FD1035

3.5" FLOPPY DISK DRIVE

PRODUCT DESCRIPTION

REV. 2

NEC Corporation
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Specifications remain subject to change to allow the introduction of design improvements.
<table>
<thead>
<tr>
<th>Edition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prepared in March 1984</td>
</tr>
<tr>
<td>2</td>
<td>Prepared in July 1984</td>
</tr>
</tbody>
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1. GENERAL

The FD1035 micro-floppy disk drive is a double-sided micro-floppy disk drive with 135 tracks per inch (TPI).

The Micro-floppy disk (abbreviated as disk in this manual) used for the FD1035 is contained in a hard jacket with auto shutter.

The FD1035 micro-floppy disk drive has a total volume one fourth that of conventional 5-1/4" mini-floppy disk drives and weights only approximately 680 g, yet has a comparable storage capacity.

The drive uses a direct-driven spindle with a brushless DC motor, and by to the low power design it consumes only 4.5 watts of power.

The low noise design assures silent operations.

In this manual the FD1035 micro-floppy disk drive is abbreviated as FDD.
2. GENERAL SPECIFICATIONS

2.1 Drive specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Specification</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Recording mode</td>
<td>MFM</td>
<td>FM</td>
</tr>
<tr>
<td>2</td>
<td>Capacity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unformatted</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Formatted</td>
<td>640</td>
<td>320</td>
</tr>
<tr>
<td>3</td>
<td>Data transfer rate</td>
<td>250</td>
<td>125</td>
</tr>
<tr>
<td>4</td>
<td>Maximum bit density</td>
<td>8717</td>
<td>4359</td>
</tr>
<tr>
<td>5</td>
<td>Tracks</td>
<td>160</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Average rotational speed</td>
<td>300</td>
<td>rpm</td>
</tr>
<tr>
<td>7</td>
<td>Seek time</td>
<td>3</td>
<td>ms</td>
</tr>
<tr>
<td></td>
<td>(Track-to-track)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Seek settling time</td>
<td>15</td>
<td>ms</td>
</tr>
<tr>
<td>9</td>
<td>Head load time</td>
<td>35</td>
<td>ms</td>
</tr>
<tr>
<td>10</td>
<td>Track density</td>
<td>135</td>
<td>TPI</td>
</tr>
<tr>
<td>11</td>
<td>Start time</td>
<td>800</td>
<td>ms</td>
</tr>
<tr>
<td>12</td>
<td>Standard external dimensions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(NOTE 1)</td>
<td>Width</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Height</td>
<td>101.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Depth</td>
<td>132</td>
</tr>
<tr>
<td>13</td>
<td>Weight</td>
<td>680</td>
<td>gr</td>
</tr>
<tr>
<td>14</td>
<td>Operating environment conditions</td>
<td>Temperature</td>
<td>4 ~ 46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relative humidity</td>
<td>20 ~ 80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum wet-bulb temperature</td>
<td>29.0 (no bedewing)</td>
</tr>
<tr>
<td>No.</td>
<td>Item</td>
<td>Specification</td>
<td>Unit</td>
</tr>
<tr>
<td>-----</td>
<td>------</td>
<td>---------------</td>
<td>------</td>
</tr>
<tr>
<td>15</td>
<td>Power supply requirement</td>
<td>Voltage (V)</td>
<td>Startup current (NOTE 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+12</td>
<td>540</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+5</td>
<td>270</td>
</tr>
<tr>
<td>16</td>
<td>Power dissipation (NOTE 2)</td>
<td></td>
<td>4.0</td>
</tr>
<tr>
<td>17</td>
<td>Heat output (NOTE 2)</td>
<td></td>
<td>3.4</td>
</tr>
<tr>
<td>18</td>
<td>Reliability</td>
<td>MTBF (NOTE 3)</td>
<td>12000 (Under standard use condition)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MTTR</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Device life</td>
<td>15000 POH or 5 years (Design life)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Retryable</td>
<td>$10^{-3}$ (Not including 2 or less retry attempts)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unretryable error ratio</td>
<td>$10^{-12}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seek error ratio</td>
<td>$10^{-6}$</td>
</tr>
<tr>
<td>19</td>
<td>Disk life</td>
<td>Pass count/track</td>
<td>$3.0 \times 10^6$</td>
</tr>
<tr>
<td>20</td>
<td>Disk</td>
<td></td>
<td>Double sided 3.5&quot; diskette specified by NEC</td>
</tr>
<tr>
<td>21</td>
<td>Drive environment</td>
<td>Operating</td>
<td>Non-operating (Storage)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temperature</td>
<td>4 ~ 46 (39 ~ 115)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relative humidity</td>
<td>20 ~ 80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum wet-bulb temperature</td>
<td>29 (84)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Largest temperature gradient</td>
<td>15 (59)</td>
</tr>
<tr>
<td>No.</td>
<td>Item</td>
<td>Specification</td>
<td>Unit</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------</td>
<td>---------------------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td>Allowable vibration (Except at resonance</td>
<td>0.5 (Less than</td>
<td>G</td>
</tr>
<tr>
<td></td>
<td>point)</td>
<td>100 Hz)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 (Less than</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 Hz)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allowable shock (Less than 10ms)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

NOTE 1: Value at the time of spindle motor start-up.

NOTE 2: Average value of current consumption taken when FDD IS READY.

NOTE 3: Under standard use conditions

(1) Device service : 8 h/day
  time (POH)

(2) Actual head load : 0.5h/day
  time (R/W time)

(3) Head load count : 240 times/day

(4) Disk insertion/ ejection : 25 times/day

(5) Motor ON/OFF : 300 times/day

(6) Average use time : 2h/day
  per disk (4 disks/day, drive)

- 4 -
2.2 Drive structure

The major component of FDD have the following functions:

(1) Base
   Constructs the frame.

(2) Spindle motor assembly
   Drives the disk using a DC spindle motor. The disk is secured to the spindle with a magnet and is driven by a driving pin.

(3) Head carriage assembly
   Contains a pair of magnetic heads facing across the medium. The R/W gap of the head on side one is dislocated 8 tracks inner than that of the head on side zero.

(4) Step motor
   Moves the carriage assembly via the steel band.

(5) Head load assembly
   Brings the magnetic head into contact with the disk in read/write operations.

(6) Index sensor
   Optically senses the index point attached to the spindle motor.
(7) Track 00 sensor
Optically senses that the magnetic head is at
track 00.

(8) Write protect sensor
Optically senses whether the write-protect
hole in the disk is open or closed.

(9) Eject mechanism
Used for insertion and removal of disk and for
automatic shutter control.

(10) P.W.B
Mounts the electric circuits that controls
positioning of magnetic head, read/write
operations, etc.

(11) Display lamp
A LED is provided for display of the FDD
status.

(12) Front panel
Dress panel installed on the Drive front.
2.3 Drive Operation

When a diskette is inserted into the FDD, the disk starts rotating and is chucked to the spindle. The FDD becomes ready when the spindle motor reaches the specified rotation speed after it was turned on. If the drive is selected, it transfers a READY signal to the controller. It takes approximately 800 ms for the spindle motor to become ready.

Then FDD moves the magnetic head to a target track for positioning according to the STEP pulse and DIRECTION SELECT signals sent from the controller.

FDD brings the magnetic head into contact with the disk by the MOTOR ON signal from the controller and selects the desired magnetic head by the SIDE SELECT signal. Now FDD is ready for read/write operations.

For a write operation, the FDD converts into a magnetized pattern the WRITE DATA signal which is the serial data sent from the controller and records on the disk.

For a read operation, FDD detects a magnetized pattern recorded on the disk, converts it into serial data, and sends to the controller as a READ DATA signal.
### 2.4 Disk Specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Media type</td>
<td>3.5&quot; double sided medium specified by NEC</td>
</tr>
<tr>
<td>2</td>
<td>Product name</td>
<td>NEC micro floppy disk</td>
</tr>
<tr>
<td>3</td>
<td>Number of disks</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Recording surfaces</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Number of total tracks per disk</td>
<td>160</td>
</tr>
<tr>
<td>6</td>
<td>Disk cartridge size</td>
<td>90 × 94 mm</td>
</tr>
<tr>
<td>7</td>
<td>Operating environment conditions</td>
<td>10 ~ 60°C (50 to 140°F)</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relative humidity</td>
<td>8 ~ 80%</td>
</tr>
<tr>
<td></td>
<td>Wet-bulb temperature</td>
<td>29°C Maximum (84°F)</td>
</tr>
<tr>
<td></td>
<td>Temperature gradient</td>
<td>20°C/h Maximum (36°F/h)</td>
</tr>
<tr>
<td></td>
<td>External Magnetic field</td>
<td>4000 A/m (50 oersted) or less</td>
</tr>
<tr>
<td></td>
<td>Standing</td>
<td>Leave the disk at least 30 minutes in the device operating environment before use.</td>
</tr>
</tbody>
</table>
2.5 Disk Structure

The floppy disk is contained in a hard jacket withinside of which liner sheets are provided for disk surface protection. The disk uses a polyethylene terephthalate base coated with magnetic layers. The liner consists of unwoven cloth and protects the disk surfaces from scratch or dust. The hard jacket is made of ABS resin.

The disk has a metal hub which is used to secure itself to the spindle. The hard jacket has a write-protect hole and automatic shutter.

The disk construction is shown in Figure 2.1.
Figure 2.1 shows the disk structure.

Fig. 2.1 Disk Structure
3. INTERFACE

3.1 General Description

FDD's may be attached to its controller in either parallel or daisy-chain configuration. The number of FDD's which can be attached to one controller depends on individual system and controller. For daisy-chain attachment, each controller can control up to 4 FDD's.

Signal line termination resistors are provided on each FDD. The basic FDD attachment to the controller is shown in Figure 3.1.

(a) Parallel attachment
(b) Daisy Chain attachment

Fig. 3.1 Basic Connection Modes
3.2 Physical Specifications

The FDD is attached to its controller through a signal connector and a power connector. A faston terminal is provided for frame ground. The connector locations are shown in Figure 3.2.
Fig. 3.2 Connector Locations
3.2.1 Signal Types and Pin Configuration

The following shows the signal connector pin configuration on the FD1030:

<table>
<thead>
<tr>
<th>Signal name</th>
<th>I/O</th>
<th>Pin number</th>
<th>Pin number</th>
<th>Signal name</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESERVED (HEAD LOAD/IN USE)</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>GND</td>
</tr>
<tr>
<td>DRIVE SELECT 3</td>
<td>Input signal</td>
<td>4</td>
<td>3</td>
<td>GND</td>
</tr>
<tr>
<td>INDEX</td>
<td>Output signal</td>
<td>6</td>
<td>5</td>
<td>GND</td>
</tr>
<tr>
<td>DRIVE SELECT 0</td>
<td>Input signal</td>
<td>8</td>
<td>7</td>
<td>GND</td>
</tr>
<tr>
<td>DRIVE SELECT 1</td>
<td>Input signal</td>
<td>10</td>
<td>9</td>
<td>GND</td>
</tr>
<tr>
<td>DRIVE SELECT 2</td>
<td>Input signal</td>
<td>12</td>
<td>11</td>
<td>GND</td>
</tr>
<tr>
<td>MOTOR ON</td>
<td>Input signal</td>
<td>14</td>
<td>13</td>
<td>GND</td>
</tr>
<tr>
<td>DIRECTION SELECT</td>
<td>Input signal</td>
<td>16</td>
<td>15</td>
<td>GND</td>
</tr>
<tr>
<td>STEP</td>
<td>Input signal</td>
<td>18</td>
<td>17</td>
<td>GND</td>
</tr>
<tr>
<td>WRITE DATA</td>
<td>Input signal</td>
<td>20</td>
<td>19</td>
<td>GND</td>
</tr>
<tr>
<td>WRITE GATE</td>
<td>Input signal</td>
<td>22</td>
<td>21</td>
<td>GND</td>
</tr>
<tr>
<td>TRACK 00</td>
<td>Output signal</td>
<td>24</td>
<td>23</td>
<td>GND</td>
</tr>
<tr>
<td>WRITE PROTECT</td>
<td>Output signal</td>
<td>26</td>
<td>25</td>
<td>GND</td>
</tr>
<tr>
<td>READ DATA</td>
<td>Output signal</td>
<td>28</td>
<td>27</td>
<td>GND</td>
</tr>
<tr>
<td>SIDE SELECT</td>
<td>Input signal</td>
<td>30</td>
<td>29</td>
<td>GND</td>
</tr>
<tr>
<td>READY</td>
<td>Output signal</td>
<td>32</td>
<td>31</td>
<td>GND</td>
</tr>
</tbody>
</table>
3.2.2 Power Connector and Pin Configuration

The following shows the power connector pin configuration:

![Printed circuit board diagram](image)

Fig. 3.3 Power Connector in Configuration

Table 3.1 Power Connector Pin Assignments

<table>
<thead>
<tr>
<th>Pin number</th>
<th>Supply voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+5 V DC</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>+12 V DC</td>
</tr>
</tbody>
</table>
3.2.3 Connector Type

The following connector type are recommended for the signal and power connections for the FDD; equivalent connector types may also be used.

Socket:
PS-34SEN-D4P1-1C-N
(closed-end type)
PS-34SEN-D4P1-1D-N
(daisy-chain type)
both by Japan Aeronotic Electronics Industry, Co., Ltd.

Cable:
3365-34 by Sumitomo-JM, Co., Ltd.
or equivalent

Signal cable

Power cable

Housing: 171822-4 by Japan AMP, Co., Ltd.
Pins: 170262-1

Fig. 3.4 Connector Locations and Recommended Models
3.3 Electrical Specifications

3.3.1 Signal Level

All the input/output signals are at TTL level with the following electrical specifications:

TRUE = Logical "0" (LOW level) 0, to +0.4 V
FALSE = Logical "1" (HIGH level) +2.5 to +5.25 V

3.3.2 Driver/Receiver

The driver which outputs signals from PDD to the controller is an open collector output circuit capable of obtaining sink current of maximum 40 mA at LOW level. The receiver which receives signals from the controller to FDD is a Schmitt trigger gate terminating with 1 kΩ.
Fig. 3.5 Driver/Receiver Circuit Example
3.4 Input Signals

3.4.1 DRIVE SELECT 0 to 3 (DS0 to 3)

DRIVE SELECT 0 to 3 are signals for selecting a specified FDD. Setting one of DS0 to DS3 to LOW level selects the corresponding FDD, which makes effective the input/output lines.

FDD is specified by shorting one of the DX selection plugs 0 to 3 on the PWB.

3.4.2 HEAD LOAD (HDL) (Option Signal)

When FDD is ready (see Section 3.5.3), setting this signal to LOW level causes the magnetic head to touch the disk surface. However, in this device, it is common to make the magnetic head touch the media surface by motor on signal.

3.4.3 STEP (STP)

Pulse signal which moves the magnetic head in the direction specified by the direction select signal. The head begins moving at the rising from LOW to HIGH level of this signal. The magnetic head moves over as many cylinders as the number of input pulses. Figure 3.6 shows the pulse timing conditions.
3.4.4 DIRECTION SELECT (DIR)

Signal instructing the direction of magnetic head movement. The HIGH level indicates the direction toward the outer tracks and the LOW level indicates toward the inner tracks.

This signal must be switched definitely 0.8 $\mu$s before the trailing edge (positive going) of the STEP signal.

3.4.5 SIDE SELECT (SSL)

Signal selecting one of the heads used for write or read. The HIGH level selects the magnetic head on the side "0" of the disk and the LOW level selects the side "1".

This signal must be switched 100 $\mu$s before start of the read/write operation.
3.4.6 WRITE GATE (WGT)

This signal writes data when at LOW level and reads data when at HIGH level. Do not turn off the HEAD LOAD signal, switch the SIDE SELECT signal, or start positioning, for 1 ms after this signal has gone to HIGH level.

3.4.7 WRITE DATA (WDT)

Pulse signal that supplies data to be written to the disk. Every time the signal changes from HIGH to LOW level, the write current in the magnetic head changes direction, which changes the direction of magnetization on the disk.

Figure 3.7 shows the WRITE DATA specification.
3.4.8 MOTOR ON (MON)

Setting this signal to LOW turns the spindle motor.

Setting this signal to LOW makes the magnetic head touch the disk.
3.5 Output Signals

3.5.1 INDEX (IDX)

Signal for indicating the origin on the disk. This is output once every revolution. Figure 3.8 shows the output pulse specification.

The reading edge of the pulse is used as a reference.

![INDEX Pulse Specification](image)

Fig. 3.8 INDEX Pulse Specification

3.5.2 TRACK 00 (TK0)

When at LOW level, this signal indicates that the heads are on track "00".

This signal is generated by the signal from the track 00 sensor and the (excitation) phase of the step motor.
3.5.3 READY (RDY)

Signal indicating that FDD is ready to operate. This signal goes to LOW level, when the FDD is selected, if the following conditions are satisfied:

(i) DC power is supplied.

(ii) A disk is mounted.

(iii) The rotational speed of the floppy disk has reached 90% of the specification.

3.5.4 READ DATA (RDT)

Data read from a disk which is shaped into a pulse string.

Figure 3.9 shows the READ DATA signal obtained when normally recorded information is read.

Fig. 3.9 READ DATA Signal Specification
3.5.5 WRITE PROTECT (PRT)

If a disk with its WRITE PROTECT hole uncovered is inserted into the drive, the PRT line goes low, which places the FDD in the WRITE PROTECT state.
3.6 Interface Signal Timing

3.6.1 Step and Track 00

Step (STP)                                           2.5 ms (max.)

Track 00 (TK0)

3.6.2 Access Timing

Write Gate (WGT) 0.8 µs ~ 2 ms

Step (STP) 3 ms 18 ms (min.) 0.8 µs

Direction Select (DIR)

(NOTE) An interval of at least 18 ms is required between step pulses when the direction changes.
3.6.3 Write Timing

Step (STP)  

Side select (SSL)  
100 μs (min.)

Write gate (WGT)

3.6.4 Read Timing

STEP (STP)  
18 ms (min.)

SIDE SELECT (SSL)  
100 μs (min.)

WRITE GATE (WGT)  
1 ms (min.)

Valid read data  
Valid
3.6.5 Write Data Timing

3.6.6 DRIVE SELECT and Output Signal Timing

The drive control and status signals are become valid 500 mS after that the DRIVE SELECT line is selected.

Only the MOTOR ON signal is independent of the DRIVE SELECT signal.
3.7 Power Interface

3.7.1 Input Power Specifications

Table 3.2 lists the DC power specifications for FDD. A sequence for each DC power is not needed.

**Table 3.2  Input Power Specifications**

<table>
<thead>
<tr>
<th>Item</th>
<th>+12 V power</th>
<th>+5 V power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>+12 V ±5%</td>
<td>+5 V ±5%</td>
</tr>
<tr>
<td>Current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Startup</td>
<td>540 mA</td>
<td>270 mA</td>
</tr>
<tr>
<td>Steady-state</td>
<td>160 mA</td>
<td>410 mA</td>
</tr>
<tr>
<td>Ripple voltage (NOTE 1)</td>
<td>200 mVp-p or less</td>
<td>100 mVp-p or less</td>
</tr>
</tbody>
</table>

**NOTE 1:** This includes the spike voltage.
4. OPERATING PROCEDURES

The basic operating procedures for FDD include the power on/off, disk setting and removal.

4.1 Setting A Floppy Disk

(1) Turn on DC power.

(2) Insert the diskette slowly into the slot until the Eject button pops out.

4.2 Removing the Floppy Disk

(1) Make sure the write/read operation of FDD has finished.

(2) To eject the diskette from the drive, just press the Eject button.

4.3 Display Lamp

The Display lamp indicates the FDD status. It comes on while heads are loaded.
5. EXTERNAL SHAPE AND INSTALLATION

5.1 External Shape and Fitting Hole Positions

Figure 5.1 shows the external shape and fitting hole positions.

NOTE 1: The faston terminal and cable are excluded from the size 128±1.

Fig. 5.1 External Shape and Fitting Hole Positions
5.2 Installation

FDD may be installed in the following manners:

(a) Vertical

(b) Vertical

(c) Horizontal

Consider the location of FDD in the system, so that it may be protected against the noise from CRT, power supply, etc.; especially when installing it inside CRT.
5.3  Recommended Air Flow

(1) Installing one FDD

![Diagram of installing one FDD]

(2) Installing two FDDs

![Diagram of installing two FDDs]

NOTE: Appropriate cooling is required if the ambient temperature around FDD rises considerably.
6. PACKING AND TRANSPORTATION

(1) For external packing, either use the packing material used in the carrying in of FDD or make sure no direct shock will be transmitted to FDD.

(2) Insert for packing the protective sheet used in the carrying in.

(3) Make sure that FDD will sustain no excessive shock during transportation.