CONTENTS

Total Pages

29

1. SCOPE

This document describes the characteristics and specifications for NP37-2 Disk Storage Drive.

2. GENERAL DESCRIPTION

NP37-2 Disk Drive is a fixed Disk, random access memory device used for large capacity data storage which is designed to be suitable for the data processing system with Fixed Block Architecture and to be enlarged in storage capacity comparing present model of NP37 keeping same system configuration. There are two types of module in NP37-2 A02,B02 and C02. (See Fig. 2.1.1, 2.1.2) The A02 module has two main parts: a controller and a drive. The controller contains the logic necessary to control up to eight NP37-2 addresses and power supplies for Logic of controller part. The drive part of the A02 module contains one Head Disk Assembly (HDA) which has two movable actuators. It also contains power supplies and Drive Logic which controls each actuator.

The data to be written or read is transfered in 8 bits parallel NRZ mode between Storage Controller and A02 controller part.

The data is encoded into new encoding technic 2-7 code and transfered between A02 controller part and drive part of A02 or B02.

It is, finally, written or read on the disk surface through write/read head.

The B02 module is same as the drive part of the A02 module.

The A02 module has an optional feature of String Switch(SSW) which makes the one string to communicate with two storage controllers.

Two actuators in the HDA are actuated by a Voice Coil Motor and each is accessed on seven recoding surfaces, which are six data surfaces and one servo surface. (See Fig. 2.2) An actuator has 12 movable read/write data heads and one servo head corresponding with 7 surfaces, of which data surface there are two read/write heads on each data surface.

Each data surface is divided into two data areas associated with each data head, each of which data areas is separated into 962 cylinders numbered 000 through 961. These cylinders are assigned as follows.

o Customer data cylinder	000 through 957
o CE cylinder	958 and 959
o Surface analysis cylinder	960 and 961

Surface analysis cylinders contain a record of all HDA surface defects. The surface analysis cylinders are generated while formatting and analizing the HDA at the manufacturing process.

	W D H mm	Weight
A02	775 X 813 X 1000	300 Kg
B02	525 X 813 X 1000	210 Kg

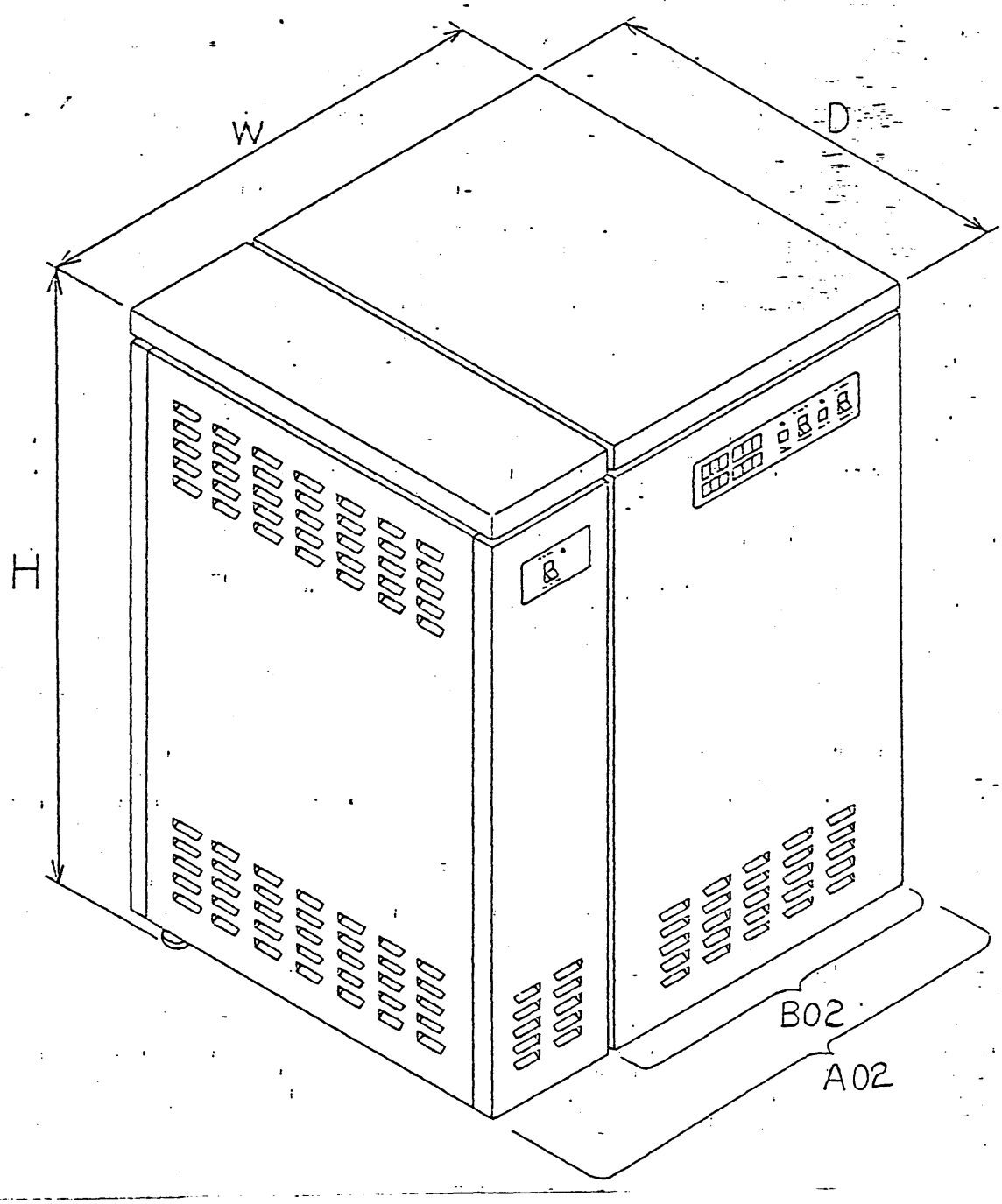

Fig. 2.1.1

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	W × D × H mm	Weight
C02	775 × 813 × 1000	300 Kg

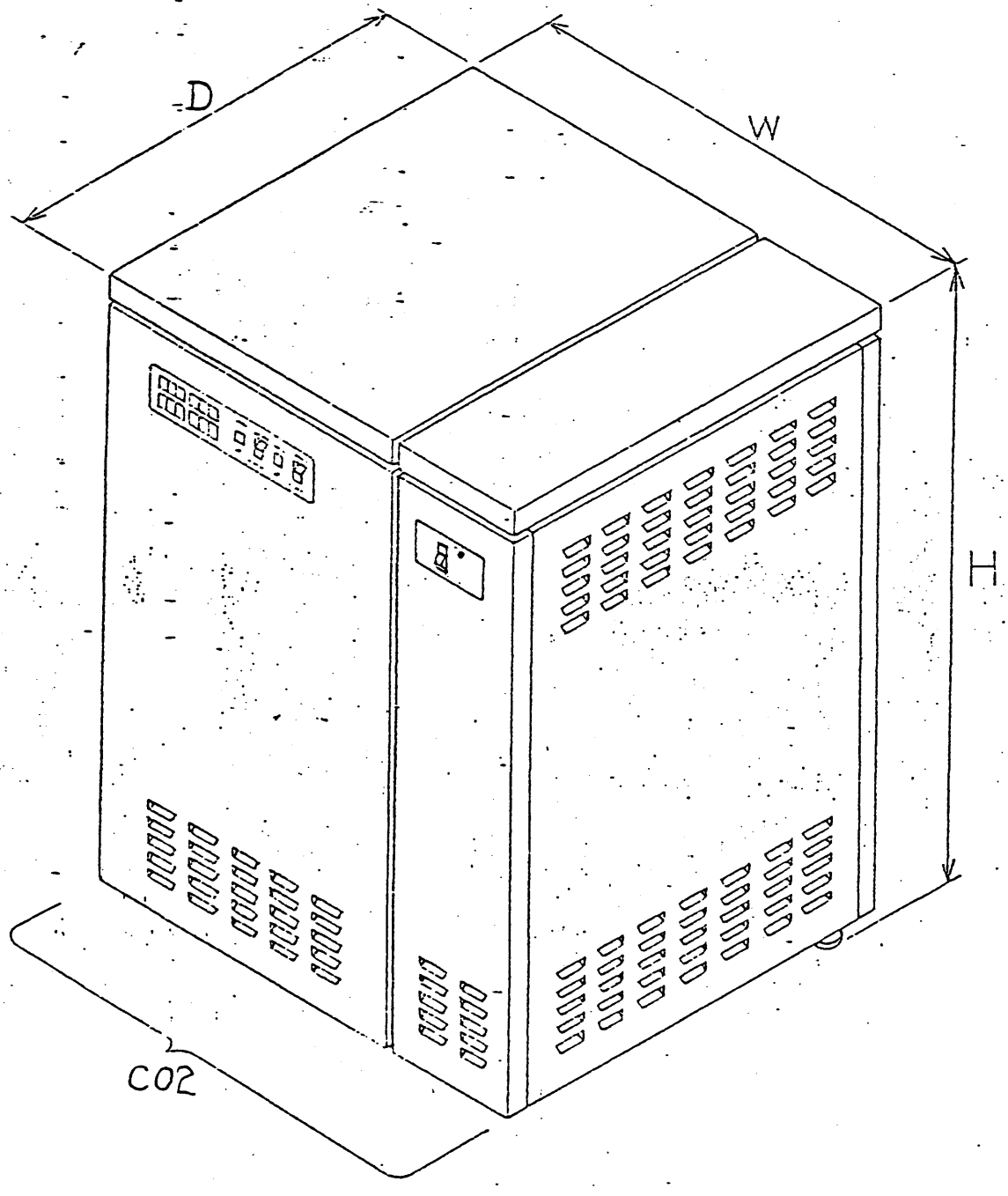

Fig. 2.1.2

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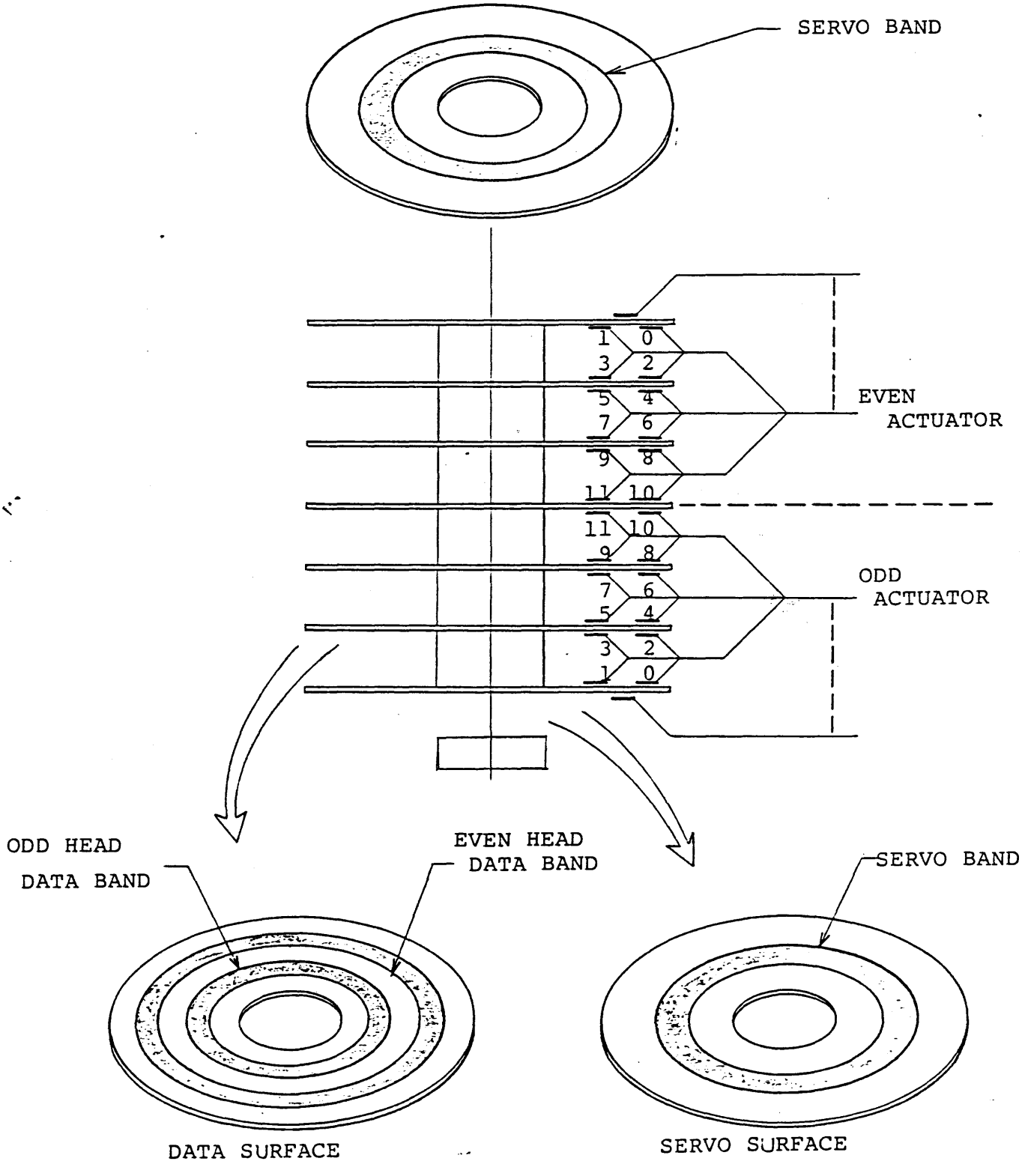
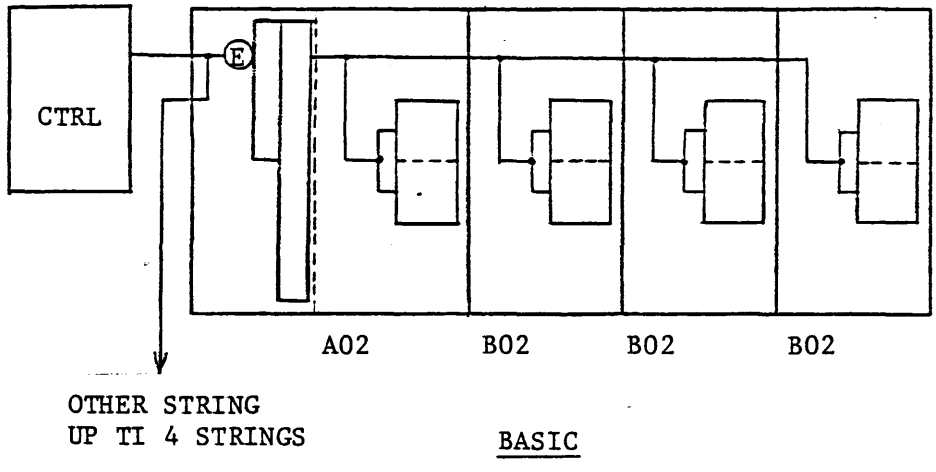

SERVO BAND
1 0
3 2
5 4
7 6
9 8
11 10
EVEN
ACTUATOR
11 10
9 8
7 6
5 4
3 2
1 0
ODD
ACTUATOR
ODD HEAD
DATA BAND
EVEN HEAD
DATA BAND
SERVO BAND
DATA SURFACE
SERVO SURFACE

Fig. 2.2

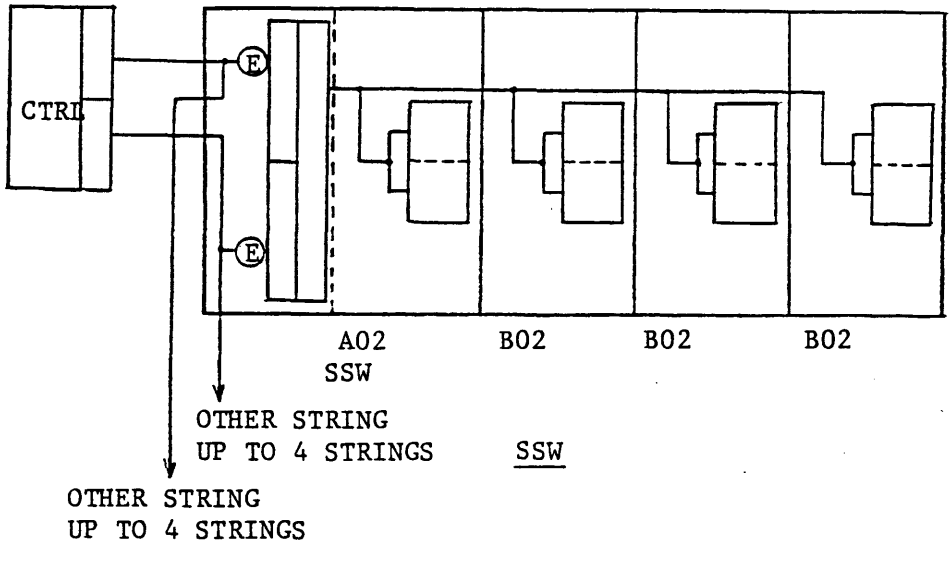
The NP37-2 Disk Storage Drives are connected to storage controller in the configurations as follows.

①



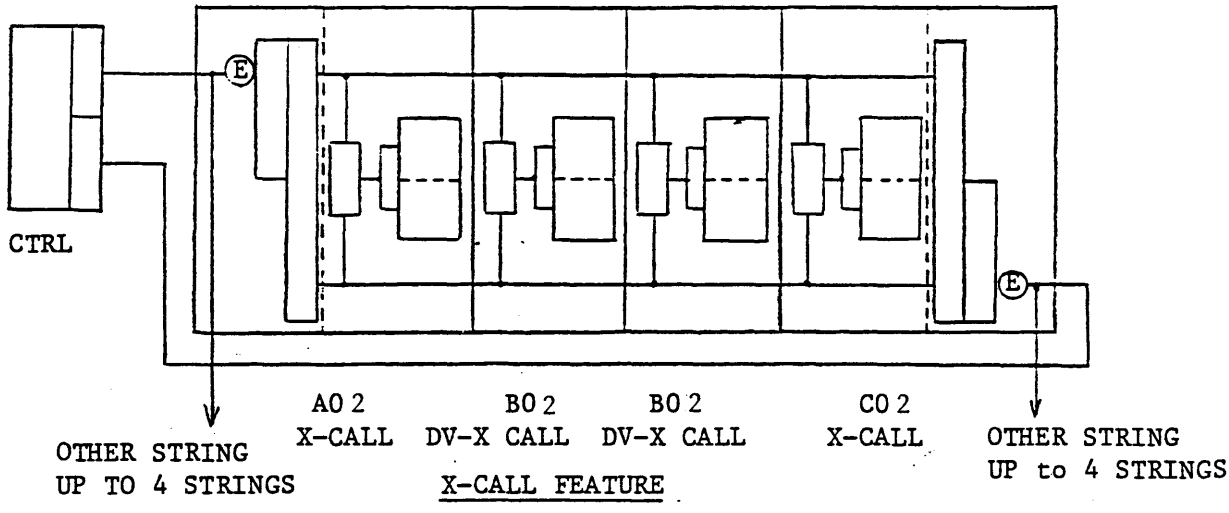
BASIC

②



SSW

③



X-CALL FEATURE

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3. ENVIRONMENTAL REQUIREMENTS

The disk drive shall perform satisfactorily when operating under the following environmental conditions.

3.1 Temperature

a. Equipment operational:	16 to 32°C, with a max. gradient of 10°C per hour.
b. Equipment non-operational:	4 to 43°C
c. Temperature Cycling:	No condensation shall result.
d. Max. wet bulb temp:	26°C (Non Operating 27°C)

3.2 Relative Humidity

a. Equipment operational:	8 to 80% R.H., provided there is no condensation.
b. Equipment non-operational:	5 to 80% R.H., provided there is no condensation.

3.3 Altitude

a. Equipment operational:	Mean sea level up to 6,000 ft above sea level.
b. Equipment non-operational:	From 1,000 ft. below sea level to 40,000 ft. above sea level.

3.4 Vibration

a. Equipment operational:	The equipment shall withstand 0.2G and 3G for impact.
b. With packing (Export):	The equipment shall withstand 0.5G, and 5G for impact.

3.5 Dust Control

The particle count, with a disk pack spinning and the heads loaded shall be less than 300 particles larger than 0.5 microns per cubic foot per minute.

3.6 A.C Power

Voltage (standard):	200, 208/230 VAC ± 10%, 60 Hz(± 1.5%) three phases, four wires.
Voltage (standard):	380 VAC ± 10%, 50 Hz(±1.5%), 3 phases, 5 wires
Voltage (standard):	200, 220/235 VAC ± 10%, 50Hz (±1.5%), 3 phases, 4 wires.
Current (starting): Note	one drive : 35 amperes 5 seconds four drives (max.) : 50 amperes 15 seconds
Current (operating):	4 amperes RMS/drive/phase maximum.(200V/50Hz)

Note: Initial 1 cycle after Power on is 150 amperes peak, but this is regardless to the fuse or breaker specification.

3.7 Service Life

The drive is designed and constructed to provide a useful life of 5 years or 35,000 operating hours, whichever occurs first, before a factory overhaul or replacement is required. Repair or replacement of parts will be permitted during the lifetime.

3.8 Performance Specification

Average Machine Usage 500 hours/month

	A02	B02	C02
1. MTBF hours	3,500	5,000	3,500
Unrecoverable Interrupt/month	0.14	0.1	0.14
2. Duration of Unrecoverable Interrupt Hours/Machine/Interrupt (without transit time)	1.0	0.8	1.0
3. Unscheduled Maintenance Hours/month/Machine	0.14	0.08	0.14
4. Scheduled Interrupt/month	0.1	0.1	0.1
5. Duration of scheduled Interrupt Hours/Machine/Interrupt	0.3	0.3	0.3
6. Scheduled Maintenance Hours/month/Machine (4 x 5)	0.03	0.03	0.03
7. Maintenance hours Hours/month/Machine (3 + 6)	0.17	0.11	0.17
8. Error Criteria			
Seek Errors	1 in 10^6 access		
Data Errors	Correctable - less than 1 in 10^9 bits Non-recoverable - less than 1 in 10^{12} bits		

4. Specifications

4.1 Disk drive performance

Item \ Model	NP37-A02	NP37-B02	NP37-C02
Total Capacity	729.858 M bytes		
Positioning Time Min. Ave. less than Max. Average Latency Time Rotational speed Data Transfer Rate Number of spindle	 5 msec 19 msec 40 msec 10.12 msec 2964 rpm 1,859 K bytes/sec 1		
Features String Switch X-call DV-X call	 optional optional —	 — — optional	 — optional —
Physical dimensions (W x D x H)	775x813x1000 mm	525x813x1000 mm	798x813x1000 mm
Weight	280kg	210kg	280kg
Power Requirement	200 , 220 , 235 , 380/50Hz 3 phases 200 , 208 , 230/60Hz 3 phases		
Power Consumption	1.2KVA Include Service-Outlet Consumption	0.8KVA	1.2KVA Include Service-Outlet Consumption
Heat output	2400 BTU/hr	1750 BTU/hr	2400 BTU/hr
Operating Environment Temperature Humidity	 16 ~32°C 8 ~80%RH		

4.2 Head Disk Assembly (HDA)

4.2.1 Specification of HDA

Number of Platter	7
Data Surfaces	12
Servo Surfaces	2
Actuator per Spindle	2
Byte Capacity per Spindle (M Bytes)	729.858
Byte Capacity per Actuator (M Bytes)	364.929
Cylinders per Actuator	958
Tracks per Cylinder	12
Blocks per Track	62
Byte Capacity per Block	512
Bit Density (BPI)	12,128
Track Density (TPI)	810

Fig. 4.2.1

4.2.2 Track Format

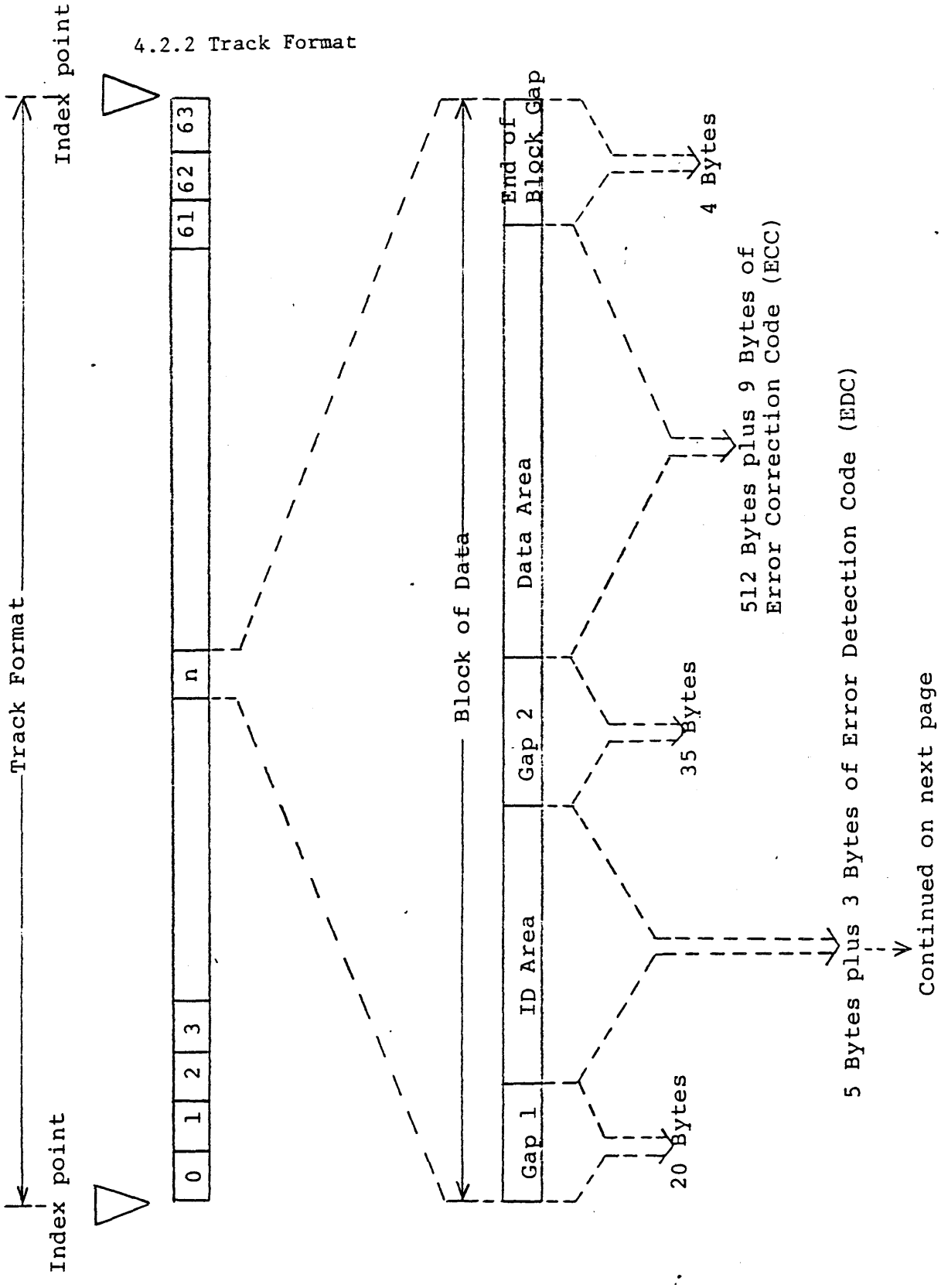
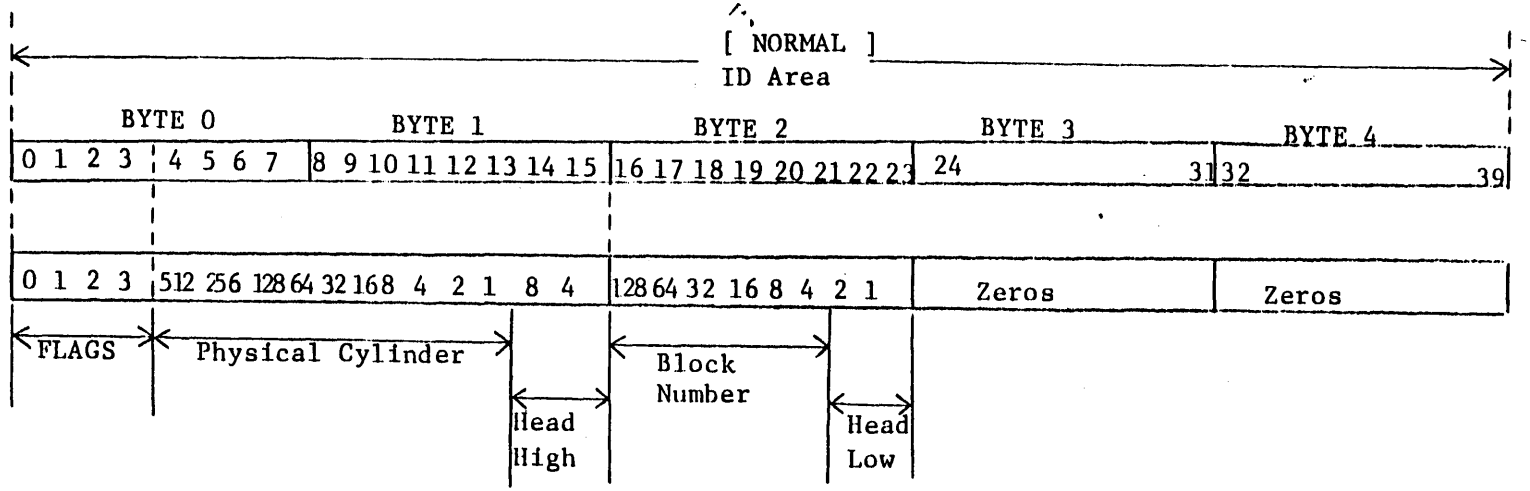


Fig. 4.2.2

Fig. 4.2.3



[Alternate/Defective]
ID Area

	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE 4
	0 1 2 3 | 4 5 6 7	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
Defective Block (Alternate is on the same Cylinder)	1 0 0 1 (1 0 1 1) | Physical Cylinder High	Physical Cylinder Low	Physical Sector	Alternate Cylinder Low	Alternate Cylinder High | Alternate Sector Offset
Defective Block (Alternate is off the same Cylinder)	1 0 0 0 (1 0 1 0) | Physical Cylinder High	Physical Cylinder Low	Physical Sector	Alternate Cylinder Low	Alternate Cylinder High | Alternate Sector Offset
Alternate Block (Not used)	0 1 0 0 | Physical Cylinder High	Physical Cylinder Low	Physical Sector	Zeros	Zeros
Alternate Block (used)	0 1 1 0 | Defective Cylinder High	Physical Cylinder Low	Physical Cylinder High | Physical Sector Offset	Defective Cylinder Low	Defective Sector
Defective Alternate Block	1 1 0 0 (1 1 1 0) | Physical Cylinder High	Physical Cylinder Low	Physical Sector	Zeros	Zeros

Bit 3 = Alternate on Cylinder
Bit 2 = Alternate Assignment
Bit 1 = Alternate Block
Bit 0 = Defective Block

Note: (XXXX) in Byte 0,bit 0 - 3 is Factory Assignment

4.3 SIGNAL TYPES AND NAMES

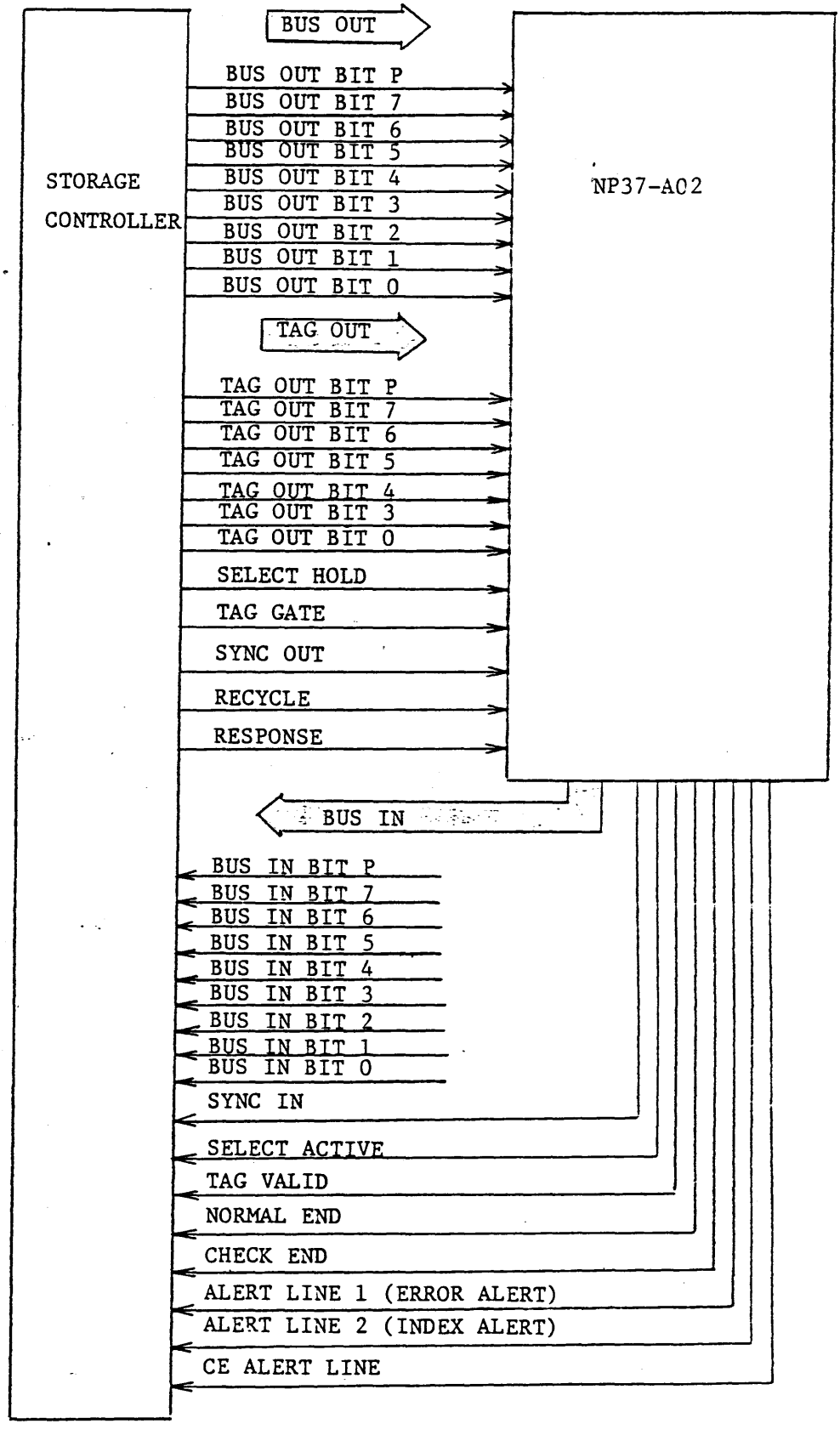


Fig. 4.3

4.4 Description of Signal Line

Signal Name and Meaning are described as follows.

(1) BUS OUT, TAG BUS, BUS IN

Bus Out or Bus In varies in meaning according to Tag Bus decode output.

(2) TAG GATE

Tag Gate activates the functions which are determined by Bus Out and Tag Bus.

Tag Gate must be held 'on' until Tag Valid is returned.

(3) SELECT HOLD

Select Hold is raised simultaneously with Select Tag when a controller or a device is selected.

Select Hold is held 'on' to keep selection.

(4) SYNC OUT, SYNC IN

Sync Out and Sync In are used for data transfer and data count.

(5) RECYCLE

This line is not used in NP37-A01.

(6) RESPONSE

Response indicates that storage controller receives NORMAL END or CHECK END.

(7) SELECT ACTIVE

Select Active indicates that a controller or a device is selected normally.

(8) TAG VALID

Tag Valid indicates that Tag Gate is received normally.

(9) NORMAL END

Normal End indicates that all the operations are completed normally.

In performing immediate operations, Normal End is raised simultaneously with Tag Valid.

(10) CHECK END

Check End indicates that an extended operation is terminated abnormally.

Abnormal termination is induced by

- o Sync Out Timing Error
- o No Sync Byte Found
- o ID Miscompare
- o ECC Data Check

(11) ALERT LINE 1

Alert Line 1 indicates that an abnormal condition occurs in the controller or device.

- o Microprogram Detected Error
- o Controller Check
- o DEV R/W Check

(12) ALERT LINE 2

Alert Line 2 indicates that Index is detected.

If SSW is installed in NP37-A02, Alert Line 2 represents Short Busy for SELECT operations.

(13) CE ALERT LINE

CE Alert Line indicates that EXECUTE SW on the CE panel is set at the proper positions.

4.5 Interface Signal Connectors

(1) Interface signal connector of two types

- o A-type connector
- o B-type connector

Fig. 4.5.1, Fig. 4.5.3 show the pin layout of the interface signal connector.

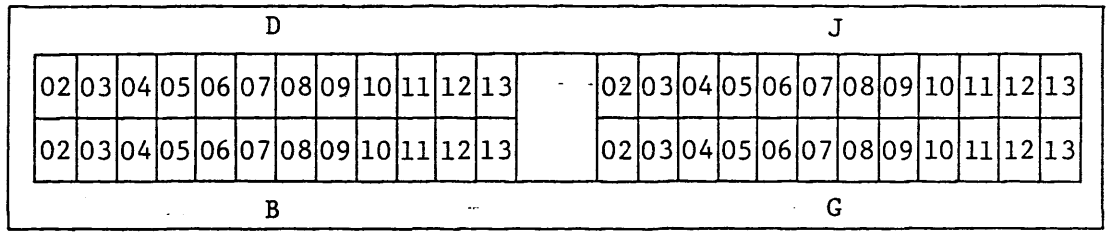
(2) NP37-A02/C02 without SSW attached has four connectors. (connector Numbers E-H)

NP37-A02/C02 with SSW has eight connectors. (connector Numbers A-H)

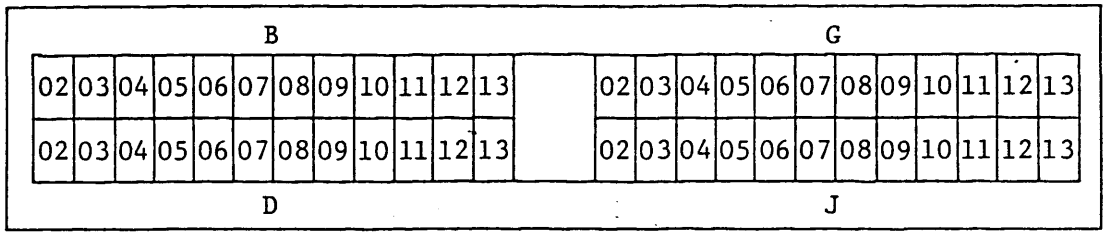
Fig. 4.5.2 shows the type of connectors A-H.

(3) Fig. 4.5.4 to Fig. 4.5.7 show the signal names and pin numbers for each connector (A-H).

(4) Interface cable terminators (95Ω ± 2%) should be connected to the Interface connectors A-H of the last string.

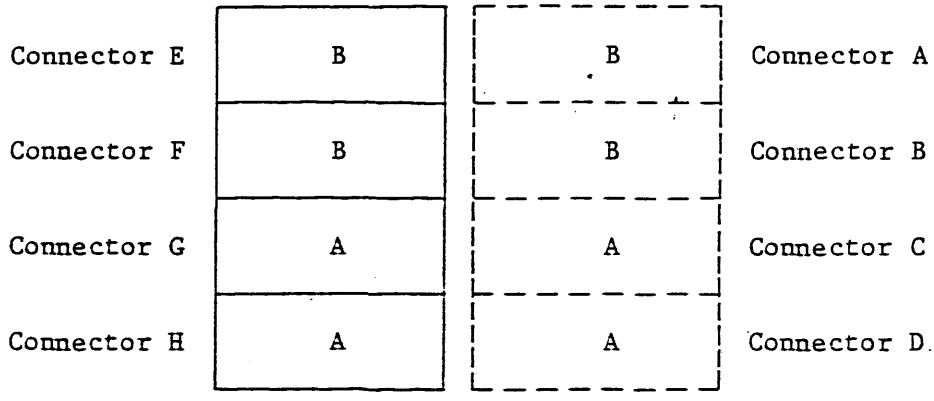


A-type connector pin layout
(From the view of the cable side)



B-type connector pin layout
(From the view of the cable side)

Fig. 4.5.1 Interface Connector Pin Layout



Note: The boxed A and B indicate the connector type (cable side)

Fig. 4.5.2 Connector Type

Connector Number	Connector Type	
	For Panel	For Cable
A, B E, F	A-type (Brown) Fujitsu Ltd. C630-5170-T801	B-type (Black) Fujitsu Ltd. C630-5170-T802
C, D G, H	B-type (Black) Fujitsu Ltd. C630-5170-T802	A-type (Brown) Fujitsu Ltd. C630-5170-T801

Fig. 4.5.3 Interface Signal Connector

Connectors Pin No.	Signal Name
B 02	GRD
03	TAG BUS A BIT 0
04	GRD
05	TAG BUS A BIT 4
06	-
07	GRD
08	TAG BUS A BIT 6
09	GRD
10	TAG GATE A
11	-
12	END RESPONSE A
B 13	GRD
D 02	-
03	-
04	TAG BUS A BIT 5
05	GRD
06	TAG BUS A BIT 7
07	GRD
08	GRD
09	TAG BUS A BIT P
10	GRD
11	SELECT HOLD A
12	GRD
D 13	RECYCLE TAG A

Connectors Pin No.	Signal Name
G 02	GRD
03	SELECT ACTIVE A
04	GRD
05	NORMAL END A
06	-
07	GRD
08	ERROR ALERT A
09	-
10	-
11	-
12	CE ALERT EXEC A
G 13	GRD
J 02	-
03	-
04	TAG VALID A
05	GRD
06	CHECK END A
07	GRD
08	GRD
09	INDEX ALERT A
10	-
11	-
12	-
J 13	-

Fig. 4.5.4 Connectors E and G

Connectors Pin No.	Signal Name
B 02	GRD
03	BUS OUT B BIT P
04	GRD
05	BUS OUT B BIT 1
06	-
07	GRD
08	BUS OUT B BIT 3
09	GRD
10	BUS OUT B BIT 5
11	GRD
12	BUS OUT B BIT 7
B 13	GRD
D 02	TAG BUS B BIT 3
03	-
04	BUS OUT B BIT 0
05	GRD
06	BUS OUT B BIT 2
07	GRD
08	GRD
09	BUS OUT B BIT 4
10	GRD
11	BUS OUT B BIT 6
12	GRD
D 13	SYNC OUT B

Connectors Pin No.	Signal Name
G 02	GRD
03	BUS IN B BIT P
04	GRD
05	BUS IN B BIT 1
06	-
07	GRD
08	BUS IN B BIT 3
09	GRD
10	BUS IN B BIT 5
11	-
12	BUS IN B BIT 7
G 13	GRD
J 02	-
03	-
04	BUS IN B BIT 0
05	GRD
06	BUS IN B BIT 2
07	GRD
08	GRD
09	BUS IN B BIT 4
10	GRD
11	BUS IN B BIT 6
12	GRD
J 13	SYNC IN B

Fig. 4.5.5 Connectors F and H

Connectors Pin No.	Signal Name
B 02	GRD
03	BUS OUT A BIT P
04	GRD
05	BUS OUT A BIT 1
06	-
07	GRD
08	BUS OUT A BIT 3
09	GRD
10	BUS OUT A BIT 5
11	GRD
12	BUS OUT A BIT 7
B 13	GRD
D 02	TAG BUS A BIT 3
03	-
04	BUS OUT A BIT 0
05	GRD
06	BUS OUT A BIT 2
07	GRD
08	GRD
09	BUS OUT A BIT 4
10	GRD
11	BUS OUT A BIT 6
12	GRD
D 13	SYNC OUT A

Connectors Pin No.	Signal Name
G 02	GRD
03	BUS IN A BIT P
04	GRD
05	BUS IN A BIT 1
06	-
07	GRD
08	BUS IN A BIT 3
09	GRD
10	BUS IN A BIT 5
11	-
12	BUS IN A BIT 7
G 13	GRD
J 02	-
03	-
04	BUS IN A BIT 0
05	GRD
06	BUS IN A BIT 2
07	GRD
08	GRD
09	BUS IN A BIT 4
10	GRD
11	BUS IN A BIT 6
12	GRD
J 13	SYNC IN A

Fig. 4.5.6 Connectors A and C

Connectors Pin No.	Signal Name
B 02	GRD
03	TAG BUS B BIT 0
04	GRD
05	TAG BUS B BIT 4
06	-
07	GRD
08	TAG BUS B BIT 6
09	GRD
10	TAG GATE B
11	-
12	END RESPONSE B
B 13	GRD
D 02	-
03	-
04	TAG BUS B BIT 5
05	GRD
06	TAG BUS B BIT 7
07	GRD
08	GRD
09	TAG BUS B BIT P
10	GRD
11	SELECT HOLD B
12	GRD
D 13	RECYCLE TAG B

Connectors Pin No.	Signal Name
G 02	GRD
03	SELECT ACTIVE B
04	GRD
05	NORMAL END B
06	-
07	GRD
08	ERROR ALERT B
09	-
10	-
11	-
12	CE ALERT EXEC B
G 13	GRD
J 02	-
03	-
04	TAG VALID B
05	GRD
06	CHECK END B
07	GRD
08	GRD
09	INDEX ALERT B
10	-
11	-
12	-
J 13	-

Fig. 4.5.7 Connectors B and D

4.6 Power Supply

AC power for NP37A02 string should be supplied to AC power input terminals, then it is sent to subsequent BO2s through the power sequence circuitry of each drive. A02/C02 has +24V Bootstrap supply which is energized by AC power supply at the AC input terminal directly as the DC power source, for power sequence control circuitry. A02 also has phase rotation detector and indicator to prevent from wrong phase connection.

If the phase rotation is wrong, power on sequence cannot be initiated.

There are two controlling modes of power on/off: Remote and local, which is determined by the manual switch inside the A02. See item 5.1.1.

4.6.1 Specification for Input Power

(1) Input voltage

AC 3 phases 200, 220, 235, 380V/50 Hz
AC 3 phases 200, 208, 230V/60 Hz

(2) AC Input terminal

- Terminal screw diameter M
- Terminal board name TBPS
- Terminal number R.S.T.N.G

(3) Input breaker capacity 20 Amp

4.6.2 Power Control Signal

(1) Connector

Connector Number	Part Number
P86	AMP 171433-1
P87	

Fig. 4.6.1 Power Control Signal Connector

(2) Meaning of power control signals

NP37A02 has two power control modes selected by internal manual switch. In the local mode, power on/off sequence is performed by operating Enable on/Delayed power off switch. See item 5.1.1. In the remote mode, power on/off sequence is controlled by the power control signals sent by storage controller. Each signal has following meaning.

(a) Unit Source

This is +24 V DC power (+24 V Bootstrap supply) generated in NP37A02. This signal should be used for making signals Power Pick and Power Hold as the signal source.

(b) System Source

This is DC power sent from Storage Controller and the voltage should be determined by Storage Controller side. This is used for making Power Complete signal as the signal source.

(c) Power Pick

This is +24 V pulse signal sent from Storage Controller to make NP37-2 to be powered on. Under the condition that the Power Hold signal is kept on, by receiving this Power Pick pulse, A02 is powered on at first, then B02s are powered on orderly with 4 seconds interval for each.

(d) Power Hold

This is +24 V DC signal sent from Storage Controller to make NP37-2 to be powered on or off.

Power on sequence is initiated by combination of this signal and Power Pick signal. See item C. As long as this signal is kept on, NP37-2 is kept powered on. When this signal is made off, power off sequence is initiated and NP37-2 will be powered off approximatedly 12 seconds later.

(e) Powering Complete

This signal is sent to Storage Controller to inform that the power on sequence is completed within NP37 string, by deriving the System Source signal through a contact of Powering Complete relay.

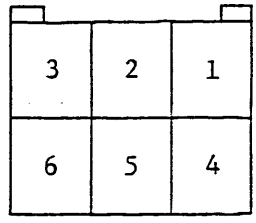


Fig. 4.6.2 Connector Pin Layout
(From the view of the cable side)

Pin No.	Signal Name
1	UNIT SOURCE (+24 V)
2	Not used
3	SYSTEM SOURCE
4	POWERING COMPLETE
5	POWER HOLD
6	POWER PICK

Fig. 4.6.3 Connector Pin Numbers

5. Switches and Indicators

5.1 Controller Operator Pannel

5.1.1 Enable on/Delayed Power off Switch

o In the Local mode

By setting this switch to Enable on position, power on sequence is initiated, namely A02 or C02 is powered on first, then B02s are powered on orderly with 4 seconds interval for each.

By setting this switch to Delayed Power Off position, power off sequence is initiated and NP37-2 will be powered off approx. 12 seconds later.

o In the Remote mode

Under the condition that this switch is set to Enable On position, the power on/off sequence can be controlled by Power Control signals from Storage Controller as described in item 4.6.

If this switch is set to Delayed Power Off position, an NP37-2 is powered off regardless of Power Control signals from Storage Controller.

5.1.2 ENABLE/DISABLE Switch

This switch functions to connect or disconnect the control line between the equipments A02,C02 and Storage Controller.
This is conveniently used for SSW function, in which system test is performed with one of the two controllers disconnected.

5.1.3 POWER ON lamp (L. E. D)

This lamp keeps lighting as long as the equipment is supplied with AC power.

5.2 Drive Operator Pannel

5.2.1 READY lamp (L.E.D)

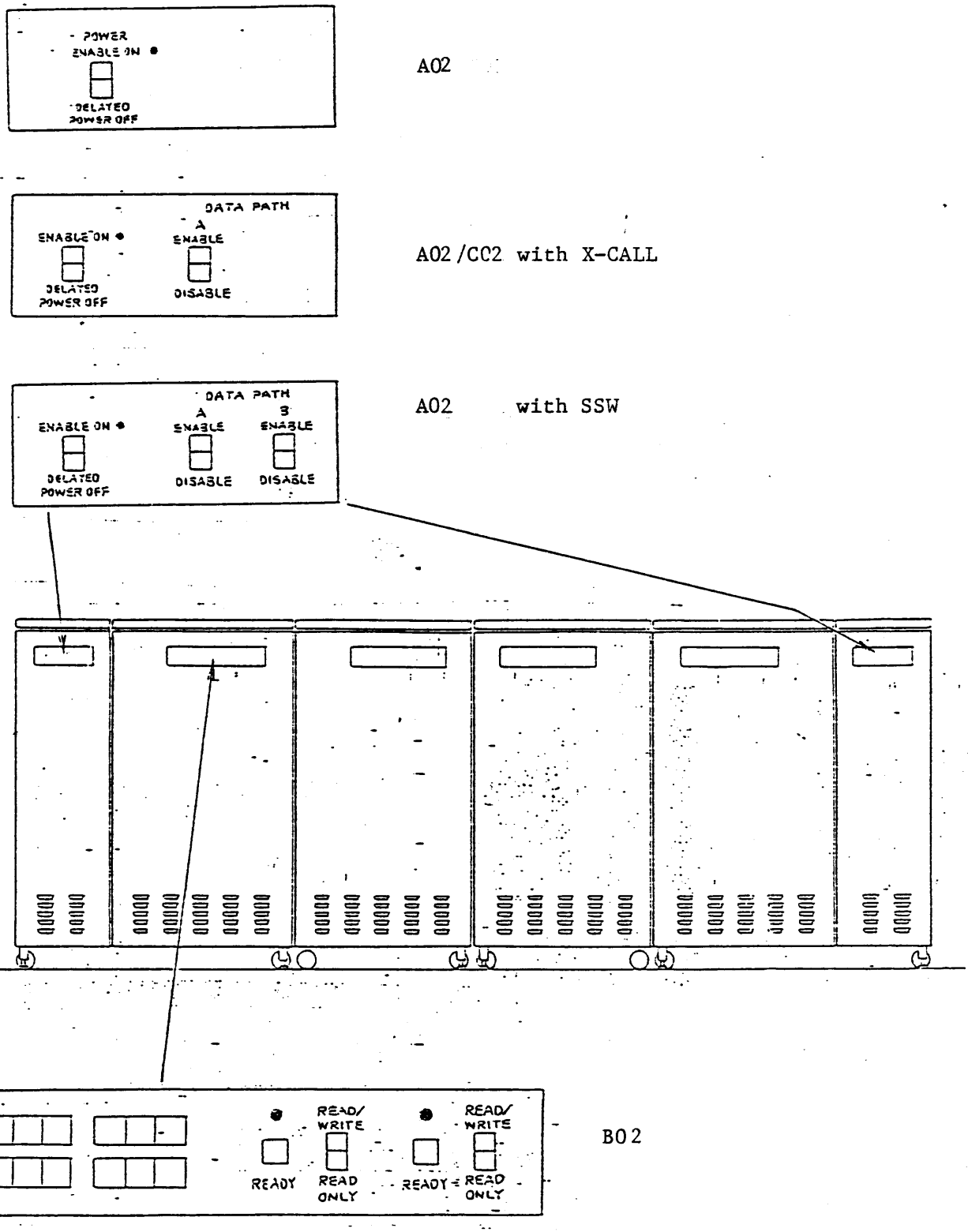
This lamp lights up when a necessary condition is established in which instructions from the system can be received.
To be more precise, the START/STOP switch is first turned to START, the disk reaches a required rpm, the head is positioned at track 000 due to rezero operation and thus the lamp lights up, which indicates the equipment is ready for operation. The lamp is off while the head is in seek operation.

5.2.2 ATTENTION switch

Depressing this switch causes the equipment to perform rezero operation and the head to move to track 000.
Thus, an ATTENTION signal is sent to the controller and the equipment is ready for operation.

5.2.3 R/W / READ ONLY switch

Turning this switch to the upper side (R/W) causes the drive to perform read/write operation.
Turning the switch to the lower side (READ ONLY) allows the drive to perform read-only operation. In this case, write operation is inhibited, so that the file is protected.



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