CITIZEN

Model: Z1DA-78A

3.5” Micro Floppy Disk Drive

Specification

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Abbreviation/Mnemonics

BPI	Bit per Inch
CRC	Cyclic Redundancy Check
DS	Drive Select
FDD	Floppy Disk Drive
FM	Frequency Modulation
MFM	Modified FM
MTBF	Mean Time Between Failures
MTTR	Mean Time to Repair
PCB	Printed Circuit Board
PM	Preventive Maintenance
P-P	Peak to Peak
R/W	Read and Write
TP	Test Point
TPI	Track per Inch

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1 Introduction

1.1 Purpose

This material provides the information necessary to interface the Z1DA series micro floppy drive to floppy disk controller, and provides all the information usually needed to integrate the Z1DA series of disk drives into a computer system.

1.2 General Description

CITIZEN 3.5 inches micro floppy disk drives are designed for portable and desktop computers.
Z1DA, feature 2.0/1.0Mbytes of unformatted storage capacity, 3ms track to track access time, low power consumption (1.45W in reading/ 0.038W in standby), single power operation (4.5 to 5.5V) and internal write-protect circuitry.
Z1DA is interface compatible with 5.25-inch floppy disk drives.
Key Features;

- ✓ 2.0/1.0MB Switchable
- ✓ Compact size..... 1" high, 4" wide, 5.9" deep
- ✓ Single power operation..... 4.5V to 5.5V
- ✓ Light weight..... 1.041lb (470g)
- ✓ Direct drive DC motor
- ✓ Interface compatibility with 5.25-inch floppy disk drive
- ✓ Button stroke 4.55mm
- ✓ Dust-proof structure
- ✓ Low power consumption ..... 1.45W (read), 0.038W (standby)
- ✓ High vibration resistance ..... Operating: 0.5G, 5-500Hz
  Standby: 4.5G, 5-500Hz

1.3 Specifications Summary

1.3.1 Performance Specifications

TABLE 1 PERFORMANCE SPECIFICATIONS

	1.0MB Mode	2.0MB Mode
Capacity (Kbytes)		
Unformatted		
per disk	1000	2000
per surface	500	1000
per track	6.25	12.5
Formatted per disk		
256B/sector	655.2 (16)	1311 (32)
512B/sector	737.2 (9)	1475 (18)
1024B/sector	819.2 (5)	1638 (10)
Transfer Rate (Kbit/sec)	250	500
Average latency (msec)	100	100
Access Time (msec)		
Track to track without settling	3	3
Average with settling	94	94
Settling time (msec)	15	15
Motor start time (sec)	0.5	0.5

1.3.2 Functional Specifications

TABLE 2 FUNCTIONAL SPECIFICATIONS

	1.0MB Mode	2.0MB Mode
Rotational Speed (rpm)	300	300
Recording Density (BPI)	8717	17434
Track Density (TPI)	135	135
Tracks	160	160
Encoding Method	MFM	MFM

1.3.3 Physical Specifications

TABLE 3 ENVIRONMENTAL LIMITS

	Operating	Shipping	Storage
Ambient Temperature	5°C to 45°C	-40°C to 60°C	-20°C to 50°C
Relative Humidity	20 to 80%	8 to 90%	8 to 80%
Maximum Wet Bulb	85°F (29.4°C)	No condensation	No condensation

DC Voltage Requirement +4.5V to +5.5V

DC Power Current

Motor start (5V)	0.77A max.
Read	0.3A typ.
Write	0.3A typ.
Seek	1.20A max.
Standby	0.0075A typ.

Mechanical Dimensions (inch)

Height	1” (25.4mm)
Width	4” (101.6mm)
Depth	5.9” (150mm with bezel)
Weight	1.041lb (470g)

Shock

Operating:	10G’s with duration of 11 milliseconds (no hard error) 5G’s with duration of 11 milliseconds (no soft error)
Non-operating	60G’s with duration of 11 milliseconds

TABLE 4 VIBRATION

	Frequency	Displacement	Acceleration
Operating	5-20Hz	0.01”	
	20-500Hz		[i]0.5G
Non-operating	5-20Hz	0.27”	
	20-500Hz		4.5G

1.3.4 Reliability Specifications

MTBF 12000 power on hours under typical usage[ii]

MTTR 30 minutes

Life 5 years

Error rates

Soft read errors	1 per 10^9 bits read
Hard read errors	1 per 10^{12} bits read
Seek errors	1 per 10^6 seeks

Media life

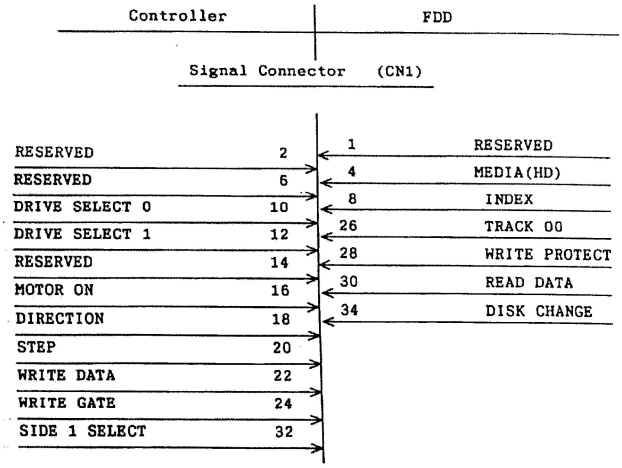
Passes per track	$3.0x10^6$
Insertions	20000+ times

[i] Except resonant frequency

[ii] Assume the duty cycle of the drive spindle motor to be 20%.

2 Electrical Interface

2.1 Interface Connection



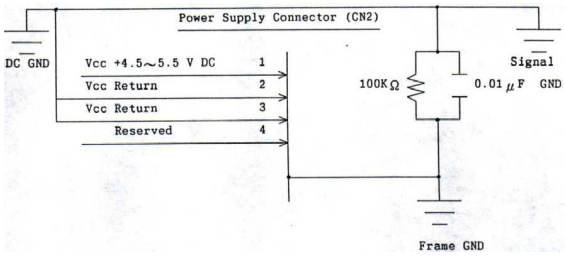


FIGURE 1 CN1 & CN2

2.2 Interface Circuits

The drive uses open drain as output line drivers, and CMOS as input line receivers. It is recommended that an open collector (SN7438, 06, 07 or equivalent) should be used as output drive of the controller side and SN74LS14 or equivalent as input receiver. Each input receiver is terminated in 1.0kΩ to V_{CC}.

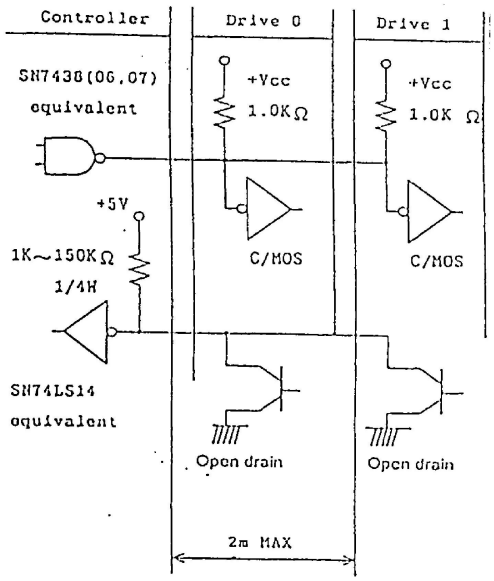


FIGURE 2 RECOMMENDED CIRCUIT

2.3 Interface Signals

Interface signals have following characteristics.

TABLE 5 INPUT AND OUTPUT LEVEL

Input Signals	
HIGH	2.4 to V_{CC}
LOW	0 to 0.6 V
Input Impedance	1 kΩ terminated to V_{CC}
Output Signals	
HIGH	Source current: 100μA max.
LOW	Sink current: 40mA 0.6V max.

2.4 Input Signals

The drive has the following input lines;

1. DRIVE SELECT
2. MOTOR ON
3. DIRECTION
4. STEP
5. WRITE DATA
6. WRITE GATE
7. SIDE1 SELECT

2.4.1 Drive Select

Two input lines, DS0 and DS1 are provided for drive select, DRIVE SELECT and can be activated by soldering appropriate jumper. A “LOW” level on the input signal DRIVE SELECT enables the drive to operate.

2.4.2 Motor ON

The spindle motor starts when this signal becomes “Low”.

2.4.3 Direction

This signal determines the direction of R/W heads movement by the following;
“High” level: Out (towards Track 00)
“Low” level: In (towards Track 79)

2.4.4 Step

This line causes the R/W Heads to move.
The period of a step pulse must be a minimum of 3ms.
An 18ms delay following the last STEP pulse is required before the read or write operation can be initiated.
An 18ms delay following the last STEP pulse is required for the next STEP pulse when the DIRECTION is changed.
The following examples describe several cases that make STEP pulse valid or invalid;

1. STEP pulses towards the outside after the TRACK00 signal has been generated are invalid.
2. STEP pulses which intervals are less than 3ms may cause seek errors.
3. A step pulse should be generated at more than 4ms when DIRECTION signal had been reversed.

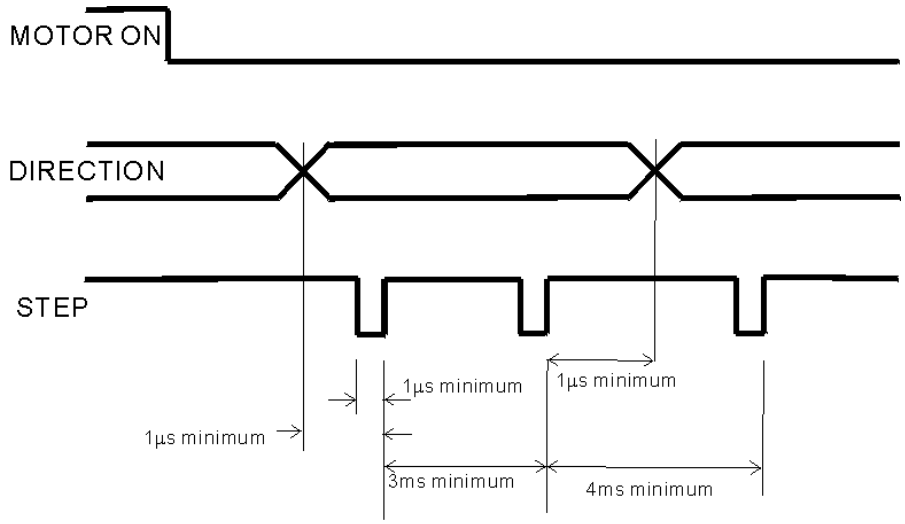


FIGURE 3 STEP PULSE TIMMING

In consideration of a delay of a STEP pulse in a drive, the DIRECTION is latched at the trailing edge of the STEP pulse.

2.4.5 Write Data

This line provides data to be written on the disk.
Each transition from "High" to "Low" changes the polarity of the R/W Head Current and causes a data bit to be written on the disk.

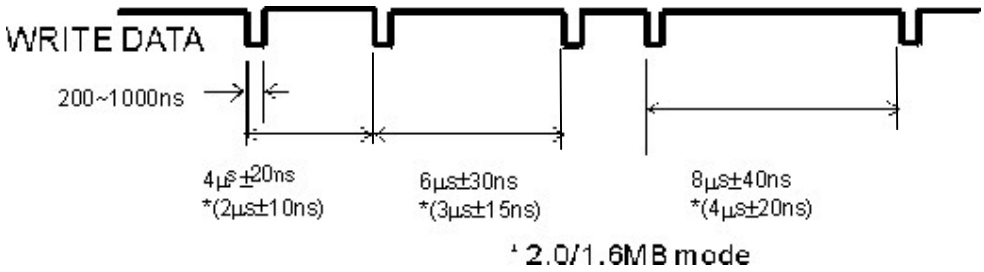


FIGURE 4 WRITE DATA TIMING (MFM)

When the power is turned on or when the source voltage is suddenly dropped lower than 3.5V & returned to normal voltage, the write data signal is invalid for 10ms after the source voltage returns to a normal level.

2.4.6 Write Gate

A "Low" level on this line enables writing.
When the READ DATA or STEP lines are activated, the signal on this line must be "High". The change of DRIVE SELECT, start of reading, Drive Select off, Motor Off and STEP must be delayed by 1.2ms (0.59ms for 2/1.6MB mode) after WRITE GATE become "High", because the erase head is operating at this time. When the above is not observed, data errors may occur.

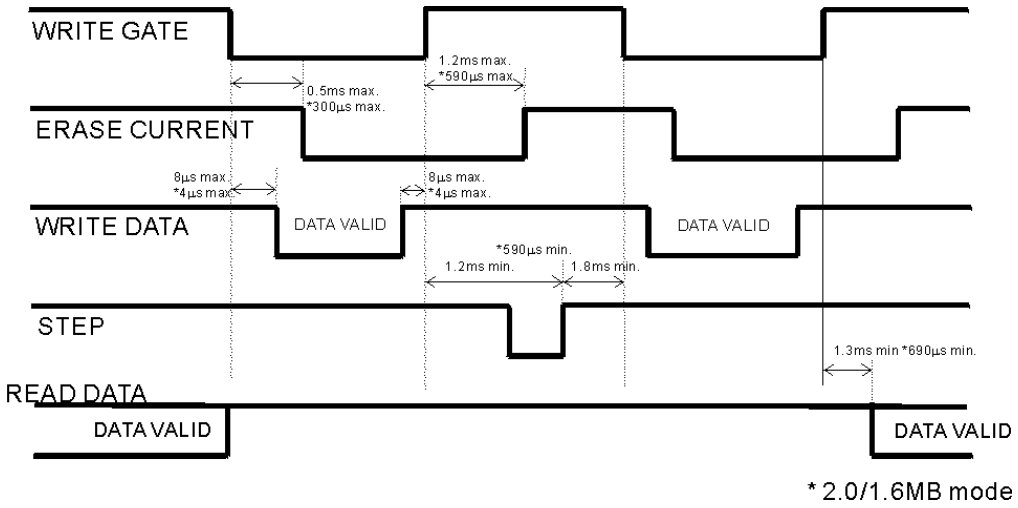


FIGURE 5 WRITEGATE & WRITEDATA TIMING

2.4.7 Side 1 Select

"Low" level on this line selects Side 1 and "High" selects Side 0.
When the WRITE GATE is "Low", change of side is invalid.

2.5 Output Signals

Output signals are as follows. All output signals are gated by DRIVE SELECT signal.

1. INDEX
2. TRACK00
3. WRITE PROTECT
4. READ DATA
5. DISK CHANGE
6. MEDIA

2.5.1 Index

This line is used for indicating the reference position of a track.
The leading edge of an INDEX pulse should be used when an INDEX signal is needed.

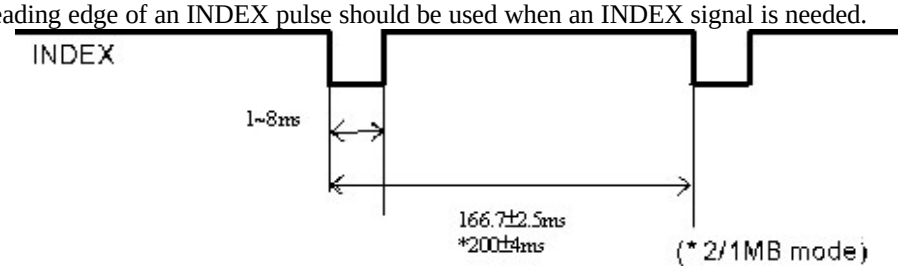


FIGURE 6 INDEX SIGNAL TIMING

2.5.2 Track 00

This signal becomes "Low" when the R/W heads are positioned at track00. Figure below shows the timing for the last STEP pulse and the TRACK00 signal.

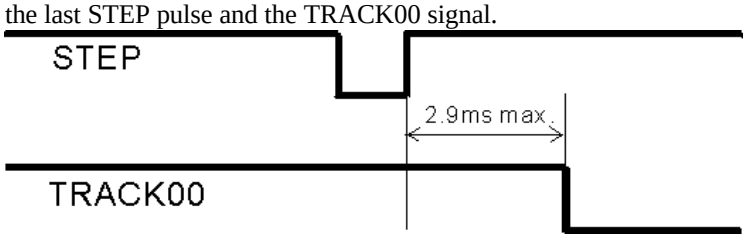


FIGURE 7 TRACK00 SIGNAL TIMING

2.5.3 Write Protect

A "Low" level on this line indicates that a write protect disk is inserted, or the V_{CC} is below the level of write protect.

2.5.4 Read Data

This line provides "raw data". (Clock and data information not separated) Details refer to below figure.

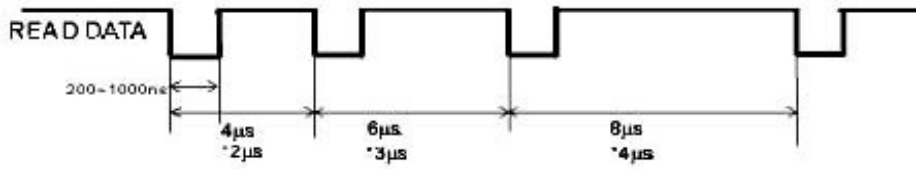


FIGURE 8 READ DATA TIMING

NOTE:

- ✧ Figures indicate the nominal positions.
- ✧ The accuracy of READ DATA to reference position is ±0.7µs (±0.35µs for 1.6/2.0MB mode)

2.5.5 Disk Change

When one of the following conditions is satisfied, the signal becomes low.

1. Power is turned on.
2. Disk is ejected.

When the following condition is satisfied, this signal becomes high.

1. STEP signal is received while disk is loaded.

Following figure shows the DISK CHANGE timing.

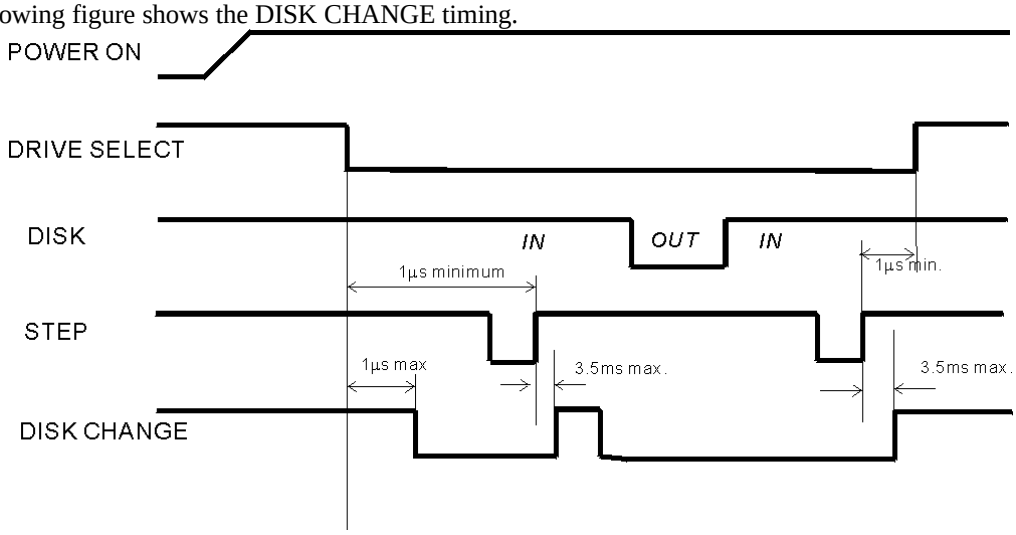


FIGURE 9 DISK CHANGE TIMING

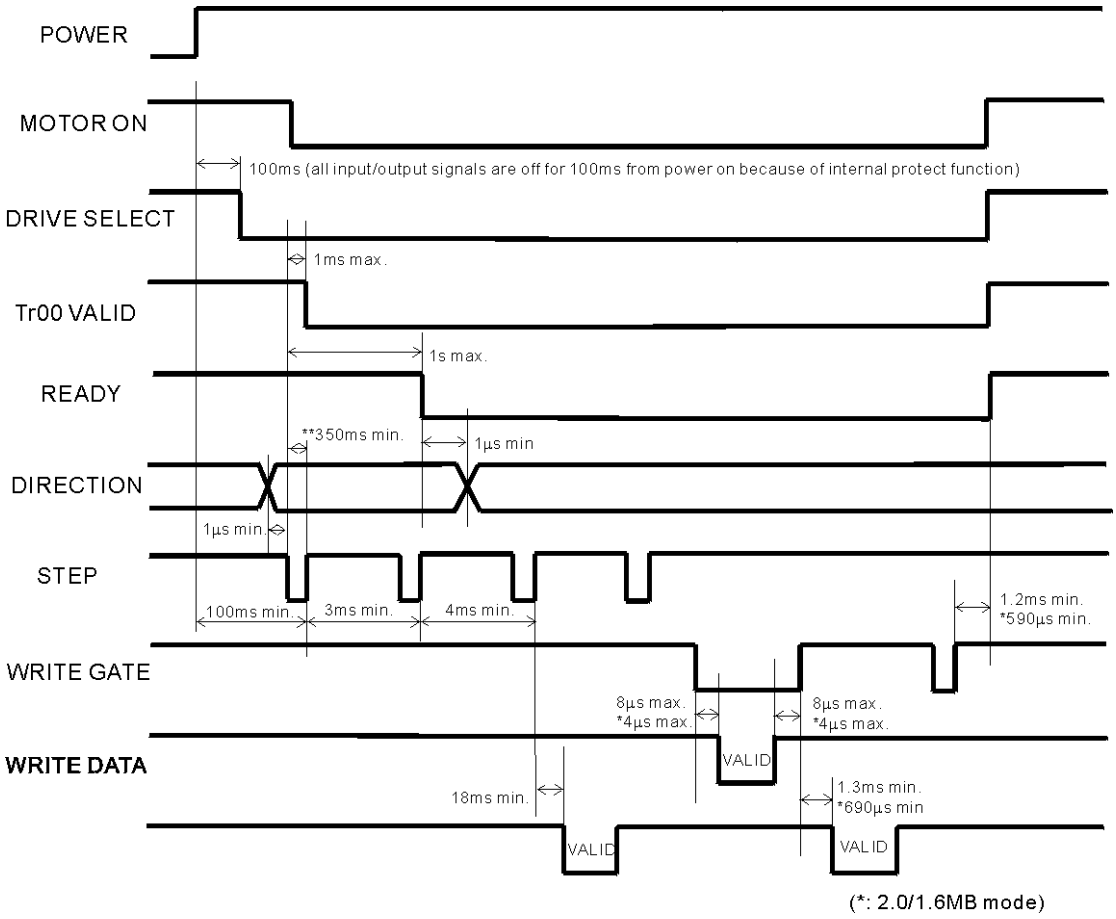
2.5.6 Media

This signal is changed by Media Type as follows;

2.0MB Media (HD Media): LOW
1.0MB Media (DD Media): HIGH

2.6 Interface Timing

Below figure shows the timing relationship for Host/Drive interface signals



**: This is our recommended value to keep power

FIGURE 10 TIMING RELATIONSHIP FOR HOST/DRIVE INTERNAL SIGNAL

2.7 Power Interface

2.7.1 Power Supply Specifications

Power supply and current are shown in below Figure and Table.

TABLE 6 POWER SUPPLY CURRENT

	MODE					
POWER CONSUMPTION		SPINDLE MOTOR ON	[i] SEEK (PEAK)	[ii] READ	[iii] WRITE	[iv] STANDBY
	TIME (MS)	200MS	15MS	-	-	-
	PEAK TYPICAL V_{CC}=5V	650MA	1040MA	290MA	290MA	7.5MA
	PEAK MAXIMUM V_{CC}=5.5V	770MA	1200MA	410MA	410MA	9.5MA

Note: Voltage: 4.5~5.5V, Acceptable ripple voltage: 0.1V_{P-P} max.

2.8 Other Functional Characteristics

2.8.1 Automatic Motor ON/OFF

The spindle motor starts when both of the following conditions are satisfied.

1. The cartridge is correctly loaded.
2. The MOTOR ON signal is “Low”.

The spindle motor stops when either of the above is not satisfied.

Figure below shows the timing of the spindle motor rotation.

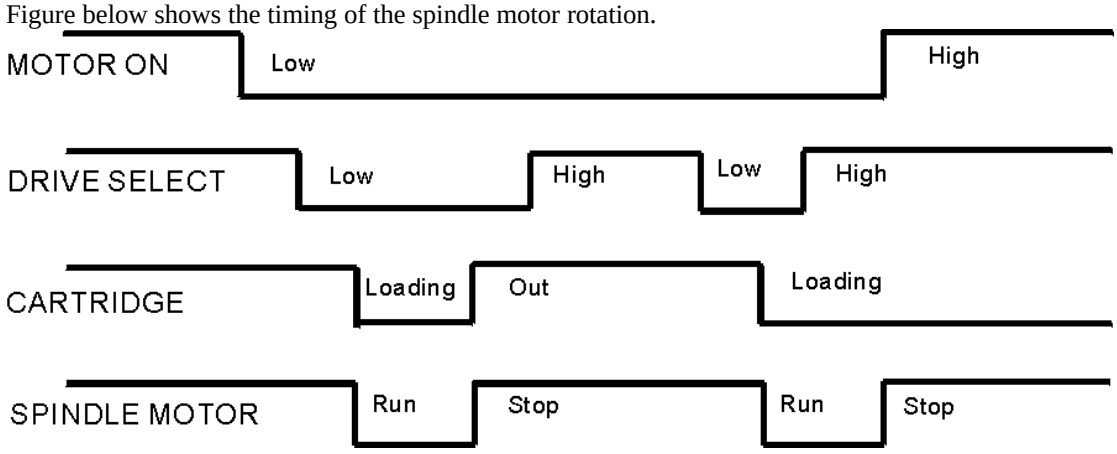


FIGURE 11 TIMING OF SPINDLE MOTOR ROTATION

2.8.2 Stand-by

When the MOTOR ON signal becomes “High”, the power consumption is very low in the standby mode

2.8.3 In-use LED

The in-use LED lights when the DRIVE SELECT signal is low.

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[i] Seek typical: 3ms; Seek maximum: 6ms.
[ii] Measured track: track00.
[iii] Measured track: track00.
[iv] All input signals are high.

3 Physical Interface

3.1 Cable Connections

The electrical interface between the Z1DA and the host system is via two connectors.
The first connector CN1 provides the signal interface, and the second connector CN2 provides the DC power

TABLE 7 SIGNAL CONNECTOR PIN ASSIGNMENTS

Return Pin #	Signal Pin #	Signal
	1	RESERVED
	2	RESERVED
3	4	MEDIA (HD)
5	6	RESERVED
7	8	INDEX
9	10	RESERVED
11	12	DRIVE SELECT
13	14	RESERVED
15	16	MOTOR ON
17	18	DIRECTION
19	20	STEP
21	22	WRITE DATA
23	24	WRITE GATE
25	26	TRACK 00
27	28	WRITE PROTECT
29	30	READ DATA
31	32	SIDE 1 SELECT
33	34	DISK CHANGE

TABLE 8 DC POWER CONNECTOR PIN ASSIGNMENT

Pin #	Power Supply
1	+4.5 to +5.5V
2	RETURN
3	RETURN
4	RESERVED

3.2 Connectors & Cable

3.2.1 Signal Connector and Cable (CN1/P1)

CN1 connector is 34pin male connector located at the rear of the drive.
Recommended signal connector and cable are as follow;

Connector: 3M 3414-6000
Cable: 3365-34 (2.0m max.)

3.2.2 Power Connector and Cable (CN2/P2)

CN2 connector is a four pin male connector located at the rear of the drive.
Recommended signal connector and cable are as follow;

Connector Housing: AMP 171822-4
Contact Pins: AMP 170204-2
Cable: AWG 20 (2.0m max.)

3.2.3 Connector Pin Assignment

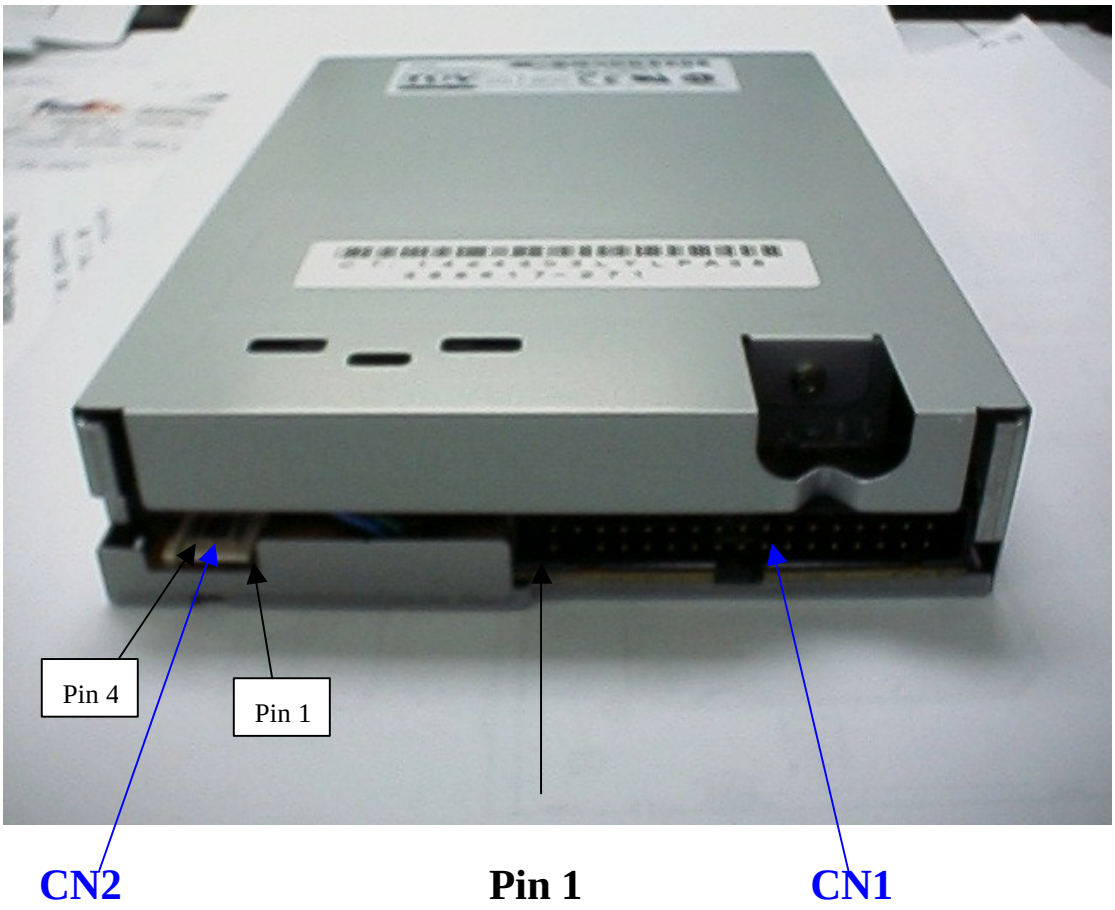


FIGURE 12 REAR VIEW OF THE DRIVE

3.2.4 Daisy Chain Connector

The Z1DA circuits consist of CMOS, which terminates in 1.0kΩ.
In a Daisy Chain, there is no need to change the terminators. Resistance is 1.0kΩ with one drive and 500Ω with two drives.
Cable length in a chain is allowed to a maximum of 2m.
When more than two drives are utilized, use the same power for each drive.

4 Installation

4.1 Mechanical Dimensions

The dimensions are as follows:

Width:	101.6 +0.1, -0.6mm	(4.0 +0.004, -0.02”)
Depth:	150±0.5mm	(5.91±0.02”)
Height:	25.4±0.5mm	(1.00±0.02”)

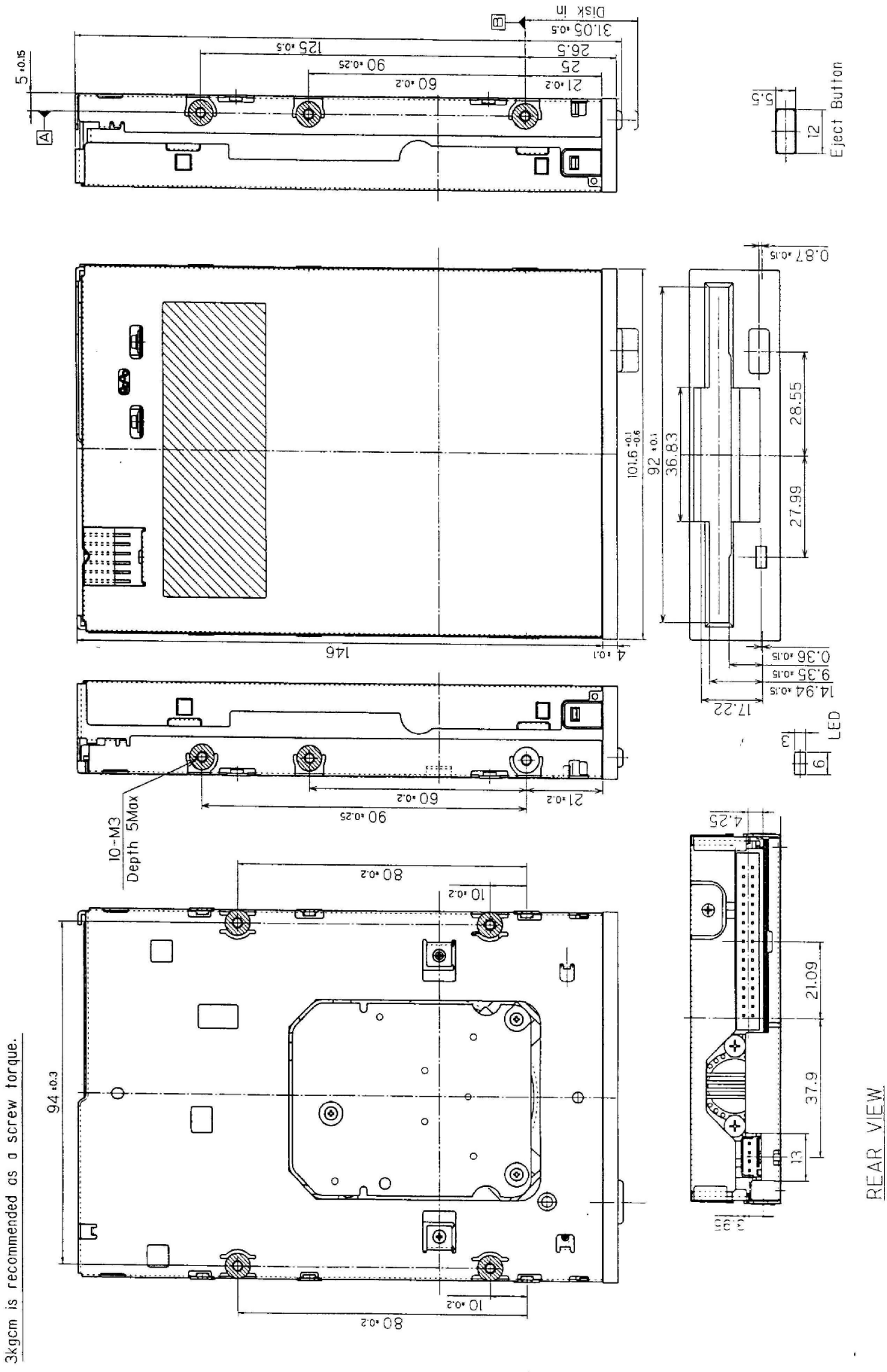


FIGURE 13 MECHANICAL DIMENSION

4.2 Mounting Direction

The drive can be mounted in three directions as shown in the diagram.

FIGURE 14 MOUNTING DIRECTION

The drive should not be mounted at an angle exceed 30°.

FIGURE 15 MOUNTING ANGLE

5 Recording Format

Recommended Format

The format of the data recorded on the disk is totally, a function of the host system, and can be designed around the user's application to take best advantage of the total available bits that can be written on any track.

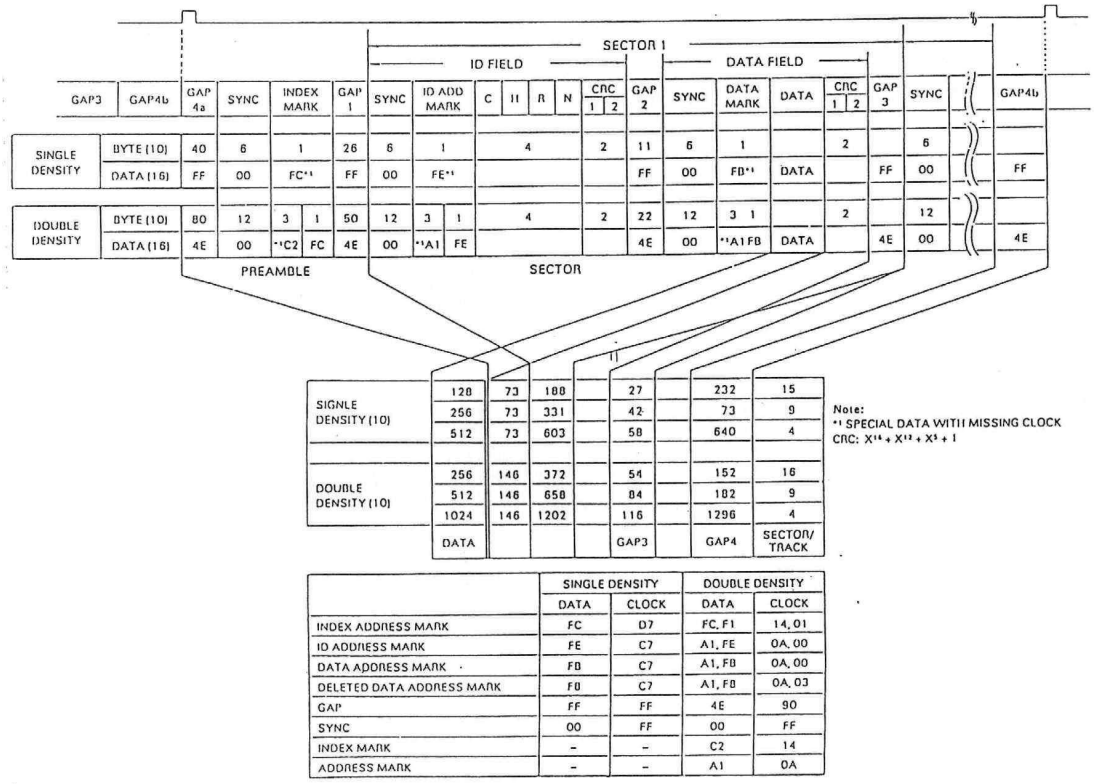
The following tables and figures shows the typical record formats.

TABLE 9 1MB FORMAT

FM/MFM	*IBM FORMAT*	*ISO FORMAT*
128/256 BYTES/SECTOR	*15 SECTORS (FM)*	*16 SECTORS*
	16 SECTORS (MFM)	
256/512 BYTES/SECTOR	*9 SECTORS*	*9 SECTORS*
512/1024 BYTES/SECTOR	*4 SECTORS*	*5 SECTORS*

TABLE 10 2MB FORMAT

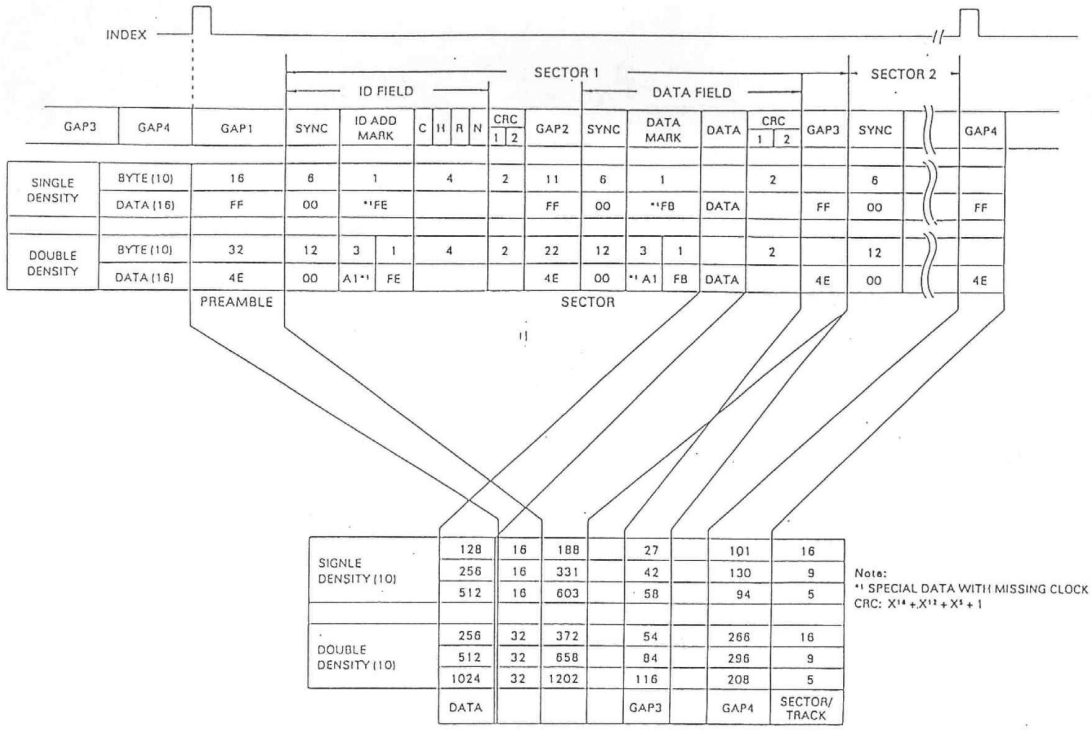
FM/MFM	*IBM FORMAT*
128/256 BYTES/SECTOR	*32 SECTORS*
256/512 BYTES/SECTOR	*18 SECTORS*
512/1024 BYTES/SECTOR	*10 SECTORS*



	DATA	GAP3	GAP4
SIGNLE DENSITY (10)	128	27	15
	256	42	9
	512	58	4
DOUBLE DENSITY (10)	256	54	16
	512	84	9
	1024	116	4

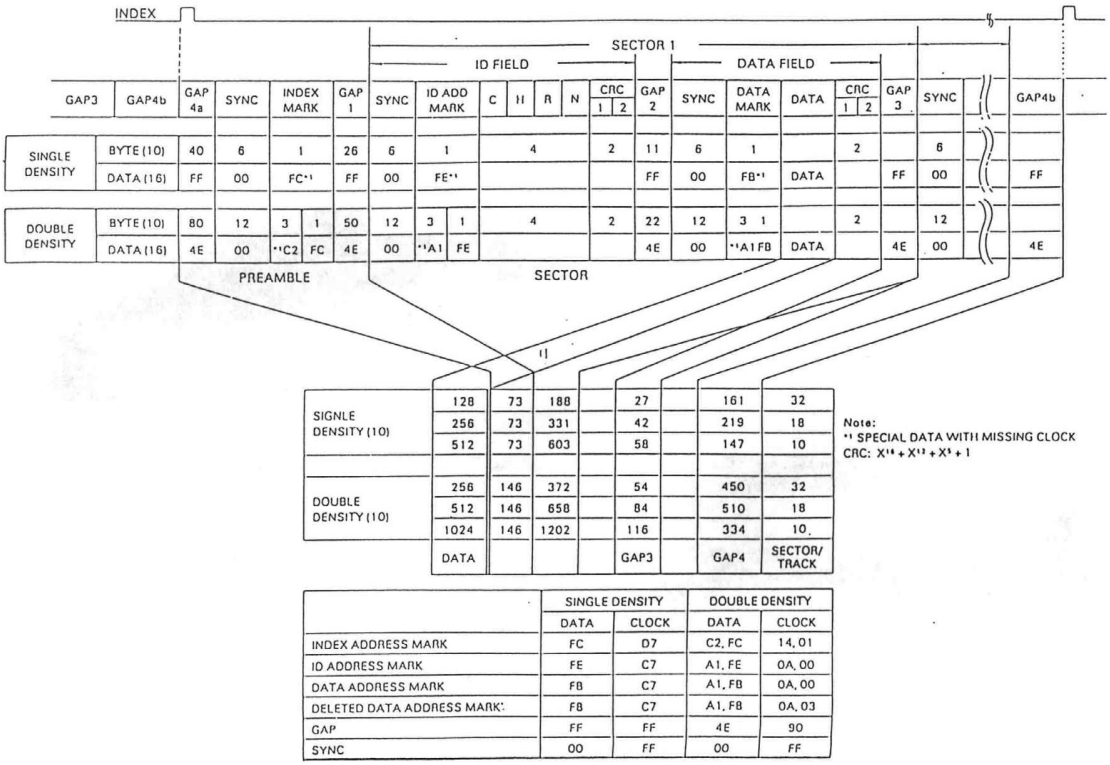
	SINGLE DENSITY		DOUBLE DENSITY	
	DATA	CLOCK	DATA	CLOCK
INDEX ADDRESS MARK	FC	D7	FC, F1	14, 01
ID ADDRESS MARK	FE	C7	A1, FE	0A, 00
DATA ADDRESS MARK	FB	C7	A1, FB	0A, 00
DELETED DATA ADDRESS MARK	F8	C7	A1, F8	0A, 03
GAP	FF	FF	4E	90
SYNC	00	FF	00	FF
INDEX MARK	-	-	C2	14
ADDRESS MARK	-	-	A1	0A

FIGURE 16 1.0M IBM FORMAT



	DATA	GAP3	GAP4
SIGNLE DENSITY (10)	128	27	101
	256	42	130
	512	58	94
DOUBLE DENSITY (10)	256	54	266
	512	84	296
	1024	116	208

FIGURE 17 1.0M ISO FORMAT



	SINGLE DENSITY		DOUBLE DENSITY	
	DATA	CLOCK	DATA	CLOCK
INDEX ADDRESS MARK	FC	D7	C2, FC	14, 01
ID ADDRESS MARK	FE	C7	A1, FE	0A, 00
DATA ADDRESS MARK	FB	C7	A1, FB	0A, 00
DELETED DATA ADDRESS MARK	FB	C7	A1, FB	0A, 03
GAP	FF	FF	4E	90
SYNC	00	FF	00	FF

FIGURE 188 2.0M IBM FORMAT