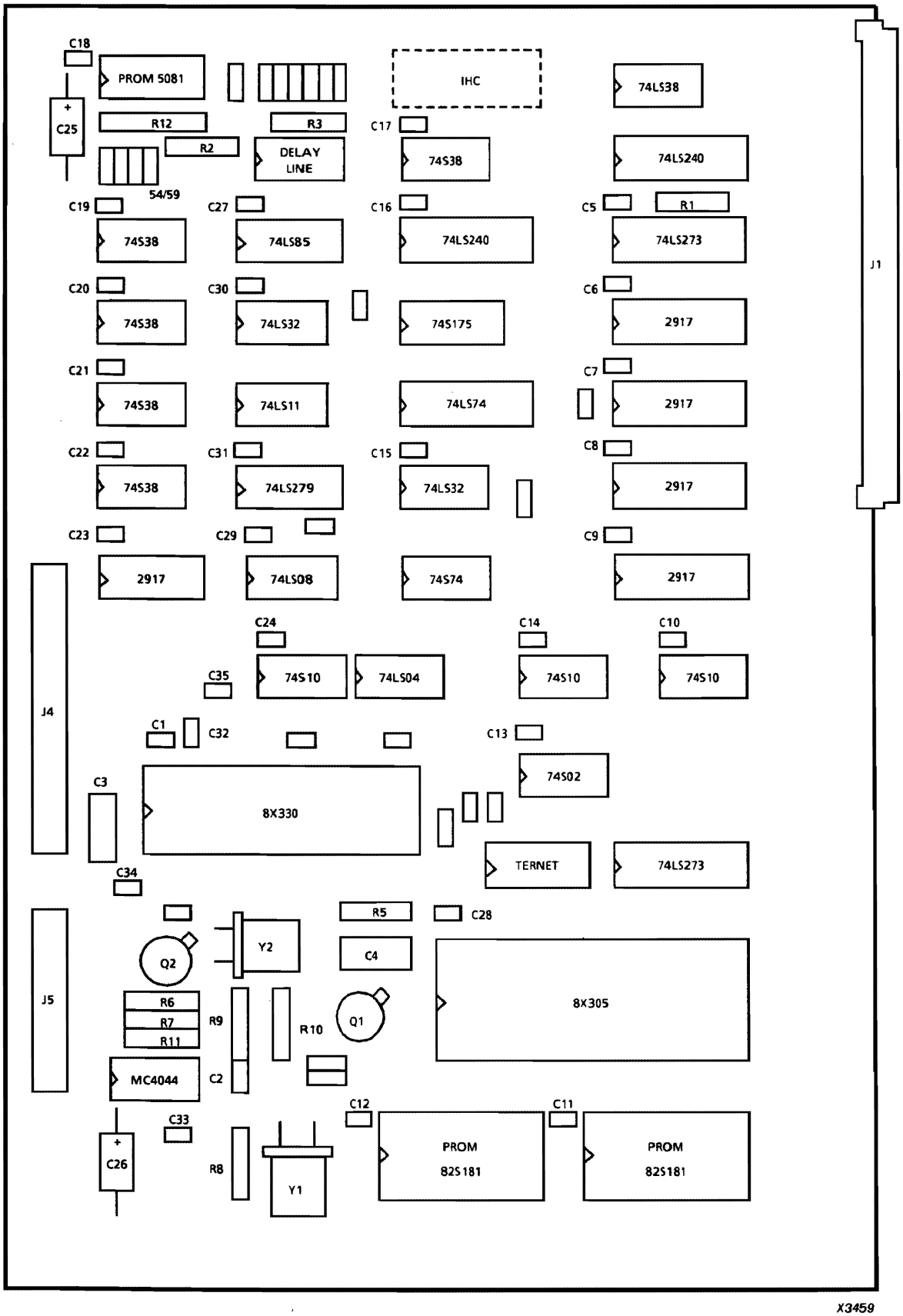
MIFZ version 5111 199 49920



X3459

For MIFZ - CMS 5111 199 49160, standard IC's are applied, but passive components are replaced by "Surface Mounted Components".

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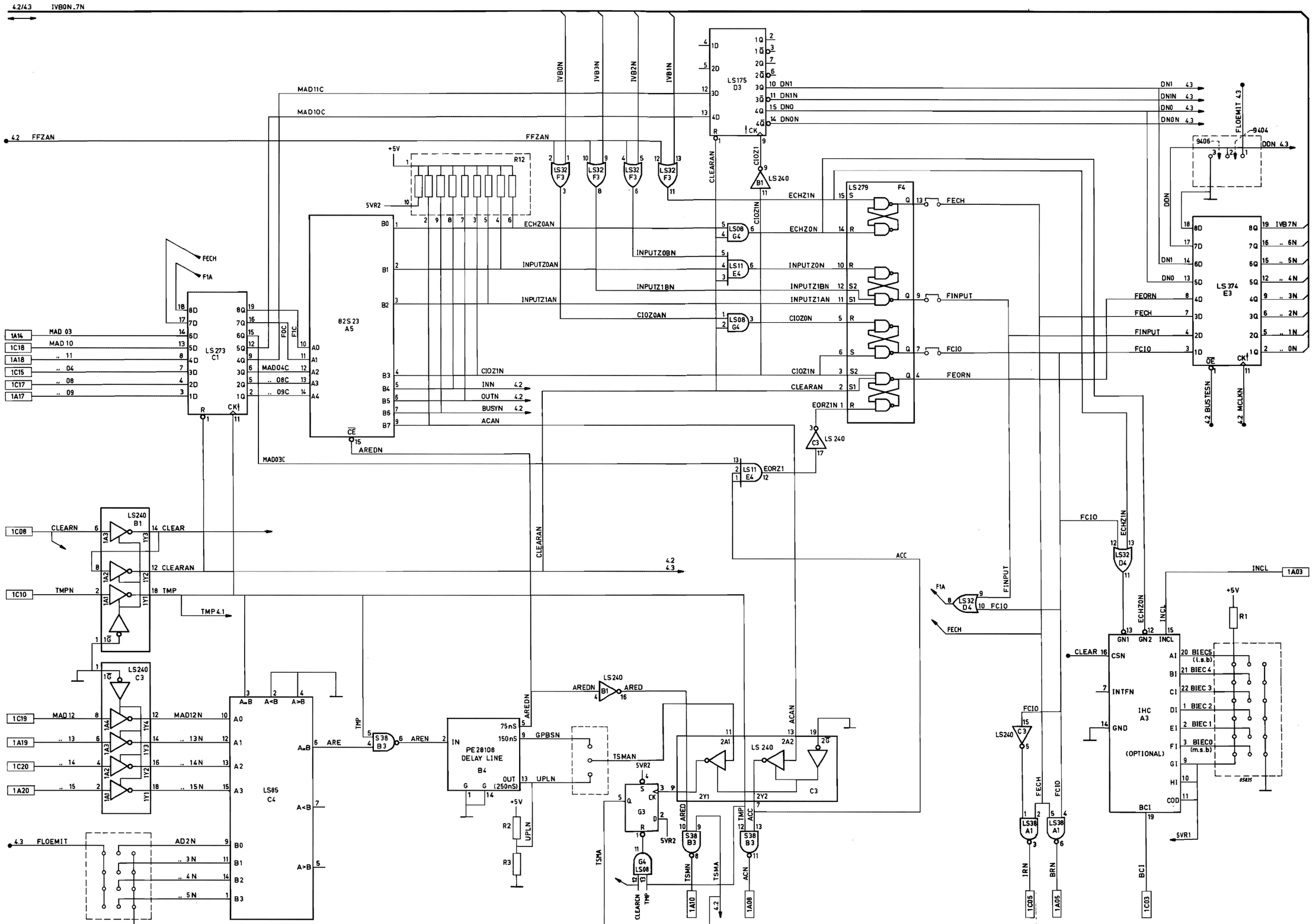

Figure 4.1 Address / Command Decode and Break / Interrupt Logic

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Figure 4.2 Microprocessor and Bus Transceivers

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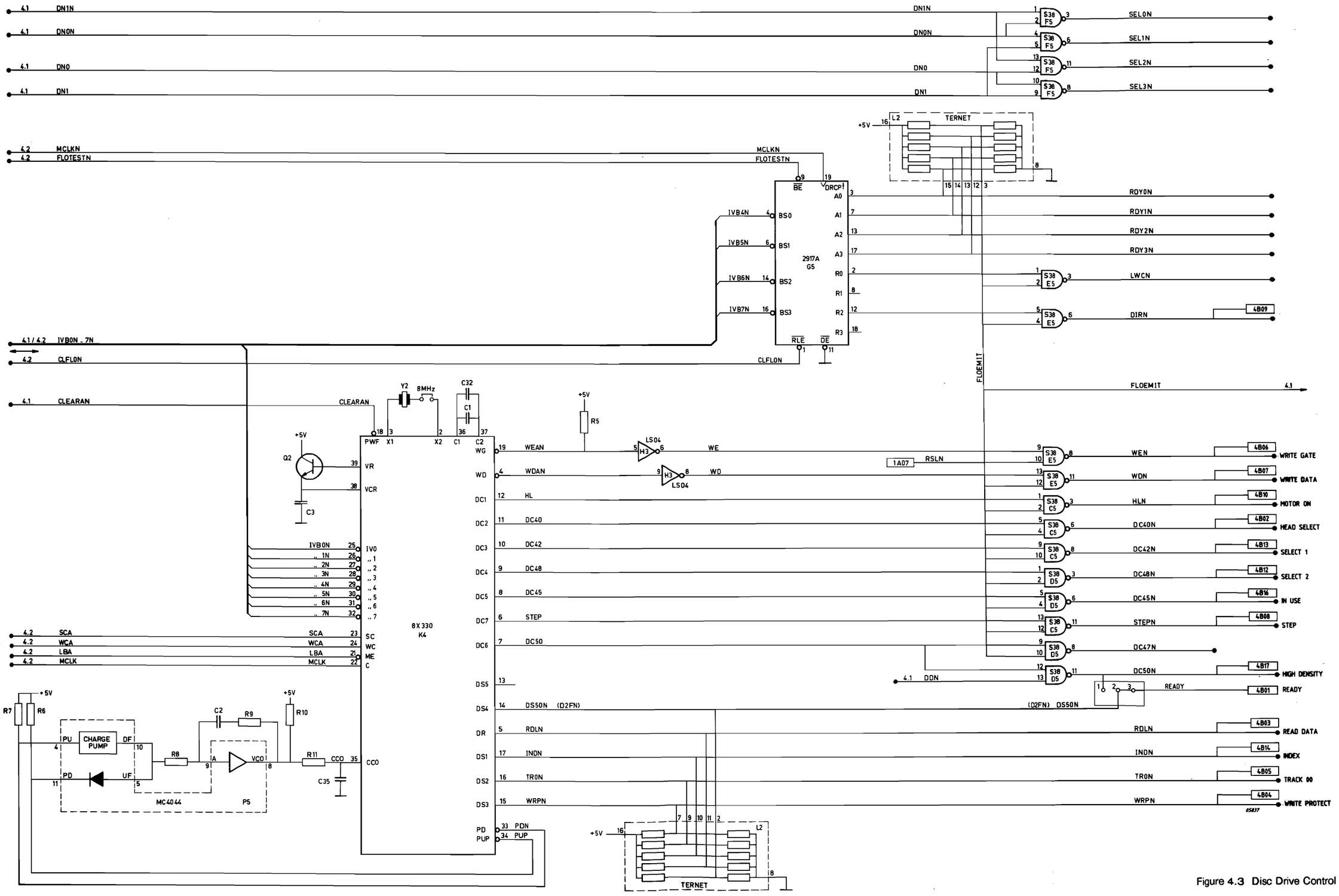

Figure 4.3 Disc Drive Control Logic

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5 MICROPROGRAM

			Page
Section	5.1	M1FZ 9743/9753	5-1

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```
                        ************************************************
                        *                                              *
                        *        INITIALIZATION  AFTER  POWER  ON      *
                        *                                              *
                        ************************************************
                        *
                                ORG     0
                        *
                        *MANAGE INITIAL STATE OF ACTIVE OUTPUT REGISTERS
                        *
0000    CF5C                    SEL     COMAND          SET FOR 360 RPMN
0001    CB04                    XMR     00000100B
0002    CF5A                    SEL     CNTRL           VCO LOCK ON CRISTAL
0003    DB8F                    XMIT    1111B,33H,4
0004    CF5B                    SEL     MODE
0005    CB41                    XMR     01000001B       8 MHZ
0006    CF48                    SEL     SP0             BOTH DRIVES NOT OPERATIONNAL
0007    CB0C                    XMR     00001100B
0008    CF49                    SEL     SP1             HEAD POSITION
0009    D821                    XMIT    1,PNC           DRIVE 0 NOT KNOWN
000A    CF4A                    SEL     SP2             HEAD POSITION
000B    D821                    XMIT    1,PNC           DRIVE 1 NOT KNOWN
000C    CF4B                    SEL     SP3             DEFAULT FORMAT
000D    CB00                    XMR     00000000B       ECMA 99, BOTH DRIVE
000E    CF52                    SEL     SP10            RESET SKEW PARAMETER DRIVE 0,
000F    CB00                    XMR     00000000B       FT0 AND BDC0
0010    CF53                    SEL     SP11            RESET SKEW PARAMETER DRIVE 1,
0011    CB00                    XMR     00000000B       FT1 AND BDC1


                        ************************************************
                        *                                              *
                        *        SCANNING  :  MOTOR ON HANDLING        *
                        *                     AND WAIT FOR A COMMAND   *
                        *                                              *
                        ************************************************
                        *
                        *LOOP WHERE READY AND INDEX SIGNALS ARE SCANNED
        0012    SCAN    EQU     *
0012    CF57            SEL     SP15
0013    CB00            XMR     00000000B       RESET COMAND TYPE REGISTER
0014    CF4E            SEL     SP6             RESET COMAND SECTOR NUMBER
0015    CB00            XMR     00000000B       AND FLAGS
0016    CF4D            SEL     SP5             RESET OPERATION STATE FLAGS
0017    CB00            XMR     00000000B
0018    CF4C            SEL     SP4             RESET LAST READ IDENTIFIER
0019    CB00            XMR     00000000B       AND INTERLACE SCRATCH INFO
001A    CF54            SEL     SP12            INIT RETRY COUNTERS TO 4
001B    CB44            XMR     01000100B
001C    CF50            SEL     SP8             RESET ID READ CYLINDER
001D    CB00            XMR     00000000B       INFORMATION
001E    CF51            SEL     SP9             RESET REMAINING ID READ
001F    CB00            XMR     00000000B       INFORMATIONS
                        *
0020    CF5C    SCANX   SEL     COMAND          ->RIGHT BANK
0021    C7FE            SEL     TEST            ->LEFT BANK
0022    B825            NZT     MOTOR,SCAN1      MOTOR ON ?
0023    B023    SCAN0   NZT     CION,SCAN0       CIO COMAND?
0024    E048            JMP     DECOD            YES DECODE IT
                        *MOTOR IS STILL ALREADY ON ,BUT THERE IS NO MORE CIO. WE KEEP
                        *MOTOR ON ,AND MANAGE READY STATE OF BOTH DRIVES,UNTILL
                        *40 SECONDS ELAPSES.
0025    C300    SCAN1   XMIT    0,R3             ALTERNATE DRIVE HBNR FLAG RESET
0026    C600            XMIT    0,R6             RESET ROTATIONNAL COUNTER
0027    C501            XMIT    1,R5             RESET INDEX DETECTION FLAG
0028    C001            XMIT    1,AUX            INCREMENT COUNTER VALUE
0029    CF5D    SCAN2   SEL     STATUS           LAST SELECTED DRIVE
002A    BA36            NZT     READYN,SCAN5     STILL READY ?
002B    CF5A            SEL     CNTRL            YES,SO CHECK INDEX SIGNAL
002C    1F22            MOVE    INDN,R2          TO MANAGE ROTATIONNAL COUNTER
002D    A231            NZT     R2,SCAN4         INDEX SIGNAL ACTIVE ?
002E    A531            NZT     R5,SCAN4         YES,ALREADY ENCOUNTERED ?
002F    2606            ADD     R6,R6            NO,INCREMENT ROTATE COUNTER
0030    A842            NZT     OVF,SCAN3        COUNT OUT ? 40 S ELAPSED.
0031    6205    SCAN4   XOR     R2,R5            RESET R5: INDEX EVENT FLAG
0032    C900            CALL    SHBNR            SEE IF ALTERNATE DRIVE READY
0033    E732
0034    B029            NZT     CION,SCAN2       PRESENT CIO COMAND ?
0035    E048            JMP     DECOD            YES DECODE IT.
                        *
                        *MANAGING SPECIAL CASES OF SCAN ROUTINE
                        *
                        *->LAST SELECTED DRIVE WAS FOUND NOT READY,WHAT ABOUT THE ALTERNATE ?
```


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```
0036  A342        SCAN5   NZT     R3,SCAN3            ALTERNATE WAS NOT READY TOO ?
0037  C301                XMIT    1,R3                NO ,FLAG THIS EVENT
0038  CF5C                SEL     COMAND              AND SCAN THE ALTERNATE DRIVE
0039  BA3E                NZT     SEL0,SCAN6          DRIVE 1 SELECTED ?
003A  DB42                XMIT    10B,SELX            YES, SELECT DRIVE 0
003B  C901                CALL    SHBNR1              MANAGE FLAGS HBNR1,NOTOP1
003C  E72B
003D  E029                JMP     SCAN2               NOW SCAN DRIVE 0.
003E  DB41          SCAN6 XMIT    01B,SELX            SELECT DRIVE 1
003F  C902                CALL    SHBNR0              MANAGE FLAGS HBNR0,NOTOP0
0040  E726
0041  E029                JMP     SCAN2               AND NOW SCAN DRIVE 1.
                    *
                    *THE TWO DRIVES WERE SCANNED NOT READY BEFORE 40 S TIME ELAPSE
                    *OR 40 S WERE TIME-OUT.
0042  CF5C          SCAN3 SEL     COMAND              UNLOAD THE
0043  DC20                XMIT    0B,INUSE            TWO DRIVE'S HEADS
0044  D820                XMIT    0B,MOTOR            SWITCH OFF BOTH MOTORS
0045  C903                CALL    SHBNRX              MANAGE NOTOPX HBNRX FLAGS
0046  E71F
0047  E020                JMP     SCANX               LOOP ON SCANNING CIO EVENT.
```

```
                    ************************************************
                    *                                              *
                    *        DECODING  ; VERIFICATION OF COMMANDS  *
                    *                                              *
                    ************************************************
                    *
                    *DECODE AND MANAGE CIO COMMANDS
                    *
0048  C904          DECOD CALL    CODOK               CHECK ACCEPTANCE OF CIO
0049  E6DE
                    *CIO ,ACCORDING TO HBNRX FLAGS,IS ACCEPTED IN DECODING.
004A  C7F7                SEL     BIL                 BIO INPUT MSB
004B  1124                MOVE    21H,1,R4            HEAD NB/ OF COMMAND IN R4
004C  1542                MOVE    25H,2,R2            BIO 4-5 IN R2
004D  CF4F                SEL     SP7
004E  C0FF                XMIT    -1,AUX              ONE COMPLEMENT VALUE
004F  771F                XOR     BIL,SP7             BIO/ MSB-->SP7
0050  1F21                MOVE    37H,1,R1            SP7 BIT 7 IN R1
0051  0141                MOVE    R1(2),R1            IN BIT POSITION 1
0052  C7FB                SEL     BIR                 BIO INPUT LSB
0053  C002                XMIT    10B,AUX             MASK BIT 14
0054  5700                AND     BIR,AUX             SEARCH FOR FORMAT CIO
0055  A059                NZT     AUX,OLD
0056  C001                XMIT    01B,AUX             MASK BIT 15
0057  5700                AND     BIR,AUX             SEARCH FOR FORMAT CIO
0058  A05C                NZT     AUX,NOTEST
0059  C0B2          OLD   XMIT    10110010B,AUX       MASK BIO 1-4-5-7
005A  5F00                AND     SP7,AUX             ZEROS IN BIT VALUES ?
005B  A068                NZT     AUX,BUG             ELSE ERROR.
005C  C7FB          NOTEST SEL    BIR
005D  C03F                XMIT    77H,AUX             MASK BITS 2-3-4-5-6-7
005E  75C0                XOR     25H,6,AUX           LSB BIO X-X-8-9-10-11-12-13
005F  2103                ADD     R1,R3               BIO X-7-8-9-10-11-12-13
0060  02C2                MOVE    R2(6),R2            BIO/ 4-5 IN BIT4-5
0061  1740                MOVE    27H,2,AUX           BIO/ 14-15
0062  2202                ADD     R2,R2               BIO/ 4-5-14-15
0063  CF57                SEL     SP15                CIO COMAND REGISTER
0064  827B                XEC     TBDEC(R2)           RECOGNISE CIO
                    *IT IS ASSUME HERE THAT CIO IS ONE OF WRITE,WRITE DDAM,READ,
                    *READ SKIP DDAM,VERIFY,SO CYLINDER POSITION MUST BE KNOWN.
0065  C001                XMIT    1,AUX               INCREMENT VALUE
0066  2303                ADD     R3,R3               TO FIT IBM SECTOR NUMBER
0067  A369                NZT     R3,NOBUG            ZERO VALUE ?
0068  E3CE          BUG   JMP     WST11               YES,-->ERROR.
0069  CF48          NOBUG SEL     SP0
006A  C049                XMIT    73,AUX              SP1 @
006B  394F                ADD     DNX,R17             SP1-2 @
006C  B828                NZT     PNC,BUG             POSITION KNOWN ?
006D  1F02                MOVE    RIV,R2              YES,R2 WORKING REGISTER
006E  CF4F                SEL     SP7                 ON ACTUAL CYLINDER
006F  021F                MOVE    R2,SP7
0070  CF4E                SEL     SP6                 STORE FIRST SECTOR
0071  031F                MOVE    R3,SP6              OF COMMAND
```


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```
                        *CHECK NOW SECTOR NUMBER ACCORDING TO FORMAT SET.
0072    CF48                    SEL     SP0                     REQUESTED DRIVE ?
0073    B937                    NZT     DN1,DEV1                DEVICE 0 ?
0074    CF4B                    SEL     SP3                     :DRIVE 0.
0075    1A40                    MOVE    SETF0,AUX               TAKE FORMAT 0
0076    E079                    JMP     FEAT1
0077    CF4B            DEV1    SEL     SP3                     :DRIVE 1.
0078    1D40                    MOVE    SETF1,AUX               TAKE FORMAT 1
0079    808B            FEAT1   XEC     PARM1(AUX)              ASK FOR HIGHER SECTOR NUMBER
007A    E09E                    JMP     VERCOM                  CARRY ON VERIFYING THE COMAND
                        *DECODING TABLE OF COMMAND INFORMATION
                        *
007B    E3CE            TBDEC   JMP     WST11                   CODE ERROR
007C    E454                    JMP     WRIFOR                  COMMAND WRITE FORMAT
007D    E3CE                    JMP     WST11                   CODE ERROR
007E    E3E3                    JMP     WSTOK                   COMMAND LOCK
007F    E3CE                    JMP     WST11                   CODE ERROR
0080    E3CE                    JMP     WST11                   CODE ERROR
0081    DB21                    XMIT    1,33H,1                 SET BIT 3 OF SP15  WRITE DDAM
0082    DE21                    XMIT    1,36H,1                 SET BIT 6 OF SP15  READ SKIP DDA
0083    E3CE                    JMP     WST11                   CODE ERROR
0084    E3CE                    JMP     WST11                   CODE ERROR
0085    DD21                    XMIT    1,35H,1                 SET BIT 5 OF SP15  VERIFY
0086    E3E3                    JMP     WSTOK                   COMMAND UNLOCK
0087    E093                    JMP     SEEK                    COMMAND SEEK
0088    E410                    JMP     FORSET                  COMMAND SET FORMAT
0089    DC21                    XMIT    1,34H,1                 SET BIT 4 OF SP15  WRITE
008A    DF21            ENDTB   XMIT    1,37H,1                 SET BIT 7 OF SP15  READ
                        *
                        *TABLE CONTAINING COMPLEMENTARY MAXIMUM VALUE NUMBER
                        *OF SECTORS IN A SET FORMAT.
008B    C0E5            PARM1   XMIT    229,AUX                 FORMAT 0:255-26
008C    C0F0                    XMIT    240,AUX                 FORMAT 1:255-15
008D    C0F6                    XMIT    246,AUX                 FORMAT 2:255-9
008E    C0F7            EPAR1   XMIT    247,AUX                 FORMAT 3:255-8
                        *
                        *TABLE CONTAINING COMPLEMENTARY MAXIMUM VALUE NUMBER
                        *OF TRACKS IN A SET FORMAT.
008F    C0B0            PARM2   XMIT    176,AUX                 FORMAT 0:255-79
0090    C0B0                    XMIT    176,AUX                 FORMAT 1:255-79
0091    C0D8                    XMIT    216,AUX                 FORMAT 2:255-39
0092    C0D8            EPAR2   XMIT    216,AUX                 FORMAT 3:255-39
                        *
                        *SEEK COMMAND :VERIFY CYLINDER NUMBER ACCORDING TO THE FORMAT SET.
                        *
0093    DA21            SEEK    XMIT    1B,32H,1                SET BIT SEEK IN COMAND REGISTER
0094    CF4F            BLIND   SEL     SP7                     SEEK ENTRY WHEN FORMATING
0095    031F                    MOVE    R3,SP7                  STORE REQUESTED CYLINDER NUMBER
0096    CF48                    SEL     SP0                     WHICH DRIVE ?
0097    B93B                    NZT     DN1,DEV21
0098    CF4B                    SEL     SP3                     : DRIVE 0.
0099    1A40                    MOVE    SETF0,AUX               FORMAT VALUE
009A    E09D                    JMP     FEAT2
009B    CF4B            DEV21   SEL     SP3                     :DRIVE 1

009C    1D40                    MOVE    SETF1,AUX               FORMAT VALUE
009D    808F            FEAT2   XEC     PARM2(AUX)
                        *
                        *TEST SECTOR VALUE OR CYLINDER VALUE OF COMMAND.
009E    2303            VERCOM  ADD     R3,R3                   VALUE+MAX COMPLEMENT VALUE
009F    A87B                    NZT     OVF,TBDEC               IF OVERVALUE ERROR
                        *IN CASE OF READ/WRITE SELECT THE NEEDED HEAD.
00A0    CF5C                    SEL     COMAND                  INTERFACE DRIVERS
00A1    D920                    XMIT    0,H1SEL                 PRESELECT HEAD 0
00A2    A4A4                    NZT     R4,OFACE                WHICH HEAD ?
00A3    D921                    XMIT    1,H1SEL                 SELECT HEAD 1
                        *100 US MIN DELAY TIME,AFTER SWITCHING HEADS,FOR ANY READ/WRITE COMMAND.
        00A4            OFACE   EQU     *
                        *LOOK FOR WRITE PROTECTED DISKETTE AND WRITE TYPE COMMAND.
00A4    C0A7                    XMIT    10100111B,AUX           MASK FOR WRITE TYPE COMMAND
00A5    CF57                    SEL     SP15                    COMAND TYPE REGISTER
00A6    5F00                    AND     SP15,AUX                VERIFY WRITE TYPE COMMAND
00A7    A0B4                    NZT     AUX,COMOK
00A8    CF48                    SEL     SP0                     :WRITE TYPE COMMAND
00A9    B92D                    NZT     DN1,DEV31               WHICH DRIVE ?
00AA    CF4B                    SEL     SP3                     :DRIVE 0.
00AB    1A40                    MOVE    SETF0,AUX               WHICH FORMAT SET ?
00AC    E0AF                    JMP     FEAT3                   IS IT FORMAT 0 ?
00AD    CF4B            DEV31   SEL     SP3                     :DRIVE 1.
00AE    1D40                    MOVE    SETF1,AUX               WHICH FORMAT SET ?
00AF    A0B3            FEAT3   NZT     AUX,ERR11               ONLY FORMAT 0 WRITE-AVAILABLE
00B0    CF5D                    SEL     STATUS                  :IT IS FORMAT 0.
00B1    B934                    NZT     31H,1,COMOK             PROTECTED DISKETTE ?
00B2    E3F4                    JMP     WST07                   YES,SIGNAL IT.
00B3    E3CE            ERR11   JMP     WST11                   PROGRAM ERROR
```


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```
                        *COMMAND INFORMATION VALUES ARE CORRECT:WE MANAGE THE MOTOR SPEED
                        *AND THE QUARTZ FREQUENCY.
00B4    CF48            COMOK   SEL     SP0
00B5    B93C                    NZT     DN1,DEV41               WHICH DRIVE ?
00B6    CF4B                    SEL     SP3                     :DRIVE 0
00B7    1920                    MOVE    TF0,AUX                 ASK MSB OF SETF0
00B8    CF5C                    SEL     COMAND
00B9    7D20                    XOR     HIDEN,AUX               COMPARE THE DENSITY IN STATE
00BA    A0CF                    NZT     AUX,MOTON               IDEM ?IF NOT,SEE IF MOTOR ON
00BB    E0C1                    JMP     COMUT                   YES,COMUTE THE ACTUAL SPEED
00BC    CF4B            DEV41   SEL     SP3                     :DRIVE 1
00BD    1C20                    MOVE    TF1,AUX                 ASK MSB OF SETF1
00BE    CF5C                    SEL     COMAND
00BF    7D20                    XOR     HIDEN,AUX               COMPARE THE DENSITY IN STATE
00C0    A0CF                    NZT     AUX,MOTON               IDEM ?IF NOT,SEE IF MOTOR ON
                        *                                       YES,COMUTE THE ACTUAL SPEED
                        *COMUTE MOTOR SPEED AND CRISTAL FREQUENCY DIVIDER.
00C1    CF5C            COMUT   SEL     COMAND
00C2    BD27                    NZT     HIDEN,VIT0              WHICH SPEED ?
00C3    DD21                    XMIT    1B,HIDEN                SWITCH TO 360 RPMN
00C4    CF5B                    SEL     MODE                    VCO LOCK ON QUARTZ(WGE=1)
00C5    CB41                    XMR     01000001B               8 MHZ FREQUENCY
00C6    E0CA                    JMP     ONTOM                   HANDLE MOTOR TIME
00C7    DD20            VIT0    XMIT    0B,HIDEN                SWITCH TO 300 RPMN
00C8    CF5B                    SEL     MODE                    VCO LOCK ON QUARTZ(WGE=1)
00C9    CB40                    XMR     01000000B               4 MHZ FREQUENCY
                        *                                       HANDLE MOTOR TIME
                        *WE HAD COMUTED DENSITY,IF MOTOR WAS ON: WAIT 400 MS MAX.
00CA    CF5C            ONTOM   SEL     COMAND
00CB    B82D                    NZT     MOTOR,POT               MOTOR ON ?
00CC    E0D1                    JMP     STARTR                  NO,GO TO START ROTATION
00CD    C40A            POT     XMIT    10,R4                   YES,400 MS INSTEAD OF 500 MS
00CE    E0D4                    JMP     WAITOP                  400 MS TIME-OUT FOR READY.
                        *SPEED DIDN'T NEED TO COMUTE,CHECK IF MOTOR IS ON.
00CF    CF5C            MOTON   SEL     COMAND                  MOTOR ON ?
00D0    B83E                    NZT     MOTOR,TOP               IF ON, CHECK READY SIGNAL
00D1    D821            STARTR  XMIT    1B,MOTOR                SET MOTOR ON,
00D2    DC21                    XMIT    1B,INUSE                LOAD ON HEADS.
00D3    C410                    XMIT    16,R4                   500 MS TIME OUT FOR READY.
                        *WAIT 500 MS IF MOTOR WAS OFF,400 MS IF MOTOR WAS ON BUT SPEED COMUTED.
                        *ANYWAY READY STATUS IS CHECKED EVERY 50 MS STEP,IN ORDER TO SEE IF
                        *DRIVE IS READY BEFORE TIME OUT.
00D4    CD64            WAITOP  XMIT    100,R15                 100*500 US
00D5    C905                    CALL    MIC500                  WAITING ROUTINE
00D6    E702
00D7    2404                    ADD     R4,R4                   (AUX=-1 WHEN RETURN)
00D8    CF5D                    SEL     STATUS
00D9    BA3B                    NZT     READYN,WAIT             IS READY SIGNAL ACTIVE ?
00DA    E0E1                    JMP     COMEX                   YES,EXECUTE COMAND.
00DB    A4D4            WAIT    NZT     R4,WAITOP               NO,CAN WE STILL WAIT ?
00DC    C906            NOP     CALL    NOTOP                   TIME-OUT:DRIVE NOT OPERATIONNAL
00DD    E6FC
                        *MOTOR WAS ON,NO SPEED COMUTED: JUST CHECK READY SIGNAL.
00DE    CF5D            TOP     SEL     STATUS
00DF    BA3C                    NZT     READYN,NOP              IF READY INACTIVE:SEND NOTOP
00E0    E0E1                    JMP     COMEX                   READY SIGNAL ACTIVE:OK
                        *DRIVE IS READY,ASK IF SEEK NEEDED,UNLESS CATCH IDENTIFIER.
00E1    C907            COMEX   CALL    FLANOP                  RELEASE NOTOP0 OR NOTOP1 FLAG.
00E2    E7A7
00E3    CF57                    SEL     SP15                    COMMAND TYPE REGISTER
00E4    BA27                    NZT     32H,1,TRIP              SEEK WANTED ?
00E5    B927                    NZT     31H,1,TRIP              SEEK FOR FORMAT ?
00E6    E1D5                    JMP     SID1                    NO,START IDENTIFIER RESEARCH.
                        *SEEK REQUESTED,INIT OPERATION,ASK STARTING POSITION.
00E7    C049            TRIP    XMIT    111H,AUX                SP1@
00E8    CF48                    SEL     SP0                     WHICH DRIVE ?
00E9    392F                    ADD     DN1,R17                 SELECT SP1 OR SP2.
00EA    1F06                    MOVE    RIV,R6                  ASK STARTING SEEK CYLINDER.
00EB    E100                    JMP     SKNORM                  OPERATE NORMAL SEEK.

                        ****************************************
                        *                                      *
                        *       SEEK : EXECUTE SEEK            *
                        *                                      *
                        *                                      *
                        ****************************************
                        *
                        *EXECUTE STEP ACTIONS TO SEEK TO THE DESIRE TRACK:ONE PHYSICAL TRACK AT
                        *FOR 96 TPI,TWO PHYSICAL TRACKS AT A TIME FOR 48 TPI.
                                ORG     100X
0100    C300            SKNORM  XMIT    0,R3                    RESET ACTION HEAD FLAG
0101    CF4D            MORESK  SEL     SP5                     (RETURN TO ORIGINATE IN RETRY)
0102    DC41                    XMIT    01B,FSK                 RESET SEEK FLAGS TO NORMAL
0103    CF4F                    SEL     SP7                     CIO WANTED CYLINDER
0104    1FE4                    MOVE    37H,7,R4                WORKING VALUE WITHOUT RETRY FLAG
0105    C080                    XMIT    10000000B,AUX           PNC MASK
0106    4600                    AND     R6,AUX                  SEE IF TRACK POSITION KNOWN
0107    A028            SKSTEP  NZT     AUX,SEEK0               IF NOT-->SEEK TO 0.
0108    A40A                    NZT     R4,COMPAR               TRACK 0 WANTED ?
0109    E128                    JMP     SEEK0                   YES,HANDLE INCONDITIONNAL SEEK.
```


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```
                        *COMPARE CURRENT TRACK POSITION WITH THE WANTED ONE.
                        *R6 CURRENT POSITION (FROM SP1 OR SP2),FLAG PNC=0 HERE.
                        *R4 WANTED POSITION (FROM SP7).
010A    C0FF    COMPAR  XMIT    11111111B,AUX       ONE'S COMPLEMENT VALUE
010B    6600            XOR     R6,AUX              COMPLEMENT R6
010C    2400            ADD     R4,AUX              COMPARE POSITIONS
010D    A822            NZT     OVF,SUPER           WANTED TRACK>CURRENT TRACK
010E    C101            XMIT    1,R1                INCREMENT VALUE
010F    2100            ADD     R1,AUX              WANTED TRACK OBTAINED ?
0110    A025            NZT     AUX,INFER           IF NOT 0-->WANTED<CURRENT
                        *OK NEEDED TRACK OBTAINED.
0111    CF4D            SEL     SP5
0112    BC34            NZT     FSKN,SETTLE         NORMAL SEEK ?
0113    E101            JMP     MORESK              NO,RETRY SEEK:CONTINUE PROCESS
0114    A316    SETTLE  NZT     R3,STABIL           SEEK ACTION HAS BEEN NECESSARY ?
0115    E119            JMP     ENDSK               NO,SO STABILISATION NOT NEEDED.
                        *SETTLE TIME FOR HEAD STABILISATION,WHEN SEEKS FINISHED.
0116    CD28    STABIL  XMIT    40,R15              SET 20 MS
0117    C908            CALL    MIC500              FOR HEAD STABILISATION.
0118    E702
                        *SEEKS COMPLETELY FINISHED.
0119    CF4F    ENDSK   SEL     SP7
011A    B83F            NZT     RTRY,TRACE          IF RETRY,GO ON PROCESS.
011B    CF57            SEL     SP15                COMMAND REGISTER
011C    B93E            NZT     31H,1,WRITFT        FORMAT COMMAND ?
011D    E1D5            JMP     SID1                IF NOT SEARCH FIRST IDENTIFIER.
011E    E477    WRITFT  JMP     ALGO
011F    CF4F    TRACE   SEL     SP7
0120    D820            XMIT    0B,RTRY             PERFORM 2ND PHASE OF RETRY .
0121    E1EE            JMP     SYNCO               TRY TO FINISH PROCESS.
                        *WANTED TRACK NUMBER >CURRENT TRACK NUMBER==>SEEK INNER
0122    C101    SUPER   XMIT    1,R1                INCREMENT VALUE
0123    C201            XMIT    1,R2                SET DIRECTION FLAG INNER
0124    E12B            JMP     INISTE              OPERATE SEEK ACTION
                        *WANTED TRACK NUMBER <CURRENT TRACK NUMBER ;OR INCONDITIONNAL SEEK
                        *TO TRACK 0 REQUESTED,ANYWAY SEEK OUTER.
        0125    TSTRO   EQU     *                   ENTRY TO FORCED SEEK TO TRACK 0
0125    C1FF    INFER   XMIT    -1,R1               DECREMENT VALUE
0126    C200            XMIT    0,R2                SET DIRECTION FLAG OUTER
0127    E12B            JMP     INISTE              OPERATE SEEK ACTION
                        *INCONDITIONNAL SEEK TO TRACK 0 INITIALISATION.
0128    CF4D    SEEKO   SEL     SP5                 OPERATION STATE REGISTER
0129    DB21            XMIT    1,FSTRO             FLAG EVENT:BLIND SEEK TO 0
012A    E125            JMP     TSTRO               OPERATE SEEKS.
                        *EXECUTE SEEK AFTER COMPARING POSITIONS.
012B    C7DF    INISTE  SEL     FL0                 LEFT BANK OUTPUTS.
012C    0236            MOVE    R2,DIR              SET DIRECTION SIGNAL.
                        *0.8 US DELAY TIME BEFORE ISSUING FIRST STEP ACTION.
                        *(OK:WITH NUMBER OF INSTRUCTIONS)
012D    CF4D            SEL     SP5
012E    1A20            MOVE    FDIR,AUX            RECALL OLD DIR VALUE
012F    023A            MOVE    R2,FDIR             STORE NEW DIRECTION
0130    6200            XOR     R2,AUX              COMPARE OLD/NEW DIR
0131    4300            AND     R3,AUX              IF NO SEEK DONE,NO MATTER
0132    A038            NZT     AUX,WAITST          IF #DIR,WAIT 11 MS.
                        *BEFORE ISSUING STEP ACTION,CHECK TRACK 0 DETECTOR.
0133    CF5D    SETDIR  SEL     STATUS
0134    B837            NZT     TR0N,STEPXA          TRACK 0 SIGNAL ACTIVE ?
                        *TRACK 0 SIGNAL ACTIVE HERE.IF DIRECTION SET INNER GO ON.
                        *IF DIRECTION SET OUTER:OPERATION TERMINATED OR SEEK TO 0
                        *PART OF RETRY PROCESS.
0135    A237            NZT     R2,STEPXA            SET INNER,SO GO ON.
0136    E13C            JMP     TSTRY               VERIFY RETRY FLAG.
0137    E142    STEPXA  JMP     STEPX
                        *DELAY TIME BEFORE SEEKING IN THE OPPOSITE DIRECTION.
0138    CD16    WAITST  XMIT    22,R15              11 MS DELAY
0139    C909            CALL    MIC500              WAITING ROUTINE
013A    E702
013B    E133            JMP     SETDIR              SET INIT AND VERIFY.
                        *IN CASE OF RETRY PROCESS ...
013C    CF4D    TSTRY   SEL     SP5                 OPERATION STATE REGISTER
013D    BC3F            NZT     FSKN,NOTRTY         RETRY PROCESS ?
013E    0604            MOVE    R6,R4               YES,SAVE PREVIOUS CURRENT CYLIND
013F    C600    NOTRTY  XMIT    0B,R6               WE ARE ON TRACK 0
0140    DC41            XMIT    01B,FSK             RESET SEEK FLAGS TO NORMAL.
0141    E10A            JMP     COMPAR              CHECK IF FINISHED.
                        *SEEK MONITORING:IF 96 TPI =>ONE STEP,IF 48 TPI (ID 300 RPMN)
                        * -->TWO STEP,UNLESS FSTRO=1(PNC=1 OR TRACK 0 WANTED)-->ONE STEP.
0142    C301    STEPX   XMIT    1,R3                FLAG ACTION EVENT.
0143    CF5C            SEL     COMAND              ACTIVE SIGNAL REGISTER.
0144    DE21            XMIT    1B,STEP             STEP SIGNAL ON.
0145    CD01            XMIT    1,R15               SET 500 US DELAY TIME
0146    C90A            CALL    MIC500              TIMING LOOP
0147    E702
0148    CF5C            SEL     COMAND              ACTIVE SIGNAL REGISTER
0149    DE20            XMIT    0B,STEP             STEP SIGNAL OFF.
014A    CD09            XMIT    9,R15               SET 4.5 MS DELAY TIME
```


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0148  C908              CALL    MIC500              TIMING LOOP
014C  E702
                  *CHECK IF INCONDITIONNAL SEEK TO 0(THE STEP IS DONE),OR IF
                  *48 TPI (ONE MORE STEP).
014D  CF4D              SEL     SP5                 OPERATION STATE REGISTER
014E  BB3A              NZT     FSTR0,TPI96         IF SEEK TO 0,LINK SEEKS.
014F  CF5C              SEL     COMAND              ACTIVE OUTPUT SIGNALS
0150  BD3A              NZT     HIDEN,TPI96         48 TPI ?
0151  DE21              XMIT    1B,STEP             STEP SIGNAL ON.
0152  CD01              XMIT    1,R15               SET 500 US DELAY TIME
0153  C90C              CALL    MIC500              TIMING LOOP
0154  E702
0155  CF5C              SEL     COMAND              ACTIVE OUTPUT SIGNALS
0156  DE20              XMIT    0B,STEP             STEP SIGNAL OFF
0157  CD09              XMIT    9,R15               SET 4,5 MS DELAY TIME
0158  C90D              CALL    MIC500              TIMING LOOP
0159  E702
      015A        TPI96 EQU     *
015A  0100        LINKSK MOVE   R1,AUX              ASK INCREMENT OR DECREMENT VALUE
015B  2606              ADD     R6,R6               WORK ON COUNTER.
015C  CF4D              SEL     SP5                 OPERATION STATE REGISTER
015D  BB3F              NZT     FSTR0,STR0          INCONDITIONNAL BLIND SEEK TO 0
015E  E10A              JMP     COMPAR              HANDLE HEAD SITUATION.
015F  E125        STR0  JMP     TSTR0

                  ****************************************
                  *                                      *
                  *       SEARCH ONE BYTE OF '0'         *
                  *            AND IDENT OR DATA         *
                  *                ADDRESS MARK          *
                  *                                      *
                  ****************************************
                  *
0160  C90E        LIKNOP CALL   NOTOP               HANDLE NOT OPERABLE DRIVE.
0161  E6FC
                  *
0162  CF5A        DECR1 SEL     CNTRL
0163  DB64              XMIT    100B,33H,3
0164  C0FF              XMIT    -1,AUX
0165  CF5D              SEL     STATUS
0166  BA20              NZT     READYN,LIKNOP       DRIVE STILL READY ?
0167  CF5A              SEL     CNTRL               INDEX DETECTOR ACTIVE ?
0168  BF2B              NZT     INDN,SAGAIN
0169  A56C              NZT     R5,AGAINS
016A  E1F0              JMP     SYNC1
016B  C500        SAGAIN XMIT   0,R5                RESET INDEX STATE FLAG
016C  A477        AGAINS NZT    R4,SCH0             ELAPSED TIME ?
016D  C104              XMIT    4,R1                DELAY TIME FOR
016E  E206              JMP     SYNC3               QUARTZ/VCO SYNCHRONISATION
                  *
016F  E177        TBBR2 JMP     SCH0                SEARCH ZERO BYTES
0170  C0FF              XMIT    -1,AUX              DECREMENT VALUE
0171  E182              JMP     SCHB0               SEARCH 2ND ZERO BYTE
0172  0000              MOVE    AUX,AUX             NOT USED
0173  E182        ETBBR2 JMP    SCHB0               SEARCH 2ND HALF 0 BYTE
                  *
0174  2404        DECTIM ADD    R4,R4
0175  A478              NZT     R4,SCHB1
0176  E162              JMP     DECR1
                  *LOOK FOR FOUR FOLLOWING HALF BYTES OF ZERO DATA.
                  *
0177  C41E        SCH0  XMIT    30,R4
0178  CF5A        SCHB1 SEL     CNTRL
0179  BE34              NZT     BYTRA,DECTIM
017A  CF5F              SEL     DATA
017B  CF5F              SEL     DATA
017C  CF5F              SEL     DATA
017D  CF5F              SEL     DATA
017E  C0AA              XMIT    10101010B,AUX
017F  7F04              XOR     DATA,R4
0180  A462              NZT     R4,DECR1
0181  C208              XMIT    8,R2
0182  C408        SCHB0 XMIT    8,R4
0183  0222              MOVE    R2(1),R2
0184  CF5A        SCHB2 SEL     CNTRL
0185  BE27              NZT     BYTRA,DECTIS
0186  E1D0              JMP     TWOUS
0187  2404        DECTIS ADD    R4,R4
0188  A484              NZT     R4,SCHB2
0189  E162              JMP     DECR1
                  *
018A  CF5F        ASK   SEL     DATA
018B  CF5F              SEL     DATA
018C  CF5F              SEL     DATA
018D  CF5F              SEL     DATA
018E  7F04              XOR     DATA,R4
018F  A462              NZT     R4,DECR1
0190  826F              XEC     TBBR2(R2)
0191  8C99              XEC     TBR1(R14)
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                        *SEARCH AN ADDRESS MARK (@M)
                        *
0192    CF5A    SCHAM   SEL     CNTRL
0193    BE35            NZT     BYTRA,DECAM
0194    E1AF            JMP     TSAM
0195    2404    DECAM   ADD     R4,R4
0196    A492            NZT     R4,SCHAM
0197    A362    DECR2   NZT     R3,DECR1
0198    E264            JMP     RETRY
                        *
0199    C107    TBR1    XMIT    7,R1                    IN MFM 8 HALF BYTES OF @M
019A    C101    ETBR1   XMIT    1,R1                    IN FM 2 HALF BYTES OF @M
                        *
019B    E1C0    BTBL0   JMP     RAML2                   FOR R1=/FF WITH TBL0
019C    0000    TBL0    MOVE    AUX,AUX                 NOT USED
019D    C089            XMIT    10001001B,AUX           6TH HALF BYTE OF AM IN MFM
019E    C044            XMIT    01000100B,AUX           5TH HALF BYTE OF AM IN MFM
019F    C089            XMIT    10001001B,AUX           4TH HALF BYTE OF AM IN MFM
01A0    C044            XMIT    01000100B,AUX           3RD HALF BYTE OF AM IN MFM
01A1    C089            XMIT    10001001B,AUX           2ND HALF BYTE OF AM IN MFM
01A2    C044    ETBL0   XMIT    01000100B,AUX           1ST HALF BYTE OF AM IN MFM
                        *
01A3    C055    TBL1    XMIT    01010101B,AUX           7TH HALF BYTE OF AM IN MFM
01A4    C0F5            XMIT    11110101B,AUX           1ST HALF BYTE OF AM IN FM
                        *
01A5    C054    TBL2    XMIT    01010100B,AUX           8TH HALF BYTE OF IDENT AM IN MFM
01A6    C07E            XMIT    01111110B,AUX           2ND HALF BYTE OF IDENT AM IN FM
                        *
01A7    C045    TBL3    XMIT    01000101B,AUX           8TH HALF BYTE OF DATA  AM IN MFM
01A8    C06F            XMIT    01101111B,AUX           2ND HALF BYTE OF DATA  AM IN FM
                        *
01A9    C04A    TBL4    XMIT    01001010B,AUX           8TH HALF BYTE OF DDAM IN MFM
01AA    C06A            XMIT    01101010B,AUX           2ND HALF BYTE OF DDAM IN FM
                        *
01AB    A097    RAM1    NZT     AUX,DECR2
01AC    C0FF            XMIT    -1,AUX
01AD    CF5A    LOOP0   SEL     CNTRL
01AE    BE2D            NZT     BYTRA,LOOP0
01AF    2101    TSAM    ADD     R1,R1
01B0    A1BE            NZT     R1,RAML0
01B1    DA21            XMIT    1,DCMXN                 1ST HALF BYTE OF LAST BYTE OF AM
01B2    8CA3            XEC     TBL1(R14)
01B3    CF5F    RAM2    SEL     DATA
01B4    CF5F            SEL     DATA
01B5    CF5F            SEL     DATA
01B6    CF5F            SEL     DATA
01B7    7F00            XOR     DATA,AUX
01B8    A8AB            NZT     OVF,RAM1
01B9    A0C2            NZT     AUX,RAM4
01BA    A3BC            NZT     R3,RAM3                 AM IDENT FOUND
01BB    E264            JMP     RETRY
01BC    C108    RAM3    XMIT    8,R1
01BD    E221            JMP     AMIDOK
01BE    819C    RAML0   XEC     TBL0(R1)
01BF    A8B3            NZT     OVF,RAM2
01C0    8CA5    RAML2   XEC     TBL2(R14)               LAST HALF BYTE OF IDENT
01C1    E1B3            JMP     RAM2
01C2    A362    RAM4    NZT     R3,DECR1
01C3    8CA9            XEC     TBL4(R14)               LAST HALF BYTE OF DDAM
01C4    7F00            XOR     DATA,AUX
01C5    A0CA            NZT     AUX,RAM5
01C6    CF4E            SEL     SP6                     DDAM FOUND
01C7    D821            XMIT    1,DDAM
01C8    C100            XMIT    0,R1
01C9    E292            JMP     DAMOK
01CA    8CA7    RAM5    XEC     TBL3(R14)               LAST HALF BYTE OF DAM
01CB    7F00            XOR     DATA,AUX
01CC    A097            NZT     AUX,DECR2
01CD    C101            XMIT    1,R1                    FLAG DAM FOUND EVENT
01CE    E292            JMP     DAMOK                   DAM FOUND
01CF    E162    RESYNC  JMP     DECR1
01D0    023B    TWOUS   MOVE    R2,SYNE
01D1    0000            MOVE    AUX,AUX                 TWO US DELAY
01D2    0000            NOP
01D3    0000            NOP
01D4    E18A            JMP     ASK                      RETURN TO ASK NEXT DATA
                        ****************************************
                        *                                      *
                        *       SET TIMING                     *
                        *                                      *
                        ****************************************
                        *SET DELAY TIME,RECORDING METHOD PARAMETERS IN ORDER TO
                        *SEARCH AND CATCH AN IDENTIFIER.
                        *WE ARE ON WANTED CYLINDER,TAKE INFORMATIONS FROM CIO COMAND.
01D5    CF4E    SID1    SEL     SP6                     SECTOR NUMBER IN COMAND+FLAG
01D6    1FA0            MOVE    37H,5,AUX               FIVE BITS SECTOR NUMBER
01D7    DA21            XMIT    1,SID                   ADDRESS MARK SEARCH FLAG FOR ID
01D8    CF55            SEL     SP13                    WANTED SECTOR
01D9    001F            MOVE    AUX,SP13                SP13 = SECTOR OF COMMAND
01DA    CF4F            SEL     SP7                     COMAND CYLINDER NUMBER
01DB    1FE1            MOVE    37H,7,R1                SEVEN BITS CYLINDER NUMBER
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                        *PREPARE FOR SYNCHRONISATION(WGE ALWAYS AT 1,AT 0 ONLY IN WRITE ROUTINE)
01DC    CF5B    READBY  SEL     MODE                    ACTIVE MODE REGISTER
01DD    D921            XMIT    1B,READN                SET READN FOR CRISTAL SYNCHRO
                        *HANDLE CODING METHOD ACCORDING TO THE SET FORMAT.
                        *IF TRACK 0,HEAD 0,FORMAT 0 -->FM
                        *ELSE MFM.
01DE    CF5C            SEL     COMAND                  INTERFACE DRIVERS
01DF    1920            MOVE    H1SEL,AUX               ASK THE SELECTED HEAD.
01E0    2101            ADD     R1,R1                   FIND IF HEAD 0,TRACK 0.
01E1    CF5B            SEL     MODE                    PRESET MFM RECORDING METHOD
01E2    DD20            XMIT    0B,FM                   MFM INIT
01E3    A1EE            NZT     R1,SYNC0                MFM OK ?
                        *HEAD 0,TRACK 0 REQUESTED HERE.
01E4    CF48            SEL     SP0                     FM PERHAPS NEEDED
01E5    B929            NZT     DN1,DEV51               WHICH DRIVE ?
01E6    CF4B            SEL     SP3                     :DRIVE 0
01E7    1A40            MOVE    SETF0,AUX               ASK DRIVE FORMAT.
01E8    E1EB            JMP     FEAT5                   TEST IF MFM OK ?
01E9    CF4B    DEV51   SEL     SP3                     :DRIVE1
01EA    1D40            MOVE    SETF1,AUX               ASK DRIVE FORMAT.
01EB    A0EE    FEAT5   NZT     AUX,SYNC0               FORMAT 0 ?
01EC    CF5B            SEL     MODE
01ED    DD21            XMIT    1B,FM                   YES,FM INIT.
                        *INITIAL QUARTZ SYNCHRONISATION.
01EE    CF56    SYNC0   SEL     SP14                    PRESET VIEWED INDEX COUNTER
01EF    DF02            XMIT    2,SP14                  SET 2 POSSIBLE DETECTIONS.
01F0    C500    SYNC1   XMIT    0,R5                    FLAG ALLOW WORK ON COUNTER SP14
01F1    CD01            XMIT    1,R15                   500 US DELAY TIME
01F2    CF5A            SEL     CNTRL                   ACTIVE CONTROL REGISTER
01F3    9F34            XEC     ACTIV(INDN)             INDEX SIGNAL ACTIVE ?
01F4    E1F6    ACTIV   JMP     SYNCS1
01F5    E205            JMP     SYNC3M
                        *INDEX SIGNAL ACTIVE:SYNCHRO ON QUARTZ DURING 500 US,AND MANAGE INDEX ME
                        *EVENT,SKIP INDEX ADDRESS MARK.
01F6    C90F    SYNCS1  CALL    SSP                     INDEX,READY HANDLING PROCEDURE
01F7    E6CE
01F8    E1F9            JMP     SYNCS                   AFTER SYNCHRO QUARTZ,SYNCHRO REA
                        *SYNCHRONISE VCO ON CRISTAL QUARTZ FOR 96 US.
                        *SYNCHRONISE ON BIT STREAM FROM READ LINE.
01F9    CF5B    SYNCS   SEL     MODE                    SET READ LINE MODE
01FA    D920            XMIT    0,READN                 READ FROM DATA INTERFACE LINE.
01FB    1D2C            MOVE    FM,R14                  R14 CONTAIN FM TYPE.
                        *30.4 US DELAY TIME FOR READ BIT STREAM SYNCHRONISATION.(AUX=-1).
01FC    C125            XMIT    37,R1                   SHORT TIME COUNTER
01FD    2101    SUBST   ADD     R1,R1                   DECREMENT COUNTER.
01FE    A1FD            NZT     R1,SUBST                LOOP.DELAY TIME END ?
01FF    CF4E            SEL     SP6                     SECTOR NUMBER + FLAGS
0200    1A23            MOVE    SID,R3                  ASK ADDRESS MARK TYPE FLAG(ID,DA
0201    CF57            SEL     SP15                    COMMAND REGISTER
0202    B924            NZT     31H,1,DETECT            IF FORMAT CHECK VIRGINITY
0203    E177            JMP     SCH0                    BEGIN TO SEARCH ZERO BYTES
0204    E47E    DETECT  JMP     SBYTRA                  SEARCH FOR TWO BYTRAS
                        **************
0205    C118    SYNC3M  XMIT    24,R1                   SHORT TIME COUNTER.
0206    CF5A    SYNC3   SEL     CNTRL                   ACTIVE CONTROL REGISTER
0207    DB64            XMIT    100B,33H,3              PREPARE BIT STREAM SYNCHRONISATI
0208    CF5B            SEL     MODE                    START VCO LOCK
0209    D921            XMIT    1,READN                 ON CRISTAL QUARTZ
020A    C910    SYNC    CALL    READYT                  CHECK READY STATUS.
020B    E6F7
020C    C0FF            XMIT    -1,AUX                  DECREMENT VALUE
020D    2101            ADD     R1,R1                   DECREMENT SHORT TIME COUNTER
020E    A80A            NZT     OVF,SYNC                 96 US DELAY TIME
020F    E1F9            JMP     SYNCS

                        ****************************************
                        *                                      *
                        *       READ IDENTIFIER                *
                        *               AND CONTROL IT         *
                        *                                      *
                        ****************************************
        020C    BGTBST  EQU     *-4                 BEGINNING OF STORE ACTION
0210    0659    TBST    MOVE    R6,DATLID
0211    06BF            MOVE    R6,SECTID
0212    0638            MOVE    R6,SIDID
0213    06FF            MOVE    R6,CYLID
                        *
0214    1F06    RID1    MOVE    DATA,R6
0215    C0FC            XMIT    -4,AUX
0216    2100            ADD     R1,AUX
0217    CF5A            SEL     CNTRL
0218    0839            MOVE    OVF,CRCE
0219    A81F            NZT     OVF,STRID
021A    E221            JMP     AMIDOK
        0217    BGTBID  EQU     *-4                   BEGINNING OF STORE TABLE
021B    CF51    TBID    SEL     SP9                 FORMAT IN DATLID
021C    CF51            SEL     SP9                 SECTOR IN SECTID
021D    CF50            SEL     SP8                 SIDE   IN SIDID
021E    CF50    ETBID   SEL     SP8                 TRACK  IN CYLID
021F    8117    STRID   XEC     BGTBID(R1)
0220    810C            XEC     BGTBST(R1)          STORE VALUES
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                        *
                        *
0221    C0FF    AMIDOK  XMIT    -1,AUX
0222    CF5A    LOOP1   SEL     CNTRL
0223    BE22            NZT     BYTRA,LOOP1
0224    CF5F            SEL     DATA
0225    CF5F            SEL     DATA
0226    CF5F            SEL     DATA
0227    2101            ADD     R1,R1
0228    A114            NZT     R1,RID1
0229    A63E    ALLID   NZT     R6,RSYNCA
022A    1F00            MOVE    DATA,AUX
022B    A03E            NZT     AUX,RSYNCA
022C    CF5A            SEL     CNTRL
022D    D867            XMIT    111B,33H,3      CRCE=1,DCMXN=1,SYNE=1
022E    CF5B            SEL     MODE
022F    D920            XMIT    0,READN
0230    CF50    IDENTOK SEL     SP8
0231    1FE4            MOVE    CYLID,R4
0232    C049            XMIT    111H,AUX
0233    CF48            SEL     SP0
0234    392F            ADD     DN1,R17
0235    041F            MOVE    R4,RIV
0236    CF57            SEL     SP15
0237    BFBF            NZT     37H,5,SECTS     SEEK COMMAND?
0238    CF4F            SEL     SP7             YES
0239    1FE6            MOVE    37H,7,R6
023A    0400            MOVE    R4,AUX
023B    6600            XOR     R6,AUX
023C    A04B            NZT     AUX,BTSK        TRACK ID = TRACK COMMAND ?
023D    E3B9            JMP     NOWR            Y&S
023E    E1CF    RSYNCA  JMP     RESYNC
                        *
023F    CF55    SECTS   SEL     SP13
0240    C0FF            XMIT    -1,AUX
0241    7F00            XOR     SP13,AUX
0242    2300            ADD     R3,AUX
0243    CF51            SEL     SP9
0244    3FA6            ADD     SECTID,R6
0245    A654            NZT     R6,SYNC4
0246    E2E3            JMP     REAWRI
0247    B92A    TBT2    NZT     BT2,BTPB        TWO BAD TRACKS FOUND ?
0248    D921            XMIT    1,BT2            NO
0249    E24F            JMP     BTSEEK
024A    E3DD    BTPB    JMP     WST06           BAD TRACK PROBLEMS
024B    D821    BTSK    XMIT    1,RTRY
024C    CF4D            SEL     SP5
024D    B827            NZT     BT1,TBT2         ONE BAD TRACK FOUND ?
024E    D821            XMIT    1,BT1            NO
024F    C0FF    BTSEEK  XMIT    -1,AUX
0250    BA32            NZT     FDIR,OUTDIR      ONE STEP IN THE SAME DIRECTION
0251    C001            XMIT    1,AUX
0252    2606    OUTDIR  ADD     R6,R6            EXECUTE A CORRECTION SEEK
0253    E100            JMP     SKNORM           (CASE OF BAD TRACK)
0254    CF48    SYNC4   SEL     SP0
0255    8939            NZT     DN1,DEV61
0256    CF4B            SEL     SP3
0257    1A40            MOVE    SETF0,AUX
0258    E25B            JMP     FEAT6
0259    CF4B    DEV61   SEL     SP3
025A    1D40            MOVE    SETF1,AUX
025B    805F    FEAT6   XEC     TIMSEC(AUX)
025C    C911            CALL    BRIND
025D    E6D5
025E    E205            JMP     SYNC3M
025F    CD09    TIMSEC  XMIT    9,R15
0260    CD11            XMIT    17,R15
0261    CD23            XMIT    35,R15
0262    CD23    ETIMSC  XMIT    35,R15
0263    0000            NOP

                        ********************************
                        *                              *
                        *        RETRY  PROCEDURE      *
                        *                              *
                        ********************************
                        *
        0264    RETRY   EQU     *
0264    CF5B            SEL     MODE            SET SYNCHRO ON QUARTZ
0265    D921            XMIT    1,READN
0266    CF4E            SEL     SP6             SAVE NORMAL SID FLAG
0267    1A21            MOVE    SID,R1
0268    DA43            XMIT    11B,32H,2       FORCED FLAGS: SID=1,FR=1
0269    CF54            SEL     SP12            SELECT RETRIES COUNTERS
026A    C0FF            XMIT    -1,AUX          DECREMENT VALUE
026B    3B9B            ADD     RDR,RDR         DECREMENT READ RETRY COUNTER
026C    BB93            NZT     RDR,XSYNCO      READ COUNTER DOWN ?
026D    C912            CALL    RETNR           YES,CHECK SEEK COUNTER.
```


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```
026E    E730
026F    A878            NZT     OVF,SKRY            SEEK COUNTER DOWN ?
0270    A172            NZT     R1,IDNTFD           YES,CHOOSE ERROR,
0271    E3F2            JMP     WST13               DATA FAULT IF SEARCH DATA AM
0272    E3D2    IDNTFD  JMP     WST05               SECTOR NOT FOUND IF SEARCH ID
0273    E1EE    XSYNC0  JMP     SYNC0               OPERATE SYNCHRO PROCESS
                *SEEK RETRY COUNTER NOT DOWN,HANDLE SEEK TO 0 OR SEEK TO MAX (77:96 TPI,
                *38:48 TPI).
0274    C600    SKZ0    XMIT    0,R6                RETRY SEEK TOWARD OUTER (TRACK 0
0275    DC42            XMIT    10B,FSK
0276    C101            XMIT    1,R1
0277    E125            JMP     TSTR0
0278    1F21    SKRY    MOVE    37H,1,R1            R1 : LSB OF SEEK RETRIES CT
0279    CF4F            SEL     SP7
027A    D821            XMIT    1,RTRY              SET RTRY FLAG FOR SEEK
027B    C0B3            XMIT    -77,AUX             PRESET MAX RETRY SEEK
027C    CF5C            SEL     COMAND              ASK OUTPUT INTERFACE
027D    BD3F            NZT     HIDEN,T80A          96 TPI ?
027E    C0DA            XMIT    -38,AUX             :48TPI
027F    CF4F    T80A    SEL     SP7
0280    1FE6            MOVE    37H,7,R6            SET ON ACTUAL CYLINDER
0281    2600            ADD     R6,AUX
0282    CF4D            SEL     SP5
0283    C300            XMIT    0,R3                NO STEP DONE
0284    A88F            NZT     OVF,SKZ0X           TRACK > OR = MAXCYL ?
0285    A686            NZT     R6,PLUS2            NO ,TRACK = 0 ?
0286    E288    PLUS2   JMP     SKMX                YES
0287    A18F            NZT     R1,SKZ0X
0288    C44D    SKMX    XMIT    77,R4               RETRY SEEK TOWARD INNER (TRACK 7
0289    CF5C            SEL     COMAND
028A    BD2C            NZT     HIDEN,T80B
028B    C426            XMIT    38,R4
028C    CF4D    T80B    SEL     SP5
028D    DC40            XMIT    00B,FSK
028E    E10A            JMP     COMPAR
028F    E274    SKZ0X   JMP     SKZ0

                ****************************************
                *                                      *
                *       DAMOK : READ A SECTOR          *
                *                                      *
                *                AFTER DATA AM FOUND   *
                *                                      *
                ****************************************
                *
0290    A195    DAMOKM  NZT     R1,DAMOK3           IF DDAM FOUND AND READ SKIP DDAM
0291    E385            JMP     IMSCT               INCREMENT SECTOR NUMBER
0292    CF57    DAMOK   SEL     SP15
0293    C500            XMIT    0,R5
0294    BE30            NZT     36H,1,DAMOKM
0295    1F44    DAMOK3  MOVE    37H,2,R4            R4 = 0 : COMMAND VERIFY
0296    A49A            NZT     R4,WBYT             R4 # 0 : COMMAND READ OR READ SK
0297    C7EE    BRZ1    SEL     FFZTES
0298    B33A            NZT     EOR,WBYT            IF EOR = 0
0299    D384            XMIT    ECHZ1,FFZ           SEND A BREACK
029A    CF5A    WBYT    SEL     CNTRL
029B    BE3A            NZT     BYTRA,WBYT
029C    CF5F            SEL     DATA
029D    CF5F            SEL     DATA
029E    CF5F            SEL     DATA
029F    CF5F            SEL     DATA
02A0    C0FF            XMIT    -1,AUX
02A1    7F01            XOR     DATA,R1             INVERT FIST BYTE AND STORE IT IN
02A2    0400    TESRDY  MOVE    R4,AUX              SAVE R4
02A3    C913            CALL    READYT
02A4    E6F7
02A5    0004            MOVE    AUX,R4
02A6    C0FF            XMIT    -1,AUX
02A7    A6C2            NZT     R6,WBYT2
02A8    CF4C            SEL     SP4                 ASK IF START OF 256 WORDS COUNT
02A9    182A            MOVE    CT256,R12           USE R12 TO TEST
02AA    AAC0            NZT     R12,WBYTD           DO WBYTD IF FIRST OF 256 WORDS
02AB    CF5A            SEL     CNTRL               IF ALL DATA BYTES AND FIRST CRC
02AC    D920            XMIT    0,CRCE              ARE READ ,WAIT FOR CALCULATED CR
02AD    C103            XMIT    3,R1
02AE    1F02    WCRC    MOVE    RIV,R2
02AF    2101            ADD     R1,R1
02B0    CF5A    LOOP2   SEL     CNTRL
02B1    BE30            NZT     BYTRA,LOOP2
02B2    CF5F            SEL     DATA
02B3    CF5F            SEL     DATA
02B4    CF5F            SEL     DATA
02B5    CF5F            SEL     DATA
02B6    A1AE            NZT     R1,WCRC
02B7    A2BD            NZT     R2,WST13R           IF CRC IS NOT CORRECT
02B8    BF1D            NZT     DATA,WST13R         'DATA FAULT' WITHOUT RETRY
02B9    C7FE            SEL     TEST                CRC OK
02BA    B23C            NZT     ECHN,*+2            WAIT FOR THE LAST EXCHANGE IS EX
02BB    E2BA            JMP     *-1
02BC    E385            JMP     IMSCT
```


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```
02BD    CF4E        WST13R  SEL     SP6
02BE    D920                XMIT    0,FR                GO TO WAIT STATUS 'DATA FAULT'
02BF    E3F2                JMP     WST13
02C0    CF4C        WBYTD   SEL     SP4                 TAKE OFF FLAG FOR FIRST OF 256 W
02C1    D820                XMIT    08,CT256
02C2    CF5A        WBYT2   SEL     CNTRL
02C3    BE22                NZT     BYTRA,WBYT2
02C4    CF5F                SEL     DATA                RESET BYTRA
02C5    CF5F                SEL     DATA
02C6    CF5F                SEL     DATA
02C7    CF5F                SEL     DATA
02C8    7F02                XOR     DATA,R2             INVERT SECOND BYTE AND STORE IT
02C9    2606                ADD     R6,R6               DECREMENT WORDS COUNTER
02CA    C7FE                SEL     TEST
02CB    122A                MOVE    ECHN,R12            USE R12 TO TEST
02CC    AACE                NZT     R12,*+2             IF PRECEDING EXCHANGE IS NOT FIN
02CD    E3F0                JMP     WST14               GO TO WAIT STATUS 'THROUPUT ERRO
02CE    A4DC                NZT     R4,SENDW            VERIFY COMMAND ?
02CF    B13D                NZT     INPUTN,WST11R
02D0    A59A                NZT     R5,WBYT
02D1    1325                MOVE    EOR,R5              R5 MEMORIZE EOR
02D2    C7F7                SEL     BIL
02D3    1700                MOVE    BIL,AUX
02D4    6100                XOR     R1,AUX              COMPARE FIRST BYTE
02D5    A0BD                NZT     AUX,WST13R          OK ?
02D6    C7FB                SEL     BIR                 YES
02D7    1700                MOVE    BIR,AUX
02D8    6200                XOR     R2,AUX              COMPARE SECOND BYTE
02D9    A0BD                NZT     AUX,WST13R          OK ?
02DA    A697                NZT     R6,BRZ1             IF WORD COUNTER # 0 ,SEND A BREA
02DB    E29A                JMP     WBYT                OTHERWISE CHECK CRC
02DC    B13E        SENDW   NZT     INPUTN,*+2          READ COMMAND
02DD    E3CE        WST11R  JMP     WST11               WRONG INITIALIZATION OF IOP
02DE    C77F                SEL     BOL
02DF    0117                MOVE    R1,BOL              TRANSMIT FIRST BYTE
02E0    C7BF                SEL     BOR
02E1    0217                MOVE    R2,BOR              TRANSMIT SECOND BYTE
02E2    E297                JMP     BRZ1

                    ****************************************
                    *                                      *
                    *       REAWRI : AFTER IDENT OK        *
                    *                EXECUTE READ          *
                    *                   OR  WRITE          *
                    *                                      *
                    ****************************************
                    *
02E3    CF57        REAWRI  SEL     SP15
02E4    1C41                MOVE    34H,2,R1            R1=0 IF READ OR VERIFY COMMAND
02E5    C7EF                SEL     FFZ
02E6    D382                XMIT    INZ0,FFZ            RESET FINPUT
02E7    CF51                SEL     SP9                 ASK LENGTH READ IN ID
02E8    1946                MOVE    DAILID,R6           TAKE THE TWO SIGNIFICANT BITS
02E9    86EF                XEC     WRDLG(R6)           WORD SECTOR LENGTH IN R6
02EA    CF4E        DECIDE  SEL     SP6
02EB    DA20                XMIT    0,SID               DATA FIELD SEARCH FOR INIT
02EC    A1EE                NZT     R1,WREXEX           WRITE TYPE OPERATION ?
02ED    E205                JMP     SYNC3N              NO,SYNCHRONISE ON DATA FIELD.
02EE    E303        WREXEX  JMP     WREXE
                    *TABLE CONTAINING THE DATA RECORD LENGTH TRANSLATING
                    *IN NUMBER OF 16-BITS-WORDS.
02EF    C640        WRDLG   XMIT    64,R6               128 BYTES=64 16-BITS-WORDS
02F0    C680                XMIT    128,R6              256 BYTES=128 16-BITS-WORDS
02F1    E2F3                JMP     LONGER              512 BYTES=256 SPECIAL HANDLING
02F2    E3CE        EWRDLG  JMP     WST11               NOT USE, WRONG DISKETTE
02F3    C600        LONGER  XMIT    000,R6              512 BYTES=256 16-BITS-WORDS+CT25
02F4    CF4C                SEL     SP4                 INIT FLAG FOR 512 BYTES
02F5    D821                XMIT    1B,CT256
02F6    E2EA                JMP     DECIDE

                    ****************************************
                    *                                      *
                    *       WREXE  :  WRITE  SEQUENCE      *
                    *                                      *
                    ****************************************
                    *
                            ORG     0300X               NEXT SEGMENT.
0300    E378        WENZ0   JMP     MODIWR
0301    0201                MOVE    R2,R1
0302    E309                JMP     CTBYT
                    *
0303    D384        WREXE   XMIT    ECHZ1,FFZ
0304    C0FF                XMIT    -1,AUX
0305    8C33                XEC     TBW1(R14)           R1 : NB OF GAP BYTES TO SKIP
0306    8C35                XEC     TBW2(R14)           R2+2 : NB OF '0' BYTES TO WRITE
0307    CF5A                SEL     CNTRL
0308    DA21                XMIT    1,DCMXN
0309    CF5A        CTBYT   SEL     CNTRL
030A    BE29                NZT     BYTRA,*-1
030B    CF5F                SEL     DATA                RESET BYTRA
030C    CF5F                SEL     DATA
```


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```
030D  CF5F              SEL     DATA
030E  CF5F              SEL     DATA
030F  DF00              XMIT    0,DATA
0310  2101              ADD     R1,R1               DECREMENT R1
0311  A109              NZT     R1,CTBYT
0312  CF5A              SEL     CNTRL
0313  B820              NZT     WEN,WENZ0           WRITE BYTES OF '0'
0314  CF57              SEL     SP15
0315  0CE0              MOVE    R14(7),AUX
0316  3B20              ADD     33H,1,AUX
0317  8037              XEC     TBW3(AUX)           R2 : LAST HALF BYTE OF DAM
0318  8C45              XEC     TBW4(R14)           R1+1 : NB OF HALF-BYTES OF DAM
0319  8C3B              XEC     TBW5(R14)           R3 : 1ST HALF-BYTE OF LAST BYTE
031A  C0FF              XMIT    -1,AUX
031B  2101    WRAM      ADD     R1,R1               DECREMENT R1
031C  813E              XEC     TBAMW(R1)           R11 : HALF BYTE OF DAM TO WRITE
031D  CF5A              SEL     CNTRL
031E  BE3D              NZT     BYTRA,*-1
031F  CF5F              SEL     DATA                RESET BYTRA
0320  CF5F              SEL     DATA
0321  CF5F              SEL     DATA
0322  CF5F              SEL     DATA
0323  0C1F              MOVE    R14,DATA
0324  CF5A              SEL     CNTRL
0325  DB41              XMIT    01B,33H,2           DCMXN=0,SYNE=1
0326  A81B              NZT     OVF,WRAM
0327  C7FE    WRDATA    SEL     TEST
0328  132C              MOVE    EOR,R14
0329  CF4D              SEL     SP5
032A  924F              XEC     TBTES(22H,2)        TEST ECHN AND INPUTN
032B  C1FF    WR00B     XMIT    -1,R1
032C  C2FF              XMIT    -1,R2               WRITE BYTES OF '0'
032D  CC01              XMIT    1,R14
032E  E352              JMP     WRDAT
032F  DE21    TBTES     XMIT    1,THER              LAST EXCHANGE NOT FINISHED (ECHN
0330  E34C              JMP     ECHWOK              LAST EXCHANGE OK
0331  DE21              XMIT    1,THER              LAST EXCHANGE NOT FINISHED (ECHN
0332  DF21              XMIT    1,PROGER            WRONG INITIALIZATION OF IOP (INP
0333  C110    TBW1      XMIT    16,R1               NB OF GAP BYTES TO SKIP IN MFM
0334  C107              XMIT    7,R1                NB OF GAP BYTES TO SKIP IN FM
0335  C208    TBW2      XMIT    11,R2               12 BYTES OF '0' TO WRITE IN MFM
0336  C205              XMIT    5,R2                6 BYTES OF '0' TO WRITE IN FM
0337  C245    TBW3      XMIT    01000101B,R2        LAST HALF-BYTE OF DAM  IN MFM
0338  C24A              XMIT    01001010B,R2        LAST HALF-BYTE OF DDAM IN MFM
0339  C26F              XMIT    01101111B,R2        LAST HALF-BYTE OF DAM  IN FM
033A  C26A              XMIT    01101010B,R2        LAST HALF-BYTE OF DDAM IN FM
033B  C355    TBW5      XMIT    01010101B,R3        7TH HALF-BYTE OF AM IN MFM
033C  C3F5              XMIT    11110101B,R3        1ST HALF-BYTE OF AM IN FM
033D  020C              MOVE    R2,R14              LAST HALF-BYTE OF AM
033E  030C    TBAMW     MOVE    R3,R14              NEXT TO LAST HALF-BYTE OF AM
033F  CC89              XMIT    10001001B,R14       6TH HALF-BYTE OF AM IN MFM
0340  CC44              XMIT    01000100B,R14       5TH HALF-BYTE OF AM IN MFM
0341  CC89              XMIT    10001001B,R14       4TH HALF-BYTE OF AM IN MFM
0342  CC44              XMIT    01000100B,R14       3RD HALF-BYTE OF AM IN MFM
0343  CC89              XMIT    10001001B,R14       2ND HALF-BYTE OF AM IN MFM
0344  CC44              XMIT    01000100B,R14       1ST HALF-BYTE OF AM IN MFM
0345  C107    TBW4      XMIT    7,R1                8 HALF-BYTES OF AM IN MFM
0346  C101              XMIT    1,R1                2 HALF-BYTES OF AM IN FM
0347  2601    ETCW2     ADD     R6,R1
0348  AC2B    ETCW3     NZT     R14,WR00B           IN CASE OF EXCHANGE ERROR OR EOR
0349  A127              NZT     R1,WRDATA           WRITE BYTES OF '0'
034A  CC01              XMIT    1,R14               IF LAST WORD TO WRITE ,NO BREACK
034B  E329              JMP     WR00B-2
034C  C7F7    ECHWOK    SEL     BIL
034D  1701              MOVE    BIL,R1              R1 : 1ST BYTE OF WORD TO WRITE
034E  C7EB              SEL     BIRFFZ
034F  1702              MOVE    BIR,R2              R2 : 2ND BYTE OF WORD TO WRITE
0350  AC52              NZT     R14,WRDAT           IF EOR IN R11 WAS 1 , NO BREACK
0351  D384              XMIT    ECHZ1,FFZ           SEND A BREACK
0352  C7FE    WRDAT     SEL     TEST
0353  CF5A              SEL     CNTRL
0354  BE33              NZT     BYTRA,*-1
0355  CF5F              SEL     DATA                RESET BYTRA
0356  CF5F              SEL     DATA
0357  CF5F              SEL     DATA
0358  CF5F              SEL     DATA
0359  611F              XOR     R1,DATA
035A  CF5A              SEL     CNTRL
035B  DA21              XMIT    1,DCMXN             DCMXN= 1
035C  2606              ADD     R6,R6               DECREMENT WORDS COUNTER
035D  CF5A              SEL     CNTRL
035E  BE3D              NZT     BYTRA,*-1
035F  CF5F              SEL     DATA
0360  CF5F              SEL     DATA
0361  CF5F              SEL     DATA
0362  CF5F              SEL     DATA
```


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```
0363    621F                    XOR     R2,DATA
0364    A672                    NZT     R6,ETCWB
0365    C105                    XMIT    5,R1                    ALL DATA BYTES WRITEN
0366    CF5A            DECBW   SEL     CNTRL
0367    BE26                    NZT     BYTRA,*-1
0368    CF5F                    SEL     DATA
0369    CF5F                    SEL     DATA
036A    CF5F                    SEL     DATA
036B    CF5F                    SEL     DATA
036C    DF00                    XMIT    0,DATA                  WRITE CRC AND ONE BYTE OF '0'
036D    2101                    ADD     R1,R1
036E    CF5A                    SEL     CNTRL
036F    8173                    XEC     TBCRCW(R1)
0370    A166                    NZT     R1,DECBW
0371    E385                    JMP     IMSCT
0372    E347            ETCWB   JMP     ETCW2
0373    D943            TBCRCW  XMIT    11B,31H,2               WEN=1,CRCE= 1
0374    D941                    XMIT    01B,31H,2               WEN=0,CRCE= 1
0375    D941                    XMIT    01B,31H,2               WEN=0,CRCE= 1
0376    D940                    XMIT    00B,31H,2               WEN=0,CRCE= 0
0377    D940                    XMIT    00B,31H,2               WEN=0,CRCE= 0
                        *       MODIFICATION OF WRITING FOR COMPATIBILITY
0378    DB20            MODIWR  XMIT    0,33H,1                 SYNE=0
0379    CF5B                    SEL     MODE
037A    D921                    XMIT    1,READN
037B    C10E                    XMIT    14,R1
037C    CF5F            WSYNC   SEL     DATA
                        ********************            SEL     DATA
037D    CF5F                    SEL     DATA
037E    CF5F                    SEL     DATA
037F    DF00                    XMIT    0,DATA
0380    2101                    ADD     R1,R1
0381    A17C                    NZT     R1,WSYNC
0382    CF5A                    SEL     CNTRL
0383    D820                    XMIT    0,WEN
0384    E301                    JMP     WENZO+1
                        ****************************************
                        *                                      *
                        *       IMSCT  :  SECTOR  CHAINING     *
                        *                                      *
                        ****************************************
                        *
0385    C7FE            IMSCT   SEL     TEST
0386    CF48                    SEL     SP0                     WHICH DRIVE ?
0387    B92B                    NZT     DN1,DEV71
0388    CF4B                    SEL     SP3                     ASK FORMAT
0389    1A40                    MOVE    SETF0,AUX               DRIVE 0 FORMAT
038A    E38D                    JMP     FEAT7
038B    CF4B            DEV71   SEL     SP3                     ASK FORMAT
038C    1D40                    MOVE    SETF1,AUX               DRIVE 1 FORMAT
038D    80B5            FEAT7   XEC     SECMAX(AUX)             ASK MAX SECTOR NUMBER
038E    C914                    CALL    READYT                  TEST IF DRIVE SILL READY
038F    E6F7
0390    CF56                    SEL     SP14
0391    DF02                    XMIT    2,SP14                  REINIT VIEWED INDEX COUNTER
0392    CF55                    SEL     SP13
0393    7F01                    XOR     SP13,R1
0394    C001                    XMIT    1,AUX
0395    A1A7                    NZT     R1,IMSECT               TEST IF LAST SECTOR OF TRACK
0396    DF01                    XMIT    1,SP13                  YES, NEXT READ OR WRITE WITH SEC
0397    CF4E            TESFOR  SEL     SP6
0398    DA21                    XMIT    1,SID
0399    7FA0                    XOR     37H,5,AUX
039A    CF4D                    SEL     SP5
039B    BF5F                    NZT     37H,2,ENDCOM            IF ERROR OR EOR , ABORT COMMAND
039C    B33F                    NZT     EOR,ENDCOM
039D    A0AE                    NZT     AUX,IMOK                IF THE FULL TRACK PROCESSED
039E    DD21                    XMIT    1,35H,1
039F    CF57            ENDCOM  SEL     SP15
03A0    1F6A                    MOVE    37H,3,R12               USE R12 TO TEST
03A1    AAB9                    NZT     R12,NOWR
03A2    C020                    XMIT    40H,AUX                 FORCE TO READ NEXT ID
03A3    001F                    MOVE    AUX,SP15
03A4    CF4C                    SEL     SP4                     FLAG EVENT IN CASE
```


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03A5    DF01                XMIT    1,SP4                       OF STATUS NOT OK.
03A6    E3AE                JMP     IMOK
                *
03A7    3F1F        IMSECT  ADD     SP13,SP13           INCREMENT SECTOR
03A8    1F00                MOVE    SP13,AUX
03A9    E397                JMP     TESFOR
                *
03AA    C001        VERLG   XMIT    01,AUX              MFM 8" FORMAT
03AB    C002                XMIT    02,AUX              MFM PC AT FORMAT
03AC    C002                XMIT    02,AUX              MFM PC9 FORMAT
03AD    C002        EVERLG  XMIT    02,AUX              MFM PC8 FORMAT
                *
03AE    CF54        IMOK    SEL     SP12
03AF    DB84                XMIT    4,RDR               INIT RETRIES COUNTERS
03B0    DF84                XMIT    4,SKR
03B1    E1F0                JMP     SYNC1
03B2    E3F0        WST14X  JMP     WST14
03B3    E3CE        WST11X  JMP     WST11
03B4    E3D0        WST12X  JMP     WST12
                *
03B5    C01A        SECMAX  XMIT    26,AUX              8"FORMAT
03B6    C00F                XMIT    15,AUX              AT FORMAT
03B7    C009                XMIT    9,AUX               PC9 FORMAT
03B8    C008        ESCMAX  XMIT    8,AUX               PC8 FORMAT
                *
03B9    CF4D        NOWR    SEL     SP9
03BA    BE32        TSTAT   NZT     THER,WST14X
03BB    BF33                NZT     PROGER,WST11X
03BC    BD34                NZT     FTP,WST12X
                *
03BD    CF51                SEL     SP9                 ASK READ LENGTH FROM ID
03BE    194A                MOVE    DATLID,R12            STORE IN WORKING R12
03BF    CF5B                SEL     MODE                ACTIVE MODE REGISTER
03C0    BD2A                NZT     FM,FMODUL           SIMPLE FREQUENCY MODULATION
03C1    CF48                SEL     SP0                 NO,ASK MFM COMAND DATA LENGTH
03C2    B926                NZT     DN1,DEV81           WHICH DRIVE ?
03C3    CF4B                SEL     SP3                 ;DRIVE 0
03C4    1A40                MOVE    SETF0,AUX           ASK FORMAT DATA LENGTH
03C5    E3C8                JMP     FEAT8               ASK DATA LENGTH
03C6    CF4B        DEV81   SEL     SP3                 ;DRIVE 1
03C7    1D40                MOVE    SETF1,AUX           ASK FORMAT DATA LENGTH
03C8    80AA        FEAT8   XEC     VERLG(AUX)          VERIFY LENGTH INIT
03C9    E3CB                JMP     TESTLG              TEST LENGTH OPERATION
                *
03CA    C000        FMODUL  XMIT    00,AUX              FM 128 BYTES INIT
03CB    6A00        TESTLG  XOR     R12,AUX
03CC    A0B3                NZT     AUX,WST11X          IDEM ?
03CD    E3E3                JMP     WSTOK               YES,GO ON

                ************************************************
                *                                              *
                *           STATUS LOOP                        *
                *                                              *
                *             PREPARE AND WAIT TO SEND  STATUS *
                *                                              *
                ************************************************
                *
        03CE    WST11   EQU     *
03CE    C0EF                XMIT    11101111B,AUX       PROGRAM ERROR
03CF    E400                JMP     ST6
03D0    C0F7        WST12   XMIT    11110111B,AUX       FULL TRACK PROCESSED
03D1    E3E4                JMP     ST2
03D2    CF4C        WST05   SEL     SP4
03D3    BF15                NZT     SP4,*+2
03D4    E3D7                JMP     WST05X
03D5    C915                CALL    NOTOP
03D6    E6FC
03D7    CF57        WST05X  SEL     SP15                SECTOR NOT FOUND
03D8    C1F9                XMIT    11111001B,R1
03D9    BA3E                NZT     32H,1,ST1           SEEK COMMAND ?
03DA    C1FB        WST05Y  XMIT    11111011B,R1        NO
03DB    C0FF                XMIT    11111111B,AUX
03DC    E3E5                JMP     ST4
03DD    C1FD        WST06   XMIT    11111101B,R1        SEEK ERROR
03DE    CF48        ST1     SEL     SP0
03DF    C049                XMIT    111H,AUX
03E0    394F                ADD     DNX,IVR
03E1    D821                XMIT    1,PNC
03E2    E3F5                JMP     ST3
03E3    C0FF        WSTOK   XMIT    11111111B,AUX       STATUS OK
03E4    C1FF        ST2     XMIT    11111111B,R1
03E5    CF4E        ST4     SEL     SP6
03E6    B828                NZT     DDAM,*+2
03E7    E3EC                JMP     ST5
03E8    CF53                SEL     SP11
03E9    011F                MOVE    R1,SP11
03EA    DC20                XMIT    0,34H,1
03EB    1F01                MOVE    SP11,R1             DELETED DATA A.M.
03EC    CF4E        ST5     SEL     SP6
03ED    1922                MOVE    FR,R2
03EE    6260                XOR     R2(3),AUX           RETRY
```


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```
03EF  E401            JMP     ST7
03F0  C0FD  WST14     XMIT    11111101B,AUX          THROUPUT ERROR
03F1  E3E4            JMP     ST2
      03F2  WST13     EQU     *                      /
03F2  C0FB            XMIT    11110011B,AUX          DATA FAULT OR DATA AM NOT FOUND
03F3  E3E4            JMP     ST2
03F4  C1FE  WST07     XMIT    11111110B,R1           WRITE PROTECTED
03F5  C0FF  ST3       XMIT    11111111B,AUX
03F6  E3EC            JMP     ST5
03F7  0000            NOP                            !
      03F8  WST01     EQU     *
03F8  C916            CALL    FLASET
03F9  E713
03FA  C1BF            XMIT    10111111B,R1
03FB  C0FF            XMIT    11111111B,AUX
03FC  E401            JMP     ST7
      03FD  WST15     EQU     *
03FD  C917            CALL    FLASET
03FE  E713
03FF  C0FE            XMIT    11111110B,AUX        NOT OPERABLE
0400  C1FF  ST6       XMIT    11111111B,R1
0401  CF48  ST7       SEL     SP0
0402  1924            MOVE    DN1,R4
      0403  ST8       EQU     *
0403  6440            XOR     R4(2),AUX              DRIVE NUMBER ( BITS 08-09 )
0404  C77F            SEL     BOL
0405  0117            MOVE    R1,BOL                 STATUS  BITS 00-07
0406  C7BF            SEL     BOR
0407  0017            MOVE    AUX,BOR                STATUS  BITS 08-15
0408  C7EE            SEL     FFZTES
0409  D381            XMIT    INZ1,FFZ               FORCE EXEC STATE
040A  D388            XMIT    CIOZ0,FFZ
040B  D384            XMIT    ECHZ1,FFZ              SEND INTERRUPT
040C  D382            XMIT    INZ0,FFZ               GO TO WST STATE
040D  B22F            NZT     ECHN,*+2
040E  E40D            JMP     *-1                    WAIT FOR SST
040F  E012            JMP     SCAN
                      *
                      *
                      *
                      *
                      *SET FORMAT COMMAND,IF SPEED IS DIFFERENT, SET UNKNOWN HEAD POSITION
0410  C7F7  FORSET    SEL     BIL                  ASK BIO MSB
0411  1704            MOVE    BIL,R4               TAKE BIO MSB
0412  B134            NZT     21H,1,OK1            VERIFY BIT 1
0413  E3CE            JMP     WST11                COMMAND BIT NOT NULL
0414  C0FF  OK1       XMIT    -1,AUX               1'S COMPLEMENT VALUE
0415  6404            XOR     R4,R4                R4/
0416  C080            XMIT    10000000B,AUX        MASK BIT 0
0417  440A            AND     R4,R12               TAKE BIT 0
0418  0AEA            MOVE    R12(7),R12           IN BIT 7 POSITION
0419  C003            XMIT    0011B,AUX            MASK BITS 6-7
041A  1345            MOVE    23H,2,R5             TAKE BIO/ 2-3 BIT
041B  A51D            NZT     R5,OK23             VERIFY 11/ VALUE
041C  E3CE            JMP     WST11                VALUE/ =11
041D  4485  OK23      AND     R4(4),R5             TAKE COMMAND 2-3
041E  C018            XMIT    11000B,AUX              MASK BITS X4-X3
041F  44A4            AND     R4(5),R4                SAVE X4-X3
0420  C7FB            SEL     BIR                  SELECT BIO LSB
0421  1706            MOVE    BIR,R6               TAKE BIO LSB
0422  B324            NZT     23H,1,OK11           TEST BIT 11
0423  E3CE  PBM11     JMP     WST11                COMMAND BIT 11 SET
0424  C0FF  OK11      XMIT    -1,AUX               1'S COMPLEMENT VALUE
0425  6606            XOR     R6,R6                LSB COMMAND IN R6
0426  C0E0            XMIT    11100000B,AUX        MASK BIT 8-9-10
0427  4600            AND     R6,AUX               TAKE X2-X1-X0
0428  00A0            MOVE    AUX(5),AUX           IN BIT 5,6,7
0429  2404            ADD     R4,R4                X FIELD
042A  C0E6            XMIT    -26,AUX              MAX VALUE
042B  2400            ADD     R4,AUX               TEST X FIELD
042C  A823            NZT     OVF,PBM11            PROGRAM ERROR
042D  C003            XMIT    11B,AUX             MASK SETFOR
042E  4646            AND     R6(2),R6                SETFOR IN R6
042F  A632            NZT     R6,VERIFF            VERIFY FIELD
0430  E437            JMP     ECMA                 ECMA:VALUE AUTHORISED
0431  E447  FOR1X     JMP     FOR1
0432  C000  VERIFF    XMIT    00,AUX               CLEAR AUX
0433  2400            ADD     R4,AUX               ADD FIELD X
0434  2500            ADD     R5,AUX               ADD FT
0435  2A00            ADD     R12,AUX              ADD BDC
0436  A023            NZT     AUX,PBM11            ONLY ZEROES AUTHORISED
0437  CC00  ECMA      XMIT    00,R14               CLEAR FOR TEST
0438  CF48            SEL     SP0
0439  B931            NZT     DN1,FOR1X
043A  CF52  FOR0      SEL     SP10                  :DRIVE 0
043B  04BF            MOVE    R4,SKEW0              STORE PARAMETERS
043C  0559            MOVE    R5,FT0
043D  0A3A            MOVE    R12,BDC0
```


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```
043E  CF4B            SEL     SP3
043F  1A40            MOVE    SETF0,AUX          SAVE OLD FORMAT
0440  065A            MOVE    R6,SETF0           SET NEW FORMAT VALUE
0441  660C            XOR     R6,R14             CHANGE SPEED AT NEXT CIO ?
0442  AC44            NZT     R14,ZNPC           TEST MSB OF SET FORMAT
0443  E3E3            JMP     WSTOK              COMMAND OK.
0444  CF49  ZNPC     SEL     SP1
0445  D821            XMIT    1,PNC              SET POSITION NOT KNOWN
0446  E3E3            JMP     WSTOK              COMMAND OK
0447  CF53  FOR1     SEL     SP11              :DRIVE 1
0448  04BF            MOVE    R4,SKEW1          STORE PARAMETERS
0449  0559            MOVE    R5,FT1
044A  0A3A            MOVE    R12,BDC1
044B  CF4B            SEL     SP3
044C  1D40            MOVE    SETF1,AUX          SAVE OLD FORMAT
044D  065D            MOVE    R6,SETF1           SET NEW FORMAT VALUE
044E  660C            XOR     R6,R14             CHANGE SPEED AT NEXT CIO ?
044F  AC51            NZT     R14,NPNC          TEST MSB OF SET FORMAT
0450  E3E3            JMP     WSTOK              COMMAND OK.
0451  CF4A  NPNC     SEL     SP2
0452  D821            XMIT    1,PNC              SET POSITION UNKNOWN
0453  E3E3            JMP     WSTOK              COMMAND OK.
                *
                *
                ********************************************************************
                *                    WRIFOR:WRITE FORMAT COMMAND                   *
                *                                                                  *
                *                                                                  *
                ********************************************************************
                *
0454  D921  WRIFOR  XMIT    1B,31H,1           WRITE FORMAT COMMAND IN SP15
0455  C0FF            XMIT    -1,AUX             1'S COMPLEMENT VALUE
0456  C7F7            SEL     BIL                SELECT BIO LEFT
0457  7700            XOR     BIL,AUX            TAKE TRUE VALUE:BIO/
0458  0061            MOVE    AUX(3),R1          RIGHT SHIFT 3
0459  0022            MOVE    AUX(1),R2          RIGHT SHIFT 1
045A  C001            XMIT    00000001B,AUX      MASK Y0
045B  4202            AND     R2,R2              TAKE Y0
045C  C01E            XMIT    00011110B,AUX      MASK Y4_Y3_Y2_Y1
045D  4100            AND     R1,AUX             TAKE Y4_Y3_Y2_Y1
045E  2202            ADD     R2,R2              TAKE Y4_Y3_Y2_Y1_Y0
045F  C0E6            XMIT    -26,AUX            MAX AUTHORISED VALUE
0460  2200            ADD     R2,AUX             TEST Y FIELD
0461  A876            NZT     OVF,FAULT          WST11 IF > 25.
0462  CF4E            SEL     SP6                SELECT COMMAND SECT REGISTER
0463  02BF            MOVE    R2,ITL             STORE INTERLACE VALUE
                *
0464  CF48            SEL     SP0                WHICH DRIVE ?
0465  B92A            NZT     DN1,DEVF01
0466  CF52  DEVF00   SEL     SP10               DRIVE 0
0467  1944            MOVE    FT0,R4             TAKE FORMAT TYPE
0468  1A2A            MOVE    BDC0,R12           TAKE  BLANK CHECK
0469  E46D            JMP     FEATF1
046A  CF53  DEVF01   SEL     SP11               DRIVE 1
046B  1944            MOVE    FT1,R4             TAKE FORMAT TYPE
046C  1A2A            MOVE    BDC1,R12           TAKE  BLANK CHECK
046D  CF4E  FEATF1   SEL     SP6                STORE FOR WORK
046E  0459            MOVE    R4,FT              STORE FORMAT TYPE
046F  0A3A            MOVE    R12,BDC            STORE CHECK TYPE
0470  C001            XMIT    01B,AUX            MASK LSB OF TYPE
0471  040A            MOVE    R4,R12             SAVE VALUE
0472  4404            AND     R4,R4              TAKE LSB IN R4
0473  CF5C            SEL     COMAND             ACTIVE OUTPUT REGISTER
0474  0439            MOVE    R4,H1SEL           SELECT NEEDED HEAD
0475  E094            JMP     BLIND              GOTO SEEK ACTION
0476  E3CE  FAULT    JMP     WST11              PROGRAM ERROR STATUS
                *
0477  CF4E  ALGO     SEL     SP6                SELECT WORKING VALUES
0478  1A20            MOVE    BDC,AUX
0479  A092            NZT     AUX,ERASE          FORCED FORMAT ?
047A  E1DC            JMP     READBY             NO,CHECK RECORDED PULSES
                *
                *
047B  2404  WAITBY   ADD     R4,R4              DECREMENT TIMING LOOP
047C  A482            NZT     R4,SEARCH          TIMER OUT ?
047D  E489            JMP     OSIDE              YES,CHECK OTHER SIDE IF NEEDED
047E  CF5F  SBYTRA   SEL     DATA                RESET BYTRA FLAG
047F  CF5F            SEL     DATA
0480  C0FF            XMIT    -1,AUX              DECREMENT VALUE
0481  C41E            XMIT    30,R4               TIMER FOR # 48 US
0482  CF5A  SEARCH   SEL     CNTRL               INTERFACE REGISTER
0483  BE27            NZT     BYTRA,SEEBY        IF NO BYTE,WAIT
0484  CF5F            SEL     DATA                ASK DATA ,RESET BYTRA FLAG
0485  CF5F            SEL     DATA
0486  BF08            NZT     DATA,WARN13         IF #00,DATA FAULT
0487  E47B  SEEBY    JMP     WAITBY              IF 00 WAIT FULL 48 US
0488  E6C6  WARN13   JMP     WST13B               DATA FAULT REPORT STATUS
0489  AA92  OSIDE    NZT     R12,ERASE           IF FT=00 BDC CHECK DONE OK.
048A  CF5C            SEL     COMAND              CYLINDER FORMAT COMMAND
048B  1924            MOVE    H1SEL,R4            TAKE ACTUAL HEAD SELECTION
```


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048C  C001            XMIT    1B,AUX          INVERTED VALUE FOR BIT LSB
048D  6404            XOR     R4,R4           INVERT R4
048E  0439            MOVE    R4,H1SEL        SELECT ALTERNATE HEAD
048F  C004            XMIT    100B,AUX        FLAG SECOND CHECK
0490  2A0A            ADD     R12,R12         STORE FLAG
0491  E1DC            JMP     READBY          SET TIMING FOR NEXT READ CHECK
                      *
0492  CF4F  ERASE     SEL     SP7             ASK COMMAND CYLINDER
0493  1FE3            MOVE    COMCYL,R3       STORE IN R3
0494  CF4E            SEL     SP6             ASK COMMAND INTERLACE
0495  C0E7            XMIT    -25,AUX         TEST VALUE
0496  3FA0            ADD     COMSEC,AUX      TEST IF ITL=25
0497  A099            NZT     AUX,NOTHG       IF NOT DO NOTHING
0498  DFA0            XMIT    0B,COMSEC       ITL 25 FORCED TO 00
0499  C001  NOTHG     XMIT    1B,AUX          FLAG FIRST  TRACK
049A  CF48  TWOFAC    SEL     SP0             WHICH DRIVE ?
049B  B93E            NZT     DN1,DEVF31
049C  CF49            SEL     SP1             ;DRIVE 0
049D  E49F            JMP     FEATF3
049E  CF4A  DEVF31    SEL     SP2             ;DRIVE 1
049F  0038  FEATF3    MOVE    AUX,PNC         SET POSITION UN/KNOWN
04A0  03FF            MOVE    R3,CYLIND       SET CYLINDER FIELD
04A1  CF4E            SEL     SP6             ASK COMMAND FT
04A2  194A            MOVE    FT,R12          USE R12 FOR TEST
04A3  CF5C            SEL     COMAND
04A4  8AAC            XEC     SELHED(R12)     SELECT NEEDED HEAD
04A5  A0B4            NZT     AUX,PREPAR      IF FIRST TRACK;PREPAR
04A6  8AB0            XEC     TABFMT(R12)     SECOND TRACK TO FORMAT ?
04A7  CF4E            SEL     SP6             YES,FLAG EVENT
04A8  0059            MOVE    AUX,FT          THIRD RUN LEAD TO END
04A9  CF5C            SEL     COMAND          SELECT HEAD 1
04AA  D921            XMIT    1B,H1SEL
04AB  E4B4            JMP     PREPAR          PREPARE FORMAT PROCESS
                      *
04AC  D920  SELHED    XMIT    0B,H1SEL        SELECT HEAD 0
04AD  D920            XMIT    0B,H1SEL        SELECT HEAD 0
04AE  D921            XMIT    1B,H1SEL        SELECT HEAD 1
04AF  D921            XMIT    1B,H1SEL        SELECT HEAD 1
                      *
04B0  C003  TABFMT    XMIT    11B,AUX         FLAG FOR SECOND FACE TRACK
04B1  E4B3            JMP     END             TRACK SIDE 0 FORMATTED
04B2  E4B3            JMP     END             TRACK SIDE 1 FORMATTED
04B3  E6CB  END       JMP     WSTOKB             CYLINDER FORMATED
                      *
                      *       END    FORMAT FINISH
                      *
                      *PREPARE FORMAT WRITTING PROCESS
                      *
04B4  CF5B  PREPAR    SEL     MODE            ACTIVATE 8X330
04B5  D921            XMIT    1B,READN        ON CRISTAL SYNCHRONISATION
04B6  DD20            XMIT    0B,FM           PRESELECT MFM MODE
04B7  CF5C            SEL     COMAND          8X330 COMMAND
04B8  0000            NOP
04B9  1920            MOVE    H1SEL,AUX       INVERT INTERFACE SIGNAL
04BA  CF4F            SEL     SP7             ASK COMMAND CYLINDER
04BB  1FEA            MOVE    COMCYL,R12
04BC  CF50            SEL     SP8             ID REGISTER 1
04BD  0038            MOVE    AUX,SIDID       SET SIDE IDENTIFIER
04BE  0AFF            MOVE    R12,CYLID       SET CYLINDER IDENTIFIER
04BF  2A0A            ADD     R12,R12         TEST IF TRACK 0
04C0  C001            XMIT    1B,AUX          PRESET DATA LENGTH=01
04C1  AAC5            NZT     R12,MODFM       IF NOT TRACK 0;MFM OK
04C2  CF5B            SEL     MODE            FM MODE
04C3  DD21            XMIT    1B,FM
04C4  C000            XMIT    00B,AUX         DATA LENTH=00
04C5  CF51  MODFM     SEL     SP9             ID REGISTER 2
04C6  0059            MOVE    AUX,DATLID      SET DATA LENGTH IDENTIFIER
04C7  CF5A            SEL     CNTRL           8X330 CONTROLS
04C8  DB66            XMIT    110B,33H,3      CRCE=DCMXN=1;SYNE=0,
04C9  CD01            XMIT    1B,R15          DELAY TIME PARAMETER
04CA  C918            CALL    MIC500          500 US MIN DELAY
04CB  E702
                      *
                      *
04CC  CF4F  PREPRO    SEL     SP7             ASK COMMAND CYLINDER
04CD  1FE4            MOVE    COMCYL,R4       TAKE VALUE
                      *
                      *FIND THE TRACK_SKEW VALUE IN FUNCTION OF COMMAND CYLINDER
                      *AND IN FUNCTION OF COMMAND SKEW
                      *
04CE  C200            XMIT    00B,R2          TRACK SKEW INIT TO 0,
04CF  CF48            SEL     SP0             WHICH DRIVE ?
04D0  B933            NZT     DN1,DEVF41
04D1  CF52            SEL     SP10            ASK SKEW PARAMETER 0
04D2  E4D4            JMP     FEATF4
04D3  CF53  DEVF41    SEL     SP11            ASK SKEW PARAMETER 1
04D4  1FA0  FEATF4    MOVE    SKW,AUX         TAKE SKEW
04D5  A0D7            NZT     AUX,COMPUT      IF NOT NULL;COMPUTE
04D6  E4E3            JMP     VAL7            SKEW NULL ASK NB VALUES IN SET
04D7  A4D9  COMPUT    NZT     R4,CMPUTE       IF TRACK#0; COMPUTE
```


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04D8  E4E3              JMP     VAL7            ASK NUMBER OF VALUES IN SET
04D9  1FA0  CMPUTE      MOVE    SKW,AUX         TAKE SKEW VALUE
04DA  2202              ADD     R2,R2           INCREMENT TRACK_SKEW BY SKW
04DB  C0E6              XMIT    -26,AUX         MODULO 26 TEST
04DC  2200              ADD     R2,AUX          TRACK_SKEW -26
04DD  A8DF              NZT     OVF,KPSUB       IF TRACK_SKEW >25
04DE  E4E0              JMP     MORTRA          TEST IF ALL TRACKS PROCEED
04DF  0002  KPSUB       MOVE    AUX,R2          KEEP SUBSTRACTION
04E0  C0FF  MORTRA      XMIT    -1,AUX          DECREMENT VALUE
04E1  2404              ADD     R4,R4           TEST IF ALL TRACKS PROCEED
04E2  E4D7              JMP     COMPUT          R4=0 IF ALL TRACKS PROCEED.
                        *
                        *FIND THE NUMBER OF SIGNIFICANT VALUES IN THE SET IN FUNCTION OF
                        *THE INTERLACE FACTOR
                        *
04E3  CF4E  VAL7        SEL     SP6             ASK ITL VALUE
04E4  C0F1              XMIT    -15,AUX         TWO WAYS OF DESCRIBING THE SET
04E5  3FA0              ADD     ITL,AUX         COMPARE AUX WITH 15 VALUE
04E6  A8EA              NZT     OVF,DECMT       IF NOT ITL >= 15
04E7  C101  INCRMT      XMIT    1,R1            0<ITL>15,INCREMENT PROCESS
04E8  1FA3              MOVE    ITL,R3          VAL7= ITL
04E9  E4F1              JMP     INVERT
04EA  A0EC  DECMT       NZT     AUX,DECRMT       IF NOT ITL >15
04EB  E4E7              JMP     INCRMT          INCREMENT PROCESS
04EC  C1FF  DECRMT      XMIT    -1,R1           ITL>15 DECREMENT PROCESS
04ED  1FA0              MOVE    ITL,AUX         TAKE INTERLACE
04EE  6100              XOR     R1,AUX          1'S COMPLEMENT ITL
04EF  C319              XMIT    25,R3           PREPARE TWO COMPLEMENT
04F0  2303              ADD     R3,R3           NBVAL7=24-ITL
04F1  C0FF  INVERT      XMIT    -1,AUX          1'S COMPLEMENT
04F2  6303              XOR     R3,R3           R3/
04F3  C001              XMIT    1,AUX           2'S COMPLEMENT
04F4  2303              ADD     R3,R3           ;-R3,R3=-VAL7
                        *
                        *PRESET POINTERS ACCORDING TO TRACK SKEW
                        *
04F5  C4FF  PREPTR      XMIT    -1,R4           PRESET INTER_STEP COUNTER
04F6  0100              MOVE    R1,AUX          TAKE IN/DE_CREMENT VALUE
04F7  6400              XOR     R4,AUX          PRESET TO INVERTED VALUE(R4=-1)
04F8  C601              XMIT    1,R6            2'S COMPLEMENT VALUE
04F9  2606              ADD     R6,R6           R6 PRESET TO -(R1)
04FA  0205              MOVE    R2,R5           TAKE TRACK SKEW
04FB  A5FD              NZT     R5,BEGPPT       IF NOT NULL BEGIN PRESET POINTERS
04FC  E508              JMP     INVR2           TRACK SKEW NULL
04FD  C0FF  BEGPPT      XMIT    -1,AUX          1'S COMPLEMENT VALUE
04FE  6505              XOR     R5,R5           R5/
04FF  C01A              XMIT    26,AUX          PREPARE 2'S COMPLEMENT
0500  2505              ADD     R5,R5           ;25-TRACK SKEW
0501  A50D  MAKSTP       NZT     R5,DESCRI       DESCRIBE  THE SET VALUE
0502  C400  SDORDR       XMIT    0,R4            CLEAR INTER_STEP COUNTER
0503  0100              MOVE    R1,AUX          TAKE IN/DE_CREMENT VALUE
0504  2606              ADD     R6,R6           VALIDATE SECOND ORDER SET FLAG
0505  C0FF  TSTEND      XMIT    -1,AUX          DECREMENT VALUE
0506  2505              ADD     R5,R5           DECREMENT R5
0507  A50D              NZT     R5,DESCRI       END OF PREPROCESS ?
0508  C0FF  INVR2       XMIT    -1,AUX          1'S COMPLEMENT VALUE
0509  6202              XOR     R2,R2           R2/
050A  C001              XMIT    1,AUX
050B  2202              ADD     R2,R2           ;-(R2).R2=-(TRACK SKEW)
050C  E515              JMP     DETIND          PRESETING DONE,DETECT RISING INDEX
                        *
050D  0300  DESCRI      MOVE    R3,AUX          COMPARE ISFC / -VAL7
050E  A310              NZT     R3,COMP1        ITL=0 ?
050F  E502              JMP     SDORDR          YES:INCREMENT ONLY SET ORDER
0510  2400  COMP1       ADD     R4,AUX          PRIMARY SET  DESCRIBED ?
0511  A802              NZT     OVF,SDORDR      IF NOT,TAKE SECOND ORDER
0512  C001              XMIT    1,AUX           INCREMENT VALUE
0513  2404              ADD     R4,R4           INCREMENT ISFC
0514  E505              JMP     TSTEND          VERIFY IF END
                        *
                        *
                        *DETECT RISING EDGE OF INDEX SIGNAL
                        *COMUTE THE WRITE ENABLE GATE OF SELECTED DRIVE
                        *
0515  CF5B  DETIND       SEL     MODE            WHICH CODE ?
0516  BD39              NZT     FM,GAPIFM       IF 1,FM GAP INDEX
0517  CE4E              XMIT    4EX,R16
0518  E51A              JMP     RISIND          RISING INDEX DETECTION
0519  CEFF  GAPIFM      XMIT    OFFX,R16
051A  1D2A  RISIND      MOVE    FM,R12          TAKE FLAG
051B  C5FF              XMIT    -1,R5           INITIATE SECTOR STEP COUNTER
051C  CD01              XMIT    1,R15           FLAG INDEX DETECTED
051D  C000              XMIT    0,AUX           FIRST LOOP COUNTER
051E  0008              MOVE    AUX,R13
051F  C001              XMIT    1,AUX           INCREMENT VALUE
0520  CC00              XMIT    0,R14           SECOND LOOP COUNTER
0521  CF5D  INCURL       SEL     STATUS          ASK READY STATE
0522  BA27              NZT     READYN,OPERPB   IF NOT READY PB OPERABLE
0523  CF5A              SEL     CNTRL           ASK INDEX LINE STATE
0524  BF28              NZT     INDN,FLALOW     IF NOT FLAG INDEX INACTIVE
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0525  AD29                NZT     R15,SAMIND          IF NOT SAME INDEX
0526  E538                JMP     GATWRI              VALIDATE WRITE GATE
                  **************
0527  E3FD      OPERPB    JMP     WST15               DRIVE NOT  OPERABLE
0528  CD00      FLALOW    XMIT    0,R15               FLAG INDEX INACTIVE STATE
0529  2B0B      SAMIND    ADD     R13,R13             INCREMENT FIRST COUNTER
052A  A82C                NZT     OVF,SCDLOP          IF 1,INCREMENT SECOND LOOP
052B  E521                JMP     INCURL              MAKE OTHER CURL
052C  2C0C      SCDLOP    ADD     R14,R14             INCREMENT SECOND COUNTER
052D  A82F                NZT     OVF,MORTIM          IF 1 WAIT MORE TIME
052E  E521                JMP     INCURL              MAKE OTHER CURL
052F  CCFF      MORTIM    XMIT    -1,R14              DECREMENT VALUE
0530  2C0C                ADD     R14,R14             TEST IF TWO RUNS
0531  AC27                NZT     R14,OPERPB          NOT OPERABLE INDEX
0532  C002                XMIT    2,AUX               SPECIAL INCREMENT VALUE
0533  E521                JMP     INCURL              MAKE OTHER CURL
                  *
                  *
0534  CE4E      GPV1      XMIT    4EX,R16             GAP MFM VALUE
0535  CEFF                XMIT    0FFX,R16            GAP FM VALUE
                  *
0536  CD4E      LENGAP    XMIT    78,R15              MFM 80 BYTES(1 BYTE LATE)
0537  CD26                XMIT    38,R15              FM 40 BYTES(1 BYTE LATE)
                  ***************************START FORMAT*********
0538  CF5A      GATWRI    SEL     CNTRL               OUTPUT LINES
0539  8A36                XEC     LENGAP(R12)
053A  D820                XMIT    0B,WEN              ENABLE WRITE GATE
053B  C0FF                XMIT    -1,AUX              DECREMENT VALUE
053C  C919      SENDBY    CALL    PURGBY
053D  E74D
053E  C91A      FIELD2    CALL    SYNCRZ              WRITE ZERO SYNCHRO BYTES
053F  E758
                  *SEND INDEX**************************
0540  AA43                NZT     R12,R15V11           FM ? / MFM ?
0541  CD08                XMIT    8,R15               MFM
0542  E544                JMP     SENDIN
0543  CD0B      R15V11    XMIT    11,R15               FM
0544  C91B      SENDIN    CALL    MARKAD              WRITE INDEX MARK FIELD
0545  E767
0546  CF5A                SEL     CNTRL
0547  DB21                XMIT    1B,SYNE             STOP CRC COMPUTE
0548  8A34                XEC     GPV1(R12)           TAKE GAP VALUE
                  *
0549  E5BE                JMP     STRSEC              START TO SEND BEGINING OF SECTOR
                  ************************************
054A  CD2D      FILLSE    XMIT    45,R15              46 MFM BYTES REMAINING
054B  CD15                XMIT    21,R15              22 FM BYTES REMAINING
                  *
054C  8A4A      PREAMB    XEC     FILLSE(R12)         ASK REMAINING BYTES
054D  C0FF      BYREST    XMIT    -1,AUX
054E  C91C                CALL    TRANSM              4 BYTES SENT
054F  E74B
0550  C91D                CALL    SYNCRZ              SEND SYNCHRO ZEROES
0551  E758
0552  AA55                NZT     R12,R15V21          FM ?/MFM ?
0553  CD12                XMIT    18,R15              MFM
0554  E556                JMP     SENDID
0555  CD15      R15V21    XMIT    21,R15              FM
0556  CC00      SENDID    XMIT    0,R14               FLAG IDENT @M FOR MFM
0557  C91E                CALL    MARKAD              SEND IDENTIFIER
0558  E767
0559  CF50                SEL     SP8
055A  1FEE                MOVE    CYLID,R16
055B  C91F                CALL    TRANSM
055C  E74B
055D  CF50                SEL     SP8
055E  182E                MOVE    SIDID,R16
055F  C920                CALL    TRANSM
0560  E74B
0561  CF51                SEL     SP9
0562  1FAE                MOVE    SECTID,R16
0563  C921                CALL    TRANSM
0564  E74B
0565  CF51                SEL     SP9
0566  194E                MOVE    DATLID,R16
0567  C922                CALL    TRANSM
0568  E74B
0569  C923                CALL    SNDCRC               SEND CRC BYTES
056A  E79A
056B  8A34                XEC     GPV1(R12)           ASK GAP VALUE
056C  AA6F                NZT     R12,FGAP3            ASK GAP3 LENGTH
056D  CD15                XMIT    21,R15              MFM 22 BYTES
056E  E570                JMP     GAP3RE
056F  CD0A      FGAP3     XMIT    10,R15              FM 11 BYTES
0570  C924      GAP3RE    CALL    TRANSM
0571  E74B
0572  C925                CALL    SYNCRZ               SEND SYNCHRO ZEROES
0573  E758
0574  AA77                NZT     R12,R15V24
0575  CD12                XMIT    18,R15
0576  E578                JMP     SENDDA
```


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```
0577  CD18        R15V24   XMIT    24,R15
0578  CC01        SENDDA   XMIT    1,R14              FLAG DATA @ MARK FOR MFM
0579  C926                 CALL    MARKAD             SEND DATA FIELD
057A  E767
057B  AA7E                 NZT     R12,R15127
057C  CDFF                 XMIT    255,R15
057D  E57F                 JMP     SENDNB
057E  CD7F        R15127   XMIT    127,R15
057F  0D0E        SENDNB   MOVE    R15,R16
0580  C927                 CALL    TRANSM
0581  E74B
0582  C928                 CALL    SNDCRC
0583  E79A
0584  CE00                 XMIT    0,R16
0585  C929                 CALL    TRANSM
0586  E74B
0587  8A34                 XEC     GPV1(R12)
0588  AA8D                 NZT     R12,FMTER
0589  CE4E                 XMIT    4EX,R16
058A  CD02                 XMIT    2,R15              SEND THREE FIRST BYTES MFM
058B  C92A        MFMTER   CALL    TRANSM
058C  E74B
058D  E5BE        FMTER    JMP     STRSEC             LOOP TO NEXT SECTOR
                  ************************************
                  *
058E  C0A6        FINAL1   XMIT    0A6X,AUX             % 598__+4 /MFM
058F  C006                 XMIT    06X,AUX            % 247__+2 /FM
                  *
0590  C0AF        FINAL2   XMIT    0AFX,AUX             % 598__-4 /MFM
0591  C00B                 XMIT    0BX,AUX            % 247__-2 /FM
                  *
0592  C2FC        CLEAN    XMIT    -4,R2              MFM
0593  C2FD                 XMIT    -3,R2              FM
0594  CD30        TRPART   XMIT    48,R15             REMAINS 49 MFM
0595  CD18                 XMIT    24,R15             REMAINS 25 FM
                  *
                  *          *******SAGA     JMP      SDAGAI
                  *
0596  0000                 NOP
0597  0000                 NOP
0598  C0FF        TRAGAP   XMIT    -1,AUX             ONE BYTE SENT
0599  8A94                 XEC     TRPART(R12)        TAKE FIRST PART OF TRACK GAP
059A  C92B        REMTG    CALL    TRANSM             SEND FIRST PART
059B  E74B
                  *
059C  C001                 XMIT    1,AUX              INCREMENT VALUE
059D  CC00                 XMIT    0,R14              INIT SPY COUNTER
059E  CD00                 XMIT    0,R15              ONLY ONE BYTE SEND AT A TIME
059F  CF5A        LINDEX   SEL     CNTRL
05A0  BF35                 NZT     INDN,SDAGAI
05A1  8A92                 XEC     CLEAN(R12)
05A2  C92C        SDCLEA   CALL    TRANSM
05A3  E74B
05A4  2202                 ADD     R2,R2
05A5  A2A2                 NZT     R2,SDCLEA
05A6  CF5A                 SEL     CNTRL
05A7  D821                 XMIT    1B,WEN               SWITCH OFF WRITE ENABLE
05A8  8A8E                 XEC     FINAL1(R12)          TAKE SLOW SPEED TEST
05A9  2C00                 ADD     R14,AUX              COMPARE
05AA  A8AD                 NZT     OVF,SPEED
05AB  8A90                 XEC     FINAL2(R12)          TAKE HIGH SPEED TEST
05AC  2C00                 ADD     R14,AUX              COMPARE
05AD  CF4C        SPEED    SEL     SP4                !!!!!!!!!
05AE  001F                 MOVE    AUX,SP4            !!!!!!!!!
05AF  A8B1                 NZT     OVF,TERMI
                  *
                  * SPEED    JMP      WST15                SPEED PROBLEM DURING WRITING
                  *
05B0  0000                 NOP
05B1  C000        TERMI    XMIT    0,AUX              RETURN VALUE
05B2  CF50                 SEL     SP8                RESTORE COMMAND CYLINDER
05B3  1FE3                 MOVE    CYLID,R3             IN R3
05B4  E49A                 JMP     TWOFAC             SECOND FACE TO PROCEED ?
                  ************************************
05B5  C92D        SDAGAI   CALL    TRANSM
05B6  E74B
05B7  2C0C                 ADD     R14,R14              INCREMENT SPY COUNTER
05B8  CF5D                 SEL     STATUS
05B9  BA3B                 NZT     READYN,INWPB         NOT OPERABLE
05BA  E59F                 JMP     LINDEX
                  **********
                  **********
05BB  CF5A        INWPB    SEL     CNTRL
05BC  D821                 XMIT    1B,WEN             DISABLE WRITE GATE
05BD  E3FD                 JMP     WST15              SEND NOT OPERATIONNAL STATUS
```


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```
                    **********
                    *
05BE    CD00        STRSEC  XMIT    0,R15
05BF    C92E                CALL    TRANSM          A01 :TRANSMIT CONTENT OF R16
05C0    E74B
05C1    C001                XMIT    1,AUX           INCREMENT VALUE
05C2    2505                ADD     R5,R5           INCREMENT SECTEUR COUNT
05C3    C0E6                XMIT    -26,AUX         VERIFY IF LAST
05C4    2500                ADD     R5,AUX               SECTOR PROCEED
05C5    A0C7                NZT     AUX,DETRSK      DETECT TRACK SKEW VALUE
05C6    E598                JMP     TRAGAP          LAST SECTOR PROCEED
05C7    0200        DETRSK  MOVE    R2,AUX          TAKE TEST VALUE
05C8    2500                ADD     R5,AUX          TEST IF TRACK SKEW REACHED
05C9    0000                NOP
05CA    A0CC                NZT     AUX,SERIAL      IF NOT NORMAL SERIE
05CB    E5FD                JMP     VALSKW          SKEW VALUE REACHED
05CC    0300        SERIAL  MOVE    R3,AUX          TAKE ISFC
05CD    C92F                CALL    TRANSM          A02
05CE    E74B
05CF    A3D1                NZT     R3,SERI1        ITL=0 ?
05D0    E5D6                JMP     R4SUP           YES,INCREMENT ONLY Z FLAG
05D1    2400        SERI1   ADD     R4,AUX          COMPARE ISFC WITH -NBVAL7
05D2    A8D6                NZT     OVF,R4SUP
05D3    C001                XMIT    1,AUX           INCREMENT VALUE
05D4    2404                ADD     R4,R4           INCREMENT ISFC
05D5    E5DF                JMP     PROM
                    *
05D6    C400        R4SUP   XMIT    0,R4            CLEAR  ISFC
05D7    0100                MOVE    R1,AUX          TAKE IN/DE_CREMENT
05D8    2606                ADD     R6,R6           UPDATE Z FLAG
05D9    E5DF                JMP     PROM
                    *
05DA    CF51        PROMRT  SEL     SP9             ASK SECOND ID REGISTER
05DB    00BF                MOVE    AUX,SECTID      VALIDATE FIELD WITH SECTOR NUMBER
05DC    C930                CALL    TRANSM          A04
05DD    E74B
05DE    E54C                JMP     PREAMB          FINISH PREAMBULE
                    **********
                    *       PROM
05DF    CF4E        PROM    SEL     SP6             ASK INTERLACE FACTOR
05E0    1FA0                MOVE    ITL,AUX         TAKE FACTOR
05E1    80E3                XEC     ADRPT(AUX)      POINT TO ORIGIN OF VALUES
05E2    E60B                JMP     POINT
                    *
05FD    C931        VALSKW  CALL    TRANSM          B02
05FE    E74B
05FF    C601                XMIT    1,R6            FOR 2'S COMPLEMENTATION
0600    C4FF                XMIT    -1,R4           PRESET VALUE
0601    0100                MOVE    R1,AUX          TAKE IN/DE_CREMENT VALUE
0602    6400                XOR     R4,AUX          AUX=R1/
0603    2606                ADD     R6,R6           R6 PRESET FOR NEXT STEP
0604    CF51                SEL     SP9             ASK SECOND ID REGISTER
0605    DFA1                XMIT    1,SECTID        SECTOR IDENTIFIER=1
0606    C932                CALL    TRANSM          B03
0607    E74B
0608    C933                CALL    TRANSM          B04
0609    E74B
060A    E54C                JMP     PREAMB          FINISH SECTOR ID GAP
                    *
060B    C934        POINT   CALL    TRANSM          A03
060C    E74B
060D    2400                ADD     R4,AUX          ADD OFFSET TO POINT VALUE
060E    8011                XEC     SETVAL(AUX)     TAKE VALUE IN SET
060F    2600                ADD     R6,AUX          UPDATE WITH RANGE SET VALUE
0610    E5DA                JMP     PROMRT           RETURN PROM STORAGE AREA OF VALUES
                    ********************************************************************************
06C6    C935        WST13B  CALL     FLASET
06C7    E713
06C8    CF4E                SEL      SP6              CLEAN FLAGS FOR
06C9    DA60                XMIT     000B,32H,3       REPORT STATUS WST13
06CA    E3F2                JMP      WST13
06CB    CF4E        WSTOKB  SEL      SP6
06CC    DA60                XMIT     000B,32H,3
06CD    E3E3                JMP      WSTOK
06CE                        PROC    SSP
06CE    CF56                SEL     SP14
06CF    A5D5                NZT     R5,BRINDX
06D0    C0FF                XMIT    -1,AUX
06D1    3F1F                ADD     SP14,SP14
06D2    A8D4                NZT     OVF,*+2
06D3    E264                JMP     RETRY
06D4    C501                XMIT    1,R5
                            ENTRY   BRIND
        06D5        BRINDX  EQU     *
06D5    CF5A                SEL     CNTRL
06D6    DB64                XMIT    100B,33H,3
06D7    CF5B                SEL     MODE
```


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```
06D8  D921                XMIT    1,READN                 SAVE R11 ;2ND LEVEL SUBROUTIN
06D9  0903                MOVE    R11,R3
06DA  C936                CALL    MIC500
06DB  E702
06DC  0309                MOVE    R3,R11                  RESTORE R11
06DD  E7AD                RTN
                          END     SSP

                  *
                  *       SEARCH IF DRIVE SELECTED
                  *       HAS BEEN NOT READY
                  *      BEFORE EXECUTING CIO
                  *
                  ****************************************
                  *
06DE                      PROC    CODOK
06DE  C7FE                SEL     TEST            ->LEFT BANK
06DF  C003                XMIT    11B,AUX         DRIVE NUMBER MASK
06E0  7540                XOR     DNXN,AUX        TEST CIO NUMBER
06E1  B423                NZT     24H,1,*+2       DN1N MUST BE SET:
06E2  E3CE                JMP     WST11           DRIVE NB #0 OR 1
06E3  CF48                SEL     SP0             DRIVE NB OK
06E4  0059                MOVE    AUX,DNX         TRUE DRIVE NB IN DNX
06E5  B92D                NZT     DN1,STAT1       WHICH DRIVE ?
06E6  CF5C                SEL     COMAND          ->SELECT DRIVE 0
06E7  DB42                XMIT    10B,SELX
06E8  CF48                SEL     SP0
06E9  BE2B                NZT     HBNR0,STAT0
06EA  E6F6                JMP     OKCIO
06EB  BC34        STAT0   NZT     NOP0,NTOP0
06EC  E3F8                JMP     WST01
06ED  CF5C        STAT1   SEL     COMAND          -> SELECT DRIVE 1
06EE  DB41                XMIT    01B,SELX
06EF  CF48                SEL     SP0
06F0  BF32                NZT     HBNR1,STAT3
06F1  E6F6                JMP     OKCIO
06F2  BD34        STAT3   NZT     NOP1,NTOP0
06F3  E3F8                JMP     WST01
06F4  C937        NTOP0   CALL    NOTOP
06F5  E6FC
06F6  E7AD        OKCIO   RTN
                          END     CODOK
                  ************************************************************
                  *
                  *
06F7                      PROC    READYT
06F7  CF48                SEL     SP0
06F8  1924                MOVE    DN1,R4
06F9  CF5D                SEL     STATUS
06FA  BA3E                NZT     READYN,NOTOPX
06FB  E7AD                RTN                             RETURN
                          ENTRY   NOTOP
06FC  CF48                SEL     SP0
06FD  1924                MOVE    DN1,R4
06FE  C049        NOTOPX  XMIT    111H,AUX
06FF  240F                ADD     R4,IVR
0700  D821                XMIT    1,PNC
0701  E3FD                JMP     WST15
                          END     READYT
                  ****************************************
                  *                                      *
                  *                                      *
                  *       DELAY TIME ROUTINE             *
                  *                                      *
                  ****************************************
0702                      PROC    MIC500
0702  AD04                NZT     R15,MIC2                TRANSFERT VALUE =0 ?
0703  E70D                JMP     MIC3                    YES,RETURN.
0704  C0D0        MIC2    XMIT    208,AUX                 INIT MINOR LOOP
0705  CEFF        MIC1    XMIT    -1,R16                  DECREMENT VALUE
0706  0000                NOP                             USEFULL 395NS
0707  0000                NOP                             USEFULL 395NS
0708  2E00                ADD     R16,AUX                 DECREMENT MINOR COUNTER
0709  0000                NOP                             USEFULL 395NS
070A  A805                NZT     OVF,MIC1                MINOR TIME ELAPSED ? AUX=-1
070B  2D0D                ADD     R15,R15                 DECREMENT MAJOR COUNTER
070C  AD04                NZT     R15,MIC2                MAJOR TIME ELAPSED ? AUX=-1
070D  E7AD        MIC3    RTN                             YES,RETURN TO MAIN.
                          END     MIC500
                  *
                  ********************************
                  *
                  *       PROC PAGE-ERROR
                  *
                  ************************
```


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```
                        *
070E                            PROC    PAGERO
070E    0000                    NOP
070F    0000                    NOP
0710    0000                    NOP
0711    0000                    NOP
0712    E7AD            EXOK    RTN
                                END     PAGERO
                        *
                        *
                        **********************************
                        *
                        *       SET FLAGS NOPX,HBNRX
                        *
                        **********************************
                        *
0713                            PROC    FLASET
0713    CF48                    SEL     SP0
0714    B93A                    NZT     DN1,FSET1
0715    DE20            FSET0   XMIT    0B,HBNR0
0716    DC21                    XMIT    1B,NOP0
0717    CF49                    SEL     SP1
0718    D821                    XMIT    1B,PNC                  MODIF JULY 3 86
0719    E71E                    JMP     QUIT
071A    DF20            FSET1   XMIT    0B,HBNR1
071B    DD21                    XMIT    1B,NOP1
071C    CF4A                    SEL     SP2
071D    D821                    XMIT    1B,PNC
071E    E7AD            QUIT    RTN
                                END     FLASET
                        *
                        *
071F                            PROC    SHBNRX
071F    CF48                    SEL     SP0
0720    9D42                    XEC     TBS(35H,2)
0721    E7AD                    RTN
0722    DF43            TBS     XMIT    11B,37H,2
0723    DE21                    XMIT    1,36H,1
0724    DF21                    XMIT    1,37H,1
0725    E7AD                    RTN
                                END     SHBNRX
                        *
                        *
                        *
0726                            PROC    SHBNR0
0726    CF48                    SEL     SP0
0727    9C29                    XEC     TBS0(34H,1)
0728    E7AD                    RTN
0729    DE21            TBS0    XMIT    1,36H,1
072A    E7AD                    RTN
                                END     SHBNR0
                        *
                        *
                        *
072B                            PROC    SHBNR1
072B    CF48                    SEL     SP0
072C    9D2E                    XEC     TBS1(35H,1)
072D    E7AD                    RTN
072E    DF21            TBS1    XMIT    1,37H,1
072F    E7AD                    RTN
                                END     SHBNR1
                        ******************************************
                        *
                        *       SEARCH IF THE ALTERNATE DRIVE
                        *       IS NOT READY
                        *
                        ************************************************
                        *
0730                            PROC    RETNR
0730    DB84                    XMIT    4,RDR
0731    3F9F                    ADD     SKR,SKR
                                ENTRY   SHBNR
0732    CF5C                    SEL     COMAND
0733    BA3F                    NZT     SEL0,DRIV0
0734    DB42            DRIV1   XMIT    10B,SELX
0735    CF5D                    SEL     STATUS
0736    BA38                    NZT     READYN,INR0
0737    E73C                    JMP     HB0
0738    0902            INR0    MOVE    R11,R2
```


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```
0739  C938            CALL    SHBNR0
073A  E726
073B  0209            MOVE    R2,R11
073C  CF5C      HB0   SEL     COMAND
073D  DB41            XMIT    01B,SELX
073E  E749            JMP     DOUZ
073F  DB41      DRIV0 XMIT    01B,SELX
0740  CF5D            SEL     STATUS
0741  BA23            NZT     READYN,INR1
0742  E747            JMP     HB1
0743  0902      INR1  MOVE    R11,R2
0744  C939            CALL    SHBNR1
0745  E72B
0746  0209            MOVE    R2,R11
0747  CF5C      HB1   SEL     COMAND
0748  DB42            XMIT    10B,SELX
0749  CF54      DOUZ  SEL     SP12              IN CASE OF CALL BY RETRY
074A  E7AD            RTN
                      END     RETNR
                    ***********************************************
                    *              TRANSMIT DATA TO 8X330
                    * R15=(NB BYTES)-1 TO TRANSMIT AUX=-1
                    *IF R15=0 ONE TRANSMISSION(AUX NON SIGNIFICANT)
                    *R15=0 AT RETURN AUX UNCHANGED
                    *
074B                  PROC    TRANSM
074B  CF5A      SEEFLA SEL    CNTRL
074C  BE2B            NZT     BYTRA,SEEFLA            BYTRA DETECTED ?
                      ENTRY   PURGBY
074D  CF5F            SEL     DATA
074E  CF5F            SEL     DATA                    SET BYTRA FLAG
074F  CF5F            SEL     DATA
0750  0E1F            MOVE    R16,DATA                SEND DATA
0751  CF5A            SEL     CNTRL                    PREPARE 8X330
0752  D921            XMIT    1B,CRCE                  CRC NOT DATA SOURCE
0753  DA21            XMIT    1B,DCMXN                 ONLY DATA
0754  AD56            NZT     R15,CNTDWN               IF NOT NULL COUNT DOWN
0755  E7AD            RTN
0756  2D0D      CNTDWN ADD    R15,R15                 DECREMENT BYTES COUNTER
0757  E74B            JMP     SEEFLA
                      END     TRANSM
                    *
                    ***********************************************
                    *
                    *       WRITE ZERO SYNCHRO BYTES
                    *
                    * AT RETURN R15=0 AUX=-1
0758                  PROC    SYNCRZ
0758  8A65            XEC     SYNZER(R12)
0759  CF5A            SEL     CNTRL
075A  DB20            XMIT    0B,SYNE             CLEAR CRC REGISTERS
075B  CF5A      ZEROWR SEL    CNTRL
075C  BE3B            NZT     BYTRA,ZEROWR        WAIT FOR BYTRA
075D  CF5F            SEL     DATA
075E  CF5F            SEL     DATA                SET BYTRA FLAG
075F  CF5F            SEL     DATA
0760  C800            XMR     00000000B             GIVE VALUE
0761  2D0D            ADD     R15,R15
0762  AD5B            NZT     R15,ZEROWR
0763  E7AD            RTN
0764  0000            NOP
0765  CD0C      SYNZER XMIT   12,R15              SET FOR 12 ZEROES
0766  CD06            XMIT    6,R15               SET FOR 6 ZEROES
                      END     SYNCRZ
                    *
                    ****************************
                    *
0767                  PROC    MARKAD
0767  8D7B      GIVVAL XEC    CODVAL(R15)             ASK VALUE
0768  CF5A      ASKVAL SEL    CNTRL
0769  BE28            NZT     BYTRA,ASKVAL            BYTRA DETECTED
076A  CF5F            SEL     DATA
076B  CF5F            SEL     DATA                    SET BYTRA FLAG
076C  CF5F            SEL     DATA
076D  0E1F            MOVE    R16,DATA                SEND CODED VALUE
076E  2D0D            ADD     R15,R15                 INCREMENT POINTER
076F  CF5A            SEL     CNTRL               START CRC COMPUTATION
0770  DB65            XMIT    101B,33H,3          CRCE=1,DCMXN=0,SYNE=1
0771  E767            JMP     GIVVAL                  GO TO NEXT ACTION
0772  AC75      TSTEND NZT    R14,NBDA                IDENT OR DATA ?
0773  CD1B            XMIT    27,R15                  :IDENT MFM,
0774  E767            JMP     GIVVAL                   GIVE VALUE
0775  CD1E      NBDA  XMIT    30,R15                  :DATA MFM,
0776  E767            JMP     GIVVAL                   GIVE VALUE
0777  CD00      GORTN XMIT    0,R15                   ONE BYTE AT A TIME
0778  E7AD            RTN
0779  0000            NOP
077A  0000            NOP
```


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```
                    ********************************************
077B    E777        CODVAL   JMP     GORTN                      : MFM INDEX
077C    CE52                 XMIT    52X,R16                    :C MFM INDEX
077D    CE55                 XMIT    55X,R16                    :F MFM INDEX
077E    CE24                 XMIT    24X,R16                    :2' MFM INDEX
077F    CE52                 XMIT    52X,R16                    :C MFM INDEX
0780    CE24                 XMIT    24X,R16                    :2' MFM INDEX
0781    CE52                 XMIT    52X,R16                    :C MFM INDEX
0782    CE24                 XMIT    24X,R16                    :2' MFM INDEX
0783    CE52                 XMIT    52X,R16                    :C MFM INDEX
                    *
0784    E777                 JMP     GORTN                      : FM INDEX
0785    CE7A                 XMIT    7AX,R16                    : C' FM INDEX
0786    CEF7                 XMIT    0F7X,R16                   : F' FM INDEX
                    *
0787    E772                 JMP     TSTEND                     : MFM @MARK
0788    CE89                 XMIT    89X,R16                    : 1' MFM @MARK
0789    CE44                 XMIT    44X,R16                    : A MFM @MARK
078A    CE89                 XMIT    89X,R16                    : 1' MFM @MARK
078B    CE44                 XMIT    44X,R16                    : A MFM @MARK
078C    CE89                 XMIT    89X,R16                    : 1' MFM @MARK
078D    CE44                 XMIT    44X,R16                    : A MFM @MARK
                    *
078E    E777                 JMP     GORTN                      : FM IDENT
078F    CE7E                 XMIT    7EX,R16                    : E FM INDENT
0790    CEF5                 XMIT    0F5X,R16                    : F FM INDENT
                    *
0791    E777                 JMP     GORTN                      : FM DATA
0792    CE6F                 XMIT    6FX,R16                    : B FM DATA
0793    CEF5                 XMIT    0F5X,R16                    : F FM DATA
                    *
0794    E777                 JMP     GORTN                      : MFM IDENT
0795    CE54                 XMIT    54X,R16                    : E MFM INDENT
0796    CE55                 XMIT    55X,R16                   : F MFM INDENT
                    *
0797    E777                 JMP     GORTN                      : MFM DATA
0798    CE45                 XMIT    45X,R16                    : B MFM DATA
0799    CE55                 XMIT    55X,R16                   : F MFM DATA
                    *
                             END     MARKAD
                    *
                    ******************************
                    *
079A                         PROC    SNDCRC
079A    CF5A        CRC1SD   SEL     CNTRL
079B    BE3A                 NZT     BYTRA,CRC1SD          SEND FIRST CRC
079C    CF5F                 SEL     DATA
079D    CF5F                 SEL     DATA                  SET BYTRA FLAG
079E    CF5F                 SEL     DATA
079F    CF5A                 SEL     CNTRL
07A0    D920                 XMIT    0B,CRCE               CRC SOURCE OF DATA
07A1    CF5A        CRC2SD   SEL     CNTRL
07A2    BE21                 NZT     BYTRA,CRC2SD           SEND SECOND CRC
07A3    CF5F                 SEL     DATA
07A4    CF5F                 SEL     DATA                  SET BYTRA FLAG
07A5    CF5F                 SEL     DATA
07A6    E7AD                 RTN
                             END     SNDCRC
                    *
                    ******************************
                    *
                    *       FLAG NOPX
                    *
                    ***************************
                    *
07A7                         PROC    FLANOP
07A7    CF48                 SEL     SP0
07A8    B92B                 NZT     DN1,FNOP1
07A9    DC20        FNOP0    XMIT    0B,NOP0
07AA    E7AC                 JMP     EXOK
07AB    DD20        FNOP1    XMIT    0B,NOP1
07AC    E7AD        EXOK     RTN
                             END     FLANOP
                    *
                    ************************
                    *
                             END     MIFZFC
```


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6 PARTS LIST

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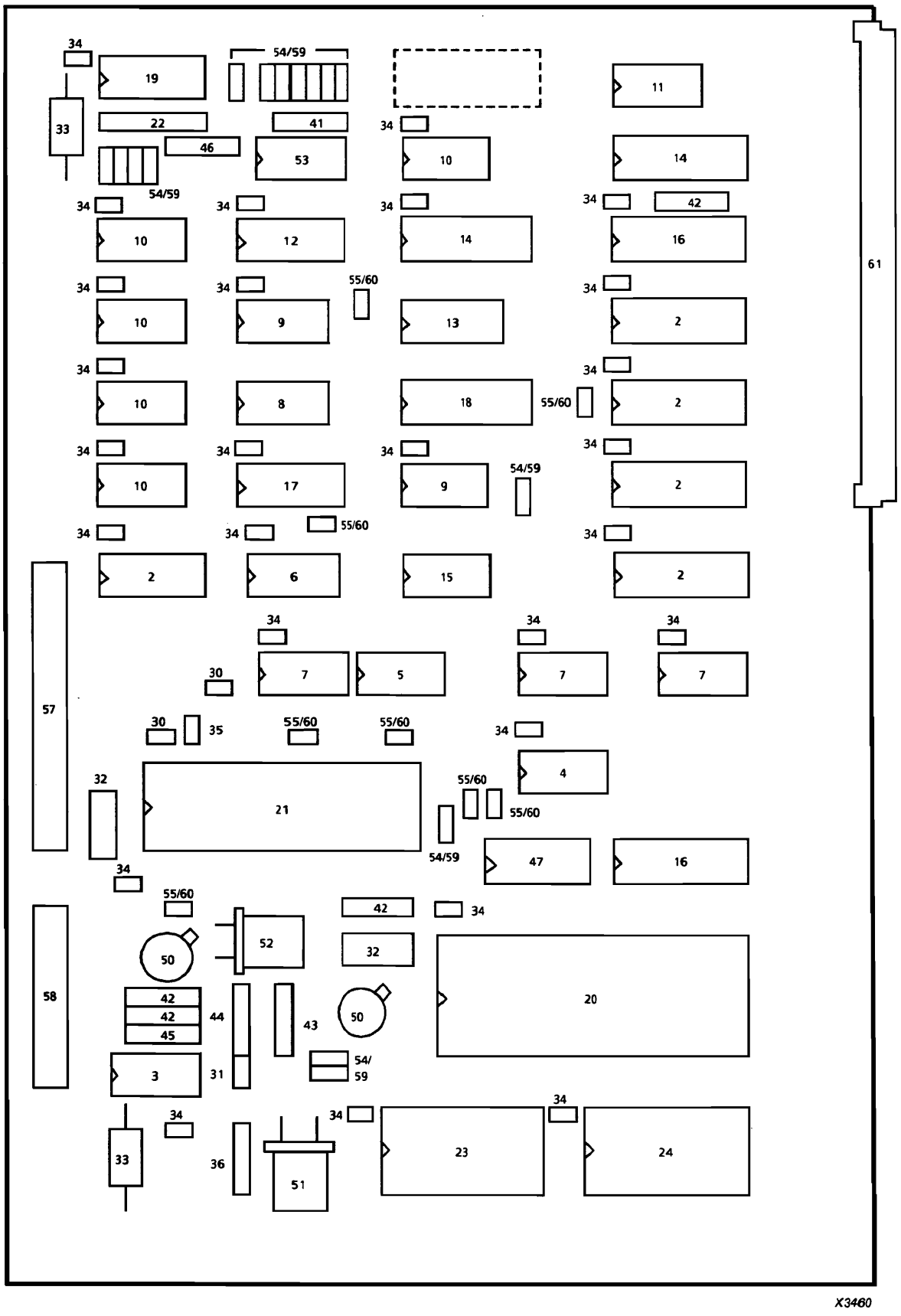

Figure 6.1 P.C.B. for MIFZ

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6.1 PARTS LIST PCB - MIFZ

Pos.	Code Number	Description
1	5111 199 49920	PCB MIFZ Compl.
2	5111 000 04251	IC 2917A
3	5111 000 04161	IC MC4044L
4	5111 000 02241	IC N74S02A
5	5111 000 02661	IC 74LS04
6	5111 000 02701	IC SN 74L08N
7	5111 000 00921	IC SN 74S10N
8	5111 000 02481	IC N74LS11A
9	5111 000 02721	IC N74LS32
10	5111 000 04291	IC 74S38
11	5111 000 03691	IC N74LS38A
12	5111 000 03591	IC N74LS85N
13	5111 000 01821	IC N74S175B
14	5111 000 04091	IC SN74LS240N
15	5111 000 00791	IC SN74S74
16	5111 000 03911	IC N74LS273N
17	5111 000 03681	IC SN74LS279N
18	5111 000 03941	IC SN74LS374N
19	5111 010 05081	IC PROM5081(82S23)
20	5111 000 08331	IC 8 X 305
21	9335 503 90112	IC 8 X 330
22	5111 000 05291	RNW 681 - 09
23	5111 010 09750	PROM (MIFZ)
24	5112 010 09740	PROM (MIFZ)
30	2222 678 58339	Capacitor 33pF 2% 63V
31	2222 630 18472	Capacitor 4,7nF 10% 100V
32	2222 344 90101	Capacitor 0,1uF 10% 100V
33	2222 030 38109	Capacitor 10uF 63V
34	2222 629 18103	Capacitor 10nF 63V
35	2222 678 34109	Capacitor 10pF 2% 63V
	2222 678 03338	Capacitor 3,3pF 2% 63V
	2222 678 03688	Capacitor 6,8pF 2% 63V
	2222 678 58129	Capacitor 12pF 2% 63V
	2222 678 58159	Capacitor 15pF 2% 63V
	2222 678 58189	Capacitor 18pF 2% 63V
	2222 678 58229	Capacitor 22pF 2% 63V
	2222 678 58279	Capacitor 27pF 2% 63V
36	2322 211 13392	Resistor 3,9K 1/4W 5%
40	2322 211 13681	Resistor 680E, 1/4W 5%
41	2322 151 51871	Resistor 187E, 1/8W 1%
42	2322 211 13102	Resistor 1K 1/4W 5%

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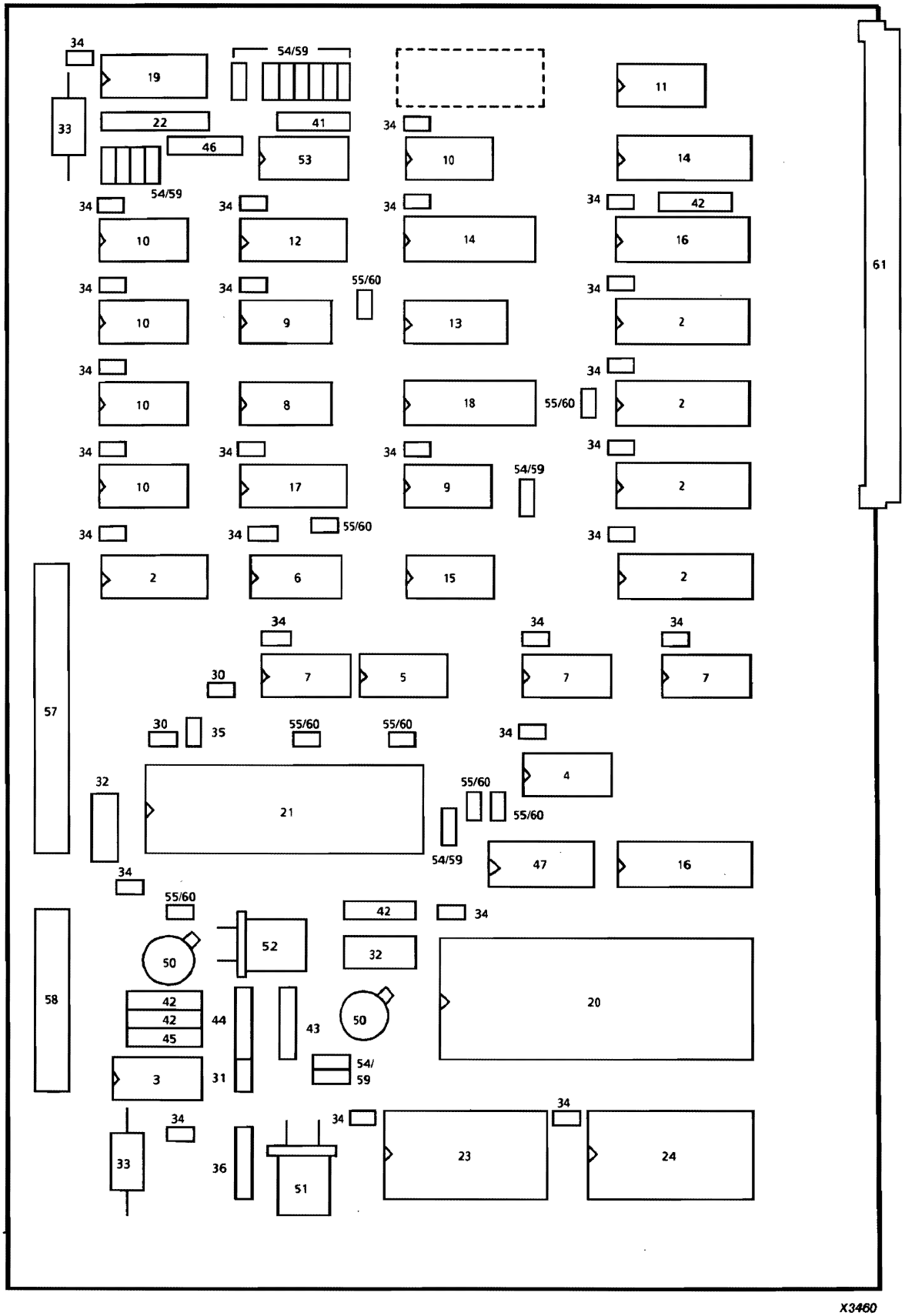

Figure 6.1 P.C.B. for MIFZ

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Pos.	Code Number	Description
43	2322 211 13152	Resistor 1,5K 1/4W 5%
44	2322 211 13103	Resistor 10K1/4W 5%
45	2322 211 13512	Resistor 5,1K 1/4W 5%
46	2322 151 52151	Capacitor 215E 1/8W 1%
47	5111 010 01701	Resistor 220/390 Ohm
50	9331 737 10112	Transistor BUY47
50	9390 004 90112	Transistor Mounting T05
51	4322 144 04541	Crystal QA60 5,0688 MHz
52	2411 535 01334	Crystal QA60 8MHz
53		
54	5111 000 05021	Delay Line LRP250
54	2411 024 01029	Jumper link 365 - 08
59	2411 010 15034	Pin 381 0358
55	2411 024 01024	Jumper link 2MM54
57	2422 025 01502	Connector 2 X 17 pin
58	2422 025 02766	Connector 2 X 13 pin
59	5111 000 05701	Connector 2 X 32 pin
60	2411 010 15049	Connector 2 pins

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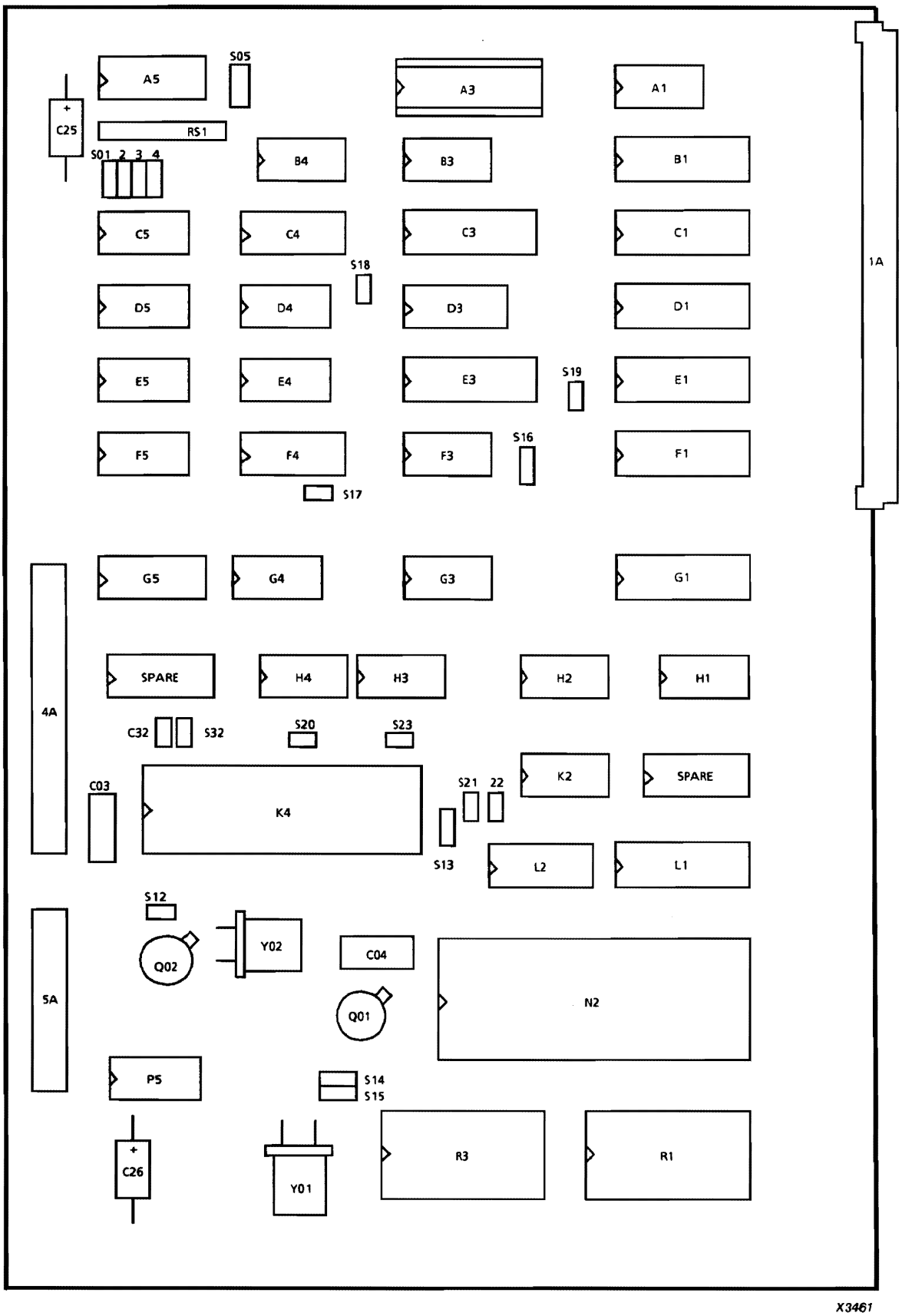

Figure 6.2 P.C.B. MIFZ - CMS (component side)

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6.2 PARTS LIST PCB MIFZ - CMS

Loc..	Code Number	Description
	5111 199 49163	PCB MIFZ CMS Compl.
D1,E1,F1,G1,G5	5111 000 04251	IC 2917A
P5	5111 000 04161	IC MC4044L
K2	5111 000 02241	IC N74S02A
G4	5111 000 02701	IC 74LS08
H3	5111 000 02661	IC 74LS04
H1,H2,H4	5111 000 00921	IC SN 74S10N
E4	5111 000 02481	IC N74LS11A
F3,D4	5111 000 02721	IC N74LS32
B3,C5,D5,E5,F5	5111 000 04291	IC 74S38
A1	5111 000 03691	IC N74LS38A
C4	5111 000 03591	IC N74LS85N
D3	5111 000 01821	IC N74S175B
B1,C3	5111 000 04091	IC SN74LS240N
G3	5111 000 00791	IC SN74S74
C1,L1	5111 000 03911	IC N74LS273N
F4	5111 000 03681	IC SN74LS279N
E3	5111 000 03941	IC SN74LS374N
A5	5111 010 05081	IC PROM5081 (82S23)
N2	5111 000 08331	IC 8 X 305
K4	9335 503 90112	IC 8 X 330
RS1	5111 000 05291	RNW 681 - 09
R3	5111 010 09750	PROM (MIFZ)
R1	5112 010 09740	PROM (MIFZ)
C03,C04	2222 344 90101	Capacitor 0,1uF 10% 100V
C25,C26	2222 030 38109	Capacitor 10uF 63V
C32	2222 678 34109	Capacitor 10pF 2% 63V
C32	2222 678 03338	Capacitor 3,3pF 2% 63V
C32	2222 678 03688	Capacitor 6,8pF 2% 63V
C32	2222 678 58129	Capacitor 12pF 2% 63V
C32	2222 678 58159	Capacitor 15pF 2% 63V
C32	2222 678 58189	Capacitor 18pF 2% 63V
C32	2222 678 58229	Capacitor 22pF 2% 63V
C32	2222 678 58279	Capacitor 27pF 2% 63V
A3	5111 000 05451	IC socket DIL 22

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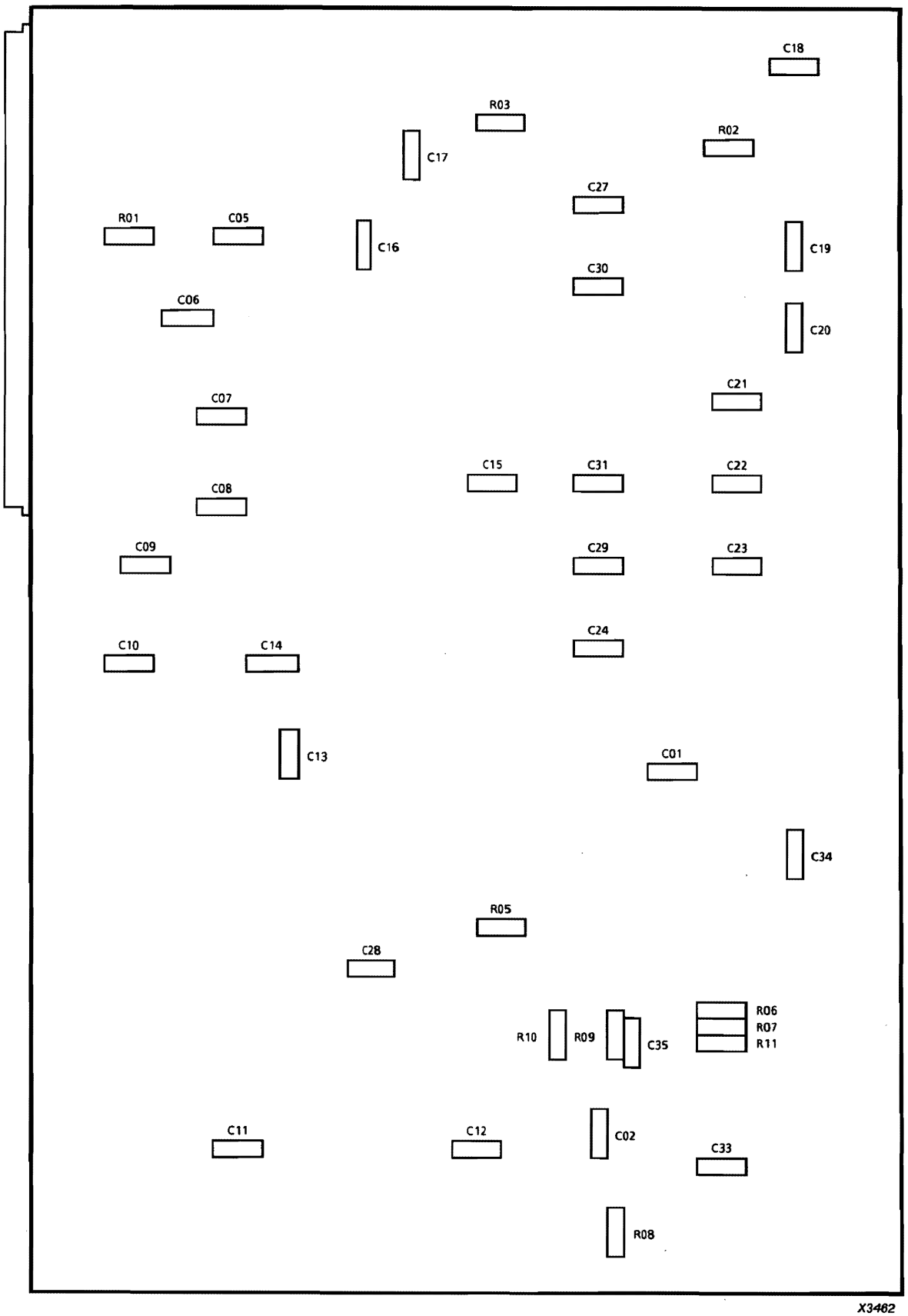

Figure 6.2 P.C.B. MIFZ - CMS (non-component side)

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Loc.	Code Number	Description
L2	5111 010 01701	Resistor 220/390 Ohm
Q01,Q02	9331 737 10112	Transistor BUY47
Q01,Q02	9390 004 90112	Transistor Mounting T05
Y01	4322 144 04541	Crystal QA60 5,0688 MHz
Y02	2411 535 01334	Crystal QA60 8MHz
B4	5111 000 05021	Delay Line LRP250
S01-S05,S13-S16	2411 024 01029	Jumper link 365 - 08
S01-S05,S13-S16	2411 010 15034	Pin 381 0358
S17-S23,S12	2411 024 01024	Jumper link 2MM54
4A	2422 025 01502	Connector 2 X 17 pin
5A	2422 025 02766	Connector 2 X 13 pin
1A	5111 000 05701	Connector 2 X 32 pin
S12,S17-S23,S32	2411 010 15049	Connector 2 pins
C02	2222 591 16623	Capacitor 4.7nF 10% 63V
C05-C24,C27-C31,C33,C34	2222 591 16627	Capacitor 10nf 10% 63V
C01,C35	2222 863 12339	Capacitor 33pF 5% 63V
R01,R05,R06,R07	2322 723 51002	Resistor 1K 1% CMS
R09	2322 723 51003	Resistor 10K 1% CMS
R10	2322 723 51472	Resistor 1K47 1% CMS
R03	2322 723 51781	Resistor 178E 1% CMS
R02	2322 723 52151	Resistor 215E 1% CMS
R08	2322 723 53832	Resistor 3K83 1% CMS
R11	2322 723 55112	Resistor 5K11 1% CMS

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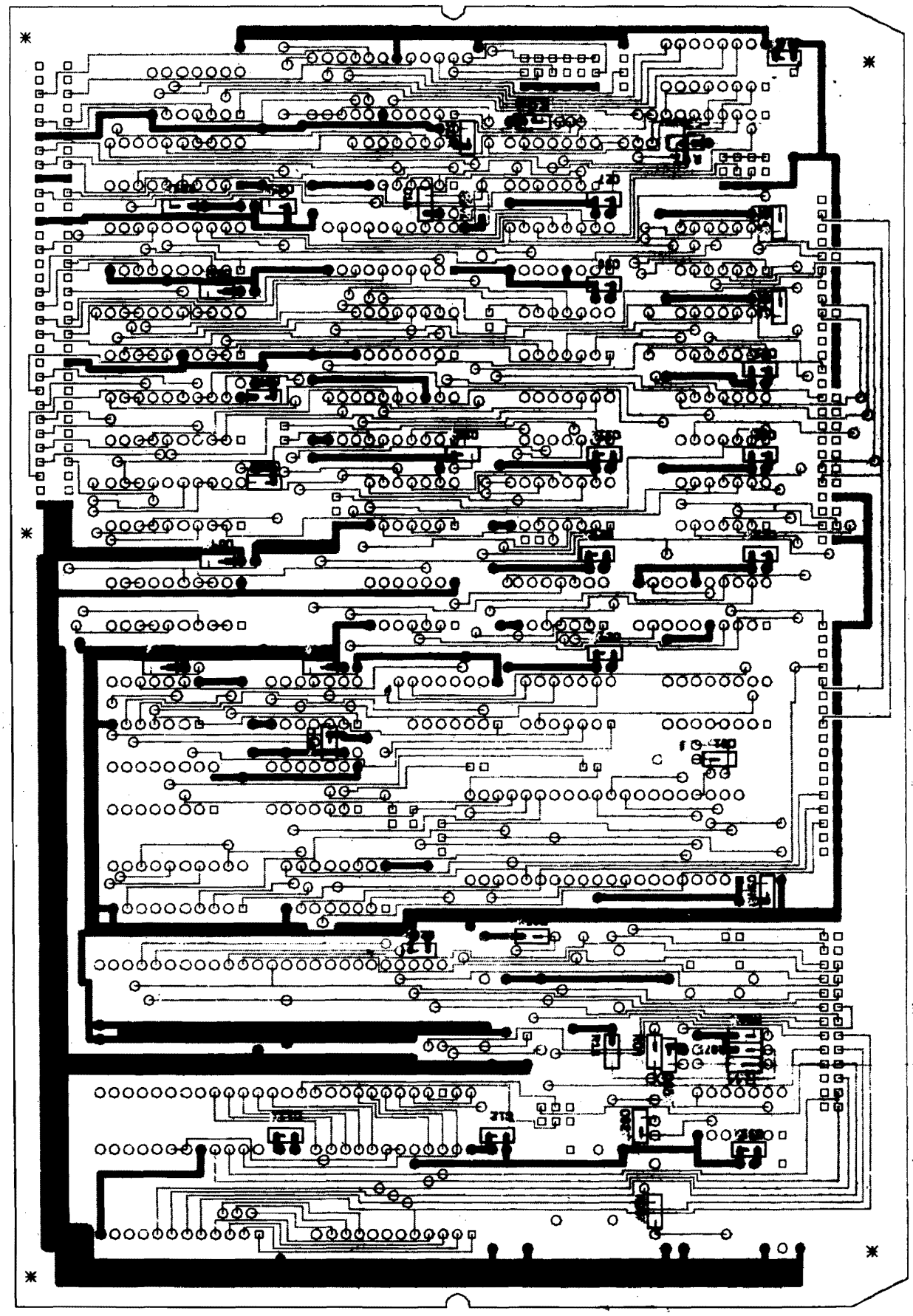

Figure 6.3 P.C.B. for MIFZ - CMS (non-component side)

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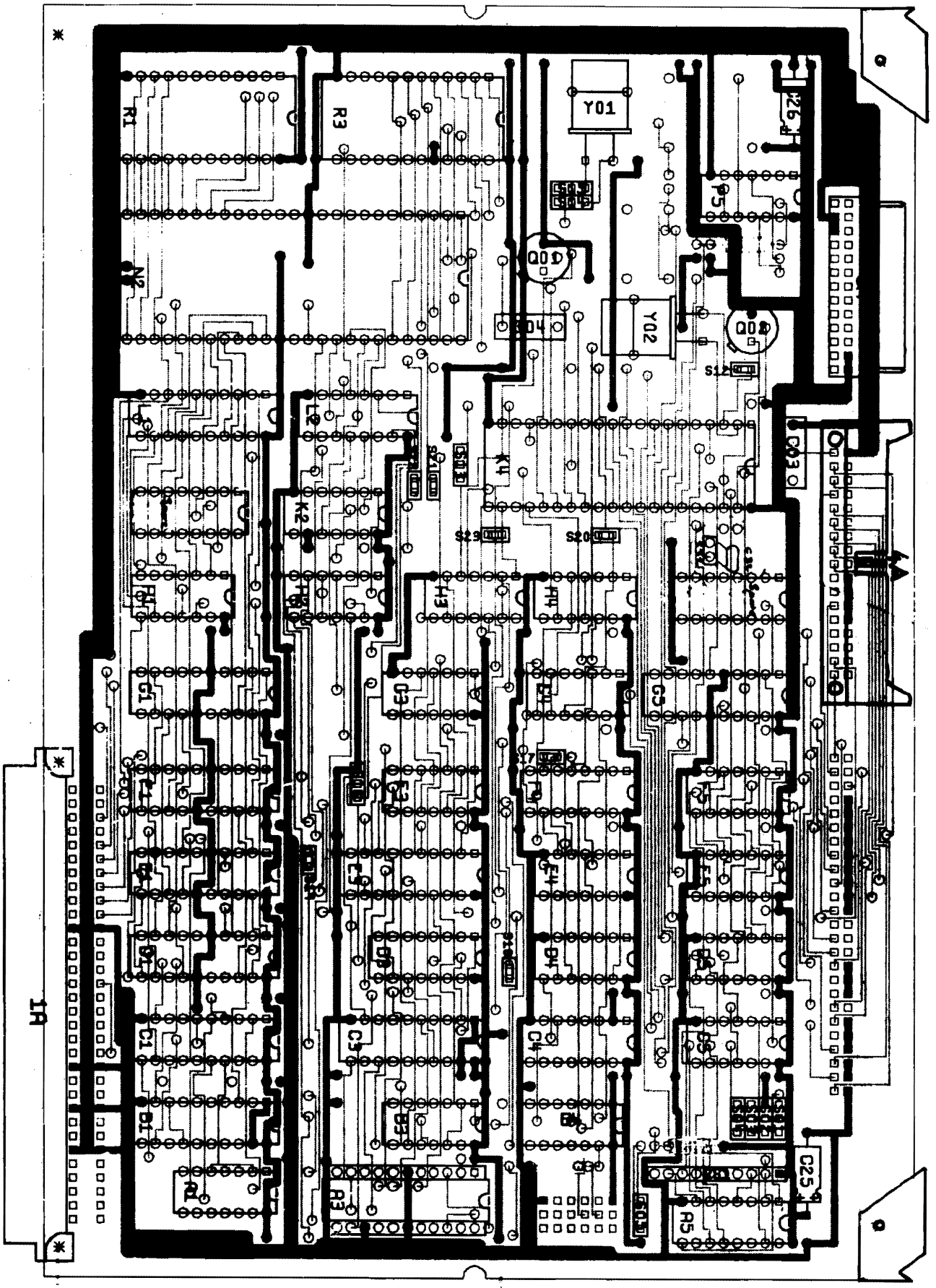

Figure 6.4 P.C.B. for MIFZ - CMS (component side)

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6.3 CONVERSION LIST PCB MIFZ (- CMS)

pcb complete

Factory 12Nc	Service 12Nc	
5111 199 49920	5322 216 21822	MIFZ
5111 199 49160	5322 216 22133	MIFZ-CMS

FACTORY CODE NUMBER	SERVICE CODE NUMBER	DESCRIPTION
2222 030 38109	4822 124 20728	CAP 10UF 63V 50%
2222 344 90101	5322 121 40323	CAP 0.1UF 100V 10%
2222 591 16623	4822 122 31784	CAP 4NF7 63V 10%
2222 591 16627	4822 122 32442	CAP 10NF 63V 10%
2222 629 18103	4822 122 30043	CAP 10NF 63V 80%
2222 629 51103	4822 122 30043	CAP 10NF 63V 80%
2222 630 51472	5322 122 32261	CAP 4700PF 100V 10%
2222 678 03338	5322 122 32514	CAP 3.3PF 100V 2%
2222 678 03688	5322 122 32516	CAP 6.8PF 100V 2%
2222 678 34109	5322 122 34059	CAP 10PF 100V 2%
2222 678 58129	5322 122 32517	CAP 12PF 100V 2%
2222 678 58159	5322 122 32518	CAP 15PF 100V 2%
2222 678 58189	4822 122 31985	CAP 18PF 100V 25
2222 678 58229	5322 122 34196	CAP 22PF 100V 2%
2222 678 58279	4822 122 32149	CAP 27PF 100V 2%
2222 678 58339	4822 122 32405	CAP 33PF 100V 2%
2222 863 12339	4822 122 32444	CAP 33PF 63V 5%
2322 151 51871	5322 116 54494	RES 187E 1% 0.4W
2322 156 11002	4822 116 53108	RES 1K 1% 0.6W
2322 156 11003	4822 116 53022	RES 10K 1% 0.6W
2322 156 11472	5322 116 53185	RES 1K47 1% 0.6W
2322 156 11871	5322 116 80144	RES 187E 1% 0.6W
2322 156 12151	5322 116 53325	RES 215E 1% 0.6W
2322 156 15112	5322 116 53494	RES 5K11 1% 0.6W
2322 211 13103	4822 116 52452	RES 10K 5% 0.33W
2322 211 13152	4822 116 52399	RES 1K5 5% 0.33W
2322 211 13392	4822 116 52422	RES 3K9 5% 0.33W
2322 211 13512	4822 116 52437	RES 5K1 5% 0.33W
2322 711 20102	5322 111 90092	RES 1K 2% 0.125W
2322 711 20103	4822 111 90249	RES 10K 2% 0.125W
2322 711 20152	4822 111 90151	RES 1K5 2% 0.125W
2322 711 20392	4822 111 90571	RES 3K9 2% 0.125W
2322 723 51002	5322 116 80427	RES 1K 1% 0.125W
2322 723 51003	5322 116 80428	RES 10K 1% 0.125W
2322 723 51472	5322 116 81224	RES 1K47 1% 0.125W
2322 723 51781	5322 116 81225	RES 178E 1% 0.125W
2322 723 52151	5322 116 81226	RES 215E 1% 0.125W
2322 723 53832	5322 116 81227	RES 3K83 1% 0.125W
2322 723 55112	5322 116 81228	RES 5K11 1% 0.125W
2411 010 15034	5322 268 14116	CONN PIN

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FACTORY CODE NUMBER	SERVICE CODE NUMBER	DESCRIPTION
2411 010 15049	4822 255 30124	TEST TERM. PIN 2 PL
2411 024 01024	5322 268 10182	JUMPER LINK 2MM54
2411 535 01334	5322 242 74136	CRYSTAL 8MHZ
2422 025 01502	5322 265 64119	CONN 65268-010 2X17P
2422 025 02766	5322 265 54067	CONN PIN 2X13 POL
4322 144 04541	5322 242 70691	CRYSTAL 5.068800 MHZ
5111 000 00791	5322 209 84183	IC SN74S74N
5111 000 00921	5322 209 84954	IC SN74S10N
5111 000 01821	5322 209 85451	IC N74S175B
5111 000 02241	5322 209 85407	IC N74S02A
5111 000 02481	5322 209 81628	IC N74LS11A
5111 000 02661	5322 209 81625	IC 74LS04
5111 000 02701	5322 209 81626	IC SN74LS08N
5111 000 02721	5322 209 85311	IC N74LS32A
5111 000 03591	5322 209 85615	IC N74LS85N
5111 000 03681	5322 209 85346	IC SN74LS279N
5111 000 03691	5322 209 85605	IC N74LS38A
5111 000 03911	5322 209 85792	IC N74LS273N
5111 000 03941	5322 209 81646	IC SN74LS374N
5111 000 04091	5322 209 85862	IC SN74LS240N
5111 000 04161	5322 209 85821	IC MC4044L
5111 000 04251	5322 209 86193	IC AM2917A
5111 000 04291	5322 209 85677	IC 74S38
5111 000 05021	5322 320 44052	IC LPR250 DELAY LINE
5111 000 05241	5322 255 44264	SOCKET 24POL. (DIL)
5111 000 05291	5322 111 90061	RNW 681 09
5111 000 05451	5322 255 40365	IC SOCKET DIL22
5111 000 05701	5322 265 61032	CONN BUS 2X32 POL.
5111 000 08331	5322 209 81971	IC 8X305
5111 010 01701	5322 209 85083	RES 220/390E
5111 100 44610	5322 405 50003	LOCKING BRACKET
9331 737 10112	5322 130 44084	TRANS BUY47
9335 503 90112	5322 209 80902	IC 8X330
9390 004 90112	5322 255 40059	TRANS MOUNTING TO 5

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7 TROUBLE SHOOTING AND REPAIR

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7.1 SHORT ROUTINES

7.1.1 Seek Test Program F1SEEK

```
00000                          IDENT   F1SEEK
00001                  * SEEK TEST FOR          FLOPPY CU 1MB
00002                  * SEEKS BETWEEN CYL 00 AND 32
00003                  * DRIVE 0 ONLY. STATUS IN A5
00004                  * IF SEEKING, YOU HEAR THE REGULAR MOVEMENT
00005                  *
00006                  * REG A4 IS PRESET BIT 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
00007                  *              /0003    0 0 0 0 0 0 0 0 0 0  0  0  0  0  1  1
00008                  *                                              ----------------
00009                  *                                              SEEK CYLINDER NUMBER
00010          0009    DA      EQU     9
00011  0000            RES     /40
00012  0080  FFFF      DATA    DATA    /FFFF
00013  0082  0000              DATA    0
00014  0084  0403      START   LDK     A4,3
00015  0086  207F              HLT
00016  0088  20BF              INH
00017  008A  44C9      RET     CIO     A4,1,DA                 SEEK
00018  008C  5C04              RB(4)   *-2
00019  008E  4DC9              SST     A5,DA                   STATUS
00020  0090  5C04              RB(4)   *-2
00021  0092  8514              LDR     A5,A5                   SET CR ACCORDING STATUS
00022  0094  5104              RF(1)   ST
00023  0096  3480              XRK     A4,/80                  CHANGE CYL 00 - 32, ETC
00024  0098  5F10              RB      RET
00025  009A  207F      ST      HLT                             STATUS ERROR
00026                          END     START
```

7.1.2 Program for Measuring Purposes F1LOOP

```
00000                          IDENT   F1LOOP
00001                  *
00002                  * PROGRAM TO WRITE AND READ A SECTOR CONTINUOUSLY (CU 1MB)
00003                  * WRITE BUFFER /200 UP UNTIL /27E
00004                  * READ BUFFER /300 UP UNTIL /37E
00005                  * DRIVE 0 ONLY.  REG A5 CONTAINS STATUS
00006                  *
00007                  *    PRESET A1: BIT 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
00008                  *             /0001  0 0 0 0 0 0 0 0 0  0  0  0  0  0  0  1
00009                  *              =CIO    -                I----------I     -
00010                  *                    HEAD               SECTORNO.        WRITE
00011                  *
00012                  *            A2: BIT 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
00013                  *             /C040  1 1 0 0 0 0 0 0 0 1  0  0  0  0  0  0
00014                  *              =WER1   -              I---------------------I
00015                  *                    WRITE                BLOCK LENGTH
00016                  *
00017                  *            A3: BIT 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
00018                  *             /0200  0 0 0 0 0 0 1 0 0 0  0  0  0  0  0  0
00019                  *              =WER2 I-----------------------------------I
00020                  *                                BUFFER  ADDRESS
00021                  *
00022                  *            A4: BIT 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
00023                  *             /0003  0 0 0 0 0 0 0 0 0 0  0  0  0  1  1
00024                  *             =SEEK                    I---------------I
00025                  *                                       CYL NUMBER
00026                  *
00027                  * CHECK CORRECT RUNNING:STOP PROGRAM , COMPARE IF /200 AND ON
00028                  * EQUALS /300 AND ON.
00029                  * IF YOU EXECUTE INST BY INST: HEAR DRIVE LOAD / UNLOAD HEADS
00030                  *    NOTE: DISCETTE FORMAT 0,SS,SD  26 SECTORS,64 WORDS/SECTOR
00031                  * ERROR: STATUS STOP AT /BC (/00BE AT HHP) ;A5 CONTAINS STATUS WORD
00032                  *
00033          0009    DA      EQU     9
00034  0000            RES     /40
00035  0080  FFFF      DATA    DATA    /FFFF
00036  0082  0000              DATA    0
00037  0084  0101      START   LDK     A1,1                    PRESET REG
00038  0086  8220              LDKL    A2,/C040
       0088  C040
00039  008A  8320              LDKL    A3,/200
       008C  0200
00040  008E  0403              LDK     A4,3
00041  0090  207F              HLT
00042  0092  20BF              INH
00043  0094  44C9              CIO     A4,1,9                  SEEK
00044  0096  5C04              RB(4)   *-2
00045  0098  4DC9              SST     A5,9                    STATUS
00046  009A  5C04              RB(4)   *-2
00047  009C  8514              LDR     A5,A5
00048  009E  511C              RF(1)   ST                      STATUS FAULT
00049  00A0  7212      RET     WER     A2,/12
00050  00A2  7313              WER     A3,/13
00051  00A4  41C9              CIO     A1,1,9                  PREPARE WRITE (OR READ)
00052  00A6  5C04              RB(4)   *-2
00053  00A8  4DC9              SST     A5,9                    STATUS
00054  00AA  5C04              RB(4)   *-2
00055  00AC  8514              LDR     A5,A5
00056  00AE  510C              RF(1)   ST                      STATUS FAULT
00057  00B0  3101              XRK     A1,1
00058  00B2  B220              XRKL    A2,/4000                CHANGE WRITE TO READ,VICE VERSA
       00B4  4000
00059  00B6  B320              XRKL    A3,/0100
       00B8  0100
00060  00BA  5F1C              RB      RET                     OR REPLACE BY HLT (/207F)
00061  00BC  207F      ST      HLT
00062                          END     START
```


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7.1.3 Read-Only Program READF1

This program can be used in case program load failes.
The program READF1 checks on read errors and can be used to distinguish read errors and software problems.

```
00000                           IDENT    READF1
00001                    *
00002                    *  READ CHECK ON IDENTIFIERS AND DATA
00003                    *       DISCETTES     1M  26 SECTORS
00004                    *
00005          0009      DA       EQU      9
00006                    *
00007                    *  START BY SOP SWITCH
00008                    *  STATUS BITS DISPLAYED ON SOP:
00009                    *  -
00010                    *   SOP IND.NO     MEANING
00011                    *         1        SECTOR NOT FOUND
00012                    *         2        SEEK ERROR
00013                    *         3        -
00014                    *         4        -
00015                    *         5        -
00016                    *         6        RETRY
00017                    *         7        -
00018                    *         8        -
00019                    *         9        DATA ERROR
00020                    *        10        THROUGHPUT ERROR
00021                    *        11        NOT OPERABLE
00022                    *  NO INDICATOR MEANS DDAM FOUND: CONTINUE
00023                    *
00024                    *
00025  0000                      RES      /40
00026  0080  FFFF                DATA     /FFFF,0
       0082  0000
00027  0084  20BF        CIOS    INH
00028  0086  47EE                CIO      A7,1,/2E              START SOP
00029  0088  4F2E                INR      A7,0,/2E              WAIT FOR SOP INTERRUPT
00030  008A  5C04                RB(4)    *-2
00031  008C  87A0                LDKL     A15,/180              STACK
       008E  0180
00032  0090  4DC9                SST      A5,DA
00033  0092  0100                LDK      A1,0                  SELECT HEAD 0
00034                    *********SEEK*********
00035  0094  0403        HEAD    LDK      A4,3                  CYL 0
00036  0096  44C9        NXTCY   CIO      A4,1,DA               SEEK
00037  0098  F7A1                CF       A15,STATUS
       009A  008E  R
00038                    *********READ*********
00039  009C  8220                LDKL     A2,/8000
       009E  8000
00040  00A0  7212                WER      A2,DA+DA
00041  00A2  8320                LDKL     A3,/200               DATA BUF ADDR
       00A4  0200


00042  00A6  7313                WER      A3,DA+DA+1
00043  00A8  41C9                CIO      A1,1,DA               READ FROM DRIVE 0
00044  00AA  F7A1                CF       A15,STATUS
       00AC  008E  R
00045  00AE  1404        ON      ADK      A4,4                  NEXT CYL
00046  00B0  EC20                CWK      A4,/133               CYL 767
       00B2  0133
00047  00B4  5A20                RB(2)    NXTCY
00048  00B6  9120                ADKL     A1,/4000              HEAD 1
       00B8  4000
00049  00BA  5928                RB(1)    HEAD
00050  00BC  5F38                RB       CIOS+2                READ FINISHED
00051                    *
00052  00BE  4DC9        STATUS  SST      A5,DA
00053  00C0  5C04                RB(4)    *-2
00054  00C2  A520                ANKL     A5,/0E27
       00C4  0E27
00055  00C6  500C                RF(0)    RTN
00056  00C8  452E                OTR      A5,0,/2E              STATUS TO SOP (/000=DDAM,CONTINUE!
00057  00CA  4F2E                INR      A7,0,/2E              WAIT FOR SOP INTERRUPT
00058  00CC  5C04                RB(4)    *-2
00059  00CE  8720                LDKL     A7,/780               CLEAR SOP OUTPUT TO/FOO
       00D0  0780
00060  00D2  472E                OTR      A7,0,/2E
00061                    * CONTINUE AFTER DDAM (A5=/800) MEANS DDAM IS NOT COPIED
00062  00D4  F03E        RTN     RTN      A15
                                END      CIOS
```


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7.1.4 Format Program

```
00001                    IDENT   FORMAT
00002                   *
00003                   * FORMAT 5" DISKETTES DR 0
00004                   * PRESS SOP SW TO START
00005                   *
00006                   * STATUS BITS DISPLAYED ON SOP:
00007                   *-----------------------------
00008                   * SOP LAMP  MEANING
00009                   * 1         SECTOR NOT FOUND
00010                   * 2         SEEK ERROR
00011                   * 3         WRITE PROTECT
00012                   * 4         -
00013                   * 5         -
00014                   * 6         RETRY
00015                   * 7         -
00016                   * 8         -
00017                   * 9         DATA ERROR
00018                   *10         -
00019                   *11         NOT OPERABLE
00020                   *
00021                   * CHECK THE DISK AT COPY/VERIFY TIME
00022                   *
00023                   DA EQU 9
00024  0000                      RES /40
00025  0080  FFFF                DATA     /FFFF,0
       0082  0000
00026  0084  20BF      PROG      INH
00027  0086  8720                LDKL     A7,/780              CLEAR SOP,DISP /F00
       0088  0780
00028  008A  46EE      CIOS      CIO      A6,1,/2E
00029  008C  4E2E                INR      A6,0,/2E             WAIT FOR SOP SWITCH
00030  008E  5C04                RB(4)    *-2
00031  0090  0200                LDK      A2,0
00032  0092  422E                OTR      A2,0,/2E
00033  0094  87A0                LDKL     A15,/180             STACKPOINTER
       0096  0180
00034  0098  4DC9                SST      A5,DA
00035  009A  8120                LDKL     A1,/8002             SET FORMAT CMD
       009C  8002
00036  009E  8420                LDKL     A4,/0C02             SEEK & FORMAT
       00A0  0C02
00037                    ****FORMATTING*******
00038  00A2  41C9                CIO      A1,1,DA              REJECT FOR MOTOR ON
00039  00A4  F7A1                CF       A15,STAT2            NOT-READY STATUS
       00A6  00C0
00040  00A8  41C9      NXTCY     CIO      A1,1,DA              SET FORMAT
00041  00AA  F7A1                CF       A15,STAT2
       00AC  00C0
00042  00AE  44C9      NXTCYL    CIO      A4,1,DA              SEEK & FORMAT
00043  00B0  F7A1                CF       A15,STAT2
       00B2  00C0
00044  00B4  1404      ON        ADK      A4,4                 NEXT CYL
00045  00B6  EC20                CWK      A4,/0D3E             CYL 79 --> 'D3E
       00B8  0D3E
00046  00BA  5ADE      RB        RB(2)    NXTCYL
00047  00BC  472E                OTR      A7,0,/2E             DISP /F00
00048  00BE  5F34                RB       CIOS+2               FINISHED
00049                   *
00050                   ***INTERRUPT ROUTINE***
00051  00C0  4DC9      STAT2     SST      A5,DA
00052  00C2  5C04                RB(4)    *-2
00053  00C4  A520                ANKL     A5,/F27              MASK STATUS
       00C6  0F27
00054  00C8  5008                RF(0)    RTN                  NO STATUS ERROR
00055  00CA  452E                OTR      A5,0,/2E             STATUS TO SOP
00056  00CC  4F2E                INR      A7,0,/2E             WAIT FOR SOP SWITCH
00057  00CE  5C04                RB(4)    *-2
00058  00D0  472E                OTR      A7,0,/2E
00059  00D2  F03E      RTN       RTN      A15
                                 END      PROG
```


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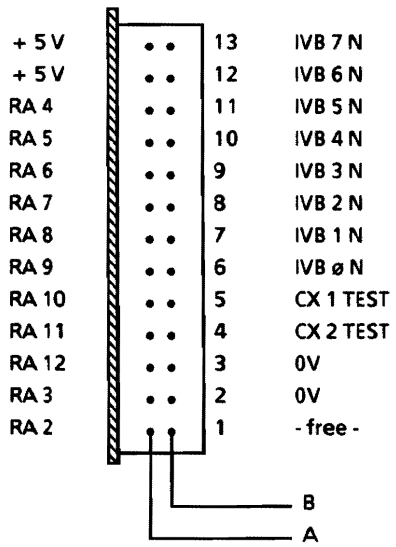
7.2 TEST INTERFACE

In case of a defective pcb, the microprogram will probably not follow its normal sequence. Tracing the microprogram may easily indicate the failing signal.

Logic analyser:
A logic analyser may be connected to the testconnector J5, where RAD2 is the most significant bit and RAD12 is the least significant bit. Signal CX2 TEST (or better: MCLKN) can used as clock.

Another possibility of testing is to build a coïncidence test tool, which compares the microprogram address with a preset value in switches. Match may either give a sync signal for an oscilloscope, or set a flip flop forcing the clock to ground. Afterwards, the testprogram can be continues step by step upon pressing a step - switch.

Test connector lay-out: (J5)



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