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</table>
1. **OUTLINE**
This specification provides a description for the TEAC FD-235HF, dual density (2/1MB, 2-modes), 90mm (3.5-inch) micro floppy disk drive (hereinafter referred to as FDD). Table 1-1 shows the outline of the FDD, and Table 1-2 shows the signal interface pin-assignment.

*(Table 1-1) Specification outline*

<table>
<thead>
<tr>
<th>Model name</th>
<th>FD-235HF-A529</th>
<th>FD-235HF-A540</th>
<th>FD-235HF-A591</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front bezel</td>
<td>Black</td>
<td>Beige (AT)</td>
<td>Beige (PS)</td>
</tr>
<tr>
<td>Eject button</td>
<td>Black</td>
<td>Beige (AT)</td>
<td>Beige (PS)</td>
</tr>
<tr>
<td>LED indicator</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety standard</td>
<td>UL, CSA &amp; TÜV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation modes</td>
<td>2MB mode Write and read</td>
<td>1MB mode Write and read</td>
<td></td>
</tr>
<tr>
<td>90mm (3.5-inch) disk used</td>
<td>High density (2HD)</td>
<td>Normal density (2DD)</td>
<td></td>
</tr>
<tr>
<td>Unformatted data capacity</td>
<td>2M bytes</td>
<td>1M bytes</td>
<td></td>
</tr>
<tr>
<td>Data transfer rate</td>
<td>500k bits/s</td>
<td>250k bits/s</td>
<td></td>
</tr>
<tr>
<td>Disk rotational speed</td>
<td>300rpm</td>
<td>300rpm</td>
<td></td>
</tr>
<tr>
<td>Track density</td>
<td>5.3track/mm (135tpi)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track to track time</td>
<td>3ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required power</td>
<td>+5V single (4.5 ~ 5.5V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal output driver</td>
<td>CMOS, 3-state</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input signal pull-up</td>
<td>1kΩ ±30%, unremovable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer selectable strap</td>
<td>14 selections (DC0 ~ 3, RY34, DC34, DC2, HO2, HI2, HA, REN, ACD, IR, FG)</td>
<td>Refer to item 11.1</td>
<td></td>
</tr>
<tr>
<td>Function setting at delivery</td>
<td>1. Strap setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 DS1 : DRIVE SELECT 1 on pin 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2 DC34 : DISK CHANGE on pin 34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3 HA : Automatic density setting for 2DD (1MB) disk or 2HD (2MB) disk.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4 REN : Auto-recalibration at power on.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5 FG : Frame is electrically shorted to DC 0V.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Other interface setting</td>
<td>2.1 Pin2 : Open</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2 Pin4 : Open</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Other function setting</td>
<td>3.1 LED turn on condition: DRIVE SELECT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2 Motor rotating condition: MOTOR ON</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3 Ready and seek-complete gate (full-mask) for INDEX and READ DATA output pulses.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.4 Auto-chucking at disk installation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interface connector</td>
<td>34 pin right-angled header connector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power connector</td>
<td>Equipped</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other optional function</td>
<td>Not equipped</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The FDD is equipped with a discrimination switch for the high density (HD) hole of an installed disk cartridge. Refer to item 8.3.13 as to the detailed explanation for density mode setting.

2. DISK

(1) Work disk
90mm (3.5-inch) micro floppy disks which are mutually agreed between the customer and TEAC.
For 2MB mode : High density disk (2HD)
1MB mode : Normal density disk (2DD)

(2) Cleaning disk
The FDD does not require any cleaning disk. However, the dry type disk which is mutually agreed between the customer and TEAC is used when requiring a cleaning disk.

(Table 1-2) Signal interface pin-assignment

<table>
<thead>
<tr>
<th>Pin Nos.</th>
<th>Signals</th>
<th>Pin Nos.</th>
<th>Signals</th>
<th>Direc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
<td>2</td>
<td>HD IN (HD at HIGH level)/HD OUT (HD at HIGH level)/DISK CHANGE/OPEN</td>
<td>Input/Output</td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td>4</td>
<td>OPEN</td>
<td>–</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>6</td>
<td>DRIVE SELECT 3/OPEN</td>
<td>Input</td>
</tr>
<tr>
<td>7</td>
<td>0V</td>
<td>8</td>
<td>INDEX</td>
<td>Output</td>
</tr>
<tr>
<td>9</td>
<td>0V</td>
<td>10</td>
<td>DRIVE SELECT 0/OPEN</td>
<td>Input</td>
</tr>
<tr>
<td>11</td>
<td>0V</td>
<td>12</td>
<td>DRIVE SELECT 1/OPEN</td>
<td>Input</td>
</tr>
<tr>
<td>13</td>
<td>0V</td>
<td>14</td>
<td>DRIVE SELECT 2/OPEN</td>
<td>Input</td>
</tr>
<tr>
<td>15</td>
<td>0V</td>
<td>16</td>
<td>MOTOR ON</td>
<td>Input</td>
</tr>
<tr>
<td>17</td>
<td>0V</td>
<td>18</td>
<td>DIRECTION SELECT</td>
<td>Input</td>
</tr>
<tr>
<td>19</td>
<td>0V</td>
<td>20</td>
<td>STEP</td>
<td>Input</td>
</tr>
<tr>
<td>21</td>
<td>0V</td>
<td>22</td>
<td>WRITE DATA</td>
<td>Input</td>
</tr>
<tr>
<td>23</td>
<td>0V</td>
<td>24</td>
<td>WRITE GATE</td>
<td>Input</td>
</tr>
<tr>
<td>25</td>
<td>0V</td>
<td>26</td>
<td>TRACK 00</td>
<td>Output</td>
</tr>
<tr>
<td>27</td>
<td>0V</td>
<td>28</td>
<td>WRITE PROTECT</td>
<td>Output</td>
</tr>
<tr>
<td>29</td>
<td>0V</td>
<td>30</td>
<td>READ DATA</td>
<td>Output</td>
</tr>
<tr>
<td>31</td>
<td>0V</td>
<td>32</td>
<td>SIDE ONE SELECT</td>
<td>Input</td>
</tr>
<tr>
<td>33</td>
<td>0V</td>
<td>34</td>
<td>DISK CHANGE/READY</td>
<td>Output</td>
</tr>
</tbody>
</table>
3. PHYSICAL SPECIFICATION

(Table 3-1) Physical specification

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<thead>
<tr>
<th>Width</th>
<th>101.6mm (4.00 in), Nom.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>25.4mm (1.00 in), Nom.</td>
</tr>
<tr>
<td>Depth</td>
<td>145mm (5.71 in), Nom., excluding front bezel</td>
</tr>
<tr>
<td>Weight</td>
<td>345g (0.76lbs), Nom., 360g (0.79 lbs), Max.</td>
</tr>
<tr>
<td>External view</td>
<td>See Fig. 3-1.</td>
</tr>
<tr>
<td>Cooling</td>
<td>Natural air cooling</td>
</tr>
<tr>
<td>Mounting</td>
<td>Mountings for the following directions are acceptable. (a) Front loading, mounted vertically. (b) Front loading, mounted horizontally with spindle motor down. (c) Mounting angle in items (a) and (b) should be less than 25° with front bezel up or down. Note: As to the other mounting directions than the above will be considered separately.</td>
</tr>
<tr>
<td>Installation</td>
<td>With installation holes on the frame of the FDD. Refer to Fig. 3-1.</td>
</tr>
<tr>
<td>Material of flame</td>
<td>Aluminium die-cast</td>
</tr>
<tr>
<td>Material of front bezel</td>
<td>PPHOX (Complying with UL94-5V)</td>
</tr>
</tbody>
</table>
(Fig. 3-1) FDD external view
4. OPERATIONAL CHARACTERISTICS

4.1 2MB Mode Data Capacity

(Table 4.1-1) 2MB mode data capacity

<table>
<thead>
<tr>
<th>Recording method</th>
<th>FM</th>
<th>MFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data transfer rate k bits/s</td>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>Tracks/disk</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>Innermost track bit density bpmm (bpi)</td>
<td>343.19 (8,717)</td>
<td>686.38 (17,434)</td>
</tr>
<tr>
<td>Innermost track flux density frpmm (frpi)</td>
<td>686.38 (17,434)</td>
<td>686.38 (17,434)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data capacity</th>
<th>Unformatted</th>
<th>Formatted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>k bytes/track</td>
<td>6.25</td>
</tr>
<tr>
<td></td>
<td>k bytes/disk</td>
<td>1,000</td>
</tr>
<tr>
<td>32 sectors/track</td>
<td>k bytes/sector</td>
<td>0.128</td>
</tr>
<tr>
<td></td>
<td>k bytes/track</td>
<td>4.096</td>
</tr>
<tr>
<td></td>
<td>k bytes/disk</td>
<td>655.36</td>
</tr>
<tr>
<td>18 sectors/track</td>
<td>k bytes/sector</td>
<td>0.256</td>
</tr>
<tr>
<td></td>
<td>k bytes/track</td>
<td>4.608</td>
</tr>
<tr>
<td></td>
<td>k bytes/disk</td>
<td>737.28</td>
</tr>
<tr>
<td>10 sectors/track</td>
<td>k bytes/sector</td>
<td>0.512</td>
</tr>
<tr>
<td></td>
<td>k bytes/track</td>
<td>5.12</td>
</tr>
<tr>
<td></td>
<td>k bytes/disk</td>
<td>819.2</td>
</tr>
</tbody>
</table>
### 4.2 1MB Mode Data Capacity

(Table 4.2-1) 1MB mode data capacity

<table>
<thead>
<tr>
<th>Recording method</th>
<th>FM</th>
<th>MFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data transfer rate</td>
<td>k bits/s</td>
<td>125</td>
</tr>
<tr>
<td>Tracks/disk</td>
<td></td>
<td>160</td>
</tr>
<tr>
<td>Innermost track bit density</td>
<td>bpmm (bpi)</td>
<td>171.61 (4,359)</td>
</tr>
<tr>
<td>Innermost track flux density</td>
<td>frpm (frpi)</td>
<td>343.19 (8,717)</td>
</tr>
</tbody>
</table>

#### Data capacity

<table>
<thead>
<tr>
<th>Unformatted</th>
<th>k bytes/track</th>
<th>3.125</th>
<th>6.25</th>
</tr>
</thead>
<tbody>
<tr>
<td>k bytes/disk</td>
<td>500</td>
<td>1,000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Formatted</th>
<th>16 sectors/track</th>
<th>k bytes/sector</th>
<th>0.128</th>
<th>0.256</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>k bytes/trac</td>
<td>2.048</td>
<td>4.096</td>
<td></td>
</tr>
<tr>
<td></td>
<td>k bytes/disk</td>
<td>327.68</td>
<td>655.36</td>
<td></td>
</tr>
</tbody>
</table>

| 9 sectors/track | k bytes/sector | 0.256 | 0.512 |
|                 | k bytes/trac    | 2.304 | 4.608 |
|                 | k bytes/disk    | 368.64 | 737.28 |

| 5 sectors/track | k bytes/sector | 0.512 | 1.024 |
|                | k bytes/trac   | 2.56  | 5.12  |
|                | k bytes/disk   | 409.6 | 819.2 |

### 4.3 Disk Rotation Mechanism

(Table 4.3-1) Disk Rotation Mechanism

<table>
<thead>
<tr>
<th>Spindle motor</th>
<th>DC brushless motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spindle speed</td>
<td>300rpm</td>
</tr>
<tr>
<td>Motor servo method</td>
<td>Frequency servo by ceramic oscillator</td>
</tr>
<tr>
<td>Motor/spindle connection</td>
<td>Motor shaft direct</td>
</tr>
<tr>
<td>Disk speed</td>
<td>The same as the spindle speed.</td>
</tr>
<tr>
<td>Long term speed variation (LSV)</td>
<td>±1.5% or less</td>
</tr>
<tr>
<td>Instantaneous speed variation (ISV)</td>
<td>±2% or less</td>
</tr>
<tr>
<td>Start time</td>
<td>480ms or less</td>
</tr>
<tr>
<td>Average latency</td>
<td>100ms</td>
</tr>
<tr>
<td>Ready waiting time</td>
<td>505ms or less for motor on</td>
</tr>
</tbody>
</table>
4.4 Index Detection

(Table 4.4-1) Index Detection

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of index</td>
<td>1 per disk revolution</td>
</tr>
<tr>
<td>Detection method</td>
<td>Rotor detection of spindle motor by Hall element or FG output.</td>
</tr>
<tr>
<td>Detection cycle</td>
<td>200ms ±1.5%</td>
</tr>
<tr>
<td>Index burst detection timing error</td>
<td>±400µs or less</td>
</tr>
</tbody>
</table>

4.5 Track Construction

(Table 4.5-1) Track Construction

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Track density</td>
<td>5.3 tracks/mm (135tpi)</td>
</tr>
<tr>
<td></td>
<td>Track pitch 187.5µm</td>
</tr>
<tr>
<td>Number of cylinders</td>
<td>80 cylinders</td>
</tr>
<tr>
<td>Number of tracks</td>
<td>160 tracks/disk</td>
</tr>
<tr>
<td>Outermost track radius (track 00)</td>
<td>Side 0 39.500mm (1.5551 in)</td>
</tr>
<tr>
<td></td>
<td>Side 1 38.000mm (1.4961 in)</td>
</tr>
<tr>
<td>Innermost track radius (track 79)</td>
<td>Side 0 24.6875mm (0.9719 in)</td>
</tr>
<tr>
<td></td>
<td>Side 1 23.1875mm (0.9129 in)</td>
</tr>
<tr>
<td>Positioning accuracy</td>
<td>±15µm or less, with specified test disk (Track 40, 23 ± 2°C, 45 ~ 55%RH, horizontal)</td>
</tr>
</tbody>
</table>

4.6 Magnetic Head

(Table 4.6-1) Magnetic Head

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic head</td>
<td>Read/write head with erase gap, 2 sets</td>
</tr>
<tr>
<td>Effective track width after trim erase</td>
<td>0.115 ± 0.008mm (0.0045 ± 0.0003 in)</td>
</tr>
<tr>
<td>Read/write gap azimuth error</td>
<td>0° ± 18’, with specified test disk</td>
</tr>
</tbody>
</table>
4.7 Track Seek Mechanism

(Table 4.7-1) Track Seek Mechanism

<table>
<thead>
<tr>
<th>Head position mechanism</th>
<th>Stepping motor and lead screw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stepping motor</td>
<td>4-phase, 20 steps per revolution</td>
</tr>
<tr>
<td>Stepping motor drive</td>
<td>2 steps per track</td>
</tr>
<tr>
<td>Track 00 detection method</td>
<td>Photo-interrupter</td>
</tr>
<tr>
<td>Track to track time</td>
<td>3ms (excludes settling time, refer to item 8.3.4)</td>
</tr>
<tr>
<td>Settling time</td>
<td>15ms or less (excludes track to track time)</td>
</tr>
<tr>
<td>Average track seek time</td>
<td>94ms (includes settling time)</td>
</tr>
</tbody>
</table>

4.8 Window Margin and Others

(Table 4.8-1) Window Margin and Others

<table>
<thead>
<tr>
<th>Window Margin (with specified test disk, MFM method, PLL separator)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2MB mode</td>
</tr>
<tr>
<td>1MB mode</td>
</tr>
<tr>
<td>Recommendable write pre-compensation</td>
</tr>
<tr>
<td>2MB mode</td>
</tr>
<tr>
<td>1MB mode</td>
</tr>
<tr>
<td>Head load mechanism</td>
</tr>
<tr>
<td>File protect mechanism</td>
</tr>
<tr>
<td>Disk detection mechanism</td>
</tr>
<tr>
<td>Disk inserting force</td>
</tr>
<tr>
<td>Disk ejecting force</td>
</tr>
<tr>
<td>Acoustic noise at 50cm</td>
</tr>
<tr>
<td>Disk type discriminating mechanism</td>
</tr>
</tbody>
</table>
## 5. ENVIRONMENTAL CONDITIONS

### (Table 5-1) Environmental Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Operating</th>
<th>Storage</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>4 ~ 51.7°C (39 ~ 125°F)</td>
<td>–22~60°C (~8 ~ 140°F)</td>
<td>–40 ~ 65°C (~40 ~ 149°F)</td>
</tr>
<tr>
<td><strong>Temperature gradient</strong></td>
<td>20°C (36°F) or less per hour</td>
<td>30°C (54°F) or less per hour</td>
<td>30°C (54°F) or less per hour</td>
</tr>
<tr>
<td><strong>Relative humidity</strong></td>
<td>20 ~ 80% (no condensation) Max. wet bulb temperature shall be 29.4°C (85°F)</td>
<td>5 ~ 90% (no condensation) Max. wet bulb temperature shall be 40°C (104°F)</td>
<td>5 ~ 95% (no condensation) Max. wet bulb temperature shall be 45°C (113°F)</td>
</tr>
<tr>
<td><strong>Vibration</strong></td>
<td>14.7m/s² (1.5G) or less (10 ~ 100Hz, 1 octave/ min sweep rate)</td>
<td>——</td>
<td>19.6m/s² (2G) or less (10 ~ 100Hz, 1/4 octave/ min sweep rate)</td>
</tr>
<tr>
<td></td>
<td>9.8m/s² (1.0G) or less (100 ~ 200Hz, 1 octave/ min sweep rate)</td>
<td>——</td>
<td>——</td>
</tr>
<tr>
<td></td>
<td>4.9m/s² (0.5G) or less (200 ~ 600Hz, 1 octave/ min sweep rate)</td>
<td>——</td>
<td>——</td>
</tr>
<tr>
<td><strong>Shock</strong></td>
<td>Write &amp; read: 49m/s² (5G)(11ms, 1/2 sine wave) or less</td>
<td>——</td>
<td>686m/s² (70G) (11ms, 1/2 sine wave) or less</td>
</tr>
<tr>
<td></td>
<td>Read only: 98m/s² (10G)(11ms, 1/2 sine wave) or less</td>
<td>——</td>
<td>——</td>
</tr>
<tr>
<td><strong>Altitude</strong></td>
<td>–300m (~980feet) ~ 5,000m (16,400feet)</td>
<td>——</td>
<td>——</td>
</tr>
</tbody>
</table>

Notes: The above requirements are applied for the FDD without shipping box. When a long period is required for transportation such as by ship, storage environmental conditions should be applied.
# 6. RELIABILITY

(\textit{Table 6-1}) Reliability

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MTTF</strong></td>
<td>30,000 power on hours or more (for typical operation duty)</td>
</tr>
<tr>
<td><strong>MTTR</strong></td>
<td>When failure, the FDD should be replaced in unit of the drive and not repaired in unit of parts or assemblies.</td>
</tr>
<tr>
<td>Design component life</td>
<td>5 years</td>
</tr>
<tr>
<td>Disk life</td>
<td>$3 \times 10^6$ passes/track or more</td>
</tr>
<tr>
<td>Disk insertion</td>
<td>$1.5 \times 10^4$ times or more</td>
</tr>
<tr>
<td>Seek operation</td>
<td>$1 \times 10^7$ random seeks or more</td>
</tr>
<tr>
<td>Preventive maintenance</td>
<td>Not required (for typical operation duty)</td>
</tr>
<tr>
<td><strong>Error rate</strong></td>
<td></td>
</tr>
<tr>
<td>Soft error</td>
<td>1 or less per $10^9$ bits read</td>
</tr>
<tr>
<td></td>
<td>A soft (recoverable) error means that it can be recovered correctly within three retries.</td>
</tr>
<tr>
<td>Hard error</td>
<td>1 or less per $10^{12}$ bits read</td>
</tr>
<tr>
<td></td>
<td>A hard (unrecoverable) error means that it cannot be recovered correctly within three retries. However, it is recommended to be followed by a recalibration to track 00 and four additional retries.</td>
</tr>
<tr>
<td>Seek error</td>
<td>1 or less per $10^6$ seeks</td>
</tr>
<tr>
<td></td>
<td>A seek error means that it can seek to a target track within one retry including a recalibration to track 00.</td>
</tr>
<tr>
<td><strong>Safety standard</strong></td>
<td>Approved by UL, CSA and TÜV</td>
</tr>
<tr>
<td><strong>Electro-static discharge test</strong></td>
<td>15kV (150pF, 330Ω)</td>
</tr>
<tr>
<td></td>
<td>No hard error and/or no component damage occur when the test is applied to the operator access area (front bezel area).</td>
</tr>
</tbody>
</table>
7. POWER INTERFACE

7.1 Required Power
The following specifications are applied at interface connector of the FDD.

(1) DC +12V : Not required
(2) DC +5V
(a) Voltage tolerance :±10% (4.5 ~ 5.5V)
(b) Allowable ripple voltage :100mVp-p or less (including spike noise)
(c) Current and power consumption

(Table 7.1-1) Current and power consumption

<table>
<thead>
<tr>
<th>Operating mode</th>
<th>Average current</th>
<th>Average power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stand-by</td>
<td>8mA</td>
<td>10mA</td>
</tr>
<tr>
<td>Read operation</td>
<td>0.30A</td>
<td>0.40A</td>
</tr>
<tr>
<td>Write operation</td>
<td>0.30A</td>
<td>0.40A</td>
</tr>
<tr>
<td>Seek operation</td>
<td>0.56A</td>
<td>0.66A</td>
</tr>
<tr>
<td>3ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6ms</td>
<td>0.60A</td>
<td>0.70A</td>
</tr>
<tr>
<td>Seek operation peak</td>
<td>0.9A</td>
<td>1.0A</td>
</tr>
<tr>
<td>Spindle motor start</td>
<td>0.62A</td>
<td>0.70A</td>
</tr>
</tbody>
</table>

Notes:
1. Values of Typ. current and power are specified at 5.0V, while the values of Max. are at 5.5V (+10%) with a disk of large running torque.
2. Stand-by mode is defined at the stop condition of spindle motor and seek operation.
3. Seek operation peak means the operation during the settling (15ms) after the seek completion.
4. Rush current flows within 150ms after the motor start.
5. Short time peak current except for power-on surge is less than 1.0A.
6. Refer to item 9.4 as to the current consumption profile.
### 7.2 Power Interface Connector and Cable

(1) Power interface connector

<table>
<thead>
<tr>
<th>(Table 7.2-1) Power interface connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDD side connector</td>
</tr>
<tr>
<td>Pin numbers</td>
</tr>
<tr>
<td>Protection method for mis-connection</td>
</tr>
<tr>
<td>Connector external view</td>
</tr>
<tr>
<td>Connector location</td>
</tr>
<tr>
<td>Power interface connections</td>
</tr>
<tr>
<td>Cable side matched connector</td>
</tr>
<tr>
<td>Cable side matched pin</td>
</tr>
</tbody>
</table>

(2) Power interface cable: Any appropriate cables taking the maximum power consumption of the FDD will be acceptable.

<table>
<thead>
<tr>
<th>(Table 7.2-2) Power interface pin-assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power voltage</td>
</tr>
<tr>
<td>DC +5V</td>
</tr>
<tr>
<td>0V</td>
</tr>
<tr>
<td>(0V)</td>
</tr>
<tr>
<td>(No conection)</td>
</tr>
</tbody>
</table>
(Fig. 7.2-1) Power interface connector external view
8. SIGNAL INTERFACE

8.1 Signal Interface Connector and Cable

(1) Signal interface connector

<table>
<thead>
<tr>
<th>Table 8.1-1 Signal interface Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDD side connector</td>
</tr>
<tr>
<td>Pin numbers and pin pitch</td>
</tr>
<tr>
<td>Connector external view</td>
</tr>
<tr>
<td>Connector location</td>
</tr>
<tr>
<td>Cable side matched connector</td>
</tr>
</tbody>
</table>

Note: It is recommended to use a polarizing type connector with a projection on the center of the housing to avoid mis-connection. Refer to Fig. 8.1-1. For such a polarizing connector, Vmark of the connector housing may show pin No.34.

(2) Signal interface cable Maximum cable length : 1.5m (5 feet), by terminator of 1kΩ or less (For daisy chain connection, the total cable length should be less than 1.5m).
(Fig. 8.1-1) Signal interface connector external view
8.2 Electrical Characteristics
“Vcc” means +5V power voltage supplied to the FDD.

8.2.1 FDD side receiver and driver
The specification are applicable at the interface connector of the FDD.

(Table 8.2.1-1) FDD side receiver and driver

<table>
<thead>
<tr>
<th>Electrical characteristics of receiver</th>
<th>Interface driver/reciver</th>
<th>See Fig. 8.2-1.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input signals (TTL level)</td>
<td>LOW level (TRUE)</td>
<td>0 ~ 0.7V</td>
</tr>
<tr>
<td></td>
<td>LOW level input current</td>
<td>5.9mA, Max. (Including terminator current)</td>
</tr>
<tr>
<td></td>
<td>HIGH level (FALSE)</td>
<td>2.2V ~ +5V power voltage</td>
</tr>
<tr>
<td>Terminator resistor value</td>
<td>1kΩ ±5%</td>
<td>Terminator (pull-up) resistor is connected to each input.</td>
</tr>
</tbody>
</table>

8.2.2 Host side receiver and driver

(HTable 8.2.2-1) Host side receiver and driver

<table>
<thead>
<tr>
<th>Host side receiver</th>
<th>TTL, CMOS, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver required sink current</td>
<td>FDD input current × Number of daisy chained FDD</td>
</tr>
<tr>
<td>Host side receiver</td>
<td>TTL, CMOS, etc.</td>
</tr>
<tr>
<td>Terminator is required for each output signal line from the FDD.</td>
<td></td>
</tr>
<tr>
<td>Host side terminator resistor value</td>
<td>Usually 1 ~ 2.2kΩ is used. (150Ω Min.)</td>
</tr>
</tbody>
</table>
(Fig. 8.2-1) FDD signal interface circuit
8.3 Input/Output Signals
In the following, input signals are those transmitted to the FDD while output signals are those transmitted from the FDD.
LOW level of the signals is TRUE unless otherwise specified.
Refer to Table 1-2 as to the signal needed in this specification.

8.3.1 DRIVE SELECT input signal
(1) Signal to select a specific FDD for operation in multiplex control.
(2) Only the DRIVE SELECT signal of the same number as of on-state strap is effective.
(3) All the input/output signals except for the MOTOR ON and HD IN are valid after this signal is made TRUE. The time required to be valid is 0.5µsec, Max. including transmission delay time of the DRIVE SELECT signal through the interface cable.
(4) Refer to item 11.1 as to the turn-on condition of the front bezel indicator.
(5) Refer to item 11. and Table 1-2 as to the strap setting and the selection of signal function.

8.3.2 MOTOR ON input signal
(1) Level signal to rotate the spindle motor.
(2) The spindle motor reaches to the rated rotational speed (300rpm) within 480ms after this signal is made TRUE.
(3) Refer to item 11.2 as to the rotational condition of the spindle motor.

8.3.3 DIRECTION SELECT input signal
(1) Level signal to define the moving direction of the head when the STEP line is pulsed.
(2) Step-out (moving away from the center of the disk) is defined as HIGH level of this signal. Conversely, step-in (moving toward the center of the disk) is defined as LOW level of this signal.
(3) The signal shall maintain its level for 0.8µs, Min. prior to the trailing edge of the STEP pulse. Refer to Fig. 9.2-1.

8.3.4 STEP input signal
(1) Negative pulse signal to move the head. The pulse width shall be 0.8µs or more and the head moves one track space per one pulse.
(2) The access motion (head seek operation) is initiated at the trailing edge of the STEP pulse and completes within 18ms after starting the access including the settling time.
(3) For the subsequent motion in the same direction, the STEP pulses should be input with the interval of 3ms or more, while the pulses should be input with the interval of 4ms or more for a direction change. Refer to Fig. 9.2-1.
STEP pulses less than 3ms interval for the same direction or less than 4ms interval for a direction change may cause seek error.
(4) STEP pulses are ignored and the access motion is not initiated when one of the following conditions is satisfied.
   (a) The WRITE PROTECT signal is FALSE and the WRITE GATE signal is TRUE.
   (b) The TRACK 00 signal is TRUE and the DIRECTION SELECT signal is HIGH level (step-out).
   (c) Step-in operation (DIRECTION SELECT signal is LOW level) from track 81.

8.3.5 WRITE GATE input signal
(1) Level signal to erase the written data and to enable the writing of new data.
(2) The FDD is set to write mode when the following logical expression is satisfied.
   WRITE GATE * DRIVE SELECT * WRITE PROTECT
(3) This signal shall be made TRUE after satisfying all of the following conditions.
   (a) 18ms has been passed after the effective receival of the final STEP pulse.
   (b) 100µs has been passed after the level change of the SIDE ONE SELECT signal.

(4) The following operations should not be done at least 650µs after this signal is changed to FALSE.
   (a) Make the MOTOR ON signal FALSE.
   (b) Start the head seek operation by the STEP pulse.
   (c) Make the DRIVE SELECT signal FALSE.
   (d) Change the level of the SIDE ONE SELECT signal.
   (e) Change the level of the HD IN signal.

8.3.6 WRITE DATA input signal

(1) Negative pulse signal to designate the contents of data to be written on a disk. The pulse width should be 0.1µs through 1.1µs and the leading edge of the pulse is used.

(2) WRITE DATA pulses are ignored while either of the following conditions is satisfied.
   (a) The WRITE GATE signal is FALSE.
   (b) The WRITE PROTECT signal is TRUE.

(3) This signal should be input according to the timing in Fig. 8.3-2.
   It is recommended to stop the input of the WRITE DATA pulses during the read operation in order to avoid harmful cross talk.

8.3.7 SIDE ONE SELECT input signal

(1) Level signal to designate which side of a double sided disk is used for reading or writing.
(2) When this signal is HIGH level, the magnetic head on the side 0 surface (lower side) of the disk is selected, while the magnetic head on the side 1 surface (upper side) is selected when this signal is LOW level.

(3) The READ DATA pulse on a selected surface is valid more than 100µs after the change of this signal level.

(4) Write operation (the WRITE GATE signal is TRUE) on a selected surface shall be started more than 100µs after the change of this signal level.

8.3.8 TRACK 00 output signal

(1) Level signal to indicate that the head is on track 00.
(2) This signal is valid more than 2.8ms, after the effective receival of the STEP pulse.

8.3.9 INDEX output signal

(1) Negative pulse signal to indicate the start point of a track and one index pulse per one disk revolution is output.

(2) INDEX pulse is output when the following logical expression is satisfied.
   \[
   \text{Index detection} \times \text{DRIVE SELECT} \times \text{Ready state} \times \text{Seek-complete}
   \]

Notes: (a) Ready state:
   • The FDD is powered on.
   • A disk is installed.
   • Auto-chucking completed.
   • A motor-on command is TRUE and 505ms, approx. has been passed.
   • An INDEX pulse has been detected after motor-on command.
   • Change the level of the HD IN signal when the strap is on-state.

(b) Seek-complete means the state that 15.8 ~ 17.9ms has been passed after the trailing edge of the
final STEP pulse.

(3) Fig. 8.3-1 shows the timing of this signal. Leading edge of the pulse shall be used as the reference and pulse width is 1.5ms through 5ms.

8.3.10 READ DATA output signal

(1) Negative pulse signal for the read data from a disk composing clock bits and data bits together.
(2) Fig. 8.3-3 shows the timing of this signal. Pulse width is 0.15µs through 0.8µs and the leading edge of the pulse shall be used as the reference.
(3) READ DATA pulse is output when the following logical expression is satisfied.
   
   Read data detection * DRIVE SELECT * Write operation * Ready state * Seek-complete

Notes: (a) Refer to item 8.3.9 as to the ready state.
   (b) Write operation is the state while the WRITE GATE input signal is FALSE and erase delay time has been passed after the WRITE GATE signal changed to FALSE.
   (c) Refer to item 8.3.9 as to the seek-complete.

(4) Output pulse is valid while all of the following conditions are satisfied.
   (a) 18ms has been passed after the effective receival of the final STEP pulse.
   (b) 100µs has been passed after the level change of the SIDE ONE SELECT signal.
   (c) 650µs (2MB mode) or 690µs (1MB mode) has been passed after the WRITE GATE signal is changed to FALSE.

8.3.11 WRITE PROTECT output signal

(1) Level signal to indicate that the write inhibit hole of an installed disk is open.
(2) When this signal is TRUE, data on the disk are protected from miserasing and write operation is inhibited.

8.3.12 DISK CHANGE output signal

(1) Level signal to indicate that a disk in the FDD is ejected.
(2) This signal changes to TRUE when either of the following conditions is satisfied.
   (a) Power on.
   (b) A disk is removed.
(3) The signal returns to FALSE when both of the following conditions are satisfied. Refer to Fig. 8.3-4.
   (a) A disk has been installed.
   (b) A STEP command is received when the DRIVE SELECT signal is TRUE.

8.3.13 READY output signal

(1) Level signal to indicate that the FDD is in ready state (refer to item 8.3.9) for read and write operations.
(2) Refer to item 11 as to the strap setting for this signal output.
(3) Required time for this signal to be TRUE after the start of the spindle motor is 505ms, Max.
(4) When a motor-on command is made FALSE, this signal is also changed to FALSE within 0.3ms.

8.3.14 Input/Output signals for density mode setting (HD IN/HD OUT)

Every FDD model, there are any basic methods for setting the density mode of the FDD as shown in the following.

Use the applicable method for the FDD in contents shown below.
(1) Method A using HD IN input signal
   (a) HIGH or LOW level of the HD IN signal from host controller is used to designate the density mode of the FDD. There is no output signal from the FDD for disk type identification.
   (b) Table 8.3.14-1 shows the meaning of the logic level.
(2) Method B without using any interface signal (OPEN)
(a) Interface signal is not used between the FDD and host-controller.
Density mode of the FDD and host system are determined independently.

(b) Density mode of the FDD is automatically set by discriminating the HD hole of an installed disk. If the
density mode of the FDD is not coincident with that of the host controller, data errors always occur at
read operation.

(c) It can not be selected when the HD IN input signal is setted to HIGH DENSITY at LOW level.

(3) Method C using HD OUT output signal
(a) Density mode of the FDD is automatically set by discriminating the HD hole of an installed disk.
(b) HIGH or LOW level of the HD OUT signal from the FDD is used to inform host controller which type
of disk is installed in the FDD. And the density mode of the host is automatically determined according
to this signal.

(c) Table 8.3.14-1 shows the meaning of the logic level.

(d) It can not be selected when the HD IN input signal is setted to HIGH DENSITY at LOW level.

(4) Method D using HD IN/HD OUT signals
(a) HIGH or LOW level of the HD OUT signal from the FDD is used to inform host controller which type
of disk is installed in the FDD. Refer to method C.
On the other hand, the density mode of the FDD is set by the HIGH or LOW level of the HD IN signal
from the host. Refer to method A.

(b) Usually both of the density mode of the FDD and the host are the determined according to an installed
disk type like method C.
For a special case, however, that on installed disk had already been written at unsuitable density, the
system can forced (or over write) only using the HD IN signal by operator designation.

(c) Table 8.3.14-1 shows the meaning of the logic level.

<table>
<thead>
<tr>
<th>Signal name</th>
<th>Logic level</th>
<th>HIGH DENSITY at HIGH LEVEL</th>
<th>HIGH DENSITY at LOW LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD IN</td>
<td>HIGH</td>
<td>2MB mode</td>
<td>1MB mode</td>
</tr>
<tr>
<td></td>
<td>LOW</td>
<td>1MB mode</td>
<td>2MB mode</td>
</tr>
<tr>
<td>HD OUT</td>
<td>HIGH</td>
<td>2HD disk or no disk</td>
<td>2DD disk</td>
</tr>
<tr>
<td></td>
<td>LOW</td>
<td>2DD disk</td>
<td>2HD disk or no disk</td>
</tr>
</tbody>
</table>

8.3.15 NO CONNECTION (NC)
The NC pins are electrically isolated from any other circuit in the FDD.
8.3.16 Treatment of not-used signals

If some of the provided input/output signals are not necessary for your application, keep the unused signal lines open or pull up by an appropriate resistor value (refer to item 8.2.2) at the host side.

![INDEX timing](Fig. 8.3-1)

<table>
<thead>
<tr>
<th>Density mode</th>
<th>rpm</th>
<th>t1</th>
<th>t2</th>
<th>t3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2MB mode</td>
<td>300</td>
<td>2μs, Nom.</td>
<td>3μs, Nom.</td>
<td>4μs, Nom.</td>
</tr>
<tr>
<td>1MB mode</td>
<td>300</td>
<td>4μs, Nom.</td>
<td>6μs, Nom.</td>
<td>8μs, Nom.</td>
</tr>
</tbody>
</table>

(Fig. 8.3-2) WRITE DATA timing (MFM method)
<table>
<thead>
<tr>
<th>Density mode</th>
<th>rpm</th>
<th>t4</th>
<th>t5</th>
<th>t6</th>
<th>t7</th>
</tr>
</thead>
<tbody>
<tr>
<td>2MB mode</td>
<td>300</td>
<td>2μs, Nom.</td>
<td>3μs, Nom.</td>
<td>4μs, Nom.</td>
<td>±350ns</td>
</tr>
<tr>
<td>1MB mode</td>
<td>300</td>
<td>4μs, Nom.</td>
<td>6μs, Nom.</td>
<td>8μs, Nom.</td>
<td>±700ns</td>
</tr>
</tbody>
</table>

(Fig. 8.3-3) **READ DATA timing (MFM method)**

![Diagram](image)

Note: To simplify the timing chart, the DRIVE SELECT signal is assumed always TRUE in the above figure.

(Fig. 8.3-4) **DISK CHANGE signal timing**
9. CONTROL SEQUENCE

9.1 Power-on

(1) Protection against power on and off
   (a) In the transient period when the +5V power is lower than 3.5V, the FDD is protected against miswriting and miserasing whatever the state of input signals are.
   (b) Except for the condition of item (a), the FDD is protected against miswriting and miserasing as long as the WRITE GATE input signal does not change to TRUE.

(2) Power reset time in FDD.
   When REN strap is OFF: Less than 100ms
   When REN strap is ON: Less than 400ms, including auto-recalibration

(Fig. 9.1-1) Power on sequence
9.2 Seek Operation

Seek operation can be done independently of the spindle motor rotation.

(Fig. 9.2-1) Seek operation timing
9.3 Read Write Operation

(Fig. 9.3-1) Read/Write operation timing
9.4 Current Consumption Profile

(Fig. 9.4-1) Typical average current profile
(1) Stand-by mode
   When both of the following conditions are satisfied, FDD goes to the stand-by mode (low power con-
   sumption mode).
   (a) The spindle motor stops.
   (b) Not in the seek operation (including the settling time).
   Note: In the stand-by mode, the FDD can immediately respond to a command from host controller with no
   restriction.
      If the polling operation of the DRIVE SELECT line is done in the stand-by mode, current flows
   intermittently and +5V current slightly increases.
(2) Simultaneous operation of motor start and seek
   If a seek operation is done during the start-up of the spindle motor, or if the motor starts during the seek
   operation, +5V current at motor start increases by 0.55A. Max. from the value in Table 7.1-1.
   Stepping motor is energized at high power from the first STEP to 15msec after the last STEP.
(3) +5V current increases for 15ms after a lapse of 500ms by energizing of the motor.
10. FRAME GROUNDING

(1) The FDD frame is electrically connected to DC 0V by the FG strap on the main PCBA. (See Fig. 10-1)
(2) If it is required to separate the FDD frame from DC 0V, remove the FG strap. However, the FDD frame must be electrically connected to DC 0V by some other method when the FDD is tested alone.
(3) If it is required to connect the FDD frame to the host side by other cabling method, M2.6 tapped hole at the rear side of the FDD can be used. (See Fig. 3-1).

(Fig. 10-1) Frame ground internal connection
11. CUSTOMER SELECTABLE STRAPS

11.1 Function Summary of Straps

The FDD is equipped with the following selectable straps on the main PCBA. Insertion of a short bar onto the post pin is defined as the on-state of the strap. Refer to Table 1-1 in item 1. as to the strap setting at delivery and selectable straps.

(Table 11.1-1) Function summary straps

<table>
<thead>
<tr>
<th>Strap</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS0</td>
<td>DRIVE SELECT 0 input on pin 10</td>
</tr>
<tr>
<td>DS1</td>
<td>DRIVE SELECT 1 input on pin 12</td>
</tr>
<tr>
<td>DS2</td>
<td>DRIVE SELECT 2 input on pin 14</td>
</tr>
<tr>
<td>DS3</td>
<td>DRIVE SELECT 3 input on pin 6</td>
</tr>
<tr>
<td>RY34</td>
<td>READY output on pin 34</td>
</tr>
<tr>
<td>DC34</td>
<td>DISK CHANGE output on pin 34</td>
</tr>
<tr>
<td>DC2</td>
<td>DISK CHANGE output on pin 2</td>
</tr>
<tr>
<td>HA</td>
<td>Density set automatically</td>
</tr>
<tr>
<td>HI2</td>
<td>Density set by HD IN on pin 2</td>
</tr>
<tr>
<td>HO2</td>
<td>HD OUT output on pin 2</td>
</tr>
<tr>
<td>IR</td>
<td>LED on: DRIVE SELECT * Ready</td>
</tr>
<tr>
<td>ACD</td>
<td>Disable for auto-chucking</td>
</tr>
<tr>
<td>REN</td>
<td>Enable for auto-recalibration</td>
</tr>
<tr>
<td>FG</td>
<td>Short between FDD frame and DC 0V</td>
</tr>
</tbody>
</table>

Notes:
1. *straps overlap with other strap posts. Insert a short bar according to your priority.
2. You may select one of the two short bar positions, (A) and (B), for ACD strap.

11.2 DS0/DS1 and DS2/DS3 Straps

(1) In the multiplex control, these straps designate the address of the FDD.
(2) By the combination with the DRIVE SELECT 0 ~ 3 signals, four addresses, Max. can be designated. Refer to Fig. 8.2-1 and Table 11.1-1.
11.3 HA/HI2/HO2 Straps
(1) Straps to select a designating method of the density mode and to select a signal pin number.
(2) Table 11.3-1 shows the combination of the straps and selectable functions.
(3) Refer to Table 11.1-1 as to selection of signal pin number and overlapping with the other strap function.

(Table 11.3-1) Designating methods for density mode

<table>
<thead>
<tr>
<th>Sel. No.</th>
<th>Strap setting</th>
<th>Input</th>
<th>Output</th>
<th>Density designation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HO2</td>
<td>HI2</td>
<td>HA</td>
<td>Pin 2</td>
</tr>
<tr>
<td>A</td>
<td>—</td>
<td>ON</td>
<td>—</td>
<td>HD IN</td>
</tr>
<tr>
<td>B</td>
<td>—</td>
<td>—</td>
<td>ON</td>
<td>OPEN</td>
</tr>
<tr>
<td>C</td>
<td>ON</td>
<td>—</td>
<td>ON</td>
<td>OPEN</td>
</tr>
</tbody>
</table>

Notes: 1. "-" mark indicates the off-state of the strap.
2. Refer to Table 11.1-1 as to overlapping with the other strap functions.
3. Refer to item 8.3.14 as to the detailed signal functions.

11.4 RY34/DC34/DC2 Straps
(1) RY34 strap is used to output the READY signal on interface pin No.34.
(2) DC34/DC2 straps are used to output the DISK CHANGE signal on interface pin No.34, 2.
(3) Refer to Table 11.1-1 as to selection of signal pin number and overlapping with the other strap functions.

11.5 IR Strap
IR strap is used to select a turn-on condition of the front bezel indicator (LED). Refer to item 12.1 as to the detailed explanation.

11.6 ACD and REN Straps
(1) ACD strap is used to inhibit the auto-chucking at disk installation.
   (a) When the ACD strap is off-state, the auto-chucking operation is executed. The spindle motor automatically rotates for 490ms, approx. (500ms, Max.), and all of the interface signals are effective in accordance with the explanation in item 8.3 during the above auto-chucking operation.
   (b) When the ACD strap is on-state, the auto-chucking operation is inhibited.
(2) REN strap is used to execute the auto-recalibration (heads move to track 00) at power-on.
   (a) When the REN strap is off-state, the auto-recalibration is inhibited.
   (b) When the REN strap is on-state, the auto-recalibration is executed at power-on.

11.7 FG Strap
FG strap is used to electrically connect the FDD frame to DC 0V. Refer to item 10. as to the detailed explanation.
12. TURN ON CONDITION OF INDICATOR AND SPINDLE MOTOR

12.1 Front Bezel Indicator
Two types of indicator (LED) turn-on condition are offered for selection using the IR strap. However, the indicator keeps off until 3.1ms has passed after the DRIVE SELECTion to avoid the polling operation of the DRIVE SELECT signal.

(Table 12.1-1) Turn-on condition of LED

<table>
<thead>
<tr>
<th>Strap</th>
<th>Turn-on condition of LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR</td>
<td>DRIVE SELECT</td>
</tr>
<tr>
<td>—</td>
<td>DRIVE SELECT * Ready state</td>
</tr>
</tbody>
</table>

Notes:
1. "-" mark indicates the off-state of the strap and "*" mark indicates the AND condition.
2. Refer to item 8.3.9 as to the ready state.

12.2 Spindle Motor
The spindle motor rotates while the MOTOR ON signal is TRUE. However, the spindle motor does not rotate at any condition while no disk is installed.
When the ACD strap is off-state, auto-chucking operation is executed at disk installation. Refer to item 11.6.