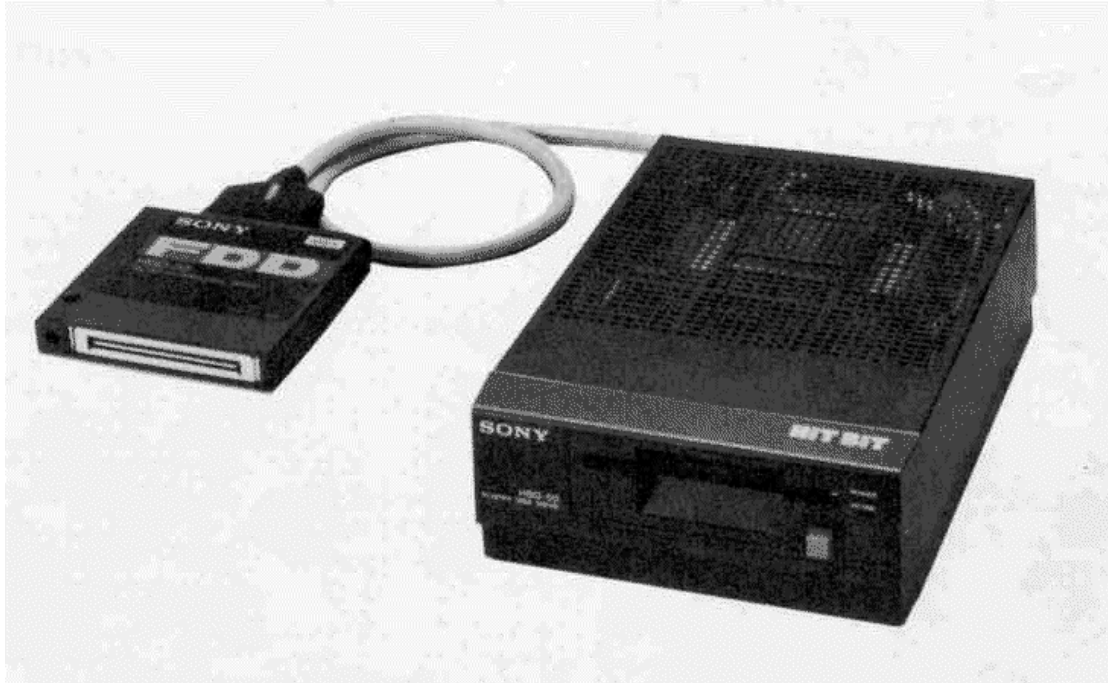


MICRO FLOPPYDISK DRIVE UNIT

HBD-50



SONY[®]
SERVICE MANUAL

Scanned and converted to PDF by MSXHans, 2001

TABLE OF CONTENTS

1. OPERATION

1-1.	FEATURES	1-1
1-2.	SPECIFICATIONS	1-1
1-3.	PARTS IDENTIFICATION	1-1
1-3-1.	Drive Unit	1-1
1-3-2.	Interface Cartridge	1-1
1-4.	CONNECTING THE UNIT	1-2
1-5.	INSERTING A DISK	1-2
1-6.	STARTING UP MSX-DISK BASIC	1-2
1-7.	FORMATTING A BLANK DISK	1-3
1-8.	PIN ASSIGNMENT OF THE CONNECTORS	1-3

2. SERVICE INFORMATION

2-1.	CAUTION AND OTHER INFORMATION	2-1
2-2.	DISASSEMBLY	2-1
2-2-1.	Disassembly of Case, Panel and Plate	2-1
2-2-2.	Disassembly of FDC Board	2-1
2-2-3.	Disassembly of Drive Ass'y	2-2
2-3.	REPAIR PARTS	2-2

3. THEORY OF OPERATION

3-1.	FDI	3-1
3-1-1.	Memory Map	3-1
3-1-2.	Selection by FDI Cartridge	3-1
3-1-3.	Selection by FDC Controller	3-1
3-2.	FDC	3-1
3-2-1.	Memory Map Det	3-1
3-2-2.	Selection of Individual FDC (IC1) Registers	3-1
3-2-3.	Operation of Individual Registers	3-1

4. BLOCK DIAGRAM

OVERALL	4-1
SEMICONDUCTOR PIN ASSIGNMENTS	4-3

5. SCHEMATIC DIAGRAM AND PRINTED CIRCUIT BOARD

FUSE, LED, POWER, TR(A), TR(B) BOARD	5-1
FDI BOARD	5-2
FDC BOARD	5-5

6. TROUBLESHOOTING

6-1.	PREPARATION	6-1
6-1-1.	Test Programs	6-1
6-2.	DISK MOTOR "ON" CHECKS	6-2
6-2-1.	When Motor will not Rotate	6-3
6-3.	STATUS CHECKS	6-4
6-4.	SEEK CHECKS	6-5
6-4-1.	When No Seek Sounds Emanate	6-5
6-5.	RAW DATA CHECKS	6-6
6-6.	REGISTER CHECKS	6-7
6-7.	WD2793-02 CHECKS	6-8

7. ALIGNMENT

7-1.	ADJUSTMENT OF READ PULSE WIDTH	7-1
7-2.	ADJUSTMENT OF VCO FREQUENCY	7-1

8. REPAIR PARTS AND FIXTURE

8-1.	EXPLODED VIEW	8-1
	MAIN ASSEMBLY	8-1
	INTERFACE ASSEMBLY, FD	8-3
8-2.	ELECTRICAL PARTS LIST	8-4
8-3.	PACKING MATERIAL AND ACCESSORY	8-7

CHAPTER 1 OPERATION

1-1. FEATURES

The HBD-50 floppydisk drive unit allows 3 1/2-inch micro floppydisks to be used with an MSX standard computer.

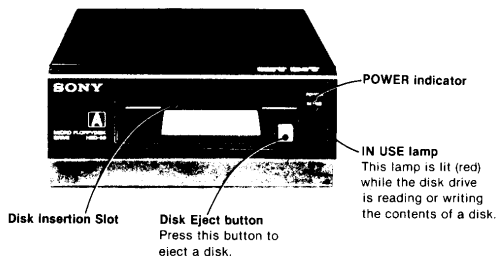
The 3 1/2-inch micro floppydisk is packaged in a hard case provided with a metal disk guard. 360K bytes of data can be recorded on a single disk and the contents can be easily retrieved and rewritten. This floppydisk drive unit will greatly extend the information-handling capabilities of your MSX computer.

1-2. SPECIFICATIONS

Interface Section	
Interface specifications	Fits to MSX slots
Internal ROM	16K bytes Standard I/O routines Standard DOS routines MSX-Disk BASIC Utility routines
Power consumption	+ 5 V, 300 mA or less
Drive Section	
Disk used	3 1/2" micro floppydisk
Disk type	Single-sided
Recording capacity	Unformatted: 500K bytes Formatted: 360K bytes Bytes/sector: 512 Sectors/track: 9 Tracks/cylinder: 1 Tracks/disk: 80 Bytes/disk: 360K
Recording density	8187 bits/inch
Track density	135 tracks/inch
Total no. of cylinders	80 cylinders
Total no. of tracks	80 tracks
Recording method	MFM (Modified-Frequency Modulation)
Disk rotation speed	300 rpm
Data transfer rate	250 K bits/sec
Average latency time	100 msec
Access time	Average: 350 msec Between tracks: 12 msec Settling time: 30 msec
Controller	WD2793-02
General	
Power requirements	United Kingdom model 240V ac, 50Hz European model 220 V ac, 50 Hz
Power consumption	United Kingdom model 25W European model 24 W
Operating temperature	10°C-35°C (50°F-95°F)
Dimensions	160 × 67 × 260 mm (w/h/d) For the drive unit only, including the projecting parts
Weight	Interface cartridge: 240 g Drive unit: 2.7 kg (excludes the disk)
Accessories	Blank disk (1) Disk labels (3)

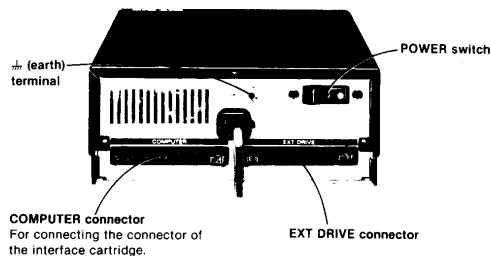
1-3. PARTS IDENTIFICATION

1-3-1. Drive Unit

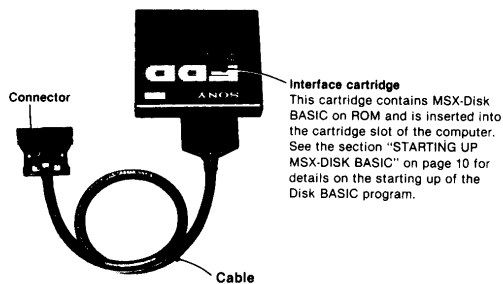


NOTE
While the IN USE lamp is on, do not set the POWER switch to OFF, press the RESET button of the computer, disconnect the interface connector or remove the disk. Such actions may erase the contents of your disk.

Rear Panel



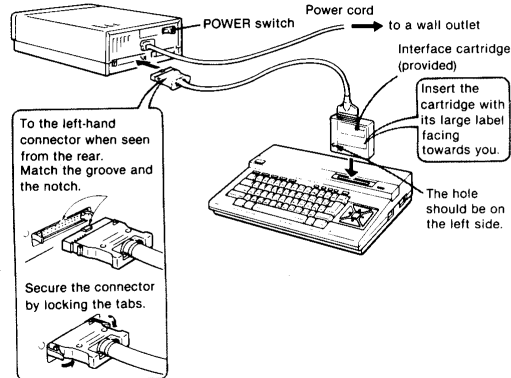
1-3-2. Interface Cartridge



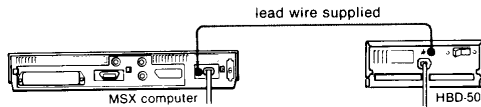
1-4. CONNECTING THE UNIT

Notes on connection

- Set the POWER switch of the device to be connected to OFF. Connecting the device while its power is ON may damage the internal circuitry.
- When disconnecting the connector or cartridge, be sure to take hold of the plug or the cartridge. Pulling on the cord may break the wires.
- As a safety precaution, do not connect the power cord until all other connections have been completed.

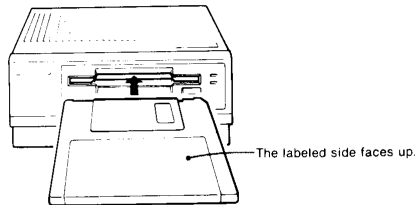


Earth wire connection

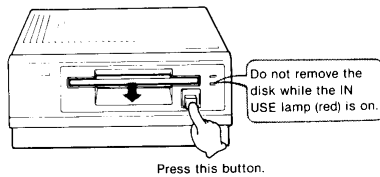


1-5. INSERTING A DISK

Without opening the metal disk guard, insert the floppy-disk and gently push it in until you hear a click.

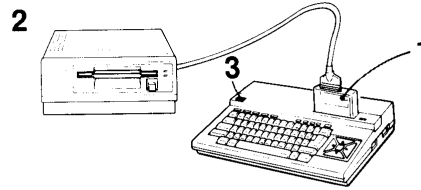


Removing the disk



1-6. STARTING UP MSX-DISK BASIC

MSX-Disk BASIC is stored in ROM (read-only memory) within the interface cartridge of HBD-50. When the interface cartridge is inserted into the cartridge slot of the computer, Disk BASIC is started up by simply switching on the power of the disk drive unit and the computer.



- 1 Insert the interface cartridge.
 - 2 Set the POWER switch of HBD-50 to ON.
 - 3 Set the POWER switch of the computer to ON.
- When Disk-BASIC begins operating, the following message is displayed on the screen:

```
Enter date (D-M-Y)
```

- 4 Enter the year, month, and date using two digits per entry (and connecting each entry by a hyphen) or simply press the [RETURN] key¹⁾. When the [RETURN] key is pressed, the screen will display the following message which indicates the Disk-BASIC has "signed on".

```
MSX BASIC VERSION 1.0  
Copyright 1980 by Microsoft  
32768 Bytes Free  
Disk BASIC Version 1.0  
OK
```

Precautions

Be sure to switch on the power of the drive unit before that of the computer. If the computer has been turned on first, either press the RESET button of the computer or set the POWER switch of the computer to OFF, then to ON.

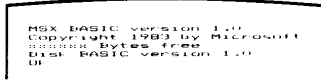
1) With MSX Disk-BASIC, date data set in this situation is not used.

1-7. FORMATTING A BLANK DISK

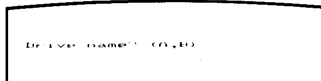
In order to use a new disk, you must first "format" it. Formatting a disk enables you to store data on the disk. Disks that are unformatted or have been initialized with a different format cannot be used with MSX-Disk BASIC. Note that formatting a disk erases all previously stored data and/or programs on that disk.

The formatting procedure

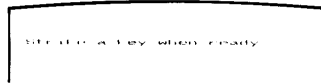
- 1 Start up MSX-Disk BASIC.



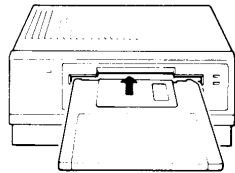
- 2 Type the sequence . The screen will display the following message:



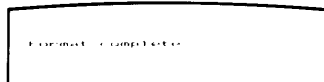
- 3 Press to specify the drive in which the disk to be formatted is to be inserted. The following message will appear.



- 4 Insert the blank unformatted disk into the drive.



- 5 Press any single key on the keyboard to start the formatting operation.
- 6 When formatting is completed, the following message is displayed on the screen:



This indicates that the computer is awaiting entry of a Disk BASIC command.

1-8. PIN ASSIGNMENT OF THE CONNECTORS

Pin Assignment of the Connectors

COMPUTER connector (34 pins)

33	31	29	27	25	23	21	19	17	15	13	11	9	7	5	3	1
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
34	32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2

Pin No.	Signal	Pin No.	Signal	Pin No.	Signal
1	N.C.	13	RETURN	25	RETURN
2	DRQ	14	A1	26	D4
3	N.C.	15	RETURN	27	RETURN
4	IRQ	16	A2	28	D5
5	RETURN	17	RETURN	29	RETURN
6	WE	18	D0	30	D6
7	N.C.	19	RETURN	31	RETURN
8	CS	20	D1	32	D7
9	RETURN	21	RETURN	33	RETURN
10	RE	22	D2	34	RESET
11	RETURN	23	RETURN		
12	A0	24	D3		

EXT DRIVE connector (34 pins)

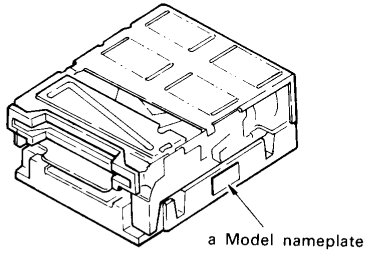
33	31	29	27	25	23	21	19	17	15	13	11	9	7	5	3	1
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
34	32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2

Pin No.	Signal	Pin No.	Signal	Pin No.	Signal
1	DISK CHANGE RESET	13	RETURN	25	RETURN
2	DISK CHANGE	14	DRIVE SELECT 2	26	TRACK 00
3	RETURN	15	RETURN	27	RETURN
4	IN USE	16	MOTOR ON	28	WRITE PROTECT
5	RETURN	17	RETURN	29	RETURN
6	DRIVE SELECT 3	18	DIRECTION	30	READ DATA
7	RETURN	19	RETURN	31	RETURN
8	INDEX	20	STEP	32	(HEAD SELECT)
9	RETURN	21	RETURN	33	RETURN
10	DRIVE SELECT 0	22	WRITE DATA	34	READY
11	RETURN	23	RETURN		
12	DRIVE SELECT 1	24	WRITE GATE		

CHAPTER 2 SERVICE INFORMATION

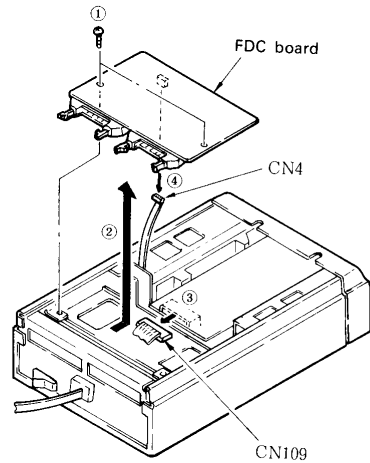
2-1. CAUTION AND OTHER INFORMATION

- For drive Ass'y, refer to the service materials of OAD-33V.
- A similar drive Ass'y is used in other systems, but is should not be used in HBD-50.
- When replacing the drive Ass'y, check the model nameplate and make sure it is a drive Ass'y exclusive to HBD-50 (MFD-33V).



2-2-2. Disassembly of FDC Board

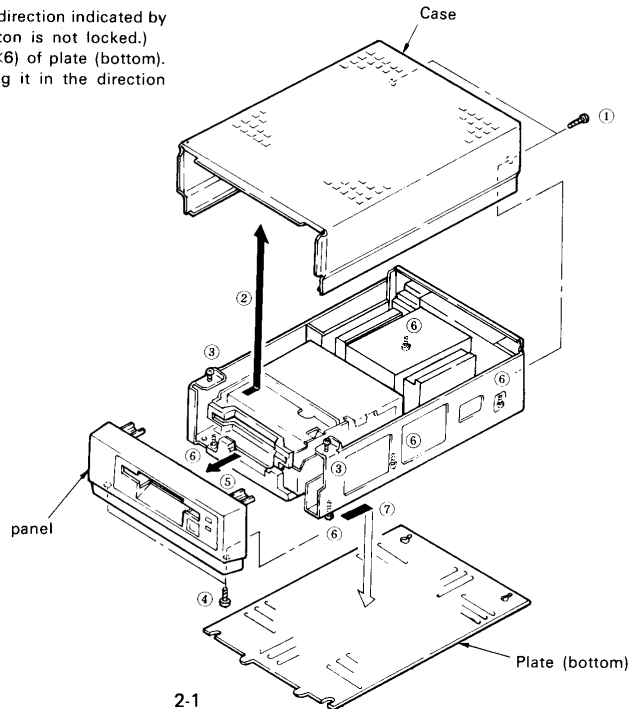
- ① Remove the two set screws (BVTT 3×6).
- ② Pull out the FDC board in the direction indicated by the arrow. (Note: That the two connectors in the rear section should not be caught by the chassis.)
- ③ Disconnect the connector CN109 (34P) on the rear side of drive Ass'y.
- ④ Disconnect the power supply connector CN4 (34P).



2-2. DISASSEMBLY

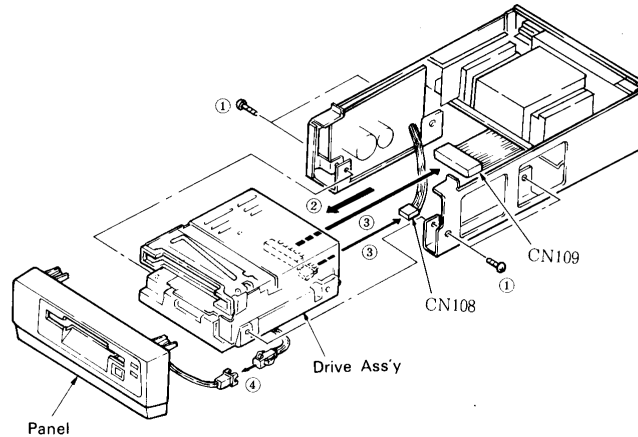
2-2-1. Disassembly of Case, Panel and Plate (bottom)

- ① Remove the two set screws (BVTT 3×6) of the case.
- ② Remove the case by sliding it in the direction indicated by the arrow.
- ③ Loosen the two set screws (BVTT 3×6) of upper part of panel.
- ④ Remove the two set screws (BVTT 3×6) of lower part of panel.
- ⑤ Remove the panel by sliding it in the direction indicated by the arrow. (Note: That the eject button is not locked.)
- ⑥ Loosen the five set screws (BVTT 3×6) of plate (bottom).
- ⑦ Remove the plate (bottom) by sliding it in the direction indicated by the arrow.



2-2-3. Disassembly of Drive Ass'y

- Remove the case.
- Remove the front panel.
- ① Remove the four set screws (P3×6).
- ② Pull out the drive Ass'y forward.
- ③ Disconnect the connectors CN108 (4P), and CN109 (34P) on the rear side of drive Ass'y.
- ④ Disconnect the LED connector.



2-3. REPAIR PARTS

1. Safety Related Components Warning.
Components identified by shading marked with Δ on the schematic diagrams, exploded views and electrical spare parts list are critical to safe operation. Replace these components with Sony parts whose part numbers appear in this manual or in service bulletins and service manual supplement published by Sony.
2. Replacement Parts supplied from Sony Parts Center will sometimes have a different shape from the original parts. This is due to "accommodating the improved parts and/or engineering changes" or "standardization of genuine parts".
This manual's exploded views and electrical spare parts list indicate the parts numbers of "the standardized genuine parts at present".
Regarding engineering parts changes in our engineering department, refer to Sony service bulletins and service manual supplements.
3. Printed Components in Bold-Face type on the exploded views and electrical spare parts list are normally stocked for replacement purposes. The remaining parts are not normally required for routine service work. Orders for parts not shown in Bold-Face type will be processed, but allow for additional delivery time.
4. Units for Capacitors, Inductors and Resistors
The following units are assumed in schematic diagrams, electrical parts list and exploded views unless otherwise specified:
Capacitors: μF
Inductors: μH
Resistors: ohm

5. Abbreviations

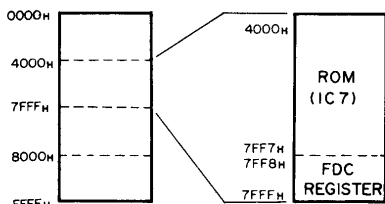
Ref. No.	Description
C□□, CV□□	CAPACITOR
CN□□	CONNECTOR
CP□□	COMBINATION PARTS
D□□	DIODE
DL□□	DELAY LINE
F□□	FUSE
FL□□	FILTER
H□□	HEAD
IC□□	IC
L□□, LV□□	INDUCTOR
M□□	MOTOR
PL□□	LAMP
PM□□	SOLENOID
Q□□	TRANSISTOR
R□□, RV□□	RESISTOR
RY□□	RELAY
S□□	SWITCH
T□□	TRANSFORMER
TH□□	THERMISTOR
X□□	CRYSTAL

CHAPTER 3 THEORY OF OPERATION

3-1. FDI

3-1-1. Memory Map

The FDI cartridge uses the MSX computer cartridge slot. Addresses 4000H through 7FFFH on the memory map have been allocated to the FDI cartridge.

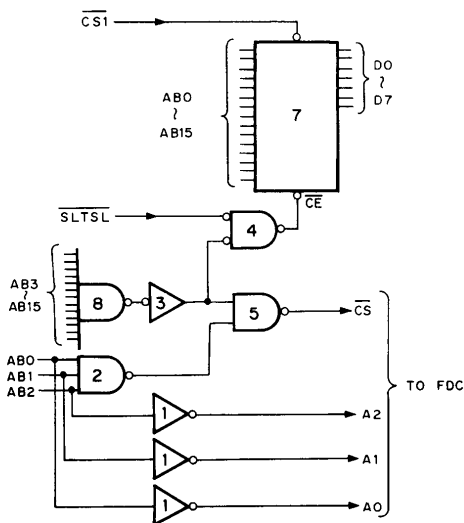


3-1-2. Selection by FDI Cartridge

- ① When an FDI cartridge has been inserted into the MSX computer cartridge slot, addresses 4000H through 7FFFH will be selected by the FDI connector signal $\overline{CS1}$.
- ② In addition, IC4 will AND signal SLTSL and the IC8 (address decoder) output that has been inverted by IC3, and will provide an output to IC7 (ROM) pin \overline{CE} for selection of the ROM.

3-1-3. Selection by FDC Controller

Individual registers of the FDC have been allocated to the memory space for addresses 7FF8H through 7FFFH, and are selected by address signals A0 through A2 and signal \overline{CS} .



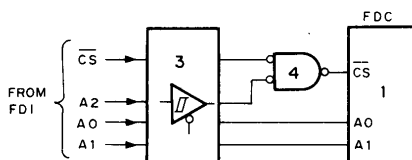
3-2. FDC

3-2-1. Memory Map Det

Address Port	Write Mode of CPU	Read Mode of CPU
7FF8H	Command Register	Status Register
7FF9H	Track Register	Track Register
7FFAH	Sector Register	Sector Register
7FFBH	Data Register	Data Register
7FFCH	Side Select	Side Select
7FFDH	Drive Select	Drive Select
7FFFH		IRQ/DRQ Status

3-2-2. Selection of Individual FDC (IC1) Registers

Individual registers of the FDC (IC1) have been allocated to addresses 7FF8H through 7FFBH, and are selected by address signals A0 through A2 and signal \overline{CS} .



- CR ;COMMAND REGISTER
- DR ;DATA REGISTER
- DSR ;DATA SHIFT REGISTER
- SCR ;SECTOR REGISTER
- TR ;TRACK REGISTER
- STR ;STATUS REGISTER

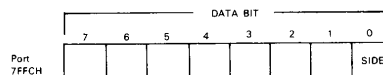
REGISTER SELECTION

CS	A1	A0	RE = 0	WE = 0
1	X	X	NON SELECT	DAL=HI-Z
0	0	0	STR	CR
0	0	1	TR	TR
0	1	0	SCR	SCR
0	1	1	DR	DR

- 0 ; LOW LEVEL
- 1 ; HIGH LEVEL
- X ; DON'T CARE
- HI-Z ; HIGH IMPEDANCE

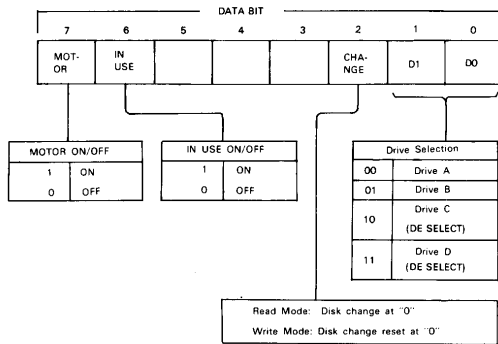
3-2-3. Operation of Individual Registers

- ① Side Select

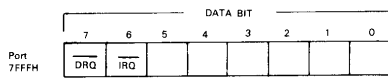


At "0", side 0 will be selected, and at "1", side 1 will be selected.

② Drive Select



③ IRQ/DRQ Status



IRQ will be made "0" when the completion of a command has been either concluded or terminated during process.
DRQ will be made "0" when the data write/read are being requested.

④ Command Register (CR)

This is an 8-bit write register, where the commands that correspond to the WD2793-02 operation will be written from the processor.
With the exception of a forced interrupt command, the command writing operation takes place after completion of the previous WD2793-02 command.

⑤ Status Register (STR)

This is an 8-bit read register. This register indicates the WD2793-02 internal status, the command execution processed status, and the disk drive status. The significance of individual bits will vary depending on whether the command is being executed or the command execution has already been concluded.

⑥ Data Register (DR)

This is a read/write register. In a disk reading mode, the data read of the disk will be loaded into this register. In a disk writing mode, the data that has been written earlier into this register will be written into the disk. In a seek mode, the target track address will be written into this register.

⑦ Track Register (TR)

This is an 8-bit read/write register. The low-high transition of MR (master reset) will set TR at FFH. When TROO becomes low, TR will be made OOH.

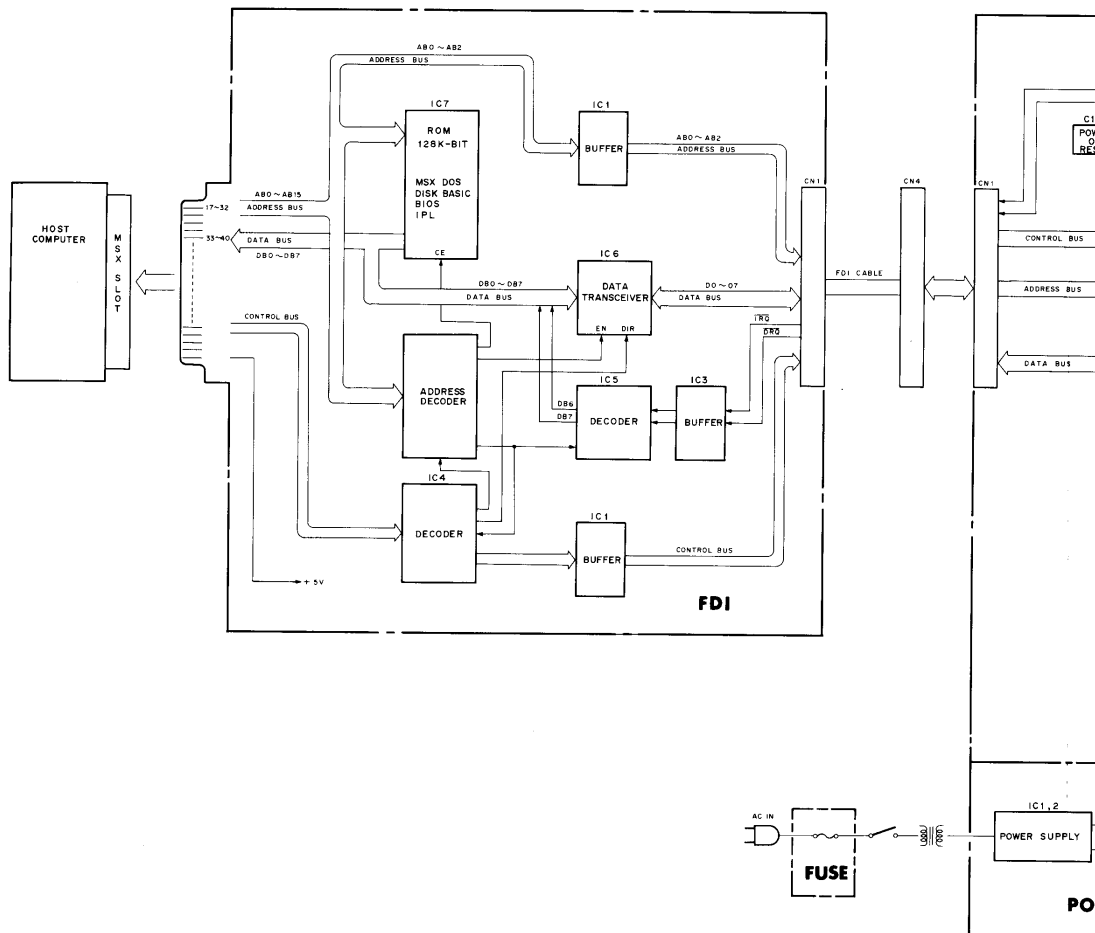
The track number at which the head is located will usually be set in this register. At WD2793-02, this value may either be updated or not, depending on the command. In the case of a read data command or a write data command, the contents of this register will be compared with an ID field track number read of the disk, and when they coincide with each other, the read or write operation will duly be carried out.

⑧ Sector Register (SCR)

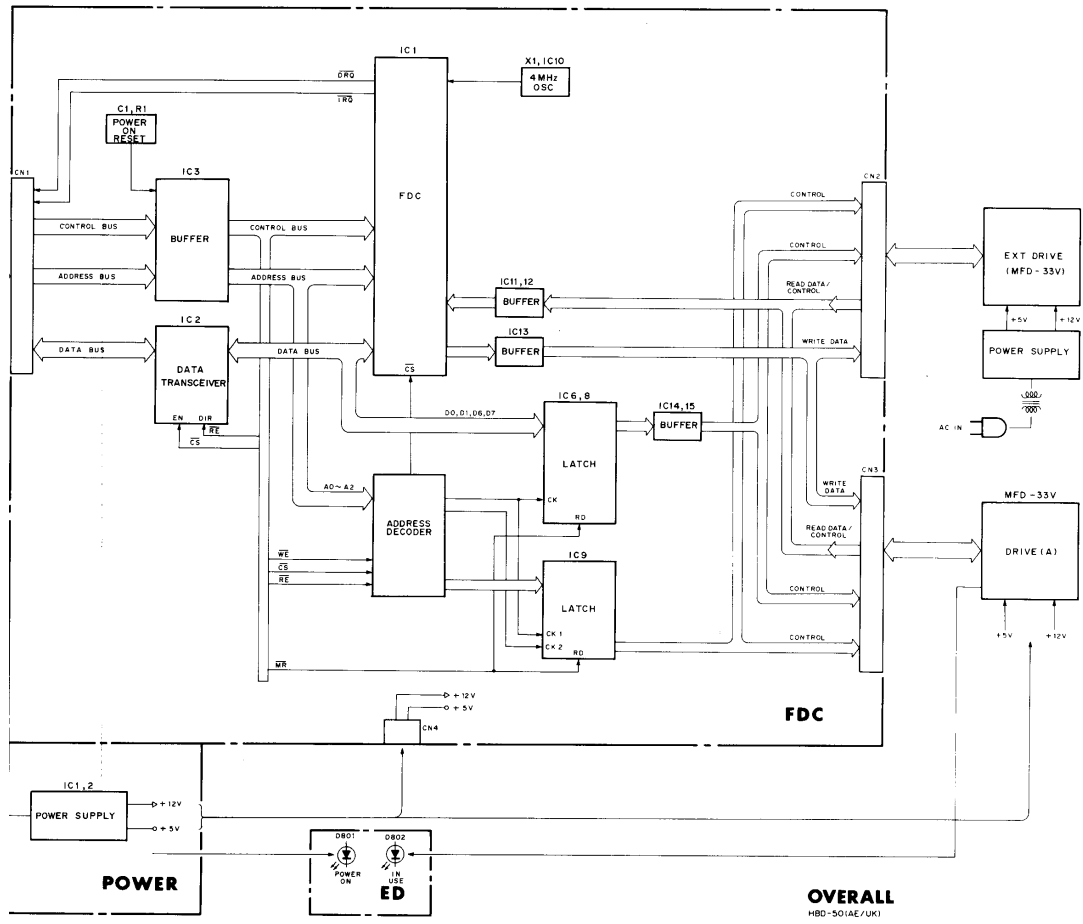
This is an 8-bit read/write register. In the case of a read data command or a write data command, the contents of this register will be compared with an ID field track number read of the disk, and when they coincide with each other, the read or write operation will duly be carried out. When under a read address command, the ID field track number will be retained intact.

CHAPTER 4 BLOCK DIAGRAM

OVERALL



ALL OVERALL



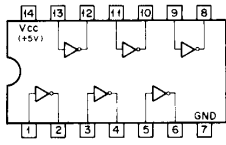
SEMICONDUCTOR PIN ASSIGNMENTS

MB74LS04 (FUJITSU)

SN74LS04N (TI)

TTL INVERTER

— TOP VIEW —



$A \rightarrow \text{bubble} \rightarrow Y = \bar{A} \rightarrow \text{bubble} \rightarrow Y$

$Y = \bar{A}$

A	Y
0	1
1	0

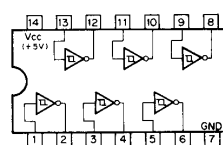
0: LOW LEVEL
1: HIGH LEVEL

MB74LS14 (FUJITSU)

SN74LS14N (TI)

TTL SCHMITT TRIGGER INVERTER

— TOP VIEW —



$A \rightarrow \text{bubble} \rightarrow Y = A \rightarrow \text{bubble} \rightarrow Y$

$Y = \bar{A}$

V IN \rightarrow bubble \rightarrow V OUT

A	Y
0	1
1	0

0: LOW LEVEL
1: HIGH LEVEL

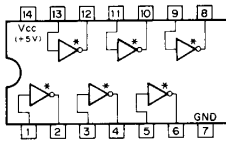
SN7414N-----0.9 1.7V
SN74LS14N---0.8 1.6V

M53206P (MITSUBISHI)

SN7406N (TI)

TTL INVERTER BUFFER/DRIVER WITH OPEN-COLLECTOR

— TOP VIEW —



$A \rightarrow \text{bubble} \rightarrow Y = A \rightarrow \text{bubble} \rightarrow Y$

$Y = \bar{A}$

A	Y
0	1
1	0

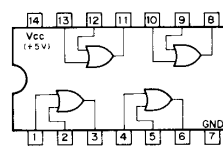
0: LOW LEVEL
1: HIGH LEVEL
*: OPEN COLLECTOR

MB74LS32 (FUJITSU)

SN74LS32N (TI)

TTL 2-INPUT POSITIVE-OR GATE

— TOP VIEW —



$A \rightarrow \text{OR} \rightarrow Y = A + B \rightarrow \text{OR} \rightarrow Y$

$Y = A + B = \bar{A} \cdot \bar{B}$

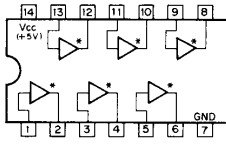
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

0: LOW LEVEL
1: HIGH LEVEL

SN7407N (TI)

TTL BUFFER/DRIVER WITH OPEN-COLLECTOR

— TOP VIEW —



$A \rightarrow \text{bubble} \rightarrow Y = A \rightarrow \text{bubble} \rightarrow Y$

$Y = A$

A	Y
0	0
1	1

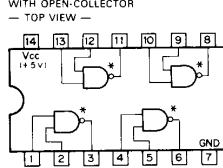
0: LOW LEVEL
1: HIGH LEVEL
*: OPEN COLLECTOR

MB74LS38 (FUJITSU)

SN7438N (TI)

TTL 2-INPUT POSITIVE-NAND GATE BUFFER WITH OPEN-COLLECTOR

— TOP VIEW —



$A \rightarrow \text{bubble} \rightarrow Y = A \rightarrow \text{bubble} \rightarrow Y$

$Y = \bar{A} \cdot \bar{B} = \bar{A + B}$

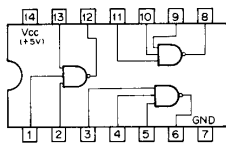
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

0: LOW LEVEL
1: HIGH LEVEL
*: OPEN COLLECTOR

SN74LS10N (TI)

TTL 3-INPUT POSITIVE NAND GATE

— TOP VIEW —



$A \rightarrow \text{NAND} \rightarrow Y = \bar{A} \cdot \bar{B} \cdot \bar{C} \rightarrow \text{NAND} \rightarrow Y$

$Y = \bar{A} \cdot \bar{B} \cdot \bar{C}$

A	B	C	Y
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

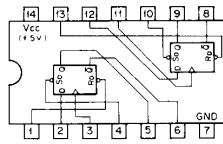
0: LOW LEVEL
1: HIGH LEVEL

MB74LS74A (FUJITSU)

SN74LS74AN (TI)

TTL D-TYPE FLIP FLOP WITH DIRECT SET/RESET

— TOP VIEW —



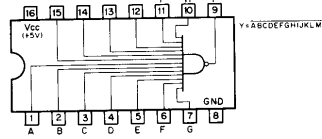
INPUTS		OUTPUTS	
S	R	Qn+1	Qn+1'
0	1	X	X
1	0	X	X
0	0	1	0
1	1	0	1
1	1	0	1*
1	1	0	1*
1	1	0	1*
1	1	0	1*

0: LOW LEVEL
1: HIGH LEVEL
X: DON'T CARE
*: NONSTABLE

SN74ALS133N (TI)

TTL 13-INPUT NAND GATE

— TOP VIEW —

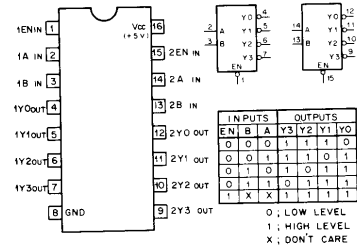


MB74LS139 (FUJITSU)

SN74LS139N (TI)

TTL 2-TO-4-LINE DECODER/DEMULTIPLEXER

— TOP VIEW —

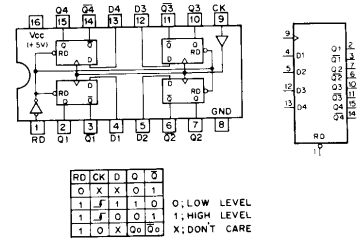


MB74LS175 (FUJITSU)

SN74LS175N (TI)

TTL D-TYPE FLIP-FLOP WITH CLEAR

— TOP VIEW —

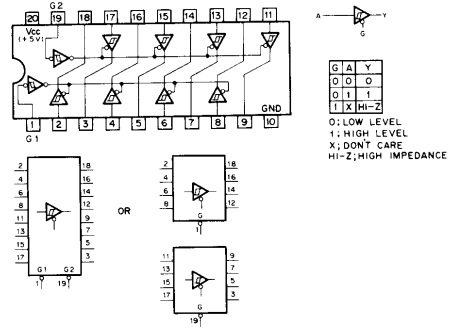


MB74LS244 (FUJITSU)

SN74LS244N (TI)

TTL 3-STATE SCHMITT TRIGGER BUFFER/DRIVER

— TOP VIEW —

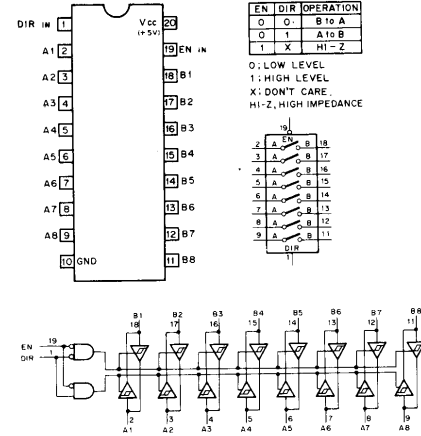


MB74LS245 (FUJITSU)

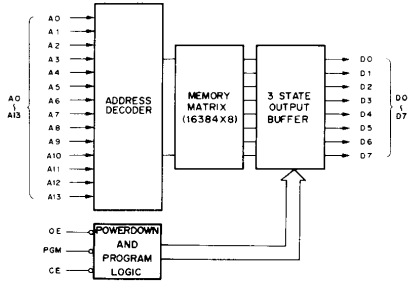
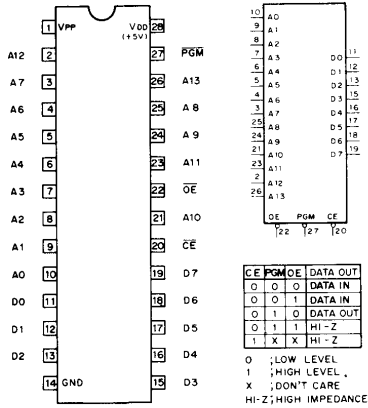
SN74LS245N (TI)

TTL BILATERAL SCHMITT TRIGGER BUS TRANSCEIVERS WITH 3-STATE OUTPUT

— TOP VIEW —

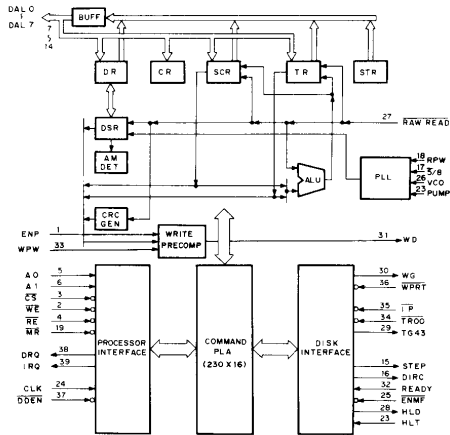
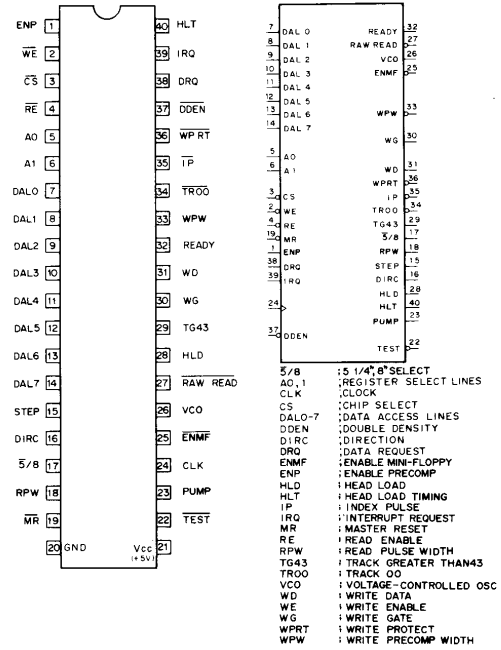


HN482712BG-25 (HITACHI) (ACCESS TIME = 250nS)
 HN482712BG-30 (HITACHI) (ACCESS TIME = 300nS)
 HN482712BG-45 (HITACHI) (ACCESS TIME = 450nS)
 N-MOS ERASABLE AND PROGRAMMABLE ROM 128K-BIT (16384x8)
 — TOP VIEW —



A0-A13 : ADDRESS INPUT
 CE : CHIP ENABLE
 D0-7 : DATA
 OE : OUTPUT ENABLE
 PGM : PROGRAM

WD2793-02 (WESTERN DIGITAL)
 N CHANNEL 5/8 MOS FLOPPY DISK FORMATTER/CONTROLLER
 — TOP VIEW —



CR : COMMAND REGISTER
 DR : DATA REGISTER
 DSR : DATA SHIFT REGISTER
 SCR : SECTOR REGISTER
 TR : TRACK REGISTER
 STR : STATUS REGISTER

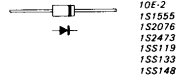
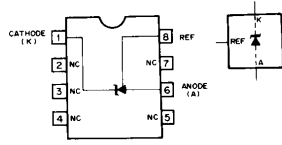
REGISTER SELECTION

CS	A1	A0	RE=0	WE=0
1	X	X	NON SELECT	DAL=HI-Z
0	0	0	STR	CR
0	0	1	TR	TR
0	1	0	SCR	SCR
0	1	1	DR	DR

0 : LOW LEVEL
 1 : HIGH LEVEL
 X : DON'T CARE
 HI-Z : HIGH IMPEDANCE

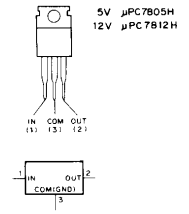
HBD-50(AE/UK)
 HBD-50(J)

TL431CP (T1)
ADJUSTABLE PRECISION SHUNT REGULATOR
— TOP VIEW —



10E-2
1S1555
1S2076
1S2473
1S3119
1S3133
1S3148

μPC7805 (NEC)
POSITIVE VOLTAGE REGULATOR (1A)



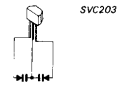
GL-9NG24: YELLOWISH GREEN
GL-9PR24: RED



BOTTOM VIEW



S2VB20

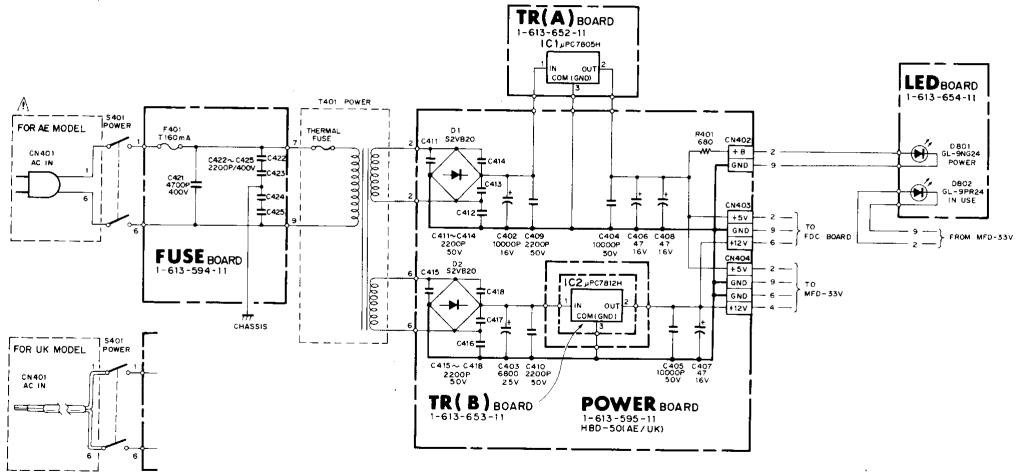


SVC203

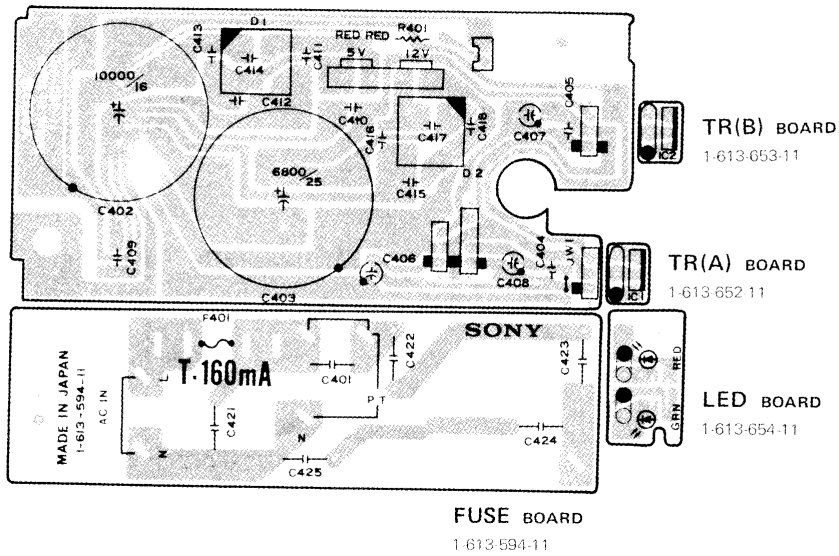
CHAPTER 5

SCHEMATIC DIAGRAM AND PRINTED CIRCUIT BOARD

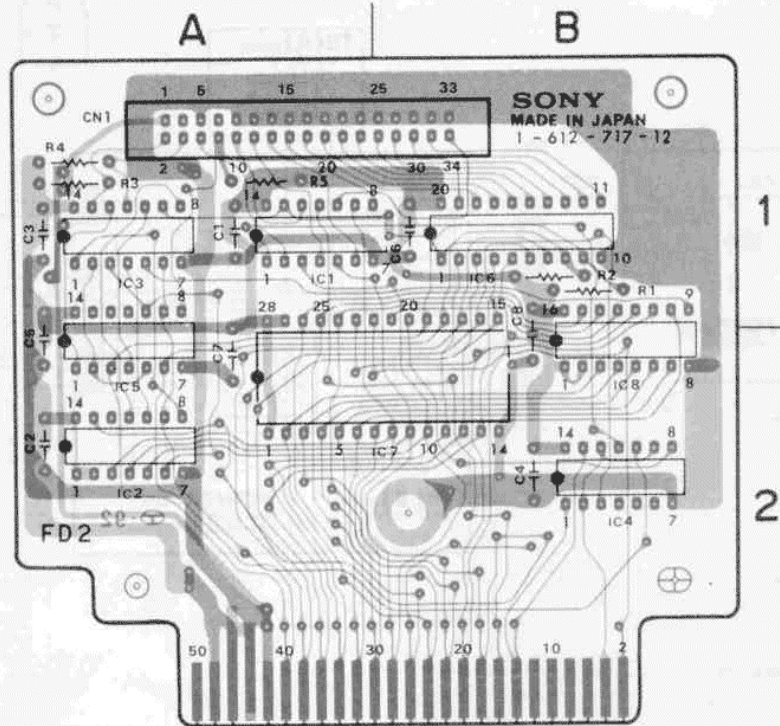
FUSE, LED, POWER, TR(A), TR(B) BOARD



POWER BOARD – COMPONENT SIDE –
1 613-595-11
HBD-50(AE/UK)



FDI BOARD

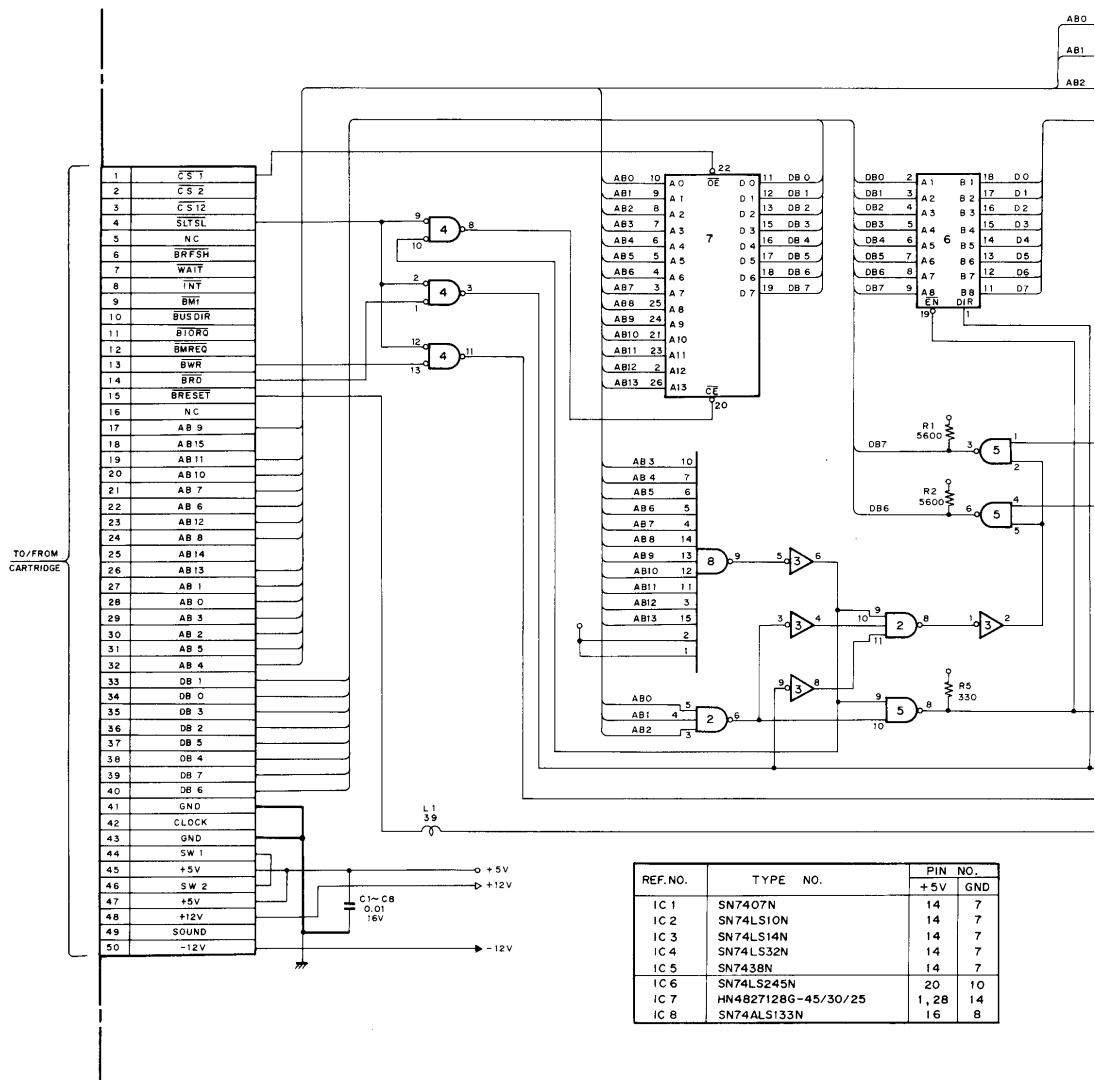


Note: The blue pattern on board layout is COMPONENT SIDE.
The gray pattern on board layout is SOLDERING SIDE.

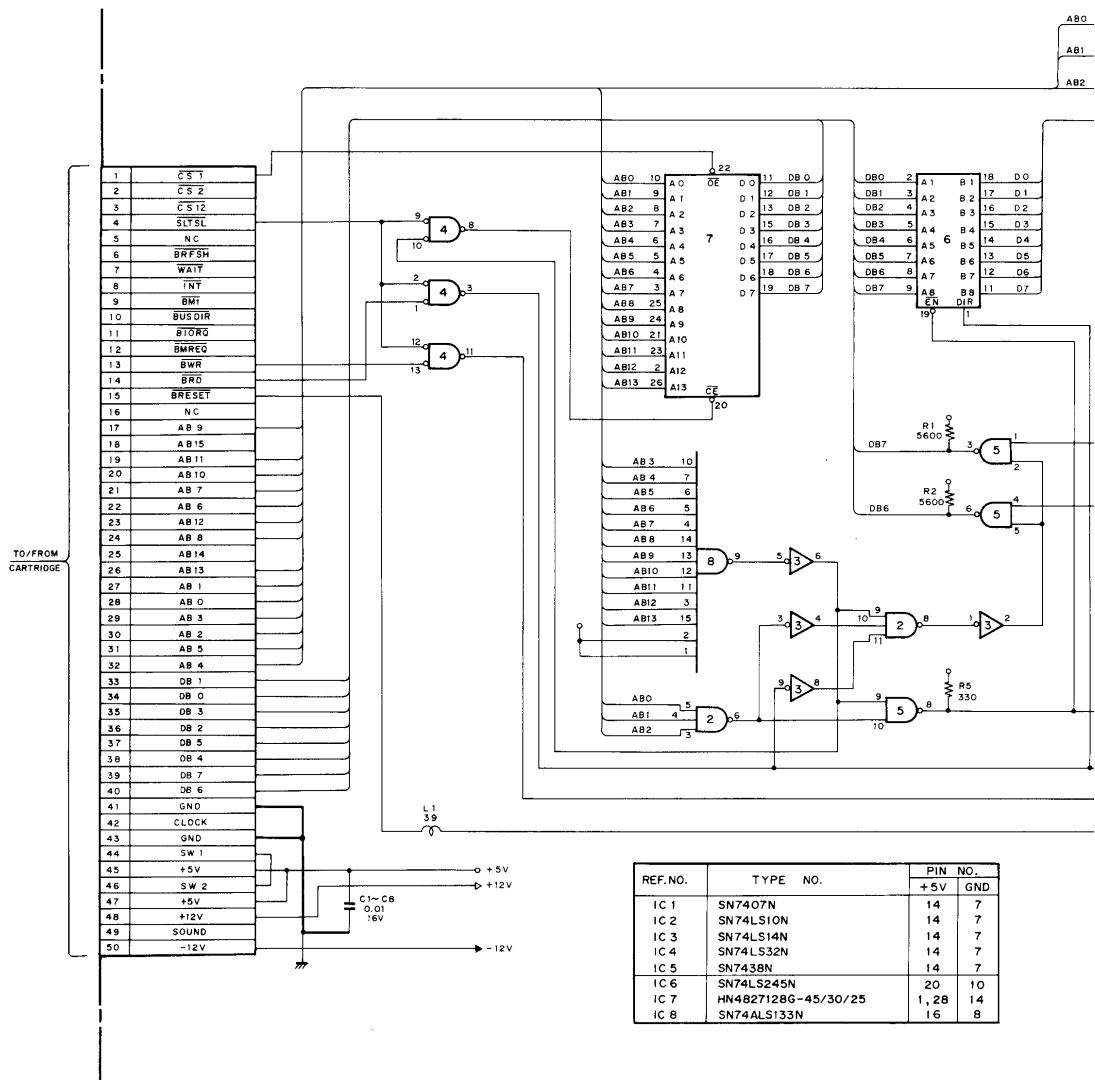
FDI BOARD – COMPONENT SIDE –

1-612-717-12
HBD-50(AE/UK)

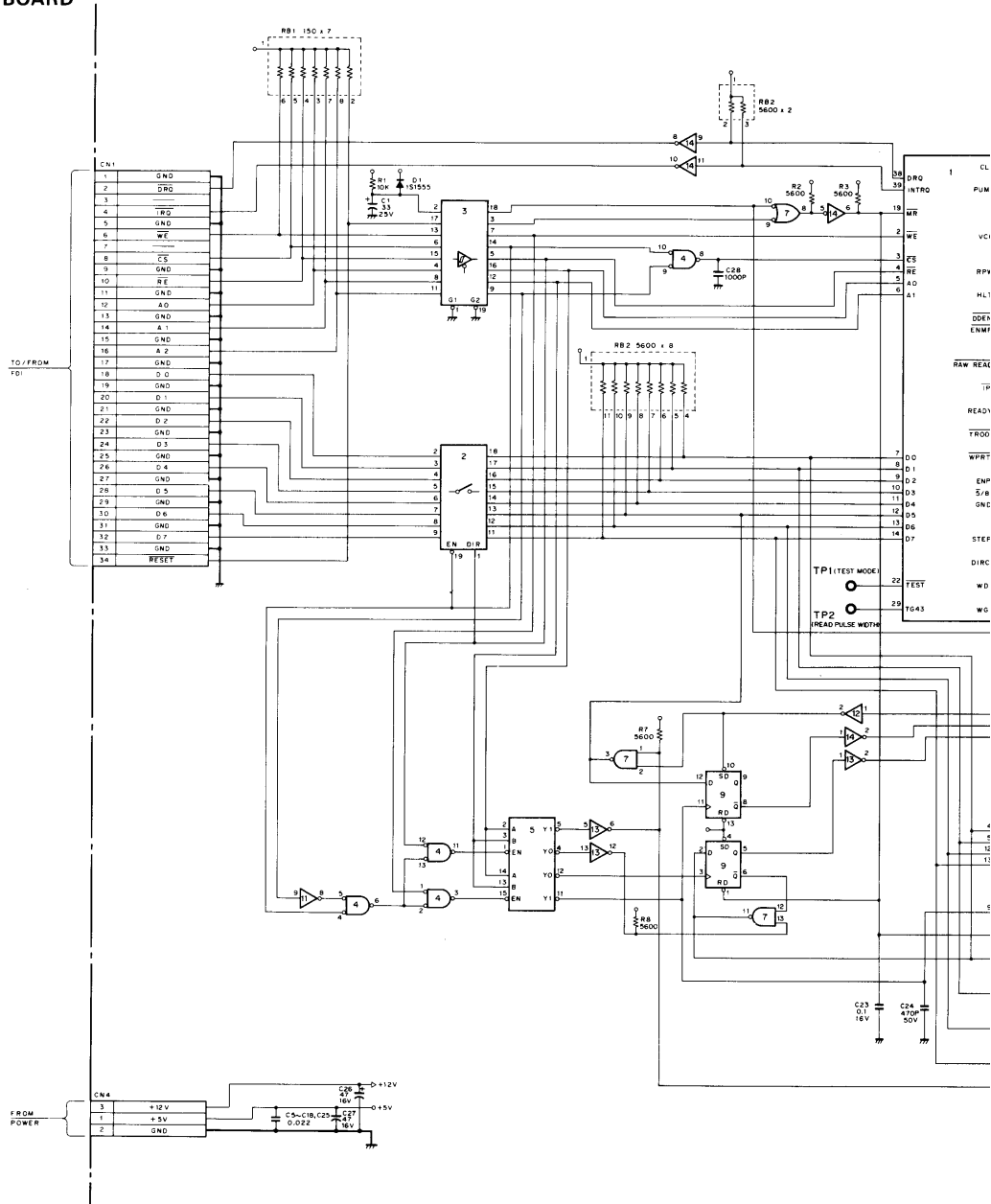
FDI BOARD

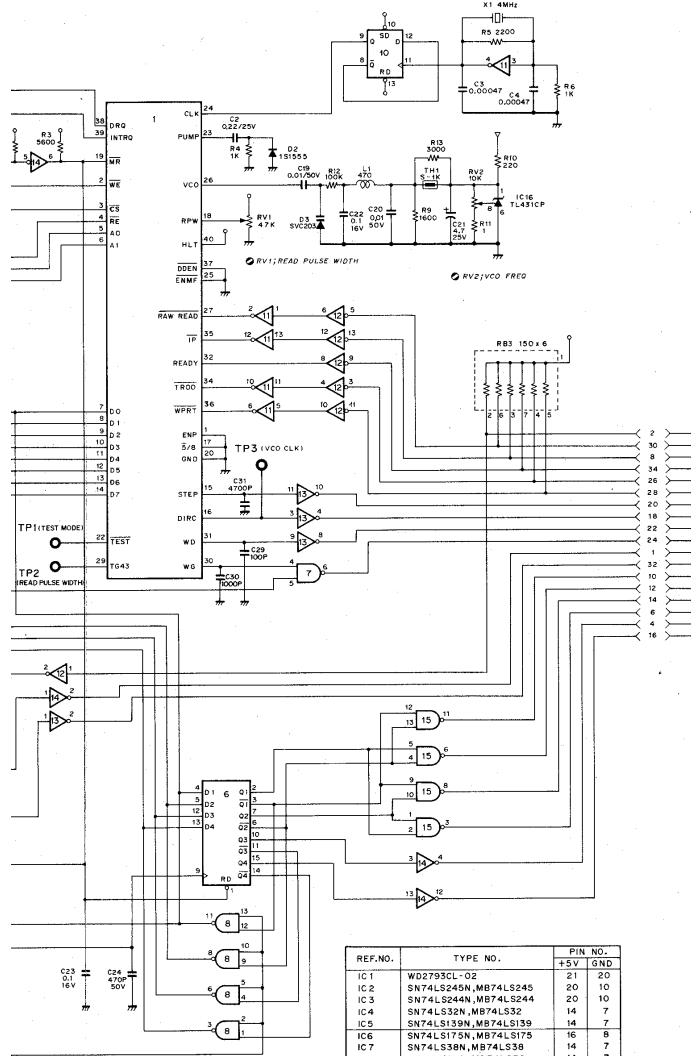


FDI BOARD

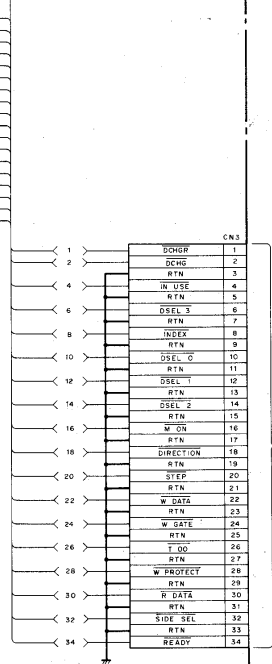
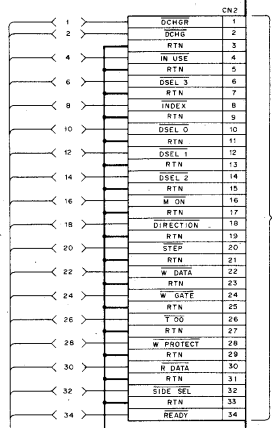


FDC BOARD



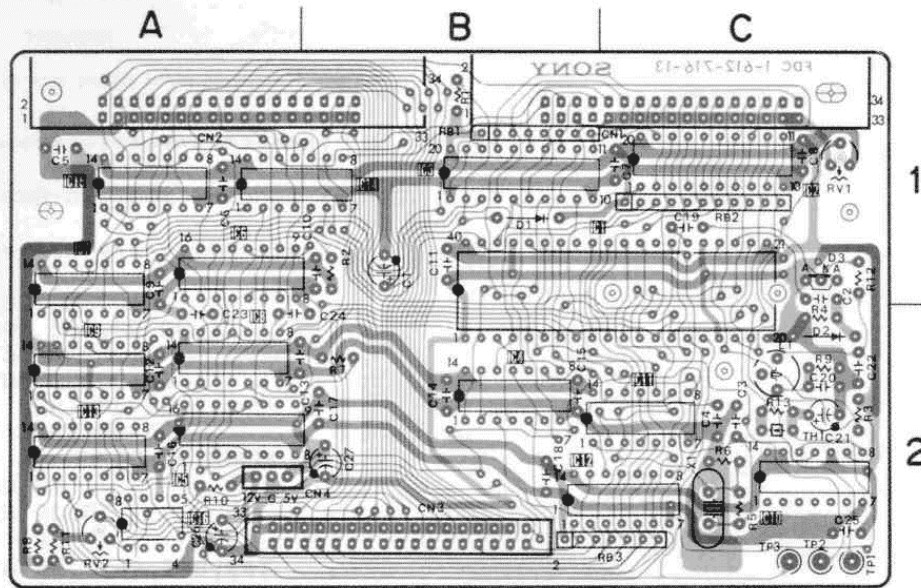


REF. NO.	TYPE NO.	PIN NO.
IC 1	WD2793CL-02	21 20
IC 2	SN74LS245N, MB74LS245	20 10
IC 3	SN74LS244N, MB74LS244	20 10
IC 4	SN74LS32N, MB74LS32	14 7
IC 5	SN74LS139N, MB74LS139	14 7
IC 6	SN74LS175N, MB74LS175	16 9
IC 7	SN74LS38N, MB74LS38	14 7
IC 8	SN74LS38N, MB74LS38	14 7
IC 9	SN74LS74AN, MB74LS74A	14 7
IC 10	SN74LS74AN	14 7
IC 11	SN74LS04N, MB74LS04	14 7
IC 12	SN74LS14N, MB74LS14	14 7
IC 13	SN7406N, M53206P	14 7
IC 14	SN7406N, M53206P	14 7
IC 15	SN7438N	14 7
IC 16	TL431CP	- -



FDC BOARD
 I-612-712-11,12,13
 HBD-50 (J)
 HBD-50 (AE/UK)

FDC BOARD



Note: The blue pattern on board layout is COMPONENT SIDE.
The gray pattern on board layout is SOLDERING SIDE.

FDC BOARD – COMPONENT SIDE –
1-612-716-13
HBD-50(AE/UK)

Note: The blue pattern on board layout is COMPONENT SIDE.
The gray pattern on board layout is SOLDERING SIDE.

C1	B - 1	CN1	C - 1	R1	B - 1
C2	C - 1	CN2	A - 1	R2	B - 1
C3	C - 2	CN3	B - 2	R3	C - 2
C4	C - 2	CN4	A - 2	R4	C - 2
C5	A - 1			R5	C - 2
C6	A - 1	D1	B - 1	R6	C - 2
C7	C - 1	D2	C - 2	R7	B - 2
C8	C - 1	D3	C - 1	R8	A - 2
C9	A - 1			R9	C - 2
C10	B - 1	IC1	C - 1	R10	A - 2
C11	B - 1	IC2	C - 1	R11	A - 2
C12	A - 2	IC3	B - 1	R12	C - 1
C13	A - 2	IC4	B - 2	R13	C - 2
C14	B - 2	IC5	A - 2		
C15	B - 2	IC6	A - 1	RB1	B - 1
C16	A - 2	IC7	A - 1	RB2	C - 1
C17	B - 2	IC8	A - 2	RB3	C - 2
C18	B - 2	IC9	A - 2		
C19	C - 1	IC10	C - 2	RV1	C - 1
C20	C - 2	IC11	C - 2	RV2	A - 2
C21	C - 2	IC12	C - 2		
C22	C - 2	IC13	A - 2	TH1	C - 2
C23	A - 2	IC14	A - 1		
C24	A - 2	IC15	A - 1	TP1	C - 2
C25	C - 2	IC16	A - 2	TP2	C - 2
C26	A - 2			TP3	C - 2
C27	B - 2	L1	C - 2		
				X1	C - 2